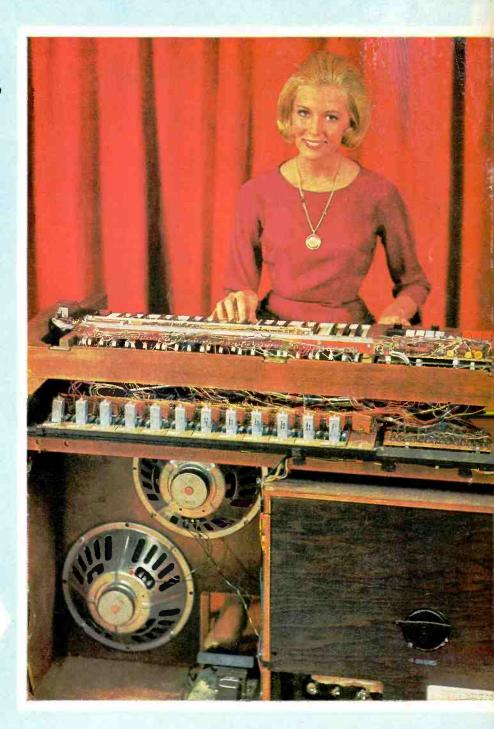


REPAIRRecord Changers

BUILD
The Busy Box:
A THINKING TOT'S TOY

TRACK
Radio and
TV Interference

BUILT FROM A KIT: All-transistor Electronic Organ







Model 630-NA

VOLT-OHM-MILLIAMMETER PRICE \$7950

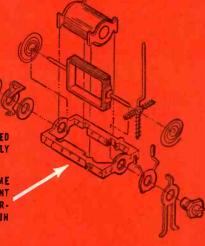
EXCLUSIVE PATENTED

Bar-Ring Shielded Movements



INSIDE SOFT IRON RING: FULLY SELF-SHIELDED

DIE CAST ONE-PIECE FRAME PROVIDES PERFECT ALIGNMENT FOR TOP AND BOTTOM BEAR-INGS. HOLDS IRON CORE IN **EXACT ALIGNMENT**



FACTS MAKE FEATURES:

6000 OFF 6000.

- 70 RANGES-nearly double those of conventional testers. Unbreakable window. Mirror Scale.
- HIGHEST ACCURACY-11/2% DC to 1200 volts, 3% AC to 1200 volts; mirror scale and knife-edge pointer to eliminate parallax.
- FREQUENCY COMPENSATED—Flat from 20 CPS to 100,000 CPS; varies from 1/4 to 11/4 DB at 500,000 CPS. Temperature compensated. Meter protection against overloads.

THE TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

Uses Unlimited:

FIELD ENGINEERS # APPLICATION ENGINEERS = ELECTRICAL, RADIO, TV, AND APPLIANCE SERVICEMEN ■ ELECTRICAL CONTRACTORS ■ FACTORY MAINTENANCE MEN INDUSTRIAL ELECTRONIC MAIN-TENANCE TECHNICIANS BHOME OWNERS, HOBBYISTS

Circle 1 on reader's service card



THE WORLD'S MOST COMPLETE LINE OF V-O-M'S. AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK



Every 40 seconds a burglary takes place in the United States.

TECHNICAL INFORMATION

The RADAR SENTRY ALARM is a complete U.H.F. Doppler Radar System which saturates the entire protected area with invisible r.f. microwaves. It provides complete wall to wall-floor to ceiling protection for an area of up to 5,000 square feet. Without human movement in the protected area, the microwave signal remains stable. Any human movement (operation is unaffected by rodents and small animals)in the area causes the doppler signal to change frequency approximately 2 to 4 cps. An ultra-stable low frequency de-tector senses this small frequency change, amplifies it and triggers the police type sirenwhich is heard up to a half mile

In addition, the RADAR SEN-TRY ALARM's protection can be extended to other areas with the use of the following optional accessories:

- remote detectors for extending coverage to over 10,000 sq. ft.
- rate of rise fire detector U.L. approved for 2,500 sq. ft. of coverage each (no limit on the number of remote detectors that can be used)
- · hold-up alarm
- central station or police station transmitter and receiver (used with a leased telephone line)
- relay unit for activating house
- · battery operated horn or bell which sounds in the event of: powerline failure; equipment malfunction or tampering

At that rate, it's a multi-million dollar a year business...for burglars.

And an even better business opportunity for you.

Why? Because burglary can be stopped...with an effective alarm system.

In fact, police and insurance officials have proved that an alarm system reduces, and in many cases, eliminates losses-even helps police apprehend the criminal.

Here's where you come in.

Only a small percentage of the more than 100 million buildingsstores, offices, factories, schools, churches and homes are protected by an effective alarm system.

That means virtually every home, every business is a prospect.

You can sell them!

And you don't have to be a super-salesman to sell the best protection available—a Radar Sentry Alarm unit. All you have to do is demonstrate it...it sells itself.

A glance at the technical information shows why.

It's the most unique and effective alarm system ever invented.

And here's the proof.
In the past six years, thousands
of RADAR SENTRY ALARM units have been sold in the Detroit, Michigan area alone-sold by men like yourself on a part-time and full-

Here are just a few customers who are protected by RADAR SENTRY ALARMS:

U.S. Government U.S. Air Force Detroit Board of Education Hundreds of Churches, Banks, Businesses and Homes.

Everyone is a prospect.

So take advantage of your profession. Put your technical knowledge and experience to work for you in a totally new area—an area that will make money for you!

Don't wait!

Let us prove that crime does pay

Become a distributor.

Write now for free details.

RADAR SENTRY ALARM



Circle 2 on reader's service card

Mail to: RADAR DEVICES MANUFACTURING CORP. 22003 Harper Ave., St. Clair Shores, Michigan 48080



Please tell me how I can have a business of my own distributing Radar Sentry Alarm Systems. I understand there is no obligation.

City____State & Code____



Get with the new PRECISE Green line for truly new design and decor in test instruments. These unique units have color dynamic front panels featuring easy-on-the-eyes Green to aid readability and accuracy. New functional design and layout make operation fast and foolproof. Inside, they're on line with sophisticated circuitry checked out for reliability. So when it comes to test instruments, take the best course. Swing with PRECISE scopes, VTVMs, power supplies, signal generators, tube testers, decade boxes and probes.

MODEL 636
AF SINE SQUARE GENERATOR — 20 cps to 200 kc in four ranges. Less than 0.25% sine wave distortion at 10 vrms into 600 ohms load.

Kit: \$45.95 Net Wired: \$61.95 Net

MODEL 780
CONTINUOUSLY VARIABLE REGULATED VOLTAGE SUPPLY — Regulated dc output from 0 to +400 v at 150 ma, and 0 to -150 v bias. Also provides unregulated ac. Meters for voltage and current.
Wired: \$99.95 Net

WODEL 905
VACUUM TUBE VOLTMETER — Comes with assembled dc/ac-ohms probe. Direct reading of p-p voltages. Separate ac low voltage scale. Low 0.5 vdc range for transistor circuit measurements.

Kit: \$32.95 Net Wired: \$49.95 Net



PRECISE ELECTRONICS / Division of Designatronics, Inc. / Mineola, L. I., N.Y.

Radio-Electronics

97 New Books

77 New Literature

Over 55 Years of Electronic Publishing

SEIVII-A	1111	UAL INDEX	
	84	Index for July-December 1965, inclusive	
EDITOR	HAL		
	31	Fuel Cells	Hugo Gernsback
AUDIO	•		
COVER STORY	40	We Built An Electronic Organ	F J Sh
COVER STORT	40	Formidable-sounding project is easy with new Heathkit	rrea Suunaman
	42	Home "Message Center" Features Electronic Stop	Robert F. Scott
	. –	Miniature tape recorder signals when message has been left	
	46	Repair Record Changers	Homer L. Davidson
		All at sea with mechanical things? This article should help	
	56	Feedback, Phase & Instability	Norman Crowhurst
	27.	A peek into what makes modern amplifiers sound so good-	
	64	Equipment Report: Sonotone RM-2 Speaker System; Elec	
		Studio Monitor Loudspeaker (p. 68)	
	77	RIAA Issues Tape Standard	F11 . D 11
	80	The Search for Sound Restrain yourself, buddy	Elbert Kobberson
ELECT			
			D 117 1
	48	De Luxe Printing Timer Build-your-own darkroom accessory works with contact prin	
	58	The Ion Gage-A Tube Looking for a Vacuum	
	36	It has a large, deliberate hole in it	I. F. Sinciair
TECTI	ve		
159111		RUMENTS	
	53	Scope Plug-In Unit Seeks Range, Shows Waveform	E1 C C 1
	54	Scope Improvers Four quick, inexpensive alterations for low-priced scopes	Elmer C. Carlson
	64	Equipment Report: EICO Model 342 FM Multiplex Genera	uton
	69	Add a Zero-Setter to Your AC VTVM	
	0,9	Mercury cell bucks out zero offset due to internal hum and	
GENER	ΔΙ		
DEIVE		Service Clinic	I I. D
	14	Replacing Weak High-Current Seleniums	Jack Darr
	43	What's New	
	44	Busy-Box: A Thinking Tot's Toy	John A Tiso
	77	Build one for the Junior Engineer	
CAREER SERIES	51	The Factory Analyzer	Charles R. Wheeler
		Could you make the grade in this exciting field?	
	55	What's Your EQ?	
TELEVIS	1018	V	
	32	How to Track Interference	Thomas R. Haskett
		Systematic procedure for finding the source of radio-TV into	
	38	Service Color TV-Traps and Pitfalls	Matthew Mandl
		Some familar black-and-white circuits are a little different i	n color sets
RADIO			
	34	Are We Really Making Progress?	Harold Davis
-	35	Transistorize Your Tube Portable	James E. Pugh, Jr.
		Emitter-coupled stages use old antenna, i.f. and oscillator tr	ansformers
	50	Check That Antenna Pigtail	
THE DE	PΔ	RTMENTS	
Correspondence	. , ,		eworthy Circuits
Gorrospondence		7 TICH I TOUGES	on on the children

Cover photograph by Harry Schlack

87 New Semiconductors & Tubes

4 News Briefs

70 Reader's Service Page

Member,
Institute of High Fractity
Radio-Electronics
is indexed in
Applied Science
& Technology Index
(Formerly

HUGO GERNSBACK, editor-in chief and publisher. M. HARVEY GERNSBACK, editor. Fred Shunaman, managing editor. Robert F. Scott, W2PWG, technical editor. Peter E. Sutheim, associate editor. Jack Darr, service editor. I. Queen, editorial associate. John J. Lamson, eastern sales manager. Wm. Lyon McLaughlin, technical illustration director.

88 Technotes
92 Try This One

55 50 Years Ago

RADIO-ELECTRONICS, December 1965, Volume XXXVI. No. 12, Published monthly by Gernsback Publications, Inc. at Ferry Street, Concord. N. H. 03302. Second-class postage paid at Concord, N. H. Prin ed in U.S.A. One-year tubscription rate: U.S. and possessions, Canada. \$5. Pan-American countries, \$6. Other countries, \$6.50. Single copies: 50¢.

© 1965, by Gernsback Publications, Inc. All rights reserved. POSTMASTERS: Send Form 3579 to 154 W. 14th St., New York 10011.

NEWS BRIEFS

AUTOMATED NEWSPAPER ESTABLISHED IN ENGLAND

The Evening Post of Reading, England is going to press with computer control, photographic typesetting and offset color printing. The owner of the new Post, Lord Thomson of Fleet, states that computer operations may be extended to more of his 128 newspapers. He said, "I can envisage one big computer that would be capable of setting type for the whole of England."

The copy is first typed manually onto punched tape. This tape is fed into a computer, which divides the typed material up into lines and justifies the lines—makes a uniform right margin—like a newspaper column. It also hyphenates words properly when they have to be divided at the end of a line.

The tape produced by the computer is fed into a photographic type-setting device that turns out readable newspaper columns. These are assembled on pages and reproduced on photosensitive plates from which the newspaper is printed by the offset method.

ANALYZING HEARTBEATS ULTRASONICALLY

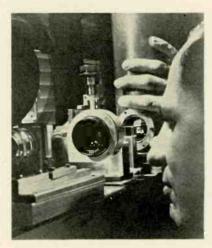
A device which uses the Doppler shifts of frequency in the ultrasonic echoes returned by moving surfaces is being used in cardiovascular research at the National Naval Medical Center in Bethesda, Md. The invention of J. R. Richards, it can detect the respiratory activity of a goldfish, monitor different parts of the heart, or keep check on a baby's heart during delivery. Cost is estimated at about one-seventh the price of a complete electrocardiograph.

NEW LASER LIGHT DETECTOR HAS HIGH SENSITIVITY, SPEED

A new supersensitive light detector for practical laser communications has been announced by the Radio Corporation of America. Developed by Drs. Henry S. Sommers, Jr. and Edward K. Gatchell, the new light sensor is said to be the first detector developed with a sensitivity, speed and frequency range that could make laser communications practical across the optical spectrum. It can sense up to 100 million intensity changes a second in a beam of light. Thus it could dis-

tinguish as many as 25 separate TV programs carried simultaneously.

The new light sensor is a frecklesize speck of photoconductive material mounted in a small cavity, con-



Herbert Ogawa of RCA's Princeton Laboratories checks the high-frequency laser detector.

tinuously bathed in microwaves at a frequency of 10 gigacycles. When amplitude-modulated light enters the cavity and strikes the photoconductor, it frees electrons, which begin to oscillate rapidly up and down within the material in response to the alternating electric field of the microwaves. The amplitude of these oscillations controls the amount of microwave power permitted to leave the cavity. Thus intensity variations in the incoming light are converted to intensity variations in the outgoing microwaves. The modulated microwave signal can then be detected and processed by conventional techniques.

MICROWAVE FREQUENCY MULTIPLIER SHOWS 4-DB POWER GAIN

The first single transistor to offer watts of microwave power was announced recently by RCA Electronic Components & Devices. The new device is an "overlay" transistor, RCA 2N4012. It extends transistor performance into the gigacycle frequency region with 2.5 watts output and 4 db conversion gain when operated as a tripler with output at 1 gc. One 2N4012 can replace both the transistor power-amplifier and varactordiode stages formerly required, making it possible to simplify circuit design greatly and to reduce cost in new telemetry and microwave equipment. Frequency multiplication with power amplification is possible with the overlay structure because the variable collector-to-base capacitance becomes the nonlinear element of a harmonic generator. The collector-to-base capacitance acts like a variable-capacitance diode, or varactor, in parallel with the amplifier section of the transistor.

In the overlay structure, which has been used before for uhf-microwave work, are a number of individual emitter sites, all connected in parallel and used with a single base and collector region. This arrangement provides a substantial increase over other transistor structures in emitter periphery, increasing current or power; and a corresponding decrease in emitter and collector areas, reducing input and output capacitances. The overlay structure thus offers greater power output, gain, efficiency and frequency capability.

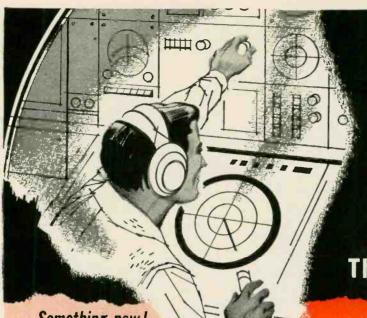
SWEDISH STAMP COMMEMORATES ONE HUNDRED YEARS OF ITU

The Swedish government has issued a stamp with a short-wave antenna motif, commemorating the centenary of the International Telecommunications Union. The stamp is mod-



eled after an actual log-periodic antenna belonging to a remote-controlled short-wave transmitting station of the Swedish Post Office. The antenna is installed at Grimeton. It is rotatable, and both its direction and frequency are automatically controlled from Stockholm, 300 miles away.

The 43-meter antenna and its single-sideband short-wave transmitter



5,000 FIRMS HAVE **EMPLOYED** DEVRY TECH **ELECTRONICS GRADUATES...**

There Must be a Reason!

Something new!

LEARN AUTOMOTIVE and Maintenance **ELECTRICITY AT HOME!**

Here's another great opportunity for the man who wants has own business or a bigger pay check with a brighter future. It is a NEW DeVry program that gives you the advantage of earning while you learn.

Prepare in spare time at home for profitable jobs which can take you all the way from trouble-shooting on the electrical systems of automobiles, marine engines, trucks, tractors and other gazoline engines, to the general maintenance of e ectrical equipment in the home or in light industry.

DeVry's new program "brings the classroom to your home" through the magic of AUDIO-VISUAL AIDS Lectures recorded by DeVry in-structors combined with colorful 8 x 10" transparencies to make learning easier. You get the advantages of "programmed" learning through modern texts which are also handy for future



reference. To develop practical skill, you get and keep valuable shop equipment and manuals. This includes building the brand-new DeVry Transistorized Automotive Analyzer and the DeVry Silicon Battery Charger — ideal "tools" for earning ext a money as you go.

This new program covers the entire electrical extens in automobiles and other vehicles in

systems ir automobiles and other vehicles, insystems ir automobiles and other vehicles, including transistorized ignition systems, alternators and regulators, and other applications. In the maintenance field, it covers lighting, electric motors, ccatrols, wiring — even transistors. The graduate from this program can be either a specialist as a troubleshooter on the electrical system of an automobile, or handle electrical lighting, meating, alarm and control systems. It is ideal for "one man" maintenance denortments. is ideal for "one man" maintenance departments. Check coupon at right and mail it today for

ACCREDITED MEMBER OF NATIONAL HOME STUDY COUNCIL

DeVry Technical Institute

Let Us Prepare You at Home or In One of Our Two Big Resident Schools for a Profitable Career in

ELECTRONIC

Across the continent, leading employers of personnel trained in electronics tell us that DeVry training is "Tops." Get the full story of DeVry Tech and the advantages it offers, by filling in the coupon below. The two free booklets pictured below tell of many fine opportunities for trained men in electronics: the great variety of jobs, from research, production, operation, maintenance and servicing of electronic equipment - to a neighborhood TV-radio sales and service business of your own. They'll tell you too, how DeVry has prepared men for good jobs with outstanding firms: on practical, "brass-tacks" problems with actual electronic equipment.

Here's good news: you don't need advanced education or previous technical experience to get started. If you can follow simple directions, you should be able to prepare with DeVry's help for real money in a field that may offer the opportunity of your lifetime.

Employment Service: With many employers so enthusiastic about Devry Tech graduates, it's no wonder our Employment Service can help our graduates get started in electronics, or can assist them toward promotions later.

DeVRY TECHNICAL INSTITUTE 4141 Belmont Ave., Chicago, IIL 60641, Dept. RE-12-V

FREE!

SEND COUPON FOR BOOKLETS ON ELECTRONICS AS A CAREER



TATA Belliont Ave., Chicago, HE	1004x, Dept. NE-12-V			
☐ I AM INTERESTED IN ELECTRONICS. Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in				
Space Travell's also include de trails and the control for				
Space Travel"; also include details on how to prepare for a career				
in this field. The following opportunity fields (check one or more)				
interest me:				
Space & Missile Electronics	☐ Communications			
☐ Television & Radio	☐ Computers			
☐ Microwaves	☐ Industrial Electronics			
☐ Automation Electronics	☐ Broadcasting			
☐ Radar	☐ Electronic Control			

Broadcasting ☐ Electronic Control

☐ I AM INTERESTED IN AUTOMOTIVE AND MAINTENANCE ELECTRICITY. Please supply further information.

NAME _ AGE_ ADDRESS _

CITY STATE

☐ Check here if you are under 16 years of age. Available in Canada

FREE facta



*Major Parts are additional in Canada

were designed and built by the German firm of Rohde & Schwarz. Sweden, one of the 20 nations that 100 years ago signed the International Telegraphic Convention that led to today's ITU, has issued the stamp in two denominations, 60 and 140 ore (about 12 and 24 cents).

ULTRASONIC PROBES— NEW TEST INSTRUMENTS

An ultrasonic detector is being used to locate breakdowns in a series of 80 capacitors in 12-foot long, 2-million-volt flash X-ray pulser assemblies.

The equipment was designed by Lyman Davidson of the Field Emission Corp. in Oregon. According to its developer, it gives immediate indication of the breakdown's nature and locates it to a module of four capacitors among the 80.



Engineer checks for point of greatest noise in 2-mev flash X-ray system.

The device, known as the Delcon Ultrasonic Translator, is the size of a small camera, and consists of two interchangeable probes that respond to signals between 36 and 44 kc, plus equipment that translates the ultrasonic signal into the audible range and amplifies it for headphones.

The internal arcing caused by discontinuities in the encapsulating resin of a capacitor releases 40-kc energy which, when translated and amplified, is recognized by technicians as the sputtering, frying sound of corona.

NEW YORK HI-FI SHOW BUCKS NEWSPAPER STRIKE

The 1965 New York High Fidelity Music Show, held Sept. 29 through Oct. 3, drew sizable crowds in spite of the fact that only two of New York's six major daily papers were being published, and therefore publicity was limited.

The extensive display of home

← Circle 5 on reader's service card

high-fidelity equipment, which covered four floors of the New York Trade Show Building, was sponsored by the Institute of High Fidelity.

With the 1965 show, transistors have finally gained the upper hand over tubes. While many manufacturers are still using tubes primarily, all are now producing transistor equipment. Marantz, one of the most steadfastly conservative manufacturers in the matter of transistor design, presented an all-solid-state stereo control center which its president, Saul Marantz, described as "a transistor version of the model 7." Dyna, another holdout, announced its first transistor stereo power amplifier, which was to become available some time early in 1966.

Shure displayed a transistor headphone-only amplifier, the first of its kind, and McIntosh introduced a tubeand-transistor receiver—the first such beast from that company.

Newer manufacturers, children of the solid-state era—Acoustech, C/M Labs and Hadley—also showed new transistor units.

The show also featured seminars for the public, designed to acquaint them with component high fidelity and its advantages over "package" or "furniture" systems.

"MONGOLISM" LINKED TO RADAR

Mongolism, a form of mental retardation in children in which a fanciful resemblance to Mongol facial characteristics is noted, may be caused by radar exposure, according to a report presented to the annual meeting of the American Public Health Association held recently in Chicago.

A four-year study by Johns Hopkins University researchers shows that a significant number of mothers of mongoloid children had been exposed to larger than usual doses of radiation and that some of the fathers had a history of working around radar equipment.

German measles during the early part of the mother's pregnancy is considered the chief factor inducing mongolism.

H. A. HARTLEY DEAD

H. A. Hartley, loudspeaker designer and audio-high-fidelity author, died late in August. He had a sudden heart attack while vacationing.

Mr. Hartley's name is associated with Hartley speakers and with the "Boffle" (box/baffle) enclosure. He was the author of the Gernsback Library book Audio Design and of other books on a variety of subjects, as well as numerous articles in RADIO-ELECTRONICS and other magazines.

www.americanradiohistorv.com

america's no.1



VHF/UHF/FM ANTENNA!

Because it delivers best 82-channel TV performance—COLOR or black/white—plus FM/Stereo—using only a single downlead!

No other antenna works like the 82-channel JFD LPV-VU Color Log Periodic . . .

■ Only the JFD LPV-VU is designed according to the patented log periodic design of the University of Illinois Antenna Research Laboratories.

■ Only the JFD LPV-VU utilizes capacitor* coupled Cap-Electronic dipoles for higher mode operation that achieves higher gain, narrower beamwidths on VHF channels 7 to 13 and UHF channels 14 to 83. (Our competition's copies of the JFD LPV-VU use only fundamental mode which resonate as simple dipoles with consequently limited gain.

■ Only the JFD LPV-VU offers true frequency-independent performance that insures brilliant color on any channel.

JFD[®]

LPV-VU COLOT LOG PERIODIC

You bet you can have everything you want in one antenna—VHF, UHF, FM—with a single down-lead, too! Start teaming up JFD 82-channel LPV-VU Color Log Periodics with all the 82-channel TV sets in your area—see the difference in profits and performance. Call your distributor or write

for brochure 806.

32 million readers of LIFE will be seeing spectacular JFD LPV Color Log Periodic advertisements all season long. This unprecedented LIFE campaign will be preselling JFD LPV antennas for you!

Full-color television commercials will show millions more why the LPV's patented space-log periodic design works beston any channel—color & black/white.

5 GREAT MODELS TO CHOOSE FROM











JFD ELECTRONICS CORPORATION 15th Avenue at 62nd Street, Brooklyn, N. Y. 11219

Circle 6 on reader's service card

ATTENTION! CB OPERATORS

save on citizens radio equipment

Discontinued Models From International Radio Exchange

Select that extra transceiver for mobile or base installation, or equip a new station. Our stock includes International types as well as other makes.

Write Today for A Complete List of Equipment in Stock



RADIO EXCHANGE 18 NO. LEE, OKLA, CITY, OKLA, 73102 Division Of International Crystal Mfg. Co. Dealing In Used Citizens Radio Equipment



Circle 7 on reader's service card

NOW! Solve Electronics Problems fast with New Patented Slide Rule.



That's right! This amazing new Electronics Slide Rule will save you time the very first day you use it. It's a patented, all-metal 10" rule that features special scales for solving reactance, resonance, inductance and circuitry problems . . . an exclusive "fast-finder" decimal point locater . . . widelyused formulas and conversion factors for instant reference. And there's all the standard scales you need to do multiplication, division, square roots, logs, etc.

Best of all, the CIE Electronics Slide Rule comes complete with an Instruction Course

of four AUTO-PROGRAMMED lessons. You'll quickly learn how to whip through tough problems in a jiffy while others plod along the oldfashioned "pad and pencil" way.

Electronics Slide Rule, Instruction Course, and handsome, top-grain leather carrying case . . . a \$50 value for less than \$20. Send coupon for FREE illustrated booklet describing this Electronics Slide Rule and Instruction Course and FREE Pocket Electronics Data Guide. Cleveland Institute of Electronics, 1776 E. 17th St., Dept. RE-117, Cleveland, Ohio 44114.

*TRADEMARK

Cleveland Institute **GET BOTH FREE!** of Electronics **ELECTRONICS** 1776 E. 17th St., Dept. RE-117, Cleveland, Ohio 44114 Send FREE Electronics Slide Rule Booklet, Special Bonus: Mail ELECTRONICS promptly and get FREE Pocket Electronics Data Guide too! SLIDE RULE GUIDE (Please Print) Send ADDRESS. coupon STATE ZIP today-A leader in Electronics Training...since 1934

Circle 8 on reader's service card

CALENDAR OF EVENTS

International Conference on LIHE Television. Nov. 22-23; London, England Fall Joint Computer Conference, Nov. 30-Dec. Fall Joint Computer Conference, Nov. 30-Dec. 2; Convention Center, Las Vegas, Nev. Philco Service Training Meetings: Montgomery, Ala., Nov. 23, South Ala. Distrib. Co.; Andalusia, Ala., Nov. 24, J. B. Restaurant; Columbia, S. C., Nov. 29, Brown-Rogers-Dixon Co.; Winston-Salem, N. C., Dec. 1, Brown-Rogers-Dixon Co.; Raleigh, N. C., Dec. 2, Brown-Rogers-Dixon Co.; Chattanooga, Tenn., Dec. 13, Philco Distributors, Inc. Knoxyille Dec. 13. Philco Distributors, Inc.; Knoxville, Tenn., Dec. 15, Philco Distributors, Inc. For more detailed information, exact times and places, contact the local Philco distributor.

BRIEF BRIEFS

Exact locations of piston-ring blow-by and cylinder scoring in operating engines and compressors are detected with an ultrasonic microphone by a new electronic analytical procedure.

Using an engine analyzer and an ultrasonic detection unit that translates sounds in the 36-44-kc range to audible signals, the electronic inspection gives the maintenance engineer an instantaneous scope presentation of each cylinder's complete stroke.

William Shockley, one of the Bell Lab team that invented the transistor. will join Bell Telephone Laboratories again after an absence of over 9 years. His new title is Executive Consultant on Applied Research and Development of Electronic Components.

A new type of magnetohydrodynamic generator, recently tested successfully by North American Aviation, uses a liquid metal rather than the superhot gas used in previous MHD generators.

US servicemen, according to a poll conducted by the USO in Vietnam, want voice tape recordings from their families for Christmas more than any other one thing.

RADIO-ELECTRONICS is published by Gernsback Publications, Inc.
Chairman of the Board: Hugo Gernsback Vice President: Treasurer: Charles A. Raible

Edi<mark>toria</mark>l, Advertising, Subscription and Executive offices: 154 West 14th Street, New York 10011.

Subscribers: When requesting change of address please furnish an address label from a recent issue. Allow one month for change of

ADVERTISING REPRESENTATIVES: East: John J. Lamson, Eastern Sales Manager, RADIO-ELECTRONICS, 154 West 14th Street, New York 10011, 212 AL 5-7755; Midwest: P. H. New York 10011, 212 AL 5-7755; Midwest: P. H. Dempers Co., 740 North Rush Street, Chicago, Illinois 60611, 312 MI 2-4245; South Central: Media Representatives, Inc., 2600 Douglas Avenue, Irving, Texas 57060, 214 BL 5-6573; West Coast: J. E. Publishers' Representative Co., 8380 Melrose Avenue, Los Angeles, California, 213-653-5841; United Kingdom: Publishing Co. Ltd Mikro Huseliching. lishing & Distributing Co., Ltd., Mitre House, 177 Regent St., London W.1, England.

RECENT PROFESSIONAL INSTALLATIONS OF AR SPEAKERS

$AR-2^x$

(\$89-\$102, depending on finish)

Aeolian-Skinner reverberation system corrects excessively dead acoustics in the chapel of Choate School, Wallingford, Connecticut. Duncan Phyfe, musical director of the school, describes the effect on live pipe organ and chorus as "so natural one is not aware of an electronic reverberation system."

Similar Aeolian-Skinner installations are operating in Christ Church, Cambridge, Massachusetts, and in St. John's Episcopal Church, Washington, D. C. AR speakers were chosen because of their lack of coloration, their undistorted, full-range bass, and their reliability.



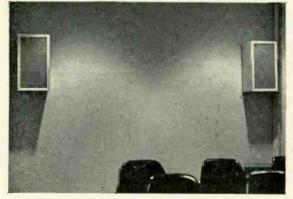
AR-2ax

Sound reinforcement system for the summer jazz concerts in the sculpture garden of New York's Museum of Modern Art. Live music had to be amplified without giving the sound an unnatural, "electronic" quality; AR speakers were chosen after testing many brands.

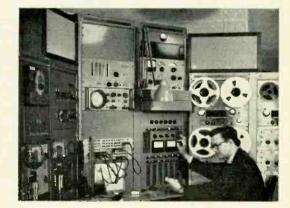


\$1965, LINCOLN CENTER FOR THE PERFORMING ARTS





One of the listening rooms in the Library & Museum of the Performing Arts at Lincoln Center in New York City. AR-3's were chosen for these rooms to achieve an absolute minimum of artificial coloration.



Experimental Music Studio of the University of Illinois. Dr. Hiller (seated) writes about the AR-3's, used as monitor speakers: "I wish all our equipment were as trouble free."

AR speakers and turntables are often used professionally, but they are primarily designed for natural reproduction of music in the home. Literature is available for the asking.

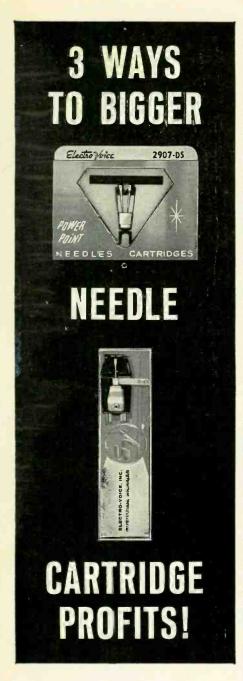
Circle 9 on reader's service card

ACOUSTIC RESEARCH, INC.,

24 Thorndike Street,

Cambridge, Massachusetts 02141

DECEMBER, 1965

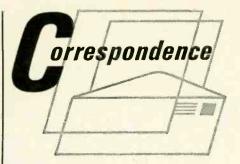


- 1. More "look-alike" exact replacement models than any other brand. Over 350 needles, 225 cartridges.
- 2. Easy-to-use reference material. E-V computer-printed catalogs make proper needle/cartridge selection easy, fast and accurate.
- 3. Highest standards. Rigid quality control and inspection cuts call-backs, gives full value to every customer.

Stock and sell E-V needles and cartridges for more profits. Pick up your FREE replacement guide at your nearby Electro-Voice distributor today!

ELECTRO-VOICE, INC.
Dept. 1257E, Buchanan, Michigan 49107





WRONG-WAY DIODE

Dear Editor:

I believe that in the Motorola MC1524 circuit (New Semiconductors and Tubes, Sept. 1965), the diode connected to ground from the base of the transistor with the 20,000-ohm emitter load is in backward. As it is, the diode is reverse-biased and thus isolates the transistor from the rest of the circuit. Hence there can be no transistor action.

GARY LORENZ

Compton, Calif.
[He's right.—Editor]

ECHOES EDITORIAL SENTIMENTS

Dear Editor:

The editorial by Fred Shunaman in the September 1965 issue ("End of the Service Technician?") was of very special interest to me, the subject of the editorial fitting my own situation: a "dropout" from the radio-TV field. I am now in industrial electronics. After 9 years in that, I would welcome the company of more electronic technicians of the sort that (to quote Mr. Shunaman) "at least tries to understand what he is doing." I have encountered innumerable responsible people who erroneously blame faulty operation of systems on equipment (namely electronic) that they do not understand. They, pretending to understand, would make adjustments to such equipment, including combustion controls, without considering the possible drastic consequences. In agreement with Mr. Shunaman's statement "I will not touch adjustments on illuminating-

BUILD THIS VIDEO MODULATOR

It takes the signal from any TV camera and puts it on your TV set—on any channel! Use it for closed-circuit, educational TV, for home fun, amateur TV, and experiments. Crystal oscillator keeps it tuned perfectly.

Coming in January
RADIO-ELECTRONICS,
the 3rd Annual Color-TV issue

gas equipment ", I would add: " until I understand fully the operation of the complete system."

MYRLE DEPPER

Selinsgrove, Pa.

RESEARCH ON SHOCK DANGER

Dear Editor:

I agree wholeheartedly with reader Piette's statement ("Watch Where You Stimulate!", Correspondence, August 1965) that the probes [of my Muscle Stimulator described in June R-E] should not be used in the chest area or in any way that might cause current to flow through the heart. I also would not advocate placing the probes at one's temples in an effort to induce sleep or electronarcosis. This is dangerous ground for the uninitiated.

I have conducted a brief literature search on the topic of shock. Here is a table from an article in the January 1960 Electrical Manufacturing by Ed-

win Schechter:

The Effects of 60-cycle Alternating Current on the Human Body

1 ma	No sensation
More than	Painful shock
5 ma	
More than	Local muscle con-
10 ma	traction sufficient
	to cause freezing
	to the circuit in
	2.5% of popula-
	tion
More than	Ditto, 50% of pop-
15 ma	ulation
More than	Breathing difficult;
30 ma	can cause un-
5 0 . 400	consciousness
50 to 100	Possible ventricular
ma	fibrillation
.01 to 2 or 3	Certain ventricular
ampere	fibrillation

Another source, Electrical Safety by H. W. Swan, states that an adult male can let go of a 60-cycle circuit as long as the current is 9 ma or less. Women have a lower limit: 6 ma. The "danger zone" given is 20 to 24 ma.

So Mr. Piette's figure of 5 ma for "complete muscle control" seems small; but my unit's 150 volts across 2,000 ohms is 75 ma, and that's enough to warn everyone to be very careful.

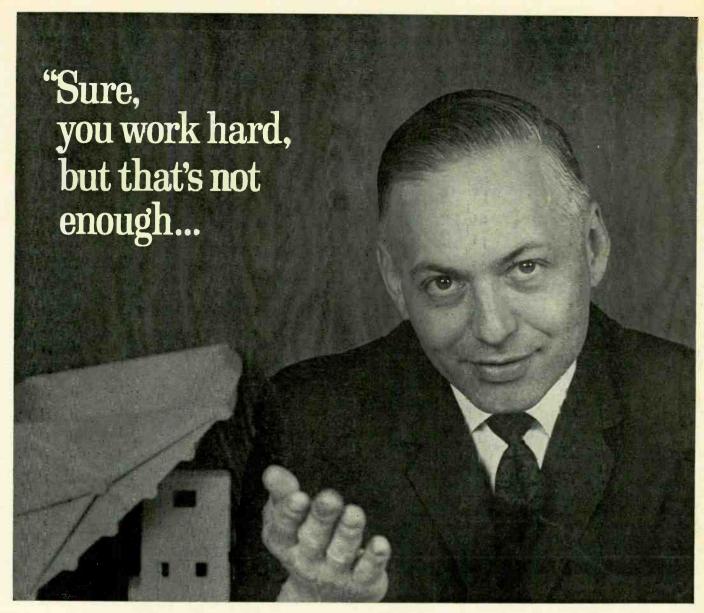
SAM BRESKEND

Washington, D. C.

HONEYCOMB COILS

Dear Editor:

I thought you might be interested to know that recently I dug up some old De Forest honeycomb inductances, and, using one tube, I managed to breadboard a set and pick up a lot of stations around 10 to 20 kc (NAA, NSB and many



...you need more education to get ahead in electronics"

No matter how hard you work, you can't really succeed in electronics without advanced, specialized technical knowledge.

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

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

Accredited Member of the National Home Study Council



You're eligible for a CREI Program if you have a high school education and work in electronics. Our FREE book gives all the facts. Mail coupon or write: CREI, Dept. 1412C 3224 Sixteenth Street, N.W., Washington, D. C. 20010

SEND FOR FREE BOOK



The Capitol Radio Engineering Institute
Dept. 1412C 3224 Sixteenth Street, N.W.
Washington, D.C. 20010

Please send me FREE book describing CREI Programs in Electronics and Nuclear Engineering Technology. I am employed in electronics and have a high school education

Name		Year Born	
Address			
City	State	Zip Code	
Employed by			
Type of Present W	ork		

others). The reception was fine and the news reports being sent were the best. The code sending was very good and in a few minutes I was doing pretty good, after a lapse of many years.

LEROY H. SMELTZER

Greensburg, Pa.

UNIJUNCTION TO DRIVE DEMO CIRCUITS

Dear Editor:

R. E. Baird's "Look Inside an Amplifier" (August 1965) can be a real asset in helping "see" dynamic circuit variations. There is no question that the person who can visualize several complex circuit variations at one instant will be more confident and successful in electronics than one who cannot. Practical demonstrations, as suggested by Mr. Baird, can certainly be helpful during course work.

A simple and economical method to drive such an active demonstration is with the basic unijunction relaxation oscillator. This oscillator is unusually simple, requires few components and will perform at low supply voltages. Sweep rates to a fraction of a second are easily obtained. The unijuncton is presented

in Chapter 13 of the seventh edition of General Electric's Transistor Manual. JOHN F. CLEARY

General Electric Co. Syracuse, N.Y.

TACHOMETERS MAKE HARD STARTING

Dear Editor:

I have found after constructing and installing several kinds of electronic tachometers that they cause hard starting when the engine is cold.

I went through a long round of troubleshooting and replacement (coil, condenser, carburetor, points) before I decided that the hard starting is due to the fact that a vital but little known function of the capacitor (condenser) across the points is hindered by the low input resistance of the tachometer circuits.

It is common knowledge that one purpose of the capacitor is to prevent arcing across the breaker points when the coil primary circuit is suddenly opened. But another function of the capacitor is often overlooked.

The coil primary is energized by the battery when the breaker points close. When the points break the circuit, the current tends to continue in the same direction, and the stored magnetic energy in the core starts to collapse. The flux cuts primary and secondary windings. The faster the flux can be brought to zero (i.e., the greater its rate of change), the higher will be the voltage induced in the secondary.

With the points now open, the capacitor, which had been shorted (directly across the closed points), now acts itself as a short circuit for an instant as it becomes charged by the current created in the primary by the collapsing field. It thus aids in bringing the induced current rapidly to zero. If the capacitance is correct, it will discharge through the battery and the coil before the points close again.

The reverse flow of energy stored in the capacitor "purges" the coil of flux so there will be no counter-emf to oppose the flow of current from the battery when the points close again. This cycle repeats itself as long as the engine runs.

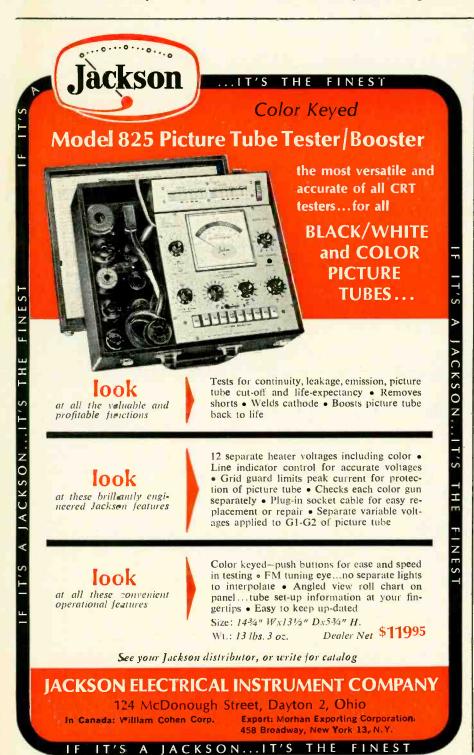
Any resistance across the breaker points (and hence across the capacitor) reduces the effectiveness of the capacitor and impairs the function of the whole ignition system.

I am eager to hear other views on this subject.

Philadelphia, Pa.

L. E. MUELLER END

RECEIVE FREE literature and catalogs by mailing Readers'
Service Card, page 70.



Use this check list before you install a home TV distribution system

	COAXIAL VHF	TWINLEAD* VHF	COAXIAL UHF/VHF	TWINLEAD* UHF/VHF AND UHF ONLY
Channels received	2-13	2-13	2-83	2-83 (14-83 for UHF only)
Color reception when properly installed	Excellent	Excellent	Excellent	Excellent
Cable loss: @ channel 13 for VHF only @ channel 83 for UHF/VHF	4 db (foam filled) 6 db (solid)	1.8 db/100 ft. @ Channel 13	9 db (foam filled) 13 db (solid)	5.6 db/100 ft. @ Channel 83
Loss increase when wet	Nil	Negligible	Nil	Negligible
Reception when run near or through small metal areas	Excellent	Excellent when properly installed	Excellent	Excellent when properly installed
Reception when run near or through considerable amounts of metal	Excellent	Not recommended	Excellent	Not recommended
Ease of installation	More difficult	Easy	More difficult	Easy
Extra parts required	Connectors, matching transformers	None	Connectors, matching transformers	None
Performance in strong-signal areas	Excellent	Excellent—fair**	Excellent	Excellent—fair**
Performance in weak-signal areas	Excellent	Excellent	Excellent	Excellent
Cable pickup of interference (ignition, appliances, etc.)	None***	None—slight**	None***	None-slight**

Once you know the facts—there is one best choice for your home system—Blonder-Tongue. Whether you prefer 300 ohm or a 75 ohm coax system, Blonder-Tongue has the products you'll need. There is only one way you can protect your home TV system against obsolescence when new UHF stations come on the air—that's with a Blonder-Tongue all-channel UHF/VHF system.

Blonder-Tongue products designed for all-channel home systems include: All-channel signal amplifiers (V/U-All-2 indoor and U/Vamp-2 mast mounted); all-channel couplers (A-102-U/V two-set and A-104-UV four-set). Rounding out the all-channel concept are UHF/VHF matching transformers (Cablematch U/V set mounted; MT-283 mast-mounted) and the TF-331-U/V flush-mounted feed-thru.

Take your pick. Blonder-Tongue makes them all—and all are "Color Approved". Buy the line with 15 years of quality leadership. Write for free booklet "How to Plan a Color-Approved Home TV System".



BLONDER-TONGUE

9 Alling Street, Newark, New Jersey 07102 home TV accessories • closed circuit TV • community TV • UHF converters • master TV

Circle 13 on reader's service card



FAST, 24-HOUR SERVICE with full year warranty

Sarkes Tarzian, Inc., largest manufacturer of TV and FM tuners, offers unexcelled tuner overhaul and factory-supervised repair service.

Tarzian-made tuners received one day will be repaired and shipped out the next. More time may be required on other makes. Every channel checked and realigned per original specs. And, you get a full, 12-month guarantee against defective workmanship and parts failure due to normal usage. Cost, including labor and parts (except tubes) is only \$9.50 and \$15 for UV combinations. Replacements at low cost are available on tuners beyond practical repair.

Always send TV make, chassis and Model number with faulty tuner. Check with your local distributor for Sarkes Tarzian replacement tuners, parts or repair service. Or, use the address nearest you for fast, factory-supervised repair service.

SARKES



TUNER SERVICE DIVISION 537 S. Walnut St., Bloomington, Ind. Tel: 812-332-6055

10654 Magnolia Blvd., N. Hollywood, Calif. Tel: 213-769-2720

TUNER SERVICE



CORPORATION

(Factory-supervised tuner service authorized by Sarkes Tarzian, Inc.) 547 Tonnele Avenue, Jersey City, N.J. Tel: 201-792-3730

Manufacturers of Tuners, Semiconductors, Air Trimmers, FM Radios, AM-FM Radios, Audio Tape and Broadcast Equipment

SERVICE CLINIC

By JACK DARR Service Editor

Replacing Weak High-Current Seleniums

The Gulbransen Transistor Organ (and that's all it says on the label—no model number) uses transistor tone generators, and tubes for power amplifiers. The amplifier tubes and the power supply are on a small chassis in the upper right side of the cabinet, from the front. To get at it, and the "works", lift the upper manual, or take out the three big screws along the top of the back panel, and take the top off.



Checking load capability of a supply is merely a matter of hanging on various load resistors and watching what happens to current and voltage.

The trouble in this organ was in the stops. Any one would work, but when more than one was pushed, nothing. The stops (which select the different "voices" of the organ) are relay-operated, in an unusual way. Normal-looking relays are used, but instead of closing spring-blade contacts, each one pulls a string! The string causes a long, thin rod to turn 180°. Resting against the rod are very fine wire contacts. Half of the circumference of the rod is insulated; when it turns, the wires make contact with the bare half. There is a total of 14 such assemblies in this instrument.

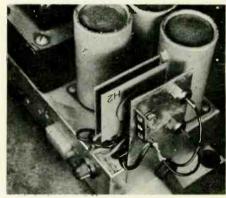
This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 10011.

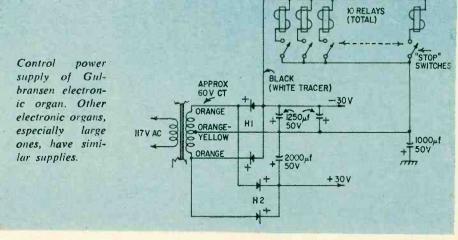
The relays weren't closing when more than one was used. The voltage fell badly when more than one was switched in. I bridged the big filter capacitors, just in case, but that wasn't it, so it had to be one of the big selenium rectifiers in the power supply.

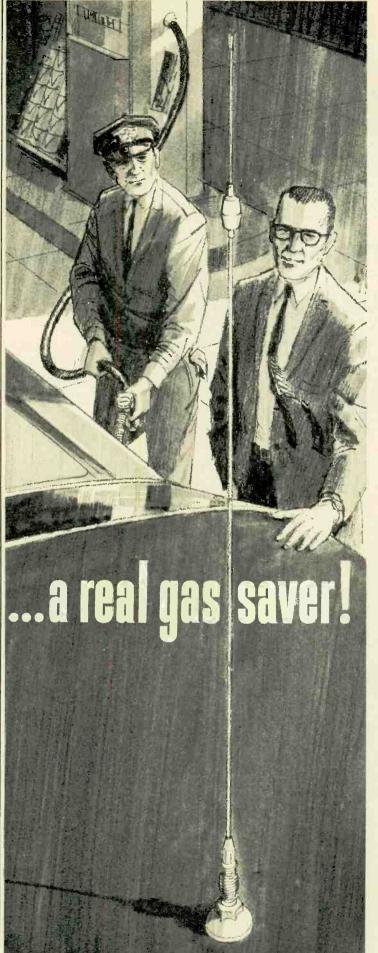
I broke the circuit and inserted a dc milliammeter. Each relay drew 500 ma. So, the rectifier had to supply 7.0 amperes. Bench tests with various load resistors and an ammeter showed that the voltage dropped badly at about 2-3

Continued on page 20



The new silicon rectifiers, mounted with insulating mica washers on a small aluminum plate as a heat sink.





DX Roof Topper for Citizens Band

How many times every day, week or month do you find yourself back-tracking or heading for some distant hill so that you can get your mobile unit within range of your base station? Certainly a lot more times than would be necessary if your mobile unit was equipped with a Hy-Gain "DX Roof Topper". Hy-Gain "DX Roof Toppers" are a breed all their own. In fringe areas where signals are weak using other mobile antennas, signals on both transmit and receive are loud and clear with a "DX Roof Topper". As a matter of fact, with a "DX Roof Topper", you can maintain rocksolid communications with remote areas you never dreamed possible. For less back-tracking or heading for some distant hill to get within range of your base station...to save time, save gas...to get a whole new dimension in 2-way communications, get a Hy-Gain "DX Roof Topper". Guaranteed to out-perform any other mobile antenna for Citizens Band, or your money back. Comes complete with antenna, stainless steel shock spring, "can't leak" roof mount, 16' of coaxial cable with PL-259 connector and a special adapter plate for replacing any existing roof mount antenna. Model TQRDX\$16.95 Net

OTHER TOPPER MODELS -- Each one unconditionally guaranteed to out-perform any other CB mobile antenna of comparable length and mounting position:

- AM-CB Combination Jiffy Trunk Mount
- Fender Mount Shorty Roof Topper
 - Cowl Mount Marine Topper

Tree Mobile Antenna Comparison Report No. 15 Available today from your Hy-Gain Distributor or Dealer or write...

HY-GAIN ELECTRONICS CORPORATION 8560 N.E. Highway 6 • Lincoln, Nebraska 68501

You get more for your money from NRI-

America's oldest and largest Electronic, Radio-TV home-study school

Compare if you like. You'll find—as have so many thousands of others—that NRI training can't be beat. From the delivery of your first lessons in the remarkable, new Achievement Kit we senc you, to "bite size," easily-read texts and carefully designed training equipment... NRI gives you more value.

Shown below is a dramatic, pictorial example of all of the training materials included in Just one NRI Course. Everything you see pictured below is included in low-cost NRI training. Other major NRI courses are equally complete. Text for text, kit for kit, dollar for dollar—your best homestudy buy is NRI.



GET A FASTER START WITH NRI'S NEW EXCLUSIVE ACHIEVEMENT KIT

The day we receive your enrollment application we mail out your Achievement Kit. It contains everything you need to make an easy, fast start in the Electronics training of your choice. This attractive, new starter kit is an outstanding, logical way to introduce you to homestudy as NRI teaches it . . . an unparalleled example of the value of NRI training . . . training that is backed up by a dedicated staff and the personal attention you should expect of a home-study school. It is your first of a number of special training aids carefully developed by the NRI laboratories to make your adventure into Electronics absorbing, meaningful. What's in the Achievement Kit? Your first group of lesson texts; a rich vinyl desk folder to hold your study material; the industry's most complete Radio-TV Electronics Dictionary; valuable reference texts; lesson answer sheets; pre-addressed envelopes; pencils; pen; engineer's ruler-even postage. No other school has anything like the NRI Achievement Kit.

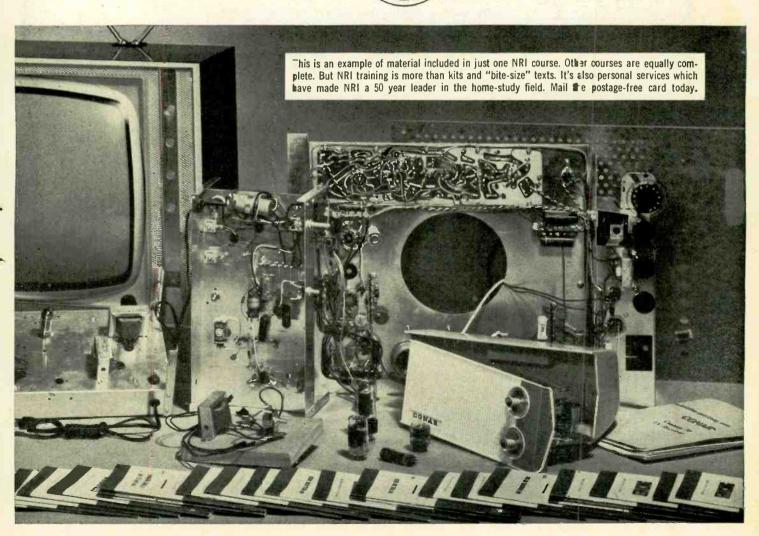
LEARNING BECOMES AN ABSORBING ADVENTURE WITH NRI TRAINING KITS

Electronics comes alive with NRI training kits. What better way to learn than by doing it? That's why NRI pioneered and perfected the "home lab" technique of learning at home in your spare time. You get your hands on actual parts and use them to build, experiment, explore, discover. NRI invites comparison with training equipment offered by any other school. Begin NOW this exciting program of practical learning. It's the best way to understand the skills of the finest technicians—and make their techniques your own. Whatever your reason for wanting to increase your knowledge of Electronics . . . whatever your field of interest . . . whatever your education . . . there's an NRI instruction plan to fit your needs, at low tuition rates to fit your budget. Get all the facts about NRI training plans, NRI training equipment. Fill in and mail the attached postage-free card today. No salesman will call. NATIONAL RADIO

INSTITUTE, Washington, D.C. 20016.

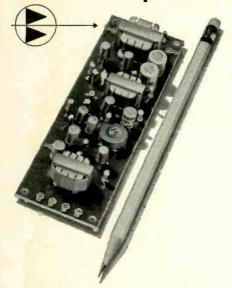
OUR 50th YEAR OF LEADERSHIP

IN ELECTRONICS TRAINING



DECEMBER, 1965 19

Birnbach's Compact Transistor Audio Amplifier



Look at these amazing features . . .

