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MARCH-APRIL 75¢

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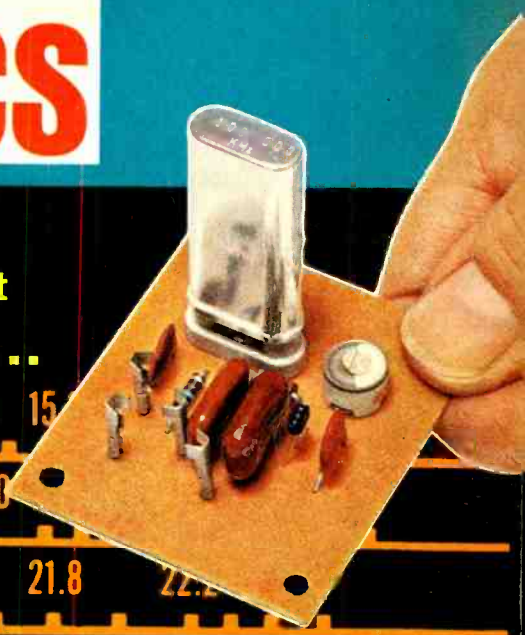

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IN THIS BASIC ELECTRIC

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Engineering excellence, 100% capability, striking esthetics, the industry's only **TOTAL PERFORMANCE STEREO at lowest cost.**

A Silicon Solid-State 70-Watt Stereo Amplifier for $89.95 kit, $139.95 wired, including cabinet. Cortina 3070.

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The newest excitement in kits.
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Fun to build and use. Expandable, interconnectable. Great as "jiffy" projects and as introductions to electronics. No technical experience needed. Finest parts, pre-drilled etched printed circuit boards, step-by-step instructions.

Electronic Siren $4.95, Burglar Alarm $6.95, Fire Alarm $6.95, Intercom $3.95, Audio Power Amplifier $4.95, Metronome $3.95, Tremolo $8.95, Light Flasher $3.95, Electronic "Mystifier" $4.95, Photo Cell Nite Lite $4.95, Power Supply $7.95, Code Oscillator $2.50, FM Wireless Mike $9.95, AM Wireless Mike $9.95, Electronic VOX $7.95, FM Radio $9.95, AM Radio $7.95, Electronic Bongos $7.95.

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Two years ahead! Model 7923
All Solid-State 23-Channel 5W Transceiver. 4 exclusives: dual-crystal lattice filter for razor-sharp selectivity; efficient up-converter frequency synthesizer for advanced stability; precision series-mode fundamental crystals; Small: only 3"H, 8"W, 8¾"D. $189.95 wired only.

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The industry's *greatest* V-O-M values. Designed, made to Eico's high standards of professionalism. Each *complete* with batteries & test leads. Backed 100% by famous EICO warranty.

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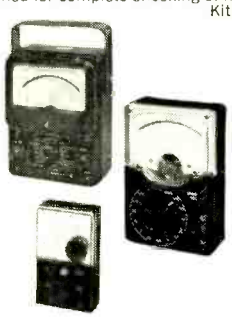
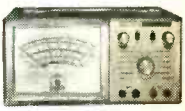


Automotive

EICO 888—Car/Boat Engine Analyzer.
For all 6V/12V systems; 4, 6, 8-cyl. engines.



Now you can keep your car or boat engine in tip-top shape with this solid-state, portable, self-powered universal engine analyzer. Completely tests your *total* ignition/electrical system.

Complete with a Tune-up & Trouble-shooting Manual. Model 888; $44.95 kit, $69.95 wired.

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100 best buys to choose from.

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—laboratory precision at lowest cost.

Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. $109.95 kit, $149.95 wired.

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MARCH/APRIL 1968
VOL. 6 NO. 1

elementary Electronics

Dedicated to America's Electronics Hobbyists

BEGINNING IN THIS ISSUE— A GREAT NEW SERIES!

Cover Photo by Leonard Heicklen

☆ Cover Highlights

AUTHORS IN THIS ISSUE:

Robert M. Brown—K2ZSQ, Len Buckwalter —K1ODH, Homer L. Davidson, James A. Fred, Herb Friedman, Webb Garrison, Jorma Hyypia, Edward A. Morris—WA2VLU, C.M. Stanbury II, and the ELEMENTARY ELECTRONICS' Editorial Staff.

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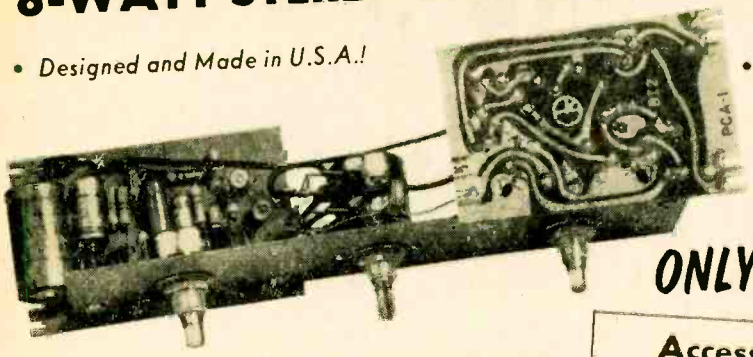
8-WATT STEREO AMPLIFIER SEMI-KIT

- *Designed and Made in U.S.A.!*
- *A Cinch to Assemble — Just Add Leads!*



ONLY **10.95**

Your chance to scoop up a pre-wired solid state stereo amplifier for only $10.95! Devise your own custom-installation! No engineering skills are required! Just add the leads. 2 volume controls, one for each channel, plus a wide-range tone control. Input impedance is 600KΩ with frequency response from 50-20,000 cps. Operating either on AC or battery, the amplifier accepts 8-16Ω speakers; crystal or ceramic cartridge of AM/FM stereo tuner. Transformerless output circuit. You needn't shop around for other parts. Purchase the accessory kit especially designed for the amplifier (see right). #30-1969

Accessory Kit for 8W Amplifier

ONLY **3.95**

- *Knobs*
- *Transformer*
- *Line Cord*
- *Switch*
- *Diode*
- *Battery and Clips*
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30-1968, Ship. wt. 1 lb. Net 3.95

THE COMPLETE STEREO SEMI-KIT PACKAGE!

27.95

Hook Up, Install Anywhere!

- *8-Watt Stereo Amplifier Semi-Kit Complete with Accessory Kit!*
- *Turntable, Tone Arm and Stereo Cartridge!*
- *Two 8-Inch Round Speakers!* • *No Extras to Buy!*

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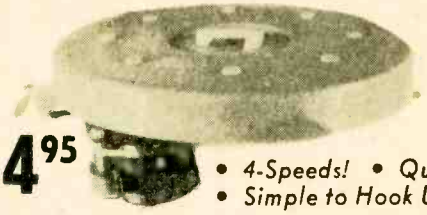

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- *4-Speeds!* • *Quiet!*
- *Simple to Hook Up!*

Use with stereo amplifiers! Vibration-free AC operation assured by rubber shock-mounted friction drive motor. Speed changes controlled by idler driving the 8" metal turntable. 4½ x 3⅜" mounting centers; 2⅛" below base plate. #42-129; #278-1255, AC Line Cord, .39 net.

STEREO ARM/ CARTRIDGE

2.99

- *Simple to Mount!*
- *Straight Line Design!*

Modernistic 8" tone arm has off-set head, and high output stereo crystal cartridge (2½V) with dual synthetic sapphire styli. Stylus pressure is adjustable by variable spring tension. Comes with finger lift. #42-128

Special Purchase! **Manufacturer's Closeout!**

8" ROUND SPEAKER

- *The Perfect Low-Cost Extension or Replacement Speaker!*

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Use with semi-kit shown above! Our huge 190-store buying power brings you this quality speaker at sensational savings! Buy several — bring stereo to every room in your home! U.S.-made. Magnet weight: 1.47 oz. 8 ohms. #40-1271.

Store Addresses, Order Form, See Page 20

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- *4-Track, Reel-to-Reel!*
- *Same as Getting 6 Stereo Tapes!*
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- *7" Reel!* • *3¾ IPS!*

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SEPARATELY: $5.95 EACH

QUIET JAZZ: Pool some of America's top jazz musicians, mix in top-notch musical repertories, and the result: a really great 47-hit tape! Pete Jolly and Bob Freeman are just two of the artists. A "must" for every jazz lover! #51-3001

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Available Only at Radio Shack

- *3 Complete Stereo Albums — IN ONE CARTRIDGE!*
- *30 Full-Length Tunes!*

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AND THEN THEY WROTE: Hits of Porter, Gershwin, Lerner and Loewe, etc., played by the Kingsbridge Strings. #51-3009

3-Disk Audio Fidelity Stereo LP Sets!

ORGAN IN STEREO

3 Record Stereo Set

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An Audiophile Series standout! 36 selections engineered to bring out the best in any stereo system. Leon Berry at the giant Wurlitzer organ; Al Melgard at the Chicago Stadium organ, and Eddie Osborn at the Baldwin and bongos. 2 hours of entertainment! #50-2000

- *Studio Quality!*
- *20-20,000 CPS!*

ARMED FORCES SOUND EFFECTS

3 Record Stereo Set

4.95

The drama of actual combat; the sound of airpower; a nuclear explosion and the fast-paced action of the world's greatest aircraft carrier. Listen to ceremonial military drills and marches. 3 records at what you'd expect to pay for one! #50-2001

- *Studio Quality!*
- *20-20,000 CPS!*

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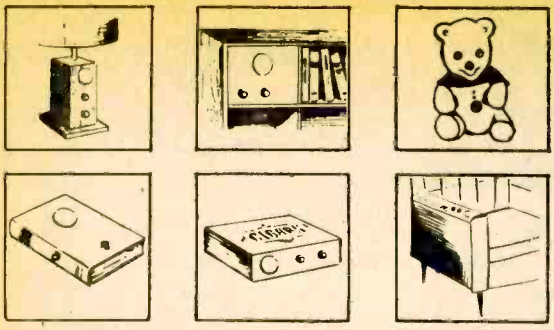


SEE PAGE 5

SAVE EVEN MORE, USE YOUR

FREE $1.00 YEAR END BONUS

NO STRINGS! USE LIKE MONEY!

ONE DOLLA

What's your project for our "Build In" radio?

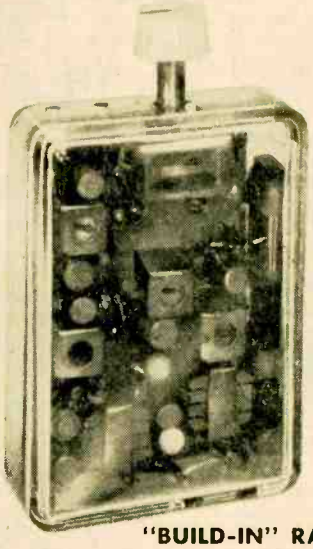
Here's a wired transistor radio in 3 pieces. Dextrous do-it-yourselfers should have a field-day with this one.

You carpenters, metal-workers and gift designers will really appreciate Radio Shack's novel "Build In" — a 6-transistor superhet that's really *a kit that isn't a kit.* Confused? Part *one* is the radio, 100% wired, installed in a crystalline 2¼ x 1 x 3⅛" case with the tuning knob sticking out of one end, and 8 wires out of the other. Part *two* is a separate volume control with built-in switch, knob, and soldered leads. Part *three* is a 2¼" PM speaker installed in a plastic case, with soldered leads.

The three parts (plus a flat 9V battery, not included) can be installed in, on, or under anything, in just about any desired angle or position. And you don't have to be an engineer — Radio Shack's geniuses have provided a simple, idiot-proof lashup pictorial. Now all you need is the price *(just $6.98, Cat No. 12-1150)* and some Yankee ingenuity! Whether you hide "Build In" in a jug of corn likker, junior's wagon or Tillie's sewing box, the result is sure to please.

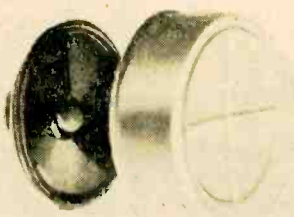
The basic radio itself looks like a little jewel, a real work of art — our photo doesn't do it justice. And the "kit that isn't a kit" is another of Radio Shacks's exciting exclusive products that can't be bought elsewhere. Get a "Build In" at your nearest Radio Shack store.

For Store Addresses, Order Form, See Page 20



"BUILD-IN" RADIO

VOLUME CONTROL AND SWITCH



PM SPEAKER IN CASE

RADIO SHACK PROJECT BOOKS (4¢ A PROJECT)

"50 EASY TO BUILD SOLID STATE PROJECTS"

Build your own transistor radios, electronic organs, amplifiers, code oscillators, megaphones, generators, etc. Ideal for hobbyists.

62-1050 ..... Net 2.00

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Build your own wireless microphone, AM broadcast tuner, audio preamp, PA system, experimenter's power supply, etc. 50 schematics.

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EACH BOOK $2

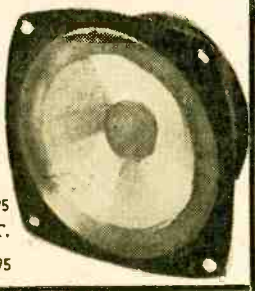
SPEAKERS, MIKES, TOOLS FOR THE EXPERIMENTER

SEE PAGE 5

SAVE EVEN MORE, USE YOUR
FREE $1.00 YEAR END BONUS
NO STRINGS! USE LIKE MONEY!
ONE DOLLAR

BUILD "EI'S" MIGHTY SUB-MINI SPEAKER

4" Acoustic Suspension FE-103 Speaker System!



The fabulous Realistic FE-103, complete with cabinet construction details as published in Electronics Illustrated! 30-17,000 cps; 15 watts; 8 Ω.

7.95

40-1197, FE-103, Wt. 5 lbs. Net 7.95

CONTOUR NETWORK KIT. With instructions.
40-808, coil, capacitor, etc., Net 3.95

MINIATURE PM SPEAKERS FOR TRANSISTOR PROJECTS, RADIOS

8 Ohm Impedance

Small in size but big in sound! Three sizes to choose from: 2½", 2¼", or 2". All for the same bargain price!

40-247, 2½", ... Net .98
40-246, 2¼", ... Net .98
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ONLY 98¢ EACH!

MIDGET EARPHONES

For Transistor Radios

98¢

Resp. 50-9000 cps. With replaceable earplug, cord. 10 ohms.
33-175, Wt. 2 oz. ..... Net .98
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STEREO HEADSET

Separate Transducers!

2.79

Perfect for use with receivers, tuners, amplifiers, kits and recorders! 8 ohms.
33-1008, ... Net 2.79

CRYSTAL LAPEL MIKE

- *For Recorders, PA, Paging!*

1.89

Sensitive! Concealable! Response: 200-300 cps.
33-100, Wt. .8 oz. .... Net 1.89

CRYSTAL MIKE CARTRIDGE

89¢

Precision made crystals! Response up to 7000 cy.
270-095, 8 oz. ..... Net .89

FABULOUS THERMO-ELECTRIC GLUE GUN REALLY WORKS!

60-Second Bonding Plus Instant-set Caulking!
No Clamping! No Cleaning!

5.99
for make-or-mend jobs

Makes all other kinds of gluing obsolete! Uses unique hot-melt glue sticks: melted glue bonds permanently in 60 seconds, providing a flexible bond that's perfect for furniture, pottery, metal, leather, plastic or fabric. Use with white sealer sticks for water proof caulking. Glue and caulking included.
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Neck/Hand/Desk Use!

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POWERFUL CERAMIC MAGNETS

1,000's of Home, Office, Auto Uses!

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LOW COST 25-W. SOLDERING IRON

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Precision designed! Comes complete with UL Cord and Plug. Uses 117V AC/DC.
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OUR OWN 60/40 SOLDER

69¢ Each
12 & UP
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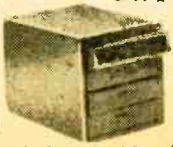
U.S. made with superactive rosin core. Fits fed. specs. QQ-S-571d
64-0002 ..... Net .69

STEEL CATCH-ALL STORAGE BOX

6"H x 8¼"D x 5¾"W



1.95

4 draws with adjustable compartments.
64-2050, 3 lbs. ..... Net 1.95

ASSORTED ELECTRIC HARDWARE

6"Hx8¼"Dx 5¾"W

99¢

Over 600 pieces! Something here for everyone! All brand new — no sweepings! One full pound. Comparable value: $4.50!
64-2890, Wt. 1 lb. .... Net .99

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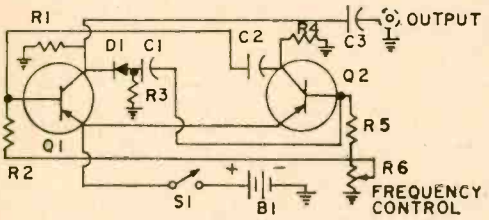
THESE ELECTRONIC PROJECTS HAVE EARNED CASH AWARDS FOR RADIO SHACK CUSTOMERS

Build Yourself — or Win Cash by Sending Us Your Own Ideas!

W. R.
San Francisco, California

SQUARE WAVE GENERATOR

Check Out the Frequency Response of Hi-Fi Amplifiers — Tape Recorders — Preamplifiers



PROJECT PARTS LIST

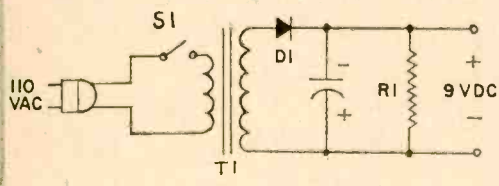
Stock No.	Item	Net
23-464	9V Rectangular Battery	.29
71-5194	.01 mfd Capacitors (C1, C2)	.18
71-0409	.1 mfd Capacitor (C3)	.22
276-1709	1N34 Germanium diode (D1)	.27
276-401	PNP Transistor (Q1, Q2)	.99
70-0195	3.3 K Resistor (R1, R3, R4)	.12
70-0195	6.8 K Resistor (R2, R5)	.12
271-1716	50 K Potentiometer (R6)	.59
275-602	SPST Toggle Switch	.30
270-325	Set of 5 battery connectors	.69
276-1390	Prepunch breadboards, 4½ x 5⅝"	.55
270-1395	Solderless terminals, (set of 5)	.99

Use this square wave generator, together with an oscilloscope, to analyze the frequency characteristics of any audio amplifier. The unit is adjustable over a broad range of audio frequencies.

F. R. F.
Chatsworth H.S. California

ELIMINATOR/CHARGER

Use Either in Place of a 9-Volt Battery or to Charge Batteries to Full Power. Save $$$!



PROJECT PARTS LIST

Stock No.	Item	Net
270-325	9 volt battery connectors (kit of 5)	.69
273-050	6.3V @ 1.2A Filament Transformer	1.19
274-687	Terminal strips (kit of 5)	.40
276-1135	Rectifier epoxy (kit of 2)	.29
275-602	SPST Switch	.30
272-986	Capacitor 500 μf (1)	.72
70-0195	10 KΩ ½W Resistor (1)	.12
278-1253	6 Ft. Line cord (1)	.39
276-1390	Prepunched breadboard (1)	.55
275-602	SPST Toggle Switch	.30

Now you can run electronic kits and experiments that use 9V DC power without buying new batteries! Simply plug into any 117 VAC outlet; delivers up to 250 ma. at 9 VDC.

$$ FOR YOUR ELECTRONIC IDEAS!

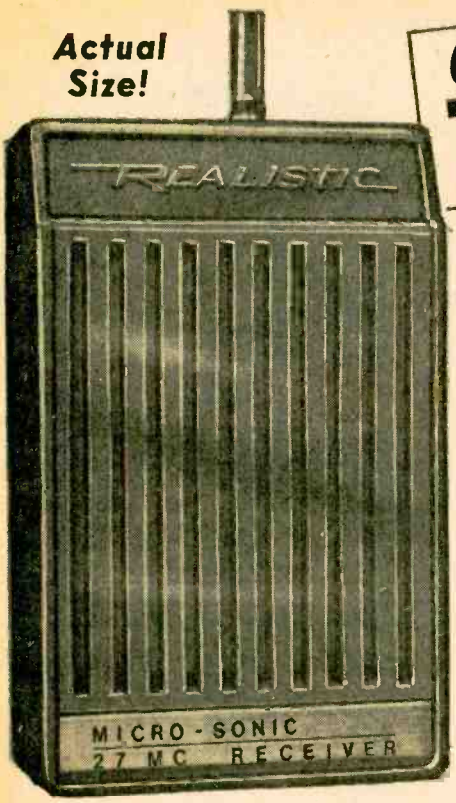
Turn Ingenuity and Hobby into Spare-Time Profits!

We are looking for experiments built around Radio Shack or other electronic parts. These will be published regularly in our catalogs. If published by us WE WILL PAY YOU AN AUTHOR'S FEE and reimburse you for parts bought from us — maximum $50 cost. By submitting it, you state it's original with you. If we accept it, it is understood we can publish it for use by our catalog, flyer, book and magazine readers. Submissions cannot be returned. Send description, parts list, stock numbers, and schematic. DO NOT SEND ACTUAL SAMPLE as we will build it here to see if and how it works. Write today!

SEND TO: **Radio Shack, Attn: Lewis Kornfeld, Vice-President**
730 Commonwealth Avenue, Boston, Mass. 02215

RADIO SHACK EXCLUSIVE! ADD A SLAVE "WALKIE" TO YOUR BASE, MOBILE, OR WALKIE TALKIES!

Actual Size!



ONLY 7.95

Crystal-controlled superhet receiver ONLY! Add as many ears to your network as you want. Fits in a shirt pocket — an excellent paging or guided tour device!

This unusual Radio Shack product, called the Realistic Microsonic 27MC Receiver, comes complete with a Ch. 11 CB crystal — and because it's a plug-in, it can be changed to any of the 23 channels. It's a teeny 3½ x 2½ x 1⅜". It includes an earphone with clip, and the phone's lead acts as the antenna. So if you want to hide it away as a pager, there's nothing showing. For DX we've included a 16" telescopic whip to be used only if necessary. Let your imagination run wild with this novel device!

21-109 Microsonic 27MC Receiver ..... Only 7.95

NEW IDEA #2 — as a companion to the above, or a wireless CB microphone (!), there's also the Realistic Microsonic CB transmitter. Same size, color, everything. But transmit only, 100mw of course, with plug-in crystal for Ch. 11. Uses? For example: one of these plus x-number of receivers and you have a guided tour technique that'll never quit!

21-110 Microsonic CB Transmitter ..... Only 7.95

FREE ACCESSORIES:

- Receiver — earphone and whip antenna
- Transmitter — 35" telescopic antenna

Note: both units include crystals but require a 9V transistor battery to operate. 23-464, 29¢ each.

RADIO SHACK'S FABULOUS SPACE PATROL® TWOSOME

STANDARD FULL SIZE

ARCHER

SPACE PATROL®

Talk up to ¼ mile with our perennial favorite in the 100MW no-license class. Over 100,000 of these transceivers now in use! "Lock-on" talk switch for continuous transmission when needed. Extra-long 43" telescopic antenna! Channel 14 crystal & battery included.

11.95 PER PAIR

ARCHER MICRO

SPACE PATROL®

Double transformer talk-power in the world's smallest (3-5/6 x 2-7/16 x 1¼") case. Fits easily in your shirt pocket (and your budget). Handsomely styled hi-impact, custom-chromed case. Easy to operate with a hideaway "push-to-talk" button. 9-section telescoping antenna. With channel 14 crystal and battery.

14.95 PER PAIR

For Store Addresses, Order Form, See Page 20

CB'ers MOBILE REALISTIC® TRANSCEIVERS!

23-CHANNEL CRYSTAL-CONTROLLED TRANSCEIVER

139.95

ALL CRYSTALS SUPPLIED!

ONLY 6"x7"x1-3/4"

- *18 Transistors; 4 Diodes!*
- *Antenna Change-Over Relay!*
- *Low Battery Drain!*
- *Synthesizer Circuitry!*
- *Illuminated "S" Meter & Channel Selector!*
- *Wood Grain & Chrome Front Panel!*

Obsoletes all other 23-channel crystal-controlled transceivers! High-efficiency — up to 3.5 watts output with 5 watts input. Dual conversion, with 10.62 Mhz and 455 Khz IF's for sharp selectivity. Sensitivity: 0.25 μv at 10 db S/N. Adjustable squelch control and automatic series gate noise limiter. 12 VDC neg. ground. Plug-in ceramic mike and retractable coil cord, fusable DC power cable, bracket, instructions and hardware.
21-124, TRC-24, Ship. Wt. 6 lbs. ..... Net 139.95

REALISTIC® 12 CHANNEL CB TRANSCEIVER

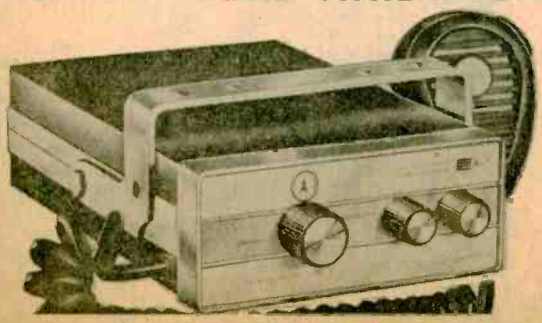
Single Crystal Operation for Receive and Transmit

99.95

- *Solid State Circuitry!*
- *Dual Conversion 6.2 MHZ and 455 for Greater Sensitivity & Selectivity!*
- *Mechanical 455 KC Filter!*
- *Push-to-talk Dynamic Mike!*

A truly versatile communications package. Incorporates advanced frequency synthesis technique used on higher priced models, the TRC-18 transmits and receives with only one crystal per channel. Up to 3-watts output with a full 5 watts of RF input. Low battery drain in any 12 VDC neg. ground vehicle. Adjustable squelch control; automatic noise limiter; illuminated channel selector and meter. Sensitivity: 0.5 μv for 10 db S+S/N. With cords, brackets, crystal for channel 11. 7½" x 6⅜" x 2⅛".
21-120, Ship. Wt. 8 lbs. ..... Net 99.95

REALISTIC® SOLID STATE MOBILE 2-WAY RADIO



79.95

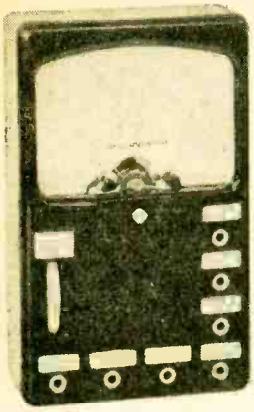
- *8-Crystal Controlled Channels!*
- *All Silicon Transistors!*

Economy priced. Model TRC-14 features full 5-watts input, adjustable squelch control and advanced electronic antenna switching. Sensitivity: 1 μv for 10 db SN/N. 12 VDC neg. ground. Set of crystals for channel 11, push-to-talk ceramic mike, mounting bracket, DC cable and instructions. 8¼ x 5⅜ x 2⅛".
21-032, Ship. Wt. 5 lbs. ..... Net 79.95
TRC-15 — Same as above but for 12 channel operation, illuminated channel selector, die cast panel, extruded trim and coil cable push-to-talk.
21-033, Wt. 5 lbs. ..... Net 89.95

For Store Addresses, Order Form, See Page 20.

EASY-TO-USE EMICRONTA TEST EQUIPMENT!

1,000 OHMS/VOLT MULTITESTER



5.95 *Factory Wired*

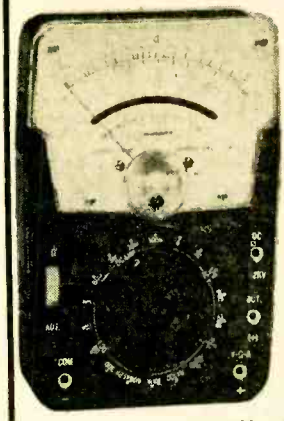
- *Convenient Thumb-Set Zero Adjustment!*
- *Reads AC/DC Volts in 3 Ranges: 0-5, 150, 1000!*

Only 3½ x 2⅛ x 1"!

Great for home or workshop! Pin jacks for all 5 ranges; 2-color 1¾" meter scale. DC Current 0-150 ma. Resistance: 0-100,000 ohms. Accuracy is ±3% of full scale value on DC ranges, ±4% of full scale on AC ranges. A rugged black bakelite case. Comes with pair of color-coded test leads, instructions, battery.

22-4027, Ship. Wt. 1 lb. ..... Net 5.95

20,000 OHMS/VOLT MULTITESTER



14.95 *Factory Wired*

- *28-Ranges!*
- *Mirrored 2-Color Scale!*
- *Jewelled Movement!*

Only 3⅝ x 5-3/16 x 1¼"!

Single-knob range selector with separate ohms adjustment. Spec.: DC Volts 0-3/15/60/300/600/1200 @ 20,000 ohms/volt. AC Volts 0-6/30/120/600/1200 @ 10,000 ohms/volt. DC Current 0-60μ, a/3 ma, 30 ma, 300 ma. Resistance range 0-12K, 120K, 1.2 meg and 12 meg (at center scale 60, 600, 6K & 60K). Decibels: −20 to +63 db (5 ranges).

22-022, Ship. Wt. 2 lbs. ..... Net 14.95

50,000 OHMS/VOLT MULTITESTER

27.95 *Factory Wired*

- *4" Full View Meter with Mirrored Scale!*
- *Meter Protection Circuit!*
- *1% Precision Resistors!*
- *26-Ranges!*

Only 7 x 5½ x 5⅝"!

Great for technicians, mechanics and hobbyists. Specs: DC volts: 0-0.5-2.5-10-50-250-500-1000V @ 50,000 Ω/volts. AC volts: 0-2.5-10-50-250-1000V @ 12,500 Ω/volts. DC current: 0-25ma-2.5ma-250ma-1 amp-10 amps. DC Resistance: 0-10,000/100,000/1 meg./10 meg-ohms. Center scale: 90/900/9000/900,000 ohms. Decibels: −20 to +62 (5 Ranges).

22-150, Ship. Wt. 5½ lbs. ..... Net 27.95

For Store Addresses, Order Form, See Page 20.

EMICRONTA 6½" VTVM METER

39.95 *Factory Wired*

- *Precision Resistors!*
- *Measures Peak-to-Peak and RMS (7 Ranges on Each Function)!*
- *Frequency Response: 30 cps to 10 mc!*
- *Easy-to-Read 2-Color Full View Mirrored Scale!*

Features a zero-center scale for alignment of FM-TV detector circuits. Specs: AC volts: RMS 0.1 to 1500 V. (7 ranges); DC volts: 0.1 to 1500 V. (7 ranges). Peak-to-peak 4-4000 V. (7 ranges). Output −20 db to +65 db (7 ranges). Resistance: 0.2Ω to 1000 meg-ohms (7 ranges). Tubes: 12AU7, 6AC5 and SR1A. Power: 117 VAC, 50/60 cycles.

22-025, Ship. Wt. 7 lbs. ..... Net 39.95

EXCITING ELECTRONIC PARTS VALUES

10 Germanium Diodes

Similar to 1N34, 1N34A, 1N60

99¢

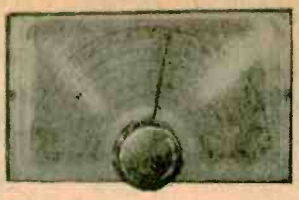
Equivalent in use to silicon diodes with lower forward voltage drop.
276-821, Wt. ¼ lb. ..... Net .99

JUMPER LEAD CLIPS

99¢ Set of 10

Ten 14" jumper lead wires with miniature alligator clips on each end. Leads are color coded for testing!
278-1156, Ship. Wt. 6 oz. ..... Net .99

5" VERNIER DIAL



3.99 • *6:1 Drive Ratio!* • *5 Blank Scales!*

Large face is ideal for test equipment, calibration, etc. 0-180 logging scale. Hairline pointer ¼" dial shaft in rear can be coupled with another shaft. Plastic see-through window, plus large easy-to-grip knob.
274-388, Ship. Wt. 1 lb. ..... Net 3.99

Variable Loopstick Antenna Kit

99¢ Kit of 3

3-pc pack for general replacement in small radios. Variable core tunes to 365 mmf tuning condenser Tapped for transistor applications.
270-376 ..... Net .99

JUMBO 100 PC. RESISTOR PAK

2.19

50 carbons, 30 precisions, 20 power resistors. Popular values. ½, 1, 2, 3, 5, 7, 10 watt sizes. Some 1% & 5% incl.
271-302, Ship. Wt. 2 lbs. ..... Net 2.19

STANDARD ¼" PHONE PLUG

99¢ Kit of 4

Plugs into standard ¼-inch phone jack. Screw terminal connections.
274-1536, Wt. 4 oz. ..... Net .99

INSULATED CLIP SET

99¢ Set of 14

With rubber insulators — 7 black, 7 red. Solder type Length 1⅝"
270-1545, Ship. wt. 4 oz. ..... Net .99

1" MATCHED KNOB KIT

99¢ Set of 5

Black knurled knobs w/polished aluminum inlay. Brass inserts for ¼" shaft. Set screw. 1 x ¾".
274-1552, Ship. Wt. 4 oz. .... Net .99

500' HOOK UP WIRE

2.98

Mammoth bargain. 5-100 ft. coils in popular colors. Sizes #18 thru #22, suitable for most wiring jobs. Stranded and solid types.
278-1484, Sh. wt. 2 lbs. ..... Net 2.98

MINIATURE LAMP ASSEMBLIES

99¢ Kit of 4

Complete with miniature 6V bulbs. Contains 2 red and 2 green jewels. Mounts in 5/16" hole.
272-344, Ship. Wt. ¼ lb. ..... Net .99

½ lb. Jumbo Pack of Disc Capacitors

2.49 Per Pak

OVER 300 PIECES! All popular values and voltages. Most are marked with capacity and voltages.
272-987, Ship. Wt. ½ lb. ..... Net 2.49

60-PC. TRANSISTOR SURPRISE PAK

2.98

Includes NPN's, PNP's, 10W, 20W and 50W transistors, as well as subminiature types, 60 in all!
276-034, Sh. wt. 2 lbs. ..... Net 2.98

SCREW TERMINAL KIT

99¢ Kit of 13 Pc.

1½, 2¼, and 2¾" lengths, by ⅝" H.
274-345, Ship. Wt. ¼ lb. ..... Net .99

NEON PILOT LIGHTS

Kit of 3 **99¢**

Built-in neon lamps. Jewel front; 2 red, 1 yellow. For 117 VAC use. With 3 dropping resistors.
272-338, ¼ lb. ..... Net .99

MINIATURE PUSHBUTTON SPST SWITCHES

99¢ Pkg of 5

Momentary pushbutton switches. Normally open circuit. Solder lug terminals. Panel mounting, Red button and black phenolic housing. 2 x ⅜".
275-1547, Ship. wt. ¼ lb. ..... Net .99

3 CIRCUIT PLUG & JACK

99¢ Set of 2

Set of two 3-circuit ¼" phone plugs, jacks. Black bakelite handle. Solder lug terminals. Open circuit jack complete with mounting hardware.
274-323, Ship. wt. ¼ lb. ..... Net .99

Infra-Red Detector Transducer Kit

1.98

Parabolic reflector, 3" filter, and detector complete with pictorial diagram. Wonderful experimenters kit!
276-035, Ship. Wt. ½ lb. ..... Net 1.98

For Store Addresses, Order Form, See Page 20.

SEMI-CONDUCTORS FOR THE HOBBYIST

ARCHER Replacement Transistors

PNP TYPES

For high frequency, RF-IF, and converter circuits. Replaces: 2N247, 2N248, 2N252, 2N267, 2N274, 2N308, 2N309, 2N310.
276-412, Wt. 3 oz. 1.29

For mixer/oscillator converter circuits. Replaces: 2N112, 2N113, 2N114, 2N135, 2N136, 2N137, 2N140, 2N175, etc.
276-401, Wt. 3 oz. ..... .99

For universal IF circuits. Replaces: 2N111, 2N112, 2N139, 2N218, 2N219, 2N315, 2N366, 2N406, etc.
276-402, Wt. 3 oz. ..... .99

For 6 volt audio circuits. Replaces: 2N77, 2N104, 2N105, 2N107, 2N109, 2N130, 2N131.
276-403, Wt. 3 oz. ..... .99

For 12 volt audio circuits. Replaces: 2N36, 2N37, 2N38, 2N41, 2N43, 2N44, 2N45, 2N46, etc.
276-404, Wt. 3 oz. ..... .99

For 9 volt audio circuits. Replaces: 2N188, 2N189, 2N190, 2N191, 2N192, 2N195, 2N196, 2N197, etc.
276-405, Wt. 3 oz. ..... .99

For auto radio AF amplifier circuits. Replaces: 2N176, 2N178, 2N179, 2N234, 2N235, 2N35B, 2N236, 2N242, etc.
276-406, Wt. 3 oz. 1.19

For high power AF circuits in auto radios. Replaces: 2N173, 2N174, 2N277, 2N278, 2N441, 2N442, 2N443, 2N1515, etc.
276-407, Wt. 3 oz. 2.29

Silicon Epoxy high gain. Replaces: 2N940-2N946, 2N2333-2N2337, 2N3548-2N3550.
276-420, Wt. 3 oz. ..... Net 1.09

Silicon Epoxy medium gain. Replaces: 2N1132, 2N923-2N928, 2N2372, 2N859, 2N865.
276-421, Wt. 3 oz. ..... Net .99

NPN TYPES

For mixer/oscillator converter circuits. Replaces: 2N193, 2N194/A, 2N211, 2N2-12, 2N233, 2N234, 2N357, 2N358.
276-408, Wt. 3 oz. 1.09

For universal IF amplifier circuits. Replaces: 2N98, 2N99, 2N100, 2N145, 2N146, 2N147, 2N148, 2N149, etc.
276-409, Wt. 3 oz. 1.15

For 9 volt AF amplifier circuits. Replaces: 2N35, 2N169A, 2N213, 2N214, 2N228, 2N306, 2N312, 2N313, etc.
276-410, Wt. 3 oz. ..... .99

For 12 volt AF amplifier circuits. Replaces: 2N306A, 2N445A, 2N446A, 2N447A, 2N556, 2N557, 2N587, 2N649, etc.
276-411, Wt. 3 oz. ..... .99

Silicon Epoxy high gain. Replaces: 2N3704-2N3709, 2N3415-2N3417, 2N3877.
276-422, Wt. 3 oz. ... Net 1.09

Silicon Epoxy Medium gain. Replaces: 2N706TPP, 2N3663, 2N3843A, 2N3900, 2N3901, etc.
276-423, Wt. 3 oz. ..... Net .99

Integrated Circuit Specials!

1.98 Up

- *Ideal for the Hobbyist, Builder, Experimenter!*
- *Fantastic Savings!*

New from Radio Shack! Resistor-Transistor Logic type ICs are ideal for builders, hobbyists, labs, industry etc. Guaranteed to be 100% perfect electronically and mechanically. Each comes complete with diagram and lead locations. Power requirements: 3 volts. Flat Pak type. Size ¾ x 5/16 x 1/16".

DUAL 3 INPUT GATE. Can be used as a 6 input microphone mixer. Contains up to 6 transistors & 8 resistors in pak. Elements can be used parallel to increase current capabilities.
276-430, Wt. 3 oz. ..... Net 1.98

DUAL JK FLIP-FLOP. Construct your own binary computers, digital adding machines, etc. Contains up to 26 transistors & 50 resistors per pak.
276-431, Wt. 3 oz. ..... Net 2.49

For Store Addresses, Order Form, See Page 20.

Silicon Field-Effect Transistors

1.98

- *High Impedance Input!*
- *Low Noise! High Gain!*
- *Characteristics Similar to Pentode Vacuum Tube!*

1000's of applications where pentode tubes are used in low level circuits; field strength meters, "gate dippers," receivers, flea power transmitters, etc. TO-5 case. Includes specifications.
276-664, Sh. wt. 2 oz. ..... Net 1.98

IBM Component Boards

29¢

SAVE!

4 for 1.00

All quality American made parts. Each board contains at least two transistors, plus loads of other components: resistors, capacitors, coils, diodes, modules, chokes, and heat sinks. Size: 2⅜ x 3⅞".
276-616, Sh. wt. ¼ lb. ..... Net .29

3 Amp Silicon-Controlled Rectifiers

1.95

TO-66 Case! 200V

Designed to deliver loads up to 3 amps. Ideal for use in speed control operation, power converters.
276-1065 ..... Net 1.95
276-1066, TO-66 mtg. hdwr. ..... .30

100-Pc. Jumbo Pak Assorted Transistors

3.98

Includes Silicon & Planars

NPN & PNP in TO-5 case; power transistors, too! Ideal in RF & IF driver, output, switching, general audio purposes.
276-544, Sh. wt. 1 lb. ..... Net 3.98

SEE PAGE 5

SAVE EVEN MORE, USE YOUR

FREE $1.00 YEAR END BONUS

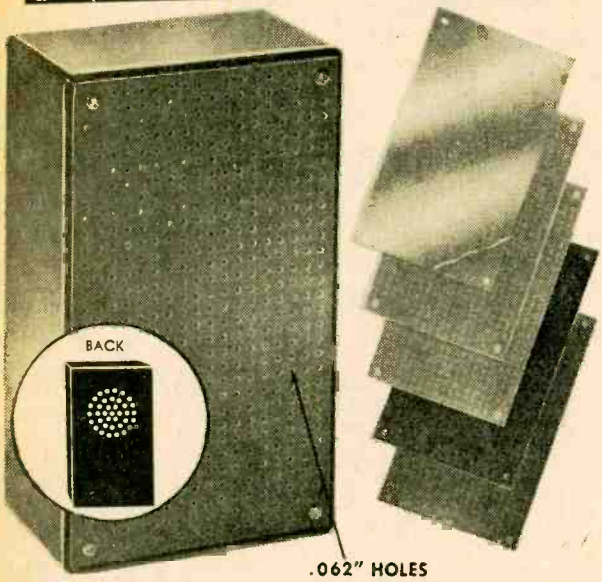
NO STRINGS! USE LIKE MONEY!

