

POWER UP WITH CB ACCESSORIES

elementary Electronics

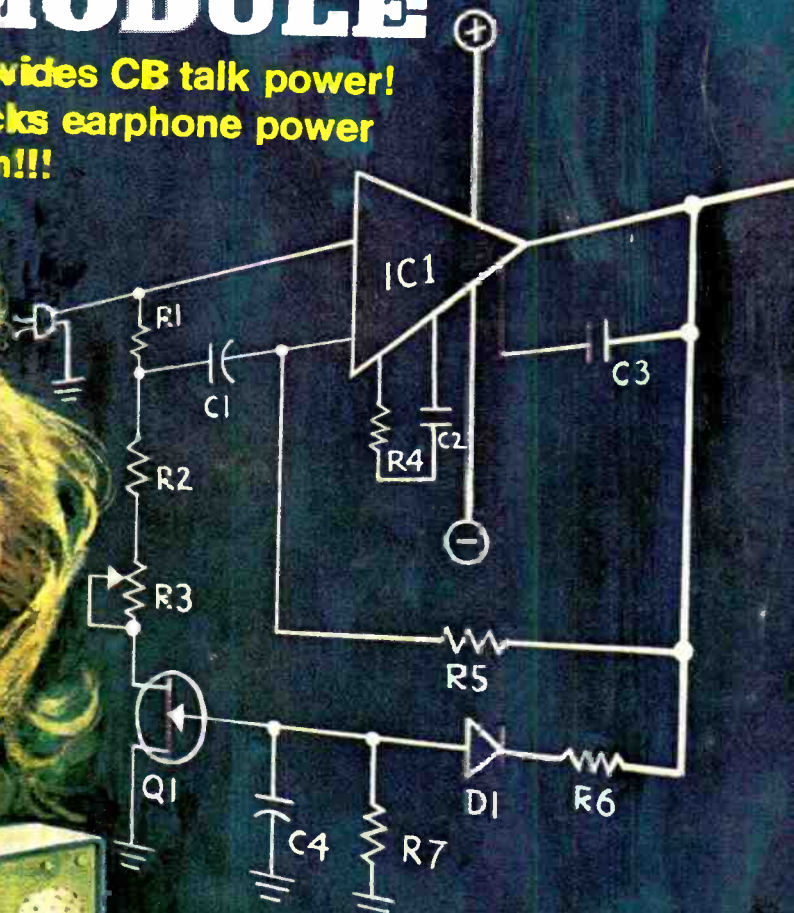
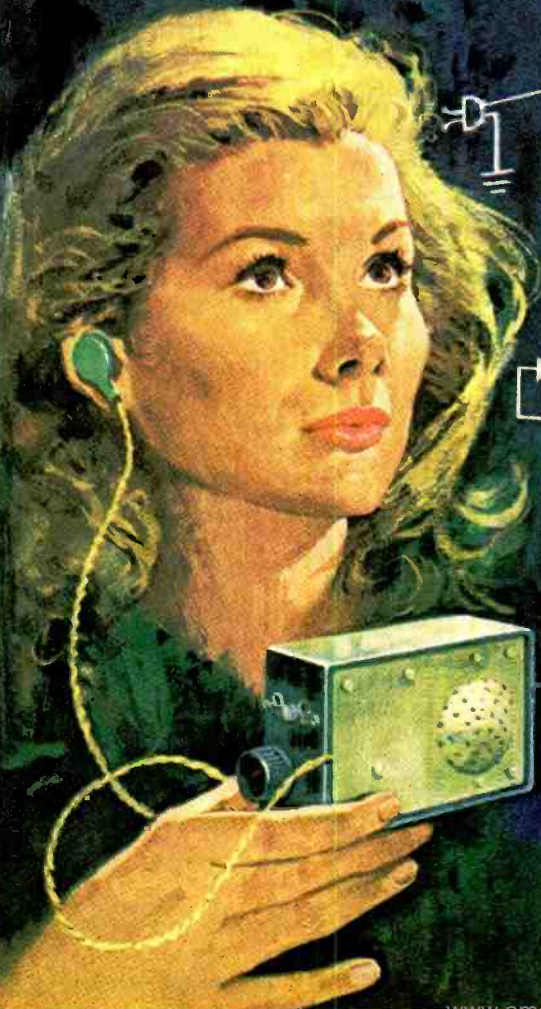
NOVEMBER-DECEMBER
1972
75c

FOR BEGINNERS ONLY
**BASIC
COURSE**
UNDERSTANDING
CAPACITORS

Build our...

MIKE MODULE

Peps up hearing—provides CB talk power!
IC and FET circuit packs earphone power
and boasts AVC action!!!



We Test—

- ✓ Heathkit SW
- ✓ Revox A77
- ✓ Gilfer
- ✓ SBE C
- ✓ Allied SX-190 SW Receiver

WHEN YOU BUY A BURGLAR OR FIRE ALARM, YOU MAY BE BUYING A FALSE SENSE OF SECURITY.

There's a world of difference between the professional system and corner-cutting imitators. Only the professional system has all these benefits and features:

PROFESSIONAL BENEFITS	PROFESSIONAL FEATURES
1. 4-way protection: against intruder, burglar, fire, emergency.	4 major protection circuits: intruder-burglar "closed circuit," intruder-burglar "open circuit," 24 hour fire protection circuit and intruder "open circuits," emergency panic circuit.
2. Expandable System: additional sensors (smoke, flood, freeze, etc.), remote control stations, entrance key switches may be added any time to meet future needs.	Compact Centralized Security Control Center (EICO FC-100) with independent circuit loops for monitoring, and accommodating detectors, alarms, accessories. Ideal for apartment, home and factory installations.
3. System safe to install and operate.	Powered by low voltage supplies - 6 volts.
4. Power failure does not disable system.	Fail-safe Power Circuit: If AC power fails or is cut, internal lantern battery automatically takes over; automatically switches back to AC when power is restored.
5. Long battery life.	Battery gets trickle charge when AC power is on.
6. Battery monitoring.	Built-in Meter to check condition of battery.
7. Positive monitoring of alarm circuits.	Signal lights at entrance key switches, remote control stations and Control Center; white "Circuit Test" light, red "Alarm On" light.
8. Remote setting of security system.	Alarm can be activated or turned off from any desired entrance or inside location.
9. No false alarms.	Highly reliable circuit design and circuit components.
10. Visible intruder-burglar deterrence.	Warning decals, red "Alarm On" light at key switch, visible alarm bell.
11. System concept provides tamper-proof protection.	Security Control Center is designed to be easily "hidden from view" - in closet, basement, etc. Tampering with outside bell sets off alarm.
12. GUARANTEED professional reliability.	EICO guarantee on all parts - incontrovertible proof of EICO's superior circuit and component reliability.
13. Exclusive EICO Security Handbook.	Enables anyone without any technical knowledge to install a complete home security system by himself.

BEWARE THE IMITATORS OF EICO

They look like EICO but what they leave out gives you a false sense of security.

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(Test Report Summary E/E Magazine Aug 1972)

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CIRCLE NO. 24 ON PAGE 17 OR 103

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elementary Electronics

Dedicated to America's Electronics Hobbyists

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☆
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Highlights

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Cover Illustration
by
Jack
Thurston

NOT JUST ANOTHER PRETTY FACE.



At 6 lbs., 12 oz., there isn't an ounce of fat on the Cobra 132. It's one of the smallest SSB units ever made.

But with 15-watt P.E.P. input, 100% modulation and Dynaboost voice compression, this AM/SSB two-way radio has what it takes to send a booming signal over land or sea.

You have 23 AM and 46 SSB sending/receiving modes. Two separate

transmitters give you the best of each, with overload protection.

As for reception, this Cobra has the crispest, cleanest sound ever. Over 60 dB cross modulation interference rejection completely eliminates bleedover.

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ceramic—keep adjacent channels under wraps.

And when you kick on Cobra's AM/SSB noise blander, noise levels drop unbelievably.

In addition, the Cobra 132 has an adjustable AM/SSB RF gain control. Backlit RF output/S meter. And full-function controls.

Ask your CB dealer for the solid-state Cobra 132. Its beauty is more than skin-deep.

COBRA 132
AM/SSB
\$299⁹⁵

microphone included

Product of Dynascan Corporation, 1301 West Belle Plaine Avenue, Chicago, Illinois 60613

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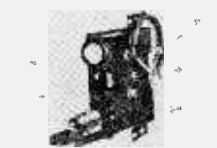
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ULTRA LOW PRESSURE SENSOR



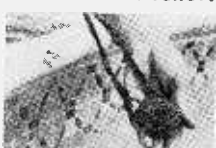
Big surplus bargain—tiny electrical pressure switch activated by only 0.02 psi air or 1/2" or less water pressure. Single pole, normally open, 10ma DC contact rating, 30w AC/DC (usual loads require sensitive relay or solid state control). Use as sensor, switch, control, counter, edge guide, instrument alarm. Long life (1,000,000 operations), impervious to extreme shock, vibration. 1" sq. polycarbonate case, 3/16" diameter barbed pressure ports. Wt—10 grams. Original cost \$11.50. Stock No. 41,623EK . . . \$3.95 Ppd.

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Listen to fish "talk" with this gov't surplus Hydrophone! Terrific buy! \$49 value! Make an accurate fish finder, pool splash-alarm, hear dolphins talk, add sound to underwater movies. Use with both high & low impedance amplifiers, tape recorders. Frequency response: 10-6000 Hz. Working depth to 300 ft. Minimum sensitivity 1000 Hz. at depths of 60 or 300 ft. Operating temperature range: 0 to 35°C. Punctus and shock resistant. Includes leads (approx. 8' long) and instrs. Cable not incl. Wt. 2 oz. Stock No 41,759EK . . . \$5.00 Ppd.



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**elementary
 Electronics**

Nov./Dec. 1972

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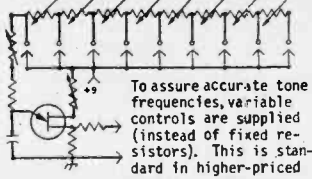
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— ELECTRONIC GOODIES —

ELECTRONIC ORGAN WITH ADJ. RESISTORS



To assure accurate tone frequencies, variable controls are supplied (instead of fixed resistors). This is standard in higher-priced organs. This basic,

single octave, diatonic organ kit comes complete with everything except batteries and keys. Push switches, instead of keys, may be used. This circuit is designed to have a range of three octaves—low, middle and hi—"C". This kit is useful in the lab as a signal generator/injector, when trouble shooting electronic equipment. We include an illustrated, step-by-step construction/instruction booklet. And if you would like to see a little girl's eyes light-up, install this organ in her toy piano.

Kit KC4B includes:-
 9 variable controls
 1 transistor
 2 resistors
 1 capacitor
 2 perf boards
 1 batt clip (for 9V)
 color coded wires
 Instruct. Booklet
**OUR KIT #KC4B
 PRICE \$3.99**

READY-WIRED RADIO-AMPLIFIER WITH PRE-AMP.

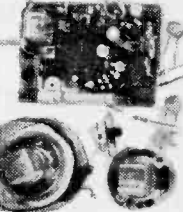


**OUR #RA2
 PRICE \$2.88**

Instruction sheets included.

This chassis includes jacks for earphones, AC adapter, mike (OR RECORD CHANGER) input; also means for switching same—radio or amplifier. Requires 6 volts, batt or AC adapter. All wires color-coded, the shielded wires clearly marked.

Imported. In original, sealed plastic bag. This is a fine, well made unit with a built-in pre-amplifier. Several hundred thousand RADIO-CASSETTE PLAYER-RECORDER units were made using these identical chassis. The design was changed and we purchased what was left at a SURPLUS price. These are not inferior (cheap) radio chassis.



OUR #KRA1 is a kit consisting of the radio chassis plus all the parts needed to build the following:-
 Telephone Amplifier 4-1/2" L.
 Two-way, Wired intercom 3-1/4" W.
 Code practice oscillator 1-1/4" H.
 Amplifier for Mike, phono, tape, etc.
 See our accompanying booklet details.

KIT #KRA1 PRICE \$4.88

ELECTRONIC COIN-TOSSER

Why tire yourself out tossing coins? Our electronic coin tosser uses the Fairchild uL 923 (IC) Only one of the lamps is always on. When you press the button the circuit oscillates hundreds of times a second. There is no way of controlling which lamp will light when you release the button. The lighted lamp wins. No one has ever found a way to tamper with this circuit—its honest—its fool-proof—its fun its interesting. Our illustrated booklet describes in non-technical language and in complete detail how the coin-tosser kit works. Also included are diagrams, theory of operation and step-by-step construction procedure. We believe this "decision-maker" is probably as knowledgeable as your Wall Street stockbroker.



7 Resistors
 1 Capacitor
 2 Transistors
 1 UJT
 1 uL 923 IC
 2 Lamps
 1 Battery Clip
 1 Perf. Board
 Colored Wires
**Kit #KC38
 \$3.25**

NOISE—DISTURBANCE—VIBRATION DETECTOR our#2K7

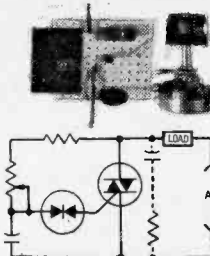


This fully assembled, ready wired, ready to use unit has only three wires connecting the battery and bell or siren alarm (or other indicating device). Simple in construction, it is reasonably fail-safe. Banging on a door or using burglar tools sets off vibrations which the microphone picks up.

Connect this unit into your present alarm system—in parallel with any detection device you are using. Consists of a mike and SCR plus resistor/capacitor components.

48¢

LAMP DIMMER WITH TRIAC, KIT #KC68



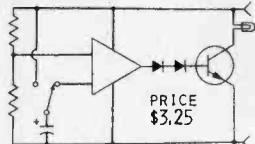
This kit consists of:-
 1 Diac 1 Heat Sink
 1 Triac 1 Resistor
 1 Control 1 perf board
 1 Capacitor Colored wires

It adjusts electric lights to any brightness—from full-on to almost zero. It is a simple, useful, fool-proof gadget. Will fit inside the base of a table lamp. Booklet tells more.

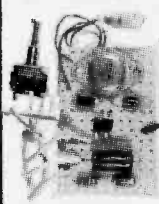
PRICE FOR THE KIT \$2.95

ACCURATE INTERVAL TIMER KIT

Kit includes:-
 1 IC 741 (A) mini-dip
 6 Resistors (4 for Timing)
 2 Rectifiers
 1 Capacitor
 1 Power transistor
 1 Micro-Switch, push



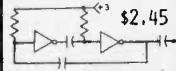
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KIT #KC70

This circuit can be relied on for accurate repetition of pre-determined time intervals. Wide time-range; From 100 microseconds to over five minutes. Without a heat-sink, the power transistor will carry a half ampere continuously. For long time intervals a relay may replace the lamp when driving heavy loads; but at faster intervals a reed relay or direct driving is necessary for instantaneous response.

TONE GENERATOR PROBE KIT #KC37A



\$2.45

Probe holds all components, including the Fairchild uL 914 (IC) and perforated board. Enough room for two mercury batteries (Not supplied).

Instruction booklet included.

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Mail FREE CATALOG, also The circuit diagrams of ALL your KITS.
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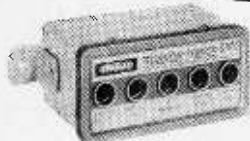
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- #KC51 Light Activated Relay Kit w/SCR -- \$4.05
- #KC57 Reed Switch and Relay Kit w/SCR -- \$2.85
- #KC58 Neon Relaxation Oscillator Kit ---- \$.99
- #KC62 Warning Siren Oscillator Kit ----- \$2.65
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- #KC64 Diode Switch Kit ----- \$1.35
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- #KC68 Lamp Dimmer using a Triac Kit ----- \$2.95
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- #KC70 Interval Timer Kit w/741 IC ----- \$3.25

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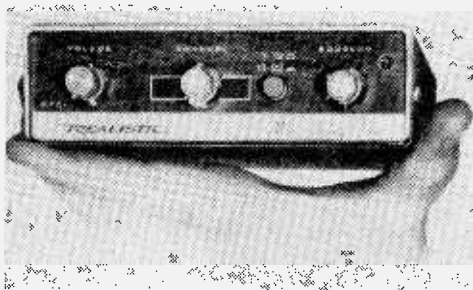
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Hey,
 look me over

Showcase of New Products

Smaller than a Cigar Box

How would you like a 23-channel Citizens
 Band transceiver that is small enough to fit
 in your car's glove compartment, yet sells
 for under \$100? Then take a peek at Realis-
 tic's Model TRC-50 Mini-Twenty Three sold
 in Radio Shack stores all over the country.
 The transceiver, which is only 1½x5¼x7⅞-
 in., is rated at a full 5-watts input and has

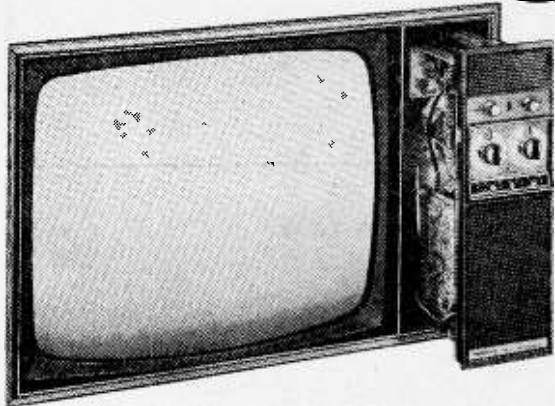


frequency-synthesis for 23-channel operation.
 Receiver section is dual conversion with ce-
 ramic filters. Sensitivity is given as 1.0uV at
 10 dB S+N/N, with 40 dB selectivity. The
 unit has an adjustable squelch control and
 built-in automatic noise limiter, illuminated
 channel selector and transmit/modulation
 indicator light. Priced at \$99.95, the TRC-50
 comes with mike, mobile mounting bracket
 and 12 VDC power cable. For all the facts
 circle No. 38 on Reader Service Page.

Instant 4-Channel

Owners of existing two-channel stereo sys-
 tems need only add two extra rear-channel
 speakers, in addition to the Sansui QS100,
 for a complete up-dating that accommodates
 all forms of four-channel sound, whether
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 tape or FM. The QS100 combines a synthe-
 sizer, a matrix decoder, two channels of pow-
 er amplification and a complete set of con-
 trols and accessory circuits for two-and
 four-channel stereo performance. The syn-
 thesizer can detect the non-direct ambient
 information in most two-channel stereo re-
 cordings and broadcasts, processing these

FREE...demonstration lesson to prove that you can learn TV servicing at home.



Practice on a new 25" MOTOROLA QUASAR II® chassis.

TV Servicing is a satisfying career . . . and the pay is great. Qualified men are needed now to maintain the 93 million sets in U.S. homes. And prospects for the future are even brighter.

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This chassis with automatic fine tuning control is ideal for training purposes because it combines solid state devices with vacuum tubes to give you both kinds of practical experience.

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It took guts to redesign a CB radio and then put it in the same familiar cabinet.

We know today's CBeR is looking for real value. So we redesigned our Messenger 123 where it counts—on the inside. Our engineers gave the model "A" new improved circuitry. With a new acoustically isolated speaker and voice-tailored audio that cuts noise—increases clarity. Plus a new ceramic selectivity filter that rejects adjacent channel chatter. And, of course it has built-in electronic speech compression for famous Johnson "talk power." At \$149.95, the Messenger 123A is a real value. And come to think about it, it's still a great looking CB radio just the way it is.

Messenger 123A.
New where it counts:
Inside.



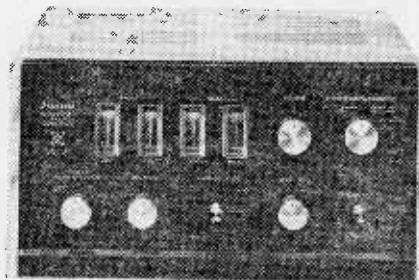
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CIRCLE NO. 8 ON PAGE 17 OR 103

HEY, LOOK ME OVER

signals for rear-channel presentation to produce a remarkably realistic four-channel effect. The decoder can accurately recover and reproduce the four original channels of any compatibly matrixed four-channel recording or FM broadcast. The amplifier section fea-



tures 15 watts per channel of continuous power at 8 ohms for driving the rear channels. Features include four VU meters, input-output connections for two-channel and four-channel tape decks, a four-gang master volume control, left-right balance control for the rear channels, slide type balance control for front-rear balance, and a multi-mode function selector. Fair trade price of the QS100 Synthesizer-Decoder-Amplifier is \$214.95. Complete specifications and additional information may be obtained by circling No. 39 on Reader Service Page.

A Plug for Ground

The new Eagle E-Z Ground when attached to any AC receptacle automatically grounds it to any grounded metallic wallbox, eliminating



the use of a bonding jumper and saving much labor and costs. Regular steel screws are used, which are treated to resist corrosion. They are color-coded green so the electrical inspector can recognize the Eagle E-Z Ground and know that no jumper is required. Look for this Eagle product when you replace faulty products in your home, especially in your workshop.

The Way To Go 4-Channel

The new Lafayette LA-524 Quadnaural Auxiliary Amplifier is designed for converting stereo systems into discrete and SQ matrix 4-channel stereo systems. It features built-in

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AM/FM Receiver
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EVX-44
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Decoder \$99.95

Now Electro-Voice offers our new universal decoder circuit built into both a stereo receiver and a 4-channel decoder.

The EVR-4X4 Receiver has every needed feature for 2- and 4-channel sound. Yet it costs no more than many 2-channel units that offer half the pleasure. And it will properly decode any matrix 4-channel input without switching. Ideal for playing SQ*, Stereo-4t, or any other matrixed records, tape, or FM sources.

The EVX-44 Universal Decoder creates a 4-channel control center for existing stereo equipment. Just add a second stereo amp and two more speakers. Unique separation enhancement circuit automatically adjusts front-back separation as required by program material.

Both the receiver and the decoder are also designed to accommodate 'discrete' inputs like 8-track tape if you wish. Hear the finest in four-channel sound at your Electro-Voice showroom. Where the excitement is!

E-V 4-channel products are produced under U.S. Patent No. 3,632,886

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Electro-Voice

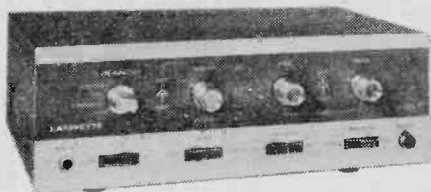
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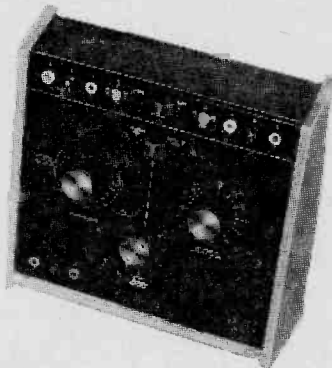
SQ decoding circuitry for playback of the 4-channel Columbia SQ discs. With the LA-524 and two rear speakers, you are now ready to plug-in a discrete 4-channel input



source such as a 4-channel 8-track cartridge or reel-to-reel tape deck. For regular 2-channel stereo program sources, Lafayette's exclusive "Composer" and circuitry enables the listener to derive 4 dimensional sound from 2-channel stereo records, tapes and FM broadcasts. A master volume control adjusts the level of all four channels simultaneously. Power output is 47 watts IHF. Price: \$79.95. For giant catalog and all the facts, circle No. 40 on Reader Service Page.

Tracer Maps Semiconductors

Dynascan's B & K division has come up with a new semi-conductor curve tracer, Model 501-A, with electronic current limiting and true current and voltage steps. Generally recognized as one of the best and fastest ways to analyze semiconductors, the 501-A displays their characteristic curves on the screen



of any auxiliary scope. It measures gain (beta can be read from the curve at a glance), leakage breakdown voltage (nondestructive test), output admittance, linearity effects of capacitance and temperature. It tests J-FET's, MOS-FET's, signal and power bipolars, UJT's (unijunctions) and diodes; Triacs, SCR's; tunnel, zener, other diodes. Electronic current limiting eliminates IR drops that could affect the curve and insures full display of waveforms up to 100 volts at 100 mA. A DC-coupled scope is recommended for use with the 501-A to avoid trace shift. Built-in

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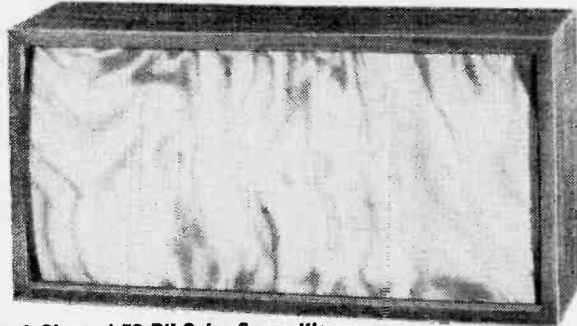


Five easy-to-build kits that add spectacular "space age" lighting effects to your favorite musical selections. Whether your bag is Bach or Rock, you can fill it with an entire new dimension in sight AND sound experience! See them at any of our over 1500 stores in all 50 states.



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Strobe Lite Kit makes any party a "now" scene! Stops motion—pulses of blue-white light give a throbbing "far-out" effect. Adjustable to tempo of music from 60 to 600 beats per minute. Has super-bright xenon strobe bulb, woodgrain vinyl case. It's the "with-it" way to add good vibes to any situation! \$29.95



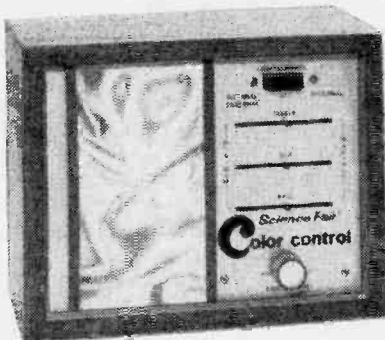
3-Channel "3-D" Color Organ Kit

3-Channel "3D" Color Organ Kit connects to any hi-fi set and makes reds, greens and blues dance to your musical beat! Each color responds to a different frequency, and color brilliance controls let you adjust 'em the way you want! \$29.95

3-Channel Light Control/Color Organ Kit. Here's a two-way fun-maker that guarantees a good time! Use the built-in color organ, or plug in three separate light sources (room lamps, Christmas tree bulbs, etc.) to create a pulsating scene. Handles 900 watts. \$29.95

Psychostrobe Kit. Super-compact—take it along to create an exciting "stop-motion" effect on any party scene. Has 100's of hobby and mechanical uses too! Xenon bulb, intensity switch, and three "freeze-speed" ranges with fine adjustment control. \$19.95

Psycholite Kit attaches to the speaker terminals of your music system, lets you hook up room lights so they pulsate with your music. Also doubles as light dimmer. Handles 600 watts. \$14.95



3-Channel Light Control/Color Organ Kit



Psychostrobe Kit



Dazzling "Psycholite" Kit



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BOOK & KIT FOR PRICE OF KIT ALONE:

Yes, for the price of a kit alone, you get a complete kit to help you start building and learning—PLUS a book by an electronics expert, loaded with scores of ideas and plans for projects you will want to build! Each kit contains all the necessary parts to construct the unit.

AUDIO MIXER—Mixes audio from 3 sources!—This FET mixer has a 3-channel input—mixes sound from all three without circuit loading or impedance mismatching. Book is "125 One-Transistor Projects." Order No. K-1 (Total value \$11.90) **\$7.95**

5-WATT HI-FI AMPLIFIER—High power transformerless circuit—This hi-fi amplifier will provide 5 watts or more of audio into any 3-4 ohm speaker. No preamps or transformers required. Book is "125 One-Transistor Projects." Order No. K-2 (Total value \$13.90) **\$9.95**

ELECTRONIC FORTUNE TELLER—Have fun with the laws of chance!—As a mystery fortune teller, this fun device will answer all yes-no questions at the touch of a button. Book is "104 Easy Projects for the Electronics Gadgeteer." Order No. K-3 (Total value \$8.90) **\$4.95**

AM WIRELESS MIKE—Broadcasts through any AM radio!—This wireless mike will "broadcast" through any AM radio set...from up to 100 ft. away. Book is "Transistor Circuit Guidebook." Order No. K-4 (Total value \$11.90) **\$6.95**

ELECTRONIC TOUCH SWITCH—Touch and light goes on!—This modern device automatically switches on body contact. Lamp automatically comes on when switch is touched, goes off when contact is stopped. Book is "Practical Solid-State Principles and Projects." Order No. K-5 (Total value \$10.90) **\$6.95**

AUTOMATIC LIGHT-SENSITIVE GARAGE LIGHT CONTROL—Unit switches when light hits it—Auto headlights will turn on either inside or outdoor garage lights. Turn them off manually when safely inside. Book is "64 Hobby Projects for Home & Car." Order No. K-6 (Total value \$13.90) **\$9.95**

AUDIO SIGNAL GENERATOR INJECTOR—Use as a tester, audio oscillator, or RF generator!—Makes a precision instrument for checking frequency response of amplifiers and for signal tracing. Can be used as a stable tone oscillator for 2-way radios or as an RF signal generator. Book is "125 One Transistor Projects." Order No. K-7 (Total value \$9.90) **\$5.95**

LOW-VOLTAGE DC POWER SUPPLY—Well filtered, full-wave miniature circuit—An effective DC power source (10V, 1A) for test bench applications, powering transistor circuits, charging batteries, etc. Book is "104 Easy Projects for the Electronic Gadgeteer." Order No. K-8 (Total value \$8.90) **\$4.95**

DIODE TESTER—Checks diodes in or out of circuit!—This diode tester gives a quick go, no-go test for all types of diodes. Also identifies polarity of unmarked diodes. Book is "104 Easy Transistor Projects." Order No. K-9 (Total value \$9.90) **\$5.95**

HIGH POWER LAMP DIMMER—Replaces wall-mounted light switch—Provides full adjustment of lamp brilliance. Handles any number of lamps up to 1000 watts. Book is "104 Easy Transistor Projects You Can Build." Order No. K-10 (Total value \$8.90) **\$4.95**

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calibration enables you to calibrate the scope just once, with no need to recalibrate for that scope. Accessories supplied include cables to scope, the B & K FP-3 probe, and a Mylar 10x10 graticule. The B & K 501-A Semiconductor Curve Tracer carries a \$129.95 price tag. For more information, circle No. 41 on Reader Service Page.

Portable Lectern Sound System

Argos Products Company has announced the introduction of Speech Director II, an improved portable lectern sound system. The



new unit features an all-new solid-state amplifier, sound column speaker system, and modernized styling that fits every speech situation. Speech Director II is completely self contained and sets up in seconds. It is ideal for church groups, Boy Scouts, fraternal lodges, etc. Its ease, operation and ability to provide effective sound coverage in any room with audiences up to 500 persons and more, provides quality performance exceeding many installed sound systems. Operating on 110 VAC or the single self-contained 12-V battery, Speech Director II can be used in every location, even outdoors. The built-in column 4-speaker sound system aims the sound to the audience in a focused beam. The result is more efficient coverage of the audience with a more distinct, natural sounding voice reproduction. Suggested user net price is \$249.95. Circle No. 61 on Reader Service Page.

Hi-Fi Stereo Components for Cars

Heath Company brings living-room fidelity to

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automobiles with a stereo component system. The CR-1000 FM Stereo Tuner combines with the CRA-1000-1 Power Amplifier to deliver a full 7 watts (3.5 watts minimum per channel into 4 ohms) continuous power



output with less than 2% total harmonic distortion. And it boasts a frequency response ± 1 dB, 30Hz to 15,000 Hz; 3 μ V sensitivity; 60 dB selectivity and 40 dB minimum separation. The FM tuning unit is preassembled and aligned to simplify and speed assembly. The CT-1001 Cassette Deck adds the convenience of quality stereo tape entertainment as well as single-channel dictation to any automobile. Pacesetter features of the cassette deck include all solid-state circuitry, a regulated motor, 30 Hz to 10 kHz response; 45 dB or better S/N ratio; 0.3% or less wow and flutter; 2% or less total harmonic distortion; and 30 dB or better channel separation. The Heathkit CR-1000 FM Stereo Tuner is priced at \$64.95 mail order . . . the CT-1001 Cassette Deck including the microphone at \$89.95. The CRA-1000-1 Stereo Power Amplifier is priced at \$29.95 mail order. Kits include all necessary hardware for under-dash or transmission hump mounting. A choice of high fidelity speakers include a pair of 5-in. cone, 4 ohm, door-mount speakers with grilles, adapters and speaker leads priced at \$19.95. For further information circle No. 1 on Reader Service Page.

