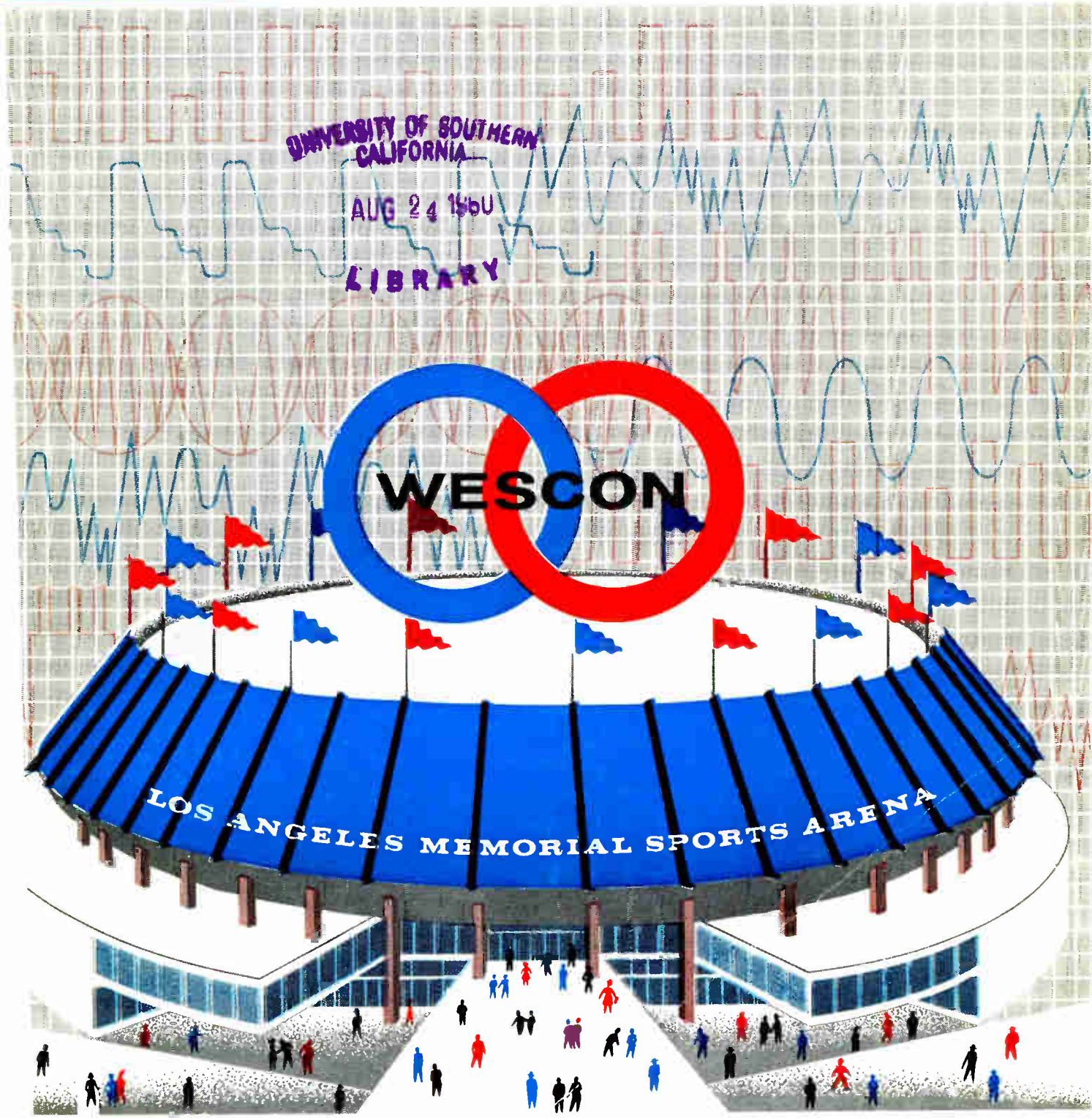
ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION



Issue:

ELECTRONICS IN AGRICULTURE!

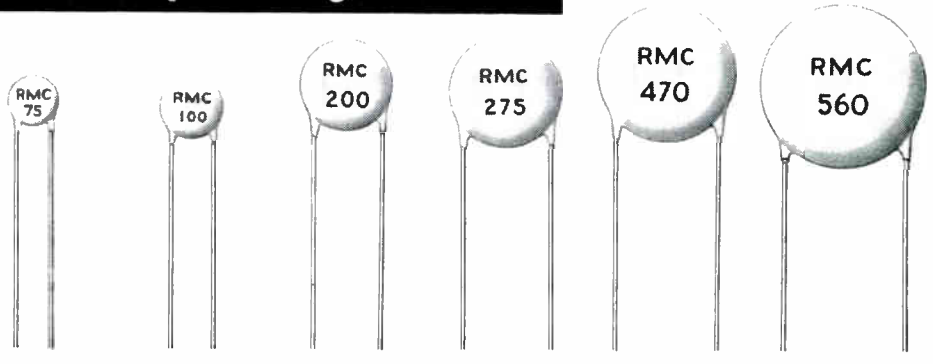
New Semiconductor — The Binistor • 1960 Directory of Western Electronic Mfrs.

August
1960

Trouble-free Performance

RMC DISCAPS

Temperature Compensating TYPE C



TC	.290	.400	.570	.660	.790	.890
P-100	1- 5 MMF	6- 10 MMF	11- 20 MMF	—	—	—
NPO	1-15	16- 33	34- 69	70- 85 MMF	86-115 MMF	116-175 MMF
N- 33	1-15	16- 33	34- 69	70- 85	86-115	116-175
N- 75	2-15	16- 33	34- 69	70- 95	96-130	131-190
N- 150	2-15	16- 36	37- 67	68- 95	96-130	131-230
N- 220	3-15	16- 36	37- 75	76-100	101-160	161-230
N- 330	3-15	16- 47	48- 75	76-115	116-190	191-270
N- 470	3-20	21- 51	52- 80	81-120	121-208	201-275
N- 750	3-32	33- 75	76-155	156-220	221-300	301-470
N-1500	10-74	75-140	141-220	221-399	400-550	551-800
N-2200	20-75	76-150	151-299	300-450	451-680	681-900

Temperature Coefficients up to N5200 Available on Special Order

SPECIFICATIONS

POWER FACTOR: Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle.
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
CODING: Capacity, tolerance and TC stamped on disc
INSULATION: Durez phenolic-vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
LEADS: No. 22 tinned copper (.026 dia.)
TOLERANCES: ±5% ±10% ±20%
These capacitors conform to the E.I.A. specification for Class 1 ceramic capacitors.
The capacity of these capacitors will not change under voltage.

RMC Type C DISCAPS meet or exceed all specifications of the EIA standard RS-198. Rated at 1000 working volts, Type C DISCAPS provide a higher safety factor than other paper or mica capacitors.

Constant production checks assure that all specifications and temperature characteristics are met. Another phase of complete quality control consists of 100% testing of capacities.

Throughout the years leading manufacturers have relied on RMC for quality of product and maintenance of delivery schedules. Write on your company letterhead for additional information on DISCAPS.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS COMPANY
A DIVISION OF P. R. MALLORY & CO., INC.
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Circle 1 on Inquiry Card

ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

1960—WESCON and Western Horizons

IT'S WESCON time again and so again welcome to our *ninth consecutive* annual West Coast issue!

Over the past decade WESCON has grown steadily in stature. Today it is recognized as one of industry's principal annual events. This year, for the first time, the show and convention moves into the new Los Angeles Memorial Sports Arena which only recently housed the 1960 Democratic National Convention. There will be more than 900 exhibits on display and the attendance is expected to exceed 34,000. (Detailed show information begins on page 78.)

During the past ten years we have seen the number of electronic manufacturers in the eleven western states grow from about 400 to well over 1800 today. (Western Electronic Manufacturers Directory starts on page 161.) Originally these companies produced proprietary electronic items primarily. Later their location and engineering talents favored the development and manufacture of military electronic equipment. This in turn spread to equipment for manned aircraft and more recently to guided missile electronic systems. Now, however, with the latter becoming more and more standardized and sophisticated, western producers are eyeing electronic horizons for new achievement goals and for new electronic markets. What will these be?

Because of present space and military requirements there will be a continued effort to miniaturize and microminiaturize components and equipment. With practical molecular electronic circuits still far in the R & D future, we can expect a much greater emphasis to improve the reliability of present day components and equipment. Ways and means will be generated to take advantage of the tremendous know-how that has been developed in the electronic industries over the last ten years so that it can be applied in other industries. To develop these new electronic markets considerable applied research and development will be needed. (See Electronics in Agriculture—2nd in the series of New Electronic Markets—starting on page 91.) Finally, there will have to be new and greater efforts in the areas of basic research in order to develop the new materials, concepts, methods and techniques to assure a virile and lasting industry.

Along these lines, and in keeping with our past practice, we have included two guest editorials from leading western electronic personalities that we believe will have considerable reader interest. The first, by Dr. Harper Q. North, President Pacific Semiconductors Inc., discusses where we are going with semiconductors and molecular electronics (page 76). The second is by Mr. Rollin M. Russell, Executive Vice President of the Electronic Specialty Co., and reviews the search for new electronic markets by the electronic producers (page 77).

In the last year Hawaii became our 50th state. Its location, of course, links it most closely with the eleven western state group. While it does not possess extensive electronic activity at present there is considerable interest for future expansion here. "The 50th State—Its Electronic Future" should be of interest to many (page 232).

Again this year the members of Electronic Industries' editorial, research and sales staff will be on hand to greet you at WESCON-1960. We will all be at booth 2716 and we shall be delighted to render any service we can. Until August 23 then—Aloha.

* * *

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ELECTRONIC INDUSTRIES

Vol. 19, No. 8 August, 1960

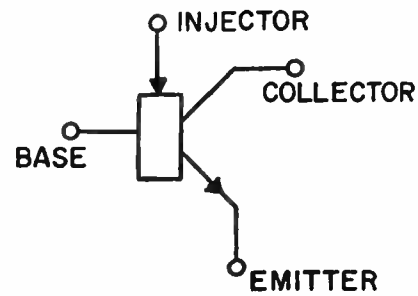
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

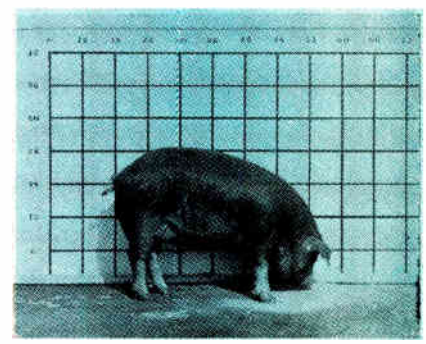
DEPARTMENTS

Highlights of this issue

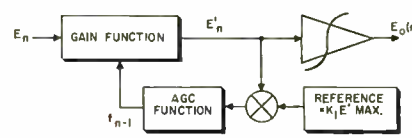
Fluxgate Principle



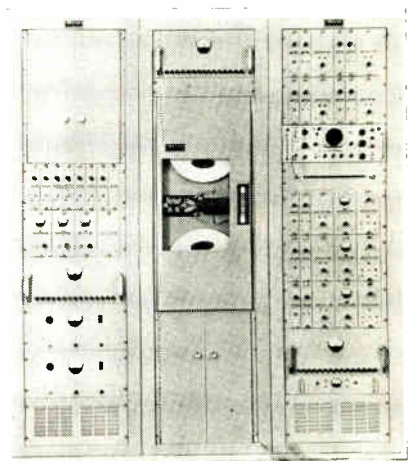
The Binistor



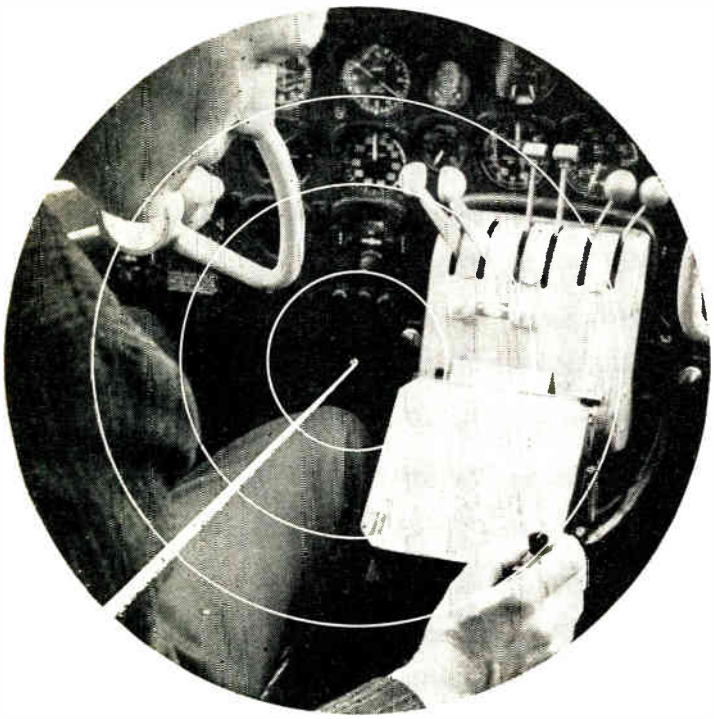
Electronics in Agriculture



System Analysis
Recording to 1MC



RADARSCOPE



AIR NAVIGATION

Pictorial navigation display unit for aircraft developed by ACF Electronics Div., ACF Industries uses transparent slide maps and a luminescent "bug" (in upper right quadrant) that tells the pilot of the aircraft where his ship is at all times.

WHERE STEREO has dominated interest at Hi-Fi shows during the past three years "reverberation effect" are being touted to provide the excitement this Fall. Every major audio equipment manufacturer is expected to have reverberation units available by the end of the year, though there is still much discussion as to whether the reverberation effects really enhance the listening on all records.

HEAT-TO-ELECTRICITY CONVERTER which provides practical amounts of power from the heat of ordinary fuels has been developed by RCA Labs. The thermionic converter tube, developed under an Air Force Research contract, operates with 14% of efficiency from heat sources of 1100°C, equivalent to the heat produced by burning gasoline. The device was developed primarily for the conversion of solar heat to energy in space, and contains no moving parts.

JAPANESE EXPORTS of transistor radios (3 or more transistors) to the U. S. in 1960 are expected to be approximately 4 million units—about the same as last year. The figures are estimated by the Electronics Div., Business and Defense Service Administration of the Dept. of Commerce, on the basis of trade reports from Japan.

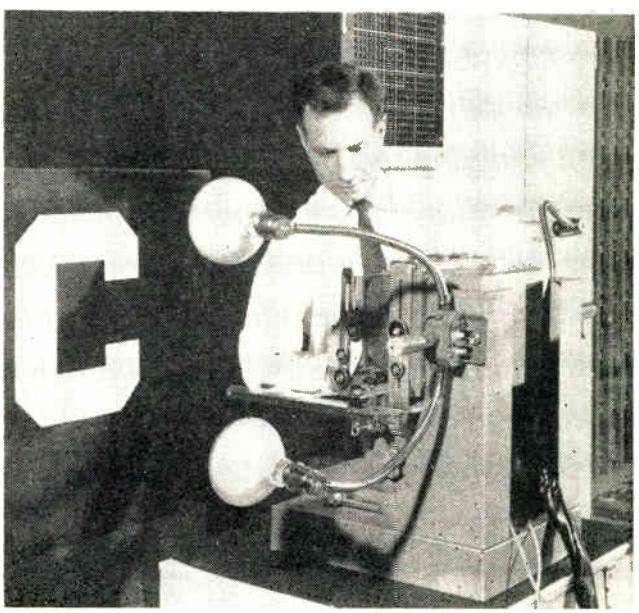
FEDERAL TRADE COMMISSION has a raft of proceedings against cathode-ray tube rebuilders, charging that firms are failing to disclose that the TV tubes they "manufacture" are rebuilt and contain used parts. Many of the firms are going to considerable lengths to identify themselves as manufacturers of "new" tubes.

TO INSURE MORE BIDDERS for its 160 million dollar research and development business, the U. S. Army Signal Supply Agency is installing an electronic Addressograph Bidders Source List at the Ft. Monmouth Procurement Office. The Signal Corps wants to catalog the research and development abilities of all firms, large and small, in the country, for use in future contract bidding.

UHF-TV STUDY will be made by the FCC during fiscal years 1961 and 1962 to determine the feasibility of using these channels for satisfactory TV coverage of the New York City market area. The FCC is looking for interested people from all sections of the industry to serve on an advisory committee. Representatives from the NAB, the EIA, the Assoc. of Maximum Service Telecasters, The IRE, the Joint Technical Advisory Committee, the Joint Council on Educational Television, the Television Allocations Study Organization, the Association of Federal Communications Consulting Engineers, and others have been invited to serve on the committee.

MACHINE THAT "LEARNS"

Cornell Aeronautical Lab's Mark I Perceptron is an experimental machine that can be trained to automatically identify objects such as letters of the alphabet. Here a CAL engineer adjusts the machine's photo "eye" during training sequence.



ELECTRONIC MEASUREMENT STANDARDS for the new higher frequencies are so lacking that both industry and the National Defense Program are being hampered. A series of measurement research conferences between the National Bureau of Standards and Industry representatives will look at each field to determine which needs are most urgent and how they can best be met. The Aerospace Industries Association initiated the series.

AIR FORCE RADARS are from time to time being turned to use as weather predicting tools in the hands of specially trained weather bureau meteorologists. The big radars, used by ADC for warning of unidentified aircraft, cover most of the U. S. coast line subject to hurricanes and most of "tornado alley."

RADIATION EFFECTS on components and military equipment will be studied using a new nuclear research reactor designed by General Dynamics Corp. for the Army's Diamond Ordnance Fuse Lab. The reactor will be specifically designed to minimize the possibility of radiological hazard in operation and will be installed next year at Walter Reed Army Medical Center, with the total facility to be known as Diamond Ordnance Radiation Facility.

EUROPEAN INSTRUMENTATION techniques are slowly approaching the U. S., principally in industrial controls, says Herman Schaevitz, president of Schaevitz Engineering, just returned from an extended European tour. Schaevitz estimated the gap could be closed in 5 years. Then, he said, "The European industry will be capable of pulling even with the U. S. only from the standpoint of engineering methods, their principles and applications." European industry in general is hamstrung because their economy is not yet capable of assimilating mass production.

RUSSIA'S ABILITY in certain areas of electronics are fairly well recognized, but there is some question whether they approach the U. S. in the application of automatic control techniques. Engineer Rufus Oldenburger, Purdue University, after a tour of Russian plants voiced his opinion that while some of the theoretical work being done by Russian mathematicians is quite advanced, there is a considerable lag in actually applying the techniques to industry.

FCC is taking an increasingly tough line under the leadership of the new chairman. Last month the commission took Miami's controversial Channel 10 from National Airline's Public Service TV, Inc., and gave it to L. B. Wilson, Inc. The first signs of a "get tough" policy are welcomed by many industry officials who hope for settlement of a number of long standing industry problems.

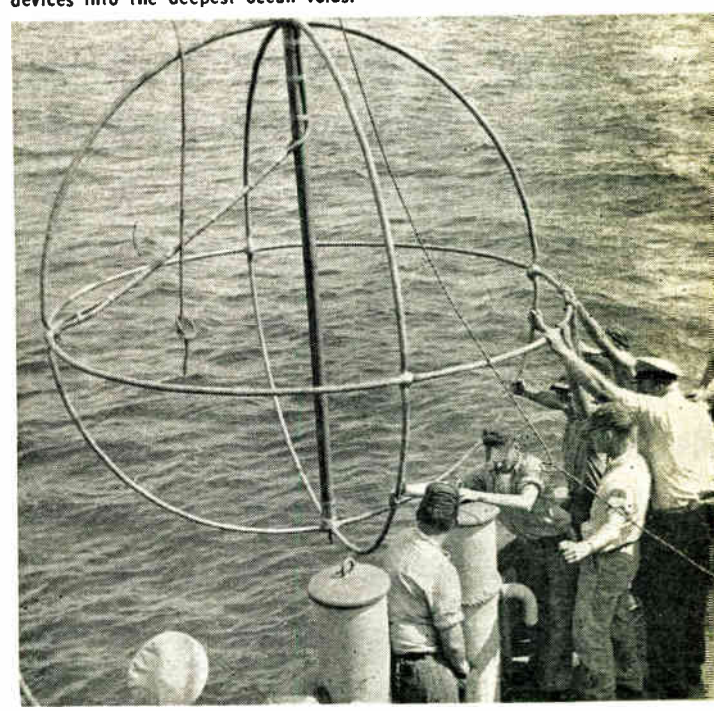
JAPANESE EXPORTS to the U. S. during the first 3 months of 1960 declined seasonally to approximately $16 million from the volume reached in the last quarter of 1959. This figure, however, is still double the level of the first quarter of last year, according to Electronics Div. of Business & Defense Service Administration, U. S. Dept. of Commerce.