ONE DOLLAR

Ingenious New Radio Shack PERFBOX™

"Professionalizes" Project Building

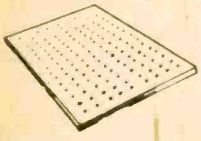
The bloody-knuckle brigade will appreciate Radio Shack's effort to eliminate chassis cutting and drilling and make things easier!



Somebody at "The Shack"—thank heaven! — must hate metal chassis and the generally sloppy look of breadboard projects. Now they've come up with a bakelite chassis box into which they've installed (4 screws) a 3½" x 6" perfboard top. But that's not all — the back of the box is pre-drilled for a 2¼" or other PM speaker, and there's a pre-drilled ¼" outlet hole on one side! This much-needed item is called the Radio Shack Experimenter's PERFBOX™. *(Cat. No. 270-097, price $1.69)* and should sell like film at Expo 67. As an added fillip, there's a companion deal they call Radio Shack Experimenter's 5-Piece Panel Set, consisting of 3 perfboards and 1 aluminum and 1 bakelite panel board, all 3¼"x6" predrilled to fit the PERFBOX™. The latter two boards are un-perfed (to coin a word), and the 5-piece set *(Cat. No. 270-100, price $1.69)* should answer just about any need for extending the usefulness of the PERFBOX short of filling it with champagne!

RECOMMENDED PARTS FOR USE IN PERFBOX PROJECTS

DESIGN, CONSTRUCT YOUR OWN CIRCUITS . . . using these time-saving phenolic boards, breadboard or permanent type. 3/32" holes punched on 0.265" centers. Can be sawed. Shipping weight 1 lb.

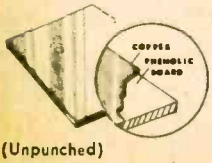


Punched

UNCLAD PERF-BOARD

- *Accepts Miniature Components!*
- *Easy-In, Easy-Out Mounting!*
- *Ideal for Modular Construction!*

276-1582, 3.65x6.87x1/16" ..... Net .59
276-1583, 6.87x9.8x1/16" ..... Net 1.15

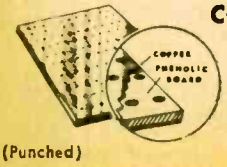


(Unpunched)

COPPER-CLAD SOLID BOARD

- *Make Your Own Printed Circuits!*
- *Quality-Manufactured Board*
- *Bonded with Copper!*

276-1586, 3.65 x 6.87 x 1/16" ..... Net .79
276-1587, 6.87 x 9.8 x 1/16" ..... Net 1.50



(Punched)

COPPER-CLAD PERF-BOARD

- *For Printed Circuit Design and Circuit Checkout!*
- *Easily Etched and Worked!*

276-1584, 3.65x6.87x1/16" ..... Net. .89
276-1585, 6.87x9.8x1/16" ..... Net 1.75

PUSH-IN TERMINAL KIT

1.49 Kit of 100

Use with prepunched perf boards. .062 diameter holes (1/16"). Serrated slots. Easy multiple connections.
270-1394, ¼ lb. Net 1.49

SPRING BANANA PLUGS

99¢ Set of 10

Ideal for 3/32" hole perforated boards. Overall length 1".
270-1543, 2 oz. .... Net 99¢

SOLDERLESS TERMINALS

99¢ Set of 15

Use with .093 diameter holes. Takes up to 7 leads without soldering. USA made. Spring action.
270-1395, 4 oz. .... Net 99¢

ALLIGATOR CLIP SET

99¢

10 brass plated 1⅜" long with insulated phenolic barrels. Strong spring. 5 red, 5 black.
270-1540, 2 oz. .... Net 99¢

For Store Addresses, Order Form, See Page 20

ANY ARCHER-PAK ON THIS PAGE **$1** PER PAK

SEE PAGE 5

SAVE EVEN MORE, USE YOUR **FREE $1.00 YEAR END BONUS**

NO STRINGS! USE LIKE MONEY!

ONE DOLLAR

20 Power Resistors

Package consists of high-quality vitreous, cand-ohm and wire-wound types. Includes 5 to 25-watt power resistors; individual catalog net — $10!

271-1202, 2 lbs. ..... Net 1.00

35 Precision 1% Resistors

Large assortment of popular ½, 1 and 2-watt values; includes encapsulated, bobbin, carbon film, etc. Made by Aerovox, Shellcross, IRC, and other famous names.

271-1196, 1 lb. ..... Net 1.00

50 Tubular Capacitors

An assortment of quality tubular capacitors, 100 mmf to .1 mf to 600 WVDC. Includes molded, paper and porcelain types. $10 if purchased individually from catalog!

272-1568, 1 lb. ..... Net 1.00

4 Subminiature 455KC IF Transformers

Slug tuned, made for printed circuitry mtg., shielded. Size: ⅜ x ⅜ x ½".

273-515, ¼ lb. .... Net 1.00

8 Sets - RCA Plugs & Jacks

Quality items, ideal for use in phono amplifiers, tuners, recorders, etc. Take advantage of this Radio Shack Special low price!

274-1575, ½ lb. ..... Net 1.00

35 Miniature Resistors

World's smallest ¼-watt carbon type resistors! All have axial leads; built for transistor and subminiature circuitry: Assorted values, with resistor color code chart.

271-1566, ½ lb. ..... Net 1.00

40 Coils and Chokes

Shop assortment consisting of RF, OSC, IF, parasitic, peaking and many more types. Individually purchased, this would cost you $15!

273-1569, 1 lb. ..... Net 1.00

45 Mica Capacitors

Famous name micas — Aerovox, Sangamo, C.D., etc. This assortment includes popular values 100 mmf to .01 mf, as well as silver type condensers. A $10 catalog net value!

272-1573, 1 lb. ..... Net 1.00

8 Volume Controls

Most Popular Values

Contains 8 assorted values including long and short shaft types. A tremendous bargain for servicemen!

271-127, 1 lb. ..... Net 1.00

Special! 50 Capacitors

Assortment of many types including disc, ceramic, mylar, temperature coefficient, molded, paper, oil, Vit-Q. You save $9 over industrial net catalog prices!

272-1199, 1 lb. ..... Net 1.00

60 Half-Watt Resistors

Made by Allen Bradley and IRC. Many 5% and 10% tolerance. Color chart. All most popular values. An absolute "must" for hobbyists and kit-builders.

271-1612, 1 lb. ..... Net 1.00

50 Ceramic Capacitors

Wide variety of popular values by Centralab and other famous-name makers. 10 mmf to .04 mf to KV. Assortment includes tubulars, discs, NPO's, temp. coefficient, etc.

272-1566, 1 lb. .... Net 1.00

48 Terminal Strips

You get a wide variety of screw and solder lug type terminal strips with 1 to 6 lugs. Outstanding value at this low price! 101 uses for the builder and experimenter.

274-1555, 1 lb. ..... Net 1.00

35 Disc Type Capacitors

A varied assortment of types, including NPO's, Hi-Q, N-750's, mylar and ceramic. 10 mmf to .01 mf to 6 KV. A $10 catalog net value!

272-1567, ¼ lb. ..... Net 1.00

150' of Hook-Up Wire

Assortment consists of 6 V rolls of 25' each — solid and stranded wire. #18 through #22. Necessary for multitude of jobs and always useful!

278-025, ½ lb. ..... Net 1.00

40 One-Watt Resistors

Here are resistors for hundreds of uses! Assortment has Allen Bradley and IRC carbons, with 5% values included. This pack is a regular $8.00 catalog net!

271-1576, 1 lb. ..... Net 1.00

4 Transistor Transformers

Made by UTC and Remington Rand. Famous miniatures. Includes subouncer, mike, input types. Color coded leads.

273-1581, 1 lb. ..... Net 1.00

$25 SURPRISE PACKAGE!

Loaded with Parts! $1

The biggest surprise package yet! Enough electronics components to make your eyes pop! Resistors, capacitors, condensers, diodes . . . your guess is as good as ours. The famous-make parts are worth *at least* $25.00!

270-1251, 1 lb., Net 1.00

50 Plugs and Sockets

Ideal bench assortment for servicemen, hams, etc. Subminiature and printed circuit types included! This assortment saves you $10 over individual catalog prices!

274-1562, 1 lb. ..... Net 1.00

30 2-Watt Resistors

These quality 2-watt resistors are non-inductive, magnetic film, carbon types. Many with 5% values. Made by famous-name manufacturers.

271-1211, ½ lb. ..... Net 1.00

For Store Addresses, Order Form, See Page 20

BRILLIANT NEW KIT LINE!

Science Fair™

Perf-board electronic projects make soldering optional, let builder re-use parts or change circuit!

At last! — electronic kits that let you work the same way engineers do — by "breadboarding". Designed by Radio Shack's engineers and produced by its new Science Fair Electronics division, the kit line features step-numbered construction data, pictorial, schematic and add-on instructions.

AC/DC POWER SUPPLY KIT

6.95 NO. 28-104

Converts 117 VAC (house current) to either 6 or 9 volts DC. Play battery operated equipment on house line! Also ideal for use with Science Fair™ kits & other projects.

"OTL" AUDIO AMPLIFIER KIT

4.95 NO. 28-106

Ideal for use with tuners, mikes, phonograph systems. OTL output. Frequency response up to 15,000 cycles. Rated up to 2 watts peak.

For Store Addresses, Order Form, See Page 20

TRANSISTOR RADIO KIT

3.95 No. 28-102

Tunes the standard AM broadcast band; can also be used as a tuner. Battery-operated. Comes complete with earphone. Perf-board construction.

TRANSISTOR ORGAN KIT

5.95 NO. 28-101

Each note on the seven-note scale is separately tone variable. Unit is battery-operated and features perf-board construction. Fun to build & operate!

WIRELESS AM MIKE KIT

3.95 NO. 28-103

Transmit through any radio up to 20 feet away! Battery-operated microphone is a real broadcaster! Constructed of sturdy perf-board.

1-TUBE DC RADIO KIT

3.95 NO. 28-100

Battery-operated! Learn tube theory and build a real working radio. Equipped with sturdy perf-board construction. Kit comes complete with earphone.

Now Everyone Can Own a Second Telephone!

Standard Desk Telephone

Ready to Install **7.95**

Enjoy the extra convenience of an extra phone! Our most popular style; it's modern, low-cost, and easy to install. Each phone is factory reconditioned to give trouble-free service. Bakelite body and handset; metal base. Dial, bell and coil included. (Note: use of telephone equipment not installed by a telephone company may be subject to local tariff.)

279-371, Sh. wt. 10 lbs. ..... Net 7.95

- Save Time!
- Save Steps!
- Save Money!

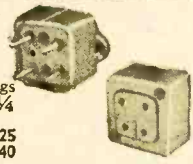
For Private Phone and Intercom Systems.

30 Ft. Telephone Extension Cord

Move your phone from room to room! Highest-quality 4-conductor flexible cord plus standard telephone jack and plug. Ideal for intercom. Use 2 or more for extra length.

279-1261, Sh. wt. 1¼ lbs. ..... Net 2.98

Telephone Plugs & Jacks



Ideal for making extensions, these plugs and jacks each weigh approximately ¼ pound.

279-366, plug ..... Net 1.25
279-367, jack ..... Net 1.40

Coiled Phone Cords

Stretches up to six feet. 3-conductor. Shipping weight: ¼ pound.

278-361 ..... Net 1.19

Four conductor extends up to fifteen feet. Shipping weight: ½ pound.

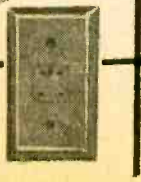
278-1389 ..... Net 5.95

Shoulder Rest

Frees both hands! Spring mechanism enables arm to be folded out of sight when not in use. Easy to attach to any phone. Long lasting metal construction. Manufactured in the United States. Weight: 1 pound.

279-606 ..... Net 1.49

Telephone Wall Jack



For 2, 3, 4-wire systems. Fits standard wall conduit boxes. 1 lb.

279-1507 ..... Net 1.99

Carbon Type Handset

For Mobile and Replacement Use!

Great for use with mobiles & intercoms, or as outdoor mike for camps and construction sites. Withstands extreme temperatures. High output mike can be used with low gain circuits. Adapt to your CB transceiver or radio. Includes earpiece and 3-conductor cord.

279-1351, Sh. wt. 1 lb. ..... Net 2.99

Sound-Powered Elements

Kit of two! Talk without electricity — your voice powers these devices. Hook them up and talk up to 300 feet. Shipping weight: ½ pound.

279-1353 ..... Net .99

100 Ft. 3-Conductor Telephone Wire

Multi-use 100' 3- conductor wire for telephone work. Ideal for linking temporary phones for field uses.

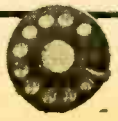
278-370, Sh. wt. 2 lbs. ..... Net 3.49

Handset Hanger

Hang up your phone without cutting off party on other end. Ideal for wall telephones. Anodized black aluminum.

279-1528, Sh. wt. ¼ lb. ..... Net 1.25

Telephone Dials



Standard Western Electric unit. Can be used with automatic control circuits, & electronic combination lock circuits.

279-359, Sh. wt. 1¼ lbs. ..... Net 2.99

Store Addresses, Order Form, See Page 20

ORDER BY MAIL FROM YOUR NEAREST RADIO SHACK STORE

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LITTLE ROCK University Plaza, 562-3202

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DOWNEY Stonewood Shopping Center, 923-1709
GARDEN GROVE 9836 Garden Grove Blvd., 537-1450
GLENDALE Broadway & Chevy Chase Dr., 241-5106
LA HABRA 1511 W Whittier Blvd. 697-6707
LONG BEACH 4684 Long Beach Blvd., 423-5444
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Mission Hills 10125 No. Sepulveda Blvd., 892-3118
Reseda 19389 Victory at Tampa, 881-3142
West L. A. 10650 W. Pico Blvd. at Overland, 870-4752
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NO. HOLLYWOOD Laurel Plaza Shop. Ctr.
OAKLAND (San Leandro) Bay Fair Shop. Ctr., 278-5200
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2713 South Main St., 545-0405
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TORRANCE 22519 Hawthorne Blvd., 373-1984
WEST COVINA 2516 East Workman Ave., 339-1227

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Westland Shopping Center, 238-6323
2186 So. Colorado Blvd., 756-1678
North Valley Shop. Ctr.

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BRIDGEPORT Lafayette Plaza
HAMDEN Hamden Mart Shopping Center, 2300 Dixwell Ave., 288-7911
MANCHESTER Manchester Shopping Parkade, 649-5247
NEW BRITAIN Newbrite Plaza, 225-8787
NEW HAVEN 230 Crown St., 787-7121
NEW LONDON New London Shop. Ctr., 442-0522
ORANGE Whiteacre Shop. Ctr., 795-9731
STAMFORD 29 High Ridge Rd., 325-4371
TORRINGTON Torrington Parkade
WEST HARTFORD 39 So. Main 236-5441

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JACKSONVILLE Regcy Shop. Ctr. 725-7477
ORLANDO Winter Park Mall, Winter Park, 647-8646
WEST PALM BEACH 1801 Palm Beach Lake Blvd., 683-1502

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No. DeKalb Shop. Ctr., Dec. 638-8002

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NEWPORT Newport Plaza, 70 Carothers Rd., 441-4361

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NATICK 136 Worcester Rd. (Durrell Div.), 655-1850
QUINCY 221 Quincy Ave. (Durrell Div.), 471-3318
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Sears Shop. Ctr. (Lincoln Park)

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140 Apache Plaza, 788-4911
Hub Shopping Ctr., 866-5027
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MISSOURI
KANSAS CITY:
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Antioch Shop. Ctr., 454-2400
ST. JOSEPH 505 No. Belt Hgy., 233-2423
ST. LOUIS:
1125 Pine (Walter Ashe Div.) 241-1125
South County Shop Center, 892-1800
Northland Shopping Center, 381-5190
10483 St. Charles Rock Rd., St. Ann, 423-1700

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OMAHA 3002 Dodge St., 346-2433

NEVADA
LAS VEGAS 953 East Sahara, 734-2835

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LIMA Lima Mall, 331-5085
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Hillcrest Shop. Ctr., 681-5591
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GREENSBURG Greengate Mall, 837-0370
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1128 Walnut St., 923-2198
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WARWICK 296 Midland Mall, 828-4141

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1208 Southland Mall, Whitehaven, 396-7762
96 North Avalon, 272-7589
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POSITIVE FEEDBACK

JULIAN M. SIENKIEWICZ, EDITOR

☐ From time to time your Editor breaks away from his desk long enough to visit manufacturers of electronic products. One recent visit took him to the ultra-new EICO plant in Brooklyn where one can see firsthand how electronic kits are dreamed up, designed, manufactured, and packed before shipment to the consumer or store. (See photo below.) Most interesting were the EICO engineering facilities where quality is put in and bugs are taken out. The racks of test equipment would make the heart of any experimenter skip a beat.

In this issue of ELEMENTARY ELECTRONICS we continue with our free printed-circuit board program. Many have asked us how we can undertake such a project. The answer is quite simple—we owe it all to Sentry Manufacturing Company who designs the boards, makes them up, supplies them to the readers requesting them with our coupon, and, in general, handles all the time-consuming paper work. So, our hats are off to Sentry for the wonderful service they are supplying for you, the reader. ■

Photo of a boy from Brooklyn (your Editor right), with Harry R. Ashley (left), EICO president, and Abe Stark (center), Brooklyn's Boro President at the EICO's new plant opening and gala party.

12 NEW KITS FROM HEATH...

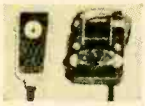
For The Whole Family . . . New Deluxe "227" Color TV

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

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

Advanced Features. Boasts new RCA Perma-Chrome picture tube for 38% brighter pictures . . . 227 sq. in. rectangular viewing area . . . 24,000 v. regulated picture power . . . improved phosphors for brilliant, livelier colors . . . new improved low voltage power supply with boosted B+ for best operation . . . automatic degaussing . . . exclusive Heath Magna-Shield to protect against stray magnetic fields and maintain color purity . . . ACC and AGC to reduce color fade and insure steady, flutter-free pictures under all conditions . . . preassembled & aligned IF with 3 stages instead of the usual 2 . . . preassembled & aligned 2-speed transistor UHF tuner . . . deluxe VHF turret tuner with "memory" fine tuning . . . 300 & 75 ohm VHF antenna inputs . . . two hi-fi sound outputs . . . 4" x 6" 8 ohm speaker . . . choice of installation — wall, custom or optional Heath factory assembled cabinets. Build in 25 hours.

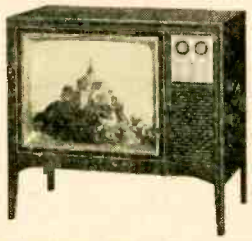
Kit GR-227, (everything except cabinet). . . $42 dn., as low as $25 mo. . . 114 lbs. **$419.95**
GRA-227-1, Walnut cabinet. . . no money dn., $6 mo. **$59.95**
GRA-227-2, Mediterranean Oak cabinet (shown above) . . . no money dn., $10 mo. **$94.50**



Kit GRA-27
$19.95

New Remote Control For Heathkit Color TV

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



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

Deluxe Heathkit "295" Color TV

Color TV's largest picture . . . 295 sq. in. viewing area. Same features and built-in servicing facilities as new GR-227. Universal main control panel for versatile in-wall installation. 6" x 9" speaker.

Kit GR-295, (everything except cabinet), 131 lbs. . . . $48 dn., $42 mo. **$479.95**
GRA-295-1, Walnut cabinet (shown above), 35 lbs. . . . no money dn., $7 mo. **$62.95**
Other cabinets from $94.50

Kit GR-180
$359.95
(less cabinet & cart)
$31 mo.

Deluxe Heathkit "180" Color TV

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

Kit GR-180, (everything except cabinet), 102 lbs. . . . $36 dn., $31 mo. **$359.95**
GRS-180-5, table model cabinet & mobile cart (shown above), 57 lbs. . . . no money dn., $5 mo. **$39.95**
Other cabinets from $24.95

FREE 40-Lesson Record Course With Either Heathkit/Thomas Organ! A $50 Value! Includes four 33⅓ rpm records, music book & leatherette album.

Kit TO-67
$995
(including bench)
$200 dn., as low as $29 mo.

Heathkit®/Thomas "Paramount" Theatre Organ

Save Up To $500! Build in 80-100 hours. All Thomas factory-made parts . . . 15 manual, 4 pedal voices; instant-play Color-Glo; all-transistor circuit; 200 watts peak power: 2-speed rotating Leslie plus main speaker system with two 12" speakers; 44-note keyboards; horseshoe console with stop tablets; 28-note chimes; 13-note bass pedals; repeat & attack percussion; reverb; headset outlet; assembled walnut finish hardwood cabinet & bench; and more. 265 lbs. 7", 33⅓ rpm demonstration record 50c.

America's Lowest Cost Solid-State Organ

Kit GD-325B
$394.90
$40 dn., $34 mo.

Save Up To $205! Instant-play Color-Glo: 10 voices; 13-note bass pedals; repeat percussion: 37-note keyboards; 75-watt peak power; vibrato; assembled walnut cabinet & bench. 172 lbs. 7", 33⅓ rpm demonstration record 50c.

Exclusive Band Box Percussion

Automatically or manually adds 10 percussion voices to any Heathkit/Thomas organ. Build & install in 12 hours.
Kit TOA-67-1, no money dn., $14 mo. **$145.00**

Exclusive Playmate Rhythm Maker

Adds 15 fascinating rhythms to any Heathkit/Thomas Organ. Requires Band Box percussion (above) for operation.
Kit TOA-67-5, no money dn., $18 mo. **$189.90**

USE COUPON TO ORDER NOW!

TO-68
$349.95
$35 dn., $30 mo.

NEW! VOX "Jaguar" Transistor Combo Organ By Heathkit

Save Up To $150 on the world's most popular combo organ with this new Heathkit version. Features the most distinctive sound of any combo organ. Has a special bass output that gives a brilliant stereo bass effect when played through a separate or multi-channel amplifier, 4 complete octaves, vibrato, percussive effects and reversible bass keys. Includes hand crafted orange and black cabinet, fully plated heavy-duty stand, expression pedal and waterproof carrying cover and case for stand. Requires a bass or combo amplifier like Heathkit TA-17 (opposite page).

Kit TO-68, 80 lbs.... $35 dn., $30 mo..... **$349.95**

NEW! Deluxe Solid-State Combo Amplifier & Speaker System . . . Choose Kit Or Factory Assembled.

Amplifier
Kit TA-17
$175
$17 mo.
(Assembled TAW-17 $275)

Speaker System
Kit TA-17-1
$120
$11 mo.
(Assembled TAW-17-1 $150)

Special Combination Offer
Amplifier & Two Speaker Systems
Save $20
Kit TAS-17-2
$395
$40 dn.
$34 mo.
(Assembled TAW-17-2 $545)

All the "big sound" features every combo wants . . . tremolo, built-in "fuzz", brightness, reverb, separate bass and treble boost and more. Delivers a shattering 120 watts EIA music power (240 watts peak power) through two TA-17-1 speakers . . . or 90 watts through one TA-17-1 speaker. Features 3 independent input channels, each with two inputs. Handles lead or bass guitars, combo organ, accordion, singer's mike, or even a record changer. All front panel controls keep you in full command of all the action.

Speaker system features two 12" woofers, special horn driver and matching black vinyl-covered wood cabinet with casters & handles for easy mobility.

Kit AR-17
$72.95
(less cabinet)
$8 mo.

NEW! Lowest Cost Solid-State Stereo Receiver

Features wide 18-60,000 Hz response @ ±1 db at full 5 watts RMS power per channel . . . 14 watts music power . . . inputs for phono and auxiliary . . . automatic stereo indicator . . . outputs for 4 thru 16 ohm speakers . . . adjustable phase for best stereo . . . flywheel tuning . . . and compact 9¾" D. x 2⅞" H. x 11½" W. size. 12 lbs. Optional factory assembled cabinets (walnut $7.95, beige metal $3.50).

Kit AR-17, (less cab.) 12 lbs. . . . . no money dn., $8 mo.. **$72.95**
Kit AR-27, 7-Watt FM Mono Only Receiver (less cab.) 9 lbs. . . . no money dn., $5 mo..... **$49.95**

Kit IM-17
$19.95

NEW! Solid-State Portable Volt-Ohm-Meter

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

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Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, electric guitar & amplifier, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

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Prices & specifications subject to change without notice. CL-312R

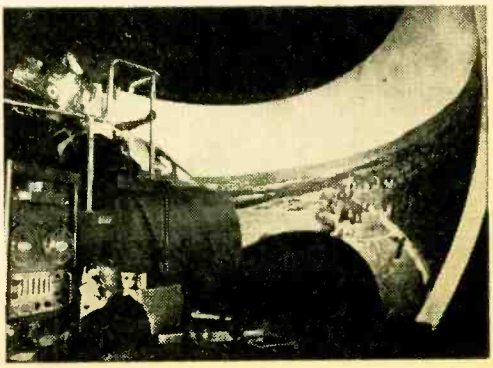
NEWSCAN

Cinema for Zappers

Now our fly boys can zoom into a full color wide angle projection display system which realistically presents the view from cockpit of a high-speed aircraft during low-level flight. The "flicker" simulation system has been designed to evaluate a pilot's visual target acquisition capabilities. The system has two major elements—one for the acquisition of photographic imagery and data, the other for the display of this material.

The photographic imagery is obtained with a 65mm motion picture camera equipped with a special Fairchild 160° f/4 photographic lens and automatic exposure control device. This assembly is mounted in the tail of a B-25 bomber with the camera operating in the reverse direction to provide proper ground terrain movement when the imagery is projected normally.

The data are displayed on a spherical screen



High-resolution pic is projected on a hemispheric screen by the projector (top left) in this new Fairchild Space and Defense Systems development to simulate high-speed low-level flight conditions. The pilot in a simulated F-86 cockpit (center) watches for targets or very tall trees!

using a projector equipped with another Fairchild 160° f/4 lens of the same basic design as the lens on the camera. This results in true perspective in the imagery, and enables scientific experimenters to evaluate and catalog its content frame by frame.

After this evaluation, the imagery can be continuously displayed at various rates ranging from 12 frames per second to 48 frames per second without flicker. Trained pilots view this imagery from a simulated aircraft cockpit. As they recognize a target, they press a thumb switch which is coupled to a counter that records the passage of each frame of film through the projector. As the pilot identifies pre-selected targets on the film, the information is plotted against pre-edited frame numbers so that his reaction time and visual target acquisition capabilities can be accurately measured.

The real test comes when they play back some of old John Wayne pics. Imagine, winning the Battle of Midway several times a day!

Computer Juice

A new fluorochemical liquid featuring a boiling point of 90°F is expected to have many applications as a non-corrosive, low-temperature refrigerant and as a coolant for electronic systems including computers. Computers could use the new fluid called 3M brand Inert Fluorochemical Liquid, FC32, to maintain lower running temperatures making possible faster and higher powered operations.

The liquid is one of a series of five completely fluorinated liquids developed by 3M to provide a high degree of electrical protection. The

Heat from a painted light bulb is sufficient to boil 3M's new fluid, FC-32. The liquid's boiling point of 90°F makes possible many applications as a non-corrosive, low-temperature refrigerant and as a coolant for electronic systems. Its electrical non-conductivity is demonstrated here as the entire socket is immersed in the fluid with no effect except for the bubbles!

liquids feature a high dielectric strength as well as low dielectric constants and heat dissipation factors. It's almost like water having the electrical properties of air.

Environmental test applications of these fluids have proven very economical. Production figures were boosted as much as 200% at one semi-conductor manufacturer's plant while reject rates were decreased from 55% to less than 1% in the production of amplifier circuits at another plant. The day may come when your TV set will bubble like an aquarium and if there is any plankton visible, it'll be time for your 1000-mile checkup.

News in the TV

The first full-time, all-electronic news service for the home is now available to almost 2,000 CATV systems located around the country. It's called the service, "Alphamatic News," and is now available to New York's Manhattan residents via a CATV network. The first installation of its kind in the country, Alphamatic News brings to home television sets UPI world and local news, and stock market prices 24 hours a day.

Heart of the system is a space-age device, manufactured by RCA Victor, Ltd., known as a *character generator*. The character generator converts a telegraph signal to words which appear as sentences flowing across the television set at an easily readable flow. Each line holds 42 characters. When 12 lines of copy are presented, the copy is erased (except for the bottom line) and the entire sequence starts again at the top.

Here's what it looks like, an all-electronic news service for the home or office. News is presented without sound, offering the Manhattan businessmen an opportunity to monitor the latest scoops in a casual, almost leisurely manner, without affecting their work routines. (Sorry, no cartoons.)

In its application on the Manhattan cable system, subscribers receive the Alphamatic service on previously unused Channel 8. Early indications from subscribers indicate that they are attracted by the ease with which they can catch up on the news at any time by simply tuning in the channel. The fact that the news is presented without sound also offers the opportunity to Manhattan businessmen to mount a small monitor on or nearby their desks and view the news in a casual, almost leisurely manner, without affecting their work routines (just great for the latest racing results).

New China Clipper

The first electronic type-setting to compose Chinese, Japanese and Korean written language directly from a keyboard has been delivered by RCA to the U. S. Army. The Chinese-Japanese-Korean Ideographic Composing Machine employs a technique that is the first practical departure from hand-set type in the 3,000-year history of these written languages.

By combining the latest in computer, television and optical techniques, it does away with the formidable typographical problems posed by ideographic languages with their 'alphabets' of thousands of characters. The machine can set 60 to 100 characters a minute—each character representing a word, a phrase or a complete sentence from any of the three languages—from a storage bank of some 10,000 characters. This speed compares with the hitherto tedious task of a man painstakingly choosing the correct characters by hand from massive cases of type—truly a time clipper.

The machine is for use by the Army in typesetting training publications, orientation literature, information leaflets and other printed materials in the three Oriental languages. It is an extension of a device developed earlier by RCA's Advanced Technology activity to compose Chinese only.

The machine does not set type in the conventional way that a Linotype machine does in American printshops. It is instead an electronic system, utilizing television techniques and an optical tunnel to reproduce the characters very rapidly on film and then transfer them to lithograph plates for offset printing. The machine can be operated manually by keyboard or automatically by means of paper tape punched in advance. The latter method would make it possible to set type automatically at a number of different printing plants at one time.

To achieve the 10,000 characters, 21 basic strokes were chosen — horizontal, vertical, curved—and 28 complete symbols, such as circles, squares, triangles, in various combinations to make up virtually all characters in those three complex languages. These basic strokes and symbols, plus 11 punctuation marks, are

Here's RCA's Chinese-Japanese-Korean Ideographic Composing Machine, the first electronic typesetting machine to compose those three written languages directly from a keyboard. The machine can set 60 to 100 characters a minute from a storage bank of 10,000 characters, turning a tedious task into an electronically-fast one.

represented on the machine's keyboard. A basic advantage of the machine is that it can set the characters from top to bottom, as in the old-style printing in these languages, or from left to right, the more modern format. It also does away with the mountainous task of redistributing the metal type in cases after its use, or of melting it to be made into new type. Furthermore, the electronic system can be switched to produce any one of four type sizes for headlines and/or text.

Among the important techniques involved is the method of character image storage and selection. The images are arranged in a matrix of blocks of 16, approximately 200 such blocks appearing on each of three photographic plates. The three plates are served by the three branches of a beam-splitting optical system and together they form the input to an "optical tunnel"—a four-walled mirror structure which (in combination with a lens) has the unique property of being able to image all of the 600 character blocks at a single location instantaneously and simultaneously.

Character selection logic is based on the fact that an ideograph when handwritten is built up from many strokes but from a limited number of types (only 21).

In addition, a special character insertion capability is also provided. If a desired character, such as a proper name, is not present in the machine vocabulary, the operator may place his copy, or document containing the desired character, on a character tray. When the "insert" key on the keyboard is depressed a separate television camera picks up the character on the copy and records it on the film at the same magnification as the internally composed characters. And moo-goo-gai-pan to you! ■

ELEMENTARY ELECTRONICS ETYMOLOGY

By Webb Garrison

Cyclotron

▲ Scientists at Cambridge, England, perfected the first "atom smasher" in 1932. By today's standards it was crude and clumsy. But with it, Crockcroft and Walton bombarded nuclei of lithium atoms with protons and produced helium atoms.

Particles employed as "atomic bullets" at Cambridge were accelerated through a vacuum and travelled straight. But the energy level of this system was limited to about 250,000 electron volts.

How could one get higher energies with greater penetrating power?

At the University of California, Ernest O. Lawrence concluded that the problem could be solved by spinning charged particles in centrifugal fashion, thereby imparting highly increased energy to them. Equipment he subsequently built sent his "bullets" through spiral paths from which they burst at energy levels up to 10,000,000 electron volts.

New power had been harnessed and the world of subnuclear physics was to be opened as a result. There obviously could be no doubt at all about the importance of the system. But what to call it?

Lawrence turned to classical languages. He combined *cycl-* (a modern prefix derived from a Greek term for a wheel) and *-tron* (a suffix from the same source that indicates any tool or instrument). Since his heavy-duty atom smasher used charged particles as tools and discharged them after rotary motion, it was logical to call his "machine" the *cyclotron*.

Pioneers Commemorated

▲ Meeting in London in 1908, an international electrical congress formally adopted ten separate terms—all serving as verbal memorials to pioneer scientists.

Stories behind the terms *Watt, Ampere, Volt,* and *Ohm* have already been told in previous pages of e/e ETYMOLOGY. Other terms chosen in 1908 are more technical or less widely used.

Coulomb (unit of electrical charge) commemorates French physicist Charles A. Coulomb. The *Farad* (unit of capacitance) is so named from the great Michael Faraday.

German mathematician Karl Frederich Gauss is remembered by the *Gauss*, electromagnetic unit of magnetic induction. American physicist Joseph Henry is now all but forgotten except by those who use *Henry* to name a unit of inductance. As a unit of energy, *Joule* commemorates English physicist James P. Joule. And German physicist Wilhelm E. Weber is honored through a unit of magnetic flux, which is called the *Weber*.

Quark

▲ James Joyce is among the few contemporary writers to win recognition in three mediae: verse, drama, and prose fiction. Like mathematician-author Lewis Carroll *(Alice in Wonderland, Through the Looking Glass)*, Joyce sometimes deliberately played with sounds. His 1939 novel *Finnegans Wake* includes a famous pattern of nonsense-sounds that urge: "—Three quarks for Muster Mark!"

American physicist Murray Gell-Mann, already noted for work in subnuclear physics, arrived at a radical new view in 1962. There must be—there simply *has* to be—a "fundamental building block of the universe," he concluded. Since such an elemental particle has never been found, he turned to the realm of fantasy for a name.

In selecting the title *quark* from James Joyce, Gell-Mann was simply devising a label for use with theoretical concepts. But once the name was given, search for the thing behind the name began in earnest and has continued unabated ever since.

Today, it's generally assumed that the quark really does exist—and upsets many concepts basic to physics and electronics. All subnuclear particles identified to date are either electrically neutral or have charges equivalent to whole multiples of the basic charge of the electron. But the quark is thought to be as queer as its name—having a charge of either one- or two-thirds that of an electron. Theoretical considerations suggest that it is extremely heavy (on a nuclear scale) and it is also believed that it most likely possesses enormous binding power.

Fully as elusive in the laboratory as in *Finnegans Wake*, when and if it is discovered, the quark will be the only building block of the universe to take its name from fiction. Chances of finding it are slim until atom smashers become at least 25 times as powerful as the strongest now in use.

☆ ☆ ☆

Attractive Sound Storer

You can store up to nine hours of tape recording handily in the Norelco Cassette album. The handsome book-type album is bound in black leatherette stamped in gold, and contains a molded plastic tray, pre-packed with six blank tape cassettes and index guide. With six 60-minute cassettes, the total price is $15.90; with six 90-minute tapes it goes for $22.50. The album measures 10⅛x9⅜x¾-in., and comes with protective outer sleeve. Available at Norelco tape recorder dealers, or write to Norelco, 100 E. 42nd St., New York, N.Y. 10017.

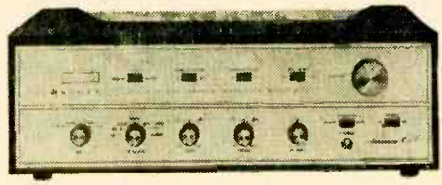
Norelco Book-Style Cassette Album

Fail-Safe Amp Kit

Right in the design of the new Scott LK-60B 120-watt solid-state stereo amplifier kit is a "fail-

HEY, LOOK ME OVER . . .

safe" circuit that protects the kit-builder against accidental transistor blowout. It uses an ordinary light bulb, which absorbs excess power when the completed LK-60B is first turned on. This causes the bulb to glow brightly, warning the builder he must recheck his wiring. The LK-60B uses pre-tested heavy-duty components,

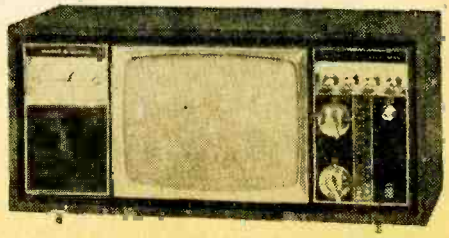


H. H. Scott LK-60B Stereo Amp Kit

including massive military-type heat sinks, heavy printed circuit boards, and new silicon output transistors. Critical electrolytics have operating capabilities far exceeding circuit requirements. Other features: built-in circuit monitor allowing balance and bias of the output stage to be set for absolutely minimum distortion; rumble and scratch filters; front-panel stereo headset output; separate bass and treble controls for each channel; tape recorder input and output facilities; massive power supply for high-power surges; dual speaker switches for selecting main, remote, or both sets of speakers. List price is $179.95, and you can get more dope by writing H. H. Scott, Inc., 111 Powder Mill Rd., Maynard, Mass. 01754.

It's a Clock—It's a Radio—It's a TV!

Now you have your choice of waking to radio news, or to your favorite morning (or afternoon?) television program. Sears Roebuck has developed an 8-in. television set, FM/AM radio, and clock-timer in a cabinet only 17¾-in. wide. A full-featured clock automatically turns on the radio or black-and-white television at a pre-set time. Five minutes after either set comes on a buzzer alarm sounds. The electric clock also has a sleep switch that can be set to turn off the TV or radio after two hours of nighttime listening. The fully-transistorized set has a walnut veneer cabinet and earphone with 12-ft.

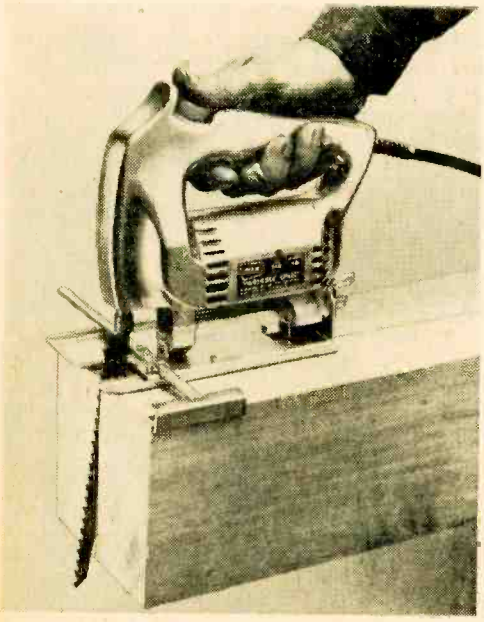


Sears Model 8102 Television-Clock-Radio

cord. The set (#8102) is available at any Sears Roebuck store for only $130.00. Now put out the lights and go to sleep.