Caddy Packs a Drill

A new drill kit concept with a molded plastic tool Caddy, enabling the user have all his equipment at the job, has been introduced by Black & Decker. The 21-piece #7122 caddy kit includes a $\frac{3}{8}$ -in. variable speed drill with infinite speed lock and a wheel arbor, 5-in. rubber backing pad, 5-in. lambswool bonnet, 3-in. buffing wheel, 3-in. grinding wheel, a paint mixer, 3 drill bits and 10 sanding discs. Additional compartments provide storage area for other tools and

new 19-piece midget reversible ratchet offset screwdriver set



3-3/4" heavy duty, stainless steel reversible 20-tooth ratchet with short turning radius for close work.

Unique 6" spinner/extension has drive socket insert in handle for ratchet. Use also as regular screwdriver with bits.

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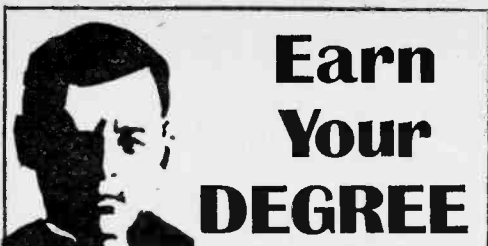
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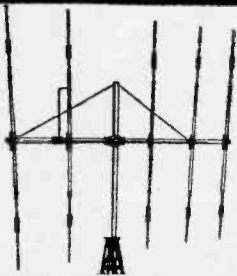
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NEW 5-ELEMENT

CB MINI-BEAM

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These coils are built to take a powerful beating--- in fact, the same coils are used in the construction of 10-meter amateur antennas.

The GA-5D is lightweight. Erect on TV antenna mount and turn with an inexpensive TV rotor.

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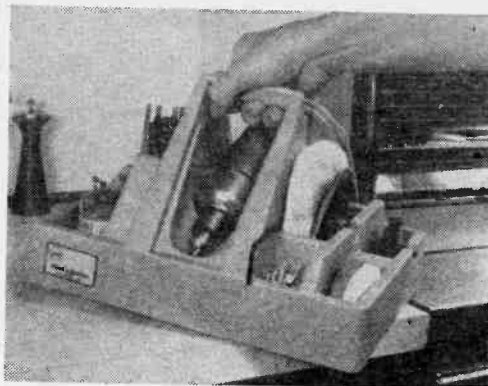
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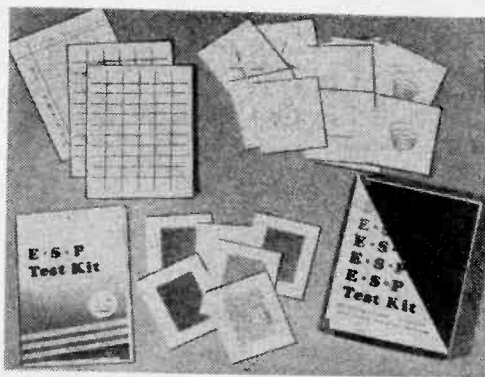
materials needed at the project site. The variable speed feature of the drill is ideal for making holes in ceramic and metals. The unit's $\frac{3}{8}$ -in. capacity handles the more rug-



ged jobs and its infinite speed lock allows the user to maintain a pre-set drilling speed. The #7122 $\frac{3}{8}$ -in. variable speed drill caddy kit assortment is available at \$29.95 from all retail outlets handling the Black & Decker product line. The #71-990 molded plastic kit is available separately at \$7.99. For more information circle No. 42 on Reader Service Page.

Extra Sensory Perception Kit

This fascinating kit enables you to employ scientific techniques for testing your power of ESP. It can be used individually, or with groups, for hours of stimulating fun and games. Available by mail from Edmund Sci-



entific Co., 380 Edscorp Bldg., Barrington N J 08007, for just \$3.00 (Stock No. 41,454). The ESP kit can be invaluable as a party stimulator for adults and teenagers, and at meetings and social functions. Students will find that it makes a highly interesting Science Project. It also provides for testing telepathy (the ability to send messages from one mind

READER SERVICE PAGE

• The Editor of ELEMENTARY ELECTRONICS offers readers an easy way to get additional information about products and services advertised in this issue. Also, if you would like more information about any new product mentioned in our column "Hey, Look Me Over," it's yours for the asking. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost.

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advertisement or editorial mention that interests you. Then, carefully print your name and address on the coupon. Cut out the coupon and mail to ELEMENTARY ELECTRONICS, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today!

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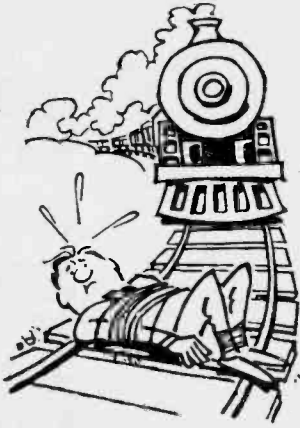
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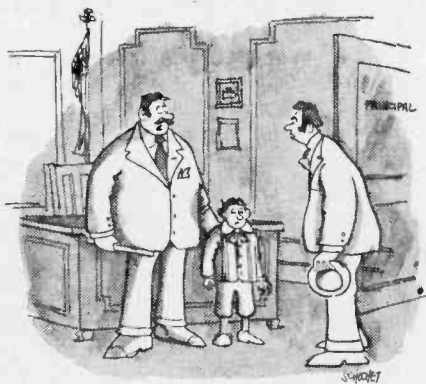
to another); perception; psychokinesis (an ability to influence movement of things by mental power); and precognition (the ability to see into the future). For literature and jam-packed 148-page catalog, circle No. 43 on Reader Service Page.

Do-It-Yourself Replacement Grille Fabric

Put on a new speaker face, and transform the looks of your stereo speakers, TV sets, radios. You can do it yourself, in minutes—it's easy with Change-A-Grille, the new self-



stick acoustic fabric that you place right on top of your existing grille. Here's how it's done: you simply cut Change-A-Grille with ordinary household scissors to size for your speakers, lay it over your existing grille, press in place; that's it. Change-A-Grille is decorative acoustic fabric laminated to sounding board material. Choose from the designer collection of patterns and colors to suit your own taste, to blend with your own decor. Change-A-Grille retails for \$4.95 for an 18-in. x 24-in. panel. On sale, now, at leading hi-fi stores throughout the country.



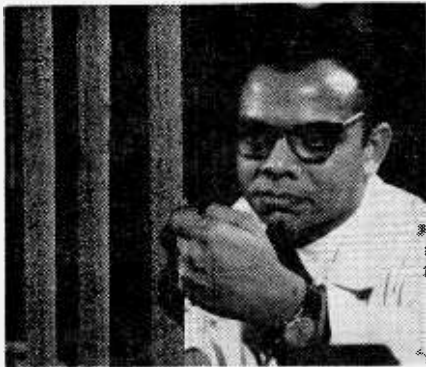
"I am sorry, but your son has a bad habit of copying, Mr. Xerox!"

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Electronics in the News!

POLLUTION PREVENTION MAKES A BUCK

A continuous system for etching printed circuit boards simultaneously recovers the dissolved copper and regenerates the etchant. In addition to recycling the etchant and recovering the copper, the new system, put into operation by Western Electric, eliminates the problem of having to stop production to replenish the etchant as well as the even knottier problem of



An engineer of the Western Electric Company's Columbus Works in Ohio scrapes some copper off one of the plating cathodes used to recover copper etched off printed circuit boards. The cathode is one of 57 used in a new system.

disposing of spent etchant. (Pollution fighters please note!) Since the etchant is continuously regenerated, the etch rate remains relatively constant. Also, the process works at only 100 degrees Fahrenheit, reducing evaporation, fuming, and stress on men, equipment and materials.

The etchant, a solution of cupric chloride and hydrochloric acid, flows continuously between spray etching machines and a plating tank. In the plating machine two processes take place simultaneously. Copper is plated at the cathodes and regeneration of the spent etchant takes place at the anodes. The plating current is maintained at a minimum of 3000 amperes. The maximum current is 12,600 amperes at 6.3 volts. A minimum current of 3000 amperes prevents the copper cathodes from dissolving. At a high current density, low temperature and high chloride concentration, a fine grain, loosely adhering deposit of copper is formed and salvaged. Resale value of this metal will form a

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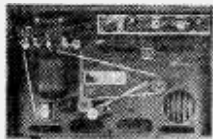
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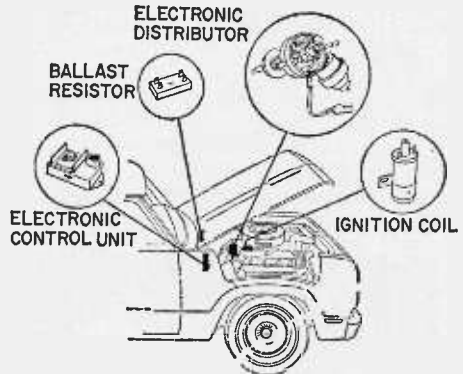
CIRCLE NO. 26 ON PAGE 17 OR 103

NEWSCAN

substantial part of the \$150,000 Western Electric expects to save this year. A price payoff for solving a difficult pollution problem.

IT HAD TO COME

Want lower maintenance costs, longer spark plug life, and a cleaner burning engine on your light-duty truck? Sure you do, for these are just a few advantages of a new electronic igni-



Dodge is offering a fully electronic ignition system in its light duty pickup trucks, compact wagons and vans, and two motor home engines.

tion system offered in light duty Dodge trucks. 1972 was the first time a complete electronic ignition system has been offered on any light-duty truck.

The new ignition device eliminates breaker points and condensers, a common cause for poor engine performance, pollution, and additional maintenance costs. The system is set and tuned at the factory, and, aside from a drop of oil about once a year, it is essentially mainte-



"It's my answering service, Wanda. How did they know I was here?"

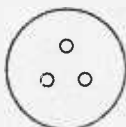
nance free. As a result of improved engine performance and cleaner combustion, spark plug life is greatly extended. Offered as optional equipment on both Dodge motor home engines and the V-8 powerplants available in the compact vans and wagons and pickup trucks, the electronic ignition system will be attractive in both commercial and private truck applications. Models for other light truck manufacturers are sure to have similar electronic ignition systems.

COLOR TV GETS IN LINE

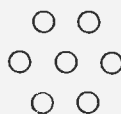
A new color television picture tube and systems concept that is a radical departure from the RCA-developed tri-color-dot shadow mask tubes, introduced in 1954, has been announced by RCA Electronic Components.

The new color television picture tube utilizes a new precision unitized, in-line, triple-beam, gun structure and a line-focus type *precision static toroidal* (PST) deflection yoke that eliminates the need for dynamic convergence correction. In addition, the shadow-mask has slit-shaped apertures which are vertically oriented with small cross ties, or webs, to provide the strength required to form the mask into a basically spherical contour. The resulting phosphor array of the screen, as exposed through the mask, forms continuous vertical lines of phosphor, arranged in an alternating green, red, and blue line sequence. (Turn page)

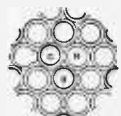
STANDARD DELTA SYSTEM



ELECTRON GUN

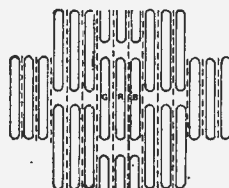
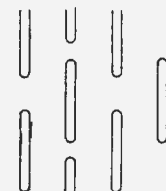
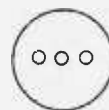


SHADOW MASK



SCREEN (OPERATING)

RCA PRECISION IN-LINE SYSTEM



The drawing illustrates the basic geometrical differences between the old and the new—the 1954 RCA Standard Delta System and the 1972 RCA Precision In-Line System.

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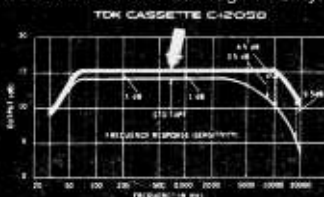
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TDK

Until TDK developed *gamma ferric oxide*, cassette recorders were fine for taping lectures, conferences, verbal memos and family fun—but not for serious high fidelity.

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The new magnetic oxide used in **TDK Super Dynamic** tape distinctively differs from standard formulations in such important properties as coercive force, hysteresis-loop squareness, average particle length (only 0.4 micron!) and particle width/length ratio. These add up to meaningful performance differences: response capability from 30 to 20,000 Hz, drastically reduced background hiss, higher output level, decreased distortion and expanded dynamic range. In response alone, there's about 4 to 10 db more output in the region above 10,000 Hz—and this is immediately evident on any cassette recorder, including older types not designed for high performance. There's a difference in clarity and crispness you can hear.

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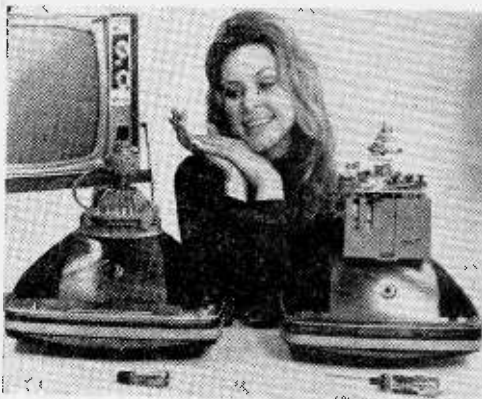
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NEWSCAN

This new precision in-line color tube and system concept is uniquely suited for portable color TV sets with sizes of 19-inch V (diagonal viewing) and smaller, employing 90-degree deflection. Converging magnetic pole pieces are not required in the color tube. And electro-



Susan Gailey eyes new simplified RCA color television picture tube system (left) that will make installation and setup adjustments of a color tube comparable to that of a black-and-white tube. The new RCA precision in-line color tube system eliminates many of the complex circuit components and adjustments shown on the conventional color tube on the right

magnetic pole piece exciters and associated convergence circuits are no longer required to converge the green, red, and blue beams on the luminescent screen.

The precision unitized, in-line, triple-beam, gun structure features bipotential lens focus, and is arranged in a horizontal coplanar line. The cathodes are electrically separated for cathode video drive which is more compatible with solid-state technology. The gun is about one-half the size of the current delta gun array, and is used in 29-mm rather than 36-mm neck diameter glass, resulting in improved convergence and register, and lower deflection power requirements.

The new system uses a potentially lower-cost PST deflection yoke. The vertical and horizontal deflection wires are precisely placed into winding grooves molded into plastic rings which are cemented to each end of the PST ferrite core. The new PST yoke has proven to give precise and uniform performance in deflecting and converging the three beams. A single static convergence and purity device assembly is included in the system.

The PST deflection yoke and convergence/purity assembly can be mechanically bonded to the neck of the color tube to form an integral tube-component assembly. For the first time, the new assembly feature allows installa-

tion and setup of a color tube assembly comparable to that of a black-and-white tube. At last!

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With surgical care, an electronic module for a long-lived heart pacemaker is assembled. Aerospace reliability techniques are employed in the manufacture of the new devices to pace the beat of a human heart.

powered by nuclear energy to give them a life of ten years instead of two, as presently experienced with mercury batteries. Raytheon is building the units in an experimental program conducted by the Atomic Energy Commission to study the reliability of the new devices.

The program was instituted by the AEC after studies indicated that as many as half of
(Continued on page 101)



"Let's put it this way—If you were a transceiver, your crystal lattice filter would be clogged!"

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Hank Scott, our Workshop Editor, wants to share his project tips with you. Got a question or a problem with a project you're building—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Sorry, he isn't offering a circuit design service. Write to:

**Hank Scott, Workshop Editor
ELEMENTARY ELECTRONICS
229 Park Avenue South
New York NY 10003**

Some People Must be Told Twice

Why are microwave ovens unsafe?

—F.D., Hewlett Harbor NY

I have heard of one case where a man broke his leg when his microwave oven fell on his foot. Then there was the nut who placed his wife's head in the oven, but she was uninjured—he couldn't find the gas valve. Seriously, microwave ovens *are safe*. Interlocking switches prevent accidental exposure of humans to the heating effect of microwaves. Door seals on consumer ovens have been proven satisfactory—no harmful amounts of energy leaked out. I believe more people are injured by sticking their fingers inside hot toasters than microwave ovens falling on legs.

Socket Lock-it

What's a loctal tube?

—S.L., Harrison NJ

Ask one of your neighbors, because your home town has produced more vacuum tubes than any other in the world. A loctal is very much like an octal base tube except the prongs are stiff wires protruding from a glass base, as opposed to hollow metal prongs fixed to a bakelite base. Loctals were designed for mobile and aircraft use—they snapped into the socket and required some wiggling and pulling to remove. Octals, under vibration conditions, would work out of their sockets if not clamped in place. Loctals were normally seven-volt filaments with electrical characteristics identical to their 6-volt counter-parts. For example, a 7N7 would be identical to a 6SN7 except for the base construction and filament requirements. (Also: 7A4, 6J5, 7A7, 6SK7; 7B5, 6K6GT; 7C5, 6V6; 7HG8, 6HG8; etc.) By the way, I don't think you can buy them any more.

Family Problems Ironed Out

My wife will not let me replace the line cord on her steam iron. She says that it requires special skills and parts, not to mention tools. Tell her she is wrong, please!

—N.M., Kingston NY

Oh well, here I go breaking up a home. Honey, let your husband work on the iron. I've done it several times for my wife and neighbors. It's easy. In most cases all you

need do is remove a plastic plate by unscrewing one or two screws, twisting off two nuts and removing the line cord. Now, take the old line cord to an appliance repair store and buy an exact replacement. Many hardware stores carry these line cords. It's important to get an exact replacement. The wire ends come finished in a round pressed washer for good mechanical and electrical connection. Also, you can be sure the cord can take the *heat* and *pull* line cords of this type handle during normal usage. Install in reverse order of disassembly. Now with the money you saved buy the Mrs. a box of candy.

Swish

How fast does electricity travel? My friends tell me it's as fast as light.

—M.C., Garry IN

In free space, electricity travels at the speed of light if it were in the form of an electrostatic or electromagnetic field. But, I'm sure you are talking about electricity in wires. I do not know the exact figures nor do I know where to find them. However, if you'll trust my memory, I'll give you some ball park figures and I ask you not to quote me. DC passes through copper wire at a speed of about 50,000 to 100,000 miles per second. RF signals travel not in a wire but near the surface, thus their speeds are about 95% of the speed of light—186,000 miles per second. Radio signals travel through the air at about the speed of light because the air offers very little "resistance." Does anyone know exact values and can quote a source book?

You Gotta Hear Something

I bought a dual-band monitor receiver (30-50 MHz, 150-174 MHz) but can hear only a few stations. I thought there were lots of channels. Why can't I hear them?

—J.R., New York NY

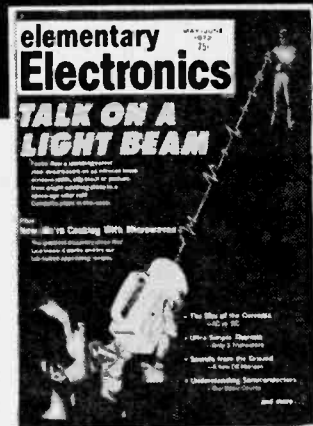
There are 637 channels in the 25-50 MHz band, 547 in the 150-174 MHz band, and 450-470 MHz band, allocated to the mobile radio services. In the New York City area, there are more than 10,000 base (fixed location) stations and 70,000 mobile units. But, they don't transmit continuously, only long enough

(Continued on page 104)

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DX central reporting

A world of SWL info!

By Don Jensen

□ In the DX Central logbook there's a strange entry under the date of June 3, 1972. There's nothing particularly rare about the station heard. It was *WWV*, the easily heard standard time and frequency station on 10,000 kHz. What is unique is the time of the logging—23 hours, 59 minutes and 60 seconds GMT!

The world's longest day, that's what they called the 30th of June. Because in timekeeping, the regularity of the earth's rotation comes out second best as compared to the accuracy of the modern atomic clock. And so, the world's official clockwatchers decided to correct the error by adding an extra second to that day.

On *WWV*'s transmission, that additional second was marked by an extra "non-tock" silent moment just before the start of the new day, July 1, Greenwich Mean Time.

Of course this DX Central reception was not a rare station. But it was a novelty, a curiosity, a bit of DX trivia that can add an extra "kick" to an already fascinating hobby.

Sometimes the SWL stumbles on these strange little listening experiences by pure chance. More often it happens when the listener notes a bit of news in the papers or on TV that suggests unique DXing opportunities.

Suppose you read that there's to be an eclipse. As a medium wave DXer you know that due to certain propagation phenomena, *BCB* stations "get out" further at night. And, during a solar eclipse, when the moon's shadow traces a path across the earth, for a brief time and in a relatively small area, twilight or even full darkness occurs during what normally are daylight hours. The result is that DXers living in the path of the eclipse may find unique nighttime listening conditions at some mighty unusual times of the day!

A rare occurrence! Certainly, but a few years back some east coast listeners did manage to log some distant medium wave stations during a solar eclipse. The same opportunity may never repeat itself for these DXers, but they were alert and informed and had their one shot at some unusual DXing.

Human events sometimes result in unique

listening experiences. TV and press reports tipped DXers off to the fact that Mainland China launched its first space satellite a few years ago. Major newspapers carried information on the times and paths of the satellite—called *CHICOM I*—across the U.S. Some stories even reported the frequency used. As a result, wide-awake DXers, who'd done their homework, managed to hear these transmissions from space—weird telemetry signals and fragments of the revolutionary melody, "The East is Red."

Political termoil can also offer unique listening experiences. At DX Central we once had the opportunity to hear the minute-by-minute development of a revolution-in-progress as broadcast from a South American nation. The final hours of the breakaway nation of Biafra and the clandestine drama of broadcasting during the Soviet invasion of Czechoslovakia were also heard.

Keeping tabs on what's happening out there in the world beyond your DX shack is essential, if you want to catch these rare—sometimes once-in-a-lifetime—events in broadcasting. And if you dig the off-beat, this sort of "NOW" DXing is for you!

Tip Topper. A good bet for most DXers is *Radio Norway*. Still it probably isn't among the first 15 or 20 countries a beginning SWL logs. It's not because Norway's transmitters are not powerful. Most of them are 100 or 120 kilowatts. And it is not because of limited broadcasting hours. *Radio Norway* broadcasts eleven 90-minute programs every day.

If *Radio Norway* isn't in your log book now, it's probably because you've been looking for English language programming, but not at the right time. English programs are all concentrated in one 24-hour period each week, overlapping Sunday and Monday.

East coast listeners should try Sundays from 1400 to 1430 and 1600 to 1630 GMT on 17,825 kHz, and 2000 to 2030 GMT on 15,175 kHz. On Mondays, additional English programming can be found on 11,850 kHz from 0000 to 0030 and 0200 to 0230 GMT, and on 9,610 kHz from 0400 to 0430 GMT.

Mid-continent listeners will find English programs beamed their way Mondays from 0400 to 0430 GMT on 11,850 kHz.

Sundays, west coast SWLs may tune from 1600 to 1630 GMT on 15,175 kHz. On Mondays, try 0400 to 0430 GMT on 11,735 kHz, and at 0600 to 0630 GMT on both 11,735 and 11,850 kHz.

The transmissions include a weekly broadcast, "Norway this Week," a shortwave picture of the country's cultural, political and economic life.

Radio Norway is a friendly station that quickly verifies correct reception reports with an attractive QSL card. Your letters can be addressed simply to Radio Norway, Oslo, Norway.
(Continued on page 98)



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71. Kit builder? Like weird products? EICO's 1972 catalog takes care of both breeds of buyers at prices you will like.
72. Want some groovy PC boards plus parts for communication projects? Then get a hold of International Crystal's complete catalog.
73. See brochures on Regency's 1973 lineup of CB transceivers & VHF/UHF receivers (public service/business bands—police, fire, etc.)
74. A pamphlet from Electra details the 6 models of the Bearcat III, a scanning monitor receiver.
75. Dynascan's new B&K catalog features test equipment for industrial labs, schools, and TV servicing.
76. Before you build from scratch, check the Fair Radio Sales latest catalog for surplus gear.
77. Hallicrafter's literature features new American-made FPM-300, 250 watts P.E.P., SSB/CW 5 band amateur transceiver.
78. Want a deluxe CB base station? Then get the specs on Tram's super CB rigs.
79. Learn how you can do all kinds of jobs with Xcelite's new 19-pc. midjet reversible ratchet offset screwdriver set & 5-pc. pocket kit.
80. Bomar claims to have C/B crystal for every transceiver . . . for every channel. The catalog gives list of crystal to set interchangeability.
81. Pep-up your CB rig's performance with Turner's New M-3 mobile microphone.
82. A fully illustrated brochure from Midland gives readers a look at their new, complete line of radio monitoring receivers and CB transceivers.
83. For everything in electronics—get the 1973 catalog from EDI (Electronic Distributors, Inc.). 152 pages of leading brands at bargain prices.
84. Get all the facts on Progressive Edu-Kits Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.
85. Olson's catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names.
86. Trigger Electronics has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.
87. Get the free, new twenty-four page HUSTLER CB and Monitor antenna catalog featuring improved antennas and accessories for base station and mobile operation.
88. Teaberry Electronics has information on CB radios—Twin "T," Big "T," Mini "T" II, and Five by Five; also information on Scan "T" Monitor radio receiver.
89. Keep up-to-date on latest electronics bargains with Burstein-Aplebee's 1973 catalog and supplements.
90. Two leaflets by R. L. Drake Co. are available. One is on their SPR-4 communications receiver; the other on the SW-4A international short wave broadcast receiver.
91. Edmund Scientific's new catalog contains over 4000 products that embrace many sciences and fields.
92. Cornell Electronics' "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.
93. Radio Shack's 50 Anniv. cat. has 180 pages, colorfully illustrated, of complete range of hi fi, CB, SWL, ham equip. and parts (kits or wired) for electronics enthusiasts.
94. It's just off the press—Lafayette's all-new 1972 illustrated catalog packed with CB gear, hi-fi components, test equipment, tools, ham rigs, and more.
95. Mosley Electronics, Inc. is introducing 78 CB Mobile Antenna Systems. They are described and illustrated in a 9-page, 2-color brochure.
96. RCA Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.
97. You can become an electrical engineer only if you take the first step. Let ICS send you their free illustrated catalog describing 17 special programs.
98. Avanti antennas (mobile and base for CB and VHF/UHF) are fully described and illustrated in new catalog.
99. A new free catalog is available from McGee Radio. It contains electronic product bargains.
100. Semiconductor Supermart is a new 1973 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductor.—all from Circuit Specialists.
101. Heath's new 1973 full-color catalog is a shopper's dream—chockful of gadgets and goodies everyone would want to own.
102. E. F. Johnson's 1973 line of CB transceivers and CB accessory equipment is featured in a new all-line brochure. Send for your free copy today.
103. If you want courses in assembling your own TV kits, National Schools has 10 from which to choose. There is a plan for GIs.
104. Free 1973 Catalog describes 100s of Howard W. Sams books for the hobbyist and technician. Includes books on projects, basic electronics and many related subjects.

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 New York, N.Y. 10023

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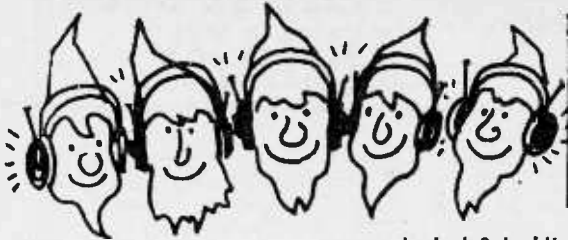
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| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
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Not Valid After March 31, 1973

'Tis the Season...



by Jack Schmidt



Effective Immediately—said sleigh must be equipped with a transponder providing altitude data in addition to suitable direction finding gear pursuant to Section 341.2B, and ...



"... and bring a doll house, and a wagon for my sister, and ..."

STEREO



"Gee, Dad, Mom only wants to use the TV rotor 'till after Christmas."



"Miss Glockenspiel, our organist, informs me that, as a result of a stuck KA11DY relay, Hymn No. 44 will truly be 'Silent Night'!"

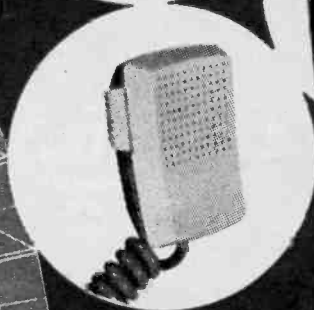
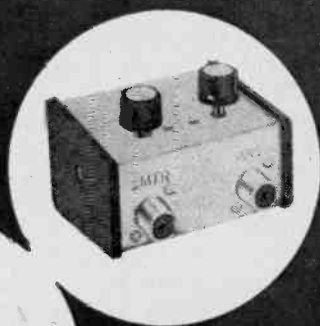
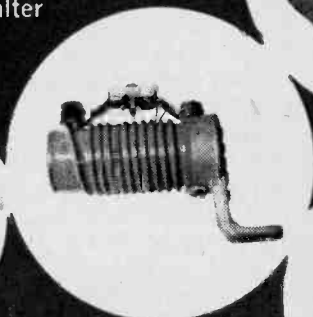
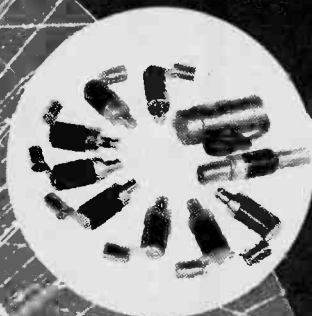


"... and now we'll run 'Jingle Bells' through the Dolby on chrome tape."

Our Scanner Sweeps The Field For...

CB Accessories

by Len Buckwalter



Dealer shelves and mail-order catalogs bulge with nearly two dozen different accessories for the active CB operator. Some will improve your station's performance, while others are valuable tools for use during installation and troubleshooting. Almost none of them call for high-level technical skill yet they could prevent an expensive trip to the service shop. The cost of CB accessories? They run from a piddling \$1.50 for a dummy load to \$159.95 for a complete base station control center. Let's take a look now at what manufacturers are offering . . .

● Field Strength Meter

This inexpensive gem tells plenty about any CB system. It acts like a miniature receiver that picks up your transmitter signal and reads its strength, much as an S-meter does. Since the instrument picks up the signal after it leaves the antenna, it takes into account every link in the chain—transmitter, coaxial cable and antenna. Place a field strength meter near a newly-installed antenna; you can make transmitter tuning adjustments for maximum output by viewing the meter for an increase. Once you see a peak, use it as your reference for future troubleshooting. Some field strength meters, such as the Heath PM-2 Relative Power Meter, have a magnetic base, so you can place them on a dashboard. You'll have a continuous and positive monitor of output power each time you press the mike button. Another handy model is the Midland 23-125 which has a 9-inch telescoping whip antenna and earphone. That earphone enables you to hear and check the quality of your modulation while transmitting. These meters, incidentally, need no batteries because they're driven directly from on-the-air signals captured by the antenna.

● SWR Indicator

This is another excellent accessory that should be owned by any CBER who wants a better electronic view of his rig. SWR, which means standing wave ratio, is a mea-

sure of how much power is sent to the antenna, compared to the amount that bounces back from the antenna because of impedance mismatch. Since reflected power acts to cancel and reduce forward power (that's the part actually transmitted), you want lowest SWR. If you can cut it to less than 2:1, you have acceptable performance and good efficiency. An SWR meter inserted in the coaxial cable tells the figure. When the meter indicates too high, your transmitter is poorly tuned, the coaxial cable isn't 50 ohms or something's amiss with the antenna or its installation. In a base station, high SWR could mean the antenna is too close to a mass of metal (maybe a rain pipe running down the house). Broken antenna elements or shorted cable can do the same.