THE NATIONAL ASSOCIATION OF BROADCASTERS is opposing a move to expand the activities of non-commercial, educational FM stations into commercial subsidiary broadcasting areas through the use of multiplexing. NAB's stand, in opposition to a petition filed by the National Association of Educational Broadcasters says, "the establishment of a genuinely educational type of service would not be furthered by permitting educational institutions to operate in substantially the same manner as commercial applicants though they may choose to call it limited commercial non-profit operation."

FM RADIO SALES, so long a subject of optimistic sales projections, finally are being realized. Trade newsletter "Television Digest" estimates 1960 sales of FM radios, phonos with FM, FM tuners and imports, somewhere in the neighborhood of 2,000,000 units, up more than 30% over 1959. The number of FM stations is increasing rapidly also. The total now is 741 on the air, 64 of them new stations started during the first half of 1960.

FOR OCEANIC RESEARCH

Large electro-magnetic antenna for Operation Deep Dip is lowered over the side of the U.S.S. Stallion for calibration prior to tests of the complete Deep Dip unit in the Tongue of the Ocean off Nassau. Deep Dip was developed by Naval Ordnance Lab to carry research devices into the deepest ocean voids.



MADT® transistors from Sprague*

- for the highest r-f operating frequency of all mass-produced transistors
- for the fastest switching time of all mass-produced transistors
- for storage temperatures up to 100°C

DESIGN AROUND SPRAGUE

MICRO-ALLOY DIFFUSED-BASE TRANSISTORS

available now at sensible prices you can afford!

Sprague Germanium Micro-Alloy Diffused-Base Transistors, well-known for their rugged vhf performance, are now *priced below other transistors* with comparable electrical characteristics. In many areas, this permits designers to improve circuit techniques without necessarily increasing costs. Expanded production facilities enable us to *ship quantity orders on short notice.* Add to this their *ultra-fast switching time,* and you have three good reasons why Sprague MADT® Transistors have achieved their high level of acceptance.

With Sprague Transistors, circuits in vhf amplifiers and oscillators can now operate with collector currents as high as 50 ma . . . with power dissipation up to 50 mw . . . with collector to base voltages to 15 v. They have been application tested through the entire military electronics vhf spectrum.

The application table may well suggest the use of one or more Micro-Alloy Diffused-Base Transistor types in your latest circuit designs.

● ● ●

MICRO-ALLOY DIFFUSED-BASE TRANSISTOR APPLICATIONS	
Type	**Application**
2N499	Amplifier, to 100 mcs
2N501	Ultra High Speed Switch (Storage Temperature, 85 C)
2N501A	Ultra High Speed Switch (Storage Temperature, 100 C)
2N504	High Gain IF Amplifier
2N588	Oscillator, Amplifier, to 50 mcs

For complete engineering data on the types in which you are interested, write Technical Literature Section, Sprague Electric Co., 233 Marshall St., North Adams, Massachusetts.

You can get off-the-shelf delivery at factory prices on pilot quantities up to 999 pieces from your local Sprague Industrial Distributor.

* *Sprague micro-alloy, micro-alloy diffused-base, and surface barrier transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type numbers are manufactured to the same specifications and are fully interchangeable.*

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THE MARK OF RELIABILITY

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
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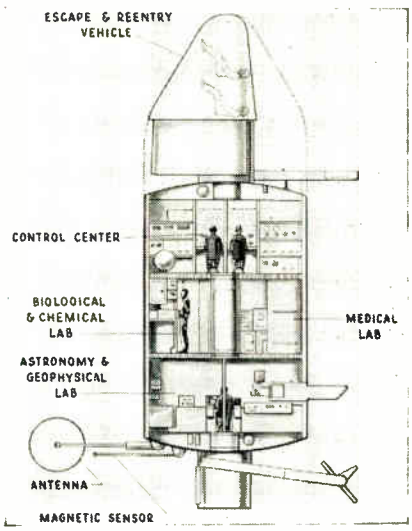
As We Go To Press...

PROPOSED SPACE LAB



No space suits or provisions for artificial gravity are needed in this 16-ton space lab proposed by engineers at the Martin Co.'s Baltimore Div. Carrying 4 to 6 men, it would stay in a 400 mile orbital altitude a year.

U.S. Top Latin America Electronics Supplier

The U. S. continues to be the principal supplier of electron tubes and semiconductors in nine Latin American countries, namely, Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Peru, Uruguay and Venezuela, according to BDSA's Electronic Div. survey of those countries.

Despite increasing competition from Western Europe and Japan, a strengthening market for U. S. manufactured electron tubes and components exists, pointing to a continuing demand.

ASR Radars Ordered

Texas Instruments Incorporated, Dallas, Tex., is supplying new ASR's (Airport Surveillance Radar) for the Federal Aviation Agency. A total of 34 airports will get the Radars during the next year and a half.

The radars have a range of 60 miles and reach an altitude of 25,000 feet. They will increase FAA capability in handling air traffic—particularly high speed jets. They can be set to present moving objects only and are supplied with an electronic map which shows navigation aids and ground installations.

Subscription TV Application Filed

The Hartford Phonevision Co., a subsidiary of RKO General, Inc., has filed a formal application with the Federal Communications Commission to conduct a three-year test by broadcasting from station WHCT, Channel 18, Hartford, Conn., without use of telephone wires or cable.

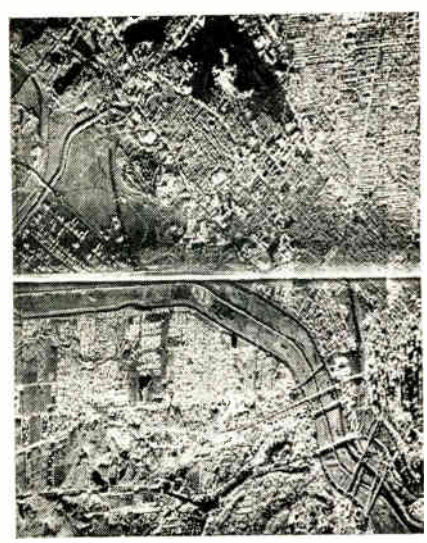
RKO General, TECO, Inc. and Zenith Radio Corp. of Chicago have also joined in filing the application, the former having developed the Phonevision system and the latter to manufacture the equipment and provide technical and other assistance.

It is proposed that WHCT operate as a conventional commercial station through most of its broadcast day, with one or two premium subscription programs aired each day in popular viewing hours without commercials for subscribers use only.

When 2,000 decoders have been installed, Hartford Phonevision proposes to commence operations —possibly within six months after FCC approval.

A preliminary estimate contemplates 10,000 families enjoying subscription within one year. There are 300,000 homes within range of WHCT.

RADAR MAPPING SYSTEMS



Radar map of Dallas, Tex., was made by the AN/APQ-55 surveillance radar developed by Texas Instruments Incorporated, Dallas, Tex., for the U. S. Air Force. Shadows help determine height of objects. Side-looking radar can pin point targets scattered over wide areas.

FOR PROJECT MERCURY

Astronaut M. Scott Carpenter (left) tests communication controls for Project Mercury. Controls, supplied by Collins Radio Co., Dallas, Tex., are in a pressure suit simulator (arm and glove section only).

Largest Radio 'Scope Operational in Fall

A radio telescope, 600 ft. long, 400 ft wide, and 62½ ft deep (its 160,000 ft² of receiving area is more than twice that of the Jodrell Bank Radio Telescope in Manchester, Eng.), will go on the air early this fall near Danville, Ill. Primary mission of the telescope, designed to pick up faint sources outside our own Milky Way galaxy, will be to make detailed maps of the universe. Celestial objects previously undetected and far beyond the range of present optical telescopes, will be charted. The Univ. of Illinois is responsible for construction and will operate it under sponsorship of the ONR.

Since the scope is not steerable, observers will take advantage of the earth's rotation to bring objects over the telescope. The first project will be a detailed map of the sky at 611 MC. The Navy is building a 600-foot steerable dish at Sugar Grove, W. Va.

RCA Price-Cuts Mesa

RCA announced a 36% cut in the price of its 2N1300 Mesa computer transistor last month.

More News on Page 8

Electronic SHORTS

▸ Numerical control system employing all-static, transistorized circuitry for automatic machine tool control is available from Westinghouse. The PRODAC (programmed digital automatic control) system controls 1 to 5 machine tool motions over a 999.999-in. span. Control is on a point-to-point positioning basis—with an accuracy of ±0.005 inch.

▸ Self-reproducing machine which can improve succeeding models of itself is theoretically possible, says Prof. John Myhill of Stanford Univ. The self-improving series of machines would each be built of 3 parts—a builder, an instructor and a computer. By telling the original machine, built by man, to reproduce itself and improve its "offspring," the machine would produce a better version of itself.

▸ Ballistic Missile Radiation Analysis Center at the Univ. of Michigan's Willow Run Labs is collecting data on radiation emitted by ICBM's and IRBM's as they leave and re-enter the atmosphere. Aim is to develop mathematical models of missile behavior which will permit identifying unknown missiles.

▸ Aerojet-General is exploring "hybrid" rocket power plants—combining the best features of liquid and solid-propellant rockets. The hybrid rocket would employ a liquid oxidizer which would be sprayed into a core of solid fuel.

▸ Bell Labs has reduced switching times and collector resistances of diffused base transistors by combining diffused base technology with the epitaxial film technique. Switching time of silicon devices is reduced by a factor of more than 10, and there is a comparable reduction in the collector resistance.

▸ A development of IBM Advanced Systems Development Div. Lab., San Jose, Calif., detects and corrects errors, or bursts of errors, that occur during transmission of computer information over communication links. Transmission errors are caused mainly by static and short interruptions.

▸ "Universal" circuit card which can be prefabricated and adapted to different circuit requirements has been developed by Librascope, Inc., Glendale, Calif. The card contains a universal etched pattern which can be modified by interconnections to form any desired circuit function.

▸ First airborne telemetering gear for the new military band (2150 to 2350 MC), a radio transmitter designated AN/AKA-1, will be developed by General Instrument Corp.'s Advanced Development Lab, Westbury, N. Y. The unit will transmit more than 18 channels of information simultaneously.

▸ Supermendur, an alloy discovered 50 years ago, may reduce significantly the weight and size of transformers, magnetic modulators, filter chokes and other inductive components, according to M. Lauriente and R. E. Lee of Westinghouse.

▸ Non-profit organization, Aerospace Corp., formed by the Air Force to manage over-all research and development of missile and space programs will begin operations by assuming some work responsibility of Thompson Ramo Wooldridge.

▸ House Space Committee is urging NASA to adopt a top-priority program to "place a manned expedition on the moon before 1970." Development of a nuclear rocket and 1,500,000 pound-thrust single-chamber F1 space engine are regarded as vital space research projects, necessary elements to continued U. S. leadership.

▸ Pentagon officials say that Atlas Intercontinental Missile Installation is months behind schedule in key combat sites. However, despite delays, the Air Force's Ballistic Missile Division, which oversees the contractor's work, must achieve the Pentagon's aim of 129 Atlas Missiles deployed and ready for combat by the end of Calendar 1962.

Build New Electronics Center on West Coast

The Radio Corporation of America has opened a new West Coast Electronics Center on a 50-acre site adjoining the Van Nuys Airport in West Van Nuys, Calif. The facility will be used for the engineering and production of missile checkout, guidance, control, and data processing and display systems.

Over 400 space electronics engineers assemble outside RCA's new West Coast Electronics Center at Van Nuys, Calif. Their combined professional experience exceeds 4,000 man-years.

Two of the major systems now being produced at Van Nuys for ground support of missiles are the Atlas ICBM checkout system, and the Thor IRBM autopilot. Other RCA electronic systems produced there are long-range radar navigation instruments, weather radar for the Air Force and Navy; electronic countermeasures equipment, and elements of the Ballistic Missile Early Warning System (BMEWS).

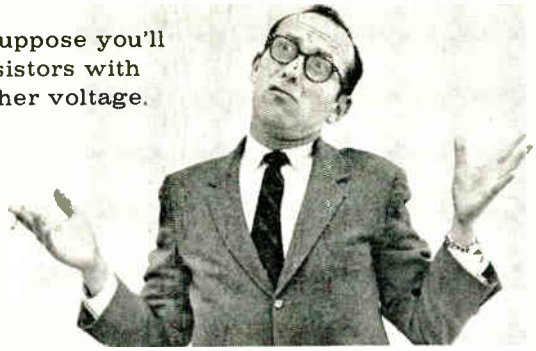
Mobile Long-Range Radar

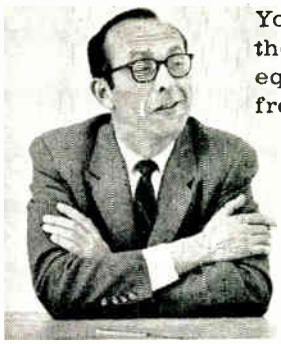
Long-range detection capabilities with full maneuverability and mechanical ease of operation are incorporated in a mobile high-power radar developed by GE's Heavy Military Electronics Dept., Court St., Syracuse, N. Y.

The system, "Project Butterfly," uses a retractable folding antenna structure. Transmitting and receiving portions of the system are housed in a wheel-mounted antenna assembly.

More News on Page 14

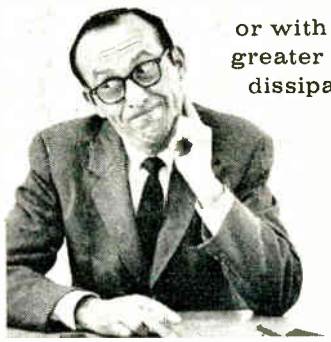
Yes, I suppose you'll find transistors with higher voltage.





You'll find them with equal or higher frequency...

or with higher gain...

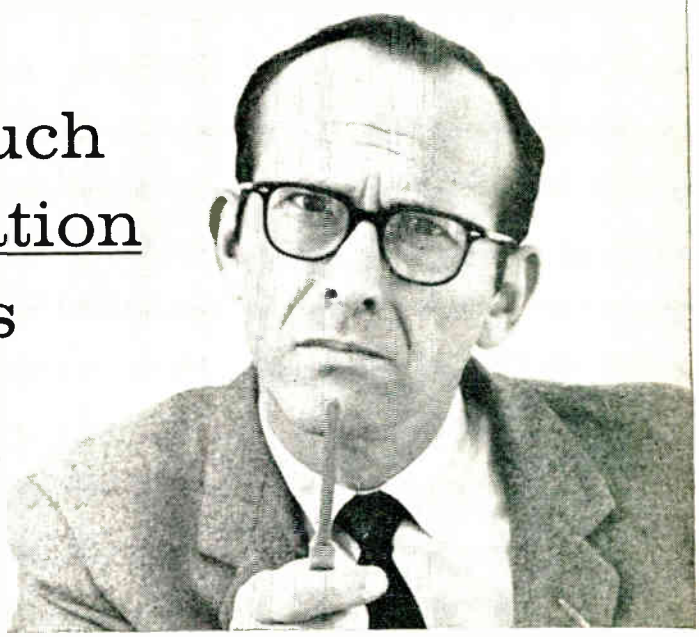


or with greater power dissipation

One or two others even approach the temperature range. BUT..

no other transistor has such an ideal combination of parameters

as the Hughes 2N1196 or 2N1197 double-diffused mesa silicon transistor amplifier.



No other transistor gives you such ideal parameters; no other gives you such reliability. These Hughes high-frequency devices meet or exceed every possible amplifying requirement of a PNP silicon transistor. They have high operating voltage, high temperature rating, high alpha cutoff frequency, high gain at high frequencies, low collector shunt capacitance, good power dissipation, and low signal distortion. In a 5000-hour storage-life test at 200°C, the units re-proved their ruggedness and reliability by showing no significant changes in the beta or leakage current.

The Hughes 2N1196 & 2N1197 transistors were originally developed in conjunction with the U.S. Army Signal Corps on an IPS contract for military devices, and meet the exacting requirements of MIL-T-19500A.

Now they're available for you. If you need high-frequency, double-diffused, mesa transistors for i.f. amplifiers, h.f. amplifiers, oscillators, for communication telemetering, or similar electronic equipment, order from Hughes today. Just call or write your nearest Hughes Semiconductor sales office or authorized distributor—or write Hughes Semiconductor Division, Marketing Department, 500 Superior Avenue, Newport Beach, California.

SPECIFICATIONS @ 25°C			
ABSOLUTE MAXIMUM RATING	2N1196	2N1197	Units
V_{CEO} @ I_{CEO} = −100 μA	−70	−70	volts max
V_{CBO} @ I_{CBO} = −100 μA	−70	−70	volts max
V_{EBO} @ I_{EBO} = −100 μA	− 4	− 4	volts max
ELECTRICAL CHARACTERISTICS			
P.G. @ V_{CE} −10v, I_E = 2mA	28 @ 4.3MC	22 @ 12.5MC	db typ
F_{eb} @ V_{CB} = −10v, I_E = 2mA	45	55	MC typ
C_{ob} @ V_{CB} = −10v, I_E = 0, f = 140KC	3	3	μμ fd typ
h_{fb} @ V_{CB} = −10v, I_E = 2mA, f = 1KC	.9	.94	typ

350 mW dissipation in Free Air
Operating temperature range −65°C to +200°C

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HUGHES

SEMICONDUCTOR DIVISION
HUGHES AIRCRAFT COMPANY

Circle 3 on Inquiry Card

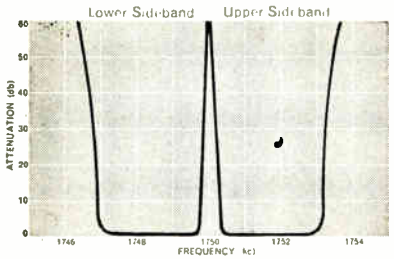
TIGHTEN YOUR "SPECS" WITH HUGHES CRYSTAL FILTERS

HUGHES has the highly skilled personnel, the "know-how" and the production facilities to fill your every crystal filter need—in any quantity —and with guaranteed on-time delivery.

Experienced Hughes Applications Engineers are available now to work with you on your filtering problems. For additional information, call your nearest Hughes Semiconductor Sales Office or Representative listed below. Or write:

Hughes Industrial Systems Division, International Airport Station, Los Angeles 45, Calif.

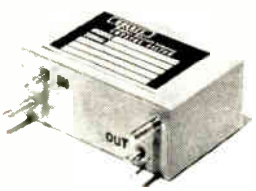
For export information, write Hughes International, Culver City, California.



LOWER SINGLE SIDEBAND 1.75 Mc.

Specifications:

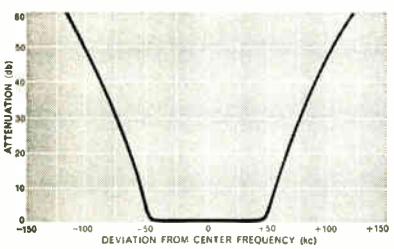
Passband width	2.7 Kc
Carrier rejection	50 db
Maximum ripple	±0.75 db
Impedance (in/out)	50/50 ohms
Maximum insertion loss	3 db
Size	8.5 cu. in.



BANDPASS 10 Mc.

Specifications:

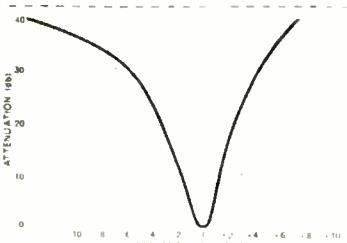
3 db bandwidth	40 Kc
Shape factor (60 db/3 db)	2.2 to 1
Maximum ripple	±0.75 db
Maximum insertion loss	6 db
Impedance (in/out)	1.5K/1.5K
Size	3.6 cu. in.



BANDPASS 30 Mc.

Specifications:

3 db bandwidth	108 Kc
Shape factor (60 db/3 db)	2.1 to 1
Maximum ripple	±1 db
Maximum insertion loss	8 db
Impedance (in/out)	2K/2K
Size	6 cu. in.



BANDPASS 100 Kc.

Specifications:

6 db bandwidth	2 cps max.
Shape factor (30 db/6 db)	5 to 1
Impedance (in/out)	1K/1K
Size	11.75 cu. in.

