

Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

CLOSED-CIRCUIT TV
Security On The Job

HERE COMES THE FEMTOWATT
It's New To FM Tuner Specs

BUILD ALL SOLID STATE
Infra-Red Detector

PROTECT YOUR HOME
Build An Electronic Alarm System

GUGLIELMO MARCONI
100th Anniversary

LIQUID-CRYSTAL CLOCK
IN A KIT...see page 3



PLUS

TV Service Clinic
Jack Darr's Appliance Clinic
Two More Electronic Casino Games For You

GERNSBACK

PTS ELECTRONICS

Precision Tuner Service



now available near you

OREGON:
PTS ELECTRONICS, INC.
5220 N. E. SANDY BLVD.
PORTLAND, OREGON 97213
TEL. 503. 282-9636

COLORADO:
PTS ELECTRONICS, INC.
4958 ALLISON ST.
ARVADA, COLO. 80001
TEL. 303. 423-7080

CALIFORNIA—NORTH:
PTS ELECTRONICS, INC.
4611 AUBURN BLVD.
SACRAMENTO, CALIF. 95841
TEL. 916. 482-6220

CALIFORNIA—SOUTH:
PTS ELECTRONICS, INC.
5111 UNIVERSITY AVE.
SAN DIEGO, CALIF. 92105
TEL. 714. 280-7070

OKLAHOMA:
PTS ELECTRONICS, INC.
3007 N. MAY
OKLAHOMA CITY, OKLA. 73106
TEL. 405. 947-2013

KANSAS:
PTS ELECTRONICS, INC.
3116 MERRIAM LANE
KANSAS CITY, KANSAS 66100
TEL. 913. 831-1222

MINNESOTA:
PTS ELECTRONICS, INC.
815 W. LAKE ST.
MINNEAPOLIS, MINN. 55408
TEL. 612. 824-2333

TEXAS—NORTH:
PTS ELECTRONICS, INC.
MOPAC LANE
LONGVIEW, TEX. 75601
TEL. 214. 753-4334

TEXAS—EAST:
PTS ELECTRONICS, INC.
4324-26 TELEPHONE RD.
HOUSTON, TEX. 77032
TEL. 713. 644-6793

LOUISIANA:
PTS ELECTRONICS, INC.
2914 WYCHWOOD DRIVE
METAIRIE, LOUISIANA 70033
TEL. 504. 885-2349

INDIANA:
PTS ELECTRONICS, INC.
5233 S. HWY. 37
BLOOMINGTON, IND. 47401
TEL. 812. 824-9331

OHIO:
PTS ELECTRONICS, INC.
5682 STATE RD.
CLEVELAND, OHIO 44134
TEL. 216. 845-4480

FLORIDA:
PTS ELECTRONICS, INC.
1918 BLANCOING BLVD.
JACKSONVILLE, FLA. 32210
TEL. 904. 389-9952

NEW YORK:
PTS ELECTRONICS, INC.
993 SYCAMORE ST.
BUFFALO, N.Y. 14212
TEL. 716. 891-4935

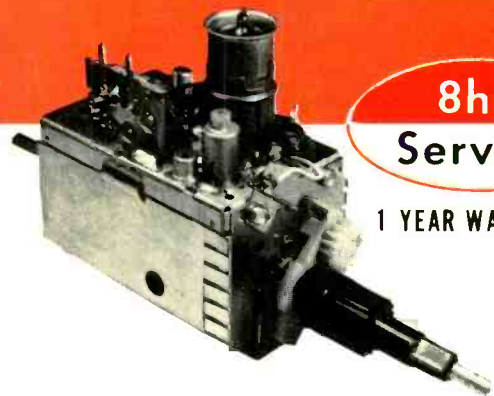
MASSACHUSETTS:
PTS ELECTRONICS, INC.
191 CHESTNUT ST.
SPRINGFIELD, MASS. 01103
TEL. 413. 734-2737

NEW YORK CITY—NEW JERSEY:
PTS ELECTRONICS, INC.
158 MARKET ST.
E. PATERSON, N.J. 07407
TEL. 201. 791-6380

PENNSYLVANIA—EAST:
PTS ELECTRONICS, INC.
1921 S. 70TH ST.
PHILADELPHIA, PA. 19142
TEL. 215. 724-0999

MARYLAND:
PTS ELECTRONICS, INC.
1105 SPRING ST.
SILVER SPRING, MD. 20910
TEL. 301. 565-0025

PENNSYLVANIA—WEST:
PTS ELECTRONICS, INC.
257 RIVERVIEW AVE. W.
PITTSBURGH, PA. 15202
TEL. 412. 761-7648



8hr Service

1 YEAR WARRANTY

9⁹⁵VHF-UHF-FM
16⁹⁵UV-COMB.

PTS will repair any tuner—no matter how old or new—black & white or color—transistor or tubes—varactor or detent UHF—8 hour service is a must!



PARTS

PTS is the only tuner service to publish an 80-page Tuner Replacement Guide and Parts catalog—and sell you any or all parts (3rd edition of top information available for one dollar)

8hr Service

1 YEAR WARRANTY

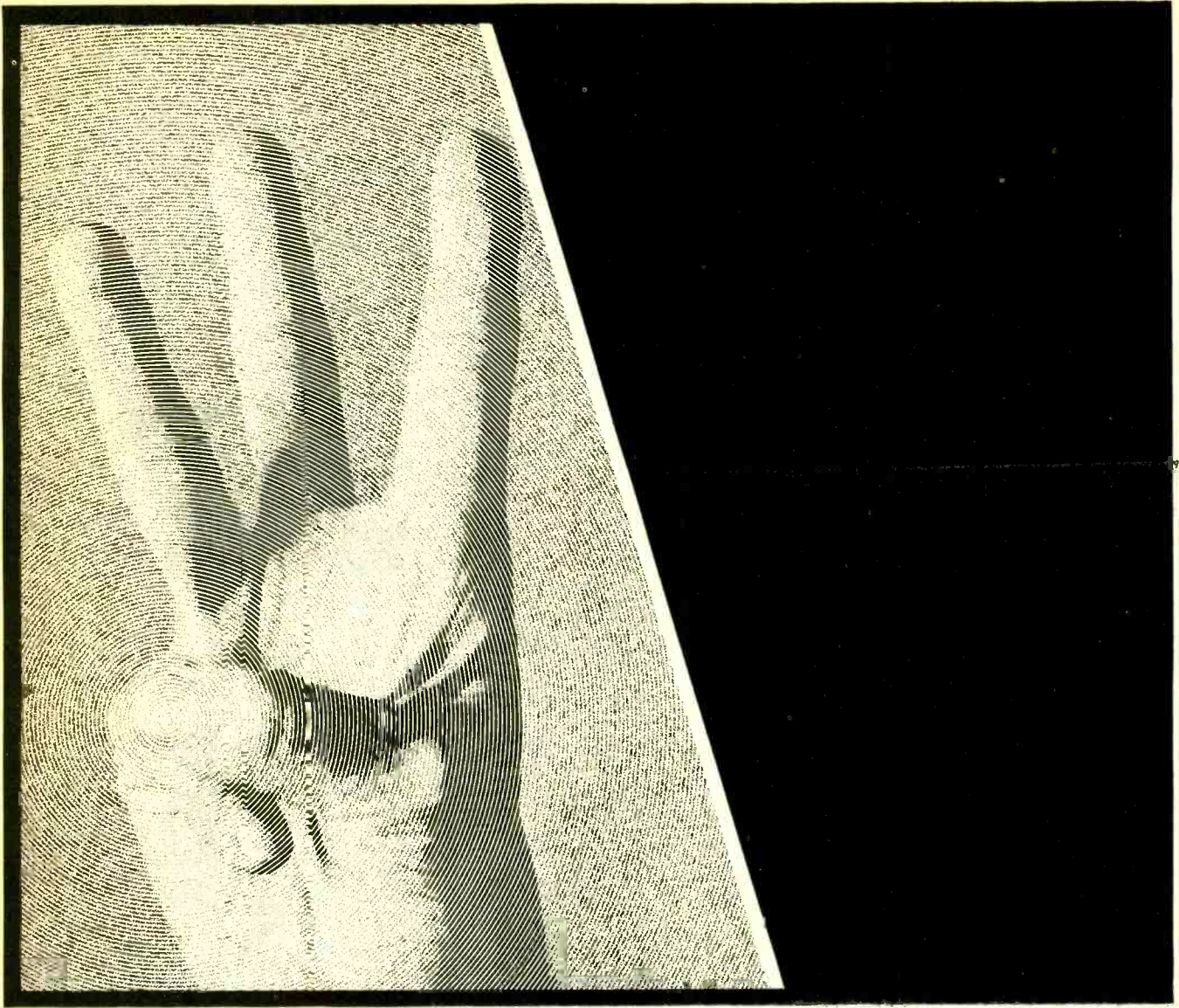
12⁵⁰IF-SUBCHASSIS

PTS was 1st to repair IF modules and make a success of it. We do it right the 1st time. (All prices are dealer net! Major parts, tubes and transistors charged at net cost)

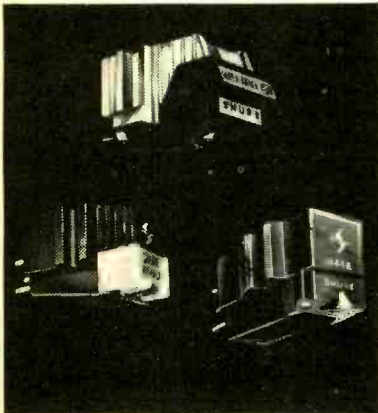
PTS-NUMBER ONE

AND STILL TRYING HARDER!

(NOT A FRANCHISE COMPANY)
Circle 1 on reader service card



Best. Best. Best.



Permit us this momentary bit of self-indulgence, because our intentions are pure: to assist you in choosing the best phono cartridge for your hi-fi system, within the practical limitations of your audio budget. To begin, if you feel uncomfortable with anything less than state-of-the-art playback perfection, we heartily recommend the Shure V-15 Type III, a cartridge of such flawless performance it is the perfect companion to the finest turntables and tone arms available today — and those coming tomorrow. At a more moderate level of performance and price, we suggest the Shure M91ED, a superb performer second in trackability only to the Type III. Finally, for optimum performance under a budget austerity program, the yeoman Shure M44E is for you. All in all, these are three great ways to enjoy music with the kind of system you have decided is best for you.

Shure Brothers Inc.
222 Hartrey Ave., Evanston, Ill. 60204
In Canada: A. C. Simmonds & Sons Ltd.



Circle 2 on reader service card

IC replacement guide

INDEX

Integrated Circuit Replacement Guide by Part Number	2
Integrated Circuit Replacement Guide by Equipment	
Manufacturer	4
Admiral	4
Automatic Radio	4
Bendix (Auto Radio)	4
Chrysler (Auto Radio)	5
Curtis-Mathes	5
Deico (General Motors)	5
Electrohome	5
Fisher	5
General Electric	5
Heathkit	5
H. H. Scott	5
KLH	5
Magnavox	5
Marantz	6
McIntosh	6
Motorola	6
Packard-Bell/Teledyne	6
Philco	
Home Entertainment Products	6
Automobile Radio	7
RCA	7
Sears	7
Sylvania	7
Voice Of Music (V-M)	7
Walter	7
Wells-Gardner	7
Zenith	8
Imported "IC" Replacement Guide	8
Auto Radio Kit	8
Major Brand Home Entertainment Kit	8

SYLVANIA
ECGTM
semiconductors

Here's one book you can really tell by its cover.

We don't have to waste time telling you about our new integrated circuit replacement guide.

Just read the index on the cover.

If that doesn't convince you, nothing will.

Available from your local Sylvania distributor.

Sylvania Electronic Components, 100 First Ave., Waltham, Mass. 02154

GTE SYLVANIA

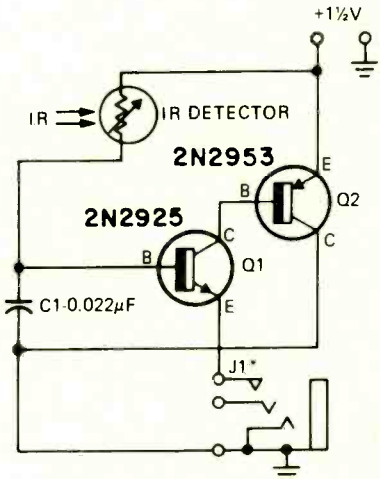
Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

More than 65 years of electronics publishing

APRIL 1974

SOLID-STATE ELECTRONICS	53	Liquid Crystal Digital Clock In A Kit \$89.95 kit you turn into a CMOS IC battery-powered clock with a liquid-crystal display.		
	58	Electronic Casino Part II: Here are the final two games that complete your private gaming casino. <i>by Waller Scott</i>		
BUILD ONE OF THESE	33	Electronic Security System Protects Your Home Easy-to-make system safeguards against unwanted intruders. <i>by Michael S. Robbins</i>		
	56	IR Finder For Your Pocket Infrared detector you can hold in the palm of your hand. <i>by Forrest M. Mims</i>		
HI-FI AUDIO STEREO	50	Here Comes The Femtowatt A preview of a new proposed FM tuner specification. <i>by Len Feldman</i>		
100TH ANNIVERSARY	46	Guglielmo Marconi 100 years ago, this famous radio pioneer was born. Here's a brief look at his remarkable contributions. <i>by Stanley Leinwoll</i>		
GENERAL ELECTRONICS	4	Looking Ahead Tomorrow's news today. <i>by David Lachenbruch</i>		
	22	Appliance Clinic Nicad batteries. <i>by Jack Darr</i>		
	43	All About Transformers How they work, what they do, and how they are used. <i>by Earl Jacob Waters</i>		
TELEVISION	16	Equipment Report TeleMatic KC-270 Crys-Mate		
	25	Service Clinic Focus facts and fallacies. <i>by Jack Darr</i>		
	26	Reader Questions R-E's Service Editor solves reader problems.		
	36	CCTV On The Job Case history applications of closed-circuit TV in bank security, police work, and department store protection. <i>by Robert S. Haines</i>		
	64	Step-By-Step Troubleshooting Charts Color TV and your scope. <i>by Stan Prentiss</i>		
DEPARTMENTS	102	Advertising Index	79	New Literature
	24	Letters	76	New Products
	6	New & Timely	82	Next Month
		105 Reader Service Card		



BUILD THIS IR FINDER to study the practical applications of infra-red light. The entire unit can be built into a palm size flashlight. . . see page 56

Hugo Gernsback (1884-1967)
founder
M. Harvey Gernsback, editor-in-chief and publisher
Larry Steckler, CET, editor
Robert F. Scott, W2PWG, CET, technical editor
Jack Darr, CET, service editor
I. Queen, editorial associate
Leonard Feldman, contributing high-fidelity editor
David Lachenbruch, contributing editor
Barbara Schwartz, editorial assistant
Vincent P. Cicenja, production manager
Sarah Martin, production assistant
Harriet I. Matysko, circulation director
Arline R. Fishman, advertising coordinator

Cover photograph by Walter Herstatt
Cover design by Louis E. Rubsam

Radio-Electronics is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.



Radio-Electronics, April 1974, Vol. 45, No. 4. Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York City 10003. Second-class postage paid at New York, N.Y. and additional mailing office. One-year subscription rate: U.S.A., U.S. possessions and Canada, \$7. Pan-American countries, \$8. Other countries, \$8.50. Single copies 60c. © 1974 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Boulder, Colo. 80302.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

As a service to readers, **Radio-Electronics** publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, **Radio-Electronics** disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

looking ahead

Domestic satellite

The United States' first "domestic satellite" communications system is now in operation — but the satellite itself is Canadian. RCA has inaugurated the "Satcom" system, linking the East and West Coasts and Alaska. For its initial phase, RCA has leased two rf channels on Canada's Anik-2 domestic satellite, sending and receiving via its own earth stations in New York, San Francisco, Juneau and Anchorage. Although some network television programs have already been relayed to Alaska via the satellite, it's expected that the initial service will be primarily devoted to public telephone communications, data links and private-line telephone. Some time in 1976, the Satcom system is scheduled to have three of its own satellites and additional earth stations near Atlanta, Chicago, Dallas, Denver, Los Angeles, Seattle and Washington, as well as Valdez, Prudhoe Bay, Nome and Bethel, Alaska.

By leasing channels from Canada's satellite, RCA got the jump on Western Union, which plans to inaugurate domestic service using its own satellites this summer. Both systems, as well as others planned for the future, will offer all types of electronic communications services, including network television relay, as an alternative to current land-line links.

Video outlook dim

That gee-whiz product of the future, the low-cost home videoplayer, now seems likely to remain a product of the future at least through the end of this year, despite numerous false starts in the last few years. The energy crisis, parts and materials shortages, unexpected technical bugs and

marketing timidity appear to have pushed the mass-market videoplayer into next year at least. This wonder product has been "imminent" for at least the last five years, and, except for its appeal to those consumers well heeled enough to pay \$1,500 or \$2,000, the video recorder and player will probably continue to be a commercial-industrial-education market item into 1975.

The only 1972-1973 venture into the consumer market, Cartridge Television Inc.'s home videotape system, bit the dust last year in a bankruptcy proceeding. RCA's MagTape SelectaVision home VTR deck, originally scheduled for introduction in late 1973, has undergone a long series of delays as a result of supply problems, design modifications and other vexations, and is now tentatively scheduled for "test marketing" next December, with no firm decision as to whether it actually will be offered to the mass consumer market at all.

The videoplayer which seemed most likely to succeed in 1974 — the TeD videodisc system developed by Germany's Telefunken and Britain's Decca — now is also back on the drawing board. Although mass marketing in Germany had been announced last fall and deliveries to consumers had been scheduled to start at the first of this year, Telefunken was forced to stop production after mechanical problems were discovered. Telefunken is still talking about getting its system on the market around midyear, but there is strong evidence that it may decide to hold off for the rest of the year until a strong library of pre-recorded videodiscs can be built up.

Japan, which usually is in the forefront of consumer electronics developments, has been playing the "home video

revolution" real cool. Sanyo Corporation, the TeD hardware licensee for Japan, still maintains its marketing target is "late 1974" — but concedes that slippage (or a complete review of the whole situation) is possible. Other Japanese manufacturers — Japan Victor, Sony, Panasonic — are already offering "home color VTR's" through department stores in their home market. These, however, are actually standard closed-circuit videocassette machines in consumer dress, and they're priced at around \$1,400 for a deck attachment, or \$2,200 to \$2,500 for a console version including a color set — far above any mass-market price. And these recorders can't be expected to come down in price in their present form.

Materials and power shortages have sharply reduced the incentive for manufacturers to offer innovative products on the consumer market. "Look at it this way," said one manufacturer. "We know there's a market for color TV sets and stereo. A home videodisc or videotape system is an unknown quantity. OK, so we've a limited quantity of plastic or semiconductors or something else that could be used in either product. We're going to play it safe and put it in the product we know we can sell."

TV set safety

How safe are television receivers? The question is under investigation again — this time by the government's new Consumer Product Safety Commission. A preliminary report from the Commission's field offices, involving 42 counties, unearthed 916 fires in the 12 months ended Aug. 31, 1973 which appear to have been caused by TV sets. Another report by the Commission, based on consumer complaints, hospital records

and newspaper clippings, analyzes accidents involving 51 TV sets, almost all of them color, in which it is stated that 23 people were killed and 51 injured. Most of the incidents were the result of fires, but five involved electric shocks, one an "explosion."

In other data released by CPSC, the National Electronic Injury Surveillance System is quoted as listing 857 injuries related to television in the year ended last August 31. Of these, six involved burns, five electric shocks; the remainder seemed to be the result of falling TV sets, injuries received by consumers trying to lift heavy sets, and so forth.

Philco name sold

One of the oldest brand names in consumer electronics — Philco — is being sold for the second time. Founded in 1892 as a producer of batteries, Philco made its first radio in 1928 and was sold to Ford Motor Co. in 1961. At press time, Ford had agreed to sell U.S. rights to the Philco name, as well as its American sales organization, to White Consolidated Industries of Cleveland. The current Philco-Ford organization plans to continue domestic manufacture and sale of car radios and other automotive products, and will sell color TV sets to White, which will market them. White is scheduled to take over the Philco-Ford plants in Taiwan (Formosa) and in Watsonstown, Pa. White manufactures machine tools as well as Kelvinator, Gibson and Hamilton home appliances. Philco's Latin American subsidiaries will continue to be owned and operated by Ford, as will its aerospace and communications operations.

by DAVID LACHENBRUCH
CONTRIBUTING EDITOR

Take a leaf from the Mallory Money Tree and save on famous Mallobins.[®]

Our Mallobin benchtop organizers are worth many times their modest cost in keeping electronic components neatly sorted, labeled, protected and ready for use. Now, you can save on buying them, too. For

instance, this PTC semiconductor Mallobin organizer can be purchased at a special discount at your Mallory Distributor. Just present the Mallory Money Tree coupon below.



MALLORY DISTRIBUTOR PRODUCTS COMPANY

a division of P. R. MALLORY & CO. INC.
Box 1284, Indianapolis, Indiana 46206; Telephone: 317-636-5353

Batteries • Capacitors • Controls • Security Products • DURATAPE[®] • Recorders • Resistors • SEMICONDUCTORS • SONALERT[®] • Switches • Timers



DURATAPE[®] and SONALERT[®] are registered trademarks of P. R. Mallory & Co. Inc.

Money Tree Coupon

This coupon valid through Sept. 1, 1974. Only one coupon valid on each purchase. This coupon not valid where prohibited or taxed by law. Coupon does not apply to sales tax, if applicable.

TO MALLORY DISTRIBUTOR

This coupon redeemable for \$1.00 credit towards the purchase of any Mallory products or \$1.00 in cash provided it is tendered to Mallory Distributor Products Company, a division of P. R. Mallory & Company Inc., Indianapolis, Indiana prior to Oct. 1, 1974. Invoices showing purchase of Mallobin organizers sufficient to cover coupon must be shown on request.

Worth

\$100 OFF

on any purchase of any Mallory Mallobin organizer at a Mallory Distributor.

RE44

new & timely

Recording cuts coming

A threatening shortage in the production of vinyl, the petroleum-based raw material for modern records, is causing postponements and uncertainty in the recording industry. "Nobody says, 'We don't have any vinyl' but some pressers have gone to two or three days production a week" reports the head of one company that depends on outside pressers for its records.

Some reporters are hoping that the threatened shortage may increase the talent/vinyl ratio in records, as companies eliminate marginal recordings in favor of the better artists. However, the situation may well make it hard for the new performer—talented or otherwise—as record companies concentrate on pressings of name artists that are sure of a good market.

Oddly, a major cause of the tight situation—other than international politics—is said to be an exploding demand for plastic plumbing pipe, which—like phono records—is made of polyvinyl chloride. ●

First domestic satellite system launched over U.S. and Alaska

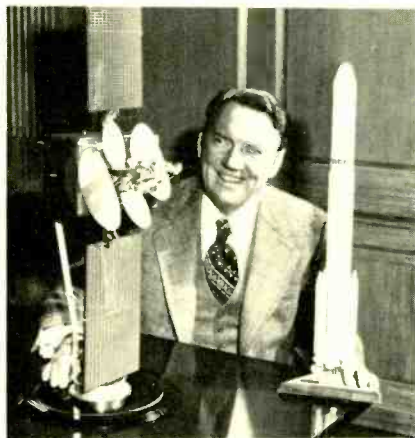
The nation's first domestic satellite communications system was inaugurated January 8, in ceremonies attended by the Governor of Alaska, the Lieutenant Governor of California, the Chairman of the FCC, Senator Jacob Javits of New York, and other public figures from Alaska and elsewhere.

In the first phase of the joint operation by RCA Global Communications and RCA Alaska Communications, channels are being leased on Canada's Anik II satellite, which is in stationary orbit over the Equator at 109° west longitude, and

"sees" the whole Western Hemisphere. Later, RCA satellites, the first of which is expected to go into operation in late 1975, will take over.

The present earth stations are near New York City, San Francisco, Anchorage and Juneau. Other stations are planned, especially in Alaska.

The Satcom system is now using the 5925-6245-MHz (5.925 and 6.245 GHz) band for transmission from earth stations to satellite, and the 3700-4200-MHz band from satellite to earth.



THE 1976 satellite and launcher, exhibited in model form by Howard R. Hawkins, Executive Vice president of RCA. The three satellites will carry 24 transponders each and will be lifted into space by Thor/Delta rockets.

A combination of frequency division multiplexing-frequency modulation (FDM/FM) and FM single-channel-per-carrier techniques are used, with a capability of up to 1000 one-way FDM/FM voice channels and 600 one-way voice channels with the single-channel per-carrier technique.

A second phase, is expected to go into operation in 1976. It will use three satellites, each with 24 transponders, each capable of handling 1000 FDM/FM and 600 single voice channels, as well as a television channel and a high-speed data stream. The number of ground stations will also be augmented.

The new system will reduce costs of communications across the United States, as well as between the 48 states and Alaska, and makes live television more practical economically for Alaska. It will also permit upgrading telephone facilities in that state, and will facilitate introducing specialized services, such as transmitting programs for CATV operators. ●

Mrs. David Sarnoff

Lizette Sarnoff, widow of David Sarnoff, died January 8 in New York City, after a brief illness. She was the wife of David Sarnoff from July 4, 1917, until his death in December 1971. Speaking only French when she met the young David, she is credited with teaching him just enough French to propose.

Mrs. Sarnoff, an accomplished amateur sculptress, was a trustee of the Sculpture Center of New York City, a member of the Women's Executive Committee of the United Hospital Fund, a member of the Manhattan chapter of the Board of the National Women's Committee of Brandeis University, a member of the Executive Committee and honorary national chairman of the Women's Division, Albert Einstein College of Medicine, and honorary vice president of its New York chapter.

Mrs. Sarnoff is survived by her three sons: Robert W. Sarnoff, New York, Chairman and Chief Executive Officer of RCA; Edward Sarnoff, New York, Chairman of the Board, Fleet Services Inc., and Thomas W. Sarnoff, Beverly Hills, California, Staff Executive Vice President, West Coast, the National Broadcasting Company. Also surviving are nine grandchildren. ●

Fourth Annual Hugo Gernsback Scholarship Awards

Radio-Electronics announces the fourth Annual Hugo Gernsback Scholarship Awards for 1974. The program consists of a \$125 grant to the most deserving student at each of eight technical home-study schools serving the electronics field.

Eight second awards to the second most deserving student at each of these homestudy schools, have been provided by RCA Electronic Components, Harrison

(continued on page 12)

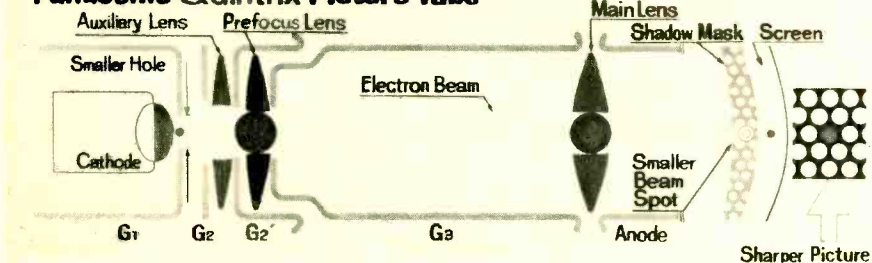
Multi-grid television tube improves picture brightness

The Quintrix picture tube was unveiled by Panasonic in its first 19-inch Quatrecolor television receiver at the recent Chicago Consumer Electronics Show.

The new tube is stated to maintain sharp focus on high brightness pictures.

This is due to an additional focusing grid that minimizes blooming. A high-voltage chassis and high electron current increase the brightness. Picture contrast is improved by a negative guard-band matrix.

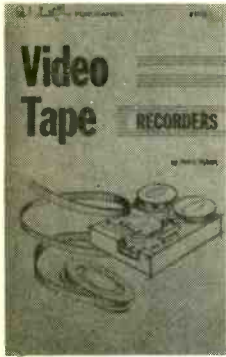
© Panasonic Quintrix Picture Tube



PANASONIC QUINTRIX PICTURE TUBE uses an additional grid to produce effects.

Essential Electronic Servicing Help from Sams

Here are seven extremely helpful books that can make a serviceman's work much easier. Five of them are just off the press, one is a new second edition, and one came out in '73. It'll pay you to check them out.



VIDEO TAPE RECORDERS

By Harry Kybett

This basic text on the fast-growing field of helical vtr's contains information seldom found in service manuals, which only cover specific models. It explains the fundamentals of video tape recording; describes electronic circuits and mechanical systems in currently available machines; lists basic problems encountered and their solutions; and presents recent developments in the field. 352 pages, softbound.

No. 21024 \$8.95

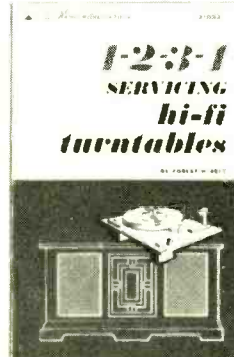


ELECTRONIC FLASH EQUIPMENT

By Verl Mott

A fully informative book on the use of flash/strobe equipment, the problems sometimes encountered, and the service information needed to overcome those problems. Its information on the basic flash unit, flash tubes, triggering circuits, power sources, storage, and service can save you time and frustration. 112 pages, softbound.

No. 21020 \$4.50

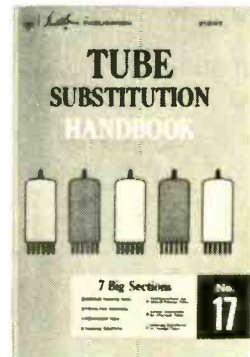


1-2-3-4 SERVICING HI-FI TURNTABLES

By Forest H. Belt

Greatly simplifies understanding of the mechanisms in terms of four divisions: record changers by sections, assemblies within sections, breakdown of assemblies, and mechanical parts. The following chapters cover specifics for each type of drive system, tone arm and turntable. In addition, problem diagnosis—locating, isolating, and pinpointing faults is explained so that servicing can be accomplished quickly and easily. 192 pages, softbound.

No. 21032 \$4.95

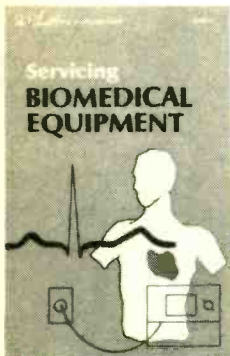


TUBE SUBSTITUTION HANDBOOK, 17th Edition

By the Howard W. Sams Engineering Staff

Quick and accurate information for making suitable substitutions when exact replacements are not available. Lists over 18,000 replacements in seven sections: American receiving and picture tubes, industrial tubes, cross-reference of subminiature tubes, communications and special tubes, cross-reference between American and foreign tubes. 96 pages, softbound.

No. 21007 \$1.95



SERVICING BIOMEDICAL EQUIPMENT

By Elliott S. Kanter

Introduces the biomedical technician to the specialized types of electronic and electromechanical devices used in present-day hospitals. Describes test procedures, service and maintenance techniques, and safety factors of centrifuges, electrocardiographs, defibrillators, monitoring devices, oxygen and vacuum devices. 160 pages, softbound.

No. 21011 \$5.50



COLOR-TV SERVICING GUIDE 2nd Edition

By Robert G. Middleton

This guide uses color photos of symptoms of circuit defects as they appear on the picture-tube screen. If the serviceman follows these picture clues and uses proper troubleshooting methods, he can service sets correctly and in less time. Covers both tube and solid-state circuits. 112 pages, softbound.

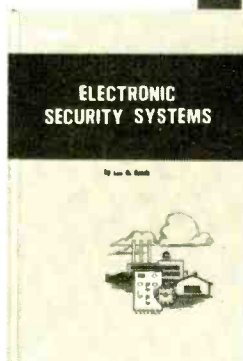
No. 20990 \$4.95

ELECTRONIC SECURITY SYSTEMS

By Leo G. Sands

The principle and operation of the various electronic devices used for industrial and home security systems are covered in detail. Chapters on: scope and application, switches and relays, sensors and encoders, indicators and alarms, electrical and electronic control and alarm circuits, security communication and systems installation, closed-circuit tv, transmission media. 416 pages, hardbound.

No. 23205 \$5.95



HOWARD W. SAMS & CO., INC.
4300 W. 62nd St., Indianapolis, Ind. 46206

Order from your Electronics Parts Distributor, or mail to Howard W. Sams & Co., Inc.

Send books checked at right, \$_____ enclosed. Please include sales tax where applicable. Canadian prices slightly higher.

Send FREE 1974 Sams Book Catalog.

Name _____

Address _____

City _____ State _____ Zip _____

RE-044

21024

21020

21032

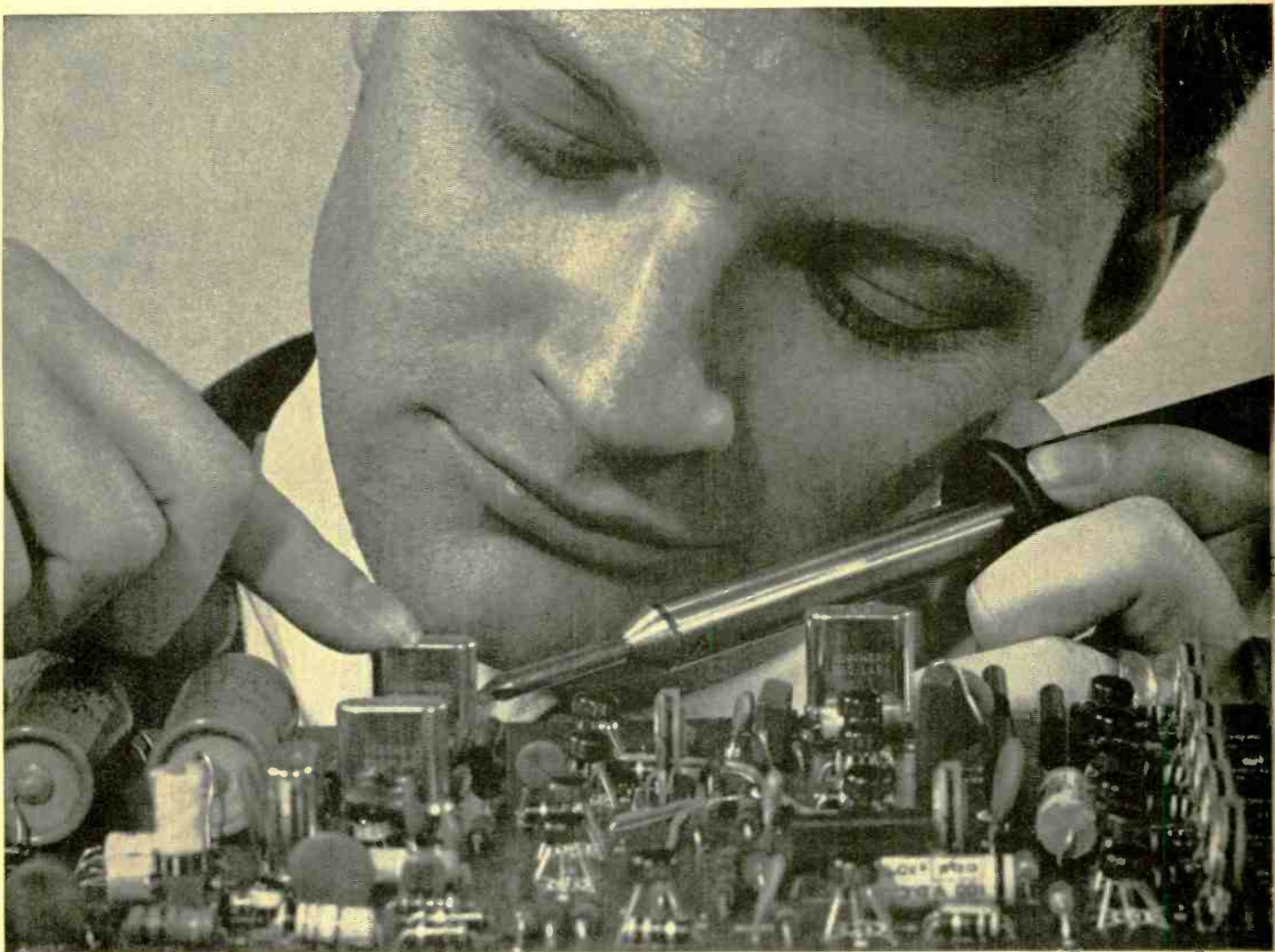
21007

21011

20990

23205

**NRI "hands-on" training in
Television, Communications,
Electronics and Computers
can give you as much
as 2 years of on-the-job
experience.**



EARN YOUR FCC LICENSE – OR YOUR MONEY BACK

NRI Communications training programs will qualify you for a First Class Commercial Radiotelephone License issued by the FCC. If you fail to pass the FCC examinations for this license after successfully completing an NRI Communications course we will, on request, refund in full the tuition you have paid. This agreement is valid for the period of your active student membership and for six months after completion of your training. No school offers a more liberal FCC License agreement.

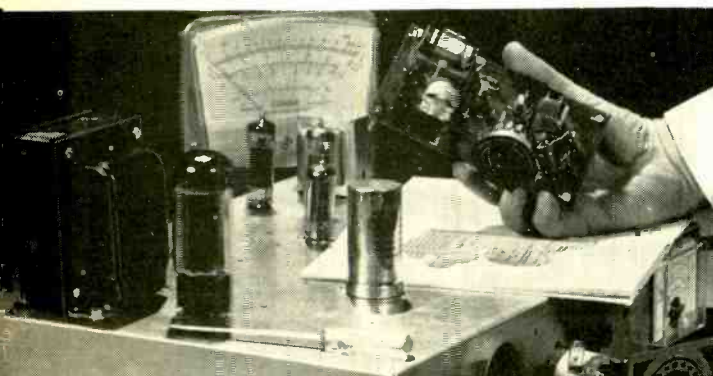
Experience is still your best teacher



NRI Achievement Kit is educator-acclaimed and the original "starter" kit in home study training. Imitated but never duplicated, this kit is designed and personalized for you and your training objective. It has one purpose — to get you started quickly and easily.



"Bite-Size" Texts average an easily-digested 40 pages of well-illustrated, scientifically prepared subject matter in the course of your choice. Questions in each book are carefully hand-graded and returned to you with helpful instructional notes. You get unlimited personal help from the day you enroll.



Designed-For-Learning Equipment

Like this phone-cw transmitter (Kit #7 in the Communications course) is engineered from chassis up to demonstrate principles you must know. NRI does not use modified hobby kits for training, but the finest parts money can buy, professionally and educationally applied.

...here's how you get it with unique NRI training at home

Ask any teacher, job counselor, engineer, technician or prospective employer about the need for practical application of theory in Electronics. He'll tell you Electronics is as much a "hands-on" profession as dentistry or chemistry. That's how you learn at home with NRI. You prove the theory you read in "bite-size" texts, by actual experimentation with the type of solid-state, transistor and tube circuits you'll find on the job today — *not* hardware or hobby kits. You introduce circuit defects, analyze results, discover quickly the kind of trouble-shooting and design techniques that will make you employable in Electronics.

Train with the leader — NRI

NRI lab equipment is designed from chassis up for effective, fascinating training — not for entertainment. The fact that end results are usable, quality products is a bonus. In Communications, for example, you build and analyze, stage by stage, your own 25-watt phone/cw transmitter. It's suitable for use on the 80-meter amateur band, if you have an interest in ham radio. In TV-Radio Servicing your practical training gives you your choice of monochrome or color TV sets. All training equipment is included in the low tuition — you pay nothing extra. Discover for yourself the ease, excitement and *value* of NRI training. Mail postage-free card today for new NRI Catalog . . . or use the coupon below. No obligation. No salesman will call on you. NATIONAL RADIO INSTITUTE, Washington, D.C. 20016.

APPROVED UNDER NEW GI BILL

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

MAIL THIS COUPON IF CARD IS GONE



NATIONAL RADIO INSTITUTE 3-044
Washington, D.C. 20016

Please send me your new NRI Catalog. I understand no salesman will call and there is no obligation.

Name _____ Age _____

Address _____

City _____ State _____ Zip _____

Check for facts on new GI Bill

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

N. J. This award consists of an RCA WV-529A Service Special VOM, user price \$53.50 each.

The scholarships were established by **Radio-Electronics**, in memory of the late Hugo Gernsback, electronic pioneer, inventor and publisher to perpetuate Mr. Gernsback's interest in developing the technological skills of young people.

Hugo Gernsback founded **Radio-Electronics** magazine in 1929 for electronics service technicians, engineers, and advanced hobbyists. The 1974 scholarship award winners will be announced in the magazine during the course of the year.

The eight schools participating in the program are: Bell & Howell Schools, Cleveland Institute of Electronics, CREI Capitol Radio Engineering Institute, Grantham School of Engineering, International Correspondence Schools, NRI Training, National Technical Schools and Sylvania Technical School. ●



GEORG NEUMANN OF MICROPHONE FAME receives the **Maker of the Microphone Award** for 1973. The award, given each year by Deutsche Grammophon for an outstanding contribution to the world of sound, is presented by Peter Burkowitz (left), engineering director of the firm, in memory of Emile Berliner, inventor of the microphone and disc record, and founder of the company. Neumann is discussing the award with his managing director, G. Luetzkendorf (right). ●

CET's now number more than 7K

The International Society of Certified Electronics Technicians (ISCET) reports that over 7,000 certified technicians are now registered. According to Ron Crow, executive director of the program, there are CET's in all 50 States, in Canada and Mexico, and in 15 other countries.

Certified Electronic Technicians are persons with a total of four years experience or schooling in electronics technology and who have passed the written examination administered by ISCET (a subsidiary of NESDA, the National Electronic Service Dealers Association).

The examination consists of a basic section, which all examinees must take, plus several options: Consumer Electronics, Audio-Hi Fi, Communications, Industrial and MATV reception.

The program is already making itself felt, and according to Dick Glass, CET, executive vice president of NESDA, some employers are beginning to pay a higher hourly rate to CET's than to non-certified employees.

CET exams are given quarterly, on June 15, Sept. 15, Dec. 15 and March 15. Most

test locations are in public or commercial educational institutions. (Tests in the New York City area may be taken at RADIO-ELECTRONICS.) The exam fee is \$10. For further details, or to reserve a seat at the next test session, technicians are invited to write to ISCET, 1715 Expo Lane, Indianapolis, IN 46224. ●



MEETING OF CETA AT POUGHKEEPSIEhears Radio-Electronics' Editor Larry Steckler discuss warranties. CETA (Consumer Electronics Technicians Association) has been active in the Poughkeepsie—Kingston area of New York, and had already brought up the matter of warranty abuse in a Newsletter last Fall. Left to right in the photo are Mrs. Ken Parese, CET; Ken Parese, CET, treasurer of CETA; Larry Steckler, CET, at podium; Ron Palluth, CET, president of CETA; Mrs. Palluth, and Dick Jones, vice president of CETA.

Radio-Electronics is published by Gernsback Publications, Inc. 200 Park Ave. S. New York, N.Y. 10003 (212) 777-6400
President: M. Harvey Gernsback
Secretary: Bertina Baer

ADVERTISING SALES

EAST
Stanley Levitan, Sales Manager
Radio-Electronics
200 Park Ave. South
New York, N.Y. 10003
(212) 777-6400

MIDWEST/Texas/Arkansas/Okla.
Ralph J. Bergen
The Ralph J. Bergen Co.
6319 N. Central Ave.
Chicago, Ill. 60646
(312) 792-3646

PACIFIC COAST/Mountain States
Jay Eisenberg
J.E. Publishers Representative Co.,
8732 Sunset Blvd., 4th Floor
Los Angeles, Calif. 90069
(213) 659-3810

420 Market St.,
San Francisco, Calif. 94111
(415) 981-4527

SOUTHEAST
E. Lucian Neff Associates
25 Castle Harbor Isle,
Fort Lauderdale, Florida 33308
(305) 566-5656

MOVING?

Don't miss a single copy of **Radio-Electronics**. Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH
LABEL
HERE

name (please print)

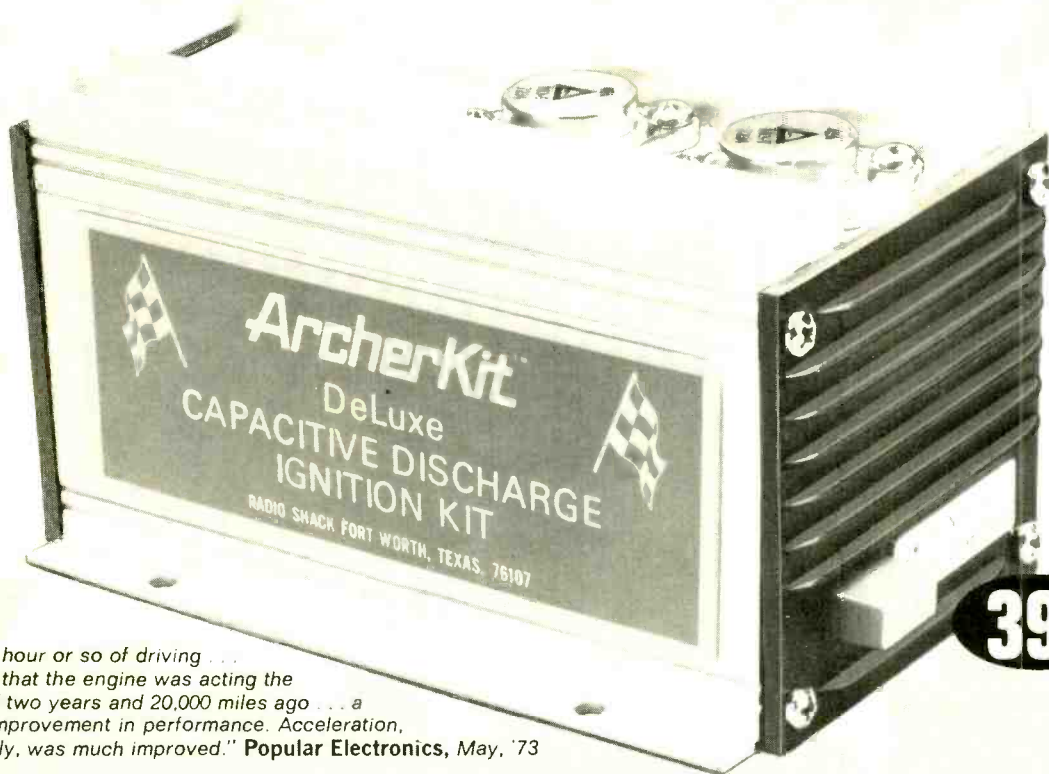
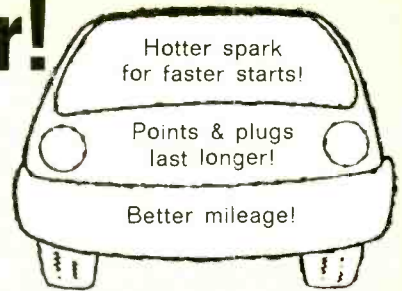
address

city state zip code

Mail to: **Radio-Electronics**
SUBSCRIPTION DEPT., BOULDER, COLO.
80302

Build yourself a better car!

Build an ArcherKit™ from Radio Shack



"After an hour or so of driving . . . we noted that the engine was acting the way it did two years and 20,000 miles ago . . . a definite improvement in performance. Acceleration, specifically, was much improved." **Popular Electronics**, May, '73

Radio Shack's Deluxe Capacitive Discharge Ignition puts more "Go" in every gallon! It delivers 50% more spark power for faster acceleration and more complete combustion. That means you get better gas mileage, and your points and plugs will last 3 to 10 times longer. An in/out button lets you make instant performance comparisons with your old ignition. And it makes tuneups easier. The thorough step-by-step manual makes it easy for even a first-time kit builder to assemble and install—no wires to cut. Improves any 12-volt negative ground vehicle. #28-3203.

Deluxe, High-Intensity Timing Light Kit



Tune-up aid for any engine. For full power & economy. Bright flash is visible even in daylight! #28-4016.

1995 With All Cables

Retail prices may vary at individual stores.



376

FREE '74 CATALOG

AT YOUR NEARBY STORE OR
MAIL THIS COUPON

180 Pages . . . Full Color! Hi-Fi, CB, Kits,
Recorders, Antennas, Parts, More!

PLEASE PRINT CLEARLY

Name _____ Apt. # _____

Street _____

City _____ State _____ ZIP

ArcherKit

by

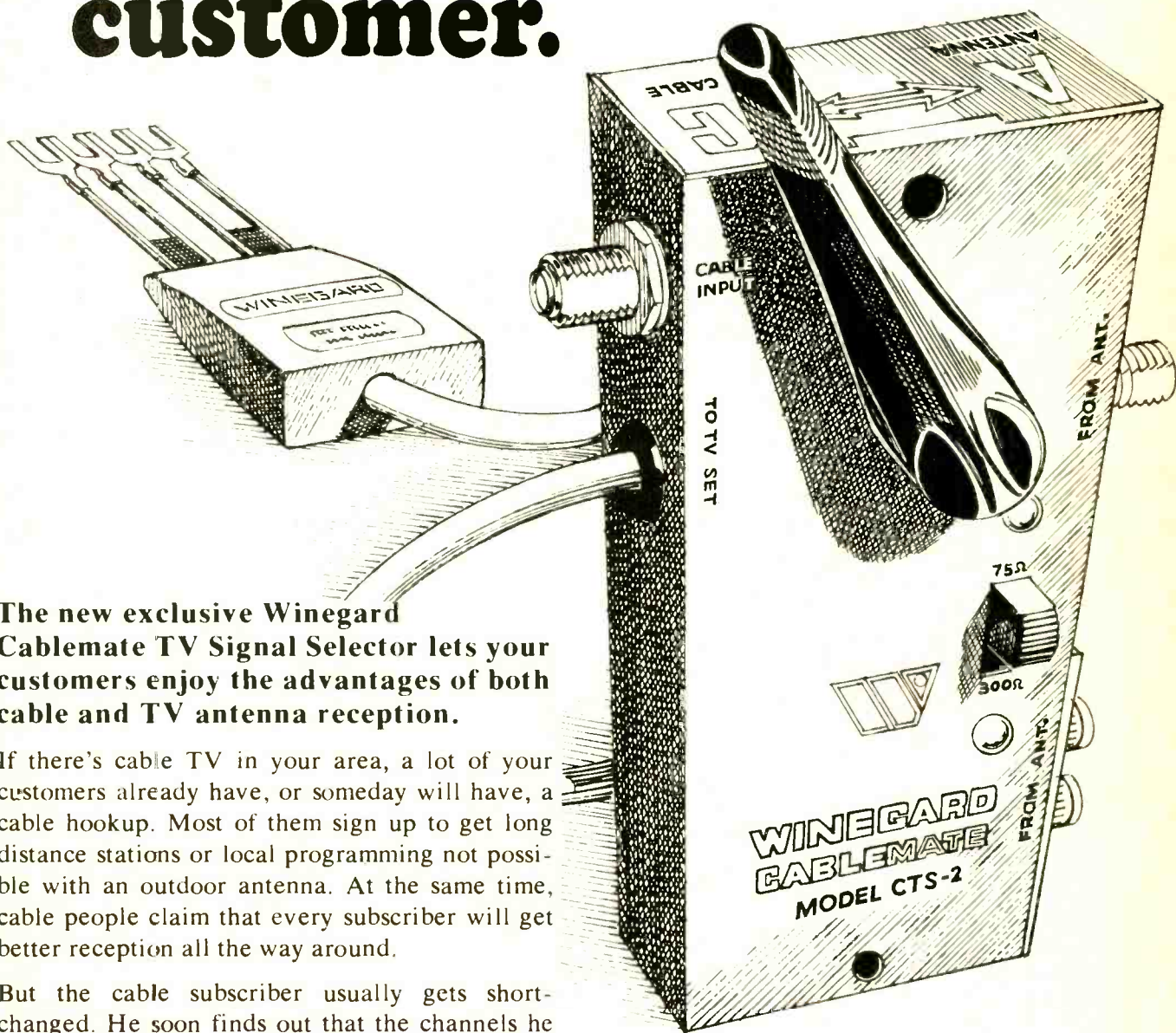
Radio Shack®

and ALLIED RADIO STORES
A TANDY CORPORATION COMPANY

P. O. Box 1052, Fort Worth, Texas 76107

Circle 5 on reader service card

This unusual switch cable TV user into your customer.



The new exclusive Winegard Cablemate TV Signal Selector lets your customers enjoy the advantages of both cable and TV antenna reception.

If there's cable TV in your area, a lot of your customers already have, or someday will have, a cable hookup. Most of them sign up to get long distance stations or local programming not possible with an outdoor antenna. At the same time, cable people claim that every subscriber will get better reception all the way around.

But the cable subscriber usually gets short-changed. He soon finds out that the channels he regularly watched with an outdoor antenna **don't** come in as clear on cable. And these are almost always the network stations, the ones people watch 90% of the time.

Technicians Frequently Get Blame

The problem of poor quality cable reception on one or more channels is a common one in city after city. Too often the TV technician is called for TV set repair when the cable is really at fault.

Cable outages, too, are a frequent customer complaint.

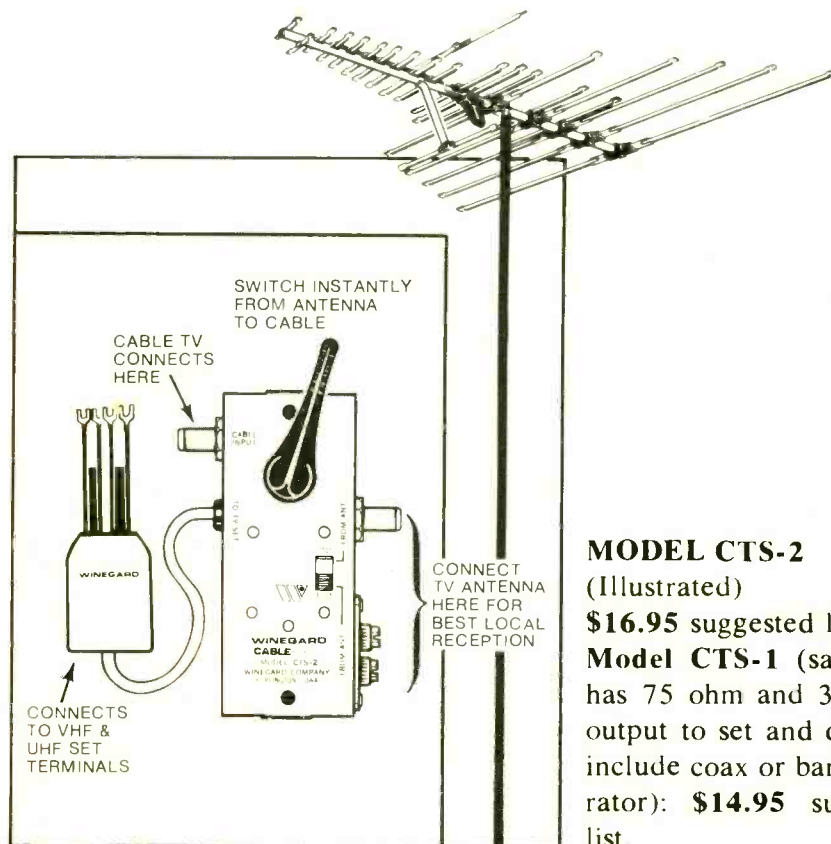
That's where you come in. With a Winegard Cablemate TV Signal Selector and a Winegard outdoor antenna.

Cablemate lets you connect cable signal **and** the antenna signal to the TV receiver. The viewer simply flips a switch to select antenna or cable.

can turn a new TV antenna

Not "Just Another Switch"

Cablemate, of course, is not an ordinary switch. It has specially designed circuitry with 58db isolation to prevent interference between cable and antenna signals. And it gives you a choice of coax or twinlead antenna input.



MODEL CTS-2

(Illustrated)

\$16.95 suggested list.

Model CTS-1 (same, but has 75 ohm and 300 ohm output to set and does not include coax or band separator): **\$14.95** suggested list.

Customers Are Waiting For You

If your cable TV customer already has a good antenna on the roof, then all he needs is Cablemate. But if he has an inadequate antenna or none at all, then he's a hot prospect for **both** an antenna and Cablemate. That's profitable business . . . and the easiest way yet to sell a TV antenna to a cable subscriber.

As you can tell, you stand to gain a lot from one switch! But then remember it comes from Winegard, the folks who consistently originate new and better products for the TV service industry.