- **★ 5 Transistors and 1 Thermistor**
- ★ Shielded Input Transformer with 2 PRI-MARY WINDINGS . . . 50 ohms and High Impedance
- ★ Output Transformer with 2 SECONDARY WINDINGS . . . 8 ohms (for speakers), 500 ohms (for modulation and high impedance loads)
- ★ Volume Control included and mounted on Circuit Board
- ★ Low Distortion . . . 400 Milliwatt Push-Pull Output
- Extremely high gain . . . 80 db! Handles low level mikes, phono pickups, telephone pickups, etc.
- ★ Sturdy Printed Circuit Board is 5½" long by 1¾" wide
- ★ Weighs only 3½ ounces
- ★ Power Supply: Any 9-volt DC source
- * Standard 90 day warranty

USE IT FOR:

PA System
Hi-Fi System (use 2 for stereo)
Guitar Amplifier
Surveillance Listening System
Electronic Stethoscope
Intercom Amplifier
Modulation for Transmitter
Phono Amplifier
Utility Amplifier
Science Projects

COMPLETE AMPLIFIER \$7.95 each

INCLUDING SCHEMATIC DIAGRAM We Pay Postage!

BIRN-BACH Radio Co., Inc. Dept. R, 435 Hudson St., New York, N.Y. 10014
Please rush me
Address
CityStateZip

SERVICE CLINIC continued

amps. So, new rectifier needed. Big seleniums are hard to find. I used a pair of stud-mounted silicons, rated at 10 amps each.

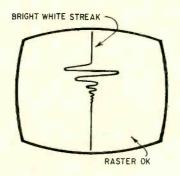
One of the photos shows the mounting of the replacements. The original mounting hole was enlarged and another one drilled; the studs of the silicons (the cathodes) had to be insulated; mica washers come with them. One terminal strip was added, to hold the common negative connection securely.

One final word: if you make load tests with resistors on a new high-current hookup, don't pick up the resistors with your bare hands! They get HOT!

A very short Christmas tree

I've got one I don't understand. It's a Motorola TS-579B. It gets a flashing white streak down the middle of the picture (Fig. 1) and there are flashes and pops. Tuner seems to affect this on channels 2 and 6, which are unused. With a strong signal, it flashes only once in a while. Everything else is OK—brightness, contrast, etc. This has been going on for some time.—D. D., Glendive, Mont.

This is actually a "very short Christmas tree" (one that was picked too young?). In other words, your horizontal output (oscillator—damper—output tube—HV-rectifier—yoke)—something in there—is cutting in and out very rapidly! If you had a few more streaks, you'd see the regular Christmas-tree pattern.



This could be in any one of the major parts of the horizontal output stage, as listed above. About the fastest way to run it down is to substitute for various sections.

Lift the plate cap from the 6DQ6 horizontal output tube and feed in a "plate-drive" signal from a horizontal sweep tester or from another TV set in good working order. Connect the plate of its horizontal output tube to the plate lead on the Motorola flyback. (Don't use an ac/dc TV for this!) Now, turn 'em both on, and see if this cures the flashing. If so, the trouble is before this point, in the horizontal oscillator, afc. etc.

If the flashing is still there, then it's in the flyback, yoke or damper circuits of the Motorola. Go over these very carefully, looking for a loose solder joint or small arcover point. You've probably done this already, but replace the damper tube; it's a common cause of such troubles, via internal arcing between plate and cathode or heater and cathode. Take an insulated tool and work over the various connections around this circuit. Poke, pry and jar things, looking for one that'll cause the streak to show up. Don't overlook the socket connections on the damper tube, etc. Be sure they're clean and tight.

The high-voltage rectifier doesn't cause too much of this particular kind of trouble (you're losing horizontal sweep: note the pattern!) but check it in the same way. Shouldn't take too long to find the cause, especially if you use a logical process of elimination and substitute various drive signals from another set. Good luck!

Another mystery set

The owner says this is an RCA TV set. The only numbers I can see are 'K66132' Uses two 5U4's; the power transformer has "ET101B" on it. Can you tell me anything about this set?—E. H., Winchester, Va.

I can tell you one thing: it isn't an RCA! From the numbers, it is most apt to be a "Mattison" (Macy's, Mirrortone, Artone, etc.) Many of these were made by Hallicrafters for different mailorder houses.

Get a catalogue from one of the transformer makers: Triad, Merit, Stancor, etc., and go through the set, looking up part numbers on the major parts like power transformer, vertical output transformer, and so on. In this way, you can often match up numbers and find out what the set is.

"Open" meter in vom?

My vom suddenly quit working. I opened the case and checked the meter movement itself. It seems all right. It's one of the printed-circuit-board types. Do you think this is a PC board break, or what?—F. D., Yuma, Ariz.

Suggestion, from an experience I had once: loosen the mounting nuts on the meter terminals, which hold the PC board in this instrument. Clean these connections and retighten, and see if the vom doesn't work fine again. These instruments are moistureproofed by varnishing, and once in a while this varnish gets between the terminals.

If this doesn't work, disconnect the meter movement and, with another vom, check back from the meter terminals to the ohmmeter jacks. This will give you an idea of where a possible open circuit could be: bad switch contacts, etc.

FREE

with your purchase of a PHOTOFACT®

Library...

sells at retail for \$14950

now yours

FREE

with the purchase of a Photofact Library consisting of 225 Sets or more...ACT NOW—get the Encyclopedia in time for your family Christmas!

THERE ARE 4 CONVENIENT WAYS TO SELECT YOUR PHOTOFACT LIBRARY

- 1. Complete your present Photofact Library.
- Order a Photofact "Starter" Library—225 Sets (Sets 451-675—coverage from 1959 to 1964—only \$14.29 per month).
- Order by brand name and year—see the handy selection chart at your distributor.
- 4. Order a complete PHOTOFACT Library—and the famous 14-Volume New Standard Encyclopedia is yours FREE!

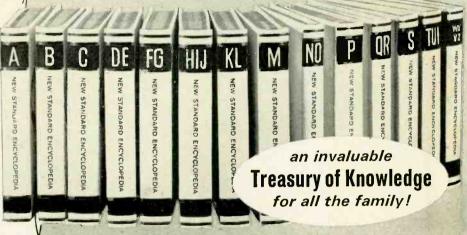


ORDER YOUR PHOTOFACT LIBRARY NOW— AND GET YOUR FREE STANDARD ENCYCLOPEDIA

See your Distributor for the full details of the PHOTOFACT-Encyclopedia Deal, or send coupon at right! Also ask about a Standing Order Subscription to current PHOTOFACT and Specialized Service Series (FREE File Cabinets available with Subscriptions). ACT NOW!

SEE YOUR DISTRIBUTOR OR SEND COUPON TODAY

the supreme Christmas Gift for your family...the famous 14-volume NEW STANDARD ENCYCLOPEDIA!



give your family this wonderful gift— give your earning power a big boost with PHOTOFACT—world's finest TV-radio service data

Now, more than ever, it pays to own a Photofact Library—the time-saving, troubleshooting partner guaranteed to help you earn more daily. Now, you can start or complete your Photofact Library the special Easy-Buy way, and get absolutely FREE with your purchase, the famous 14-volume NEW STANDARD ENCYCLOPEDIA. It's a great reference library for all the family—complete, authoritative, indispensable. Retails for \$149.50—yours absolutely FREE with the purchase of a Photofact Library consisting of 225 Sets or more!

OWN A PHOTOFACT LIBRARY THE EASY-BUY WAY:

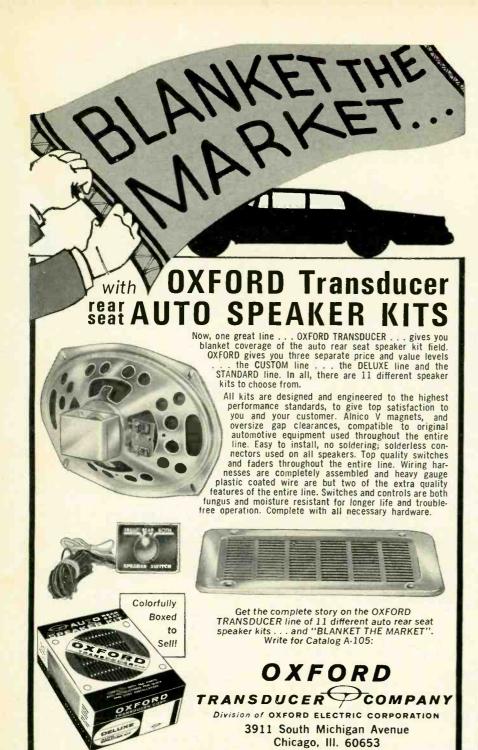
- Only \$10 down 30 months to pay
- No interest or carrying charges Prepaid transportation
- Add-on privilege of a year's advance subscription to current Photofact data, on the same Easy-Buy contract
- Save 30¢ per Set—special \$1.95 price applies on Easy-Buy (instead of regular \$2.25 price)

THERE'S NEVER BEEN A DEAL TO EQUAL THIS!



HOWARD W. SAMS & CO., INC.
Howard W. Sams & Co., Inc., Dept. REF-12 4300 W. 62nd St., Indianapolis, Ind. 46206
Send full information on the PHOTOFACT Library- Encyclopedia Deal, and details of the Easy-Buy Plan
My Distributor is:
Shop Name
Attn.
Address
CityStateZip

Circle 18 on reader's service card



Circle 19 on reader's service card

EW...POSI

Positively-

- CONTAINS NO CARBON TETRACHLORIDE
- HARMLESS TO ANY PLASTICS KNOWN TO **KRYLON**
- CLEANS AS IT LUBRICATES
- NON-FLAMMABLE
- NON-CORROSIVE . . . NON-TOXIC

Contact your local jobber for Tuner Cleaner and other everyday Krylon aerosol products—Crystal Clear, Let-Go (oil penetrant), Red Insulating Varnish, Silicone Lubricant, Cleaner and Degreaser

If you prize it ... KRYLON-ize it!®



OUR STANDARD ABBREVIATIONS

RADIO-ELECTRONICS has always tried to maintain a consistent style in the abbreviations used in text and artwork (diagrams and photo "callouts"). New abbreviations are developed as new terms are added to our electronic vocabulary. We are printing this revised list of abbreviations to bring our old readers up to date and to help readers who have not been with us long enough to recognize the forms consistently used in our magazine.

The abbreviations are indexed by symbol with Greek letters treated like English phonetic equivalents. Many of those listed are always spelled out in the text and are abbreviated in our artwork. Terms used only in artwork—and those capitalized in text—appear in capitals. Abbreviations in lower-case letters are so used in text and are capitalized in artwork. Periods are used in abbreviations only where the abbreviation might be confused with a word. For example, rf and i.f. are our abbreviations for radio frequency and intermediate frequency, respectively.

ABBREVIATION

ac ADJ afc AFT ago AM amn ANT apc ATTEN **AUTOTRANS** avc AWG b or base BAL MOD BALUN

BATT

BCI bfo BTO C, CAP CALIB cath (K on tube diagrams) CATH FOLL

CB CCTV CENT CH CHAN CHG CKT CKT BKR coax COM COND CONN

CONV counter emf CRO CRT

ELECTRONIC TERM ampere(s) alternating current automatic chroma control adjacent, adjustment audio frequency automatic frequency control audio-frequency transformer automatic gain control amplitude modulation ampere(s) amplifier antenna automatic phase control attenuator autotransformer automatic volume control American wire gage base (of transistors) balanced modulator balanced-to-unbalanced transformer

battery broadcast interference beat frequency oscillator Barkhausen oscillation blocking-tube oscillator collector (of transistors) capacitor (capacitance) calibrate cathode

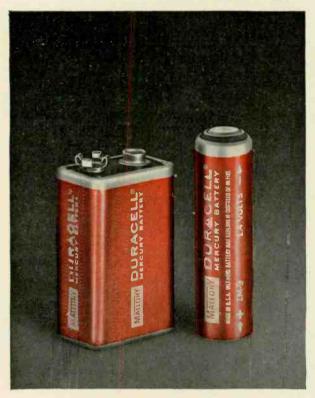
cathode follower community-antenna television Citizens band closed-circuit TV centering choke channel charge circuit circuit breaker coaxial common conductor connector, connection control convergence, converter counter electromotive force cathode-ray (tube, etc). cathode-ray oscilloscope cathode-ray tube

RADIO-ELECTRONICS

center tap



Why New Duracell® Mercury Batteries last even longer in transistor radios



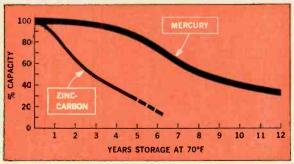
COMPARATIVE CHART
MERCURY vs. ZINC-CARBON

Continuous discharge
through 500 Ohms at 70°F

Minimum Operating
Voltage Level-5.4V

Minimum Operating
Voltage Level-5.4V

Continuous Hours Usage



The best way to explain why mercury batteries are better is to compare a typical transistor radio with a standard 2 cell flashlight. The vast majority of flashlights use zinc-carbon batteries. The bulb draws about ½ ampere. And the flashlight is used only a minute or two at a time. Therefore the zinc-carbon battery does a reasonably adequate job.

But a typical transistor radio draws only 10 milliamperes . . . (the flashlight draws 50 times as much current). And the radio is used for hours on end. What's needed here is a battery which supplies power in small doses over a very long period of time. There is such a battery and it was invented by Mallory. Over the years, it has been improved so much we've given it a new name . . . the DURACELL Mercury Battery. The DURACELL crams more useable power into less volume than any other battery system available. Strangely enough, you'd expect to pay more, but it is actually more economical.

Want proof? Okay, the new TR146X is the 9 volt size that fits most transistor radios. It will run a typical transistor radio at least 37 hours. The zinc-carbon equivalent goes for only 9 hours, or less than ½ as long. (We're talking about top-quality domestic zinc-carbon's here . . . not cheap imports with very short life.)

What does this mean to the pocketbook? The zinc-carbon costs 69c while the TR146X \$1.95... but don't let that fool you. Divide 69c by 9 and you'll see that it costs you 7.67c per hour to use the zinc-carbon. Now divide \$1.95 by 37 and you'll see that it comes to only 5.27c! That's a bargain! In the penlight size, the ZM9 DURACELL gives 4.8 times more life for only 3.8 times more money . . . another bargain.

Forget the money! Think of performance. Mercury battery voltage stays constant while the zinc-carbon fades fast. This means that B+ voltage stays where it belongs for days longer rather than dropping into the distortion range.

Forget the money! Forget the performance! Think of storage life. Zinc-carbon batteries die in a few months whether they are used or not. Mercury batteries can sit around for 2 or 3 years and still provide instant power.

There's more, too . . . dependability. The same dependability and safety that makes the heart pacer possible.

If you need *more proof*, try a new DURACELL Mercury Battery in *your* radio or any electronic gadget . . . you can get 'em at your Mallory Distributor. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

Circle 21 on reader's service card



This is the allnew, all-transis-tor Schober

tor Schober Recital Model...the most versatile electronic organ available today. Its 32 voices (plus anazing "Library of Stops"), 6 couplers and 5 pitch registers delight professional nusicians...make learning easy for beginners. Comparable to ready-built organs selling from \$5000 to \$6000.

The pride and satisfaction of building one of The pride and satisfaction of binding one of these most pipe-like of electronic organs can now be yours...starting for as low as \$550. The Schober Spinet, only 39¼ inches wide, fits into the smallest living room. The new, all-transistor Schober Consolette II is the aristocrat of "home-size" organs... with two full 61-note manuals, 17 pedals, 22 stops and coupler, 3 pitch registers and authentic theatre voicing.

AND YOU SAVE 50% OR MORE BECAUSE YOU'RE BUYING DIRECTLY FROM THE MANUFACTURER AND PAYING ONLY FOR THE PARTS, NOT COSTLY LABOR.

It's easy to assemble a Schober Organ. No special skills or experience needed. No technical or musical knowledge either. Everything you need is furnished, including the know-how. You supply only simple hand tools and the time.

You can buy the organ section by section...so you needn't spend the whole amount at once.

You can begin playing in an hour, even if you've never played before—with the ingenious Pointer System, available from Schober.

Thousands of men and women-teenagers, too housands or men and women—teenagers, too—have already assembled Schober Organs. We're proud to say that many who could afford to buy any organ have chosen Schober because they preferred it musically.

Send for our free Schober Booklet, describing in detail the exciting Schober Organs and op-tional accessories; it includes a free 7-inch "sampler" record so you can hear before you buy.

THE Schober Organ CORPORATION 43 West 61st Street, New York, N.Y. 10023

Also available in Canada, Australia, Hong Kong, Mexico, Puerto Rico, and the United Kingdom

THE SCHOBER ORGAN CORP., DEPT. RE-40 43 West 61st Street, New York, N.Y. 10023
☐ Please send me FREE Schober Booklet and free 7-inch "sampler" record.
☐ Enclosed find \$2.00 for 10-inch quality LP record of Schober Organ music. (\$2.00 refunded with purchase of first kit.)
Name
Address
CityStateZip No

Circle 22 on reader's service card

cw	continuous wave	NE
D	diode	NEG
db	decibel	NET
dc	direct current	N.O.
dcc DC REST	double cotton covered (wire) direct current restorer	NP
DEFL	deflection	
DEMOD	demodulator	n-p-n
DET	detector	OF
df DIELEC	direction finder dielectric	osc
DIFF	differentiator	P
DISCH	discharge	PA
DISCRIM	discriminator	PC PERM
dpdt	double pole double throw double pole single throw	pf
dpst dsc	double silk covered (wire)	phone(s)
DYN	dynamic	PHOTO MULT
dx	distance	pix PL
e	emitter (of transistors)	PM
E (sometimes	potential V in	PM
	dia-	p-n-p
grams)	voltage	200
ECO	electron-coupled oscillator	POS POT
ELEC	electric; electrolytic	PP
ELECT emf	electrode electromotive force	PPI
ENAM	enameled (wire)	
EQUIV	equivalent	pps
ERASE HD	erase head	preamp prf
ERP	effective radiated power external or extension	PRI
EXT F (f as suffix)	farad(s)	PT
f, FREQ	frequency	Q
FET	field-effect transistor	Q
	tube	QUAD R
diagrams)	filament frequency modulation	RCDG
FM FOLL	follower (-ing)	RCDR
g	giga (one billion)	RECT
G (in tube	dia-	REG regen
grams)	grid	rf
GCA	ground controlled approach grid dip oscillator	RFC
GDO GEN	generator	RFI
GND	ground	RFT
h	henry (-ies)	rms RY
HD	head	S
hf HORIZ	high frequency horizontal	SCA
HTR (H)	heater	
1	current	SCC
IC	internal connection (on	SCR sec
: 4	tubes) intermediate frequency	SEL (RECT)
i.f.	intermediate frequency	SEP
	transformer	SG
ILS	instrument landing system	SIG SIL or Si (RECT)
IM	intermodulation	SLD
INT	integrator inverter	spdt
ips	inches per second	
j ,	jack	SPKR
K	thousand	spst
K	ca‡hode (on tubes) kilocycle	SSB
kc kw	kilowatt	ssc
λ (lambda)	wavelength	SW
L	inductor (inductance)	SWR sync
L	coil	T
LDR If	light-dependent resistor low frequency	- TELEG
LIM	limiter	TERM
LIN	linearity	tptg TRANS
μ (mu)	micro- (one-millionth)	trf
μf	microfarads microhenry(ies)	TVI
μh μμf	see pf	uhf
μsec	microseconds	v v
M	meter	V va
М	million	vac, vdc
ma	milliampere(s)	VAR
MATV		
MAX -	master antenna television	VC
	master-antenna television maximum	VDR
mc	master antenna television	
mc meg	master antenna television maximum megacycle(s)	VDR VERT VFO vhf
mc	master antenna television maximum megacycle(s) megohm	VDR VERT VFO Vhf VIB
mc meg mh	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum	VDR VERT VFO Vhf VIB VOL
mc meg mh mike	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator)	VDR VERT VFO Vhf VIB
mc meg mh mike MIN MOD MPX	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex	VDR VERT VFO Vhf VIB VOL VOM
mc meg mh mike MIN MOD MPX MULT	master antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier	VDR VERT VFO vhf VIB VOL VOM VR vtvm VU
mc meg mh mike MIN MOD MPX MULT MVB	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier multivibrator	VDR VERT VFO Vhf VIB VOL VOM VR vtvm VU W
mc meg mh mike MIN MOD MPX MULT MVB	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier multivibrator nano- (one-billionth)	VDR VERT VFO Vhf VIB VOL VOM VR Vtvm VU W X
mc meg mh mike MIN MOD MPX MULT MVB n NBFM	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier multivibrator nano- (one-billionth) narrow-band FM	VDR VERT VFO Vhf VIB VOL VOM VR vtvm VU W X xtal
mc meg mh mike MIN MOD MPX MULT MVB n NBFM NC	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier multivibrator nano- (one-billionth) narrow-band FM neutralizing capacitor	VDR VERT VFO vhf VIB VOL VOM VR vtvm VU W X xtal Z
mc meg mh mike MIN MOD MPX MULT MVB n NBFM	master-antenna television maximum megacycle(s) megohm millihenry(ies) microphone minimum modulation (modulator) multiplex multiplier multivibrator nano- (one-billionth) narrow-band FM	VDR VERT VFO vhf VIB VOL VOM VR vtvm VU W X xtal Z

neon

negative network

relay)

oscillator

capacitor)

normally open (switch or

nonpolarized (electrolytic

negative-positive-negative (transistors)

oil-filled (capacitor)



SERVICE AM & FM AUTO AND TRANSISTOR RADIOS AT A PROFIT!

Jobs that used to be unprofitable now go so quickly that you can make good money handling them! There are millions of auto radios and transistor radios in the field—portables, auto and table models, plus hi-fi and communications equipment. Instead of turning them away, you can turn them into money-makers with the B&K Model 970 Radio Analyst.

The 970 is effective because it's accurate and complete. Using the famous B&K signal injection technique, this all-in-one instrument provides the required dc power, lets you test power and signal transistors in and out of circuit; generates RF and audio signals, and includes a rugged, accurate VOM. Four functions in one compact package—with solid state reliability, B&K professional quality.

LOW INVESTMENT—QUICK RETURN

See your B&K Distributor or write for Catalog AP22-R

Net \$19995



B & K MANUFACTURING CO. DIVISION OF DYNASCAN CORPORATION 1801 W. BELLE PLAINE AVE. • CHICAGO, ILL. 60613

Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

Circle 23 on reader's service card

FEATURES:

BUILT-IN POWER SUPPLY

Auto Radios—High current, low-ripple, for transistor, hybrid, and vibrator types.

Transistor Portables—1½ to 12 volts for battery substitution—plus separately variable voltage tap for bias.

QUICK AND ACCURATE TESTING OF POWER AND SIGNAL TRANSISTORS

In-Circuit—stage by stage DC signal injection and sensitive metering of power supply current.

Out-of-Circuit—Direct Beta and Leakage meter scale readings. Easy balancing or matching.

VERSATILE SIGNAL GENERATORS

RF Generators—provide broadcast and IF frequencies for both AM and FM bands. Audio Generator—for AM or FM modulation of the RF signals, and for trouble-shooting audio circuits.

RUGGED VOM

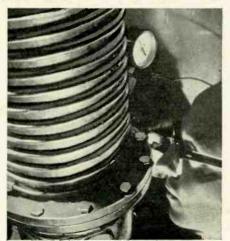
Volt-OHM-Milliammeter—with rugged, taut band meter—provides correct ranges for easy, fast servicing of all home and auto radios, as well as transistor portables.

Government Report* Points Out Rapidly Growing Job Opportunities: Need for Trained Electronics Technicians An Important Factor

By Bill Gordon, RCA Institutes, Inc.

President Johnson Emphasizes Need. In his 1964 annual manpower report, President Johnson indicated that the demands for manpower are expanding most in, among other fields, service and technical (including technician) occupations. This expansion is the result of a handful of causes underlying today's big changes in the occupational picture: (1) increasing complexity of modern technology, (2) trend toward automation of industrial processes, (3) growth of new areas of work, such as in the field of atomic energy, earth satellites and other space programs, and (4) data systems analysis and data processing. Indicative also of the growing importance of the use of technicians is a recent revision of the "List of Critical Occupations" published by the U.S. Department of Labor in which technicians are listed for the first time by the U.S. Government.

Salary Levels for Trained Technicians Rising Fast. Beginning salaries for graduates of top level technician education programs have continued to go up during the past five years, at a faster rate than salaries of similar types of jobs. In fact, a U.S. Labor Department projection based on the figures shows that by 1970, technician salaries will average an all-time high.

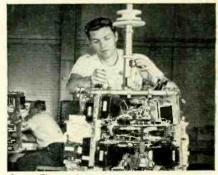


Nuclear Instrumentation

Technical Education is One of Today's Best Investments. Today, a person interested in becoming a technician can choose Home Training or Classroom Training to begin building his career. One of the nation's largest schools devoted to training electronics technicians, RCA Institutes, offers a wide variety of courses in both categories. In addition, the RCA "AUTOTEXT" Programmed Instruction Method is helping people learn faster and easier so they can get started on their careers in the shortest possible time. Dramatic proof comes from the success stories of countless graduates who find profitable positions in government, industry, or in their own businesses.

Of the total 696,000 technicians needed by 1970, it can be estimated that electronics technicians at all levels will form a vital core in today's major job picture.

*"Scientists, Engineers, and Technicians in the 1960's" U.S. Department of Labor, Bureau of Labor Statistics.



Space Electronics

RCA DEVELOPS AN EASY WAY TO LEARN ELECTRONICS AT HOME

New "Career Programs" Help Train You For Expanding Job Opportunities. RCA "AUTOTEXT" Instruction Method Speeds Learning

Choose an RCA "Career Program" that will train you for the job you want in Electronics! No time wasted learning things you'll never get to use. "Career Programs" answer the need for today's growing job opportunities for trained Electronics Technicians. They can help you get the job you want faster and easier than you ever dreamed possible!

And each "Career Program" starts with the amazing "AUTOTEXT" Programmed Instruction Method.—the scientific way to learn that's almost automatic! "AUTOTEXT" helps even those who have had trouble with ordinary methods of home training in the past. This is the "Space Age" way to learn everything you need to know with the least amount of time and effort!

Choose a "Career Program" now. Each one is designed to train you for a specific, rewarding career in one of the following exciting fields:

- TELEVISION SERVICING
- FCC LICENSE PREPARATION
- AUTOMATION ELECTRONICS
- AUTOMATIC CONTROLS
- DIGITAL TECHNIQUESTELECOMMUNICATIONS
- INDUSTRIAL ELECTRONICS
- NUCLEAR INSTRUMENTATION
- SOLID STATE ELECTRONICS
- ELECTRONICS DRAFTING

In addition to these "Career Programs" RCA Institutes offers a wide variety of separate



Radar Microwave

DECEMBER, 1965

courses on many subjects—from Electronics Fundamentals to Computer Programming.

VALUABLE EQUIPMENT INCLUDED

And, with your RCA Training, you receive top-quality equipment to keep and use on the job. When you train with RCA Institutes, you never have to take apart one piece to build another. You'll get the new Programmed Electronics Breadboard which provides limitless experimentation...and, with which you construct a working signal generator and a superheterodyne AM Receiver.

SPECIAL BONUS -

OSCILLOSCOPE and METER KITS

Valuable Oscilloscope and Multimeter Kits are yours at no additional cost when you enroll in any one of the RCA Career Programs..."must" equipment for electronics technicians in almost all jobs.

LIBERAL TUITION PLAN

Only RCA offers you this most economical way to learn. You pay for lessons only as you order them. No long term contracts. You may stop your training at any time without owing a cent.

CLASSROOM TRAINING ALSO AVAILABLE

If you prefer to learn in a classroom, RCA Institutes maintains one of the largest schools of its kind where the latest classroom and laboratory training is available in day or evening sessions. You may be admitted without any previous technical training.

Preparatory courses are available if you haven't completed high school. Coeducational classes start four times a year.

FREE PLACEMENT SERVICE

RCA Institutes records prove that in a recent class 9 out of 10 Resident School students who used the Free Placement Service had their jobs waiting for them when they graduated. And, many of these jobs were with top companies in the field—IBM, Bell Telephone Labs, General Electric, RCA, and radio and TV stations, and other communications systems throughout the world.

SEND THE ATTACHED POSTAGE PAID CARD FOR COMPLETE INFORMATION WITHOUT OBLIGATION. NO SALESMAN WILL CALL. VALUABLE FREE BOOK INCLUDED. CHECK HOME STUDY OR CLASSROOM TRAINING.



Computer Programming



RCA INSTITUTES, Inc., Dept. ZRE-D5 A Service of Radio Corporation of America 350 West 4th St., New York, N. Y. 10014



THE MOST TRUSTED NAME IN ELECTRONICS

® "AUTOTEXT"—An RCA Trademark

Circle 24 on reader's service card

Be super-critical.

Whether you're looking for the fun and economy of building quality kits or you want ready-to-use factory-wired equipment — before you buy, examine carefully. Compare EICO with anybody else — feature for feature, chassis for chassis, part for part. The more critical you are, the more you'll see for yourself that your best buy is EICO.



Over 3,000,000 EICO instruments now in use! Preferred by engineers, scientists, technicians and students. EICO equipment is available nation wide through 2500 EICO dealers.



New Model 435 — DC Wideband Scope. Topquality DC 4.5mc scope with 3" flat-face CRT. Zener calibrator. Outperforms 5" scopes three times its size, facilitates on-location color TV and other servicing. \$99.95 kit, \$149.95 wired.



New Model 342 — FM Multiplex Signal Generator. Design lab quality. Both composite audio and FM RF outputs. Inputs for stereo audio source for store demonstrations, critical A/B listening tests. \$149.95 wired.



New Model 965 — FaradOhm Bridge/Analyzer. 9-range, low-voltage capacitance-resistance bridge safely measures even 1-volt electrolytics. Metered bridge balance, leakage test voltage (6 DC VTVM ranges 1.5-500V), leakage current (11 DC VTAM ranges 0.15ua-15ma). DC VTVM & VTAM externally usable. \$129.95 wired.



New Model 1030 — Regulated Power Supply. Speeds troubleshooting, design work, production line testing, electronics teaching. Variable bias and plate sources regulated to ½ of 1%: 0-150V @ 2ma; 0-400V @ up to 150ma. Ripple less than 3mv rms. Unregulated fil. volts of 6.3V & 12.6V, @ 3A. Switchable, monitoring milliammeter and voltmeter. \$59.95 kit, \$99.95 wired.



New Model 378 Audio Generator, Near-distortionless sine wave generator (< 0.1% 20-20,000c) providing fast, convenient, switch-selection of frequencies from 1c to 110kc (1c steps 1c-100c, 10c steps 100c-1kc, 100c steps 1kc-10kc, 1kc steps 10kc-110kc). 8-pos. 10db/step output attenuator & fine attenuator. Output meter (44/2° 200ua) with 8 voltage ranges & db scale. \$49.95 kit, \$69.95 wired.



Model 232 Peak-to-Peak VTVM. A must for color or B & W TV and industrial use. 7 non-skip ranges on all 4 functions. With Uni-Probe. \$29.95 kit,



New Model 779 — Sentinel 23 CB Transceiver. 23-channel frequency synthesizer provides crystal-controlled transmit and receive on all 23 channels. No additional crystals to buy ever! Features include dual conversion, illuminated S/RF meter, adjustable squelch and noise limiter, TVI filter, 117VAC and 12VDC transistorized dual power supply. Also serves as 3.5 watt P.A. system. \$169.95 wired.



New Model 712 — Sentinel 12 Dual Conversion 5-watt CB Transceiver. Permits 12-channel crystal-controlled transmit and receive, plus 23-channel tunable receive. Incorporates adjustable squelch & noise limiter, & switches for 3.5 watt P.A. use, spotting, & Part 15 operation. Transistorized 12VDC & 117VAC dual power supply. \$99.95 wired only.



New Model 753 — The one and only SSB/AM/CW Tri-Band Transceiver Kit. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC. Unequalied performance, features and appearance. Sensationally priced at \$179.95 kit, \$299.95 wired.



New Model 3566 — All Solid-State Automatic FM MPX Stereo Tuner/Amplifier. No tubes, not even nuvistors. Delivers 112 watts IHF total to 4 ohms, 75 watts to 8 ohms. Completely pre-wired and pre-aligned RF, IF and MPX circuitry, plus plugin transistor sockets. \$219.95 kit (optional walnut cabinet \$14.95), \$325.00 wired including walnut cabinet. UL approved.



Model ST70 70-Watt Integrated Stereo Amplifier. Best buy of highest ranked stereo amplifiers according to independent testing, \$99.95 kit, \$149.95 wired. ST40 40-Watt Integrated Stereo Amplifier, \$79.95 kit, \$129.95 wired. ST97 Matching FM MPX Stereo Tuner, \$89.95 kit, \$139.95 wired. EICO Electronic Instrument Co., Inc. 131-01 39th Ave., Flushing, N. Y. 11352

Send for FREE catalog describing the full EICO line of 200 best buys and name of nearest dealer.

I'm interested in:

- test equipment
- ☐ hi-fi
 ☐ ham radio
- ☐ ham radio
- CICB

Name_

Address

City__

State___

RE-12

1945-1965: TWENTY YEARS OF LEADERSHIP IN CREATIVE ELECTRONICS

Circle 25 on reader's service card

FUEL CELLS

... The fuel cell was discovered in 1839, but its use has only begun

he fuel cell was discovered by Sir William Grove in 1839. Fifty years later, Ludwig Mond and Carl Langer experimented with a similar device and coined the name "fuel cell." But the dynamo was then becoming a cheap and convenient means of generating electricity, and fuel-cell development was pushed into the background. It did not receive any serious attention until F. T. Bacon started work with his hydrogen-oxygen cell in the early 1930's. The present-day fuel cell had its first important use in the Gemini spacecraft

Fuel cells produce power from a continuous supply of fuel. They weigh far less than other batteries of comparable power output. Modern tests on fuel cells have shown no sign of wearout in more than 7 months of continuous operation.

The General Electric fuel cells which have been used in spacecraft contain an anode and a cathode which are in contact with a solid electrolyte that permits the exchange of hydrogen ions between the electrodes. The key to the modern long-life cell lies in the new solid polymer electrolyte which is extremely resistant to chemical oxidation at high temperature.

The fuels commonly used are hydrogen and oxygen. The hydrogen fuel is introduced on one electrode and the oxygen on the other. By the aid of a catalyst the hydrogen atoms give out one electron each, forming ions which migrate through the solid electrolyte to the cathode. There they combine with oxygen to produce electricity and, as a byproduct, potable water, which is carried off by capillary action in wicks to a collection point.

The unusual feature of fuel cells is their high efficiency: they convert between 50% and 70% of their energy to electric power. A fuel cell produces uninterrupted electrical power directly from a continuous chemical reaction, as long as the fuel and oxidant are supplied. Normally, fuel cells have no moving parts and therefore need little or no maintenance. They are silent and give off no fumes.

The principal components of a typical fuel-cell power system are: the fuel supply system, the battery of fuel cells, water and heat removal, setup electrical control. Fuel consumption is approximately 0.9 lb per kilowatt hour.

The fuel cells used in the Gemini craft operate at a voltage of 0.73 to 0.9, delivering up to 73 watts per square foot of cell.

Fuel cells are, of course, never recharged as are storage batteries, but work by the use of fuel only.

One of the latest developments of the G-E fuel cell is centered in the solid polymer electrolyte already mentioned. This design is characterized by the use of a tough, thin sheet of polymer plastic. An ion exchange membrane forms the electrolyte. By binding a simple catalytic electrical structure to each side of the sheet, it becomes possible to construct a fuel cell of unique simplicity and light weight. As the membrane rejects water above a fixed amount, that byproduct of operation can be easily removed by condensing the vapor on cool wicks, which carry it off by capillary action.

G-E scientists have also announced development of a fuel cell that operates from hydrogen and air, and also one that operates from hydrocarbon fuel and air. Furthermore, the 8-day Gemini project proved that fuel cells can provide spacecraft power under almost all space conditions, irrespective of the space-gravity conditions.

Fuel cells are connected in series and parallel to obtain the necessary power output. In the Gemini unit, 32 cells are connected into modules, with three modules electrically in parallel in each fuel-cell battery. The complete Gemini fuelcell battery system is composed of two batteries, each in a container about 2 feet long and 1 foot in diameter.

When operated together, these two fuel-cell batteries produce up to 2 kilowatts peak power, and give 1 pint of water per kilowatt hour of operation. The complete system weighs 135 lb, exclusive of fuel.

On preliminary tests, one fuel-cell battery completed a 6-week test run of 1,100 hours, equal to more than 750 orbits; in other words, five times to the moon and back.

These are only the bare facts about the fuel cell, which is still in the early stages of its development. What may we expect from it in the future? It would seem that in most cases where storage batteries are used the fuel cell will be able to do the job much better. First, we have replacement for ignition batteries. Wherever weight is of not much consequence, the fuel cell can do the work better and often cheaper. It is true that the usual storage battery gives 2 volts per cell whereas the fuel cell gives only slightly less than half of this. Yet, if all factors are weighed, the fuel cell will come out on top.

Where power is concerned, the fuel cell will often prove much cheaper and much lighter than storage batteries. It may in many instances replace the gasoline engine.

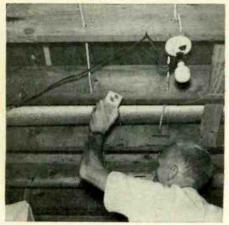
The fuel cell may often prove more advantageous than an isolated electric plant which requires an internal combustion engine to furnish power. Wherever it is impossible or impractical to employ an electric line, the fuel cell will find an opportunity.

Delivery trucks, some of which still use storage-battery propulsion, will find fuel cells very useful. The Allis Chalmers Co. has developed an experimental fuel-cell-powered tractor.

Because fuel-cell power units can be stored for long periods, they promise many other industrial applications, including power supplies for remotely located commercial equipment, TV repeater stations, beacons, etc. -H.G.

Merry Christmas—Happy New Year

The Staff of RADIO-ELECTRONICS



Chase it along the cord . . .



to the outlet box . . .



through the breakers . . .

HOW TO TRACK INTERFERENCE

A small transistor portable, moved along suspected wiring, can guide you to the source of the noise or snow

By THOMAS R. HASKETT

INTERFERENCE IS ANY SIGNAL THAT interferes with a radio listener's or a TV viewer's enjoyment of his desired program. This includes reception of CB, amateur and two-way radio, as well as all entertainment sources. Before you can eliminate interference, you have to identify the source, localize the source and track it down.

While it won't always help, if you can identify the source, you can often go straight to it and remedy the trouble. For example, if you hear CB or a ham operator coming in on your TV or broadcast receiver, write down the call letters. Amateur radio call signs consist of K or W followed by a numeral from 0 to 9 and two or three letters. The letters A, B or N may be inserted between the first letter and the digit. Examples

of amateur call signs are W2PWG, KAØXKC, WN2HTW and WB7XAZ. Older Citizens band licensees have call signs consisting of one or two digits, one or two letters, followed by four digits. All other two-way radio stations such as fire, police, ambulance and taxi cabs and CB stations licensed since January 1962 use call signs consisting of the letter K followed by two letters and three or four numerals. Examples of these are 2W3056 and KEC863. If it is an amateur or CB station you may be able to contact the operator through the local amateur or CB club. If you can't identify the station, send the call letters to the FCC or call the FCC field office in your area. Once you contact the operator, you can take it from there. While he may not be at fault, he can (and usually will) tell you what frequency he's operating on, and thereby enable you to try trapping out his signal. If you know what you're looking for, it's usually easier to search. Except for atmospheric static, which we won't consider here, interference sources fall into three categories.

1. Nonradio, manmade sources: Electric motors, fluorescent lights, oil burners, blinker or traffic lights, old long-filament light bulbs, neon signs, arc welders, thermostats and the power line itself. The point to remember here is that these sources make clicks, pops, buzzes and other peak noises, that identify them as nonradio in origin. They are actually rf, but they don't originate from what's usually considered radio equip-

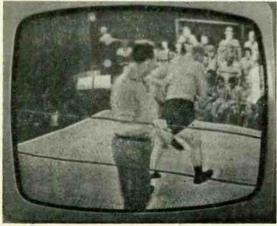
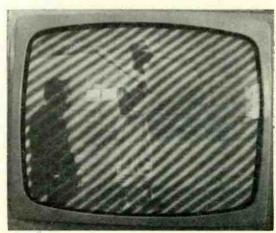


Fig. 1 — Irregular white flecks are usually motor noise—caused by sparking brushes.

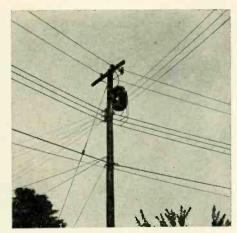
Fig. 2 — Heavy oblique bars often result from beat between video carrier and some other unmodulated carrier near it in frequency.



RADIO-ELECTRONICS



up the service drop . . .



along the power lines!

ment. Sometimes they radiate through free space; most of the time such interference enters a receiver via the power line. An example of the video pattern produced by one of these noises is shown in Fig. 1—the source is dirty brushes in an electric drill motor, brought into the TV set through the power line.

2. Transmitters: Broadcast, amateur, police, CB and other transmitters can cause interference, but often not at their fundamental frequency. Every transmitter is a harmonic generator. Although FCC rules require harmonics to be suppressed, rigs sometimes become defective. At times the fundamental of one transmitter cross-modulates the fundamental of another; the resultant sum or difference frequency can pop up in the middle of a TV channel. When an FM station is heard through a TV set on one channel only, cross-modulation is often the cause.

Sometimes a transmitter puts such an intense signal into an area that it causes rectification and spurious signal generation in such things as conduits, air ducts, drain pipes, metal laths and stove pipes. Seldom a problem in new houses, this trouble is usually found in older construction.

Strong fundamental frequencies from nearby transmitters also get into battery chargers, electronic control devices, and even audio amplifiers, wheresome nonlinear element produces beats and reradiates this interference. Since this type of interference consists of a radio wave, it appears as a steady carrier, sometimes with identifying modula-

tion, but often without.

Figs. 2 and 3 show what happens when a strong rf carrier gets into a TV, producing the familiar herringbone pattern characteristic of a steady carrier. In this case, it was the third harmonic of a CB transmitter interfering with channel 6. In Fig. 2, the presence of few bars tells you the interference is located close to the video carrier on

83.25 mc. In Fig. 3, the presence of a fine-mesh pattern of many bars indicates the interference is located well away from the video carrier. Of course, similar results would be produced by interference getting into the video i.f. in either the 20- or 40-mc range.

An oft-reported type of interference produces "strange voices" from the electronic organ in a church or funeral parlor, from the PA system at the stadium or the sound system at the movie house. This occurs when a strong rf signal-usually from a hf or vhf transmitter-gets into audio circuitry and is rectified. The interfering signal can come from a TV, FM, CB, ham or any two-way radio transmitter. This problem is generally caused by direct pick-up of a fundamental signal and is solved by installing rf filters and shields in the audio circuits. If the signal is intermittent ask the station operator to help when testing or adjusting the rf

Remember that some transmitters carry no modulation or only raw ac—such as diathermy equipment, some radio-controlled garage-door openers, mercury-vapor germicidal lamps, and rf heating equipment. Remember also that cross-modulation often occurs in the

receiver's rf or mixer stage. The rf amplifier may be overdriven by strong interference, and thereby operate on the nonlinear portion of its plate-characteristic curve, producing heterodynes; the mixer is already nonlinear and will readily produce other beats.

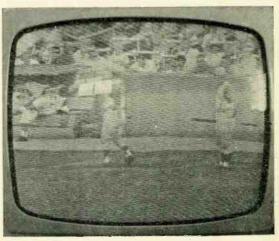
3. Receivers: They can interfere with each other and with themselves. Nearly all contain a local oscillator. TV's also contain horizontal and vertical oscillators, and their respective outputamplifier stages. These are usually operated class-C and have high harmonic content. The vertical is seldom troublesome, but the horizontal output is a buzzsaw that can mar reception across the broadcast band and well into the 80meter ham band. Local-oscillator interference usually consists of an unmodulated carrier that rides in over a desired station (in radio) or produces a herringbone (in TV). Occasionally a receiver interferes with itself. An example is Barkhausen oscillations, consisting of vertical stripes down the left side of the raster, produced by a harmonic of the horizontal scanning output, picked up by the TV's own tuner.

Localize

If you cannot go directly to the source, eliminate the negatives and concentrate your attention on the most likely path for interference.

- 1. Substitute another receiver, known to be in good condition, at the same location, to prove the interference is not self-generated. If an outdoor antenna is used, as in TV, be sure to attach it to the substitute receiver. It's usually easier to combine this step with the next one.
- 2. Use a battery-powered receiver at the location of the problem receiver, eliminating the ac line. Open the breaker or fuse box and disconnect the particular branch circuit feeding the receiver location. If the interference disappears, it's being carried via the power line and you can trace it accordingly. If not, try grounding the *load* side of the ac

Fig. 3—Light "tweed" pattern is higher-frequency beat, from carrier comparatively far in frequency from video carrier.



line at the breaker box, to see if this gets rid of the interference. Caution: be very careful with that jumper. Kill the main circuit breaker first. Then attach the jumper to the electrical ground bus, which will have white wires connected to it. Finally, touch the jumper to each branch circuit in turn (Fig. 4) and see if the interference disappears. When finished, remove the jumper, replace the protective panel, and restore the main breaker. If you can't kill the interference by grounding the power line, chances are it's coming in through space.

Track

1. If the interference is coming via the power line, it won't be too difficult to run it down. First determine if it's inside or outside the building. Pull the main breaker at the breaker box, follow the power line up the service drop, and out to the street, with a portable receiver. If the interference is gone. it must be generated within the house. Put the main breaker back in and throw off all branch circuit breakers but one, listening on the receiver to see if the interference reappears. After you find the offending circuit, trace wiring to outlets, unplug appliances, until the trouble disappears. You may have to crawl into an attic or basement fruit cupboard to dig out an all-but-forgotten outlet. Sometimes old radios, TV boosters or heating pads are ignored and left on for years. They can radiate over a wide area.

If the interference enters the building via the power company's service cable, it may be due to the power line itself. In many cases it won't go much beyond a pole transformer, and it's a good idea to take the portable receiver as close to the pole as possible. Check service drops to other houses. If in doubt, call the power company and have them send out an interferencetracing crew. They are usually quite cooperative and will take any reasonable steps to get rid of interference caused by their own equipment. Cracked or open insulators on lines will generate buzz and crackling noises. Sometimes lines sag and intermittently touch grounded objects.

2. If interfence is not being received through the power line, it must be traveling by free-space radiation. The only way to track it is by using a portable receiver with a directional antenna. The usual portable AM radio has a bidirectional loop, and the signal nulls (points of minimum reception) are at right angles to the plane of the loop. Some portable FM and TV receivers have monopole antennas, which are useless for direction finding. Get rabbitears and connect them in place of the monopole. You will then have a simple



Fig. 4—Transistor portable traces interference on power lines. Be very careful! Pull main breaker or fuses before beginning this test

dipole antenna, which has its nulls along its length. The reason for using nulls is that they offer sharper indication than lobes (points of maximum reception).

Nulls pinpoint direction, but to determine whether the interference is getting better or worse, it's necessary to use lobes. It might be supposed that receiver ave or age defeats the attempt at direction finding, but this isn't true. You aren't concerned with the absolute field strength of the radiated interference—you're interested only in the ratio of undesired to desired signal, and ave won't alter that, provided you are still getting a clear pickup of signal from the desired transmitting station. Each time you take a bearing, note which way the nulls point, and move one way or the other along this line. If the interference gets worse, you're going in the right direction.

It is sometimes possible to speed up the tracking process by using an automobile. Whatever the method, you can usually determine the interference source. The owner can be politely asked to remedy the situation. If it's not his fault, you can at least determine the frequency or frequencies the radiation is emitted at, which will then allow you to use traps or filters to keep it out of the receiver. It is usually more desirable to correct the problem at the source, for then you clean up many receivers. Besides, once the interference gets into the vicinity of a receiver it's difficult to eliminate it entirely. Remember that where the interference source is clearly at fault, and a polite request to investigate the problem doesn't produce any action, you can always report the matter to the FCC, either in Washington, D.C., or their nearest district office. END

ARE WE REALLY MAKING PROGRESS?

1 WAS CLOSING MY CADDY WHEN SHE said, "Wait a minute. I have something else for you to look at."

She came back a minute later with an old radio in a wood cabinet. I could spot the vintage by the bay window that housed the speaker. I also knew the tubes with top caps were not 6BQ6's.

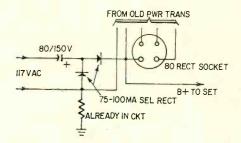
"This old set has the best tone I ever heard, and I would like to get it fixed. It also has a sentimental attachment. My first boy friend gave it to me."

It was the light in her eye as she said this that made me tuck it under my arm and promise to try.

The next day I dug it out and plugged it in. There was not a sound.

I slipped the chassis out of the cabinet. The voltmeter revealed no B-plus. Touching a screwdriver from the plates of the 80 to chassis indicated no ac on them. The ohmmeter showed the secondary of the power transformer wide open both sides of center tap.

I was thinking in terms of forgetting it right then, but I remembered the twinkle in the eye and decided to go a step further.



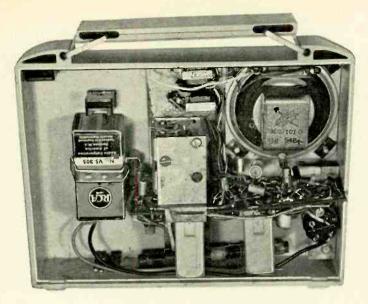
I rigged up a voltage-doubling circuit with two seleniums and an 80-uf 150-volt capacitor, just lying on the bench. When I touched the positive to the 80 filament connection, the volume seemed up to normal and the tone was good. (It sounded almost like a hi-fi.)

I flipped the bandswitch to the short-wave position just to see, and was really surprised to pick up a Britisher and a bunch of Spaniards, even though the antenna was only a few feet of wire lying on the floor.

I installed the voltage-doubling circuits permanently (no trouble finding space) and slid the chassis back into the cabinet. The solid wood case rounded out the tone to a point that left nothing to be desired.

A check of tubes revealed that all were at least 15 years old. None needed replacing.

As I fastened the back on I couldn't help but wonder—Are we *really* making progress?—*Harold Davis*



Wide-open space around battery is where bulky A-and B- batteries of tube set used to be. When you do your conversion, you might want to shuffle the parts around and install a bigger speaker—or twin speakers.

TRANSISTORIZE Your Tube Portable

We don't normally like the word "transistorize", but we really mean it here! You can rebuild your old tube portables to use transistors, and save a lot in tube and battery replacement!

By JAMES E. PUGH, JR.

Practically every experimenter has wondered whether it might be practical to convert old portable tube radios—now universally discarded as uneconomic—to transistors. Until now the low input impedance and medium output impedance of transistors would have required replacing or drastically altering all rf, i.f. and oscillator transformers.

But now you can do it—with only the simplest rewiring. A flexible way to get high input and output impedances makes it possible to connect transistors directly to unmodified tube-type rf, i.f. and oscillator transformers. All you add are suitable transistor biasing networks and a few turns to the oscillator transformer.

This circuitry can, of course, be used to convert any tube-type broadcast set—table, console or auto, as well as portables.

The basic circuit is an emitter-coupled amplifier. It uses two transistors per stage, coupled together across a common-emitter resistor—R in Fig. 1. Q1 is a common-collector amplifier (high input impedance and very low output impedance). Q2 is a common-base amplifier (very low input impedance and high output impedance). Considered together as one stage, this emitter-coupled pair has an input and output

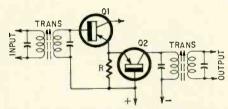


Fig. 1—Basic emitter-coupled amplifier has tubelike input and output impedances.

impedance much higher than normal in a transistor stage.

The input impedance is slightly lower than optimum, but the output impedance is high enough to give no perceptible deterioration in performance. Input capacitance is slightly higher, and output capitance slightly lower, than that of the tube which the transistor pair replaces. Overall power gain is slightly greater (theoretically) than from a well matched common-emitter

stage. Voltage and current gains are about the same.

Fig. 2 shows a complementary p-n-p/n-p-n pair in the same kind of circuit.

Fig. 3 is the complete circuit diagram of a converted radio. The basic emitter-coupled circuit is used in the rf section, but with one high-impedance input section (the rf amplifier) and two high-impedance output sections (the oscillator and mixer). In this stage Q1 is direct-coupled to Q3 across R1 to form a pair like that in Fig. 1.

Since the oscillator is a commonbase section with low input and high output impedance, it too can be coupled into the mixer at the low-impedance point (R1) through capacitor C3, putting a negligible load on transformer T1. This section has its own emitter resistor, and the signal injection into the mixer is determined by the size of C3.

This circuit not only gives conventional oscillator and mixer action, but also an rf amplifier with about 15 db gain.

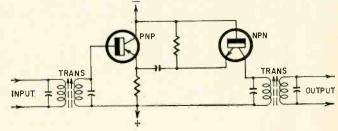
The i.f. amplifier is essentially the same as the basic circuit in Fig. 1. It uses double-tuned transformers for very good selectivity (four tuned circuits) in just one stage. Ave voltage from the detector (D1) is applied to both sections of this stage as well as to the rf and mixer sections.

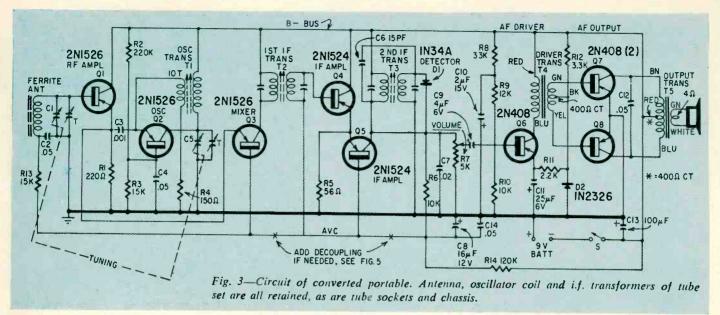
Although all these transistors obtain their base and collector voltages from a common source, separate decoupling filters are not used in the i.f. afc lead or in the collector return of any transistor. Where possible, all such parts were eliminated to keep conversion costs to a minimum. But if your set has two i.f. stages, you will have to add decoupling and possibly neutralize both stages to prevent oscillation.