SALES OFFICES: HUGHES OFFICES—**California**—Palo Alto, DAvenport 6-7780 · **Colorado**—Denver, SUnset 9-0549 · **Illinois**—Chicago, NAtional 2-0283 · **Massachusetts**—Boston, WEllis 3-4824 · **Michigan**—Detroit, UNiversity 3-6700 **Minnesota**—Minneapolis, WEst 9-0461 · **New Jersey**—Newark, MArket 3-3520 · **New York**—Garden City, Pioneer 1-4620, Syracuse, GRanite 1-0163 · **Ohio**—Cincinnati, ELmhurst 1-5665, 6, 7 **Pennsylvania**—Philadelphia, MOhawk 4-8365, 6 **Texas**—Dallas, LAkeside 1-4111

S. S. LEE ASSOCIATES: Alabama—Huntsville, JEfferson 6-0631 · Florida—Orlando, CHerry 1-4445 · Maryland, Lutherville, VAlley 3-3434, Wheaton, LOckwood 5-3066 · North Carolina—Winston-Salem, STate 8-0431

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HUGHES flat-face storage tubes, now available in quantity, enable you to increase display capability by a factor of 4. Display readouts are easier and more accurate because of the new picture clarity, sharper focus and finer detail provided by the optically-flat face and high light output of these new TONOTRON® Tubes from HUGHES.

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FEATURES:

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- Electrostatic focusing
- Electromagnetic deflection
- P20 aluminized phosphor

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another FIRST from HUGHES!

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Coming Events in the electronic industry

Aug. 1-3: Nat'l Symp. on the Future of Manned Military Aircraft (Class), IAS; San Diego, Calif.

Aug. 1-3: 4th Nat'l Symp. on Global Communications, IRE, U. S. Signal Corps; Statler-Hilton Hotel, Washington, D. C.

Aug. 6-9: 20th Annual Nat'l Conv. & Exhibit, Nat'l Audio-Visual Assoc.; Morrison Hotel, Chicago, Ill.

Aug. 8-10: Annual Meeting, Assoc. of the U. S. Army; Sheraton-Park Hotel, Washington, D. C.

Aug. 8-12: Pacific General Meeting, AIEE; San Diego, Calif.

Aug. 15-17: Heat Transfer Conf. & Exhibit, ASME, AIChE; Statler-Hilton Hotel, Buffalo, N. Y.

Aug. 18-19: Electronic Packaging Symp.; Univ. of Colorado, Boulder, Colo.

Aug. 22-26: Symp. Intro. to Thermonuclear Plasma Physics, Oak Ridge Nat'l Lab., Oak Ridge Institute of Nuclear Studies, U. S. AEC; Gatlinburg, Tenn.

Aug. 23-26: 15th Nat'l Meeting, Assoc. for Computing Machinery; Marquette Univ., Milwaukee, Wis.

Aug. 23-26: WESCON, IRE, WEMA; Ambassador Hotel & Memorial Sports Arena, Los Angeles, Calif.

Aug. 24-Sept. 3: Radio and TV Exhib.; Earl's Court, London, England.

Aug. 25-Sept. 3: Int'l Conf. on High Energy Nuclear Physics, Int'l Union of Pure & Applied Physics, Commission on High Energy Physics; Rochester, N. Y.

Aug. 29-31: Semiconductors Conf. AIME; Statler-Hilton Hotel, Boston, Mass.

Aug. 29-Sept. 2: Int'l Conf. on Semiconductor Physics, Czechoslovak Academy of Sciences, Int'l Union of Pure & Applied Physics; Prague, Czechoslovakia.

Aug. 29-Sept. 3: Int'l Information Theory Meeting, IEE, IRE; London, England.

Aug. 29-Sept. 3: Int'l Conf. on Nuclear Structure, Int'l Union of Pure & Applied Physics, Atomic Energy of Canada Ltd.; Queen's Univ., Kingston, Ont., Canada.

Sept. 5-9: Medium and Small Power Reactors Conf.: Int'l Atomic Energy Agency; Vienna, Austria.

Sept. 5-15: Int'l Scientific Radio Union, 13th General Assembly; Univ. College, London, England.

Sept. 6-16: Production Eng. Show; Navy Pier, Chicago, Ill.; Machine Tool Show; Int'l Amphitheatre, Chicago, Ill.

Sept. 6-17: Use of Radioisotopes in Physical Sciences and Industry Conf.; Int'l Atomic Energy Agency, Copenhagen, Denmark.

Sept. 7-9: 1st Joint Automatic Control Conf., IRE (PGAC), ASME, ISA, AIEE, AIChE; Mass. Inst. of Technology, Cambridge, Mass.

Sept. 9-10: Conf.: Tomorrow's Techniques in Electronics—A Survey, IRE; Roosevelt Hotel, Cedar Rapids, Iowa.

Sept. 11: Fall Meeting, The Material Handling Institute, Inc.; The Cavalier Club, Virginia Beach, Va.

Sept. 11-17: Reliability Training Conf., IRE, ASQC; Dallas-Ft. Worth, Tex.

Sept. 11-20: European Machine Tool Exhib., West German Machine Tool Industry; Hanover, Germany.

Sept. 12-13: Nationwide Conf. on "The Use of Computers in Undergraduate Engineering Instruction"; Ford Foundation on Computers at Univ. of Michigan, Ann Arbor, Mich.

Sept. 12-15: Int'l Conf. on Atomic Masses, Int'l Union for Pure & Applied Physics, Nat'l Research Council, McMaster Univ., U. S. Nat'l Science Foundation; Hamilton, Ont., Canada.

Sept. 12-16: 2nd Int'l Congress, Int'l Council of the Aeronautical Sciences, IAS; Zurich, Switzerland.

Sept. 13-14: Symp. on Infant Science of Bionics, Air R&D Command's Wright Air Develop. Div.; Dayton Biltmore Hotel, Dayton, Ohio.

Sept. 14-15: 4th Annual Joint Military-Industrial Electronic Test Equipment Symp., Museum of Science and Industry, Chicago, Ill.

Sept. 15-16: 8th Annual Engineering Management Conf., ASME, AIEE, IRE, AIChE; Morrison Hotel, Chicago, Ill.

Sept. 15-17: 2nd Upper Midwest Electronic Conf. & Exhibit, Twin City Electronic Wholesalers Assoc., Electronic Representatives Assoc.; Minneapolis and Minneapolis, Minn.

Sept. 18-22: 65th Annual Conf., Int'l Municipal Signal Assoc.; Astor-Manhattan Hotels, New York, N. Y.

Sept. 18-23: 1st ERA Business Mgt. Institute, Electronic Representatives Assoc.; Univ. of Ill., Monticello, Ill.

Sept. 19-21: Int'l Symp. on Data Transmission, Benelux Section IRE, Het Nederlands Radiogenoots, IRE, Sectie voor Telecommunicatiete of the Koninklijk Instituut van Ingenieurs; Technisghe Hogeschool-Delft, Netherlands.

Sept. 19-21: 1960 Nat'l Symp. on Space Electronics & Telemetry, IRE (PGSET); Shoreham Hotel, Washington, D. C.

Sept. 21-22: 9th Annual Nat'l Industrial Electronics Symp., IRE (PGIE), AIEE; Manger Hotel, Cleveland, Ohio.

Sept. 21-23: Power Conf. ASME, AIEE; Phila., Pa.

Sept. 21-25: 1960 Aerospace Panorama, Air Force Assoc.; San Francisco Civic Center, San Francisco, Calif.

Sept. 22: 1st SPE (Society of Plastic Engineers) Reg. Tech. Conf., "Plastics in Business Machines"; Sheraton Inn, Binghamton, N. Y.

Sept. 23-25: Chicago High Fidelity Show, Int'l Sight and Sound Expos., Inc., Palmer House, Chicago, Ill.

(*Continued on page 32*)

"CALL FOR PAPERS"

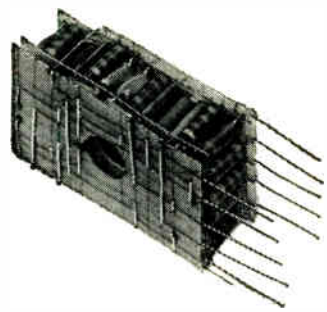
Nat'l Symp. on Engineering Writing and Speech, IRE (PGEWS), Oct. 13-14, Bismarck Hotel, Chicago, Ill. Complete papers deadline is Oct. 1.

1960 Symp. on Adaptive Control Systems, IRE (Long Island Sect.), Oct. 17-19, Garden City Hotel, Garden City, L. I., N. Y. Final manuscripts of accepted papers due Aug. 31. Harold Levenstein, Chairman, Program Committee, in care of W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y.

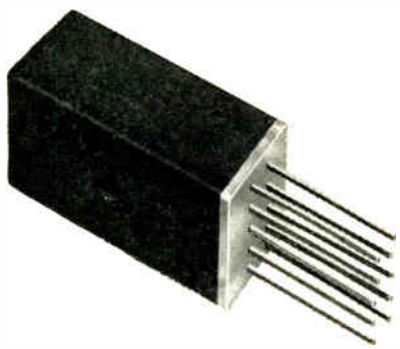
Seventh East Coast Conf. on Aeronautical and Navigational Electronics, IRE (Baltimore Section), Oct. 24-26, Lord Baltimore Hotel, Baltimore, Md. Complete papers deadline, Sept. 1, to Sanford Hershfield, Mail No. G-3143, The Martin Co., Baltimore 3, Md.

Sixth Annual Conf. on Magnetism and Magnetic Materials, Nov. 14-17, New Yorker Hotel, New York, N. Y. Deadline for Titles and Abstracts of proposed papers is Aug. 26. Submit to A. M. Colgston or R. C. Fletcher, Program Chairman, Bell Tele. Labs., Murray Hill, N. J.

1960 Eastern Joint Computer Conf. (EJCC), Dec. 13-15, Hotel New Yorker and Manhattan Center, New York, N. Y. Submit Abstracts and Summaries of tech papers by Aug. 13 to Tech. Program Chairman, Elmer C. Kubie, Computer Usage Co., Inc., 18 E. 41st St., New York 17, N. Y.



how do you play the numbers game?



The current numbers game consists of seeing how many components you can wedge into a small space. But there's a catch to it.

Some circuit modules may seem small until you string them together and find that interconnections and supporting structure take more space than the modules themselves. That's why it's important, in evaluating miniaturization, not to consider the module size alone, but to be concerned with the over-all size, including module, interconnections, and supporting structure.

New EECO MINIWELD circuit modules are designed with over-all system size in mind. They offer optimum miniaturization not only of modules, but also of interconnections and supporting structure. Add to this the reliability of proven circuits incorporating readily available standard catalog components rather than hard-to-get specials, the superior strength of welded rather than soldered connections, and you have an unbeatable combination of advantages.

We invite you to see for yourself at WESCON, Booth 1017.

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Write, wire, or 'phone today for detailed information on the revolutionary new MINIWELD space-saving package.

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EI's International News

RCA to Open New Research Laboratory in Japan

Tokyo, Japan—RCA will open a new research laboratory in Japan in the near future to conduct fundamental studies in the physics and chemistry of solids, M. E. Karns, Director of License Operations, RCA International Div., announced.

The new organization, Laboratories RCA, Inc., Tokyo, will be located in a building now under construction in the Japanese capital. Dr. Martin C. Steele has been appointed Director of Research.

The laboratory will be staffed initially by several scientists recruited from among Japanese University graduates, with gradual expansion of the staff as required by the growth of the research program.

Laboratory work will include basic studies of the electrical, magnetic, and optical properties of materials. The organization will not be concerned, in any way, with engineering development for the manufacture of electronic equipment.

New Canadian Div. Formed

Toronto, Ontario — Standard Instrument Corp. has formed a new Canadian Division, called Standard Instrument (Canada) Ltd., under the direction of Thomas A. Lisle, formerly of Lisle Instrument Systems.

This new division (767 Warden Ave., Scarborough, Toronto, Ontario) will manufacture and market the same line of instruments as the parent company in New York City.

Production at the Scarborough plant is already underway, and distributors for the line are being established throughout Canada.

U.S. and U.K. Companies Enter 21-Year Exchange Pact

London, England—Robert C. Sprague, Chairman of the Board, Sprague Electric Co., North Adams, Mass., has announced an agreement made with the Telegraph Condenser Co., Ltd., of Great Britain, whereby an exchange of research and technical information plus engineering knowledge shall take place immediately between the two companies.

Additionally, over the next 21 years there will be a further exchange of research, development and manufacturing know-how, extending beyond the field of capacitors (electric condensers) and embracing all of the products of each company.

Sprague has also sold the rights to its U.K. patents and applications to T.C.C., together with the technical and engineering information necessary to exploit them.

Sprague Electric's 1959 sales volume was $56,352,000. More than 6000 persons are employed in 12 plants in Massachusetts, Vermont, New Hampshire, North Carolina, California and Wisconsin with subsidiaries conducting operations in Italy and Puerto Rico.

Swiss Office For Burroughs

Fribourg, Switzerland—A new company in Switzerland spearheads a major expansion of operations in Western Europe for Burroughs Corp., named Burroughs International, S. A., E. G. Wallace, who has been General Sales Manager for the firm's International Div., has been named President and Managing Director.

On the Continent, Burroughs has manufacturing plants in Pantin and Villers-Ecalles, France. Three other international factories are located in the United Kingdom and Brazil.

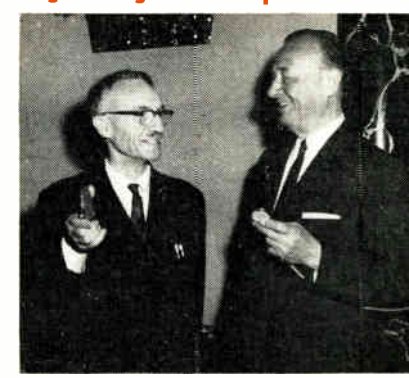
Japanese Study Group

Dr. K. Morganstern, President, Radiation Dynamics, Inc., Westbury, L. I. explains control panel for a Dynamitron Accelerator, an industrial radiation source, to leaders of a Japanese Radiation Utilization Study Project. (L to r) Junichi Hayakawa; Toshizo Titani, Tetsuro Watanabe; Dr. Morganstern, and Masao Yanagi (interpreter).

New Additions To Telex

New York — RCA Communications, Inc., has added Iran and Panama, including the Canal Zone, to its global Telex system. The new circuits permit subscribers in both countries to engage in two-way teleprinter conversations with over 40,000 subscribers in the U. S. RCA now has 49 overseas points in their worldwide Telex network.

Lightweight Loudspeaker



Dr. R. R. Gamzon(L), Weizmann Institute, Israel, shows new acoustic device to B. Abrams, President, Emerson Radio and Phonograph Corp., Jersey City, N. J. Wafer thin device can be used as a loudspeaker or microphone. Sponsored by Emerson, the device was developed in Israel. Larger model above is 4 x 8 inches.

New Swiss Subsidiaries

Fullerton, California — Beckman Instruments, Inc., has formed two new subsidiaries which will serve as headquarters for the company's foreign sales and manufacturing activities.

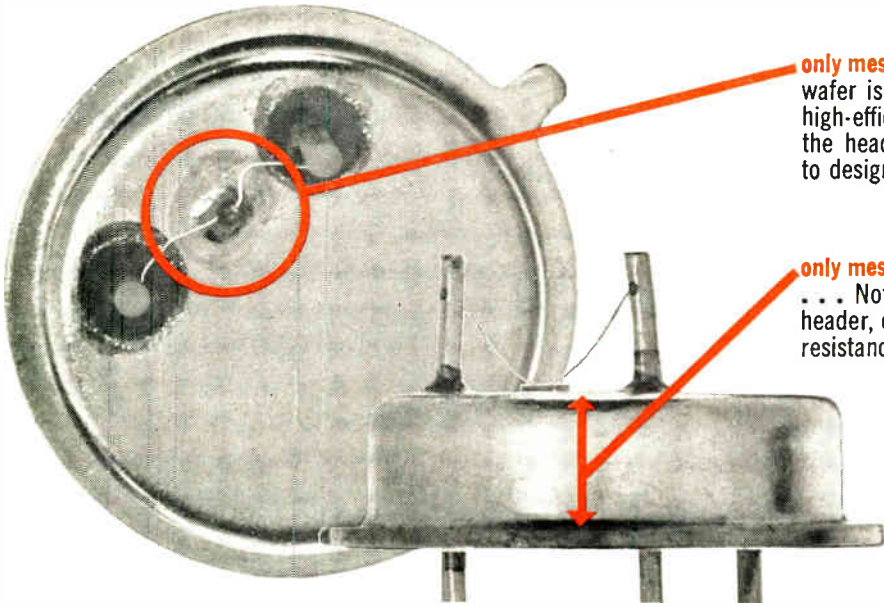
The two new subsidiaries are Beckman Instruments International, S. A., and Beckman Instruments Investment, S. A. The first is an operating company which will coordinate Beckman's overseas marketing operations, and the second is a holding company which will own the operating firm and existing Beckman subsidiaries in Munich, Germany, and Glenrothes, Scotland.

The new Swiss operating company will be headed by Edward H. Cherniss, formerly manager of foreign operations for Beckman.

The directors of Beckman Industries Investment, S. A., are Dr. Beckman, Maurice Merkt, Geneva attorney, and Maurice Trottet, a director of the Geneva branch of Credit Suisse, an international commercial banking firm. Directors of Beckman Instruments International, S. A., are Cherniss, Merkt and Trottet.

(Continued on page 24)

NEW TI GENERAL-PURPOSE SILICON MESA TRANSISTORS



only mesas give you maximum dissipation . . . Note how wafer is bonded directly to header, forming a direct, high-efficiency metal-to-metal thermal path through the header. High dissipation capabilities permit you to design conservatively for maximum reliability!

only mesas give you maximum mechanical ruggedness . . . Note how active element is bonded directly to header, close to unit's center of gravity—for maximum resistance to vibration and shock.

TI 2N1564 series GUARANTEES -55°C beta, 600-mw dissipation and gain at 30mc

Design now with industry's first small-signal silicon mesa transistors . . . the new TI 2N1564-series! Take advantage of guaranteed –55°C betas of 12, 20 and 40 . . . guaranteed 600-mw free-air dissipation . . . guaranteed current gain at 30 mc. Apply the design flexibility of 1 to 50 ma collector current operating range; 20-50, 40-100 and 80-200 beta spreads at 25°C and 60-v collector-emitter breakdown voltage to your audio, medium-power and higher frequency amplifier and switching designs . . . Specify the new TI 2N1564-series.

absolute maximum ratings at 25°C ambient (unless otherwise noted)

Collector-Emitter Voltage (see note 1)	60 v
Emitter-Base Voltage	5 v
Total Device Dissipation at 25°C Case Temperature (see note 2)	1.2 w
Total Device Dissipation at 25°C Ambient Temperature (see note 3)	0.6 w
Collector Junction Temperature	175°C
Storage Temperature Range	−65°C to +200°C

Note 1: The voltage at which h_{FB} approaches one when the emitter-base diode is open circuited. This value can be exceeded in applications where the dc circuit resistance (R_{BE}) between base and emitter is a finite value.

Note 2: Derate linearly to 175°C case temperature at the rate of 8.0 mw/°C.

Note 3: Derate linearly to 175°C ambient temperature at the rate of 4.0 mw/°C.

Available TODAY in production quantities through all TI Sales Offices and Authorized TI Distributors.

	Parameter	Test Conditions		2N1564 Min.	2N1564 Typ.	2N1564 Max.	2N1565 Min.	2N1565 Typ.	2N1565 Max.	2N1566 Min.	2N1566 Typ.	2N1566 Max.	Unit
I_{CBO}	Collector Reverse Current	V_{CB} = 40 v	I_E = 0			1			1			1	μa
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 10 μa	I_E = 0	80			80			80			volt
BV_{CEO}*	Collector-Emitter Breakdown Voltage	I_C = 10 ma	I_E = 0	60			60			60			volt
h_{fe}	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE} = 5 v, f = 1 kc	I_E = −5 ma	20		50	40		100	80		200	
		V_{CE} = 5 v, T_A = −55°C	I_E = −5 ma, f = 1 kc	12			20			40			
		V_{CE} = 5 v, f = 30 mc	I_E = −5 ma	1	4		2	4.5		2	5.0		

News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

TEXTRON ELECTRONICS has acquired Allegany Instrument Co. Allegany will operate as a division with no change in management.

