Electronics World

SEPTEMBER, 1971
60 CENTS

DIRECTORY OF COLOR-BAR GENERATORS FOR SERVICING

HOW ELECTRONICS HELPS FIGHT AIR POLLUTION

HAND TOOLS FOR SERVICING & MAINTENANCE

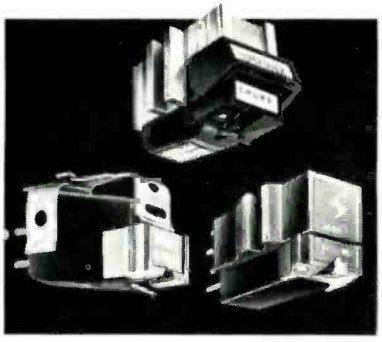
HI-FI LAB REPORTS— Wharfedale W-35 Speaker & Pickering V-15 Phase IV Cartridge

WHICH COMPUTER

Desk Top—Mini—or Time Sharing

FOR THE ENGINEER-TECHNICIAN?

To each his own.



Not *everybody* needs a concert grand piano, nor does everybody *need* the best cartridge Shure makes to enjoy his kind of music on his kind of hi-fi system. Eventually, you'll want the renowned *V-15 Type II Improved,* the peerless cartridge for advanced systems and ample budgets. But, if your exchequer is a little tight, consider the *M91E*, widely acclaimed as the *second best* cartridge in the world. With a sharply circumscribed budget, all is *far* from lost. Choose any of the four models in the *M44 Series*, built for optimum performance in the easy-to-take $18-25 price range. Write for a complete catalog:

Shure Brothers Inc.,
222 Hartrey Ave., Evanston, Illinois 60204.

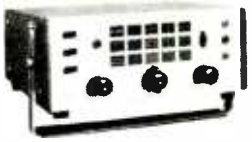
SHURE

CIRCLE NO. 150 ON READER SERVICE PAGE

Why does LEADER

give you Four Color Bar Generators?

MODEL LCG-384
MINI-PORTABLE, BATTERY-OPERATED, SOLID STATE PRECISION



MODEL LCG-388
THE ULTIMATE IN PATTERN STABILITY THROUGH DIGITAL ACCURACY

MODEL LCG-389
RELIABILITY AND STABILITY, IN-SHOP OR ON-CALL.

MODEL LCG-390
SURE DEPENDABILITY UNCHANGED BY TEMPERATURE EXTREMES.

Because we know what you need...when you want it!

$109.50

High quality test patterns through our exclusive digital clock binary system! Uses just four 1.5V penlight cells, is AC adaptable and fits into all tube caddies. Has 2 pushbutton selectable frequencies. 8 basic patterns, with gated rainbow; and temperature change protection. Includes carry case, extra battery comp't and all accessories.

$159.50

The finest available thanks to our unique digital clock, binary frequency divider. Features: lab grade performance in 15 patterns for both RF and video frequencies with single dot and crosshatch; two switch selectable channels; regulated DC power supply and ambient temperature control. All accessories incl.

$99.00

Stable operation that's hard to beat! Fits into any caddy for use on call or on the bench. Offers our exclusive binary frequency dividers for reliable operation plus a convenient scuff-proof carry case. Patterns include gated rainbow, dots, crosshatch, horizontal and vertical lines. All accessories, carry case incl.

$119.50

Crystal controlled oscillators, PC board construction and our own digital clock frequency dividers assure full reliability, regardless of temperature. Patterns include gated rainbow, R-Y, B-Y and —(R-Y); dots; crosshatch; single crosshatch. All leads, gun-killers, accessories incl.

Instruments to believe in. Leader

Send for catalog. See Your Distributor.

INSTRUMENTS CORP.
37-27 Twenty-Seventh St. Long Island City, N.Y. 11101 (212) 729-7410

CIRCLE NO. 122 ON READER SERVICE PAGE

Electronics World

SEPTEMBER 1971 VOL. 86, No. 3

Contents

Electronics World

THIS MONTH'S COVER shows three of the newest programmable calculators on the market. Offering many features of the minicomputer but more sophisticated than electric calculators, these compact desk-top units are gaining wide acceptance. Shown at top is the Olivetti P602 with magnetic card memory; bottom Wang Series 700 which uses cassette tape memory, and the Hewlett-Packard 9100A also with magnetic card memory. See article on page 27 for details on such calculators.

Publisher
LAWRENCE SPORN

Editor
WM A. STOCKLIN

Managing Editor
PRISCILLA B. HOEFER

Assistant Editor
STELLA HALL

Contributing Editors
WALTER H. BUCHSBAUM
Prof. ARTHUR H. SEIDMAN
FOREST H. BELT

Art Editor
RICHARD MOSS

Technical Illustrator
J. A. GOLANEK

Advertising Manager
JOSEPH E. HALLORAN

Advertising Service Manager
MARGARET DANIELLO

Associate Publisher
STANLEY NEUFELD

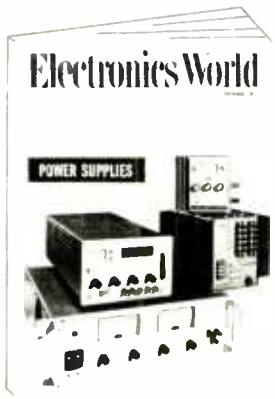
Group Vice President Electronic & Photographic
FURMAN H. HEBB

September, 1971

MONTHLY FEATURES

Coming Next Month

Special Issue



POWER SUPPLIES

Four important, timely articles covering the various aspects of power supplies. Ed Brenner of Lambda discusses the general-purpose supply which is uniquely suited to bench-type lab work; Geoffrey Walker of Hewlett-Packard tells how SCR supplies can provide large amounts of fixed or slowly varying d.c. power; Fred Heath of Trio Labs explains why switching regulator supplies are so useful in applications requiring light weight and low heat dissipation—even if they are more expensive; while Paul Birman of Kepco discusses the use of operational amplifiers in the control of a.c.-d.c. power supplies, making it possible to control analog output by digital instructions.

Hirsch-Houck Lab Tests Stereo Headphones

The increase in "audio pollution" in many locations has switched audiophiles from speakers to headphones in their desire for high-fidelity reproduction. This "survey" analyzes the performance and features of thirty such units from twelve of the leading manufacturers.

Which Computer—The Minicomputer?

The second of three articles covering the different types of computers suitable for the technician/engineer. According to Rob Katz of Digital Equipment Corp., the minicomputer has many of the advantages of the programmable calculator and the time-sharing computer—yet few of the disadvantages of either. See why he thinks so.

Interstellar Communications

All attempts to pick up intelligent communications from the stars have failed thus far, but some scientists are still wondering about intelligent beings on other worlds and our ability to contact them. Read what is being done in field.

*All these and many more interesting and informative articles will be yours in the **October** issue of ELECTRONICS WORLD . . . . . on sale **September 21st.***

ZIFF-DAVIS PUBLISHING COMPANY

William Ziff, President
W. Bradford Briggs, Executive Vice President
Hershel B. Sarbin, Senior Vice President and Secretary
Stanley R. Greenfield, Senior Vice President
Philip Sine, Financial Vice President and Treasurer
Walter S. Mills, Jr., Vice President, Circulation
Phillip T. Heffernan, Vice President, Marketing
Frank Pomerantz, Vice President, Creative Services
Arthur W. Butzow, Vice President, Production
Edward D. Muhlfeld, Vice President, Aviation Division
Irwin Robinson, Vice President, Travel Division
George Morrissey, Vice President
Sydney H. Rogers, Vice President

Editorial and Executive Offices
One Park Avenue
New York, New York 10016
212 679 7200

NEW YORK OFFICE
212 679 7200
Joseph E. Halloran, Adv. Mgr

MIDWESTERN OFFICE
307 North Michigan Avenue
Chicago, Illinois 60601 312 726-0892
George B. Mannion, Jr.

WESTERN OFFICE
9025 Wilshire Boulevard
Beverly Hills, California 90211
213 CRestview 4-0265, BRadshaw 2-1161
Western Advertising Manager Bud Dean

JAPAN: James Yagi, Oji Palace Aoyama
6-25, Minami Aoyama, 6-Chome, Minato-ku
Tokyo 407-1930/6821

CIRCULATION OFFICE
P.O. Box 1093, Flushing, N.Y. 11352

MPA · HIGH FIDELITY · ABC

Member Audit Bureau of Circulations

Radio & TV News ● Radio News ● Radio-Electronic Engineering Trademarks Reg. U.S. Pat. Off.

SUBSCRIPTION SERVICE: Forms 3579 and all subscription correspondence should be addressed to Electronics World, Circulation Department, P.O. Box 1093, Flushing, N.Y. 11352. Please allow at least eight weeks for change of address. Include your old address, as well as new—enclosing if possible an address label from a recent issue.

EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care, however publisher assumes no responsibility for return or safety of art work, photographs, or manuscripts.

ELECTRONICS WORLD (September, 1971, Vol. 86, No. 3) Published monthly at One Park Avenue, New York, New York 10016, by Ziff-Davis Publishing Company—also the publishers of Airline Management, Boating, Business & Commercial Aviation, Car and Driver, Cycle, Flying, Modern Bride, Popular Electronics, Popular Photography, Skiing, Skiing Area News, Skiing Trade News, Stereo Review, and Travel Weekly. One year subscription rate for U.S., U.S. Possessions, and Canada, $7.00, all other countries, $8.00. Second Class postage paid at New York, N.Y. and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada and for payment of postage in cash.

NEW IR-18M solid-state 12-speed chart recorder kit

NEW GR-371MX 25" square-corner solid-state color TV kit

NEW GD-29 microwave oven kit

NEW IB-101 solid-state 15 MHz frequency counter kit

NEW IB-102 175 MHz solid-state frequency scaler kit

NEW IO-102 solid-state 5" scope kit

NEW IM-105 solid-state VOM kit

Seven new Heathkit® improvement ideas for home or shop

NEW! **Heathkit IR-18M 10" chart recorder kit** provides 12 different chart speeds...instant pushbutton selection from 5 sec/in. to 200 min/in. Digital logic delivers accuracy unobtainable with ordinary gear trains. Two input ranges permit accurate measurements from 0-1 & 0-10 mV full scale. Hi-Z input minimizes loading. 3-terminal floating input. Light-operated modulator eliminates problems of a mechanical chopper...operates at 240 Hz to reduce 60 Hz noise. Internal temperature-stabilized reference voltage eliminates troublesome reference battery. Coarse & Fine zero controls allow fast, accurate pen positioning. Other features: versatile pen holder that accepts virtually any writing instrument & hinged top for easy paper loading. For the best value going in a chart recorder, order your IR-18M now. **Kit IR-18M, 15 lbs., 149.95***

NEW! **GR-371MX 25" solid-state ultra-rectangular color TV.** Check out the competition for standard features like these: 25" square corner Matrix picture tube for the biggest, brightest, sharpest color picture ever...high resolution circuitry plus adjustable video peaking ...Automatic Fine Tuning...pushbutton channel advance..."Instant-On"...Automatic Chroma Control...factory assembled 3-stage solid-state IF and VHF & UHF tuners for superior reception, even under marginal conditions...adjustable noise limiting & gated AGC...adjustable tone control...hi-fi sound output to internal speaker or your hi-fi system. Plus your choice of installation in one of the three beautiful Heath cabinets or custom wall mounting capability. And the exclusive Heath self-service features let you do all normal adjustment & servicing, saving hundreds of dollars in service costs. If you want the finest, this is it...order your 371MX now. **Kit GR-371MX, 125 lbs. 579.95***

NEW! **GD-29 microwave oven**...the most modern way to prepare food. Cooks up to 70% faster with better vitamin retention. Cooks on glass, ceramics, even paper plates. low profile design fits under cupboards easily, yet has one of the largest oven capacities in the industry. Operates anywhere on standard 120 VAC current. Kit includes specially prepared cookbook. **Kit GD-29, 97 lbs. ..... 379.95*** Roll-around cart gives oven easy mobility, **Model GDA-29-1, 24.95***

NEW! **IB-102 Scaler and IB-101 Frequency Counter** combination give you frequency measurement capability to 175 MHz at low, low cost. IB-101 counts from 1 Hz to over 15 MHz. Hz/kHz ranges & over-range indicator let you make an 8-digit measurement down to the last Hz in seconds. 5-digit cold-cathode readout...extremely low input triggering...all solid-state with 26 ICs, 8 transistors. NEW IB-102 Frequency Scaler can be used with virtually any counter on the market to extend your measurement capability well into the VHF range...at a price far below the cost of a 175 MHz counter. 10:1 and 100:1 scaling ratios give resolution down to 10 Hz...1:1 ratio provides straight-thru counting for frequencies in range of counter. Exclusive Heath input circuit triggers at very low levels – at 100 MHz less than 30 mV is needed. A handy Test switch gives a quick, accurate check of proper operation. All solid-state; fully regulated supplies; convenient carrying handle/tilt stand. Extend your frequency measurement capability now with these two new kits. **Kit IB-101, 7 lbs. ....199.95*** **Kit IB-102, 7 lbs. 99.95***

NEW! **IO-102 solid-state 5" scope** ideally suited for general purpose service & design work. Features wide DC-5 MHz response, 30 mV/cm sensitivity and 80 ns rise time. Switch-selected AC or DC coupling for greater versatility. Frequency-compensated 3-position attenuator. FET input provides hi-Z to minimize circuit loading. Recurrent, automatic-sync type sweep provides five ranges from 10 Hz to 500 kHz with vernier. External horizontal and sync inputs are also provided. One volt P-P output provides an accurate comparison voltage source. Additional features include a big 5" CRT with high visibility trace; 6x10 cm ruled graticule that can be replaced with a standard camera mount; solid-state zener-regulated supplies for extra display stability and 120/240 VAC operation. An excellent all-around scope that belongs on your bench now. **Kit IO-102, 29 lbs., 119.95***

NEW! **IM-105 solid-state portable VOM**...an extremely rugged, highly accurate, low cost meter for hundreds of applications. High impact Lexan® case and ruggedized diode & fuse protected taut-band meter movement will suffer extreme abuse and still maintain specifications. 95° wide viewing area provides high resolution. 3% DC accuracy; 4% AC accuracy; 3% DC current accuracy. Temperature compensated. 8 DCV ranges from 0.25 to 5000 V full scale...7 ACV ranges from 2.5 to 5000 V full scale...6 DC current ranges from 0.05 mA to 10 A full scale...5 ohms ranges from x1 to x10k with center scale factor of 20...5 dB ranges from −10 to +50 dB. Other features include DC polarity reversal switch; front panel thumbwheel ohms zero; self-storing handle and fast, easy assembly. A lot of meter at a little cost...that's the new IM-105. Order yours now. **Kit IM-105, 7 lbs., 47.95***

See these kits at your local Heathkit Electronic Center . . . or Send for Free Catalog

CALIF.: Anaheim, 330 E. Ball Road; **El Cerrito,** 6000 Potrero Avenue; **La Mesa,** 8363 Center Drive; **Los Angeles,** 2309 S. Flower St.; **Redwood City,** 2001 Middlefield Rd.; **Woodland Hills,** 22504 Ventura Blvd.; **COLO.: Denver,** 5940 W. 38th Ave.; **GA.: Atlanta,** 5285 Roswell Road; **ILL.: Chicago,** 3462-66 W. Devon Ave.; **Downers Grove,** 224 Ogden Ave.; **MD.: Rockville,** 5542 Nicholson Lane; **MASS.: Wellesley,** 165 Worcester St.; **MICH.: Detroit,** 18645 W. Eight Mile Rd.; **MINN.: Hopkins,** 101 Shady Oak Rd.; **Mo.: St. Louis,** 9296 Gravois Ave.; **N.J.: Fair Lawn,** 35-07 Broadway (Rte. 4); **N.Y.: Jericho, L.I.,** 15 Jericho Turnpike; **New York,** 35 W. 45th Street; **OHIO: Cleveland,** 5444 Pearl Rd.; **Woodlawn,** 10133 Springfield Pike; **PA.: Philadelphia,** 6318 Roosevelt Blvd.; **Pittsburgh,** 3482 William Penn Hwy.; **TEXAS: Dallas,** 2715 Ross Avenue; **Houston,** 3705 Westheimer; **WASH.: Seattle,** 2221 Third Ave.; **WIS.: Milwaukee,** 5215 W. Fond du Lac.

Retail Heathkit Electronic Center prices slightly higher to cover shipping, local stock, consultation and demonstration facilities. Local service also available whether you purchase locally or by factory mail order.

HEATHKIT
a Schlumberger company

HEATH COMPANY, Dept. 15 9
Benton Harbor, Michigan 49022

☐ Enclosed is $_____, plus shipping.
Please send model (s)_____
☐ Please send FREE Heathkit Catalog. ☐ Please send Credit Application.
Name_____
Address_____
City_____ State_____ Zip_____

*Mail order prices; F.O.B. factory.
Prices & specifications subject to change without notice. CL-411

LETTERS

LARGE D.C. MOTORS

To the Editor:

Regarding your January, 1971 article, "Speed Control for Large D.C. Motors," I was amused by what you consider *large*, since the article covered fractional-horsepower motors.

Our company manufactures rectifiers and related equipment for d.c.-motor-driven power tools. One of our current models uses a variable autotransformer which feeds into a full-wave bridge/filter circuit to supply variable d.c. voltages of from 0 to 170 volts at 15 amps. Our equipment has been occasionally abused by construction workers who attach it to a.c. motors or use it for arc welding, which burns the carbon brushes on the autotransformer and melts the copper wire contact surface, causing irreparable damage.

We have developed and are now testing a solid-state d.c. motor speed control which eliminates the variable autotransformer. It uses a variation of phase-shift control, delivering at the output low-ripple, filtered direct current. Our prototype delivers 10 amps d.c. variable 5 to 120 volts and has an allowable maximum demand of 20 amps for 10 seconds.

Incidentally, we are currently developing the circuit to handle *large* crane and mill motors—to the 500 horsepower range.

EDWARD HECK, Chief Engineer
Price & Rutzebeck
Hayward, Cal.

* * *

HI-FI VOLUME EXPANDER

To the Editor:

I was glad to see the June, 1971 article by Richard Wilt on a "Low-Distortion Hi-Fi Volume Expander." I have been using a somewhat more sophisticated expander for a year now and it has added significantly to my listening pleasure. I would urge interested readers to try Mr. Wilt's unit. However, I beg to differ with the author on one point.

He recommends placing the expander between the preamp and the power amp. I have obtained better results with the unit in the tape monitor circuit.

If placed at the power-amp input, tone controls can influence the amount of expansion, leading to possible amplifier overload or blown-out speakers. Moreover, the expander placed at the preamp outputs is required to handle a wider voltage range, which could also create problems, depending on the expander design.

If placed in the tape monitor circuit, however, not only is there a narrower input voltage range to the expander, but the program source is the sole determining factor in the amount of expansion—which is as it should be.

With some systems, it may be necessary to add a monitor switch so that the expander can be used with all program sources and not just with a tape recorder, but this switch can be easily incorporated into the expander chassis design.

FORREST C. GILMORE
Valley Station, Kentucky

* * *

TURNTABLE TESTING

To the Editor:

We are interested in using the speed-test method referred to by Julian Hirsch in his June, 1971 article on "Automatic Turntables."

At present, we are using a similar system on all types of tape recorders. We have produced our own tapes of various types, using locally available professional tape transports, but we have not been able to produce or locate a suitable frequency test record of the type he described. We would be most appreciative if you could advise us where such a record is available.

W. H. GEARHART, JR.
The Crestline Co.
Corpus Christi, Texas

The record Mr. Hirsch referred to is the CBS *STR-100, available from* CBS Labs, *High Ridge Rd., Stamford, Conn. 06906.—Editor*

* * *

DWELL/TACH

To the Editor:

In Jon Colt's May, 1971 article, "Dynamic Dwell/Tachometer," instructions for calibration of the dwell portion were omitted from the third-from-last paragraph on page 80.

I would appreciate receiving this additional information.

S. HALL
Brooklyn, N.Y.

After you have attached the power and ground leads appropriately under

the hood—while the engine is running—temporarily attach the "to points" lead (See Fig. 2) to the car battery's positive terminal. Then adjust R5 for the appropriate dwell set for your car. (The readings indicated in the article are correct as is.) Just remember to remove the "to points" lead and attach it appropriately again after you have completed the dwell calibration measurements.

JON COLT
Tucker, Ga.

* * *

V.T.V.M. BATTERY ELIMINATOR

To the Editor:

I would like to thank Mr. Warren G. Heller for his article "V.T.V.M. Battery Eliminator" in the April issue of ELECTRONICS WORLD (page 72).

I built mine on a phenolic board and installed it inside the instrument housing. For *D*1 and *D*2, I used *IR*'s SD500-F diodes; for *C*1, *C*2, *C*3, and *C*4, I used a 1000-μF, 15-volt capacitor; for *Q*1 and *Q*2, I used a *GE*-28 and a *GE*-20, respectively.

It works like a champ in my *Conar* Model 211.

THOMAS E. SHAFFER
Dwight, Ill.

* * *

WAVESHAPING WITH LOGIC GATES

To the Editor:

I wish to take this opportunity to acknowledge the invaluable assistance of Mr. Gayle C. Russell of *Texas Instruments, Inc.*, with my article "Waveshaping With Logic Gates" which appeared in a recent issue of ELECTRONICS WORLD. Since Mr. Russell's work resulted in the final circuit forms and empirical data presented in the article, I feel his contribution should be recognized.

JAMES E. MCALISTER
West Helena, Ark.

* * *

SPECIAL SECTIONS

Reprints of the seven "Special Sections" listed below are still available at 25c each from ELECTRONICS WORLD, *One Park Ave., New York, N.Y. 10016.*

"Computer Memories"	*October, 1970*
"Linear IC's"	*July, 1970*
"Solid-State Diodes"	*July, 1969*
"Filters"	*April, 1969*
"Cables & Connectors"	*October, 1968*
"Linear IC's"	*July, 1968*
"Power Supplies"	*April, 1968*

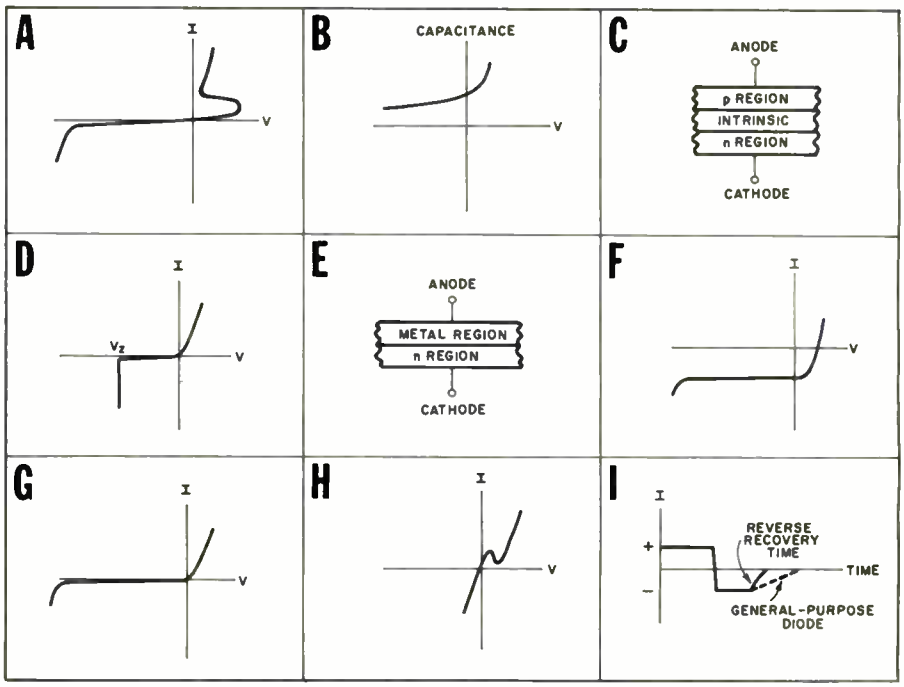
Diode Quiz

By WESLEY A. VINCENT
Electronic Engineer, Motorola Inc.
Government Electronics Division

Here's a chance to determine your "diode quotient" by taking this test.

TEST your ability to recognize different diode characteristics. Match the I-V curve or other distinguishing characteristic shown in the figure with the correct diode type listed below. Answers, with a brief description of each diode, are printed upside-down below.

1. Zener diode ( )
2. Rectifier diode ( )
3. Varactor diode ( )
4. "P-n-p-n" diode ( )
5. "P-i-n" diode ( )
6. Step-recovery diode ( )
7. Photodiode ( )
8. Tunnel diode ( )
9. Schottky-barrier diode ( )



Answers

1. **(D)** The zener diode consists of a *p-n* junction operated in the reverse-bias breakdown mode. This zener region is used for voltage regulation or to supply a known voltage reference. Commercial diodes are available with zener voltages from about 2.4 to 200 volts with a tolerance of ±5%.

2. **(G)** Ordinary rectifier diodes are used in a wide variety of general-purpose applications including rectifiers, switching circuits, and as biasing components. One of the earliest electronic components, a majority of early radios used rectifying diodes for detection.

3. **(B)** The varactor diode utilizes the voltage-variable depletion capacitance of a *p-n* junction for its operation. Varactors are used to tune receivers, for harmonic generation in multipliers, and other applications where its unique characteristics can be employed.

4. **(A)** The *p-n-p-n* diode consists of four semiconductor layers with two *p-n* junctions. This diode is useful in switching circuits. When the forward blocking voltage is exceeded, the diode switches from its high-impedance "off" state to low-impedance "on" state. An SCR results with the addition of a gate connection to an inner semiconductor region.

5. **(C)** The *p-i-n* diode derives its name from an intrinsic semiconductor region sandwiched between *p*- and *n*-type regions. This special diode is used at high frequencies as a microwave switch, or as a variable resistance when its conductance is altered by changing the applied bias.

6. **(I)** The step-recovery diode is designed so that it has a short reverse recovery time when switched to a reverse-bias "off" state. The sharp turn-off transition makes this diode especially suited for harmonic generation and for use in pulse generators.

7. **(F)** The I-V curve for the photodiode, when illuminated, is shown. Without light its I-V characteristics are similar to the rectifier diode. Since light causes the normally "dark" reverse current to increase, the photodiode is useful in light-sensing applications.

8. **(H)** The tunnel diode relies on the tunneling phenomenon, which causes the current to peak at low forward voltages. Tunneling occurs as the forward voltage increases until usual barrier injection takes over. Tunnel diodes are used for high-speed switching, microwave circuits, and many other applications.

9. **(E)** The Schottky-barrier diode, also called a hot-carrier diode, consists of metal and usually *n*-type semiconductor regions. Storage time, a delay allowing current to flow after forward bias is removed, is virtually non-existent for this diode. Thus the Schottky-barrier diode is used mainly in extremely fast switching circuits.

HI-FI PRODUCT REPORT

EW LAB TESTED

by Hirsch-Houck Labs

Wharfedale W-35 Speaker System
Pickering V-15 Phase IV Stereo Cartridge

Wharfedale W-35 Speaker System

For copy of manufacturer's brochure, circle No. 1 on Reader Service Page.

THE *Wharfedale* W-35 is a compact, low-priced speaker system, whose shape and size provide more than usual versatility in mounting and room placement.

Basically, the W-35 is housed in a square-format oiled-walnut cabinet, 15" on a side and 8" deep. Weighing only 16½ pounds, it can be installed on any bookshelf where its depth can be used to advantage. Of course, it is equally adaptable to placement on almost any cabinet or table, or even on the floor.

The rear edges of the cabinet are sliced off at 45-degree angles so that the W-35 can be installed snugly in any corner. An optional mounting bracket (the Model B-66) is available for wall mounting in a corner. The speaker grille is about 14" from the corner when so mounted. Aside from esthetic considerations, corner mounting improves the bass response of any speaker and the effective high-frequency dispersion is improved because the listener is always within 45 degrees of the speaker axis.

The W-35 is a three-way, 8-ohm system in a fully sealed enclosure. It uses an 8" woofer, a 3¼" mid-range speaker, and a 2½" tweeter. Shallow, curvilinear cones are used on the latter two drivers for improved dispersion. Separate level controls are provided for the two higher frequency speakers. The crossover network, whose frequencies are not specified, has 12 dB/octave slopes.

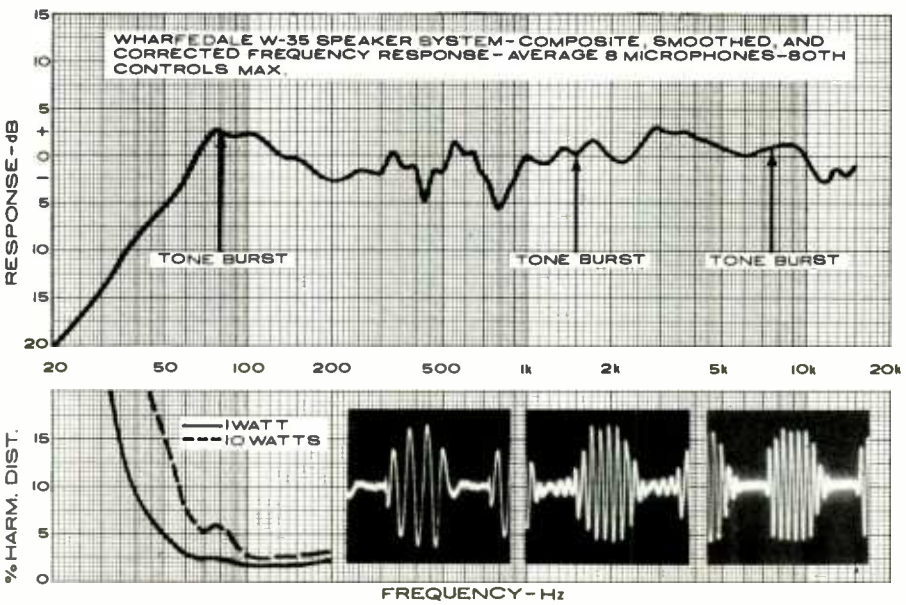
Our frequency-response measurements, in which we tried various combinations of level-control settings, suggested that the woofer/mid-range crossover takes place at about 800 Hz, while the transition to the tweeter occurs at about 2500 Hz. The controls have considerable range and permit tailoring the over-all response of the system to suit the room environment, mounting position, or personal taste.

With all level controls at maximum, the W-35 has a very uniform frequency response, with no significant peaks or holes. It was within ±3 dB from 57 Hz to 13 kHz, and within ±2 dB from 450 Hz to 10 kHz. The high-frequency dispersion was fairly good, but we feel that corner mounting could be used to good advantage to cover all parts of the listening area with the full frequency range of the speaker.

The tone-burst response of the W-35 was generally good, with no tendency to ring or generate spurious frequencies. However, 2 or 3 cycles were required for the burst output to build up to its final output level or to decay fully, suggesting a slightly over-damped system.

The low-frequency distortion at a 1-watt drive level was low above 60 Hz, rising to 5% at 50 Hz and 10% at 40 Hz. This was measured with center-wall mounting; some improvement could be expected with corner mounting. Increasing the drive to 10 watts caused a considerable increase in low-frequency harmonic distortion, to 5% at 85 Hz and 10% at 57 Hz. This is in contrast to many other speakers whose distortion rises only slightly with increased power, at frequencies above their "break point." Fortunately, the W-35 is quite efficient in comparison to most other speakers of similar size or price—about 3 to 6 dB more efficient over most of its frequency range. This means that it can produce a strong, clean output with moderate drive levels and should never require undue "pushing" to develop a more-than-adequate listening level.

The electrical impedance of the W-35 varied over rather wide limits, reaching its maximum of 25 ohms at the bass system resonance of 70 Hz, and with another broad maxi-



mum of 18 ohms at about 800 Hz. The minimum impedance of 4.5 ohms occurred at about 10 kHz.

How does the W-35 sound? Very good indeed, although some care is needed in adjusting its level controls for proper balance. We found maximum high-frequency level and about ⅔ mid-range level to be the best in our somewhat "live" listening room. In the "live *vs* recorded" listening test, using a specially prepared tape and reference speaker system, the W-35 acquitted itself admirably. The highs were almost perfect, although the reproduction of wire brush and cymbal sounds gave evidence of diminished output above about 10 kHz (which also showed up in our frequency-response measurements). Most of the mid-range was reproduced faithfully, with a slight coloration of the lower middles. Over-all, the balance was excellent, with the system sounding neither bassy nor over-bright. Although the small size and physical design of the W-35 allows it to be installed unobtrusively in a small den, its sound is perfectly suited—both in magnitude and quality—in any living room.

The *Wharfedale* W-35 carries a list price of $82.00, with a suggested "minimum resale" price of $69.75. ▲

Pickering V-15 Phase IV Stereo Cartridge

For copy of manufacturer's brochure, circle No. 2 on Reader Service Page.

PICKERING's XV-15 series of stereo phono cartridges, with its unusually wide choice of styli having different sizes, shapes, and tracking-force requirements, has been further augmented by the new V-15 Phase IV cartridge.

The V-15 Phase IV series, which includes four models, is basically quite similar to the XV-15 design. The most obvious external change is in the mounting system, which features a "keystone" mounting adapter. This is a plastic plate which can be installed in many tonearm shells separately from the cartridge. Then the cartridge slides into the "keystone" grooves and locks into place when pushed fully forward. Cartridge removal requires only pressing on the front of the clip and sliding the cartridge to the rear, without removing any screws or disturbing the position of the mount in the arm.

The removable, stylus assembly has the same "V-Guard" design used in the other *Pickering* cartridges and can be pulled out or inserted in an instant without the use of tools. It carries the "Dustamatic" brush, a soft hinged brush that rides on the record surface just ahead of the stylus and effectively removes surface dust and lint from the record as it is played. The brush weighs one gram and allowance is made for this by setting the arm tracking force one gram higher than the rated tracking force after it has been balanced.

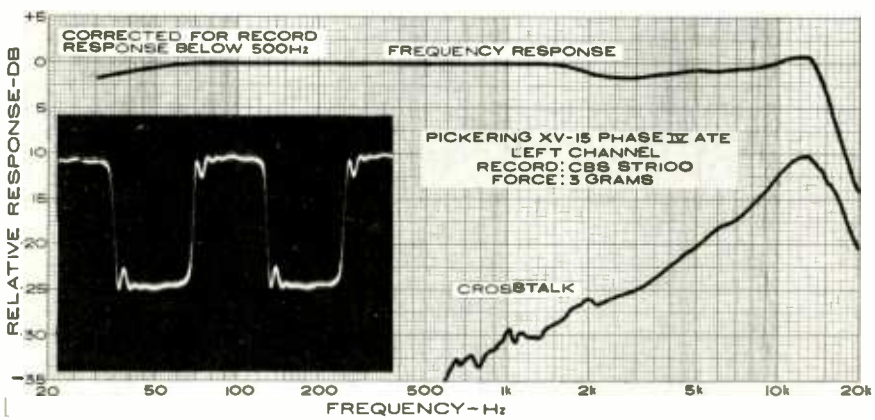
At this time, the Phase IV series includes the AME, a 0.3 × 0.8-mil elliptical stylus tracking at 1¼ grams; the AM, a 0.7-mil spherical stylus tracking at 2 grams; the ATE, a 0.4 × 0.8-mil elliptical stylus for 3-gram operation in automatic turntables; and the AT, which is similarly rated but has a 0.7-mil spherical stylus. Two accessory styli are also available (and the ease of changing them makes their use entirely practical). These are the 4510, a 1.0-mil spherical stylus for playing LP mono records and the 4527, a 2.7-mil spherical stylus for old 78 r/min records. Their rated ranges of tracking force are 2-5 and 3-7 grams, respectively.

For this report, we tested the V-15 Phase IV ATE installed in a *Garrard* Zero 100 automatic turntable arm. A stylus force of 3 grams was required for optimum tracking of very high level low-frequency and middle-frequency signals. The output from the 3.54 cm/s bands of the *CBS* STR100 record was about 8.9 millivolts. This is somewhat higher than the value that is indicated in the manufacturer's specifications.

The output of the V-15 Phase IV ATE was quite uniform, within ±1.5 dB up to about 15 kHz and fell off rapidly at higher frequencies. Stereo channel separation was good, better than 30 dB at mid-frequencies and between 10 and 13 dB from 10 kHz upward.

IM distortion was satisfactory up to stylus velocities of about 18 cm/s, increasing rapidly above that point. Increasing the tracking force to 4 grams (the maximum recommended value) reduced the high-level IM distortion slightly, but not enough to warrant the higher force. Hum shielding was fair (as compared to other cartridges we have tested) and no problems from induced hum are likely to occur.

The 1000-Hz square-wave response from the *CBS* STR110 record was very good. In fact, the only significant departure from ideal shape was a single cycle of low-level ringing.



The V-15 Phase IV ATE had a good listening quality, without any obvious coloration or audible distortion. Its 3-gram tracking force is compatible with the requirements of most low-priced automatic turntable arms. The 0.4 × 0.8-mil stylus shape is relatively "mild" as elliptical styli go, and should not produce undue record wear at the rated force.

Price of the *Pickering* V-15 Phase IV ATE is $39.95. ▲

THE SANSUI QS-I QUADPHONIC SYNTHESIZER®

SANSUI QS-I

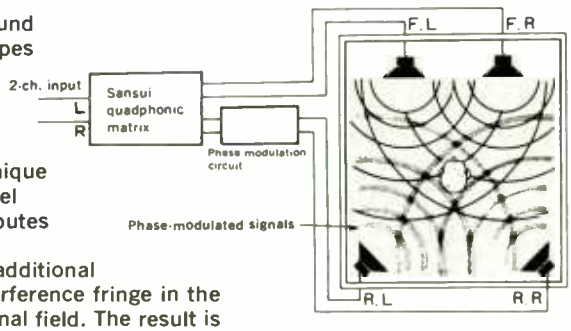
4-CHANNEL SOUND FROM ANY 2-CHANNEL SOURCE

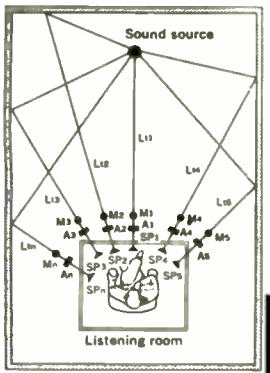
Senses and recovers the ambient information hidden in your stereo discs, tapes and broadcasts

After having discovered that the ambient components of the original total sound field are already contained in hidden form, in conventional stereo records, tapes and broadcasts, Sansui engineers developed a method for sensing and recovering them. These subtle shifts and modulations, if re-introduced, breathtakingly recreate the total of the original sound as it existed in the recording or broadcast studio.

The heart of the Sansui Quadphonic Synthesizer* is a combination of a unique reproducing matrix and a phase modulator. The matrix analyzes the 2-channel information to obtain separate direct and indirect components, then redistributes these signals into a sound field consisting of four distinct sources.

This type of phase modulation of the indirect components, applied to the additional speakers, adds another important element. It sets up a complex phase interference fringe in the listening room that duplicates the multiple indirect-wave effects of the original field. The result is parallel to what would be obtaind by using an infinite number of microphones in the studio (Ml through Mn in the accompanying illustration) and reproducing them through a corresponding number of channels and speakers.





The startling, multidimensional effect goes beyond the four discrete sources used in conventional 4-channel stereo, actually enhancing the sense of spatial distribution and dramatically expanding the dynamic range. Also, the effect is evident anywhere in the listening room, not just in a limited area at the center. And that is exactly the effect obtained with live music! This phenomenon is one of the true tests of the Quadphonic system.

The Sansui Quadphonic Synthesizer QS-1 has been the talk of the recent high-fidelity shows at which it has been demonstrated throughout the country. You have to hear it yourself to believe it. And you can do that now at your Sansui dealer. Discover that you can hear four channels plus, today, with your present records and present stereo broadcasts. $199.95.

*Patents Pending

Sansui®

SANSUI ELECTRONICS CORP.
Woodside, New York • Gardena, California

SANSUI ELECTRIC CO., LTD., Tokyo, Japan • Frankfurt a M., West Germany
Electronic Distributors (Canada), British Columbia

FIVE VITAL COMPONENTS

FOR KNOWLEDGE . . . FOR PROFIT . . . FOR SHEER MUSIC AND ELECTRONICS ENJOYMENT!

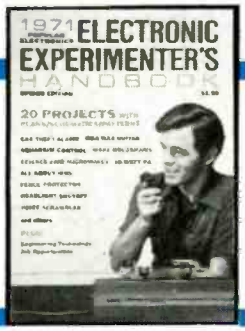
OUT-OF-PRINT
NO LONGER
AVAILABLE

1971 STEREO/HI-FI DIRECTORY

The complete guide to everything you need for your home music system. Everything available from all the manufacturers: amplifiers • tuners • receivers • chargers • tape machines—cartridge, cassette and reel-to-reel • speakers • cabinets • compact hi-fi systems • cartridges, arms, accessories. Picture-crammed pages and complete, accurate, reliable facts on every piece of equipment including full technical specifications, model numbers, dimensions, special features, optional accessories, manufacturers prices. If you intend to buy just one new piece of equipment this year getting hold of the 1971 Stereo/Hi-Fi Directory is your most important first step.

1971 TAPE RECORDER ANNUAL

The experts guide to getting the best use and pleasure from your tape recorder. What's available and how to choose what's best for you! WHAT TO BUY: reel-to-reel recorders, 4 and 8 track cartridge players, cassettes; HOW TO USE IT: taping off the air, tape editing, using test tapes; TAPE TACTICS: tape recorder maintenance, replacing your tape heads, using an oscilloscope — PLUS a complete Directory of Manufacturers • Glossary of Tape Recorder Terminology • fact filled Tape Recorder Directory covering Video tape recorders • Recorders, players, transports • Combination "Music Center" Machines • Raw tape • Tape accessories • Microphones—PLUS a round-up of the best pre-recorded tapes of the year!

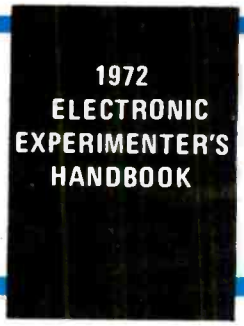


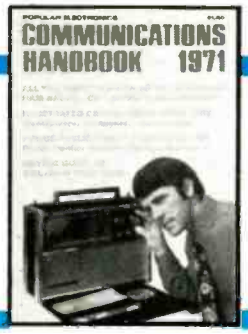
1971 ELECTRONIC EXPERIMENTER'S HANDBOOK — SPRING EDITION

20 electronics construction projects in the Spring 1971 Electronic Experimenter's Handbook. All lab-tested by the Editors, with parts list, easy "How-To-Do-It, How-It-Works" instructions—many with actual size PC foil patterns! Experimenter's Laser • Ten-Watt PA Amplifier • A Pair Of Loaded Dice • Automatic Vehicle Burglar Alarm • "No-Fooling" Fence Alarm • The Thumpa-Thumpa Box • Electric Aquarium Heater • Beginner's Signal Generator • Plus 12 others and these informative features: Caution-Laser . . . Rally Round The Reflex . . . Engineering Level Opportunities For You . . . Strange Power of Air Ions.

1972 ELECTRONIC EXPERIMENTER'S HANDBOOK — WINTER EDITION

Join in this big semi-annual projects festival! You'll get 33 electronics construction projects, each one lab tested by the editors, complete with parts list, easy "how-to-do-it, how-it-works" instructions, and many with actual size PC foil patterns and I. C. diagrams! Build these brain-busters for home and car, for experience, for fun—The Frisky Four Speaker System • Automatic Lightning Protector • Super Flash • Remote Camera Shutter Release • Design Your Own Printed Circuits • Laser Beam Communicator • Modify Your Electric Guitar Sound • Electronic Overload Protection • Electronic Combination Ignition Lock • Build A Low-Cost Relay • Photocell Motor Control Demonstrator • Wire Music • Super Substitution Box—Plus 20 More.





1971 COMMUNICATIONS HANDBOOK

Here's everything you want to know—need to know—about Citizens Band, Amateur Radio, Short Wave Listening. It's the world's most complete guide to communications. Fact-packed pages for the CB, SWL and HAM. Equipment buyers guide—photos—tables—charts—getting a license—ideas—tips—PLUS a special bonus listing of frequencies for all channels used by police, sheriff, fire and other public safety agencies in all states and territories and 249 cities across the country.

BACK ISSUES AVAILABLE!

If you've missed any of these previously published Annuals, a wide selection is still available. To place your order, circle the corresponding numbers on the coupon on this page.

Tape Recorder Annual: 1969 **#81**, 1970 **#99**.
Stereo Hi-Fi Directory: 1969 **#82**.
Communications Handbook: 1968 **#53**, 1969 **#86**, 1970 **#10**.
Electronic Experimenter's Handbook: 1968—Spring **#84**, 1970—Winter **#97**, 1970—Spring **#14**, 1971—Winter **#33**. 1971—

USE THIS COUPON TO ORDER YOUR COPIES TODAY!

