

Solar power & basic IC projects

60c ■ DEC. 1967

Radio-Electronics®

TELEVISION · SERVICING · HIGH FIDELITY

A
GERNSBACK
PUBLICATION

BUILD

Flutter Meter
Transmitter Monitor
Hi-Intensity Lamp

SPECIAL FEATURE
Career Opportunities
Your future in electronics

SERVICE

TV Vertical Sweep
Rotary Stepping Switches



A1068 64,5028XGN0032E0A5M
4
PA 174 03
A R WAGNER
32 N EAST ST
YORK

Stereo Tape Recorder Syncs
Slide Projector Automatically

(See page 32)

**WORLD'S LARGEST SELLING
AND WORLD'S NEWEST**

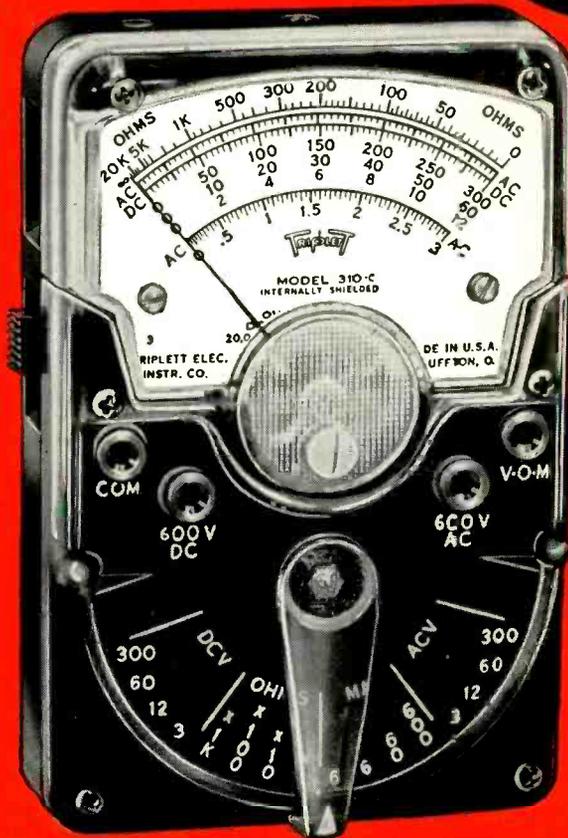
Hand Size v-o-m's



MODEL 310-C
World's Newest
Volt-Ohm-Milliammeter



MODEL 310
World's Largest Selling
Volt-Ohm-Milliammeter



**BOTH TESTERS
SHOWN
ACTUAL SIZE**

- 1** HAND SIZE AND LIGHTWEIGHT, but with the features of full-size V-O-M's.
- 2** 20,000 OHMS PER VOLT DC; 5,000 AC (310)—15,000 AC (310-C).
- 3** EXCLUSIVE SINGLE SELECTOR SWITCH speeds circuit and range settings. The first miniature V-O-M's with this exclusive feature for quick, fool-proof selection of all ranges.

SELF-SHIELDED Bar-Ring instrument; permits checking in strong magnetic fields. FITTING INTERCHANGEABLE test prod tip into top of tester makes it the common probe, thereby freeing one hand. UNBREAKABLE plastic meter window. BANANA-TYPE JACKS—positive connection and long life.

Model 310—\$42.00 Model 310-C—\$53.00 Model 369 Leather Case—\$4.00

ALL PRICES ARE SUGGESTED U.S.A. USER NET, SUBJECT TO CHANGE

THE TRIPLET ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

310-C PLUS FEATURES

1. Fully enclosed lever range switch
2. 15,000 Ohms per volt AC (20,000 O/V DC same as 310)
3. Reversing switch for DC measurements

MODELS 100 AND 100-C

Comprehensive test sets. Model 100 includes: Model 310 V-O-M, Model 10 Clamp-on Ammeter Adapter; Model 101 Line Separator; Model 379 Leather Case; Model 311 leads. (\$78.00 Value Separate Unit Purchase Price.)

MODEL 100—U.S.A. User Net..\$74.00
MODEL 100-C—
Same as above, but
with Model 310-C,
Net.....\$84.00



USES UNLIMITED: FIELD ENGINEERS • ELECTRICAL, RADIO, TV, AND APPLIANCE SERVICEMEN • ELECTRICAL CONTRACTORS • FACTORY MAINTENANCE MEN • ELECTRONIC TECHNICIANS • HOME OWNERS, HOBBYISTS
THE WORLD'S MOST COMPLETE LINE OF V-O-M's • AVAILABLE FROM YOUR TRIPLET DISTRIBUTOR'S STOCK

What Does electronics Mean To You?

As you know, this is the "electronics age." And electronics technology is changing so rapidly that the average technician's store of knowledge is highly obsolescent. He must get more education or get out of this field! He must understand *fundamental principles and concepts*. Only on the basis of such understanding can he easily adapt to the swift changes now occurring.

The technician who knows only the "how" of electronics is left behind again and again by new designs and techniques. But by comprehending the "why," he remains an *expert* — well paid and respected in his field.

Where Do YOU Go From Here?

Are you standing still? If you mean to be an electronicsman, get with it. You must prepare for the swift changes which are now occurring. Grantham strong-foundation training in electronics engineering technology leads to non-obsolescent skills — to skills which are based more on reasoning than on merely doing.

Earn Your FCC License and Associate Degree

The entire Grantham educational program is *five semesters* in length. Semesters 1, 2, and 4 are offered by correspondence. In the first two semesters (by correspondence*) you earn your first class FCC license and radar endorsement. But you don't have to stop there.

In today's world of electronics employment, an FCC license is important and worthwhile, but it's not enough! Without further education, you can't make it to the top. Train with the School which gives associate-degree credits for your license training, and offers you the opportunity to advance beyond the FCC license level to a college degree in electronics. The entire curriculum is as follows:

Semester 1 — Basic Electronics Technology
(by correspondence,* 80 lessons)

Semester 2 — Communications Circuits & Systems
(by correspondence,* 80 lessons)

At this point you are prepared to pass the FCC examination for your first class radiotelephone license.

Semester 3 — Electronics Laboratory
(in residence, or credit given for practical experience)

Semester 4 — Advanced Technical Mathematics
(by correspondence, 80 lessons)

Semester 5 — Circuit Design, & Computer Technology
(in resident classes)

Upon completion of the five-semester curriculum, you are awarded the Degree of *Associate in Science in Electronics Engineering*.

Grantham School of Electronics

1505 N. Western Ave. 818 18th Street, N.W.
Hollywood, Calif. 90027 or Washington, D.C. 20006

Telephone:
(213) 469-7878

Telephone:
(202) 298-7460

Credit for Practical Experience

Technicians who have had extensive practical experience in electronics may receive credit in advance for Semester 3, thus reducing the *resident-instruction* requirement for the associate degree to one semester — Semester 5. Also, credit for Semester 1 may be obtained by the passing of an advanced-standing examination. Details concerning these credits are found in our current School Bulletin. Ask for your free copy.

Accreditation, and G.I. Bill Approval

Grantham School of Electronics is *accredited* by the National Home Study Council, and is *approved* under the G.I. Bill. For seventeen years, Grantham has been preparing men for successful electronics careers.

It's Your Move

The move you make today can shape your future. Begin now with a step in the right direction — Step #1 — and then follow through with Steps #2, #3, and #4.

Step #1 is a simple request for full information on the Grantham Associate Degree Program in Electronics. You take this step by filling out and mailing the coupon shown below. We'll send full information by return *mail*. No salesman will call.

Step #2 is earning your FCC first class radiotelephone LICENSE and radar endorsement. You complete this step in the first two semesters of the Grantham educational program.

Step #3 is earning your ASEE DEGREE. This degree is conferred when you have earned credit for all five semesters of the Grantham curriculum.

Step #4 is getting a better job, greater prestige, higher pay on the basis of your extensive knowledge of electronics.

It's your move! Why not begin now with Step #1.

*Semesters 1, 2, and 3 of the Grantham electronics curriculum are available *also in resident classes* at our Washington, D.C. school — at the address shown below.

Grantham School of Electronics 12-67-RE

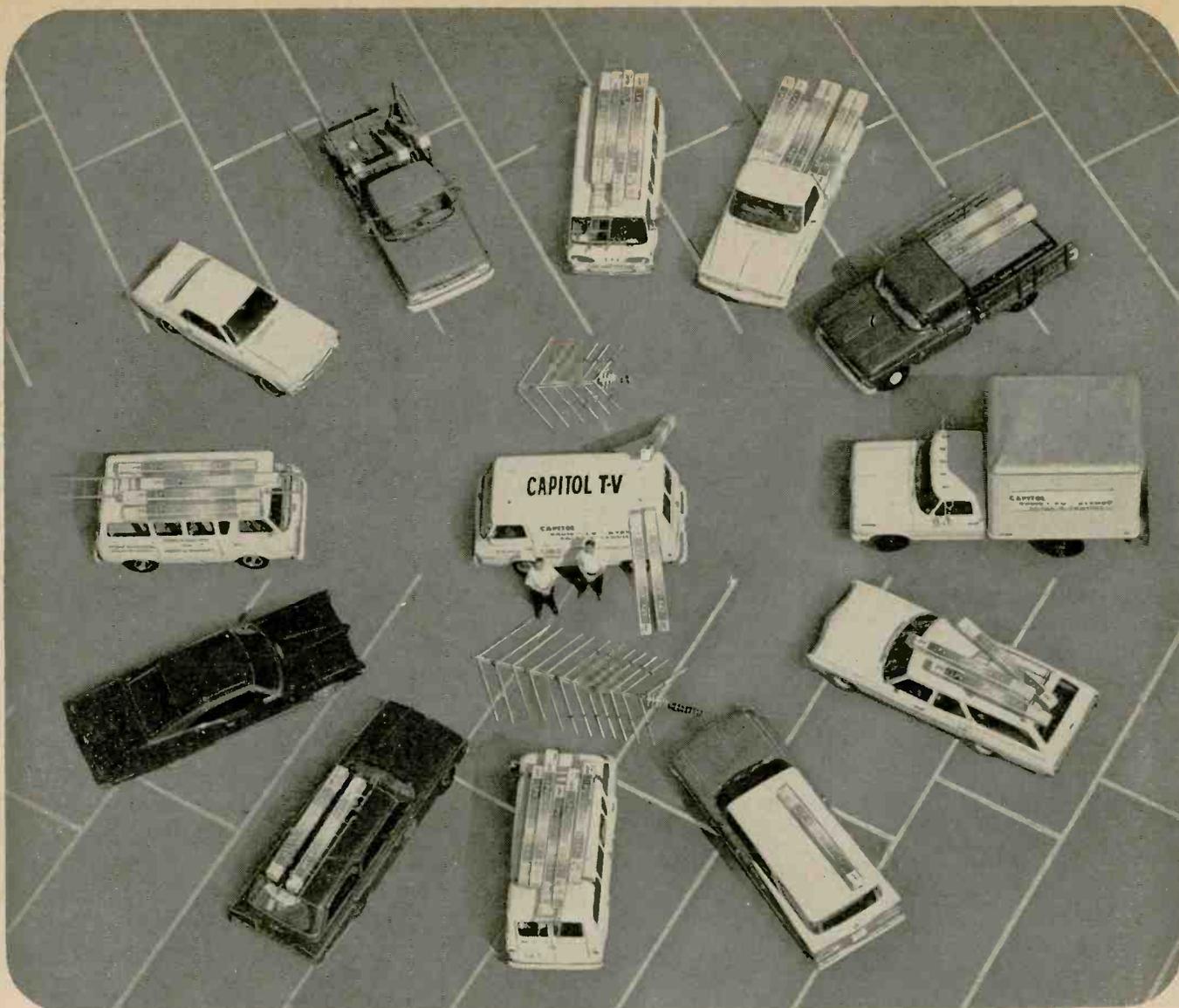
1505 N. Western Ave., Hollywood, Calif. 90027

Please mail me free literature describing Grantham courses in electronics. I understand no salesman will call.

Name _____ Age _____

Address _____

City _____ State _____ Zip _____



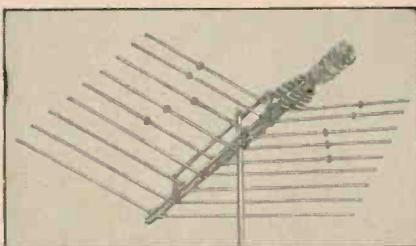
"When you guarantee finer color pictures..."

...like we do, you *better* deliver!" says George Comer and Bob Garrison, of Capitol TV Sales and Service, Atlanta, Georgia.

"We install antennas for many dealers, retailers, chains and department stores here in the Atlanta area. They look to us to give their customers the fine color reception their customers were guaranteed when they bought their sets. We make sure we deliver the best possible color pictures by installing JFD Color Lasers.

"Before using Color Lasers, we installed VHF LPV Log Periodics. Frankly, we didn't think a combination 82-channel antenna would work so well across the VHF, UHF and FM bands. But the Color Laser is proving it to us where it counts — in happy customers and protected profits."

George Comer and Bob Garrison know from experience—like other professionals



— that JFD Color Lasers come through with the superb reception people expect from a professional service company.

Only Color Lasers offer:

BRILLIANT COLOR — flat (frequency independent) response across each channel, free from suck-outs or roll-off. Keeps colors vivid and alive.

PATENTED W-I-D-E BAND LOG PERIODIC DESIGN — the most efficient ever developed — provides higher gain, better

signal-to-noise ratios, needle-sharp directivity. Eleven patents cover its revolutionary space-age design.

MORE DRIVEN ELEMENTS. Harmonically resonant capacitor coupled design makes dual-function elements work on both VHF and UHF frequencies. *Entire* antenna (not just part of it as in other log periodic imitations) responds on every channel.

LUSTROUS, ELECTRICALLY CONDUCTIVE GOLD ALODIZING promotes signal transfer, protects against corrosion, enhances appearance.

The Best Antenna for Color TV is The Color Laser by

JFD®

Now at your JFD distributor!

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

JFD International, 64-14 Woodside Ave., Woodside, N.Y. 11377 JFD Canada, Ltd., Ontario, Canada

JFD de Venezuela, S.A., Avenida Los Haticos 125-97, Maracaibo, Venezuela

LICENSED UNDER ONE OR MORE OF U.S. PATENTS 2,958,081; 2,985,879; 3,011,168; 3,108,280; 3,150,376; 3,210,767. RE. 25,740 AND ADDITIONAL PATENTS PENDING IN U.S.A. AND CANADA. PRODUCED BY JFD ELECTRONICS CO. UNDER EXCLUSIVE LICENSE FROM THE UNIVERSITY OF ILLINOIS FOUNDATION. LICENSED UNDER ONE OR MORE OF U.S. PATENTS 2,955,287 AND 3,015,821 AND ADDITIONAL PATENTS PENDING.

Circle 9 on reader's service card

Radio-Electronics

December 1967 VOL. XXXVIII No. 12
Over 55 Years of Electronics Publishing



p 38—BETTER JOBS AHEAD

RADIO - ELECTRONICS, DECEMBER 1967, Volume XXXVIII; No. 12, Published monthly by Gernsback Publications, Inc., at Ferry St., Concord, N. H. 03302

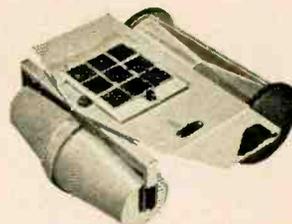
Editorial, Advertising, and Executive offices: 154 West 14th Street, New York, N. Y. 10011. Circulation Office, Boulder, Colo. 80302.

Second-class postage paid at Concord, N. H. Printed in U.S.A. One-year subscription rate: U. S. and possessions, Canada, \$5. Pan-American countries, \$6. Other countries, \$6.50. Single copies: 60c. © 1967, by Gernsback Publications, Inc. All rights reserved.

POSTMASTERS: Notices of undelivered copies (Form 3579) to Boulder, Colo. 80302.

CAREERS

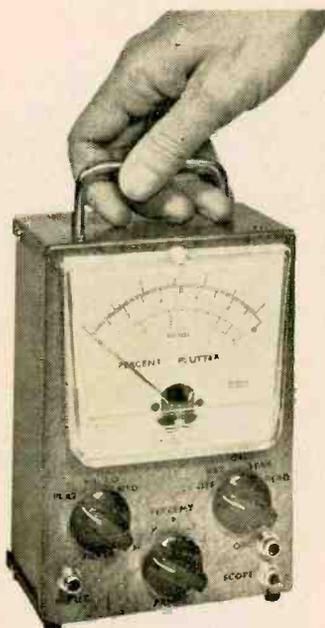
- 38 Your Future in Electronics**Ray Clifton
Upgrade yourself . . . opportunity is knocking
- 40 Q & A on an Electronics Career**
- 40 Electronic Schools Directory**
- 41 The FCC License . . . and How to Get It**Thomas R. Haskett
Your ticket to exciting jobs



p 34—IT RUNS ON SUNLIGHT

CONSTRUCTION PROJECTS

- 32 Build a Solid-State Tape/Slide Synchronizer** . . .Robert S. Havenhill
Let your tape recorder trigger your slide projector
- 34 The Solar-Powered Gamma Goat**John Hoke
One way to get your youngsters interested in electronics
- 43 30 Basic IC Projects**R. M. Marston
Useful applications for an 80-cent integrated circuit—Part 1 of a series
- 52 A Compact, High-Performance Flutter Meter**Earl T. Hansen
Spot tape recorder speed variations within 0.1%
- 56 Build a Professional Quality Transmitter Monitor**.....J. P. Neil
Keep tabs on your CB, ham or commercial two-way rig
- 59 Build a Two-Way, Two-Way Lamp**Byron G. Wels
Inexpensive low-cost, high-intensity light and transformer-less too



p 52—FLUTTER METER

COVER FEATURE

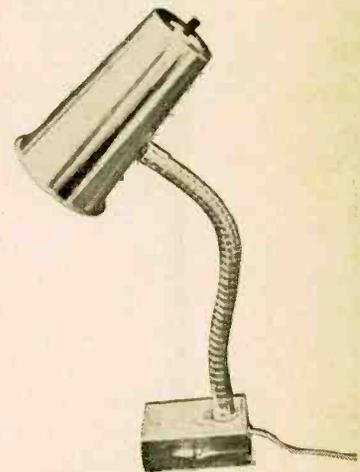


p 32—SLIDE TRIGGER ON TAPE

Equipment shown on cover: Sony Superscope Tape recorder TC-200 and Nikkormat Autofocus Slide Projector.

SERVICING

- 16 In the Shop . . . With Jack**Jack Darr
Service Clinic
- 49 Vertical Sweep Manual**Homer L. Davidson
Ups and downs scanning problems



p 59—HI-INTENSITY LAMP

GENERAL ELECTRONICS

- 46 Rotary Stepping Switches**Tom Jaski
Part 2 of 2 parts . . . round and round it goes
- 62 Equipment Report: Ampex 985 Music Center**
- 67 Equipment Report: Amphenol Millivolt Commander**



p 56—XMTR MONITOR

THE DEPARTMENTS

- | | |
|---------------------------------|--|
| 82 Annual Index | 88 New Semiconductors and Microcircuits |
| 6 Correspondence | 4 News Briefs |
| 78 Miss-Q | 92 Noteworthy Circuits |
| 78 New Antenna Equipment | 87 Technotes |
| 75 New Audio Equipment | 93 Try This One |
| 80 New Literature | 72 Reader's Service Page |
| 79 New Products | |

p 49—VERTICAL BUGS



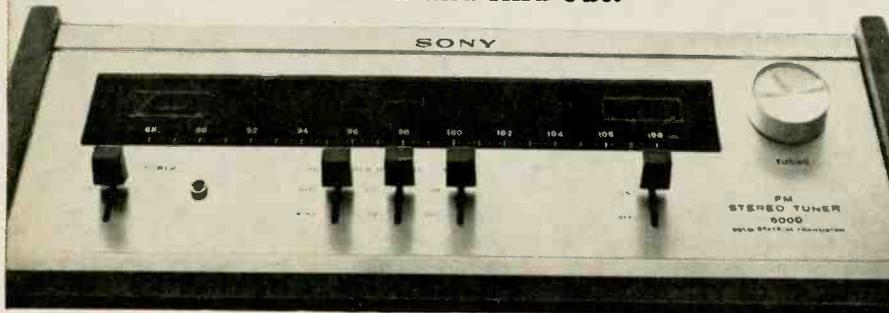
Member,
Institute of High Fidelity.
Radio-Electronics is indexed in
Applied Science & Technology Index (formerly *Industrial Arts Index*)

NEWS BRIEFS

The new Sony FM Stereo Tuner is highly sensitive. It pulls in the weakest stations sharply and clearly. For all its sensitivity, it is unusually insensitive. An ingenious new cadmium-sulfide CdS bandpass RF attenuator protects weak stations from being blanketed by strong signals. There's so much to recommend the ST-5000W. Double-tuning IF transformers, at all 8 stages of the IF section, reject spurious signals and noise. A 5-gang, high precision, silver-plated tuning capacitor contributes to excellent sensitivity. A

tuning meter pinpoints the center of any channel visually. Another meter helps adjust the antenna for maximum signal pick-up. A stereo switch automatically selects the correct mode—stereo or mono. An indicator light spots stereo programs. An adjustable muting switch suppresses interstation noise. Tune in the ST-5000W at your hi-fi dealer. Suggested list \$399.50. Sony Corp. of America, Dept. H., 47-47 Van Dam St., Long Island City, **SONY**® New York 11101

Can a sensitive FM Stereo Tuner also be insensitive?
Tune in and find out.



Circle 10 on reader's service card

People who built their own Schober Organs wrote this ad

Here's what they say about the pleasure of assembling the Schober Electronic Organ from kits . . . and enjoying the magnificent sound of an instrument they've created in their spare time.

Building was fun
"Building it was at least as much fun as playing it!"
Mr. Lester F. Schwartz,
Somerset, N. J.

So proud I could pop
"I've done over 90 per cent of the work on this organ myself—and I'm so proud I could about pop!"
Mrs. V. P. Allbert,
Topeka, Kansas

Nothing as fine under \$5,000
". . . I could not find any organ that sounded as fine as the Schober under \$5,000."
Mr. Jerome J. Fraenkel,
Franklin Square, N. Y.

Proud to own
"I am proud to own such a valuable instrument."
Mr. Jean J. Juteau,
Montreal, Canada



The NEW Schober THEATRE ORGAN—
one of four models available

Most cherished possession
"My spinet has become the most cherished possession in our home—fabulous, indeed."
Mr. Frank J. Marion,
North Bergen, N. J.

Tremendous sound
"The sound is conservatively, tremendous."
Mr. Paul DeForest Wren,
Westbrook, Conn.

Unbelievably easy to build
"When we ran out of instruction, the organ was finished . . . To me it was unbelievable!"
Mr. Ted Sowinski,
Chicago, Illinois

pleasure—and enjoy the satisfaction of doing it yourself?

Free Information and Demonstration Recording
Send today for your free copy of Schober's 16-page, full color booklet, plus 7" free recording.

The Schober Organ Corp., Dept. RE-52
43 West 61st Street, New York, N. Y. 10023

- Please send me Schober Organ Catalog and free 7-inch "sample" record.
- Enclosed please find \$1.00 for 12-inch L.P. record of Schober Organ music.

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

Circle 11 on reader's service card

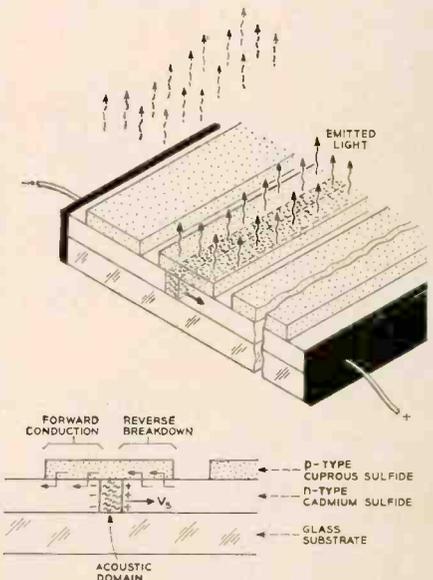
TRANSISTORS— THREE FOR A PENNY?

That's the prediction of a major semiconductor manufacturer. By 1970, according to Philco-Ford's Microelectronics Division, the cost-per-transistor will be a few tenths of a cent. By 1975, cost should be down to a few hundredths of a cent.

The reason is LSI, or large-scale integration. Now being produced is an IC package containing 10 IC's, each of which contains 1,200 transistors fabricated at the same time. The package total is 12,000 transistors in a space only slightly larger than an ordinary IC.

NEW LIGHT GENERATOR AND DETECTOR

An *acoustic domain*—a concentration of crystal lattice vibrations moving at the speed of sound—has been used by Bell Telephone Laboratories to generate light from an array of pn junctions (see sketch).



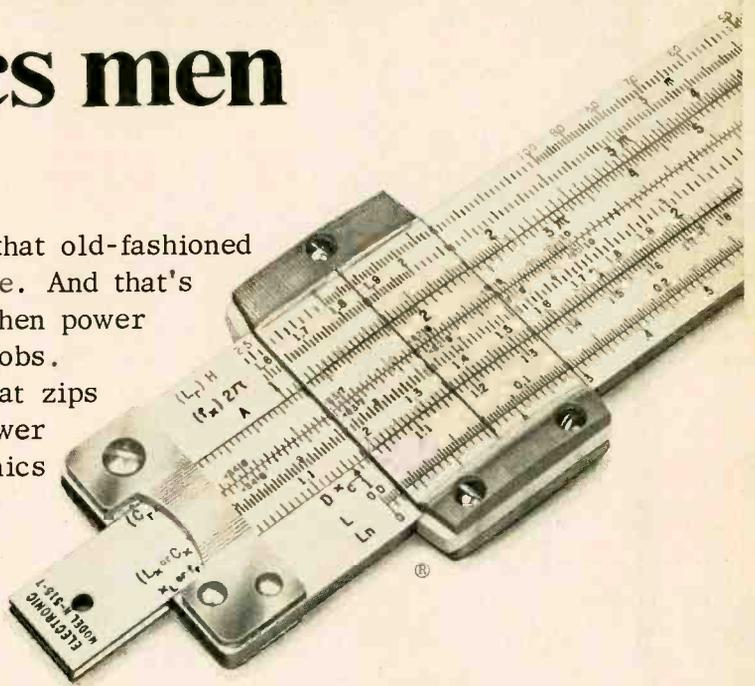
When excited by an external electric field, SALS (for Solid-state Acousto-electric Light Scanner) emits light. Unlike other light-emitting solid-state devices, each SALS pn junction need not be connected in the circuit; the acoustic domains travel down the rows, exciting each junction in turn.

Depending on junction breakdown voltage and applied voltage, SALS may also be used as a light detector.

R-E

Amazing "power tool" for electronics men

Still working electronics problems with that old-fashioned manual tool, the pencil? You're not alone. And that's kind of a shame in this wonderful age when power tools have speeded up so many manual jobs. Now here is an amazing "power tool" that zips through electronic calculations like a power saw through soft pine. The CIE Electronics Slide Rule. It has a special scale that works reactance problems in seconds. And another scale that does the same for resonance problems. Plus two more scales that tell exactly where the decimal points go.



No guesswork. No paperwork. No rough calculations. You get an accurate answer in 20 seconds or less.

It also does the things ordinary slide rules do. Like multiply, divide and extract square roots in one setting. Or find reciprocals for resistance formulas, logarithms for decibel formulas, and trigonometric functions for AC circuitry formulas. And work the formulas in seconds.

The Electronics Slide Rule is easy to use even if you've never worked a slide rule before. It was developed by CIE, one of America's leading electronics schools. And it comes with a 4-lesson course that turns you into an expert. Not just an instruction manual, but a real Instruction Course. With assignments you may send in for grading by our instructors. And when you finish, a Certificate of Achievement that "tells the world" you're an electronics slide rule expert.

The slide rule and course are sold together -- for about half what we think they're worth. It's our way of getting acquainted with men around the country who want to get ahead in electronics.

Mail the coupon for FREE booklet describing this Electronics Slide Rule. Or write to Cleveland Institute of Electronics, Dept. RE-147, 1776 E. 17th Street, Cleveland, Ohio 44114. No charge or obligation.

POCKET ELECTRONICS DATA GUIDE

GET BOTH FREE!

How to Solve Electronics Problems in Seconds

With new Electronics Slide Rule and Instruction Course

SEND COUPON TODAY →

CIE **Cleveland Institute of Electronics**
1776 East 17th Street, Cleveland Ohio 44114

Please send me without charge or obligation your FREE booklet, "How To Solve Electronics Problems In Seconds," describing the CIE Electronics Slide Rule and Instruction Course.

Name _____ (please print)

Address _____

City _____ State _____ Zip _____

Also free if you act now—our famous shirt-pocket Electronics Data Guide with useful formulas, conversion tables, color codes, and more.

Accredited Member National Home Study Council • A Leader in Electronics Training ... Since 1934

RE-147

Circle 12 on reader's service card

impedance mismatch problems?

When most voice coil impedances were either 3.2 ohms or 8 ohms, speaker replacement was relatively simple. Then came transistor sets, and equip-

ment without output transformers, and now voice coil impedances range all over the map.

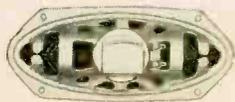
It's important to remember that a mismatched impedance in a speaker replacement will almost surely create problems... from a loss of volume to a blown transistor.

Quam... and only Quam... helps you avoid these problems these three ways:

1. WIDE CHOICE—As Photofacts/Counterfacts participants, we know in advance what voice coil impedance the new equipment will require, so we generally have the right speaker in our comprehensive line *when you need it.*

2. VERSATILE SPEAKERS—Quam *multi-tap speakers* offer a choice of impedances in a single unit. Available in all the sizes you need for automotive replacement, Quam multi-taps handle 10, 20, or 40 ohm applications.

3. SPECIAL SERVICE—Just in case you run across an oddball, we offer this convenient exclusive: *any Quam speaker can be supplied with any voice coil impedance, only \$1.00 extra, list price.*



QUAM

THE QUALITY LINE
FOR EVERY SPEAKER NEED

QUAM-NICHOLS COMPANY

234 East Marquette Road • Chicago, Illinois 60637

Circle 13 on reader's service card

Correspondence

INSTRUCTIVE AND ENJOYABLE

Why not more of your articles on "Learn Color the Programed Way". It was very instructive and enjoyable to read. And for Jack Darr, once again, he is very helpful with his articles in "Service Clinic".

ANTHONY POLLIFIONE
Fairview, N.J.

More of these articles coming up, Tony.

RADIATION AND CROWD CONTROL

Do private and government broadcasting stations control crowds and riots by various and varying pulsations? I am interested in city planning and would like to know if the street lighting and ground pulsations of a city affect outer space radiation.

OTIS H. McLAUGHLIN, JR.
Oklahoma City, Okla.

Don't know about street lighting and ground pulsations, but the broadcast stations use propaganda and advertising to move crowds. However, it's an idea: could try modulating the lights and the earth's tremblings.

TAPE/SLIDE SYNCHRONIZER

In your June, 1967 issue there is an article by Lyman E. Greenlee describing a voice-controlled sound relay. I would like to control a slide projector from a specific sound recorded on a tape. Do you suppose Mr. Greenlee could write another article showing how this could be done?

ROBERT C. GAYHART
Boulder, Colo.

Bob, you must have been doing some mindreading . . . see page 32.

INFO ON HYPERBOLIC HORNS WANTED

I am taking your suggestion and writing to tell you what I would like to see in R-E. I liked Novak's article on speakers and enclosures ("Baffle: Speaker-Air Interface," June 1967). How about having him write an article
(continued on page 12)

6

Radio-Electronics

154 WEST 14TH STREET
NEW YORK, N. Y. 10011

HUGO GERNSBACK (1884-1967)

editor-in-chief and founder

M. HARVEY GERNSBACK, publisher

ROBERT CORNELL, editor

Robert F. Scott, W2PWC, senior editor

Thomas R. Haskett, managing editor

Jack Darr, service editor

Peter E. Sutheim, audio editor

I. Queen, editorial associate

Matthew Mandl, contributing editor

Linda Albers, assistant to editor

Wm. Lyon McLaughlin,

technical illustration director

Bruce Ward, production manager

Adelaide Cassity, production assistant

G. Aliquo, circulation manager

Cover by Harry Schlack

RADIO-ELECTRONICS is published by Gernsback Publications, Inc.

President: M. Harvey Gernsback

Vice President-Secretary: G. Aliquo

ADVERTISING REPRESENTATIVES

EAST

John J. Lamson,

RADIO-ELECTRONICS, 154 West 14th Street, New York, N. Y. 10011, 212-255-7755

MIDWEST/N.&S. Car., Ga., Tenn.

Robert Pattis, the Bill Pattis Co., 4761 West Touhy Ave., Lincolnwood, Ill. 60646, 312-679-1100

W. COAST/Texas/Arkansas/Oklahoma

J. E. Publishers Representative Co., 8380 Melrose Ave., Los Angeles, Calif. 90069, 213-653 5841; 420 Market St., San Francisco, Calif. 94111, 415-981-4527

UNITED KINGDOM

Publishing & Distributing Co., Ltd., Mitre House, 177 Regent St., London W.1, England

SUBSCRIPTION SERVICE: Send all subscription correspondence and orders to RADIO-ELECTRONICS, Subscription Department, Boulder, Colo. 80302. For change of address, allow six weeks, furnishing both the old and new addresses and if possible enclosing label from a recent issue.

MOVING? Or writing about subscription? Be sure to fill out form below.

For FASTEST service on address change, missing copies, etc., attach old mailing label in first space below. Otherwise please print clearly your address as we now have it.

OLD ADDRESS (Attach old label if available)

Name

Address

City State

Zip Code

NEW ADDRESS

Name

Address

City State

Zip Code

Mail to: RADIO-ELECTRONICS
Subscription Dept. Boulder, Colo. 80302



A SUBSIDIARY OF



BELL-HOWELL

SEE WHY

so many
DeVry-trained
Men Step Into
Electronics Jobs
the Day after
Graduation!

EVERY GRADUATE CAN ALSO RECEIVE EMPLOYMENT HELP THROUGH HIS ENTIRE CAREER, AT NO ADDED COST

DeVry's greatest claim to fame is the progress of its graduates. Our aim is to prepare a man so thoroughly that we can recommend him to employers . . . ready to step into a job the day after graduation. If we expect to continue to help employers, our graduates have to be good! That is why we provide top quality instruction—followed by career-long employment service at no added cost.

DeVry's educational programs are designed to prepare men 17-45 in their spare time at home or in any of our three well-equipped, modern resident schools in Chicago, Phoenix or Canada. Why not fill in and mail coupon for free facts today?

Approved for Veterans.

For FREE Information

Lack of technical experience is no barrier to the man who wants to prepare for a career in ELECTRONICS. Send coupon for two FREE booklets and find out why.



Accredited Member of National Home Study Council

DEVRY INSTITUTE OF TECHNOLOGY
4141 BELMONT AVENUE, CHICAGO, ILLINOIS 60641

DeVRY INSTITUTE of TECHNOLOGY

4141 Belmont Avenue, Chicago, Ill. 60641, Dept. RE-12-X

Please give me your two free booklets, "Pocket Guide to Real Earnings," and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

- | | |
|--|---|
| <input type="checkbox"/> Space & Missile Electronics | <input type="checkbox"/> Communications |
| <input type="checkbox"/> Television and Radio | <input type="checkbox"/> Computers |
| <input type="checkbox"/> Microwaves | <input type="checkbox"/> Broadcasting |
| <input type="checkbox"/> Radar | <input type="checkbox"/> Industrial Electronics |
| <input type="checkbox"/> Automation Electronics | <input type="checkbox"/> Electronic Control |

Name _____ Age _____

Address _____ Apt. _____

City _____ State or Province _____ Zone or Zip Code _____

Check here if you are under 16 years of age.

HOME STUDY AND RESIDENT SCHOOL PROGRAMS
AVAILABLE IN CANADA. SEND FOR DETAILS.

2106

Electronics comes alive with NRI Training Kits



DISCOVER THE EASE AND EXCITEMENT OF TRAINING AT HOME THE NRI WAY

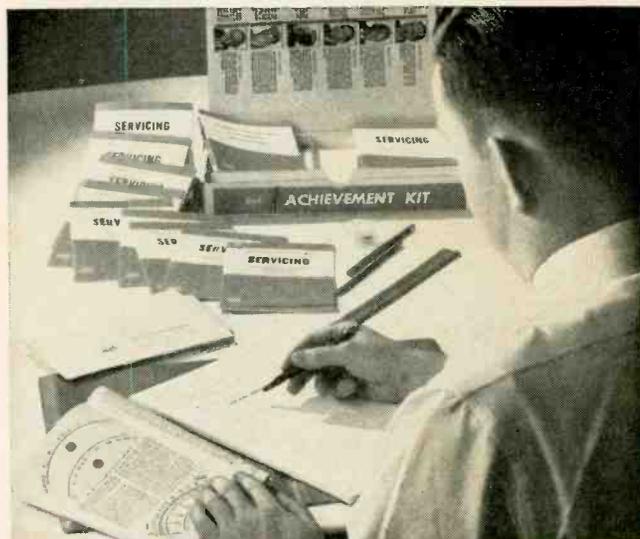
New Achievement Kit—Custom Training Kits—"Bite Size" Texts

Only NRI offers you this pioneering method of simplified "3 Dimensional" home-study training in Electronics, TV/Radio and Broadcasting/Communications. It's a remarkable teaching idea unlike anything you have ever encountered, the result of more than half a century of simplifying, organizing and dramatizing learning-at-home techniques. If you are an ambitious man—regardless of your education—you can effectively learn the Electronics field of your choice the NRI way.

NRI has *simplified* Electronics by producing "bite size" lesson texts averaging only 40 pages each. Dozens of illustrations open wide a picture window through which you'll see and understand practical uses of Electronics. You start out with NRI's exclusive Achievement Kit, containing everything you need to get started fast. (Illustrated at right.)

NRI has *organized* Electronics training to take you step-by-step from the first stages into more intriguing areas. Once you know the fundamentals thoroughly, it's easy to grasp more advanced theory and techniques. You move with confidence and enthusiasm into a new adventure filled with the excitement of discovery.

NRI has *dramatized* Electronics through the careful development of special training equipment that is *programmed* into your training systematically . . . beginning with your first group of lessons. Things you read about come alive in your hands as you build, experiment, purposely cause "problems" in circuits—and solve them. You learn to use test equipment, to build radios and TV sets, transmitter, or computer circuits. It's the priceless "third dimension" in NRI training . . . practical experience.



YOU GET MORE FOR YOUR MONEY FROM NRI

Mail postage-free card now for your free NRI catalog. Then, compare. You'll find—as have thousands of others—NRI training can't be beat. Read about the new Achievement Kit sent the day you enroll; about "bite-size" texts and custom designed training equipment. See why NRI gives you more value. Whatever your reason for wanting more knowledge of Electronics, NRI has an instruction plan for you. Choose from major programs in TV/Radio Servicing, Industrial Electronics and Complete Communications. Or select from special courses to meet specific needs. Check the course of interest to you on postage-free card and mail today for free NRI catalog. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Div., Washington, D.C. 20016.

Available Under NEW GI BILL

If you served since January 31, 1955, or are in service, check GI line in postage-free card.

More than 50 years of leadership
in Electronics Training



Career? Part-Time Earnings? Hobby? Choose From 12 Training Plans

1. TELEVISION-RADIO SERVICING — Learn to fix all TV sets, including Color. Includes your choice of NRI Color Kit or 19" black-white TV Kit. Also covers radios, stereo hi-fi, etc. Profitable field spare or full-time.

2. INDUSTRIAL-MILITARY ELECTRONICS — Basics to computers. Starts with fundamentals, covers servos, telemetry, multiplexing, phase circuitry, other subjects.

3. COMPLETE COMMUNICATIONS* — Operation, service, maintenance of AM, FM and TV broadcasting stations. Also covers marine, aviation, mobile radio, facsimile, radar, microwave.

4. FCC LICENSE* — Prepares you for 1st Class FCC License exams. Begin with fundamentals, advance to required subjects in equipment and procedures.

5. MATH FOR ELECTRONICS — Brief course for engineers, technicians seeking quick review of essential math: basic arithmetic, short-cut formulas, digital systems, etc.

6. BASIC ELECTRONICS — For anyone wanting a basic understanding of Radio-TV Electronics terminology and components, and a better understanding of the field.

7. ELECTRONICS FOR AUTOMATION — Not for beginners. Covers process control, ultrasonics, telemetry and remote control, electromechanical measurements, other subjects.

8. AVIATION COMMUNICATIONS* — Prepares you to install, maintain, service aircraft in-flight and landing systems. Earn your FCC License with Radar Endorsement.

9. MARINE COMMUNICATIONS* — Covers electronic equipment used on commercial ships, pleasure boats. Prepares for FCC License with Radar Endorsement.

10. MOBILE COMMUNICATIONS* — Learn to install, maintain mobile transmitters and receivers. Prepares for FCC License exams.

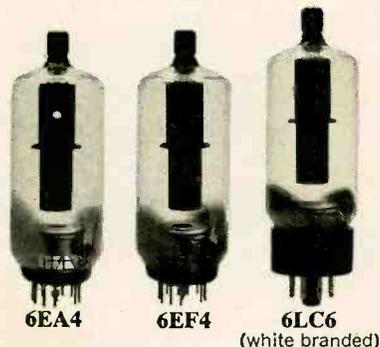
11. ELECTRICAL APPLIANCE REPAIR — Learn to repair all appliances, including air conditioning, refrigeration, small gas engines. Leads to profitable part or full-time business.

12. ELECTRONICS FOR PRINTERS — Operation and maintenance of Electronic equipment used in graphic arts industry. From basics to computer circuits. Approved by major manufacturers.

* You must pass your FCC License exams (any Communications course) or NRI refunds in full the tuition you have paid.

Reward

for the recovery of each of these shunt regulator tubes



General Electric has discovered that certain of its large screen color TV sets containing these high voltage regulator tubes could emit soft X-radiation in excess of desirable levels.

Almost all of the sets which might have this potential X-ray emission have been found and modified with a new regulator tube specially designed for the purpose. We are now conducting a nationwide search for the remaining obsolete regulator tubes.

We are looking for these tubes in two ways. **Those in use** in any model General Electric color television set. **And new tubes in cartons**, on shop shelves, in trucks and kits.

Now here's how you can help us and pick up your reward.

First, look for the above tube types of any brand in every large screen GE color set you service. If you find one, remove it and return it to this address:

General Electric Product Service Section
Northern Concourse Building
North Syracuse, New York 13212

For every one you turn in, you will receive a check for \$5.00 plus a new replacement tube at no extra charge. To qualify, you need only to provide the customer's name and address and the model and serial number of the TV set serviced.

Second, should you have unused tubes bearing these numbers in your shop or truck, send them to the following address, and you will receive a check in the amount of 50% of list price (plus transportation expense) for each and every tube returned:

General Electric Company
Building #12, Old Hartford Road
P.O. Box 1008
Owensboro, Kentucky 42301

Remember, every used tube will get you \$5.00 when mailed to Syracuse. And every new, cartoned tube when mailed to Owensboro will bring you a check worth 50% of the list price.

If you haven't seen it, we recommend you ask your GE Distributor for a copy of GE's recent "Service Talk" on X-ray precautions in servicing color TV receivers.

GENERAL  ELECTRIC

CORRESPONDENCE continued

cle on hyperbolic horns, both bass and high frequency, including nomograms to calculate the necessary parameters since the math is so complicated.

ARTHUR GONTY, M.D.
Menominee, Mich.

SUBMINIATURE INTEGRATED ANTENNA

In News Briefs (July 1967), you mentioned the Subminiature Integrated Antenna developed from the use of high-gain rf transistors, under an Air Force program. Can you provide me with information to build one of these antennas at home?

WILLIAM G. RINGEL
Indianapolis, Ind.

I am very much interested in the Subminiature Integrated Antenna concept, and would like to see more on this subject as it becomes available.

DAVID B. GIBSON
Dade City, Fla.

I would like more detailed information on S.I.A. antennas or possibly a schematic diagram.

ANDREW USIS
Cleveland Heights, Ohio

One article on how to make an S. I. Antenna is scheduled to appear in the February 1968 issue, if we can get the antenna to work.

R-E IN VIETNAM

I want to take this opportunity to thank you for your wonderful Reader's Service. We really appreciate a great magazine like yours over here where it's so hard to get information and literature, so thanks again.

PFC RAYMOND R. SAKSA
3rd Marine Division
Vietnam

REMINDER BETTER ON TAIL LIGHTS

The "Parking Light: Brake Reminder" described in Noteworthy Circuits (April 1967) will work with either parking lights or headlights if the buzzer is connected to the tail lights rather than the parking lights.

WILLIAM R. SPEAKMAN
Reading, Pa.

WANTS FAIRCHILD'S μ 1914

I would like to build the Audio Tone-Burst Generator (July 1967) described by Dr. De Sa. However, I have not been able to locate the Fair-

NEW!
MASTER COURSE
IN COLOR TV...

WITH NTS COLOR KITS

Big 25" Color TV kits included in new Master Color TV Home Study program. Learn Color TV; keep the new 25" color TV receiver you build with exciting kits we send you. 10 million homes in this country will have color TV by the end of 1967. This industry needs technicians as never before, and NTS-trained men can move quickly into the big money.

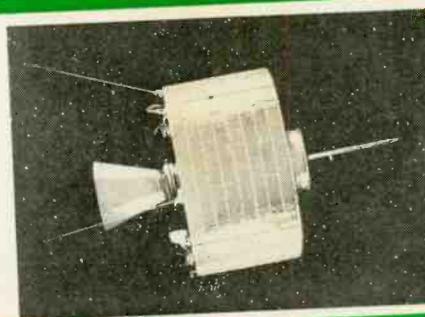
COLOR TV SERVICING BRINGS HIGH PROFITS

New color sets need careful installation, precision tuning and skilled servicing. NTS home training can put you in this profit picture—prepare you for big pay, security, or start a business of your own.



LIFT OFF...TO A "SPACE AGE" CAREER IN ELECTRONICS

This is the "space age". It offers new opportunities in communications, industrial electronics, computer technology, and many others. Automation has increased the need for skilled electronics technicians in thousands of manufacturing plants. Only the well trained man makes it big. Industry wants and demands this kind of man... the NTS man. Pick your field. Let an NTS Project Method Program help you toward a well-paid career in Electronics wherever you travel.



NEW CAREER KIT... FAST, EASY START TO NTS HOME TRAINING

The exclusive Project Method Career Kit helps you move quickly into your training program. Earn while you learn as you progress with your shop-tested Project Method lessons and kits.

Send for the New illustrated NTS Color Catalog. It shows the equipment and kits you work with and keep. Describes in detail the advantages of NTS Project Method Home Training. Tells you everything you need to know about starting your career in electronics.



HIGH SCHOOL AT HOME

National offers accredited high school programs. Take only subjects you need. Study at your own pace. Everything included at one low tuition. Check special High-School box in coupon for full information & FREE catalog.

CLASSROOM TRAINING AT LOS ANGELES

You can take Classroom Training at Los Angeles in Sunny Southern California. NTS occupies a city block with over a million dollars in facilities devoted exclusively to technical training.

MAIL REPLY CARD OR
 COUPON FOR NEW, FREE
 COLOR CATALOG AND
 SAMPLE LESSON.



NATIONAL TECHNICAL SCHOOLS

World Wide Training Since 1905
 4000 S. Figueroa St., Los Angeles, Calif. 90037
 You enroll by mail

We have no salesmen: This means lower tuition for you.
 Accredited Member National Home Study Council. Accredited
 Member: National Association of Trade & Technical Schools

NATIONAL TECHNICAL SCHOOLS

4000 S. Figueroa St., Los Angeles, California 90037

APPROVED
 FOR
 VETERANS



Please rush Free Color Catalog and Sample Lesson, plus detailed information on field checked below. No obligation.

- MASTER COURSE IN COLOR TV SERVICING
- COLOR TV SERVICING
- MASTER COURSE IN TV & RADIO SERVICING
- PRACTICAL TV & RADIO SERVICING
- MASTER COURSE IN ELECTRONIC COMMUNICATIONS
- FCC LICENSE COURSE
- INDUSTRIAL & COMPUTER ELECTRONICS
- STEREO, HI FI & SOUND SYSTEMS
- BASIC ELECTRONICS
- HIGH SCHOOL AT HOME

Dept. 206-127

Name _____ Age _____

Address _____

City _____ State _____ Zip _____

- Check if interested in Veteran Training under new G.I. Bill.
- Check if interested ONLY in Classroom Training at Los Angeles.





**NEW
HOLLOW
SHAFT**

nutdriver set
with Locknut/Screw
adjusting feature

Speeds, simplifies setting of combination locknut/slotted screw adjustments on rheostats and similar controls used in a wide variety of electrical and electronic equipment.

Handle is drilled so you can run an 8" screwdriver blade right through its center and down through the hollow nutdriver shaft.



Ideal for all-around production, maintenance, and service work, this new HSC-1 Set contains eight interchangeable hollow nutdriver shafts in the most popular hex opening sizes from 3/16" thru 9/16"



Really compact! Set is small enough, light enough to carry in your hip pocket. Sturdy, see-thru, plastic carrying case doubles as a bench stand.

WRITE FOR BULLETIN N867



XCELITE, INC., 10 Bank St., Orchard Park, N. Y. 14127
In Canada contact Charles W. Pointon, Ltd.

Circle 17 on reader's service card

CORRESPONDENCE continued

child μ L914 integrated circuit, at the price mentioned (under \$1.00). Would you please advise me as to where I may order this part. Incidentally, I enjoy your magazine a great deal, especially the construction articles.

LT. CHARLES D. HAMILTON, USAF
Valdosta, Ga.

Try Powell-Florida, 2049 W. Central Blvd., Orlando, Fla., 32805; Cramer Florida, Inc., 4141 N.E. Sixth Ave., Ft. Lauderdale, Fla., 33308; Hall Mark Electronics, 7233 Lake Ellenor Drive, Orlando, Fla., 32809; Carolina Radio, 221 W. Washington St., Greenville S.C., 29601; or Schweber Electronics, 2109 Clinton Bldg., Huntsville, Ala., 35805. These are 5 stocking distributors nearest you. If you still have a problem, write directly to Fairchild Semiconductor Div., P.O. Box 1058, Mountain View, Calif., 94040. Keep in mind when ordering that many distributors have a minimum charge per order requirement and the less-than \$1.00 charge may not be available to you if your order is too small.

MANUFACTURERS AS VILLAINS?

Dear Editor:

I suppose you would not dare to tell about how the manufacturer is the serviceman's worst enemy, since he comes along with different parts just to be different. I mean minor changes not affecting quality. They should not be allowed to introduce new components unless there is at least a 5% increase in quality or performance. The electronic business should be cleaned up.

V. N. EVERT
Moncton, N. B., Canada

If the manufacturer is the serviceman's worst enemy, as you say, he would not make it possible for the serviceman to be in business. At the risk of oversimplification—the formula is simple; no products made and sold, no products to service. Would you believe that a manufacturer does not make a change or add more parts to his inventory than he has to? Each addition or modification costs both time and money and complicates his operation. There is no argument about the need to reduce number of parts to be inventoried, but if things were made simpler, you would have more people competing with you for your servicing business. As it stands, there is a shortage of servicemen.

R-E

new Sams books

Microminiature Electronics

by Israel Kalish. Microminiature electronics developed for the space and missile programs is now spreading into all phases of electronics, and will soon be commonplace in entertainment, commercial, and industrial electronic equipment design. This book clearly explains microminiature basics, and will not only help the reader prepare for packaging, operating, and servicing military microminiature equipment, but also orient him in the "think small" trend in civilian equipment. The text is of the programmed type, including questions and answers to review and accelerate learning. 304 pages; 5 1/2 x 8 1/2". Order 20582, only \$495

AM-FM-TV Alignment

by Robert G. Middleton. This book tells you all you need to know about the proper alignment of a-m, f-m radios and tv sets. Each section of the receiver is analyzed step by step, and the fastest, easiest methods of alignment are shown. Separate chapters are devoted to alignment of the following: a-m receivers, f-m receivers, black-and-white tv, color-tv, f-m stereo multiplex adapters; special chapter on audio-amplifier frequency-response checks. 160 pages; 5 1/2 x 8 1/2". Order 20602, only \$350



ABC's of Thermocouples

by John D. Lenk. This book provides much-needed information on the important but little known subject of thermocouples. Provides a basic understanding of how they work, how they are constructed, and the many ways in which they are applied. Standard types of thermocouples and their accessories are described; color coding is explained; includes full data on calibrating and methods of compensation control for use in laboratory, flight, data system, and other environments. Also covers thermocouple readouts, recorders, and controllers. 128 pages; 5 1/2 x 8 1/2". Order 20586, only \$225

Symfact® Guide to TV Servicing

by Howard W. Sams Engineering Staff. Explains the normal operation of a given tv circuit, and then shows exactly the waveform display, voltage, symptoms, picture-tube display, etc., that occur when any component in that circuit is faulty. This invaluable book, in eight main sections, illustrates and describes the malfunctions that occur in specific circuits and shows how to identify and overcome them. Unbelievably practical for fast troubleshooting. 160 pages; 5 1/2 x 8 1/2". Order 20597, only \$295

Practical Power Supply Circuits

by John Potter Shields. Provides a thorough understanding of the basic types of power supplies used in current electronic equipment. Explains the operation of various rectifier circuits—half-, full-wave, and bridge types—and describes the characteristics of gas and high vacuum tubes, as well as scr's used in these circuits. Explains the basics of filters and voltage regulators; describes solid-state voltage and current regulation. Includes semiconductor-type power supplies, converters, and inverters. Provides typical values and construction data. 112 pages; 5 1/2 x 8 1/2". Order 20571, only \$250

These and over 300 other SAMS Books are available from your local Electronics Parts Distributor . . .

HOWARD W. SAMS & CO., INC.
4300 WEST 62nd ST. • INDIANAPOLIS, INDIANA 46288

Circle 18 on reader's service card

EXTRA POWER with **FINCO** AMPLIFIERS

*For perfect color TV and
FM Stereo Reception*

FINCO MODEL #65-4
Antenna Amplifier
\$47.95 list VHF-TV
Two-transistor Antenna
Amplifier for 75 OHM
Downlead, and power
supply with built-in
single or dual 300 ohm
outputs. Provides 12
dB gain in the low band
and 14 dB gain in the
high band.



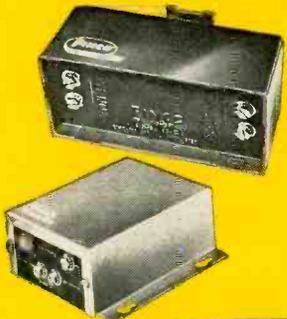
FINCO MODEL #65-1
Distribution Amplifier
\$29.95 list 2-tube 4-
output VHF-TV or FM
Distribution Amplifier
for 300 OHM Opera-
tion, providing 8 dB
gain at each 300 ohm
output to feed home or
commercial systems.

FINCO MODEL #65-5
Distribution Amplifier
\$44.95 list VHF-TV 75
OHM Single Outlet Dis-
tribution Amplifier for
deluxe home or com-
mercial use to feed
multiple sets through
line tap offs or split-
ters. Delivers 17 dB
Low Band and 14 dB
High Band.



FINCO MODEL #65-2
Distribution Amplifier
\$39.95 list 2-tube 4-
output VHF-TV or FM
Distribution Amplifier
for 75 OHM CO-AX
Operation, providing 6
dB gain at each 75 ohm
output to feed deluxe
home or commercial
systems.

FINCO MODEL #65-6
Amplifiers \$79.95 list.
VHF-TV Antenna Mount-
ed two-transistor pre-
amplifier with 75 OHM
two-tube Single Output
Distribution Post-am-
plifier up to 30 dB gain
for improved reception.
Used in home or com-
mercial installations to
feed multiple sets.



FINCO MODEL #65-3
Antenna Amplifier
\$44.95 list New VHF-
TV Antenna Amplifier
and Power Supply with
built in single or dual
outputs to improve re-
ception of weak signals
in fringe areas. Pro-
vides 12 dB gain in the
low band and 14 dB
gain in the high band.

FINCO MODEL #65-7
FM Signal Amplifier
\$24.95 list. One-trans-
istor Indoor Behind-
the-set FM amplifier
with a passive filter in-
put circuit to reject sig-
nals outside the FM
band which cause in-
terference. Delivers 20
dB Gain.



Sets "COME ALIVE" with Brilliant Sound and Color

A Finco high-gain, low-noise amplifier
will bring in the sharpest **COLOR** or
B & W TV picture and the finest sound!

**All FINCO Products are Engineered
For Color!**



Write for Color Brochure #20-411.