LORAL ELECTRONICS CORP. has recently acquired Hillburn Electronic Products Co. of New York. Hillburn will operate as a subsidiary.

BAY STATE ELECTRONICS CORP., Boston, Mass., has taken over the Southbridge manufacturing facilities of Harvey-Wells Electronics, Inc.

THE BENDIX CORP., Radio Div., Towson, Md., has received $4-million dollar contract authorizing construction of a 5-story demonstration model of the computer-controlled ESAR (electronically steerable array radar) by the Air Force Rome Air Development Center.

BUDD ELECTRONICS, INC., has received a U. S. Signal Corps award of $1,219,204 for radio equipment.

WALTHAM PRECISION INSTRUMENT CO. has signed an agreement to purchase the Boesch Mfg. Co. of Danbury, Conn. Boesch specializes in design and manufacture of patented toroidal coil winding machines, controls, and accessories.

RAYTHEON COMPANY has just dedicated a new Airborne Equipment Center at Sudbury, Mass. This is the seventh major Raytheon facility to be completed and become operational within the past year.

POLARAD ELECTRONICS CORP. has recently acquired 100,000 sq. ft. of modern manufacturing facilities adjacent to its existing plants and is now in full operation in these facilities.

THE ITEK CORP. and **HERMES ELECTRONICS CO.** have jointly announced that their respective Boards of Directors have agreed upon a merger of the two organizations subject to stockholder approval.

ACF INDUSTRIES INC. has announced the consolidation of its Avion and Nuclear Products-Erco Div. into a new organization known as ACF Electronics Div.

CBS LABORATORIES has received a contract from the U. S. Army Signal Corps to develop new techniques for the formation of micro-junctions in semiconductors.

GENERAL ELECTRIC'S Electronic Specialty Capacitor Product Section, Irmo, S. C., has announced the signing of an R&D contract for high-reliability capacitors for the Minuteman guidance system. The sub-contract with Autonetics, a div. of North American Aviation, is for $1.8 million.

LOCKHEED ELECTRONICS CO.'s decision to locate its headquarters in the Princeton, N. J., area was cemented with the final closing on the 210 acre property.

BULOVA RESEARCH & DEVELOPMENT LABS, INC., Woodside, N. Y., has received a $244,000 contract from the Air Force Special Weapons Center to develop a new type of safing-arming device for use in missile warheads.

AEROVOX CORP., New Bedford Div., has announced, after carefully reviewing all aspects of material and labor costs, that an increase in prices must be considered immediately in the oil and electrolytic capacitor areas.

MICROWAVE ASSOCIATES, INC., has entered into an agreement with Antenna Systems, Inc., for a long term loan to Antenna Systems, in return for which Microwave Assoc. receives rights to purchase up to 28% of the outstanding common stock.

ARCO ELECTRONICS, INC., has been awarded two contracts totaling $122,400 by the Air Force and Naval Ordnance to supply kits containing miniaturized plug-in-type precision capacitor standards.

ELECTRALAB PRINTED ELECTRONIC CORP., Needham Heights, Mass., has acquired the assets and business of Minitron, Inc. of Calif., printed circuits manufacturer, in a cash and stock transaction.

NATIONAL CARBON CO. has been awarded a $700,000 contract by the Atomic Energy Commission for high-purity nuclear graphite for use in an experimental gas-cooled reactor at Oak Ridge, Tenn.

LORAL ELECTRONICS CORP. has received three new contracts totaling $5,016,000 and including a $3,467,500 Navy award for the production of electronic equipment.

TECHNOLOGY INSTRUMENT CORP., Acton, Mass., has reported the acquisition of the product line of electromagnetic clutches and brakes from the Haddam Mfg. Co.

MID-WEST

AVCO CORP., Crosley Div., has received new contracts totaling almost $8 million for spare parts to be used on bomber fire control systems. Contracts were awarded by the Warner-Robins Air Materiel Area of Robins Air Force Base, Ga.

TELEX, INC., has purchased Aemco, Inc., Mankato, Minn., manufacturer of components for the electrical and electronic industries.

THE JACKSON ELECTRICAL INSTRUMENT CO. has completed a plant expansion program involving the transfer of office and production facilities of its Commercial Div. into 15,000 sq. ft. of space at Dayton, Ohio.

EMERSON ELECTRIC MFG. CO., Electronics and Avionics Div., St. Louis, Mo., has received a contract of about $10 million from the Boeing Airplane Co. for design and testing of an electronic, active defense system for the B-52H strategic bomber, being produced by Boeing.

DELCO RADIO has started construction of a new engineering building in Kokomo, Ind. The building will contain 132,259 sq. ft. and should be completed by June, 1961.

SOLAR SYSTEMS, INC., 8241 N. Kimball Ave., Skokie, Ill., is a new company just formed to manufacture silicon solar cells, silicon readout assemblies and silicon photocells.

MIDWESTERN INSTRUMENTS, INC., Tulsa, Okla., has just received a $470,470 contract from the Dept. of the Navy, Bureau of Ships, for magnetic tape recorder/reproducers.

WEST

CHANCE VOUGHT, Electronics Div., has been awarded a $3,338,258 contract for continued development and manufacture of a highly-advanced actuator system for the Minuteman Intercontinental Ballistic Missile. Award was made by Autonetics, a division of North American Aviation, Inc.

RYAN ELECTRONICS now has a total of $34 million in contracts for AN/APN-122(V) Doppler navigation systems together with spares, documentation, and other special support equipment. Contracts were issued by the Bureau of Naval Weapons.

AIRBORNE ACCESSORIES CORP., West Coast Div., is now located in a modern office and manufacturing building located at 5456 W. Washington Blvd., Los Angeles, Calif.

HUGHES AIRCRAFT CO. has received a U. S. Navy contract for $7.5 million to build guidance systems for the Polaris missile. The new contract brings total of Polaris work awarded to Hughes to more than $15 million.

EITEL-McCULLOUGH, INC., has started construction of two new buildings at a cost of over $1 million in San Carlos, Calif.

AERONUTRONIC, a Div. of Ford Motor Co., has broken ground for the seventh major building in the multimillion dollar Engineering and Research Center located in Newport Beach, Calif.

VEEDER-ROOT INC., manufacturers of computers and counting instruments, is opening a manufacturing facility, as well as having sales and service facilities already established at a plant located in Glendale, Calif.

INTERNATIONAL RESISTANCE CO. has opened a new West Coast Engineering Laboratory for customer service on precision potentiometers in Hollywood, Calif.

SERVOMECHANISMS/INC., Research Div., Goleta, Calif., has announced receipt of a contract awarded from Picatinny Arsenal for the development and fabrication of a 560 watt thermoelectric generator.

VARIAN ASSOCIATES and **SEMICON ASSOCIATES, INC.**, have completed negotiations for Varian's acquisition of Semicon at a recent meeting.

BECKMAN INSTRUMENTS, INC., has received a $375,000 contract from Lockheed Missiles and Space Div. for a high-speed EASE analog computer to be used in development and testing of the Polaris missile and its components.

HOUSTON FEARLESS CORP., Los Angeles, Calif., has acquired Marchetti Associates, a Boston electronics research-engineering company formerly affiliated with Avco Corp.'s Crosley Div.

CONTINENTAL ELECTRONICS MFG. CO., a subsidiary of Ling-Altec Electronics, Inc., has received a $3.5 million contract for additional super power radar transmitters for the U. S. Air Force's Ballistic Missile Early Warning System.

EITEL-McCULLOUGH, INC., has announced receipt of over $6 million in new orders in the past month. These are firm production orders now entered on the company's books.

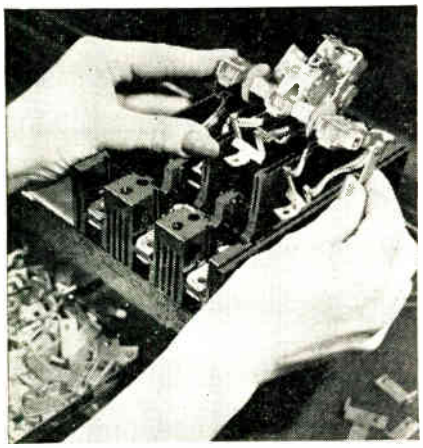
Important facts to know about Laminated Plastics

LAMINATED PLASTICS *What they are, where they can be used*

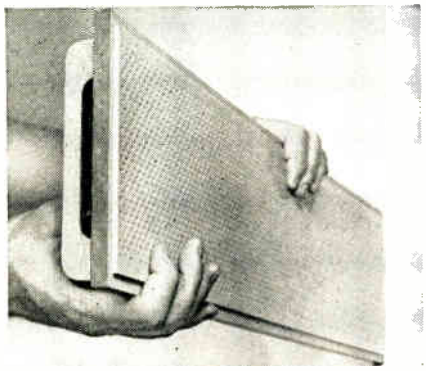
Taylor laminated plastics, also known as reinforced plastics, are thermosetting-type materials formed by impregnating paper, cotton cloth, asbestos, glass cloth, nylon or other base materials with synthetic resins and fusing them into sheets, rods, tubes and special shapes under heat and pressure. These materials exhibit a valuable combination of characteristics, including high electrical insulation resistance, structural strength, strength-to-weight ratio, and resistance to chemical reaction; also adaptability to fabricating operations.

Types of laminated plastics made by Taylor

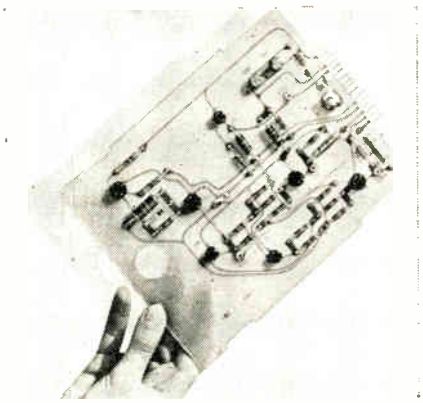
There are four basic types of Taylor laminated plastics commonly specified and used throughout industry today. They are as follows:



Phenolic Laminates. Paper, cotton fabric or mat, asbestos, glass cloth or nylon bases impregnated with phenol formaldehyde resins. These provide strength and rigidity, dimensional stability, resistance to heat, chemical resistance, and good dielectric characteristics. Some Taylor grades are excellent basic materials for gears, cams, pinions, bearings and other mechanical applications. Others are widely used in terminal boards, switchgear, circuit breakers, switches, electrical appliances and motors. Also in radios, television equipment and other electronic devices; and in missiles as nose cones, exhaust nozzles, and combustion chamber liners.

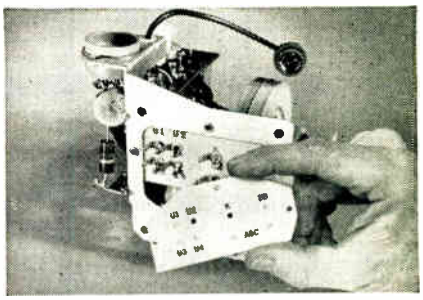


Melamine Laminates. Glass cloth or cotton fabric impregnated with melamine formaldehyde resin. Taylor melamine laminates have superior mechanical strength and are especially desirable for their arc-resistant qualities. Good flame and heat resistance, good resistance to the corrosive effects of alkalis and most other common solvents, besides other favorable characteristics. Typical applications include arc barriers, switchboard panels, and circuit-breaker parts in electrical installations.



Silicone Laminates. Continuous-filament woven glass fabric impregnated with a silicone resin. These laminates combine high heat resistance (up to 500°F. continuous) with excellent electrical and mechanical properties. They are primarily used in high-temperature electrical applications and high-frequency radio equipment.

Epoxy Laminates. Continuous-filament woven glass fabric or paper impregnated with epoxy resin. Glass-fabric grades are designed for use in applications requiring high humidity-resistance, good chemical resistance,



and strength retention at elevated temperatures. Paper grades are used under high-humidity conditions where resistance to acids and alkalis is required. Both grades are characterized by good dielectric strength, low dielectric losses, and high insulation resistance even following severe humidity conditions.

• • •

Recent technical advances in the bonding of various metallic and nonmetallic materials to laminated plastics have opened up new design opportunities. It is now possible to bond virtually any compatible material with a laminated plastic to form a composite which combines the advantages of both. One of the first composite materials was a copper-clad laminate used for printed circuits. More recent composite laminates, usually manufactured to customer specification, include the following: Taylorite® vulcanized fibre-clad, rubber-clad, asbestos-clad, aluminum-clad, beryllium-copper-clad, stainless-steel-clad, magnesium-clad, and silver- and gold-clad. Any one of these materials can be sandwiched between sheets of laminates, too, and can be molded to fit specific requirements.

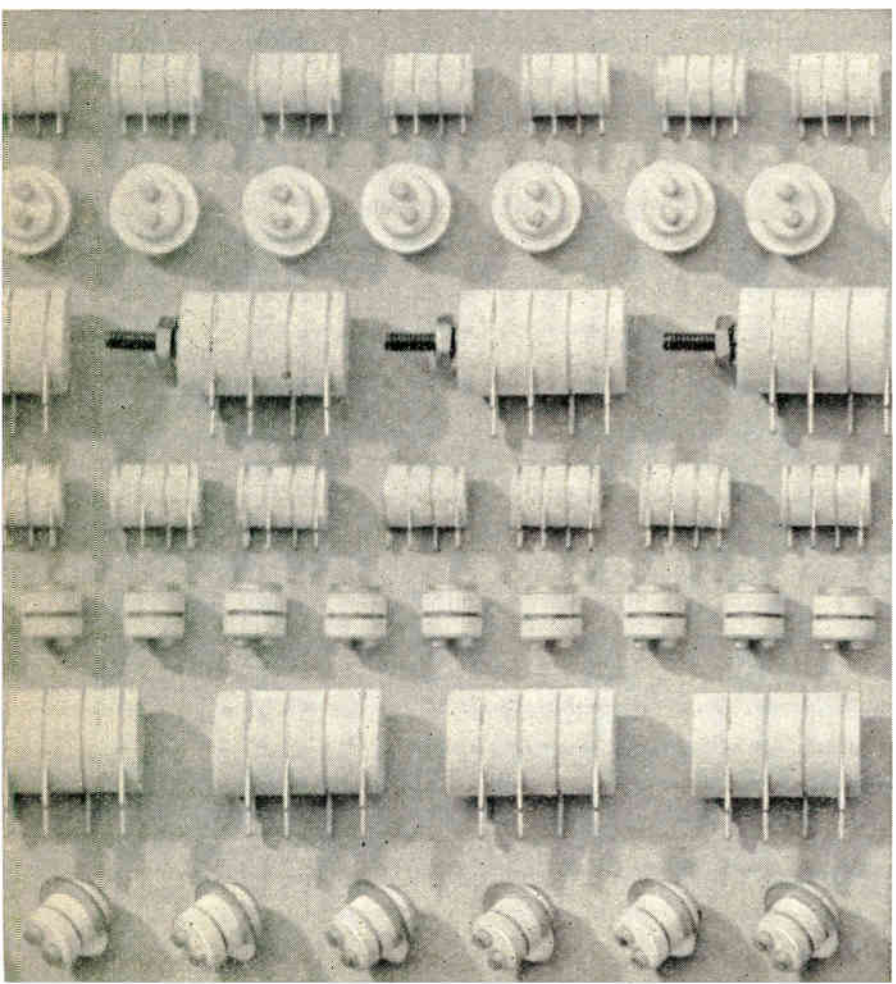
Send for complete information about any or all of these Taylor laminates. And remember Taylor's new selection guide will simplify your problems in choosing the right laminate for your specific application. Taylor Fibre Co., Norristown 53, Pa.

Taylor

LAMINATED PLASTICS VULCANIZED FIBRE

RELAX! Just select the power output, bandwidth, everything else you need and radiation tolerance..

Telephone today! New York, WI 7-4065....Boston, DE 2-7122....Washington, EX 3-3600....Chicago, SP 7-1600....Dallas, RI 7-4296



(ACTUAL SIZE)

7462
RF-amplifier triode

7486
RF oscillator-mixer triode

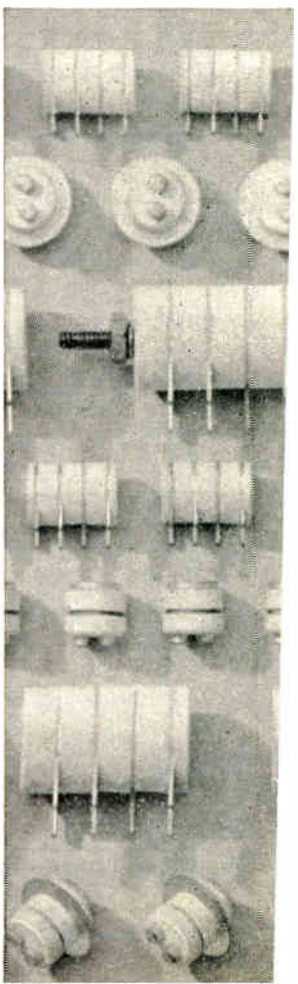
7296
VHF-UHF low-power triode, shown with mounting bolt

7625
High voltage-gain triode

7266
VHF-UHF detector diode

Developmental, broadband, 40,000-G_m triode

7077
RF-amplifier triode



right frequency, function,

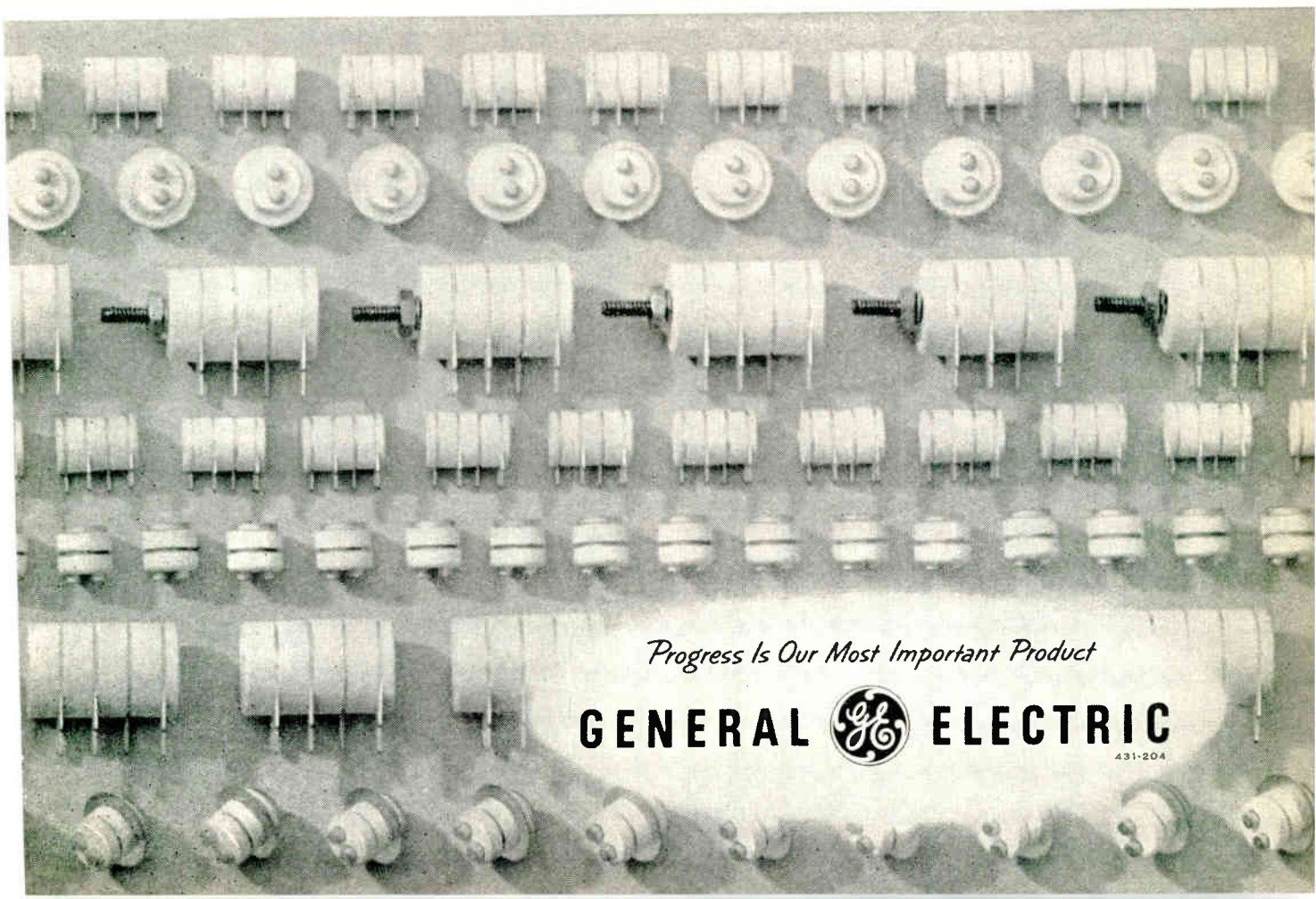
G-E Ceramic Tubes have

ruggedness...temperature

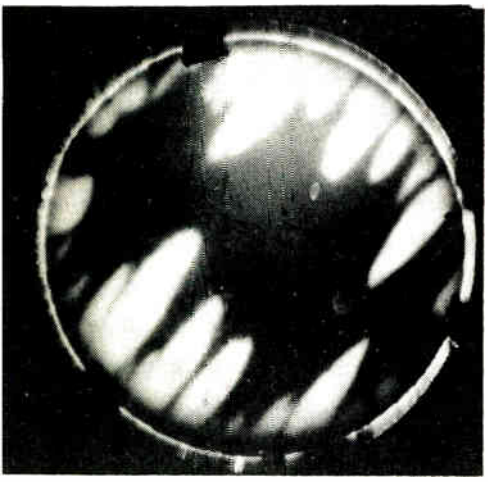
high gain...low noise.