The audio amplifier is conventional except that it uses an inexpensive germanium diode (instead of a thermistor) that not only compensates for temperature, but also extends battery life by automatically regulating the base-bias voltage for Q7 and Q8 to minimize crossover distortion as the battery voltage drops off with age.

Since this particular case is roomy, I used a large 9-volt battery for economy. It should last about 200 hours with a 9-ma drain, while the conventional 2U4 would last only about 35 hours. Of course, I could have reduced cost by

Fig. 2—Basic complementary (p-n-p/n-p-n or vice versa) emitter-coupled amplifier.





C1, C5—tuning capacitor* C2, C4, C12, C14—.05-μf, 100-volt paper or Mylar -.001-μf ceramic C6—15-pf ceramic C7—.02-μf, 100-volt, paper or Mylar C8—16 μf, 12 volts C9—4 μ f, 6 volts C10—2 μ f, 15 volts C11—25 μ f, 6 volts C13—100 μ f, 15 volts

C8, C9, C10, C11, C13 are electrolytic -1N34A or equivalent D2-1N2326 (RCA)

using 6 type-C flashlight cells.

The conversion

The first step in making your conversion is to determine what changes, if any, will be necessary in the circuit shown in Fig. 3. If you use two i.f. stages, add the second one to the diagram. Make it identical with the one shown, but add decoupling filters to the first stage.

Next, remove all parts that will not be used, leaving only the rf, i.f. and oscillator transformers, the tuning capaci-

Q1, Q2, Q3-Q4, Q5-2N -2N1526 (RCA) -2N1524 (RCA) Q6, Q7, Q8—2N408 (RCA) -220 ohms R2—220,000 ohms R3, R13—15,000 ohms -150 ohms R5-56 ohms R6, R10-10,000 ohms -volume control, 5,000 ohms, audio taper R8-33,000 ohms R9-12,000 ohms R11--2,200 ohms R12-3,300 ohms

REPORT ON TRANSISTORIZED PORTABLE R-E checked the converted set 25 miles from New York City. 18 stations were received with fair volume, and more could be received with careful tuning. One exceptional night, Bonaire in the Netherlands West Indies was received. Tone quality and selec-tivity were about the same as those of a similar tube portable. A tendency to drop off at the high-frequency end was noticed—all stations were received at 1400 kc or below.

tor, and the tube sockets if you want to use them for tie points. Also, remove all wiring. If it is an etched-circuit board, existing conductors can, by careful plan-

R14-120,000 ohms S-spst switch oscillator transformer T2—i.f. transformer, input*
T3—i.f. transformer, output*
T4—audio transformer, 10,000 to 2,000 ohms ct (Stancor TA-35 or equivalent)
T5—audio transformer, 500 ohms ct to 4/8/16 ohms (Stancor TA-21 or equivalent)
SPKR—3.2 ohm speaker*

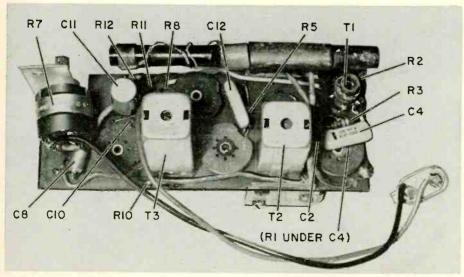
* parts retained from tube circuit BATT-9-volt battery (RCA VS-305 or equiva-

ning, be used with only minor changes. Although the original volume control can be used, the value shown gives better results.

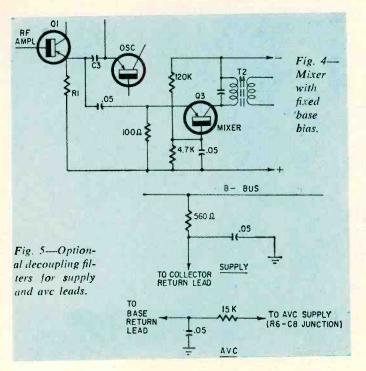
The next step is to plan the layout of all parts. Unused portions of foil conductors can be cut out with a sharp knife, and any necessary bridges between sections made with short pieces of insulated hookup wire.

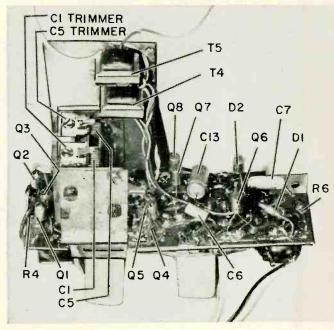
Solder all parts in place (transistors last, of course), and then wind 10 turns of enameled wire (about No. 32) adjacent to the present oscillator coil. Fasten it in place with coil dope or melted wax. Connect the battery and momentarily bridge a milliammeter across the switch (with switch off). The current drain should be about 8 to 10 ma if everything is satisfactory.

If current is normal, remove the meter, turn the switch on, and set the tuning capacitor to the high end of the band. Now peak the i.f. transformers at 455 kc. Start with the last and work toward the mixer. If double-tuned transformers are used, the primaries and the secondary connected to the detector should not need much adjustment. Any secondary connected to the base of a transistor will need to be retuned more. Back out the slug or loosen the capacitor to peak the transformer at 455 kc. If the i.f. amplifier oscillates, try grounding the transistor cases. A very fine wire can be soldered quickly to the case and then to ground without damaging the transistors. If this doesn't stop oscillation, try



Top of converted chassis. Several turns of the antenna winding have been pulled toward end to lower total inductance.





Underside of chassis displays most of the small parts.

neutralizing each stage.

Next, see if you can hear any stations. If not, reverse the two leads from the added oscillator winding. Then adjust the oscillator tuned circuit to cover the broadcast band. If a slug-tuned oscillator transformer is used, adjust the slug to give correct tracking at the low end of the band, and use the trimmer on the tuning-capacitor oscillator section to adjust the top end of the range. The trimmer adjustment should be adequate in most sets that do not use a slug-tuned coil. If not, the coil inductance can be changed by removing turns from the secondary to shift the low-end coverage

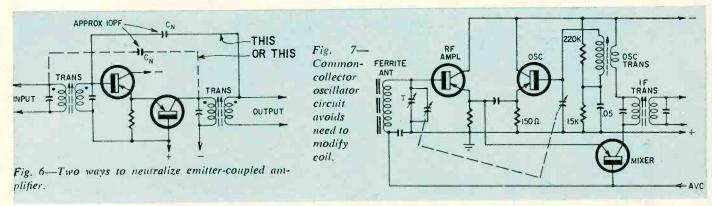
these adjustments two or three times to get the best alignment. There is always some interaction between oscillator and antenna circuits.

Possibly you will want to use some of the parts that were removed in this economy program, so you can be sure of top performance under all conditions. Fig. 4 shows what's needed for a separate bias network to the mixer. The separate emitter resistors and a coupling capacitor are necessary for maximum isolation of the mixer from the ave circuit. Otherwise the ave voltage will pull the mixer circuit.

Decoupling filters for ave and

this circuit the i.f. transformer supplies the 180° phase shift when the feedback is taken from the correct end of the secondary. If oscillation increases, simply reverse the connections to either primary or secondary.

Fig. 7 shows how the oscillator transformer can be used without changes. Connect the windings as shown, and reverse the leads of either (if necessary) to get oscillation. This circuit is good, but adds slightly more capacitance across the oscillator's tuned circuit than is desirable for full coverage of the broadcast band. It can be used if you want the utmost simplicity at the cost



up, or by adding turns to shift it down.

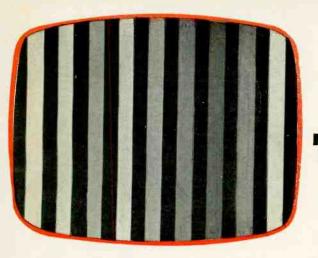
When you get the oscillator perking, tune up the antenna circuit by sliding a few turns of the antenna winding toward the end of the ferrite core for maximum response at 600 kc. Next, adjust the antenna trimmer for maximum response at 1400 kc, and check to see if any touchup is required on the low-frequency end. Sets with antennas that can't be adjusted may require a slight readjustment of the oscillator frequency to peak the response at 600 kc. Go over

battery supply leads are shown in Fig. 5. Simply add them as needed for the required stability.

If your set needs to be neutralized, keep in mind that both the common-collector and the common-base amplifier have no phase inversion between input and output; thus there will be no phase inversion in the emitter-coupled stages used in this set. Since the feedback voltage must be 180° out of phase with the input voltage to neutralize any amplifier, a method like Fig. 6 must be used. In

of a slight reduction in coverage at the high-frequency end of the band.

If your set uses the older loop antenna without a ferrite core, you may want to replace it with a ferrite type for increased performance. Make sure the inductance of the new antenna is right for your tuning capacitor. Mount it at least 2½ to 3 inches from the chassis and not too close to an unshielded oscillator coil. If necessary, put a shield between oscillator coil and antenna.



Service Color TV Traps and Pitfalls

Three sections of a color receiver worth special attention

By MATTHEW MANDL

THE SPECIAL CIRCUITS IN COLOR REceivers need special care in service. Even then, some results may be highly unexpected to the man who is used to black-and-white. The best way to localize any fault in any electronic equipment is to understand the circuit and apply logical checks to pinpoint a defective component. The really tricky circuits are those that have a dual purpose, and can affect several others.

The sound trapping in color sets is more elaborate than in black-and-white, so there often isn't enough sound signal at the output of the video detector to use the conventional sound takeoff found in black-and-white sets. An additional detector circuit is used.

A typical dual detection system is shown in Fig. 1. It is used in the Admiral color chassis D11, 1D11, 2D11, etc. Here the 6JC6 third pix i.f. feeds two diodes as shown. The sound detector mixes the sound i.f. and video carriers, and heterodyning produces the 4.5-mc sound i.f. signal. The video detector demodulates the picture signal but at the same time does what it does in a black-and-white receiver—that is, produce a 4.5-mc signal. The sound signal is then trapped out completely before

it can reach the first video amplifier stage.

Because we have two diode detector circuits here instead of the single one used in black-and-white, possibility of trouble is doubled. Note that the sound detector also supplies the signals for the sync-separator and age systems. Hence, defects in the sound detector circuit will also affect sync and gain control.

With no sound (but with picture) the usual continuity and component checks used for black-and-white receivers are a good start. The 10,000-ohm resistor shunting the diode detector is its load resistor and you can connect a scope there to check for a signal. (Don't expect to find audio here—only the 4.5-mc i.f. signal, which must still be amplified and detected later.) Check for a leaky coupling capacitor between the plate of the 6JC6 and the crystal diode. A voltage leak can affect detector operation and kill the sound.

Note the adjustable traps in the video detector circuit. The coupling transformer from the 6JC6 to the video detector is also a 43.8-mc resonant circuit—part of the overall i.f. tuning system. Above this is the 41.25-mc sound i.f. trap, and an additional sound-rejection potentiometer is used in this

input circuit. A 4.5-mc sound i.f. trap is also included.

Thus, when interference bars show up on the screen (and vary with the audio), the sound traps should be adjusted slightly. If the traps haven't been tampered with, and were correctly adjusted originally, not much retuning should be necessary. Try adjusting the 41.25-mc trap first. If there are still some faint interference lines, adjust the 4.5-mc trap.

If drastic readjustments are necessary (or if tuning doesn't eliminate the interference), check components. Substitute a new video crystal diode when troubles occur. Lack of video (but sound OK) localizes the trouble to the video detector circuit, or the stages after it. (Presumably, if there is sound, all stages before the dual detection system are OK.)

An oscilloscope check for signals at the grids of the two video amplifier stages will help pinpoint the stage that's giving trouble. If the fault seems to be in the dual detector system, remember how the third pix i.f. feeds both detector systems. Trouble in one circuit can influence the other.

Shorted or defective parts in one detector system will often reduce effi-

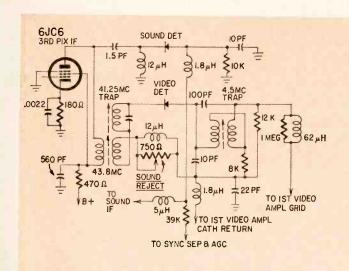


Fig. 1—Dual detectors in Admiral chassis—one for video, one for sound.

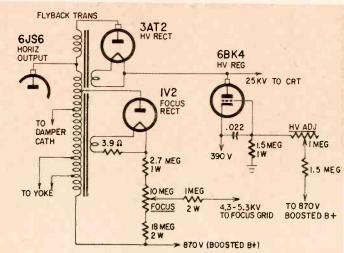


Fig. 2—Focus and high-voltage rectifiers in Zenith 25MC30 chassis.

ciency in the other. Thus, a leaky coupling capacitor in the sound detector circuit could reduce sound output (or produce distorted sound) and also reduce picture contrast. Also, a weak third pix i.f. tube will affect both picture and sound. Because the third pix i.f. feeds two detector systems, both low impedance, its gain is not as high as that of the first and second video i.f. stages, and any decline in performance shows up immediately at the detectors.

Focus rectifier and HV regulator

Another circuit in color receivers with a dual function compared to black-and-white sets is the high-voltage system, which most cases includes a focus rectifier to generate a separate 5,000 volts for the focus electrode of the picture tube. There is usually also a shunt regulator for more precise control of the high voltage for the pix tube.

A typical high-voltage system used in the Zenith 25MC30 is shown in Fig. 2. The focus rectifier does the same thing as the high-voltage rectifier, except that its anode is tapped off at a lower-potential point on the horizontal output transformer as shown. A 10-megohm focus control adjusts picture-tube focus.

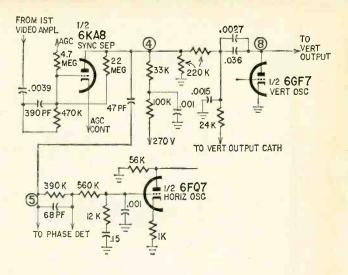
The shunt regulator is a variable load on the high voltage and tends to keep the output voltage constant, once it has been set by the 1-meg high-voltageadjust pot. The circuit is designed so that the grid bias for the shunt regulator changes with changes in high voltage. If the high voltage increases, the grid bias decreases and the shunt regulator conducts more heavily. Then it imposes a greater load on the high voltage and reduces it. If the high-voltage decreases, the bias on the regulator increases (goes more negative) and the tube conducts less; thus the load is decreased and high voltage goes up.

Special high-voltage probes must be used here to set voltages to the levels recommended by the manufacturer. If you don't get the right voltages, check tubes by substitution before doing anything else. Next, check resistor values around the adjusting pots. Occasionally a resistor will increase considerably in value. As in all high-voltage compartments, check for arcing. Clean the terminals, avoid sharp bends in the wiring, and cut away pointed pieces of solder. Make sure the damper tube is functioning properly, because it can affect both the focus voltage and the high voltage.

Scope patterns

When you use a scope for signal observation and testing, be careful not to assume that the same signal waveform exists at all points fed from a common point. This is another tricky aspect of

Fig. 3—Sync feed in RCA CTC16. Waveforms at the three test-points are not the same.



trouble shooting often overlooked. Take, for instance, the sync separator and oscillator sections shown in Fig. 3. It would appear that a scope signal at test point 4 on the schematic would look about the same as that at 5, since this is the same feed line with only a 47-pf coupling capacitor between. Similarly, it would seem that the same signal should appear at test-point 8, since it too is fed from test point 4.

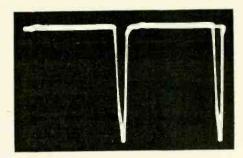


Fig. 4—Waveform at test-point 4 in Fig. 3 (60 volts peak-to-peak).

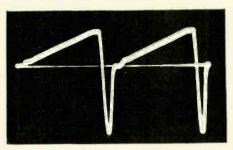


Fig. 5—Waveform at test-point 5 in Fig. 3 (20 volts peak-to-peak).

Actually, however, the waveform at point 4 consists of inverted sync pulses as shown in Fig. 4, but at test point 5 the waveform is a typical relaxation-oscillator type (Fig. 5). At point 4 the peak-to-peak voltage is 60, while at point 5 it is 20. At point 8 the same waveform shown in Fig. 5 will be observed, except that the peak-to-peak voltage is 185, as indicated in the service

schematic for this RCA CTC16. Incorrect waveshapes and voltages localize a defective stage immediately. Once the defective stage has been found, the same procedures apply to color receiver circuits as to black-and-white. First test tubes, then components and voltages.

The same basic principles apply to other sections of color receivers. And for circuits virtually identical to black-and-white designs, the same testing procedures apply. For circuits exclusive to color receivers, additional equipment may be necessary (color dot-bar generators, etc.). Signal tracing, scope-pattern observation, and voltage and component testing all follow familiar lines. Take a little extra care, and you'll have no trouble.

SOLDER SUCKER FOR PC BOARDS

Unsoldering components from printed-circuit boards is a beastly nuisance. For occasions when you have a lot of unsoldering to do, get set with this efficient vacuum-cleaner method.

Take an empty plastic squeeze bottle, such as the kind glue comes in (the 1½-oz size), cut off the bottom and about 3% inch of the nozzle. Wash the bottle out, peeling any hardened glue off the inside surfaces. Slip the open bottom end over the vacuum-cleaner hose.

The best way to handle the job is to melt the solder with a clean, hot iron until it flows freely, then quickly cover the terminal with the suction nozzle. The air current will draw the solder up into the bottle. If you don't get all the solder the first time, go back again. When the nozzle gets clogged, poke out the solder—it doesn't stick to the plastic. Any solder that gets into the vacuum cleaner will have hardened, and won't do any more harm than the metal filings you normally pick up with it.—

John H. Hughes

WE BUILT AN ELECTRONIC ORGAN!

Heath introduces kit version of Thomas all-transistor electronic organ

> By FRED SHUNAMAN MANAGING EDITOR

BUILD AN ORGAN? THE IDEA SOUNDED tempting, but would it even be possible? With the literally thousands of connections, the hundreds of chances for error, could a person ever get it straightened out and debugged? Many years of experience as constructor and repairman had taught me a great deal about bugs and debugging, and it seemed incredible that such a complex thing would start immediately after being hooked up and turned on. And the time! I remembered spending all my spare evenings during a whole summer on an automatic audio voltmeter, and this looked several times

I would have given up the idea-

actually I would never have reached ithad I not made the mistake of mentioning it at the dinner table. My 14-yearold daughter was delighted. "Let's build an organ! I'll do the work."

That made it quite a bit easier. I knew that if she would stick to it she could do the soldering. (She had been following kit-assembly instructions on simple pieces of equipment from age 6.) So, after eliciting solemn affirmations of perseverance, we sent away for the kit.

Experience was with me. At least I can boast of having made a lot of the mistakes before. Maybe it wouldn't be necessary to repeat them. When the equipment came—a Heathkit GD-983

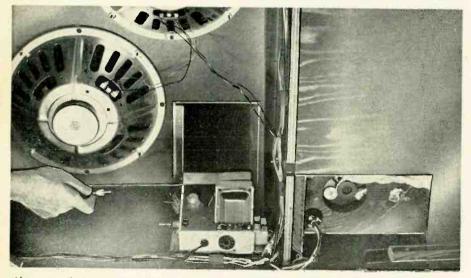
-every bit of packing was gone over carefully, then religiously saved in the basement against the day we should put the organ into operation. Evelyn and Margery-ages 9 and 6-claimed the big box. It was dedicated as a summer

The precautions paid off. A few items were missing, but were turned up as soon as they could be identified properly. But the biggest single unit, the distribution circuit board, was not to be found. Before writing to complain, however, we took one last careful look through all the packing, and sure enough, between two sheets of cardboard which together made a piece just the same size and shape as several other padding strips, we found the slim board. Three keys were also missing, but they had dropped behind some of the equipment and were wedged against a bookcase in the living room. The precaution of not sweeping the livingroom during the assembly period had also paid off!

Wiring went on in a strangely uneventful way. A few things puzzled us for a time, but further progress straightened them out. Every time we guessed, we guessed right. I found no errors in the instruction book. (This is a bit strange, because Heath assured me there were a few. However, it is sometimes as easy to pass over a mistake when the right way is obvious as it is to make an error when the instructions are correct and explicit.)

A little slip of paper mentioned a 220-ohm resistor that wasn't on the parts list and urged us not to be puzzled about it, but there was no mention of a missing 10,000-ohm resistor—maybe it





Almost ready to go . . . connecting audio signal lead to power amplifier. Heath organ, a kit version of Thomas Coronado BL-3, has two 12-inch main speakers and a two-speed Leslie rotating speaker system, for chorus, celeste and vibrato effects.

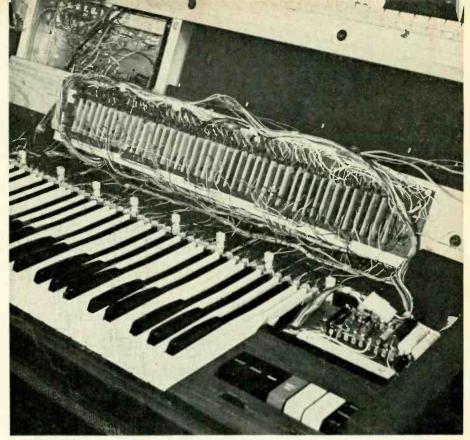
was something else that went out in the packing. And we were terribly startled to have a transistor left over. However, well along in the book we discovered that an extra transistor had been packed, so that straightened itself out.

One other slight difficulty was home-made. We were working 1 hour every evening during the week, and put in as much time as possible over weekends. To make more efficient use of our time, we split our efforts—and consequently the book. After a while it became rather difficult to get the pages in sequence and to find out exactly what we had to do next.

But we triumphed over all these things. Just a little more than a month from the time the equipment arrived, we came to the instruction "Turn the organ on." We did—and got a beautiful sync buzz from the amplifier. Turning it off quickly for fear that overload might blow the output transistors, we checked wiring and joints. Two joints that were not soldered at all, and three that looked dubious, were resoldered.

We put the amplifier back again, but the buzz continued. Tried the expression pedal (volume control). It had no effect. In desperation I used the old radioman's remedy—a sharp blow to the transformer with the flat of the hand. It worked—temporarily—but there was still no sound. We went through circuitry until we were interrupted by smoke rising from the 15-ohm resistor in the circuit to the swell keyboard. It had 15 volts on one side of it, and was supposed to have about the same on the other. Unfortunately, the voltage on the other side was zero.

I was a bit afraid of using ohmmeters on circuits containing transistors, but I dug up an ancient volt-ohmmilliammeter with a shunt type lowvolts range made by shorting the ordinary ohmmeter terminals, and connecting the probes directly across the meter.



Keying filters on long factory-assembled printed-circuit board occupy space between manuals. (Upper manual is shown tilted back.) Wiring is orderly and systematic.

With the zero adjustment set for full scale, the greatest current that could possibly flow was 1.5 ma.

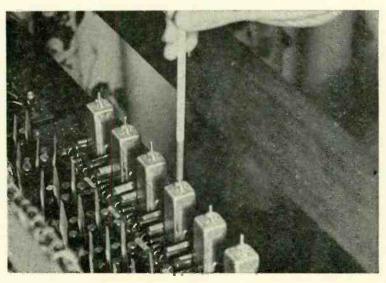
The multitester showed a solid ground on the swell keyboard. Tracing the leads down, I found a washer-head bolt screwed down firmly on top of the bare 15-volt lead that ran along the back of the swell-manual frame. Releasing it made everything normal, and we went ahead, up to the point where the instruction "Press any key near the middle of the great keyboard" started us playing the organ. It worked. We couldn't resist pressing all the other keys, in spite of the fact that this test was not

supposed to come for another page or two, and found that everything produced good sound.

Following through with a series of tests as instructed, we found that the SUSTAIN tab killed everything. Ohmmeter checks showed a 15-volt circuit grounded. We carefully traced the ground down to the big swell-circuit distribution board. I had a vision of a shorted diode among the 160 or so on that board.

It was Friday evening, so we decided to leave that job until the next morning. Unscrewing the board and turning it over, we started with the input strip, which ran along the lower edge of the board. Following it down about twothirds of the way, and looking at each point in turn, we discovered a small solder bridge—a thin thread that was actually above the board rather than on it. A touch of the soldering tip and everything checked normal. It sounded normal, too, when we put the board back again and tried it out. Meantime, the buzz had started up again in the amplifier, and we had to quit everything to attend to it.

The amplifier trouble showed us something about soldering transistor circuits. Old radio and TV technicians have run into many instances of sets that have developed intermittents or absolute opens after years of use, and have cured the trouble with a soldering iron on a dry or rosin-insulated joint. The marvel has always been that the set would work so long without giving trouble. No tech-



After checkout comes tuning. Step-bystep instructions according to an ingenious method make it
easy for anyone. No musical or electronic skill is
required.

DECEMBER, 1965

nician is likely to have that trouble on transistor equipment. Where your high voltage is in the order of 15 the rosin joint shows up immediately. And the ancient technique of wiggling, so seldom useful in tube circuitry, does work with transistors.

I found that by moving a wire at the ground connection of the two filter capacitors, we could produce or stop the buzz. Careful inspection of the joint showed absolutely nothing wrong, but a good resoldering stopped the buzz entirely, and we could not make it start again by flexing any of the leads or pushing the terminal strip back and forth.

Tuning was quite an experience. Heath supplies one oscillator wired and pretuned, and the others are tuned by comparison with it, using the "beat" method. I think the organ is reasonably well tuned, though I may get an expert in to confirm or deny it, or possibly try to hook the scope up so that I can see the beats instead of trying to count them with a watch. Anyhow, the organ sounds good.

Only one disadvantage—the instrument may introduce complications that we had not bargained for. Ellen is already planning to take organ lessons this year, and her younger sister is demanding to learn with her. And my wife says, "I'm going to learn to play that, too."

For myself, I'm just going to master a few bars of "Oh where and oh where has my Hieland laddie gone" and use it to demonstrate the instrument.

One thing remains to be done—put the back on. Admiring neighbors and friends always like to look at the work and a number of interested people who were going to come watch us put it together are still eager to see it. (They underestimated the time it would take us to do the job.) We are planning to invite them all over some evening and have a big celebration—an orgy, naturally.

SPECIFICATIONS

Thomas-Heathkit de Luxe Transistor Organ Model GD-983

Swell Manual (44 keys; F1 through F6).

Voices: 16 ft—Bourdon, Diapason, Bass Clarinet, Trumpet; 8 ft—Flute, English Horn, Violin, Oboe; 51/3 ft—Quint; 4 ft—Flute d'Amour

Great Manual (44 keys; F1 through C5).
Voices (all 8 ft): Diapason, Saxophone, French
Horn, Cello

Pedals (13 keys, C0 through C2): 8 ft, and 16 and 8 ft pitches

Percussion: medium or short decay, repeatable
Sustain: long or short (short called "reverb")

Amplifier power: 371/2 watts music power

Speakers: two 12-in. main speakers; one twospeed Leslie rotary system; headphone jack

Power requirements: 115 watts

Cabinet: walnut finish

Dimensions (overall): 43 x 43½ x 25 in.

Price: \$799 including bench

Heath Co., Benton Harbor, Mich.

Home "Message Center" Features Electronic Stop

By ROBERT F. SCOTT
TECHNICAL EDITOR

AN UNUSUAL AUTOMATIC ELECTRONIC stop is used in a new special-purpose tape recorder for personal messages in the home. The housewife can leave messages for her family and domestic help, leave intsructions for smaller children who can't read, and generally use the recorder to replace the family bulletin board and telephone message pad.

When a message has been recorded, a signal lamp comes on to indicate to members of the household that there is a message on the tape. At the end of the message, the tape automatically advances to the beginning so it need not be rewound before it can be replayed or a new message recorded.

This new recorder is the Westinghouse Message Center. The recordplay electronics uses four transistors: two voltage amplifiers and a push-pull power-output stage. De bias is used on the record and erase heads when recording. There is no on-off switch. The motor turns off automatically at the end of the tape. A 2½-inch pm speaker is the mike for recording. A voltage-regulated power supply stabilizes tape speed.

The messages are recorded on an endless 3-minute tape on a cartridge type reel wound on the outside and unwound from the center. The ends are joined by a short strip of metallized tape which actuates the stop circuit.

Electronic automatic stop

The voltage-regulator and automatic-stop circuits are shown in the diagram. The power supply delivers -8.6 volts from a bridge rectifier. The Mes-

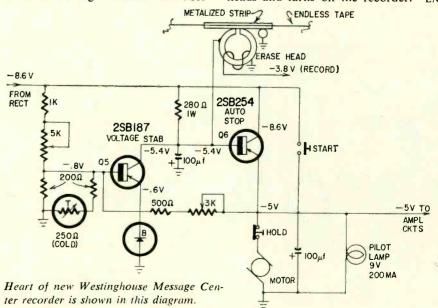
sage Center is turned on and off by closing and opening the -5-volt line to the motor and amplifier. Q5 is the control transistor that stabilizes the output of Q6, the auto-stop transistor that operates as a series voltage regulator.

A voltage divider across the -8.6-volt line sets Q5's base bias at -0.8 volt. The Zener diode sets the emitter bias at 0.6 volt. Any change in the source voltage changes Q5's bias. This varies the voltage drop across the 280-ohm collector resistor and shifts Q6's bias in the proper direction to keep the emitter (output) voltage constant at 5.0.

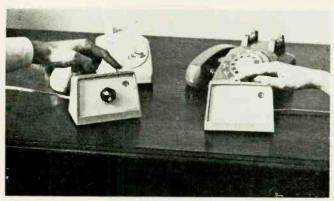
Note that Q6's base is connected to the core of the erase head. A grounded tape guide is mounted close to the heads. When the metallized strip reaches the heads, it grounds Q6's base. This removes the forward bias and turns off the motor, amplifier and pilot lamp. (The MESSAGE lamp remains on until the PLAY-button is pressed for playback.) The machine is now ready for playing the message or recording a new one.

The RECORD button applies bias to the erase and record—play heads, connects the speaker to the amplifier's input and the record head to the output stage, bypasses the volume control and turns on the MESSAGE lamp. This button remains depressed during recording and is not released until the PLAY button is pressed. The PLAY button returns the audio circuits to normal with the speaker connected to the amplifier output and the record—play head to the input.

Pressing either the PLAY OF RECORD button momentarily closes the START switch (see diagram) and applies 8 volts to the motor. The motor starts and pulls the metallized tape section past the heads and ungrounds Q6's base. The motor is now supplied from the regulated 5-volt line and continues to run until the HOLD button is pressed or until the metallized section of tape again reaches the heads and turns off the recorder. END



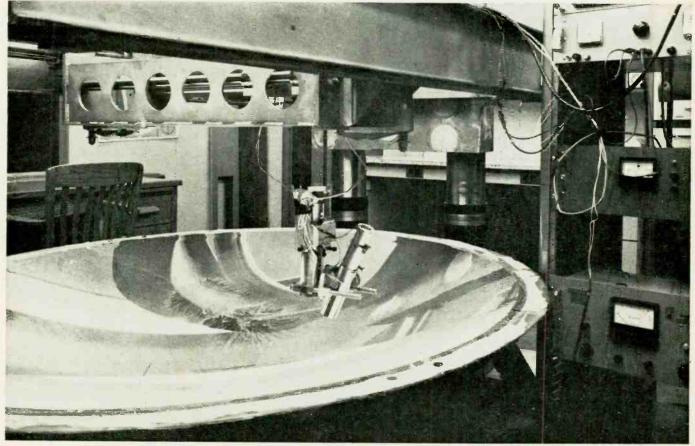
WHAT'S NEW



SENSICALL permits deaf people to use telephone by sight or touch. Deaf people who can see can use one kind of Sensicall —the kind that has a light that blinks in time with impulses on the line. Deaf-blind persons can use a kind with a vibrating button, which they must touch. Person at other end of line "talks" by humming, tapping or whistling to make Morse or other code symbols. Users of either kind can easily learn to distinguish between dial, ringing and busy tones. Device was developed by New York Telephone Co.

STREAMERS OF LIGHT graced opening of 1966 Shipstads & Johnson Ice Follies. They're made of Sylvania Tape-Lite flexible electroluminescent ribbon. Excited with ac, tape glows with light ranging from green to blue, depending on frequency. Performers carry self-contained battery-powered verter, making them independent of external power and free to move any distance. Changes in color and intensity are possible via elaborate radio remote control.





by ordinary instruments. Electro-optical scanner moves above tions in surface contour.

PRECISE MEASURING WITHOUT TOUCHING is the specialty of mirror. One of its units projects pinpoint of light, which is rethis device developed by the Boeing Co. for gaging accuracy of flected into second unit. Servomotors work to keep reflected extremely fine-finished parabolic mirrors that would be scratched light centered in prism, and their motions are recorded as valia-



THE BUSY-BOX:

A Thinking Tot's Toy

Build your kids a Christmas toy that does things

By JOHN A. TISO

How MANY TIMES HAVE YOU BOUGHT a new toy for the baby or some young friend, only to have it join a host of dust-covered predecessors in the closet after a few hours of use? "Too many times!" you say? Don't despair, you've plenty of company. Young children have a very short span of interest, and, with added competition these days from TV, a new toy just doesn't have the kick it used to have.

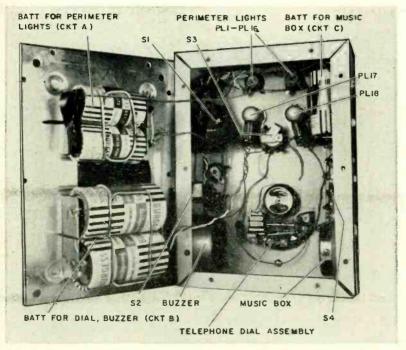
and 16 No. 112 miniature lamps, connected in parallel from each pole of S1 to the common side of the 1½-volt battery supply. Note that only 16 of S1's 17 poles are used. Switch S2 is included so the circuit can be turned off, conserving batteries and bulbs.

Circuit B includes the telephone dial, paralleled by pushbutton switch S3 (clown's nose), the buzzer, and the miniature No. 136 lamps (PL17, PL18)

Circuit C is simply the music-box movement wired in series with push-button switch S4 and a 1½-volt battery. Use the right polarity here, since the motor must turn in the correct direction.

Construction

It's smart to acquire all the parts before starting. Begin by laying out and drilling all the holes in the aluminum chassis box. Follow the drawing in Fig. 2 as closely as possible—some clearances are tight. Notice that the drawing does not show the exact hole sizes and locations for all the components; because of possible slight variations. The cutout for the telephone dial is an irregular shape,



Inside, the box is crowded, but a little care in planning will insure success.

The Busy Box is different. It's rugged, has lots of variety and, while primarily intended for 2- or 3-year-old, will also attract the attention of older youngsters. You'll see this toy used and enjoyed long after the other trinkets have bit the dust.

The Busy Box consists of three separate, simple switching circuits, each with its own power supply for maximum battery life.

Circuit A (Fig. 1) is made up of rotary switch S1 in series with toggle S2,

for the clown's eyes. Use the 3-volt buzzer specified in the parts list, since imported types were found to be unreliable.

You may have to spend a couple of minutes to determine which terminals to use on the telephone dial. With the dial at rest, the circuit should be open. When a number is dialed, the circuit should close, and, as the dial is released and spins back to rest, the contacts will open and close intermittently. This will make the eyes "blink" accompanied by a series of short "beeps" from the buzzer.

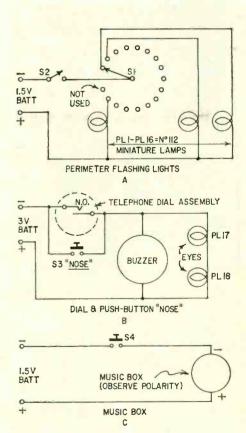


Fig. 1—Busy-Box is made of three separate, simple circuits. Complete details are given in the text.

RADIO-ELECTRONICS

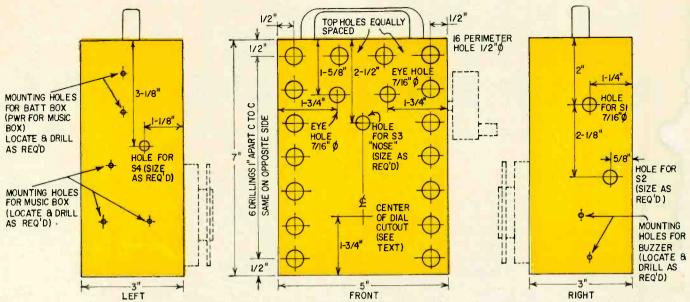


Fig. 2—How to lay out the chassis box. Exact hole sizes and positions depend on particular parts used. Better have them on hand before you pick up the drill!

and will depend on the particular unit you buy. The best way to cut it is to make a trial-and-error template from thin cardboard. Make sure the cutout clears all moving parts of the dial, and locate the mounting holes accurately. Transfer this layout to the aluminum box, then drill and cut.

The miniature lamp sockets around the perimeter of the box are mounted by force-fit in the rubber grommets. Therefore, make the holes for these grommets carefully, to insure a tight fit. As shown in the photograph, two of the battery boxes are mounted on the inside of the rear cover. Be especially careful when locating these boxes so they will not interfere with other parts when the cover is put on.

Smooth all rough edges, and make a trial assembly of the components. With any kind of luck, they will all fit perfectly. OK? Now, remove everything

PL1-PL16-Sixteen No. 112 miniature lamps with miniature screw-base sockets (Dialco No. 507)

PL17, PL18-Two No. 136 miniature lamps with panel jewel assemblies (Dialco No. 510-121) -Daven SP, 17-point rotary switch (Burstein-Applebee 18C503)

spst toggle switch S4 — Momentary-contact, normally-open,

pushbutton switches 3-volt buzzer (E. F. Johnson type 114-400 or

Telephone-dial assembly (available from Radio Shack Corp., Fair Radio Sales, or Olson Electronics)

Electronics)
Aluminum chassis box 5 x 7 x 3 in., with back cover (bottom)
Spinner knob for ¼-in. shaft, 2% in. dia
Battery-operated music box movement (Burstein-Applebee 18B166. Not in catalogs but available through 1966)

C-cell battery boxes

16 rubber grommets, 1/2-inch mounting hole Handle, wire, hardware

Burstein-Applebee Co., 1012 McGee St., Kansas City, Mo. 64106 Radio Shack Corp., 730 Commonwealth Ave.,

Boston 17, Mass.
Olson Electronics, Inc., 260 So. Forge St., Akron, Ohio 44308

Fair Radio Sales Co., 2133 Elida Rd., Lima, Ohio 45802

from the chassis box, and you're ready for finishing.

Spray on a couple of coats of enamel or lacquer (don't forget the screw heads which will show), and let dry thoroughly. Next, paint the clown's face. You don't need much talent to do this; a clown's face is supposed to be funny. But, if you're chicken, you can probably find a suitable decal transfer at the local hardware store.



18-month-old Marilyn Tiso, busy discovering the secrets of the Busy-Box.

When the paint is completely dry, you can start final assembly. Put the handle on first, then mount all the parts on the face of the box. The miniature sockets for the perimeter lamps PL1-PL16 are forced into the rubber grommets after the grommets have been installed. A little rubber cement will make this operation easier, and hold the sockets firm. Now wire the "common" lugs for these lamps together, and bring out a lead to be connected later to the batteries on the rear cover.

Rotary switch S1 comes next. It must be wired before being installed. Multiple-conductor telephone cable is good for this, since the wires are very

thin and color-coded. The switch on the unit shown here was wired for consecutive operation, so that the lights create a rotating effect, but a random pattern might be even better. However you decide, cut each lead to approximate length, and twist the resulting bundle of wires tightly together. Bring a lead out from the fixed or "hot" pole, to be connected later to switch S2. Now mount SI where shown, and wire the leads from each of the 16 poles to the "hot" lugs of PL1 to PL16. At this stage, push all wiring out of the way into the corners of the chassis, and see that S1 rotates freely.

All the remaining parts on the sides of the box, as well as the battery boxes on the rear cover, can now be installed and wired, following the schematics and photographs. When all wiring is completed, install the batteries, bulbs and spinner knob, and carefully secure the back cover, checking for shorts. Bare No. 16 wire wrapped tightly around the ears of the battery boxes, as shown in the photograph, will keep the batteries from falling out when jarred. The No. 112 miniature lamps are fairly strong but, as an extra precaution, paint each bulb with clear model cement to prevent shattering if broken.

Finally, test the operation. The telephone dial and pushbutton nose should beep the buzzer and blink the eyes; \$4 will activate the music box; and, with S2 on, the rotary knob will light the perimeter lamps, one at a time.

After you've had your fun with the Busy Box, offer it to the nearest 2-yearold. You'll be surprised how eagerly it's accepted, and how rapidly its functions are figured out. Your only problem now is how to deal with requests for copies of the Busy Box from relatives and friends. Maybe this wasn't such a good idea after all? END

REPAIR RECORD CHANGERS

First of two parts-What the mechanism does, and how; what goes wrong, and how to fix it

By HOMER L. DAVIDSON

IT IS NOT EASY — NOR PROFITABLE — TO turn down record changer business. More record changers on the market means more record changer repair. Since hi-fi and stereo have come into their own, we've never seen record changer business so good.

The technician will find most of his work organized into three main divisions—cycling, speed and adjustment. Fig. 1 is a top view of a typical record

changer, and Fig. 2 shows its underside. When the function control is set at automatic (AUT), speed control at 33½ rpm and the reject arm triggered, the changer starts to go through its cycle.

Let's load the changer. Lift the stabilizer arm and place a stack of 12-inch records on the spindle. Pull the arm over on the records and let it rest on them. (Do not pull the stabilizer arm up by its free end, but lift near the back post.) If the arm is hard to pull up or moves jerkily, rub some light oil on its shaft

with a cloth.

With the control knob in automatic position, trip the reject button. Underneath, the linkage (Fig. 2) moves the on-off switch, and the motor starts. The opposite end of the control lever actuates the automatic neutral link detent lever, and this engages the drive wheel. The turntable starts to turn. The flanged end of the control lever strikes the tab end of the trip pawl lever. The lever comes out into the path of a flange that rotates with the turntable hub, starting the cycling gear in motion.

When it doesn't work

If the changer does not cycle, check for a bent control lever tab, bent trip pawl lever or a dry trip pawl bearing. Sometimes the small trip pawl lever is dry and will not be pushed out far enough to engage the protrusion on the turntable hub. Lubricate with a light machine oil. If the motor does not turn, check the on-off switch with an ohmmeter to see if the contacts are open. One of the small tips or tabs on the switch assembly might also be broken off. Repair of the phono motor itself will be discussed in the next instalment.

As the cycling gear rotates, the cycling slide (Figs. 3 and 4) moves forward. The cycling gear goes through one complete revolution. A lift pin on the pickup arm rises along the lance of the moving cycling slide, causing the pickup arm to lift. When the flat portion of the lance on the cycling slide is past, the arm has finished rising and has also unlatched the shutoff activator and landing lever (Fig. 5). The pickup arm moves toward the record and contacts the pickup arm lever. The feeler (or cycling slide) reaches its full position and now starts the arm for the correct setdown point, according to the record diameter. At this time the pickup arm is free and can go downward. The arm should never be touched when the changer is cycling. When the cycling slide has reached its outermost position. it causes the actuator spring to latch the pickup arm momentarily, until the pushoff lever drops another record on the turntable

The push-off lever activates the push-off finger on the thin spindle and one record falls. The cycling gear is now halfway through its rotation. If the pick-up arm moves erratically, check the lift

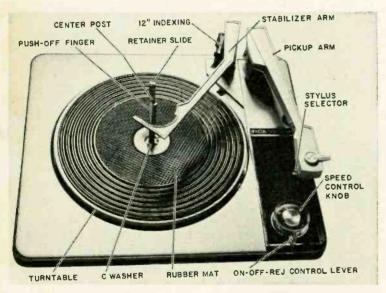


Fig. 1—Principal parts of a record changer above deck.

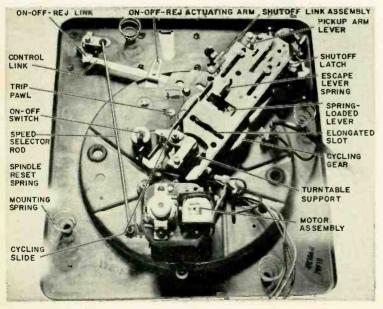


Fig. 2—Proper names for the doodads, thin gamajigs and whosises under the base.

pin for dryness and sharp edges.

One of the biggest changer complaints is "all the records fall down on the turntable at once." This is caused by either a pulled-up retainer slide or too-large holes in the records. If the retainer slide is in its correct position, only one record can fall at a time. Sometimes, when the user plays a load of records, he pulls them up along the spindle to load them again for a repeat performance. If they are not pulled clear off the spindle, the retainer slide will be caught and stay up with them. When the reject button is tripped, all the records will be pushed off and down. Demonstrate this when you sell a unit.

The cycling slide starts the rest of the rotation, and the pickup arm follows the landing lever. Spring force moves the landing lever at this time. When the cycling gear has finished one complete revolution, the pickup arm lands at the starting diameter of the chosen record. The lift pin has gone down the small incline and the engagement pawl is reset by striking the casting on the hub of the turntable assembly. Oil on the landing lever and improper height adjustment will cause erratic landing.

The record has now started to play. If the changer keeps tripping and does not play the record, check the clutch lever and trip pawl. On some changers, this trip pawl may stay stuck out if it is bone-dry, causing continuous tripping. The pickup arm may skate across the record grooves and toward the center. Check for a worn needle and improper leveling of the changer. A defective record will do the same thing.

When the last record has been played, most new changers shut themselves off. The cycle starts to repeat and the shut-off latch is forced inward, missing the shut-off lever. The pickup arm lever and the landing lever remain in position. The stabilizer arm shaft drops to the shut-off lever and triggers the on-off switch.

If the changer is loaded with several records and shuts off automatically before playing the last record when the reject button is tripped, check the stabilizer arm shaft. It may be bent, letting the shaft extend down in front of the shut-off lever.

Another complaint is "The arm of my record changer starts over in the middle of the record." You'll always find this condition (perfectly normal) when only one record is on the turntable, the stabilizer arm is not in position, and there is no 12-inch record on the spindle to fall and trip the 12-inch index lever.

In the next installment, we'll talk about speed troubles, drive slippage and motor overhauling, and cover a few simple adjustments you can make quickly.

TO BE CONTINUED

SPRING-LOADED LEVER
REJECT
LEVER
MOUNTING SPRING
CARTRIDGE
CONNECTIONS
IN SLIDE
SLIDE LOCATING SPRING

ELONSATED
SLOT

SPRING GEAR
URNTABLE SUPPORT
CYCLING SLIDE

SPRING

CONNECTIONS

CYCLING SLIDE

CYCLING SLIDE

SPRING

MOUNTING SPRING

CARTRIDGE
CONNECTIONS

CONNECTIONS

ASSEMBLY

Fig. 3—End of cycling slide near motor.

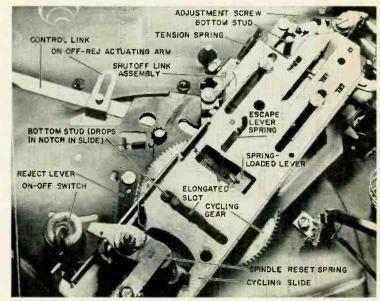


Fig. 4 — The cycling slide's other end.

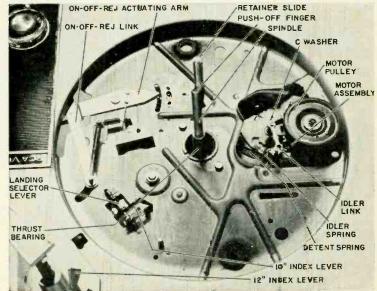
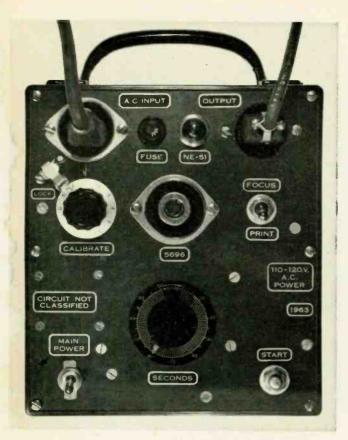
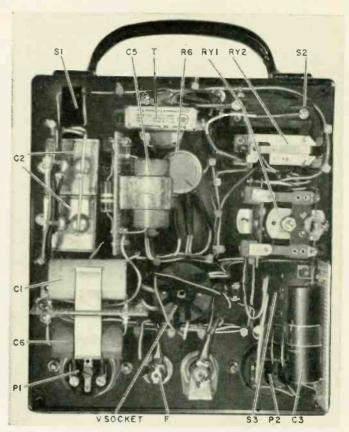


Fig. 5—There are parts even under the turntable.



In use, timer lies flat with handle toward rear. This keeps controls handy, cords out of the way.



Inside the timer. Layout is compact but not crowded. Major components are called out here.

De Luxe Printing Timer

Simple, accurate, versatile darkroom timer assures painless prints

By RONALD L. IVES

THE PROBLEM OF TIMING PHOTOgraphic printing processes accurately and consistently has been with us since the days of wet plates and albumen paper. Until recently most printing processes were timed by guess, even though a variety of mechanical and electromechanical printing timers have been marketed. Although some were most ingenious in design, few were widely adopted. In unhappy consequence, few photographers can produce 100 prints all exactly alike without an enormous waste of paper and time.

Two general types of printing timers are commercially available—the kind incorporating an electric clock movement, as does the Gra-Lab; and the type employing a thyratron tube and an electronic delay circuit, such as the popular Heathkit darkroom timer. Recent improvements of the electronic timer have made it most suitable for photographic work¹, and some changes in the conventional format add to versatility.

¹R. L. Ives, "Linearizing the Thyratron Timer," Electronics World, Vol. 67, No. 5, May 1962, pp. 92-95.

It is now possible to build a printing timer, using standard over-the-counter parts, that will time either contact prints or enlargements for intervals from 5 to 85 seconds, with a maximum error of 1 second and with repeatability to within one-fifth second at any setting.

In normal operation there are only two controls—the time setting (SEC-ONDS), and the actuating pushbutton (START). A panel switch is provided to give continuous illumination (FOCUS).

The circuit is shown in Fig. 1. A 5696 computer thyratron is used here, in place of the slightly less expensive and more popular 2D21, because of its lower grid and heater currents.

General formula for the operation of the circuit is—

 $T = 2.303 RC \log_{10} (E_s/E_d)$

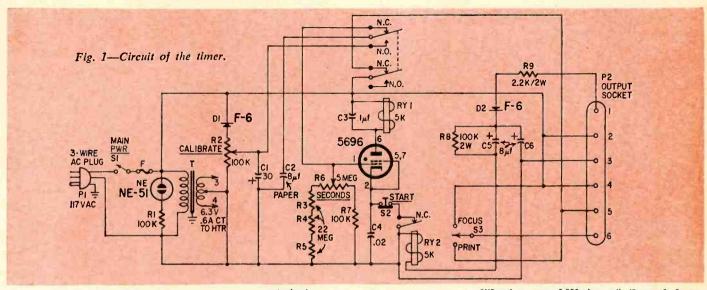
Here, T is the time in seconds, R the control resistance in megohms, C the storage capacitance in microfarads, E, the calibration voltage, and E, the extinction voltage of the thyratron. T/R is a constant, so that time intervals measured are exactly proportional to the set-

ting of R, which is the time setting control seconds.

How it works

When the timer is connected to the line and the power is turned on, the thyratron tube draws current on each positive half cycle, no holdoff voltage being applied at this time. Plate relay buzzing is prevented by shunt capacitor C3. The armature of the plate relay is held down, so that there is no voltage on contact 5 of the output plug. At the same time, storage capacitor C2 is charged from the line through rectifier D1 and calibration potentiometer R2 to a voltage determined by the calibration setting.

When the START pushbutton is depressed, opening the cathode circuit of the thyratron, conduction stops and the armature of the plate relay is released. This puts voltage on contact 5 of the output plug, disconnects the storage capacitor from the calibration voltage supply and connects it into the grid circuit of the thyratron, providing holdoff voltage, so that the tube does not immedi-



C1-30 µf, 250 volts, electrolytic
C2-Two 4-µf, 150-volt paper capacitors paralleled
C3-1 µf, 400 volts, paper
C4-.02 µf, 600 volts, disc ceramic
C5, C6-8 µf, 250 volts, electrolytic
D1, D2-silicon diodes, 400 piv, 150 volts rms
(Sarkes-Tarzian F-6 or equivalent)
E-2-ampere fuse 150 volts rms

F—2-ampere fuse NE—NE-51 neon lamp P1—3-pin male recessed industrial plug (Amphenol 160 series)
P2-6-pin female plug (Cinch-Jones S-306-RP or

equivalent)
R1—100,000 ohms, ½ watt
R2—pot, 100,000 ohms, 2 watts (Ohmite AB-CU1041
or equivalent)
R3, R4, R5—22 megohms, ½ watt
R6—pot, 5 megohms, 2 watts linear (Ohmite AB-CU5052 or equivalent)
R7—100,000 ohms, 1 watt
R8—100,000 ohms, 2 watts
R9—2,200 ohms, 2 watts
RY1—relay, dpdt, 5,000 ohm coil (Potter & Brumfield LM-11 or equivalent)

RY2—relay, spst, 5,000-ohm coil (Potter & Brumfield LB-5 or equivalent)
S1—spst taggle switch
S2—spst pushbutton, normally closed
S3—spdt taggle switch
T—small filament transformer, 117 to 6.3 volts, ct
(Stancor P-6465 or equivalent)
V—5696 tube Case, sockets, tie points (see text), miscellaneous hardware, labels.

ately resume conducting. Initial charge on the storage capacitor, determined by the calibration voltage setting, is E, of the formula. This declines at a rate determined by the setting of the SECONDS resistor (R6 + R7, Fig. 1) until the

voltage is less than the extinction voltage of the thyratron.

Immediately thereafter, the tube again goes into conduction, pulling down the armature of the plate relay and removing the voltage from terminal 5 of the output plug. This completes the timing cycle and prepares the circuit for the next cycle.

The string of high resistances (R3, R4 and R5) across the timing potentiometer (R6, R7) makes the timing circuit slightly nonlinear to compensate for the contact potential in the gridcathode circuit of the thyratron. It is to keep this contact potential at a minimum that a 5696 computer thyratron is used instead of the cheaper 2D21. The 100,000-ohm resistor (R7) compensates for minor nonlinearity near the zero setting of the pot, and prevents burnout of the pot if the timer is actuated with the SECONDS control set very close to zero.