ZIFF-DAVIS SERVICE DIVISION • Dept. W • 595 Broadway, New York, N.Y. 10012

Please send me the Annuals I've checked below: EW-971

☐ 1971 Tape Recorder Annual, $1.50 ☐ 1971 Electronic Experimenter's Handbook—Spring, $1.50
☐ 1972 Electronic Experimenter's Handbook—Winter, $1.25 ☐ 1971 Communications Handbook, $1.50

Also, I have circled the numbers below of the additional Annuals I wish to receive:

$1.25 each 53 82 84 $1.35 each 10 81 86 97 99 $1.50 each 14 33

I am enclosing a total of $_____ for the Annuals ordered above. I've enclosed an additional 35c per copy for postage and handling. (For orders outside the U.S.A. all Annuals are $2.50 per copy, postpaid.)

print name _____

address _____

city _____ state _____ zip _____

PAYMENT MUST BE ENCLOSED WITH ORDER

NEWS HIGHLIGHTS

Mariner 9 On Its Way to Mars

Mariner 9, on its 161-day cruise to Mars, had its trajectory slightly altered on June 4 to carry it close enough to the planet so that it could be injected into Martian orbit. If this correction had not been made, the satellite would have flown past Mars approximately 16,000 miles above the surface. It was deliberately aimed at this point to insure that it would not impact Mars. With the June 4 correction, the new flight path will cause the satellite to skim past Mars at approximately 1000 miles from the surface. A second, mid-course maneuver, if necessary, is planned for around October 24. Finally, a 14-minute burn of the on-board rocket engine on November 13 will insert the spacecraft into an orbit about Mars with a low point of 750 miles and a high point of 10,000 miles. Mariner 9 is planned to return scientific data on the atmosphere and surface and 5000 to 6000 photographs for at least 90 days while orbiting Mars. When the satellite arrives at Mars on November 13, the planet will be 75.5 million miles from earth. Our spacecraft's arcing trajectory will have covered 247 million miles.

HEP Program Expanded

One hundred and sixty-seven new device types have been added to *Motorola's* HEP semiconductor line. This now makes HEP one of the broadest semiconductor lines available to serve the radio/TV and industrial maintenance, repair, and operations markets. The line now totals 470 devices including mounting hardware and accessories which actually substitute for nearly 32,000 individual semiconductors. To locate replacements for any semiconductors, including foreign ones, write Jack Jaques, HEP Technical Manager, *Motorola Semiconductor Products Inc.*, 8201 E. McDowell Rd., Scottsdale, Ariz. 85251.

E-V and Scheiber Join Forces

Lawrence LeKashman, president of *Electro-Voice*, and Peter Scheiber, president of *Audiodata Company*, jointly announced that the two have reached an agreement in principle to cooperate in the area of four-channel matrixing systems for broadcasting, recording, and home-entertainment equipment. The companies have pooled their efforts in seeking encoding standards in the industry based on the *E-V* system. The agreement will also include co-patent protection and probably manufacture of equipment using developments from both firms. Scheiber was one of the first to develop a four-channel matrixing system. At least this is the start toward industry standardization.

No Hands

Next time you're walking by a street telephone booth and notice a caller without a telephone handset tucked by his ear and apparently talking to himself, don't be surprised. He's okay, and so is the telephone. The caller is probably using a new coin booth called a "hands-free' model, which will soon undergo *Bell System* field trials. A microphone in the booth picks up any voice transmissions and a loudspeaker mounted in the booth, behind walls specially designed for acoustical balance, is used as a receiver. Should the caller forget to press the "off" button, an automatic timer will disconnect the call after a few seconds.

New ATC System for New York Area

As an outgrowth of the FAA's study of near mid-air collisions during 1968, a new system of air traffic control is scheduled to be implemented in the New York area early this fall. It will be shaped something like a giant three-stemmed mushroom, rising 7000 feet in the air, with the three stems, or columns, anchored at Newark, LaGuardia, and Kennedy airports. The radii of the columns would range from four miles at Newark to six at LaGuardia to eight at JFK. The main body would extend outward on a radius of 20 miles from each airport to form three concentric circles, giving the mushroom its shape. Although the top would be a flat 7000 feet, the base would vary from ground level inside the columns to 1500 feet in the area immediately around the columns (1800 feet north of Newark) to 3000 feet farther out—with the exception of the area over *Grumman*-Bethpage, *Republic*, and *Zahns* airports on Long Island where it would rise to 4000 feet, and the

area south of JFK where it would remain at 1500 feet. This configuration would permit uncontrolled aircraft operating under visual flight rules (VFR) to fly underneath the TCA and between the columns, if necessary, when arriving or departing one of the nearby general-aviation airports.

The Columbia Stereo/Quadraphonic Record

CBS Records and the *Sony Records Division* of *Sony Corp.* (Japan) have jointly announced the development of a complete quadraphonic disc system. A supposedly major electronic breakthrough developed by *CBS Labs* under commission from *Columbia Records*, the system permits four channels of sound to be reproduced from a two-track source. To produce a quadraphonic disc, four channels of a master tape are passed through an encoder which preserves undiluted signals of the two front channels and, according to the announcement, produces two additional circular modulations on the disc which correspond to the back channels. Since a phono stylus can record or reproduce in only two modes—vertical and lateral—the quoted "circular modulation" seems to be confusing. It would appear that the system is not really very different from the Len Feldman *Electro-Voice* matrixing/decoding design. The only difference would probably occur in the value of level and phase shift parameters. Although *CBS* plans to release 50 titles in quadraphonic sound by year-end, we think it would be to the industry's advantage to first set specific standards.

A single National Service Organization?

The following Joint Resolution was passed by NATESA and NEA in Dallas last February and is now subject to adoption by the respective Houses of Delegates of the two groups: "Since the National Electronics Association (NEA) and the National Alliance of Television and Electronic Service Associations (NATESA) are continually confronted by problems affecting their livelihood and even their very existence, the two national service associations have enjoyed an increasing spirit of cooperation in recent months in matters of mutual interest to both groups, and since the general aims and goals of NATESA and NEA are quite similar—therefore the two national service associations pledge a full spirit of cooperation in joint endeavors and that concrete steps shall be taken to achieve a better understanding and more harmonious relationship between our groups and within our industry." At least they are working together to solve mutual problems.

Did You Know That?

Allied Radio Shack will open its 1000th store in July, according to Lewis F. Kornfeld, president of the giant consumer electronic store chain. Present plans call for a total of 1500 stores by 1973 and increased company-owned manufacturing facilities to keep pace with this rapid growth . . . the Western Electronic Show and Convention (WESCON) will be held August 24 through 27 at Brooks Hall/Civic Auditorium in San Francisco . . . *Lafayette Radio Electronics* is opening its third store in Columbus, Ohio—its 46th fully owned hi-fi and electronics center . . . Steam-powered transit buses with low-pollution engines will be running in California this year. Thanks to a $409,448 federal grant and local contributions of $204,724, three different steam engine systems are now being built and installed in three transit buses to be operated by public transit companies in Oakland, San Francisco, and Los Angeles. The project is to prove that a low level of air polution from transport vehicles is possible. (What ever happened to electric vehicles?) . . . 1970 was the safest year in air transport history, with a fatality rate of 0.001. Airline passengers had a 99.999999 percent chance of completing their flight safely.

Congratulations!

"Man of the Year" Hank Russell (president, *Russell Industries*) was awarded the AEM plaque for substantial contributions to the growth and well-being of our industry and for dedicated service to the Association of Electronic Manufacturers (AEM Eastern) . . . Dr. Norman Hilberry was recently named an Honorary Member of the Western Society of Engineers by virtue of his distinguished career in nuclear science and engineering. He was part of the organization which first achieved a self-sustained, controlled nuclear chain reaction on Dec. 2, 1942, and was instrumental in formulating proposals which led to the establishment of the Atomic Energy Commission and the creation of Oak Ridge, Brookhaven, and Argonne National Laboratories. The Society elects no more than two honorary members in any given year . . . *RCA*'s chief executive, Robert W. Sarnoff, frequently cited for his contributions to civic and charitable organizations, has now been awarded the honorary degree of Doctor of Public Service by Temple University (Philadelphia) . . . "Tiger of the Year" Francis "Mac" McAllister (vice president, *Newark Electronics*) received the coveted citation from the Electronic Industry Young Tigers this year. Equivalent to the Oscar in the electronics industry, the award is presented in recognition of an outstanding career in electronics distribution. ▲

Electronics World

READER SERVICE PAGE

FREE INFORMATION SERVICE!

Here's an easy and convenient way for and to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below . . . and the material will be sent to you promptly free of charge.

1 On coupon below, circle the number(s) that correspond(s) to the key number(s) at the bottom or next to the advertisement or editorial mention that is of interest to you. (Key numbers for advertised products also appear in the Advertisers' Index.) Print or type your name and address on the lines indicated.

2 Cut out the coupon and mail it to: Electronics World, P.O. Box 7842, Philadelphia, Pa. 19101

NOTE:

If you want to write to the editors of ELECTRONICS WORLD about an article on any subject that does not have a key number, write to ELECTRONICS WORLD, One Park Avenue, New York, N.Y. 10016. Inquiries concerning circulation and subscriptions should be sent to ELECTRONICS WORLD, P.O. Box 1093, Flushing, N.Y. 11352

Electronics World

P.O. Box 7842
Philadelphia, Pa. 19101

Void 60 days after date of issue
971

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150

Name (Print Clearly) _____ Title _____

Company Name _____

Address _____

City _____ State _____ Zip Code _____

na

Electronics World

P.O. Box 7842
Philadelphia, Pa. 19101

Void 60 days after date of issue
971

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150

Name (Print Clearly) _____ Title _____

Company Name _____

Address _____

City _____ State _____ Zip Code _____

nb

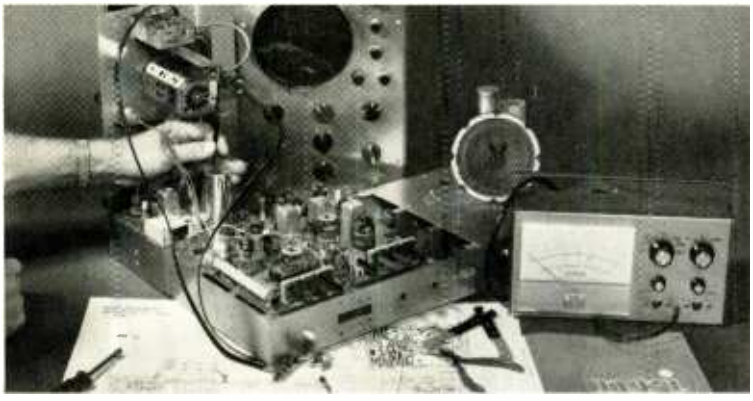
NOW train at home with NRI to be a Computer or Digital Technician– no other program is so complete in digital logic, computer operation and programming.

ANOTHER nri FIRST

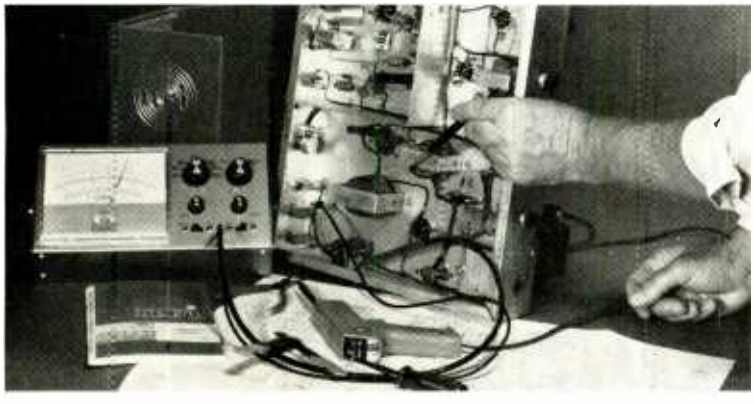
Your own digital computer included at no extra cost

This may very well be the most unique educational aid ever developed for home training—a *real* digital computer you build yourself and use to learn organization, operation, trouble shooting and programming. This remarkable training aid performs the same functions as bigger commercial computers. One of ten training kits you receive in the new NRI Complete Computer Electronics course.

NRI FIRSTS *make learning Electronics fast and fascinating—give you priceless confidence*



FIRST to give you Color TV training equipment engineered specifically for education—built to fit NRI instructional material, *not* a do-it-yourself hobby kit. The end product is a superb Color TV receiver that will give you and your family years of pleasure. You "open up and explore" the functions of each color circuit as you build.



FIRST to give you true-to-life experiences as a Communications Technician. Every fascinating step you take in NRI Communications training, including circuit analysis of your own 25-watt, phone/cw transmitter, is engineered to help you prove theory and later apply it on the job. Studio equipment operation and trouble shooting become a matter of easily remembered logic.

FIRST to give you completely specialized training kits engineered for business, industrial and military Electronics Technology. Shown is your own training center in solid-state motor control and analog computer servo-mechanisms. Telemetering circuits, solid-state multivibrators and the latest types of integrated circuits are included in your course.

There is so much to tell you about this latest "first" in home training from NRI, you must fill in and mail the postage-free card today to get the full story of the Complete Computer Electronics course and the amazing digital computer you build and use as you learn.

Planned from the start to include specially designed training equipment in the pioneering NRI tradition, this exceptional new course succeeds in combining kits with NRI "bite-sized" texts to give you an easy-to-understand educational package. But, unlike other home training, this is not a general electronics course. Lessons have been specifically written to stress computer repair. You perform a hundred experiments, you build hundreds of circuits. Included are over 50 modern, dual-in-line TTL integrated circuits you use in the construction of your computer. You use professional test equipment. In addition to your digital computer, you build and use your own solid-state voltohmmeter and oscilloscope. Because you work with your hands as well as your head, your training is as much *fun* as it is education.

Train with the leader—NRI

As it has in other fields of home-study Electronics training, NRI has taken the leadership in computer training because the "Computer Age" continues to leap ahead. Qualified men are urgently needed, not only as digital technicians and field service representatives, but also for work on data acquisition systems in such fascinating fields as telemetry, meteorology and pollution control. Office equipment and test instruments also demand the skills of the digital technician. Like other NRI courses, this exciting new program can give you the priceless confidence you seek to walk into a technician's job and know just what to do and how to do it. Mail the postage-free card for the FREE NRI Catalog. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Washington, D.C. 20016.

GET FACTS ABOUT 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.

If postcard has been used, mail this coupon

NATIONAL RADIO INSTITUTE
Washington, D.C. 20016 2-091

Please send me your FREE NRI CATALOG with details about new Complete Computer Electronics training.

Name_____ Age____

Address_____

City_____ State_____ Zip____

☐ Check here for facts on GI Bill

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

BOOKS

"SEMICONDUCTOR DEVICES AND CIRCUITS" by Charles L. Alley & Kenneth W. Atwood. Published by *John Wiley & Sons, Inc.*, New York. 485 pages. Price $11.95.

This volume is an outgrowth of a course given by the authors at the Technical Institute, Division of Continuing Education, University of Utah and is presented at the junior college or technical institute level. It is designed to bridge the gap between theoretical knowledge and practical design experience. Although calculus would be useful, those understanding trig and algebra can handle this material.

The text is divided into 16 chapters dealing with circuit basics, semiconductors, junction diodes, junction transistors, common-emitter amplifiers, devices with high input impedance, RC-coupled amplifiers, transformer-coupled amplifiers, small-signal tuned amplifiers, direct-coupled amplifiers, multistage amplifiers, power amps, negative feedback, IC's, power supplies, and pulse and digital circuits. A useful appendix lists semiconductor device characteristics.

* * *

"TRANSISTOR SUBSTITUTION HANDBOOK" compiled and published by *Howard W. Sams & Co., Inc.*, Indianapolis. 160 pages. Price $2.25. Soft cover.

This is an eleventh edition of this handy manual and, as in previous editions, the substitutions have been computer-selected for nearest match of electrical and physical parameters.

Representative types of American, European, and Japanese transistors are included. A second section of the handbook provides pertinent data on general-purpose replacement transistors including the manufacturer, polarity, material, and recommended applications.

* * *

"HANDBOOK OF MAGNETIC RECORDING" by Finn Jorgensen. Published by *Tab Books*, Blue Ridge Summit, Pa. 186 pages. Price $7.95.

While this volume covers all types of magnetic recording and recorders (audio, video, and computer), most of our readers will find the material as applied to audio recorders of greatest interest.

The first three chapters are general and cover magnetic recording and playback, the tape recorder, and the transport. The balance of the text covers magnetic heads and tapes, amplifiers and equalization, the selection of tapes and accessories, applications and proper use of tape recorders, care and maintenance, specialized techniques, and measurements and standards. The text material is appropriately illustrated by photographs, line drawings, graphs, and tables.

* * *

"A CASEBOOK OF BASIC CIRCUITS FOR ELECTRONICS INSTRUMENTATION" edited by George C. Stanley, Jr. Published by *Rinehart Press*, San Francisco. 212 pages.

The editor is Product Training Manager for *Hewlett-Packard* and the contributors are all members of the corporate training staff of the company. From their on-the-job experience they have determined that what has been lacking in the past was practical material on common failure patterns and fault diagnosis for commercial instrumentation.

The material is divided into 13 "circuits" covering the power supply with and without feedback, the Wien bridge, differential amplifiers, integrators, trigger circuits, sampling oscillography, decade counting and divider assemblies, operational amplifiers, voltage-to-frequency converters, the basic feedback amplifier, phase-lock circuits, and shaping circuits.

Suitable for either technicians or engineers, the material is presented in such a way that the text can be used in training courses for instrumentation designers and troubleshooters. There are review questions appended to each "circuit" with answers provided for self-checking if this volume is to be used as a home-study text.

* * *

"ABC'S OF INFRARED" by Burton Bernard. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 141 pages. Price $3.50. Soft cover.

This manual delves into the fundamentals of infrared physics and optics with mathematical examples and calculations provided throughout. From this basis, the book goes on to the design of basic infrared systems and instruments. It behooves the reader to have the necessary skills for solving equations since the questions at the end of each chapter require mathematical manipulation in most cases and, although the correct answers are indicated in the back of the book, picking the correct statement from the multiple-choice offerings requires understanding not guesswork.

Throughout the text the material is illustrated by charts, graphs, pictorials, line drawings, and photos of commercially available units for various applications. On the whole these serve their purpose except for the few cases where typographical errors have slipped through.

* * *

"INTRODUCTION TO PROGRAMMING AND COMPUTER SCIENCE" by Anthony Ralston. Published by *McGraw-Hill Book Company*, New York. 501 pages. Price $9.95.

The author, chairman of the Department of Computer Science at State University of New York (Buffalo), has expanded his lecture notes for a one-semester course in computing into this present volume. It is designed for undergraduates at all levels, irrespective of their majors, since the author feels that ultimately the computer will touch everyone's life and a basic understanding of computer science is a "must."

After a comprehensive introductory chapter, the book continues with the basic concepts of computers and computer languages; memory organization and computer numbers; constants and variables; computer languages; program structure, preparation, and testing; functions, sub-programs, and procedures; iteration and recursion; logic, logical design, and logical variables and statements; input and output; and operating systems and time sharing.

Although meaty, there is no reason why most readers could not gain a better understanding of programming and computer operation by a careful perusal of this text. Since the author is convinced that such knowledge will be required of all "educated" people in the near future, his presentation is persuasive.

* * *

"TRANSISTOR AUDIO AMPLIFIERS" by Jack Darr. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 189 pages. Price $5.50. Soft cover.

This volume is addressed to service technicians and is intended to make their jobs easier and more profitable when confronted by a transistor audio amplifier on the service bench.

In ten chapters he provides basic information on transistors and typical circuits; drivers and output stages; power supplies; test instruments and test methods; small, medium, high, and very-high powered amplifiers; replacing small-signal transistors; and the power-output transistor. This is a practical book written by a "pro" for "pros." ▲

Train on this 315 sq. in. picture color TV and get the skills that mean a high-paying career!

Solid-State — the newest development

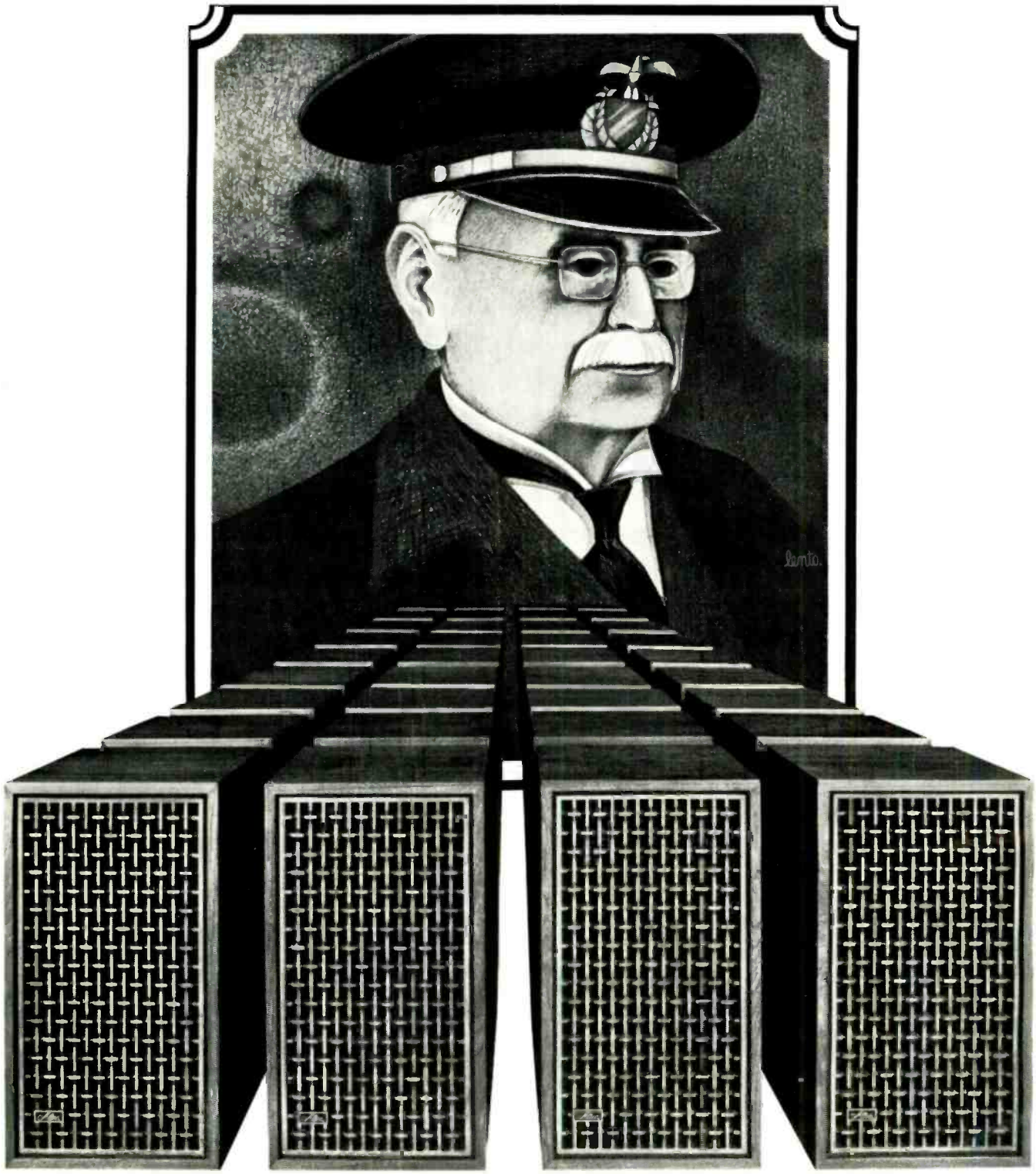
Count on NTS training to always feature the latest electronic equipment.

Now included in two exciting NTS color TV courses, this set is the largest, most advanced color television made. Guided by the NTS "Lab-Project Method" of combining professional kits and easy-to-follow lessons, you build this color TV step by step — learning TV Servicing as you go! NTS has successfully trained thousands of men at home for rewarding careers as electronics technicians. Prepare for the great opportunity fields of TV-Radio Servicing, Computers, Communications, and Automation.

This solid-state color set contains: 45 transistors, 55 diodes, 2 silicon controlled rectifiers, and 4 advanced Integrated Circuits representing an additional 46 transistors and 21 diodes. The first solid-state color TV this large — yours to keep! It features Automatic Fine Tuning; "Instant On"; an Ultra-Rectangular Screen (25 in. diagonal measurement) that lets you see the complete transmitted image for the first time — a full 315 square inches; exclusive built-in Self Servicing features which eliminate the need to buy costly test equipment; exclusive design Solid-State VHF Tuner with an MOS Field Effect Transistor; 3-stage Solid-State IF; Automatic Chroma Control; Adjustable Noise Limiting and Gate Automatic Gain Control; High Resolution Circuitry; Matrix Picture Tube; and a specially formulated Etched Face Plate that eliminates unwanted glare, and heightens contrast. Colors are more vivid, fresh tones more natural, and the picture is sharper than ever before. By training on this unique color TV, you'll gain the most up-to-date skills possible in TV Servicing!

Other valuable equipment you build and keep includes an AM SW Radio, Solid-State Radio, FET Volt-Ohmmeter, and Electronic-Tube Tester. All included in your tuition. You learn troubleshooting, hi-fi, multiplex systems, stereo, and color TV servicing. Step right into a technician's job at top pay or open a business of your own! For complete details on *all* NTS electronics courses, mail the coupon today for the full-color NTS Catalog. No obligation. No salesman will call.

Sousa lives in the new Altec Segovia



If you're going to listen to Sousa, it should sound like Sousa. Oom-pa, oom-pa, oom-pa-pa. It should be so real that you can reach over and nudge the tuba player when he gets out of step.

The new Altec Segovia is the first bookshelf speaker system that lets you hear every sound clearly and distinctly and naturally. Oom-pa. From bass drum to triangle. There's nothing added and there's nothing taken out. Oom-pa. All you hear is what Sousa wanted you to hear. Oom-pa-pa.

Ask your dealer to put on some Sousa when you listen to the new Altec Segovia speaker system. You've never heard him so good.

ALTEC LANSING®
ALTEC DIVISION OF LTV LING ALTEC INC

The new Altec Dynamic Force Segovia sells for $250.00. It's the culmination of years of building professional sound equipment and working with room acoustics and equalization while developing the proven Altec Acousta-Voicette Stereo Equalizer. Hear it at your local Altec dealer today. He's in the Yellow Pages under "High Fidelity & Stereo Sound Equipment" under Altec Lansing.

WHICH COMPUTER- The Programmable Calculator?

By PAUL ASMUS/Application Engineer
Calculator Products Div., Hewlett-Packard Co.

The author compares the desk-top programmable calculator as an engineering tool with mini and time-sharing types and explains why such calculators have a unique role to fulfill.

Editor's Note: We have scheduled for next month an article covering "minicomputers" by Rob Katz of Digital Equipment Co. *and, in the following issue, we hope to bring you the "case" for time-sharing, as presented by Lee N. Beyer of* General Electric.

THERE seems to be a new gap in the engineering and scientific community. In fact, it is a yawning chasm. Call it the computing gap. On one side of the gap is a computer with its awesome power; on the other side is the slide rule, adding machine, pencil, and you . . . with a fist full of problems. If you are an engineer, scientist, technician—if you are engaged in any type of technical work, a large part of your job involves calculating. There are design calculations to make, reports to prepare, and things to analyze. How many of those particular components should be stocked? What would happen if we moved the center frequency down to 21 kHz? What's the mean time between failure for those modules? How many of those parts do we have to test to be sure they are going to meet a certain spec? And the list goes on.

Some problems are a perfect match for a computer; they are big; they are unwieldy; they require lots of data; and they don't require much human interaction. Quite a few problems can be done in your head or just scratched out in 20 seconds on a piece of paper. But an uncomfortably large percentage of calculations that have to be made fall right in the middle of the computing gap. Some of them are too small to put on a computer, but too big to do in your head or on a slide rule. Some are things you never really decided how best to handle, or things that had to be done by a certain time but couldn't be processed through the system soon enough. All are things that, for one reason or another, did not fit the computer and just couldn't be done by hand. As a result of their falling into the gap, many of these problems never get solved to your satisfaction. They get worked out one way or another—maybe you guess that a 10% resistor would do. A "wet finger in the wind" told you that if you tested five of them, the rest would be OK. You never knew for sure. You never got that answer you wanted. Some of these problems may still be around.

Bridging the Gap

The programmable calculator bridges the computer gap because it's approachable and personal: approachable because it is easy to use—almost self-explanatory, and personal because it's flexible enough to be tailored to your requirements. You set it up to do what you need in the way you need it done. And even though it is as approachable as your slide rule, it still has much of the calculating power of a big computer.

Inside, the programmable calculator is really a small computer: it has a memory, it has control, input-output elements, it stores data, and it can be programmed. On the outside it's quite different. It is small—about the size of a typewriter—and has a keyboard and display. The display is numerical, showing answers and interim results. Most calcula-

Users of programmable calculators interact more closely with their calculations and gain knowledge in the process.

tors display the contents of two or three registers where calculations are done.

The keyboard is an "English language" one, much like that of an adding machine. Parts of it actually operate like an adding machine. There is a plus key for adding, a minus key for subtracting; there are keys for finding square roots or even cosines. When a key is pressed, the result is displayed immediately. The keyboards of most programmable calculators are divided into four main functional groups: the arithmetic group, storage group, special-function group, and programming group.

Somewhere near the center of the keyboard will be the arithmetic group. This group facilitates number entry and includes all arithmetic operations: add, subtract, multiply, divide, and square root. Numbers can be entered either in decimal or scientific notation (powers of 10). Most programmable calculators display at least 10 digits. Numbers entered can be displayed either in scientific notation or in straightforward decimal notation, with as many decimal

Programmable calculators are approachable, powerful, and easy to use. Various input and output peripherals are also available.

places as the user needs. Although the machine always calculates its answers to 12 places, you can have the answer displayed with only two-place accuracy and it will even round the answer for you.

The second group of keys, usually located in close proximity to the arithmetic group, is for storage and manipulation. These keys control storage and exchange of numbers between display and storage. Numbers storage is easy—simply press a storage instruction key and the key corresponding to the desired storage location, and the number is stored. To get the number back, press the recall instruction key and the key corresponding to the storage location. Sometimes recall is done with a single key stroke. For example, in the keyboard shown in the photograph, to store the contents of the X-display register in the register called "d." one simply presses the key-stroke sequence: ':x→( ),' "d" (called "x to" d). To recall that number, the "d" key is pressed.

The third group, which gives the unit extra calculating power, is a special-function group. The special-function group includes commonly used mathematical functions, such as trig functions, logs, square roots, and exponentials. Often these keys include such functions as rectangular-to-polar conversion or single key-stroke summations. All functions are represented by a single key; to find the *sine* of a number, simply enter the number *via* the arithmetic keyboard and press the *sine* key.

Given the first three blocks of keys, the calculator becomes an electronic slide rule, combining the best features of an adding machine, a slide rule, and a book of tables. Expressions like $e = E_F (1-e^{-t/RC})$, the voltage on a capacitor, can be determined in seconds with just a few operations. No special training is required—only an understanding of what each key does. Most programmable calculators have a pull-out card which explains what each key does and gives examples of how the keys work. It is possible for a person totally unfamiliar with a calculator to do a fairly complicated problem on the calculator the very first time he tries. As a matter of fact, this has been the experience of many calculator users.

The fourth and final key block is for programming. This set of keys controls the program mode of the calculator and defines certain functions necessary for programming: such as starting a program, stopping a program, taking data from input devices or sending data to a peripheral, branching to a different part of a program, making a decision, etc. Calculator programs are written by switching the calculator to a "program" or "learn" mode; pressing the keys corresponding to the desired operation in the same sequence that would have been used to do the calculation manually; and then switching back to the "run" mode. Several keys in the programming keyboard must be used at the beginning of the program and at various points in the program, in addition to the keys needed to do the calculation manually. Anyone who can do a calculation manually can write a program for his calculation. The transition from machine operation to machine programming is an easy one. Most people can learn to program a calculator in less than one working day and become proficient calculator programmers in a few days.

Besides being approachable, easy to use, and easy to program, programmable calculators are powerful and accurate, with accuracies generally on the order of one part in a trillion and dynamic ranges large enough to simultaneously handle numbers as small as 10^{-98} and as large as 10^{99}. Handling picofarads and megohms in the same expression is no problem. Most programmable calculators can handle programs varying in length from about 200 program steps for a basic machine to about 3500 steps for a fully expanded machine, where each program step represents one keyboard key-stroke. Basic calculators with memories in the 200 to 500 program-step range can handle various problems in-

cluding statistics, electrical engineering, solutions to four simultaneous equations, amplifier gain and phase calculations, simple filter designs, conversions from S-parameters to other parameters, and so on.

A good example is an *RC* timing or trigger-circuit design program written by one user. This program can calculate either capacitor value, resistor value, critical voltage, or delay time. Given any three values, the calculator finds the fourth. Then the program allows the operator to change any of the four values and note the effect on any of the other three. For example, he can change the resistor from the calculated value to the next closest standard value and note the effect on delay time; or can change capacitance value in a similar way; or vary the resistance value 10% to see how resistor tolerance will affect delay time. This isn't a complicated calculation, but does involve manipulation of exponential functions. It could be done on a slide rule or with a book of tables, but on the calculator it is done more quickly. And it allows the engineer to optimize the circuit instead of just design it, probably in less time than it would have taken him to do one calculation by hand. Here we have a problem too small for a computer and just a bit too complex to do by hand—one that probably wouldn't get done without a calculator.

The calculator keyboard and display—the "heart" of a personal computing system.

A fully expanded calculator, one with 3000 to 4000 steps, almost rivals a small computer in capability. Such a calculator can do a problem like an *RCL* network analysis with 15 nodes and as many as 45 components, and plot results on a Smith chart or log paper; or could fit a 12th order curve to a set of data points; or invert a 14 × 14 matrix. Although such a calculator, fully expanded, virtually matches a small computer in capability, it still is as easy to use as a basic calculator.

Inputs and Outputs

There is more to a problem than just getting an answer; there's the matter of getting results in a usable form. Basic calculators can be expanded to include a wide variety of peripherals to generate outputs and accept inputs in about any form the user desires. There are printers, fast, quiet, reliable, and inexpensive; there are typewriters and teletypewriters for fully formatted outputs, for filling out forms and reports; there are X-Y plotters to help provide the invaluable insight that only plots and graphs can give; there are tape readers, card readers, and interfaces to measuring instruments; and there are large-screen displays, memory extenders, and even a new peripheral called the "Digitizer" that allows graphical data from a plotter or hand-drawn graphs to be entered into the calculator. The calculator system can be configured to meet almost any requirement and then later expanded and modified to meet different requirements. Get a calculator now; as your work load increases replace the printer with a typewriter and keep the printer for smaller jobs, or add a plotter. As the need for larger programs arises, expand the memory to handle them. A fully expanded system with all the peripherals is still just as approachable as your slide rule.

More than a Calculator

Calculators offer much more than just solutions to problems. They make better engineers and technicians by helping them make better decisions. They help people learn about computing, about computers, about mathematics and programming, and more about the work they are doing.

For example, the programmable calculator encourages people to do things they might not otherwise tackle. A perfect example of this is the *RC* timing circuit program mentioned earlier. Here is a problem that might not have been solved without a calculator. But, because the calculator was so easy to program, maybe even fun to program, someone wrote a program to solve a simple but persistent problem that had been around for a while. And it turned out to be quite valuable. This will, in turn, encourage an engineer to try other things—maybe, "I haven't time to mess with that" will be replaced by, "Let's try that on the calculator."

A programmable calculator can also stimulate new awareness and insight. Since the calculator is so easy to use and program, it is possible to interact more closely with the problem. Freed from the leg work of setting up the problem, users have time to take a closer look at what they are doing. Consider, for example, an engineer designing an antenna. One of the tools he uses is a pattern plot or plot of field-strength *versus* direction. Although calculations involved in making such a plot are not especially difficult, they are often messy and time consuming; nothing really unusual in them, but lots of *sines* and *cosines* to look up and lots of things to jot down. A plot program is easily prepared for a programmable calculator, especially one with built-in trig and single-step rectangular-to-polar conversion functions. With the calculator and a peripheral plotter, a finished plot is ready in less time than it would have taken to calculate one point by hand. So, instead of making just one plot, the designer decides to change a couple of variables and make another plot; in fact, several plots—he changes the number of turns of this and terminations of that, or length of the other. Pretty soon he starts to notice things; that back lobe which wouldn't meet Federal specifications alternately widens and narrows as he varies the length of one of the elements; or those pesky side lobes start to disappear as the number of turns exceeds a certain figure. He's gaining insight into what antennas are all about. Next time he designs an antenna, he'll know more about it because he learned while doing calculations.

There are other benefits, too; for example, having calculator power available when you need it, as in lab situations where it is important to process data as soon as it appears or when a production facility must be shut down while someone decides on a course of action. Also, people who have never used computers or calculators before will be encouraged to try their hand on a programmable calculator.

Then, there is the matter of cost. A programmable calculator system can be put to work for less than $1 per computing hour. One survey conducted by *Hewlett-Packard* in-

dicated that its customers feel that an average of 58 percent of all the calculating they had to do could be done on their programmable calculators; while 16 percent reported that 90 percent of their work could be handled on a programmable calculator. The basic calculator system costs less than $4000 but can be enlarged to a fully expanded system with all peripherals for an additional $10,000. The most expensive calculator system one can configure would cost less than $20,000 and rival a small computer in capability. A calculator system which would meet the needs of most people would cost about $5000.

What About Mini and Time-Share Computers?

In general, it can be said that calculators make poor computers and computers make poor calculators. That is to say nothing derogatory about either computers or calculators but rather to point out that they aren't really competitive. One does not use a calculator instead of a computer and *vice versa*. Each is designed to handle a specific job and are complementary.

Calculators are useful for those jobs that fall in the gap—jobs that don't get done now, jobs that need your personal attention, and ones no one seems to have time to do. Calculators are designed to help people interact with their problems. Computers—big computers, small computers, and time share—have wider scope; they can perform more complicated calculations in much less time—often for a great deal more money. They can accommodate many users and many different languages. They are general-purpose machines, intended for no specific kind of problem; but capable, after some programming, of handling about any task.

But the more general the device, the more one must know about it in order to use it profitably. There is no way of looking at a computer and telling what it is doing, where its answers are, or even what programming language it is using. One doesn't just walk up to a computer and ask what $(1-e^{.06})$ is. One doesn't look at a computer or time-share terminal and get the anwers; the user must program it to present the answers on one of the many output devices. But, once a person understands how to use the computer, he has almost unlimited computing power.

If a computer is to be utilized effectively, it must serve many people, and so must be administered. Anything an intended user wishes to do must pass, to some extent, through that administration. One doesn't just walk up and grab a computer. Thus a computer is less approachable than a calculator, and necessarily so.

Organizations faced with a wide variety of problems find that a combination of calculators and computers gives them the best return for their computing dollar and best utilization of their people. This way there is something for everyone; calculators aren't overtaxed to the point where they become inefficient and computers aren't tied up doing simple problems. They also find that computer familiarization is easier and that people who learn about calculators and computers have a better understanding of each.

How Do You Pick a Calculator?

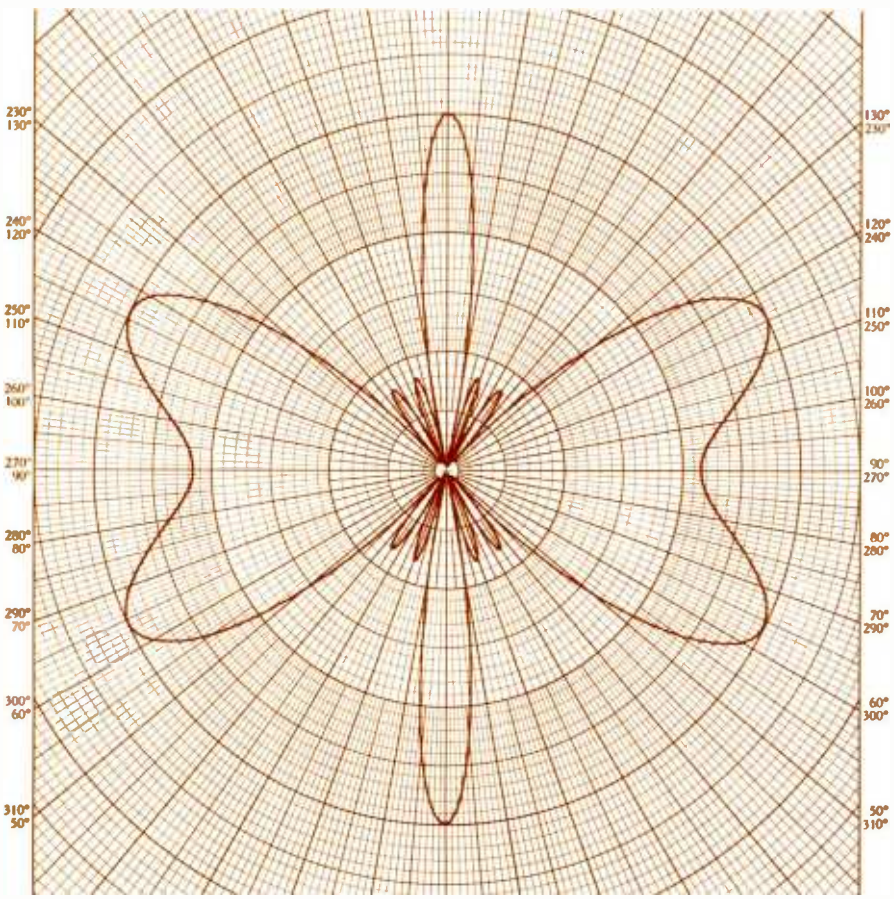
The best answer—considering a calculator as a personal computing system—is to select a calculator which you, the user, feel will best handle your requirements and your problems. Since programmable calculators are a relatively new product, there is disagreement as to what constitutes the "best" calculator. Some say it's the one with the most program steps; others say the one with the most built-in functions; still others insist it is the one that weighs the least, or has the most peripherals. If it were only a matter of program steps, then the best choice wouldn't even be a calculator, since there are many computing-equipment devices that have more program steps than the biggest calculator. If it were a matter of weight, a slide rule would win.

It is not inconceivable that you might even consider the calculator's portability if you need it away from your office. Some engineers are known to take their calculators along with them on business trips.

Remember, the programmable calculator was designed to be a personal, interactive computing system to help you solve problems the way you want them solved. So, your calculator must be easy to use, easy to understand, easy to program, and flexible enough to meet your changing needs. Perhaps the best way to choose a programmable calculator is to try several and choose the one that best fits the way you plan to use it. Try it out on one of your problems to see how easy it is to program. After all, it is to be your personal computing system.

Programmable calculators have helped close the computing gap. Now there is a calculating tool for almost every kind of problem. The trend in calculators will most certainly be towards smaller units, with greater capability, that are even easier to use and easier to program—probably at lower prices. There will be more peripherals and they will be more flexible. Advances in electronics technology will make possible large amounts of calculating capability in a box no larger than a typewriter, yet still be as approachable as your slide rule. ▲

A broadside array antenna plot made by a programmable calculator. Automatic plotting facilitates new design development.



Reliable Electronic Intrusion Alarm

By GENE M. PRESSON

A solid-state alarm that will foil even a clever burglar by the use of two different types of detection circuits.

MOST electrical, or electronic, intrusion-alarm systems fall into one of two categories. The first type is activated when its detector circuit is broken; the second type is activated only when its detector circuit is shorted. Disarming one of these is relatively simple once a burglar determines which type of circuit is being used. Combining both detection methods into one system makes it impossible for the burglar to determine what bypass device he should use.

This alarm sounds off when its detector circuit is either shorted *or* broken. Hence, a window or door may be protected in more than one way by the same alarm system.

Some electronic burglar alarm systems use a relay which, after months of inactivity, can fail to function properly and sabotage the entire protection system. This particular intrusion-alarm circuit eliminates the relay and its possible failure.

Finally, the circuit is all solid-state. Thus the system draws such a small amount of current that a standard six-or twelve-volt lantern battery will power it for months. This also provides protection against power failures during storms or by removal of the a.c. power by a burglar.

How it Works

Operating the push-button switch *S*1 (Fig. 1) applies operating voltage to the silicon controlled rectifier *SCR*1. The 1.5-volt battery (*B*1) however prevents current flow through the circuit by holding *Q*1 turned off. If the protector lines are short-circuited by the closing of any of the parallel normally open (n.o.) switches, *Q*1 is triggered into conduction by *R*2. At this time the silicon controlled rectifier *SCR*1 is triggered into conduction, causing the alarm to sound off.

If the protector lines are broken or if any of the series normally closed (n.c.) switches are opened, *Q*1 and *SCR*1 are again triggered into conduction by the voltage through *R*2, sounding the alarm. *R*3 acts as a holding resistor when a conventional alarm bell is used.

The alarm, once activated, will continue to ring as long as the alarm battery holds out, or until the circuit is reset. To reset the alarm circuit it is necessary to push *S*1 twice—once to disconnect the alarm battery, and then once again to re-arm the circuit.

The author mounted all the components except *S*1 and *R*1 on a 1½ × 3-in piece of perforated phenolic board. The circuit board may be glued inside a plastic box or mounted in a small metal box. Standard phono plugs make excellent connectors for the external parts of the circuit.