Circle 9 on Inquiry Card

Angeles, GR 9-7765, BR 2-8566 .... San Francisco, DI 2-7201 .... Or call your General Electric Industrial Tube distributor.

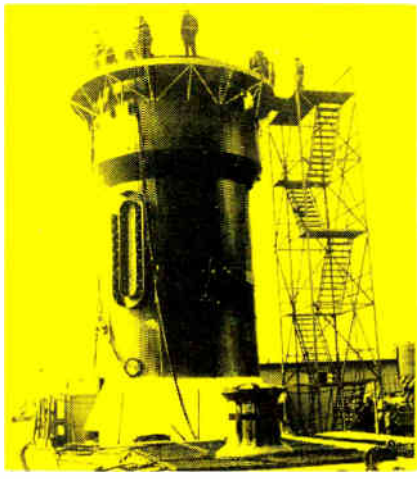


Snapshots . . . of the Electronic



SUPERCONDUCTIVITY

Thin sheet of tantalum shows effect of cold rolling on intermediate state in a superconductor. Normal areas are light — superconducting areas are dark. Dr. Warren DeSorbo of GE developed this technique permitting direct visual observation of the intermediate state.



"OPERATION POP-UP"

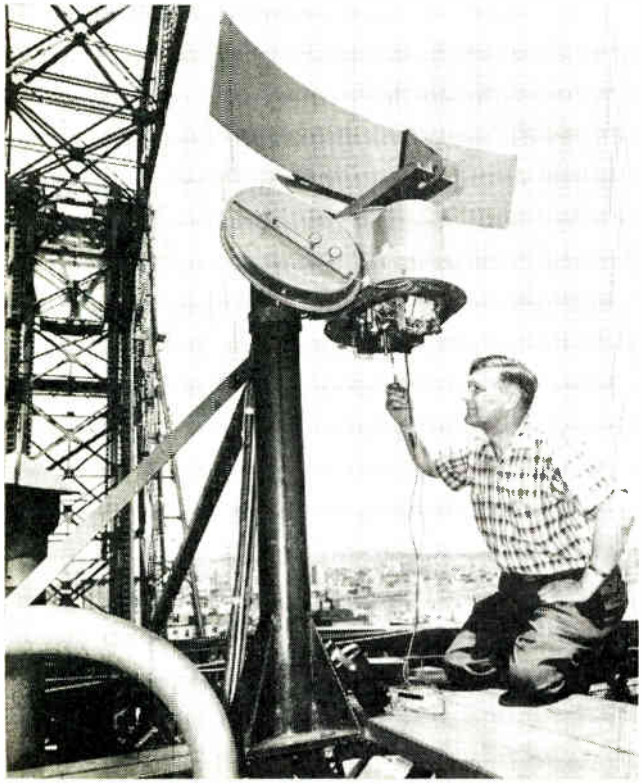
Underwater launcher for testing Polaris components during "Operation Pop-Up" maneuvers off the California cost. The "Level-Tel" system used in controlling launcher submergence was designed by Robertshaw-Fulton's Aeronautical and Instrument Div., Anaheim, Calif.

RADOME TOOL

Tools for fabricating this radome were made of high temperature epoxies. Epoxy tools allow continuous operations at temperatures to 300° F. Tools used 10-Q gel coatings and 10-K laminating resins with liquid high temperature hardeners made by Furane Plastics, Inc., Los Angeles.

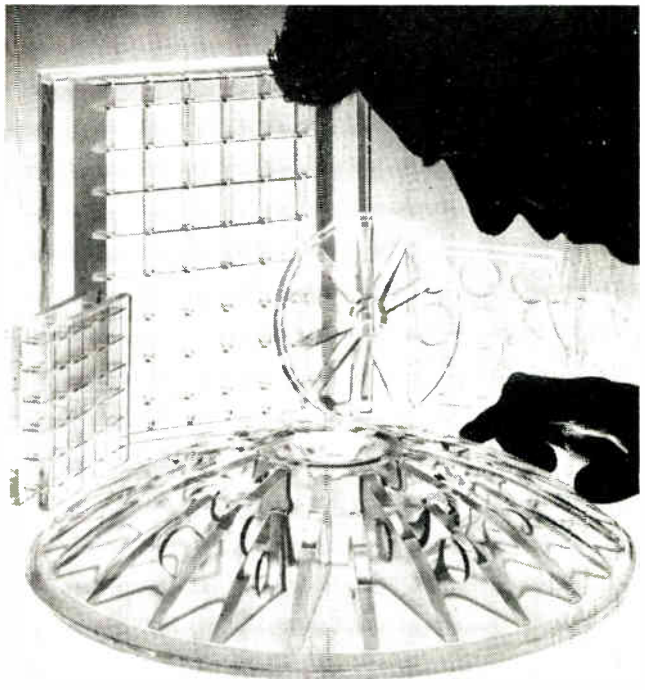
BRIDGE RADAR INSTALLED

Raytheon Engineer, R. D. Spoolman tests new radar installed atop control room of vertical lift bridge on Lake Superior. Radar warns bridge tenders of approaching ships in heavy weather.

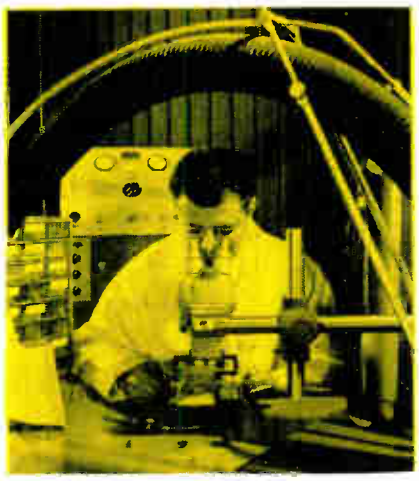


SPACE TELESCOPE MIRRORS

Mirrors for outer space telescopes are made of two plates of fused silica. Lightweight discs were made by Corning Glass Works, Corning, N. Y. for missile, satellite and aircraft use.



Industries

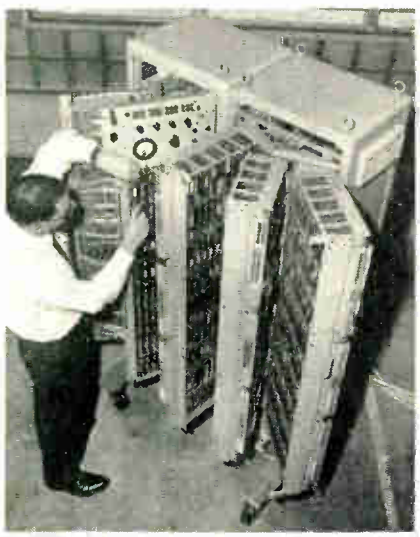


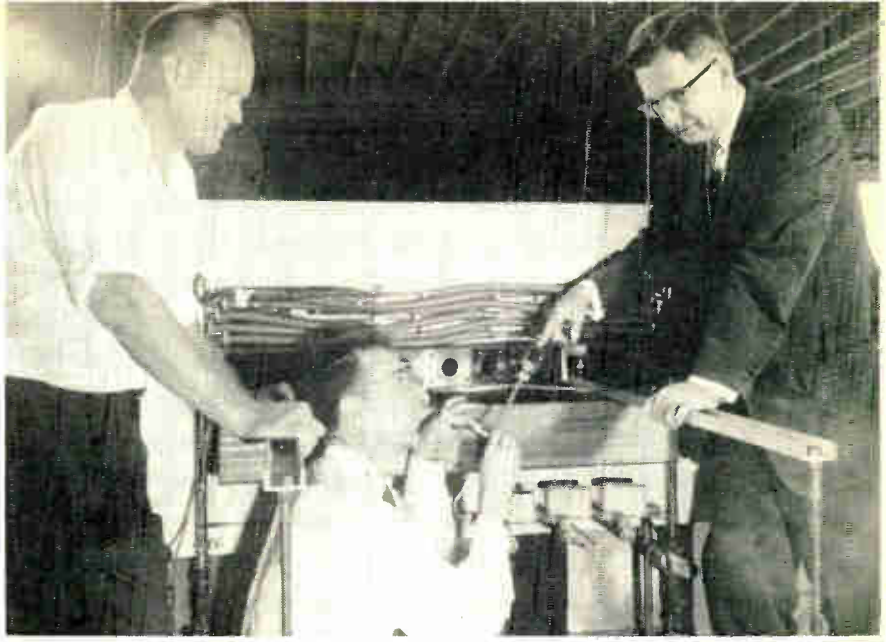
"DO IT YOURSELF"

Engineers can build their own circuit prototypes with this micromodule kit developed by RCA, Somerville, N. J. Kit includes wafers and all equipment for building and testing up to 10 modules. Engineer is using kit to adjust termination patterns on semiconductor diode.

STARDAC COMPUTERS

Epsco, Inc., Cambridge, Mass., has delivered STARDAC control computers to the U. S. Navy for installation on two Polaris missile-firing submarines. STARDAC is comprised of 88,612 electronic components of which 13,226 are transistors and 2,587 are magnetic cores. Packing density is 3,820 components per cu. ft. Operating temperature and shock requirements are 0° to 50° C. and 100 g's respectively.





COMMERCIAL CYCLOTRON

Drs. Kenneth R. MacKenzie (left) and Byron T. Wright (center) display nation's only commercially manufactured cyclotron to Dr. John W. Clark of Hughes Aircraft. Machine is scheduled for September delivery to Pomoma (Calif.) College.

ABSTRACT ART?

IBM has been engaged in developing a vapor growth process for "growing" semiconductors. Photo shows a typical epitaxial growth on a (100) silicon substrate magnified 350 times.

International News

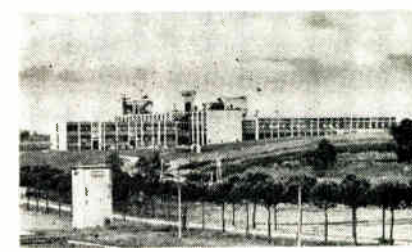
(*Continued from page* 14)

Canadian Subsidiary Formed

New York—Ultrasonic Industries Inc., Albertson, L. I., N. Y., has formed a Canadian subsidiary, Ultrasonic Industries (Canada) Ltd., 1512 Eglinton Ave. West, Toronto, Ontario, the first of several such companies contemplated by UI in its development of international markets. The Toronto based company will direct the marketing, distribution and service activities for its parent U. S. company in Canada.

Julian Conway has been elected President of the new company. Other officers and directors are Paul M. Platzman, Chairman of the Board; Herbert A. Frankel, Vice President and Director; Barbara A. Jewett, Secretary-Treasurer and Director, and Harold S. Remz, Director.

New Electronics Firm



Headquarters and engineering labs near Rome for Selenia, new electronics company formed by Raytheon Co., Waltham, Mass., and Finmeccanica, an Italian holding company, and the Italian Societa Edison. Company will build radars, industrial controls, microwave equipment, facsimile apparatus, signal equipment, and electronic test equipment. First assignment will be Hawk missile components for NATO.

Marconi Mark IV Cameras For Poland, U.S.A. & Britain

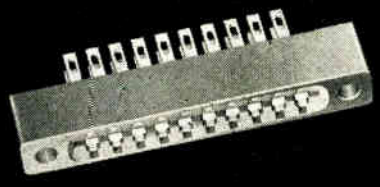
England—An order for three Marconi Mark IV television camera channels and ancillary equipment for the Warsaw studios has been placed by Elektrim, the official Polish import and export organization for electrical products. The cameras will operate to O.I.R. standards (625 lines, 50 fields, 8 Mc/s channel) which are the same as in use in the U.S.S.R. The television station at Katowice, the biggest in Poland, is entirely Marconi-equipped.

Other recent orders for Mark IV camera channels include 10 more for the Ampex Corp. of America, and 2 for Tyne Tees Television Ltd., the program contractors to the independent Television Authority for the North-East of England.

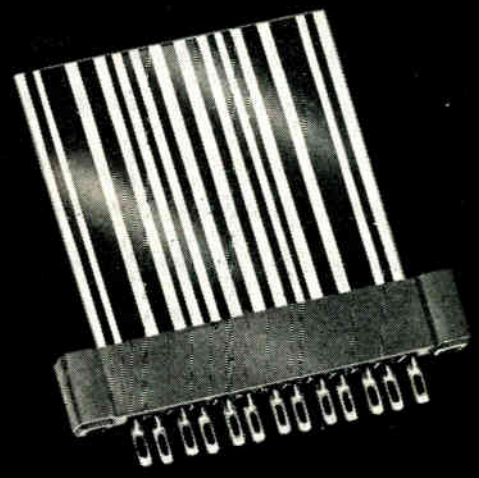
(*Continued on page* 26)

ACTUAL SIZE

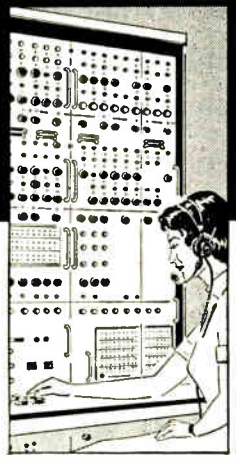
Series 600-7-1 18 contacts
for 3/64" PC board or cable



Series 600-4PC10 10 dual contacts
for 1/32" PC board or cable



Series 600-4PCSC13 13 contacts
for 1/32" PC board or cable



Continental Connector
MINIATURE PRINTED CIRCUIT CONNECTORS

Continental printed circuit connectors and "Bellowform" contacts are covered by patent number 2,875,425

WHERE RELIABILITY IS A MUST

and space limitations are critical . . . specify Continental Miniature PC Connectors

Series 600 precision miniature printed circuit connectors provide a positive, space-saving connection between printed circuitry and conventional wiring, through printed circuit boards, tape cables or plug-mounted sub-assemblies.

SERIES 600-7-1. For 3/64" printed circuit board or tape cable. 18 contacts for #24 AWG wire. Solder lug terminations are staggered to simplify soldering operations.

SERIES 600-4PCSC13. For 1/32" printed circuit board or tape cable. 13 staggered contacts accommodate #22 AWG wire. Module design permits stacking of any reasonable number of single units. Contacts have minimum spacing with maximum contact wiping surface.

SERIES 600-4PC10. Accepts 1/32" printed circuit board or tape cable. Double row of 10 contacts with solder lug terminations provides a total of 20 connections. For #22 AWG wire. Overall length only 1⅞".

Continental Connector's "Bellowform" contacts are used in this series and provide coil spring action grip that clasps the printed circuit board firmly over the entire contact area regardless of board tolerance variations.

Contact material is spring temper phosphor bronze with gold plate over silver plate. Body molding compound is glass reinforced Diallyl Phthalate (MIL-M-19833, Type GDI-30, green color).

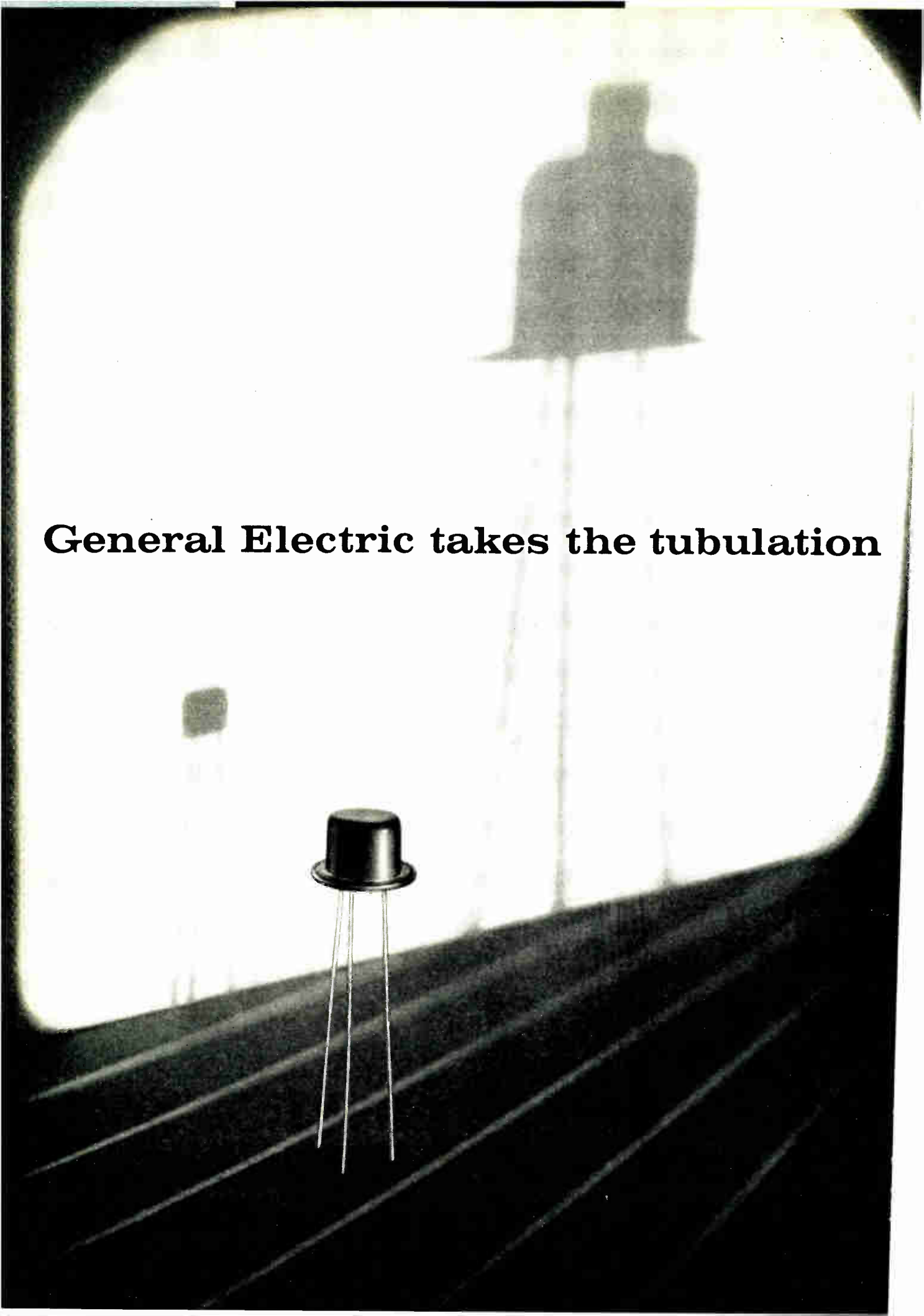
Technical literature on Continental Connector Series 600 Miniature PC Connectors is available on request. Write to Electronics Division, DeJUR-AMSCO CORPORATION, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agent)

CONTINENTAL CONNECTORS

MANUFACTURED BY
CONTINENTAL CONNECTOR CORPORATION,
AMERICA'S FASTEST GROWING LINE OF
PRECISION CONNECTORS

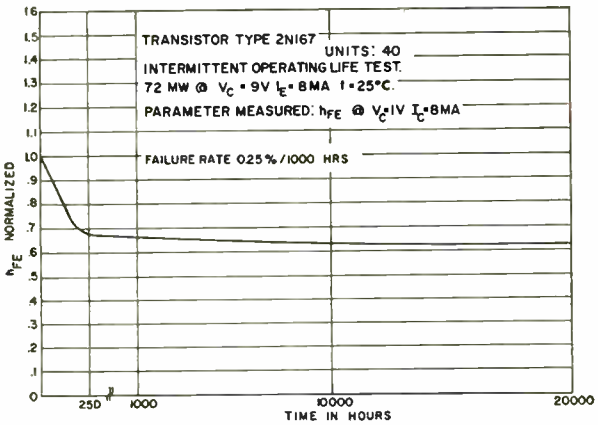
VISIT US AT WESCON SHOW BOOTHS 855-856

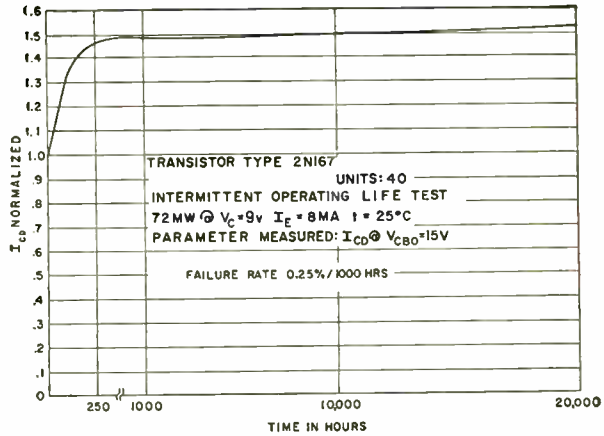
Circle 11 on Inquiry Card


General Electric takes the tubulation

General Electric transistors hold the record in rate-grown reliability

General Electric has manufactured millions of rate-grown transistors in the past seven years. As a result of this experience, G.E.'s parameters are exceptionally stable and a vast amount of reliability data has been accumulated, some of which is shown here. These curves cover 29 lots of General Electric 2N167, tested to MIL-T-19500/11.