Do a Sabre Dance with Your Thumb

From Wen Products comes the new Model 521 variable-speed sabre/jig saw, which takes advantage of the natural downward pressure of the operator's hand when gripping the man-size handle of the saw and guiding the saw through the work. Due to a pressure-sensitive, thumb-operated, continuously variable speed control switch called "Mind-Reader," torque and cutting speed of the saw can be automatically varied. If more speed and torque is desired, more thumb pressure is applied to the control switch. A ½-hp, 4-Amp, 100-120 VAC cool running



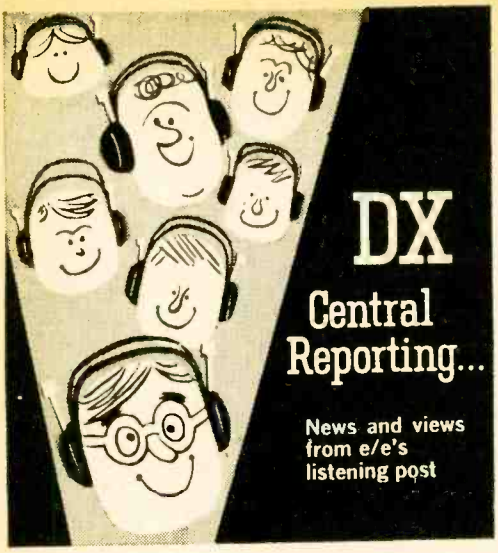
Wen Model 521 Variable Speed Sabre/Jig Saw

motor supplies lots of power to cut through metal, plastic, plaster board, rubber, leather, wood. An extra-large adjustable shoe plate firmly supports the saw, and a continuous air stream from the motor fan blows over the work and permits easy line-of-sight cutting. Model 521, with seven blades, calibrated rip guide and one-year guarantee is priced at $34.95. Just knock together one speaker cabinet and you save more than that. For further info, write Wen Products, Inc., 5810 Northwest Highway, Chicago, Ill. 60631.

Cool It!

Here's an Aerosol product with loads of applications. The MS-240 Quik-Freeze from

(Continued on page 112)



Most SWLs strenuously object to receiving Communist propaganda along with their verification cards and letters. It's not that they are afraid of being indoctrinated by Red pamphlets and magazines, but rather that the average DXer seems to be terrified by what his friends (and enemies) will say when they see this junk. Whether this is a reasonable attitude (after all, every SWL presumably owns a waste basket) we won't attempt to settle here. But if you do intend reporting to Communist stations, this is a rundown on what you can expect.

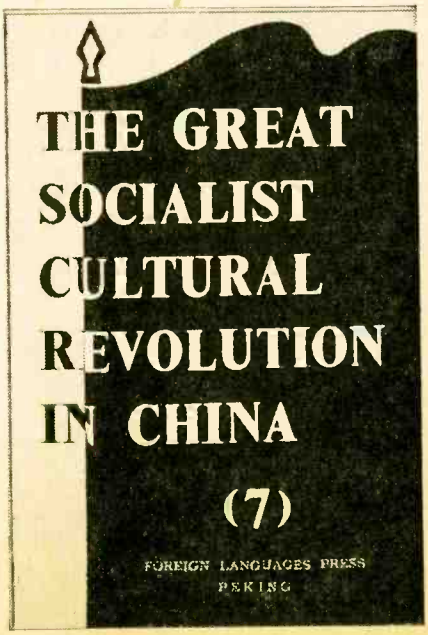
The major Communist stations of Eastern Europe have become considerably subtler during the past few years. If the DXer sends them a reception report, he will receive in return a QSL card, program schedule, an invitation to join their SWL Club (if they have one), some picture post cards, and often a coupon which the SWL can return if he would like to receive some of their "magazines." If you don't take this bait, the only thing further you'll receive will be their next schedule and maybe a New Year's card. In short, East European stations have taken a lesson from our own VOA and switched to the soft sell.

If you report to R. Pyongyang (North Korea), R. Havana (Cuba) or R. Hanoi, you will certainly receive propaganda of various sorts. Actually, there is no legal mail service between the U. S. and either North Korea or North Vietnam, but if a DXer is really determined to obtain their QSLs, he can sometimes get a report through to them % R. Peking, or % R. Prague. However, if after receiving the QSL, the SWL does not write them again, he will probably not be bothered much in the future. Meanwhile, to receive a Cuban verification without any propaganda, try for Circuito CMQ on 640 kHz (L y 23, Vedado) and CMCA "The Friendly Voice of Cuba" on 830 kHz (Apartado 6951). Both of these Havana BCB stations (addresses in brackets) have their own cards and are currently sending out nothing but QSLs.

At the very bottom of the list is R. Peking itself. Not only are their hazily worded QSLs accompanied by wide eyed Marxist hate literature, but even if you never write them another word, you'll still be periodically deluged with Mao's thoughts. However, as no other Communist Chinese stations answer DX reports, that is the price DXers will have to pay if they want to verify this country.

Another Epic! Dig up a mystery for DXers, and you'll find umpteen thousand guys trying to solve it so they can become "experts" over night. The latest "in" puzzle is that 50-KW portable unit which VOA secretly removed from Marathon, Florida, a few years back. This valuable piece of taxpayers' property includes such goodies as two movable towers, a phasing kit so that the desired directional pattern can be quickly achieved any place the station is set up, plus two portable 200-KW diesel power supplies —all of which can be shipped anywhere in the world by air.

After this was replaced at Marathon with a more or less permanent facility, the guessing game began. And the list of possible new locations get wilder as it goes along—Hue (Vietnam), Botswana, Thailand, Perim Island, and one "authority" even suggested a connection with Swan Island (but we don't really think he was serious). The missing unit could have been



Sending reception reports to Red China often results in receiving Red propaganda pamphlets.

at Hue briefly, but is not there now. According to the American SWL Club, it almost certainly was used in Botswana against Rhodesia and may still be there. Thailand is an outside possibility while the Perim Island (home of BBC's now defunct East Africa relay) theory is ridiculous.

We have a terrible feeling that the number of would-be prophets claiming to know the "true" whereabouts of this phantom station is going to grow, but meanwhile you can log its three-towered replacement at Marathon on 1180 kHz.

UFO Department. SWLs who specialize in satellite and related signals often tend to have overactive imaginations. Anytime an unidentified signal appears on one of the three major space bands (15016 kHz, 19990-20010 kHz, 30005-30010 kHz) they jump to wild conclusions. Some UFOs are merely images (stations transmitting on another frequency and erroneously picked up by your receiver superheterodyne circuits.) On 20 MHz an image can be readily spotted. The second signal will create a heterodyne whistle with WWV (assuming of course WWV is audible). If, when you turn your dial slowly, the pitch of that heterodyne varies, this UFO is an image.

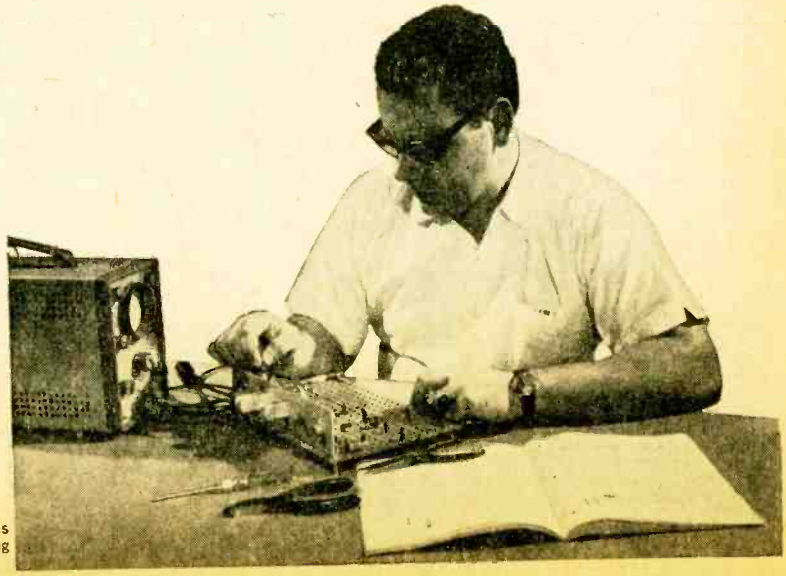
Other UFOs are the result of stations being on space frequencies that don't belong there. For example on October 28, 1967, Spanish speaking Utility stations were working each other on 19998 kHz. On that date, according to an unconfirmed and later denied press report, a giant manned Soviet space ship was supposedly circling the Earth. Now while the USSR may indeed maintain space communications stations in Cuba, they would probably be speaking Russian, not Spanish. ■

ELEMENTARY ELECTRONICS
MARCH-APRIL 1968

". . . and then, by mere chance, I discovered that the parrot stand makes an excellent antenna."

10 Reasons why RCA Home Training is

Your best investment for a rewarding career in electronics:



Performing transistor experiments on programmed breadboard — using oscilloscope

1 LEADER IN ELECTRONICS TRAINING

When you think of electronics, you immediately think of RCA...a name that stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., a service of Radio Corporation of America, has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

Beginner or refresher, AUTOTEXT, RCA Institutes' own method of programmed Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

3 THOUSANDS OF WELL PAID JOBS ARE NOW OPEN TO MEN SKILLED IN ELECTRONICS

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. Every year, literally thousands of high paying jobs in electronics go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Start today on the electronics career of your choice. On the attached card is a list of "Career Programs", each of which starts with the amazing AUTOTEXT method of programmed instruction. Look the list over, pick the one best suited to you and check it off on the card.

5 SPECIALIZED ADVANCED TRAINING

For those already working in electronics or with previous training, RCA Institutes offers advanced courses. You can start on a higher level without wasting time on work you already know.

6 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

7 VARIETY OF KITS YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself. You never have to take apart one piece to build another. At no extra cost, they're yours to keep and use on the job.

8 FROM RCA INSTITUTES ONLY — TRANSISTORIZED TV KIT, VALUABLE OSCILLOSCOPE

Those enrolled in RCA's television course or program receive complete transistorized TV Kit. All students receive a valuable oscilloscope—both at no extra cost and only from RCA Institutes.

9 UNIQUE TUITION PLAN

With RCA Home Training, you progress at the pace that is best for you! You only pay for lessons as you order them. You don't sign a long-term contract. There's no large down-payment to lose if you decide not to continue. You're never badgered for monthly bills. Even if you decide to interrupt your training at any time, you don't pay a single cent more.

10 RCA INSTITUTES GRADUATES GET TOP RECOGNITION

Thousands of graduates of RCA Institutes are now working for leaders in the electronics field; many others have their own profitable businesses. This record is proof of the high quality of RCA Institutes' training.

CLASSROOM TRAINING ALSO AVAILABLE

If you prefer, you can attend classes at RCA Institutes Resident School, one of the largest of its kind in New York City. Coeducational classroom and laboratory training, day and evening sessions, start four times a year. Simply check "Classroom Training" on the attached card for full information.

JOB PLACEMENT SERVICE, TOO!

Companies like IBM, Bell Telephone Labs, GE, RCA, Xerox, Honeywell, Grumman, Westinghouse, and major Radio and TV Networks have regularly employed graduates through RCA Institutes' own placement service.

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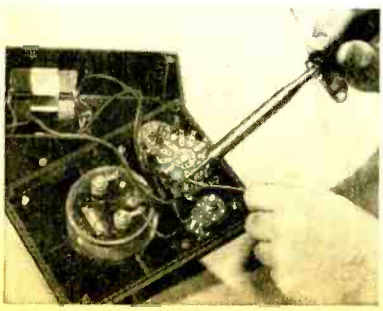
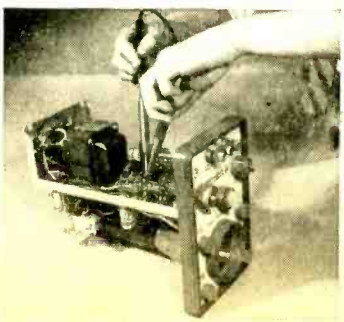
The Most Trusted Name in Electronics

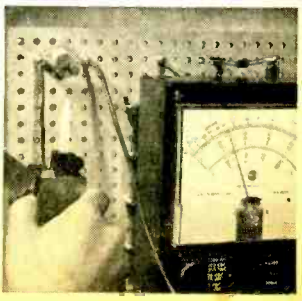
Construction of Multimeter.





Construction of Oscilloscope.

Temperature experiment with transistors.



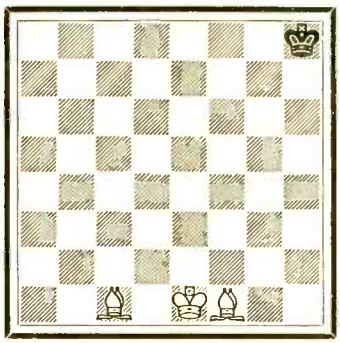
EN PASSANT

BY JOHN W. COLLINS

Six columns ago I explained that a game of chess is divided into three parts—the opening, the middle game, and the ending—and that the latter, though chronologically last, should be studied first. As a starter, I showed how King and Queen force checkmate against the lone King and how King and Rook do likewise. Those are the two easiest elementary mates. Now I shall give two more, harder ones.

The first is that of King and two Bishops against King. The lone King must be driven into one of the four corners; any will do. The mate can always be effected in less than thirty moves, whatever the original position. In this example it takes only fourteen.

Black



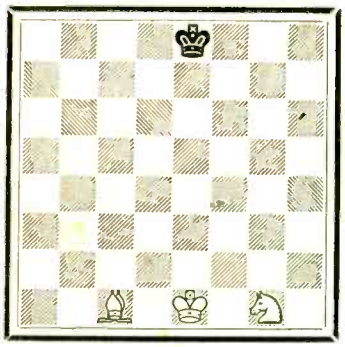
White

1	B-Q3	K-N2	8	B-N6	K-N1
2	B-KN5	K-B2	9	K-R6	K-B1
3	B-B5!	K-N2	10	B-R5!	K-N1
4	K-B2	K-B2	11	B-K7	K-R1
5	K-N3	K-N2	12	B-KN4!	K-N1
6	K-R4	K-B2	13	B-K6#	K-R1
7	K-R5	K-N2	14	B-B6 mate	

And the second is that of King, Bishop, and Knight against King. This is the most difficult

of all the elementary mates and often causes trouble for fairly strong players. It requires about thirty moves too, and the mate can only be given in one of the corner squares controlled by the Bishop. Here it is fascinating to see how the three pieces converge on the single one, the Bishop working on the dark squares and the King and Knight on the light ones.

Black



White

1	K-K2	K-Q2	16	B-B4	K-N6
2	K-Q3	K-B3	17	B-K5	K-R5
3	B-B4	K-Q4	18	K-B4	K-R4
4	N-K2	K-B4	19	B-B7#	K-R5
5	N-B3	K-N5	20	N-Q3	K-R6
6	K-Q4	K-R4	21	B-N6	K-R5
7	K-B5	K-R3	22	N-N2#	K-R6
8	K-B6	K-R2	23	K-B3	K-R7
9	N-Q5	K-R1	24	K-B2	K-R6
10	N-N6#	K-R2	25	B-B5#	K-R7
11	B-B7	K-R3	26	N-Q3	K-R8
12	B-N8!	K-R4	27	B-N4!	K-R7
13	N-Q5	K-R5	28	N-B1#	K-R8
14	K-B5!	K-N6	29	B-B3 mate	
15	N-N4	K-B6			

These two endings illustrate the individual power of the pieces, how to use the King, the finesse of waiting moves, and the art of weaving a mating net with a minimum of force. The student should study and practice them at some length.

Game of the Month. Fresh from winning the Puerto Rican Championship, sixteen year old Julio Kaplan flew to Jerusalem and won the Junior World Championship. In the 1st Round of the Finals he crushed Jan Timmans of the Netherlands in the following miniature French Defense:

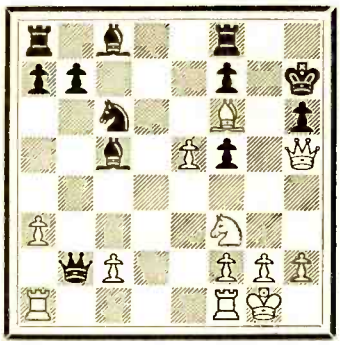
1	P-K4	P-K3	8	N-B3	BxP
2	P-Q4	P-Q4	9	B-Q3	0-0
3	N-QB3	B-N5	10	B-KN5	Q-N3
4	P-K5	P-QB4	11	0-0	Q-N5
5	Q-N4	N-K2	12	Q-R3	P-KR3
6	PxP	QN-B3	13	P-R3!	Q-N3
7	B-Q2	N-B4	14	BxN	KPxB

EN PASSANT

15 NxP	QxP	17 BxBP	K-R2
16 N-B6#!	PxN	18 Q-R5!	Resigns

Position after 18 Q-R5!

Black



White

Why did Black resign? Because there is no defense to White's mating threat. Here is the analysis—

A. If 18 . . . K-N1 19 QxRP, any 20 Q-N7 mate.

B. If 18 . . . QxBP 19 N-N5# K-N1 20 QxP, any 21 Q-N7 mate.

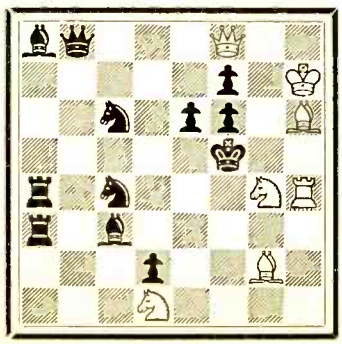
C. If 18 . . . R-KN1 19 QxBP/7# R-N2 20 QxR mate.

D. If 18 . . . BxP# (desperation) 19 RxB, QxR# 20 R-B1, QxR# 21 KxQ, and the mate goes on.

Problem 11

By Charles W. Sheppard
United States

Black



White

White to move and mate in two.
Solution in next issue.

Charles W. Sheppard was a prolific American problemist. He was awarded First Prize, Informal Tourney, 1952, American Chess Bulletin, for the above two-mover with its five attractive self-blocks on the same square.

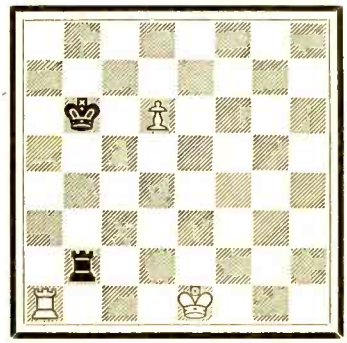
Solution to Problem 10: 1 Q-B8.

E/E EN PASSANT Readers Roy Brand of Lake Mohegan, Carl Lanzendorfer of Glasgow, and Norm Strawser of Harrisburg, wrote in that there was something rotten in the state of our diagram for Problem 9 by Julius Buchwald in the November-December, 1967, issue. Thanks, fellows. You are so right! The printer did us wrong. Too many Black Kings spoil the broth (or diagram) and a White King is essential! The extra Black King at K1 should be a White one. With that detail corrected everything is in order and the solution is 1 N-B4. Sorry!

End Game Study #3

By Alexis S. Selesniev

Black



White

White to Play and Win.
Solution in next issue.

This is a cutie. The solution runs only four moves or so, but it has a gimmick—and is a little unfair!

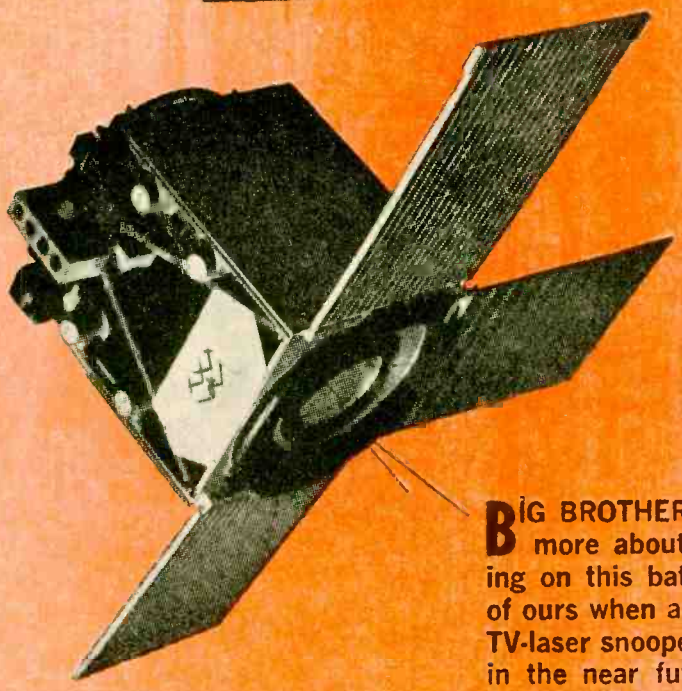
News and Views. Bent Larsen, the doughty Dane, amassed 6-3 to tie for first and second with Klaus Darga of West Germany in the 1967 Canadian Centennial Grand Masters Tournament at Winnipeg. They were followed by Keres, Spassky, Benko, Szabo, Gheorghiu, Matanovic, Yanofsky, and Kagan.

United States Champion Robert J. Fischer finished first with 13½—3½ at Skopje, Yugoslavia, in the "Tournament of Solidarity." Second and third were taken by Geller and Matulovich, half a point behind.

Wolfgang Unzicker, Germany, took top honors at Maribor, Yugoslavia, with 10—5. Right behind him with 9½—5½ was veteran Samuel Reshevsky, several times U. S. Champion—and that after losing his first round game! ■

elementary Electronics MARCH-APRIL 1968

meet the TV Laser



electronics' NEW eye on the world

By Jorma Hyypia

BIG BROTHER will know a lot more about what's happening on this battered old planet of ours when a new gimlet-eyed TV-laser snooper goes into orbit in the near future. The super-quality photographs snapped by the system will show every pimple and pore on Mother Earth's face as clearly as would a Karsh portrait.

Riding in a 500-nautical-mile orbit in a (Continued overleaf)

satellite, the new eye will send back pictures so sharp that objects only 100 feet in diameter will be recognizable. If that doesn't seem especially spectacular, just think of it in ordinary photographic terms. The feat is akin to snapping a camera in Philadelphia and getting a recognizable image of a suburban ranch house in Cincinnati, 500 miles distant!

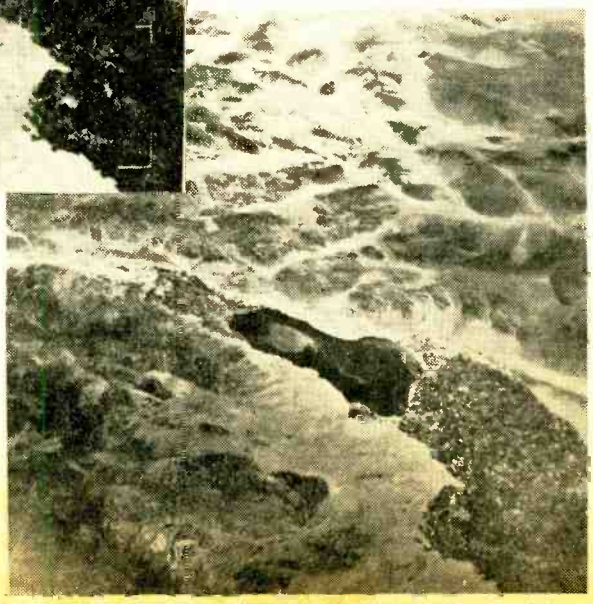
Home TV pictures now have something approaching 525-line resolution, and the best TV equipment used in space projects has about 800-line resolution. But the new system, developed by RCA, is capable of 5000-line resolution. Result: the pictures it produces are ten times clearer than those you see on a home TV screen.

Worth noting too, is the fact that resolution can be further stepped up to a theoretical limit of 8000 lines. This would make still smaller objects recognizable. Perhaps even then it wouldn't be quite good enough to catch you sunbathing in the back yard—but then again it just might capture all of *that* and more!

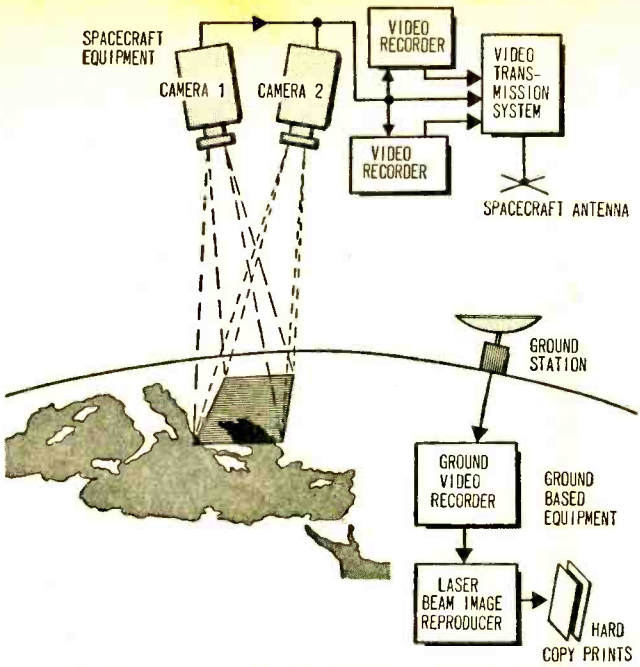
How is it done? By mating a new type of vidicon TV camera in the satellite with a specially designed reproducer that translates beamed signals into pictures with the aid of laser optics. Though only one camera is needed to take pictures, two or more may at times be carried in the same satellite. The extra cameras will permit sampling several areas of the light spectrum. Moreover, the use of three cameras would allow the satellite's views to be reproduced in color.

Project EROS. RCA's vidicon camera has been specially designed for use in the Department of Interior's proposed Earth Resources Observation Satellite (EROS). The primary objective is to take an exhaustive inventory of the earth's natural resources from an unmanned satellite.

The information provided by this project will almost certainly be of immense benefit to mankind. It will yield wholly new knowledge relating to such topics as agricul-



Some idea of TV laser's tremendous increase in resolution can be gained from these photos, though reproduction here is far, far cry from original. Photo above, taken during Gemini 5 flight, was produced by TV imaging system typical of those presently in use in space programs; resolution is about 800 lines, and there is excessive contrast and much loss of detail, especially in darker areas. Photo at right is identical, except that it was produced by new RBV/LBIR system. Original photo reveals astounding improvement in detail, though most has been lost in this printed image.



Satellite-eye view of new TV-laser system in block-diagram form shows basic components of spy-in-the-sky setup. Return Beam Vidicon (RBV) housed in satellite beams data to ground-based equipment which translates it into pictures with Laser Beam Image Reproducer (LBIR).

tural crops, topography, forestry, water supplies, and mineral resources, both on land and in the oceans. For example, the vidicon camera is sensitive enough to detect the difference between a normal food crop and one that is blighted; hence farmers can be warned to take corrective measures *before* their crops are destroyed.

Better geological maps made from EROS data may lead to the discovery of rich mineral deposits deep in the earth. The study of ocean currents, coastline and sea-floor variations may aid the fishing and shipping industries. Hydrologists will have new information to develop water resources and combat water pollution and to plan better irrigation systems. Improved maps will facilitate probing and solving problems related to population and transportation.

The new system may also lead to better meteorological studies than are now possible. For example, a synchronous satellite might be placed into orbit about 22,000 miles above the earth; the TV camera would then provide meteorological views as sharp and detailed as those now gathered by satellites in low earth orbits. The advantage of the high-orbit views would be that a very large area of the earth could be observed continuously. Equipment now in use can view only relatively small areas, and only once during each revolution as the low-orbit satellite passes overhead.

Though earth will be the first planet to be probed by the TV-laser system, it is very likely that the equipment will become equally useful in the observation of other planets in our solar system.

Military Implications. Officially, nothing is being said about potential military applications of the new eye-in-the-sky. But no one would be so naive as to miss seeing the obvious advantages of a military snooper that would make existing photographic devices look like Brownie cameras by comparison.

If you are taking high-resolution pictures of farmlands, mountains, cities, and oceans, you're not likely to miss seeing such interesting subjects as military bases, materiel stockpiles, rocket launch sites, and the like. (And such details aren't likely to be stuffed into the files of the Department of Interior, unnoted by the Department of Defense.)

If you feel a mite itchy about the idea of Uncle Sam peering down at you from outer space, don't be. Instead, just start scratching at the thought that similarly equipped satellites launched by *other* nations will sooner or later be involved in this new international hobby of candid space photography.

We haven't yet said much about the laser reproducer part of the system. Aside from

its basic function to complement the vidicon camera, it has some startling potentials of its own. We'll cover some of these after seeing just how the vidicon camera and the laser reproducer actually work.

Special Vidicon. The Return Beam Vidicon (RBV) tube developed by RCA is a magnetically deflected and focused vidicon imaging device with a 2-in. diam. faceplate. It operates as a vidicon (a type of sensor tube used in TV cameras) in that an electrically charged photoconductor "target" is discharged by an electron scanning beam. The electrical charge pattern on the target represents the various tonal ranges in the scene being viewed and recorded. The more positively charged areas on the target correspond to highlights of the TV image.

The photoconductor target is scanned by a low-velocity electron beam produced by an electron gun consisting of a thermionic cathode, a control grid, and an accelerating grid. The beam is focused on the target by the axial magnetic field of an external focusing coil and the electrostatic field of another grid.

The shape of the decelerating field is adjusted by a grid to obtain uniform landing of electrons over the entire target area. Alignment of the beam on the target is accomplished by a transverse magnetic field produced by an external coil located at the base of the vidicon. Deflection of the beam is accomplished by transverse magnetic fields produced by external deflection coils.

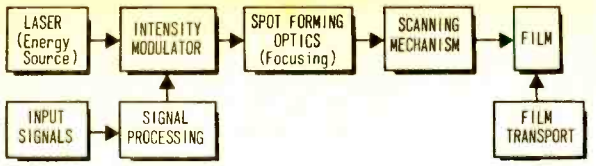
The RBV differs from usual vidicon operation in that the return beam, formed by electrons turned back at the target, is used as a signal path somewhat as in the operation of an image orthicon—another type of sensor tube used in TV cameras. This return beam is amplitude-modulated by absorption of electrons at the target (which is thus discharged). The amount of electron absorption is of course related to the pattern of charged areas produced originally on the target by the incident light.

The complete electron round trip occurs in much less time than it takes to laterally displace the beam with the deflection field. The return beam is directed to the first dynode of a five-stage, electrostatically focused electron multiplier which amplifies the modulated beam current.

The video preamplifier is a solid-state device connected with short leads to the vidicon pins. This 4-MHz bandwidth amplifier circuit provides beam blanking during retrace and includes a peaking stage to compensate for roll-off caused by shunt capacitance in the electron multiplier output. An aperture-correction circuit is also used to compensate for fall-off in response associated with the finite size of the scanning beam. In addition to increasing the limiting resolution, this compensator circuit allows for a modulation transfer function, resulting in a more efficient utilization of the video bandwidth.

Most of the electronic circuitry required to operate the RBV is located in a single electronics package. This unit contains the power supply, regulator circuits, deflection circuits, and video amplifier circuits. All of these electronic circuits have been flight-

Engineer Dennis Woywood eyes RCA's new Laser Beam Image Reproducer (far right); new Return Beam Vidicon camera is in center. Though designed primarily for EROS satellite, vidicon camera could be made lightweight and compact enough for use in TIROS M advanced weather satellite, currently under construction.



Basic components of Laser Beam Image Reproducer, ground-based member of new TV spy-in-the-sky. Effectively a sophisticated optical pencil, reproducer displays RBV-recorded image by scanning photographic film line by line.

qualified on either the Nimbus or TIROS/TOS programs and are of proven high-reliability designs.

High Resolution. Resolution is defined as the reciprocal of the smallest dimension of a pattern that is barely perceptible. This is a rather subjective measurement. But it has been experimentally shown that the recognition limit of any feature corresponds to a video signal-to-noise ratio of 11.1 dB peak-to-peak/rms. This definition of resolution is used to define the limiting resolution of the RBV. For a video channel having a signal-to-noise ratio of 40 dB, p-p/rms, the resolution limit is 3.6% response point on the modulation transfer characteristic.

The RBV's extremely high resolution is made possible by *slow* scan operation and return beam design. The size of a scanning beam in a vidicon is directly proportional to the beam current. As the scan rate is decreased, the beam current can be decreased to maintain a constant number of electrons landing on a unit area of the photoconductor target. Thus a smaller spot size and higher resolution are obtained at slow scan rates.

Use of the return beam as a signal path permits utilization of electron multipliers to amplify the signal; this increases the sensitivity of the device. The RBV requires much less incident light on the photoconductor than does a normal vidicon. Thus the beam current may be reduced even more to improve resolution.

There is an optimum "develop" time associated with the vidicon photoconductor that results in the best sensitivity and resolution. For this reason a delay time is introduced between the time the photo-conductor is exposed to light and the time readout is initiated. The ASOS photoconductor used has a delay time of 1.2 seconds. Also, sensitivity and resolution is a function of readout time of the full picture. The best resolution occurs when the photoconductor is read out for 5 seconds beginning 1.2 seconds after exposure.

Operational Sequence. A three-step operational cycle (prepare, expose, readout) takes a total of 20 seconds. The first 200 milliseconds of the prepare sequence are used to erase any residual image that may be on the vidicon photoconductor. To accomplish this, the photoconductor is completely discharged by illuminating it with a set of four small tungsten flood lamps. After erasure, the photoconductor is charged uniformly to the cathode potential. The preparation operation consists of scanning the vidicon target five times at twice the normal scan and frame rates. This requires 12.5 seconds.

During the expose period the RBV electron gun is biased off, and the target voltage is changed to its readout potential. After 1.3 seconds the photoconductor is optically exposed to the scene being photographed.

During readout the electron gun is turned on. The readout scan rate is 1200 Hz; readout is completed in 5 seconds to give a total of 6000 scan lines.

RBV Spawns LBIR. The successful development of the high-resolution RBV created a new problem: how to reproduce the transmitted data most efficiently to retain the high degree of picture clarity offered by the satellite unit. RCA tried many techniques such as electron beam recording, drum facsimile scanning, and the use of a matrix of cathode ray tubes. All were ruled out because of excessive image degradation.

RCA scientists eventually turned to laser optics and developed the Laser Beam Image Reproducer (LBIR)—a remarkable achievement in itself. It not only solves the immediate problem of reproducing RBV data properly, but gives promise of being uniquely adaptable to many uses not at all related to the space photography project.

Laser Pencil. In effect, the LBIR is a sophisticated optical pencil that recreates the image recorded by the RBV by scanning a piece of photographic film line by line. Signals from the RBV are simply fed into the recorder and the picture is recreated at a rate of 1200 lines per second.

To accomplish this, the LBIR must do four things: 1) provide a basic recording energy source (coherent light); 2) modulate

this light with the RBV signals; 3) focus the modulated light into a high-energy density recording spot; 4) scan a recording medium (photographic film) with this spot.

Intensity modulation of the laser is accomplished by means of electro-optic techniques. The modulator uses ferroelectric electro-optic crystals to effect polarization *rotation* of the laser beam which is already linearly polarized. This polarization rotation is a direct function of the applied signal voltage.

Polarization modulation is connected into intensity modulation through the use of a polarization analyzer affixed to the modulator. The modulator used in the LBIR can achieve contrast ratios in excess of 100-to-1 for a change in signal of 105 volts.

The recording spot is formed with conventional refractive optical components. Scanning of the recording film (or sensitive paper) is accomplished both through movement of the recording spot across the film (scanning) and transport of the film past the scanning station. A rotating mirror assembly is used to produce scanning of the recording medium.

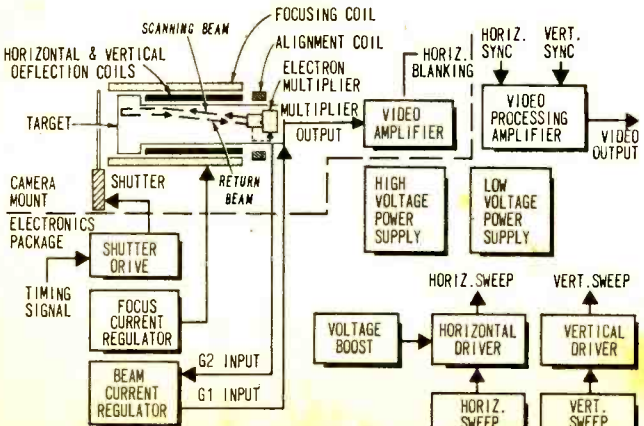
LBIR Bonuses. It is very probable that the new laser reproduction system—in its present or in modified forms—will become an extremely versatile device for use in earth-based activities. It could ultimately outmode many standard photographic procedures.

For example, when integrated microelectronic circuits are made photographically, several tedious steps are required to reduce the original master layout to the small size of the final product. At present this procedure takes at least 10 hours of working time. The laser reproducer may do the job in a single step and cut the time down to less than one hour.

The system could be used to record architectural drawings and blueprints for storage and later reproduction. Industry, business organizations, and government agencies have a growing problem in the handling of enormous amounts of filed-for-reference information. In addition to recording written material, the laser system may permit storage of picture material on magnetic tape instead of on microfilm (which is relatively bulky to store). Information retrieval, even the reproduction of pictures, would be very speedy.

In future, news media may be able to bring you better pictures much more quickly from all over the world by relaying them via satellite to ground-based laser reproducers. In fact, the day may come when the laser will find its way into your own living room. It will be used to project enlarged TV pictures onto the wall of your room, or onto a projection screen. It could also be coupled to your radio to receive signals that the laser will translate into printed text and pictures.

Meanwhile, *smile!* Time was when you might have been on Candid Camera, but now it's candid satellite! ■

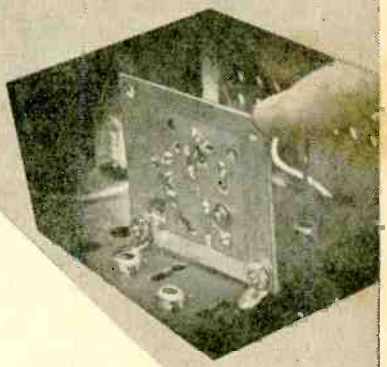


Simplified block diagram of Return Beam Vidicon (RBV). Shutter assembly in device is focal-plane mechanism fastened to front of camera mount. Separate solenoids drive two shutter blades mounted in parallel planes across vidicon faceplate; each blade has aperture equal in size to entire vidicon image format.

COVER STORY

Calibrate your communications gear with our

ADD-ON FREQUENCY STANDARD



Built on our free printed-circuit board, it mounts right inside your receiver!

By The Editors of ELEMENTARY ELECTRONICS

Few shortwave receivers—even when brand-spanking new—have a dial calibration that can be relied on. And given a few months' use, the calibration drift can be so great that even the most skilled short wave listener will experience difficulty in locating exact frequencies.

But just add a rock-stable frequency standard such as found in the more expensive communications receivers, and things will be mighty different—and then some. Even if the receiver's dial calibration drifts off the table, you'll have dependable frequency markers which will at least put your tuning in the ball park.

Whether you spend $20 for an add-on frequency standard or $300 for a gold-plated special, the frequency standard will most *(Continued on page 48)*

likely the old standby. It will be a 100-kHz crystal-controlled oscillator, with an output rich in harmonics, generating 100-kHz markers extending to 15 or 20 MHz. If the calibrator is equipped with a crystal trimmer capacitor, the calibrator's output frequency can be adjusted within a few cycles of WWV reference.

A solid-state crystal calibrator with a WWV trimmer small enough to be built into even the lowest-cost receiver is shown in our photo. Utilizing printed circuit (PC) board construction, the entire calibrator measures just 2¼x2 in. It operates off 9 to 12 VDC at a nominal 3 mA, which can be tapped off the receiver's power supply as shown in the power supply schematic.

Later in this article, we'll show how we mounted our frequency standard in a Lafayette Explor-Air Mark V communications receiver. However, remember that our calibrator can also be used with most other SW, ham, and CB gear. Total cost of the entire calibrator less the crystal is only $3.50. The crystal, a special Sentry model made available to only our e/e readers, is priced at a low $9.00.

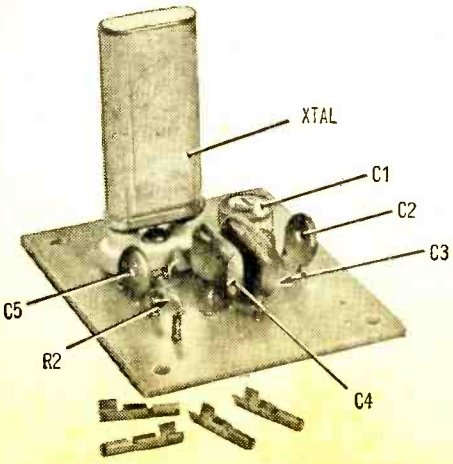
For best results the calibrator should be built exactly as shown, using the Sentry PC board. To ensure accuracy of component layout, the PC board is available *free* to e/e readers (not even a postage or handling charge). Just clip and mail the coupon, and you'll get your PC board as soon as your request can be processed.

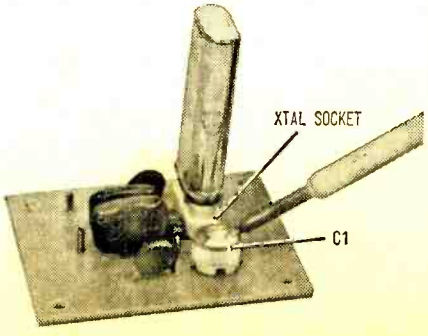
The free PC board is supplied with bare, unplated foil and is not pre-drilled. However, if you order the complete calibrator kit ($3.50), a plated and pre-drilled PC board will be supplied. The type SCX-13 100-kHz crystal is suitable for either the free PC board or the kit.