THE FINNEY COMPANY

34 W. Interstate Street • Dept. RE • Bedford, Ohio 44146

In the Shop . . . With Jack

By JACK DARR

R_x
avoid headaches

use Sony Tape

If you've been using any of the so-called bargain tapes, chances are you should have your heads examined. The odds are good that the heads are excessively worn and you're not getting the most out of your recorder. If you want to keep "factory-fresh" sound to your recorder—and avoid future "headaches" and keep it that way—Here's the prescription—buy Sony Professional-quality Recording Tape. Sony Tape is permanently lubricated by the exclusive Lubri-Cushion process. Sony's extra-heavy Ox-Coating won't shed or sliver and is applied so evenly that recordings made on Sony Tape are not subject to sound dropouts. Sony Tape captures and reproduces the strength and delicacy of every sound—over and over again. There's a bonus, too, with every 5" and 7" reel of Sony Tape—a pair of Sony-exclusive "Easy Threader" tabs to make tape threading the easiest ever. And Sony reels are a sturdier, heavier gauge plastic for protection against possible warping. It's just what the "Doctor" ordered and yours for just pennies more than "bargain" tape.

SONY SUPERSCOPE
 SUN VALLEY, CALIFORNIA • 91352
 Circle 20 on reader's service card

ONE OF THE WORST PROBLEMS IN A TV is the flyback that runs hot with no apparent cause—no shorts, yoke good, and so on. It just runs hot! The set usually makes a pretty good picture: Voltages are off just enough to be obvious, and the cathode current of the horizontal output amplifier (tube or transistor) will be too high. (The energy's got to come from somewhere, to heat the flyback, and this is it.

All right now—why? Well, let's look at the basic characteristics of all flyback circuits, especially the amplifier itself. It's a pulsed stage. Although the tube or transistor used will have a rating of maybe 15 watts, the actual power dissipated during conduction can run as high as 500 watts!

The reason the stage can get away with this massive overload is simple—it goes on only for a few microseconds. Then, the poor thing cools off for quite a while, comparatively speaking, until the next pulse comes along. You can see that *conduction time* is a key factor in how much power the tube or transistor has to dissipate. Another factor is the output load (the flyback transformer).

Now, we're getting near the key point—the *shape* of the driving pulse voltage. Fig. 1-a shows a normal tube pulse, and Fig. 1-b a transistor drive pulse. Note the difference between "on time" and "off time." This is it.

Pulse shape is determined by the driving circuits and the horizontal oscillator. In transistor circuits, you'll usually find a *driver* stage; its main purpose is to get the required rectangular pulse shape, and to set the on-off time ratio.

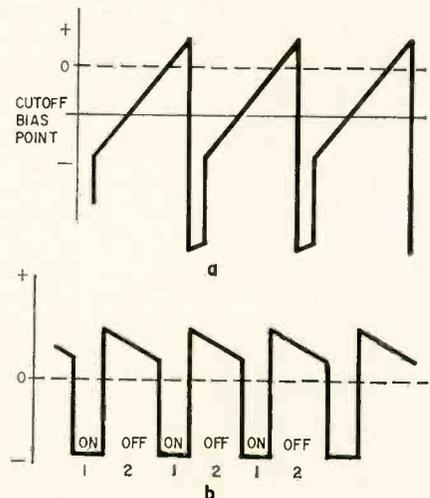


Fig. 1

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.

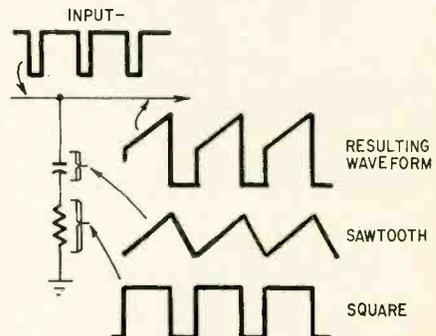


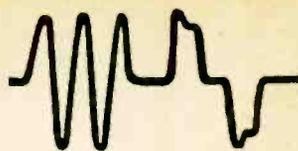
Fig. 2

The basic output of the horizontal oscillator may be a sawtooth, sine wave or even a fair square wave. None of these shapes will do, for driving the output amplifier. Transistor output stages are driven by what looks like a square wave. A close look with a scope shows that it's actually a rectangular wave, with a very precise *ratio* of on-time to off-time, usually about 1:2.

This output wave is shaped by RC networks to make the proper shape. Fig. 2 shows the basic circuit, and what it does. The output waveform is determined by the point of takeoff, and by the ratio of part values—resistance to capacitance. The proportions of the drive waveform, with respect to the cutoff point (bias) of the output amplifier, determine the on-off time of the amplifier and its total power consumption.

Sounds complicated but it isn't. Use a scope to look at the waveform and compare it to the one shown on the schematic. Then measure its p-p voltage. If there is enough distortion to cause trouble, it'll be pretty obvious. Confirm the diagnosis by taking voltage measurements, current readings and checking the output. Another way: substitute a known good drive waveform from another TV set.

If you "sub" a drive signal from
(continued on page 22)



Remember to ask—"What else needs fixing?"



That's the question to ask to add extra profit to every service call. It makes sense. Just about every customer who calls you for TV repair owns other electronic products that are excellent prospects for service. You've already invested your time getting to his home. So why not see what further service you can render?

Does it work? You bet! On a test program sponsored by Electronic Industries Association, in which Mallory is an active member, service men got 6% more profit from business they added just by asking that simple question.

Here are some tips that you can use to cash in on this idea.

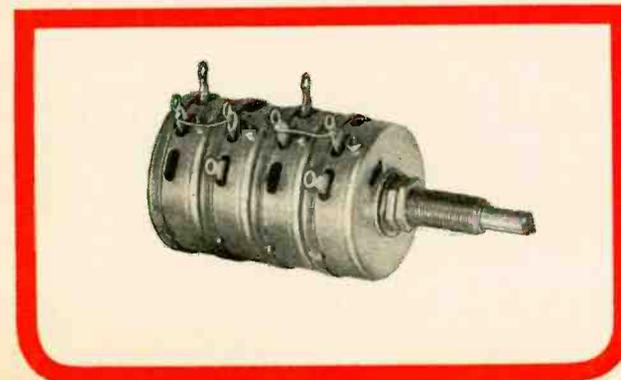
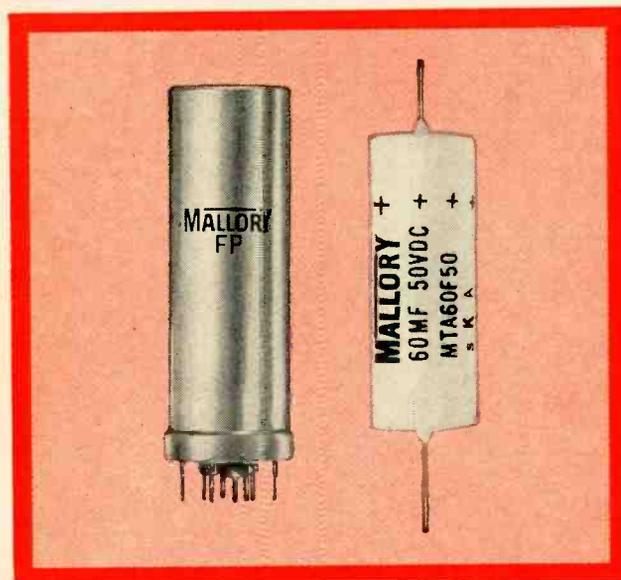
Portable radios, for instance. Most homes have at least one. Ask 'em, "How about fresh batteries?" And then sell Mallory Duracell® batteries . . . best buy in long life and fade-free power. And don't forget cameras, flashlights and toys. They need batteries, too, and there's a Duracell type for every job.

Ask to check table radios . . . then listen for hum as the set warms up. Many people put up with hum because they've forgotten how well the radio sounded when new. But hum may be a sign that a filter capacitor is near the end of its life. Replace with a Mallory FP, WP, TC or MTA. Your Mallory Distributor can supply the exact size and rating you need.

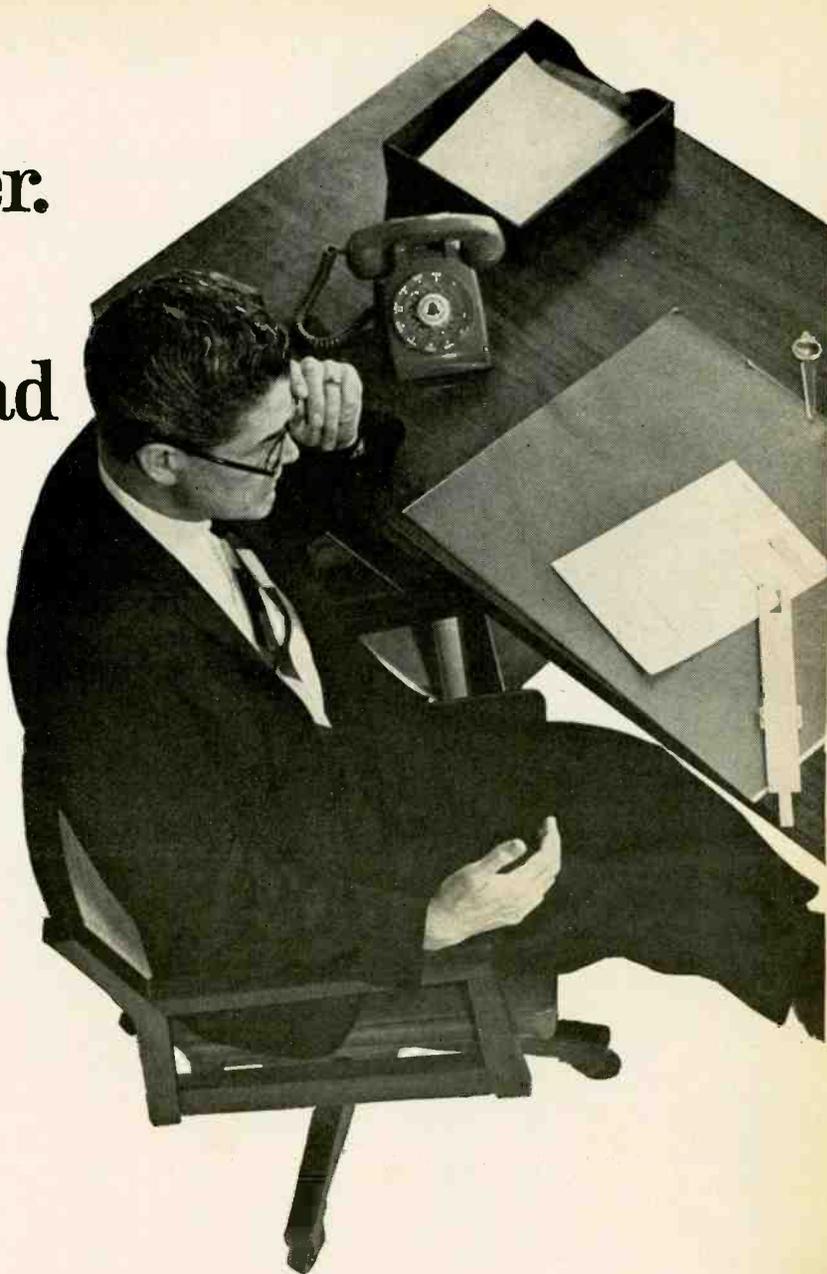
How about hi-fi and stereo? Ask to turn them on, and see if you detect anything that calls for service. You can suggest adding remote speakers for a porch or family room. Be sure to include a Mallory balance control and remote volume controls, to make the installation complete. Record changers and electronic organs are good service opportunities, too.

Try this profit-building "What else needs fixing?" idea on the next calls you make. And for the quality components that make every job sure, see your Mallory Distributor. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

©Duracell is a registered trademark of P. R. Mallory & Co. Inc.



**“He’s a good worker.
I’d promote him
right now if he had
more education
in electronics.”**



Could they be talking about you?

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

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

Going back to school isn't easy for a man with a

full-time job and family obligations. But CREI Home Study Programs make it possible for you to get the additional education you need without attending classes. You study at home, at your own pace, on your own schedule. You study with the assurance that what you learn can be applied to the job immediately.

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



Founded 1927



Accredited Member
of the National Home Study Council

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. Airmail post-paid card for your copy. If card is detached, use coupon at right or write:

CREI, Dept. 1412E
3224 16th St., N.W.,
Washington, D.C. 20010.



The Capitol Radio Engineering Institute

A Division of McGraw-Hill, Inc.

Dept. 1412E, 3224 Sixteenth Street, N.W.

Washington, D.C. 20010

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

NAME _____ AGE _____

ADDRESS _____

CITY _____ STATE _____ ZIP CODE _____

EMPLOYED BY _____

TYPE OF PRESENT WORK _____ G.I. BILL

- I am interested in Electronic Engineering Technology
 Space Electronics Nuclear Engineering Technology
 Industrial Electronics for Automation
 Computer Systems Technology

APPROVED FOR TRAINING UNDER NEW G.I. BILL

NEW FROM INJECTORALL



HERE'S PROOF!

PROOF that "SUPER 100" tuner cleaner is BETTER!
 Tested by a leading independent laboratory against competitive products!

	SUPER 100	A	B	C
CLEANING	Excellent	Good	Fair	Fair
LUBRICATION	Good	Fair	Fair	Poor
PLASTIC ATTACK	None	None	None	None
FLAMMABILITY	None	None	None	None
CONDUCTIVITY	None	None	Slight	Slight
ANTI-STATIC PROTECTION	Excellent	Fair	Poor	Poor
DRIFT	None	Slight	Yes	Yes



SUPER 100 TUNER CLEANER . . . for COLOR and Black and White TV tuners
 6 oz. spray can with INJECTORALL steel needle
 CAT. NO. 100-6 net \$1.95

Buy it at your Electronic Parts Dealer.
 For free catalog on the complete line, write to:

INJECTORALL ELECTRONICS CORP. • Great Neck, N. Y. 11024

Circle 22 on reader's service card

Popular Science Top-Rates Scott's Stereo Tuner Kit (THERE'S A SOUND REASON.)



Popular Science magazine's reviewer said, "I rate the LT-112-B as one of the finest FM tuners available — in or out of kit form." All of this fabulous tuner's critical circuitry comes pre-wired, pre-tested, and pre-aligned . . . and the full-size, full-color instruction manual makes the rest simple. In just eight hours, you'll have it completed. Again, in the reviewer's words: "Stereo performance is superb, and the set's sensitivity will cope with the deepest fringe area reception conditions . . . drift is non-existent." See your Scott dealer and review the new LT-112B-1 for yourself. Only \$199.95.



©Copyright 1967, H.H. Scott, Inc.

H.H. Scott, Inc., Dept. 570-12, Maynard, Mass. 01754. Export: Scott International, Maynard, Mass. 01754

Circle 100 on reader's service card

In the Shop . . . With Jack

(continued from page 16)

a working set, read the cathode current and compare its value to what you had with the original drive. This will tell you what's really going on.

Divide and conquer

In all cases of flyback trouble, you should divide the circuit into two parts: input (or drive) and load (see Fig. 3). The load includes everything fed by the flyback: yoke, damper, HV rectifier (also regulator and focus rectifiers in color sets), and the boost circuits, including the boosted-boost. The drive section includes the horizontal oscillator and driver, afc and all wave-shaping networks in its output.

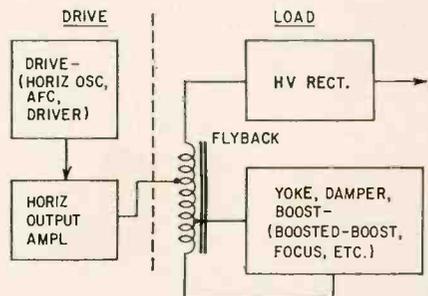


Fig. 3

Load defects are usually pretty easy. They'll affect the output pretty badly—narrow sweep, low HV, etc. If you suspect yoke trouble, substitute the horizontal windings of another yoke, and read the boost voltage. Since the flyback pulse from the yoke is considered as the source of boost, if boost returns to normal, you've confirmed your diagnosis without even seeing a raster!

Input trouble can be harder. A substitute signal can confirm the diagnosis pretty quickly, after a scope check has shown the possibility of trouble—drive signals with excessive flattening of the tops, curvature, too much spiking, and so on; any kind of noticeable deviation from the correct waveform shown on the schematic.

Monitor the cathode current of the output amplifier as a good guide. When you find the real trouble, cathode current will go back down to normal, and the output will come up to normal.

Now, if a sub-signal shows that the set's own oscillator circuit is out of shape somehow, you've got to find out what and why. The cause of this kind of trouble is usually pretty simple (like

(continued on page 26)



Are you eligible for the Bright Guy Awards?

It's easy to get them—and to get all the business they'll bring you. New customers. More sales. More money.

The Bright Guy Awards is the big program Sylvania's running this year to boost your sales.

Your Sylvania distributor can put your name and address in TV Guide ads in your area. The ads call you "the brightest serviceman in town"—and tell people in your town why they should call you.

You'll get into the Yellow Pages, too, under the heading "TV Service and Repairs."

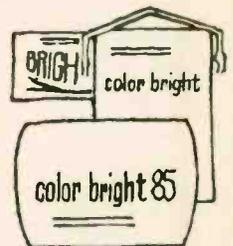
Once again this year you'll be eligible for over one hundred valuable, interesting



SMB-Bright Guy gifts, just for buying the Sylvania TV replacement parts you normally buy anyway.

And you'll get window displays proclaiming you "the brightest"—the TV serviceman everyone's reading about.

You're eligible for the Bright Guy Awards just by buying Sylvania's famous *color bright 85* picture tube. And our other picture tubes, and our receiving tubes. So see your Sylvania distributor.



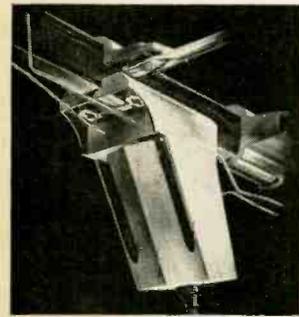
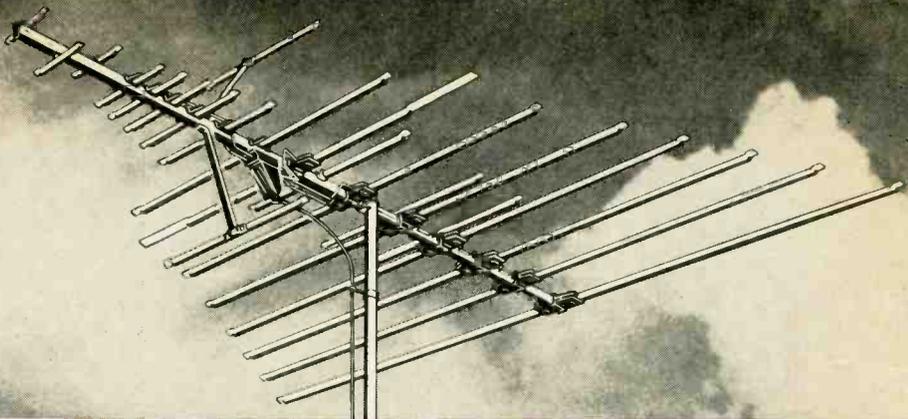
Sylvania Electronic Tube Division, Electronic Components Group, Seneca Falls, New York 13148.

SYLVANIA

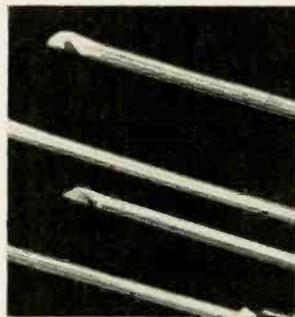
A SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS

Circle 23 on reader's service card

Winegard put these features in to bring the best color out



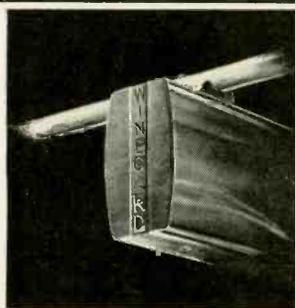
Download and Pre-Amplifier Housing—permanent housing is built-into the antenna; provides complete weather-proofing for download connector cartridge or pre-amp cartridge.



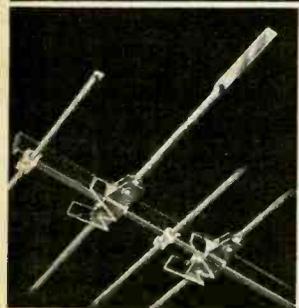
High Tensile Aluminum Elements; with Gold Anodizing—aluminum alloy has PSI rating of 38,000 compared to 27,000 PSI for alloys used in other antennas. More than 49% stronger and 29% more resistant to bend and wind distortion. Elements and boom are gold anodized for the only permanent protection against corrosion and fading.



Solid State Pre-Amplifiers—incorporate revolutionary new silicon overlay transistors, the best performing and most powerful transistors available for antenna use. Drop into pre-amplifier housing at point of signal interception.

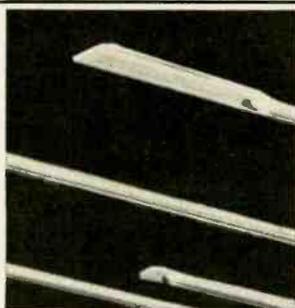


Ellipsoidal Boom—the only aluminum shape engineered especially for antenna use; proved far stronger than any other boom design.

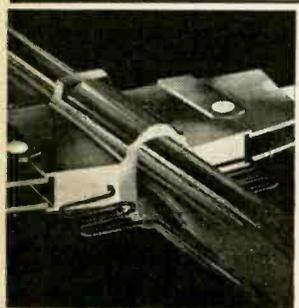


Electro-Lens* Director System—patented system absorbs entire signal and focuses it directly onto driven elements for pinpoint directivity.

*U. S. Patent No. 2700105
Canada No. 511984



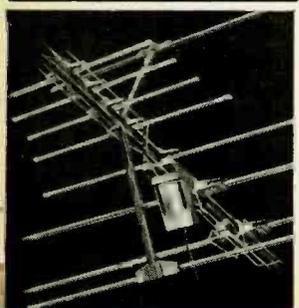
FM Control Element—provide exceptionally high gain on FM bands and provide for the attenuation of FM bands in areas where strong FM signals interfere with tv reception.



Impedance Correlators—patented correlators automatically increase 75 ohm driven elements to 300 ohms to provide 100% signal transfer from antenna to set.



CS-285 Band Separator (with printed circuit)—comes at no additional cost with all 82 channel Super Colortrons to separate UHF and VHF signals. Attaches easily to terminals on back of set.



Vertical Resonant Reflectors—UHF reflectors achieve highest realizable gain on channels 14 to 83 because of exceptionally large vertical capture area; more UHF gain than any other 82-channel design.

Antenna Model No. _____	Registration Number 00000
Installed By _____	Date _____
	
24 Month Antenna Replacement Warranty (2 YEAR)	
See Reverse For Details SAVE FOR YOUR RECORDS	

2-Year Antenna Replacement Warranty—the only antenna in the industry that gives your customer a 2-year replacement privilege.

No wonder so many dealers are selling so many Winegard Super Colortrons so fast.

You're right, that's a lot of features. A lot more than any other antenna ever designed.

But what's really important is what happens when all those features are sandwiched into one super-performing, super-compact antenna.

And just in case you don't know yet, we'll tell you what happens.

First off, you get an antenna so powerful and with such pinpoint directivity (even without solid state pre-amps) that it eliminates ghosts and snow more effectively than anything you've ever seen before.

And when you drop-in an instant-loading pre-amplifier (there are eight to choose from not counting the color spectrum filter) you've got yourself an antenna that does just about anything you want it to do, just about anywhere—

especially when it comes to color tv.

The solid state pre-amplifiers enable you to instantly increase gain on all channels. They let you custom match the Super Colortron to any reception requirement in seconds, using either 75 ohm coax or 300 ohm downlead—and with all connections completely enclosed and protected against the weather.

You can take your choice. There are ultra high gain, low noise 82-channel UHF-VHF-FM pre-amplifiers... VHF-FM pre-amplifiers... UHF pre-amplifiers... and FM pre-amplifiers. And then there's that color spectrum filter. It shuts out electro-magnetic interference... lets only pure TV signals come through for the clearest color pictures ever.

So you see, there's really a lot to talk about when it comes to Super Colortron

antennas, all 14 models—with 7 patents and patents pending.

And that's why we're doing a lot of talking in Life and Newsweek and Sunset. 17 ads, between now and Christmas, telling more than 60,000,000 prospects exactly how remarkable the "transistorized" Super Colortron is.

No wonder so many dealers are selling so many Super Colortrons so fast.

So what are you waiting for?



—biggest, most powerful national advertising campaign in the industry.



WINEGARD COMPANY

• 3000 KIRKWOOD STREET •

BURLINGTON, IOWA 52601

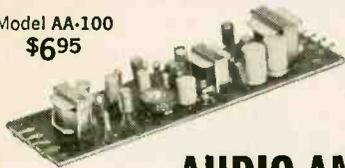
Circle 24 on reader's service card

©Copyright 1967, Winegard Company, Burlington, Iowa

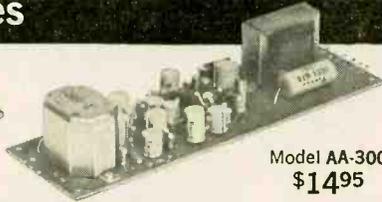
Solid State Circuit Boards

Featuring Professional Performance at Low-Budget Prices

Model AA-100
\$695



Model AA-300
\$1495

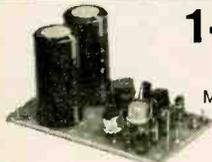


AUDIO AMPLIFIERS

Transistorized audio pre-amplifiers and amplifiers capable of delivering 200 MW of audio power, sufficient to drive a small speaker or a number of ear-phones. The AA-100, which includes a mounted volume control, is designed for general purpose audio applications and can also be used to modulate the TR-100 Transmitter (see below). The AA-300, a 200 MW amplifier, has excellent frequency response and low distortion characteristics which make it ideally suited for broadcast, recording, and TV applications. Either amplifier may be powered from a 9 volt source such as a battery or the PS-300 Power Supply. In applications where greater audio power is required, the AA-100 or the AA-300 may be used to drive the Model AA-400 Power Amplifier (see below).

	Model AA-100	Model AA-300
Frequency Response	±3 db, 100 to 12K cps	±1 db, 20 to 20K cps @ 200 MW ±2 db, 20 to 35K cps @ 100 MW
Harmonic Distortion	Less than 3%, 100 to 12K cps	Less than 1%, 20 to 20K cps @ 100 MW Less than 2%, 20 to 20K cps @ 200 MW
Input Impedance	150, 600, and 100K ohms (shielded transformer)	50 to 150 ohms, or 600 ohms, balanced (mu-metal shielded permalloy core transformer) 2K or 100K ohms unbalanced
Gain	70 db	80 db, 50 ohm input, 8 ohm load
Output Impedance	500 ohms and 8 ohms (grain oriented transformer) 200 MW	
Circuit	5 transistors, 1 thermistor	7 transistors, 1 thermistor
Power Supply	9 volts DC, 50 MA	9 volts DC, 100 MA
Size	5½" L x 1¾" W x 1" H	8" L x 2¼" W x 1½" H
Weight	3½ ounces	12 ounces

1-WATT AUDIO POWER AMPLIFIER



Model AA-400
\$995

A transistorized audio power amplifier that can be driven to a full 1-watt output by a 1.5 volt signal. When the AA-400 is used with the Round Hill AA-100 or AA-300 Amplifier, a complete high gain, 1-watt audio system is obtained. Power can be furnished by any stable DC source delivering 14 volts at 150 MA, such as the PS-300.

Frequency Response.....	±1 db, 20 to 20K cps @ 1 watt	Output Impedance.....	4 to 16 ohms
Harmonic Distortion.....	Less than 1.5%, 20 to 20K cps @ 1 watt	Circuit.....	4 transistors
Input Impedance.....	500 ohms and 2,000 ohms	Power Supply.....	14 volts DC, 150 MA
		Size.....	3½" L x 2" W x 2" H
		Weight.....	3 ounces

REGULATED POWER SUPPLY

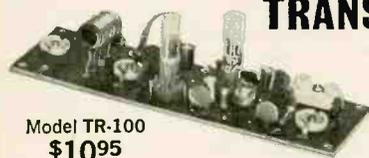
The PS-300 is a zener-referenced, voltage regulated power supply which delivers a highly stable, extremely low ripple DC output of 9 volts with loads up to 200 MA and an unregulated output of 14 volts DC. The PS-300 is ideally suited for transistor circuit applications requiring a well-filtered regulated DC source, and may be used to furnish power to all Round Hill circuit boards.



Model PS-300
\$1895

Input Voltage.....	105-120 volts AC, 60 cps, 5 watts	Output Voltage.....	9 volts DC fully regulated; 14 volts DC unregulated
Regulation.....	Line + load 5 MV	Size.....	5½" L x 1¾" W x 2" H
Ripple.....	Under full load 10 MV, peak-to-peak	Weight.....	23 ounces (with transformer)
Maximum Load Current.....	200 MA		

TRANSMITTER



Model TR-100
\$1095

The TR-100 is a complete crystal controlled Transmitter for the Citizens' Band. It is factory pre-tuned and supplied with a channel 10 crystal. The Transmitter is capable of an RF output in excess of 100 MW and may be modulated with the Round Hill AA-100 Amplifier. Transmitter power supply requirements are 9 volts DC which can be obtained from the PS-300 Power Supply.

Circuit.....	Crystal controlled, 3 transistors	RF Output.....	100 MW, 50 ohm load
Frequency Range.....	Any CB channel (channel 10 crystal supplied)	Power Supply.....	9 volts DC, 50 MA
Modulation.....	CW or AM with external modulator such as Round Hill AA-100	Size.....	5½" L x 1¾" W x 2" H
		Weight.....	3½ ounces
		Additional CB Crystals.....	\$3.00 each

ROUND HILL ASSOCIATES INC. A SUBSIDIARY OF MILO ELECTRONICS
434 Avenue of the Americas, New York, N.Y. 10011

PLEASE SEND ME THE FOLLOWING CIRCUIT BOARDS:

MODEL	QTY.	PRICE ea.	AMOUNT
AA-100 AUDIO AMPLIFIER		\$ 6.95	\$
AA-300 AUDIO AMPLIFIER		\$14.95	\$
AA-400 AUDIO POWER AMPLIFIER		\$ 9.95	\$
PS-300 POWER SUPPLY		\$18.95	\$
TR-100 TRANSMITTER		\$10.95	\$
CB CRYSTAL (channel:)		\$ 3.00	\$
TOTAL:		\$	\$

- Send postpaid—enclosed is full payment.
 Send C.O.D.

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

In the Shop . . . With Jack

(continued from page 22)

all others!): too much leakage in a small capacitor, or a resistor that has drifted off value too far.

A wee bit of leakage in the coupling capacitor from oscillator output to amplifier grid will really shake things up, by upsetting the dc bias level on the grid. (This of course, determines the cutoff point of the amplifier, and the amount of time it is held in conduction, dissipating power.)

Normally, this kind of trouble will not be in the frequency-determining parts of the circuit or in the afc. If it is, you can certainly tell! The most common cause will be a defective "saw-forming network" somewhere between the oscillator and output.

Red hot mystery

Once in a while you'll find a trouble, the cause of which won't be a short or a leak, but an open input capacitor, as in the B+ boost filter circuit shown in Fig. 4.

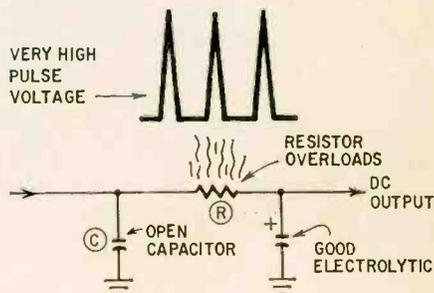


Fig. 4

If the input filter capacitor is open, a greater proportion of the pulses goes through the resistor; some of which are bypassed to ground by the output filter capacitor and some of which get into other circuits to cause other troubles.

Under this circumstance you could wind up with a big mystery . . . the resistor would run red hot even though there is nothing abnormal on the load side to draw an excessive amount of current.

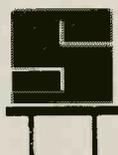
To find these things, use the scope again; it's the only thing that'll let you see what's going on. Look for the presence of high pulse voltages in what should be "pure dc" circuits. Hook the scope to the circuit, and then bridge good capacitors across all suspected ones. When you find the open one, the pulse will just about disappear.

Just remember the old adage: "This thing worked, once, with these part values in it. So, if I can get all the parts back to where they were then, it'll work again!" **R-E**

Merry Crystals from...



Send for our catalog...
It will cost you nothing.



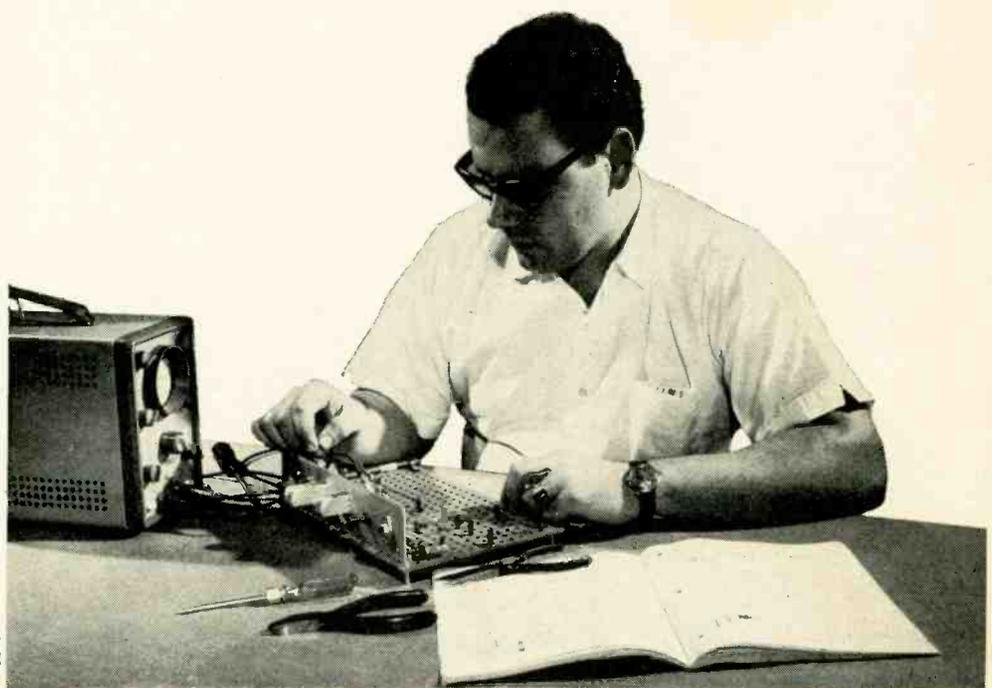
SENTRY MANUFACTURING COMPANY

1634 Linwood Boulevard - Oklahoma City, Oklahoma 73106

PHONE: 405-232-1431-TELEX: 071-361-TWX: 910-831-3175

Circle 25 on reader's service card

**10 Reasons why
RCA Home Training is
Your best
investment
for a rewarding
career
in electronics:**



Performing transistor experiments on programmed breadboard — using oscilloscope.

1 LEADER IN ELECTRONICS TRAINING

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

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

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

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

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

4 WIDE CHOICE OF CAREER PROGRAMS

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

5 SPECIALIZED ADVANCED TRAINING

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

6 PERSONAL SUPERVISION THROUGHOUT

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

7 VARIETY OF KITS YOURS TO KEEP

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

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

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

9 UNIQUE TUITION PLAN

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

bills. Even if you decide to interrupt your training at any time, you don't pay a single cent more.

10 RCA INSTITUTES GRADUATES GET TOP RECOGNITION

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

CLASSROOM TRAINING ALSO AVAILABLE

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

JOB PLACEMENT SERVICE, TOO!

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

SEND ATTACHED POSTAGE PAID CARD TODAY! FREE DESCRIPTIVE BOOK YOURS WITHOUT OBLIGATION! NO SALESMAN WILL CALL!

All RCA Institutes courses and programs are approved for veterans under the New G.I. Bill.

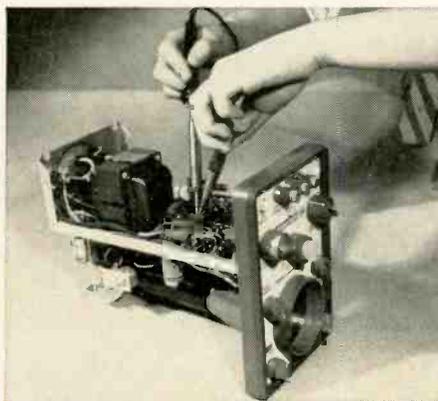
RCA INSTITUTES, INC. Dept. RE-D7
320 West 31st Street
New York, N.Y. 10001

ACCREDITED MEMBER National Home Study Council



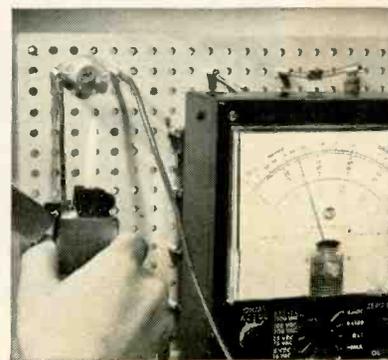
The Most Trusted Name in Electronics

Construction of Multimeter.



Construction of Oscilloscope.

Temperature experiment with transistors.



BUILD A SOLID-STATE TAPE/SLIDE SYNCHRONIZER

Easy automatic slide changing with commentary from your tape recorder

By ROBERT S. HAVENHILL



SHOWING COLOR SLIDES is a good way to recreate your vacation for friends. By adding commentary on tape, you're relieved of repeating the same thing, and you can't forget what you said last time. But changing slides is still a nuisance.

The synchronizer changes slides for you automatically. All you need is a stereo tape recorder. You put the voice commentary on one track, and a sync signal on the other. When friends drop in, you simply load the projector and the recorder, turn them on, and the show runs automatically. The recorded sync pulses advance slides as your commentary moves ahead. And there are no relays to chatter or stick.

Theory

The heart of this synchronizer is a bidirectional thyristor, called a Triac. As you know, a silicon controlled rectifier can conduct only on one-half of an applied ac voltage. Why? Because an SCR is simply a diode with a gate. A Triac consists of essentially *two* diodes in reverse parallel, with a gate. It can conduct on both halves of an ac waveform and can be used as a full-wave control and switch. A Triac can also be gated by ac, which is quite useful.

Figure 1 shows the symbol for a Triac and one method of triggering it. When S1 is closed the gate is connected to anode 2 through current-limiting resistor R2. The Triac then conducts and switches on the ac motor. (Some slide changers are operated by a solenoid, but the principle is the same.)

Figure 2 illustrates a second method of triggering: An ac signal is applied to the gate-anode 1 circuit of the Triac through isolation transformer T1. This second method is used in the tape/slide synchronizer on playback. The recorded sync signal on the tape is fed to the primary of T1. The signal then

triggers the Triac, which conducts and activates the motor (or solenoid) in the projector. The slide advances.

In the record mode, it's necessary to simultaneously trigger the Triac (to advance the slide) and produce an ac signal (to put sync on the tape). The circuit is shown in Fig. 3. Closing S1

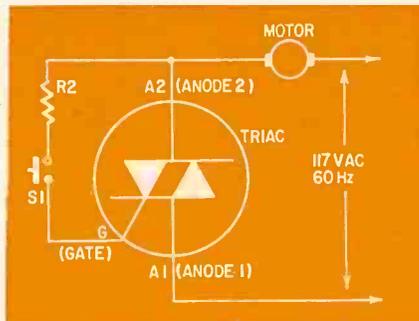


Fig. 1—Triac is turned on with voltage between gate and anode 2. It can conduct on both halves of an applied ac voltage.

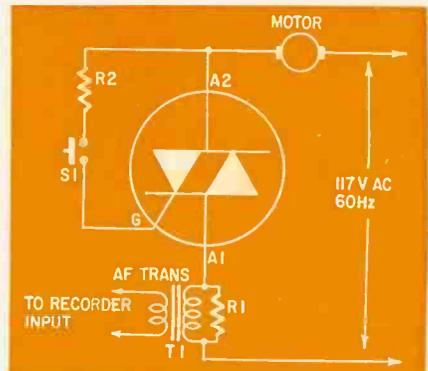


Fig. 3—Drop across R1 is sync signal.

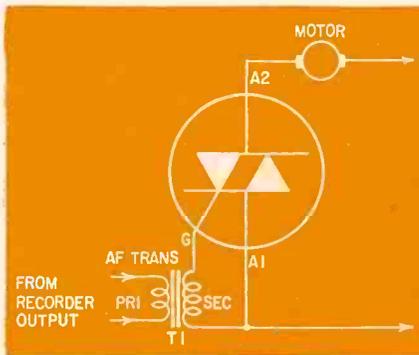


Fig. 2—Either ac or dc will trigger the Triac. Signal can also be applied between gate and anode 1 to turn the device on.

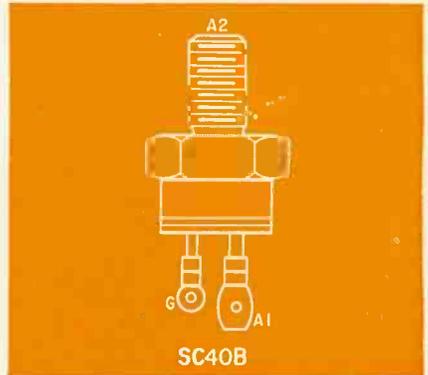


Fig. 4—Typical Triac outline, terminal connections, with mounting stud at top.

The Solar-Powered

Self-powered amphibious vehicle will get the

By JOHN HOKE



Fig. 1—First lay out the materials you will need to build the solar vehicle.

A FULL-SCALE GAMMA GOAT IS A MILITARY vehicle designed to operate effectively on any kind of ground. This solar-powered model doesn't look much like the real thing, but it does have similar rough-terrain capabilities. It manages well on land or water, and solely with light power.

You'll find the goat easy to build. It's assembled almost completely from tailored-to-fit parts that can be obtained easily from local sources (see Fig. 1).

The vehicle frame is made from $\frac{1}{8}$ " balsa wood, with $\frac{1}{4}$ " balsa used for the yoke and for local reinforcement of the thinner wood.

To make later finishing much easier, all surfaces of the balsa should be filled before you cut out the parts. Spread shellac or Elmer's glue smoothly over the wood surface. Lightly sand the treated surface (when it's dry) with about a 320-grit paper before cutting. Use a one-sided razor blade or X-Acto knife to cut the wood. Follow the plans shown in Fig. 2.

Roller construction

Assemble the front roller as shown in Fig. 3. Use acetone or methylene chloride to cement together the lids of two 6-oz Styrofoam cups. Carefully cut a $\frac{1}{2}$ " hole through the center of both lids. An eyelet "bearing" must be centered in the bottom of each cup, to receive the axle.

Next, make the balsa yoke for the front roller, following the plans shown in Fig. 2. Assemble the yoke and mount the front roller in it (Fig. 4). Install two eyelets "bearings" in the yoke with collars inward. The axle can be a piece of coat-hanger wire.

The drive roller is the only component that must be constructed to fairly exacting tolerances. The arrangement is a fixed-shaft device in which the whole roller and motor revolve around an axle held stationary to the frame of the vehicle. The roller is made of two more Styrofoam cups glued together bottom to bottom as shown in Fig. 5. Be sure to cut well-centered holes large enough to accom-

modate the motor. A sharp razor blade, wet with soapy water, makes cutting the Styrofoam much easier. (Make sure all parts are dry before you cement them.)

Using RTV (room-temperature vulcanizing) rubber, cement the motor mount—a discarded core from a roll of cellophane tape—into place against the bottom of one of the two cups. Center it well so that the motor, when put into the mount, also will be properly centered.

Making the wheels

The end plates (Fig. 6) seal the drive roller. They also are the wheels on which the model runs on land. Each is made from a balsa disk and a plastic cup cover. The eyelets "bearings" used to support the drive roller in the frame of the vehicle must be carefully centered. Cement a cup lid to each balsa disc so the grooves into which the lip of the cup fits will remain uncovered. Be careful to center the lids well on the balsa discs. Use Silastic for joining these two pieces.

Six paddles are provided for propelling the model in water. Mark paddle locations on the drive roller as follows: Using a compass, draw a circle on paper—make it a bit larger than the drive roller ends. Then make a six-pointed star pattern with the compass. Transfer the points directly to the rim of one cup, marking them with a pen (see Fig. 5).

The paddles should be sanded smooth, and filled with shellac or Elmer's glue. To keep the paddles from trapping air or picking up water when running in water, cut vent holes ($\frac{3}{32}$ " notches) into the apex of each paddle, as shown in the pattern (Fig. 2).

Next, cement the paddles to the drive roller (Fig. 7).

After the drive-roller end plates and covers have been bonded firmly together, drill out the center holes in which the eyelets will be mounted. Hole size depends upon the size of the eyelets you use. Be sure to strip the eyelets of paint or enamel; they have to carry current from the solar cell to the

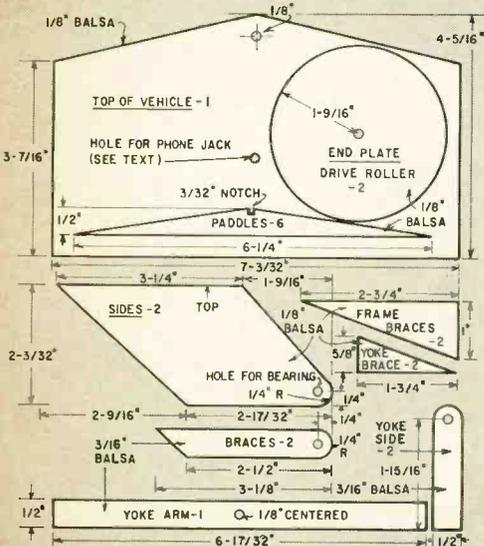


Fig. 2—Unless otherwise marked, sections are cut from two sheets of $\frac{1}{8}$ " balsa.

Gamma Goat

kids out in the sun this Christmas

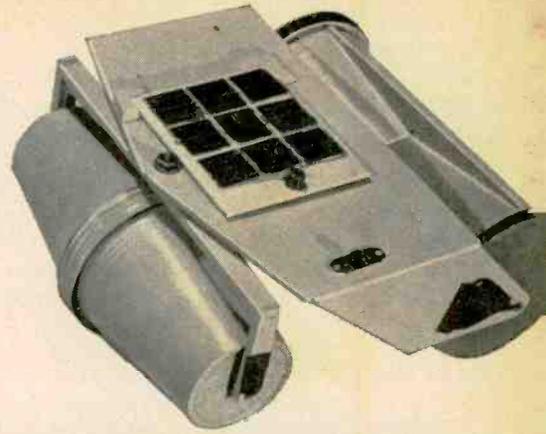


Fig. 3—The front roller assembly: Glue two Styrofoam cup lids together. Then cut $\frac{1}{2}$ " hole through each lid center for axle. Finally, push cups into lids as shown.

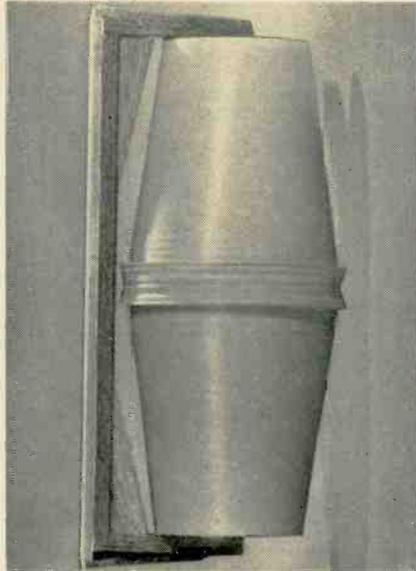


Fig. 4—Front roller is mounted beneath the movable yoke, using two eyelet bearings and a piece of coathanger wire. Unit functions as the steerable roller axle.

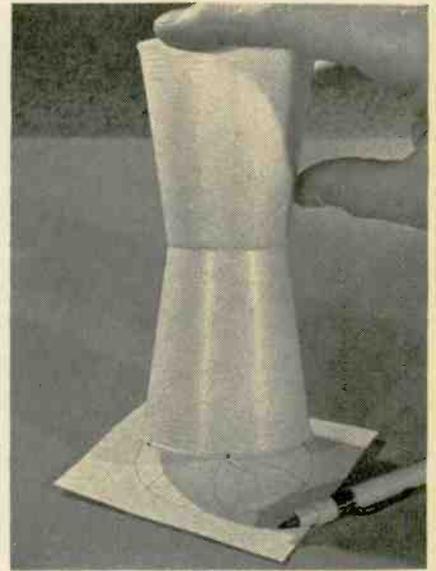


Fig. 5—Cement two additional Styrofoam cups together, bottom to bottom, to form the drive (or motor) roller. Then mark ends for locations of six drive paddles.

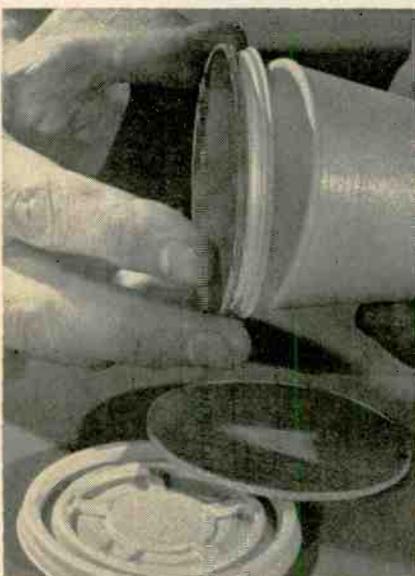


Fig. 6—Cement a balsa disc (follow the pattern of Fig. 2) to each Styrofoam cup lid. Then slip each "sandwich" on end of a drive-roller cup. Use two cups and lids.



Fig. 7—Use silastic rubber (or bathtub caulk) to cement paddles to the outside of the drive roller. Be careful not to plug or block the vent holes in paddles.

Materials List

- Balsa wood— $\frac{1}{8}$ " x 8" x 2' (vehicle frame)
- $\frac{1}{4}$ " x $\frac{3}{8}$ " x $\frac{1}{2}$ " x 3' (yoke and supports)
- Cups and lids—Styro cups, 6 oz. #67s
- Eyelets—Brass, or painted eyelets
- Model paint—For painting styrene; Spray Pla by Testor's, and AMT lacquer
- Anodized aluminum (or Lucite)—3' x 4" x $\frac{3}{32}$ "
- Shaft coupler—Motor and drive-shaft coupling; Aristo M233:20, Universal coupling, two required
- Solar cells—Series strings of three cells each; H. & R. No. TM13K490/3; \$2.50 per 3-cell module. Minimum of two modules required. Herback & Rademan, 1204 Arch St., Philadelphia, Pa. 19107
- Phone plug—Subminiature two-conductor (Switchcraft No. 850)
- Phone jack—Subminiature two-conductor (Switchcraft No. TR-2A)
- Gearhead motor—Dc drive motor, Inca-bloc No. SR601A0, with reductor of 1, 5, 10, 15, or 20 rpm (select one speed) \$8.37 to \$9.42 depending on speed (plus shipping). Portescap U.S., 730 Fifth Avenue, New York, N.Y. 10019
- Switch—D.p.d.t. toggle switch
- Miscellaneous—Dow RTV silicone rubber, bathtub caulk (white-clear), Elmer's glue, spray paints, shellac, epoxy, pins, tape.

motor. As Fig. 8 shows, you'll need four eyelets, each with about 8" of wire attached. Use an enameled wire—No. 26 is a good choice—for this hookup. Make the connection to the outside of the eyelet so the wire won't interfere with the axle. Two eyelets are used in the vehicle frame (Fig. 9) and two more are used in the drive roller (Fig. 10). Wire the drive-roller eyelets to the motor terminals, as shown in Fig. 11.

Instead of eyelet bearings, you can use miniature phone jacks and plugs (transistor radio size) at one end of the drive roller. This is a much easier and more reliable way to apply power to the motor.

Construction of the vehicle frame is straightforward—refer to Figs. 2

and 9. Take care to locate the side panels exactly before you glue them; their leading and trailing edges are not parallel. (Carry the "top" marking onto the pieces, when you cut them.) Use Elmer's glue or a twin-mix epoxy resin for bonding.

Hole drilling

To make things easier later on, drill out the bearing holes as soon as the side members and their braces have been cemented. Drill all other holes, too, so you won't have to juggle the finished frame while you are trying to drill holes in it.

If you plan to use a "plug-in" solar panel (so you can remove the panel to use it for other purposes) drill

an opening for the phone jack at this time (Fig. 12). If you also wish to use a forward-reverse switch, do necessary drilling and cutting at this time. In all such drilling operations, use pieces of backup wood so the holes will be neat. Add epoxy cement to the wood around the phone jack hole, for strength.

Before spray-painting the frame, sand it lightly with a fine emery paper. When spraying the model, take care not to get any paint on the unfinished roller assemblies; most spray paints will dissolve Styrofoam. A special paint (see Parts List) must be used to finish the rollers.

Assembly of the drive roller comes next. Use a round pin file or a tube of emery paper to clean out the eyelet bearings thoroughly so they will offer

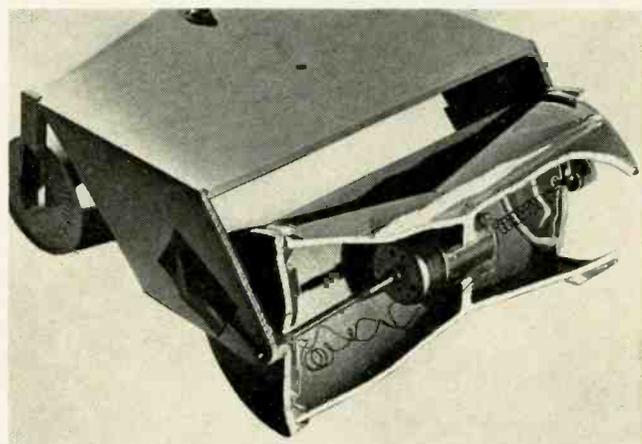
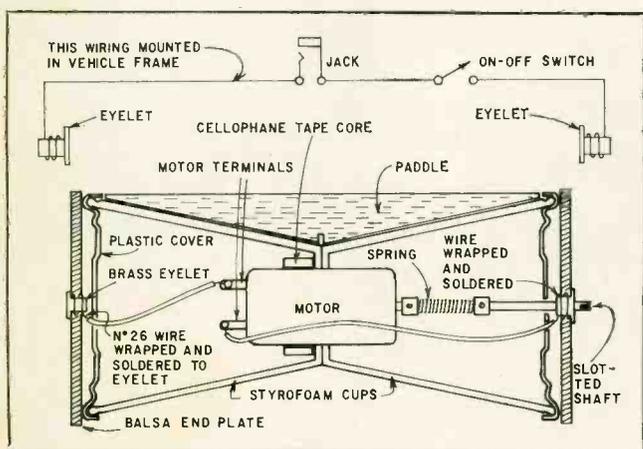


Fig. 8—Cement the motor inside the drive roller with some RTV rubber. Cellophane tape core holds motor securely in place.

Fig. 9—Motor and drive roller turn when power is applied. Drive shaft is held fixed by cotter pin tied to vehicle frame.

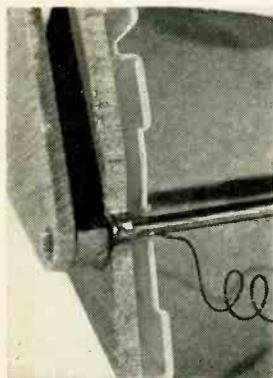


Fig. 10—Solder motor wire to eyelet; mount eyelet in end of drive roller with collar out.

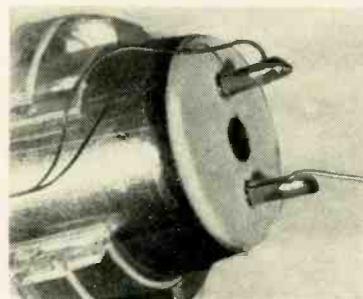
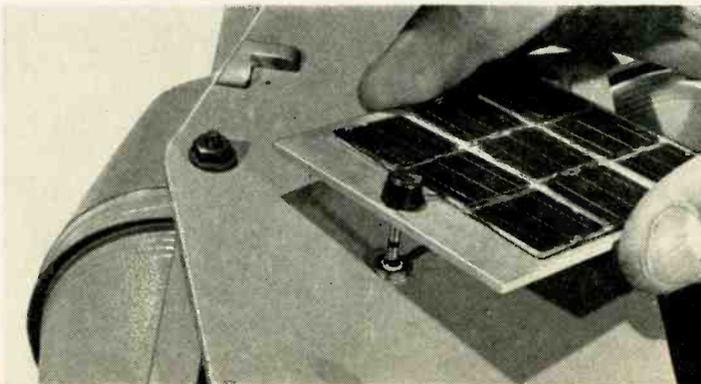


Fig. 11—Solder wires from the drive-roller eyelets to the two motor terminals. Don't overheat.

Fig. 12—Cement the solar cells to piece of Lucite or aluminum with a phone plug at one end. Wire cells, plug in series.



good electrical contact. Carefully study Fig. 8 and you will note that one axle is friction-fitted to the motor shaft with a piece of snug-fitting spring. If the vehicle is to be run in only one direction—that in which the spring will “grab” the shafts—this simple hookup is all that will be needed. If, however, you plan to provide a forward/reverse switch, you will need to use a nonslip coupling, such as one with set screws at both ends.