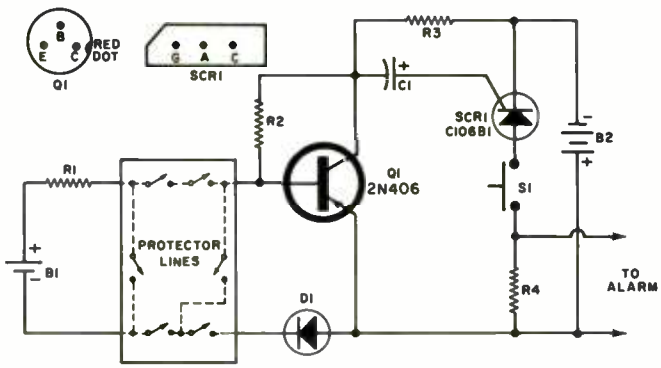
Installing the System

A convenient, concealed location (such as inside a cabinet, a closet, or under a stairway) should be selected for mounting the box and alarm battery. A hidden location on the outside of your house or in an attached garage may be used for mounting *S*1. With this arrangement you can arm the system before leaving home and disarm it before going into the house when you return.

A wide variety of switches can be used to trip the alarm circuit (Fig. 2). These do not have to be either expensive or complex.

Each door and window in the house should be protected by at least two different types of switches. One of these should be designed to break one of the series protector lines, and the other switch should short-circuit the protector lines when the window or door is opened. The aluminum ribbon for window glass can be cut from regular kitchen aluminum foil and glued or taped in position. You may prefer to buy aluminum tape with adhesive applied. This tape is sold by most tape-recorder dealers.

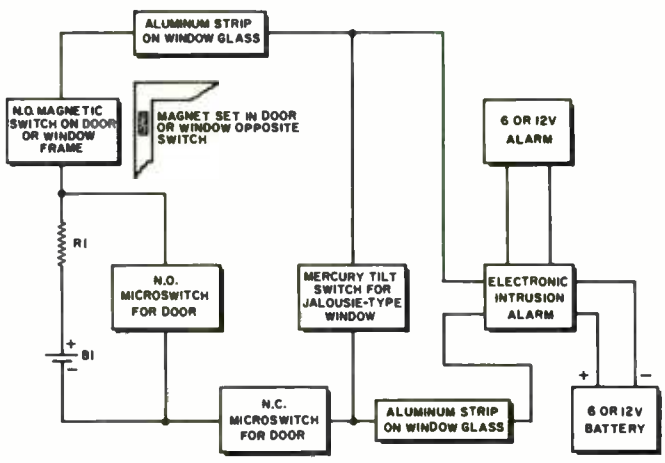
You might want to mount the sounding system, which may be any 6- or 12-volt d.c. device, such as a bell, buzzer, or horn, somewhere on top of the roof. In this location it will alert your neighbors, or a nearby police car, and hopefully drive away a potential burglar who may see it. ▲



R1—100 ohm, ½ W res.
R2—180,000 ohm, ½ W res.
R3—10,000 ohm, ½ W res.
R4—120 ohm, 2 W res.
C1—1 μF, 50 V elec. capacitor
S1—S.p.s.t. push-button switch
B1—1.5V "D" cell
B2—6 V or 12 V lantern battery
D1—1N5059 diode (GE)
SCR1—Silicon controlled rectifier (GE C106B1)
Q1—2N406 (RCA)

Fig. 1. Protector lines shown dashed represent the various combination of switches and conductive foil (sensing tape).

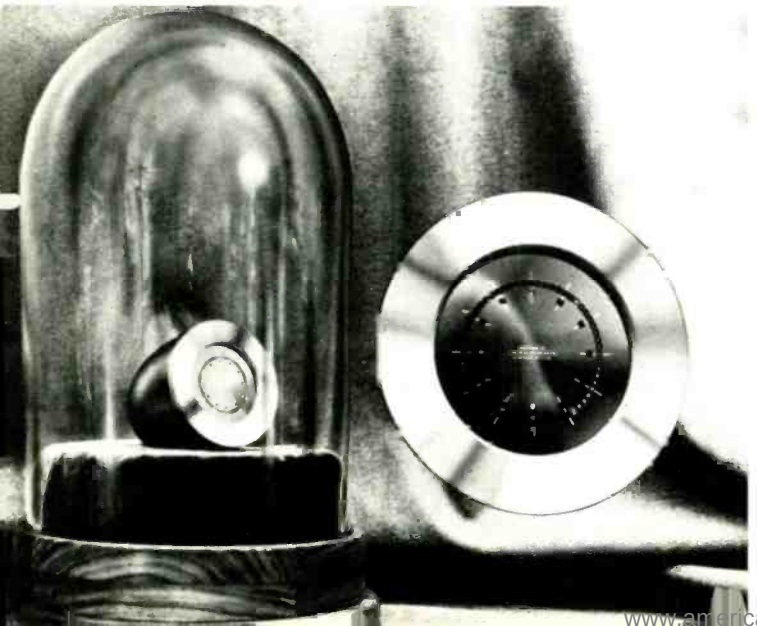
Fig. 2. Arrangement of switches and aluminum foil. Any number of switches or conductive strips may be paralleled.



Recent Developments in Electronics

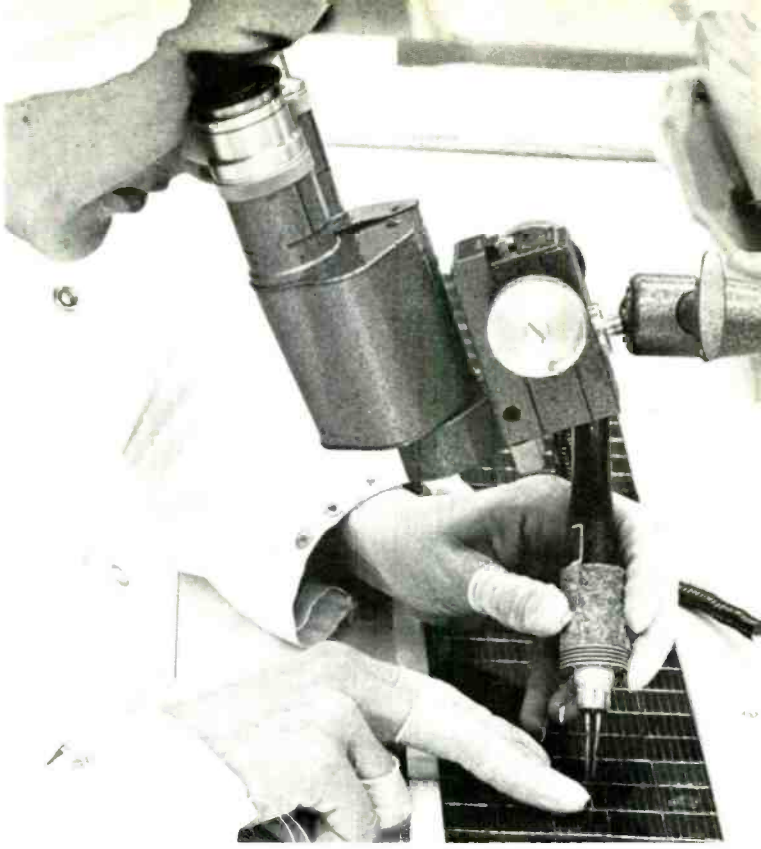
Precision solid-state film transport developed by Teledyne Ryan Aeronautical for U. S. Air Force utilizes piezoelectricity to advance film instead of rotary mechanisms. According to Dr. Charles M. Davis, Teledyne Ryan project engineer shown positioning film in transport, the principle involving piezoceramic materials provides precise film advance accuracies of one micrometer, essential in high-quality image recorders which build up imagery from a succession of evenly spaced scan lines. The precision film transport is capable of moving film continuously or in discrete steps over wide speed ranges, yet is compact and relatively simple in design and construction. Feasibility testing is being accomplished at the Air Force Avionics Laboratory at Wright-Patterson AFB, Ohio.

This photograph, taken solely by starlight on a moonless night, demonstrates the "seeing" ability of a small, self-contained, direct-view image intensifier developed by Westinghouse Electric Corporation's electronic tube division. The intensifier brightens images by converting weak incoming light into electrons, amplifying them, and reconverting them back into visible light. Similar intensifiers are a built-in feature of ultrasensitive Westinghouse SEC (secondary electron conduction) image tubes that literally "see in the dark." These tubes, in the company's television cameras, have been aboard every manned space flight since Apollo 9, and have enabled millions of people around the globe to follow man's first flights to the moon and his first walks upon its surface. (Photograph was taken from a distance of 650 feet, using a 76-mm objective lens set at f:0.87.)

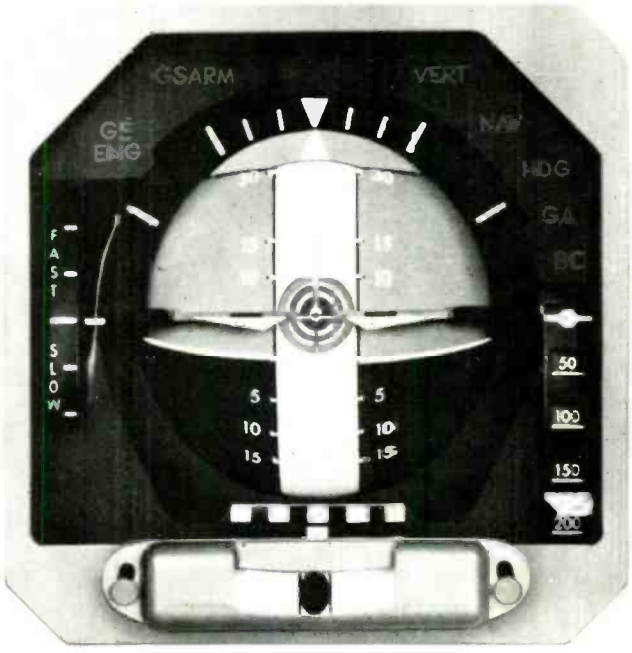


The desk clock shown in the photograph does have one thing in common with a sundial . . . there are no moving parts. This unique timepiece was built by the Motorola Semiconductor Products Division Central Research Laboratories, at a developmental cost of about $25,000, to demonstrate what can be done with semiconductors and what could happen with the clocks and watches of the future. This clock represents three departures from the conventional design. First, there are no moving hands; instead, there are 72 light-emitting diodes arranged in two circles. The outside circle is made up of 60 diodes and marks the seconds and minutes. Each second or minute is marked by an apparently moving red light as the circuit switches power to the appropriate diodes in sequential fashion. The inside circle of 12 diodes marks the hours in the same fashion. With this arrangement, only three diodes are turned on at any one time. This is an important design aspect because the diodes draw current which, in the case of portable clocks, must be supplied by a small battery. With this newly developed system, it is expected that two small batteries can drive the clock for about one year before needing replacement. The second departure is that the mechanical movement has been replaced by tiny integrated circuits. These circuits provide the signals that turn on the appropriate diodes to indicate hours, minutes, and seconds. The third departure is that the timing device is a quartz crystal instead of a tuning fork or a circular balance staff. Although currently only in the research phase, it is almost certain that the electronics inside will be commercially adopted not only in clocks but in wristwatches as well. It is expected that a fully integrated form of the clock circuit will exist within the year for application in clocks. Further work is being done to increase the efficiency of the light-emitting diodes so that the small battery of a wristwatch will be able to operate it. (In fact, wristwatches with motor-driven hands using similar integrated circuits are in the developmental stages now by watch companies here in the U. S. and abroad.)

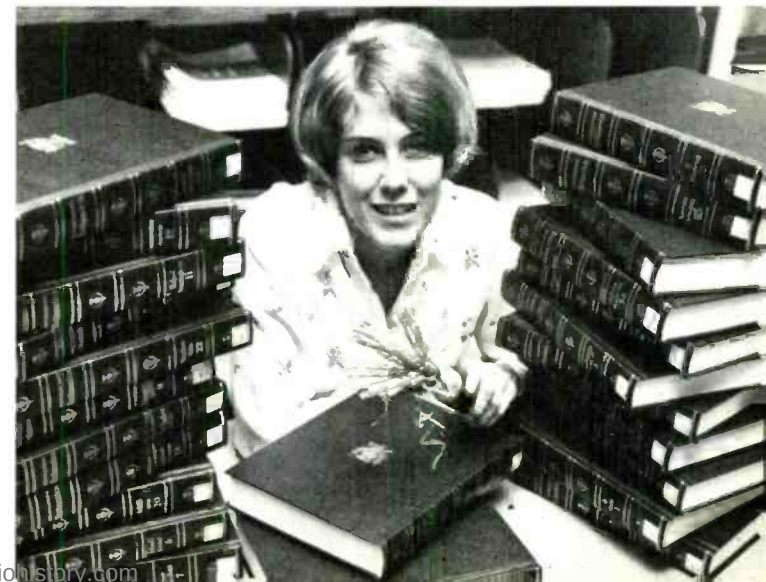
Handwork is still vital in making solar arrays. Whether they are satellite links for relaying communications, space stations, or lunar bases—they are all likely to have one thing in common and that is solar arrays for producing electrical power from the sun's energy. Solar arrays are composed of solar panels filled with thousands of solar cells—square silicon wafers measuring about $\frac{2}{3}$-in. on each side. The wing-like solar panels on a satellite are as much as 80 feet long. At Lockheed Missiles & Space Co. much of the exacting work of assembling solar cells into panels and arrays is done by hand with the aid of microscopes to enable the technician to see where to apply solder to joints and check the cleanliness of the junction. In final assembly, the cells are covered with a very thin pane of glass that filters out radiation and protects the cells from the hazards of handling as well as from in-space particle bombardment. Studies presently under way at Lockheed might well lead to requirements for flexible solar arrays up to 10,000 square feet in area, or about one million solar cells and four million soldered joints.



A unique "Bullseye" attitude director indicator for guiding an aircraft along the radio beams of an aerial flight path and down an airport's Instrument Landing System (ILS) has recently been patented by The Bendix Corporation. The flight director is manufactured by the corporation's Navigation & Control Division in Teterboro, N. J. It is currently flying dual installations on the U. S. Air Force's giant C-5A military transport and some of the 360-passenger Boeing 747's. In addition, it has flown on the twin-engine Beech A-80 Queen Air and recently was ordered as standard equipment for Cessna Aircraft's new Citation, a twin-jet, six-passenger business aircraft. The aircraft flight director gets its "Bullseye" nickname from three concentric rings that rotate into view when the aircraft engages the glide slope beam of an airport ILS system. As the plane proceeds toward a landing down the ILS glide-path, about five miles from the airport it passes over an outer marker beacon which triggers a light that flashes blue in the center of the "Bullseye." About a half-mile from the airport, it passes over a middle marker beacon that triggers the middle ring to flash amber. At minimum decision altitude, a radio altimeter triggers the outer and largest ring to light up red. A crossbar symbol that's mounted in the center of the concentric rings represents the center of localizer and glide-slope beams. When displaced from the fixed-reference aircraft in the center of the instrument, displacement of the aircraft from beam intersection is indicated. During cruise, the "Bullseye" and crossbar symbol rotate out of view. Pitch and roll steering-command bars and the fixed-aircraft reference symbol are in view whenever the flight director is engaged. In addition to showing localizer and glide-slope displacement, the patent discloses use of the instrument for showing other displacement information such as height above the ground.



The Bell System has developed a new high-capacity communications link to provide economical telephone service between cities as far as 500 miles apart. Engineers who developed the system are now testing it in Willow Grove, Pa., in preparation for its introduction into commercial service next year. The system, known as T-2, can carry over 4400 telephone conversations simultaneously over two 50-pair cables (the cable size used in Willow Grove), but it is expected that larger cables will be used in commercial operations. The system carries information, in digital form, at a rate of 6.3 million bits per second. In less than four minutes, it could transmit all 36,372,800 words in the 24-volume Encyclopedia Brittanica over a single pair of wires. The error rate should be one incorrect bit per billion for the average 500-mile line. T-1, an earlier version introduced in 1962, has nearly one million voice channels in operation. T-2 has four times the capacity of T-1. Digital systems transmit information in the form of electrical pulses. Groups of pulses representing separate communications can be interleaved by multiplexing into a single stream for high-speed transmission. A new multiplex terminal developed for the T-2 system combines as many as four T-1 "bit" streams into a single 6.3-megabit signal.




A

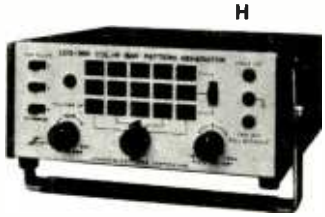
B


C

Color-Bar Generators


F


G


H

I

SPENDING on consumer goods has been tight for more than a year, and it hasn't loosened up much even now. During such times people tend to have things fixed instead of buying new ones. Take a color-TV set for instance. It may be in someone's home or it may be a closed-circuit receiver in an elementary school. It might even be a monitor in a broadcast studio. But, sooner or later, they all have to be tuned up or repaired. When that time comes, the first tool you will probably reach for is a color-bar generator.

If you have to buy one, you could be slightly bewildered by the variety of models. Which one you'll pick depends to some extent on how much you want to pay. There are all sizes, shapes, and prices. But more important is the application. How do you plan to use the instrument?

What's New

No two models are alike, yet many of the differences are minor. The main pattern, the color test signal, is basically the same—the now-standard *gated rainbow* (keyed rainbow) signal. Only two instruments in the accompanying directory use an NTSC-type single-bar signal instead.

Video patterns let you check purity, gray scale, and convergence. You'd think they might be standard by now. But no. There are at least a dozen kinds and shapes of dot and line patterns. Actually, not even the rainbow pattern is always generated in the same way.

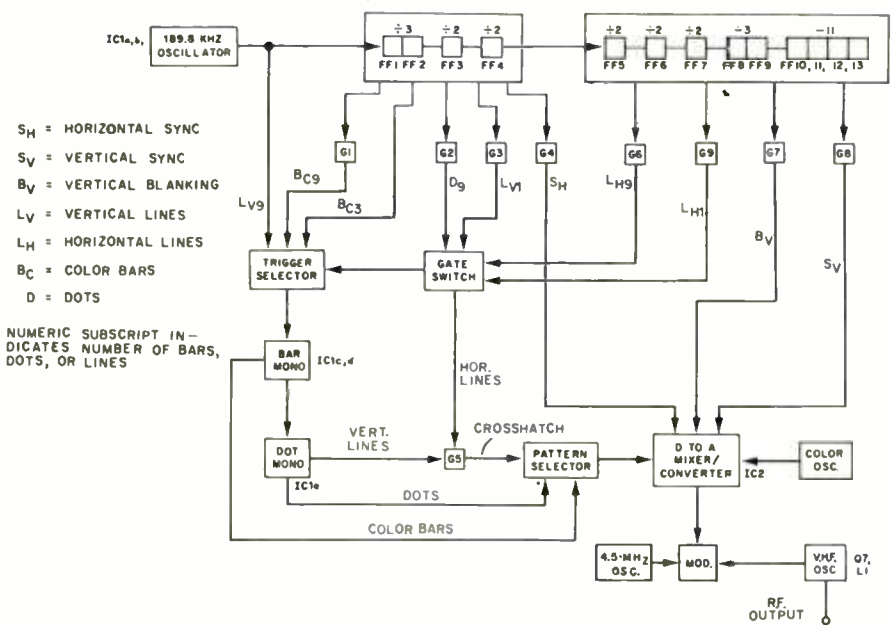
If you've kept up with color test instruments, you probably wonder what is new this year. So we'll detail a few of the innovative features before showing the multiplicity of patterns and what you can do with them.

Integrated circuits are the main thing that's new. *Heath* put digital IC's into the Model IG-28 a couple of years ago. Now you will also find them in *B&K* Models 1243 and 1246, both of which are brand-new. IC's are part of the tiny new *Leader* Model LCG-384.

Down-counters in the frequency-dividing chains of these generators are integrated circuits. Horizontal and vertical line patterns are developed by sharpening pulses from a 189-kHz timer oscillator and from divider circuits that develop submultiples of 189 kHz.

The block diagram of Fig. 1 is of the *B&K* 1246. The master or timer oscillator is a two-stage IC and a crystal feed-

Fig. 1. Block diagram showing how pulses are timed, divided down to lower frequencies, then recombined to form video.



D

E

for Servicing

By FOREST H. BELT

The newest color generators are solid-state while several models feature digital-IC counting circuits for stability.

Some of new color-bar generators designed for service applications. (A) Mercury Model 1901; (B) RCA Model WR-508A; (C) Sencore CG159; (D) B&K Model 1246; (E) Heath Model IG-28; (F) Hickok Model CG660; (G) Eico Model 380; (H) Leader LCG-388; (I) Lectrotech Model V6-B.

back network. The crystal is cut to run precisely at 189.8 kHz. (Most generators are timed at exactly 189 kHz, although *RCA* uses 189.6 kHz. More about these odd-fraction frequencies later.)

The two down-counter blocks in Fig. 1 list division factors. Some of the integrated circuits are wired for basic divide-by-2 flip-flop (FF) action. Others, in combination, exhibit odd-submultiple division: two of them by 3 and one by 11. Gating diodes, sometimes called *logic gates*, feed the proper submultiple frequencies to a shaping gate switch and a trigger selector.

The advantage of IC frequency division is stability. Small increments make for rigid counting. Patterns developed by IC's are rock-solid and appear on the TV screen without jitter. The flip-flop system of down-counting has also proven less susceptible to such external influences as temperature and voltage fluctuation. Not only are video patterns dependable, but frame and line sync pulses are steady—divider relationships stay constant.

Another IC in the Model 1246 is a digital-to-analog mixer/converter. Video signals selected by the Pattern switch are mixed there with sync and blanking to build composite video for the modulator.

Several other manufacturers have models which are new this year. The *Leader* Model LCG-384 has the distinction of being the smallest color generator at present. It is only 1⅜ inches thick and, at 5" × 7¾", it's smaller than a book. Powered by four penlight batteries, the LCG-384 is plenty portable.

But it's not the lightest. That distinction belongs to the *RCA* Model WR-508A, another instrument just recently introduced. You just can't find a color generator that weighs less than its 19 oz. It is small too: 3" × 6½" × 4". Power is a single 4.5-volt alkaline battery.

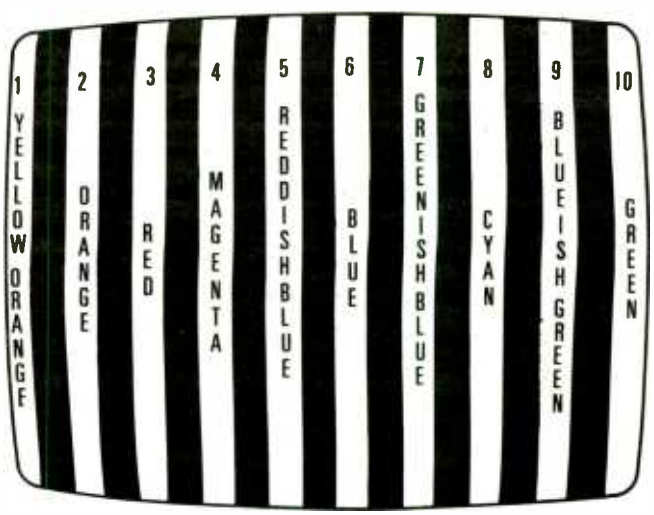
Sencore has a new model, the CG159 which replaces the CG153. One feature is reduced weight; it's 2½ lb lighter than the older model. Temperature stability for the counters is rated from –30° to +150°; the usual range is –20 to +140 degrees. This newer version has no direct video/sync output.

Putting Patterns to Work

Your choice of one model over another probably boils down to minor differences. Some units provide only a few patterns, others have many. If the extra ones make your particular job easier, consider them. Price may be higher but so may utility. To help you evaluate, here are details of various patterns and what you can do with them.

NTSC Color Bar: This is a single bar, usually about half the screen width, centered, with black on either side. A switch lets you select one of several NTSC colors. Each color is generated with a definite chroma phase and brightness (Y) level. These characteristics are set by the National Television Standards Committee.

Fig. 2. Rainbow display, with bars labeled to show sequence of colors when television receiver or monitor works properly.



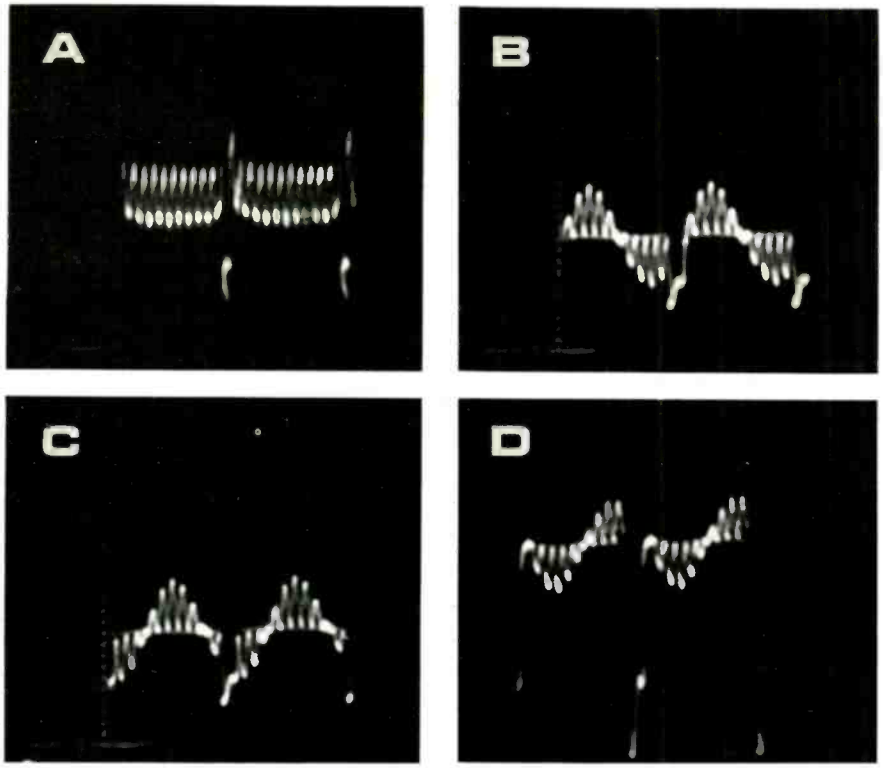


Fig. 3. Waveform of gated-rainbow color signal can be traced with oscilloscope through chroma section of receiver. (A) In Y, chroma, and bandpass amps, before demodulation. (B) After R-Y demodulation. (C) After B-Y demodulation. (D) After G-Y demodulation. The highest peak drives that particular color gun the hardest.

In makeup this test signal most resembles a station color signal. But the gated rainbow is just as useful—some insist more so. And it's less costly to generate. In the directory you will notice that the keyed rainbow outnumbers NTSC displays.

Gated Rainbow Display: This is a series of colored bars. Normal sequence is shown in Fig. 2. They are produced by what is sometimes called the "offset subcarrier" method.

Frequency of the color oscillator in the generator is offset from 3.579545 MHz by exactly the horizontal line frequency (usually 15,750 Hz). Mixing in the chroma demodulators of the receiver, this 3.563795 and the set's own 3.579545 MHz cause a color shift of 360 degrees from one end of each raster line to the other. The result is a rainbow-like raster display. It begins yellowish-orange at the left side then continues smoothly through red, magenta, blue, and cyan and finally to green at the right.

The rainbow is chopped into bars by gating. The offset subcarrier inside the generator is turned on for 15 degrees (a full line is 360 degrees) and then off for 15 degrees. While it is off, the raster is black. Thus black bars alternate with bars of color.

Not all color generators use 3.563795 MHz. The *RCA* instruments use 3.563741 MHz for the offset subcarrier. This still works out okay for a 360-degree color change on each raster line, because horizontal sync from this generator locks the set at 15,804 Hz. That's close enough to 15,750 Hz to present no problem in receivers. The 15,804 Hz facilitates a special scan system.

Both *B&K* generators have a nonstandard horizontal sync frequency. It runs at 15,816 Hz. That's why the *B&K* master oscillator runs at 189.8 kHz instead of 189 kHz. (*RCA's* runs at 189.6 kHz, you may recall.) Consequently, for a 360-degree color change on each raster line, the color oscillators in the 1243 and 1246 are crystal-controlled at 3.563729 MHz.

What does a gated rainbow let you do? You can trace it with an oscilloscope from video detector all the way to the color demodulators. Its shape is distinctive (Fig. 3A). With the receiver color control wide open, you should find good amplification in chroma bandpass and color amps. You can check how color killer and a.c.c. stages work.

The chroma demodulators in the monitor or receiver separate red from green from blue. The gated rainbow lets you see if they work right. Each demodulator should produce a waveform that has a certain bar at maximum amplitude. From the R-Y demodulator, the third bar is peak (Fig. 3B). From B-Y, the sixth bar is peak (Fig. 3C). From G-Y, the tenth bar is peak (Fig. 3D). If a different bar is at the peak, a demodulator may be faulty.

Some generators have a Color or Chroma control, marked "100%" or sometimes "200%." The purpose is to let you turn down color-signal amplitude without weakening line and frame sync. The receiver should hold a weak color signal without barber pole or floating color. If you have to turn up more than 100% to have steady color, the receiver or monitor needs repair.

Three-Bar Color: A few generators produce this adaptation of the rainbow signal. All bars are blanked off except red, blue, and bluish-green. Fig. 4 is how the screen looks. The colors still have their same positions on the screen, but there is less confusion which bar is which. They represent (and are often labeled) R-Y, B-Y, and –(R-Y).

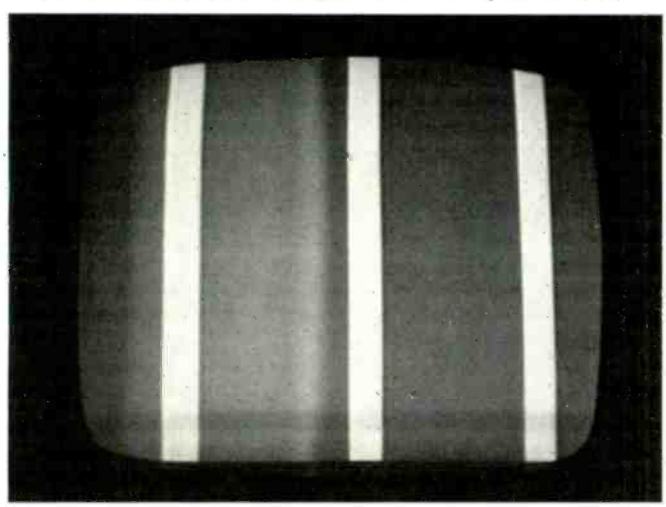
If one is a wrong color, the demodulator isn't working right. If all are wrong colors, the receiver hue control is set wrong or there's burst-phase trouble. Watching an oscilloscope display at the picture-tube cathode and switching between rainbow and three-bar display, you can quickly see which bar should be highest.

Horizontal and Vertical Lines: These are about the same in all generators, although some omit them. Together, H and V lines make crosshatch. Lines and crosshatch are for dynamic convergence.

Some generators supply crosshatch only. But many technicians find it hard to concentrate on (for example) vertical lines only, if the adjustment they're making also affects hor-

(Continued on page 72)

Fig. 4. Three-bar presentation is the same as gated rainbow with all bars blanked out except third, sixth, and ninth. The signals represented are R-Y or red, B-Y or blue, and –(R-Y). Reciprocal of R-Y is bluish-green bar near right of display.



Directory of Color-Bar Generators for Servicing

Mfr. & Model	Power		Counter Design	TV Chan.	4.5 MHz Carrier	Outputs		Color Patterns		Video Patterns							Dot/Line Size Cont.	Gun Killer	Dimensions (in.)			Wgt. (lbs.)	Price ($) (k = kit)
	Batt.	A.C.				R.F. (μF)	Video (Vp-p)	Keyed Rainbow	NTSC Bar	Other	H Lines	V Lines	Cross-hatch	Dots	Single Dot	Cross-hair	Other			H	W	D		
B & K																							
1243	—	X	IC	3,4, or 5	—	10k	—	X	—	3-bar	—	—	9 x 9	81	X	X	Purity	X	—	2¼	9¼	7	3	99.95
1246	—	X	IC	3 and 4	X	10k	—	X	—	3-bar	—	—	1 x 9 9 x 9 9 x 1	81	X	X	Purity	X	X	2¼	10¾	7	3.5	149.95
EICO																							
380A	—	X	Xstr.	3	X	50k	10	—	X	—	13	10	13 x 10	130	—	—	—	X	—	8½	5¾	6⅜	4	225.00
385	X	X	Xstr.	3	—	50k	—	X	—	—	7	8	7 x 8	56	—	—	—	—	X	3	8½	8½	3	109.00 79.95(k)
HEATH																							
IG-28	—	X	IC	2 thru 6	X	50k	1	X	—	3-bar	3 or 10	3 or 11	3 x 3 10 x 11	9 or 110	—	—	Purity, shading bars	—	X	5⅛	13½	8	6½	114.95 79.95(k)
HICKOK																							
GC660	—	X	Xstr.	3,4, or 5	X	50k	2	X	—	—	18	18	18 x 18	324	—	—	—	—	X	10⅜	10¼	5	6¼	179.50
JACKSON																							
X-100	—	X	Xstr.	2 thru 6	—	50k	4	—	X	—	15	20	15 x 20	300	—	—	—	—	—	6¼	10	4½	9	149.95
LEADER																							
LCG-388	—	X	Xstr.	5 or 6	—	10k	3	X	—	3 bar, rainbow	1,2, or 15	1, 3, or 21	2 x 3 15 x 21	6 or 315	X	X	—	—	X	3⅛	7¾	7¾	4½	159.50
LCG-389	—	X	Xstr.	5 or 6	—	10k	3	X	—	—	15	21	15 x 21	315	—	—	—	—	X	2⅛	7¾	7¾	3	99.00
LCG-390	—	X	Xstr.	5 or 6	—	10k	3	X	—	3 bar	15	21	15 x 21	315	—	X	—	—	X	2¼	7¼	7¾	3	119.50
LCG-384	X	—	IC	5 and 6	—	10k	—	X	—	—	—	—	15 x 21	315	—	X	—	—	—	1⅜	5	7¼	2	109.50
LECTROTECH																							
V-6 B	—	X	Xstr.	3,4, or 5	—	10k	—	X	—	—	13	9	13 x 9	117	—	—	Purity	X	X	3½	7⅛	9	5½	99.50
V7[1]	—	X	Xstr.	3,4, or 5	—	10k	4	X	—	—	13	9	13 x 9	117	—	—	—	X	X	7½	8¼	12⅞	13	199.50
MERCURY																							
1900	—	X	Xstr.	3,4,or 5	—	X	—	X	—	—	14	10	14 x 10	140	—	—	—	X	X	6¼	10	4½	?	99.95
1901	X	—	Xstr.	3,4, or 5	—	X	—	X	—	—	14	10	14 x 10	140	—	—	—	X	X	6¼	10	4½	?	94.95
RCA																							
WR-502A	X	—	Xstr.	3 or 4	X	10k	—	X	—	—	13	10	13 x 10	130	—	—	Purity	—	X	6½	7½	4	4	148.50
WR-508A	X	—	Xstr.	3	—	10k	—	X	—	—	—	—	13 x 10	130	—	—	Purity	—	—	3	6½	4	1¼	75.00
SENCORE																							
CG18	X	—	Xstr.	2 thru 6	X	2k	—	X	—	—	14	10	14 x 10	140	—	—	—	X	X	8	9	4	7	129.95
CG19	X	—	Xstr.	2,3,4,5 or 6	—	2k	—	X	—	—	14	10	14 x 10	140	—	—	—	X	—	2¼	8	6	3	84.50
CG159	—	X	Xstr.	2 thru 6	X	5k	—	X	—	—	14	10	14 x 10	140	X[2]	X[2]	—	X	—	9	10	3½	6½	169.50

Notes: 1. Includes vectorscope; 2. Movable.

Two column speakers on each side of stage provide coverage over a wide horizontal area and create the illusion of source-oriented sound.

LAST month we discussed the various types of microphones, their placement and use, and how they are tied into the mixer/amplifier. Now we continue with the amplifier section of our system and then go into the types and use of loudspeakers in a portable sound system.

It is very important to check the impedance of the speaker load that is to be used with the power amplifier. If this point is disregarded, it is very likely that maximum output power from the amplifier will not be obtained and damage to either the speakers or amplifier, or both, may possibly occur.

For example, take the case of an all-transistor 100-watt amplifier without an output transformer, designed to operate into a 4-ohm speaker load. This amplifier, when loaded with 4 ohms, will produce 100 watts. When an amplifier is operated with its rated speaker load, it is generally operating at its maximum voltage and current output; this results in maximum power output. If this same amplifier is operated at a higher impedance load, for example 8 ohms, the available output voltage is the same, but less output current is required and the amplifier might typically produce only 60 or possibly 70 watts. If it were connected to a 2-ohm speaker load, the amplifier would operate at its maximum current capabilities trying to drive the 2-ohm load but would not be able to reach maximum voltage conditions. Again, output power would be limited. In this case it may produce only 10 or 20 watts. (See Fig. 1.)

Some amplifiers are not protected against low-impedance or short-circuited speaker loads. Such components may be damaged if operated at speaker loads less than those specified by the manufacturer. Generally, when an amplifier is operated at a lower impedance load than that recommended by the manufacturer, it will tend to overheat and may damage some of the transistors. Some amplifiers incorporate thermal switches to avoid such damage due to overheating. When the speaker load cannot be exactly matched to the recommended amplifier loading, it is generally better to use a speaker load impedance that is somewhat higher than recommended rather than one that is lower. Operating an amplifier in this way sacrifices less power (see Fig. 1) and increases reliability.

Some solid-state amplifiers employ voltage- and current-protection circuitry. This type of amplifier, while capable of producing tremendous amounts of output power to a resistive load, may not deliver the same amount of power to a highly inductive speaker load such as may be encountered with 15-inch heavy-duty cone-type speakers. Under these conditions the amplifier may "current-limit," producing a triangular-shaped output rather than flat-top clipping which is normally associated with output distortion. If this happens, the speaker load impedance should be increased by reconnecting the individual speakers in a different impedance configuration.

Speaker Phasing and Cables

Speaker and speaker-cable phasing is usually more important than microphone phasing. Proper phasing of speakers and speaker cables will insure that all speakers will work together rather than canceling out each other's efforts. Each individual speaker in a speaker cabinet or enclosure should be checked for proper phasing with every other speaker in that cabinet. A simple method for checking the phasing of loudspeakers is to connect a 1½-volt flashlight battery between the speaker cabinet terminals and noting the direction in which the speaker cones move. All cones should move in the same direction, either towards or away from the grille cloth. All speaker systems or assemblies and speaker cables should also be checked for proper phasing.

If more than one type of power amplifier is being used to drive the different speakers, it is important to check the phasing of the over-all power-amplifier/speaker system. Depending on the number of transistors in the amplifier, phasing from the input terminals to the speaker terminals may be different for different power amplifiers. The simplest way of checking the entire speaker/power-amplifier system is to play program material, preferably with low-frequency content, or have someone talk into a microphone while another person walks through the listening or audience area, checking for dead spots between the various speaker cabinets. Should a dead zone be found, simply reverse the speaker wires at the power amplifier to change the phasing until all the speakers are in-phase.

Selection of Speakers

Sound-reinforcement speaker systems may be divided into two basic types: these are called the "distributed

Portable Sound Systems for Performers– *Part 2: Amplifiers & Loudspeakers*

By DONALD L. PATTEN/Sr. Development Engineer, Shure Brothers Inc.

Because of loud performers, poor halls, and lots of noise and feedback, assembling a good sound system is a real challenge. Here are hints on choosing, locating, and hooking up loudspeakers and amplifiers to overcome these problems.

speaker system" and the "source-oriented speaker system."

The distributed speaker system utilizes a large number of loudspeakers mounted at equidistant intervals over a large area—usually in the ceiling. Generally speaking, these speakers may be of low-power-handling capability since each individual loudspeaker is required to cover a relatively small area. The major advantage of this type of system is that it provides very uniform sound intensity over virtually any area and is ideally suited for paging and background music in such locations as airports, restaurants, hotel lobbies, and industrial plants. All of these applications require uniform coverage over large areas at relatively low levels of sound intensity. Of greatest significance, however, is the fact that these installations do not require that the listener be able to see the sound source for it to function as a good sound-reinforcement system.

A speaker system for any of the performing arts must be source-oriented to give the listener the illusion that all sound is coming directly from the actual source. Two basic speaker systems are in general use for providing source-oriented sound: one system employs both high- and low-frequency horns, the other employs speaker columns or line radiators.

The horn-speaker approach usually employs two drivers, one for low frequencies and another for higher frequencies. The single-horn low-frequency speaker exhibits a directional characteristic that becomes less defined at low frequencies. Quite often, this nondirectional pattern will lead to low-frequency acoustic feedback. Also, as the pattern becomes less directional, the total radiated energy on the listening axis of the speaker is decreased.

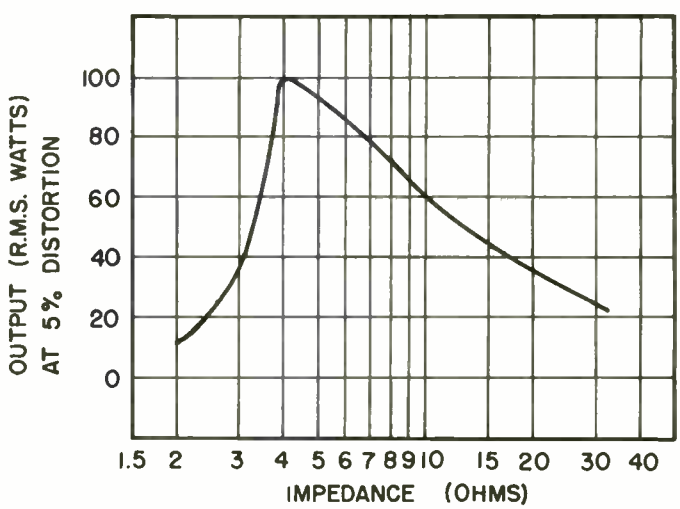
High-frequency horn-driver combinations can be made to have very uniform directional characteristics with respect to frequency. When used in conjunction with the low-frequency horns, a full-range system is obtained. Due to the non-directional character at low frequencies and the highly directional character at high frequencies, such a system will have an imbalance of low- to high-frequency directional characteristics. For example, when the low-frequency device is reproducing a low-frequency tone as an omnidirectional source, the on-axis intensity is low; at the same time, the high-frequency device may be operating and its on-axis intensity is high. The result will be a very "metallic" sound, exhibiting a lack of low-frequency content. Increasing the amplifier bass controls to balance the sound may cause low-frequency feedback.

The high efficiency of this type of speaker system is its major advantage over most column speaker systems, although this difference is rapidly disappearing as better column speakers are developed.

The column speaker or line-radiator offers a number of significant advantages over the other types of speaker systems where source-oriented sound is required. The column speaker can offer high-quality reproduction at modest cost; columns are generally small, compact, and light in weight, which minimizes mounting problems and provides considerable flexibility in their placement. Narrow vertical distribution and wide horizontal distribution are characteristics of a column, which make it such an outstanding sound-reinforcement tool.

The wide horizontal front distribution pattern of a column speaker is generally the same as that of any single

Fig. 1. Available output power of typical amplifier for various loudspeaker loads. This particular unit has been optimized for a 4-ohm speaker load. Other impedance values reduce available output power. Where mismatch is unavoidable, always pick higher rather than a lower impedance.



The small center speaker permits the entertainer to hear herself and provides "sound fill" for the first few rows of the audience. Column speakers located at the sides of the stage provide source-oriented sound which covers entire room.

loudspeaker within the column; the design of the column has virtually no effect on horizontal distribution. It is the length of the column that determines the *vertical angle* of dispersion—the longer the column the smaller the angle.

Some column speakers use rear ports to produce a bidirectional low-frequency horizontal polar pattern. This design reduces the omnidirectional properties which are exhibited by all speakers at low frequencies. Rather than an omnidirectional low-frequency characteristic, which might lead to acoustic feedback, the bidirectional characteristic provides a relatively "dead" area at the sides of the column, with the result that microphones may be placed there with minimal low-frequency-feedback problems.

Speaker Placement

It must be remembered that every room or space is acoustically unique and there are no set rules for speaker placement. However, a number of generalizations may be made which will at least provide a good starting point.

Always consider speaker placement in relation to microphone placement. It is desirable for the loudspeaker and microphone to be in close proximity in order to provide the illusion of source-oriented sound. It is also desirable to keep loudspeaker and microphone separated in order to achieve a high threshold of acoustic feedback. While these two statements are contradictory, a good solution can generally be found. When the column speakers are used on stage, the speakers should be placed at each side of the stage and as far forward as possible. With this setup, the entire stage area will be relatively free from acoustic feedback; also the illusion of sound coming from the center of the stage will be quite good except for those occupying the first few forward rows of seats.