SWR meters are available as separate instruments, like Antenna Specialists' VSWR Bridge (Model M-254, \$29.95) or the Gold Line VSWR Mini-Bridge. They have coaxial connectors which permit insertion into an antenna line where they monitor output full-time, if you wish, without robbing more than a snippet of power. SWR instruments, incidentally, are fine companions to the field-strength meter. When you tune a rig and watch an SWR meter for the lowest possible reflected power, there's a chance you may be reducing the forward power, too. (That's like drilling holes in the hull of a boat to let out the bilge!) But if you make SWR adjustments while simultaneously viewing a field strength meter, you can't be misled. When SWR drops, field strength should increase.

MANUFACTURERS OF CITIZEN BAND ACCESSORIES

Antenna Specialists Co., 12435 Euclid Ave., Cleveland OH 44106

Avanti R & D, Inc., 33-35 W. Fullerton, Addison IL 60101

Barker & Williamson, Inc., Bristol PA 19007

Cush Craft, 621 Hayward St., Manchester NH 03103

R.L. Drake Company, 540 Richard St., Miamisburg OH 45342

GC Electronics, 400 South Wyman St., Rockford IL 61101

Gold Line Connector, Inc., Muller Ave., Norwalk CT 06852

Hallet Mfg. Co., 136 N. Ash St., Inglewood CA 90301

Heath Co., Benton Harbor MI 49022

Hy-Gain Electronics Corp., 8451 NE Highway 6, Lincoln NE 68501

E.F. Johnson Co., Waseca MN 56093

Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset NY 11791

Midland Communications Co., 1909 Vernon St., North Kansas City MO 64116

Radio Shack Corp., 2615 W. 7 St., Fort Worth TX 67105

Turner Microphone Co., 909 17th St. N.E., Cedar Rapids IA 52402

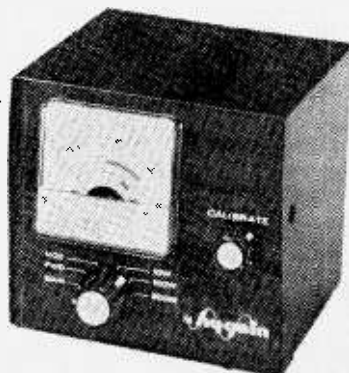
Lafayette CB Multitester. \$39.95
Circle No. 50 on Reader
Service Page.



Gold Line Mini VSWR bridge. \$13.95
Circle No. 51 on Reader Service Page



Realistic CB tester. \$21.95
Circle No. 52 on Reader Service Page



Hy-Gain Power/Modulation/SWR
Meter \$39.95
Circle No. 53 on Reader Service
Page

Heath Field Strength Meter.
\$12.95 kit
Circle No. 1 on Reader Service Page



● Watts Up Front Count

The instruments described above are invaluable, but they have one limitation. They read relative, not actual output power. If you wish to read the actual number of watts emanating from your rig, look into an in-line watt-meter. Your system may be tuned for highest power and lowest SWR, but a weak tube or transistor could be cutting the maximum power the rig had when it was new. The wattmeter answers this one. It has direct-reading scales calibrated in, say, 0-10 watts and 0-100 watts. Some examples are Midland's Model 25-526 and Antenna Specialists M-252 (\$27.95). Each has a selector switch for changing the power scale, and the instrument may be left in the coaxial line.

● Combos

The engineers needed no imagination to realize that, like Romeo and Juliet, cer-

tain things go well together. That's why they often combine several testers in one case. Besides convenience and compactness, it shaves the cost because watts, SWR or relative power can be indicated on one meter (which is usually the most costly component). For example, Hy-Gain's Model 421 reads three power levels, 0-10 watts, 0-100 watts and 0-500 watts, and also indicates percentage modulation and SWR. Cost of the 5-scale instrument is \$39.95. Another example is a "Three-Way CB Tester" recently introduced by Radio Shack. The three functions are SWR, power in watts and percentage modulation. As in most units there is no need for batteries or AC power since the circuit is energized by a tiny sampling of CB signal. This one sells for \$21.95.

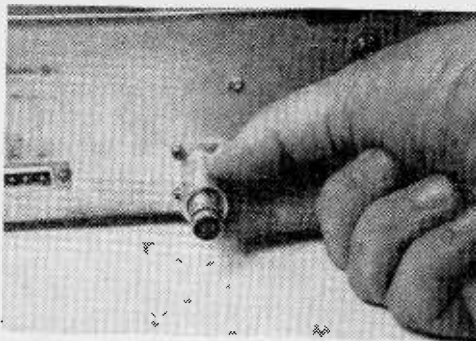
The combo concept is carried further in a breed of instrument that's nearly a

e/e CB ACCESSORIES

portable service shop. A good example is the new Lafayette CB Transceiver Multi-tester; it measures about a dozen different items. In addition to all the measurements already discussed, it reveals the condition of a crystal, DC volts to 15, and DC amps to 1. These latter two measurements are handy to know if you suspect trouble in the primary power source (the car ignition, for example). The CB instruction manual should tell the correct input voltage and the amount of current consumed during transmit and receive. An instrument of this type also acts as a signal generator for checking a receiver. It produces an RF signal on a CB channel or modulates that signal with audio. The instrument's versatility makes it an excellent aid for almost any level of CB troubleshooting.

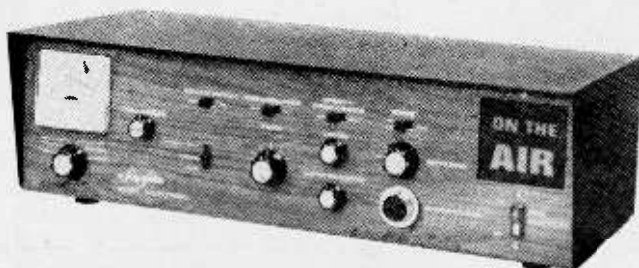
● Dummy Load

As one of the lowest-priced accessories, this gadget was called a "phantom" load back in Teddy Roosevelt's day. In some manuals and instruction sheets today we're told to construct a dummy load from a No.

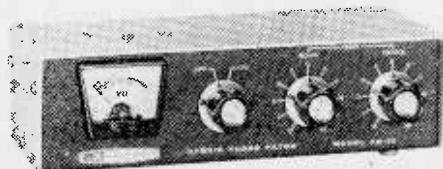


Help keep 27 MHz clean. Do your CB testing with a dummy load. Dissolves RF power as heat in a resistance—keeps CBers cool.

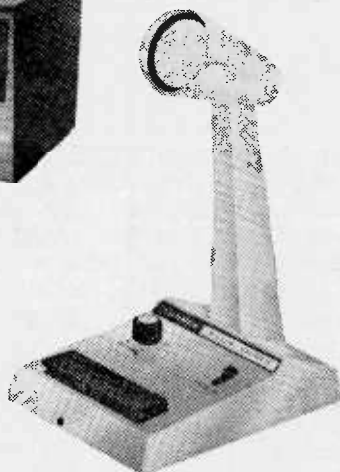
47 pilot lamp and tune the rig for maximum brightness. The problem is that the filament within the lamp is something of a radio-frequency coil and, worse yet, changes resistance at different degrees of heating. The lamp, therefore, is not a true load for CB, which should be 50 ohms (sometimes indicated as 52 ohms to agree with coaxial cable ratings, but you can ignore the small difference.) Several manufacturers offer an accurate dummy load in the \$1.50 to \$3



Hy-Gain Base Station Control. \$159.95
Circle No. 45 on Reader Service Page



Heath Phone Patch. \$24.95
Circle No. 1 on Reader Service Page



Turner Plus 3 amplified mike. \$45.00
Circle No. 46 on Reader Service Page

class. Two advantages over the lamp are a non-inductive load whose value won't change with power, and adequate shielding to prevent any escaping signal from causing undue interference on the air. Thus you can make adjustments to your rig without radiating an illegal signal. Another reason to own a dummy load is that it checks your other test instruments. Almost all CB test gadgets are designed to operate into or out of a 50-ohm impedance. If your various measurements somehow appear out of whack, you can always install the dummy load (in place of the antenna, for example) and be assured of an accurate 50 ohms.

● Lightning, Switching, Matching

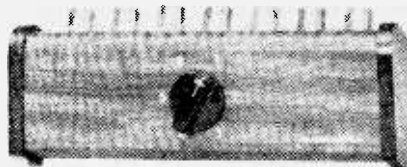
Here are three small items fitted with coaxial connectors for easy attachment into the antenna line. Lightning arresters protect against lightning strikes (but on a direct hit, prayer works better). It has an internal discharge gap which helps shunt static charges to ground before there's damage to equipment. To do the job, though, you must provide a good electrical ground and connect it to the terminal supplied on the arrester. Cush Craft's "Blitz Bug" is a good example of an arrester now on the market.

Blitz Bug at \$3.95
Circle 47



Coaxial antenna switches form another helpful group of antenna accessories. There's quite a variety, depending on the functions you want. Simplest is the two-position model which connects your transceiver to one of two antennas at a flick of a switch. This is handy when you have both a beam and a conventional non-directional antenna. The switch may also work in reverse; it can connect one of two transceivers to one antenna line. Cost of these switches runs from about \$5 for the two-position type, up through six-position models for about \$10. Price varies with number of positions, styling and wattage rating (though the standard CB rig may not run more than 4 watts RF output).

Antenna matching is also a matter for accessories. Manufacturers design transceivers for an output of 50 ohms, coaxial cable for 50 ohms and antennas for 50 ohms. Connect all together and, *voila!* There is a perfect impedance match for



Six to one. Select any one of six antennas with the flip of a switch. By Radio Shack. Circle No. 48 on the Reader Service Page.

maximum efficiency. Well, not completely. Sometimes a line presents an odd impedance because it's upset by an antenna which may not be operating at 50 ohms. A good example is mounting a 50-ohm antenna on a vehicle, where interaction with the car body may cause impedance to drop to 30 ohms or so. Although the mismatch is not serious in most cases, an antenna matcher inserted in the line is available to anyone who wants to tweak the last particle of power from his transmitter. To use one of the many matchers on the market, you'll need an SWR meter to adjust the matcher knobs for lowest SWR. An example of what's available is the E.F. Johnson "Matchbox" for \$15.95. It has two controls marked *tune* and *load* to correct for an SWR mismatch of up to 5:1. Through careful adjustment, you should be able to reduce this to 1:1.1, an almost perfect match.

● Mikes

All accessories so far had something to do with a rig's output signal. Here are a couple of items that hook to the other end of the rig—the input—and help the signal at an earlier stage. A microphone is standard equipment on a CB rig, but you can obtain special units that add extra zing through transistors. They help fill out the carrier by keeping the modulation percentage as close to 100 percent as possible, but without annoying splatter. High average modulation improves your readability when conditions are poor or distances are excessive. Some amplified mikes automatically keep modulation high, even when you change talking distance from the mike. One example of the deluxe variety is the Turner Model Plus Three. It has both a preamp for boosting the audio signal and a compressor circuit to keep audio at a relatively constant level under varying conditions. You shouldn't have too much trouble wiring the mike since it comes with instructions for more than 100 different transceivers.

(Continued on page 40)

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*Move ahead in America's
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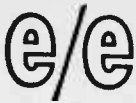
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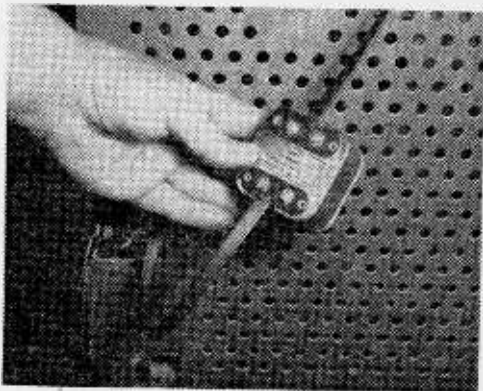
CB ACCESSORIES

(Continued from page 35)

A recent electronic addition to this category is the Hy-Gain Hy-Level Modulator. It's in an external cabinet and processes audio through both compression and clipping. It also provides his and her mike inputs so two can talk at once. Cost is \$59.95.

● Ma Bell, Too

Until several years ago, there was a taboo against installing a *phone patch* on home equipment. But thousands of hams did it anyway and Ma Bell tolerated it with a knowing wink; the patches were used by hams to help overseas servicemen talk to their homes without ringing up many dollars per minute. Recently the rules were relaxed and now several phone patch models are offered to the CBer. A patch works this way. An incoming voice through the CB rig is injected into the telephone line. It means you can "patch" the CB-carried voice to any phone in the world. The direction is reversible; a voice arriving on your phone line can be jacked into your CB rig and transmitted over the air. This makes you an intermediate, or relay, station. One advantage is that the two parties can speak directly to each other without you verbally repeating the message. You can buy a phone patch in kit form from Heath, or purchase a Lafayette model for \$15.95. One high-priced model we encountered is the B&W Model 3002W offered for \$99.95. The extra cost is due to a built-in amplifier/limiter to boost weak signals and keep modulation at a high level.



A TV high pass filter attenuates RF signals below about 52 MHz. Costs under \$6. Drake. Circle No. 49 on the Reader Service Page.

Phone patches are wired to the speaker and mike leads of the CB set and also connect to the telephone terminal block in the room.

A phone patch is also found in Hy-Gain's Base Station Control. This deluxe unit houses an imposing array of instrumentation for measuring SWR, modulation percentage and power, plus antenna switching and an on-the-air indicator. There's a built-in speaker, a speech processor, a receiver preamplifier, and a big switch that turns everything off in a single flick.

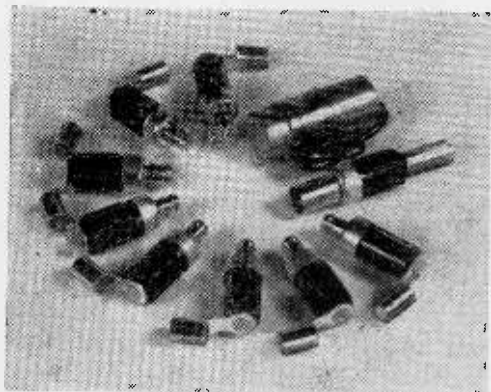
● Noise Killers

The greatest threat to CB mobile operations is interference caused by a car's ignition system. So manufacture's offer a number of attachments to filter, bypass or stifle the noise before it reaches the receiver. If your car isn't already equipped with radio resistance cable to the spark plugs, there are add-on suppressors which attach to each plug and the distributor. They cost approximately 50 cents each. For bad cases, use a complete kit (like the Hallett Hash Husher) for about \$13 which contains suppressors and shielded wire. Some kits contain several coaxial capacitors that are especially effective for bypassing ignition hash to ground. These capacitors fasten to alternator or generator, the voltage regulator and ignition coil, according to directions enclosed with these products. They can really reduce ignition noise.

● Fractured Screens

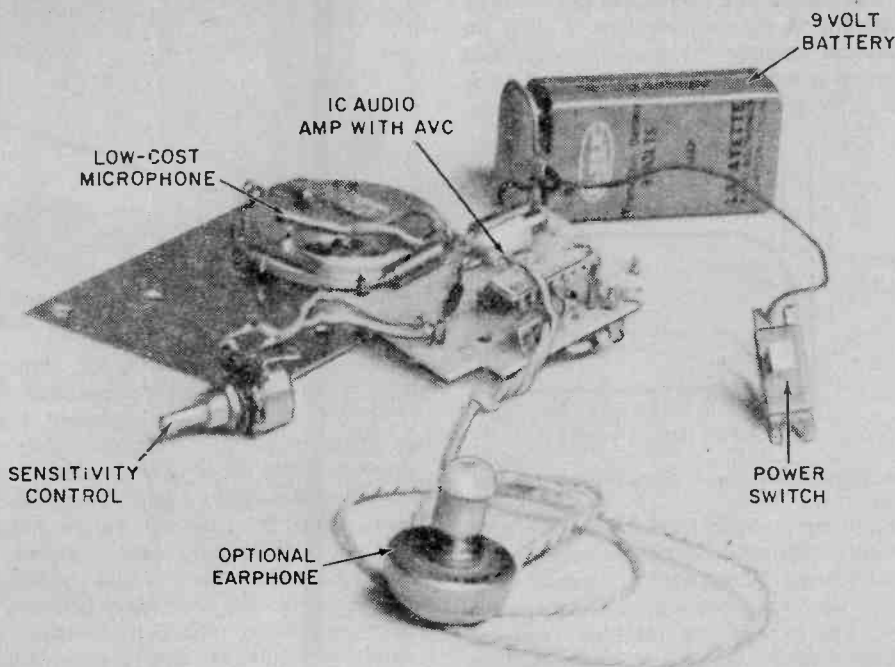
According to law, a CB setmaker builds his rig to reduce false radiation (mainly the second harmonic at two times the CB sig-

(Continued on page 100)



Help increase useful range by reducing the ignition and other electrical noise with a noise suppression kit. From GC Electronics. Circle No. 44 on the Reader Service Page.

BUILD YOUR OWN... AMPLIFIED MICROPHONE WITH AUTOMATIC VOLUME CONTROL



Build special hearing aid, or amplified mobile or base station CB mike for extra talk power

By W. H. Sandford Jr.

EVER wonder why television commercials seem to be so much louder than the average program they accompany, or why some very low-level CB signals are more readable than others? In both cases, you can bet that the audio is passed through some kind of volume compressor or peak limiter before being applied to the modulator. In plain terms, it is an example of what more talk power can do!

Here is a volume-controlled microphone-preamp that does much of what the professional limiting circuits do—but at a much

lower cost, and it's one you can build yourself. Any sound loud enough to overmodulate a transmitter automatically reduces the output of the mike to prevent overmodulation, while softer sounds benefit from the normally high mike gain and modulate the transmitter with a much higher percentage than they normally would. Hence, you get a higher *average* level of modulation and more talk power.

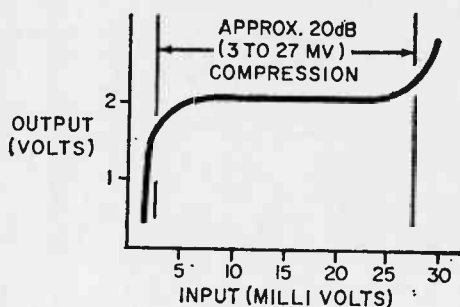
But this is really a universal circuit; instead of using it to modulate a transmitter, replace the level control with a high impedance earphone, and presto—a hearing aid with AVC.

(Turn leaf)

e/e AMPLIFIED MICROPHONE

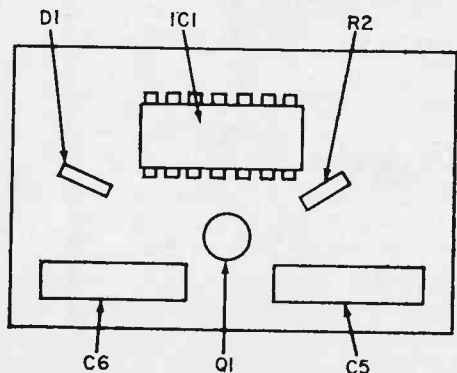
If this circuit is used in a homemade hearing aid as shown in the photographs, the sensitivity (volume) control can be turned way up to catch distant or soft sounds, but loud or very close sounds will be lowered to prevent eardrum overload.

How it Works. Sound waves picked up by the crystal microphone are converted to electrical signals and applied to the input of the integrated circuit amplifier. Called an *operational amplifier* by manufacturers and engineers, it amplifies signals to a sufficient power level to drive the dynamic earphone.



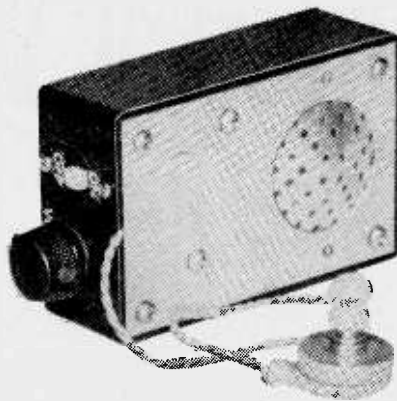
Curve illustrates ideal compression action.

It can put out a sound level of such strength to be uncomfortably loud for a person with normal hearing. When used as a microphone preamp, up to 2-volts are available at the output. The gain of the amplifier (and the resulting output level) is controlled by the amount of signal fed back, by R5, from the output to the inverting input of the amplifier. The more signal fed back, the lower



Location of components on top of perf board. IC1 comes in three different packages. Mark pin numbers of package you use on diagram.

the amplifier gain. Assume a case where the volume control is adjusted for maximum gain (R3 set for zero resistance). In the absence of sound waves falling on the microphone, Q1 acts as a low resistance compared to the resistance of R2, and the gain of the amplifier is approximately equal to the



Now in actual use, the author built this compact hearing aid for under 20 dollars.

ratio of R2 + R5 divided by R2, about 667 times. A 3-millivolt input signal will result in a 2-volt output signal. Converted to decibels (dB), this is a gain of about 57dB.

Lowers Gain. When sound waves fall on the microphone and an output signal is generated, diode D1 conducts on the negative going portions of the output signal and charges C4. This negative bias on the gate of Q1 causes the resistance between the source and drain of Q1 to increase. The greater the voltage developed across C4, the greater the increase in resistance Q1 adds in series with R2. This reduces the overall gain to about 75, which means a 27-millivolt input is required for a 2-volt output. Converting again to dB gives us a gain of about 37dB.

Thus if the FET receives a voltage on the gate great enough to cause its drain-to-source resistance to increase to about 12,000 ohms, the amplifier gain is seen to be reduced by 20 dB. Tests with an audio oscillator replacing the microphone and an oscilloscope observing the output waveforms have shown that after the output signal reaches a peak amplitude, the input signal can be increased another 20 dB without changing the output level. Further increases in input signal level result in distortion of the output waveform and this condition must be taken care of by reducing the amplifier gain with the introduction of resistance into the circuit at

R3 (the sensitivity control). R3 is of such a value to permit 30dB of volume control action.

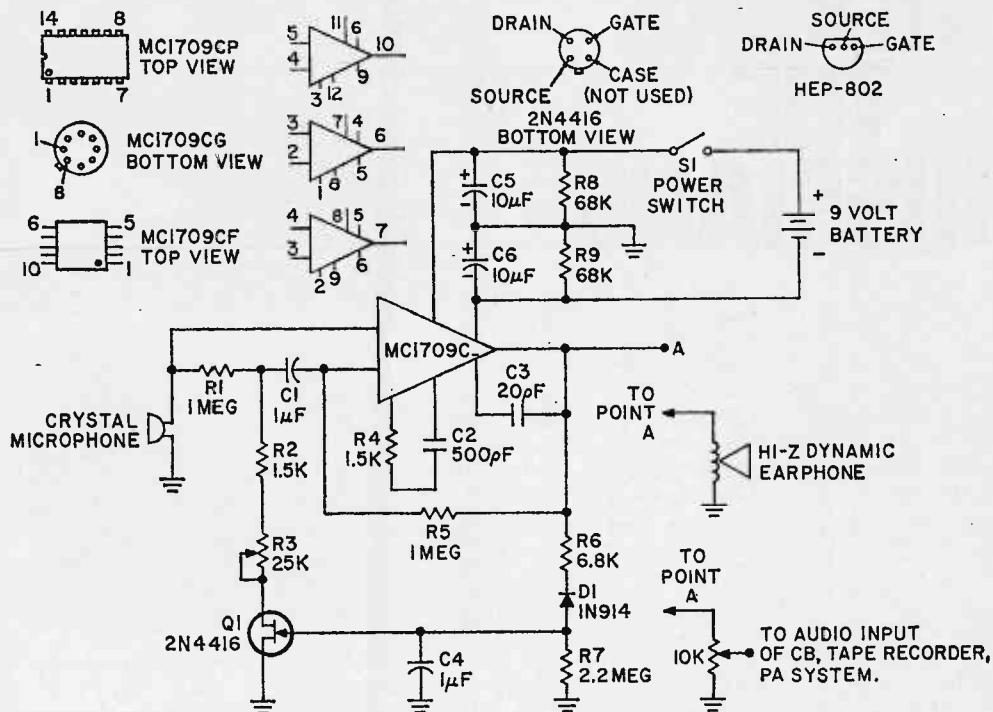
Bounces Back. The AVC (automatic volume control), or gain reduction, has a fast attack since the diode charges C4 rapidly. The gain recovery takes several seconds after the sound level is reduced due to the discharge of C4 through R7. This is standard practice in compressor circuits.

The standby power drawn by the amplifier from the battery is very low. The required positive and negative voltages needed to operate the integrated circuit are obtained by the low current divider R8 and R9. These resistors are bypassed for signals by the two capacitors C5 and C6.

A desirable feature of the circuit is the

bootstrapping of the positive amplifier input by returning R1 to the junction of R2 and C1 instead of to ground. This increases the apparent input impedance of the input and reduces loading on the microphone.

The hearing aid is constructed in a 3¼-in. x 2⅛-in. x 1⅛-in. bakelite case with an aluminum panel. All the parts except the battery and switch are mounted on a small piece of perf board which is then fastened to the panel. A hole is cut in the panel for the microphone, and the switch and sensitivity control are mounted through one end of the case. No provision was made to secure the battery since, in my case, the parts placement permitted wedging the battery into the case in such a way that the rest of the components kept it from moving about. ■



PARTS LIST FOR AMPLIFIED MICROPHONE

- B1—9-volt battery, Eveready 216 or equiv.
 C1, C4—1μF electrolytic capacitor, 3 VDC or better
 C2—500 pF disc capacitor, 50 VDC or better
 C3—20 pF disc capacitor, 50 VDC or better
 C5, C6—10μF tan-alum capacitor, 6 VDC or better
 D1—Diode, silicon, 1N914 or HEP-156
 EP1—Earphone, dynamic, high impedance (Lafayette 40-78010)
 IC1—IC amplifier, MC1709CF, G or P (Motorola)
 M1—Microphone, crystal (Lafayette 99-45103; Radio Shack 270-095)

- Q1—N-channel FET, 2N4416 or HEP-802
 R1, R5—1-megohm, ¼ watt resistor
 R2, R4—1500-ohm, ¼ watt resistor
 R3—25,000-ohm linear taper potentiometer
 R6—6800-ohm, ¼ watt resistor
 R7—2.2-Megohm, ¼ watt resistor
 R8, R9—68,000-ohm, ¼ watt resistor
 S1—Slide or toggle switch, SPST

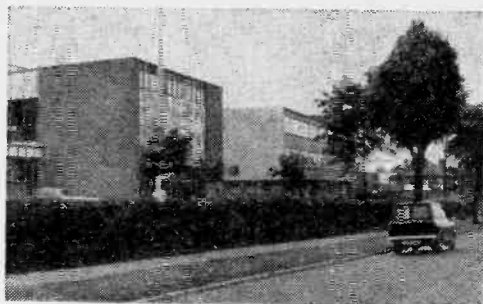
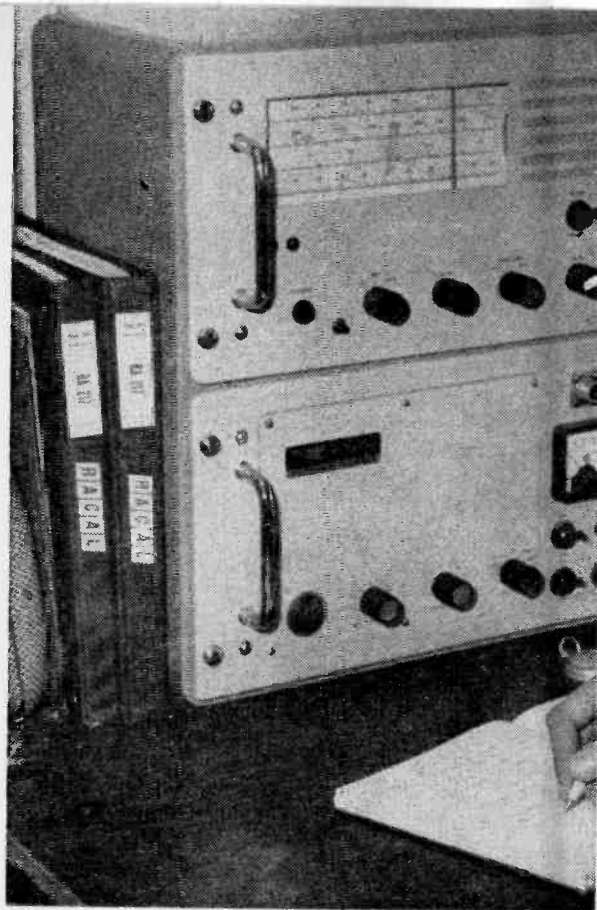
Misc.—Hardware, knobs, perforated board, push-in clips, wire, solder, battery connector, etc.

THE LITTLE RED SCHOOL HOUSE THAT TRACKS THE RUSSIANS

□ The front pages of the world press await the teleprinter's dramatic message of a new Soviet space mission. The source of this news? It's from the boys at Kettering Grammar School in Northhamptonshire, England! That's right, it's not from TASS or from NASA, but a group of adept young 13-year olds—known as COSPAR 2289.

Unlike the larger space tracking stations, this school-based operation has used rudimentary equipment and yet, these boys have scooped the world on tracking information. In April, 1970 they received the West's first signals from the Chinese satellite. Not a bad record, and the list of their accomplishments goes beyond that one event.

It all started around 1960 with the introduction of an inexpensive shortwave receiver—a \$60 model from government surplus. But the boys in Kettering's advanced Physics course managed to adjust the receiver to pick up the Russian's space tracking band. And their scoop isn't just a matter of reporting first, they also manage to pinpoint the orbit to perfection! Signals are received in morse code and these signals are recorded on tape. These shortwave listeners can tell by the volume of signals if an important launch is imminent. No 24-hour

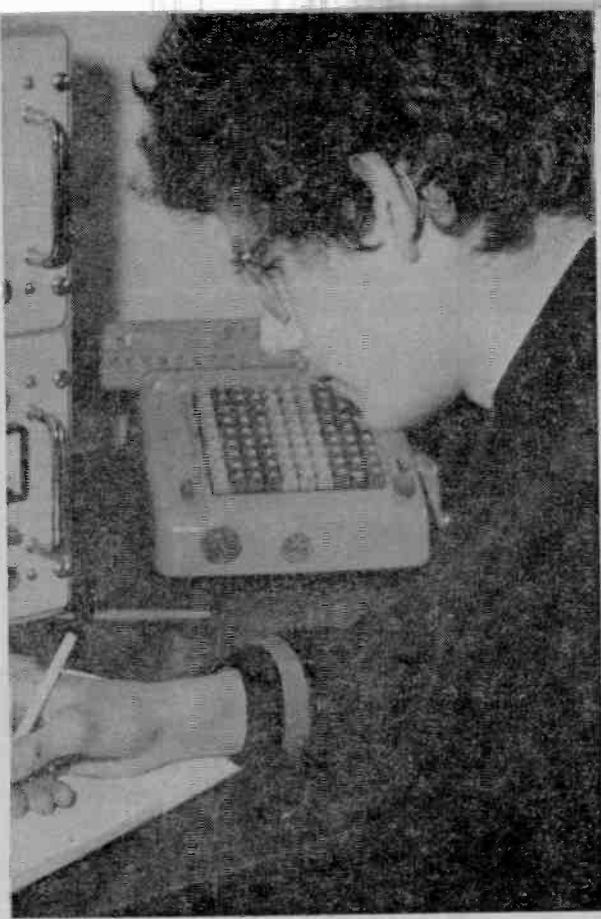


watch is kept, merely a 90-minute continuous watch each day.

This extra-curriculum subject has won the School praise throughout the world. They've received congratulations from NASA, Britain's Jodrell Bank, and on one occasion the Soviet Academy of Sciences—of course, that was when they tracked the Chinese.

It may seem strange that a bunch of young boys with an inexpensive receiver and a crude 75-foot wire antenna have managed to become a world information source. They surely have launched themselves into the exciting hobby of shortwave listening.