Construction. If you are building the calibrator on the free PC board, the first step is to drill the holes for the components. Following the board assembly diagram that shows the component positions, drill the necessary holes for the components and the corner mounting holes. Standard wire-gauge drills should be used.

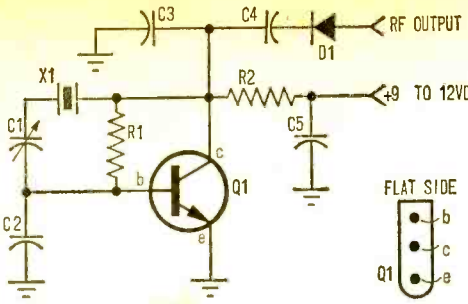
The corner holes should be drilled for the size mounting screws you intend using: use a #29 bit for #6 screws and a #33 bit for #4 screws. As for the other holes, those for the capacitors and resistors are drilled with a #57 bit; those for the crystal socket's terminals with a #35 bit; that for the socket's mounting screw with a #29 bit. The transistor leads require a #57 bit, C1 a #55 bit, and the male power pins used for the power input and RF output require a #50 bit.

After the holes are drilled, clean the oxide off the copper foil by lightly scrubbing with a household cleanser (Ajax is a good bet), then rinse the board under running water to ensure that all the cleanser is washed away. If you are using the PC board supplied in the kit, no drilling or

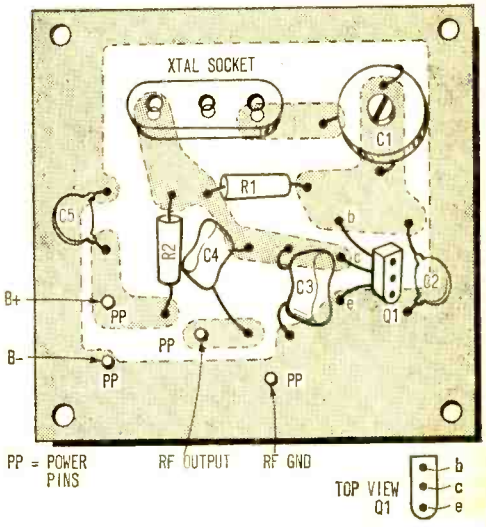




Completed frequency standard, assembled on a Sentry printed-circuit board and ready to be installed in receiver, is shown at left. Clips are used to make connections to PC board pins. At right, pointer indicates trimmer capcitor C1.



Schematic is primarily for reference purposes since unit should be built on free PC board. Pictorial below shows mounting location of all components except diode D1 which is wired between RF output and receiver's antenna connection. The diode is used to enrich harmonic content of output.



PARTS LIST

C1—10 to 60 pF trimmer capacitor
C2, C5—0.01-uF, 100-VDC capacitor
C3—3000-pF, 100-VDC capacitor (silver mica, 5%)
C4—1500-pF, 100-VDC capacitor (silver mica, 5%)
D1—1N34A diode
Q1—2N4292 transistor
R1—100,000-ohm, ½-watt resistor
R2—680-ohm, ½-watt resistor
X1—100-kHz crystal, type SCX-13 (see below)
1—Crystal socket
Misc.—Wire, solder, stake terminals, etc.

The type SCX-13 crystal is available for $9.00 postpaid from Sentry Mfg. Co., Box 12322, Oklahoma City, Okla. 73112. A complete kit of parts for the calibrator (less crystal) is available for $3.50, postpaid. The calibrator with the crystal is available for $12.50, postpaid.

cleaning will be necessary before starting.

First step is to install the crystal socket and capacitor C1, the crystal trimmer. If you are building the kit, the three-prong trimmer supplied will fit into the pre-drilled holes. Should you be using your own components, try to obtain a three-prong trimmer that will fit the existing holes (though the circuit will work as well with even a standard low-cost mica or ceramic trimmer).

If you use a mica-type compression trimmer, pass a #20 or #22 solid wire through C1's PC board hole closest to the crystal socket, wrap the wire around one trimmer solder tab, and solder. Then pass a wire through the remaining trimmer solder tab and through either of the two remaining trimmer holes and solder.

FREE PRINTED CIRCUIT BOARD OFFER

As a special service to readers, the Editors of ELEMENTARY ELECTRONICS have arranged for you to receive a Free Frequency Standard PC Board from Sentry Manufacturing Company. Just fill out and mail the coupon on the next page so it's postmarked on or before May 1, 1968. Should you desire to purchase the complete parts-package, place an X in the appropriate box and include a check or money order for $12.50 (price includes postage). Make checks payable to Sentry Mfg. Co. This free offer is invalid unless accompanied by the coupon on the following page.

The Editors
ELEMENTARY ELECTRONICS

FREQUENCY STANDARD

Once the crystal socket and C1 have been installed, mount resistors R1 and R2, and then all the capacitors and the four male power pins. Transistor Q1 must be the last item mounted to avoid soldering heat damage.

Installing Q1. Use Q1's full lead length; do not cut the leads short or try to mount Q1 flush to the board. Note that Q1 has one flat end and one round end. Looking at the bottom, the lead nearest the flat end, as shown in the diagram, is the *base*. The center lead is the *collector*, and the lead nearest the round end is the *emitter*. Install Q1 so that the flat end (base lead) is opposite C1. The round end will point towards the edge of the PC board.

Using long-nose pliers, slightly fan out the emitter and base leads, then insert the leads in the corresponding board holes so approximately ⅛ to ¼ in. of each lead sticks through the foil side of the board. Then solder the leads quickly, using an iron rated no higher than 50 watts. If you must use a heavier iron—100 watts is absolute maximum—make certain to use a heat sink such as an alligator clip on each transistor lead when soldering.

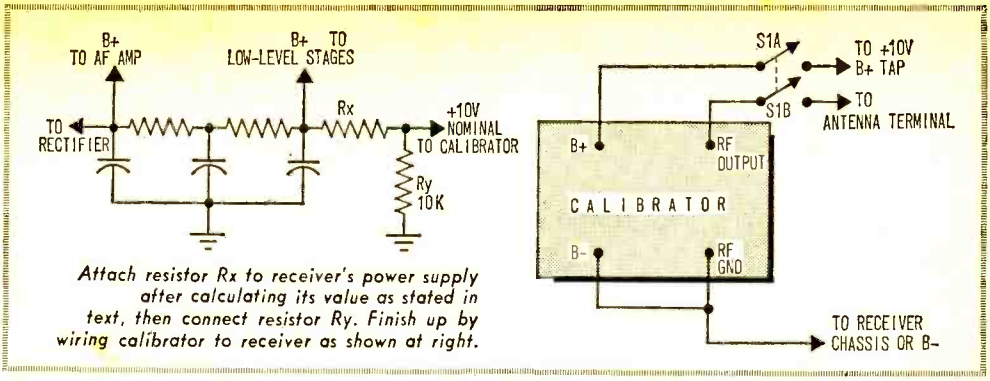
Tune-up and Checkout. Do not plug in the crystal at this time. Connect the negative lead of a 9- or 12-volt battery to the board's ground terminal. Connect the positive lead of a 0-10 mA (or higher) DC milliammeter to the battery's positive terminal, and connect the meter's negative lead to the board's positive power terminal (indicated +12 V). The meter should read between 2 and 5 mA. If the meter indicates less than 2 mA or more than 6 mA, check for a wiring error.

Now plug in the crystal; the meter will probably rise very slightly. Adjust C1 until the meter shows a peak (the peak is very broad and very slight). *Make a note of the meter current,* since you'll need this figure later.

Connect the PC board's remaining ground pin to the receiver's chassis. Connect one end of diode D1 to the board's RF output pin and the other end of D1 to the receiver's antenna terminal. Then tune across the broadcast band; at each 100 kHz you will hear a "quieting," indicating the 100-kHz marker. If the receiver is equipped with a BFO, turn it on and you will hear a beat-note every 100 kHz.

Zero-Beating WWV. Turn off the calibrator and tune in a WWV signal at 2.5, 5, 10, or 15 MHz. Then turn the calibrator on and adjust C1 so the beat note slides *downscale* from a high to a low frequency. At some setting of C1 there will be no beat note and further adjustment of C1 will cause the note to reappear and slide upscale. Perfect adjustment of C1 is the zero-beat setting, indicating that the 100-kHz marker is within a few cycles of the WWV reference.

Installing The Calibrator. Locate a clear area on top of the receiver chassis near the antenna terminals. Orient the PC board in this area so the power terminals are closest



Attach resistor Rx to receiver's power supply after calculating its value as stated in text, then connect resistor Ry. Finish up by wiring calibrator to receiver as shown at right.

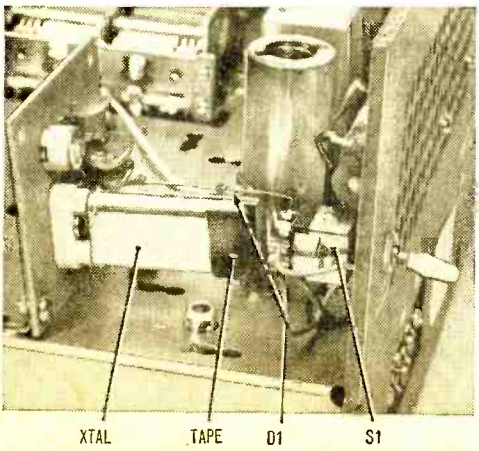
to the chassis and mount the unit as shown in the photos.

Next, mount a small switch on the receiver's rear apron, or rear cover, near the antenna terminals. This done, select some point in the receiver's B+ circuit and measure the voltage to ground. Install a voltage divider consisting of resistors Rx and Ry between this B+ point and ground. (Rx is a 1-watt resistor of a value to be calculated, and Ry is a 10,000-ohm, ½-watt resistor in all cases.) Add 1 mA to the current drawn by the calibrator when it was battery-powered, and calculate the value for Rx for a fixed voltage across Ry of 10 volts.

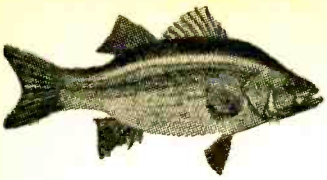
As an example, let's assume your calibrator pulled 5 mA; adding 1 mA your calculating current is 6 mA. Assuming the receiver's B+ measures 100 V, in order to maintain 10 V across Ry, resistor Rx must drop 90 volts. Using Ohm's law, R = E/I, Rx equals the voltage drop across Rx (90 V) divided by 6 mA (5 mA + 1 mA), or Rx = 90/.006 = 15,000 ohms (the same formula applies regardless of values). Just remember, the output voltage *must* fall between 9 and 12 volts.

Install the voltage divider across the B+. Mount the calibrator on the chassis by soldering the solder lugs to the chassis and connect the board's positive power terminal to one S1a terminal. Connect the remaining S1a terminal to the junction of Rx and Ry. Connect either end of D1 to the board's RF output pin and the other end of D1 to S1b. Connect the remaining S1b terminal to the receiver's antenna input.

Using The Calibrator. When S1 is installed, the calibrator is wired so that when power is removed from the calibrator, the calibrator's output is disconnected from the receiver's antenna input. When power is applied by closing S1, the calibrator is automatically connected to the receiver's antenna terminal. To use the calibrator, simply turn S1 *on* and tune for the "quieting" markers or turn on the receiver's BFO and tune for a "beat." ■



In prototype, calibrator is attached to solder lugs bent at right angles and soldered onto chassis. Note how diode D1 is installed between PC board and switch S1. Top of Xtal is taped to prevent shorts to S1.



Ultrasonic Fish Tale

There's a rotten frozen mackerel in every bunch; here's how to find it!

■ New ultrasonic studies conducted jointly by the National Research Council of Canada and the Fisheries Research Board hold out the promise of a simple and effective method of making a post-freezing assessment of meat and fish.

The studies form part of a research program started two years ago by NRC's Division of Applied Physics when the Board sought information on physical methods applicable to quality determination and control of fish. The work is being conducted by the Division at the request of the Fisheries Research Board.

One of the Board's interests was the development of a simple method of showing whether fish had been frozen previously and also how long and how fast thawed fish had initially been frozen.

Mr. David Makow, who had been working with ultrasound for some time, undertook exploratory work on such a method using ultrasonic techniques.

Ultrasonic Tattletale. The propagation conditions of ultrasound depend on the physical properties and structure of the tissue. If the tissue has been affected by the freezing process, then ultrasound should reveal these changes.

Following consultations between the Board and the Division, it was decided to conduct a research program on the ultrasonic approach. Manfred Freese of the Board's Freshwater Institute in Winnipeg was sent to Ottawa to work with Dr. Makow.

Experiments were conducted with microsecond ultrasound pulses at a frequency of three to five million Hertz. The reflections or echoes received from the various interfaces of tissue inside the sample were studied from both fresh fish samples and samples which had been frozen and thawed.

A definite correlation was found between the freezing history of the sample and the number and amplitude of the received echoes. The thawed fish tissue showed an echo pattern of larger amplitudes and number as compared with that of fresh tissue.

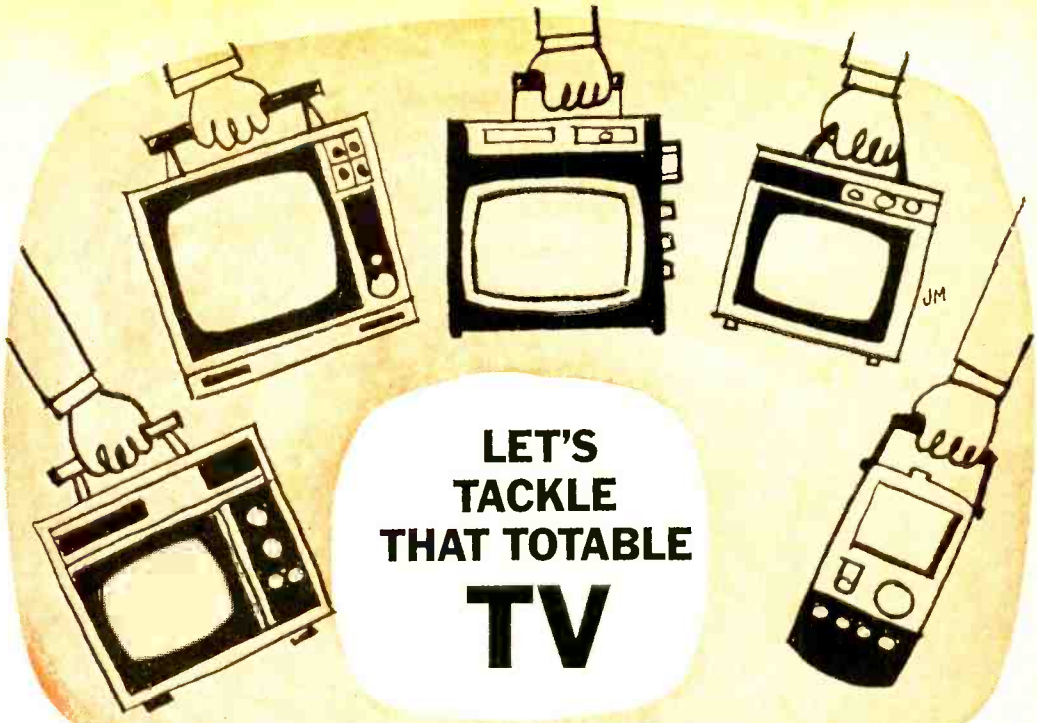
The work was extended to determine whether similar effects could be obtained with animal tissue. Samples of beef filet mignon were tested and the echo patterns were found to have characteristics similar to those obtained in the fish tests.

"These findings now are being further explored at the Freshwater Institute in Winnipeg," Mr. Freese says. "They hold promise of leading to a simple and effective method of assessment of fish and meat condition."

Sound With A Future. Mr. Freese and Mr. Makow expect that the method will find use in food inspection services. The quality of fish and meat depends to some degree on whether it has been frozen at all, whether it has been frozen for a short or long period, whether it has been frozen and thawed several times, and the speed at which it was frozen.

The equipment used for the experiments consists of a small tank of water, an ultrasonic transducer, a transmitter and receiver, and an oscilloscope. The tissue sample was placed in the tank with the transducer from which ultrasound pulses were directed at the tissue. The echoes returned to the transducer were then amplified in the receiver and appeared on the oscilloscope as a tracing. ■

Researcher Freese using an ultra-new ultrasonic method to determine quality of frozen whitefish. Silent echo from ultrasonic sound pulse beamed at frozen fish sample is viewed on oscilloscope.



LET'S TACKLE THAT TOTABLE TV

By Homer L. Davidson

Fixing that portable takes a knowing hand; here a pro lends his!

When that portable TV is on the blink, you've got two choices: figure on spending a bundle having it fixed, or doing it yourself. Of course, doing it yourself can be a problem even if you've had experience with big-brother console. That's because size considerations makes for design and construction differences. But take heart —the most common problems of a portable TV are often the easiest to repair. And with a few items of test gear and a little know-how you can tackle that misbehaving portable with confidence.

No Nothing. This symptom is the easiest trouble of all to correct. Let's take a look at the block diagram in Fig. 1. We see that practically every stage gets power from the low-voltage power supply. Let's begin right here.

Roll up your sleeves and pull the TV back cover off. First, see if the portable is an AC/DC or power-transformer type. The AC/DC portable TV receiver does not have a power transformer like the one shown in Fig. 2. All filaments in the AC/DC portable are hooked in series. In the power-transformer variety, the transformer supplies 6.3 VAC to all tubes in a parallel circuit.

Now check the circuit breaker on the rear apron of the TV chassis. In most late-model sets, it's in the form of a small protruding red rod. Push this and the circuit breaker will reset. If this was the problem, the filaments should begin lighting. Often a tube in the sweep circuit, such as the damper tube, will arc over, kicking out the circuit breaker. If the tube starts arcing when the circuit breaker is reset, replace the tube.

Fused Fuse. Take a look and see if all tubes light up. If they don't, check for a defective fuse. Some portable receivers have a circuit breaker and a low-ampere fuse in the AC line. Check the continuity of the fuse with an ohmmeter. Just looking at the fuse may not tell the tale. OK, the fuse is blown, so in goes another one. In some cases, only the type designed for the set will plug into the fuse holder.

Look at the schematic of your set and see if the fuse in the low-voltage power supply is like the hookup in Fig. 3. Here is a 2-A fuse protecting the overload that may occur in the low-voltage power supply if

associated circuitry suddenly shorts out.

What makes the fuse blow in the low-voltage power supply? Check for a shorted selenium or silicon diode rectifier. Then go to the filter capacitors and check for other possible defective components that can be shorted causing an overload in the B+ line.

string portable TVs (transformerless) is shown in Fig. 4. Here the fuse is a 0.4-amp type at the output of the power supply. After checking the fuse, go directly to plug-in resistor, R113 and see if it has burned open.

Now check the front-to-back resistance of SR101 and SR102, the two silicon diodes. Remember to always cut one lead loose for accurate measurement. If they're OK, then check the voltage-doubler capacitor, C111. These capacitors will dry out after several

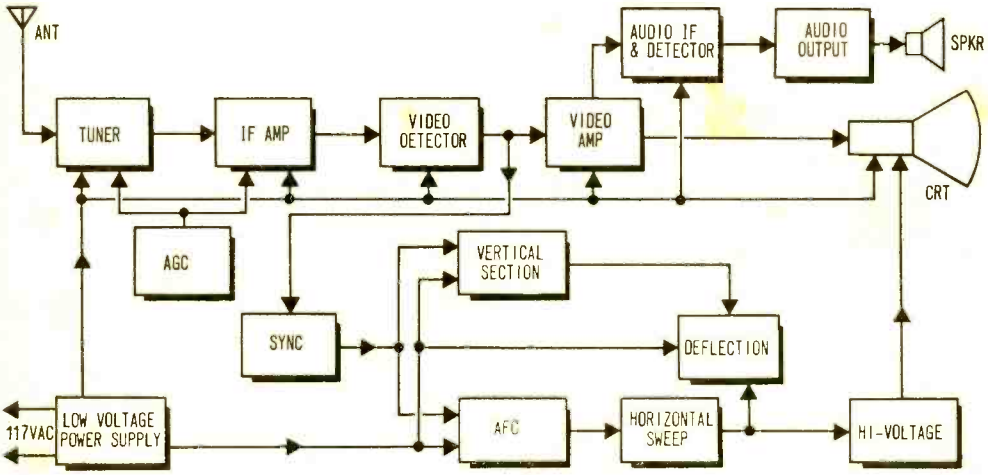


Fig. 1. Block diagram of standard TV set is useful when attempting to track down power supply troubles.

You can make a quick check of silicon diodes with the low-ohms scale of the VOM. Remove one end of the suspected diode, then place the ohmmeter leads across the diode rectifier. You should have a 5- to 15-ohm reading in one direction. Now reverse the ohmmeter leads. Does the ohmmeter still read 5 to 15 ohms? If so, the diode is shorted. A very high resistance reading should be noted with reversed ohmmeter leads. Very rarely do silicon diodes go open; they usually short out.

Smelly Selenium. Selenium rectifiers will have a resistance reading from 20 to 25 ohms in one direction and over 3000 in the other. You can easily spot a defective selenium rectifier by its pungent smell. Also, black burned spots form on the selenium side of a defective rectifier of this type.

Let's say, for instance, the fuse is good but there's still no output voltage from the low-voltage supply. In this same circuit (Fig. 3), check to see if the 3-ohm resistor is open.

A voltage-doubler circuit used in series

years of use. A white substance may have leaked out at the bottom of the filter, indicating the capacitor is defective.

To check the capacitor, shunt a new one across it. If that cures the problem, replace the defective capacitor.

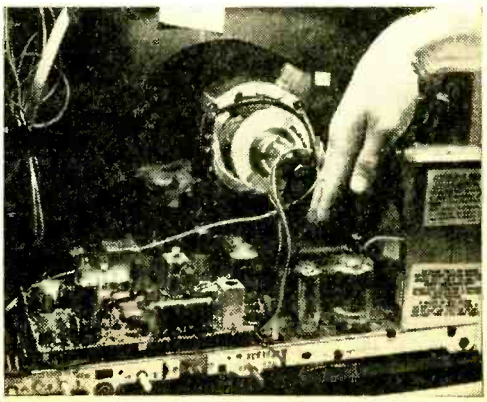


Fig. 2. Hand points to power transformer in transformer type set. The absence of this or similar transformer indicates TV set is of the series string variety, which the majority of low-cost portables are.

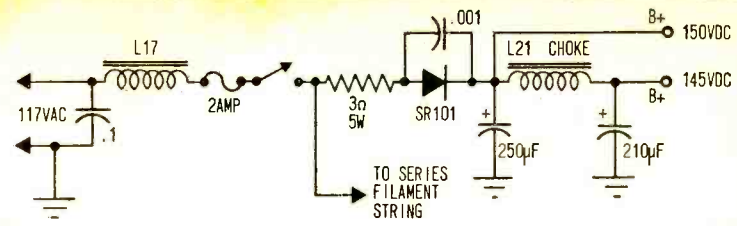


Fig. 3. Schematic shows typical transformerless low-voltage power supply used in many current portable TV models. Here, a 2-Amp fuse is used to protect set from damage in case of short circuit developing in the B-plus line or associated components.

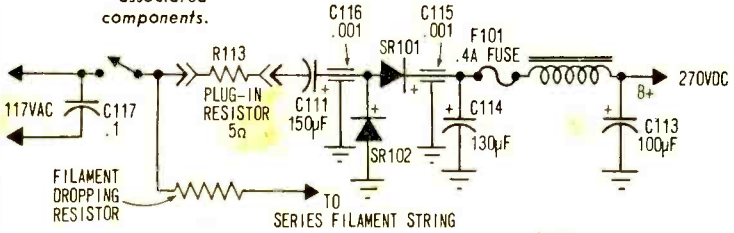


Fig. 4. In this power supply circuit, the B-plus output is fused by F101 and the AC line protected by fusable resistor R113. This hookup is a voltage doubler, the output being twice the input rms value.

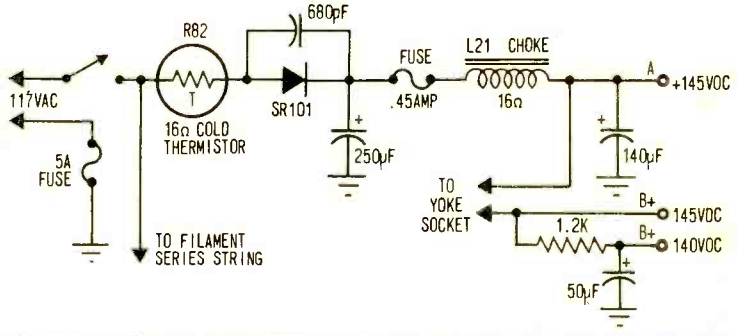


Fig. 5. In some sets, a thermistor is connected in series with the AC line to prevent voltage surges from damaging set when turned on. The thermistor protects set by having high initial resistance which then drops as thermistor warms up.

Hummm . . . If there's hum in the sound or dark bars across the screen, check the filter capacitor in your set equivalent to C113 and C114 in Fig. 4. Shunt a new capacitor of at least 450-VDC rating across the suspected filter capacitor and see if the hum disappears—if so, you've located the fault. When checking the power supply, always have the AC switch turned *off* while clipping the test capacitor across a suspect filter capacitor.

In Fig. 5 is another low-voltage power supply using a silicon diode as rectifier. Notice the thermistor resistor ahead of the diode. This resistor protects the series-string tubes by preventing surge voltage from being applied to cold tubes.

After several years' usage, the wires soldered to each side of the thermistor can pop off or come loose, leaving a high-resistance or open-current path. The results are intermittent or no output from the low-voltage power supply.

A low-voltage power supply circuit using a power transformer is shown in Fig. 6. The secondary winding is wired up for full-wave rectification with two silicon diodes in each leg. Notice the circuit breaker in the center leg of the transformer. In case heavy current drain in the B+ results because of defective components or a short circuit, the circuit breaker will kick out.

No H.V.? When this type of set is dead, check the B+ output supply voltage with a DC voltmeter. Also check the resistance of the two silicon diodes. Generally, when one is found defective, both silicon diodes in that leg should be replaced. If the circuit breaker keeps kicking out after it's been reset a few seconds, short across the terminals with an alligator clip. Occasionally, the circuit breaker will become defective and will not hold under the ordinary power load and will have to be replaced.

The second winding on the power transformer is the heater circuit. Tubes in transformer-type portable sets usually all operate on 6.3 VAC. This particular heater winding (hot side) has a 1-in. piece of #28 fuse wire so that in case of a filament or

pilot lamp short circuit, the wire will open, protecting the transformer winding from overload. If the filaments don't light, check for an open fuse wire—if OK, check for an open transformer winding with an ohmmeter and one transformer lead disconnected.

When the tubes are dark in a series-string set, all tubes will have to be checked for an open filament because if one goes out, none will light. So with a tube filament checker as shown in Fig. 7 or with an ohmmeter, check filament continuity.

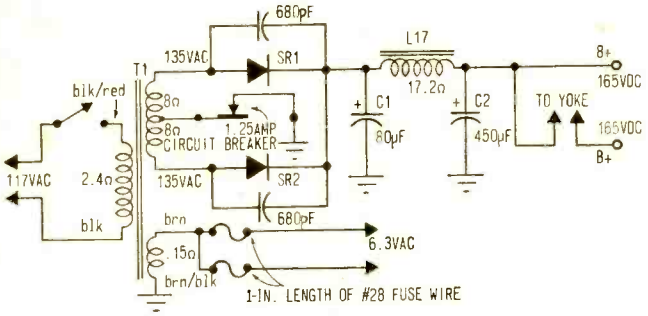


Fig. 6. Transformer power supply is used in better portable TVs. Typically, a circuit breaker is used in either AC line or in B-plus circuit as shown here. Full-wave rectification is provided by the use of two silicon diodes in this configuration, or in some cases, a bridge circuit employing four diodes. Typical DC-ohms values shown on transformer windings and choke lets them be easily tested with an ohmmeter.

Continuity Check. We know that one of these tubes, or possibly two, may have an open heater element. Take one tube out at a time and check it for continuity. Start with the horizontal output tube, damper, and sound output tube, in that order. These tubes run hot and are most likely to have a defective filament.

When checking filament continuity with an ohmmeter, switch to a low-ohm scale and place the probes across the heater terminals. The larger the heater voltage required by the tube, the greater the filament resistance measured should be. See Fig. 8 for a filament resistance chart.

In case the problem hasn't been found after checking tube continuity, bring out the AC voltmeter (see Fig. 9). Switch the voltmeter to the 150-VAC scale. Place the voltmeter probes across the *on/off* switch—it could be open. If this checks out OK, put one voltmeter lead to the *on/off* switch and trace the heater wires starting at the grounded side (Fig. 10).

Most tuner tubes are located at the grounded side of the series filament string. Quickest way to eliminate a possible defective tube socket or broken heater wire in the tuner is to clip a shunt wire from the brown heater wire going from the tuner to the chassis ground. If the problem is in the tuner, the other series string of tubes will light up when the set is turned on. If so, you have isolated the heater trouble to the tuner section.

Mostly Series. Remember that most portable receivers are of the series heater variety. When one tube goes out, the whole string is open like a cheap string of Christmas tree lights.

Fig. 11 shows a typical power transformer heater circuit with all tubes wired in parallel. In this type, one or two tubes may not light up indicating they are dead or their heater wiring defective. If all the tubes are dead in a power-transformer TV set, check for defective power transformer, broken heater wires, or open fuse wire.

When the picture tube has a raster, but there is no sound or picture, the trouble is probably in the tuner. The tuner is just behind the station selector knob. Substitute or check the RF and oscillator tube. If substituting tubes here doesn't produce picture or

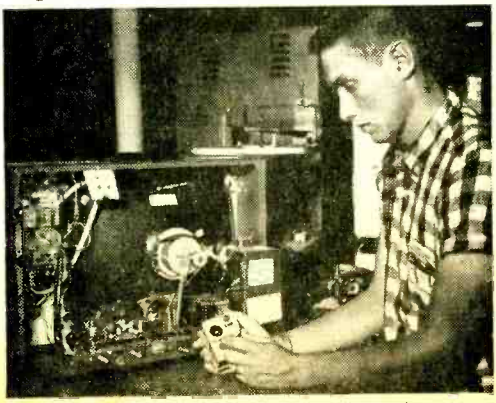


Fig. 7. Easiest way to check many tube filaments in a series-string TV is with simple continuity tester. What happens in this type of set is that when one filament burns out, none of the tubes will light up.

TUBE HEATER RATINGS

VOLTAGE (VOLTS)	3	6	12	17	25	35	50
RESISTANCE (OHMS)	1–1½	2–5	3–12	5–12	10–20	30–50	50–60

Fig. 8. If a continuity tester isn't available, tube filaments can be checked with an ohmmeter. Listed above is the approximate resistance value for tubes of various voltage ratings, e.g., 12BQ6 is 3—12.

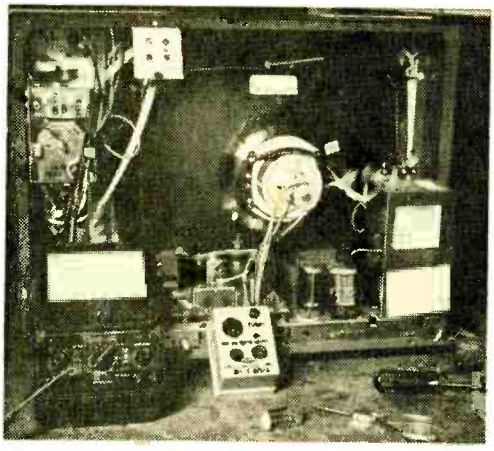


Fig. 9. If all tube filaments check out good, test the AC power switch with an AC voltmeter. If switch is good, no voltage should be indicated when on, 117 VAC should be indicated when off.

No Picture — Raster — Good Sound. When there is sound, a good raster, but no picture, the trouble is likely to be in the video circuits. Most portable TV sound circuits are connected to the beginning of the video circuit, so the problem will be somewhere after this point. Substituting or checking the video amplifier tubes will usually solve this problem.

The cause of excessive picture smear and tearing can usually be found in the video amp circuits. Open peaking coils in the video output circuit will result in a smeary picture—see Fig. 12. An open or leaky coupling capacitor from video amp to CRT can also cause picture smear.

Another possibility is a shorted picture tube. Simply tap near the end of the CRT, but *gently*, while watching the picture in a hand mirror. If the fault comes and goes while you're tapping, replacement of the CRT is the answer.

No Sound—Good Picture. When everything is fine but the sound is missing, go directly to the sound amplifier section and check the sound tubes, starting with the output tube—see Fig. 13. A defect here can cause no sound, extreme distortion, or excessive hum. If a tube is not at fault, check

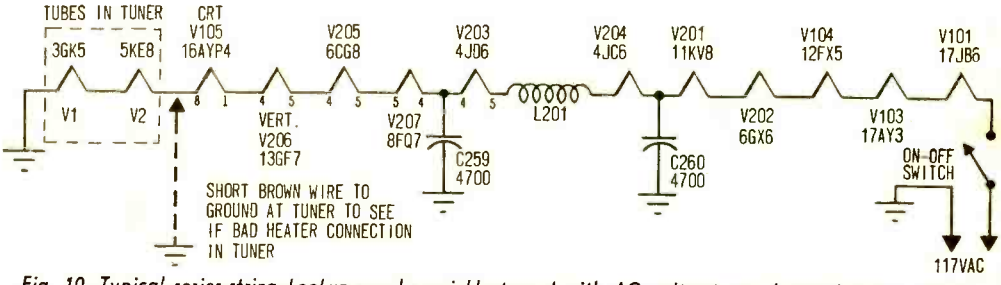


Fig. 10. Typical series-string hookup can be quickly traced with AC voltmeter to locate break in circuit.

sound, check the IF and video output tube. Always replace these tubes if any element indicates shorted on a tube tester.

If the problem persists, try pulling the AGC (automatic gain control) tube out of its socket (with the set on) and see if the picture or sound returns for a split second. If so, your set has AGC troubles. A defective AGC tube can cut off both picture and sound. Another method for checking AGC is to turn to a weak TV station. The picture and sound may appear on a weak signal but can be blocked by AGC action on a strong TV station.

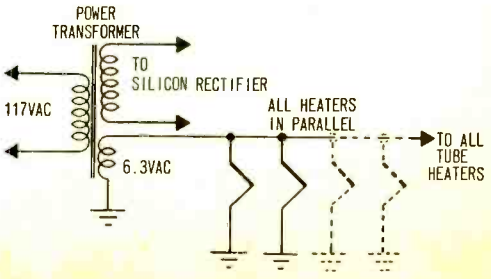


Fig. 11. In transformer type set, one or two filaments may not light up indicating tube or associated heater wiring is defective. If no tubes light up in this type of set, check the power transformer, fuses in AC or filament line or circuit breaker, and AC switch.

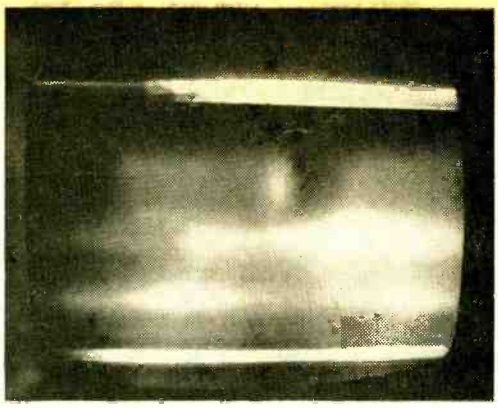
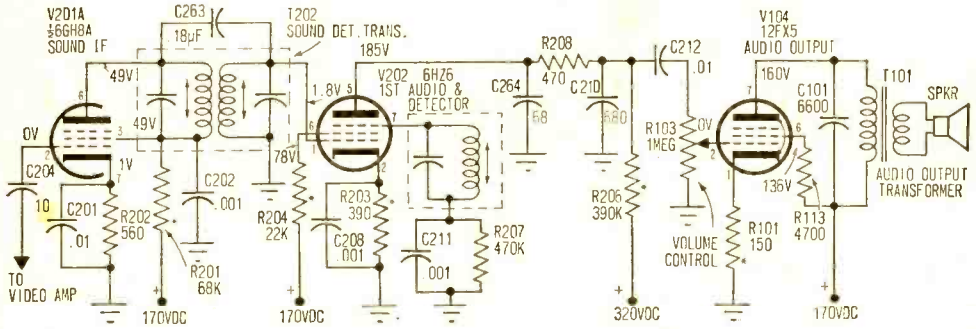


Fig. 12. Picture smear with complete loss of detail is caused by defects in either the video amplifier circuit or a shorted picture tube. Easy way to check picture tube is to tap it gently on the base and neck while watching picture in mirror.

Fig. 13. The audio circuitry in your portable TV will look very much like this. If poor, distorted or weak sound is the problem, start by checking these tubes or their counterparts in your set. The next thing to check is the speaker (see text).



the speaker and cable connections. Also check for a defective output transformer. This can easily be accomplished with an ohmmeter continuity check. Distorted sound can be caused by the cone resting on the center pole piece, in which case the speaker must be replaced. Small holes poked into the speaker cone can be repaired with glue.

Intermittent sound can be caused by a cracked PC board. Push and move the small parts on the PC board with an *insulated* tool while the set is on. Intermittent IF and detector coils may have cold solder connections inside the metal can.

Black Screen—Good Sound. Here we probably have a horizontal sweep problem (but be sure it is not just the brightness control turned all the way down). Be extremely careful when working in this section as LETHAL voltages exist. Keep the set turned *off* unless stated otherwise. The CRT capacitively stores up to a 20,000-volt charge

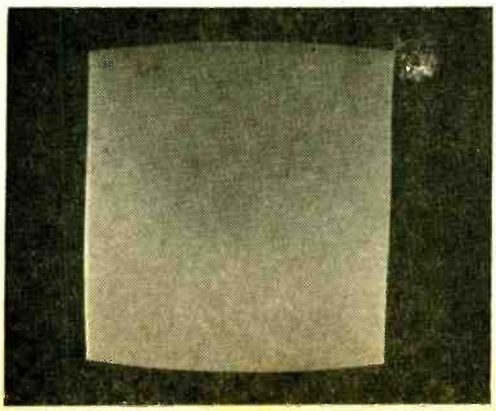


Fig. 14. Insufficient width is caused by the horizontal sweep voltage being low. This problem is most often traced to a weak or defective horizontal output or damper tube, but can also be low B-plus voltage.

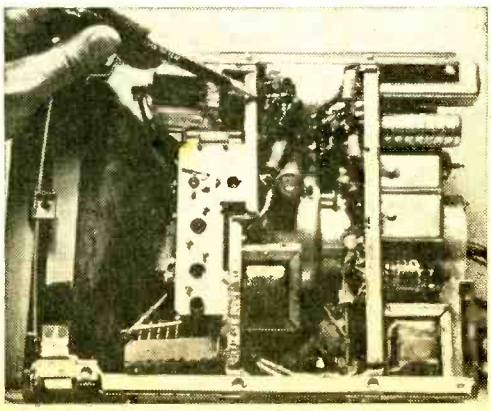


Fig. 15. If tubes are not the cause of a narrow raster, circuit components associated with the horizontal and damper tubes are likely candidates. The pencil points to the horizontal output tube circuit.

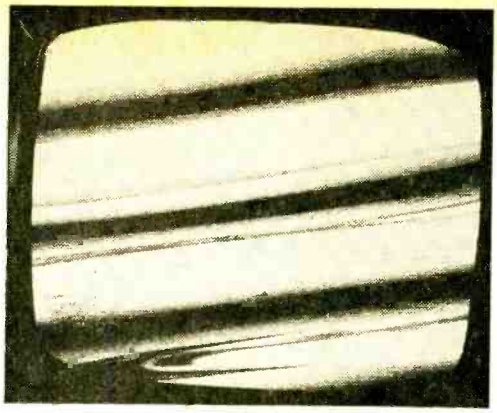
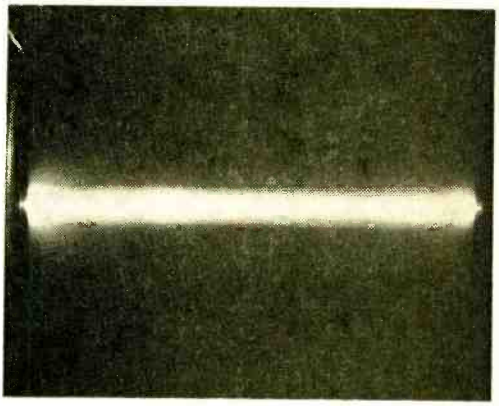
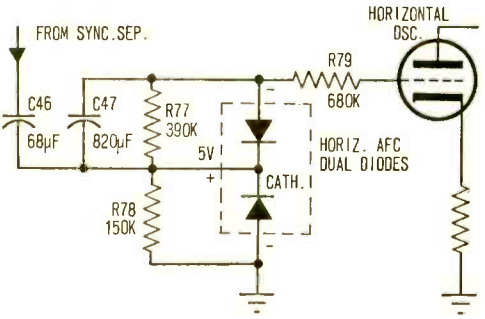


Fig. 16. When the horizontal won't lock in, check the horizontal oscillator and output tubes. If alright, try adjusting the horizontal frequency coil slug, usually on rear skirt of set.