For more information, circle the reader's service card or write to: Winegard Company, 3000 Kirkwood Street, Burlington, Iowa 52601



WINEGARD

TELEVISION SYSTEMS

Winegard Company / 3000 Kirkwood Street / Burlington, Iowa 52601

Circle 77 on reader service card

The
Professional
Line

Wanted by
the most
Discerning
Audiophiles



SX824

There is a distinct difference between tape equipment mass-produced by a consumer manufacturer and tape equipment built by a professional audio manufacturer. At Crown International this distinct difference involves five things: over-engineering, rugged construction, hand-crafting, exhaustive testing and conservative rating. After 26 years, Crown is the only remaining original U.S. tape equipment manufacturer still marketing professional quality to discerning audiophiles.

The Crown tape equipment line is designed for audio pros who make their living by recording, to whom an equipment failure at a taping session means money out the window. After four years, when many hi-fi models are traded in, Crown decks still produce recordings with truer fidelity than most new hi-fi decks. No wonder Crowns enjoy such high resale value.

At Crown, each active electronic component, each circuit module and each completed unit is tested from every angle. A tape deck undergoes over 100 hours cumulative testing. Finally, each unit is accompanied by its individual hand entered proof-of-performance report.

For free product data on Crown professional monaural, stereo and quadraphonic tape decks and players, write Crown, Box 1000, Elkhart, Indiana, 46514.



CROWN

Made Only in America

16 Circle 7 on reader service card

equipment report

TELEMATIC KC-270 "CRYS-MATE"



Circle 76 on reader service card

A SOURCE OF ACCURATE RF SIGNALS is a very very handy thing indeed to have around an electronics shop. Of course, a quartz crystal is considered as a standard. On many occasions we need a quick and easy source of signals, or, we need to *check* a crystal. The Telematic Co. has brought out another of the little handy-dandy test instruments that will do all of these things. This is the model KC-270 Crys-Mate Crystal checker and frequency standard.

It's about the size of a pack of Super-King cigarettes and not nearly as hazardous to your health (according to the label). It's a self-contained transistor oscillator circuit, very likely a Pierce. It will oscillate with any stock crystal. Just plug the crystal in and away you go. It even has a tiny pilot light on the panel; if the crystal is oscillating, this glows quite brightly. No oscillation, no glow, and no go!

The applications for such a unit would fill a book, of course. One very handy test would be for activity of a 3.58-MHz crystal from a color TV set. Just take it out of the circuit, and plug it in. If the INDICATOR light glows brightly, this crystal is able to oscillate. If it isn't oscillating in the circuit, something else is wrong. With another 3.58-MHz crystal, you might use the Crys-Mate as a substitute color-oscillator, to clear up doubts about operation of a given circuit. A pin-jack on the panel provides rf output. You can plug a short piece of wire in here to radiate signals into any circuit. Or: plug a test-lead in here, and feed the signal through a small capacitor into any circuit.

If you run into a need for an odd-ball marker frequency when doing sweep align-

ment work, plug a crystal on that frequency into the Crys-Mate and couple its output into the sweep generator's EXT MARKER input.

Use a 4.5-MHz crystal, and align TV sound i.f. stages and sound detectors precisely. The crystal will give you a very accurate source of rf for "zero-ing" the detector output. Use a 10.7-MHz crystal, and check i.f. alignment of any FM receiver. The FM detector can be precisely set on zero, and the shape of the S-curve checked; this can be done without a scope if you must. For the best FM stereo reception, the detector must be right on the nose.

The oscillator circuit is powered by one 9-volt battery. Without a crystal plugged in, it draws only 4 Ma. With a crystal, about 50 mA. So, the battery life should be good. An on-off switch is provided to save battery life.

A good crystal gives a surprisingly bright glow of the INDICATOR light. This can be used as an indication of crystal activity, as well as for the rare but possible intermittent crystal. Some of these will operate, but are hard to start. This tester will catch these, as well as cracked crystals, which may oscillate, but will be away off frequency.

For checking frequency of unknown crystals, or known crystals for that matter, feed the rf signal from the Crys-Mate's rf output into the antenna of a communications type radio receiver that will cover the frequency band needed. Now, feed in the rf output of an rf signal generator. Tune the radio dial until you hear the "thump" of the Crys-Mate's unmodulated output. (If you want to hear it more easily, turn on the bfo). Now, tune the rf signal generator until you hear a zero-beat. The signal generator is now on the crystal frequency. If the receiver dial is very well calibrated, it can be used to find the frequency. Either one can be used to check the other.

You will usually be able to pick up a great many harmonics of the crystal's fundamental frequency, as you go higher in frequency on the dial. The lowest frequency signal, at the greatest amplitude, will be the fundamental. I have heard signals as high as the twentieth harmonic, on a sensitive vhf communications receiver.

The crystal socket used will fit the small type crystal cases, like those used on the 3.58-MHz color crystals. If you have one with a different case, just stick a couple of pieces of solid wire in the socket, and bend them until you can make each one touch one pin of the crystal being tested. That's all you need; if it's good, the light will tell you.

The Crys-Mate isn't an expensive instrument, but it can certainly be a very useful one. You'll find lots of things to do with this piece of test gear.

R-E

THERE'S A BETTER WAY TO GO.



Energy shortages tell us we have to change our driving style. Now! It doesn't mean we have to go back to horse and buggy days. But it does mean we have to make every drop of gas give us the most go for our money. Anyone with horse sense knows that a well-tuned car gets better mileage, and in times of fuel shortages, better mileage means a lot.

The Mark Ten B Capacitive Discharge System keeps your car in better tune so it burns less gas. Using Mark Ten B is more than horse sense. It's the smart move under the hood, helping a nation survive an energy crisis and keeping you on the road. Delta Mark Ten. The best way to go.



DELTA PRODUCTS, INC.

P.O. Box 1147, Dept. RE
Grand Junction, Colo. 81501
(303) 242-9000

Please send me free literature.

Enclosed is \$ _____ Ship ppd. Ship C.O.D.
Please send: _____ Mark Ten B assembled @ \$59.95 ppd. _____ Mark Ten B Kit @ \$44.95 ppd. (12 volt negative ground only) _____ Standard Mark Ten assembled, @ \$44.95 ppd. _____ 6 Volt: Neg. Ground Only _____ 12 Volt: Specify _____ Pos. Ground _____ Neg. Ground _____ Standard Mark Ten Deltakit™ @ \$29.95 ppd. (12 Volt Positive or Negative Ground Only)

Car Year _____ Make _____

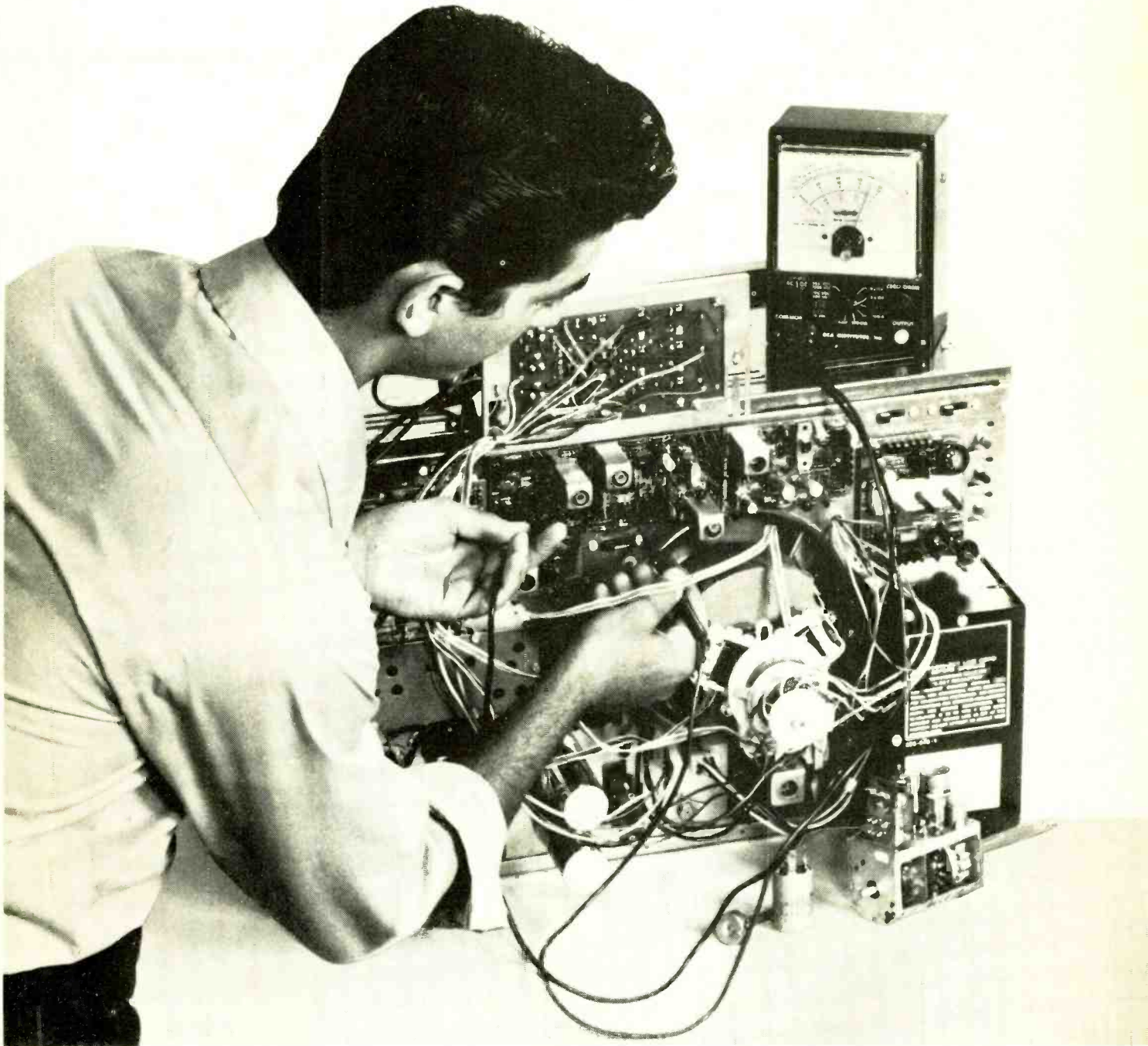
Name _____

Address _____

City/State _____ Zip _____

Why a Sylvania home training program may be

your best investment for a rewarding career in electronics



1 LEADER IN ELECTRONICS TRAINING

Over the years, Sylvania Resident Schools have trained thousands of men and women for key positions in the electronics field. Now, through Sylvania Home Training, you can receive the same high-quality career training at home. In your spare time. While you hold your present job. Remember, this training is designed with one purpose in mind — to give you the background you need to land the electronics job you really want!

2 AUTOTEXT TEACHES YOU ELECTRONICS RAPIDLY, EASILY.

AUTOTEXT, offered exclusively by Sylvania, is the proven step-by-step method of home training that can help you learn the basics of electronics quickly and easily.

3 CASSETTE SYSTEM

This innovative learning-by-hearing approach is a special option that adds an extra dimension to AUTOTEXT. It's almost like having an instructor in your own home. As you play the cassette tapes, you'll have an instructor guiding you through your AUTOTEXT lessons. Explaining the material as you read it. Going over schematics with you, reinforcing the basic electricity and electronics study materials with you. Everything you need to know to get you started towards a highly regarded position as an electronics technician — all in an easy-to-understand, conversational tone.

4 SPECIALIZED ADVANCED TRAINING

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

5 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your exams are reviewed and your questions are answered by Sylvania instructors who become personally involved in your efforts and help you over any "rough spots" that may develop.

6 HANDS-ON TRAINING

To give practical application to your studies, a variety of valuable kits are included in many programs. In Sylvania's Master TV/Radio Servicing Program, you will actually build and keep an all solid-state black and white TV set, and a color TV set. You also construct an oscilloscope which is yours to keep and use on the job.

7 FCC LICENSE TRAINING — MONEY BACK AGREEMENT

Take Sylvania's Communications Career Program — or enter with advanced standing and prepare immediately for your 1st, 2nd, or 3rd class FCC Radio Telephone License examinations. Our money-back agreement assures you of your money

back if you take, and fail to pass, the FCC examination taken within 6 months after completing the course.

8 CONVENIENT PAYMENT PLANS

You get a selection of tuition plans. And, there are never any interest or finance charges.

SEND ATTACHED POSTAGE PAID CARD TODAY! FREE DESCRIPTIVE BOOK YOURS WITHOUT OBLIGATION!

Sylvania Technical Systems, Inc.

If reply card is detached send this coupon

SYLVANIA TECHNICAL SCHOOL

Home Study
909 Third Avenue
New York, N.Y. 10022

Please send me FREE illustrated career catalog. I understand that I am under no obligation.

Name _____

Address _____

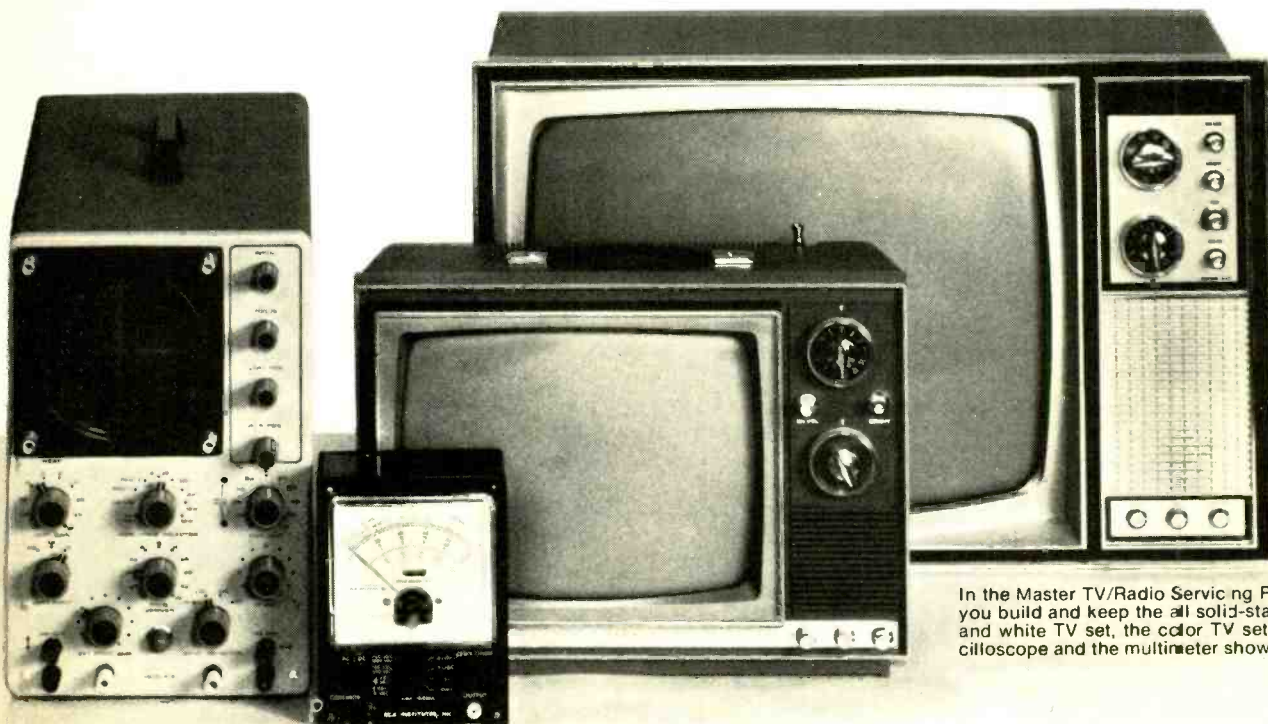
City _____

State _____ Zip _____

Age _____

Veterans: Check here 758-404-0

GTE SYLVANIA



In the Master TV/Radio Servicing Program, you build and keep the all solid-state black and white TV set, the color TV set, the oscilloscope and the multimeter shown above.

New—Low Distortion COMPRESSOR expander



Restore the original dynamic range of your music—increase your stereo separation, OR make your own background music with our new compressor-expander kit. Our circuit uses an electronic gain control integrated circuit for fast attack, slow release type operation with none of the lags and distortion found in the old photocell lamp controlled circuits. Expansion beginning level and compression beginning signal levels are adjustable. Up to 20 db of expansion and 40 db of compression are available with less than 1.0% THD under worst case conditions. Typically less than .05% under most operating conditions. Frequency response of 2 Hz to 100,000 Hz. Self contained power supply. Connects to preamp output, or to "Tape Monitor" jacks if available.

EX-1 Kit 3.0 lbs \$29.95

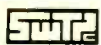
REVERB ADAPTOR



Put more life into your music with this self powered stereo reverb adaptor system. The reverb circuit electronically simulates the longer reverberation time of a large hall, giving your music more life and realism. Separate spring units and controls for each channel may be used with any stereo system by connecting the adaptor between the amplifier and preamp.

No. 239 Reverb Adaptor Kit with two spring units
Shipping Weight 5½ lbs. \$38.50

Circle the reader service card number below for a FREE copy of our latest catalog.



SOUTHWEST TECHNICAL
PRODUCTS CORPORATION

DEPT. REL

219 W. Rhapsody
San Antonio, Texas 78216

appliance clinic

NICAD CHARGING RATES?

by JACK DARR
SERVICE EDITOR

A READER WRITES, I WANT TO CHARGE NiCad batteries, in a 4-cell unit. Can I use resistors to regulate the current flow, with either a transformer operated dc power supply or a line-connected charger? Also, how about the new battery units I've been hearing about, that will charge in 3 or 4 hours. Can I adapt the regular types for this, without damage?"

Let's take this a piece at a time. Yes, you can use resistors to regulate the current flow. Charging at too high a rate can damage the cell, or even cause it to explode. For correct charging use a dc voltage just enough greater than the cell voltage to cause the charging current to flow at the given rate.

This maximum current varies with the battery type. There are quite a few different sizes, from the small "button" cells up to the large C and D cells! For an Eveready type B20 cell, at 1.25 volts, which must be charged at a rate not greater than 2.0 mA for 14 hours, up to the high capacity CH2.2T cell (also a 1.25-volt type, but it can be charged at a rate of 220 mA.)

Voltages will be given as "volts per cell" or 1.25 volts each. To get higher voltage, the cells are simply stacked in series. Although the charging voltage will vary, the charging current must be the same for multiple cells as for one cell, since they are in series. Charging voltage for a single cell will be 1.35 to 1.45 volts. For a 15-volt "battery" (group of cells) the charge voltage would be 16.2 to 17.4 volts, for a 50-mA rate in this one battery.

As for charging circuits, I would personally prefer a transformer-isolated dc power supply circuit, like Fig. 1. A single half-wave rectifier can be used; no filtering is needed. (I don't like line-connected circuits; they scare me.) With a dc supply like this, you could adapt it for different battery voltages by simply hooking a large bleeder resistor as a voltage divider across the dc output. By making this variable or ad-

justable, the charging voltage and current can be set to any needed value.

The fast-charge types

The fast-charge types are probably the Eveready units called "Fast-Charge Hustler" type cells. They can be completely recharged in about 3 to 4 hours. For uses such as cordless power tools, etc.

Before you try to recharge ANY NiCad cell at a high rate, be very sure that it is one of the fast-charge types!

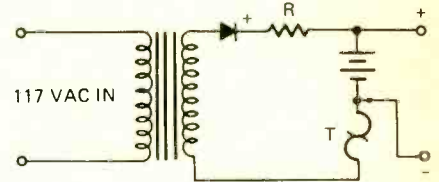


FIGURE 2

A specially designed charger should always be used with these. The Eveready Battery Handbook recommends several circuits for this; the simplest is shown in Fig. 2. Note the thermostat. When this type of cell is being recharged, the cell-temperature is the best indicator of reaching a full-charge condition. During recharge, the cell stays at almost a constant temperature of around 75°F. When it approaches a full-charge, the temperature rises very rapidly. When it reaches cutoff temperature, of around 112 to 120°F, it's fully charged. The thermostat opens at 110 to 120°F, and recloses from 95 to 105°F.

This action will automatically start recharging again, just as soon as the cell has cooled down far enough. So, the cell will be kept at full charge at all times, without over-charging. It'll always be ready to go at full charge.

There are several different charging circuits given; they range from the simpler one of Fig. 2 up to an electronic voltage-regulated type. In this, a small thermistor is built right into the battery. This is the temperature-sensor which controls the electronic voltage regulator.

Incidentally, the complete title of the invaluable Handbook used for the preparation of this Appliance Clinic is the "Eveready Battery Applications Engineering Data", and is published by Union Carbide Corp., Consumer Products Division, 270 Park Ave. New York, N.Y. 10017. It is available at most radio-TV supply houses, for \$6.95.

R-E

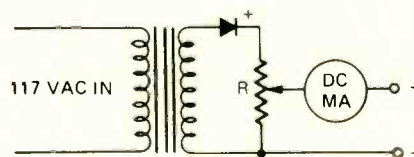


FIGURE 1

TESTING!

with MITS lab quality test equipment

One



SG 1900—The Audio Sweep Generator provides the capabilities of both a fixed frequency (CW) and a sweep generator in a laboratory quality instrument. Modes include CW, linear sweep, and log sweep with a sweep time of 10 milliseconds to 100 seconds. Waveforms are sine, square, and triangle. The range is from 1 Hz to 100 KHz. The output has fixed attenuation levels of 0, 20, and 40 dB \pm 1 dB, as well as continuously variable attenuation.
Prices: Kit \$119.95 Assembled \$149.95

Two



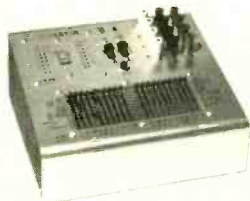
WG 1700—The Waveform Generator/Frequency Counter is well suited to a wide variety of test work. Six carrier waveforms (sine, triangle, square, ramp, sawtooth, and pulse) and three internal AM or FM modulator waveforms (sine, triangle, and square) are featured. The carrier frequency range is 1 Hz to 1.5 MHz in twelve overlapping ranges; the modulator waveform frequency range is 100 Hz to 150 KHz in six overlapping ranges. Both outputs are buffered for low output impedance. The unit also accepts external AM or FM modulating signals. The frequency counter with adjustable sensitivity measures the waveform generator output frequency and frequency of external signals from 1 Hz to over 10 MHz, with input impedance of 100K ohms.
Prices: Kit \$199.95 Assembled \$249.95

Three



DV 1600—The 2-1/2 digit Digital Voltmeter is a perfect companion for MITS' other fine test equipment. Features include full scale measurement of alternating and direct current in five ranges from 1 ma to 1 amp, measurement of AC and DC voltage in four ranges to 1000 volts, and measurement of ohms in six ranges to 10 megohms. The resolution in low ranges for voltage is 10 mv; for current, 10 μ a; and for resistance, 1 ohm. The DC accuracy is \pm 5% and the AC accuracy is \pm 1%. Other features include autopolarity and 100% overrange capability on all ranges, which effectively doubles full-scale capability.
Prices: Kit \$ 89.95 Assembled \$129.95

Four



ICT 1800—The Integrated Circuit Tester is ideal for testing digital integrated circuits and for breadboarding IC's while developing circuits. The eighteen LED indicators show the status of the IC under test. The internal 5 volt 1 amp power supply, which has overtemperature and over-current shutdown capabilities, is also available for external use. The cross bar switch allows complete programming of the IC under test. Other features include an internal two speed clock, single step capability, and four each remote outputs and inputs.
Prices: Kit \$119.95 Assembled \$169.95

Plus

ICT 1810—The Operational Amplifier Tester with fast, simple GO/NO GO test capability tests operational amplifiers for gain, stability, input offset voltage, and input bias current in a dynamic operating environment. A single LED indicates IC status.
Prices: Kit \$29.95 Assembled \$39.95

Power Sale

PS 500—The 5 Volt Power Supply, which has overtemperature and overcurrent shutdown capability, is an ideal unit to power TTL, DTL, and other IC's. Features include load regulation at 0.6% and line regulation at 0.005%. Output voltage is 5 volts \pm .2 volt.

Prices: Kit ~~\$29.95~~ \$19.95 WHILE THEY LAST!

Warranty: Full two-years warranty on assembled units, ninety days on kits.

*Prices subject to change without notice. Available from your local Olson Electronics Dealer.

MITS INC.

"Creative Electronics"

6328 Linn, N.E., Albuquerque, New Mexico 87108
505/265-7553 Telex Number 660401

Enclosed is a Check for \$ _____
or BankAmericard # _____
or Masier Charge # _____
Credit Card Expiration Date _____ Kit
Include \$5.00 for Postage and Handling Assembled
 SG1900 WG1700 DV1600 ICT1800 ICT1810 PS500
 Please Send Information on Entire MITS Line.

NAME _____
ADDRESS _____
CITY _____
STATE & ZIP _____
MITS/ 6328 Linn, N.E., Albuquerque, New Mexico 87108 505/265 7553 Telex # 660401

RE-4-74

letters

TV TYPEWRITER CLEARING HOUSE

I am in the process of building Don Lancaster's TV Typewriter project. Things are getting more and more interesting, and I have found myself wishing that I had someone else who is also building this to correspond with.

I am interested in becoming a "clearing house" for those involved with this project. Will the readers that are willing to participate in an exchange of ideas and problems, please write to me at the following address: Kenneth R. Prouty, WBØJFR, Safeguard MSR Box 42B, Nekoma, N.D. 58355. I will attempt to compile and distribute the names and addresses of those people along with other information or problems that are submitted to me.

When writing, please include as much helpful information as possible — including problems and/or solutions, the sources of the parts that you gathered, add-on's that you propose or have designed, etc.

Participants may wish to exchange cassettes with other owners of the TV Typewriter, exchange data by telephone,

or over the air (if properly licensed). The possibilities are many if enough interest is shown, and I think there will be. Let's hear from you!

KENNETH R. PROUTY
Nekoma, N.D.

A LITTLE CHARITY IS A GREAT IDEA

There are numerous boys' homes around the cities with maybe 100 to 400 boys each. They could use readers' older copies.

To make them last longer with the rough usage they will get going through so many hands, it is advisable to make them stronger.

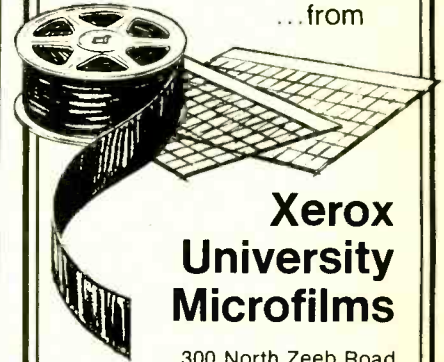
Just run library binding, or 3/4-inch clear magic tape down the spine. A tab at the top and bottom on the inside also helps.

So, get your unused copies into circulation again. The boys will appreciate them. Where is the home nearest to you?

GEORGE O. MORRISON
Monrovia, Calif.

This Publication is Available in MICROFORM

...from



Xerox University Microfilms

300 North Zeeb Road
Ann Arbor, Michigan 48106

Xerox University Microfilms

35 Mobile Drive
Toronto, Ontario,
Canada M4A 1H6

University Microfilms Limited

St. John's Road,
Tyler's Green, Penn,
Buckinghamshire, England

PLEASE WRITE FOR COMPLETE INFORMATION

INTERNATIONAL Frequency meter FM-2400CH



The **FM-2400CH** provides an accurate frequency standard for testing and adjustment of mobile transmitters and receivers at predetermined frequencies.

The FM-2400CH with its extended range covers 25 to 1000 MHz. The frequencies can be those of the radio frequency channels of operation and/or the intermediate frequencies of the receiver between 5 MHz and 40 MHz.

Frequency Stability: $\pm .0005\%$ from $+50^\circ$ to $+104^\circ\text{F}$.

Frequency stability with built-in thermometer and temperature corrected charts: $\pm .00025\%$ from $+25^\circ$ to $+125^\circ$ (.000125% special 450 MHz crystals available).

Self-contained in small portable case. Complete solid state circuitry. Rechargeable batteries.

WRITE FOR CATALOG!



- Tests Predetermined Frequencies 25 to 1000 MHz
- Extended Range Covers 950 MHz Band
- Pin Diode Attenuator for Full Range Coverage as Signal Generator
- Measures FM Deviation

FM-2400CH (meter only).....	\$595.00
RF crystals (with temperature correction)	24.00 ea.
RF crystals (less temperature correction)	18.00 ea.
IF crystals.....	catalog price



CRYSTAL MFG. CO., INC.
10 NO. LEE • OKLA. CITY, OKLA. 73102

R-E's Service Clinic

The color TV picture
—getting it in focus

by JACK DARR
SERVICE EDITOR

FROM OUR MAIL IN THE SERVICE Clinic, it seems that there are a few things which ought to be cleaned up on the general subject of focusing of a color picture tube. These include what it is, what it does, and what voltages you should expect to read. There are also a few common beliefs that aren't true; we'll see about those too, while we're here.

The focus voltage in a standard tri-gun picture tube is not necessarily a *fixed* value. That is, you can't say "I'll set the focus voltage at exactly 4268 volts and that's it!" The focus voltage must be a *percentage* of the high voltage on the ultron at any given instant. This will be roughly 17-20% of the high voltage. For 25 kV, focus will be very close to 5000 volts. If the high voltage drops, the raster will de-focus if the focus does not drop with it!

Fortunately, for us, the design of the high-voltage supply, in almost all color sets, is such that the focus voltage and the high voltage *will* rise and fall together. They both come from the same source. The high voltage is developed by the high-amplitude flyback pulse coming back from the yoke, during the horizontal retrace interval, or flyback time. This is stepped up because the high-voltage winding is coupled to the primary of the flyback. Peak voltage will be about 30 kV. This is rectified, and fed to the ultron of the picture tube.

If you check the schematic of a flyback, you'll see that the focus rectifier is fed directly from this pulse. It is tied to the same connection as the plate of the horizontal output tube, on the primary of the flyback. Typical pulse amplitude at this point is about 5000 volts peak. This is connected to a small high-voltage rectifier, filtered just a little; then applied to the G3 or focus grid of the picture tube. This isn't actually a grid. There are three little cylinders, one in each gun, all connected together.

Like a grid, though, this is a single-ended circuit. It goes nowhere; just sticks out inside the tube and stops. Now, here's a valuable fact which can be used in analyzing many focus problems. This is absolutely a dry circuit; no current flows in it at all. This is why you find very high value resistors in series with the focus supply. Since there's no current flow, there's no voltage drop across them.

If you do see a voltage drop, the chances are that this is a meter drop due to the loading effect of your voltmeter. High-impedance voltmeters, with high-voltage probes, should always be used for any readings in these circuits.

Under some fault conditions, you will find current being drawn by the focus circuit. This causes a large voltage drop across the big series resistors, a drop in focus voltage at the socket, and a severe de-focusing of the raster. The main cause is gas in the picture tube. Too many of us call this grid current, but it's really gas current. In any case, there's a quick check.

Pull the picture tube socket off the tube. Now, recheck the focus voltage at the socket pin. If it has now come back up to normal, and the focus control will cause a normal variation (about 2000 volts), the focus circuit is OK but you need a new picture tube! If the focus voltage does not come back up with the picture tube disconnected, *then* you check the focus supply circuit.

First fallacy; what is focus? The focus voltage does exactly *ONE THING*. It focuses the *horizontal scanning lines* in the raster! Period. It has absolutely *nothing* to do with the horizontal resolution of the picture, and darn little with the vertical resolution.

De-focusing will cause a slight smear of *all* objects in the picture, if it's minor. If it's bad enough (1000 volts low, say), all objects will be badly smeared. A complete loss of the focus voltage will usually put the raster completely out. If you find a dark screen, but the high voltage is up to normal, read the focus voltage just for luck. If you can adjust the focus control, and get good sharp scanning lines on a blank raster, the focus voltage is normal!

Fallacy No. 2. One common complaint in the mailbag is, "This set has focus problems! The close-ups are sharp, but things in the background are always fuzzy!" Check the scanning lines. If these are sharp, your focus is good. Most especially, if *close-ups* are sharp. This phenomenon is perfectly *normal*. It's due to the "f-stop" setting being used on the lens of the *TV camera*.

Check any photograph with a clear sharp image of something in the center. Now check the background: it will be fuzzy and "out of focus." A lens will not focus over an *infinite* distance. When you "stop down" or make the aperture smaller, the depth of focus (depth of field) will be longer, but you get much less light. Beside this, they generally don't want the background anyhow. What they're interested in is the person or thing in the close-up.

Focus rectifiers; problems

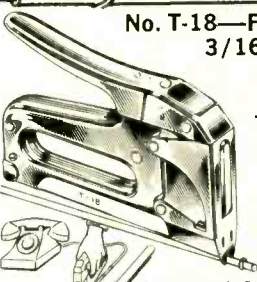
The original color sets used small tubes as focus rectifiers, such as the 1V2 and others. The new sets use solid-state focus rectifiers.

ARROW AUTOMATIC STAPLE GUNS

CUT WIRE & CABLE INSTALLATION COSTS

without cutting into insulation!


SAFE! Grooved Guide positions wire for proper staple envelopment! Grooved Driving Blade stops staple at right depth of penetration to prevent cutting into wire or cable insulation!



No. T-18—Fits wires up to 3/16" in diameter.

BELL, TELEPHONE, THERMOSTAT, INTERCOM, BURGLAR ALARM and other low voltage wiring.

Uses T-18 staples with 3/16" round crown in 3/8" leg length only.



No. T-25—Fits wires up to 1/4" in diameter.

Same basic construction and fastens same wires as No. T-18.

Also used for **RADIANT HEAT WIRE**

Uses T-25 staples with 1/4" round crown in 9/32", 3/8", 7/16" and 9/16" leg lengths.

T-18 and T-25 staples also available in Monel and with beige, brown and ivory finish at extra cost.



No. T-75—Fits wires and cables up to 1/2" in diameter.

RADIANT HEAT CABLE, UF CABLE, WIRE CONDUIT COPPER TUBING or any non-metallic sheathed cable.

Also used as **DRIVE RINGS** in stringing wires.

Uses T-75 staples with 1/2" flat crown in 9/16", 5/8" and 7/8" leg lengths.

Arrow Automatic Staple Guns save 70% in time and effort on every type of wire or cable fastening job. Arrow staples are specially designed with divergent-pointed legs for easier driving and rosin-coated for greater holding power! All-steel construction and high-carbon hardened steel working parts are your assurance of maximum long-life service and trouble-free performance.

Ask your Electrical Supply Dealer or write for further details.

ARROW FASTENER COMPANY INC.
Saddle Brook, New Jersey 07863
**"Pioneers and Pacesetters
For Almost A Half Century"**

SAVE TIME WITH OUR CHEMICAL SIGNAL TRACER

Time is money. And nothing eats up time like troublesome Intermittents.

There is a way to fight back, though. With a faster kind of test equipment that comes in a can: SUPER FROST AID. After the set 'cooks' and the problem appears, hunt it down in minutes with SUPER FROST AID's unbeatable (-55°F) cooling power. Even on the most crowded printed circuit, SUPER FROST AID's lack of liquid residue lets you check component-by-component with pinpoint applications. And it's long-lasting—saves you more by using less!

Next intermittent you run across, cure the problem faster with a chemical signal tracer, SUPER FROST AID (catalog #1500)—one of the best-selling chemical tools from

CHEMTRONICS INC.
1260 RALPH AVE., BROOKLYN, N.Y. 11236
TEL. (212) 629-4300

Our business is improving yours.

Circle 12 on reader service card

SERVICE SOLID STATE ON YOUR RIG!

Telematic SUPER SERVICE AIDS

Telematic TRANSVERTER

TELEMATIC TRANSVERTER
WORKS WITH ANY TEST RIG

PLUG IN—to service solid state
UNPLUG—for tube type

Matches

- RCA • ZENITH
- MOTOROLA
- SYLVANIA
- MAGNAVOX

And All Others!

Telematic

2245 Pitkin Ave., Brooklyn, N.Y. 11207

FREE! Adaptor Quick Reference Chart

Circle 13 on reader service card

These are made of many, many selenium diodes stacked in series. They use enough of them so that the total voltage rating will be high enough to stand the applied voltage. Voltage ratings of these should be about 7500 volts max.

Tube rectifiers can get weak from old age, like any other tube. This is easy to check: just pop in a new tube. If the focus voltage comes back up, this was it. The solid-state focus rectifiers can also "grow weak." If enough of the little pills short or leak, the output voltage will drop. If they arc over internally, they'll sometimes make the case bulge or blow open in the middle.

In general, a solid-state focus rectifier can be substituted directly for any of the tube types. This is a very handy thing, especially in those irritating cases where the socket of the focus rectifier has arced over and burned up. Instead of replacing the socket, which is usually a rough job, take the plate lead loose. Mount a solid-state focus rectifier on terminal strips, to keep it from arcing to other things, and tie the plate lead to the anode (negative) end. Tie the lead from the focus control to the positive end. Be sure to clean up and tie the heater leads of the original tube, so they can't get into any trouble.

There are lots of readily available solid-state replacements: RCA SK-3066, and others. These have a voltage rating of 7500 volts, and plenty of amperage (sic: 5 mA max!)

Final hint: in a dry circuit, you would think that any series resistance would have little effect. Yet, if the focus pin or its socket contact, on the picture tube, "corrodes," this can cause a very tricky *intermittent* loss of focus! Confirmation: personal experience plus many letters in the Clinic! Clue: focus voltage, read at the focus control, source, etc. does *not* change when the raster de-focuses.

To check for this, pull the picture tube socket off, and examine the focus pin and the socket contact. This will be the one with a pin missing on each side of it. If you can see distinct traces of a light green powdery substance, look out! You may find that the socket contact has been almost eaten away. This is apparently the same as the green "corrosion" we used to see in audio transformers, etc. in old radios. Seems to be caused by the presence of air on a copper conductor carrying a positive voltage. Can't do better than that, but it's close. Some of them can be cleaned up. If it's bad enough, the socket must be replaced. R-E

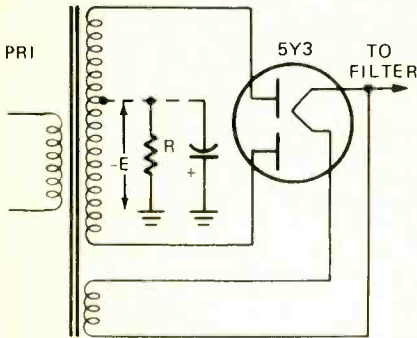
reader questions

HOW TO WASTE DC VOLTAGE

I'm restoring an old radio, a Crosley 66TC. Original power transformer was 300 volts, and I've got one with 350 volts each side of the center tap. How can I get rid of the excess dc voltage?—E.S., Laura, Ohio

"Throw it away". Open the HV

secondary center tap and add a resistor to ground. Adjust the value of this so that it develops whatever voltage drop



you want. This will subtract from the dc "B+" voltage.

This shouldn't cause any hum, but it might. If so, add a filter capacitor as shown. Don't forget to connect the + to ground. A lot of the older sets used this negative voltage for bias on power tubes, etc.

ODD COLOR PROBLEMS

The color keeps popping in and out, and acting very funny, on this GE CB21 chassis. All tubes in the color section have been replaced; no help. Where do I go from here?—H.S., Vincennes, Ind.

After all of the tests you have made (which were right!) I believe I'd go and have a look at that little neon lamp in series with the burst amplifier grid. This has caused some intermittent color problems in the past. Try a new one.

THE BOOST THAT DIDN'T!

This Motorola TS-579-A has the most weird group of symptoms I ever saw! Raster only half-width, high voltage low, boost low. However, the 6DQ6 cathode current is 110 Ma.; screen voltage OK, grid drive 150 volts peak to peak. Tubes good.

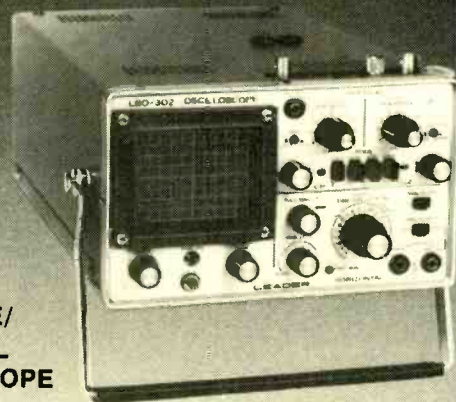
Suspecting the boost capacitor, I bridged it; no help. There's another one in there; bridged it. No help. Noticed that the schematic said the boost capacitor went to +135 volts. Thought this was a typo, and shunted a capacitor from boost to +270 volts. Whammo! I got the raster, boost and high-voltage back!

Later, I checked the Motorola schematic, and the boost capacitor does go to +135 volts! But, it won't work with it hooked there. What's going on?—J.G. Mena, Ark.

That isn't a typo. The boost capacitor does go to +135 volts on this chassis. I thought the same thing, the first time I ran into it. After some intensive head-scratching, I tried the same thing you did—shunting the boost capacitor to the +270 volts. That other 0.1- μ F capacitor you see in there is the

(continued on page 69)

Our little "3-incher" is bigger than anybody's!



**LBO-302
3" DUAL TRACE/
DUAL CHANNEL
TRIGGERED SCOPE**

\$699.⁹⁵
With accessories

Conquer the test bench squeeze! Obtain lab-grade quality! Here's solid state accuracy plus push-button convenience for trig. & auto. sweep & "free run" momentary function. • 10MHz b'width • 10mVp-p/div to 5Vp-p/div Vert. Sen-

sitivity, 9 steps. • Sep. or simult. sweep display, ch 1 & 2 - alt., chopped, algebra added and X-Y vector. • Sweep range from 1 μ s/div (0.2 μ s w/5X mag) to 0.2s/div, 17 steps. • Polarity inversion on ch 2. • 4 $\frac{3}{4}$ "H, 10 lbs.

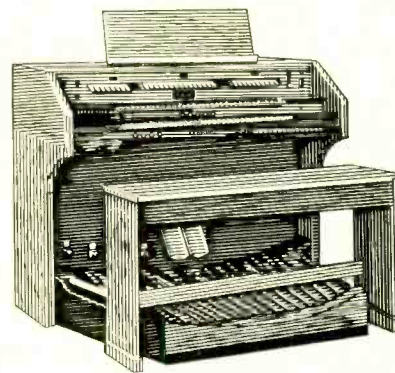
LEADER

INSTRUMENTS CORP. 151 Dupont St., Plainview, L.I., N.Y. 11803 (516) 822-9300

"Put us to the test!"

Circle 14 on reader service card

Now...the most enjoyable do-it-yourself project of your life—A Schober Electronic Organ!



You'll never reap greater reward, more fun and proud accomplishment, more benefit for the whole family, than by assembling your own Schober Electronic Organ.

You need no knowledge of electronics, woodwork or music. Schober's complete kits and crystal-clear instructions show you — whoever you are, whatever your skill (or lack of it) — how to turn the hundreds of quality parts into one of the world's most beautiful, most musical organs, worth up to twice the cost of the kit.

Five superb models with kit prices from \$500 to around \$2,000, each an authentic musical instrument actually superior to most you see in stores, easy for any musically minded adult to learn to play, yet completely satisfying for the accomplished professional. And there are accessories you can add any time after your organ is finished—life-like big auditorium reverberation, automatic rhythm, presets, chimes, and more.

Join the thousands of Schober Organ builder-owners who live in every state of the Union. Often starting without technical or music skills, they have the time of their lives — first assembling, then learning to play the modern King of Instruments through our superlative instructions and playing courses.

Get the full story FREE by mailing the coupon TODAY for the big Schober color catalog, with all the fascinating details!

The Schober Organ Corp., Dept. RE-125
43 West 61st Street, New York, N. Y. 10023

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

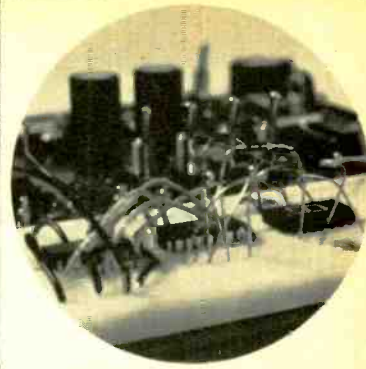
NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

Circle 15 on reader service card

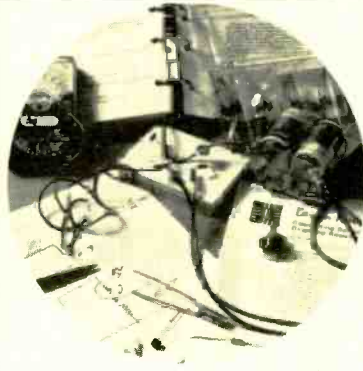
**Communications
Engineering**

**Aeronautical
& Navigational**

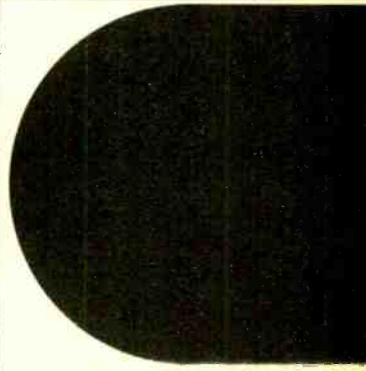
**Television
Engineering**



**Automatic
Control
Engineering**

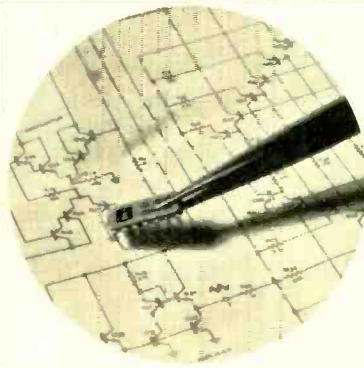


**Missile &
Spacecraft
Guidance**

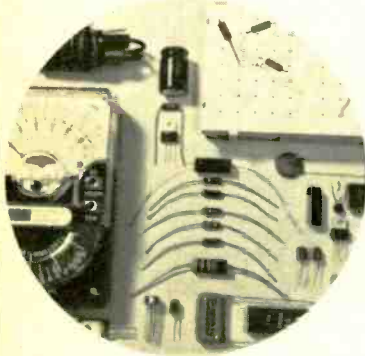


**Radar &
Sonar
Engineering**

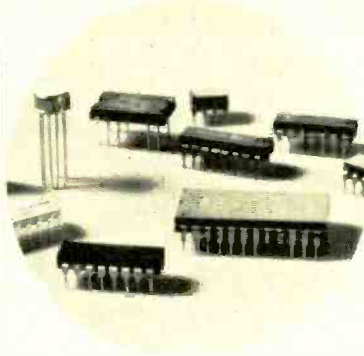
**Digital
Communications**



**Industrial
Electronics**



**Microwave
Engineering**



**Satellite
Communications**

**Cable
Television
Engineering**

**Electronic
Engineering
Technology**

**Nuclear
Instrumentation
& Control**

**Special Programs
for Electronic
Engineers**

Computer
Engineering

If you are too busy to go to college to learn advanced electronics, CREI brings college level training to you. CREI programs give you practical engineering training that you can apply in your work to move ahead to higher paying jobs. And CREI lets you specialize in exactly the area of electronics you want. You have a choice, depending on your qualifications, of 18 different programs.

Not only are CREI programs college-level but arrangements are available for you to earn college credit applicable to advanced degrees.

Only CREI offers you a choice of 18 programs in advanced electronics

Electronic
Systems
Engineering

For over 45 years CREI programs have been recognized by leading technical organizations as effective home study training in advanced electronics.

NEW OPTIONAL LAB PROGRAM



CREI now offers a supplementary ELECTRONIC DESIGN LABORATORY PROGRAM to make learning advanced electronics easier and to give you actual experience to use in your work. Only CREI offers this complete college type laboratory program. You learn to actually design electronic circuits. At the same time you get extensive experience in tests and measurements, breadboarding, prototype building and other areas important to your career.

Qualifications to Enroll. To qualify for enrollment in a CREI program, you must be a high school graduate (or equivalent). You should also be working in electronics or have previous training in this field.

Send for FREE book. If you are qualified, send for CREI's newly published book describing your career opportunities in advanced electronics. This full color book is filled with facts about career opportunities for you.

Nuclear
Engineering
Technology

Special Programs
for
Non Electronic
Engineers



Accredited Member, National Home Study Council

CREI, Dept. E-1404-E
3939 Wisconsin Avenue
Washington, D. C. 20016

Rush me your FREE book describing my opportunities in advanced electronics. I am a high school graduate.

Name _____ Age _____

Address _____

City _____ State _____ ZIP _____

If you have previous training in electronics, check here

Employed by _____

Type of Present Work _____

Veterans and servicemen, check here for G. I. Bill information

CREI

**CAPITOL
RADIO
ENGINEERING
INSTITUTE**

A Division of McGraw-Hill
Continuing Education Co.
3939 Wisconsin Avenue,
Washington, D. C. 20016

This 10 MHz Triggered Scope is 1/3 the size of comparably performing scopes.



MODEL 1431 \$399.95

It's a lightweight 13 pounds in your hand and a heavyweight performance wideband scope with a 35 nanosecond rise time on your bench or jobsite. Whether you're servicing or designing industrial equipment or TV, there's the right sweep speed and sync for easiest operation. If you know our Model 1460, the leader in wideband 5" CRT scopes, you know our new 3" Model 1431 which gives you the same high performance in one third the size. (Only 4 $\frac{3}{4}$ "Hx7 $\frac{7}{8}$ "Wx12 $\frac{7}{8}$ "L)

Servicing, production, inspection, quality control and lab applications are all easier with this versatile all solid-state instrument. Triggering is accomplished with only 0.5V peak-to-peak. Ten millivolts per division sensitivity, 0.5 usec/cm to 0.5 sec/cm automatic and triggered sweep in 19 calibrated ranges, and external trigger input are just a few of the reasons you'll like it.

If you have been waiting to buy a portable scope until you could get all the features you'll ever need at a price you want to pay, you've been waiting for Model 1431. Contact your distributor or write Dynascan Corporation.



Shown with optional carrying cover and probe pouch.

B&K PRODUCTS OF
DYNASCAN

1801 W. Belle Plaine Ave.
Chicago, IL 60613 • (312) 327-7270

The Job

problems faced by many banking provides efficient surveillance is the story of three installations.

by ROBERT S. HAIMES

ATOP UTILITY POLE, the CCTV camera keeps watch on street activities. Camera is monitored by police.



controls, intercoms, CCTV monitors and other related equipment. The area in which the master control console is located, is the most totally secure area in the entire building. The console itself, is misleading: for while it looks formidable, and ultra-complex, it is basically quite simple.

At his console desk, the security officer monitors the arrival of armored cars on CCTV cameras as well as persons entering any department of the bank. He views all of the many parking levels in the building, and the 10th floor restaurant—without interfering with normal procedures in the 22-story building. Each of the systems is designed to aid and assist the guards.

Let's start with the two weather-proof CCTV cameras that are mounted on the rear alley side of the building's rollaway basement door. They guarantee that only authorized vehicles such as armored cars and special bank messenger cars can enter the basement parking area. The guard at the console—at a touch—can pan, tilt, or

zoom the CCTV camera so he can check not only the license of each vehicle, but the driver as well.

Once cleared for entry, the guard at the master control raises the door, and then promptly closes it as soon as the vehicle is inside. To continue control inside the basement, two more indoor cameras are positioned to monitor traffic.

Protect the computer

To safeguard the computer center at the bank, two CCTV cameras are mounted immediately inside of each access door, giving the guard at the master control console total surveillance of the area. This coverage is teamed with bullet-resistant Plexiglas doors at each of the elevator lobby areas, premise alarms (to detect forced entry) to control access and guards positioned immediately inside each elevator door lobby.

On the four floors occupied solely by bank personnel, the security system is again wrapped around CCTV cameras

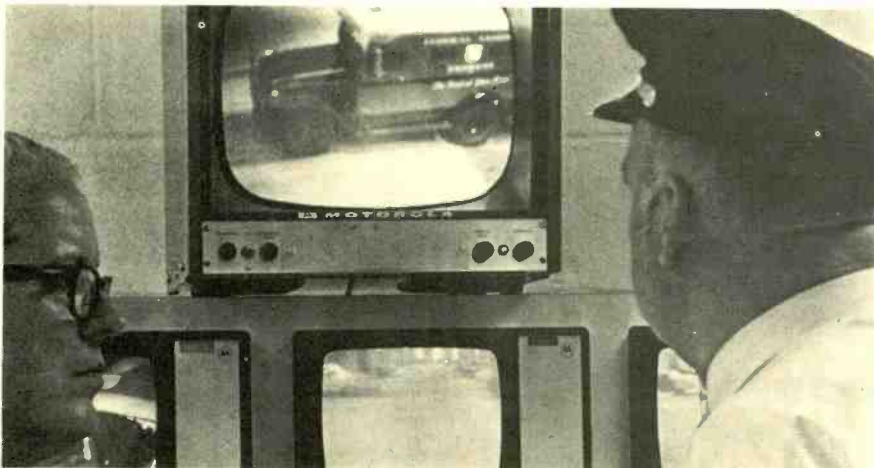
that are located inside each elevator lobby door and premise alarms on the glass doors at both ends of each elevator lobby. An intercom is also used for questioning by the guard in the master control room, if necessary.

The bank's executive offices also contain a CCTV camera, a premise alarm and a secretary-receptionist with a radio-voice link to the main guard room for emergencies.

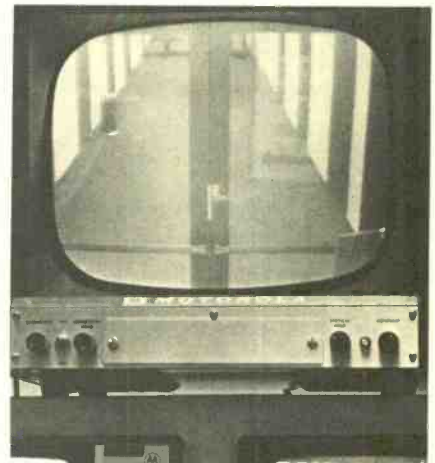
Finally, the security system also keeps a check on the upper three floors of parking, all of which are reserved for bank-owned vehicles and cars of bank employees. In addition to regular guards, the parking area is constantly monitored via CCTV camera with voice contact to the master control console. Traffic control gates prevent the general public from using the bank parking areas, and CCTV cameras ensure that the system is foolproof.

CCTV and the police

Another relatively new area for CCTV is in police work. Let's look at



SECURITY PERSONNEL at monitor watch arrival of armored truck at basement entrance of First Maryland Building. The monitor they are watching is one of nearly thirty mounted in the master control console in the bank's basement area.



THE 14-INCH MONITORS allow pictures on any of the 9-inch screens in the console to be blown-up for closer observation.

One of our most successful students wrote this ad!

Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.

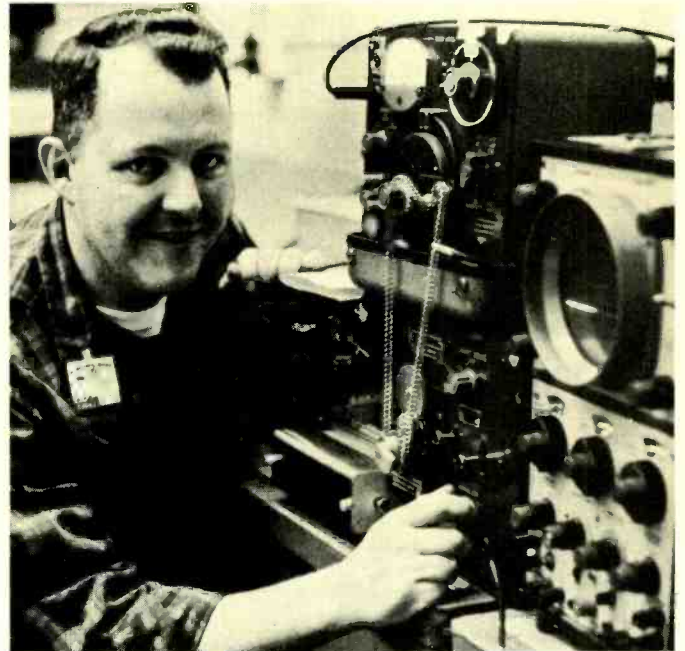
By Harry Remmert

"AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

"Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

"Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find



Harry Remmert gives his CIE Electronics course much of the credit for starting him on a rewarding career. He tells his own story on these pages.

necessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

"Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

"The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams, and the material had always seemed just a little beyond my grasp. Score another point for CIE.

*CIE backs its courses with this famous Money-Back Warranty: when you complete a CIE license preparation course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. Warranty is valid during completion time allowed for your course.

"Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

"When a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. I wanted to be a full-fledged student instead of just a tag-a-long, so CIE's exclusive home-study program naturally attracted me.

"Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

"From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

"Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later.

"These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

"In closing, I'd like to get in a compliment for my Correspondent Counselor who has faithfully seen to it that my supervisor knows I'm studying. I think the monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. My Counselor has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

"And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

"I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many

times over, both in increased wages and in personal satisfaction."