Motor coupling

The drive shaft can be a piece of coat-hanger wire, but a length of $\frac{1}{8}$ " drill rod is better. Cut the axle long enough to let it extend through both the bearing in the drive-roller end

plate and the bearing in the vehicle frame (see Fig. 10). About $\frac{1}{8}$ " to $\frac{1}{4}$ " of the shaft should extend beyond the frame bearing. As the shaft must be held stationary at this point, it should be slotted with a file. A $\frac{1}{16}$ " hole drilled through the tip also will provide a means to anchor the shaft.

When the motor and shaft are in place, the two end plates can be put in place, the cup lips tucking into the grooves of the lids.

The drive-roller assembly will need an axle for use in the opposite end of the assembly when it is placed in the frame. A piece of bare coat-hanger will work, but a piece of heavy copper wire is better, since this axle also must conduct electrical current.

This axle is slipped into place

through both frame and drive-roller bearings, when the drive roller has been positioned in place. You can bolt the axle in place if you wish, but a simple right-angle key-headed member is all that is needed. Use a piece of Mylar tape, placed over the keyed portion, to hold it in place.

When the drive axle is in place, it must be pinned so that it cannot turn. Use a partially straightened-out paper clip, leaving a “key head” on it over which Mylar tape can be put to hold it to the frame. The end slips through the axle slot to keep it from turning.

Before mounting the drive-roller assembly, spray it with a paint that will not dissolve or damage the Styrofoam cups (see Parts List.) Do *not* use heat to hasten drying; it will permanently damage the Styrofoam.

The yoke of the steering roller is secured to the frame with a small nut and bolt. An eyelet can be potted into the frame to serve as a mount if you wish. Washers should be used to distribute the loading this junction must endure. A flat rubber faucet washer should be sandwiched between the yoke and frame both to separate them and to provide enough friction to hold the yoke in any position.

Final assembly

After the yoke is mounted, the roller assembly that fits into the yoke is secured in the yoke bearings. A single, straightened-out piece of coathanger rod extending through all bearings does the job nicely. An L-bend in one end of the wire provides a lever across which to tape the rod in place to one leg of the yoke.

A word about choice of motors: The gear reduction you select from those listed depends on how you plan to use the vehicle. If you use three strings of solar cells, the goat will go over pretty rough ground with a 10 to 15 rpm motor—in sunlight. Even with a 20-rpm motor, it will manage well on dirt or grass.

If you want it to perform well on water, the higher the rpm the better! (Even a 40-rpm unit will run it on water.) The prototype model was made with a 15-rpm motor, which moves over fairly rough ground; it also runs at a reasonable rate on water.

Under a full sun, it is exciting to watch such a device operate, knowing that the energy source is free! But take care: If you tire of watching the goat—or if the sun goes behind a cloud—don't just go away and leave the Gamma Goat untended. You might forget it. Then, when the sun returns, it will wander off! It's a toy and it's in time for Christmas, so have a Merry Christmas.

R-E



Fig. 13—A 150-watt flood lamp at 4 feet will run the goat on smooth floor indoors.



Fig. 14—In water, the goat sinks a bit due to motor weight. But it floats!

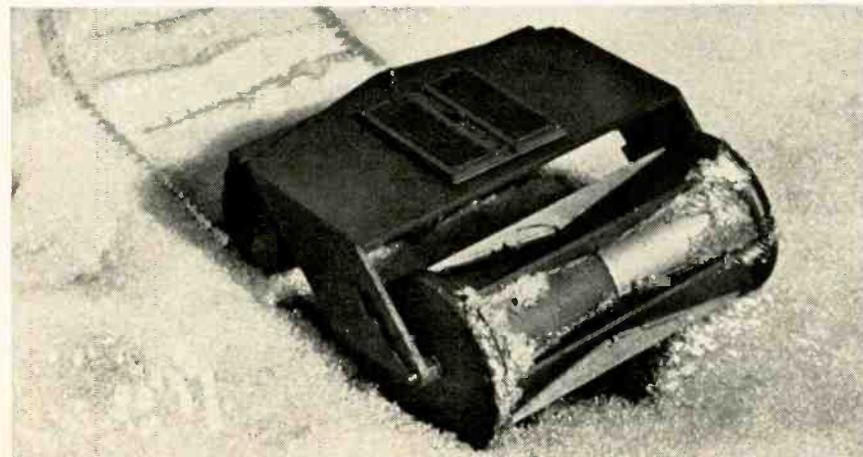
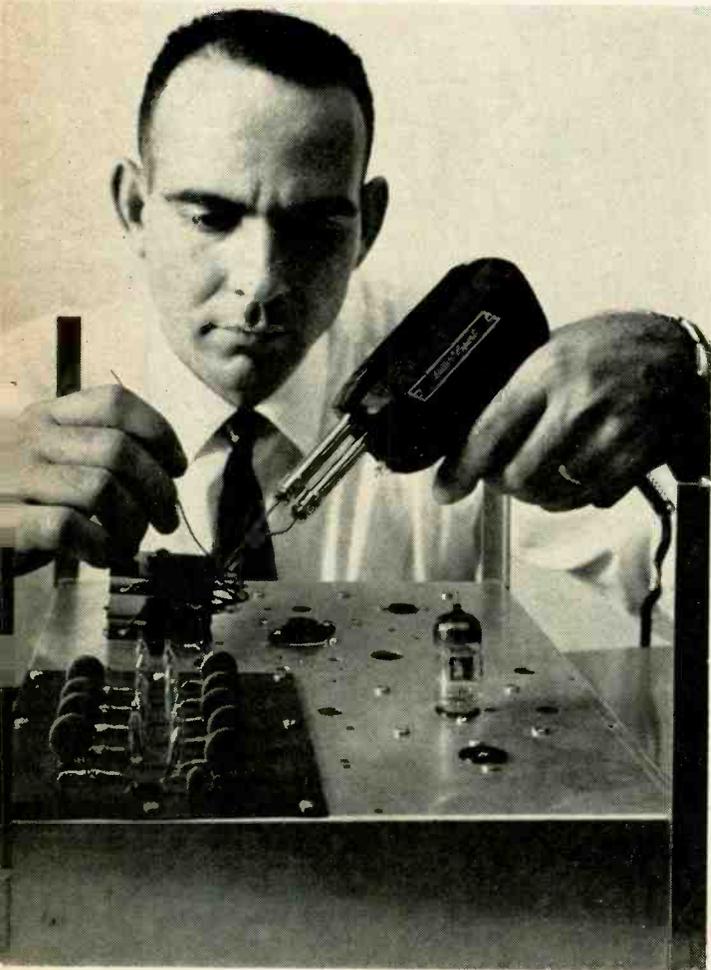


Fig. 15—Drive-roller paddles permit the goat to chop its way through deep snow.

YOUR FUTURE IN ELECTRONICS



**Exciting, challenging opportunities await
you in this fast-growing field**

By **RAY CLIFTON**

Photos courtesy of DeVry Institute of Technology, Grantham School of Electronics, National Radio Institute and RCA Institutes, Inc.

Item: Today at least 50,000 trained electronics technicians are urgently needed to fill well-paying jobs in the U.S.

Item: Additional jobs are being created each year for electronics technicians. The field is expanding rapidly.

Question: Are you an electronics technician?

Question: Would you like to become one—or become a better one?

Statement: Whether you become a (better) technician or not is up to you. Here's how you can.

Job Opportunities

Consumer electronics: Installing and servicing home radio and television receivers, hi-fi and stereo equipment, public-address systems, burglar and fire alarms, and other electronic devices are included in this segment of the industry. Some technicians are self-employed, and some work for others.

With widespread public acceptance of entertainment and other electronic equipment for the home, this field is wide open for skilled technicians.

Industrial electronics: Installation and service of in-plant gear, including computers, servo systems, microwave equipment, burglar and fire alarms, closed-circuit television equipment, intercoms, electronic machine controls, etc. Most technicians work in a plant; some are field-service representatives traveling around the country with expenses paid, and some are self-employed.

These days the wheels of industry are turned electronically, and technicians are in high demand. Wages are good, with periodic raises and promotions, paid vacations and health benefits.

Electronics manufacturing: Quality control, assembly-line inspection and testing, installation and maintenance of in-plant electronic equipment, building prototypes, instrument calibration, etc.

Many technicians in this field are promoted to engineering assistants or associate engineers. They have prestige and a solid future. Salaries are good and employment is steady.

Broadcasting and communications: Includes operation, installation and maintenance of transmitters, studio and associated equipment at AM, FM, TV and shortwave broadcast stations. Installing and servicing commercial two-way mobile radio and fixed stations, and telephone equipment. Operation, installation, maintenance of tape, disc and film equipment for motion-picture and recording studios.

More people use radio communications today than ever before. The number of transmitters in use grows each year. All need qualified technicians to service them.

Hobby electronics: Some persons like electronics for its own sake. They are hi-fi/stereo addicts, ham radio operators, construction builders or CB enthusiasts. They often study electronics because it makes their hobby more fun. A hobby isn't a job, but playing around with a hi-fi amplifier or a ham rig is an easy way to gain valuable practical experience. An electronics hobby can even help you get a better job.

Skills Needed

Regardless of the type of electronics work you would like to do, you must know a certain amount of theory and have some practical experience. The more you know about any equipment, the better and faster you can get it to work; that means money and personal satisfaction.

Consumer electronics: You must know how to use basic test equipment such as a voltmeter, oscilloscope, signal generator, etc. You must be familiar with AM, FM and TV receivers, as well as their antennas, and audio amplifiers and

power supplies. You should understand how transistors, vacuum tubes and semiconductor diodes work, as well as how to handle them.

Industrial electronics: You should be as qualified as the man in the consumer electronics field. In addition you must be familiar with the specialized equipment or systems used in your chosen industrial electronics field. Such things as tachometers, Q-meters, dc choppers, magnetic control amplifiers, polyphase rectifier circuits, telemetering equipment, medical equipment, closed-circuit TV systems, TV cameras, etc., are all part of this exciting industry.

Electronics manufacturing: You need most of the preceding skills, and more. Since your work can be that of an engineering assistant, you must be able to construct equipment from notes, schematics and other plans. You should know how to use laboratory-type test equipment. You may be given an opportunity to supervise and instruct others.

Broadcast and communications: A technician in this field must first have an FCC Commercial Radio Operator license, so he may legally operate, service and maintain radio and TV transmitters. He needs a working knowledge of electronic test instruments and of transmitters. Test equipment includes rf bridges, field-intensity meters, sound-level meters, etc. Other equipment includes TV sync generators and cameras, subcarrier generators and single-sideband equipment.

Acquisition of Skills

There are several ways to become technically qualified for a rewarding career in electronics.

Self-study: You buy a book, read it, work some problems and examples, perhaps build some electronic devices to get to know circuit operation and hardware. This method requires much self-discipline. You have no teacher to guide you or explain things not covered in the book. Many technicians have started this way, but as their thirst for knowledge grew with their experience, many of them found it to their advantage to pursue a more formalized program.

On-the-job training: Quite a few technicians got their start helping out around a radio or TV shop after school. They learned the tools of the trade, the hardware and much of the jargon. However, on-the-job training is only as good as the quality of supervision and programming of activities. Just taking any job in any radio and TV store or factory is not the answer.

But on-the-job training, while it puts you in electronics right away and brings in income, can be a dead end unless you also study theory. Many persons use the self-study method along with work. Some attend manufacturer's seminars and technician association training meetings. Most technicians at one time or another have beefed up their training with a correspondence course.

Home study (Correspondence course): You follow formal lesson plans designed by experts to include all needed information. After studying a lesson, you answer questions on the subject; your answers are read and graded by instructors. They will answer any questions you have and give you extra help when necessary. Kits are often used. You begin your program with a course in basic electronics, then pick a more specialized area to work in, such as industrial electronics or consumer electronic servicing.

You can study at home while you are employed full-time. You set your own speed, and you study at your convenience. Costs and time are determined by the complexity and completeness of a course.

Classroom study: For many persons, this is the best way to learn electronics in the shortest time. You attend regular classes, meet your instructor face-to-face at each session,

and follow a planned course. You learn not only "book theory" but perform bench experiments and get the feel of the hardware.

Supplementary Reading

You will find many fine electronics books and magazines in your local electronics distributors, bookstores, and newsstands. Some books are short and deal with a specific subject such as how transistors work using a vom, etc. Oth-



Home-study courses often include useful electronic projects.



With training, you can be a part of the big TV network shows as a video control technician.

ers are complete texts, and still others are comprehensive reference books. Practically all electronics technicians read such books and magazines from time to time to keep up with the field.

Guidance

Many companies will advise you how to go about qualifying for employment with them. Some have complete on-the-job training programs for new employees, and will start you as an apprentice with little or no electronics knowledge at first.

You can also seek guidance from the last school you attended, or from the school you would like to attend. You can write any school and ask them for their catalog and other descriptive material about the courses they offer. The National Council of Technical Schools and the National Home Study Council (see the partial listing of electronic schools for address and more photos on page 40) will also provide you with helpful information.

R-E

Q. and A. On an Electronics Career

Q: Can a woman study electronics and work in the field?
A: Yes. Sex is no barrier to training or employment. Knowledge, ability and experience are what count.

Q: Is there any age limit for new students?
A: Generally no, but educational prerequisites make it difficult for young children to qualify. Teenagers and persons in their 60's have benefited from electronics training.

Q: What educational requirements are there?
A: For vocational training (such as radio-TV servicing or industrial electronics) at least an 8th-grade education is necessary. For engineering technology (assistant to engineer in manufacturing) a student must often be a high-school graduate. These are general rules; each school has its own requirements.

Q: Does a student *have* to take a basic electronics course first?
A: Not always. If you're already working in electronics and have basic knowledge, you may qualify for an intermediate or advanced course. Most schools have guidance counselors to help you choose the right course for you.

Q: Does an electronics school have contact with major electronics employers to assist graduates to obtain jobs?
A: Yes—most schools maintain placement services for such purposes.

Q: Will a school guarantee a graduate a job?
A: An ethical school won't make such a promise. The final decision on employment is a personal one between graduate and employer.

Q: Do employers recognize diplomas?
A: Yes. Accredited schools must meet standards which require that only students who have made passing grades obtain diplomas. Thus the certificate means you have satisfactorily completed a course or program.

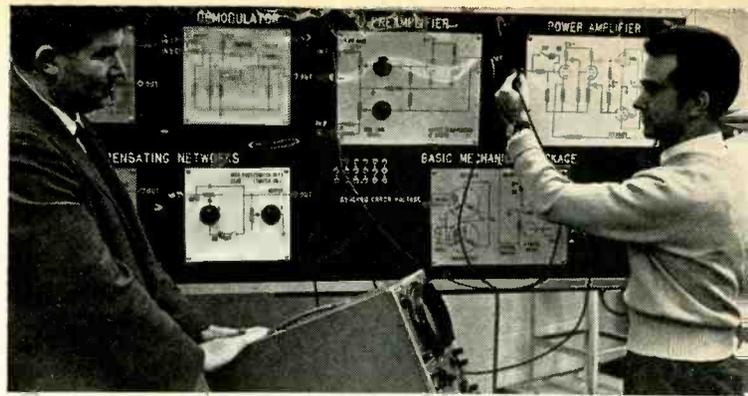
Q: Does a student have to choose his entire program at once?
A: No—you can take each course as you want it. (However, you must take certain subjects before advanced ones.)

Q: Can a student take a home-study course, then transfer to resident school and receive credit?
A: Generally yes, depending on the school(s) involved. It is usually easier to do this at the same school.

Q: Can members of the armed forces on active duty enroll in correspondence courses?
A: Yes. Since lessons are handled by mail, it makes no difference where the student is.

Q: Can veterans attend electronics schools under the GI Bill?
A: Yes. Most schools are approved for veteran training.

Q: Don't training courses become obsolete, with such new devices as FET's and IC's appearing in electronics?
A: Yes—advances in electronics make lessons out-of-date from time to time. Because of this, schools constantly revise and update their courses to include the latest technical material. Some schools even issue regular bulletins to students and graduates, with details of new devices and techniques.



All schools today use training aids and test equipment. You learn the functions, the symbols, and how the circuits work.



Part of your training should be working in the laboratory to develop the feel of tools, test equipment and troubleshooting.

Electronics Schools Directory

- | | |
|---|--|
| Academy Avionics
Reno-Stead Airport
Reno, Nev. | Indiana Home Study Institute
P.O. Box 1189
Panama City, Fla. 32401 |
| American Institute of Engineering and Technology
1139 W. Fullerton Pkwy.
Chicago, Ill. 60614 | International Correspondence Schools
Scranton, Pa. 18515 |
| American School
Drexel Ave. at 58 St.
Chicago, Ill. 60637 | National Radio Institute
3839 Wisconsin Ave., N.W.
Washington, D.C. 20016 |
| Canadian Institute of Science & Technology
263 Adelaide St., W.
Toronto, Ont., Canada | National Technical Schools
4000 So. Figueroa St.
Los Angeles, Calif. 90037 |
| Capitol Radio Engineering Institute
3224 16 St., N.W.
Washington, D.C. 20010 | Niles Bryant School
3631 Stockton Blvd.
Sacramento, Calif. |
| Central Technical Institute
1644 Wyandotte St.
Kansas City, Mo. 64108 | Northrop Institute of Technology
1199 W. Arbor Vitae
Inglewood, Calif. |
| Cleveland Institute of Electronics
1776 E. 17 St.
Cleveland, Ohio 44114 | Philco Technical Institute
219 No. Broad St.
Philadelphia, Pa. 19107 |
| Commercial Trades Institute
1400 W. Greenleaf Ave.
Chicago, Ill. 60626 | RCA Institutes, Inc.
320 W. 31 St.
New York, N.Y. 10001 |
| Cook's Institute of Electronics Engineering
P.O. Box 10634
Jackson, Miss. 39209 | Sams Technical Institute, Inc.
1720 E. 38 St.
Indianapolis, Ind. 46218 |
| Coyne Electronics Institute
1501 W. Congress Pkwy.
Chicago, Ill. 60607 | Technical Training International Inc.
10447 So. Torrence Ave.
Chicago, Ill. 60617 |
| DeVry Institute of Technology
4141 Belmont Ave.
Chicago, Ill. 60641 | Tri-State College
2487 College Ave.
Angola, Ind. 46703 |
| Elkins Institute
2603 Inwood Rd.
Dallas, Tex. 75235 | Valparaiso Technical Institute
Valparaiso, Ind. 46383 |
| Grantham School of Electronics
1505 N. Western Ave.
Hollywood, Calif. 90027 | |
| Heald College
1215 Van Ness Ave.
San Francisco, Calif. 94109 | |
| Hemphill Schools
1584 W. Washington Blvd.
Los Angeles, Calif. 90007 | |
- Some schools offer correspondence courses, some residence training, some both. This is only a partial listing. For more information about other schools, write:
- National Council of Technical Schools**
1507 M St., N.W.
Washington, D.C. 20005
- National Home Study Council**
1601 18 St., N.W.
Washington, D.C. 20009



The FCC License ...and how to get it

Your admission ticket to a career.

By **THOMAS R. HASKETT**

ONE OF THE MOST COMMON "DIPLOMAS" FOUND IN ELECTRONICS is the Commercial Radio Operator license issued by the Federal Communications Commission. By act of Congress, most of the nearly 2 million radio and television transmitters used in the US today must be operated—and all must be serviced and maintained—only by persons holding one of the various classes of FCC operator license.

To obtain a "ticket," you must pass a written examination covering, among other things, electronics and radio theory and practice. Thus, possession of an FCC license is generally considered proof of electronics knowledge. Such proof can help you obtain a technical job, even though the position may not legally require a license.

To work as a technician servicing transmitting equipment you must have a ticket, of course. But even if you don't intend to troubleshoot transmitters, a license can be helpful. At nearly half of the 7000 US broadcast stations, for instance, you'll be a more valuable employee if you have a Radiotelephone Third-Class license with a broadcast endorsement. Whether you're an announcer, a typist or a janitor, you can then legally perform routine transmitter operation.

License requirements

To be eligible, you must be a US citizen and capable of transmitting and receiving spoken messages in English. Further requirements depend on the class of license you want. Table I lists the elements of the examination you must pass for each license. Here's what the exam covers:

Element 1—Basic Law: Radio laws, treaties and regulations which every operator must know.

Element 2—Basic Operating Practice: Procedures used when communicating by means of radiotelephone stations.

Element 3—Basic Radiotelephone: Technical, legal and other matters which apply to radiotelephone stations (other than broadcast). Covers general electronics theory.

Element 4—Advanced Radiotelephone: Advanced technical, legal and other matters which apply particularly to AM, FM and TV broadcast stations. Covers advanced electronics theory.

Element 5—Radiotelegraph Operating Practice: Procedures used when communicating by means of radiotelegraph stations.

Element 6—Advanced Radiotelegraph: Technical, legal and other matters which apply to all classes of radiotelegraph stations, and associated matters such as radio navigational aids and message traffic routine. Covers advanced electronics theory.

Element 7—Aircraft Radiotelegraph: Basic theory and practice in the operation of radio communication and navigational systems used on aircraft.

Element 8—Ship Radar Techniques: Specialized theory and practice which applies to installation, servicing and maintenance of ship radar equipment used for marine navigation.

Element 9—Basic Broadcast: Basic regulatory matters which apply to the operation of AM and FM broadcast stations.

Table I—Requirements for FCC Operator Licenses

	Element 1 Basic Law	Element 2 Basic Operating Practice	Element 3 Basic Telephone	Element 4 Advanced Telephone	Element 5 Telegraph Operating Practice	Element 6 Advanced Telegraph	Element 7 Aircraft Telegraph	Element 8 Ship Radar	Element 9 Basic Broadcast	Code Speed	Special Requirements
RADIOTELEPHONE											
First-Class License	X	X	X	X				(3)			
Second-Class License	X	X	X					(3)			
Third-Class Permit	X	X							(4)		
Restricted Permit											At least 14 yrs old; declaration only req'd.
RADIOTELEGRAPH										(5)	
First-Class License	X	X			X	X	(1)	(3)		25/20	At least 21 yrs old; 1 year service
Second-Class License	X	X			X	X	(2)	(3)		20/16	
Third-Class Permit	X	X			X					20/16	

- 1 Aircraft telegraph endorsement required on this license to operate radiotelegraph station on aircraft. (Exception: If license holder has been chief or sole operator in such capacity prior to 2-15-50.)
- 2 Aircraft telegraph endorsement, 25-wpm code speed, and at least 18 years of age required on this license to operate radiotelegraph station on aircraft.

- 3 Ship radar endorsement required on these licenses to service and maintain ship radar equipment.
- 4 Basic broadcast endorsement required on this license to operate certain classes of broadcast transmitters.
- 5 First figure indicates plain-language words; second figure indicates 5-character code groups; both per minute.

Preparing for the exam

There are two general ways to study: One is to buy (or borrow) a handbook. Several are listed in Table II.

These books contain sample questions similar to those contained in the FCC exam. Each question is followed by the correct answer and the theory behind it. The best way to study is to cover the answer with a piece of paper while you read the question. Then write your answer. If you are correct, check that question off and go on to the next. When you miss a question, study the background material and work a few problems based on the subject. Refer to other books if you like; the object is to become familiar with the theory and practice, not just the answer.

The second way to study for the FCC exam is to enroll in a correspondence or residence school and take a course designed to prepare you on this subject.

To pass the examination for any class of radiotelegraph license, you must be able to transmit and receive International Morse code at the rate specified in Table I.

Code instruction is seldom available at the schools

Table II—License Study Manuals

Commercial Radio Operator's Question & Answer Guide, by Martin Schwartz. No. 8-01 (Elements 1, 2 and 9) 1964, \$0.75; No. 9-01 (Element 3) 1967, \$1.95; No. 10-01 (Element 4) 1958, \$1.25. Ameco Publishing Corp., Williston Park, N.Y.

First-Class Radiotelephone License Handbook, B0N-2, by E. M. Noll. Howard W. Sams & Co., Inc., Indianapolis, Ind., 1966, \$5.25.

Radar License Endorsement Handbook, RLH-1, by E. M. Noll. Howard W. Sams & Co., Inc., Indianapolis, Ind., 1964, \$2.95.

Radio Operating Questions and Answers, 13th Edition (text), by J. Hornung and A. McKenzie. McGraw-Hill Book Co., Inc., New York, N.Y., 1964, \$6.00.

Radio Operator's License Handbook, RON-1, by E. M. Noll. Howard W. Sams & Co., Inc., Indianapolis, Ind., 1965, \$3.25. (Covers Third-Class Radiotelephone license with broadcast endorsement.)

Radio Operator's License Q & A Manual, 7th Edition, by Milton Kaufman. Hayden Book Co., Inc., New York, N.Y., 1966, \$7.95.

Radiotelephone License Manual, 3rd Edition, by Woodrow Smith. Editors & Engineers, Ltd., New Augusta, Ind., 1962, \$5.75.

Second-Class Radiotelephone License Handbook, 3rd Edition, QAN-2, by E. M. Noll. Howard W. Sams & Co., Inc., Indianapolis, Ind., 1966, \$4.95.

Successful Preparation for FCC Radio Operator License Examinations, by D. L. Geiger. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1960, \$9.95.

mentioned; they usually prepare you only for radiotelephone exams. Code-practice tapes, records and books are available through electronics distributors.*

Taking the exam

If you live in or near any of the cities listed in Table III, look up the FCC field-office phone number and call them for information. Exams are usually given each week at these offices.†

If you live away from the cities in Table III, your best bet is to write to the nearest listed office. Ask them where your nearest examining point is, and when the next exam will be given. Ask them also to send you one each of FCC Forms 756 and 756-B (the official applications for license). When you plan to take an exam anywhere but an FCC district office (those shown in Table III) you must fill out and mail in the application in advance.

You must pay a fee with your application for a license.

*One useful book is *Learning the Radiotelegraph Code*, American Radio Relay League, Newington, Conn., \$0.50.

†Don't apply to a field office for a Restricted Radiotelephone Permit. While there are some exceptions, you should usually write to FCC, Gettysburg, Pa. 17325. Ask for FCC Form 753, which is the application for this class of permit.

Table III—FCC Field Offices

P.O. Box 644	Boston, Mass. 02109
Anchorage, Alaska 99501	Detroit, Mich. 48226
Los Angeles, Calif. 90014	St. Paul, Minn. 55102
San Francisco, Calif. 94126	Kansas City, Mo. 64106
San Pedro, Calif. 90731	Buffalo, N. Y. 14203
Denver, Colo. 80202	New York, N. Y. 10014
Washington, D.C. 20555	Portland, Ore. 97205
P.O. Box 150	Philadelphia, Pa. 19106
Miami, Fla. 33101	P.O. Box 2987
Atlanta, Ga. 30303	San Juan, P. R. 00903
Honolulu, Hawaii 96808	Dallas, Tex. 75202
Chicago, Ill. 60604	Houston, Tex. 77002
New Orleans, La. 70130	Norfolk, Va. 23510
Baltimore, Md. 21202	Seattle, Wash. 98104

Address all communications to "Engineer in Charge, Federal Communications Commission."

If you appear at an FCC district office in person, you may pay cash; otherwise send only check or money order by mail. Cost depends on the class of license or permit: First-Class, \$5; Second-Class, \$4; Third-Class, \$3; Restricted Radiotelephone permit, or renewal of any license, or endorsement of license, or duplicate license, \$2.

When you take the exam, you'll be given the code test first if you apply for any class of Radiotelegraph license. You must receive and transcribe consecutive words or code groups for a period of one minute without error at the specified rate of speed. If you fail the code test, you won't be given the written exam.

You will be given a series of printed questions to answer in writing, and (for some elements) you'll be required to draw (or correct) a few schematic diagrams. The minimum passing grade for each element is 75%.

If you fail any element, you are not allowed to go any further in the exam. You will be issued, however, whatever license you have qualified for. For example, suppose you applied for a Radiotelephone First-Class license, passed Elements 1 and 2, but failed Element 3. You would then be issued a Radiotelephone Third-Class permit.

Once you have failed an element, you normally cannot take another commercial exam for two months. (If you have urgent need for the license and are willing to do further study at once, however, you can apply for a waiver of this rule, on FCC Form 757-B.)

License privileges

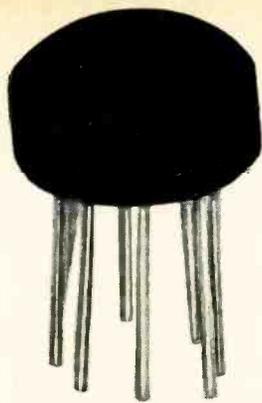
Okay, you passed the exam, you got the license—now what can you do with it? That depends on which license.

The *Restricted Radiotelephone permit* is intended for operators only, and has limited usefulness. You are authorized to operate the following classes of stations: remote-pickup broadcast, land and ship maritime telephone, aviation, public safety (police and fire), industrial, land transportation (taxicab and trucking). You may not perform any servicing or maintenance of transmitters.

The holder of a *Radiotelephone Third-Class permit* may operate all of the preceding stations, plus instructional fixed TV stations, international fixed public stations (common carriers) and—with a broadcast endorsement—AM broadcast stations with power output of 10 kW or less and nondirectional antennas, and FM broadcast stations with power output of 25 kW or less. This permit does not allow any servicing or maintenance of transmitters.

A *Radiotelephone Second-Class license* permits operation of all the preceding (no broadcast endorsement required to operate broadcast stations), plus TV auxiliary and booster stations, and CATV relay stations. This license is also really useful in an electronics sense; it allows you to perform servicing and maintenance at the following types

(continued on page 71)



30 BASIC IC PROJECTS

Part 1 of 2 parts to help you learn how to work with IC components and their related circuits
By R. M. MARSTON

HAVE YOU IGNORED INTEGRATED CIRCUITS in your construction projects as "too expensive" or "specialized"? Forget those ideas—cheap, plentiful IC's are here, and you can build many circuits with them.

A real winner is the Fairchild μ L914—it costs less than a dollar. For your money you get 4 silicon planar 2N708 transistors and six resistors, all encased in an epoxy block roughly the size of a TO-5 case. The 2N708 transistors have an f_T (gain-bandwidth product) of 450 MHz.

The internal circuit of the μ L914 is shown in Fig. 1, and lead connections in Fig. 2. By juggling around the connecting leads and maybe adding a few extra components, you can come up with: a differential amplifier, a multichannel audio mixer, or an audio oscillator, just to name a few examples.

Remember just two basic rules:

- (1) Do *not* think of an IC as some fantastic new technical device needing new application techniques all its own.
- (2) Do think of the IC as a bunch of perfectly normal transistors and resistors, bonded together in a single block, and requiring perfectly normal transistor-circuit design techniques.

With Rule 2 in mind, take a look at Fig. 1, the internal circuit schematic

of the μ L914. Unwanted transistors can be effectively cut out of the circuit by shorting them base to emitter.

Cut Q2, Q3 and Q4 out of circuit by shorting pins 2, 3, 4 and 5. Wire a bias resistor from pin 1 to pin 7, and you're left with a perfectly normal common-emitter amplifier, Q1. Short out only Q2 and Q3, and apply bias to Q1 and Q4, and you have two normal common-emitter amplifiers.

Cut Q3 and Q4 out of circuit, and apply bias to Q1 and Q2. Now you have a two-channel mixer with output at pin 7. Apply bias to all four transistors and short pins 6 and 7, and the IC works as a four-channel mixer.

As you can see, it's easy to wire the μ L914 to work in a number of alternative basic modes. Once you've figured out which mode you want, you can get on with circuit design just as if you were using standard transistors.

Want to use the μ L914 in pulse or logic applications? A nice feature about this micrologic line of IC's is that you don't have to figure input and output drives in terms of impedance and current. Fairchild specifies input and output needs as so many *units of drive*, as shown circled in the diagrams.

Thus, the μ L914 needs 3 units of drive at each input and gives 16 units of drive at each output. Each output can therefore drive as many as five following input stages. This means that, if you want to use a stack of the circuits interconnected, you can easily

calculate just how many inputs each output can drive directly, and normally complex circuit layout calculations can be simply made.

Now let's look at some practical applications.

Waveform generators

When the μ L914 is operated as a differential amplifier, one of the two outputs will be in phase with, but of greater amplitude than, the input signal. It follows that if this signal is fed back to the input the circuit will act as an oscillator or waveform generator. The waveform generated will depend on the form of positive feedback connection used in the circuit.

Fig. 3 shows how to connect the IC as a wide-range audio generator to cover 150 Hz to 40 kHz in three ranges. An approximately rectangular waveform is generated, since a simple RC (R6-C2) feedback network is used. R6 acts as the variable frequency control.

Fig. 4 shows the connections for making the circuit act as a 1-kHz Wien bridge sine-wave generator. The frequency-determining components are R1-C3-R6-C2.

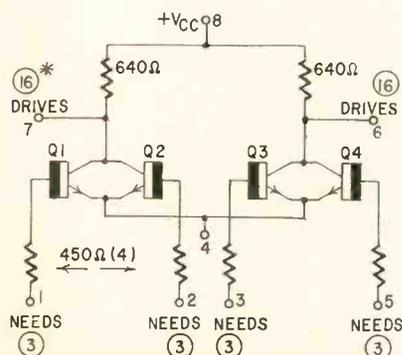
When using this circuit R6 should be adjusted to give a pure sine wave on an oscilloscope. It is possible, using a 4.5-volt supply, to obtain a pure sine-wave output of about 1 volt peak to peak from the circuit. Note that the values used for C2 and C3 are not standard and must be built up by wiring standard components in parallel. The operating frequency can be changed, if required, by changing the values of C2 and C3; an increase in value gives a decrease in frequency.

Dc meter amplifier

The differential amplifier is widely used as the basis of an electronic voltmeter or for increasing the sensitivity of moving-coil current meters. The trouble with normal transistors in these applications is that the circuits are subject to considerable zero drift with small changes in temperature. This is partly due to differences in characteristics of individual transistors. Another reason is that, due to its physical position in the circuit, one transistor may be subjected to larger temperature changes than the other.

When an IC is used as a meter amplifier, however, drift troubles do not exist. IC transistors are etched on a common slab of silicon and must inevitably be held at equal temperatures and have their characteristics closely matched as a result.

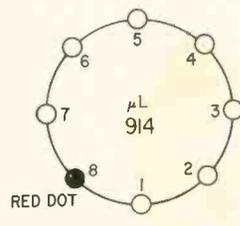
Fig. 5 shows how to wire the μ L914 for use as a dc meter amplifier. If a 1-mA meter is used, its sensi-



* FIGURES INDICATE NUMBER OF "GAIN UNITS"—SEE TEXT

INTERNAL CIRCUIT OF μ L914

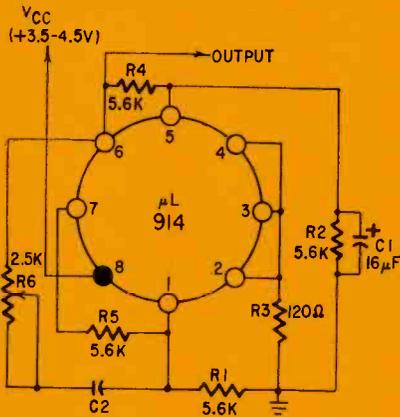
Fig. 1



TOP VIEW
BASE LEAD CONNECTIONS OF

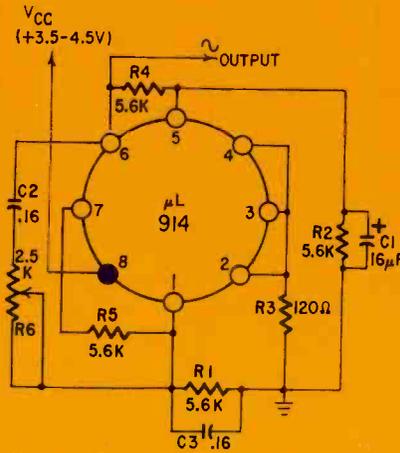
μ L914

Fig. 2



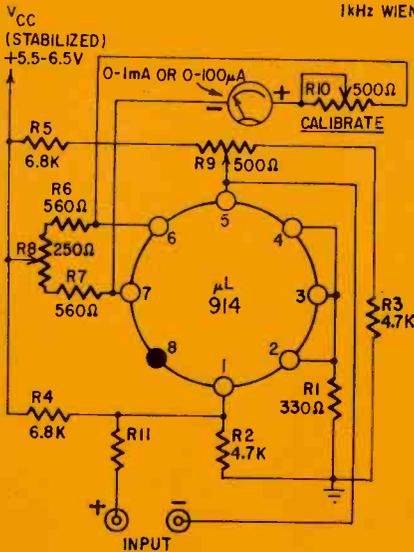
WIDE-RANGE AUDIO GENERATOR
 $C2 = 1\mu F$, $f = 150\text{Hz TO } 3\text{kHz}$
 $\cdot 1$, $f = 3\text{kHz TO } 15\text{kHz}$
 $\cdot 02$, $f = 12\text{kHz TO } 40\text{kHz}$

Fig. 3



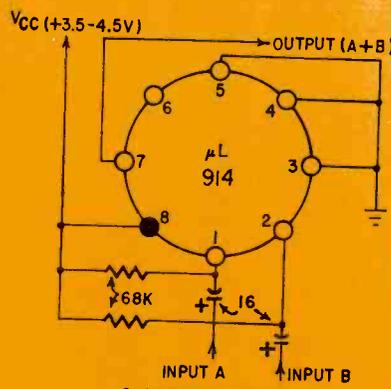
1kHz WIEN-BRIDGE SINEWAVE OSCILLATOR

Fig. 4



DC METER AMPLIFIER
 $R11 = \text{VOLT METER RANGE MULTIPLIER}$
 $= 20\text{K}\Omega/\text{VOLT FOR } 1\text{mA METER}$
 $= 100\text{K}\Omega/\text{VOLT FOR } 100\mu\text{A METER}$

DC METER AMPLIFIER
 Fig. 5



2-CHANNEL MIXER
 Fig. 6

[The $\mu L914$ IC retails for \$0.80 at Fairchild distributors. Most of them do not accept mail orders for less than \$10.00. Semiconductor Specialists, P.O. Box 8725 O'Hare International Airport, Chicago, Ill. 60666 accepts mail orders of \$3.00 or more. If you must purchase by mail-order, we suggest you order four $\mu L914$'s. They are quite versatile and you can use them in future construction projects.—Editor]

tivity will be increased more than 20 times (to $50\mu A$). A $100\text{-}\mu A$ meter can be increased more than 10 times (to better than $10\mu A$).

If a voltage-range multiplier ($R11$) is wired in series with the input lead as shown, the sensitivity of the resulting electronic voltmeter will be raised to 20,000 ohms/volt using a 1-mA meter, and to 100,000 ohms/volt with a $100\text{-}\mu A$ meter. Note that this circuit uses a 6-volt stabilized supply which can be obtained from a Zener diode.

Once the meter amplifier has been built, set it up as follows:

- Short the input terminals, and set $R8$ for a zero reading on the meter.
- Open the input terminals and set $R9$ for zero on the meter.
- Repeat (a) and (b) until no further zero adjustment is required.
- Select the multiplier ($R11$) for the full-scale voltage required. Example: If a 1-mA meter is used and a full-scale value of 10 volts is required, $R11$ should be 200,000 ohms.

(e) Apply a known voltage close to the required full-scale value to the input terminals and adjust $R10$ to indicate this voltage on the meter. The voltmeter is now ready for use.

When using the voltmeter, this series of checks should be repeated occasionally to make sure that calibration is correct. Readjustment will rarely be needed in practice, and $R8$, $R9$ and $R10$ can be preset types tucked away out of sight at the rear of the completed instrument. The unit may be used as a multirange voltmeter by providing switch selection of various $R11$ values.

Mixer circuits

Since the $\mu L914$ contains two pairs of transistors sharing a common collector load, each pair of transistors can be made to operate as a two-channel audio mixer if the transistors are suitably biased.

Fig. 6 shows how to wire the IC as a two-channel mixer using the $Q1$ - $Q2$ pair of transistors only, and Fig. 7 shows the alternative connection using

the Q3-Q4 pair. Both these circuits give a voltage gain of about 16, between each input and the output.

The $\mu\text{L}914$ can be made to serve as a four-channel mixer by using both halves of the circuit and shorting all collectors to a common load. Fig. 8 shows the circuit. The voltage gain between each input and the output is about 8 in this mode.

Emitter follower

You can obtain a normal emitter follower by using the connections shown in Fig. 9. Input impedance is about 12,000 ohms; it can be increased by using normal bootstrap techniques, if required. Only one emitter follower can be made from each $\mu\text{L}914$.

Common-emitter amplifiers

The differential amplifier can be used with advantage to replace conventional common-emitter amplifier stages. The current taken by a C-E stage from the supply line remains virtually constant under operating conditions, and there is thus no great need to incorporate decoupling networks in the supply lines when cascading stages.

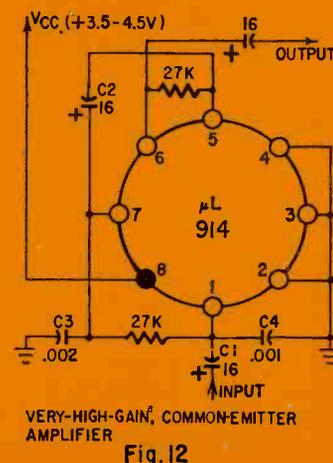
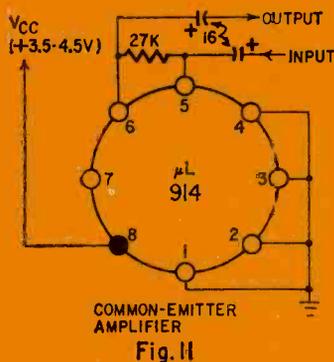
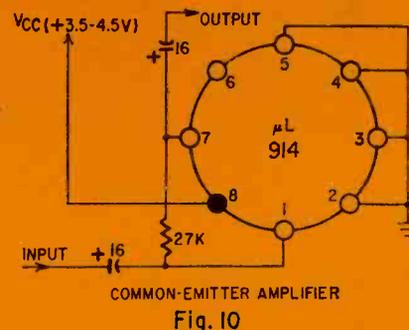
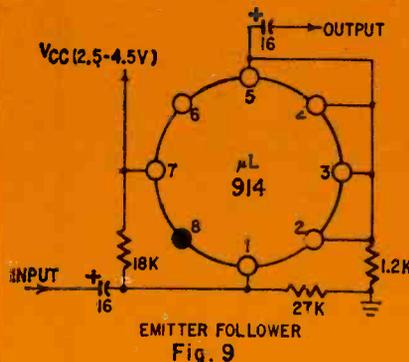
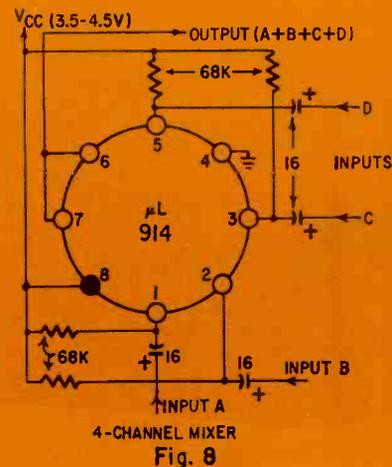
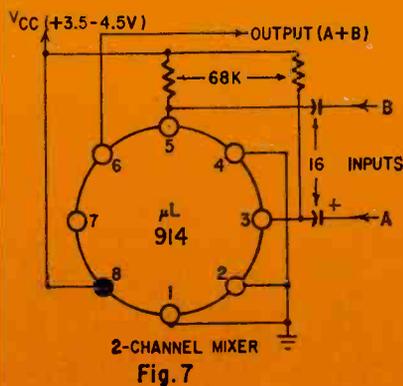
The $\mu\text{L}914$ can, however, also be used to replace a conventional common-emitter amplifier. Fig. 10 shows one connection using Q1 only, while Fig. 11 shows an alternative connection using Q4. Both these circuits give voltage gains of about 20, and have flat frequency response within 3 dB from 60 Hz to well over 1 MHz.

The $\mu\text{L}914$ connections can be modified so that the amplifiers of both Figs. 10 and 11 are incorporated in a single circuit, and two independent common-emitter amplifiers are made available. Alternatively, this modification can be made and the two amplifiers cascaded to form a single very-high-gain amplifier. The connections for this mode are shown in Fig. 12.

The circuit of Fig. 12 gives a voltage gain of about 400, and has a frequency response that is within 3 dB from 100 Hz to about 200 kHz. The low-frequency end of the spectrum can be extended by increasing the values of C1 and C2. Capacitors C3 and C4 limit the upper end of the frequency response; if they are not used, the circuit will, through internal feedback, act as an oscillator operating at a frequency of several megahertz.

Now that you've seen these first 10 applications of the $\mu\text{L}914$, you may want to try a couple. Next time we'll show you even more interesting uses for this inexpensive IC.

Continued next month



Rotary Stepping Switches—They're Everywhere

Part 2—Use them for counting, circuit selection and remote control

By TOM JASKI

PART 1 OF THIS SERIES DESCRIBED HOW rotary switches are used for the selection of as many points as the selecting switch carried, but with only a single sequence of pulses. A telephone dial is a useful control device which produces a maximum of 11 pulses. Thus supplying control pulses with such a dial might make it necessary to dial several times until the correct *total* number of pulses were delivered. Note too that most telephone-type dials will deliver one extra pulse. Thus if 3 is dialed, 4 pulses are actually delivered by an unmodified dial.

Fortunately, it's possible to prevent such action. An electrical modification can be made, by inserting a slow-release relay in the circuit. The relay is then picked up by the first pulse—the relay blocks all line pulses until it is picked up. It's also possible to modify the dial mechanism mechanically.

Changing a telephone dial

Fig. 1 shows how to eliminate the extra pulse from a standard older-type telephone dial. Note the "off-normal" contacts. These are operated by a small brass foot attached to the shaft. When the dial is rotated, the normally closed contacts are opened (and the normally open contacts are closed). The pulses are produced by the interrupter as the dial is on the return stroke. By extending the brass foot of the off-normal contacts a little (this can be done by soldering on a small piece of brass) and sending the pulses through one of these contacts, the extra pulse can be eliminated. The last pulse is then blocked by the off-normal contact.

Note too that the dial's mode of forming pulses—making or breaking contacts—can be changed by adjusting the position of the interrupter cam on the geared shaft.

Using the dial for selection leads to a more sophisticated, two-level system. By using a switch of 10 points per level and 10 levels (Automatic Electric type 80, or equivalent), a 2-digit code can select any one of 99 points. Fig. 2 shows the diagram for such a selector system. S1 is a minor switch, operated by the first digit dialed; this action selects the *level* of S2. The next set of pulses then rotates S2 to the desired contact. As arranged here, the pulse line also becomes the control line, and the circuit resets



The Roto-Netic stepping motor from Heinemann Electric Co. converts pulses into rotary motion consisting of 10 precise steps. The device (see photo) consists of a linear solenoid, a spring-loaded, plunger-type armature, and a ratchet-and-pawl actuator on the end of the plunger that turns the output shaft.

When the solenoid is energized by a pulse, the plunger is drawn into the coil against spring tension. After the pulse, the solenoid is de-energized, and the spring forces the plunger back to "rest" position. This drives the actuator against a 10-tooth starwheel and produces 36° of shaft rotation (one step).

The actuator prevents the starwheel from rotating more than 36°, and a pawl prevents reverse rotation. This means there's no possibility of overshoot, and overshoot compensation isn't necessary. Each step is precisely the same as the last, and since the power stroke occurs upon de-energization, even the last stroke is recorded in case of power failure.

Speed is nominally 600 steps per minute and operates on either 12 volts dc or 115 volts ac with a bridge rectifier.

on a single pulse, but only after it has come to rest.

1CR is the relay which translates the pulses so a local power supply can be used. As pulses arrive, motor magnet MM1 steps S1 to the desired level of S2. Slow-release relay 2CR also energizes on the first pulse and remains energized until the pulses stop. When they do, and 2CR releases, relay 3CR is energized through now closed off-normal contacts ONS1 (which are on switch S1) and locks up on the supply. This action removes future pulses from S1 and also sends pulses through contacts 1CR-3 to motor magnet MM2. This second set of pulses causes MM2 to rotate S2.

When this sequence is finished, 2CR again drops out, now connecting 4CR, through 2CR-3, to the line and also to the wipers that make the controlled circuit. A tone arriving over this line does not affect the dc circuit, but a dc pulse will energize 4CR, a slow-release relay that will allow MM2 to step home on the interrupter and will energize the release magnet of S1, resetting these switches. Off-normal contact ONS1 on S1 then drops 3CR.

This circuit can deliver any one of 99 points on demand (even 100 by including the code 00). Using the same principles with more switches and relays would make it possible to extend the system indefinitely. Most industrial control or monitoring problems can be handled easily by a system that provides selection of any of 100 points—especially if the system has random access, like this one.

Output pulse polarity

One point about generating pulses with a stepper: The circuit of Fig. 3-a produces negative pulses—i.e., no voltage during steps. Positive pulses—voltage *only during* steps—can be produced with the hookups of Fig. 3-b and c. At (b) the outgoing line is grounded as long as the switch remains on a contact; when the arm moves, a positive voltage goes to the line. The resistor prevents shorting the battery. At (c) a relay inverts the pulses.

The device of Fig. 4 has several functions. First, it counts pulses in decades from a switch-type transducer. By mounting numbered discs or cylinders on the switch shafts this count can be

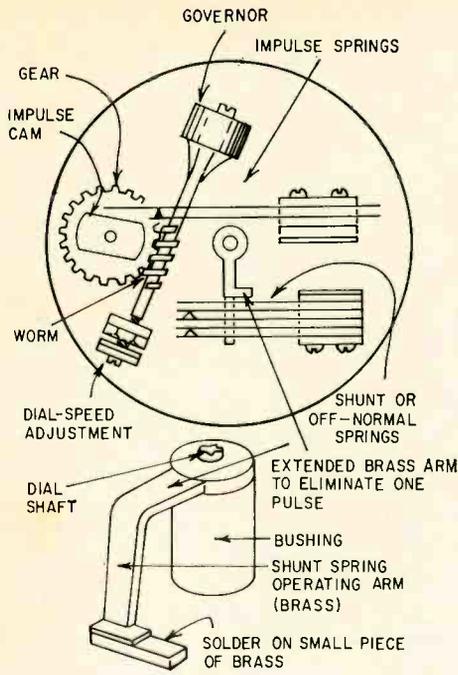


Fig. 1—How a telephone dial's shunt-spring operating arm is modified to eliminate the extra pulse that it normally generates.

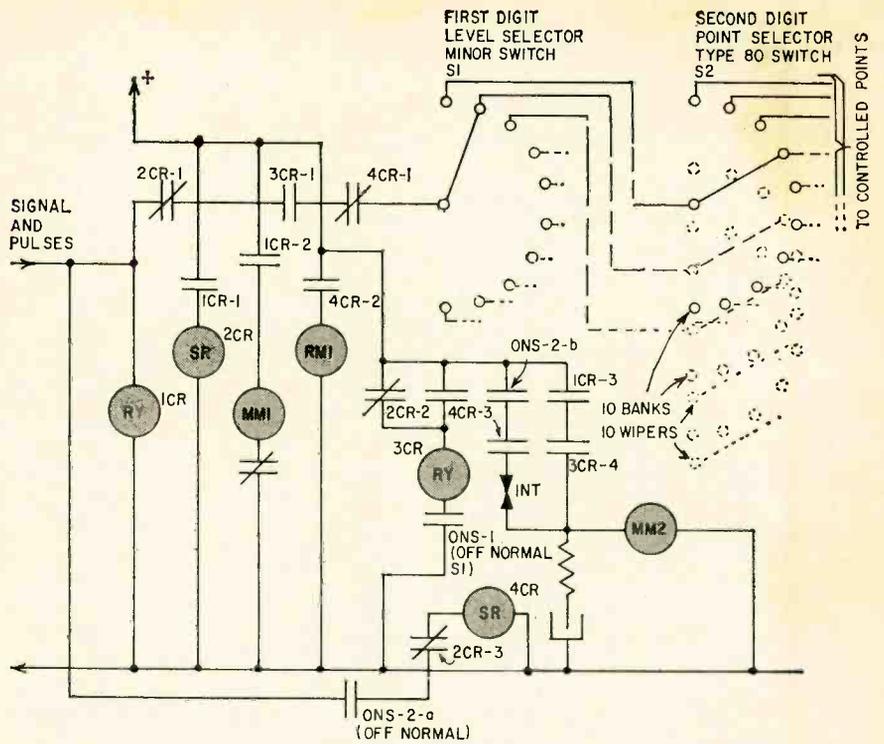


Fig. 2—A two-level selector can select any one of 99 points by actuating S1, then S2.

read directly. By supplying different tones for each switch, characteristic signals can be sent out over a single line, to identify units, tens and hundreds. (Of course, three separate lines can be brought out for this purpose.)

Circuit operation is simple: Incoming pulses operate relay 1CR, which is present for the usual reason (to keep

from loading the pulse line). It causes S1 to step, and on the tenth pulse to S1 causes a wiper contact to connect MM2 to the positive dc line. This starts S2 on its first step. This same wiper contact energizes relay 2CR, which resets S1. The next two steps operate similarly, and just one pushbutton resets the whole circuit.

Again it's possible to say that this circuit can be expanded to include "thousands," "ten thousands" and so on. For practical purposes a count of 999 is quite large. The circuit shown was used for registering gallons pumped by gas pumps in a service station. A remote register totaled all the data from the pumps, using a storage or "memory"

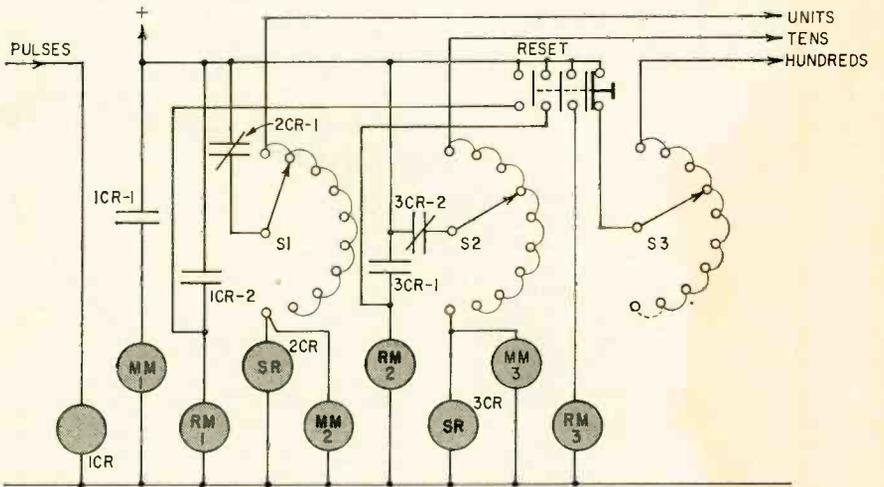
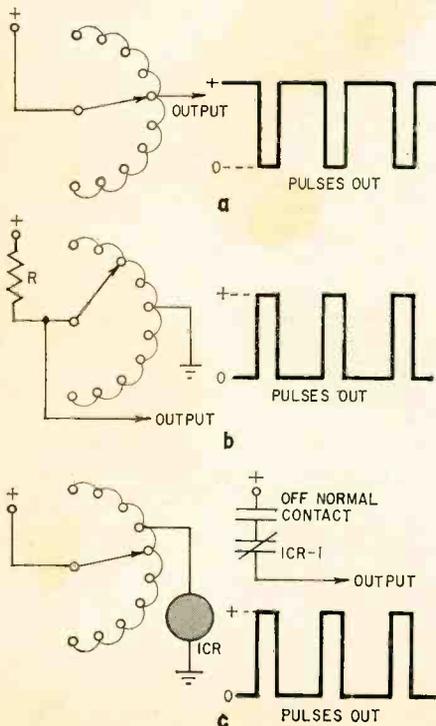


Fig. 4—(above)—Decade counting circuit. Separate lines send units, tens and hundreds pulses to readouts. Distinctive tone codes can be sent out over a single line.

Fig. 3—How stepper generates pulses. a—Negative (zero-voltage) pulse output when arm is between contacts. b—Positive-pulse generator. c—Relay ICR inverts pulses.

Rotary Stepping Switches—They're Everywhere

circuit if several pumps were used simultaneously.

These circuits have been designed for direct-operated switches. For accurate timing it may make a difference whether switches are operated direct or indirect. An indirectly operated switch acts on the *cessation* of a pulse, rather than on the starting of one. In the circuits shown, that makes little difference. Also, all levels of contacts have been shown for nonbridging wipers. Bridging wipers running across contacts would not generate pulses.

Another point: A switch steps home much faster than it steps out, and pulses are produced by it much faster than dial pulses occur. (The latter run from 10 to 20 per second.) A switch stepping home on interrupters can be slowed down, as was described in Part I. But the homing speed of a minor switch can be regulated only by adjusting mechanical friction or spring tension. The speed can be slowed down some but not much.