Fig. 17. If horizontal still can't be locked in, the next thing to check is the AFC (automatic frequency control) diodes. They are usually in the form of a single common-cathode three-lead package.

Fig. 18. A single bright horizontal line usually means the vertical oscillator or output tube is defective. Also try adjusting the vertical height and linearity controls (see text).





so do not touch the high voltage nipple—even with the set *off*. As a further precaution, keep one hand *behind* your back, away from the ground or chassis, working with the other. This will keep possible shock from being dangerous.

First off, check the horizontal output, damper, and horizontal oscillator tube, in that order, with the set *off*. Then check the high-voltage rectifier tube after shorting all exposed high-voltage cage connections to ground to assure everything is discharged.

Look closely for a burned spot on the flyback transformer indicating it is defective and may have to be replaced. Then take a small, *well-insulated* screwdriver blade, slip the blade under the horizontal output cap while the set is *on* and draw a small arc from the plate terminal. If no arc appears, there is probably insufficient drive voltage to the horizontal output tube. Take a voltage reading at the grid pin; it should be from −5 to −25 VDC.

All of these checks can be made from the top of the chassis. Never measure the cap, or plate, voltage on a horizontal output tube. You can easily wrap the meter hand around the stop terminal. To measure the grid drive voltage, pull the plate cap off the horizontal output with the set *off* and then turn set *on*. If the voltage is normal, the horizontal oscillator section is performing. The trouble must be between the horizontal output tube to the CRT.

Careful Now. With the set off, carefully pull the cap off the high voltage rectifier tube with a pair of insulated long-nose pliers.

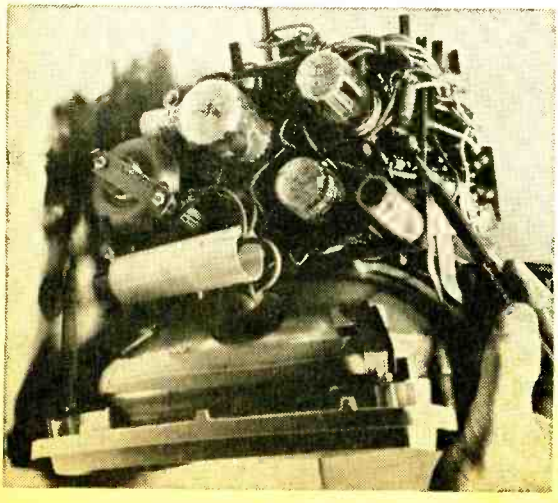


Fig. 19. The vertical oscillator circuit can also cause the absence of vertical sweep. The pencil points to the oscillator feedback coupling capacitor, one possible suspect; also check the vertical transformer.

Turn the set *on*, let it warm up, and then arc the screwdriver blade to the terminal inside of the high voltage cap. A good hot arc can be drawn up to half an inch long, if the horizontal sweep section is working properly. Turn the set *off* and replace the tube cap.

To see if the high voltage is being applied to the CRT, short the high voltage nipple on the CRT to chassis ground with a long, *well-insulated* screwdriver. Be extremely careful here. Placing the metal screwdriver

Fig. 20. A snowy picture with little contrast and weak detail is often caused by a weak RF amplifier tube in the tuner. This symptom can also mean a broken lead-in wire, shorted antenna, or open antenna coils.

to the ground and sliding it to the high-voltage anode connection should produce a sharp high-voltage arc.

If not, shut down the TV. Short the picture tube high-voltage cap to chassis ground. Also discharge the CRT by using two large screwdrivers, one on the anode connection and the other to black CRT coating. Snap

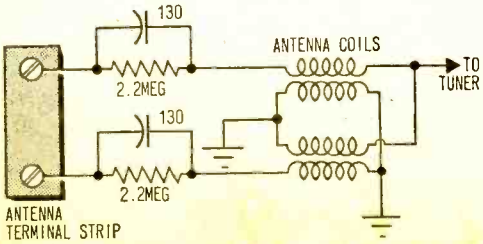


Fig. 21. The antenna coils are usually hooked up in this way. The capacitor/resistor network is designed to prevent lightning from damaging tuner. Check that capacitors, resistors and coils haven't been damaged.

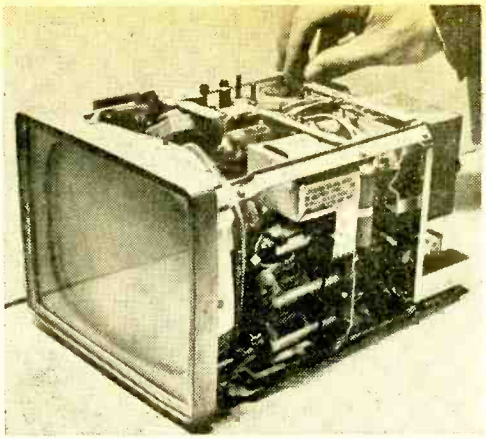


Fig. 22. If the picture jumps around every time you touch the channel selector, the tuner probably needs cleaning. Get a good spray lube and spray it on the contacts while briskly rotating the selector knob.

out the high-voltage cable and fire up the receiver. Arc the high-voltage cable to chassis and a sharp-high-voltage arc should occur. In case there is plenty of high voltage, the picture tube is probably defective.

Sides Pulled In. Insufficient horizontal width indicates insufficient high voltage on the CRT. The trouble can be a weak horizontal output, damper, oscillator tube, or all three. Don't overlook the possibility of a weak low-voltage rectifier tube that supplies power to the horizontal sweep stages. Check the setting of the horizontal linearity or width coil, as shown in Fig. 14.

The screen-grid resistor and bypass capacitor of the horizontal output tube are likely components to check if insufficient width is

(Continued on page 113)

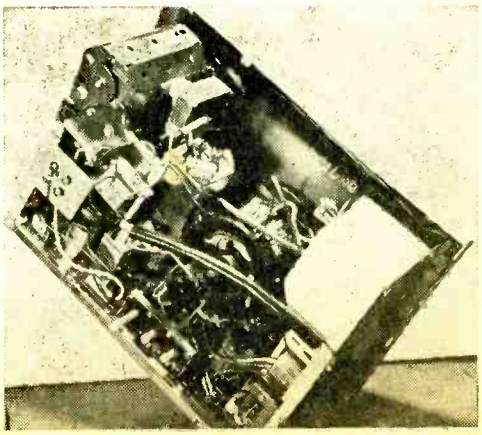


Fig. 23. Attempts at reducing overall size of portable TV sets have resulted in very crowded chassis layouts. This makes the portable a great deal more difficult to work on and care must be used not to damage set.

TROUBLESHOOTING STIC

Getting the most for the least is the story of this dirt-cheap IC signal tracer.—By Herb Friedman

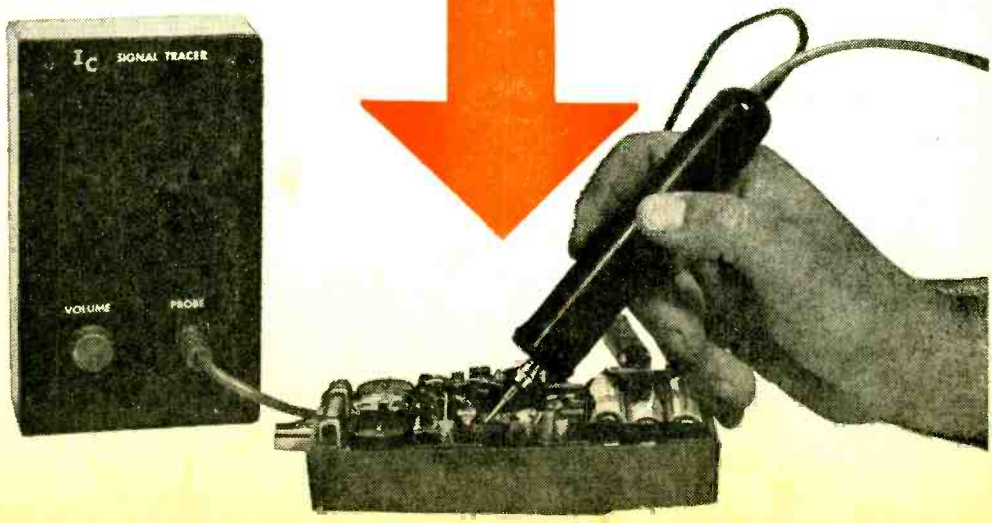
One of the most useful items on the test bench—particularly for the experimenter with a low test-gear budget—is the RF/AF signal tracer. Fact is, most amplifier and radio servicing can be done with nothing more than a signal tracer and a VOM or VTVM (preferably the latter).

The signal tracer's value lies primarily in its ability to localize defects—and localization is 90 percent of any service job. Once you've located the defective stage, the VOM or VTVM is used to find the defective component(s).

The signal tracer is basically a high-gain audio (AF) amplifier with an accessory detector probe for detection of radio frequency (RF) signals. In a typical service job, you might attach the RF probe and connect it after a receiver's last IF transformer: if you hear the signal in the tracer, you know the problem is somewhere after the IF transformer. Then, switch the tracer to straight AF input and proceed from the radio's detector towards the speaker. When you can no longer hear the radio signal in the tracer, you've located the defective stage.

If there were no tracer signal detection at the last IF transformer, you would leave the diode-detector probe connected and work back towards the antenna until you located the defective stage.

(Continued overleaf.)



e/e TROUBLESHOOTING STIC

IC Simplicity. Our IC Signal tracer is like most other solid-state tracers, the big difference being that it is intended as quick and easy construction project, even for the novice. To accomplish this, it uses an integrated circuit (IC) module. While some IC construction projects use more parts than the same item employing discrete components (many require unusual power-supply voltages), our IC project uses few parts. It is powered by a standard battery (Burgess Z4 or equivalent) and uses a really rock-bottom priced IC—like how hard can $2.80 possibly hit your pocketbook anyway?

IC All The Way. As shown in the schematic (Fig. 1), the entire signal tracer consists of a single IC—there are no extra add-on circuits or transistors. The circuit represented hy the IC, an RCA CA3020, is shown in Fig. 2.

The IC consists of a 7-transistor circuit and contains many of the necessary resistances. The addition of a few external components completes the IC amplifier which is capable of up to 0.4 watt output, with a 58-dB power gain.

To understand how the IC works, let's trace the circuit backwards from output transistors Q6 and Q7. The Q6/Q7 combo must be connected to an output transformer, as shown in Fig. 1. Connected in this man-

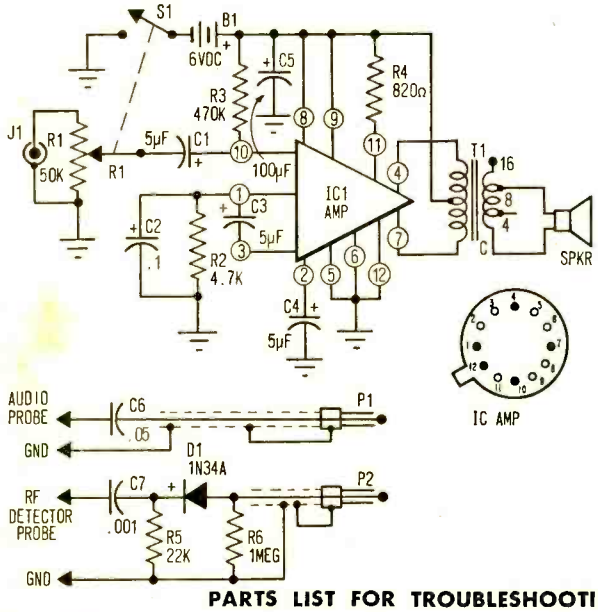


Fig. 1. Thanks to the use of the IC, few parts are needed to complete wiring of circuit. IC containing seven transistors costs less than most individual transistors so overall price of signal tracer is very low. Note that two values are given in parts list for some capacitors. The first value given is for a relatively narrow frequency response for the unit, the second is for wide-band response. The AF/RF probe wiring diagram is shown at bottom left.

PARTS LIST FOR TROUBLESHOOTING STIC

B1—6-VDC transistor battery (Burgess Z4 or equiv.)
C1—.02 or 5-uF, 9-VDC capacitor (see text)
C2—.01 or .1-uF, 9-VDC capacitor (see text)
C3, C4—1 or 5-uF, 9-VDC capacitor (see text)
C5—100-uF, 9-VDC capacitor
C6—.05-uF, 500-VDC capacitor
C7—.001-uF, 500-VDC capacitor
D1—1N34A germanium diode
IC1—RCA CA3020 integrated circuit (available from Allied or Lafayette Radio)
J1—RCA type phono jack
P1, P2—Phono plug
R1—50,000-ohm potentiometer with switch
R2—4700-ohm, ¼-watt resistor
R3—470,000-ohm, ¼-watt resistor
R4—820-ohm, ¼-watt resistor
R5—22,000-ohm, ½-watt resistor
R6—1,000,000-ohm, ½-watt resistor
S1—Switch on R1
T1—Transistor output transformer: 100-ohm CT pri.; 3.2-, 8-, 16-ohm sec. (Allied Radio 54B4149 or equiv.)
Spkr—2¼-in., 8-ohm speaker
1—Cabinet (Radio Shack 270-097 Perfbox or equiv.)
1—Panel kit (Radio Shack 270-100 or equiv.)
1—Probe kit (Keystone 1810 or equiv.)
Misc.—Shielded cable, push-in terminals, wire, solder, etc.

(The Keystone probe kit is available for $1.98 including postage and handling from Tridac Electronics Corp., Box 313, Alden Manor Branch, Elmont, N.Y. 11003. N.Y. State residents add appropriate sales tax. No foreign orders.)

ner, they form a typical transformer-output circuit—there's nothing unusual here. Transistors Q4 and Q5 function as low-impedance (emitter output) drivers for output transistors Q6 and Q7.

Transistors Q2 and Q3 form a differential amplifier—a fancy name for a push-pull amplifier. Look carefully at both Q2 and Q3; note that both circuits are identical (terminal 3 being the base input to Q2, and terminal 2 being the base input to Q3).

Except for Q2 and Q3's common emitter resistor, R2, both Q2 and Q3 are individual amplifiers, each with its own input. Essentially, the circuit is analogous to a push-pull tube amplifier with a common cathode resistor.

Inverting The Phase. If Q3's base is grounded for AC via a capacitor from terminal 2 to common (ground) terminal 12, the circuit becomes analogous to the tube-type long-tailed phase inverter. When an input signal voltage is applied across terminals 3 and 12, the collector current of Q2 develops a voltage across emitter resistor R2 that is in-phase with the input signal. Remember, it is the collector voltage that is 180° out of phase with the input voltage.

Keep in mind that Q3's base is AC-grounded. If the applied input signal to Q2's base-emitter is positive-going at the base, it is "negative" at the bottom of R2, terminal 12. The voltage developed across R2 is therefore positive at the emitter end and negative at the bottom (terminal 12).

Since Q3's base is at AC ground—terminal 12—the voltage across R2 is the voltage applied to Q3's base-emitter. And as far as Q3 is concerned, the voltage input to Q3's base-emitter is negative-going at the base—yet the input signal applied to Q2's base is positive-going. The signal voltage at Q3's collector is therefore 180° out of phase with Q2's collector. Phase inversion has been accomplished.

By the proper choice of circuit parameters, the voltage developed across R2—which is the applied input voltage to Q3—is the same magnitude as the input signal to Q2. Hence, the voltages at Q2 and Q3's collector are equal in magnitude but 180° out of phase.

The push-pull signal at Q2-Q3 is then fed to the Q4-Q6/Q5-Q7 push-pull amplifier.

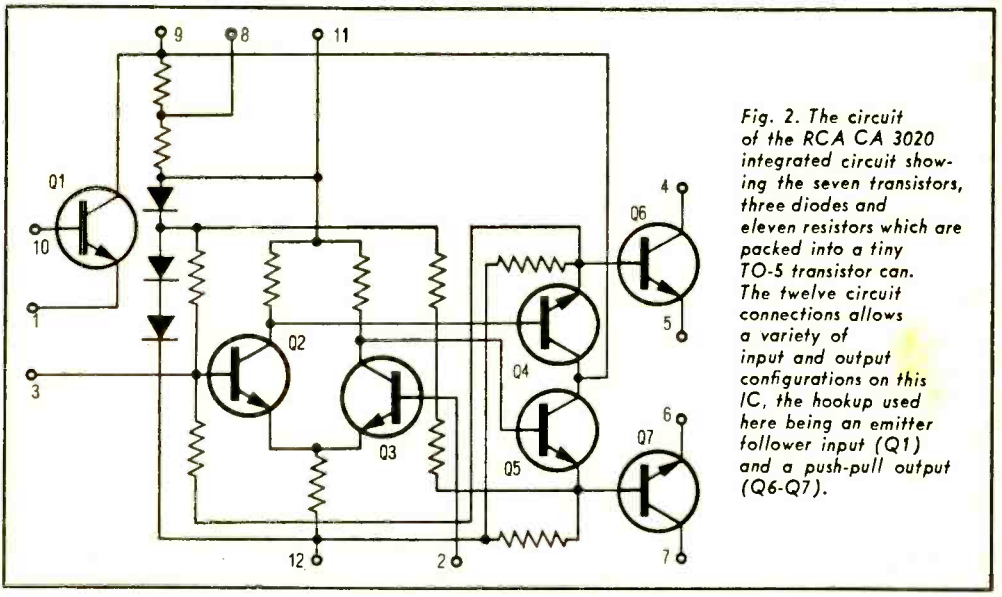


Fig. 2. The circuit of the RCA CA 3020 integrated circuit showing the seven transistors, three diodes and eleven resistors which are packed into a tiny TO-5 transistor can. The twelve circuit connections allows a variety of input and output configurations on this IC, the hookup used here being an emitter follower input (Q1) and a push-pull output (Q6-Q7).

Low To High. Unfortunately, the input impedance across terminals 3 and 12 is in the order of 600 ohms. And for signal tracing we require a relatively high input impedance so that the circuit under test will not be unduly loaded. What's needed is an emitter-follower amplifier with a high input impedance and a low output impedance. This is where Q1 comes in.

Referring to Fig. 2, note that Q1 is a complete circuit except for the emitter resistor. If an external resistor is connected from Q1's emitter (terminal 1) to ground as shown in the schematic, Q1 is hooked up as an emitter-follower. If a capacitor is connected from terminal 1 to Q2 input ter-

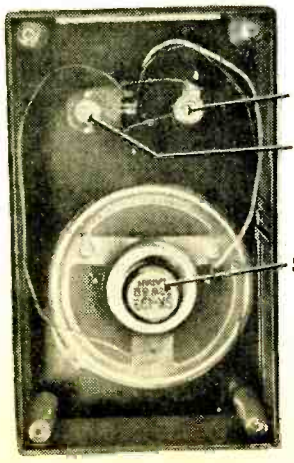
minal 3, we have a high-impedance-input cathode follower (nominally, 50K ohms input impedance) driving Q2.

IC Tracer. Fig. 1 shows the IC signal tracer, complete with a variable input level control. Since the 50K input control is in parallel with the 50K IC input, the result is a total input impedance of 25K. If you find the input impedance too low for some uses, connect a 50 to 75K resistor between input jack J1 and R1.

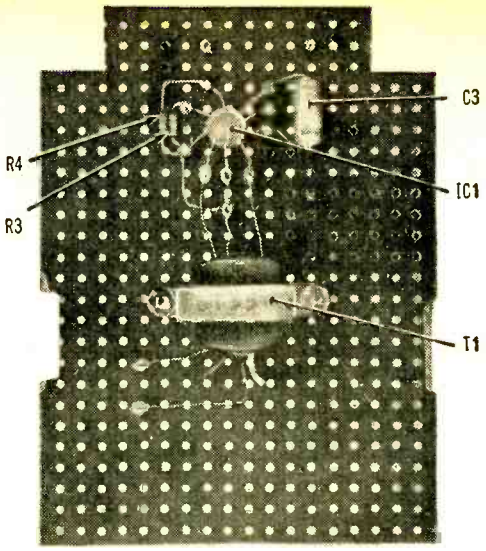
An Amp Too. The signal tracer section itself, less the probes, can be used as a general purpose low-power amplifier. It's output power of 0.2 watt (using the 6-volt power supply) is equivalent to that of a good transistor portable radio.

Because of the power-handling limitations of the small speaker and output transformer T1, overall frequency response is limited at the low end to approximately 250 Hz. Actually, the frequency capability of the IC is from DC to 6 MHz. To ensure that you can utilize the circuit in other projects requiring a better frequency response than that needed for signal tracing, the Parts List gives values for both restricted and wideband response.

For example, in the Parts List the value for C3 is shown as 1 μF or 5 μF. The first value is proper for the signal tracer's attenuated low frequency response. The second value is for a wide-band operation when a larger output transformer and speaker are utilized. Remember, when two values are shown, the first value is for the signal tracer, the second value for a wideband amplifier. Values in-between will produce a frequency response somewhere between the attenuated and wideband response.



Perf-box plastic cabinet comes with speaker hole pre-cut for a two-inch or larger speaker. Laying out and drilling holes for potentiometer R1 and jack J1 is first step in constructing signal tracer.

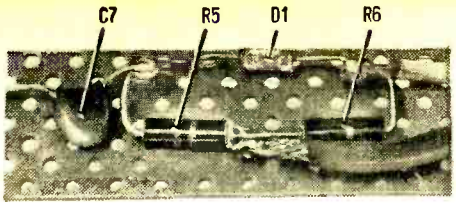


Perf-board comes with cabinet, note how it's notched allowing it to fit into cabinet box. IC is press-fitted into hole drilled in perf-board; leads are then bent over and soldered to stake terminals.

Note that the components shown in the photographs are the wideband values. This was done to make certain the physically larger wideband components would fit into the layout. You can be certain the signal-tracer value components will fit without a hitch.

Building The Tracer. The signal tracer is assembled in a Radio Shack *Perfbox*. This cabinet is a standard size 2 x 6 x 3¾-in. bakelite cabinet pre-drilled for a 2-in. or larger speaker. Its companion 5-piece panel kit includes the metal cabinet cover used for the signal tracer and a perforated (Perfboard) panel board that will be used for the amplifier sub-assembly; push-in terminal are used for tie points.

First assembly step is to drill ¼-in. holes for J1 and R1 midway betwen the bottom of the speaker holes and the bottom edge of the cabinet, then install the speaker. Install J1 and R1 and prewire the cabinet components. Connect about 6 inches of free lead where necessary (to the speaker terminals, R1's wiper output, etc.)



RF probe is built on small perf-board supplied in Keystone probe kit. Be sure to heat-sink when soldering diode D1. After parts are mounted and wired, wrap entire board in electrician's tape.

Position the battery between the speaker and the cabinet and cut a section of the perforated panel so that it will touch the cabinet on one end and the battery on the other—the perfboard will then serve as the battery holder.

Notch the corners and sides of the perfboard so that it will drop into the cabinet. (A center support on both sides of the cabinet makes it necessary to center-notch the perfboard.) Drop the perfboard into the cabinet so it rests on the speaker, then mark the perfboard end of the cabinet for a support. Cement a small strip of left-over perfboard in the cabinet as shown in the photos; this strip will be the end support for the perfboard panel.

IC Layout. Now lay out the position of transformer T1 and IC1. Since T1 is mounted on the underside of the board, make certain it will clear the speaker. Drill a 21/64-in. hole for IC1; the integrated circuit is then gently press-fitted into the hole. Mount T1 and then pre-solder the following IC1 leads: fold leads 5 and 12 to lead 6. Wrap 5 and 12 once around 6, solder quickly, and cut off the excess lead wire (do not cut the 6 lead). Then, press-fit the IC into the hole with lead 6 pointing towards T1.

With IC1 in the hole, fold each lead at right angles as shown in the photos. Bend the leads about 1/16-in. above where the lead exits the IC body, then use a push-in terminal opposite each lead for a tie point.

To avoid a parts jam, components are mounted on both sides of the board, with terminals providing through-board connections. To permit the cabinet cover to fit, make certain the topside board components are flat against the board.

Final Assembly. Position the cabinet-mounted components' leads so they will come through to the top of the board when it's placed in the cabinet. Place a drop of cement on top of the speaker and mount the amplifier assembly board so it rests on top of the speaker and the board edge rests on the end support. When the cement is dry, connect the cabinet components' leads to the amplifier and connect the battery—*make absolutely certain the battery polarity is correct.*

Since the IC is not provided with a heat sink, avoid driving it at maximum volume continuously. With 6 volts applied, the IC is on the borderline of requiring a heat sink. As long as the output level is kept a shade below maximum you'll have no problems.

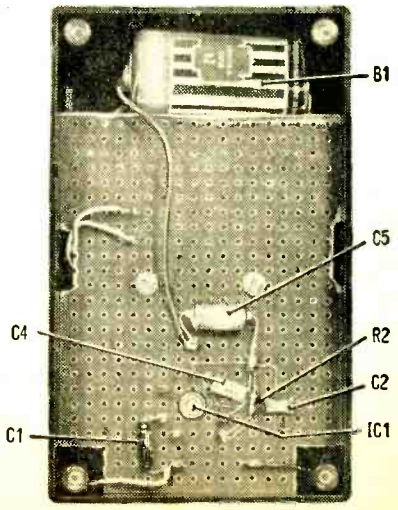
The Probe. The audio probe schematic is shown in Fig. 1; it consists of only DC blocking capacitor (C6), which can be installed in any probe—as long as the capacitor will fit inside. The output cable must be shielded.

The RF probe is assembled in a Keystone test-probe kit. The kit consists of the handle, probe-tip, pre-punched terminal board, terminals, and a brass shield tube. Assemble the probe, wiring it as shown in Fig. 1. Note diode D1's polarity—cathode towards the probe tip.

Also note that one end of the terminal board has a premounted lug. Solder the ground point, the junction of R5 and R6, to this lug; connect the ground of the test cable (which should be stranded wire) to the lug, then wrap the terminal board in paper or tape.

Slide the brass shield over the board as far as the ground lug and solder the lug to

(Continued on page 115)



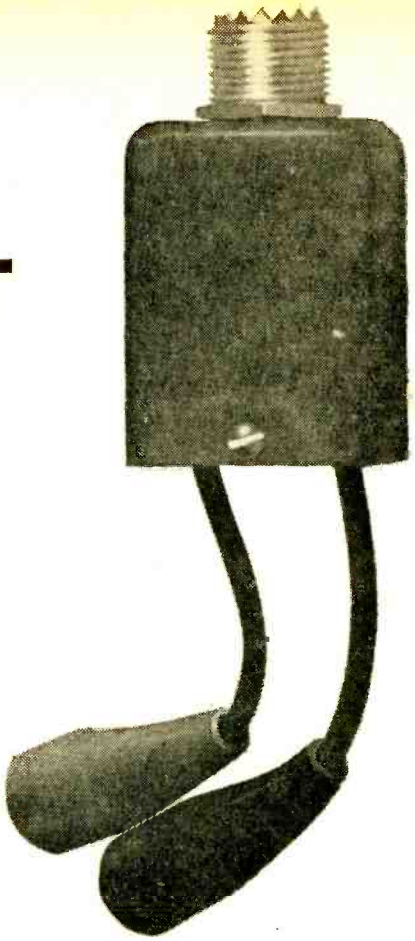
When perf-board wiring is complete, install board as shown. Bring wires from box-mounted components up past board so they can be connected. Then install battery and make a test run.

Clip-on COAX Connector

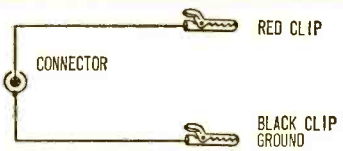
By James A. Fred

This nifty adapter is pretty handy when you've got a receiver with an antenna terminal strip and an antenna with a coax lead-in and connector. It's made from an aluminum shell with a plastic end-plate holding two banana plugs. To make the adapter, drill out the banana plug staking and remove the plugs. Then make a 5/8-in. diameter hole in the closed end of the aluminum shell. Mount an SO-239SH coax connector in this hole after you've soldered a piece of test lead wire to the connector body and to the center terminal of the connector. Tie a knot in each wire to prevent pulling them through the hole in the header. Thread each wire through the banana-plug hole in the header and slip a clip insulator on each wire. Fasten the wires to the clips by screw or by soldering and slip the insulator over the clip.

After finishing the adapter, simply fasten the PL-259 connector to the end of the coaxial lead-in cable and connect the clips on the adapter to the antenna screw terminals on your receiver. ■



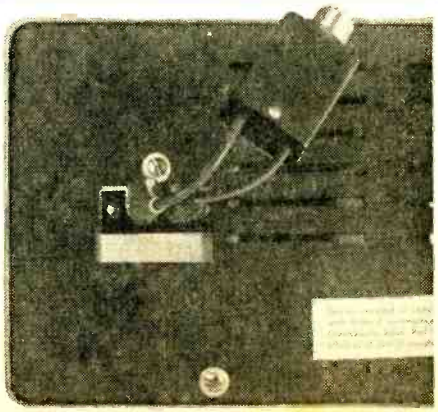
Finished coax adapter ready to go.



Wire up the clips and connector before assembling unit in the aluminum shell.

PARTS LIST

1—Connector, PL-259 (Radio Shack 278-200 or equiv.)—connects to antenna coax
1—Connector, SO-239SH (Lafayette 42C6907 or equiv.)
2—Alligator clips (Radio Shack 270-377 or equiv.)
2—Clip insulators, one red, one black (Lafayette 32C3535C or equiv.)
1—Aluminum shell (Keystone 659—see text)
Misc.—Test lead wire, solder, etc.



The coax adapter can be used in any application where a coaxial cable termination needs to be connected to a terminal or barrier strip.

THOSE WONDIFEROUS WALKIE-TALKIES

BY ROBERT M. BROWN* K2ZSA

The ins and the outs of what's happening in the world of terrific totables.

If you've been hearing a lot these days about walkie-talkies, it's for good reason. Right now, one of the biggest controversies in the electronics field concerns itself with whether or not these gadgets should operate on their own "exclusive" band or continue functioning on CB frequencies, to say nothing of the scandal early in 1967 over what the FCC thought about walkie talkies and their users. Meanwhile, walkie-talkies are selling faster than ever before and more and more manufacturers are hopping on the bandwagon.

Electronic financial moguls figure that the pushbutton wonders outsell conventional CB gear five-to-one in terms of total annual volume. Predictions for 1968 are that over $300 million worth of the devices will be sold—and this doesn't even include the other types of walkie-talkies being used extensively by police and fire departments, etc. No one seems to know if the feared "saturation level" will ever hit this market but right now it is clearly the biggest moneymaker in the entire two-way radio industry.

* Robert M. Brown is author of the recent book on electronic eavesdropping, *The Electronic Invasion*.

It's easy to understand the popularity of these wondrous gadgets: they're compact and portable, they really do work, and they're relatively cheap. Pass any corner department store these days and you'll be greeted with a window display just brimming over with glistening, chrome-plated walkie-talkies—many priced as low as $9.88 per pair. On the other hand, the major CB manufacturers are churning out $199-per-pair high-powered units which boast of "ranges up to 15 or 20 miles" and make the toys look like peanut whistles in comparison.

But before you rush out and plunk down your hard-earned dollars for a pair of these electronic marvels, let's consider just what you can do with them and what you'll *really* be getting for your money.

Basically, there are two types of walkie-talkies that operate on CB frequencies: (1) the Class D (must be licensed by the FCC) models and (2) the so-called "license-free" low-power units which have come to be known as "Part 15" units.

What the FCC Says. The greatest majority of walkie-talkies sold over the counter

these days fall into the last category, the no-license types. Their nickname has come from Part 15, a regulatory section of the FCC Rules which pertains to *non-interference* communications. To qualify for license-free operation under this open-end clause, a transceiver can be designed for just about any frequency (the AM wireless broadcasters, for example), so long as its power input does not exceed 100 milliwatts (1/10th watt). Most attractive is the fact that there are no age requirements for the user, who might otherwise not be able to communicate on CB frequencies at all since he must be 18 years of age or older for a Class D ticket.

Bear in mind, though, that just because anything under one-tenth of a watt qualifies for Part 15 this does not imply that all units are rated at 100 milliwatts or are even checked by the Commission. The sad truth of the matter is that the FCC imposes no design or construction restrictions upon the manufacturers—only on the user.

The FCC does ask the Part 15 walkie-talkie enthusiast to observe a few basic ground rules, though for the most part they are not as sticky as those for licensed communications. Since they're looked upon as non-interference units, it means that unlicensed walkie-talkies must relinquish the channel if their operation is interfering with communications of a Class D user. The general rule is to listen first to make sure no one is on the air, and then periodically check the channel while communicating. 'Talkie users that persistently cause problems for a licensed CBer are likely to have a run-in with the FCC.

Further, the law demands that you don't transmit indecent or profane language, that you don't broadcast phony emergency or distress messages, and that you don't slander anyone over the air. Additionally, intermittent pressing-down of the transmit button is considered to be malicious interference and construed as "jamming," punishable under federal law by a stiff fine.

The easiest way to avoid problems with Part 15 regulations is simply to remember that your walkie-talkie communications are not private; they can be heard by anyone who also has a walkie-talkie on the same channel, to say nothing of the licensed CBers who listen in. It's like a long-distance PA system with a diverse audience of listeners. Bear this in mind, and chances are you'll never have to worry about breaking the FCC rules.

Operationally, it should be pointed out that Part 15 people can only communicate with other unlicensed walkie-talkies. Under no circumstances may you talk with a licensed Class D station. Not only would the CBer be risking his license, but you would stand a stiff fine if the truth were out.

The 49-MHz Proposal. Though the controversy rages on in some governmental and manufacturing circles, at the moment there is no 49 MHz walkie-talkie band—though one has been formally proposed by the Commission. The idea was to create an "exclusive band of nine channels" expressly for the present unlicensed walkie-talkie users down on 27 MHz; but reaction thus far has been largely unfavorable. In fact, one FCC commissioner has suggested that the frequency 27.59 MHz be made available ex-

Since their debut, walkie-talkies have spread through the country like wildfire. Their inherent usefulness makes them a natural on the construction site scene as at right.

clusively for unlicensed use, precluding the necessity for a 49 MHz band or any other.

The main problem, according to the FCC, has been too many signals crammed onto frequencies in the area of CB channels 9 and 11—many of which are said to interfere with legitimate Class D communications. By removing them from these channels, the Commission would hope to alleviate the problem once and for all.

The real crimper, however, is that the FCC wants to have these little sets "type accepted" for walkie-talkie use. This means a host of new technical requirements, antenna limitations, etc., that would ultimately create more problems at the manufacturing end and probably raise the per-unit retail price. Many observers feel that the proposal was really aimed at eliminating the competition to American producers presented these days by Japanese companies (several estimates have put the proportion of Japanese walkie-talkies at nearly 70 per cent of the total).

For the time being, however, nothing's been finalized. If some groups have their way, we'll ultimately wind up better off than we started—with a brand-new walkie-talkie band that only requires our changing crystals in the units. Moreover, even the controversial FCC Public Notice #98917 which proposed the 49 MHz concept provided for a solid seven years before present operations would be phased out.

So, for all the clamor, there's really not a heck of a lot to get excited about. The license-free concept has proved immensely popular in this country; the FCC would hardly legislate precipitously with so many citizens involved (at last count nearly 3 million).

Advantages Of Part 15 Sets. Now that we've rather thoroughly dissected all the restrictions, limitations, and controversies pertaining to these hot little gadgets, it's time for some good news.

Since there are virtually no restrictions on the hobby use of non-Class D walkie-talkies, many fellows have formed "flea-power" DX Clubs. These groups specialize in seeing how far you can communicate with Part 15 walkie-talkies. Indeed, there have been instances of contacts over several hundred miles. Just a few years back, in fact, there was a case of a 1400-mile contact due to a propagational phenomenon known as Sporadic-E skip. Since these "freaks" have been occurring more and more frequently in recent years, the DXers are even converting to CW (code) operation—based on the fact that code will cut through the distance barriers much more effectively than voice modulation. Caught in a pinch, the enthusiasts tap out International Morse Code by just pressing their transmit-receive button! Many hobbyists delight in "converting" their Part 15 rigs to base stations, complete with code keys, headsets, and even AC power supplies to replace the battery packs. General Electric recently brought out a commercial version of such a base setup which looks a great deal like a ham radio station—yet it's all perfectly legal under Part 15!

Just as there are range factors and legal restrictions governing how far the CBer can talk over Class D CB (5-watt) rigs, there are the same general considerations that bear on Part 15 work. Since the unlicensed operator is working with a telescoping-mast whip antenna and much less power, however, range expectations will be somewhat lower. Best bet is to ignore the "one-mile communications" propaganda the manufacturers churn out and figure dependable two-way range as considerably less. Under normal conditions, and operating with a unit that has a superheterodyne receiver, several city blocks is about all the range that can be counted on—in open country (pretty much line-of-sight—no Empire State Buildings in the road, etc.) a lot further. Across open water is generally the best bet; frequently as far as five miles or more. Forget about hard-and-fast range estimates, and count on a minimum communications range; when this is ex-

Walkie-talkies in the wilderness is the name of the game that keeps you in touch wherever you may be, whether on a hunting trip in the Rockies or a picnic in the Catskills.

ceeded, it will just be all the more exciting.

Best time to get greatest distance is in the wee hours of early morning—when there's hardly anybody on, and when the proverbial "night-time factor" is in full swing. It's a known fact that after midnight it is often possible to communicate over three, four, and five times the normal daylight-hours distances. Provided there isn't excessive interference, the would-be DXer can also take advantage of a multitude of fantastic phenomenas—such as tropospheric bending (which will get up to 25 to 35 miles), tropo ducting (up to 75 to 125 miles), and the elusive Sporadic-E which likes to pick up signals and deposit them 500 to 700 miles distant, and frequently double that!

Aside from these exciting considerations, there is also the fact that Part-fifteeners can say just about anything over the air providing they don't go too far. For example, you can broadcast ham-type "CQs" if you like. Additionally, there is no time limitation on how long you can talk (such as the five-minutes-on, five-minutes-off Class D recommendations). And if you want to tamper a bit with your transceivers, you don't need an affidavit from the FCC stating that you're a 1st or 2nd Class commercial licenseee in order to do it.

If you're a really eager non-license enthusiast, here's a tip: Try to get a pair of sets equipped for Channel A (27.995 MHz), the hobbyists' favorite frequency. See *Part 15 Walkie-Talkies Channels* table. If you're a CW eager-beaver, switch to Channel B (27.045 MHz). And if you really want to go all-out, you can wire-in a variable frequency oscillator (VFO) which will allow you to use any of the frequencies on the 26.970 to 27.270 MHz band without crystals!

Types Of Part 15 Units. With literally hundreds of different brands of walkie-talkies on the market, it's hard to tell exactly what's what. There seems to be an almost endless stream of them these days. They aren't all alike—sometimes you've probably deduced for yourself when you've looked at the $5 units and compared them with look-alikes going for $39.95.

For the most part, the bulk of the cheaper units are intended to be used as toys. These types are characterized by superregenerative receivers, plastic cases, single-channel construction, three or four transistors, and actual power levels as low as 30 to 50 milliwatts. While these sets are most certainly worth the $10 a pair or so cost, they should hardly be considered as a reliable means of communications by the serious user. For the kiddies, you can't beat them; a youngster will get just as big a charge from an $8 unit as he would from one costing $25. Additionally, the end result will be much the same after he's used the telescoping mast as a baseball bat or had a few antenna duels, or when he's taken it in the bathtub to test its underwater effectiveness! Even if you have the most extraordinary youngster in mind, he'll quickly lose interest when he realizes that it's his allowance money that has to be paid for new batteries when the set's gone dead and the novelty's worn off.

Sets that sell for more than $15, however, are what you are after if you figure you'll ever really want to use them for actual radio communications. And, of course, these sets offer a bit more transmit-pizazz than their cheaper counterparts.

As you go up the scale in price, you'll notice that various added features are incorporated into the models. Most of the better types, such as Radio Shack's Realistic Superhet TRC-25 at $18.95, have a "Call-Alert" feature—a button that you can push to signal a distant station. A high-pitched tone tells your companion station that he'd better get to his unit for an in-coming message. Many of these same types feature "lock-in" transmitting so that you won't wear your thumb to the bone fighting the push-to-talk-button's mainspring during long transmissions.

These terrific totables are available in all shapes and sizes; everything from 30-milliwatt pipsqueak cheapies to relatively expensive 5-Watt boomers. The big ones come complete with a host of features besides high power, such as tone-alert (see text), several switchable channels, and battery condition meters.

Johnson 100-milliwatter

More goodies to look for in Part 15 sets: range boosting in the audio circuits, multi-channel operation, a squelch control, 10 or more transistors overall, good noise limiting for high-noise level areas, push-pull receive audio, separate mike and speaker, and even provision for an external 117-VAC power supply and/or battery charger. The "ultimate" Part 15 walkie-talkies even include a battery-condition meter that tells you ahead of time whether or not to charge or replace the cells!