Perhaps you too, like Harry Remmert, have realized that to get ahead in Electronics today, you need to know much more than the "screwdriver mechanics." They're limited to "thinking with their hands" . . . learning by taking things apart and putting them back together . . . soldering connections, testing circuits, and replacing components. Understandably, their pay is limited—and their future, too.

But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. He was recently promoted, with a good increase in income, to the salaried position of Senior Engineering Assistant working in the design of systems to silence submarines. For trained technicians, the future is bright. Thousands of men will be needed in virtually every field of Electronics from two-way mobile radio to computer testing and troubleshooting.

Send for Complete Information — FREE

Many men who are advancing their Electronics career started by reading our illustrated school catalog, "Succeed in Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you're "shopping around" for the training you need to move up in Electronics, this interesting book may have the answers you want. We'll send it to you FREE. With it, we'll also include our other helpful book, "How To Get A Commercial FCC License."

To get both FREE books, just fill out and mail the reply card. For your convenience, we will try to have a representative call. If card is missing, use coupon below.

APPROVED UNDER G.I. BILL

All CIE career courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

CIE Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114

Please send me your two FREE books:

1. Your school catalog, "Succeed in Electronics."
2. Your book on "How To Get A Commercial FCC License."

I am especially interested in:

- | | |
|---|--|
| <input type="checkbox"/> Electronics Technology | <input type="checkbox"/> Electronic Communications |
| <input type="checkbox"/> Broadcast Engineering | <input type="checkbox"/> Industrial Electronics |
| <input type="checkbox"/> First Class FCC License | <input type="checkbox"/> Electronics Engineering |
| <input type="checkbox"/> Electronics Technology with Laboratory | |

Name _____
(Please Print)

Address _____

City _____

State _____ Zip _____ Age _____

Veterans & Servicemen: Check here for G. I. Bill information

RE-29

For men with prior electronics training . . . Electronics Engineering Course

. . . Covers steady-state and transient network theory, solid-state physics and circuitry, pulse techniques, computer logic and mathematics through calculus. A college-level course for men already working in Electronics.

the way a Motorola CCTV system has already made an impressive start on reducing successful burglaries in Hoboken, N.J. Hoboken Police Chief George W. Crimmins says that the system has already "proven itself", and Hoboken Mayor Louis DePascale says that city government wants "all of Hoboken" under the protection of the

CCTV cameras.

Prior to the new system, Hoboken tried high-intensity lights with increased patrolling. This was not effective enough.

On paper and in practice, the CCTV system seems simple. Three television cameras are mounted at varying vantage points along streets making up one

of Hoboken's most crime-prone neighborhoods. Cables from the three cameras reach back to police headquarters where officers monitor the 19-inch screens for signs of lawlessness first, traffic offenses second.

Two of the cameras, Motorola S1140B high-performance models—are set in fixed positions where they continuously view the neighborhood street scene. The automatic light compensation for these cameras has a 10,000 to 1 light compensation and 0.5 foot-candles sensitivity.

The third camera, is a Motorola S1170A low-light-level camera. It delivers clear, sharp pictures in bright sunlight or darkness and does this job automatically. Its light compensation range is 200,000 to 1 without adjustment and sensitivity is .005 foot candles. In addition the camera has a motorized 10 to 1 zoom lens, pan and tilt controls and can view 360°.

The Hoboken Police Department communications control center—where the three 19-inch monitors are located—is atop the City Hall, located in the heart of the business district. Dispatchers in the center communicate with patrol cars and beat officers and now view the conduct of citizens on the downtown streets.

If something catches the dispatcher's eye, he can use the low-light-level camera to zoom in on a specific area. If it is something that arouses his attention further, he can use the half-inch video tape recorder to make a permanent record of his observations.

The dispatcher can also pan the street, tilt the camera for different angles and record all this if he wants to do so. The camera can also revolve 360°, so it can follow the subject under observation. This camera works effectively without external light, amplifying available light to keep monitor images clear and sharp. It can also see through fog, haze, smoke, rain and snow. The housings for all three cameras are bulletproof and impervious to efforts to blind them with flashing lights.

In the Hoboken Police Department, the electronic "rookie" is already well received. Officers who know they have the support of an irrefutable witness—the CCTV tape recorder—when they take a case to court, are able to move with more assurance in their rounds. Some criminal actions have already been witnessed as they occurred and in one recent burglary the criminal fled into the range of the CCTV system, neatly depositing himself in the city's jail.

The idea in Hoboken is not to catch more criminals, but rather to discourage criminal activity by convincing potential lawbreakers that they may be seen on the police department's vision of "Candid Camera." **R-E**



SENSORS PLACED ON MONITOR SCREENS detect changes in light intensity, indicating presence of some person in the area being watched. This system is particularly useful after sales hours. At Macy's, cameras scan stockrooms, corridors and sales areas for prowlers who stay in store after closing and steal by night. Now, any movement in normally quiet area will be detected and a patrol or guard/dog team will be alerted.



CONTROL CENTER AT MACY'S Herald Square store. Dispatchers sit before radio console and CCTV monitors. Here, they can reach or observe personnel throughout the 21 floors of the store. Center is focal point of the radio system and controls a combination of approximately 50 small 2-way radios and pocket pagers used by security personnel throughout the store. Two smaller monitors for close-ups (inset) are in the console.

ALL ABOUT TRANSFORMERS

Transformers are the "heart" of modern-day electricity and electronics. Without them, long-distance power transmission and radio and electronic devices would be impractical. Here's how they work.

by FARL JACOB WATERS

TRANSFORMERS ARE FOUND IN MANY KINDS of electronic or electrical apparatus. All transformers, whether the power type on the utility pole or the "shirt-pocket" radio i.f. type, depend upon *electromagnetic induction*. The reaction to a varying magnetic field, is the development of a voltage or current.

As lines of magnetic force encircle and are "cut" by a conductor, a force (voltage) is developed which causes electrons to move as a current. Inversely, a current through a conductor develops a magnetic field as shown by Fig. 1-a. An alternating current produces a magnetic field that also changes magnitude and direction. As this alternating magnetic field increases and decreases, its lines "cut" that conductor as well

as any other conductor that may be close (Fig. 1-b). Thus, if a conductor carrying alternating current is near a second conductor, a current will be induced into that second conductor.

Transformers have conductors coiled as shown by Fig. 2. Alternating current

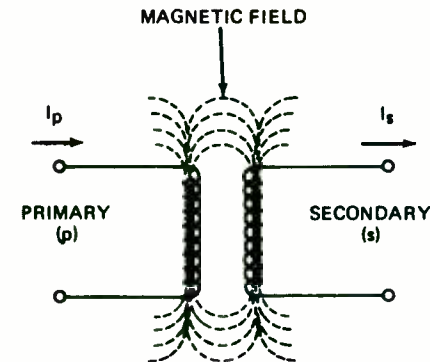


FIG. 2—TRANSFORMER CONDUCTORS are coiled to concentrate field for better magnetic linkage.

through coiled conductor P (the primary) produces a concentrated magnetic field. That magnetic field also surrounds and "cuts" the turns of conductor S (the secondary) to induce a current into that winding. The density of the magnetic field is dependent upon the primary current I_p and upon the number of turns within that winding N_p .

Magnetic density, $\phi = N_p I_p$
This same magnetic density develops the current I_s within secondary winding of N_s turns.

$$\begin{aligned} \text{Magnetic density, } \phi &= N_s I_s \\ \text{then } I_p N_p &= N_s I_s \\ \text{and } I_p / I_s &= N_s / N_p \end{aligned}$$

It can also be shown that the primary and secondary voltages, E_p and E_s , are related to the number of turns, N_p and N_s .

$$\begin{aligned} E_p / E_s &= N_p / N_s \\ E_p I_p &= E_s I_s \end{aligned}$$

$$\begin{aligned} \text{Primary impedance, } Z_p &= E_p / I_p \\ \text{Secondary impedance, } Z_s &= E_s / I_s \\ \text{and } Z_p / Z_s &= (N_p / N_s)^2 \end{aligned}$$

In common language the above equations become:

1. A transformer's voltage ratio, E_p/E_s , is directly related to its turns' ratio, N_p/N_s .
2. A transformer's current ratio, I_p/I_s , is

inversely related to its turns' ratio, N_p/N_s .

3. A transformer's impedance ratio, Z_p/Z_s , is directly related to the square of its turns' ratio $(N_p/N_s)^2$
4. A transformer's primary volt-ampere product, $E_p I_p$, is equal to its secondary volt-ampere product, $E_s I_s$.

Therefore, a transformer can be used to change voltage, to change current, or to change impedance.

Losses and limiting factors:

A transformer consists of two or more windings on a magnetic core (Fig. 3). Transformers used to couple rf or i.f. stages require a very low density magnetic field, and

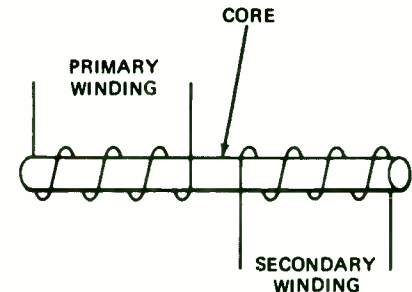


FIG. 3—CLASSIC TRANSFORMER has two or more coils wound on a common core.

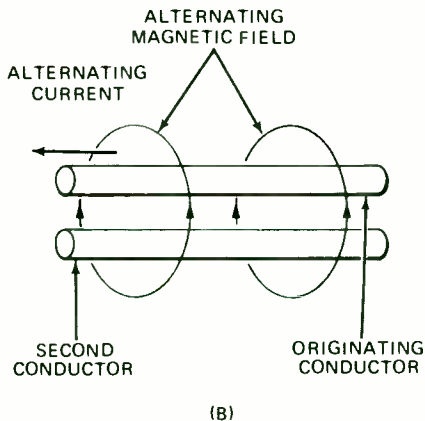
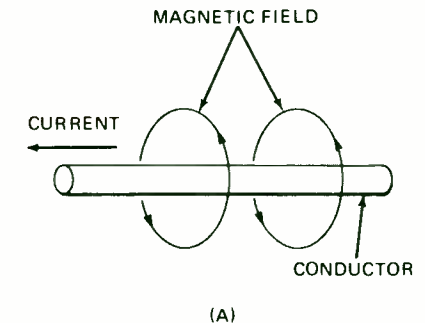


FIG. 1—CURRENT IN CONDUCTOR produces a magnetic field (a). Field from ac generates alternating current in adjacent conductor.

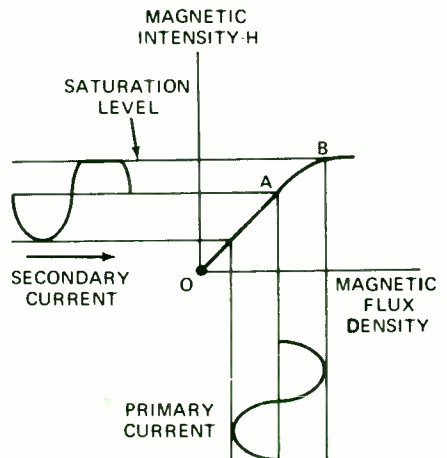


FIG. 4—TOO MUCH PRIMARY CURRENT causes distortion when magnetic core saturates.

are likely to have an air core. Conversely, the power transformer must have a very strong magnetic field and an iron core of sufficient cross-section. Each winding must be of sufficient wire size to avoid excessive voltage and power loss, or occupying excessive space. Iron cores are laminated or powdered to reduce core losses (hysteresis and eddy currents) for an overall efficiency of 90% or better.

Figure 4 shows that the magnetic force increases directly with the increase in current between point O and point A. Between points A and B, the magnetic force increases little with the current increase. In other words, the iron core has acquired a *magnetic saturation* between A and B. Primary current above this saturation level will not induce additional voltage into the secondary. Transformers used in audio amplifiers often carry dc to further limit the saturation level. Audio current exceeding that saturation level will not induce additional voltage into the secondary. Thus, the secondary voltage will not have the same shape as the primary voltage wave—the secondary voltage wave is distorted.

Transformer uses

The first use for transformers that comes to mind is the changing of voltage. Power companies commonly generate power at a low voltage, use transformers to step-up the voltage for transmission, and then step-down the voltage to a safe level for use in our homes. Within electronic apparatus using transistors, it is necessary to step-down the supplied 117 volts to a value of less than 50 volts. Tubes often require voltage greater than 117 volts, and step-up transformers are commonly a part of their associated power supply circuits. Filaments or heaters of electron tubes use lower voltages—5.0, 6.3, 10.0, 12.6—from step-down transformers.

Figure 5 shows a transformer of a full-

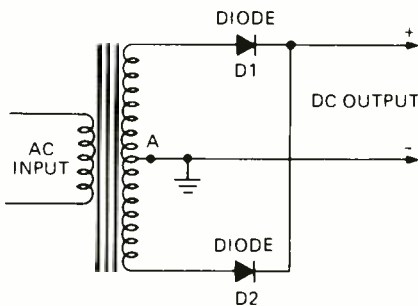


FIG. 5—POWER TRANSFORMER in full-wave rectifier has center tap on secondary winding.

wave rectifier circuit having a center-tap at point A. This center-tap divides the secondary voltage to two equal values, and provides a return path for the dc. Push-pull amplifier circuits and discriminators also use transformers with center-tapped primaries or secondaries.

Transformers are seldom used for the changing—step-up or step-down—of current. However because of the excessive voltage drop and power loss encountered in usual measuring methods, power companies often use current transformers in series with the transmission line as shown by Fig. 6. So-called "snap-around" meters use this same principle with the line conductor serving as the primary. The coupling of transis-

tor amplifier stages by transformers often steps-up the current, but this is the result of impedance matching.

A transformer, with its impedance ratio (Z_p/Z_s) equaling the square of its turns' ratio (N_p/N_s)², is a convenient means of changing or transforming impedances. The

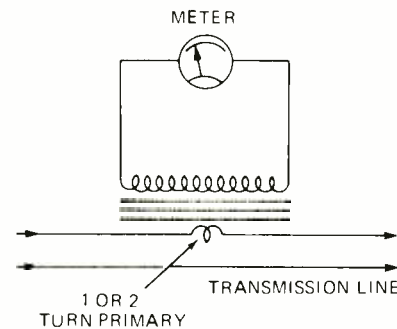


FIG. 6—CURRENT TRANSFORMER has 1- or 2-turn primary and is often used for metering.

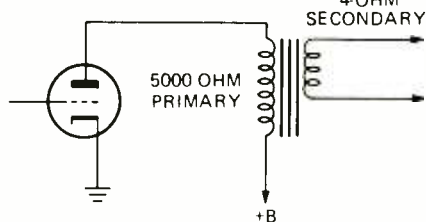


FIG. 7—AUDIO OUTPUT TRANSFORMER matches tube impedance to that of the speaker.

audio amplifier designed to develop its output across 5,000 ohms may be coupled to a speaker having an impedance of 4.0 ohms by a transformer having a turns' ratio of 35.2:1. So if the speaker in Fig. 7 is across 10 turns of the secondary, its 4.0 ohms will appear across 352 turns of its primary as 5,000 ohms ($35.2^2 \times 4$). Impedance transformations, or *impedance matching*, are often made between

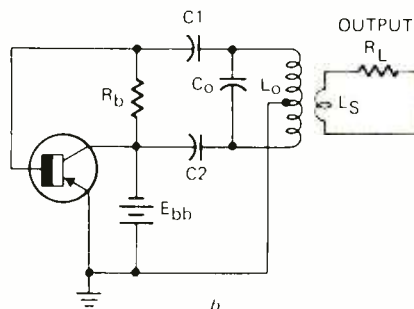
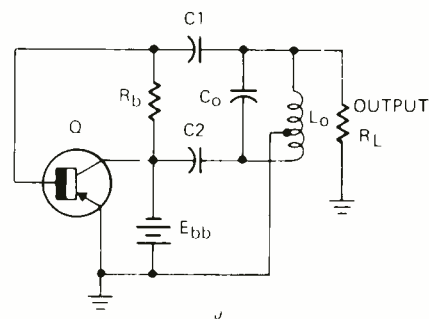


FIG. 8—DIRECT COUPLED OSCILLATOR (a) may not work; transformer coupled circuit (b) minimizes loss of essential feedback.

transistor or tube amplifier stages, between amplifiers and transmission lines, between microphones and amplifiers, between transmission lines of differing impedances, etc.

Power of the automobile engine cannot be directly applied to its wheels, and must be coupled by gear and clutch arrangements. In a like manner, an oscillator circuit directly coupled to its load reduces the power feedback to the input and prevents oscillations. Figure 8-a shows such an oscillator circuit directly coupled to load R_L , while the transformer formed by inductors L_O and L_S serves to couple the circuit of Fig. 8-b to its load. The circuit of Fig. 8-b will oscillate while that of Fig. 8-a probably will not.

To eliminate some of the interference on power lines and to add a factor of safety isolation, transformers are often used. Isolation transformers with a 1:1 turns' ratio have a non-magnetic (electrostatic) shield between the primary and secondary windings acting as a barrier to electrostatic fluctuations (Fig. 9). Since one side of the second-

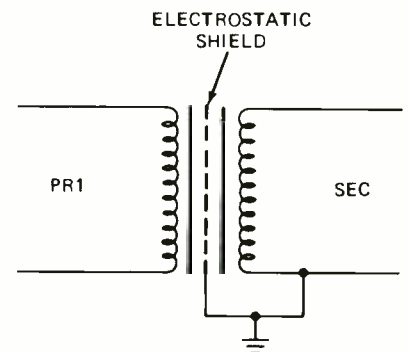


FIG. 9—ELECTROSTATIC (FARADAY) SHIELD prevents coupling through stray capacitance.

ary can be grounded as shown in Fig. 9, there is the added factor of knowing which side of the power line is at ground potential. Isolation-type transformers are also used with audio transmission lines to eliminate undesirable noises as well as being a barrier to direct current.

Transformer ratings

Transformer ratings vary greatly with usage. Power companies use transformers rated in volt-ampere or kilovolt-ampere capacity. Ac circuits commonly have a phase difference between the voltage and the current, and the power consumption is seldom equal to the voltage current (EI) product. Thus, it is essential to rate the power transformer by its maximum voltage-current product. A 1,000-watt load with a 30° phase difference and a power factor of 0.866 across a 115-volt secondary will draw a current of 10.1 ($1,000/115 \times 0.866$) amperes, and the transformer capacity must be 1,160 volt-ampere or 1.16 kilovolt-ampere. Power transformers used in electronic equipment are designed for an 80% power factor, and the true volt-ampere rating is not given.

In addition to the power rating, audio output transformers are also rated with regard to impedance ratio and frequency response. The output transformer has an impedance ratio based upon the speaker impedance at 400 Hz. However, at other frequencies the speaker's impedance differs greatly, and any impedance match is actu-

TABLE 1. AUDIO TRANSFORMERS

TYPES	PRIMARY Z OHMS	SECONDARY Z OHMS	POWER RATING
MICROPHONE OR LINE TO GRID	100 400CT	70,000 195,000	
LINE TO LINE OR VOICE COIL	500/1000/ 1500/2000/ 2500/3000	8/16/24/32/ 40/48	
PLATE TO P-P GRID	5000 7000 10,000	4/8/16/250/ 500 20,000 4/8/16/500 2/4/8 40,000 90,000	
OUTPUT	20 48 100 400 500 600 1250 2500	8 8/16 3.2/8/16 4/8/16 4/8/16 4/8/16 4/8/16 4/8/16	10 5 10 10 0.3 0.3 0.15 0.15 0.15 0.3
INTERSTAGE	100 500 5000 10,000	10 1000 1500 50 500 5000 50,000 7500 10,000 200 2000	0.15 0.25 0.3 0.16 0.3 1.0 0.15 0.15 0.15 0.15 0.15
DRIVERS	20 100 500 1000	36 200 100 200 200	1.0 0.5 0.5 0.5 0.05

ally a compromise. In turn, the frequency response of the output transformer and speaker combination is also a compromise within reasonable limits up to 12,000 Hz. As well as possible, high-fidelity (hi-fi) equipment makes use of high-frequency feedback and bass-boost systems to compensate for the inadequacies of the transformer-speaker combination.

Inter-stage audio transformers transfer little or no power. While inter-stage transformers used in tube circuits made the use of lower supply voltages possible, that advantage has become insignificant with transistor circuits. Interstage transformers are rated by their impedance ratios which will be a step-up (5,000: 1.0 meg.) in tube circuits and a step-down ratio (10,000:200) in transistor circuits.

Impedance and turns' ratios of i.f. transformers for tube circuits are often not listed by the catalogs. This assumes that i.f. tube

circuits are fairly standardized, but most i.f. transformers used in transistor circuits are listed with their impedance ratios.

Type of transformers:

Many early radio receivers used a step-up power transformer to provide 250 to 500 volts for the plate circuits as well as step-down transformers to supply the heaters. Quite often, these step-up and step-down transformers were combined with a single primary winding as shown by Fig. 10. In time, more efficient electron tubes and circuits made the voltage step-up unnecessary, and series wiring of heaters eliminated the step-down transformer. However, better television receivers used filament transformers to prolong tube life. Figure 11 shows the basic construction of a power or filament transformer with its windings formed on paste-board, and thin E- and I-shaped pieces of this iron core insulated by a coat-

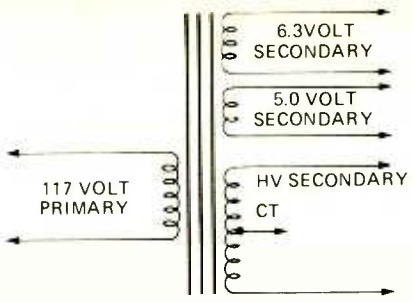


FIG. 10—POWER TRANSFORMER for tube sets has step-up and step-down secondary windings.

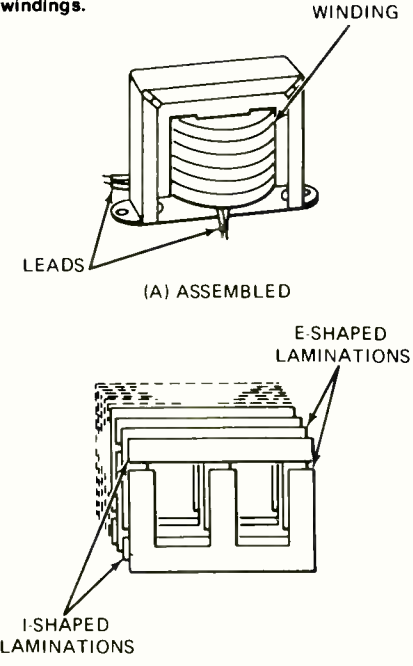


FIG. 11—POWER AND FILAMENT TRANSFORMER CORES are interleaved "I" and "E" segments.

ing of iron-oxide (rust). Plate supply transformers typically had secondary voltages up to 930 volts (465 volts each side of the center-tap) at 150 mA., measuring 3 x 4 x 3 inches and weighing nearly 8 pounds.

With transistorized receivers operating on ac, it is necessary to step-down the 117 volts to less than 50 volts. Except for transistorized receivers and record players with large audio outputs, the current drain is low, and the power transformer does not need a heavy magnetic core. Filament and transistor power transformers have ratings of 2.5 to 80 volts at up to 30 amperes.

Audio frequency transformers used in coupling and impedance matching are similar in construction to power transformers. However, in most cases the current and power of audio circuits are small, and the core and windings need not be large. Most coupling and impedance matching audio transformers are rated by their impedance ratios as shown by Table 1. Power ratings are insignificant except for those used as driver and output transformers. Driver stage transformers have power ratings of 0.5 and 1.0 watt while output transformers may have as much as 35-watt capacity. Although often not listed, another important factor of audio transformers is the frequency response. Figure 12 shows the typical frequency response at A, a very poor response

(Continued on page 74)

MARCONI-

We celebrate the 100th anniversary of the possible. Here is a brief



Guglielmo Marconi

On December 12, 1901, an event took place on a hill overlooking St. John's, Newfoundland, which was destined to have a profound effect on the social, cultural, political, and economic affairs of all people and nations on earth from that day onward. At 12:30 PM on that cold and blustery day, a handsome young man of 27 worked busily at a table on which an unusual collection of electrical equipment was assembled. The building in which the apparatus was housed barely sheltered him from the harsh winds that blew outside.

The young man held a telephone receiver tightly to his ear, listening intently, his features strained. Suddenly, his expression brightened. He beckoned to his assistant, who had been waiting nearby, and handed him the receiver. "Can you hear anything, Mr. Kemp?" he asked.

Kemp took the telephone and pressed it to his ear. He listened for several seconds, then he smiled and nodded affirmatively, handing the receiver back to the young man whose name was Guglielmo Marconi.

Both had heard the three faint clicks in the receiver, Morse Code for the letter "S." The signal which produced the clicks had traveled over 2000 miles without wires, having been sent toward its frigid St. John's, Newfoundland destination from Poldhu, near Land's End, in Cornwall, England. The two men, Marconi and Kemp, heard the signals again at 1:10 and 2:20 PM the same day, and at 1:28 PM the following day, Friday, December 13th.

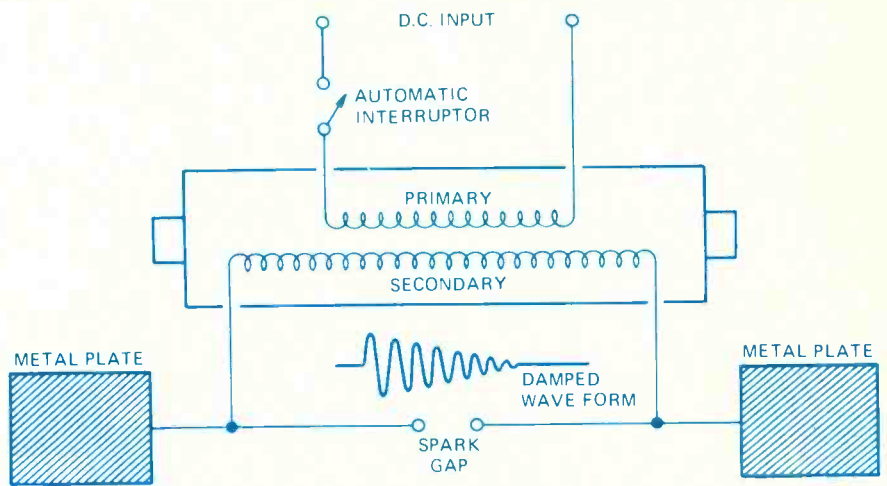
The announcement, given to the press on December 16, 1901, startled the world. Electrical signals had been sent across the Atlantic Ocean without the use of connecting wires!! The experiment, one of the more significant steps forward in the course of human history, climaxed seven years of work by the Italian scientist. The world would never be the same again.

GUGLIELMO MARCONI WAS BORN 100 years ago, on April 25, 1874, in Bologna, northern Italy. His father Giuseppe, was an able and well-to-do businessman. His mother, Annie Jameson, was Irish. She had been born in Dublin, the daughter of Andrew Jameson, who operated one of Ireland's largest whiskey distilleries. Annie had come to Italy to study bel canto. There she met, and later married, Giuseppe.

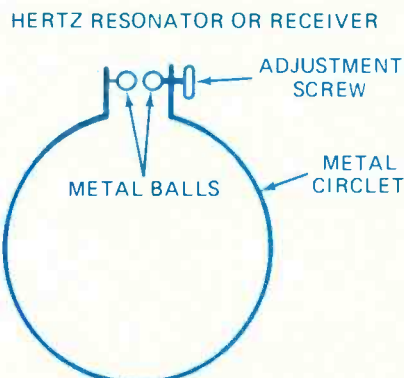
As a child, Guglielmo had few friends. At

the age of five, he went to England with his mother for two years, and his first elementary school education was at a private school in Bedford. For several years thereafter, his education was provided primarily by tutors and by his mother, who taught him in English. He went to school in Florence at age 12, and at 13, attended the Leghorn Technical Institute. In his teens, Marconi attended some of Professor Righi's lectures. Augusto Righi was Italy's leading authority

GUGLIELMO MARCONI in his room in the old Barracks Hospital on Signal Hill, St. Johns, Newfoundland. The receiving equipment he used to detect wireless telegraph signals from Cornwall, England—2200 miles away—is on the table.



HERTZ TRANSMITTER produced a damped spark chain at the gap as interruptor opened and closed. This induced similar spark chain in receiving loop.



on electromagnetic radiation. The lectures stimulated Marconi's interest in electrical phenomena, and by the time he was twenty he had read extensively on the subject.

The turning point in Marconi's life came when, at the age of 20 he read, while on vacation in the Italian Alps, a paper on the experiments of Heinrich Hertz. Using a battery, an induction coil, a switch, and a pair of metal plates with a spark gap between them, Hertz had produced an electrical dis-

Used with the permission of Charles Scribner's Sons from their forthcoming book FROM SPARK TO SATELLITE by Stanley Leinwoll. Copyright © 1974 Stanley Leinwoll.

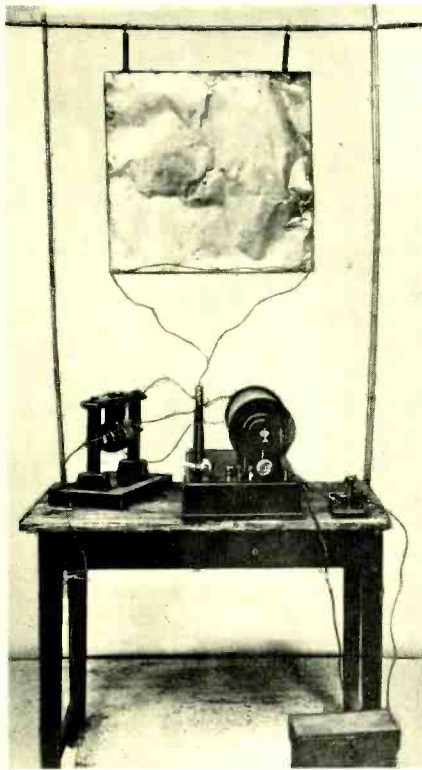
100th ANNIVERSARY

*birth of the pioneer who made transatlantic radiotelegraphy
chronicle of events leading to the breakthrough*

by **STANLEY LEINWOLL**

charge between the metal plates. The discharge was detected several feet away by a cirlet of wire with a small gap in it. When the discharge between the plates occurred, tiny sparks could be observed across the gap in the cirlet, indicating that energy had been transferred through space.

Although he knew that a theory had been proposed postulating such waves, Marconi



MARCONI'S FIRST TRANSMITTER in Italy in 1895 looked like this replica.

had not been aware that their existence had been proved experimentally. His imagination fired by the article, young Marconi curtailed his vacation and returned to the family's country estate, the Villa Griffone, outside Bologna. Signora Marconi had given her son a room on the third floor of the estate to use as a workshop and laboratory, and it was in this room that Guglielmo Marconi conducted his first experiments using electromagnetic waves as a means of communicating.

He started by duplicating the apparatus used by Hertz. After several failures, Marconi was successful. Guglielmo's early efforts consisted of modifying the Hertzian apparatus in an attempt to produce bigger sparks at greater distances. He had seen the possibilities immediately: Hertzian waves could potentially be used to transmit and receive messages over great distances without

the use of wires!

It was not long before Marconi was able to produce a spark the full length of his room. This done, it became clear to Marconi that further development would have to lie in two directions: to increase the transmission distance of the sparks, and to make these sparks perform a function - to transmit intelligence in some manner. Young Marconi realized that development along these lines would take capital, and he went to his father for it. The elder Marconi was totally against his son's activities initially, but soon saw the commercial possibilities of his son's "wireless" experiments, and he gave the boy a substantial sum of money with which to continue his work.

He started with equipment being used by the others. This included the Hertzian transmitter in the sending circuit, and a receiver which substituted a coherer for Hertz's spark ring. The coherer had been developed by a French physicist, Edouard Branly, who found that if a small glass tube were filled with metal powder, then exposed to electromagnetic waves, the metal particles cohere - that is, their resistance dropped, and they were able to conduct electricity. Branly had used iron filings in his coherer. He used a galvanometer, an instrument designed to detect the flow of electric current, to show the coherer was working.

Although Marconi's new equipment worked, the ranges he obtained with it were comparable to those being achieved by other researchers in the field—a matter of yards at the most. Discouraged, Marconi turned to other electrical research—attempts to pick electrical discharges from thunderstorms using an elevated antenna. A sudden flash of insight inspired Marconi to combine the elevated antenna of the electrical storm experiments with his wireless equipment.

He mounted a copper plate atop a tall mast, and attached it to one end of his Hertzian transmitter. The other end was connected to a copper plate that was buried in the ground. At the receiver, Marconi erected a similar elevated antenna which was connected to one side of a coherer. The other side led to a metal plate in the ground. These modifications led to dramatic increases in the distance to which he could transmit his wireless signals. The grounded antenna, often referred to as a Marconi antenna, was the young inventor's first original contribution to radio, and for many years afterward, the symbol for wireless was an antenna with one end elevated and the other grounded.

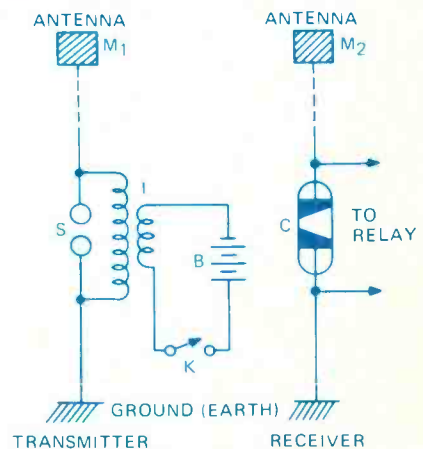
The improvement in range was so marked that Marconi had to move his equipment out of doors to continue his experiments. There, he found that the distance he could transmit a signal varied approximately in proportion

to the length of the vertical wires, as well as the height of the plates above ground. At this point, Marconi's equipment included a telegraph key and relay, which he had introduced in late 1894 and early 1895 experiments; this enabled him to produce long or short trains of sparks, depending on the length of time the key was depressed. In the receiving circuit, Marconi replaced the galvanometer used by Branly with a battery-operated relay and a Morse inker which recorded the signals being sent. He also introduced a tapper into the coherer circuit. The tapper worked like a hammer in an electric bell. When reception of Hertzian waves caused the coherer's electrical resistance to drop to a low value, an electrical circuit was established between a battery and the tapper. The hammer thereupon gave the coherer a light tap which decohered the metal particles, rendering them nonconducting until another train of waves arrived.

At the time the tapper was introduced, Marconi also introduced an improved coherer. He had found that the Branly tube was too erratic to provide reliable Morse signals, so he devoted considerable time to improving the device. He experimented with 300-400 different combinations of filings and metals before evolving a satisfactory coherer which contained nickel and silver. All of these modifications further improved Marconi's equipment as a communication device.

Each impulse reaching Marconi's receive-

MARCONI TRANSMITTER AND RECEIVER



- M₁, M₂ = Metal Plates
- S = Spark Plug
- I = Induction Coil
- K = Morse Key
- B = Battery
- C = Coherer

GROUNDING TRANSMITTER AND RECEIVER with elevated antenna were the key to greater communications range.

ing equipment produced the same result: the particles cohered, current flowed, the tapper struck the tube containing the particles which decohered, and current stopped flowing. Using this device, Marconi was able to transmit dots and dashes on a continuing basis, over a distance of about one mile. He soon discovered that by placing the receiving equipment on the far side of a hill, signals could still be received, indicating that the radiation was either traveling through or over the hill.

In 1895, at the age of 21, the young Marconi offered his invention to the Italian Ministry of Posts and Telegraphs, which turned it down because it had no particular use for it. Marconi was told that his equipment would be more useful to a maritime nation because it seemed to lend itself more to communication between ships or between ship and shore. At that time, the world's most powerful maritime nation was England, and with his mother's friends and influential acquaintances in that country, it seemed a most logical place for him to take his wireless.

Marconi arrived in London in February of 1896 with two trunks containing his wireless equipment. Customs officials were suspicious of the young Italian immigrant, fearful that he was an anarchist and that his mysterious apparatus was a bomb, and they proceeded to dismantle his equipment completely. They were then unable to put it together again because some of it had been damaged in the process. Before he was able to proceed with demonstrations, therefore, Marconi had to make some hasty repairs and reassemble his equipment.

The first man to see the Marconi wireless operate in England was his cousin, Henry Jameson-Davis, an influential businessman in his own right; plans were immediately made to patent Marconi's invention. On June 2, 1896, Marconi applied for a patent—the first of its kind—for his wireless telegraph equipment. By this time, Marconi had already contacted several prominent engineers in Great Britain, among them William Henry Preece, chief engineer of the British Post Office. Preece had conducted his own research of telegraphy, and had tried to approach wireless by use of induction techniques which were not successful. He was amazed when he learned of Marconi's achievements. Preece, acting as a watchdog for the Post Office, keeping an eye on what might turn out to be a rival system to the existing line-conductor internal telegraph message carrying, offered to assist Marconi in any way he could. Marconi was interested in the Post Office because it was potentially a valuable customer. The two, therefore, formed an association of mutual convenience. Marconi demonstrated his equipment to officials of the Post Office and the War Office in July and August, 1896, transmitting signals to distances of several hundred yards. This brought a request for further demonstrations, and the equipment was moved to Salisbury Plain, where successful communication over a distance of one and three quarters miles was established. Subsequent tests extended the distance covered over Salisbury Plain to four miles, and a test across Bristol Channel extended the range of the equipment to eight miles.

Marconi used his wireless in 1898 to report the Kingstown Regatta yachting races for the Dublin Express. He followed the

racing yachts in a tug which had been specially equipped with wireless equipment, sending back to shore a running commentary of race positions and developments in Morse code. This marked one of the first times wireless had been used for journalistic purposes.

Queen Victoria was so taken with the Kingstown Regatta reporting that she requested that wireless communication be established between her residence at Osborne House, on the Isle of Wight, and the Prince of Wales, who was recovering from an injury aboard the royal yacht Osborne, several miles away. Over 100 messages were exchanged between the queen and the prince, and wide newspaper coverage was given these exchanges.

In 1899, the French Government requested that Marconi conduct tests to determine whether communication between England and the European continent was feasible. The tests, carried out over a 30-mile distance, were a complete success, and were given wide publicity by the many reporters from both countries who wit-

lifetime—international recognition and respect, wealth, a place in history. But the task was just beginning, and his greatest moments still lay ahead. By 1900, Marconi was experiencing serious competition from foreign sources, particularly from Germany, where Braun, Slaby, and Arco were notable workers. The head start Marconi had gained was being held, but others were close behind, and he needed some innovation that would give him a significant lead.

Frequency selection

One of the biggest problems at that time was co-station interference. Because control of the frequency at which the wireless equipment functioned was virtually nonexistent, it was a frequent occurrence to find that two stations operating in close geographical proximity drowned each other out. There was no way, in 1900, of separating a wanted from an unwanted signal, and since there was no regulation of usage, either geographically or in time, chaotic conditions often arose in which receiving stations could not work efficiently, receiv-



FAN-SHAPED TRANSMITTING ANTENNA used at Poldhu, Cornwall, England to send first transatlantic signals to Signal Hill at St. Johns, Newfoundland. The first—a circular array—came down in a seasonal gale.

MARCONI (extreme left) and assistants launch kite that raised antenna used at Signal Hill, Newfoundland to receive the first wireless signals from across the Atlantic Ocean. Storm made reception very difficult.



nessed them. At last, wireless was beginning to gain international attention.

In the same year, Marconi came to the United States to conduct a series of tests for the war and navy departments. The American military, satisfied that Marconi's system was the best available, adopted it for use by the army and navy. While in the United States, Marconi gained widespread publicity by reporting the results of the America's Cup yacht races off Sandy Hook.

Although press coverage during Marconi's stay in the United States was excellent, and purchases of Marconi's equipment were made by the U.S. Government, the most significant development of Marconi's visit was the formation, in November, 1899, of Marconi Wireless Telegraph Company of America, which, some two decades later, was to become the Radio Corporation of America.

At 25, Guglielmo Marconi had gained what most men fail to achieve in a

ing only a hodge-podge of incoming signals from two or more transmitting stations.

Marconi first addressed himself to the problem by improving his antenna systems, and experimenting with different types of coherers. Some improvement was noted, but it was not enough. It was evident to the young Italian genius that limiting the radiation by narrowing the band of frequencies transmitted was the answer.

The solution to the problem of interference was found by using tuned, or resonant, circuits. The principle of resonance, called "syntony" by Sir Oliver Lodge, who demonstrated it in 1897, made use of virtually identical antennas, inductances, and capacitances in both the transmitter and receiver. Braun had patented a similar device in 1899. But the systems that Lodge and Braun had patented had one serious drawback: very little energy was radiated into space. Two simple yet ingenious innovations by Marconi solved the problem. He coupled the an-

tenna inductively to the transmitter, and made both this inductance, as well as the capacitance in the transmitting circuit, variable. These changes enabled him to tune his transmitting circuit to resonance, and the resulting oscillations radiated considerable energy into space.

Marconi then matched his receiving circuits to those at the transmitter, tuning to the frequency being transmitted. No longer did his wireless equipment radiate a broad band of frequencies. By using syntonic circuits with variable inductances and capacitances, stations could operate in the same vicinity and, simply by varying the values of the circuit components, could transmit and receive with greatly reduced interference. As soon as he was certain that syntony was the answer, Marconi applied for an all-inclusive patent on his system. On April 26, 1900, one of the most important patents ever granted, the famous No. 7777, was issued to Marconi by the United States. The stage for one of the great experiments of the age was rapidly being set.

Beyond the horizon

Coincident with the work on "syntonic" or tuned circuits, Marconi had become aware of an apparent paradox in connection with his wireless system. He knew that, according to the well-understood laws governing electromagnetic wave propagation, wireless telegraphy ranges should theoretically never greatly exceed optical distances. This is because radio waves, like light waves, travel virtually in straight lines. Therefore, because of the earth's curvature, they would be expected to leave the surface at a tangent to disappear out into space. While diffraction and refraction effects would increase the range to a little beyond the horizon, no significant extension could theoretically be expected.

Scientists of the day were therefore unanimous in declaring that wireless telegraphy communication would be limited to these just-beyond-the-horizon distances. Yet Marconi had found that in practice, he was obtaining ranges which were at least twice those that mathematical calculation indicated. He did not know why this should be so; he only knew that it was.

Encouraged by the 60- to 100-mile ranges he was already getting, Marconi decided to gamble by seeing whether the signals could bridge the Atlantic. The audacity of this scheme can be gathered by remembering that all wireless equipment at that time was small and battery-powered, whereas the transatlantic project would demand a huge power plant and antenna system of a kind of never before visualized. Marconi proposed to erect two such stations, one on each side of the Atlantic, with which he hoped to effect two-way communication, and thereby to deal a mortal blow to the cable companies.

He put his proposal to his board of directors who were far from enthusiastic, for tremendous expenditures were involved and, according to the text books, the scheme could never succeed. At length, however, and with considerable misgivings, the board agreed.

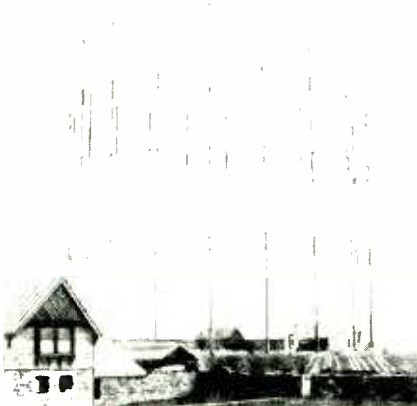
When the news was released, many noted scientists scoffed. The earth was round, Hertzian waves traveled in straight lines, and the signals would be lost in outer space long before they reached their destination. There was no way, they said, that the exper-

iment could succeed. Marconi was stubborn and would not be dissuaded.

To assist him, Marconi engaged the services of an eminent scientist and engineer, J.A. Fleming, who was Professor of Electrical Technology at London University. Fleming, who would later invent the diode detector, was an expert in the operation of high-power alternating current generators, and was an authority on the work of Maxwell and Hertz, as well. He had duplicated Hertz's experiments, and followed closely the work of Marconi.

In mid-1900, a site at Poldhu, on a finger of land just east of Land's End, Cornwall, was chosen for the transmitter site, and construction was begun in October, 1900, the work being carried out secretly. The size of the Poldhu station was massive. In place of previously used battery power supplies, a 32-horsepower generator was installed to drive a 25-kilowatt alternator, whose output was 2000 volts. This voltage was stepped up to 20,000 volts by a transformer.

The antenna system at Poldhu consisted of 20 wooden masts, each 200 feet high, erected in a circle. Circumferential support was provided by horizontal triatics between each mast, and the guy wires anchoring the



FIRST TRANSMITTING ANTENNA at Poldhu — a circular array — was blown down in gale.

masts were broken up and held together with lanyards. From an engineering standpoint, the horizontal support arrangement left much to be desired, because it meant that if one mast were to fall, it would in all probability carry the others down with it. The designers were aware of this shortcoming, but decided the gamble was justified, in view of the relatively low losses the system would have from leakage current. They would need every bit of power possible.

By March, 1901, the Poldhu station was nearly ready, and Marconi, satisfied that things were going well there, sailed with an assistant for the United States. An ocean-front site at South Wellfleet, Cape Cod, Massachusetts was chosen, and Marconi left the construction of the receiving equipment and the receiving antenna system, which was identical to that at Poldhu, to an assistant, and he returned to England.

Preliminary tests conducted in the fall of 1901 from Poldhu to Crookhaven, on the west coast of Ireland, were successful. The distance between these points was 225 miles, well beyond the 186-mile record established from Poldhu several weeks before, and indicated once again that the Hertzian waves were not traveling tangent to the curvature of the earth. Since no other possibil-

ity was conceived of at the time, it was generally supposed by Marconi and his associates that the signals were traveling along the surface of the earth.

During the period of these preliminary tests, construction of the Cape Cod station continued while the finishing touches were being put to the Poldhu station. Then, in close succession, a double disaster struck. In September, the worst fears of the antenna designers were realized when a severe gale struck the west coast of England, and the antenna system at Poldhu was totally destroyed, with all 20 masts collapsing, leaving a mountain of twisted debris.

Marconi would not be deterred. He immediately ordered the wreckage to be cleared, and an alternate temporary antenna system erected. It consisted of 54 copper elements arranged in a fan shape, and mounted between two 150-foot wooden masts. Within the month, the site had been cleared, and the second array under test. While the tests on the temporary antenna were being conducted, plans were made to substitute a more powerful, permanent antenna. But the test with the temporary system was going so well that Marconi decided not to wait, but to use the alternative instead. Then, just as Marconi was ready to start his transatlantic tests, the second disaster, identical to the first, befell the Cape Cod antenna. In November, 1901, it collapsed in shambles during a northeastern storm. It seemed that fate was conspiring against the inventor.

Marconi decided that he could not wait for the reconstruction of the stateside system. Instead, he and two associates, George S. Kemp and P.W. Paget, set sail for the point of nearest landfall in the Americas—Newfoundland. They carried with them an assortment of wireless equipment, including different receivers and coherers, and antenna accessories, including large canvas kites, balloons, and varying lengths and thicknesses of wire.

Marconi and his associates landed at St. John's on December 6, 1901, and met with Sir Cavendish Boyle, the governor of Newfoundland, and Sir Robert Bond, the Prime Minister, both of whom promised Marconi all possible assistance. They made available to the party an abandoned barracks hospital which lay on a hill some 600 feet above St. John's harbor, facing Poldhu. The location, now called Signal Hill, was not far from where John Cabot, the discoverer of Newfoundland, first landed.

S . . . S . . . S . . . S . . .

By December 9th, Marconi and his assistants had assembled their equipment in a ground floor room of the hospital, and Marconi sent a cable to Poldhu instructing the technicians there to start transmission of test signals on December 11th. They were to send S's—three dots in the Morse code continuously between the hours of 11 AM and 3PM Newfoundland time. The choice of the letter S was made for several reasons. The switching arrangements at Poldhu were not constructed to withstand long periods of operation without considerable wear and tear on the equipment. This was especially so if dashes were to be sent. Furthermore, an automatic transmitting device could be employed if S's were sent. Finally, Marconi felt that three dots would probably be heard

(continued on page 80)

FEMTOWATT— Here It Comes

The standards used to rate the performance of FM tuners and receivers have been varied and only loosely followed. A new standard proposed by EIA/IHF meets the needs of today's technology.

by LEN FELDMAN

THE ELECTRONIC INDUSTRIES ASSOCIATION (EIA) and the Institute of High Fidelity (IHF) recently held a joint engineering meeting to try to come up with one national (and hopefully, perhaps international) standard for measuring the performance of FM tuners and receivers. Ever since 1958, when the first IHF Tuner Measurement Standards were issued, the hi-fi component manufacturing segment of the audio industry has, for the most part, tried to specify product performance using these measurement standards. Mass-market manufacturers, such as makers of console "package" radio-phonographs and table model FM sets have either used specific portions of the IHF standards, sections of the older (1947 and 1949) IRE FM measurement standards (now the IEEE), or have come up with measurement standards of their own to suit their advertising requirements.

Admittedly, even the IHF standards of 1958 are sadly out of date. For one thing, they make no mention of stereo FM performance or related measurements, since in 1958, stereo FM was still three years away. New drafts of measurement standards developed separately by both the IHF standards committee and the EIA sought to update and clarify FM performance measurements in the light of present-day technology and knowledge.

Undoubtedly, the final approved version or versions will take proper account of such important parameters as stereo separation, stereo signal-to-noise ratio (which is always poorer than the S/N realized in monophonic performance) and stereo harmonic distortion. SCA and 38-kHz carrier product rejection will also appear in the new standards, along with more wide-ranging intermodulation and harmonic distortion measurements in general—all intended to more clearly spell out the relative merits (or demerits) of an FM receiver product so that its performance can be meaningfully and

completely compared with competitive products being shopped by the knowledgeable audiophile. Details of these new measurement requirements will be reported on here as the new standards near finalization and issuance. Our purpose this time, however, is to analyze a much more fundamental concept which came under investigation at the joint EIA-IHF meeting—and that has to do with the way in which we measure signal input levels to receivers—be they FM, AM, TV, or other communications types.

to only 3.3×10^{-13} watts, or $\frac{1}{4}$ the previous power. Looking at it another way, if a manufacturer rates his FM tuner as having a sensitivity of 2.0 microvolts (referencing a 300-ohm input impedance), another manufacturer might well rate a similar product as having a 1 microvolt sensitivity if he refers his sensitivity to a 75-ohm input impedance, since $(2.0 \times 10^{-6})^2/300 = (1.0 \times 10^{-6})^2/75 = 1.33 \times 10^{-14}$ watts. Few manufacturers of true hi-fi components play this game any more, but the possibility of this

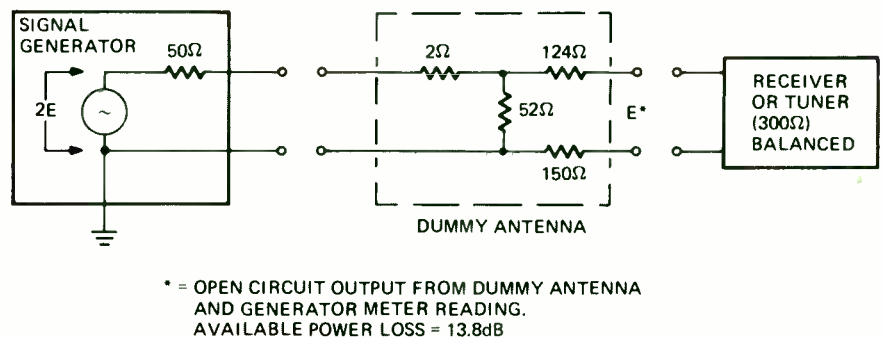


FIG. 1—VOLTAGE RELATIONSHIPS using an FM signal generator matched for use with a receiver having an antenna input impedance of 300 ohms, balanced.

Microvolts vs power

Even though it is intuitively recognized by engineers and technicians alike that a signal induced in the antenna of any communications receiver involves a transfer of power to the antenna terminals, some segments of the industry (notably, in the consumer FM and AM receiver field) have traditionally dealt with signal inputs in terms of voltage or, more specifically, microvolts. Obviously, we can easily translate microvolts appearing across a given impedance into microwatts of power. For example, 10 microvolts appearing across an input impedance of 75 ohms may be expressed as 1.3 micro-microwatts (1.3×10^{-12} watts) since power, $P = e^2/R$. However, the same 10 microvolts appearing across a 300-ohm input impedance is equivalent

abuse does exist, and either statement would be true if the manufacturer bothers to reference the impedance being used in the calculation.

"Hard" and "Easy" microvolts

Continuing to use microvolts rather than power as a reference input signal for tuner or receiver measurements leads to other possible points of confusion. The available power from a typical signal generator (used to measure FM performance) having a source voltage E (equivalent to the induced antenna voltage) and an internal source resistance of R (equivalent to the antenna resistance) is the power which would be delivered to a matched load (the receiver input terminals). It is equal to $E^2/4R$, where E is the open-circuit voltage and R is the generator

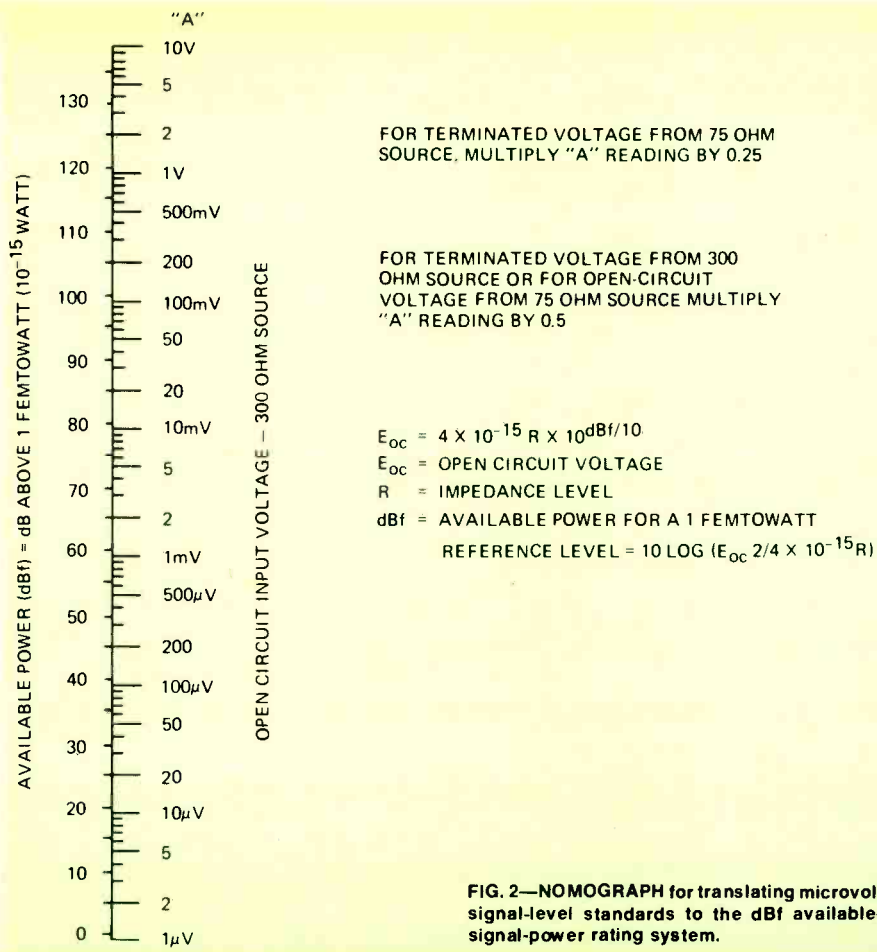


FIG. 2—NOMOGRAPH for translating microvolt signal-level standards to the dBf available-signal-power rating system.

resistance. The terminated voltage is the voltage delivered to the matched load, and is therefore equal to one-half the open-circuit voltage.

In the diagram of Fig. 1, the generator produces a voltage $2E$, internally, and has a 50-ohm source resistance. Most generators are calibrated directly in terms of available power level—that is the power available to a matched load, so that they are direct reading in available power (or signal). Thus, in Fig. 1, the microvolts indicated on the generator's own internal voltmeter would be " E " rather than $2E$. The resistors shown in the dummy antenna configuration serve to terminate the output of the generator, and present a "looking back" impedance of 300 ohms required by the 300-ohm antenna terminas of the receiver under test.

Using this kind of dummy antenna and working according to present IHF standards, a technician would consider the signal intensity applied to the receiver to be $E/2$, rather than the true open-circuit voltage of E . Thus, if the generator meter's reading was 5 microvolts, he would divide this figure by 2, and say that the receiver had only 2.5 microvolts applied. The reasoning, of course, is that half of the internally available " $2E$ " voltage is voltage divided between the internal 50-ohms impedance and the external matching

network. A second voltage division takes place between the voltage available across the 52-ohm resistor and the combination of series resistors and the internal impedance of the receiver (which is presumed to be exactly 300 ohms). Bear in mind that the generator's meter already takes into account the first match, and is calibrated to read " E " and not " $2E$."