Rear view of a typical 100-watt mixer/amplifier. Loudspeakers are plugged into jacks at left while up to six microphones can be plugged into 3-pin Cannon-type connectors at the right. There are built-in attenuator switches above each microphone connector.

Generally the stage is higher than the main audience area, therefore placing the speakers on the stage helps to project sound over the heads of the audience. If the stage is low, or a dance floor is directly in front of the stage, it may be necessary to raise the speakers by placing them on platforms or solid boxes.

Keeping in mind that the speaker columns have a narrow coverage angle in the vertical plane and a broad coverage angle in the horizontal plane, we can generalize on speaker requirements for various room shapes. A deep, narrow auditorium would generally require only two speakers if the seating is all on one level. If balconies are added to this same room, additional speaker columns would be required to aim sound up into them. A shallow, broad room might require four speakers in order to cover the entire horizontal expanse. Again if balconies are added, four more speakers might be required to expand the vertical coverage. A "theater-in-the-round" configuration will almost always require the use of at least four columns. More speakers might be required to provide adequate horizontal coverage if the theater is very deep.

To adequately cover all phases of speaker placement in all types of rooms would consume a great deal of space and still would not answer all possible criticism and arguments. *Every* room is different from *any* other and thus correct speaker placement will vary from room to room.

Good speaker placement will provide an audience with even distribution of sound intensity, sound which is free from excessive reverberation and echoes, and the illusion of sound emanating from the real source.

Providing good sound reinforcement is an art-science requiring vast technical knowledge and a good deal of practice to become a master. However, by using the techniques we have discussed, the performer and soundman should be able to improve their performances. Good equipment is necessary, but proper use of the equipment is of greater importance. Using these guidelines as a tool, the performer must experiment with his equipment to find the particular sound he desires. In this respect, microphone placement, mixer/amplifier control settings, and speaker placement are like tuning a fine instrument. Of these, the correct placement of speakers is the hardest problem to solve. Only after a great deal of practice will you be able to make good first choices. Let the people in the audience be your judge and listen to their comments. ▲

Electronics Helps Fight AIR POLLUTION

By SIDNEY L. SILVER

Our technology is expanding but the quality of our air continues to deteriorate as more and more pollutants are poured into the atmosphere, Types of pollutants, standards, and electronic methods of monitoring and control are covered.

IN recent years, there has been a rapidly growing international concern about the quality of the human environment. Air pollution, for example, is generally recognized as one of the most significant and challenging problems of modern society. It is a paradox that with an advancing and expanding technology, the quality of the air continues to deteriorate as more and more pollutants are poured into the atmosphere.

The fear exists that the spread of air contamination is so rapid that society may suffer irreversible effects before the destructive capabilities of various pollutants are firmly established. For this reason, the task of tracking down, isolating, and eliminating the important air contaminants calls for an interdisciplinary effort involving the collaboration of many trained persons in various fields of applied science and technology. Among these areas are electrochemistry, opto-electronics, toxicology, meteorology, and the nuclear sciences.

Nature of the Problem

Air pollution is a complex and diverse problem, the nature and seriousness of which can vary from one place to another, from season to season, and even from hour to hour. It may be broadly defined as the presence in the ambient air of one or more pollutants in such quantity and of such duration as to be injurious to human, animal, and plant life, or to property; or as to interfere unreasonably with the comfortable enjoyment of life and property. These pollutants consist of foreign matter suspended in the atmosphere in the form of smoke, vapor, mist, or dust particles which can adversely affect the environment by producing undesirable changes in the physical, chemical, or biological characteristics of the air.

As a rule, individual contaminants do not exist alone in the air but are intermixed with other pollutants at various concentration levels. These substances sometimes react with each other, *e.g.*, in the presence of sunlight, to produce new and sometimes unknown compounds. There are other meteorological variables, such as wind direction, wind velocity, and air-temperature variations with altitude, which influence the transport and dispersal of air pollutants, resulting in the subsequent dilution of concentration levels. Topography also plays a role in creating a localized atmospheric system, thereby affecting the air quality. In big cities, for example, the many huge structures rising to different heights and arranged in various patterns, provide a large surface for the absorption of more solar energy into the urban atmosphere.

An important factor is the cause-and-effect relationship between air contamination and health, namely, the specific mechanism by which this phenomenon can produce disease. While statistical evidence indicates that adverse health effects are most common in communities having the greatest concentration levels, no correlation can be made to show that any single pollutant is the cause of these symptoms. Moreover, the health effects of less intense pollution exposures over long periods of time are not known. At the present time there is insufficient reliable, quantitative information concerning the "tolerable levels," *i.e.*, the specific measured point at which normal persons exposed to an identifiable pollutant will experience no adverse reactions or physical impairment.

Sources of Air Pollution

The contamination of the atmosphere is caused by various natural phenomena, as well as human activity. Some of the natural forces that create pollution are volcanic eruptions, earthquakes, some forest fires, and natural radioactivity. This article, however, will deal specifically with man-made or artificial air pollution which derives mainly from the everyday activities of the inhabitants in various communities.

In urban and industrial areas, the primary sources of air pollution are the combustion processes involving fossil fuels

(mainly coal and oil) for the generation of power, space heating, the processing of materials, as well as the burning of waste products. The principal mobile source of pollution is the gasoline-powered motor vehicle. Although the exhaust emissions of other modes of transportation such as locomotives, airplanes, and ships may be significant locally, they do not add much to the community-wide air pollution.

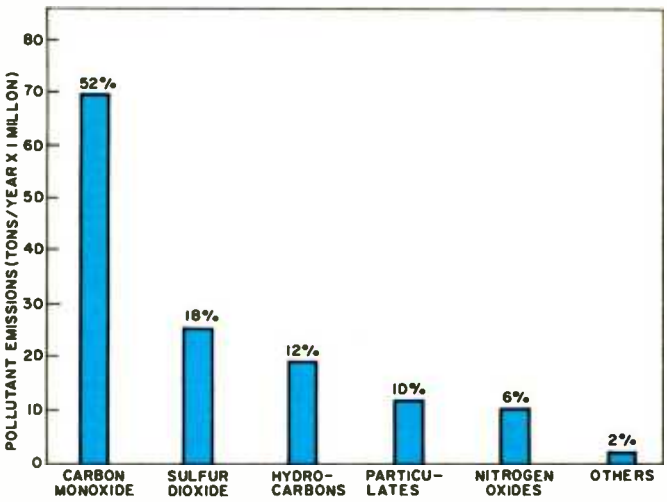


Fig. 1. Pollutants discharged into atmosphere over U.S. yearly.

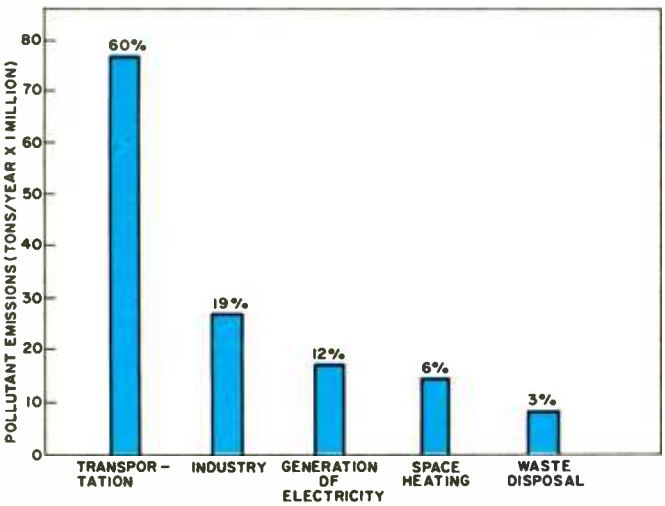
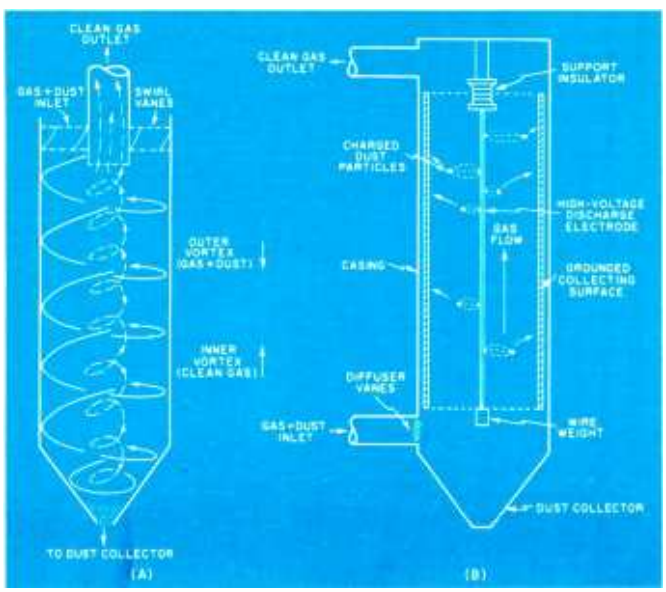


Fig. 2. Sources of pollutants in atmosphere over U.S. annually.

Fig. 3. (A) Cyclone separator uses centrifugal force to collect dust. (B) Cutaway of tubular electostatic precipitator.



As a result of these operations, about 142 million tons of pollutants are released into the atmosphere in the U.S. each year; the most common of which are carbon monoxide, the sulfur oxides, hydrocarbons, particulate matter, and the nitrogen oxides. Fig. 1 indicates the average concentration levels annually.

The contribution of various sources during the same period is shown in Fig. 2. It can be observed that the carbon monoxide (CO) level exceeds that of all other contaminants combined, and thus can be regarded as one of the prime indicators of air pollution. Carbon monoxide is an invisible, toxic gas pollutant which comes mostly from fuel that is not completely oxidized to carbon dioxide and water; motor-vehicle exhausts accounting for over 90% of the total CO emitted into the atmosphere. The hydrocarbons are another class of pollutants which emanate as unburned, or partially burned gaseous compounds formed during the high-temperature combustion process.

Still another product of the fuel-burning process is nitrogen oxide (NO), chiefly contributed by internal combustion engines. NO is formed because of the very high temperature dissociation of molecular nitrogen and oxygen from the intake air used to burn the fuel. After emission into the atmosphere, the NO is converted to nitrogen dioxide (NO_2) which, in turn, reacts with other contaminants in the air to produce a variety of toxic substances. For example, the interaction of a dilute mixture of NO_2 and hydrocarbons produces complex chemical changes during the sunlight hours, resulting in the formation of photochemical smog.

The second most prevalent gaseous pollutant in the atmosphere is sulfur dioxide (SO_2), produced mainly by the combustion of coal and oil which contain appreciably large quantities of sulfur as an impurity. Owing to catalytic action with other materials in the ambient air, the SO_2 is more or less oxidized to form sulfur trioxide (SO_3) which, in turn, reacts with water vapor to yield a dilute but corrosive mist of sulfuric acid (H_2SO_4).

Besides the pollutant gases dumped into the atmosphere, there are the visible emissions caused by the presence of fine solid and liquid particles, or particulate matter, mainly discharged by industrial smokestacks. These particulates are composed of a wide range of substances, including dust, soot, grease, mineral matter, and microscopic particles of metals and metal oxides. Some of these particles are large enough to settle rapidly toward the earth, but many others are sufficiently small to remain suspended indefinitely in the ambient air until they are removed by wind or precipitation.

Control Techniques

Technology exists today for controlling and reducing most of the pollutants that stationary sources would otherwise release into the atmosphere. The primary function of any pollution-control device is the removal and neutralization of particulate matter and gaseous material. Generally, the particles on which the gas pollutants have been absorbed are separated by particulate collectors, and then the gases are either reduced to harmless substances or recovered by other methods.

In the case of particulate matter, particle size distribution and the amount of dust involved are critical parameters because they determine selection of the proper control device. The common denominator used in referring to particle size distribution is the micron (one-thousandth of a millimeter), with atmospheric dust particles ranging from hundreds of microns in diameter down to almost molecular dimensions. Usually, particles larger than 50 microns do not remain airborne for long periods of time unless there is considerable air turbulence.

The simplest method of reducing stack emissions is the cyclone collector which depends upon the property that

particulates have greater inertia than gaseous substances. In operation (Fig. 3A), the dust-laden gas is forced into a cylindrical tube through swirl vanes which induce a high-velocity spiral action to the gas-dust mass. Owing to centrifugal force, the particles are flung to the walls of the chamber and subsequently carried down by gravity to a dust outlet. At the bottom of the chamber (usually terminated in a cone), the clean gas stream reverses its vortex and flows upward through a center exit port. Devices of this type achieve a high collection efficiency with particles in the 10 to 200 micron range. Sometimes wet inertial devices, or "scrubbers," are employed in which high-pressure jets of liquid are able to extract gaseous pollutants from particulate matter.

Another way to remove dust from process gases is by filtration, where particulates are trapped by a large number of fabric filters, while the dust-free gas passes through the filter to an outlet. For large particles, the inertial impaction of the dust on the filter fibers is the predominant collector mechanism. However, as the dust accumulates, the submicron particles are actually sieved from the gas by molecular diffusion. The resistance of the gas flow to the collected material eventually increases so that the filter must be cleaned periodically by subjecting the system to mechanical vibration.

At the present state of the art, the most widely used high-efficiency collector of particulate matter is the electrostatic precipitator. As shown in Fig. 3B, the basic device consists of a tubular collecting surface placed at ground potential, with a discharge electrode centered along the longitudinal axis. The center electrode is energized with a high negative potential (on the order of 100 kV peak) so that a corona discharge is established around the electrode. As the gas-dust mass passes through the corona the gas is ionized, and these ions migrate toward the collecting surface where they collide with the suspended dust particles. During the ion bombardment, the dust particles take on a negative charge and drift in the direction of the grounded collector, where they adhere until removed by electromagnetic vibration. These devices have a high efficiency in the collection of small particles in the 0.01- to 1-micron range.

The removal of gaseous pollutants may sometimes be accomplished by oxidation, whereby combustible process gases are recycled into the burning chamber. Gases which are more or less soluble in water may be removed by absorption. Here very small droplets of water (containing certain chemicals to enhance solubility) present a high surface area to the gas stream so that the gas dissolves or reacts across the gas-liquid interface. In the adsorption method (Fig. 4), the pollutant gas is forced to adhere to the surface of activated carbon material where the molecules adsorbed from the gaseous state are collected into a condensed layer. The carbon is then regenerated with low-pressure steam, and the resultant steam-vapor mixture is cooled in a condenser unit, then fed to a separator where the gas is recovered.

For some pollutants, such as the sulfur oxides, no completely satisfactory method of removal has yet been fully developed. Obviously, the removal of sulfur from coal prior to burning would be the ideal solution, but this is not feasible at present because most of the sulfur is organically bound to the coal and can only be released by combustion. One process which has been developed involves the injection of powdered limestone into the combustion chamber, thereby producing reactive compounds which combine with and eliminate some of the SO_2. Alternate means of control include the use of low-sulfur coal, desulfurized oil, and natural gas.

The reduction of air pollution produced by motor vehicles requires im-

	Sulfur dioxide (ppm) 24-hr avg.	Smoke shade (rud) 24-hr avg.	Carbon monoxide (ppm) 8-hr avg.	Oxidents (ppm) 6-hr avg.
Danger Level	> .4	> 5	> 60	> .15
Unhealthy	.1-.4	1-5	20-60	.07-.15
Unsatisfactory	.06-.1	.6-1	15-20	.03-.07
Acceptable	.03-.06	.3-.6	10-15	.01-.03
Good	0-.03	0-.3	0-10	0-.01

Table 1. Criteria of daily air-pollution index for N.Y. City.

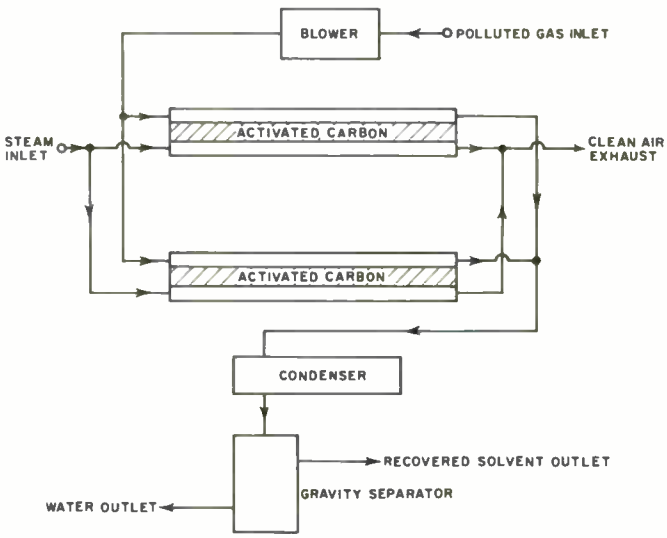


Fig. 4. A flow diagram of a typical adsorption system.

proved systems for controlling the emissions of hydrocarbons, carbon monoxide, and the oxides of nitrogen. Hydrocarbons and CO emissions may be reduced by the injection of air into the exhaust manifold at the point of hottest gas temperature, in order to continue the combustion of these pollutants in the exhaust system. Since gasoline is highly volatile, the gas tank and carburetor lose hydrocarbons through evaporation, these vapors also contributing to air pollution. To offset this problem, the system may incorporate a liquid-vapor separator in the fuel system, with a line returned to the carburetor to permit the purging and burning of stored vapors. The control of NO emission may be achieved by automatically regulating the spark advance and controlling fuel combustion so that peak burning temperatures are reached at lower levels.

Although a sharp reduction in pollutant emissions will probably be attained during the next decade, attention must be given to new approaches involving propulsion systems with inherently low emission characteristics. These in-

Fig. 5. The operation of an air-quality monitoring and control system.

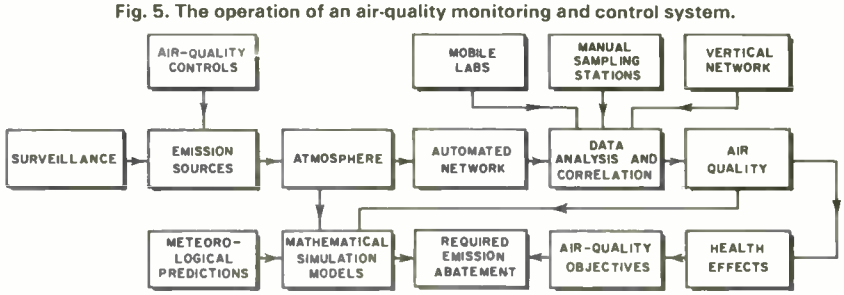


Fig. 6. Technician checks the readings for smokeshade at one of New York City's ten automated telemetry stations.

clude such power systems as turbine and steam engines where the levels of hydrocarbons and CO emissions are considerably lower. Electrically propelled vehicles appear to offer some potential as pollution-free devices, but further advancement in battery or fuel-cell technology will be required before acceptable performance is achieved.

Air-Quality Standards

In setting standards, the quantitative relationship between the contamination of the air and the sources of emission is difficult to determine, since there are usually many sources which emit similar or identical pollutants. Ambient air standards are concerned with the concentration of pollutants present in the atmosphere, while emission standards apply to the quantities of pollutants discharged from specific sources.

In order to deal systematically with these problems in the U.S., the Air Quality Act of 1967 was developed and passed to strengthen the control effort. This law builds on earlier legislation going back to 1955, and is in the form of an amendment to the Clean Air Act of 1963. Accordingly, the Department of Health, Education, and Welfare (HEW) has designated specific air-quality control regions that cover various communities sharing a common air-pollution problem.

HEW has also developed and published a number of air-pollution criteria indicating the extent to which a specific pollutant, or a combination of pollutants, is harmful to health or damaging to property. These criteria reflect the best available scientific data on the effectiveness of existing technology for the prevention and control of air contamination. As soon as the control techniques for a particular pollutant are issued, each state involved in the region is given the responsibility for developing air-quality standards and plans for implementing them.

An important section of the 1967 law provides for a comprehensive study of the need for, and effect of, national emission standards for stationary sources of air pollution. As a consequence, to broaden the scope of the law, the House and Senate have recently passed separate bills to establish national air-quality standards. In the Senate version, the national standards would cover 10 major contaminants, and would prohibit all emissions of a hazardous nature not covered by the standards. The bill would further require that the 1975-model automobiles achieve a 90% reduction of present-day standards for emissions of carbon monoxide, hydrocarbons, and the nitrogen oxides. As of this writing, both bills are before a Senate-House conference committee to resolve the differences between the two measures.

As an example of how the Federal criteria are applied, Table 1 shows the daily air-pollution index for the New York City area. Here the numerical values and time spans are given for four of the most common pollutants. These designations, covering various concentration levels, relate to the New York State standards which, in turn, are based on the health-effects criteria developed by HEW.

In the case of sulfur dioxide, for example, the designation "good" (corresponding to the range from 0 to 0.03 parts per million) has been set as the annual average goal for that area because there is no scientific evidence of any adverse health effects within this range. The criteria further state that the 24-hour average concentration of sulfur dioxide should not rise above 0.1 ppm (to the "unhealthy" range) more than about three times a year. It should be pointed out that the objectives set forth in these criteria will be immediately subject to revision if further scientific investigation reveals any new health hazards associated with air-pollution levels.

The standards applied to carbon monoxide suggest negligible health effects below 10 ppm when levels are averaged over an 8-hour period. Since concentrations rarely reach this magnitude on a city-wide basis, the measurement is regularly taken in high-traffic areas where the levels are high at breathing level.

Smokeshade, sometimes referred to as the soiling index, is a measure of the dust, grime, and particulate matter in the ambient air, and is expressed in terms of the reflectance units of dirtshade (rud). Here the range of levels covers the average city-wide concentrations over a 24-hour period. The oxidents refer to a group of toxic photochemical compounds, *e.g.*, ozone, formed by the action of sunlight on the oxides of nitrogen and hydrocarbons. These levels are averaged over a 6-hour period during the time of strongest sunlight.

In order to minimize the impact of air-pollution episodes, such as may occur during periods of stagnant weather, air-quality control limits must be established. These limits are usually stated as a concentration level that should not be exceeded when either averaged or integrated over a predetermined time interval. These serve as a reference value

(Continued on page 78)

Table 2. Control limits for various air-pollution conditions.

1. Forecast Stage:
Meteorological conditions indicate that a high pollution potential will exist for the next 36 hours.

2. Alert Stage:
Stage is reached if for any consecutive 6 of the previous 12 hours:

1. Forecast predicts that adverse weather conditions (stagnation) will continue for 12 more hours.
2. Sulfur-dioxide exposure = 2 ppm-hrs
3. Soiling-index exposure = 2 rud-hrs
4. Carbon-monoxide exposure = 180 ppm-hrs

3. Warning Stage
Stage is reached if for any consecutive 6 of the previous 12 hours:

1. Forecast predicts that stagnation will continue for 12 more hours
2. Sulfur-dioxide exposure = 3 ppm-hrs
3. Soiling-index exposure = 25 rud-hrs
4. Carbon-monoxide exposure = 300 ppm-hrs

4. Emergency Stage:
Stage is reached if in a 24-hour period:

1. Forecast predicts that stagnation will continue for 12 more hours
2. Sulfur-dioxide exposure = 15 ppm-hrs and is rising
3. Soiling-index exposure = 200 rud-hrs

Air-Core Coil Nomogram

By JAMES E. McALISTER

An aid to designers and experimenters who must fabricate their own coils. Chart is applicable to both hand-wound and prewound coil stock.

THE inductance of a single-layer air-core coil can be expressed by the well-known formula: $L = (n^2r^2)/(9r + 10l)$ where: r is coil radius in inches, n is total number of coil turns, l is total coil length in inches, and L is coil inductance in microhenrys. This formula becomes more potent if the winding pitch N in turns per inch is used in place of total turns ($n = Nl$). This substitution, for example, will allow quick inductance calculations to be performed for prewound coil stock of fixed pitch and radius. The problem is then simply one of choosing the proper length of stock to give the proper inductance.

Similarly, hand-wound coils can be designed by selecting an appropriate pitch and radius and, as before, solving for the proper coil length. Since pitch and radius are often chosen by trial and error, several calculations may sometimes be required before a realistic coil length is obtained. For this reason, a nomogram can be usefully employed to allow quick convergence on a meaningful design.

Problem: Choose the proper length of coil stock of ½-inch radius and 4 turns per inch to give an inductance of 0.5 μH.

In this case, the radius is fixed at ½ inch. This value should be located on the R scale of the nomogram. Note that values of R are expressed in eighths of an inch, so the value of R chosen is 4 (point A). Next, the winding pitch of 4 turns per inch should be found on the N scale (B). A line is drawn connecting these two points and is extended to intercept the T scale (C).

From C, another line is drawn through 0.5 (the required inductance) on the L scale (D) and is extended to cross the Q scale (E). From E, a horizontal line is projected to intercept the graph at F. A vertical line is then drawn to cross the X-axis at G and on to cross the appropriate R line (the radius R is expressed in eighths of an inch here, too) at (H). A horizontal line is drawn through H to intersect the Y-axis at J.

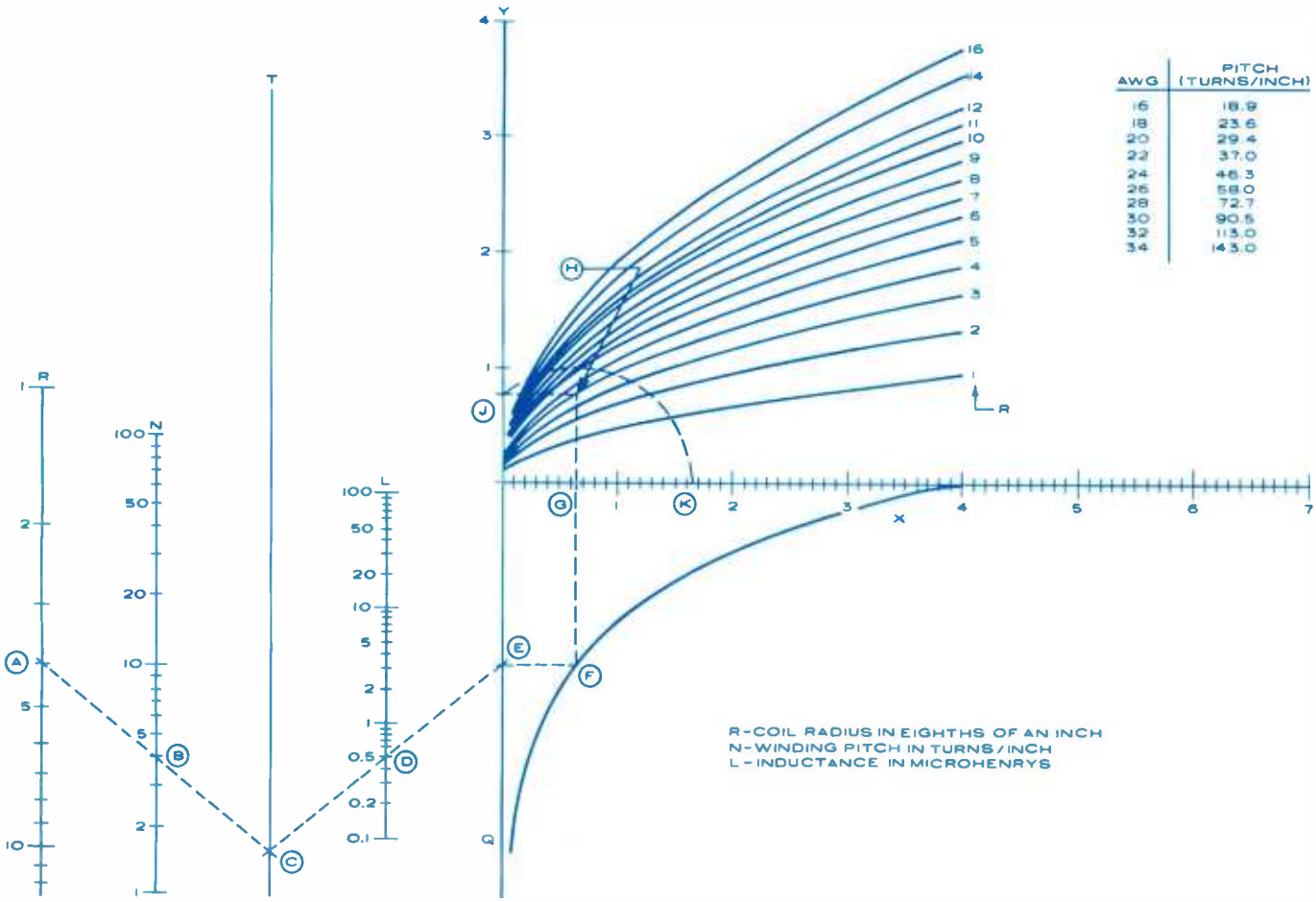
With a pair of dividers or a compass, an arc is drawn from J (with G as the center) to the X-axis (K). The value of X at K (in this case, 1.65) is the length in inches of the coil stock required to give the desired inductance.

Actual calculation of the coil inductance using the length of 1.65 inches gives 0.52 μH, rather than 0.5 μH. This represents an error of only 4%, which is certainly within reason. It should also be noted that the original formula is accurate within 1% whenever coil length is greater than or equal to eight-tenths of the radius.

If the coil is being wound by hand with a length of 1.65 and a pitch of 4, it may be advantageous to wind 6.6 turns evenly in 1.65 inches of length. The pitch will then automatically be the necessary 4 turns per inch.

The pitch of close-wound coils is approximately the reciprocal of the wire diameter. Approximate pitches for common wire sizes are tabulated below for enameled, solid copper wire. Data for other types of insulations and wire sizes may be found in a rather complete table in "The Radio Amateur's Handbook" (ARRL). ▲

AWG	PITCH (TURNS/INCH)
16	18.9
18	23.6
20	29.4
22	37.0
24	46.3
26	58.0
28	72.7
30	90.5
32	113.0
34	143.0



Automatic Railroad-Car Identification

By DAVID L. HEISERMAN

Optical-electronic scanning system accurately records type, owner, registration number for every freight car in a train moving at speeds up to 80 miles an hour.

THERE are about 1.8 million freight cars on the tracks in the United States and Canada. The paperwork involved in keeping tabs on all these cars has always created monumental problems. To complicate the situation even further, railroads share cars and facilities freely, but have different ideas on how to handle the necessary paperwork. It's little wonder, then, that losing track of a couple hundred freight cars for a day or two is a common occurrence.

With the help of the Association of American Railroads (AAR), the rail industry tried to cut down on paperwork and keep better track of its cars by installing sophisticated data-processing and communications centers.

During the 1960's, most of the routine paperwork involved in keeping track of cars began to diminish, and the flow of inter-company information improved considerably. A few years' experience, however, showed there was still something wrong with the system. The AAR began working on the problem as early as 1959 and, by late 1967, provided the solution.

It seems that the weak link in the new railroad data-processing system was in the information input phase of the operation. The computers were handling available data as well as could be expected, but the input data was going into a modern system by means of an iron-horse-age technique—a clerk with a clipboard, pencil, and a check sheet noting cars on a passing train. Unless the train happens to be going by at less than about 20 miles an hour, it is difficult to verify or record registration numbers visually with any degree of accuracy. And if the input information is faulty, a computer can cause more problems than it solves.

The automatic-car-identification (ACI) system proposed by the AAR could accurately record the type, owner, and registration number for every freight car in a train moving between zero and 80 miles an hour. In 1967, the AAR accepted a *Sylvania* version of the ACI system. Marketed under the tradename KarTrak, there are now more than 150 of these ACI systems in full operation in North America and many times more expected by 1975.

How ACI Works

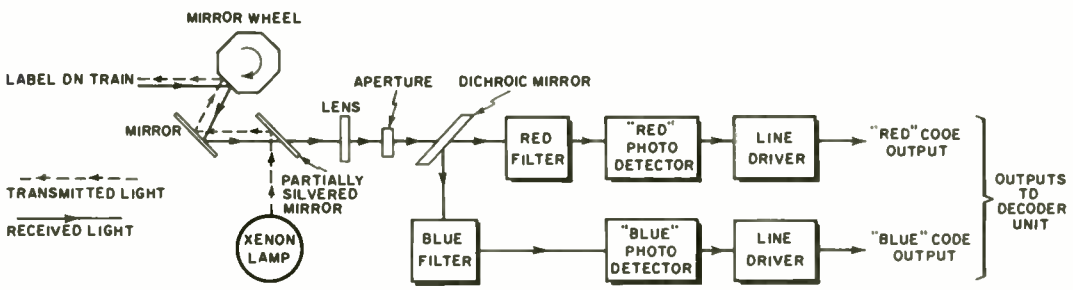
The KarTrak ACI system consists of three parts: (1) a set of retro-reflective color-coded labels which are applied to each side of a freight car, (2) a trackside optical-electronic scanner that reads the labels as the train moves past, and (3) a data decoder and transmission unit that digitizes the scanner's output and transmits the data to far-away Teletype printers and data-processing units.

The labels are made up of 13 color-coded strips of red, blue, and white Scotchlite tape. The strips, arranged in a ladder-like fashion, lie within a 10 × 22½-inch area of non-reflective black paint. The information coded into a label includes the type of car, its owner, and its registration number.

An approaching train activates a switch that turns on the power supplies and ignites the xenon lamp inside the scanner. A set of rapidly rotating mirrors make the scanner send out a beam of bright light that scans the side of the train in an upward direction. When the beam scans across one of the labels, a string of color-coded dashes of light reflect into the scanner.

The incoming pulses of light first pass through a series of mirrors, a lens, and an aperture. The next element they encounter is a dichroic mirror—a special optical device that reflects light of one color and transmits light of another color. In the KarTrak scanner, the dichroic mirror directs the red and blue pulses of incoming light to separate sets of

Fig. 1. Block diagram of Sylvania's ACI scanner. It is apparent that red and blue are the two basic colors used, with black indicating absence of color and white used to excite both channels. As each color is scanned, it produces a pulse of a specific duration. In the case where dual red or dual blue stripes are used, the electronically timed pulse width is equivalent to two shorter pulses. The system of conversion from color stripes into numbers is the Steits method (after Francis Steits, the designer). These color stripes are electronically converted first into pulses and, through the use of 2 separate channels and 4 flip-flops, are then converted into numbers in the conventional binary manner. Refer to the text for complete details.



SCANNER OUTPUT SIGNALS

LIGHT INPUT SIGNALS	"RED" OUTPUT	"BLUE" OUTPUT
RED	+	0
BLUE	0	+
WHITE	+	+
BLACK	0	0

LOGIC TABLE FOR ACI SCANNER

colored filters and photo detectors. The detectors, in turn, generate a pulse of electrical energy when they're activated.

A pulse of blue light reflected into the scanner, for example, activates only the "blue" photo detector. A pulse of red light, on the other hand, activates only the "red" detector. Since white light is actually a mixture of all colors, the dichroic mirror separates both red and blue light from incoming pulses of white light. A pulse of white light, then, activates both detectors. To complete the logic scheme, the black portions of a label produce no reflected light, and neither photo detector generates an output signal. See Fig. 1 for a block diagram of the scanner.

After leaving the photo detectors, the label code is still intact, but in the form of electrical pulses rather than strips of color-coded tape. A pair of line drivers delivers the two sets of scanner signals to the decoder unit.

The input section of the decoder unit contains two sets of amplifiers and analog-to-digital converters that clean up the detector outputs and adjust their pulse heights and widths to meet a standard format. The data is then serially loaded into a logic circuit that performs a preliminary validity check on the information. A red-light reflector on the side of a boxcar, for example, could activate the system unintentionally. This single pulse of red light, however, cannot pass the first validity check, so the logic circuit would scrap the entry. Data that passes the first validity check goes through a binary coded decimal (BCD) circuit that converts binary into standard decimal code. This completes translation of the labels into decimals. (See Fig. 2.)

The decimal numbers accumulate in a storage register until all the information for one label is in. At the same time, data goes to a circuit that runs a complete parity check on the information. If the circuit calculates a "bad" parity, a logic circuit instructs the system to receive data from another scan over the same label. The system, in fact, continues to accept a label's code, check, and recheck the data until either the parity circuit finds "good" parity or the label moves out of the scanner's range.

At the user's option, the label data can be stored and retrieved at a later time, or sent through leased lines to a distant Teletype and computer center as soon as the car passes over a magnetic "end of car" sensor mounted on the tracks. In either case, the data leaves the decoder unit *via* a format generator that establishes the formal layout of information for the Teletype printer.

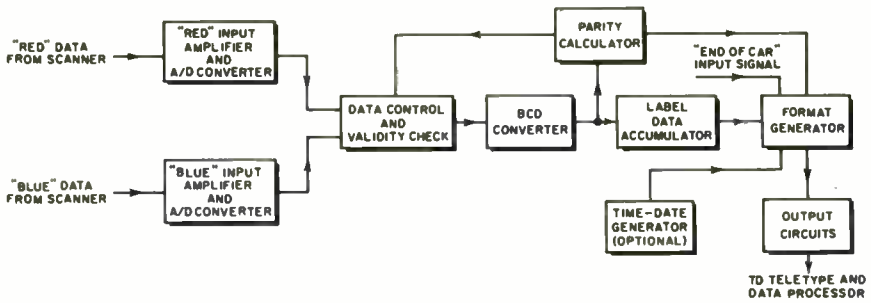
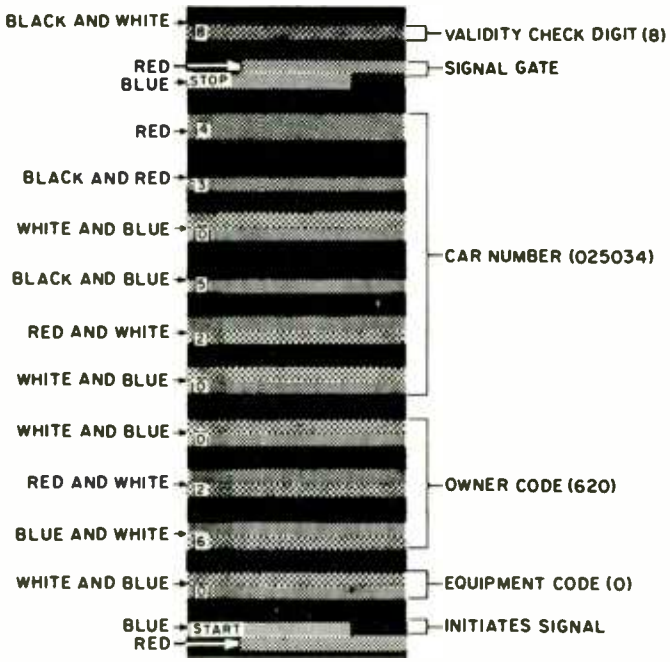


Fig. 2. The ACI decoder unit processes data from the scanner and prepares it for transmission to distant Teletype printers and data-processing units.



ACI labels are made of 3M's "Scotchlite" retro-reflective tapes. The non-reflective black background provides a "no-signal" input to the scanner. The ACI system converts the color-coded labels into a conventional, easy-to-process Teletype print-out.

Sylvania's automatic-car-identification scanner shown being used to read a label on a "piggyback" car carrying a trailer.

Optional Features

Among the most common optical ACI features are a digital time-date generator, multiple scanner units, and piggyback readers. There are other optional features available from *Sylvania*, but they are mostly concerned with formatting and data-transmission techniques.

Railroads must use at least two scanners where there is the possibility of two trains passing the same place at the same time. *Sylvania* engineers designed a duplexer circuit that lets a single decoder unit accept simultaneous inputs from more than one scanner.

A popular trend in modern railroading involves shipping freight on flatcars loaded with "piggyback" truck trailers or special shipping containers. The ACI piggyback option allows the user to place a label on the flatcar and on each of the vans or containers riding "piggyback" on it. The scanner then reads all the labels and the decoder prepares a Teletype and computer format that shows information about the flatcar and every piece of equipment on it that carries an ACI label. ▲

◀ Set of the most basic tools—those that every radio and TV service technician must have. This particular assortment is available as a kit from General Cement but other firms offer similar sets.

Hand Tools *for the Technician*

By JOHN FRYE

There are so many new and unusual tools that will make your work easier and save you time. Using the right tool at the right time is an art—and this article tells you how to be a real "pro."

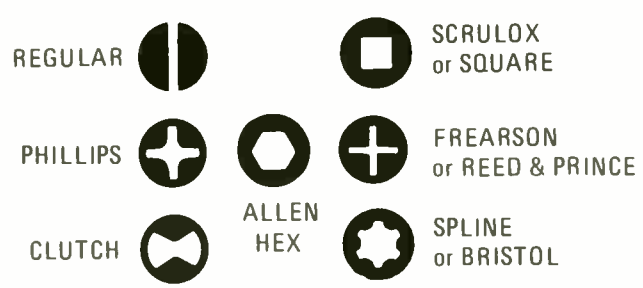
MANY electronics technicians are careless mechanics. Why, they ask, replace all four chassis bolts when two will do the job? After all, the important diagnostic portion of their work is done in "the little gray cells;" so the manual use of tools to perform the actual repair seems rather dull and boring after the intellectual excitement of using exotic instruments to corner the trouble. Still, repairing electronic gear usually ends with pulling tubes, moving wires, snipping out defective parts, installing and soldering in new ones, realigning tuned circuits—in short, with the use of hand tools—and the efficiency of the technician and the quality of his work is often judged by what he does with his tools.

Lack of proper tools may account for part of the technician's mediocre mechanical performance. Need for the proper tool can make a simple job time-consuming, temper-fraying, and equipment damaging. On the other hand, possessing the correct tool saves the technician's valuable time and renders mechanical work much easier and more pleasant. So why doesn't he provide himself with proper tools? Because he is instrument-oriented. Electronic instruments, not hand tools, are the status symbols of his profession. He may trade his perfectly good v.t.v.m. in on a new digital type when he has only the same three worn-bitted screwdrivers he had when he opened his shop!

Another reason for the technician's tool-poverty may well be that he simply does not realize what a rich variety of excellent specialized tools has been developed for his needs. Catalogues and magazine advertisements he usually sees devote more display space to service instruments than to hand tools.

This article will review many useful hand tools available to the technician, discuss their features and proper use, and list manufacturers and jobbers from whom the tools—or more information about them—can be obtained. Since electronic chemicals were covered by the writer in the May 1971 issue and solder and soldering equipment were discussed in the June issue, these items will not be included here.

Fig. 1. You will need most, if not all, of these specialized screwdriver bits. Their common names are indicated for each type. This photo is courtesy of Jensen Tools & Alloys.



Screwdrivers

Let's start our discussion with screwdrivers. The cardinal rule in their use is: the driver bit should fit the screw slot correctly. With regular single-slot screws, the bit width should be slightly less than the full length of the slot, especially on flathead countersunk screws, because the slot length is less at the bottom than at the top. If the bit is as wide as the top of the slot, the corners of the bit will be sticking out at the bottom of the slot. On the other hand, if the bit width is too narrow, leverage is lost and the screw slot may be marred or the bit tip twisted. The thickness of the bit tip should not be so great as to prevent its reaching the bottom of the slot. The shaft of a cabinetmaker's screwdriver is round and of a diameter equal to the width of the bit so the tip can reach deep into a hole to turn a countersunk screw. Other screwdrivers may have round or square shafts. Heavy-duty screwdrivers often employ the stronger square design on which a wrench can be used for additional torque. See Fig. 1 for identification of screw types.

There are two kinds of cross-slotted screws: the Phillips and the Frearson or Reed & Prince. The former has modified U-shaped slots of uniform width, while the Frearson has V-shaped slots with tapered sides. While either driver will work, after a fashion, with either screw, both work much better with the screws for which they were intended. In addition to using the proper type, it is also important to use the right size driver for these cross-slotted screws. Using too small or too large a driver is likely to ruin both screw and driver.

Other screws you encounter, especially if you do industrial electronics servicing, just often enough to make having proper drivers on hand a necessity are: the Allen head,

clutch head, Scrulox or square head, and Bristol head types. Each requires a specially shaped driver of exactly the right size and there is no good substitute.

Lincoln said a man's legs should be long enough to reach the ground, and a screwdriver should be long enough—or short enough—to reach and turn a screw wherever it may be used. That means you need stubby drivers, two-foot-long drivers, and offset drivers. And to start screws in those hard-to-reach places, you need screw-launching drivers which grip the screw head, not only for single-slot but also for cross-slot screws, such as those manufactured by *Vaco*. For working on live circuits, screwdriver tips insulated by being plastic dipped are available and offer insurance against short-circuit damage. Screwdrivers using non-sparking, non-magnetic blades of beryllium-copper, such as those offered by *Xcelite*, are a must when working in explosive atmospheres or around sensitive color-TV tubes. Another must is a set of miniature jeweler's screwdrivers, such as those offered by *Moody Machine Products*, consisting of several single- and cross-slot bits that can be chucked into a knurled handle. If you work on miniature radios, these will be in constant use.

Finally, a man who removes and drives lots of screws, such as the chassis-remover-and-replacer in a large shop, may want to use speedy ratchet screwdrivers. The simple type allows the handle to ratchet on the bit with a choice of directions. The spiral type converts a pushing action on the retractable handle into rotation of the bit so that pre-started screws or screws being replaced can be seated with one motion. Here, too, the direction of rotation of the bit is reversible so that the tool can also be used for rapid screw removal.