To permit the use of the internal switch in a standard contact printer, as well as an external START control, control relay RY2 opens the cathode circuit of the thyratron momentarily when contacts 1 and 2 of the output plug are interconnected. By using a rectifier, with a series capacitor and drain resistor, operation of the relay is momentary no matter how long the circuit through points 1 and 2 of the output plug is kept closed. Because of the time constants of the circuit, there is a "dead time" of slightly more than 1 second between the completion of one operation and the beginning of the next. This delay is considerably shorter than the time it usually takes to change paper, so a more sophisticated (and more costly) "instantaneous" circuit is not needed here.

For use with an enlarger, the high side of the printing lamp is connected to pin 6 of the output plug, instead of pin 5 as in the case of the contact printer. For focusing, the PRINT-FOCUS switch (S3) is thrown to FOCUS, and the enlarger lamp stays on continuously. When this switch is thrown to PRINT, illumination begins when the START button is pressed, and terminates at the end of the predetermined time.

External connections

Plug connections for both the contact printer and the enlarger are shown in Fig. 2. Other functions can be added within the capacity of the relay con-

PLUG EXTERNAL PLATEN OUF USED RED PILOT RED PILOT OTHER CONSTANT LOADS N.C. PRINTING LIGHT ENLARGER LAMP b

Fig. 2-Connecting the timer to (a) a contact printer, and (b) an enlarger.

tacts. As here connected, the red pilot lamp remains on continuously. A cooling fan for the enlarger lamp house can be connected in this same circuit.

Construction

Parts can be arranged to suit your convenience and darkroom space. Careful and rugged workmanship is strongly recommended. "Particular" darkroom work is difficult enough at best, and interruptions due to misbehaving electronics make it even harder.

Because a darkroom is damp, and your hands may be wet, take special care to insure that you cannot come in contact with any "hot" circuit component. Despite folklore to the contrary, 110 volts can kill.

The timer was built in a 7½ x 8½ x 3-inch bakelite instrument case (H. H. Smith No. 2289), with a bakelite cover. The case is fitted with four large rubber feet near the bottom corners, and a large carrying handle (Stanley No. 3) at one end. All electronic components are mounted on the cover for easy assembly and servicing, and to eliminate a tangle of interconnecting wires from case to panel.

The most commonly used controls on-off switch, time setting and START button—are mounted at the bottom of the panel, nearest the operator. Cable sockets are mounted at the top of the panel so that the cables can be dressed along the back of the bench, out of the operator's way.

The sunk mounting for the 5696 tube is made from a defunct high-voltage socket with a conventional 7-pin miniature socket mounted in the bottom. All other parts are entirely standard, and equivalent components of the same grade can be substituted for those specified.

Most of the minor components are mounted on small sections of punched epoxy board (Vector 85G24WE) with push-in terminals (Vector T-28). To prevent strain on the terminals, all capacitors are also held with clips or clamps bolted to the boards. Wiring is cabled at strategic points.

Although most photographers, used to working in total darkness, operate their equipment "Braille", function labels are most desirable. Those used here are Metalphoto, made and applied by the Kohler techniques². Decals can also be used here, if they are protected against wear and dampness by a coating of clear lacquer.

Connection to printer or enlarger will be easier if the external device is equipped with a plug (Cinch-Jones P-306-RP), wired as in Fig. 2, to take care of the specific needs of the device. Such a connector, mounted on a small contact printer, is shown in a photo here.

Connecting cable between timer and printer or enlarger is a good grade six-wire cable with a male connector (Cinch-Jones P-306-CCT) on one end and a female connector (S-306-CCT) on the other. Pin connections are 1—1, 2—2, 3—3, etc. With this method of connection, the same cable will connect printer or enlarger, and transfer of the plug from one to the other automatically also changes the switching functions of the timer.

Adjustment

When all wiring is completed and checked, insert a fuse in the socket and connect power. Allow the timer to warm up for 15 minutes. Then, with the SECONDS control set at any convenient low value (such as 15), check the operation of the plate relay by pressing the START button and noting if the relay armature releases immediately and pulls in again after a short time (not necessarily 15 seconds). Next check the remote start control by shorting terminals 1 and 2 of the output plug. This should also cause the plate relay to release immediately, and to pull in again after a short time.

Now connect any sort of an indicator, preferably a self-starting electric clock, between terminals 3 and 5 of the output plug. Set the SECONDS control at 30, press the START button and note the time at which the indicator starts. Repeat this process, adjusting the CALIBRATE dial, until the on cycle of terminals 3 and 5 is exactly 30 seconds, then lock the calibration dial. Check several times as a safety measure—they will be



Airequipt "Junior" contact printer, adapted for use with timer by addition of six-contact recessed plug, mounted in aluminum box.

right on within about 1 second unless you have either a bad misconnection or a defective timing potentiometer (rare trouble).

This completes the routine adjustment of the timer.

Maintaining a timer of this general type is quite simple, as most of the parts are rugged and pretty much immortal. Timing should be checked about every 100 hours of operation, and the tube changed when either the timing drifts badly or the tube is 5,000 hours old, whichever occurs soonest.

Relay contacts should be cleaned (not filed) about every three months, and the relay hinges very sparingly lubricated with a good grade of clock oil at the same time.

With the exception of the thyratron (5696), which has a life somewhat over 5,000 hours in this type of service, all components have an operating life of 5,000,000 or more cycles.

Performance

This time is one of several built for use in darkrooms where sensitized metal plates are processed. The principal requirement is that plates printed in one production run will exactly match in tone those printed in another production run several months previously. This type of processing calls for rigorous standardization of chemical solutions, uniformity of temperatures, regulation of line voltages for the printing lamps—and standardization of development and printing times.

When used with processes of this type, which are more "particular" than ordinary print processing, this timer is entirely satisfactory in both accuracy and consistency. In ordinary printing and enlarging, it is equally satisfactory, and usually gives good results even with unregulated line voltages. Its timing varies roughly with the logarithm of the supply voltage, making it quite insensitive to ordinary line-voltage fluctuations. END

CHECK THAT ANTENNA PIGTAIL

Mobile whip connection can cause erratic transmission or none at all

If the mobile ham rig or CB transceiver works fine when receiving, but the transmitter won't get out or works erratically, check the little braided pigtail inside the base spring of the antenna (photo). Grab the antenna and bend it over to spread the turns of the spring.

That bit of braid is absolutely necessary in these antennas. Without it, the turns of the spring act as a coil, and the movement of the car changes the inductance continuously! This helps the tuning no end, as you can imagine!

To replace a broken pigtail, take the spring off and remove the antenna rod. Clamp one end in a vise and bend the spring over. Some springs have small



Allen (recessed hex-head) setscrews on the side of the end pieces; others have Allen setscrews inside the holes where the antenna rod and base screw into the spring. Remove the setscrews and pull out the old pigtail.

Replace it with a piece of ¼-inch shielding braid squeezed flat except at the ends. Run just a bit of solder into the ends. Now, thread the ends through the holes from inside the spring. Hold the turns open by inserting a small wooden block in them. Push the end of the braid through the hole, and then run the setscrew down on it; this will flatten it out and hold it tightly.

Make a habit of checking this pigtail every time you get near the antenna, and your transmission will be more reliable.

Radio-Electronics Is Your Magazine!

Tell us what you want to see in it. Your suggestions may make it a better magazine for the rest of the readers as well as yourself. Write to the Editor, RADIO-ELECTRONICS, 154 West 14th St., New York 10011.

²G. M. Kohler, "Photography Makes Custom Labels" Electronics, Vol. 33, No. 1, Jan. 1, 1960, p. 100 et seq.

The Factory Analyzer

Technical men with this specialty are in critically short supply—the field demands high, pays high

MATHEMATICS CAN PROVE IT IS IMPOSsible to mass-produce TV sets. What's more, with ordinary methods of statistical analysis, the mathematics would be correct! Yet sets are mass-produced every day. There must be an X factor at work that defeats the mathematics. This article is about the X factor.

What is it? Skilled electronics technicians with special training: factory electronics analyzers. Except possibly for service technicians, they constitute the largest group of skilled technicians in the country.

Factory analyzers are usually the best paid technicians in every factory, and their take-home pay is increased by considerable overtime. Their work must be done at high speed; they are respected and essential. Depending on the plant and products, top analyzers make from \$6,800 to \$9,000 a year.

Why analyzers? Television and similar devices are by long odds the most complex electronic devices mass-produced. The average unit consists of 300 to 500 parts whose characteristics must be precisely controlled. Failure of one part in 500 results in a reject chassis. One human error results in a reject chassis. Uncontrolled, this would result in such a high percentage of rejects that no manufacturer could afford to build anything.

With careful inspection and quality control, the reject level drops to 0.2%. In any other industry, that would be fabulous. For electronics it is not good enough. It would soon choke a plant with rejects, and halt production.

Let's examine a specific case: a printed-circuit-board line running 100 units per hour. Each board carries 300 parts including jumper wires.

This means that, besides the boards, an average of 30,000 parts per hour must be installed. If the combination of faulty parts and workmanship is 0.2%, it is possible for 60 boards out of 100 to be defective, or 60%! (This figure is high for a number of reasons; the final figure will usually come to 15% to 25%.) Imagine: out of a run of 10,000 TV sets, 2,500 would be sitting around needing repairs!

Which part among the 300 on that board is missing? Which capacitor is open? Which resistor is off value? Which

By CHARLES R. WHEELER

i.f. coil has reversed windings? What combination of parts in a network has tolerance runout that throws the unit out of engineering limits and results in a poor i.f. curve?

An inspector is helpless with problems like these. Someone must tell the repair department speedily and accurately what part must be changed so production can move.

Without good analyzers an electronics company is faced with these alternatives: price itself out of the market, or go broke.

An analyzer demonstrates his job

Motorola's enormous new building is on the outskirts of Chicago and is guarded like Fort Knox. I was taken in hand by Bill Mahoney of Public Relations and brought into the factory. The production department is a huge cavern jammed with production lines, conveyors and electrical test equipment. The odor of hot bakelite and resin flux is everywhere.

Thousands of men and women are busily engaged in turning more than a million parts a day into finished TV sets. We pass a TV chassis line. One set a minute rolls off the line for electrical test. And this is only one line—

one operation.

Bill introduces me to John Waycuilis, a tall chap with an engaging grin, whose official title is assistant plant manager. He seems to be the focus of an endless number of analyzers and supervisors with problems that won't wait. Finally he settles down for a few minutes and explains the plant analyzing setup.

I asked him if analyzing is a function of inspection or of quality control.

"Neither," he answered. "The system that works best for us seems to be an independent analyzing and electrical test department under one head. But this doesn't mean we don't work closely with the other groups.

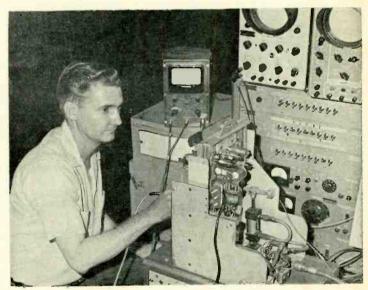
"Workmanship is the direct responsibility of the inspection department here, and one function of analyzing is to feed back immediately to inspection any deviations from workmanship standards. Inspection takes it from there and has the problems corrected.

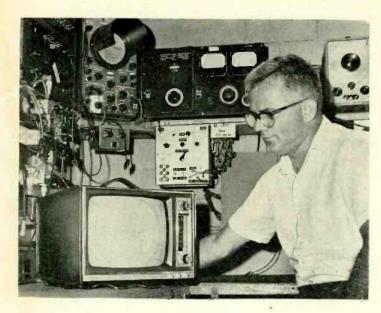
"While parts quality runs high, we always have problems. When you realize the large number of parts per day, supplied by hundreds of outside manufacturers. . . ." I nodded.

"When problems run less than 2% on a given part we handle it as an analyzing function on units in process.

Motorola analyzer Willard Spivey checks reject TV i.f. board on alignment jig. All connections to board are made automatically through pneumatically actuated contact fingers.

Photos by the author





Zenith qualitycontrol analyzer Ray Paluch touches up vertical linearity on model 1290 transistor portable.

This is the cheapest way, because the trouble is usually random or confined to small batches of parts, and tends to correct itself.

"At 2% or up our analyzers will alert us and we get Quality Control on the job immediately. They will 100%-inspect the lots affected or do whatever else they consider necessary.

"Let me take you over to Willard Spivey, one of our ace analyzers. He can show you directly how we operate and let you see some of the operations."

Willard was apparently very busy on the firing line. He was analyzing phasing rejects on an i.f. board fixture. We watched him for a few minutes.

He read the reject tag, glanced briefly at the foil side of the board and slapped it into the fixture to warm up. Meanwhile he checked the top-side parts visually. Then he moved into the affected circuit with a scope and signal-traced to the defective area. After pinpointing, he moved in with the vtvm as a final check. Within 3 to 5 minutes after starting he wrote out the repair tag and bounced the job to Repair.

He picked up another reject. Glancing at the tag, he frowned, then inspected the top of the board. "This is the third board in the last half hour with the wrong capacitor for C104."

Suddenly there was flurry of activity. A supervisor warned the inspector, then went into a huddle with the production supervisor. The production supervisor checked the production operator while the inspection supervisor checked the line from the operator down to the end. Four more bad boards were found and sent to Repair; finally a few wrong capacitors were found mixed in the production operator's bin and cleaned out. A minor crisis was over.

Over coffee in the cafeteria I asked him how he ever got into the analyzing

field.

"I came to Motorola 17 years ago and got a job on auto radios. I saw pretty soon that analyzing was the field for me, but I found it very hard to get in. I studied basic electronics on my own, but it wasn't enough. The analyzing information I needed wasn't in books.

"So I took steps to knock out my daily quota early, then went over to the analyzers and rubber-necked. I gradually caught on, and 3 years later I made analyzer. If what I needed had been in books, I could have made it in one year."

"That's hard for me to understand, Willard. I thought everything could be found in books."

"Many articles written for service techs are invaluable. But the greatest flaw in books and articles from the would-be analyzer's point of view is that they always discuss electronics according to how a circuit should operate. What the analyzer needs to know is how a circuit works when it is defective."

"It doesn't work."

Willard laughed. "I don't mean that. Let me give you an illustration. You saw the little incident this afternoon involving the wrong-value C104. The first one I saw was on the bench of another analyzer. The video amp was cut off. He was a new man. He said he had a 'sneaker'; would I please take a look at it?

"Normally V5-a runs 65 volts on the plate, 30 on the screen and -5 on the control grid. The cutoff stage ran plate 145, screen 145 and grid -25 volts. Plate and screen voltages showed that the tube was not conducting. The high negative grid voltage was clearly the reason. A few simple checks then showed that the stage ahead of the detector was oscillating and generating a high negative voltage through the de-

tector, cutting off V5-a. Oscillation was caused by the wrong value of C104.

"This problem was *not* a sneaker. It was a perfectly simple problem we expect an analyzer to solve as fast as any other. In our work speed is essential if we are to meet production schedules.

"Now, here's the point: this man was not dumb. He passed a very stiff test for basic electronic knowledge before he was hired. Yet he had never been taught tube conduction theory thoroughly. Except for men who have worked in other factories, we always have to teach tube theory to new men on the factory floor. This is one major reason why it costs so much to train new men. It also explains why so many fail to make the grade.

"Regardless of how much a new man knows, even where he has had actual servicing experience, he always seems to be weak on tube conduction theory. The same thing goes for transistors. Another weakness is a lack of thorough practical knowledge of Ohm's law. It isn't just three formulas to manipulate arithmetic with on paper. It is an extremely practical tool for the analyzer to obtain rapid answers to problems in defective circuits."

"OK, Willard. What advice can you give to a man interested in analyzing for a living?"

"First, learn the basic electronics taught in schools and books. Then train yourself to be a good visual inspector, sharp at catching wrong parts and hairline shorts. Get thorough training in using a scope for signal-tracing and pinpointing trouble. Learn to interpret Ohms' law and tube conduction with a thorough mastery of the vtvm. Sprinkle all this with a liberal dose of horse sense and you'll make the grade as an analyzer in any plant in the country."

John Waycuilis had told me that Willard Spivey was always used as lead-off analyzer on major new products. The many projects he had started off at Motorola included the analyzing used for color and transistor TV.

Later that evening I met Willard at his home in Wood Dale near Chicago. He and his wife Jo were planning their vacation trip to Colorado and oiling up their fishing gear. They spanked the kids and sent them off to bed and we settled down for a short visit. I needed a little more personal information about Willard.

While his seniority with Motorola is 17 years, more than 2 of these years were spent as a radio instructor in the Army, at Fort Knox, Camp Pickett and Camp McCoy. He also spent some time in Colorado.

His wife volunteered something Willard hadn't mentioned. In 1955 he started an electronics course at DeVry Technical Institute in Chicago and achieved the highest grade average the school ever gave: 96.8%.

Another man's view

Zenith Radio Corp. is another Chicago electronics giant on the far west side. Deep beneath the hurly-burly of production runs the same undercurrent—the need for highly trained technical production personnel.

I met Ray Paluch in the office of Ted Kreuger, chief of Zenith quality control. Ray is an analyzer with special duties who works directly for Quality Control. He is specifically charged with liaison between QC and design engineering. In his lab, I asked him in what way liaison between factory and engineering benefited Zenith.

He thought for a moment. "Let's take a hypothetical case," he said. "Assume that a new job is running and production complains that the set breaks into oscillation at a certain stage of alignment. Is the test equipment at fault? Is set design at fault? Is it the man doing the testing? It's my job to find out what and why in a hurry!

"Remember, engineering specifications are our bible and the set was thoroughly checked before engineering released it. In addition, I myself checked out the first sets as routine before releasing them to Production. So it's my baby!

"The solution to the problem may be changes in alignment procedures or in test equipment. If so, I must see that the changes are made.

"Occasionally, on new models, the design of the set may be involved; some little thing that didn't show up before the production run. First I must prove the cause on my bench to eliminate factory problems. Then I get together with Engineering on the best solution and make up and test samples of the new changes. These are then released to Production."

"Sounds like a good way to work it, Ray," I said. "But you don't have problems like this every day, do you? What is your normal routine?"

"I run electrical checks on five sets a day of every model that runs through Installation. That's enough to catch any tendency in Production or Phasing before it drifts too far from engineering design centers. To save trouble in installation we try to stay well within engineering limits. Steady sampling makes any drift easy to correct.

"Based on what I learn from steady sampling, I also supply production with realistic standards of electrical performance. For instance, Engineering sets the specifications on a job based on a history of past average parts runs. This spec we must meet or we cannot ship to distributors.

"But often it's possible to better

these specs considerably if parts averages permit. We can take advantage of this by setting factory standards higher. However, such decisions take nice judgment. The other face of the coin might involve production stalled at costs of hundreds of dollars an hour.

"In my lab there's a duplicate production alignment setup. No set can run in production if it does not align and meet engineering specs on this equipment. If it is necessary to change factory equipment for a specific model, it will be done."

I nodded. "Ray, how did you get into this line of work?"

He grinned and his eyes twinkled. "My godfather gave me a cat's whisker, a Quaker Oats box and a coil of wire!"

"Are you joking?"

"No, sir. Building my first crystal set started me off and interested me in radio. Later I took a 2-year course in radio at Crane Technical High School in Chicago.

"In 1945 I went to work for Zenith as an engineering stock chaser. Of course, I was a greenie, but was in a good spot to see how engineers tackled design problems. You might say I got to be a very nosy stock chaser. The men taught me a lot.

"During lunch hour we practiced code in the engineering lab, and in 1947 I got my ham license—K9IZZ.

"Shortly afterward I was transferred to Zenith Consumer Products as an electrical repairman. There I got my first chance to practice applied electron-

ics and get analyzing experience.

"My taste of the engineering and analyzing approach made me want more of the same. Ham radio gave me the opportunity to upgrade my knowledge. I became a 'home-brew 'artist. Using Q meters, impedance bridges, generators and such in my own design gave me a tremendous advantage over analyzers with only basic theory.

"Many of the projects I designed and built took firsts in ham radio contests, and that gave me an incentive to continue. I directly attribute my first real break at Zenith to my ham radio experience. Forty books couldn't have taught me as much.

"When Zenith Space Command (TV remote control) was under development, I was put in charge of a group of analyzers assigned to that project only. Management felt that my ham radio design background made me the logical choice. This group was in on Space Command from the pilot-run stage all the way to production. The project was a hush-hush first and was quite an experience for all of us."

"Ray, aside from technical knowledge, what one thing will most help a man who tries to become an analyzer?"

"Know the product you are working on. Don't think you know it—know it! Engrave the schematic and parts layout on your brain! My experience has been that this is the greatest failing of analyzers and would-be analyzers. They do not really take the trouble to know the product."

Scope Plug-In Unit Seeks Range Automatically

New Tektronix plugin amplifier for production-line scopes uses transistor logic circuits to eliminate need for resetting vertical sensitivity where signal volt-Range ages vary. (volts per division of scope graticule) is read out in window at top of plug-in, while the waveform is shown on the screen. In 100 msec, circuits compare signal amplitude with preset reference. If it exceeds reference, pulse from logic circuits fires ring counter, which trips reedswitch attenuator to next higher range. This continues until display is within preset limit on screen.

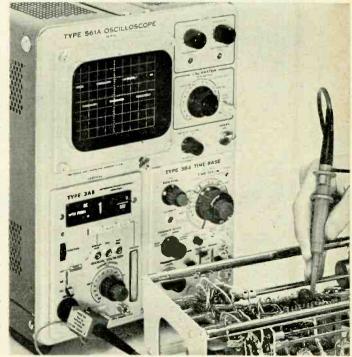
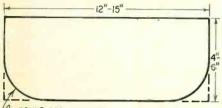
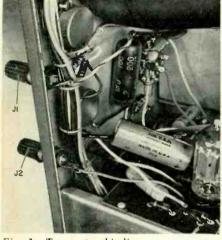


Fig. 1—Light shield over CRT face cuts down glare and confusing reflections.



~ROUND OFF CORNERS

Fig. 2—Sheet metal for light shield of Fig. 1 can be cut quickly with tinsnips.



12AU7

SCOPE IMPROVERS

Make your scope more useful and convenient. Couple of hours and a few parts are all you need

By ELMER C. CARLSON

CUSTOM-BUILDING A SCOPE EXACTLY THE way you want it is likely to cost more time and money than you can afford. But, as with ready-made clothing, there's a pretty wide variety of designs to choose from, and you can usually select a scope to fill your requirements. But again, like a ready-made suit, your choice needs to be altered to fit just right. Here are a few suggestions for simple modifications that have made my scope more useful.

A light shield

If light reflections make scope waveforms hard to see, make a light shield (Fig. 1) from sheet metal.

Take a piece of aluminum or steel 4 to 6 inches wide and about two-thirds the circumference of the CRT screen (about 12 to 15 inches for a 5-inch CRT). Trim off the corners on one edge (Fig. 2) and bend it around a coffee can about 4 inches in diameter. The spring action of the bent metal will hold this to the scope bezel around the CRT face. A small sheet-metal screw at the top will make a more secure mounting.

Sweeping changes

Two added binding posts on the front panel of the scope (Fig. 3) and two short lengths of wire to connect them to the circuit (Fig. 4) provide a sawtooth source and a terminal where additional capacitance can be connected into the R-C network to increase the time constant, making low-frequency sweeps possible.

Sweep speeds lower than 10 cycles are not often used for servicing but an experimenter may have an occasional need for them. For best waveform viewing, a CRT with a P7 phosphor is required. The normal P1 phosphor has

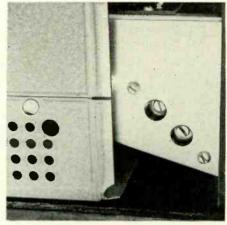


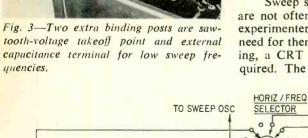
Fig. 5—Holes in cabinet match vertical attenuator compensating trimmers.

too short persistence with sweep speeds near 1 cycle per second.

Some scopes have a terminal available for taking a signal to allow the vertical input step-attenuator trimmers to be checked. Others just indicate a wiring point or tube-socket pin where such a signal can be found. This often means removing the scope from the case.

If the trimmers are not adjustable from the outside of the scope, it might be convenient to drill two small holes (Fig. 5) through the side of the cabinet. Double-check to make sure the holes will line up with the trimmer adjusting screws before you use the drill.

Follow the scope service-manual procedure for adjusting the attenuator trimmers before attempting to adjust the low-capacitance probe trimmer. Proper and improper traces are given in Fig. 6.



200V HORIZ

Fig. 4—Partial schematic of horizontal amplifier and sweep frequency selector show where to add binding posts.

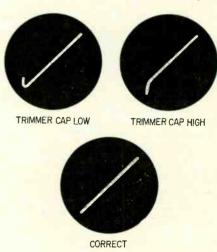


Fig. 6—Sawtooth-against-sawtooth trace checks compensating trimmer adjustment. Follow procedure in scope manual.

RADIO-ELECTRONICS

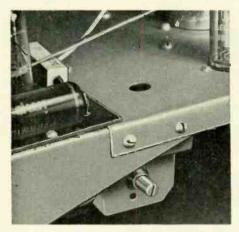
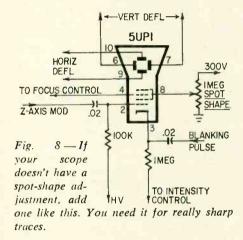


Fig. 7-Mount astigmatism (spot-shape) control were it can be reached easily through a hole in the cabinet.



While the drill is handy, another hole for the astigmatism (spot-shape) adjustment is useful, particularly where power-line voltages vary considerably. When the voltages to the CRT elements change, spot shape, as well as the focus, is affected.

Many early scopes neglected the astigmatism (spot-shape) control but it is easy and inexpensive to add one once you find a mounting place (Fig. 7) for it. A common circuit is shown in Fig. 8.

A length of tubing slipped over the control shaft will make it easier to find with the screwdriver, if the control shaft end is far from the case wall. Flaring the end of the tubing will make this even easier. This can be done with an inexpensive flaring tool or by an obliging garage mechanic.

Variable-phase 60-cycle sync

The Heath O-11 scope has a 60cycle sweep which is phase-adjustable for use with sweep generators. A simple wiring change (Fig. 9) makes the 60cycle sync phase-variable too.

While the variable sync makes it easy to shift the display waveform of any pattern that is a multiple of the line frequency, it is especially useful for checking vertical sweep distortion in a TV chassis. It allows one cycle to be displayed on the screen for maximum viewing size. Sync can be phased so that the retrace portion of the trace is either at the right, as usual, or at some place near the center as in Fig. 10. END

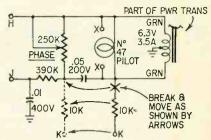


Fig. 9—Phase-variable 60-cycle sync is as useful as sweep. Changing one connection does the job.

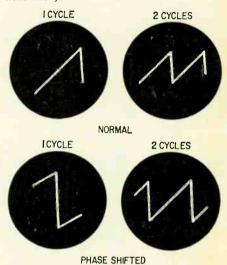


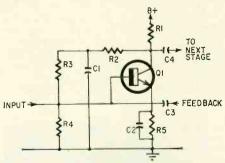
Fig. 10-What you can do with phasevariable sync in viewing TV vertical-sweep waves: center any part of the wave on the screen, and check for parasitics or measure retrace time.

Conducted by E. D. CLARK

WHAT'S YOUR EG

Printed Circuit

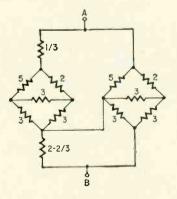
Given the following stage from an electronic circuit, find a way to put it on a printed-circuit board without redrawing the circuit.-William B. Adams



Three puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay \$10 for each one occepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.
Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.
Answers to this month's puzzles are on page 95.

How Many Ohms?

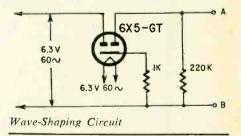
These two unbalanced bridge circuits are tied together at three points.



What's the resistance between terminals A and B?-E. D. Clark

Wave-Shaping Circuit

What is the waveform and polarity of the voltage between terminals A and B?—Kendall Collins



50 Pears Ago

In Gernsback Publications In December, 1915 Electrical Experimenter

By Wireless Phone from Arlington to

Audion Bulbs Produce Musical Tones Vibrating Reed Radio Amplifier

How to Make an Electrolytic Rectifier

Feedback, Phase & Instability

FEEDING PART OF AN AMPLIFIER'S OUTPUT back to its input out of phase does wonders in reducing distortion and noise and extending frequency response. But it also opens a Pandora's Box of subtleties, which are worth knowing about in some detail if you enjoy designing, modifying, or just understanding high-quality amplifiers.

A feedback loop connected in the most conventional way (Fig. 1) usually contains a phase-compensating capacitor. This is a convenient point at which to make small adjustments in the amplifier's overall response. If the response from input to output is level, then because of the phase-compensating capacitor, the response from the output back to the cathode will have a high-frequency boost (Fig. 2). This means that the loop gain from the grid as input point back to the cathode as feedback insertion point must be given a corresponding high-frequency boost, if the overall response measured externally is to be flat.

In measuring amplifier phase and feedback performance, a very important factor is how the input and output circuits, particularly the latter, are loaded. Change in output loading, from nominal resistance load to open circuit, or to loudspeaker load, either dynamic or electrostatic, can make a tremendous difference to these phase measurements, as well as to the response, as normally measured.

Loudspeakers

Another realm where we hear quite a bit about phase concerns loudspeakers. Measurements can help here too, and may dispel some of the misstatements one hears.

To check the phasing of different units in a multiway system or of complete loudspeaker systems either on single-channel or stereo, apply a suitable frequency to the input of the system, and use it as a phase reference. For multiway systems, use the crossover frequency, so the two units give out the same relative level. For separate channels use a fairly low frequency to avoid

ambiguity and, in a stereo system, parallel the inputs to give in-phase operation.

Now place the microphone so it is a short distance, and the same distance, from the units being phased (Fig. 3). Switch off each unit in turn to see what the phase angle of the other unit is and thus check that the phase angle of both are in the same region. It may vary by a few degrees between the two units, but the important thing is to see that the phase difference between them is within a few degrees of 0° and not a few degrees of 180°. More about this in a minute.

We sometimes get statements about the phase response of a speaker. This cannot be checked with a microphone because the sound has to travel from the loudspeaker to the microphone, which takes time—an interval which corresponds with a phase angle that is proportional to frequency, and at the high-frequency end is probably many wavelengths (or n × 360°).

The only way to measure the phase performance of the speaker is to use a motion-sensing coil on the diaphragm. A simple way to do this is to cement lightly a turn or two of fine wire out in front of the voice coil, where there will be enough leakage field to indicate direction and phasing of movement by the voltage developed (measured on a scope screen), if not to show the linearity (because the field itself will be nonlinear). With this setup, the phase relation between drive current, or voltage, and voice-coil motion can be measured. Also, a rough indication of the response of the speaker drive mechanism, as distinct from its external acoustic response as measured with a microphone in an anechoic chamber, can be obtained (Fig. 4).

The impedance characteristic of a speaker can be measured, in both magnitude and phase, by a similar technique, by comparing voice-coil current with its terminal voltage. None of these measurements will get beyond a range of ±90°, but phase and magnitude measurements can help in determining

the effectiveness of an enclosure in conforming to theory—for example, how a bass reflex achieves its phase reversal.

Equipment and method

So much for the phase measurements that can be made and are useful in audio and high-fidelity work. Now for how to make them. A very simple method uses the comparator ellipse on an oscilloscope (Fig. 5). The "reference" voltage is fed into the "horizontal" terminals of the scope, with the switch in the "external" position. The output, or whatever voltage whose phase relation to the reference is required, is connected to the usual "vertical" input.

A line sloping one way represents inphase condition, while one the other way represents 180°. In between come ellipses, which can best be interpreted for phase by adjusting the deflection so the height is equal to the width (center group of patterns in Fig. 6). The phase can be recognized by identifying it in the family shown in Fig. 6. If the slope is nearer the in-phase line, the reading gives phase angle direct. If the slope is the opposite way, subtract the reading from 180°.

If the oscilloscope method is used for phasing speakers, adjust the distance of the microphone from the speakers to get a line, or approximately a line trace, rather than something near to a circle. Phase reversal from a circle gives another circle. Phase reversal from a sloping line reverses the slope. So the latter readily permits distinguishing 0° from 180°, which the circle does not.

If the device whose phase is measured produces some harmonic distortion, the comparator method also indicates the phase of the harmonics, as well as the fundamental, although precise evalation of fundamental phase is a little more difficult. To aid in interpreting "odd shapes," Fig. 7 tabulates possibilities with the simpler harmonics.

Another method is to use an electronic switch with a scope so both wave-

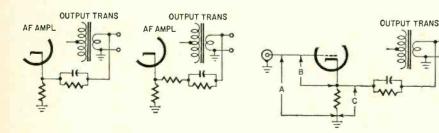


Fig. 1—Different ways in which phase compensating capacitor can be connected in feed-back.

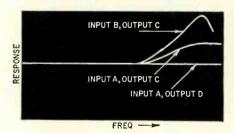


Fig. 2—Why use of a capacitor in feedback means loop gain response must show peaking.

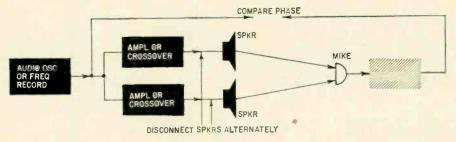


Fig. 3—Using a microphone to check phase of speakers, whether multiway or separate system.

forms can be displayed on the same screen (Fig. 8). Then phase is simply measured as a fraction of the complete wave. If both waves are not pure sine waves, it may be difficult to assess precisely the lateral distance representing phase difference on the scope.

Finally, an even more elaborate device has the advantage of being able to measure phase and give a direct indication. This is done by first converting both waves into square waves by clipping, using a circuit known as an automatic mark-space control to make the top of the square wave equal to the bottom. This works on an avc principle. Finally, the square waves are used to control the current in a "gating" circuit. Current flows only for the part of a cycle during which the square waves are opposite. Thus in-phase square waves give no current-zero phase. Out-of-phase square waves give current for a complete half-cycle-180°. Intermediate readings are proportionate, and a simple integrating meter that reads average current will give a direct read-

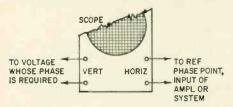


Fig. 5—The oscilloscope comparator method is simple to set up

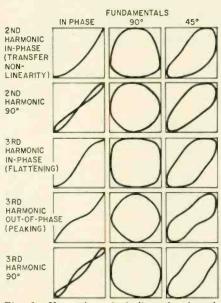


Fig. 6—How phase is indicated using the comparator method.

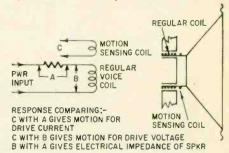
ing of phase in degrees, independent of frequency (Fig. 9).

One thing should be apparent from this article: phase reading is always relative. You always have to compare the phase of one waveform with that of another of the same frequency related to it. There is no such thing as a 1,000cycle note coming out of a loudspeaker "out of phase." It has to be out-ofphase with something else. This seems obvious enough, but it is surprising how often one reads or hears a statement about phase without any mention of the reference point. END

References

H. Nyquist, "Regeneration Theory," B.S.T.J., January 1932.

Fig. 4—Using motion sensing coil on dynamic speaker can provide more detailed information about speaker's performance.



H. W. Bode, Network Analysis and Feedback Amplifier Design, D. Van Nostrand, 1945.

Norman H. Crowhurst, "Speaker Phasing and Dissociation Effect," Radio-Electronics, February 1953.

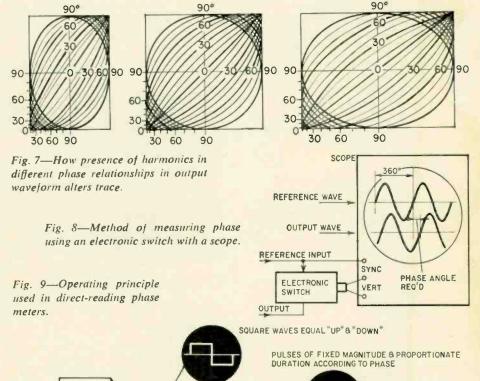
Norman H. Crowhurst, "Oscilloscope Patterns Aid Diagnosis," Radio-Electronics, October 1953.

Norman H. Crowhurst, "A New Approach to Negative Feedback," Audio Engineering, May 1953.
F. P. Moss, "An Audio-Frequency Phase Meter," Electronic Engineering, August 1954.
Norman H. Crowhurst, "Feedback from the Voice Coil," Radio-Electronics, October 1956.

Norman H. Crowhurst and George Fletcher Cooper, High-Fidelity Circuit Design, Gernsback Library,

Joseph Marshall, Maintaining Hi-Fi Equipment, Gernsback Library, 1956.

Norman H. Crowhurst, "Phase, Feedback and Insta-Radio-Electronics, December 1964



GATING

SQUARE WAVE

INTEGRATING METER

CONTROL

CONTROL

CLIPPING

MARK-SPACE RATIO CONTROL

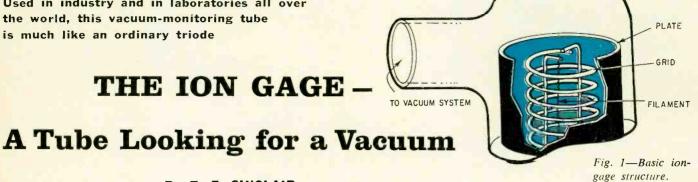
MARK-SPACE

INPUT

OUTPUT

Used in industry and in laboratories all over the world, this vacuum-monitoring tube is much like an ordinary triode

THE ION GAGE



By T. F. SINCLAIR

EVERY SERVICE TECHNICIAN KNOWS the "gassy" electron tube. When a receiving tube partially loses its vacuum, it acquires drastically different operating characteristics and can no longer work properly in its circuit. Substituting a well evacuated replacement cures the trouble.

A not-too-distant cousin of the common electron tube is designed to operate in partial vacuums. The resulting changes in its operating characteristics measure very low gas pressures (vacuums). The hot-filament ionization tube, more commonly known as the ion gage, is an electronic vacuum gage that has been used by vacuum technologists for several decades.

Measuring vacuum has become particularly important in recent years with the growth of industrial vacuum processes. The preparation of ultra-

TO VACUUM ION GAUGE TUBE EB

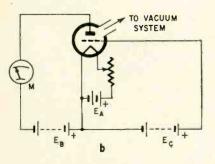


Fig. 2—Simple circuits for measuring vacuum with an ion gage. a—Grid maintained negative. b-Plate maintained negative for greater stability and sensitivity.

pure materials for semiconductors and the deposition of thin-film circuits are two important processes carried out in a vacuum. Of course, our tremendous program in space exploration requires producing and measuring extreme vacuums to simulate the conditions of outer space. The ion gage serves as the workhorse of the vacuum industry. Measuring pressures from a millionth of an atmosphere to ones a million times lower again, the ion gage operates over the range most useful to modern technol-

by the grid toward the plate. These fastmoving electrons have a good chance of hitting a gas molecule between the grid and the plate. If an electron and a gas molecule collide, the energy of the impact may cause the molecule to release one of its own electrons. This process is called ionization and a molecule stripped of an electron is a positive ion.

GLASS ENVELOPE

The number of positive ions formed is directly proportional to the gas pressure in the gage tube. If the plate is maintained at a negative potential, it will collect the positive ions



Varian Associates

Ion-gage control unit. Meter is calibrated in pressure and in altitude.

How it works

The ion gage has much in common with the familiar electron tube. The arrangement of electrodes in the basic gage is very similar to that in a triode electron tube. In fact, early vacuum workers used ordinary triodes as vacuum gages. The ion-gage structure (Fig. 1) consists of a tungsten filament, centrally placed inside a spiral-wound wire grid. The plate is a metal cylinder which surrounds both the filament and the grid. The electrodes are then enclosed in a glass envelope which connects to the system under vacuum.

When the filament is heated, it emits electrons which are accelerated formed. The ion current which then flows in the circuit is a direct measure of pressure in the gage tube.

lon-gage circuits

Two simple circuits which may be used to measure the ion current are shown in Fig. 2. The schematic in Fig. 2-a should be familiar to electronic technicians—it is very similar to a typical triode amplifier. In this arrangement the grid is negatively charged and collects the positive ions. Meter M indicates the ion current flowing in the grid circuit and may be calibrated directly in pressure units. Although this hookup is not particularly stable or sensitive. grid current has been used by electrontube makers to indicate the pressure in sealed-off vacuum tubes.

A more sensitive gage can be obtained if the *plate* is used as the negative electrode, as in Fig. 2-b. Sensitivities are greater by at least a factor of 2 with this circuit. Ion current flowing in the plate circuit is indicated by meter M. The variable resistor in the filament lead is an emission control. This control is adjusted to maintain a constant current between filament and grid for stable operation. Typical operating potentials would be 150 volts on the grid and -45 on the plate.

These simple circuits bring up several problems. The heater current has to be maintained constant manually in a system where the composition and pressure of gas are changing. Also, the ion currents are very small and the sensitivity of the meter limits the range of the instrument. Electronic control circuits and high-gain amplifiers have been developed to overcome these difficulties

Commercial ion-gage control circuits have automatic emission regulators. In some, saturable reactors hold the emission from the filament constant with changes in line voltage or pressure.

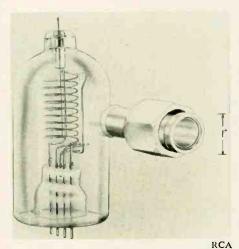
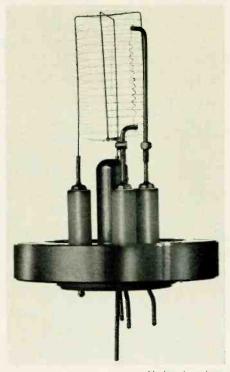


Fig. 3-Inverted-structure ion gage

The ion current amplifier is usually a multistage, electrometer type circuit with 100% negative feedback. In addition, a safety shutoff feature is often provided that will automatically turn off the power to the filament when the pressure inside the gage becomes too high. Special modifications are also available. The control unit shown in the photo has a readout meter calibrated in altitude as well as pressure.

Limits of operation

The basic ion gage has limits of operation at both the high and low pressure ends of its range. At gas pressures greater than a millionth of an atmosphere,



Varian Associates Fig. 4—"Nude" ion gage with inverted structure, for direct insertion into vacuum system. Such a unit can cost \$150.

the ion current tends to saturate and levels off at a constant value which is independent of pressure. High concentrations of reactive gases inside the gage cause rapid failure or burnout of the filament. Fortunately, other vacuum gages operating on the thermal-conduction principle perform satisfactorily in this range of pressures.

At the other end of the scale, the measurement of very low pressures is limited by the emission of X-rays, which are formed when the ionizing electrons

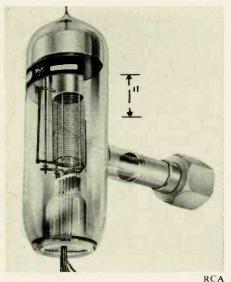


Fig. 5—Suppressor type ion gage with inverted structure, for ultra-high-vacuum measurements.

strike the grid wire. The X-rays fall on the plate and release photoelectrons which cause a current to be produced at the plate. This current is of the same sign as the ion current but it is independent of pressure. At very low pressures the ion current becomes less than the current caused by the X-rays, and the gage has reached its useful limit.

Modifications for lower pressure

The development of an inverted-structure ion gage has extended the lower limit of the hot-filament ion gage by a factor of at least 200. The inverted gage (Fig. 3) has the filament *outside* the spiral-wound grid. The plate is reduced to a single, fine wire suspended inside the grid. The plate is several hundred times smaller than the usual metal cylinder and receives only a fraction of the X-rays produced at the grid. Because of its lower operating limit, the inverted-structure gage has become the standard measuring instrument for workers in the ultra-high vacuum field.

UNITS OF VACUUM

Any pressure less than atmospheric pressure is considered to be a vacuum. While early workers in the field measured vacuum in inches or centimeters of mercury, modern vacuum technologists express low pressures in terms of the absolute unit: torr. One torr, named after Torricelli who discovered the principle of the barometer, is equal to 1/760 of a standard atmosphere. Therefore, normal atmospheric pressure may be considered to be 760 torr. The pressure in a typical vacuum tube is about 1×10^{-6} or .000001 torr. The basic ion gage, described in this article, has a useful range from 1×10^{-3} torr to about 1×10^{-6} torr.

Vacuum technology is closely associated with space exploration. The table here shows the degree of vacuum that would be encountered at various heights above the earth's surface.

Height in miles	Pressure in torr
Sea level	760 or 7.6 × 10°
10	1×10^{2}
100	1×10^{-5}
1,000	1×10^{-11}
Interplanetary space	1 × 10-16

The walls of the glass envelope and the tube connecting the gage to the vacuum system sometimes interfere with accurate measurements. To overcome these problems, the ion gage is available in an unenclosed or "nude" form (Fig. 4). The electrodes are sealed directly into the vacuum system.

Several other design modifications have been employed to extend the useful range of the hot-filament ion gage. As an example, the gage tube in Fig. 5 has added elements in the form of a suppressor ring and a collector shield, which aid in extending the limits of vacuum measurements.

The common electron tube and the highly specialized ion gage have much in common. The service technician who pulls a "gassy" tube and the scientist who measures high vacuums with an ion gage are dealing with the same problem. They both have a vacuum tube that needs a vacuum.

You can earn more money if you have an FCC License



Employers are paying good money for men holding FCC tickets. Read how to get yours:

When you hold a Commercial License issued by the FCC (Federal Communications Commission) you have written proof that you know and understand basic electronic theory and fundamentals. It's worth plenty... particularly to companies on the lookout for qualified electronics technicians. Here's how one of the country's leading office machine manufacturers rates men with FCC Licenses:

"An FCC License is an asset to any man looking to enhance his career in the field of electronics. At our Company, a licensed man is well-rewarded because an FCC License attests to his knowledge of electronics theory . . ."

Thousands of employers will tell you the same thing. Licensed men get the good jobs. They make more money

work. What's more, they're needed badly in every field of electronics. Industrial electronics. Radio-TV Broadcasting. Aerospace. Electronics Servicing . . . including mobile and marine radio plus CB.

Yes... your opportunities are unlimited once you're carrying that FCC Commercial Ticket. AND CLEVE-LAND INSTITUTE OF ELECTRONICS CAN GET ONE FOR YOU! On the facing page, read how four ambitious men just like you have cashed in on CIE's sure-fire FCC Licensing Program. Read about CIE's exclusive money-back offer. And then send in the postage paid reply card. CIE will quickly send you complete FREE information. You will soon be on your way to a Commercial FCC License and the many rewards that go with it!

These CIE men have good jobs

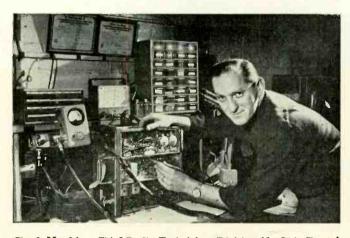
(they have Commercial FCC Licenses)



Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE. "I give Cleveland Institute credit for my First Class Commercial FCC License. Even though I had only 6 weeks of high school algebra, CIE's AUTO-PROGRAMMING teaching method makes electronics theory and fundamentals easy. After completing the CIE course, I took and passed the 1st Class Exam. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises!"



Ted Barger, Electronic Technician, Smith Electronics Co. "I've been interested in electronics ever since I started operating my own Ham rig (K8ANF). But now I've turned a hobby into a real interesting career. Cleveland Institute of Electronics prepared me for my Commercial FCC License exam . . . and I passed it on the first try. I'm now designing, building and testing all kinds of electronic equipment . . . do a lot of traveling, too. It's a great job . . . and thanks to CIE and my FCC License, I'm on my way up."



Chuck Hawkins, Chief Radio Technician, Division 12, Ohio Dept./
Highways. "Cleveland Institute Training enabled me to pass both
the 2nd and 1st Class License Exams on my first attempt... even though I'd had no other electronics training. (Many of the others who took the exam with me were trying to pass for the eighth or ninth time!) I'm now in charge of Division Communications and we service 119 mobile units and six base stations. It's an interesting, challenging and extremely rewarding job. And incidentally, I got it through CIE's Job Placement Service . . . a free lifetime service for CIE graduates."



Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company (subsidiary of Mid-Continent Telephone Company). "There's no doubt about it. I owe my 2nd Class FCC License to Cleveland Institute. Their FCC License Program really teaches you theory and fundamentals and is particularly strong on transistors, mobile radio, troubleshooting and math. Do I use this knowledge? You bet. We're installing more sophisticated electronic gear all the time and what I learned from CIE sure helps. Our Company has 10 other men enrolled with CIE and take my word for it, it's going to help every one of them just like it helped me."

FCC License Course will quickly prepare you for a Commercial FCC License. If you don't pass the FCC exam...on the first try... after completing your course, CIE will refund all your tuition. You get an FCC License... or your money back!

Two out of three men who took the 1st Class Commercial FCC License exam in 1964, failed.

Nine out of ten CIE-TRAINED men who take this exam, pass...the very first try!

And that's why CIE can back their courses with the warranty you see at the left. CIE-trained men know their stuff... because CIE AUTO-PROGRAMMED Home Study works!

Get started now. Send postage-paid reply card for free information about a plan that gets you an FCC License or costs you nothing!



CIE Cleveland Institute of Electronics 1776 East 17th Street, Dept. RE-11, Cleveland, Ohio 44114

new SAMS BOOKS

Color-TV Servicing Guide



by Robert G. Middleton. This great new book on color-TV troubleshooting follows the same

troubleshooting follows the same picture-tube-and-trouble-symptom format made famous in the best-selling TV Servicing Guide, now used by more than 100,000 servicemen. Shows how to apply fast troubleshooting procedures, based on an analysis of trouble symptoms. Includes many full-color picture tube photos illustrating various operating troubles, accompanied by clear, concise explanations of probable causes and diagnosing procedures. Takes you through each section of the color-TV receiver, describing the symptoms for various types of troubles. A final chapter explains in detail how to test and service color-TV, this book is a gold-mine of help. \$395

OTHER SAMS COLOR-TV SERVICING BOOKS
Color TV Training Monual (new 2nd Edition), by
Oliphant & Ray. Order TVC-2, only \$5.95
Color TV Servicing Made Easy, by Wayne Lemons
and Carl Babcoke. Order CSL-1, only \$2.95 Know Your Color-IV Test Equipment, by Robert G. Middleton. Order KOC-1, only \$2.50

Inventors Idea Book

by L. George Lawrence. Have you ever thought of inventing a laser defense against nuclear warheads, or a thawing device for water hydrants? These are just two of hundreds of ideas awaiting the attention of an inspired inventor. If you are an experimenter, technician, engineer, or student with imagination and initiative, this new book is for you. Contains more than 175 suggestions about specific needs of industry and technology; provides possible approaches toward their solution. Encompasses such varied areas as safety appliances for the home, devices for communications, metereology, aeronautics, transportation, medicine, and the conquest of space. This challenging book not only points up the vital need for original invention, but also stimulates creative thinking. 128 pages; 5½ x 8½". 195

Know Your Square-Wave and Pulse Generators

Know Your Square-Wave and Pulse Generators by Robert G. Middleton. Square-wave and pulse generators are very useful in component testing, and for making amplifier performance checks with an oscilloscope. This book, another in the practical "know your test equipment" series, offers comprehensive information on the operating principles and applications of square-wave and pulse generators and tells how to determine their performance quality in terms of their rise (and fall) time. Begins with basic principles and proceeds to a step-by-step analysis of both service and laboratory-type generators. Mathematics is used only when absolutely necessary. This book provides technicians and technical institute and engineering students with a sound foundation for further study. 144 pages, \$1/2 \times Order KOP-1, only.

Transistor Etched-Circuit Projects



by James Kyle. The only complete book available on etched-circuit construction for experimenters, hobbyists, and students. Unique, easy-to-use negatives are included right in the book; just clip them out and follow the simple instructions. You can build 30 fascinating projects; each is explained so that you gain a fuller understanding of the principles in volved. One chapter also tells you how to design and photo-etch your own projects; a list of suppliers of materials required for photo-etching is included. The only book of its kind, packed with building fun and valuable instruction. 144 pages; 5½ x 8½°.

HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. RE-12 4300 W. 62nd Street, Indianapolis, Ind. 46206
Send me the following books:
☐ SGC-1 ☐ CSL-1 ☐ IBL-1 ☐ TCK-1
☐ TVC-2 ☐ KOC-1 ☐ KOP-1
Send FREE Sams Boaklist. \$enclosed
Name
Address
CityStateZip
My Distributor is

Circle 32 on reader's service card

EQUIPMENT REPORT

Sonotone RM-2 Speaker System

Circle 37 on reader's service card



SONOTONE'S RM-2 IS A RECENT ADDITION to what is now a family of three speakers. It all began about a year ago with the RM-1, a midget system with a 6inch woofer. Now redesigned, the RM-1 by flanked two newer signs: the baby, whimsically named the RM-0.5, and a big brother, the RM-2, which has an 8-inch woofer and a 3inch cone tweeter.

Measuring 19 x 12 x 8 inches, the RM-2 cabinet is sturdily built of walnut-veneered chip-and-resin (great stuff for nonresonant boxes even better than plywood), with lots of corner bracing. The back is fastened with a generous number of screws (12), spaced an average of about 6 inches around the edges. No rattles here.

This rugged box is completely filled by two thick blocks of glass wool; there is virtually no "empty" air space in the enclosure. The somewhat paradoxical result, as any acoustician will be happy to puzzle you with, is an enclosure effectively quite a bit larger than its actual structural size. This technique, related to that of the acoustic suspension speaker systems, is being used in a large number of bookshelfsize speakers.

The woofer is brought out to the terminals through a coil, to keep high frequencies out of it, and the tweeter is connected through a capacitor (to block lower frequencies) and a potentiometer, which allows its output to be varied between nothing at all and full volume. The nominal crossover frequency is 4,500 cycles; the nominal impedance, 8 ohms

The RM-2 sounds pleasant and listenable. At the manufacturer-recommended tweeter control setting of 8, the highs are rather steamy, which isn't irritating, because it's smooth, but just a bit unnatural. In any case, the control permits adjustment to suit individual taste. High-frequencies are beamed somewhat, as is typical of most simple cone tweeters.