The rate-grown process produces a small, clean junction which exhibits almost no drift or deterioration at high voltages and offers the user low I_{CO} and I_{EO}. Two new types, the 2N1510 and 2N1217, will be useful for low-level switch and neon indicator applications. Both the 2N1217 and 2N167 operate at extremely low current and leakage levels, making them ideal for starvation circuits of 2 ma or less.

off rate-grown NPN transistors!

Remove the tubulation (pinch-off) from rate-grown transistors without sacrificing reliability? General Electric has done just that and even improved reliability with stabilized beta and collector cutoff current. Prices have been reduced on some types up to 20%.

Removal of the tubulation was made possible by adding a sieve or getter. Improved beta and collector cutoff current results from a 125-hour 85°C bake, which also improves the paint's resistance to solvents and chipping. Pellet, pellet mount and processing are identical to the previous process before encapsulation. Then a sieve is added rather than evacuation and subsequent pinch-off. The sieve is the same used and proved for years on G.E.'s PNP low-frequency 2N525 and PNP high-frequency 2N396 lines.

The high-reliability 2N78A and 2N167A have guaranteed 71°C I_{CO} and tight AQL's. The 2N78A also features a 20 volt BV_{CEO} rating compared with the 2N78's 15 volts. The 2N167A, in addition to 71°C I_{CO}, has a lower I_{EO}. For more information, see your G-E Semiconductor Sales Representative or Authorized Distributor. General Electric Company, Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

ADVANTAGES TO YOU: 40% lower height • Reduced prices • Stabilized I_{CO} and h_{FE}. All units baked 125 hours at 85°C • Greater resistance of paint to solvents, chipping, and salt spray • Improved low-temperature performance and reliability.

Type No.	Maximum Ratings				Electrical Parameters					
	$P_C$mw @ 25°C	BV_{CE} BV_{CB}	I_C ma	T_J°C	MIN h_{FE}	@ I_C ma	MIN $f_{\alpha b}$mc	MIN Gedb	MAX I_{CO} (μa)	@ V_{CB}
2N78	65	15	20	85	45	1	5	27	3	15
2N78A	65	20	20	85	45	1	5	29	3	15
2N78A (Cert)	65	20	20	85	45	1	5	29	3	15
2N167	65	30	75	85	17	8	5	—	1.5	15
2N167A	65	30	75	85	17	8	5	—	1.5	15
USAF2N167A (per MIL-S-19500/11)	65	30	75	85	17	8	5	—	1.5	15
2N169A	65	15	20	85	34	1	—	27	5	15
2N1198	65	25	75	85	17	8	5	—	1.5	15
2N1217	65	20	20	85	40	2	5	—	1.5	15
2N1510	75	75	20	85	8	1	—	—	5	75

IN STOCK FOR FAST DELIVERY FROM YOUR AUTHORIZED GENERAL ELECTRIC DISTRIBUTOR

GENERAL ELECTRIC

As We Go To Press (Cont.)

Navy To Train Sub Crews With Electronic Battles

The Ordnance Div., Minneapolis-Honeywell Regulator Co., 2600 Ridgway Rd., Minneapolis, Minn., is developing a $3.6 million nuclear submarine training center for the Navy. Electronically controlled, it will simulate full-scale naval battles with a "startling degree of realism" for crews of Polaris-armed and other nuclear submarines.

The trainer, located at the Navy's Submarine School, New London, Conn., will use a giant computer and advanced electronic techniques. Periscopes for each sub trainer will realistically simulate the view of targets on the surrounding horizon. The targets will appear in color at the correct relative bearing and at a size proportional to the range. The facility will have a Master Instructor's Console for presenting realistic training problems.

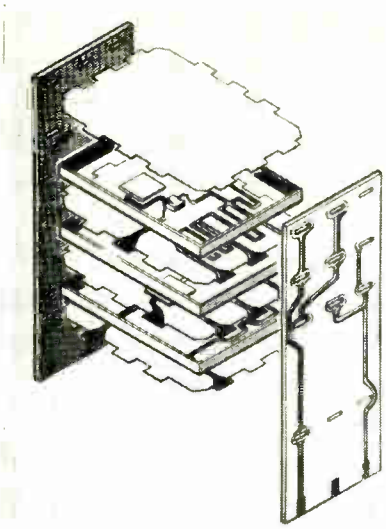
Bidding Team Formed

Seven technical companies in the New York metropolitan area have formed a non-profit technical bidding organization — The New York Research and Development Team. It will specialize in electronic, nuclear, chemical, and mathematic activities. Heart of the "team" is a working force of over 300 employees of which more than 100 are scientists and engineers. The seven companies have a combined sales volume in excess of $4,000,000 annually.

Members are: Aerolite Corp., Union City, N. J. (electronic components); Computech Corp., N. Y. C. (data processing and computing); Glenn Assoc., N. Y. C. (engineering services); Manhattan Physical Research Group, Inc., N. Y. C. (technical research and consulting); New York Testing Labs, N. Y. C. (general electronics and chemical testing); Stratos Missiles, Inc., N. Y. C. (systems engineering and research); and Radiation Research Corp., N. Y. C. (nuclear engineering and research).

For more information—they are interested in inquiries from other technical firms who may wish to join—write to: Sy Richman, 118 Seventh St., Garden City, N. Y.

MINIATURE CIRCUITS



Microminiature modules, developed by Sylvania Electric Products, Inc., are for packaging electronic circuits on a series of wafers. A complete functioning circuit stage is on a surface less than ½ in. sq. and 1/100 in. thick. Entire stage is hermetically sealed as a fused spacer element.

Tiros TV Pictures Oriented by Computer

Specially designed computers, designed by RCA's Astro-Electronic Products Div. at Princeton, N. J., calculate the relative position with respect to the sun of the Tiros weather satellite each time it takes a TV Picture.

The computer gets signals from the satellite itself. A "north indicator" system measures the angle of the sun in relation to Tiros' spin axis. Nine special solar sensing cells are arranged at points 40° apart around the perimeter of the satellite. Each cell produces a distinctive pulse signal when it faces the sun directly. The pulses are sent along with the TV picture. By measuring times between pulses and between pulse and picture exposure the exact angle of the sun with respect to the satellite's axis is determined. The figure is displayed with the picture.

New Alloy For High Temperatures

The General Electric Co. Labs at Schenectady, N. Y., have announced a new alloy with heat expansion properties similar to alumina. Fernico-5, an alloy of iron, nickel, and cobalt, will be used in electron tubes, thermionic energy converters and high temperature circuits.

Coming Events

(*Continued from page* 12)

Sept. 26-28: 9th Annual Meeting, Standards Engineers Soc.; Pittsburgh-Hilton Hotel, Pittsburgh, Pa.

Sept. 26-28: Petroleum Mechanical Eng'g Conf., ASME; Jung Hotel, New Orleans, La.

Sept. 26-30: Fall Instrument-Automation Conf. & Exhibit and 15th Annual Meeting, ISA, Coliseum, N. Y., N. Y.

Oct. 3-5: Nat'l Midwestern Conf. on Air Logistics, IAS; Tulsa, Okla.

Oct. 3-5: 6th Nat'l Communications Symp. IRE (PGCS), Rome-Utica Section; Hotel Utica & Utica Memorial Audit., Utica, N. Y.

Oct. 3-5: 7th Annual Meeting, IRE (PGNS), Oak Ridge Nat'l Lab.; Gatlinburg, Tenn.

Oct. 4-6: 6th Conf. on Radio Interference Reduction and Electronic Compatibility, All 3 Military Services, Armour Research Foundation, IRE (PGRFI); Museum of Science and Industry, Chicago, Ill.

Oct. 4-7: 10th Annual Instrument Symp. and Research Equipment Exhibit, American Assoc. of Clinical Chemists, Amer. Chem. Soc., ISA, Soc. of Amer. Bacteriologists, Soc. for Experimental Biology and Medicine; Nat'l Institutes of Health, Bethesda, Md.

Oct. 5-6: 2nd EIA Value Engineering Conf., Electronic Industries Assoc.; Disneyland Hotel, Anaheim, Calif.

Oct. 5-7: 2nd Midwest Business Opport. Exhibit, Business Develop. Dept's of: Minnesota, N. & S. Dakota, Nebraska, Iowa, Montana, Wyoming, Wisconsin and Illinois, Dept. of Defense, Fed. Civ. Agencies, Local and State Chamber of Commerce Organizations; St. Paul Municipal Auditorium, St. Paul, Minn.

Oct. 9-13: Meeting, The Electrochemical Soc., Inc.; Shamrock Hotel, Houston, Tex.

Oct. 9-14: Fall General Meeting, AIEE, Computing Devices & Systems Committees, New York, N. Y.

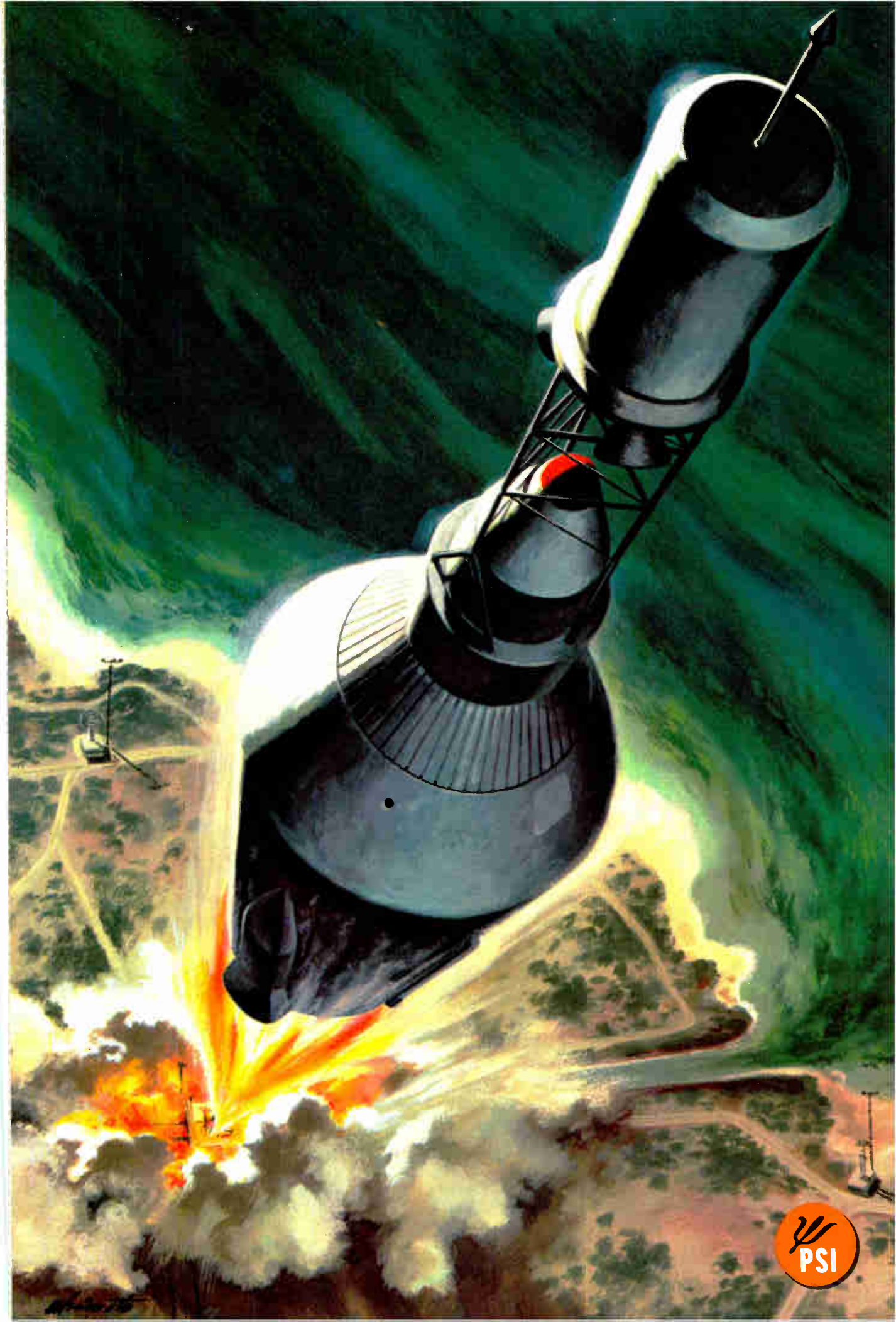
Oct. 10-11: Fuels Conf., ASME, AIEE; Daniel Boone Hotel, Charleston, W. Va.

Oct. 10-12: Nat'l Electronics Conf., AIEE, IRE, Illinois Institute of Technology, EIA, SMPTE; Northwestern Univ., Univ. of Illinois, Hotel Sheraton, Chicago, Ill.

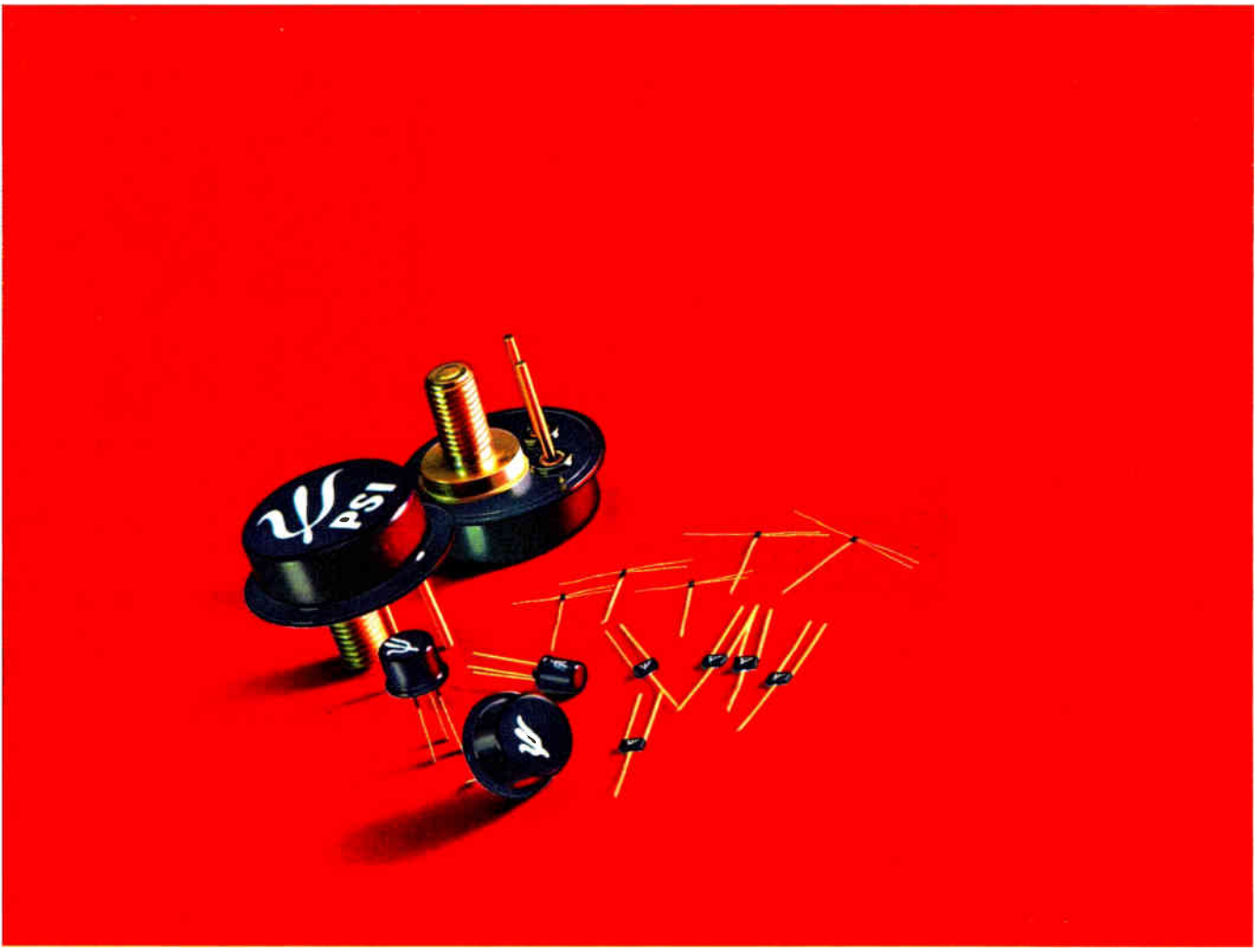
Oct. 10-12: 16th Annual Conf., Nat'l Electronics Conf., AIEE, Ill. Inst. of Technology, IRE, Northwestern and Illinois Univ.; Sherman Hotel, Chicago, Ill.

ABBREVIATIONS

AEC: Atomic Energy Commission
AIChE: Amer. Inst. of Chemical Engineers
AIEE: Amer. Soc. of Electrical Engineers
AIME: Amer. Inst. of Metallurgical Engineers
ASME: Amer. Soc. of Mechanical Engineers
IAS: Institute of Aeronautical Sciences
IEE: Institute of Electrical Engineers (Brit)
IRE: Institute of Radio Engineers
ISA: Instrument Soc. of America
WEMA: Western Electronic Manufacturers Assoc.


PSI

HERE'S ONE WAY OF LOOKING AT PRODUCTION CAPABILITY



These silicon transistors are a sample of the production capability housed in the laboratory and manufacturing complex of Pacific Semiconductors, Inc. Each is an advanced type not previously available . . . each is a PSI origination designed to fill a carefully forecast commercial need.

Because production capability at PSI is based solidly on product origination and product reliability, The Company is carrying on a continuing search for experienced scientists, physicists and engineers of outstanding ability. If you have these talents, you will find unlimited career opportunities at commercially oriented PSI.

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE, INC.
CORPORATE HEADQUARTERS: 10451 West Jefferson Boulevard, Culver City, California
General Sales Offices: 12955 Chadron Avenue, Hawthorne, California

LITHO IN U. S. A.