—Myrtle Gronk



The COSPAR 2289 tracking station is staffed by an experienced crew of young boys who know the world of shortwave listening well. A 90-minute daily watch is kept to monitor all Russian launches. Details of the watch are carefully entered into the log book (left) which is received in Russian morse code (below). Russian is one of the more popular languages studied at the school.



These DXers also learn about the space craft they track (above) from their science teacher. But their accomplishments are truly amazing when one considers their antenna (left), composed of 75-feet of wire strung between two of the school buildings. What seems to matter is not the quality of equipment, although it can help, but knowing how to work with what you have.

CB coffee break

THIS ISSUE'S COLUMNIST—JULIAN S. MARTIN, EDITOR-IN-CHIEF

□ **It's time to upgrade.** One undisputed truth about electronic equipment is that from the instant the power switch is first turned on, performance slowly starts to slide downhill. It's a very gradual deterioration in performance, so slow in fact, that from day to day it goes unnoticed; but somewhere along the way the performance level falls so low it's unusable, so the reason that the old reliable CB rig suddenly can't raise anyone on Channel 9 when you're stuck on the turnpike. It's the reason why the CB'er down the block is working a 5-station net on channel 16 and you can't hear anyone. And it's also the reason that one day your modulation turns to mush; true, it wasn't too great yesterday, but today no one can undersand what you're saying.

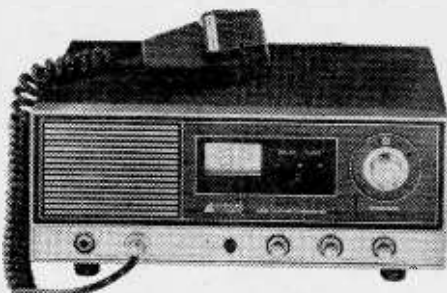
Just about everything contributes to signal deterioration. Crystals become less active, thereby reducing the drive to the final RF amplifier. Tubes and solid state devices age, not only reducing their output but also detuning tuned stages such as the RF and IF amplifiers. And, of course, corrosion eats away at antenna joints and connections until there's more power being

Courier's Cadet 23, their new 23-channel solid-state transceiver, is mini in size but large on features. Measuring a mere 1¼-in. x 5½-in. x 7½-in., this rig boasts easy installation, lighted 23-channel selector and illuminated S/RF meter. Other features include a P.A. switch with rear speaker jack, squelch



control, and a sealed receiver/transmitter antenna relay switch. Quality performance is assured from its one IC, 20 transistors and 6 diodes. It's also mini-priced at \$109.95. Circle No. 34 on Reader Service Page for more info on the Cadet 23.

The newest addition to Pearce-Simpson's Wild Bunch of "Cats" is the Lynx 23, a 23-channel base station. Featuring a



variable mike preamp built-in, this cat costs \$159.95. For more details on this new Wild Cat, circle No. 35 on Reader Service Page.

consumed in the connections than is being radiated by the antenna.

Another factor that contributes towards poor CB performance is the simple fact that today's equipment is a hell of a lot better in just about every respect than most equipment just a few years' old. Receivers are more sensitive, transmitters are more efficient, and solid state modulation is much better than early attempts at getting talk-power out of transistors. And let us not overlook antennas. The old ground plane and coax antennas that got us started in CB are nowhere near as good as the "stretched" groundplanes (omnidirectional beams) that put two to three times more signal on the ground—where it's needed—than a conventional ground-plane or coax.

Add it all together—the deterioration of your own equipment and the improved performance of modern equipment—and it's more than likely you're ready for a complete upgrading; everything from the corroded skyhook, to the dried and brittle power-robbing coax to the rig itself.

One thing you're sure to notice as the gear is upgraded is that there is a much wider choice of equipment available today, specifically tailored to your needs. For example, most of us who needed miniature mobile rigs usually had to compromise with perhaps 5 or 6 plug-in chan-

(Continued on page 97)

DXers Delights

Allied SX-190 receiver

Gilfer A-20 preselector

Heath SW-717 receiver kit



3 equipment reports for the SWL

by the ELEMENTARY ELECTRONICS editorial staff

□ The thrill of logging a long-sought mini-power transmitter is a shortwave listener's delight. QSL card or not, it's still a thrill to slice a 250-watt pip-squeak Cook Islands outlet from a sea of one-hundred kilowatt behemoths. Sure, you can come up with the VOA on a budget portable. Sometimes results can be phenomenal with these receivers. But a real DX buff with a true SWL receiver can bag the real rarities. So, we've selected three pieces of SWL communications gear for our report. Two receivers show what you can do on a medium or short budget. And for any budget, our third item, a preselector, adds two important requirements to any DX snooper's receiver—sensitivity and image rejection.

● ALLIED SX-190 11-BAND SHORTWAVE SOLID-STATE RECEIVER

HERE'S a real winner for the SWL looking for high performance reception at a reasonable price. Fact is, unlike many other so-called communications receivers which are basically amateur receivers with short-wave thrown in, the Allied SX-190 is specifically tailored and intended for the SWL, and the features are those required for optimum DX'ing.

The SX-190 is 15-in.W x 7-in.H x 10-in. D. It provides frequency coverage from 3.5

to 30 MHz in 11 crystal controlled bands. The main tuning dial tunes up 500 kHz from the selected crystal frequency; for example, if the receiver bandswitch is set to 7 MHz, the tuning range is 7 to 7.5 MHz.

The SX-190 is factory supplied with 9 crystals for the 3.5, 5.7, 7.0, 9.5, 11.5, 14.0, 15.0, 17.5 and 27 MHz bands. There are two blank positions on the dial for user selected crystals, though any of the crystals can be changed. *(Turn page)*



Allied SX-190, \$249.95
Circle No. 60 on Reader Service Page

The receiver operating modes are LSB, USB, standby, AM, and ANL (AM detection with automatic noise limiter). A tuneable select-reject Q-multiplier is provided.

Among the many minor features are a calibrated preselector, 100 and 25 kHz crystal calibrators, RF gain control, AC and DC power supply, S-meter, VFO output, and both speaker and headphone outputs and an output for a tape recorder.

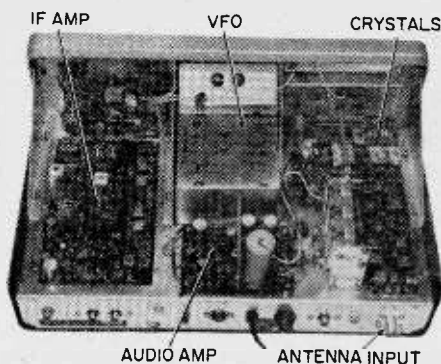
Circuit Facts. The basic circuit line up is very similar to the finest communications receivers. The preselector input is an FET and the preselector switching is ganged with the band selector switch so that the proper preselector range is automatically selected by the band switch. The output of the preselector is heterodyned by a crystal controlled high frequency oscillator and applied to a 2.920 to 2.420 MHz bandpass IF amplifier. The output of the bandpass IF is applied to the second mixer where it is mixed with a 500 kHz bandwidth tuneable oscillator. The second mixer's output of 455 kHz is fed to a mechanical filter 455 kHz IF amplifier and on to the appropriate detector. A crystal controlled balanced modulator is used for the sideband signal detection.

Aside from the stable VFO (tuning) oscillator, crystal controlled tuning and detection oscillators, considerable attention was paid to insure precise frequency readout. What appears to be a main tuning dial is actually two dials. The main dial, with the quick-tune finger hole, is surrounded by a friction clutched dial calibrated from 0 to 50 in 1 kHz segments. To calibrate the dial you turn on either of the two calibration signals and adjust the main tuning dial for a zero beat in the speaker. Then, while holding the main tuning dial, you adjust the

calibrated dial so a "0" or "25" appears opposite the dial cursor. The receiver is now calibrated. To tune, for example, 7.325 MHz, you would set the band selector to 7 MHz, adjust the main tuning so the main dial indicates "300" (for 7.3 MHz) and then advance the tuning just a little so the tuning knob dial indicated "25"—the final result is 7.325 MHz.

As far as we can determine the dial can be set with good accuracy to within 500 Hz of the desired frequency; that's as good as receivers twice the SX-190's price.

Performance. The sensitivity for AM signals between 3.5 and 9.5 MHz measured 1 μ V or better for a 10 dB Signal plus noise to noise ratio. Between 11.5 and 27 MHz the sensitivity was 1.5 μ V or better for 10 dB S+N/N. The difference in sensitivity for the two ranges appears to be due to the preselector tuning which is divided into two bands regardless of the number of tuning ranges. At the higher frequencies the pre-



Considered by many to be the best system, crystal controlled front end and VFO tuner put this receiver right up front in tests.

selector is not quite as hot as it is for lower frequencies. What is important is the little difference in low to high frequency sensitivity for a reference audio output level—the SX-190 is almost as hot at 27 MHz as it is at 3.5 MHz.

The selectivity, measured through the antenna input, was 60 dB down at 10 kHz, which is excellent. Image rejection averaged 80 dB. The AGC action for the signal range of 1 to 10,000 μ V was 5.5 dB, meaning that if you tune from a very weak to a very strong signal you won't be blasted by a sudden increase in the speaker volume.

The S-meter is calibrated to indicate S9 on 6.3 μ V signals below 11 MHz and 10 μ V above 11 MHz. In the range of S5 to S9 each S-unit represents a signal level change

of 4 dB. Outside this range the signal strength readings are relative.

One interesting feature is that there are absolutely no microphonics. Even with the receiver tuned to 27 MHz you can pound the table or the receiver itself and there is no ringing or howling.

After a 15 minute warm-up the stability was better than 300 Hz; in plain terms this means you can tune in an SSB station and take your hand off the knob, the signal won't drift into monkey chatter.

Technical Knock Out. The Q-multiplier works very well in both the select and reject functions. When set to select the Q-multiplier sharply peaks the tuned signal well above the level of interfering adjacent signals; however, select can be used only for CW signals. The reject function can be used for both phone and CW; its notch is so

deep and narrow we were able to squash an interfering CW signal that was almost obliterating a 7.3 MHz phone signal.

Because the overall selectivity is fixed at a high value, shortwave programs tend to sound bassy as the high frequency sidebands beyond 2 kHz are attenuated. It's one of the compromises necessary to maintain high overall performance at a reduced price. (Variable selectivity would require additional mechanical filters, and they are expensive.) In the long run, though, the SX-190's sharp selectivity pays off in DX'ing.

Summing Up. From any viewpoint the Allied SX-190 Shortwave Receiver is a real winner. You'd be hard pressed to find something better anywhere near its modest price of \$249.95.

For additional information circle No. 60 on the Reader Service Page. ■

● GILFER A-20 4 TO 22 MEGAHERTZ SHORTWAVE PRESELECTOR

THERE is always one more station to hear. Whether your shortwave receiver is a rock-bottom priced budget model or the best of the "gold plated specials" there is always just one more signal you'd like to receive—and it's often buried well below the receiver's sensitivity threshold.



Gilfer A-20, \$49.95
Circle No. 59 on Reader Service Page

One good way to try for those signals everyone *but* you seems to hear is by adding more front-end gain to your receiver with a preselector—a high gain *tuneable* RF amplifier that connects between the antenna and receiver.

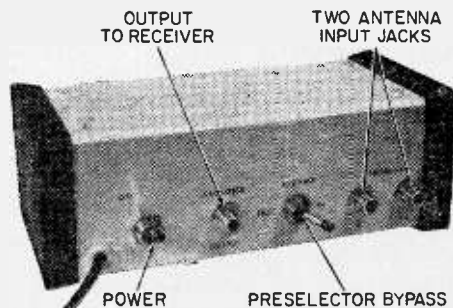
One of the very best preselectors specifically designed for the shortwave listener that we have seen is the Gilfer Model A-20 PreSelector, which not only delivers outstanding performance, but also offers flexibility and conveniences not usually seen outside the most expensive equipment.

The model A-20 PreSelector, which is housed in an 8½-in. W x 3-in. H x 3½-in.

D cabinet, has a single tuning range covering 4 to 22 MHz—the important SWL frequencies. The tuning control is an oversize 3:1 vernier of quite good calibration. Also located on the front panel is a gain control and an antenna selector switch. The rear apron contains the power supply switch, preamp in-out selector, phono jacks for antennas A and B and the preamplifier output which is also a phono type jack.

The A-20 PreSelector is AC powered. The amplifier itself uses two transistors and a torroid coil in the tuning circuit. Except for the panel hardware, all components, including the power transformer, are assembled on a printed circuit board.

Of some importance, and don't think this is an old design, is the use of transistors and not FET's. By using good, low noise



Features include dual antenna input with switchover, and bypass switch for strong signal overload prevention and protection.

e/e DXers DELIGHTS

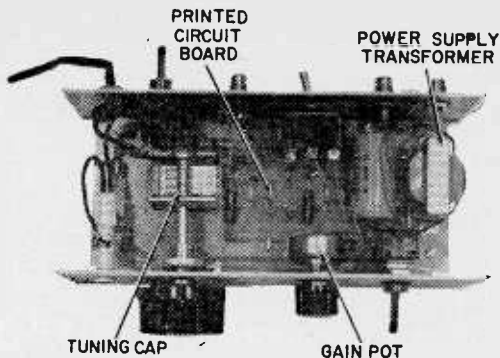
transistors, the A-20 performance is quieter than expected. Usually, FET's only reduce the possibility of strong signal overload at the expense of a higher noise level. Since the preselector is intended for reception of very weak signals and is switched out for strong signals, there is no need to compromise overall performance just for the sake of using FET's.

Performance Is Outstanding. We tried out the A-20 PreSelector on three receivers—one real rock-bottom priced, one medium price, one a "gold plated special." In all instances the A-20 coupled into the receiver with absolutely no feedback instability of any kind, and total gain was approximately 25 dB in all three instances. The A-20's tuning was relatively sharp, which produced a striking reduction in image interference common to the less expensive receivers—this alone was worth the A-20's price of \$49.95.

Using the A-20, we were able to receive *cleanly* signals that were not even discernable when the three receivers were running barefoot.

One interesting fact is that even when the antenna lead-in was crossing and touching the preselector's output cable, there was no instability or feedback of any kind, something rather uncommon in high gain preselectors.

What About Overload? Even with the full output of our signal generator, which is 50,000 μ V, we were unable to overload the A-20. Conceivably, stronger signals could cause overload. But can we expect signal levels that even approach 50,000 μ V? We could find no signals within the A-20's en-



Only operating controls are positioned on front panel. Oversize tuning knob makes it a snap to adjust extra sharp tuning system.

tire tuning range that would overload the preselector.

The only thing about the A-20 that takes some getting used to is the tuning. It is so sharp that it must be present to the approximate frequency you are interested in monitoring, or you will hear nothing. For example, if the preselector is preset to 5 MHz and the receiver is tuned to 15 MHz the A-20 will reject just about every 15 MHz signal. This is, of course, a big plus, for it is the reason the A-20 does an excellent job at rejecting image signals.

Construction. There is nothing chintzy about the A-20. All components, hardware and PC board are oversize and first-rate quality. Even the cabinet material is about three times the usual gauge.

In summing up we have no reservations about recommending the Gilfer A-20 PreSelector. If you require maximum receiver sensitivity in the 4 to 22 MHz range, the A-20 is a *must have*.

For additional information circle No. 59 on the Reader Service Page. ■

● HEATH SW-717 SHORTWAVE SOLID-STATE RECEIVER KIT

USING some of the latest solid state techniques, the Heathkit SW-717 Shortwave Receiver scores as a trouble-free beginners kit. It's sure to please just about anyone getting started as an SWL or electronic hobbyist.

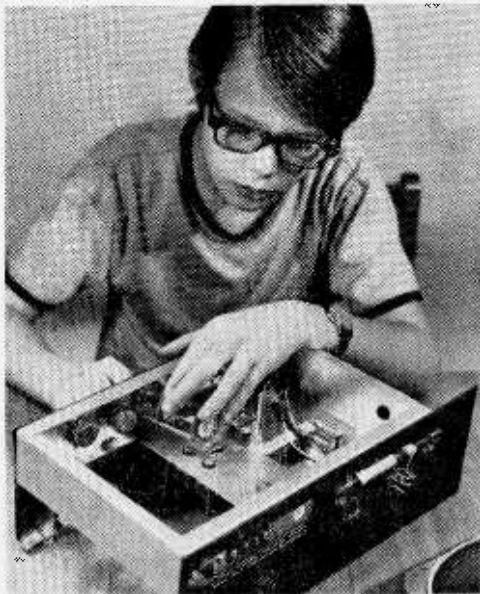
The SW-717, priced at \$59.95 (kit form only), covers from 550kHz to 30 MHz in four overlapping ranges and features electrical bandspread, a relative signal strength meter, a BFO, automatic noise limiter and a low impedance headphone output (use com-



Heath SW-717, \$59.95
Circle No. 1 on Reader Service Page

munications or hi-fi type phones). A built-in rod antenna is provided for the broadcast band. All circuits are solid state, with a transformer power supply that operates from 120 to 240 VAC depending on the transformer connections.

The circuit features a dual gate FET input, three ceramic IF filters (no adjustment—ever), a Darlington IF and a bipolar amplifier, an AGC amplifier, and an OTL (output transformerless) audio power amplifier.



Don't think you can? Well he did! Young 12 year old Erik Hyypia assembled this kit in less than three days. Shown here, he adds hardware to bandswitch assembly before installing completed printed circuit board.

BFO Bonus. Though not mentioned in the Heathkit specifications, there is also a Q-multiplier! The BFO is actually a controlled feedback path between the IF amplifier's output and its input. As the control is adjusted, the IF amplifier is brought to the point where the IF amplifier oscillates, thereby producing the beat note. However, just before the oscillation begins, the Q of the IF amplifier rises very sharply—the exact same effect as would be provided by an add-on Q-multiplier. By keeping the BFO control just below the point of oscillation it is possible to drop adjacent frequency interference from a phone signal. For CW, you simply rotate the control a little further to produce oscillation, and don't forget to disable the AGC (automatic gain control).

Terms and Abbreviations

- AGC**—Automatic gain control, a feature in modern receivers that prevents excessive volume changes when received signals vary.
- ANL**—Automatic noise limiter, a circuit in modern receivers that prevents excessive static from being heard.
- Bi-polar**—Another term for transistor (NPN or PNP type).
- DXer**—One who listens to distant radio stations as a hobby.
- Front end**—Signal processing area of radio receiver to which the antenna is connected.
- Q**—Quality of an inductor. Normally, high-Q is an advantage in communications receivers.
- Selectivity**—Ability of a receiver to separate stations.
- Zero beat**—Act of bringing two AC signals to the same frequency of oscillation.

The SW-717's front panel controls are—*BFO, volume, band, selector, mode (AM-standby-CW), main and bandspread* tuning. The *ANL* (noise limiter) switch is mounted on the rear apron. A phone jack is mounted on the front panel; it automatically disconnects the internal speaker when the phones are plugged in.

A new SWL will find station hunting a snap; the main dial is both frequency and activity calibrated, indicating the popular Ham, international broadcasting, marine and weather frequencies.

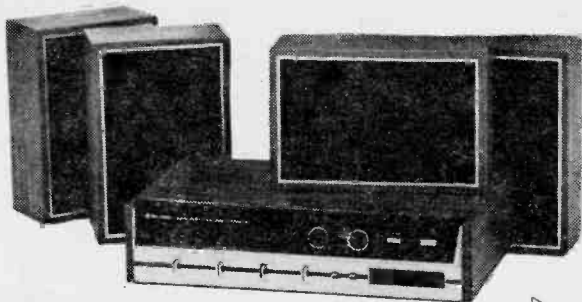
Just about every critical circuit is assembled on a single printed circuit board. By modern standards, the PC board is oversized and just about goof-proof; there are no parts jams to confuse the builder.

Once completed, the kit can be aligned easily without instruments, but it is necessary to be able to receive stations at certain *check* or alignment frequencies. Better performance can be obtained with an instrument alignment, for which an inexpensive RF signal generator will suffice.

Performance. Quite obviously a rather simple circuit with received signals fed directly to the mixer is not going to be the equal of a high priced communications receiver. As far as we can determine, the SW-717's performance is about the equal of other budget receivers in the \$50 to \$99 price range. The big plus, of course, is that *you* build it, *you* get the pleasure out of completing a relatively complex project, and *you* learn something about receivers and receiver alignment while assembling the kit.

For additional information circle No. 1 on the Reader Service Page. ■

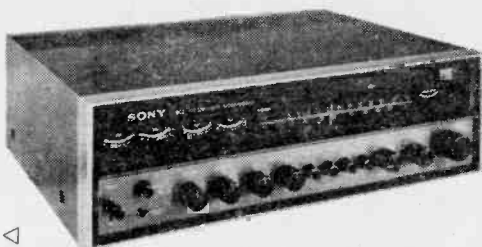
FOUR-CHANNEL FOR YOU



CIRCLE NO. 63 ON READER SERVICE PAGE

The Bell & Howell 3555 CST "Quatrix" home entertainment center provides a matrix 4-channel AM/FM-stereo receiver and an 8-track cartridge player. The matrix decoder can be used to create synthesized 4-channel sound from stereo sources, by reproducing the ambient background information. The 3555 CST is \$209.95.

Sony's SQR-6650 SQ receiver has two built-in decoding circuits, one for SQ, the other for all other matrix systems on the market. This AM/FM-stereo receiver has input and control facilities for 4-channel cartridges and tapes, and can also provide derived 4-channel from stereo broadcasts and recordings. The quadraphonic amplifier delivers 32 watts of continuous rms output power into 8 ohms. The SQR-6650 is priced at \$329.50.



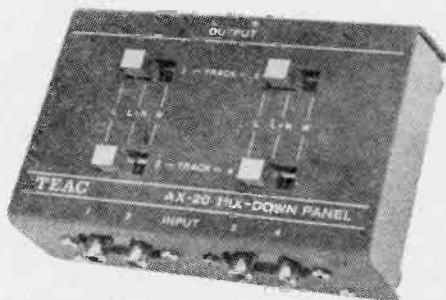
CIRCLE NO. 64 ON READER SERVICE PAGE



CIRCLE NO. 65 ON READER SERVICE PAGE

The Electro-Voice EVX-44 Stereo-4 decodes matrixed 4-channel records, tapes, and FM broadcasts. No switching is required by the listener to play any of these sources. The EVX-44 also increases the separation between front and back speaker when a solo voice or instrument is located in the center front. The EVX-44 is \$99.95.

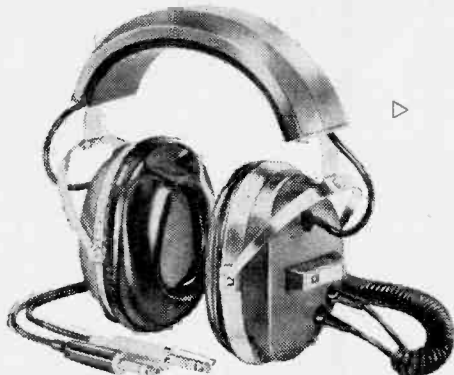
From TEAC, the AX-20 mix-down panel will convert 4-channel tapes to 2-channel and perform many other operations when editing, mixing or transferring recorded material from multi-channel or simul-sync recorders. It allows track-placement switching without having to plug and unplug cables, and is priced at \$30.00.



CIRCLE NO. 66 ON READER SERVICE PAGE

Although it's a question which 4-channel system will become the standard—Columbia, Electro-Voice, JVC-RCA-Panasonic, or Sansui—it's no question that just about every hi-fi component manufacturer now

has several quadraphonic items on the market. Even if you don't dig 4-channel, it seems to be here to stay, so why not relax and enjoy it? These components will help.



The Koss PRO-5Q Quadraphone features a stereo/four-channel switch, making it compatible with both modes of sound reproduction, by connecting the two driver elements in each earcup in parallel when in the 2-channel position. Fluid-filled earcushions exclude distracting outside sounds and extend the bass response. Rotary controls in each earcup balance the front-to-rear and right and left sound levels of quadraphonic sources; \$70.00.

CIRCLE NO. 67 ON READER SERVICE PAGE

The Fisher 40 is a 4-channel, 200-watt AM/FM-stereo receiver with a built-in 4-speed automatic/manual turntable, 4- and 2-channel cartridge player, and the Fisher 2 + 2 Decoder that extracts hidden ambience information from conventional stereo programs and plays it through the rear channels to achieve a 4-channel effect. The Fisher 40 music center is \$499.95.



CIRCLE NO. 68 ON READER SERVICE PAGE



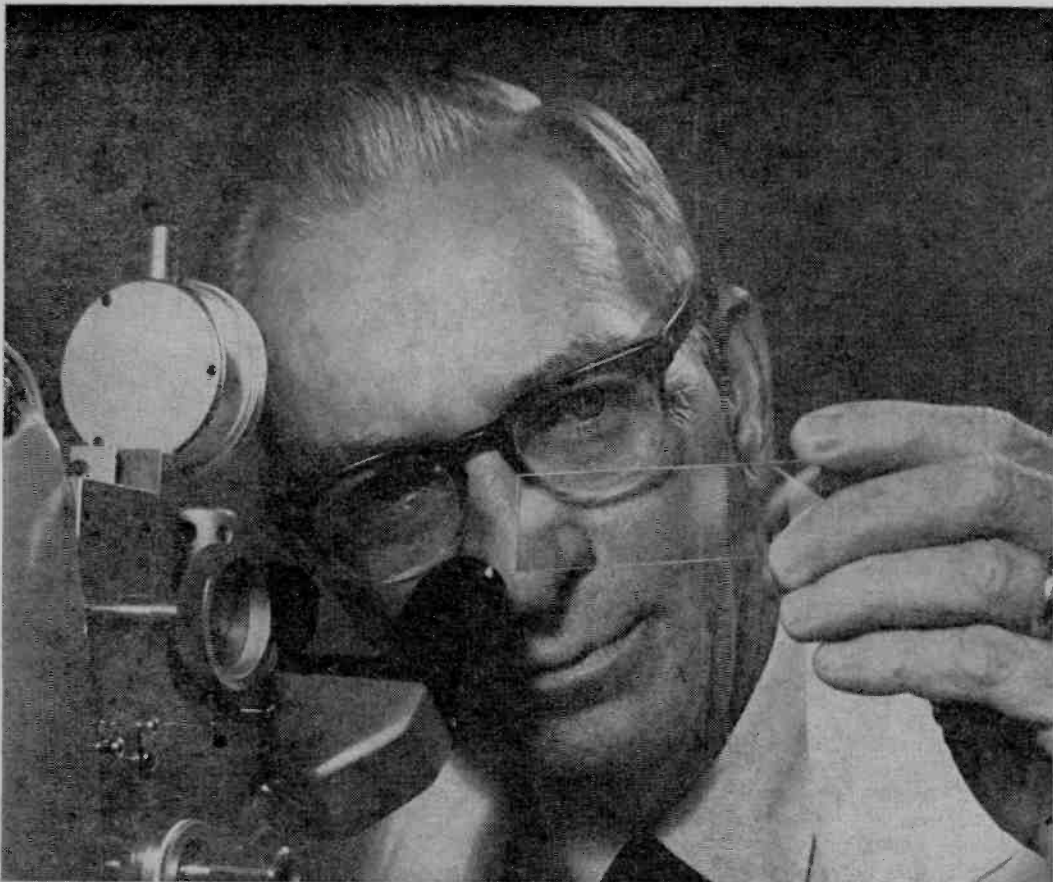
The four-in-one Wollensak 8060 8-track cartridge player/recorder reproduces all forms of 2- and 4-channel recordings. The 8060 will record and reproduce conventional 2-channel stereo, matrixed discs, and pre-recorded discrete 4-channel tapes, and will also record matrixed FM-stereo broadcasts and reproduce them in either stereo or 4-channel; \$199.50.

CIRCLE NO. 69 ON READER SERVICE PAGE

CIRCLE NO. 70 ON READER SERVICE PAGE

From JVC, the 4VC-5244 automatic record changer has a built-in 4-channel demodulator and a new cartridge containing the Shibata stylus. The CD-4 demodulator switches automatically to accommodate either 2-channel or discrete 4-channel records. This two-speed (33 $\frac{1}{3}$ and 45 rpm) changer is \$189.95.





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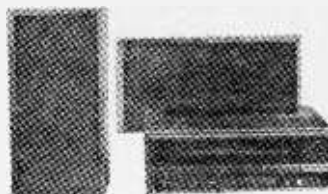
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CIRCLE NO. 13 ON PAGE 17 OR 103

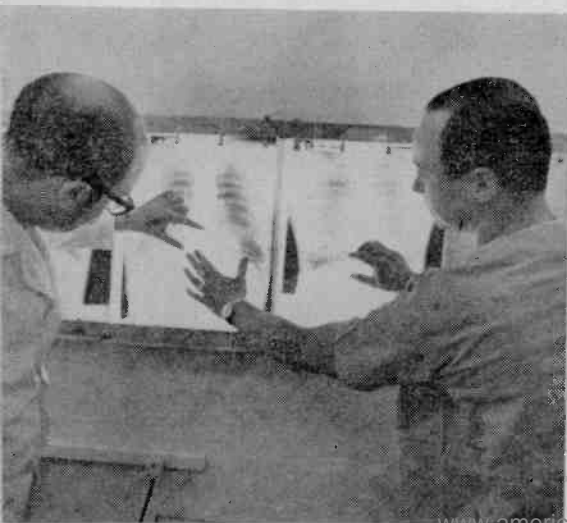
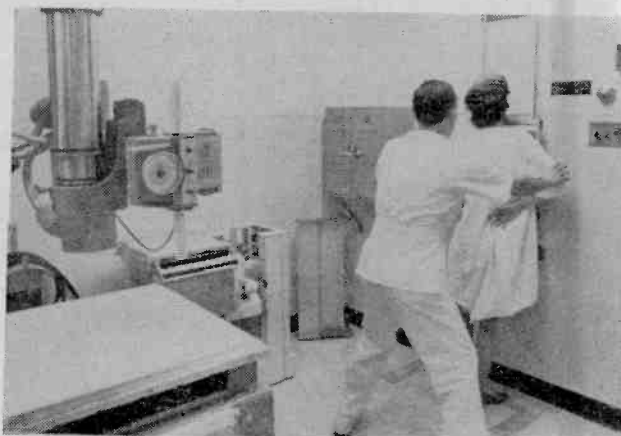


Not an actress, but a real-life heart patient, this woman enters The Norwalk Hospital to star in an X-rayed flick of her heart.

The Film of Your Heart is X Rated

by Myrtle Gronk

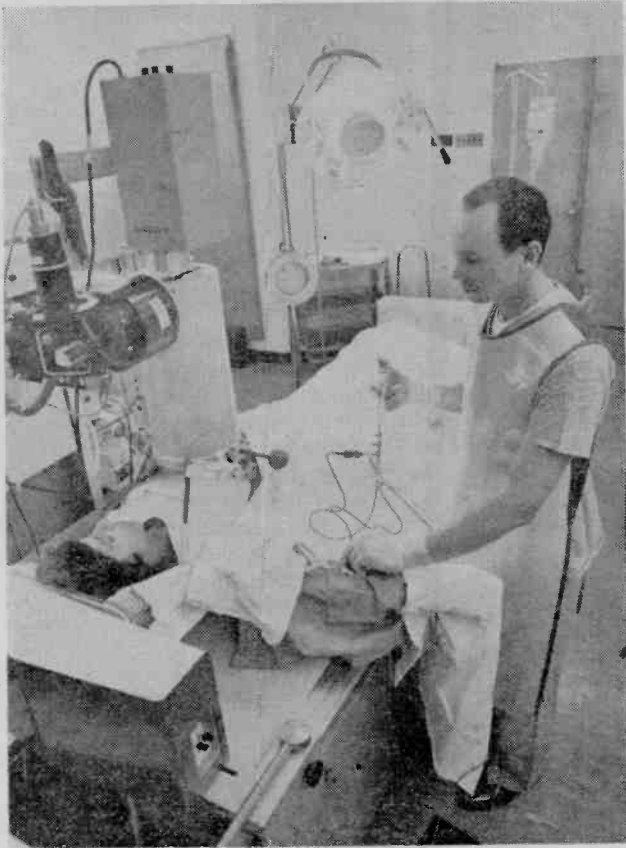
The new diagnostic procedures at Norwalk Hospital include a large battery of tests and monitoring devices. This woman is undergoing one of the initial X rays (right) which will be followed by a motion picture X ray. A specially trained team of physicians then carefully study the results of these X rays (below) before proceeding to cardiac catheterization.