This procedure has been labelled as the "soft," "easy," or terminated microvolts approach. Alternatively, "hard" microvolts are used by some to measure receivers, in which the number of microvolts would be the open-circuit microvolts (in this case " E "), or exactly the number of microvolts read by the generator's own meter—without the "divide by two" factor. Thus, if the meter reading is "5 microvolts," one faction might term

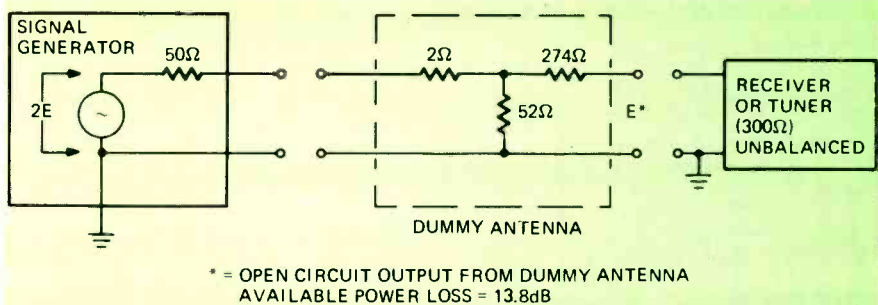


FIG. 3—DUMMY ANTENNA for matching signal generator to unbalanced 300-ohm antenna inputs on FM tuners and receivers. The dummy antenna should be shielded to avoid stray pickup.

sensitivity as $5 \mu\text{V}$, while those who subscribe to the well-established IHF procedure would designate the same receiver's sensitivity as $2.5 \mu\text{V}$.

Enter the femtowatt

The joint IHF-EIA committee has suggested that henceforth all input signal levels should be expressed in terms of available power, to avoid confusion over whether receiver sensitivity expressed in microvolts is in "open-circuit" or "terminated" microvolts. In addition to resolving the 6-dB ambiguity of "hard" vs "easy" microvolts, expression of receiver input levels in available power has been accepted for many years as being the more fundamental measure of receiver input level. It would be particularly advantageous when comparing measurements in receivers designed for different source impedances (as, for example, 75-ohm coaxial lines or 300-ohm lines).

To make the scale a convenient one, the reference level that has been selected is one femtowatt (1×10^{-15} watt). 0 dBf, using this reference, works out to an open-circuit voltage of approximately 1.1 microvolt, and +120 dBf corresponds to 1.1 volt, both referred to a 300-ohm impedance level. The nomograph of Fig. 2, along with the accompanying notes, will enable the reader to translate any relationship between available power, open-circuit microvolts, and terminated microvolts at both the 300-ohm and the 75-ohm impedance levels. Typical sensitivity figures for today's state-of-the-art component tuners and receivers might be expected to fall at around 10 dBf, using this system. As can be seen from Fig. 2, this would correspond to an open-circuit voltage of $3.4 \mu\text{V}$ at 300 ohms, or a terminated voltage (similar to that used in the present IHF specs) of $1.7 \mu\text{V}$.

Calibration of generators

Some FM generators are already calibrated in some form of decibel scale, but this should not be confused with the new femtowatt 0-dB reference. For example, one well-known generator is calibrated with a dB scale in which 0 dB is 1 volt, and a change of 20 dB corresponds to a 10 to 1 change in

voltage. This scale would show a 1000- μ V signal as -60 dB (the minus sign is in fact omitted on the actual scale). Still other generators have adopted a reference of 0 dB = 1 μ V while others choose the 0-dB point as

is direct reading in available power (once the new scale has been designed and affixed to the generator). If resistive pads are used for making the impedance match, the loss in available power would have to be subtracted

from the generator reading to find the power available to the receiver. A few examples of dummy antennas for various configurations, together with corresponding available power loss, are shown in Figs. 1, 3, 4, 5, and 6. The latter two are required in making measurements such as capture ratio and selectivity, in which the use of two FM generators is required both in the old and newly suggested standards.

Standard input levels

Many of the presently required standard measurements made on FM tuners and receivers (such as distortion, separation, signal-to-noise, etc.), in accordance with existing IHF measurement standards, require standard input signal levels of 1000 μ v or 1 mV. It has been suggested that the new standard mean level for these measurements be done at an available power level of 60 dBf. As can be seen from the nomograph of Fig. 2, this would correspond to an open-circuit input voltage of about 1100 microvolts (referred to a 300-ohm impedance level). For just about any tuner or receiver we can think of, this slight change in signal level would not materially affect measured results previously made at the 1000- μ V level, and the figure of "60 dBf" is a convenient and easily remembered one. Similarly, for those measurements (such as capture ratio and AM suppression) that were previously required to be made at a signal level of 100 microvolts, a power level of 40 dBf would be substituted, corresponding to about 100 μ V for 300-ohm impedance levels. This minor change, too, would not be expected to materially affect readings and performance ratings.

As of this writing, a final draft of the new combined FM measurement standards is being prepared. As noted, the new standard is far more comprehensive in scope than anything previously attempted with respect to FM performance measurements. As approval becomes imminent, we will report on some of the specifics and on some of the new parameters that IHF members will have to report in their published specifications. In the meanwhile, the femtowatt, or power concept of signal input, may take a bit of getting used to on the part of engineers and technicians who have become accustomed to less meaningful signal level references, but once adopted, the system should prove simple, unambiguous, and easy to use. After all, we're all going to have to get used to the metric system before long, too — simply because it makes more sense than the system of measurement will be replacing.

R-E

WHAT IS A FEMTO?

Femto is a prefix meaning 10^{-15} . The proper symbol denoting femto is a lower case f. Be careful not to confuse it with F for Farad.

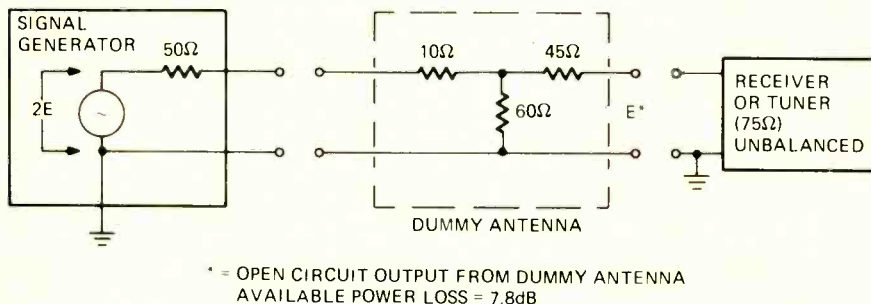


FIG. 4—THE DUMMY ANTENNA presents the signal generator and receiver or tuner under test with a resistance approximating their respective output and input impedances.

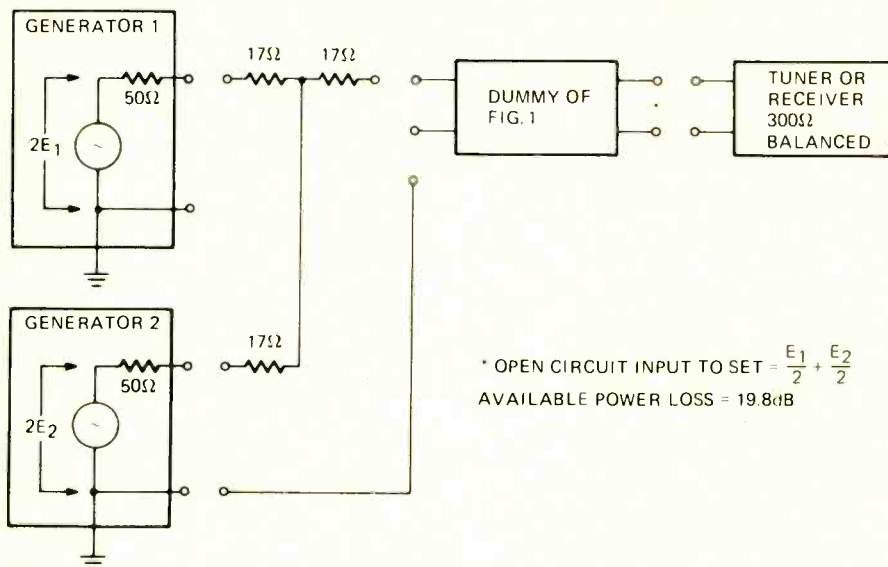


FIG. 5—TWO-GENERATOR SETUP like this is required the old and the proposed standards when measuring selectivity and capture ratio of a tuner with a 300-ohm balanced input.

1000 μ V, or 1 mV. Measurements using this reference generally speak of "so many dBmV." None of the above scales corresponds to the one now being suggested by IHF-EIA, and it will be necessary to affix a proper scale to your existing FM generator scale if the new system is adopted.

Once this is done, however, the scale will apply for all receiver measurements, and you will simply have to allow for the power loss of the dummy antenna used.

A dummy antenna consists of a network which presents to the receiver the source impedance for which that receiver was designed. The standard 300-ohm dummy antenna presents a balanced 300-ohm source impedance. Since provision for a 75-ohm balanced or unbalanced input is frequently provided on some tuners or receivers, appropriate dummy antennas will have to be used in such cases. The ideal dummy antenna is loss-free, and transforms the generator impedance directly to 300 ohms or 75 ohms. When such a dummy antenna is used, the generator

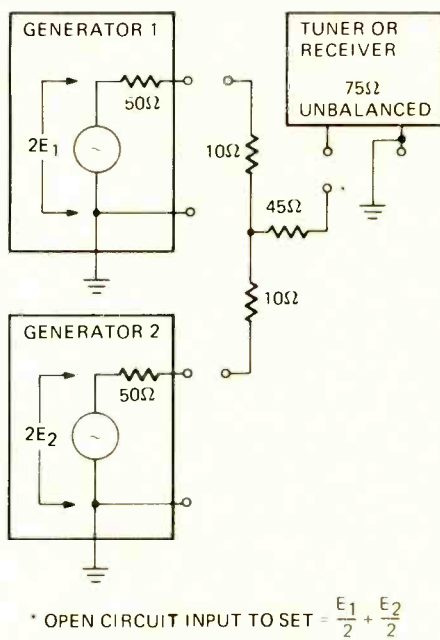
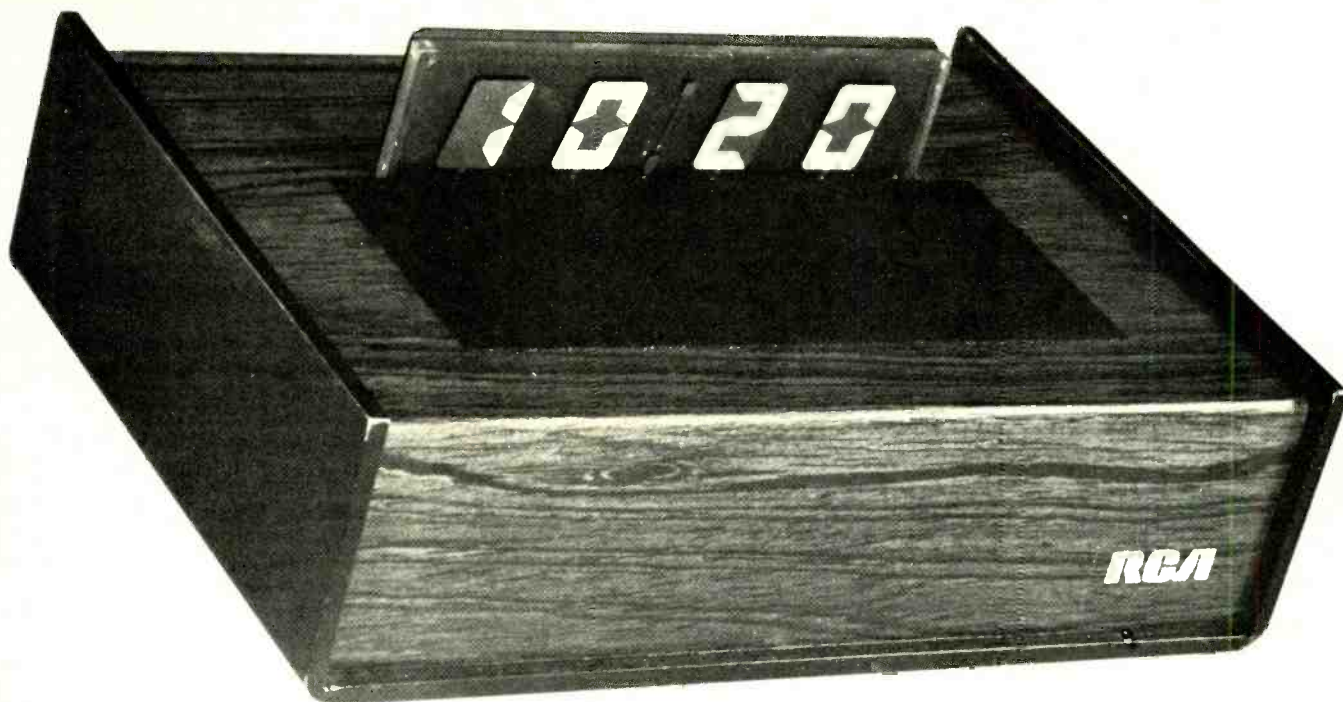


FIG. 6—TYPICAL MATCHING NETWORK used between two FM generators and a tuner or receiver with a 75-ohm unbalanced antenna circuit.



Liquid-Crystal Clock

Build it from a kit for \$89.95. It runs on one set of pen light batteries for a year. Crystal oscillator makes it accurate.

WE FIRST BROACHED THE IDEA OF A practical IC digital clock using low-power CMOS IC's driving a liquid-crystal digital readout in **Radio-Electronics**, one year ago, in the April 1973 issue. At that time we presented a construction article on just such a clock. Unfortunately, both the IC's and the readout were hard to come by, and their prices were staggering. Anyone building the clock now has one of the most expensive digital clocks our readers ever built.

Now, just one year later, we are pleased to report on a new liquid-crystal clock kit, that is very similar to the clock project we presented. It's the RCA model KC-4014 and will be available from RCA distributors across the United States for \$89.95.

This is a complete kit with all parts and construction details. IC's, liquid crystal display, two-sided circuit board, case, oscillator crystal, even the batteries are included.

An interesting clock

The liquid-crystal display provides a 4-digit readout that tells the hour and minute. The colon between the hours

and minutes blinks off the seconds. There are 18 CMOS IC's mounted on one side of a two-sided circuit board that has plated-through holes. The readout plugs into a special set of contacts that the builder solders to the board.

All parts except for the three time-setting switches mount directly on the circuit board. The switches are attached to the rear of the clock case and connected with ordinary hookup wire

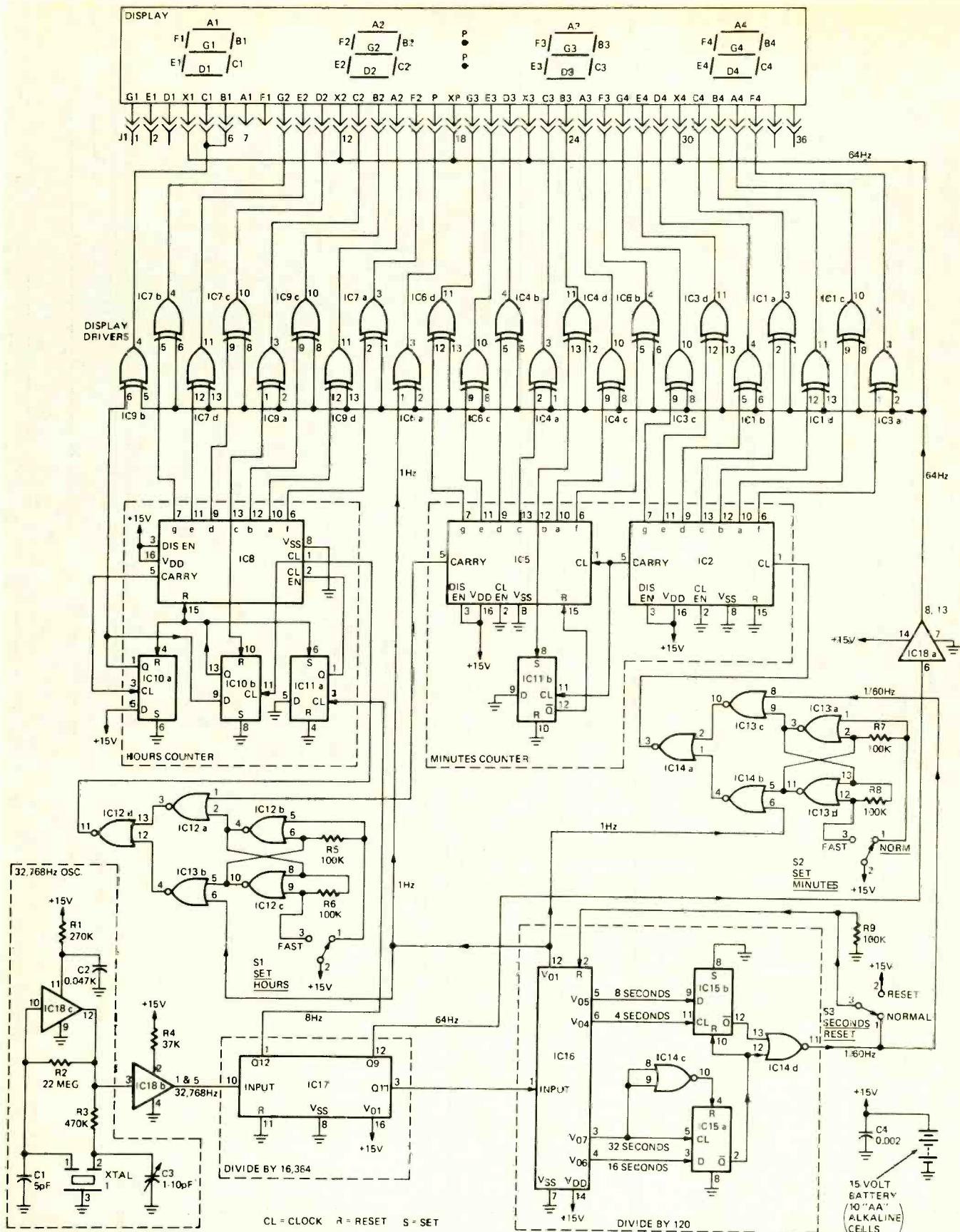
to the circuit board.

The oscillator crystal is in a miniature TO-8 type case. There is one special feature of this device that deserves special notice. When you take a close look at it you'll see that the top of the crystal case is transparent. This is done because the crystal is trimmed to its precise frequency after it is in its case. It's done with a laser.

The liquid crystal display is highly visible, as you can see in the photos



LOOKING FROM the rear you can see the three time-set switches and the crystal oscillator frequency adjustment.



COMPLETE SCHEMATIC OF THE CLOCK. CMOS IC's and liquid-crystal readout combine to make this completely portable unit that requires no ac hookup.

IC TYPES

IC1, IC3, IC4, IC6, IC7, IC9—KD2134
 IC2, IC5, IC8—KD2135
 IC10, IC11, IC15—KD2136

IC12, IC13, IC14—KD2137
 IC16—KD2138
 IC17—KD-2140
 IC18—KD2139

READOUT—KD-2133

OSCILLATOR CRYSTAL—KD2141

List of RCA distributors who have this clock kit will be published by RCA next month.

and on this month's cover. This is true even when light levels are low. The reflective type display, with the back plate and black felt in front of it provides maximum visibility.

Why batteries?

Battery operation makes this clock completely portable and independent of the ac line. As a result you can use it anywhere, indoors or out. Battery powered digital clocks have been built before, but the major problem has always been the life of the battery. Normally, between the current drain of the IC's and the power required by the display, batteries will only last for a relatively short time. Some battery powered clocks are set up so the time display is turned on only when you want it, to conserve power.

In this clock we see only CMOS IC's. They, in conjunction with the liquid-crystal display (another power-saving device) make it possible. For more information on CMOS IC's see the article "CMOS—Why Is It So Good" by Don Lancaster in the December 1973 issue of **Radio-Electronics**.

If you are looking for full circuit operation of this clock we suggest you take a look at the April 1973 issue where we presented the original story "Battery-Powered IC Digital Clock" by Steve Leckerts.

R-E Puts it all together

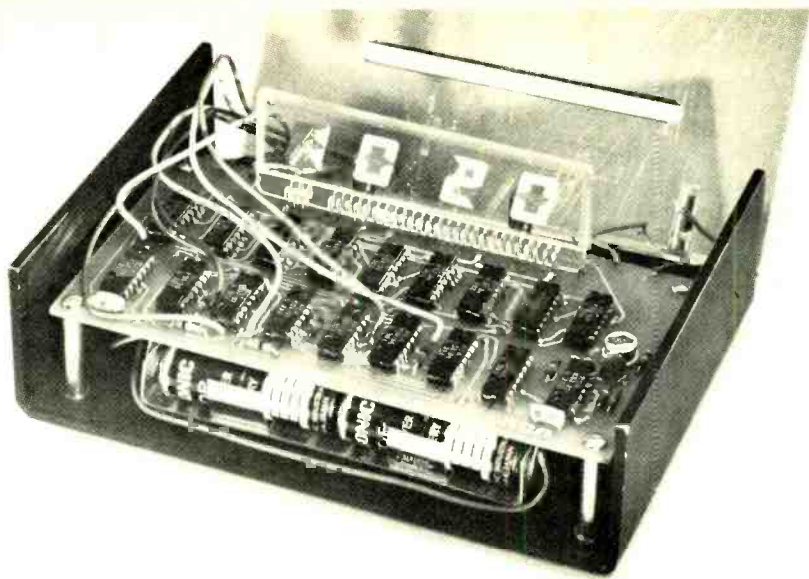
Assembling the kit is a snap. The parts plug into the board and are soldered into place. Since the board has plated through holes you only have to solder on one side.

The one thing we did notice, is that this is not a quick 1 - 2 - 3 assembly job. There are 19 IC's and that means an awful lot of soldered connections that must be made. The biggest problem we had was making sure that we didn't create solder bridges between the IC connections. We do suggest that when you build your clock you double check each time you complete soldering one set of IC connectors. A solder aid brush and a hot iron are all you need to cure this potential problem.

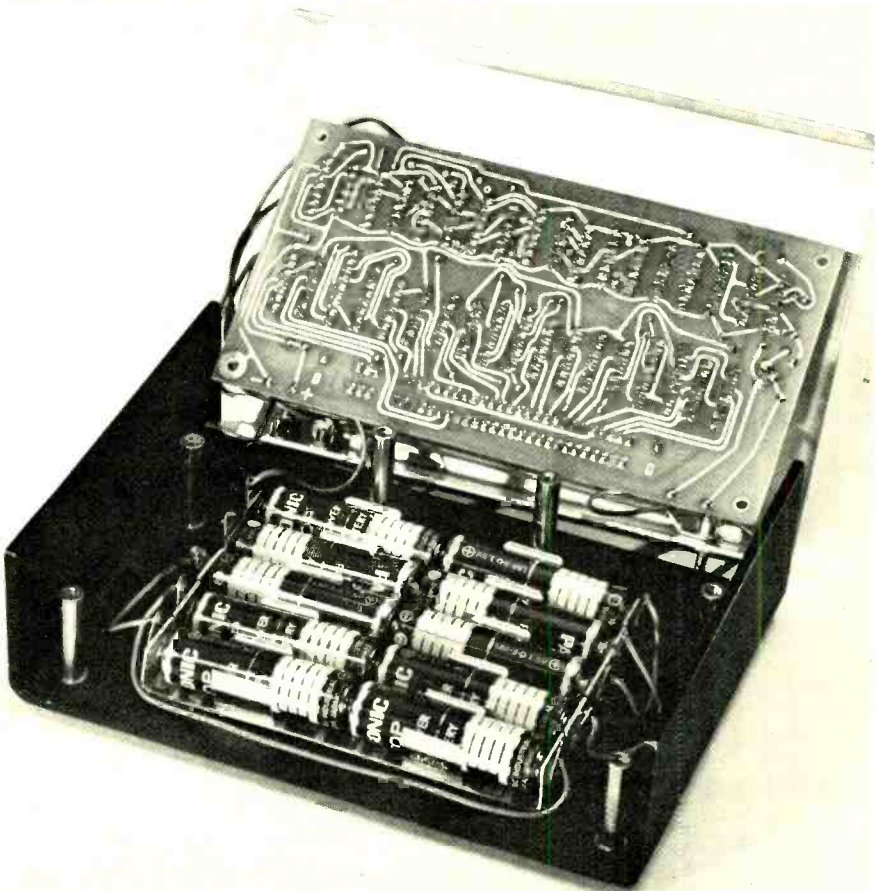
It is vital that you use a small iron—one with small tip size that is. A 1/16-inch tip is excellent for the job. But except for this one caution, normal printed circuit assembly techniques will see you through.

After you've got all the parts on the board the batteries are plugged into place and the board fastened down over them. There's more than enough clearance, but make sure you trim all leads projecting from the bottom of the circuit board to avoid shorts.

With the circuit board in place the cover is fitted in place over the top and fastened down. Now it's just a matter of setting the clock to the proper time.



WITH THE TOP COVER REMOVED you can see all the inner workings. Digital readout plugs into the circuit board. It is a reflective liquid crystal display.



TEN PEN LIGHT CELLS IN BATTERY CLIPS, located under the circuit board, power this clock. As battery replacement is not frequent compact stacking is practical.

This is done using the three rear-panel switches.

If you find your assembled clock is not keeping precise time, you will have to adjust the oscillator frequency with the adjustment capacitor. This can be done with or without equipment. With a frequency counter you simply set the oscillator up to provide the exact frequency specified in the instructions. Using a communications receiver

tuned to WWV, you can adjust the oscillator precisely in a matter of minutes. Without equipment you simply adjust the oscillator capacitor and wait a few hours to judge the result.

We tried setting up the clock without the counter and found that it took about four days to get the adjustment on the nose. Since then we've had the clock operating for about three months and find no significant drift.

R-E

THE IR FINDER

Infrared radiation is widely used in security countermeasures and in scientific, military and industrial applications. You can get to know what it's all about with this simple IR detector

by FORREST MIMS

THE IR FINDER IS A SENSITIVE, VERSATILE infrared detection system that can be assembled in less than an hour, once the necessary parts have been collected. A variety of infrared detectors can be used with the unit. The completed instrument has many experimental and practical applications.

The heart of the IR Finder is a simple 2-transistor oscillator whose frequency is varied by an infrared sensitive photoconductive cell or thermistor. Infrared rays falling on the detector alters its resistance, changing the oscillator's output frequency. Normally, the output of the system is a low-frequency buzz. But when the unit is pointed toward a source of infrared, a high-pitched tone is heard.

The prototype IR Finder was installed in a small plastic flashlight case for convenience, and to take advantage of a built-in parabolic reflector. Using a parabola to collect the infrared is important for two reasons. First, it focuses more radiation on the detector. Second, a reflector is more efficient than a lens, since most kinds of glass absorb infrared. In essence, the reflector is to the detector what an antenna is to a radio.

While the flashlight I used is available from many distributors for about \$1.20, the IR Finder can easily be installed in any convenient container. If you are using a flashlight case like the one in the photographs, begin construction by opening the flashlight and removing the battery contact from the top side of the back of the case. This makes room for a miniature phone jack. Leave the two battery contacts on the lower side of the case in place, as the unit's power supply cell will be inserted in this space later. Install the phone jack by carefully drilling a 1/4-inch hole in the rear of the case in the space formerly occupied by the battery clip.

Following the parts layout in the

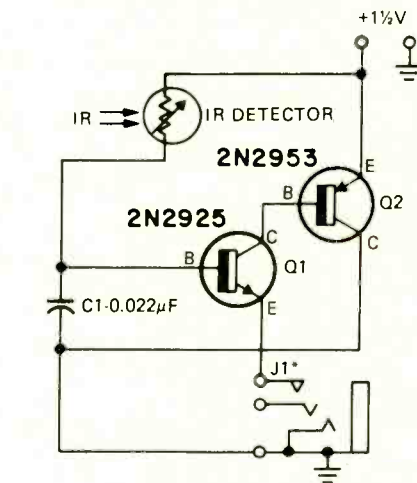
photo, assemble the oscillator circuit. Solder the leads directly to one another to form a self-supporting structure. There are only three components to install, so a conventional circuit board is not necessary. Use insulation, if neces-

sary, to prevent leads from shorting. Do *not* trim excess lead lengths from the components at this point.

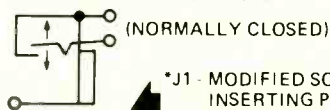
When the components are soldered together, solder 2-inch lengths of hookup wire to the appropriate leads of Q1 and Q2 so they will reach the phone jack and detector contact. Then trim all excess lead lengths except from C1. Bend the leads of C1 as shown in the photo, and insert them in the appropriate spaces in the flashlight switch and phone jack. It isn't necessary to solder the two leads inserted into the contact holes as the friction should be great enough for a good electrical contact. Complete the electrical assembly by soldering the leads connected to the negative battery terminal and phone jack.

The IR Finder is completed by installing a detector. The prototype uses a small lead sulfide (PbS) cell purchased from Radio Shack as part of an infrared detector package. The cell sensitive to a range of wavelengths extending from about 1 to 3 microns at room temperature. Other detectors can be used as well—so long as their resistance varies with temperature or infrared. For example, a thermistor with a room temperature resistance that falls somewhere between 10,000 and 100,000 ohms can be used, but its response time will be much slower than the PbS cell. For near-IR detection at about 0.75 microns, an inexpensive cadmium selenide (CdSe) detector such as the Clairex CL603, CL703, or CL903 can be used.

The parabolic reflector of the plastic flashlight makes for a convenient detector installation. Remove the PR-4 lamp from the holder, and carefully break and remove the glass bulb. Be sure to protect your eyes from flying glass. A good technique is to wrap the bulb in several layers of tissue, and crack it with gentle pressure from a pair of pliers.



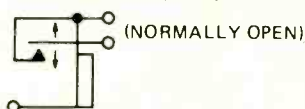
UNMODIFIED PHONE JACK:



(NORMALLY CLOSED)

*J1 - MODIFIED SO THAT INSERTING PHONE CONNECTS BATTERY AND ACTIVATES UNIT.

MODIFIED PHONE JACK:



(NORMALLY OPEN)

CIRCUIT OF THE INFRARED DETECTOR

PARTS LIST

- B1 — 1.5-volt AA cell
- C1 — 0.022 μ F
- J1 — miniature phone jack
- Q1 — 2N2925 or equivalent
- Q2 — 2N2953 or equivalent
- IR1 — Infrared detector (see text)

Magnetic earphone, hookup wire, solder, flashlight (Mallory or Radio Shack), PR-4 lamp (supplied with flashlight), etc.

R TV IS HERE!

Build it yourself... the perfect way to learn all about the exciting field of digital electronics!

It's part of a complete at-home program!

Imagine spending your spare time actually building your own 25-inch diagonal digital color TV! It's a project you can work on right in your home. You'll enjoy the challenge... exploring the new systems of digital circuitry and performing experiments to test what you learn.

There's no travelling to classes, no lectures to attend, and you don't have to give up your job or paycheck just because you want to get ahead. When you finish this new Bell & Howell Schools program, you'll have the skills you need plus a great color TV to keep and enjoy for years!



Digital electronics is changing our lives!

There's a lot more to digital electronics than just the numbers! True, that's what you see on more and more products like digital calculators, clocks and watches. But behind the numbers lies a fantastic technology that's creating higher standards of accuracy and dependability. The versatility of digital electronics has begun another industrial revolution. Its growth and applications are giving us new and better ways of doing things and spectacular products like this new Bell & Howell digital color TV!

You need no prior electronics background!

We start you off with the basics. You'll receive a special Lab Starter Kit with your first lesson so that you can get immediate "hands on" experience to help you better understand newly-learned electronics principles. Later, you'll use your new knowledge and learn valuable skills as you build the digital color TV. You can take advantage of our toll-free phone-in assistance service throughout the program and also our in person "help sessions" held

in major cities throughout the year where you can "talk shop" with your instructors and fellow students.

Pick up valuable skills in electronics that could lead to extra income, full or part time... perhaps a business of your own!

Once you complete this new at-home program from Bell & Howell Schools, you'll have the specialized skills to service not only color TV's but a variety of today's most modern home entertainment electronics equipment. These skills could open up new income opportunities for you, full or part time. Get the complete story on this exciting, learn-at-home program... the world's first color TV course employing digital electronics technology! No better or more practical at-home training in electronics is available anywhere!

Mail card today for full details, free!

If card has been removed, write:

An Electronics Home Study School
DeVRY INSTITUTE OF TECHNOLOGY

ONE OF THE
BELL & HOWELL SCHOOLS
4141 Belmont Chicago, Illinois 60641

Electro-Lab is a registered trademark of the Bell & Howell Company.

598 R1

Step-by-step TV Troubleshooters Guide

A TV set with multiple troubles can be a "dog" if you don't use the right approach. Let's look at simultaneous sync, agc and color ills.

by STAN PRENTISS

JUST IN CASE YOU'VE FORGOTTEN, there are still some vacuum-tube color TV's around, and there will be some for at least another ten years. But the newer ones have their tubes and transformers, deflection and convergence assemblies mounted just a little closer together, and circuit board components buried a little further underneath. So with boards that don't unplug, hot tubes, and less working space, servicing these hybrid or all-tube receivers can become a chore. But the right tools and a considered approach can overcome many handicaps.

For instance, a "friend" brought in a 1967 RCA CTC22 (Fig. 1) that had the usual "minor" troubles such as no horizontal and vertical sync, agc that would cut off but not saturate, no

color, and a brightness control whose rotation had positively no effect. He swore all tubes had been checked. dc voltages were good, and that just a little "twiddling" would turn the beast into a winner. I agreed that certainly something could be done. But instead of using a voltmeter, we put in a tube mount following the video detector, and "scoped" the first video amplifier and the sync, agc, and chroma driver V203B. We found both a cathode-shortened 5GH8A and no output. The tube was replaced, but apparently damage had been doubly done, for the same troubles continued, and we still could not control sync or luminance, or produce color.

The approach

Now the worst possible action in

such a situation is to begin pulling tubes, probing with voltmeters, and otherwise aimlessly killing time. What needs doing is to find the problem circuit as quick as possible, then select stage and components for checks in the likely area. The easiest way, of course, is with a well-calibrated dc oscilloscope, preferably with accurate, stable, triggered sweep. And the first point to look at is TP201, just following the video detector. Here you can determine if the signal has normal amplitude—that is, has approximately a ratio of 30 percent for sync pulses and 70 percent for video (fully modulated)—and whether there is clipping, smear (high-frequency information where it shouldn't be), ripple (low-frequency sinewave-type interference

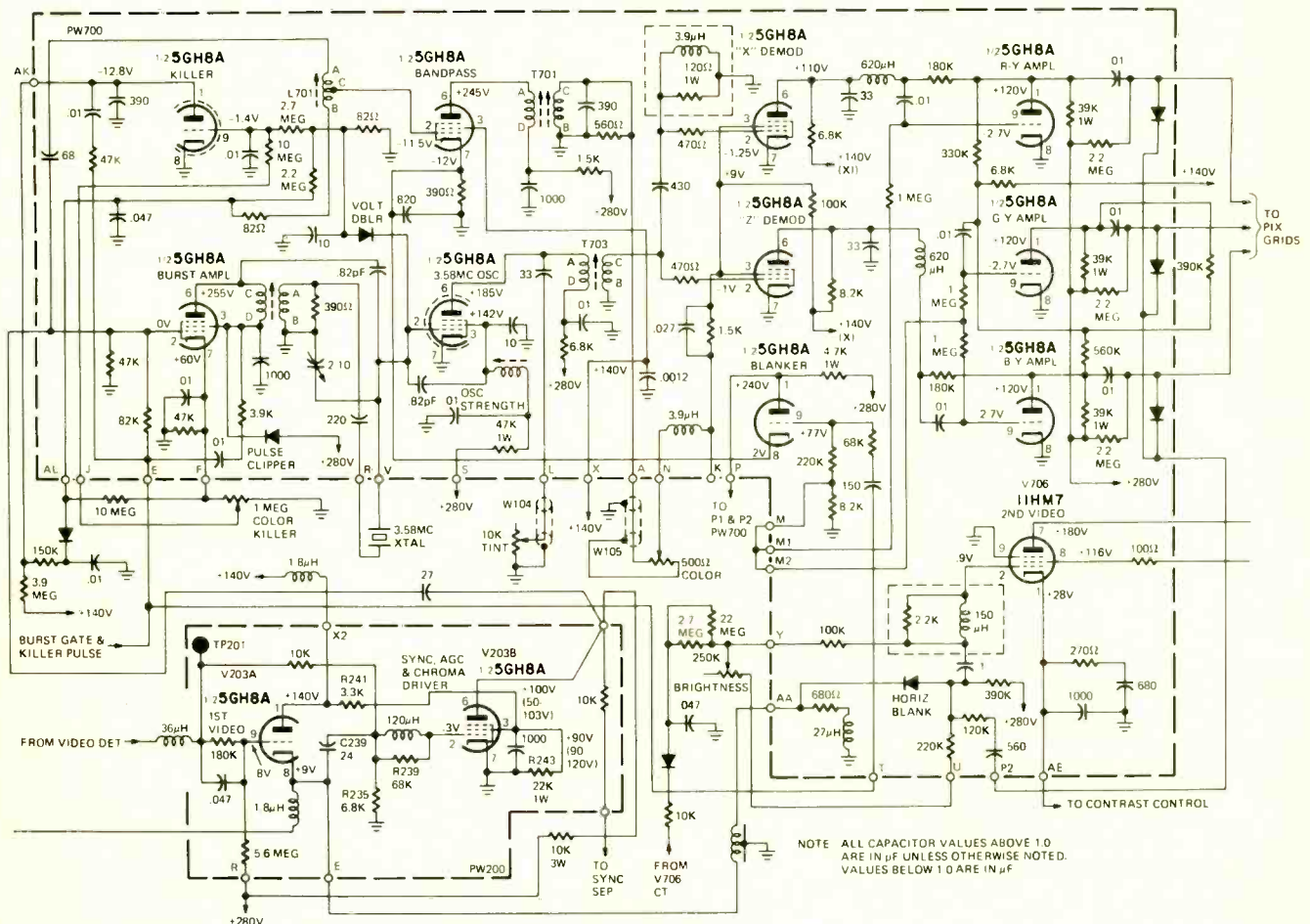


FIG. 1—RCA CTC22 LUMINANCE AND CHROMA SUBSYSTEMS. The trouble was due to a shorted V203B (sync, agc, and chroma driver).

weave, usually from the power supply), or sync compression, which ordinarily means age problems.

In the Y1W1 trace (Fig. 2), you can see none of these, even at the grid of the sync, age, and chroma driver V203B, although the dc level is more than 3 volts negative, while the schematic shows only 0.3 volts positive. (But this voltage is probably *static* and taken without incoming signal.) C239, R235, and R239 probably generate some self bias; so, we'll pass this negative situation by for the time being. In the plate circuit of V203B, however, with its 10-K, 3-W load resistor, no video shows (Y2W1, Fig. 1), but the 100-volt-per-division dc has risen to 280 volts, the value of the receiver's dc prime power supply. With no ripple, adequate value, and steady state, there is obviously nothing wrong with B+ Nonetheless, the V203B tube is not conducting.

Evaluation

Like any careful technician would, let's see what the screen grid, its divider, and bypass capacitor have to offer. RCA's dc readings say it should be between 90 and 120 volts. And here you read (on your dc scope) 0 volts! Do you jump on this right away? Not by a long shot! What's the voltage at the plate of V203A? It turns out to be 165. This indicates immediately that the pin 3 1-watt screen divider is probably open, since the 140-volt supply is less loaded, and therefore has risen 20 percent.

Before we move too fast, though, remember that brightness is frozen, age offers short range, and sync remains poor. If R243 is actually open, would one resistor cure *all* these problems? Chroma, sync, and age would certainly benefit, but the brightness control is nothing more than a negative dc bias for the grid of the second video amplifier, derived by diode rectification from the heater of the V706 video amplifier, and may not respond unless the video level itself changes radically when the sync, age, and chroma driver fault is repaired. At any rate, let's see And remember that not one portion of the receiver has yet been disturbed except for the exchange of a single tube—the 5GH8A—for a new one, to see if sync and chroma would return to normal. The tube mount and new tube remain in place.

So the next step is to remove both tube and mount, and look around. The first thing we see is a 1-watt resistor burned to a crisp, located "conveniently" as always, just *under* the large video detector and third i.f. transformer shielding. Another 1/2-watt resistor alongside is little more than gray carbon ash. A look at their positions on the PW200 board reveals they are the R243 screen bypass and R241, the

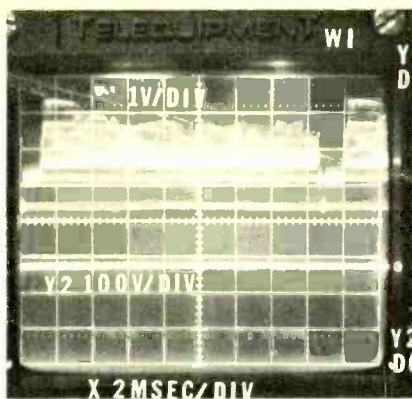


FIG. 2—V203B, SIGNAL IN AND OUT.

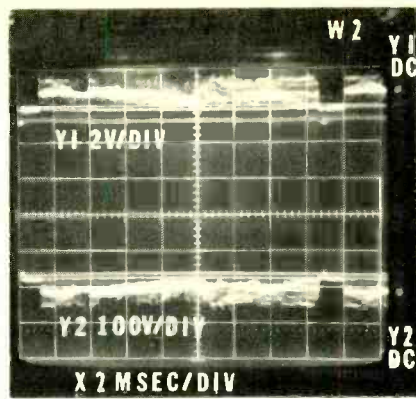


FIG. 3—GRID AND PLATE SIGNALS ON V203B after burned resistors were replaced.

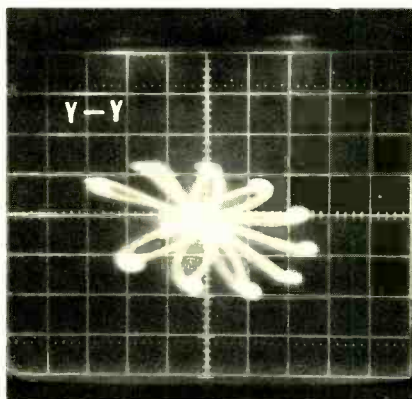


FIG. 4—FIRST VECTORSCOPE PATTERN.

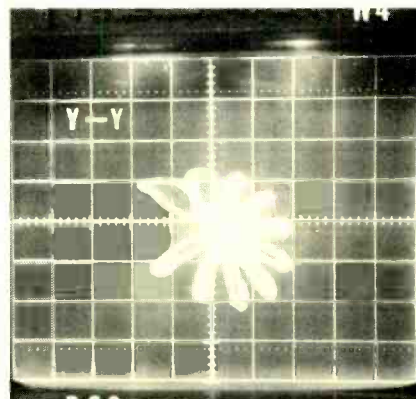


FIG. 5—PATTERN AFTER ADJUSTMENT.

other portion of the series divider to the 140-volt bus. Obviously this is the seat of the problem, and both require replacing. A cathode short can do remarkable damage.

The repair

Since complete chassis removal is not easy, bottom and top retaining screws can be backed out, and a little discreet prying will uncover the upper right and center subsection. Then, if the leads of the damaged resistors are clipped close to their bodies, a certain amount of solder-coated copper lead remains. A hot soldering iron and a pair of long-nose pliers can now be used on the *component* side of the board to push the cut leads through far enough to be identified. Then, tinned and shortened replacement resistor leads inserted in the pc board can now be easily located on the board's *circuit* side and soldered securely in place. The "pry" is then removed, safety insulation (hot chassis) checked, the tuner-to-chassis ground resoldered, and the usual dozen screws replaced.

But how about the 1,000-pF bypass capacitor that shunts R243—do you have to haul that out and check it too? Not at all! With your new 5GH8A sitting in the tube mount, simply put the dc oscilloscope to pin 3, and see what happens. If you have at least between 90 and 120 volts, there is no further problem at this terminal unless you see

excessive signal. A 0.001- μ F capacitor isn't going to remove all video here, so a modest remnant is all right.

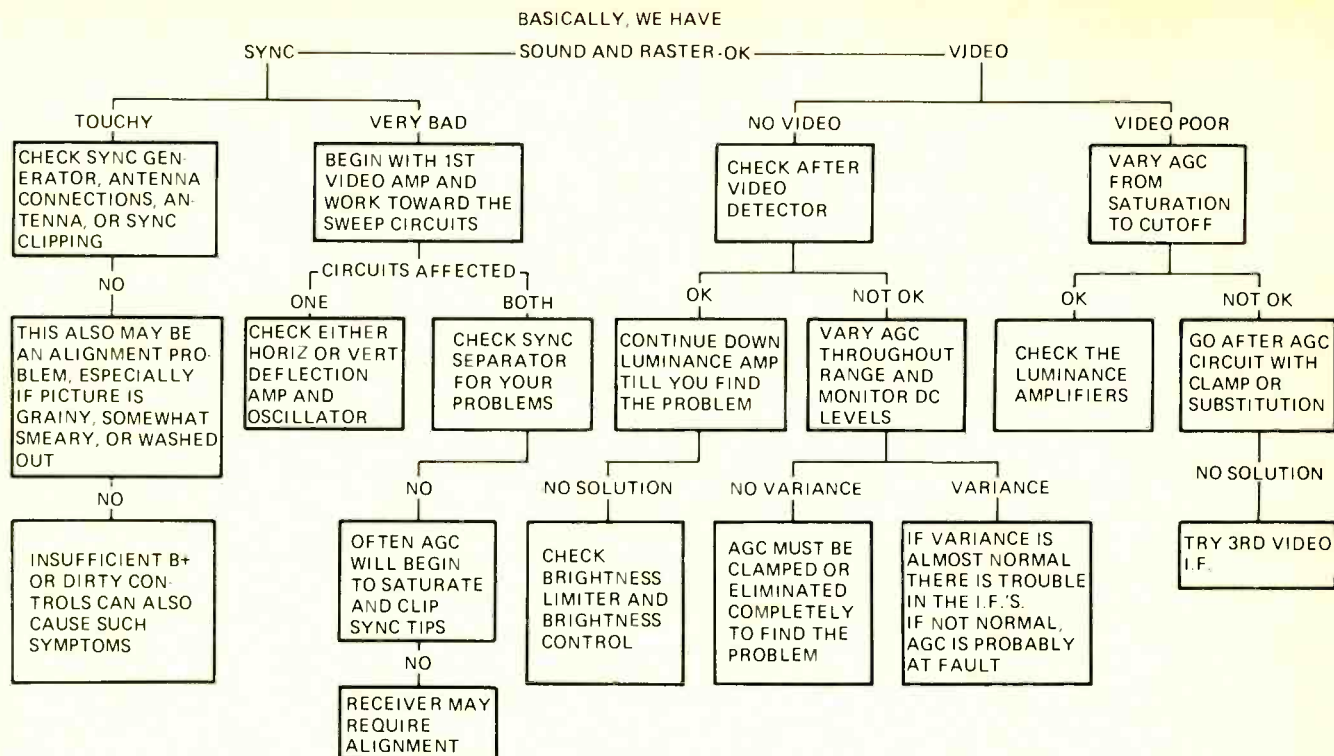
The resulting waveforms for grid and plate of V203B now appear in Fig. 3 (W2). The Y1W2 top is 2 volts per division, and the Y2W2 bottom is 100 V/div. The only possible fault that can now be found might be the amplitude of the sync pulse portion of Y2W2. However, both vertical and horizontal sweeps are steady, and there is no reason to believe there are further problems, at least in this stage. Further, age will now swing from saturation to cut off, and remove all picture information at either end.

The color portion, however, does take a few extra moments to merge from something nearly purple to normal flesh tones. Since there's no width problem, this often means slow warm-up of the picture tube or a second set of 5GH8A RGB-Y amplifiers. With a new set installed, the receiver turned on properly, color appeared and remained in satisfactory phase and amplitude, and focus plus overall luminance seemed ample. There was one other consideration, however Are the chroma circuits aligned?

Using a vectorscope

In modestly priced tube receivers such as this one, burst transformers firing ringing crystals are often used to excite either a 3.58-MHz subcarrier

TROUBLE-FINDING CHART—SYNC AND CHROMA



amplifier or oscillator, with the tint function simply an RC control about the oscillator itself. Now, if the tint potentiometer will turn flesh tones from natural to green at one extremity of rotation and to lavender at the other, you have the usual 30-degree plus swing on either side of control mechanical center, and nothing further need be done. If an adjustment is necessary, set the tint control at center, and twiddle the burst transformer for flesh tones *while the receiver is on the air*. The T703 3.58-MHz output transformer seldom, if ever, needs adjustment, and then only for an ac-dc null. In this case, with only one bandpass transformer, all that needs tender adjustments are chroma take-off coil L701 and double-tuned bandpass transformer T701.

But we must use an oscilloscope/vectoroscope that won't load the high-impedance tube outputs, and a color bar generator that hasn't got "crawlies," color bars that run up and down, or broad striped bars instead of narrow, clean ones. Here we used a new Sencore Color King IV and a Telequipment (Tektronix) D66 with Y-Y instead of X-Y inputs so that both Y channels are phase-matched and have identical and adjustable gains, plus the same 10-megohm impedance when used with the usual 10X low-capacitance probes. Further, since this receiver is an R-Y and B-Y system, with luminance and chroma matrix in the picture tube, no removal of luminance information is necessary, as in RGB receivers where *both* luminance and chroma go to the cathodes of the picture tube already mixed.

Our initial pattern on a channel 3 input appears as in W3 (Fig. 4). The objective of the entire procedure is to get relatively symmetrical, straight-sided petals out of the pattern with *absolutely no crossovers*. Initially, be *positive* your fine tuning places the magenta fourth bar from the left—the first color bar is usually hidden—exactly on target with tint control at mechanical center. Then go to chroma take off L701 and T701, and twiddle these two for best pattern.

If the initial pattern as shown in W3 looks this good on single bandpass transformer receivers, you could stop right here and not do a lick more. But there is a crossover in petal No. 1 (extreme left), and you may be able to reshape all petals symmetrically and delete crossovers at the same time with some careful manipulation of the bottom and top cores of T701, you're pretty close when the pattern in W4 (Fig. 5) is completed. A visual check of the color bars on the CRT still shows the fourth magenta bar where it should be, the tint control rotatable through its green to lavender range, producing flesh tones at center.

R-E

READER COMMENTS WANTED

We'll soon complete the listing of substitutes for semiconductors with 2N type numbers and will then start on foreign types. We can begin with either European types like the AC105 and BC107 or Japanese types such as the 2SA152. Please let us know whether you want the European or Japanese listings first.

R-E's Substitution guide for replacement transistors

PART XIV

compiled by

ROBERT & ELIZABETH SCOTT

- ARCH**—Indicates the Archer brand of semiconductors sold only by Radio Shack and Allied Radio stores, Allied Radio Shack, 2725 W. 7th St., Ft. Worth, Texas 76107
- DM**—D. M. Semiconductor Co., P.O. Box 131, Melrose, Mass. 02176
- GE**—General Electric Co., Tube Product Div., Owensboro, Ky. 42301
- ICC**—International Components, 10 Daniel Street, Farmingdale, N.Y. 11735
- IR**—International Rectifier, Semiconductor Div., 233 Kansas St., El Segundo, Calif. 90245
- MAL**—Mallory Distributor Products Co., 101 S. Parker, Indianapolis, Ind. 46201
- MOT**—Motorola Semiconductors, Box 2963, Phoenix, Ariz. 85036
- RCA**—RCA Electronic Components, Harrison, N.J. 07029
- SPR**—Sprague Products Co., 65 Marshall St., North Adams, Mass. 01247
- SYL**—Sylvania Electric Corp., 100 1st Ave., Waltham, Mass. 02154
- WOR**—Workman Electronic Products, Inc., Box 3828, Sarasota, Fla. 33578
- ZEN**—Zenith Sales Co., 5600 W. Jarvis Ave., Chicago, Ill. 60648

Radio-Electronics has done its utmost to insure that the listings in this directory are as accurate and reliable as possible; however, no responsibility is assumed by Radio-Electronics for its use. We have used the latest manufacturers material available to us and have asked each manufacturer covered in the listing to check its accuracy. Where we have been supplied with corrections, we have updated the listing to include them. The first part of this Guide appeared in March 1973.