Storing numbers

The circuit of Fig. 4 can be used to store three digits (and more by extension). A simple readout can be built to show the final setting of the three switches. Such a readout arrangement is shown in Fig. 5. The banks at right of the diagram are one level each from the three minor switches of Fig. 4. The

stepping switch used for readout must be adjusted to make 30 contacts in sequence (on two levels), by properly setting the wipers. Each set of 10 is connected to the minor-switch contact banks. The switch will step through the first contacts (after starting, and this switch steps slowly) and will energize 4CR when a "ground" is encountered on the minor-switch bank. 4CR then stops further pulses (up to 10) from appearing on the output line.

When point 10 is reached, 4CR is reset by 2CR-3, and the switch then scans the bank of the second minor switch, and so on. The result is a series of three sets of pulses which will signal in order the units, tens and hundreds count of the three minor switches. If a pause is needed between sets of pulses, 2CR and 3CR can be used also to energize slow-operating relay 5CR. For the duration of its on-off cycle, 5CR prevents 1CR from stepping the switch. This function is indicated by dotted lines. The START button can be any momentary-contact type—even a relay contact.

For example, with several storage registers, a sensing circuit could be used to hold off one register until another has been "read." Any relay can be used as such a sensor by either the absence or presence of a voltage on its coil.

[In Fig. 5, the stepping switch is shown with two sets of 30 contacts ar-

ranged in circles. Each set of 30 contacts has 3 wipers. The method of presentation is used for simplicity. Actually, each set of 10 contacts is on a separate level and the wipers are 120° apart. Thus, contacts 1 through 10 are on one level, 11 through 20 on the next, and so on. This switch—Automatic Electric type 44 or equivalent—accommodates up to six 10-point bank levels. It is driven by a 33-tooth ratchet providing 10 "on-the-bank" positions followed by an "off-the-bank" position for each one-third revolution.—Editor]

Relay code selection

The individual code selector is a useful device. It can select one, and only one of several circuits, by means of one line or radio channel. While such selectors are made by various manufacturers (there are even electronics selectors with no moving parts), it's possible to build this kind of selector by using stepping switches and relays. Fig. 6 shows one circuit, which uses a type 44 switch, again arranged for 30 points.

Incoming pulses operate the slow-release relay and the motor magnet (the usual pulse relay has been left off). This switch, as shown has been arranged for the code 4-5-9. (Up to 0-9-9 can be used with the 44 switch.) If the switch wiper lands on any point connected to relay 2CR, the switch will immediately step home. Only by *successively* landing on the code-specified contacts will the

(continued on page 70)

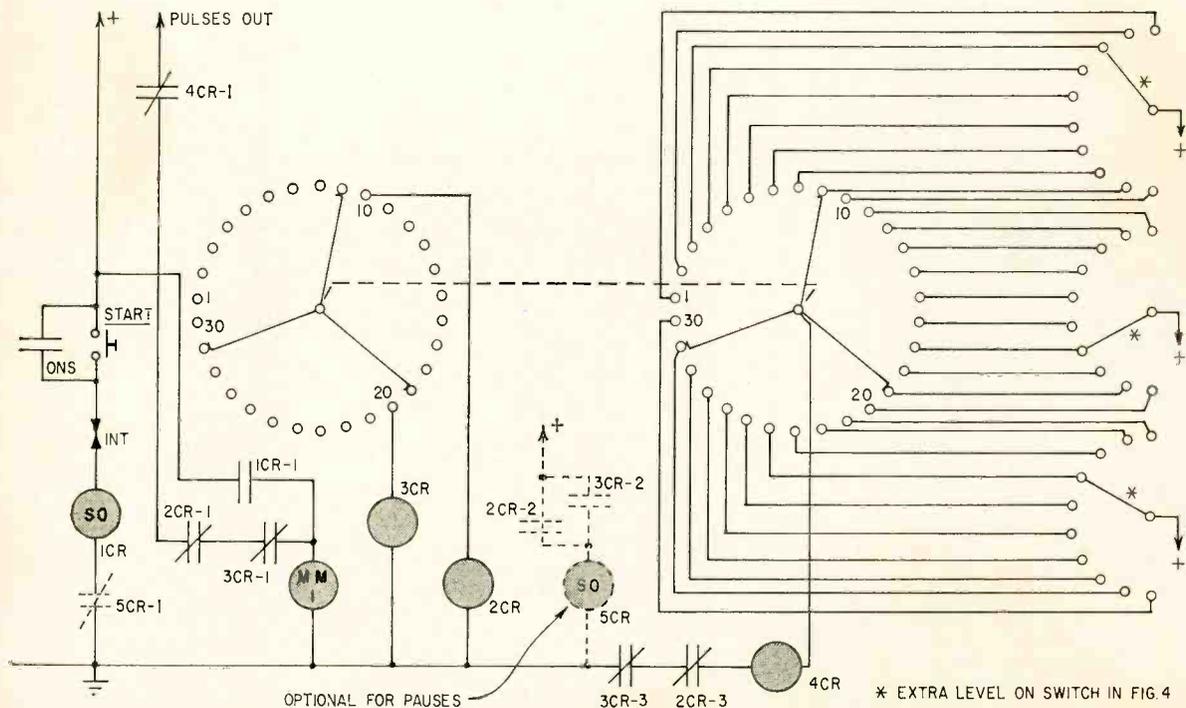
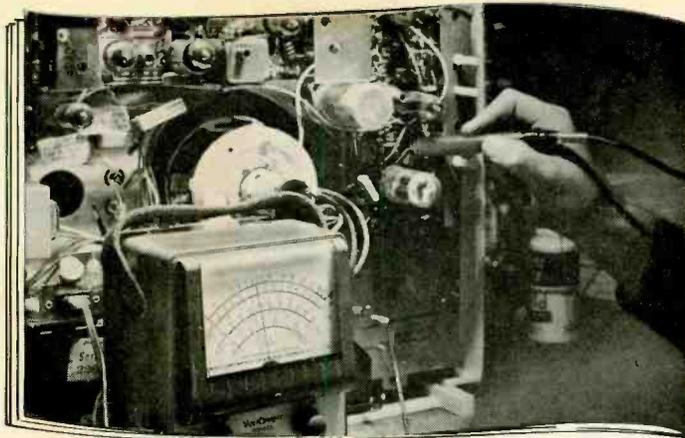


Fig. 5—Readout to indicate settings of switches in Fig. 4. An extra relay on contact 30 can replace the reset (START) switch.



VERTICAL SWEEP MANUAL

Learn vertical sweep servicing as
an expert analyzes typical problems.

By HOMER L. DAVIDSON

VERTICAL SWEEP TROUBLES ARE EASY to spot. They appear on the screen as if to tell you exactly where to find them. If you know the functions of the vertical oscillator and output sections the visual symptoms can become most significant to you.

No vertical sweep shows up as a picture completely collapsed into a thin horizontal bright line. The line is usually bright because the energy of the electron beam that would normally be displaced over the full height of the screen is all concentrated in the line. Insufficient sweep shows up as a partially shrunken picture on top, bottom, or both. Nonlinear vertical sweep can cause heads to stretch or become flat-topped and feet to appear to be too long or too short . . . in severe cases the top and bottom of the picture folds over on itself.

Picture rolling can be caused by improper vertical oscillator frequency or loss of sync due to a weak signal, old age, poor video separation and other troubles in the video signal handling circuits.

Vertical deflection circuits

There are three types of vertical-deflection systems, but only two are widely used. The oldest is the simplest to repair. It has a *blocking oscillator* and a vertical output stage as shown in Fig. 1. An integrating network keeps all pulses except vertical sync out of the vertical oscillator.

Take care when checking the voltage at the plate of the vertical output tube. The high-amplitude spikes can damage the meter. The best bet is to use a scope with an appropriate probe. If the waveshape is good and the amplitude correct, you can assume that the plate voltage is okay. Start at the vertical oscillator and proceed to the output stage.

Another method is to connect two pieces of flexible hookup wire to the

leads of a 0.05- μ F, 600-volt capacitor. Solder alligator clips to the free ends of the wires. You can check the vertical-deflection voltage by clipping an alligator clip to the center terminal of the volume control. Touch the other clip to the input and output of each stage in the vertical section. You will hear a 60-cycle buzz that will get louder as you progress toward the yoke. If the buzz drops off, you have located a trouble spot.

If you do not have a negative voltage on the blocking oscillator grid, the stage is not oscillating. Check the blocking-oscillator transformer windings with an ohmmeter. Many times the secondary is open. If it's okay, check the plate voltage and resistances. The vertical-output transformer's resistance should also be checked against the manufacturer's data. Also check to see that none of the transformer windings are shorted to the transformer core.

In many older TV receivers that come in for repair, the vertical hold control will move the picture only one way. The quickest [but not necessarily the best—*Editor*] repair here is just to change the vertical hold circuit. Simply tie a couple of clip leads to a 2.5-meg pot. Clip one to the vertical oscillator grid and the other to the top terminal of the hold control. Set the hold control in the center of its range and adjust the clipped-on pot until the picture rolls both ways when you turn the set's hold control. Now disconnect the pot and measure it. Solder in a 1-watt resistor of the closest 10% value.

The second kind of vertical-deflection system uses a *multivibrator*, and a vertical output stage. The third system is just like the second, only the vertical-output stage is part of the multivibrator. This third system is used quite extensively in newer TV receivers; in many, only one two-section tube is used, such

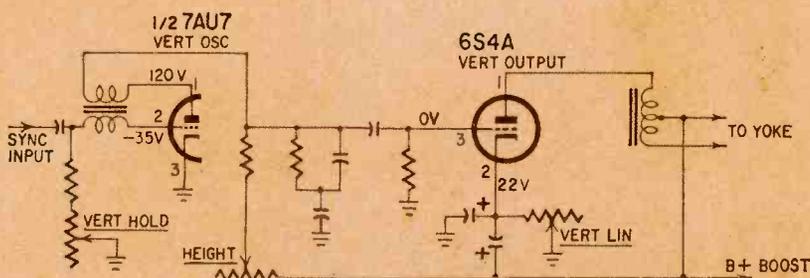


Fig. 1—A typical blocking-tube type vertical oscillator and output stage.

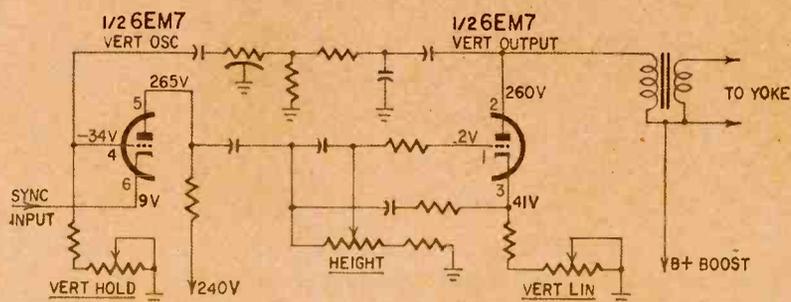


Fig. 2—The multivibrator hookup is a very popular vertical deflection system.

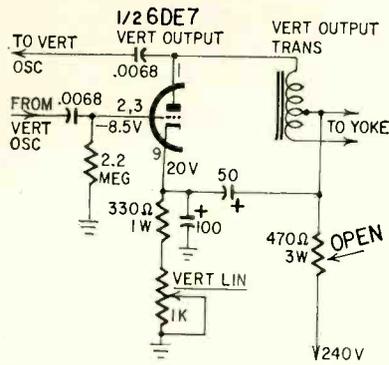


Fig. 3—The 470-ohm resistor opened, causing total loss of vertical sweep.

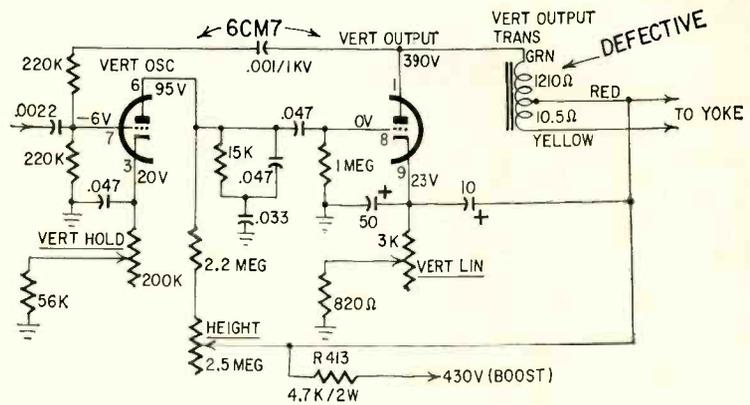


Fig. 4—Increase in transformer resistance cut pix height to 2 inches.

as a 6EM7. Fig. 2 shows a typical modern vertical-deflection system.

A multivibrator is a two-stage amplifier with the output of each stage fed to the input of the other. This positive feedback causes the circuit to oscillate. If any stage or a part of the feedback circuit becomes defective, the circuit will not oscillate.

Actual troubles

Let's take the case of only a horizontal line on the TV screen—let's say this is an Admiral 20US6 (Fig. 3). The brightness control should be turned

down so the line is just visible. Otherwise you can burn a line across the tube.

The 6DE7 tube was checked and found okay. The trouble was an open 470-ohm, 3-watt B+ dropping resistor.

This same trouble can also be caused by a feedback coupling capacitor at the plate of the output stage. There is a high peak voltage at this point and even the 1,000-volt capacitors usually used there can short or start to leak. A small Admiral portable, chassis 15UA2, came in with this trouble. The feedback capacitor had shorted, leaving only a white line on the screen. Replace such

capacitors with 1,600-volt types (the kind used as buffer capacitors in vibrator power supplies).

Another insufficient-height trouble was in an Admiral 14UY30 chassis (Fig. 4). There was only 2 inches of raster. Turning up the height control didn't help a bit. The output plate voltage was 200, and the grid voltage zero. The cathode voltage was only 11.5; it should have been around 23.

Most of the voltage, it turned out, was being dropped across the vertical-output transformer primary. A resistance check here showed that the winding had increased from 1,210 ohms to 1,580. The transformer was replaced, and we were in business. On this same chassis, I have found that R413 increases in resistance and causes the same trouble. Increased resistance in the height control or plate dropping resistor will cause the same symptoms.

Rolling picture

Many things can cause the picture to roll: insufficient sync, a defective integrator circuit, too-high resistance, leaky capacitors or some variety of intermittent. Let's take a look at a RCA KCS97D chassis (Fig. 5).

The vertical hold control had no effect on the rolling picture. This control didn't even seem to be in the circuit. Control open? Checked it. Nope. Wrong again. Voltages on the vertical-oscillator tube were quite close to what they should be. I just *knew* the trouble was in the vertical hold circuit. R153 checked 5.5 meg. It should have been 6.8, but that didn't seem to be too serious a difference.

The original complaint was intermittent vertical rolling. Now the set just rolled, period! Back to R153. I cut one end of the resistor loose and checked the resistance. Here was the trouble. The resistor was wide, wide open.

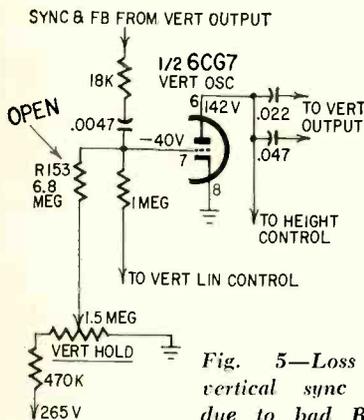


Fig. 5—Loss of vertical sync was due to bad R153.

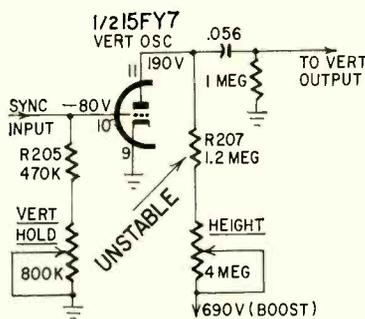


Fig. 6—R207 shifted with changes in temperature. This caused the picture to roll intermittently.

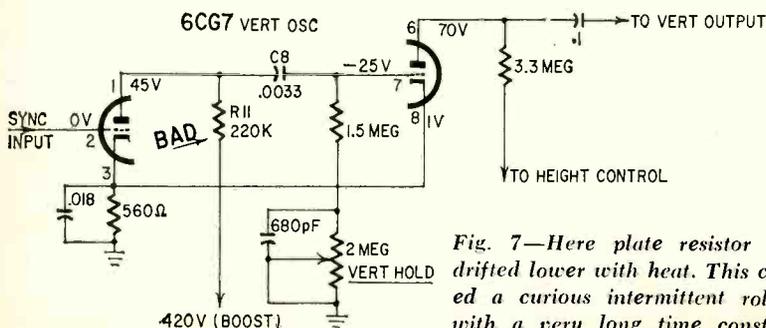
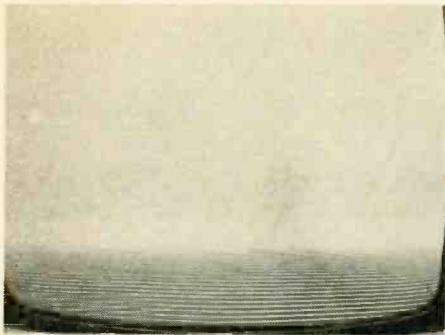


Fig. 7—Here plate resistor R11 drifted lower with heat. This caused a curious intermittent rolling with a very long time constant.



A case of severe nonlinearity at bottom of the screen. The cause is shown in Fig. 9.

(Sometimes it just pays to work a hunch.) The 5.5-meg reading? Shunt paths elsewhere in the circuit.

Now let's check some intermittent vertical-roll troubles. I had a G-E QX chassis (Fig. 6) that would be okay for about 2 minutes and then roll. I would set the vertical hold for a stable picture and within 5 minutes it was rolling again. That told me resistance values were changing or perhaps a capacitor was leaking.

When a picture rolls intermittently, the trouble is usually in the grid or plate circuit of the vertical-oscillator stage. Sometimes the trouble is in the cathode circuit, but usually the cathodes are grounded.

I measured the grid resistor, R205. It was off by a bit, so I replaced it, but to no avail. Finally I came to R207, a 1.2-meg resistor. As the set warmed up, its resistance changed. Replacing it solved the problem.

You will find that many intermittent vertical-roll troubles can be traced to the oscillator plate resistor. If you have any doubts, replace it. A change of resistance in the vertical hold control or the height control can cause vertical rolling.

The main trouble from height controls is a burned spot. When you try to increase the height, the raster collapses to a few inches. Always remember: the height control affects the bottom of the picture most, while the linearity control has its main effect at the picture top.

Another rolling trouble, in a Philco model 9L60U (Fig. 7). Here more time elapsed between rolls. This set wouldn't roll until after it was on for 1½ hours. I could reset the vertical hold control and again the picture would sit still for an hour or two. Great! To top it, when the back was removed the set wouldn't roll at all!

I pulled the chassis, set it on the bench and checked all the tubes. They were okay. Heat seemed to figure in the trouble. I tried a new 6CG7 vertical tube, just in case. I put the set back in its box. Sure enough, in about 2 hours

the same trouble appeared. Capacitor C8 was replaced because it was a little leaky. Still the set rolled after a couple of hours.

R11 seemed quite warm. It measured 220K. The next time the set started to roll, I jerked the line plug out and clipped out one end of R11. It now read 150K. R11 was changing with heat. I should have followed my own advice: "Replace the plate load when in doubt."

Odd vertical troubles

After this Silvertone model 45-528.51680 receiver was on a few seconds, the raster was only about 3 inches high and quite jittery. It bounced. Of course the vertical tube was the first thing checked. It was okay. The grid voltage was off a little and the plate voltage on pin 5 was only 50 (Fig. 8). According to the service data, I should have had 90. The height control and the 1-meg series resistor were checked; they were good. Something was leaking and pulling that voltage down.

I pulled the vertical tube and checked its plate voltage. (You have to do this very rapidly in a series-heater receiver, because of course the other tubes go out when one is pulled.) Here I found only the same 50 volts; I should have been getting the full voltage at the height control.

I checked C30 for leakage; it was good. C29 showed some leakage. When

I cut one end, I measured 100K across it. Replacing the capacitor restored the full raster.

In many sets, a jumping raster is caused by a defective vertical-output transformer. This is especially true in old, long-used sets.

This next case looked like vertical linearity trouble. The bottom of the picture had wider scanning than the top line did. This is shown in photo at left.

It was an Admiral model UP9808 (Fig. 9). Someone else had attempted to repair the set, for the thermal relay had been shorted out. Sometimes the picture looked like it was suffering from vertical bunching, but this proved not to be the case. All voltages in the vertical circuit were checked, and they all seemed fine.

After searching the vertical section for trouble, I traced the B+ wires back to the power-supply filter. I found after a little browsing that the silicon rectifier had been replaced. Something didn't add up. The B+ line that fed the vertical and horizontal circuits came directly off the rectifier. It should have gone first through the filter choke.

The B+ wire to the horizontal and vertical circuits had been removed and hadn't been resoldered to the correct point. This goes to show that the poor helpless television receiver may have, not only its own troubles, but a few extras put in. **R-E**

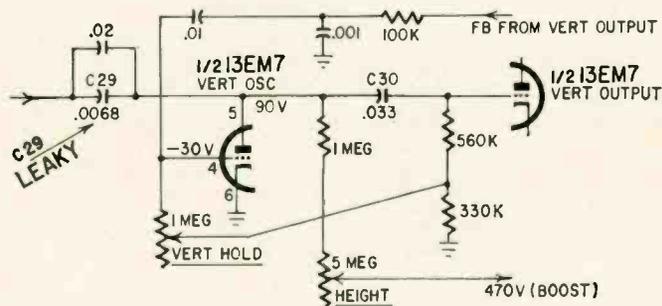


Fig. 8—Leakage in C29 upset the normal operation of the vertical multivibrator and produced a bouncing 3-inch high raster.

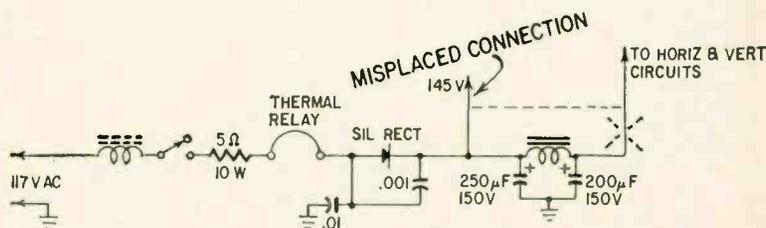
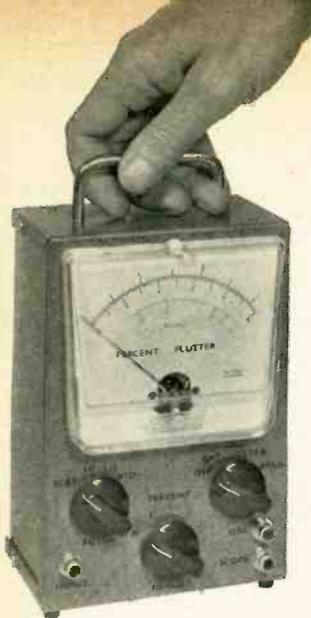


Fig. 9—Nonlinearity developed after a careless technician inadvertently bypassed the pi-network filter after replacing the silicon rectifier.



A Compact, High-Performance Flutter Meter

Useful in servicing tape recorders, this meter can measure tape-travel inaccuracy of less than 0.1%

By EARL T. HANSEN

IS YOUR TAPE RECORDER AS GOOD AS IT was when new? As mechanical parts wear, slight speed variations can cause a degradation of recorded tapes; the fault becomes progressively worse as tapes are copied. This meter will let you make easy, periodic measurements of such signal degradation, to help you avoid poor recordings.

This meter uses the latest solid-state components, including an integrated circuit and an FET. Battery operation keeps the cost down, provides portability, and—most important—eliminates 60-Hz hum pickup from the ac line.

Alignment and calibration require only a vtvm and an audio oscillator, though a scope and an ac voltmeter will assure greater accuracy.

Flutter consists of undesirable and relatively rapid changes in pitch of recorded and reproduced sound. It is caused by irregular mechanical motion during recording or playback of tape, disc or film. Per cent flutter is defined as the rms deviation from the average frequency as a percent of that average frequency.

Flutter meters normally detect flutter rates from 0.5 Hz to 120 Hz; some even go up to 200 Hz, if intended for measurements of motion-picture equipment.

(Undesirable but relatively slow changes in pitch are known as *wow*; frequency variation is typically 0.5 Hz to 5 Hz. *Wow* occurs principally in disc recording and playback, so we aren't concerned with it here.)

How it works

The basic idea for most flutter meters is to use some kind of FM discriminator or detector. Proper limiting to remove amplitude modulation is important—just as in an FM receiver. The signal from the discriminator is filtered to remove the audio carrier frequency and to limit the range of flutter rates. The rms value of the sig-

nal is then measured by a high-sensitivity ac vtvm with extended low-frequency response.

A commonly used frequency for flutter tests is 3 kHz; the frequency was chosen many years ago for motion-picture use, when sound-system response barely reached 5 kHz. This meter uses 5 kHz as a test frequency for several reasons. The discriminator could be more easily designed around readily available components. The higher carrier frequency allows measurement of higher flutter rates and simplifies the required filter.

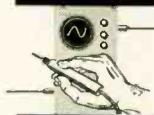
In this meter (Fig. 1) an inexpensive integrated circuit makes an ideal amplifier and limiter. The IC contains 10 transistors, a voltage regulator, and those resistors necessary to complete a three-stage amplifier. Because of the internal regulator, changes in battery voltage have minimum effect on the limited output amplitude (a 5-kHz square wave) which drives the discriminator coils. The IC has very high gain and will saturate with 30 mV at input jack J1.

Minimum input level should be 0.1 volt, to lessen the effect of tape dropouts. Diode D1 protects the IC against possible damage by an external voltage overload.

A 5-kHz signal is fed to input jack J1 and then through limiter IC1. Output from this stage is a square wave, which goes through isolating resistors R6 and R7 to the discriminator. The discriminator consists of tuned circuits L1-C5 and L2-C6, and associated components. One circuit is tuned to 4 kHz, the other to 6 kHz. Each drives a voltage-doubling rectifier (or peak-to-peak detector). Diodes D2 through D5 are polarized so as to have opposite dc polarity at the output; positive from the L1 side, and negative from the L2 half.

When the voltages induced in the coils are equal (at approximately 5 kHz) the dc outputs will be equal

BENCH



TESTED

Two RADIO-ELECTRONICS editors used this flutter meter to check out a medium-quality tape deck. Following the author's instructions, we recorded the 5-kHz test signal at

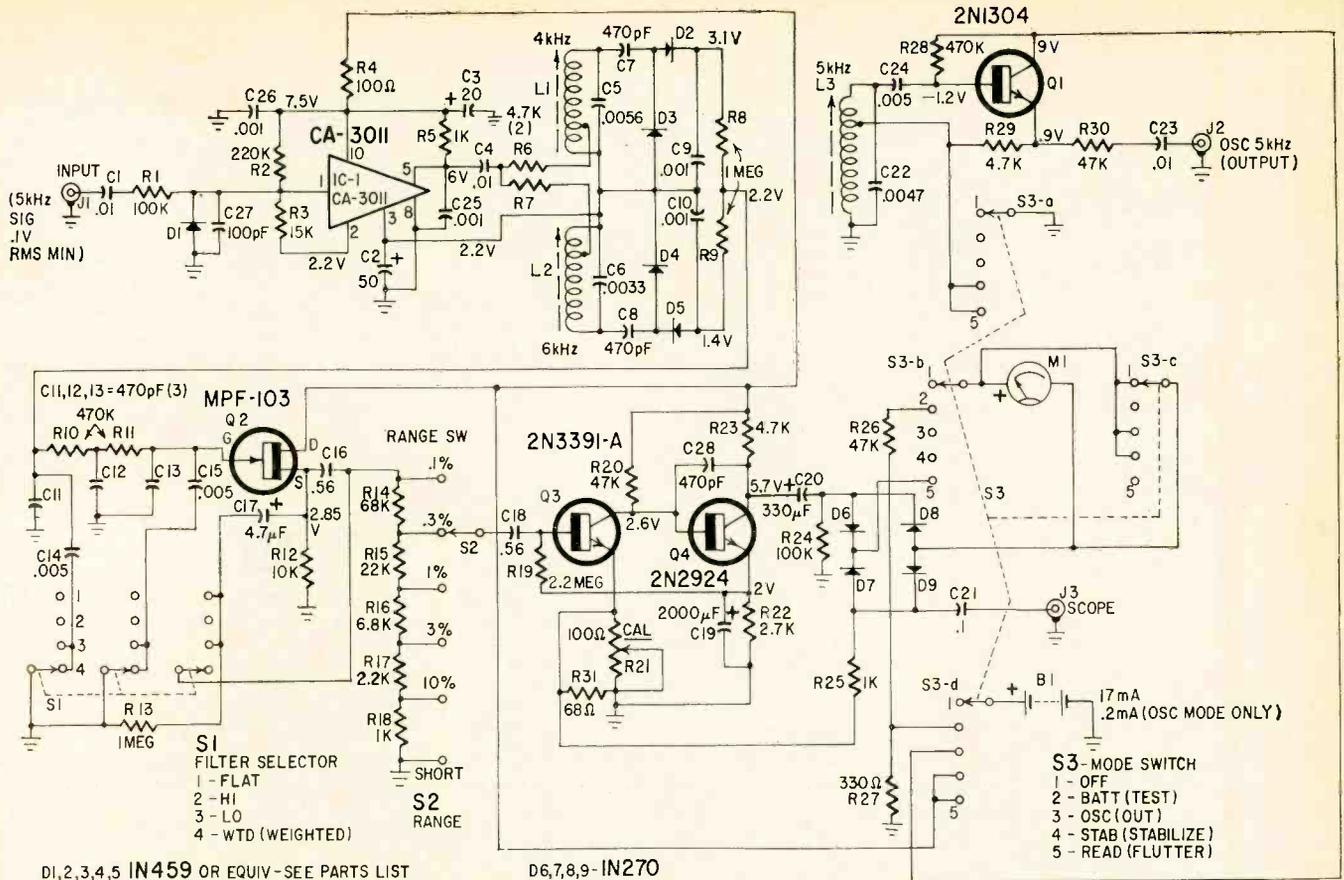
7½ ips. Then we played back the tape and read flutter on the meter. Our average for several measurements was about 0.1%, within specifications for the tape deck. At 3¾ ips, the machine had about 0.15% flutter. By rapidly jabbing a finger against the tape or the capstan during playback, we could artificially increase flutter to over 1% as read on the meter.

A reader using the author's calibration tape should not rewind it in the normal manner, as this might stretch the tape and alter its calibration. Instead, reverse reels and run it back at "play" speed.

and opposite in polarity; thus they cancel to zero at the junction of R8 and R9. When the input frequency changes toward either 4 kHz or 6 kHz, the ratio of the voltages in the two halves of the discriminator will not be equal and the dc at the junction will change. Fig. 2 shows the frequency-vs-output curve for the discriminator, as measured at the source of Q2.

Note that the voltage is 2.85 rather than zero at the middle frequency. This is a result of two voltages which are added to the discriminator output. One is the difference in potential across FET Q2 (gate to source). The other is the result of the discriminator return being connected to pin 3 of IC1. This is a convenient source of approximately 2 volts forward bias on the FET (which acts as a source follower); the bias sets the correct operating point on the FET transfer curve for handling larger voltage swings.

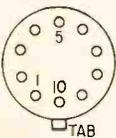
A three-section RC filter between the discriminator and Q2 removes any remaining 5-kHz carrier, and deter-



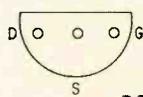
DI,2,3,4,5 IN459 OR EQUIV-SEE PARTS LIST

D6,7,8,9-IN270

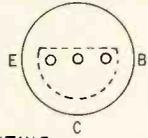
CA-3011



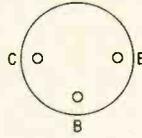
MPF-103



2N3391-A, 2N2924



2N1304



BOTTOM VIEWS

Fig. 1—Sine-wave input signal is fed to IC1, which produces square-wave output. Discriminator (L1-C5, L2-C6) furnishes error voltage to amplifier Q2. Voltmeter section (Q3-Q4) reads this error as flutter produced by the tape recorder tested.

Flutter Meter Specifications

Ranges: 0.1%, 0.3%, 1%, 3%, 10% full scale rms

Input level: 0.1 volt rms minimum for good limiter saturation

Input frequency: 5kHz, $\pm 5\%$

Battery: 9 volts, NEDA 1602

Battery drain: 0.2 mA in OSC mode, 17 mA in all other modes

Internal OSC output: 5kHz, 4 volts rms unloaded, with less than 5% distortion

Internal noise: The residual reading due to the combined effects of internal oscillator FM variations and random noise is less than 0.001% flutter

Stabilization time: 30 seconds after power on, or 5 seconds after applying signal input

Flutter rate bandwidth: FLAT (filter switch position), 0.6 to 200 Hz, ± 3 dB

HI, low-frequency rolloff, down 6 dB at 1.5Hz
LO, high-frequency rolloff, down 6 dB at 35 Hz

WTD (weighted filter position) combines the rolloff of the HI and LO filters

Parts List

R1, R24—100,000-ohm resistor
R2—220,000-ohm resistor
R3—15,000-ohm resistor
R4—100-ohm resistor
R5, R25—1000-ohm resistor
R6, R7, R23, R29—47000-ohm resistor
R8, R9, R13—1-megohm resistor
R10, R11, R28—470,000-ohm resistor
R12—10,000-ohm resistor
R14—68,000-ohm, 5% resistor
R15—22,000-ohm, 5% resistor
R16—6800-ohm, 5% resistor
R17—2200-ohm, 5% resistor
R18—1000-ohm, 5% resistor
R19—2.2-megohm resistor
R20, R30—47,000-ohm resistor
R21—100-ohm miniature potentiometer (Mallory MTC or similar)
R22—2700-ohm resistor
R26—47,000-ohm, 5% resistor
R27—330-ohm resistor
R31—68-ohm resistor
All resistors $\frac{1}{4}$ -watt or more, unless otherwise noted
C1, C4, C23—0.01- μ F paper or ceramic capacitor
C2—50- μ F, 6-volt electrolytic capacitor
C3—20- μ F, 10-volt electrolytic capacitor
C5—0.0056- μ F mica capacitor

C6—0.0033- μ F mica capacitor
C7, C8, C11, C12, C13, C28—470-pF ceramic capacitor
C9, C10, C25, C26—0.001- μ F ceramic capacitor
C14, C15, C24—0.005- μ F ceramic capacitor
C16, C18—0.56- μ F tantalum capacitor (Kemet C series or similar)
C17—4.7- μ F, 10-volt, tantalum capacitor (Kemet C series or similar)
C19—2000- μ F, 10-volt, electrolytic capacitor
C20—330- μ F, 10-volt, tantalum capacitor
C21—0.1- μ F paper or ceramic capacitor
C22—0.0047- μ F mica capacitor
C27—100-pF ceramic capacitor
All capacitors 20 volts, or more, unless otherwise noted
IC1—Integrated circuit amplifier, RCA CA3011
Q1—Germanium npn transistor, 2N1304
Q2—N-channel junction field-effect transistor (Motorola MPF-103 or similar)
Q3—Silicon planar npn transistor (G-E 2N3391A or similar)
Q4—Silicon planar npn transistor (G-E 2N2924 or similar)

D1, D2, D3, D4, D5—Small-signal silicon diode, 1N459 or similar
D6, D7, D8, D9—Germanium diode, 1N270
J1, J2, J3—Phono jack
S1—3-pole, 4-position, shorting rotary switch (Centralab 1012 or similar)
S2—1-pole, 6-position shorting rotary switch (Centralab 1000 or similar)
S3—4-pole, 5-position shorting rotary switch (Centralab 1012 or similar)
L1, L2, L3—78–240-mH tapped inductor (Miller 9018 or similar)
B1—9-volt battery (NEDA 1602 or 1605; see text)
M1—200- μ A meter, scales 0–3 and 0–10 (Heathkit 407-85 or similar. Available from Heath Co., \$10.40 plus postage)
Misc.—3" x 5" x 7" metal box (Bud CU-2108A or similar); perforated board, push-in terminals, handle, knobs, wire, and small hardware

Note:—A 3" reel of calibration tape is available for \$2.40 postpaid, from E. T. Hansen, 3361 Millcreek Rd., Salt Lake City, Utah 84109. Instructions are included.

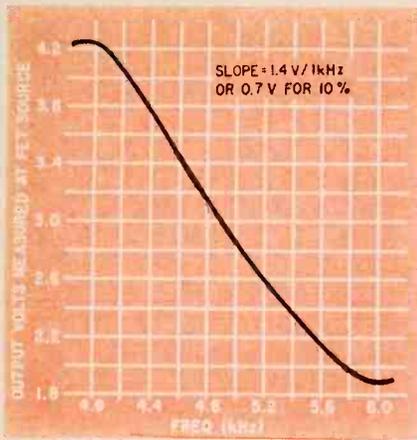


Fig. 2—Discriminator output curve. Circuit converts frequency shift to dc.

mines the desired curve for the flutter-rate frequency response. Figure 3 shows the curves for the four settings of filter switch S1. As a source follower with a gain of less than one, Q2 matches the very high impedance of the discriminator and filter to Q3.

Transistors Q3, Q4 and associated components constitute a feedback-stabilized ac voltmeter. Large coupling and bypass capacitors—C20 and C19—extend the low-frequency response to the required range. Feedback ratio (and therefore gain) is adjusted by the calibration control, R21. Resistor R25 develops a voltage proportional to meter current, which allows the actual flutter waveform to be observed on an external oscilloscope via J3. Approximately 0.5 volt peak to peak appears at J3 with full-scale meter deflection.

Construction

I would suggest a slightly larger metal box than the one I used, unless you are concerned about size. Assembly will be easier if things are not so crowded. Many small components can be mounted on the switches: mount the others on a perforated board with push-through terminals (see Figs. 4, 5 and 6). Coils L1 and L2 should be separated by at least 1½" to avoid interaction; location of L3 is not so critical though, since it is shorted out during the READ mode. Leads on the ceramic capacitors which bypass pins 1, 5 and 10 of IC1 to ground should be kept as short as possible. Otherwise the IC may oscillate at some rf rate.

The tap location on the coils is important. On L1 and L2 the taps are nearest the ends which go to pin 3 of IC1. On L3 the tap is farthest from ground. The unused pins (4, 6, 7 and 9) on IC1 may be snipped off to minimize congestion. If you do use a larger case I would suggest the next size larg-

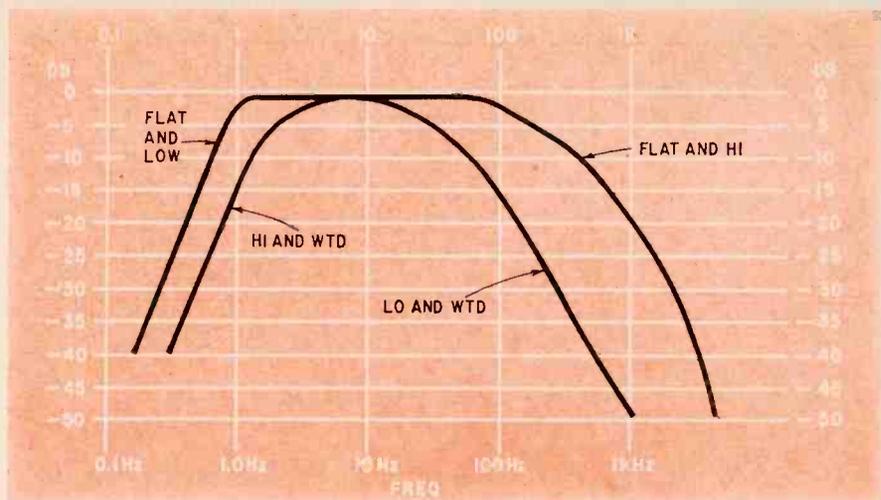


Fig. 3—Filter output curves for the four positions of filter selector switch S1.

er battery (NEDA 1605). It has a longer life at about the same cost.

In case you want to substitute, component types are not critical except as follows: Q1 must have at least a 10-volt emitter-base rating. Switches should be the shorting type to avoid transients. Q3 and Q4 must be high-gain, low-leakage silicon-planar types. Q3 should be a low-noise type.

Test and calibration

Connect a milliammeter in series with the battery and make sure that the current is not excessive. It should be zero in the OFF position, about 0.2 mA in the OSC position, and about 17 mA in the other positions. The test current in the BATT position depends on the value of R27.

Apply a 1-volt, 5-kHz signal from a sine-wave audio generator to the input, J1, and set S3 to the STAB position. There should be a square wave on pin 5 of IC1. The waveform should be about 2.4 volts peak to peak and will be tilted. Set the generator to 4.0 kHz. Connect the hot lead of a dc vtm to the junction of D2 and C9, with the common lead to ground. Adjust L1 for maximum reading on the vtm. Next set the generator to 6.0 kHz and adjust L2 for minimum positive voltage at the junction of D5 and C10. Set S3 to the OSC mode and monitor the output. Set the generator to 5.0 kHz and compare the frequencies, audibly, or preferably with the scope. Adjust L3 so the output at J2 is 5 kHz.

Measure the dc voltages on Q3 and Q4. The collector voltage on Q4 should be between 4.5 and 7. If it is not, the value of R20 should be changed slightly. Increasing R20 will increase the Q4 collector voltage and vice versa. If it is necessary to go above 100,000 ohms for R20, Q3 has low gain and should be changed. This

completes everything except the actual calibration adjustment (R21).

As a start, adjust R21 for a reading of 38 ohms from Q3's emitter to ground—with the flutter meter turned off, of course. At this point the meter will be accurate enough for most home comparison-type measurements. This includes correction for the 0.707 factor described below in the section on using the meter.

For a more accurate calibration proceed as follows: The end accuracy will depend on the accuracy of your equipment, the audio generator, the dc vtm and the ac voltmeter. Connect the dc vtm to the Q2 source (junction of R12 and C16). Set the audio generator to 4.5 kHz, 1 volt out, connected to J1, and set S3 to STAB. Read the voltage with both 4.5-kHz and 5.5-kHz inputs (one at a time). Note the difference between the two readings; it will be 1.4 volts typically. This difference is equivalent to a peak-to-peak frequency swing of 20%, or half the difference is equal to the peak frequency swing of 10%. Therefore an rms voltage equal to the difference would be equivalent to 10% rms swing (or flutter).

Set the generator to 20 Hz. Connect the generator output to the top of the range switch (junction of R14 and C16). Then set the range switch to 10% and set S3 to READ. Measure the audio amplitude from the generator with the ac voltmeter and adjust it to an rms value equal to half the dc difference voltage noted above. As an example, if the difference measured above is 1.46, set the generator output to 0.73 volt rms.

Adjust R21 until the flutter meter reads full scale (10%), if you desire a true flutter reading, or do as I did and adjust R21 until the meter reads 7.07%. This will let you make measurements without factoring when re-

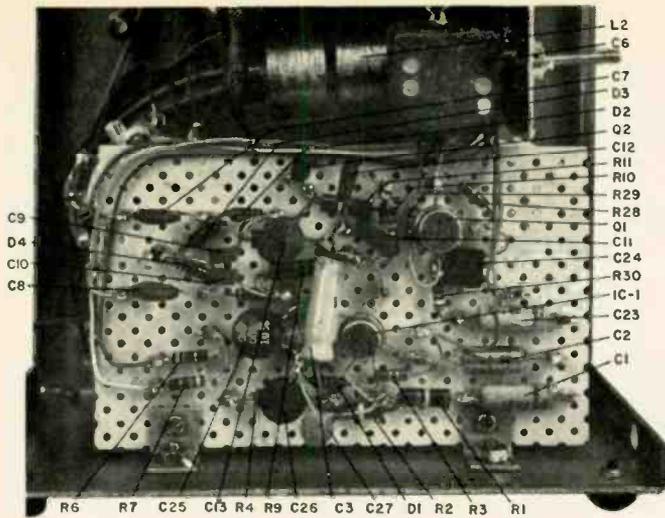


Fig. 4—Limiter-discriminator layout is easily done on board.

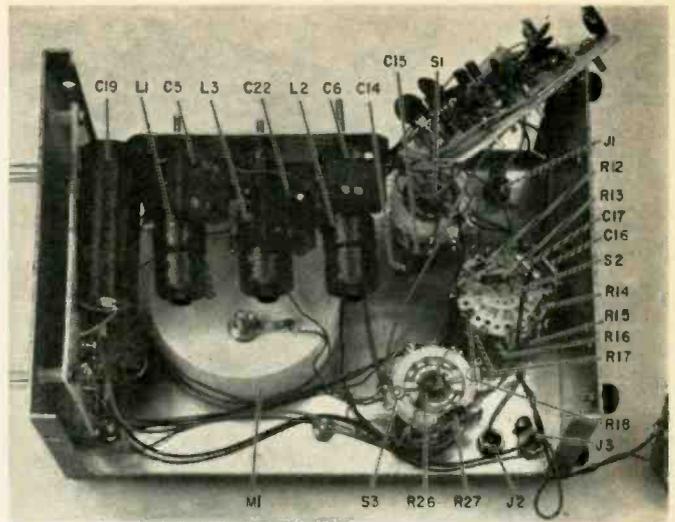


Fig. 5—Coils are mounted on a bracket beside meter movement.

ording and playing back. Otherwise factoring is necessary to compensate for the flutter created by both the recording and the playback of a tape.

The cover on the metal box must be in place before using high-sensitivity positions of the range switch, to avoid stray pickup.

An alternate and more accurate method of calibration is to obtain a calibration tape. See the parts list.

Using the meter

The mode switch has four active positions. BATT measures the battery voltage with a resistive load equal to the normal meter drain. Osc operates only the internal 5-kHz oscillator, which is available at J2 for recording onto a tape. The recorded 5-kHz signal is then played back into the flutter meter to obtain a reading. STAB is the stabilize position, used prior to taking a reading. In this position the meter is shorted out until the long time constants in the ac voltmeter circuit become stabilized; otherwise the meter would bang the peg a time or two. The READ position gives a meter reading of the flutter amplitude.

Battery voltage has a negligible effect on accuracy until it drops below 7.5. The battery should be changed when it drops to 8 volts, as indicated on the meter in BATT position. Useful life of the NEDA 1602 battery is about 40 hours of intermittent use, except for the osc mode, which is very much longer.

There are two methods of measuring flutter in sound equipment. One (known as the standard method) uses a standard recorded reference, that is a tone (carrier) recorded on a tape (or disc or film) with a flutter content very

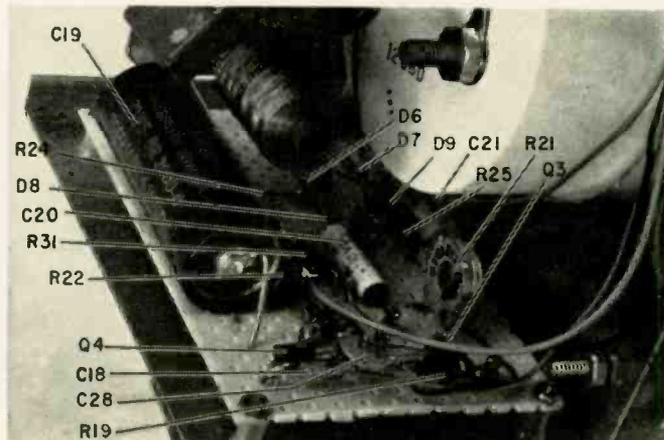


Fig. 6—Voltmeter circuit is also mounted on perforated board.

much less than that of the equipment to be tested. By this method the flutter content can be obtained directly from the meter without factoring, or rerunning to get an average. The flutter meter described here can be used for this method. However, standard tapes with low flutter content are very expensive.

The second (or nonstandard) method is to record a tape from a very stable source (such as the oscillator built into this meter) and play it back through the meter. This method has one drawback: the recorder adds flutter to the tape during recording and again during playback. The two flutter conditions will add vectorially, and readings can vary considerably, depending on the phase and regularity of the two sources. Generally the resultant will be greater than either of the two sources alone. The generally accepted practice is to take the average of several readings and multiply it by 0.707 to obtain a true flutter measurement. The 0.707 factor has been included in the calibration of this meter

and need not be considered when making measurements.

It is good practice to average several readings. Rewind the tape slightly between each reading to change the recorded flutter to machine flutter/phase relationship. Fig. 7 shows typical flutter viewed on a scope.

When recording the carrier (5 kHz) on a tape, use the maximum record level. The amount of distortion will have no effect on the flutter content. Record several minutes of the carrier so there will be plenty of time for meter stabilization and multiple readings.

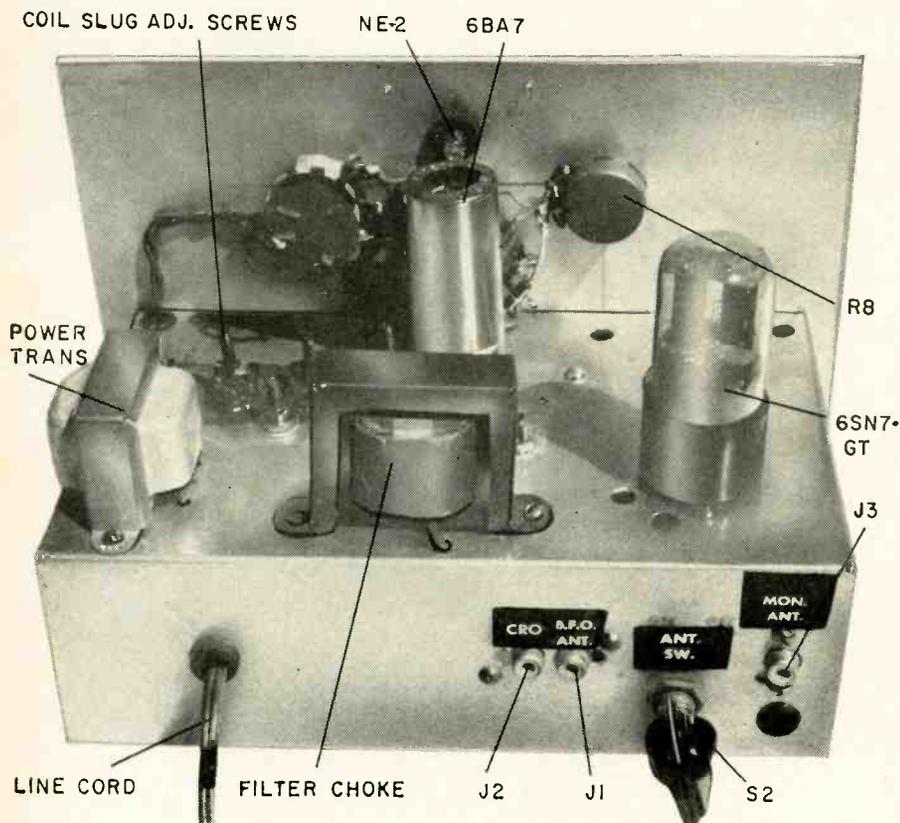
The filter switch gives a choice of flutter-rate response characteristics. The FLAT position has maximum bandwidth and reads flutter at its worst. The HI position removes very low flutter rates—as might be caused by an off-center reel—and therefore helps to isolate the source and type of speed variation. The LO position removes the higher frequencies—which might origi-

(continued on page 60)

BUILD

A Professional Quality Transmitter Monitor

Solid-state and vacuum-tube versions of a handy rf watchdog for hams, CB'ers and commercial operators



By J. P. NEIL

ANYONE WHO OPERATES A RADIO STATION—amateur, CB or commercial two-way—will find an rf monitor useful. It enables you to keep tabs on the transmitter while operating. The ones described here don't require any physical connection to the transmitter itself. Here's what each does:

1. Permits continuous visual and aural carrier on-off monitoring: has relay contacts to operate external alarm (solid-state version only).
2. Acts as CW keying monitor. (*Note:* Does not warn of key clicks or CW hum.)
3. Demodulates an AM signal for quality check of audio.
4. Supplies rf output to drive an oscilloscope. You can then observe either trapezoid or envelope waveforms to check percentage of modulation.

General description

Block diagram, Fig. 1, illustrates monitor function. Rf is fed through a

beat oscillator and mixer and a low-pass filter. The filter output (below 1 MHz) is split, appearing on terminals for scope display, and being fed to the carrier-alarm circuit (solid-state version only). The carrier-alarm circuit triggers a relay, the contacts of which may be used to operate an external alarm.

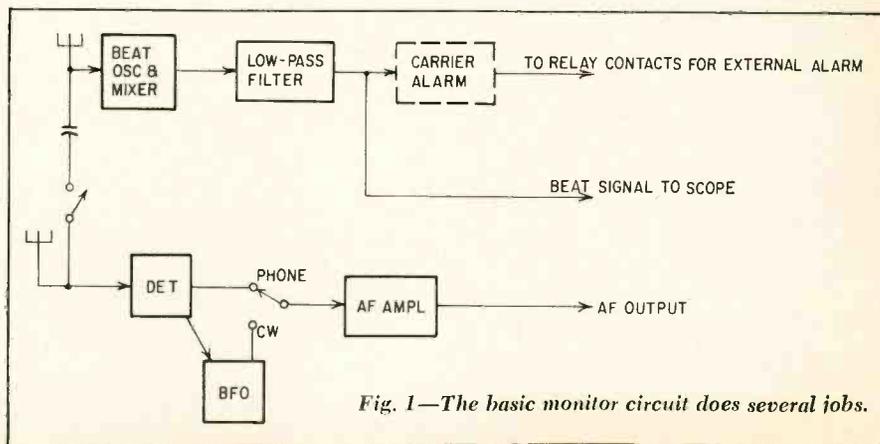


Fig. 1—The basic monitor circuit does several jobs.

Rf is also fed to a detector, a bfo and an audio amplifier. These circuits provide monitoring and quality checks of CW keying and AM modulation.

Circuit details

Figure 2 is the schematic of the solid-state version, which operates as follows: if a pickup antenna is used at J3, closing S4 will usually produce enough rf drive to operate the alarm circuit. If this is not the case, a separate antenna may be connected to J1. Whichever jack is used, rf travels through RF GAIN pot R1 and C4, then to the base of Q1. This transistor works as both an oscillator and a mixer, its frequency being determined by the particular LC tank selected by S1. All oscillator coils are slug-tuned to about 355 kHz above or below the transmitting frequency in the selected band. C6 is a panel adjustment for trimming the beat frequency.

In the alarm circuit, L2 and C9 resonate at about 355 kHz, so C6 is adjusted for maximum signal at the base of Q2. Depending on the relay used, Q2 will operate with about 10 or 15 mA. It should be heat-sinked if the monitor will be used continuously in the carrier-on mode.

The keying- and modulation-monitor section uses diode D to rectify incoming rf. For CW monitoring, Q3—a tone generator—acts as a bfo which is switched on and off by transmitter keying. For AM modulation monitoring, demodulated rf from D is fed through S5 to Q4 and Q5. These stages are direct-coupled, npn to pnp. J4 is a closed-circuit jack; normally the speaker is used

Parts list for solid-state model

- R1—1000-ohm potentiometer (including S3—s.p.s.t. switch)
- R2—15,000-ohm resistor
- R3, R9—10,000-ohm resistor
- R4—1800-ohm resistor
- R5—20,000-ohm potentiometer
- R6, R10—100-ohm resistor
- R7—50,000-ohm potentiometer
- R8—91,000-ohm resistor
- R8—470-ohm resistor
- C1, C2—(See coil table)
- C3—5-pF capacitor
- C4, C5, C7, C11, C13, C15, C19—0.01- μ F capacitor
- C6—25-pF variable capacitor
- C8, C9—20-pF, silver mica capacitor
- C10—470-pF capacitor
- C12—0.22- μ F capacitor
- C14, C16, C17—25- μ F, 25-volt, electrolytic capacitor
- C18—0.02- μ F capacitor
- C19—100- μ F, 25-volt, electrolytic capacitor
- C20—0.05- μ F capacitor
- C21—0.5- μ F capacitor
- J1, J2, J3—Phono jacks
- J4—Closed circuit phone jack
- L1—1-mH rf choke (J. W. Miller 4652-E)
- L2—10-mH rf choke (J. W. Miller 4672-E)
- L3—2.4-mH rf choke (J. W. Miller 4666-E)
- D—1N4009 diode
- Q1, Q4—2N2924 transistor
- Q2—2N696 or 2N169 transistor
- Q3—2N1617, 2N2160 or 2N2646 transistor
- Q5—2N1415 transistor
- S1—2-pole 6-position rotary switch
- S2, S4, S6—S.p.s.t. toggle or slide switch
- S3—(See R1)
- S5—D.p.d.t. toggle switch
- SPKR—2" or 3" speaker, 4-ohm coil
- T—Output transformer: 500-ohm primary, 4-ohm secondary
- RY—Relay: 50–500-ohm coil resistance, 10–15-mA operating current. Contacts N.O. or N.C., as desired.
- BATT 1—battery, 12 volts
- BATT 2—battery, 9 volts

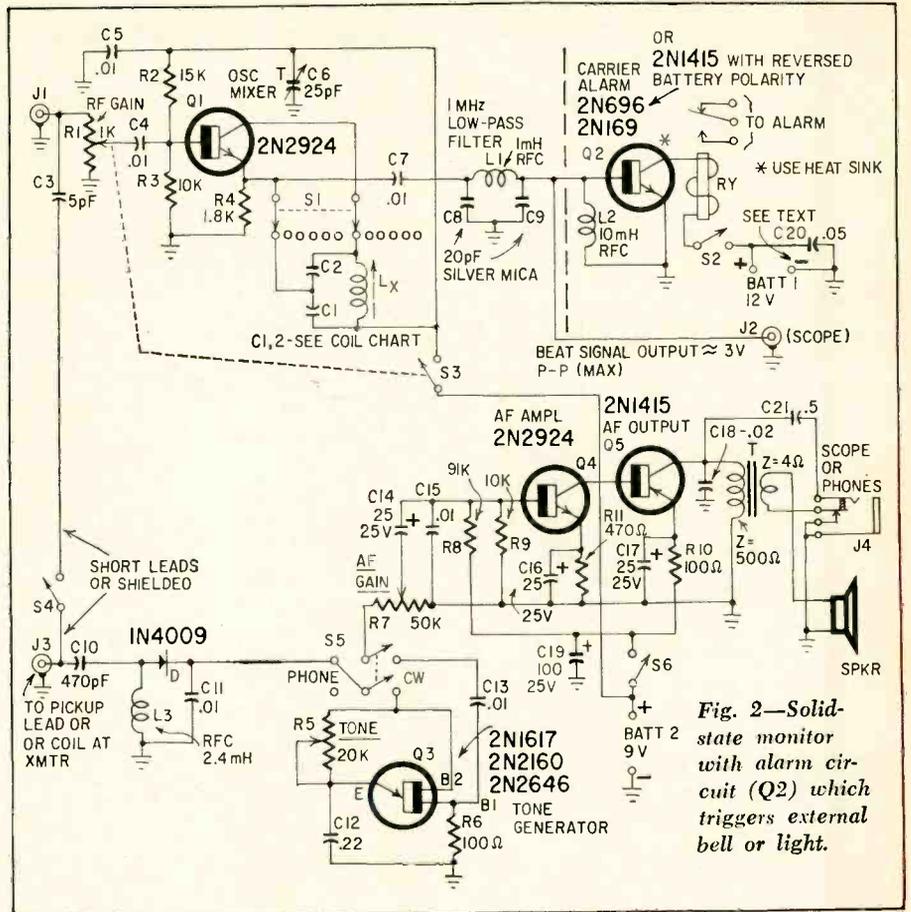


Fig. 2—Solid-state monitor with alarm circuit (Q2) which triggers external bell or light.