There's a great new picture with a great plot—guaranteed to go straight to your heart! It's showing at the Norwalk Hospital in Connecticut. The theme: better preventive care for the number one killer—heart disease. A team of specially trained doctors utilize the newest medical equipment and techniques to monitor your heart and circulatory functions.

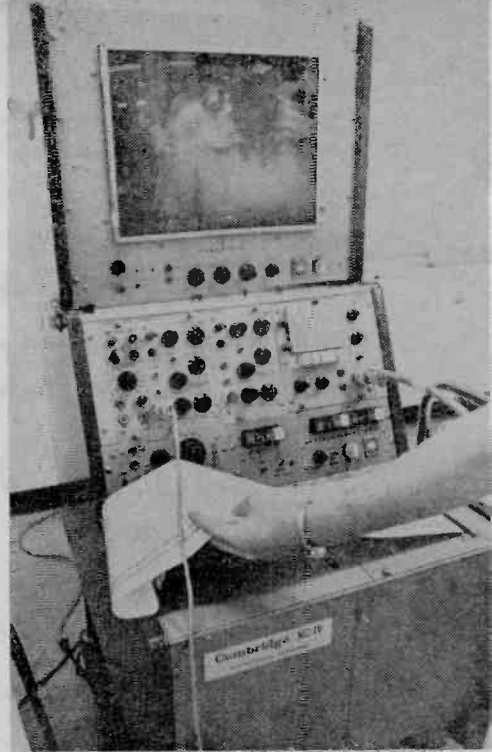
Even a special X ray machine is used, designed to use very small amounts of X ray energy, and takes high-speed motion pictures of the heart and related chest areas. There is also a fluoroscope attached to an image intensifier which allows precise detail monitoring of areas under study.

A technician (left) reads the special X ray unit which can take motion pictures as well as still photos. Attached to it is an image intensifier which picks up images and converts the light into electric energy, allowing pin-point detailed study of the area. Then the patient undergoes cardiac catheterization (below) which traces the flow of a special liquid through the circulatory system.



But the most unique method used is cardiac catheterization which visually reveals the blood supply to the heart. This one-hour operative procedure entails the insertion of a catheter into a vein or artery. A special liquid is injected into the catheter and monitored by X rays. The path of this liquid is traced on the intensifier screen as it passes through the circulatory system. At the end of this hour, the doctors have a good evaluation of the patient's heart and blood vessel functions.

This work at Norwalk Hospital is surely a step in a necessary direction. So, here's your chance to star in a multi-media movie, and think of the return—a healthier you!



While the data is being recorded on graphs and videotape, the X ray technician (above) observes the examination while it is in progress. Other visual equipment includes a video-playback machine (below) which enables the doctor to study the results of the motion pictures taken of the patient during the test.



e/e checks out the...

REVOX A77 TAPE DECK WITH DOLBY



Something new has been added to a well known recorder

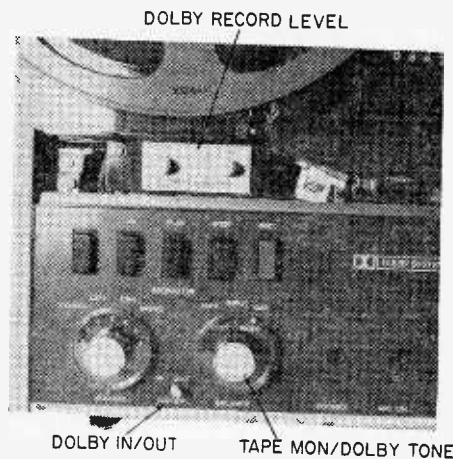
How do you improve upon an already superb tape deck? If you are Revox you simply avoid gimmicks that would only complicate what is probably the easiest-to-operate mechanism—whether professional or amateur—and concentrate on squashing the tape noise through use of a Dolby B noise-reduction system. The fact is, the only apparent difference between the old A77 and the Dolby A77 is the Dolby system. Well, it's the Dolby, but with a big difference. You don't get a calibration tape with the Revox because the machine is supplied so precisely adjusted you don't have to match tapes, make any corrections, or do anything other than record as you normally would.

The only apparent difference between a standard A77 and the Dolby A77 is two small switches at the bottom edge of the front panel. One switch is the Dolby selector, the other is the filter for the FM-stereo pilot signal, as Dolby circuits easily get "loused up" if pilot-signal leakage from a receiver rides along with the audio signal into the recorder. The only other apparent difference is the tape-monitor switch. The original A77 switch had three positions: one for NAB equalized playback and one for CCIR equalized playback and one for source monitoring. The new tape-monitor switch still has three positions but the CCIR play equalization is now replaced by a Dolby calibration oscillator. By placing the switch in the CAL position, a tone signal is auto-

matically applied to the recording amplifiers.

That's the whole change in external appearance. The other obvious change lies behind the drop-down strip that conceals the tape-drive path and the REEL MOTORS OFF switch on the standard A77. The Dolby A77 no longer has the reel-motor control switch. (Brake tension has been re-

(Continued on page 99)



Closer inspection shows a Dolby selector switch adjacent to the volume control, and a tone-calibrate position on the monitor selector. Sliding down the tape-slot cover reveals Dolby record-level adjustments in place of the reel motors off switch found on the non-Dolby A77.

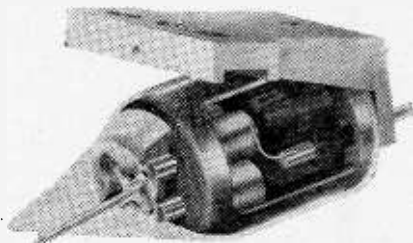
HEY HERB

THE AUDIO ANSWER MAN

by Herb Friedman



Hey Herb: Does it matter whether my pickup's stylus is conical or spherical for 4-channel records?



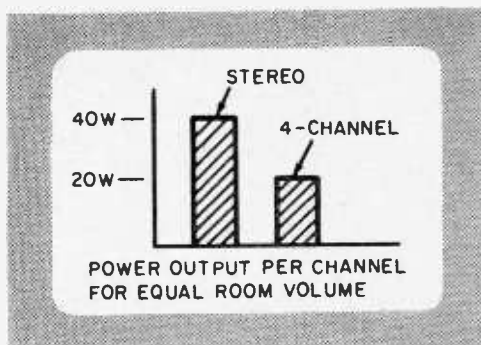
The spherical stylus tends to give from slightly better to really outstandingly better sound—depending on the particular record. But then, I've had really fine 4-channel results with a B&O pickup having a conical stylus. As a general rule, the top-of-the-line pickups from ADC, Empire, Stanton and Shure are your best bet for optimum 4-channel—the derived kind.

Hey Herb: I understand one of the manufacturers of Dolby cassette decks claims Dolby is not really needed. What kind of jazz are they handing us?

The outfit you refer to—whose name totally escapes me at the moment—makes two decks, one of which is Dolbyized. They contend, and they are right, that if you record almost exclusively *pop* and/or *rock* there's no need for the extra expense of going Dolby. Pop and rock records have very heavy compression, almost no dynamic range. In addition, radio stations playing the records throw on another 20 dB or so of compression for maximum average modulation; now there is "zero" dynamic range. So with the recorder's meter virtually holding at "zero VU" you will not have much of a noise problem; maybe a hiss between selections. On the other hand, classical and light pops can range from thundering sound levels to a little less than a whisper, and a Dolby is absolutely required to avoid having low level material buried in the tape hiss.

Hey Herb: How many watts per channel would you suggest for a stereo rig in a 12-ft. wide x 25-ft. long x 8-ft. high living room that's carpeted, has drapes on all windows (two walls) and plush furniture?

Congratulations. You have the so-called *average* listening room. The required power output will be sharply influenced by the speaker(s) efficiency. For the AR, KLH and similar speakers I'd go for nothing less than 40-watts rms per channel for wall-rattling sound. With Martin speakers, or similar high-efficiency types I'd settle for 25-watts per channel. You'll never need anywhere near these power recommendations except for program peaks, but if you like a high level transient burst to come out clean you need those power



capacities. Personally, I like about 100 watts per channel because I listen to a lot of *live* piano recordings (live meaning on-location, no compression), and live piano has 20 dB peaks.

If you're interested in 4-channel you can get away with about 1/2 less power in each channel due to psychoacoustic effects.

Hey Herb: Can you explain how to interpret the "tone burst" tests shown in reports on loud-speakers?

No. It would take a book and even then I'd be wrong because tone bursts have different meanings to different technicians and engineers. For example, a tone burst can instantly show how a speaker will perform at low volume levels by clearly indicating the linear axis shift—or the position of the speaker's voice coil(s) relative to a linear magnetic field. To date, no lab has published comments on this effect, which correlates very closely with listening tests. I understand the *Hi-Fi STEREO BUYER'S GUIDE* is presently assembling equipment to allow meaningful in-

e/e HEY HERB

terpretation of tone burst tests by the average reader. Until then, I don't feel tone bursts can tell the reader anything. (Of course, it helps to dress up the test report.)

Hey Herb: Are the new *open back* headphones really superior to the standard, enclosed type of phones?

Like everything else in this world, physical characteristics, and even the overall design concept, has nothing to do with performance. A lot of the newer low cost headphones push something called *open back* design. But when you open the back of garbage you still have garbage. On the other hand, Pioneer's low cost but outstanding



SE-L20 phones have both an open back and pressure cushions (non-circimaural). Since they know their phones are good they haven't talked up any of the *open back* nonsense. Never, but never get hung up in hi-fi hardware fads; the only rule to follow is "How does it sound to me?"

Hey Herb: I might be square but I like my sound low—a lot lower than so-called "concert hall" levels. My equipment dealer thinks I'm nuts but I contend that some speakers sound great at low levels while others are rotten. The dealer takes the position that a speaker which sounds good at high levels has got to be good at low levels. Who is right?

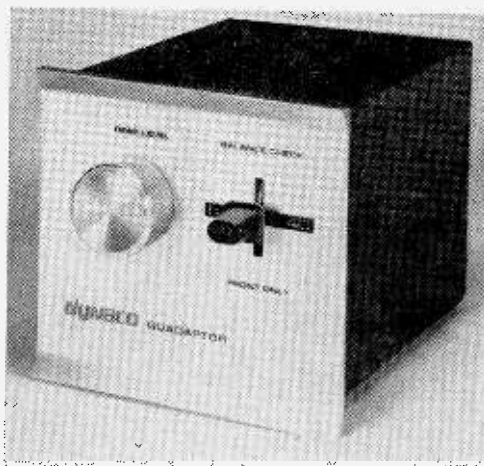
It's time you found a new dealer. Some absolutely outstanding high level speakers aren't worth the price of the wood used in the cabinet when played at low levels. If you want to hear what low level sound should be like, find a dealer who will let you hear a Rectilinear Low-Boy at really low volume levels. And if you want to hear what a thousand or so dollars buys you, listen to any of the Klipsh speakers at low level. Low level is really the worst-case test. Just about anything

Herb would like to answer all the questions our readers send. However, he can only sample the questions received and answer as many as possible through this column. Sorry, it's impossible to answer questions by return mail. Questions of a personal listening nature cannot be answered. Send your questions to Hey Herb, ELEMENTARY ELECTRONICS, 229 Park Avenue So., New York NY 10003.

decent will sound great if the sound level is so high it generates more distortion in the ear than there is in the entire electronic chain.

Hey Herb: Which of the 4-channel gear would you suggest as a starter?

It all depends on which type of 4-channel sound you want. If you're interested in pre-recorded 4-channel *carts* get yourself a *cart* player deck. If you just want ambient sound to fill in some space behind you, a real cheap Dynaco or Lafayette adaptor will sound as good as anything you're likely to buy for a lot more money. And the Dynaco type adaptor requires only your regular



stereo amplifier plus two more speakers. Other than ambient I'd sit the whole thing out until the manufacturers kill each other off and settle on one 4-channel surround-sound system (encoded on two tracks or disc). There's too many folks around who splurged on a 4-channel decoder only to find that a month or so later there was a new, *improved* system. Why join these poor folk with their outdated equipment?

Hey Herb: I'm having some trouble with noise from my hi-fi. Do you think you can supply me with a squelch circuit to kill the noise during quiet music passages?

Hey, pops, the time has come to blow taps for your mono PA system. The diagram of that tube job you sent with the letter tells me you are listening to BSS—before solid state! It's time for a new hi-fi setup!



by Kathi Martin KA10614

KATHI'S CB CAROUSEL

IT ISN'T often that I lift my bonnet to anyone—few ideas are really that good. But after using the new SBE Coronado II CB Scanning Transceiver, I not only lift my ski cap, I face Watsonville, California, and blow a big kiss to those folks at Linear Systems, purveyors of the SBE CB gear.

Linear Systems has really come up with a *biggie* for us CB'ers involved in public service through REACT, ALERT and other emergency teams. Their newest idea, the Coronado II, is actually a scanning transceiver very similar in operation to the scanners used on the action bands (police-fire monitors).

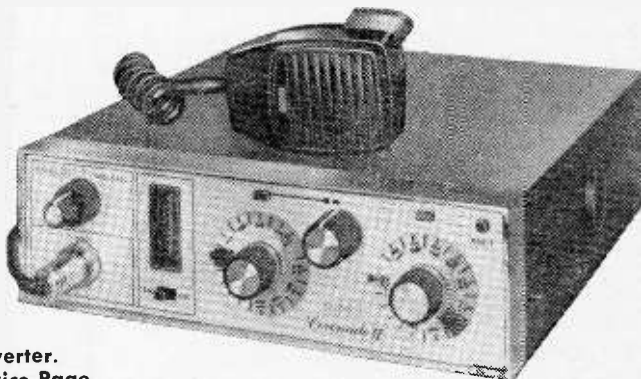
Dual Dials. Unlike the usual CB transceiver, a Coronado II has *two* channel selectors covering all 23 channels. Either channel selector can determine the receiver and transmitter frequency, and each can be preset to a specific channel and used independently of the other. For example, selector 1 can be switched to channel 16 after selector

2 is switched to channel 8. A mode switch on the front panel allows you to instantly select either of the two set-ups. This alone is not much help to an active CBER, *but* the mode switch has a third position that causes the receiver to automatically scan back and forth *between* the two selections. The instant a signal breaks the squelch (and it *must* break the squelch) the scanner locks onto that selector bringing in the signal. When the signal goes off, the scanning resumes until another signal appears on either channel.

With the Coronado II, it's almost like having two transceivers but only one set of controls to worry about—and, only one antenna!

Kathi's System. Here's how I use my scanner. Usually, I keep one channel tuned to the home base frequency so I can receive calls from the family and office. I keep the second channel set for my REACT group's operating frequency. With those scanning

Linear Systems took us by surprise with this one. It's a scanning transceiver monitoring any two of our twenty-three channels. Great for emergency standby monitoring on dual-channel nets, or use it as a Channel 9 monitor with 23-channel flexibility. Unit locks onto first scanned channel with audio present. Basically a mobile unit, I pressed it into home service with a power converter. Circle No. 55 on the Reader Service Page.

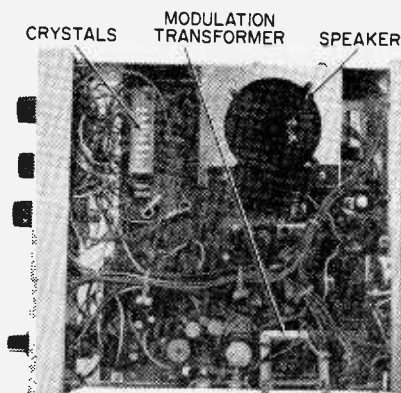


e/e KATHI'S CAROUSEL

lights blinking left-right, left-right, I know for certain I'm not going to miss any calls. When the REACT group shuts down I simply flip one selector to channel 9 so I can keep an ear out for emergency calls.

When I'm on the road, I keep one channel on 9 and the other switched to whatever channel the local CBers use for emergency assistance—many small towns have the frequency posted on their welcome sign.

To lock the transceiver to either of the two channels I simply flip the mode switch left or right and I'm right on frequency without fumbling through a channel selector.

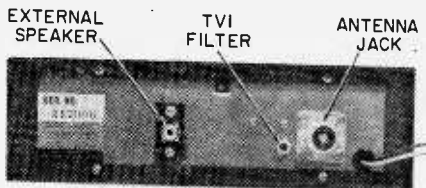


Frequency synthesizer means only fourteen crystals are required for full coverage.

The Coronado II is basically a mobile rig 8 $\frac{3}{8}$ -in. W x 2 $\frac{1}{2}$ -in. H x 8 $\frac{1}{2}$ -in. D. The power supply is 12 VDC negative ground and requires a converter for use with home-style 60 Hz power. A unit is supplied with all crystals, a mobile bracket, and a plug-in microphone. The front panel contains two channel selectors, the *mode* switch, concentric *volume* and *squelch* controls, a recessed S/RF meter, a *PA-CB* switch and indicator lights for each channel selector. The rear apron contains only the antenna jack and the PA speaker output; the DC power cables are attached to the rig.

Except for the scanner control circuits the Coronado II's innards are typical of today's modern units. The receiver is double conversion and has a mechanical filter in the second IF. An integrated circuit that provides amplification for the second IF drives into a detector and noise limiter. The trans-

mitter is conventional with a pi-net output and a TVI filter. Fourteen crystals in a frequency-synthesizer provide full 23 channel coverage.



Uncluttered rear panel includes adjustable TVI filter and non-detachable power cables.

Doubles Up. The scanner circuitry consists basically of a multivibrator and diodes that serve as crystal switches. The multivibrator, normally free-running, sweeps the two channel selectors alternately. An audio signal will turn *off* the multivibrator, thereby locking reception to the channel selector that caused audio to appear.

Top Notch Performance. Unlike other CB gear with fancy features and nothing in the way of useful performance, the Coronado II is a hot performer in all respects, for the scanner has been added to what is basically a fine transceiver. The sensitivity measured 1 μ V for a 10 dB signal plus noise to noise ratio (S+N/N). Adjacent channel rejection was an interference-squashing 50 dB, while the image rejection was 80 dB. The AGC action, where many sets fall short, over a 2 to 10,000 μ V range was a narrow 2 dB, and only 5 dB over a signal range of 1 to 100,000 μ V. This means that if you have the volume cranked open to hear a very weak signal, a station opening up down the block is not going to blast the speaker cone across the front seat. Fact is, the local powerhouse will cause but a barely perceptible increase in speaker volume.

The transmitter delivered 3.3 watts RF into a 50 ohm dummy load. The modulator sensitivity for 85 percent modulation was -31 dB, which is considerably more sensitive than the average -21 dB: this means that you'll fully modulate the rig with a very low voice level. My model was not limited to 100% modulation.

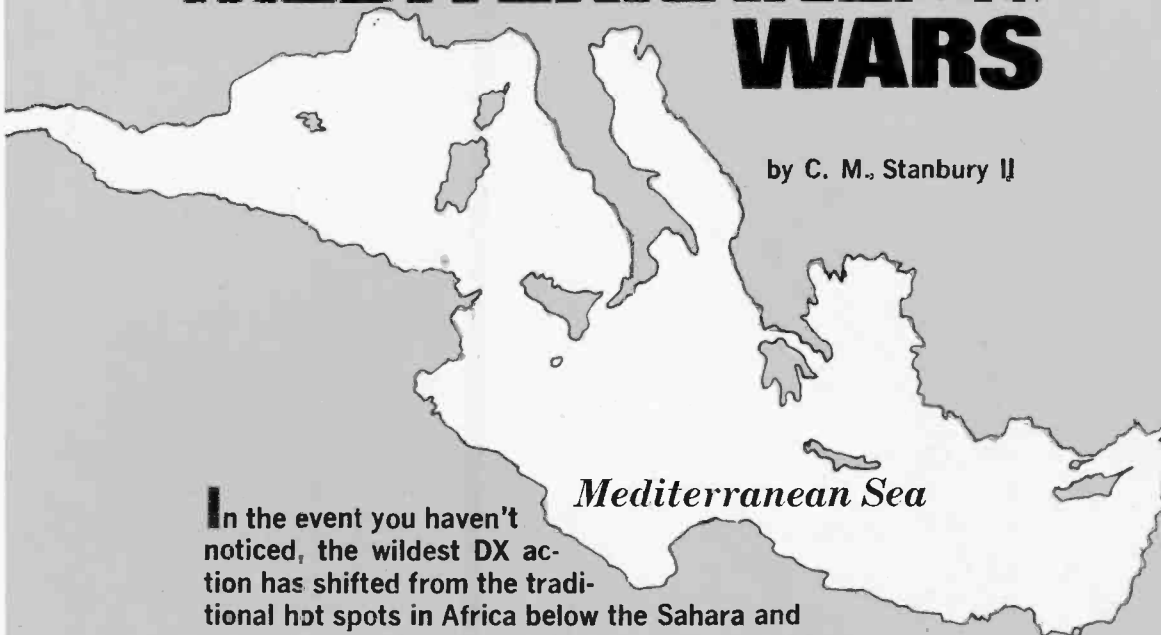
Summing Up. It's really hard to sum up a rig that does so much, so well. As far as this girl is concerned, the Coronado II is a beautiful way to increase a CBers REACT and emergency-team efficiency.

The SBE Coronado II is priced at \$229.95. For additional information circle No. 55 on the Reader Service Coupon. ■

SHORTWAVE BULLETS ARE FLYING IN THE ...

DX MEDITERRANEAN WARS

by C. M., Stanbury II



In the event you haven't noticed, the wildest DX action has shifted from the traditional hot spots in Africa below the Sahara and Latin America to the mighty inland sea, the Mediterranean. This ancient sea not only links three continents, but also washes the shores of such key radio islands as Cyprus and Malta. On Cyprus last summer the BBC began using a 1457 kHz transmitter to jam R. Peking's new medium wave relay in Albania. Only a couple months earlier, the BBC had used another transmitter on the very same frequency to successfully disrupt English pop music broadcasts from R. Monte Carlo, on neighboring 1466 kHz. Meanwhile, this same Monaco based commercial broadcaster has built its own eastern Mediterranean relay on Cyprus. And these are only some of the controversial DX prospects operating from this part of the globe.

It is unlikely that many DXers on this side of the Atlantic are going to hear R. Monte Carlo's new Cyprus operation. Frequency is 1232 kHz, only a couple kHz above a North American graveyard channel. The regular 1466 kHz outlet in Monaco is heard from time to time by expert medium-wave listeners east of the Missis-

e/e DX MEDITERRANEAN WARS

sippi, as will *R. Peking's* Albanian powerhouse on nearby 1457 kHz. But both stations, of course, can be more easily logged via shortwave. RMC is heard on 7135 kHz around 0100 EST; *R. Peking* uses its Albanian relay for evening English and Spanish transmissions to the Americas on approximately 7120 and 9780 kHz—the exact frequencies vary a few kHz, or more, from week to week. Albania's own *R. Tirana* identity has evening transmissions to the Americas on roughly 6200 and 7300 kHz. Again, the exact frequencies vary considerably.

The Big Islands. To log Cyprus itself, one of BBC's shortwave frequencies is your best bet—probably 15420 kHz where this key eastern Mediterranean relay has English late evenings and midday EST. Meanwhile, some 1500 miles west of Cyprus, on the island of Malta, the BBC is also up to its neck in clandestine operations. These activities were

Abbreviations for Beginners

BBC	British Broadcasting Company
DX	long distance, distant (contact or country)
DXer	hobbyist who seeks DX contacts
EST	Eastern Standard Time
kHz	kilohertz (kilocycles)
MW	medium wave
NA	North America
NRC	National Radio Club
R.	Radio (as in <i>R. Peking</i>)
RMC	Radio Monte Carlo
RTA	Radio-Television Algeria
S/Off	sign off (going off the air)
SW	shortwave

first brought to the DX communities' attention by an article in the National Radio Club's "DX News." Among other things, the NRC maintains that maximum radiation from the BBC's MW station here (last reported on 1511 kHz) is at 175 degrees. (This has been borne out by reception in North America off the back of the beam.) They also state that this transmitter is secretly concentrating on the Arab state of

TUNE IN THE MEDITERRANEAN HOT SPOTS

kHz	Identity	Location	When to Listen (EST)
6200v	R. Tirana	(near) Tirana, Albania	Evenings
7110	Voice of America	Rhodes Dodecanese Islands	2200-2400
7120v	R. Peking	(near) Tirana, Albania	Evenings
7135	R. Monte Carlo	Monte Carlo, Monaco	0100
7165	R. Libya	(near) Benghazi, Libya	Late afternoons & late evenings
7205	Voice of America	Thessaloniki, Greece	1900 S/Off
7300v	R. Tirana	(near) Tirana, Albania	Evenings
8630	R. Libya	(Unknown)	Variou
8931	Malta Aeradio	Valetta, Malta	Variou
	Nicosia Aeradio	Nicosia, Cyprus	Variou
9470	R. Cairo	Cairo, Egypt	Evenings
9510	RTA	Alger, Algeria	1900 S/Off
9780v	R. Peking	(near) Tirana, Albania	Evenings
11810	RTA	Alger, Algeria	Late afternoons
13970	R. Libya	(Unknown)	Variou
15165	Voice of Turkey	Ankara, Turkey	1700
	R. Damascus	Damascus, Syria	Afternoons
15190	Voice of Turkey	Ankara, Turkey	1700
15420	BBC	Limassol, Cyprus	Midday & late evenings

v—frequency varies.

e/e DX MEDITERRANEAN WARS

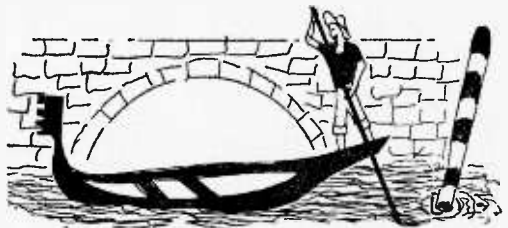
Libya. On August 15, 1969, this station had changed frequency and a memo concerning the move was issued to supervisory personnel at other BBC sites. Although the memo's content was definitely not intended for public consumption, we have now been able to obtain a copy. The memo implies that BBC Malta is intended for general day and evening coverage of North Africa. But a beam of 175 degrees would cover only Libya; this obviously provides very poor coverage of many of the more populous area of North Africa. It seems that those in charge of other British transmitter sites were not let in on Malta's secret.

Then, early in 1971, the *Voice of Germany* announced that it would build a short-and medium-wave relay on Malta (BBC's is only MW). However, about that same time the island elected a new government—one which supposedly wanted to sever all NATO links, and maybe let Russia use this strategically placed isle as a naval base. The matter was settled in 1972 indicating Malta was simply angling for more Western financial aid. BBC's clandestine-tinged outlet and the projected West German station may not be eliminated. For country counters, Malta can at present be most easily logged via their *Aeradio* on 8931 kHz. *Nicosia Aeradio* on Cyprus also uses this channel.

Switching to BBC Malta's apparent target, *R. Libya* has a super-power MW transmitter on 1124 kHz, and a shortwave outlet on 7165. Both will be best late afternoons and late evenings EST. Members of the North American SW Association have also reported *R. Libya* on such weird off-band frequencies as 8630 and 13970 kHz. To add

to the confusion, Libya has recently formed a loose federation with Egypt and Syria. *R. Cairo* NA service is widely heard evenings on 9470 kHz, while *R. Damascus* can be heard on 15165 kHz until they S/Off at 1700 EST.

On Africa's Shores. Another Arab Mediterranean nation where Marxism has become a powerful factor is Algeria, which in contrast to Libya receives virtually no BBC medium-wave coverage. But even the Algerian situation is not simple. Some nights, for example, when RTA concludes its regular programs on 9510 and 11810 kHz, the transmitters are turned over to a clandestine Portuguese identity *A Voz de Libertade*. This station is at least partially in compe-



dition with an East European clandestine —*R. Portugal Libre* (transmitting from Roumania).

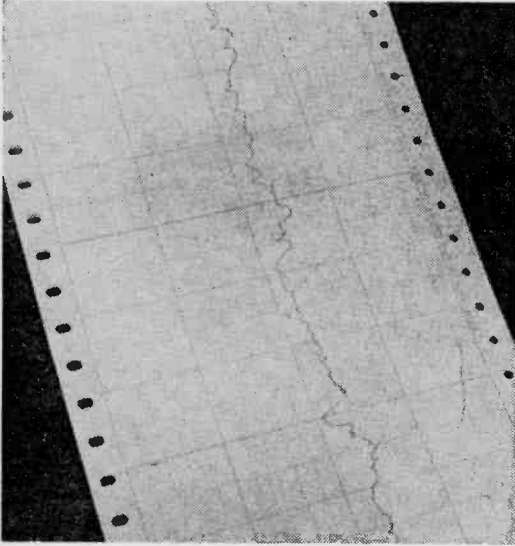
If you stay tuned to 15165 after *R. Damascus* S/Off at 1700, you will recross the political aisle and receive English from the *Voice of Turkey*. And that brings us back where we started, because Turkey along with its controversial NATO partner Greece have also been tangled in bitter Cypriot disputes. Despite widespread criticism of the Greek military regime, the *Voice of America* continues to operate a pair of relays on Greek soil; at Rhodes, in the Dodecanese Islands and at Thessaloniki which will soon be replaced by a new higher powered facility. ■

THE MISS YOU KISS CAN BE MEASURED BLISS

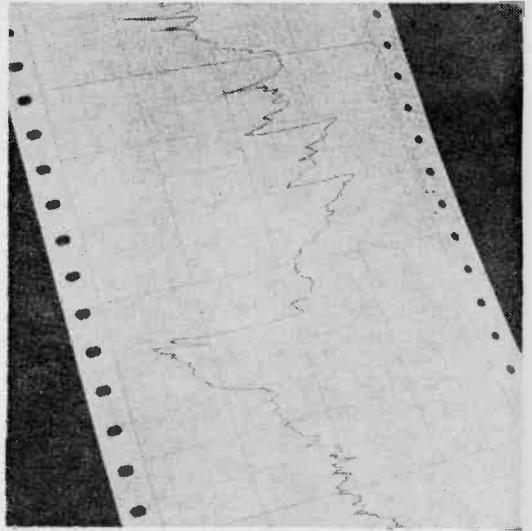
Test the electrifying quality of your kisses! Show the world once and for all, scientifically of course, the measure of your passion. All you need is the 7710 Storage Display Oscilloscope. Originally designed by engineers for the more banal task of measuring electrical resistance in high precision work (which may account for the far from romantic name for a passion tester), this device is accurate up to 100 millionths of a second—just long enough for a quick kiss to be measured. And just think, it only costs around \$1700 to perform this very important experiment. After all, isn't your love more valuable? —Myrtle Gronk



This Green Plant Knows What You



Abrupt changes in the chart are quite obvious as this plant senses the excitement of the experimenter. Plants too can share the joys and fears of their owners—and you don't have to take them out for a walk.



Plants can sense what is going on around them and such primary perception can be recorded on a polygraph. This plant is quite content during a calm conversation taking place adjacent to it. But wait . . .

Your Spanish Ivy is watching you! Sound silly? Well, it's not. Various independent studies of green plants have shown that this supposedly simple life form is not as primitive as most people thought. Green plants do have primary perceptions—they can "sense" emotional experiences—which implies some sort of nervous system. And much of this data was the result of an innocent experiment.

It all started when Mr. Cleve Backster, a lie-detector expert, was watering a plant. He decided to trace the flow of water from the soil to the top of the plant by applying the principles of the lie-detector. These tests measure the emotional reaction by the reduced resistance of the subject which causes the graph line on the polygraph to go up. So, he attached the electrodes to a leaf of a plant. But what happens when the subject is a plant? The results were far from expected.