Always bear in mind, however, that the maximum power in any unlicensed set is going to be 100 milliwatts and no more. Once this has been achieved, start looking to the receiver for added extras: you will be getting exactly what you pay for. Many of the extremely cheap sets look darned pretty from the outside, but don't buy until you find out what's happening inside. By the same token, certain unscrupulous overseas producers are packing many Part 15 units with "14 transistors." Close inspection reveals that only five are working in the circuit; the other nine are mere duds—the second oldest gimmick in the book.

Class D CB Walkie-Talkies. For true high-power operation, you'll want to "graduate" from 100-milliwatters to something a bit higher powered. And here again, there are a host of units to choose from—priced anywhere from $29.95 for Radio Shack's 300 mW unit to $79.95 for Lafayette Radio's 5-Watt boomer. Structurally, these sets are a bit more hefty than their Part 15 counterparts—and for good reason. Most are constructed with several times the innards, and they're generally built to take a beating.

Part 15 Walkie-Talkie Channels

Channel A (most hobbyists)	26.995 MHz
Channel B (the CW favorite)	27.045 MHz
Channel C	27.095 MHz
Channel D	27.145 MHz
Channel E	27.195 MHz
Channel F	27.235 MHz
Channel G	27.245 MHz
Channel H	27.265 MHz

Channels are selected between Class D operating frequencies to avoid interference.

These sets are largely produced by American companies for the more sophisticated user. Many buyers are already licensed CB-ers with elaborate base stations. These boys can use the walkie-talkie for direct communication with base as "KOD2239 Unit Two." On the other hand, the high-power units are also many people's first real experience with 27 MHz CBing—and they can be quite satisfactory indeed. While you must pay an $8 filing fee to the FCC and wait a few weeks for your license to arrive before you go on the air, invariably you'll find your walkie-talkies packed with the FCC form and full instructions. The manufacturer usually instructs you on how to fill out the form and supplies you with plenty of reading material to acquaint you with CB while you're waiting for that license. And there is nothing stopping you from doing a bit of eavesdropping on the band in the interim!

The Lafayette Dyna-Com 5, for example, is sort of the Cadillac of presently-available Class D walkie-talkies. It contains all the features mentioned earlier and provides a solid five watts of transmit power on any one of three CB channels. This set has

Heathkit GW-52

Knight C-555

Realistic TRC-99

Lafayette Dyna-Com 5

been known to communicate 15-17 miles unit-to-unit through heavy interference; much more when the frequency is clear. A pair of these with all the extras will run you about $235.00.

Actually, the list goes on and on. There are nearly 100 different models of Class D sets to choose from that take the form of walkie-talkies, and nearly all are worth every penny.

Unlike the Part 15 units, there are few out-and-out gyp artists practicing in this area. Most of these high-power sets are solidly built and backed up by warranties. Once again, however, you're going to get exactly what you pay for. Consider first the almighty dollar and how much power you really need in your units, then go on to the "extras" such as battery-condition meters, range-boosting, etc. Many buyers seem to overemphasize the appearance of their sets, to the neglect of the actual power levels and communications capability.

A word of warning. Do not try to link these sets to your 100-milliwatt Part 15 set-up. Just because they look similar doesn't imply you can talk to anyone other than licensed Class D base, mobile, or portable stations.

Imports vs. Stateside Types. While its nice to say, "I'm not buying anything that isn't a brand name," you may have difficulty when it comes to walkie-talkies. Most of these sets—particularly the Part 15 unlicensed types—come in from Japan and the importers put their own brand names on the units. It's not unusual for the very same walkie-talkie to be selling under four or five different brand names . . . and at different prices! This isn't to knock the performance or quality of the sets, however; it's just to let you know that the only real brand names are from companies which are regularly engaged in selling other electronics gear. Some of these manufacturers: Amphenol-Sangamo, Demco, Fanon, GE, Hallicrafters, Heath, E. F. Johnson, Knight-Kit (Allied), Lafayette Radio, Pace Communications, Radio Shack, Raytheon, etc.

Tip: Always get full information on the back-up guarantee of a set you intend to buy. You don't want to be mailing a $12.95 walkie-talkie back to Japan (at a cost of $18.25) for repairs! If you can't have the guarantee cover servicing here in the United States, forget the whole thing.

Watch out for walkie-talkies selling for "50 per cent" in those going-out-of-business novelty shops. You'll never get them serviced, and invariably there's something wrong with the sets in the first place. Additionally, intelligent comparison shopping will frequently reveal that a comparable guaranteed set can be had by mail from reputable manufacturers for the same price—or less! Your best bet is always to rely on known electronics suppliers and mail-order houses.

Fun & Games. While selecting your unit is serious business, you can still have a lot of fun with your walkie-talkies—providing you adhere to the FCC regulations as they apply to your type of set.

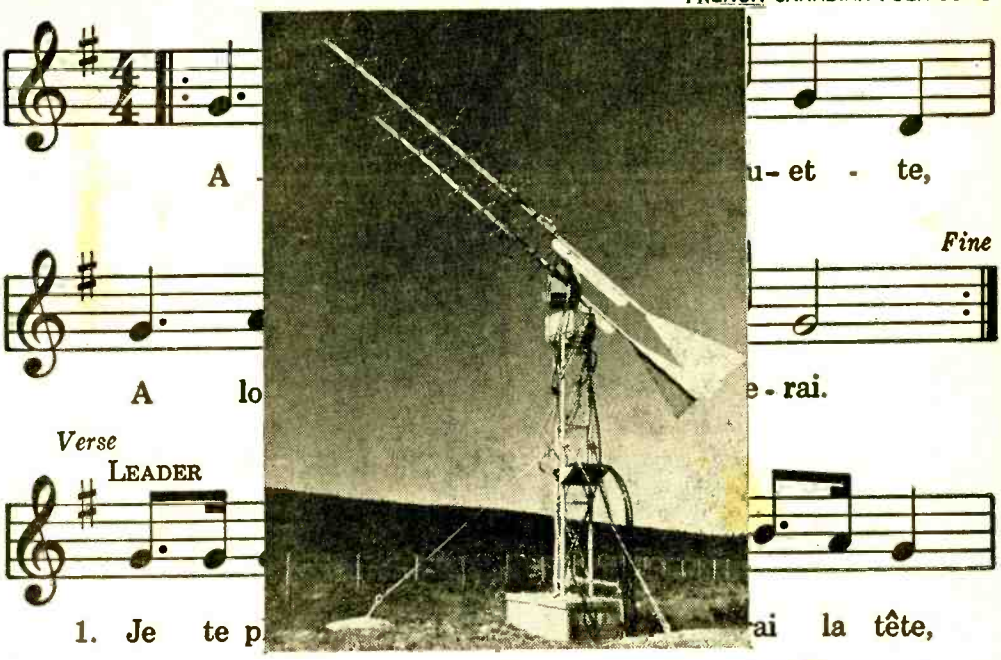
Designed especially for the Part 15 CB DXer, this little General Electric job can be used with either mike or CW key.

For the unlicensed Part 15-ers there are few restrictions to worry about. In fact, you can make up your own "official" callsigns for use at outings, field trips, hunting or fishing expeditions, etc. Just make certain your callsign isn't similar to an established FCC ham or CB call—something on the order of "N-880 calling N-881" is OK.

For Class D walkie-talkie operations, you must be familiar with FCC regulations that are the same as if you were operating a regular 5-watt rig. But either way, walkie-talkies offer the ultimate in low-cost portable communications and are a lot of fun. And whether your requirements are for serious communications or low-powered fun and frolic, there's a little rig on the market with your name on it. ■

Alouette, Gentille Alouette...

FRENCH CANADIAN FOLK SONG



Space-age Canadians give Uncle Sam a hand at satellite tab-keeping

Courtesy National Research Council of Canada

One of Canada's contributions to cooperative space research with the United States is the staffing and maintaining of a satellite tracking station at Stiles Cove, Newfoundland.

The station, which celebrated its sixth anniversary last August, is operated as part of the Satellite Tracking and Data Acquisition Network (STADAN) of NASA.

The National Research Council's Space Research Facilities Branch has been responsible for the administration of the station since 1966. Prior to that it was administered by the Radio and Electrical Engineering Division of NRC.

In its brief lifetime, 55 different satellites —two of them Canadian—have made thousands of passes within range of the station's data receiving and recording instruments.

The purpose of a STADAN station (there are 13 around the world) is to determine the angular positions of satellites or other vehicles coming into its field of vision, to receive and record data transmitted from such vehicles, and to issue commands regarding the operation of such vehicles.

Baker's Dozen. The St. John's station employs a total of 13 antennas arranged as interferometers for recording the position of satellites passing over the station. For telemetry passages, two antennas are used for receiving data from satellites and three antennas are used for command transmissions to satellites.

An average satellite is in view of the station at predicted times for as long as 20 minutes on each orbit. Such a passage will be repeated three or four times at perhaps two-hour intervals followed by a much longer period in which no passages occur within the station's range. Thus, on certain days, it is possible for the station to be handling six to eight satellites involving 30 to 40 separate operations.

A typical day's operation for the 24-man station staff, working in three shifts, would include 20 interferometer recordings of satellite positions, 20 telemetry passages during which data is received from—and commands sent to—the satellites, and perhaps half a dozen camera shots of satellites against star-field background. *(Turn page)*

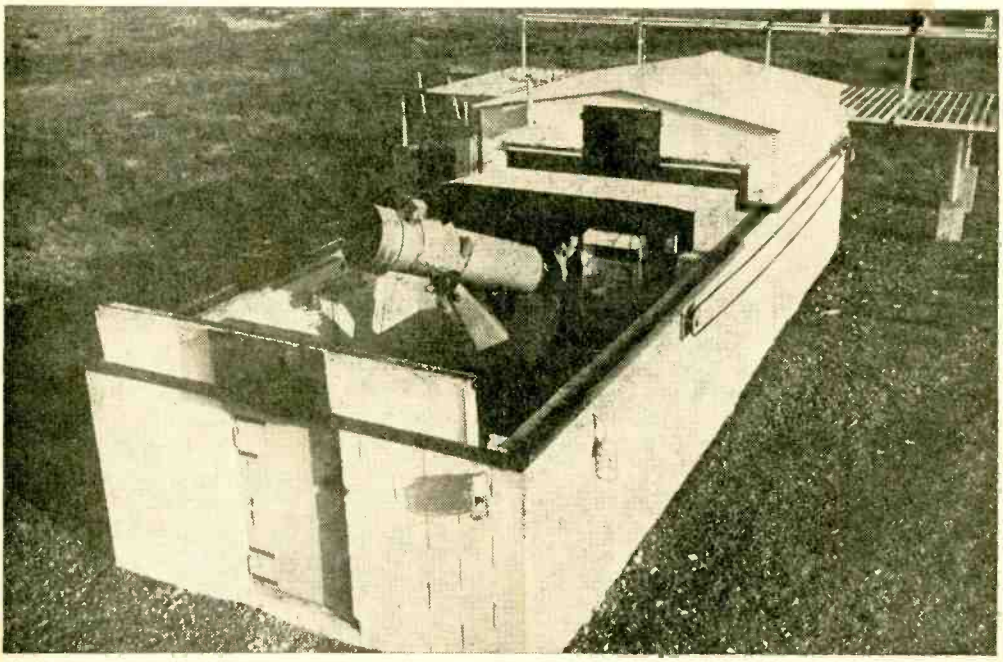
e/e GENTILLE ALOUETTE

Keeping In Touch. Since 1961, there have been more than 20,000 interferometer trackings and more than 13,000 telemetry contacts with satellites by the St. John's station.

In the last two years approximately 200 passes each for the Canadian satellites Alouette I and Alouette II have been tracked to give accurate orbital information.

During the same period, some 600 telemetry recordings have been made of Alouette I data and additionally, over 3000 on Alouette II.

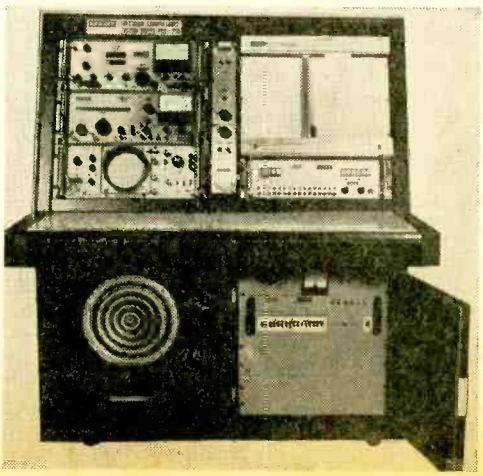
Positive information and telemetered data is forwarded to the Goddard Space Flight Center, near Washington. This is the control center for the 13 STADAN stations in Australia, North and South America, South Africa, England, and Hawaii. ■



This big eye on the sky photographs satellites in their night-time passings by.

SWL's El Dorado

■ What could conversationally be called the ultimate in multi-band receivers has recently hit the marketplace. Frequency coverage of 20 kHz to 1000 MHz in 16 bands may just make this the idle-rich SWL's Cadillac as it were. Actually, this Fairchild Camera Corp. system is not really designed for the hot-eared shortwave snoop but is more prosaically called upon to analyze the radio spectrum and produce an output displayed on graph, scope, and even heard on a loudspeaker for the nosy. Oh well, if owning a rig like this can only be wishful thinking for an itinerant SWL, a guy can dream, can't he? ■



Color sync has been the cause of many a good man's cop-out, but take heart! Here's what to do

WHEN COLOR WON'T STAY PUT

By Len Buckwalter, K1ODH

Of all the troubles that attack the color TV screen, running hue is one of the easiest to spot. It produces a number of weird patterns, but there's always one revealing symptom—color seems to separate from the black-and-white image. The monochrome picture keeps operating normally while color washes in waves across the screen. Stripes can drift horizontally, vertically, or diagonally. They might rush by at dizzying speed or float lazily to and fro. Worse yet, width of roaming color stripes often varies from narrow to broad.

This classic symptom—separation of color from the black-and-white picture—is strong evidence that the problem is "lack of color sync" (synchronization). A similar effect in a black-and-white receiver is uncontrolled vertical rolling, or a slashing of the image into horizonal lines. In those troubles, the receiver's vertical and horizontal stages are not in step with signals transmitted by the TV station. When color sync is lost, the receiver also fails to mesh with transmitted signals.

Sync-ing Fast. There's good reason why the color set must latch onto the transmitting station. When today's color system was approved, the FCC decided color must not interfere with regular black-and-white reception. To fulfill the requirement, engineers created a vehicle to carry color in a manner the black-and-white set would ignore. They came up with the "color subcarrier." When color voltages from the studio camera are modulated onto a frequency of 3.58 MHz, the color subcarrier, it was found they would drop into "holes" already existing in the black-and-white signal. Now color and monochrome receivers could co-exist in a compatible system.

But the color receiver must have special circuits to recover the subcarrier. Reason is that color *modulation* is transmitted, but the subcarrier remains behind. (Color modulation exists just above and below 3.58 MHz.) This system proves technically economical. Since the subcarrier is killed at the transmitting end (after it's done its job of creating color modulation frequencies), it simply

e/e COLOR WON'T STAY

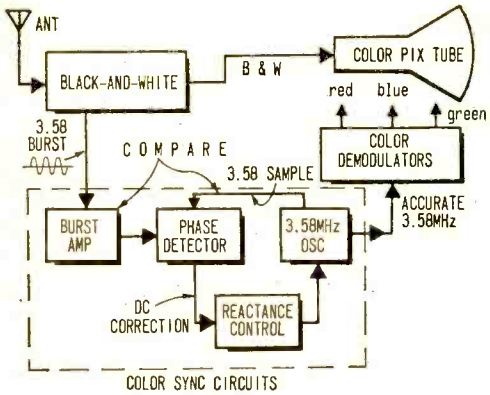


Fig. 1. Color sync circuits are enclosed in dotted line. To maintain correct color on screen, both frequency and phase of 3.58-MHz Oscillator is locked-on to station signal.

isn't present to interfere with black-and-white reception. The color receiver, however, must create a *local* subcarrier to serve as a key for decoding, or demodulating, the original color signal generated at the studio.

Just Like CW. This action can be compared to tuning a ham or shortwave receiver for code reception. Code enters the receiver as a radio-frequency signal which can't be fed directly to the speaker. So the receiver provides a local radio signal (from a BFO, or beat-frequency oscillator) and the resulting mixture creates an audio tone. In the color receiver, the subcarrier reconstructs the original camera signals so they can be fed to the picture tube.

Because of incredible accuracy needed for good color, the color circuits have a few refinements.

For one thing, the station transmits only a tiny sampling of the 3.58 subcarrier. Since it's about 8 cycles long, it's aptly called the "burst." So brief is the signal that it can be squeezed in during the time the screen is dark for a fraction of a second at the end of each horizontal scanning line. The burst, though, is long enough to inform the receiver of the correct subcarrier frequency. This is the initial step in synchronizing color between transmitter and receiver.

As for that subcarrier, the color receiver generates its own on 3.58 MHz. It's done with a stable, crystal-controlled oscillator. Nevertheless, the oscillator can't approach the required accuracy, and the incoming burst is used to kick it on frequency.

Another element of the color sync system is a control "loop." As we'll see, this will tie the incoming burst—the reference—to the local crystal oscillator. Anything which disturbs this system causes running color, an aimless spilling of tints off the basic black-and-white image.

A Trip On AFPC. In Fig. 1 is a block diagram of major stages for color sync. This is the set's AFPC, or Automatic Frequency Phase Control system. As the name implies it controls both frequency and phase of the receiver's locally generated subcarrier. Actually, frequency and phase are mostly a matter of degree. When the oscillator is a few dozen cycles above or below 3.58 MHz the system may be considered controlling frequency.

But as the burst signal and oscillator start

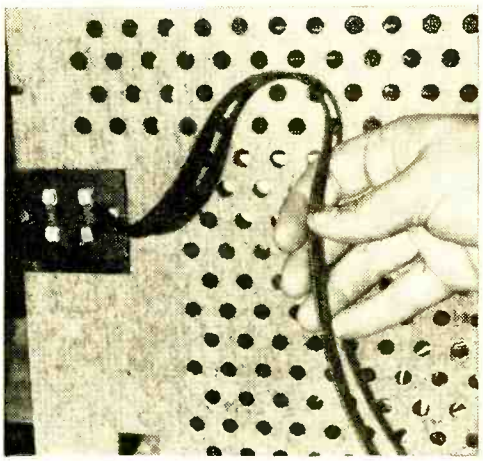


Fig. 2. Poor sync or runny color can sometimes be traced to a defective antenna or lead-in. Flat twin-lead exposed to the elements is especially subject to color-wrecking damage.

to get into step, the control system operates on the more precise level of phase; that is, both signals must begin at zero at exactly the same instant, then alternate through 360 degrees together. Unless locking action is total, picture hues may shift toward the green or purple end of the scale. Major functions of the color-sync section, blocked in Fig. 1, are as follows.

Burst Amp. An incoming colorcast travels through the conventional part of the receiver at upper left. Note that it is basically a black-and-white receiver that feeds

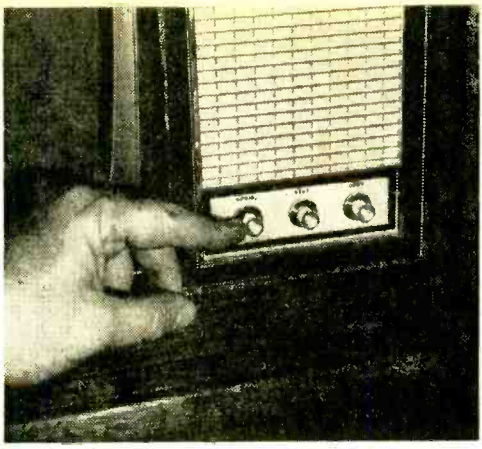


Fig. 3. Before tearing into the color TV to look for causes of poor color sync, make sure that all the controls are properly set—especially the horizontal hold control.

the specialized color circuits found below. Synchronizing action begins as an incoming burst signal reaches the Burst Amp. This is the rapid-fire group of cycles sent as a reference by the TV station and thus they become the reference for the complete control system. They are strengthened by the Burst Amplifier before proceeding further. Notice that the burst is next applied to the Phase Detector.

Phase Detector. An electronic comparison occurs here. The stage is designed to accept two signals, then produce one output voltage which encodes any differences between the original signals. The burst is one signal; the other is from the 3.58 MHz Oscillator.

3.58 MHz Oscillator. This crystal-controlled oscillator generates the local color subcarrier. As mentioned earlier, it is stable, but not accurate enough. A small portion of oscillator signal is sent to the Phase Detector as a 3.58 MHz sample. The Phase Detector is now receiving two signals for comparison and it produces an output (shown as the DC correction).

Reactance Control. This tube serves as an electronic tuning capacitor, much the same as the tuning capacitor used to tune any radio. Only it has no moving plates. Its capacity can be controlled by the DC correction voltage supplied by the Phase Detector. Further, the Reactance Tube is connected as a variable capacitor across the tuning circuits of the 3.58 MHz Oscillator.

To sum up the overall action of Fig. 1: an incoming burst signal is compared with the local 3.58 Oscillator at the outset. The Phase Detector senses error between the two, then operates the Reactance Control. Capacity changes then re-tune the 3.58 Oscillator until it is on the exact subcarrier frequency. Note that the oscillator produces a continuous signal, though it is being controlled by the burst.

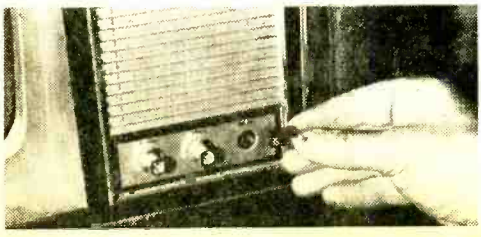


Fig. 4. Another adjustment that can affect color sync is the AGC. Here, control is located behind a front-panel knob, though usually it's on the rear apron. Set AGC as described in text.

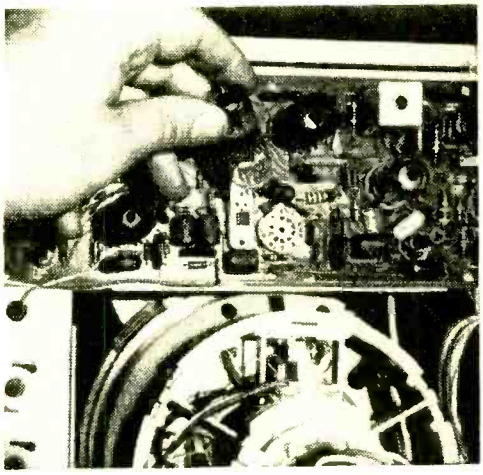


Fig. 5. Tubes account for most sync circuit troubles. They will usually all be found on the set's chroma board; checking by substitution is the easiest way to find a bad one.

The 3.58 signal, now precisely correct, goes to the Color Demodulators which produce correct voltages for operating the picture tube guns. At this point, any loss of sync detaches color from the black-and-white image.

Manual Control. When color sync acts up, there are a couple of initial checks which will determine whether it's caused by something outside the chassis. We'll assume the set is receiving a normal black-and-white picture in order to rule out problems which might originate in other sections of the receiver. The antenna and lead-in (Fig. 2) are also considered to be in good condition and aren't deteriorating the color signal before it enters the receiver.

COLOR WON'T STAY

Turn to a color program and carefully adjust the fine-tuning control. This is critical to stable color reception since it places the burst into correct position within the set's tuning circuits. If the burst is attenuated, it won't be available to control the crystal oscillator. Another adjustment that might

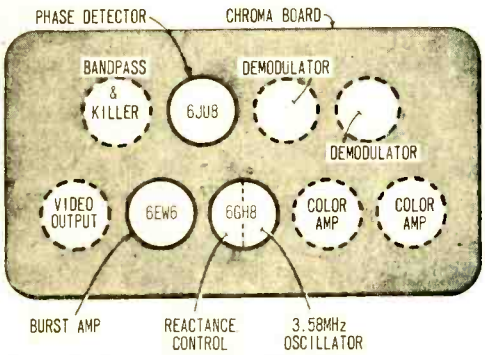


Fig. 6. On this typical chroma board, stages directly concerned with color sync are shown in solid circles. Poor sync is usually caused by one or more of these tubes being defective.

affect the burst signal is the horizontal hold control (Fig. 3).

Though these circuits occur in different sections of the receiver, there is some interaction. You may recall that a burst occurs at the end of every horizontal scanning line. To help keep the Burst Amplifier firing properly, it is locked into the set's horizontal scanning section. Mistuning of the horizontal hold control is apt to disturb the timing. For this reason, always set the horizontal hold

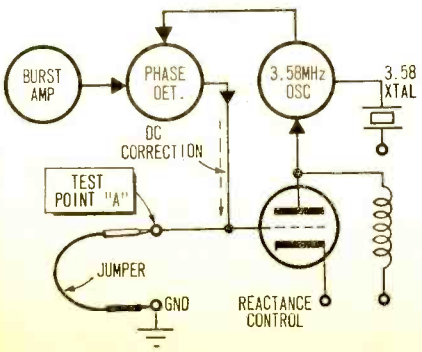


Fig. 7. If tubes are not the problem, shorting the grid of the reactance tube to ground may isolate trouble. Manufacturer's service literature may be needed to locate test point.

so the picture is centered on the screen. (You'll note the hold is able to shift the picture slightly left or right before the image breaks up.)

Consider The Killer. Another adjustment to check is the Color Killer. This circuit doesn't directly participate in color sync but it could have an effect. The "killer" is a stage which closes off the receiver's color stages during black-and-white reception to keep color from accidentally spilling through and disturbing the image.

If the killer is set at a critical point, it's possible for a part of the color signal to be wiped away, which could lead to unstable operation. Turn the control fully off to check if this is the sync problem. The correct setting is one that doesn't produce colored "confetti" on the screen when the set is tuned to an unused channel. Location of the killer control is usually along the rear

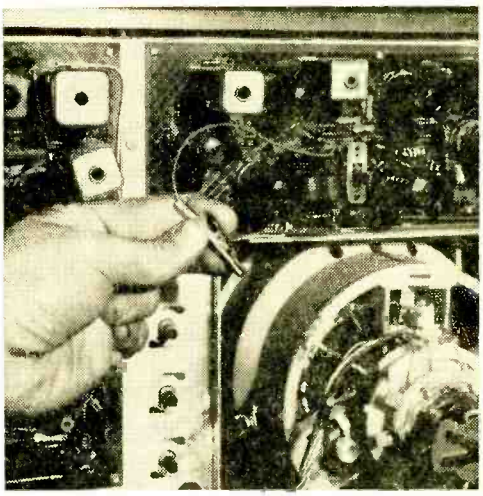


Fig. 8. If color sync improves when reactance tube grid is grounded, reactance and oscillator stages are probably alright. Be careful not to disturb yoke components while working on set.

chassis apron: on some sets it's accessible when one of the front-panel knobs is removed.

Finally, check the AGC (automatic gain control) adjustment if the set has one (Fig. 4). Should AGC be set too high (thereby severely reducing gain of the receiver's front-end), there could be partial clipping of the color signal. The usual adjustment for AGC is done while viewing the strongest local channel. The control is turned until the picture starts tearing or turns negative, which indicates overload. Then the control is re-

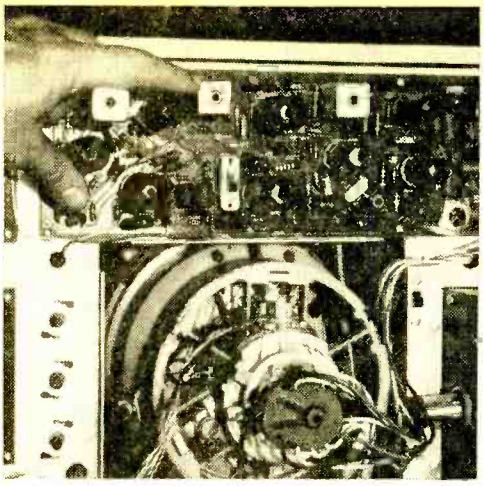


Fig. 9. Alignment of transformers in the color section should not be disturbed since realignment is complicated. However, transformer windings can readily be checked for continuity.

One useful test point indicates whether the fault is in the Burst Amp and Phase Detector stages or the Reactance Control and 3.58 Oscillator stages. If the simplified diagram in Fig. 7 is traced, it is seen that a test point (A) occurs in the grid of the Reactance Control tube. This is the stage that acts like a variable capacitor across the oscillator and continuously adjusts frequency with a DC correction voltage.

The test point enables you to ground the DC correction voltage and observe certain effects. Watch the color picture when you ground the test point with a clip lead to the chassis (Fig. 8). If it improves color sync—color stops moving through the picture—it's a good sign the Reactance Control and oscillator stages are not at fault.

No Reactance Volts. During this test, you removed the action of the Burst Amplifier and Phase Detector from the circuit. Further, in grounding the test point, you

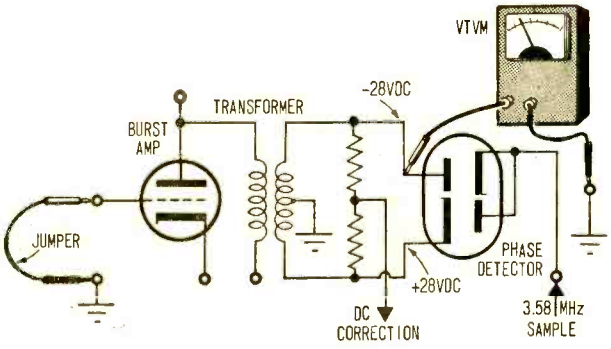


Fig. 10. To determine if Burst Amp and Phase Detector are working properly, ground the Burst Amp grid as shown, then measure the voltages (with a VTVM) on the transformer side of the diode. The actual voltages will vary from set to set, but should be equal and of opposite polarity.

tarded slightly until a normal image is obtained. If these preliminaries don't cure a case of color instability, the back cover of the set is removed for the next step.

Troublesome Tubes. As in most other circuits, tubes account for the bulk of color-sync faults. You can locate tubes (Fig. 5) associated with color sync by examining the set's chroma (or color) board. It's usually a subchassis or printed circuit that bears most circuitry for processing color signals. The layout of a color board used in a recent Westinghouse receiver is shown in Fig. 6. When color sync acts up, check those tubes by substituting known good ones before probing more deeply into the set.

Manufacturers often provide convenient test points on a color chassis to help pinpoint troublespots. Thus, it's a good idea to obtain the service literature for a particular set if you wish to probe further into a color sync problem.

placed zero volts on the grid of the Reactance Control stage, a voltage which is about right during normal reception. If color sync improves, you have proved that both reactance and oscillator stages are capable of approximately normal operation.

We say "approximate" since color may

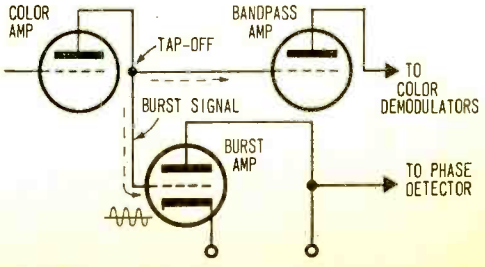


Fig. 11. The next circuit to have a close look at is the Burst Amp. If Phase Detector voltages are incorrect, perhaps the burst signal is being interrupted between Color and Burst Amp. The only way to find out is with a scope.

e/e COLOR WON'T STAY

not lock completely in place, but possibly drift slowly across the screen. If you get this action, shift suspicion to the burst and detector stages. Measure tube-socket values of voltage and resistance to find the faulty component. Leaky capacitors are frequently the trouble, followed by resistors which have changed value (rarely will a 3.58 crystal go bad). Alignment of various coils or transformers in this section (Fig. 9) shouldn't be touched unless you've exhausted all other test possibilities.

Slap In The Phase. One shortcut helps tell whether Phase Detector or Burst Amp is at fault. In Fig. 10 is a simplified schematic of these stages, as used in an RCA color chassis. During operation, the Burst Amp is boosting the received burst signal and applying it to the Phase Detector. Here the signal is split in the transformer leading to a tube with a pair of detector diodes. At the same time, a 3.58 MHz Sample is applied to the other side of the diodes. This circuit com-

(Continued on page 115)

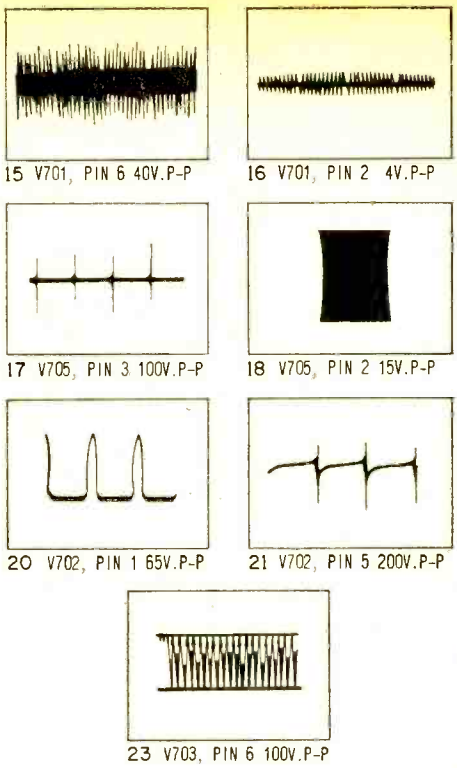
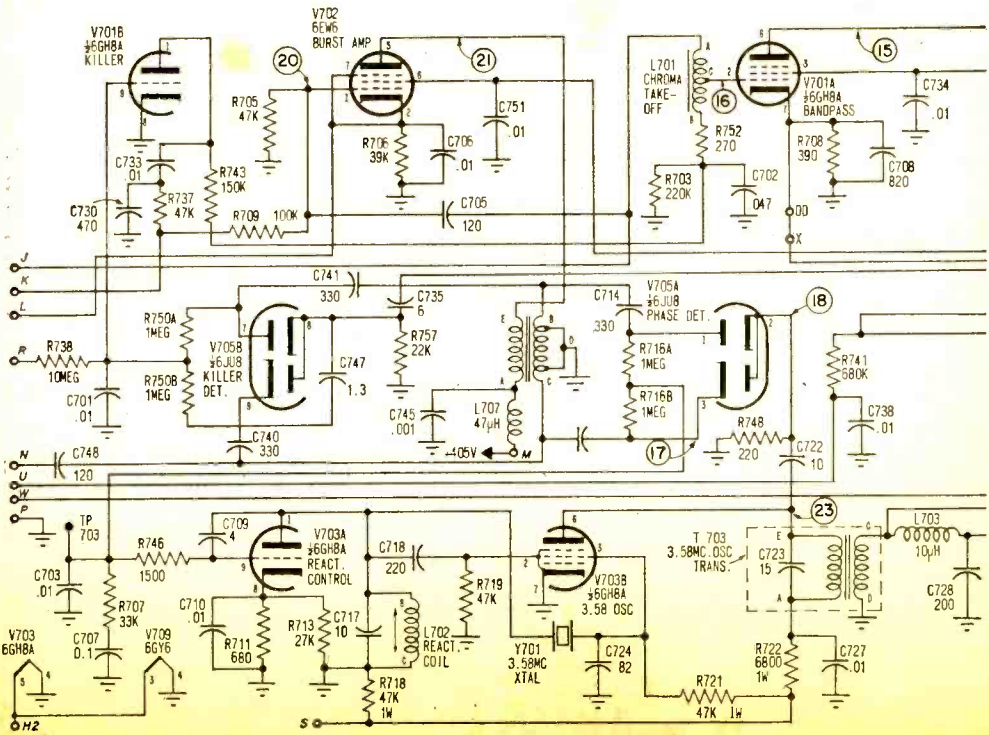


Fig. 12. Typical service literature provides waveforms at different circuit points so that burst and other signals can readily be traced through various stages with an oscilloscope.



Scrooge Special

Load your rig with this one and for a fact the dummy won't be you!

By Edward A. Morris, WA2VLU

Bring up the subject of dummy loads with a group of average Hams or CBers, and you are likely to find that most are still using common light bulbs as a substitute for a good dummy load. Granted, they are inexpensive and readily available, but they also make darn poor dummy loads! This is especially true over 30 MHz, where they are usually more reactive than resistive!

What can you do about it, aside from sneaking into the old sugar jar to pay for a good commercial unit? Build our 100-watt Scrooge Special dummy load! It's low cost is achieved through the use of four surplus tin-oxide, glass resistors. New, these resistors run several dollars each, so total cost will be somewhat more if surplus resistors aren't used.

These non-inductive resistors permit the construction of a dummy load which has all the sought-after features of a good, resistive RF load, at a cost not much greater than the light bulbs it replaces.

Fully shielded, it will not, unlike a light bulb, radiate interference-causing stray RF energy. Its precise 50-ohm input impedance matches the output impedance of today's transmitters to a tee. Its simple, easy-to-build design makes it a one-evening project and with adequate ventilation provided by the vent holes, it can dissipate 100 watts continuously. And finally, our Scrooge Special will demonstrate a VSWR of under 1.5:1 at 150 MHz if reasonable care is used in assembly.

Putting It Together. Although construction is simple, the parts layout is critical and the load resistors, R1 and R2, are also critical

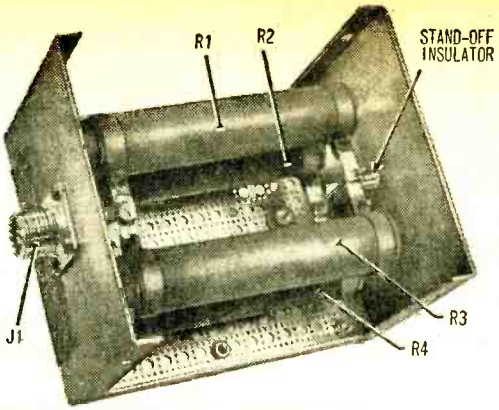
components. Do not make any substitutions for these parts. In general, to obtain best results it is suggested that you carefully follow the layout presented here. Parts placement can be determined from the photographs.

The dummy load is built into a 5 x 4 x 3-in. aluminum chassis box. Begin construction by laying out and marking the spots to be drilled. The use of a T-square here should help to make things a bit easier, as well as producing more accurate placement of holes.

Due to the large number of vent holes to be cut, simplify matters and use a Greenlee chassis punch to make these holes, if one is available. The vent holes can also be cut with a hand nibbler. After you have finished the mechanical work on the case, *de-burr* all holes and cutouts.

The case can then be prepared for painting. Begin by cleaning the case well with soap and hot water to remove all traces of dirt and oil. If the case is particularly dirty, give it a good going-over with cleansing powder. Just a trace of an oil film on the surface of the aluminum will prevent the paint from making a good bond.

Case Painting. Next spray on several *light* coats of an aluminum primer paint. Be sure to follow the directions on the can. After the primer has thoroughly dried, apply



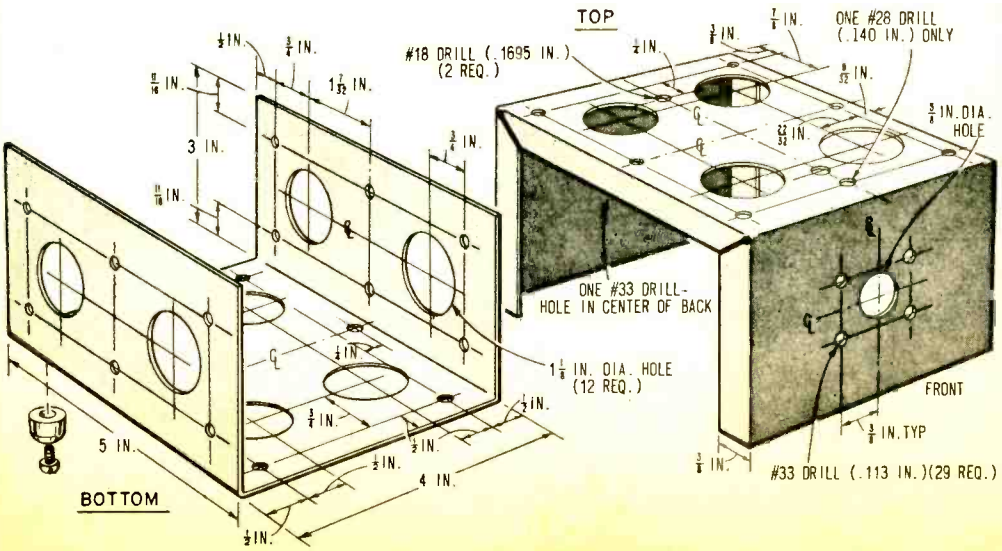
To obtain best SWR ratio, mount resistors exactly as shown in photo. Stand-off insulator holds one end of the resistors, with the center and ground contact of J1 holding the other.

the finish coats of paint. Don't try to cover the entire surface with but one or two coats of paint. Instead, spray on very light, thin coats of paint, allowing each coat to dry before applying the next. Repeat the process several times until you have built up a smooth, hard finish.

Next cut the perforated aluminum ventilation-hole covers to size. The aluminum can easily be cut with a pair of ordinary kitchen scissors. Mount the aluminum strips over the vent holes with 4-40 hardware.