At low frequencies, there is some doubling below about 80 cycles. This is not a serious flaw. All speakers—even big ones—begin producing more second-harmonic than fundamental eventually, as you go down the scale. Secondharmonic distortion is mild, inoffensive stuff; the ear can tolerate large amounts of it without being disturbed—sometimes without even noticing it, and it gives a satisfying illusion of real bass.

(A popular radio design of the 30's and 40's used an audio amplifier that, with the help of a simple R-C feedback network, generated controlled amounts of second- and third-harmonic distortion, while suppressing the fundamental below about 150 cycles. This predistorted audio, fed to a 5-inch speaker, produced amazingly full sound. It was called synthetic bass.)

The RM-2 isn't guilty of a tubby or boxy sound, characteristic of many small systems. What is missing is really only the gut-rumbling bass around 50 cycles that only two or three of the small bookshelf speaker systems can produce. (And they cost more than the RM-2.)—Peter E. Sutheim

EICO Model 342 FM Multiplex Generator

Circle 38 on reader's service card

JOINING THE LIST OF LOW-COST, EFFIcient instruments for testing and aligning FM stereo multiplex circuits as well as complete stereo FM receivers, the model 342 just introduced by Eico proves to be design-lab quality at service-bench cost. The model 342 has extraordinary circuit refinements to insure excellent separation in the composite stereo signal. The measured separation capability of this instrument actually exceeded the 40 db claimed in the specifications. When you recall that the FCC requires only 30-db separation from broadcasters, the significance of this outstanding figure can be fully appreciated.

It is perhaps this refinement in design which prompted Eico to offer the model 342 in wired form only. The average kit builder might well find it difficult to calibrate this instrument to the precision that can be achieved in the factory. After subjecting the unit to several hours of continuous use, I noticed absolutely no drift in the alignment of the circuits that produce the composite stereo waveform. The rf signal (available as a convenience in aligning tuners or receivers) did drift during warmup, but this is not serious. Simply tune the receiver under test to around 100 mc until the test signal is found.

The model 342 has both a controlled amplitude composite audio output for direct injection into multiplex circuits (beyond the detector), and the same signal-modulating an FM rf carrier at about 100 mc with controlled deviation (±75 kc)—for connection to the antenna terminals. Either a built-in 1-kc audio oscillator or an external oscillator may be used for left-only, rightonly, difference (L - R) or sum (L + R) signals. The 19-kc pilot signal is crystal-controlled and may be switched on and off independently of the composite signal. A signal can also be set up without audio information and only the 19-kc pilot.



A scope sync output offers a choice of either 19-kc sync or 1-kc sync. The 342 also has an input for connecting an external audio oscillator to provide an SCA (background music subcarrier) signal when required.

Another important feature of the model 342 (and one not found on most competitive units) is a pair of inputs and isolation amplifiers for a stereo program source to permit FM stereo demonstrations to customers when there are no stereo programs being broadcast. The amplifiers even pre-emphasize the program material properly (75 μ sec), just like an FM broadcast transmitter, so that tone controls do not have to be radically altered from flat when the program is heard on a receiver with normal de-emphasis.

While an rf signal is very handy in evaluating the performance of a complete tuner or stereo receiver, I felt that the signal strength of the 100-mc carrier in the model 342 is so great that it pre-

vents judging a receiver's stereo performance under "weak signal" conditions. Of course, the rf cable can be removed from the antenna terminals of the receiver being tested to approximate a weak signal, but then there is no way of knowing how weak the signal is. In other words, some form of calibrated attenuator would have been desirable to allow the unit to double as a general FM rf generator. But in view of its superior performance for aligning multiplex sections of receivers, this minor omission certainly does not detract from the very fine qualities of this compact, well designed instrument.—Leonard Feldman

MANUFACTURER'S SPECIFICATIONS

Separation: 40 db minimum from 200 cycles to 10 kc; 30 db minimum from 50 cycles to 15 kc.

Composite signal output: 0-5 v p-p, continuously variable; output impedance 1,500

Rf output: 200 millivolts; output impedance 50 ohms

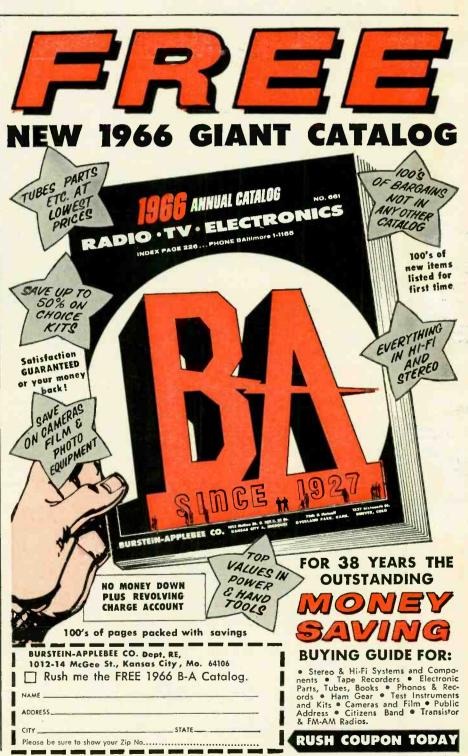
Pilot frequency: 19 kc ±2 cycles, crystal controlled

Signal selection: L + R, L - R, L only, R only,

19 kc only, external stereo source
Power requirement: 117 vac, 50-60 cycles
Size: 8½ x 5¾ x 12½ inches
Weight: 10 lb

Price: \$149.95 (wired only)

Continued on page 68



New Ideas For Christmas Giving ...

A Gift For Everyone . . . In This Vast Heathkit Selection!



New Heathkit 10-Band Transistor Portable!

10 bands tune Longwave, Standard Broadcast, FM and 2-22.5 mc Shortwave. 16 transistors, 6 diodes, and 44 factory assembled and pretuned circuits. Two separate AM & FM tuners and IF strips. FM tuner & IF strip are same components used in deluxe Heathkit FM stereo gear. 2 built-in antennas. Battery saver switch cuts current drain up to 35%. Rotating tuning dial. Dial light. 4 simple controls for tuning, volume, tone, AFC and band switching. 4" x 6" PM speaker. Earphone & built-in jack. Optional 117 v. AC converter/battery charger available @ \$6.95. Time zone map & "listener's guide." Man size: 131/2" W x 51/8" D x 101/6" H. 17 lbs.



Kit CD-983 Now Only

Ideal Gift For The Whole Family . * * Heathkit®/Thomas Organs!

The Heathkit/Thomas "Coronado" Transistor Organ, (illust.) boasts 17 organ voices, two 44-note keyboards, Leslie plus 2-unit main speaker system, 28 notes of chimes, 13-note heel & toe pedalboard, color-tone attack & repeat percussion, matching bench, plus many more professional features. 242 lbs. Also the Heathkit/Thomas "Artiste" Transistor Organ with 10 voices, two 37-note keyboards, repeat percussion, etc. now at only \$332. 154 lbs. . . . Both organs have all genuine Thomas factory fabricated components.



New 23-Channel, 5-Watt Transistor CB Transceiver!

23 crystal-controlled transmit & receive channels for the utmost reliability . . . at competitive prices! All-transistor circuit for instant operation, low battery drain... only .75 A transmit, .12 A receive. Only 27%" H x 7" W x 10½" D ... ideal for car, boat, any 12 v. neg. gnd. mobile use. "S" meter, adjustable squelch, ANL, built-in speaker, ceramic PTT mike, aluminum cabinet. 8 lbs. Kit GWA-14-1, optional AC power supply, 5 lbs., \$14.95.



Kit SB-100

New DeLuxe 5-Band SSB Ham Transceiver

Full SSB-CW transceive operation on 80-10 meters. 180 watts PEP SSB-170 watts CW. Switch select for USB/LSB/CW operation. Operates PTT and VOX; VOX operated CW with built-in sidetone. Triple Action Level Control TM allows greater variation in speech level. Heath SB series Linear Master Oscillator (LMO) for true linear tuning. Mobile or fixed operation with appropriate power supply. 23 lbs. Accessory mobile mount, SBA-100-1 \$14.95.



New Deluxe Shortwave Radio

Compare it to sets costing \$150 and more! 5 bands cover 200-400 kc, AM, and 2-30 mc. Tuned RF stage, crystal filter for greater selectivity, 2 detectors for AM and SSB, tuning meter, bandspread tuning, code practice monitor, automatic noise limiter, automatic volume control, antenna trimmer, built-in 4" x 6" speaker, headphone jack, gray metal cabinet, and free SWL antenna. 25 lbs.

Kit GR-54

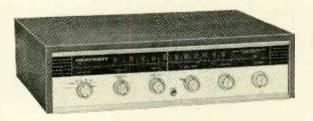


New Heathkit Solid-State Electronic Keyer

All solid-state circuitry. Speed range-15 to 60 words per minute. Solid-state switching-no relays to stick or clatter. Adaptable to either right or left handed operators. Convertible to semi-automatic operation. Variable dot-space ratio. Self-completing dashes. Sealed switches on paddle-no exposed contacts to clean or adjust. Builtin paddle-"feel" is adjustable to your fist during assembly. "Hold" switch for transmitter tuning. Transformer-operated power supply isolates keyer from line power. Fused for protection. 6 lbs.

... "Do-It-Yourself" Heathgifts!

Now Choose From 2 Heathkit® Transistor Stereo Receivers!



New 30-Watt Transistor FM Stereo Receiver . . . Less Than \$100!

Features 31 transistors, 11 diodes for cool, natural transistor sound; 20 watts RMS, 30 watts IHF music power @ ±1 db, 15 to 60,000 cps; wideband FM/FM stereo tuner plus two preamplifiers & two power amplifiers; front panel stereo headphone jack; compact 37%" H x 151/4" W x 12" D size. Assembles in 20 hours or less. Custom mount it in a wall, or optional Heath cabinets (walnut \$9.95, beige metal \$3.95) 16 lbs.

Kit AR-14 \$995 (less cabinet)

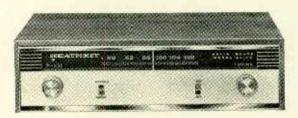


66-Watt Transistor AM/FM Stereo Receiver

Just add 2 speakers for a complete stereo system. Boasts AM/FM/FM Stereo tuning; 46-transistor, 17-diode circuit for cool, instant operation and natural transistor sound; 66 watts IHF music power (40 watts RMS) at ±1 db from 15 to 30,000 cps; automatic switching to stereo; preassembled & aligned "front-end" & AM-FM IF strip; walnut cab. 35 lbs.

Kit AR-13A Now Only \$18400

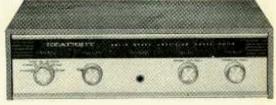
Best Hi-Fi News Of '65 . . . New Low-Cost Transistor Stereo Twins!



New Transistor FM/FM Stereo Tuner

Heath's easiest to build stereo/hi-fi kit . . . takes only 4 to 6 hours! 14 transistor, 5 diode circuit for cool instant operation, transparent transistor sound. Phase control assures best stereo performance. 3 transistor "front-end" plus 4-stage IF section. Filtered outputs for direct stereo recording. Automatic stereo indicator light. Preassembled & aligned "front-end." Install in a wall or either Heath cabinet (walnut \$7.95, beige metal \$3.50). 6 lbs.

Kit AJ-14 \$4995 (less cabinet)



Matching 30-Watt Transistor Stereo Amplifier

Assembles in 10 hours or less! 17 transistors, 6 diodes. 20 watts RMS, 30 watts IHF music power @ ±1 db, 15 to 60,000 cps. No audio transformers ... assures minimum phase shift, extended response, lower distortion. Solid-state power supply plus electronic filter for regulation within 10%. Accommodates phono, tuner, auxiliary ... 4, 8, 16 ohm speaker impedances. Lighted panel. Installs in wall, or Heath cabinets (walnut \$7.95, metal \$3.50). 10 lbs.

Kit AA-14 \$5995 (less cabinet)

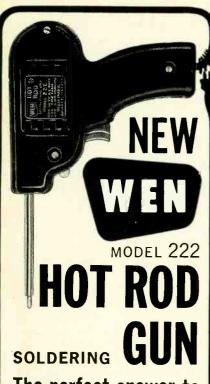
NEW 1966 CATALOG!



Free! 108 pages ... many in full color ... describe these and over 250 easy-to-build Heathkits. Save up to 50%. Mail coupon for your free copy.

---- Buy Now-Use This Order Blank---

Benton Harbor, Michigan	49023	HEA	19:4:44
☐ Please send FREE H	eathkit Catalog		
Model	Description	Weight	Price
			-
Name			
Italiic	(Please Pi	rint)	
Address			
City	State	Zip	
SHIP VIA:	ress Collect 🗌 Freight 🔲 20	% Included, C.O.I	D. Best Way
	ons subject to change without		C1-33



The perfect answer to all Radio, TV and electronic soldering jobs.

222, with Wen's exclusive ATR (Automatic Thermal Regulation), is a power packed, lightweight precision instrument that gives you more than just dual heat. It gives you an effective and efficient range of heat up to 200 watts. The Wen Hot Rod Soldering Gun can deliver the heatpower found in a 200-watt soldering device on a current draw of only 110 watts surge and 55 watts working. Feature for feature, there's not a better soldering gun to be found anywhere. Check 'em off.

- Exclusive ATR (Automatic Thermal Regulation) permits heat-power to be automatically adjusted to the correct level for the job being done.
- Tip automatically adjusts heatpower up to 200 watts.
- New CS 1200 heat element in the tip puts heat-power on the
- Economy performance more heat-power, less current draw.
- Lighter weight, more compact - beautifully balanced,
- ONLY \$7.95

Model 222 K-5 Kit, with rugged custom fitted case, contains flat iron and plastic cutting attachments which seal plastic bags, remove wood dents and perform dozens of accessory jobs. Kit also contains fine soldering tip for delicate soldering jobs. Only \$11.95.



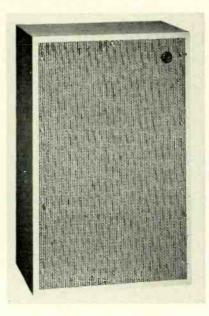
Circle 35 on reader's service card

EQUIPMENT REPORT continued

Electro-Voice Sentry II Studio Monitor Loudspeaker

Circle 39 on reader's service card

DURING A RECENT TRIP THROUGH THE Midwest, I stopped, among other places, at Electro-Voice. There I was introduced (among other things) to a special kind of speaker I hadn't come upon before. It was Electro-Voice's Sentry II studio monitor loudspeaker. It is, the manufacturer claims, designed for extremely smooth, flat response and lack of coloration, and intended for use as a broadcast or recording studio monitor, rather than to satisfy someone's conception of "what the public wants."



The Sentry II is a big box. It measures 32 by 20 by 13 inches outside, which amounts to an internal volume of about 7,000 cubic inches, or about 4 cubic feet. It contains a 12-inch Electro-Voice SP-12B woofer and a small horn tweeter, with, I would guess, a pretty high crossover point, judging by the size of the tweeter horn. E-V does not specify the crossover frequency. The enclosure, built of 3/4-inch stock, is a bass-reflex type with a 61/2-inch duct behind the port. About an inch of acoustic padding lines about half the inside surface of the enclosure.

Extensive listening on all kinds of music and on speech showed that the Sentry II is indeed free of a particular "color", and in general has an easy, effortless quality of reproduction that usually comes only from the biggest speaker systems. The high end is bright, and there is a suggestion of either a peak or some harmonic distortion somewhere in the lower treble. (However, I listened to it in a hard, bright room. Broadcast studios and control rooms are usually heavily padded with acoustic tile.) The overall sound is smooth and extremely pleas-

Bass goes quite low; there is plenty of power at 50 cycles and still some audible output at 30, though much of what comes out at 30 cycles input is really 60 and 90 cycles. About 35 cycles is the "true bass" limit of this speaker. Absolutely no effort has been made, apparently, to firm up the bass end to please a bass-happy public. And the bass is flat, praise 'em-no boom, no heavy onenote emphasis.

The Sentry II is at least about four times more efficient than acoustic-suspension and other sealed-enclosure designs. (Studio monitoring amplifiers generally produce between 10 and 25 watts output; the 50-, 60-, 100-watt monsters that have become so common in the hi-fi field are almost unknown in broadcast studios.) Such a high efficiency makes it practical to fill a room with sound from a 5-watt amplifier, or, to look at it another way, almost every high-quality amplifier on the market today would simply loaf along even at high-power orchestral passages. About 34 (electrical) watt at 100 cycles fed to this speaker makes a loud noise in a 10 x 15

This is definitely not everyman's (Electro-Voice obviously knows this, for it has not promoted the Sentry II among audiophiles.) But if you think you might be happy with an "austere" speaker—one that doesn't have any "warmth," "color," "sweetness," as such, built into it, and you have room for it, you might want to listen to the Sentry II. Its sound, speaking subjectively, is one of great naturalness on speech as well as on music.

Electro-Voice also manufactures a Sentry I, whose electrical and acoustic specifications are the same as those of the Sentry II, but which has a slopingfront cabinet design for mounting between wall and ceiling or halfway up a corner, between two walls. It measures 17 by 37 by 2134 inches and its profile is just like that of the popular wooden baffles for wall-mounting intercom or paging speakers.

Both Sentry I and Sentry II come with a built-in transformer that can match the system's impedance (nominally 16 ohms) to 150- or 600-ohm lines. Both come in sanded, grain-sealed, light-colored wood cabinets, ready for painting.—Peter E. Sutheim

MANUFACTURER'S SPECIFICATIONS

Frequency response: 30-20,000 cycles EIA sensitivity rating: 49 db Impedance: 16, 150 or 600 ohms Power-handling capacity: 20 watts Size: 32 x 20 x 13 inches Weight: 68 lb. Price: \$159. Electro-Voice, Inc.

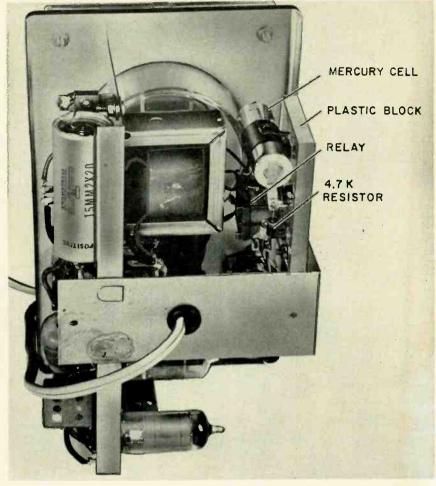
ADD A ZERO-SETTER TO YOUR AC VTVM

A few parts can stop the nuisance of having to subtract residual reading from your audio meter readings

By LYMAN E. GREENLEE

MANY AC VACUUM-TUBE VOLTMETERS never read zero on any range. There is always a small residual indication from internal hum and noise. This reading increases on the lower-voltage ranges because of increased sensitivity. The slightest leakage through the coupling capacitors will add to this residual reading. It would be difficult to select capacitors with such low leakage that there would be absolutely no residual meter reading.

If we introduce a small voltage of opposite polarity across the meter movement, we can force a reverse current through the meter and return the pointer to zero. I did that on my Heath AV-2. Source for this voltage is a mercury cell that can be wired permanently into the circuit. (Current drain is so small that the battery will seldom need replacing.) The reverse current through the meter can be controlled with a series rheostat (R2), and, if we make the resistance large enough, the battery will be virtually out of the circuit at the maximum setting and almost no movement of the meter can be detected. Re-



Zero-set parts are mounted on clear plastic block fastened to chassis brackets

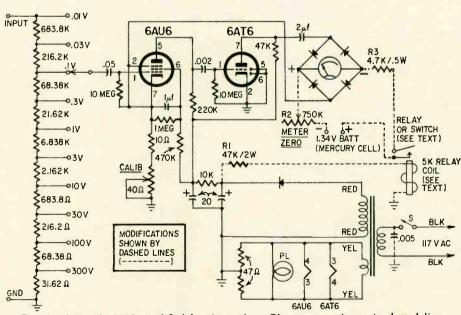
sistor R3 must be included in series with R2 to protect the meter from accidental overload as R2 is adjusted.

When the instrument is not in use, the battery should be disconnected. There are two ways of doing this. You can replace the power switch with a double-pole double-throw slide switch, or you can use a relay. I happened to have a miniature 5,000-ohm relay in the odd-parts box. It fitted nicely into the available space. The primary advantage of a relay is that it keeps the meter circuit away from the 60-cycle ac line. A double-pole slide switch puts the two circuits very close together, and there is bound to be some leakage in the switch itself.

R1 was chosen to allow about 12 to 15 volts drop across the relay coil. The zero adjustment is a 750,000-ohm miniature potentiometer. These miniature "dime size" pots are so small they will fit almost anywhere. The .005- μ f ceramic capacitor was added from switch to chassis (ground) to improve the stability on the low ranges.

Set the meter to zero by adjusting the miniature pot with the input terminals shorted. The zero adjustment can also be used to balance out any residual voltage from the circuit being measured; the meter reading will then indicate the actual voltage under observation.

Anyone who goes to the trouble of adding these modifications will find that the results are well worth the small cost and effort.



Circuit of Heath AV-2 modified by the author. Changes are shown in dotted lines.

The following free advertising material is available through

RADIO-ELECTRONICS READER'S SERVICE

ACOUSTIC RESEARCH INC. (Pg. 9) Circle 9
Literature on AR speakers and turntables. ALLIED RADIO CORP. (Pg. 75) Circle 110
Free 1966 catalog. B & K MANUFACTURING CO. (Pg. 25) Circle 23
Complete catalog.
Free booklet "How to Plan a Color-Approved Home TV System".
BROOKS RADIO & TV CORP. (Pg. 92-93) Circle 125 Catalog sheets and price lists of tubes and parts. BURSTEIN-APPLEBEE CO. (Pg. 65) Circle 33
New 1966 Giant catalog. CASTLE TV TUNER SERVICE, INC. (Pg. 6) Information on complete tuner overhaul by mail.
CLEVELAND INSTITUTE OF ELECTRONICS (Pg. 8) Circle 8 Free electronics slide rule booklet and pocket electronics data guide.
CORNELL ELECTRONICS CO. (Pg. 97) Circle 131 Catalog and price list of tubes and parts.
CONAR INSTRUMENTS (Pg. 73) Circle 108 Catalog on Conar electronic kits. COYNE ELECTRONICS INSTITUTE (Pg. 96) Circle 129
Book on "Your Opportunities in Electronics." DE VRY TECHNICAL INSTITUTE (Pg. 5) Circle 4
Free booklets "Pocket Guide to Real Earnings" and "Electronics in Space Travel." EDLIE ELECTRONICS, INC. (Pg. 94) Circle 126
Latest catalog of electronic components, tubes and equipment. EICO ELECTRONIC INSTRUMENT CO. (Pg. 30)
Free catalog on full EICO line of 200 best buys and names of nearest dealers.
ELECTRONIC COMPONENTS CO. (Pg. 98) Circle 133 Information on rectifiers and transistors.
GRANTHAM SCHOOL OF ELECTRONICS (Pg. 96) Circle 130 Free 48-page booklet, "Careers in Electronics."
HEALD'S ENGINEERING COLLEGE (Pg. 95) Circle 128
Catalog and registration application. HEATH COMPANY (Pg. 66-67) Circle 34
New 1966 108-page catalog of easy-to-build kits. HY-GAIN ELECTRONICS CORP. (Pg. 15) Circle 15
Free Mobile Antenna Comparison report No. 15. INTERNATIONAL CRYSTAL MFG. CO. INC. (Third Cover)
Information on International Model MO Transceiver for Citizens Radio Service.
INTERNATIONAL RADIO EXCHANGE (Pg. 8) Circle 7 Complete list of equipment in stock.
JFD ELECTRONICS CORPORATION (Pg. 7) Circle 6 Information on JFD LPV Color Log Periodic Antennas. JACKSON ELECTRICAL INSTRUMENT COMPANY (Pg. 12) Circle 12
Complete catalog on test instruments. JERROLD ELECTRONICS CORP. (Pg. 81) Circle 115
Information on the Tele-Mate cordless UHF converter. LAFAYETTE RADIO ELECTRONICS (Pg. 83) Circle 118
Free 1966 Lafayette catalog 660. MALLORY DISTRIBUTOR PRODUCTS CO. (Pg. 23)
Information on Solid State Circuits Circle 21
MULTICORE SALES CORP. (Pg. 75) Circle 111 Information on Ersin Multicore 5-core solder.
OLSON ELECTRONICS, INC. (Pg. 72) Circle 107 Free one year's subscription to Olson Electronics cata-
log.
OXFORD TRANSDUCER CO. (Pg. 22) Circle 19 Complete catalog on the Oxford Transducer line of 11 different auto rear seat speaker kits and "Blanket the Market."
POLY PAKS (Pg. 101) Circle 135
Catalog of Semi-conductors. PRECISE ELECTRONICS & DEVELOPMENT (Pg. 2)
Information on the new line of test instruments. PROGRESSIVE "EDU-KITS" INC. (Pg. 89) Circle 122
Information describing Edu-Kits. RADAR DEVICES MANUFACTURING CORP. (Pg. 1) Circle 2 Information on how to have a business of your own distributing Radar Sentry Alarm Systems.
distributing Radar Sentry Alarm Systems. RADIO SHACK (Pg. 102) Radio Shack Catalog. Circle 136
RAY-TEL CB PRODUCTS (Pg. 91) Circle 124 Complete details on Ray-Tel TWR-5 and TWR-7.
RCA INSTITUTES INC. (Pg. 26-29) Circle 24 Brochure on home study and classroom study.
RYE SOUND CORPORATION (Pg. 82) Information on the Kleps 30 test prober. Circle 117
HOWARD W. SAMS & CO. INC. (Pg. 64) Circle 32 Free Sams booklist.

HOWARD W. SAMS & CO. INC. (Pg. 21) Circle 18 Information on Photofact Library Encyclopedia deal. SCHOBER ORGAN CORP. (Pg. 24) Circle 22
Booklet and 7" sampler record. SENCORE (Pg. 90) Circle 123 Information on CG135 Transistorized color generator.
TRIPLETT ELECTRICAL INSTRUMENT (Second Cover) Circle 1 information on the world's most complete line of V-O-M's
TURNER MICROPHONE COMPANY (Pg. 80) Complete Turner Microphone catalog.
UNITED RADIO CO. (Pg. 99) Circle 134 Complete parts catalog.
UNIVERSITY SOUND (Pg. 72) Circle 106 Free book, "Microphones '66" for tape recording.
WARREN ELECTRON:C COMPONENTS (Pg. 95) Information on Silicon rectifiers.
WELLER ELECTRIC CORP. (Pg. 88) Circle 120 Information on New Marksman Pencil soldering iron.
Information on Wen hot rod soldering gun
WINDSOR ELECTRONICS, INC. (Pg. 82) Circle 116 Booklet entitled "The Open Door to TV Profits."
WINEGARD CO. (Pg. 74) Fact-finder #242 with information on Chroma-Tel antenna.

Here's how you can get manufacturers' literature fast:

- Tear out the post card on the facing page. Clearly print or type your name and address.
- 2. Circle the number on the card that corresponds to the number appearing at the bottom of the New Products, New Literature or Equipment Report listing in which you are interested. For literature on products advertised in this issue circle the number on the card that corresponds to the number appearing at the bottom of the advertisement in which you are interested, or use the convenient checking list in the column at the left.
- 3. Mail the card to us (no postage required in U. S. A.)

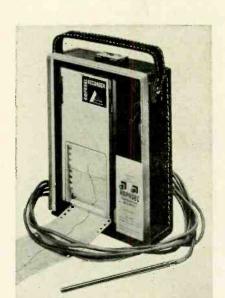
Note: If the postcard has already been detached from your copy of RADIO-ELECTRONICS, use the coupon on this page instead. Enclose the coupon in an envelope and address it to: RADIO-ELECTRONICS READER'S SERVICE, P. O. Box 7365, Philadelphia, Pa. 19101. (Use this address only for Reader's Service requests.)

	RA	DI	0-E	LE	CT	RO	NI(CS	RE/	ADI	ER'	SS	ER	VIC	CE
	The	numb	ersIl				ow inc							rece	eive:
VOID	1 16 31	2 17 32	3 18 33	4 19 34	5 20 35	6 21 36	7 22 37	8 23 38	9 24 39	10 25 40	11 26 41	12 27 42	13 28 43	14 29 44	15 30 45
VOID AFTER J	46 61 76	47 62 77	48 63 78	49 64 79	50 65 80	51 66 81	52 67 82	53 68 83	54 69 84	55 70 85	56 71 86	57 72 87	58 73 88	59 74 89	60 75 90
JANUARY	91 106 121 136	92 107 122 137	93 108 123 138	94 109 124 139	95 110 125 140	96 111 126 141	97 112 127 142	98 113 128 143	99 114 129 144	100 115 130 145	101 116 131 146	102 117 132 147	103 118 133 148	104 119 134 149	105 120 135 150
31, 1966		ne	130	133	140		142	143	144	140	140	147	140	143	130
	Add	lres s .				41									
	City		1						Stat	e					
	12-6	5							Zip	Code	S.C.I.				

NEW PRODUCTS

More information on these new products is available free from the manufacturers. Each item is identified by a Reader's Service number. Turn to the Reader's Service Card facing page 70 and circle the numbers of the new products on which you would like further information. Detach and mail the postage-paid card.

MINIATURE STRIP-CHART RECORDER, model LT8100, will record temperature in 2 ranges; -50° to $+100^{\circ}$ F; $+50^{\circ}$ to $+250^{\circ}$ F. Monitors temperature conditions on pressure-sensi-

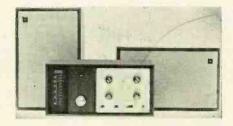


tive strip chart 30 ft long by 2½-in. wide. Leather case; available with 1-, 6-, or 12in. per hour feed speed.—Amprobe In-

Circle 46 on reader's service card

AUTO RADIO ANTENNA, the A-85 CB/AM combination, uses encapsulated top-loading coil to get one-quarter-wavelength resonance. VSWR 1.1 to 1. No degradation when used for entertainment radio. Signal divider prevents 27-mc signals from entering AM radio. 47 in. extended, telescopes to 30 in.—Webster Mfg.

Circle 47 on reader's service card



the Stereomaster 2400. Frequency re-

sponse 20–20,000 cycles; sensitivity 2.8 μ v; distortion at normal listening level less than 0.5%. Walnut cabinet. Tuner/amplifier 12% x 7 x 7 in. Speakers (each) 14 x 8% x 5 in. Shipping weight with speakers, 34 lb.—H. H. Scott, Inc.

Circle 48 on reader's service card

UHF TRANSLATOR, model U-75, converts any rf signal between 55 and 85 mc to any uhf channel between 15 and 75. Requires minimum signal of 2,500 µv.



Input for either 300 ohms balanced or 50-75 unbalanced. Uhf dial calibration exact for 69 mc; maximum error ±5 channels. Uses standard 9-volt battery. 6 x 6 x 4 in., 3 lb. For color and black-and-white.—Lectrotech, Inc.

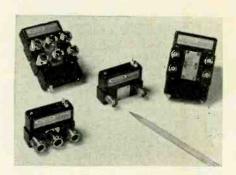
Circle 49 on reader's service card



SOUND RECORDING TAPE now available in brown-and-beige library-box packaging. Space on back of box for listing taped selections. Identifying sleeve is removed after purchase of tape; sizes from 625 feet on 5-in. reel to 3,600 feet on 7-in. reel.—Eastman Kodak Co.

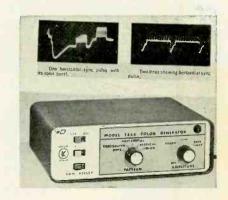
Circle 50 on reader's service card

COAXIAL SWITCHES. New Dynaform switch line uses standard modules to produce hundreds of combinations.



Special-purpose switches available in a few days in prototype quantities for breadboarding. Spdt and transfer switches weigh about 4 oz; dpdt types about 8 oz. Gold-plated beryllium copper bifurcated moving-contact blades; area of contact and pressure satisfactory for 500 watts. Mechanical life rating minimum 1 million cycles.—Amphenol RF Div.

Circle 51 on reader's service card



SOLID-STATE COLOR GENERATOR, model 1245, permits accurate setting of color-killer threshold control without waiting for color telecast. Produces all necessary waveforms to station quality standards. Complete blanking of all video information during sync periods. Crystal-controlled keyed rainbow color bar display; dot/crosshatch/horizontal line/vertical line patterns, gun killer controls. Dots are one line high, 0.2 µsec wide. 2% x 8½ x 8% in., 3 lb.—B & K Mfg. Co.

Circle 52 on reader's service card

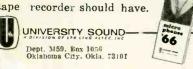
MINIATURE SEALED ELECTRO-LYTIC CAPACITORS. Operating temperature rating from -20° to $+85^{\circ}$ C and close tolerance on capacity of -0, +100%. Available capacitances range from 2 to 1,000 μ f; voltage ratings from 6 to 50

DECEMBER, 1965



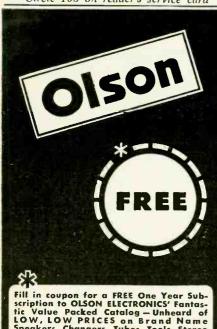
... right into your tape recorder then play it back and listen to the lively sound of your own voice so natural, no one can tell the difference. University's new revolutionary Attaché is the smallest cardioid dynamic microphone ever

made. Priced right too!
Free! "Microphones '66" a book every owner of a tape recorder should have.



Name Address City

State Zip Circle 105 on reader's service card



Fill in coupon for a FREE One Year Sub-scription to OLSON ELECTRONICS' Fantas-tic Value Packed Catalog — Unheard of LOW, LOW PRICES on Brand Name Speakers, Changers, Tubes, Tools, Stereo Amps, Tuners, CB, Hi-Fi's, and thousands of other Electronic Values. Credit plan available.

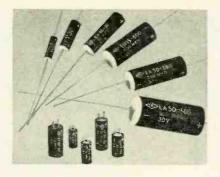
ADDRESS___ __ZONE__STATE

If you have a friend interested in electronics send his name and address for a FREE subscription also.

OLSON ELECTRONICS,

432 S. Forge Street Akron, Ohio 48430

Circle 107 on reader's service card



de working volts. Molded phenolic plastic case, epoxy-sealed ends. Axial and printed-circuit lead types. Case dimensions small as 1/2-in. long by 1/2-in. diameter for 25-µf 6-volt unit.—Centralab

Circle 53 on reader's service card

FM STEREO RECEIVER, the 440-T. 70 watts of music power at 4 ohms; 50 watts at 8-ohm impedance. 2.0-μν sensitivity (IHF). Wide-band ratio detector;



wide-band solid-state i.f. strip; 4 i.f. stages; 3 limiters; d'Arsonval tuning meter; time-division multiplex system; tape and phono facilities; gold-plated front panel. 16% x 5% x 12% in., 21 lb.—Fisher Radio Corp.

Circle 54 on reader's service card

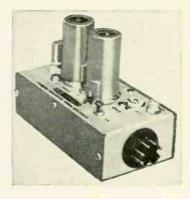
LINE OF COLOR AMPLIFIERS, Tele-Amp. HVU-3; up to 18 db gain; noise 4.2 db; 3 transistors. HV-2; up to 13 db gain for 2 sets, up to 8 db for 4 sets; noise figure to 4 db; 2 transistors. HV-1; for vhf fringe reception with high-pass filter: up to 12 db gain for 2 sets, up to 8 db with all outputs used;



noise 4.5 db; 1 transistor. HF-1 amplifies FM/FM stereo up to 15 db gain; noise 5.1 db; 1 transistor. EV-1 for vhf fringe, 2 vhf/FM outputs: up to 17 db gain for 1 set, to 14 db with both outputs; noise to 5.1 db; 1 transistor. EF-1: economy amplification; 15 db gain; noise 5.6 db; 1 transistor.-JFD Electronics Corp.

Circle 55 on reader's service card

2- AND 6-METER CONVERTER KITS. Heathkit model SBA-300-3, the 6-meter model (shown), extends coverage of SB-300 receiver from 48 to 54 mc (50 to 52 mc with crystal supplied), and the 2-meter converter, kit SBA-300-4, ex-



tends coverage from 142 to 150 mc (144 to 146 me using crystal supplied). Each converter uses 6DJ8 cascode amplifier for low noise factor and high sensitivity. Age provision.-Heath Co.

Circle 56 on reader's serivce card

SOLID-STATE POWER VERTER, the Tempest model 50-170. Changes battery current of car or boat to



117 vac. Capacity 125 to 150 watts. Copper-clad case, carrying handle.-Terado

Circle 57 on reader's service card

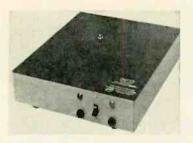
MINIATURIZED AUDIO TRANS-FORMER, the PIL-50. 5/16-in. diameter, 3/16-in. high, 1/20 oz. Primary impedance 500 ohms ct; unbalanced de in primary 3 ma; primary de response 40 ohms;



maximum level 100 mw; ±3-db frequency range at 1 mw 800 cycles-250 kc.-United Transformer Corp.

Circle 58 on reader's service card

BULK TAPE ERASER, Cinema type 9205A for erasing program and residual noise from magnetic tape on 17-in. reel or



films with magnetic sound tracks. Active field area can erase recorded signal to more than 50 db below saturation. Double-pole switches, double-fused with pilot lights; 3-conductor cord with 2-prong plug and ground connector with 6-ft rubber-covered cord.—Aerovox Corp., Hi-Q Div.

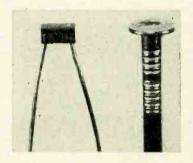
Circle 59 on reader's service card

TRANSISTOR REGULATED POW-ER SUPPLY KIT, model PZ-107, will deliver output continuously variable from 7 to 25 volts at 200 ma dc (30 v at 100 ma dc). Input 105–125 v 50–60 cycles ac.



Load regulation ±0.2%. Line regulation ±0.4%. Ac ripple less than 1 my. 3% x 4% x 5% in.—Viking Engineering

Circle 60 on reader's service card



CERAMIC CAPACITOR, EPCO4 Nailhead. Capacitance range of 10 pf through .027 μ f; case measures 0.2 x 0.1 x 0.1 in. Modified barium titanate dielectric. Available in axial-lead tubular style as well as rectangular case shown.—Marshall Industries, Electron Products Div.

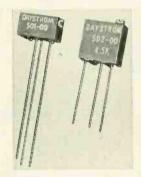
Circle 61 on reader's service card

AUDIOMATIC GENERATOR, model 610-A. Manual frequency range 25-46,000 cycles in one continuous range. Automatic range by separate control from 0 to 20 kc, markings at 1,000-cycle increments. Accuracy of-calibration ± (1% + 5 cycles). Output impedance: 4,000 ohms single-ended and 600 ohms

balanced to ground. Output power 100 mw at 4,000 ohms, + 19 db at 600 ohms. Output essentially flat from 50-10,000 cycles. Waveform distortion less than 0.5% over most of range. Ac hum less than 0.1%. 19½ x 11 x 15 in., 48 lb.— The Clough-Brengle Co.

Circle 62 on reader's service card

POTENTIOMETERS, models 501 (back pins) and 502 (side pins) Square-trims, require only .07 cubic inch space. Range 10 to 30,000 ohms. Precision tolerance is ±5%; resolution better than 0.124%. Adjustability 15 turns with slip-



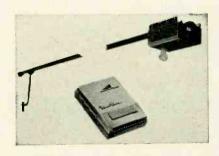
clutch. High power 0.5 watt at 70°C; low noise 100 ohms maximum. Temperature range -55° to +150°C; low-temperature coefficient ±70 ppm maximum.—Weston Instruments, Inc.

Circle 63 on reader's service card

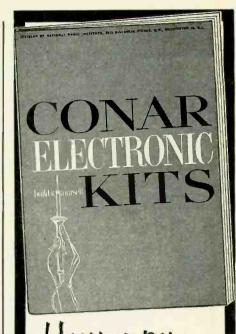


CABLE INSULATION STRIPPING TOOL, model 369, cuts, slits, strips insulation from cables ranging from No. 1 to 1,000 MCM (Million Circular Mils). Designed to remove insulation without cutting or nicking conductor strands. Guide markings for each cable size. Tool can be used at end of conductor or anywhere along its length.—Thomas & Betts Co.

Circle 64 on reader's service card



GARAGE-DOOR OPENER, model G-670, which claims to be free from

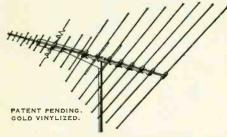


Jour copy
is waiting...
The
do-it-yourselfer's **newest**

Here's your new catalog of quality electronic kits and assembled equipment ... your shopping guide for TV set kits, transistor radios, voltmeters, scopes, tube testers, ham gear, PA systems, and a host of other carefully engineered products. Every item in the Conar catalog is backed by a no-loopholes, moneyback guarantee. It's not the biggest catalog, but once you shop its pages you'll agree it's among the best. For years of pleasurable performance, for fun and pride in assembly, mail the coupon. Discover why Conar, a division of National Radio Institute, is just about the fastest growing name in the kit and equipment business.

Circle 108 on reader's service card

Meet Winegard Chroma-Tel



First ½ size all-band (UHF, VHF, FM) antenna with full size power

- Delivers Brilliant Color, Beautiful Black and White, Full-Tone FM Sound
- Brings in All the UHF, VHF and FM Stations in Your Area

Now there's an All-Band (UHF, VHF, FM) antenna that is actually half the size of most other all-band antennas. It eliminates half the bulk, half the wind loading, half the storage space, half the truck space and half the weight of ordinary all-band antennas... without sacrificing one bit of performance! Features Winegard's new Chroma-Lens Director System and impedance corrolators.

and impedance corrolators.
Compare size, cost and performance... you'll choose Winegard Chroma-Tel every time. Ask your distributor or write for Fact-Finder #242 today.

3 Models from \$17.50 list.

Winegard Co. ANTENNA SYSTEMS

3000 Kirkwood • Burlington, Iowa

Circle 109 on reader's service card

for your convenience

600 electronic parts distributors

Radio-Electronics

in the United States and Canada phantom operation by stray radio signals, employs new radio coding system. This unit works via pulse tone modulation, a patent-applied-for technique that makes each radio signal personal, and complies with FCC rules. Transmitter and receiver are all-transistor; motor is controlled by computer logic circuit. Handles metal, fiberglass or wood doors up to 20 feet wide and 8 feet high; works from 117 v, 60 cycles.—Perma-Power Co.

Circle 65 on reader's service card

REGULATED POWER SUPPLY, model 1030, has two continuously variable sources: one bias output from 0–150 volts at 2 ma; the other from 0–400 volts at up to 150 ma. The latter output is regulated to .03% for loads up to 100 ma. Change of line voltage of ± 10 volts will

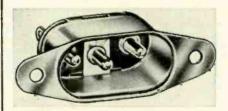
cause less than 0.5-v maximum change in output. Ripple less than 3 mv rms.



Front-panel connections provide unregulated filament voltages of 6.3 v, with or without centertap, and 12.6 v, all at 3 amperes. 13 x 8½ x 7 in., operates from 117-volt 50-60 cycle line. Power consumption 160 watts. Wired or kit.—EICO

Circle 66 on reader's service card

3-PIN AC RECEPTACLES, part No. AC3 (ungrounded), AC3G (grounded), have self-aligning feature which allows movement of pins 1 and 3 in shell to take up off-centering of plug contact locations.



Stationary center pin 2 acts as guide. AC3C has metal strap to ground pin 2. Each mates with Belden type PH-243 plugs or equivalent. Both are rated at 115 volts, 7 amperes.—Switcheraft Inc.

Circle 67 on reader's service card

DIELECTRIC STRENGTH CHECKER, the *Insta Test*, gives audio and visual response at breakdown point of windings used in coils, motors, transformers, etc. Selection scale graduated in ranges of 750, 1,000, 1,250, 2,000, 3,000 ac volts. Operates on 117 volts at 50 or 60 cycles. Two high-voltage probes permit quick check across any winding; buz-



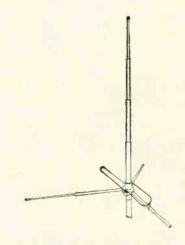
zer sounds at potential breakdown point; red lamp lights if part is defective.— Grand Transformers, Inc.

Circle 68 on reader's service card



STEREO DYNAMIC HEAD-PHONE for use in school language labs announced by Koss/Rek-O-Kut. Model K/R 2+2 has boom-mounted microphone, hi-fi sound and special foam-filled ear cushions to prevent outside room noise from disturbing study. Shatterproof plastic is basic material; cord is reinforced.—Koss Electronics Inc.

Circle 69 on reader's service card



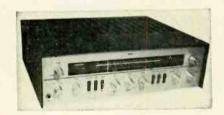
ANTENNA FOR BUSINESS BAND, the Dispatcher DP-275, for 27.23 to 50 mc. % wave vertical; radial radius of 9 feet and height of 20 feet at 27 mc. Radi-

RADIO-ELECTRONICS

ation pattern 360°. Coax female connector in radial support assembly. VSWR 1.5/1 or better. Gain 3.4 db over \(\frac{1}{2}\)-wave ground plane; 5.9 db compared to isotropic source. Maximum power input 1,000 watts.—Mosley Electronics Inc.

Circle 70 on reader's service card

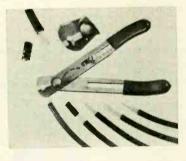
SOLID-STATE STEREO RE-CEIVER, model RA-727. Tuner sensitivity 1 μν. Image ratio over 30 db. MPX separation 30 db. Amplifier output 44 watts music power. Response: 30 to 30,-



000 cycles. Crosstalk more than —32 db. Distortion 0.5% at 1,000 cycles. Input sensitivity: phono 8 mv. Auxiliary: 300 mv. Brushed-gold panel, 9½ x 5½ x 12½ in., oiled walnut cabinet.—Olson Electronics, Inc.

Circle 71 on reader's service card

COAX CUTTER AND STRIPPER, stock No. X55F, is designed to cut and strip RG-59/U coax. Two stripping holes:



larger for removing outer insulation and braid; smaller removes inner insulation. Spring steel, honed and heat-treated cutting edges.—Hunter Tools

Circle 72 on reader's service card

FM STEREO TUNER, model 532. Range 87.5–108.5 mc with 2-µv sensitivity. 800-kc bandwidth; channel sepa-



ration of 30 db. Afc circuit, stereo beacon light, antenna inputs for 75 and 300 ohms. 12% x 7 x 2% in. Power consumption 30 watts.—Trutone Electronics, Inc.

Circle 73 on reader's service card

SOLID-STATE WIRELESS INTER-COM, stock No. 99-4573M. No wiring required; plug each unit into ac outlet. Each unit is master with volume/on-off control, push-to-talk bar with lock-bar feature for

DECEMBER, 1965



continuous operation. Plastic case with rubber-tipped base. 6½ x 5 x 2½ in., 2 lb. For 110–120 volts 60 cycles ac.—Lafayette Radio Electronics Corp.

Circle 74 on reader's service card

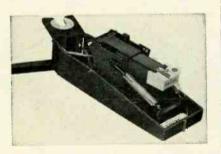
COMPACT TRANSISTOR AUDIO AMPLIFIER, to handle low-level mikes, phono pickups, etc., features: volume control; 5 transistors; 1 thermistor; shielded input transformer with 2 primary



windings for 50 ohms and high impedance; output transformer with 2 secondary windings, 8 ohms (for speakers), 500 ohms (for modulation and high impedance loads). 400 mw push-pull output; 80 db gain; 9-volt dc source. Mounted on printed circuit board 5½ x 1¾ in., 3½ oz.—Birnbach Radio

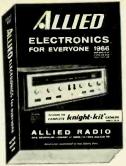
Circle 75 on reader's service card

ELLIPTICAL STYLUS CARTRIDGE ASSEMBLY, the Gard-A-Matic model M80E, features retractile safety suspension system and elliptic diamond stylus, plugs into tone arm of Garrard Lab 80 and Type A70 changers. Response: 20–20,000 cycles. Output volt-



age 6.6 mv per channel at 1,000 cycles at 5 cm/sec. Channel separation over 25 db at 1,000 cycles. Recommended load impedance 47,000 ohms. Compliance 25 × 10-6 cm/dyne. Tracking force: 1-1½ grams maximum. Inductance 720 mh. Dc resistance 630 ohms.—Shure Brothers, Inc.

Circle 76 on reader's service card



FREE

send for your MONEY-SAVING 508-page

1966 ALLIED CATALOG

SAVE MOST ON:

Stereo Hi-Fi
Tape Recording
CB 2-Way Radio
Shortwave & Ham Gear
Automotive Electronics
FM-AM & AM Radios
Portable TV & Phonos
Test Instruments
TV Tubes & Antennas
Power Tools, Hardware
Parts, Tubes, Transistors

See the world's largest selection of top money-saving buys, including exclusive Knight-Kits and products available only from ALLIED. Get fastest service, easy-pay terms, satisfaction guaranteed or your money back. Send coupon today for your free 1966 ALLIED Catalog.

EASY TERMS: Use the Allied Credit Fund Plan.



Circle 110 on reader's service card



TRANSISTORIZED MICRO-PHONE, model + 2, has adjustable out-



put level, will increase range and signal strength of any transceiver. Operator can dial output level best for his set; changes output for big or little voice, close or far work. Touch-to-talk or lock on-off switching. Screwdriver adjustment connects

"BEST BUYS in GOV'T. SURPLUS Electronic Equipment FULL OF TOP QUALITY ITEMS-Transmitters, Receivers, Power Supplies, Inverters, Microphones, Filters, Meters, Cable, Keyers, Phones, Antennas, Chokes, Dynamotors, Blowers, Switches, Test Equipment, Headsets, Amplifiers, etc., etc. SEND 25¢ (stamps or coin) for CATALOG and receive 50¢ CREDIT on your order. Address Dept. RE.

FAIR RADIO SALES P.O. Box 1105 · LIMA, OHIO · 45802

terminal wire in base for electronic switching or relay switching. SSB response limited to 300-3,000 cycles. Onepiece diecast case.-Turner Microphone

Circle 77 on reader's service card



CAPACITORS, type P8292ZN, use plastic-cased metallized paper. Rated de voltages of 200, 400, 600 based on life test of 14 times working voltage at 100°C for 1,000 hours. Capacitance values available from .01 to 10 μf.-Aerovox Corp.

Circle 78 on reader's service card



SOUND SYSTEM FOR CARS, the Norelco Car-Mount, can play

back through car radio as well as record and be removed from car for use as portable, separate recorder. Comprises a universal mounting attached below dashboard, plus the Carry-Corder 150, a cordless, cartridge-loaded, portable tape recorder.-North American Philips Co., Inc.

Circle 79 on reader's service card



PLAYBACK SPEAKER SYSTEM, the 847A Seville. Contemporary upright walnut cabinet with Spanish wood fretwork grille, uses less than 2 sq. ft. of floor space. Inside are type 414 12-in. bass speaker, exponential horn, compression high-frequency driver, 2-section 3,000cycle crossover network. Operates from 8 or 16 ohms; rated at 20 watts; response 40 to 22,000 cycles. 26 x 19 x 14 in.-Altec Lansing.

Circle 80 on reader's service card

3 New GERNSBACK LIBRARY Paperback books...

TV SWEEP **OSCILLATORS**

By Harry E. Thomas TV SWEEP OSCIL-LATORS is a practical working tool and handy reference book for everyone who fixes TV sets. Written in

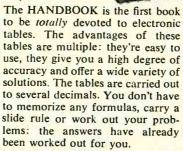


clear, easy-to-understand language, it gives you all the practical facts you will ever need on the subject. Includes:

TV Sweep Systems-The Relaxation Oscillator... Capacitor Charge and Discharge-Pulse Techniques . . . Multivibrators and Blocking Oscillators . . . Sawtooth Generation in Sweep Systems . . . Variations in Sweep Oscillators . . . Failure Analysis in the General Operation and Servicing of Sweep Oscillators ... and much more! No. 119 Paperback-252 pages\$3.95

THE HANDBOOK OF **ELECTRONIC TABLES**

is fast ... easy ... accurate . . . unique ... and provides a wide variety of solutions to electronics problems!



No. 125 Paperback-160 p.\$2.95

ADVANCED RADIO CONTROL

by Edward L. Safford, Jr.

A revolutionary challenge for the hobbyist interested in expanding his knowledge of radio control.

NEW IDEAS and con-

cepts stimulating the imagination of the radio control hobbyist.

EXPLAINS how to use advanced radio control techniques for model planes, boats, trains, trucks, tractors, autos, and robots. This latest book brings you ideas which have never appeared in print before. And ... it's a practical introduction to rockets and robots at the hobby level. Contains clear and concise diagrams.

No. 122 Paperback-192 pages\$3.50



Get your copies of these new **GERNSBACK LIBRARY**

Handy Paperback books at Your local Radio-Electronics Parts Distributor ... or use the handy coupon to order

GIVE THIS COUPON to your local Parts Distributor or mail to: **GERNSBACK LIBRARY** 154 West 14th Street, New York, N.Y. 10011

Please	send	me:

No. 119 TV SWEEP OSCILLATORS \$3.95

No. 125 THE HANDBOOK OF ELECTRONIC TABLES

No. 122 ADVANCED RADIO CONTROL \$3

NAME		
MANIE		
STREET AL	DDRESS	

NEW LITERATURE

All booklets, catalogs, charts, data sheets and other literature listed here are free for the asking (except where a price is given). Each item is identified by a Reader's Service number. Turn to the Reader's Service Card facing page 70 and circle the number of items you want. Then detach and mail the card. No postage required!

SOLDERING-GUN BROCHURE, No. 15.
8 pages of pictures and text on applications of Markel's soldering guns and accessories.—Markel Circle 81 on reader's service card

CINEMA PRECISION AUDIO EQUIP-MENT, Catalog 32-EF. 8 pages of specs, photos, surves on equalizers, dip filters, transmission measuring sets, power supplies.—Hi-Q Div. of Aerovox Circle 82 on reader's service card

ISO-CURVE THERMISTORS, Bulletin L-2, 6-page foldout with 3 data sheets, curves, photos, configurations, resistance vs temperature characteristics table on Iso-Curve line of curve-matched, interchangeable thermistors.—Fenwal Electronics

Circle 83 on reader's service card

CAPSULE THERMISTOR COURSES 1 through 10, now collected in one 5½ x 11 in. booklet. Plus glossary.—Fenwal Electronics Inc.