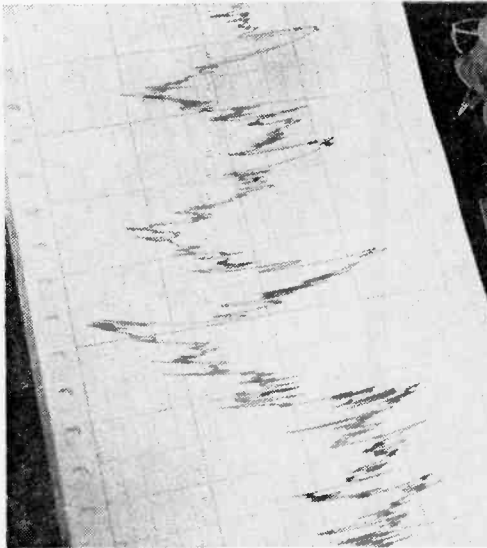
Mr. Backster had planned to measure the increase in the leaf's moisture content on

the polygraph tape using Wheatstone bridge circuitry. But after one minute of chart time, the tracing looked quite similar to that of a human experiencing a short-term emotional stimulation. Thus, indicating some sort of emotional response.

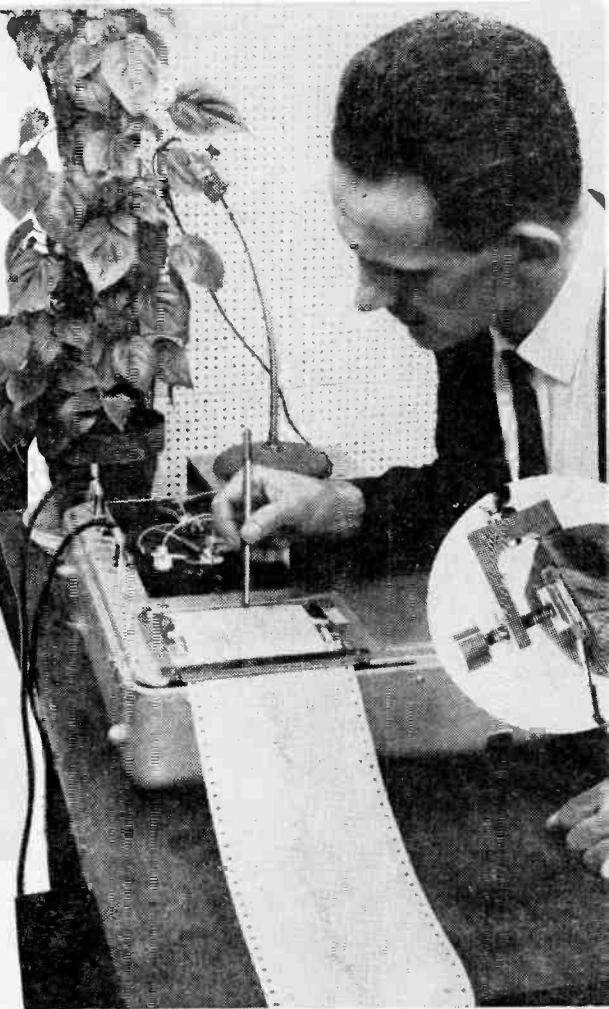
So, Backster decided to trigger off another emotional reaction. He *decided* to take a match and burn a leaf. The result of this thought: a dramatic change shown by an abrupt and prolonged upward sweep in the chart. He had not touched or moved the plant, merely thought of inflicting pain! This seems to indicate some form of undefined perception.

Similar experiments in Moscow had similar results. Hundreds of tests were run which all point to a nervous system which works much in the same way as an animal's, although more primitive. The experiments involved electronic apparatus which all recorded the ability of plants to sense what was going on around them. Plants can sense

Are Thinking



By simply attaching the polygraph's electrodes to the leaf, cushioned by gauze, Mr. Backster recorded data as exciting as it was unexpected. This tape reveals the "anxiety" exhibited at the mention of war.



their surroundings and make physiological adjustments to sudden and severe weather changes. Signals are received, passed through special channels to a certain center where this data is received, processed and then acted upon. The data also indicated a definite rhythm of life, requiring regular periods of rest. And plants can sense the difference between night and day. Both the Russian and Backster findings point to an elementary memory in plant life as well.

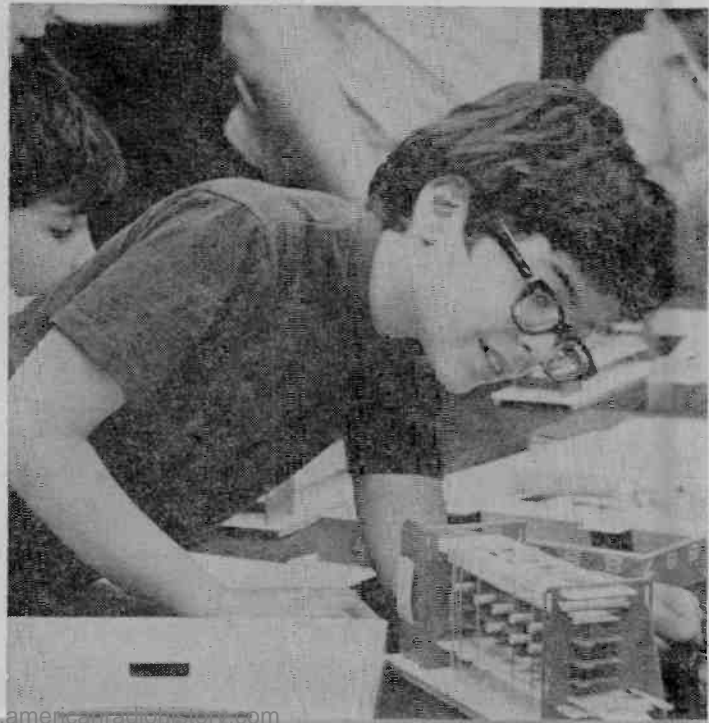
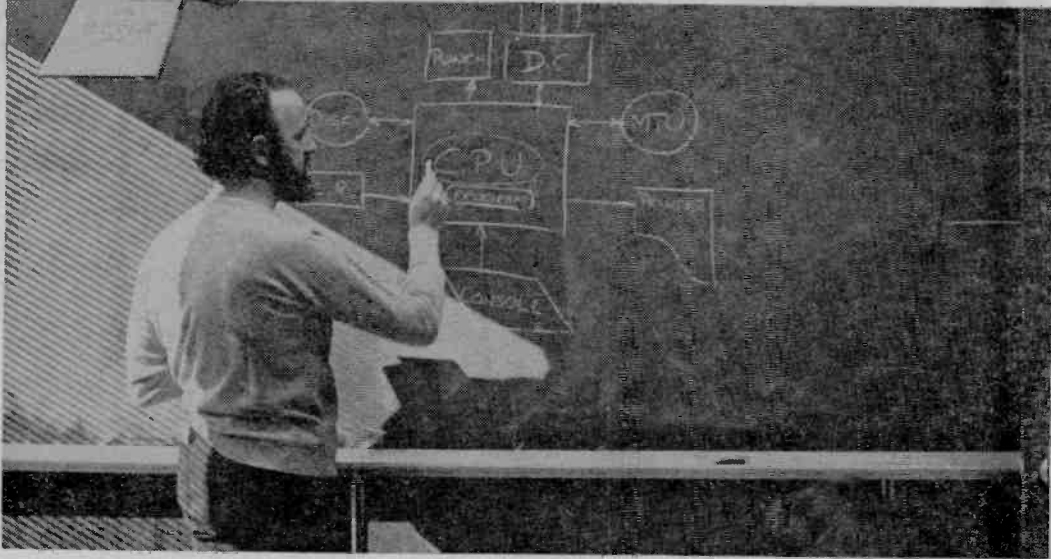
Probably one of the most surprising findings was that plants not only react to threats to their own well-being, but also to the emotional crises of other life forms. Mr. Backster set up a "death-machine" to document this. The victims were tiny brine shrimps which were killed in a random pattern by suddenly dropping them into boiling water. The plants were also set up in the same room. And once again, the plants surprised him by registering an emotional reaction every time a shrimp died.

Another test was performed to further check these amazing results. Six men were sent into a room to visit two plants. Backster entered last and found one on the floor, torn from its pot, broken and "murdered." Only the remaining plant knew the culprit. One by one, the men were sent into the room where the plant was once again rigged to the polygraph. When the "killer" entered, the plant immediately displayed an emotional reaction. A rather unusual key witness.

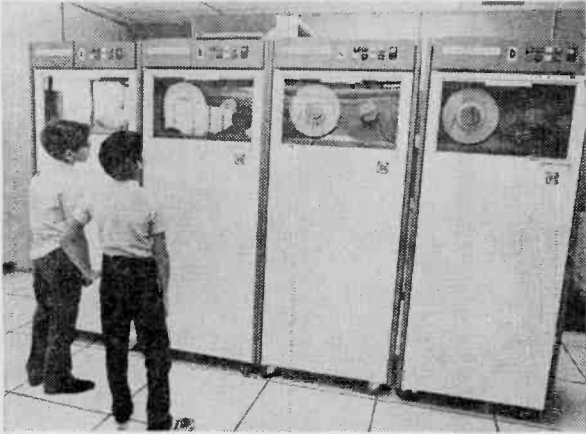
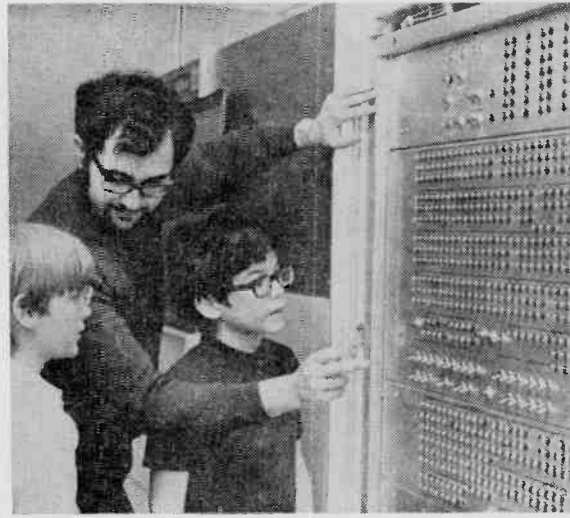
Like humans, plants also seem to eventually become blasé to such stimulation—a sort of memory. A rather fantastic notion but one that certainly has incredible implications for our ideas about perceptions.

No one can say what exactly the nature of these plants' emotions are—fear, relief, joy? However, it does point to a communications link among all cell life. But, let this serve as a warning to be kind to your Venus Fly Trap—he may remember if you're mean, and that could cause problems! —Myrtle Gronk

BUILDING WITH COMPUTERS INSTEAD OF BLOCKS



Unlike most classrooms, this one is comprised of parents and children alike. Here the fundamentals of computers are discovered through both lectures and construction of simple mechanical computers. This is only one part of a program designed to encourage children with an aptitude. The interest shown may very well develop into expertise.



Now, it's time to meet the giant computers. At this stage, the children's knowledge of the mechanical workings of the machine must be translated into an understanding of the electronics involved. After a careful inspection inside and out, it's finally time to actually operate and program.

Children frequently build simple models of machines they find fascinating—cars, planes, even rockets. In this electronic age it was only logical that computers join the list of favorites among the young; and that's exactly what's happening in Port Washington NY at the North Shore Junior Science Museum. Here, both parents and their children are learning and enjoying the workings of these electronic giants by constructing mechanical equivalents of various types of computer logic.

It is a two-fold program in which a group of fourth graders discover the rudi-

mentary workings of computers by building and by applying these principles on actual computers. Building simple models under supervision helps them to grasp the number system used in computer work. In addition to building, the children also learn to operate and program full-sized machines.

Although the course is primarily designed to enlighten children with special talent in this area, many parents also take part. But don't think that the parents necessarily help their kids; we bet it's often the other way around **with** these mini-experts of the future.

—Myrtle Gronk

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is convenient, you can have the equipment shipped to your home in return for a small deposit, which is refundable when you return the equipment.

Find out more about this exciting new Bell & Howell Schools program. There's no obligation.



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Let Bell & Howell Schools help you get ready for an exciting career or business of your own in two-way radio electronic communications!

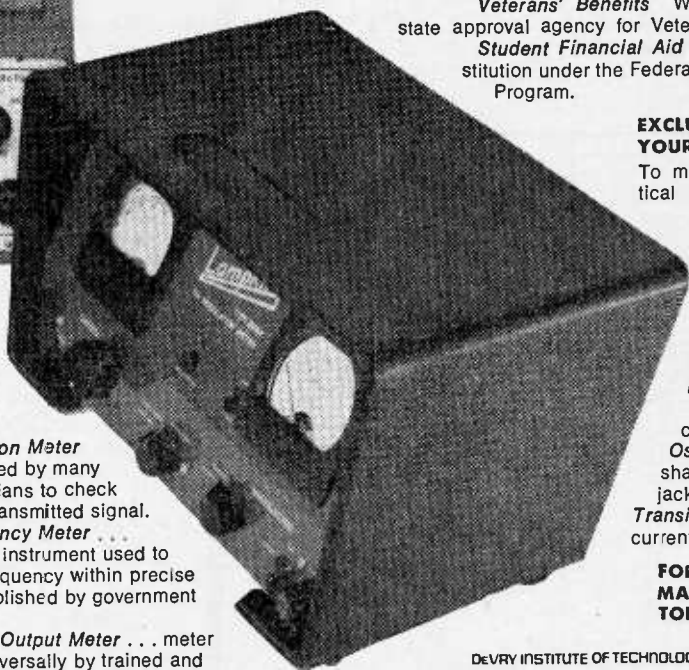
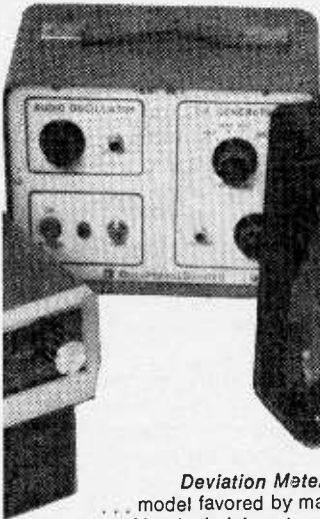
Bell & Howell Schools has helped many thousands of people prepare for careers—and businesses of their own—in electronics. You can have absolute confidence in the training you get.

Expert instructors at Bell & Howell Schools plan each program to answer a single question: "What qualifications will you need to take advantage of *actual career opportunities* in electronics?" They then build each program to give you those exact qualifications.

To get ready for a business of your own in two-way radio, you need: 1) career-oriented training; 2) FCC License; 3) "hands on" experience with commercial-grade equipment. Bell & Howell Schools now offers this new at-home training program that gives you all three. (See FCC License Guarantee on attached card.)

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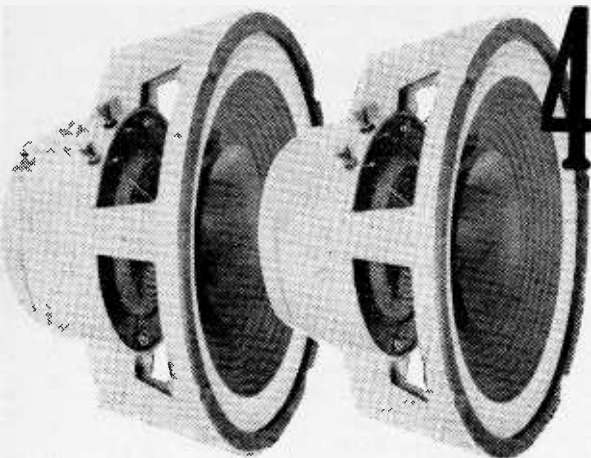
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4-CHANNEL FOUR

... and some common sense!

Four-Channel Sound. It's *stupendous!* It's *colossal!* It's *magnificent!* And it is also a *bomb!* The plain truth is that most hi-fi dealers are having a difficult time moving 4-channel equipment; many won't touch the hardware, and many of the dealers that do stock and demonstrate 4-channel do their absolute best to dissuade you from buying any 4-channel gear with the worst possible demonstration of 4-channel "surround sound."

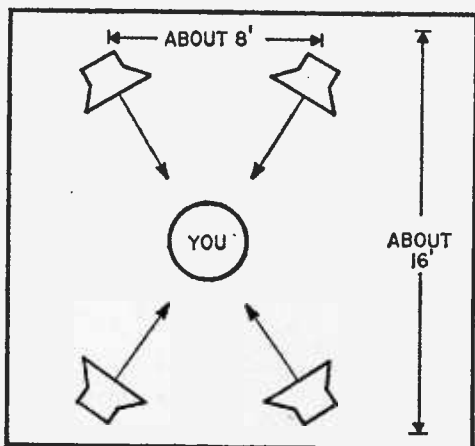


Figure One. A showroom arrangement of 4-channel speakers.

Yet in all honesty, 4-channel sound—of any variety; discrete-surround, SQ or derived ambient—is a better sound *if you ever get a chance to hear it*. Or rather, if you ever get to hear it as it would sound in your own home *after the hardware gets integrated with your furnishings*.

The Showroom. To illustrate the problem, assume you have just heard a superb

demonstration of discrete-surround in the showroom. You are suitably impressed by the surround effect of four speakers spaced about 8 feet apart, beaming sound at you from all directions, as illustrated in the typical "surround-sound" speaker placement shown in Fig. 1. You love it—a new dimension in listening pleasure; you tuck the extra hardware under your arm and head for home.

Now what? Are you going to place four speakers in the center of the living room and sit on a hard kitchen chair just so you can be "in the sound center"? Maybe for the first 15 minutes. But is this what you're going to demonstrate to your neighbor? Is the spouse going to tolerate this new furniture arrangement for more than one evening? Not a chance.

After the initial thrill is worn off, the front speakers go back where they were—or belong; the rear speakers get pushed into some non-conspicuous location like behind the couch and you become another unimpressed 4-channel user; unimpressed along with your friends and neighbors who

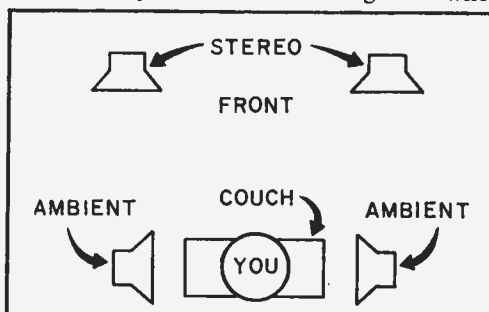
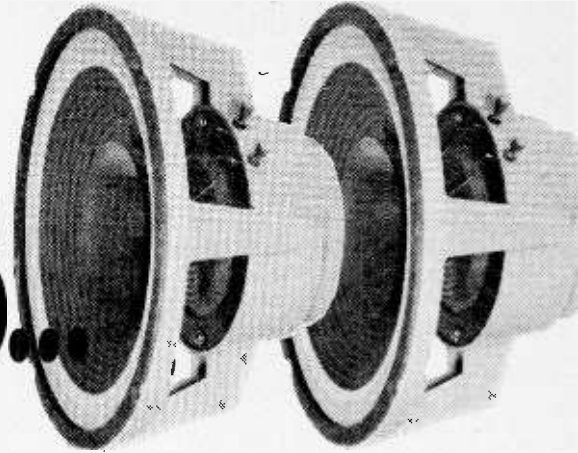


Figure Two. The usually suggested placement for 4-channel ambient-sound speakers.

TAKES SPEAKERS.



by Herbert Friedman

were smart enough not to “upgrade” until they heard what *your* money bought.

Let’s look at another example. This time, derived ambient 4-channel. The usual speaker arrangement suggested, commonly demonstrated in showrooms, is shown in Fig. 2. There you sit, standard stereo up front and the ambient speakers blasting a thin, reverberant sound (usually with lots of distortion) directly into your ears. C’mon! Who ever heard that in any concert hall? Sure it sounds great in a showroom; but in your living room? In your living room it sounds like *two* stereo systems: a good system up front and a pair of \$14.95 child’s phonographs immediately adjacent to your ears—one on each side.

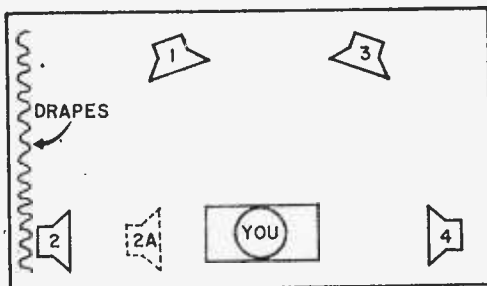


Figure Three. An optimum starting point for placing SQ and discrete 4-channel speakers.

To obtain the true benefits of 4-channel sound *in your home* takes a lot of common sense when it comes to locating the speakers. Firstly, you must acknowledge that in general you are not prepared to redecorate the entire listening room just to squeeze in two more speakers. Somewhere along the line you must compromise on the speaker placement. Secondly, and more

importantly, know in advance what you are going to get in the way of 4-channel sound, or rather, know how you can obtain the most pleasing sound from a compromised speaker arrangement.

The exact speaker arrangement depends on the type of 4-channel sound you expect to use most frequently, for there is no ideal arrangement that will accommodate all the 4-channel systems.

Discrete. The most spectacular 4-channel system is *discrete surround*, in which the program material is deliberately split up into four individual channels. Each channel can contain all the direct musical information for a particular instrument or section. You must, theoretically, place yourself at the sound center if you are to hear the program as it was intended to be heard. Under ideal conditions this would require the speaker arrangement shown in Fig. 1.

Slightly less—or much less—or spectacular, depending on your point of view, is SQ 4-channel, in which the program material is encoded in such a manner that when played back through a suitable decoder the listener hears essentially the same surround

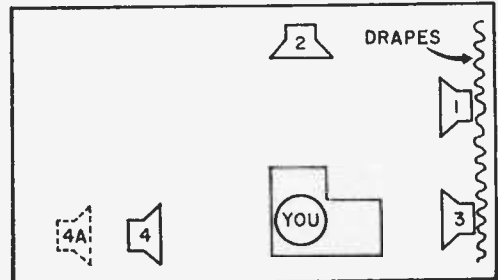


Figure Four. A compromise starting point for SQ and discrete 4-channel speakers.

effect as if the program were in four discrete channels. This, of course, is a joke. SQ is nowhere near the equal of discrete 4-channel. Optimum separation is about 6 dB between channels (at the present time). In a slightly reverberant room the whole effect is less spectacular than if you just placed two remote stereo speakers behind you. Obviously, outside the showroom, the recommended speaker arrangement of Fig. 1 is not going to produce any "new dimension in sound." Other matrix (encoded) 4-channel systems are in the same boat.

Derived Ambient. The third 4-channel system is *derived ambient*, whereby a decoder extracts the ambient sound of the recording location that is "accidentally" encoded by the stereo microphones. Except that there can be little or no ambient from a mix-down recording, as used for pop music, where the band is recorded on Monday on tracks 1, 2, 3, etc.; and the vocalist is recorded on Tuesday on tracks 4 and 5, and the chorus gets paid overtime for coming in on Saturday to record tracks 6, 7 and 8. The recording engineer puts it all together by mixing the eight (or maybe 16) tracks into two stereo tracks. Your chance of getting an ambient rear output from a mix-down recording is as good as your imagination.

But putting aside any unusual problems—such as getting true ambient sound from mix-down, there are three basic 4-channel reproduction systems, of which only the discrete system has inherent capacity for a spectacular surround-sound effect. The other two systems are going to require considerable juggling of speaker locations to obtain all the advantages of 4-channel.

SQ Sound. Let's start with SQ, because if the SQ sounds good the discrete 4-channel will also sound good. Under the best of circumstances—recording techniques, decoding, etc.—the sound from each of the four channels is a direct sound and should therefore reach your ears with essentially the same degree of room reverberation and time delay as from any other speaker. This is most easily accomplished by having each speaker an equal distance from your listening location, and by having an equal reflective surface in front of the speaker. Getting equal distance is no problem, most of the time.

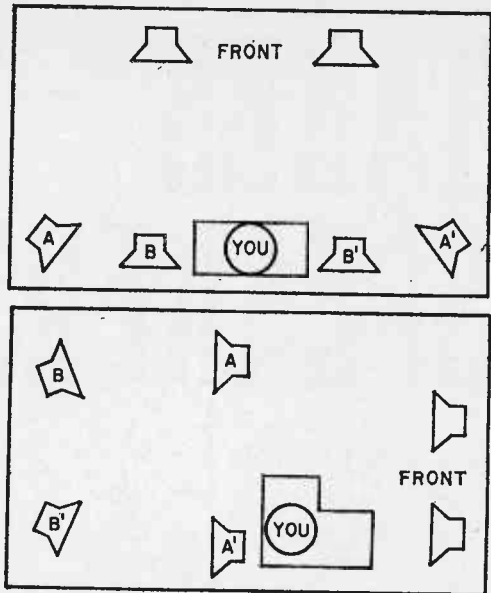


Figure Five. Suggested starting points for diffuse ambient sound.

Figures 3 and 4 show two possible speaker arrangements. Figure 3 is optimum; Fig. 4 is a compromise because of the seating location, but it is typical of what can be expected because of furniture placement. Note that though the speakers are "scattered" they are more or less equidistant from the listener, thereby retaining the surround-sound effect. Now we must allow for drapes or curtains placed in front of windows. In Fig. 3 the sound from channel 2's speaker would reflect off the opposite wall and you, the listener, would hear channel 2's reverb coming from the direction of the channel 4 speaker. Channel 4's speaker, however, sees the drapes on the opposite wall so there would be little reverb coming from the direction of channel 2's speaker; there would be a disconcerting unbalance in liveness. To balance the sound you must either remove the drapes (! ! !), or move the channel 2 speaker to position 2A. Moving the speaker to position 2A will reduce the reverb path length and place more direct sound at the listening location.

In Fig. 4, we have a similar problem created by drapes or curtains, but here we are limited in how far, or where we can reposition channel 3's speaker. We might cure the unbalance by increasing the reverb-path length of channel 4's speaker by positioning the channel 4 speaker at location 4A.

(Continued on page 99)



Birds and jets don't
mix—see what fowl
discoveries have been made . . .

RADAR GETS THE BIRDS TO CHICKEN OUT

Man's feathered friends have inhabited the earth for millions of years — the most ancient fossils known are more than 150 million years old, and the oldest American species are about 100 million years. Today, there are over 8,000 species of birds ranging in size from two inches in length to the ostrich which stands some eight feet in height.

Birds are the most mobile of all animals and can travel great distances at high speed. Ducks have been reported flying at speeds of up to nearly 60 miles an hour, while some small song birds may fly at speeds as high as 37 miles an hour.

Birds have better vision than any other animal, so that when they are travelling faster or at about the same speed as an aircraft, they have time to avoid it, and there is little danger they will come into actual contact with it. However, as aircraft flying speeds have increased, the risk of collision also has increased. A jet landing or taking off at over 100 miles an hour closes so rapidly upon a bird that the bird is unable to get out of the way.

Bird's Eye View. The incidence of bird strikes, including cases in which birds were ingested into air intakes of jet engines, has reached serious proportions. One single incident cost Air Canada some \$50,000 when a snowy owl was ingested into the engine of a Vanguard aircraft during takeoff at Toronto International Airport. More important, sev-

e/e RADAR AND THE BIRDS

eral commercial airline planes have crashed with loss of life and limb of passengers and crew because of bird strikes.

At the present time, bird movements are closely monitored by radar in some areas to enable airline operators to advise pilots of the locations of large concentrations of birds. Even though appropriate diversionary action can be taken, complete avoidance of birds is virtually impossible and the strike hazard remains ominously present.

Flying with microwaves. Since the early days of radar during World War II, reports have appeared in the literature from time to time that birds become disoriented and confused when they intercept a radar beam. On closer examination, these reports revealed that in each case the microwave field through which the birds were flying was of very low intensity. In fact, it was too low for the disorientation to be explained in terms of thermal effects produced in the organism by the conversion of microwave energy to heat. Thus, it must be the pulsed microwave field itself electrically interacting with the nervous system of the bird that causes this reaction.

Since 1966, the Control Systems Laboratory in Canada has been conducting studies using electromagnetic fields to confirm the hypothesis that microwaves can profoundly influence birds. The aim of the program is

to design microwave fields that will have the greatest effect on birds for the least expenditure of power.

Deterrance. When exposed to microwaves, birds generally try to escape. Although there are behavioral differences between species, it was found that the escape reaction dominated the behavior patterns of domestic fowl, pigeons and sea gulls tested. A few seconds after the microwave field was switched on, the wing outside the field of radiation became collapsed, while the opposite wing in the field became extended. A similar phenomenon was observed with the legs. The microwave field had the bird flying on one wing.

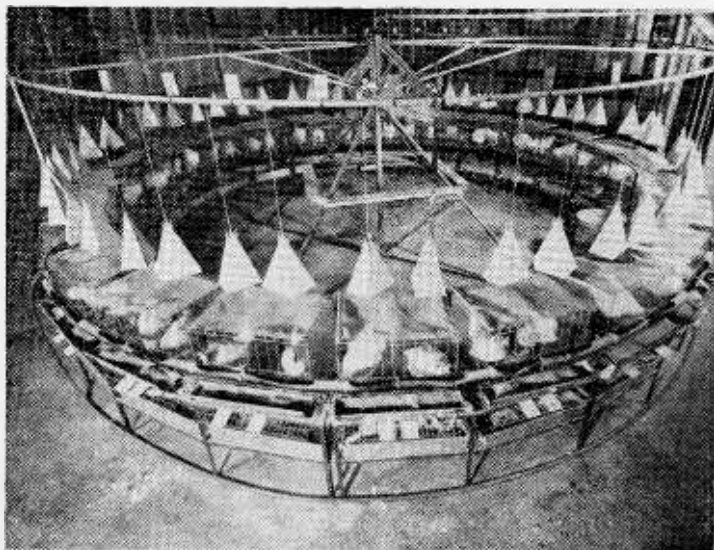
In other words, the microwave beam interacted with the nervous system of the birds in such a way that they became temporarily immobilized. Pigeons and seagulls reacted similarly, though the sea gulls to a lesser degree.

Tests both outdoors and under laboratory conditions showed that radiation of a feeding area also deterred the birds from approaching that area.

These findings prompted scientists to take a closer look at the physiological factors involved in order to identify the control hierarchy and sensory mechanisms involved.

From this information they hope to design the appropriate microwave field to produce the avoidance reaction desired.

The Unknowns. However, at the present time, the biological effects of microwaves are not fully understood—environmental factors are also known to be involved. This in-



Chicken check-out. Not a fast-food assembly line but a ring of cages used in microwave study. Only one horn is real. This insures chicken's reaction is to microwaves, not a strange object overhead.

cludes the effects of temperature and humidity on the birds' physiology. Moreover, it is a two-fold problem: birds' reactions both in the air and on the ground. In the latter, it is a matter of deterring them from certain feeding areas. While the problem in the air is one of quick dispersal to avoid collision.

Electrophysiological studies have revealed that all areas of a bird show changes when the bird is subjected to pulsed microwave radiation. For example, parakeets observed in flight were found unaffected by increased humidity. They behaved normally, performing tasks they had learned during a month's training session. But when the microwave beam was switched on, the compound effect was such that in most of the trials the birds strongly avoided the field. After a number of trials, they showed signs of sickness, disorientation or extinction of their previously learned behavior.

Whether these changes are due to peripheral effects, such as local changes in the skin, or physical changes in the behavior of the animal such that feedback of the motor activity is modified, have yet to be determined.

What physiological mechanism, for instance, associated with feathers may be activated by a microwave field?