Parts list for vacuum-tube model

- R1—1000-ohm potentiometer (including S3—s.p.s.t. switch)
- R2, R6—10,000-ohm resistor
- R3, R5, R14—27,000-ohm resistor
- R4—150-ohm resistor
- R7—1500-ohm resistor
- R8—1-megohm potentiometer
- R9, R11—1-megohm resistor
- R10—47-ohm resistor
- R12—47,000-ohm resistor
- R13—2-megohm potentiometer
- R15—100,000-ohm, 1-watt resistor
- C1—5-pF capacitor
- C2, C14, C17—220-pF capacitor
- C3—50-pF capacitor
- C4, C15—0.005- μ F capacitor
- C5, C9, C10, C12, C13, C18—0.01- μ F capacitor
- C6—25-pF variable capacitor
- C7, C8—20-pF capacitor
- C11—10 μ F, 50-volt, electrolytic
- C16—0.002- μ F capacitor
- C_x—See Table 1
- All capacitors 400v unless noted
- J1, J2, J3—Phono jacks
- J4—Phone jack
- S1—2-pole 6-position rotary selector switch
- S2, S5—S.p.s.t. toggle or slide switch
- S3—(See R1)
- S4—D.p.d.t. toggle switch
- D—1N4009 diode
- T—Output transformer: 10,000-ohm primary to 4-ohm secondary
- L1—1mH rf choke (J. W. Miller 4652-E)
- L2—2.4-mH rf choke (J. W. Miller 4666-E)
- L_x—See Table 1
- V1—6BA7 tube
- V2—12AU7, 6SN7-GT or similar tube
- PL—6.3-volt pilot lamp
- NE—NE-2 neon lamp

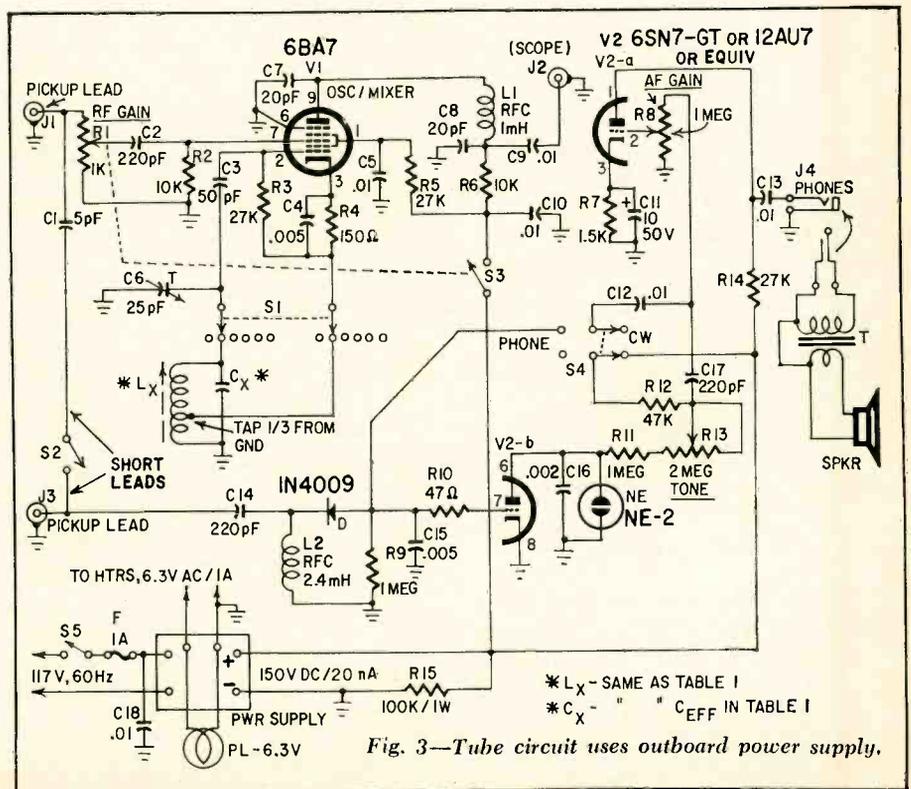
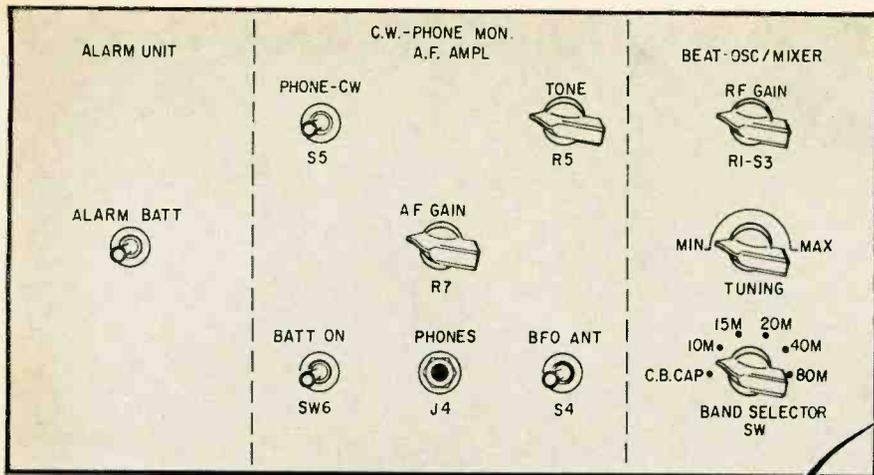


Fig. 3—Tube circuit uses outboard power supply.



SUGGESTED MODULAR PANEL LAYOUT

J2 AT REAR OF THIS CHASSIS SECTION

Fig. 4—Panel layout is not critical . . . position parts to fit without crowding.

Build a Professional Quality Transmitter Monitor

for CW monitoring while only the phones are used on AM. Thus the speaker is killed and feedback is avoided, where the monitor is used near the transmitter microphone.

Note that Q3 requires no power supply: it operates from incoming rf. Q5 takes most current from the battery, but it operates class AB. Hence the total drain of Q4 and Q5 will be from only 2.9 to 5.2 mA, depending on audio level.

The vacuum-tube model operates the same as the solid-state model. There is no carrier-alarm circuit, but it would not be difficult to build one using a thyatron and a plate relay. As before, C6 must be adjusted to resonance, and the easiest way is by tuning to peak the waveform observed on a scope at J2. There is also no power supply, but requirements are small: 6.3 Vac at 1 amp and 150 Vdc at 20 mA. Note that the 6BA7 should be shielded.

Assembly and setup

It's up to the user whether to build the monitor on a conventional chassis or a printed-circuit board. The solid-state version is easily constructed on a perforated board, while the vacuum-tube unit goes best on a standard chassis. A suggested panel layout is shown in Fig. 4 and the photo.

Values listed in the coil table cover the bands listed, all tunable with C6. Use the coil slugs to set operating frequencies, and trim with C6.

To adjust the carrier alarm in the solid-state version, first couple rf into the monitor by a pickup antenna connected to J3 or J1. Adjust R1 and C6 for maximum current through the relay coil. Don't overdrive the transistor. Monitor the current with a vom and if Q2's rating is exceeded, you may have to drop the battery voltage with a divider.

In the monitor section, R5 adjusts

Coil table

Band	Freq. (MHz)	L _x (μH)	C _{eff} (pF)	C1 (pF)	C2 (pF)	L _x (turns)	Wire Size
80 m	4.05	8	200	600	300	26	N. 24 dcc
40 m	7.35	5.4	100	300	150	20	"
20 m	14.355	2.5	50	150	75	10*	"
15 m	21.455	2.0	50	150	75	7½*	N. 18 enam.
CB/CAP	27.3	0.7	50	150	75	6*	"
10 m	29.5	0.6	50	150	75	5*	"

* Equally spaced turns

Coils are wound on 3/8" diameter forms with 3/4" winding length. Slug core material for 1-30-MHz service. (J. W. Miller type 21A000RB1, Cambridge Thermionic LS3 series or similar.)

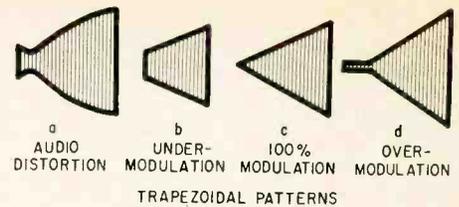


Fig. 5—Trapezoid waveforms you'll see on your scope when checking AM transmitters.

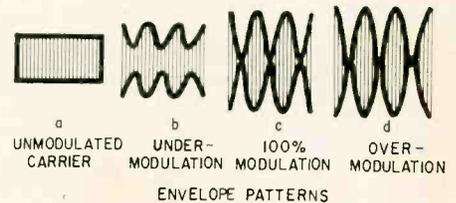


Fig. 6—Envelope modulation patterns.

the keying-monitor tone, and R7 sets AM-monitor gain.

To check the percentage of modulation of a transmitter with a scope you must modulate the rig with a single-frequency tone, preferably from a good-quality audio generator. To obtain a trapezoid pattern: Connect the scope vertical input to J2. Set horizontal gain at minimum. On the monitor, set R1 at maximum and adjust C6 for maximum vertical trace on the scope. Set the scope vertical gain to fill about one-third of the screen, and connect the horizontal input to J4, switching the horizontal input selector to the EXTERNAL position. Adjust horizontal gain to about one-third or one-half full. Set S5 to PHONE position and adjust audio gain with R7 until horizontal sweep just about fills the screen.

You'll find one of the traces shown in Fig. 5 on the scope screen. If there's distortion, it may be occurring due to overload in the monitor or the scope. Reset R1, R7 and the scope vertical gain control to see if this eliminates the distortion. If it doesn't, the transmitter is probably at fault.

It's simpler to obtain the envelope patterns of Fig. 6. You need only take the output from J2, feeding it to the scope vertical input. If the transmitter is modulated with a 1,000-Hz tone, adjust the scope horizontal sweep rate to 250 Hz and you'll see four cycles on the screen. If the peaks of the modulated envelope are flattened, there's distortion somewhere.

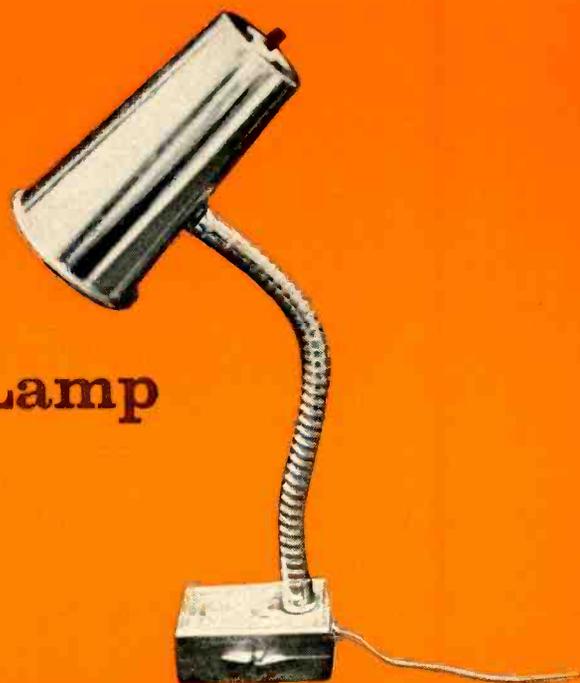
Low-priced scopes generally have limited frequency response, and won't show much of a trace of rf above 1 MHz. The monitor circuits described here beat the transmitter frequency down to below 1 MHz, where it can be easily displayed by nearly all scopes. **R-E**

BUILD

A Two-Way, Two-Way Lamp

Let there be more light this Christmas

By BYRON G. WELS



DOUBLE TALK? NOT REALLY. THIS lamp does double duty in two ways. For one thing, it's a high-intensity lamp with a "two-speed" control. In the first switch position, the lamp is off. In the second position it is about half bright; in the third position, the lamp is fully bright—and don't get the idea that you need an automobile lamp to get high intensity, either!

It's also two-way because this lamp can mount either on its base like any other lamp or (because the base is filled with small magnets) you can mount it on any ferrous metal surface.

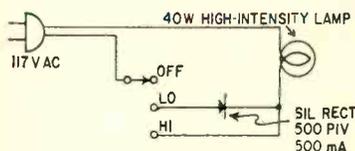
As the diagram shows, a three-position switch is used. This gives you OFF (no current to lamp), HI (full current) and LO (half current). In the LO position, a silicon rectifier conducts only on every other half-cycle of the ac voltage, thus reducing current drain (and lamp brightness).

While you can purchase all the materials new, you may wish to modify an old lamp or salvage some parts from your scrap box to keep the costs down.

Construction tips

I mounted the switch on the base of an aluminum tumbler, and cemented the lamp socket to the switch. You'll want to use a s.p.d.t. pin switch with wire leads. Start by mounting the back of the switch on the base of the lamp socket. Use RTV cement to hold it in place, and allow it to set overnight.

Next align the magnets so they aid rather than repel each other, and place them in the bottom of the plastic



Silicon rectifier reduces lamp intensity by allowing current to flow only 50% of the time. Its polarity is not important.

Materials List

- 1—High-intensity lamp, 117 volts, 40 watts (G-E 40 S11N/1 or similar)
- 1—Socket to fit lamp
- 1—S.p.d.t. pin switch, 117 volts (two on positions, one off position) with leads
- 1—Silicon rectifier diode, 500 piv, 0.5 amperes
- 1—Ac line cord and plug
- 1—Anodized aluminum cup or tumbler
- 1—Flexible gooseneck, about 10" long by about $\frac{3}{4}$ " diameter
- 1—Plastic or nonferrous metal box, about 3" x 2" x 1"
- 1—Tube of Dow Corning RTV 732 Silastic cement or similar

Several small, strong magnets (old speaker magnets will do)

Note: You can obtain the diode, the ac line cord and plug, the plastic or metal box, and possibly the magnets, at an electronic parts house. You'll probably have to get the lamp, socket, switch and gooseneck at an electrical supply house or hardware store, where you can also obtain the Silastic cement. Magnets are also available from Edmund Scientific Co., Barrington, N. J. 08007.

or nonmagnetic metal box used as a base. You can use RTV cement generously to hold the magnets in the box. A double layer of magnets will give the base added gripping power.

Locate the center of the bottom of the drinking cup or tumbler and drill a $\frac{3}{8}$ " hole for the switch. Make another $\frac{3}{8}$ " hole on one side to support the gooseneck. Placing the gooseneck closer to the open lip of the cup will not only make for a more artsy-craftsy look, it will also make the nut on the end of the gooseneck easier to tighten and give you more working room inside.

Make a final $\frac{3}{8}$ " hole in the top of the plastic or metal box to mount the other end of the gooseneck. Now snake the line cord up through the box and gooseneck; pull out plenty of slack from the front of the cup, which is now your lampshade.

Following the wiring diagram, connect the switch, lamp socket and line cord. Carefully wrap all exposed leads with plastic electrical tape (or shrinkable tubing). Now insert the switch through the hole in the back of the shade, and fasten it in place with its nut. The switch is now supporting the socket as well. Pull the excess wire back through the bottom of the box and, with your soldering gun, make a small indentation in the plastic to allow the line cord to pass. If you use a metal box you'll have to drill a hole for the wire.

Try the lamp . . . if it works paint it gold or any other color to go with your room decor. **R-E**

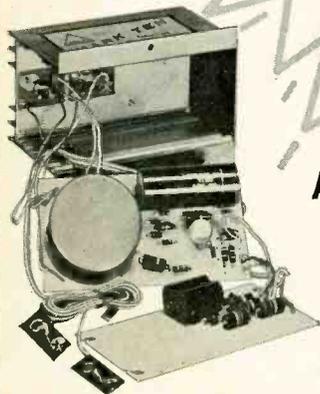
Get Top **PERFORMANCE** from
your Car! **Buy The Best!**



DELTA'S Remarkable, Proven

MARK TEN CAPACITIVE DISCHARGE IGNITION SYSTEM

ONLY
\$44.95
ppd.



Available in Easy-to-Build

DELTAKIT®

ASSEMBLE IT
YOURSELF!

ONLY
\$29.95
ppd.

You've read about the Mark Ten in Radio Electronics, Electronics World, Mechanix Illustrated, Electronics, Popular Mechanics and other leading publications! Now discover what dramatic improvement in performance with capacitive discharge ignition is yours for your car, truck, jeep, boat—any vehicle! Delta's remarkable electronic achievement—on the market since 1963 and so unique that a patent has been granted—saves on gas, promotes better acceleration, gives your car that zip you've always wanted. Even Detroit has finally come around. Delta's Mark Ten, the original, the proven winner from Sebring to Suburbia, has set new records of ignition benefits attested to by thousands of satisfied purchasers. No re-wiring necessary. Works on literally any type of gasoline engine. Satisfaction guaranteed.

Order from coupon below, specifying car make, voltage and polarity. Like to build your own? Order a Deltakit® and save!

COMPARE THESE PROVEN BENEFITS!...

- ▲ DRAMATIC INCREASE IN ACCELERATION
- ▲ LONGER POINT AND PLUG LIFE
- ▲ IMPROVED GASOLINE MILEAGE
- ▲ MORE COMPLETE COMBUSTION
- ▲ SMOOTHER PERFORMANCE

Order Your Mark Ten Today! Shipped Postpaid at Once.



DELTA PRODUCTS, INC.

P.O. BOX 1147 RE — GRAND JUNCTION, COLORADO 81501

Enclosed is \$_____ Ship prepaid. Ship C.O.D.
 Mark Tens (Assembled) @ \$44.95 Mark Tens (Deltakit®) @ \$29.95
(12 volt positive or negative ground only)

Specify 6 Volt: Negative Ground only.
 12 Volt: Specify Positive Ground Negative Ground

Car Year _____ Make _____

Name _____

Address _____

City/State _____ Zip _____

HIGH PERFORMANCE METER

(continued from page 55)

nate with motor torque variations—and again helps to isolate a problem.

The WTD position gives a weighted measurement. The term "weighting" applies to noise filters designed to pass noise frequencies in proportion to their degree of objection. Weighting filters are used for audio and video noise measurements as well. In the WTD position the flutter reading is more of an indication of just how objectionable or noticeable a speed variation will be to the ear. As an example, a flutter rate at 100 Hz of a given amplitude will not be so noticeable or objectionable as one at 10 Hz at the same amplitude. The ear is most sensitive to rates between 2 and 10 Hz.

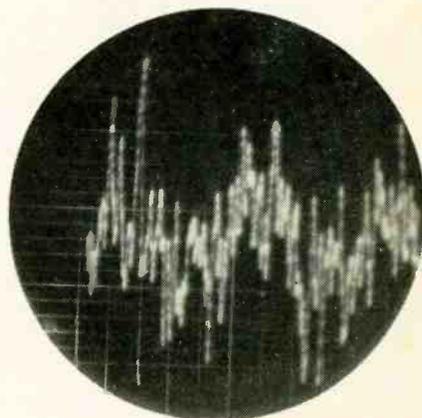


Fig. 7—Typical scope trace of flutter in tape playback. Sweep rate is 0.2 second and vertical sensitivity is 0.5 volt peak to peak. Note random characteristic of flutter in the signal.

To summarize using the flutter meter, set the mode switch to osc and record several minutes of the 5-kHz signal on a tape, at the tape speed you wish to check. Set the mode switch to STAB for at least 30 seconds or until the tape is rewound. Play the tape back into the flutter-meter input and set the mode switch to READ. Then set the range switch as required, and read the average flutter. Since flutter is usually a random thing, the meter pointer will not be steady; take an average pointer reading. Rewind the tape slightly each time and take at least four more readings. The average of the five readings will give a good indication of the tape equipment quality and condition. Well-built tape machines will average less than 0.1% flutter at 7½ ips. For checking turntables, use a frequency-test record with a 5-kHz test band on it. **R-E**

If you like
big speakers,



listen to the mammoth little E-V SEVEN!

E-V The E-V SEVEN is the small speaker for people who don't really want a small speaker. Built in the shadow of one of the biggest speakers of them all (the vast Patrician 800) the E-V SEVEN refuses to sound as small as it is.

But why does an E-V SEVEN grow up when it's turned on? Our engineers point to years of painstaking exploration in the byways of sound. They'll patiently explain the virtues of our low resonance 8" woofer and 3½"

cone tweeter with symmetrical damping (an E-V exclusive). They may even mention—with quiet pride—the unusual treble balance RC network that adjusts E-V SEVEN response more smoothly than any conventional switch or volume control.

But when it comes to describing the sound, our engineers prefer to let the E-V SEVEN speak for itself. And while they'd be the last to suggest that the E-V SEVEN sounds just like speak-

ers many times larger (and costing much more) they treasure the pleased look of surprise most people exhibit when they hear an E-V SEVEN for the first time.

If you have just 19" of shelf space, 10" high and 9" deep...and have \$66.50 to invest in a speaker, by all means listen carefully to the E-V SEVEN. It might well be the biggest thing to happen to your compact high fidelity system!

high fidelity systems and speakers • tuners, amplifiers, receivers • public address loudspeakers • microphones • phonograph needles and cartridges • organs • space and defense electronics

ELECTRO-VOICE, INC., Dept. 1274E, 613 Cecil Street, Buchanan, Michigan 49107

Electro-Voice®

EARN YOUR DEGREE Electronics Engineering Through Home Study

Highly Effective Home Study Courses In:

- Electronics Engineering Technology
- Electronics Engineering Mathematics

Earn your degree in Electronics Engineering and upgrade your status and pay to the engineering level. Complete college level courses in Electronics Engineering. Outstanding lesson material—thorough and easy to understand. Up-to-date in every respect. The knowledge and ability that means the difference between a low paying technician job and a high paying engineering position. Low tuition cost with low monthly payments. Free engineering placement service for our graduates. Write for free descriptive literature. No salesman will call on you.

COOK'S INSTITUTE of Electronics Engineering

Established 1945

Formerly Cook's School of Electronics

Forest Hill Road

P. O. Box 10634

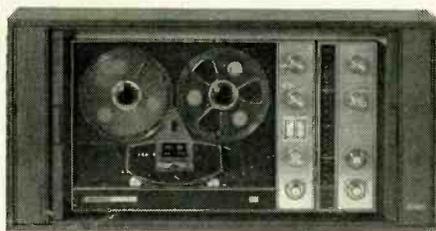
Jackson, Mississippi 39209

Circle 28 on reader's service card

EQUIPMENT REPORT

Ampex 985 Music Center

Circle 43 on reader's service card



WITH THE GROWING popularity of three-piece modular stereo music systems, it was only natural that Ampex should introduce a *music center*. Their device is built around a tape recorder (naturally), rather than the more common record changer/receiver concept. Housed in an attractive walnut cabinet, the music center is a three-speed ¼-track stereo and mono audio tape recorder complete with AM, FM and FM-stereo receiver. The tape transport uses bidirectional playback which eliminates reel turnover; it has a push-to-reset digital tape counter and a fingertip control panel. There are two separate electronic control panels: one for the recorder and one for the radio.

The recorder control panel has a recording mode selector (STEREO or

MONO), and a record safety button, which prevents accidental erasure of recorded programs. There are individual channel record-level meters, a five-position source and playback selector switch and dual record-level controls.

The radio control panel contains a flywheel tuning control; a mode selector for choosing FM, AM or FM-stereo reception; dual ganged bass and treble controls; individual channel loudness controls; a tuning meter effective on both FM and AM, and an FM-stereo beacon indicator.

As expected, the recorder was a joy to operate. Reel threading is as simplified as this operation can be made; after some experimenting I was able to make some creditable recordings using both microphones supplied.

An interesting innovation is the automatic reverse feature, which allows playback of both tape sides without reel turnover. This mechanism is activated by a 20-Hz signal (inaudible) recorded on the tape. The reversing signal can be dubbed onto any tapes you may presently own (prerecorded or otherwise).

The overall frequency response of the recorder is listed by the manufacturer as 50 to 15,000 Hz ± 4 dB at the 7½-ips speed. This was actually bet-

THE MOST USEFUL GIFTS FOR CHRISTMAS ARE GIFT WRAPPED WHEN YOU BUY 'EM

With more hi-fi kits, TV's, ham radios and electrical appliances being sold this season than ever before, it's a sure thing your friends will be needing topnotch soldering tools. Give them the best—Weller guns or Marksman irons in colorful yuletide packages. Gun kit sleeves are perforated to fit inside the open case, will be a welcomed sight under the Christmas tree . . . a useful gift all year long.



Weller® SOLDERING KITS



Dual heat soldering gun kit. Includes trigger-controlled 100/140 watt Weller gun with 3 soldering tips, tip-changing wrench, soldering aid, flux brush and solder in plastic utility case. Holiday wrapped Model 8200PK-X.

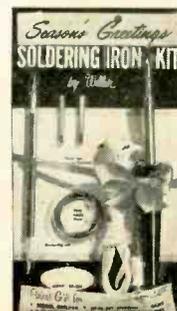
Heavy-duty dual heat gun kit. Features 240/325 watt Weller gun plus extra tips for smoothing and cutting, tip-changing wrench, and solder. Holiday wrapped Model D550PK-X.

MARKSMAN pencil iron kit by Weller. Featherweight 25-watt iron for outstanding continuous-duty soldering, two extra tips, soldering aid and solder. Holiday wrapped Model SP23K-X.

At Your Electronic Parts Distributor . . . Available in Canada

WELLER ELECTRIC CORP., Easton, Pa. World Leader in Soldering Technology

Circle 29 on reader's service card



Circle 30 on reader's service card →

tered by the unit I tested, using a standard-frequency test tape. Signal-to-noise ratio at 7½ ips was measured at 45 dB (as opposed to the 46 dB listed by the manufacturer). That's well within the classification of "excellent" for home recorders and better than some of the so-called "professional" recorders I've seen. More important, what little residual noise there was consisted of inobtrusive background hiss, or white noise, rather than the more annoying hum components so often prevalent in high-gain devices such as tape recorders.

While the amplifier section boasts a modest 7.5 watts per channel (15 watts combined music power), the model 830 speakers supplied with the unit I tested supplied plenty of sound—even for the concert-hall-level listener. This illustrates a seldom noted advantage of "modular component purchasing."

Since the manufacturer has control of speakers and amplifier selection, he will make sure to supply speakers which are efficient enough to operate properly with his own amplifier, regardless of its *electrical* power rating. It is, after all, *acoustic* power that counts: A 10%-efficient speaker fed by 2 watts of power will sound as loud as a 1%-efficient speaker fed by 20 watts of electrical power!

Obviously emphasizing recorder performance in the descriptive literature, Ampex failed to mention any FM or FM-stereo performance specifications, so I decided to measure them. They shouldn't have been ashamed to publish specs. IHF measured sensitivity was 5 µV, not the best there is, but certainly adequate. This was borne out by my ability to receive satisfactorily FM-stereo stations 20 miles away with full limiting action, using just the built-in dipole. Full limiting occurred with 8 µV of signal. The stereo beacon lit at 3 µV input, though reception at this level was quite noisy.

Separation for FM-stereo, with a 100-µV signal was 25 dB at 1,000 Hz on one channel, 22 dB on the other. At 10 kHz separation was still in excess of 15 dB, not bad at all for a multiplex section with only three transistors!

AM reception was quite adequate; the circuitry is conventional.

All electronics in the 985 are fully transistorized, employing a total of 42 transistors.

If tape recording is your special interest, and if the compactness of modular component approach to stereo sound has appeal, you would do well to check into the model 985 Ampex music center. —Leonard Feldman

Price: \$599.95



has
everything
in

chemicals

From service cements to aerosol cleaners, from solvents to lubricants, only GC satisfies the critical chemical needs of the electronics field.

All GC chemicals are formulated to meet rigid requirements; packaged for convenience; and "proven in use" to make electronic jobs easier, faster, more profitable.

Remember too, with GC aerosols you get double value . . . highest product quality plus valuable GC "BONUS COUPONS".

Get more for your money . . . always insist on GC!

Write for your Giant FREE GC Catalog today . . . over 12,000 items including TV Hardware, Phono Drives, Chemicals, Alignment Tools, Audio, Hi-Fi, Stereo & Tape Recorder Accessories, Nuts & Bolts, Plugs & Jacks, Service Aids, and Resistive Devices.



*only GC gives you
everything in electronics.
..... for almost 40 years!*

GC ELECTRONICS COMPANY

400 South Wyman Street
Rockford, Illinois 61101

A DIVISION OF HYDROMETALS, INC.

Circle 31 on reader's service card



Radio-Television
Service Cement
Cat. No. 30-2



SPRA-ELEEN
Contact-Control Cleaner
Cat. No. 8666



SPRA-LUBE
Cleaner-Lubricant
Cat. No. 8668



GC "JIF"
Contact and Control
Cleaner
Cat. No. 8670



"Super Grip"
Epoxy Glue
Cat. No. 347



Super Freeze Mist
Cat. No. 8568



"King of the hill"

Keep on top of your solid-state replacements... with RCA "Top-Of-The-Line" SK-Series. They make up just a handful of types—17 transistors, 2 rectifiers, and 2 integrated circuits. Together these 21 RCA SK-Series types can keep you ahead of 9,000 solid-state replacements in entertainment-type equipment. Designed especially for this purpose, you'll find these devices useful in line-operated and battery-operated radios, phonographs, tape recorders, TV receivers, AF amplifiers, and automobile radios.



RCA SK-Series transistors and rectifiers and the 9,000 types they replace are cross-referenced in the RCA Solid-State Replacement Guide. It's a handy booklet listing comparably-rated types including industry standard EIA types, foreign types, and those identified only by device manufacturers' or equipment manufacturers' parts numbers.

Check with your RCA Distributor. He stocks the complete line in either cartons or see-through display packs. Also, pick-up your copy of the RCA Replacement Guide SFD-202-D available through your RCA Distributor.



RCA Electronic Components and Devices, Harrison, N. J. 07029



The Most Trusted Name in Electronics



Amphenol 870
Millivolt Commander
Circle 44 on reader's service card

Manufacturer's Specifications

Dc Voltmeter
Ranges: 100 mV to 100 volts full scale
Accuracy: $\pm 2\%$ of full scale
Input resistance: 10.6 megohms

Ac Voltmeter
Ranges: 10 mV to 300 volts rms full scale
Accuracy: $\pm 3\%$ of full scale
Input impedance: 10 megohms, 50 pF

Decibels
Ranges: -40 to +50 dBm
Accuracy: $\pm 3\%$ full scale, 50 Hz-50 kHz

Ohmmeter
Ranges: 10 ohms to 10 megohms center scale
Accuracy: $\pm 3^\circ$ of arc

Size: 9 1/4" x 5 3/4" x 6 3/8"
Weight: 5 lb
Price: \$99.95



FOR MANY YEARS, most of us have struggled with non-portable vtvm's which had to be plugged into an ac line and warmed up every time we moved 'em. If you needed high input impedance to avoid circuit loading, you babied that vtvm, 'cause a vom wouldn't do the job.

Amphenol's Millivolt Commander, model 870, will do the job. Input impedance is 10 megohms on all ranges, and the instrument has full-scale deflection of 100 mV on dc and 10 mV on ac. These features are obtained by using an FET input stage. The entire voltmeter is solid-state and battery-operated, for complete portability and stability.

There's still another advantage—you aren't tied to the ac line, so you can hang the meter across nearly any kind of circuit with no regard for where the ground is.

You'll find the model 870 can measure almost any voltage or resistance you run into in electronic servicing—with the possible exception of TV high voltage. Accuracy is good (see below) and the instrument is stable. In the dc mode, there is 60 dB of ac rejection at the 60-Hz line frequency.

The heart of this voltmeter is a dc amplifier which has good temperature stability. To eliminate drift, this amplifier is supplied with a constant bias voltage; the cells supplying this voltage are loaded with a constant current. Drain is minimal, and the cells should last two years in normal service.

Actually, there are three separate battery supplies: One is used for the ohms supply, one for the zero reference, and one for the amplifier supply. All batteries are AA size. Zinc-carbon cells are cheapest, but for best and longest performance, you might want to try alkaline cells.

One thing I noticed was the appreciable effect of the ohms battery on the accuracy of the Rx1 scale. I put a 15-ohm, 1% resistor across the test leads on the Rx1 scale of the 870 as supplied by Amphenol. The reading was 9 ohms. Then I replaced the ohms battery with a fresh cell and read 13 ohms (which is within specifications).

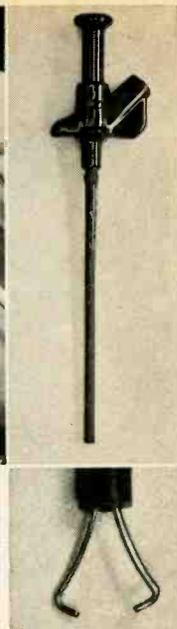
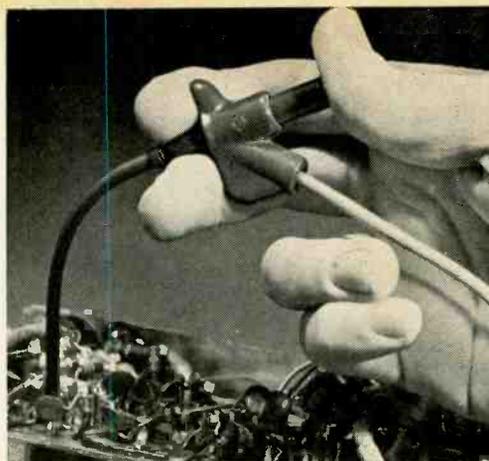
Good mechanical design is evident in the model 870. The meter movement has been designed to operate satisfactorily in both the horizontal and the vertical plane, so you can set up the voltmeter any way you want. A brace in back permits you to tilt the meter up at a 45° angle when reading it.

The circuit is shielded by a metal interior case (to avoid stray pickup) with a leatherette exterior case and front-panel cover (for portability).

You can do a lot with the Millivolt Commander. You can check microphones and phono cartridges for output level and balance, you can measure transistor bias voltages, and you can evaluate the performance of small-signal equipment. All in all, this is a most handy instrument.

—Ray Clifton

R-E



Clever Kleps 30

Push the plunger. A spring-steel forked tongue spreads out. Like this  Hang it onto a wire or terminal, let go the plunger, and Kleps 30 holds tight. Bend it, pull it, let it carry dc, sine waves, pulses to 5,000 volts peak. Not a chance of a short. The other end takes a banana plug or a bare wire test lead. Slip on a bit of shield braid to make a shielded probe. What more could you want in a test probe?



Available through your local distributor, or write to:

RYE INDUSTRIES INC.

128 Spencer Place, Mamaroneck, N.Y. 10543

Circle 33 on reader's service card

\$147

GAS WELDING TORCH



Uses **OXYGEN**
and **LP GAS**

- Completely self-contained.
- Produces 5000° pin-point flame.
- Welds, brazes, solders.
- Hundreds of lightweight uses.
- Suggested list — \$19.95.

GET COMPLETE DETAILS AT MOST INDUSTRIAL DISTRIBUTORS, OR WRITE TO MICROFLAME, INC.



HOME WORKSHOP



TECHNICIANS



REPAIR AND SERVICE SHOPS

MICROFLAME, INC.

7800 COMPUTER AVENUE
MINNEAPOLIS, MINNESOTA 55424

Circle 34 on reader's service card

◀ Circle 32 on reader's service card

14 KIT-GIVING IDEAS FROM HEATH...

For The Whole Family...

New Deluxe "227" Color TV

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

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

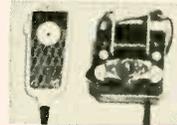
Kit GR-227, (everything except cabinet)... \$42 dn., as low as \$25 mo. ... 114 lbs. **\$419.95**

GRA-227-1, Walnut cabinet... no money dn., \$6 mo. **\$59.95**

GRA-227-2, Mediterranean Oak cabinet (shown above) ... no money dn., \$10 mo. **\$94.50**



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



Kit GRA-27
\$19.95

New Remote Control For Heathkit Color TV

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



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

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



Deluxe Heathkit "295" Color TV

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

Kit GR-295, (everything except cabinet), 131 lbs. ... \$48 dn., \$42 mo. **\$479.95**

GRA-295-1, Walnut cabinet (shown above), 35 lbs. ... no money dn., \$7 mo. **\$62.95**
Other cabinets from \$94.50

Deluxe Heathkit "180" Color TV

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

Kit GR-180, (everything except cabinet), 102 lbs. ... \$35 dn., \$30 mo. **\$349.95**

GRS-180-5, table model cabinet & mobile cart (shown above), 57 lbs. ... no money dn., \$5 mo. **\$39.95**
Other cabinets from \$24.95



FREE... 40-Lesson Record Course With Either Heathkit / Thomas Organ! A \$50 Value! Includes four 33 1/3 rpm records, music book & leatherette album.

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

Heathkit®/Thomas "Paramount" Theatre Organ

Save Up To \$500! Build in 80-100 hours. All Thomas factory-made parts... 15 manual, 4 pedal voices; instant-play Color-Glo; all-transistor circuit; 200 watts peak power; 2-speed rotating Leslie plus main speaker system with two 12" speakers; 44-note keyboards; horseshoe console with stop tablets; 28-note chimes; 13-note bass pedals; repeat & attack percussion; reverb; headset outlet; assembled walnut finish hardwood cabinet & bench; and more. 265 lbs. 7", 33 1/3 rpm demonstration record 50c.

America's Lowest Cost Solid-State Organ

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

Save Up To \$205! Instant-play Color-Glo; 10 voices; 13-note bass pedals; repeat percussion; 37-note keyboards; 75-watt peak power; vibrato; assembled walnut cabinet & bench. 172 lbs. 7", 33 1/3 rpm demonstration record 50c.



Exclusive Band Box Percussion

Automatically or manually adds 10 percussion voices to any Heathkit/Thomas organ. Build & install in 12 hours.

Kit TOA-67-1, no money dn., \$14 mo. **\$145.00**

Exclusive Playmate Rhythm Maker

Adds 15 fascinating rhythms to any Heathkit/Thomas Organ. Requires Band Box percussion (above) for operation.

Kit TOA-67-5, no money dn., \$18 mo. **\$189.90**



USE COUPON BELOW TO ORDER NOW

NEW! VOX "Jaguar" Transistor Combo Organ By Heathkit



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

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

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

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

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

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

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



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

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

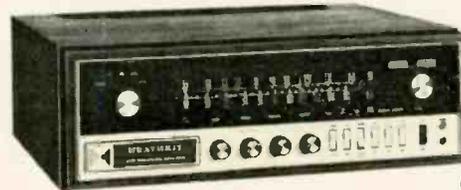
NEW! Lowest Cost Solid-State Stereo Receiver

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



Features wide 18-60,000 Hz response @ ±1 db at full 5 watts RMS power per channel . . . 14 watts music power . . . inputs for phono and auxiliary . . . automatic stereo indicator . . . outputs for 4 thru 16 ohm speakers . . . adjustable phase for best stereo . . . flywheel tuning . . . and compact 9 1/4" D. x 2 7/8" H. x 11 1/4" W. size. 12 lbs. Optional factory assembled cabinets (walnut \$7.95, beige metal \$3.50).

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



Kit AR-15
\$329.95
(less cabinet)
\$28 mo.

Assembled
ARW-15 \$499.50
(less cabinet) \$43 mo.

World's Most Advanced Stereo Receiver

Acclaimed by owners & experts for features like integrated circuits & crystal filters in IF amplifier; FET FM tuner; 150 watts music power; AM/FM and FM stereo; positive circuit protection; all-silicon transistors; "black magic" panel lighting; and more. Wrap-around walnut cabinet \$19.95

Kit AR-15 (less cab.), 34 lbs. . . \$33 dn., \$28 mo. **\$329.95**
Assembled ARW-15, (less cab.), 34 lbs. . . \$50 dn.,
\$43 mo. **\$499.50**

Professional 10-Band Shortwave Receiver

Kit SB-310
\$249
\$23 mo.



Covers 49, 41, 31, 25, 19 & 16 meter shortwave . . . 80, 40 & 20 meter ham . . . 11 mete·CB Includes 5 kHz crystal filter for AM, SSB and CW listening. Features selectivity that slices stations down to last kHz; 11-tube circuit; crystal-controlled front-end and more. 20 lbs. SB-600 8 ohm 6" x 9" speaker in matching cabinet \$18.95.

NEW! Solid-State Portable Volt-Ohm-Meter

Kit IM-17
\$19.95



So Handy, So Low Cost we call it "every man's" meter. Just right for homeowners, hobbyists, boatowners, CBer's, hams . . . it's even sophisticated enough for radio & TV servicing! Features 12 ranges . . . 4 AC & 4 DC volt ranges, 4 ohm ranges; 11 megohm input on DC, 1 megohm input on AC; 4 1/2" 200 uA meter; battery power; rugged polypropylene case and more. Easy 3 or 4 hour kit assembly. Ideal gift for any man! 4 lbs.



NEW FREE 1968 CATALOG!

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

HEATH COMPANY, Dept. 20-12
Benton Harbor, Michigan 49022
In Canada, Daystrom Ltd.

Enclosed is \$ _____, including shipping.

Please send model (s) _____

Please send FREE Heathkit Catalog.

Please send Credit Application.

Name _____

Address _____

City _____ State _____ Zip _____

Prices & specifications subject to change without notice.

CL-310

Rotary Stepping Switches

(continued from page 48)

switch stay in the last position it reaches.

For example, with the circuit shown, we can dial circuit 9 only by dialing first 4 and then 5. Any other sequence causes the stepping switch to home. 1CR-1 opens at the beginning of the first series of pulses, disconnecting the battery from the wiper and prevents false triggering. At the end of the pulse 1CR-1 closes and connects the battery to the wiper. If the correct number (4) had been dialed, 3CR is energized and locked in through 3CR-2 and ONS2. The next series of 5 pulses steps the switch to position 9.

If the code is misdialled or 9 is dialed directly, 2CR is energized and the stepping switch homes through 2CR-1 and off-normal contacts ONS1.

For low digits an additional relay may be needed, to prevent landing on the third digit position. It would be necessary to use a second code of pulses to ensure that the switch comes to rest successively on all three points or not at all. Line connection is made through a second level of contacts (not shown in the diagram). Any additional pulse after the three-digit code will of course have the same effect as too many pulses—it will send the switch home.

Where only a few selectors are to be used on a line, relay RY1 can be eliminated simply by making the first digit 0 (tenth contact) and the second digit 9 or 0. This makes it unlikely that accidental connection could take place, yet allows for the use of 9 selectors. With that many pulses needed it is also unlikely that accidental connection could take place, yet the circuit allows for the use of 9 selectors. It is equally unlikely that random pulse noise might connect a selector.

The circuit of Fig. 6 has many applications. It can be used to read voltages or currents of a remotely located transmitter (or any other electronic device, for that matter). A suitable meter would be used at the dial (pulse-originating) location, while series and shunt connections would be made at the stepper (pulse-receiving) location.

Another use would be to switch microphone circuits remotely into a single amplifier and line.

Rotary stepping switches have been used for many years in telephone, communications and industrial electronics. Today's models are highly sophisticated and capable of complex functions. In spite of the hundreds of thousands of steppers in daily use, many persons interested in electronics have little knowledge of stepping-switch function. These switches aren't really so complicated, however, as this series has shown. R-E

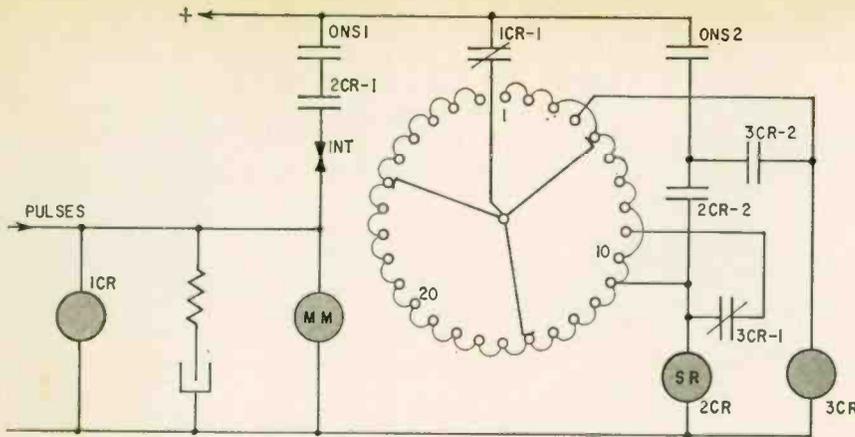


Fig. 6—A 3-digit selector using type 44 switch. Can be reset with a single pulse.

NO MORE GUESSWORK!



AMERICA'S MOST RELIABLE TUBE ANALYZER

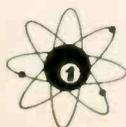
CONTINENTAL

You don't need three guesses to tell if a tube is bad—or why. With the new Sencore MU140 Continental, you know. Right now. And you simply can't go wrong. Because it's a complete tube analyzer for 4-way testing—true mutual conductance (using exclusive 5000 hertz square wave), full cathode emission, 100 megohm grid leakage, and internal shorts. Tests all tubes, including foreign—over 3000 in all. Obsolescent-proof, too—with "new socket" panel, and controls so standard the switch numbers correspond to the pin numbers in any tube manual.

If it's reliability you want—for years to come—you need the Continental. It's the best way to be sure—

See America's most complete line of professional test instruments—at your Distributor now.

for only
\$179⁵⁰



SENCORE
NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT
426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 37 on reader's service card

The FCC License
(continued from page 2)

of stations: experimental, auxiliary, booster, translator, and instructional fixed TV; developmental and remote-pickup broadcast; noncommercial educational FM broadcast with power output not more than 1 kW; CATV relay; land, maritime, aviation, public safety, industrial, land transportation, and domestic public. You may perform maintenance at a ship radar station only with a ship radar endorsement.

If you get a *Radiotelephone First-Class license* you have the most privileges (and the most qualifications) in this group. You may operate all the preceding, plus AM broadcast stations with power output over 10 kW or with directional antennas, FM stations with power output over 25 kW, TV stations and shortwave broadcast stations.

You may also perform servicing and maintenance at those stations so listed under *Radiotelephone Second-Class*, plus AM broadcast, commercial FM, TV, shortwave broadcast, and noncommercial educational FM stations with power output over 1 kW. You may perform maintenance at a ship radar station only with a ship radar endorsement.

The *Radiotelegraph Third-Class permit* holder is quite limited in permissible duties, and may operate only land maritime telegraph and telephone stations, ship maritime telephone, public-safety telegraph and telephone, industrial telephone and telegraph, land transportation telephone and telegraph, domestic public telegraph, and international fixed public stations. He may not perform any servicing or maintenance.

A *Radiotelegraph Second-Class license* allows you to operate all the preceding, plus AM broadcast stations with both power output of 10 kW or less and nondirectional antennas, FM stations with power output of 25 kW or less, and remote-pickup broadcast stations. You may also operate aircraft telegraph stations but *only* if you are at least 18 years of age and have an aircraft telegraph endorsement, and have passed a code test of 25 wpm.

This license, like its radiotelephone counterpart, is for the technician. With it, you may perform maintenance at noncommercial educational FM stations with not more than 10 watts power, land and ship maritime telegraph, aircraft telegraph, public-safety telegraph and telephone, industrial telegraph and telephone, land transportation telegraph and telephone, and domestic public telegraph stations. You may perform maintenance at a ship radar station only with a ship radar endorsement.

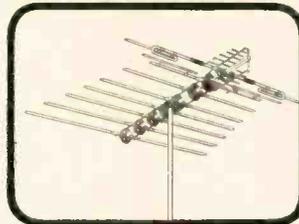
The *Radiotelegraph First-Class license* is the most difficult ticket to get, and it really means something. To insure the safety of life at sea, the holder of this license may not only operate all the preceding, but *only he* may act as chief or sole operator on a cargo vessel (other than a vessel operated exclusively on the Great Lakes) which is required by treaty or statute to be equipped with a radiotelegraph installation, and only after he has completed 6 months' service as a radio operator aboard a US ship.

With this license, you may perform maintenance at those stations listed under *Radiotelegraph Second-Class*. You may also operate aircraft telegraph stations, but only with an aircraft telegraph endorsement. You may perform maintenance duties at a ship radar station only with a ship radar endorsement.

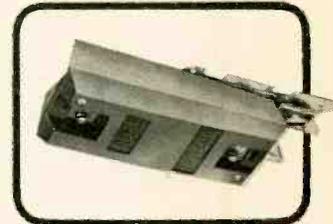
An FCC operator license can mean a lot in your electronics future. Make it easy on yourself—try for a Third, or maybe a Second. Study one element at a time. With a second phone you can do CB, two-way business radio and trucking company servicing. Then get that first phone. Or, if you'd like to go to sea, study code and try for a second telegraph. But get that ticket. You may find it's your meal ticket—and you may find yourself eating steak. **R-E**

JERROLD

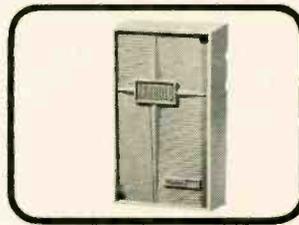
**Focusing on one thing...
better reception**



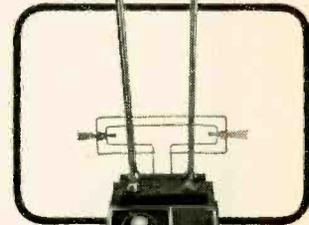
Outdoor antennas



Home preamplifiers



Distribution equipment



Indoor antennas



Jerrold Electronics Corporation

Distributor Sales Division
401 Walnut St., Philadelphia, Pa. 19105

Circle 38 on reader's service card

The Second Generation Arrives!

TRAM[®] TITAN II

Standard AM and Double Sideband

Suppressed Carrier Citizens Band Base Station

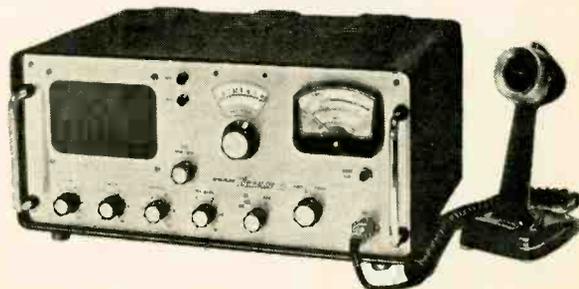
Now—Tram wraps two CB rigs into one. The mighty Tram Titan II in sideband operation, focuses more talk-power than ever with much greater range, virtual immunity from pulse-type and skip interference, plus a choice of either upper or lower sideband reception or standard AM tuning. Completely compatible with AM, DSBRC, DSBSC and SSB.

Titan II, at authorized Tram dealers, \$482

SEND FOR BROCHURE No. G-12

TRAM CORPORATION

Lower Bay Road, Winnisquam, N. H. 03289
Phone 603-524-0622



All use must conform with Part 95, F.C.C. regulations. Hobby type communications or aimless small talk prohibited

Circle 39 on reader's service card

RADIO-ELECTRONICS READER'S SERVICE

Here's how you can get manufacturers' literature fast:

1. Tear out the post card on the facing page. Clearly print or type your name and address.

Include zip code! Manufacturers will not guarantee to fill your requests unless your zip code is on the reader service card!

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** 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. Use the convenient index below to locate quickly a particular advertisement.

3. Mail the card to us (no postage required in U.S.A.)

Advertisements in this issue offering free literature (see the advertisements for products being advertised):

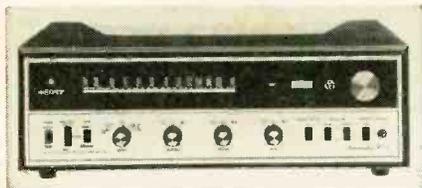
ALLIED RADIO CORP. (Pg. 76)	Circle 107
ARCTURUS ELECTRONICS CORP. (Pg. 94)	Circle 141
ARTISAN ORGANS (Pg. 80)	Circle 113
BROOKS RADIO & TV CORP. (Pg. 88-89)	Circle 117
BURSTEIN-APPLEBEE CO. (Pg. 86)	Circle 126
CASTLE TV TUNER SERVICE, INC. (Pg. 91)	Circle 121
CLEVELAND INSTITUTE OF ELECTRONICS (Pg. 5)	Circle 12
CLEVELAND INSTITUTE OF ELECTRONICS (Pg. 63-64)	Circle 30
COOK'S INSTITUTE OF ELECTRONICS ENGINEERING (Pg. 62)	Circle 28
CORNELL ELECTRONICS CO. (Pg. 96)	Circle 145
DELTA PRODUCTS, INC. (Pg. 60)	Circle 26
EDMUND SCIENTIFIC CO. (Pg. 95)	Circle 142
EICO ELECTRONIC INSTRUMENT CO., INC. (Third Cover)	Circle 149
FINNEY CO. (Pg. 15)	Circle 19
GC ELECTRONICS COMPANY (Pg. 65)	Circle 31
HEALD COLLEGES. (Pg. 91)	Circle 122
HEATH COMPANY (Pg. 68-69)	Circle 36
INJECTORALL ELECTRONICS CORP. (Pg. 22)	Circle 22
INTERNATIONAL CRYSTAL MFG. CO., INC. (Pg. 98)	Circle 148

JERROLD ELECTRONICS CORPORATION (Distributor Sales Division) (Pg. 71)	Circle 38
JFD ELECTRONICS CO. (Pg. 2)	Circle 9
MALLORY DISTRIBUTOR PRODUCTS COMPANY (Div. of P. R. Mallory & Co., Inc.) (Pg. 17)	Circle 21
MICROFLAME, INC. (Pg. 67)	Circle 34
MIKE QUINN ELECTRONICS (Pg. 97)	Circle 146
MULTICORE SALES CORP. (Pg. 91)	Circle 120
MUSIC ASSOCIATED (Pg. 79)	Circle 111
NOVA-TECH, INC. (Pg. 79)	Circle 110
OLSON ELECTRONICS, INC. (Pg. 92)	Circle 123
OXFORD TRANSDUCER COMPANY (A Division of Oxford Electric Corporation) (Pg. 80)	Circle 112
PHILADELPHIA WIRELESS TECHNICAL INSTITUTE (Pg. 93)	Circle 125
POLY PAKS (Pg. 97)	Circle 147
QUAM-NICHOLS COMPANY (Pg. 6)	Circle 13
RCA ELECTRONIC COMPONENTS AND DEVICES SEMICONDUCTORS (Pg. 66)	Circle 32
READING IMPROVEMENT PROGRAM (Pg. 89)	Circle 118
RYE INDUSTRIES, INC. (Pg. 67)	Circle 33
SALCH & CO., INC., HERBERT (Marketing Division of Tompkins Radio Products) (Pg. 80)	Circle 114
SAMS & CO., INC., HOWARD W. (Pg. 14)	Circle 18
SCHOBER ORGAN CORP., INC. (Pg. 4)	Circle 11
SCOTT, INC., H. H. (Pg. 22)	Circle 100
SEMITRONICS CORP. (Pg. 76)	Circle 108
SENCORE (Pg. 70)	Circle 37
SENCORE (Pg. 87)	Circle 115
SENTRY MANUFACTURING COMPANY (Pg. 27)	Circle 25
SHURE BROS. (Pg. 75, 77, 79)	Circle 106
SOLID STATE SALES (Pg. 95)	Circle 143
SONOTONE CORP. (Electronic Applications Div.) (Pg. 88)	Circle 116
SONY CORP. OF AMERICA (Pg. 4)	Circle 10
SONY/SUPERSCOPE (Pg. 16)	Circle 20
SPRAGUE PRODUCTS COMPANY (Pg. 78)	Circle 109
SURPLUS CENTER (Pg. 92)	Circle 124
SYLVANIA (Subsidiary of General Telephone & Electronics) (Pg. 23)	Circle 23
TAB BOOKS (Pg. 90)	Circle 119
TRAM CORPORATION (Pg. 71)	Circle 39
TRIPLETT ELECTRICAL INSTRUMENT COMPANY (Second Cover)	Circle 7
WARREN ELECTRONICS COMPONENTS (Pg. 96)	Circle 144
WELLER ELECTRIC CORP. (Pg. 62)	Circle 29
WINEGARD CO. (Pg. 24-25)	Circle 24
XCELITE, INC. (Pg. 14)	Circle 17

NEW AUDIO EQUIPMENT

More new product information is available free from the manufacturers of items identified by a Reader's Service number. Turn to the Reader's Service Card facing page 72 and circle the numbers of the new products on which you would like information. Detach and mail the postage-paid card.