Silicon General Purpose Diodes

ACTUAL SIZE

EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Maximum Forward Voltage DC @ 25°C (volts) @ 100 mA	Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts) @ 25°C	@ 150°C	Maximum Average Rectified Current (mA) @ 25°C	@ 150°C
1N488A	420	1.0	.100 @ — 380v	25	200	70
1N488	420	1.1	.250 @ — 380v	50	125	50
1N487A	330	1.0	.100 @ — 300v	25	200	70
1N487	330	1.1	.250 @ — 300v	50	125	50
1N486B	250	1.0	.050 @ — 225v	10	200	70
1N486A	250	1.0	.050 @ — 225v	25	200	70
1N486	250	1.1	.250 @ — 225v	50	125	50
1N485B	200	1.0	.025 @ — 175v	5	200	70
1N485A	200	1.0	.025 @ — 175v	15	200	70
1N485	200	1.1	.250 @ — 175v	30	125	50
1N484B	150	1.0	.025 @ — 125v	5	200	70
1N484A	150	1.0	.025 @ — 125v	15	200	70
1N484	150	1.1	.250 @ — 125v	30	125	50
1N483B	80	1.0	.025 @ — 60v	5	200	70
1N483A	80	1.0	.025 @ — 60v	15	200	70
1N483	80	1.1	.250 @ — 60v	30	125	50
1N482B	40	1.0	.025 @ — 30v	5	200	70
1N482A	40	1.0	.025 @ — 30v	15	200	70
1N482	40	1.1	.250 @ — 30v	30	125	50

EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Minimum Forward Current @ +1.0 VDC @ 25°C (mA)	Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts) @ 25°C	@ 150°C	Maximum Average Rectified Current (mA) @ 25°C	@ 150°C
1N464A	150	100	.5 @ 125	30 @ 125	200	70
1N464	150	3	.5 @ 125	30 @ 125	40	
1N463A	200	100	.5 @ 175	30 @ 175	200	70
1N463	200	1	.5 @ 175	30 @ 175	30	
1N462A	70	100	.5 @ 60	30 @ 60	200	70
1N462	70	5	.5 @ 60	30 @ 60	50	
1N461A	30	100	.5 @ 25	30 @ 25	200	70
1N461	30	15	.5 @ 25	30 @ 25	60	
1N459A	200	100	.025 @ 175	5 @ 175	200	70
*1N459	200	3	.025 @ 175	5 @ 175	40	
1N458A	150	100	.025 @ 125	5 @ 125	200	70
*1N458	150	7	.025 @ 125	5 @ 125	55	
1N457A	70	100	.025 @ 60	5 @ 60	200	70
*1N457	70	20	.025 @ 60	5 @ 60	75	
1N456A	30	100	.025 @ 25	5 @ 25	200	70
1N456	30	40	.025 @ 25	5 @ 25	90	

* JAN Types

Zener Diodes 500 mW Power Dissipation

PSI Type Number	Elect. Equiv.	Zener Voltage @ 5 mA @ 25°C E_z Min. (V)	E_z Max. (V)	Maximum Dynamic Resistance (ohms)	Maximum Inverse Current I_b @ 25°C (μA)	I_b @ 100°C (mA)	At Inverse Voltage (V)
PS6465	1N465	2.0	3.2	60	75	100	1
PS6466	1N466	3.0	3.9	55	50	100	1
PS6467	1N467	3.7	4.5	45	5	100	1
PS6468	1N468	4.3	5.4	35	5	100	1.5
PS6469	1N469	5.2	6.4	20	5	100	1.5
PS6470	1N470	6.2	8.0	10	5	50	3.5

1. Measured at 10mA DC Zener current with 1mA RMS signal superposed.

Also Available PS6313-6318 covering 7.5v to 27v Zener Voltages.

EIA TYPES	Zener (Breakdown) Voltage @ 5 mA E_z Min. (v)	E_z Max. (v)	Maximum Inverse Current I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)	Maximum Dynamic Resistance (ohms) 1
1N702	2.0	3.2	75	100	−1	60
1N703	3.0	3.9	50	100	−1	55
1N704	3.7	4.5	5	100	−1	45
1N705	4.3	5.4	5	100	−1.5	35
1N706	5.2	6.4	5	100	−1.5	20
1N707	6.2	8.0	5	50	−3.5	10

1. Measured at 10 mA DC Zener current with 1 mA RMS signal superposed.

Also Available 1N708-1N723 covering 5.6v to 27v Zener Voltages.

EIA Type[1]	Zener Voltage E_z (Volts)[2]	Max. Inverse Current $E_R = -1V$ μA 25°C	150°C	Max. Dynamic Resistance $I_z = 20mA$ $I_{ac} = 1mA$ (Ohms) (Max.)
1N746	3.3	10	30	28
1N747	3.6	10	30	24
1N748	3.9	10	30	22
1N749	4.3	2	30	23
1N750	4.7	2	30	19
1N751	5.1	1	20	17
1N752	5.6	1	20	11
1N753	6.2	0.1	20	7
1N754	6.8	0.1	20	5
1N755	7.5	0.1	20	6
1N756	8.2	0.1	20	8
1N757	9.1	0.1	20	10
1N758	10.0	0.1	20	17
1N759	12.0	0.1	20	30

1. ±10% Zener Voltage Tolerance
2. E_z measured at Test Current I_z = 20mA

All of the above types can be supplied in ±5% Tolerance of center Zener Voltage Value. (Add suffix "A" for these units.)

Silicon Diffusion Computer Diodes

The Broadest Line in the Industry . . .

PSI has developed these fast recovery silicon diodes for every application in advanced computer design. Choose from military approved, low capacitance, high conductance, low leakage, high voltage types—with assurance of unsurpassed reliability!

ACTUAL SIZE

Fast Recovery Types

MILITARY TYPES

Type Number	Minimum Saturation Voltage * @ 100 μa (volts)	Minimum Forward Current @ +1.0 volt (mA)	Maximum Reverse Current (μa) 25°C	100°C	Reverse Recovery Characteristics Reverse Resistance (ohms)	Maximum Recovery Time (μs)
1N663*	100	100	5 (75v)	50 (75v)	200K	0.5
1N662†	100	10	1 (10v) 20 (50v)	20 (10v) 100 (50v)	100K	0.5
1N658*	120	100	.05 (50v)	**25 (50v)	80K	0.3
1N643†	200	10	.025 (10v) 1 (100v)	5 (10v) 15 (100v)	200K	0.3
1N789	30	10	1 (20v)	30 (20v)	200K	0.5
1N790	30	10	5 (20v)	30 (20v)	200K	0.25
1N791	30	50	5 (20v)	30 (20v)	200K	0.5
1N792	30	100	5 (20v)	30 (20v)	100K	0.5
1N793	60	10	1 (50v)	30 (50v)	200K	0.5
1N794	60	10	5 (50v)	30 (50v)	200K	0.25
1N795	60	50	5 (50v)	30 (50v)	200K	0.5
1N796	60	100	5 (50v)	30 (50v)	100K	0.5
1N797	120	10	1 (100v)	30 (100v)	200K	0.5
1N798	120	10	5 (100v)	30 (100v)	200K	0.25
1N799	120	50	5 (100v)	30 (100v)	200K	0.5
1N800	120	100	5 (100v)	30 (100v)	100K	0.5
1N801	150	10	1 (125v)	30 (125v)	200K	0.5
1N802	150	50	5 (125v)	50 (125v)	200K	0.5
1N803	200	10	5 (175v)	50 (175v)	200K	0.5
1N804	200	50	10 (175v)	50 (175v)	200K	0.5
1N659	60	6	5 (50v)	25 (50v)	400K	0.3
1N660	120	6	5 (100v)	50 (100v)	400K	0.3
1N661	240	6	10 (200v)	100 (200v)	400K	0.3
1N625	30	4 @ 1.5v	1 (20v)	30 (20v)	400K	1 μsec
1N626	50	4 @ 1.5v	1 (35v)	30 (35v)	400K	1 μsec
1N627	100	4 @ 1.5v	1 (75v)	30 (75v)	400K	1 μsec
1N628	150	4 @ 1.5v	1 (125v)	30 (125v)	400K	1 μsec
1N629	200	4 @ 1.5v	1 (175v)	30 (175v)	400K	1 μsec

*Maximum DC working inverse voltage is 85% of minimum saturation voltage.

†Mil-E-1/1171 (SigC) ‡Mil-E-1/1139 (SigC) •Mil-E-1/1140 (SigC) *Mil-E-1/1160 (SigC)

**Max. Reverse Current at 150°C.

OTHER SPECIFICATIONS: Peak Pulse Current, 1 μsec, 1% duty cycle: 3.0 Amps.
Storage and Operating Temperature Range: −65°C to 200°C.

Fast Switching Low Capacitance Types

TYPE NO.	MIN. SAT. VOLTAGE @ 100 μa (volts)	MIN. FWD. CUR. @ 1.0 volt (mA)	MAXIMUM REVERSE CURRENT (μa) 25°C	100°C	REVERSE RECOVERY CHARACTERISTICS REVERSE RESIST. (Ohms)	MAX. RECOV. TIME* (μs)	TYPICAL RECOV. TIME** (Mμs)	MAX. CAP. @ ZERO VOLTS (μμf)
1N925	40	5	1.0 (10v)	20 (10v)	20K	0.15	5.0	4.0
1N926	40	5	0.1 (10v)	10 (10v)	20K	0.15	5.0	4.0
1N927	65	10	0.1 (10v) 5.0 (50v)	10 (10v) 25 (50v)	20K	0.15	5.0	4.0
1N928	120	10	0.1 (10v) 5.0 (50v)	10 (10v) 25 (50v)	20K	0.15	5.0	4.0

*Switching from 5mA to −10 volts (R_L = 1K, C_L = 10μμf)
**Switching from 5mA to −10 volts ($R_{L(opt)}$ = 100 ohms, C_L = 8μμf including diode capacitance)

PSI

Pacific Semiconductors, Inc.

Very High Voltage Silicon Rectifiers

- Many values . . . 1,000 to 16,000 Volts
- No voltage derating over entire temperature range of −55°C to 150°C
- Extremely rugged
- Non-metallic "cold" case
- Wire-in leads . . . easy to use
- Use in printed circuit board applications

EIA TYPE NUMBER	Peak Inverse Voltage (volts)	Maximum Average Rectified Current (mA) @ 25°C	@ 100°C	MAX RMS Input Voltage* (volts)	MAX DC Fwd Voltage Drop @ 100 mA DC 25°C	Dimensions (Inches) L.	Dia.
1N1730	1000	200	100	700	5	.5	.375
1N1731	1500	200	100	1050	5	.5	.375
1N1732	2000	200	100	1400	9	1.0	.375
1N1733	3000	150	75	2100	17	1.0	.375
1N1734	5000	100	50	3500	18	1.0	.5
1N2382	4000	150	75	2800	18	1.0	.5
1N2383	6000	100	50	4200	27	1.5	.5
1N2384	8000	70	35	5600	27	1.5	.5
1N2385	10000	70	35	7000	39	2.0	.5

*Resistive or Inductive Load
Maximum DC Reverse Current @ Rated PIV 10μA @ 25°C, 100μA @ 100°C.
Maximum Surge Current (8msec.): 2.5 Amps.
Continuous DC Voltage same as PIV.
Operating Temperature Range −55°C to 150°C.

EIA Type	Length Inches	Absolute Max. Rtgs. H.W Res. Load at 75°C Ambient Peak Inverse Voltage Volts	Max. Rectified DC Output Current mA	Electrical Characteristics at 25°C Ambient Forward DC Volt Drop at Rated DC Current Volts	Reverse DC Current at Rated PIV mA
1N1139	4⅝	3600	65	27.0	.025
1N1140	2½	3600	65	18.0	.025
1N1141	4⅝	4800	60	36.0	.025
1N1142	2½	4800	50	24.0	.025
1N1143	4⅝	6000	50	45.0	.025
1N1143A	4⅝	6000	65	30.0	.025
1N1144	6⅛	7200	50	54.0	.025
1N1145	4⅝	7200	60	36.0	.025
1N1146	6⅛	8000	45	60.0	.025
1N1147	6⅛	12000	45	60.0	.025
1N1148	6⅛	14000	50	52.0	.025
1N1149	6⅛	16000	45	60.0	.025

Storage and Operating Temperature Range −55°C to 150°C

½ ACTUAL SIZE

NEW! Very High Voltage Cartridge Rectifiers 12 to 30 KV 1N3052 thru 1N3061

Silicon Subminiature Rectifiers

MEDIUM POWER - Military Types*

EIA TYPE NUMBER	Peak Inv. Voltage (v)	Maximum Avg. Rectified Current (mA)† @ 25°C	@ 150°C	Minimum Saturation Voltage @ 100°C	Maximum Reverse Current @ PIV (μA) @ 25°C	@ 100°C	Max. Avg. Voltage Drop @ I_F = 400 mA @ 25°C (v)
AF1N645	225	400	150	275	0.2	15	1.0
AF1N646	300	400	150	360	0.2	15	1.0
AF1N647	400	400	150	480	0.2	20	1.0
AF1N648	500	400	150	600	0.2	20	1.0
AF1N649	600	400	150	720	0.2	25	1.0

* Mil-E-1/1143 (USAF)
1. Resistive or Inductive Load
Maximum Storage and Operating Temperature Range −65°C to 150°C

TYPE NO.	MAXIMUM RATINGS Recurrent Peak Inv. Voltage at 150°C (Volts)	RMS Voltage at 150°C (Volts)	Avg. Forward[1] Current I_O (mA) at 25°C	at 150°C	ELECTRICAL CHARACTERISTICS Min. E_z at 100 μA at 25°C (Volts)	Max. E_f at 500 mA at 25°C (Volts)	Max. I_R (μa) Recurrent Peak Inv. Voltage at 25°C	at 100°C	Max. Avg. Inverse Current[2] at 150°C (ma)
PS405	50	35	400	150	75	1.5	5	50	500
PS410	100	70	400	150	130	1.5	5	50	500
PS415	150	105	400	150	180	1.5	5	50	500
PS420	200	140	400	150	240	1.5	5	50	500
PS425	250	175	400	150	285	1.5	5	50	500
PS430	300	210	400	150	340	1.5	5	50	500
PS435	350	245	400	150	400	1.5	15	75	500
PS440	400	280	400	150	450	1.5	15	75	500
PS450	500	350	400	150	560	1.5	15	75	500
PS460	600	420	400	150	675	1.5	15	75	500

TYPE NO.	MAXIMUM RATINGS Recurrent Peak Inverse Voltage (Volts) @ 100°C	RMS Voltage @ 100°C (Volts)	Avg. Forward Current I_O (mA)[1] @ 25°C	@ 100°C	ELECTRICAL CHARACTERISTICS Min. E_z @ 100 μA @ 1.0V E_f @ 25°C (Volts)	Min. I_f @ Recurrent Peak Inv. Voltage @ 25°C (mA)	Max. I_R (μa) @ Recurrent Peak Inv. Voltage @ 25°C	@ 100°C	Max. Avg.[2] Inverse Current @ 100°C (ma)
PS005	50	35	250	140	75	100	10	75	100
PS010	100	70	250	140	130	100	10	75	100
PS015	150	105	250	140	180	100	10	75	100
PS020	200	140	250	140	240	100	10	75	100
PS025	250	175	250	140	285	100	10	75	100
PS030	300	210	250	140	340	100	30	100	100
PS035	350	245	250	140	400	100	30	100	100
PS040	400	280	250	140	450	100	30	100	100
PS050	500	350	250	140	560	100	30	100	100
PS060	600	420	250	140	675	100	30	100	100

1. Resistive or Inductive Load.
2. Average over one cycle for half wave resistive or choke input circuit with rectifier operating at full rated current and maximum RMS input.

PSI® High-Q Varicap®

VARICAP TYPE	Capacitance* @ 4VDC 50MC (μμf)	Quality Factor Min. (Q) @ 4VDC 50MC	Max. Working Voltage (VDC)	Minimum Saturation Voltage @ 100 μADC (VDC)	Maximum Inverse Current @ 50VDC (μADC)
PC-112-10	10	50	80	90	0.5
PC-113-22	22	50	80	90	0.5
PC-114-47	47	50	80	90	0.5

CAPACITANCE CHANGE: From 2VDC to 80VDC, 4.0 to 1 Min.

VARICAP TYPE	Capacitance* @ 4VDC 50MC (μμf)	Quality Factor Min. (Q) @ 4VDC 50MC	Max Working Voltage (VDC)	Minimum Saturation Voltage @ 100 μADC (VDC)	Maximum Inverse Current @ 75VDC (μADC)
PC-115-10	10	100	100	110	0.5
PC-116-22	22	100	100	110	0.5
PC-117-47	47	100	100	110	0.5
PC-122-47	47	75	100	110	0.5

CAPACITANCE CHANGE: From 2VDC to 100VDC, 5.2 to 1 Min.
*All capacitance values are ±20% All values at 25°C
"VARICAP" is the registered trade-mark of silicon voltage-variable capacitors manufactured by Pacific Semiconductors, Inc.

Voltage Reference Diodes

EIA Type Number	REFERENCE VOLTAGE @ 7.5 mA @ 25°C (volts) Min.	Avg.	Max.	Max. Voltage change from 25°C Reference Voltage (volts) −55°C to + 100°C	Max. Dynamic[1] Resistance (ohms)
1N2765	6.46	6.80	7.14	±0.050	20
1N2766	12.92	13.60	14.28	±0.100	40
1N2767	19.38	20.40	21.42	±0.150	60
1N2768	25.84	27.20	28.56	±0.200	80
1N2769	32.30	34.00	35.70	±0.250	100
1N2770	38.76	40.80	42.84	±0.300	120

1. Measured with 1 mA AC superposed on 7.5 mA DC
Max. Operating Temp. @ I_Z=7.5 mA: −65°C to +175°C.

NEW! Regulator Diodes 1.5v to 3.0v ±5% and ±2% types—PS1171 thru PS1177

SALES OFFICES:

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DeWitt, N.Y.—4455 E. Genesee St.

Ottawa—227 Laurier Ave. West. • CE 2-8504

PENNSYLVANIA—320 Huntingdon Pike, Rockledge, Philadelphia, Pa. • Pilgrim 2-8089 • TWX: ROCKLEDGE PA 1064

Baltimore, Md.—1811 North Rolling Rd. • Windsor 4-3622

St. Petersburg, Fla.—P.O. Box 8215 • WAverly 1-9735

ILLINOIS—6957 W. North Avenue, Oak Park, Illinois • Village 8-9750 • TWX: OKP 1547

Dallas—2981 Freewood Drive • P.O. Box 6067 Riverside 7-1258

Detroit—1204 N. Woodward, Royal Oak 4 • LIncoln 8-4722

CALIFORNIA—8271 Melrose Ave., Los Angeles 46, Calif. • OLive 3-7850

Palo Alto—701 Welch Road, Suite 305 • DAvenport 1-2240

DISTRIBUTORS IN MAJOR ELECTRONIC CENTERS COAST-TO-COAST

PSI HIGH-RELIABILITY MINIATURIZATIONS

SPECIFICATIONS ON THE WORLD'S SMALLEST EIA SILICON DIODES

These low leakage EIA types with 250 mW dissipation have been exhaustively tested for reliability and long life. All are available for delivery in production quantities.

Type No.	Min. Sat. Voltage @ 100 mA (v)	Min. Fwd. Current @ +1.0 V (mA)	Maximum Reverse Current (nA) 25°C	Maximum Reverse Current (nA) 100°C	Reverse Recovery Characteristics: Reverse Res. (Ohms)	Reverse Recovery Characteristics: Max. Recov. Time (μS)
1N897	50	5	.025 (10V) .1 (40V)	.5 (10V) 20 (40V)	100K	1.0
1N898	50	100	.025 (10V) .5 (40V)	.5 (10V) 20 (40V)	100K	0.3
1N899	100	5	.025 (10V) .1 (80V)	.5 (10V) 20 (80V)	100K	0.3
1N900	100	50	.025 (10V) .1 (80V)	.5 (10V) 20 (80V)	100K	0.3
1N901	100	100	.025 (10V) .5 (80V)	.5 (10V) 20 (80V)	100K	0.3
1N902	200	10	.025 (10V) 1.0 (100V)	.5 (10V) 15 (100V)	200K	0.3

Phone, wire or write for new low prices and delivery schedules on production quantities

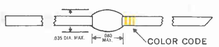
NEW LOW PRICES ON PD-100

*micro*diode

PSI's super-miniaturized PD-100 silicon diodes are available now at price reductions of as much as 20%! Look at the performance characteristics of these fast-recovery silicon computer types:

High power dissipation..... 250 milliwatts
High conductance.....up to 100 mA @ 1 volt
High voltage..... 200v operating voltage
Fast recovery..... 200K @ .3 microseconds
High temperature.....Operating range −65°C. to 150°C.
High reliability.....Degradation rates of .01 to .1%/1000 hrs. (or .001%/1000 hrs. with special aging)

Type Number	Min. Sat. Voltage @ 100 mA (v)	Min. Fwd. Current @ +1.0v (mA)	Maximum Reverse Current (nA) 25°C	Maximum Reverse Current (nA) 100°C	Reverse Recovery Characteristics: Reverse Res. (ohms)	Reverse Recovery Characteristics: Max. Recov. Time (μs)
PD-101	50	5	1.0 (10v)	25 (10v)	100K	1.0
PD-102	50	20	.5 (10v)	25 (10v)	100K	0.3
PD-103	50	100	.5 (10v)	25 (10v)	100K	0.3
PD-104	100	5	.5 (10v)	25 (10v)	100K	0.3
PD-105	100	20	.5 (10v)	25 (10v)	100K	0.3
PD-106	100	50	.5 (10v)	25 (10v)	100K	0.3
PD-107	100	100	.5 (10v)	25 (10v)	100K	0.3
PD-108	200	10	.5 (10v) 5.0 (100v)	25 (10v)	200K	0.3
PD-109	200	10	.025 (10v) 1.0 (100v)	5 (10v)	200K	0.3



PHYSICAL CHARACTERISTICS:
HERMETICALLY SEALED—Bonded Surface films.
TERMINALS— .004x.019 gold plated leads. Lead length ½ inch minimum.
MARKING—Type number designated by color of body and color of stripes on pointed (cathode) lead.
ALL DIMENSIONS SHOWN IN INCHES.