Pluckin' your chickens. The reaction of chickens whose tail feathers only were subjected to microwave radiation was explored in the laboratory together with the effects of radiation on defeathered birds. In the case of the former, when radiation was switched on, the bird immediately ceased what had

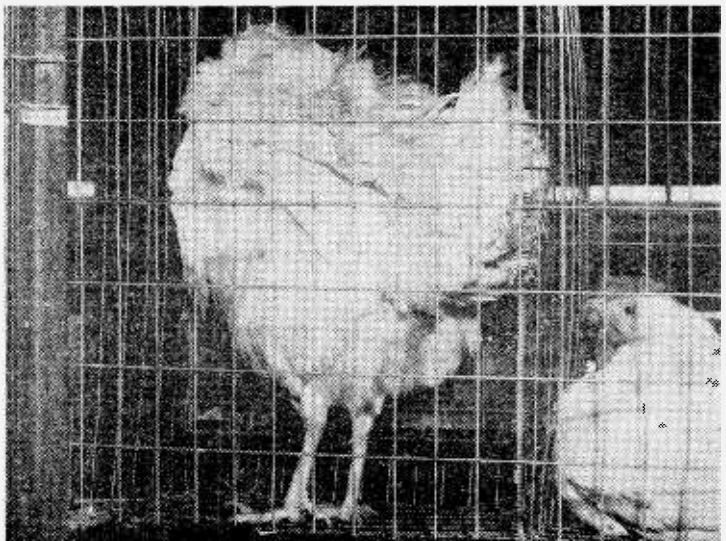
been a moderately inquisitive exploration of its cage. After a period of 10 to 20 seconds, it showed mounting signs of distress vented in the form of vocalization, defecation and the initiation of flight. Repeated periods of exposure produced the distress reaction in a shorter time. Tests on members of the same species produced the same results. In each case, when the field was switched off, a bird responded by fluffing its body feathers and actively preening. The feathers alone appeared to be responsible for this reaction.

With plucked chickens, exposure to microwave radiation for two minutes every day produced little or no reaction until the twelfth day. At this time, it was observed that new feathers had started to grow and their tips protruded from the surface of the skin.

However, similar experiments conducted on chickens that had been defeathered by cutting the feathers revealed apparent indifference to the microwave field up to 30 days following defeathering. The results thus point to the sensory role of feathers.

Poultry View. All this points to the possible use of a microwave beam to scan a runway, once the appropriate intensity and frequency are determined. Such scanning should provide a safety corridor for aircraft. This may even be accomplished by the modification of present radar equipment. Before such work is implemented, we must first learn more about the effects of microwaves on man, and on all living tissue. Once again, man must examine the possibility of pollution and its costs. ■

Bird wants out. Chicken on right lays egg while radiated bird wants out! Fowl desire to move may be key to clearing birds from runways and flight paths of airliners.





BOOKMARK BY BOOKWORM

Semiconductor Theory. A new learning experience on the fundamentals of solid-state electronics has been uniquely published in book form by Texas Instruments Incorporated. Titled, *Understanding Solid-State Electronics*, this paperback provides any interested person a comprehensive foundation in semiconductors and how they work together in solid-state electronics systems. The 12-chapter text helps the reader become familiar with all phases of electronics—



Soft cover
242 pages
\$2.95

from electrical systems to electronic devices comprising these units. All the material is presented in a crystal-clear and concise manner with the layman being carried step-by-step through the course.

Each lesson was discussed in detail prior to actual writing with considerable thought given the subject to be covered so the copy would communicate effectively. Words and phrases were weighted carefully to eliminate any misunderstanding of the material. In all cases, technical words such as power dissipation, capacitance, and breakdown voltage are translated into terms any reader can understand. This Bookworm rates *Understanding Solid-State Electronics* as the best beginner's text of 1972. Write to Texas Instruments, Inc., Components Group, P.O. Box 5012, Dallas, TX 75222 or circle No. 62 on Reader Service Coupon on page 17 or 103.

A Good Reference. Updated and expanded edition, the 1972 *Popular Tube/Transistor Substitution Guide* by Tab Books Editorial Staff is the only 2-in-1 substitution guide available. It lists the best substitutes for all popular tubes and transistors, including foreign types. Designed to fit into a tiny slot in a tube caddy or on the workbench, this guide lists 99 percent of the tubes and transistors which normally need replacing in home-entertainment equip-



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ment. Moreover, only readily-available and comparably-priced substitutes are listed—no need to search through lists of tubes and transistors rarely used. Published by Tab Books, Blue Ridge Summit PA 17214. For more information, circle No. 57 on Reader Service page.

A Nation Hooked Up. Fred Friendly, former president of CBS News, described *Wiring the World*, released by the Book Division of U. S. News & World Report, Inc., as "the first authentic primer on the challenges and the opportunities of cable television." Easily understandable to the general reader, and complete enough to be useful to specialists, the book explains the nature and implications of the radical change that is coming in the communications life of the nation. *Wiring the World* presents a history of the growth of cable television; a description of how cable TV works; analysis of the programming of cable TV, and the advantages and disadvantages as compared to broadcast TV; and a history of the growth of government regulation of cable TV. The book also informs the reader about picture tele-



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phones, video-cassettes, and the development, present and potential uses of communications satellites. *Wiring the World* is available directly from the publisher, Book Division, U.S. News & World Report, 2300 N Street, N.W., Washington DC 20037. Please include 23¢ for postage.

For Active Hams. Today, the radio amateur is confronted with extremely crowded band conditions. This situation makes it more important than ever before to use the best operation.
(Continued on page 107)

ELEMENTARY ELECTRONICS



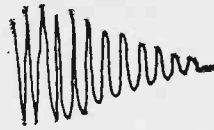
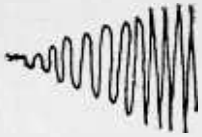
all *NEW* BASIC COURSE in ELECTRICITY & ELECTRONICS

UNDERSTANDING CAPACITORS

What you will learn. A capacitor is another very basic but highly useful circuit component. Since it can regulate current, as do resistors and coils, the capacitor is used for this purpose in most electronic and many electrical circuits. Upon completing this chapter, you will understand what capacitors are, how they are used, and how they are connected in circuits.

* This series is based on **Basic Electricity/Electronics, Vol. 1**, published by **Howard W. Sams & Co., Inc.**





WHAT IS A CAPACITOR?

A capacitor is a storage device for electricity. Because it can do this, it is able to control the amount and the manner in which current will flow in a circuit.

Most electronic circuits consist of a combination of only three components—resistors, inductors and capacitors. Each reacts in a different way to AC and DC voltage and current.

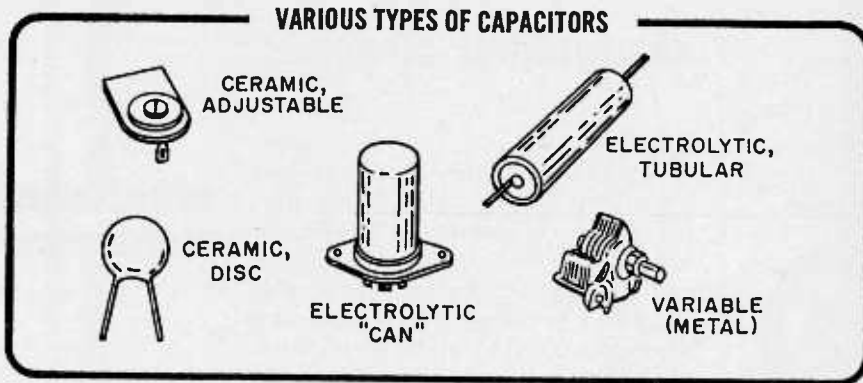
A *resistor*, as you recall, *controls* electricity by limiting the flow of current. This reaction is called *resistance*. It affects the flow of either AC or DC current.

An *inductor* controls electricity by regulating the flow of AC current. The magnetic field in an inductor cuts its own coils, developing a voltage that opposes a change in current. This is called *inductance*.

A *capacitor* controls electricity by also regulating the flow of AC current. It stores an electrical *charge* which opposes any change in current. This property is called *capacitance*.

HOW DOES A CAPACITOR WORK?

A capacitor, sometimes called a *condenser*, is manufactured in several shapes and sizes. A number of capacitors are shown below. You may recognize a few.



Several of each kind of capacitor are probably in your home. They can be found in radios, television receivers, intercoms, audio systems, and other electronic equipment. A capacitor is used with some electrical motors and even in the ignition systems of automobiles.

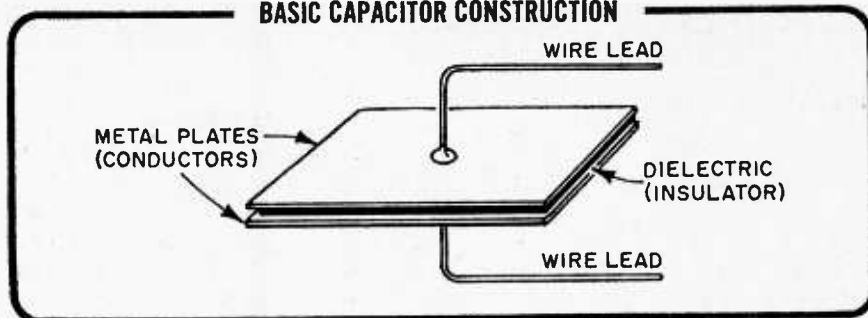
Basic Construction

Every capacitor is constructed in the same basic manner. An insulating material, called a *dielectric*, is sandwiched between two conductors (usually a pair of metal plates). A wire is connected to each plate to form the leads or terminals of the capacitor. Details are shown at top of next page.

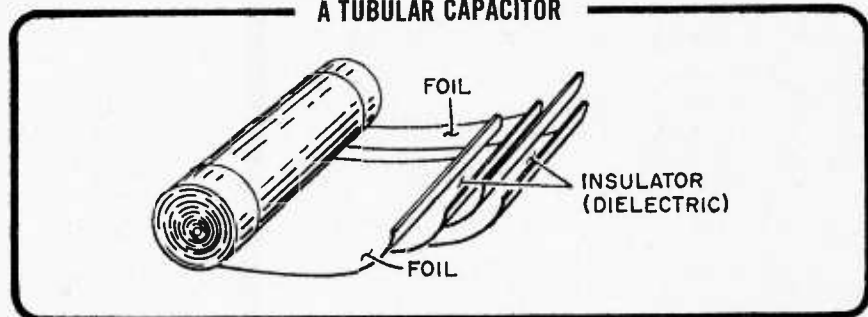
This basic principle is elaborated upon to produce the shapes shown in the box above. For example, the plates of the variable capacitor are curved and exposed. Since air is an insulator, it forms the dielectric.

The tubular capacitor, as shown below, uses lengths of metal foil as the plates, which are separated by strips of treated paper to form a dielectric. Wire leads are connected to the exposed ends of the foil and the assembly is rolled into a tight spiral and placed in a case.

BASIC CAPACITOR CONSTRUCTION



A TUBULAR CAPACITOR



- Q1. The opposition to current flowing through the atomic structure of material is called
- Q2. The reaction of a changing magnetic field to current change is called
- Q3. The reaction of a stored electrical charge to current change is called

Your Answers Should Be:

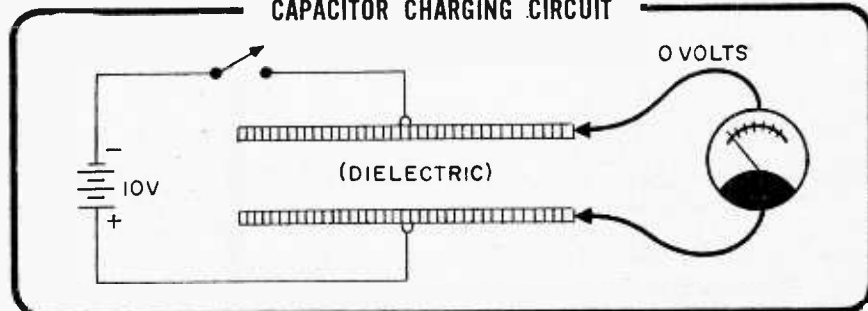
- A1. The proposition to current flowing through the atomic structure of material is called **resistance**.
- A2. The reaction of a changing magnetic field to current change is called **inductance**.
- A3. The reaction of a stored electrical charge to current change is called **capacitance**.

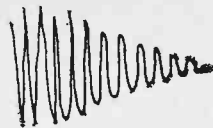
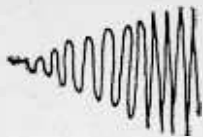
Electrical Principle

The structure of a capacitor obeys the fundamental principles of voltage and current as applied to conductors and insulators. Assume, as shown in the following diagram, that the plates of a capacitor are connected to a battery through a switch. An edge view of the plates is illustrated.

The open switch prevents the battery voltage from being applied across the

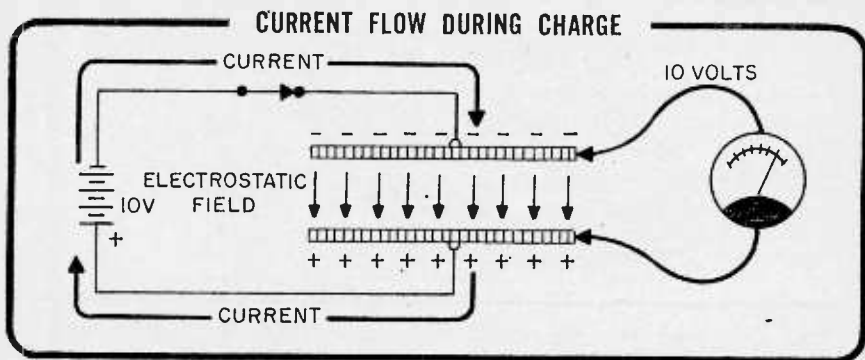
CAPACITOR CHARGING CIRCUIT





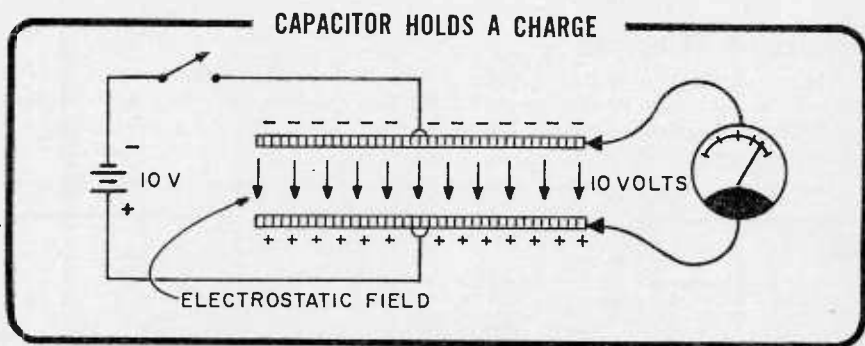
capacitor. A voltmeter will show a zero voltage between the plates. This is normal, since all matter tends to seek a natural balance when no forces are applied.

Suppose the switch is now closed. A first thought might be that no current would flow. Current does not flow through an insulator, and the dielectric is an insulator. Current will flow in the circuit, however.



Current will flow until a charge (voltage) of 10 volts appears across the plates. The plates are conductors and therefore have electrons free to flow as current. Electrons have a negative charge. They are repelled (caused to move) by the negative pole of the battery and attracted by the positive pole. The positive terminal pulls electrons away from the bottom plate of the capacitor, and the negative terminal forces them to accumulate on the top plate.

A deficiency of electrons results in a positive *potential* (voltage) on the bottom plate, and an excess of electrons makes the upper plate negative. Current flows, rapidly at first, but more slowly as the voltage across the capacitor builds up to the same potential as the battery. When current ceases to flow, 10 volts will be across the capacitor.



A field of force, equal to 10 volts, now exists between the two plates. This field is called an *electrostatic* force and has a direction as shown by the arrows—from negative to positive. The excess electrons are attracted to the positive plate, and it is this attraction that develops the force. Suppose the switch is now opened. Will the electrostatic force of 10 volts disappear?

The voltage across the capacitor is still 10 volts, just as it was before the

switch was opened. The excess electrons remain because there is no path for them to return to the positive plate (assuming the voltmeter has infinite internal resistance through which no electrons can travel).

- Q4. Electrons leave the capacitor plate connected to the battery terminal.
- Q5. Electrons are repelled by a voltage.
- Q6. The plate that has a(an) (excess, deficiency) of electrons has a negative charge.
- Q7. A(an) force is set up between the plates of a charged capacitor.
- Q8. The insulating material through which the force lines extend is called a (an)

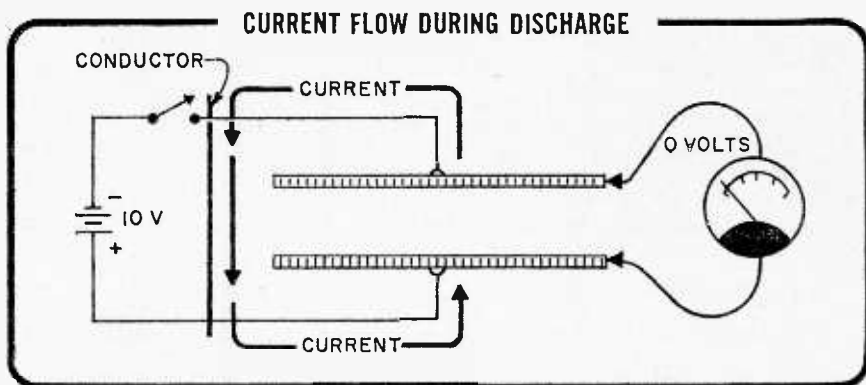
Your Answers Should Be:

- A4. Electrons leave the capacitor plate connected to the **positive** battery terminal.
- A5. Electrons are repelled by a **negative** voltage.
- A6. The plate that has an excess of electrons has a **negative** charge.
- A7. An **electrostatic** force is set up between the plates of a charged capacitor.
- A8. The insulating material through which the force lines extend is called a **dielectric**.

Capacitor Charge and Discharge

Charging is the term used when a capacitor is acquiring a potential. In the example on the preceding page, the capacitor was charged to 10 volts.

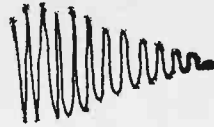
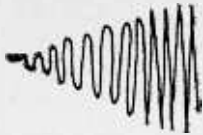
Some capacitors can be charged to extremely high voltages and will retain this charge for long periods. The capacitor in the high-voltage section of a TV receiver builds up to 10,000 volts or more. So be careful when working around capacitors. A capacitor can be discharged either through normal operation of a circuit or by shorting the capacitor leads.



When the capacitor discharges, the excess electrons return to the positive plate, the difference in potential (voltage) between the two plates becomes 0, and the electrostatic force disappears. As a matter of fact, the voltmeter constitutes a circuit between the plates of the capacitor, thus forming a path for the electrons to return to the positive plate. The high resistance of the meter, however, limits the current, resulting in a long discharge time. This can be seen by watching the meter pointer.

Effect on DC Current

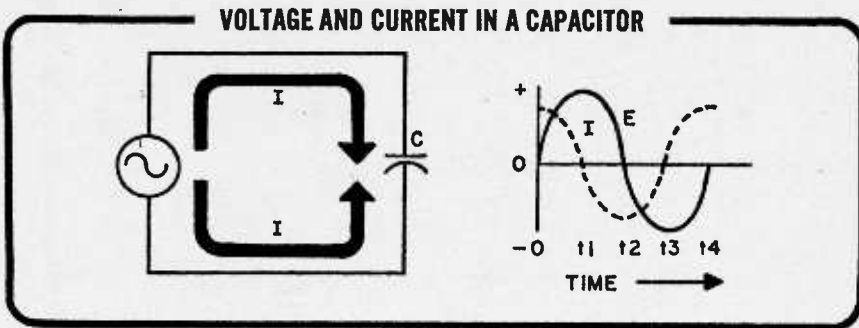
As you have seen, a capacitor *blocks* the passage of DC current. Current flows only long enough to build up a charge equal to the source potential.



Effect on AC Current

You will often hear or read that AC flows through a capacitor. This is not true. As long as the dielectric retains its insulating quality (as long as the applied voltage does not become great enough to puncture a path through the dielectric), very few electrons will pass through.

With AC voltage applied, electrons accumulate first on one plate and then the other, as the voltage changes polarity. But this electron current does not change in phase (in step) with the voltage. The diagram shows the schematic symbol and letter designation for a capacitor, and a graph of the current and voltage relationships.



At time zero, the applied voltage starts to go positive. At that instant, current flow from one capacitor plate to the other is maximum. As the source voltage increases, I decreases because the charge in the capacitor is getting closer and closer to the applied E. When E reaches maximum positive (at time t1), the capacitor is charged to the same value. Current is zero. When source E decreases toward zero volts, capacitor E is greater and causes current to flow in the opposite direction. At zero source volts, current has become maximum negative (time t2). The difference and equality of the source voltage and the capacitor charge continue in the same time sequence for the next half cycle. As the graph shows, current is always a quarter of a cycle ahead of the source voltage.

Q9. Current leads AC voltage by a (an) cycle in a capacitor circuit.

Your Answer Should Be:

A9. Current leads AC voltage by a quarter cycle in a capacitor circuit.

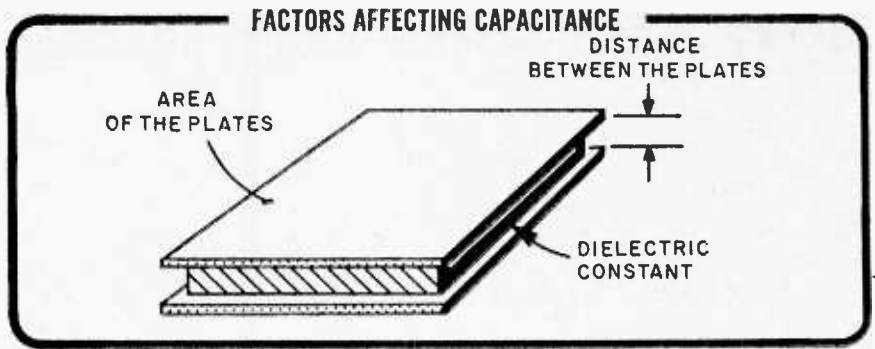
CAPACITOR CHARACTERISTICS

Before circuits are shown that prove the effects of a capacitor on AC and DC current, you must learn a little more about capacitor characteristics.

Units of Measurement

A capacitor is measured in terms of its capacitance, which is a definition of how many excess electrons it can store on one plate to develop a specific charge. A Farad is the unit of capacitance just as ohm is the unit of resistance.

However, when a Farad was first defined it was too large a unit for any practical purpose. Capacitors are either measured in micro-Farads (one-millionth of a Farad), abbreviated μF , or in micromicro-Farads, (one-millionth of a millionth of a Farad), abbreviated $\mu\mu\text{F}$ (this is now called pF).



Capacitance. (Farads) is determined by three factors:

1. Area of the plates. Larger area, greater capacitance.
 2. Distance between the plates. The closer the plates, the greater the capacitance.
 3. Dielectric constant (type of material). A higher constant, a larger capacitance.
- The constant for air is given as 1. Paraffin paper is 3.5; mica, 6; flint glass, 9.9. This means that a mica capacitor would have six times as much capacitance as a capacitor with air as a dielectric, all other things being equal.

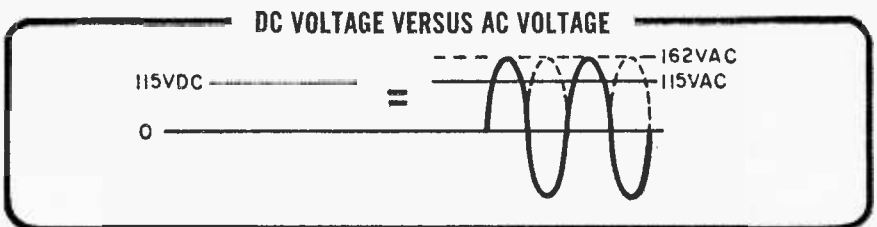
Voltage Rating

If the voltage applied across a capacitor is too large, the dielectric fails to maintain its insulating qualities. It breaks down under the stress of the electrostatic force and allows current to flow from one plate to the other.

Capacitors are given a *working-voltage* rating. This rating is the highest voltage that a capacitor can withstand without the possibility of creating a short-circuit through the dielectric. The type of material and thickness of the dielectric determines what the working voltage will be.

Since the distance between plates is one of the factors which determines the capacitance and working voltage, a capacitor having both a large capacitance and a high voltage rating will also have a large plate area.

A working-voltage rating pertains to a DC voltage or the *peak* value of AC. The peaks of an AC voltage wave are about 1.41 times its effective or working voltage. 115 volts DC and 115 volts AC are compared below.



The peaks of 115 volts AC are actually 162 volts. A capacitor with a 150-volt rating will work well on 115 volts DC but not 115 volts AC. Standard practice is to use a capacitor with a working voltage about 50 percent higher than any voltage expected in the circuit.

- Q10. A (thick, thin) dielectric allows more capacitance.
- Q11. A small plate area develops (greater, less) capacitance than a larger area.
- Q12. Glass is a (better, poorer) insulator than mica.
- Q13. Working voltage is equal to the DC value or to the value of AC.
- Q14. A higher working voltage will be possible with a (thicker, thinner) dielectric.

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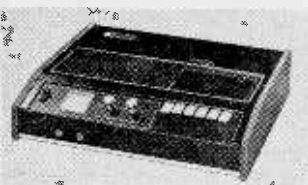
Kit AR-1214 **169⁹⁵***

(AJ-1214 Tuner & AA-1214 Amp, 89.95* each)

New Heathkit 50-watt Stereo Receiver

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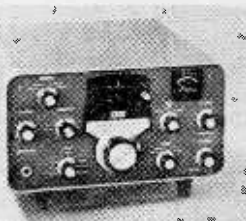
ing unit provides 2 uV sensitivity and a 2 dB capture ratio. The phono preamp section also uses integrated circuitry and has its own level controls so turntable volume can be set to coincide with tuner levels. All this in a money-saving kit project that's a pleasure from start to finish. Most circuitry mounts neatly on just three printed boards. The FM tuner is preassembled. Three evenings and just four simple alignment adjustments will have it all together. And the cabinet is included in the low price. Other features are: Black Magic panel lighting to hide the dial face when the receiver is off; flywheel tuning; stereo indicator light; headphone jack; speaker on/off button; built-in AM antenna. And there are complete tape monitor facilities so you can hear recorded material as it is committed to tape, make use of the many add-on components that use these jacks, or combine your AR-1214 with the matching AA-1214 Amp for a great sounding 4-channel system at a nice price. Stereo "separate" versions of the AR-1214 are also available: the AJ-1214 AM/FM Stereo Tuner at 89.95*; and the AA-1214 Stereo Amp at 89.95*. Both prices include cabinets. For a bold new sound in your listening room, order your Heathkit AR-1214, today. 16 lbs.



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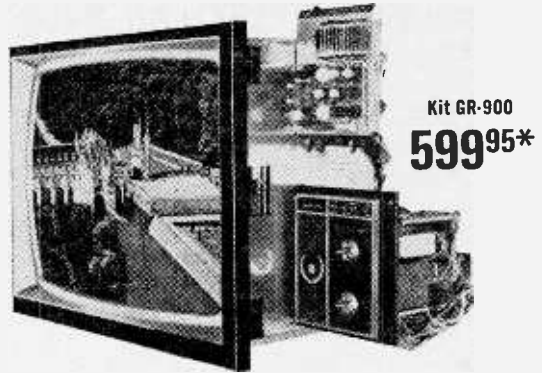
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Kit GD-348
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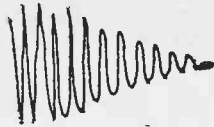
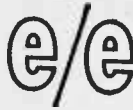
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Spots metal objects as small as a dime underground, searches under water up to 2 ft. deep. Unit sounds off only when metal is neared, tone gets louder as you approach. Convenient grip-mounted controls. Handle telescopes, head swivels to fold into neat flat package for carrying in optional leather carrying case with shoulder strap (6.95*). Headphones (4.50*) and battery (1.50*) are optional. Order your GD-348 today. 6 lbs.

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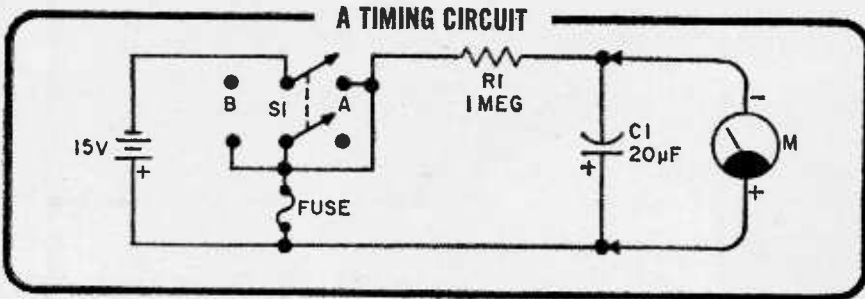


Your Answers Should Be:

- A10. A thin dielectric gives more capacitance.
- A11. A small plate area will develop less capacitance than a larger area.
- A12. Glass is a better insulator than mica.
- A13. Working voltage is equal to the DC value or to the peak value of AC.
- A14. A higher working voltage will be possible with a thicker dielectric.

A TIMING CIRCUIT

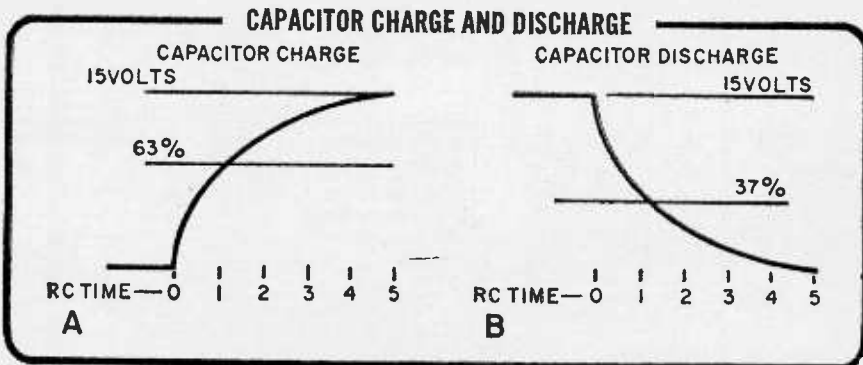
A capacitor and a resistor can be placed in a circuit to operate as a timing device. If the values of R and C are carefully selected, the circuit can determine when an exact number of seconds has elapsed. This circuit contains components from previous circuits—a 15-volt battery, a 1-megohm resistor, a DPDT switch, and a 20- μ F electrolytic capacitor (connected as shown).



The resistor limits the amount of current flow which charges C1. The values of R1 and C1 determine the charge time.

If you have constructed the circuit, you can see the build-up of the capacitor charge (voltage) by watching the voltmeter. At the instant S1 is moved to position A, the meter pointer begins to move quickly across the scale. As the capacitor increases its charge (in opposition to battery voltage), current starts to decrease. The pointer moves slower and slower. As it approaches 15 volts (full charge), its movement is almost impossible to see.

In an RC (resistance-capacitance) circuit, charge and discharge times are



measured in RC seconds. Part A in the illustration below shows the rise of voltage across a capacitor during charge.

RC is a quantity obtained by multiplying R (ohms) by C (Farads). Any capacitor in an RC circuit (such as this one) charges to 63 percent (actually 63.2 percent) of its final value (battery voltage) in one RC second. In 5 RC seconds it reaches full value. The arithmetic statements are:

$$R \text{ (ohms)} \times C \text{ (Farads)} = \text{time (seconds)}$$

or

$$R \text{ (megohms)} \times C \text{ (micro-Farads)} = \text{time (seconds)}$$

Since R is one megohm and C is 20 micro-Farads in the circuit on the preceding page, the capacitor charges to 63 percent of its full charge in 20 seconds (63 percent of 15 volts is 9.45 volts). When the meter pointer reaches this value you know that 20 seconds have passed since moving S1 to position A.

If you move S1 to position B, the capacitor discharges at the rate shown in Part B (the exact reverse of Part A). The capacitor discharges to 37 percent of its full charge in one RC second, a value of 5.55 volts. The RC time constant, as it is called, holds true for any voltage.