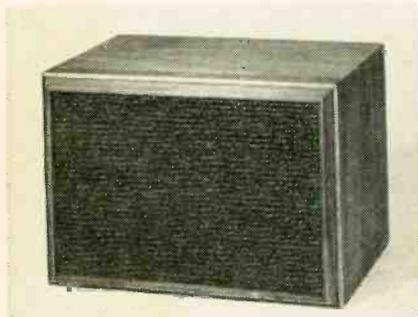
65-WATT STEREO RECEIVERS, FM stereo 342B, and AM/FM stereo 382B. Both feature Scott FET circuitry, which eliminates all cross modulation and drift in both AM and FM. Driver and output transformers are eliminated from the design of the two models. Output is direct coupled, each model has dual speaker switches for main, remote, both speakers, or all-speakers-off for headphone listen-



ing; noise filter; front panel headphone jack; separate bass, treble, and volume controls for each channel. Both receivers achieve 2.2 μ V sensitivity with 80 dB cross-modulation rejection. Separation is 36 dB. 382B features automatic variable bandwidth and automatic gain control. 342B features integrated circuit i.f. 342B is \$299.95 and 382B is \$339.95.—H. H. Scott, Inc.

Circle 46 on reader's service card

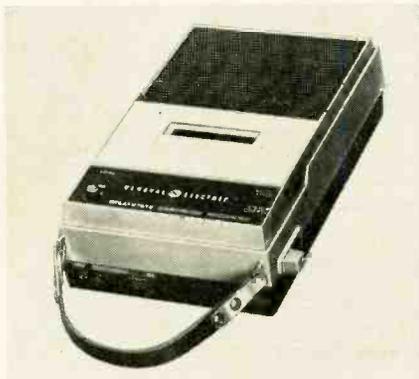
FOUR SPEAKER SYSTEMS. The *Maximus 22* is a 2-way system (shown) and *Maximus 55* is a 3-way system. Both may be used horizontally on bookshelves or in a vertical position, free standing. The *Maximus 33* and *Maximus 44*, along with the other models, offer an integrated line of speakers. All units employ the acoustic suspension principle with a



higher efficiency because of the magnetic design, permitting use of amplifiers of relatively low power. They all have removable grilles to permit use of custom grille fabrics to blend with room decor, and make cleaning easy. All speakers have hand-rubbed, oiled walnut cabinets. *Maximus* series 22, 55, 33, and 44 are \$39.95, \$99.50, \$56.00, and \$76.00 respectively.—UTC Sound, Div. of TRW.

Circle 47 on reader's service card

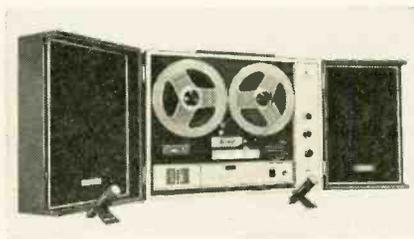
CASSETTE CARTRIDGE TAPE RECORDER, The M8320 is operated on four "C" batteries. Play, record, rewind and stop functions are controlled by a slide switch. This unit features a remote control microphone with pouch, a detachable carry strap, a neon recording-level



indicator, capstan drive for constant tape speed and a cassette guard which prevents accidental tape erasure. Optional accessories are an ac converter, a patch cord and an earphone. 60 or 120 minute blank or pre-recorded music cassettes may be used. \$49.95—General Electric

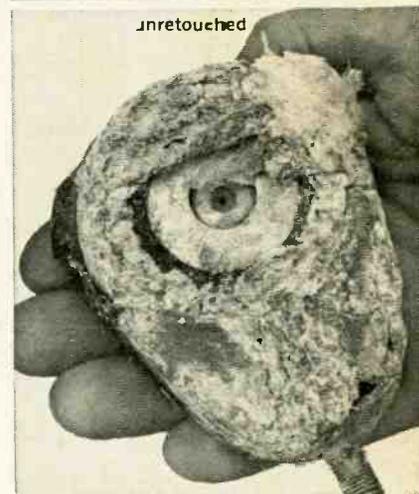
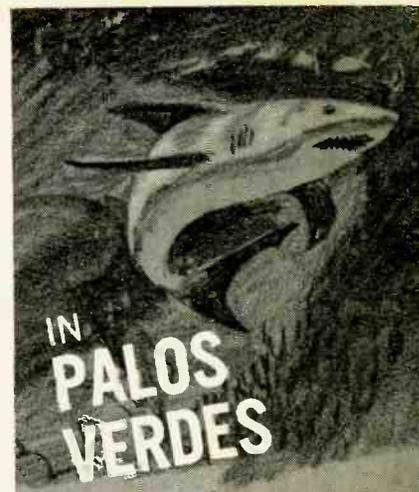
Circle 48 on reader's service card

3-SPEED TAPE RECORDER, Model 1040. Detachable speakers are this unit's feature. It uses 4-track stereo and mono at 7 $\frac{1}{2}$, 3 $\frac{3}{4}$ and 1 $\frac{1}{2}$ ips. Instant stopping permits editing as you go. The same single control is used for rewind, stop, play and fast forward operations. Novice and expert operators will find the digital counter and the two VU meters useful.



The solid-state amplifier (10-watt peak) has a fold-down panel which conceals recording controls, record interlock and inputs. The recorder and speaker fold into a compact portable case. Shutoff is automatic. Response: 30–18,000 Hz at 7 $\frac{1}{2}$ ips; flutter and wow: less than 0.1% at 7 $\frac{1}{2}$ ips. \$169.95 price includes two speakers, 2 microphones, 7" take-up reel and patch cords.—Allied Radio Corp.

Circle 49 on reader's service card



**SHURE
MICROPHONE
ATTACKED
BY
OCEAN
TERROR**

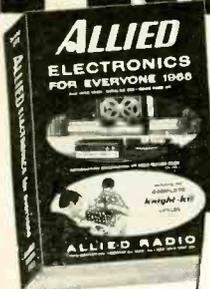
This Shure hand-held microphone was suspended over Marineland of the Pacific to pick up the "voice" of a porpoise. An undiscovered pinhole break in an external protective plastic cover subjected the unit to ruinous salt spray for months on end. But since Shure routinely tests microphones with salt spray, it wasn't particularly surprising that after being corroded beyond recognition

**... IT STILL
WORKED**

© 1967 Shure Brothers, Inc.

Circle 105 on reader's service card

FREE!



ALLIED
NEW 1968
CATALOG
518
PAGES

SAVE ON:

- Famous Knight-Kits®
- Stereo Hi-Fi
- Tape Recorders, Tape
- CB 2-Way Radios
- Walkie-Talkies
- FM-AM & AM Radios
- Shortwave Receivers
- Portable TV
- Phonographs
- Amateur Gear
- Intercoms & PA
- Automotive Electronics
- Test Instruments
- TV Antennas & Tubes
- Power Tools, Hardware
- Tubes, Transistors
- Parts, Batteries, Books

TOP SAVINGS ON THE BEST IN ELECTRONICS FOR EVERYONE

Shop by mail and save at Allied, world's largest electronics headquarters. Hundreds of money-saving values. NO MONEY DOWN. Up to 2 years to pay!

MAIL COUPON BELOW

ALLIED RADIO, Dept. 2M
P.O. Box 4398, Chicago, Ill. 60680

NAME (Please Print) _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

Circle 107 on reader's service card

EASY TO BUILD SOLID STATE ELECTRONIC KITS

FOR STUDENTS, BEGINNERS AND HOBBYISTS

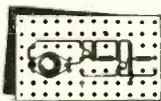
With these Semitronic Kits, you learn by doing. Build complete, functional electronic equipment. Here are a few of the projects you can construct quickly. Each project works—all have been laboratory tested. No technical background needed, no special tools required—just pliers, screwdriver, & soldering iron.

KITS NOW AVAILABLE:

- 2-Transistor Radio, a hot little AM radio, w/plastic case and earphone . . . Model SS-1200, \$4.95
- Code Instructor, 2-transistor oscillator for practicing Morse code, for Ham license, etc. . . . Model CI-10, \$1.95 (w/spkr, \$2.95)
- Electronic Organ, 8 keys, plays tunes . . . Model EO-15, \$3.95 (w/spkr, \$4.95)
- Electronic Siren, for burglar alarms, fire, bike, auto, or model trains, etc. . . . Model ES-12, \$3.95 (w/spkr, \$4.95)
- Intercom, sensitive, uses 1 or more speakers, for room-to-room conversations . . . Model IC-20, \$3.95 (less spkrs)
- Universal Amplifier, a 3-transistor unit for dozens of uses in the lab, for mike and telephone . . . Model UA-3, \$3.95
- Electronic Project Book, by Semitron. With this book any student, beginner, hobbyist, can have fun and excitement of building electronic projects that work—even if you've never worked with electronics before. Projects use inexpensive parts . . . EP-1, \$2

ALSO AVAILABLE:

- Chass-Eze, electronic construction kit, great for bread-boarding experimental circuits quickly . . . Model PB-46, only \$1.89



When ordering by mail, please include Model No.

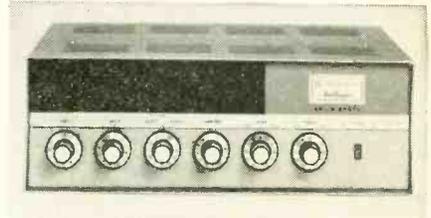
SEMITRONICS CORP.
265 Canal St., New York, N.Y. 10013
School Discounts Available

Circle 108 on reader's service card

New Audio Equipment

continued from page 75

SOLID-STATE P.A. AMPLIFIERS, Challenger CHS series. Available in four models ranging in power from 20 watts to 100 watts, this new line will operate at full output from -20°C (-4°F) to $+65^{\circ}\text{C}$ ($+149^{\circ}\text{F}$). In higher powered models, CHS100 and CHS50, all-silicon semiconductors are used. Rated at 100 watts and 50 watts, respectively, these amplifiers have two microphone inputs. The 35-watt CHS35 offers two mike inputs and can be operated from a 12-volt battery as well as ac. Model CHS20 is rated at 20 watts and has one mike input.



All models have two auxiliary inputs on a fader control. The CHS chassis has a panel-mounted preamp designed for two additional microphones. The accessory, PMA-2, can be inserted in less than five minutes. All models have both high- and low-impedance microphone inputs. A built-in circuit permits microphone precedence over music or adjustment of volume from distances up to 2,000 feet. Memory Markers aid in returning controls to previously determined levels without blare or dead spots. Other features include wide-frequency response, individual amplifier control, constant-voltage output, light-weight cabinet. Accessories such as phonograph tops, locking cover, rack panel mounting kit, remote controllers, carrying case are available. Bogen CHS100 shown.—Bogen Communications Div./Lear Siegler, Inc.

Circle 50 on reader's service card

STEREO HEADPHONES. Norelco has introduced its new Models K-20 and K-60 stereo headphones. Both weigh eleven ounces. The standard K-20 has a single tension-spring head band and plastic ear cushions. Frequency range is 20 to 20,000 Hz; impedance is 600 ohms per

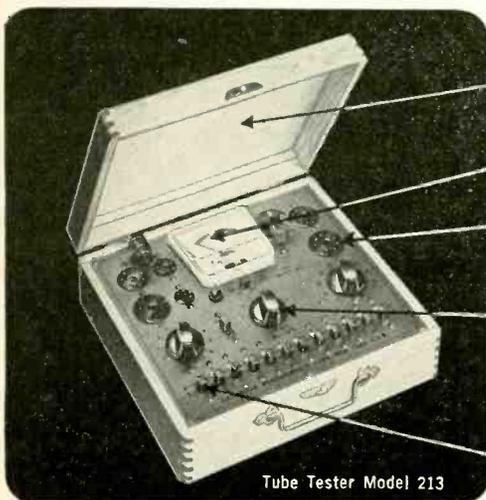


channel. The K-60 deluxe professional headset has a multi-adjustable dual head band and cushioned ear-fitting cups. Its frequency range and impedance level are the same as in model K-20. K-20 is \$19.50 and K-60 is \$39.50.—North American Philips Co., Inc.

Circle 51 on reader's service card

NO COMPETITORS

Nobody else but **EMC** designs in so much value



Tube Tester Model 213

Compact, light-weight portability. Use it on the bench or in the field.

Full-view meter gives direct, clear-cut quality indications.

Full complement of sturdy sockets accepts compactron (12-pin), nuvistor, novar, 10-pin, 9-pin, octal, loctal, and miniature tubes.

Three heavy-duty controls for quick set-up of all tests. Check a fistful of tubes in the time it often takes to test one.

Precise programming. Only one socket per tube-base configuration prevents accidental plug-in.

12 slide switches for individual selection of tube pins provides versatility in testing, prevents obsolescence.

THE MODEL 213 saves you time, energy, money ■ Checks for shorts, leakage, intermittents, and quality ■ Tests all tube types including magic eye, regulator, and hi-fi tubes ■ Checks each section of multi-purpose tubes separately ■ Gives long, trouble-free life through heavy-duty components, including permanently etched panel ■ Keeps you up to date with FREE, periodic listings on new tubes as they come out ■ Your best dollar value in a tube tester. Available in high-impact bakelite case with strap: \$31.40 wired; \$20.40 in kit form. Wood carrying case (illustrated) slightly higher.



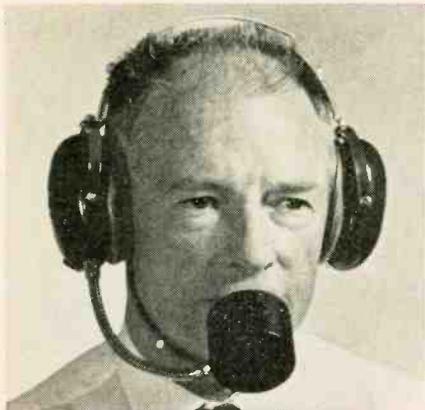
ELECTRONIC MEASUREMENTS CORPORATION
625 Broadway, New York 12, New York
Export: Pan-Mar Corp., 1270 B'way, N. Y. 1, N. Y.

EMC, 625 Broadway, New York 12, N.Y.
Rush me FREE catalog describing all EMC value-loaded test instruments and name of local distributor.

NAME _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

RE-2

MICROPHONE HEADSETS, These new headsets permit two-way radio or wired communications in high ambient noise



areas, and are easily adapted to radio transceivers. The transistorized model works directly into common audio line.—Industrial Communications Co.

Circle 52 on reader's service card

3 NEW MICROPHONES, Unispheres. Model 585SAV has a volume control mounted on the microphone case, enabling the speaker to change the loudness of the PA system to which the mike is connected. Model 565S has an on-off switch as part of the swivel connector assembly. Model 566 (shown in photo)



offers shock mounting to prevent pickup of mechanical vibrations and handling noise. It also features a Cannon-type connector and a combination impedance change (50 or 150 ohms), on-off switch. All of these models are designed to minimize feedback, breath sounds and wind noise. Models 585SAV, 565S, and 566 are \$72.50, \$100.00, and \$140.00 respectively.—Shure Brothers, Inc.

Circle 53 on reader's service card

AM/FM STEREO COMPACT SYSTEMS, models 1050 and 1030. Model 1050 is a powerful unit which features the Elac/Miracord 50 automatic turntable, EMI model 92 speakers and a Benjamin solid-state receiver with 85-watt (IHF) output. A microphone and instrument input with gain controls permit playing guitar or other instruments through the system and doing "voice over" records. Model 1030 features the Miracord 620 player and EMI 62 speakers and delivers 50 watts (IHF) output. Both units use the Elac 244 compatible mono-stereo magnetic cartridge with dia-

mond stylus and they come with two EMI speakers. Model 1050 is \$499.50 and Model 1030 is \$399.50. Tape re-



order accessory that fits under the cabinet of either model is \$139.50.—Benjamin Electronic Sound Corp.

Circle 54 on reader's service card

AM/FM STEREO MUSIC CENTER, The LRC-60 solid-state 60-watt receiver features four IC's, FET front end, and a BSR McDonald 500 4-speed automatic stereo turntable with a Pickering V15/AC-3 Dustamatic stereo cartridge. It plays 7, 10, or 12" records at 16 $\frac{1}{2}$, 33 $\frac{1}{2}$, 45, and 78 rpm. Impedance: 8-16



ohms; frequency response: 20-20,000 Hz \pm 1dB; tuner FM sensitivity: 1.8 μ V IHF; capture ratio: 1.25 dB. Provides a full set of audio controls: D'Arsonval tuning meter; automatic FM stereo/mono switching; stereo indicator light; stereo headphone jack; tape recorder jacks; and vernier dial drive. For 117V, 50/60 cycle ac.—Lafayette Radio Electronics Corp.

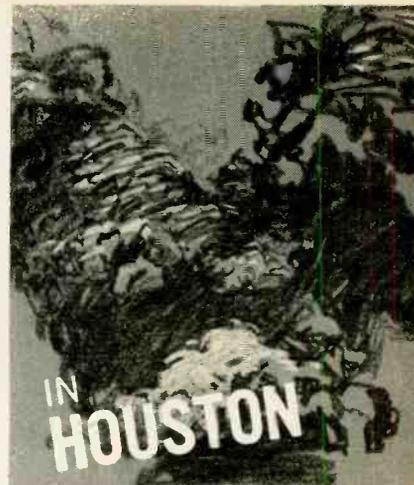
Circle 55 on reader's service card

AM/FM STEREO RECEIVER with IC's. Model S-7800. Each IC has 5 silicon transistors in a monolithic semiconductor package. Specs include 2-dB capture ra-



tio, 0.15% distortion at 100% modulation, and 55 dB of AM rejection. Features Field-Effect Transistors in rf and mixer stages for elimination of multiple responses. Receiver delivers 140 watts of music power into 4-ohm loads at 0.6% harmonic distortion. IM distortion is 0.1% at normal listening levels; FM sensitivity, 1.8 μ V. The unit carries a 3-year warranty for defective parts, including transistors. \$419.50. In walnut-grained leatherette case \$428.50.—Sherwood Electronic Laboratories, Inc. R-E

Circle 56 on reader's service card



**SHURE
MICROPHONE
BURNED
IN
CLUB
BLAZE**

This Shure 55SW Unidyne survived a very hot time the night Rosalie's Club burned in Houston. Even though the heat melted the hard plastic section of the switch plate, the microphone was in almost perfect working order. But, since Shure routinely tests microphones at a searing 185° F. for day-long periods, it wasn't particularly surprising that after the fire

**... IT STILL
WORKED**

© 1967 Shure Brothers, Inc.

Circle 106 on reader's service card

SOME SHOP OWNERS DO MORE BUSINESS THAN OTHERS BY DOING BASIC THINGS LIKE THESE:

 <p>1 Reading what's new in leading technical magazines.</p>	 <p>2 Keeping their trucks ready to roll at a moment's notice.</p>	 <p>3 Arranging to have their phones answered promptly.</p>
 <p>4 Making sure their caddies are organized and properly stocked.</p>	 <p>5 Keeping accurate track of their time on each job.</p>	 <p>6 Smiling . . . often . . . both on and off the job.</p>



7 INSTALLING SPRAGUE DIFILM® CAPACITORS

DIFILM® ORANGE DROP® . . .
The world's finest radial-lead capacitor

DIFILM® BLACK BEAUTY® . . .
Ultimate in molded tubulars

These two great Sprague capacitors are expressly made for men who are in the TV service business to do business . . . as it should be done. Both feature the ultimate in tubular capacitor construction to keep you out of call-back trouble:

- Dual dielectric . . . combine best properties of both polyester film and special capacitor tissue.
- Impregnated with HCX® to provide rock-hard capacitor section.
- Because impregnant is solid, there's no oil to leak, no wax to drip.
- Designed for 105°C (220°F) operation without voltage derating.

DIFILM® ORANGE DROP® Dipped Tubular Capacitors

A "must" for applications where only radial-lead capacitors will fit. Perfect replacements for dipped capacitors used in most leading TV sets. No other dipped tubular capacitors can match them. Double-dipped in rugged epoxy resin for positive protection against extreme heat and humidity.

DIFILM® BLACK BEAUTY® Molded Tubular Capacitors

World's most humidity-resistant molded capacitors. Feature tough, protective outer case of non-flammable molded phenolic . . . which cannot be damaged in handling or installation. Will withstand the hottest temperatures of any radio or TV set . . . even in the hottest, most humid climates.

For complete listings, ask your Sprague distributor for Catalog C-617, or write to Sprague Products Company, 81 Marshall Street, North Adams, Massachusetts 01247.

**DON'T FORGET TO ASK YOUR CUSTOMERS
"WHAT ELSE NEEDS FIXING?"**

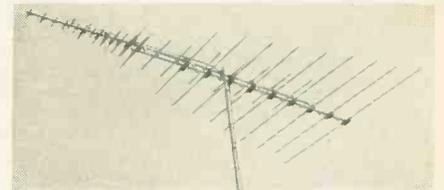


Circle 109 on reader's service card

www.americanradiohistory.com

New Antenna Equipment

UHF-VHF LONG-RANGE ANTENNA, Model CPC-33G, with a single down-lead receives all 82 channels plus FM. The "Piggy-Back" power pack insures extra reception quality for both



color and black and white, even in fringe areas. A band-splitter is provided for use at the TV set. Finished in K-T Gold Coat, the unit has a built-in-lead-in support and strain relief for durable installation.—Kay-Townes Antenna Co.

Circle 57 on reader's service card

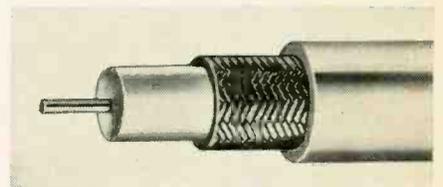
PERFORATED TV ANTENNA WIRE. Improves color, uhf and vhf black and white reception. **PERFO 8-0** is constructed with 20-gauge copper conductors. Air spaces between the conduc-



tors allow little signal loss. Impedance is 300 ohms. Available in 500-ft. spools and 50, 75 and 100 ft. pre-cut lengths, the wire is light weight, flexible and less resistant to wind.—Jersey Specialty Co., Inc.

Circle 58 on reader's service card

75-OHM SOLID COAX, model No. 8221. Available in standard colors of black, white and gray, this 22-AWG coax has a foam polyethylene vinyl jacket. It is installed easily with RG-59/U connec-

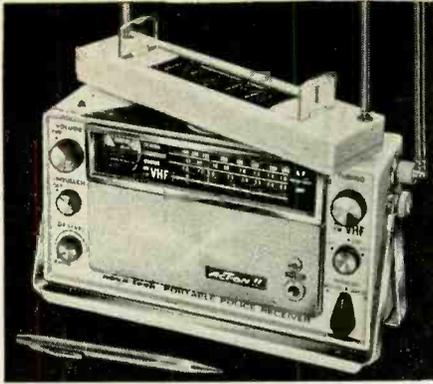


tors and meets MATV, CATV and CCTV requirements for indoor or outdoor use. Features a flexible all-weather jacket and comes in 100-, 500- and 1000-ft lengths as a standard catalog item.—Belden Corp. **R-E**

Circle 59 on reader's service card

Miss-Q

Price of book, "Principles of Aerial Design," published by D. Van Nostrand Co. Inc., as reviewed (August 1967), should read \$8.95 and not \$1.75.



New 5 Band POLICE PORTABLE

"A SPECTACULAR CHRISTMAS GIFT"

Hear all police communications: patrol cars, base stations, motorcycles, helicopters. Also tunes Fire Departments, State Highway Patrols, Sheriff's Departments, auto telephones, taxis, all radio equipped vehicles. *Fascinating and exciting listening 24 hours a day!* Marine/Shortwave Band brings in all marine communications. Special Weather Band gives accurate forecasts and reports around the clock. Regular AM Broadcast Band brings in stations ordinary radios never get. *Also plugs into regular house current.*

5 BANDS: 150-175 MC, 30-50 MC, 1.5-4.5 MC
200-400 KC, 550-1600 KC

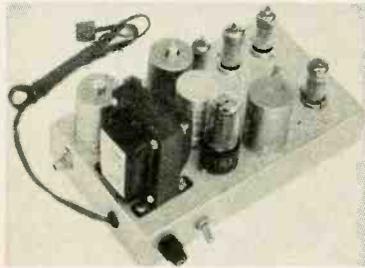
Complete with leather case, batteries, antennas, house current adapter. \$129.95. Unconditional 10 day money back return privilege. *Write for Free Booklet.*

Nova-Tech, Inc., 630 Meyer Lane, Dept. RE, Redondo Beach, Calif. 90278

Circle 110 on reader's service card

Enjoy the "music-only" programs now available on the FM broadcast band from coast to coast.

- NO COMMERCIALS •
- NO INTERRUPTIONS •



It's easy! Just plug Music Associated's Sub Carrier Detector into multiplex jack of your FM tuner or easily wire into discriminator. Tune through your FM dial and hear programs of continuous commercial-free music you are now missing. The Detector, self-powered and with electronic mute for quieting between selections, permits reception of popular background music programs no longer sent by wire but transmitted as hidden programs on the FM broadcast band from coast to coast. Use with any FM tuner. Size: 5 1/2" x 9". Shipping weight approx. 7 lbs.

KIT \$49.50

(with pre-tuned coils, no alignment necessary)

WIRED \$75.00 (Covers extra \$4.95 ea.)

Current list of FM Broadcast stations with SCA authorization \$1.00

MUSIC ASSOCIATED

65 Glenwood Road, Upper Montclair, N. J.
Phone: (201)-744-3387 07043

Circle 111 on reader's service card

NEW PRODUCTS

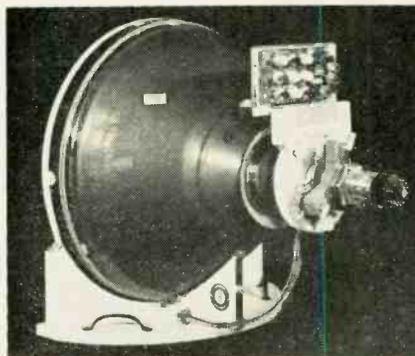
IN-CONVERTER AND VOLTAGE REGULATOR, accessories for converting polarity and/or voltage in automotive electrical systems. *In-Converter* has dc input of 6 or 12 V and output of 6 or 12 V of polarity desired, or output of 18 or 24 V



of same polarity as input. *Voltage Regulator* accepts 24-32 vdc and furnishes output of 13 vdc at 14 watts. *Voltage Regulator* (positive ground), \$14.95; (negative ground), \$17.95. *In-Converter*, \$22.95.—E. F. Johnson Co.

Circle 60 on reader's service card

COLOR TEST TUBE PEDESTALS, models C21, R19. For 19- and 21-in. TV's. Designed to secure test tube and convergence panel in position for



direct hookup. Provide a full picture view in service mirror. C21, for all 70° color tubes, 45 lb; R19, for 21-, 23-, 25-in., 90-92° color tubes. \$14.50—Eight Ball Co. R-E

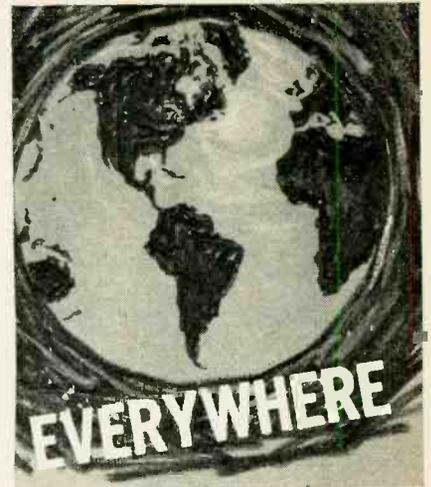
Circle 61 on reader's service card

How to Kill Color Ghosts

Improve your color-TV picture by getting rid of annoying ghosts and spurious signals. Learn how the professionals get clean color signals. Find out all about the color ghost situation in our January issue.

DECEMBER 1967

79



SHURE
MICROPHONES
KEEP
ON
WORKING

...ABOVE AND BEYOND THE CALL OF DUTY

Shure microphones undergo exceedingly rigid and demanding laboratory and field tests—are designed to perform faithfully for years even if subjected to severe use and abuse. They are backed by special know-how and critical quality-control that assure you the utmost in reliability. When the pressure is on they work!

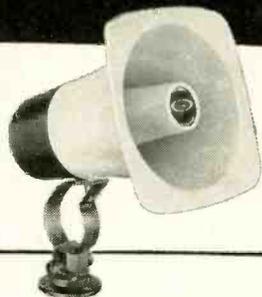
send for complete catalogs:

Shure Brothers, Inc.
222 Hartrey Ave., Evanston, Ill. 60204

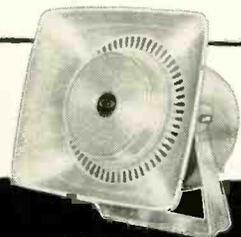
© 1967 Shure Brothers, Inc.
Circle 106 on reader's service card



Commercial Sound Speaker Source...



You never compromise with fidelity or quality when you specify Oxford on all your speaker needs.



That's because Oxford electronic and sound engineers know that specialized applications require specialized developments. Oxford doesn't produce just horn or cone types. Oxford studies the application and the problem and develops specific units for specific needs. You're never stuck with trying to pour a bushel basket into a pint measure. Paging and talk-back horns, outdoor hi-fi systems, P.A. systems and other commercial sound installations all find the perfect speaker for the system at Oxford.



Match your skills with the Oxford line of speakers that bring out the best in every sound installation. Write for the Oxford catalog of "speakers for every purpose" today!

OXFORD TRANSDUCER COMPANY
A Division of
Oxford Electric Corporation

3911 S. Michigan Ave.
Chicago, Ill. 60653

Circle 112 on reader's service card

NEW LITERATURE

All booklets, catalogs, charts, data sheets and other literature listed here with a Reader's Service number are free for the asking. Turn to the Reader's Service Card facing page 72 and circle the numbers of the items you want. Then detach and mail the card. No postage required!

TWO-WAY RADIO COMMUNICATIONS SYSTEMS. This 16-page booklet enables a business/industrial user to select the right system for his requirements. It explains licensing requirements, range expandability and frequency selection, and how to create typical systems from Johnson units. With this booklet potential users of business/industrial radio can design their own two-way radio systems.—**E. F. Johnson Co.**

Circle 62 on reader's service card

POTENTIOMETERS, TRIMMERS, DIALS, INSTRUMENT MOTORS, Catalog No. C-67. This new 120-page catalog covers Amphenol products in depth. Each is shown in a cutaway view with a listing of mechanical, electrical and environmental specs.—**Amphenol Corp.**

Circle 63 on reader's service card

THE TAPE CARTRIDGE: How it Began and What It's All About is a 12-page booklet describing the tape cartridge as a medium of quality sound reproduction and recording for music lovers. It discusses the two types of cartridges—continuous loop and the cassette system. Diagrams make for easy understanding. Tips on proper cartridge handling are given.—**Audio Devices, Inc.**

Circle 64 on reader's service card

FREE SAMPLE KIT OF WIRE/CABLE HARNESSES & MARKERS. Engineers, draftsmen and contractors will be interested in this kit which includes Spirobond, strapping, cable tie and adjustable P-Clip harnessing systems; three types of markers, and a grommet-strip which is cut to size. A business reply card asking for additional information and samples is attached.—**Electrovert, Inc.**

Circle 65 on reader's service card

MAGNETIC TAPE RECORDING HANDBOOK, Application Note No. 89. 44-page handbook covers fundamentals of magnetic tape recording, including FM recording, predetection recording, pulse recording, how electrical signals are stored and recovered from magnetic tape and the function of the bias signal. Characteristics of recording head, tape transport mechanisms, record/reproduce electronics, and the tape itself are also covered.—**Hewlett-Packard**

Circle 66 on reader's service card

Write direct to the manufacturers for information on the item listed below:

INTRODUCTION TO TAPE RECORDING. No. a67-21 "Let the Music Get Through to You." a 4-color 24-page booklet, tells how magnetic tape and the tape-recording process work, what to look for when selecting a stereo tape player/recorder, and the advantages of stereo tape libraries over disc collections. 25¢—**Ampex Corp.** P.O. Box 3728, Chicago, Ill. 60654

RE

80

RADIO-ELECTRONICS

Yes, you can



YOU CAN BUILD

AN ARTISAN TRANSISTORIZED ORGAN WITH KITS AND SUB-ASSEMBLIES

save \$2000 or more

Easy enough to be fun. Difficult enough to be challenging.

Relax with one of the world's most rewarding hobbies... build a full-size, concert quality transistorized organ. The Artisan Kit Organ has the same rich pipe-like tones, the same features, as the famous Artisan Custom Organ. There's not one bit of difference in tonal beauty, console style, high quality.

10 styles for home, church, school



Write for brochure

Dept. RE
1372 East Walnut Street
Pasadena, Calif. 91106

Circle 113 on reader's service card

TUNAVERTER

POLICE-FIRE-AIRCRAFT CALLS
—TUNABILITY — USABILITY — QUALITY —



TUNABLE, CALIBRATED solid state converters to change your auto and home radios into excellent, sensitive, selective, and calibrated VHF receivers!

"Of all of the converters tested by POPULAR ELECTRONICS there is little doubt that the "TRP TUNAVERTER" is the most versatile." —POPULAR ELECTRONICS MAGAZINE, August 1967.

- 6-1 reduction tuning!
- HF—2 gang tuning!
- VHF—3 gang tuning!
- FREE 24" conn. coax!
- Plug into auto radio!
- American Made!
- 9 volt btry powered!
- Size 2 1/4 x 3 1/2 x 4 1/2"
- 2 WEEK MONEY BACK GUARANTEE!

Models for AM & FM

BAND	MODEL	COVERS	OUTPUT	PRICE
Marine	Marine	2.0-2.85 mc	550 kc	\$19.95 ppd
SW & WWV	SWL	9.3-10 mc	550 kc	\$19.95 ppd
CB & 10 M	273	26.9-30 mc	1500 kc	\$29.95 ppd
6 meters	504	50-54 mc	1500 kc	\$29.95 ppd
2 meters	1450	144-150 mc	1500 kc	\$29.95 ppd
Police, fire, & Marine	1564	308 30-38 mc	1500 kc	\$29.95 ppd
		375 37-50 mc	1500 kc	\$29.95 ppd
		1564 150-164 mc	1500 kc	\$29.95 ppd
Aircraft	1828	118-128 mc	1500 kc	\$29.95 ppd

Radiation Loop & Extension Antenna for using TUNAVERTER with home and transistor radios \$3.95 ppd

Order from: Fast AIR MAIL add \$.85 ea.

HERBERT SALCH & CO. Marketing Division of
Woodsboro RE12, Texas 78393 Tompkins Radio Products

Circle 114 on reader's service card

RCA Announces two important new test instruments for service, industrial and lab applications.

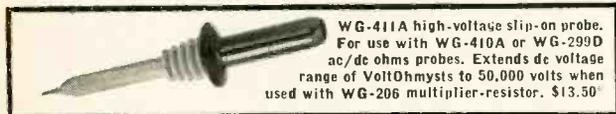


All solid-state battery operated VOLTOHMYST® WV-500A

Eliminate warm-up time! Eliminate zero-shift that can occur in tube-operated voltmeters! RCA's new WV-500A VoltOhmyst is an all solid-state, battery operated, completely portable voltmeter that is ideal for service, industrial and lab applications. Seven overlapping resistance ranges measure from 0.2 ohm to 1000 megohms. Eight overlapping dc-voltage ranges measure from 0.02 volt to 1500 volts (including special 0.5 dc volt range), ac peak-to-peak voltages of complex waveforms from 0.5 volts to 4200 volts, and ac (rms) voltages from 0.1 to 1500 volts. Input impedance of all dc ranges is 11 megohms.

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

Solid-state reliability and convenience for only \$75.00*



WG-411A high-voltage slip-on probe. For use with WG-410A or WG-299D ac/dc ohms probes. Extends dc voltage range of VoltOhmysts to 50,000 volts when used with WG-206 multiplier-resistor. \$13.50*



In-circuit / out-of-circuit TRANSISTOR TESTER WT-501A

Completely portable and requiring no external power source, RCA's new WT-501A tests transistors both in-circuit and out-of-circuit, tests both low and high power transistors, and has both NPN and PNP sockets to allow convenient transistor matching for complementary symmetry applications. The instrument tests out-of-circuit transistors for dc beta from 1 to 1000, collector-to-base leakage as low as 2 microamperes, and collector-to-emitter leakage from 20 microamperes to 1 ampere. Special low impedance circuitry assures reliable in-circuit testing.

Collector current is adjustable from 20 microamperes to 1 ampere in four ranges, permitting most transistors to be tested at rated current level. A complete DC Forward Current Transfer Ratio Curve can be plotted. The three color-coded test leads are provided for in-circuit testing, and for out-of-circuit testing of those transistors that will not fit into the panel socket.

Extra features... RCA reliability... for only \$66.75*

*Optional Distributor resale price. All prices subject to change without notice. Prices may be slightly higher in Alaska, Hawaii and the West.

Ask to see them at your Authorized RCA Test Equipment Distributor, or write RCA Commercial Engineering Department L39W, 415 South Fifth Street, Harrison, N.J.



RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

1967 ANNUAL INDEX

RADIO-ELECTRONICS January-December 1967 of Vol XXXVIII

A

Air-War Tactics, Efficiency Testing (Darr)	Apr 5
All-Silicon Regulated Power Supply (Rogers)*§ (Corres)	Aug 16
All-Transistor Mixer-Amplifier (Inman)*§	Aug 54
Amplifiers, see Audio—high fidelity—stereo	
Analog Fundamentals, Digital-to- (Math)	Feb 40
ANTENNA(S)	
Auto (JFD ATV111) (ER)	Mar 68
Breakthrough (NB)	Jul 4
Clinic (Darr)	Apr 22
Coupler, TV/FM (NC)	Jun 90
Grounding (CI)	Oct 26
Height (CI)	Apr 22
Ignition-noise pickup (CI)	Apr 22
Lead-ins, In's and Out's of (Lacy)	Aug 42
Lightning Arrester, CB	Apr 46
Masts, slowing (TTO)	Apr 89
Mounts, Two Useful Pitched-Roof (Pyle and Strand)	Apr 60
Preamp, Mast-Mounted (Schenfield)	Apr 36
Report	Sep 50
Rotator harness, quick (TTO)	Oct 95
Tower, world's first multi-antenna (WN)	Jan 45
Towers on Bonded Roofs, Erecting (Gupton)	Apr 53
Tuning stub, "second chance," (TTO)	Feb 88
Uhf TV (NB)	Sep 4
Appliances, Solid State in Electric (Haskett)	
	Jun 42; Jul 41
Attenuator, remote-controlled†	May 53
Audio Man's Audio System (Haskett)	Feb 52
AUDIO—HIGH FIDELITY—STEREO, see also Servicing,	
Audio—High Fidelity—Stereo	
Amplifier(s)	
Class-D Hi-Fi (Queen) §	Sep 72
Gain control, transistor variable (NC)	Mar 94
Mixer, All Transistor (Inman)*§	Aug 54
Transistor Power, Convert Heath WA-P2 for (Olson)	May 48
Tremolo circuit for guitar (NC)	Nov 96
Attenuator, remote-controlled†	May 53
Cannonic imitation via hi-fi (NB)	May 6
Components and systems†	Oct 36
Hi-fi	
Hi-Fi, All Around the House	Feb 47
1968	Oct 35
Wider the Band, the Higher the Fi? (Sutheim)	Oct 54
IC's in (NB)	Feb 6
L- and T-Pads, Know Your (Fred)	Sep 36
Mike mixer, 3-channel§ (NC)	Jul 90
Mixer	
Amplifier, All-Transistor (Inman)*§	Aug 54
High-Impedance Transistor (Lehman)*§	Mar 40
Mike, 3-channel (NC)	Jul 90
Organ Music, Special Sounds of (Dorf)	Jun 52
PA	
Remote Control for Systems (Darr)	May 47
Switching circuit, audio (NC)	Sep 98
Tape recording from output (CI)	Nov 26
Preamp—Solid-State and High-Z Too (Wherry)*§, Corr	Jan 12
Record players	
Cartridge(s)	
and record to test it (Shure V-15 Type II) (ER)	Aug 71
1968	Oct 38
Systems and Quality (Silke)	Feb 35
Tracking Tests (Ward)	Oct 32
Mono disc to fade (NB)	Aug 4

KEY TO SYMBOLS AND ABBREVIATIONS

* Construction Articles	
† Section of full-length article	
§ Transistorized	
CI	Service Clinic
Corr	Correction
Corres	Correspondence
ER	Equipment Report
NB	News Briefs
NC	Noteworthy Circuits
Tech	Technotes
TTO	Try This One
WN	What's New
Regular departments not itemized are New Books, New Literature, New Products, What's Your EQ?	

Auto (continued)

Ignition, C-D Solid-State under \$25 (Ward)*§ Feb 32; (Corres)	Apr 6
Inverter, Transistorized (Electro Products TI-100A) (ER)	Apr 64
Lights On?	
Are You? (NB)	Apr 4
Reminder for Your Car (Montan'e*), (Corres) Mar 16; (Corres)	Jun 14
Reminder, simpler (NC)	Mar 94
Parking, and brake, reminder (NC)	Dec 12
Apr 90; Corres	
Radio	
Servicing, see Servicing, radio, auto	
Solid-State (Motorola FM106M AM-FM) (ER)	Apr 66
Tachometer/Dwellmaster, Simplest (Sweet*), (Corr) (Corres)	Jul 14
Tape, fast-forward (NB)	Feb 4
Thieves, Crusade Against (Fasal)*	Mar 47
Voltage regulator, IC (NB)	Nov 22

Audio—high fidelity—stereo (continued)

Speakers	
Baffle, Speaker-Air Interface (Novak) Jun 49; (Corres)	Sep 12
1968†	Oct 39
Woofing the Tweeter (McCormick)	Nov 42
Stereo	
Adapter, Modern FM (Buegel)*§ Aug 32; (Corres)	Nov 14
Amplifier	
All-Transistor (Knight-Kit KG-895) (ER)	Feb 68
T-40/40 (Meyer)*§, output problem in (CI)	Jun 22
FM Stations Aug 34; (Corres)	Nov 12
Headphone Control Center (Sutheim)*	Nov 35
Hi-fi, Hi-fi, All Around the House	Feb 47
System, Audio Man's (Haskett)	Feb 52
Tape recorder(s)	
Car, fast-forward (NB)	Feb 4
Disc fights (NB)	Apr 6
Flutter Meter, Compact, High-Performance (Hansen)*§	Dec 52
Music Center (Ampex 985) (ER)	Dec 62
1968†	Oct 40
Professional (Heathkit-Magnecord AD-16) (ER)	Jun 66
Recording from PA output (CI)	Nov 26
Tape/Slide Synchronizer, Solid-State (Havenhill)*§	Dec 32
Tone control, five-channel (NC)	Oct 94
Transistors in, Engineer Talks About (Sutheim)	Apr 57; May 55
Tremolo circuit for guitar amplifier (NC)	Nov 96
Audio Tone-Burst Generator (DeSa)*§	
Jul 44; Corres	Dec 12
AUTO	
Antenna (JFD ATV111) (ER)	Mar 68
Brake	
Laser (NB)	Mar 6
Reminder, parking light and (NC)	Apr 90
Electric	
Bike (NB)	Feb 4
Vehicles being tested (NB)	Jan 4
Electronics in the Modern (Holder)	Nov 43
Highway control system, micromodule (NB)	Oct 16

B

Baffle: Speaker-Air Interface (Novak) Jun 49; (Corres)	Sep 12
Balls of Fire, Lightning, Plasma and (Smith)	Apr 40
Batteries	
Eliminator from tube tester (TTO)	Aug 95
Fuel Cells—Power for Tomorrow (Smith)	Feb 44
Selection Guide Feb 60; (Corres)	Apr 16
20-year (NB)	Aug 12
Be Brave! Take On Transistor Radios! (Davidson)	Sep 51
Burglars Got it Bad—and That's Good (Darr)	Jun 46

C

Camera, Solid-State, Is Here (Clifton)	Jun 58
Canada's First Satellite Station (Essex)	Aug 45
Capacitance relay, unusual (NC)	Jan 102
Capacitors, electrolytic ac (NC)	Dec 92
Careers	
Electronic Schools Directory	Dec 40
FCC License . . . and How to Get It (Haskett)	Dec 41
Man's World? Not to These Women (Smyth)	Jul 62
Q and A on an Electronics Career	Dec 40
Technician to Technical Writer (Holder)	Feb 49
Why Servicers Like Servicing (Glass and Tracy)	May 45
Your Future in Electronics (Clifton)	Dec 38
Car Thieves, Crusade Against (Fasal)*	Mar 47
Cartridge(s), see also Audio—high fidelity—stereo, record players	
Systems and Quality (Silke)	Feb 35
Tracking Tests (Ward)	Oct 32
CB, see Radio, CB	
C-D Ignition under \$25, Solid-State (Ward)*§	
Feb 32; Corr	Apr 6
Characteristic Plotter, Transistor (Fasal)*§	
Sep 44; (Corres)	Nov 6

Check and Recalibrate Test Gear (Getz)	Jul 58
CB Frequencies with BC-221 and a Converter (Gunn)*	Aug 50
Circuit-Breaker Testing (Darr) Feb 38; (Corres)	Jul 14
Circuits from an Experimenter's File, Selected (Scott)	May 53
Transistor, from Scratch (Van Houten)	Mar 41
Class-D Hi-Fi Amplifier (Queen) §	Sep 72
Coils Forms, quick, from tape (TTO)	Apr 89
Toroids, Simple Winding Aid for (Null) Mar 81; (Corres)	Aug 16
Color, see also Servicing, television, color; Television, color	
TV Tube Popularity Guide	Jan 100
Voltages Ain't Circular to Me! (Kirk)	Jan 53
Compact, High-Performance Flutter Meter (Hansen)*§	Dec 52
Computer(s) Airliner lands automatically (NB)	May 6
D • U • D, Servicing with (Goodman) (fiction)	Apr 39
Read handwritten numbers (NB)	Jan 12
R/C (NB)	May 4
Thinking? Think Small (Whitmer)	May 34
Comsat: Communications in the Space Age (Throver)	May 49
CONSUMER ELECTRONICS, see also specific subject	
Appliances, Solid State in Electric (Haskett)	Jun 42; Jul 41
Burglars Got It Bad—and That's Good (Darr)	Jun 46
Consumers Union, Radio-Electronics Interviews (Belt)	Jun 60
House of Tomorrow (Ward)	Jun 34
Light system, emergency (NC)	Nov 96
Show, First.	Nov 57
Sound Relay, IC (Greenlee)*§	Jun 77
Consumers Union, Radio-Electronics Interviews (Belt)	Jun 60
Controlled Rectifiers, Quick-Checker for (Anglin)*	Mar 70
Convergence Without a Color Generator (James)	Apr 43
Convert Heath WA-P2 for Transistor Power Amp (Olson)	May 48
Creative Electronic Servicing (Allen)	Sep 39
Crusade Against Car Thieves (Fasal)*	Mar 47
Crystal switching with diodes (NC)	May 98

D

Designing with Integrated Circuits	Mar 32
Development of a Color-TV Signal (Sizer)	Jan 59
Digital -to-Analog Fundamentals (Math)	Feb 40
Voltmeter, Poor Man's (Todd)*§, (Corres)	Jan 22; Apr 16
Direct-View 3-D Images! (Smith)	Jan 46
Don't Neglect Color-TV Linearity (Mandl)	Jan 76
Doorbell extension, unusual (NC)	Feb 92
DOTnBAR—Professional Quality Pattern Generator (Lancaster)*§	Jul 36
Double Feature, Starring Timers (Chesson and Ives)*	Feb 56
Down with Knob Twisting (Hadrick and Michelotti)	Jul 79
D • U • D, Servicing with (Goodman) (fiction)	Apr 39
Dummy Load and Rf Meter (Rice and Mueller)*	Nov 50

E

EDITORIALS	
Brainwaves and Electronics (Belt)	Sep 2
Can Electronics Get Much Smaller (Belt)	Mar 2
Careers in, see Careers	
Electronics and the Worlds Beyond (Belt)	May 2
FCC, CB and the Public (Haskett)	Aug 2
Hands that Feed ETV (Belt) Apr 2; (Corres)	Aug 14
Microelectronics and Test Instruments (Scott)	Jul 2
Our Electronic Future (Belt)	Jun 2
Psychology of Pay TV (Belt)	Feb 2
What Price Color? (Belt)	Jan 2
Efficiency-Testing Air-War Tactics (Darr)	Apr 51
Electric Bike (NB)	Feb 4
Vehicles being tested (NB)	Jan 4
Electrolytic ac capacitors (NC)	Dec 92
Electronic, see also Electronics	
Antenna Rotation (Throver)*	Aug 47
Calculations, Nomorule in (Fasal)	Apr 48
Flash Power of, Measure (Norman)	Mar 83
Slave, for \$5 (Keith)*	Jun 45
Schools Directory	Dec 40

ELECTRONICS, see also Electronic	
Airliner lands automatically (NB)	May 6
Air-War Tactics, Efficiency Testing (Darr)	Apr 51
Aluminum or copper? (NB)	Apr 4
Business outlook (NB)	Jun 12
Capacitance relay, unusual (NC)	Jun 102
Capacitors, electrolytic ac (NC)	Dec 92
Circuits from an Experimenter's File, Selected (Scott)	May 53
Computers, see Computers	
Consumer, see Consumer Electronics	
Consumers Union, Radio-Electronics Interviews (Belt)	Jun 60
Digital-to-Analog Fundamentals (Math)	Feb 40
Fiber optics at IEEE (NB)	Jun 4
Fuel Cells—Power for Tomorrow (Smith)	Feb 44
Gamma Goat, Solar-Powered (Hoke)*	Dec 34
House of Tomorrow (Ward)	Jun 34
Hydronic-Radiation Transmitter (Althouse)*§	May 37
Hydronics, More About	Aug 82
Imaginary Numbers Are a Cinch (Crowhurst)	May 57
In the Modern Auto (Holder)	Nov 43
Infrared Data transmission (NB)	Jul 4
Detector, world's smallest (NB)	Sep 4
Laser beam converted to green (WN)	Jan 45
Insulation, Shrink on the (Jablin)	Nov 61
Lamp, Two-Way, Two-Way (Wels)*	Dec 59
Law and (NB)	Jun 6
Light System, emergency (NC)	Nov 96
Generator and detector, new (NB)	Dec 4
Lightning, Plasma and Balls of Fire (Smith)	Apr 40
Microscope, biggest (NB)	Nov 22
Midyear Report (Allen)	Jun 37
Polarity-reversal hint	May 54
Printed-Circuit Boards, How to Make (Montan'e)	Nov 62
Reaction-Time Testing of Race Drivers (Davis)	May 32
Resistor breakthrough (NB)	Oct 16
Rotary Stepping Switches—They're Everywhere (Jaski)	Nov 39; Dec 46
Show, First Consumer Switch, noncontact (NB)	Jan 12
Time-delay relay, SCR†	May 53
Treasure Finder (Rakes)*§	Nov 32
Tuning, noninductive (NB)	Aug 4
Zero-crossing detector, simple (NC)	Jun 90
Electronics Culture Corner (Barlow)	Mar 43
Engineer Talks About Transistors in Audio (Sutheim)	Apr 57; May 55
Erecting Towers on Bonded Roofs (Gupton)	Apr 53
Experimenter's Transistor Test Set (Hicke)*§	Mar 57
Socket markings (Corr)	May 12
Exploring the Jungle of Color Troubles* (Davidson)	Jan 56

F

FCC License . . . and How to Get It (Haskett)	Dec 41
Field Meter, Remote-Reading (White)*§	Aug 60
First Consumer Electronics Show	Jun 57
Five-In-One TV Shop (Smith)	Jun 55
Flutter Meter, Compact High-Performance (Hansen)*§	Dec 52
FM Antenna coupler, TV/FM (NC)	Jun 90
at Your Fingertips (Buegel)*§	Jul 47
Receiver boom (NB)	Nov 22
Servicing, see Servicing, radio	
Stereo Adapter, Modern (Buegel)*§ Aug 32; (Corres)	Nov 14
Housewife Builds (Tracy and Spencer)	Jun 32
Stations Aug 34; (Corres)	Nov 12
Fuel Cells—Power for Tomorrow (Smith)	Feb 44

G

Gamma Goat, Solar-Powered (Hoke)*	Dec 34
Generators, see Test instruments	
Gernsback, Hugo, 1884-1967 Oct 6; (Shunaman)	Nov 4
Getting to Know Low-Cost IC's (Scott)	Mar 44
H Headphone Control Center, Stereo (Sutheim)*	Nov 35
Hertz not new (Corres)	Jan 16
Hi-Fi Hi-Fi, All Around the House	Feb 47
1968	Oct 35
Wider the Band, the Higher the F? (Sutheim)	Oct 54

H

High fidelity, see Audio—high fidelity—stereo	
High-Impedance Transistor Mixer (Lehman)*§	Mar 40
Holography Direct-View 3-D Images! (Smith)	Jan 46
Lasers for (NB)	Feb 13
3-D, with ordinary light (NB)	Apr 12
Home Movies Time-Compression Machine (Johnson)*§	Oct 41
House of Tomorrow (Ward)	Jun 34
Housewife Builds FM Stereo (Tracy and Spencer)	Jun 32
Hydronic-Radiation Transmitter (Althouse)*§	May 37
Hydronics, More About	Aug 82
I IC (s) Designing with Integrated Circuits	Mar 32
Getting to Know Low-Cost IC's (Scott)	Mar 44
Glossary (Scott)	Mar 85
in receivers (NB)	Feb 6
Noninductive tuning (NB)	Aug 4
Projects, 30 Basic (Marston)	Dec 43
Sine-Square-Saw Generator (Hansen)*§	Jul 54
Sound Relay (Greenlee)*§	Jun 77
Voltage regulator (NB)	Nov 22
Imaginary Numbers Are a Cinch (Crowhurst)	May 57
Incentive Licensing and Distinctive Call Signs	Nov 16
Industrial Electronics Computers, see Computers	
Light system, emergency (NC)	Nov 96
Servicing, see Servicing, industrial electronics	
Telephone, no-talk (WN)	Jan 45
Zip-code monitor (NB)	Nov 22
Infrared Data transmission (NB)	Jul 4
Detector, world's smallest (NB)	Sep 4
Laser beam converted to red (WN)	Jan 45
Integrated Circuits, see IC	
In's and Out's of Lead-ins (Lacy)	Aug 42
Insulation, Shrink on the (Jablin)	Nov 61
Intercom remote will signal master (NC)	Feb 92
Interference Nullers, Two (Althouse and Van Houten)*§	Aug 38
Inverter, Transistorized (Electro Products TI-100A) (ER)	Apr 64
It Can't Be All Bad (Prindle)	Sep 58

K

Know Your L- and T-Pads (Fred)	Sep 36
--------------------------------	--------

L

L- and T-Pads, Know Your (Fred)	Sep 36
Lamp, Two-Way, Two-Way (Wels)*	Dec 59
Laser(s) Brake for cars (NB)	Mar 6
Broadband light modulators (NB)	Mar 4
Infrared beam converted to green (WN)	Jan 45
Latest on (NB)	May 12
Medicine and (NB)	Aug 4
More on (NB)	Feb 12
Sun bottle (NB)	Oct 16
Learn Color the Programed Way (Rawlings)	Sep 32
Licensing, Incentive, and Distinctive Call Signs	Nov 16
Light System, emergency (NC)	Nov 96
Generator and detector, new (NB)	Dec 4
Lightning Arrester, CB	Apr 46
Plasma and Balls of Fire (Smith)	Apr 40
Lights-on Reminder for Your Car (Montan'e)*, (Corres) Mar 16; (Corres)	Jun 14
Line-voltage indicator†	May 53
Luck Is a Lady (Salerno)	Aug 67
Lucky Hunts Horizontal Hold (Lemons)	Feb 42

M

Man's World? Not to These Women (Smyth)	Jul 62
Mast-Mounted Preamp (Schenfeld)	Apr 36
MAT • MOST • MOSFET • UFET • FET: Understanding Solid-State Talk (Turner)	Sep 48