	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	WOR	ZEN
2N2987	NA	T-714	GE-18	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N2988	NA	T-714	GE-18	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N2989	NA	T-714	GE-18	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N2990	NA	T-714	GE-18	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N2991	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA	NA
2N2992	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA	NA
2N2993	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA	NA
2N2994	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA	NA
2N2995	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA	NA
2N2996	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	SK 3006	NA	NA	WEP-637	ZEN 301
2N2997	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	NA	WEP-637	ZEN 301
2N2998	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N2999	NA	T-636	NA	NA	TR-17	PTC 107	NA	NA	NA	ECG 160	WEP-637	NA
2N3000	NA	NA	NA	NA	NA	NA	HEP-630	NA	NA	NA	NA	NA
2N3001	NA	NA	NA	NA	NA	NA	HEP-R1001	NA	NA	ECG 5400	NA	NA
2N3002	NA	NA	NA	NA	NA	NA	HEP-R1002	NA	NA	NA	NA	NA
2N3003	NA	NA	NA	NA	NA	NA	HEP-R1003	NA	NA	NA	NA	NA
2N3004	NA	SR-1005	NA	ICC-R1005	NA	NA	HEP-R1005	NA	NA	NA	NA	NA
2N3005	NA	NA	NA	NA	NA	NA	HEP-R1001	NA	NA	ECG 5400	NA	NA
2N3006	NA	NA	NA	NA	NA	NA	HEP-R1002	NA	NA	ECG 5401	NA	NA
2N3007	NA	SR-1003	NA	NA	NA	NA	HEP-R1003	NA	NA	ECG 5402	NA	NA
2N3008	NA	SR-1003	NA	NA	NA	NA	HEP-R1005	NA	NA	ECG 5404	NA	NA
2N3009	RS276-2009	T-50	GE-20	ICC-50	IRTR-64	PTC 136	HEP-50	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 100
2N3010	RS276-2011	T-56	GE-61	ICC-56	IRTR-24	PTC 136	HEP-56	SK 3039	RT-113	ECG 108	WEP-56	ZEN 104
2N3011	RS276-2011	T-56	GE-20	ICC-56	IRTR-24	PTC 136	HEP-56	SK 3039	RT-113	ECG 108	WEP-56	ZEN 104
2N3012	RS276-2023	T-52	GE-21	ICC-52	IRTR-24	PTC 127	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3013	RS276-2011	T-56	GE-20	ICC-56	IRTR-64	PTC 136	HEP-56	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 104
2N3014	RS276-2011	T-56	GE-20	ICC-56	IRTR-64	PTC 136	HEP-56	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 104
2N3015	NA	T-729	GE-17	NA	NA	PTC 121	HEP-S3001	NA	RT-100	NA	WEP-51	NA
2N3016	NA	NA	NA	NA	NA	NA	HEP-S3002	NA	NA	NA	NA	NA
2N3017	NA	NA	NA	NA	NA	NA	HEP-S3004	NA	NA	NA	NA	NA
2N3018	NA	NA	NA	NA	NA	NA	HEP-S3004	NA	NA	NA	NA	NA
2N3019	NA	T-714	GE-18	ICC-714	NA	PTC 125	HEP-714	NA	NA	NA	NA	NA
2N3020	NA	T-706	GE-27	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N3021	NA	TS-3031	GE-69	NA	NA	NA	HEP-246	NA	NA	NA	NA	NA
2N3022	NA	TS-3031	GE-69	NA	NA	NA	HEP-246	NA	NA	NA	NA	NA
2N3023	NA	TS-3031	GE-69	NA	NA	NA	HEP-246	NA	NA	NA	NA	NA
2N3024	NA	TS-3031	GE-69	NA	NA	NA	HEP-705	NA	NA	NA	NA	NA
2N3025	NA	TS-3031	GE-69	NA	NA	NA	HEP-705	NA	NA	NA	NA	NA
2N3026	NA	TS-3031	GE-69	NA	NA	NA	HEP-705	NA	NA	NA	NA	NA
2N3027	NA	SR-1001	NA	ICC-R1001	NA	NA	HEP-R1001	NA	NA	ECG 5400	NA	NA
2N3028	NA	SR-1002	NA	ICC-R1002	NA	NA	HEP-R1002	NA	NA	ECG 5401	NA	NA
2N3030	NA	SR-1001	NA	ICC-R1003	NA	NA	HEP-R1003	NA	NA	ECG 5402	NA	NA
2N3031	NA	SR-1002	NA	ICC-R1002	NA	NA	HEP-R1002	NA	NA	ECG 5401	NA	NA
2N3032	NA	NA	NA	NA	NA	NA	HEP-R1003	NA	NA	ECG-5402	NA	NA
2N3033	NA	NA	NA	NA	NA	PTC-125	NA	NA	NA	NA	NA	NA
2N3034	NA	T-714	GE-18	NA	IRTR-53	PTC 123	NA	NA	NA	NA	WEP 243	NA
2N3035	NA	T-714	GE-18	NA	TR-21	PTC 153	NA	SK 3039	RT-113	ECG 108	WEP 56	NA
2N3036	NA	T-714	GE-18	NA	IRTR-87	PTC 123	HEP-714	NA	NA	NA	NA	NA
2N3037	NA	T-714	GE-18	NA	IRTR-87	PTC 123	HEP-S0001	NA	NA	NA	NA	NA
2N3038	NA	T-714	GE-18	NA	IRTR-87	PTC 123	HEP-S0001	NA	NA	NA	NA	NA
2N3039	NA	T-715	GE-21	ICC-715	TR-28	PTC 103	HEP-715	NA	NA	NA	WEP 717	ZEN 106
2N3040	NA	T-716	GE-21	ICC-716	TR-28	PTC-103	HEP-716	NA	NA	NA	WEP 717	ZEN 107
2N3043*	NA	T-728	GE-10	ICC-728	TR-24	PTC 121	HEP-728	NA	NA	NA	WEP 735	ZEN 114
2N3044*	NA	T-728	GE-10	ICC-728	TR-24	PTC 121	HEP-728	NA	NA	NA	WEP 735	ZEN 114
2N3045*	NA	T-728	GE-10	ICC-728	TR-24	PTC 121	HEP-728	NA	NA	NA	WEP 735	ZEN 114
2N3046*	NA	T-729	GE-10	ICC-729	TR-24	PTC 121	HEP-729	NA	NA	NA	WEP 735	ZEN 115
2N3047*	NA	T-729	GE-10	ICC-729	TR-24	PTC 121	HEP-729	NA	NA	NA	WEP 735	ZEN 115
2N3048*	NA	T-729	GE-10	ICC-729	TR-24	PTC 121	HEP-729	NA	NA	NA	WEP 735	ZEN 115
2N3049*	NA	T-716	NA	ICC-716	TR-20	PTC 103	HEP-716	NA	NA	NA	WEP 717	ZEN 107
2N3050*	NA	T-716	NA	ICC-716	TR-20	PTC 103	HEP-116	NA	NA	NA	WEP 717	ZEN 107
2N3051*	NA	T-716	NA	ICC-716	TR-20	PTC 103	HEP-716	NA	NA	NA	WEP 717	ZEN 107
2N3052*	NA	TS-3020	GE-63	NA	TR-25	PTC 144	HEP-S0004	NA	NA	NA	WEP 243	NA
2N3053	RS276-2018	T-714	GE-63	ICC-S3011	IRTR-87	PTC 144	HEP-S3011	SK 3024	RT-114	ECG 128	WEP 243	NA
2N3054	RS276-2017	T-703	GE-66	ICC-703	TR-57	PTC 112	HEP-703	SK 3026	RT-154	ECG 175	WEP 701	NA
2N3055	NA	T-704	GE-14	ICC-704	IRTR-36	PTC 140	HEP-704	SK 3027	RT-131	ECG 130	WEP 247	NA
2N3056	NA	T-714	GE-18	NA	IRTR-87	PTC 144	HEP-714	NA	NA	NA	NA	NA
2N3057	NA	T-714	GE-18	ICC-714	IRTR-87	PTC 110	HEP-714	NA	NA	NA	WEP S3021	NA
2N3058	RS276-2023	T-52	GE-21	ICC-52	NA	PTC 103	HEP-52	SK 3114	RT-115	ECG 150	WEP 717	NA
2N3059	RS276-2023	T-52	GE-67	ICC-52	NA	PTC 127	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3060	RS276-2023	T-52	GE-67	ICC-52	TR-28	PTC 123	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3061	NA	TS 3031	GE-67	NA	TR-28	PTC 103	HEP-739	NA	NA	NA	NA	NA
2N3062	RS276-2023	T-52	GE-21	ICC-52	IRTR-88	PTC 127	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3063	NA	T-51	GE-21	NA	IRTR-88	PTC 127	NA	NA	NA	NA	NA	NA
2N3064	NA	T-51	GE-21	NA	IRTR-88	PTC 127	NA	NA	NA	NA	NA	NA

NA=NOT AVAILABLE

(turn page)

	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	WOR	ZEN
2N3065	NA	T-51	GE-21	NA	IRTR-88	PTC 127	NA	NA	NA	NA	NA	NA
2N3066	NA	T-801	GE-FET-1	NA	NA	PTC 151	NA	SK 3112	NA	ECG 133	WEP 801	NA
2N3067	NA	T-801	GE-FET-1	NA	NA	PTC 151	NA	SK 3112	NA	ECG 133	WEP 801	NA
2N3068	NA	NA	NA	NA	NA	NA	NA	SK 3112	NA	ECG 133	WEP 301	NA
2N3069	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	NA	NA	NA	WEP 802	ZEN 123
2N3070	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3071	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3072	RS276-2023	T-52	GE-67	ICC-52	TR-28	PTC 127	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3073	RS276-2023	T-52	GE-21	ICC-52	TR-20	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N2074	RS276-2003	T-3	GE-9	ICC-3	TR-17	PTC 109	HEP-3	SK 3006	NA	ECG 160	WEP 637	ZEN 301
2N3075	RS276-2004	T-253	GE-9	ICC-253	IR-17	PTC 109	HEP-253	SK 3006	RT 118	ECG 100	WEP 254	ZEN 304
2N3077	NA	T-713	GE-18	ICC-713	TR-21	PTC 121	HEP-713	SK 3124	RT-114	ECG 128	WEP 243	NA
2N3078	NA	T-713	GE-18	ICC-713	TR-21	PTC 121	HEP-713	SK 3124	RT-114	ECG 128	WEP 717	NA
2N3081	RS276-2021	T-51	GE-67	ICC-51	NA	PTC 103	HEP-51	SK 3114	RT-115	ECG 159	WEP 717	ZEN 101
2N3082	NA	T-729	GE-17	NA	NA	PTC 121	HEP-718	SK 3039	RT-108	ECG 107	WEP 720	NA
2N3083	NA	T-729	GE-17	NA	NA	PTC 121	HEP-718	SK 3039	RT-108	ECG 107	WEP 720	NA
2N3084	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3085	NA	T-803	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3086	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3087	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3088	NA	T-802	EG-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3089	NA	T-802	GE-FET-1	ICC-802	NA	PTC 151	HEP-802	SK 3112	NA	ECG 133	WEP 801	ZEN 123
2N3100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2N3107	NA	TS-3002	GE-18	ICC-S3002	IRTR-87	PTC 144	HEP-S3002	NA	NA	NA	WEP S3002	NA
2N3108	NA	TS-3002	GE-18	ICC-S3002	IRTR-87	PTC 144	HEP-S3002	NA	NA	NA	WEP S3002	NA
2N3109	NA	TS-3001	GE-18	ICC-S3001	IRTR-87	PTC 144	HEP-S3001	NA	NA	NA	NA	NA
2N3110	NA	TS-3001	GE-18	ICC-S3001	TR-25	PTC-144	HEP-S3001	NA	NA	NA	NA	NA
2N3112	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3113	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3114	NA	T-714	GE-27	ICC-714	IRTR-78	PTC 110	HEP-714	SK 3104	RT-110	ECG 154	WEP S3021	NA
2N3115	RS276-2009	T-53	GE-20	ICC-53	TR-21	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	WEP 735	ZEN 102
2N3116	RS276-2009	T-53	GE-20	ICC-53	TR-21	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	WEP 735	ZEN 102
2N3117	RS276-2009	T-55	GE-18	ICC-55	TR-21	PTC 123	HEP-55	SK 3124	RT-114	ECG 128	WEP 243	ZEN 103
2N3118	NA	T-714	GE-18	ICC-714	IRTR-87	PTC 110	HEP-714	NA	NA	NA	WEP S3021	NA
2N3119	NA	T-714	GE-27	ICC-714	IRTR-78	PTC 111	HEP-714	NA	NA	NA	WEP S3021	NA
2N3120	NA	T-53	GE-67	ICC-53	IRTR-88	PTC 127	HEP-53	SK 3025	RT-115	ECG 129	WEP 242	ZEN 102
2N3121	RS276-2021	T-51	GE-21	ICC-51	TR-20	PTC 103	HEP-51	SK 3114	RT-115	ECG 159	WEP 242	ZEN 101
2N3122	RS276-2009	T-53	GE-18	ICC-53	IRTR-63	PTC 144	HEP-53	SK 3122	RT-102	ECG 123A	WEP 735	ZEN 102
2N3123	NA	NA	NA	NA	NA	NA	HEP-S3011	NA	NA	NA	NA	NA
2N3124	NA	NA	NA	NA	NA	NA	HEP-625	NA	NA	NA	NA	NA
2N3125	RS276-2006	T-232	NA	ICC-232	IRTR-35	PTC 105	HEP-232	SK 3014	RT-127	ECG 121	WEP 232	ZEN 326
2N3126	NA	T-230	GE-3	NA	IRTR-35	PTC 138	HEP-625	NA	NA	NA	NA	NA
2N3127	NA	T-3	NA	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP 637	ZEN 301
2N3128	NA	T-729	GE-17	NA	NA	PTC 123	HEP-722	SK 3124	RT-102	ECG 123A	WEP 735	NA
2N3129	NA	T-729	GE-17	NA	NA	PTC 123	HEP-729	SK 3122	RT-102	ECG 123A	WEP 735	NA
2N3130	NA	T-709	NA	NA	NA	PTC 123	HEP-S0007	SK 3122	RT-102	ECG 123A	WEP 735	NA
2N3131	NA	NA	NA	NA	NA	NA	HEP-S0004	NA	NA	NA	NA	NA
2N3132	RS276-2006	T-232	GE-16	ICC-232	TR-01	PTC 105	HEP-232	SK 3009	RT-127	ECG 121	WEP 232	ZEN 326
2N3133	RS276-2021	T-51	GE-21	ICC-51	TR-19	PTC 103	HEP-51	SK 3025	RT-115	ECG 129	WEP 242	ZEN 101
2N3134	RS276-2021	T-51	GE-67	ICC-51	TR-19	PTC 141	HEP-51	SK 3025	RT-115	ECG 129	WEP 242	ZEN 101
2N3135	RS276-2021	T-51	GE-21	ICC-51	TR-19	PTC 103	HEP-51	SK 3114	RT-115	ECG 159	WEP 717	ZEN 101
2N3136	RS276-2021	T-51	GE-67	ICC-51	TR-20	PTC 103	HEP-51	SK 3114	RT-115	ECG 159	WEP 717	ZEN 101
2N3137	RS276-2011	T-56	GE-11	ICC-56	IRTR-64	PTC 133	HEP-56	SK 3039	RT 108	ECG 107	WEP 720	ZEN 104
2N3138	NA	TS-5003	GE-66	ICC-S5003	IRTR-66	NA	HEP-S5003	NA	NA	NA	NA	ZEN 210
2N3140	NA	TS-5003	GE-66	ICC-S5003	IRTR-66	NA	HEP-S5003	NA	NA	NA	NA	ZEN 210
2N3142	NA	TS-5003	GE-66	ICC-S5003	IRTR-66	NA	HEP-S5003	NA	NA	NA	NA	ZEN 210
2N3144	NA	TS-5003	GE-66	ICC-S5003	IRTR-66	NA	HEP-S5003	NA	NA	NA	NA	ZEN 210
2N3146	NA	T-230	GE-3	NA	NA	PTC 138	NA	NA	NA	NA	NA	NA
2N3147	NA	NA	GE-3	NA	NA	PTC 138	NA	NA	NA	NA	NA	NA
2N3148	RS276-2003	T-3	GE-1	ICC-3	TR-17	PTC 109	HEP-3	NA	NA	ECG 160	WEP 637	ZEN 301
2N3152	NA	TS-3021	NA	ICC-S3021	NA	NA	HEP-S3021	NA	NA	NA	WEP S3021	ZEN 208
2N3153	RS276-2003	T-3	GE-62	ICC-3	NA	PTC 129	HEP-3	NA	NA	ECG 160	WEP 637	ZEN 301
2N3154	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2N3163	NA	T-248	NA	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3164	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3165	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3166	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3167	NA	TS-5008	NA	ICC-S5008	NA	NA	HEP-S5008	NA	NA	NA	WEP WS5005	NA
2N3168	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3169	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA

*Indicates a dual transistor for high-speed switching, diff amplifier etc. Likely to be a matched pair. Use two of the type specified, matching when necessary, on a curve tracer or lab-type transistor checker.

NA=NOT AVAILABLE

(continued next month)

READER QUESTIONS

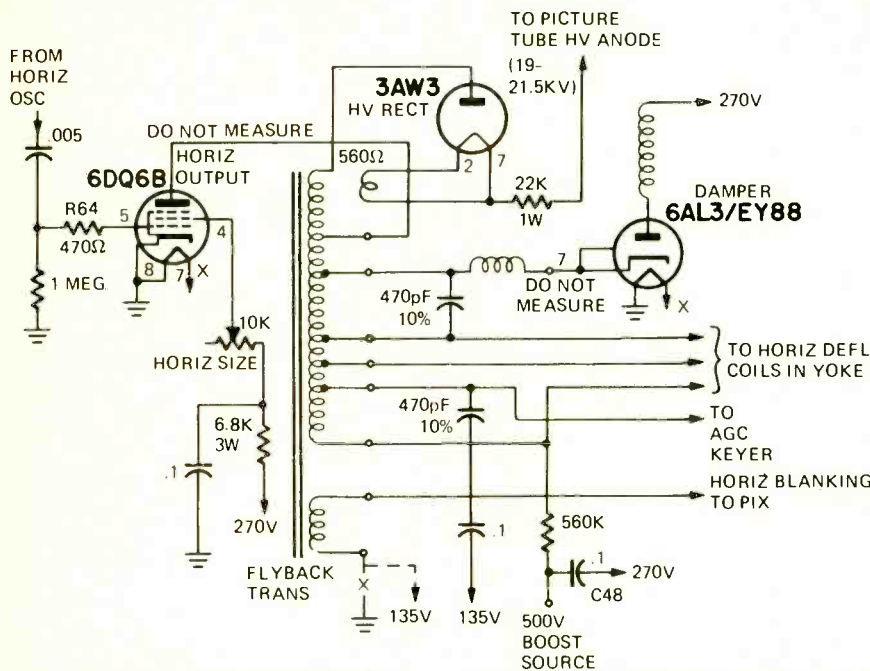
(continued from page 27)

boost filter; note that the boost goes through 560k before it gets there.

If you'll check that 10- μ F electroly-

much that you don't develop any boost voltage. I found about 75 to 80 volts p-p of hash on the one I had, indicating that the capacitor was wide open.

Without boost voltage (which is the plate voltage of the 6DQ6 horizontal output) you won't get enough output;



tic capacitor in the +135 volt line, you'll find that it's open! This puts the 12K resistor "in series" with the boost pulse, and raises the impedance so

you'll have half the high voltage and half the sweep width. This is a rather unusual circuit, but the basic reactions are just the same. R-E

need belts?



We've thousands in stock

Ready for immediate shipment! Belts for over 1800 makes and models of tape recorders, projectors, dictating machines, video recorders and our simplified cross reference system makes it easy for you to order. Drive tires, wheels, phono idlers also listed. On most items we can ship the same day. Call or write today for your free catalog/cross reference chart.

PROJECTOR-RECORDER BELT CORP.

314 Whitewater St., Whitewater, Wisconsin 53190 414/473-2151
Circle 18 on reader service card

PRESENTING:



MODEL RE-7400

MERRIMACK'S FANTASTIC

AUDIO SWEEP FUNCTION GENERATOR ONLY \$179.95 COMPLETE

FEATURES

- SWEEPS ENTIRE AUDIO RANGE WITH RANGE SWITCHING
- SWEEPS ALL FUNCTIONS
- OUTPUTS: SINE, SQUARE, TRIANGLE, SAWTOOTH
- RANGE: 1Hz to 20K Hz
- ALSO USED AS STANDARD FUNCTION GENERATOR
- SWEEP SPEEDS UP TO 10 SECONDS
- MODULAR CONSTRUCTION

USES

- EDUCATIONAL DEMONSTRATION
- RADIO STATION CHECKOUT
- AUDIO R & D
- PLOTTING AMPLIFIER RESPONSE CURVES
- FILTER BODY PLOTS
- FREQUENCY RESPONSE CURVES
- VOLTAGE TO FREQUENCY CONVERSION

**FOR YOUR RE-7400
SEND CHECK, M.O., OR PURCHASE ORDER TO:
MERRIMACK INSTRUMENTS INC.
FOOT OF JOHN ST.
LOWELL, MASS. 01852
617-459-0152**

Circle 75 on reader service card

Train at home on NTS equipment like this:

NTS Audio Electronics Servicing

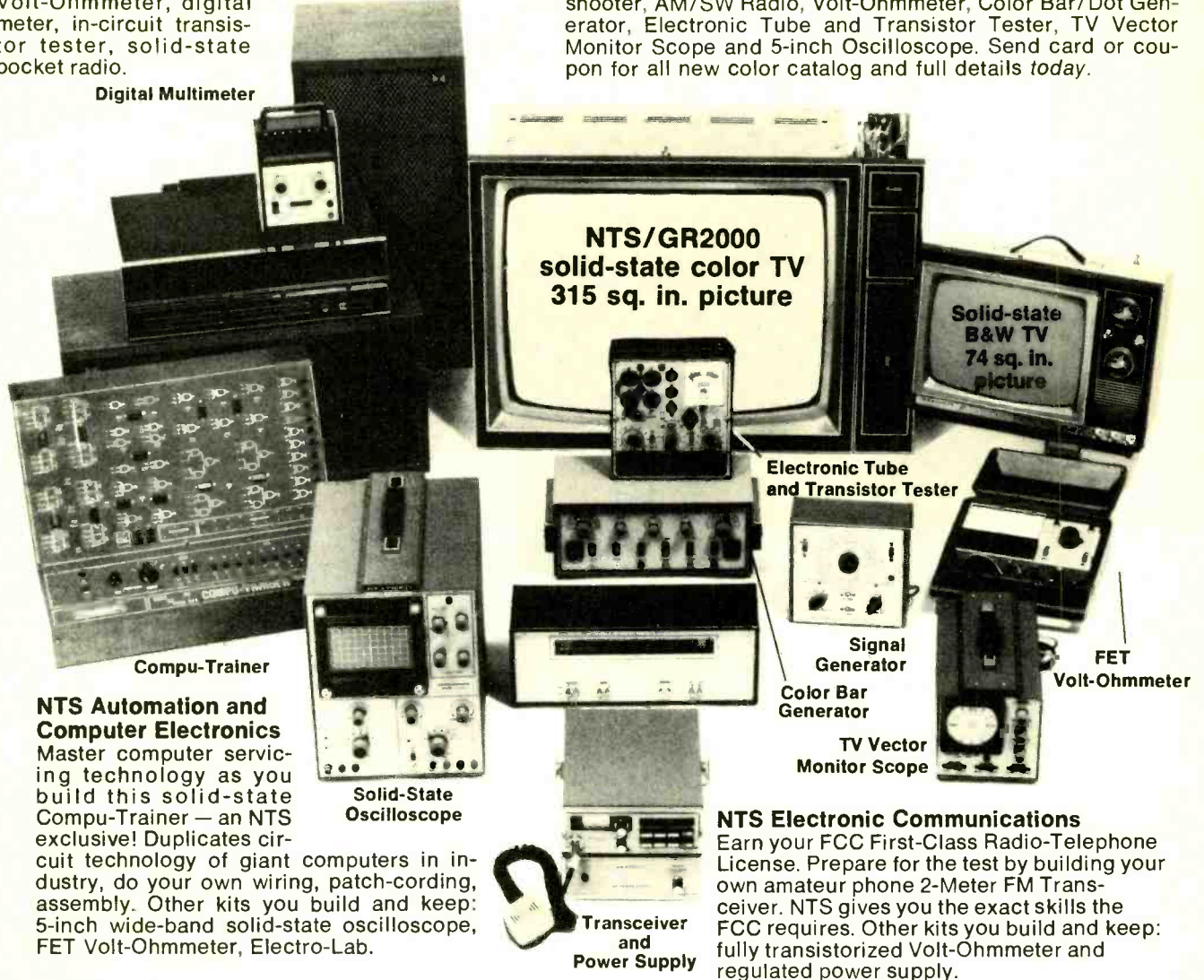
Know tweeters, woofers and baffles— sound distortion, amplification and control — public address and music systems. Kits you build and keep include Heath 60-watt stereo receiver, twin speakers, Volt-Ohmmeter, digital meter, in-circuit transistor tester, solid-state pocket radio.

**AM-FM Solid-State
60-Watt Stereo Receiver
and Twin Speakers**

Digital Multimeter

NTS color and b&w tv servicing

Build the largest and most advanced solid-state color TV. A 315 sq. in. ultra-rectangular matrix picture tube, Varactor Diode Tuner, Electronic Character Generator and more. Or build B&W TV with cabinet. Both TV's feature "instant on" Automatic Fine Tuning, solid-state design, and more. Other kits you build and keep: Solid-State Pocket Radio, Troubleshooter, AM/SW Radio, Volt-Ohmmeter, Color Bar/Dot Generator, Electronic Tube and Transistor Tester, TV Vector Monitor Scope and 5-inch Oscilloscope. Send card or coupon for all new color catalog and full details today.



**NTS/GR2000
solid-state color TV
315 sq. in. picture**

**Solid-state
B&W TV
74 sq. in.
picture**

Compu-Trainer

NTS Automation and Computer Electronics

Master computer servicing technology as you build this solid-state Compu-Trainer — an NTS exclusive! Duplicates circuit technology of giant computers in industry, do your own wiring, patch-cording, assembly. Other kits you build and keep: 5-inch wide-band solid-state oscilloscope, FET Volt-Ohmmeter, Electro-Lab.

**Solid-State
Oscilloscope**

**Electronic Tube
and Transistor Tester**

**Signal
Generator
Color Bar
Generator**

**TV Vector
Monitor Scope**

**FET
Volt-Ohmmeter**

**Transceiver
and
Power Supply**

NTS Electronic Communications

Earn your FCC First-Class Radio-Telephone License. Prepare for the test by building your own amateur phone 2-Meter FM Transceiver. NTS gives you the exact skills the FCC requires. Other kits you build and keep: fully transistorized Volt-Ohmmeter and regulated power supply.

Project Method Training — "heart" of the NTS system.

NTS Project Method Training is a better way to learn electronics. With easy-to-follow lessons, comprehensive kit manuals, large fold-out charts and more, you'll build advanced equipment while you learn electronics principles and applications. You'll learn how components work, why they work, what to do when they don't work. In short, you'll use your mind *and* your hands to develop ability and confidence. This is why the NTS Project Method is such an invaluable part of your program.

NTS gives you confidence-building extras!

- Job Getting Manual
- Advice On Starting A Business
- Answers To On-The-Job Questions
- Illustrated Electronics Dictionary
- Mechanics & Science Bulletins

NATIONAL TECHNICAL SCHOOLS

Technical-Trade Training Since 1905
Resident & Home Study Schools

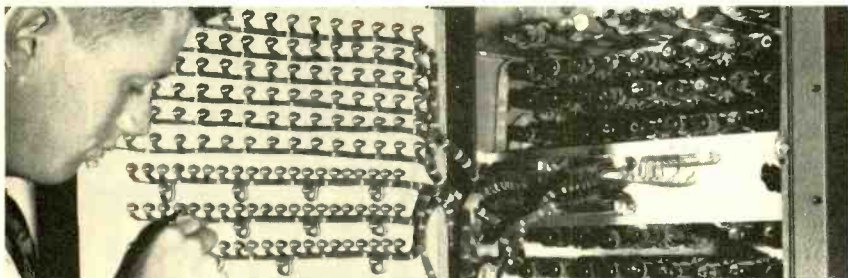
4000 SOUTH FIGUEROA ST., LOS ANGELES, CA. 90037

Feel at home on jobs like these:

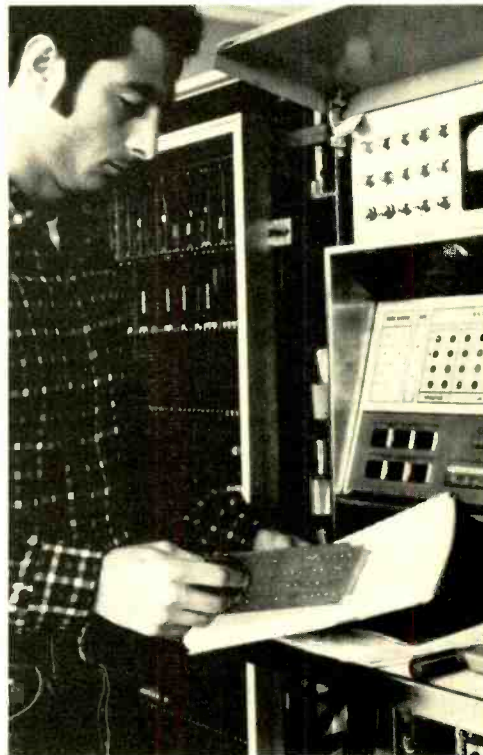
NTS builds your confidence with more solid training in Solid-State

NTS Training on professional solid-state equipment prepares you for many careers — in many consumer, commercial and industrial fields. If television is your chosen field, you could join a first class TV repair center, start a shop of your own, or specialize in industrial applications of television such as security system installation. And other electronic fields are continuing to grow, revolutionizing industry and communications, even reshaping our own lives. Opportunities are opening in home entertainment areas, commercial audio systems, mobile communications,

computer servicing, industrial controls and many other service technician areas. Yes, this is truly "The Age of Electronics." Your NTS training and the equipment you receive prepare you for these exciting careers wherever electronic technicians are needed. Start now! Build your confidence along with new skills in electronics. You may start earning extra money even before you graduate! Check your course on the card or coupon and mail today! No obligation. No salesman will call.



Master Technician: Communications Electronics



Master Technician: Computer Electronics



Master Technician: Industrial Electronics



Master Technician: Home Entertainment Electronics

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. Check box in coupon.

Approved for Veteran Training

Accredited Member: National Association of Trade and Technical Schools; National Home Study Council.

NTS guide
to careers in
Electronics

Please rush Free Color NTS Guide To Careers In Electronics and Sample Lessons, plus information on course checked below. No obligation. No salesman will call.



National Technical Schools
Technical-Trade Training Since 1905
Resident & Home Study Schools
4000 So. Figueroa St.
Los Angeles, Ca. 90037

- Master Course in Color TV Servicing
- Color TV Servicing (For Qualified Technicians)
- Master Course in B&W TV & Radio Servicing
- Master Course in Electronic Communications
- Practical Radio Servicing
- FCC License Course
- Master Course in Electronics Technology
- Automation & Industrial Electronics
- Computer Electronics
- Basic Electronics
- Audio Electronics Servicing
- Audio Technology for Qualified Technicians

Dept. 206-044

NAME _____ AGE _____

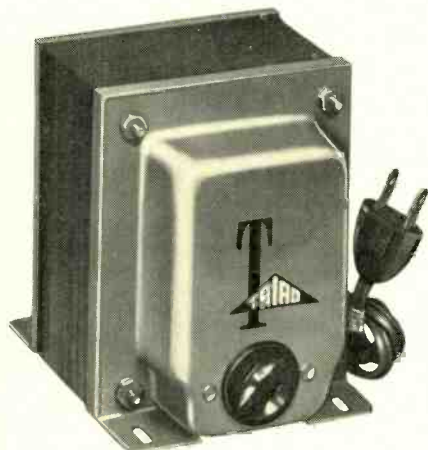
ADDRESS _____

CITY _____

STATE _____ ZIP _____

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

Reduce shock hazard
Bypass line noise
use **TRIAD**
isolation
transformers



Available from stock
at your Triad Distributor

Since many TV sets now have one side of the power line connected to the chassis, an isolation transformer is a "must" to prevent shock. For safety's sake, use Triad when you have a set on the bench to repair.

Triad isolation transformers are also ideal for use in screen rooms for isolation of laboratory test equipment... reduction of line disturbances... elimination of undesired grounds. Available in a wide range of volt-ampere ratings for operation at 50/60 Hz. Static shielding, separating primary and secondary windings, provides inductive coupling which is essentially free from capacity coupling. Write for the Triad catalog today. Triad-Utrad Distributor Services, 305 N. Briant St., Huntington, Ind. 46750.

Cat. No.	Output (VA)	Input Volts	Output Volts
*N-51X	35	115	115
N-68X	50	115-230§	115
N-53M	85	115	115
N-54M	150	115	115
N-73A	150	115	115-230§
N-74A	150	115	57.5-115§
N-67A	150	115-230§	115
N-55M	250	115	115
N-66A	250	115-230§	115
N-59M	1000	115	115
N-469A	50	220-440§	115
N-470A	150	220-440§	115
N-471A	300	220-440§	115

*60Hz only. §Split Winding.

TRIAD-UTRAD
Litton Distributor Services

ALL ABOUT TRANSFORMERS
(continued from page 45)

at B, and an ideal response at C. The typical transformer response varies less than 2.0 dB between 100 and 10,000 Hz. and is acceptable for most uses.

For replacement purposes, the "universal" audio output with many taps for impedance variation has been popular for many years. Figure 13 shows a similar transformer

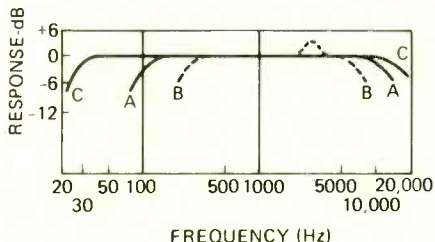


FIG. 12—FREQUENCY RESPONSE of three grades of transformers. Curve A is typical, C is h-fi and B is acceptable for narrow-band communications equipment.

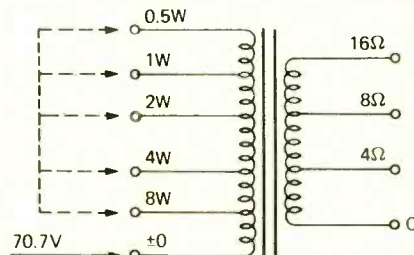


FIG. 13—PA MATCHING TRANSFORMER designed to distribute speaker power as needed.

that has recently become popular with 70.7-volt audio distribution systems. With this system, the output of an audio power amplifier at 70.7 volts (or 25 volts) can be divided in any desired manner among any number of speakers. And those speakers may have any combination of impedances.

Although meeting the definition of a transformer, the two windings used to inductively couple stages of radio frequency amplification are seldom referred to as being a transformer. Naturally this is one reason that most receivers use a heterodyne system to develop the intermediate frequency (i.f.). With standardization of the intermediate frequencies at 455 kHz., 4.5 MHz., 10.7 MHz., and 40 to 48 MHz. for the various broadcast services, it becomes simple to design and construct transformer units. Such i.f. transformer units usually include capacitors, resistors, or other inductors associated with the resonant and amplifying circuits. For example, the converter of a standard broad-

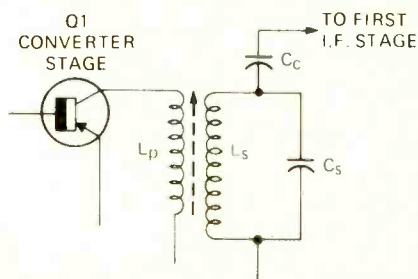
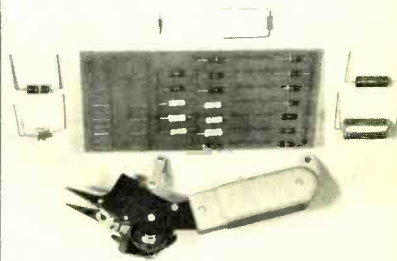


FIG. 14—I.F. TRANSFORMER with untuned primary is common in transistor AM receivers.

**COMPONENT
LEAD
BENDER**

- Eliminates trial and error lead bending.
- Fast, exact, thumbwheel adjusted spacing between bends.
- "Breezes" through special units and short production runs.
- Increases production 50%. Pays for itself within a week.

Ask for MODEL N-300 for 1/4 watt and larger components; MODEL N-400 for micro-components.



Immediate delivery from...

HARWIL COMPANY
903 Colorado Avenue, Santa Monica
California 90401 phone: 213 / 394-4710

Circle 19 on reader service card

**Security
is the
infant TV
was in 1954**

By 1994 most American homes and businesses will have security systems just as most have a TV set today.

In 1974 some electronic service technicians and communication specialists are going to enter the security field by installing 8 to 10 security systems.

PLC Security Systems are designed and prepackaged for installation by electronics businessmen, and the proof is in the PLC catalog. Send for your free copy today.



Electronics, Inc.

39-50 Crescent St., L.I.C., N.Y. 11101

Circle 20 on reader service card

cast receiver feeds into an untuned primary of an i.f. transformer as shown by Fig. 14. Also included within this transformer unit is the capacitor C_s of Fig. 14 which resonates with the secondary inductor L_s . The i.f. transformer feeding into the FM discriminator (Fig. 15) also has a capacitor

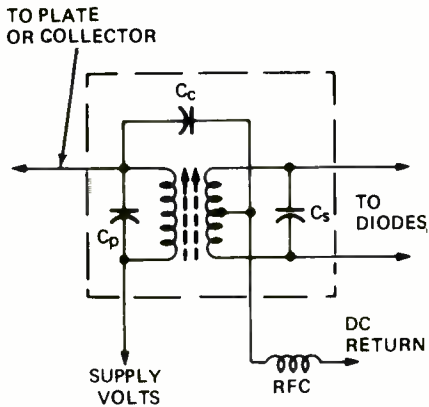


Fig. 15—FM DISCRIMINATOR TRANSFORMER has tuned windings and capacitance coupling to the secondary center tap.

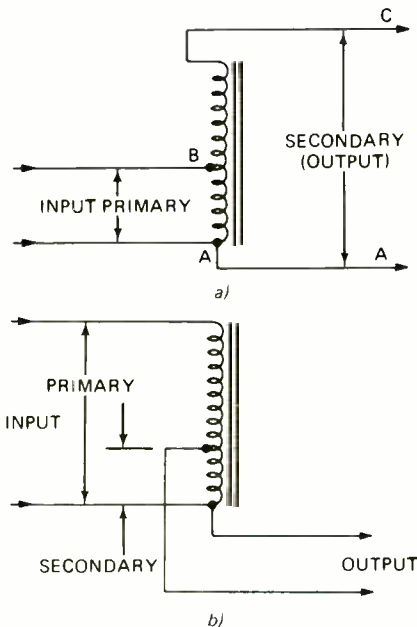
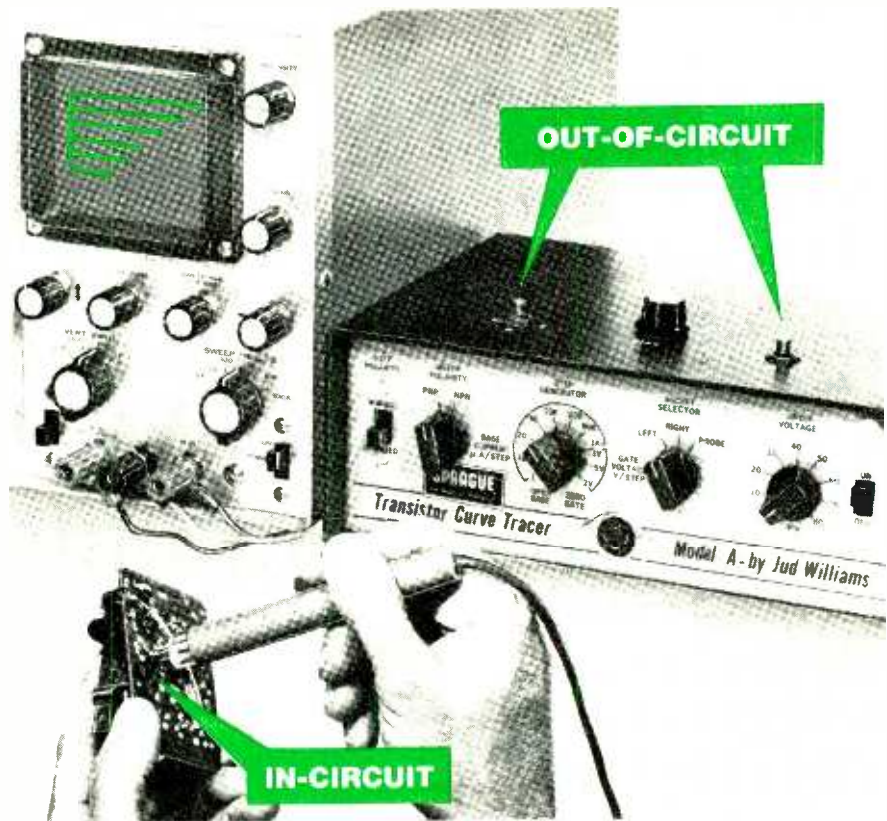


FIG. 16—AUTO TRANSFORMER may be step-up (a) or step-down (b), depending on connections.

coupling the high side of the primary to the secondary center-tap as well as an rf choke.

TV receivers make use of a special transformer in developing the very high voltage (up to 30,000 volts) accelerating the electron beam toward the picture tube screen. This is the horizontal output or flyback transformer. It has only one winding, and is a type of autotransformer. In Fig. 16-a, a small portion of this single winding is the primary of a step-up transformer. With the entire winding of the autotransformer in Fig. 16-b used as the primary to develop the magnetic field, it becomes a step-down type. Sawtooth voltages fed into the primary (between A and B of Fig. 16-a) produce a high voltage across the secondary between A and C. Actual flyback transformers have other secondary windings providing filament voltage for the high-voltage rectifier as well as horizontal deflection current.

R-E



The fastest, easiest, most-reliable, least-expensive way to test transistors

Sprague's Model A Transistor Curve Tracer by Jud Williams Incorporates Dynamic Signature Pattern™ Servicing Technique

Eliminate transistor damage.

Did you ever unsolder a transistor to test it, find it defective, then wonder if it was ruined in removal? Or, if the device tested OK, how about the ticklish job of resoldering without damage to either transistor or board? The solution to such problems is in-circuit testing with the "Signature Pattern" technique.

What are Signature Patterns?

They are scope readouts of the dynamic impedance of in-circuit transistors. With this unique test method, the transistor under test is actually **turned on**, not merely made to oscillate, as with conventional techniques. The "Signature Pattern" method of trouble-shooting has these definite advantages: (1) Quick, decisive, "good-or-bad" tests of suspect transistors; (2) Discovery of defective components within transistor circuits even when transistors are good; (3) Elimination of damage to transistors and other components; (4) Safe testing with system power removed.

Quick, accurate tests.

By observing the family of curves, you can determine at a glance such parameters as gain, linearity, saturation, avalanche point, and leak-

age. No zeroing or balancing is necessary. The Model A also performs the all-important breakdown voltage test. It will identify a transistor type as either silicon or germanium. In addition, it will analyze an FET as either junction-type or insulated gate, as well as determine the pinch-off voltage.

Service modules profitably.

With more and more set-makers switching to modular circuitry, it becomes economically difficult for service shops to stock a variety of plug-in panels in quantity . . . not to mention excessive costs to your customers when panel replacements are made. Also, you waste valuable time processing paper work and preparing modules for shipment to the factory for repair or credit. The practical solution is to quickly and economically repair defective modules in your own shop with the "Signature Pattern" test technique.

Low-cost testing.

When the Sprague Model A Curve Tracer is connected to any general-purpose scope, you have the most complete semiconductor testing facility possible at a budget price . . . only \$149.50.

Get the Sprague Model A Transistor Curve Tracer from your Sprague distributor now. Or, ask him for Brochure M-957. If his supply of brochures is depleted, write to Sprague Products Co., 81 Marshall St., North Adams, Mass. 01247.

Circle 21 on reader service card



64-3128

NEW

from endeco



The Pencil Soldering Iron with Operating Light, 2 Heats and On/Off Switch

**\$10.95
NET**

Model 540S
Soldering Iron
Length 8½"
Weight 2 oz

- Light shows when it's on
- 2 heats—20w and 40w—for any job
- Ironclad tips for longer life
- Cool, unbreakable polycarbonate handle
- Burn-resistant neoprene cord
- Converts to a desoldering iron with low cost attachment

The Pencil Desoldering Iron with Operating Light, and On/Idle/Off Switch

**\$15.95
NET**

Model 510 | Length 8½"
Desoldering Iron | Weight 3½ oz

- Light shows when it's on
- Operates at 40w; idles at 20w for longer tip life
 - 6 tip sizes available to handle any job
- Cool, unbreakable polycarbonate handle
 - Burn-resistant neoprene cord
- Exclusive new bracket insures alignment, prevents damage

New kits also available!

- Soldering Kits • Desoldering Kits
 - Soldering/Desoldering Kits
- See your distributor or write ...



5127 EAST 65TH ST.
INDIANAPOLIS,
INDIANA 46220
PHONE 317/251-1231

enterprise
development
corporation

new products

More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

TRANSISTOR AND FET TESTER, TF26 Touch Tone Cricket. Just hook the test leads to the three elements in any pattern and push the buttons. The "Cricket" chirps, indicating a good test. Good/bad levels are indicated on meter:



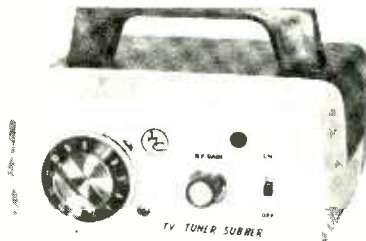
meter tells you good or bad for replacement without removal from circuit. Out-of-circuit leakage test in microamps is included.

Lead storage compartment and sliding meter cover included in unbreakable acrylic case. 10 x 5½ x 3½ in.; 4 lbs.. \$140.00—Sencore, 3200 Sencore Drive, Sioux Falls, S.D. 57107.

Circle 31 on reader service card

TV TUNER SUBBER, model Mark IV-A. New model of *Subber Mark IV* comes complete with batteries plus wall plug-in transformer and in-built power supply. Change-over to battery operation is automatic when ac transformer is disconnected.

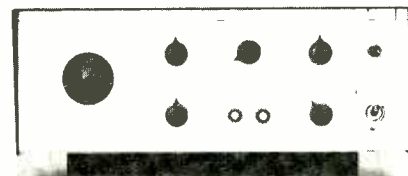
Unit substitutes for tuner; also substitutes for 40-MHz i.f. signal at any point in i.f. chain up to final i.f. stage. Receiver operates normally



without overriding agc line with fixed bias supply. Low-impedance output circuit matches older bandpass coupling i.f. inputs, late model link coupled inputs, and any input in i.f. chain to final i.f. stage. Output level is high; output bandwidth is maintained. \$54.95.—Castle Television Tuner Service, Inc., 5710 North Western Avenue, Chicago, Ill. 60645.

Circle 32 on reader service card

FUNCTION GENERATOR, model Mk1 features decade frequency ranges from 10 Hz to 1 MHz; dc offset control, 20 volts p-p maximum output; variable plus calibrated attenuator, output amplitude flat over entire frequency range; auxiliary TTL output on rear panel; FM or VCO operation through rear panel jack; independent controls; waveform symmetry constant over frequency

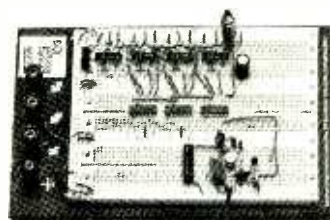


range.

Dial accuracy: ±5% of full scale. Variable attenuator: 0 to -20 dB. minimum: calibrated attenuator: 3 positions—normal (0 dB), -20 dB, and -40 dB. Output impedance is 600 ohms; sinewave distortion: less than 3% from 10 Hz to 100 kHz, less than 5% from 100 kHz to 1 MHz. Power requirements: 117 Vac, 50-60 Hz, less than 10 W. 11 x 4 x 8½ in.; kit \$135.00; assembled \$195.00.—American Circuits and Systems, Inc., P.O. Box 149, Planetarium Station, New York, N.Y. 10024.

Circle 33 on reader service card

BREADBOARDING SYSTEM, Proto Board 103. Allows user to build, plug-in, modify, wire, test, add, or remove circuits quickly, using twenty four 14-pin DIP's, without solder or patch cords. Input/output and processing circuits separate



by using different power buses and separate sockets for every part of the design. Each section can be tested independently because user can break up power and ground lines. Extra IC's or components can be plugged-in and interconnected with No. 22 AWG solid hook-up wire.

Board uses multiple QT sockets and bus strips as interconnecting components for expanding or contracting a system. There are 2,250 solderless plug-in tie points. Socket array consists of three QT-59S's with 1,770 tie points (354 terminals with 5 tie points each), distribution matrix (bus strips) consists of three QT-59B's with 480 tie points (8 buses of 50 tie points each). There is one QT-47B with 80 more tie points (2 buses of 40 tie points each). 6 x 9 x ⅛ inches; \$59.95.—Continental Specialties Corp., 325 East Street, P. O. Box 1942, New Haven, Conn. 06509.

Circle 34 on reader service card

EXCITER/TRANSMITTER, B-910 & B-910T. 10-watt educational FM broadcast transmitter and FM exciter. Phase-lock techniques control the FM oscillator operating at one-half the assigned frequency. Features low FM noise, -68 db or better, af distortion at 0.3%, and ±0.5%



frequency response. Permits immediate conversion to stereo and/or SCA multiplex by inserting optional modules.

Automatic protective circuitry provides indication of phase lock condition, plus carrier interruption if center frequency should shift 100 kHz or more from assigned operating frequency. Metering of all supply and phase lock control voltages, relative rf output, and semi peak audio input voltages is provided. B-910 exciter \$1,995.00; B-910T transmitter \$2,331.00.—**McMartin Industries, Inc.**, 605 North Thirteenth Street, Omaha, Neb. 68102.

Circle 35 on reader service card
LOUDSPEAKER SYSTEM. Advent 2 is housed in molded cabinet composed of inner shell of high-density polyurethane, bonded to outer shell of thermoplastic.

Uses acoustic suspension woofer and 2 direct radiator tweeters. Resonance is 58 Hz; nominal crossover point is 1500 Hz; impedance



is 8 ohms; recommended minimum power is 10 watts per channel. 11½" x 19" x 7¼"; \$58.00.—**Advent Corp.**, 195 Albany Street, Cambridge, Mass. 02139.

Circle 36 on reader service card

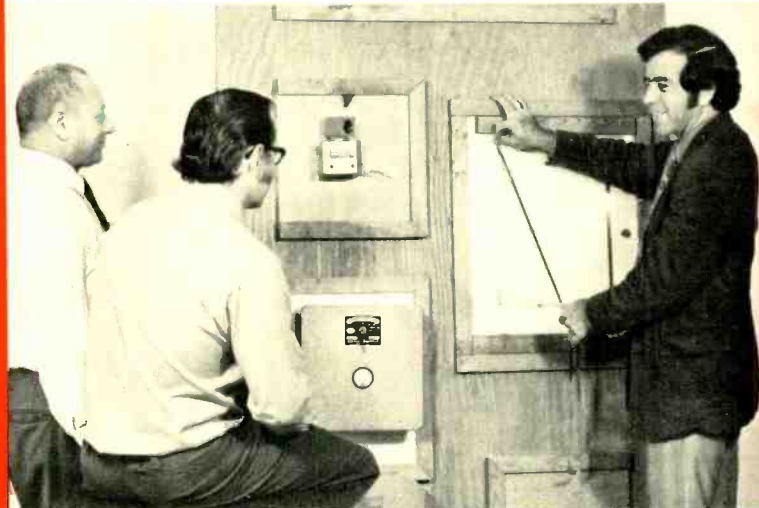
AUTOMATIC TURNTABLE/CHANGER, model Dual 1216, has 1-piece die-cast platter that weighs 4 lbs. Same anti-skating system used in other Dual models. Other features include high-torque constant-speed motor, 6% pitch



control for all three speeds (33⅓, 45, 78 rpm), silicone damped cue control, and elevator-action changer spindle. Pickup arm tracks as low as 0.75 grams.—**United Audio Product, Inc.**, 120 South Columbus Avenue, Mt. Vernon, N.Y. 10553.

Circle 37 on reader service card

LEARN THE BURGLAR ALARM BUSINESS!!!



Burglar alarm installation is one of the most rapidly growing industries today. The tremendous publicity associated with security systems has created a widespread demand for installation of alarm systems.

A formal program has not been previously available to an individual seeking training in this profitable field. Now Ademco, the world's leading manufacturer of burglar alarm equipment offers you an opportunity to learn alarm installation techniques even if you have little or no experience in the alarm field. In just two short days you can be ready to install your first alarm!

Seminars are held throughout the year at Ademco's plant in Syosset, New York and at various locations throughout the country. All sessions are limited in attendance, so reservations should be made well in advance.

**FOR FURTHER INFORMATION CONTACT:
ALARM DEVICE MANUFACTURING CO.**

A DIVISION OF PITTSWAY CORPORATION

**165 Eileen Way, Syosset, N.Y. 11791
Area Code 516-921-6700**



Everything you wanted to know about CD Ignition Systems but didn't know whom to ask.

Send for *FREE* Tiger booklet (20 pages) which answers all your questions.

Name _____

Address _____

City _____

State _____ Zip _____

CLIP OUT THIS AD AND SEND TO—

TRI-STAR CORP.
P. O. Box 1727 Dept. H
Grand Junction, Colo. 81501

Circle 23 on reader service card

Circle 24 on reader service card

LOW COST DIGITAL KITS

NEW BIPOLAR MULTIMETER: AUTOMATIC POLARITY INDICATION



Model ES 210K

Displays Ohms, Volts or Amps in 5 ranges • Voltage from 100 Microvolts to 500 V • Resistance from 100 Milliohms to 1 Megohm • Current from 100 Nano Amps to 1 Amp \$77.00
Case ex: \$12.50 (Optional probe) \$5.00

40 MHz DIGITAL FREQUENCY COUNTER:

- Will not be damaged by high power transmission levels.
- Simple, 1 cable connection to transmitter's output.



ES 220K — Line frequency time base. 1 KHz resolution. 5 digit: \$69.50 Case extra: \$10
ES 221K -- Crystal time base. 100 Hz resolution. 6 digit: \$109.50 Case extra: \$10.00

DIGITAL CLOCK:



ES 112K/124K • 12 hr. or 24 hr. clock \$46.95
Case extra: Walnut \$12.00 • Metal \$7.50

CRYSTAL TIME BASE:

ES 201K — Optional addition to ES 112K, 124K or 500K. Mounts on board. Accurate to .002%.

I D REMINDER:

ES 200K Reminds operator 9 min. 45 sec. have passed. Mounts on ES 112 or 124 board. Silent LED flash \$10.95 Optional audio alarm \$4.00 extra.

Dependable solid state components and circuitry. Easy reading, 7 segment display tubes with clear, bright numerals. These products operate from 117 VAC, 60 cycles. No moving parts. Quiet, trouble free printed circuit.

Each kit contains complete parts list with all parts, schematic illustrations and easy to follow, step by step instructions. No special tools required.

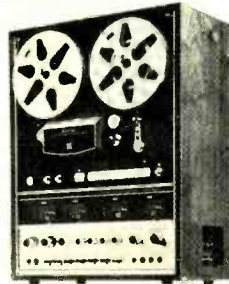


ORDER YOURS TODAY:
Use your Mastercharge or BankAmericard
Money Back Guarantee

10418 La Cienega • Inglewood, Ca. 90304
(213) 674-3021

78 Circle 25 on reader service card

TAPE DECK, QD-5500 has record and playback in 4- and 2-channel modes. Auto reverse operates for 2-channel playback and record. Three-motor design; capstan motor is 4-pole/8-pole hysteresis type; reel motors are 6-pole induction types. Low-distortion, high-linearity record/play preamp uses 3-stage direct-coupled negative-feedback design with wide dynamic range. Four microphone and 4 line inputs allows 3-way mixing. Has independen-



dent 4- and 2-channel outputs; 6-position record selector switch. Cue button moves tape against playback head when machine is in either fast mode.

Transport mechanism operates via pushbuttons and electromagnetic relays with built-in delay circuit to prevent undue pressure on tape; automatic shut-off stops reel motion when tape is wound on either reel or when tape breaks; tape shifters move tape away from head surface during fast operation. Frequency response at 3¾ ips of 30 to 12,000 Hz ±3 dB, and 20 to 20,000 Hz ±3 dB at 7½ ips. Signal-to-noise ratio is 60 dB. Wow and flutter is less than 0.12% at 3¾ ips, and 0.07% at ½ ips. Channel separation is better than 50 dB at 1,000 Hz. 16% x 21% x 10% in.; 53.4 lbs.; \$749.50—**Sansui Electronics Corp.**, 55-11 Queens Blvd., Woodside, N.Y. 11377.

Circle 38 on reader service card

OP-AMP DESIGNER, OA-2, is used in linear work and CMOS digital circuitry. Updated version of the OA-1 features heavier current capacities on all three power supplies (175 mA on the +/-15-volt supplies and 500 mA on the +5-volt) with current limiting throughout.

Has sensitive null detector and full function



generator with external frequency adjustment. Interconnections are solderless, and use SK-10 socket and BP-22 breadboarding pins incorporated in the design. Kit \$89.95; assembled unit \$139.295—**E&L Instruments, Inc.**, 61 First Street, Derby, Conn. 06418.

Circle 39 on reader service card

MULTI-PURPOSE RECTIFIER, series MPR. Eight-pin octal base plug-in rectifiers can be programmed into various rectifier configurations such as center-taps, bridges, voltage multipliers, halfwave elements, etc.

Consists of four voltage types with each type containing four independent, electrically isolated diode elements. Basic peak reverse voltages (per type number, per element) at 500, 1,000, 1,500, and 2,000 volts are available. Rectified current output currents from 0.05 to 3.0 amperes average. All diode elements have 50-ampere peak single cycle surge current rating. Price (1-4 qty.): **MPR105** (500 volts*) \$4.85; **MPR110** (1,000 volts*) \$7.35; **MPR115** (1,500



volts*) \$9.60, **MPR120** (2,000 volts*) \$12.25. (* = voltage ratings per element when programmed into either single-phase bridge, dual center-tap or quadrupler configurations.)—**Rectifier Components Corp.**, 1112 Lousons Road, Union, N.J. 07083. **R-E**

Circle 40 on reader service card

FASCINATING HOBBY!

VINTAGE RADIO brings you the pioneer days of wireless and radio in pictures. The collector's bible, it opens doors to a new hobby. Great browsing, too. Over 1,000 pictures, 263 pages. 1887-1929.

RADIO COLLECTOR'S GUIDE lists over 50,000 facts on 4,000 radios, 1921-32; maker, model, year, original price, style, circuit type. 264 pages.



Announcing: New limited reprint of S. Gernsback's 1927 **RADIO ENCYCLOPEDIA**, a priceless record of old-time wireless and radio. Choice of hard-cover or handbook. 175 pages, 1,000 subjects.

SEND TODAY to Vintage Radio, Dep't R, Box 2045, Palos Verdes Peninsula, CA., 90274

Vintage Radio, hard cover	\$ 6.95	<input type="checkbox"/>
Vintage Radio, handbook	4.95	<input type="checkbox"/>
Radio Collector's Guide	3.95	<input type="checkbox"/>
Radio Encyclopedia, hard cover	12.95	<input type="checkbox"/>
Radio Encyclopedia, handbook	9.95	<input type="checkbox"/>

Postage Paid, California residents add 5% Tax.

Name _____
Street _____
City _____ State _____ Zip _____

ENJOY THE OLD DAYS!

new lit

All booklets, catalogs, charts, data sheets and other literature listed here with a Reader Service number are free. Use the Reader Service Card inside the back cover.