The four rubber feet are attached to the case with the same hardware used to mount the aluminum strip on the bottom of the case. Self-tapping screws may be used.

Now mount connector J1, the handle,

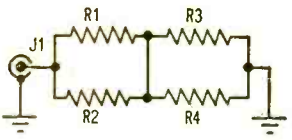


Laying out and cutting the many holes required for proper ventilation is the biggest job. After all holes are cut and deburred, apply several coats of spray paint to the case.

PARTS LIST

J1—RF connector, single hole mounting, type SO-239SH (Lafayette 42H6907 or equiv.)
R1, R2, R3, R4—50-ohm, 100-watt, 1% non-inductive resistors (Corning Glass R-35* or equiv.)
1—5x4x3-in. aluminum chassis box (Lafayette 12H8389 or equiv.)
4—Rubber feet, ⅜-in. dia. (Lafayette 13H6035 or equiv.)
1—Equipment handle (Allied Radio 42E8078 or equiv.)
Misc.—Wire, solder, perforated aluminum, nuts, bolts, spray paint, insulated terminal lug, etc.

*Available from John Mesha, Jr. Surplus, 19 Allerton St., Lynn, Mass. 01904



Wire resistors together as shown in schematic, then install in chassis box.

ground lug, and the insulated terminal post as shown in the photo.

Finishing Up. Carefully note the physical placement of the load resistors R1 through R4. These resistors are supported by the connecting wires to connector J1 and the ground lug on one side of the case, and to the insulated terminal lug on the other side. The sole purpose of the insulated terminal lug is to support the load resistors, no other wires or components are connected to it.

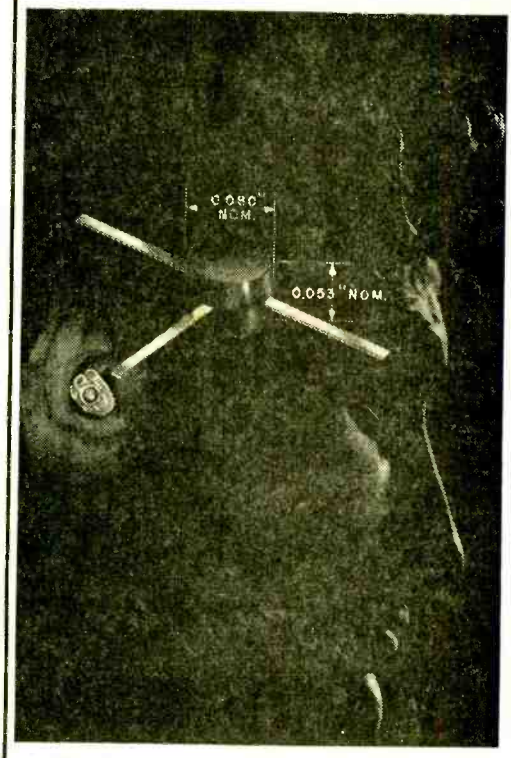
To speed construction, first wire the load resistors together per the schematic. After having completed this, they can then be wired into the case. Be sure to refer to the photos for the exact placement of these resistors. Try to keep the same spacing between the resistors and between the walls of the case as shown, as this will ensure correct resistive impedance values and minimum VSWR.

Be careful when handling and installing these resistors. Though they are quite rugged, they are deposited on a glass form. If excess strain is placed on them—well, you have been warned!

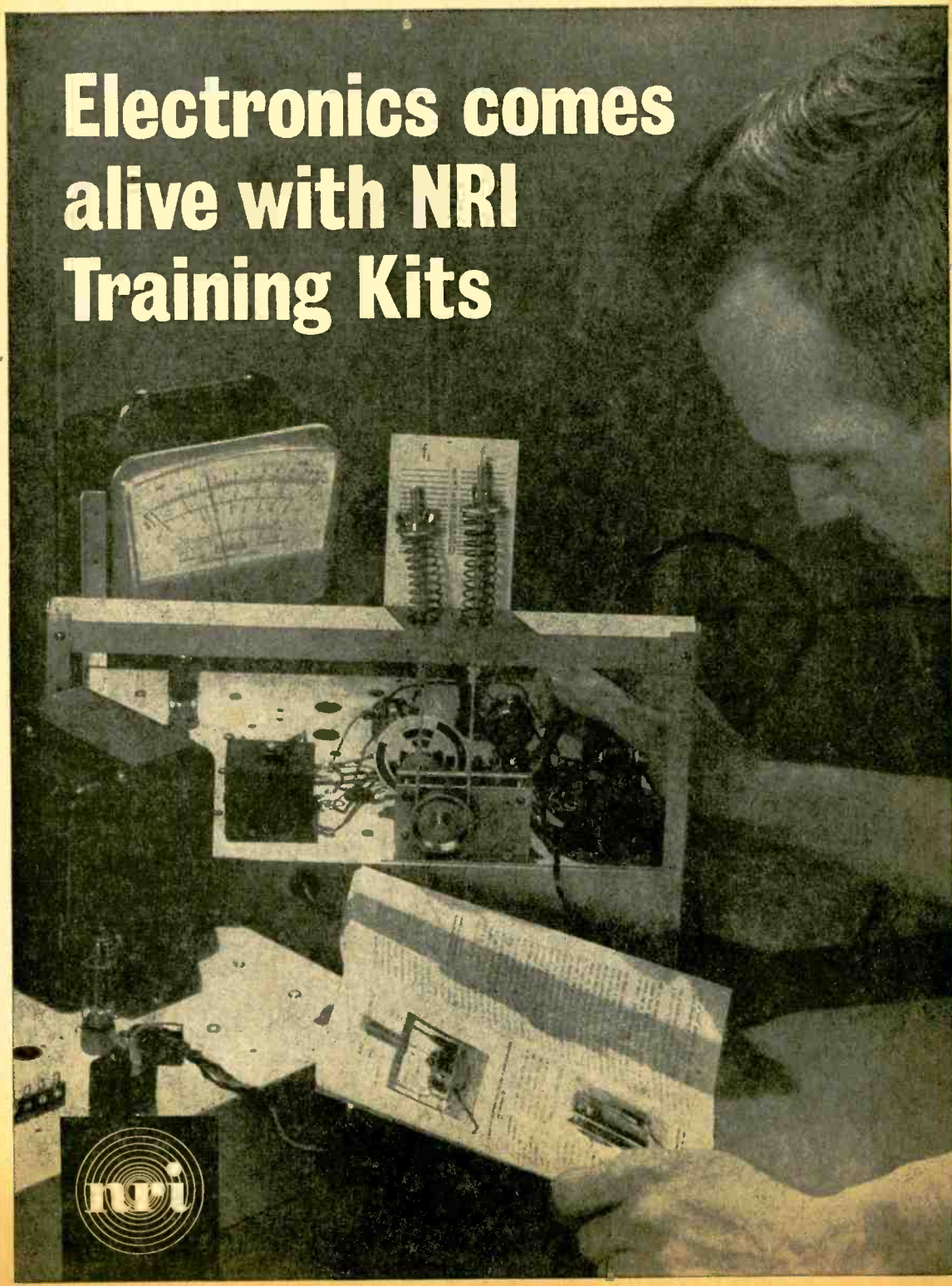
When the Scrooge Special is completed, check to be sure there are no cold solder joints, accidental shorts, and that the unit is wired according to the diagram. As a final check, measure the resistance between the center pin of connector J1 and ground. This resistance should be exactly 50 ohms. OK? Now put those light bulbs back in the lamps where they belong. ■

MIDGET WIDGET

PACKED IN PLASTIC



Miniaturization has primarily taken the form of integrated circuitry, but other research has been directed at miniaturizing discrete components. In this effort, Motorola comes to the market place with a new line of tiny transistors suitable for many uses such as in hearing aids, electronic watches, and satellites. Labeled the Micro-T, these little plastic encapsulated transistors are so small that 144 of them can comfortably be placed on a 2½-in. square printed-circuit board. In discrete circuit applications, their small size can effect as much as a 50-percent size reduction as compared to standard transistors while offering the performance and flexibility of discrete-device design. Slated as an ideal transistor for use in thick-film and unitized circuit assemblies, Micro-T has a small price to go along with its size—about $1.60 or so if you can use a hundred. ■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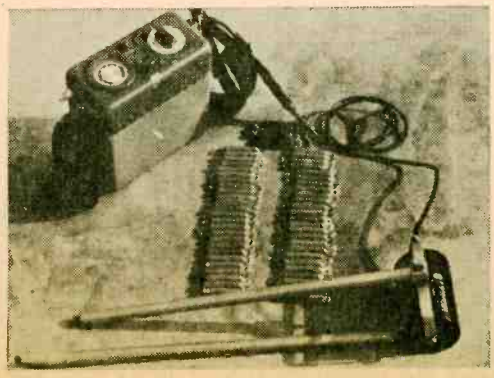
FOUND
...in an avalanche with a lodestone

Skiers and mountain climbers buried in snow avalanches now have greatly increased chances for discovery and survival. Sole catch is that they must be equipped with a special magnet (made by Arnold Engineering) which rescue crews can quickly detect with a portable magnetometer (itself a development of Varian Associates).

Worn on the person of the skier, the magnet guides the detection-unit-bearing rescue team to the buried skier's location. The detection unit consists of the portable magnetometer, a pole-mounted sensor, and headphones. The sensor is designed so its output signal changes tone at the recognizable rate of 5Hz per gamma as the magnetic field varies.

When an avalanche victim equipped with the ski magnet is approached, the magnetic field changes rapidly and results in wide variations in audible tone. A simple cross-pattern of search over the suspected area readily locates the spot where the tone changes most abruptly, pinpointing the exact location of both the buried magnet and the victim. ■



Arnold Engineering's magnets and Varian Associates' magnetometer form team to locate buried skiers.

Worn on ski boots, small cylindrically-shaped magnets can be detected at distances up to 18 ft. away.

e/e TEST GEAR

KNIGHT-KIT Model KG-686
Solid-State, Calibrated
RF Signal Generator

■ Nearly every experimenter and most service technicians have a dream shop with all the test instruments they ever wanted. Most likely, the calibrated RF signal generator is on everyone's dream list, for it is the only way to accurately measure sensitivity, selectivity, image rejection, CW sensitivity and input-to-output level of receivers and transceivers—whether Ham, CB or SWL—not to mention home brew convertors and preamplifiers.

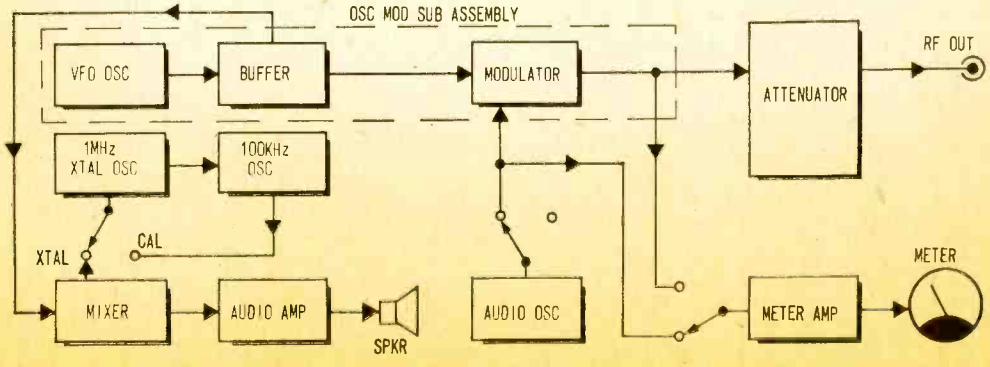
But the calibrated generator need no longer be a "dream" representing an investment of several hundred dollars, because Allied Radio's Knight-Kit Calibrated RF Generator, Model KG-686, is budget-priced at only $95 in kit form.

The KG-686 covers the range of frequencies from 100 kHz to 54 MHz in five bands on fundamentals. Six switch-selected attenuators in combination with a variable (fine) attenuator allows the user to select any output voltage from 120,000 μV down to 0.5 μV when the generator is terminated into a 50-ohm load. When the generator output feeds a high impedance, the maximum output voltage is substantially greater than 120,000 μV, the exact value depending on the band in use. The actual output voltage is indicated by combining the amount of switch-selected attenuation with the front-panel meter reading.

The output RF signal may be either unmodulated, internally modulated with approximately 400 Hz, or externally modulated via panel-mounted binding posts. The modulation level is adjustable from zero to 50 percent, the exact modulation depth indicated by the output/modulation meter.

Both a 100 kHz and a 1 MHz crystal calibrator are provided—primarily for accurate dial calibration of the VFO. A "beat detector" amplifier and speaker is part of the generator and allows the user to easily calibrate the VFO dial against the crystal standard(s). A BNC-connected 50-ohm loaded cable is used for the RF output connection.

How It Works. The circuit operation for the KG-686 is shown in the block diagram. The VFO feeds an emitter follower used as a buffer amplifier to reduce frequency



Containing all the elements of a lab-grade instrument, the KG-686 is a fine performer.

changes caused by the adjustment of the RF level control. The emitter follower feeds the modulator whose RF output is fed to both the meter amplifier (and meter) and the attenuators. When the attenuator output is terminated in 50 ohms, the combination of meter reading and attenuator loss indicates the exact RF output level at the RF output jack.

The 1-MHz crystal-controlled calibration oscillator output is fed to the 100-kHz oscillator, where the 1-MHz frequency is divided by ten. The 100-kHz oscillator is therefore "locked" to every tenth pulse from the 1-MHz oscillator, thereby obtaining an exact harmonic relationship between the two calibration frequencies.

The output of the calibration oscillators is combined with a sample of the VFO output from the buffer stage. The two signals are fed into the mixer, a non-linear amplifier/mixer. The resultant "beat note" is amplified by the audio amplifier and passed on to the speaker.

The audio oscillator is used to modulate the RF output. The AF signal is fed to the modulator through a level control, and a modulation adjust control. The level control determines the reading of the modulation meter and the percent modulation. The modulation adjust sets the overall modulation calibration to the desired amount.

Assembling The Kit. While the idea of a calibrated generator construction might strike you as formidable, such is not the case. In fact, the Knight-Kit KG-686 is a rather easy assembly by any standards, due primarily to rather thorough component packaging. As examples, all resistors and diodes are supplied mounted on keyed cards; all wires are color-coded, pre-cut to size and tinned. The hardware, of which there is a considerable quantity, is packaged separately, the small screws and nuts in one package, medium screws in another, etc.

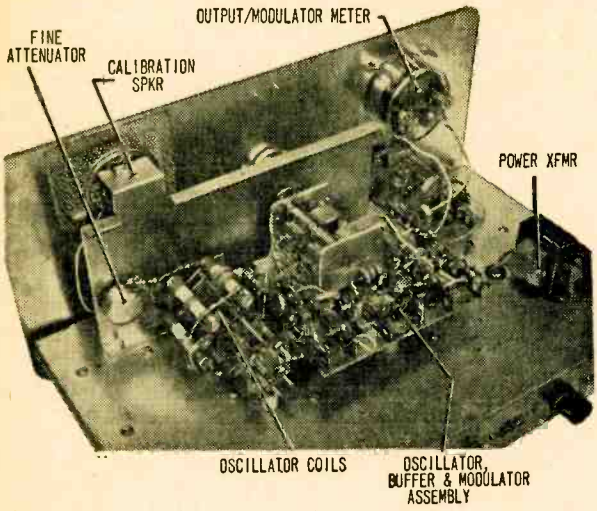
The generator is built in two sections; the main chassis contains everything except the oscillator, buffer, and modulator which are on a separate chassis.

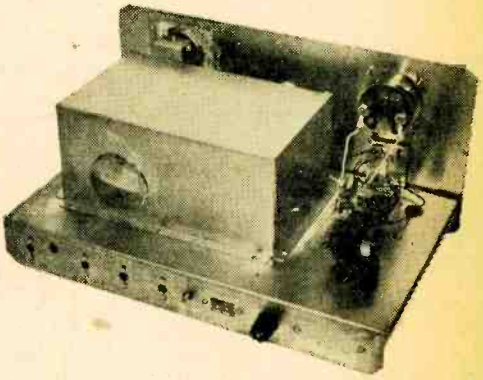
Both sections use an instrument-type component layout whereby most of the components connect from one terminal strip directly to another in a straight line. This arrangement sharply reduces the possibility of a wiring error.

The one difficult spot in the assembly is the oscillator coils, whose terminals are extremely fragile. Use extra care when installing the coils on the band selector switch. Just a little too much pressure will cause the terminals to pull out of the coil form. The connections to the coil itself won't break so easily but the coil will be hanging free, causing possible frequency instability.

Alignment. You will need access to a VTVM and a wide-band (TV type) scope

(Continued on page 116)





The oscillator, buffer, and modulator stages are wired as a separate assembly which is mounted on top of the main chassis. This arrangement provides for better frequency stability.

continental DX

Old world/New look — By C. M. Stanbury II

European SW Broadcast stations are usually the easiest for NA listeners to hear, the easiest to QSL and, generally speaking, the *dullest*. But during the past couple years, several interesting developments have appeared on the scene which should provide important targets for every DXer and SWL.

Ever since World War II, high-powered privately-owned stations in tiny countries like Andorra have been pulling in big profits from the larger (and richer) European nations where commercial broadcasting was almost unknown. When the *pirates* came along a few years ago, the business really boomed. And now that most of the pirates have been forced out of business, stations like R. Andorra have the field all to themselves.

In the spring of 1967, R. Andorra (the oldest broadcaster in this mountain top republic) set up a London office (M. Bailey-Watson Esq., 82 Chelsea Manor St., London SW3) and began looking for the medium-wave frequency which would be best received in England. At last report this was 701 kHz. But of even more interst to NA DXers is another Andorran station—Sud Radio, the newly renamed R. des Vallees, which recently reactivated its SW outlet on a test basis. Watch for it very late after-

Abbreviations

DX	long distance, distant (contact or country)
DXer	Long distance radio transmlssion listener
EST	Eastern Standard Time
FBC	Finish Broadcasting Company
HNBI	Hellenic National Broadcasting Institute
kHz	kilohertz (kilocycles)
kW	kilowatt
NA	North America(n)
QRM	noise or signal interfering with desired signal
QSL	decorated post card or letter from station acknowledging reception report
R.	Radio (as in Radio Sofia)
SW	shortwave
SWL	shortwave listener
VOA	Voice Of America

noons on 6195 kHz. R. Andorra's 701 kHz transmitter will be best about the same time.

Albania. While the battle for free-enterprise broadcasting goes on in Western Europe, the schism within the ranks of international Communism also continues to make SW news. Up until a few years ago, R. Tirana (Albania) had no high-powered transmitters at all and their NA service was actually beamed our way via R. Sofia. When Albania sided with Mao, R. Peking took over these relay duties. But now, with Chinese help, Tirana has put on the air two high-kW SW rigs of their own.

Although a Peking ally, Tirana's broadcasts to North America are somewhat less virulent than their Chinese counterparts. The attacks on Moscow are especially toned down. This may or may not mean anything, and of course could change at any time depending upon the power struggle within the Communist world. These transmissions can be heard at 1930, 2030 and 2200 EST on 7300 kHz. Consistent monitoring can provide interesting insight on this aspect of the Communists' private cold war.

Finland. While the fight for "free" broadcasting goes on in the West (and freedom of speech is nonexistent in Eastern Europe), an interesting political hand is being played out within the state-owned Finnish Broadcasting Company. Until mid-'67, FBC aired a weekly DX program produced by the Swedish DX Alliance. "SweDX" was the only program of its kind to air controversial subjects (for example the R. Americas matter). Now this production has been cancelled—supposedly because its last editor had to devote more time to his studies.

However, a reliable source tipped off the author that the Helsinki government had recently taken a more serious interest in the international service (perhaps to promote tourism) and it's reasonable to surmise that controversial matters play no part in these plans. FBC now airs a daily English transmission to NA at 1800 EST on 15155 kHz in addition to the Saturday and Sunday programs at 0730 on 15185 kHz.

Greece. If the events discussed in this article are signs of what's to come, the future of European SW assuredly looks uncertain. In keeping with this trend was the overthrow about a year ago of the democratic (but admittedly disorganized) government of Greece by a group of right wing military men who suspended the constitution, parliament and such civil liberties as freedom of speech, freedom of the press, etc. In effect, Greece became Western Europe's third dictatorship.

At present, Athen's major SW station—

(Continued on page 114)

EUROPEAN SW ACTION AT A GLANCE

kHz	STATION & COUNTRY	TIME (EST)
6195	Sud Radio, ANDORRA	Late afternoons
7130	VOA (Rhodes), GREECE	2230
7205	VOA (Thessaloniki), GREECE	1600
7290	HNBI/VOA (Thessaloniki), GREECE	1500
7295	VOA (RHODES), GREECE	1600
7300	R. Tirana, ALBANIA	1930, 2030 & 2200
9710	HNBI/VOA (Thessaloniki), GREECE	0545-0930
15155V	F.B.C, FINLAND	1800
15185	F.B.C, FINLAND	0730 (Sat. & Sun. only)
15345	H.N.B.I. (Athens), GREECE	1230
17745	H.N.B.I. (Athens), GREECE	1940 (reported but unconfirmed)

V—frequency varies

Bulgaria's R. Sofia actually aired Albanian broadcasts until relatively recently. Here, technician tunes up Sofia's transmitters so Western listeners can hear Communist Gospel from Bulgaria's major mouth.

ELENEX TIGER TAIL
Portable CB
Whip Antenna

■ Until the introduction of the Elenex *Tiger Tail* CB antenna, there has been no really efficient portable antenna available. Problem was that nearby objects, such as window frames and structural steel, seriously affected an antenna's resonance, producing a high to very high SWR.

The Elenex *Tiger Tail,* on the other hand, is specifically designed to overcome the problems of detuning. In addition, it provides impedance matching to the transmission line under all conditions. To ensure that the user obtains optimum performance, a reflected power meter is built into the antenna's base.

The *Tiger Tail* is specifically designed for portable and/or window operation and is supplied with a special wing-nut locking bracket that will secure the antenna to virtually any window frame. The bracket is fashioned so that the antenna always angles away from the building or support regardless of the type of mount.

Inside Tiger Tail's base is the load-matching coil, tuning slug drive system, and the reflected power meter pickup loop and circuit components. The antenna's clamping assembly allows it to be semi-permanently installed and used almost anywhere and under most any conditions.

The radiating element is shortened through the use of a loading coil. The element itself "breaks" into two sections for portability, with the top, or whip, section simply plugging into the loading coil.

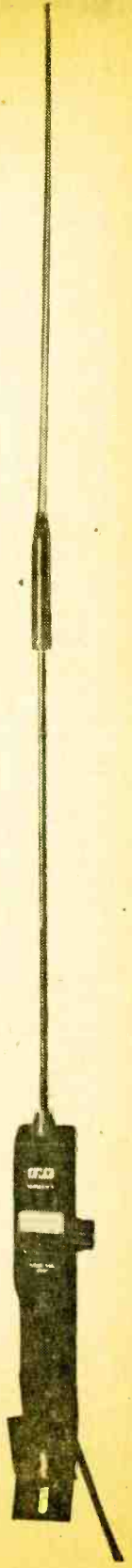
At the base of the whip is a small metal box with a meter and a knob. The meter indicates the amount of reflected power—power lost due to an improperly tuned radiator. Rotating the knob adjusts the loading coil, proper tuning being indicated by a minimum reading on the meter.

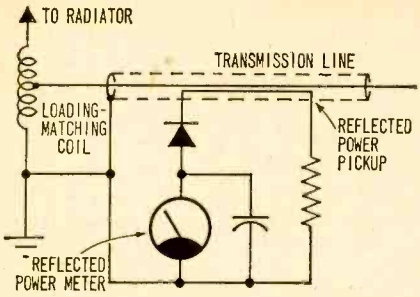
Coax Antenna. The section of transmission line supplied with the *Tiger Tail* is somewhat different from regular coax in that it has two shields. The extra one is used as a ¼-wavelength shield, which we'll have more to say about later.

The loading coil is of particular interest because of the unusual tuning method employed. Obviously, one cannot always safely hang out of a window to tune a loading coil located in the center of the radiating element. The *Tiger Tail* makes tuning convenient by using a mechanical arrangement to tune the coil via the knob at the base of the antenna.

As shown in the detail drawing, the lower section of the antenna and the loading coil are hollow. A thin plastic rod inside the lower section extends from the coil to the base. A ferrite tuning slug attached to the coil end of the rod is free to slide in and out of the coil's core. The base end of the rod is attached through a string drive to the tuning knob. As the knob is turned, the plastic rod is moved, causing the tuning slug to slide inside the loading coil, thereby tuning the antenna to resonance.

The *Tiger Tail* is essentially a coaxial antenna with an electrically shortened radiator and a ¼-wavelength coaxial sleeve. The purpose of the sleeve is to electrically isolate the transmission line from the antenna. If the radiator were fed directly by the



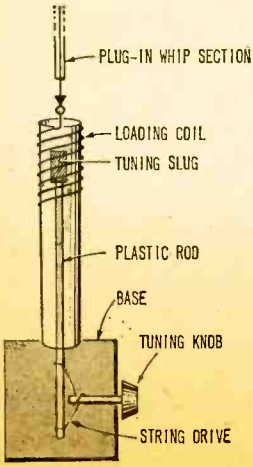


With a built-in reflected power measuring system and a means for tuning the radiator, Tiger Tail will provide excellent results in any situation and can be used with just about any CB transceiver.

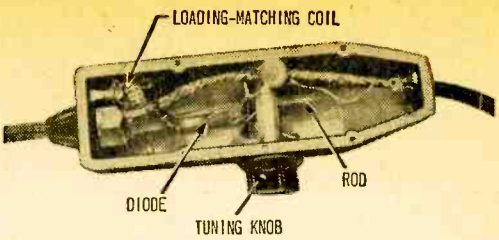
transmission line without some form of RF shielding, some RF energy would be radiated into the transmission line, causing the line to radiate also. The line radiation would combine with the antenna's radiation and alter the antenna's normal omnidirectional pattern.

A coaxial antenna normally has a 50-ohm impedance, but when an antenna is electrically shortened, the feed point impedance is reduced and there is a mismatch between the transmission line and the antenna feed point. Generally, the more the antenna radiator is shortened through coil loading, the lower the input impedance.

To avoid the power losses caused by electrical antenna shortening, the *Tiger Tail* uses a small loading/matching coil at the base of the antenna. The coil provides some loading of the antenna but primarily



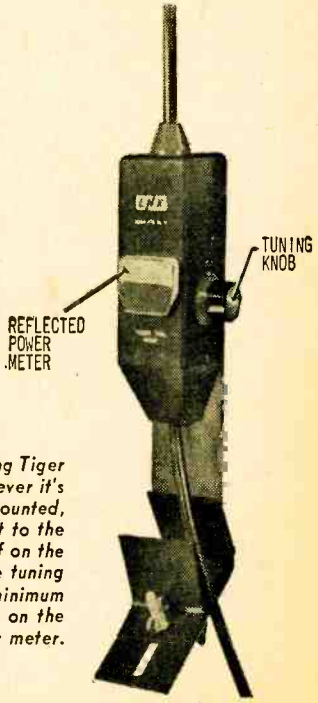
The loading-coil tuning system used on Tiger Tail is shown at left. Moving the ferrite slug in and out of the loading coil changes the coil's inductance and thereby electrically changes the antenna's length.



Cast base housing and good internal construction make Tiger Tail rugged and able to withstand the rigors of CB field days and other outings.

serves as an impedance match for the transmission line.

Performance. We tried the *Tiger Tail* on several different window mounts and, except for casement windows, the *Tiger Tail* bracket could lock sufficiently tight to provide a semi-permanent mount if desired. Casement windows have so little metal area that the *Tiger Tail* cannot be "permanently" mounted unless the antenna bracket is



After clamping Tiger Tail down wherever it's going to be mounted, simply connect it to the rig, put yourself on the air and adjust the tuning control for minimum reading on the reflected power meter.

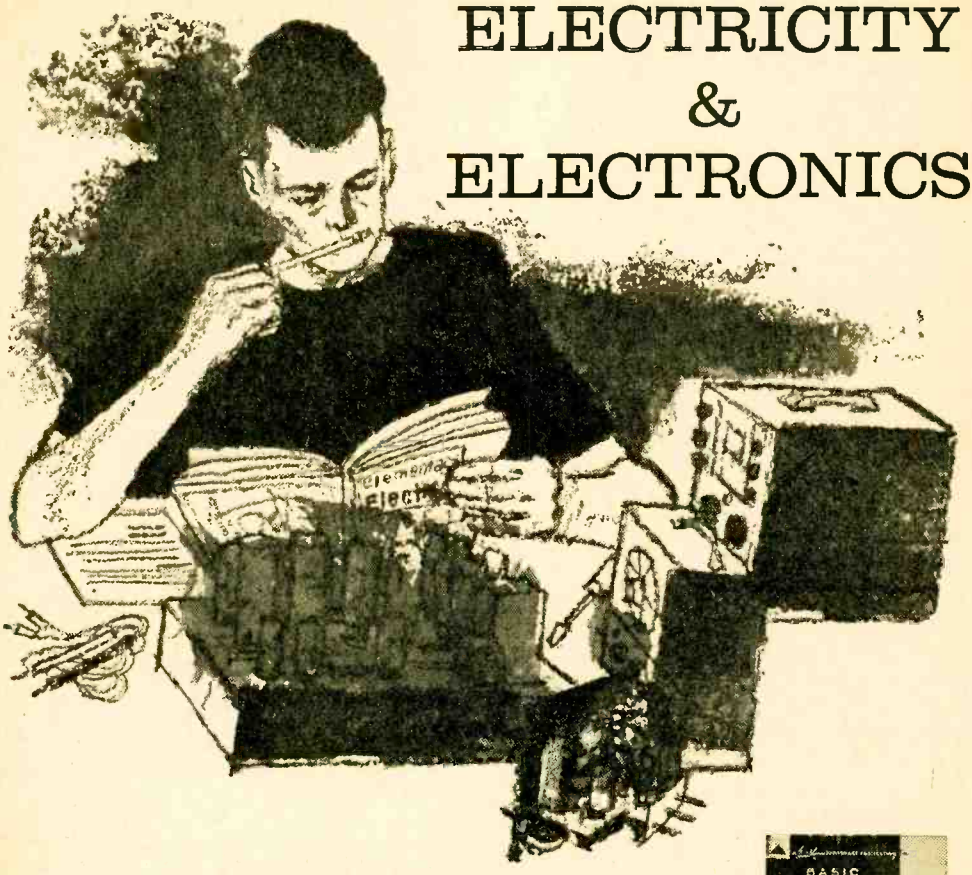
drilled and screw-mounted to the window frame or ledge. We found that the *Tiger Tail* could be easily attached to car doors, trees, and fences for field operation.

Tuning the antenna took but a matter of seconds; we simply adjusted the tuning knob for minimum meter reading.

Signal check with another station indicated that the *Tiger Tail* was at least as good

(Continued on page 112)

announcing... A BASIC COURSE IN ELECTRICITY & ELECTRONICS



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This series is based on Vol. 1 of
BASIC ELECTRICITY/ELECTRONICS,
published by Howard W. Sams & Co., Inc.

WHAT YOU WILL LEARN. You are now going to learn what electrical circuits are, what they consist of, and what each device in the circuit does. You will become more familiar with voltage and current and will learn the difference between direct current (DC) and alternating current (AC). You will become acquainted with electrical diagrams and construction of circuits.

COMPLETE ELECTRICAL CIRCUITS

If you look in a dictionary, you will find that *circuit* means to make a

complete trip. In electricity, current makes a complete trip through an *electrical circuit.*

If the circuit is not complete, current does not flow. Current flows only if the path through the circuit is complete. A broken wire, a loose connector, or a switch in the *off* position will prevent current from flowing.

You have now learned two important facts regarding the flow of current. A voltage source *causes* current to flow, and a complete circuit *allows* current to flow.

Q1. In electricity, a circuit provides a path for _____ _____ to make a _____ trip.

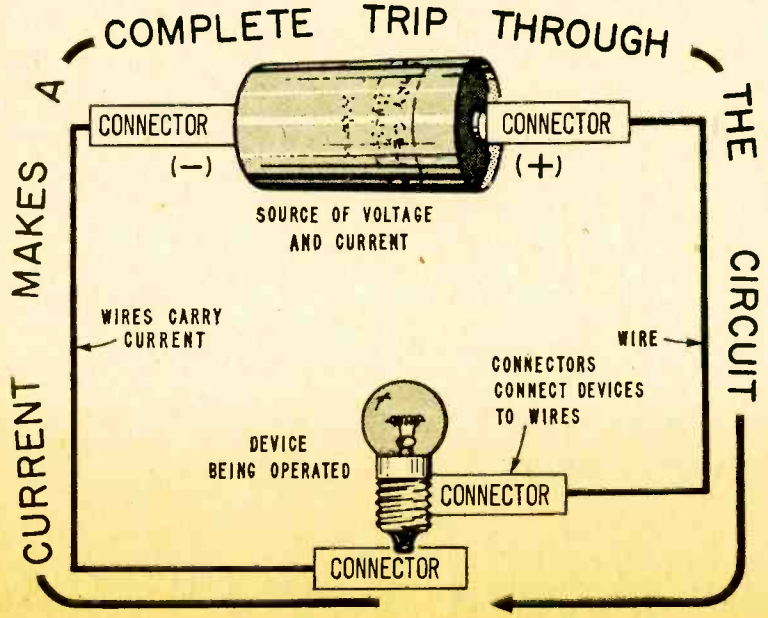
Q2. Current flow is caused by a(an) _____ _____ and permitted by a(an) _____ _____.

Your Answers Should Be:

A1. In electricity, a circuit provides a path for current to make a *complete* trip.

A2. Current flow is caused by a voltage source and permitted by a *complete circuit.*

A Basic Electrical Circuit



HOW ELECTRICAL CIRCUITS ARE MADE

All electrical circuits consist of the basic units shown in the illustration. The device being operated, of course, can be any electrical or electronic device. In fact, many electrical circuits contain more than one device to be operated.

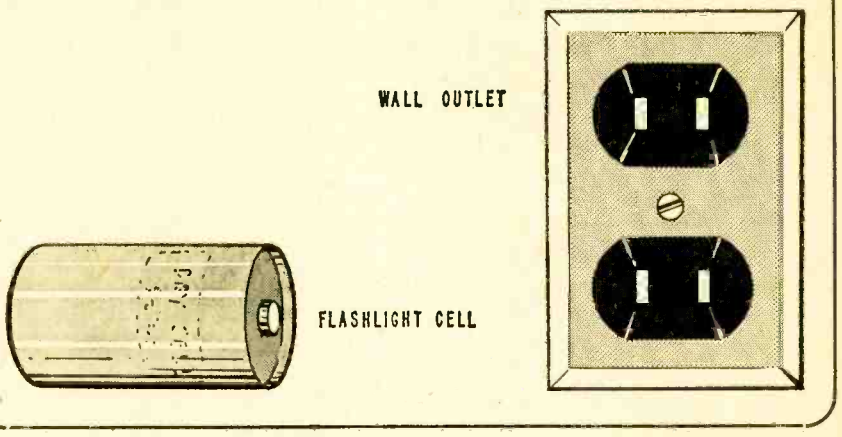
Now that you are familiar with the basic units of an electrical circuit, you are ready to learn more about each part.

Voltage Source

A battery is an example of a voltage source. As you recall, a voltage source is also a source of current.

The electrical wall socket (or outlet) is another widely used source of voltage and current. The outlet is part of another circuit that has a generator as a voltage source. There may be many miles of wire between the generator and the outlet.

Familiar Sources of Voltage and Current



The battery shown in the illustration is more properly called a *cell*. A cell was originally considered to be a storage device. Cells, such as those used in a flashlight, develop approximately 1.5 volts each. A *battery*, such as the 6- or 12-volt source in an automobile, is constructed of two or more cells. In everyday English, a cell is often referred to as a battery.

Q3. List the four basic units of an electrical circuit.

Q4. A lamp will light only when it is part of a(an) _____.

Q5. A(an) _____ joins wires to a voltage source or operating device to make a complete current path.

Q6. A(an) _____, such as a battery, is also a source of current.

Q7. Voltage sources of the type used in a flashlight are more properly called _____.

Q8. A single flashlight cell is a source of _____ volts.

Q9. If a 6-volt battery has four 1.5-volt cells, a 12-volt battery will have _____ 1.5-volt cells.

Your Answers Should Be:

A3. The four basic units of an electrical circuit are:
1. Voltage source.
2. Device being operated.
3. Wires.
4. Connectors (terminals).

A4. A lamp will light only when it is part of a *complete circuit.*

A5. A *connector* joins wires to a voltage source or operating device to make a complete current path.

A6. A *voltage source,* such as a battery, is also a source of current.

A7. Voltage sources of the type used in a flashlight are more properly called *cells.*

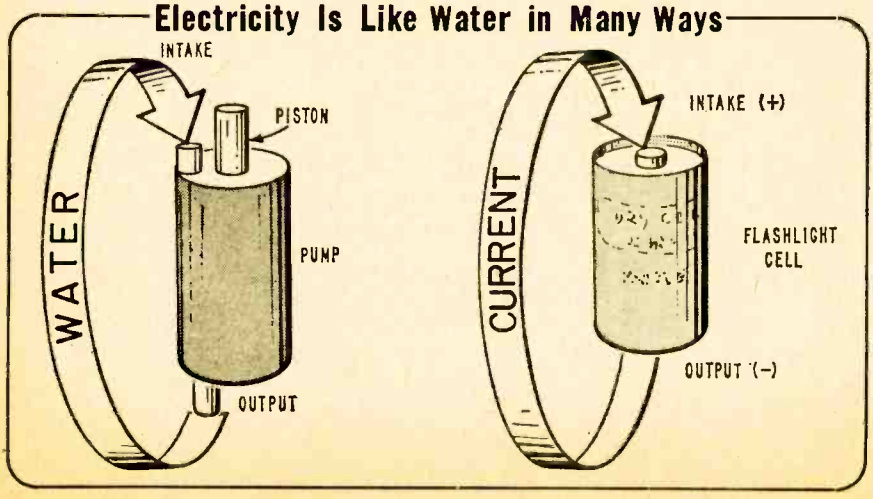
A8. A single flashlight cell is a source of *1.5* volts.

A9. If a 6-volt battery has four 1.5-volt cells, a 12-volt battery will have *eight* 1.5-volt cells. (If a 12-volt battery provides twice as much voltage as a 6-volt battery then it must have twice as many cells.)

Voltage Source Connections

All sources of voltage (and current) have at least two connections.

The source of voltage and current in an electrical circuit is similar to a pump in a water system. The *pump* provides both the *pressure* and the *water* to



cause a flow through the *water system.* A *voltage source* provides *electrical pressure* (voltage) and *current* (electrical equivalent of water) to cause a flow through an *electrical circuit.*

Like the water pump, *the source of voltage and current requires an input connection and an output connection.*

Safety Note. Caution must always be observed when working near voltage sources or circuits. If you come in contact with both connections of the source, *your body becomes part of the circuit,* and current will flow through you. This can cause painful burns and even death. If you touch only one side of the source or a single wire leading to it, *be sure you do not touch a pipe or other metal surface in contact with the ground.* This precaution is necessary because many voltage sources have one connection wired to ground.

Conductors and Insulators

Wires provide a path for electric current just as pipes provide a path for water. Metals such as copper and aluminum are most commonly used in the manufacture of electrical wire. Their atomic structures make these metals good *conductors* of current. Silver is the best conductor but is much more expensive than other metals. Other more economical metals, such as copper and aluminum, are good conductors and are quite easily formed into wire. When connected into a circuit, wire is most often referred to as a *conductor.*

Most nonmetals are very poor conductors of electric current. These materials are called *insulators.* Rubber and plastic are two commonly used materials for insulators because they are flexible, easily molded, and can be readily cut when necessary. Because of their better insulating qualities, glass and ceramic material are used where high-voltage insulators are required.

Q10. How many connections must be made to a voltage source?

Q11. Materials which provide an easy path for current are called _____. Those which do not provide an easy path are called _____.

Your Answers Should Be:

A10. *At least two connections* must be made to a voltage source.

A11. Materials which provide an easy path for current are called *conductors.* Those which do not provide an easy path are called *insulators.*

Working With Wire

Practically all wire used in electrical and electronic work consists of a conducting metal (usually circular in cross section) covered with insulation. The insulation prevents *undesired connections* to and between conductors.

Exceptions include wire used for heating purposes. In these cases, the heating element (wire) is wrapped or formed on an insulating material or supported in air (a nonconductor) between insulators.

If a bare wire comes in contact with another conductor or other metal in an electrical unit, a *short circuit* develops. Current will flow through the *short* instead of the complete circuit containing the operating device. For this reason, wire should be handled with sufficient care to ensure that its insulation is not damaged.

Wire Stripping. In order to join a wire to a connector, a length of insulation

must be removed from the wire. A metal-to-metal connection is required to permit current flow.