Circle 84 on reader's service card

CATALOG, No. S-323, of Littel Multi-Switches, series 35000, 36000, 37000, 38000. 10 pages, photos, drawings, specs of illuminated and nonilluminated switches, ganged assemblies, accessories, special functions—Switcheraft Inc.

Circle 85 on reader's service card

CONTROL KNOBS BROCHURE, 4 pages, illustrated, with military specs of the KMS series of knobs.—National Radio Co., Inc.

Circle 86 on reader's service card

POWER SUPPLY CATALOG, 48 pages, photos, diagrams, application notes, nomogram of voltage drop, glossary. Supplies indexed by output voltage.—Kepco, Inc.

Circle 87 on reader's service card

QUICK-REFERENCE METER CATALOG, M865, 12 pages, cross-section of complete line of custom-built panel and switchboard meters.—Hickok Electrical Instrument Co.

Circle 88 on reader's service card

CANADIAN MAIL-ORDER CATALOG, introductory No. 1, features hi-fi, test equipment, tools, tape recorders, transceivers, etc.—Gladstone Electronic Supply Co.

Circle 89 on reader's service card

CB AND HAM EQUIPMENT CATALOG. 12 pages of CB, commercial, amateur antennas; fixed-station, portable, mobile, tone-signaling CB equipment; mobile mounts and springs; accessories (shielding systems).—Webster Band Spanner

Circle 90 on reader's service card

SPECTRUM ANALYZER BOOKLET, 8 pages, titled "Getting Acquainted with Spectrum Analyzers." General discussion of the electromagnetic spectrum, nature of signals in various radiofrequency bands, heterodyning, related problems of analysis.—Tektronix, Inc.

Circle 91 on reader's service card

DESIGNER DATA BOOK, 45 pages, "Piezoelectric Technology—Data for Designers." Principles of piezoelectricity, characteristics of materials, applications—Piezoelectric Div. of Clevite Corp.

Circle 92 on reader's service card

CATALOG 65/66, 65 pages, photos. Wire, cable, tubing, hardware, switches, radio-TV accessories, components, government and commercial specifications.—Birnbach Radio Co. Inc.

Circle 93 on reader's service card

FACTORY PRICE LIST, quantities 1 to 999, of Texas Instruments' semiconductor products. 24 pages, looseleaf-punched, from their distributor in New York, Delaware Valley and Washington.—Milgray

Circle 94 on reader's service card

APPLICATION NEWS, Vol. 3, No. 2, 15 pages. Contains an illustrated paper called "A New Method for Precise Voltage Regulation for Use with Photomultipliers." Also other gas-tube applications, most contributed by readers.—Signalite, Inc.

Circle 95 on reader's service card

TERMINAL-BLOCK/BARRIER-STRIP CAT-ALOG, No. XLX-7A. Items formerly manufactured by Excellex Electronics Inc.—Eby Sales Co. Inc. Circle 96 on reader's service card

CATALOG, No. 252, "1965 Gift Season Specials". 82 pages, color photographs. Bargains in hi-fi, tape recorders, cabinetry, mikes, test equipment, many other gift ideas.—Allied Radio

Circle 97 on reader's service card

SWITCH CATALOG, 4 pages, looseleaf punched, lists EECoSWITCH Series 700/800 sealed and lighted subminiature thumb-wheel switches. Includes specs, output code tables, and covers related mounting hardware.—EECo-SWITCH, Div. of Engineered Electronics Co.

Circle 98 on reader's service card

TEST AND REPAIR INSTRUMENT CAT-ALOG, 8 pages; photos, specs, of tube testers, component substitutor, capacitor tester, signal generator, CRT tester-reactivator, color TV analyzer, multi-head pix-tube adapter, voltmeter, vom.— Mercury Electronics Corp.

Circle 99 on reader's service card

Write direct to the manufacturers for information on the items listed below:

TV CHASSIS SERVICE MANUAL, Singlpak. At 79 cents each, all the TV service manuals of top line TV set manufacturers for the years 1955 through 1965.—Singlpak, Inc., 58 Stewart Ave., New Hyde Park, N. Y.

APPLICATION NOTE, No. 69, 40 pages, titled "Which DC Voltmeter?", explains available types of multirange analog and digital meters and the reasons for their existence, tells how to minimize the effect of unwanted signals. Analyzed from point of view of applications.—Hewlett-Packard, PO Box 301, Loveland, Colo. 80537

HOW YOU SEE COLOR -

in color TV. Read how the three-gun, shadow-mask picture tube really works. (It's used in every US-made color set.) Also, get astonishing details on an entirely different kind of color tube—that has only one beam, no convergence or degaussing nuisance.

Coming in January
RADIO-ELECTRONICS —
the 3rd Annual Color-TV Issue

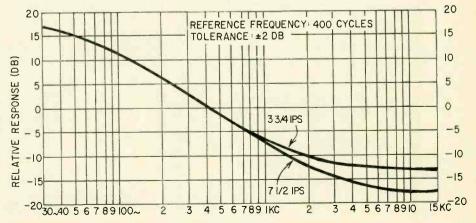
RIAA ISSUES TAPE STANDARD

The curves below show the new RIAA playback response standard for magnetic tape at 334 and 7½ inches per second. The 7½-ips curve is the same as the long-time NAB 15-ips standard; the 3¾-ips curve is new, but differs from the higher-speed characteristic only in having less high-frequency rolloff, to compensate for the poorer high-frequency response at the slower speed.

In terms of time constants, the new curves are described by the same low-frequency constant: 3,180 µsec. The

high-frequency constant of the $7\frac{1}{2}$ -ips curve is 50 μ sec; that of the $3\frac{3}{4}$ -ips curve, 90μ sec.

The curve is drawn and described in the RIAA's Bulletin No. E5, issued July 15, 1965. The leaflet, titled "Standards for Magnetic Tape Records", also covers speed, dimensions, direction of tape wind, and sequence of tracks in two, four and eight-track recordings. Copies are available from the Record Industry Association of America, 1 E. 57th St., New York, N.Y. 10022

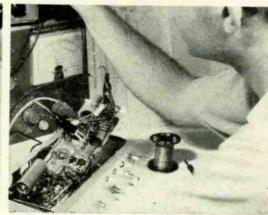


DECEMBER, 1965

AT LAST, A REALLY PRACTICAL WAY TO build your electronics know-how... boost your income and prestige and make substantial savings on the most valuable handbooks you can own!







Accept your risk-free membership in the famous Electronics Book Club and enjoy these advantages now!

Everyone talks about the great future of Electronics—but how many people are really doing something about it? If you are the one man in seven who is determined to get ahead in electronics—who wants to cash in on the steadily increasing demand for trained technicians—the Electronics Book Club has astonishing benefits for you

Your membership in this unique book Club will help you to protect your future... increase your knowledge and earning power... keep you up-to-date on all the latest electronic developments... and bring you greater enjoyment from leisure hours if electronics is your hobby.

SPECIAL INVITATION

Judge for yourself, without risk, what the Electronics Book Club can do for you. Examine the special introductory offer on the opposite page. See how you can receive your choice of \$25 electronics self-training programs for only \$2, with membership. TAKE YOUR CHOICE of either of these outstanding electronics self-training programs for only \$2—with membership in the Electronics Book Club. Perhaps you want the course on HOW TO FIX TRANSISTOR RADIOS AND PRINTED CIRCUITS; or maybe you'll choose RADIO SERVICING MADE EASY. Whichever you take, remember this: both originally sold for \$25 each as home-learning courses; Now they're available in two-volume book-format. Take your pick at once as your introduction to membership.

RISK-FREE GUARANTEE: You enjoy this air-tight, no questions-asked guarantee: If you are not pleased when you receive these books, you may return them in good condition in 10 days and cancel your membership, and that will end the matter.

7 EXCLUSIVE MEMBERSHIP BENEFITS: (1) Members are offered the widest possible range of books covering everything in electronics from repair, troubleshooting and building... to experimental and hobby projects... to self-teaching handbooks on important areas of electronics; (2) The Club saves you up to 30% off the regular retail prices on electronics books that interest you most; (3) Club books are practical working tools written to give you clear answers, help you solve problems, increase your know-how and electronics enjoyment; (4) You receive only the books you want because the Club News bulletin tells you about the books every other month so you can accept or reject them in advance; (5) Special charts and reports are now given FREE with many Club selections to expand and illuminate the text; (6) You need send no money in advance; you pay for your books after you receive and examine them and decide to keep them; (7) Permanent Risk-FREE Guarantee: if you are ever dissatisfied with a book, you may return it in 10 days for full credit.

Mail valuable coupon on opposite page>

DO YOU KNOW HOW A paper clip can be used for adjustment of the trimmer? (0) GANG TRIMMER ADJUSTMENT TOOL DETAIL Fig. 1012. A paper clip can be used for adjustment of the trimmer. For more information, see page 91 in volume 2 of HOW TO FIX TRANSISTOR RADIOS AND PRINTED CIRCUITS

Which of these \$25 electronics self-training programs do you want for **ONLY \$2—**

with risk-free membership in

simply take 4 additional books

within a year at low Club prices!

the Electronics Book Club:

DO YOU KNOW HOW to draw the circuit for a manual noise limiter?

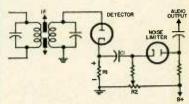


Fig. 918. This noise-limiting circuit has to be adjusted for noise conditions. It is called a manual noise limiter (mnl)

For more information — see page 117 in Volume 2 of RADIO SERVICING MADE EASY

Here is a complete course on fixing transistor radios and printed circuits in TWO DELUXE, HARD BOUND VOLUMES. Written by expert, Leonard C. Lane, it was originally developed as a \$25 home study program. It's yours for only \$2 with

membership. It treats every aspect of transistors, much of it new, original, unavailable anywhere else in book form. Hundreds of illustrations aid understanding. Completely covers semiconductor fundamentals, how transistors work, transistor types, amplifiers, RF and

IF stages, printed circuits, specific servicing methods and techniques. Gives answers to hundreds of questions including those on trouble in the audio section, working with printed-circuit boards, signal generators, the vtvm, defects and repairs, soldering techniques and useful tools,

speaker defects, volume control, surface-barrier transistor, silicon transistors, transistors at work, servicing chart, antennas on auto radios, de to dc converter, and many many other subjects.

This important two-volume set was originally prepared as a \$25 homestudy course by famed technician and writer Leonard C. Lane. Now you receive both deluxe hard bound volumes for only \$2 with membership. Tells you everything you want

and need to know about radio servicing in clear, down-toearth language. Just a few of the many answers you will receive: Working with transistors. Getting started with transistors. Approaching the transistor. Testing transistors and printed circuits. Things to remember. Checking transistors.

Servicing transistor radios. Servicing the transistor receiver. Stage-by-stage analysis. Servicing auto radios. Installation and removal. AM receivers. Frequency range. Ac-dc power supplies. Troubleshooting. FM receivers. AM-FM tuners. Why should we have tuners? Communications receivers. Frequency range. Voltage stabilization. Noise limiters. Checking the gain control. Single-sideband reception. Marine receivers. Marine frequencies. The beacon band. The marine band. Mobile radio.



MAIL THIS VALUABLE COUPON TODAY!

It will bring you either of these TWO-VOLUME TRAINING COURSES for only \$2—when you join the Electronics Book Club . . . and agree to take only 4 additional books within a year—out of a wide selection that will be offered—all at low Club prices. Thousands of others have already profited from membership. Discover now how you can profit too!

ENJOY THIS RISK-FREE GUARANTEE!

Select your TWO-VOLUME, deluxe, hardbound SET of books right now. Clip and mail coupon today, while supplies last. You will be protected by this RISK-FREE GUARANTEE: if you are not pleased when you receive the books, you may return them in 10 days and forget the matter. Mail coupon right away.

Gernsback Library ELECTRONICS BOOK CLUB c/o Dept. RE-1265 154 West 14th Street, New York, N.Y. 10011

Please enroll me as a	mambas of the	Electronics Book	Club an	d sand	me one	0
Please enroll me as a	member of the	Flectionics poor	Ciub all	a sella	IIIG OHG	V

the TWO VOLUME SETS checked below:

How to Fix Transistor
Radios and printed Circuits

Bill me only \$2 plus shipping. If not pleased, I may return both books in 10 days and this membership will be cancelled.

I need only accept as few as four additional books a year—and may resign any time after purchasing these four additional books. All selections will be described to me in advance, every other month, in the Club Bulletin, and a convenient form will always be provided for my use if I do not wish to receive a forthcoming selection. You will bill me the special Club price for each book I take. This will often be as much as 30% off retail prices, plus a few cents postage.

Name(please print)	
Address	
City State Zip Code No.	

☐ SAVE POSTAGE COSTS—enclose your payment of \$2 now and we will pay postage. Same return guarantee privilege.

Recommend the TURNER 500

Cardioid

DON'T GO WRONG

... GO TURNER

In your business, your reputation depends on your recommendation. Don't risk either - always recommend the high-performing, troublefree Turner 500 Cardioid. Most problems in PA or sound applications - extraneous noises, poor acoustics, etc. — can be successfully solved by incorporating Turner 500's into the system. So before you make your next installation, write for the complete Turner catalog. Get details on the Model 500 - list price \$84.00 — and the rest of the Turner line, including the popular and versatile microphones shown below.



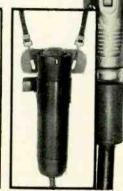
MODEL 251

Low cost, high performance paging microphone with Turner's unique lift to talk feature. List price \$49.50



MODEL SR585D

Fixed mounted microphone conveniently mounted on a flexible 16" gooseneck.
List price \$40.



MODEL 58

A natural for any application requiring freedom and mobility ... does double-duty on desk stand. List price \$57.



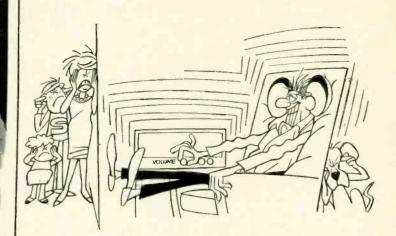
MICROPHONE COMPANY

933 17th Street N.E. Cedar Rapids, Iowa

In Canada: Tri-Tel Associates, Ltd.

Export: Ad Auriema Inc., 85 Broad Street, New York 4, N.Y.

Circle 114 on reader's service card



THE SEARCH FOR SOUND

By ELBERT ROBBERSON

I DON'T SEE LARRY ANY MORE. NOBODY SEES HIM. NOT EVEN his wife, Ellen. She left, taking their kids and everything in the house but the sound.

I know the mover. "The guy acted nuts," he told me. "He kept yelling, 'Don't touch this room!' I told him to cool it—I wasn't after that stuff. Another thing—why would a guy wear a hat in the house in August?"

I remember when it started. Larry came into the shop, quietly browsing around, spinning the turntables, hefting the tone arms. Then he turned to the speakers lined up open on the shelf. Lightly he tapped his fingertips on the cones. "Tump, tump," he would go, then move to the next speaker, cocking his head first one way and then the other as he tumped.

"There shouldn't be any coloration," he said. He tumped on a cone. "This one rings."

He carried out a box of Bozaks—a woofer, a squawker and a tweeter. The second load was a McIntosh preamp and 50-watter, and his third a professional turntable. He didn't raise his voice over the price, just asked me to help hook up the system.

That evening, I did. He had a nice wall-to-wall house, some fair paintings, well behaved kids, and a pleasant blonde wife. When we were finished, she offered me a drink, as Larry put a record on the turntable, set the knobs to "flat" and settled back in the deep chair with his eyes closed.

"Listen to that dynamic range," he breathed during a lull.

"But why so loud?" Ellen asked. She made a flat-handed motion toward her ears, crinkling her nose.

"Has to be, so you can get the quiet passages. Listen—did you hear that? He hums while he plays!"

Ellen winked me out the door. "He'll get over it."

"Yeah, the novelty wears off. And thanks for the drink."

The second time I visited was to bring a tape deck. There were some strays in Ellen's coif, and the kids were commandos.

"He's in there," Ellen said, jerking her head. "It's the Sound Room, now."

In the other room a steam locomotive was whistling for a grade crossing, its connecting rods clanking and the wheels clicking on the rail ends. One of the boxcar wheels thumped from a flat-they get that way when the brakes lock on a downgrade. Ellen shook her head and sighed. "I ask him why doesn't he just go down to the freight yard, if that's what he wants to hear. But that's too far from the gold-mine stamp mill on the next band."

Larry was hunched in his chair, hands cupped behind his ears. "This does things for the sound," he said to me. "Try it. You get it all-nothing goes by."

I did. "I see what you mean," I said.

"What did you say?"

"It . . ."

"It fills in the whole sound," he shouted. "Puts you right

I connected up the tape deck and left. Ellen waved a wet hand from the kitchen. "See you," she said.

What comes after a professional turntable, tape deck, a monaural amplifier and speakers? Stereo, naturally. This was a whole new setup: double amplifiers, new matched speakers. And Larry wanted more power.

When I came to make the hookup, Ellen was rushing out, makeup dabbed. She yelled at one of the kids. "Tie that shoelace, idiot, before you trip and break your little neck! We're off to the drive-in," she explained, then slammed the door.

Larry was in his chair, head centered between two curved reflectors that reached out like metal clam shells growing from his ears.

"Had these especially cast from my own patterns," he yelled. "Quarter-inch-thick aluminum, no resonance. Sound gathering is tremendous. Leave the stuff-I'll hook it up later."

"Why don't you get earphones," I asked. "We've got some that go from below 50 cycles to above 15,000."

"You'll have to talk louder," he yelled.

"Earphones . . ." I started.

"Can't wear 'em. Besides, you lose the depth, and the room."

As I left, I wondered what sound 1/4-inch reflectors could bring out of a bank of fiddles that wasn't already present.

There was a long lapse, with no Larry. Then I got a note, asking me to drop by.

At the door, Larry yelled, "Pardon the delay-had to put a flasher on the doorbell; don't always notice it. Ellen's out, come on in."

Larry looked like the villain in a late-late movie. His head was shaved, and he had a couple of suction cups stuck to

"Bone conduction was all right for a while, but the reproducers just didn't have it. Now I'm trying electrical stimu-

Coming next month Radio-Electronics 3rd Annual Color TV Issue

Information-packed issue, designed to bring you up-to-the-minute on everything that's happening in the field. Front-to-back, every word, picture and page will bring you facts you want to know . . . about how the color tube works, the latest sets and circuits, trends in tubes, parts, antennas, test equipment, progress and problems of color TV, how to rejuvenate old color sets, plus a valuable chart to help you spot TV color troubles in a hurry.

color troubles in a hurry. January Issue is on sale December 21st at your favorite newsstands and

electronic parts distributors.



JERROLD COLORAXIAL

Reception System

The old familiar twinlead, that worked pretty well for black-and-white TV, is hopelessly inadequate for color reception. When your customers complain about changes in color, ghosting, and smearing of pictures, chances are the fault lies squarely with the twinlead connecting the set to the antenna.

What's the answer? Jerrold announces the exciting

Coloraxial TV Reception System—an absolute necessity for color, and also best for black-and-white and FM stereo. With Coloraxial, you can quickly convert any outdoor antenna to shielded coax operation. Installs anywhere in minutes, without need for standoff insulators or the fear of running near metal objects.

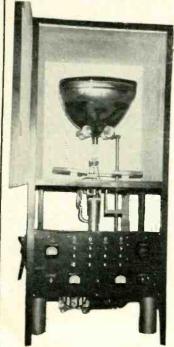
Your customers will welcome the predictable, perfect reception that's assured with a Coloraxial system. And you'll welcome the simplicity and profitability of a Coloraxial installation. Jerrold Coloraxial Kits give you everything you need for a quick, perfect job: 50 or 75 feet of sweep-tested, shielded RG-59/U cable with fittings already on; matching transformers for both ends of the cable—even Coloraxial (75-ohm) antennas and preamplifiers where the job calls for them.

Talk with your Jerrold distributor today about Coloraxial, or send coupon for complete information.



	rold Electronics Corporation
	tributor Sales Division h & Lehigh Ave., Philadelphia, Pa. 19132
Ser Jer	nd me complete information on the new rold Coloraxial TV Reception System.
Na	me
Cor	mpany
Ad	dress
Cit	yStateZip

Me ...? Rebuild Color Tubes????



Windsor Equipment Handles Color & Bonded-Face As Well As Black-and-White Tubes.

So What?

Rebuilding with Windsor is a QUALITY PROCESS . . . and PROFITABLE !!!

Rebuild Color Tubes for a Cost of \$11.75 each ... You sell them for??? Windsor Equipment pays for itself in a few months.

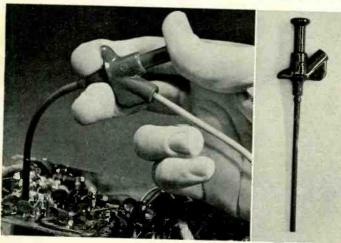
Financing Available
Free Training at our

Write for our Booklet "The Open Door to TV Profits"

WINDSOR ELECTRONICS, INC.

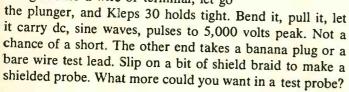
Equipment Division 999 N. Main St., Glen Ellyn, Illinois

Circle 116 on reader's service card



Clever Kleps 30

Push the plunger. A spring-steel forked tongue spreads out. Like this Hang it onto a wire or terminal, let go





Available through your local distributor, or write to:

\$147

RYE SOUND CORPORATION 123 Spencer Place, Mamaroneck, N.Y.

Circle 117 on reader's service card

lation, but the output impedance of these amplifiers doesn't match, and I wondered if you could fix me up with a couple of transformers. Wish you could hear this" he beamed. "It's the greatest! Gets the juice right to the auditory nerve without any distortion at all."

"If you step up the amplifier output impedance, the output voltage will go up, too," I told him.

"Speak into my ear," he said.

"You'll get a shock—a loud passage might knock you out."

"Oh, I know. I get some tingles now. Puts real body into it—you can really feel it!"

"The damn fool," I thought. But I connected him up to the 70-volt taps on his amplifiers.

His smile was beatific. I got out as quickly as I could.

Time passed. Then I got a note from Larry. It started: "To get the proper stimulus, the voltage had to be too high, and it knocked me out a couple of times. I've read that doctors have been able to implant needle electrodes directly into the nerves or brain to give full stimulus at lower voltages. I thought you might know a doctor who has worked in medical electricity. . . ."

I quit reading. Isn't there some agency, some law against driving yourself crazy? Electro-shock could make a nice quiet moron out of him. I called a doctor friend.

"As long as he's not my patient, I can't stop him," he said. "Is he hurting anybody?"

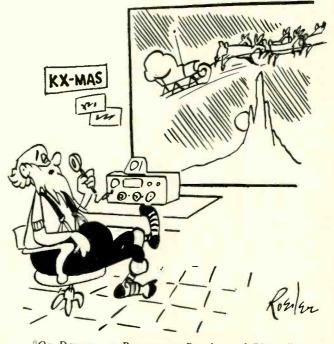
"Just himself and his family."

"Can you prove it? If they don't complain, you could find yourself in trouble, making accusations you can't back up."

"But the guy's nuts—he ought to be taken care of!"

"Aren't all of us, a little?"

I hung up. But the question still churned: there must be something that can be done before it's too late! Too late? Then I remembered the rest of what the mover had said: "... a hat in the house in August—with wires coming out from under!"



"On Dancer, on Prancer, on Donder and Blitzen"

RADIO-ELECTRONICS

Coming Next Month

Radio-Electronics

COLOR TOWN

Here are a few of the exciting features you'll be reading:

- How you see color—an analysis of how the color tube works.
- Roundup of 1966 color sets. A complete directory that gives you the lowdown on features and circuits in new color TV receivers. It's a valuable reference for set owner and service technician alike.
- A rundown on the latest color test equipment for service technicians and experimenters.
- Color TV trends in tubes, parts, antennas.
- A report on the progress and problems of Color TV.
- Special chart to spot TV color troubles.
- Convergence in basic English: why it's needed, how it's done.
- Rejuvenating old color TV sets.

Plus many other articles of vital interest to you!

JANUARY ISSUE on sale December 21
AT YOUR FAVORITE NEWSSTANDS
AND ELECTRONIC PARTS DISTRIBUTORS



Live Better Electronically With

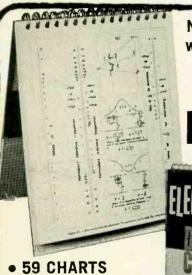
1965 SEMI-ANNUAL INDEX

							Aug	54
						Landing system in a suitcase, automatic (NB)	Oct	4
						LCR bridge, 10-turn pot is heart of (NC) Streamers of light (WN)	Oct 1 Dec	04 43
						Microwave Motors—Space-Age Power?		42
					_	Microwave frequency multiplier		
1065 CEMI	A		INUAL INDI	3		shows 4-db power gain Music, What Is (Seawright) (Corres)	Dec Sep	16
IAOD SEWI-			MACAL HADI	5/		Newspaper, automated, established in England (NB)	Dec	4
						Nomogram, do-it-yourself (Corres)		14
PADIO-FIECTPONICS I	ılv.	De	cember 1965 of Vol XXXV	/1		Oscillator, optical-frequency, can now be tuned (NB)	Oct	4
KADIO-LLECIROTTICS ST	. y		compet 1705 of Vol XXX			Q, Measuring with Scope (Cohn) Solar Cells: Space Power (Stoner)	Aug	61 32
Α			KEY TO SYMBOLS AND ABBREVIATE	ONS		TCS's, Make Own (Lavender)*§ Transformers, Using surplus (TTO)	Oct	58 92
	Dec	22	Construction Articles			Typesetting and TV trends (NB) Voltage Doubler Doesn't Really (Patrick)	Jul	4 56
Add Zero-Setter to Ac Vtvm (Greenlee)		69	† Section of full-length article § Transistorized			Engineers' Right-hand Men (Career Series)	Aug	
Pluto Tells Where It Is (Brown)*	Aug	50	CI Servi			(Leslie) Exposure Meter (Knight-Kit KG-275)†	Sep	53 45
Antenna Longest in world built in Antarctic (NB)	Jul	8	Corres Corres	ponde	en ce			
	Dec	50	NB Net			F		
Hams (Bintliff)*	Jul	46 34	Tech	Techn	otes	Factory Analyzer (Career Series) (Wheeler)	Dec	51
the treatily making treatment (Dec	34	TTO Try			Feedback, Phase and Instability (Crowhurst) Fence Charger, SCR Electronic (Hansen)*§	Dec Jul	
AUDIO—HIGH FIDELITY—STEREO—see also Servicing, Audio			Regular departments not itemized are New	v Bo	oks,	Filters for Recording FM Stereo (Blechman)	Jul	48
Amplifiers Complementary Amplifier/Loudspeakers.			New Literature, New Products, What's Your EQ?			Antenna, master, on Empire State (NB)	Jul	4
New Designs in (Augspurger)	Nov	48				Stereo, Filters for Recording (Blechman)*	Jul	48
Latest Transistor Power Designs (Meyer)	Oct	38				Tuner/amplifier, solid-state (Eico 3566)†	Aug	64
Output stages, matching transistors in (NC)	Jul	80	8			Foolproofing the Transistor Duo (Turner) 40 Watts in 40 Ounces!—Two-State Amplifier	Sep	39
Transistor, Output Circuit Protection for (Sutherm) (Corres)	Sep		Boat's Electronics, Launching (Robberson)			(Crowhurst)* Aug 35;	Sep	48
Two-State (Crowhurst) *8			(Corres)	Jul	13			
Part I—Principles Part II—40 Watts in 40 Ounces!	Aug	35	Broadcast Engineering: Radio (Career Series) (Darr)	Jul	50	G		
Part III—Construction Colorgan (Lancaster)*	Sep Oct	48	Burnout-proof Your Vom for Less Than Dollar (Dezettel)	Nov		Garage-door openers jam air navigation (NB) Get All TV Channels (Reinken) (Corres)	Aug	4
Concert Hall Gets New Sound (Moir) Delay Line, What's A (Kramer)	Aug Sep	44 56	Busy-Box—Thinking Tot's Toy (Tiso)*	Dec	44	Get Mil 14 Cuannels (Keinken) (Colles)	Sep	12
Feedback, Phase and Instability	Dec	56				н		
40 Watts in 40 Ounces!—Two-State			C			Headset Hi-fi: Shure Solo-phone Stereo		
Amplifier (Crowhurst)*§ Aug 35; Filters for Recording FM Stereo	-	48	Calibrate Your Scope (Middleton) Career Series	Nov	36	Amplifier (Sutherm) Home "Message Center" Features	Oct	66
(Riechman)		48	Broadcast Engineering: Radio (Darr) Engineers' Right-hand Men (Leslie)	Jul Sep	50	Electronic Stop (Scott)	Dec	42
"Message Center," Home, Features Elec- tronic Stop (Scott)	Dec Aug	42 38	Factory Analyzer (Wheeler)	Dec		How to Set Up Color Bar Generator Wrong (Darr)	Nov	94
Microphones, Magnetoresistive Mike adapter, miniature, to standard	_		CB 1.f.'s on the Nose (Conhaim) Change Plus-Ground to Minus-Ground	Aug	34 50	How Tape Recorders Work (Smith) (Corres) How to Track Interference (Haskett)	Aug	
organ, We Built an Electronic	Aug	86	Check That Antenna Pigtail Chokes, low-inductance, high-current (NC)	Dec Sep	50 96	How to Wide-Band Scope (Turner)*	Aug	58
(Shunaman) Public Address	Dec	40	Coax Isn't All That Great (Finkel) Code-Practice Oscillator—on a Key (Chesson)*§	Sep				
Concert Hall Gets New Sound (Moir) Old-Timer Builds the Intercombo	Aug	44	Colorgan (Lancaster)*	Oct	34			
(Darr)	Oct Jul	46 65	Come Along on CB Service Call (Mivec) (Corres) Component Curve Tracer (Blechman)*	Nov	16 52	Inductance Checker and Tone Generator (Posklensky)*§ (Corres)	Aug	14
Receiver, Harman-Kardon SR-900† Recording, electrical, 40 years old (NB)	Jul	4 80	Concert Hall Gets New Sound (Moir) Convergence by ABC's (Middleton)	Aug	39	Industrial Electronics Long Arm of Remote Control (Dietrich)	Aug	60
Search for Sound (Robberson)	Oct	67	Cycloids for Frequency Measurement (Jaski)*	Jul	60	Servo Amplifier Has Heavy Feedback Intercombo, Old-Timer Build the (Darr)	Jul Oct	39 46
Speaker System (Sonotone RM2)† Squelch, fail-safe (NC)	Dec Aug	64 82				Intercom-radio circuit, novel (NC)	Aug	83
Stereo	_		D			Ion Gage—Tube Looking for Vacuum (Sinclair)	Dec	58
Amplifiers Headset Hi-fi (Shure Solo-phone)	Oct	66	De Luxe Printing Timer (Ives)* Diode RF Switches (Math)	Dec Sep	48 40	K		
(Sutheim) T-40/40: 80-Watt All-Transistor	Oct		Do You Understand What You Read on Meter? (Margolis)	Nov	46	Keyed Circuit, What's a (Darr)	Jul	37
(Mayer) ° § (Corr) Center channel for (NC)	Aug	62 94	(mai Soute)					
Filters for Recording FM Stereo	Jul	48	E			L		
(Blechman) FM tuner/amplifier, solid-state				See	27	Laser(s)	Ab	
(Eico 3566)† Pickup (Euphonics Miniconic semi-	Aug		Easy Alignment with Semi-Sweeper (Stoner)*§	Sep	37	Astronauts plan communication to earth wi	Sep	4
conductor)†	Sep Sep	66 34	EDITORIAL Electromedicine: End of Wonder-Drug Era?		L	Beam, 2-mile, generated by multiple reflections (NB)	Jul	8
Tape Players for Your Car (Blechman) Tape Recorders	2000		(Hixson) Electronics and Programmer Instruction	Jul	27	Flowing gas, has 16 watts output (NB) Fog detector (NB)	Oct	6
How They Work (Smith) (Corres) VOX for (Corres)	Aug	12 14	(Jaski) Aug 31; (Corres) (Allen) End of Service Technician? (Shunaman)	Oct		Light detector has high sensitivity, speed (NB)		-
Tane Standard, RIAA Issues	Dec	77	(Corres)	Dec	10	Transmitter (WN)	Nov	
Turntable Wow and Flutter, Measuring (Villchur)	Jul	32	Fuel Cells (Gernsback) High Fidelity, What Is (Goldmark) (Corres)	Aug		Latest Transistor Power Amplifier Designs (Meyer)	Oct	
Wow and Flutter, Measuring Turntable (Villchur)	Jul	32	Past and Future of Test Equipment (Meagher)	Nov		Long Arm of Remote Control (Dietrich) Launching the Boat's Electronics (Robberson)	Aug	60
50000			Television in Space (Gernsback) Educational Television	Oct	33	(Corres) Look Inside Amplifier (Baird)	Jul Aug	
Analyzer, Service Your Car with Electronic	11	39	Delaware initiates state-wide system (NE) Done with mirrors in French classroom (NB)			(Corres)	Dec	
Auto (Dezettel)	Jul		Electronic writing unit competitor to (NB)	Jul	4			
Dwell angle, setting (TTO) System, electronic, uses photocell	Sept	91	Phonograph records, pictures on (NB) Writing unit competitor (NB)	Jul Jul				20
breaker (NB)	Aug	4	ELECTRONICS			Magnetoresistive Microphones Make a Variable Electrolytic (Jaski)	Aug	52
Transistor (Corres) Aug 15, Sep 13,	Nov	16	Chokes, low inductance, high-current (NC) Coaxial cable handles 32,400 channels (NB	Sep Nov		Make Your Own TCS's (Lavender)*§	Oct	58
Piston-ring blowby located by electronic analytical procedure (NB)	Dec	8	Coils, massive final (WN)	Nov	45	Measuring Q with a Scope (Cohn) Measuring Turntable Wow and Flutter (Villchur	Oct	61
Radio	Description of the last of the		Computer rounds up scofflaws (NB) Electrolytic, Make Variable (Jaski)	Oct	52	Medicine	_	
New Life for Old (Burr) (Corres) Jul Servicing—see Servicing, Radio	12,	13	Electro-optical scanner (WN) Fence Charger, SCR (Hansen)*§	Dec	35	Heartheats analyzed ultrasonically (NB) ''Mongolism'' linked to radar (NB)	Dec	6
Tachometer makes hard starting (Corres) Tachometer, Reliable (Gross) §	Dec	12 54	Fuel-cell system, experimental (WN) Jon Gage—Tube Looking for Vacuum	No	45	Muscle Stimulator (Breskend)*§ (Corres) Aug 1	4; Dec	: 10
Tape Players (Blechman) Sep 34; (Corres)		14	(Sinclair)	Dec	: 58	Television tranquilizes caged gorillas (NB) Aug	4

Metal Detectors			SERVICING			Closed-circuit, hum and ripple (Tech)	Dec	90
Proton Magnetometer (Marriner)	Sep	42 51	Audio Feedback (Mc's P.A.) (CI)	Sep	26	Amplifier output (Winegard Colortron)		
Microwave Motors—Space-Age Power?	Oct	42	German (Grundig Einlander TK-30) (Corres)	Jul	14	(Tech)	Jul	77
Music			High lost on tape playback (Uher		78	B-plus voltage low (Admiral) (CI)	Aug	24
	Oct Sep	16	SR111) (Tech) Limit switch (Korting 158 and 158S)	Nov Sep	86	Aug 25; (Emerson C504A) (CI) Color Bar Generator, How to Set Up	Aug	24
			Pilot light for amplifier (Pioneer AMR 81) (Tech)	Aug	67	Wrong (Darr)	Nov	94
N			Record Changers, Repair	Dec	46	Convergence by ABC's (Middleton)	Aug	39
New Concept in Color Bar Generators (Cerveny)	Sep	59	(Davidson) Record level (Grundig TK14) (Tech)	Sep	86	Green lowlights (RCA CTC5) (CI) High-voltage regulators (CI) July 20;	Aug	22
New Designs in Complementary Amplifier/Loud-	Nov	48	Recorder distortion (Grundig TK45) (Tech)	Aug	68	(Corres)	Oct	12
speakers (Augspurger)		10	Recording impossible (Norelco/Philips 300—EL 3542A) (Tech)	Sep	89	Rectifier red-hot (RCA CTC11) (CI)	Oct	24
0			Seleniums, replacing weak high-			Speakers, enclosed-field PM for replacement (Tech)	Oct	95
	Oct	46	current (CI) Sound projectors (Victor 16-mm)	Dec		Traps and Pitfalls (Mandl)	Dec	
Old-Timer Builds Intercombo (Darr) Output Circuit Protection for Transistor			(Tech) Tape-head substitute (Tech)	Oct Aug	94 68	Vertical blanking-bar diamonds (Curtis-		
Amplifiers (Sutherm) (Corres)	Sep	16	Tone arms, viscous-damped Transistor cell or flashlight cell (TTO)	Dec	89 96	Mathes 425-21) (CI)	Sep	24
				Oct	30	What, No Color? (Davidson) Contrast, self-changing (Zenith 16D25)	Jui	37
P			Auto Analyzer, Service Your Car with an			(CI)		24
Photography Exposure Meter (Knight-Kit KG-275)†	Oct	45	Electronic Auto (Dezettel)	Jul	38	Conversion, German standards (Corres) Dc vs ac readings (Admiral) (CI)	Jul Aug	13 25
Drinting Times Deluye (lyes)*	Dec		Dwell angle (TTO)	Sep	91	Degausser, Putting in Automatic	_	
Plug In to MATV (Cantor)	Nov Jul	28	Transistor (Corres) Aug 15, Sep 13,	Nov	16	(Davidson) Degaussers, testing automatic (CI)	Oct :	20
Plus-Ground to Minus-Ground, Change	Aug	34 50	Radios—see Servicing, Radio Cheater box, fuse your (TTO)	Sep	91	"Do Not Measure" (CI)	Sep	22
Pressure Cells, Electronic, Aid Civil Engineers	Aug	54	Coils, making flat (TTO) Crystals, checking frequency of unmarked	Jul	84	Fuse retainers, handling (TTO) Get All TV Channels (Reinken) (Corres)	Dec Sep	12
Proton Magnetometer (Marriner)	Sep	42	(TT 0)	Oct	96 49	Hash in B-plus; agc trouble (Admiral		
Putting in an Automatic Degausser (Davidson)	UCI	101	Dial-Cord Hints, Slipping (Oberto) Door-opener, checking portable (Tech)	Aug Dec	81	16L1C) (CI) Horizontal	Jul	24
			Drills, protecting small (TTO) Industrial Electronics	Jul	84	Hash, killing during alignment (Tech)	Sep	87
R			Drill position error (Pratt & Whitney Tapeomatic) (Tech)	Jul	76	Multivibrator (G-E M3 and others) (Tech)	Sep	29
RADIO—see also Servicing, Radio			SCR speed control (Heath GD-973)			Trouble (Trav-Ler 1180-62) (CI)	Oct	26
Amateur Antenna Rotator Remote Control for	1	46	(Tech) Stethoscope amplifier, transistorized	Sep	86	Instant-on, instant (Motorola) (Tech) Instant-on rectifier reversed? (Muntz	Aug	67
TV, CB and Hams (Blintliff)* Modulation %, What's Your	Jul	46	(CI) Welding timers (Tech)	Jul Aug	25 67	624T) (CI)	Jul	
(Blechman) Antenna Pigtail, Check That	Sep	41 50	Knobs, Epoxy resin compound repairs		77	Interference, How to Track (Haskett) Intermittent (Muntz 37B4) (CI) Aug 21;	Dec	32
Auto		13	broken (TTO) Jul 84; (Tech) Tighten knurled or flatted (TTO)		93	(RCA KCS-68-C) (Tech)	Sep	87
New Life for Old (Burr) (Corres) Jul Plus-Ground to Minus-Ground, Change	Aug	34	Meter reading, misleading (CI) Patch connections, tandem clips speed	Nov	22	Mystery set (RCA) (CI) Picture on Oscilloscope Screen	Dec	20
Broadcast Engineering (Career Series) (Darr)	Jul	50	(TTO)	Oct	96	(Huneault)	Oct	92
CB Antenna Rotator Remote Control for			Radio			Picture split (Fleetwood 17-5) (Tech) Portables, Transistor (Scott)	Jul Jul	76 40
TV, Hams and (Blintliff)*	Jul Aug	46 82	Antiques, modern tubes for (TTO) Auto	Sept	90	Radiation, Spurious, from 42-Mc I.f.	,,,,	70
Modulation %, What's Your			Frozen? (CI) Intermittent transistor (Buick)	Aug	24 69	TV Sets (Austin) Snow in video i.f. (Philco 49-1450) (CI)	Oct	54 22
(Blechman) Signaling Systems for Stations	Sep	41	Plus-Ground to Minus-Ground, Change	_		Sound poor (Tele-King K21) (CI)	Sep	26
(Stafford) Code-Practice Oscillatoron a Key	Oct	56	Remote control (police car)		34	Stacked-B stages, identifying (CI) Sync, brightness trouble (Zenith 19R20)	Jul	25
(Chesson)*§	Jul Sep	53 40	(Tech) Reversed-polarity electrolytics	Sep	88	(CI)	Aug	20
Diode Rf Switches (Math) Intercom circuit, novel (NC)	Aug	83	(Ford 2TBO and 3TBO) (Tech) Sep 88; (Corres)	Nov	14	Tube		
Interference producers, FCC requests control over (NB)	Nov	4	Ten Transistor and Hybrid Troubles (Held)		40	Life short in 12L6 vertical output (Muntz) (CI)	Jul	25
Interference, rf, injures space vehicles (NB) Output stages, matching transistors in	Sep	4	Transistor ignition and resistance			Plates, why warning on (CI) With sense of time? Jul 64,	Aug	
(NC)	Jul	80	wiring (Buick Skylark (CI) CB I.f.'s on the Nose (Conhaim)	Aug	25 52	Tuner Troubles (Darr)	Sep	
Jupiter's radio emission linked with lo (NB)	Nov	12	CB Service Call, Come Along on (Mivec) (Corres)	Nov	16	Tuners (Canadian G-E using Sarkes Tarzian) (Tech)	Aug	66
PLUTO Tells Where It Is (Brown)*§ Portable	Aug	50	Heater-string trouble (G-E) (Tech) Local oscillator checks (Tech)	Jul	76	Uhf tuner antenna-connection repair	Aug	
Listen to your glasses Search tuning featured in transistor	Oct	55	Marine	Mug	00	(Tech) Vandals, reward offered for tips on (NB)	Oct Jul	94
(NB)	Jul Dec	10 35	Soldering iron for boats (Tech) (CI)	Aug	67	Vertical	Jul	-
Transistorize Tube (Pugh) Restoring Old Radios (Darr)	Jui	43	Power supply (G-E 250) (Tech) Rf coils, changing (Westinghouse	Sep	87	Creep (G-E 21C1548) (CI) Foldover at bottom (Philco 41U) (CI)	Sep	24
700 volts Lights 80 Well (Amorose) Transistor	Jul	56	Y2102) (CI) 700 volts lights 80 well (Amorose)	Sep Jul	26 56	Lock, no (Zenith 16D21) (CI)	Oct	26
Search tuning featured in portables (NB)	Jul	10	Solvent, watch that (Tech)	Jui	77	Oscillator/amplifier replacement (Tech Output tube (12L6) life short (Muntz)) Jul	77
Repair Record Changers (Davidson)	Dec Sep	46 54	Switch won't shut off. (Tech) Transistor	Dec		(CI)	Jul	
Reliable Tachometer (Gross)*§ Remote Control	ССР	-	Battery saver (NC) Cell or flashlight cell (TTO)	Nov Oct	98 96	Yoke Troubles (Darr)	Aug	47
Antenna Rotator for TV, CB, and Hams (Bintliff)*	Jul	46	My Strangest Radio Repair Job			Test instruments		
Garage-door openers jam air navigation (NB)	Aug	4	(Fred) Tube substitution (Zenith G402) (CI)	Aug		Audio generator (Eico 377) (Tech)	Jul	77
Long Arm of (Essex)	Aug	60 50	Two-way radio squelch; intermittent (Motorola T51GGV) (Tech)	Dec	88	Audio generator spurious oscillations (Eico 377) (Tech)	Dec	89
PLUTO Tells Where It is (Brown)*§ Resistors, make close-tolerance (TTO)		91	Resistors, make your own close-tolerance (TTO)	Sep	91	Capacitor tester (Heath H-1) (TTO)	Dec	
Restoring Old Radios (Darr)	Jul	43	Screws, heat loosens Phillips	Dec	90	Check tube won't light (8YP4) (CI) Color bar generator calibration (CI)	Aug	
			Shop—A Service Tool (Darr) Solder bottle, toolbox (TTO)	Nov Dec	93	Scope trace broadened (Tech)		77
S			Soldering, toothpicks handy in (TTO) Sound projectors (Victor 16-mm) (Tech)	Oct	97	Scope trace flickers or is intermittent (Tektronix 561-A) (Tech)	Dec	88
Scope Improvers (Carlson) Scope Plug-in Unit Seeks Range,	Dec	54	Standoffs, small wire Static can damage transistors (Tech)	Oct Dec	92 95	Test yoke/CRT for bench (CI) Vom, "open" meter in (CI)	Nov	26
Shows Waveform	Dec Nov	53 56	Stethoscope amplifier, transistorized (CI)	jni	95 25	Vom, Topen' meter in (CI) Vtvm	Dec	20
Scope × 100 (Jaski) SCR's			Telephone pickups, flat coils for (TTO)	Jul	84	Erratic readings (Paco V-70) (Tech) Residual reading (Heath AV-3) (Tech)		77 68
Bring marvels to average housewife (NB) Electronic Fence Charger (Hansen)*§	Oct Jul		Television Antenna			Zero-adjust fails (Eico 232) (Tech)	Aug	77
Trigger for Your Photoflash (Greenlee)* Search for Sound (Robberson)	Nov	40 80	Connection, uhf tuner, repair (Tech) Guys, coil springs keep tight (Tech)	Oct	94 69	Transistor cell or flashlight cell (TTO) Transistors, static can damage (Tech)	Oct Oct	
Semiconductor Coding, European (Corres)	Oct		Master system, setting up (CI) Signal injection slip-on (TTO)	Oct	22 92	Tube shields slide off easily (TTO)	Oct	97
Service Color TV—Traps and Pitfalls (Mandl)	Dec	38	Rotators, scope checks (Tech)	Aug	66	Wire, free high-voltage (TTO) Servo Amplifier Has Heavy Feedback	Aug	86 39
Service Your Car With Electronic Auto Analyzer (Dezettel)	Jul	38	Systems, interference in (CI) Christmas tree (Motorola TS-579B) (CI)		24 20	Signaling Systems for CB Stations (Safford)		56
								OF

DECEMBER, 1965

Signal-Makers, Complete Directory	Nov	60	Tube, RCA 15-inch rectangular (NB)	Nov	4
Solar Cells: Space Power (Stoner)	Aug	32	Tubes, G-E will manufacture (NB)	Jul	10
Solid-State Muscle Stimulator (Breskind)*§			Commercials		
(Corres)	Aug	14	Boycott campaign encourages good taste		
Space			(NB)	Sep	4
Digital TV, Mariner-earth transmissions us			FCC raps loud (NB)	Sep	7
(NB)	Sep	6	Digital, Mariner-earth transmissions use		
Laser beam, astronauts plan communication	n		(NB)	Sep	6
to earth with (NB)	Sep	4	Keyed Circuit, What's (Darr)	Jul	37
Martian ionosphere weak (NB)	Sep	6	Pay-TV		
Rf interference injures space vehicles (NB)	Sep	4	California ban ruled unconstitutional		
Spurious Radiation from 42-Mc. I.f. TV Sets			(NB)	Aug	6
(Austin)	Oct		Destined to fail? (NB)	Oct	4
Switches, Diode Rf (Math)	Sep	40	Phonograph records, pictures on (NB) Portables	Jul	9
T			Can be carried off (NB)	Jul	9
			Pocket-size (WN)	Nov	45
T40/40: 80-Watt All Transistor Stereo Amplifie	r		Transistor (Scott)	Jul	40
(Meyer)*§ (Corr)	Aug	62	Production to double in 2 years (NB)	Sep	4
Tachometer, Reliable (Gross)*†	Sep	54	Stations Packaged for Inexperienced Owner	Sep	58
Tape Players for Your Car (Blechman)			Tape recorder		
Sep 34; (Corres) Nov	14	Color or black-and-white (NB)	Sep	4
TCS's, Make Your Own (Lavender)*§	Oct	58	Home, to sell for less than \$1,000 (NB)	Aug	4
Telephone			Ingenious pickoff (NB)	Aug	4
Bandwidth, new trick squeezes	Nov	96	Variable-speed (NB)	Aug	8
Sensicall for deaf (WN)	Dec	43	30-kc bandwidth uses velocity scanning		
Subway system, for New York, leaky-coax			(NB)	Nov	12
(NB)	Aug	6	Trends (NB)	Jul	4
Writing unit competitor to CCTV (NB)	Jul	4	Uhf		
TELEVISION—see also Servicing, Television			Converting Vhf to, for Tests and		
Antenna (s)			Demonstrations	Jui	47
Ears so good, maybe foot is better? (NB	Aug	8	Philadelphia service techs promote (NB)		6
Master, setting up (CI)	Oct	22	Stations, compact planned (NB)	Aug	4
MATV, Plug Into (Cantor)	Jul	28	Wasteland in Monte Carlo (NB)	Sep	6
Rotator Remote Control for TV, CB and			Ten Transistor and Hybrid Auto Radio Troubles		40
Hams (Bintliff)*	Jul		(Held)	Oct	49
Coax Isn't All That Great (Finkel)	Sep	100	TEST INSTRUMENTS—see also Servicing; Servi	cing,	
Closed-circuit			Test Instruments		
Competitor (NB)	Jul	4	Amplifier, Look Inside (Baird)	Aug	43
Done with mirrors in French classroom			Audio signal generator, continuous tuning		
(NB)	Jul	6	for (Heath IG-72) (NC)	Sep	95
Prevents subway crime (NB)	Jul	4	Auto Analyzer, Service Your Car with		00
Color			Electronic (Dezettel)*	Jul	38
Delay Line, What's (Kramer)	Sep	56	Capacitor tester (B&K 801)† Nov 72;		
New G-E 11-inch (NB)	Jul	10	(Mercury 1400 in-circuit)†	Sep	66



Now save hours of design time with GERNSBACK LIBRARY'S new

ELECTRONIC DESIGN CHARTS

A comprehensive collection of nomographs in one convenient book.

Simplifies design procedures. Saves hours of time and effort on computations. Helps solve virtually every electronic design problem quickly. Eliminates uncertainty and mistakes. Large, accurate, clear charts on 81/2 x 11 page size. Lies flat or stands up.

128 PAGES

FULL EXPLANATION

EASY-TO-READ TEXT

An invaluable, convenient working tool for engineers and technicians with useful charts like these: Frequency and Wavelength . Reactance and Frequency . Time Constants . Input Chokes · Vector Addition of Complex Quantities . Parallel Resistors and Series Capacitors • AND 53 OTHER CHARTS.

BOOKS PURCHASED FOR PROFESSIONAL PURPOSES ARE TAX DEDUCTIBLE

Permanently cloth-bound \$5 Money-back guarantee within 10 days if not completely satisfied with book

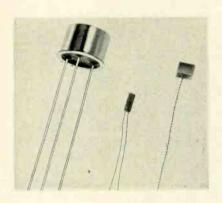
GERNSBACK LIBRARY, Inc., Dept. 1265 154 West 14th Street, New York, N. Y. 10011 Enclosed is \$_ .. Please send____copy(ies) of Electronic Design Charts @ \$5.95. Street State Zip Code

Cheater box, fuse your (TTO)	Sep	91
Color Bar Generators		
How to Set Up Wrong (Darr) New Concept in (Cerveny)	Nov Sep	94 59
Curve Tracer, Component (Blechman)*	Nov	52
Cyoloids for Frequency Measurements		•
(Jaski)* Dip Meter, Versatile (Turner)	Nov	60 42
Frequency Standard (Viking VFS)†	Jul	65
Horizontal deflection circuit meter		••
(Lectrotech T-100)† Inductance Checker and Tone Generator	Oct	68
(Posklensky)*§ (Corres)	Aug	14
LCR bridge, 10-turn pot is heart of (NC)	Oct	
Leakage detector (NC) Meter, Do You Understand What You Read	Sep	96
on (Margolis)	Nov	46
Meters, borrowing saves expense (Corres)	Jul	12
Multiplex Generator (Eico 342 FM)† Probes, ultrasonic (NB)	Dec Dec	64
Scope	200	
Calibrate Your (Middleton)	Nov	36
Dc/wide-band (Eico 435)† Grid, easy-to-make (TTO)	Nov	73 100
Improvers (Carlson)	Dec	54
Measuring Q (Cohn)	Oct	61
Plug-In Unit Seeks Range, Shows Waveform	Dec	53
× 100 (Jaski)	Nov	56
Wide-Band Your (Turner)*	Aug	58
Semi-Sweeper, Easy Alignment with (Stoner)*§	Sep	37
Signal injector (NC)	Dec	94
Signal-Makers, Complete Directory	Nov	60
Square-wave adapter, simple signal-powered		100
(NC) Test record, speaker balancing (KCS)†	Oct Oct	66
Tone Generator and Inductance Checker		
(Posklensky)*§ (Corres) Voltmeter	Aug	14
Meterless Dc (Stasior)*	Nov	51
Volt-ohm-microammeter (Triplett 630-M)†	Aug	64
Vom		
Scale Expander Measures Low Resistance (Roetger)*	Oct	44
Burnout-proof, for less than Dollar		
(Dezettel) Vtvm (EMC 107A)†	Nov	39
Zero-Setter for Ac (Greenlee)	Nov	75 69
Toilet Trainer, 20th Century	Oct	51
Tone Generator and Inductance Checker		14
(Posklensky)*§ (Corres) TRANSISTOR(S) (IZED)	Aug	14
Coding, European (Corres)	Oct	14
Matching in audio output stages (NC)	Jul	80
Tube Portables (Pugh) TV Portables (Scott)	Dec Jul	35 40
Vacuum tube's day not yet over? (NB)	Jul	4
Tunnel Diodes detect sound (NB)	Aug	6
TV Picture on Oscilloscope Screen (Huneault) TV Technician's Dictionary (Salerno)	Oct	92 41
TV Tuner Troubles (Darr)	Sep	45
Two-State Amplifier (Crowhurst)*§		
Part I—Principles Part II—40 Watts in 40 Ounces!	Jul Aug	54 35
Part III—Construction	Sep	48
U		
Uhf Converting Vhf to fee Tests and		
Converting Vhf to, for Tests and Demonstrations	Jul	47
Philadelphia service techs promote (NB)	Oct	6
Station, compact planned (NB)	Aug	4
V		
Variable Electrolytic, Make a (Jaski) Versatile Dip Meter (Turner)	Oct Nov	52 42
Voltage Doubler Doesn't Really (Patrick)	Aug	56
Vom Scale Expander Measures Low Resistances (Roetgar)*		
(workar)	Oct	44
W		
We Built An Electronic Organ! (Shunaman)	Dec	40
What, No Color? (Davidson) What's a Delay Line (Kramer)	Jul	57 56
What's a Keyed Circuit (Darr)	Sep	56 37
What's Your Modulation % (Blechman)	Sep	41
Who Invented It? (Middleton)	Sep	44
X Y Z		
Yoke Troubles (Darr)	Aug	47
Yoke Troubles (Darr) Your Shop—Service Tool (Darr)	Aug Nov	47 34

NEW SEMI-CONDUCTORS AND TUBES

WIDE-SWING MAGNETORESISTORS

A new line of magnetoresistors with an unusually large resistance change when placed in a magnetic field has been announced by Instrument Systems Corp.