RADIO & TV COIL REPLACEMENT GUIDE, No. 174. 100-page catalog contains cross-reference directory for all known domestic and foreign color and black & white TV sets, auto and home radios. 30,000 replacement coils for 375 manufacturers' names are listed.—**Bell Industries, J.W. Miller Div., 19070 Reyes Avenue, Compton, Calif. 90224.**

Circle 41 on reader service card

XQ COMPONENTS CATALOG. 19-page catalog illustrates Cambion components, including terminals, jacks, plugs, handles, battery holders, IC sockets, IC breadboards, coils, chokes, and an assortment of others. Postcard on last page enables the reader to send away for the company's other catalogs.—**Cambion, Dept. XQ, 145 Concord Avenue, Cambridge, Mass. 02138.**

Circle 42 on reader service card

88.014 MHz. SECURITY EQUIPMENT

Security Transmitter:

Crystal controlled, tone modulated, R.F. device which contains: crystal, audio+R.F. transistors, reed switch, audio+R.F. coils, etc.

\$1.25 each 2/\$2.00
4 oz. Shp. Wt.

Super Het. Control, Receiver:

Crystal controlled, with re-transmitter. Contains timing circuits, electronic siren, 12 volt power supply with relay output. Operates on 110 VAC or 12 VDC.

\$5.00 each 2/\$7.50
3½ lb. Shp. Wt.

Remote Receiver:

Crystal controlled receiver includes timing circuit, power supply with relay output. Operates on 110 VAC or 12 VDC.

\$3.50 each 2/\$5.00
3¼ lb. Shp. Wt.

All equipment sold as is.

Include sufficient postage, excess refunded. No cash or C.O.D., please. California residents add sales tax.

R. A. G. S.
666 Willow Street
San Jose, California 95125

Circle 26 on reader service card

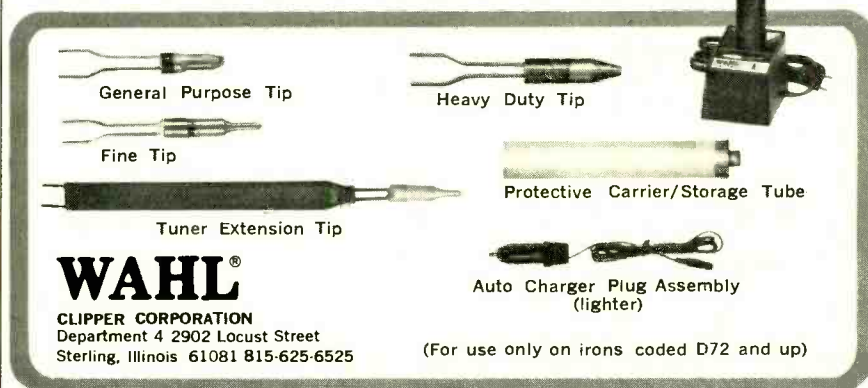
The practical cordless original

When the Wahl Iso-Tip® Cordless Soldering Iron was introduced, it became practical to eliminate the cord from soldering.

Weighing only six ounces, compact and fast heating, the Iso-Tip can make up to 125 electronic joints (or more) per charge. Its recharging stand repowers its batteries overnight. And its worklight lets you see what you're soldering.

Accessories include carrier storage tube, auto charger, and 4 replacement tips. For all the details, see your local electronic component distributor.

Still the greatest advance in soldering since electricity.



Circle 27 on reader service card



HALF PRICE SALE 5 DIGIT FREQ. COUNTER

\$189.95
WHILE THEY LAST!!

WESTON 1250 FREQUENCY COUNTER AT A NEVER TO BE REPEATED PRICE. NEW UNITS WITH ONE YEAR WARRANTY. 5 digit LED readout, 5 Hz to 32 MHz frequency range with 250mV sensitivity and ±10ppm crystal controlled time base. All solid state units. AC powered, tilt stand - carrying handle. For Telephone Orders Call Toll Free 800-527-4642.

Fluke PM-250 prescaler available to increase coverage to 250 MHz with no loss in accuracy. ORDER PM-250 at \$135.00. ORDER 1250 at \$189.95 plus \$2.75 shipping & handling (Residents of Illinois, California, Texas & New Jersey add 5% state tax).

<input type="checkbox"/> Check or Money	SHIP TO:
<input type="checkbox"/> Order Enclosed	NAME _____
<input type="checkbox"/> Ship COD	ADDRESS _____
Charge to My:	CITY _____ STATE _____
<input type="checkbox"/> Bank Americard	ZIP _____
<input type="checkbox"/> Master Charge	
<input type="checkbox"/> American Express	

Card No. _____

Expiration Date _____

Signature _____

TUCKER ELECTRONICS CO.
P. O. BOX 1050
GARLAND, TEXAS 75040
R-E 474

MARCONI
(continued from page 49)

most easily in the presence of heavy atmospheric noise.

On December 10th, an antenna was sent up, carried by a large kite, in preparation for the tests which were to commence the following day. The operation went smoothly. On December 11th, the weather deteriorated. The wind increased steadily, and by mid-morning a full gale was blowing. Attempts to send an antenna aloft met with failure, and a kite and balloon were lost in the severe winds that lashed the hillside; no signals were heard that day.

The next day, December 12, 1901, the

weather continued harsh, and a full gale continued to rage. In spite of the weather, an antenna carried by a kite was sent to an altitude of 400 feet, and Marconi began his listening vigil in the hospital room. But the howling winds made the motion of the kite highly erratic, dipping and soaring like a terrified bird. These sporadic movements altered the angle the antenna made with the earth, as a result of which the characteristics of the antenna were in a constant state of flux. Marconi heard nothing.


He had substituted a telephone receiver for the Morse inker which he had been using. The latter would have given Marconi a printed record of the experiment, but was not as sensitive to signals as the human ear.

Marconi had also replaced his syntonizer receiver with an older model. Different types of coherer were employed; one of these was to so-called Italian Navy coherer which had been developed by a lieutenant in the Italian Navy, Luigi Solari; it consisted of a glass tube with a plug of iron at one end and carbon at the other, with a globule of mercury between. The device is of particular historic interest because it appears to be a forerunner of the semiconductor rectifiers brought into use nearly half a century later. Semiconductor rectifiers employ dissimilar materials to rectify current, and the mercury, coated by an oxide layer, constituted the elements of the rectifier.

Marconi listened intently, growing more discouraged by the moment. Suddenly, at 12:30 PM on December 12th, he heard the signals! Uncertain at first, he continued to listen. Soon, there was no doubt. The faint but unmistakable signals were there, and Kemp was shortly to confirm their presence. The series of dots could only be coming from Poldhu, some 2000 miles to the east. Marconi's second assistant, Paget, was ill on December 12th, and was not present; he would regret the illness the rest of his life.

On the following day, signals were heard again faintly for a brief period, in spite of a howling storm that raged. By December 14th, however, it had become apparent that obtaining evidence on the inker was not feasible with the equipment at hand, and that no better receiving apparatus could be erected because of the terrible weather conditions. Marconi then had to decide whether to announce the results to the world. There

C159
TUBE BONANZA!
20
assorted tubes for \$1.00
Untested (some will be good, some bad).




TAKE A CHANCE FOR \$1.00
SLIDE SWITCHES
12 for \$1.00
All types, SPDT, DPDT, etc. C106



TRANSISTOR REPAIR KIT \$1.00
Includes resistors, condensers, transistors, transformers and various & sundry parts used to repair transistor radios, walkie-talkies, tape recorders, etc. C107

PRECISION RESISTORS
60 for \$1.00
All 1%, 1/2 watts & 1 watt. From low to high ohmages. C113



DUAL POTENTIOMETERS
25 for \$1.00
Assorted ohmages. Originally for Hi-Fi, Stereo and TV. C123



TIE LUGS
50 for \$1.00
From 2 lugs up C143



MISCELLANEOUS MINIATURE TUNING METERS.
2 for \$1.00 C190




MONEY BACK GUARANTEE
Terms: Minimum order \$4.00. Include postage. Either full payment with order or 20% deposit, balance C.O.D.
FREE CATALOG

BARGAIN BONANZA OF EDLIE HIGHEST QUALITY KITS ONLY NEW PRODUCTS EXCELLENT MIXTURE
C188 GIANT PACK OF ASSORTED TRANSISTORS

Silicon Planar
Untested, NPN & PNP
Power, Audio, RF
100 for \$1.98

CZ165 ASSORTED BATTERY OPERATED MOTORS
3 for \$1.00



VOLUME CONTROLS
20 for \$1.00
Wire wounds & carbons, up to 1 meg, some with switches. C126




10 SHIELDED WIRE ASSEMBLIES for \$1.00
With RCA molded plug at one end & tinned wire at the other. C145



WRITE FOR FREE VALUE PACKED CATALOG

BONUS FREE CAPACITOR KIT
With Every \$5 Purchase

DISC CAPACITORS
60 for \$1.00
Assorted capacitances from .0001 to .1. Different voltages, mostly 600 volts N.P.O. N750. C140



MINIATURE TRANSISTOR ELECTROLYTES
13 for \$1.00
Some axial leads, some vertical mount, mixed capacitances and mixed capacitances and mixed voltages. C121



MINIATURE POTS
12 for \$1.00
Used in transistor and miniature applications. C141



Acquired from U.S. Defense depots or removed from equipment (new and used). These are laboratory tested and guaranteed for one full year. Most are of such standard makers as RCA, GE, etc.



RADIO & TV Receiving
Any 3 for \$1.19
11L4, 1S5, 1T4, 1U5, 3CB6, 3DG4, 3EH7, 3EJ7, 3KT6, 3S4, 3V4, 4BC5, 4BN6, 4BU8, 5CZ5, 5J6, 5T8, 5U4, 6AC7, 6AF4, 6AG5, 6AJ8, 6AK5, 6AK6, 6AL5, 6AQ5, 6AX4, 6B10, 6BA6, 6BA11, 6BL7, 6BL8, 6BN4, 6BN11, 6BQ6, 6BS3, 6BU8, 6BW4, 6BZ6, 6CB6, 6CD6, 6CF6, 6CG3, 6CG8, 6CJ3, 6CM3, 6CQ4, 6DA4, 6DE4, 6DG6, 6DK6, 6DN7, 6DT6, 6DW4, 6EA7, 6EH5, 6EH8, 6FD7, 6FM7, 6GF7, 6GH8, 6GK6, 6GL7, 6GM6, 6GN8, 6GU7, 6GV5, 6HE5, 6HJ7, 6HJ8, 6HS8, 6J6, 6JN6, 6JW8, 6K7, 6K11, 6KM6, 6KY8, 6LF8, 6LY8, 6SA7, 6SH7, 6SN7, 6SV7, 6T8, 6T10, 6V4, 6W4, 6X4, 7GS7, 8CM7, 8CN7, 8EB8, 8SN7, 12AD6, 12AE7, 12AU7, 12AT7, 12AU6, 12AV5, 12AX4, 12BA6, 12BE6, 12BH7, 12BY7, 12C8, 12CN5, 12DS7, 12R5, 12SC7, 12SN7, 15KV8, 18FW6, 19T8, 20EZ7, 22BW3, 35C5, 35Y4, 36AM3, 50B5.

CARBON RESISTORS
175 for \$1.00
Most with cut leads (long enough for soldering), some pre-formed. Most all 5% or 10%.

PAIA MAKES SYNTHESIZER KITS

MODELS PRICED FROM \$139



but you know we also have . . .

A DEMO RECORD FOR 75¢ AND A FREE CATALOG LISTING DOZENS OF OTHER GOODIES

PAIA ELECTRONICS
BOX R14359, OKLAHOMA CITY, OK 73114

were, after all, no objective witnesses to the accomplishment. After cabling London with the results, Marconi advised the press on December 16th.

Marconi was immediately involved in several stormy controversies. On December 16th, the Anglo-American Telegraph Company, which had a monopoly on message-carrying activities throughout Newfoundland, threatened legal action if the experiments were not terminated at once. Marconi decided not to contest the action, which could have been costly and time-consuming. The United States or Canada had no such monopolies in existence, and since no significant outlay for receiving equipment had been made in Newfoundland, there did not seem to be much purpose in fighting.

The second, and more far-reaching, controversy involved the accuracy of Marconi's report. In the absence of proof of his claim, many prominent scientists throughout the world expressed doubt about what he actually heard, believing that what he thought were signals could have been caused by heavy static.

It should be pointed out that to this day, a number of responsible and respected scientists believe that no signals were actually heard on December 12, 1901, and that the story was a "myth." Several reasons have been given to support the contention, the most important of which were the primitive nature of the receiving equipment and the wavelength of the signal. Although the exact wavelength was not measured at the time of the experiment, Marconi himself has stated it was about 366 meters (820 kHz).

(continued on page 83)



IS YOUR BLOOD PRESSURE HIGH?

Only your doctor can control high blood pressure. Protect yourself 2 ways:

Get regular medical checkups and support your heart. Association is fighting against this leading cause of heart attacks and strokes.

GIVE... so more will live HEART FUND

HOW TO INCREASE YOUR EARNING CAPACITY IN JUST 6 WEEKS



FORREST D. WRIGHT
Field Engineer

Here's how our Digital Circuit Design course helped Mr. Wright: "... your course helped me immeasurably. I recently applied for a new position and got it. Your special training is now helping me fulfill my responsibilities on the job."

Learn advanced CIRCUIT THEORY in your spare time; without higher math!

THE CENTER understands and anticipates your needs for working in electronics today. Our courses get results for you quickly, with convenient home study. All courses are 100% tax deductible. You take no risks. You receive everything on a 5 day FREE TRIAL basis. Decide your future, act today!

SEND FOR FREE INFORMATION TODAY!

Send me complete information on the following:

- Digital Circuit Design IC Logic Design Power Supply Design
 MOS/FET & J/FET Circuit Design UJT Circuit Design

Name _____ Age _____

Street _____

City _____ State _____ Zip _____

The Center for technical development Inc. 

Dept: RE374

Phone: 513/296-1020
2876 CULVER AVENUE
DAYTON, OHIO 45429

For faster service

USE ZIP CODE

on all mail

FREE catalog over **1000** unique tools, handy kits, precision instruments, technical supplies.



Our 21st year of service to the World's finest craftsmen and technicians.

National Camera
2000 West Union Ave. Dept. G28
Englewood, Colorado, 80110

Send a FREE copy of the nc Flasher

name _____

address _____

city _____

state _____

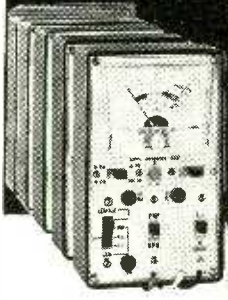
zip _____

National Camera
2000 West Union Ave. Dept. G28
Englewood, Colorado, 80110

Circle 30 on reader service card

Circle 61 on reader service card

EIGHT INSTRUMENTS IN ONE



- Out-of-Circuit Transistor Analyzer
- Dynamic In-Circuit Transistor & Radio Tester
- Signal Generator
- Signal Tracer • Voltmeter
- Milliammeter
- Battery Tester
- Diode Checker

Transistor Analyzer Model 212

Factory Wired & Tested—\$24.50
Easy-to-Assemble Kit—\$16.00

YOU DON'T NEED A BENCH FULL OF EQUIPMENT TO TEST TRANSISTOR RADIOS! All the facilities you need to check the transistors themselves — and the radios or other circuits in which they are used — have been ingeniously engineered into the compact, 6-inch high case of the Model 212. It's the transistor radio troubleshooter with all the features found only in more expensive units. Find defective transistors and circuit troubles speedily with a single, streamlined instrument instead of an elaborate hook-up.

Features:

Checks all transistor types — high or low power. Checks DC current gain (beta) to 200 in 3 ranges. Checks leakage. Universal test socket accepts different base configurations. Identifies unknown transistors as NPN or PNP.

Dynamic test for all transistors as signal amplifiers (oscillator check), in or out of circuit. Develops test signal for AF, IF, or RF circuits. Signal traces all circuits. Checks condition of diodes. Measures battery or other transistor-circuit power-supply voltages on 12-volt scale. No external power source needed. Measures circuit drain or other DC currents to 80 milliamperes. Supplied with three external leads for in-circuit testing and a pair of test leads for measuring voltage and current. Comes complete with instruction manual and transistor listing.

EMC, 625 Broadway, New York 12, N. Y.

Send me **FREE** catalog of the complete value-packed EMC line, and name of local distributor.

NAME _____ RE-4

ADDRESS _____

CITY _____ ZONE _____ STATE _____

EMC

ELECTRONIC MEASUREMENTS CORP.
625 Broadway, New York, N. Y. 10012



Clever Kleps

Test probes designed by your needs — Push to seize, push to release (all Kleps spring loaded).

Kleps 10. Boathook clamp grips wires, lugs, terminals. Accepts banana plug or bare wire lead. 4¾" long. **\$1.39**

Kleps 20. Same, but 7" long. **\$1.49**

Kleps 30. Completely flexible. Forked-tongue gripper. Accepts banana plug or bare lead. 6" long. **\$1.79**

Kleps 40. Completely flexible. 3-segment automatic collet firmly grips wire ends, PC-board terminals, connector pins. Accepts banana plug or plain wire. 6¼" long. **\$2.59**

Kleps 1. Economy Kleps for light line work (not lab quality). Meshing claws. 4½" long. **\$.99**

Pruf 10. Versatile test prod. Solder connection. Molded phenolic. Doubles as scribing tool. "Bunch" pin fits banana jack. Phone tip. 5½" long. **\$.89**

All in red or black - specify. (Add 50¢ postage and handling). Write for complete catalog of - test probes, plugs, sockets, connectors, earphones, headsets, miniature components.

Available through your local distributor, or write to:



RYE INDUSTRIES INC.
127 Spencer Place, Mamaroneck, N. Y. 10543
In Canada: Rye Industries (Canada) Ltd.

Circle 62 on reader service card

next month

MAY 1974

■ New Projection Color TV

This set, available now, delivers a color TV picture that measures 4 feet by 5 feet. It costs \$2500. We show how it works and what it will be like to service.

■ Inside MATV Antennas

Forest Belt tells what's new and what's different in these special-purpose TV antennas.

■ What's New In Automotive Electronics

New circuits and devices are common in today's automobile. Both add-on and original-equipment items are described in this article.

■ Designing Active Bandpass Filters

Don Lancaster shows how to design an inductor-free high-Q bandpass filter circuit. Use it for electronic music in percussion and bell circuits, as well as for audio filtering.

■ New Noise-Reducing Circuit For FM Tuners

It's in the new line of Pioneer equipment and it works. Get the details in this story by R-E's Contributing High-Fidelity Editor

PLUS:

Appliance Clinic

Service Clinic

R-E's Transistor Replacement Guide

MAY ISSUE ON SALE APRIL 16, 1974



Lend a Hand — And a Home

If your family cares
about the world and its people...

If you live in a community
that shares that concern...

Then let a student from another culture
understand you and your life better.

Invite an AFS scholar into your home.



**AMERICAN FIELD SERVICE
INTERNATIONAL SCHOLARSHIPS**

313 East 43rd St., New York, New York 10017

MARCONI

(continued from page 80)

In light of our present knowledge of propagation phenomena, the tests took place at the worst possible time, because both the transmission site and the receiving site were in daylight. There is little possibility that the frequency of 820 kHz could propagate over 2000 miles during daylight because absorption by the ionosphere during those hours is at a maximum, and even powers of the order of thousands of kilowatts would not deliver a significant signal over the Atlantic in that frequency range.

G. R. M. Garratt has theorized that reception of the signals did not take place at the frequencies for which the equipment was designed, but at much higher frequencies: the Poldhu transmitter probably radiated considerable higher order harmonics which would be capable of being propagated over a daylight path, since absorption by the ionosphere decreases as the transmission frequency is increased. In view of the fact that radio amateurs of today are frequently capable of signalling across the Atlantic using powers of the order of watts, it is quite likely that Marconi actually heard the historic series of dots on that bleak and dreary day, but on a frequency in the 10,000 to 15,000-kHz range, in the short-wave portion of the electromagnetic spectrum.

Most of the doubts were dispelled less than three months later, when Marconi sailed across the Atlantic from Southampton to New York aboard the liner Philadelphia. The ship was equipped with Marconi's latest syntonic receiving equipment and an antenna lashed to a specially constructed 150-foot mast aboard the ship. A Morse inker recorded signals as they were received, and the captain of the ship verified all observations.

As the ship sailed on, signals continued loud and clear. At a distance of 700 miles, they were being recorded in broad daylight. Beyond that, the Poldhu transmitter could only be heard at night. This was the first observation of the curious nighttime effect which radio amateurs were to observe countless times—that signals traveled much greater distances at night than during the day.

During most of Marconi's historic voyage, signals were being received before witnesses. Poldhu's S's were recorded to a distance of 2099 miles, almost precisely the distance between Poldhu and St. John's. There could no longer be any doubt. The miracle of long distance communication without wires had come to pass. Much of the miracle lay in the fact that this was only the beginning! **R-E**

If You Work In Electronics:

GRANTHAM OFFERS YOU College-Level Training and a college degree.

Electronic Circuit Design, Engineering Analysis (including mathematics thru calculus), Classical and Solid-State Physics, Engineering Design, etc., etc., are all part of the Grantham home-study degree program in Electronics Engineering.

PUT PROFESSIONAL RECOGNITION IN YOUR CAREER.

By adding college-level home training and a college degree to your experience, you can *move up* to greater opportunities in electronics.

Grantham offers the A.S.E.T. degree by correspondence. After earning this degree, you may continue with additional correspondence plus a 3-day residential seminar and certain transfer credits, to earn the B.S.E.T. degree. Then, the B.S.E.E. is available through further study.

GRANTHAM SCHOOL OF ENGINEERING

2000 Stoner Ave., Los Angeles CA 90025

● Telephone (213) 477-1901 ●

Worldwide Career Training thru Home Study
Mail the coupon below for free bulletin.

Grantham School of Engineering RE-4-74

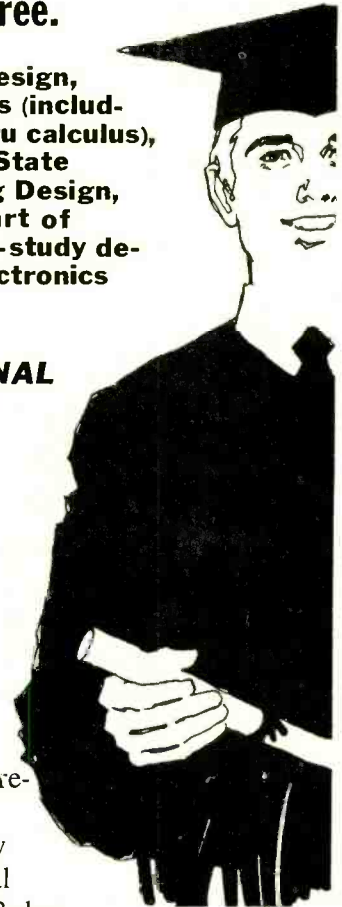
2000 Stoner Ave., Los Angeles, CA 90025

I have been in electronics for _____ years. Please mail me your free bulletin which gives details concerning your electronics degree programs.

Name _____ Age _____

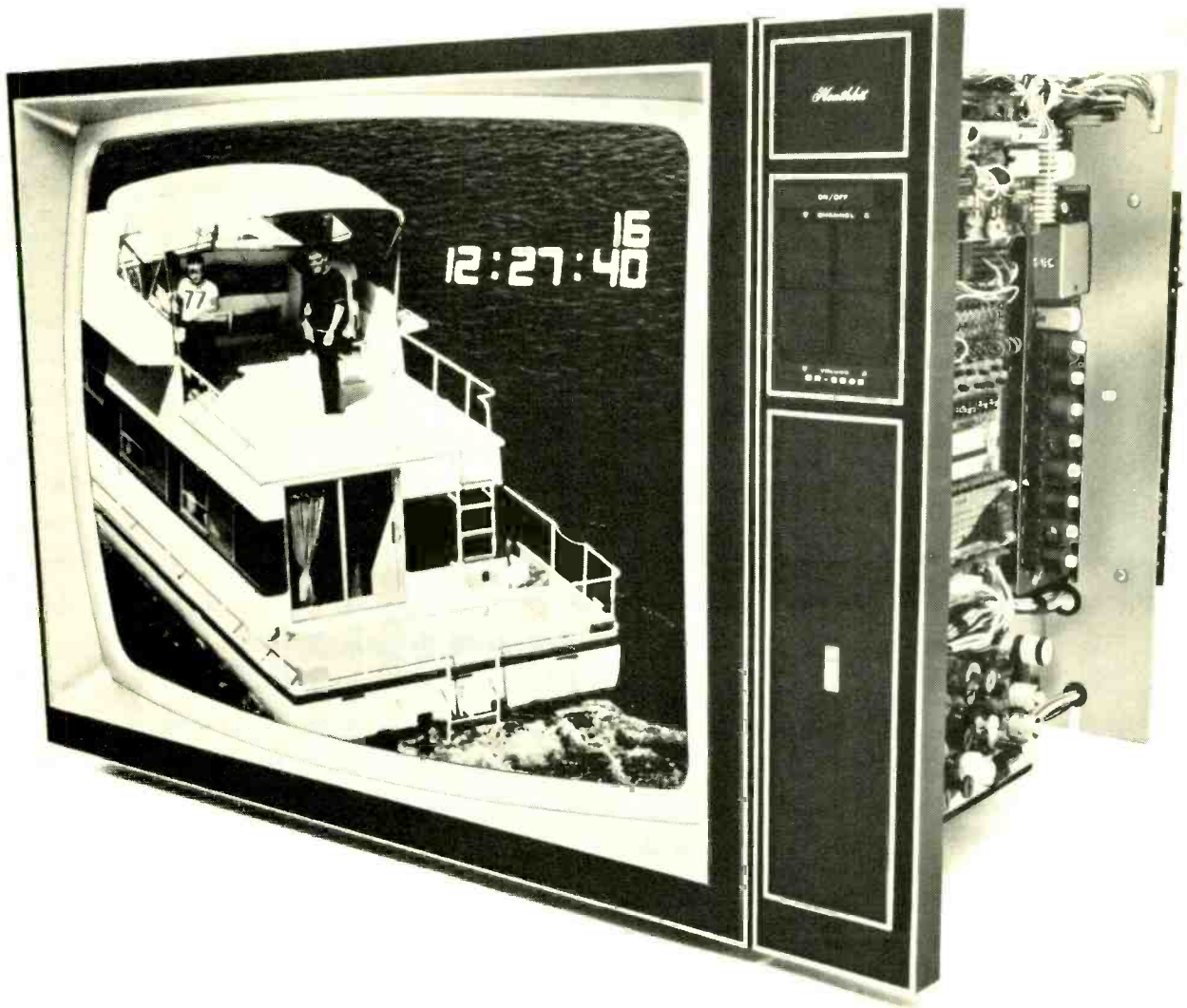
Address _____

City _____ State _____ Zip _____



Heathkit® Digital Color TV...

Digital technology comes to TV with the new Heathkit GR-2000 Color TV. It has on-screen digital channel numbers and a digital clock — programmable digital channel selection, all electronic varactor tuning, and an IF that never needs alignment! So advanced, it's like nothing you've ever seen before.



GREAT VALUES

FREE \$1 BUY WITH EVERY 10 YOU ORDER Only applies to "\$1" Buys
CANADIANS: Ordering is easy — we do the paperwork — try a small order

FREE GIFT WITH EVERY ORDER
SHANNON MYLAR RECORDING TAPE

IBM COMPUTER SECTIONS

8 assorted Units we sell for \$1 are loaded with over 150 valuable parts.

Incl. — Transistors, Condensers, Resistors, Heat Sinks, Diodes, Etc.

8 for \$1
100 for \$10

WESTINGHOUSE ALL TRANSISTOR HOME/OFFICE MESSAGE CENTER

Leaves messages for other for replay... Built in speaker/microphone for talk-into convenience... Records up to 3 minutes of messages... Illuminated signal shows when a message is waiting. Control adjusts playback volume without affecting recording volume... Capstan Drive; BRAND NEW SOLD AS IS **\$7.95**

3" — 225'	.19	CASSETTE C-60	.59
3 1/4" — 600'	.68	CASSETTE C-90	1.19
5" — 600'	.72	CASSETTE C-120	1.97
5" — 900'	.90	8-Track — 64 Min.	1.29
5" — 1200'	1.07	8-Track — 80 Min.	1.59
5" — 1800'	1.59	8-Track — Cleaner	1.49
7" — 1200'	.87		
7" — 1800'	1.22	3" TAPE REEL	.07
7" — 2400'	1.89	3 1/4" TAPE REEL	.09
7" — 3600'	2.95	5" TAPE REEL	.19
		7" TAPE REEL	.24

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 **\$3.95**

100% off in lots of 3

MARKET SCOOP COLUMN

- ZENITH COLOR DEMODULATOR CHIP PART #221-39 (Sprague Epy TVC-M-1) **\$3.95**
- BLUE LATERAL MAGNET ASSY. Re- placement for most color TV's **\$1.79**
- UNIVERSAL TV ANTENNA Back of set mounting — 5 section rods **\$2.79**
- COLOR CONVERGENCE ASSEMBLY Uni- versal type—good for most sets **\$2.49**
- COLOR-TV RECTIFIER — Used in most color sets—6900 kv 3 for **\$1.95**
- COLOR-TV CRT SOCKETS Wired leads for all color TV's **\$1.79**
- RCA 110 CRT SOCKETS Wired leads for all TV's **\$1.79**
- 70 COLOR TUBE BRIGHTNER **\$3.95**
- 90° COLOR TUBE BRIGHTNER **\$4.95**
- 2 — COLORBURST QUARTZ-CRYSTAL For Most Color TV sets 3579 645 KC **\$1.89**
- 5 ASSTD. GLOBAR VARISTOR Popular re- placements for most COLOR TV **\$1.79**

MATCHED PAIRS TRANSISTORS NPN & PNP (2N 1252-2N2904) (2N2222-2N2907) Each set **\$1**

KNOB SPECIAL

- 100 — ASSORTED RADIO KNOBS All standard types \$30 value **\$1**
- 50 — TV KNOBS — POPULAR TYPES Mostly Selector & Fine Tuning **\$1**
- 20 — VERTICAL LINEARITY KNOBS Long shank Front mount as- sortment **\$1**
- 20 — VERTICAL LINEARITY KNOBS Side mount Standard sizes **\$1**
- 25 — KNURLED SHAFT KNOBS Hard to get Best selection **\$1**
- 25 — CLOCK & RADIO KNOBS most popular types **\$1**
- ANY 6 KITS FOR \$5

- 300 — ASSORTED HEX NUTS 2, 5/16, 3/8, 1/2, 5/8, 3/4, 1, 1 1/2
- 250 — ASST. SOLDERING LUGS best types and sizes
- 250 — ASST. WOOD SCREWS finest popu- lar selection
- 250 — ASST. SELF TAPPING SCREWS #6, #8, #10, etc.
- 150 — ASST. 6/32 SCREWS and 150 #6/32 HEX NUTS
- 150 — ASST. 8/32 SCREWS and 150 8/32 HEX NUTS
- 150 — ASST. 2/56 SCREWS and 150 2/56 HEX NUTS
- 150 — ASST. 4/40 SCREWS and 150 4/40 HEX NUTS
- 150 — ASST. 5/40 SCREWS and 150 5/40 HEX NUTS
- 500 — ASSORTED RIVETS most useful se- lected sizes
- 300 ASSORTED WASHERS most useful se- lected sizes
- 100 — ASST. RUBBER BUMPERS for cabi- net bottoms — other uses
- 100 — ASSORTED RUBBER GROMMETS best sizes
- SIMPSON 2 1/2" ROUND PANEL METERS Model 125 (0-100) DC Milliammeters Large Magnet **\$3.95**
- 12" UNIVERSAL SPEAKER Top Quality Large Magnet **\$4.89**
- 10" PHILCO SPEAKER Top Quality Large Magnet **\$2.99**
- 8" UNIVERSAL SPEAKER — Large Magnet—Special Buy **\$2.99**
- 4" UNIVERSAL TWEETER 1 oz. Magnet **\$1.29**
- UNIVERSAL 4" PM SPEAKER Top Quality **\$1**
- 2 1/2" x 4" SPEAKER Special Buy For 85 **69c Ea**
- 4" x 6" "QUAM" 16 OHM SPEAKER Large magnet Special BUY (10 for \$13.90) **\$1.79**
- RONETTE STEREO CARTRIDGE latest dual sapphire flipover type
- STEREO HEADPHONES Hi-Fi Quality Complete with Stereo plug **\$5.95**
- 10 — STANDARD TRANSISTORS NPN & PNP 2N2904, 2N114, etc.
- UTAH 8" — HEAVY DUTY 10 OZ. SPEAKER Ceramic Type 8 Ohm **\$3.95**
- 2 — ELECTROLYTIC CONDENSERS 200 mfd. 250 Volt
- 2 — SPRAGUE ELEC. CONDENSERS 80004 1 Mfd. 475 V
- 2 — ELECTROLYTIC CONDENSERS 200/304 1 Mfd. 350V
- 8-TRACK TAPE PLAYBACK DECK Compact design fits anywhere
- 3 — ELECTROLYTIC CONDENSERS 100 mfd. 100 V, 50 mfd. 75 V
- 32' — TEST PROD WIRE DELUXE QUALITY red & black
- SOLID STATE UHF CONVERTOR Chan- nels 14-83, easy to install
- VARCO STEREO CARTRIDGE CN 72 With mounting bracket, flipover needle
- ELECTROLYTIC CONDENSER 100 Mfd. 250V
- CO-AX CABLE RG59U grey or black 250' — \$9 100' — \$3.69 50' —
- 15 — MINIATURE 456KC IF TRANS- FORMERS PC 1/2 X 1/2 — good value
- 2 — 12BH7 RCA TUBES
- ELECTROLYTIC CONDENSERS 200/304 Mfd. 250V
- 2 — ELECTROLYTIC CONDENSERS 150 mfd. 35V
- 1 — 5" SPEAKER with output trans- former
- MERCURY TUBE TESTER MODEL 985 Compact, latest model **\$39.95**
- MIDLAND STEREO AMPLIFIER Model 26-092, 12 Watt, solid state **\$36.50**
- MIDLAND STEREO AMPLIFIER Model 26-093, 25 Watt, Solid State **\$55.00**
- 2 — ELECTROLYTIC CONDENSERS 10 Mfd. 500V, 10 Mfd. 400V
- COLOR POWER TRANSFORMER — Good for most sets 26R150 List Price — \$36.75 **\$6.95**
- TUBE & CONTINUITY CHECKER Model FT425 (Tests fuses, heaters, lamps, etc.) **\$1.98**

- 110 TV DEFLECTION YOKE for all types TV's incl schematic **\$4.95**
- "COMBINATION SPECIAL" RCA 110 FLYBACK plus 110 DEFLECTION YOKE **\$6.95**
- 90° FLYBACK TRANSFORMER for all type TV's incl schematic **\$2.95**
- 90 TV DEFLECTION YOKE for all type TV's incl schematic **\$2.95**
- 70 FLYBACK TRANSFORMER for all type TV's incl schematic **\$2**
- 70 TV DEFLECTION YOKE for all type TV's incl schematic **\$2**
- SHARP 110 FLYBACK & YOKE COMBI- NATION #SPT-582 Good for most port- able TV **\$5.95**
- 90 COLOR YOKE For all Rectangu- lar 19 to 25" color CRT's
- RCA COLOR FLYBACK Part #118823 (Zenith or HO-601C) **\$12.95**
- ZENITH IC — TV COLOR SIGNAL PROCESSOR Part #221-45 **\$3.95**
- 70 COLORE YOKE For all round color CRT's **\$12.95**
- SONY UHF TUNER—TRANS- ISTOR TYPE exact replace- ment, complete w knobs **\$3.95**
- 4 — TV ALIGNMENT TOOLS most useful as- sortment #1 **\$1**
- 4 — TV ALIGNMENT TOOLS For Color TV #2 **\$1.49**
- 6 — TV COLOR ALIGNMENT TOOLS Most popular type **\$2.79**

KLEPS "CLEVER" TEST PRODS

"Third-hand" test prods, reach into out of way places - Insulated - cannot slip - accommodates bare wire or banana plug - no soldering.

- PRUF 10 — VERSATILE TEST PROBE **89**
- KLEPS 10 — BOATHOOK CLAMP 1/4" long **\$1.39**
- KLEPS 20 — BOATHOOK CLAMP 7/8" long **\$1.49**
- KLEPS 30 — FLEXIBLE FORKED TONGUE 6" long **\$1.79**
- KLEPS 40 FLEXIBLE PC BOARD TERMINALS 6 1/2" long **\$2.59**
- KLEPS — ECONOMY KLEPS FOR LIGHT WORK **99**

- TRANSISTOR RADIO most type good, bad, broken, as-is, polkuk **\$1.50**
- TAPE RECORDER — assorted types good, bad, broken, as-is, polkuk **\$4**
- 300 — ASST 1/2 W RESISTORS Top Brand, Short Leads, Excellent selection
- 100 — ASST 1/4 WATT RESISTORS choice ohmages, some in 5's
- 100 — ASST 1/4 WATT RESISTORS choice ohmages, some in 5's
- 70 — ASST 1/2 WATT RESISTORS choice ohmages, some in 5's
- 35 — ASST 2 WATT RESISTORS choice ohmages, some in 5's
- 50 — PRECISION RESISTORS best list- price \$30 less 98%
- 20 — ASSORTED WIREWOUND RESIS- TORS, 5, 10, 20 watt
- 10 — ASSORTED SLIDE SWITCHES SPST, SPDT, DPDT, etc.
- 20 — SYLVANIA HEAT SINKS For Transis- tors
- 20 — ASSORTED TV COILS I.F., VIDEO, sound, radio, etc.
- 1 — ELECTROLYTIC CONDENSERS 200/300 100 100 MFD — 25 V
- 1 — ELECTROLYTIC CONDENSERS 100 mfd. 100V
- 3 — ELECTROLYTIC CONDENSERS 20 20 mfd. MFD-45 V
- 5 — 9 VOLT MOTORS Excellent for hobby- ists
- 6" PHILIPS "INVERTED CONE" SPEAKER Top quality Thinline
- 1-6" x 9" HEAVY DUTY 10 OZ SPEAKER Ceramic Type 8 Ohm
- 10 — ASSORTED DIODE CRYSTALS 1N41, 1N48, 1N49, 1N54, etc.
- 6 — TOP BRAND SILICON RECTIFIERS 1 amp. 1000 PIV
- 5 — PNP TRANSISTOR general purpose, TO-5 case
- 5 — NPN TRANSISTORS general purpose, TO-5 case
- 25 — ASSORTED TRANSISTORS big fac- tory scoop solid as-is
- TV TWIN LEAD-IN 300 ohm 500 — \$7.00 \$1.90
- 10 — MINIATURE ELECTROLYTIC CONDENSERS — ERS for Transistor & miniature work
- 20 SHIELDED TWO CONDUCTOR CABLE Grey
- WEN SOLDERING GUNS Model 222K25 — \$12.95 Model 250 — \$18.95 Model 100K — \$9.50 Model 288 — \$12.95
- 8 ELEMENT COLOR OUTDOOR AN- TENNA Big shot Jr. Last \$11.95
- 4 — POLARIZED CHEATER CORDS 6' —
- 25 SHIELDED MICROPHONE CABLE 25' Grey
- 4 — ELECTROLYTIC CONDENSERS 75 30mfd. 150V

SARKES TARZIAN TUNER 41mc

Latest Compact Model good for all 41 mc TV's.

BRAND NEW—

Best TUNER "SARKES TARZIAN" ever made—last word for stability, definition & smoothness of operation. An opportunity to improve and bring your TV Receiver up-to-date.

COMPLETE with Tubes **\$7.95**

- WESTINGHOUSE FM TUNER #476-V-015001 Transis- toring **\$3.99**
- WESTINGHOUSE FM TUNER (121BT Tube) **\$1.00**
- UHF TUNER—TRANSISTOR TYPE Used in all TV sets **\$3.95**
- STANDARD TUNER—TRANSISTOR (GUIDE GR1) 4 Channel closed circuit **\$1**
- PHILCO TV TUNERS Model-76-128983-3 **\$4.95**
- MAGNAVOX TV TUNER 340137-3 68CG8-8 68K5 tubes **\$7.95**
- 5 — AC LINE CORDS Approved **\$1**
- WELLS GARDNER TUNER Part #7A 120-1 14G87 — 2HA7 Tubes **\$7.95**
- WELLS GARDNER TV TUNER 25A1284 (6128-6HA5 tubes) **\$7.95**

- ASTATIC PICKUP MODEL 700-89T Con- tains 89T ceramic cartridge LIST PRICE \$17.00 **\$2.95**
- 20 — DIPPED MYLAR CAPACITORS 100V 800V **\$1**
- 20 — DIPPED MYLAR CAPACITORS 100V 800V **\$1**
- 20 — DIPPED MYLAR CAPACITORS 100V 800V **\$1**
- 15 — MOLOED TUBULAR CAPACITORS 105V 400 V
- 20 — DIPPED MYLAR CONDENSERS 100V 400 V
- 10 — SPRAGUE "ORANGE DROP" CAPACITORS 0.666-2000 Volt
- TACHOMETER 2 1/2" SQUARE PANEL METER 1-V DC, full scale, 33 Ohm coil resistance 0.600 R.F.M.
- 1 — CASSETTE TYPE DYNAMIC MI- CROPHONE with universal plugs—300 Ohms
- 10 — SETS PHONO PLUGS & PIN JACKS RCA type
- 8 — PRINTED CIRCUIT IF TRANSFORMERS 4-Lug, 456 KC
- STEREO TONE ARMS Most popular type turn over cartridge **\$2**
- 4 — 50' HANKS HOOK-UP WIRE assorted colors
- 100' SPOOL SPEAKER WIRE 2 cond. mini zip, clear, 101 uses **\$1.95**
- 10 — ASST RADIO & TV TUBES Every Tube a good number
- 5 — AUDIO OUTPUT TRANSFORM Sub-min for Trans Radios
- 5 — I.F. COIL TRANSFORMERS Gaike for Transistor Radios
- 6" UNIVERSAL SPEAKER Top quality 3" Spind Iny Ea **\$1.79**
- ALL AMERICAN TUBE KIT (12AV6-12BE6-12BA6-6X4-450Y5) **\$2.99**
- STEREO MICROPHONE'S **\$5.50**
- UTAH "CELESTA" 3-WAY CO-AX SPEAKERS 8-10 oz Mag 30 Watts **\$16.95**
- UTAH "CELESTA" 3-WAY CO-AX SPEAKER 12-20 oz Mag 45 Watts **\$24.95**
- VU 1" PANEL METER 0-20 db Scale **\$1.29**

TEST EQUIPMENT SPECIAL DISCOUNT PRICES

BK **TEIGOL**

Leader

SENCDRE

IMMEDIATE DELIVERY... Scientific light packing for safe delivery at minimum cost.
HANDY WAY TO ORDER... Send check or money order, add extra for shipping. Lists of new offers will be returned in your order.

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 212-874 5600 TELEPHONE

DISCOUNT TEST EQUIPMENT SPECIALISTS

B&K

EICO

SENCORE

Leader

COMPLETE LINE OF
ELECTRONIC SUPPLIES
ICC/Mullard & Raytheon Tubes
Telematic Test Rigs
TV Tuner Subber

FREE CATALOG

FORDHAM

Radio Supply Co., Inc.
558 Morris Ave., Bronx, N.Y. 10451
Tel: (212) 585-0330

Circle 68 on reader service card

ELECTRONIC TECHNICIANS!

Raise your professional standing
and prepare for promotion! Win
your diploma in

ENGINEERING MATHEMATICS

from the Indiana Home
Study Institute

We are proud to announce two great
new courses in Engineering Mathematics
for the electronic industry.

These unusual courses are the result of
many years of study and thought by the
President of Indiana Home Study, who
has personally lectured in the classroom
to thousands of men, from all walks of
life, on mathematics, and electrical and
electronic engineering.

You will have to see the lessons to ap-
preciate them!

NOW you can master engineering
mathematics and actually enjoy doing it!
WE ARE THIS SURE: you sign no
contracts—you order your lessons on a
money-back guarantee.

In plain language, if you aren't satis-
fied you don't pay, and there are no
strings attached.

Write today for more information and
your outline of courses.

You have nothing to lose, and every-
thing to gain!

The INDIANA HOME STUDY INSTITUTE

Dept. RE-4, P.O. Box 1189, Panama City, Fla.
32401

Circle 69 on reader service card

He's Back

Hire the
Disabled
Veteran

TUBES

SAVE money on parts and transmitting-
receiving tubes, foreign-domestic. Send 25c for
Giant Catalog. Refunded first order. **UNITED
RADIO COMPANY**, 56-R Ferry Street, Newark,
N.J. 07105

RECEIVING & industrial tubes, transistors. All
brands-biggest discounts. Technicians, hob-
byists, experimenters—request free giant
catalog and save! **ZALYTRON**, 469 Jericho
Turnpike, Mineola, N.Y. 11501

ELECTRONIC ENGINEERING & INSTRUCTION

TV tuner repairs—Complete course details. 12
repair tricks. Many plans. Two lessons, all for \$1.
Refundable. **FRANK BOCEK**, Box 3236 (Enter-
prise), Redding, Calif. 96001.

ELECTRONICS training. College level course.
FCC license, Broadcast Engineering, Satellite
Communications. Home study. Free brochure.
GTI, 5540 Hollywood Blvd., 10, Hollywood, Calif.
90028

CALCULATOR owners: use your + - x ÷
calculator to compute square roots, cube roots,
sin (x), cos (x), tan (x), arcsin (x), arccos (x),
arctan (x), logarithms, exponentials, and more!
Quickly, accurately, easily! Send today for the
improved and expanded edition of the first and
best calculator manual—now in use throughout
the world . . . only \$2.00. Unconditional
money-back guarantee—and fast service!
MALLMANN OPTICS AND ELECTRONICS,
Dept. 5B, 836 South 113, West Allis, Wisc. 53214

BUSINESS OPPORTUNITIES

START small, highly profitable electronic pro-
duction in your basement. Investment, knowl-
edge unnecessary. Postcard brings facts.
BARTA-AD, Box 248, Walnut Creek, Calif. 94597

BUILD your own speaker systems. Lowest
wholesale prices on famous brands. Write for
176 page catalog. **McGEE RADIO COMPANY**,
1901 McGee Street, Kansas City, Mo. 64108

FOR SALE

LOGIC probes from \$9.95. Free catalog.
ELECTRO INDUSTRIES, 4201 Irving Park,
Chicago, Ill. 60641

NAME brand digital test equipment, discount
prices. Free catalog and price list. **SALEN
ELECTRONICS**, Box 82, Skokie, Ill. 60076

INTEGRATED circuit bargains—723 voltage
regulators 10/\$5.00. 7441 Nixie drivers 10/\$7.00.
7490 decade counters 10/\$8.00. 74193 up-down
counters 10/\$12.00. 8W-rms integrated circuit
stereo amplifier kit \$13.50. 1A-400PIV epoxy rec-
tifiers 50/\$3.00. Large light-emitting diodes
12/\$2.00. Large MAN-1 7-segment LED readouts
3/\$5.00. Large multicolor LED's 2/\$1.00. 10 lbs.
aluminum chassis/heat sink stock \$3.50. **Free
bonus surprise. ELECTRONIC UNLIMITED**,
P.O. Box 91, Olney, Md. 20832

NEW FM deviation meters \$75.00. Free informa-
tion. Write **ECM**, 412C N. Weinbach, Evansville,
Indiana 47711.

TOOL KITS

FOR THE FIELD ENGINEER



Includes more
than 100 tools!

JTK-17

Write for brochure

More than 100 fine tools used for servicing in the field.
Used on communications equipment, business machines,
computers, all kinds of electronic systems. All tools and
VOM tester are furnished in deluxe attache case.

FOR THE ELECTRONIC TECHNICIAN



Industrial electronic technician kit JTK-2 includes 44
most-wanted tools used for making breadboards and mock-
ups. Write for list of included items.

Free Catalog

Includes 72 pages of hard-to-find tools
used by electronic technicians, instru-
ment mechanics, engineers, scientists.
Over 1700 items listed. Write today.



JENSEN TOOLS and ALLOYS
4117 N. 44TH STREET, PHOENIX, ARIZONA 85018

Circle 70 on reader service card

FREE BURGLAR- FIRE ALARM CATALOG 400 PRODUCTS



Full line of quality systems and supplies
for professional or electronic hobbyist.
Prompt delivery, quantity prices.



mountain west alarm
4215 n. 16th st.
phoenix, az. 85016

Circle 71 on reader service card

Market Center

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). \$1.00 per word . . . minimum 10 words.
NONCOMMERCIAL RATE (for individuals who want to buy or sell personal items) 70¢ per word . . . no minimum.

FIRST WORD and NAME set in bold caps at no extra charge. Additional bold face at 10¢ per word. 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 June issue must reach us before April 1.

EXPERIMENTERS regulated power supplies 5Vdc-1A integrated circuit supply kit \$13.00. 5Vdc-10A integrated circuit supply kit \$36.50; (remote current sense \$42.50.) Adjustable dual operational amplifier supply kit (provides two independent 1-amp regulated 5-20Vdc supplies) only \$19.50. Fixed dual operational amplifier supply kit \$13.50 (specify +/-15Vdc or +/-12Vdc). 12Vdc 40-ampere, voltage-regulated power supply kit \$45.00. Complete kits including printed circuit board, chassis, heat sinks, transformers, regulators, hardware. Include postage. **ELECTRONICS UNLIMITED**, P.O. Box 91, Olney, Md. 20832

TWENTY disc, or 10 bar magnets. \$1.00. **MAGNETS**, Box 192-E, Randallstown, Md. 21133

GIANT 126 page Canadian surplus catalog. \$1.00. **ETCO ELECTRONICS**, Dept. RE, Box 741, Montreal, Canada.

DIGITAL electronics! Complete schematics, parts lists, theories—Discrete Component Digital Clock, \$3.00. Increase technical competence, hobby skills—Complete course in Digital Electronics is highly effective, \$10.00. Free literature. **DYNASIGN**, Box 60R2, Wayland, Mass. 01778

LOUDSPEAKERS - BOSE 901 replacements. \$7.98 postpaid. Quantity discounts. Money back guarantee. **AURATONE**, Box 580-3B, Del Mar, Calif. 92014

RADIO & TV tubes 36c each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL**, 4217-E University, San Diego, Calif. 92105

CANADIAN'S free catalog LED's, IC's, transistors, SCR's diodes, parts. **CORONET ELECTRONICS**, 649A Notre Dame West, Montreal 101, Que., Canada

UNUSUAL numerical readout projects catalog: Free! GBS, Box 100M, Greenbank, W.Va. 24944

JAPANESE transistors, wholesale prices, free catalog. **WEST PACIFIC ELECTRONICS**, Box 25837, W. Los Angeles, Calif. 90025

SEMICONDUCTOR and parts catalog. **J. & J. ELECTRONICS**, Box 1437, Winnipeg, Manitoba, Canada

FREE Catalog
OF THE WORLD'S FINEST
GOVERNMENT SURPLUS
ELECTRONIC EQUIPMENT

And BETTER Than Ever

Name _____
Address _____
City _____ State _____ Zip _____

Mail Coupon for Your FREE Copy, Dept. RE
FAIR RADIO SALES
1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

INFRARED VIEWER PARTS

TYPE 6022 INFRARED IMAGE TUBE
20,000 volt Image Converter tube fibers made
through MIL E-1 tube new solid image plate
Based with 1000000 8 KV input. Price
in 100's during a 6012 for viewer construction
plus 50¢. Built for

ONLY \$12.50 each

FOR:
• Crime Detection • Laser Study • Research

**LAMPS • TUBES
FILTERS • PARTS**

We have the largest stock of surplus IR materials. A \$1 cash
two plane sends you via Air Mail your latest listing of Military
Insured parts & Equipment. Includes a \$100 Credit Certificate
applicable in first order. Sorry. U.S.A. offer only.

TERMS Cash With Order. Firms O&B Rated (DD) 1st. Net 10 Days
As Export Orders

McNEAL ELECTRIC & EQUIPMENT CO.
4736 Olive St., St. Louis, Mo. 63108

LINEARS			
NE540	\$2.00	748	\$1.00
NE555	1.50	CA3018	1.00
NE560	3.25	CA3026	1.00
NE561	3.25	CA3045	1.00
NE565	3.25	LM100	1.00
NE5558	1.00	LM105	1.25
709	.45	LM302	1.25
710	.75	LM308	2.00
711	.40	LM311	1.75
723	1.00	LM370	2.00
741	.55	LM703	.45
747	1.00	LM309K	2.00
NE566	4.00	LM3900	2.00
NE567	4.00	LM309H	1.25
		LM1595 4-quad. mult.	2.00

7400 DIP	
7400	\$.25
74H00	.35
7401	.20
7402	.35
74H01	.35
7403	.30
7404	.28
74H04	.35
7405	.35
7406	.70
74H05	.35
7408	.35
74H08	.35
7410	.25
74H11	.35
7413	1.25
7417	.40
7420	.25
74L20	.35
74H20	.35
74H22	.35
7430	.25
74H30	.35
74L30	.40
7440	.25
74H40	.35
7441	1.25
7442	1.20
7446	1.20
7447	1.50
7448	1.00
7450	.25
74H50	.35
74L51	.25
74H51	.35
7453	.20
7454	.25
74L54	.35
74L55	.35
7460	.20
74L71	.30
7472	.40
74L72	.50
7473	.60
74L73	.75
7474	.65
74H74	.80
7475	1.40
7476	.60
74L78	.80
7480	.65
7483	1.00
7489	4.00
7490	1.20
7491	1.00
7492	.90
7493	1.15
7494	1.15
7495	1.15
74L95	2.00
74107	.70
74121	1.25
74123	1.50
74154	2.30
74163	2.00
74192	2.50
74193	1.50
74195	1.00

LED's

MV-50 Red Emitting 10-40MA @ 2V
\$.25; 10/\$1.25
100/\$10.00

MV5024 Red TO-18 High Ome @ 2V
\$.35; 10/\$2.95

MV-10B Visible Red 5-70MA @ 2V
\$.30; 10/\$2.50

MAN-3 Seven-segment readout:
Each only \$1.25
Ten or more, each . . . 1.00
W/O decimal, each 75

MAN-4 Seven-segment OIP. \$2.75

RCA 2010
Numitron Digital Display Tube,
Incandescent 5-Volt 7-Segment
.6" High Numeral Visible
from 30 feet
Standard 9-Pin Base (Solder-
able)
Left-hand Decimal Point
Each \$ 5.00
5 For \$20.00

CT5005
A single MOS chip with all the
logic necessary for a 12-digit
four-function calculator with
an extra storage register for
constant or memory application
.28 Lead DIL package
Capabilities (+, -, x, ÷)
Chain calculations
True credit balance sign
display
Automatic Keyboard Debounce
Single voltage supply is
possible
Complete with data . . . \$14.95
Data only (refundable)
with purchase of chip . . . 1.00

SINGLE CHIP 40 PIN
Add, Subtract, Multiply, and
Divide
12-Digit Display and Calcula-
tor
Chain Calculations
True Credit Balance Sign
Output
Automatic Overflow Indication
Fixed Decimal Point at 0, 2,
3, or 4
Leading Zero Suppression
Data only (refundable
with purchase of chip) . . . \$1.00
Complete with data . . . \$9.95

CD-2 COUNTER KIT
Unit includes board, 7490, 7475
quad latch, 7447 seven-segment
driver, and RCA DR2010.

Each \$.95
Ten for \$7.95

TRIAC
2N6344 600V 8A TO-
220 \$.75

Keyboard Assembly
TRW Data Systems unit; 10 keys
0-9; 3 (or 4) 24V lamps; prin-
ted circuit board w/14 1N4001
diodes, capacitors, transistor,
and resistors. All mounted in
an attractive case approx. 4 1/2
x 4 1/2 x 2 1/2. These are used;
no schematic is available.
\$6.95 Each

Power Supply SPECIAL!
723-T (TO-5) vari-
able regulator chip
1-40V, + or - out-
put @ 150MA 10A
with external pass
transistor--With
diagrams for many
applications.

TRIAC
2N6344 600V 8A TO-
220 \$.75

CMOS
CD4001 \$.75
CD400275
CD4010 1.00
CD401175
74C0075
74C2075
74C160 3.25

SEND FOR FREE FLYER!
C.O.D. PHONE ORDERS
ACCEPTED--\$10 MINIMUM

All IC's new and fully-tested; leads plated with
gold or solder. Orders for \$5 or more are shipped
prepaid; smaller orders add 55¢. California resi-
dents add Sales Tax. ICs shipped within 24 hours.
P. O. Box 41727
Sacramento, CA
95841
(916) 334-2161

BABYLON ELECTRONICS



COMPUTER KEYBOARD W/ENCODER \$35
Another shipment just received. Alpha-numerics
keyboard excellent condition. Once again we expect
an early sellout. Price of \$35 includes prepaid ship-
ment in the US and shipment made within 24 hours
of receipt of order.