The process of removing the insulation is called *wire stripping*. Both wire cutting and stripping are usually done with a type of pliers called *diagonal cutters*.

Precautions. When stripping wire, do not be discouraged if at first you cut the end of the wire while stripping it. Success will come with practice.

Do not squeeze the plier handles too tightly when attempting to remove the insulation from the wire. Just break the surface of the insulation with the cutting head. The cut need not go through to the wire. A steady pull should then part or tear the remaining insulation. Placing the index finger between the handles prevents the cutters from closing completely and nicking or cutting the wire.

Q12. Nearly all metals will conduct _____.

Q13. Copper or aluminum are used in electric wires because they are good _____.

Q14. Materials that are nonconductors of current are called _____.

Q15. Insulation is used on wires to (make, prevent) contact with other conductors of current.

Q16. Undesired contact between two conductors is called a(an) _____.

Q17. _____ is the process of removing insulation from a wire. It can be accomplished by pliers known as _____.

Your Answers Should Be:

A12. Nearly all metals will conduct *current.*

A13. Copper or aluminum are used in electric wires because they are good *conductors.*

A14. Materials that are nonconductors of current are called *insulators.*

A15. Insulation is used on wires to *prevent* contact with other conductors of current.

A16. Undesired contact between two conductors is called a *short circuit.*

A17. *Wire stripping* is the process of removing insulation from a wire. It can be accomplished by pliers known as *diagonal cutters.*

Devices

Current from a voltage source operates devices such as electric light bulbs, heaters, and motors. Radio and television receivers are also operated by cur-

rent from voltage sources. These devices process voltage and current contained in received radio waves by changing the input energy into sound and pictures. The voltage sources make it possible for these devices to perform this process.

Connections. As stated earlier, all electrical devices must have *two or more* connections to a circuit. These connections are used to join conductors to the device, thus completing the circuit and permitting current to flow into and out of the device.

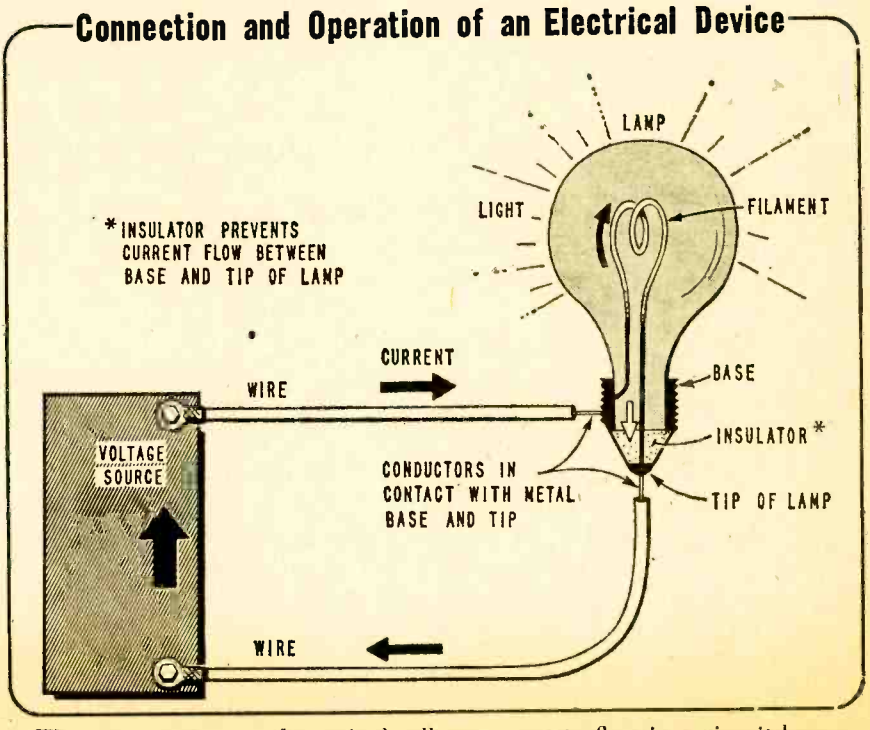
Operation. The voltage source operates the device by forcing current through the circuit. All connections must be made in the circuit, including those at the device and the source. Current will then be able to flow through the device and cause it to operate.

Connectors

The terms *connectors* and *terminals* are often used interchangeably. A *connector*, however, is normally thought of as being a mechanical part, such as a battery clamp, used to connect a conductor to a device. A *terminal*, on the other hand, is a point on a device where a connection can be made—a screw or other contact point.

The illustration below shows how connections are made to a voltage source and an operating device. The lamp will light with the bare conductors merely touching the lamp terminals. In practice, however, the lamp is placed in a socket and the wires connected to the socket terminals.

Connection and Operation of an Electrical Device



Wires, connectors, and terminals allow current to flow in a circuit because they are made of conducting metals. Care must be taken, however, when joining these parts to each other. Metal at the contact points must be clean and free from the insulating properties of dirt, grease, etc. Sandpaper or a small file can be used to clean these junction points when necessary. After a

wire has been stripped, it should be cleaned of any remaining insulation.

When connecting a wire to a terminal, make sure the screw or clamp makes a tight connection. For current to flow, all parts of the circuit must be connected.

Q18. To permit current to flow into and out of a device, the device must have at least _____ connections.

Q19. That part of a device where a connection can be made is called a _____.

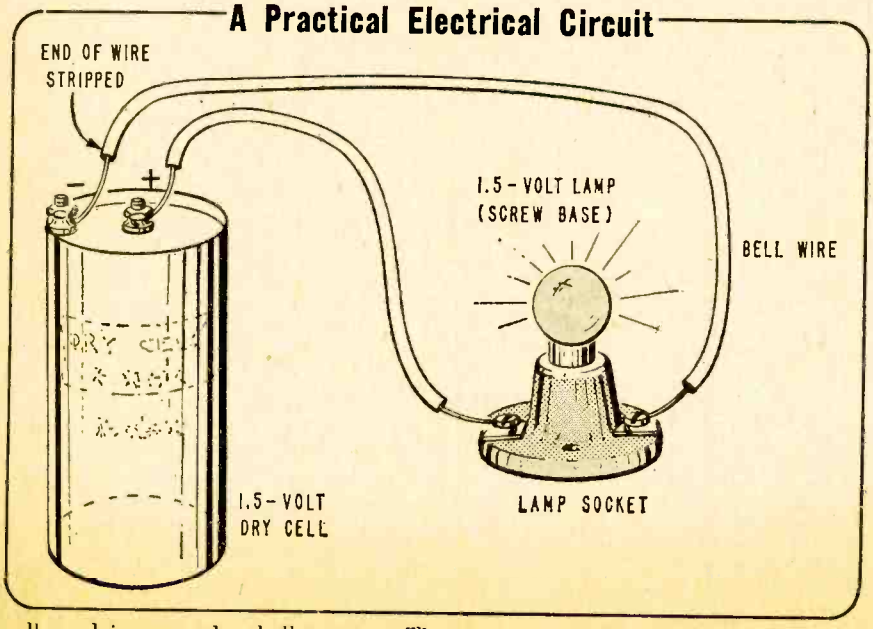
Your Answers Should Be:

A18. To permit current to flow into and out of a device the device must have at least *two* connections.

A19. That part of a device where a connection can be made is called a *terminal.*

A PRACTICAL CIRCUIT

The circuit shown below demonstrates the way in which all basic circuits are connected. It contains a voltage source, wires, connectors (or terminals), and an operating device. The voltage source pictured is a large 1.5-volt dry



cell used in some doorbell systems. This is a practical circuit because it will actually work and is often used.

Open Circuits

If all the connections are made as shown in the illustration, the lamp will

light. If any of the connections are not properly made, the lamp will not light —a condition known as an *open circuit*. An open circuit represents a condition that prevents the flow of current. In other words, the circuit is not complete.

Closed Circuits

A *closed circuit* has all of its connections made and forms a complete path through which current can flow.

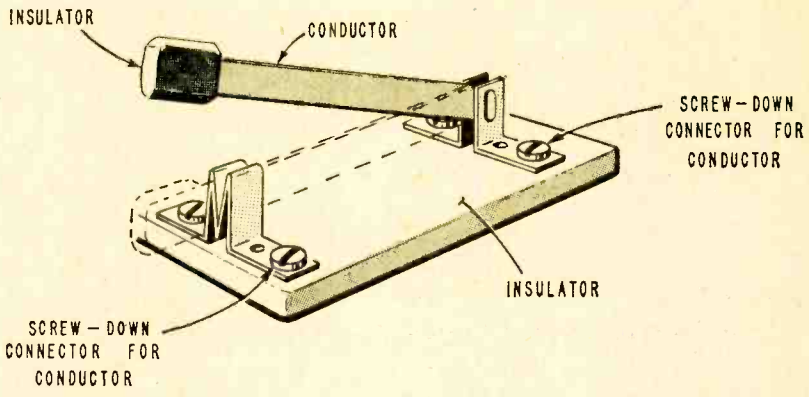
SWITCHES

Since it is often desirable to open and close a circuit, nearly all circuits contain some form of *switch*.

Knife Switch

The simplest type of switch is called a *knife switch*. It was given this name because it has an element resembling the blade of a knife.

A Knife Switch



Q20. The lamp in the illustration on the opposite page lights because is it a(an) (open, closed) circuit.

Q21. Disconnecting one of the wires will develop a(an) (open, closed) circuit.

Q22. To permit opening and closing a circuit, a(an) _____ can be connected into it.

Q23. A(an) _____ is the basic type of switch.

Your Answers Should Be:

A20. The lamp lights because it is in a *closed* circuit.

A21. Disconnecting one of the wires will develop an *open* circuit.

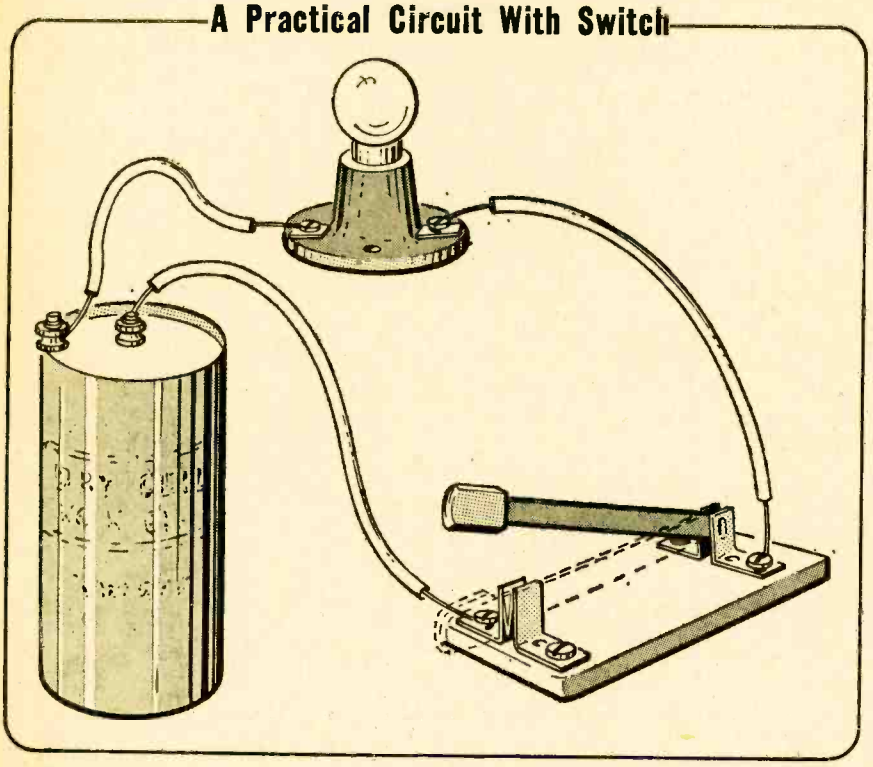
A22. To permit opening and closing a circuit, a *switch* can be connected into it.

A23. A *knife switch* is the basic type of switch.

The basic circuit just explained can be reconnected to include a knife switch. The illustration on the next page shows how the connections are made. Be sure

understand what happens to the flow of current when the switch is open (position shown) and when it is closed.

A Practical Circuit With Switch



There are many other types of switches, some of which you have used. For example, there are switches on the walls of your home, on the front of your appliances, and on the dashboard of your car. Nearly all operate on the knife-switch principle. In the closed position, a metal blade makes an electrical contact between at least two conductors.

WHAT YOU HAVE LEARNED ABOUT COMPLETE CIRCUITS

1. An electrical circuit provides a complete path for current flow.
2. Every electrical circuit consists of: (1) a source of voltage which causes current to flow; (2) conductors which provide a path for the current; (3) electrical devices which are operated by the current; (4) connectors (terminals) to join conductors to a source or a device.
3. Voltage sources and electrical devices always have at least two connections. All connections must be made in order for current to flow through them.
4. Most metals can conduct current and are called conductors. Most nonmetals provide a very poor path for current and are called insulators.

5. A wire consists of a conductor (usually copper) covered by insulation (usually rubber or plastic). Insulation may be stripped from the wire with diagonal cutters.
6. An open circuit is a condition in which the current path is interrupted. A closed circuit is the same as a complete circuit. A short circuit occurs when a conductor makes an undesirable contact with another conductor or metal part.
7. Switches are designed to open and close circuits. By operating the switch, a device may be turned on or off.

Review Questions

(Mark them true or false.)

Q24. A voltage source causes current to flow if a complete circuit is provided.

Q25. Current will flow if there is a complete electrical path from the voltage source to the device, through the device, and back to the voltage source.

Q26. If otherwise complete, current will not flow in a circuit if its switch is closed.

Q27. When a wall switch is flipped to the *on* position, the switch is open, permitting the lamp to light.

Q28. If the insulation on a wire is broken or damaged, it may cause a short circuit.

Your Answers Should Be:

A24. A voltage source causes current to flow if a complete circuit is provided. *True.*

A25. Current will flow if there is a complete electrical path from the voltage source to the device, through the device, and back to the voltage source. *True.*

A26. If otherwise complete, current will not flow in a circuit if its switch is closed. *False.*

A27. When a wall switch is flipped to the *on* position, the switch is open, permitting the lamp to light. *False.*

A28. If the insulation on a wire is broken or damaged, it may cause a short circuit. *True.*

VOLTAGE AND CURRENT

In this section you will become acquainted with voltage and current measurement units. You will also become familiar with the commonly used values of these units.

Voltage

Voltage is measured in terms of a unit called a volt. A measurement unit indicates quantity or amount, as in gallons of water or pounds of sugar. As a similar unit, *volts* expresses a quantity contained in a voltage source. Though voltage is not visible like water and sugar, the number of volts expresses the amount of electrical pressure available from the source. As you remember, it is this pressure that causes current to flow. The greater the pressure (number of volts), the greater the current will be.

Current

Current is measured in terms of a unit called an *ampere*. The number of amperes defines the amount of current that is flowing in a circuit. A typical flashlight lamp (bulb), for example, draws 0.25 *ampere* (abbreviated as *amp*) from the voltage source.

A 100-watt lamp draws approximately 1 amp from the 117-volt home electrical system. Ten amps flow through some electric irons, toasters, and heaters. A car battery supplies 100 amps or more to a starter motor.

Large and Small Values

Values of voltage and current can be very large or very small. Since it is awkward to talk and write about 500,000 volts or 0.003 amp, units which are more easily handled have been developed. With this system the quantities mentioned become 500 kilovolts and 3 milliamps, respectively. A *kilovolt* represents 1000 volts and a *milliamp*, 0.001 amp.

The table on the next page will help you convert from one unit to another.

Q29. Voltage is measured by a unit called a(an) _____.

Q30. The number of volts indicates the quantity of _____ _____ contained in a voltage source.

Q31. An ampere is a unit that indicates the quantity of _____.

Q32. Assuming that the voltage source can provide the current, what determines the number of amps that will flow in a circuit?

Q33. 3 kilovolts is (larger, smaller) than 100 millivolts.

Q34. How much of an amp is 15 microamps?

Q35. Convert 16 megavolts to volts.

Your Answers Should Be:

A29. Voltage is measured by a unit called a *volt*.

A30. The number of volts indicates the quantity of *electrical pressure* contained in a voltage source.

A31. An ampere is a unit that indicates the quantity of *current*.

A32. The *operating device* determines the number of amps that will flow in a circuit, assuming the voltage source can provide it.

A33. 3 kilovolts is *larger* than 100 millivolts.

A34. 15 microamps is *0.000015 amp*.

A35. 16 megavolts is equivalent to *16,000,000 volts*.

DIRECT CURRENT

A current that always flows in the same direction is called a *direct current*. Dry cells and batteries are sources of direct current. Some types of electric

CONVERSION TABLE

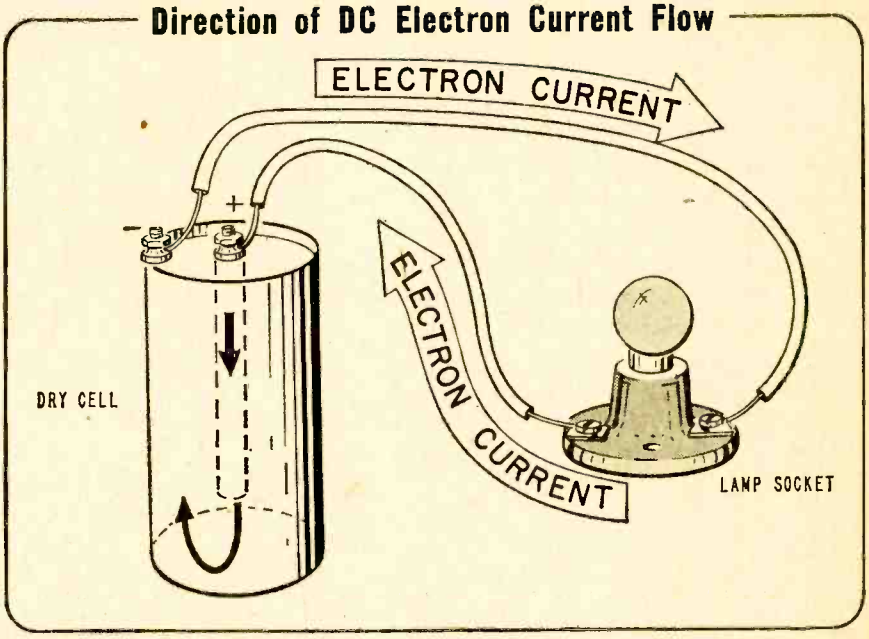
When You See	Do This to Convert	Example
Mega or M	Multiply by 1,000,000	2 Megavolts is 2,000,000 volts
Kilo or K	Multiply by 1,000	5 Kiloamps is 5,000 amps
Milli or m	Divide by 1,000	7 Millivolts is 0.007 volt
Micro or μ	Divide by 1,000,000	9 μamps is 0.000009 amp
Nano or n	Divide by 1,000,000,000	5 nano volts is 0.000000005 volt
Pico or p	Divide by 1,000,000,000,000	4 pico-amps is 0.000000000004 amp

generators also supply direct current. Later you will learn about a power supply which provides direct current for use within radio and TV receivers.

Is There a Direct Voltage?

Yes. A voltage which provides direct current is considered to be a direct voltage. Since direct current is abbreviated DC, the abbreviation is used to identify direct voltage as DC voltage. Direct current is often shortened to DC current, or merely DC.

Direction of DC Electron Current Flow



Direction of Current Flow

Marking the terminals of a voltage source with plus (+) and minus (−) signs indicates the direction in which current flows in a circuit. There are two systems describing the direction of current flow—*conventional* and *electron*.

The conventional current theory was the first to be developed. Benjamin Franklin is considered to be its originator, and it is still being used in many electrical engineering texts. *Conventional current* is said to flow *from the positive* (+) voltage terminal, through the circuit, and to return *to the negative* (−) voltage terminal.

The *electron current* theory, of more recent origin, permits a clearer expla-

nation of how current flows through electronic circuits. For this reason, the electron current direction of flow will be used in this course. This theory states that current *leaves the negative* (−) terminal, flows through the circuit, and *returns to the positive* (+) terminal of the voltage source.

If you learn the rules of electron flow, conventional flow should not be confusing. You will find it easy to mentally reverse directions.

Current flow does all the work involved in the operation of any electrical or electronic device, whether it is a simple lamp or a complicated electronic computer. In any application a continuous path must be provided between the two terminals of a voltage source before current can flow.

Q36. The connecting posts on the cell in the illustration are marked (+) and (−). The (+) post is the _____ terminal.

Q37. Inside the cell, electron current flows from the _____ terminal to the _____.

Your Answers Should Be:

A36. The (+) post is the *positive* terminal.

A37. Inside the cell, electron current flows from the *positive* terminal to the *negative* terminal. Though the text did not provide this information, the illustration reveals the proper direction. Current must flow in this direction inside the battery if it is to move from negative to positive through the circuit.

ALTERNATING CURRENT

A current that reverses its direction of flow at regular intervals is called *alternating current (AC)*. You might ask, "Why should we have a current that is constantly changing its direction?" The answer is fairly simple. AC has certain features that make it desirable. The two main reasons are:

Reason 1. Wall outlets in your home supply an AC voltage. This voltage is produced by generators located many miles away. During the earliest days of electricity, DC was supplied to homes. However, DC can be sent through lines for only short distances.

AC can be easily changed to a higher or lower value. This characteristic makes possible its economical transmission over long distances—hundreds of miles in some cases. As a result, AC generating plants can be located at remote sources of water power and still be able to supply customers miles away. A good example of this application is the generating equipment at Hoover Dam in Arizona supplying power to cities on the West Coast, hundreds of miles distant.

Reason 2. Energy in many forms, such as sound and radio waves, occurs in alternating cycles. Sound waves, for instance, are alternating areas of

maximum and minimum air pressure. When converted into electricity, as in the telephone, the resulting current is also alternating, thus the sound is faithfully transmitted. Clearly, it simply isn't feasible to convey such information via DC.

WHAT YOU HAVE LEARNED

1. The measurement unit of electrical pressure is the volt. It defines the amount of electrical pressure available in a voltage source.
2. The measurement unit for current is the ampere, abbreviated amp. Assuming that a sufficient amount of current can be supplied by the voltage source, the number of amperes that flow in a circuit is determined by the needs of the operating device. Operating devices are designed for a specified number of volts, and are so constructed as to draw the required number of amps when operated at that voltage.
3. Volt and ampere quantities are often expressed in very large and very small numbers. To ease the task of writing or speaking of very large or very small numbers, prefixes, such as mega-, kilo-, milli-, and micro-, have been added to the basic units of volts and amperes.
4. A current that always flows in the same direction is direct current. Its abbreviation is DC, which can be used to specify DC current or DC voltage.
5. Current flows from the negative terminal of a voltage source, through the circuit, and returns to the positive terminal. Inside the voltage source, current flows from the positive to the negative terminal. This is in accordance with the electron current theory.
6. A current that reverses its direction of flow at regular intervals is called alternating current (AC). AC voltage and current can be transmitted over long distances, but DC cannot. AC is also the only means of converting certain types of energy into useful electrical representations.

Q38. A volt is a measurement of _____, and an ampere is a measurement of _____.

Q39. According to the electron current theory, current flows from the _____ voltage terminal, through the circuit and returns to the _____ terminal.

Your Answers Should Be:

A38. A volt is a measurement of *voltage*, and an ampere is a measurement of *current*.

A39. According to the electron current theory, current flows from the *negative* (−) voltage terminal, through the circuit, and returns to the *positive* (+) terminal.

NEXT ISSUE: Part II—Understanding Resistors

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. @ $19.95. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

LITERATURE

★ Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

LIBRARY

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★102. Before you buy your next *xtal*, get ahold of *Sentry's* 1968 catalog. *Sentry* lists the best in precision quartz crystals and communications goodies. Check off 102 now!

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★23. No electronics bargain hunter should be caught without the 1968 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

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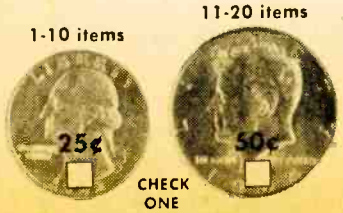

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Tiger Tail

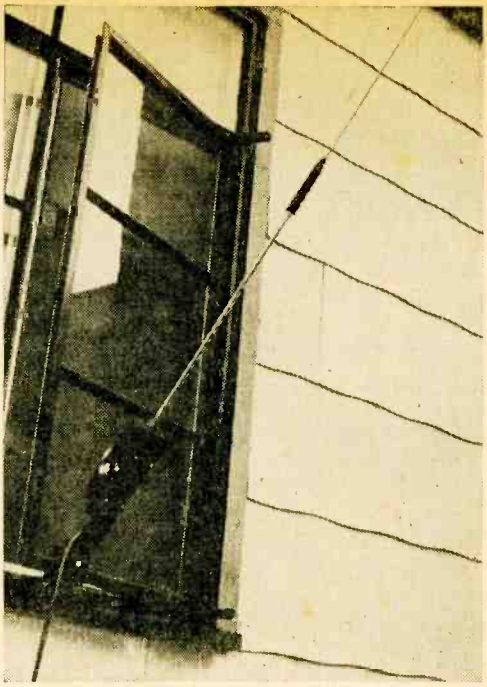
Continued from page 94

as any other portable antenna and far surpassed most types such as shortened and full-length whips. The reason appears to be that whips are generally designed to operate against a ground plane—usually a large horizontal metal surface—which produces a 50- or 72-ohm antenna impedance and a low angle of radiation. Without the ground plane, which is usually provided by wire radials or the metal surface of a vehicle, the antenna impedance can be well below that of the transmission line, causing severe mismatch.

The design of *Tiger Tail* is such that it provides its own "ground plane" through the coaxial isolation and matching section. Combined with the impedance-matching transformer at the base of the radiator, the *Tiger Tail* generally presents an input impedance approximating that of the transmission line, and therefore maintains a low radiation angle and good SWR characteristics.

Summing Up. There's not much more we can say about something that does everything it's supposed to do. But if you need a portable, window, or semi-permanent, side-mounted antenna, the *Tiger Tail* will undoubtedly be your best choice.

The *Tiger Tail*, which comes complete with mounting bracket, 10 feet of transmission line, and a coax connector, is priced at $29.95. For additional information write to Elenex. Inc., Dept. D, 123 Main St., Naples, N.Y. 14512. ■



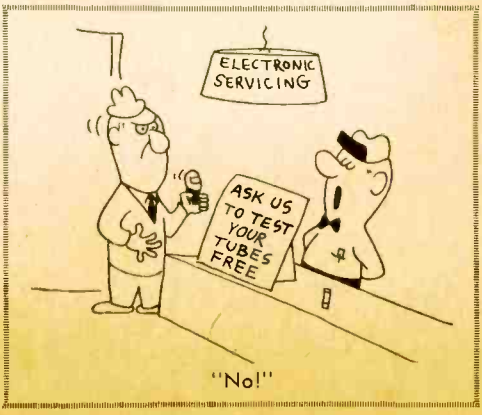
Ready to put you on the air any place, any time, Tiger Tail is shown here in a typical quickie installation, clamped on a kitchen window frame.

Hey, Look Me Over!

Continued from page 31

Miller-Stephenson Type MS-240 Component Quik-Freeze

Miller-Stephenson Chemical Co. will freeze any small area instantly to −50°F. with either its wide spray nozzle or a 6-in. extension pin-point nozzle. Quik-Freeze is recommended for: protecting valuable parts while heat testing; locating defective intermittent components; prototype testing of circuitry; leak detection; and preventing heat transfer during soldering or welding operations. But don't spray it on your skin—it can cause frostbite. In 12-oz. spray cans, their price schedule goes $1.95 a can from 1-11 dozen; $1.65 per can from 12-47 dozen; and their minimum order is 4 cans at $3.00 per can. Write to Miller-Stephenson Chemical Co., Inc., Rte. 7, Danbury, Conn. 06810. ■



Tackle That Totable TV

Continued from page 60

the trouble and the tubes are O.K. Check for low grid drive voltage on the output tube and check the associated components. Most width problems are found in the horizontal output sweep circuit (see Fig. 15).

Also look for a brass sleeve (on some portables) around the CRT gun and yoke assembly. Loosen up the yoke assembly screw and pull the brass shim out toward the picture tube socket to increase picture width. On deluxe portables with a horizontal drive control, check that it's set correctly. Try adjusting the control for correct width. Going too far will produce one or two white vertical drive lines from the middle to the left side of the CRT screen, in which case the control should be backed off a bit.

Horizontal Lines. Check the horizontal tubes when lines are lying across the CRT and cannot be straightened up with the horizontal hold control (see Fig. 16). If this doesn't do the job, adjust the horizontal frequency coil slug. Set the horizontal hold control in the center of rotation and adjust the horizontal frequency coil slug until the picture locks in. Now switch the channel selector knob to another channel and see if the horizontal circuit stays locked in. If not, it may be necessary to make another fine adjustment of the horizontal frequency coil.

When the horizontal lines will not straighten up or the raster goes into a *Christmas-tree* effect or jagged horizontal lines, check for a defective AFC circuit. In current portables, a duo-diode rectifier with three leads serves as the AFC component as shown in the schematic in Fig. 17.

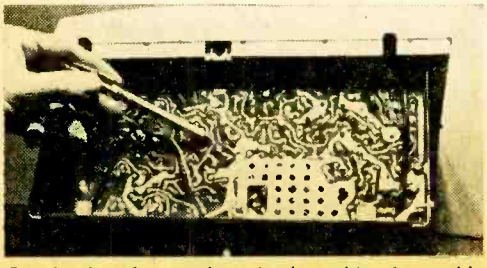


Fig. 24. Last but not least in the stable of portable TV troubles is the printed circuit board. Check it for cracks and cold solder joints in the area of the defective circuit, especially around heavy components.

To remove the duo-diode, cut off the leads about ½ in. from the PC board. Now you can solder a new AFC diode (or the old one) to these leads. Take a resistance measurement of the duo-diode rectifier; these are usually of the common cathode type (the center terminal is common to the two outside leads). Connect the ground lead from the ohmmeter to the center diode terminal. Now measure the resistance from each outside lead; the reading should be around 20 K. Reversing the ohmmeter leads should produce a zero-ohms reading. A leaky duo-diode will show a low resistance both ways.

A keystone, or triangular, picture is caused by a shorted deflection yoke and can only be remedied by replacing it with a new one. Bending and pulling of the picture can be caused by a defective horizontal oscillator or output tube. Excessive blooming of the picture when the brightness control is cranked up is caused by weak horizontal output or high voltage tube.

Bright Horizontal Line. If the picture consists of a single horizontal line, replace the vertical oscillator and multiplier tube. The bright horizontal line indicates the vertical sweep is not operating (see Fig. 18).

If tube replacement does not help, try adjusting the vertical height and linearity controls, or both. It is possible for the vertical height control to have a burnt spot, causing the vertical sweep to collapse. Check for continuity of the vertical output transformer windings. Also check to see if the feedback coupling capacitor shown in Fig. 19 is leaky.

For insufficient height, at top or bottom of the raster, adjust the vertical height and linearity controls. A weak vertical oscillator or output tube can cause this problem, too.

Constant vertical rolling of the picture can often be cured with a new vertical oscillator tube. If the picture is unstable both vertically and horizontally, the fault lies in the sync section. Replace both vertical and sync separator tubes. Some portables have both features in one tube, while others may have these sections in a separate tube or located in one-half of another dual-function tube.

Snowy Picture. A picture very light in detail with a lot of snow on the screen as in Fig. 20 is usually caused by a defective RF tube in the tuner. Substitute a new RF, oscillator, and first IF tube and see if the situation improves.

Picture still snowy? Then dig into the antenna coils and lead-in connections. Most portable receivers have isolating capacitors in the antenna input terminals. These capacitors protect the antenna coils and tuner (see Fig. 21).

In case lightning has struck your antenna, you may find one or both of these capacitors blown open. With an ohmmeter, check continuity of both antenna coils. You will find the antenna coils located on top at the rear, or inside, of the tuner cover. Be sure and replace damaged antenna coils with direct factory replacements.

Stations Won't Stay On Channel. In case the picture will not stay on channel or becomes snowy when the channel selector is jogged, clean the tuner (Fig. 22) with a good tuner spray lube. With the strip or turret-type tuner, clean the contact points with rag and cleaning solution. Bear down with the clean section of the rag to brighten up the contacts. Apply contact grease over the clean contacts and don't forget to spray the contact springs located under the tuner drum.

Many small tuners use a rotating multisection wafer switch. Spray these contacts and rotate the tuner shaft at the same time. Select a good tuner spray that won't be harmful to plastic parts in the tuner assembly.

Conclusion. There are many troubles that can develop in a portable TV. Remember to go slow and easy. Look, listen, and try to isolate which section the trouble is in. Be careful not to break off any control knobs on the rear of the chassis or damage the set in any other way.

You will find that all tubes and parts are quite close together in portables. Some of the tubes and parts are hard to get at, so proceed with caution (see Fig. 23). If the set has been subjected to abuse, don't forget to check the PC board for possible intermittent condition (see Fig. 24). Especially on the earlier sets, PC boards were subject to many problems.

But with care and a little use of the old think tank, most portable TV problems can be easily solved. So, go to it with confidence and save a few bucks while you're at it. ■

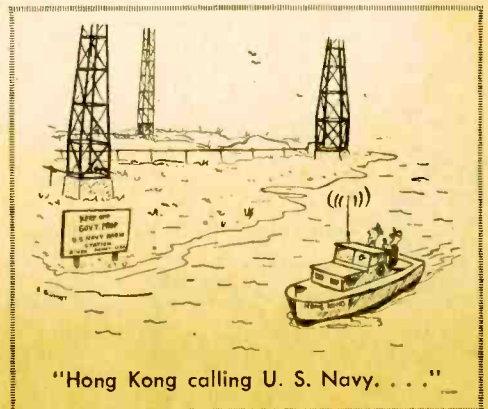
Continental DX

Continued from page 92

the Hellenic National Broadcasting Institute —has only a very limited international service, intended for Greek seamen aboard. This is best heard in NA on 15345 kHz at 1230 EST. The station can be readily identified via its flute interval signal. However, it is also reasonable to assume that the Athens government will, like R. Portugal, find it expedient to sell their policies through the media of international broacasting. If so, that would mean an expanded schedule for HNBI and possibly new high-powered transmitters. Already there is an unconfirmed report of test transmissions in French and English on 17745 kHz at 1440 EST.

It is also a little disturbing to note that, under an agreement made with the previous democratic regime, HNBI continues to use Voice of America facilities at Thessaloniki (frequencies include 9710 at 0545-0930 and 7290 kHz at 1500 EST). Just how long this arrangement will continue is a matter of speculation. The VOA's own transmissions from Greece are not too difficult to hear. Try 7205 and 7295 around 1600, or 7130 around 2230 EST (1930 PST) S/On. ■

Reception verification card from Swedish DX alliance.



"Hong Kong calling U. S. Navy. . . ."

When Color Won't Stay Put

Continued from page 80

pares burst and 3.58 oscillator frequencies and creates the DC correction voltage.

But for comparison action to occur, the diodes in the Phase Detector must be electrically balanced, even when no burst is present. This provides a basis for a simple test. First, place a shorting jumper from grid to ground of the Burst Amp, as shown. This kills any incoming burst which would disturb the test.

Then place a VTVM across the plate of the Phase Detector and to ground. If your circuit is typical of many, you should read approximately −28 VDC at this point. Next measure the diode cathode to ground for a reading of +28 VDC. Voltages in different circuits may vary, but the important feature is that they are typically equal and opposite. This is a good indication of proper balance in the stage. Resistors and capacitors should be checked if voltages are unequal.

O.K. Phase. If there's good voltage balance in the Phase Detector, shift attention to the Burst Amplifier. Voltage and resistance checks here stand a good chance of revealing the trouble. If you can't pinpoint the culprit, perhaps the incoming burst signal isn't reaching the Burst Amp.

We've shown the source of the burst in Fig. 11. Note that it's from a tap-off point from the Color Amp. If any components between this point and the grid of the Burst Amp are defective, there could be an interruption of the burst signal. So check resistors, capacitors, or coils in this part of the circuit. If you're getting color on the screen, even if it's out-of-sync, chances are the other stages shown in Fig. 11 are functioning. Explanation for this fact is that the color signal must traverse those stages in order to reach the picture tube.

Thus, with little more than a VTVM and a jumper wire, you should be able to track down most troubles in color sync circuits. The simple tests described help locate the general area, or even a particular stage that's upsetting color stability.

If you run into an exotic problem that won't yield to these tests, chances are you'll need an oscilloscope to examine actual signals in transit through color-sync stages. Fortunately, set manufacturers usually provide ample information and scope traces to serve as a guide.

A typical schematic by RCA is illustrated in Fig. 12. Note that the scope waveforms seen at the bottom correspond to numbered points in the diagram. Both the shape of wave and its P-P (peak-to-peak) voltage are given for running comparisons with what you see on your scope. ■

Troubleshooting Stic

Continued from page 65

the shield. Then complete the probe assembly. Again, the output cable must be shielded.

The ground test lead passes, with the output cable, through the pre-drilled hole in the rear of the probe. The terminal board is oriented so the end with the lug is nearest this hole.

Using The IC Signal Tracer. When checking audio circuits, such as an amplifier or a radio after the detector stage, connect the audio (AF) probe to J1. When checking radio frequency circuits connect the RF probe to J1.

IF and low-level audio circuits of tube-type equipment generally will have a high enough voltage (except for possibly the RF stage) to produce at least a very weak signal tracer volume. Solid-state circuits, on the other hand, are current devices, and circuit voltage may be too low to produce usable signal-tracer volume. This is also generally true of low level amplifiers—the mixer or first IF of a solid-state radio or a microphone preamplifier in a PA system or tape recorder.

Sometimes a signal generator can be connected to the equipment under test, with the generator level high enough to produce a usable signal tracer volume even in the low-level stages.

Of course, the basic tracer itself—less the probes—can be used as a general-purpose amplifier to check home-brew projects or for an audio preamplifier. Either way, for a very small investment in time and money you become the proud owner of an essential piece of bench test gear that'll stand you in good stead for many a year to come—not to mention the fact that you'll have obtained practical experience in the newest of the new, integrated circuits. ■

Knight-Kit KG-686

Continued from page 90

for alignment. Dial calibration does not require a frequency meter as the internal 1 MHz and 100 kHz calibrators provide accurate alignment signals.

Since the final performance will be determined entirely by the alignment, do it slowly and patiently; figure one to two hours for a complete job—most of the time devoted to the dial calibration. Since the coils are pre-aligned, you'll be very close to accurate alignment before you start. Actually, you will just be "trimming" the oscillator, which, if done carefully, will result in dial calibration equal or better than that of a lab grade generator.

Performance. Regardless of its cost, a calibrated generator is worthless if the output voltage indication isn't accurate—and low price is not an excuse for inaccuracy in this instance. Accordingly, we compared the Knight-Kit KG-686 against a Measurements 80, a lab-grade calibrated RF generator.

Up to 30 MHz, the limit of our measuring equipment, the output voltage of the KG-686 was within 0.5 μV of the lab "standard" between the output voltages of 0.5 and 10 μV. Allowing for the tolerance of both generators, this was outstanding performance. Between 10 and 100,000 μV, the KG-686 was well within its rated tolerance.

The modulation depth is user calibrated at 50 percent. However, the actual percent modulation of the test RF signal was somewhat higher than the indicated 30 percent modulation shown on the KG-686. Since 30 percent is more or less the standard test modulation depth, we suggest you calibrate your KG-686 to be accurate at 30 percent meter reading.

The dial accuracy was extremely good, surpassing that of several lab-grade generators. This is due completely to the built-in crystal calibrators and is an indication of the performance you can expect if you take plenty of time and do a good job on the overall alignment.

The RF waveform is slightly distorted, lacking symmetry; and there is a lack of symmetry of the positive and negative modulation. However, lack of signal purity will not affect the average Ham, CBer, experimenter or service shop to any serious—or even noticeable—degree. In fact, a laboratory-type solid-state job priced at approximately $300 showed the same reduced waveform purity.

Then what is the difference between the Knight-Kit KG-686 and a lab grade calibrated generator? The difference is primarily frequency stability. A lab grade generator will hold its frequency-set even under rough handling. The KG-686, on the other hand, is extremely sensitive to handling. Fact is, just a slight pressure on the cabinet or panel is enough to cause the output frequency to change slightly. However, we could not detect any frequency drift when the generator wasn't handled—so take your cue from that.

Another difference is long term calibration. A lab grade generator will stay on calibration due to ruggedized components and general lab-grade quality. The KG-686 uses standard grade components and you should expect to re-align occasionally, perhaps once or twice a year; but when you've done the alignment once, doing it again is a routine job and is a small price to pay for a low-cost calibrated generator.

Summing Up. The performance of Knight's KG-686 represents a value considerably in excess of the $95 kit price. It is presently the only low cost means of accurately determining the performance of receiving equipment. All in all, its outstanding features and low cost should put it on a lot of peoples' test-gear dream list.

For additional information write to Allied Radio Corp., Dept. 20, 100 N. Western Ave., Chicago, Ill. 60680. ■

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