SPECIFICATIONS NOW AVAILABLE!

*pico*transistor

PSI Type	Equivalent
PMT 011	2N1409
PMT 012	2N1410
PMT 013	2N696
PMT 014	2N697

*micro*transistor

PMT 111	2N1409
PMT 112	2N1410

Write or phone for details on these exciting new Micro components!

ACTUAL SIZE

Please note:
All specifications and information contained herein are current as of
July 15, 1960

HERE'S ONE WAY OF LOOKING AT PRODUCTION CAPABILITY

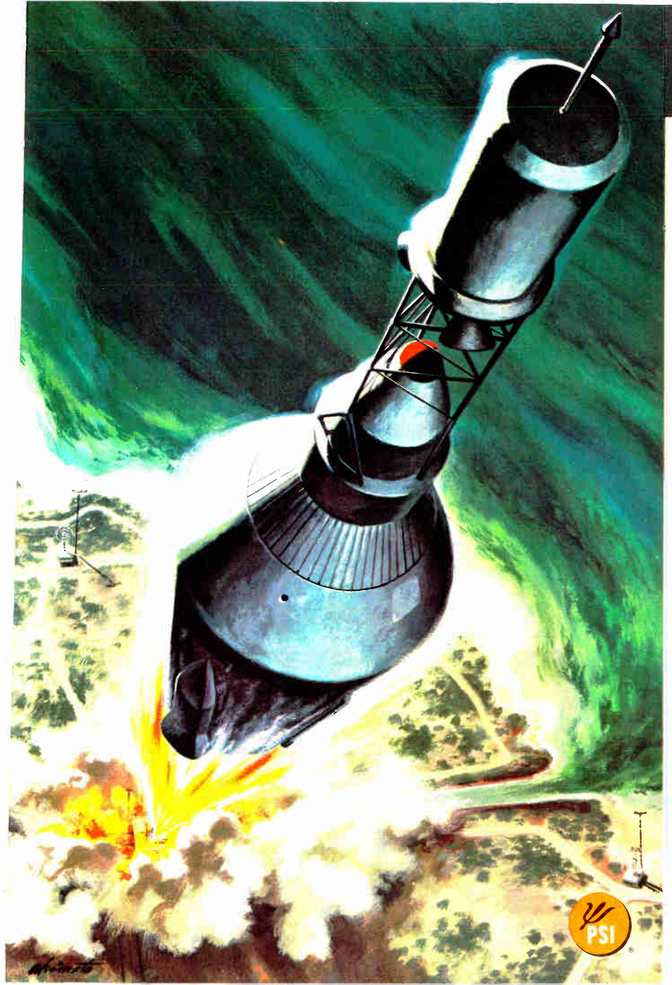
These silicon transistors are a sample of the production capability housed in the laboratory and manufacturing complex of Pacific Semiconductors, Inc. Each is an advanced type not previously available . . . each is a PSI origination designed to fill a carefully forecast commercial need.

Because production capability at PSI is based solidly on product origination and product reliability, The Company is carrying on a continuing search for experienced scientists, physicists and engineers of outstanding ability. If you have these talents, you will find unlimited career opportunities at commercially oriented PSI.

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE, INC.
CORPORATE HEADQUARTERS: 10451 West Jefferson Boulevard, Culver City, California
General Sales Offices: 12955 Chadron Avenue, Hawthorne, California

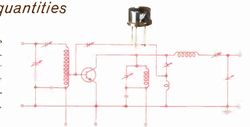
LITHO IN U.S.A.



ADVANCED SILICON TRANSISTORS WITH UNIQUE CAPABILITIES...

TYPES 2N1505, 2N1506

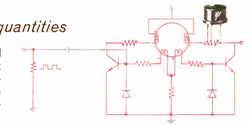
Available immediately in production quantities



These NPN VHF power amplifiers and oscillators are specially designed for high frequency, high power operation at low supply voltages. They give typical power outputs of 1 w at 70 mc and 500 mw at 200 mc. Highly efficient high frequency operation is assured by combining either with a High-Q Varicap frequency multiplier.

TYPES 2N1409, 2N1410

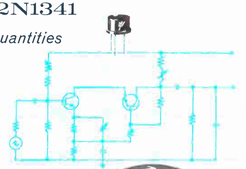
Available immediately in production quantities



These NPN high speed, high current core drivers and general purpose switches offer fastest switching time at high current ratings with extremely low saturation resistance. This combination makes them ideal for use in transistor-ferrite circuitry and many other computer applications.

TYPES 2N1335 through 2N1341

Available immediately in production quantities



A unique combination of high voltage, VHF and high power is the outstanding feature of these NPN Mesa transistors, which make it possible for the first time to design video amplifiers with output voltages of 140 v and bandwidth of 10 mc. Other applications are power amplifiers, power oscillators and high voltage switches. *At right: Typical high voltage video amplifier circuit.*

TYPES PT 900, PT 901

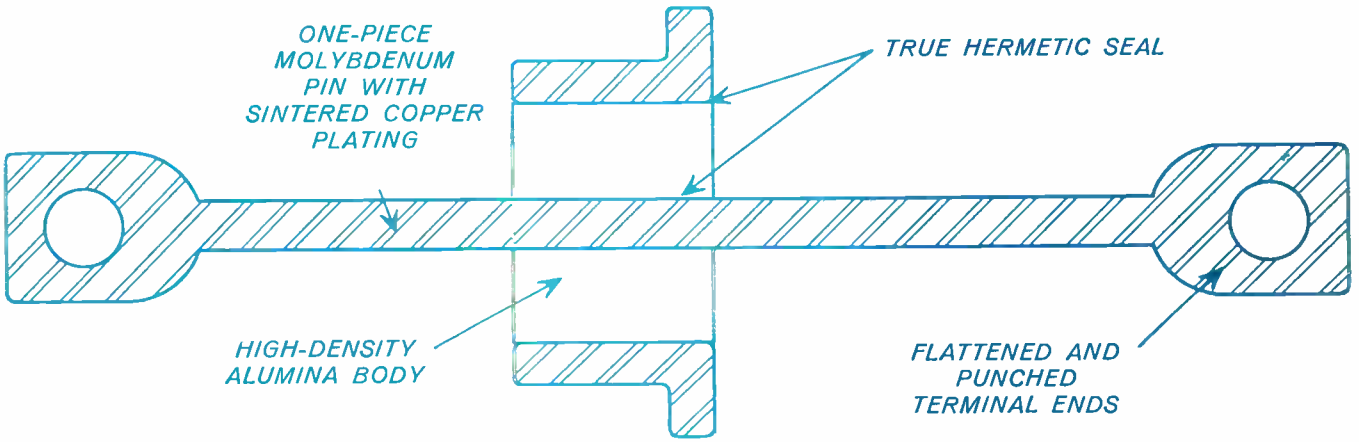
Available now for evaluation

10 ampere high frequency, high speed, high power oscillators, amplifiers, switches and converters. These are the only power transistors that offer 100 w at 5 mc plus μs high current switching. *At right: Typical 40 w 10 mc amplifier circuit.*

Now Available! **TYPES 2N696, 2N697**

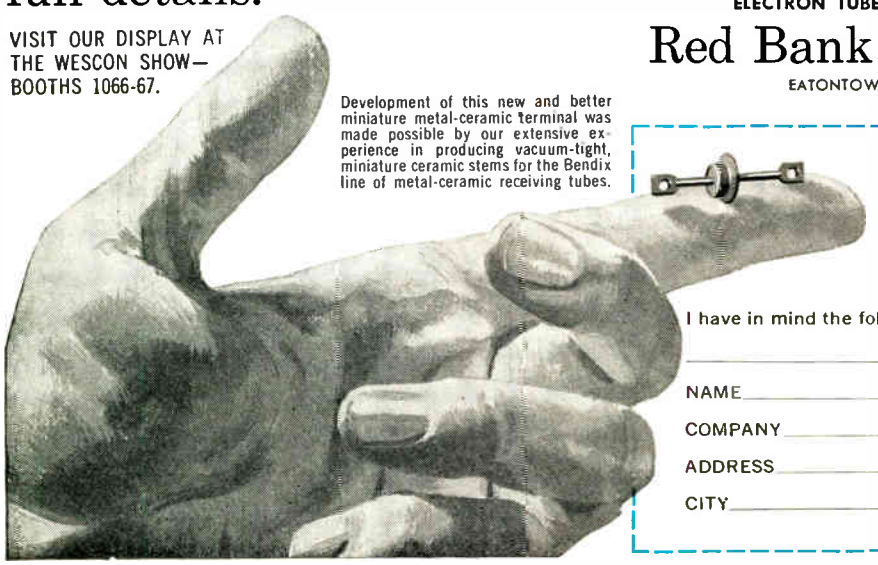
LOOK INSIDE FOR LATEST INFORMATION AND SPECIFICATIONS ON PSI SILICON DIODES, ZENERS AND RECTIFIERS

NEW BENDIX CERAMETERM™ (CERAMIC-METAL TERMINAL) is offered as a superior solution to glass terminal problems confronting manufacturers of military electronics gear, transformers, condenser banks, relays, transistors and similar equipment.



Now in production—this new and better terminal with 8 big advantages: **1** Developed especially for super-reliability on high-performance applications involving shock and high temperatures. **2** Vacuum-tight seal. **3** Will withstand brazing temperatures at 1500°F. **4** Tested to 11,000 psi shear stress without failure. **5** Ideal for encapsulated devices. **6** For both replacement and original equipment use. **7** Extreme resistance to cracking under mechanical or thermal stresses. **8** Variety of configurations. Send for full details.

VISIT OUR DISPLAY AT THE WESCON SHOW—BOOTHS 1066-67.



Development of this new and better miniature metal-ceramic terminal was made possible by our extensive experience in producing vacuum-tight, miniature ceramic stems for the Bendix line of metal-ceramic receiving tubes.

ELECTRON TUBE PRODUCTS

Red Bank Division

EATONTOWN, N. J.

THE Bendix CORPORATION

Electron Tubes Dept. E8
The Bendix Corporation
Eatontown, New Jersey

Gentlemen: Please send me complete details on your new Bendix CERAMETERM.
I have in mind the following applications_____

NAME_____ TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE___ STATE_____

Machine to "Identify" Objects Developed

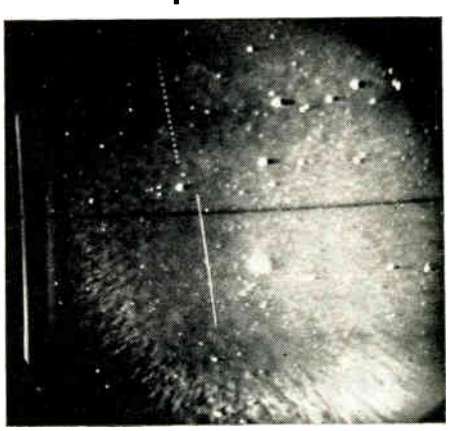
The Mark I Perceptron, an electromechanical machine, which can be trained to automatically identify objects or patterns, such as the alphabet, has been developed at the Cornell Aeronautical Laboratory, Buffalo, N. Y., to demonstrate the feasibility of the basic perception concept.

The Perceptron Research Program is sponsored by the Office of Naval Research with assistance from the Rome Air Development Center, Rome, N. Y., of the Air Research and Development Command.

Though not designed for practical applications, the Mark I Perceptron is rather a limited capacity version of what may become a family of efficient pattern-recognizing machines. However, the Perceptron, unlike some pattern-recognition machines, does not recognize forms by matching them against an inventory of stored images or by performing a mathematical analysis of characteristics. Instead, its recognition is direct and almost instantaneous since its memory is in the form of altered "pathways" through the system rather than a coded representation of the unique stimuli.

The Mark I consists basically of a "sensory unit" of photo cells which views the pattern shown to the machine, "association units" which contain the machine's memory, and response units which visually display the machine's pattern-recognition response.

THERE IT GOES! (Sputnik IV)



Russian satellite is photographed passing over Detroit. Photo was successful test of Bendix Corp's. TV Satellite Tracker developed at their Research Labs at Southfield, Mich. Tracker was developed for National Space Surveillance Control Center (Bedford, Mass.) under a program sponsored by Advanced Research Projects Agency, DOD.

AGE IT!

Ancient Egyptian artifacts from University of Nebraska State Museum

INHERENT STABILITY
Assured in a DALOHM RS Resistor

IN-HER-ENT, *adj.* Firmly infixed; esp., involved in the essential character of anything.

Stored on the shelf for months . . . or placed under continuous load . . . operating in severe environmental, shock, vibration and humidity conditions . . . Dalohm precision resistors retain their stability because it has been "firmly infixed" by Dalohm design and methods of manufacture.

For all applications demanding resistors that meet or surpass MIL specifications, you can depend on Dalohm.

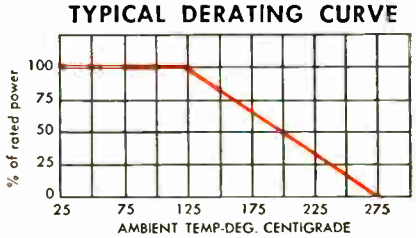
WIRE WOUND • PRECISION • POWER

DALOHM TYPE RS RESISTORS

When space is at a premium, and precision and power are needed, specify DALOHM RS Type resistors.

Configurations: Type RS with radial leads and in most ratings and resistances shown: Type RLS with axial leads for printed circuits, and Type RSE for clip mounting.

TYPICAL DERATING CURVE



- Rated at ½, 1, 2, 3, 5, 7, and 10 watts
- Resistance range from .05 ohm to 175K ohms, depending on type
- Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%
- Temperature coefficient within 0.00002/degree C.
- Operating temperature range from —55° C. to 275° C.
- Smallest in size, ranging from 5/64" by 5/16" to 3/8" by 1-25/32". Ten choices.
- Completely protected, impervious to moisture and salt spray
- Complete welded construction from terminal to terminal
- Silicone sealed, offering high dielectric strength and maximum resistance to abrasion.
- Surpass requirements of MIL-R-26C.

Write for Bulletins R-23, R-25 and R-30, with handy cross-reference file cards.

SPECIAL PROBLEMS?

You can depend on Dalohm, too, for help in solving any special problem in the realm of development, engineering, design and production. Chances are you can find the answer in our standard line of precision resistors (wire wound, metal film and deposited carbon); trimmer potentiometers; resistor networks; collet-fitting knobs; and hysteresis motors. If not, just outline your specific situation.

from **DALOHM**
Better things in smaller packages
DALE PRODUCTS, INC.
1304 28th Ave., Columbus, Nebr.

Tele-Tips

A LITTLE KNOWLEDGE . . . The technique of building "mathematical models" of businesses has intrigued mathematicians for some time, though selling the idea to business men has not been easy. The non-mathematical mind finds it difficult to comprehend that mathematical analogs of businesses can be manipulated to predict actual profit returns. It was made a little easier by the cooperative spirit of the businessmen. They were, as a matter of fact, awed.

But lately the mathematicians have begun to suspect that they have explained too much. Inquiries now sound like this, "What can Boolean algebra do for my business?"

RADIOACTIVE materials being transported across state lines are a concern and a problem of local state governments. An experiment is being conducted in New York City to determine whether it is feasible to monitor highways for the illegal transport of radioisotopes. Tracerlab Inc. designed a continuous radiation monitor which is checking all cars and trucks crossing New York's George Washington Bridge.

TV RECEIVERS have been installed on each tier of Cook County Jail, providing recreation for the 2,000 inmates in the maximum security institution. The jail is the only institution in the country permitting TV viewing by inmates under maximum security. The 37 Admiral receivers operate on their own built-in antennas.

ENGINEER EMPLOYMENT ads are one of the most reliable barometers of industry trends, and often tell interesting little stories of their own. Our eye was caught by this line, "CANADIANS COME HOME." "Salaries are not always equal to the highest. The weather can be miserably uncomfortable. But there are interesting and challenging jobs in companies whose future is geared to the country."

Tung-Sol/Chatham CROWBAR Thyratrons

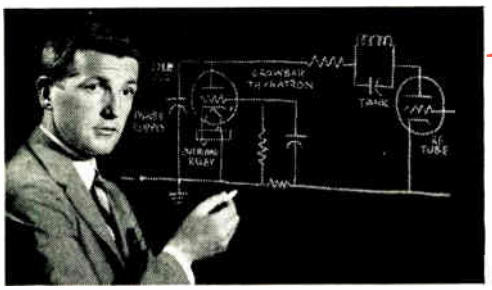
PROTECT HIGH-POWER CIRCUITS AGAINST DESTRUCTIVE ARCS

Any one of a host of causes can trigger internal arcs in high-power tubes with little or no warning . . . even if the tubes are well designed, operate in well-engineered circuits, and have conservative demands placed upon them. Cosmic rays, line-voltage transients, parasitic oscillations, spurious primary and secondary electrons and material whiskers are just a few of the potential sources of these highly destructive arcs.

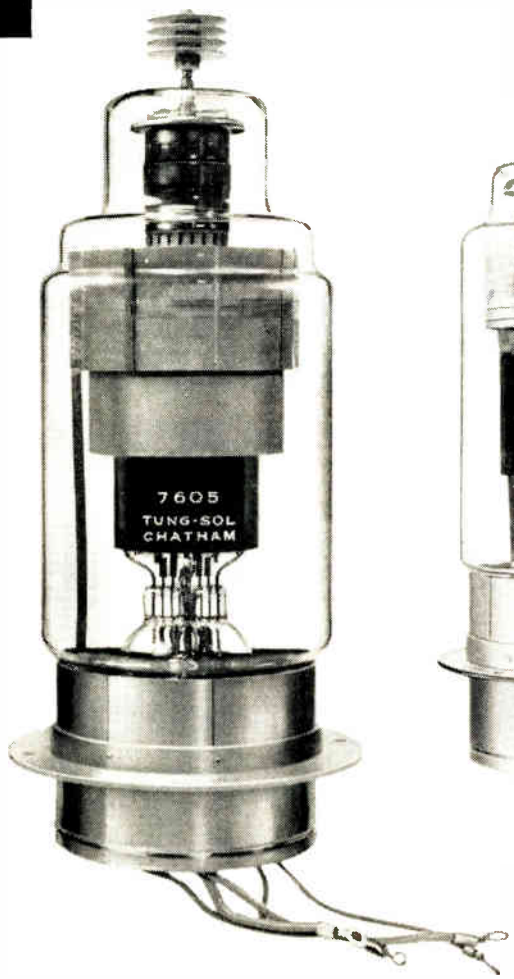
But by engineering Tung-Sol/Chatham high reliability crowbar hydrogen thyratrons into your design, you can safeguard against costly arc-generated breakdowns. By short-circuiting destructive currents, these zero bias "arc-busters" extinguish the arcs before circuit elements can be damaged.

Instantaneous response and the ability to carry extremely large currents make these rugged thyratrons ideally suited for this purpose. Moreover, they are able to conduct these heavy surge currents even after having been idle for long periods. Each tube contains a hydrogen reservoir which promotes long life and permits optimum gas pressure adjustment for various operating conditions. Write for full technical details. Tung-Sol Electric Inc., Newark 4, N. J. TWX: NK193

Technical assistance is available through the following sales offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Toronto, Ont.



Typical application: *A crowbar thyratron is connected in series with a suitable impedance across the filter of the high voltage power supply for a high frequency amplifier tube. Whenever an arc occurs in the power tube, the rising current is used to deliver a suitable signal to the grid of the thyratron. The thyratron immediately conducts to short circuit the power supply, until the protective circuit breaker opens 0.1 second later.*



Type	DC. