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POPULAR ELECTRONICS

APRIL 1968

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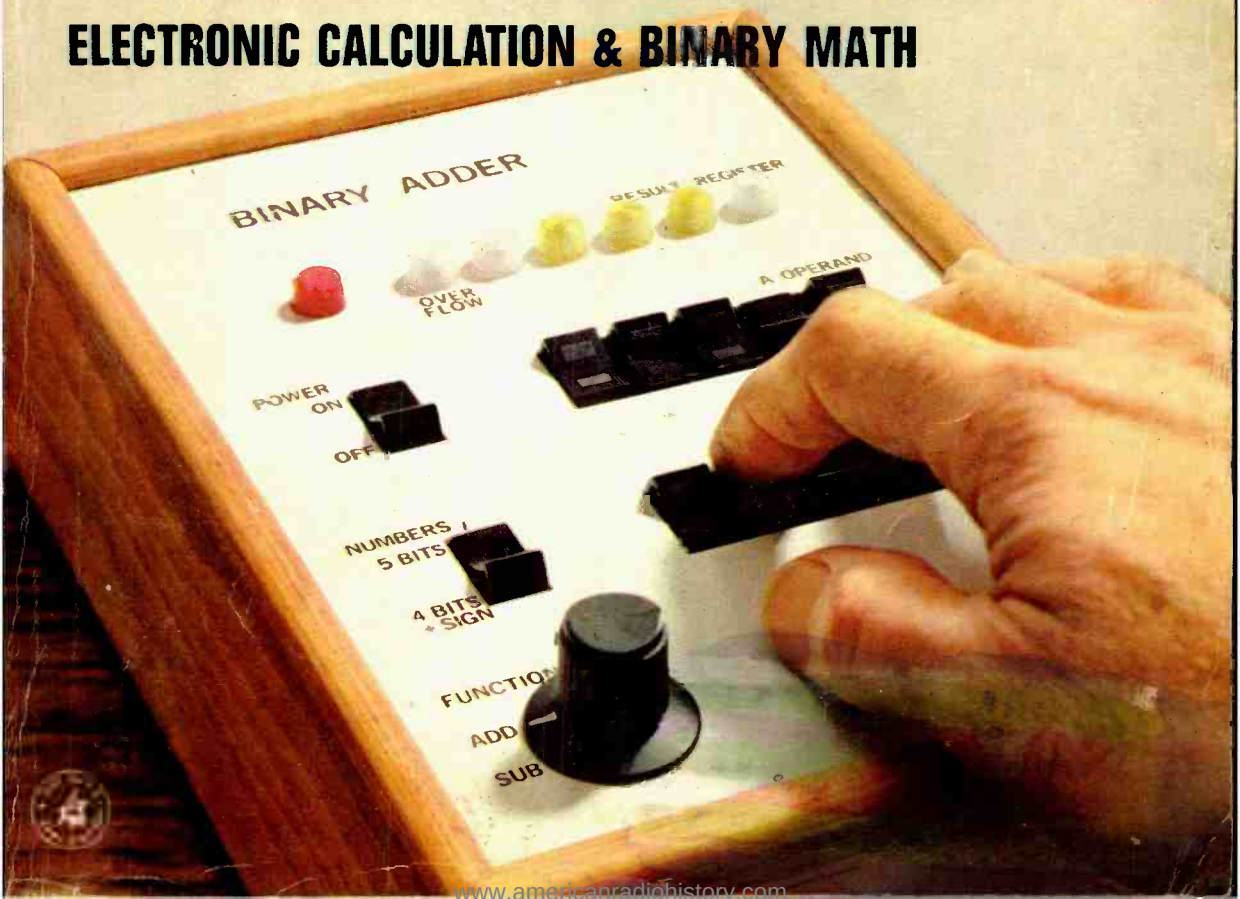

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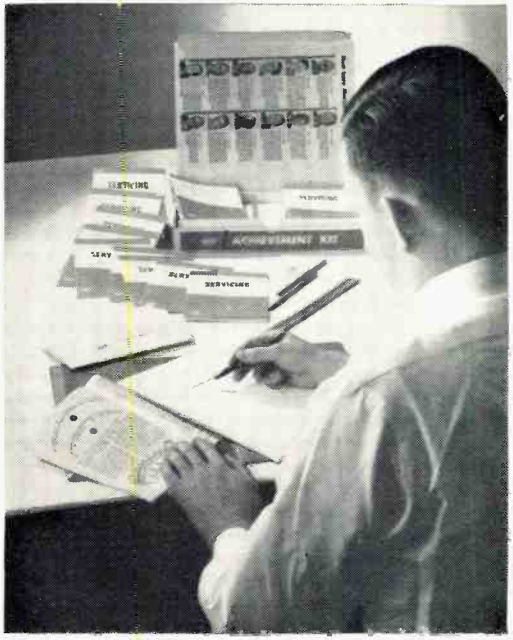

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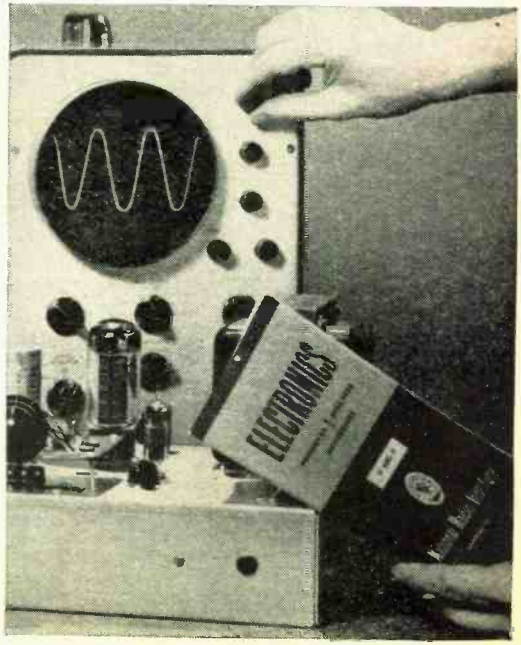

POPULAR ELECTRONICS

VOLUME 28 NUMBER 4 APRIL, 1968

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This month's cover photo by Bruce Pendleton

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Editorial and Executive Offices
One Park Avenue, New York, New York 10016
212 679-7200
Eastern Advertising Manager, RICHARD J. HALPERN

Midwestern Office
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letters

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TO THE RESCUE

May I be of service to you and your readers? I am in a position to supply certain specialized components used in your feature projects. At present, this is a part-time venture for me. I can supply only units manufactured by Fairchild Semiconductor and Motorola. I am able to process orders promptly, accurately, and—most important—at the lowest possible price since I have a very low overhead. I can also supply technical information and specification sheets.

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Now there should be no reason why our readers cannot obtain so-called "hard-to-get" Fairchild and Motorola parts. So, if your local distributor disappoints you, don't write to us —write to Bob Glassman.

TRANSCEIVER PROBLEM

I don't feel that Charles Schauers was of much help to the person who had a problem with his Hammarlund CB-23 transceiver ("Information Central," February, 1968). [As indicated on a wattmeter, the transmitter was putting out 3 watts, but it could not be heard on a walkie-talkie only 50 feet away nor at a base station five blocks away.] With a short across the output terminals of a normally operating 3-watt transmitter, you would be able to receive the signal on a walkie-talkie 50 feet away. Since the wattmeter registered 3 watts, either one of the crystals in the synthesizer circuit was not operating, or the synthesizer coils in one of the oscillators were improperly adjusted.

In a case like this, I would suggest that a qualified, licensed technician use a VTVM on the input grid of each oscillator stage and tune the tank coils for maximum negative voltage. If one oscillator did not register a bias voltage when tuned, that stage would be inoperative. The technician could then make frequency measurements and corrections as needed.

F. LEE HOOD
Lansing, Mich.

The question is: was the antenna connected when the power output was measured with

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All measurements are made with a sturdy, wired-in-single-unit probe with fully shielded input cable. The probe is quickly adapted to either dc measurement or ac and resistance measurement by a convenient built-in switch. And an accessory slip-on high-voltage probe is also available to make possible measurements up to 50,000 dc volts.

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CIRCLE NO. 30 ON READER SERVICE PAGE

LETTERS (*Continued from page 8*)

an in-line wattmeter? If this was the case, there could not be a short in the transmitter output circuit. Conversely, if the reading was taken with the antenna and transmission line disconnected from the transmitter, an output indication on the wattmeter could mean that the transmitter was operating correctly and there was a short in the antenna circuit, or that the transmitter was off frequency and there might or might not be a short in the antenna circuit.

You are probably correct about a short across the output terminals radiating enough power for a walkie-talkie 50 feet away to pick up a signal. But if we assume that a shorted coaxial cable was used, there would be so little power radiated that a signal might not be heard even 10 feet away.

"APRIL FOOL" IN FEBRUARY?

Am I biting on something I should be laughing off? I refer to the "Resistor Standards" article (February, 1968). How in the world did resistor value tolerances suddenly become involved in such things as the twelfth root of ten? It would be much simpler if I could buy a 10% tolerance, 3300-ohm carbon resistor and expect a deviation in value of no more than 330 ohms either way. In fact, this has always been the case in my experience. And the deviation has been even less with wire-wound resistors—which the article claims should give more trouble. Maybe the article was meant for your April issue—as an "April Fool" joke?

JOHN F. BRENNAN
Philadelphia, Pa.

In the article on "Resistor Standards," there seems to be some confusion about the meanings of resistor "tolerance" and "preferred" resistor values. The computation factors referred to in the article are used for determining preferred numbers for nominal resistance values—not the minimum and maximum excursions around a nominal. A series of values (based on the 6th, 12th, and 24th roots of 10^n) has been adopted for carbon composition resistors to determine the progression of preferred values of 20%, 10%, and 5% tolerance resistors. The value of "n" can be a positive or negative integer. Therefore, each preferred value differs from its predecessor by a multiplier with the result conveniently rounded off to two significant figures.

The tolerance of a resistor is the maximum allowable deviation for nominal resistor values. Thus, ±10% of a specific value means exactly that. So the 3300-ohm carbon composition resistor given as an example in the article would measure between 2970 and 3630 ohms for a stated tolerance of ±10%.

The preferred, or standard, value of 3300 ohms was arrived at by using the 12th root of 10^{42} (equal to 3160 ohms); by convention, this figure has been raised to 3300 ohms for the

(*Continued on page 95*)

Now There Are 3 Heathkit® Color TV's

The NEW Deluxe Heathkit "227" Color TV

Exclusive Heathkit Self-Servicing Features. Like the famous Heathkit "295" and "180" color TV's, the new Heathkit "227" features a built-in dot generator plus full color photos and simple instructions so *you* can set-up, converge and maintain the best color pictures at all times. Add to this the detailed trouble-shooting charts in the manual, and you put an end to costly TV service calls for periodic picture convergence and minor repairs. No other brand of color TV has this money-saving self-servicing feature.

Advanced Features. Top quality American brand color tube . . . 227 sq. in. rectangular viewing area . . . 24,000 v. regulated picture power . . . improved phosphors for brilliant, livelier colors . . . new improved low voltage power supply with boosted B+ for best operation . . . automatic degaussing . . . exclusive Heath Magna-Shield to protect against stray magnetic fields and maintain color purity . . . ACC and AGC to reduce color fade and insure steady, flutter-free pictures under all conditions . . . preassembled & aligned IF with 3 stages instead of the usual 2 . . . preassembled & aligned 2-speed transistor UHF tuner . . . deluxe VHF turret tuner with "memory" fine tuning . . . 300 & 75 ohm VHF antenna inputs . . . two hi-fi sound outputs . . . 4" x 6" 8 ohm speaker . . . choice of installation — wall, custom or optional Heath factory assembled cabinets. Build in 25 hours.

Kit GR-227
$419.95
(less cabinet)
$25 mo.

Kit GR-227, (everything except cabinet)
. . . $42 dn., as low as $25 mo. **$419.95**
GRA-227-1, Walnut cabinet . . . no money dn., $6 mo. **$59.95**
GRA-227-2, Mediterranean Oak cabinet (shown above),
. . . no money dn., $10 mo. **$94.50**

Kit GRA-27
$19.95

New Remote Control For Heathkit Color TV

Now change channels and turn your Heathkit color TV off and on from the comfort of your armchair with this new remote control kit. Use with Heathkit GR-227, GR-295 and GR-180 color TV's. Includes 20' cable.

Kit GR-295
$479.95
(less cabinet)
$42 mo.

Deluxe Heathkit "295" Color TV

Has same high performance features and built-in servicing facilities as new GR-227, except for 295 sq. in. viewing area (industry's largest picture) . . . 24,000 volt picture power . . . universal main control panel for versatile in-wall installation . . . and 6" x 9" speaker.

Kit GR-295, (everything except cabinet), 131 lbs. . . .
$48 dn., $42 mo. **$479.95**
GRA-295-4, Mediterranean cabinet (shown above), 90 lbs. . . .
no money dn., $11 mo. **$112.50**
Other cabinets from $62.95.

Kit GR-180
$349.95
(less cabinet & cart)
$30 mo.

Deluxe Heathkit "180" Color TV

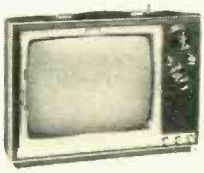
Same high performance features and exclusive self-servicing facilities as new GR-227 (above) except for 180 sq. in. viewing area.

Kit GR-180, (everything except cabinet), 102 lbs. . . .
$35 dn., $30 mo. **$349.95**
GRA-180-5, table model cabinet & mobile cart
(shown above), 57 lbs. . . . no money dn., $5 mo. **$39.95**
Other cabinets from $24.95

Deluxe 12" Transistor Portable B&W TV – First Kit With Integrated Circuit

Unusually sensitive performance. Plays anywhere . . . runs on household 117 v. AC, any 12 v. battery, or optional rechargeable battery pack ($39.95); receives all channels; new integrated sound circuit replaces 39 components; preassembled, prealigned tuners; high gain IF strip; Gated AGC for steady, jitter-free pictures; front-panel mounted speaker; assembles in only 10 hours. Rugged high impact plastic cabinet measures a compact 11½" H x 15¾" W x 9⅜" D. 27 lbs.

Kit GR-104
$119.95
$11 mo.



Kit GR-104, 27 lbs. . . . no money dn.,
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for Universal Protection

GD-87
Wireless Smoke/Heat
Detector-Transmitter

GD-77 Wireless Receiver/Alarm
fail-safe, always alert

Applications Unlimited . . . Customize Your Own System. Here's reliable, low cost, 24-hour protection for your family and property. System warns of smoke, fire, intruders, freezing, thawing, cooling, rising or receding water, pressures . . . any change you want to be warned about. Uses unique new signaling method developed by Berkeley Scientific Labs., exclusively licensed to Heath. Your house is already wired for this system, just plug the units into any AC outlet. "Load transmission" design (not a carrier type as in wireless intercoms) generates unusual signal that is practically unduplicable in other devices or random noise sources. Solid-state circuitry has built-in fail-safe capability to sound alarm if power fails, if power supply components in any unit fail, or if 50,000 hour bulb in smoke detector fails. Receiver/Alarm has 2800 Hz transistor alarm and receptacle for extra 117 VAC bell or buzzer to extend range, plus rechargeable battery (always kept charged) to sound alarm if power fails. Smoke-Heat Detector-Transmitter capability may be extended to other areas by adding extra heat sensors to its built-in sensor. Utility Transmitter accepts any type of switch or sensor for any purpose; examples: magnetic reed switches for doors and windows to warn of entry; step-on switches for door or driveway; micro switches with trip wire around yard; heat sensors; water pressure switches warn of pump failure; thermal switches warn of freezing in gardens, or thawing in freezers; two wires act as switch to warn of changing water levels in sump-pump wells, pools, etc. Units are small and unobtrusive in beige and brown non-reflecting velvet finish. Any number of units may be used in the system. All units feature circuit board construction; each unit takes only 3 hours to build. Operating cost similar to electric clocks. Invest in safety for your family now with this unique Heath system.

Kit GD-77, receiver/alarm, 4 lbs. **$39.95**
Kit GD-87, smoke/heat det.-trans., 5 lbs. **$49.95**
Kit GD-97, Utility trans., 4 lbs. **$34.95**
(numerous accessory switches available from Heath)

New! Low Cost Heathkit 5-Band SSB-CW Transceiver

Kit HW-100
$240.00

You asked for it . . . a 5-band version of the Heathkit "single-banders" . . . a low cost SSB transceiver for 10 or 15 meters . . . an SSB transceiver equal or superior to many wired rigs but at much lower cost. It's the new HW-100, the most SSB equipment you can get for the money. Features build-it-yourself solid-state (FET) VFO; 80-10 meter coverage; switch-selected upper or lower sideband or CW; crystal filter; full coverage on all bands with 500 kHz per band segment; smooth vernier control; built-in 100 kHz calibrator; separate offset CW carrier crystal; TALC; quiet, enclosed relays; fixed or mobile operation with accessory power supplies; 180 watts PEP, 170 watts CW input; PTT or VOX on SSB; CW transceive by VOX from keyed tone using grid-block keying; less than 100 Hz drift per hour after warmup; less than 100 Hz variation under 10% line voltage variation; receiver sensitivity less than 0.5 uv for 10 dB S+N/N ratio for SSB operation; selectivity 2.1 kHz at 6 dB down, 7 kHz at 60 dB down; image & IF rejection better than 50 dB; easy circuit board construction with one large wiring harness; handsome 2-piece green wrinkle finish cabinet. It's a winner!

Kit HW-100, 19 lbs., no money dn., $22 mo. **$240.00**

New! Heathkit High-Power Inverter for Boats, Cars, Campers

Kit
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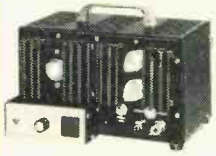
$99.95



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New! Heathkit/Kraft 5-Channel Digital Proportional System with Variable Capacitor Servos

System Kit GD-47
$219.95
$21 mo.

This Heathkit version of the internationally famous Kraft system saves you over $200. The system includes solid-state transmitter with built-in charger and rechargeable battery, solid-state receiver, receiver rechargeable battery, four variable capacitor servos, and all cables. Servos feature sealed variable capacitor feedback to eliminate failure due to dirty contacts, vibration, etc.; three outputs: two linear shafts travel ⅝" in simultaneous opposite directions plus rotary wheel. Specify freq.: 26.995, 27.045, 27.145, 27.195 MHz.

System Kit GD-47, all of above, 5 lbs. **$219.95**
Kit GDA-47-1, transmitter, battery, cable, 3 lbs. **$86.50**
Kit GDA-47-2, receiver, 3 lbs. **$49.95**
GDA-47-3, receiver rechargeable battery, 1 lb. **$9.95**
Kit GDA-47-4, one servo only, 1 lb. **$21.50**

New! Heath/Mitchell COLORVAL Darkroom Computor . . . Kit or Assembled

Kit PM-17
$89.95
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Colorval takes the work out of color printing, leaves the creativity to you. Colorval is easy to set up . . . you "program" the scan filter pack for the type of film, paper, and equipment you use . . . we show you how. Unique Color Probe allows visual determination of ideal enlarger filter combination. Color Wheel and table shows what filter changes are needed. Exposure Probe scans shadows and highlights; exposure scale on Computer indicates proper contrast for color and b/w printing. Get started in color the right way, quickly, easily.

Kit PM-17, 6 lbs., no money dn., $9 mo. **$89.95**
Assembled PMW-17, 6 lbs. . . no money dn., $13 mo. . . **$125.00**

See 300 More in FREE Catalog

What would you expect to pay for a Vox "Jaguar" Combo organ with a 180-watt 3-channel amp? $1000? $1250? $1500? More?

You can get both for only $598 during this Special Heathkit Offer!

Now you can get this famous professional combo organ with a versatile high-power piggy-back amp. and matching speaker system for just a little more than you'd expect to pay for the "Jaguar" alone! The Heathkit/Vox "Jaguar" is solid-state; two outputs for mixed or separated bass and treble; reversible bass keys for full 49 key range or separate bass notes; bass volume control; vibrato tab; bass chord tab; four voice tabs (flute, bright, brass, mellow); keyboard range C_2 to C_6 in four octaves; factory assembled keyboard, organ case with cover, and stand with case. Also available separately; you'll still save $150 (order Kit TO-68, $349.95).

The Heathkit TA-17 Deluxe Super-Power Amplifier & Speaker has 180 watts peak power into one speaker (240 watts peak into a pair); 3-channels with 2 inputs each; "fuzz", brightness switch; bass boost; tremolo, reverb; complete controls for each channel; foot switch; 2 heavy duty 12" speakers plus horn driver. Also available separately kit or factory assembled (Kit Amplifier TA-17, $175; Assembled $275; Kit Speaker TA-17-1 $120; Assembled $150; Kit TAS-17-2, amp. & two speakers $395; Assembled TAW-17-2, amp. & two speakers $545).

Kit TOS-1
Organ, Amplifier & Speaker Kits (240 lbs.)
$598.00

Kit TOS-2
Organ Kit, Assembled Amplifier & Speaker (240 lbs.)
$698.00

New! Solid-State Portable Volt-Ohm-Meter

Kit IM-17
$19.95

So Handy, So Low Cost we call it "every man's" meter. Just right for homeowners, hobbyists, boatowners, CBer's, hams ... it's even sophisticated enough for radio & TV servicing! Features 12 ranges ... 4 AC & 4 DC volt ranges, 4 ohm ranges, 11 megohm input on DC, 1 megohm input on AC; 4½" 200 uA meter; battery power; rugged polypropylene case and more. Easy 3 or 4 hour kit assembly. 4 lbs.

New! Heathkit Guitar Headphone Amplifier

Kit TA-58
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Now you can play and practice your electronic guitar in private! Just plug this miniature amplifier into the jack of your guitar and use a pair of headphones. Solid-state circuit has tailored response; automatic off-on switching; self-contained battery (not supplied); and capability of operating one or two pairs of mono or stereo headphones of 4 to 2 meghohms. Ideal for practice or instruction. Easy to build.

Kit TA-58, 2 lbs. **$9.95**

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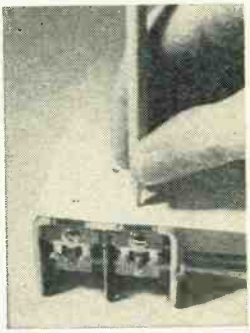
CIRCLE NO. 19 ON READER SERVICE PAGE

PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

PAPER "TEMPLATE" SPEEDS CHASSIS HOLE DRILLING

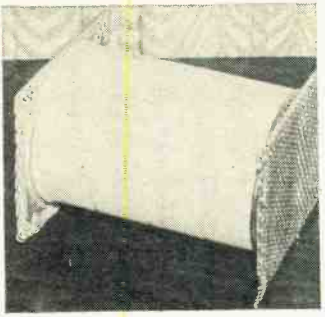
Orienting the mounting holes for irregularly shaped components, such as tuning capacitors, on a chassis can be time-consuming if you use ordinary measuring techniques A much quicker and more direct approach is to line up the edges of a sheet of paper with the sides of the component, locate the holes through the paper by touch, and punch through the paper with a pencil as shown in the photo. Make sure the paper stays put as you punch the holes. Then flip the paper "template" over and mark the drilling points on the chassis.



—Robert E. Kelland

YOU CAN CONNECT 3.2-OHM SPEAKERS TO YOUR 8-OHM AMPLIFIER

While most modern audio amplifiers are designed for 8-ohm loads, there is a way to connect 3.2-ohm speakers to the new amplifiers without an impedance-matching transformer. You just connect two such speakers in series across the 8-ohm tap on your amplifier (see photo). The 4"-diameter speakers can be mounted at opposite ends of a one-pound coffee can and the speaker cones covered with expanded aluminum grilles or a grille cloth. For other size 3.2-ohm speakers, appropriate size containers can be used. For best results, the speakers should be connected so that their phasing is opposite. (To check phasing, momentarily connect a 1.5-volt battery to the two free wires and observe the movement of the



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4 a

TIPS

(*Continued from page 14*)

speaker cones; one cone should pull inward while the other moves outward. If both cones move in the same direction simultaneously, reverse the connections of one of the speakers.) —*W.S. Gohl*

BAD POTENTIOMETER CAN CAUSE TROUBLE

Don't be surprised if an electronic device you stored away a few years ago fails to operate properly when you put it back into service. If the set still won't work after you have made all the obvious tests and/or installed new parts, take a look at the potentiometer(s). Connect the probes of an ohmmeter to the center and one of the outer lugs of each potentiometer (if the pot is in parallel with any other component in the set, remove the wires from one of the outer lugs), and rotate the shaft while observing the meter. The meter pointer should deflect smoothly from the minimum to the maximum resistance stamped on the potentiometer. Then check the resistance from each lug to the potentiometer case (see photo); it should be infinite. If incorrect readings are obtained, and a suitable cleaner will not rectify the problem, the potentiometer should be replaced. —*Lewis A. Harlow*

"RUBBER-STAMP" YOUR PRINTED CIRCUIT BOARDS

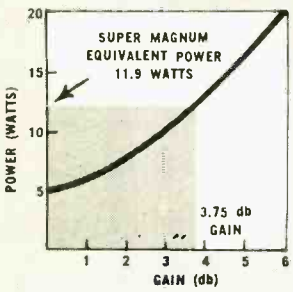
If you want to avoid the tedious job of laying out resist patterns individually for several one-of-a-kind printed circuit boards, you can use a home-made rubber stamp. First, prepare a mold by pouring a $\frac{1}{16}$"-thick layer of melted beeswax into a flat, level container. While the wax is setting, make a tracing of the foil pattern. Then lay the tracing on the wax, and draw a light impression of the pattern on the wax with a ball-point pen. Remove the tracing, and use an X-acto knife to remove the unwanted wax and "true" the lines; cut completely through the wax to the container. Finally, work a pliable adhesive (such as General Electric "Silicone Seal") into the impressions, taking care to prevent air bubbles from forming. Spread a smooth ¼"-thick layer of the adhesive over the entire mold surface, and let it set overnight. When the adhesive has set, remove it from the mold, and cement it to a suitable handle. To stamp the etch patterns on the copper-clad side of the boards, use a regular ink pad.

—*R.B. Halliday*

IS THERE A WAY TO OPERATE ON CB LEGALLY AT 11.9 WATTS??

"stati-lite noise reducer!

Drastically reduces receiver noise. No pointed ends to create sparking.



far more rugged construction!

Over twice the contact area at telescope joints (no swaging!) Heavier-gauge seamless tubing.

super "Power-Play" transformer!

Super-heavy coil permanently encased in water-proof, rugged housing. VSWR: a fabulous 1.17—best by far.

You know the FCC strictly prohibits putting more than 5 watts of RF into your CB set's final amplifier or using a linear amplifier. But there is a way of making your CB system perform exactly as if your set had 11.9 watts of RF power. And it's completely legal!

Model M-117 omni-directional

SUPER MAGNUM citizens band base station antenna

HERE'S HOW. The Antenna Specialists' Super Magnum base station antenna gives you an unprecedented 3.75 omni-directional gain—**at least 10% more true gain than any other omni-directional CB base antenna made.** The Super Magnum will reach out—like you had a 11.9 watt transmitter. HERE'S WHY! Db antenna gain can be translated to input power equivalent by this chart.

Equally important is the Super Magnum's tremendous signal to noise improvement by 6-20 db. It's the world's most popular CB base antenna by far, and over 200,000 legal owners know why.

full ½-wave "solid state" radials for maximum RF decoupling!

We simply mean solid aluminum, 108" radials (four of em!) for maximum RF decoupling of radiator.

SPRING TUNE UP TIME

Perfect Match for MAXIMUM RANGE

FAMOUS MAGGIE MOBILES

The world's most popular mobile antennas. (You'll see them everywhere you turn.)

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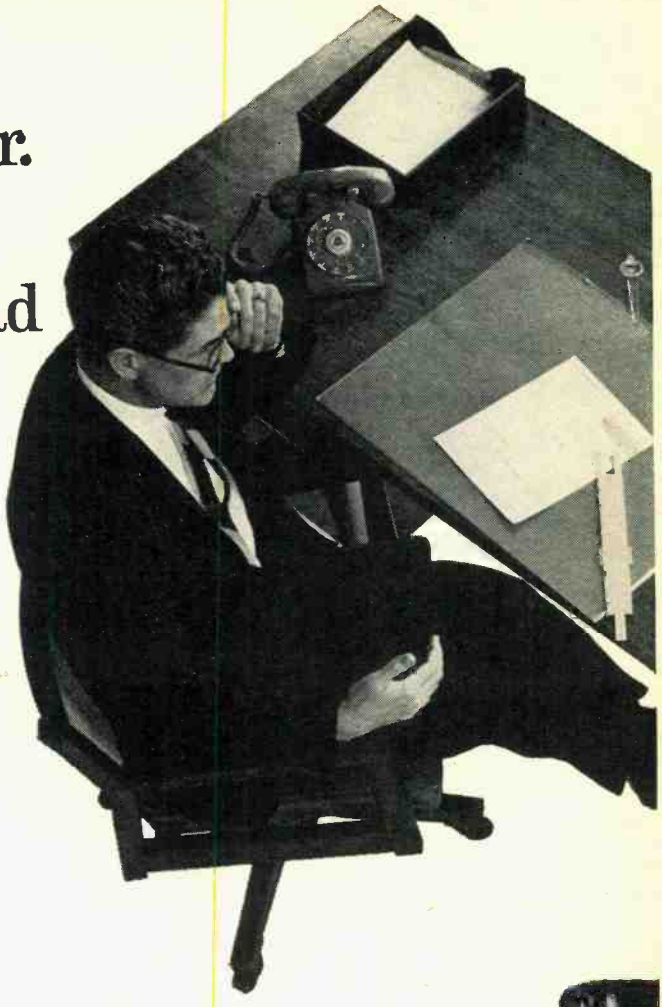
"He's a good worker. I'd promote him right now if he had more education in electronics."



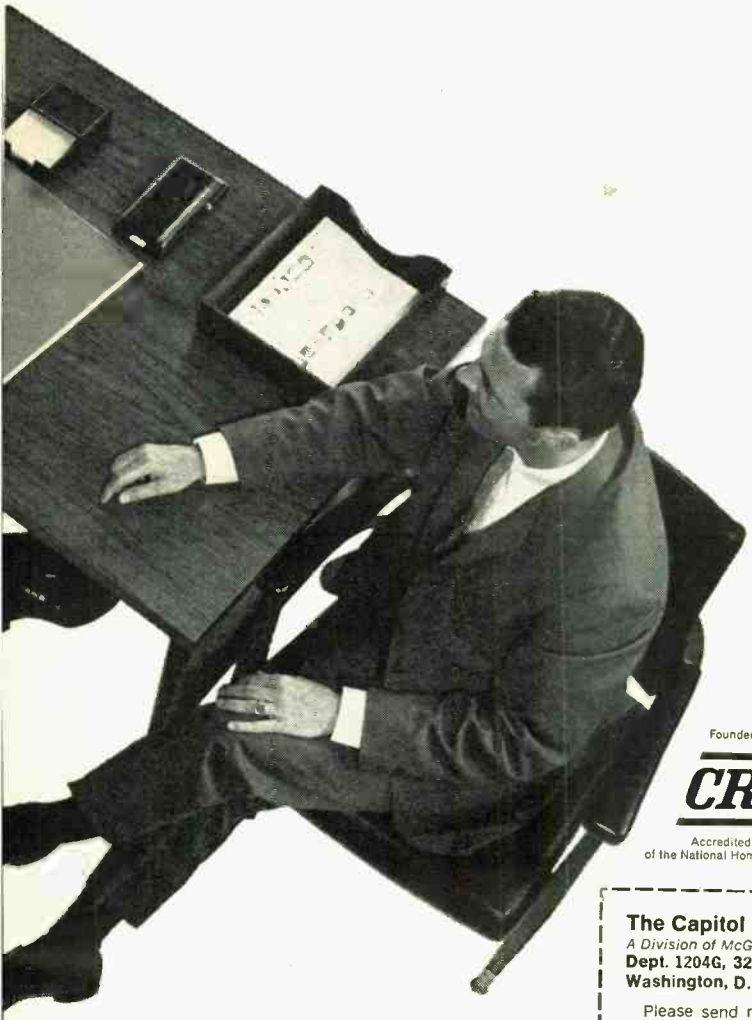
Could they be talking about you?

You'll miss a lot of opportunities if you try to get along in the electronics industry without an advanced education. Many doors will be closed to you, and no amount of hard work will open them.

But you can build a rewarding career if you supplement your experience with specialized knowledge of one of the key areas of electronics. As a specialist, you will enjoy security, excellent pay, and the kind of future you want for yourself and your family.

Going back to school isn't easy for a man with a full-time job and family obligations. But CREI Home Study Programs make it possible for you to get the additional education you need without attending classes. You study at home, at your own pace, on your own schedule. You study with the assurance that what you learn can be applied to the job immediately.

CREI Programs cover all important areas of electronics including communications, radar and sonar, even missile and spacecraft guidance. You're sure to find a program that fits your career objectives.



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NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15 or 115.

TUBE-TYPE CB TRANSCEIVER

According to *Courier Communications, Inc.*, its new "Courier 23-Plus" will pull in all 23 channels louder and clearer than any other tube-type rig in its price class. The "Courier 23-Plus" features a cascode front end and nuvistor mixer, and includes every known feature to dampen and filter out the noise you

don't want to hear. Other features: an exclusive modulation sampler that "makes a weak voice strong," dual conversion, single-knob tuning, transistorized power supply, modulation indicator, and a built-in range-expander circuit. Both the S/r.f. meter and channel selector are illuminated for easy reading. The transceiver comes complete with crystals for all channels, mounting brackets, power cords, and a microphone.

Circle No. 75 on Reader Service Page 15 or 115

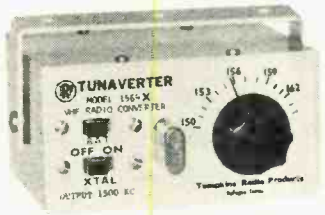
ALL-IN-ONE TURNTABLE

The "Module SLx" automatic turntable recently introduced by *Garrard* has one feature that most component turntables do not have —it comes complete with simulated wood grain base and magnetic cartridge. Another feature of the SLx turntable is Garrard's exclusive "Synchro-Lab" motor which maintains constant speed under all conditions. The unit has an unusually light and thin tone arm with a built-in stylus pressure gauge, permitting the use of a small-size, lightweight counterbalance and keeping tracking force down to a minimum. The magnetic cartridge that comes with the SLx is pre-matched to the turntable and tone arm, and tracking force is correctly pre-set.

Circle No. 76 on Reader Service Page 15 or 115

150-164 MHZ R.F. CONVERTER

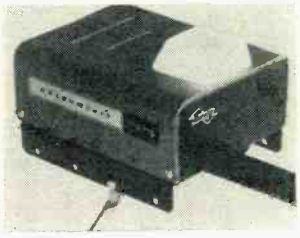
Police, fire, and other public services operating in the 150-164 MHz band can be heard over auto radios when *Tompkins Radio Products*' "Tunaverter" Model 1564X converter is plugged in between the car's antenna and the radio. Announced by Herbert Salch and Co., Marketing Division, the converter employs a FET which makes possible the monitoring of any number of crystal-controlled channels by plugging in the correct crystal. On the other hand, if you want to tune across the band, all you have to do is flip a switch. Each circuit is peaked with a three-gang tuning capacitor to achieve improved selectivity, sensitivity, image rejection, and signal-to-noise ratio. Power for the Model 1564X is provided by a 9-volt transistor battery.



Circle No. 77 on Reader Service Page 15 or 115

GARAGE DOOR OPENER SYSTEM

With the "Liftmaster" Model G-6100 garage door opener system, you can start the door on its travels from half a block away, so that it's completely up as you pull in. Manufactured by *Perma-Power*, the system consists of a "Signal Sender" solid-state transmitter, a wall-mounted solid-state receiver, and a ceiling-mounted motor mechanism (shown in the photo). A "Velvet Glide" clutch device provides smooth and quiet door operation and is so sensitive that a well-balanced door's travel can be instantly arrested if the door encounters an obstacle, even a fingertip. And a unique signal-and-pause triple code prevents unauthorized signals from actuating the system's receiver. The "Liftmaster" not only opens and closes garage doors by silent R/C command, but it also turns the garage lights on and off.



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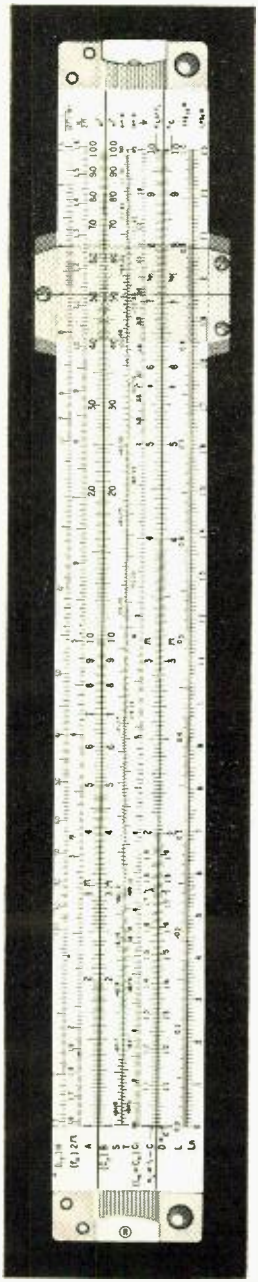
HIGH-VOLTAGE TEST PROBE

Accurate and safe high voltage checks on all color as well as black-and-white TV re-

Now, for men in electronics —"a whole new era of quick calculations"



thanks to this specially designed electronics slide rule

"THERE MUST BE THOUSANDS OF PEOPLE in electronics who have never had the marvelous adventure of calculating problems with a single slide rule; other thousands have had to content themselves with a slide rule not specifically designed for electronics. For both groups, the new slide rule designed and marketed by Cleveland Institute of Electronics and built for them by Pickett will open a whole new era of quick calculations.

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From an article in Radio Electronics Magazine

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CIRCLE NO. 12 ON READER SERVICE PAGE

PRODUCTS *(Continued from page 22)*

ceivers can be performed with the new 40,000-volt d.c. portable test probe designed to operate with *Triplett Electrical Instrument's* Model 600 volt-ohmmeter. [The Model 600 was discussed in an article in our January issue, page 30.] Three d.c. ranges can be checked with the Model 72-265 probe: 40 kV, 16 kV, and 4 kV. Easy removal of an internal resistor makes the probe flexible so that it can be used with other test instruments.

Circle No. 79 on Reader Service Page 15 or 115

HI-FI "MUSIC CENTER"

The best place for modern component hi-fi equipment is inside a cabinet like the Model 303 "music center" available from *Audio Originals*. Part of an extensive line of hi-fi equipment cabinets and speaker enclosures, the Model 303 has the graceful flowing lines of

Danish modern furniture. It features two adjustable component shelves, sized to fit most stereo amplifiers and tuners; a changer/turntable shelf that can be pulled out, moving effortlessly on ball-bearing slides; and plenty of space for records. The Model 303 is made of genuine hardwood and finished in oiled walnut.

Circle No. 80 on Reader Service Page 15 or 115

DUAL-BAND COMMUNICATIONS RECEIVER

Four integrated circuits and a choice of crystal or tunable operation on either of two VHF bands are featured in *Lafayette Radio's* Model PF-175 solid-state FM communications receiver. This dual-band re-

ceiver provides coverage from 30 to 50 MHz and 152 to 174 MHz. The IC's are in the four i.f. stages, and a single four-position front panel selector switch gives the user his choice of crystal or tunable operation. Other features of the PF-175 include a variable squelch control, illuminated dial, 4" speaker, external earphone jack, tape recorder jack, simulated wood grain finish, and a built-in universal power supply which allows operation from a 117-volt a.c. or a 12-volt d.c. power source.

Circle No. 81 on Reader Service Page 15 or 115

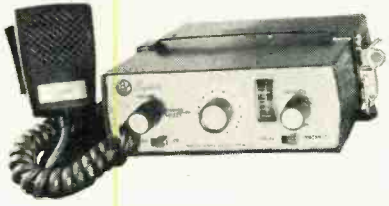
CB MOBILE ANTENNAS

A unique mounting device called the "Claw" is the featured attraction of *Hy-Gain Electronics'* "Hellcats" (CB mobile antennas). The "Claw" enables an antenna to be mounted in any existing hole between ⅜" and ¾" in diameter; it "grasps" the sides of the hole securely—even if the hole is not perfectly round. Also incorporated in the new "Hellcat" line is an etched copper loading coil which is photographically etched instead of printed to insure consistent micro-accuracy and provide a d.c. ground to help eliminate static. The antenna whip used is a 17-7 PH stainless steel unit. Four models of "Hellcats" are available—roof-mounted; trunk-lip-mounted; magnetic-mounted; and a "shorty" rooftop model.

Circle No. 82 on Reader Service Page 15 or 115

CB MOBILE TRANSCEIVER

Browning Laboratories is introducing a companion to its line of "Eagle" CB base stations: the "Eaglette" mobile unit. A 23-channel, silicon-transistor transceiver, it boasts



an illuminated "S"-meter and channel selector switch, p.a. function with separate jacks for p.a. and remote speakers with 3¼-watts of audio, a squelch control, and a noise limiter. Sensitivity is 0.35 μV for 10 dB signal-to-noise plus noise at 40% modulation. Crystals for operation on all 23 channels are included.

Circle No. 83 on Reader Service Page 15 or 115

BLIND RIVETER AND RIVETS

"Pow'Rivets" and a "Pow'Riveter" introduced by *Vaco Products* make it possible to fasten anything up to one-half-inch thick from one side. The four-way head of the blind "Pow'Riveter" has a nozzle that will accommodate any size of blind rivet, and is claimed to outperform all other blind riveters. The "Pow'Rivet," four sizes of which will replace eleven sizes of ordinary blind rivets, expands up to its head diameter for use in wide-tolerance holes, and a superior clamp-up action assures a snug fit. The rivets and riveter can be purchased separately, but they are also available as a kit.

Circle No. 84 on Reader Service Page 15 or 115

MORE POWER!
MORE PUNCH!
MORE RANGE!

only $169.95

COBRA 23

23 Channel Solid State CB

Our latest and best! Ready to operate on all 23 channels. Solid state throughout—23 silicon transistors and 9 diodes! 100% modulation means greater power output, more punch, increased range. It's a B&K breakthrough . . . at a breakthrough price . . . only $169.95.

COBRA V
Famous "Punchy Galore" 5 channel solid state CB. The "hot one"! $99.95

CAM 88
A proven 23 channel CB performer. Extra range and power. $214.95

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ELECTRONICS library

QUIET

BEGINNER'S GUIDE TO ELECTRONICS

by Terence L. Squires

This is a revised edition of a book that favorably impressed your reviewer in 1964 (see August issue, page 36). We recommended the "Beginner's Guide" because of its clarity and its short-cut method of introducing electronics to the adult or teen-ager. Our recommendation still stands—only more so. The revised edition includes information on developments that occurred in 1965, 1966, and 1967, and one or two minor errors have been corrected. The author is British, but the language of electronics is universal, and you should enjoy his mathematics-less treatment of everything from a single electron to a digital computer.

Published by Philosophical Library, Inc., 15 East 40th St., New York, N.Y. 10016. Hard cover. 194 pages. $6.00.

MOST-OFTEN-NEEDED 1968 TELEVISION SERVICING INFORMATION, Volume TV-27

Compiled by M.N. Beitman

Like the earlier volumes in Supreme's TV servicing series, the latest one contains a wealth of information on servicing monochrome TV chassis. Popular TV chassis from every major U.S. manufacturer and Sony's TV-500U and TV-900U solid-state TV chassis are covered in detail. Whether TV servicing is a full-time business for you or a part-time venture, this book belongs on a shelf in your workshop.

Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. Soft cover. 192 pages. $4.00.

ELECTRONIC SENSING DEVICES

by A. F. Giles

Not too many years ago almost every manufacturing process was directly controlled by a watchful human operator. That situation is rapidly being reversed and few—if any—steps in some manufacturing plants are left to us poor mortals. The electronics of overseeing industrial operations is the subject of this book. Details on a wide variety of sensors (magnetic, capacitive, solid-state, electrolytic, etc.) are included.

Distributed in U.S. by the Chemical Rubber Co., 2310 Superior Ave., Cleveland, Ohio 44104. Hard cover. 158 pages. $8.95.

30

We know a man doesn't come by $539.80 just **like that**. And parts with it only after carefully **deliberating** his alternatives.

So we've put together a new illustrated booklet **that** explains just what you'll be getting into should you decide to spend $269.90 for our completely hand wired Director 23 mobile radio telephone; just what you'll be getting into should you decide to spend $269.90 for our matching hand wired Guardian 23 (or 23-B) base station radio telephone. And just what you could be getting into should you decide that $539.80 is too much to spend for two two-way radios.

Total cost for the booklet? Nothing. But you've got to mail the coupon to let us know you want one, and that'll set you back six cents.

But just in case you're thinking you'll save six cents because you already know all about our 23's, you might just as well know that we've redesigned them to include some rather exotic new features. (The all solid state Director 23, for instance, now boasts a final transistor that won't blow—even if you key up and forget to connect the antenna. Plus a tone control. Plus a front-mounted speaker.)

Plus features like HetroSync® Circuitry. (Which has all but completely wiped out spurious signals.) And our remarkable Superhet Receiver. (Which is so good that sloppy signals from adjacent channels have virtually become a thing of the past.)

And electronic switching, dual function S-meter, and your choice of two base stations. (The Guardian 23 comes with a conventional palm microphone. The Guardian 23-B, which comes without a microphone, comes with a built-in solid state pre-amplifier which permits the operator to remain from 1 to 1½ feet from a desk microphone and still broadcast at 100% modulation. Costs are identical.)

In short, we think it's well worth the price of a stamp to know exactly what you're getting into before you decide to get into it. So we'd like to send you one of our brand new illustrated booklets that tells you all about all of our new CB radios, and some things about some CB radios that aren't ours.

If you'll just tell us where to send it.

Director 23 (23-channel mobile unit), $269.90


Guardian 23, 23-B (23-channel base stations), $269.90

Before you spend $539.80 for one of Pearce-Simpson's new base stations and matching mobile units, spend 6¢ and find out why you should.

F.C.C. Type Acceptance pending

Pearce-Simpson, Inc.
P.O. Box 800/Biscayne Annex, Miami, Florida 33152
Gentlemen: I'd like to receive one of your new booklets. PE-468

Name

Address

City

State Zip

Overseas military personnel may write for special military price list.

CIRCLE NO. 27 ON READER SERVICE PAGE

Squires Sanders

OUT TO LAUNCH THE SS FLEET, that is.

NOW HEAR THIS . . . the all new Squires-Sanders fleet of top performance CB transceivers is now being launched. Shiver-me-timbers, you've never seen such an array of fine CB equipment this side of Davy Jones' locker. This is the ALL SOLID STATE fleet — with the best in performance, features, and styling at prices to suit every requirement or desire. Top deck is the luxurious ADMIRAL 23 channel base station . . . then the COMMODORE mobile with the patented Pulse Eliminator. On the bridge the SKIPPER is blasting out on all 23 and in the wheelhouse is the terrific 2 channel 3 watt YEOMAN portable. The SS all solid state fleet is for you . . . from port to portable! You are invited to the launching — Ask your distributor for details and write today for full color literature.

The ADMIRAL: luxurious new all solid state 23 channel CB base station ● highly sensitive receiver ● Pulse Eliminator ● 5 watt transmitter ● Speech Compression ● +2 mike ● dual antenna ● HiLo sensitivity ● Public Address ● Delta Tune ● adjustable squelch ● ON-THE-AIR light ● illuminated S meter ● digital panel clock ● earphone jack ● regulated AC power supply

$329.95

The SKIPPER: new low priced solid state 23 channel CB transceiver ● superb dual conversion FET/IC no-overload receiver ● advanced design noise limiting ● illuminated S meter and channel ● solid state T/R switching ● Speech Clipping ● 100% modulation ● P.T.T. mike ● Local/Distant sensitivity ● external speaker jack ● Public Address ● Exclusive "All Position" Safety Breakaway Mount ● only 3 lbs.: 1¾ x 6 x 8"

$159.95

The COMMODORE: 23 channel, solid state mobile CB transceiver ● Ultra sensitive ½ μv double conversion receiver ● crystal filter, 7 KC selectivity ● adjustable squelch ● flat AGC ● Pulse Eliminator removes ignition noise ● 3 watts audio ● 5 watts input ● 100% modulation ● PTT mike ● 26 transistors, 7 diodes ● 4 lbs, 3½ x 7 x 8

$199.95

The YEOMAN: fine, powerful portable CB transceiver ● 2 channels, equipped with ch 7 ● Sensitivity ½ μv ● AGC ● Adjustable Squelch ● Noise Limiter ● 3 watts input, 2½ watts output ● Operates on 8 pen-lite batteries ● Battery/RF Power ● Call signal ● 54" whip antenna ● Earphone ● under 2 lbs 3 x 8 x 1¾

PAIR **$149.95**

SQUIRES-SANDERS, INC., Box A, Martinsville Road, Liberty Corner, New Jersey 07938 U.S.A.

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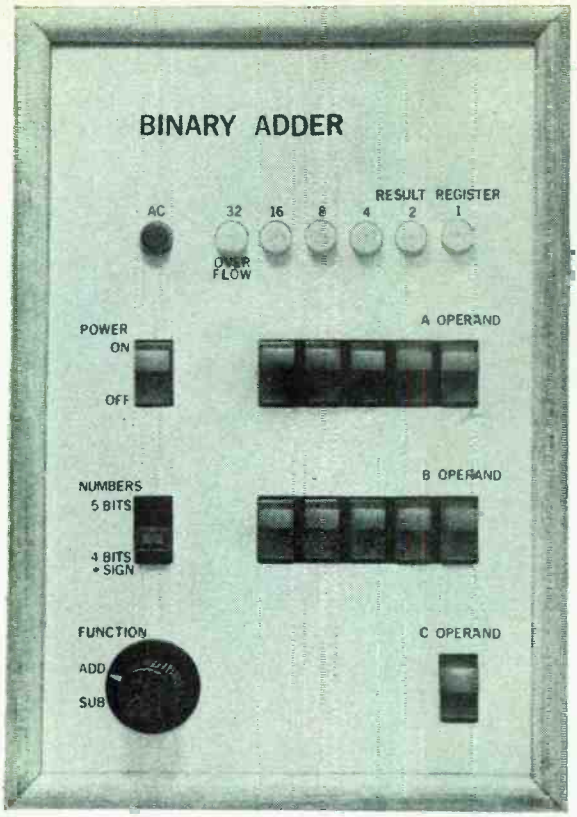

DEMONSTRATING BINARY COMPUTATION WITH THE *Binary Adder*

BY BARRY W. BEALS

SCIENCE FAIR OR CLASSROOM PROJECT ILLUSTRATES FUNDAMENTALS OF DIGITAL COMPUTER OPERATION

THE MODERN digital computer is an awe-inspiring sight and probably represents the most complex piece of equipment that most people have ever seen. However, there are two fascinating facts about a computer that the average individual is completely unaware of: first, all a computer can actually do is add, subtract, and remember (via a magnetic memory); second, the entire number vocabulary of the computer is limited to only two digits.

The choice of two digits becomes obvious when you consider that the entire vocabulary can be generated with a simple s.p.s.t. switch. One position (state) of the switch represents one digit, while the other position (state) represents the second digit. With the introduction of high-speed solid-state switches, operation at many millions of times per second is now possible.

The name of this two-digit arithmetic is "binary notation," with the *bi* representing the base 2. On the other hand, no pun intended, finger counting is called decimal notation (*dec*—to the base 10) because we count on 10 fingers, then repeat. Other values of notation are used in large-scale digital computers, but are too complex to be covered here.

The "Binary Adder" discussed in this article is a very simple, low-cost digital computer that will not only teach you binary arithmetic and give you a good idea of how a modern digital computer works, but will also give you a good insight to the "new math" being taught in our schools.

The article is divided into three sections. The first, starting on page 30, covers binary arithmetic, explains what it is, how it is notated, how it is used, and gives some practice examples as an aid to understanding the subject. The second section, starting on page 31, explains the operation of this simple digital computer; while the third section, starting on page 40, tells you how to build and use the "Binary Adder."

HOW BINARY SYSTEM WORKS

The peculiarity of the binary number system lies in the fact that a serial arrangement of only two digits, "0" and "1," can be made to represent any number (units, tens, hundreds, thousands, etc.). Before delving into the following analysis of the binary number system, keep in mind that the use of these two digits is especially appropriate to computer technology and electronic calculation. Either "0" or "1" can be represented electrically in many simple ways: a voltage being present or absent; a switch being *on* or *off*; or any other function that can take either of two discrete stable states. Because one electrical switch can only "count" to 1 (e.g., 0, 1), several switches would be required to count to 2, 3. . .10, etc. This is the reason why binary numbers are usually represented in groups of several zero's and one's, with the length of the group depending on the values of the final number you require.

Looking at an array of binary digits, the right-most column represents either a zero or a one and is called the one's (or unit's) column—thus, five-digit binary number 00000 is zero, while 00001 is one. The second digit (or column) from the right is the two's position; thus, 00010 represents two. In combination then, binary 00011 represents three (one 2 plus one 1).

In similar fashion, the value of each binary digit to the left is twice that of the bit to its right. These "place values" in the binary system are therefore 1, 2, 4, 8, 16, etc. Table 1 lists these numbers and their corresponding binary representation. Note that the 1 symbol indicates that a place value is to be counted, while a 0 indicates that it is *not* to be counted.

TABLE 1: BINARY PLACE VALUES

Digit Position	Place Value	Binary Representation
1 (right-most)	1	00001
2	2	00010
3	4	00100
4	8	01000
5	16	10000

COMMONLY USED TERMS

Binary A numbering system using only two symbols (such as 0 and 1) to express any number by combinations of the symbols. Also referred to as a system whose successive digits are interpreted as coefficients of the successive powers of the base two.

Bit An abbreviation of binary digit. Equal to one binary decision, or the designation of one or two possible and equally likely values or states of information being stored. A bit may be conveyed by one binary code element or symbol.

Carry A signal or expression produced by an arithmetic operation when the sum of two digits exceeds the base of the numbering system being used.

Logic Circuit A set of switches (mechanical or electronic) that performs logical functions: add, subtract, etc.

Operand A result, parameter, argument, or an indication of the location of the next computer instruction.

Overflow The condition that arises when the result of an arithmetic operation exceeds the capacity of the number representation (e.g., readout).

Sign Bit. When used, a bit (the left-most) in a binary number which tells you whether that number is positive or negative.

Truth Table A tabular means of identifying all the conditions that can arise in a given logical function. For each combination of inputs to the logic function, the table illustrates all possible outputs.

Two's Complement A means of representing negative binary numbers, obtained by inverting all the bits of the binary number (changing 0's to 1's and vice versa) and adding 1 to the result.

Using Table 1, the binary representation of any number up to 31 can be found. For example, the decimal number eleven can be broken up as eight plus two plus one, so that the binary equivalent is 01011 (no units of sixteen, one unit of eight, none of four, one of two, and one of one); decimal number seven is 00111; twenty-six is 11010. and thirty-one is 11111. To convince yourself of the ease with which the binary equivalent of a decimal number can be found, try the following:

(a) five 00101
(b) twelve 01100
(c) thirty 11110

(*Continued on page* 32)

BASIC ONE-BIT ADDER

The circuit used to perform binary addition of one digit from each of two operands is shown in Fig. 1. Each of the digits is represented by a d.p.d.t. switch and the result is read out on a neon lamp. To understand the operation of this circuit, refer to the extended truth table (Table 3).

Column 4 in Table 3 answers the question "Is the A Operand Bit different from the B Operand Bit?"—with 1 meaning yes, and 0 meaning no. Column 5 answers the question "Are both operand bits a 1?"

Using this table, you will see how the circuit in Fig. 1 performs binary addition—that is, how the Result and Carry Out are formed properly for all combinations of the A Operand Bit, B Operand Bit, and Carry In.

Result Generation. As shown in Fig. 1, switches S1(b) and S2(a) connect the B+ supply to the right side of the neon lamp when the switches are in opposite positions. Otherwise, resistor *R2* holds the right side of the lamp at ground potential, for all practical purposes. Thus, the right side of the lamp obeys Column 4 of Table 3, with ground meaning 0 and B+ meaning 1.

In Table 3, notice that the Result is a 1 only when Column 4 differs from the Carry In column. By wiring the left side of the neon indicator to the Carry In terminal, the neon lamp will light whenever the left and right side voltages differ (one at ground and one at B+).

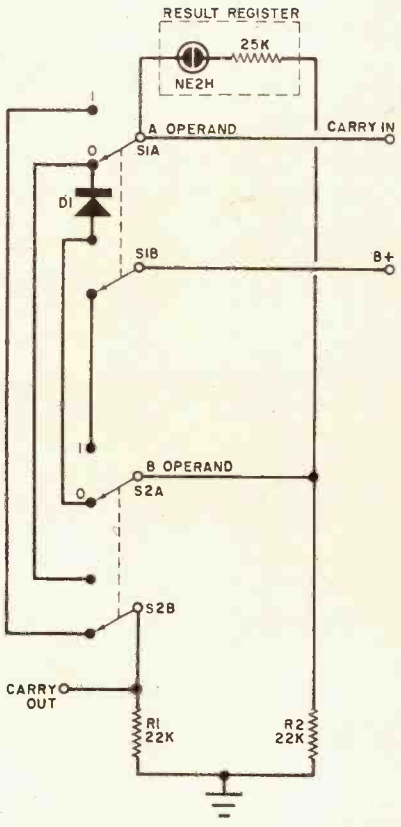

Fig. 1. This basic one-bit adder circuit shows how the Binary Adder operates.

Thus, the neon lamp displays the Result column under all circumstances.

(*Continued on page* 33)

TABLE 3: EXTENDED TRUTH TABLE

1	2	3	4	5	6	7
A Operand Bit	B Operand Bit	Carry In	A=/=B	A&B=1	Result	Carry Out
0	0	0	0	0	0	0
0	1	0	1	0	1	0
1	0	0	1	0	1	0
1	1	0	0	1	0	1
0	0	1	0	0	1	0
0	1	1	1	0	0	1
1	0	1	1	0	0	1
1	1	1	0	1	1	1

HOW BINARY SYSTEM WORKS / CONTINUED

It is just as easy to convert a binary number back into a decimal number. You add up the values of the place values for each binary 1. Thus, 00110 represents four plus two equals six. Likewise, 11011 represents sixteen plus eight plus two plus one equals twenty-seven. Try these conversion examples:*

(d) 01001 ____
(e) 01110 ____
(f) 10011 ____

Binary Addition. Adding two binary numbers is also simple. For example, add 01001 (nine) to 10010 (eighteen):

```
 01001  (nine)
+10010  (eighteen)
-----
 11011  (twenty-seven)
```

As in decimal addition, start adding the columns from the right to the left. In this example 1+0 is 1, 0+1 is 1, 0+0 is 0, 1+0 is 1, and 0+1 is 1. However, if the sum of any column exceeds 1 (example, 1+1), then a "carry" into the next column to the left is required. For example, add 01101 (thirteen) to 01101 (thirteen);

```
  11 1  carries
  01101 (thirteen)
+ 01101 (thirteen)
-------
  11010 (twenty-six)
```

Proceeding from right to left in the above example, 1+1 is two, which is 10 in binary numbers. Therefore, the right-most column sum is 0 with a carry of 1. The carry of 1 plus the two 0's in the next column give a 1 with no carry. The third column again produces a 0 with a carry of 1. The fourth column presents an interesting situation. Here, the carry plus the two 1's gives a column sum of three. Since three is 11 in binary, the result is 1 with a carry of 1. Finally, the left-most column sum is 1. To help you understand binary addition, try:

```
(g)  00100
    +01010
     -----
     01110
(h)  00111
    +01110
     -----
```

Answers to all problems are on page 92.

The preceding examples show that a number of combinations can arise during binary addition. Table 2 lists each of these combinations and their outcomes. This table, called a "*truth table*," shows the situation for a single digit of the binary number. The first two columns in each of the 8 lines show a digit from each of the two operands and the "Carry In" column indicates whether or not a carry *into* the position from the preceding one occurred.

To illustrate the meaning of the truth table entries, let's use it to add seven and fourteen in binary:

```
 00111
+01110
-----
```

Starting with the right-most digit, we must add 1+0+no carry-in. Line 3 of the table covers this situation; the "Result is 1 and the "Carry Out" is 0. Thus, the addition so far has yielded:

```
                 00111
                +01110
                -----
(partial total)      1
```

Working with the second column, we have 1+1+no carry-in. Line 4 of the truth table shows the "Result" to be 0 with a "Carry Out" of 1. Consequently, we now have:

```
(carries)     1
              00111
             +01110
             -----
(partial total)  01
```

For the third column, use line 8 of the truth table—where the "Result" is 1 with a "Carry Out" of 1. So, the sum is:

```
(carries)    11
             00111
            +01110
            -----
(partial total) 101
```

Line 6 covers the next situation, with the results being:

```
(carries)   111
            00111
           +01110
           -----
(partial total) 0101
```

To complete the addition, use line 5 of

(*Continued on page* 34)

Carry Out Generation. An inspection of Table 3 will reveal that the Carry Out signal is the same as the Carry In whenever Column 4 is a 1, 1 when Column 5 is a 1, and 0 otherwise.

Examination of Fig. 1 shows that: the first condition is met by switches *S1(a)* and *S2(b)*, which connect the Carry In terminal to the Carry Out terminal whenever these switches are set differently; the second condition is met by diode *D1*, which conducts the B+ supply voltage to the Carry Out terminal when the switches are both set at 1; and the third condition is met by the grounding of resistor *R1*.

Subtraction Circuitry. Binary subtraction is accomplished by adding the two's complement of the second operand to the first. The "invert" step of forming the two's complement is provided by *S3*, as shown in Fig. 2. The four poles of switch *S3* electrically invert *S2* by exchanging its connections to *S1*.

The "add 1" step required to complete the two's complement is accomplished by forcing a Carry In signal into the adder stage for the right-most digit position (which usually has no Carry In), thereby increasing the total by 1. This part of the operation will be discussed more fully in the next section.

The C Operand Switch. This switch (*S5*) permits an extra 1 to be added to, or subtracted from, the A Operand and B Operand result. The wiring of this switch is shown in Fig. 3. For clarity, Fig. 3 does not show the wiring of the five individual adder stages (i.e., the wiring in Fig. 2). The Carry Out (CO) of each stage is wired to the Carry In (CI) of the next stage. The Carry In for the first stage (the right-most position, or place value one) is determined by the FUNCTION (ADD/SUB) switch (*S3*) and by the C OPERAND switch.

For the ADD function, the setting of

(*Continued on page* 35)

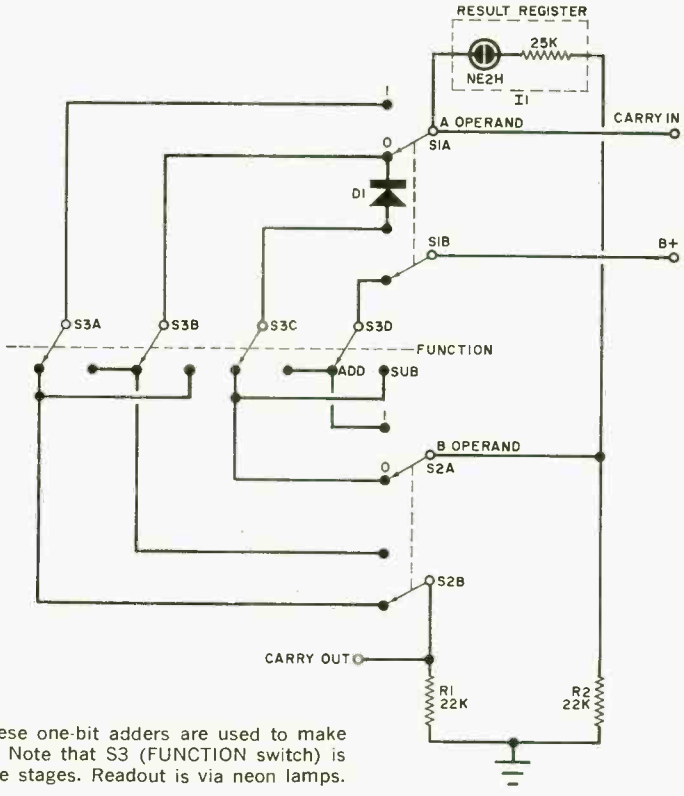

Fig. 2. Five of these one-bit adders are used to make the Binary Adder. Note that S3 (FUNCTION switch) is common to all five stages. Readout is via neon lamps.

the truth table (0+0+"Carry-In" of 1) to give the final result:

```
(carries)  111
            00111
          +01110
           10101
```

Negative Numbers. Up to now, we have been dealing solely with positive binary numbers. What about *negative* numbers? In decimal operations, we normally precede a number by a minus sign (−) to show that it is less than zero. However, in computers it is necessary to use an extra binary digit (or *bit*) to convey the sign of the number: 0 meaning "plus" and 1 meaning "minus."

It has been shown that a plus five would be written as 00101. Rather than use the left-most bit as the sixteen position, we will now use it as the sign bit (and having made that decision, we must cease to think of it as the "sixteen" digit, to avoid confusion). Thus, a minus five might be written as 10101. In this example, the magnitude of the number (i.e., the five) is represented the same way in both its positive and negative form—10101. This means of representing negative numbers is called the *true* form.

Obviously, this form is convenient to use—we simply append a sign bit (0 or 1) to the left end of a binary number. However, true-form negative numbers are not used in today's computers, since the circuitry required to manipulate them is unnecessarily complicated (and therefore slower and more costly). Rather, a complement form of manipulation is used.

Two's Complement Form. The *two's complement* form for negative numbers makes it possible to build computers in which *no* special provision has to be made for negative numbers. This form is obtained by inverting every digit of the number (that is, changing all 1's to 0's and all 0's to 1's) and then adding 1. For example, to find the two's complement representation of minus five:

(a)	plus five in binary	00101
(b)	invert every bit	11010
(c)	add 1	11011

The representation 11011 is minus five in two's complement form. As with true form, the left-most digit is used as the sign; here the left-most 1 indicates a negative number. Thus, 10010 and 11111 are negative numbers, while 01110 and 01001 are positive numbers.

Unfortunately, the numerical values of 10010 and 11111 are not apparent by inspection. To find the values of negative numbers, take the two's complement again. For example:

(a)	unknown negative number	10010
(b)	invert every bit	01101
(c)	add 1	01110

Since 01110 is plus fourteen, the value of 10010 is minus fourteen. Similarly, the value of 11111 can be found to be minus one. You will want to test yourself on these exercises—in each case, give the *value* of the binary numbers

(*Continued on page* 40)

TABLE 2: TRUTH TABLE FOR BINARY ADDITION

Line	A Operand Bit	B Operand Bit	Carry In	Result	Carry Out
1	0	0	0	0	0
2	0	1	0	1	0
3	1	0	0	1	0
4	1	1	0	0	1
5	0	0	1	1	0
6	0	1	1	0	1
7	1	0	1	0	1
8	1	1	1	1	1

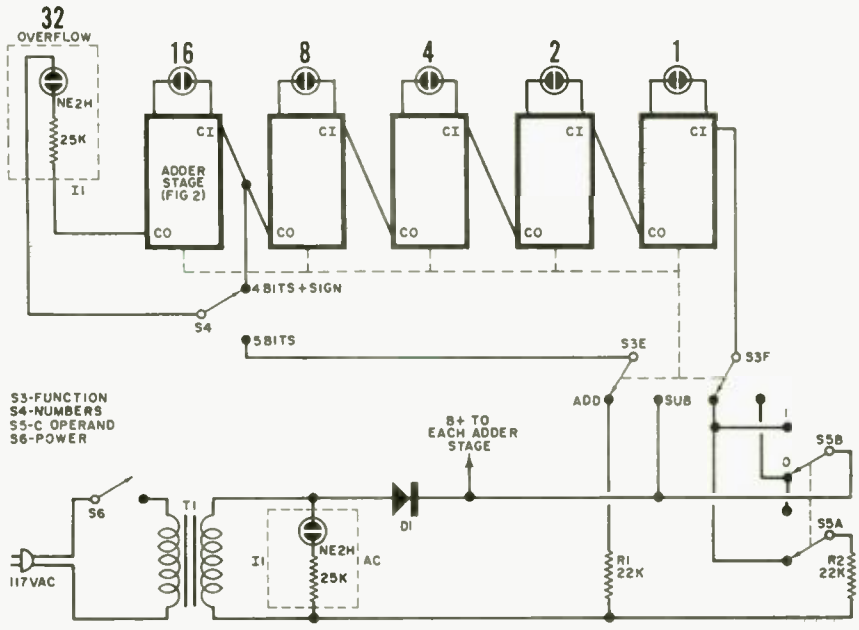

Fig. 3. To reduce illustration complexity, each of the five one-bit adders are shown in block form with only the Carry In (CI) and Carry Out (CO) of each stage identified.

PARTS LIST

D1—Rectifier diode, 200 PIV, 500-m.1 (six required)
I1—Neon lamp assembly, NE2H and 25,000-ohm resistor (Allied Electronics 60 E 8700, six white required, 60 E 8698, one red required)
R1, R2—22,000-ohm, ¼-watt resistor (12 required)
S1, S2, S4, S5, S6—D.p.d.t. rocker switch, 13 required (Burstein-Applebee 18D512 or similar)
S3—24-p.d.t. rotary switch (IRC-CTS T239 or similar)
T1—Isolation transformer, 117-volt a.c. to 117-volt a.c.
Misc.—Case (preferably wooden), front panel, decals, knobs, rubber feet, power line cable, etc.

the C OPERAND switch is identical to the Carry In for the first adder stage. If the C OPERAND is set to 0, the Carry In is zero; if it is set to 1, then the Carry In is one, which will increase the sum by 1.

For the SUB(tract) function, the action of the C OPERAND switch is inverted by the wiring of *S3(f)*. That is, when the C OPERAND is in the normal (0) position, the Carry In is a 1 since *S5(b)* selects the B+ supply voltage in the 0 position.

This initial carry-in completes the two's complement operation by adding 1 to the A and inverted-B Operand total. On the other hand, if the C OPERAND switch is in the 1 position, then no Carry In will be present. As a result, the total will be 1 lower than the difference between the operands.

Numbers Switch. This switch (*S4*) enables you to use either signed or unsigned binary numbers as the A and B OPERANDS. With *S4* in the "4 BITS+ SIGN" position, the binary numbers represented by the A and B OPERAND switches and in the right-most five bits of the RESULT REGISTER are thought of as being signed numbers. For example, 01110 (fourteen) + 11110 (minus two) will be 01100 (twelve).

Notice that, with *S4* in this position, the right-most 5 bits of the RESULT REGISTER cannot contain the sum of all possible numbers that can be entered. For example, 01111 (fifteen) + 00011 (three) will display as 10010. But since the fifth bit is being used as the sign

(*Continued on page* 100)

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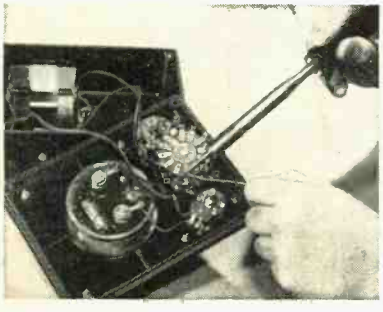
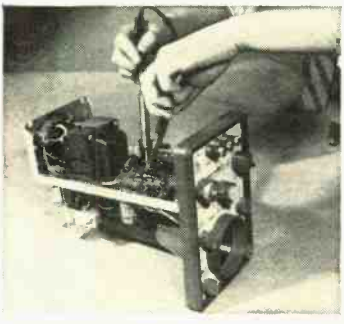
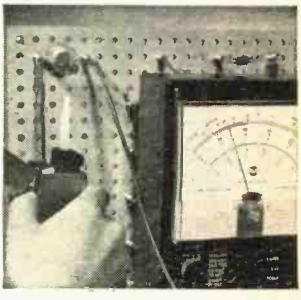




Construction of Oscilloscope.

Temperature experiment with transistors.



listed, remembering that the left-most bit is the sign of the number.

(i) 00111 +7
(j) 11001 −7
(k) 10011 −13

Binary Addition With Negative Numbers. As was mentioned earlier, the selection of two's complement form for negative numbers means that no special circuitry is required to manipulate them. In other words, the addition of positive and negative numbers is performed exactly as was shown above. For example, the addition of five and minus one would be:

carries	11111
five	00101
minus one	+11111
four	00100

In this case, the carry out of the left-most bit is simply discarded.

Interestingly enough, if the addition results in a negative total, no extra work is required either. For example, the sum of minus five and one is:

carries	11
minus five	11011
one	+00001
minus four	11100

That 11100 is minus four can be verified by inverting 00011 and adding 1 (00100).

A final example would be minus five plus minus one:

carries	11111
minus five	11011
minus one	+11111
minus six	11010

Again, the left-most carry is discarded.

Binary Subtraction. We have seen how binary addition works, that "carries" are produced in much the same way as in the decimal system, and we have defined a truth table that shows how to add two binary digits under all circumstances. Likewise, we could (but will not) develop the mechanics of binary subtraction, with rules for "borrowing," etc. In keeping with this straightforward approach, the older digital computers actually had separate circuitry for performing subtraction. But that is unnecessary.

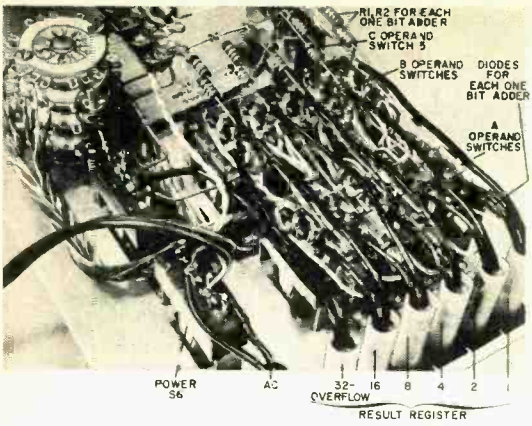
Subtraction can be thought of as the addition of one number with the *negative* of a second number. That is, five minus one is the same as five plus (minus one); or, in general, "x−y" is identical to "x+(−y)." Therefore, today's computers (and the "Binary Adder" as well) perform subtraction by taking the negative of the second operand and then adding the two together. Since we are using two's complement negative numbers, we will perform subtraction by taking the two's complement of the second number, and then adding the two operands together. The

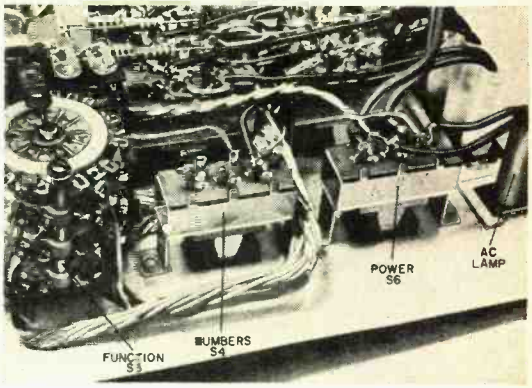
(*Continued on page* 92)

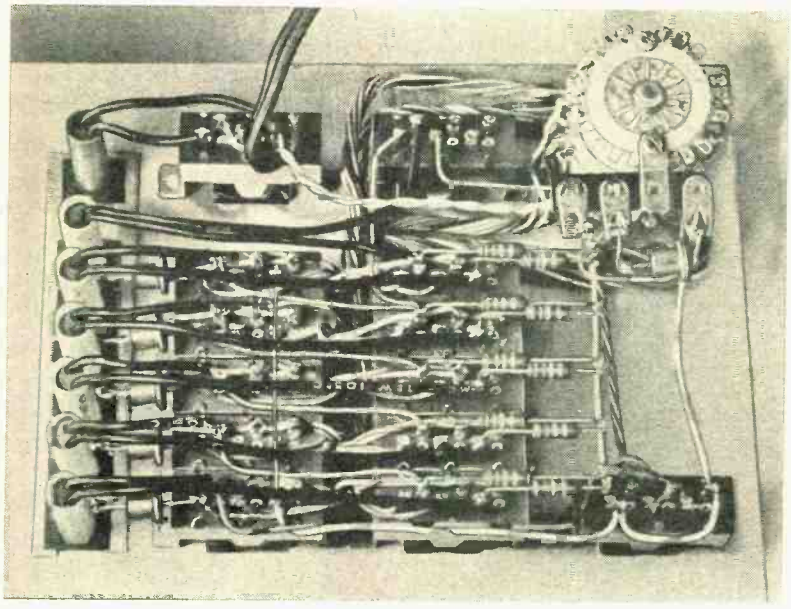
CONSTRUCTION & APPLICATIONS

No special construction techniques are necessary to build the "Binary Adder." The easiest method is to drill the front panel to accept the various switches and readout lamps before doing anything else. The author used the physical arrangement shown in the photo on page 29, although any other arrangement can be used, depending on the type of switches and lamps you use. A "nibbling" tool was used to make the cutouts for the switches, and dry transfer lettering was used for front-panel marking.

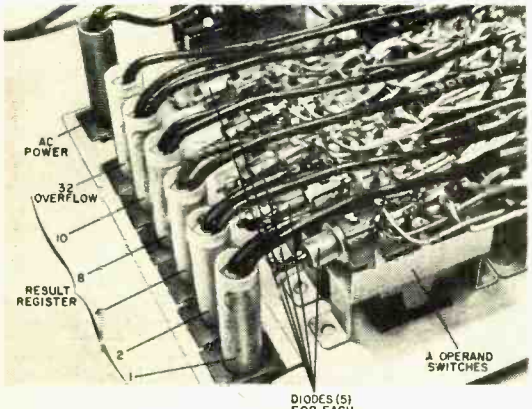
The only requirements for proper layout is that the six readout lamps (RESULT REGISTER) be installed in an equally spaced row across the upper end of the panel, with the "1" indicator at the right and the "32-OVERFLOW" lamp at the left. The five A OPERAND switches should be located sequentially under each readout bulb, starting at the right-hand side; the B OPERAND switches should be located directly under the A OPERAND switches; and the C OPERAND switch should be mounted di-

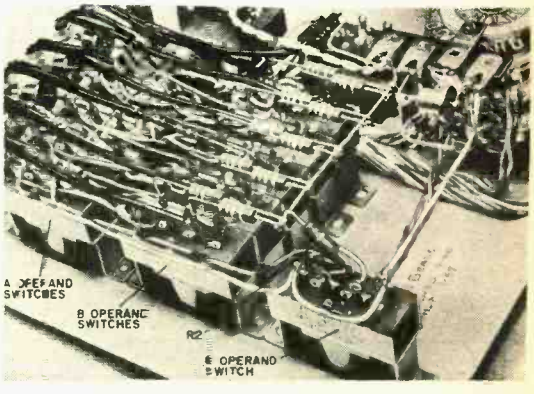






Overall interior view of the Binary Adder is shown at the left. The four photos surrounding this view identify the various components within the circuit. Note the alignment of each A and B Operand switch with its associated Result Register readout indicator.





rectly under the right-hand column (see the photos on pages 29 and 41).

Each OPERAND rocker switch is mounted so that the switch is "off" when the side toward the user is "down." The positions of the other switches and the a.c. indicator lamp are not important. The power transformer and its associated rectifier can be mounted wherever convenient.

Once all components are properly mounted, wire the circuit point-to-point in accordance with Fig. 3. (This figure does *not* detail the repetitive internal circuitry of the five adder stages in Fig. 2 to avoid schematic complexity.) Make sure that all diodes are mounted with the correct polarity, and properly identify the terminals of the OPERAND switches. Note that a 22-pole, 2-position switch is required for the FUNCTION switch; you will have to identify the required contacts and use color-coded wire to avoid mix-ups.

Initial Checkout. Once wiring has been completed and checked as to accuracy, the "Binary Adder" should be tested. Plug the unit into a source of 117-volt a.c. and turn the POWER switch ON—the red a.c. indicator lamp should come on. Place the NUMBERS switch (*S4*) in the 5 BITS position and the FUNCTION switch in ADD. With the A, B, and C OPERAND switches all set to zero (or down), the RESULT REGISTER indicator lamps should all be off.

Working with a single bit at a time, try the following operations:

	(a)	(b)	(c)	(d)	
A OPERAND	0	0	1	1	
B OPERAND	0	1	0	1	
C OPERAND	0	0	0	0	
RESULT REGISTER	$\overline{0}$	$\overline{1}$	$\overline{1}$	$\overline{0}$	plus carry out

"Carry out" is indicated by the next light (to the left) coming on. For example, if the "2" digit position is being tested, carry out is signaled by the "4" lamp coming on. As a test of the carry circuitry, perform the following addition:

A OPERAND (21)		1	0	1	0	1
B OPERAND (10)		0	1	0	1	0
C OPERAND (1)						1
RESULT REGISTER (32)	1	0	0	0	0	0

If the above tests are good, the subtract operation can be checked. Place the FUNCTION switch in the SUB(tract) position and perform the following operations:

	(a)	(b)	(c)
A OPERAND	11111	00000	00000
B OPERAND	11111	00000	00001
C OPERAND	0	1	0
RESULT REGISTER	$\overline{000000}$	$\overline{111111}$	$\overline{111111}$

As a final check, place the NUMBERS switch in the 4 BITS + SIGN position and perform the following operations:

(a)	
A OPERAND (+5)	00101
B OPERAND (sub. −6)	11010
C OPERAND	0
RESULT REGISTER (+11)	01011

(b)	
A OPERAND (−16)	10000
B OPERAND (sub. +2)	00010
C OPERAND (sub. +1)	1
RESULT REGISTER	01101 + OVERFLOW

In the (b) example above, the expected result of −19 exceeds the limitations of the "Binary Adder" (which is restricted to the range of +15 and −16 inclusive) so that the OVERFLOW indi-

(*Continued on page 92*)

CONTROLS AND INDICATORS

NUMBERS Switch This s.p.d.t. switch changes the arrangement of the RESULT REGISTER indicator lamps. When it is in the "4 BITS + SIGN" position, the left-most bit is considered as the sign bit, so that the A and B OPERANDS may be positive or negative. When it is in the "5 BITS" position, no sign bit is used, so the left-most bit has the place value of sixteen; and only positive operands may be entered.

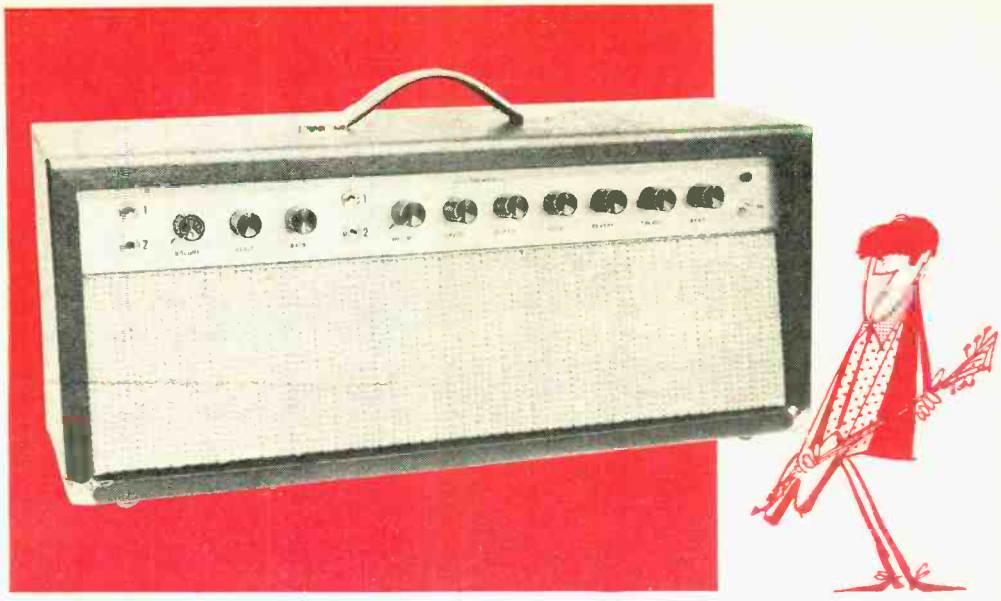
FUNCTION Switch This switch selects either an "ADD" or "SUB" (subtract) function.

A OPERAND Switches A set of five d.p.d.t. switches used to insert one five-bit binary number.

B OPERAND Switches A set of five d.p.d.t. switches used to insert a second five-bit binary number.

C OPERAND Switch A single d.p.d.t. switch with which a binary 1 may be added or subtracted from the total.

RESULT REGISTER Indicator Lamps A set of six neon indicator lamps which display the sum or difference of the "A, B, or C OPERANDS." A turned-off lamp indicates a binary 0, while a glowing lamp indicates a binary 1.



BUILD THE

M/M/M Instrument Amplifier

60-WATT SOLID-STATE GUITAR AMPLIFIER WITH TREMOLO, REVERB, AND FUZZ

PART 1

BY DANIEL MEYER

HOW WOULD YOU like to build a custom sound system for your electric guitar with the exact controls and features that you want? Or, if you are satisfied with your present arrangement, how would you like some "add ons"—such as controllable fuzz, tremolo, and reverb, that can very easily be hooked up to your system? If you already have a relatively low power amplifier, how about a clean 60-watt booster so that you can be heard?

If desired, the entire system can be built "from scratch" for about $85, and will have features not found in most professional units which cost many times as much. It even includes a high-quality straight preamplifier for vocals or voice announcements.

The M/M/M (Mix, Match, Musical) Instrument Amplifier is built on four printed boards each of which can be made or purchased as a complete kit, so circuit duplication will present no problem. To put the icing on the cake, the entire system has been tested over a period of eight months by a professional combo and has aroused much comment. Circuit reliability has proven excellent.

Power Amplifier. The power amplifier circuit, shown in Fig. 1, uses five silicon transistors to insure maximum temperature stability. The two power output transistors, *Q4* and *Q5*, are complementary types, as are drivers *Q2* and *Q3*. These four transistors form a class-B, push-pull, emitter-follower power ampli-

POWER AMPLIFIER PARTS LIST

C1, C3—10-μF, 15-volt electrolytic capacitor
C2—200-μF, 6-volt electrolytic capacitor
C4—50-μF, 25-volt electrolytic capacitor
C5—4000-μF, 50-volt electrolytic capacitor
D1, D2—1N3754 diode
D3—Silicon bias diode (1N645 or similar)
Q1, Q3—MM4005 transistor (Motorola)
Q2—MM3005 transistor (Motorola)
Q4—SJ3507 transistor (Motorola)
Q5—MJ2802 transistor (Motorola)
R1—10,000-ohm, ½-watt resistor
R2, R3, R4, R9—4700-ohm, ½-watt resistor
R5—68,000-ohm, ½-watt resistor
R6—220-ohm, ½-watt resistor
R7—50,000-ohm trimmer potentiometer
R8—47-ohm, ½-watt resistor
R10—2200-ohm, ½-watt resistor
R11, R12—470-ohm, ½-watt resistor
R13, R14—0.27-ohm, 5-watt resistor
SPKR—4-ohm, 60-watt capability speaker
Misc.—Heat sink, diode clamps (2), mica insulating washers (2), mica transistor insulator, silicone grease, mounting hardware, etc.

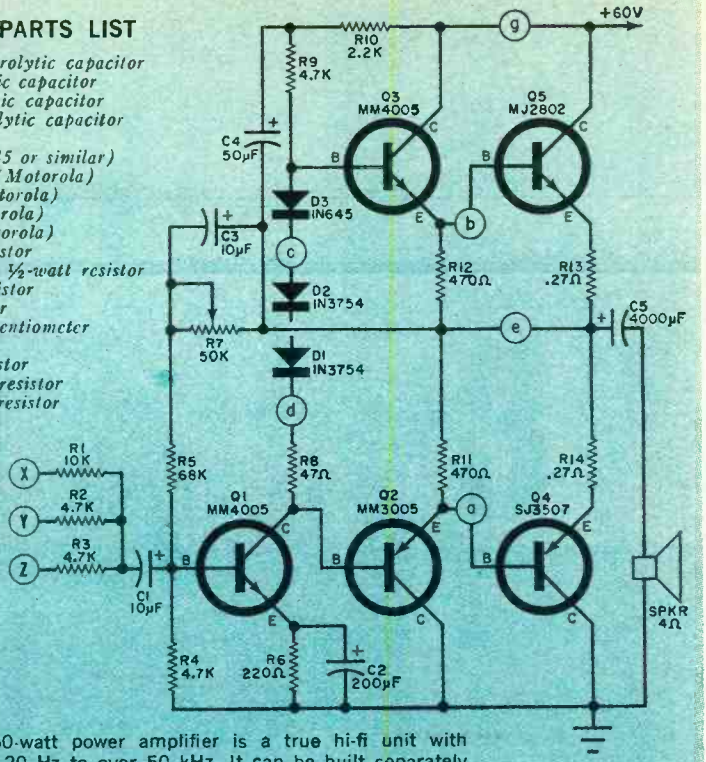


Fig. 1. This 60-watt power amplifier is a true hi-fi unit with response from 20 Hz to over 50 kHz. It can be built separately and used as a power booster for any instrument (or audio) system.

fier that provides exceptionally clean output at high power and low cost. The first stage, *Q1*, is a conventional voltage amplifier.

Diodes *D1*, *D2*, and *D3* are connected between the bases of the driver stages and provide forward bias to turn the output transistors slightly on to prevent crossover distortion. Two of these diodes (*D1* and *D2*) are clamped to the output transistors' heat sink so as to stabilize the forward bias for any variations in operating temperature of the output power transistors.

Power output is a continuous 60 watts, corresponding to a peak music power rating of about 140 watts. Frequency response is from 20 Hz to at least 50 kHz, and the amplifier is designed to supply any 4-ohm speaker that can carry the power. Two 8-ohm speakers, each having at least a 35-watt rating can be used connected in parallel.

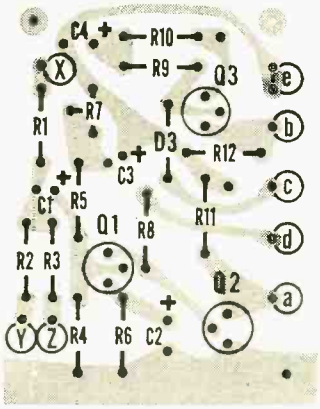
The power amplifier, with the exception of the two output transistors (*Q4* and *Q5*), their associated diodes (*D1* and *D2*), emitter resistors *R13* and *R14*, and output capacitor *C5*, is assembled on a printed board such as that shown actual size in Fig. 2. Components are affixed to the board as shown in Fig. 3. The letter-coded connections in Fig. 3 correspond to those in Fig. 1 for wiring to the external components.

The two power transistors are mounted on the heat sink, with a mica insulating sheet and insulating washers used on *Q5* only. Use a thin coating of silicone grease on both sides of the mica insulator sheet, and on the bottom of both transistors so as to make a good thermal bond between the transistors and the heat sink. One mounting screw of each power transistor should also secure a diode clamp. Insert one 1N3754 diode in each clamp, then tighten the screws. (The author's assembly is shown in Fig. 4.)

Make sure that diodes *D1* and *D2* are correctly wired into the circuit by ob-

Fig. 2. Actual-size printed board for amplifier. The two power transistors and associated components are mounted externally due to their heat dissipation.

Fig. 3. Install the board components as shown. The letter designations correspond to those in Fig. 1.



(or point "e" on the circuit board), and adjust trimmer *R7* for half the power supply voltage (about 30 volts). If you have a sine-wave audio generator and oscilloscope, drive the amplifier to full output with a 4-ohm load connected and adjust trimmer *R7* for symmetrical clipping of both sides of the sine wave.

Instrument Preamplifier. The major difference between a preamplifier designed for a hi-fi system and one designed for an instrument amplifier is that in the latter case there is no need for equalization, and a greater dynamic range must be handled. A recording seldom has more than a 40-dB dynamic range (due to the limitations of the tape or record being used). However, this limitation is not placed on a musical instrument, and the preamplifier must be capable of handling

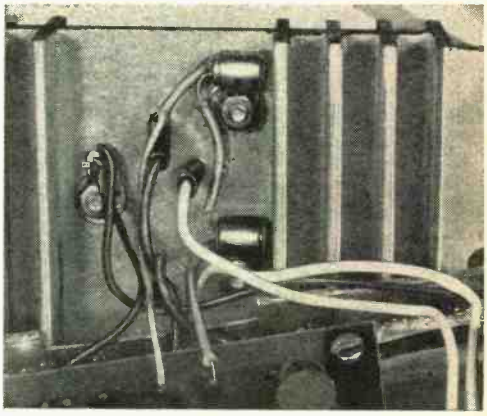


Fig. 4. Diodes D1 and D2 are thermally coupled to Q4 and Q5 by means of a heat sink and diode clamps.

serving that a red dot on each diode case identifies the cathode of the diode. Failure to wire these diodes correctly may damage the power transistors.

Once the heat sink assembly has been completed, it can be wired to the printed board (see Fig. 1). The two emitter resistors (*R13* and *R14*) and output capacitor *C5* are mounted elsewhere on the chassis.

In testing the power amplifier, use a 60-volt power supply, preferably the one designed for this circuit and covered in Part 2 of this article. Connect a voltmeter to the junction of *R13* and *R14* in excess of 60 dB dynamic range during operation. It must also be capable of handling signals from a millivolt up to a volt or so without overloading or clipping.

The main circuit, shown in Fig. 5, makes a very useful instrument preamplifier and incorporates a number of circuits not usually found in most preamps. Besides the usual bass and treble tone controls, this preamp features a built-in fuzz and tremolo circuit.

The first stage (*Q1*) is a common-emitter amplifier directly coupled to an emitter follower output stage (*Q2*). The

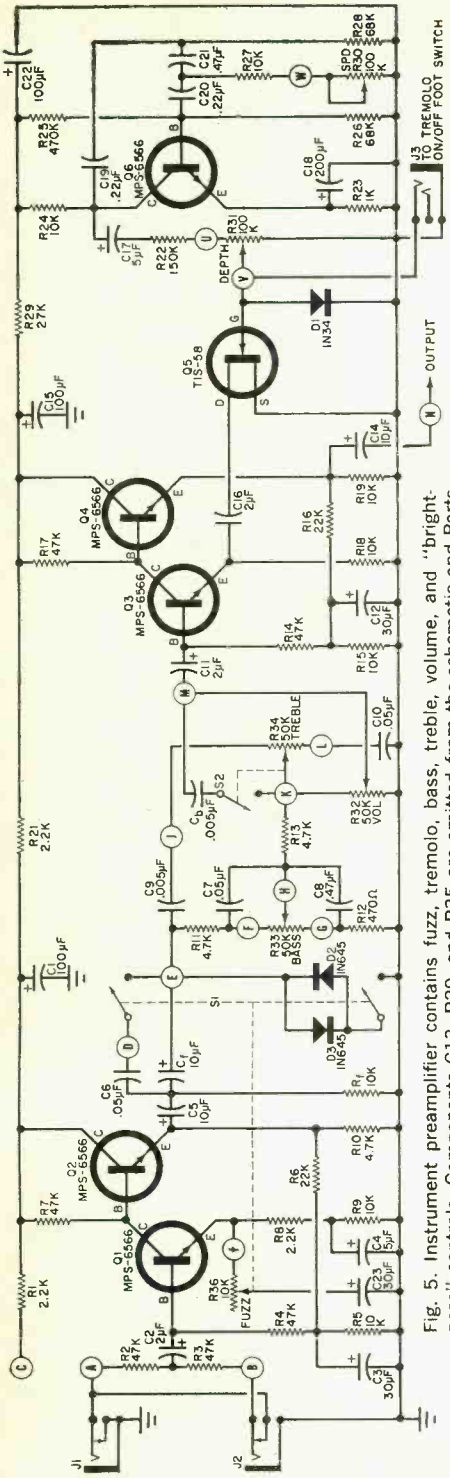


Fig. 5. Instrument preamplifier contains fuzz, tremolo, bass, treble, volume, and "brightness" controls. Components C13, R20, and R35 are omitted from the schematic and Parts List since they are not used here but in the straight preamp which is built on a similar board.

two inputs are fed to *Q1* through isolation resistors *R2* and *R3* wired so that they will be in parallel only when *J1* is being used. The emitter circuits of *Q1* and *Q2* contain the fuzz arrangement.

When "Fuzz" level control *R36* is rotated from its off position, switch *S1* operates. One pole of this switch introduces a pair of clipping diodes (*D2* and *D3*) into the audio circuit. The other pole introduces a parallel coupling capacitor (*C6*) into the interstage coupling. This switching does two things to the signal: first, the diodes clip all signals that exceed one-volt amplitude; second, all low-frequency signals are attenuated and given a sawtooth shape. As *R36* is rotated, the amount of unbypassed emitter resistance in the *Q1* circuit is reduced and the stage gain is increased, which, in turn, increases the amount of clipping and distortion caused by the diodes. This type of variable fuzz is far more versatile than the more conventional fixed fuzz.

INSTRUMENT PREAMPLIFIER PARTS LIST

C1, C15, C22—100-μF, 50-volt electrolytic capacitor
C2, C11, C16—2-μF, 15-volt electrolytic capacitor
C3, C12, C23—30-μF, 6-volt electrolytic capacitor
C4, C17—5-μF, 15-volt electrolytic capacitor
C5, C14—10-μF, 25-volt electrolytic capacitor
C6, C7, C10—0.05-μF capacitor
C8, C21—0.47-μF capacitor
C9, Cb—0.005-μF capacitor
C18—200-μF, 6-volt electrolytic capacitor
C19, C20—0.22-μF capacitor
Cf—10-μF, 15-volt electrolytic capacitor
D1—1N34 or similar germanium diode
D2, D3—1N645 or similar silicon diode
J1, J2—Closed-circuit phone jack
J3—3-conductor phone jack
Q1, Q2, Q3, Q4, Q6—MPS6566 transistor (Motorola)
Q5—TIS58 field-effect transistor (Texas Instruments)
R1, R8, R21—2200 ohms
R2, R3, R4, R7, R14, R17—47,000 ohms
R5, R9, R15, R18, R19, R24, R27, Rf—10,000 ohms
R6, R16—22,000 ohms
R10, R11, R13—4700 ohms
R12—470 ohms
R22—150,000 ohms
R23—1000 ohms
R25—470,000 ohms
R26, R28—68,000 ohms
R29—27,000 ohms
R30, R31—100,000-ohm linear potentiometer
R32, R33, R34—50,000-ohm potentiometer
R36—10,000-ohm CCW log taper potentiometer
S1—D.p.s.t. switch (on R36)
S2—S.p.s.t. switch (on R34)

(all ½-watt resistors)

Fig. 7. Component layout for instrument preamplifier. Components Rf and Cf determine the degree of fuzz, and may be varied in value from those shown.

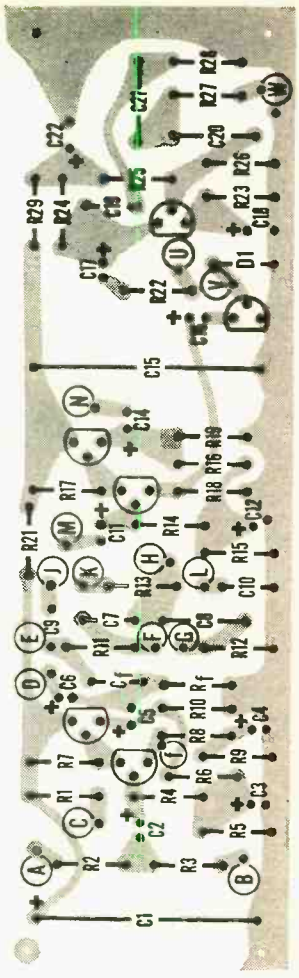


Fig. 6. Actual-size printed board for assembly of instrument preamplifier. The preamp can also be used independently with any instrument audio system.

The signal from *Q2* is then passed through a bass and treble tone control circuit (15 dB cut or boost) before it is further amplified by *Q3*. There is one unique feature about the treble control used here. When switch *S2* is activated, capacitor C_b is introduced to bypass the high-frequency sound around volume control *R32*. Introducing this capacitor in the circuit produces a "bright" signal that is a type of fixed treble boost. Although switch *S2* is shown coupled to *R34*, it can be an independent switch.

The output signal at the collector of *Q3* is directly coupled to emitter-follower *Q4*, from which it is fed to the power amplifier. However, the built-in tremolo is introduced at the emitter of *Q3*.

The tremolo circuit consists of *Q3*'s emitter bypass capacitor (*C16*) in se-

(*Continued on page* 99)

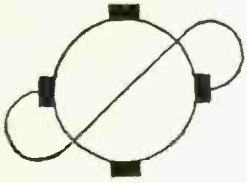
Electronic "A" Quiz

BY ROBERT P. BALIN

Electronic technicians and hobbyists must learn the meaning of many technical terms related to their work. Illustrated below are 10 such terms having nothing in common except that they all begin with the letter "A." Test your knowledge of electronic terminology by filling in the missing letters.

(*Answers appear on page* 98)

1



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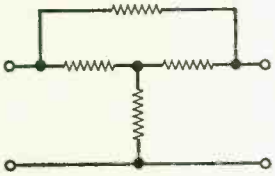

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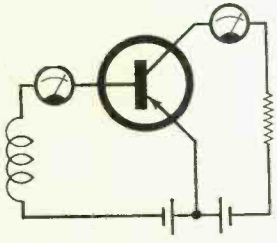

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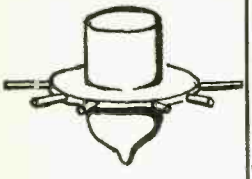

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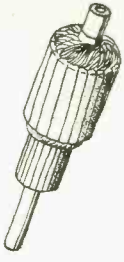

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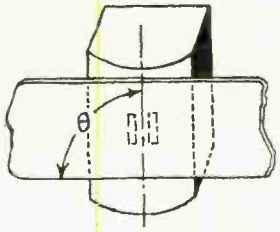

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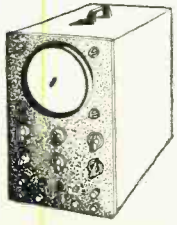

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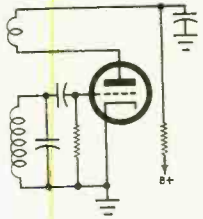

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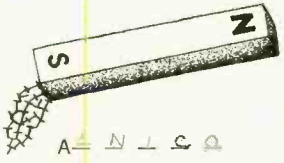

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10

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THE NEWEST TOOL of the education innovators—programmed instruction—is coming to the aid of the electronics correspondence or home study institute. If you study at home, programmed instruction (PI) promises to make it easier and faster for you to learn almost any subject (including electronics), and to retain more of what you learn for a longer time than with other study techniques.

Programmed instruction is theoretically *the* most effective home study technique. Students using PI materials need neither the help of a teacher nor additional textbooks. In fact, the philosophy of the people who prepare PI materials is: "If you don't understand a topic or point after reading it in a PI book, you're not to blame—it's the fault of the person who wrote it."

Many names have been given to PI materials. Regardless of what name is applied to them, however, you can recognize PI materials by their carefully-worded, bite-size bits of information. These bits are usually arranged in such a manner that they force you to focus your attention on them. As a result, the once tedious process of learning becomes almost effortless.

If you find it rough going trying to study from conventional textbooks, it

will be well worth your while to investigate PI books. You will see for yourself at first hand that you have nothing to lose and everything to gain from these new materials.

What Programmed Instruction Is. The unique techniques used in programmed instruction evolved from the work of Professor B. F. Skinner, a psychologist at Harvard University. In 1954, Professor Skinner described the first PI course wherein each student reads the same material from start to finish without skipping ahead. His technique is known today as "linear programming," and came about as the result of extensive studies of animal and human behavior and learning habits.

The characteristics of linear programming are small, bite-size bits of information, each of which is followed immediately by a question—and its answer (given on the same page as the question or on the page directly following it). A sample of the linear programming technique is shown on page 51. Each successive bit of information is based on the bits preceding it so that the student is forced to remember what he has learned in earlier frames. (A frame consists of a statement, a question, and an answer.)

SAMPLER OF PI BOOKS ON BASIC ELECTRONICS

Basic Electronics. Edited by Jack W. Friedman, Harry G. Rice, and Gerald McGinty, RCA Institutes, Inc. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Linear program. (Subject material is concerned with basic electricity.) 533 pages. $9.95.

Basic Electricity/Electronics, A Programmed Learning Course. By Training and Retraining, Inc. Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Five-volume set. Each volume is divided into two-page segments, each covering a single idea. Set includes a total of 1300 pages, and sells for $19.95. Volumes are: Basic Principles And Applications, $4.50; How A.C. And D.C. Circuits Work, $4.50; Understanding Tube And Transistor Circuits, $4.50; Understanding And Using Test Equipment, $4.50; Motors And Generators—How They Work, $4.50.

D.C. Circuit Principles. By Training Systems, Inc., and Stanley L. Levine. Published by Hayden Book Co., Inc., 116 West 14 St., New York, N.Y. 10022. Linear program, 246 pages. $3.95.

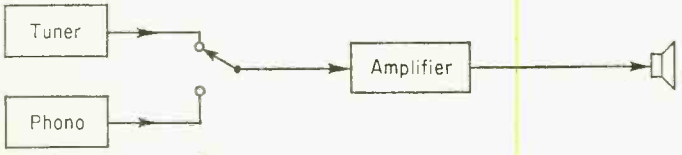
Introduction To Electronics. By R.J. Hughes and P. Pipe. Published by Doubleday Book Co., Garden City, L.I., N.Y. 11530. Branching program under trade name "TutorText." 421 pages. $4.95.

A Programmed Course In Basic Electronics. By New York Institute of Technology. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N. Y. 10036. Linear program; takes approximately 50 hours to complete. 416 pages. $4.95.

Electron Tubes At Work, A TutorText. By James B. Owens and Paul Sanborn. Published by Doubleday Book Co., Garden City, L.I., N.Y. 11530. 557 pages. $6.95.

A Programmed Course In Basic Electricity. By New York Institute of Technology. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Linear program; takes approximately 50 hours to complete. 333 pages. $4.95.

In the following diagram, switching a hi-fi amplifier input from "Tuner" to "Phono" is what type of precision check?



Page 94. Moderately precise
Page 106. Very precise; it covers few possibly defective parts
Page 124. Not very precise; it covers many possibly defective parts

This sample page of a scrambled PI textbook appears in "Logical Electronic Troubleshooting" by Donald H. Schuster (page 86). Copyright 1963 McGraw-Hill. Used by permission of the McGraw-Hill Book Company.

How small is a bit of information? To keep the reader's attention focused on the text of PI books in linear programming, each statement is kept as short as possible. The wording is of extreme importance, and every word or phrase that does not directly contribute toward getting the topic or idea across to the reader is painstakingly weeded out. Consequently, a statement can be as short as a single sentence for a simple idea, or it can cover several pages if the subject or topic is of extreme complexity.

Don't mislead yourself into believing that a PI book is one long examination because of the frequent questions asked; this can hardly be true since answers are promptly given. There is a psychologically sound reason for presenting statement, question, answer in rapid-fire order. This technique, many psychologists have found, helps to firmly impress the idea behind each statement in the reader's memory.

It can be shown that making a statement—no matter how long or short—does not in itself cause the reader to remember it. Asking a question about the statement at once, however, causes the reader to think about what he has read. And, to finally impress the essence of the statement indelibly in the reader's mind, the answer is immediately given. If the reader's response to a given question is correct, knowing he is correct will force it home. If he gave an incorrect response, the reader is more likely to go back over the material to see where he went wrong.

Now compare PI's linear programming technique with textbook techniques. With

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SET 41 Common-Emitter Amplifier: Voltage Gain

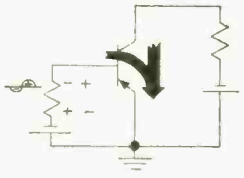
•

41-1 An important application of the common-emitter circuit is in devices requiring a voltage gain. By voltage gain, we mean that the output signal voltage is _____ than the input signal voltage.

stronger, larger
greater

•

41-2 Let us now determine how voltage gain occurs. An a-c signal alternately drives the base more negative and _____ negative.



less

•

41-3 The varying base-to-emitter voltage alternately (1) _____ and (2) _____ the forward base bias.

(1) and (2) increases, decreases *or* aids, opposes

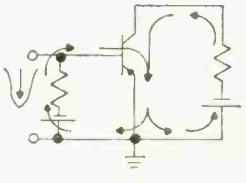
•

41-4 The varying base bias _____ the resistance of the base-emitter junction.

varies, changes

•

41-5 When the resistance of the base-emitter junction changes, the base current and the collector current must _____.



change, vary

Sample from a linear programmed PI book. RCA Service Company, "Fundamentals Of Transistors: A Programmed Text" © 1966 (page 121). Reprinted by permission of Prentice-Hall, Inc., Englewood Cliffs, N. J.

conventional study books, the reader is forced to wade through an entire chapter before he is asked a question about what he has learned. If a chapter is sufficiently long, he will have forgotten most of what he has read; so to answer all the review questions, he may have to reread the chapter several times. Then, he may have to look in another section of the book for the answer key—if the book contains the answers.

All of this is time-consuming, boring, and frustrating. Behavioral psychologists feel that a delay of even a few seconds between statement, question, and answer tends to spoil the learning effect.

Anyone who studies by means of conventional techniques doesn't know what kind of progress he is making. He generally has to wait until he attempts to answer the review questions at the end of each chapter before he realizes that he missed an important point. This is not the case with PI books; the student knows exactly what his progress is at all times. If he misses a point anywhere in a PI book, he has to stop and immediately retrace his steps; there is no point in going on since that will only compound the problem.

In addition to linear programming, there are at least two other techniques used in PI books available at present. Although linear programming is by far the most popular, "intrinsic" or "branching" programming is preferred by many students. A third type—adjunctive programming—is also being tried.

The big difference between linear and branching programming is the makeup and arrangement of each frame. While linear frames are short and concise, the branching technique uses more wordy statements, generally has multiple-choice questions following the statement, and each choice directs the reader to a different page in the book to tell him whether he is correct or incorrect. If an incorrect response is given, the reader is also told what page to refer back to so that he can determine where he went astray.

The pages in the branching programmed book are intermixed, or scrambled, making it impossible for the reader to make any sense out of the text if he were to read each page in numerical order. In any case, if he should attempt to read the text in this manner, a statement such as: "If you're reading this page, you're not following instructions" would set him straight.

Some people still feel that the small steps used in PI books tend to bore the reader. On the other hand, proponents of PI strongly feel that any subject, no matter how complex, can be broken down into a sufficient number of bite-size pieces to make a program that any reader can easily absorb.

Even so, some experts in the field hesitate to define exactly what programmed instruction is. Allen Calvin, President of Behavioral Research Laboratories cautions, "Just calling materials 'programmed' does not create a true program sequence." But there can be little doubt that PI has caught on and is definitely growing.

Who Uses PI. When PI first appeared on the scene in the mid-1950's, it was loaded with fancy teaching machines and a lot of sales double-talk. A few salesmen went so far as to promise school administrators that their teaching ma-

SAMPLE PI BOOKS ON SOLID-STATE ELECTRONICS

Simplified Transistor Theory, A Programmed Text. By Training Systems, Inc., and Stanley L. Levine. Published by Hayden Book Co., Inc., 116 West 14 St., New York, N.Y. 10011. Linear program. 228 pages. $3.95.

Transistors. By Federal Electric Corp. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Linear program; takes approximately 47 hours to complete. 430 pages. $13.25.

Fundamentals Of Transistors, A Programmed Text. By RCA Service Co. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Linear program; takes approximately 15 hours to complete. 223 pages. $12.00.

A Programmed Course In Basic Transistors. By New York Institute of Technology. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Linear program; takes approximately 50 hours to complete. 473 pages. $5.95.

Special Purpose Transistors. A Self-Instructional Programmed Manual. By Federal Electric Corp., Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Linear program; takes 8 to 11 hours to complete. 129 pages. $6.75.

chines would eliminate the teacher in the classroom. The teachers who would be affected obviously had strong feelings against PI. But after a few years had elapsed and the wild claims died down, teachers began to accept—and even welcome—the help PI can give in the classroom. There will always be a need for teachers, but PI can make their jobs easier.

Today, teaching machines have all but disappeared; the ones remaining are used on an experimental basis until their worth can be better ascertained. But although the machines are gone, PI textbooks abound. An estimated five million students, from elementary school through college, will use PI materials during 1968. And, although this is a big jump over last year's figure, it is small when compared with estimated future jumps.

A few top men in the education field still feel that PI is a passing fad. But other education officials—as well as large corporations and well-known foundations—continue to study and heavily invest in PI. The Ford Foundation and Carnegie Corporation are among those supplying grants for the investigation and possible utilization of PI materials. The American Management Association and the National Society for Professional Engineers offer PI courses to their membership.

PI BOOKS ON MATHEMATICS FOR ELECTRONICS

Math For Electronics. By Federal Electric Corp. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Linear program; takes 40 to 60 hours to complete. 640 pages. $11.95.

Mathematics For Electronics Engineers And Technicians. Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. 256 pages. $6.95.

PI BOOKS ON TROUBLESHOOTING

Transistor Circuit Troubleshooting Course, ETR 4423. By General Electric Co., Dept. B, 3800 N. Milwaukee Ave., Chicago, Ill. 60641. 3 volumes, 240 pages. $14.25.

Logical Electronic Troubleshooting, A Programmed Book. By Donald H. Schuster. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Scrambled program. 303 pages. $4.50.

Electronic Troubleshooting, A Self-Instructional Programmed Manual. By Philco Technical Institute. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Scrambled program. 274 pages. $10.50.

Professors at 23 universities have prepared programs that are considered to be "remarkably effective." Through a Programmed Learning Committee, the American Society for Engineering Education has been instructing engineering professors in the preparation and use of PI materials.

At last count, the Air Training Command, the Air Force's training arm, is using a total of 339 PI packages. As a result of the effectiveness attributed to PI techniques, ATC has directed all of its technical training centers to add them to airman training programs.

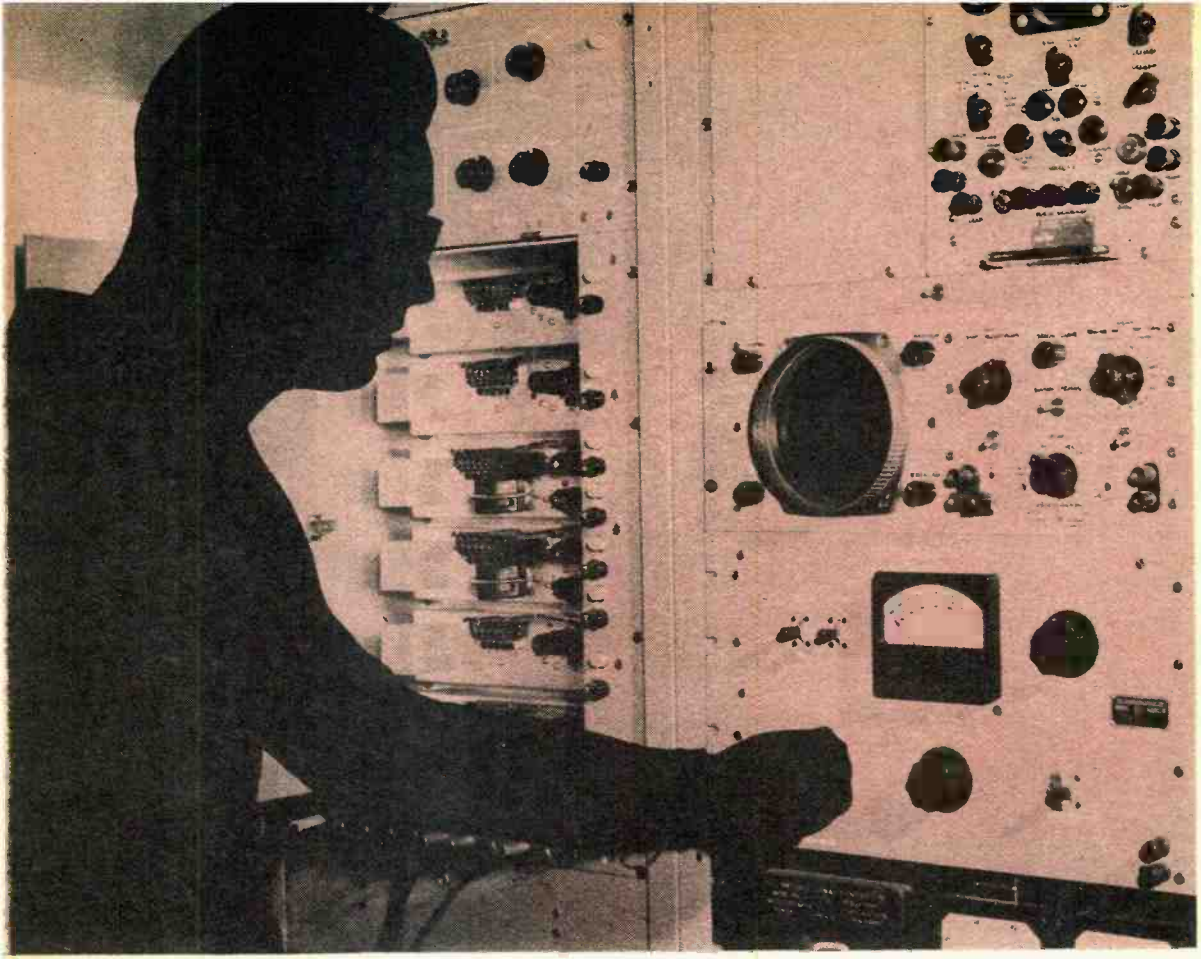
Correspondence schools employ variations of all three PI techniques (linear, branching, and adjunctive). The RCA Institute PI course, "Introduction to Electronics," has been available since 1963. This course is written in a linear programming style called "Auto-Text" by RCA.

Jack W. Friedman, Director of RCA Institutes Home Study School says: "Students learn more quickly with programmed material, and they greatly prefer programmed lessons to the conventional type. However," he adds, "we have no evidence that scholastic results are very much better than those achieved by conventional material. We do not use programmed texts for any other course in the Home Study School primarily because of high costs and long production time."

At International Correspondence Schools, elements of PI are used in several textbooks on different subjects—chiefly to provide a review and drill after the student has gone through a conventional textbook. Since 1964, ICS has offered an electronics fundamentals course in both the PI and conventional formats. In the PI course, the student reads a regular ICS book, then completes a PI study guide for each book. The individual ICS study guides contain up to 500 linear programmed self-instruction frames.

National Technical Schools is developing and marketing a "Programmed Tutor" which introduces the reader to a form of programmed review examinations. According to NTS officials, the "Programmed Tutor" is a modification of the "multiple-branch" linear programming technique.

(*Continued on page* 96)



The Electronics Technician—His Job and His Future

Careers in Electronics

GUIDANCE FOR THOSE PLANNING TO WORK IN ELECTRONICS AFTER COMPLETING HOME STUDY OR RESIDENT COURSES

BY ELWIN L. LISKE

DURING the past few years, electronics has grown far beyond its traditional limits of radio, television, and commercial broadcasting. At present, almost every industry in the United States uses some form of electronics for day-to-day business. The home, too, is a proving ground for electronic devices and gadgets. And in every consumer and business area, the use of electronics is expected to become even more widespread.

This expansion has caused a growing need for technically trained personnel to produce, maintain, and repair electronic gear. Where will the technically prepared men who are in current demand—and those who will be in even more demand in the future—come from? Are there enough industry-satisfying programs being offered in today's educational institutions? And, finally, where do currently available electronics technicians and trainees fit into the picture?

To obtain the most authoritative an-

swers, these and other questions were put to 15 different companies employing technicians. These 15 companies represented an approximate total of 48,000 employees of which about 6.3% were electronics technicians. The products manufactured by these companies include integrated circuits, communications equipment, electronic kits, vacuum capacitors, aerospace equipment, magnetic recording devices, transmitting tubes, satellite tracking and communications systems, digital and microwave equipment, etc. All of the information garnered from these companies plus technical bulletins provide background material to help you decide whether or not you want to aim for a technical career in electronics.

Employment Outlook. According to Department of Labor forecasts for a period extending through 1975, the need for technicians in all categories will continue to increase significantly. In Bulletin #1512 (titled "Technician Manpower: Requirements, Resources, and Training"), the Department states: "Requirements for engineering technicians, the largest technician specialty, are expected to grow from about 309,000 in 1963 to 533,000 in 1975, or about 73%, a rate of increase similar to the rate for all technicians. Because of the relative size of the field, however, more people will be needed to fill openings arising from growing requirements in the engineering technician specialty than in any other specialty."

This forecast was made in 1966, and has already been proved accurate. Each of the companies contacted during the preparation of this article agree that good technicians are hard to find—sometimes even more difficult than engineers.

A number of major companies have representatives who travel throughout the U.S. interviewing interested individuals for possible employment. Quite a few plants indicated that they currently had a large number of vacancies for technicians, and some of the larger companies have in-plant training programs to supplement their technician force. Candidates for in-plant training are chosen from among the unskilled labor force.

Service technicians who repair and maintain consumer goods are also in short supply. The RCA Service Company, for example, recently decided to establish permanent training centers in six key cities. This giant undertaking, the first of its kind in the television industry, will enable RCA to train 2500 TV service technicians in 1968—about double the number trained in 1966. Estimates have been made which indicate that some 25,000 additional color TV service technicians will be needed in each of the next five years to keep pace with expected color TV sales increases during this period. At the present time, every major color TV manufacturer is in dire need of factory service technicians.

Salaries And Benefits. Electronics is a highly competitive field, but a good technician is generally assured of premium

WHAT IS AN ELECTRONICS TECHNICIAN?

The term "technician" has no generally accepted definition. It is used by schools and industry to apply to a wide range of occupations. There is very little correlation between one application and another as to the work performed or educational preparation required.

In general, technicians do work similar to that of scientists and engineers but with greater emphasis on the practical. The technician must be able to solve problems and present written and/or oral reports relative to his work. In addition to his particular specialty, the technician is expected to be quite adept at one or more of the skilled trades. He is not, however, expected to perform with the precision of a craftsman in these areas, but must be familiar with industry machinery, tools, equipment, and processes.

Technicians are normally classified according to the area of specialization—for example, instrumentation, aeronautics, electronics, etc. These classifications are then subdivided to pinpoint the particular work to be performed by the technician.

According to the survey made by the author, there is considerable variation between companies as to electronics technician subcategories. In the majority of the plants contacted, however, there were two basic categories: engineering technician; and production technician. The engineering technician generally works in research and development, assisting the engineers; he is often called on to perform minor design and/or redesign and modification of existing equipment. The production technician usually is concerned with product testing, calibration, checkout, or maintenance of equipment.

salary and excellent fringe benefits. Neither salaries nor benefits are standardized throughout the various electronics industries, but a fairly accurate idea of what you can expect in the way of wages can be obtained from the "Average Pay Scales" table shown below. The table reflects the high and low wages paid by

AVERAGE PAY SCALES

COMPANY	PER HOUR RATE	
	LOW	HIGH
A	$2.28	$4.85
B	2.50	5.00
C	2.75	5.00
D	2.88	4.60
E	3.00	4.25
F	3.10	4.85
G	3.18	4.50
H	3.30	5.05
I	3.57	4.12

nine of the major aerospace companies on the West Coast, but the figures given can apply as well to salaries in most areas of the country. If engineering technician pay rates were not at the top of all pay scales for non-electronics technicians and skilled tradesmen, they were very near it.

The 40-hour work week appears to be standardized, and suitable pay adjustment is generally made for work done in excess of 40 hours. In some areas of the country—especially in the Northeast—a great many companies have a 35-hour work week, but overtime pay is still based on the 40-hour week.

In addition to base pay, fringe benefits are generally substantial. One company executive estimates that the cash value of the benefits amounts to an additional $1 to $1.25 per hour. Among the more common benefits you are likely to find are profit-sharing plans, the privilege of purchasing company stock, substantial retirement pensions, insurance policies, sick leave, paid holidays and vacations, and educational assistance plans.

The profit-sharing plans are often most attractive, representing a mean of 7% additional pay over gross income. Employees, generally only in the larger companies, have an opportunity to buy company shares at from 25 to 50% off the regular market value of the stocks. The retirement pension plans are usually entirely paid for by the company, and actual benefits received by the employee at retirement depend on length of service with the company. Personal health, accident, life, and disability insurance are almost always paid for—at least in part—by the employer.

Most companies encourage their employees to continue their education by attending adult education classes or taking correspondence courses. To provide an incentive for employees to pursue higher education, many companies will reimburse a good part of the tuition paid by their employees. If a course is job-related, the entire tuition is generally repaid.

At the present time, electronics technicians are held in high regard by the

JOB DESCRIPTION SHEETS

Most companies use what is termed a "Job Description Sheet" which describes in detail the requirements for a particular job. Such sheets also include information on job qualifications, the work to be performed, equipment to be used, etc. Shown below is the content of a typical job description sheet for a beginning electronics technician.

JOB TITLE: Test Technician

DEPARTMENT: Production

FUNCTIONS AND GENERAL SCOPE OF JOB:

Under moderate supervision, the performance of necessary testing to ascertain that the instruments meet the electrical specifications prescribed by a detailed procedure. Writing reports from test data. Applicant must have the ability to read and understand electronics specification sheets, test procedures, schematics, blueprints, and sketches.

WORKED PERFORMED:

(1) Testing of electronic instruments using standard test equipment such as vacuum-tube voltmeter, power supplies, oscilloscope, and related equipment.
(2) Calibration of instruments by following written test procedures.
(3) Replacement of faulty components when tests indicate malfunctions.
(4) Writing necessary test reports on findings.

QUALIFICATIONS

High school plus one or two years of electronics theory. Basic knowledge of electronics. Work record consistent with high standards of quality, quantity, and attitude. Radio amateur background helpful.

EQUIPMENT USED:

All standard electronic measuring devices such as oscilloscope, frequency meter, vacuum-tube voltmeter, volt-ohm-milliammeter, pulse analyzer, signal generators, etc.

ELECTRONIC TECHNOLOGY PROGRAM*

COURSES	CLASS HOURS	LABORATORY HOURS	OUTSIDE STUDY HOURS	TOTAL HOURS
FIRST SEMESTER				
Physics for Electronics I (Electricity)	3	6	6	15
Technical Mathematics I (Algebra & Trigonometry)	5		10	15
Electronic Devices	3	6	6	15
Communication Devices	3		6	9
TOTAL	14	12	28	54
SECOND SEMESTER				
Physics for Electronics II (Mechanics, Heat)	3	3	6	12
Technical Mathematics II (Applied Calculus)	4		8	12
Circuit Analysis, A.C. & D.C.	3	6	6	15
Electronic Amplifiers	3	6	6	15
TOTAL	13	15	26	54
THIRD SEMESTER				
Instruments and Measurements	3	6	6	15
Communication Circuits	3	6	6	15
Introduction to Computers	4	3	8	15
Technical Reporting	2		4	6
Drawing, Sketching, and Diagramming		3		3
TOTAL	12	18	24	54
FOURTH SEMESTER				
Control Circuits and Systems	3	3	6	12
Communication Systems	3	3	6	12
Electronic Design and Fabrication	1	5		6
Introduction to New Electronic Devices	2		4	6
General and Industrial Economics	3		6	9
Industrial Organizations and Institutes	3		6	9
TOTAL	15	11	28	54

*U.S. Department of Health, Education and Welfare, "Electronic Technology: A Suggested 2-Year Post High School Curriculum"

industries which employ them. Most companies regard their technicians as professional men, rather than tradesmen, giving the technician a greater degree of freedom and opportunity for initiative and advancement.

Education. The byword of the electronics industries is education . . . and more education. Although a tremendous need for technicians exists, the various industries still carefully screen applicants for technical positions. The decision as to whether a company hires or does not hire you depends on your technical and practical education.

A technical education generally has its roots in high school mathematics and sciences. On this score, the Electronics Industries Association points out that graduation from high school is important, and the student should take as many courses in math and science as his school has to offer. The industrial arts—such as radio, electronics, drafting and blueprint reading, sheet metal work, and machine shop work—should receive equal attention in your high school education.

Careers in Electronics

MIDDLE-LEVEL MODEL CURRICULUM*

COURSE	SEMESTER HOURS	SELECTED TOPICS
FIRST SEMESTER		
Electronics I	3	P-N junction diodes, tunnel and zener diodes, silicon controlled rectifiers, E-I characteristics (diode and transistor)
Electrical Principles I	5	
Mathematics I	3	Introduction and review of general mathematics, simple linear equations, algebraic processes, slide rule
	11	
SECOND SEMESTER		
Electronics II	3	Transistors (p.n.p. and n.p.n.), current in solid-state devices, E-I characteristics (diode and transistor), dynamic parameters of electronic devices
Electrical Principles II	5	
Mathematics II	3	Algebraic processes, elementary topics in geometry and trigonometry, slide rule
	11	
THIRD SEMESTER		
Electronics III	6	Transistor multivibrators, transistor amplifiers, feedback effects, filters, regulated power supplies
Mathematics III	3	Application of number systems, logic systems
	9	
FOURTH SEMESTER		
Electronics IV	5	Logic circuits (basic): techniques for triggering, gating, synchronization; techniques for storing and comparing
Electronics Specialty	3	
	8	
COURSE TOTAL: 39 HOURS		

*Angelo C. Gillie, "Planning Future Content of Electronics Curriculums," Technical Education News, McGraw-Hill Book Company. December, 1966.

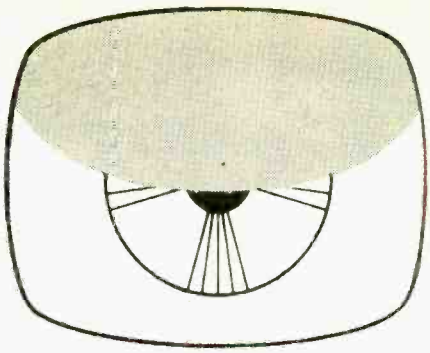
If you are still in high school, make an effort to participate in school science programs and/or radio club activities. In high school or out, keep up with electronics developments by subscribing to and reading magazines, and read new books and technical bulletins. For practical experience, you can join an amateur radio club.

Bear in mind that industry is generally reluctant to hire you unless you have some practical experience in your specialty. Post high school education in a technical school, junior college, college, or military school is preferred. Even then, most companies will put you in a training program to familiarize you with specific pieces of equipment. Remember that as electronics grows so must your technical knowledge.

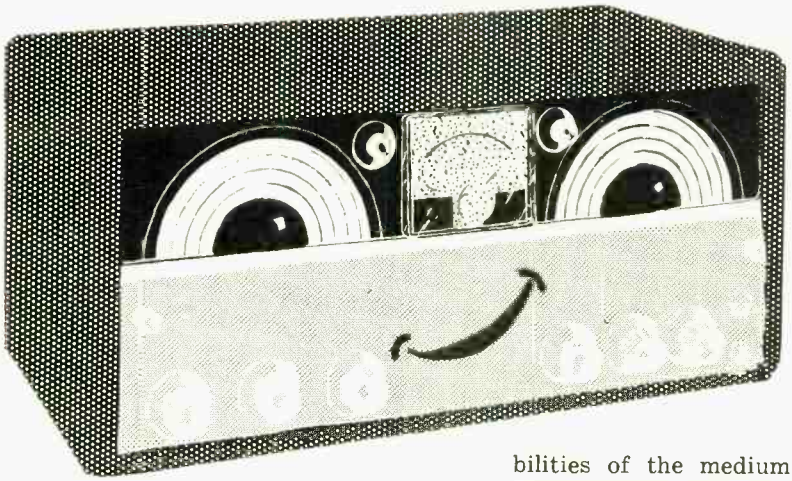
Industry has some very definite views on the type of training a technician should have. Today's technician must have a working knowledge of overlapping fields; he must know and understand basic electronics theory, understand applied physics and basic mechanics, and be able to handle power tools used in fabrication.

In this regard, A. C. Bodeau, manager of the Vehicle Testing Laboratory of the Ford Motor Company has the following to say in the "Technician Edu-

(*Continued on page* 102)



TIRED OF TV?



TRY RADIO DRAMA

GIVE YOUR EYES A BREAK
AND LISTEN IN
ON THE SHORT WAVES

BY LARRY LISLE, K9KZT

IN THE last few years there has been a reawakening of interest in "radio drama" in America. It is reflected in the increasing numbers of dramatic programs heard on AM and FM stations, sales of records and tapes of old radio shows, and the publication of several books on the subject.

This current enthusiasm for radio drama can't be classed entirely as nostalgia, for many of the most devoted listeners are too young to remember the golden age of radio. Instead, it evidently stems from an appreciation for the capabilities of the medium, which in some ways surpass those of TV or motion pictures. Which, for example, seemed more realistic: the time machine built for a recent TV series—or the space ships of the invaders from Mars on the Orson Welles radio program of thirty years ago?

Radio stimulates the listener's imagination. Heroes are as heroic and villains as villainous as the listener wants to make them. Settings can be ancient Rome or modern New York with equal ease. On radio, the listener "identifies" and almost becomes a member of the cast.

Twenty years ago, we suffered with "One Man's Family," leaped tall buildings with Superman, and became invisible with the Shadow as we fought the

evil lurking in the hearts of men. Today these programs and others like them are becoming available in America more and more.

In many foreign countries, radio drama has never lost its popularity, and is often featured as part of short-wave schedules. With a few exceptions, the programs in the table below are broadcast by the more powerful short-wave stations. So, if all the TV shows are starting to look alike to you, dust off that old console radio in the living room and listen to something different! —30—

STATIONS THAT BROADCAST RADIO DRAMA

STATION	FREQUENCY (megahertz)	DAY	BROADCAST TIME (EST)	PROGRAM
Australian Overseas Service	15.320, 17.840	Mondays	8:05 p.m.	Storyteller
Perth Regional Network (Australia)	9.610	Sundays	7 a.m.	Sunday Playbill
	15.425	Sundays	7:45 p.m.	Serial
	15.425	Sundays	9 p.m.	Serial
	15.425	Mondays	7:45 p.m.	Serial
	15.425	Mondays	9 p.m.	Serial
	9.610	Tuesdays	6:45 a.m.	National Radio Theatre
	15.425	Tuesdays	7:45 p.m.	Serial
	15.425	Tuesdays	9 p.m.	Serial
	15.425	Wednesdays	12:30 a.m.	Story Time
	15.425	Wednesdays	7:45 p.m.	Serial
	15.425	Wednesdays	9 p.m.	Serial
	15.425	Thursdays	12:40 a.m.	Stories for the Junior Listener
	9.610	Thursdays	8:15 a.m.	Thursday Night Feature
	15.425	Thursdays	7:45 p.m.	Serial
	9.610	Fridays	6:45 a.m.	Encore
Station CBL (and other Canadian Broadcasting Corp. medium-wave affiliates)	0.740	Sundays	2:03 p.m.	CBC Stage
		Tuesdays	10:30 p.m.	Anthology
		Tuesdays	11:03 p.m.	Introducing
		Wednesdays	9:03 p.m.	Midweek Theatre
		Fridays	7:03 p.m.	Adventure Theatre
		Fridays	9:30 p.m.	Mystery Theatre
		Saturdays	8:30 p.m.	A Touch of Greasepaint
British Broadcasting Corp. World Service	6.110, 9.580, 11.865, 15.140	Sundays	8 p.m.	Drama Series
		Mondays	9:15 p.m.	Serial
		Wednesdays	6:15 p.m.	World Theatre
		Wednesdays	8 p.m.	Short Story
		Saturdays	7:30 p.m.	Theatre of the Air
Radio RSA (Rep. of South Africa)	9.705, 11.875, 15.220	Sundays	7 p.m.*	300 Years in Africa
		Mondays	7 p.m.*	Bantu Fireside Tales
		Saturdays	7 p.m.*	Stories of the Veld
Voice of America (beamed to Latin America)	11.885, 11.955, 15.250, 9.650,** 9.565**	Sundays	8:15 p.m.	American Short Story
		Wednesdays	6:15 p.m.	Short Stories
		Saturdays	10:00 p.m.	American Musical Theatre
Voice of America (beamed to Europe)	5.960, 15.205	Sundays	11:15 a.m.	American Short Story
		Sundays	1:15 p.m.	American Short Story
		Sundays	4:15 p.m.	American Short Story
		Wednesdays	9:15 a.m.	Short Stories
		Wednesdays	12:15 p.m.	Short Stories
		Saturdays	9:30 a.m.	American Musical Theatre

Repeated at 7 p.m., local time, for all zones; higher frequencies to East Coast, lower frequencies to West Coast

**These frequencies are in use after 8:30 p.m.*

UNIQUE PATENTS

Electronic Lip Reader

Invented by E. G. Nassimbene Patented June 29, 1965—No. 3,192,321

Are you interested in becoming the feature attraction of a tooth whitener and brightener TV commercial? Do your friends say that you open your mouth too much? Is your "00" syllable enunciation as good as it should be? If you want to double-check, this is the invention that may hold all the answers. Consisting of one or more miniature light sources, and two, three, or four miniature photocells, it reads out the reflectivity around your mouth, lips, teeth, and tongue. Wonder if the same idea could be applied to reading someone else's lips—what a handy spy device!

"CIE training helped pay for my new house,"

says Eugene Frost
of Columbus, Ohio

Gene Frost was "stuck" in low-pay TV repair work. Then two co-workers suggested he take a CIE home study course in electronics. Today he's living in a new house, owns two good cars and a color TV set, and holds an important technical job at North American Aviation. If you'd like to get ahead the way he did, read his inspiring story here.

IF YOU LIKE ELECTRONICS—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay TV repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future—but soon found he was stymied there too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

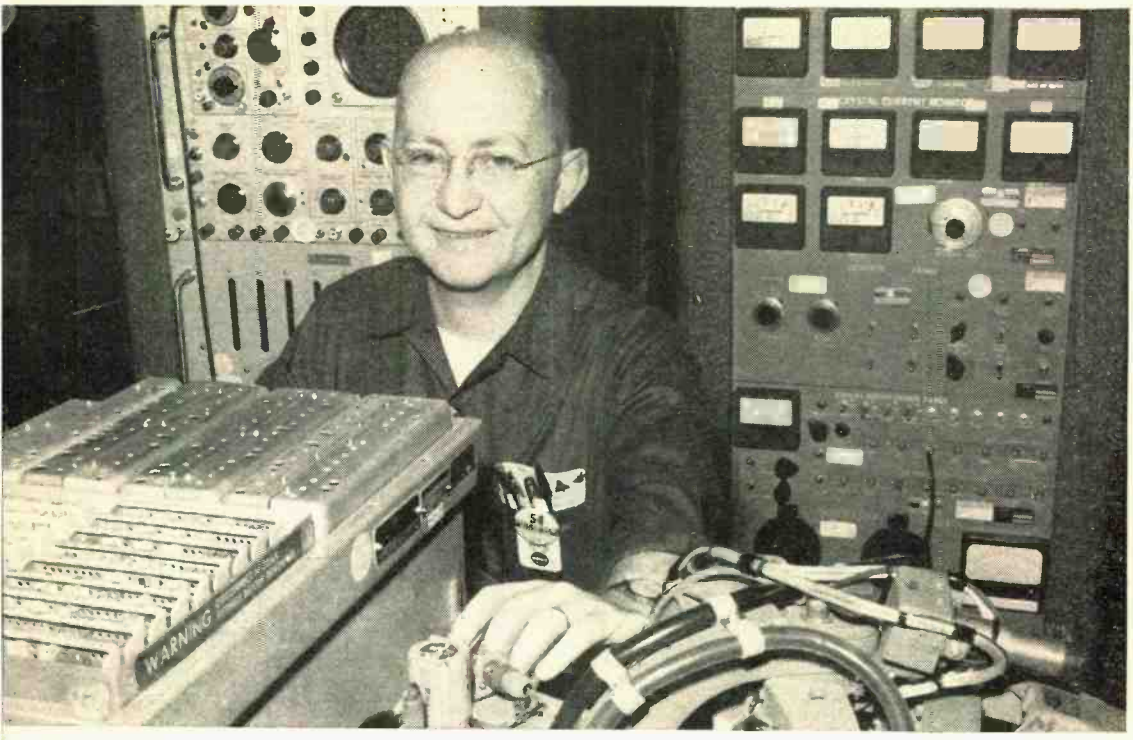
Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses... preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Aviation. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"



Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" ...learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screwdriver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are desperately needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

How can you get the training you need to cash in on this booming demand? Gene Frost found the answer in CIE. And so can you.

Send for Free Book

Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed In Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you'd like to get ahead the way Gene Frost did, let us send you this 40-page book free. With it we'll include our other helpful book, "How To Get A Commercial FCC License." Just fill out and mail the attached card. Or, if the card is missing, write to CIE at the address below.

ENROLL UNDER G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

CIE

Cleveland Institute of Electronics

1776 E. 17th St., Dept. PE-65
Cleveland, Ohio 44114

Accredited Member National Home Study Council

CIRCLE NO. 14 ON READER SERVICE PAGE

Megahertz UJT Oscillator

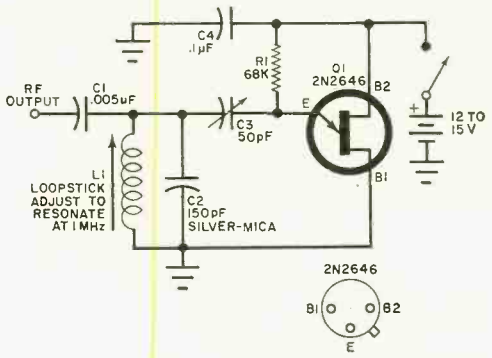
THEY SAID IT COULDN'T BE DONE

BY FRANK H. TOOKER

USED in simple relaxation oscillators, unijunction transistors (UJT's)—particularly those of the inexpensive variety—will not operate very far into the low radio-frequency range. However, the circuit shown at right enables sine-wave output from 2N2646 UJT's at 1 MHz. With selected UJT's of this type, the circuit will continue to operate up to about 1.5 MHz, above which frequency performance is poor.

In the circuit, *L1* and *C2* make up a tuned circuit which is resonated at 1 MHz by adjusting the core of *L1*. Components *C3* and *R1*, in series with *L1-C2*, comprise a relaxation oscillator circuit. Capacitor *C3* charges through *R1*, and when the peak-point emitter voltage of UJT *Q1* appears across *C3*, the UJT fires, discharging *C3* across the *L1-C2* tuned circuit. This sets the tuned circuit into oscillation and, thereafter, the positive-going excursions of the voltage across *L1-C2* add to the voltage across *C3* to fire the UJT.

Conventional UJT's will not operate at 1 MHz—and even selected ones operate poorly at 500 kHz—but at lower submultiples of 1 MHz (333 kHz, 250 kHz, and 200 kHz), the UJT fires dependably. The setting of variable capacitor *C3* determines *Q1*'s firing rate. Thus, by adjusting *C3*, the firing of the UJT can be synchronized (accurately locked-in) with every third, fourth, or fifth cycle of oscillation of the *L1-C2* tuned circuit.



The UJT operates at submultiple of output frequency and shock-excites tank circuit to generate r.f. output. This oscillator circuit can reach 1.5 MHz.

Since a comparatively large voltage is developed across *L1-C2*, the lock-in setting of *C3* isn't especially critical. In practice, all that is necessary is to adjust *C3* to the minimum value of capacitance that will produce a maximum signal at the oscillator's r.f. output terminal. To avoid hand-capacitance effects while you're adjusting *C3*, it is essential that its stator (not the rotor) be connected to the emitter of the UJT.

If you have several UJT's, try each one, for some 2N2646's work better in this circuit than others. The output of the oscillator is at a very high impedance; thus, if it is to be loaded at all, it must be worked into a high impedance to maintain oscillation.

-30-

Careers in Electronics

Twenty Questions ON GETTING Your FCC License

BY E. F. RICE and ANDREW J. MUELLER

ANY TIME is a good time to prepare for a commercial radio operator's FCC license. But now, while the technician shortage is in full swing, is a particularly advantageous time. The electronics industries need technicians and the communications field in particular needs *licensed* technicians. There are far too many positions open for the available licensed technicians to fill. Those technicians who obtain FCC licenses now, before the manpower shortage eases off, will be in seniority positions and have established well-paying careers when and if a surplus arises.

Employers are willing—and sometimes eager—to pay "top dollar" for the services of the capable licensed technician or operator. In fact, the wages paid to experienced First Class License holders average $10,000 per year. And inexperienced Second and Third Class License holders are receiving very high starting salaries in comparison with the rest of the electronics industries.

In some respects, a First Class Radio Telephone License can be worth a great deal more to you than a college diploma. It can be the key to an interesting and well-paying future—even if you decide not to go into the communications field. The exacting requirements for a license are known to practically all employers.

It will require study time and perse-

LICENSEE ACTIVITIES

RADIO TELEPHONE LICENSES

Third Class Operator Permit: Bearer can operate any type of phone transmitter, under supervision of First Class licensee; is permitted to operate certain classes of broadcast transmitters with Broadcast Endorsement.

Second Class License: Licensee may tune and adjust transmitters in Public Safety, Business, and Citizens Bands, and operate certain classes of broadcast transmitters.

First Class License: Licensee has all of the above privileges, may also operate all broadcast FM and TV stations.

RADIO TELEGRAPH LICENSES

Third Class Operator Permit: Bearer may operate coastal CW stations up to 250 watts and certain low power aircraft transmitters.

Second Class License: Licensee may operate all CW stations, operate and maintain ship CW transmitters (after passing Coast Guard Exam for Ship Radio Officer and serving six-month apprenticeship); must take First Aid course before going to sea.

First Class License: Licensee must have one year experience as a Second Class Radio Operator; is qualified for chief operator on ship.

Restricted Radio Telephone Permit. Bearer may operate ship-to-shore radio under 4 MHz; may not adjust or tune transmitter in any way. (No exam is required. Applicant must be a minimum age of 14 years. Request FCC Form 753; fill in and mail to the Federal Communications Commission, Gettysburg, Pa. 17325.) Apply at any FCC District Office.

verance, but if you have an interest in electronics, an FCC license can take you a great deal further than you might have gone if you remained an unlicensed technician. Career opportunities in communications electronics are wide open. It is even possible for you to work your way up from an operator or maintenance man to occupy an executive position.

If you have been planning to obtain your license, but have been holding back because of a lack of adequate information, the following questions and answers should help clear the air. The twenty questions are those most often asked by prospective licensees.

Who needs a license?

Anyone who operates or maintains commercial communications transmitters and associated equipment is required by law to possess an FCC license.

How many types of licenses are there?

The FCC has divided all licensing into two very broad categories—radiotelephony and radiotelegraphy. Special types of communications equipment operation and/or maintenance fall under restricted headings called "endorsements." The telegraphy and telephony licenses are each divided into three classes, with more privileges accorded as you go from third- to second- to first class.

An endorsement is an extra privilege accorded you in addition to the privileges you receive with a given class and type of license. For example, a Second Class Radio Telephone License does not allow operation of a CW transmitter in an aircraft unless you have an Aircraft Telegraphy endorsement.

There are four separate endorsements available: Radar, Aircraft Telegraphy, Broadcast, and Telegraphy.

The privileges accorded for each class and type of license are outlined in the FCC Regulations, Volume I, Part 13, and a brief description is given in most license preparation texts.

LICENSING REQUIREMENTS

Applicants for commercial radio operator licenses must be citizens of the United States and pass an FCC exam composed of the appropriate elements outlined below.

RADIO TELEPHONE

Third Class Permit: Elements 1 and 2
Second Class License: Elements 1, 2, and 3
First Class License: Elements 1, 2, 3, and 4

RADIO TELEGRAPH

Third Class Permit: Elements 1, 2, and 5. Applicant must be able to send and receive 20 words/minute plain language, 16 words/minute Morse code groups

Second Class License: Elements 1, 2, 5, and 6. Applicant must be able to send and receive plain language and Morse code groups as for Third Class Permit

First Class License: Elements 1, 2, 5, and 6. Applicant must be able to send and receive 25 words/minute plain language or 20 words/minute Morse code groups, be 21 years of age, and have at least one year of experience in public ship or Coast Guard Station using CW.

ENDORSEMENTS

Radar: Element 8
Aircraft Telegraphy: Element 7
Broadcast: Element 9
Telegraphy: No exam. Applicant must show proof of at least six months service on ship.

ELEMENT BREAKDOWN

ELEMENT	MATERIAL COVERED
1	Basic radio laws, treaties, and regulations
2	Basic operating procedures in communication between AM stations
3	Legal and technical matters for operation of radiotelephony stations other than commercial broadcast stations
4	Advanced legal and technical matters concerned with operation of broadcast stations
5	Radiotelegraphy procedures covering communications with radiotelegraph stations but not including maritime mobile
6	Advanced radiotelegraphy procedure covering technical and legal matters applicable to operation of all radiotelegraphy station classes
7	Basic theory and practices for operation of radio communications and navigational equipment in general use in aircraft
8	Specialized theory and practices for servicing and operating ship radar
9	Basic regulations for operation of commercial and non-commercial broadcast stations

The material covered in most study guides and all formal courses is divided into nine categories, called "elements" to conform with the FCC's testing procedure. Different combinations of these elements are needed for each class and type of license and endorsement. The elements are of two types: one type is devoted to the FCC Rules and Regulations; the other covers purely technical material.

How do I prepare for the FCC exam?

There is no "best" method that can be recommended for everyone interested in obtaining a commercial radio operator's license. You can take a resident full-time course in a technical institute that features licensing instruction, you can take a correspondence course, or you can elect to "go it alone" with the help of authoritative textbooks. Whichever method of preparation you choose will depend on your budget, the amount of time you can spend in study, the pace you want to set, and your technical background.

Most people who cannot devote themselves to full-time study benefit from an accredited correspondence course. Only if you have a considerable background in electronics should you attempt to go it alone.

Is much math required?

If you can transpose equations, use logarithms and powers of ten, and have no difficulty in solving for unknowns in the questions in your study texts, you should have no trouble with the math on the FCC exam. A knowledge of elementary algebra and trigonometry will be sufficient.

Are there many questions about transistors on the FCC exam?

At the present time, there are very few questions on solid-state devices. You might, for example, be asked to interpret a set of transistor specifications. But to be fully prepared—in case of a change in the exam—study transistor biasing networks, power dissipation, heat sinks, and other related transistor topics.

How long will it take me to prepare for the first class license exam?

This depends on several factors: the extent of your interest and/or experi-

SOME USEFUL STUDY TEXTS

Study Guide and Reference for Commercial Radio Operator Examinations (Revised). U.S. Government Printing Office, Washington, D.C. 75¢

Second Class Radiotelephone Handbook, Second Edition. By Edward Noll. Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206 $4.75

First Class Radiotelephone Handbook, Third Edition. By Edward Noll Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206 $4.95

Radar Endorsement Handbook. By Edward Noll. Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206 $2.95

Radio Operator's License Q and A Manual. Seventh Edition. By Milton Kaufman. John F. Rider Publisher, Inc., 116 West 14 St., New York, N.Y. 10011 $7.10

Electronic Communications, Second Edition. By Robert L. Shrader. McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036 $9.50

ence in electronics, the method you choose to prepare for the exam, etc. If you are an active ham or have worked in electronics for a considerable time, you can prepare for the exam in six months. For most people who have little or no familiarity with electronics, it may take 15-18 months.

What type of questions are asked?

The entire exam contains only multiple-choice questions. Although you can reasonably expect to do a lot of mathematical computation for the technical elements of the exam, you will not be expected to show your work.

Should I try to memorize the material in my study texts?

Memorizing the material—particularly in the technical sections—can be more harmful than helpful. The only things you should know by rote are the exact operating frequencies and power limits specified by the FCC. So far as the Rules and Regulations are concerned, a basic understanding of what they mean will see you through—that's the most important thing.

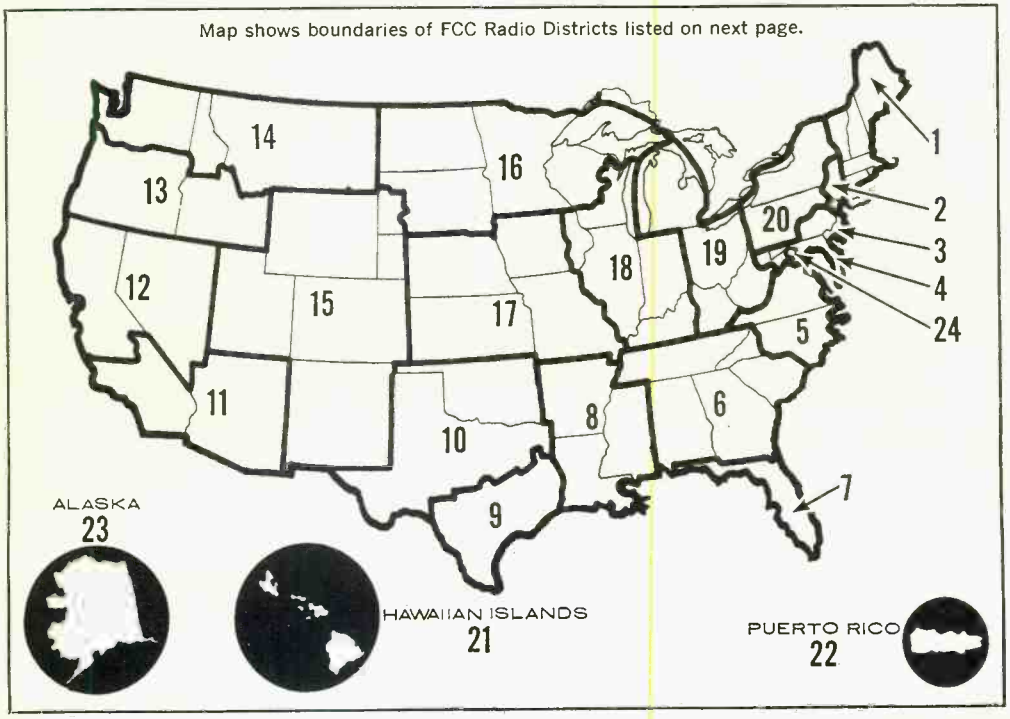
How do I apply for my FCC exam?

When you are ready to take your exam, contact, or write to, your FCC District Office and request FCC Forms 756 and 756B and a copy of the exam schedule so that you will know exactly when the exam you want is given. Fill in both sides of the two forms, make out a check or money order (payable to the Federal Communications Commission), and mail them to the District Office where you want to take the exam. Or apply in person at the District Office.

When and where does the FCC conduct exams?

The exams are given at regular intervals at all District Offices (see page 71). You do not need a prior appointment if you report on the proper day for a given exam. It is best to check first, since schedules change, and be prepared to pay the fee by check or money order—not cash. If you wish, however, to take the exam at a location other than the office of the Engineer in Charge, you must mail in your application and fee prior to the exam date. You will be notified when to appear.

Map shows boundaries of FCC Radio Districts listed on next page.



ADDRESSES OF FCC RADIO DISTRICT OFFICES

1 Customhouse
Boston, Mass. 02109

2 Federal Building
641 Washington St.
New York, N.Y. 10014

3 New U.S. Customhouse
Philadelphia, Pa. 19106

4 U.S. Customhouse
Gay & Water Sts.
Baltimore, Md. 21202

5 Federal Building
Norfolk, Va. 23510

6 2010 Atlanta Merchandise Mart
240 Peachtree St., NE
Atlanta, Ga. 30303
*Post Office Building
P.O. Box 77
Savannah, Ga. 31402

7 Federal Building
P.O. Box 150
Miami, Fla. 33101

8 Federal Building
600 South St.
New Orleans, La. 70130
*U.S. Courthouse
& Customhouse
Mobile, Ala. 36602

9 New Federal Office
Building, Room 5636
515 Rusk Ave.
Houston, Texas 77002
*Post Office Building
P.O. Box 1527
300 Willow St.
Beaumont, Texas 77704

10 States General Life
Insurance Building
708 Jackson St.
Dallas, Texas 75202

11 849 South Broadway
Los Angeles, Calif. 90014

12 Customhouse
555 Battery St.
San Francisco, Calif. 94126

13 New U.S. Courthouse
620 SW Main St.
Portland, Ore. 97205

14 Federal Office Building
First Ave. & Marion St.
Seattle, Wash. 98104

15 New Customhouse
19 St. (Between Calif.
& Stout Sts.)
Denver, Colo. 80202

16 Federal Courts Building
Sixth & Market Sts.
St. Paul, Minn. 55102

17 Federal Office Building
911 Walnut St.
Kansas City, Mo. 64106

18 U.S. Courthouse
219 South Clark St.
Chicago, Ill. 60604

19 New Federal Building
Detroit, Mich. 48226

20 Post Office Building
Buffalo, N.Y. 14203

21 Federal Building
P.O. Box 1021
Honolulu, Hawaii 96808

22 Federal Building
P.O. Box 2987
San Juan, Puerto Rico
00903

23 U.S. Post Office &
Courthouse Building
P.O. Box 644
Anchorage, Alaska 99501

24 1919 M St., N.W.
Washington, D.C. 20055

*Denotes District Sub-Office

QUARTERLY EXAM LOCATIONS

Alabama, Birmingham
Arizona, Phoenix
Arkansas, Little Rock
California, Fresno
Indiana, Fort Wayne
Indiana, Indianapolis
Iowa, Davenport
Iowa, Des Moines
Kentucky, Louisville
Michigan, Grand Rapids
Missouri, St. Louis
Nebraska, Omaha
New York, Schenectady
New York, Syracuse
North Carolina, Winston-Salem
Ohio, Cincinnati
Ohio, Cleveland
Ohio, Columbus
Oklahoma, Oklahoma City
Oklahoma, Tulsa
Pennsylvania, Pittsburgh
Pennsylvania, Williamsport
South Dakota, Sioux Falls
Tennessee, Knoxville
Tennessee, Memphis
Tennessee, Nashville
Texas, Corpus Christi
Texas, San Antonio
Utah, Salt Lake City
West Virginia, Charleston
Wisconsin, Milwaukee

What fees are charged by the FCC?

The fees charged are determined by the class of license you apply for and the services you want. First, second, and third class license fees are $5, $4, and $3, respectively, and separate endorsements are each $2. (There is no charge for the endorsement when both a license and an endorsement are applied for simultaneously.) Renewals, duplicates, and replacements—no matter what class of license—are each $2.

What materials am I allowed to take with me into the exam room?

You can take a slide rule—if it doesn't have any electronics formulas or tables on it—and math tables that are not part of a textbook. Come prepared with several pencils, an eraser, a pen, and a rule or straightedge.

Is there an exam time limit?

There is no specific time limit. However, you must complete the exam for each element required for the class of license you apply for by the District Office closing time. You will not be allowed to leave the room while you are answering any element of the exam.

What is the passing grade?

You must earn at least 75% on each element required for the class of license you apply for. If you fail some elements and pass others, you will be awarded the highest class license for which you qualified. However, if you fail either element 1 or element 2, you will not receive a license—even if you receive 100% on every other element.

(*Continued on page* 100)

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

PROFESSIONAL SWL RECEIVER (Heathkit Model SB-310)

"At least someone knows we're alive" is the way one short-wave listener (SWL) greeted the announcement of the SB-310. Yes, apparently last in line (after the hams and CB'ers), the SWL's now have a truly professional short-wave receiver with direct frequency dialing and readout, plus all the little extras that go into making a good product great.

The SB-310 is an offshoot of the renowned Heathkit SB line-up of amateur radio equipment. This means that the SB-310 is a tried-and-true receiver incorporating the preassembled and tested Heathkit LMO (Linear Master Oscillator)—the heart of the direct frequency dialing technique. Dialing accuracy has been checked at POPULAR ELECTRONICS as being better than 200 Hz on all nine tuning ranges of the SB-310.

Unlike the ordinary broad-coverage short-wave receiver, the SB-310 tunes special segments of preselected short-wave bands. Each segment is a little over 500 kHz wide starting at 3.5, 5.7, 7.0, 9.5, 11.5, 14.0, 15.0, 17.5, and 26.9 MHz. Thus, included in the segments are the 49-, 41-, 31-, 25-, 19-, and 16-meter international broadcast bands; the 75-, 40-, and 20-meter ham bands; and the 11-meter CB channels.

From a circuit viewpoint, the SB-310 is a double-conversion superhet with two i.f. stages a high gain r.f. stage, noise limiter, AM detector, product detector for SSB reception, S-meter, built-in 100-kHz calibrator, and three special crystal filters for optimizing selectivity. In addition to the usual loudspeaker and earphone outputs, the SB-310 has a hi-fi output connection and a 500-ohm audio line feed that the SWL will find handy for use with his tape recorder.

Assembling the SB-310 takes 18-20 hours. A few kit builders might shave this to 16 hours and a "first time out" builder might need 22-23 hours. All in all, 19 hours is a good average. There are no significantly difficult steps in building an SB-310. Wiring around the coil band and band change switch must be executed with care—but even this step takes only 1½-2 hours.

Alignment of the completed receiver is easy because the built-in 100-kHz calibration oscillator can be used as a r.f. signal generator and the strength of the upper-sideband signal can be accurately measured via the S-meter. However, in order to set up the all-important heterodyne oscillator, a VTVM or TVM (set for negative 5 volts full scale) is required. Your reviewer aligned the SB-310 first with the 100-kHz oscillator and again using a RCA WR-50B r.f. signal generator. Sensitivity difference between the two methods was less than two S-units in favor of the outboard r.f. generator.

When attached to a 125′ flat-top antenna, the SB-310 assembled by your reviewer was the equal of any SWL receiver he has used in the past 10 years—including one model costing over $1000. All three ham bands were alive and crowded with signals while the international broadcast bands offered up premium DX. In a few hours of casual tuning, stations from 33 countries were heard and identified while many more could only be "guessed at" according to frequency and language.

In your reviewer's opinion, the nine tuning ranges of the SB-310 are a good—but not a perfect—choice. Tuning the 49-, 41-, 31-, 25-, 19-, and 16-meter international broadcast bands is mandatory, but inclusion of the CB tuning range in place of the 13-meter broadcast band is an unfortunate selection.* On the ham bands, some SWL's might prefer the substitution of 15 meters for the 75-meter ham band.

When buying the SB-310 kit, the ham-band SWL DX'er should consider buying the SB-310-2 Deluxe SSB Filter ($39.93) as an accessory. This filter makes for superior SSB reception on all ham bands and sharpens up selectivity to enable the SWL to dig out the weak DX signals on 40 or 20.

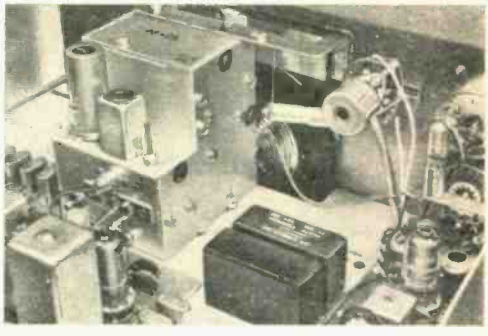
The SB-310 is a welcome addition to the ranks of top-quality SWL receivers. The "mix" of broadcast band and ham bands provides for interesting DX possibilities at any time of day or night. The inclusion of a crystal calibrator, noise limiter and BFO for CW and SSB reception are "extras" not seen in competitive products.

Circle No. 85 on Reader Service Page 15 or 115

**The Heath Company is considering the release of a modification kit which will permit SWL's to tune the 13-meter band—eliminating CB coverage. Details from Mr. Al Robberson, Heath Co., Benton Harbor, Mich.*

HEATHKIT SB-310 PROFESSIONAL SHORT-WAVE RECEIVER

New Heathkit receiver, patterned after tried-and-proven SB line-up of ham radio gear, is shown above with optional extra SB-600 matching speaker. Heart of the SB-310 is the linear oscillator which permits direct dialing to exact frequencies. In view below, dials are set to readout 341 kHz. This frequency is added to primary crystal frequency.



Inside the SB-310, the two black rectangular boxes are the special filters that permit optimum selectivity on both international broadcast and ham bands. Tunable linear oscillator is at upper left.

This is the coil bank before the shielding is installed. Tuning these coils requires a VTVM or TVM.

tpg

CONTINUED

IC'S FOR THE EXPERIMENTER (RCA KD-2112 Kit)

For the past couple of years, several companies have been putting low-cost solid-state kits on the market. Such kits usually include an etched and drilled PC board, all the required components, and a small booklet explaining how to assemble the kit, how the circuit works, and suggested uses for the kit. It was only a matter of time before a manufacturer started producing a line of low-cost integrated-circuit kits to introduce the electronics experimenter to the new world of IC's.

Radio Corporation of America has now taken this first step with the introduction of the KD-2112 Experimenter's Kit (suggested retail price of $9.95, available at most RCA distributors). The kit is based on the RCA CA3020 monolithic silicon multipurpose wideband audio amplifier. This particular chip contains seven transistors, 11 resistors, and three diodes, all in a 12-lead TO-5 package (about the size of a conventional small-signal transistor).

The blister-packaged kit comes with an etched and drilled PC board, and all the components required to make either a low-power (500-mW) audio amplifier, or an audio oscillator for use either as a code-practice oscillator or as a source of fixed frequency audio tone. Components not supplied are battery, speaker, and the telegraph key for the oscillator. The well-written construction manual contains all details of circuit assembly, and includes a brief description of integrated circuits, how they are made, and how they work.

An interesting item—the RCA kit also includes an "open" IC (a complete silicon chip bonded to its base, but without the metal top hat) so that the experimenter can see the "innards" of an IC by using a magnifying lens. Incidentally, your reviewer found that this open IC makes a cute decoration when soldered to a tie clasp.

The IC amplifier goes together nice and easy, and shouldn't take anyone more than an hour or so to assemble. The 500-mW output is more than enough to drive a small speaker. A crystal receiver was used to drive the amplifier and the combination sounded pretty good. So far as the oscillator is concerned, the tone was pleasant and had more than enough volume to fill a room.

Circle No. 86 on Reader Service Page 15 or 115

PROFESSIONAL VTVM (EICO Model 235)

If you don't already own one, now is a good time to think about buying a vacuum-tube voltmeter. A VTVM is a must if you work on modern solid-state or vacuum-tube equipment where voltage readings must be accurate and meter loading can become a serious problem. While there isn't much difference among available VTVM's when it comes to the loading effect they have on circuits under test, there is a great deal of diversity in features and versatility among the individual units offered.

For the hobbyist or technician looking for modest cost vs. versatility, EICO's Model 235 Professional VTVM (available from EICO Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, N.Y. 11207) probably ranks among the few meters anyone would want to start and stay with. It is the equal of any VTVM—and superior to some—on the market in its price range ($49.95 as a kit; $64.95, factory-wired and calibrated).

With the Model 235 VTVM, the user can accurately measure d.c. voltages from a low of 0.1 volt to 1500 volts (up to 3 kV with optional high-voltage probe) in eight ranges. Input resistance on all d.c. voltage ranges is 11 megohms, and accuracy is within 3% full scale.

Seven a.c. r.m.s. ranges are provided—0 to 1.5, 5, 15, 50, 150, 500 and 1500 volts—also accurate within 3% full scale (for less than 1% harmonic distortion sine-wave input). The first five ranges have an input impedance of 830,000 ohms, while the 500-volt range impedance is 1.3 megohms, and the 1500-volt range is 1.5 megohms. Frequency response is ±1 dB from 30 Hz to 3 MHz, but it can be extended to 250 MHz with optional r.f. probe.

There are also seven ohmmeter ranges for measuring resistances as low as 0.2 ohm and as high as 1000 megohms. Other features include zero-center for accurate FM detector alignment, a single zero point adjustment for all functions and ranges, floating ground, and a heavy-gauge steel cabinet continuing EICO's "professional" look. One other feature deserves special mention—direct readout of peak-to-peak conversions for measured a.c. r.m.s. voltages.

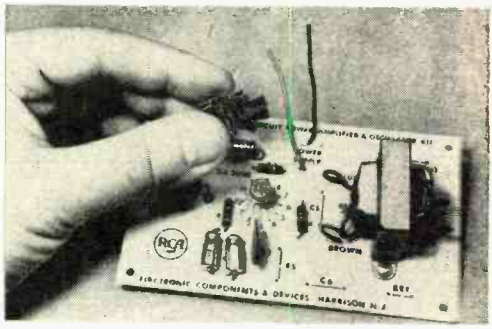
Assembly time for the kit will average between four and five hours, with the greater part of the time being spent on wiring the range and function switches. But once the unit is assembled, less than a half hour is required to calibrate the individual ranges for each function.

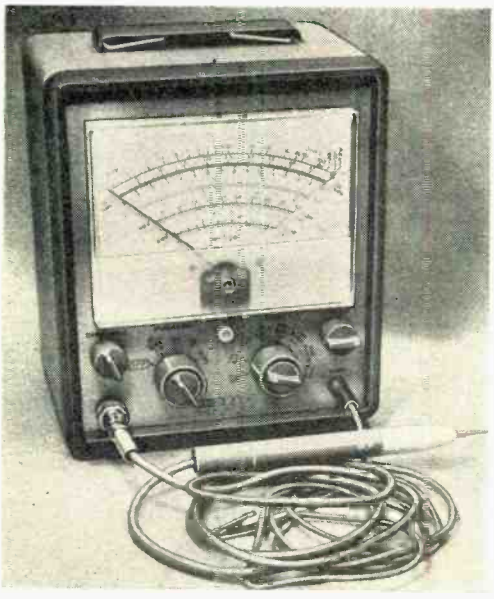
Many of the features available with the EICO Model 235 VTVM can be found on

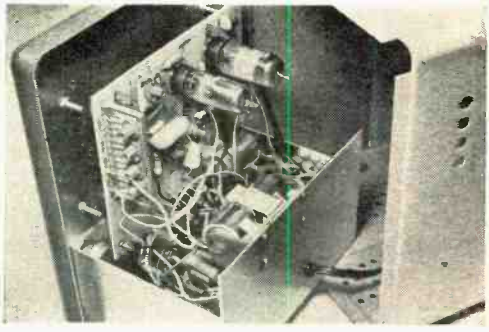
(*Continued on page 94*)

RCA IC EXPERIMENTER'S KIT

The first in a series of kits introducing this experimenter to RCA integrated circuits (IC's), this blister-packaged kit contains all components needed to make a 500-mW audio amplifier or a code-practice oscillator. The instruction book is complete, and everything is furnished (PC board mounting) except battery, speaker, and a telegraph key.

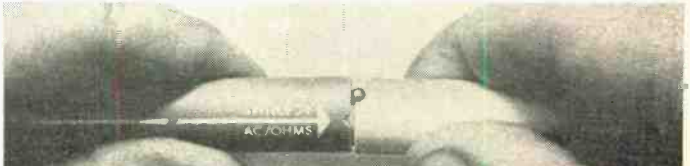






EICO PROFESSIONAL VTVM

This VTVM has the neat, functional appearance of a professional instrument. Almost all components inside the roomy heavy-gauge steel cabinet mount on an oversized printed circuit board for simplified assembly. The meter movement features a one-position zero-set for all range and function scales. Several holes in the cabinet provide easy access to the various calibration potentiometers.



"Uni-Probe" provided with the Model 235 eliminates the need for separate test leads for each function. The nose portion of the probe revolves and has two lock-in positions; one position is for a.c. volts and resistance measurements, the other position (with built-in 1-megohm resistor) for d.c. voltage measurements.

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

A NUMBER of letters have been received by your *Information Central* editor relative to a.c. adapter problems. (An a.c. adapter converts the 117-volt a.c. power line to some low value of d.c. for transistor radios, tape recorders, etc.) Most problems occur when you use a low-cost adapter not specifically designed for the device being powered.

The most common problem is hum. In most cases, a 500-μF (or larger) electrolytic capacitor, of the correct voltage rating and proper polarity, can be connected across the adapter output to reduce the hum level.

The second problem is voltage output. Sometimes it is too low to power the radio properly, etc., and sometimes it is far too high. In the former case, very little can be done outside of a complete redesign of the adapter. In the latter case, you should use a resistor in series with one d.c. output lead, terminated in a large value electrolytic, to reduce the voltage to that required. The value of the resistor depends on how much voltage you want to drop; the capacitor should be about 500 μF or larger.

Adding A.F.C. *I have an FM tuner that drifts badly. How can I add a.f.c. to the set?*

Adding a.f.c. to any tuner is a major operation. Basically, the drifting problem lies in the local oscillator drifting with heat, so try to keep your tuner away from radiators or other heat-generating objects. Also, make sure that the set is well ventilated. And you could try having a serviceman check the fixed capacitors in the oscillator circuit—some may have to be changed.

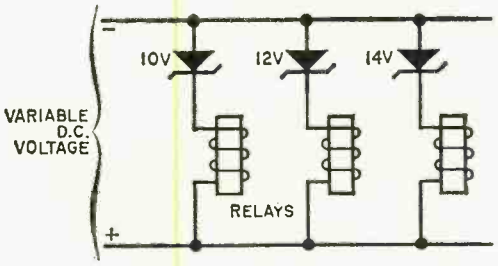
Stabilizing the voltage to the local oscillator may help. You can stabilize it with a zener diode if the oscillator is a transistor circuit or a voltage-regulator tube if it is a vacuum-tube circuit. Here again, it might be worthwhile to consult your serviceman.

RC Time Constant. *What is the time constant of a resistor-capacitor (RC) circuit, and how is it figured?*

The time constant (*tc*) of an *RC* circuit is the time required to charge the capacitor to 63.2% of its final voltage or to discharge it to 36.8% of its original charge. To calculate the *tc*, the following formulas can be used: t (sec) $= R$ (megohms) $\times$ C (μF); t (microseconds) $= R$ (ohms) $\times$ C (μF); and t (microseconds) $= R$ (megohms) $\times$ C (pF).

Remote Control. *I want to remotely control three sequential functions using only a variable d.c. source. Can you recommend a circuit?*

As shown in the schematic below, all you need is three zener diodes of appropriate voltages in series with three relays across the line. As the variable voltage is raised to 10 volts, the first relay will close. As the



voltage goes up, each zener will conduct at its voltage and close its associated relay. You can select the zeners and relays for almost any range of d.c. voltage required.

"Lighting" Noise Problem. *Sometimes when we play our electric guitars in TV or recording studios, or entertainment halls, severe noises come out of our speakers. We understand that this may be due to the lighting circuits used in many of these places. What can we do about it?*

It does sound as if you were picking up r.f.-like spikes generated in high-power lighting circuits. Make sure that the guitar leads to the amplifier and the speaker leads from the amplifier are shielded and bonded to the amplifier chassis. Then try to see to it that the chassis is shielded and grounded when you're working in such areas. You may have to feed the a.c. power to the amplifier through 0.5-μF coaxial capacitors to remove any interference coming in along this route.

Signal Booster. *I live in a fringe TV reception area and would like to know if an antenna-mounted amplifier would be worthwhile.*

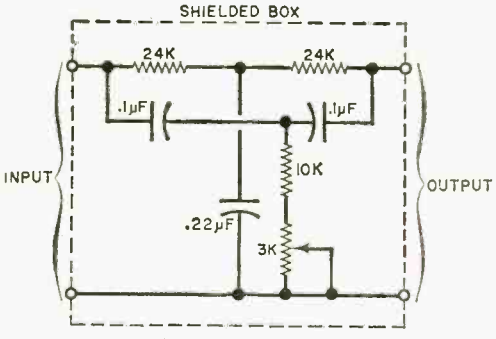
The only way you can find out is by trying. Your local TV dealer will be glad to install one to determine whether or not it will help your reception.

Stalled Record Player. *When I load my record player (it's a good model) and trip the "Reject" button to drop the first record on the turntable, the player immediately stalls. Then I have to push the turntable around until the record drops and the motor takes over. What could be wrong?*

Since the record doesn't drop, there is something binding the action of the record release mechanism. Just what that something is may be difficult to find out unless you have details of the mechanism itself in your instruction manual. Have you oiled the record player according to the manufacturer's instructions? Since each player is different (and we don't know which one you have), we suggest sending it to the manufacturer's warrantee or repair service shop.

60-Hz Attenuator. *I must remove as much 60-Hz stray signal as possible from an experimental amplifier I am constructing. I can't connect a large value filter capacitor across the input for obvious reasons. What can I do?*

Try the selective 60-Hz reject network shown below. Install the reject network in



series with the signal lead and adjust the potentiometer for maximum 60-Hz rejection.

Color-TV Antenna. *I have been told that an ordinary TV antenna is not good for color-TV reception. Is this true?*

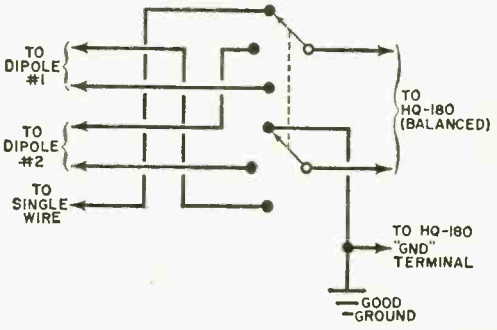
Generally, yes. However, if you are in a strong signal area, an ordinary TV antenna *will* work—but not as well as one designed for color reception. A color-TV antenna is designed for maximum bandwidth.

Transistor Battery Charger. *I have a 9-volt transistor battery charger and it seems to work fine; but when I tried using it to directly power the radio set, it wouldn't. Do you know why?*

Your battery charger evidently was not made to power equipment, but just to charge batteries with *low* current. Such units simply do not put out enough power to operate a transistor radio.

SWL Antenna Switching. *My new SWL setup has a Hammarlund HQ-180 and three antennas. Two of the antennas are dipoles and the third is a single-wire-fed long-wire. How can I arrange a switch to select any antenna I want?*

Very simply, if you can locate a 2-pole, 3-position rotary switch. Since that is unlikely, we would suggest a 2-gang switch (it's easier to work with) such as the Mallory Type 1325L. You will then have extra positions available in case you decide to add another receiver or another antenna to your setup. Wire the switch according to the diagram above (we are assuming that you have 300-ohm twin-lead dipoles).



Replace Tubes With Transistors. *I like my tube-type VTVM, but having to wait while it warms up is a nuisance. Also, the tubes age, and I always have to reset the "zero." Can I replace the tubes with some of these new field-effect transistors?*

Sorry, but just because FET's have the characteristics of vacuum tubes doesn't mean that the two are interchangeable. And if the tubes *could* be replaced by FET's, the voltages in the VTVM would need to be reduced, and so would all of the component values in the surrounding circuitry.

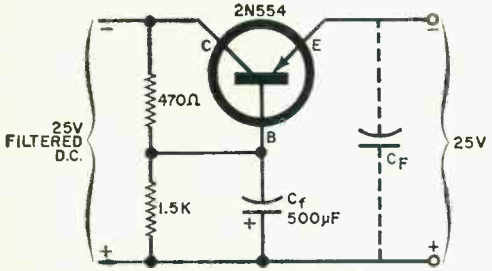
Cannibalized Receivers. *I have developed the knack of cannibalizing Japanese transistorized radio receivers but don't understand what the color-coded components are that look like miniature dumbbells.*

They are miniature resistors with ¼-watt ratings. Both of the connecting leads are at one end of the resistor. The color coding is only three numerals (no tolerance color coding). You read the coding down, starting from the end away from the leads. For example, a descending color code (assuming that the resistor is soldered to a PC board)

of red, violet, and yellow would mean that the resistor was valued at 270,000 ohms.

High-Value Filter. *I need a large-valued filter capacitor (in excess of 10,000-μF) rated at about 15 volts. I can't seem to find one. Can you help me?*

If you think of a capacitor as a passive device that has certain electrical characteristics and not as two pieces of conducting material separated by a dielectric, you can come up with the electronic filter shown below. The effective filter capacitance C_F appearing across the load is approximately



equal to $C_f\ H_{FE}$ where H_{FE} is the current gain of the transistor being used. In the example shown, the effective C_F is about 25,000 μF.

Sealed Vs. Open Switches. *Do you recommend a sealed or unsealed rotary switch, and why?*

The sealed type of rotary switch, where the contacts are not exposed, lasts much longer. Dust, which can often carbonize and foul the contacts, is prevented from reaching the contacts.

Mono or Stereo Cartridge. *I have an old mono phono system that I would like to convert to stereo. How is this done?*

Usually, it doesn't pay to convert old systems, as you need a stereo cartridge, a new needle, another amplifier with similar characteristics to the one you now have, another speaker, and probably a beefed-up power supply to handle the greater load. The cost, in money and effort, is just not worth it.

Vacuum Cleaner Noise. *My biggest problem when trying to listen to the short-wave bands is the enormous amount of noise generated by vacuum cleaners operating in my apartment house. What can I do to reduce this noise?*

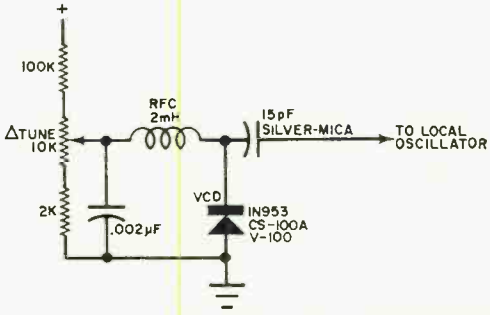
Outside of putting a noise filter on each vacuum cleaner, your best bet is to get the most out of your antenna and feeder system. Put the dipole as far up and as far away from the noise source as possible, and use a good-quality coaxial cable between the antenna and the short-wave set, making sure that the braid of the coax is well grounded at the receiver. Then make sure that the short-wave receiver is well shielded and grounded. In fact, both the receiver metal chassis and the coax braid should be connected to a cold water pipe for best grounding. You can also use plug-in line noise filters (properly grounded) on the set's input line cord. Another possibility is to bridge both sides of the power line to ground (chassis) inside the set, using 0.01-μF capacitors.

Output Impedance Matching. *The transistor stereo amplifier that I have specifies an 8-ohm output impedance. Why can't I use 4-ohm speakers with it?*

In most cases, the power that the amplifier delivers to the load (speakers, in this case) is a function of the load impedance. If you reduce that value too far, the amplifier will literally burn itself up trying to power the wrong load. This can lead to destroyed transistors.

Off-Set Tuning. *Can you supply a diagram for incorporating off-set tuning in my transceiver? I would like to tune about 2 kHz or so either side of my crystal-controlled frequency.*

The circuit below should do the trick. Some adjustment of values (depending on



the variable capacitor diode used) may be necessary. Delta tuning is accomplished by varying the value of the 10,000-ohm potentiometer.

Rejuvenating Tubes. *I understand that it is possible to rejuvenate certain types of vacuum tubes. How is this done?*

There have been many schemes for "rejuvenation." One is to use a slightly higher filament voltage, as in commercial CRT brighteners. Another is to apply about 400 volts d.c. or so for about 10 seconds between the cathode and grid; the positive lead goes to the grid and the negative lead goes to the cathode. However, neither of these methods gives any really extended life to the tube. -30-

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

WAS THAT EMERGENCY NECESSARY?

"WHAT were they trying to prove? What bit of scientific information heretofore unknown and indispensable to man did they bring back?" These questions from a veteran amateur and commercial ship operator were triggered by the account in this column (October, 1967) of how amateur, commercial, and military services cooperated to rescue three adventurers from their sinking balsa raft in the Pacific. The men were attempting to float from Ecuador to Australia in emulation of prehistoric sailors, but our bitter friend points out that the trip has already been made several times (Kon-Tiki, etc.); therefore, they were risking their lives for no good purpose.

This veteran amateur's ship was in the Gulf of Mexico at the time that the balsa raft was sinking, and every half hour from 11 p.m. until daylight, NBA in the Canal Zone repeated the information that the raft was in difficulty, and that its crew had requested immediate rescue. Each transmission triggered the ship's automatic distress-call warning system. The operator questions the necessity of NBA keeping hundreds of ships "awake" all night by transmitting the same information again and again. He concluded his comments with: "If such 'expeditions' were forced to post healthy cash bonds to guarantee the rescue they expect when they get their feet wet, there would be fewer of them."

The above plaint reminds your Amateur Radio Editor of the time when he and dozens of other members of an emergency net monitored the transmissions of a mobile amateur who insisted on attempting to travel with his wife and two small children (one of whom was ill) from Chicago, Ill., to Dayton, Ohio, during one of the midwest's severest snow storms. Ignoring the advice of everyone, including the weather bureau and the highway patrols of Illinois, Indiana, and Ohio, he started out early in the morning and spent the entire day creeping down one road until it became completely impassible, then back-tracking to a crossroad and try-

AMATEUR STATION OF THE MONTH

When Ivar J. Lindstrom, W7UZU, of White City, Oregon, closes the doors of the home-built cabinet in which his amateur station is located, it looks like a fine piece of light-oak living room furniture. The cabinet houses a Johnson "Viking-II" transmitter, VFO, antenna "Match Box," and Collins 75A-4 receiver. Licensed since he was 14 years old, Ivar is now Net Control Station for two MARS nets and holder of a MARS "Operator of the Month" award. W7UZU will receive a one-year subscription for submitting the winner for April in our Amateur Station of the Month contest. To enter the contest, send a clear picture of your station with you at the controls and some details on the equipment you use and your ham career to Amateur Radio Photo Contest, c/o Herb S. Brier, Box 678, Gary, Ind. 46401.

Dick Morris, WA9PZZ, of Downers Grove, Ill., uses his skill as a professional photographer to design and print his own QSL cards, a facsimile of which is shown here. See "News and Views" on page 117 for information on Dick's hamming equipment.

ing again. The family finally ended up at dark in a motel less than 75 miles from the point where the "expedition" had started ten hours earlier—much to the relief of the members of the snow emergency net who realized that if the car had become snowbound a rescue party would have to go out and bring the family in to safety.

Fortunately, as long as there is human life involved, there always seems to be someone brave enough and compassionate enough (or stupid enough?) to go out and rescue people from the results of their own heedless actions.

Illinois Sesquicentennial. In the photo below, L. A. Wollan, Jr., Assistant Director of the Illinois Sesquicentennial Commission, and R. W. "Bud" Drobish, W9QVA, of Hallicrafters Company, are shown presenting Illinois Governor Otto A. Kerner with the first of 100,000 Illinois Sesquicentennial QSL cards to be supplied to Illinois amateurs by Hallicrafters. Watching, at the right, are Edmond A. Metzger, W9PRN, Vice Director, American Radio Relay League Inc., and Charles Wilson, W9FFP, QSL Chairman of the Sangamon Valley Amateur Radio Club. Illinois amateurs may receive a supply of the QSL cards from W9FFP, Illinois Sesquicentennial Commission, 1016 Myers Building, Springfield, Ill. 62701.

Non-Illinois amateurs may earn an attractive certificate by working 10 Illinois stations on the VHF bands or 25 stations on the high-frequency bands. Illinois amateurs must work 60 other Illinois stations on the VHF's or 150 on the HF's to qualify for a certificate. Applications go to W9FFP at the address given; must be postmarked no later than midnight, June 30; and should list call letters, dates, times, and frequency bands of claimed contacts. (Since the claimed contacts will be cross-checked by a committee, no QSL cards should accompany the applications.)

AM Phone Downgraded Again. Further handwriting on the wall for those amateurs who still insist that conventional AM phone is superior to SSB is contained in the Fall, 1967, Collins *Signal*. The *Signal* reports that the commercial maritime services of several

(*Continued on page* 116)

The first of 100,000 free Illinois Sesquicentennial QSL cards is being presented here. See text above for the details.

ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

A HEFTY BUNDLE of money is being spent by CB clubs across the U.S. and Canada in preparation for the 1968 CB Jamboree season. Many groups are promising spectacular events with fireworks, carnival rides, concession stands, Bingo, TV celebrities, thousands of dollars in prizes, etc. Other, less wealthy organizations will be content to invite the entire country to their localized "picnic," and you gotta bring your own everything!

CB JAMBOREE SEASON

At least one group plans to attract the curious from all over the U.S. by promising the theme of *CB's Tenth Anniversary Celebration!* The Citizens Radio Service, as exercised on 11 meters, will officially reach its 10th birthday in September.

Rumors indicate that another CB organization will sponsor a "CB Happening." We would suppose that transceivers to be used and shown at the event will be psychedelically trimmed, equipped with mini-mikes, and the action wild and woolly, or, *mod*erate!(?)

One harbinger of doom is taking bets that CB Jamborees in some areas this year will bring about the downfall of a number of clubs. He maintains that thousands of CB'ers who will make a success of CB jamborees displaying 50 or more booths (with only 5 or 6 of those booths relating to electronics or CB communications) will make a flop of next year's events by failing to attend. In the last five years, CB'ers have begun to weed out the dead ones. They're getting tired of traveling hundreds of miles to a highly promoted jam only to find that the local club got financially out from under by selling display space to anyone who could be pitched.

Also, they're a little fed up with organizing large caravans that are presented with the "first prize" trophy for their efforts—especially when the award is a 49-cent, 1½-inch "Great-Golfer" trophy, with the inscription changed to read "Courageous Caravan!" And most of all, CB'ers are getting a little discouraged at traveling 1, 10, or 1000 miles to find themselves staring at several hundred other communications buffs all day, with very little interest, due to poor planning on the part of the jamboree programming committee.

Successful jamborees will be presented by

(*Continued on page 96*)

1968 OTCB JAMBOREE CALENDAR

Citizens Band clubs that are planning jamborees, get-togethers, banquets, or something that will be "happening" (for the good of CB) are requested to send the details to the 1968 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. If possible, include a report on last year's event, plus a glossy photograph (or photographs) taken at the 1967 shindig. For more detailed information on the jamborees listed below, contact the club or club representatives at the addresses given.

Rockford, Illinois — **May 19**

Event: Fourth Annual RRVCBC Jamboree. Location: Rockford Armory, 605 N. Main Street. Sponsor: Rock River Valley Citizens Band Radio Club. Contact: Pierre LaBounty, KPK3273, 2015 Glenwood, Dept. AP, Rockford, Ill.

Wooster, Ohio — **May 31-June 2**

Event: Annual Wayne County REACT Campout and Jamboree. Sponsor: Wayne County REACT. Contact: Jamboree, P. O. Box 281, Wooster, Ohio.

London, Ontario, Canada — **June 29-30**

Event: Campout '68, held in conjunction with London's annual Fortnight Festival. Sponsor: South Western General Radio Association. Contact: Peter Harding, Campout '68 Chairman, 26 Grosvenor St., London, Ontario, Canada.

Lexington, Massachusetts — **June 16**

Event: CB Jamboree. Location: Suburbs of Boston, Mass. Sponsor: Paul Revere Emergency Radio Service. Contact: Robert Sweet, Secretary, P.O. Box 495, Lexington, Mass.

Lexington, North Carolina — **August 17-18**

Event: First CB Jamboree. Location: Davidson County Fairgrounds. Sponsor: Pioneer CB Club. Contact: Virginia Athay, KOK3171, 11 Hawthorne Lane, Lexington, N.C. 27292.

Warminster, Pennsylvania — **Date Pending**

Sponsor: Eastern Pennsylvania REACT, Inc. Contact: Edward Wolfgang, president EP/REACT, P.O. Box 309, Warminster, Pa. 18974

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA FOR THE MONTH OF APRIL

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME EST	TIME GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7:15 a.m.	1215	Melbourne, Australia	11.71
		Montreal, Canada	9.625, 11.72
7:45 a.m.	1245	Copenhagen, Denmark	15.165
6 p.m.	2300	Helsinki, Finland	15.155
		London, England	6.11, 9.58, 11.78
		Montreal, Canada	9.625, 11.945, 15.19
6:45 p.m.	2345	Tokyo, Japan	15.135, 17.825
7 p.m.	0000	Moscow, U.S.S.R.	9.665, 11.735, 11.90
		Sofia, Bulgaria	9.70
7:30 p.m.	0030	Budapest, Hungary	9.833, 11.91, 15.16
		Johannesburg, South Africa	9.705, 11.875
		Kiev, U.S.S.R. (Mon., Thurs., Fri.)	9.665, 11.735
		Stockholm, Sweden	11.805
7:50 p.m.	0050	Vatican City	9.69, 11.76, 15.285
8 p.m.	0100	Berlin, Germany	9.50, 9.73
		Havana, Cuba	9.525
		Madrid, Spain	6.13, 9.76
		Peking, China	15.06, 17.68, 17.795
		Prague, Czechoslovakia	7.345, 9.63, 11.99
		Rome, Italy	9.575, 11.81
8:30 p.m.	0130	Berne, Switzerland	6.12, 9.535, 11.715
		Bucharest, Rumania	9.51, 11.94, 15.25
		Cologne, Germany	9.64, 11.945
		Hilversum, Holland	9.59 (Bonaire relay)
		Tirana, Albania	7.30
8:45 p.m.	0145	Copenhagen, Denmark	9.52
9 p.m.	0200	Cairo, Egypt	9.475
		Lisbon, Portugal	6.025, 9.68, 11.935
		London, England	6.11, 9.58, 11.78
		Melbourne, Australia	15.22, 17.84
		Moscow, U.S.S.R.	9.665, 11.735, 11.96
		Stockholm, Sweden	11.805
9:10 p.m.	0210	Hanoi, North Vietnam	9.525 (via Havana)

TO WESTERN NORTH AMERICA

TIME PST	TIME GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7 a.m.	1500	Tokyo, Japan	9.505
6 p.m.	0200	Melbourne, Australia	15.22, 17.84
		Taipei, China	15.125, 15.345, 17.89
		Tokyo, Japan	15.135, 15.235, 17.825
6:30 p.m.	0230	Johannesburg, South Africa	9.705, 11.875
7 p.m.	0300	London, England	6.11, 9.58, 11.78
		Madrid, Spain	6.13, 9.76
		Peking, China	11.82, 15.095, 17.68
		Seoul, Korea	15.43
7:30 p.m.	0330	Bonaire, Netherlands Antilles	11.82
		Prague, Czechoslovakia	7.345, 9.63, 11.99
		Stockholm, Sweden	11.705
7:45 p.m.	0345	Berlin, Germany	11.84, 11.97
8 p.m.	0400	Havana, Cuba	6.135, 9.525
		Lisbon, Portugal	6.025, 9.68, 11.935
		Moscow, U.S.S.R. (via Khabarovsk)	9.54, 11.85, 15.18
		Peking, China	11.82, 15.095, 17.68
		Sofia, Bulgaria	9.70
8:15 p.m.	0415	Bangkok, Thailand	11.91
8:30 p.m.	0430	Bucharest, Rumania	9.51, 11.94, 15.25
		Budapest, Hungary	9.833, 11.91
		Kiev, U.S.S.R. (Mon., Thurs., Sat.)	9.665, 11.735
8:40 p.m.	0440	Hanoi, North Vietna	9.525 (via Havana)
8:45 p.m.	0445	Berlin, Germany	11.84, 11.97
		Cologne, Germany	9.545, 11.945
9 p.m.	0500	Havana, Cuba	6.135, 9.525
		Tokyo, Japan	15.105
9:15 p.m.	0515	Berne, Switzerland	6.12, 9.695
10 p.m.	0600	Moscow, U.S.S.R. (via Khabarovsk)	9.54, 11.755, 11.85
10:30 p.m.	0630	Havana, Cuba	9.655

SHORT-WAVE LISTENING

By **HANK BENNETT**, W2PNA/WPE2FT
Short-Wave Editor

GREAT BRITAIN GOES TO GMT PLUS ONE

GREENWICH Mean Time, known and respected the world over as the absolute basis of timekeeping on our planet, has been abondoned by the British as their primary time zone. DX'ers will recall that for many years Great Britain has had a form of Daylight Saving Time whereby it was on GMT during the winter months and on "British Summer Time" (or GMT plus one hour) for the remainder of the year. Now, in a move little noted by the Western Hemisphere press, Great Britain has changed its local time to GMT plus one on a permanent basis, thereby placing the country in the same time zone as most of Western Europe.

Greenwich Mean Time is still universal time to all extents and purposes, however. It will continue to be used as local time in Portugal, Canary Islands, Ghana, Morocco, Togo, Mali, and other points along the Greenwich meridian. And it will continue to be recognized and used by scientists, airline pilots, ship navigators, and radio operators.

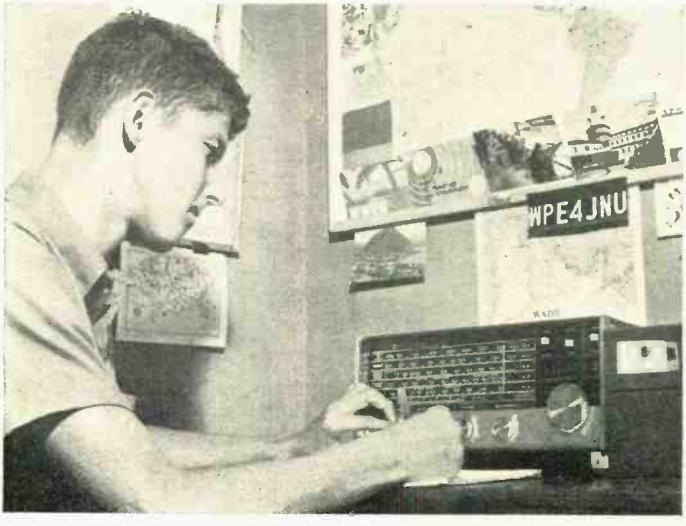
Furthermore, Great Britain's change of time zone will in no way affect the operation of this column. All material published here continue to be listed as Greenwich Mean Time (EST plus five hours).

(*Continued on page* 110)

DX Award Honor Roll

Here is an up-to-date listing of the DX Award Honor Roll, for which the following DX'ers have qualified. When will we be able to add your name to the list? The figures at the right indicate the number of countries, states, and Canadian provinces/territories verified, in that order.

James Young (WPE6ENA) Wrightwood, Calif.	230	50	12
Chuck Edwards (WPE4BNK) Fort Lauderdale, Fla.	180	50	10
Ed Fellows (WPE7BLN) Seattle, Wash.	200	....	12
Paul Kilroy (WPE3FOB) Washington, D.C.	150	50	12
Don Jensen (WPE9EZ) Racine, Wis.	190	20	....
L. E. Kuney (WPE8AD) Detroit, Mich.	150	50	10
Charles Matterer (WPE6DGA) San Leandro, Calif.	150	50	8
Richard Markell (WPE6DXC) Los Angeles, Calif.	150	50	....
Frank Scolaro, Jr. (WPE2LUZ) Yonkers, N. Y.	150	50	....
Nathan Rosen (WPE2CY) New York, N. Y.	150	50	....
Frank Peters (WPE9EZI) Chicago, Ill.	200	....	....



Robert Bergner, WPE4JNU, DX'es from Fort Myers, Fla., with a Zenith M660-A receiver. His antenna is a 75-foot inverted-L. A member of the BBC World Radio Club, Bobby has a record of 31 states and 41 countries verified to date.

SOLID STATE

By LOU GARNER, Semiconductor Editor

ENGINEERS and scientists at the Bell Telephone Laboratories (where the transistor was invented) have been among the leaders in developing new applications for semiconductor devices. Understandably, many of their developments have been in the communications field. The latest BTL development may, one day, permit deaf people to communicate via telephone by

Bell Telephone Laboratories developed this experimental device to enable deaf people to use phone.

reading letters and numbers flashed on the screen of a small device attached to their home telephones.

The new experimental device uses solid-state circuitry and digital logic techniques to convert coded tone signals generated by a conventional Touch-Tone® telephone into sequential letter and number displays. The letters A through N, except I and J, appear in the left window (see photo), O through Z in the center window, and letters I and J as well as digits 0 through 9 in the right window. Flashes of light in two lower windows indicate the end of a word or sentence, or that letter coding is in progress.

A simple code has been developed which utilizes the arrangement of the letters as they actually appear on the dial buttons. Letters A, B, and C are sent using the "2" button, D, E, and F with the "3" button, and so on through the alphabet. Depressing the "2" button once indicates A, twice indicates B, and three times, C. A special readout circuit (triggered by the 0 button) stores the signals until a letter is fully coded. Letters of the alphabet not used in dialing (Q and Z) are coded with the 1 button, which is also used as a word separator (as 111) and to end a sentence (as 111,111). The 1 button can also be used to erase stored signals.

Tests of the new device, which are still continuing, indicate that the average user can attain a coding rate of eight words per minute with just a little training. This rate can be doubled with practice and increased even more by adaptation of the short-hand signals normally used by the deaf in manual communications. The maximum speed of the present device is about 150 letters per minute, which compares well with acceptable rates in Morse code.

The unit is still experimental and no production is planned for the immediate future. Further development will depend not only upon the results of the continuing experiments but also upon the refinement and perfection of less costly and less demanding visual display devices.

Readers' Circuits. Inexpensive component testers are popular projects with many hobbyists and experimenters because, properly used, they can be real time and money savers. A spare parts box full of questionable capacitors, for example, might become an assortment of valuable parts if checked and classified.

Two readers—Kenneth Scharf (2569 W. 2nd St., Brooklyn, N.Y. 11223) and Eugene Richardson (310 E. Mason Ave., Alexandria, Va. 22301)—have each submitted a simple capacitor checker circuit. Both circuits use semiconductor devices—one a transistor and the other a diode. Both are easy to build and use, require relatively few components, and either can be assembled in a single evening. Their principles of operation are entirely different, however.

Ken's circuit (Fig. 1) uses a *pnp* power transistor as a simple audio oscillator, with its feedback provided by the capacitor (*Cx*) under test. It is suitable for checking mid-range (0.002 to 0.1μF) mica, ceramic, plastic film, or paper capacitors, and will indicate whether the component is defective (open or shorted) and its approximate value.

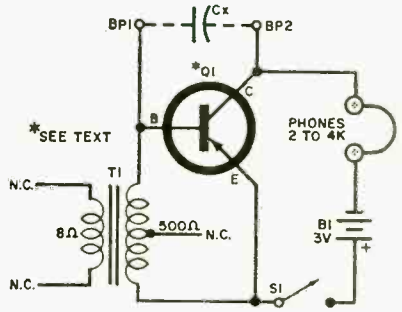


Fig. 1. Suggested by Kenneth Scharf, this capacitor tester has an audio output tone whose frequency is determined by the capacitor undergoing test.

Transistor *Q1* is a general-purpose power transistor (a 2N176, 2N301, 2N554, or similar) while *T1* is a 500-ohm CT to 8-ohm miniature output transformer. Transformer *T1*'s 500-ohm primary is used as an inductance in this application, and the CT and 8-ohm leads are not connected. Battery *B1* is made up from two penlight cells in series, and *S1* is a s.p.s.t. toggle or slide switch. Test terminals *BP1* and *BP2* can be binding posts, banana jacks, alligator clips, or similar connectors. Moderate impedance (2000- to 4000-ohm) electromagnetic headphones are used. The instrument can be "jury-rigged" breadboard fashion or, if preferred, assembled in a small metal or plastic case as a permanent addition to the home laboratory.

In operation, feedback capacitor *Cx* determines the circuit's frequency, and hence the output tone serves as an indication of the test component's value. To use the instrument, connect the unknown capacitor to test terminals *BP1* and *BP2*, and, while listening through the headphones, close switch *S1*. If the capacitor is shorted or open, no tone will be heard. If an audio tone is developed, a higher-frequency tone (pitch) indicates a smaller value. You can "calibrate" the instrument, if you wish, by checking capacitors of known value and noting the pitch of the resulting tones, comparing these to the signals produced by the test capacitors.

In contrast to Ken's design, which features an audible output signal, Eugene's circuit (Fig. 2) uses an inexpensive neon bulb as a visual indication device. It can be used for checking most types of capacitors, including electrolytics, with rated working voltages of 150 volts or more.

In operation, transformer *T1* and half-wave rectifier *D1* form a basic d.c. power supply, with *R1* and *C1* serving together as a simple ripple filter. Resistor *R2* acts as a current-limiting device to protect the neon bulb which, in turn, is used both as a test indicator and as a relaxation oscillator. Two test modes are provided, selected by d.p.d.t. switch *S1*.

Transformer *T1* is a standard 1:1, 117-volt isolation transformer, while *D1* is a general-purpose silicon diode such as an ALCO Type SA-1 or Workman Type S500C. Resistors *R1* and *R2* are half-watt types and *C1* is a 10 to 20 μF, 200-volt electrolytic capacitor. The neon bulb can be an NE-2 or an NE-51. A toggle, slide, or a rotary switch can be used for *S1*. Test terminals *BP1* and *BP2* are panel binding posts or equivalent test jacks.

The instrument can be assembled on a perf board, an etched circuit board, or point-to-point on a conventional metal chassis, as preferred. A metal or plastic case, or even a painted cigar box, can house the completed unit. An additional s.p.s.t. power on-off switch in series with one side of the line cord is optional.

Ceramic, mica, plastic film, and paper capacitors are checked with *S1* in its "up" position (as shown in the diagram). Simply connect the test capacitor (*Cx*) to *BP1* and *BP2* and plug the line cord into a standard outlet. The neon bulb should flash briefly *once* with the brightness and duration of the flash proportional to the capacitor's value.

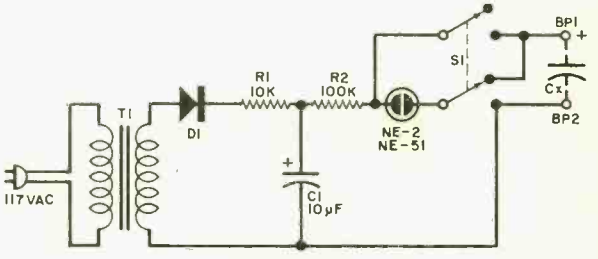


Fig. 2. Reader Eugene Richardson's capacitor tester has visual readout.

The bulb and capacitor are connected in series during this test, and the bulb lights only as *Cx* charges. If the bulb fails to flash, the capacitor is "open." If the bulb flickers, *Cx* is intermittent. If the bulb lights dimly, but continuously, the capacitor is leaky. Finally, if the neon lights to nearly full brilliancy, *Cx* is shorted.

Electrolytic capacitors are checked with *S1* switched "down." With this arrangement, the capacitor (*Cx*) and neon bulb are in parallel, forming a relaxation oscillator in connection with series resistor *R2*. As before, connect *Cx* to *BP1* and *BP2, observing d.c. polarity*, and plug the line cord into a standard outlet. If the capacitor is in good condition, the bulb should flash at a periodic rate inversely proportional to the capacitor's value—that is, the larger the capacitor, the lower the flashing rate. If the neon lamp lights continuously, the capacitor is either "open" or its value low (the bulb may appear to be on continuously when flashing at a rate faster than the eye can follow). If the bulb fails to light, the capacitor is either leaky or shorted. You can obtain a rough "calibration" by checking capacitors of known value and noting the flashing rate.

Manufacturer's Circuit. Featuring a hybrid integrated-circuit operational amplifier, the d.c. millivoltmeter circuit in Fig. 3 has a full-scale sensitivity of only 10 millivolts, yet requires a minimum of components. It is one of the nearly two-score circuit applications described in a folder published by Opamp Labs (172 S. Alta Vista Blvd., Los Angeles, Calif. 90036). Other IC amp applications in the folder include a Wien bridge oscillator, timer, Schmitt trigger, high-voltage d.c. amplifier, tuning fork oscillator, voltage regulator, a.c. millivoltmeter, temperature controller, pulse width modulator, crystal-controlled oscillator, a.g.c. amplifier, and an active notch filter.

Resistors *R1*, *R2*, and *R3* are half-watt'ers, with low tolerance (2% or 5%) types preferred. The IC is an Opamp Labs Model 4009 (these sell for $10 each in unit quantities). The meter is an 0-1 mA unit, while *BP1* and *BP2* can be conventional binding posts or panel test jacks. Either a battery or line-powered type d.c. power supply can be used.

Suitable for a variety of laboratory and experimental applications, the completed d.c. millivoltmeter could be used for such varied tasks as measuring the output of thermocouple elements or other transducers, or even for checking biological potentials. If desired, a step-type voltage-divider could be added to permit the instrument to serve as an ultra-sensitive d.c. voltmeter.

Device News. Accurate time delays of up to 30 days may be possible with a new device developed by the Battery Division of the Sonotone Corporation (Elmsford, N.Y. 10523). The solid-state timer uses a special nickel-cadmium control cell as its timing element in place of the more familiar capacitor, taking advantage of the cell's characteristically short rise in voltage as it reaches full charge. Early experimental models have achieved delays for periods of from an hour to a week, but the firms's engineers feel that refinements in design will extend the range of future models to from 10 minutes to 30 days.

Another new device has been announced by Bell Telephone Laboratories—a monolithic FM discriminator which is about as "solid" as a solid-state device can be. As shown in the drawing, Fig. 4, the discriminator consists of a quartz plate about

(*Continued on page* 104)

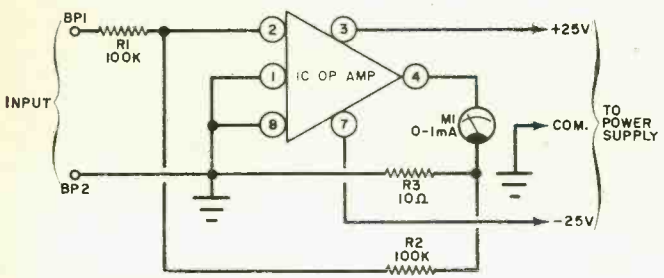


Fig. 3. Opamp Labs millivoltmeter circuit, which features an IC, is capable of measuring down to 0.01 volt full scale.

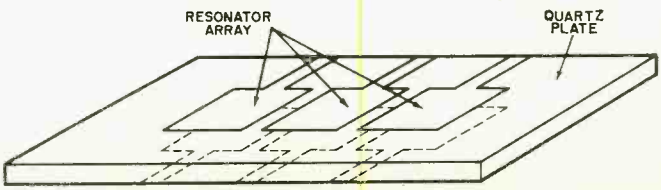


Fig. 4. The new look in FM discriminators? Another Bell Labs contribution, this device can operate between 10 and 30 MHz.

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other *P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information,* write him directly—*he'll appreciate it. If* you *need help, send a postcard to Operation Assist,* POPULAR ELECTRONICS, *One Park Avenue, New York, N.Y. 10016. Give maker's name and model number of the unit. If you don't know both the maker's name and the model number, give year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Because we get so many inquiries, none of them can be acknowledged.* POPULAR ELECTRONICS *reserves the right to publish only those items not available from normal sources.*

Atwater Kent Model S65-976, circa 1935. Schematic and servicing data needed. **National** Model NC 125 receiver. Operating manual needed. (William J. Ziaja, 38 Oxford Ave., Dudley, Mass.)

National SW-3 receiver. Schematic needed. (Perrin C. Cothran, HQS Camp Howard, APO San Francisco, Calif. 96271)

Dumont Model RA113-B3 TV receiver. Schematic and servicing data needed. (Flavio Dotta, Jr., Av. San Joao 253, 4 Andar Conjunto 41, Sao Paulo, Brazil)

Hallicrafters Model TW-1000 radio receiver. Volume control needed. (Walter Wilusz, 316 Bruck Ave., Perth Amboy, N.J.)

Superior instruments Model TV-12 transconductance tube tester. Schematic and operating manual needed. (Paul I. Brunk, 2733 Quail Ln., Dayton, Ohio 45439)

Radiotechnic Lab Model 130 tube and battery tester. Latest tube chart needed. (Louis Malaric, 5093 French Rd., Detroit, Mich. 48213)

Radio City Products Model 657 VTVM. Schematic or wiring diagram and/or details of power supply needed. (P.G. Summerfield, 3 Lancelot St., Five Dock, Sydney, Australia)

Hallicrafters Model DD-1 "Skyrider Diversity" receiver, 1938. Receiver with accessories and manual wanted. (Bruce Sugarberg, 1415 DeWitt Dr., Akron, Ohio 44313)

Lear Jet Model ASFM 830 8-track stereo car player, with FM receiver, universal mount. Schematic and servicing instructions needed. (G.E. Durtler, 2248 E. 46 Ave., Vancouver 16, B.C. Canada)

Solar Model C-E capacitor checker. Operating instructions needed. (Ralph Musco, 2119 74 St., Brooklyn, N.Y. 11204)

Philco Model 48-200 BCB receiver; code 121; has 5 tubes; 115-volt a.c. or d.c. Schematic needed. (Tim Ohrman, 1210 Old Concord Rd., Monroeville, Pa. 15146)

Webster Model 80-1 "RMA 375" wire recorder. Operating manual, schematic, and extra wire spools needed. (Albert M. Foster, 1515 Avenue B, Eau Claire, Wis.)

Superior Model TV-12 tube tester. Tube chart needed. (Agostino DiCamillo, 27 Lawrence St., Milford, Mass.)

Grundig "Majestic Model 8095" radio receiver. Tuning capacitor (part #1005-022) needed. (James C. Masters, Jr., Star Route 3, Box 48, Alsea, Ore. 97324)

Multi-Elmac Model AF-67. Instruction manual and schematic needed. (George R. Young, 49 Freetown Rd., Belize City, British Honduras)

Harman-Kardon "Citation V" amplifier and "Citation I" stereo control center. Operating manuals needed. (Garry Weingarten, 45 Burch Dr., Morris Plains, N.J. 07859)

Superior Instruments Model TV-50A "Genometer" signal generator. Schematic or instruction manual needed. (R.J. McGinty, 831 Ratone, Manhattan, Kan. 66502)

Philco receiver, code 121, circa 1939; has 5 tubes; tunes broadcast band and SW up to 18 MHz. Schematic needed. (Steve Zimmerman, 542 E. Huntington, Rossville, Ga. 30741)

Grundig "Reporte 500" tape recorder; has 4 tubes and magic eye. Schematic needed. (SSgt. D. B. Summers, Jr., 95th C.A.M.S., Box 458, APO, New York, N.Y. 09677)

Encore transistor radio, AM-FM, 10 transistors; made in Japan. Schematic needed. (Marvin D. Hanson, 130 E. Northwest Highway, Des Plaines, Ill. 60016)

RCA Model 5T6 receiver; tunes 540-6600 kHz. Schematic and source for parts needed. (David Christenson, 162 Forest Rd., Aromas, Calif.)

Nelson radio receiver: European-made. Schematic and information as to what tube to substitute for EK2 needed. (Paul D. Crotts, 1003 Nancy Ln., Winston-Salem, N.C. 27107)

Landers, Frary & Clark recorder/reproducer; subassembly sound RD-149/TNH-2B. Schematic or information on power supply and amplifier needed. (Leo J. Stengel, 1126 Charles St., Louisville, Ky. 40204)

UV199 tube and socket needed for home-brew radio receiver. (Lawrence Meikle, R.R. #1, Richmond Hill, Ontario, Canada)

DeVry Model IG09 5" oscilloscope; supplied with training course in kit form. Schematic and assembly instructions needed. (John Petrucelli, 135 Mt. Pleasant St., Meriden, Conn. 06450)

Emerson ED354 receiver, "Silver Jubilee" model, circa 1945 or earlier; tunes 55 to 150 kHz. Tube chart, instruction manual, and schematic needed. (Thom Ramsey, 143 Devon Rd., Albertson, N.Y. 11507)

Multi-Elmac mobile receiver; tunes 0.55 to 28.7 MHz. Tube layout for receiver and power supply needed. (D.E. Richards, 1327 N. St., Fresno, Calif. 93721)

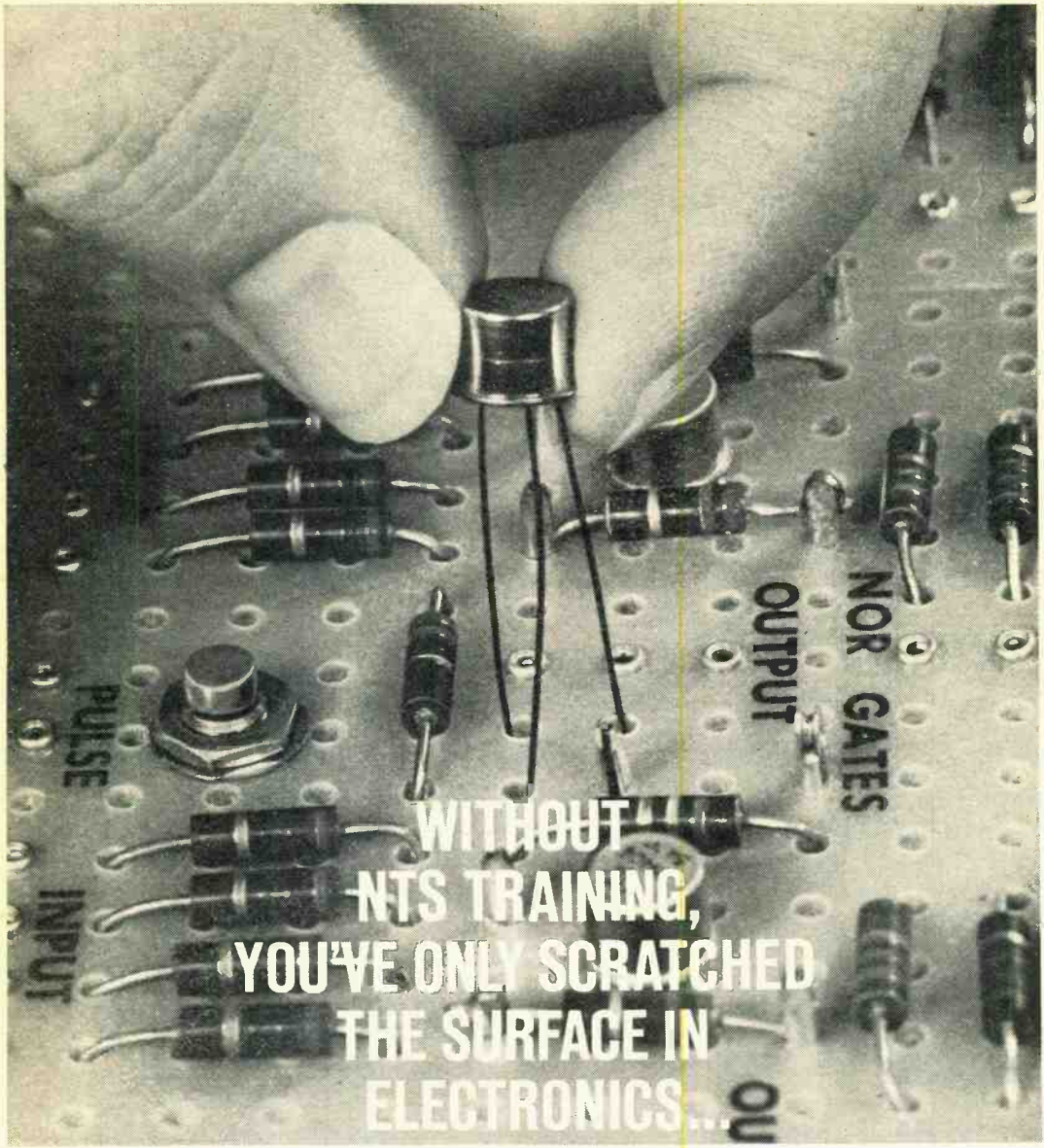
Phonograph needles made before 1940 needed; steel, tungsten, or other substances; .003-inch tips. (Ron Graham, 63A Werner Ave., Daly City, Calif. 94014)

Philco Model 37-160 receiver. Schematic, operating manual, and source for parts needed. (Herman G. Herbig, P.O. Box 425, Gardnerville, Nev. 89410)

Alfred Barber Model 32 high-frequency electronic voltmeter. Schematic and calibration data needed. **Motorola** Model H11-1AM walkie-talkie with trans. type 1A-113; operates on 33.14 MHz. Schematic, alignment procedure, and conversion data needed. **Hickok** Model 547A mutual conductance tube tester. Tube chart, schematic, and source for adapters needed. (Donald E. Smith, 1142 W. Grand, Pomona, Calif. 91766)

SOURCES OF INFORMATION

"Operation Assist" is published as a service to the readers of POPULAR ELECTRONICS who cannot find schematics, parts, etc., for old or no-longer-manufactured equipment. Military—or Government surplus—equipment is not itemized in this column, since schematics and copies of Tech Manuals for military equipment can be obtained from a variety of independent sources: Slep Electronics, Drawer 178, Ellenton, Florida 33532; Quaker Electronics, P.O. Box 215, Hunlock Creek, Pa. 198621; etc. Unusual or difficult-to-find schematics and servicing information can frequently be obtained from Supreme Publications, 1760 Balsam Rd., Highland Park, Ill., for a slight charge.



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COMPUTATION WITH THE BINARY ADDER

(Continued)

HOW SYSTEM WORKS

(Continued from page 40)

subtraction of seven from ten proceeds as follows:

```
Step (a)   01010   (ten)
          −00111   (seven)

             11    (carries)
Step (b)   01010   (ten)
          +11011   (minus seven)
           00011   (three)
```

Likewise, ten from seven is:

```
Step (a)   00111   (seven)
          −01010   (ten)

             11    (carries)
Step (b)   00111   (seven)
          +10110   (minus ten)
           11101   (minus three)
```

Try the following example as an exercise.

```
(m)        01100   (twelve)
          −00111   (seven)
```

After you have read the above text, you might want to gain a greater familiarity with binary arithmetic by creating a number of exercises and solving them using the methods demonstrated.

ANSWERS TO BINARY PROBLEMS

(a) 00101; (b) 01100; (c) 11110; (d) nine; (e) fourteen; (f) nineteen; (g) fourteen; (h) twenty-one; (i) plus seven; (j) minus seven; (k) minus thirteen; (m) change 00111 to 11001 and add to give 00101 (five).

CONSTRUCTION & APPLICATION

(Continued from page 42)

cator lamp comes on, and the contents of the RESULT REGISTER are incorrect.

Using the "Adder." The following exercises can be done on paper first, then checked on the "Binary Adder." Place the NUMBERS switch in the 4 BITS + SIGN position. All numbers must be thought of as *signed* binary numbers.

To better appreciate the binary number system, and the "place value" concept, add a few simple positive numbers (2+2, 3+5, etc.), by first converting the decimal numbers to binary, then confirming the result on the "Binary Adder." Then add both positive and negative numbers (2+ minus 1, 7 + minus 8, etc.). Remember that the negative number must be represented by the two's complement.

For more experience in using the two's complement form, perform some subtraction: 8—(—2), 12—(—5), 4—(—6), —3—(—1), etc. Remember that negative numbers themselves must be in two's complement form, and that when you are performing the subtract operation, you must first find the two's complement of the second number, then add the two numbers together.

When working with the "Binary Adder," the complement function required to perform the subtraction is done automatically by the circuitry with the FUNCTION switch placed in the SUB(tract) position. —30—

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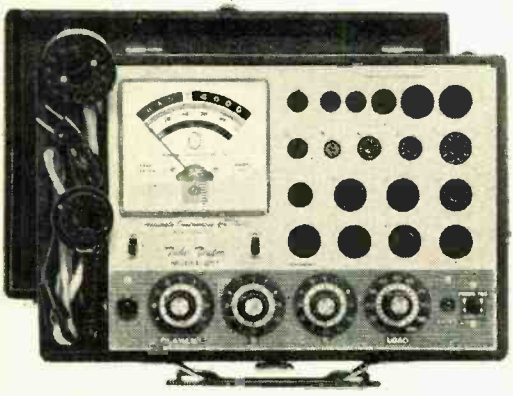

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- All Picture Tubes, Black and White and Color

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

COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

STANDARD TUBES:

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

BLACK AND WHITE PICTURE TUBES:

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

COLOR PICTURE TUBES:

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

The Model 257 is housed in a handsome, sturdy, portable case. Comes complete with all adapters and accessories, ready to plug in and use. No "extras" to buy. Only **$47.50**

NOTICE *We have been producing radio, TV and electronic test equipment since 1935, which means we were making Tube Testers at a time when there were relatively few tubes on the market, 'way before the advent of TV. The model 257 employs every design improvement and every technique we have learned over an uninterrupted production period of 32 years.*

Accurate Instrument Co., Inc.

SEND NO MONEY WITH ORDER
PAY POSTMAN NOTHING ON DELIVERY

Try it for 10 days before you buy. If completely satisfied then send $10.00 and pay the balance at the rate of $10.00 per month until the total price of $47.50 (plus P.P., handling and budget charge) is paid. If not completely satisfied, return to us, no explanation necessary.

ACCURATE INSTRUMENT CO., INC.
Dept. 560 2435 White Plains Road, Bronx, N. Y. 10467

Please rush me one Model 257. If satisfactory I agree to pay $10.00 within 10 days and balance at rate of $10.00 per month until total price of $47.50 (plus P.P., handling and budget charge) is paid. If not satisfactory, I may return for cancellation of account.

Name_____

Address_____

City_____ Zone_____ State_____

☐ Save Money! Check here and enclose $47.50 with this coupon and we will pay all shipping charges. You still retain the privilege of returning after 10 day trial for full refund.

CIRCLE NO. 41 ON READER SERVICE PAGE

THE PRODUCT GALLERY

(*Continued from page 74*)

similar meters—sometimes at an additional cost. But on a cost-versus-versatility basis, this meter is an excellent buy.

Circle No. 87 on Reader Service Page 15 or 115

VHF MONITOR RECEIVER

(Hallicrafters Model CRX-102)

Hand-held VHF receivers are becoming as common as any other type of transistorized pocket or portable radio receiver. One of the three new VHF receivers marketed by Hallicrafters (600 Hicks Rd., Rolling Meadows, Ill. 60008) was recently tested by POPULAR ELECTRONICS. This particular receiver tuned from 144 through 174 MHz (Model CRX-102 —$39.95, list price) and is similar in styling and appearance to the manufacturer's other models tuning 27-50 MHz and 108-135 MHz.

The CRX-102 is a 9-transistor superhet with 3 i.f. stages powered by a regular NEDA 1604 9-volt battery. Good sensitivity is insured by a separate r.f. stage that also serves to decouple the collapsible antenna from the mixer. Automatic gain control and noise limiting are included in the superhet circuit. Jacks mounted around the case are provided to power the receiver from an external 9-volt source, for connection to an outdoor antenna, and for an earphone.

Portables such as the CRX-102 are not intended to replace the easily tuned a.c.-operated base station receivers, but to permit the owner to monitor a special channel or frequency (police, fire, CAP, ham, weather, etc.). If this distinction between types of receivers is accepted, the user will find that the portable has many advantages. For example, frequency drift is eliminated, battery life is usually very long, and the handiness of taking the receiver with you (if only from room to room) cannot be denied.

Volunteer firemen or auxiliary police should welcome the advantages of a desk or bedside VHF receiver. Sensitivity with built-in antenna is usually sufficient for local 3-7 mile VHF reception. Use of outdoor antenna tuned to VHF will triple receiving range. Similar models tune CB or aero bands.

(Circle No. 88 on Reader Service Page 15 or 115)

WWV and WWVH Use New Codes

The standard frequency broadcasting stations of the National Bureau of Standards have instituted a new coding system for "Geoalerts." The new system will permit three types of information to be announced at each broadcast —each in the form of letters repeated three times in slow International Morse Code. Geoalerts advise listeners of past, present, or future short-wave receiving conditions. Forecasts are made at 0400 GMT and the first broadcast for a given day is heard over WWV at 0418 GMT and WWVH at 0448 GMT. The broadcasts are repeated hourly until a new alert is issued.

A sample broadcast in slow Morse would be: GEO SSS EEE DDD. The GEO letter group is the standard introduction and the SSS is a prediction of a proton solar flare. If no event is predicted, the EEE group would have been transmitted in place of SSS. Similarly, a III group indicates that solar flares are predicted and TTT indicates that a magnetic storm disrupting radio communication is expected. The UUU group says that both flares and a magnetic storm are expected, and the VVV group says that a proton flare and magnetic storm are predicted. Additional groups, HHH, DDD, BBB, and MMM, pertain to similar events, but include a stratospheric warning. The last, and next to last group of letters transmitted pertain to the occurrence of and the approximate time of observed solar or geophysical events in the preceding 24 hours.

Details can be obtained from the National Bureau of Standards, Boulder, Colorado 80302. Ask for Bulletin Number 53.

LETTERS (Continued from page 10)

preferred value. The next highest preferred value with a 10% tolerance would be 3830 (using the 12th root of 10^{13}); this is rounded off for a preferred value of 3900 ohms.

FRED STERN
Chief Engineer,
Philadelphia Division
IRC, Inc.
Philadelphia, Pa.

After what Fred has written, what more can we say but that he is perfectly correct? The mixup obviously occurred as the result of a misinterpretation of the meanings of tolerances and preferred values for resistors. But when the article went to press, it was not meant as an "April Fool" joke, John.

READY-MADE PROJECT SUPPLIERS

I noticed the question from one of your readers in the "Information Central" column (February, 1968) asking if there was anyone who builds and sells POPULAR ELECTRONICS projects. While Precision Devices is primarily a maker of quartz crystals, it has a well-equipped facility to assume all tasks from procurement of parts to machine work and assembly in connection with any construction project printed in your magazine. Since this facility was recently idled due to completion of a government contract, it is possible that many of your readers would find such a service valuable.

DAVID SULLIVAN, President
Precision Devices Div.
619 Vermont Ave.
Lawrence, Kans. 66044

We are receiving an unusually large response from readers willing to supply ready-made POPULAR ELECTRONICS *projects on a one-shot basis. Look for a complete listing in the May issue.*

INCORRECT COLOR CODE

Anyone who buys the Alco FR-101 isolation relay described in "Meet Mr. Versatile" (December, 1967) will realize that you made a mistake in the color-coding of the relay's wires. The correct coding should be: relay contact wire, blue; other contact common with the 117-volt line, white; and the remaining 117-volt line, black.

DAVID LANSDOWN
Chico, Calif.

You are probably correct about the particular relay you have, but the color-coding that appeared in the article was and is correct for the latest model of the FR-101 isolation relay. Alco tells us that the color-coding of the relay's wire leads was changed recently to conform with accepted industry standards. If anyone who has purchased this relay is in doubt about which wires go where, refer to instructions that came with the relay. —30—

PROGRAMMED INSTRUCTION

(*Continued from page* 53)

Cleveland Institute of Electronics uses the adjunctive technique for all of its technology level courses; lessons written before 1963 are currently being revised. Using this technique, sections in the CIE "Auto-Programmed" books—called "What Have You Learned?"—are placed at the end of each topic to insure active participation by the student. Answers are given immediately below the questions.

Dr. Robert A. Nottenburg, Vice-President for Education and Training at CIE states: "We accept for the most part the definition and criteria of programmed instruction generally adopted by the field; that is, small bits of information carefully sequenced; each concept built on what was previously learned; the student responds actively; the correctness of each response is immediately confirmed; and each student proceeds at his own pace."

"With the exception of immediate reinforcement," Dr. Nottenburg continues, "these criteria are not far from the home study technique that has been used in this country for over 75 years."

Says H. B. Bennett, Director of the Student Services Division of National Radio Institute: "While NRI does not use programmed instruction, we are fully aware of the importance it has attained in education. Programmed Instruction has proved itself in many situations, but we believe it leaves much to be desired as a home study method of teaching. With PI, the student becomes increasingly aware that he is performing a mechanical process. In our courses using NRI's discovery teaching method [described in the Summer, 1966, issue of the "Home Study Review" available from NRI on request], we try to foster an atmosphere in which each student knows he is an individual."

But Mr. Bennett concludes: "NRI does not arbitrarily rule out PI or any other learning device. Actually, most correspondence schools, including NRI, use some principles of PI."

Most book publishing houses are engaged in producing the PI-type textbook for general use. The PI books you will find on electronics generally came into being as a result of courses given by large electronics companies to their employees. With PI writers on their staffs, these companies have an excellent means of validating and testing their material at first hand.

For example, RCA has been developing custom-tailored PI materials for the government, business, and industry since 1959. Their programs range from gas station attendance to property management for the Department of Agriculture. Varian Associates gives a course on klystrons to its sales engineers and junior engineers. The General Electric Industrial Sales Division uses PI courses on semiconductors and capacitors. And DuPont has prepared its own PI courses for more than 150 job-related subjects since 1959. Today there are PI courses available for virtually every area of private business, industry, and government.

Will PI Help You? Programmed instruction materials, you'll find, are generally more expensive than conventional textbooks. But they are extensively tested and retested over a long period of time for flaws, and this must be taken into account.

The PI books spotted throughout this article are devoted entirely to the subject of electronics. They encompass general and specialized areas, both on basic and advanced levels. If you are planning to study electronics at home, one or more of these books should suit your needs.

The only way you'll ever really know if PI can help you is to give it a try. Your evaluation of PI can be honest only after you have used it. —30—

ON THE CITIZENS BAND

(*Continued from page* 81)

groups that have plans to entertain the whole family, from junior to grandpa, but not necessarily with psychedelic or carnivalistic designs. Fun should be part of a jamboree, but not used as a primary draw. Programs of interest should include latest electronic equipment displays, addresses by D.O.T. or FCC personnel, technical and authoritative chats by equipment manufacturers' personnel, etc. *Then* bring on the fun!

Thousands of dollars will be raised by many groups this year, with the proceeds going (as in the past) to needy families, children's homes, hospitals, and homes for the mentally retarded. Others will use profits to modernize the clubhouse, renovate the old school bus into a communications van, and add needed equipment to local police or sheriff's headquarters for emergency CB monitoring.

A listing of upcoming jamborees that have reached your CB Editor's attention appears on page 81. As we go to press, late news has been received of a CB jamboree that will take place in Lawrenceville, Georgia, on May 4-5. Location: City Park, Highway 29. Sponsor: The Gwinnett Communications Club of Georgia. Contact: William L. Bell, R.F.D. 4, Lawrenceville, Ga. 30245. The proceeds will go to the Hi-Hope School building fund for retarded children.

Club Chatter. Middle Georgia CB Radio Club, Inc., Macon, Ga., has supplied its members with a new decal which signifies their participation in Red Cross and Civil Defense activities. The club membership of

20 in 1961 has grown to 160. Club emergency van has served in search and rescue, is equipped with emergency communications and rescue gear. Official club publication is *The Little Beam,* edited by Wayne Barr.

The *CB Chatterbox,* club publication of the Cereal City Citizens Radio Club, Inc., Battle Creek, Mich., recently celebrated its fifth birthday. Sixty-one successive issues have been printed and distributed monthly without fail by CCCRC Chatterbox editors. The first issue appeared through the efforts of Skip Schepel (then KHG5557); Don Cortright, KPM0665, picked up the honors after the third issue and followed through until May, 1966; at which time George Gemrose, KRM9159, took charge.

The Citizens Radiophone Association, Detroit, Mich., recently reported in the *Gridleak* the receipt of very impressive brochures and application forms from an "organiza-

tion" called the Associated Special Investigators and Police, International, with an invitation for the club members to join the Highway Radio Patrol, International. For $2.85, members were promised an I.D. card and badge, presenting each as a worldwide combatant of crime and aide to emergency operations. When checked by the Canadian Government and the province of New Brunswick, the "organization" was found wanting as to legal existence and recognition.

San Gabriel Valley REACT would like to exchange news and ideas with other CB groups. Interested parties should contact Ron Hamlet, editor of the S.G.V. REACT NEWS, P.O. Box 3271, Industry, Calif., 91744.

I'll CB'ing you,

—Matt, KHC2060

ANSWERS TO "A" QUIZ

(*Quiz appears on page* 48)

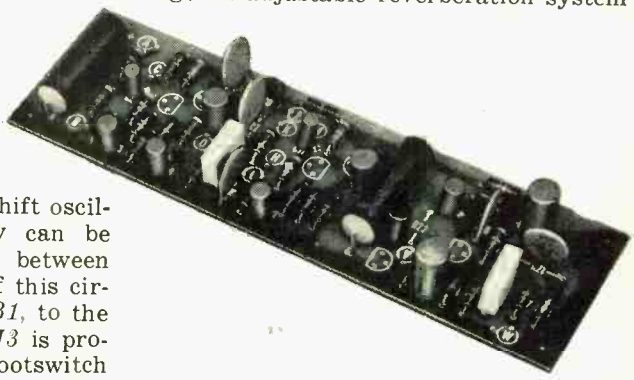
1. An AMPLIDYNE is a rotary magnetic amplifier used as a power amplifier stage in servo systems.
2. An ATTENUATOR is a circuit used to reduce a signal by a known ratio while also matching input source and output load impedances.
3. The ALPHA, or current amplification factor, of a transistor is the ratio of collector to base currents.
4. An ACORN tube is a UHF amplifier designed for high-frequency operation by eliminating the base and bringing the pins directly out through the sides of the glass envelope.
5. The ARMATURE of a motor is the rotating winding assembly energized through the commutator and brushes.
6. The AZIMUTH angle of a tape recorder is the angle between the tape and the gap in the recording head.
7. ASTIGMATISM refers to a CRT problem whereby an out-of-round or out-of-focus spot appears on the screen.
8. An ARMSTRONG oscillator circuit uses a two-winding, four-terminal oscillator coil to provide plate-to-grid feedback.
9. ALNICO is a commonly used magnetic material made of aluminum, nickel, and cobalt alloyed with iron.
10. An ALKALINE cell of the common manganese-zinc type can deliver 30-40 watts per pound with high overall efficiency.

INSTRUMENT AMPLIFIER

(*Continued from page 47*)

ries with a FET (*Q5*) acting as a voltage-variable resistor. As the voltage to the FET gate is varied, more or less bypass is introduced into the *Q3* circuit. This, in turn, will vary the gain of the output signal, producing tremolo (signal level variation).

Fig. 8. Completed instrument preamplifier on printed board before installation of the transistors.



Transistor *Q6* is in a phase-shift oscillator circuit whose frequency can be varied (by speed control *R30*) between 4 and 15 Hz. The a.c. output of this circuit is fed, via level control *R31*, to the gate of *Q5*. Open-circuit jack *J3* is provided so that an external footswitch can be used to turn on the tremolo if desired.

PC BOARDS AND PARTS KITS

The following are available from Southwest Technical Products: etched and drilled PC board for instrument preamplifier (#141), $3.00; straight preamplifier (#141P), $2.50; reverb unit (#141R), $2.10; and power amplifier (#141A), $2.10. A complete amplifier kit including all parts and punched chassis, less cabinet and panel markings (#MMC141) is $85.00. Send self-addressed envelope for price list on separate parts kits for each portion of the system to Southwest Technical Products Corp., 219 W. Rhapsody, Box 16297, San Antonio, Texas 78216.

The actual-size printed board for the instrument preamplifier is shown in Fig. 6 with the components mounted as in Fig. 7. A completed board, before the semiconductors are installed, is shown in Fig. 8. This board was made from the kit.

Part 2 of this article (to appear next month) will contain the construction details for a straight preamplifier that can be used for announcements, vocals, or instruments not requiring signal conditioning; an adjustable reverberation system that has no signal loss, including some methods of installing it in any audio system; a power supply capable of operating either the entire M/M/M Instrument Amplifier, or any portion of it; and the interconnection details for assembling the entire instrument amplifier system in one package.

Incidentally, the straight preamplifier will also make an excellent hi-fi preamplifier for any audio system. It incorporates adjustable bass and treble controls —15 dB boost or cut—and an independent volume control. —30—

BASIC ONE-BIT ADDER

(*Continued from page 35*)

bit, 10010 should be read as minus fourteen, which of course is incorrect. In such a case (i.e., when the capacity of the RESULT REGISTER has been exceeded), the sixth (left-most) 32-OVERFLOW indicator of the register will light. This overflow indicator mirrors the situation that arises in large computers—when an operation produces a result that exceeds the register capabilities, an indicator is turned on so the computer programmer can test for overflow and take corrective action.

With *S4* in the "5 BITS" position, the binary numbers are thought of as having no sign bit, and the left-most bit of the operands simply represents a place value of sixteen. Thus, numbers in the range from zero (00000) through thirty-one (11111) may be entered, and they are always considered positive.

With the NUMBERS Switch in the "5 BITS" position, the left-most indicator in the RESULT REGISTER (32-OVERFLOW) has a dual meaning, depending upon the setting of the FUNCTION switch. For an ADD operation, that indicator is just another bit of the result and has a place value of thirty-two. For example, if 01111 (fifteen) and 10110 (twenty-two) are added, the result will show as 100101 (thirty-two plus four plus one equals thirty-seven).

With *S4* in the "5 BITS" position, and for a subtract operation, the left-most indicator is the sign of the result. For example, 01001 (nine) less 01011 (eleven) will display as 111110, which is minus two in two's complement form. Likewise, eleven minus nine will be 000010, or plus two.

As shown in Fig. 3, the wiring of the NUMBERS switch and the "32-OVERFLOW" indicator is simple. With *S4* in the "4 BITS+ SIGN" position, the indicator is connected across the last adder stage's Carry In (CI) and Carry Out (CO) terminals. Thus, it will light whenever the carry in and the carry out of the "16" place value stage differ. Such a test is all that is needed to determine if the register capacity has been exceeded. —30—

TWENTY QUESTIONS

(*Continued from page 71*)

What are the most common reasons for exam failures?

Most failures are due to not knowing the Rules and Regulations outlined in Elements 3 and 4. Jumping to conclusions about answers is another cause for failure. Many people tend to choose the first answer that seems reasonably correct without reading all the choices given.

Don't attempt to take too many elements at one sitting. By doing so, you may tire, become discouraged, and not be able to do your best. It is better to take fewer elements and obtain a good score than to take many elements and get only mediocre or even some failing scores.

If I fail, how long must I wait before I can apply again?

Under current FCC regulations, the minimum waiting period is two months. However, if requested for a good reason, the examiner may give you a waiver to allow you to be re-examined sooner. Waivers are normally given at the discretion of the field engineer on the basis of the score obtained and the amount of further preparation it is felt you need. If you fail by only a few points, for example, chances are good that you will receive a waiver, since it is obvious that you need very little extra preparation time. When you apply a second time, you must fill in FCC Forms 756 and 756B once more, and pay the license fee again.

How long after taking the exam will I be notified of the results?

If you pass, you will receive your license in from one to three weeks after you take the exam. Applicants failing to pass are normally notified within ten days. If you are impatient to know the results, you might wait around for a half hour or so after submitting your answer sheet and ask the examiner whether or not you passed; most answer sheets are immediately checked.

Are licenses issued for any specific length of time?

Each class and type of license is good for a period of five years from the date of issue and must be renewed thereafter. Endorsement renewals are automatic with the renewal of a license. To renew a license, simply complete FCC Forms 756 and 756B again, and send them and your $2 renewal fee to your District Office. You do not have to show proof that you need a license in order to perform your work. The FCC has temporarily waived the "proof of service" clause in the regulations.

Application for a license renewal should be made during the last ninety days of the five-year period. If you fail to renew on time, you are allowed an additional one-year grace period in which to do so without having to take the exam again. During the grace period, your license will be invalidated, and you will not be allowed to perform the duties of a commercial licensee.

For what reasons can a license be suspended or revoked?

Any intentional violation of the rules and regulations—such as allowing someone else to use your license—are grounds for suspension of a license. Evidence of cheating on the exam or false statements on your application will result in a revocation.

After I'm licensed, where can I get a job?

Broadcasters, airports, trucking and shipping firms, taxi cab companies, construction and salvage outfits all require FCC licensed personnel to supervise the operation of transmitters. And any small organization using two-way radio equipment has it serviced by licensed technicians.

Civil Service job openings range all the way from radar installations on the DEW Line to state, county, and city police operators and technicians. These positions require qualifications through Civil Service exams in addition to an FCC license.

Also, the Merchant Marine Service recently issued a call for licensed operators

to sail on American cargo vessels. The minimum requirement here is the Second Class Radio Telegraph Operator License and a passing grade on the Coast Guard exam for radio officers aboard ships. -30-

ELECTRONICS TECHNICIAN

(*Continued from page* 58)

cation Yearbook" (1965-1966): "Our more competent technicians are generally outstanding in technical knowledge and manual skills. The characteristic most essential to the competent technician is technical knowledge about the components tested and the equipment to be used. Manual skills are a highly essential quality for an engineering technician, and it is technical knowledge that directs the effective application of these skills."

The majority of the company executives interviewed for this article indicated that the junior college is one of the best sources of training for technicians. However, the general feeling is that existing junior colleges should modify their programs so that they provide improved technical training. The areas most often suggested for improvement are instrumentation, circuit analysis, test and troubleshooting procedures, and solid-state theory. The general consensus is that communications skills (speaking and writing), general physics courses, courses in the use of the slide rule and in logic should be strengthened.

It is thought that some schools, in attempting to cover a broad area in a short time, are defeating the purpose of education. Many company officials feel that schools should pare away the frills, eliminate or greatly reduce vacuum tube theory, and give only cursory attention to calculus. Algebra and trigonometry are considered sufficient for electronics technicians. There were a few officials who felt that a three-year technology program (instead of the usual two-year programs now being offered) would be a good idea for junior colleges.

Military schools in electronics are generally quite well-thought-of. The feeling, however, is that military schools are too

specialized. But military education in electronics can provide a sound building block leading to a more liberal and general education in electronics engineering technology. Military training has one redeeming compensation: it lets you learn while you earn and fulfill your military obligation as well.

A number of agencies have been studying electronics programs and have developed suggested curriculums for electronics technology students. A direct comparison can be made between the curriculums suggested by the U.S. Office of Education and the industries that hire technicians (see pages 57 and 58). The program suggested by the industry was developed by Dr. Angelo Gillie, Associate Professor at Rutgers University. This program represents the conclusions of a study conducted by program experts in electronics, supervisors of electronics departments in industry, and directors of technical personnel in industry.

The Technician Gap. Electronics is an exciting, interesting, and challenging field. It has a better than 6% annual growth rate, making it the fastest-growing and most diversified industry. The number of people employed in electronics has quadrupled since 1950, and there does not seem to be an end to the growth in the foreseeable future.

This phenomenal expansion has created what is commonly known as the "Technician Gap." There are simply not enough technically prepared men to meet the current demand, and the situation will worsen before it gets better. The electronics equipment manufacturing industry alone will require an additional 45,000 technicians during the next four years.

The future of electronics and electronics technicians is bright. But to take full advantage of the many opportunities for growth, pioneering new horizons in aerospace, avionics and astrionics, cryogenics, and plasma electronics—not to mention the many fields now well established in electronics—you have to start early.

Where do you fit into this picture? You'll never know until you make a commitment, and if you invest your time and money in an electronics career, only you can decide how far and how fast you'll go. Think about it. —30—

SOLID STATE

(*Continued from page 86*)

½-inch long by ¼-inch wide with three gold electrodes deposited on each of its two major surfaces. The amount of gold deposited makes the middle region resonant at the desired center frequency, while the other two regions are adjusted to the proper frequencies above and below the center value by the same method. In operation, electromechanical conversion is achieved through the piezoelectric effect. Suitable for use in a variety of FM receivers, discriminators can be produced to operate at center frequencies in the range of 10 to 30 MHz, with passbands ranging from 0.01% to 0.02% of the midband frequency.

Major semiconductor manufacturers have been trying for some time to combine junction type FET's and bipolar transistor elements in a single monolithic structure. Ironically, the news that this long sought-after goal has been achieved comes—not from a semiconductor manufacturer—but from an instrument firm, Tektronix, a producer of top-quality oscilloscopes. Developing the technique for their own use, the firm has produced a three-stage, wideband amplifier containing five *p*-channel FET's and 30 *npn* bipolar transistors on a 50-mil square chip.

If you're looking for a "second source" of solid-state lamps similar to those described in "Let There Be Light" in the December, 1967, column, you might check with Monsanto Electronics (800 N. Lindbergh Blvd., St. Louis, Mo. 63166). This firm offers a series of solid-state lamps, including lasers, visible and infrared light sources, and multiple arrays. Single unit prices range as low as $9.85 for an infrared type.

A new series of 25-ampere silicon triacs has been introduced by Texas Instruments, Inc. (P.O. Box 5012, Dallas, Texas 75222). Designed specifically for power control applications, they are available with voltage ratings of 200, 400, and 600 volts, and are designated, respectively, as Types 2N5273, 2N5274, and 2N5275. Although relatively small, these devices can handle up to 10 kW of a.c. power in motor speed control, light dimming, temperature regulation, and similar applications.

Transitips. "Which transistor tester should I buy?" Your columnist has been asked this question hundreds—perhaps thousands—of times. Ethical considerations prevent suggesting specific brands, and the pat answer, "the best you can afford," is simply a dodge, for it is not the right answer.

CIRCLE NO. 15 ON READER SERVICE PAGE→

Choosing a transistor tester is an individual and, to some extent, a very personal thing, for your needs and expectations as well as the state of your finances must be the determining factors in your final choice of an instrument. The "best" tester for an experimenter who uses bargain transistors and specializes in audio circuitry may not be the "best" for the advanced hobbyist or student working with microwaves, nor for the service technician repairing transistorized receivers and CB equipment.

Before choosing a tester, your first step should be to write down a list of the operational features *you actually need* in your work or hobby. Add to this a supplementary list of the features you'd like to have. Then check the specifications of available testers to see which offer the features on both lists, comparing the relative costs of any "extras" you'd like, but which are not essential to your work.

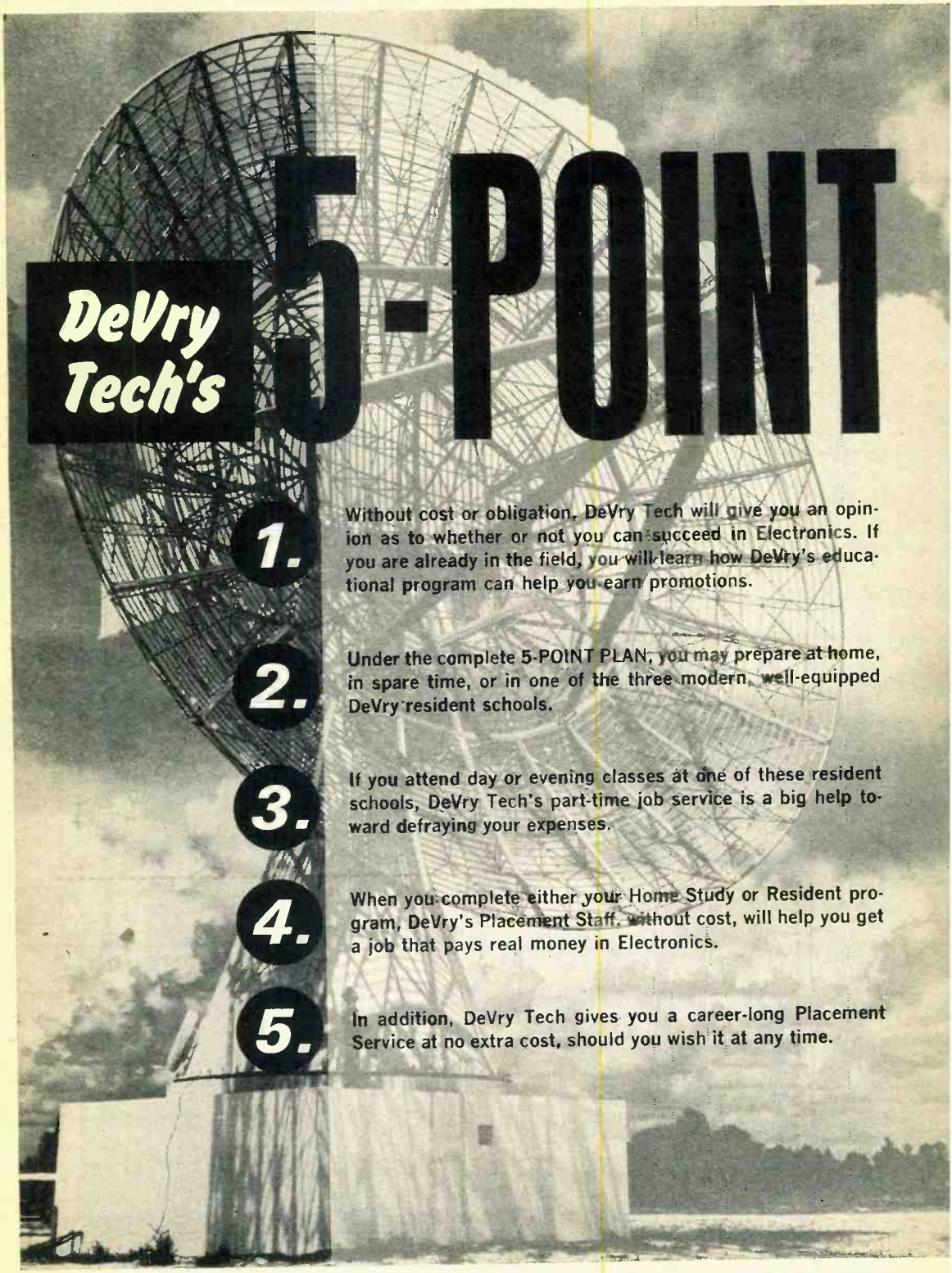
Technical specifications and operational features are important, but relative values must be considered. If you use, say, only a dozen transistors a year and always buy top-quality units, you might not consider it wise to invest several hundred dollars in a tester, for it would be far, far cheaper to buy a few extra transistors. But you might consider an inexpensive tester for quick tests. On the other hand, if you use hundreds of transistors a year and like to purchase "bargain packs" and low-cost "assortments," you might find that the additional features of a moderately priced tester are justified in helping you to sort and classify your purchases.

Your "basic" tester should have some provision for leakage and gain (*beta*) measurements. A simple "good-bad" indication is adequate for many applications, but if you work with critical circuits or do part-time servicing, you might prefer a tester which will give quantitative readings—actual gain and leakage figures.

If servicing is a major part of your activity, you'll find that an "in circuit" test feature is highly desirable as a time-saver, but not at the cost of such a basic test as leakage. The ability to identify a transistor as to basic type (*pnp* or *npn*) is a highly desirable feature when you're working with unfamiliar electronic equipment or with hard-to-identify transistors (as are often found in bargain assortments). In the final analysis, however, only *you* can determine what type of tester *you* need, and how much that tester is worth to you in terms of hard cash.

Until next month . . .

—*Lou*



SHORT-WAVE LISTENING

(Continued from page 83)

Club Notes. The Canadian DX Club (CDXC) is now celebrating its eighth anniversary with the proud boast that it is the largest DX Club in Canada and the second largest in North America. The club bulletin, *CADEX*, features columns on short-wave, broadcast, utility, FM, and TV station DX'ing, and card swapping. Present officers include: Ralph Irace, Jr., president (4 Fox Ridge Lane, Avon, Conn. 06001), to whom all membership requests should be sent; Michael Scott, secretary; and Dave Bennett, publisher.

Congratulations are in order for Don Billingsley, WPE6GXM, Sacramento, Calif., who has been appointed Editor of "Short Wave Review," a feature column of the American Short Wave Listeners Club (ASWLC). Information on this club can be obtained by writing to the ASWLC, 16182 Ballad Lane, Huntington Beach, Calif. 92647.

Your Short-Wave Editor recently sent out a number of Leaflet H (Clubs and Publications) which, through an error, had been printed on only one side of the paper. If you have received such a copy, please return it to us and we will send you the complete leaflet.

New Short-Wave Booklet. A 16-page booklet entitled "Your Window On The World" is now being offered by the Hammarlund Mfg. Co., 73-88 Hammarlund Drive, Mars Hill, N.C. 28754. Tightly written, this booklet describes the short-wave bands, radio signal propagation, and receiver operation. Also covered are antennas, time signals, and where to get more information. Price, 25 cents.

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month: be sure to include your WPE identification, and the make and model number of your receiver.

Albania—*R. Tirana* is again active on 9515 kHz, as noted at 0255 closing a Spanish xmsn and at 0300 opening in Russian.

Your Short-Wave Editor has received a report that *R. Shkodra* is being heard on 8215 kHz with an editorial program at 0000-0100, but this does not agree with the listed schedule of 0500-0630, 1300-1400, and 1630-2000. Can anyone definitely confirm the above time period?

Biafra—*V. of Biafra*, Enugu, has been found on 6145 kHz with music from 0540, an IS and tuning signal at 0600, then Eng. news, Eng. commentary at 0611, and pop music until 0648 fade.

Bolivia—*R. Cruz del Sur*, La Paz, is moving from 4985 kHz to 5025 kHz, according to a note from the

DX PROVINCES AWARDS PRESENTED

To be eligible for one of the DX Provinces Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 6, 8, 10, or 12 Canadian provinces. (For these awards, the Yukon Territory and the Northwest Territories are considered as provinces.) The following DX'ers have qualified for and received awards in the categories indicated.

TWELVE PROVINCES VERIFIED

Gary Ligon (WPE4JAX), Cliffside, N. C.
Roger Thering (WPE6FUB), Barstow, Calif.

TEN PROVINCES VERIFIED

Ronald Hartwig (WPE5ELA), Midland, Texas
Robert Brickner (WPE3FYF), Pittsburgh, Pa.
Jack Forbing (WPE9AMH), Fort Wayne, Ind.
Fred Noakes (VE2PE2E), Montreal, Quebec, Canada
Kerry Plantenga (WPE9ITC), Lafayette, Ind.
Viktor Decyk (WPE1FCD), Pawtucket, R. I.

EIGHT PROVINCES VERIFIED

Jim Homan (WPEØEUS), Florissant, Mo.
Christopher Lucas (WPE1FNH), Fairfield, Conn.
Fred Bourjaily (WPE8JIE), Seven Hills, Ohio
Charles Milhans (WPE7COE), Tacoma, Wash.
Clarence Hagerman (WPE2NRU), Delaware, N. J.

SIX PROVINCES VERIFIED

Douglas Robinson (WPE2OVM), Johnstown, N. Y.
Kevin Wiese (WPEØEZY), Madison, S. D.
Sheldon Chorney (WPE2AWZ), Brooklyn, N. Y.
Robert Buckner (WPE2NMO), Rush, N. Y.
David Greene (WPE4IUM), Pensacola, Fla.
Sam Chmell (WPE9ITW), Elmwood Park, Ill.
Richard Houlis (WPE3GOK), Monessen, Pa.
Gary Cooper (WPE7CQV), Nampa, Idaho
Glenn Haffly (WPE4JBO), Randelman, N. C.
Bill Lee (WPEØEJK), Lawrence, Kan.
Jack Bacon (WPEØFDJ), Bloomington, Minn.
Mike Finigan (WPE4ISQ), Monroe, N. C.

Program Director. At press time, the station was still operating on 4985 kHz, but some tests were apparently being made on the higher channel.

Brazil—*R. Globo*, Rio de Janeiro, 11.805 kHz, was tuned at 0100 with Brazilian music to past 0135; ID's, commercials, and annits in Portuguese make up the balance of the format. *Radio Rio de Janeiro* is definitely being tuned on 5045 kHz at 2300 with typical native programming. Other loggings include: ZYV74, *R. Guarani*, Belo Horizonte, 6175 kHz, at 0000-0100 with Brazilian ballads and commercials, and news at 0100; and ZYR78, *R. Bandeirantes*, São Paulo, found with a similar format at 0130-0200 on 11.925 kHz; all-Portuguese.

Czechoslovakia—*R. Prague* operates on 9575 kHz in Eng. with news from 0700 beamed to the Pacific, Far East, and Europe.

Dahomey—*R. Cotonou* is audible on the West Coast on 4870 kHz from 0600 with BBC Eng. lessons conducted in French.

Ecuador—*R. Cultura Religioso*, Banos, is a newly reported station on 2470 kHz that is being heard at times from 1030 with anthem, to 1105 with Catholic Mass, and to fade-out with organ music. Station HCB12, *R. El Mundo*, Guayaquil, 4750 kHz, is fair around 0330 with U.S. and Latin American pop music.

Egypt—Cairo, 12.005 kHz, was logged with clock chimes and anthem at 1900, then Italian, and from 2145 s/on in Eng. to Europe. An outlet on 21.580 kHz was noted in an African dialect from 1810 to 1835, with the familiar clock chimes at 1830.

Ethiopia—*V. of Ethiopia*, Addis Ababa, 6185 kHz, carries Somali service from 0330 to 0430, then goes into Arabic. This channel may parallel 7293 kHz.

Fiji Islands—Fiji B/C Commission, Suva, has this current schedule: Eng. at 1800-0345 on 6005 kHz, and at 0345-1030 on 3230 kHz; vernacular at 1800-0330 on 5955 kHz, and at 0330-1030 on 3286 kHz. The use of 60 meters has been cut down to a religious broadcast relay at 1800 on Saturdays on 4756 kHz (500 watts).

France—*Ici Paree ORTF*, Paris, listed for 5955 kHz, is presently operating on 5960 kHz, as noted at 0410, with light variety programming. The 9620-kHz channel has French at 0800 beamed to French

SHORT-WAVE ABREVIATIONS

annt—Announcement
BBC—British Broadcasting Corporation
B/C—Broadcasting
Eng.—English
ID—Identification
IS—Interval signal
kHz—Kilohertz
kW—Kilowatts
N.A.—North America
QRM—Station interference
R.—Radio
s/off—Sign-off
s/on—Sign-on
V.—Voice
xmsn—Transmission

Polynesia. New Caledonia, and New Hebrides. English is noted on 15,130 kHz at 1915-1930 (news, commentary, and music) and on 21,580 kHz at 1300-1330; French follows at 1330. The service to Latin America includes Spanish at 2300 and 2345, and Portuguese at 2315 on 11,845 and 17,730 kHz, French at 0000 on 9755, 11,845, 15,245, and 17,730 kHz, and Spanish from 0030 to 0200 on the same channels (but only to 0130 on 17,730 kHz).

Germany (East)—*R. Berlin International,* 21,540 kHz, has Eng. to S. E. Asia heard around 1330.

Ghana—*R. Ghana,* Accra, has this Eng. schedule: to N. A. and Caribbean at 2000-2100 on 9760 and 11,850 kHz; to South and Central America and Australia at 1500-1545 on 17,910 and 21,545 kHz; to Europe at 2045-2215 on 9545 kHz; to W. Africa at 1400-2215 on 6130 kHz; and to S. Asia, Far East, and E. Africa at 1400-1430 on 17,910 kHz, at 1500-1545 on 21,720 kHz, and at 1645-1730 and 1815-1900 on 15,285 kHz.

Guatemala—Station TGCH, *R. Chortis,* Jocotan, 3380 kHz, has light music from 0230 to 0305 s/off (with the theme from "Bonanza"). Station TGWB, Guatemala City, 6180 kHz, is the easiest Guatemalan to log on the West Coast; it can be heard any time after 0000 with marimba music. Station TGNA, Box 601, Guatemala City, has Eng. on 5955 kHz at 0300-0430 weekdays.

Honduras—Station HRVC, *Evangelical Voice of Honduras,* Tegucigalpa, 4820 kHz, was heard at 0116-0130 with light music, to 0200 with a religious program, and at 0300-0330 in Eng. (Mondays only).

India—*All India Radio,* New Delhi, was found with Eng. on 9915 kHz from 2040 to past 2135 beamed to Africa; and on 11,810 kHz (dual to 15,175 kHz) to S. E. Asia at 1328-1415, with news given at 1330.

Indonesia—*R. Republik Indonesia,* Djakarta, 9770 kHz, has a National Program in Indonesian from 1430 to past 1505; news at 1500.

In a Dutch TV program, information was given on *R. Panbjasila,* operated by students in Djakarta on 3950 kHz. Simply equipped, the station broadcasts march music, requested music, and news. No schedule was mentioned.

Iraq—*R. Baghdad* has retimed its s/on to 0425, in Arabic; both the 7180-kHz and 11,785-kHz channels are affected. English can be heard well on 6095 kHz at 1940-2020.

Ivory Coast—A new frequency for *R. Abidjan* is 11,920 kHz, noted with s/off just prior to 0000; pop music and a news session in French are featured before closing.

Jordan—Amman, 11,810 kHz, was logged from 1500 to 1615 with news at 1500 and 1600; the remainder of the program consisted of talks and Arab instrumental and vocal music. This is the Arabic

John Zapisek, WPE2OKD, Wading River, N.Y., has two receivers: a Knight-Kit "Star Roamer" and a Conar 500. It's no coincidence that the latter unit has ham-band coverage: John is also a radio amateur and just received his General license (WB2DRW). His SWL'ing record is 19 states and 40 countries.

Eric Lebowitz, WPE2JJY, of Jackson Heights, Long Island, N.Y., and his Hallicrafters SX-42 receiver have racked up 4 provinces, 25 states, and 54 countries verified (out of a 117-verie total.) Eric's most prized QSL's came from his monitoring a contact between VIS25, Overseas Radio Terminal, Sydney, Australia, and the British liner "Orsova" (GNDL), located on a bearing 91° from Sydney.

Home Service. Listen very carefully for the ID; it is literally whispered at times.

Kenya—*V. of Kenya*, Nairobi, 4915 kHz, opens at 0330 after a flute and drums IS; then time pips and s/on in (possibly) Swahili; news at 0400; time pips at 0415. The outlet on 4934 kHz has a variety musical program in vernacular with a newscast at 0400 and time pips on the hour and each quarter-hour. However, the two channels have not been found to be operating in dual.

Korea (South)—*V. of Free Korea*, Seoul, 9640 kHz, was tuned at 1031 with Eng. news to S. E. Asia; at 1035 there was a commentary and a cultural talk; at 1059, s/off.

Liechtenstein—The government of this country has declared that there will be no private radio stations. There had been a rumor that a private station might be operating from Liechtenstein in the near future.

Mozambique—Lourenco Marques has been providing good reception in the West on 11.780 kHz with the Eng.-Afrikaans "B" program from 0400; this program features pop and orchestral music, commercials, and dual-language annts. The channel is dual to 6050 and 4855 kHz, neither of which is audible. A new frequency for the Portuguese service is 15,296 kHz; this service is heard well at 1725.

Niue Island—West Coast DX'ers might try for 2ZN operating on 550 kHz with 2000 watts. They are scheduled on Tuesdays, Thursdays, and Saturdays at 0530-0730 in Eng. and Nuiean. Good DX—if you can log it!

Panama—The only known Panamanian station operating on the short waves that we know of is *La Voz del Baru*, David, 6045 kHz. Often strong, it can be heard until 0400 in Spanish with frequent gongs and ID's.

Poland—*R. Warsaw's* Eng. service to N. A. has been heard at good level at 0315-0345 on Saturdays on both 7205 and 9655 kHz. By the time you read this item, this service should be on 11.870 kHz.

South Africa—*R. RSA*, Johannesburg, calls Libya, Egypt, and Jordan at 1700 in Eng. on 25.790 kHz, opening with news; this channel is dual to 21.535 kHz and runs along with the Central and West African service to 1854 s/off. Another new frequency in use is 15.360 kHz, Portuguese was heard from 2000 s/on to past 2045.

Swan Island—*R. Americas, The Continental Voice of Truth*, 1157 and 6000 kHz, is requesting that reports be sent to P. O. Box 11186, Pereo de Chacow, Caracas, Venezuela. S/on is at 0958. The 1157-kHz

outlet is being reported widely all over the eastern half of N. A.

Switzerland—The low-powered HER22, 3985 kHz, reported here last month, continues to be heard in many areas, with German at 0600, French at 0615, Spanish at 0630, and Eng. at 0700.

U.S.A.—While *Voice of America,* Honolulu, is inactive so far as regular broadcasting is concerned, maintenance tests are being conducted on Mondays, Tuesdays, Thursdays and Fridays at 1900-0000 with 100-kW power. All reception reports should be sent to Washington, D. C.

U.S.S.R.—*R. Yerevan,* Armenian S. S. R., is heard well on the West Coast on both 15,140 and 15,180 kHz with music, an Eng. ID at 0325, Russian at 0328.

Vatican City—*Vatican Radio* has been noted on a new frequency of 21,530 kHz at 1554 closing an Eng. xmsn to India and S. E. Asia.

Vietnam (South)—*R. Vietnam,* Saigon, was noted on 9640 kHz at 1500 with IS, time pips and ID, at 1501 with what appeared to be Vietnamese opera; from 1527 with ID and Vietnamese music to 1545. At 1600, a new broadcast day begins with the ID *Day la Tieng Noi Nuoc Viet-Nam phat thanh tu Thudo Saigon;* news from 1603.

Windward Islands—W. I. B/C Service, St. Georges, 11,970 kHz, was heard at 0130 with hymns, at 0145 with a religious program, at 0200 with BBC news and regional and home news, at 0215 with s/off after frequencies are given, plus schedule, hymn, prayer, and anthem, beamed to Jamaica. The 15,115-kHz channel was heard at 2230 with home news and from 2245 with the BBC World Service.

Zambia—Salisbury, 4911 kHz, was noted on one occasion on an extended schedule from 2045 to 2121 with rock-and-roll alternated with native music and a time check in Eng. between the playing of each recording.

—30—

SHORT-WAVE CONTRIBUTORS

Chris Lobdell *(WPE1GCI)*, Reading, Mass.
Conrad Baranowski *(WPE1GXX)*, Boston, Mass.
Harley Rutstein *(WPE2IKR)*, Englewood, N. J.
William Graham *(WPE2LMU)*, Binghamton, N. Y.
Eugene Shiwotsuka *(WPE2NBL)*, New York, N. Y.
Peter Macinta *(WPE2ORB)*, Kearny, N. J.
John Banta *(WPE2PHU)*, Bay Shore, N. Y.
Stanley Hiriak *(WPE2PJL)*, Woodbridge, N. J.
Edward Sobota *(WPE2PJR)*, Fulton, N. Y.
James Riviello *(WPE2POK)*, Cherry Hill, N. J.
Alan Nachman *(WPE2QBX)*, Oyster Bay, N. Y.
Marc Riddell *(WPE3HGG)*, Williamsport, Pa.
Rudolph Menna *(WPE3HIV)*, Philadelphia, Pa.
Robert Wilkner *(WPE4ACP)*, Pompano Beach, Fla.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Douglas Anderson *(WPE4ISE)*, Tampa, Fla.
Ricky Tharrington *(WPE4JSP)*, Wilmington, N. C.
Trevor Clegg *(WPE6FAF)*, Santa Cruz, Calif.
Paul Farmanian *(WPE6GVG)*, Glendale, Calif.
Robert White *(WPE6HCP)*, San Francisco, Calif.
Rev. John Pejza *(WPE6HCP)*, Ojai, Calif.
Robert Eddy *(WPE8EQW)*, Newport, Ohio
Ray King *(WPE8JPZ)*, Sodus, Mich.
William Kilgallon *(WPE8JUL)*, Warren, Mich.
J. P. Arendt *(WPE9DX)*, Aurora, Ill.
Larry Cotariu *(WPE9GPJ)*, Chicago, Ill.
Bill Vogt *(WPE9IND)*, Tinley Park, Ill.
Gary Bullinger *(WPE9JCZ)*, Aurora, Ill.
A. R. Niblack *(WPE9KMJ)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAIE)*, Pueblo, Colo.
Bud Whitlock *(WPEØCQS)*, Augusta, Kan.
Marshall Reece *(WPEØEZL)*, Overland Park, Kan.
Rob Harrington *(WPEØFDL)*, Englewood, Colo.
Michael Mochizuki *(KH6PE4C)*, Honolulu, Hawaii
David Alpert, Morton Grove, Ill.
Leo Alster, Rahway, N. J.
Nick Grasso, Cleveland Heights, Ohio
Ed Kauzlarich, Ottawa, Ill.
Michael Krzys, Adrian, Mich.
Andy Rodan, Hewlett, N. Y.
Brian Roth, Oklahoma City, Okla.
Steve Rubenstein, Chattanooga, Tenn.
Mike Stratford, Burlington, N. C.
Larry Weintraub, Cambria Heights, N. Y.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

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AMATEUR RADIO

(*Continued from page* 86)

nations already use SSB exclusively for voice communications. In the United States, no AM transmitters will be licensed or relicensed for use in the high-frequency (4 to 22.5 MHz) maritime bands after 1970; and after 1974, no conventional AM at all will be permitted in this service. These rules do not necessarily mean that the FCC will eventually outlaw conventional AM in the crowded, low-frequency amateur bands. In this writer's opinion, however, SSB has had no difficulty in establishing its superiority over AM under difficult conditions without the benefit of any special laws.

In the January issue of the *Xtra News Letter,* Clif, K6BX, takes the American Radio Relay League, Inc., severely to task for not petitioning the FCC to outlaw AM in the amateur phone bands. He claims, in fact, that the ARRL is anti-SSB—a claim which will surprise most AM operators who usually complain that the ARRL is anti-AM and pro-SSB!

Hoosier "500" Award. The Indiana Radio Club Council, Inc., offers an especially attractive certificate free of charge to any amateur who earns 500 points by working members of amateur radio clubs affiliated with the Indiana Radio Club Council, Inc. A minimum of two points are earned for each club member worked, but additional points (up to a total of 28 or more) can be earned if the operator worked happens to hold the Indiana "Outstanding Amateur Award," the "Hoosier Courtesy Award," or has other qualifications outlined in the official award rules.

Because between 100 and 250 stations must be worked to earn the Hoosier "500," amateurs located more than a few hundred miles from Indiana may find the award difficult to obtain. However, everyone is cordially invited to try for it, no matter where he or she is located. Full rules and logging sheets are available upon a request accompanied by a large return envelope with 18 cents postage affixed addressed to: Hewitt Mills, WA9LTI, 289 W. Sumner Ave., Martinsville, Ind. 46151.

Urgent Message Handled. Stewart Reed, CE3UF, Santiago, Chile, recently broke in on Bill Cole, K4EN, Miami, with an urgent message. The father of a man vacationing in Miami had been killed in an accident and the mother was in very critical condition. CE3UF had no address at which the man could be reached. Could Bill do anything?

It was Sunday; the Chilean Consulate was closed, and the Consul had an unlisted phone number. But Bill managed to contact Eduarde Gallarde, U.S. Sales Manager of the Chilean Air Lines at his home.

Gallarde promised to do all he could to trace the wanted man, and Bill made a schedule with CE3UF for 6 p.m. After exhausting other leads, Senor Gallarde started to call all hotels in the Miami area systematically. Many calls later, he got his man, who arranged to fly back to Chile on the first available plane at midnight.

At the 6 p.m. schedule time, K4EN and CE3UF could not hear each other. However, John Shea, VE5JS, Regina, Saskatchewan was copying both stations and relayed the necessary information between Santiago, Chile, and Miami, Florida.

Our thanks to *Spurious Radiations* of the Rockaway Park, N.Y., Amateur Radio Club, and the *Oscillator* of the Etna, Pa., Amateur Radio Club for relaying this item, which originally appeared in the Miami, Florida, *Herald*.

NEWS AND VIEWS

Dick Morris, WA9PZZ, 1331 Gilbert Ave., Downers Grove, Ill., became interested in amateur radio via the SWL route. In a year, he has collected enough cards for both Worked-All-States and Worked-All-Continent certificates although he is more of a rag-chewer than a DX chaser. A Heathkit SB-300 receiver, an SB-400 transmitter, and an SB-200 linear amplifier work with an 80-, 40-meter "trap" dipole and a 10-, 15-, 20-meter, 2-element quad antenna . . . **David L. Daniel, WAØSVO,** 1626 Cadet Ave., Lawrence Kans., really isn't "code happy," even though he works all day as a Morse code telegrapher for the Union Pacific Railroad and hams in his spare time. It took Dave two months to go from Novice to General license. His National NCX-3 transceiver and Hy-Gain 14-AVS vertical antenna have put 20 states and Canada in the WAØSVO log—some on SSB, and some on CW . . . **Tommy L. Halliburton, WN6ZNL,** 13073 Carl St., Pacoima, Calif., doesn't make the power company rich with his 15-watt AMECO AC-1 transmitter. Nevertheless, he racked up Canada and six states in his first two weeks on the air. Two receivers—a Hallicrafters S-85 and S-120—help with the indoor work, and an inverted "V" does the outside work. If things turned out as Tommy planned, he is now signing a WB6 call.

Michael Pozzani, K3WBD, P.O. Box 131, North Apollo, Pa., has worked all bands from 80 through 6 meters. At present, he works 6 meters with a 60-watt transmitter, 5-element beam, and a 6-meter converter in conjunction with a Gonset G-66B receiver. All but the G-66B are home-constructed. Actually, however, Mike's big interest has been in improving his technical knowledge. As a result, he now possesses Amateur Extra, Commercial First Class phone, and Second Class Telegraph licenses. Mike says he was no whiz in high school and has had no formal radio training, but he obviously did plenty of studying on his own . . . **Bob Wilson, WN1IZS,** 179 Knollwood St., Springfield, Mass., didn't waste much time after getting his license. He earned a Rag Chewer's Club (RCC) certificate the first day and had worked eight states by the end of the third day! Bob uses a Lafayette "Starflite" transmitter, Lafayette HA-700 receiver, plus three antennas, and he operates

Steve Blakley, WA7GUC, Phoenix, Ariz., played a trick on his uncle, K7ZWR. See text below.

on the 80-, 40-, and 15-meter Novice bands. The antennas include a vertical, a horizontal dipole, and a 2-element, 15-meter beam . . . **Joe Malecki, Jr., WN3HSI,** 490 Long Vue Rd., New Kensington, Pa., worked 43 states and 28 countries running 50 watts to a Heathkit DX-60 transmitter and one more state with a DX-100 at 75 watts. He receives on a Hammarlund HQ-110, and a simple dipole does the radiating. With his General exam already passed, Joe has his bug all oiled up for 30 wpm in the General bands . . . **Cliff "Beany" Stoll, WB2PSX,** 276 Rodney Ave., Buffalo, N.Y., president of Techams, the Technical High School Amateur Radio Club (WA2WVF), expected to add at least three Novice licensees to the club membership very shortly to bring the number of licensed members to six. Running 70 watts from an EICO 720-730 combination to two dipoles 80 feet high has permitted the club to amass a total of some 40 states and 35 countries. "Beany" himself has passed the Advanced exam, finding it "moderately hard."

Stephen L. Blakley, WN7GUC/WA7GUC, 3336 W. Rosewood Ave., Phoenix, Ariz., is a little tricky. Seeing his uncle's station (K7ZWR) inspired Steve to get his Novice license. Then, without telling his uncle, he studied for and obtained his Technician license. One day K7ZWR called "CQ" on 6 meters and was answered by Steve signing WA7GUC. His uncle dashed over to Steve's house (they live next door to each other) and demanded, "What are you doing? You want to get us both in trouble?" Steve then proudly displayed his new Technician license. Steve uses a Johnson "Ranger" to excite a Hy-Gain vertical antenna on the lower frequencies and a Heathkit "Sixer" to excite a 4-element beam on 6 meters. A Navy TCS or Hallicrafters SX-28 receiver helped Steve to work 25 states and Canada . . . According to Florida *Skip*, **Barry Goldwater, K7UGA,** a member of Air Force MARS, ran over 1300 phone patches from American Servicemen in Vietnam and Southeast Asia last year . . . **Mark Halliday, WN3HMU,** 24 Scott Rd., Doylestown, Pa., has 37 states and six countries worked—ZD8CW, Ascension Island, rates as his best DX. Mark uses a Heathkit DX-60A transmitter, Hallicrafters SX-110 receiver, and a multiband dipole on the three low-frequency Novice bands.

There is no better time than now to mail us your "News and Views" and a picture of you at your station. Remember, if it is a good, sharp photo, your station has an excellent chance of becoming the "Amateur Station of the Month." Keep club papers and club news coming, too. Send all material to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ

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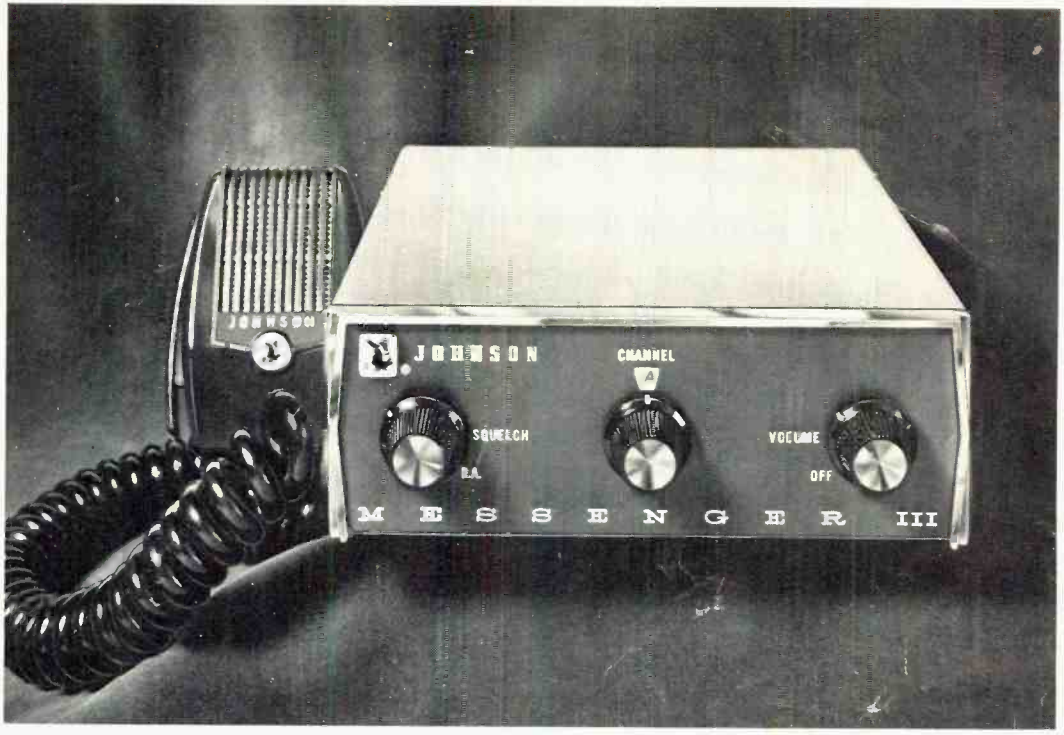

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