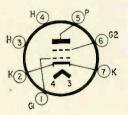
The new sensors' resistance increases from 8 to 20 times the zero-field value under the influence of a 10,000gauss magnetic field. Previous types changed by a factor of only 2 to 3 times. The new magnetoresistors are made of combined indium antimonide/nickel antimonide. They can supplant photoconductors and magnetic reed switches in many applications. Above 3,000 gauss, the ratio of resistance under flux to zero-field resistance is directly proportional to magnetic-flux density.

The photo compares the sizes of two ISC magnetoresistors to a TO-18 transistor case.

LOW CROSS-MODULATION TUBES

One of the most serious problems in designing sensitive, wide-band front ends is cross-modulation, created when an undesired signal is strong enougheven after tuning and preselection-to swing an amplifier stage into a nonlinear part of its characteristic. The nonlinearity causes the signals to intermodulate, or cross-modulate, rather than simply mix. They can then no longer be separated by tuned circuits, and the result is a whopping case of incurable interfer-

The usual approach to preventing this has been to use elaborate tuned preselector circuits, which are expensive to design and manufacture, and difficult to make track. Recently, Westinghouse Electronic Tube Division announced two miniature tetrodes designed so that an undesired signal of 5 volts peak-topeak amplitude will produce only 1% cross-modulation. One of the tubes, the WX-4733A, is intended as an rf amplifier up to 100 mc; the other, the WX-4733D, is good to 300 mc. Both were designed expressly to permit using simple, conventional circuitry.



WX-4733A WX-4733D

Both tubes have comparatively low transconductance: 2,000 µmhos for one and 2,700 for the other. This appears to be the price paid for the low crossmodulation factor.

Cross-modulation factor, by the way, is defined as the percentage of modulation transferred from an undesired carrier modulated 30% to an unmodulated, desired carrier.

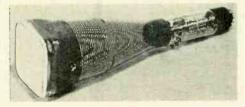
LOW-NOISE GERMANIUM AUDIO TRANSISTORS

Texas Instruments sends word of a new line of p-n-p alloy-junction germanium transistors for low-noise audioamplifier applications. They are inexpensive (around 50 cents in small quantities) and have a high breakdown voltage-50 volts between collector and base. They are named TIXA01 and -02.

Their low noise (noise figure of 4 db maximum at 1 kc) makes them attractive for low-level audio preamp service, while the high breakdown voltage makes them useful as higher-level driver stages, or even possibly as output stages for low-power amplifiers of the switching, or pulse-width-modulated, design.

Common-base alpha cutoff is 4 mc; typical beta is 180 at 6 volts between collector and emitter with 1 ma flowing. Dissipation is 150 mw; maximum collector current, 150 ma.

LOW-HEATER-POWER CRT



Powder metallurgy and other recent technologies have made possible a family of low-heater-power cathode-ray tubes, which, according to the manufacturer,

will run for 400 hours off a 11/2-volt No. 6 dry cell.

Developed primarily for portable transistor oscilloscopes and similar equipment, tubes in the new line of Sylvania CRT's consume less than 6% of the heater power of conventional CRT's. Their heaters are rated at 1.5 volts 140 ma, compared to the usual 6.3 volts 600 ma. A further benefit of the reduced power is less heat to be dissipated in the equipment.

LOWDOWN ON THE LATEST COLOR-TV SETS

Color TV is bigger and better-but it's also smaller and better in 1966. New, smaller screens are appearing alongside 21 and 23 inch tubes. See valuable directory of 1966 sets and learn what's new in features and circuits.

Coming in January RADIO-ELECTRONICS,

the 3rd Annual Color TV Issue

STATEMENT OF OWNERSHIP, MANAGE-MENT AND CIRCULATION. Required by the Act of October 23, 1962, Section 4369, Title 39 United States Code. Radio-Electronics, published

United States Code. Radio-Electronics, published monthly at 10 Ferry Street, Concord, Merrimack County, New Hampshire 03302. The General Business offices of the Publisher are located at 154 West 14 St., New York City.

1. The names and addresses of the publisher, editor and managing editor are: Publisher, Hugo Gernsback, 154 West 14 St., New York City; Editor. M. Harvey Gernsback, 154 West 14 St., New York City; Managing Editor, Fred Shunaman, 154 West 14 St. New York City

York City; Managing Editor, Fred Shunaman, 154 West 14 St., New York City.

2. The owner is: Gernsback Publications, Inc., 154 West 14 St., New York City; Hugo Gernsback, 154 West 14 St., New York City; M. Harvey Gernsback, 154 West 14 St., New York City.

3. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None

securities: None.

The above paragraphs include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of honds, mortgages or other securities of the publishing corporation have been included in the above paragraphs when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.

5. The average number of copies each issue during the preceding 12 months are: (a) Total number copies printed (net press run): 222,345; (B) Paid circulation: (1) To term subscribers by mail, carrier delivery or by other means: 97,275; (2) Sales through agents, news dealers, or otherwise: 60.091; (C) Total paid circulation: 157,366; (D) Free distribution: 2.013; (E) Total number of copies distributed: 159.379; (F) Office use, leftover, unaccounted, spoiled after printing: 62,966. The number of copies single issue nearest to filing date are: (A) Total number copies printed (net press run): 216,-681; (B) Paid circulation: (1) To term subscribers by mail, carrier delivery or by other means: 96,503; (2) Sales through agents, news dealers, or otherwise: 58,671; (C) Total paid circulation: 155,174; (D) Free distribution: 2,034; (E) Total number of copies distributed: 157,208; (F) Office use, left-

over, unaccounted, spoiled after printing: 59,473.

I certify that the statements made by me above are correct and complete

(Signed) M. Harvey Gernsback Editor



barrel with replaceable tip. Handle remains cool. Tip runs up to 750°F. Complete with cord. Model SP-23.

Also available in kit with two extra soldering tips, handy Model SP-23K. soldering aid and supply of solder.

WELLER ELECTRIC CORP., Easton, Pa.

WORLD LEADER IN SOLDERING TECHNOLOGY Circle 120 on reader's service card



Model 103AK Easy-to-Assemble Kit \$15.90 Model 103AK tasy-to-Assemble Kit \$15.90 41/2", 2% accurate, 800μα D'Arsonval type meter. One zero adjustment for both resistance ranges. High impact bakelite case. 5 AC voltage ranges: 0-12-120-600-1200-3000v. 5 DC voltage ranges: 0-6-0-300-600-3000v. 5 db ranges: -4 to +64db. 5 AC current ranges: 0-30-150-600ma. 4 DC current ranges: 0-6-30-120ma; 0-1.2A. 2 resistance ranges: 0-1K, 0-1 meg. 51/4" W x 63/4" H x 27/6" D.

POCKET SIZE VOLOMETER

Model 102A

Wired & Tested \$15.90 Model 102AK Easy-to-Assemble Kit \$14.10 Model 102AK Easy-to-Assemble Kit \$44.10 3½", 2% accurate 800µa D'Arsonval type meter. One zero adj. for both res. ranges. High impact bakelite case. 5 AC voltage ranges: 0-12-120-600-1200-3000v. 5 DC voltage ranges: 0-6-60-300-600-3000v. 3 AC current ranges: 0-30-150-600ma. 4 DC current ranges: 0-630-130ma; 0-1.2A. Resistance: 0-1K, 0-1 meg. 3¾" W x 6¼" H x 2" D.

	EMC, 625 Broadway, New York 12, N.Y. Send me FREE catalog of the complete value-packed EMC line, and name of local distributor. RE-12 NAME									
	ADDRESS									
)	CITYZONESTATE									
	EMC									

625 Broadway, New York 12, New York

Export: Pan-Mar Corp., 1270 B'way, N.Y. 1

TECHNOTES

TEKTRONIX 561-A SHOWS FLICKERING OR INTERMITTENT TRACE

A particularly baffling trouble on a Tektronix 561-A oscilloscope appeared regularly in the shop but was never to be seen when the instrument was sent out for service. As soon as the scope came back, the trouble reappeared. The trace would flicker erratically.

The cause was finally traced to an intermittent insulation failure in the high-voltage oscillator coil. The leakage or arcing depended on the humidity of the air—and apparently the air in our shop was wetter than the air in the efficiently airconditioned service shop center.

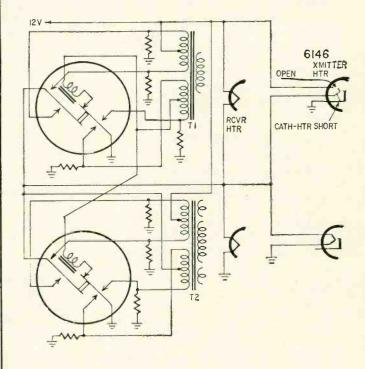
The same scope once showed a horizontal trace only half the width of the screen. After replacing many tubes and checking many voltages, someone discovered that one of the leads to the deflection-plate pins on the CRT envelope was loose enough to interrupt the circuit to that plate.—Frederick W. Chesson

MOTOROLA TSIGGV TWO-WAY-RADIO

A Motorola two-way model T51GGV radio had no squelch or audio, intermittently. Flicking the switch off and on could make the set work. The unit worked more than 50% of the time; when it didn't work the vibrator for the receiver B-plus did not function. Tapping it would cause it to start up; however, a new vibrator did not cure the difficulty. Neither did a new buffer capacitor or anything else I replaced.

Half of the heaters were not lit, and some were too bright. Hitting the vibrator, or switching the set off and on, would start the vibrator and light the rest of the heaters.

The 1701 vibrator needs a 6-volt source, which is derived from the heater string. The heaters are wired in seriesparallel and the 6 volts obtained by the drop across them. A



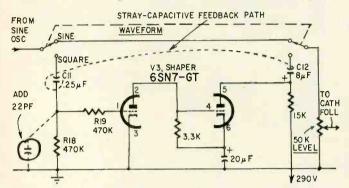
tube check showed the 6146 had an open heater with a short to cathode. However, when the vibrator was working, the heater in the 6146 would light, and the tube had normal power output. How about that! Just what was happening, I

don't know, but when the vibrator worked, it appeared to supply 6 volts to the other heater. Possibly the vibration made the filament ends weld together temporarily?—Don Dudley

SPURIOUS OSCILLATIONS IN EICO 377

An Eico model 377 Sine-Square Audio Generator, wired from a kit, began to show a parasitic oscillation riding on sine waves only, regardless of their amplitude or frequency. The generator worked perfectly in every way, except for this "fuzz" on the waves or parts of them, that hampered fine measurements.

A little investigation showed that oscillations appeared



in the output even when the WAVEFORM slide switch was halfway between SINE and SQUARE. The cathode-follower output stage, right after the switch, couldn't possibly oscillate. The sine-wave oscillator portion was producing sine waves with no fuzz, so that left only the square-wave shaper, V3.

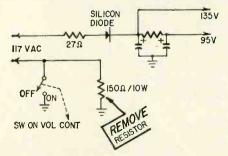
A scope at the switch terminal connected to C12 (switch set halfway between positions) showed approximately square "blobs" of high-frequency oscillation, recurring at about a 10-kc rate. Much the same waveform appeared at the junction of R18 and R19. Apparently the shaper was acting as a free-running multivibrator, all by itself! Moving C11 or C12, both physically large and close together, affected the oscillation. Separating them a little removed the capacitive feedback path from V3 pin 5 to V3 pin 1. A ceramic capacitor of 22 pf connected with short leads from the junction of R18 and R19 to ground stabilized the circuit completely without affecting square-wave quality.—P. E. Sutheim

VISCOUS-DAMPED TONE ARMS

Viscous-damped tone arms need very little attention as a rule except when the unwary audiophile attempts to move his player, spilling the oil. When you refill the ball chamber, screw the container tube right into the refill plug thread. The hard machine threads will tap the soft metal tube of the container and hold it firmly while the contents are squeezed out. This prevents a loss of fluid from spilling caused by air bubbles in the chamber. - Steve P. Dow

THE RADIO THAT WOULDN'T SHUT UP

We installed a phono jack in a Sylvania FT24BK table radio. An spst switch was added to switch in the radio or the



phono attachment. Everything worked perfectly in the shop. But in the customer's home the local radio station would

BUILD2ORADIO

CIRCUITS AT HOME RADIO "EDU-KIT" **All Guaranteed to Work!**

PRACTICAL only HOME COURSE

NOW INCLUDES

- 12 RECEIVERS 3 TRANSMITTERS
- SO. WAVE GENERATOR
- AMPLIFIER
- SIGNAL TRACER
- SIGNAL INJECTOR
- CODE OSCILLATOR
- TRAINING ELECTRONICS TECHNICIANS SINCE 1946 No Knowledge of Radio Additional Parts or No Additional Parts or Tools needed Excellent Background for TV

School Inquiries Invited Attractively Gift Packed

PREE EATRAS

RADIO & ELECTRONICS TESTER • ELE

TESTER INSTRUCTION MANUAL • MI
CLUB: CONSULTATION SERVICE • HI-FI
BOOK • FCC AMATEUR LICENSE TA

PRINTED CIRCUITRY • PLIERS-CL

L • WRENCH SET • CERTIFICATE OF
VALUABLE DISCOUNT CARD

WHAT THE "EDU-KIT" OFFERS YOU

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our kit is designed to train Radio & Electronics Techniclans, making use of the most modern methods of home training. You will learn had theory construction servicing, basic Hi-Fi and TV repairs, code, FCC amateur you will recommend the property of the proper

included. Every step is carefully explained, You cannot make a mistake.

PROGRESSIVE TEACHING METHOD

The Progressive Rode Edu-Kit' is the foremost educational radio kit in the world, and is universally edu-Kit' is the foremost educational radio kit in the world, and is universally edu-Kit' is the foremost educational principle of "learn by Doing." Therefore, you will construct radio circults, perform jobs and conduct experiments to illustrate the principles which you learn.

You begin by examining the various radio parts included in the "Edu-Kit." You begin by examining the various radio parts included in the "Edu-Kit." You will enjoy listening to regular broadcast stations, when the function is the progressive manner, and at your own rate, you will nind yourself constructing more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive mainer, and at your own rate, you will nind yourself constructing more advanced radio circuits, and doing work like a professional Radio Technician.

advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are 20 Receiver, Transmitter, Code Oscilland Radio Technician.

Included in the "Edu-Kit" course are 20 Receiver, Transmitter, Code Oscilland Radio Technician.

Included in the "Edu-Kit" course are 20 Receiver, Transmitter, Code Oscilland Radio Professional Injector, Square Wave Generator and Amplifor circuits, These are not unprofessional "Irecan board" experiments, but genulne radio circuits, tone new method of radio construction known as "Printed Circuitry," These circuits operate on your regular AG or DC house current.

The experiment of the professional wiring and soldering on metal chassis, plus the new method or radio construction known as "Printed Circuitry," These circuits to nonstruction; training for all, whether your purpose in learning radio be for hobby, business or job; progressively-arranged material, ranging from simple of the professional wiring and the professively-arranged material, ranging from simple by Quiz materials and our THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, colls, hardware, tubing, punched metal chassis, Instruction Manuals, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered bynamic radio & follows a professional electric soldering iron, and a self-powered bynamic soldering iron

to spend \$240 for a Course, but I found your ad and sent for Your Rit."

At no increase in price, the "Edu-Kit" now includes Printed Circuit Signal Injector, a unique servicing instrument that can detect many personal propular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminal of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER FROM AD - RECEIVE FREE BONUS

	MADIO G	 TICLO ON	211			OKIN 4	13
Please rush n			to	me,	as	indicated	below:

- Regular model \$26.95.

 Deluxe model \$29.95 (same as regular model, except with superior parts and tools).
- tools).

 Check one box to indicate manner of payment

 I enclose full payment. Ship "Edu-Kit" post paid.

 Ship "Edu-Kit" C.O.D. I will pay postage.

 Send me FREE additional information describing "Edu-Kit."

Progressive "EDU-KITS" Inc. 1185 Broadway, Dept. 2
Hewlett, N. Y. 11557

Circle 122 on reader's service card

at last... instant color patterns at your finger tips... zero warm-up time



THE ALL NEW SENCORE CG135 DELUXE TRANSISTORIZED COLOR GENERATOR

The big push is on in Color TV. Equip yourself now with the new, solid state Sencore CG135 and cash in on the zooming volume of new service business as Color-TV booms! Instant, service-ready RCA standard color bars, cross-hatch, white dots and individual vertical and horizontal bars enable you to set up or trouble-shoot more Color TV sets per day; earn top money in this fast growing service field. It's an analyzer too: Color gun interruptors, unmodulated video for chroma circuit trouble isolation and unmodulated sync pulses to keep Zenith receivers in sync for this test, make color trouble shooting a snap. Sturdy all-steel contruction for rugged, heavy

duty in the field or shop. Another Best Buy in profit-building service instruments from Sencore at

\$**149**95

COMPARE THESE FEATURES: SEE WHY THE CG135 IS IN A CLASS BY ITSELF

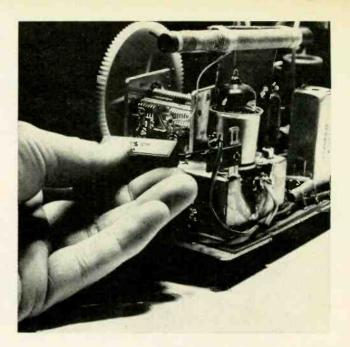
● Solid state construction employs high priced GE "Unijunctions" to develop six "jump out proof counters" that guarantee stable patterns at all times with no warm-up ● Standard RCA licensed patterns as shown on schematics throughout the industry ● Handy universal color gun interruptors on front panel ● Lead piercing clips insure non-obsolescence ● CRT adaptors optional ● Crystal-Controlled 4.5mc Sound Carrier Analyzing Signal to insure correct setting of fine tuning control ● RF output on Channel 4 adjustable to Channel 3 or 5 from front of generator when Channel 4 is being used ● No batteries to run down; uses 115 V AC ● Less than one foot square, weighs only 8 lbs.

professional quality — that's the difference!

SENCORE

426 SOUTH WESTGATE DRIVE . ADDISON, ILLINOIS

Circle 123 on reader's service card

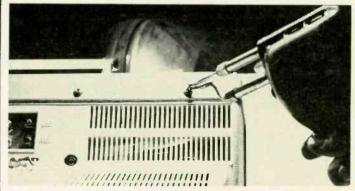


come in when the radio switch was turned off. The tubes went out when the switch was off, as far as the eye could see. It didn't seem possible that music could still come from the radio.

In the shop, it was found that the heaters seemed out, but there was voltage on the tubes. We found that a 510-ohm 10-watt resistor was wired across the ac switch to keep the tubes warm for a quick warmup when the radio is switched on. With the tubes partly warmed up, a local station was able to get through via the new audio wiring. Since the shop is shielded, this did not occur while the radio was there. We cut out the resistor.—Homer L. Davidson

HEAT LOOSENS PHILLIPS SCREWS

To remove machine-tightened Phillips head screws from plastic TV-set backs or other assemblies, try holding a



hot soldering iron against the head for a few seconds. Then use the correct size Phillips driver to loosen the screw. Don't hold the iron on too long: the plastic will melt around the screw.—Homer L. Davidson

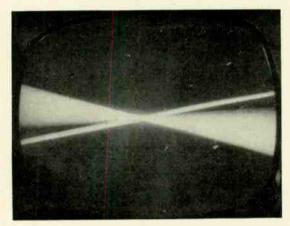
HUM AND RIPPLES IN CCTV

In a closed-circuit TV system, ripples and hum bars will sometimes drift up or down the screen. This occurs in bettergrade systems where a master oscillator is divided down to provide vertical sync. The master oscillator drifts out of the range of the automatic frequency control circuit, so that the vertical sync is no longer in phase with the ac line.

The remedy, in most cases, is simple—open the camera control unit, find the master oscillator frequency control, and

adjust it until the ripples and bars disappear. Find the range of adjustment over which the afc will hold the oscillator locked to the correct frequency, and set the frequency control to the middle of this range.—Charles Erwin Cohn

A BUTTERFLY STORY

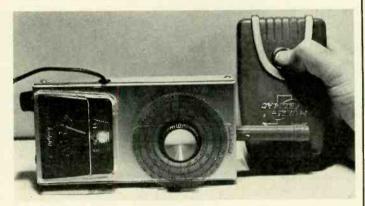


A few days ago I came upon a service case which apparently called for an entomologist rather than a TV service tech. The customer had a Zenith model D 2315 receiver, and the defect, when I saw the set, was a trapezoidal picture such as you often find with a shorted deflection yoke coil. I had no replacement yoke with me, so I decided to take the defective yoke to the workshop, hoping to be able to repair it. The customer agreed very quickly to this; the repair would cost him less than a new yoke. (Original service parts are rather expensive here in Argentina.)

In the workshop I changed the defective vertical coil and made a quick resistance check. Everything seemed all right. I went back to the customer's home and put the repaired yoke into the set. Much to our surprise we saw a picture like the one in the photograph. We had a perfect television butterfly. The cause of this defect was a reversed vertical deflection coil. Transposing its connections fixed everything very quickly.—Egon Strauss

CHECKING PORTABLE DOOR-OPENER TRANSMITTER

You can check your portable door-opener transmitter with a grid-dip oscillator, if one is handy. Set the grid-dip oscillator around 27 mc and set the meter to full scale. Place



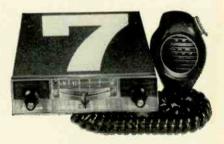
the portable door transmitter unit next to the grid-dipper's coil. Point the transmitting coil in the door opener toward the grid-dip coil.

Press the button on the door opener; the meter pointer should fall back. Adjust the grid-dip oscillator for deepest null, then let up on the button. This will show you that the transmitter is operating, and also the transmitter's operating frequency.—Homer L. Davidson





AND



PERFECT PAIR...

SOLID STATE...

SOLID STATEMENT

QUOTE:

Ray-tel, all-transistor C-B radio line, broadest of any in scope, priced to reflect full value at all equipment levels.

This fine line ranges from the sophisticated, full-feature 11-channel TWR-5 intended for personal and business communication systems, to the diminutive 5-channel TWR-7, price and performance peer of all the solid-state mobile radios.

We will be pleased indeed to send you complete details.

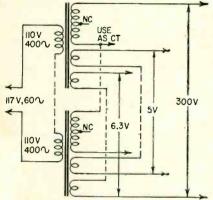
Please sene	d details on Ray-t	el TWR-5 and	d TWR-7.
Name			
	0.		
Number	Street		
City		State	Zip Code
	RAY-TI	-1	
212 5 0	nd Ave So. San		1:4 04090

Circle 124 on reader's service card

TRY THIS ON

USING SURPLUS 400-CYCLE TRANSFORMERS

Most experimenters discard 400cycle transformers when they remove them from surplus equipment. But, by connecting their primaries in series with a 120-volt 100-watt bulb, you can use them on 117-volt 60-cycle ac. You will get half the rated secondary voltage of the transformer.



Another trick is to connect two identical transformers with their primaries in series across 117 volts 60 cycles, and all corresponding secondaries in series (see diagram). The output voltage

is approximately equal to the rated output of one of the transformers. Current capacity remains at the rated value in all cases .- Milton Lenheim

SMALL WIRE STANDOFFS

To avoid undesirable coupling, it is often wise to prevent certain leads from getting too close to each other, or too close to the chassis. Jordan plastic screw



anchors cemented to the chassis make good wire standoffs. Simply wedge the wire in the anchor slot as shown.—John A. Comstock

MODIFYING THE HEATH CT-1

This capacitor tester is a unique and helpful instrument. With a few simple modifications, it can be made even handier around the shop.

To keep the 1629 "eye" tube from being pushed back, wire it to its mounting clamp through the upper hole in its socket.

The spring-return switch is not very handy for testing a large number of capacitors. The shaft and bearing assembly may be replaced with a positive-action mechanism from an old rotary switch.

Be sure not to disturb the wafer.

One side of the ac line is connected through a .02-µf capacitor, making the chassis slightly "hot." Cure this by putting the grounded side of the capacitor either to the other side of the transformer or the other side of the switch.

On occasion, in two separate in-struments, the "eye" tube has "overlapped". This has been due, in both cases. to excessive leakage in 0.1-µf capacitor across the pins 3 and 4 of the 1629 tube. Replace it with a good-quality paper or plastic capacitor.

Other modifications include adding a neon pilot lamp and wiring in the test leads permanently.—Allan Glaser

SLIP-ON TV SIGNAL INJECTION

If a TV set is dead or intermittent somewhere in the rf, i.f. or video section, connect the ground lead of your signal generator to the TV chassis. Tune the TV to an unused channel. Connect the generator output lead to a spare tube shield. Tune the signal generator to the operating frequency of the stage, with the modulation on. Place the shield over each of the i.f. and rf stages in

SARKES TARZIAN TV TUNER 41mc-

Latest Compact Model-good for all 41 mc TV's. BRAND NEW-MONEY BACK GUARANTEE Best TUNER "SARKES TARZIAN"

Best TUNER "SARKES TARZIAN" ever made—last word for stability, definition & smoothness of operation. An opportunity—to improve and bring your TV Receiver up-to-date. List price \$35—former reduced price \$15.97— now cut in ½ to \$7.95 L-3", H-4", W-2"

COMPLETE with Tubes & Schematic . . \$7.95





IBM COMPUTOR SECTIONS Each Unit "cost IBM over \$5.00" 8 assorted Units we sell for \$1 are loaded with over 100 valuable parts. 8 for \$1

RCA 110° FLYBACK TRANSFORMER We scooped the Market on 10000 Latest type RCA-standard for all 110° TV's-also good for 90° TV's RCA's design of extra large Coil Produces upwards of 18KV—assur-ing adequate width and height. Included—Schematic Diagram showing easy application for any

Your price ... \$3 10% off in lots of 3 or over

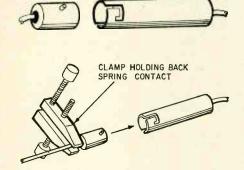
 		A demandant	***************************************		
300-ASST. 1/2 W RESISTORS \$1 Top Brand, Short leads, excellent	-	100 - ASST. CERAMIC CON- \$1		\$50 STARLITE AM-FM RADIO \$12	WESTINGHOUSE TV TUNER \$2
100-MOLDED TUBULAR COND. \$1		100 - ASST. MICA CONDEN- \$1		20 - ASSORTED TUBES Radio, Television and Industrial \$1	10 - ASST. 4 WATT WIRE S1
50-ASSORTED #3AG FUSES \$1 Popular assorted ampere ratings		100-ASST 1/4 WATT RESISTORS \$1 stand. choice ohmages, some in 5%		ALL AMERICAN TUBE KIT \$2 Top Standard Brand — 12BA6, 12BE6, 12AV6, 50C5, 35W4	4-TRANSISTOR RADIO EAR- \$1
5-I.F. COIL TRANSFORMERS \$1		100-ASST 1/2 WATT RESISTORS \$1 stand. choice ohmages, some in 5%		3 - TOP BRAND 35W4 TUBES \$1	2-G.E. PIECES OF EQUIPMENT \$1 stacked with over 200 useful parts
5 — AUDIO OUTPUT TRANS- \$1		70—ASST 1 WATT RESISTORS \$1		10-SYLVANIA 1U4 TUBES brand new Jan., individual cartons	G.E. TV POWER TRANSFORMER \$4 250ma, 360/360v, 6.3-9A, 5v-3A
4-TOGGLE SWITCHES SPST, SPDT, DPST, DPDT \$1		35—ASST 2 WATT RESISTORS stand. choice ohmages, some in 5% 150—PRECISION RESISTORS S4		also serves as IT4	50-G.E. FLASHLIGHT BULBS \$1
15-ASST. ROTARY SWITCHES \$1 all popular types \$20 value		50—PRECISION RESISTORS asst. list-price \$50 less 98%		for Transistors, etc	4-G.E. SAPPHIRE NEEDLES 4G, VR-11, etc. (\$10.50 value) . 1
CLEAN UP THE KITCHEN "JACK- \$1		RESISTORS, 5, 10, 20 watt 150—ASST. TERMINAL STRIPS \$4		Condensers, Resistors, Surprises	FATHOM DEPTH PIECE OF \$1
50-RADIO & TV SOCKETS all type 7 pin, 8 pin, 9 pin, etc. \$1		all types, 1-lug to 6-lug 1 25 — INSTRUMENT POINTER \$4		Popular type & size, plated \$15.00 RADIO PARTS "JACK- \$1	RONETTE SAPPHIRE CARTRIDGE S4
2 - UNIVERSAL 21/4" PM \$1 SPEAKERS for Radios, Intercom,		KNOBS selected popular types		POT" handy assortment 3 — ELECTROLYTIC CONDEN- \$1	dual flipover type—value \$5
as multiple Speakers, etc UNIVERSAL 4" PM TWEETER \$1 SPEAKER for FM, Hi-Fi, etc \$1		50—ASST. RADIO KNOBS all selected popular types		SERS 50/30-150v	RONETTE STEREO CARTRIDGE \$2 a-sapphire dipover type
		popular type w. indicator pointer		your choice 25, 50, 100, 1K, 5K, 10K mfs (or assorted)	Ronetie type for most cartridges
deluxe type, 2 conductor, wired		5—PNP TRANSISTORS general purpose, TO-5 case \$1		2—POWER TRANSISTORS No. 1 \$1 Replace 2N155, 2N176, 2N301, etc.	LES for all thumbserew cartridges
UNIVERSAL 4" PM SPEAKER Alnico 5 magnet, quality tone 69		5-NPN TRANSISTORS general purpose, TO-5 case \$1		SPEAKER for FM, HI-FI, etc	4—SHOCKPROOF SCREWDRIV- \$1

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y. TELEPHONE 7.2359

turn, not letting it touch chassis. The capacitance between the shield and the tube electrodes will inject the generator signal into the stage. If the stage and all following are OK, the usual bar pattern will appear on the screen. This technique is faster than pulling tubes.—Charles Erwin Cohn

HANDLING IN-LINE FUSE RETAINERS

Fuse retainers of the in-line type can be difficult to put together if they are in a tight spot that can be reached only with one hand. To simplify cou-



pling, first pull back the wire with the spring contact and hold it with a small clamp. The two sections may then be easily put together, and the clamp removed.—Hugh Lineback

TOOLBOX SOLDER BOTTLE

Dropping small bits of solder into your toolbox for field jobs is wasteful, but not having any solder is worse. A plastic solder container slips into a pocket, drops into a toolbox or stays handy on the bench and contains enough solder for any dozen jobs you're likely to encounter.

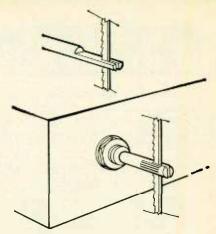
To make it, get a small pill or throat lozenge vial from your druggist and drill a ½-inch hole centered in the bottom. Now wind 2 or 3 inches of solder neatly around a pencil and leave a 2- or 3-inch "tail". Push the tail back through the coil so it sticks out about an inch at the other end. Drop the coil into the pill bottle, making the end come out through the hole, put the cap back on the bottle, and your solder bottle is finished.

Pick a vial that's sturdy enough to withstand banging around with heavy tools in your toolbox. I used one that contained Tracinets sore-throat tablets.

—Charles A. Brunjes

TIGHTEN KNURLED OR FLATTED KNOBS

When radio or TV push-on knobs on knurled or flatted shafts get too loose, slot the shaft for ½ inch with a jeweler's saw and spread the slot. Knobs will now fit tight and can be tightened



again and again if necessary. Be careful not to mar the cabinet with the saw.—

Tom Jaski

Turn Back TO PAGE 70

for Radio-Electronics FREE Reader's Service Page. Special postpaid card will bring you helpful information.

MOVING DATE EXTENDED—SALE CONTINUES

FREE \$1 BUY WITH	EVERY 10 YOU ORDER to "\$1" Buys FREE GIFT WITH EVERY O	RDER							
1000-ASST. HARDWARE KIT \$1 screws, nuts, washers, rivets, etc.	100'-MINIATURE ZIP CORD \$1 TV BARGAIN COLUMN MARKET SCOOP CO	<u>DLUMN</u>							
250-ASST. SOLDERING LUGS \$1	50 ASSORTED MYLAR CONDEN- \$1 S139 STARLITE TV PORTABLE \$47 TRANSISTOR RADIO asst 16" complete, needs adjustment good, bad, broken, as-is, poi								
250-ASST. WOOD SCREWS finest popular selection \$1	10 SETS - DELUXE PLUGS & \$1 Ino TV DEFLECTION YOKE for all type TV's incl schematic \$2 TAPE RECORDER—assorte good, bad, broken, as-is,	d types \$4							
SCREWS #6, #8, etc	10 - SETS PHONO PLUGS & \$1 90° FLYBACK TRANSFORMER \$1 10-ASSORTED DIODE CR	YSTALS \$1							
150—ASST. 6/32 SCREWS and 150 6/32 HEX NUTS \$1	10 - SURE-GRIP ALLIGATOR \$1 90° TV DEFLECTION YOKE \$1 CLIPS 2" plated	ISTORS \$1							
150-ASST. 8/32 SCREWS and 150-8/32 HEX NUTS \$1	4 different colors for all type TV's incl schematic 1 - SQ. YARD GRILLE	CLOTH \$1							
150-6/32 HEX NUTS \$1	hookups, special circuits, etc for all type TV's incl schematic	19000							
150-ASST. 2/56 SCREWS and 150-2/56 HEX NUTS \$1	GHETTI handy sizes Complete with Tubes PLUG make telephone port	table							
150—ASST, 4/40 SCREWS and 150—4/40 HEX NUTS \$1	METS best sizes	hone 31							
150—ASST. 5/40 SCREWS and 150—5/40 HEX NUTS \$1	3-1/2 MEG VOLUME CONTROLS \$1	PHONE \$1							
500—ASSORTED RIVETS most useful selected sizes \$1	with switch, 3" shaft	ELEC- \$1							
500—ASSORTED WASHERS most useful selected sizes	7-ASSORTED VOLUME CON- \$1 7-ASSORTED VOLUME CON- \$1 20-ASSORTED TV COILS \$1 7-ASST. TV ELECTR. CONDENSERS popular selections and the condense of the conde	OLYTIC \$1							
100 - ASST. RUBBER & FELT \$1	15-RADIO OSCILLATOR COILS \$1 40-ASSORTED TV KNOBS \$1 DENSERS .001 to .47 to 6	CON: \$1							
10-ASSORTED SLIDE SWITCHES \$1	20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc	5 1							
CHAPT ZU DI MITZIA "JACK- POT" double your money back if \$	BONANZA "JACKPOT" not gold. not oil, but a wealth of Electronic Items—Money-Back-guarantee 55 COLLS all popular types 10—ASST DUAL CONTRO	LS \$1							
IMMEDIATE DELIVERY Scientific light packing for safe delivery at minimum cost. HANDY WAY TO ORDER: Pencil mark or write amounts wanted in each box, place letter F in box for Free \$1 BUY. Enclose with check or money order, add extra for shipping. Tearsheets will be returned as packing slips in your order, plus lists of new offers.									
Please specify refund on shipping o	erpayment desired: CHECK POSTAGE STAMPS MERCHANDISE (our choice) with advantage to	o customer							

DECEMBER, 1965

Circle 125 on reader's service card

YOU SAVE

Now You Can. Just Write for Edlie's

E MONEY-SAVING CATALOGUE

Listed below are just a few of the many

4 TUBE STEREO AMPLIFIER

A new and completely working 2 channel unit, suitable for use



unit, suitable for use with a record changer, tape recorder, etc. Operates from a 115 volt AC or DC source. Contains 3 output transformers, 3-35EH5 and 1 - ECC83 tubes, and 1 top hat silicon rectifier. 2 single and 1 dual control, and all related components. Housed on a chassis 5½ "x6¾"x1" high. Weight 2½ lbs.

Price \$6.95

EPOXY SILICON RECTIFIER

rated at 750 ma, 500PIV RE 101

Price 22¢ each; 6 for \$1.25.

STUD MOUNTED SILICON RECTIFIER

rated at 20 amperes, 300 PIV RE 102



Price 79¢ each; 6 for \$4.50



PNP type, audio usage, suitable for use in place of 2N158, 2N235, 2N251, etc. (Over 25 other types).



Price 59¢ each; 6 for \$3.25.

DUAL HEAT SINK

Black ann. dized alumi-num with 4 fins on either side. Will house 2 power transistors size 3" x 4½". RE 104



Price 95¢ each.

HI-FI DYNAMIC MICROPHONE

Omni-Directional, moving coil type for both high and low impedance, built in desk type stand; base threaded for floor stand, suitable for tape recorder or amateur use.

RF-105 Price \$2.95.



ACME SINGLE HEADSET

1000 ohms complete headband and cord **RE 106** Price 95¢

Weston DC Milliammeter, Model 801-58

4½" Rectangular Basic 0-5 Ma, DC Scale 0-1 in 50 divisions and 0-3 in 30 divisions Price \$4.95



EDLIE ELECTRONICS, INC. Dept. RE-5

(The Electronic Bargain House)

154 Greenwich St., New York 6, N.Y.

Circle 126 on reader's service card

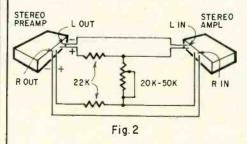
NOTEWORTHY CIRCUITS

CENTER CHANNEL FOR STEREO

A number of methods have been developed for adding a third- or center-channel speaker to a stereo system. Several were described in "Add a Third Speaker the Easy Way" in the October 1960 issue. The Merit A-4110 and Microtran HM-90 mix/match audio transformers were developed to simplify connecting a third speaker while maintaining correct impedances, signal polarities and power levels.

CENTER SPKR Z=40 RIGHT LEFT SPKR $Z = 4\Omega$ Z=4Ω 16 8 04 9 1 EFT RIGHT STEREO AMPL OUTPUT TERM STRIP Fig. I

Fig. 1 shows a recent patent-pending development by David Hafler of Dynaco. The three speakers should have the same impedance and efficiency. The outside ones are connected in series-opposing across the two output terminals for speakers of twice their impedance. The third speaker is bridged between the common or ground terminal on the amplifier and the common return lead from the outside speakers.



Mr. Hafler notes that this system may degrade separation and cause some crosstalk. This can be eliminated by a resistive bridge network—also covered in the patent application-connected between the preamps and power amplifiers or between two identical high-impedance points in the circuit. The resistive network is shown in Fig. 2.

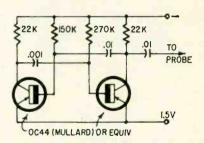
To adjust the bridge, connect only one channel of a stereo pickup to one

amplifier channel, the left one for example. Play a mono record and adjust the pot for minimum output from the right speaker. Switch the phono plug to the right channel. The control setting should be correct for minimum output from the left speaker. If not, then correct it with the amplifier's balance and tone controls.

Plug both phono channels into the amplifier and carry on from there. Incidentally, the center output can be used to feed a mono (L+R) signal to the patio, basement or any other remote point.

TRANSISTOR SIGNAL INJECTOR

A simple untuned af-rf signal generator is handy for tracking down inoperative or defective audio and lowfrequency rf circuits. You can use it on the bench, in the field and even in a well equipped lab. The diagram shows a simple multivibrator that Pye Telecommunications engineers use for rapid troubleshooting in radiotelephone transceivers. It was described in Industrial Electronics (London, England).



The circuit develops a 1-kc squarewave signal of about 0.5 volt peak to peak and rich in harmonics to about 500 kc. The tester was built on a tiny circuit board and installed in a penlight case along with the 1.5-volt battery.

HOW TO SPOT TV COLOR TROUBLES INSTANTLY

Having trouble pinning down color-tv defects to a particular spot? Jack Darr's simple Chroma Trouble Chart provides quick and easy assistance. Step-by-step, it leads you from one critical check point to the next. Guaranteed to save you time and effort in locating the fault.

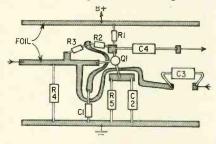
Coming in January RADIO-ELECTRONICS the big Color-TV Issue

WHAT'S YOUR EQ?

These are the answers. Puzzles are on page 55.

Printed Circuit

The trick to the solution is that the components are on one side of the board while the foil permits running a lead



This method permits running a lead "through" any component. Therefore it is not necessary to redraw the circuit to avoid crossovers.

How Many Ohms?

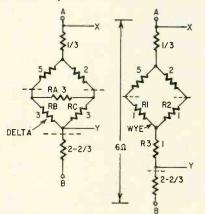
This one has a built-in joker. The center tie between the bridges can be disregarded; it connects corresponding points. Probably the easiest solution is to simplify by means of the Delta-Wye transformation. By opening the circuit at X-Y, we can find the resistance first of one bridge and then the other.

$$R1 = \frac{RA RB}{RA + RB + RC} = 1 \text{ ohm}$$

$$R2 = \frac{RA RC}{RA + RB + RC} = 1 \text{ ohm}$$

$$R3 = \frac{RB RC}{RA + RB + RC} = 1 \text{ ohm}$$

The total resistance for this bridge is 6 ohms. In the same manner, the other bridge is found to be 3 ohms and the two paralleled equal 2 ohms.

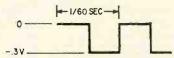


With the center tie open, connect a voltage source (say 6 volts) to A-B. Determine voltage at center tie points. In this case, they are both 23/3 volts. So, any connection between these points has no effect on terminal resistance.

Wave-Shaping Circuit

Here's how it operates: The selfpotential (Edison effect) between the

right-hand diode plate and the common cathode causes direct current to flow through the 220,000- and 1,000-ohm resistors. This dc causes a drop of 0.3 volt across the 220,000-ohm resistor, thus a potential difference of 0.3 volt between A and B. The direction of current makes terminal A negative to terminal



The left-hand section of the tube operates as a half-wave rectifier. It is, in effect, an ac electronic switch that controls the flow of dc through the righthand diode circuit. During positive halfcycles of the input voltage, a rectified voltage pulse is developed across the 1,000-ohm resistor. When this voltage exceeds + 0.3 volt, the 1,000-ohm resistor does not conduct de from the right-hand circuit and, as a result, the voltage between A and B is zero. During negative half-cycles of the input voltage, no rectified voltage opposes the dc through the 1,000-ohm resistor; therefore, dc flows through the right-hand circuit and the voltage between A and B

By using half-wave rectified voltage pulses to switch the right-hand circuit on and off, a near square-wave output is developed between A and B. The pulse repetition rate equals the frequency of the ac input voltage.

SILICON RECTIFIER SALE

IMMEDIATE FULLY GTD AMERICAN MADE



750 MA-SILICON "TOPHAT" DIODES

PIV/RM5	PIV/RMS	PIV/RM5	PIV/RMS
50/35	100/70	200/140	300/210
.05 ea.	.07 ea.	.10 ea.	.12 ea.
PIV/RMS	PIV/RMS	PIV/RM5	PIV/RM5
400/280	500/350	600/420	700/490
.14 ea.	.19 ea.	.23 ea.	.27 ea.
PIV/RMS	PIV/RMS	PIV/RMS	PIV/RMS
800/560	900/630	1000/700	1100/770
.35 ea.	.45 ea.	.60 ea.	.75 ea.

ALL TESTS AC & DC & FWD & LOAD
SILICON POWER DIODE STUDS
50 PLY 100 PLY 150 PLY 200 PLY

AMPS	35 RM5	70 RM5	105 RMS	140 RMS
3	.08 ea	.50	.16 ea	.22 ea
12	.25		.65	.75
35	.65		1.25	1.40
100	1.50	1.75 2.00	2.20	2.60 3.00
D.C.	300 PIV	400 PIV	500 PIV	600 PIV
	210 RM5	280 RM5	350 RMS	450 RMS
3	.27 ea	.29 ea	.37 ea	.45 ea
12	.90	1.30	1.40	1.65
35	2.00	2.35	2.60	3.00
50	3.25	4.00	4.75	6.00
100	3.60	4.50	5.25	7.00
HECDII	RULLICON	CONTROLLED	DEATIFIED	

PRV AMP AMP AMP PRV AMP AMP AMP

SPECIALS! SPECIALS! 100 Different Precision Resistors 1/2-1-2 watt 1/2%-1% TOL

2 amp 1000 Piv Silicon Power Rect. .70 ea. 10 for \$6.50

R.C.A. P.N.P. TRANSISTOR
4 for \$1.00, 100 for \$18.
FACTORY NEW Type 2N406

Computer Grade Condenser 15,500 MFD 15 VDC American Mfg. Type IN34 DIODE GLASS .07 ea 100 for \$5

Money Back guarantee. \$2.00 min. order. Orders F.O.B. NYC. Include check or money order. Shpg. charges plus. C.O.D. orders 25% down.

Warren Electronic Components 230 Mercer St., N. Y., N. Y. 10012 • OR 3-2620

Circle 127 on reader's service card

the valuable Reader's Service Page? Turn back to page 70 for free info.

CTRONIC



Engineering-Technicians

Bachelor of Science Degree, 30 Months Save Two Years' Time

The Nation's increased demand for Engineers,

Electronic Technicians, Radio TV Technicians is at an all time high. Heald Graduates are in demand for Architecture (B.S. Degree) Preferred High Paying Salaries. Train now for a lucrative satisfying lifetime career.

Radio-Television Plus Color Technician (12 Months) Electronics Engineering Technology (15 Months) ☐ Electronics Engineering (B.S. Degree) Electrical Engineering (B.S. Degree)

Mechanical Engineering (B.S. Degree) Civil Engineering (B.S. Degree) (36 Months)

Approved for Veterans DAY AND EVENING CLASSES

Write for Catalog and Registration Application. New Term Starting Soon.

Your Name Address

Circle 128 on reader's service card

ENGINEERING COLLEGE

Est. 1863-102 Years

Van Ness at Post, RE

San Francisco, Calif.

SCHOOL DIRECTORY

LEARN **ELECTRONICS**



FOUNDED 1899

NOT-FOR-PROFIT

Degree (2 Yrs.)

COYNE **ELECTRONICS** INSTITUTE

Electronics Engineering Technology Electrical-Electronics Technician TV-Radio-Electronics Technician Combined Electronics Technician Practical Electrical Maintenance Practical Refrigeration Air Conditioning and Appliance Repair Specialized Industrial Electronics

Diploma (40 Wks.) Diploma (40 Wks.) Diploma (80 Wks.) Diploma (32 Wks.) Diploma (24 Wks.) Diploma (16 Wks.)

Introduction to Electricity-Electronics — FCC First Class Radiotelephone — - Certificate (8 Wks.) Certificate (100 Hrs.)

Special finance plans. Part time employment service while in school. Also Free graduate employment service.



Use this coupon to get our FREE BOOK "YOUR OPPORTUNITIES IN ELECTRONICS" COYNE ELECTRONICS INSTITUTE, Dept. of Electronics 95-N 1501 W. Congress Parkway, Chicago, Illinois 60607				
Name	Age	_		
Address	Phone	_		
	ZoneState_ schools, we do not employ salesme	n		
Circle 129	on reader's service card			

B.S. degree in 36 months

Small professionally-oriented college. Fourquarter year permits degree completion in three years. Summer attendance optional. Engineering: Electrical (electronics or pow-er option), Mechanical, Civil, Chemical, Aero-nautical. Business Administration: Accountnautical. Business Administration: Accounting, General Business, Motor Transport Administration. One-year Drafting and Design Certificate program. Graduate placement outstanding. Founded 1884. Rich heritage. Excellent faculty. Small classes. Wellequipped labs. New library. New residence halls. Attractive 300-acre campus. Modest costs. Enter Jan., March, June, Sept. For Catalog and View Book, write Director of Admissions. Admissions.



ENGINEERING DEGREES

PACIFIC

c. A. s.

Associate—Bachelor
Also Associate in LIBERAL
ARTS earned by

HOME STUDY

Resident Classes Also
Available if Desired
Specify course preferred
PACIFIC
INTERNATIONAL
COLLEGE OF ARTS
& SCIENCES
Darily a correspondence

Primarily a correspondence school Chartered 1935

5507M Santa Monica Blvd. Hollywood, Calif., 90038

EARN Electronics DEGREE

You can earn an A.S.E.E. degree at home. College level HOME STUDY courses taught so you can understand them. Continue your education, earn more in the highly paid electronics industry. Missiles, computers, transistors, automation, complete electronics. Over 27,000 graduates now employed. Resident school available at our Chicago campus—Founded 1934. Send for free catalog.

American Institute of Engineering & Technology 1139 West Fullerton Parkway, Chicago 14, III.

GET INTO ELECTRONICS



VALPARAISO TECHNICAL
INSTITUTE
Department C, Valparaiso, Indiana

15.00



Learn Electronics for your SPACE-AGE EDUCATION at the center of America's aerospace industry

No matter what your aerospace goal, you can get your training at Northrop Tech, in sunny Southern California.

COLLEGE OF ENGINEERING.
Get your B.S. degree in engineering in just 36 months by attending classes year round. Most Northrop Tech graduates have a job waiting for them the day. have a job waiting for them the day they're graduated! A & P SCHOOL. Practical experience

on real aircraft. One-year course pre-pares you for F. A. A. A&P certificate. WRITE TODAY FOR CATALOG.

NORTHROP INSTITUTE OF TECHNOLOGY

1199 W. Arbor Vitae, Inglewood, Calif.

A JOB or a POSITION? The difference is ELECTRONIC MATHEMATICS

NOW! A NEW WAY TO LEARN—I. H. S. I. WAY. A complete home study course in electronic math to help you set the nosition you want—MORE MONEY—MORE RESPECT.

COURSE PREPARED BY COLLEGE PROFESSORS who have lectured to thousands of men on math and engineering. You learn at home quickly, easily—AS FAST as you want.

AS FAST as you want.

YOU SIGN NO CONTRACTS
Pay only if satisfied—you owe it to yourself to examine the INDIANA HOME STUDY INSTITUTE COURSE IN ELECTRONIC MATH.
FREE BONUS—if you join now, a refresher course in basic arithmetic.

Write for Brochure—No Obligation
THE INDIANA HOME STUDY INSTITUTE

THE INDIANA HOME STUDY INSTITUTE Dept. RE-12, P.O. Box 1189 Panama City, Fla. 32402

Earn Your A.S.E.E. DEGREE and **More Money**

Move up. Increase your salary and prestige. How? By acquiring the knowledge and skill that industry needs and pays for!

The unique A.S.E.E. degree program available at Grantham School of Electronics teaches you what industry wants you to know for advanced employment. And you can complete three-fourths of this program while at home on your present job. Only one semester must be completed in residence.

You are eligible to enroll if you are (1) a high school graduate, and (2) now employed in electronics. Even the first few lessons should help you understand your job better-perhaps enable you to earn a promotion. Upon completion of the second semester's work, you should have already passed the F.C.C. examinations for your first class radiotelephone license and radar endorsement. Upon completion of four semesters of technical work, one English course, one history course, and one year of technical employment in electronics, you are awarded the A.S.E.E. (Associate in Science in Electrical Engineering) degree. The year of technical employment may be completed either during your enrollment or within two years after you complete the educational pro-

Get the facts from our free catalog. Then, with our assistance, get the knowledge. Your F.C.C. license, your A.S.E.E. degree, and higher-paid employment follow naturally. Ask for CATALOG 57-T.

Grantham School of Electronics

1505 N. Western Av., Hollywood, Cal. 90027 (Phone: HO 9-7878)

818 18th St., NW, Washington, D.C. 20006 (Phone: 298-7460)

Circle 130 on reader's service card RADIO-ELECTRONICS

NEW

BASIC ELECTRONICS, by Bernard Grob. McGraw-Hill Book Co., 330 W. 42 St., New York, N. Y. 10036. 61/2 x 91/2 in., 588 pp. Cloth, \$7.50

A true basic book. Every effort has been made to keep the language simple, and the mathematics within the bounds of ordinary arithmetic. even when explaining such things as complex numbers, Kirchhoff's laws and Thevenin's theorems. The second edition is thoroughly revised with two chapters added.

ELECTROMAGNETIC THEORY AND GEOMETRI-CAL OPTICS, by Morris Kline and Irvin W. Kay. John Wiley & Sons Inc., 605 Third Ave., New York, N.Y. 10016. 6 x 9 in., 525 pp. Cloth, \$15

Electromagnetic-theory approach to classical geometrical optics. Written for physicists and mathematicians.

ELECTRIC GUITAR AMPLIFIER HANDBOOK, by Jack Darr. Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 144 pp. Paper, \$2.95

Typical circuits, service methods and testing techniques plus all the information available on commercial instruments. Many schematics and a few parts layout diagrams.

ELECTRONIC SYSTEMS FOR CONVENIENCE, SAFETY AND ENJOYMENT, by Edward A. Altshuler. Howard Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 255 pp. Paper, \$4.95

A review of the present and future of electronics, from a commercial rather than technical viewpoint. Covers entertainment, communication systems, controls, office systems, education, government and medicine. Part III is entitled "The ABC's of Selling Electronic Systems."

WAVEFORMS. Dover Publications, Inc., 180 Varick St., New York, N.Y. 10014. 5½ x 8½ in., 785 pp. Paper, \$3.25

Originally authored and edited by many specialists for MIT Radiation Labs. A comprehensive survey of generators, shapers, timers, counters and modulators. Includes many schematics with parts values and wave patterns. Tubes are those of 15 and 20 years ago, but circuits are still very useful.

GENERAL ELECTRIC ELECTRONIC COMPONENTS HOBBY MANUAL, (2nd edition). Electronic Components Div., General Electric, Owensboro, Ky. 5½ x 8½ in., 199 pp. Paper, \$1.50

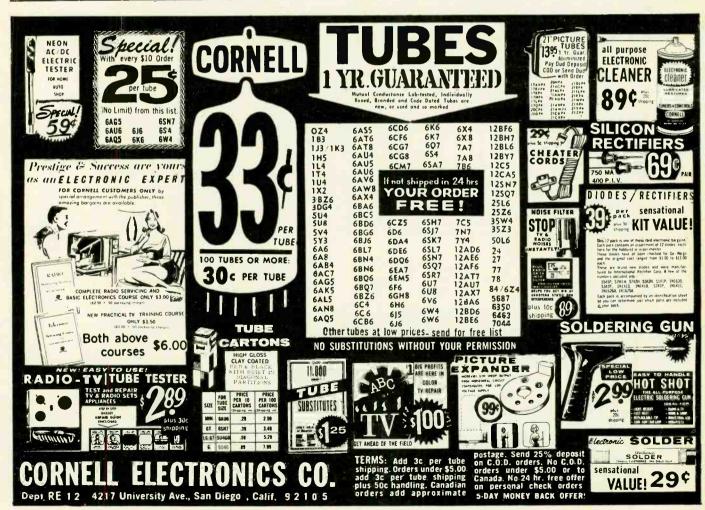
Includes 5 automobile projects, 10 entertainment projects, 9 for home or camp, and 11 for the electronic experimenter's workshop, with an excellent introduction about the structure and operation of various semiconductor components.

BEST WAYS TO USE YOUR VOM AND VIVM, written under direction of Publications Div., Allied

Radio Corp., edited by Fred Shunaman. Allied Radio Corp., 100 N. Western Ave., Chicago, Ill.

City, State.....

Complete coverage for the beginning user; describes fundamentals, testing components, checking hi-fi equipment, receivers, CB and ham gear, and continues with miscellaneous applications (measuring light intensity, soil resistance, etc.) and care of the instruments.



MARKET CENTER



Completely new 1966 edition. New items, categories, illustrations, 148 easy, to-read pages packed with nearly 4000 unusual tems. Dozens of clertrical and electrical tems. Dozens of clertrical and electrical tems. Dozens of clertrical and electrical tems. Dozens of the clertrical and electrical tems. Selection of Astronomical Telescopes, Microscopes, Binoculars, Magnifiers, Magnets, Lenses, Prisms, Many war surplus Items: for hobbylats, experimenters, workshop, factory. Write for catalog "EH".

CLIP AND MAIL COUPON TODAY

EDMUND SCIENTIFIC CO., Barrington, N. J.
PLEASE SEND ME FREE CATALOG "EH" The state of the s

CONVERTER SALE

New series 300 with 3 VHF-UHF transistors, crystal-controlled oscillator, tuned R.F. stage and low noise mixer. One microvoit sensitivity. More than 30 high quality parts carefully assembled and tested. Measures only 3" x 2½" x 2". Operates at 12 volts DC 4-5 ma. Available in the following models:

		Input	Output		
	Model	mc.	mc.	Price	
	300-D	144-148	50-54	\$12.95 ppd.	
244	300-E	144-145	.6-1.6	\$12.95 ppd.	
2M	300-F	144-146	28-30	\$12.95 ppd.	
	300-0	144-148	14-18	\$12.95 ppd.	
	300-B	50-51	.6-1.6	\$12.95 ppd.	
6M	300-C	50-54	14-18	\$12.95 ppd.	
	300-J	50-52	28.30	\$12.95 ppd.	
	200.0	14.0-	1.0-		
20M	300-G	14.35	1.35	\$11.95 ppd.	
				\$11.35 ppu.	
СВ	300-A	26.965-	1.0-		
CD	300 A	27.255	1.29	\$11.95 ppd.	
WWV	300-H	5.0	1.0	\$11.95 ppd.	
Int'l.	300-1	9.0-10.0	.6-1.6		
				\$11.95 ppd.	
CHU	300-K	7.3	1.0	\$11.95 ppd.	
CHU	300-L	3.35	1.0	\$11.95 ppd.	
Marine	300-M	2.3	.6-1.6		
Marine			.6-1.0	\$11.95 ppd.	
Aircraft	∫300-N4	121-122	.6-1.6	\$13.95 ppd.	
Aircrait	300-N5	122-123	.6-1.6	\$13.95 ppd.	
Fire, Po-	,			4 FF	
lice, etc.	300-P	155-156	.6-1.6	\$13.95 ppd.	

All above converters are supplied with Motorola type connectors. For two SO-239 connectors instead, add 75¢

For prompt shipment of stock models include postal money order or cashier's check. Special models shipped within six weeks. Personal checks must clear before shipment. For C.O.D.'s include 20% deposit. New York City residents add 5% sales tax. New York State residents add 2% Sales tax.

VANGUARD ELECTRONIC LABS Dept. R-12 190-48-99th Ave. Hollis 23, N. Y.

GENERAL

TV SERVICE ORDER BOOKS for use with your rubber stamp. Duplicate or triplicate. Low cost. Write for FREE 32 PAGE CATALOG and Special Rubber Stamp Offer. **OFLIRICH PUBLICATIONS**, 6556 W. Higgins, Chicago, III. 60656.

CONVERT ANY TELEVISION to sensitive Big-Screen Oscilloscope. Only minor changes re-quired. No electronic experience necessary. Il-lustrated plans \$2.00. RELCO-A25, Box 10563, Houston 18, Texas.

FREE Wine Recipes and Home Brewing Sup-plies Catalog COUNTRY WINEMAKER, Box 243RE, Lexington, Massachusetts

you need, we have. MARYLAND MAGNET, 5412G Gist, Baltimore, Maryland 21215.

AUTOMATIC WASHER Repair Manuals for: Frigidaire, General Electric, Hamilton, Hotpoint, Kelvinator, Kenmore, Norge, RCA Whirlpool, Speed Queen, Westinghouse. \$2.50 EA. PPD. Refrigeration Parts Catalog 50¢. Sunbeam Appliance parts list 25¢. MAJOR APPLIANCE, 13106 Caine Avenue, Cleveland, Ohio 44105.

PICTORIAL STUDY in Amateur radio. Free details. D. CROSS, 1212 Lynch, St. Louis, Mo. 63118.

ADD, SUBTRACT, MULTIPLY, DIVIDE with switches and diodes. Instructions and theory \$1.95. FERWALT, Box 27, Lewiston, Idaho 83501.

MELODY ORGAN, easy to build. Demonstration record \$1. Construction Manual \$3. Free folder. SOLOTRON COMPANY, 29641 Gilchrist, Farm-

WANTED

QUICK CASH . . . for Electronic EQUIPMENT, COMPONENTS, unused TUBES. Send list now! BARRY, 512 Broadway, New York, N. Y. 10012, 212 WALKER 5-7000.

CASH, SONY TRANSISTOR TV's etc. swapped for G.R. H-P, L&N etc. equipment. special tubes, manuals, military electronics. ENGINEERING ASSOCIATES, 428 Patterson Road, Dayton, Ohio

ELECTRICAL EXPERIMENTER, most issues 1913-1920 for cash, optical or electronic equipment or will swap Science and Invention. E. KAPRE-LIAN, 811 Phila. Rd., Joppa, Md. 21085

LABORATORY test equipment. ELECTRONI-CRAFT, P. O. Box 13, Binghamton, N.Y. 13902

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services): 60¢ per word . . . minimum 10 words.

NON-COMMERCIAL RATE (for individuals who want to buy or sell personal items): 30¢ per word . . . no minimum.

Payment must accompany all ads except those placed by accredited advertising agencies. 10% discount on 12 consecutive insertions, if paid in advance. Misleading or objectionable ads not accepted. Copy for February issue must reach us before December 10th.

WORD COUNT: Include name and address. Name of city (Des Moines) or of state (New York) counts as one word each. Zone or Zip Code numbers not counted. (We reserve the right to omit Zip Code if space does not permit.) Count each abbreviation, initial, single figure or group of figures or letters as a word. Symbols or groups such as 8x10, COD, AC, etc., count as one word. Hyphenated words count as two words. Minor over-wordage will be edited to match advance payment.

WANTED: Latest "National Radio Institute", Radio-Television Servicing Course, complete, with questions and answers. ALFORD N. LALUM, Brinsmade, N. Dakota 58320.

USED Coil winder machine (honey-comb) any make or brand. Send complete specification and price in U.S. dollar. SENEN F. FERNANDEZ, #2517-A, Sulu St. Sta. Cruz, Manila, Philippines.

SERVICES

METERS-MULTIMETERS REPAIRED and cali-brated. BIGELOW ELECTRONICS, Box 71-B, Bluffton, Ohio.

TRANSISTORIZED products dealers catalog, \$1. INTERMARKET, CPO 1717, Tokyo, Japan.

AUDIO - HI-FI

COMPONENT QUOTATIONS tapes Mylar 1800' postpaid \$1.59 each. BAYLA, Box 131RE Wantaugh, N.Y.

WRITE for highest discounts on components, recorders, tapes, from franchised distributors. Send for FREE monthly specials. CARSTON, 1686-R Second Ave. N.Y.C. 10028

RENT STEREO TAPES—over 2,500 different—all major labels — free brochure. STEREO PARTI, 1616 Terrace Way, Santa Rosa, Calif.

HI-FI COMPONENTS, Tape Recorders, at guaranteed "WE will not be undersold" prices. 15-day moneyback guarantee. Two-year waranty. NO Catalog. Quotations Free. HI-FIDELITY CENTER, 1797 (R) 1st Ave., New York, N.Y. 10028

TAPE RECORDER SALE. Brand new, latest models, \$10.00 above cost. ARKAY SALES, 1028-E Commonwealth Ave., Boston, Mass. 02215.

LOW LOW QUOTES, DYNA. A.R. GARRARD E.V. HI-FI, Roslyn, Pa. 19001

Rectifiers & Transistors

750 Ma-Silicon Diodes "Epoxy" or "Top Hat"

V PIV PIV PIV

0 5¢ 300 12¢ 600 21¢ 900 41

10 7¢ 400 14¢ 700 25¢ 1000 51

10 10¢ 500 18¢ 800 32¢ 1100 75

Full Leads, All tests, Guaranteed, American made Stiffen Power Diode Stude 100 Full Leads. Silicon Power Diode Studs

Amps	50 PIV	100 PIV	150 PIV	200 PIV
3	8¢	14€	16€	22€
15	25¢	50∉	65€	75€
18*	18¢	40¢	60€	70€
35	60	80	1.15	1.30
Amps	300 PIV	400 PIV	500 PIV	600 PIV
3	25¢	28∉	35€	40€
15 18*	90	1.30	1.40	1.65
	85	1.25	1.35	1.60
35	1.90	2.25	2.50	2.90
*Dross	Eit Dackson 4	014		

35 1.90 2.25 2.50 2.90

*Press Fit Package for Alternators
10 Watt Sil. Zener Stud 12-200 v, 20% 95¢ ea.
1 Watt Zener diode, axial leads 8-200v, 20% 50¢ ea.
Sil. diode Stud, 1500 PIV, 300ma 50¢ ea.
Sil. diode, 1500 PIV, 50ma, axial leads 35¢ ea.
Hi-Voltage-Silicon epoxy diode, 2½" x ¾" x ½"
Hoffman—3000 PIV-200ma \$1.49 ea.
Hoffman—6000 PIV-200ma \$3.49 ea.
Thermistor, bead, 900 or 1200 ohms, 600°F, 2/\$1.00
20 Watt Ger. (Int & Ext heat sink)
150 w Ger Power TD-3
2N1024 60¢ 2N1045 80¢
2N458A 90¢ 2N1022 1.25
2N458A 90¢ 2N511B 1.50
2N1021 1.00 (25 amp)
Silicon Power Transistors, 85 w, 2N1724 \$1.50
Philto Sil., NPN, 2N2479, new
HF Silicon, 2N702, 100 mc 40¢; 2N703-150 mc 60¢
Light Sensitive Resistor

Light Sensitive Resistor
75 ohms—10 meg, 100 volts, 150mow \$1.75 ea.

Varicap-Voltage Variable Capacitor 27, 47, or 100 pf, 4v, 4:1, new .

Silicon Controlled Rectifiers
1A 7A 16A PRV .75A 1A 7A 16A
20 .28 .48 200 .80 .90 1.05 1.70
40 .48 .70 300 1.20 1.30 1.60 2.20
.55 .70 1.20 400 1.70 1.85 2.10 2.70
.70 .80 1.50 500 1.95 2.05 3.80 3.30
at—1A 70.5—7A 600 2.30 2.50 3.00 3.90
ud PRV .75A 150 .60 . 75A Tophat-& 16A Stud Money back guarantee. \$2.00 min. order, include postage. Catalog 25¢.

Electronic Components Co. Box 2902B Baton Rouge, La. 70821

Circle 133 on reader's service card

HI-FIDELITY COMPONENTS, Ham Marine and Communication equipment at considerable savings. If you want to save money write us for our low prices on all your needs. AIREX RADIO CORP., 85 (RE) Cortlandt St., N.Y., N.Y. 10007

ALLWAVE RADIO KIT tunes police aircraft etc. tube and transistor included \$3.00 Headphones \$2.00. EKERADIO, Box 131, Temple City, California

STEREO TAPES. Save up to 60% (no membership fees, postpaid anywhere USA). Free 60-page catalog. We discount batteries, recorders, tape accessories. Beware of slogans "not undersold," as the discount information you supply our competitor is usually reported to the factory. SAXI-TONE, 1776 Columbia Road, Washington, D. C. 20009

EXPERIMENTERS. Stereo-reverberator mechanism—\$7.00 CAL'S Box 2, Dearborn, Michigan

MESHNA CONVERTER KITS convert car radio to short-wave receiver for police and fire. 30-50mc kit \$4.50, 100-200mc kit \$4.50. MESHNA, Lynn, Mass. 01901

STEREO AMPLIFIERS at bargain prices. Free brochure. HELIMA INTERNATIONAL, 366 Broadway, New York, N.Y. 10013.

BUSINESS AIDS

JUST STARTING IN TV SERVICE? Write for FREE 32 PAGE CATALOG of Service Order books, invoices, job tickets, phone message books, statements and file systems. OELRICH PUBLICATIONS, 6556 W. Higgins, Chicago, III. 60656. New Hyde Park 5, N.Y.

1,000 Business Cards, "Raised Letters" \$3.95 postpaid. Samples. ROUTH RE12, 2633 Randleman, Greensboro. N.C. 27406.

HOW COMPUTERS WORK. Send \$2.00 for this easy-to-understand booklet. ELECTRONICS RESEARCH LABORATORY. Box 67, St. Albans Station, New York, N.Y. 11412

BUSINESS

PIANO Tuning learned quickly at home. Tremendous field! Musical knowledge unnecessary. Information free. EMPIRE SCHOOL OF PIANO TUNING, Dep't. RE Box 327, Shenandoah Station, Miami, Florida 33145. (Founded 1935.)

New scientific transistor instrument detects buried coins, treasures. Will detect gold, silver, copper, iron, etc. \$19.95 up. Free catalog. RELCO A-25. Box 10563, Houston 18, Texas.



Prevent heartbreak and hunger across the world — each dollar sends a Food Crusade package through CARE, New York 10016.

PRICES LOWERED-NO MORE FEDERAL TAX-SAVE \$\$

The largest stock of obsolete tubes in the USA at the lowest prices—COMPARE

BRAND NEW UNITED'S FIRST QUALITY TUBES DISCOUNTS UP to

80%

GUARANTEED ONE FULL YEAR! NOT USED! NO PULLS! WHY PAY MORE?

Type Price	Type Price	Type Price	Type Price	Type Price	Type Price	Type Price	Type Price
00A/UV 200 .3.50	3LF42.45 3Q41.25	6ASS92 6AS692	6DJ8 1.65 6DK6 79	6171.69	7771.79	12EL895	1909 . 1.15
01A2.75 0A290	3052.00	6AS7 2.85	6DM496 6DN62.54	6J7G1.50	8AU8 . 1.39 8AW8 . 1.26	12EZ683	2050 . 1.25
OA4G . 1.50	3V485 4AU685	6A511 .1.90	6DN71.21	6J102.02 6J111.82	8B10 1.22	12F899	21EX6 .1.95 21GY5 .1.32
OB280	4AV670 4BA685	6AT8 11.39	6DQ5 .2.75	6JB6 2.25	88A81.24 88H8 .1.23	12FK679	21HB5 .1.65 21HJ5 .1.62
OB31.20 OC375	4BC580	6AU51.19	6DR71.32	6JC61.36 6JC81.04	8BNB . 1.11 8BQ5 99 8CG7 86	12FQ8 . 1.08	21KA6 .1.75
OG375	4BC887	6AU662 6AU754	6D551.19	6JE63.05	8CG786 8CM798	12FV7 :1.25	228H3 .1.07 228W3 1.21
0Y41.20 0Z490	4BN6 .1.30 4BQ7 .1.30	6AV51.45	6DT572	6JG6 . 2.08	8CN796 8C5798	12FX591 12FX8 .1.31	22DE498
1A31.49 1AS 2.00	48581.39 48U8 .1.19	6AV647	6DT8 . 1.29 6DV4 .224	6JH689 6JH81.48	8CW598 8CK8 1.60	12GA687 12GC6 .1.25	2329 . 2.69
1A62.00	48Z71.40	6AW8 .1.25	6DW4 .1.27 6DW5 .1.36	6JK81.35 6JM6 .1.67	8EB81.48	12GE5 .1.40 12GN7 .1.43	25A7 .3.25
1AB595 1AX275	4CB679	6AX489 6AX51.05	6DX8 . 1.05 6DZ4 . 1.34	6JN6 . 1.59 6JN8 . 1.30	8ET7 . 1.50 8F07 94	12GT5 . 1.65 12GW6 1.15	25AK4 .1.19
1AY298 18392	4CB575	6AX71.25 6AX81.28	6DZ72.89 6E51.74	6J562.95 6JT6 1.72	8GJ7 . 1.31 8GN8 1.29	12H61.40 12J51.61	25AX494
184P 2.00	4CY598 4DE695	6AY393	6EA51.29 6EA71.52	6JT8 . 1.45 6JUB . 1.09	8JV81.32	1218 . 1.58	2588 . 1.93
1C52.00 1C61.50 1D5GP98	4DK685 4DT677	6AZ8 . 1.98 6B4 5.95	6EB5 . 1.75	6JV81.33 6JZ8 1.28	8LC81.40	12JN6 .1.43 12JT6 .1.97	25C565
107 1.25	4EH7 .1.29 4EJ7 .1.29	6854.00 6861.00	6EB81.42 6EH5 .1.03	6K6GT .90	9AU794	12K5 . 1.19 12K7GT 2.25	25CD6 .1.94
1E5GP98	4EM6 .1.19 4E58 .1.55	6872.75	6EH7 1.25 6EH8 1.06	6K7G/	9CL8	12K8G 1.50 12K8M 2.95	25DN6 1.95
1F4 :95	4EW691 4GK5 .1.42	6810 . 1.19 68A3 . 1.05	6EJ71.28 6EM5 .1.15	6K8M .2.59	908 1.05	12L61.18 12L850	25F5 . 1.25 25L6
1F61.20	4GM6 .1.25 4G58 .1.15	6BA660 6BA71.85	6EQ5 . 1.10	6K111.29 6KA81.38	10BQ5 1.45	12Q7GT 1.39 12Q7M 1.50	25W487
1G392	4GZ586 4GZ61.19	6BA8 1.27 6BA11 . 1.25	6EQ71.00 6ER51.29	6KE893	10DE7 1.14	12R5 1.07 125A7 . 1.49	25751.50 257694
1G61.50 1H41.25	4HA5 .1.85 4HA7 .1.19	6BC4 1.98 6BC5 72	6E55 . 1.03 6E58 . 1.97	6KM8 1.16	10DK8 1.05	125C7M 1.89 125F5 1.30	261.40
1H598	4HC7 .1.39 4HM691	6BC7 . 1.27 6BC8 1.35	6EU793	6KU81.63	10EM7 1.62	125F7 .2.23 125G7M 1.54	27G85 1.49
11392	4H58 .1.18 4HT682	68D47.00 68D5 1.20	6EU8 1.12 6EV5 . 1.02	6KY8 . 2.65	10GN8 1.29	125H7 1.75 125J7 1.40	30 1.25
1J698 1K392	4JC6 . 1.20 4JD6 . 1.20	68D683	6EV799 6EW685	6L5G1.50	10HT8 1.21	125KG7T	321.15
1L466	5AM8 1.30 5AN8 1.35	6BE399	6EW7 .1.84 6EX62.74	6L6GA .1.48	10JY8 1.49 10KU8 1.73	125K7M 1.47 125L7GT	32L785
1LA4 . 1.30 1LA6 . 1.49	5AQ576 5AR41.49	68F51.19	6EZS . 1.15	6L6GE 1.50	10Y95	125N7 1.28	32GY7 1.95
1LB41.80	5AS8 1.50 5AT8 1.27	6BF865	6EZ8 . 1.29 6F4 4.75	6L6M 3.00 6L7M 2.48	11CY7 .1.10	125Q7GT 1,29	34 DG5A .95
11.05 : 1.80	5AU4 1.17 5AV8 1.37	6BG6 .2.19	6F5GT 1.72 6F6G 1.95	6L7G1.75 6LB81.49	11KV8 .2.15	125R7 .1.79	35.51 .1.50
ILE31.25	5AW4 .1.00 5AZ4 . 1.85	68H689 68H8 .1.24	6F73.95 6F83.08	6LC81.40 6LF81.28	12A5	12V6 . 1.15 12W6 . 1.15	35851.07
1LH4 .2.69	5881.99 58C389	68H11 .1.60	6FA799 6FB3.08	6M11 1.81	12A72.95	12X468 13CW4 1.60	35EH574
1N51.85	5BE81.10 5BK71.19	68J683 68J71.05	6FD61.45 6FD71.70	6P5 2.50 607 1.95	12A11 1.69	13DE7 1.01 13DR7 1.15	35W435
1051.95	5BQ71.35 5BR81.25	6BJ8 . 1.19	6FG5 1.25	6011 1.29	12AC675	13EM7 1.61 13FD7 1.66	35231.54
1R599	58T81.12 58W8 .1.13	6BK51.25	6FG6 1.12 6FG7 1.10	65476	12AE680 12AE7 .1.35	13FM7 1.08 13GB5 .1.36	361.50
1541.49	5CG8 .1.12 5CL8 .1.25	6BL71.26	6FG81.75 6FH595	658GT 1.50 65A7GT 1.39	12AF3 .1.25	13GF7 1.70 13J10 1.83	37 1.10
1174 ::::99	5CM8 .1.25 5CQ8 .1.35	6BM8 1.03 6BN4 1.05	6FJ5 . 2.25	65A7M 1.49	12AG6 .1.49	14A41.45 14A51.35	39/4495
10499	5CZ51.49 5DE81.15	68N6 1.03	6FJ7 . 1.24 6FM7 . 1.18	65C7 . 1.52 65D7 . 1.49	12AJ686	14A7 1.85 14AF7 . 1.85	421.98
ivi.85	5DHB 1.95 5DJ4 . 1.12	68QS79 68Q6/	6FQ5A 1.35	65F51.08	12AL8 2.23	14861.85 14881.95	45/2A3 3.25
1X2B95	5ES82.21	6CU6 1.45	6F\$51.35	65G7 : 1.55	12AQ586	14C51.75 14C72.19	4695
2A5 2.50	5EU8 .1.23 5EW698	6BR8 1.29	6FV8 . 1.06	65J7GT 1.49	12AT7 .1.03	14E61.39 14E71.39	484.00
2AF4A 1.31	SFG792 SFV81.05	68V894	6FW8 .3.49	65K7GT 1.30	12AU783 12AV5 1.48	14F7 . 2.95 14F8 . 2.23	501.75 50A1 2.60
2AH2 .1.10	5GJ71.62	68W498 68W8 .1.18	6FY7 ::1:14	65K7M 1.38 65L7GT 1.19 65N7GT .89	12AV656	14GT895	50AS 2.10 50B5 86
2AV295	5GM690	6BX7 . 1.75	6G6G 2.25	65Q7GT 1.25	12AW6 1.10	14N7 1.95	50C565 50DC463
2871.95	5HC7 .1.49 5HG8 .1.69	68Y689	6GB51.35	6557M 1.88	12AX485 12AX691	14R7 2.35	50EH572 50FE5 .1.44
2CY5 1.08	5KD8 .1.35	6BZ670 6BZ71.35	6GE51.39	65U7 . 2.00	12AX787 12AY396	14W7 1.85	50FK579 50FY8 .2.50
2DZ41.40 2EA51.35	5KE8 1.70 5T4 3.75 5T8 1.25	68Z81.49	6GF51.27	65Z71.25	12AY7 .1.55	1474 1.75	50HC686 50HC889
2EN581	5U470 5U8114	6C5M .1.63	6GH8 1.06	6TB 1.15	128497 128A656	15BD11 1.73	50HK677 50L681
2FH5 .1.30 2FO5 .1.85	5V31.30	6C8G .2.95 6C9 .2.00	6GJ71.22 6GK51.39	6U5/ 6G5 .2.35	128A7 .1.90 128D677	15FY7 .1.18 15HB6 1.25	50X6 1.96 50Y6 1.49
2F55 . 2.45 2FY5 . 1.39	5V675	6C10 .1.53 6CA470	6GK698	6U8 1.12 6U10 1.32	12BE393 12BE659	15KY8 .1.63 16A0392	53 3.50
2GK5 .1.40 2GU5 .1.50	5X4 . 1.05 5X8 . 1.20	6CA5 1.05	6GM5 .1.09 6GM694	6V31.67 6V459	12BF668 12BH796	16GK593 16GK6 1.15	561.25
2GW5 .2.20 2HK598	5Y359 5Y459	6CB554	6GM8 .1.81 6GNS .1.33	6V6GT74 6W483	12BK5 .1.28 12BL689	16GY5 .1.90 17AX391	581.50
2X260 2X2A .1.95	5231.30 524 2.75	6CD61.93	6GQ7 . 1.89 6GR7 . 1.42	6W6GT98	12BQ6/	17AX492	60FX587
3A21.20 3A31.18	6A32.75 6A42.20	6CB579	6GU5 1.54	6X5GT72 6X8A1.05	12BR7 1.08	178F11 1.57	71A1.25
3A474 3A51.10	6A61.75 6A72.90	6CG775 6CG895	6GV5 . 1.65	6Y6GA .1.45 6Z4/84 1.22	12BS3 .1.21 12BT3 .1.00 12BV7 .1.20	17BH398 17BQ6 .1.65	761.50
3A8GT .1.25 3AF4 .1.40	6A8GT 2.50 6A8M .2.39	6CH8 .1.95 6CK41.00	6GV6 . 1.85 6GV8 . 1.12	7A42.25 7A51.95 7A62.25	12BW4 .99 12BY7 .1.09	17C5 . 2.30	781.65
3AT2 .1.10	6AB476 6AB72.10	6CL53.75	6GW6 .1.39	7A72.35	12BZ676	17D496	811.35
3AV666	6AC5 . 2.12 6AC7 . 1.75	6CM6 .1.10	6GX71.70	7AD71.25	12C5/ 12CU5 84	17DE4 :1:12	83 1.75 83V3.00
382 2.49	6AE5	6CM8 1.43	6GY5 . 1.49	7AG72.10	12CA5 . 1.00	17DQ6 1.33	84/624 1.35
38A686	6AF4	6CQ4 . 1.07	6GY8 . 1.29	7AU783	12CR694	17EW899	891.50 89Y2.00
3BC584 3BE675 3BN4 .1.05 3BN8 .1.15 3BN6 .1.29	6AF4 1.35 6AF6G 2.10 6AF11 1.70 6AG5 89 6AG7 1.95 6AG11 1.34 6AH4 1.19	6CQ4 1.07 6CQ7 1.80 6CQ8 1.15 6CR6 .81 6C56 .85 6C57 .98	6GZ598 6HA5 1.39 6HA6 1.88 6HB5 1.52 6HB6 1.59 6HB7 1.08	784	12CT8 1.45	17GE5 .1.34 17GJ5 .1.82 17GV5 .1.48 17GW6 1.38	89Y . 2.00 417A 5.25 127L7 3.29 117M7 3.25 117N7 4.25 117P7 4.25 117Z3 1.56 117Z6 2.29
38V8 1.15	6AG7 1.95	6C5685	6HB5 . 1.52		12CX6 1.53	17GW6 1.38 17H379	117N7 3.25
3BN6 .1.29 3BY699 3BZ679	6AH4 . 1.19 6AH6 . 1.49	6CU584	6HB61.59 6HB71.08 6HD52.19	7C41.15 7C51.19	12D499 12DB594	17HC8 1.24 17JB6 1.89	11773 1.56
3CB679	6AJ52.25	6CU584 6CU61.45 6CU81.49	6HE5 . 1.34 6HF5 . 2.69	7062.69	12DE592 12DE8 1.12	17JG6 2.02 17JM6 1.65	5881 . 2.0
	6AH4 1.49 6AJ5 2.25 6AJ8 1.95 6AK5 1.49 6AK6 .94 6AL3 .99	6CWS 1.20	6HF8 . 1.42	784 2.35 785 2.75 786 1.25 787 2.50 788 2.00 7C4 1.15 7C5 2.69 7C7 1.23 7E5 2.00 7E6 1.25 7E7 1.95	12DK682 12DK7 .1.00	17JN6 .1.70 17JZ8 .1.19	5881 . 2.05 6146 . 2.56 6146W 5.95 6336 . 4.75 6336A 9.50
3CY51.15 3D61.48	6AL399	6CY5 1.03	6HG8 1.48 6HJ5 2.10	7E71.95 7EY61.06 7F72.59	12DL8 2.12 12DQ6 1.44	17L6 . 1.45 17LD8 .1.35	6336A 9.50 6550 3.25
3DG4 1.25 3DK882	6AL7 1.95 6AL11 1.50	6CU5 .84 6CU6 1.45 6CU8 1.49 6CW4 1.59 6CW5 1.20 6CX8 1.42 6CY5 1.03 6CY7 1.05 6CZ5 1.48 6CZ7 1.95 6D4 1.75	6HJ8 1.12	7F72.59 7F83.00	12D07 1.18 12D57 1.35	18A5 . 1.34	6550MP 7.00 7258
3CF690 3CS665 3CY51.15 3D61.48 3DG4 1.25 3DK882 3DT674 3DZ4 1.40 4EH7 1.30	6AH6 1.49 6AJ8 1.95 6AJ8 1.99 6AK5 .94 6AK3 .99 6AL7 1.95 6AL7 1.19 6AM4 1.19 6AM8 1.19 6AN4 2.27 6AN5 1.95 6AN6 2.45 6AN8 2.45 6AN6 2.45 6AN6 6.99 6AO5 69 6AO5 69	6CW4 1.59 6CW5 1.20 6CX8 1.42 6CY5 1.03 6CY5 1.05 6CZ5 1.48 6CZ7 1.95 6D6 2.50	6HL8 . 1.11 6HM5 . 1.37	7G71.99	12C06 95 12C18 95 12C18 95 12C18 95 12C18 95 12C06 98 12D85 94 12D85 94 12D85 94 12D85 94 12D88 132 12D18 132 12D18 133 12D17 130	17GES 1.34 17GUS 1.82 17GUS 1.48 17GUS 1.48 17GWS 1.38 17HC8 1.39 17HC8 1.24 17J86 1.89 17J86 1.65 17J86 1.65 17J86 1.65 17J8 1.19 17L8 1.19 17L8 1.19 17L8 1.35 18FW6 1.34 18FW6 68 18FW6 1.44 18FW6	89Y . 2.00 417A 5.25 117H7 3.29 117H7 3.23 117F7 4.25 117Z6 2.25 5881 2.05 6146 2.96 6146 2.96 6336 4.76 6336 4.76 6336 4.76 6336 4.76 6350 MP 7.00 6550 MP 7.00 758 809 . 3.75 ECC83 7.75
SEH7 1.30	6AN4 2.27 6AN5 1.95	6D10 .1.59 6DA498 6DA5 .1.08 6DB5 .1.99	6HQ5 1.72 6HR698	7HG81.29 7J72.50 7K72.96	12DU7 1.39	18GD664	ECC83/ 12AX7 .90 EL34/ 6CA7 .1.85 EL34/
JEJ71.25 JERS .1.20 JFH595	6AN6 . 2.45 6AN8 . 1.35	6DA5 . 1.08 6DB5 . 1.99	6H5698 6H5898	7L71.99	12DV8 .1.33 12DW7 1.10	19AU4 1.26	EL34/ 6CA7 .1.85
	6AM8 1.25 6AN4 2.27 6AN5 1.95 6AN6 2.45 6AN8 1.35 6AQ569 6AQ689	6D4 1.75 6D6 2.50 6D10 1.59 6DA4 98 6DA5 1.08 6DB5 1.99 6DB6 1.01 6DC6 1.28	6HK5 1.11 6HM5 1.37 6HQ5 1.72 6HR6 .98 6HS6 .98 6HS6 1.08 6HT6 1.19 6HZ6 98	707		198G6 .1.95 198Q6 .2.35 19C8 .1.25 19CL8 .1.17	EL84/ 6BQ585
IGK5 11.40 IGS8 11.15 IGW598 IHA5 11.49	6AQ689 6AQ7 .1.37 6AQ8 .1.08	6D86 . 1.01 6DC6 . 1.28 6DC8 . 1.07 6DC6 . 1.28	6HZ81.85 6H694	757 11.79		19AU4 1.26 19BG6 1.95 19BG6 2.35 19C8 1.25 19CLB 1.17 19EAB 1.09	6V455
3GW598 3HA5 .1.49 3HK5 .1.23 4HM5 .1.53	6AQ7 1.37 6AQ8 1.08 6AR5 91 6AR6 1.50 6AR8 2.00		6HKS 1.19 6HL8 1.11 6HM5 1.37 6HQ5 1.72 6HR6 98 6HS6 1.98 6HS6 1.08 6HT6 1.19 6HZG 98 6HZ6 1.85 6HG 94 6J5G 1.10 6J5G 1.10 6J5G 1.56 6J5M 1.25 6J6A .67	7HG8 1.29 7J7 2.50 7K7 2.96 7L7 1.99 7K7 2.61 7G7 1.65 7K7 2.25 7S7 1.79 7V7 1.65 7W7 2.39 7X6 1.35 7X7 2.75 7Y4 2.35	12DY8 2.90 12DY594 12EA691 12EC8 1.22 12ED598 12EG6 1.03 12EK698	19EAB .1.09 19GQ7 .1.99 19H5685 19HV8 .1.23 19JN8 .1.04	68Q585 EZ80/ 6V455 GZ34/ 5AR4 .1.50 KT-88 .4.95 KT-88MP
HMS 1.53	6AR8 2.00 6AR11 .1.48	6DE685 6DE7 .1.14 6DG692	6J6A67	7X7 2.75 7Y4 2.35	12EK698 12EL669	19HV8 1.23 19JN8 1.04	KT-88MP
	111	CEND FOR C	OMPLETE DARTE	CATALOG WIT	THOUT COCT	1200.10 . 2.04	11.00

SEND FOR COMPLETE PARTS CATALOG WITHOUT COST
TERMS: Minimum order \$5.00 exclusive of postage. Remit full price plus postage. No
C.O.D. The above list does not reflect our entire stock as we have one of the largest
selections of SPECIAL PURPOSE. BROADCAST & TV TUBES in the U.S. Write for auditation.

UNITED RADIO CO.

ESTABLISHED 1920 BOX 1000R, Dept. RE-12 NEWARK, N.J. ABOVE PRICES
SUBJECT TO CHANGE
WITHOUT NOTICE

SEND FOR COMPLETE PARTS CATALOG

-THIS AD CANCELS ALL PREVIOUS QUOTATIONS BY MAIL OR ANY OTHER ADVERTISING MEDIUM

Circle 134 on reader's service card

MARKET CENTE

DISTRIBUTOR WANTED

No competition. To service and set up new accounts in exclusive territory. Investment secured by fast moving inventory of amazing plastic coating used on all types of surfaces interior or exterior. Eliminates waxing when applied to any type of floor. Eliminates all painting when applied to wood, metal or concrete surfaces.

> Minimum Investment-\$500 Maximum Investment—\$12,000

For details write or call: Phone: 314 AX-1-1500 MERCHANDISING DIVISION P. O. BOX 66 ST. ANN, MISSOURI 63074

→ SUB CARRIER DETECTOR ←



Add programs of commercial-free music thru your FM tuner. Detector, self-powered, plugs into multiplex output of tuner or easily wired into discriminator and permits reception of famous background music programs now transmitted as hidden programs on the FM broadcast band from coast to coast. Use with ANY FM tuner.

WIRED UNIT \$75.00
KIT, with pretuned coils,
no alignment necessary \$49.50
crystal-controlled receivers available

MUSIC ASSOCIATED 65 Glenwood Road Upper Montclair, New Jersey phone 744-3387 area code 201

EMPLOYMENT OPPORTUNITIES

FLORIDA EMPLOYMENT. List of Florida Electronic-Aerospace Firms \$3.00. J. ROTHFUSS, P.O. Box 966, Lake Worth, Florida 33460.

ELECTRONICS

FREE CATALOG of 200 special slide rules and calculating aids. DYNA-SLIDE, 600 South Mich-igan, Chicago, Illinois 60605

TV CAMERAS, transmitters, converters, etc. Lowest factory prices. Catalog 10¢. VANGUARD, 190-48-99th Ave., Hollis, N.Y. 11423.

BARGAINS in Canadian Electronic equipment and surplus. Send \$1.00 for giant catalogs. ETCO, Dept. R, 520 Fifth Avenue, New York 36, N.Y.

SEMI-SWEEPER sweep generator circuit boards. Refer September issue RADIO-ELECTRONICS, \$1.00. PAULIN SALES, Box 122, Upland, Cali-

PROFESSIONAL ELECTRONICS PROJECTS — Organs, Timers, Computers, etc.—\$1 up. Catalog 25¢, refundable, PARKS, Box 25565, Seattle, Wash, 98125.

BEFORE You Buy Receiving Tubes, Transistors, Diodes, Electronic Components & Accessories send for Giant Free Zalytron Current Catalog, featuring all STANDARD BRAND TUBES all Brand New Premium Individually Boxed. One Year Guarantee—all at BIGGEST DISCOUNTS in America! We serve professional servicemen, hobbyists, experimenters, engineers, technicians. WHY PAY MORE? ZALYTRON TUBE CORP., 469R Jericho Turnpike, Mineola, N.Y. 11502

CLASSIFIED ADVERTISING ORDER FORM complete data concerning classified advertising please refer to box elsewhere in Market Center section. 10 14 13 19 20 17 18 16 25 23 22 29 30 27 35 34 32 No. of Words (@ .60 Commercial Rate) =\$. NAME ADDRESS Total Enclosed \$. Payment must ac-company order un-less placed through accred-ited advertising ZIP STATE Insert ____time(s) SIGNATURE MAIL TO: RADIO-ELECTRONICS, CLASSIFIED AD DEPT., 154 WEST 14TH ST., NEW YORK, N.Y. 10011 Starting with_ __issue agency

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below-

Acoustic Research, Inc. 9 Allied Radio Corp. 75	
Birnbach Radio Co., Inc	
Corp.) 25 Blonder-Tongue 13	
Brooks Radio & TV Corp. 92-93 Burstein-Applebee Co. 65	
Capitol Radio Engineering Institute, The 11 Castle TV Tuner Service, Inc 6	
Classified	
Cleveland Institute of Electronics 8, 60-63 Conar (Div. of National Radio Institute) 73 Cornell Electronics Co	
DeVry Technical Institute 5	
Edlie Electronics, Inc	
Electro-Voice, Inc. 10 Electronic Measurement Corp. (EMC) 88	
Fair Radio Sales	
Gernsback Library, Inc	
Heald's Engineering College	
Hy-Gain Electronics Corporation	
International Crystal Mfg. Co., Inc	
Jackson Electrical Instrument Company 12	
Jerrold Electronics Corporation (Distributor Sales Division) 81	
JFD Electronics Corp. 7 Krylon 22	
Lafayette Radio Electronics	
Mallory Distributor Products Company (Div. of P.R. Mallory & Co., Inc.)	
Milwaukee School of Science & Engineering 97	
Multicore Sales Corp. 75 National Radio Institute 16-19	
Olson Electronics. Inc. 72	
Oxford Transducer Company (A Division of Oxford Electric Corporation)	
Poly Paks 101	
Precise Electronics & Development (Div. of Designatronics, Inc.) 2	
Progressive "Edu-Kits" Inc. 89	
Radar Devices Manufacturing Corp. 1 Radio Shack 102	
Ray Tel (Raytheon) 91 RCA Components & Devices	
Tube Division Fourth Cover RCA Institutes, Inc. 26-29	
Rye Sound Corporation 82	
Sams & Co., Inc., Howard W	
Schober Organ Corp., The 24 Sencore 90	
Tarzian, Inc. Sarkes (Tuner Service Div.) 14	
Triplett Electrical Instrument Company, The Second Cover	
Turner Microphone Company, The 80)
United Radio Co. 99 University Sound (Div. of LTV Ling Altec, Inc.) 72	
Warren Electronic Components 95	
Weller Electric Co. 88 Wen Products, Inc. 68	
Windsor Electronics, Inc. 82 Winegard Co. 74	!
MARKET CENTER 98-101	
Edmund Scientific Corp.	
Electronic Components Co. Music Associated	
Penguin Plastics & Paint Corp. Vanguard Electronic Labs	
SCHOOL DIRECTORY	
Coyne Electronics Institute	
Grantham School of Electronics	
Indiana Home Study Institute	
Milwaukee School of Engineering Northrop College of Science & Engineering	

RADIO-ELECTRONICS

TRANSISTOR IGNITION! Coil, ballast 7.95 Free parts lists. TRANSFIRE Carlisle 20, Mass. 01741

TRANSISTOR ignition kits, components. Free diagrams. ANDERSON ENGINEERING, Epsom, N.H. 03239

RADIO & TV TUBES 33¢ each. One year guaranteed, Plus many unusual electronic bargains. Free catalog. CORNELL, 4217-E University, San Diego, California 92105

36 PAGE CITIZENS BAND CATALOG. All major brands and accessories. 10¢ Dealer inquiries invited. KNOX ELECTRONIC, Dept. RE-2, Galesburg, III. 61401

TUBES. "Oldies", latest. Lists free. STEINMETZ, 7519 Maplewood, Hammond, Indiana, 46324.

FREE Catalog. Electronic parts, tubes. Wholesale. Thousands of items. Unbeatable prices. ARCTURUS ELECTRONICS RE, 502-22 St., Union City, N. J. 07087

McGEE RADIO COMPANY. Big 1966 catalog sent free. America's best values, Hi-Fi-amplifiers-speakers-electronic parts. Send name, address and zip code number to McGEE RADIO COMPANY, 1901 McGee Street, Dept. RE, Kansas City, Missouri 64108

TELEVISION CAMERAS transistorized also montors. SPERA ELECTRONICS, 37-10 33 Street Long Island City, N. Y.

GOVERNMENT SURPLUS Jeeps from—\$52.50, Voltmeters from—\$1.05, Transmitters from—\$6.18, Oscilloscopes, Walkie-Talkies, Multimeters. Typical "As Is" Bid Bargains from Uncle Sam. Tremendous variety. Exciting free list. Write: ENTERPRISES, Box 402-F4, Jamaica, New York 11430.

METAL DETECTORS and kits, powerful, sensitive, light-weight, rugged. High-quality circuits, low cost. ELECTRONIC DEVELOPMENT, INC.; 2538-R Colorado, Sarasota, Florida.



Christmas Seals protect all homes.
Help protect your home against tuberculosis and other respiratory diseases. Answer your Christmas Seal letter today!





GIANT 20th Anniversary Catalog. TV Cameras and Electronic Equipment. FREE copy. DENSON ELECTRONICS, Rockville, Conn.

T.V. Servicemen. Write for free list of good buys on parts. M & S ELECTRONICS, Box 3971, Wichita, Kansas 67216.

EXPERIMENTERS, BUILDERS giant catalog—25¢, refundable. LABORATORIES, 993-B, Redwood City, California 94064.

EDUCATION/ INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING. New home study course covering all makes electronic organ including transistors. Experimental kits—schematics—trouble-shooting. Accredited NHSC-GI Approved. Write for free booklet. NILES BRYANT SCHOOL, 3631 Stockton Blvd., Dept. F, Sacramento 20, Calif.

HIGHLY—effective home study review for FCC commercial phone exams. Free literaturel COOK'S SCHOOL OF ELECTRONICS, Craigmont, Idaho 83523.

FCC LICENSE in 6 weeks. First Class Radio Telephone. Results Guaranteed. ELKINS RADIO SCHOOL, 2603E Inwood, Dallas, Tex.

SLEEP LEARNING. Hypnotism! Tapes, records, books, equipment. Details, strange catalog FREE. RESEARCH ASSOCIATION, Box 24-RD, Olympia, Wash

BROADCASTING, Communications Electronics taught quickly—resident classes; correspondence. Free details. Write: Dept. 4, GRANTHAM SCHOOLS, 1505 N. Western, Hollywood, Calif.

RADIO/TELEVISION SERVICING. Train at home in your spare time. Keep your job and still earn while you learn. No contract to sign. Write for particulars on Coodinated Taining Units. SPRAY-BERRY, Dept. CS-468-MW, 1512 Jarvis Avenue, Chicago, Illinois 60626.





COAST-TO-COAST

Phoenix: 3905 East Thomas Rd

Phoenix: 3905 East Thomas Rd.

Anahelmi: 507 East Katella Ave.
Bakersfield: 1308 19th 51.
Long Beach: 3976 Allantic Ave.
Misslon Hills: 10919 Sepulved a Blvd,
Reseda: 19389 Victory at Tampa
Torronce: 22519 Howthorne Blvd.
West Covine: 2516 East Workman Ave.
West Covine: 2516 East Workman Ave.
West Covine: 2516 East Workman Ave.
West Long 2516 East Workman Ave.
Covine: 3076 East Mortand Ave.
West Covine: 2516 East Mortand Ave.
Covine: 3076 East Mortand Ave.
Long 11.
L

Denver: 798 South Santa fe

CONNECTICUT

Hamden: Hamden Mart. Shop. Ctr.
Manchester: Manchester Shop. Parkade
New Haven: 92 Yort St.
New London: New London Shop. Ctr.
Stamford: 29 High Ridge 8d.
West Hartford: 39 So. Main St.

ILLINOIS
Chicago: Evergreen Plaza at 95th St.
MAINE
Portland: Pine Tree Shop. Ctr.
MARYLAND

Langley Parke Hampshire-Langley Sha MASSACHUSETTS Shop. Ctr.

Boston:
167 Washington St.
167 Washington St.
167 Washington St.
110 Federal S

MINNESOTA St. Paul: 473 North Snelling

St. Louis: 1125 Pine St. (Walter Ashe Div.) NEW HAMPSHIRE Manchester: 1247 Elm St.

NEW MEXICO Albuquerque: 6315 Lomas, N. E.

NEW YORK

Binghamton (Vesial), Vestal Shop, Plaza

Birtigo (Clarence), Transitions Shop, Cfr.
New York: 1128 Ave. of the Americas
Schenectagy (Rotterdam), Shopporama Cfr.
Syracuse: 3057 Erie Blvd. East

OHIO Cincinnati: 852 Swift OKLAHOMA
Oklahoma City: Mayfolr Shop. Ctr.
Tulsa: 2730 South Harvard

OREGON Portland: 1928 N. E. 42nd St.

PENNSYLVANIA Philadelphia: 2327G Cottman Ave., Roosevelt Mall 1128 Walnut St.

1128 Walnut St.
RHODE ISLAND
Cranston: 1301 Reservoir Ave.
East Providence: Shappers' Town
Abilene: 2910 North First St.
Advington: Collins at Park Row
Brownsville: 847 S. E. Elizabeth St.
Dallas:

Arlington with the state of the

2615 Yess on the Vision of the

VIRGINIA Shop. Cfr.

Arlington: Washington-Lee Shop. C WASHINGTON

Seattle: 2028 Third Ave. 837 N. E. 110th St.

LOWEST PRICE IN THE COUNTRY FOR A 3-WATT CB TRANSCEIVER

2 FOR \$78.00

- Built-in Mike/Speaker
- Push-to-Talk Lever
- Range up to 8 Miles Send and Receive Ch. 5
- Crystals Supplied Operates on 117 VAC

RADIO SHACK stuns the CB world with the most powerful and ONLY 3-watt transceiver on the market under \$60! Operates on 117 VAC.

"Intercom-type" mike/speaker: depress lever to talk . . or raise to talk continuously . release to listen. Arm's length communication with exceptionally clear modulation! Range up to 8 miles. No tangle of wires, no separate microphone, no batteries. Built-in 34" telescoping antenna, separate external antenna input; special low-power switch for optional 'no license' power. Built-in squelch control! Both send and receive are crystal-controlled with plug-in Ch. 5 crystals supplied. Crystals for other channels only \$2.49 each. Handsome \$1/2" x 51/2" x 5" beige moided case. If CB is for you, our price is irresistible! Mail order today or shop in person at your nearest Radio Shack. or shop in person at your nearest Radio Shack. 21-1160. Ship. wt. 4 lbs.

RADIO SHACK'S BEST SELLING WALKIE TALKIES

Walkie-Talkie

3995 Each Sinals Singly

Dual-Channel. Use with SELECTACOM. 100 mw. output. #21-904.

Same as above with 12 trans., battery #21-906. \$49.95

6-Transistor Walkie Talkie

2195 Each . Singly

Up to 1 Mile. Tunes with SELECTaCOM. 100 mw. output. #21-1139.

Same with 9 trans. Up to 2 miles. #21-1001. \$29.95.



"Space Patrol" Walkie-Talkie

Q50 Each in

America's favorite wired hand radio. Ready to use; not a kit! Talk up to 1/4 mile! #60-3030.



AC/DC POWER SUPPLY CONVERTER

Operate any of the 100 mw. Walkie-Talkies above on 117 VAC house current. Conserve battery power. Sturdy tabletop stand for base station operation. 2x3½x4½". #21-1002.

MAIL TO YOUR NEAREST RADIO SI	HACK	STORE
☐ Please send items I have checked at right. ADD 50¢ PER ORDER FOR PACKING AND SHIPPING		1160, SELECT
NAME (print)	21-	906, TRC-33 904, TRC-22
	21-	1139. TRC-1

☐ Send me a FREE 1966 Catalog.

STREET

CITY_ STATE ZIP

21-1160, SELECTaCOM

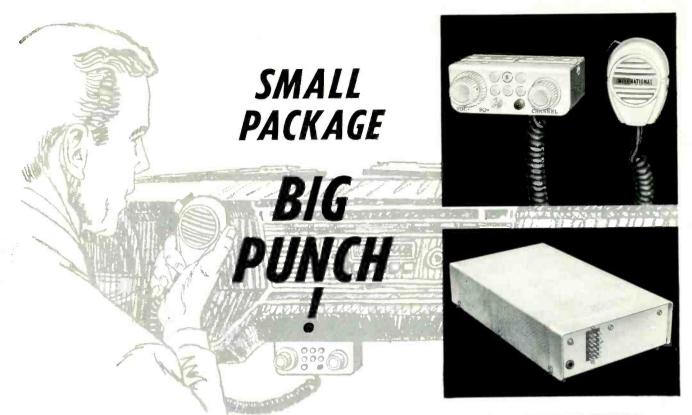
60-3030, Space Patrol 21-906, TRC-33

21-1139, TRC-1

21-1001, TRC-2 21-1002, Converter

RE-1265

Circle 136 on reader's service card

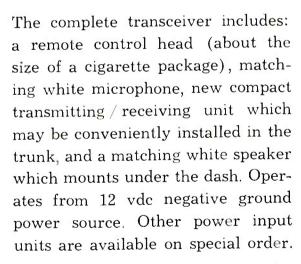


INTERNATIONAL Model MO TRANSCEIVER For CITIZENS RADIO SERVICE

- New Compact Size
- New Solid-State Crystal Switching Circuit
- New Photo-Control Volume Circuit
- New Remote Control With Matching Microphone

The International Model MO Citizens Radio transceiver, custom designed for mobile installation, provides instant push-to-talk crystal controlled operation on any 6 channels with full 5 watts power input. The new compact control head provides complete remote controlled operation. All circuits are dc using solid-state crystal switching. The operating channel is indicated by an illuminated button on the control head. Tubes and silicon transistors are combined to provide a rugged trouble-free circuit.

FCC Citizens Radio license required. All use must conform with Part 95, FCC Rules and Regulations.



See the "all new" International Model MO at your dealer today.



CRYSTAL MFG. CO., INC.

18 NO. LEE . OKLA. CITY, OKLA, 73102



WHY? Because RCA's Hi-Lite line represents a big step forward in color picture brightness—brightness that is unsurpassed in the color TV industry. Rare-earth phosphors applied by RCA's advanced screening methods create brighter reds, better contrast and natural, vivid colors . . . Everything the smart customer wants. Are you ready to service your smart customers? Keep posted. See your RCA Distributor today.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