Measure Power of Electronic Flash (Norman)	Mar 83
Mechanical Look at Tape Recorder Servicing (Mohan)	May 71
Medicine	
Color blindness, electronic cure for (NB)	Nov 22
Hearing aids (NB)	Mar 4
Lasers and (NB)	Aug 4
Meter temperature compensation (NC)	Jul 90
Microscope, biggest (NB)	Nov 22
Midyear Report on Electronics (Allen)	Jun 37
Mini-Tester, Transistor and Diode (Randall)*	Oct 46
Mixer	
Amplifier, All-Transistor (Inman)*§	Aug 54
High-Impedance Transistor (Lehman)*§	Mar 40
Modern FM Stereo Adapter (Buegel)*§ Aug 32; (Corres)	Nov 14
More About Hydronics	Aug 82
MOS FET, What'sa (Jackson)	Oct. 50
Movies, airborne, without video (NB)	May 4
Mr. IC—Tracer of Lost Signals (Greenlee)*§	Jul 66

N

Need a Power Resistor? Try a Transistor (Pepper)	Feb 51
1967 Color-TV Roundup (Lemons)	Jan 36
Nomurule	
in Electronic Calculations (Fasal)	Apr 48
Complete Calculator on Sheet of Paper (Fasal)	Mar 52
Nonpolarized Zener Clipper (Ives)	Feb 55
Nullers, Two Interference (Althouse and Van Houten)*§	Aug 38

O

Ohm Splitter (McCormick)*§	Sept 67
Organ Music, Special Sounds of (Dorf)	Jan 52
Oslo, What Happened at (Haskett)	Jan 41

P

Pattern Generator, DOTnBAR—Professional Quality (Lancaster)*§	Jul 36
PHOTOGRAPHY	
Camera, Solid-State, Is Here (Clifton)	Jun 58
Flash	
Power of Electronic, Measure (Norman)	Mar 83
Slave, for \$5, Electronic (Keith)*	Jun 45
Strobe Slaves, Twin 200-Watt-Second (Rice)*§ Mar 49; (Corres)	Sep 6
Holography	
Direct-View 3-d Images! (Smith)	Jan 46
Lasers for (NB)	Feb 13
3-D, with ordinary light (NB)	Apr 12
Home Movies Time-Compression Machine (Johnson)*§	Oct 41
Slide changer, transistor (NC)	Aug 94
Timers, Double Feature, Starring (Chesson and Ives)*	Feb 56
Weather photos, low-cost, by satellite (NB)	Jun 12
Plasma and Balls of Fire, Lightning (Smith)	Apr 40
Plastic Transistors—Future Billions (Bose)	Mar 55
Polarity-reversal hint†	May 54
Poor Man's Digital Voltmeter (Todd)*§, (Corres)	Jan 22; Apr 16
Portable Color Recorder (Roizen)	Mar 38
Power Resistor, Need a? Try a Transistor (Pepper)	Feb 51
Power Supply	
All-Silicon Regulated (Rogers)*§, (Corres)	Aug 16
(Pace 5803 Laboratory) (ER)	Feb 70
Preamp	
Mast-mounted (Schenfeld)	Apr 36
Solid-State and High-Z Too (Wherry)*§, Corr	Jan 12
Printed-Circuit Boards, How to Make (Montan'e)	Nov 62
Professional Quality Transmitter Monitor (Neil)*§	Dec 56
Professional Touch for CB (Darr)	Jan 44

PUBLIC ADDRESS	
Amplifiers (CI)	Oct 22
Remote Control for PA Systems (Darr)	May 47
Switching circuit, audio (NC)	Sep 98
Tape recording from PA output (CI)	Nov 26
Tone control, five-channel (NC)	Oct 94
Purity and Convergence Interaction (Murphy and Carr)	Jan 32

Q

Q & A on an Electronics Career	Dec 40
Quick-Checker for Controlled Rectifiers (Anglin)*	Mar 70

R

Race Drivers, Reaction-Time Testing of (Davis)	May 32
Radar, solid-state (NB)	Mar 12
RADIO, see also Servicing, radio	
Amateur—Incentive Licensing and Distinctive Call Signs	Nov 16
Auto, Solid-state (Motorola FM106M AM-FM) (ER)	Apr 66
CB	
Antenna Rotation, Electronic (Thrower)*	Aug 47
Field Meter, Remote-Reading (White)*§	Aug 60
Hits the road (NB)	Oct 16
Lightning Arrester	Apr 46
Nullers, Two Interference (Althouse and Van Houten)*§	Aug 38
Revocations (NB)	Mar 14
Squelch circuit, unusual (NC)	Sep 98
Transceiver (Lafayette HB-525 (ER)	Feb 67
Transmitter Monitor, Professional Quality (Neil)*§	Cec 56
Troubleshooter's Casebook (Mueller)	Aug 83
Type acceptance (NB)	Jun 6
Commercial overseas (NB) Jan 6; (NB) Jun 4; (Corres)	Jun 14
Communications	
Antenna Rotation, Electronic (Thrower)*	Aug 47
Nullers, Two Interference (Althouse and Van Houten)*§	Aug 38
FM, see FM	
Hydronic-Radiation Transmitter (Althouse)*§	May 37
Hydronics, More About,	Aug 82
IC's in (NB)	Feb 6
Intercom remote will signal master (NC)	Feb 92
Law, Electronics and (NB)	Jun 6
Licensing, Incentive, and Distinctive Call Signs	Nov 16
Missile base, teenage students discover Soviet (NB)	Mar 12
Police—big brother listens (NB)	May 4
Receiver (Eico 711) (ER)	Oct 67
Shortwave	
Broadcasting, more (NB)	Jan 12
Receiver, Your Own (Queen)* Aug 57; (Corr)	Sept 12
Squelch circuit, unusual (NC)	Sep 98
Superregenerator, remote-tuned†	May 53
Time signals (NB)	Jul 4
Transmitter	
Hydronic-Radiation (Althouse)*§	May 37
Microwave microtransmitter (NB)	Mar 4
Transistor—Be Brave! Take On! (Davidson)	Sep 51
Walkie-Talkie	
Power Booster (Crane) *§ Mar 60; (Corres) May 16; Corr	Jul 4
Rule change (NB) Apr 6; (NB)	Jul 4
Radio-Electronics Interviews Consumers Union (Belt)	Jun 60
R/C Job, World's Toughest (Smith)	May 39
Reaction-Time Testing of Race Drivers (Davis)	May 32
Record and Play Video Tapes with Your TV Set (McGinty)*§	Apr 32
Relay	
Capacitance, unusual (NC)	Jan 102
Self-Holding, Updating the (Ives)	Sep 61
Sound IC (Greenlee)*§	Jun 77
Time-delay, SCR†	May 53
Remote Control	
Blackboard (NB)	Jan 6
PA Systems (Darr)	May 47
Sequential tone control†	May 54
Sound Relay, IC (Greenlee)*§	Jun 77
World's Toughest R/C Job (Smith)	May 39
Remote-Reading Field Meter (White)*§	Aug 60
Repair CB Talk Troubles (Rice and Mueller)	Oct 48
Resistor	
Breakthrough (NB)	Oct 16
Power, Need a? Try a Transistor (Pepper)	Feb 51
Rf Meter, and Dummy Load (Rice and Mueller)*	Nov 50
Rotary Stepping Switches—They're Everywhere (Jaski)	Nov 39; Dec 46

S

Satellite(s)	
Comsat: Communication in the Space Age (Thrower)	May 49
Missile base, teenage students discover Soviet (NB)	Mar 12
Pacific, in regular service (NB)	Apr 4
R/C Job, World's Toughest (Smith)	May 39
Weather photos, low-cost (NB)	Jun 12

Schools Directory, Electronic	Dec 40
Scopes, see Test instruments	
SCR(s)	
Quick-Checker for Controlled Rectifiers (Anglin)*	Mar 70
Time-delay relay†	May 53
Selected Circuits from an Experimenter's File (Scott)	May 53
Semiconductors, see IC; SCR(s); Solid-state; Transistor(ized)	
SERVICING, see also specific subject; Test Instruments	
Antenna	
Grounding (CI)	Oct 26
Lead-in's, In's and Out's of (Lacy)	Aug 42
masts, stowing (TTO)	Apr 89
Rotor harness, quick (TTO)	Oct 95
Anvil, hand light-duty (TTO)	Feb 89
Audio—High Fidelity—Stereo Servicing	
Amplifier	
Diode filtering (CI)	Jun 26
Performance, Verifying (Sutheim)	Jul 80
T-40/40, output problem in (CI)	Jun 22
Cartridge Tracking Tests (Ward)	Oct 32
Changer pushoff adjustments (Webcor stereo) (CI)	Mar 23
PA amplifiers (CI)	Oct 22
Power supply, transistor (T-40/40) (CI)	Jun 22
Recorder	
POP (RCA VGT 66) (Tech)	Oct 82
Stereo, hum (RCA YGG '45) (Tech)	Oct 82
Tape recorders	
Mechanical Look at (Mohan)	May 71
Noise Annoys a Tape? What Kind of (Stillwell)	Sept 43
Battery eliminator from tube tester (TTO)	Aug 95
Circuit-Breaker Testing (Darr)*	Feb 38
Coils	
Forms, quick, from tape (TTO)	Apr 89
Toroids, Simple Winding Aid for (Null)	Mar 81
Creative Electronic (Allen)	Sep 39
Dial-cord tension (Tech)	Apr 85
Drill bits, protect (TTO)	Nov 97
Hints on New Color-TV Sets (Mandl)	Nov 37
Industrial	
Ignition contactors, indicator for (TTO)	Feb 89
Interlock (Remington CardVeyor) (Tech)	Apr 85
Lathe	
Chattering (Monarch EE-10) (Tech)	Apr 85
Speed change (Cleveland) (Tech)	Feb 74
Insulation, Shrink on the (Jablin)	Nov 61
It Can't Be All Bad (Prindle)	Sep 58
Lead-bending jig (TTO)	Jul 91
Lead-ins, In's and Out's of (Lacy)	Aug 42
Man's World? Not to These Women (Smyth)	Jul 62
PA amplifiers (CI)	Oct 22
Radio Servicing	
and TV Troubles (Davidson)	Oct 52
Auto	
Interference (Tech)	Jun 84
Intermittent (Delco/Chevrolet, 1965) (Tech)	Sep 92
Overload (1962 Chevrolet) (CI)	Sep 26
Remote volume control (CI)	Aug 27
Squelch and audio (Motorola Motran U51LLT) (Tech)	Aug 86
Battery eliminator from tube tester (TTO)	Aug 95
CB	
Frequencies, Check with BC-221 and a Converter (Gunn)*	Aug 50
Professional Touch for (Darr)	Jan 44
Range (CI)	Aug 22
Talk Troubles (Rice and Mueller)	Oct 48
Troubleshooter's Casebook (Mueller)	Aug 83
Hum (Silvertone 6023) (Tech)	Jun 84
Knob pointers (TTO)	Nov 97
PC board cracked (Pilot 602MA) (Tech)	Apr 84
35W4 tubes pop (Motorola 56CD) (Tech)	Jun 84
Table-Model AM/FM (Davidson)	Nov 52
Transistor	
Be Brave! Take On! (Davidson)	Sep 51
Speaker matching, solid-state (CI)	Jul 25
Tuners, Signal-Trace FM-Radio and TV, with a Field-Strength Meter (Fitzgibbon)	Oct 57
Series-string service, speeding (TTO)	May 99
Socket wrenches, midget (TTO)	Mar 93
Soldering	
Caddy for bench or box (TTO)	Feb 88
Desoldering	
Blow, don't suck (Tech)	Jul 84
Iron kink (TTO)	Jan 98
Tool (TTO)	Jun 91
Masking tape as aid (TTO)	Aug 95
Technician	
Training grows (NB)	Apr 4
Vanishing (NB)	Jun 4
Television Servicing	
and Radio Troubles (Davidson)	Oct 52
Antenna	
Rotor (Tech)	Sep 92
Tuning stub, "second chance," (TTO)	Feb 88
Audio	
Distortion (G-E TB chassis) (Tech)	Mar 82
Sound-tuning range (G-E SB and SC chassis) (Tech)	Mar. 82
Boost (CI)	Jan 24
Checking out (CI)	Sep 22
Color	
Bending (Heath GR-25) (CI)	Feb 26

Service (continued)									
Television servicing (continued)									
Blue misconvergence (Olympic CTC-19, -20, -21) (Tech)	Nov 86								
Chroma, Troubleshooting, with vtm (Babcoke)	May 60								
Conversions (CI)	May 22; Jun 26								
Degaussers in metal cabinets, automatic (RCA CTC11) (CI)	Jan 26								
Exploring the Jungle of Color Troubles (Davidson)	Jan 56								
Horizontal streaking (Zenith 25MC36) (CI)	Jul 25								
Linearity, Don't Neglect (Mandi)	Jan 76								
Loss, selective (CI)	Sep 26								
Pix dim, raster small (RCA CTC16) (Tech)	Jan 97								
Purity and Convergence Interaction (Murphy and Carr)	Jan 32								
Red intermittent (RCA CTC15) (CI)	Jan 26								
Remote control (Admiral) (Tech)	Aug 86								
Screen won't light (CI)	Nov 24								
Servicing Hints on New (Mandi)	Nov 37								
6CB5 life short (RCA 21CS7815U) (CI)	Jun 24								
Socket, burned-up (Zenith) (CI)	Aug 27								
Test-jig adapter (Admiral) (Tech)	Dec 87								
Triggered Scope for (Allen)	Jan 50								
Trouble That Couldn't Happen (Lowens)	Jan 94; Feb 72								
Troubles (G-E CB chassis) (Tech)	Jan 97								
Vertical retrace (Dumont) (Tech)	Jul 84								
Vertical roll (Zenith 25MC36) (Tech)	Jun 84								
Vertical roll during warmup (RCA CTC5) (Tech)	Jan 97								
Weak (CI)	Jan 16								
Width coil (Admiral 25-in.) (Tech)	Jan 97								
Worms (Zenith 29CJ20) (CI)	Jan 26								
D • U • D, Servicing with (Goodman) (fiction)	Apr 39								
Five-in-One TV Shop (Smith)	Jun 55								
Flybacks run hot (CI)	Dec 16								
Heater-string electrolytic (Star-Lite TV-810) (CI)	Oct 26								
Height insufficient (Philco 8H25) (Tech)	Feb 74								
High voltage, shorting stick for (TTO)	Sep 99								
Horizontal									
Hold, Lucky Hunts (Lemons)	Feb 42								
Sync instability (Admiral 14UY3B) (Tech)	Oct 82								
Intermittent sound and pix (DuMont RA-400 and RA-401) (Tech)	Apr 84								
Knob Twisting, Down With (Hadrick and Michelotti)	Jul 79								
Line adjustment transformer (Tech)	Nov 86								
Luck Is a Lady (Salerno)	Aug 67								
Pricing (NB)	May 4								
Raster									
Gray spot (CI)	Feb 27								
Intermittent (RCA KCS 140) (Tech)	Aug 86								
Rectifier									
Substitution of HV (RCA CTC 16X) (Tech)	Dec 87								
Testing with scope? (CI)	Jul 22								
Shop, Five-in-One (Smith)	Jun 55								
6JE6's, watch those (Tech)	Apr 84								
Transistor, Tools and Tests for (Darr)	Mar 35								
Trouble that Couldn't Happen (Lowens)	Jan 94; Feb 72								
Tuners, Signal-Trace FM Radio and TV, with a Field-Strength Meter (Fitzgibbon)	Oct 57								
Vertical									
Output transformer (Tech)	May 91								
Sweep Manual (Davidson)	Dec 49								
Troubles (Admiral C2227X) (Tech)	Mar 82								
Video amplifiers, transistor (CI)	Jul 16								
Voltage reading reversed? (Zenith R2229R) (CI)	Jul 22								
Why Services Like Servicing (Glass and Tracy)	May 45								
Width, bars and blooming (Olympic CTC17, CTC18) (Tech)	Apr 85								
X-ray callbacks (NB)	Aug 6								
Test Instrument Servicing									
Meter-rectifier hookups, ac (CI)	Mar 25								
Scope									
Adjusting kit (Eico 460) (CI)	Apr 26								
Signal-tracing vertical amplifier in (Eico 460) (CI)	Feb 26								
Tubes interchangeable? (Eico 425) (CI)	Feb 27								
Waveshape (Eico 435) (Tech)	May 92								
Test-lead shorting, prevent (TTO)	Oct 95								
Toroids, Simple Winding Aid for (Null) (Corres)	Mar 81; Aug 16								
Transistor(s)									
Fundamentals (CI)	Mar 22								
Kink (TTO)	Feb 89								
Replacement (Admiral) (Tech)	Jun 85								
Ultrasonic Cleaners (Roetger)	Sep 62								
Vise jaws, electrical tape softens (TTO)	Dec 93								
Voltage, peak, measuring with scope and diode (TTO)	Jan 98								
Wire, stripping enameled (TTO)	Jul 91								
with D • U • D (Goodman)	Apr 39								
Shrink on the Insulation (Jablin)	Nov 61								
Signal-Trace FM-Radio and TV Tuners with a Field-Strength Meter (Fitzgibbon)	Oct 57								
Simple Winding Aid for Toroids (Null) (Corres)	Mar 81; Aug 16								
Slave Flash for \$5, Electronic (Keith)*	Jun 45								
Socket wrenches, midget (TTO)	Mar 93								
Solar-powered Gamma Goat (Hoke)*	Dec 34								
Soldering									
Caddy for bench or box (TTO)	Feb 88								
Desoldering									
Blow, don't suck (Tech)	Jul 84								
Tool (TTO)	Jun 91								
Iron kink (TTO)	Jan 98								
Masking tape as aid (TTO)	Aug 95								
Solid State									
and High-Z Too (Wherry)*S, Corr	Jan 12								
Camera Is Here (Clifton)	Jun 58								
C-D Ingestion under \$25 (Ward)*S Feb 32; Corr	Apr 6								
Electric Appliances (Haskett)	Jun 42; Jul 41								
MAT • MOST • MOSFET • UFET • FET: Understanding Solid-State Talk (Turner)	Sep 48								
Radar (NB)	Mar 12								
Relay, Updating the Self-Holding (Ives)	Sep 61								
Strobe Slaves, Twin 200-Watt-Second (Rice)*S Mar 49; (Corres)	Sep 6								
Tape/Slide Synchronizer (Havenhill)*S	Dec 32								
Television, color (NB)	Aug 4								
TV Camera pickup "tube" (NB)	Feb 4								
Something New in Color Generators (Allen)	May 42								
Sound Relay, IC (Greenlee)*S	Jun 77								
Special Sounds of Organ Music (Dorf)	Jun 52								
Stereo, see also Audio—high fidelity—stereo; FM, stereo									
FM Stations Aug 34; (Corres)	Nov 12								
Generator, Transistor (Payne)*S	Jul 32								
Headphone Control Center (Zsathem)*	Nov 35								
Superregenerator, remote-tuned†	May 53								
Switch(es)									
No-contact (NB)	Jan 12								
Rotary Stepping—They're Everywhere (Jaski)	Nov 39; Dec 46								
Synchronizer, Solid-State Tape/Slide (Havenhill)*S	Dec 32								
T									
T-40/40 Stereo Amplifier (Meyer)*S, output problem in (CI)	Jun 22								
Table-Model AM/FM Radios, Service (Davidson)	Nov 52								
Tachometer/Dwellmaster, Simplest (Sweet)*; Corr (Corres)	Jul 14								
Tape recorders, see Audio—high fidelity—stereo									
Technician to Technical Writer (Holder)	Feb 49								
Technician's Apprentice (Barlow) (poem)	Jun 41								
Telephone									
Lineless (NB)	Sep 4								
No-talk (WN)	Jan 45								
Satellite(s)									
Comsat: Communication in the Space Age (Thrower)	May 49								
Pacific, in regular service (NB)	Apr 4								
Time's up!, sorry (NB)	Apr 4								
TELEVISION, see also Servicing, television									
Antenna(s), see also Antenna(s)									
Auto (JFD ATV111) (ER)	Mar 68								
Coupler, TV/FM (NC)	Jun 90								
Height (CI)	Apr 22								
Ignition-noise pickup (CI)	Apr 22								
Preamp, Mast-mounted (Schenfeld)	Apr 36								
Tower, world's first multiantenna (WN)	Jan 45								
Tuning stub, "second chance," (TTO)	Feb 88								
Birthdays, Television's 40th (Ives)	Apr 55								
Camera									
Dielectric (WN)	Jan 45								
Pickup "tube," solid-state (NB)	Feb 4								
Closed-circuit remote-control blackboard (NB)	Jan 6								
Color									
Brighter ahead (NB)	Mar 14								
Development of a Color-TV Signal (Sizer)	Jan 59								
Indicator circuit (NC)	May 98								
Learn, the Programmed Way (Rawlings)	Sep 32								
1967 Color-TV Roundup (Lemons)	Jan 36								
One gun, two colors (NB)	Aug 6								
Oslo, What Happened at (Haskett)	Jan 41								
Purity and Convergence Interaction (Murphy) and Carr)	Jan 32								
Receiver									
Heathkit GR-25 (ER)	Jan 68								
Heathkit GR-180 (ER)	May 76								
Recorder									
Home \$500 (NB)	Aug 6								
More low-cost color on tape (NB)	Apr 12								
Portable (Roizen)	Mar 38								
Signal, Development of (Sizer)	Jan 59								
Small-screen (NB)	Aug 6								
Solid-state (NB)	Aug 4								
Subjective? (NB)	Jun 4								
Tube Popularity Guide	Jan 100								
Tuning indicator (NC)	Jan 102								
Voltages Ain't Circular to Me! (Kirk)	Jan 53								
What Happened at Oslo? (Haskett)	Jan 41								
Crystal switching with diodes (NC)	May 98								
Developments (NB)	Aug 4								
Television (continued)									
\$50 (NB)	Aug 4								
IC's in (NB)	Feb 6								

Time-delay relay, SCR†
Timers, Double Feature, Starring (Chesson and Ives)*
Time signals (NB)
Tone-Burst Generator, Audio (DeSa)*§
Tools and Tests for Transistor TV (Darr)
Toroids, Simple Winding Aid for (Null) Mar 81; (Corres)
T-Pads, Know Your L- and (Fred)
Transmitter Monitor, Professional Quality (Neil)*§

TRANSISTORIZED(S), see also IC; subject article with § following author's name

Audio, Engineer Talks About (Sutheim) Apr 57; May 55
Characteristic Plotter (Fasal)*§ Sep 44; (Corres) Nov 6
Circuits from Scratch (Van Houten) Mar 41
Fundamentals (Cl) Mar 22
Gain control, variable (NC) Mar 94
Kink (TTO) Feb 89
Mini-Tester, Diode and (Randall) Oct 46
Mixer, High-Impedance (Lehman) Mar 40
MOS FET, What's a (Jackson) Oct 50
Plastic—The Future Billions (Bose) Mar 55
Power Amplifier, Convert Heath WA-P2 for (Olson) May 48
Power Resistor, Need a? (Pepper) Feb 51
Radios—Be Brave! Take On! (Davidson) Sep 51
Replacement (Admiral) (Tech) Jun 85
Slide changer (NC) Aug 94
Stereo Generator (Payne)*§ Jul 32
Test Set, Experimenter's (Hicke)*§ Mar 57
Socket markings (Corr) May 12
Three for a penny? (NB) Dec 4
TV, Tools and Tests for (Darr) Mar 35
Voltmeter, 22-Mehohm FET Dc (Jaques)*§ Oct 44
Treasure Finder (Rakes)*§ Nov 32
Triggered Scope for Color (Allen Jan 51; (Corres) Jun 14
Trouble That Couldn't Happen (Lowens) Jan 94; Feb 72
Troubleshooting Chroma with Vtvm (Babcoke) May 60
Tube(s)
Brighter color ahead (NB) Mar 14
Dimensions, TV (NB) Feb 4

Tube(s) (continued)
Popularity Chart, Color-TV Jan 100
Solid-state TV camera pickup "tube" (NB) Feb 4
Tester
Battery eliminator from (TTO) Aug 95
CRT rejuvenator repair (Sencore CR-133) (Tech) Jul 84
Sencore MU-140 (ER) Nov 72
Twin 200-Watt-Second Solid-State Strobe Slaves (Rice)*§ Mar 49
Two Interference Nullers (Althouse and Van Houten)*§ Aug 38
Two Useful Pitched-Roof Antenna Mounts (Pyle and Strand) Apr 60
Two-Way, Two-Way Lamp (Wels)* Dec 59

U

Uhf
Multiantenna tower, world's first (WN) Jan 45
Translator (Lectrotech U-75) (ER) Mar 67
Ultrasonic Cleaners, Servicing (Roetger) Sep 62
Updating the Self-Holding Relay (Ives) Sep 61

V

Verifying Amplifier Performance (Sutheim) Jul 80
Vertical Sweep Manual (Davidson) Dec 49
Video Tapes, Record and Play, w/lt Your TV Set (McGinty)*§ Apr 32
Voltages, Color, Aren't Circular to Me! (Kirk) Jan 53
Vom, see Test instruments
Vtvm's, see Test instruments, vtvm's

W

Walkie-talkie
Power Booster (Crane)*§ Mar 60; Corres May 16; Corr Apr 6; Jul 4
Rule change (NB) Apr 6; Jul 50
WANTED: Test Instrument Info (Scott) Jul 4
Weather photos, low-cost, by satellite (NB) Jun 12
What Happened at Oslo? (Haskett) Jan 41
What Kind of Noise Annoys a Tape? (Stillwell) Sep 43
Why Servicers Like Servicing (Glass and Tracy) May 45
Wider the Band, the Higher the Fi? (Suthelm) Oct 54
Wire, stripping enameled (TTO) Jul 91
Woofing the Tweeter (McCormick) Nov 42
World's Toughest R/C Job (Smith) May 39

X

X-ray
Callbacks (NB) Aug 6
Radiation in TV Sets, What You Should Know About (Lachenbruch) Nov 54

Y

Your Future in Electronics (Clifton) Dec 38
Your Own Shortwave Receiver (Queen)* Aug 57; (Corr) Sept 12

Z

Zener Clipper, Nonpolarized (Ives) Feb 55
Zero-crossing detector, simple (NC) Jun 90

FREE!



**BRAND NEW EDITION
FALL AND WINTER
RADIO-TV
ELECTRONICS
CATALOG**



**RADIO-TV
ELECTRONICS**
No. 67-8

**THE WORLD'S MOST
FAMOUS CATALOG OF
ELECTRONIC EQUIPMENT!**

YOUR BUYING GUIDE FOR:
• Stereo & Hi-Fi Systems & Components • Tape Recorders • Electronic Parts, Tubes, Tools • Phonos & Records • Ham Gear • Test Instruments & Kits • Cameras & Film • PA • Citizens Band • Radio & TV Sets • Musical Instruments

SEND FOR YOURS TODAY!

MAIL TODAY TO:

BURSTEIN-APPLEBEE
Dept. REL, 1012 McGee, Kansas City, Mo. 64106

Name _____
Address _____
City _____ State _____ Zip Code _____

DO YOUR FRIEND A FAVOR... ALSO INCLUDE HIS NAME AND ADDRESS IN ENVELOPE WHEN MAILING YOUR REQUEST

Coming Next Month . . .

COLOR TELEVISION

Learn how to get rid of color ghosts and see the best possible picture. Keep up to date on modern high-voltage and shunt-regulator circuits in color sets. Find out how to make purity adjustments, and attack intermittents in chroma circuits.

SERVICING

Take a guided tour of your scope—how to get the most out of it. Learn how to troubleshoot relays and keep them in tiptop condition. Add to your file of case histories in CB transceiver troubles.

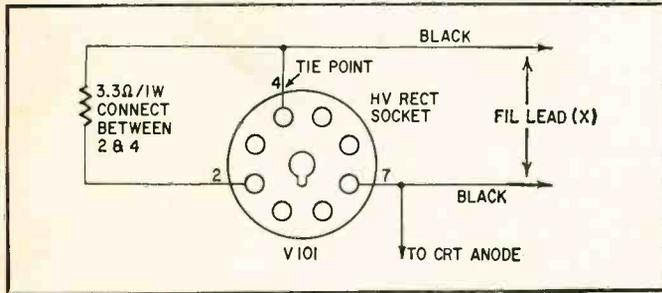
PLUS

Painless dB's—or how to use decibels without knowing logarithms. More applications for an 80-cent IC. Story of an unusual problem (how to use two-way radio in a subway tunnel) and its unusual solution. All these—and more construction projects—you'll find in our January issue.

TECHNOTES

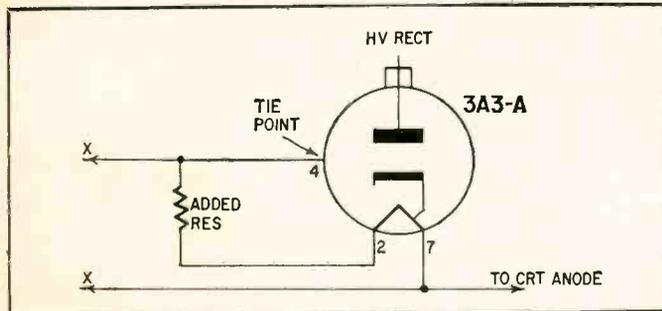
RCA CTC 16X HV RECTIFIER

Field reports show that the 3A3-A is being substituted for the 3CA3 high-voltage rectifier in this chassis. The 3A3-A



is an improved tube type and is a recommended replacement provided a 3.3-ohm, 1-watt resistor is inserted in series with the filament lead.

Some replacement tubes are double-branded 3A3-A/3CA3. These should be considered as type 3A3-A's when

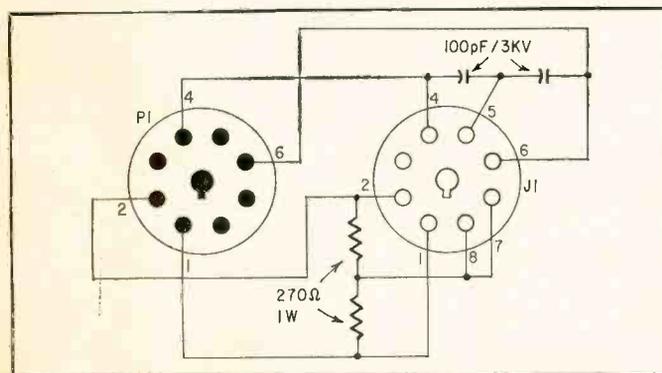


used as replacements in the CTC 16X chassis, requiring the addition of the filament resistor.

The resistor can be installed at the rectifier socket without removing the chassis. Transfer the black filament lead from pin 2 to pin 4 (used as a tie point). Connect the resistor between pins 2 and 4 as shown in the diagrams.—*RCA Television Service Tips*

ADMIRAL TV TEST-JIG ADAPTER

This diagram shows an adapter that enables you to use a color TV test jig having a 7-lead yoke to test current color TV sets employing 4-lead yokes. Plug P1 (Admiral part No.



88A23-6) fits 3H10, 4H10, 5H10, 6H10 and 9H10 chassis. Socket (part No. 87A84-2) fits 94D304-1, -2, -3, -4; 94D275-1 and 94D306-1 deflection yokes.—*Admiral Service News Letter*

R-E

Swingin'
Combo
for
Top
Performance!



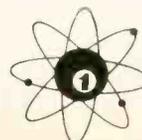
NEW SENCORE SM112B SERVICE MASTER VTVM/VOM

Here it is—the third generation of Sencore's famous Service Master—the two-in-one professional instrument that saves your time, speeds your service work, puts extra profits in your pocket.

- Just one function switch, one range switch and one probe provide all functions of VTVM and VOM.
- Voltage, current and resistance in 33 ranges — for accurate measurements anywhere, anytime.
- VTVM operates from 115v AC for precise bench or lab work; battery powered VOM gives you a 5000 ohms per volt meter.
- Lighted arrows automatically indicate VTVM scales.
- Large, easy-to-read 6-inch two percent meter covers all measurements.
- Handsome new styling in tough, vinyl-clad steel case.
- Optional high voltage probe attaches for measuring up to 30,000 volts DC.

So why use two when one will do—the new Sencore SM112B. Truly professional quality, and still only **\$89.95**

High Voltage Probe HP118 **\$9.95**



SENCORE
NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Our policies are your best insurance:



Sonotone has been the reliable, quality name in replacement phono cartridges since 1947. We've made and sold 20 million of them. When you service with Sonotone cartridges, you can be assured you are servicing with the best. *We'll stake our name on that.*

REPLACE WITH SONOTONE CARTRIDGES. There's a complete line for immediate replacement of virtually every cartridge in use today. Prove it to yourself — fill out and mail coupon TODAY for your free copy of Sonotone's 1967 "computer-programmed" cartridge replacement manual.

Send today for complete information:
Sonotone Corporation, Dept. 107
Elmstord, New York 10523

Just fill out and mail this coupon for your free copy of Sonotone's 1967 "computer-programmed" cartridge replacement manual.

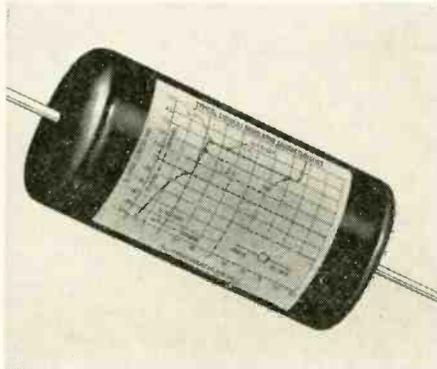
YOUR NAME _____
 ADDRESS _____
 CITY _____
 STATE _____ ZIP _____

Circle 116 on reader's service card

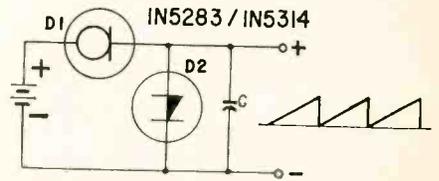
NEW SEMICONDUCTORS

FIELD-EFFECT DIODES

The Motorola 1N5283 through 1N5314 series of current regulators are field-effect diodes that establish a constant current flow regardless of applied voltage. They are the analog of the Zener diode which establishes a constant voltage independent of current.



The diodes are ideal for use as constant-current sources for differential amplifiers, ramp generators and for



transistor biasing. In voltage-reference circuits, the current regulator can supply a temperature-compensated Zener diode with a constant current to limit voltage changes caused by large swings in an unregulated circuit.

The current regulators can be used to simplify the design of sawtooth and ramp generator circuits. The diagram shows a simple sawtooth generator with a linear positive-going ramp. D1 is the current regulator diode and D2 is a 4-layer diode. The period of one cycle of the oscillator (T) is $C \times V_{BR}/I_P$; where I_P is the pinch-off current of D1, C is the value of the capacitor in μF and V_{BR} is the breakover voltage of the 4-layer diode.

The diodes are in a DO-7 glass

"CHRISTMAS SALE" YOU—HELPED US BUILD A BIG INVENTORY! THESE AMAZING BUYS—ARE YOUR DIVIDENDS

FREE GIFT WITH EVERY ORDER **FREE \$1 BUY WITH EVERY 10 YOU ORDER** Only applies to "\$1" Buys

- TAPE RECORDER — assorted types good, bad, broken, as-is, potluck \$4
- TRANSISTOR RADIO asst type good, bad, broken, as-is, potluck \$1.50
- 50 — TUBE CARTONS (colored) assorted sizes for Popular Tubes or—50 of any size you select .. \$1
- 10 — ASSORTED TUBES Radio, Television and Industrial .. \$1
- ALL AMERICAN TUBE KIT Top Standard Brand — 12BA6, 12BE6, 12AV6, 50C5, 35W4 ... \$2
- 1 — LB SPOOL ROSIN-CORE SOLDER 40/60 top quality .. \$1
- 2—G.E. PIECES OF EQUIPMENT stacked with over 200 useful parts \$1
- 100 — MIXED DEAL "JACKPOT" Condensers, Resistors, Surprises .. \$1
- 10—ASSORTED SLIDE SWITCHES SPST, SPDT, DPDT, etc. \$1
- 20 — EXPERIMENTER'S COIL "JACKPOT" assorted for 101 uses \$1
- 20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc. \$1
- 50 — ASST. DISC CERAMIC CONDENSERS popular numbers .. \$1
- 10 — ASST. RADIO ELECTROLYTIC CONDENSERS .. \$1
- 20 — STANDARD TUBULAR CONDENSERS .047-600v .. \$1
- 3—1/2 MEG VOLUME CONTROLS with switch, 3" shaft .. \$1
- 25 — SYLVANIA HEAT SINKS for Transistor and other circuits .. \$1
- WIRE "JACKPOT" good variety \$1
- 25 — TUNGSOIL FLASHLIGHT BULBS #T416, bayonet, 3.3 v. 2w \$1
- 50 — ASSORTED MYLAR CONDENSERS popular selected types \$1
- 40 — ASSORTED TV KNOBS all standard types, \$20 value .. \$1
- 7 — ASST. TV ELECTROLYTIC CONDENSERS popular selection .. \$1
- 10 SETS — DELUXE PLUGS & JACKS asst. for many purposes .. \$1
- 10 — SETS PHONO PLUGS & PIN JACKS RCA type .. \$1
- 10 — SURE-GRIP ALLIGATOR CLIPS 2" plated .. \$1
- 50 — RADIO & TV SOCKETS all type 7 pin, 8 pin, 9 pin, etc. \$1
- 50 — ASSORTED #3AG FUSES popular ampere ratings .. \$1
- 100 — STRIPS ASSORTED SPAGHETTI handy sizes .. \$1
- 100—ASSORTED RUBBER GROMMETS best sizes .. \$1
- 10—ASSORTED VOLUME CONTROLS less switch .. \$1
- 7—ASSORTED VOLUME CONTROLS with switch .. \$1
- \$15.00 RADIO PARTS "JACKPOT" handy assortment .. \$1

RCA 110° FLYBACK TRANSFORMER

We scooped the Market Latest type — standard for all 110° TV's
 RCA's design of large Coil produces 18KV— assuring adequate width
 Incl Schematic Diagram application for any TV
 List price \$13.90
Your price .. \$3
 10% off in lots of 3

- 110° TV DEFLECTION YOKE for all type TV's incl schematic same as Thordarson Y502 list \$20 \$3
- "COMBINATION SPECIAL" RCA 110° FLYBACK plus 110° DEFLECTION YOKE .. \$5
- 90° FLYBACK TRANSFORMER for all type TV's incl schematic \$2
- 90° TV DEFLECTION YOKE for all type TV's incl schematic .. \$2
- 70° FLYBACK TRANSFORMER for all type TV's incl schematic \$1
- 70° TV DEFLECTION YOKE for all type TV's incl schematic \$1
- 20—ASSORTED TV COILS I.F. video, sound, ratio, etc. \$1
- 4 — TV ALIGNMENT TOOLS most useful assortment .. \$1
- \$15.00 TELEVISION PARTS "JACKPOT" best buy ever .. \$1

- MARKET SCOOP COLUMN**
- Famous Electrolytic Condensers sparkling new—all sold at 3 for \$1
- 3 — 50/50/50mfd — 450/250/250v .. \$1
 - 3 — 100/80/20mfd — 300/300/300v .. \$1
 - 3 — 250/200/50mfd — 175/175/175v .. \$1
 - 3 — 80/40/20mfd — 300/300/300v .. \$1
 - 3 — 200/200/40mfd — 200/150/150v .. \$1
 - 3 — 80/40/40/40mfd — 150/150/150/25v .. \$1
 - 3 — 1000/1000/500mfd — 35/35/20v .. \$1
 - 3 — 50/10/160mfd — 450/400/250v .. \$1
 - 3 — 40/40/40mfd — 450/300/150v .. \$1
 - 3 — 30/200/4/4mfd — 475/475/475/25v .. \$1
 - 3 — 150/100/100mfd — 350/350/50v .. \$1
 - 3 — 50/40/30/30mfd — 450/350/300/300v .. \$1
 - 15/15/15mfd— 450/250/100v .. \$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.

Name

Address

Cost of goods

Shipping

estimated

TOTAL

Please specify refund on shipping overpayment desired: CHECK POSTAGE STAMPS MERCHANDISE (our choice) with advantage to customer

BROOKS RADIO & TV CORP., 487 Columbus Ave., New York, N. Y. 10024 TELEPHONE 212-874 5600

Be Sure and See These Brand-New GL-TAB Books at Your Parts Distributor!



SERVICING TV RECEIVER CIRCUITS—Just the kind of "how-to-do-it" handbook every practicing TV service technician should have. Contains the TV service data most needed for troubleshooting both monochrome and color receivers, all in one handy volume. Emphasis is on practical data which can be used in the home or at the service bench. 224 pgs., 34 chapters. No. 414 Paperback \$2.95



ELECTRONIC ENGINEERING MEASUREMENTS FILEBOOK:—A single source of measurement principles and practices. Describes detailed techniques, complete with test setups, waveforms, mathematical analyses, etc., for measuring. One of the most complete collections of its type available today, containing 60 complete "How-to-Measure" sections. 256 pgs. No. T131 Paper \$4.95



TEN-MINUTE TEST TECHNIQUES FOR ELECTRONICS SERVICING: Describes how trouble in any piece of electronic equipment may be pinpointed quickly and easily. Step-by-step techniques are outlined for localizing trouble to an improperly operating stage and then to the defective component itself, using a minimum amount of test equipment. 176 pgs., 125 illus. No. 424 Paperback \$2.95



TV TROUBLESHOOTER'S HANDBOOK: A carefully-planned reference source of over 350 different, tried and tested solutions to "tough-dog" TV servicing problems. A complete digest of late-model TV receiver troubles and cures, new and unusual circuits and descriptions of how they work, field and factory changes, recurring defects, etc. 125 illus. No. T-401 Paperback \$2.95

OTHER GERNSBACK LIBRARY BOOKS . . . practical and authoritative aids . . .

BASIC SERIES

Basic Transistor Course by Paul R. Kenian No. 111 Paperback \$4.10
Basic Oscillator Handbook by Norman H. Crowhurst No. 130 Paperback \$2.95
Basic TV Course by George Kravitz No. 105 Paperback \$4.10
Basic Radio Course by John T. Frye No. 104 Paperback \$4.10
Basic Math Course for Electronics by Henry Jacobwitz No. 100 Paperback \$4.50

Jack Darr's Service Clinic compiled by James Belt No. 133 Paperback \$2.95
Rapid Radio Repair by G. Warren Heath No. 78 Paperback \$2.90
Servicing Transistor Radios by Leonard D'Airo No. 76 Paperback \$2.90
Radio TV Repair by G. Warren Heath No. 60 Paperback \$2.90
Servicing Record Changers by Harry Mileaf No. 59 Paperback \$2.90

TRANSISTORS

Pinpoint Transistor Troubles in 12 Minutes by L. Garner No. 430 Hardcover \$6.95
Getting Started with Transistors by Louis E. Garner, Jr. No. 116 Paperback \$3.95
Transistor Projects by Editors of Radio-Electronics No. 89 Paperback \$2.90
Transistors No. 94 Paperback \$1.95
Transistor Circuits by Rufus P. Turner No. 63 Paperback \$2.75
Transistor Techniques No. 61 Paperback \$1.50
New Skill-Building Transistor Projects and Experiments by Louis E. Garner, Jr. No. 129 Paperback \$2.95
Fundamentals of Semiconductors by M. G. Scroggie No. 92 Paperback \$2.95

HOBBIES

Fun with Radio-Controlled Models by Edward L. Safford, Jr. No. 106 Paperback \$3.20
Radio-Control Handbook by H. G. McEntee No. 93 Paperback \$2.65
Fun with Electricity by Thomas Kennedy, Jr. No. 83 Paperback \$2.65
Model Radio-Control by Edward L. Safford, Jr. No. 74 Paperback \$2.65
Electronic Puzzles and Games by Matthew Mandl No. 70 Paperback \$1.95
Electronic Hobbyists' Handbook by Rufus P. Turner No. 69 Paperback \$2.50

DATA BOOKS

Charts and Nomographs for Electronics Technicians and Engineers by Donald W. Moffat No. 121 Clothbound \$5.95
Electronics Data Handbook by Martin Clifford No. 118 Paperback \$2.95
Electronic Design Charts by Norman Crowhurst No. 110 Clothbound \$5.95

Handbook of Electronic Tables by Martin Clifford No. 125 Paperback \$2.95

SERVICING

New Way to Service Color TV by C. Babcock No. 136 Paperback \$3.25
Horizontal Sweep Servicing Handbook by Jack Darr No. 115 Paperback \$4.10
Pinpoint TV Troubles in 12 Minutes by H. Manly No. 428 Hardcover \$6.95
Radio Servicing Made Easy by Leonard C. Lane No. 107 2 vol. Paperback \$7.20

Servicing AGC Circuits by Harry E. Thomas No. 126 Paperback \$3.95
Practical TV Troubleshooting No. 102 Paperback \$2.35
Servicing Sync Circuits by Art Margolis No. 134 Paperback \$2.95

TEST INSTRUMENTS

Test Instruments for Electronics by Martin Clifford No. 131 Paperback \$2.95
How to Test . . . Almost Everything Electronic by Jack Darr No. 132 Paperback \$2.95
The Oscilloscope by George Zwick No. 108 Paperback \$3.65
How to Get the Most out of your VOM by Tom Jaski No. 85 Paperback \$2.90
Oscilloscope Techniques by Alfred Haas No. 72 Paperback \$2.90
The VTVM by Rhys Samuel No. 57 Paperback \$2.50
Probes for Test Instr's. by Bruno Zucconi & Martin Clifford No. 54 Paperback \$2.50

THEORY & FUNDAMENTALS

Elements of Electron Physics by Norman Crowhurst No. 113 Paperback \$3.95
Learn Electronics By Building by John Schroeder No. 112 Paperback \$3.85
Industrial Electronics Made Easy by Tom Jaski No. 99 Paperback \$3.95

HIGH FIDELITY

Hi-Fi Troubles by Herman Burstein No. 120 Paperback \$3.95
Designing and Building Hi-Fi Furniture by Jeff Markell No. 79 Paperback \$2.90
Elements of Tape Recorder Circuits by Herman Burstein and Henry C. Pollak No. 67 Paperback \$2.90
Understanding Hi-Fi Circuits by Norman Crowhurst No. 64 Paperback \$2.90
Maintaining Hi-Fi Equipment by Joseph Marshall No. 58 Paperback \$2.90

If your distributor does not have the books you wish in stock, feel free to use the handy coupon below to order.

NO RISK COUPON — MAIL TODAY

TAB Books, Blue Ridge Summit, Pa. 17214
Please send me the books listed below:

I enclose \$..... (Save postage by remitting with order)
 Please invoice on 10-day FREE trial

Name
Company
Address
City State Zip
My distributor is: RE 127

GL SINGLPAK MANUAL

TV SERVICE MANUAL

79¢

ONLY SINGLPAK GIVES YOU AUTHENTIC FACTORY SERVICE DATA

CONTAINS

SCHEMATICS
PARTS LISTS
CLASSIC VIEWS
PARTS LOCATIONS
TUNERS (UHF-VHF)
PHOTOS
TUBE COMPLEMENTS
ADJUSTMENTS
ALIGNMENTS
WAVEFORMS
VOLTAGES
REVISIONS
REMOTES
SUPPLEMENTS

GL SINGLPAK MANUALS, BLUE RIDGE SUMMIT, PA 17214

... and, don't forget to see SINGLPAK MANUALS®

Here's a TV Service Manual with all data in a single pack!

Only SINGLPAK Manuals give you authentic Factory Service Data for over 8,000 TV sets—black and white or color—in SINGLE MANUAL packs.

And the cost . . . just 79¢!

No need to pay for several manuals to get the one manual you want.

SINGLPAK Manuals are now available for the 10 most popular makes introduced from 1955 to 1965—fulfills 90% of TV service data needs for this period.

SEE YOUR DISTRIBUTOR
If he doesn't have them send us his name

SINGLE PAK MANUALS AVAILABLE FOR 1955-65 SETS BY:

- ADMIRAL
- EMERSON
- GENERAL-ELECTRIC
- MAGNAVOX
- MOTOROLA
- PHILCO
- RCA
- SYLVANIA
- WESTINGHOUSE
- ZENITH

Circle 119 on reader's service card

Build A Tape/Slide Synchronizer

continued from page 33

this is not important as there is plenty of signal for recording.

Construction

The parts layout is not critical as all circuits are low impedance. Figs. 6 and 7 are top and underside views and show the location of the few parts used.

The Triac is conveniently mounted on the small aluminum plate which is insulated from and fastened to the case with 1/2" insulated, threaded spacers. Transformer T1 is mounted on the opposite side of the cabinet (Fig. 7). P1, J1, J2 and J3 are mounted on the front. As Fig. 6 shows, R3, S1 and S2 are mounted on the top of the case.

Resistor R1 should be chosen to produce a 1-volt sync signal. The resistance value will depend on the voltage value and the amount of current drawn by the slide-changer motor or solenoid. If the motor draws about 0.3 amp, which is normal for home-type changers, R1 should be 3 ohms. Check the nameplate on your projector to find

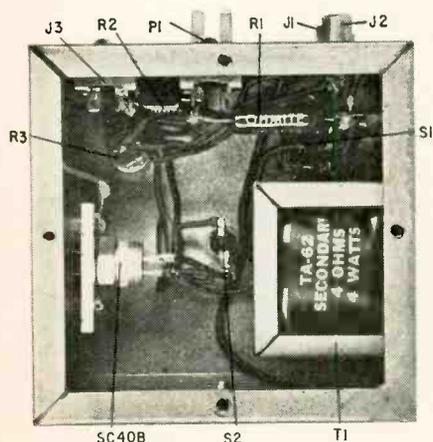


Fig. 7—Parts placement isn't critical within the box as the circuit is chiefly low impedance. Mount Triac carefully.

out how much current it draws. This figure may include the projector lamp wattage, which you must subtract. Better still, use an ac voltmeter across R1 and try different values until you come up with a 1-volt signal.

You will need a two-wire power cable with a receptacle to mate with P1 on one end. The other end of the cable should match the slide-changer remote socket. For the sync connections to the tape recorder, use phone plug on one end, and whatever you need on the other to match the recorder jacks.

R-E

WORLD'S FINEST
5-CORE SOLDER

ERSIN MULTICORE

NEW EASY DISPENSER PAK

ONLY 69¢

BUY IT AT RADIO-TV PARTS STORES

MULTICORE SALES CORP. WESTBURY, N.Y. 11590

Circle 120 on reader's service card

COMPLETE TUNER OVERHAUL

9.95

ALL LABOR AND PARTS
(EXCEPT TUBES & TRANSISTORS)*

VHF UHF COLOR UV TRANSISTOR

COLOR TUNERS GUARANTEED ALIGNMENT — NO ADDITIONAL CHARGE

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

Exact Replacements are available for tuners unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

And remember—for over a decade Castle has been the leader in this specialized field... your assurance of the best in TV tuner overhauling.

CASTLE
TV TUNER SERVICE, INC.

5715 N. Western Ave., Chicago 45, Illinois
41-96 Vernon Blvd., Long Island City 1, N. Y.

For service in Canada write to Chicago or use reader service card in this magazine.

*Major parts are charged extra in Canada.

Circle 121 on reader's service card

Radio-Electronics' 5th Annual Color TV issue coming next month. Learn how to kill color ghosts, how to whip intermittent trouble in a color TV set, how to get more life out of high-voltage circuits and how to improve purity.

ELECTRONICS



Engineering-Technicians

Bachelor of Science Degree, 30 Months
Save Two Years' Time

- 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)
 - Architecture (B.S. Degree) (36 Months)

The Nation's increased demand for Engineers, Electronic Technicians, Radio TV Technicians is at an all time high. Heald Graduates are in demand for Preferred High Paying Salaries. Train now for a lucrative satisfying lifetime career.

Approved for Veterans
DAY AND EVENING CLASSES

Write for Catalog and Registration Application.
New Term Starting Soon.

Your Name

Address

City

State



1215 Van Ness Avenue
San Francisco, California

Circle 122 on reader's service card

Olson®



FREE

Fill in coupon for a **FREE** One Year Subscription to **OLSON ELECTRONICS' Fantastic 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.

NAME _____
 ADDRESS _____
 CITY _____ STATE _____
 GIVE ZIP CODE _____

If you have a friend interested in electronics send his name and address for a **FREE** subscription also.

OLSON ELECTRONICS, INC.

770 S. Forge Street Akron, Ohio 44308

Circle 123 on reader's service card

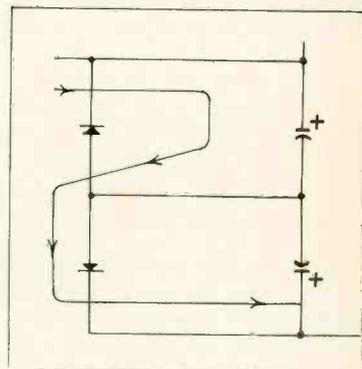
NOTEWORTHY CIRCUITS

ELECTROLYTIC AC CAPACITORS

Occasionally an industrial electronic technician has to find a temporary substitute for a defective large-value ac capacitor. The old trick of replacing it with two capacitors of double the capacitance, back to back, is well known. Unfortunately, large-capacitance high-voltage electrolytics are not easily obtainable. In some instances the technician would have to parallel two capacitors to get the needed value, and thus would find himself using four capacitors to replace one.

The problem is solved in a neater way with isolating diodes. Their current rating should be at least equal to the peak ac. On the half-cycle when the upper electrode of the top capacitor in the drawing is positive, current flow (conventional) is as shown. The reverse is true, of course, on the next half-cycle.

Another advantage of this hookup is that the reverse voltage across each



capacitor is limited to the forward voltage drop across its associated capacitor. Thus there is no reverse current. And, of course, the capacitors can be the same size as the one to be replaced.

In one instance, this circuit was used to replace a defective 150 μ f, 330-Vac capacitor in a Xenon arc-lamp power supply with two 150- μ f, 450-Vdc capacitors and two 1N3254 diodes.

—R. W. Neale

R-E

U.S. GOV'T ELECTRONIC SURPLUS

Nationally Known-World Famous SURPLUS CENTER offers finest, most expensive, Government Surplus electronic units and components at a fraction of their original acquisition cost.

ORDER DIRECT FROM AD or WRITE FOR CATALOGS

STANDARD DIAL TELEPHONE

(ITEM #75) -- Standard, commercial telephone same as used throughout U.S.A. Attractive polished nickel, like new condition. Use as extension phone to private systems or connect several phones together for local intercom system. Full instructions are furnished, wt. 9 lbs. Original Cost \$24.35.



F.O.B. \$5.95

STEP-BY-STEP AUTOMATIC SWITCH

(ITEM #738) -- Amazing "up-and-around", electro-magnetic telephone switch. Dial any bank part from 1 to 100. Make your own telephone system. Can also be used to remotely control up to 100 circuits over a single pair of wires.



One of our FOUR STAR bargains. Comes complete with dial, one dial and one line bank. Size, 5" x 7" x 13". Wt. 16 lbs. Cost Gov't Over \$25.00. Complete: Switch, cover, dial, line bank, instructions..... F.O.B. \$9.95

TYPICAL BUYS FROM OUR 1967 CATALOGS

- \$ 350.00 - Geared 2-hp Battery Golf Car Motor \$24.95
- \$ 15.00 - Westinghouse DC Ammeter, 0 to 300 \$ 7.11
- \$ 40.00 - Vacuum Pressure Pump, 12-VDC \$11.95
- - 80-MW Walkie-Talkies, Per Pair \$19.60
- - Deluxe, Multi-Range, AC/DC Tester \$ 8.98
- \$4000.00 - Carrier Telephone Amplifier System \$13.91

SPECIAL SALE

Correspondence Course In ELECTRICAL ENGINEERING



Sells For \$10.79 Outside U.S.A. \$8.79 Postpaid In U.S.A.

(ITEM #A181) -- Wonderful chance to obtain technical training at Amazing Low Cost! Lincoln Engineering School has suspended its Correspondence Courses because of increased operating costs. We offer a limited number of the school's complete Electrical Engineering Course but without the examination paper grading service. The course consists of 14 lesson unit books. Each book has the regular exams, and in a separate section, "Standard Answers" to each exam question.

Course is well written, easy to understand, profusely illustrated. Reader's Digest size, easy to carry and study in spare time. Many Lincoln Engineering School students holding excellent jobs as a result of L.E.S. training. Course contains latest information on transistors, silicon diodes, etc. Additional book on how to build and operate a "Home Laboratory and Experimental Bench" furnished with each course.

SEND 25c COIN OR STAMPS FOR 3 MAIN CATALOGS

All Items FOB Lincoln Money Back Guarantee

SURPLUS CENTER

DEPT. RE-127 LINCOLN, NEBR. 68501

Circle 124 on reader's service card



TRY THIS ONE

ELECTRICAL TAPE SOFTENS

WISE JAWS

Don't let the hard, coarse jaws of your vise mar the finish on a new chassis or panel. Instead, wrap several turns of electrical or plastic tape around the jaws before clamping the work in place. The number of turns is determined by how tight the chassis will be clamped—more protection is needed for tighter clamp-



ing. The tape is easily removed and discarded after the job is finished.