JUNK KEYBOARDS as above, "as is" for parts
\$7.00

COMPLETE MEMORY SYSTEM \$150
Measures 12 x 7 x 1 inches. Utilizes TTL IC's.
10240 memory cores. 9 installed sense amps,
addressed as 1024 locations. I/O lines include 9
data-in, 9 data-out, 10 address-in, powering
status and control. Only 40 systems on hand.
Schematics included.

#DCU \$150 pp
AUTOMOBILE REVERB \$7.00

Brand new fully assembled, ready to install in
your car to give 3rd dimension concert hall ef-
fect. Complete with instructions, rear seat
speaker, grill, wires, plugs.

#05 \$7.00
8 TRACK STEREO TAPE DECK \$14.00

With built-in stereo pre-amp, 115 volt drive
motor, channel indicator lamps. Unused, origi-
nal boxed, less cabinet. Customize your stereo
music center with one of these tape decks.

#46 \$14.00
Please add postage for above.
JOHN MESHNA JR.
PO Box 62, E. LYNN, MASS. 01904

SOUND OPERATED SWITCH — JUST 1.25
SMALL P.C. BOARD WITH CRYSTAL MIKE, SCR OUTPUT, & ADJUST SENS ONE TRANSISTOR AMPLIFIER. APPLICATION DATA SUPPLIED

SEVEN-SEGMENT READOUTS	
MAN-3—STRAIGHT LEADS—SUPER-SPECIAL	1.25
MAN-3M—CLAW TYPE	1.75
MAN-4—D.I.P.	2.50
MAN-1—THE REAL THING	3.75
MAN-1A—LATE VERSION	3.95
DL-707—UNIVERSAL LED READOUT	2.75
B7971 HUGE 4"x2" NIXIE BRAND NEW. CLOCK SCHEMATIC INCLUDED	1.50
4 FOR 5.50	6 FOR 7.50
SOCKET FOR B7971 (USED)	.40
DM8880 (DD-700) B7971 DRIVER	1.40

MV-50 LED—RED	6 FOR 1.00
NSL-100 LED—RED	7 FOR 2.00
MV-2 LED—GREEN	3 FOR 2.00

7400 7401 7402 7403 7404 7410 7420	24
7430 7440 7450 7453 7454 7460	24
7441 1.25 7475	90 7496
7442 1.15 7476	65 74107
7446 1.40 7483	1.10 74121
7447 1.40	99 74123
7448 1.25 7490	99 74153
7472 40 7492	99 74154
7473 55 7493	99 74192
7474 55 7495	99 74193

74L00 74L02 74L03 74L10 74L20 74L30 74L51 74L55	40
74L72 74L73 80 74L86	90 74L90 74L93
74L95	1.70

NATIONAL "DM" SERIES	
8820 8830 8090 8091 8092 8093	75
8200 8210 8211 8520 8551 8601 8880	1.40
8570 8590 8123 8810 8812	1.75

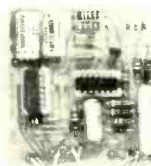
8223 FIELD PROGRAMMABLE 256 BIT ROM	6.95
CUSTOM PROGRAMMING	5.00
8424 LO-POWER DUAL RS/T FLIP-FLOP	10 FOR 5.00
INCLUDES SPECS & MANY APPLICATIONS	22 FOR 10.00
LM308 ULTRA HI-IMPED OP AMP	1.25
LM208 PRECISION ULTRA HI-IMPED. OP AMP	1.75
NE555 TIMER-WITH SPECS & APPLICATIONS	1.20
NE556 DUAL 555 TIMER WITH SPECS & APPLICATIONS	2.00
LM7524 DUAL SENSE AMPLIFIER	1.95
5558 A DUAL 741 OP AMP	.90
NE565 PHASE LOCKED LOOP	2.95
NE566 FUNCTION GENERATOR	2.95
NE567 TONE DECODER	2.95
5314 DIGITAL CLOCK CHIP	9.95

ALL IC'S BY FIRST CLASS MAIL—NO XTRA COST!
JTM ASSOCIATES
P.O. BOX 843 MANCHESTER, MO. 63011

Circle 80 on reader service card

DO YOU OWN A LOW COST SCOPE?

IMPROVE IT!
\$20.00
PREPAID
U S A & CANADA



PROFESSIONAL RESULTS
BUILD AND ADD AN "EASY TO USE VISTA KIT"
ALL SOLID-STATE USING THE LATEST OP-AMP IC'S. PARTS, CONTROLS, ALL SEMI-CONDUCTORS, CIRCUIT BOARD AND INSTRUCTIONS INCLUDED.
VISTA TRIGGER SWEEP GENERATOR

PHOTOLUME CORPORATION
BOX 139 NEW YORK N Y 10016

DIGITAL: THEORY, DESIGN, CONSTRUCTION

LOGIC NEWSLETTER

SAMPLE COPY 1.00
LOGIC NEWSLETTER
POB 252
WALDWICK, N.J. 07463

F.C.C. EXAM MANUAL

PASS FCC EXAMS! Memorize study—Tests Answers for FCC 1st and 2nd class Radiotelephone licenses. Newly revised multiple-choice questions and diagrams cover all areas tested in FCC exams. Plus Self-Study Ability Test \$9.95 postpaid. Moneyback guarantee.

COMMAND PRODUCTIONS P.O. BOX 26348 — E
RADIO ENGINEERING DIVISION • SAN FRANCISCO, CALIF. 94126

BUILD A "SPACE-AGE" TV CAMERA!!

ONLY KNOWN SOLID-STATE CAMERA IN KIT FORM!
Also available factory assembled. Ideal for experimenters, industry, education, etc. High quality performance backed by over seven years of lab and field testing. Fully Guaranteed. Completely self-contained. Connects to any TV set without modification. Easy-to-follow assembly manual. Model XT-1A, Series D complete with vidicon tube \$16.95pp. Many other kits, parts and plans also available.

PHONE or WRITE for CATALOG. DIAL 402-987-3771
BOX 453-RE ATV Research DAKOTA CITY, NEBR. 68731

Digi-Key
DIGI-KEY CORPORATION

Quality Electronic Components

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Temp. range: 40°C +85°C Tolerance: -10 to -50% for more than 4.7 ufd., -10 to -75% for 4.7 ufd or less

Value	1	10-99	100-249	Value	1	10-99	100-249
1 ufd/50V	14c	12c	11c	100 ufd/16 V	19c	15c	14c
2.2 ufd/50 V	14c	12c	11c	100 ufd/25V	24c	18c	17c
3.3 ufd/35V	14c	12c	11c	220 ufd/16 V	24c	18c	17c
4.7 ufd/35 V	14c	12c	11c	220 ufd/25 V	35c	25c	24c
10 ufd/16 V	13c	10c	9c	330 ufd/16 V	35c	25c	24c
10 ufd/25 V	14c	11c	10c	330 ufd/25 V	44c	35c	32c
22 ufd/16 V	14c	11c	10c	470 ufd/16 V	37c	30c	27c
22 ufd/25 V	15c	13c	12c	470 ufd/25 V	49c	39c	35c
33 ufd/16 V	15c	12c	11c	1000 ufd/16 V	49c	39c	35c
33 ufd/25 V	17c	13c	12c	1000 ufd/25 V	75c	60c	55c
47 ufd/16 V	17c	14c	13c	2200 ufd/16 V	75c	60c	55c
47 ufd/25 V	19c	15c	14c	*10 pcs per capacitance value			

1/2 & 1/4 WATT CARBON COMP. RESISTORS

5 each of the 85 standard 10% values (2.2-22M) 1/2 W Resistors (425 pcs)
Sorted by value \$12/set 2-4 are \$11/set 5-9 are \$10/set
5 each of the 70 standard 10% values (10-5.6M) 1/4 W Resistors (350 pcs)
Sorted by value \$12/set 2-4 are \$11/set 5-9 are \$10/set

DIGITAL TTL

7400N	32c	7446N	\$1.30	7496N	\$1.20	
7401N	32c	7447N	\$1.30	74107N	55c	
7402N	32c	7448N	\$1.35	74121N	70c	
7403N	32c	7450N	32c	74122N	72c	
7404N	35c	7451N	32c	74123N	\$1.11	
7405N	35c	7453N	32c	74141N	\$1.61	
7406N	52c	7454N	32c	74153N	\$1.56	
7407N	52c	7459N	32c	74155N	\$1.20	
7408N	36c	7460N	32c	74156N	\$1.58	
7409N	36c	7470N	36c	74158N	\$2.25	
7410N	32c	7472N	40c	74155N	\$1.46	
7411N	35c	7473N	52c	74156N	\$1.17	
7413N	63c	7474N	52c	74157N	\$1.56	
7416N	50c	7475N	85c	74158N	\$1.56	
7417N	50c	7476N	60c	74160N	\$1.95	
7418N	35c	7480N	74c	74161N	\$1.95	
7420N	32c	7482N	\$1.02	74162N	\$1.95	
7423N	75c	7483N	\$1.58	74163N	\$1.95	
7426N	36c	7486N	60c	74164N	\$1.95	
7430N	32c	7489N	\$4.50	74165N	\$2.48	
7437N	51c	7490N	85c	74166N	\$2.03	
7438N	51c	7491N	\$1.37	74180N	\$1.20	
7440N	32c	7492N	85c	74181N	\$3.38	
7441N	\$1.45	7493N	85c	74187N	\$1.17	
7442N	\$1.20	7494N	\$1.20	74192N	\$1.80	
7445N	\$1.62	7495N	\$1.20	74193N	\$1.80	
Discounts offered in quantities					74198N	\$2.78
of 100 pcs TTL in mixed lots					74199N	\$2.78

LINEAR INTEGRATED CIRCUITS

NE555V MiniDIP	\$1.00	723C DIP	\$1.15
NE565A DIP	\$3.57	741C MiniDIP	60c
NE567V MiniDIP	\$3.57	747C DIP	\$1.10
NS558V MiniDIP	95c	748C MiniDIP	60c
709C MiniDIP	44c	Quantity Discounts	

1 AMP SILICON RECTIFIERS

IN4001	50 PIV	10/\$1.00	100/\$7.00	1000/\$60.00
IN4002	100 PIV	9/\$1.00	100/\$8.00	1000/\$70.00
IN4003	200 PIV	8/\$1.00	100/\$10.00	1000/\$85.00
IN4004	400 PIV	7/\$1.00	100/\$11.00	1000/\$95.00
IN4005	600 PIV	7/\$1.00	100/\$12.00	1000/\$105.00
IN4006	800 PIV	6/\$1.00	100/\$13.00	1000/\$115.00
IN4007	1000 PIV	5/\$1.00	100/\$14.00	1000/\$120.00

MOLEX IC SOCKET PINS

100/\$1.00	200/\$1.80	300/\$2.60	500/\$4.20
700/\$5.80	1000/\$8.20	ea addn	1000/\$7.50

DISPLAY DEVICES

5 Volt 7 Segment Tube	\$3.75
Display Kit (Tube+7447+7475+7490)	\$6.15
	3/\$17.50
7 Segment LED (MAN-1 Type)	\$3.50
Display Kit (LED+7447+7475+7490+Resistors)	\$6.50
7 Segment LED (MAN-4 Type)	\$3.50
Display Kit (LED+7448+7475+7490+Resistors)	\$6.50

Also available are Transistors, IC Sockets, Slide Switches, Reed Relays, Heat Sinks and more!
Send for FREE CATALOG or Mail Readers Service Card

C.O.D. ORDERS ACCEPTED FOR SAME DAY SHIPMENT
CALL 218-481-6674

DIGI-KEY

Box 126

Thief River Falls, MN 56701

Circle 81 on reader service card

GREGORY ELECTRONICS
Reconditioned & Used
FM 2-WAY RADIO SAVINGS
Send for New Catalog

Here's a real good buy!

RCA CMFT50 25-54 MHz

Transistorized power supply, partially transistorized receiver, 50 watts, 12 volt, fully narrow banded, complete with accessories...

\$128
less crystals and antenna

GREGORY ELECTRONICS CORP.
251 Rt. 46, Saddle Brook, N. J. 07662
Phone: (201) 489-9000

Paste this inside your medicine cabinet.

Cancer's seven warning signals

1. Change in bowel or bladder habits.
2. A sore that does not heal.
3. Unusual bleeding or discharge.
4. Thickening or lump in breast or elsewhere.
5. Indigestion or difficulty in swallowing.
6. Obvious change in wart or mole.
7. Nagging cough or hoarseness.

If you have a warning signal, see your doctor.

American Cancer Society

BRAND NEW! LOWEST PRICES
GENERAL ELECTRIC 3-WATT **\$2.50**
AUDIO AMP 3 for \$6.00
 Delivers 3 watts continuous, 10 watts peak. With heat sinks, micro-mini size. 8 x 1.8 x 2.7. 9 to 30V supply. High sensitivity input. For mono and stereo phono, tape, FM, AM, TV, servo.

OVER 1,000,000-PC INVENTORY **LIMITED OFFER!**
 "OIP" Packages Buy 3 or more 0% discount
POLY PAKS SMASHES IC PRICES
 * Factory Marked Order by type number! Spec sheets on request * ONLY

WORLD FAMOUS SEMI-KON Dollar Stretchers

- 2-2N5296 35-WATT NPN PLASTIC TRANSISTORS, for NE-540 \$1.
- 2-2N6109 40-WATT PNP PLASTIC TRANSISTORS, for NE540 \$1.
- 10-1N82 GERMANIUM UHF diode, clip-in type* \$1.
- 5-5CR5 7-AMP TO-220 PRV 100 power tab \$1.
- 10-MOS FETS 3N187, 2N200, 3N128, TO-18, Fairchild* \$1.
- 5-SCRS & TRIACS up to 25amps, 6-12-24 prv, studs too \$1.
- 2-2N3819, Texas, N channel, 6500 umho TO-18 \$1.
- 2-2N2646 UNIUNCTIONS, plastic transistors, Texas \$1.
- 5-2N107, GE, most commonly used npn, germanium \$1.
- 50-SILICON, GE, most commonly used, computer, axial leads* \$1.
- 50-GERMANIUM, glass rectifiers, signal, axial leads* \$1.
- 5-2N170, GE, RF, germanium, npn, transistors, TO-22 \$1.
- 3-1AMV 1000-1V, epoxy, submini, silicon rectifiers \$1.
- 30-500W ZENERS 1.6, 9, 10, 12V rectifiers \$1.
- 4-2N3055, HOBBY, 40W npn silicon transistors, TO-3 \$1.
- 30-3-AMP RECTIFIERS, silicon, epoxy, assorted V, axial* \$1.
- 20-HEAT SINKS for all types of TO5 trans, makes 'em high power \$1.

Type	Sale	Type	Sale	Type	Sale	Type	Sale
SN7400 \$0.24	SN7432 .35	SN7471 .55	SN74108 .95	SN74161 1.59	SN74162 1.59	SN74163 1.75	SN74164 2.10
SN7401 .24	SN7437 .49	SN7472 .41	SN74112 .95	SN74165 2.10	SN74166 2.10	SN74167 1.85	SN74168 1.85
SN7402 .24	SN7440 .52	SN7473 .49	SN74113 .95	SN74169 2.10	SN74170 2.10	SN74171 1.85	SN74172 1.85
SN7403 .24	SN7441 1.19	SN7474 .49	SN74114 .95	SN74173 1.85	SN74174 2.20	SN74175 2.60	SN74176 1.85
SN7404 .24	SN7442 1.12	SN7475 .55	SN74115 .95	SN74177 1.85	SN74178 1.85	SN74179 1.85	SN74180 1.10
SN7405 .26	SN7443 1.12	SN7476 .55	SN74116 .95	SN74181 4.10	SN74182 1.55	SN74183 2.50	SN74184 2.50
SN7406 .45	SN7444 1.25	SN7477 .83	SN74117 .61	SN74185 2.50	SN74186 1.55	SN74187 1.55	SN74188 1.55
SN7407 .49	SN7445 1.19	SN7478 .85	SN74118 .69	SN74189 1.50	SN74190 1.50	SN74191 1.50	SN74192 1.50
SN7408 .27	SN7446 1.29	SN7479 .99	SN74119 .61	SN74193 1.50	SN74194 1.50	SN74195 1.50	SN74196 1.50
SN7409 .28	SN7447 1.29	SN7480 .65	SN74120 .61	SN74197 1.12	SN74198 1.25	SN74199 1.25	SN74200 2.95
SN7410 .24	SN7448 1.25	SN7481 1.25	SN74121 .69				
SN7411 .31	SN7449 1.35	SN7482 .99	SN74122 .61				
SN7413 .89	SN7450 1.35	SN7483 1.15	SN74123 .69				
SN7415 .49	SN7451 1.35	SN7484 1.15	SN74124 1.45				
SN7416 .49	SN7452 1.35	SN7485 1.15	SN74125 1.05				
SN7417 .49	SN7453 1.35	SN7486 .49	SN74126 1.45				
SN7420 .24	SN7454 1.35	SN7487 1.49	SN74127 1.45				
SN7421 .55	SN7455 1.35	SN7488 1.49	SN74128 1.45				
SN7422 .50	SN7456 1.35	SN7489 1.49	SN74129 1.45				
SN7423 .33	SN7457 1.35	SN7490 3.10	SN74130 1.25				
SN7430 .24	SN7458 1.35	SN7491 1.35	SN74131 1.00				
	SN7459 1.35	SN7492 .85	SN74132 4.95				
	SN7460 1.35	SN7493 .85	SN74133 4.95				
	SN7461 2.7	SN7494 1.05	SN74134 1.69				
	SN7462 35	SN7495 1.00	SN74135 1.29				
	SN7463 35	SN7496 1.00	SN74136 1.45				
	SN7464 35	SN7497 1.00	SN74137 1.45				
	SN7465 35	SN7498 1.00	SN74138 1.45				
	SN7466 35	SN7499 1.00	SN74139 1.45				
	SN7467 35	SN7500 1.00	SN74140 1.85				
	SN7468 35	SN7501 1.00					
	SN7469 35	SN7502 1.00					
	SN7470 35	SN7503 1.00					

1-2N3055 npn, 100W, 16A, TO-3, transistor \$1.
5-ER900 TRIGGER DIODES for SCRs & Triacs \$1.
2-FET'S 2N5457 N channel 6000 umho, TO-92 plastic \$1.
10-1N914 fast switch diodes, silicon, 4 nanoseconds \$1.
2-6 AMP TRIAC 200 PRV TO-6 \$1.
40-1JT MICRO MINI RECTIFIERS silicon porcelain to 1KV* \$1.
30-WORLD'S SMALLEST RECT. & zeners, 1W, assorted volts* \$1.
4-2N4269 Nixie tube driver transistors 100V, npn \$1.
2-PNPNs, prog. uni-transistors, 100V to GE-D13 \$1.
2-6000 PIV 50 mil epoxy rectifiers, axial leads* \$1.
10-BENDIX 25 WATT "pellet" power transistors, silicon* \$1.
1-PHOTO ELECTRIC FET, 10,000 umho, n channel \$1.
4-80 WATT, 2N1488, silicon, TO3, 60 Vcc, npn \$1.
4-1000 WATT DARLINGTON Transistors, TO-18 case \$1.
4-2N5296 HOBBY, 35 watts, plastic powers, NPN \$1.
4-2N6109 HOBBY, 40 watts, plastic powers, PNP \$1.
5-PLASTIC 35W powers, npn, silicon, hobby 2N6121 \$1.
5-PLASTIC 35W powers, npn, silicon, hobby 2N6124 \$1.
2-MOS FETS, N channel 10K umho 3N128, TO-18, RCA \$1.
2-MOS FETS, DUAL GATE, N chan. 3N187, TO-18, RCA \$1.
2-MOS FETS, DUAL GATE, N chan. 3N140, TO-18, RCA \$1.
1-RCA 2N3600 NPN, UHF transistors, 10-100, 1000mc \$1.
1-300V PLASTIC POWER TAB transistors, 6A \$1.

IC'S FOR EXPERIMENTERS
 Money Back Guaranteed! Factory Marked! \$1.00

SN7400	20 for \$1.	SN7475	5 for \$1.
SN7401	20 for \$1.	SN7476	10 for \$1.
SN7402	5 for \$1.	SN7490	5 for \$1.
SN7403	5 for \$1.	SN74107	10 for \$1.
SN7404	5 for \$1.	SN74121	10 for \$1.
SN7405	5 for \$1.	SN74123	10 for \$1.
SN7406	5 for \$1.	SN74145	5 for \$1.
SN7407	5 for \$1.	SN74181	5 for \$1.
SN7408	5 for \$1.	SN74192	5 for \$1.
SN7409	10 for \$1.	SN74193	5 for \$1.
SN7474	10 for \$1.		

SALE! 6 AMP QUADRACS *With jumbo "Top Hat" heat sink
 PRV SALE
 25 \$.88
 50 1.25
 100 1.95
 200 2.49
 400 2.98
 600 3.50
 800 3.98
Money-Back GUARANTEE on all items

I.C. & LED HOBBY-ONICS

- 3-1-WATT AUDIO AMPLIFIERS, Westinghouse, TO-5 \$1.
- 15-709 HI-PWR OP AMP, TO-5, 100% good \$1.
- 50-710-711 HI-PWR COMPARATORS, untested \$1.
- 4-DUAL 709, dip pak, op amps, untested \$1.
- 10-RCA CA-3000 OP AMPS, TO-5 case \$1.
- 5-723 VOLTAGE REGULATORS, TO-5 \$1.
- 4-PHASE LOCK LOOPS, hobby, 565, 560, 561* \$1.
- 10-TO-5 Case 536, 540, 566, 567, 741* \$1.
- 10-LINEAR AMPS, 709, 710, 711, 741, TO-5 \$1.
- 10-709 LINEAR AMPS, 741's too, DIP'S \$1.
- 5-HOBBY MEMORY CELLS, SN7481, up to 16-cell, DIP \$1.
- 5-MOS REGISTERS, 301 series, TO-5, 100% DIP'S \$1.
- 10-C-MOS IC'S, 74C and CD-1000 series, DIP pak \$1.
- 10-MINI DIPS, OP AMPS, 709, 741, 301, 307, hobby \$1.
- 3-VOLTAGE REGULATORS, LM309K, hobby, TO-5 \$1.
- 10-SIGNETIC OP AMP, 531, 533, 536, 550, 555, DIP'S, TO-5 \$1.
- 1-531-14 CLOCK ON A CHIP, 4-or-6 digit, 24-or-28 pin \$1.
- 1-CALCULATOR CHIP, 10-pin, 40 pins \$1.
- 1-2516 CHARACTER GENERATORS, hobby, for MAN-2 \$1.
- 1-2513 CHARACTER GENERATOR, hobby, for MAN-2 \$1.
- 10-NATIONAL 301 and 307 HOBBY OP AMP SPECIAL TO5 \$1.
- 15-NATIONAL & SIGNETIC TTL dip special, all marked \$1.
- 5-LM-300 Super 723 manufacturers' fallouts, u test 'em \$1.
- 5-IBM HI-PWR many pin fallouts from computers \$1.
- 1-AM RADIO-ON-A-CHIP, by Sprague, OIP, u test 'em \$1.
- 1-DUAL 2-WATT "Stereo-Amp-On-A-Chip", fallout (Sprague, West) \$1.
- 4-SPERRY SP332, twin digit, factory rejects, .33" charac, no test \$1.
- 2-OP04A HI-PWR MAN-5, 741 charac, 1-or-more segs missing \$1.
- 1-OPCOA SLA-3H*, 0.7 charac, readout, 1-or-more segs missing \$1.
- 5-MONSANTO opto isolators, no test, 1500V \$1.
- 10-LED HOBBY SURPRISE, asst. types, factory rejects, no test \$1.
- 2-OPCOA HI-PWR MAN-5, 741 charac, 1-or-more segs missing \$1.
- 2-MONSANTO MAN-4, 1.2" charac, 1-or-more segs missing, red \$1.
- 5-MONSANTO MAN-3, 1.2" charac, 1-or more segs missing, \$1.

* Reflective bar segments, while MONSANTO all LED segments.

"C-MOS" IC CIRCUITS

74C00	\$.77	RCA TYPE "C-MOS" IC'S	Sale
74C04	.95	CD4001AE	\$.61
74C10	.77	CD4002AE	.61
74C20	.77	CD4009AE	.61
74C42	1.95	CD4010AE	.61
74C73	1.50	CD4011AE	.61
74C74	1.30	CD4012AE	.61
74C76	1.50	CD4013AE	1.62
74C107	1.25	CD4019AE	1.62
74C151	1.95	CD4023AE	.61
74C154	1.95	SN7494	1.05
74C157	1.95	CD4035AE	.59
74C160	2.95	CD4038AE	3.25
74C162	2.95		
74C163	2.95		
74C198	2.75		

"AEROSPACE" BABCOCK & LEACH CRYSTAL CAN RELAYS
 All hermetically sealed Submini, 1/8", half, and full crystal can types in 6-12-24V in ass't contacts up to 4PDT 1 amp up to 10 amps. Such types as BR-60, 11, 10, 14, 16, 24, etc. Noryl, no choosing voltages or types. From factory mixtures to your Good asst. if you are unaccustomed, at low prices.

12 for \$3.50

INTEGRATED CIRCUIT SOCKETS

14-Pin, DIP	\$.45
14-Pin, Wire Wrap	\$.59
14-Pin, Side Mount	1.00
14-Pin, DIP	1.00
TO-5, 8 or 10-Pins	.29

Buy Any 3 Take 10% Discount!

8-TRACK CAR RADIO STEREO TAPE TRANSPORT 8.88
 8-Track tape transport with complete stereo playback system tests and amplifier. Operates off 12 VDC Wov & flutter proof. Use 730 preamp & ready to go. Uses 8-track tape. W. 4-lbs.

Potter & Brumfield KAP RELAYS
 Your choice 3 for \$7.50 **\$2.98**
 115 VAC 3PDT 12 VDC 3PDT

Excellent for "HAM" use as antenna switching, latching, transmit, receive, etc., and 100's of commercial or industrial uses. Includes plastic dust-cover with diagram and hookup info, 11-pin plug-in base. Contacts movable gold flashed silver, stationary overlay, with silver cadmium oxide movables. All contacts 10 amp 3PDT. Coil data, 115VAC 2250 ohms, 17.5 ma, 12 VDC 21 ohms 168 ohms. Size: 2 3/4" x 1 5/16" Wt. 4 ozs. Center pin missing. Comar Mfg. type equal too.

NATIONAL 'OP' AMPS

Type	BUY ANY 3 - TAKE 10%	Sale
LM-300	Super 723 V. reg.	\$0.91
LM-302	Hi-performance V. reg.	1.19
LM-303	Voltage follower	.91
LM-307	pos. V. reg.	1.19
LM-307	Super 741	1.19
LM-308	Hi-Q Fet Type Op Amp	.41
LM-309H	SV 200 mil V. reg.	1.19
LM-309H	1-amp V. reg.*	1.19
LM-311	Comparator	1.85
LM-319	Hi-Speed Dual comp	1.19
LM-320	Minus 5V 1-amp V.R.*	1.98
LM-320	Minus 15V 1-amp V.R.*	1.75
LM-320	Minus 15V 1-amp V.R.*	1.75
LM-350	Dual peripheral driver	1.75
LM-370	AGC squelch op amp	1.41
LM-371	R-F, I-F, op amp	1.19
LM-373	AM-FM, SSB, I.A.D.	1.25
LM-374	AM-FM, SSB, I.VAD	3.75
LM-380	2-watt audio amplifier	1.25
LM-3028	Differential RE/IF amp	1.69
LM-3070	Chrome regenerator	1.00
LM-371	TV chroma IF amp	1.00

*TO-3 case, -others TO-5

LINEAR Op Amps *FACTORY MARKED

531	Hi slew rate op-amp (TO-5)	\$2.50
532	Micro power 741 (TO-5)	2.50
533	Micro power 709 (TO-5)	2.50
536	FET input op amp (TO-5)	2.95
550	Precision 723 voltage reg. (DIP)	1.17
553	Timer 2 u Seconds to 1 hr. (A)	2.10
556	5 Times faster than 741C	2.10
558	Dual 741 (A)	1.00
560	Phase lock loops (DIP)	2.95
561	Phase lock loops (DIP)	2.95
562	Phase lock loops (DIP)	2.95
565	Phase lock loops (A)	2.95
566	Function generator (TO-5)	2.95
567	Tone decoder (A)	2.95
702C	Hi-grain, DC amp (TO-5)	4.40
703C	RF-IF, amp, 14 ckts (TO-5)	.69
704	TV sound IF system	1.50
709C	Operational amp (A)	.33
710C	Differential amp (A)	.47
711C	Dual diff. comp (A)	.47
723C	Voltage regulator (A)	.75
733	DIF. Video Amp	1.75
740C	Frequency compensator 709 (A)	.44
741CV	Freq. comp 709 (Mini DIP)	.49
747C	Dual 741C (A)	.89
748C	Freq. adj. 741C (A)	.69
753	Gain Block	1.75
759	7339 Dual stereo preamp	1.98
741-741	Dual 741C (TO-5)	.89
PA265	5-Watt voltage regulator	1.50
ULN2300M	Op amp with SCR	1.50
CA3065	Video Audio system	6.50
75451	Dual peripheral driver	1.05
75453	Dual peripheral driver	.44
75491	Quad seg driver for LED readouts	1.65
75492	Hex driver w/col. out 250 ma. 1.85	

BUY ANY 3 TAKE 10%
 (A) TO-5 or DIP dual in line pak

HI-FI 1" SQUARE MINI METERS 3 for \$7.75 **\$1.49**
 * Plastic case * Red needle indicators
 YU, front mtg, plus 3 minus 20 db.

"MEMORY LANE" Buy Any 3 Take 10%

1101	256 Bit RAM MOS	\$2.50
1103	1024 Bit RAM MOS	7.50
7481	Character Gen. ROM	7.50
8223	64 Bit RAM TTL	12.50
8223	Programmable ROM	3.25
MMS260	1024 Bit RAM	6.50
MMS262	2048 Bit RAM	7.95
		9.95

GENERAL TELEPHONE DATA ENTRY KEYBOARD
 Used in calculators, touch-tone, encoding, programming devices, 10 PUNCHES, BUTTONS, 10 to 91 KEYS, SWITCHES. All switches have 2 separate poles & 6 separate buses - totalling 6 buses & 24 poles. Any combination of which can be used! Size: 3x2 1/2x1 1/2. Easy for panel mtg. too. **\$8.88**

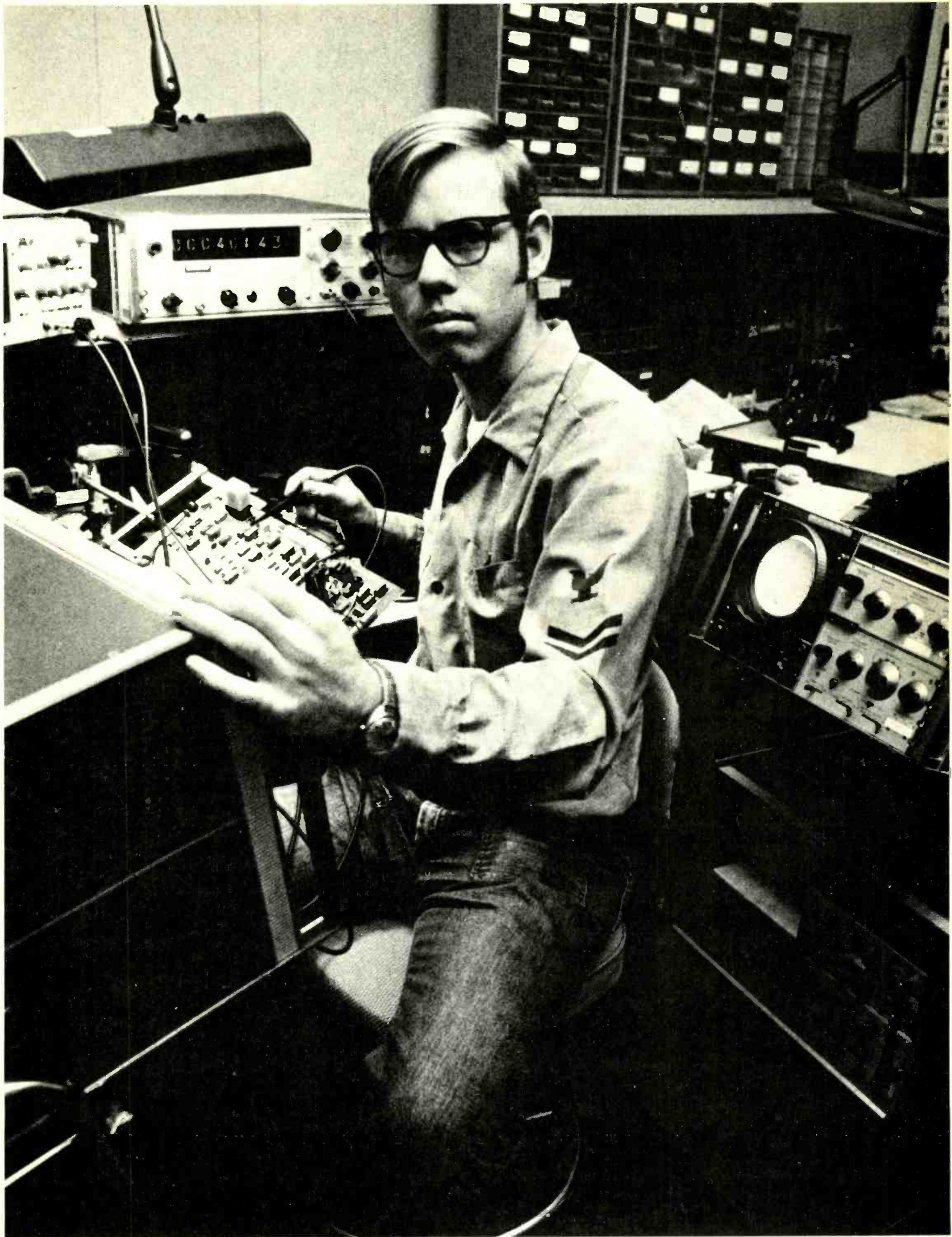
SILICON CONTROL RECTIFIERS

PRV	1A	3A	8A**	25A*	100A*	250A*
15	\$.15					
30	.25	\$.39	\$.55	\$.95	\$2.25	\$5.50
60	.39	.52	.60	1.25	2.95	6.95
100	.49	.69	.89	1.95	3.95	8.50
200	.69	.89	.69	1.25	2.95	6.95
400	.95	1.19	1.25	2.50	5.95	10.50
600				1.50	2.95	7.95

*Stud. **Plastic, power tab. Others TO-18,5.

HIGH POWER STUD RECTIFIERS

PIV	50A	250A
50	\$.69	



Ken Fransen is using his electronics training where it really counts.

Helping to save lives in the U.S. Coast Guard.

It's up to Ken to keep sophisticated electronics communications equipment in top condition.

He's part of our lifesaving team. We count on Ken and need more people like him.

You may or may not have electronics training. If, like Ken, you have training, we'll put you to work fast, on a rewarding job with responsibility and challenges. If you don't have training, we'll train you.

Say your experience goes no further than building a crystal radio set. If you have an aptitude for electronics and qualify, we'll guarantee you 25 to 38 weeks of school and turn you into a seasoned professional who'll be able to troubleshoot the most complex electronics equipment. You'll study everything from theory and principle to practical application.

Those of you who already know your way around electronics systems may qualify for our advanced promotion program. After only ten weeks, you'll be promoted immediately to a higher pay grade (up to 2nd class petty officer with pay of over \$400 a month, plus food, housing and medical care). And you may qualify for even more advanced training.

Either way, your job as a Coast

Guard electronics technician will give you a broad range of experience. Using the most modern diagnostic tools, you'll maintain, repair and calibrate the latest electronics equipment, including LORAN transceivers, computer controlled transmitters, solid state equipment and AM, FM and SSB transceivers.

You might even qualify to help design, test and evaluate new equipment or prototype models in our research laboratories, or work on cesium and rubidium atomic clocks.

You'll be doing plenty for yourself, too. The training alone is worth thousands of dollars, and the skills you learn can lead to valuable, sought-after jobs in both the Coast Guard and civilian life.

What's more, the Coast Guard offers you a combination of pay and benefits most private companies can't match. (For more about our package of benefits, read the attached card.)

Find out more about a rewarding career in electronics. Mail us the card today.

**Help others/Help yourself.
Join the lifesavers.
The Coast Guard.**

MARKET CENTER

CONVERT TV TO NEW! 6 FT. WIDE SCREEN!
Easy Do-It-Yourself Kit
 Project a giant 5'x6' picture onto wall or screen. B&W/Color. Kit contains detailed plans, Inst. and Precision Lens System. Only \$1295 ppd., or write for free illustrated details. **The Macrocam Co., Dept. FD** Washington Crossing, PA 18977
Guaranteed to Work!

Technical Excellence in Electronics.

On our small, friendly campus the emphasis is on living as well as Learning. Extra-curricular social activities, student clubs, a student operated radio station, student government, new dormitory and a full sports program help provide a world of your own in which to prepare for tomorrow. Associate Degree in Engineering Electronics. B.S. obtainable. G.I. approved.



VALPARAISO TECHNICAL INSTITUTE
 Dept. C, Yellowstone Trail, Valparaiso, Indiana 46383

ELECTRONIC music synthesizer. Printed circuit boards and kits. Satisfaction guaranteed. Free information. **UNDERWATER LABORATORIES**, Box 25066, Northgate Station, Seattle, Wash. 98125

ELECTRONIC slot machine type game. Plans \$5.00. **KAB**, 1923 Fern, Royal Oak, Mich. 48073

BURGLAR-fire alarm catalog. Wholesale supplies for home do-it-yourselfers. From the simplest to professional—alarm parts and tools. Free catalog. **WHOLESALE SECURITY DEVICES**, 2145 West 8 Mile, Detroit, Mich. 48219

AIRCRAFT type headset with tube loaded mike for CB walkie-talkies only \$9.95, literature 25c refundable. Dept. R, **CAMPBELL & COMPANY**, Box 91654, Los Angeles, Calif. 90009

MANUALS for Govt. surplus radios, test sets, scopes. List 50c. **BOOKS**, 7218 Roanne Drive, Washington, D. C. 20021

TRANSISTOR curve tracer, \$10.95, guaranteed one year. **APPALACHIAN TECHNICAL**, Box 8512, Asheville, N.C. 28804

1/2-WATT resistors all values 2 cents, minimum \$2.00. **LECTRONIX**, Box 1067, Southgate, Mich. 48195

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.

IBM COMPUTER POWER SUPPLY

- (ITEM #22-934-XYZ) - Expensive, regulated unit. Fine for college labs, research C.R.S. service shops, etc. Pure DC over a wide range of voltages. DC output voltages 6, 12, 38, etc. Wide range of AC voltages available.
- Finest transformers, filters, transistor load regulation system, independent of line voltage fluctuations. Contains five separate rectifier systems. Unit is furnished without small "regulating card" which can be easily made or can be by-passed. Data and circuit diagrams furnished. 7 1/2" x 12" x 1 1/2" (1.25 lbs.)

Cost Gov't Over \$500.00 **\$26.95**
ONCE-IN-A-LIFETIME SPECIAL

BURGLAR-FIRE ALARM SYSTEM

- (ITEM #1135-A) - Dual alarm system gives warning of fire or break-in. Operates on 115V AC. Control unit, 2-kilohm flash fire, 2-meter column, 3-door window detectors, alarm bell, 100 ft. wire, instructions. 8 1/2" x 5 1/2" x 3" (7 lbs.)

\$39.95

STANDARD DIAL TELEPHONE

- (ITEM #715) - Standard, commercial telephone same as used throughout U.S. Attractive polished black, 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 \$24.50 **\$8.79**

STEP-BY-STEP TELEPHONE SWITCH

- (ITEM #738) - Amazing "up-and-around" switch. Great experimental item when used with two-wire telephone dial will select any number from 0 to 100. Make intercom or private system. Use to turn on remote lights, start motors, etc. Complete with contact bank. 13 1/2" x 6 1/2" x 5 1/2" (18 lbs.) Cost Over \$90.00

\$8.95

Telephone dial for use with above switch (when purchased) same item as switch. Order as: T11W-T11W-V. Only **\$1.97**

MAGNETIC DIGITAL COUNTER (12 to 18-VDC)

- (ITEM #21-955) - Use to count electrically. Use to count number of times door is opened after business is closed, to show changing prices, laboratory uses, etc. Will count 1 for each pulse and will transfer 10th count to next unit. 4 1/2" x 1 1/2" x 1 1/2". Orig. Cost Over \$15.00 **\$1.99** Unit Four **\$4.99**

200 AMP., 50 VOLT, SILICON DIODE

- (ITEM #22-853) - A Four Star Buy! New, leading make. Heavy duty units excellent for use in 12 or 24-volt fast chargers, high current power supply systems, etc. 2 1/2" x 1 1/2" x 1 1/2" - 16 S.M. mounting threads. (1 lb.)

List Over \$15.00 **\$4.98**

AC PROGRAM TIMING CLOCK

- (ITEM #158) - Zenith 115-VAC unit. Use for periodic scheduling work, classes, gym, radio, etc. No. 1 plug permit ON-off switching any time in 24-hour period. Also has "skips-a-day" feature. Can be multiple programmed. 15 amp. contacts. 8 1/2" x 6 1/2" x 4 1/2" (8 lbs.)

Cost Gov't Over \$100.00 **\$15.75**

SNAP AROUND VOLT-OHM-AMMETER

- (ITEM #21-844) - Measures AC current without opening the line. Simply press handle and snap the probe around the conductor. Reads currents from .25 to 1250 amps. Reads voltages in 300, reads ohms up to 300. Test motors, appliances, etc. Three current ranges, two voltage ranges. With case. Test leads. 7 1/2" x 3" x 1 1/2" (2 lbs.)

\$39.95

SPECIAL SALE Correspondence Course In ELECTRICAL ENGINEERING

- (ITEM #9-181) - Obtain technical training at low cost! Lincoln Engineering School has suspended its Correspondence Courses because of rising costs. A limited number of Electrical Engineering Courses are available, but without the examination grading service. The course consists of 15 lesson books, each with associated exams and standard answers. Book describing prize winning Home Experimental Laboratory Bench furnished at no extra cost.

\$8.79 Prepaid in U.S.A.
\$10.79 Outside U.S.A.

RUNNING TIME METER

- (ITEM #2188) - Record number of operating hours of electric lights and electrical devices such as refrigerators, furnaces, etc. Records total hours, tenths and hundredths up to 9,999.99 hours. For 115-volt, 60-cycle. Size 4 1/2" x 3 1/2" x 2 1/2". Shipping weight 2 lbs.

\$4.39 Cost Over \$29.00

COMPUTER TRANSISTORS ON HEAT SINKS

IBM Computer Quality Units

- (#22-828) - Unit consists of one 150-watt power transistor on 100-gram ribbed aluminum heat sink. Many experimental uses. (1 lb.) Cost Gov't Over \$10.00 **\$1.98**
- (#22-918) - Unit consists of two 150-watt power transistors, 2-pin silicon diodes, capacitors, resistors, etc. on heavy ribbed aluminum heat sinks. Ideal for use as motor speed control. (4 lbs.) Cost Gov't Over \$35.00 **\$4.91**

SLA-37 segment LED readouts .77" numbers. 45 Ma/seg., red or yellow **\$7.95**

MINIATURE TRIM POTS 5K, 10K, 20K, 25K, 50K, 100K, **\$1.75** 3/\$2.00

MULTI-TURN TRIM POTS Similar to Bourns 3010 style 3/16" x 5/8" x 1 1/4" 50, 100, 500, 2000, 5000, 10,000 and 20,000 ohms. **\$1.50 ea.** 3/\$4.00

PRINTED CIRCUIT BOARD 4 1/2" x 6 1/2" double sided fiberglass board, 1/16" thick, un-etched **\$.60 ea.** 5/\$2.50

NIXIE TUBES Similar to Raytheon 8650 tubes, with socket & data sheet **\$2.25** 3/\$6.00

TIS 73 N FET **\$.60**
 2N4891 UJT **\$.50**
 ER 900 TRIGGER DIODES 4/\$1.00

VERIPAX PC BOARD This board is a 1/16" single sided paper epoxy board. 4 1/2" x 6 1/2" (standard veripax), DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16 or LSI DIP IC's with buses for power supply connections. Is also etched for 22 pin connector. **\$5.25**

FLV 100 Visible LED... \$.50
 ME-4 IR LED... \$.50
 MV5026 Vis. LED... \$.50
 MT-2 PHOTO TRANS... \$.80
 MCT-2 OPTO-ISOL... \$.90
 MCD-2 OPTO-ISOL... \$.90
 Green GAP OSL-16 LED... \$.90
 Red GAP OSL-3 LED... \$.60
 Hi intensity VIS. Red with reflector... \$.60
 MCA 2-30 photo darlington relay... \$.90
 14 PIN DIP SOCKETS... \$.40
 Silicon Power Rectifiers

PRV	1A	3A	12A	50A
100	.06	.11	.30	.90
200	.07	.16	.35	1.25
400	.09	.20	.50	1.50
600	.11	.25	.70	1.80
800	.15	.35	.90	2.30
000	.20	.45	1.10	2.75

Terms: FOB Cambridge, Mass. Send check or Money Order. Include Postage. Minimum Order \$3.00

Send 20c for our Spring catalog featuring Transistors and Rectifiers; 325 Elm St., Cambridge, Mass.

TRANSISTOR SPECIALS

2N3772 NPN Si TO-3	\$1.25
2N1137B NPN GE TO-3	\$.95
2N3137 NPN Si TO-5	4/\$1.00
MPS3393 NPN Si TO-92	4/\$1.00
2N3666 NPN Si TO-5	\$.75
2N3824 PNP GE TO-3	\$1.50
2N2369 NPN Si TO-18	5/\$1.00
2N3767 NPN Si TO-66	\$.70
2N2222 NPN Si TO-18	5/\$1.00
2N3055 NPN Si TO-3	\$1.00
2N5296 NPN Si TO-220	\$.50
2N6109 PNP Si TO-220	\$.55
2N4898 PNP Si TO-66	\$.60
MJ2252 NPN Si TO-66	\$.90
2N3638 PNP Si TO-5	5/\$1.00
2N2218A NPN Si TO-5	4/\$1.00

CAPACITORS

6V 30 UF TANT 5 \$1	
20V 4.7UF TANT 5 \$1	
12V 10UF ELECT 5 \$1	
50V 100UF ELECT \$.40	
25V 30UF ELECT 4/51.00	

MAN-1, RED OR YELLOW LED READOUT... **\$3.25**
MAN-3 LED READOUTS \$1.75
MAN-4 LED READOUTS \$2.50

Conductive Elastomer low profile calculator keyboard. A 2 3/4" x 3 3/4" x 1/2" flex key. 195K-6 keyboard having 0-9, a K-C buttons with off, on switch. **\$6.50**

TTL IC SERIES

7400-.50	7476-.75
7400-.28	7480-.70
7401-.28	7483-1.25
7402-.28	7486-.50
7403-.28	7490-1.50
7404-.33	7491-1.30
7405-.30	7492-1.30
7407-.50	7493-1.30
7408-.32	7495-1.30
7410-.28	7496-1.10
7411-.32	74107-.75
7412-.45	74121-.70
7413-.85	74123-1.10
7416-.50	74125-1.50
7417-.50	74126-1.50
7420-.28	74151-1.25
7422-.32	74154-1.95
7426-.35	74157-1.50
7427-.55	74164-2.20
7430-.28	74165-2.20
7437-.60	74173-2.20
7438-.55	74176-1.95
7440-.28	74177-1.95
7441-1.50	74192-1.75
7442-1.50	74193-1.75
7445-1.50	74195-1.50
7446-1.50	75451-1.00
7447-1.50	75452-1.00
7448-1.50	75491-1.10
7450-.28	8210-1.50
7451-.33	8211-1.50
7472-.50	8220-1.50
7473-.60	8520-1.75
7474-.50	8520-1.75
7475-1.00	LM 351-1.00

Similar to 8038C IC Voltage controlled oscillator, as featured in Oct. 73 P.E. they have sine, square and triangular outputs good to 1MHz. Two of them can be used to make an FM generator... **\$5.95**

C/MOS (DIODE CLAMPED)

CD 4001	\$.65
CD 4002	\$.65
CD 4009	\$1.50
CD 4010	\$.65
CD 4011	\$.65
CD 4012	\$.65
CD 4013	\$1.60
CD 4025	\$1.50
CD 4016	\$.65
CD 4030	\$.65

Full Wave Bridges

PRV	2A	6A
200	95	125
400	115	150
600	135	175

Injection laser—a single diode 6W, 25A Ga As unit similar to RCA 40B59 **\$10.95**

Dual tapered CdS photo cell used for optical alignment with a single plane lens. (Not included). **\$.95**

ASC II ENCODED TERMINAL KEY BOARDS **\$60.00**

LINEAR CIRCUITS

LM309K 5V 1A regulator	\$2.25
536 FET input oper amp	\$3.25
537 Precision 741	\$2.50
560 phase lock loop	\$2.95
561 phase lock loop	\$2.95
565 phase lock loop	\$2.95
567 Tone decoder	\$2.95
703 RF-IF amplifier	\$.80
Dual 709	\$.95
709C operational Amp	\$.47
723 Regulator	\$.75
741 operational Amp	\$.47
747 Dual 741	\$.25
LM 308 oper amp	\$.50
101 oper amp	\$.75
741A oper amp	\$.47
320 5V reg.	\$.75
320 15V reg.	\$.75
748 oper amp	\$.95
LM 300H—Vol. reg.	\$.25
LM370—AGC squelch oper amp	\$.25
LM 380—2 W audio amp	\$.75
555—2uS-2hr timer	\$.140
LM 3900—QUAD Oper Amp	\$.149
3822 Transistor Array	\$.95
LM 311—comparators	\$.50

TRIACS

PRV	1A	10A	25A	1.5A	6A	35A
100	40	70	1.30	40	50	1.20
200	70	1.10	1.75	60	70	1.60
400	1.10	1.60	2.60	1.00	2.0	2.20
600	1.70	2.30	3.00			3.00

SOLID STATE SALES
 Post Office Box 74D Somerville, Mass. 02143 Tel. (617) 547-4005

SURPLUS CENTER
 ALL ITEMS SHIPPED F.O.B. LINCOLN, NEBR.
 Order Direct From Ad. Money Back Guarantee.
 DEPT. RE-044 LINCOLN, NEBR. 68501

SANKEN HYBRID AUDIO POWER AMPS

Used extensively in hi-fi systems, tape decks, FM tuners, record players, stereo components, musical instruments, P.A., etc. All amplifiers, flat within 1/2 db from 20 to 100,000. Each unit properly heat-sinked, with heavy-duty connecting tie lug connections. Single-ended pushpull output. Power supply required. 2 WDC Output to 8 ohms.

Mfg's Type	Watts	Sale
SI-1010Y	10	\$ 8.88
SI-1025E	25	18.88
SI-1050E	50	29.95

Order by Stock No.

CLOCK RADIO TIMERS

Basic movement for all clock radios, by "Session" or "Teletron". Plus devices ON. Design your own "timing" opt. 0-to-24 hrs. 115/170 Hz. Switch rated at 5 amps. With hookup.

Removed from new equipment! Includes popular 2N174 "doorknob" transistor, TO-36, germanium, PNP, 150 watts, VFO 80V, 15 amps, 10 life. For ignition, high power transmitters, etc. Mounted on heat sink 3 x 2 1/2 x 1 1/4"

\$1.49

HIGH POWER TRANSISTOR WITH HEAT SINK

3 for \$3

Put Your Trust in Poly Pak's Money-Back Guarantee!

Opto Electronics Sale

LIGHT EMITTING DIODE GaAs INDICATORS

4-MV1, amber, visible jumbo epoxy lens upright	1.00
1-MV2, TO-18, dome, green, visible	1.00
1-MV2, green small dome, green diff. lite	1.00
1-MV2, clear small plastic dome, green diff. lite	1.00
1-MV3, micro-mini pin head dome, TO-18, green lite	1.00
4-MV3, visible, "coax pin pak", red, mini dome lens	1.00
1-MV4, stud, high power, red, 2-watts	3.95
1-MV4H, stud, high power, hi-dome, red, 2-watts	3.95
4-MV10B, visible, red, clear dome lens TO-18	1.00
4-MV10C, visible, red, diffused, dome lens, TO-18	1.00
4-MV50, axial leads, micro-mini dome, clear, red, TO-18	1.00
1-MV52, micro-mini, axial green lens, green lite	1.00
1-MV53, micro-mini, axial yellow lens, yellow lite	1.00
4-MV54, micro-mini, axial leads, red lens, red lite	1.00
4-MV55, micro-mini, axial leads, red lens, red lite	1.00
4-MV5012, red small dome lens, red lite, TO-18	1.00
4-MV5013, sm. dome, 2 hi red dome, soft red diff. lite, TO-18	1.00
4-MV5020, jumbo clear dome, visible, red, TO-18	1.00
1-MV5040, 4-LED red array, with 5-lead pak	1.49
4-MV5054, red jumbo dome lens, TO-18 red lite, upright	1.00
4-MV5080, TO-18, micro-mini red dome, red lite	1.00
4-MV5080, TO-18, micro-mini flat clear lens, red lite	1.00
1-MV5094, red bi-polar, solid state lamp V to 110-115VAC-DC	1.98
1-MV5222, green jumbo dome, green lite, panel snap-in	1.00
1-MV5282, micro-mini, green lens TO-18, green lite	1.00
1-MV5322, yellow jumbo lite, panel snap-in	1.49
1-MV5491, jumbo, Tri-State, RED, GREEN, OFF, special	1.98
2-MT2, photo transistor, light sensor, TO-18	1.00

LED SPECIAL #1

Includes RED LED's, jumbo, medium, small, miniature, micro-mini, in upright & axial leads. Include INFRA-RED, too! All brand new & guaranteed!

10 for \$1.50
3 Kits — Take 10%

LED SPECIAL #2

Includes GREEN LED's, jumbo, medium & miniature, upright. Brand new, guaranteed!

3 for \$1.50
3 Kits — Take 10%

7-SEGMENT LED Readouts

(All "LED" TYPES)

Type	Char.	Each	Special
MAN-1	.27	\$3.75	3 for \$9.
MAN-3	.12	1.49	3 for \$3.
MAN-4	.19	2.50	3 for \$6.

REFLECTIVE BAR TYPES

707*	.33	2.50	3 for \$6.
704*	.33	2.50	3 for \$6.
SLA-1**	.33	2.50	3 for \$6.
SLA-3**	.70	5.95	3 for \$15.
SLA-11**	.33†	4.95	3 for \$12.

9 DIGI-METER READOUT FOR PANEL INDICATION

Imagine, nine 7-segment MAN-3's mounted in a red molded plastic 2 1/2" x 1 1/2" x 1 1/2" meter like case. Properly multiplexed. For PC use. Unique panel-like construction lends itself for 100's of DIGI-METER applications for hand-held, panel and table instruments. Instructions.

\$14.95
Buy 3 take 10%

LED MITY DIGIT "DCM'S"

Scientific Devices "Digital Counting Modules" outperform any other DCM on the market today. More features than ever before! Not gaseous, not incandescent, not near but the modern LED. Choose from such famous manufacturers as Monsanto's MAN-1, MAN-4, Litronics 707 and 704, Opco's SLA-1 (the last 4 having character heights of 0.33 at no extra charge). Each kit includes 3x2 1/2" p.c. board with fingers for a FREE edge connector, side-mounting dip socket, LED readout of your choice, resistors, 3 IC's, and Molex connectors (this ELIMINATES SOLDERING YOUR IC'S!) and booklet INCLUDES P.C. EDGE CONNECTOR — FREE!

Pin-for-pin MAN-1, * Pin-for-pin MAN-1, elec. char. same

\$9.99
Buy 3 take 10%

3 LED DIGITS ON A DIP

\$4.95

7-seg (MAN-3 type) and internally "multiplexed" and driven by one SN7448. Similar to the 33 by Litronics intended for calculators, clocks, test equipment, etc. Encapsulated in red transparent epoxy in 14-pin dip pak. With decoupling. High brightness, character .12 x .077, 5V 10 mils.

\$8.88
3 for \$24.

ALLEN BRADLEY 'TRANSISTOR' POTS

Any 4 for \$1

Choose Any 3 — Buy Any 3 — for \$2.50

Ohms	7.5K	100K
75	100K	200K
100	200K	500K
200	25K	100K
250	50K	75K
500	100K	100K
750	250K	100K
1.0K	500K	2 Meg
1.5K	5 Meg	5 Meg

VOLTAGE CONTROLLED OSCILLATOR

By Nortec. Generates square, sine, triangular, sawtooth, pulse waveforms. 14-pin DIP

\$8.88
3 for \$24.

KRONOS WITH "TIME BASE"*

Cabinet is 6" x 5 1/2" x 6"

6-digits

\$47. Any Type Clock less time-base

NEW FOR 1974!

With TIME BASE \$64.95

↑ "MAN" LED readouts are "all LEDs" but the Litronix 707 and Opco SLA-1, like the MAN-1, are of the reflective bar segment technique, the 704 is the reflective bar version of the MAN-4. The Nixie tube is a 7-segment device as others.

CHOOSE YOUR READOUT

Type	LED	Charac.	Sale
KR-101	MAN-3	.12	\$47.
KR-103	MAN-4	.19	47.
KR-104	Nixie*	.45	47.
KR-105	707†	.33	47.
KR-106	704†	.33	47.
KR-107	SLA-1†	.33	47.
KR-108	Same as SLA-1 add \$12.		47.

Now two clocks in one!
For 12VDC • 110VAC!
Now adaptable to boats, planes & cars too!
One price for any LED!
The only clock of its kind in USA today!
12 or 24-hr clock

CRYSTAL TIME BASE FOR ANY KRONOS*

\$19.95
Includes precision crystal, time-base IC, pc board & accessories with info.

*Not for KR-104

20-WATT STEREO AM-FM-MULTIPLEX

Only **\$39.95**

20-watt Solid State Amplifier!
All Solid State, Printed Circuitry!
4 Speaker Systems! Slide Rule Dial
All Purpose. All Stereo System!

The most unusual HI-FI stereo buy of 1974. A unit that has so many unique and different functions, makes it the finest system of its kind at the usual Poly Pak economy prices. Features: 4-speaker system, built-in FM tuner, record player, cassette player, external FM and AM antenna, "satellite" speakers to provide 4-speaker sound, jacks for connecting a tape recorder to radio tuner or phono of systems, to record. Lower inputs for connecting tape deck that will play back thru the internal amplifier for systems. AC Jack for phone power connection. RED, GREEN and CLEAR indicators for Phono, AM, and FM respectively. Includes red indicator on front panel for STEREO indicator. Has separate input to plug into mike, guitar and other musical instruments as well as another jack for plugging in a pair of stereo headphones.

Has the following controls on front panel, PHONO-STEREO-AM-FM, MONO, FM STEREO, CITAR, TUNE, MUTE, REVERSE control switch, LOUDNESS, BALANCE, TREBLE, BASS controls, with power ON-OFF rocker switch, and AFC ON-OFF. Designed for all audio-philes to use as well unit in DEN or FAMILY ROOM, or control unit by easy chair in family room, or for those who wish to design their own console or modular system. With 6 ft. 11 1/2 VAC cord and plug. Only 13 x 7 x 3 1/2" deep. No searchlight, but we include template for one, plus diagram. Shpg. wt. 3 lbs. With knobs.

CLOCK CHIPS ON A "DIP"

MMS311	6-digit 28-Pin	\$ 8.88
MMS312	4-digit 24-Pin	8.88
MMS313	6-digit 28-Pin	8.88
MMS314	6-digit 24-Pin	8.88
MMS316	4-digit 40-Pin, Alarm	13.50

1-MMS316, DIGITAL ALARM CLOCK FACTORY FALLOUT — \$1.49 EA

CALCULATOR CHIPS ON A "DIP"

Similar to Mostek 5001. Outperforms Texas Instruments' 5012. A 40-pin DIP. Adds, multiplies, subtracts, and divides. Use with 7-segment readouts, Nixies, and LEDs.

CT5001	12-digits 40-Pin	\$6.95
CT5002-9	Volt version of 5001	8.88
CT5005	12-digits 28-Pin	9.95

with 3-function memory.

POCKET CALCULATOR KEYBOARD

For hand-held units, properly multiplexed for chip CT5001, 2, 12 or Mostek 5010-12. 18 feather-touch keys, by FLEX-KEY.

Only \$6.95
3 for \$18.

OAK FEATHER-TOUCH SWITCHES

*For RTTY
*Printed Circuits
*Far Unique Panel

Mfg. by OAK (Ham's note, RTTY, too) data systems, same as used in Keyboard calculator, SPST. Normally Open, 24V 1 amp contacts. Characters and letters easily changed. "g" high. Printed circuit.	No.	0*	8*
	1	0†	0†
	2	0†	CE†
	3	0†	CL†
	4	0†	+
	5	0†	+
	6	0†	+
	7	0†	+

†Blue top, white characters. *White top, black numbers

CALCULATOR KEYBOARD SWITCH KITS

Kit of 17 for \$6.95

Each switch made by Oak 5415, SPST normally open, includes 0-to-9 (10 switches) white with black numbers, 0† decimal, white with black dot, and CE, CL and 4 functions blue with white characters.

10-pc. kit, 0-to-9 only same type as above. **2.95**

MUX'D DIGITAL CLOCK PC BOARD

Your choice **\$2.50**

MAN-1	Litronics 707 (MAN-1*)
MAN-3	Litronics 704 (MAN-4**)
MAN-4	Opco SLA-1 (MAN-1*)
6-MAN-3A's	for above board, \$9.50. * Elec char. same as MAN-1 or 4.

1-WATT FLANGELESS TOP HAT ZENERS

5 for \$1

Type	Vk	Metal Case
Volts	4.7	1.3
	6.3	10.
	8.2	30.
		33.

Terms: add postage. Rated: net 10
Phone Orders: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield, Mass. (off Water Street) C.O.D.'S MAY BE PHONED

POLY PAKS
P.O. BOX 942R, LYNNFIELD, MASS. 01940

INTERNATIONAL ELECTRONICS UNLIMITED

APRIL SPECIALS

TTL

7400	\$ 25	7447	\$ 1.45	74123	\$ 1.15
7401	25	7448	1.50	74125	69
7402	25	7450	.29	74126	95
7403	25	7451	.32	74141	1.25
7404	29	7453	.32	74145	1.25
7405	27	7454	.45	74150	1.25
7406	55	7455	.32	74151	1.05
7407	53	7460	.30	74153	1.45
7408	29	7461	.30	74154	1.25
7409	29	7464	.45	74155	1.35
7410	25	7465	.45	74156	1.50
7411	.36	7470	.50	74157	1.50
7413	95	7472	.45	74161	1.65
7415	50	7473	.55	74163	1.80
7416	50	7474	.55	74164	2.95
7417	50	7475	.95	74165	2.95
7420	25	7476	.95	74166	1.95
7421	32	7478	.89	74173	1.95
7422	32	7483	1.25	74175	1.95
7423	37	7485	1.20	74176	95
7425	39	7486	.55	74177	95
7426	35	7489	3.25	74180	1.15
7427	39	7490	1.25	74181	4.25
7430	25	7491	1.40	74182	1.10
7432	30	7492	1.05	74190	1.65
7437	50	7493	1.05	74192	1.65
7438	55	7494	1.10	74193	1.65
7440	25	7495	1.05	74194	1.65
7441	1.25	7496	1.05	74195	1.15
7442	1.15	7499	1.25	74196	1.35
7443	1.25	74105	.55	74197	1.15
7444	1.30	74107	.55	74198	2.50
7445	1.25	74121	.65	74199	2.50
7446	1.45	74122	.55		

Low Power TTL

74L00	\$ 40	74L51	\$ 1.75	74L90	\$ 1.75
74L02	40	74L55	.60	74L91	1.50
74L03	40	74L71	.60	74L93	1.75
74L04	40	74L72	.60	74L95	1.75
74L06	40	74L73	.80	74L164	2.95
74L10	40	74L74	.80	74L165	2.95
74L20	40	74L78	.80	85L52	2.95
74L30	40	74L85	1.25	86L75	2.95
74L42	1.75	74L86	.95		

High Speed TTL

74H	\$ 40	74H21	\$.47	74H60	\$.45
74H01	40	74H22	.47	74H61	45
74H02	40	74H30	40	74H62	45
74H04	45	74H40	40	74H72	60
74H08	45	74H50	45	74H74	70
74H10	40	74H53	.47	74H76	70
74H20	40	74H55	.47		

8000 Series TTL

8054	\$ 45	8200	\$ 2.95	8554	\$ 2.95
8060	30	8210	3.95	8570	2.95
8091	69	8214	1.95	8600	1.15
8092	69	8219	1.95	8610	95
8093	69	8220	1.95	8812	1.25
8094	69	8230	2.95	8822	2.95
8121	1.05	8280	.95	8830	69
8122	1.05	8288	1.05	8831	2.95
8123	1.75	8520	1.45	8832	2.95
8130	2.50	8551	1.95	8836	69
8182	1.75	8552	2.95	8880	1.50

CMOS

74C00	\$.85	74C76	\$ 1.70	74C163	\$ 3.25
74C02	.85	74C107	1.50	74C164	3.50
74C04	.95	74C151	2.90	74C173	2.90
74C10	.85	74C154	3.50	74C192	3.25
74C20	.85	74C157	2.25	74C193	3.25
74C42	2.15	74C160	3.30	74C195	3.00
74C73	1.70	74C161	3.25	80C97	1.50
74C74	1.50	74C162	3.25		

Specify Specs Required with order

4000 Series - RCA Equivalent

CD 4001	\$.65	CD 4012	\$.65	CD 4022	\$ 2.75
CD 4002	.65	CD 4013	1.50	CD 4023	.65
CD 4009	1.00	CD 4016	1.50	CD 4025	.65
CD 4010	.65	CD 4017	2.95	CD 4027	1.35
CD 4011	.65	CD 4019	1.35	CD 4030	.65
				CD 4035	2.85

Specify Specs Required with order

Memories

1101	256 bit RAM MOS (2501)	\$ 2.50 ea.
1103	1024 bit RAM MOS	7.95 ea.
5260	1024 bit RAM 16 pin	
	Low power consumption	5.95 ea.
7489	64 bit RAM TTL	3.25 ea.
8223	Programmable ROM	6.95 ea.

TTL (DIP)

7402	Quad 2-input NOR gate	5/\$1.00
7410	Triple 3-input gate	5/\$1.00
7437	Quad 2-input NAND buffer	3/\$1.00
7438	Quad 2-input NAND buffer O.C.	3/\$1.00
7460	Dual 4-input expander	4/\$1.00
7476	Dual J-K flip-flop	\$.45 ea.
7490	Decimal counter	1.10 ea.
74121	One shot monostable multivibrator	.49 ea.

LINEAR (MINI-DIP)

380	2 watt audio amplifier	1.50 ea.
75451	Dual peripheral driver	.39 ea.
75453	(351) Dual peripheral driver	.49 ea.

Linear

LM300	Pos V Reg (super 723)	TO-5	\$.95 ea.
LM 301	HPerformance AMPL	TO-5 or MINI-DIP	.45 ea.
LM 302	Voltage Follower	TO-5	.95 ea.
LM 304	Negative Voltage Regulator	TO-5	1.25 ea.
LM 305	Positive Voltage Regulator	TO-5	1.25 ea.
LM 307	Op AMP (super 741)	TO-5 or MINI-DIP	.45 ea.
LM 308	Micro Power Op Amp	TO-5 or MINI-DIP	.45 ea.
LM 309H	5 V Regulator	MINI-DIP	1.25 ea.
LM 309K	5 V 1A Regulator	TO-3	1.95 ea.
LM 310	Voltage Follower Op Amp	TO-5	1.45 ea.
LM 311	Hi perf. Voltage Comparator	TO-5 or MINI-DIP	1.25 ea.
LM 319	Hi Speed Dual Comparator	DIP	1.65 ea.
LM 320	5.2 V Negative Regulator	TO-3	1.95 ea.
LM 320	-12 V Negative Regulator	TO-3	1.95 ea.
LM 320	-15 V Negative Regulator	TO-3	1.95 ea.
LM 339	Quad Comparator	DIP	1.95 ea.
LM 340T	Positive Voltage Regulator (5V, 8V, 12V, 15V, 18V or 24V)	TO-220	2.25 ea.
LM 370	AGC/Squelch AMPL	TO-5 or DIP	1.29 ea.
LM 372	AF-IF Strip-detector	DIP	.85 ea.
LM 373	AM/FM/SSB Strip	DIP	3.60 ea.
LM 376	Pos. Volt Regulator	MINI-DIP	.65 ea.
LM 380	2 Watt Audio AMPL	DIP or TO-5	1.75 ea.
LM 382	Low Noise Dual Pre-Amp	MINI-DIP	2.25 ea.
LM 550	Precision Voltage Regulator	DIP	.95 ea.
LM 703	RF-IF Amp	MINI-DIP	.59 ea.
LM 709	Operational AMPL	TO-5 or DIP	.45 ea.
LM 711	Dual Differential Comparator	DIP	.39 ea.
LM 723	Voltage Regulator	DIP	.75 ea.
LM 739	Dual Hi Performance Op AMP	DIP	1.25 ea.
LM 741	Comp. Op AMP	TO-5 or MINI-DIP	.65 ea.
LM 747	Dual 741 Op AMP	TO-5 or DIP	.95 ea.
LM 748	Freq Adj 741	MINI-DIP	.45 ea.
LM 1303	Stereo Pre-Amp	DIP	.95 ea.
LM 1304	FM Multiplex Stereo Demod	DIP	1.50 ea.
LM 1307	FM Multiplex Stereo Demod	DIP	.95 ea.
LM 1458	Dual Comp. Op. Amp.	MINI-DIP	.75 ea.
LH 2111	Dual LM211 Volt. Comparator	DIP	2.95 ea.
LH 3065	TV-FM Sound System	DIP	.75 ea.
LM 3075	FM Det. - LMTR and Audio Pre-Amp	DIP	.85 ea.
LM 3900	Quad Amplifier	DIP	.75 ea.
LM 3905	Precision Timer	MINI-DIP	.95 ea.
LM 7524	Core Memory Sense AMPL	DIP	1.95 ea.
LM 7525	Core Memory Sense AMPL	DIP	.95 ea.
LM 7535	Core Memory Sense AMPL	DIP	.95 ea.
LM 9601	Retriggerable One Shot	DIP	.95 ea.
LM 75451	Dual Peripheral Driver	MINI-DIP	.49 ea.
LM 75452	Dual Peripheral Driver	MINI-DIP	.49 ea.
LM 75453	(LM 351) Dual Peripheral Driver	MINI-DIP	.69 ea.

Specify TO-5, DIP or MINI-DIP Package
Specify Spec. Sheet Required with order. Add \$.50 per spec sheet for items less than \$1.00 ea.

Phase Locked Loops

NE 560	Phase Locked Loop	DIP	\$ 2.95 ea.
NE 561	Phase Locked Loop	DIP	2.95 ea.
NE 562	Phase Locked Loop	DIP	2.95 ea.
NE 565	Phase Locked Loop	DIP	2.95 ea.
NE 566	Function Generator	MINI-DIP OR TO-5	2.95 ea.
NE 567	Tone Decoder	MINI-DIP OR TO-5	2.95 ea.

Specify TO-5, Dip or Mini-Dip Package

CMOS (DIP)

74C00	Quad 2-input NAND gate	\$.79 ea.
74C02	Quad 2-input NOR gate	.79 ea.
74C107	Dual J-K flip-flop with clear	1.25 ea.
74C160	Decade counter with sync. clear	2.75 ea.
4000 Series (DIP)		
4001	Quad 2-input NOR gate	.59 ea.
4009	Hex buffer (inverting)	.89 ea.

MM5312	Digital clock chip - 28 pin - any readout - 4 digit lpps BCD with 4 MAN3M LED	Complete with data \$11.95/set
--------	---	--------------------------------

Calculator Chips

5001 LSI (40 pin)	Add, subtract, multiply & divide 12 digit	
	Data supplied with chip	\$6.95 ea.
	Data only-Refundable w/purchase	1.00 ea.
5002 LSI	Similar to 5001 except designed for battery power	
	Data supplied with chip	\$8.95 ea.
	Data only-Refundable w/purchase	1.00 ea.
5005 LSI (28 pin)	Full four function memory. 12 digit display and calc. 7 segment multiplexed output	
	Data supplied with chip	\$10.95
	Data only-Refundable w/purchase	1.00 ea.

Digital clock . . . on a Chip

MM 5311 (28 pin)	Any readout 6 digit BCD with spec. sheet	\$11.95 ea.
MM 5312 (24 pin)	Any readout 4 digit lpps BCD with spec. sheet	8.95 ea.
MM 5313 (28 pin)	Any readout 6 digit lpps BCD with spec. sheet	8.95 ea.
MM 5314 (24 pin)	LED-incandescent readout 6 digit with spec. sheet	10.95 ea.
MM 5316 (40 pin)	Normal alarm, snooze alarm, sleep timer. 12 or 24 hr. operation with spec. sheet	15.95 ea.

LED

MV10B	Visible red SUPER SPECIAL	\$.25 ea.
MV50	type red emitting	.25 ea. 5/\$1.00
MV5020	type Large red	.35 ea. 3/\$1.00
ME4	Infra red TO18	.69 ea.
MAN 1	The original	3.95 ea.
MAN 3	type	1.95 ea. 3 or more 1.49 ea.
MAN 4	type	2.75 ea. 3 or more 2.50 ea.
Date-Lite 707 (MAN 1 repl)		3.25 ea.

Opto Isolators

MCA 2-30	Darlington	\$.95 ea.
MCD 2	Diodes	1.15 ea.
MCT 2	Transistor	1.15 ea.

Untested IC's

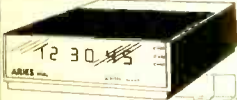
UNTESTED MOS		
MM1403	1024-bit dynamic shift register	DIP 65 ea.
MM1404	1024-bit dynamic shift register	DIP 65 ea.
MM5013	1024 bit dynamic shift register/accum.	DIP-TO-5 55 ea.
MM5016	512 bit dynamic shift register	DIP-TO-5 25 ea.
MM5019	Dual 256 bit mask prog. shift register	TO-5 25 ea.
MM5050	Dual 32 bit static shift register	TO-5 35 ea.
MM5054	Dual 64/72/80-bit static shift register	DIP 35 ea.
MOS Shift Registers 2500 Series		
2502 2506 2509 2510 2511 2518 2519 2521 2522		
Untested seconds		4/1.00
Grab Bag Specials		
15 Assorted TTL's (dips)		\$1.00/bag
25 Assorted DTL's (dips)		\$1.00/bag

ON ORDERS OVER \$25.00 DEDUCT 10%

Satisfaction guaranteed. All items except as noted are fully tested. Minimum order \$5.00 prepaid in U.S. and Canada. Calif. residents add sales tax. Orders filled within three days from receipt.

INTERNATIONAL ELECTRONICS UNLIMITED
P.O. BOX 1708 • Monterey, Calif. 93940

NEW LOW COST DIGITAL CLOCK/ALARM/CALENDAR CLOCK KIT



This is an updated version of our popular low price clock kit. In addition to the former features which were a decorator walnut case, six digit blue-green display, the clock now features 28/30/31 day calendar, 12/24 hour clock and 24 hour alarm, snooze alarm, 50/60 Hz Operation, setting any counter (time, alarm, calendar, and clock radio) is quite easy, since a separate control of the hour and minutes digits has been provided. The setting of any counter does not affect the contents of any other counter.

New Clock/Alarm/Calendar Clock Kit. Available Jan., 1974. Send \$10.00 deposit to insure early shipment. Will be shipped C.O.D. for balance of \$59.50 to make up full purchase price of \$69.50.

"OLD" Clock Kit. Uses 5311 Clock Chip does not have Alarm/Calendar features indicates hours, minutes, seconds. Available now. \$47.50

UNIVERSAL DIGITAL CLOCK - TIMER - STOPWATCH ALARM KIT



This new kit has so many features and applications, we hardly know where to start. To summarize the applications:

*The unit can be used as a conventional clock, either from internal batteries, or from the AC adapter. Makes an excellent travel clock.

*The alarm feature can be set at any time, and will generate a tone with an external speaker.

*The unit can be used as a stopwatch, either registering hours, minutes, or seconds, up to 23:59:59, or minutes, seconds, and 1/60 seconds up to 24 minutes, to an accuracy of 1/60 second.

*The unit can be used as a timer, to trigger an external device at a preset time.

This unit will be available as a complete kit in Jan. 1974. To get one of the first, and take advantage of our lower pre-issue price, send \$10.00 deposit, will be sent COD for balance. Total kit price will be \$69.50 including pillow speaker as shown. AC power adapter \$4.75 additional.

Available now, all parts, but no circuit board or detailed instructions. \$59.50

CLOCK CHIPS - INCLUDES NEW DIGITAL CLOCK/CALENDAR ALARM CHIP



These large scale integrated (LSI) chips eliminate literally thousands of components or hundreds of chips in the construction of a clock. For most applications only a single supply and a minimum of components are required.

7001 Chip - Features 28/30/31 day calendar, 12/24 hour clock, 24 hour clock, 24 hour alarm, snooze alarm, 6 digit display, direct drive to luminescent anode tubes or LED segments, single transistor interface with Sperry displays. Segment and digital outputs can be "wire or 'D'" to share calculator displays. \$14.75

MMS314 Chip - Features 6 digit seven segment output, operates from 50 or 60 Hz input, use for Minitrans LED's, Luminescent or Sperry displays. \$9.75

MMS311 Chip - Same as 5314 but with additional BCD outputs, ceramic pkg. \$12.50

FUNCTION GENERATOR CHIP, TYPE 4038

This chip gives simultaneous sine, square, sawtooth, and triangular outputs. Great for music synthesizers, or voltage controlled function generators and oscillators.

Function Generator Chip \$7.75

LUMINESCENT 7 SEGMENT NUMERIC READOUTS

Bright BlueGreen display Tube. Very pleasing to the eye. Tube exhibits fast display speed and easy to read characters of 0.57"H x 0.36"W, with decimal point. Complete with instructions to make a decade counting unit or a 6 Digit Clock. Tubes are manufactured by Tung-Sol, part number 1705.

7SD-1705 READOUT \$1.70
6 for \$8.50
10 for \$14.00



...one of the world's largest manufacturers, has sold us his surplus of multiple digit clusters with one bad digit per cluster. They were for use in the calculator, DVM, and other products. The remaining digits are guaranteed perfect in all respects and are intensity graded (marked on the back with letters A thru F) and matched, so that several strips can be combined and still result in a perfect match. These monolithic GaAsP displays require as little as 7 mW per digit, are highly readable at arm's length, and lend themselves well to hand held portable applications.

Applications include hand-held calculators, digital thermometers, stopwatches, darkroom timers, DVM's, clocks and watches, or any other product requiring low cost, low Power, long lifetime indicators.

The unit is common cathode, set up for multiplexed operation. Two decimal point styles are available; center decimal for PN 7804/05, and right decimal for PN 7814/15, as illustrated. The following configurations are available, where "8" represents a perfect digit, "X" a non-functioning digit:

X8888	7405-1 or 7415-1	X888	7414-1
8X888	7405-2 or 7415-2	8X88	7414-2
88X88	7405-3 or 7415-3	88X8	7414-3
888X8	7405-4 or 7415-4	888X	7414-4
8888X	7405-5 or 7415-5	888X	7556-1

All products are available at the following price rate:

1 - 24 digits	\$1.875/digit
25 - 99 digits	\$1.50/digit
100 - 499 digits	\$1.25/digit

Higher quantity price on request.

For the following applications we recommend the following configurations:

Pocket calculators: 7405-1 & 7405-5, which results in X88888888X, eight consecutive perfect digits @ \$1.875 = \$15.00.

Recommended Calculator chips:
Nortec 4204 @ \$19.75 (\$15.00 when ordered with displays).
Caltex 5005 @ \$9.75 (\$7.50 when ordered with displays).

Clocks: 7405-3 & 7556-1, which results in 88X88X88X, six perfect digits at \$1.875 = \$11.25.

Recommended clock chips:
National MM5314 @ \$9.75 (\$7.50 ordered with displays).
National MM5316 @ \$19.75, includes alarm, (\$15.00 ordered with displays).

For only hours and minutes, order 7405-3 only.

Digital thermometers, DVM's, stopwatches, darkroom timers, frequency counters, etc., order 7415-1 or 7415-5 for four digits (\$7.50) or 7414-1 or 7414-4 for three digits (\$5.60). Use Solitron CM 4102AE 3 1/2 digit counter decoder @ \$19.00. (\$15.00 ordered with displays).

Schematics for calculators, clocks and counters using these components free with order.



ALPHANUMERIC DISPLAY

This is a 5x7 (35 Dot) Dot Matrix which will generate alphanumeric characters when used with an appropriate generator such as the 2513. All 64 ASCII or EBCDIC codes can be generated. \$9.75



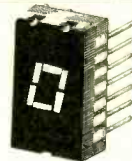
I.C. SOCKETS

Mfg. by T.I., Cinch, high quality, most gold plated. Use for SSI, MSI, and LSI chips.

<input type="checkbox"/> 14 Pin Solder Tail	3 for \$1.00
<input type="checkbox"/> 14 Pin Wire Wrap	2 for \$1.00
<input type="checkbox"/> 16 Pin Solder Tail	3 for \$1.25
<input type="checkbox"/> 16 Pin Wire Wrap	2 for \$1.25
<input type="checkbox"/> 24 Pin Solder Tail	2 for \$1.25
<input type="checkbox"/> 28 Pin Solder Tail	2 for \$1.50
<input type="checkbox"/> 40 Pin Solder Tail	\$1.00 each
<input type="checkbox"/> 10 Pin Round for to-5 style	3 for \$1.00
<input type="checkbox"/> 3 Pin Transistor Sockets	10 for \$1.00

COSMOS & MISC. CHIPS

<input type="checkbox"/> Harris 256 Bit Programmable Read only memory	\$2.50
<input type="checkbox"/> 2501 256 Bit RAM	\$2.50
4000AE Dual 3 Input NOR & INV	\$.99
4001AE Quad 2 Input NOR	\$.99
4002AE Dual 4 Input NOR	\$.99
4006AE 18 Stage Shift REG	\$4.99
4007AE Dual Comp Pair	\$.99
4009AE Hex Buffer, Inv.	\$2.19
4010AE Hex Buffer, NON-Inv.	\$2.19
4011AE Quad 2 Input NAND	\$.99



0.3 HEIGHT L.E.D. NUMERIC DISPLAYS

Always a good seller, we are now offering these displays at the lowest price ever. Use for clocks, counters, and other applications. We have previously sold these for as much as \$6.75 per digit.

0.3 inch height red LED \$2.25
6 for \$12.00

0.3 HEIGHT GREEN L.E.D. NUMERIC DISPLAY

This is the first time we have had green LED's at an economical price.

0.3 inch height green LED \$3.95
6 for \$21.00

0.3 HEIGHT YELLOW L.E.D. NUMERIC DISPLAY

Vary your display colors for coding or Variety

0.3 inch height yellow LED \$3.95
6 for \$21.00

GIANT 0.750 INCH HEIGHT RED L.E.D. NUMERIC DISPLAY

This is one of the largest LED Displays made. Used in applications where the displays must be read at greater than average distances, or for commercial and advertising purposes.

0.750 inch LED
Numeric Readout \$5.75
6 for \$30.00

LOWEST PRICE EVER ON DISCRETE L.E.D. LAMPS

These high quality red LED's are useful for Logic and Computer readouts, as Pilot Lights, or at this low price, they can be grouped together to build your own Giant size Alphanumeric Readouts.

Discrete LED's 10 pcs. \$1.75
100 pcs. \$15.00
1000 pcs. \$125.00
5000 and up \$.10 each

GREEN L.E.D. LAMPS

Same as above, but Green.
100 for \$30.00 3 for \$1.00
1000 for \$250.00 10 for \$4.00

YELLOW L.E.D. LAMPS

Same as above, but Yellow
2 for \$1.25
10 for \$5.00

RED WITH BUILT-IN RESISTOR

Same, but no resistor required for 5 Volt operation. 2 for \$1.00
10 for \$4.00

CALCULATOR CHIPS

Nortec 4204 - Eight Digit, floating point, constant operation single supply operation, very low power consumption. \$19.75 (\$15.00 with purchase of 7400 series LED's.)

5001 - Twelve Digit, fixed decimal point, no constant, may be used for six digit display. \$9.75 (\$7.50 with purchase of 7400 series LED's.)

3 1/2 DIGIT COUNTER CHIP

This chip is useful in building dim's DPM's and small counters, provides multiplexed seven segment output for LED displays, Solitron 4012 or Equivalent. (\$15.00 with purchase of 7400 series LED's.)

Send in an order and get on our special customer Mailing List.

CATALOG: Check reader's card or write.

POSTAGE EXTRA ON ALL ABOVE ITEMS



CHARGES WELCOME!

Phone in charges to 617 531-5774 or 617 532-2323. BankAmericard - Mastercharge. \$10.00 minimum. No C.O.D.'s please.

B.&F. ENTERPRISES Mass. 01960

Phone (617) 531-5774

119 Foster Street

Peabody, Mass. 01960

BUGGED??? . . . Detectors locate hidden transmitters. Literature 25c. **SECURITY**, Box 671RE, Westwood, N.J. 07675

FREE catalog. IC'S, PUT'S, transducers, thermocouples, LED'S, transistors, circuit boards, parts. **CHANEY'S**, Box 15431, Lakewood, Colo. 80215

TEXTRONIX 531A/B-\$425.-; 533/CA /\$495.-; Data Pulse 106A-\$485.-; HP330B-\$275.-; HP650A-\$195.- **DESIGN CONSULTANTS**, Box 67, Richardson, Tex. 75080

LASER diodes, 4W: \$5.95. IC's; readouts; catalog, 10c. **ELECTRONIC DISCOUNT SALES**, 138 N 81st Street, Mesa, Ariz., 85207

A NEW INSTRUMENT TO USE WITH YOUR SCOPE

MULTITRACER



Use with your present Oscilloscope to trace Resistors, Capacitors, Transformers, Diodes, Transistors, Zeners, Triggers, most Semiconductors, IC's, etc. Also shows continuity in circuit and go/no go checks. Complete with diagrams and instructions. No internal scope connections. For medium or small production runs or for hobbyist, experimenter, engineer, or ham.

ONLY \$19.95—CHECK OR MONEY ORDER WHY PAY MORE?

BOX 14, LESCO ELECTRONICS, SKOKIE, ILL. 60076

HIGHLY PROFITABLE ONE-MAN ELECTRONIC FACTORY


Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! **Postcard will do. Barta-BD Box 248, Walnut Creek, CA 94597.**

REBUILD YOUR OWN PICTURE TUBES?


With Lakeside Industries Precision equipment, you can rebuild any picture tube!

For complete details, send name, address, zip code to:

LAKESIDE INDUSTRIES
3520 W. Fullerton Ave.
Chicago, Ill. 60647
Phone: 312-342-3399



3 PRECISION 15 VOLT REGULATORS ON A PC BOARD



This board contains 3 precision 15 volt regulators. 2 of the regulators are rated at 3.0 amps, 0.1%, and the third is rated at 6.0 amps, 0.1%. At 5.0 and 10.0 amp, the rating is 0.5%. Each board has 5 150 watt NPN power transistors, 4 are used in the regulators, and 1 is a spare. Ideal for ± 15 volt op-amp supplies. Boards are brand new, factory cartons. Cost of components alone over \$48.00.

STOCK NO. F5169 \$11.95 ea. 2/22.00

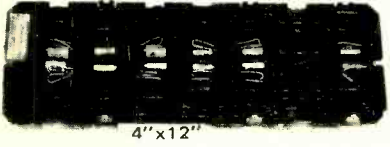
POWER TRANSFORMERS

The transformers listed below are suitable for many semiconductor projects, and ideally suited for power supplies to operate the 3 regulator board listed above.

14 V. 3.0 A. & 550 V. 0.150 A.	F9793	2.75 ea.	2/5.00
16 V. 4.0 A.	F9858	3.75 ea.	2/7.00
38 V. 1.5 A. ct & 38 V. 0.5 A.	F9718	3.50 ea.	4/12.00
32 V. 2.0 A. ct	F9743	4.25 ea.	3/12.00
34 V. 4.0 A. ct & 5.5 V. 1.5 A.	F9448	4.75 ea.	2/9.00

Av. wt. of above transformers is 3 lbs. All transformers above ideal for use with F5169 regulator board shown above. Deduct 10% when 2 or more trans. ordered with regulator board.

ANOTHER HONEYWELL BOARD



Parts bonanza boards. Precision resistors, capacitors, diodes, pulse transformers, diodes, heat sinks, TO-18, TO-5 and MADT transistors and more.

4" x 12"

STOCK NO. J9121 3 Different boards \$2.00 9/5.00 20/10.00

MINIMUM ORDER \$5.00. Include postage, excess refunded. New edition of our catalog now available.

DELTA ELECTRONICS CO.

BOX 1, LYNN, MASSACHUSETTS 01903
Phone (617) 388-4705

FREE catalog lists resistors, tubes, transistors, rectifiers, condensers, tools, tuners, etc. etc. **HYTRON HUDSON**, Dept. RE 2818 Kennedy Blvd., Union City, N.J. 07087.

WANTED

QUICK cash . . . for electronic equipment components, unused tubes. Send list now! **BARRY**, 512 Broadway, New York, N.Y. 10012, 212 Walker 5-7000

EDUCATION & INSTRUCTION

DEGREE Program in Electronics Engineering. Our 27th Year! Free literature. **Cook's Institute**, Dept. 14, Box 10634, Jackson, Miss. 39209.

SHORTCUTS to success! Highly effective, profitable short courses. (75 choices). Study at home. Diploma awarded. Our 27th year. Free literature. **CIEE-E**, Box 10634, Jackson, Miss. 39209

PLANS & KITS

ELECTRONIC organ kits, keyboards and many components. Independent and divider tone generators. All diode keying, IC circuitry. Build any type or size organ desired. Supplement your Artisan Organ, 35c for catalog. **DEVTRONIX ORGAN PRODUCTS**, Dept. B, 5872 Amapola Dr., San Jose, Calif. 95129

FREE catalog. Most unusual electronic kits available. Music accessories, surf, wind synthesizers, wind chimes, many others. **PAIA Electronics**, Box B14359, Oklahoma City, OK 73114.

WALL-SIZED TV . . . Build a TV projector for under \$15.00. Free details: **MACROCOMA**, Fax-FDE, Washington Crossing, Pa. 18977

DIGITAL/ANALOG plans for home & lab!!! For Free Catalog write: **MP PUBLISHING CO.**, Box 378, Belmont, Mass. 02178

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans \$2.00. **SANDERS**, Dept. A-25, Box 92102, Houston, Tex. 77010

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below.

READER SERVICE CARD NO.	PAGE
24	Alarm Devices Mfg. Co. 77
66	Allison Automotive 88
67	Arrow Fastener Co., Inc. 25
	Bell & Howell Schools 60-63
16	B & K Division of Dynascan Corp. 32
67	Brooks Radio & TV Corp. 89
74	Castle TV Tuner Service, Inc. Cover IV
61	Center for Technical Development 81
12	Chemtronics, Inc. 26
17	CIE, Cleveland Institute of Electronics 38-41
	CREI, Division of the McGraw-Hill Continuing Education Center 28-31
7	Crown International 16
8	Delta Products, Inc. 17
28	Edlie Electronics 80
73	Edmund Scientific Co. 104
64	EICO, Electronic Instrument Corp. 88
	E.M.C. Electronic Measurements Corp. 82
22	Enterprise Development Corp. 76
25	F. S. Enterprises 78
68	Fordham Radio Supply Co. 90
63	Grantham School of Electronics 83
	GTE Sylvania Electronic Components 2
19	Harwil Co. 74
100	Heath Co. 84-87
69	Indiana Home Study Institute 90
11	International Crystal Mfg. Co. 24
70	Jensen Tool & Alloy 90
14	Leader 27
3	Mallory Distributor Products Co. 5
75	Merrimack Instruments Inc. 69
10	MITS, Micro-Instrumentation Telemetry Systems, Inc. 23
71	Mountain West Alarm Supply Co. 90
30	National Camera Co. 81
	National Technical Schools 70-73
	NRI Training 8-11
29	PAIA Electronics 80
20	PLC Electronics 74
18	Projector Recorder Belt Co. 69
1	PTS Electronics, Inc. Cover-11
5	Radio Shack 13
26	R. A. G. S. 79
62	Rye Industries 82
4	Sams & Co., Howard W. 7
15	Schober Organ 27
2	Shure Bros. 11
9	Southwest Technical Products 22
21	Sprague Products Corp. 75
	Sylvania Technical School Home Study Division 18-21
	Technics by Panasonic Cover-111
13	Telematic 26
	Triad-Utrad Distributor 74
23	Tri-Star Corp. 77
	Tucker Electronics Co. 79
72	U.S. Coast Guard 94-97
65	Vero Electronics 88
	Vintage Radio 78
27	Wahl Clipper Corp. 79
77	Winegard Co. 14-15
MARKET CENTER	
	ATV Research Corp. 92
79	Babylon Electronics 91
	Barta 102
84	B & F Enterprises 101, 103
	Command Productions 92
85	Delta Electronics 102
81	Digi-key 92
	Fair Radio Sales 91
	Gregory Electronics Corp. 92
83	International Electronics Unlimited 100
80	JTM Associates 92
	Lakeside Industries 102
	Lesco Electronics 102
	Logic Newsletter 92
	Macrocoma 98
	McNeal Electric & Equipment Co. 91
78	Mesha Electronics, John Jr. 91
	Photolum Corp. 92
82	Polypaks 93, 99
	Solid State Sales 98
	Surplus Center 98
	Valparaiso Technical Institute 98

For faster service

USE ZIP CODE

on all mail

GIANT NIXIE CLOCK KIT

For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

□ Giant Nixie Clock Kit \$99.50

24 VOLT 5 AMP TRANSFORMER



We have just received a truckload of these high quality computer specification transformers. The floors are groaning and we are selling them at a LOW-LOW price just to clear them out. Excellent for Power Supplies, Audio Amps.

□ 24 Volt 5 Amp Xformer \$3.95
 □ 5 for \$15.00, write for prices of Mfg. quantities

LIGHTED PUSH BUTTON SWITCHES WITH INSERT



These large lighted push button switches measure 1.7" x 1.4" inches, include clear plastic cap so that legend can be inserted inside. Includes two 12 volt bipin bulbs. Contacts are DPST. If cap is inserted

upside down, switch section becomes inoperative, an excellent safeguard for burglar alarms, etc. for people who don't know the "trick"

□ Lighted push button switch \$1.00 each
 □ Write for production prices 10 for \$7.50

HEAVY DUTY DATA TERMINAL POWER SUPPLY



Originally manufactured for use in Data Terminals, these are rugged conservatively rated power supplies for continuous duty operation. The original cost of these supplies was \$278.00. All outputs

are regulated to ± 5% by a constant voltage transformer, and in addition two of the outputs are regulated to 0.2% by solid state regulators. Circuits are protected by fuses and circuit breakers. Two types are available.

*Type "A" 24 VDC @ 1.6A ± 0.2%, 26.5 V @ 3.25 A ± 2%, 18 VDC @ 6.6A ± 5%, 14 V @ 2.9A 0.2%, 12 VDC @ 1A ± 5%
 Price \$29.50
 *Type "B" Same as above except includes 5VDC @ 3.25 Amps instead of 14V @ 2.9 AMPS \$34.50
 Shipping Weight—30 lbs. either supply

MANUFACTURERS OVERSTOCK CLOSEOUT AUTO STEREO AM/FM TAPE PLAYER



This high quality tape player with AM/FM radio is made to fit right into the dashboard of your car. Looks like it's only a radio, so it's less likely to get ripped off. Why not listen to music while you're waiting in line for gas. Prevents frayed tempers and fistfights.

"Music hath charms to soothe the savage beast." Fully guaranteed by both manufacturer and B & F for 1 year, parts and labor. Super easy installation. Power 4 watts RMS per channel (10 watts peak). Your complete satisfaction is guaranteed.

*Tape AM/FM Car Stereo \$99.75
 *Pair of 6 1/2" 12 oz Magnet Speakers with padded grills for above \$14.75

POWER SUPPLY KIT



This kit includes 24 Volt, 5 AMP heavy duty transformer, bridge rectifier, 8,000 MFD capacitor, 723 regulator, pair of 2N3055 transistors, D.C. voltmeter, plus all electrical circuit breaker parts to build a complete regulated laboratory supply.

*Lab Supply Kit \$19.75
 Shipping Weight 20 Lbs

CLOSEOUT - CALCULATOR KIT



B and F was one of the first (if not the first) to introduce an under \$100.00 calculator. Now that all the giant corporations have introduced theirs, we feel it's time to move on to new kits and let the "Biggies" slug it out. We have enough parts for about 200 more calculators, which we are closing out at \$54.50 each. Floating point eight digit display, constant capability, sealed elastomer keyboard,

molded ABS case, uses (4) standard AA cells, 14 hour battery life.
 □ Pocket Calculator Kit \$54.50

STEREO TAPE CARTRIDGE PLAYER



High quality tape cartridge player has built in preamps, and requires only 115V 60Hz for motor and 12 volts for electronics to operate, four light indicators indicate channel selected. Output compatible with amplifier "Auxiliary" inputs. Here is the inexpensive high fidelity way to play those tape cartridges for your car player in your home.

□ Stereo Tape Cartridge Player \$15.00

REVERBERATION UNIT & SPEAKER



Useful in conjunction with music synthesizers, organs, and to add "presence" to music. This complete reverberation unit requires only a source of 12 Volts to operate, might also be useful for other acoustic delay experiments. Includes high quality oval ceramic magnet speaker, brand new, originally made to sell for \$24.50, now at a price you would pay for the speaker alone.

□ Reverb Unit \$6.95

1 MHz FREQUENCY STANDARD CRYSTAL

This is a 1,000,000 MHz Crystal + 5Hz, -0Hz. Can be pulled to exactly 1 MHz ± 0Hz with 5-30 PF trimmer. Excellent temperature coefficient. OD 4007 makes excellent Oscillator, buffer. Circuit included. Super. LOW price while 2,000 PCs last.

*1 MHz Crystal Standard \$4.50

QUARTZ CRYSTAL CHRONOMETER

Revolutionary!, was the reaction of our customers when they saw this kit. Measuring only 2 1/2" x 2 1/2" x 2 3/8", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats, and airplanes.

Fits into a standard 2 1/4" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e., replacing battery in car). This clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligible power drain.

The low price is only possible because of a new one chip MOS clock. Operates from 12-24 Volts D.C. An accessory unit which mounts on the back adapts the unit to 2-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.
 □ Quartz Chronometer, Kit Form \$69.50
 □ Quartz Chronometer, Wired \$99.50
 □ 24 Volt Adapter \$10.00

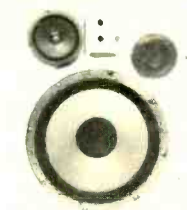
NICAD BATTERIES



No need to tell you the uses of these sealed Nickel-Cadmium batteries in all kinds of portable equipment. All brand new except the 0.5 ampere hour, which is removed from new equipment, guaranteed perfect.

Type	Volts	Amps	Price	Size
□ 1.25NCB0.5	1.25	0.5	.50	1 1/4" diam x 5/8"
□ 1.25NCB0.6	1.25	0.6	1.00	Lg. AA
□ 24NCB0.6	24	0.6	11.80	1 1/2" x 1 1/2" x 11"
□ 8NCB0.6	8	0.6	5.00	5/8" diam x 11"
□ 18NCB	18	0.5	7.50	3" x 3" x 4"

LOUDSPEAKER SYSTEM COMPONENTS



We have made an excellent purchase of an excess inventory of a local manufacturer's speaker systems, although we are not allowed to mention the mfg.'s name, the specs should make it self-evident. The woofer is a 12" free-edge (acoustic suspension) unit, with 2" voice coil and a No. 2 magnet. The mid-range is a 5" sealed back speaker and

3 1/2" flare dome tweeter for best high frequency dispersion. Crossover between woofer & mid-range is by an R-L-C network, while high frequency crossover is by an R-C network. Balance controls are provided for both mid-range and tweeter. Plans for a suitable enclosure are provided. The level controls provide frequency response to suit room acoustics, with realism that will delight even the most critical listener. Response — 25 to 250K + Hz., Power — 40 watts RMS. Impedance — 8 ohms Sh. Wt. 12 lbs.

□ LSCS \$36.00
 □ 2LSCS 2 for \$65.00

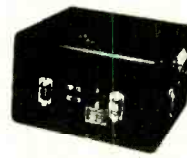
RESOLUTION TEST CHART

These 2" x 2" glass plate test charts are excellent for testing enlargers, microscopes, scanners, etc. Original cost to manufacture was over \$60.00. Complete plate is covered with test patterns. Several types available may vary slightly from illustration. A rare bargain.



□ Resolution Test Plate \$2.50

HERMETICALLY SEALED FIBERGLASS CARRYING CASES

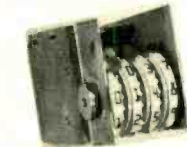


13" x 30" x 30" brand new luggage type carrying cases were originally manufactured to ship delicate electronic equipment overseas. Excellent for storing, shipping and carrying photographic equipment, instruments, etc. Includes easily

removable foam rubber inserts. Original cost to manufacture was \$160.00 would probably be even higher today because of plastics shortage.

□ Fiberglass carrying case \$25.00

RESETTABLE FOUR DIGIT COUNTERS



These counters have raised numerals for print out thru carbon ribbon, but can be used as conventional counters also, reset by wheel on side. Coil is 12 volts D.C., may be operated on 115 VAC by diode-capacitor-resistor.

□ Resettable Four Digit Counter \$2.50
 □ Diode-Resistor-Cap for 115 VAC \$5.00

TELEPHONE TOUCH-TONE KEYBOARD

Built by General Telephone, this keyboard uses 2 poles and seven busses for touch-tone keying. Never before at this low price. Size 3" x 2 1/2" x 1 1/2".



□ Telephone KB \$4.75

AM/FM RADIO CHASSIS

Quality A.C. powered AM/FM radio. Useful for construction projects. Order now, these usually don't last long.



□ AM/FM Radio \$5.75

Send in an order and get on our special customer Mailing List.
CATALOG: Check reader's card or write.
POSTAGE EXTRA ON ALL ABOVE ITEMS

CHARGES WELCOME!
 Phone in charges to 617 531-5774 or 617 532-2323. BankAmericard — Mastercharge. \$10.00 minimum. No C.O.D.'s please.
B.&F. ENTERPRISES Mass. 01960
 Phone (617) 531-5774
 119 Foster Street
 Peabody, Mass. 01960

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

3-CHANNEL COLOR ORGAN KIT

Easy to build low-cost kit needs no technical knowledge. Completed unit has 3 bands of audio frequencies to modulate 3 independent strings of colored lamps (i.e. "lows"-reds, "middles"-greens, "highs"-blues. Just connect hi-fi, radio, power lamp etc. & plug ea. lamp string into own channel (max. 300w ea.). Kit features 3 neon indicators, color intensity controls, controlled individ SCR circuits; isolation transformer; custom plastic housing; instr.



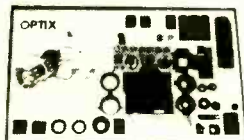
Stock No. 41,831EH\$17.50 Ppd.

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit—comparable to costlier models. Completely safe. Compreh. instr. b.klt. No. 1635EH (8x3x4": 24 oz.) . \$128.00 Ppd. **LOW COST "Starter"** Unit Stock No. 71,809EH . \$49.95 Ppd!



130 EXPERIMENTS IN OPTICS . . .



and photography! Optix® Experiments Kit is a complete optical & photography lab for 130 exciting experiments. Lets you recreate the periscope, telescope, microscope, kaleidoscope! . . . Build a 35mm reflex camera with interchangeable lens system! Make, develop photographic film! Enjoy the fun and fascination of having your own optics lab. Fully illustrated 112-pg. manual, 8½"x11", clearly explains usage of this stimulating kit's 114 precision engineered components.

Stock No. 71,646EH . . . \$22.50 Ppd.

AERONAUTICS FUN KIT (100 Experiments, Stock No. 71,840EH \$15.95 Ppd.)

MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS!

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accessories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "EH"

Name _____
Address _____
City _____
State _____ Zip _____

COMPLETE & MAIL WITH CHECK OR M.O.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND **GIANT FREE CATALOG "EH"** MERCHANDISE TOTAL \$ _____
ADD HANDLING CHARGE—\$1.00 ON ORDERS UNDER \$5.00; 50¢ ON ORDERS OVER \$5.00



I enclose check
 money order for \$ _____
NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

ELECTRONIC SOUND COLLECTOR

The Big Ear^(R) is a science toy that's fun for all, to tune in a whisper at 20 ft., normal conversations up to 100 ft., bird calls & high freq. sounds at almost 200 ft. Nearly twice as far over water! Experiment and hobby-size with it indoors or out — from baby sitting to bird watching. Big 18" plastic reflector disc pulls sound waves into transistor unit, then amplifies them. Mike system, stethoscope earphones, tripod (33½" extended). Sets up in secs.

Stock No. 80,176EH \$26.50 Ppd.



He-Ne LASERS FROM \$99.50!

Edmund quality, TEM₀₀ mode, cold cathode for long life. Completely self-contained units; solid state power supply; 100v AC. 0.3mW min — GREAT GENERAL PURPOSE LASER: 1.2 mm beam dia., 2.0 OmRad beam Diverg.

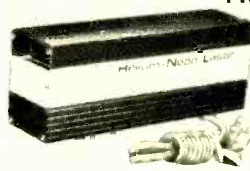
Stock No. 79,061EH \$99.50

1.0mW min — HI-PERFORMANCE LAB LASER: 1.2mm beam dia., 1 OmRad beam Diverg.

Stock No. 79,050EH \$150.00 Ppd.

3.0mW min — DEPENDABLE HI-POWERED LASER: 1.0mm beam dia., 0.8mRad beam Diverg.

Stock No. 79,052EH \$325.00 Ppd.



SUPER 6" SPACE CONQUEROR

Superb Astronomical Reflector—Up to 576X. Capable of revealing faint stars of nearly 13th magnitude, split double stars separated by less than 1 sec. of arc. Features aluminized & overcoated 6" f/8 ground and polished Pyrex (R) parabolic mirror accurate to ¼ wave. 48 F.L. 6X achromatic finder scope. 4 eyepieces—48X Kellner, ½" 96X, ¼" 192X Ramsdens, & a Barlow to double or triple power—rack & pinion focusing mount—47-¾" aluminum tube. Electric clock drive w/manual slow-motion control. Setting circles. Heavy-duty equatorial mount. Pedestal base.

Compares to \$325—\$375 models

No. 85,086EH (Shp. Wt. 68 lbs.) . . . \$259.50 F.O.B.

6" WITHOUT CLOCK DRIVE No. 85, 187EH \$222.50 F.O.B.

4-¼" REFLECTOR (48X to 275X) No. 85, 105EH \$115.00 F.O.B.

4-¼" REFLECTOR W/CLOCK DRIVE No. 85, 107EH \$149.95 F.O.B.

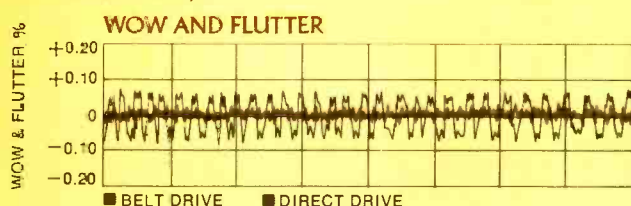
3" REFLECTOR (60X to 180X) No. 85,050EH \$36.95 Ppd.



Our most expensive turntable has direct drive. So does our least expensive.

When Technics introduced direct drive, we set new standards for turntable performance. That's why we use direct drive exclusively in all Technics turntables.

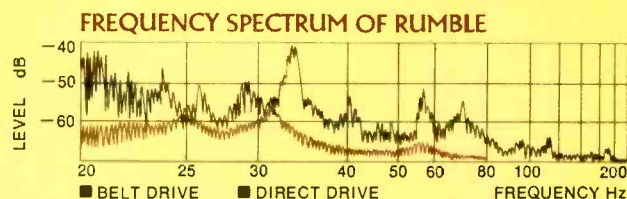
No other system measures up to direct drive. Wow and flutter are less than 0.03% WRMS. And rumble is down to -65dB (DIN A) and -70dB (DIN B).



Our DC motor has no noise- or static-producing brushes and virtually none of the hum normally found in AC motors. It reaches playing speed in half a revolution and has electronic speed control that prevents speed changes due to line fluctuations.

All Technics turntables have illuminated stroboscopes, cast aluminum platters and variable pitch controls. The SL-1200 also has a precision tone arm, viscous damped cueing and low-capacitance 4-channel phono cables.

So does the SL-1100A but with a heavier platter, bigger motor and longer tone arm.



And the SP-10 is for those who insist on choosing their own tone arm.

No matter which Technics turntable you choose, you get the finest drive system that money can buy. But don't take our word for it. Read the reviews.* And you'll agree.

The concept is simple. The execution is precise. The performance is outstanding. The name is Technics.

*SP-10: Audio, 8/71; Stereo Review, 9/71.
SL-1100A: Stereo Review, 7/73; High Fidelity, 9/73.

200 PARK AVE., N.Y., N.Y. 10017. FOR YOUR NEAREST AUTHORIZED TECHNICS DEALER. CALL TOLL FREE 800 447-4700. IN ILLINOIS, 800 322-4400.

Technics

by Panasonic



NEW

AC & BATTERY POWERED SUBBER™



Latest, all solid state version of the sensational signal circuit analyzing timesaver originated by Castle.

Invaluable for locating the break in the tuner and i.f. signal chain or analyzing agc system defects in tube TV receivers . . . essential for speedy location of signal circuit defects in modular IC, solid state and hybrid TV receivers.

A NEW APPROACH to agc system analyzing!

Permits signal injection after the agc controlled stages to simplify testing for agc defects.

- Works with any 40MHz receiver . . . color or black and white . . . solid state, tube or hybrid.
- High level, low impedance output furnishes signal usable at input of final i.f. stage.
- Special output circuit works equally well into first i.f. input of late model, link coupled systems and older, low "C" bandpass coupled systems.
- Antenna input and i.f. output electrically isolated; no "hot" chassis hazards.
- No need to disconnect supply leads from suspected tuner being tested. Substitutes the VHF tuner and tests the UHF tuner.
- Tunes all 12 VHF channels, has preset (memory) fine tuning on all channels.
- Higher overall gain than previous models with wide range gain reduction control of 60db.
- Completely self contained and battery operated, uses popular batteries available everywhere. Simple battery replacement; battery compartment in rear of custom molded case.
- Reduced current consumption extends battery life to as much as double that of previous models. Bright LED indicator warns when unit is ON.
- Use on the bench or in the home . . . anywhere.
- Comes complete with extension cables, batteries and instructions.

Specifications

Inputs:	300 ohms balanced VHF antenna terminals, electrically isolated. 75 ohms 40 MHz amplifier (Ch. #1) RCA Phono jack.
Sensitivity:	30 microvolts. Input signal handling capability: over 100,000 microvolts.
Output:	40 MHz TV i.f.; bandwidth 6 MHz. "Mastermatchcoupler" output circuit with matched cable to furnish usable signal for all input circuits. Termination is RCA Phono Jack, electrically isolated.
Tuning Range:	All 12 VHF TV channels, plus Ch. #1 40 MHz amplifier position for testing UHF tuners. High stability of 40 MHz amplifier permits two Mk. IV Subbers to be cascaded for high level 40 MHz output signal from any VHF channel.
Tuning:	Preset (memory) fine tuning.
Gain Control:	Gain reduction 60 dB.
Power supply:	18 volts. Uses two 9v transistor batteries.
Size & Weight:	6.5" x 6.5" x 3.25" exclusive of control knobs and handles. 1.5 lbs complete with batteries.
Accessories:	"Mastermatchcoupler" output cable with RCA phono jack termination. "Mastermatchcoupler" output cable with alligator clip terminations. UHF tuner test cable.

Contact your distributor.

TV TUNER SUBBER™ Mark IV (Battery model) net \$45.95

TV TUNER SUBBER™ Mark IV-A (120 VAC + Battery model) net \$54.95

All battery only models of the SUBBER may be factory modified for 120 VAC use.
Contact your distributor for details and cost or write Castle TV.

CASTLE TV TUNER SERVICE, INC.

5715 N. Western Ave., Chicago, Illinois 60645 • Phone: (312) - 561-6354

In Canada: Len Finkler Ltd., Ontario

Circle 74 on reader service card