Pliers and Snips

The variety of pliers and wire-cutters used by the technician is comparable to the screwdrivers he uses. See Fig. 2. Many of the pliers have been borrowed from other mechanical fields and adapted to his use. First there is the familiar two-position combination slip-joint pliers that come to mind when you see the word "pliers." Every technician has a pair of these. He should also have their side-looking relatives with more positions and the water-pump pliers. A more sophisticated and smoother-acting version of the water-pump pliers is *Channellock's* tongue-and-groove pliers. The common feature of all these is that the jaws can be kept nearly parallel while gripping objects of different diameters. If the technician does auto-radio work, he should have a pair of stubby-jawed battery pliers for removing or tightening storage-battery terminal connectors.

But much of his work is concerned with maneuvering, shaping, and cutting wires; and there are several types of pliers specifically designed for his use. The granddaddy is the side-cutting electrician's pliers you see in the tool holster of every lineman. This tool is fine for working on large, heavily insulated wire. But the technician also needs at least one pair each of chain nose (a long-nose plier with smooth jaws), long nose, and needle nose pliers for handling small-diameter wire in tight quarters. Which he chooses for a particular job will depend on the size and stiffness of the wire, how much room he has, and how far he has to reach to get the wire. If he is affluent, he will find an exciting array of variations of these three types in which the tips are bent, curved, and offset to provide maximum ability to reach into difficult spots. For looping and forming wire, he needs a pair of round nose pliers designed just for this job. A pair of flat nose, sometimes called duckbill, pliers will come in handy for locking or unlocking the tabs of components mounted on printed-circuit boards.

It used to be that all the wire cutting equipment you needed was a good strong pair of six-inch diagonal cutters—but not any more. Printed circuits and miniaturization changed all that. Using those six-inch cutters on a plug-in

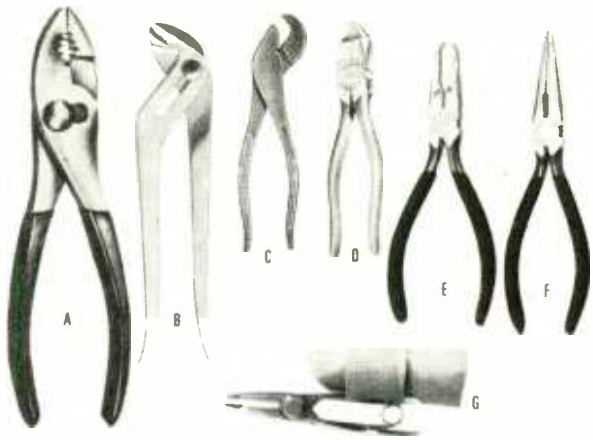


Fig. 2. Representative selection of pliers/cutters. (A) S-K combination slip-joint, (B) S-K water-pump, (C) Channellock battery, (D) Channellock lineman's, (E) Xcelite transverse cutter, (F) Xcelite radio & TV, (G) Techni-tool "Deli-Cut."

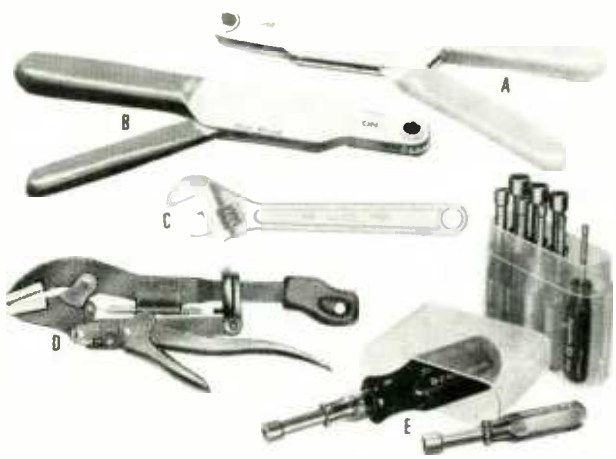


Fig. 3. Various wrenches useful for service work. (A, B) Amtronix's squeeze-action open and closed-end wrenches, (C) Vaco's crescent wrench, (D) Channellock's "Griplock" crimping tool, (E) Xcelite's Allen-hex assorted wrenches.

TV module would be as awkward as cracking peanuts with a sledge hammer. A glance at a good tool catalogue, such as the one put out by *Techni-Tool, Inc.*, will reveal dozens of imported and domestic wire cutters and nippers of every conceivable size, shape, and application. Transverse cutters will nip the wire off cleanly flush with the board. Probably one of the most versatile tools for the technician is a pair of radio & TV pliers that combine features of long nose pliers with diagonal cutters. The cutting section is a short distance back from the tip of the plier jaws.

If you do lots of miniature work, you will be interested in the tiny Deli-Cut instruments that fasten to the fingers with Velcro straps and are actuated by the opposing thumb. With tweezers on one finger and a cutter on the other, you can position and cut wires the size of a hair without having to lay down one tool and pick up another.

A pair each of inside and outside snap ring pliers can save lots of time and temper if you encounter these spring-steel C-shaped retainers. They are so easy to remove and replace with the proper pliers that it is hard to believe how stubborn they are to manage without those tools.

The way the two halves of pliers and cutters are joined together becomes increasingly important with the need for keeping the jaws in alignment. A sloppy joint is tolerated, even desirable, with slip-joint water pump pliers; but this is not true with precision cutters or pliers with long tapering

jaws. Those jaws should stay in perfect alignment even when considerable lateral strain is exerted on the tips, as happens when they are used to twist things. Some pliers employ a steel dowel pin in one jaw that slips into a hole in the opposing jaw to maintain this alignment. Others depend on lapped joints and large rivets. Possibly the best solution is the box joint in which one half of the pliers slides through a box opening in the other and the lapped surfaces hold the jaws in alignment even when there is some wear on the rivet that serves as a bearing.

Wrenches

Wrenches are not as important to the electronics technician as to the garage mechanic, but electronic equipment is still enough of a nuts-and-bolts affair to make a good assortment of wrenches essential to the well-equipped service shop. See Fig. 3. Nut drivers are the most popular wrenches with technicians. These are actually socket wrenches with screwdriver-type handles. The best ones are made of high-grade steel so the walls of the sockets are thin enough to allow working in tight quarters and the shafts are hollow to permit turning a nut far down on a long screw.

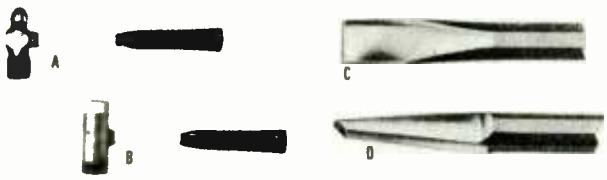


Fig. 4. Hammers and cutting tools. (A, B) S-K's ball-peen and soft-faced hammers, and (C, D) cold and cape chisels.

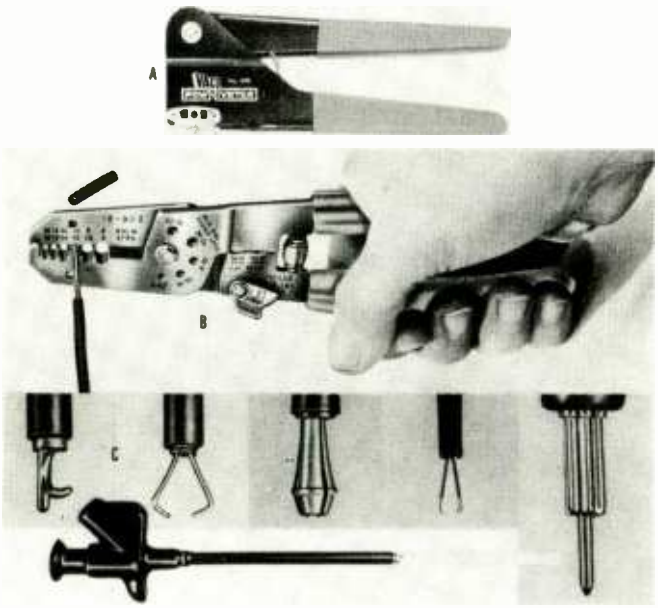
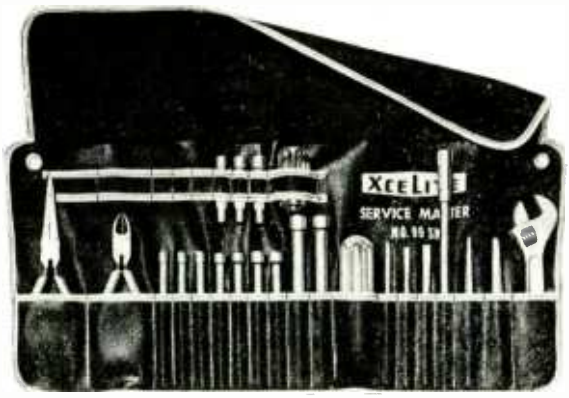


Fig. 5. Other useful tools that you should investigate. (A) Vaco's "PowRiveter," (B) Holub's wire stripper, and (C) Rye's "Clever Kleps" test leads in various configurations.

For house calls, a kit of essential tools, like this 23-piece set from Xcelite, is both important and very "professional."



Nut drivers are usually purchased in sets of six to ten drivers covering the majority of nuts encountered in radio and TV servicing. They can be had with individually color-coded handles or with separate shafts that snap into a common handle. Complete wrenches probably save time in bench work, while the snap-in type saves space in the tool box. Two or three drivers in the most popular sizes with extra-long shafts and another set with extra-short shafts are a good investment for solving special problems.

But there still will be places where a nut driver simply cannot be used, and that is where you need a set of miniature end wrenches. The offset type enables you to tighten or loosen a nut where there is only room for a small arc of action. *Amtronix* makes three unusual wrenches for special situations. The automatic ratcheting box wrench and automatic ratcheting open-end wrench provide for turning a nut by squeezing and relaxing the spring-loaded plier-type handles. The open-end wrench is for use on tubing or other places where you cannot slip the wrench over the end of the bolt. The spinning ratchet is actually a compact right-angle drive with a 1:1 gear ratio for driving socket wrenches. It is turned with a screwdriver-type handle, accepts all socket accessories, and has an optional ratchet feature.

Every shop needs two or three adjustable crescent wrenches and a multi-purpose plier wrench that can be locked onto an object with a spring-cam action. The latter is called a "vise-grip" by garage mechanics, but each manufacturer gives his version a different name. *Channellock* calls its two models "Griplock" and "Tog-L-Lok." *Xcelite* sells a handy little wrench for removing the spanner nuts that hold antenna and speaker jacks in the cases of transistor radios and CB equipment. And no shop should be without a good collection of Allen wrenches for loosening and tightening Allen setscrews that are used profusely on dial knobs and in tape recorders.

Tool Kits

It is impossible to have too wide a variety of alignment tools. The very one you lack will be the one you need. If you try to "make do" with a tool not intended for the job, a broken tuning slug is likely to result. Probably the best way to buy alignment tools is by kits. *GC Electronics* offers several kits of basic, deluxe, and specialized types as well as individual alignment tools of every kind and for every use. Speaking of kits, *Chapman Manufacturing Company* has several midget ratchet kits for driving any kind of small to medium size screw you are likely to encounter. The various shaped and sized bits work in either the ratchet or spinner handle furnished with the kit. And if you are looking for complete tool kits containing all the tools you are ever likely to need on a job in field engineering or in telecommunications, you will find several in the catalogues of either *Jonard Industries* or *Jensen Tools and Alloys.*

Soldering Aids

As previously mentioned, solder and soldering tools have been covered in detail in another article. However, a few specialized soldering hand tools deserve mention here. *Technical Equipment Company* markets a lightweight portable soldering iron powered by a rechargeable NiCad storage cell. The Express 2000 features interchangeable 40- and 25-watt tips, negligible magnetic field, an accessory charger, and complete electric isolation—an important factor in working with solid-state devices. Removing defective

STEREO REVIEW PRESENTS . . .

the answer to the cassette storage problem

DELUXE CASSETTE STORAGE CASES—Designed by the Editors of STEREO REVIEW MAGAZINE.

Decorative and sturdily constructed, Stereo Review Cassette Storage Cases are just what you've been looking for — the ideal solution to keeping your cassettes neatly stored for easy use.

- **LARGE CAPACITY:**
Individual storage slots for 60 (5 dozen) cassettes.

- **SIZED FOR THE COLLECTOR:**
13½ inches high, 12⅝ inches deep, 5½ inches wide . . . designed to fit easily on the same bookshelf as your disc collection.

- **SPILL-PROOF:**
Storage slots are tilted back slightly to prevent cartridges from falling out during handling.

- **DECORATIVE:**
Handsome outer case elegantly embossed in gold in your choice of three popular decorator colors—black, brown and green.

- **EASY-TO-IDENTIFY:**
Pressure sensitive labels included *free* of charge to identify your own blank tape dubbings as well as the occasionally unmarked pre-recorded tape.

This *all new* Stereo Review Cassette Storage Case with its handsome leatherette covering is truly the answer to the cassette storage problem. It lends itself readily to the decor of any room and serves to store an unusually large number of cassettes (60) compactly, so that they take up very little room on your bookshelf.

If you prefer or require a smaller unit, a Storage Case holding 30 cassettes is also available. It measures 13½ inches high, 6½ inches deep, 5½ inches wide and is available in the same choice of decorator colors.

60-unit Cassette Storage Cases are $13.95 each—2 units for $25.

30-unit Cassette Storage Cases are $7.95 each—2 units for $15.

8-track Cartridge Storage Cases are $4.95 each; 3 for $13; 6 for $25.

Add 50c *per unit* ordered for postage and handling (except orders for 6—8-track Cartridge Cases—add $1.50 total).

8-TRACK CARTRIDGE STORAGE CASE TOO.

For those of you faced with similar storage problems for your 8 track cartridges, this attractive unit is your solution. It measures 13¾ inches high, 6½ inches deep, 4½ inches wide, has individual storage slots for 12 cartridges and is of the same sturdy construction and decorative appearance as the Cassette Case.

Ziff-Davis Publishing Co. • Dept. 23
One Park Ave.
New York, N.Y. 10016

My remittance in the amount of $_____ is enclosed for the Cases indicated below:

_____ 60-unit Cassette Storage Cases @ $13.95 each; 2 for $25.00
_____ 30-unit Cassette Storage Cases @ $7.95 each; 2 for $15.00
_____ 12-unit Cartridge Storage Cases @ $4.95 each; 3 for $13; 6 for $25

Add 50c per unit ordered for postage and handling (except orders for 6—8 track Cartridge Cases—Add $1.50 total). Outside U. S. A. add $1.00 per unit ordered.

Check color choice for back of case (sides in black only):
☐ Brown ☐ Green ☐ Black

print name _____

address _____

city _____ EW-971

state _____ Zip _____

components from a printed-circuit board without damaging the board is always a problem, but the desoldering iron offered by *Enterprise Development Corporation* is a great help. It heats the joint with a special hollow tip and sucks the molten solder away by the action of a rubber bulb.

The technician encounters a few broken parts for which no replacement is available and that cannot be held together with tin-lead solder. This is a cue for *Microflame's* miniature welding torch that can be held, self-contained cylinders and all, in the palm of the hand. It furnishes a pinpoint flame with temperatures as high as 5000 degrees F that enables you to weld and braze small articles of steel and other metals.

In ordinary soldering you need hand tools to seize, maneuver, and hold the wires, while clip-on heat sinks protect sensitive components from lead-conducted heat. *Electronic Tool Company* is one of several offering all sorts of seizing, tweezers, and wire-maneuvering tools. Just seeing the wires you are trying to solder presents a problem in miniature equipment; so you need magnifiers to help. You have a good choice of watchmaker's loupes, headband magnifiers, and illuminated bench magnifiers in the catalogue of *Jensen Tools.*

Cutting Tools

The technician should have a good assortment of flat, knife-edge, round rat-tail, three-square, and needle files. In addition, he should have contact burnishers so he will not be tempted to use his files on relay contacts! He should carry a good pocket knife, and the bench should be equipped with scissors, tin snips, tapered reamers, a good hacksaw, and a tapping tool for tapping 6/32, 8/32, and 10/32 screws. Sometimes it is necessary to cut a new hole in a chassis to mount a new component or re-allocate one already present, and the chassis punches made by *Greenlee Tool Company* will allow you to cut any size or shape hole you desire by simply turning a wrench. Finally, a nibbling tool is excellent for cutting odd-shaped openings in plastic or thin metals of any sort.

If you do industrial maintenance and installation work, you will need a tool assortment like this 25-piece kit assembled by Jensen Tools and offered either with or without the drill.

A universal "driver" like the Tescom "Moto-Tool" will handle grinding, sanding, drilling, routing, and deburring jobs while the tiny cordless drill is useful for on-the-job tasks and for PC work. It is available from Jensen Tools.

Amtronix, Inc.
Box 44
Chula Vista, Calif. 92012

Arrow Fastener Co., Inc.
271 Mayhill St.
Saddle Brook, N.J. 07663

Channellock, Inc.
Meadville, Pa. 16335

Chapman Mfg. Co.
30 Saw Mill Road
Durham, Conn. 06422

Electronic Tool Co.
510 N. Dearborn St.
Chicago, Ill. 60610

Enterprise Development Corp.
5127 East 65 St.
Indianapolis, Ind. 46220

Gardiner Solder Co.
4820 S. Campbell Ave.
Chicago, Ill. 60632

GC Electronics Div.
Hydrometals, Inc.
400 S. Wyman St.
Rockford, Ill. 61101

Greenlee Tool Co.
Div. of Ex-Cello-O Corp.
2136 Twelfth St.
Rockford, Ill. 61101

Holub Industries, Inc.
413 DeKalb
Sycamore, Ill. 60178

Injectorall Electronics Corp.
98-100 Glen St.
Glen Cove, N.Y. 11542

Jensen Tools & Alloys
4117 North 44 St.
Phoenix, Ariz. 85018

Jonard Industries Corp.
3047 Tibbett Ave.
Bronx, N.Y. 10463

Klein & Sons Inc., Mathias
7200 McCormick Road
Chicago, Ill. 60645

Krauter/Dresser Hand Tool Div.
3201 N. Wolf Rd.
Franklin Park, Ill. 60131

Microflame, Inc.
3724 Oregon Ave., S.
Minneapolis, Minn. 55426

Moody Machine Products Co., Inc.
42-46 Dudley St.
Providence, R.I. 02905

Rye Industries, Inc.
125 Spencer Place
Mamaroneck, N.Y. 10543

Technical Equipment Co.
Box 247
Bothell, Wash. 98011

Techni-Tool, Inc.
1216 Arch St.
Philadelphia, Pa. 19107

Tescom Corp.
Instrument Division
2633 Southeast 4th St.
Minneapolis, Minn. 55414

Vaco Products Co.
510 N. Dearborn St.
Chicago, Ill. 60610

Wen Products, Inc.
5812 Northwest Highway
Chicago, Ill. 60631

Xcelite, Inc.
Thorne & Bank Streets
Orchard Park, N.Y. 14127

Utica Tool Co., Inc.
Cameron Road
Orangeburg, S.C. 29115

Companies that make and/or distribute lines of hand tools.

Hammers and Hammered Tools

While he discourages the customer's hammering on his TV set to "fix" it, the technician still uses hammers ranging all the way from the tiny tube tapper to a heavy rubber mallet. In addition, he should have a small conventional hammer, a soft face hammer, and a ball peen hammer. He will need something to use these hammers on, and he will find an excellent assortment of prick or center punches to start drills, pin punches to knock out rivets, aligning punches to line up holes in two different pieces of metal, and cold or cape chisels for cutting off rivets in the *S-K Tools* catalogue of *Krauter/Dresser.* See Fig. 4.

Power Tools

The electric drill is a much-used tool in servicing and should be selected with care. The author favors a double-insulated, variable-speed drill for safety and versatility, but each reader probably has his own preference. A hand-held high-speed grinding tool, such as the Moto-Tool sold by *Tescom*, will find dozens of uses in the shop and field. With the various furnished accessories, it grinds, sands, drills, polishes, routs, and deburrs wood, plastic, metal, glass, or ceramics. To identify positively your tools in case of loss or theft, a Model 21 electric pencil engraver by *Wen Products* will enable you to monogram steel, glass, aluminum, or whatever at a low cost in time and money. If you can afford it, a flameless heat gun, such as those offered by *Techni-Tool*,

not only is excellent for shrinking tubing, de-soldering, drying moisture out of parts, and speeding up the drying of finishes and epoxy, but it also is fine for triggering thermal intermittents, especially when used with an antagonist such as *Injectorall's* Chill-It circuit freezer spray. Finally, you need a bench grinder to keep tools in tip-top shape.

Miscellaneous

There are many hand tools that are not absolutely essential, but they certainly save time and effort. See Fig. 5. One such is *Vaco's* PowRiveter blind riveting tool that enables you to fasten an item to a surface while working just from one side. Another is a special staple gun by *Arrow Fastener Co.* for making safer, faster, neater wire and cable installations when setting up intercom and p.a. systems. Wire strippers are great time savers. *Holub Industries* makes the Little-7 wire stripper that strips wires from #18 to #6, bends them, and cuts them off. Other strippers from the same company will strip stranded or solid wire as small as #30.

Injecting a signal, picking off a signal, or monitoring a voltage on a crowded printed-circuit board can present a short-circuiting hazard unless you have seizing, insulated test probes called Clever Kleps manufactured by *Rye Industries*. The spring-loaded claw, collet, or boathook ends grip the circuit-board test points while a wire or banana plug can be inserted at the rear of the Klep for connection to an instrument. Along the same line is the flexible mechanical finger manufactured in many forms. It, too, has a spring-loaded claw spread by pushing a button on the other end of the flexible shaft and is excellent for starting screws or nuts in hard-to-reach places or for retrieving the latter if they fall down into a cranny of the chassis. A crimping tool for attaching solderless connectors should also be in the tool box of the technician.

But the list of hand tools he can use is tremendous and still growing. The best way to appreciate this is to send for the catalogues put out by the suppliers. Some of these manufacture tools specifically for electronics technicians; others sell a wide range of tools manufactured here and abroad for many mechanical applications. It is strongly recommended both types of catalogues be secured for you will often find a personal use for a tool designed for an entirely different field. The author's bench carries tools discovered in the hands of doctors, dentists, garage mechanics, typewriter repairmen, and even housewives. We who use tools have a common bond, and Winston Churchill, that international fixer, gave us our motto: "Give us the tools, and we will finish the job!" ▲

Electronics World SUBSCRIBER SERVICE

Please include an address label when writing about your subscription to help us serve you promptly. Write to: P.O. Box 1093, Flushing, N.Y. 11352

CHANGE OF ADDRESS: Please let us know you are moving at least six to eight weeks in advance. Affix magazine address label in space to the right and print new address below. If you have a question about your subscription, attach address label to your letter.

TO SUBSCRIBE: Check these boxes:
☐ 5 yrs. $26 ☐ 3 yrs. $18 ☐ 1 year $7
☐ New ☐ Renewal

SPECIFY: ☐ Payment enclosed—You get 1 extra issue per year as a BONUS!
☐ Bill me later.

If you have no label handy, print OLD address here.

name please print
address
city
state zip-code

AFFIX LABEL

name please print 0372
address
city
state zip code

Add'l postage: $1 per year outside U.S., its possessions & Canada.

Visual Aids in Servicing

Although a technician's eyes are fabulous "tools" in diagnosing troubles, with miniature electronics equipment they need help.

By **John Frye**

USUALLY Barney stormed right through the office into the service department when he came to work, but this morning he circled slowly around Matilda, the office girl sitting at her desk, staring down at her critically. She ignored him as long as she could but then hit a wrong key and gave up on her typing.

"You got a problem?" she asked, furtively checking the buttons on her blouse.

"No, I was just trying to decide what kind of nose you have," he explained, cradling his chin thoughtfully in his hand. "Is it a round nose, a long nose, a needle nose, a flat or duckbill nose, or perhaps a chain nose?"

Matilda reached for a paperweight and Barney beat a hasty retreat to the door of the service department.

"I'll 'nose' you," she threatened. "Since when did you become a connoisseur of noses?"

"Since very recently. You see the noses I'm talking about all belong on service pliers. Most of the names are self-explanatory, but chain nose pliers aren't—at least as far as I am concerned. I began to wonder what made these pliers different from, say, long nose pliers and why they were called 'chain nose.' The *Merriam Webster Third New International Dictionary* does not list the term. Neither did the newer *American Heritage Dictionary* nor the *Encyclopedia Britannica*. My distributor didn't know, nor did the salesman who sold him pliers. I looked in a huge hardware catalogue but there was no explanation there. Finally, I talked to the engineers at the local electronics factory. They admitted using dozens of the pliers in the plant, but they never really thought about the matter!

"Let me make one thing clear: these people did not *know* what made chain nose pliers different, but they had lots of diverse ideas. I was told chain nose pliers were short-jawed long-handled pliers; they were pliers with smooth jaws; the jaws had beveled edges; etc. etc. But when I looked in a few tool catalogues, I found pliers labeled chain nose that didn't match any of these descriptions. There were chain nose pliers with long jaws and short handles and *vice versa*; some had serrations in the jaws while others were smooth; some jaws had beveled edges, but there was no mention of this in others. And to make things still more confusing, I found hyphenated 'needle-chain nose pliers,' 'bent chain nose pliers,' and 'offset chain nose pliers.' "

"So what did you find out?" Mac's voice asked behind Barney. The latter gave a start because he had not realized his employer had been in the service department all the while.

"I wish you'd quit sneaking up behind a guy," Barney complained. "Do you know what these pliers are?"

"I hate to admit I don't."

"Good; then I'll tell you. On a hunch I wrote Sheldon Gates, president of *Jensen Tools & Alloys* out in Phoenix, and asked my question. He wrote back promptly and gave me his considered opinion, although he modestly denied it was authoritative. He said in the old days chain nose pliers were used in the jewelry business to make chains by hand from gold and silver wire. A strong, fairly short plier was needed to bend the wires into individual loops. The jaw had a curved bottom to make half-round of the loops. There were no serrations to nick the soft gold or silver. A radius edge to the jaw would be an advantage but probably not essential. Length of the handles would not be important.

"The thing you have to remember, Mr. Gates warns, is that the name gets passed along from item to item and eventually loses it original meaning. For example, suppose an electronics technician is using a pure chain nose plier but decides it would be more helpful for his job if the jaws were serrated. So he orders a 'chain nose plier with serrated jaws.' Even though the result would not be useful for making chains, it still carries the name of chain nose plier.

"That's why I was getting all those ideas about what the plier was like. Remember the blind men who wanted to know what an elephant was like and were permitted to feel a live elephant? One felt the animal's leg and said, 'An elephant is like a tree.' Another felt his side and said, 'No, an elephant is like a wall.' The third felt the tail and remarked, 'You are both wrong; an elephant is like a rope.' Each, of course, was partially right; but he made the mistake of trying to expand a single observed item into a complete description. Not until you know the original purpose of chain nose pliers can you say what features necessarily distinguish them from other pliers."

"Very interesting," Mac remarked; "but now come on back here and tell me what you think of a new addition to the service bench. I have a hunch it, too, came originally from the jewelers."

Dutifully Barney followed Mac back to the service bench and examined a large magnifying lens with a built-in lamp mounted by a counterbalanced adjustable arm to the end of the bench so it could be moved over a wide arc and adjusted to any desired height above the bench.

"As you know," Mac explained,"our work is becoming more like jewelers' work all the time. Electronic equipment is becoming smaller; components are shrinking; and they are being crowded closer together. The human eye, still one of the best service instruments we have, needs help. We already have jewelers' loupes of different magnification, and they are fine for a quick examination of a suspicious connection or component, but holding one of these in the eye becomes tiring very quickly if you are not used to it. I think this magnifier will be fine for actually working on a tiny printed circuit. You can stand in a normal comfortable position and watch what you are doing through this large lens. The circular lamp, as you will note, does not permit the casting of dark shadows on the work with tools or hands."

"Looks like a winner to me," Barney approved; "but let's not sell those jewelers' loupes short. I see some jewelers using a loupe fastened to a headband so you don't need to hold it in your eye like a monocle. When not in use, the loupe can be swung out of the way. I like even better the binocular headband-type with flip-up interchangeable lenses. This new large lens will be excellent for working here at the bench, but the loupes have the advantage of portability.

Lots of times in the home I want to make a very close examination of a receptacle for a plug-in unit or of a suspicious printed-circuit lead in a vertically mounted board. That's where the magnifiers I mentioned really come in handy. On top of that, I just know I look very professional and competent when I screw that loupe into my eye and peer knowingly into the innards of a customer's set."

"I can just see you making a production of the examination," Mac said with a grin; "but while we're talking about magnifiers, let's not forget a couple of others we've found very useful. I'm talking about the stylus microscope and the color-picture-tube magnifier. That stylus magnifier is the only reliable way to tell if there is anything wrong with a stylus. I know some fellows who say they can tell by the 'feel' of a stylus point if it is chipped, broken, or badly worn; but I don't believe it."

"That dot magnifier certainly does tell you what is happening when you can't seem to get proper purity on the picture tube or do anything with the static convergence," Barney offered. "When you blow up those dots until they look like poker chips—well tiddlywinks, anyway—you can tell where the picture-tube guns are really shooting. You don't need that magnifier often, but it certainly can save time when you do."

"While we're talking about visual aids," Mac suggested, "let's not forget the mirrors we use. Think what a great improvement that adjustable metal mirror on a stand we use for converging picture tubes is over the cobbled up glass-mirror arrangements we used to use—and break—with great regularity. And that nifty idea of yours for hanging a magnifying shaving mirror on the stand for close-ups of particular portions of the screen is, in the tired vernacular of the day, right on."

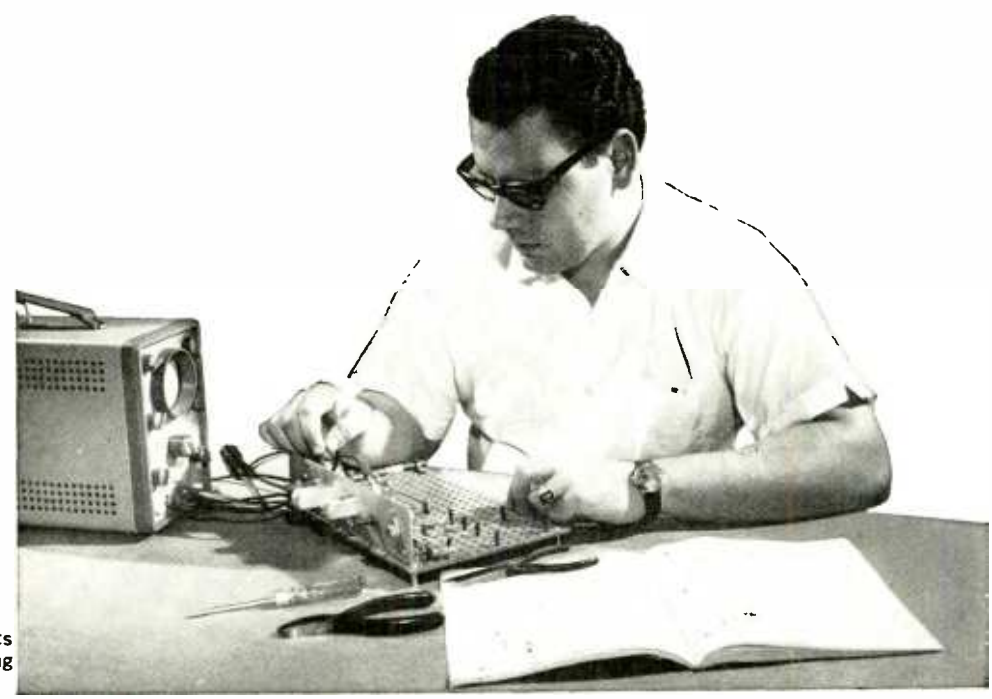
"Thank you. It is always nice to have one's true worth recognized," Barney replied with an impish grin. "But I think I get almost as much good out of those tiny dental mirrors we use as I do out of the big reflectors. They are really a life-saver when you simply have to see the back side of a bolted-down circuit board and don't want to loosen all the screws holding it in place. I'm especially glad that we have several with different lengths of handles and different sized mirrors. At one time or another, I've had a use for every one. And it's amazing how often I find myself using the adjustable little mirror mounted on the end of a pen-type flashlight. By properly adjusting that little jigger, you can send the light right into the place you need to see and make the mirror do double duty by reflecting the illuminated spot back up to your eye."

"We mustn't forget our 7 X 50 binoculars," Mac warned. "When I think of all the foot-pounds of energy those things have saved us by eliminating unnecessary trips up and down antenna towers or across rooftops, I feel like kissing them. Being able to stand on the ground and tell if a feedline is broken loose, if a coupler line is open on one side, or if a phasing bar is shorting out is no small advantage."

"I'm grateful for all these aids that permit us to make little things look big, to make far away things look close, and to enable us to see around corners," Barney testified. "As you said in the beginning, the human eye is an invaluable service instrument and diagnostic device, but it needs help in electronics servicing just as it does in the practice of medicine. The modern physician would be severely handicapped if he did not have the microscope to reveal and identify the pathogens responsible for disease in his patients. While our technicians' eyes do not need that much help yet, I would hesitate to say we will never have to use the microscope for service—at least if the present trend towards micro-miniaturization continues, and there is no reason to doubt that it will. What are you grinning about?" he demanded of his employer.

"I was just wondering if we will be using chain nose miniature tweezers," Mac replied. ▲

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



Performing transistor experiments on programmed breadboard — using oscilloscope.

1 LEADER IN ELECTRONICS TRAINING

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

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

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

3 WELL PAID JOBS ARE OPEN TO MEN SKILLED IN ELECTRONICS

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. There are challenging new fields that need electronics technicians...new careers such as computers, automation, television, space electronics where the work is interesting and earnings are greater.

4 WIDE CHOICE OF CAREER PROGRAMS

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

5 SPECIALIZED ADVANCED TRAINING

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

6 PERSONAL SUPERVISION THROUGHOUT

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

7 HANDS-ON TRAINING

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. You get over 250 projects and experiments and as many as 22 kits in some programs. Each kit is complete in itself. You never have to take apart one piece to build another. They're yours to keep and use on the job.

8 FCC LICENSE TRAINING— MONEY BACK AGREEMENT

Take RCA's Communications Career program—or enter with advanced standing and prepare immediately for your 1st, 2nd, or 3rd class FCC Radio Telephone License examinations. RCA Institutes money-back agreement assures you of your money back if you fail to pass the FCC examination taken within 6 months after completing the course.

9 CONVENIENT PAYMENT PLANS

You get a selection of low-cost tuition plans. And, we are an eligible institution under the Federally Insured Student Loan Program.

10 RCA INSTITUTES IS FULLY ACCREDITED

RCA Institutes is an accredited member of the National Home Study Council. Licensed by N. Y. State—courses of study and instructional facilities are approved by the State Education Department.

VETERANS: TRAIN UNDER NEW GI BILL

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

If reply card is detached, send this coupon today.

RCA INSTITUTES, INC.
DEP'T. 240-109-0
320 W. 31 ST.
NEW YORK, N.Y. 10001

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

Name _____

Address _____

City _____

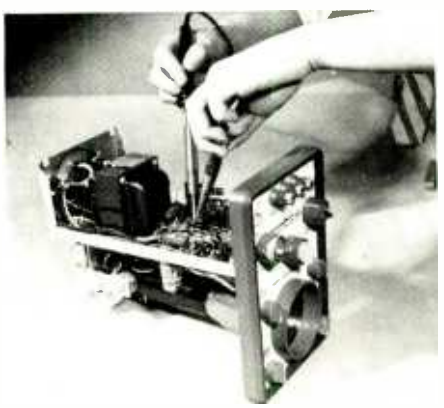
State _____ ZIP _____

Age _____

Veterans: Check here ☐

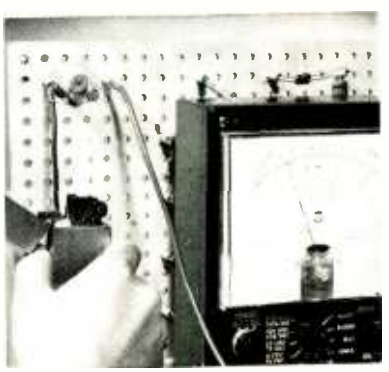
RCA

Construction of Multimeter.



Construction of Oscilloscope.

Temperature experiment with transistors.



Integrated Circuit Audio Generator

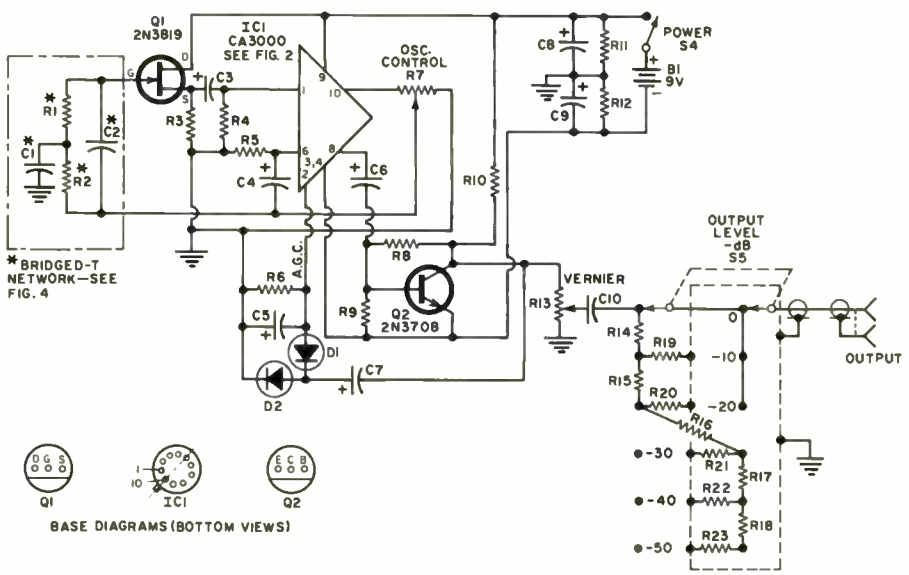
By KURT T. RUDAHL

An accurate a.f. generator, providing resettable, sine-wave audio signals, made from inexpensive IC and transistors.

Author's generator was built into small chassis box. Three controls at left set frequency to two significant figures plus multiplier. The controls at right determine the output level.

HAVE you ever wished you could set your audio generator to a particular frequency and know you could rapidly return to the same frequency later or that you could rapidly and accurately select a precise frequency anywhere within the audio range? This IC audio generator permits this to be done using three operating controls providing two switch-selected digits and multiplier. The generator provides an output level constant for all frequencies.

Fig. 1. Complete schematic diagram and parts listing for the solid-state generator.



R1,R2—See Fig. 4
R3,R4,R5—2700 ohm, ½ W res.
R6—30,000 ohm, ½ W res.
R7—20,000 ohm pot
R8—12,000 ohm, ½ W res.
R9—3300 ohm, ½ W res.
R10—1300 ohm, ½ W res.
R11—1000 ohm, ½ W res.
R12—300 ohm, ½ W res.
R13—5000 ohm pot
R14,R15,R16,R17,R18—1600 ohm, ½ W res.
R19,R20,R21,R22,R23—1100 ohm, ½ W res.

C1,C2—See Fig. 4
C3,C4,C5,C6,C8,C9—200 μF, 15 V elec. capacitor
C7—10 μF, 10 V elec. capacitor
C10—100 μF, 25 V non-polarized capacitor (or 2 back-to-back 200 μF)
D1,D2—1N625 diode
S1,S2,S3—Not shown, see Fig. 4
S4—S.p.s.t. toggle switch
S5—D.p.6-pos. rotary switch
B1—9 V battery
IC1—CA3000 integrated circuit (RCA)
Q1—2N3819 FET transistor
Q2—2N3708 "n-p-n" transistor (TI)

As can be seen from Fig. 1, the audio generator consists of an integrated-circuit amplifier with three feedback loops: (1) an adjustable broadband positive-feedback loop; (2) a frequency-selective (bridged-"T") negative-feedback loop; and (3) an automatic gain control (a.g.c.) loop.

The integrated circuit, shown in Fig. 2, consists of a single-stage differential amplifier (Q2 and Q4) with input emitter-followers and a constant-current sink (Q3) in the emitter-coupled leg. The gain of the dual-input, dual-output circuit is approximately 30 dB at frequencies up to 1 MHz.

One output from the integrated circuit is applied through capacitor C2 as broadband positive feedback. This output signal is also applied as negative feedback through the bridged-"T" frequency-determining network. As Fig. 3 indicates, the bridged-"T" network has very high impedance at the resonant frequency, falling off rapidly on either side. Consequently, the entire circuit oscillates only at that frequency at which the positive feedback exceeds the negative feedback.

The frequency-determining accuracy of the bridged-"T" network is strongly dependent on loading. A source-follower field-effect transistor (FET) stage, corresponding almost ex-

actly to a pentode cathode-follower, raises the IC amplifier's input impedance to several megohms. Probably even higher frequency-determining accuracy could be obtained using an insulated-gate FET.

The other IC output, which has a signal level of about 0.1 V p-p, is connected to a conventional common-emitter amplifier stage, Q2 in Fig. 1. Part of the output of this stage is rectified, filtered, and applied to the a.g.c. terminal of the IC amplifier. This a.g.c. compensates for temperature, power-supply variations, and frequency-determining network losses to provide an output which is pure sinusoidal and constant in amplitude for all frequency settings, within about 1 dB.

(For those readers who, like the author, enjoy redesigning before building, it should be emphasized that the a.g.c. is *not* unnecessary. Without it, the unit varies between not oscillating at all and overloading. Results are quite poor.)

This output from Q2 is also applied through the output Vernier control and the Output-Level attenuator which permit varying the output level continuously or else in 10-dB steps. With the Vernier control set at a maximum, the Output-Level steps correspond to approximately 3 mV to 1 V in six steps.

Construction

Construction of the audio generator is not critical. However, *careful* work is required, especially when wiring the frequency-determining network (Fig. 4). Obviously, no generator is more accurate than the frequency-determining components in it.

The generator was constructed in a 4" × 5" × 6" metal box. The three lowest level stages of the attenuator were constructed inside a copper shield, as shown in Fig. 1, to avoid contamination of the very low level output signal.

All parts except those attached directly to the switches were mounted on a Vectorboard. Short leads should be used throughout; in particular, leads between the frequency-determining network and the IC input should be direct and dressed away from all other signal leads. The two transistors used are economy-type plastic encapsulated units and are readily available. Total list price for the two transistors and the IC was about $6.00. The diodes can be any general-purpose silicon types. The battery should be the largest-capacity 9-volt type convenient, or an external power supply can be used.

Alignment and Troubleshooting

To align the unit, adjust the oscillator control for an a.g.c. voltage of 0.7 to 0.8 V d.c. At this setting, the output should be a clean sine wave at all frequency settings. If distortion is apparent at some settings, set the control for a lower a.g.c. voltage; if oscillation does not occur at some settings, the setting is too low. Once set, there should be no reason to change the setting. If readjustment seems indicated at some later time, check the battery voltage first.

(Note: When making any internal or external adjustments, except output-level adjustment, allow 5 to 10 seconds for the output to stabilize.)

Since 1-percent precision capacitors are not commonly available, it may be desirable to pad the capacitors on the frequency-multiplier switch to calibrate the audio generator against a known frequency.

An oscillator circuit can be very difficult to troubleshoot, since every part of the circuit interacts with every other. Some things to watch for are:

- Failure to oscillate at some frequency settings: Look for defects in the frequency-determining networks or excessive loading caused by a defective FET.
- Inaccuracies at higher frequencies: Look for capacitive coupling between the positive- and negative-feedback circuits.
- Inaccuracies at the higher settings for *each* Multiplier setting: Look for an excessive amount of network loading.
- Inability to set oscillator control as required: First, check the battery. Then check the a.g.c. circuit. If both of these check out, a *slight* adjustment in the power-supply voltage divider may be in order. ▲

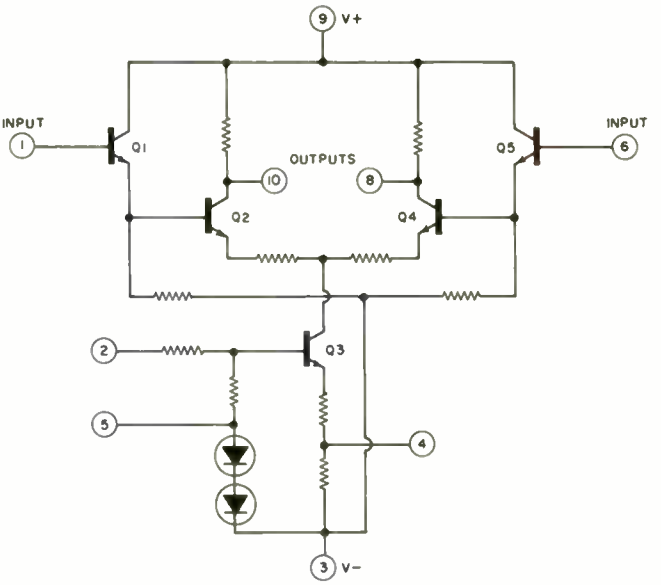


Fig. 2. Internal circuit and connection for the CA3000 IC.

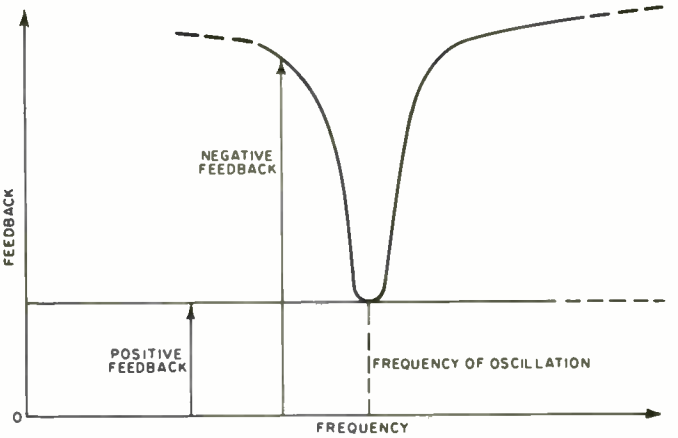


Fig. 3. Circuit oscillates at the single frequency at which positive feedback just slightly exceeds negative feedback.

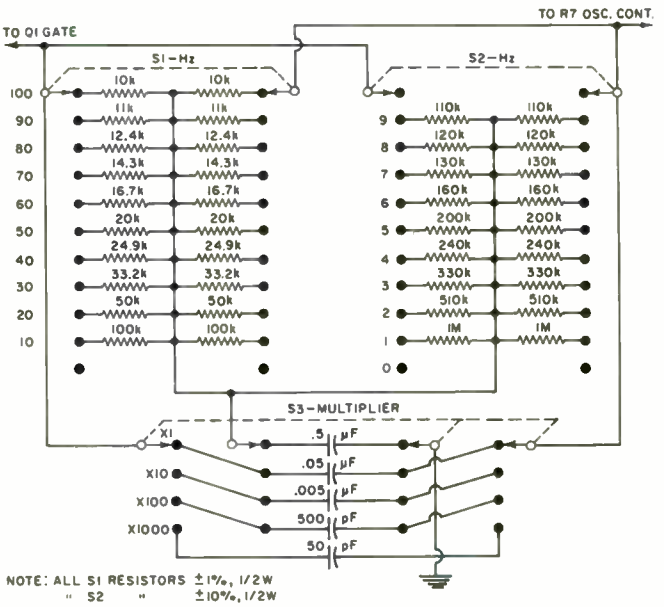
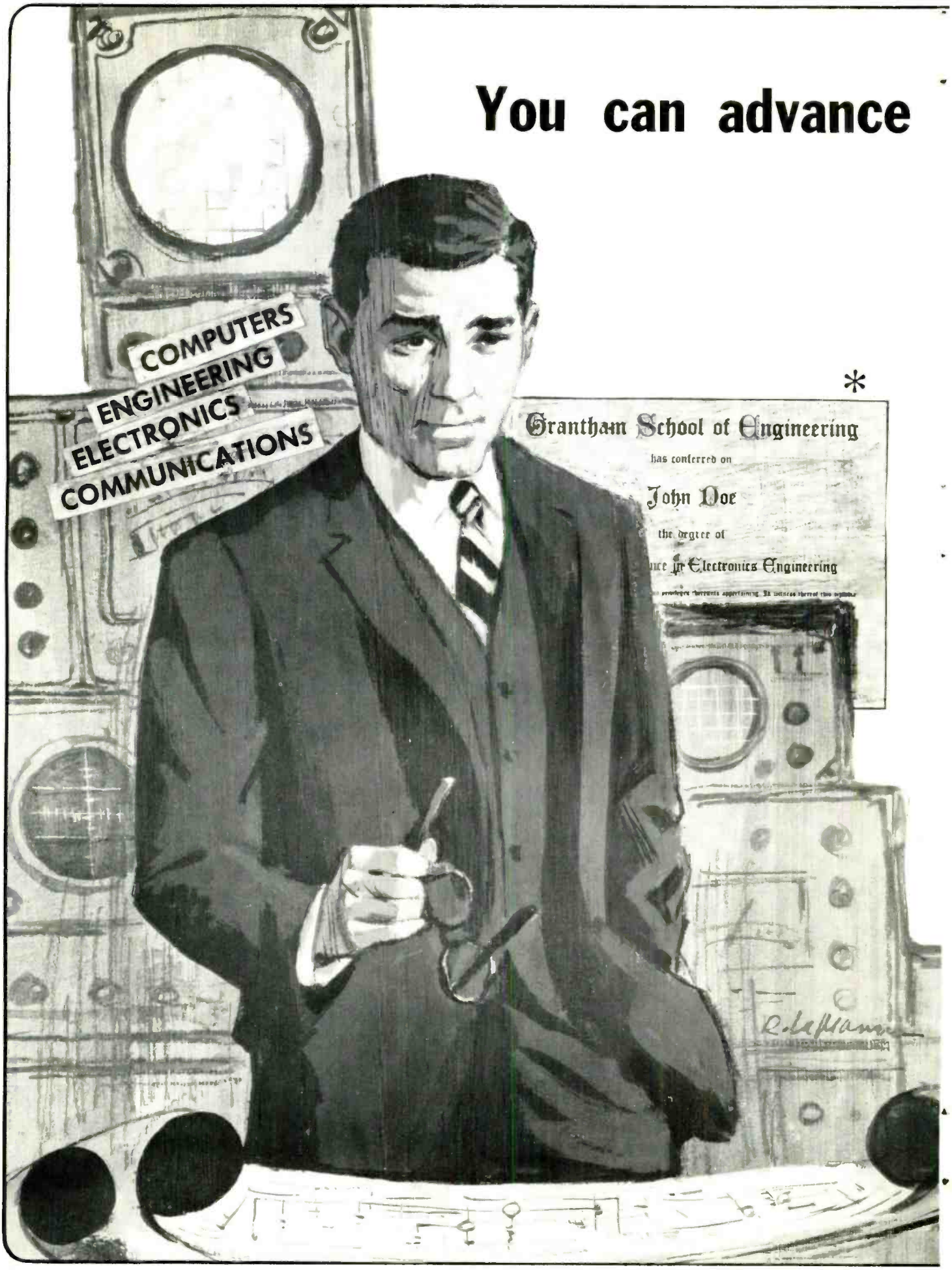


Fig. 4. Component values and switching for bridged-"T" network.



from electronics technician to ELECTRONICS ENGINEER!

Advance beyond the technician level. Become an engineer. If you are a high school graduate and have a good aptitude for electronics and mathematics, you can earn the Degree of Associate in Science in Electronics Engineering mainly by

STUDYING AT HOME

Investigate *now* the Grantham college-level program in electronics engineering, offered (by correspondence) to working technicians while they remain on their jobs. Grantham lessons place heavy stress on fundamental concepts of logic and mathematics (taught so you can understand them), and build from there in a systematic manner, covering physics, circuits, and systems. The lessons are easy to understand because they are carefully written, with step-by-step explanations and consistent review and regrouping of ideas.

Now is the time, not only to protect yourself from unemployment, but also *to prepare yourself for the greater demand in engineering* which is sure to come. You can't become an engineer in a few short weeks; it takes many months. You can be upgrading yourself in your present job while the economy is "slow", and then *be ready to move into engineering* when the national economy gets going again. Yes, now is the time to prepare, so that *you* will be ready to take advantage of opportunity when it presents itself.

Upgrading in your career begins when you begin studying the very first lessons of the Grantham ASEE Degree program in Electronics Engineering. You may very well move up *from* electronics technician *to* electronics *engineering* technician upon completion of the first 100 lessons (out of a total of 400 in the entire program). Upon completion of the program and receiving your ASEE Degree, you are then ready to work as an *electronics engineer*.

GRANTHAM SCHOOL OF ENGINEERING

"the college that comes to you"

1505 N. Western Av, Hollywood, CA 90027

*Accreditation and G.I. Bill Approval

Grantham School of Engineering is *accredited* by the Accrediting Commission of the National Home Study, is *approved* under the G.I. Bill, and is *authorized* under the laws of the State of California to grant academic degrees.

Not For Beginners

The Grantham educational program in electronics engineering is *not for beginners*. Every point is explained just as carefully as if you were a beginner, but this program is designed, written, and taught *for* and *to* experienced technicians; beginners are not accepted for enrollment. As a technician, you already know the "hardware" side of electronics, and you can upgrade from technician to engineering technician, and then to engineer, while you continue your employment in electronics.

For complete details, mail postcard or coupon.

Grantham School of Engineering *EW-9-71*

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

Gentlemen:

I have been in electronics for __ years. I am interested in the Grantham degree program in Electronics Engineering. Please send me your free bulletin.

Name _____

Address _____

City _____ State _____ Zip _____

Standardization

by ROBERT P. RASKOWITZ
Component Parts Eng. Dept., Norden Div., United Aircraft Corp.

Try to imagine the problems there would be without standardization—with 4 million active and 1½ million inactive items now federally catalogued—including roughly 225,000 resistors!

STANDARDIZATION is a never-ending quest, in an era of sophisticated dynamic technologies, to properly document and catalogue hardware. The standard of living we enjoy today and the means by which our children will reap the benefits of our continuing research and development can be credited to standardization. Rapid advances in technology and our ever-changing needs have spurred the development of guidelines and standards.

The food we eat, the clothes we wear, the roof over our heads, and virtually every product we use are subject to standards—voluntary or imposed. Voluntary standards have played a significant role in our industrial development and are preferred by many industries rather than government regulation. Standardization has also long been an important element of military logistics and designs, research, development, and engineering. It even helped establish and provide the basis for the mass production and distribution of goods to the civilian population. The military services have had standardization procedures in effect for many years for establishing requirements to be met by contractors.

Experience during two World Wars and the critical international situation that has existed since World War II have demonstrated the importance of standardization.

In order to reduce redundant effort and control documentation of specifications and standards, the Department of Defense set up the Defense Standardization Program. Its purpose was to establish current policies and responsibilities governing the DOD Standardization Program (DSP). The directive applies to all DOD departments and agencies and covers items and related engineering practices, processes, services, and documentation which supports design, development, procurement, production, inspection, supply, maintenance, and disposal functions.

In late 1966 and during 1967, NASA established a branch, called "Prince Apec," at Huntsville, Alabama. Its purpose was to provide a central agency for the collection and exchange of test data from numerous Government subcontractors. To obtain information or assistance was a simple matter of calling an operator at NASA in Huntsville and indicating the type of data needed. The only requirement for participation in the program was current involvement as a prime or subcontractor on some Government program. Copies of test data compiled at contractor facilities, in the course of evaluation of components or assemblies, were to be submitted to this information bank so that other manufacturers could benefit too. This was valuable in that it made previously unavailable data accessible. Although a useful service, it was limited primarily to collection of data of interest to NASA and its subcontractors.

A similar program, but far broader in scope, was set up by the military services in March, 1965 and designated IDEP (Interservice Data Exchange Program). This tri-service program was designed to provide automatic interchange of parts/components test data among Government contractors and agencies, thereby reducing duplicate expenditures for parts testing and improving system reliability. In March, 1968, IDEP was expanded into a storage and retrieval system for all types of data and reports, including environmental test reports and procedures, reliability specifications, failure analysis data, and general technical information as well as reports on research and development. The name was changed to Interagency Data Exchange Program and included the Military Services (Army, Navy, Air Force), the National Aeronautics and Space Administration (NASA), and the Canadian Military Electronics Standards Agency (CAMESA). With the involvement of NASA in the expanded IDEP program, "Prince Apec" was abandoned.

The need for a free exchange of information and conformity to similar standards has long been recognized and many national organizations (EIA, IEEE, ASA, and IHF, among others) have made valuable contributions toward these goals.

There are obvious benefits from standardization such as a reduction in the types, kinds, and sizes of parts that must be stocked. For example, consider a contract such as the F-111 aircraft whose prime contractor is *General Dynamics*. The subcontractors building constituent assemblies are located throughout the country. If there were no standardization on the use of components, methods of test and evaluation, as well as application, then it would be almost impossible to integrate various subassemblies into a plane.

To cite one example of the immensity of the task, according to a report by the Committee on Government Operations, there are approximately 4 million active and 1½ million inactive items now federally catalogued. There are roughly 225,000 different resistors alone.

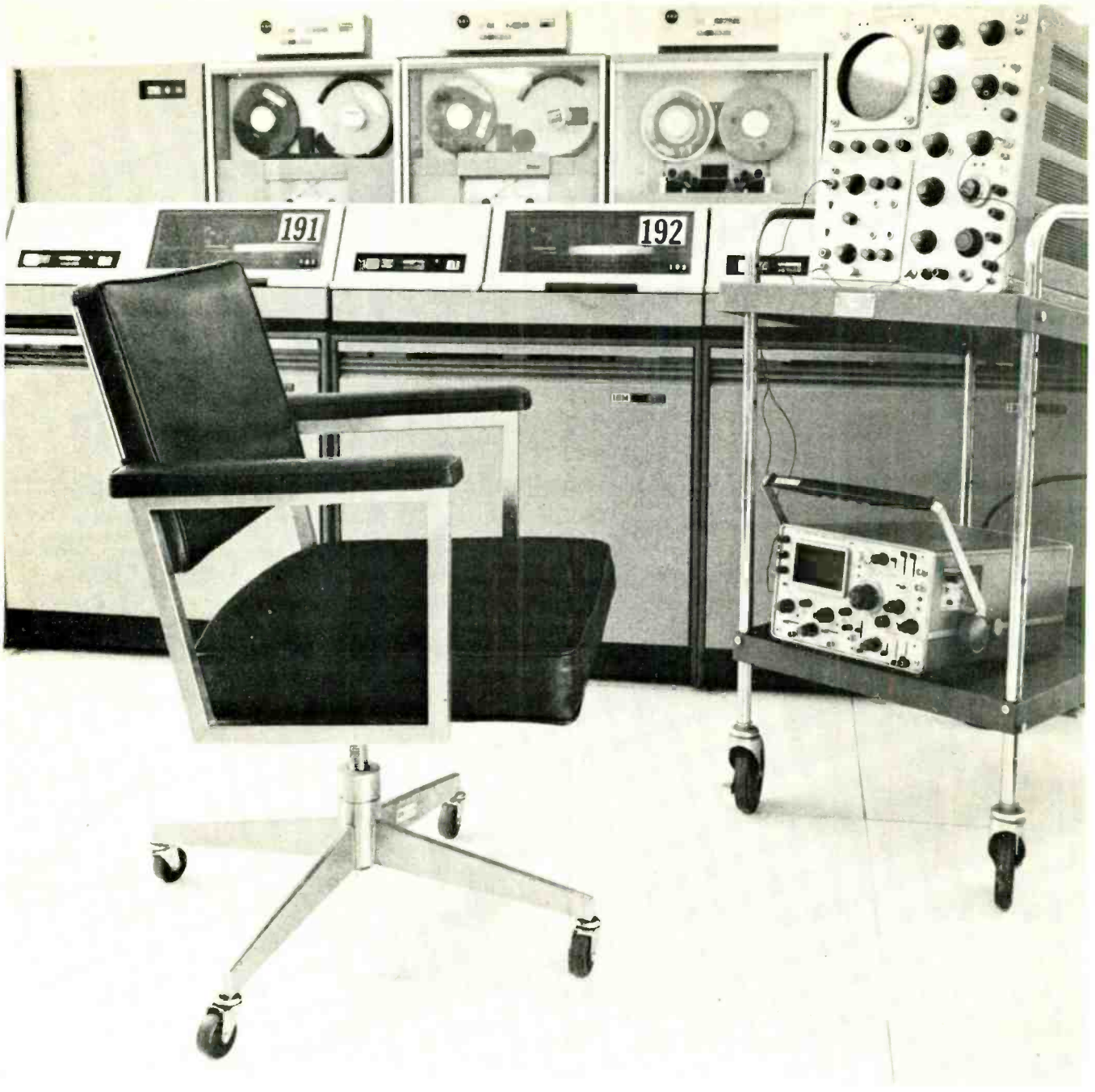
The Air Force analyzed the comparative costs of buying parts to MIL-Specs *versus* the contractor's own drawings after an initial report indicated that the F-111 would have approximately *220,000 nonstandard parts*. Investigation disclosed that certain electronic components were being purchased by a number of subcontractors, each of whom had established his own specifications. One might require that the part be burned-in (tested by operating) for 50 hours, a second for 75, a third for 120. Even though the component was the same, it was being processed differently and would therefore be assigned a different stock number. A voluntary effort was made to have the prime contractor meet with his subcontractors and arrive at common specifications on these items, which would then be used to update the military specification if necessary. A similar voluntary program was used on the C-5. It was discovered that five different diodes in the aircraft's various systems had an average cost of $13.60 if supplied from company drawings but $4.53 if bought from MIL-Specs. With 7779 such diodes being used in the plane, savings of $70, 011 per aircraft could be effected.

On any military contract it is usually specified that military standard components (referred to as MIL-STD components) must be used throughout. Any deviation or use of a nonstandard device must be amply justified and reported accordingly. MIL-STD components must meet applicable MIL-Specs and be periodically rechecked to those specifications. Most MIL-STD parts or specifications have an associated QPL list (Qualified Products List). Components from a QPL-listed manufacturer, for a particular MIL-approved part, insures that the component selected can meet applicable MIL-Specs.

If it becomes necessary, either because of a packaging (size) problem or a particular functional design requirement, to use a nonstandard (non-MIL) device, then drawings must be generated describing component requirements. These drawings, as a general rule, must be equal to existing MIL specifications insofar as the requirements for initial qualificaton testing and lot-acceptance criteria are concerned. Primary deviations from the MIL part are in physical or functional characteristics. A nonstandard part might be used if additional screening or testing over and above the MIL-STD is required to assure even higher reliability. Here, again, a special drawing must be generated.

There are two basic types of drawings used for the purchase of nonstandard parts: Specification Control and Source Control drawings. The primary difference between the two is that the Source Control drawing is used to describe a special device for procurement and complete control is to be exercised over its configuration. Thus any changes that might affect form, fit, or function, sometimes also referred to as process or geometry changes, are prevented or controlled. Also, in the Source Control drawing the approved vendors are the only firms from which the component may be purchased. The Specification Control drawing is a mechanism for describing commercial or catalogue-available components, following essentially the same format as the Source Control drawing but without limitations on configuration or vendors.

Most recent Government contracts make provision for the formation of a Parts Control Board with a requirement that each major subcontractor be a participant. This usually entails meetings once a month in the early stages of the program but less frequently as initial problems are resolved. The primary purposes of such a board are to control component usage, effect commonality wherever possible, and function as a forum where problems, however minor, can be discussed and resolved. ▲



This important job (and its big income) **is reserved for a qualified electronics technician. It can be you!**

It's a fact. There are *thousands* of jobs like this one available *right now* for skilled electronics technicians. What's more, these men are going to be in even *greater* demand in the years ahead. But how about you? Where do you fit into the picture? Your opportunity will never be greater . . . so act *now* to take advantage of it. The first step? Learn electronics fundamentals . . . develop a practical understanding of transistors, trouble-shooting techniques, pulse circuitry, micro-electronics, computers and many other exciting new developments in this growth field. Prepare yourself now for a job with a bright future . . . unlimited opportunity with lasting security . . . prestige and a steadily growing paycheck.

Cleveland Institute of Electronics courses have been stepping stones to good jobs in electronics for thousands of ambitious men. Why not join them? You can learn at home, in your spare time, and tuition is remarkably low. Read the important information on the facing page. Then fill out the postage-free reply card and drop it in the mail today. Without obligation we'll send you all the details. But act now . . . and get *your* high-paying job just that much sooner.

How You Can Succeed In Electronics
...Select Your Future From Seven Career Programs

The "right" course for your career

Cleveland Institute offers not one, but seven different and up-to-date Electronics Home-Study Programs. Look them over. Pick the one that is "right" for you. Then mark your selection on the bound-in reply card and send it to us. In a few days you will have complete details . . . without obligation.

1A. Electronics Technology
A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Solid-State Devices, and preparation for a 1st Class FCC License.

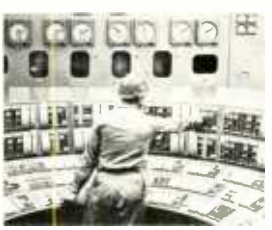
1B. Electronics Technology with Laboratory
Includes all areas of Course 1A including 1st Class FCC License preparation. In addition, student receives 161-piece Electronics Laboratory and 17 "lab" lessons for "hands-on" experience.

2. Broadcast Engineering
Here's an excellent studio engineering program which will get you a 1st Class FCC License. Now includes Video Systems, Monitors, FM Stereo Multiplex, Color Transmitter Operation and Remote Control.

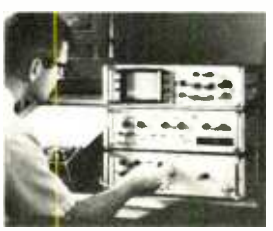
3. First Class FCC License
If you want a 1st Class FCC ticket **quickly,** this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

4. Electronic Communications
Mobile Radio, Microwave and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program. Highly recommended for jobs with telephone companies.

5. Industrial Electronics & Automation
This exciting program includes many important subjects such as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms and Solid-State Devices.



6. Electronics Engineering
A college-level course for men already working in Electronics . . . covers Steady-State and Transient Network Theory, Solid-State Physics and Circuitry, Pulse Techniques, Computer Logic and Mathematics through Calculus.



An FCC License . . . or your money back!

In addition to providing you with comprehensive training in the area indicated, programs 1A, 1B, 2, 3 and 4 will prepare you for a Commercial FCC License. In fact, we're so certain of their effectiveness, we make this **exclusive** offer:

The CIE courses described here will prepare you for the FCC License specified. Should you fail to pass the FCC examination after completing the course, we will refund all tuition payments. You get an FCC License . . . or your money back!

CIE's AUTO-PROGRAMMED® Lessons help you learn faster and easier

Cleveland Institute uses the new programmed learning approach. Our Auto-Programmed Lessons present facts and concepts in small, easy-to-understand bits . . . reinforce them with clear explanations and examples. Students learn more thoroughly and faster through this modern, simplified method. You, too, will absorb . . . retain . . . advance **at your own pace.**

Lifetime job placement service for every CIE graduate...at no extra cost

Once enrolled with CIE, you will get a bi-monthly listing of the many high-paying, interesting jobs available with top companies throughout the country. Many CIE students and graduates hold such jobs with leading companies like American Airlines, AT&T, General Electric, General Telephone and Electronics, IBM, Motorola, Penn Central Railroad, Raytheon, RCA, Westinghouse and Xerox . . . to name a few.

CIE Lessons are always up-to-date

Only CIE offers new, up-to-the-minute lessons in all of these subjects: Logical Trouble-shooting, Laser Theory and Application, Microminiaturization, Single Sideband Techniques, Pulse Theory and Application, Boolean Algebra and Solid-State Devices.

New Revised G.I. Bill Benefits:

All CIE courses are approved for full tuition reimbursement under new G.I. Bill. If you served on active duty since January 31, 1955, OR are in service now, check box on reply card or coupon for latest G. I. Bill information.

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

If card has been removed, mail this coupon for 2 FREE BOOKS

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

Please send me without cost or obligation:
1. Your 44-page book, "How To Succeed in Electronics."
2. Your book on "How To Get a Commercial FCC License."

I am especially interested in:

☐ Electronics Technology
☐ Broadcast Engineering
☐ Electronic Communications
☐ Electronics Technology with Laboratory
☐ First Class FCC License
☐ Industrial Electronics & Automation
☐ Electronics Engineering

Name _____ Age _____
(please print)

Address _____

City _____ State _____ Zip _____

☐ Veterans & Servicemen: check here for G.I. Bill information.

Accredited Member National Home Study Council. EW-93

Color-Bar Generators

(Continued from page 36)

izontal lines. You have to learn to ignore one or the other, just as you ignore all but one area of the screen at a time.

The number of lines differ. They're listed in the directory. The *Leader* LCG-388 offers a switch-selected choice of 1, 3, or 21 vertical lines and a choice of 1, 2, or 15 horizontal lines. The *Heath* IG-28 lets you choose 3 or 11 vertical lines and 3 or 10 horizontal lines.

Some models have a control that lets you adjust line thickness. These include the *B&K* 1243 and 1246, *Eico* 380, *Lectrotech* V6B and V7, *Mercury* 1900 and 1901, and all three *Sencore* models.

Crosshatch: This is made by combining horizontal and vertical line displays. If you're truly familiar with convergence, this is the display to use. You can study all areas of the screen at once, and do touchups without going through the step-by-step procedure.

Only a few generators put out a crosshatch of squares. That requires more vertical than horizontal lines; the same number of both makes a crosshatch of oblongs.

The *Eico* 385 has a crosshatch with 7 horizontal lines and 8 vertical. The *Leader* generators have 18 horizontal and 21 vertical lines. These are a ratio of approximately 3 to 4 and make squares in the crosshatch pattern. Squares make raster nonlinearity obvious.

Some generator models produce several crosshatch patterns. The *B&K* 1246 offers one crosshatch with 9 vertical lines and 1 horizontal, another with 1 vertical and 9 horizontal, and the regular crosshatch with 9 of each. The *Heath* produces a 10-horizontal/11-vertical pattern and a 3-horizontal/3-vertical pattern. The *Leader* LCG-388 offers one with 15 horizontal and 21 vertical lines and another with 2 horizontal and 3 vertical. Many technicians and engineers like patterns that have fewer lines.

Dots: Dot patterns are formed by a diode that clips out the lines of a crosshatch, leaving the intersection where the lines cross. So, dot patterns in any generator depend on what the crosshatch is like.

A dot pattern filling the screen sometimes is a bit more informative than a similar crosshatch. You can see convergence displacement in directions that may be hidden by lines.

Fewer dots make it easier to line up the center one during static convergence. The *B&K* 1243 and 1246, *Leader* LCG-388, and the *Sencore* CG159 all have a single dot—which eases static convergence. You can move the dot of the *Sencore* instrument to any spot on the TV screen. The others put the single dot about the center of the screen.

Crosshair: This is actually a crosshatch of 1 vertical and 1 horizontal line. With the *B&K* 1243 and 1246 and the *Leader* LCG-388, LCG-390, and LCG-384, the crosshair intersects at the center of the TV screen.

The *Sencore* CG159 crosshair can be moved around with the same controls that move the single dot. That facilitates checking crosshatch convergence at any area of the screen, yet without the confusion of so many lines.

Purity: This is a blank raster at gray brightness level. The r.f. signal blanks out any snow. The lack of video blacks and whites eliminates having to turn down contrast to check purity. On one or two generators without a Purity switch, you can get the same effect by turning down the Color control; it also turns down the bars, leaving a gray raster.

Shading Bars: Only one generator has this pattern: the *Heath* IG-28. The pattern is a crosshatch of various shades of gray between white and black. If color tinting appears in brighter squares, balance the receiver or monitor drive controls until the squares are cool white. When you have all the drive and screen controls right, the shading bars show only white, gray, and black—no brown, greenish, or bluish.

If you're dealing with broadcast or CCTV monitors, you might find they're video fed. If so, an r.f. output on the color generator isn't enough. You need a composite video/color output too. Many models don't have it. Video amplitude in them is only a volt or so, not enough for most video or chroma stages. Besides, you don't need video alone unless there's no front end and i.f. in the monitor.

The older *Eico* has a 10-volt p-p video output. Others are rather low. The *Heath* IG-28, 1 volt p-p; the *Hickok* GC660, 2 volts p-p; *Jackson* X-100, 4 volts p-p; three of the *Leader* instruments, 3 volts p-p; *Lectrotech* V7, 4 volts p-p.

If video-line CCTV, cable, or broadcast monitors are on your maintenance docket, be sure any generator you buy has a video/color output. The more volts the better.

For CATV and other off-the-air monitors and home sets, all the generators in the directory supply enough r.f. output if the tuner is okay. Some can drive even a weak tuner.

When you buy a color generator, study this directory. Make sure the one you want can do what you need done. Then buy it. Maintenance is only as good as the generator you use and how well you use it. ▲

POWER-SUPPLY IMPROVEMENT

By FRANK H. TOOKER

A typical solid-state regulated power-supply circuit is shown in Fig. 1A. A transformer's secondary voltage is rectified and applied across a filter capacitor, *C*. Zener diode, *D*, fed through a current-limiting resistor, *R*, regulates the output potential.

For best regulation, the voltage drop across *R* should be as large as possible, which means that the voltage rating of *C* must be quite high—perhaps twice the value of the regulated output voltage. The requirement for low ripple in the output demands a value of several thousand microfarads for *C*. This combined need for high capacitance and high voltage means large size and high cost. Furthermore, the high capacitance puts a high surge current demand on the rectifier and the transformer, every time the power supply is turned on.

The author prefers to use the circuits shown in Figs. 1B and 1C. Here, the current-limiting resistor, *R*, has been located in the a.c. side of the circuit rather than in the d.c. side. As a result of this simple change, both size and cost of the filter capacitor are reduced. The capacitance value stays the same as before, but the voltage rating now needs to be no higher than the output voltage. This can represent quite a saving, since it usually means dropping the voltage rating of the capacitor to one-half the rating required by the circuit in Fig. 1A. Relocating the resistor also allows it to limit the surge current required to charge the capacitor at each turn-on of the supply.

The circuit of Fig. 1B may use either a single resistor (as shown) or a pair of resistors—one in each side of the a.c. circuit—each having one-half the required total resistance and one-half the power rating. The value of *R* in Figs. 1B and 1C is determined by the required zener-diode current and the maximum and minimum current demands of the externally connected circuit. It need not have the same value in the a.c. location as may be required in the d.c. location. ▲

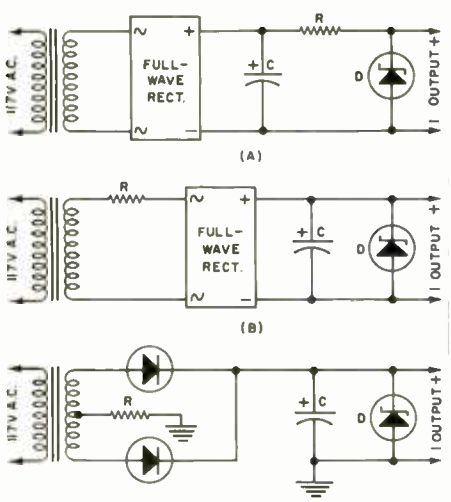


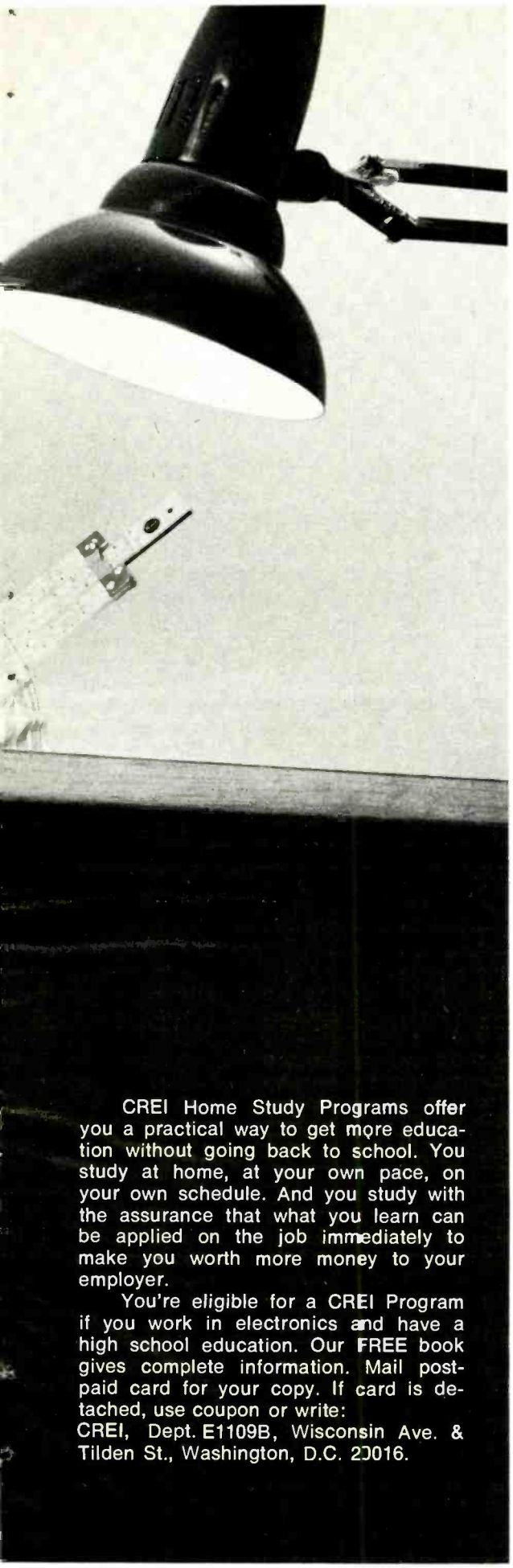
Fig. 1.

How to prepare for today's competitive job market, tomorrow's new opportunities in electronics

Competition for jobs and promotions is severe in the electronics industry today. But experts say that exciting new electronic products will create thousands of new jobs in the next few years.

One thing is certain: in good times or bad, the best opportunities come to the man with an advanced, specialized knowledge of electronics. He has a better chance of survival in a recession and will profit more in times of prosperity than the man with ordinary qualifications.

But how can you get the additional education in electronics you need to protect your future—and the future of your family? Going back to school isn't easy for a man with a job and family obligations.



CREI Home Study Programs offer you a practical way to get more education without going back to school. You study at home, at your own pace, on your own schedule. And you study with the assurance that what you learn can be applied on the job immediately to make you worth more money to your employer.

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. Mail postpaid card for your copy. If card is detached, use coupon or write:
CREI, Dept. E1109B, Wisconsin Ave. & Tilden St., Washington, D.C. 20016.

College Credits for CREI Students

Recently CREI affiliated with the New York Institute of Technology for the express purpose of making it possible for CREI students to earn college credits for their studies. The New York Institute of Technology is fully accredited by the Middle States Association of Colleges and Universities and is chartered by the New York State Board of Regents.

For the many CREI students who are not interested in college credits, but simply in improving their knowledge of advanced electronics, this affiliation with NYIT will provide additional assurance of the high quality of CREI home study education.

If you want to know more about earning college credits for CREI study, check the appropriate box when you mail the postpaid card for complete information on CREI Programs.

Founded 1927

CREI

Accredited Member of the National Home Study Council

Free book tells all about CREI programs. For your copy, tear out and mail postpaid card or write: CREI, Dept. E1109B Wisconsin Ave. & Tilden St., Washington, D.C. 20016

CREI, A Division of the McGraw-Hill Continuing Education Company

Dept. E1109B, Wisconsin Ave. & Tilden St., Washington, D.C. 20016

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

Name _____ Age _____

Address _____

City _____ State _____ Zip Code _____

Employed by _____

Type of Present Work _____ ☐ G.I. Bill

I am interested in: ☐ College credits for CREI study. ☐ Space Electronics ☐ Electronic Engineering Technology ☐ Computers ☐ Industrial Electronics ☐ Nuclear Engineering Technology ☐ Electronics Systems Engineering ☐ Non-technical course in computer programming. ☐ CATV Engineering

APPROVED FOR TRAINING UNDER NEW G.I. BILL

Air Pollution

(Continued from page 44)

for triggering control action when the measured air quality has deteriorated to a certain point. In Table 2, a representative set of control limits is given for New York City, indicating the essential steps for implementing an alert-warning system.

Air-Quality Monitoring Systems

In order to evaluate the effectiveness of a pollution-control program and determine what corrective actions are required, sophisticated monitoring systems are employed in a number of metropolitan regions to provide a detailed profile of air pollutants.

Fig. 5 shows a block diagram of an advanced air-quality monitoring system, or aerometric network, which enables a computer-controlled central processing station to determine whether specified pollution levels have been reached. In this network, major traffic areas and smoking chimneys are constantly under surveillance by mobile vehicles capable of communicating information to the central station. To provide a vertical profile of concentration levels, the system may include detection equipment mounted in towers and tall buildings, as well as an instrumented helicopter for monitoring the common pollutants and weather patterns in the upper atmosphere. If the helicopter is equipped with TV facilities, the operator at the control panel continuously scans the skyline for visible signs of smoke emissions. If he spots a potential pollutant emitter, he can activate a zoom lens on the camera to confirm his initial observation, thus identifying the offending building.

To minimize "smoke-chasing" by field personnel and increase the effective control over emission sources, on-site air-sampling devices may be installed on the smokestacks of major pollutant producers to measure the rate of flow of pollutant stack gases and to extract a sample of the gas. The telemetered information gathered from these air samplers is then fed instantaneously over telephone lines to the central control station for recording and analysis. Stack-monitoring systems, however, are generally exposed to very high temperatures within the stack (on the order of several hundred degrees F), so that these analytical instruments must be designed to withstand the severe environment. In more advanced systems, the use of electro-optical devices permits remote analysis of gaseous pollutants from an emitting source. Here a telescope is focused on the smoke plume in question and the hot pollutant gases are identified and measured using infrared analyzers.

In addition to the measurement of pollutant concentrations an essential input to any air-quality control system is a meteorological program to accurately profile the particular pollution problem. For this purpose, a number of automated telemetry stations are used at strategic locations to measure wind velocity, wind direction, and air temperature; as well as concentration levels of carbon monoxide, sulfur dioxide, suspended particulate matter, and dustfall.

Fig. 6 shows a typical automatic station forming part of New York City's aerometric network. Supplementing these operations are a number of manual stations equipped with probes to collect samples of the common pollutants, these samples being returned to the laboratories for subsequent analysis. The aerometric network thus delivers a large quantity of raw data to the central station, where a digital computer provides a rapid assessment of the prevailing air quality throughout the monitored areas. Periodically, the computer automatically interrogates each remote station and records the incoming pollutant information, the averaged data being formulated for paper punch, teleprinter, or computer entry.

The final stage of the control system includes the introduction of prediction methods involving both the expected pollution emissions and weather forecasting, so as to anticipate the concentration levels in different areas for a specified period, say 24 or 48 hours. Here the total pollution information and meteorological data are combined into a mathematical simulation model designed to interpret the over-all air quality. Given sufficient data, the control agency can then decide whether or not to initiate emergency control measures.

Ideally, air-quality control limits should also be based on an analysis of the medical effects of air pollution, including a calculation of the minimum time of exposure to various pollutants that are likely to cause certain symptoms. If the situation is considered to be hazardous to health, for example, then it is important to predict the short-term rise in pollutant concentrations, clearly a more difficult problem than predicting the extended levels.

On the international level, the United Nations Conference on the Human Environment will be convened in 1972 to consider the global effects of all types of pollution. Among the objectives will be an attempt to organize the pollution-control effort through multilateral action by many nations. This should lead to the establishment of a global network for monitoring pollutants, and provide a basis for the subsequent formulation of world-wide air-quality standards. ▲

NEW PRODUCTS & LITERATURE

For additional information on items identified by a code number, simply fill in coupon on Reader Service Card. In those cases where code numbers are not given, may we suggest you write direct to the manufacturer on business letterhead.

COMPONENTS • TOOLS • TEST EQUIPMENT • HI-FI • AUDIO • CB • COMMUNICATIONS

IC INSERTER/EXTRACTOR

The new #885 Pul-N-Sertic tool inserts and extracts integrated circuits from PC boards. Both insertion and extraction can be quickly

and easily accomplished without damage to components or the circuit board, according to the manufacturer.

To insert an IC, it is loaded into the accurately machined jaws of the tool, the lead pins on one side are lined up visually with circuit-board holes and all pins are inserted simultaneously by rolling the tool. Pushing a button on top of the tool releases the component. To extract an IC, the unit is positioned over the component to be removed and the stainless-steel spring-removal clip is lowered until the clip jaws are under the IC base. Squeezing the clip grips the component, lifting the tool pulls the IC free, and pressing the top button ejects it from the tool.

Circle No. 3 on Reader Service Page

11-METER SSB UNITS

A new line of 11-meter single-sideband communications equipment has been introduced with the SSB 600, a solid-state, AM-SSB unit and the SSB-120 for the operator desiring SSB communications only. Both units use standard miniature plug-in crystals, one per channel, which eliminates the need for a synthesizer.

Operation on either 12 volts d.c. or 117 volts a.c. is provided in both units by merely changing power cords. Telcomm Industries

Circle No. 4 on Reader Service Page

TOOL CASES

Attaché tool cases for field engineers, technicians, and inspectors are now available in three versions.

The deluxe case, which features two removable pallets holding more than 60 separate tools, has partitions in the bottom of the case to hold large tools, test meter, and parts boxes. It measures 18½" × 13½" × 4¾".

A deep deluxe version is a full 6 inches deep and provides room for special tools, test equipment, cleaning cloths, and parts boxes. It also has two removable small-tool pallets and the lid has pockets for reports, manuals, and schematics. It measures 18" × 13¾" × 6".

The compact case measures 17½" × 12½" × 3¾" and is suitable for engineers or technicians who need fewer tools in their normal work. It includes one removable pallet, a pocket for forms and schematics, and partioned compartments in the bottom for parts boxes and larger tools.

A data sheet describing all three of these models in detail is available on request. Jensen Tools

Circle No. 5 on Reader Service Page

OHMIC CONTACT ANALYZER

A new laboratory instrument that can be used for the rapid measurement of the electrical quality of ohmic contacts has been introduced as the "Ohmicity Analyzer."

The instrument functions as a high-precision standard in the study of ohmic contacts of semiconductor diodes, rectifiers, transistors, Gunn oscillators, varactors, p-i-n, thermistors, strain gages, and other semiconductor devices as well as non-linearity of resistors and electric contacts. The ohmic quality is shown by the degree of non-linearity measured.

Sample current range is 0.2 mA to 800 mA r.m.s. and sample resistance range is 0.01 ohm to 0.2 megohm. Limit of error is ±0.001%.

The instrument measures 17" × 9½" × 11" and comes in a hammertone gray finished enclosure. It weighs 23 pounds. Transene

Circle No. 6 on Reader Service Page

CONSTANT-CURRENT SOURCE

The Model 111 constant-current source is a compact, battery-powered portable instrument which provides constant d.c. current output in three ranges: 0-0.1 mA, 0-1 mA, and 0-10 mA.

The easy-to-read 3½" taut-band meter is accurate to 2%.

The unit is housed in a vinyl covered aluminum cabinet with carrying handle but a rack-mount version is available on special order. W-P Instruments

Circle No. 7 on Reader Service Page

SPEAKER-ENCLOSURE KITS

Easy-to-assemble speaker enclosures in kit form are now available at moderate cost. These 8 ⅞" × 8" × 15" enclosures will house up to 8-inch round or 6 × 9 inch oval speakers.

Constructed of walnut-finished vinyl, they come complete with all hardware, acoustic lining material, and assembly instructions. The kit does not include a speaker. Kab Kits

Circle No. 8 on Reader Service Page

STEREO MUSIC CENTER

A quadrasonic-ready stereo music center has been introduced as the Model SC-8700, a 120-watt, four-piece stereo system with a four-channel amplifier. By adding a quadrasonic program source and two rear-channel speakers, quadrasonic sound is available.

The SC-8700 also offers separate stereo programs for two areas of the home. For example, the unit's automatic 4-speed Garrard turntable can provide music in the living room while a program from the stereo-FM tuner can be fed to another room of the house. The turntable is equipped with a Pickering V-15 moving magnet cartridge and comes mounted in its own walnut and black base. It may be placed on top of the four-channel receiver or be shelf-mounted. Two compact air-suspension bookshelf speaker systems are included. Panasonic

Circle No. 9 on Reader Service Page

MIXER/AMPLIFIER

A solid-state mixer/amplifier designed to meet the performance requirements of the professional user has been introduced as the Model 2A75. It is equipped with five input channels,

each of which adapts to microphone, line, or magnetic phono at the turn of a switch. Each channel is furnished with three levels of padding (–10, –20, and –30 dB) for use in preventing overloading the system by loud voices or music.

Frequency response is 20-20,000 Hz±1 dB, distortion is less than 0.5% at +28 dBm, 20-20,000 Hz, and the power requirement is 105-125 volts, 50-60 Hz, 10 watts or +25 volts d.c. at 100 mA.

The unit can be mounted in a standard 19-inch rack or in a portable housing. DuKane

Circle No. 10 on Reader Service Page

FLAMELESS HEAT GUN

A flameless heat gun with an exclusive cone attachment is designed to provide fast, easy testing of components in repairing black-and-white and color-TV receivers.

The Model HG 201 supplies an instant heat source sufficient to enable the technician to spot defective resistors, capacitors, or coils. It can also be used in locating hairline cracks in PC boards. Master Appliance

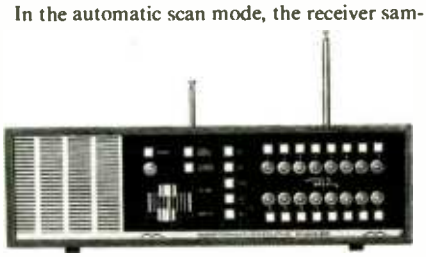
Circle No. 11 on Reader Service Page

THREE-BAND MONITOR

The new, three-band FM Monitoradio/Executive Scanner enables the user to monitor up to sixteen frequencies in the police, fire, public service, marine, and business area of the u.h.f. and high and low v.h.f. bands.

The front panel features read-out scanning lights with corresponding push-button control for any combination of frequencies in the 30-50, 148-174, and 450-470 MHz bands. The push-buttons allows the operator to quickly activate, or deactivate, any of the channels within any of the three bands.

In the automatic scan mode, the receiver sam-



ples programmed channels at a 15-channels-per-second rate. Super-fast scan action occurs by bypassing any channels the operator chooses to "program-out". A third speed is accomplished by placing the radio in manual mode and depressing the channel-selector button. In this configuration, the scanning lights slowly progress to the individual channel the operator wants to hear. Regency

Circle No. 12 on Reader Service Page

OUTBOARD DOLBY UNITS

Three outboard Dolby system noise-reduction units, designed expressly for recording applications, have been introduced as the Models AN-180, AN-80, and AN-50. The first unit is a simultaneous record-playback control center

consisting of two separate sections. The recording section contains microphone and line preamps and the Dolby recording circuitry. The playback section contains the playback line preamps and Dolby playback circuits. It is designed to be interconnected with any good tape deck.

The AN-80 is a less sophisticated version of the AN-180. Input mixing has been omitted and one Dolby circuit has been provided for each channel rather than two. The circuit functions first for recording and then for playback but not both at the same time. The Model AN-50 unit is more compact and less sophisticated than the AN-80 and is intended for use with cassette equipment. Teac

Circle No. 13 on Reader Service Page

150-WATT HORN

The SB-150/H Soundburst horn column has an effective sound throw of 100 feet and has been designed specifically to meet the needs of modern music groups.

According to the company, the unit provides an unusually rich bass response, natural full-range voice reproduction, and a high power handling capacity. An exclusive cut-out switch for the horn makes it possible for the user to extend application of the system to all musical effects.

Compatible with most amplifiers, the system features four 8-inch, 15-watt speakers, 60 watts r.m.s. and one high-frequency horn for a total of 150 watts music power. The backplate assembly includes a ¼" jack, a terminal strip, a fuse and fuse holder for overload protection, and the horn cut-out switch. Impedance is 8 ohms.

The system measures 42½" × 12" × 12". Temple Sound

Circle No. 14 on Reader Service Page

PRINTED-CIRCUIT REPAIR

Two selective plating installations for use in printed-circuit repair and for small-scale circuit production are now available. The new package installations include a special power pack with a built-in digital ampere-hour meter for precision thickness control. Completing the package are an assortment of styli/anodes adapted to printed-circuit work, all necessary accessories, and plating solutions most often used in PC work (copper, nickel, tin, gold, and rhodium).

The process of high-speed selective plating works on the theory of electroplating but in appearance more closely resembles arc welding. No plating bath is required. Selectrons

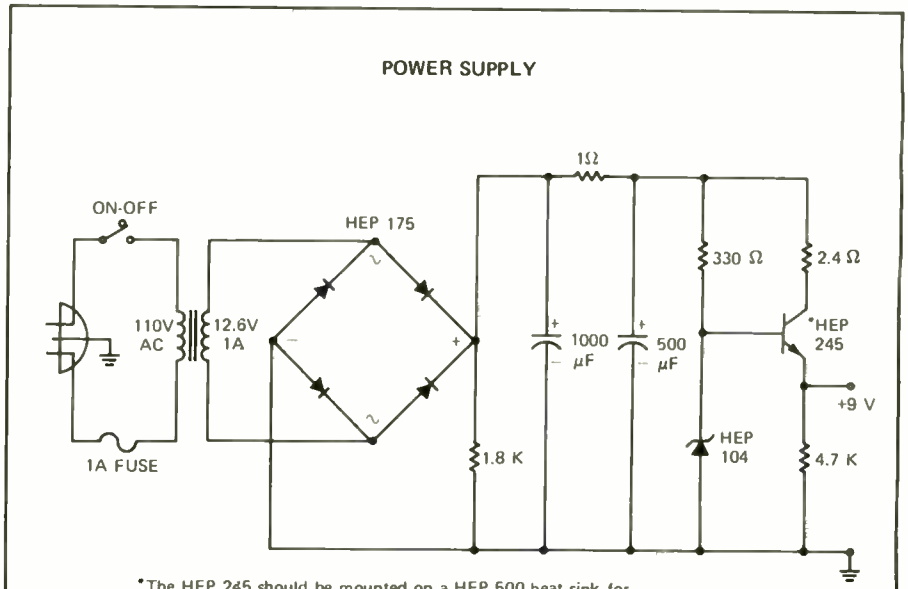
Circle No. 15 on Reader Service Page

DIGITAL MULTIMETER

The Model 3310 digital multimeter measures 32 ranges, covering most of the parameters normally used in laboratory, standards, calibration, and service testing.

Included are five true r.m.s. a.c. voltage ranges from 100 mV to 1 kV; five d.c. voltage

Simple power-supply unit designed to drive number of transistorized circuits, like one on page 82. Circuit calls for readily available Motorola HEP line parts and standard resistors/capacitors.



a remarkable listening experience for stereo headphone owners!

The phenomenal realism of binaural sound recording is demonstrated by Stereo Review's

AMAZING NEW BINAURAL DEMONSTRATION RECORD

Created specifically for playback through stereo headphones, this unique record presents the listener with sound of unsurpassed realism. It recreates at each of the listener's ears the precise sound that each ear would have heard—independently—at the original scene.

Binaural recording re-creates the directions, distances, and even the elevations of sounds better than any other recording method. The super-realism of binaural recording is accomplished by recording the acoustical input for each ear separately, and then playing it back through stereo headphones. Thus the sound intended for the left ear cannot mix together with the sound for the right ear, and vice versa. This technique eliminates all acoustical problems in playback, such as the effects of "dead" rooms, over-reverberant rooms, variations in stereo perspective caused by changes in sitting position, and variations in frequency response due to changes in speaker positioning.

Binaural recording offers the listener the identical acoustical perspective and instrument spread of the original. The sound reaching *each ear* is exactly the same as would have been heard at the live scene. The Stereo Review Binaural Demonstration Record is the only record of its kind; there is nothing else like it. It provides a unique listening experience that you will want to share with your friends.

"MAX"—GENIE OF BINAURAL RECORDING. More than a year of intense effort was devoted to the preparation of this recording. "Max," a specially constructed dummy head, was modeled by a professional sculptor, then cast in silicone rubber. Super-precision capacitor microphones were installed in Max's ears so that each microphone would pick up exactly what each human ear would hear. The two separate sound channels were then fed into an ultra-low-noise electronics system and then recorded on an advanced-design tape recorder operating at 30 inches per second.

In making location recordings for the demonstration side of the record, a recording technician taped miniature capacitor microphones into his ears, so his head would serve its normal acoustical role as an absorber and reflector of sound. The result is a demonstration of phenomenal recorded sound.

STARTLING REALITY. The Binaural Demonstration Record offers 45 minutes of sound and music of startling reality. Side 1 introduces you to binaural recording via a narrated demonstration in nine sequences, taking you through a variety of situations that show off the remarkable depth and natural perspective of binaural recording.

You'll marvel at the eerie accuracy with which direction and elevation are re-created as you embark on a street tour in binaural sound—Sounds Of The City...Trains, Planes & Ships... a Basketball Game, a Street Parade, a Steel Fabrication Plant, The Bird House at the Zoo – all demonstrating the incredible realism of binaural sound reproduction.

MUSIC IN BINAURAL. With "Max" acting as your extension ears, the musical performances presented on the Binaural Demonstration Record transport you to the concert hall for a demonstration of a wide variety of music. Selections total 23 minutes, and include examples of jazz, rock, organ, and chamber music.

A highlight of the record is the first recording of *Space Virgin*, a new jazz work by noted composer Ronnie Roullier. Insiders have already called it one of the most exciting jazz recordings ever made. The organ recordings, with Frederick Swann at the keyboard of the majestic Riverside Church organ, have been hailed for reproducing the whole range of organ sonorities totally without distortion, and are among the most memorable listening experiences of a lifetime.

The Stereo Review Binaural Demonstration Record is the ultimate in sound reproduction. It has been made without compromise for the owner of stereo headphones. If you own stereo headphones, this record is a *must*.

Note: Although headphones are necessary to appreciate the near-total realism of binaural recording, the record can also be played and enjoyed on conventional stereo systems.

Order your Stereo Review Binaural Demonstration Record today. ONLY $5.98.

RECORDS, Ziff-Davis Service Division, 595 Broadway, N.Y., N.Y. 10012

Please send _____ Binaural Demonstration Records at $5.98 each, postpaid. My check (or money order) for $_____ is enclosed. (Outside U.S.A. please send $8.00 per record ordered.) N.Y. State residents please add local sales tax.

EW-971

Print Name _____

Address _____

City _____

State _____ Zip _____

PAYMENT MUST BE ENCLOSED WITH ORDER

ranges from 100 mV to 1 kV; five true r.m.s. a.c. current ranges from 100 μA to 1 A; five d.c. current ranges from 100 μA to 1A; seven resistance ranges from 100 ohms to 100 megohms; and five dBm ranges reading from –45 to +65 dBm. Overranging on all but the kV ranges is 100%.

Fast true r.m.s. response to 50 kHz is achieved by using a specially designed all-solid-state computing-type r.m.s. converter for both voltage and current.

The 3310 measures 3½" high × 8⅜" wide × 13" deep and weighs 9¾ pounds. Battery and BCD options are available at extra cost. Hickok

Circle No. 16 on Reader Service Page

4-CHANNEL PLAYER

The new Model 8400 4-channel, 8-track player, with AM/stereo-FM receiver, features a discrete 4-channel head, four preamplifiers, and two power amps.

The unit will play regular 2-channel stereo as

is, or 4-channel when used with another stereo amplifier. The player features a choice of automatic or manual track advance. Ampex

Circle No. 17 on Reader Service Page

INFRARED-EMITTING DIODES

New high-efficiency gallium arsenide infrared-emitting diodes (LED's) with performance up to 3 milliwatts at 50 milliamps are now available as Types 40843R and 40844R.

The new units are available in the compact OP-10 package designed especially for closely spaced PC-board mounting. This package includes a parabolic reflector for focused output with a controlled beam-emission pattern that permits detection in both close-range applications and long-range service requiring the use of external optics. All types of silicon photodetectors can be used with the new LED's. RCA Commercial Engineering

Circle No. 18 on Reader Service Page

L.F. SPEAKER FOR P.A.

A low-frequency speaker for "over the proscenium" use in p.a. installations is now available as the "Medallion 6A405."

The speaker will handle 160 watts and frequency response is 40 to 2500 Hz. Input impedance is 25 ohms but other impedances can be supplied by the accessory Model 710-2134 autotransformer. The rigidly braced and acoustically damped cabinet houses two 15-inch low-frequency driver units.

The unit measures 34" high × 48" wide × 24" deep and is finished in gray spackle over gray and flat black on a center speaker mounting panel. DuKane

Circle No. 19 on Reader Service Page

COAX-CABLE STRIPPER

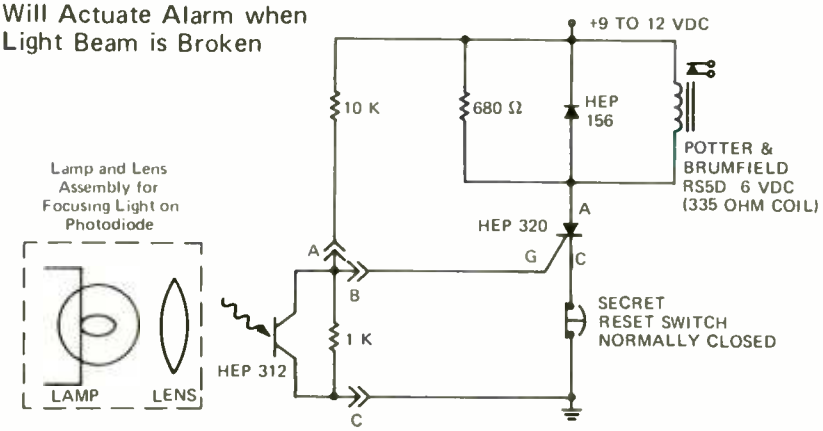
A thermal stripper for use on coaxial and other cables has been introduced as the TW-6. It can also be used for slitting as well as for circumference-cutting on all types of cables up to ⅝" diameter.

A special fixture at the end of the stripper has two slots into which the cable is positioned. One

An easy-to-build burglar alarm which uses readily available parts from Motorola HEP line. The relay is Potter & Brumfield RS5D.

BURGLAR ALARM (PHOTOELECTRIC)

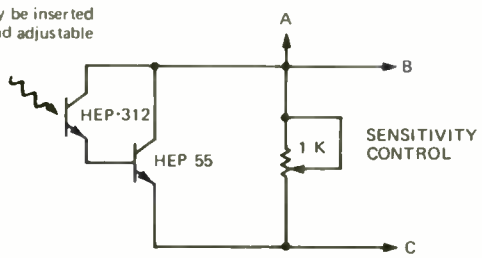
Will Actuate Alarm when Light Beam is Broken



PARTS LIST

1 HEP 312
1 HEP 320
1 HEP 156
1 Resistor, 10K, 1/2 Watt
1 Resistor, 680 ohms, 1/2 Watt
1 Resistor, 1K, 1/2 Watt
1 Relay, Potter-Brumfield RS5D, 6VDC
1 Push Switch, Normally Closed
1 Battery as Desired
Optional Circuit
1 Potentiometer, 1K
1 HEP 55

This circuit may be inserted for increased and adjustable sensitivity.



of these slots provides circumference cutting while the other provides slitting action. In both cases, operation is as simple as pressing the stripper's "on-off" button and twirling or pulling the cable along the slot.

Two models are available, one has a fixed operating temperature of 1700 degrees F for use on high-temperature insulations only while the other features a solid-state temperature control adjustable from 100 to 1700 degrees F. It is usable on the full range of available insulation materials. Jensen Tools

Circle No. 20 on Reader Service Page

DIGITAL READOUT TUNER

The Model SEL-300 digital readout stereo-FM tuner features a crystal-controlled readout

of station frequency using a 7-element incandescent readout tube; a double-sided, glass-epoxy PC board with plated-through connections; logic circuitry using 17 IC's; and an exclusive 12-pole toroidal i.f. filter yielding alternate-channel i.f. selectivity in excess of –85 dB. Sherwood

Circle No. 21 on Reader Service Page

NEW PHOTODETECTORS

Allen-Bradley Company, 1201 S. Second St., Milwaukee, Wisconsin 53204 has introduced a new line of cadmium-sulfide and cadmium sulfo-selenide photodetectors in five standard configurations.

The new photocells are available as individual units or in complex arrays up to 20 cells and with several peak spectral responses. According to the company, new manufacturing processes yield higher operating temperature ranges, better electrode stabilization, greater sensitivity, finer resolution, and improved power dissipation.

Photocell arrays may have as few as two cells or as many as 20. Individual units are available in TO-98 or a TO-18 package. Three basic materials are offered, with peak spectral responses at 515, 575, and 625 nanometers. "On" resistance, with respect to material, is 1000, 3000, and 7000 ohms when measured at 10 footcandles.

The Marketing Department of the Electronics Division will forward more information on letterhead request.

MINIATURE POWER SUPPLY

A new miniature, 75-percent efficient power supply which the company claims solves the size, weight, and thermal problems of today's systems, is now available in three ratings.

The 5-volt, 50-ampere unit has input power of 100-130 volts a.c., 47-420 Hz, ±1% line and load regulation, ripple of 50 mV peak-to-peak including all noise and spikes, and a recovery time of 50 μs to within 1% with a 10-A step load. The unit measures 5" × 6" × 7".

Other features include optional overvoltage crowbar, overload and short-circuit protection with automatic recovery, remote error sensing, and parallel operation (no elaborate interconnections required). Five-volt models at 10 and 20 amps are also available. Computer Energy

Circle No. 22 on Reader Service Page

CASSETTE TAPE DECK

A new stereo cassette deck which emphasizes exceptionally wide dynamic range, low wow and flutter, wide frequency response, and automatic stop has been introduced as the T-3300.

The deck uses a precision hysteresis-synchronous motor and automatically stops when the tape reaches its end to avoid tape damage. The unit also features a pop-up mechanism which

automatically ejects the cassette when playing is finished—an action that takes place whether the unit is set to its play mode, fast-forward, or rewind. The pop-up mechanism releases the operating buttons.

The unit is a 4-track, 2-channel stereo/mono unit operating at $1\frac{7}{8}$ in/s and can accommodate C-30, C-60, C-90, or C-120 cassettes. U.S. Pioneer

Circle No. 23 on Reader Service Page

MATCHING TRANSFORMER

A new matching transformer that permits easy use of 50-ohm v.h.f. signal generators with 300-ohm loads is now available as the Model 100. It operates over the frequency range from 54 to 216 MHz, thus covering the communications, FM, and TV bands.

The transformer has a 1:1 voltage transfer ratio, although the generator source impedance is in effect changed to 300 ohms. The voltage calibration of the signal generator is thus preserved for the 300-ohm system, a convenience for the user. In addition, the transformer converts unbalanced signal generators to balanced (300-ohm) sources.

A data sheet giving complete specs on the Model 100 is available on request. Sound Technology

Circle No. 24 on Reader Service Page

SWEEP GENERATOR

An AM-FM radio sweep generator with digital frequency synthesizer has been introduced as the Model 1019. The unit provides all world standard frequencies in a single instrument. All functions are pre-programmed with front-panel

push-button selectors, covering r.f. and i.f. frequencies, including amplitude and frequency modulation with less than 1% distortion.

Automatic frequency tracking of the unit under test allows "hands-off" test instrument alignment of any radio set, with up to 30 frequency markers. Frequency coverage extends from 250 kHz to 115 MHz. Telonic

Circle No. 25 on Reader Service Page

DESOLDERING TOOL

A new desoldering tool that permits removal of soldered components from PC boards or conventional circuits without damage to either component or circuit board is now on the market.

It uses a vacuum and a hollow tip, but the tool may also be used to resolder new components in places where the old ones have been removed.

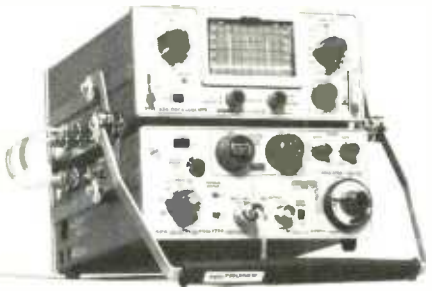
Replacement tips are available in a variety of

sizes. The tool comes complete with vacuum bulb, tip, two-wire cord, and display package. It is also available in three-wire models. Weller

Circle No. 26 on Reader Service Page

SPECTRUM-ANALYZER MODULE

The 1401A module used with the 8-pound portable Sony/Tektronix 323 or 324 or most other oscilloscopes, provides complete facilities for measurements in the 1 MHz to 500 MHz spectrum. Amplitude and frequency calibration with IM distortion of less than 60 dB of full screen is featured. A gated mode allows the 1401A to be used in viewing time-related sig-



nals, such as pulsed r.f., TV signals, sync, and VITS. A built-in calibrator furnishes both frequency and amplitude reference for calibrating the associated scope.

Among the unique features of the 1401A spectrum analyzer is automatic center-frequency positioning in a "search" mode. At 50 MHz/div frequency span (dispersion), the center frequency automatically becomes 250 MHz, preventing an erroneous display. In "search," the center frequency control positions a negative marker to indicate that part of the spectrum which will appear at center screen when the frequency span is reduced to less than 50 MHz/div.

Full specifications are available on letterhead request to Tektronix, Inc. P.O. Box 500, Beaverton, Oregon 97005.

MANUFACTURERS' LITERATURE

PHONO CARTRIDGES

A new 40-page catalogue (PC-71) has been issued covering an extensive line of exact replacement phonograph cartridges. The publication includes all pertinent information about the various cartridges, a cross-reference guide, and a listing of individual manufacturers and their part numbers—in both alphabetical and numerical order—cross-referenced to the firm's replacement number. Vidaire

Circle No. 27 on Reader Service Page

ELECTRONIC BOOKS

An illustrated, 20-page catalogue describing over 170 current and forthcoming books is now available without charge.

The following subject areas are included: schematic/servicing manuals, broadcasting, basic technology, CATV, electric motors, electronic engineering, computer technology, reference works, television, radio and electronics servicing, audio and hi-fi stereo, hobby and experimental, ham radio, test instruments, appliance repair, and transistor technology. Tab Books

Circle No. 28 on Reader Service Page

PC-BOARD MATERIALS

A new catalogue which provides condensed data and industrial net prices on more than 200 products of interest to industrial electronics design and packaging engineers, radio hams, experimenters, industrial arts instructors, and students is now ready for distribution.

Catalogue No. CC-671 is available on request. Kepro

Circle No. 29 on Reader Service Page

VOICE-COUPLER DATA

A 4-page data sheet on the EC-30-A voice coupler which provides technical information on

ABOUT YOUR SUBSCRIPTION

Your subscription to ELECTRONICS WORLD is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved, and it would start sending you two copies of ELECTRONICS WORLD each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy your name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

installation, maintenance, and connection procedures has just been published.

The unit provides voice-frequency access to the telecommunications network, limits abnormally high voice-signal voltages, isolates hazardous voltages and currents, and provides longitudinal impedance balance. According to the folder, the coupler provides 2-wire connection of customer-provided voice transmitting and/or receiving equipment on telephone lines. It must be associated with a telephone set equipped with an exclusion key. Elgin Electronics

Circle No. 30 on Reader Service Page

COMPREHENSIVE CATALOGUE

A new, 164-page catalogue (No. 715), containing a comprehensive line of equipment for the scientific, optical, and space fields, is now ready for distribution.

Presented in handy pocket-size format, the catalogue pictures and describes all types of items for the science-minded, including many hard-to-get products. The listing ranges from items used in astronomy to weather instruments. Edmund Scientific

Circle No. 31 on Reader Service Page

A.C.-D.C. POWER SUPPLIES

A complete specification catalogue on an economical line of regulated a.c.-d.c. power supplies is now available.

The catalogue lists over 600 "Voltswagon" models in two series: a 65-degree C base temperature line for high-grade industrial and commercial applications and a 95-degree C base temperature line for use in extreme MIL-type environments. Voltage-current ratings are from 4 volts d.c. at 500 mA to 125 volts d.c. at 4 A.

The listing provides complete specification data, design information, thermal considerations, as well as available options. Nuclear Corp.

Circle No. 32 on Reader Service Page

CHANGER/RECORDER PARTS

Catalogue 71D which covers a complete line of record-changer and tape-recorder belts, drives, and other related replacement parts is just off the press and ready for mailing.

The 32-page publication includes cassette and standard tape-recorder belts, phono belts, cam tires, turret drivers, idler and inter-wheel drives, pressure rollers, and pinch rollers. Detailed illustrations and dimensions are included. Also featured is a 13-page cross-reference section alphabetically listing over 165 brand-name set manufacturers, manufacturers' part numbers, description, replacement stock number, and set model numbers. A special page is devoted to cassette recorder belts and information on where they are used. E-V/Game

Circle No. 33 on Reader Service Page

THYRISTORS/RECTIFIERS

RCA's Solid State Division has just issued a 28-page catalogue describing a wide selection of thyristors (triacs and SCR's), rectifiers, and diacs.

Information appearing in the catalogue (No. THC-500A) includes data on IN and 2N series (JEDEC) types, the 4000-series types, and developmental (TA) types. Data for each type of device is arranged by series and in order of ascending current. This form of presentation displays the complete selection of types available with respect to current, voltage, and package in a particular series.

Priced at 35 cents a copy, orders should be sent to RCA Commercial Engineering, Harrison, N.J. 07029.

NEW EIA PUBLICATIONS

The Engineering Department of the Electronic Industries Association, 2001 Eye St. N.W., Washington, D.C. 20006 has just issued a new engineering standard and a new glossary of definitions on microelectronics.

The new standard, RS-289 ($4.90), called "Standard Outlines for Solid State Products" is the result of the industry's first effort to standardize the most popular and most widely accepted designs of semiconductor devices.

The second publication, "Glossary of Microelectronic Terms, Definitions, and Symbols"—JEDEC Engineering Bulletin No. 1-B ($2.15)—is an authoritative dictionary of terms and definitions in the area of microelectronics. It contains sections on physical terms, electrical terms, and terms and definitions applicable to all microcircuits—digital, linear (analog), and hybrid.

Orders must be accompanied by payment in full and mailed direct to EIA at the above address.

ROTARY-SWITCH DATA

An 8-page technical bulletin which provides complete design information for using "Multidex" standard rotary switches in thousands of design variations in commercial, industrial, and military applications is now available from Oak Manufacturing Co., Crystal Lake, Illinois 60014.

Along with dimensional specifications, the publication provides easy-to-use information needed for selecting the right combination of switch parts to fit a specific application. Included are types of clip material available, life cycle and temperature characteristics, recommended blade material, and other data needed to assure optimum design selection.

SOLID-STATE READOUTS

Dialight Corporation has published Bulletin RO5001 which provides details on its new series 745 solid-state readouts.

This single-page, two-color brochure pictures the readouts, gives mechanical specifications, pin connections, special features, and offers a general description of the units, electrical specifications, parameters, and typical application notes.

For a copy of this brochure, write the company at 60 Steward Avenue, Brooklyn, N.Y. 11237 on your business letterhead.

LIGHTING "PRIMER"

Nife Incorporated, Copaigue, N.Y. 11726 has published a "primer" on the application of nickel-cadmium storage batteries for emergency lighting.

Covered in the booklet are answers to such technical questions as: What kind of battery should be used for emergency lighting? What is a nickel-cadmium battery? What is pocket-plate construction and why is it important? How is battery reliability measured? Also included is a brief description of the state requirements regarding emergency lighting and a cut-away illustration of the firm's pocket-plate nickel-cadmium cell.

When writing for your copy of this booklet, please specify AG-432.

NEON INDICATOR LAMPS

Complete specifications on a broad range of neon indicator lamps are included in chart form in a new brochure just issued by Novelite Corporation, 226 North 6th Street, Brooklyn, N.Y. 11211.

Included in this listing are standard and high-brightness lamps with wires and based neon lamps as well as information on various options which are available to the customer.

PHOTO CREDITS

Page	Credit
9	British Industries Co.
10	Pickering & Co., Inc.
28, 29	Hewlett-Packard Co.
32 (top)	Teledyne Ryan
32 (center)	Westinghouse Electric
32 (bottom)	Motorola Semiconductors
33 (top)	Lockheed Missiles & Space
33 (center)	The Bendix Corporation
33 (bottom)	The Bell System
38, 40	Shure Brothers Inc.
47	GTE Sylvania

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. $1.00 per word (including name and address). Minimum order $10.00. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.

READER RATE: For individuals with a personal item to buy or sell. 65¢ per word (including name and address). No minimum! Payment must accompany copy.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. All copy subject to publisher's approval. Closing Date: 1st of the 2nd month preceding cover date (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, ELECTRONICS WORLD, One Park Avenue, New York, New York 10016.

FOR SALE

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Radios, Parts, Picture Catalog 25¢. Meshna, Nahant, Mass. 01908.

CONVERT any television to sensitive big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco-A22, Box 10563, Houston, Texas 77018.

INVESTIGATORS, Latest Electronic Aids. Free Literature. Clifton, 11500-J NW 7th Ave., Miami, Florida 33168.

SENCORE, B & K Test Equipment Unbelievable Prices. Free Catalog and Price Sheet. Fordham Radio, 265 East 149th Street, Bronx, N.Y. 10451.

ELECTRONIC PARTS, semiconductors, kits. Free Flyer. Large catalog, $1.00 deposit: Bigelow Electronics, Bluffton, Ohio 45817.

NEW SEMICONDUCTOR LIGHT EMITTING DIODES. Bright red lights replace light bulbs. Typical life 100 years. Operate at 1.65 volts, 50 milliamps. Order 2 for $2.98 NOW. Data sheet and instructions included. Monsanto Company, Hobby Section, 10131 Bubb Road, Cupertino, California 95014.

ELECTRONIC COMPONENTS—Distributor prices. Free catalogue. Box 2581, El Cajon, California 92021.

ELECTRONIC Ignition. Various types. Information 10¢. Anderson Engineering, Epsom, N.H. 03239.

CONSTRUCTION PLANS: Laser . . . $2.00. Investigation aids—2-FM microphone transmitters . . . $1.00. FM telephone transmitter . . . $2.00. Sound telescope . . . $2.00. Space monitor-missile tracker . . . $2.00. Free equipment and kit catalog. Howard, 20174 Ward, Detroit, Michigan 48235.

JAPAN HONG KONG DIRECTORY. World products information. $1.00 today. Sekai Shogyo Annai, Hillyard, Washington 99207.

FREE ILLUSTRATED CATALOG!! covering wide range of low-cost stock business forms from 2-Way Radio to TV Service. Write today. Free catalog; samples, too. OELRICH PUBLICATIONS, 4040 N. Nashville East, Chicago, Illinois 60634.

RECONDITIONED Test Equipment. Reasonably priced, list available. Walter, 2697 Nickel, San Pablo, CA. 94806.

BURGLAR ALARM SYSTEMS. We manufacture intruder-fire detection systems, radar and perimeter types. Accessories available. Free Literature. Inquiries for dealership and wholesale prices must be on letterhead. U.S. and Canada only. Microtech Associates, Inc., Box 10147, St. Petersburg, Florida 33733.

EUROPEAN wholesale new products catalog $1.00 refundable. Deecow, P.O. Box 9308, North Hollywood, Calif. 91609.

INTEGRATED circuits, new TTL, DTL at very competitive prices. No minimum order. Send for list. Marco Enterprises, POB 216, Dayton, Ohio 45401.

FREE SAMPLES. Resistors, Capacitors. Send 25¢, postage, handling. Comet Communications Company, 639 50th St., Brooklyn, New York 11220.

INTEGRATED CIRCUITS, 74N series, all latest types, low, low prices. 7490—$1.75, 7400—34¢. Send for free complete list. B&A Supply Co., Box 24211, Fort Lauderdale, Florida 33308.

PHOTOFLASH CAPACITORS 490MFD, 500VDC 5¾ x 1½" $1.50 each, postpaid. Electronic Surplus, 1224 Prospect, Cleveland, Ohio 44115.

CAPACITIVE DISCHARGE Ignition Systems by Delta at discount prices. Write: Southland Communications, P.O. Box 3591, Baytown, Texas 77520.

FREE ELECTRONICS Catalog. Tremendous bargains. Edu-Kits, Department C-121 E, Hewlett, N.Y. 11557.

MECHANICAL, ELECTRONIC devices catalog 10¢. Greatest Values—Lowest Prices. Fertik's, 5249 "D", Philadelphia, Pa. 19120.

SPECIAL SALE SURPLUS TEST EQUIPMENT—OSCILLOSCOPES: Tektronix 317-DC-10MHZ, $325.00; Tektronix 531-DC-15MHZ, $485.00; Tektronix RM31A-DC-15MHZ, $425.00; Tektronix RM32-DC-5MHZ, $385.00; Dumont 322A Dual Beam, $135.00; AN/USM105—Like H/P 160B DC to 14MHZ, $485.00; AN/USM24A 2HZ-5MHZ, $85.00; AN/USM38A 10HZ-6MHZ, $95.00. SIGNAL GENERATORS: TS413—75KHZ-40MHZ, $135.00; TS497—2MHZ-400MHZ, S165.00; DY5731 By H/P X-Band, $595.00; TS140 (SG15A/ME22) 2 Pcs., $185.00; TS382A-U to 200KHZ, $75.00; Tektronix 163 Pulse Gen., $65.00. FREQUENCY COUNTER AND METERS: H/P 524D 8 Digit Display, $675.00; F.R. 149/USM-159-1800MHZ, $165.00; LA6—100—500MHZ, $295.00. MISCELLANEOUS: John Fluke 801R D.C. V/M, $165.00; ME6 D/U VTVM-AC, $47.50; H/P 430CR Power Meter, $87.50; H/P 103AR Frequency Std., $385.00; H/P 452A AC Volt. Divider, $35.00; H/P 330CR Dist. Analyzer, $135.00; Tektronix 161 I.F. Amplifier, $67.50; Tektronix 121 Wide Band Pre Amp, $65.00; AN/PSM2 Megger, $47.50; WWV Receiver Model 550, $135.00. All items operational F.O.B. Fort Worth. Testronics of Texas, 609 Riverside Drive, Fort Worth, Texas 76111. We Buy Surplus Test Equipment.

DO-IT-YOURSELF

PROFESSIONAL ELECTRONICS PROJECTS—$1.00 up. Catalog 25¢. PARKS, Box 25665A, Seattle, Wash. 98125.

INTEGRATED CIRCUITS / RECTIFIERS SEMICONDUCTORS / TRIACS

BCD COUNTER KIT

Consisting of:
1—PC board 12707
2—7476 IC's
2—Silicon diodes
1—Set of instructions

When assembled by enclosed instructions, this kit will count pulses from 0-9 in BCD. These boards can be connected in series to count as high as desired. Example, two boards will count to 99, three to 999 etc. $6.95

ER900 TRIGGER DIODES. These bidirectional trigger diodes are one of the best and cheapest methods to trigger SCR's and triacs . . . . . 4/$1.00

TIS 43 GENERAL PURPOSE UNIJUNCTIONS $.50

2N3819
N-Channel FET's. 45
2N4303 P channel FET with a QMS of 2000 uohms . . . . . $.95

TRIACS

PRV	1A	10A	15A
100	.40	.70	1.00
200	.70	1.10	1.40
300	.90	1.35	1.80
400	1.10	1.60	2.20
500	1.50	2.00	2.60

LIGHT EMITTING DIODES (LED's)

Infra red OR visible spectrum . . . . . $1.20 ea.
Photo detectors for each . . . . . $.80

TTL IC SERIES (DIP)

7441 BCD Decimal Decoder . . . 2.00
7474 Dual Flip Flop 85
7475 Quad Bistable Latch . . . 1.70
7476 Dual Mast-Slave JK FF . . 1.00
7490 Decade Counter 1.85
7492 Divide By Twelve 1.85
7493 4 Bit Binary Counter 1.85
7481 16 bit read/write memory 1.85

Silicon Power Rectifiers

PRV	3A	30A	12A
100	.09	.30	.50
200	.16	.35	.80
400	.20	.45	1.20
600	.30	.70	1.50
800	.40	.85	1.80
1000	.55	1.10	2.20

NIXIE TUBES

Similar to Raytheon 8754, with socket & data sheet $4.75

Terms: FOB Cambridge, Mass. Send check or Money Order. Include Postage. Average Wt. per package ½ lb. No C.O.D.'s. Minimum Order $3.00
Rated companies 30 days net

DECADE COUNTER KIT

Consisting of:
1—Nixie tube & socket (8754)
1—7490
1—7475
1—7441
Specially priced at $9.95

709C OPER AMP . . . . . $ .80
SE 501 VIDEO AMP. 1.00
741 OPER. AMP. $1.25
723 VOLTAGE REGULATOR . $1.25

Controlled Avalanche or Epoxy Rectifiers 1 AMP.

	100	.06
	200	.07
	400	.09
	600	.11
	800	.15
	1000	.20

Silicon Control Rectifiers

PRV	3A	7A	20A	70A
50	.25	.28	.60	
100	.30	.38	.85	3.50
200	.50	.60	1.10	6.50
300	.60	.68	1.30	
400	.70	.75	1.50	9.50
500	.80	.85	1.70	
600	.90	1.20	1.90	11.00

Send for our Latest catalog featuring Transistors and Rectifiers; 325 Elm St., Cambridge, Mass.

OLID TATE ALES

Post Office Box 74B | Somerville, Mass. 02143 | Tel. (617) 547-4005

CIRCLE NO. 107 ON READER SERVICE PAGE

ALL IC's ARE NEW AND FULLY TESTED—LEADS ARE PLATED WITH GOLD OR SOLDER. ORDERS FOR $5 OR MORE WILL BE SHIPPED PREPAID. ADD 35¢ HANDLING AND POSTAGE FOR SMALLER ORDERS. CALIFORNIA RESIDENTS ADD SALES TAX.

SUMMER SALE

TTL dual in line

7400, 7401, 7402, 7404, 7405, 7410, 7420, 7430, 7440, 7450, 7451, 7453 . . . . all 3 for	$1.00
7441 BCD decimal decoder driver	1.50
7442 BCD decimal decoder	2.00
7473 dual JK flip flop	.65
7474 dual type D FF	.65
7475 quad latch	1.50
7476 duak JK FF	.75
7480 gated full adder	1.00
7486 quad exclusive or gate	1.00
7490 decade counter	1.50
7491 8 bit shift register	1.75
7493 4 bit binary counter	1.75
74192 up/down preset decade counter	2.00
74193 up/down preset binary counter	2.00
8200 parity gen/checker	1.00
8242 4 bit comparator (open collector)	.90
8280 preset decade counter	2.00
8520 25 MC divide by "N" 2 to 15	2.00
LU321 10 MC dual JK flip/flop (Signetic)	.50
N1283 Signetic 8 bit scratch pad memory	3.00
8H21 75 MC dual JK flip/flop (Signetic)	1.25

LINEAR IC's (dual in line)

723 TO5 Voltage regulator	1.00
741C compensated operational amplifier Fairchild w/gold plated leads Dip only	.75
710 voltage comparator	.75
711 dual comparator	.75
NE525 memory sense amplifier	1.50
7524 dual sense amplifier	1.50
LED Red Emitting Lamp	.60

DIGITAL COUNTER MODULE 30MC unit includes board, SN7490, SN7475 quad latch, SN7447 7 segment driver and RCA "numitron" display tube W/ decimal. 1" x 4.5" module will mount on 1" centers. kit $12—wired and tested $15.

BABYLON ELECTRONICS

5942G Don Way, Carmichael, CA. 95608 916 966 2111

CIRCLE NO. 141 ON READER SERVICE PAGE

AMPEREX NUMERICAL READOUT TUBES

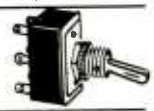
BRAND NEW

$3.00 each
10/$25.00

NIXIE TUBE POWER SUPPLY
From used eqpmt, OK.
115V input, solid state.
$4.95

MICAD CELLS 34 AH $3.00

MINIATURE SWITCHES
DPDT or SPDT $1.00 ea.
3PDT or 4PDT 1.25 ea.



HI FREQ TRANSISTORS 2N2222
400mc * 30V * 1.8W
Better than 2N706
3 for $1.00

VIDEO RECORDER TAPE
MEMOREX or AMPEX
Used, OK cond.
1500 ft x 1 inch $10
3000 ft x 1 inch $15

ASCII KEYBOARD $35.00
w/encoder diode matrix

MAGNOSTRICTIVE COMPUTER MEMORY
Magnostrictive delay line good for approx. 7000 bit storage. Details included. $25.00

MOTOROLA POWER TRANSISTOR 2N3448
NPNS * PWR * 115 watt * 80 volt $1.50

Please add postage for above items
Send 25¢ for Surplus Catalog . . .

JOHN MESHNA JR. ELECTRONICS
P.O. Box 62 E. Lynn, Mass 01904

CIRCLE NO. 118 ON READER SERVICE PAGE

LIBERTY PAYS MORE!

WILL BUY FOR CASH

ALL TYPES:

★ **ELECTRON TUBES**
★ **SEMICONDUCTORS**
★ **TEST EQUIPMENT**
★ **Military Electronic Equipment**

WIRE—WRITE—PHONE COLLECT!
We pay freight on all purchases—

LIBERTY OFFERS MORE!

PRESTEL FIELD STRENGTH METER

(Model 6T4G)

Only
$129.00
F.O.B.
New York

Larger, loud speaking model-2.5 microvolt-Model MC16 only $289.00 F.O.B. New York

★ **Never Anything Like It!**
★ **1-Man Can Do A Better Job than 3 in the Same Time!**
★ **A Gold-Mine for Antenna Installers!**

Calibrated from 40 to 230, and 470 to 860 in 4 Bands Megahertz, from 10 to 50,000 Microvolts. Nothing makes it easier to properly and speedily find the correct place to install TV, FM and Communication Antennas. You can measure and hear the signals with this 4½ volt battery economically powered unit.

LIBERTY ELECTRONICS, Inc.

548 Broadway, New York, New York 10012
Phone (212) 925-6000

CIRCLE NO. 121 ON READER SERVICE PAGE

PLANS & KITS

INTEGRATED CIRCUIT KITS—Free Catalog. FRAZER & ASSOCIATES, 3809 Surfwood Road, Malibu, California 90265.

GOOD news for electronic component users. Integrated circuits, Assemblies, Core Memories. SN7400N—55¢. Send 10¢ for latest catalog. TRI-TEK, P.O Box 14206, Phoenix, AZ 85031.

ELECTRONICS ENGINEERING AND INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING at home. All Makes including transistors. Experimental kit—troubleshooting. Accredited NHSC. Free Booklet. NILES BRYANT SCHOOL, 3631 Stockton, Dept. A, Sacramento, Calif. 95820.

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start September, February. Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana 46383.

WANT AN F.C.C. 1st CLASS LICENSE? WANT TO BECOME A DISC-JOCKEY? REI has a school near you VA approved call toll free: 1-800-237-2251 or write REI, 1336 Main St., Sarasota, Florida 33577. Florida Residents call: (813) 955-6922.

DEGREE in Electronics Engineering earned mostly by correspondence. Free brochure. Dept. G-9, Grantham School of Engineering, 1505 N. Western Ave., Hollywood, California 90027.

MATHEMATICS, ELECTRONICS. No contract, no obligation. Satisfaction guaranteed. Free brochure. Indiana Home Study, P.O. Box 1189, Panama City, Florida 32401.

FCC Type Exams . . . guaranteed to prepare you for FCC 3rd, 2nd, and 1st phone exams. 3rd class, $7.00; 2nd class, $12.00; 1st class, $16.00; complete package, $25.00. Research Company, Box 22141, Tampa, Fla. 33622.

MEMORIZE, STUDY: "1971 Tests-Answers" for FCC First and Second Class License.—plus—"Self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-P, San Francisco 94126.

TUBES

TUBES, SEMICONDUCTORS, ELECTRONIC EQUIPMENT & COMPONENTS. Quality merchandise only! Serving engineers, Purchasing Agents, TV/Hi-Fi Servicemen and Hams for 20 years. Write for Catalog or call 212-WA 5-7000. BARRY ELECTRONICS, 512 Broadway, New York, N.Y. 10012.

RECEIVING & INDUSTRIAL TUBES, TRANSISTORS, All Brands—Biggest Discounts. Technicians, Hobbyists, Experimenters—Request FREE Giant Catalog and SAVE! ZALYTRON, 469 Jericho Turnpike, Mineola, N.Y. 11501.

TUBES—36¢ each. Year guarantee. Tuner Cleaner $1.00. Free catalog. Cornell, 4213-W University, San Diego, Calif. 92105.

SAVE money on parts and transmitting-receiving tubes, foreign-domestic. Send 25¢ for giant catalog. Refunded first order. United Radio Company, 56-E Ferry Street, Newark, N.J. 07105.

WANTED

QUICKSILVER, Platinum, Silver, Gold. Ores Analyzed. Free Circular. Mercury Terminal, Norwood, Mass. 02062.

QUICK CASH . . . for Electronic Tubes, Semi-conductors, Equipment (Receivers, Transmitters, Scopes, Vacuum Variables, etc. Send list now! Write: BARRY ELECTRONICS, 512 Broadway, New York, N.Y. 10012 (212-WA 5-7000).

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free. Hermes, Berlin 11, Germany.

AUTHORS' SERVICES

AUTHORS! Learn how to have your book published, promoted, distributed. FREE booklet "ZD," Vantage, 516 West 34th St., New York 10001.

$1 PEP $1

Dollar Sale

EACH PACKAGE

MONEY BACK GUARANTEE

1 AMP
Silicon Rectifier
Choice of Package
Bullet-Glass-Min-Metal
☐ 20-50V ☐ 5-800V
☐ 17-100V ☐ 4-100V
☐ 12-200V ☐ 3-1200V

3 AMP
☐ 15-50V ☐ 4-600V
☐ 10-100V ☐ 3-800V
☐ 8-200V ☐ 2-1000V
☐ 5-400V ☐ 1-1200V

1 AMP GLASS 50-100V 15/$1.00
1 AMP METAL 600V 10/$1.00
15 AMP TRIAC PRESFIT 5-50V 7/$1.00
7 AMP SCR FLANGE PACKAGE 5-100V 10/$1.00

2 AMP BULLETS
12—200V $1.00
10—500V $1.00
8—800V $1.00

CIRCUIT BOARD SPECIAL
A-Approximately 200 diodes—7 transistors—over 50 resistors complete with board!—$1.25

40 Amp. Stud 24 V. . . . . **7 for $1.00**
Plastic low power transistors PNP No Test **25 for $1.00**

FULL WAVE BRIDGES

PRV	2Amp	3Amp	5Amp	10Amp
50V	1.25	1.35	1.50	1.70
100V	1.50	1.60	1.75	1.95
200V	1.75	1.85	2.00	2.20
400V	2.00	2.10	2.25	2.45
600V	2.50	2.60	2.75	2.95
800V	3.00	3.10	3.25	3.45

SILICON CONTROL RECTIFIERS

PRV	1 AMP	3 AMP	7 AMP
50	.20	.25	.30
100	.25	.30	.35
200	.40	.45	.50
300	.60	.70	.80
400	.75	.85	.95
500	..	..	1.00
600	..	..	1.30

TRIACS

PRV	1 AMP	3 AMP	6 AMP	10 AMP	15 AMP
100	.40	.50	.75	1.00	1.20
200	.65	.75	1.00	1.40	1.80
300	1.00	1.10	1.25	1.90	2.20
400	1.30	1.40	1.80	2.30	2.60
500	1.60	1.80	2.10	2.75	3.10

NO SALES TAX—WE PAY POSTAGE
OTHER PRODUCTS ON REQUEST

PARK ELECTRONIC PRODUCTS

P.O. Box 78, N. Salem, N.H. 03073
603-893-0276

CIRCLE NO. 116 ON READER SERVICE PAGE

DELUXE
RECORD AND TAPE CASES
Plus *Free* cataloging forms

- Padded back
- Dust proof
- Gold embossed

Decorative and sturdy cases constructed of reinforced fiberboard and covered in rich leatherette to keep your records and tapes from getting tossed about and damaged. Available in your choice of five decorator colors. Stereo Review Record and Tape Cases lend themselves handsomely to the decor of any room. Padded back (in your color choice) is gold tooled in an exclusive design available only on Stereo Review Record and Tape Cases. Sides are in standard black leatherette to keep them looking new after constant use. Extra with each record and tape case you order you will receive, free of charge, a specially designed cataloging form with pressure sensitive backing for affixing to the side of the case. It enables you to list the records, names and artists to help you locate your albums.

Record cases are available in three sizes for 7", 10" and 12" records. Center divider separates records for easy accessibility, holds an average of 20 records in their original jackets. Tape case holds 6 tapes in their original boxes.

Ziff-Davis Pub. Co. • Dept. SD • 1 Park Ave. • N.Y., N.Y. 10016

Quantity — My remittance in the amount of $_____ Is enclosed for the Cases indicated below.

_____ Tape Case at $4 ea . 3 for $11. 6 for $21.
_____ 7" Record Case at $4 ea.. 3 for $11. 6 for $21.
_____ 10" Record Case at $4.25 ea.. 3 for $12. 6 for $22
_____ 12" Record Case at $4.25 ea.. 3 for $12. 6 for $22

ADD $1.00 PER ORDER FOR SHIPPING AND HANDLING
Check color choice for back of case (sides in black only):

☐ Midnight Blue ☐ Red ☐ Spice Brown
☐ Pine Green ☐ Black

Name EW-971

Address

City State Zip

PAYMENT MUST BE ENCLOSED WITH ORDER

SILICON RECTIFIERS

PIV	25	50	100	200	400	600	800	1000	1200
1A*	—	.05	.06	.08	.10	.12	.16	.19	.24
3A	—	—	—	—	—	.23	.33	.45	.57
18A**	—	.15	.19	.29	.39	—	—	—	—
20A	—	—	—	.59	.75	1.13	1.35	1.73	2.10
40A	—	—	—	1.35	1.80	2.25	2.70	3.15	3.60

*Tophat, Flangless, **Pressfit 3, 20, 40 Studs

SILICON CONTROLLED RECTIFIERS

2N458—45¢
2N1021—60¢
2N697—6/1.00
2N699—5/1.00
2N342—10/1.00

PRV	25	50	100	200	400	600
1A*	—	—	—	.30	.55	.85
7A	—	—	—	.45	.90	1.20
18A**	—	—	—	.60	1.10	1.40
20A	.18	.30	.45	.70	1.15	1.95

*Tophat, **Pressfit, 7 & 20 Amp Stud

SILICON POWER TRANSISTORS

2N424, 85W, 80V—.65 2N498, 4W, 100V—.13
2N1724, 50W, 80V—.65 2N1719, 10W, 100V—.20

2N3053, Sil, NPN 3/$1.00; 2N1142, Ger. Hi-Freq. Amplifier 3/$1.00; Thermistor Beads, 1200 ohm or 3500 ohm 3/$1.00; Varicaps—27, 47, 100pf $1.25 ea.; P.C. Board 6"x6"x1/16", 1 oz. Copper 2/$1.00; Epoxy Diodes, 200MA, 3000 Piv. 49¢; P.C. Connectors, 28 contact 2/$1.30; Trim Pot 25 Turn, 1K ohm, 49¢; IN 34A Diode, 50/$2.50; Photo Cells, Herm Glass, 5 Diff. $1.00; IN 661 Sil. Switch, 50/$3.49, 100/$4.98; IN 658 Sil. Computer, 50/$3.49, 100/$4.98; R.F. Coil Assort. 25/$1.00; Int. Cir., TO-5-15/$1.00.

ASSORTMENTS

Precision resistors film .....50/$1.00
Precision resistors wirewound .....40/$1.00
Ferric Chloride Etchant, 24 oz. bottle $1.49
Relays 6 different types .....6/$1.00
Terminal lugs, assorted .....200/$1.00
Tie lugs, assorted .....50/$1.00
Push button switches, on-off, panel .....6/$1.00
Pots, 2-4 watt, different .....10/$1.00

SPECIALS

Output Transformer, 150 ohms-primary, 8 ohms-sec. ea. 69¢.
Electrolytic Cap.: 1500 Mfd, 25 WVDC, 1/98¢; 25 Mfd, 70 Vdc, 50 Mfd, 35 Vdc, ea. 49¢.
Speaker, 2¼", 8 ohm .....1/80¢
Stud Rectifier, 1500 Piv, 1 amp .....1/25¢
IN 727A Zener, 36V, 250 MW .....1/75¢
AM RADIO RECEIVER, VOICE TRANSMITTER, and WIRELESS CODE PRACTISE OSCILLATOR (schematics included) $4.95
TAPE RECORDER includes speaker (schematics included) $4.95
EARPHONE HEADSET, 4000 ohms $1.50
TERMS: min. order $3.00. COD's send 25%. Send sufficient postage—overage refunded. FREE catalogue with order or send 15¢.

GENERAL SALES CO.
254 E. Main St. (713) 265-2369
Clute, Texas 77531

CIRCLE NO. 130 ON READER SERVICE PAGE

MINIATURE RELAYS

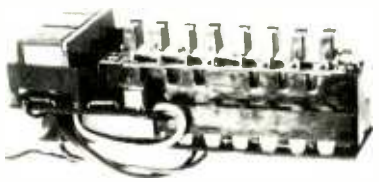
DPDT

24 VOLTS DC
¾" x ⅜" x ⅜"

ACTUAL SIZE

Stock No. H9130—2/$1.00, 5/$2.00
Printed Circuit or
Socket Mount

MOTOR SPEED & LIGHTING CONTROL



8 Push button selected controls, stop & start indicator lights. Overrun of famous blender manufacturer. Used for controlling speed of drills, saws, fans, lathes, lighting, etc.

Stock No. H5002—ready to use .$3.95 ea., 2/$7.00

Stock No. H5003—slight factory seconds, easily repaired .....$2.95 ea., 2/$5.00

Wiring diagram furnished.

COMPUTER GRADE CAPACITORS

H2049 3500 Mfd. 55 volt 4¼" x 1¾"
$.65 ea., 5/$3.00

H2062 40,000 Mfd. 10 volt 3" x 4¼" Brand new
$1.25 ea., 6/$7.00

$1.00 FREE WITH $10.00 ORDER
MINIMUM ORDER $3.00

Lots of other items—send for free flier; all merchandise fully guaranteed. Please include postage; excess will be refunded.

DELTA ELECTRONICS CO.
BOX 1, LYNN, MASSACHUSETTS 01903

CIRCLE NO. 134 ON READER SERVICE PAGE

TAPE AND RECORDERS

OLD Radio Programs on tape. 6 hours for $8.00. Catalog 50¢. Don Maris, 1926 Cherokee, Norman, Okla. 73069.

STEREO TAPE TRANSPORT—7" reel—2 speeds—pause control—made for famous manufacturer—50 to 15,000 Hz—with rec/play and erase heads, without case. Send m.o. or check for $19.50 to Alsheimer Audio Electronics, 218 Columbia St., Utica, N.Y. 13502. $2.50 for prepaid shipping and insurance.

STEREO TAPE RENTAL for particular people. Free catalog. Gold Coast Tape Library, Box 2262, Palm Village Station, Hialeah, Fla. 33012.

RENT 4-track open reel tapes—all major labels—3,000 different—free brochure. Stereo-Parti, 55 St. James Drive, Santa Rosa, California 95401.

BARGAIN MUSIC, Tape, Equipment Catalog 25¢. Saxitone, 1776 Columbia Road, Washington, D.C. 20009.

VIDEO TAPE, 1 inch. x 1 mil x 1700 feet. Used. On computer reels. $6.00 each. Lahill, P.O. Box 656, Martinsburg, W. Va. 25401.

RECORDING TAPE made by top American manufacturer, guaranteed not "seconds" or "white box;" 2400' mylar, $2.29; 1800' mylar $1.69; 1200' acetate $0.79. Send for information and quantity pricing. Alsheimer Audio Electronics, 218 Columbia Street, Utica, New York 13502.

RECORDS

POPULAR organ albums factory direct. Concert Recording, Lynwood, Calif. 90262.

HIGH FIDELITY

LOW, LOW quotes: all components and recorders. Hi-Fi, Roslyn, Penn. 19001.

HI-FI EQUIPMENT—GET Our "ROCK BOTTOM" prices on NAME BRAND amplifiers—tuners—tape-recorders—speakers FRANCHISED—60 YEARS IN BUSINESS. Write for this month's specials—NOW! Rabson's 57th St., Inc., Dept 569, 119 W. 57th St., New York, N.Y. 10019.

HI-FI components, tape recorders, sleep learning equipment, tapes. Unusual Values. Free catalog. Dressner, 1523 R Jericho Turnpike, New Hyde Park, N.Y. 11040.

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog. All merchandise brand new and factory sealed. Lyle Cartridges, Dept. E, P.O. Box 69, Kensington Station, Brooklyn, New York 11218.

GOVERNMENT SURPLUS

JEEPS Typically From $53.90 . . . Trucks from $78.40 . . . Boats, Typewriters, Airplanes, Multimeters, Oscilloscopes, Transceivers, Electronics Equipment. Wide Variety, Condition. 100,000 Bid Bargains Direct From Government Nationwide. Complete Sales Directory and Surplus Catalog $1.00 (Deductible First $10.00 Order.) Surplus Service, Box 820-K, Holland, Michigan 49423.

HYPNOTISM

SLEEP Learning. Hypnotic Method. 92% effective. Details free. ASR Foundation. Box 7021 EW, HC Station, Lexington, Ky. 40502.

FREE Hypnotism, Self-Hypnosis, Sleep Learning. Catalog! Drawer H400, Ruidoso, N.M. 88345.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

SCIENCE Bargains—Request Free Giant Catalog "CJ"—148 pages—Astronomical Telescopes, Microscopes. Lenses, Binoculars, Kits, Parts, War Surplus bargains. Edmund Scientific Co., 300 Edscorp Bldg., Barrington, New Jersey 08007.

BUSINESS OPPORTUNITIES

I MADE $40,000.00 YEAR by mailorder! Helped others make money! Start with $10.00—Free proof. Torrey, Box 318-N, Ypsilanti, Mich. 48197.

$200.00 DAILY In Your Mailbox! Your Opportunity To Do What Mailorder Experts Do. Free Details. Associates, Box 136-EW, Holland, Michigan 49423.

GREGORY ELECTRONICS

Your Best Buys In

QUALITY USED
FM 2-WAY RADIO EQUIPMENT

ALL NEW . . . JUST ARRIVED!

KAAR DT-76 MOBILE RADIO

RF POWER OUTPUT, 120 watts, 6-frequency capability. 148-174 MHz. Brand new, in factory-sealed cartons. Includes all accessories. each $345

In Quantities of Ten (10) ..... each $300

(6-Frequency Deck ..... $39)

BIG SAVINGS ON MAMMOTH RCA EQUIPMENT PURCHASE

RCA LOW BAND

CMFT 50 27-54 MHz, 50W, Checked out, with accessories. Transistor power supply; partially transistorized receiver $178

Same as above, but fully factory reconditioned, with new accessories $228

RCA HIGH BAND

CMCT 30, 30W, Checked out, partially transistorized receiver, complete accessories $168

Same as above, 30W, but fully factory reconditioned, with new accessories $208

CMCT60 60 watts. Checked out partially transistorized receiver, complete accessories $208

Same as above, 60W, but fully factory reconditioned, with new accessories $248

UHF 450-470 MHz CMUE 15, 12V/15W, transistor power supply with accessories $98

Same as above, but fully factory reconditioned, with new accessories, narrow banded $148

RCA CMU 15B 6/12 volt, 450-470 MHz less accessories $28

accessories (sold separately) $20

SEND FOR NEW 71½ CATALOG

GREGORY ELECTRONICS CORPORATION
249 Route 46, Saddle Brook, N. J. 07662
Phone (201) 489-9000

CIRCLE NO. 128 ON READER SERVICE PAGE

FREE BOOK "999 Successful Little-Known Businesses." Work home! Plymouth 445-J, Brooklyn, N. Y. 11218.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

JAPANESE Electronics New Products Monthly! Specimen copy $1, deductible. Dee, P.O. Box 9308, North Hollywood, Calif. 91609.

MAILORDER! Make big money working home. Free report reveals millionaire's trade secrets! Executive (1K9), 333 North Michigan, Chicago 60601.

DEALERS Wanted! Citizens Band, AM, SSB Two-way radios & accessories. USA and export models. We ship around the world. Send letterhead to: Baggy's Radio, P.O. Box 778, 6391 Westminster Ave., Westminster, Ca. 92683, 714-894-3301.

TREASURE FINDERS

FREE: Jetco Electronics free 24 page treasure finder catalog. Find metals, minerals, gold, silver, coins, and relics, Jetco, Box 132EW, Huntsville, Texas 77340.

IMPOSSIBLE? BARGAINS IN SURPLUS ELECTRONICS AND OPTICS

SURPLUS TTL INTEGRATED CIRCUITS, BRAND NEW IN ORIGINAL MANUFACTURERS CARTONS

B & F has one of the worlds largest inventories of surplus integrated circuits. All are new, meeting all manufacturers original specifications, and in factory packaging. The low prices should speak for themselves. Manufactured by Texas Instruments, National, Signetics or Philco, no choice. All packages are 14 16 lead silicone Dual In Line Pak. Write for additional RTL and DTL lines not listed.

ITEMS @ 50¢

7400 Quad 2 Input NAND
7401 Quad 2 Input Open Collector NAND
7402 Quad 2 Input NOR
7404 Hex Inverter
7405 Open Collector Hex Inverter
7408 Quad 2 Input
7409 Quad 2 Input AND, Open Collector
7410 Triple 3 Input NAND
7411 Triple 3 Input AND
7420 Dual 4 Input NAND
742t Dual 4 Input AND
7430 8 Input NAND
7440 Dual 4 Input NAND Buffer
7450 Dual 2 Wide 2 Input Expandable
745t Dual 2 Wide 2 Input A O I
7453 4 Wide Expandable 2 Input A O I
7454 4 Wide 2 Input A O I
7460 Dual 4 Input Expander

ITEMS @ $1.00

7406 30 Volt Hex Driver Inverter
7416 15 Volt Hex Driver Inverter
7407 30 Volt Hex Driver
7417 15 Volt Hex Driver
7426 Open Collector Hi Volt NAND Quad 2 Input
7470 J K Flip Flop
7472 J K Master Slave Flip Flop
7473 Dual J K Flip Flop
7474 Dual D Flip Flop
7486 Quad 2 Input Exclusive OR
74121 Monostable Multivibrator (One Shot)
74122 One Shot

ITEMS @ $1.75

7442 BCD to Decimal Decoder
7443 Excess 3 to Decimal Decoder
7444 Excess 3 Gray to Decimal Decoder
7475 Quad Bi Stable Latch
7480 Full Adder
7490 Decade Counter
7494 4 Bit Shift Register
7495 4 Bit Right Left Shift Reg
7496 5 Bit Shift Register
74151 8 Bit Data Selector with Strobe

ITEMS @ $2.00

7448 BCD to 7 Segment Decoder Driver
7492 Divide by 12 Counter
7493 4 Bit Binary Counter
74180 8 Bit ODD EVEN Parity Generator Checker

ITEMS @ $2.50

7447 BCD to 7 Segment Decoder Driver
7445 BCD to Decimal Decoder Driver
7483 4 Bit Binary Full Adder
74145 BCD to Decimal Decoder Driver

ITEMS @ $3.00

7441 BCD to Decimal NIXIE Driver Decoder
7491 8 Bit Shift Register

SUPER SPECIAL – TEXAS INSTRUMENTS LIGHT EMITTING DIODES (LED's) Use as logic readouts, either on panel or right on cards. Infinite life.
2 for $1.50 10 for $7.00.

ITEMS @ $4.00

74154 4 to 16 Line Decoder/De Multiplexer
74192 Bi Directional Counter BCD Output
74193 Bi Directional Counter 4 Bit Binary
74181 Arithmetic logic unit

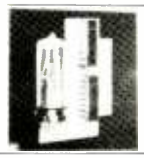
ITEMS @ $10.00

7489 64 Bit Random Access Memory
7488 256 Bit Rom ASCII to EBCDIC
2501 256 Bit MOS random access memory

20% discount on all orders for 100 or more integrated circuits. All I.C.'s postpaid, with FREE air mail on orders over $50.00. We strive to ship I.C.'s by return mail. Free data sheets on all items.

RESISTOR SPECIAL

☐ 100 1% and 2% military RN 70 specification resistors ¼, ½, 1, 2 watts, mixed values and wattages. $1.00



☐ **THIS MONTHS SUPER SPECIAL NIXIE – READOUT DECADE COUNTER KIT** including 7490 and 7441 integrated circuits, readout tube, complete etched circuit and instructions. Would you believe $8.95
(Add $2.00 for 7475 latch)

ROTARY THUMBWHEEL SWITCH

Brand new digital switch available with output in straight decimal form, or specially coded BCD. Makes obsolete old style rotary switches.

☐ Thumbwheel switch, per section decimal (10 position) output $3.25
☐ Same BCD output $3.75
☐ End pieces, per pair $.50

☐ High voltage solid state supply provides +6,500 volts 1 Ma, 5000 volts 1 Ma. Excellent for CRT, photomultiplier, flash, smoke precipitation, bug zapping etc. About 2" x 4" x 10", close out $9.75

☐ Miniboxes 7 x 5 x 3, natural finish. Handy for all types of construction projects. $1.00 + 30¢ postage and handling.

☐ Teflon standoff terminals. Quick installation, just push in chassis. Regular price about 18¢ each, package of 50 brand new $1.00

☐ **80 PAGE CATALOG** – Free with any order or send $0.25

ALL ITEMS POSTAGE PAID IN THE U.S.A.
Charges Welcome. BankAmericard – Mastercharge – $10.00 min.

B. & F. ENTERPRISES
Phone (617) 532-2323
P.O. Box 44, Hathorne, Massachusetts 01937

CIRCLE NO. 143 ON READER SERVICE PAGE

MAGNETS

MAGNETS. All Types, Specials—20 disc magnets, or 2 stick magnets, or 10 small bar magnets, or 8 assorted magnets, $1.00. Maryland Magnet Company, Box 192-E, Randallstown, Maryland 21133.

EDUCATIONAL OPPORTUNITIES

LEARN WHILE ASLEEP. Hypnotize! Strange catalog free. Autosuggestion, Box 24-ZD, Olympia, Washington, 98501.

INVENTIONS WANTED

PATENT Searches including maximum speed, full airmail report and closest patent copies, $6.00. Quality searches expertly administered. Complete secrecy guaranteed. Free Invention Protection forms and "Patent Information." Write Dept. 23, Washington Patent Office Search Bureau, 711 14th Street, N.W., Washington, D.C. 20005.

MAGAZINES

OVER 2,000,000 Backdate magazines! Specify needs. Midtown, Box 917EW, Maywood, New Jersey 07607.

JAPAN PUBLICATIONS GUIDE business, pleasure, education. $8.00. INTERCONTINENTAL, CPO 1717, Tokyo 100-91.

STAMPS

FREE! 88 DIFFERENT COUNTRIES!! An Incredible Collection of genuine postage stamps . . . from Afghanistan to Zambia, all around the world! Stamps from the North and South Poles. British, French, Portuguese, Spanish Colonies. Ancient Stamps, New Issues, Airmails, Commemoratives, Moon and Outer Space Stamps—from 88 countries! Also, other exciting stamps for free examination. Buy any or none, return balance, cancel privilege any time. Plus Big Introductory Catalog. Send 10¢ for mailing. H.E. Harris, Dept. SS-12, Boston, Mass. 02117.

WAREHOUSE-REDUCING GIVE-AWAY PRICES:

LINE-VOLTAGE REGULATORS:
Sorensen & Superior Elect. Electronic Types, 0.1% Regulation, 3% Max. Harmonics:
500 VA 95-130 v in, 110-120 v out 35.00
1000 VA ditto fob Utica, N.Y. or Los Angeles 37.50
2000 VA ditto fob Los Angeles 67.50
2500 VA ditto fob Los Angeles 79.50
5000 VA ditto fob Los Angeles 149.50
ditto 190-250 v to 220-240 v, Los Angeles 149.50
Electromechanical, 1%, No Distortion:
15 KVA 1 Ph, 95-130 v to 110-120, Los Ang. .. 195.00
27½ KVA 1 Ph 205-250 v to 220-240, Los Ang 195.00

PULSE GENER. FROM AEROSPACE PLANTS:
H.P. #211A Sq Wv 1 to 1 million pps 137.50
H.P. #212AR .07-10 usec. 50-5000 pps 49.50
Empire Devices RF Pulser, #IG-102 ..... 37.50
Servo Corp. #2140A $2300.00 2-pulser 149.50
Servo Corp. #3450A Megacycle Pulser 99.50
Berkeley #903 double-pulse generator 79.50
Alfred #305 Sq Wv 850-1150 pps 0-60 v 17.50
Gen.Radio #869A 20-4000 pps, var. wd 27.50
Gen.Rad. #1217A with #1203 pwr sply 57.50
SKL #503 mechanical, fastest risetime 37.50
KayLab Radapulser Sr. RF or pulsed RF 69.50
E-H Research Labs #130 Double Pulser 475.00
E-H Research Labs #132A 5 Hz to 3½ MHz .. 375.00

BRAND NEW FREQ-SHIFT TTY MONITOR:
Navy OCT-3: FM Receiver type, freq. range 1 to 26 MHz in 4 bands, cont. tuning. Crystal calib. Reads up to 1500 Hz deviation on built-in VTVM. Cost $1100.00 each! In original box, with instruct. book & cord, fob Mariposa, Cal 49.50

MAKE YOUR OWN 115/230 V 60 HZ POWER!
10 KVA. Late-type, brushless, ball-bearing alternator, self-excited. Take the full 10 KVA from either 1 ph or 3 ph connections. Needs a 3600 RPM engine to drive it. Etched plate tells all possible connections. Tested and grtd, fob Mariposa, Cal. 295.00

MISCELLANEOUS BARGAINS:
L&N #1554-A2: $3200.00 Capacitance & Conductance Bridge Assembly; measures insulation, etc. ... 195.00
AN/ASM-3: Complete new Test Set for AN/ASQ-8 Magnetometer, with books, fob San Diego 295.00
TIC #431 Electronic Freq. Changer (or 1000 watt amplifier?) Input 230 v 1 ph 60 Hz. Output adjustable 105-130 v, 330 to 3900 Hz, 1 ph 195.00
CML #33828 3 ph Electronic Freq. Converter, 1500 VA. Input 220 v 3 ph 60 Hz, output 115 v 3 ph, 350 to 450 Hz; or use 500 VA any leg with no danger of unbalance; or 1000 VA any leg (3 KVA total) for any 10-second starting load 295.00

R. E. GOODHEART CO. INC.
Box 1220-A, Beverly Hills, Calif. 90213
Phone: Area 213 272-5707

CLASSIFIED ADVERTISING ORDER FORM

Please refer to heading on first page of this section for complete data concerning terms, frequency discounts, closing dates, etc.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

_____ Words {@ .65 Reader Rate / @ $1.00 Commercial Rate} = $_____

Insert _____ time(s) Total Enclosed $_____

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SIGNATURE _____

WORD COUNT: Include name and address. Name of city (Des Moines) or of state (New York) counts as one word each. Zip Code numbers not counted. (Publisher reserves right to omit Zip Code if space does not permit.) Count each abbreviation, initial, single figure or group of figures or letters as a word. Symbols such as 35mm. COD, PO, AC, etc., count as one word. Hyphenated words count as two words. EW-9-71

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) -- Expensive, regulated unit. Fine for college labs, research co's., service shops, etc. Pure DC over a wide range of voltages. DC output voltages 6, 12, 48, 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. (8½" x 12" x 10". 125 lbs.)

Cost Gov't Over $500.00 **$24.95** ONCE-IN-A-LIFETIME SPECIAL

BURGLAR-FIRE ALARM SYSTEM

$29.95

• (ITEM #1135-A) -- Dual alarm system gives warning of fire or break-in. Operates on 115-V AC. Control unit, 2-kable flash fire 2-mercury column, 2-foil window strip-tapes, alarm bell, 100 ft. wire, instructions. (8½" x 7½" x 3". 11 lbs.)

STANDARD DIAL TELEPHONE

• (ITEM #715) -- Standard, commercial telephone same as used throughout U.S.A. 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 **$7.49**

STEP-BY-STEP TELEPHONE SWITCH

• (ITEM #7-906) -- Amazing telephone selector 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. (3" x 6" x 5". 16 lbs.) Cost Over $90.00 **$6.29**

• Telephone dial for use with above switch. Order as (Item #700)..... **$1.97**

MAGNETIC DIGITAL COUNTER (12 to 18-VDC)

• (ITEM #21-959) -- 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. (4½" x 1⅝" x 1⅝". 1½ lbs.)

Orig. Cost Over $19.00 Each **$1.99** Three for **$4.99**

200 AMP., 50 VOLT, SILICON DIODE

• (ITEM #22-963) -- 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. 2½" x 1½" x 1⅛". ¼"—16 SAE mounting threads. (1 lb.)

List Over $15.00 **$4.99**

AC PROGRAM TIMING CLOCK

• (ITEM #158) -- Zenith 115-V AC unit. Use for periodic signaling, work breaks, classes, turn on radio, etc. Adj. clips permit ON-OFF switching any time in 24-hour period. Also has "skip-a-day" feature. Can be multiple programmed. 15 amp. contacts. (8½" x 6½" x 4". 8 lbs.)

Cost Gov't Over $30.00 **$15.75**

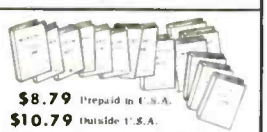
SNAP AROUND VOLT-OHM-AMMETER

• (ITEM #21-944) -- Measures AC current without opening the line. Simply press handle and snap the probe around the conductor. Reads currents from .25 to 125 amps. Reads voltages to 300, reads ohms up to 500. Test motors, appliances, etc. Three current ranges, two voltage ranges. With case, test leads. (3½" x 3" x 1¾". 2 lbs.)

$36.90 Reg. Price $59.95

SPECIAL SALE

Correspondence Course In ELECTRICAL ENGINEERING



$8.79 Prepaid in U.S.A.
$10.79 Outside U.S.A.

• (ITEM #A180) -- 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 12 lesson books, each with associated exams and standard answers. Book describing prize winning Home Experimental Laboratory Bench furnished at no extra cost.

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-cycles. Size 4½" x 3" x 2½". Shipping weight 2 lbs. **$4.39** Cost Over $29.00

COMPUTER TRANSISTORS ON HEAT SINKS

IBM Computer Quality Units

• (#22-928) -- Unit consists of one 150-watt power transistor on heavy, ribbed, aluminum heat sink. Many experimental uses. (1 lb.)

Cost Gov't Over $10.00 **$1.99**

• (#22-915) -- Unit consists of two 150-watt power transistors, 2 pots, several 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**

ALL ITEMS SHIPPED F.O.B. LINCOLN, NEBR. Order Direct From Ad. Money Back Guarantee.

SURPLUS CENTER

DEPT. EW-091 LINCOLN, NEBR. 68501

RUBBER STAMPS

RUBBER Address Stamps $2.00. Signature $3.50. Free Catalog. Jackson's, Box 443-G, Franklin Park, Ill. 60131.

MUSICAL INSTRUMENTS

30% DISCOUNT name brand musical instruments. Free catalog. Freeport Music, 127-L Sunrise Hway, Freeport, N.Y. 11520.

EMPLOYMENT INFORMATION

EXCITING Overseas Jobs. Directory $1.00. Research Associates, Box 942-E, Belmont, California 94002.

MISCELLANEOUS

WINEMAKERS: Free illustrated catalog of yeasts, equipment. Semplex, Box 122-76, Minneapolis, Minn. 55412.

WINE Recipes and Catalog, 25¢. Country Winemaker, Box 191E, RFD 1, Mattapoisett, Mass. 02739.

STOP BURGLARS THE EASY WAY! Affix authentic "Protected by Electronics Sentry Alarm" decals to auto windows, doors and windows of home, retail stores, vending machines, etc. Whether you have an alarm or not—thieves stay away! Only $1.00 for each set of two. J. Ross, 80-34 Kent St., Jamaica, N.Y. 11432, Dept. EW.

MAIL ORDER OPPORTUNITIES WAITING FOR YOU!

Classified Advertisers find more outlets for their product and service advertising in Ziff-Davis Electronics Publications than in any other media.

Monthly publications: POPULAR ELECTRONICS, ELECTRONICS WORLD, STEREO REVIEW are each acknowledged leaders in their respective special interest areas. They offer mail order businessmen the opportunity to reach additional markets with Classified Advertising that is responded to regularly by an affluent audience of active electronics enthusiasts.

Prove to yourself the effectiveness of Classified Advertising in Ziff-Davis Electronics Publications. Write today for information, assistance or sample copies to:

Hal Cymes, Classified Advertising Manager
Ziff-Davis Publishing Company
One Park Avenue, New York, N. Y. 10016

SURPLUS TTL IC's

ALL DUAL INLINE—NEW!—GUARANTEED!

Type	Function	Sale Price
7400	Quad 2 Input Nand Gate	.35
7401	Quad 2 Input Nand Gate—Open Coll.	.35
7402	Quad 2 Input Nor Gate	.35
7403	Quad 2 Input Nand Gate	.35
7404	Hex Inverter	.35
7410	Triple 3 Input Nand Gate	.35
7420	Dual 4 Input Nand Gate	.35
7430	8 Input Nand Gate	.35
7440	Dual 4 Input Nand Buffer	.35
7450	Expand. Dual and-or-Invert Gate	.35
7460	Dual 4 Input Expander	.35
7441	BCD to Decimal Decoder-Driver	1.75
7442	BCD to Decimal Decoder	1.50
7447	BCD to 7 Segment Decoder-Driver	2.50
7448	BCD to 7 Segment Decoder	2.00
7473	Dual J-K Master-Slave Flip-Flop	.75
7474	Dual D Flip Flop	.75
7475	Quad Bistable Latch	1.25
7476	Dual J-K Master-Slave Flip-Flop	.75
7490	Decade Counter	1.60
7493	4 Bit Binary Counter	1.60
74107	Dual J-K Master-Slave Flip-Flop	1.00
74192	Sync. Up-Down Decade Counter	2.00
74193	Sync. Up-Down 4 Bit Binary Counter	2.00

We Pay FIRST CLASS Postage. Californians—Add 5% S. Tax. Minimum C.O.D. Order—$10.00—25% with Order.

JTM ASSOCIATES P.O. BOX 25 FAIR OAKS, CALIF. 95628

FREE! CHOOSE ANY $1 ITEM

FREE WITH ANY $10 ORDER

WORLD'S MOST POPULAR **PARTS PAKS**

- ☐ 100 Plastic Transistors, TO-18 Pop, no test $1.98
- ☐ 25 Dual In Line 7400 Series "IC's", no test 1.98
- ☐ 10 709, 723, 741 "GOLD" TO-5 IC's, no test 1.00
- ☐ 100 GE 1-AMP Silicon rect. to 1000 volts.. 1.98
- ☐ 6 Dual In line 709, 741 w/sheet, no test .. 1.00
- ☐ 4 2N4269 Nixie tube driver transistors, .. 1.00
- ☐ 1 PHOTO Electric FET 2N3370, P-Channel 1.00
- ☐ 5 1-AMP SCR KIT, 15V, 30V, 60V, 100V, 150V, $1
- ☐ 5 — Varactor diodes, 10, 20, 30, 40, 50 pF 1.00
- ☐ 1 — "PUT" Programmable unijunction 1.00
- ☐ 8—1 AMP 1000 PIV sil. rectifiers 1.19
- ☐ 2 — 2N3370 FET, N channel TO-18, metal .. 1.00
- ☐ 2 — 2N2608 FET, P channel TO-18, metal .. 1.00
- ☐ 2 — 2N2646 Unijunction, plastic 1.00
- ☐ 2 — 2N3819 FET, N channel, plastic 1.00
- ☐ 5 — ER-900 Trigger diodes, scrs, triacs .. 1.00
- ☐ 2 — 2N3277 FET, P channel, metal TO-5 .. 1.00

GIANT SALE ON NEW TTL TEXAS & NATIONAL ICs

Guaranteed W/Spec Sheets Any 3 — 10% Discount!

Type	Description	Sale
☐ SN7400N	Quad NAND gate	$.45
☐ SN7401N	Open coll. out	.45
☐ SN7402N	Quad NOR gate	.45
☐ SN7410N	Triple 3 in. gate	.45
☐ SN7420N	Dual 4 in. gate	.45
☐ SN7430N	8 input gate	.45
☐ SN7440N	Dual 4 in. buffer	.45
☐ SN7441N	BCD-Nixie driver	1.95
☐ SN7473N	Dual J-K flip flop	.88
☐ SN7474N	Dual "D" flip flop	.88
☐ SN7475N	Quad latch	1.95
☐ SN7476N	Dual J-K flip flop	.88
☐ SN7490N	Decade counter	2.25
☐ WRITE for "IC" bargain catalog.		

EPOXY SILICON RECTIFIERS

PIV	1Amp*	2Amp	3Amp
50	$.05	$.05	$.08
100	.06	.06	.12
200	.07	.07	.15
400	.09	.09	.22
600	.12	.12	.28
800	.15	.16	.39
1000	.18	.22	.59

"FLAT PAK" EPOXY THYRISTORS (SCRS)

Similar to RCA 40504

PRV	5-Amp	PRV	5-Amp
50	$.49	400	$1.10
100	.69	500	1.25
200	.85	600	1.35
300	.95		

LIGHT EMITTING DIODES

- ☐ INFRARED "LED" $1.45
- ☐ INFRARED SENSOR * ..... .88
- ☐ VISIBLE "LED" 1.45
- ☐ VISIBLE SENSOR * ..... .88

Flame sensitive

G-E 3.5W AUDIO "IC DIP" AMP!

PA-263

Type PA-263, 3.5w cont. duty, 9-to-30v supply. For phono, tape, stereo **$3.95** 3 for $10

COUNTING SYSTEM

"DIP" COUNTING SYSTEM

Includes SN7490, SN7441, SN7475

- ☐ 3-pc. Kit .. **$4.95**
- ☐ 4-pc. Kit .. **$8.88** 4-pc. kit with Nixie tube

- ☐ NIXIE TUBE BURROUGHS **$4.50** 3 for $13. Type B-5441, with decimals 0-9 wide angle numerals, 16 pins.
- ☐ 723 VOLTAGE REGULATOR **$1.50** 3 for $3.75 Positive or negative, 0-to-40V, 1-watt, 150ma

709 OP-AMP **75¢** 3 for $2.00
- ☐ Dual In line
- ☐ TO-5 case
- ☐ Flat pak

741 OP-AMP* **$1.19** 3 for $3
- ☐ Dual In line
- ☐ TO-5 case

*709, freq. comp

6-AMP FULL WAVE RECTIFIERS

PRV	SALE	PRV	SALE
☐ 50	$.88	☐ 600	1.75
☐ 100	.99	☐ 800	1.95
☐ 200	1.25	☐ 1000	2.25
☐ 400	1.50		

DUAL OP-AMP
- ☐ Dual 709 $1.49
- ☐ Dual 741 1.98

☐ 15¢ CATALOG on Fiber Optics, 'ICs', Semi's, Parts

Terms: add postage. **Rated:** net 30, cod's 25%. **Phone Orders:** Wakefield, Mass. (617) 245-3829 **Retail:** 211 Albion St., Wakefield, Mass.

POLY PAKS P.O. BOX 942 W LYNNFIELD, MASS 01940

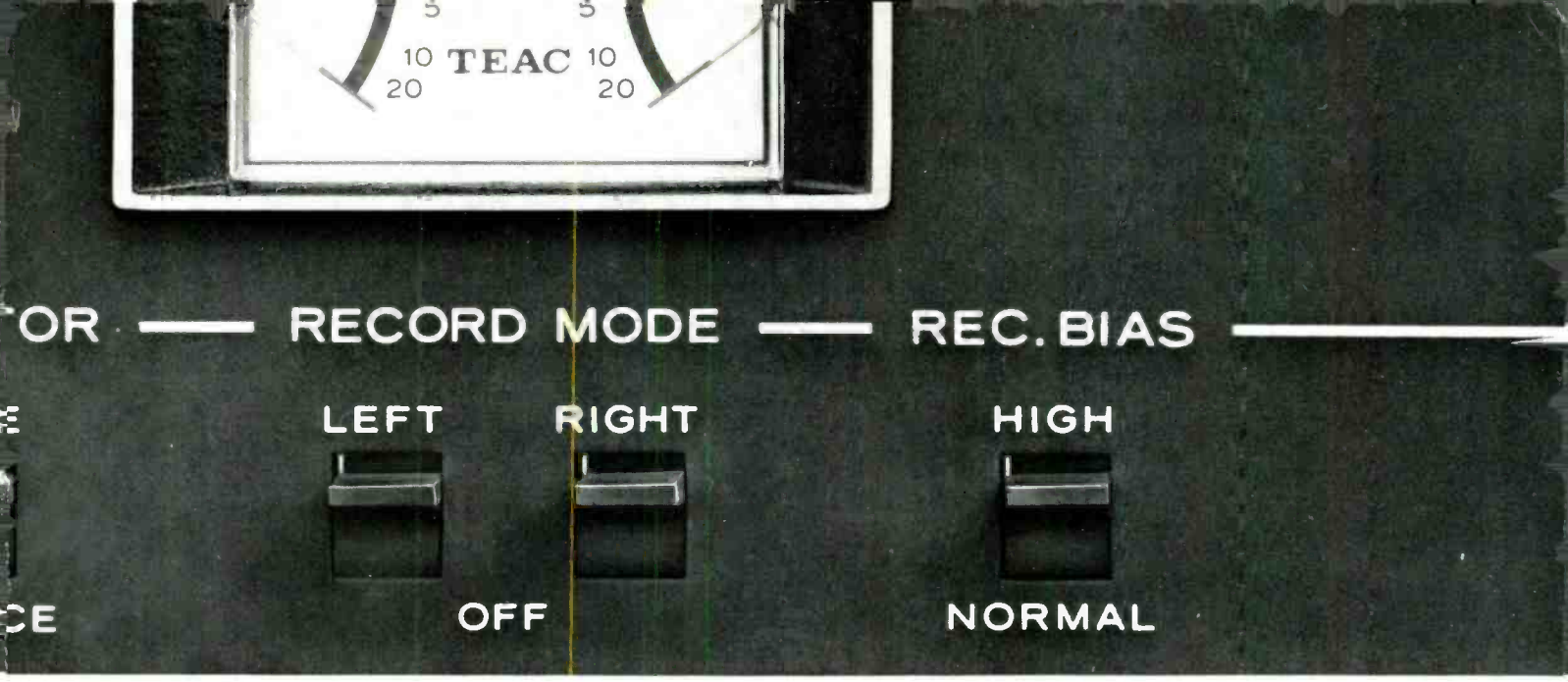
CIRCLE NO. 115 ON READER SERVICE PAGE

ELECTRONICS WORLD

September 1971

ADVERTISERS INDEX

Printed in U.S.A.



TEAC announces a current event: BiaTron.

It's the latest and greatest in dual capability: TEAC has incorporated a bias-current switch in the superlative A-1230 stereo deck. We call this feature BiaTron because it lets you choose the right bias for both standard and low-noise, high-output tapes.

The A-1230 has lots of other good news going for it, too. Like the remarkable Edi-Q Pause Control that lets you edit and cue the cleanest, click-free, pro-quality tapes while recording. And three precision motors: hysteresis-synchronous for capstan drive, eddy current types for turntable drive. TEAC constant-contact hyperbolic heads. And hair-trigger solenoid controls that make this one of the most humanly engineered decks to be found anywhere. No wonder it delivers this kind of high-performance characteristics: 30 to 22,000 Hz frequency response, 55 dB or better signal-to-noise ratio, 0.08% or less wow and flutter at 7½ ips.

Add to that such TEAC exclusives in a deck of this class as MIC and LINE mixing, TAPE and SOURCE monitoring, turntable height adjustment, independent headphone monitoring with built-in volume control. And the price is a surprisingly low $349.50.

Then to double your enjoyment, we added an auto-reverse mechanism to the A-1230, and called it the A-1250. This one is still a buy at $449.50.

Whatever your choice, you can't help keeping current when you stay tuned to TEAC.

A-1250 AUTO-REVERSE STEREO TAPE DECK

A-1230 STEREO TAPE DECK

CIRCLE NO. 149 ON READER SERVICE PAGE

TEAC

TEAC Corporation of America, 7733 Telegraph Road, Montebello, California 90640
TEAC Corporation, 1-8-1 Nishi-shinjuku, Shinjuku-ku, Tokyo, Japan • TEAC EUROPE N.V., Kabelweg 45-47, Amsterdam—W.2, Holland
In Canada: White Electronic Development Corp., Ltd., Toronto

LOUD MOUTH!

The new E-V Eliminator.

The first Eliminator was built to prove a point. Because young musicians, in a search for more volume, were literally driving the guts out of some very good speakers mounted in some very poor enclosures.

It started an intensive investigation into the failure of speakers (ours and the competition) used by guitars and organs. The testing was very rugged. For instance, we took miles of high-speed motion pictures while test speakers destroyed themselves with sound.

We found out a lot about how to improve our speakers. But we also learned that by simply putting our SRO/15 speaker in a folded horn enclosure we created a combination that was unbeatable for efficiency, high power handling capacity, low distortion, and extended bass. It was an important first step.

Of course, this now meant we needed a solid high end. So we added the time-tested 1829 treble driver and 8HD horn, or (optionally) a T25A treble driver plus a pair of T35 super tweeters. These combinations were a revelation to musicians. They got more sound power per watt than they thought possible. And they could use the Eliminator for both vocals or instruments.

But we weren't quite satisfied. If the Eliminator was good for popular music, what would it do with other kinds of program material? So we tested it in good rooms and bad rooms. With test instruments and with live audiences. And we decided that the Eliminator was too good to sell only to the young.

For example, in one test installation in a difficult domed building, four E-V Eliminator I speakers far out performed an elaborate multicell installation in naturalness of sound for voice and music, in uniform sound pressure level throughout the listening area, and in the ability to reproduce the extremes of loudness of a big, driving jazz band with ease.

Granted, the E-V Eliminators have a flash of chrome. But don't be misled. They perform to beat the band. And they solve problems. Get turned on to the great sound of the E-V Eliminators today. It can open up an important new market...and shock your old ones!

ELIMINATOR I 3-way system: Response 55-15,000 Hz; Power Handling Capacity 100 watts RMS (white noise shaped to stringent lead guitar frequency spectrum); Dispersion 100°; Sound Pressure Level 122 db at 4' with full power input; Suggested Resale $490.00.

ELIMINATOR II 2-way system: Response 55 to 10,000 Hz; Power Handling Capacity 100 watts RMS (shaped to stringent lead guitar frequency spectrum); Dispersion 100°; Sound Pressure Level 121 db at 4' with full power input; Suggested Resale $385.00.

ELECTRO-VOICE, INC., Dept. 916N
629 Cecil Street, Buchanan, Michigan 49107

Electro-Voice®
a GULTON subsidiary

FOR INFORMATION ON E-V PRODUCTS:

Microphones
CIRCLE NO. 111 ON READER SERVICE CARD

Musician's speakers/microphones
CIRCLE NO. 113 ON READER SERVICE CARD

PA Speakers/Accessories
CIRCLE NO. 112 ON READER SERVICE CARD

High Fidelity speakers/electronics
CIRCLE NO. 114 ON READER SERVICE CARD