—Robert E. Kelland

R-E

NAVY MARINE BAND WALKIE TALKIE

TRANS. & RECEIVER—Crystal controlled, can be operated on any one channel in freq. range 2.3 to 4.5 MC. Voice (A3) communication only; output of Trans. is 0.2 watts & satisfactory communication between units should be maintained up to approx. one (1) mile. With tubes: 1/1R5, 1/1R5, 2/1T4, 3/384. Voltages required: 67.5 VDC 3 MA; 135 VDC 4 MA; 1.5 VDC 225 MA for REC. —67.5 VDC 1.5 MA; 135 VDC 19 MA; 1.5 VDC 225 MA; & —6 VDC 30 MA for TRANS. Waterproof plastic case w/space for batt. or power supply. Telescoping antenna 8 ft. has special loading coil. Complete w/tubes, antenna, 2 crystals FT-243 (no choice of freq.) headphones, carbon mic., canvas cover, & manual. Size: 8 x 8 x 2 1/2". Wt.: 8 lbs. **\$9.95**

"DAY" MODEL—Same as above, but with direction finding loop circuit for homing; & lip. mic. Ply-wood case w/ carrying straps. Wt.: 11 lbs. **\$12.95**

Dry Charge Battery N-T-6 1/above Pow. Sup. **\$3.95**
 Vibrator Power Supply I/MAB & DAY—New **\$6.95**
 Prices F.O.B. Lima, O. — 25% Deposit on COD's — **BIG FREE CATALOG**—Send for your copy now. Dept. RE

FAIR RADIO SALES
 1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION. (Act of October 23, 1962, Section 4369, Title 39, United States Code.)

1. Date of filing: October 1, 1967.
2. Title of publication: RADIO-ELECTRONICS.
3. Frequency of issue: Monthly.
4. Location of known office of publication: Ferry Street, Concord, Merrimack County, New Hampshire 03302.

5. Location of the headquarters or general business offices of the publishers: 154 West 14 Street, New York, New York 10011.

6. Names and addresses of publisher, editor, and managing editor: Publisher, M. Harvey Gernsback, 154 West 14 Street, New York, New York 10011; Editor, Robert Cornell, 154 West 14 Street, New York, New York 10011; Managing Editor, Thomas R. Haskett, 154 West 14 Street, New York, New York 10011.

7. Owner: Gernsback Publications, Inc., 154 West 15 Street, New York, New York 10011; M. Harvey Gernsback, 154 West 14 Street, New York, New York 10011; Mary H. Gernsback, M. Harvey Gernsback, Maurice Coyne, Benjamin E. Winston As Trustees Under Trust Agreement dated September 30, 1965 c/o Benjamin E. Winston, Esq., 330 Madison Avenue, New York, New York 10017.

8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.

9. For completion by nonprofit organizations authorized to mail at special rates: Does not apply in this case.

10. Extent and nature of circulation. The average number of copies each issue during preceding 12 months are: (A) Total number copies printed (net press run): 223,037; (B) Paid circulation: (1) Sales through dealers and carriers, street vendors and counter sales: 46,074; (2) Mail subscriptions: 110,011; (C) Total paid circulation: 156,085; (D) Free distribution (including samples) by mail, carrier or other means: 2,416; (E) Total distribution: 158,501; (F) Office use, left-over, unaccounted, spoiled after printing: 64,536; (G) Total: 223,037. The number of copies single issue nearest to filing date are: (A) Total number copies printed (net press run): 216,677; (B) Paid circulation: (1) Sales through dealers and carriers, street vendors and counter sales: 47,789; (2) Mail subscriptions: 108,405; (C) Total paid circulation: 156,194; (D) Free distribution (including samples) by mail, carrier or other means: 2,187; (E) Total distribution: 158,381; (F) Office use, left-over, unaccounted, spoiled after printing: 58,296; (G) Total: 216,677.

I certify that the statements made by me above are correct and complete.

(Signed) M. Harvey Gernsback
 Publisher

SCHOOL DIRECTORY

GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic & advanced courses in theory & laboratory. Electronic Engineering Technology and Electronic Technology curricula both available. Assoc. degree in 29 mos. B.S. also obtainable. G.I. approved. Graduates in all branches of electronics with major companies. Start Feb., Sept. Dorms. campus. High school graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
 Dept. C, Valparaiso, Indiana 46383



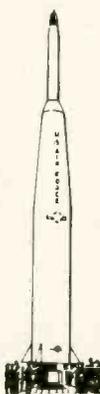
Learn Electronics for your SPACE-AGE EDUCATION at the center of America's aerospace industry

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 they're graduated!

A & P SCHOOL. Practical experience on real aircraft. One-year course prepares you for F. A. A. A & P certificate. **WRITE TODAY FOR CATALOG.**

NORTHROP INSTITUTE OF TECHNOLOGY
 1199 W. Arbor Vitae, Inglewood, Calif.



ENGINEERING MATHEMATICS

NOW! A NEW WAY TO LEARN—I. H. S. I. WAY. A complete home study course in engineering math to help you get the position 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.

YOU SIGN NO CONTRACTS

Pay only if satisfied—you owe it to yourself to examine the **INDIANA HOME STUDY INSTITUTE COURSE IN ENGINEERING MATH.**

FREE BONUS—if you join now, a refresher course in basic arithmetic.

Write for Brochure—No Obligation.

THE INDIANA HOME STUDY INSTITUTE
 Dept. RE-12, P.O. Box 1189
 Panama City, Fla. 32401

for a professional career

Tri-State graduates hold important engineering and business administration posts throughout the U. S. This professionally-oriented small college has outstanding placement record. Four-quarter year permits degree in three years. Excellent faculty. Well-equipped labs. Beautiful 300-acre campus. Accredited. Small classes. Modest costs. One-year Drafting-Design Certificate program. Enter Jan., March, June, Sept. For Catalog, write Director Admissions. Approved for veterans.



TRI-STATE COLLEGE

24127 College Avenue, Angola, Indiana 46703

Prepare today . . . for an ELECTRONICS CAREER

- Radio Broadcasting
- Television
- Computers • Radar
- Industrial Electronics
- Transistors • Transmitters
- Microwave Techniques

Free Catalog
 No Salesman Will Call
 Tuition Weekly
 No Down Payment

VETERAN APPROVED

PHILADELPHIA WIRELESS TECHNICAL INSTITUTE

1533 PINE STREET
 PHILADELPHIA, PA. KI 6-0745

MARKET CENTER

GENERAL

CONVERT ANY TELEVISION to sensitive Big-Screen Oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans \$2.00. RELCO-A25, Box 10563, Houston 18, Texas

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. OELRICH PUBLICATIONS, 6556 W. Higgins, Chicago, Ill. 60656

FREE ELECTRONICS (new and surplus) Parts catalog. We repair multimeters. BIGELOW ELECTRONICS, Bluffton, Ohio 45817

ARCTURUS INVENTORY REDUCTION SALE

• Tube Bargains, to name just a few: #6930, \$3.50; #6360, \$3.50; #6688, \$3.50; #5842/417A, \$2.50; #5847/#404A, \$2.50; #2D21, 49¢; #6146, \$2.95; #7025, 59¢; #616, 49¢; #6K7, 39¢ each, 3 for \$1; #UX200, \$1.69; #1AX2, 49¢ each, 3 for \$1; #12BN6, 39¢ each, 3 for \$1; #2516, 99¢ each, 3 for \$1.49; #6CG7, 59¢; #6BQ7, 94¢; #6AQ5, 56¢; #6U8, 77¢; #6T8, 84¢.

• Tube Cartons: 6AU6 etc. size, \$1.75 per 100. 6SN7 etc. size, \$2.10 per 100. 5U4GB size, \$2.50 per 100. 5U4G size, 03¢ each.

• Kit of 15 sub-miniature Tubes made by Sonotone for Walkie-Talkie etc. use. Cat. #29, 99¢ per kit.

• 7 inch 90 degree T.V. bench test picture tube with adapter. No ion trap needed. Cat. #7BP7, \$6.99.

• Silicon Rectifier octal-based long-life replacement for 5U4, 5Y3, 5AS4, 5AW4, 5T4, 5V4, 5Z4. With diagram. Cat. #Reet 1, 99¢ each.

• OZ4 Silicon Rectifier replacement, octal based. Cat. #Reet 2, 99¢ each.

• 10 Flangeless Rectifiers, 1 amp, 400 to 1000 p.i.v. Cat. #RS10, \$2.98.

• 10 Silicon Rectifiers, 750 MA., 50 to 300 p.i.v. Cat. #330F, 99¢.

• 12 Zener Diodes, amperages from 250 mw to 1 watt, voltages 2.7 to 40, each value marked. Axial and stud types. Cat. #ZD12, \$1.98.

• 2 Silicon controlled Rectifiers, 1 amp, general purpose units with instructions. Cat. #SCR1, \$1.00.

• 5 Transistor Circuit Boards containing up to 6 transistors, plus diodes, resistors, capacitors, etc. Cat. #TB10, 99¢.

• Color Yokes, 70 degree for all round color CRT's. Cat. #XRC70, \$12.95, 90 degree for all rectangular 19 to 25 inch color CRT's. Cat. #XRC90, \$12.95.

• Transistorized U.H.F. Tuners used in 1965 to 1967 TV sets made by Admiral, RCA, Motorola, etc. Removable gearing may vary from one make to another. Need only 15 volts d.c. to function. No filament voltage needed. Easy replacement units. Cat. #U.H.F. 567, \$4.95.

• General Electric U.H.F. miniature transistorized Tuner, G.E. Part #ET85X-33. Cat. #GE85, \$4.95.

• F.M. Tuner, Hi-Fi amplifier tuning unit complete with diagram, 2 tubes. Sam's Photofacts #620 lists 2 applications. Cat. #FM20, \$3.98.

• Flyback Transformer, in original cartons, made by Merit or Todd. Most with schematic drawing of unit. Please do not request specific type. Cat. #506, 99¢.

• Flyback Transformer Kits, 2 flybacks per kit. #502E, Emerson; #502Y, Silverstone; #502W, Westinghouse; #507, Philco; #502, RCA. Any kit \$2.99.

• Kit of 30 tested Germanium Diodes. Cat. #100, 99¢.

• Kit of 10 NPN Transistors. Cat. #371, 99¢. 10 PNP Transistors. Cat. #370, 99¢. All tested.

Send for our FREE CATALOG listing thousands of similar best buys in tubes, parts, kits, transistors, rectifiers, etc. Orders under \$5.00, add 50¢ handling charge. Include 4% of dollar value of order for postage.

ARCTURUS ELECTRONICS CORP.

502-22nd St., Union City, N.J. 07087 Dept. MRE

Circle 141 on reader's service card

TREASURE HUNTERS! PROSPECTORS! Relco's new instruments detect buried gold, silver, coins. Kits, assembled models. Transistorized. Weighs 3 pounds. \$19.95 up. Free catalog. RELCO-A25, Box 10839, Houston, Texas 77018

BACK-ISSUES, Electronic, Scientific Magazines. SEMCO, Box 130, Roxboro, Quebec, Canada

SAMS PHOTOFACT FOLDERS 1-150, fifteen binders, (few pages missing), \$502.50 value, only \$95. Extra blank binders, \$1.50 each. Old Rider Manuals, \$3 each. 100 different radio magazines, \$15. Fifty pounds radio-television diagrams, \$20. Shipped freight collect. HARTFORD, 1760 Balsam Road, Highland Park, Ill. 60035

MAGNETS. ALL TYPES. Specials—20 disc magnets, or 2 stick magnets, or 10 small bar magnets, or 8 assorted magnets, \$1.00. MARYLAND MAGNET COMPANY, 5412-G Gist, Baltimore, Maryland 21215

TRANSISTOR BOARDS

#103 2EA 2N706, 6EA 1N917 ... 6 Boards \$3.00
#101 6EA 2N711 ... 2 Boards \$3.00
#301 3EA 2N1411 ... 4 Boards \$3.00

Above, new, minimum salvageable lead length 1/2 in.
Audio Tape, 1/4 in. 1 1/2 mil, approx. 4000 ft., 2 reels \$7.50
Shipped Prepaid Continental U.S.A.

LEED'S RADIO, 57 WARREN ST., N.Y.C. 10007
Tel: (212)-267-3440

"TAB" • SILICON ONE-AMP DIODES

Full Leads		Factory Tested & Gtd! U.S.A. Mfg	
Piv/Rms	Piv/Rms	Piv/Rms	Piv/Rms
50/35	100/70	200/140	300/210
.05	.07	.10	.12
400/280	600/420	800/560	900/730
.14	.21	.30	.40
1000/700	1100/770	1700/1500	2400/1680
.50	.70	1.00	1.75

SCR-SILICON-CONTROL-RECTIFIERS!!!

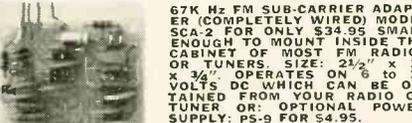
PRV	7A	25A	PRV	7A	25A
50	.45	.75	500	2.50	3.00
100	.65	1.15	600	2.75	3.60
200	1.00	1.60	700	3.00	4.00
300	1.50	2.00	800	3.60	4.75
400	2.00	2.50	900	4.30	5.90

SILICON POWER DIODES & STUDS

D.C.	50 Piv	100 Piv	200 Piv	600 Piv
Amps	35 Rms	70 Rms	140 Rms	420 Rms
15	.22	.40	.65	1.20
160	2.75	4.85	1.35	1.85
250	3.50	4.50	6.00	12.25

"TAB" TERMS: Money Back Guarantee
Our 2nd Year, \$2 Min. Add Shipping Charges
111 GX LIBERTY ST., N.Y., N.Y. 10006
Send 25¢ Phone# REctor 2-6245 for Catalog

LIKE MUSIC WITHOUT COMMERCIALS?



The SCA-2 sub-carrier adapter makes it possible for you to enjoy the background music transmitted on a 67KHz sub-carrier on many FM stations. (These programs cannot be heard on a FM set without an adapter.) In the US there are approximately 400 FM stations authorized by the FCC to transmit the 67KHz programs. If you are within 50 miles of a city of 100,000 or more, it is probable that you are within the satisfactory reception range of one or more of these stations. If in doubt write for a list of such stations in your area. The SCA-2 requires only four connections to your FM receiver or FM tuner/amplifier. These are: Multiplex output, audio input, and DC power. If your FM set does not have a multiplex output jack, we supply instructions of where to connect.

ONE YEAR FACTORY GUARANTEE
THE SCA-2 IS A STABLE, EXTREMELY LOW NOISE UNIT REQUIRING NO FIELD ADJUSTMENT.
Available in General Electric Model T2230 table radio. This is an AC operated, 15 transistor, AM/FM radio with a four inch speaker, for \$84.95.
Send order to: KENZAC, P.O. B. 66251, Houston, Tex. 77006.

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below.

Allied Radio Corp.	76
Arcturus Electronics Corp.	94
Artisan Organs	80
Brooks Radio & TV Corp.	88-89
Burstein-Applebee Co.	86
Capitol Radio Engineering Institute, The	18-21
Castle TV Tuner Service, Inc.	91
CLASSIFIED	94-97
Cleveland Institute of Electronics	5, 63-64
Cook's Institute of Electronics Engineering	62
Cornell Electronics Co.	96
Delta Products, Inc.	60
DeVry Institute of Technology (A Subsidiary of Bell & Howell)	95
Edmund Scientific Co.	7
EICO Electronic Instrument Co., Inc. Third Cover	61
Electro-Voice, Inc.	61
Electronic Measurement Corp. (EMC)	76
Fair Radio Sales	93
Finney Co.	15
GC Electronics Company	65
General Electric	12
Grantham School of Electronics	1
Heald Colleges	91
Heath Company	68-69
Injectorall Electronics Corp.	22
International Crystal Mfg. Co., Inc.	98
Jerrold Electronics Corporation (Distributor Sales Division)	71
JFD Electronics Co.	2
Mallory Distributor Products Company (Div. of P. R. Mallory & Co., Inc.)	17
Microframe, Inc.	67
Mike Quinn Electronics	97
Multicore Sales Corp.	91
Music Associated	79
National Radio Institute	8-11
National Technical Schools	13
Nova-Tech, Inc.	79
Olson Electronics, Inc.	92
Oxford Transducer Company (A Division of Oxford Electric Corporation)	80
Philadelphia Wireless Technical Institute	93
Poly Paks	97
Quam-Nichols Company	6
RCA Electronic Components and Devices Semiconductors	66
Test Equipment	81
Tubes	Fourth Cover
RCA Institutes	28-31
Reading Improvement Program	89
Round Hill Associates Inc. (A Milo Electronics Subsidiary)	26
Rye Industries, Inc.	67
Salch & Co., Herbert (Marketing Division of Tompkins Radio Products)	80
Sams & Co., Inc. Howard W.	14
Schober Organ Corp., Inc.	4
Scott, Inc., H. H.	22
Semiconics Corp.	76
Sencore	70, 87
Sentry Manufacturing Company	27
Shure Bros.	75, 77, 79
Solid State Sales	95
Sonotone Corp. (Electronic Applications Div.)	88
Sony Corp. of America	4
Sony Superscope	16
Sprague Products Company	78
Surplus Center	92
Sylvania (Subsidiary of General Telephone & Electronics)	23
TAB Books	90
Tram Corporation	71
Triplet Electrical Instrument Company	Second Cover
Warren Electronic Components	96
Weller Electric Corp.	62
Winegard Co.	24-25
Xcelite, Inc.	14
MARKET CENTER	94-97
Edmund Scientific Co.	
Kenzac	
Leed's Radio	
McGee Radio	
Spectrum Products Corp.	
Sylmur Electronics Specialties	
TAB	
SCHOOL DIRECTORY	93
Indiana Home Study Institute, The	
Northrop College of Science & Engineering	
Tri-State College	
Valparaiso Technical Institute	

BURGLAR, Fire Alarm supplies and information. Send \$1.00 (refundable) for catalog to **PROTECTO ALARM SALES**, Box 357 Birch Run, Michigan 48415

POPULAR ELECTRONICS complete file. Slip cased, mint condition. Make offer. **BILL DODSON**, 210 Arterburn, Lyndon, Ky. 40222

WANTED

QUICK CASH . . . for Electronic EQUIPMENT, COMPONENTS, unused TUBES. Send list now! **BARRY**, 512 Broadway, New York, N. Y. 10012, 212 WALKER 5-7000

Wanted, **HEATHKIT Q-METER**, **HAROLD MURRAY**, Box 74, Neffsville, Pa. 17556

ELECTRONICS

BARGAINS in Canadian Electronic equipment and surplus. Send \$1.00 for giant catalogs. **ETCO**, Box 741, Dept. R, Montreal, Canada

TUBES. "Oldies", latest. Lists free. **STEINMETZ**, 7519 Maplewood, Hammond, Indiana 46324

RECEIVING & INDUSTRIAL TUBES, TRANSISTORS. All Brands—Biggest Discounts. Technicians, Hobbyists, Experimenters—Request FREE Giant Catalog and **SAVE! ZALYTRON**, 469 Jericho Turnpike, Mineola, N.Y. 11501

Discharge **IGNITION, PHOTOFLASH**. Free catalog parts, kits. **TRANSPARK**, Carlisle, Mass. 01741

RADIO & TV TUBES 33¢ each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL**, 4217-E University, San Diego, California 92105

MESHNA'S TRANSISTORIZED CONVERTER KIT Converts car radio to receive police & fire. 35-50Mc or 100-200Mc. (one Mc tuning) with simple step instructions \$5.00. **MESHNA**, No. Reading, Mass. 01864

TV CAMERAS: Assembled and kits. Also plans, vidicons, lenses, scan coils, etc. **NEW** catalog 10¢. **ATV RESEARCH**, Box 453, Dakota City, Nebr. 68731

GIANT JAPANESE ELECTRONICS CATALOG. \$1. **DEE**, 10639A Riverside, North Hollywood, Calif. 91602

BRAND NEW TUBES. World's lowest prices on Radio, TV-industrial-special purpose tubes. Write for free parts catalog. **UNITED RADIO CO.**, Newark, N.J. 07101

UNUSUAL solid-State kits. Amplifiers, mikes, power units, controls. Amazingly low-priced quality products. Free brochure. **COSMOSE ENTERPRISES**, 507 Fifth Avenue, New York, N.Y. 10017

"**COIL WINDING**" Handbook—50¢. Experimenter's catalog includes 250 exclusive items—25¢, refundable. **LABORATORIES**, 12041-B Sheridan, Garden Grove, Calif. \$2640

AUDIO - HI-FI

RENT STEREO TAPES—over 2,500 different—all major labels—free brochure. **STEREO-PARTI**, 1616-R Terrace Way, Santa Rosa, Calif. 95404

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

HI-FI COMPONENTS, Tape Recorders, at guaranteed "WE will not be undersold" prices. 15-day moneyback guarantee. Two-year warranty. **NO** Catalog. Quotations Free. **HI-FIDELITY CENTER**, 239R East 149th St., N.Y., N.Y. 10451

TAPE RECORDER SALE. Brand new, latest models. \$10.00 above cost. **ARKAY SALES**, 1028-E Commonwealth Ave., Boston, Mass. 02215

TAPEMATES makes available to you **ALL 4-TRACK STEREO TAPES—ALL LABELS**—postpaid to your door—at tremendous savings. For free brochure write **TAPEMATES CLUB**, 5727 W. Jefferson Blvd., Los Angeles, Calif. 90016

INSTALLERS! **HAMMOND** Reverberation mechanism—\$4. **CAL'S**, Box 234, Dearborn, Michigan 48121

STEREO TAPES. Save 30% and up; no membership or fees required; postpaid anywhere USA. **FREE** 70-page catalog. We discount batteries, recorders, tape/accessories. Beware of slogans, "not undersold", as the discount information you supply our competitor is invariably reported to the factory. **SAXITONE**, 1776 Columbia Road, N.W., Washington, D.C. 20009

AMPEX VR7000 VTR with 1" tape. Portable case. Used 400 hours. New price \$3400. Selling for \$2800. **MARTIN SHALEK**, 87 Fairmont St., Malden, Mass. 02148 (617) 324-2411

OLD RADIO PROGRAMS ON TAPE. Inner Sanctum, Suspense, Jack Armstrong, Gangbusters, Sam Spade, hundreds more. Sample reel \$5.00. **Hobby Magazine** for collectors of old radio tapes, old comics and strips, pulp mags, etc., \$1.00 or sent free with tape order. **NOSTALGIC HOBBIES**, Dept. R.E., 9875 SW 212 St., Miami, Fla. 33157

INVENTIONS & PATENTS

INVENTIONS-IDEAS developed: Cash/Royalty sales. Member: **UNITED STATES CHAMBER COMMERCE**, Raymond Lee, 230-U Park Avenue, New York City 10017

WE WANT YOU TO MAKE

THE SWITCH.

JOIN OUR GROWING LIST

OF THOUSANDS OF

SATISFIED CUSTOMERS.

Our semiconductors have full factory length leads, are American made, unused, and in good physical condition. Our technical descriptions and pictures are accurate.

ZENERS

1 Watt 6-33V \$.50
10 Watt 6-200V \$.75
50 Watt 6-200V \$ 1.75

1 AMP

Top Hat & Epoxy

PRV	AMP
100	.07
200	.09
400	.12
600	.18
800	.22

PRV	AMP
1000	.35
1200	.50
1400	.65
1600	.80
1800	.90

PRV	AMP
100	.90
200	1.40
300	1.75
400	2.25
500	2.60

TRIACS

TO-66
5 AMPS



**POST OFFICE BOX 74 D
SOMERVILLE, MASS. 02143**

TELEPHONE (617)547-4005

Send For Our Fall Catalog Featuring
Transistors, Rectifiers And Components

Circle 143 on reader's service card

UNUSUAL BARGAINS

EXCELLENT
XMAS
GIFTS!

GIANT WEATHER BALLOONS



"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great backyard fun. Exciting beach attraction. Made of heavy duty neoprene. Inflate with vacuum cleaner or auto air hose; or locally available helium for high rise.

Stock No. 60.568EH . . . (8' diam.) . . . \$2.00 Ppd.
Stock No. 60.632EH . . . (16' diam.) . . . \$7.00 Ppd.

NICKEL-CADMIUM BATTERY BARGAINS

Terrific value—used government surplus. Quick-charge. Lightweight 6-volt nickel-cadmium battery. 4-amp. hour capacity. Almost unlimited life—thousands of discharge-charge cycles with minute deterioration. Charges fully in approx. 1 hr. with Edmund Charger Kit. Hundreds of uses for hobby, photography, model building, industry, etc. Only few drops of water yearly for full maintenance. Requires minimum of electrolyte-sealed to prevent loss. Delivers nearly 100% output at below freezing. Maintains constant voltage through major portion of capacity. Five vented, 1.2 volt cells strapped in 3 Polypropylene bands. 3 1/2"x2"x3/4", 10 & "Jumbo" 275 Amphere Hour Batteries also available. Write for info.

Stock No. 70.942EH \$15.00 Ppd.

ONE NEW 1.2 VOLT NICKEL-CADMIUM CELL . . . \$ 3.95 Ppd.

Stock No. 40.798EH

CHARGER KIT FOR 6-VOLT BATTERY \$ 8.00 Ppd.

Stock No. 70.807EH

Order by Stock No. Check or M. O.—Money-Back Guarantee.
EDMUND SCIENTIFIC CO. 300 EDCORP BLDG.
BARRINGTON, N.J. 08007

CLIP AND MAIL COUPON TODAY

SEND FOR FREE CATALOG "EH"

EDMUND SCIENTIFIC CO.
300 EDCORP BUILDING
BARRINGTON, N.J. 08007



Completely new 1968 edition. New items, categories, illustrations. Dozens of electrical and electromagnetic parts, accessories. Enormous selection of Astronomical Telescopes, Microscopes, Binoculars, Magnifiers, Magnets, Lenses, Prisms. Many war surplus items for hobbyists, experimenters, workshop, factory. Mail coupon for catalog "EH".

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

Circle 142 on reader's service card

MORE INTEGRATED CIRCUITS



SR FLIP FLOPS	\$.90
JK FLIP FLOPS	\$ 1.15
DUAL NAND NOR GATES . . .	\$ 1.00
SR CLOCKED FLIP FLOPS . . .	\$ 1.15
SRT FLIP FLOPS	\$ 1.15
8 INPUT NAND NOR GATES . .	\$ 1.00
DUAL AND GATE	\$ 1.00
QUAD NAND NOR GATES . . .	\$ 1.00

TO-85 flat pack with holder. Guaranteed to work. They come complete with schematic, elect. characteristic sheet and some typical applications.

CADMIUM SELENIDE PHOTO CONDUCTIVE CELLS. Dark resistance of 500 megohms. Sensitivity of 1-4.99 $\mu\text{a}/\text{ft}$ candle \$1.25

Silicon Control Rectifiers
TO-66 pack
Studs

PRV	3A	7A	20A
50	.35	.45	.70
100	.50	.65	1.00
200	.70	.95	1.30
300	.90	1.25	1.70
400	1.20	1.60	2.10
500	1.50	2.00	2.50
600	1.80	2.40	
700	2.20	2.80	
1000		4.00	

HIGH-VOLTAGE NPN 150V VBCBO at 2.5A, hi gain in TO-66 pack \$.75

Silicon Power Rectifiers

PRV	3A	12A	20A	40A
100	.09	.30	.40	.75
200	.16	.50	.60	1.25
400	.20	.70	.80	1.50
600	.30	1.00	1.20	1.80
800	.40	1.25	1.50	2.30
1000	.55	1.50	1.80	2.70

Terms: FOB Cambridge, Mass. Send check or Money Order. Rate companies 30 days net. Include Postage, Average Wt. per package 1/2 lb. Allow for C.O.D. Minimum Order \$3.00

SILICON RECTIFIER SALE

IMMEDIATE DELIVERY
FULLY GTD NEWEST TYPE
AMERICAN MADE FULLY TESTED



1 AMP SILICON "TOPHAT" & EPOXY DIODES
LOW LEAKAGE FULL LEAD LENGTH

PIV/RMS 50/35 .05 ea.	PIV/RMS 100/70 .07 ea.	PIV/RMS 200/140 .10 ea.	PIV/RMS 300/210 .12 ea.
PIV/RMS 400/280 .14 ea.	PIV/RMS 500/350 .19 ea.	PIV/RMS 600/420 .21 ea.	PIV/RMS 700/490 .23 ea.
PIV/RMS 800/560 .25 ea.	PIV/RMS 900/630 .30 ea.	PIV/RMS 1000/700 .40 ea.	PIV/RMS 1100/770 .50 ea.

ALL TESTS AC & DC & FWD & LOAD
SILICON POWER DIODE STUDS

D.C. AMPS	50 PIV 35 RMS	100 PIV 70 RMS	150 PIV 105 RMS	200 PIV 140 RMS
3	.08 ea.	.12 ea.	.16 ea.	.22 ea.
12	.25	.50	.65	.75
35	.65	.90	1.25	1.40
100	1.00	1.20	1.50	1.75
160	2.50	3.00		3.75

D.C. AMPS	300 PIV 210 RMS	400 PIV 280 RMS	500 PIV 350 RMS	600 PIV 450 RMS
3	.27 ea.	.29 ea.	.37 ea.	.45 ea.
12	.90	1.30	1.40	1.65
35	2.00	2.50	2.90	3.00
100	2.50	3.50	4.00	5.00
160	4.25	4.75	5.10	Ask

"SCR" SILICON CONTROLLED RECTIFIERS "SCR"

PRV	7 AMP	16 AMP	25 AMP	PRV	7 AMP	16 AMP	25 AMP
25	.50	.75	1.00	250	1.75	2.15	2.50
50	.60	.90	1.25	300	2.00	2.40	2.75
100	.80	1.25	1.50	400	2.40	2.75	3.25
150	.90	1.60	2.00	500	3.20	3.40	3.80
200	1.25	1.80	2.25	600	3.40	4.00	4.50

SPECIALS! SPECIALS!

Westinghouse 160 AMP, 500 PIV SILICON HI-POWER
STUD RECTIFIER IN1666. \$5.10 ea. 10 for \$45.00.
Limited quantity.

100 Different Precision Resistors
1/2—1—2 Watt 1/2%—1% TOL \$1.25

Asst transistor Kit. P.N.P.—N.P.N.
All popular types. Unchecked
100 for \$2.95 500 for \$9.95

Computer Grade Condenser 15,500 MFD
12 VDC American Mfg. .75 ea.

Type IN34 DIODE GLASS .07 ea 100 for \$5
Money Back guarantee. \$2.00 min. order. Include
additional \$ for postage. Send check or money
order. C.O.D. orders 25% down.

Warren Electronic Components

230 Mercer St., N. Y., N. Y. 10012 • 212 OR 3-2620

Circle 144 on reader's service card

MARKET CENTER

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 PUBLI-
CATIONS, 6556 W. Higgins, Chicago, Ill. 60656.

1,000 Business Cards, "Raised Letters" \$3.95
postpaid. Samples. ROUTH, 5717 Friendswood,
Greensboro, N. C. 27409

TWO-WAY RADIO SERVICE INVOICE FORMS—
Detailed. Free Sample Form No. 50 and Catalog.
OELRICH PUBLICATIONS, 6554 W. Higgins,
Chicago, Ill. 60656

Attention: TV Service Dealers. HIGHLY DE-
TAILED TV SERVICE ORDER FORM STOPS
PRICE COMPLAINTS BEFORE THEY START.
FREE CATALOG AND SAMPLE NO. 206. OEL-
RICH PUBLICATIONS, 6554 W. Higgins, Chica-
go, Ill. 60656

Attention: TV Service Dealers. TV SERVICE
CONTRACTS FORMS. Free Catalog and Samples
No. 105. OELRICH PUBLICATIONS, 6554 W.
Higgins, Chicago, Ill. 60656

"PROFIT GUARD" BOOKKEEPING SYSTEM
FOR TV SERVICE. Complete—easy to use. Free
Catalog and Sample No. 1800 Page. OELRICH
PUBLICATIONS, 6554 W. Higgins, Chicago, Ill.
60656

WRITE
NOW FOR
1968
SENT FREE

McGEE'S CATALOG

1001 BARGAINS IN
SPEAKERS—PARTS—TUBES—HIGH FIDELITY
COMPONENTS—RECORD CHANGERS—
Tape Recorders—Kits—Everything in Electronics
1901 McGee Street—Kansas City (RE), Missouri 64108



Mod. Size Hwd Net Ea.
536 2x6.2x5 \$1.89
538 3x8.2x5 2.19
Other models available
free literature

EQUIPMENT CABINETS

Modern, deluxe-styled aluminum
cabinets, rich leather-
ette covered top in black or
brown with silver grey or
gold panel. Rubber feet. At
your dealer or order direct
from:

SPECTRUM PRODUCTS CORP.
13946 Blackstone, Detroit, Mich. 48223

8 PIECE TOOL KIT

69¢
10 Shipping
contains
4 Bristle
Wrenches
1 Hex Blade
2 Alignment
(tuning) Tools

INTERFERENCE TV TRAPPER

SUPPRESS PICTURE INTERFERENCE
CAUSED BY:
• AUTO IGNITION
• AIRPLANES
• APPLIANCES
• NEON SIGNS
• OIL BURNERS
• AMATEUR RADIO TRANSMITTERS

TV LIFESAVER! STOP TUBE BURNOUTS!

PROTECTS TV TUBES
(FROM BURNING)
AND COPS DOWN
ON SERVICE CALLS!
SAVES YOU MONEY
AND GIVES GREATER
TV PLEASURE
WITH FEWER
INTERUPTIONS
AND HEADACHES!

CORNELL

33¢

PER TUBE

100 TUBES OR MORE:
30¢ PER TUBE

TUBES

1 YR. GUARANTEED

Mutual Conductance Lab-tested, Individually
Boxed, Branded and Code Dated. Tubes
are new, or used and so marked.

OZ4	6A55	6CD6	6K6	6X4	12BF6
1B3	6AT6	6CF6	6K7	6X8	12BM7
1J3/1K3	6AT8	6CG7	6Q7	7A7	12BL6
1H5	6AU4	6CG8	654	7A8	12BY7
1L4	6AU5	6CM7	6SA7	7B6	12C5
1T4	6AV6				12CA5
1U4	6AW8				12SN7
1X2	6AX4				12SQ7
3B26	6BA6				25L6
3DG4	6BC5				25Z6
5U4	6BD6	6CZ5	6SH7	7C5	35W4
5V4	6BG6	6D6	65J7	7N7	35Z3
5Y3	6BL7	6DA4	6SK7	7Y4	50L6
6A6	6BL7	6D66	6SL7	12AD6	24
6A8	6BN4	6D06	6SN7	12AE6	27
6AB4	6BQ6	6E6	6SQ7	12AF6	77
6AC7	6BQ6	6EA7	6SR7	12AT7	78
6AG5	6BQ7	6F6	6U7	12AU7	84/6Z4
6AK5	6BZ6	6GH8	6V6	12AX7	5687
6AL5	6C4	6H6	6V6	12BA6	6350
6AN8	6C6	6J5	6W4	12BD6	6463
6AQ5	6CB6	6J6	6W6	12BE6	7044

Other tubes at low prices—send for free list
NO SUBSTITUTIONS WITHOUT YOUR PERMISSION

Special!

With every \$10 Order
25¢
per tube

(No Limit) from this list
6AG5 6SN7
6AQ5 6CB6 654
6AU6 6J6 6W4

NEW—EASY TO USE!



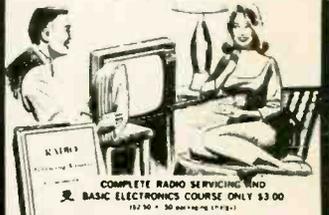
COLOR TV, 395
DEGAUSSER—40
shipped

BARGAIN CORNER

- Solder Iron 1.49
- Elect Tape .89
- Epoxy (pr.) .79
- Diode Kit .39
- Noise Filter .89
- Neon Tester .59
- Solder .39
- Antenna Coupler 1.89
- Battery Charger 4.95

Prestige & Success are yours as an ELECTRONIC EXPERT

FOR CORNELL CUSTOMERS ONLY by
special arrangement with the publisher, these
amazing bargains are available



COMPLETE RADIO SERVICING AND
BASIC ELECTRONICS COURSE ONLY \$3.00
(\$2.50 + 50¢ shipping)

NEW PRACTICAL TV TRAINING COURSE
ONLY \$3.50
(\$3.00 + 50¢ shipping)

Both above courses \$6.00

SILICON RECTIFIERS

all purpose
ELECTRONIC
CLEANER
89¢ plus shipping

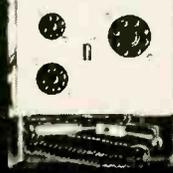


TUBE CARTONS

HIGH GLOSS
CLAY COATED
PAPER LINING
WITH BUILT IN
ADDITIONAL
PARTITIONS

SIZE	PRICE PER 100 CARTONS	PRICE PER 1000 CARTONS
100	29	2.59
100	39	3.49
100	59	5.29
100	89	7.99

11.000
TUBE
SUBSTITUTES
\$1.25



RADIO-TV
TUBE TESTER
2.89
Plus 30c
Shipping

CORNELL ELECTRONICS CO.

Dept RE12 4217 University Ave., San Diego, Calif. 92105

TERMS: Add 3c per tube
shipping. Orders under \$5.00
add 3c per tube shipping
plus 50c handling. Canadian
orders add approximate

Postage. Send 25% deposit
on C.O.D. orders. No C.O.D.
orders under \$5.00 or to
Canada. No 24 hr. free offer
on personal check orders
5-DAY MONEY BACK OFFER

SEND FOR
FREE CATALOG

Circle 145 on reader's service card

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 March issue must reach us before January 10th.

WORD COUNT: Include name and address. Name of city (Des Moines) or 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 8-10, COD, AC, etc., count as one word. Hyphenated words count as two words. Minor over-wordage will be edited to match advance payment.

88-108 MC F.M. RECEIVER

10 TUBE CRYSTAL CONTROLLED F.M. RECEIVER WITH TUBES VOLUME TONE CONTROLS 4 WATT OUTPUT. 115 V 60 CYCLE. METAL CABINET 8H x 100 x 12W. WITH DIAGRAM LESS CRYSTAL AND SPEAKER. REMOVED FROM SERVICE BY STORECAST OUTFIT THAT WENT SOLID STATE. \$14.50 EA: 2 for \$25.00 PLUS SHIPPING.

LEED'S RADIO, 57 WARREN ST., N.Y.C. 10007



CUT DOWN ON MOBIL IGNITION NOISE. DON'T BE FOOLED BY IMITATIONS! Get the ORIGINAL

SYDMUR SOLID STATE "CD" IGNITION SYSTEM!

High Quality Components used throughout. Fiberglass Printed Circuit Board. Unitized Construction. Simplified Kit Assembly.

Construction Article in Nov. 1966 Popular Electronics Thousands of satisfied customers.

Write for Free Literature TODAY.

COMPAC Assembled . . . \$34.75*

COMPAC KIT . . . 24.95*

*Add 75¢ for mailing and handling

N.Y. State Residents add Sales Tax.

SYDMUR ELECTRONICS SPECIALTIES

1268 E. 12th St. Brooklyn, N.Y. 11230

(Also Available in Canada)

INTEGRATED CIRCUIT SALE

Selling Like Crazy

ICS TO-5/T0-46 RTL, Gates, Buffers, FFs, Adders etc with 8 hole test socket 100 asstd. . . . \$10.95
 ICs, TO-85 Flatpacks DTL/RTL Some Plated include Auger Test Socket, 100 asstd. . . . \$12.95

Flatpacks, All Gold Plated w/socket, 100 . . . \$15.95
 Half Packs of above, \$5.95, \$6.95 & \$8.50. (Less test socket. Extra test sockets, \$1.00 each)
 All ICs sample test over 50-80% good. Schematics, identification & test info. included.

Hi-Gain (Darlington) Amplifier, TO-18 NPN. Similar 2N998 Tested . . . 7 for \$2.95

Field Effect Trans. (FET) P channel Similar 2N3277 TO-5, tested . . . 4 for \$2.95, U-Test 10 for \$2.95

Dual Trans. (Diff. Amplif) 6 lead choice TO-5/18 NPN/PNP, Sim. 2N2060 Tested 7 for \$2.95, U-Test . . . 50 for \$5.95, 100 for \$8.95, asstd.

NPN Sil. Power HV TO-3, TO-66, TO-59 20MHZ Choice 7 for \$2.95, U-test 50 Asstd. . . . \$6.95

Microcleared Relay 3/8" sq x 1 1/4". Ax. leads. Norm. open 3000 ohm coil, pick on 6V 3 ma. 4 for \$2.95

Memory Plane 5" x 8" with 4000 wired toroid bits . . . Perfect. \$9.75; Damaged plane . . . \$3.75

Memory Plane 10" x 10" with 10,000 wired toroid bits, perfect \$15.00. Damaged plane . . . \$5.00

Matrix Board 2" x 3" 100 wired toroids . . . \$2.00
 Memory Info. included, Add 1 lb. Postage.

Nuvistors, #7895 with socket panel . . . 4 for \$2.95
 Lampdriver, SCR Module w 6-10V lamp 6 for \$2.95

Jumbo Silic. Trans. Asst. Over 1000 TO-5, 18, 46, 52, 66, 3, 4, 6, 8 lead devices includ. mostly Trans. duals, Darl. FETs, SCRs, ICs & power types & diodes. Sample test 50 to 90% good. Including Pomona Flare top test socket. Postage 3 lbs. \$19.50; Half Pack of above, less socket . . . \$9.95

Free Goody Bag with \$10 order (25¢ postage)

Add postage for heavy items, others ppd. California orders 5% sales tax.

Catalog now ready. All mase. guaranteed

MIKE QUINN ELECTRONICS

Bldg. 727 Langley Street
 Oakland Airport, Calif. 94614

Circle 146 on reader's service card

DECEMBER 1967

REGISTRY AND JOURNAL for TV APPLIANCE AND EQUIPMENT DEALERS. Keeps record of daily sales by make, model, serial, etc. Stops inside theft. Provides quick reference. Free catalog and sample page No. 1700. OELRICH PUBLICATIONS, 6554 W. Higgins, Chicago, Ill.

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.

WANTED! TV-RADIOMEN to learn aircraft electronics servicing. Numerous job openings everywhere. Write: **ACADEMY AVONICS**, Reno/Stead Airport, Reno, Nevada

HIGHLY EFFECTIVE HOME STUDY COURSE in Electronics Engineering Mathematics with circuit applications. Earn your Associate in Science degree. Free literature. **COOK'S INSTITUTE OF ELECTRONICS ENGINEERING**, P.O. Box 36185, Houston, Texas 77036 (Established 1945.)

HIGHLY EFFECTIVE HOME STUDY REVIEW for FCC commercial phone exams. Free literature. **COOK'S SCHOOL OF ELECTRONICS**, P.O. Box 36185, Houston, Texas 77036

ASSOCIATE DEGREE IN ELECTRONICS earned, first half by correspondence and second half in residence. Free catalog. **GRANTHAM INSTITUTE**, 1505 N. Western Ave., Hollywood, Calif. 90027

FCC First Class License in six weeks—nation's highest success rate—approved for Veterans Training. Write **ELKINS INSTITUTE**, 2603E Inwood Road, Dallas, Texas 75235

"SLEEP-LEARNING." Send for free brochure, "What's It All About." **TAPES**, Box-190RE, Quincy, Mass. 02169

Top Paying Jobs—Guidance Manual \$1. **CANADIAN INSTITUTE OF SCIENCE & TECHNOLOGY**, 263E Adelaide St. W., Toronto

MASTER WATCHMAKING at home. Free sample lesson. **CHICAGO SCHOOL**, Dept. REM, Fox River Grove, Ill. 60021

GOVERNMENT SURPLUS

72 page illustrated Government Surplus Radio, Gadgets Catalog 25¢. **MESHNA**, Nahant, Mass. 01908

ELECTRONIC COMPONENTS at fractions of original cost. Buy direct from government, used and new materials, walkie-talkies, multimeters, oscilloscopes, transceivers, etc. "HOW-TO" directory plus applications for continued bulletins directly from government agencies . . . \$3.00. **SURPLUS BROKERS**, 209H East 56th Street, New York, N.Y. 10022



DOUBLE BONUS SALE!

\$25 FREE WORTH OF PLUS ANY **\$1 ITEM FREE**

Add 25¢ for handling

BOTH FREE WITH ANY \$10 ORDER

GE	Actual Size →				
	1 AMP	PIV	Sale	PIV	Sale
	MICROMINIATURE	50	7¢	600	25¢
	SILICON RECTIFIERS	100	9¢	800	20¢
		200	12¢	1000	45¢
		400	17¢		

6 amp TRIACS

SALE	PRV	100	200	300	400	600
	Sale	.90	1.40	1.75	2.25	2.60

6-MONTHS' GUARANTEE

Poly Paks, the only company of its kind in the world due to its tremendous purchasing power, quality and factory testing procedures. **GUARANTEES** all items **AS ADVERTISED** for 6 months or your money back. A "FIRST" ANYWHERE

SILICON POWER RECTIFIERS	PIV	3A	6A	12A	45A
	50	.07	.18	.22	.50
	100	.09	.25	.30	.75
	200	.16	.39	.50	1.25
	400	.20	.50	.70	1.50
	600	.30	.75	1.00	1.80
800	.40	.90	1.25	2.30	
1000	.55	1.15	1.50	2.70	

FACTORY TESTED \$1 SEMI-KON-DUCTORS

- 2-85 WATT 2N424 PLANAR, silicon, TO-53 npn \$1
- 3-40W NPN SILICON MESA, 2N1648, transistor \$1
- 4 2N170 TRANSISTORS, by GE, npn for gen'l rf. \$1
- 15 3 Amp RECT's, studs, silicon, to 800V no test \$1
- 4-2N255 POWER TRANSISTOR EQUALS . . . \$1
- 10 PNP SWITCHING TRANS'RS, 2N404, no test \$1
- 2N3088 "N" Channel FET's Very High Input Z . . \$1
- 5 2N107 TRANS'RS, by GE, npn, pop. audio pak \$1
- 4-2N1613 NPN SIL. 120 mc. by "Rheem" TO-46 \$1
- 3-45 AMP POWER RECTIFIERS, stud. silicon . . . \$1
- 5 2N706 500MW, 300 MC NPN transistors, TO-18 \$1
- 10PNP SWITCHING TRANSISTORS, no test. TO-5 \$1
- 25 TOP HAT RECTIFIERS, silicon, 750 ma, no test \$1
- 4 BIDIRECTIONAL TRANSISTORS, 2N1641 . . . \$1
- 10 NPN SWITCHING TRANS'RS, 2N338 no test . \$1
- 15 PNP TRANS'RS, CK722. 2N35, 107, no test . \$1
- 15 NPN TRANSISTORS, 2N35, 170, 440, no test \$1
- 30 TRANSISTORS, rf. if. audio osc-if. TO5 no test \$1
- 4-"EPOXY" TRANSISTORS 2N3568. 600 MC . \$1
- 4-"EPOXY" TRANSISTORS 2N3643 by Fairchild . \$1
- 3 EPOXY TRANSISTORS 2N4265 by Motorola . \$1
- 4 EPOXY TRANSISTORS 400 HFE by Fairchild . \$1
- 5-1 Amp 800 PIV EPOXYS, submini . . . \$1
- 2 2N918 TRANSISTORS 1000MC npn TO18 . . . \$1
- 3-5-WATT EPOXY B-5000 Bendix transistors . \$1
- 2 PHOTO ELECTRIC CELLS by GE Very High Z . . \$1
- 3-2 AMP 1000 PIV. axial leads silicon. . . \$1
- 10-10-AMP SILICON RECTIFIERS, studs, asst . \$1
- 4 GE 2N43 OUTPUT TRANSISTORS npn, TO3 . . \$1
- 25 GERMANIUM DIODES, glass asst . . . \$1

1 AMP TOP HAT AND EPOXIES

	PIV	Sale	PIV	Sale	PIV	Sale
	50	5¢	800	21¢	1800	90¢
	100	7¢	1000	32¢	2000	1.50
	200	9¢	1200	45¢	3000	1.90
	400	11¢	1400	65¢	4000	2.50
	600	17¢	1600	75¢		

"GLASS" ONE AMP RECTIFIERS	PIV	Sale	PIV	Sale
	50	5¢	600	17¢
	100	7¢	800	19¢
	200	9¢	1000	29¢
	400	13¢		

RETAIL STORE: 211 Albion St. Wakefield

10c FOR OUR 1968 BARGAIN CATALOG ON: Semiconductors ICs Parts

POLY PAKS TERMS: send check, money order, include postage—avg. wt. per pak 1 lb. Rated, net 30 days. CODs 25% **01940**
 P.O. BOX 942 R
 SO. LYNNFIELD, MASS.

Circle 147 on reader's service card

Meet The Dividers!

ICD SERIES INTEGRATED CIRCUIT DIVIDERS

They are new from International. Use them for crystal controlled time bases, scope calibrators, and clock sources.

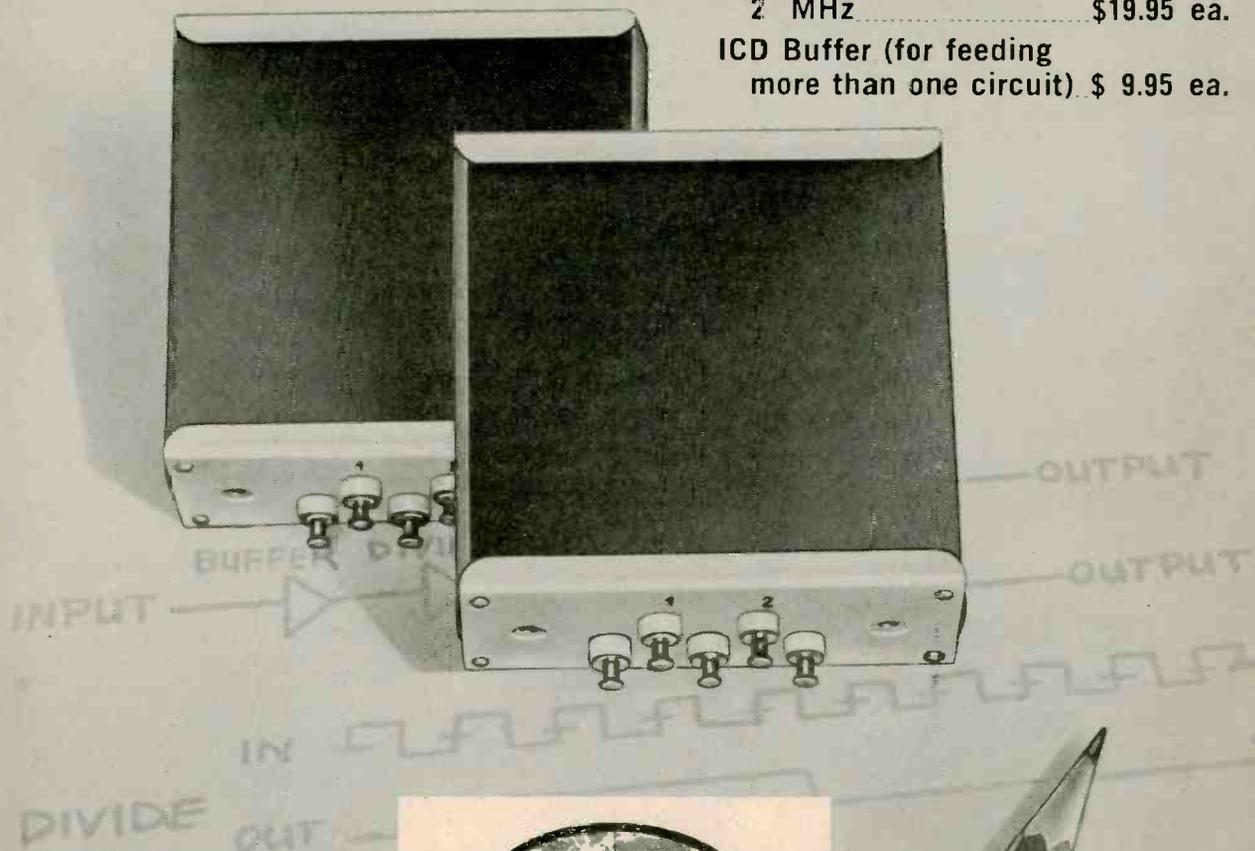
International ICD units are totally integrated circuit frequency dividers. They are smaller than a pack of cigarettes (1" x 2¼" x 2¾"). All have two separate outputs. They are packaged in nine types providing divide ratios 2 thru 10. No tuning or adjustment is required. The output pulse has the same stability as the driving pulse. Voltage required, 3.6 vdc \pm 10%.

FREQUENCY RANGE

ICD-10 to 10 MHz \$19.95 ea.

ICD-2 thru ICD-9 to
2 MHz \$19.95 ea.

ICD Buffer (for feeding
more than one circuit) \$ 9.95 ea.



WRITE FOR COMPLETE CATALOG.

INTERNATIONAL

CRYSTAL MFG. CO., INC.

10 NO. LEE • OKLA. CITY, OKLA. 73102

EICO Makes It Possible

Uncompromising engineering—for value does it!
You save up to 50% with Eico Kits and Wired Equipment.



Cortina Stereo

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

A Silicon Solid-State 70 Watt Stereo Amplifier for \$89.95 kit, \$129.95 wired, including cabinet. Cortina 3070.

A Solid-State FM Stereo Tuner for \$89.95 kit, \$129.95 wired, including cabinet. Cortina 3200.

A 70-Watt Solid-State FM Stereo Receiver for \$159.95 kit, \$239.95 wired, including cabinet. Cortina 3570.



Eicocraft

The newest excitement in kits.
100% solid-state and professional.

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



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



Citizen's Band

Two years ahead! Model 7923
All Solid-State 23-Channel 5W Transceiver. 4 exclusives: dual-crystal lattice filter for razor-sharp selectivity; efficient up-converter frequency synthesizer for advanced stability; precision series-mode fundamental crystals; Small: only 3"H, 8"W, 8¼"D. \$189.95 wired only.

The best buy in tube-type CB—"Sentinel-Pro" 23-channel dual conversion 5W Transceiver \$169.95 wired only.



EICO Trans/Match (Model 715) is a professional test set designed for complete checking of ham and CB equipment. Kit \$34.95; Wired \$49.95.



Truvohm

Professional Portable Multimeters by EICO.

The industry's greatest V-O-M values.

Designed, made to Eico's high standards of professionalism. Each complete with batteries & test leads.

Backed 100% by famous EICO warranty.

Model 100A4, 100,000Ω/V, \$34.95.

Model 30A4, 30,000Ω/V, \$19.95.

Model 30A3, 30,000Ω/V, \$15.95.

Model 20A3, 20,000Ω/V, \$12.95.

Model 4A3, 4000Ω/V, \$8.95.

Model 1A1, 1000Ω/V, \$5.95.



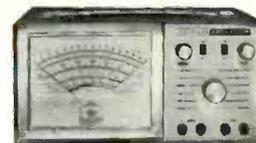
Automotive

EICO 888—Car/Boat Engine Analyzer.

For all 6V/12V systems; 4, 6, 8-cyl. engines.

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

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



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 exclusive Uni-Probe.® \$29.95 kit, \$49.95 wired.

Test Equipment **EICO**®

100 best buys to choose from.

"The Professionals"
—laboratory precision at lowest cost.

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

FREE 1968 CATALOG

RE-12

EICO Electronic Instrument Co., Inc.
131-01 39th Ave., Flushing, N.Y. 11352

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

Name _____

Address _____

City _____

State _____ Zip _____

Circle 149 on reader's service card

www.americanradiohistory.com

Yours FREE with purchase of any RCA 21" color picture tube!

In RCA's "VOLUMES OF VALUE" Program.

*Except test tubes.

LIFE Science Library

SPECIAL OFFER ON

COLOR PICTURE TUBES



Choice of 24 Volumes LIFE Science Library

Flight	Sound and Hearing
Ships	Health and Disease
Time	Man and Space
Wheels	Giant Molecules
The Cell	Drugs
The Body	The Scientist
The Mind	The Planets
Matter	The Engineer
Energy	The Physician
Growth	Food and Nutrition
Water	Mathematics
Weather	Machines

Any two LIFE Science Library books

Earn a gift that not only enriches the mind but one that will become a valued family possession. Choose from the 24 volumes of this nationally advertised library.

Each hardbound Life Science Library book comprises about 200 pages, 35,000 words of text, and hundreds of drawings, photographs, charts and diagrams, many of them in full color. Size is 8½ by 11 inches. The Library is beautifully matched and will bring to your family an ever-ready source of lively and concise information on virtually every scientific subject.

ASK YOUR AUTHORIZED RCA COLOR PICTURE TUBE DISTRIBUTOR FOR THE DETAILS! OFFER GOOD TILL JANUARY 31, 1968.



Or your choice of a Van Heusen® shirt

A huge selection of colors and styles for both men and ladies. All are Vanopress™—the permanently pressed shirt that never needs ironing. A 20-page catalog to choose from.

RCA Electronic Components and Devices, Harrison, N. J.



The Most Trusted Name in Electronics