- Q15. How long does it take the capacitor in the circuit in the preceding example to charge to 15 volts?**
Q16. If R1 were 10 megohms and C1 were 16 micro-Farads, how long would it take C1 to charge to 9.45 volts?
Q17. If a 50-volt battery were used, how many seconds would it take the capacitor to reach 63 percent of full charge. What would the voltage be at that time?

Your Answers Should Be:

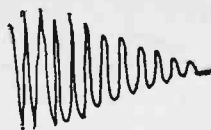
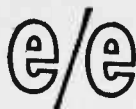
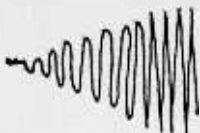
- A15. 100 seconds.** (If one RC time is 20 seconds, 5 RC time constants equal 100 seconds.)
A16. 160 seconds. (9.45 volts is the 63 percent level with a 15-volt source. $10(\text{megohms}) \times 16(\text{micro-Farads})$ is equal to 160 seconds.)
A17. 160 seconds. Regardless of the voltage, it will still take one RC time to reach 63 percent of full charge. 31.5 volts is the 63 percent level.

DC BLOCKING

By alternately manipulating the two switches in the preceding circuit, you can simulate what the capacitor will do if AC voltage is applied. Closing one switch charges (increasing AC voltage) the capacitor, and closing the other switch (and opening the first switch at the same time) discharges (decreasing AC) the capacitor.

Whether DC or AC, current in the circuit did not pass through the capacitor. Instead, it flowed back and forth through the circuit, collecting first on one plate and then on the other. The effect is that of AC being passed through the capacitor. This characteristics of a capacitor is used in most electronic circuits where it is necessary to control alternating current, but yet allow it to flow through the circuit.

Transistors and vacuum tubes operate in electronic circuits with DC voltage applied to their elements. In nearly all such circuits, an AC signal is applied to the input of the circuit (to be amplified, for example). The AC must be allowed to pass through the amplifier, but the DC voltage must not. A capacitor can be used for this purpose.



WHAT YOU HAVE LEARNED

1. Capacitance controls the flow of AC current. However, AC current does not actually flow through a capacitor.
2. Capacitors are used in many electrical and electronic circuits. They are found in radios, television receivers, hi-fi systems, and almost every other type of electronic equipment.
3. A capacitor is a pair (or pairs) of plates separated by a dielectric. The dielectric, an insulator, does not pass current as long as the applied voltage is kept within safe limits (below the capacitor voltage rating).
4. When a capacitor is connected to a voltage source, electrons move from one plate through the circuit and accumulate on the other plate. This charges the capacitor electrically and develops an electrostatic field between the plates. A capacitor discharges when the excess electrons on one plate return to the other plate.
5. DC current is blocked by a capacitor. AC appears to pass through by alternately charging and discharging the capacitor.
6. The effect of an electrostatic charge on AC is to cause current in a circuit to follow the AC wave pattern a quarter of a cycle in advance of the voltage.
7. A capacitor is measured in Farads, micro-Farads (μF), and pico-Farads (pF); the larger the area of the plates and/or the closer their spacing, the greater the capacitance will be. It has a working-voltage rating that should not be exceeded.
8. Capacitors can be used in a timing circuit where charge and discharge time is measured in terms of an RC time constant. Another use for a capacitor is to block DC from those parts of a circuit where it is not desired.

This series is based on material appearing in Vol. 1 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ \$22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

CB Coffee Break

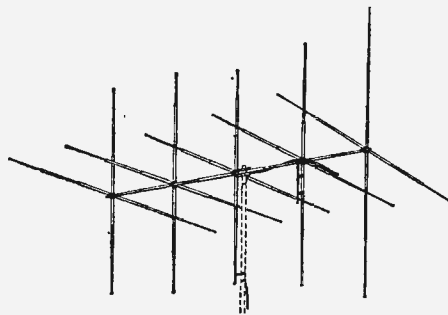
Continued from page 46

nels because full-23 coverage rigs were relatively large—they sure weren't going to slip into the glove compartment. But today, you can get a full-23 mini-rig that not only fits the glove compartment, you can even close the lid. And speaking of full-23 mini-rigs, you will now find 23-channel, 5-watt handie-talkies; think how convenient that will be for your camping—no more bulky battery packs clamped to a standard transceiver. You can shove the full-23 handie-talkie in your pack next to the mess kit.

And while you're thinking about upgrading, don't overlook single-sideband. If you use a lot of interstation communications, that is, most contacts are between units licensed to you or your club, SSB is the thing because it will almost double the effective operating range. For example, if you get out 4 miles with your AM rig you will get consistent coverage to almost 8 miles with SSB. Another plus for SSB is that noise, both atmospheric and man-made, doesn't jam or interfere with the signal as much as it does for AM. Also, SSB rigs often include noise silencers in place of, or in addition to, noise limiters, so the noise interference is squashed even further.

Speaking of noise limiters, some of the new AM rigs also feature noise *silencers*. If you operate from a noisy location one of the noise-silenced AM rigs will do a lot more than the

Antenna Specialists' Model M-216 is a dual-polarity, 5-element beam antenna for 27 MHz that has an exceptionally long boom—22 feet! Known as the Big Daddy, this super antenna has a wind rating



in excess of 100 mph and a tunable gamma match on each polarity. A vertical/horizontal polarization control box is included. All for \$159.95. Circle No. 37 on Reader Service Page.

old fashioned limiter that just clips the peaks off the noise bursts. The silencers literally punch a "hole" in the signal at each noise burst, so instead of an ear-grinding hash, you get more of a "hiss" under the received signal.

Another place you can upgrade operations is the "talk power" booster—if you use such a device. Until recently, most mike boosters were nothing more than high gain amplifiers. They worked on the principle that if you had so much mike gain, the modulation distorted, so that most people would think there was more talk power. Another type of booster was a compressor with some 6 dB of compression—just enough to make a difference. The modern talk power booster, however, provides more *low distortion* compression than you're likely to find on the local hard-rock AM station, and these compressors really add sock to your signal.

And while you're thinking about upgrading, don't limit yourself to just improving overall performance. How about upgrading your test gear to make certain your signal stays on top of the heap. Scrap the old power output meter that replaced the antenna with a dummy load. Latch onto an in-line power meter that gives a continuous indication of the power fed into the antenna. Maybe even an in-line meter that indicates both power output and SWR. And for those of you who like to sit back and relax with a cold drink while chitting-the-chat, there's a base station console complete with metering, talk-power booster and station control.

Very few CB'ers would tool a 1949 car on a modern high speed freeway; why then should you use 1950 or 1960 CB gear in the '70's? Now is the time to get your CB operations into high gear. ■

Lafayette's new HA-420

1.5 Watt CB Walkie-Talkie features a 13-transistor 4-diode superheterodyne receive circuit, with 1.5 watt 3-channel transmit operation.

The receiver includes a tuned RF amplifier for less than 1 μ V sensitivity.

Also included are automatic noise limiting, automatic volume control and variable squelch. Operating on 8-penlight batteries, the HA-420 also comes equipped with battery condition meter, external antenna connector, earphone jack and crystals for channel 10. Priced at \$36.95. Circle No. 36 on Reader Service Page and learn more about it.



DX Central Reporting

Continued from page 28

For the more experienced SWL, try for the Norwegian shortwave station at Tromsø, a port city some 2000 miles north of the Arctic Circle. This outlet is the northernmost shortwave broadcast station in the world.

It operates with 10 kilowatts on a frequency of 7,240 kHz, relaying the Norwegian home service broadcasts, primarily to the fishing fleet and ships at sea. However, there is a brief English language identification at 0500 GMT sign on.

Because of heavy interference from the ham stations that share this part of the shortwave dial, reception will take a lot of skill, patience and luck.

Bandsweep. (Frequencies in kHz, time, GMT) **3,316**—A West African that isn't too common, yet managed to put a decent signal into North America at times is *Radio Sierra Leone*. Try for it after 0630. . . . **3,995**—Halfway around the world are the Solomon Islands. An exotic catch, and not really that tough if you find the right morning, say around 0800 to 1000, is the *Solomon Islands Broadcasting Service* . . . **4,845**—How about taking a crack at a couple of Latin American outlets? Not for the rank beginner, but not among the hardest Latins to log is *Radio Fides* in Bolivia. It is being heard evenings until 0330 sign off. . . . **4,990**—*Radio Barquisimeto*, a Venezuelan station, shouldn't elude you during the evening hours if you're game. You should be able to pick out the Spanish identification. . . . **6,100**—If you should hear English spoken while tuning this frequency during the afternoon, say around 2230 for those in the eastern part of the country, it may be the *Nigerian Broadcasting Corporation's* station at Maiduguri. It shifted frequency from 4,900 not long ago. . . . **9,550**—*Radiodifusion-TV Belge* in Brussels is one of those European outlets not in everyone's log book. Listen to its English program at 0050. . . . **11,740**—Ceylon officially is Sri Lanka now, but its station still announces as *Ceylon Broadcasting Corporation* at 1100 sign on.

(Credits: Rich d'Angelo, New York; Gerry Dexter, Wisconsin; Bill Berghammer, New York; Eric Herson, Ohio; Dan Jamison, Virginia; North American Short Wave Association, Box 989, Altoona, Pa. 16603)

Backtalk. Steve Johnson, Joliet IL, does his DXing with an eight-band portable receiver, which allows him to combine his two favorite hobbies, SWLing and vacationing. When Steve travels, along goes his receiver for some on-the-road DXing.

One of his Latin American catches is *Radio Nacional* in Nicaragua, and Steve asks about

the station's address.

OK, Steve, send your reception report to Douglas Amaya, Director Artistico, c/o *Radio Nacional de Nicaragua*, Apartado 1371, Managua, Nicaragua. Hope you get a QSL!

An eight-hour graveyard shift as a police-sheriff radio dispatcher in a small town gives Michael Miller of Cathlamet WA, plenty of free time for DXing. One nice piece of DX Mike logged during the long lonely hours before dawn is *Radio Vila* in the Pacific New Hebrides Islands on 3,945 kHz.

Rick Morgan, Statesville NC, has a problem. He wrote DX Central to report that several of his prize QSLs were damaged when he removed them from some poster board he'd tacked to the wall of his room.

"Will stations replace these old QSLs," Rick asks?

While I think you'll have better luck if you listen for the stations again and send new reports, at least one DXer I know who had a similar problem—his cat ate one of his prized QSLs—requested a duplicate card from *FEBA*, the Far East Broadcasting Associates station on the island of Seychelles, and got it!

Canada's only major hobby club, the Canadian International DX Radio Club, the subject focused in DX Central's spotlight this month, just celebrated its tenth birthday this past summer.

Its monthly bulletin, the *Messenger* covers most phases of DXing and recently took on a new look, "The Social Look." This friendly bunch of guys tab their organization "The Club with the Sociable Difference." It has well over 200 members and its bulletin has plenty of interesting items for all members, from the new hobbyist to the seasoned DXer.

If you'd like to join CIDXC, or would like more information about the club, use the handy form below. Send it directly to CIDXC, though, not DX Central.

CANADIAN INTERNATIONAL DX RADIO CLUB 169 Grandview Avenue Winnipeg 16, Manitoba, Canada

I read about CIDXC in ELEMENTARY ELECTRONICS "DX Central Reporting." (Please check one.)

- I want to join. I am enclosing \$5 for one year's membership. (\$7.50 for first class mail)
- Please send me more information about CIDXC.

Name: _____

Address: _____

City: _____ State: _____ ZIP: _____

ATTENTION, READERS

Why not send a picture of you and your DXing equipment. Any clear photograph will do, but we prefer to see you at your "rig." Along with the picture, tell us a little about yourself and your activities.

ELEMENTARY ELECTRONICS

Revox with Dolby

Continued from page 60

duced to simplify threading.) In place of the switch are two controls for Dolby record-level calibration of both recording channels. In typical use you would simply set the tape-monitor switch to CAL and adjust the Dolby-level controls for a zero-VU reading on the meters. That's the whole Dolby alignment procedure.

Space Maneuvers. Since the Dolbyized Revox A77 has both record and play Dolby equalizers, so you can simultaneously play back the de-processed recording, a lot of space was required under the deck. The standard A77 already had space for pre-wired sockets that accommodated plug-in power amplifiers. The sockets were also pre-wired to two speaker-output jacks on the connection strip along the top edge of the rear apron. You will find that on the Dolby model the holes for the jacks are now plugged, as the Dolby printed-circuit boards utilize the space reserved for the power amplifier plug-ins. This arrangement retains all the conveniences of the standard A77 such as plug-in record and play amplifiers and complete user access to the bias and equalizer adjustments.

Great Performance. The non-Dolby performance is just as it was for the standard model: superb. The only thing the Dolby does is to reduce the noise level to a rock-bottom -62 dB narrow band, which is superior to the signal-to-noise ratio of many



FILTER SWITCH

Adjacent to the record-level controls is the filter-selector switch, which is needed to prevent the FM-pilot leakage from a receiver from interfering with the Dolby system. The hand-feed lever that moves the tape against the play head is retained on the Dolby A77.

non-Dolby *full-track* professional recorders. In order to obtain this excellent signal-to-noise ratio you must keep in mind that the A77 is a professional machine and has professional VU-meter calibration: zero VU is 10 dB below tape saturation (3% THD) and you need not reduce the recording level to avoid peak-signal distortion. On the A77 you ride signal peaks right up to "zero VU," and an occasional peak can go above zero VU.

Summin up. Even if the \$879 price tag of the Dolby A77 is too rich for your budget, we suggest you listen to one at your local hi-fi showroom just to enjoy truly magnificent sound quality. ■

4-Channel

Continued from page 78

Admittedly, both examples are oversimplifications, but they do illustrate what you are likely to encounter in your particular listening environment, and some methods to optimize the sound distribution.

Applying the principles of Figs. 3 and 4 to a 4-channel discrete system usually works well, primarily because the separation between speakers is maximum; you will always get the feeling of surround-sound. While SQ is supposedly also surround-sound, its sharply reduced separation can easily be turned into surround-mono in a reverberant room. Greater SQ separation can be obtained two

ways: (1) move the speakers further away from the listening area in a "dead" room, or (2) in a reverberant room, rotate the speakers slightly, just enough so the reverb path does not come straight back at you from the walls opposite the speakers.

If you have one of the newer "logic" type SQ decoders, you will not have as much problem with reduced SQ separation because the decoder's logic circuits automatically reduce the gain of the three "weaker" channels, thereby creating the illusion of greater separation. (The effect is buried in what is conveniently excused as "psychoacoustics.") It might not be "real" 4-channel surround-sound—if such actually exists, but it is a most pleasant effect.

If your listening environment is such that
(Continued on page 102)

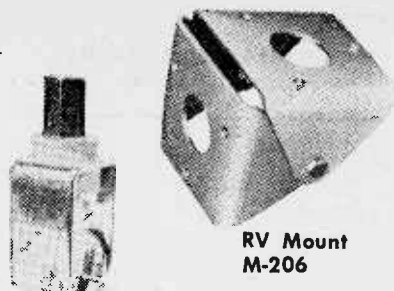
CB ACCESSORIES

Continued from page 40

nal). Such interference can attack TV reception on nearby receivers. If you're accused of TVI, first check for correct adjustment of filters which may already be installed in the rig. If this fails to cure the problem, one of the external filters in the marketplace may help. Low-pass filters for CB run about \$6 to \$10 and are placed in the coaxial cable near the rig. These units pass all frequencies below about 40 MHz to allow the CB signal to pass to the antenna, but attenuate the second harmonic on 54 MHz.

Another type of filter, the high-pass, is designed to reduce the direct entry of the 27 MHz CB signal (not the second harmonic) into the TV set. It's connected at the antenna terminals of the TV receiver and passes signals above 52 MHz. One model that's been on the market longer than most is the Drake High Pass Filter which retails for \$5.95. ■

Just don't fret! There is an antenna mount made for your set of wheels. Antenna Specialist makes these—Circle No. 58 on Reader Service page 17.



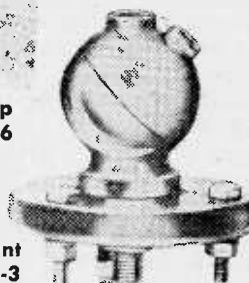
**RV Mount
M-206**



**Trunk Groove
Mount
M-68**

**Gutter Clamp
Mount, M-236**

**Swivel Mount
M-3**



e/e CB 10-CODE

- 10-1 —Receiving poorly
- 10-2 —Receiving well
- 10-3 —Stop transmitting
- 10-4 —OK, Message received
- 10-5 —Relay message
- 10-6 —Busy. Stand by
- 10-7 —Out of Service. Leaving air
- 10-8 —In service, subject to call
- 10-9 —Repeat message
- 10-10 —Transmission completed, standing by
- 10-11 —Talking too rapidly
- 10-12 —Visitors present
- 10-13 —Advise weather/road conditions
- 10-14 —Read Kathi's CB Carousel in e/e
- 10-16 —Make pickup at.....
- 10-17 —Urgent business
- 10-18 —Anything for us?
- 10-19 —Nothing for you. Return to base
- 10-20 —My location is.....
- 10-21 —Call by telephone
- 10-22 —Report in person to.....
- 10-23 —Stand by
- 10-24 —Completed last assignment
- 10-25 —Can you contact.....?
- 10-26 —Disregard last information
- 10-27 —I am moving to Channel.....
- 10-28 —Time is up for contact
- 10-30 —Does not conform to FCC Rules
- 10-32 —I will give you a radio check
- 10-33 —Emergency traffic at this station
- 10-34 —Trouble at this station. Help needed
- 10-35 —Confidential information
- 10-36 —Correct time is.....
- 10-37 —Wrecker needed at.....
- 10-38 —Ambulance needed at.....
- 10-39 —Your message delivered
- 10-41 —Please tune to Channel.....
- 10-42 —Traffic accident at.....
- 10-43 —Traffic tieup at.....
- 10-44 —I have a message for you (or)
- 10-45 —All units within range please report
- 10-50 —Break Channel.....
- 10-60 —What is next message number?
- 10-62 —Unable to copy. Use phone

NewsScan

Continued from page 25

all contemporary pacemakers fail in less than two years, and none have logged four years of operation. In addition to promoting peace of mind for the patient whose well being depends upon an artificial heart timer, the extended-life devices now in pilot production could dramatically reduce expense and inconvenience to the patient. At present, such patients must submit to chest surgery at frequent intervals within the reliability life-span of present pacemakers.

About 50,000 persons now depend upon pacemakers. It is estimated that an additional 5,000 to 10,000 will join their ranks annually as the reliability and longevity of the device is increased.

LOOKING FOR TROUBLE

Five complete *Stormfinder* radar systems that can pinpoint storms up to 250 miles away form a new typhoon detection and warning network for the Philippines. The radars are installed at San Mateo, Basco Island, Daet-Camarines Norte, Cebu and Cuyo. The *Stormfinder*, made by Raytheon, is a type of radar used extensively by the U.S. Weather Bureau, Navy, and Air Force to aid detailed storm forecasting. Similar units have also been purchased by the U.N. World Meteorological Organization and the

- 10-67—All units comply
- 10-70—Fire at.....
- 10-71—Proceed with transmission in sequence
- 10-73—Speed trap at.....
- 10-75—You are causing interference
- 10-77—Negative contact
- 10-81—Reserve hotel room for.....
- 10-82—Reserve room for.....
- 10-84—My telephone number is.....
- 10-85—My address is.....
- 10-89—Radio repairman needed at.....
- 10-90—I have TV!
- 10-91—Talk closer to mike
- 10-92—Your transmitter is out of adjustment
- 10-95—Transmit dead carrier for 5 seconds
- 10-99—Mission completed, all units secure
- 10-200—Police needed at.....

NOTE: Any 10-Code signal may be reversed by stating it as a question. For example: 10-20? Would mean "What is your location?", or 10-36? would mean "What is the correct time?"

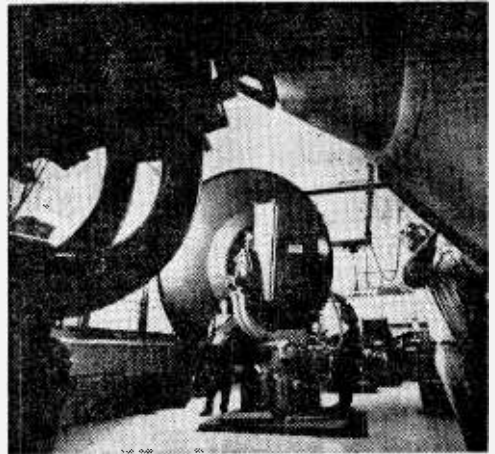


"Who the Devil told you we require a customer to show his citizenship papers before he can buy a CB rig?"

Taiwan Provincial Weather Bureau.

Each radar has a 12-foot diameter parabolic reflector antenna enclosed in a fibre glass radome. The display, on three scopes, presents a composite picture of an entire weather front over a 200,000 square mile area. Storms up to 250 miles away can be detected and tracked. The radar also distinguishes hail, rain, and snow and indicates the intensity of each in any storm development.

The Raytheon *Stormfinder* radar can probe
(Continued on page 104)



Stormfinder radars are checked out at Raytheon Company's North Dighton, Mass. plant before shipment to Manila where they were installed at five locations to provide a storm warning network for the Philippines.

4-Channel

Continued from page 99

much of the surround-sound effect is being lost regardless of how the speakers are arranged and oriented, try to move them in as close as possible so as to provide the highest ratio of direct-to-reverberant sound at the listening location. Since reverb tends to blend the higher frequency sounds from the four speakers (and it is the higher frequencies that are directive), reducing the blend by increasing the direct/reverb ratio often creates the illusion of greater separation, though it will also tend to make the sound slightly *flatter*, or lacking brilliance. (Again psychoacoustics!)

But just as you would want to reduce the reverberation blend for SQ, so would you want to *boost* the blend for derived ambient sound. Why? Because derived ambient is supposed to simulate the concert hall, or rock club. Now, when was the last time you attended a live anything and heard the sound from anywhere's other the front? The ambient sound of the hall—the reflections from the walls, floor, ceiling, furniture, and the absorption by the audience, create a vague spaciousness and overall tone quality we might define as "warm," "cold" or maybe "full bodied." Whatever the ambient sound does, it does not change the point or origination of the sound source, which is *up front*. (Yes, there are a few halls where a few seats appear to get their sound from the right and/or left side.)

Most speaker recommendations for ambient sound place the speakers as shown in Fig. 2, with the ambient "rear" speakers literally pouring the sound into the listener's ears. Just forget for a moment that nowhere does the ambient sound pour into the ear at a *noticeable* level, or from a specific direction. Consider, instead, that, depending on the record, the "rear ambient" might have considerable frontal energy and/or distortion in the form of "groove rattle" or intermod. Is this what you want?

Diffuse Ambient. Nothing in this world is going to duplicate a concert hall in your living room through speakers. At most, you will obtain a feeling of spaciousness which is a lot better than "standard stereo," and which might conceivably *start to approach* concert-hall realism. But you get this effect by diffusing the ambient sound either by a long path from the ambient speakers (which

are at a *very low level*), or by blending the sound via rear-wall bounce. Some typical speaker arrangements for a diffuse ambient sound are shown in Fig. 5. The pairs of ambient speaker are indicated as A/A and B/B'. Again, the arrangements serve only to illustrate a starting point. Regardless of the finalized speaker arrangement the balancing should be such that the ambient can barely be heard when the front speakers are off. While this is not going to "pour it down your ear" as it is done at a hi-fi showroom, after a few minutes of listening you will note a general depth to the sound field, with the sound orientation at the front where it belongs. In the long run, properly diffused and balanced rear ambient is the most enjoyable of all the 4-channel formats.

Lastly, we should point out that most all sounds in life have a specific orientation or direction. Even the ear-damaging sounds of low-flying commercial jetliners have a recognized point of origin, even when we are feeling pain. The failure of most 4-channel speaker arrangements and sound-field balancing is that the subconscious, expected sound orientation is disturbed. While the overall immediate (short-term) effect might be spectacular, it either wears quickly or the listener perceives *less than standard stereo* in terms of overall musical performance. However you arrange and level-balance your speakers for any 4-channel system, certain sounds should retain a familiar orientation: vocalists and soloists should be up front—predominantly up front. Of course there will always be the A & R man or engineer that sticks one vocalist left front, another vocalist right front and a chorus spread out twenty feet across the rear. Just buy another record; it's simply another version of stereo ping-pong—and that ain't 4-channel sound. ■



READER SERVICE PAGE

• The Editor of ELEMENTARY ELECTRONICS offers readers an easy way to get additional information about products and services advertised in this issue. Also, if you would like more information about any new product mentioned in our column "Hey, Look Me Over," it's yours for the asking. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost.

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advertisement or editorial mention that interests you. Then, carefully print your name and address on the coupon. Cut out the coupon and mail to ELEMENTARY ELECTRONICS, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today!

NOVEMBER/DECEMBER 1972

Void after March 31, 1973

ELEMENTARY ELECTRONICS

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21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

• Please limit circled items to 12 maximum.

Name (Print Clearly) _____

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State _____

Zip Code _____

(Continued from page 101)

into and beyond the center of a hurricane or typhoon to aid forecasters in evaluating its in-

tensity and plotting its advance. The radar operates in the S-Band (2700-2900 MHz) with a power of 500 kilowatts.

Ask Hank

Continued from page 26

to say "10-4, etc.". Tune slowly, and use an outdoor antenna. You'll need separate units for each band.

Nutty Question

What's a wire nut?

—B.X.C., Boulder CO

Electricians use wire nuts to insulate twisted connected solid copper wire in junction and outlet boxes. They are usually black (white and red are common) cones with a hole in the base. The twisted bare wires are inserted into the wire nut and then the nut is threaded on until it is secure and the plastic shell covers the insulation's ends. The resulting job is much neater than black electrical tape joints and much safer.

Shiny Ring

The commutator of a used DC motor (taken from a car's fan assembly) has a shiny ring. Is this okay?

—K.F., Dallas TX

Sure is! What you should watch out for is uneven marking in the brush run area—that's the shiny ring. Also, is the commutator grooved by the brushes? If so, throw it out. A final check—if the brushes are worn down, replace brushes.

An Old One

I need a schematic for an old Howard radio. Do you know where it is possible to get one?

—G.H., Rockville MD

Individual schematics for television sets and radios dating back to the 1930's are available from Supreme Publications, 1760 Balsam Road,

Highland Park IL. Radio schematics cost \$1.00, TV schematics cost \$1.50. Please be sure and give the model number when you order schematics. By the way, I had an old Howard as my first SW receiver. It's circuit was simple and my local radio repairman (before TV) tuned it up for me.

Ding-a-Ling

Is there a way to buck up the two batteries I use in my telephone circuit so the phones can be about one quarter of a mile apart?

—L.S., Bell Buckle TN

Sure, run as heavy a line as possible from one point to the other to reduce line losses. In fact, use several wires in parallel. For the return leg use the ground. Connect one side of the phones to a water pipe at both ends—should work fine. Tossing in some extra dry cells will give you some extra *push*, but don't do it if volume is sufficient.

A Weirdo

I have a TV flyback transformer I would like to operate from the 110-volt line. Is this possible?

—T.H.A., Plantation FL

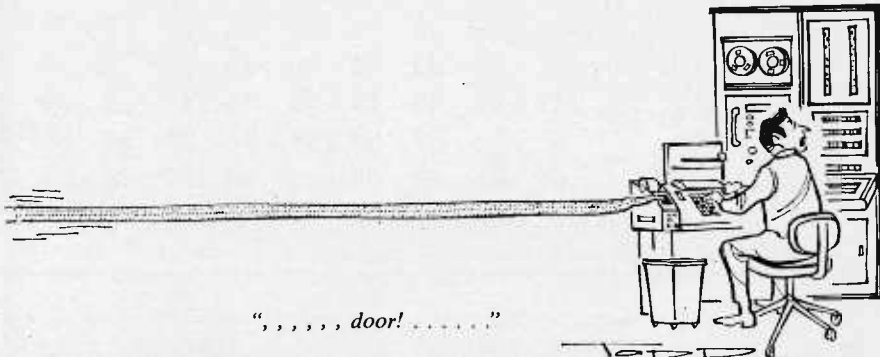
No. It is vastly different from a conventional power transformer. Flyback operate at 15 kHz and will burn up at 60 Hz.

Police Frequencies

I'd like to know the police frequencies in my hometown. Can you help me?

—I.P., Springfield MS

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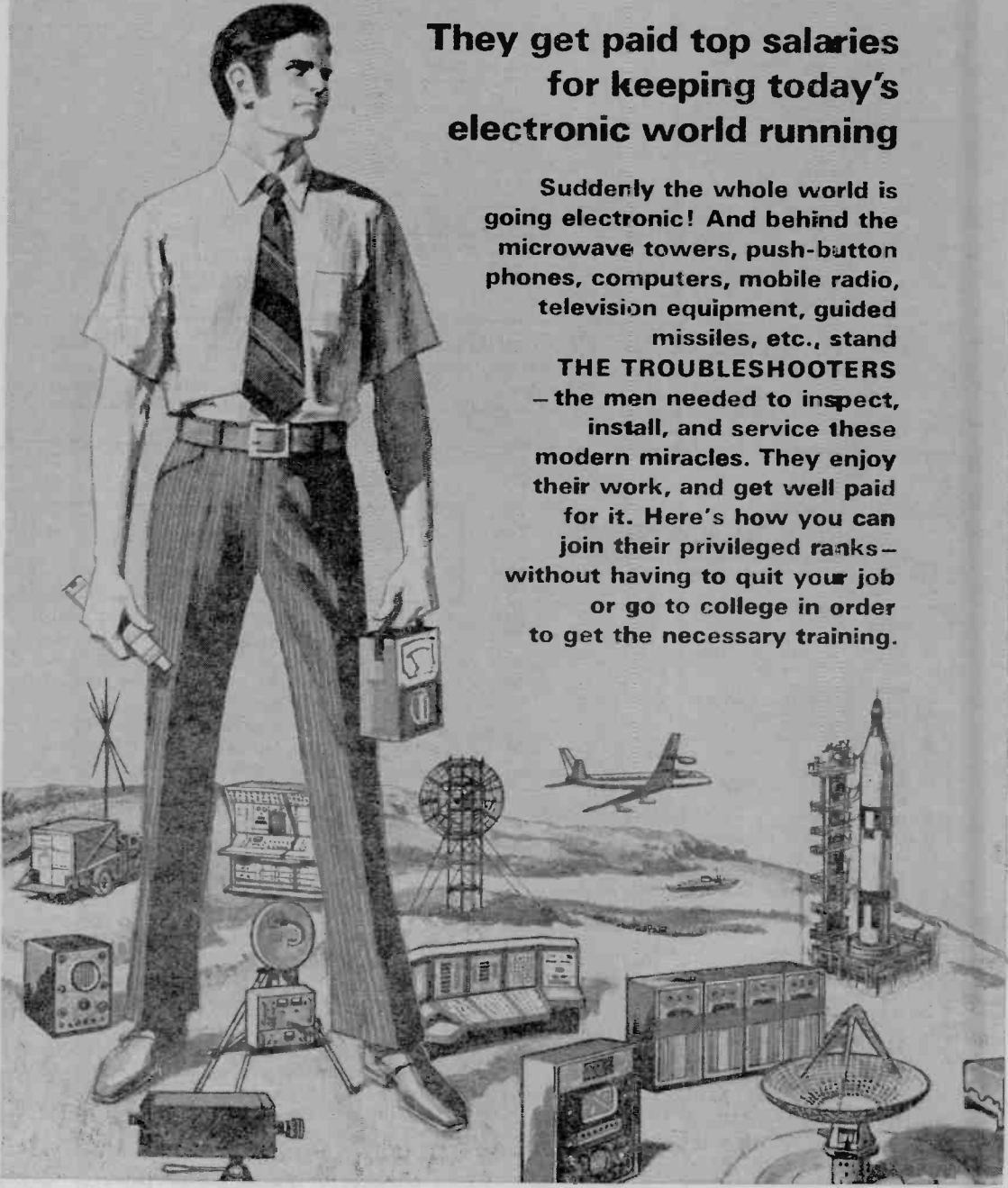
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- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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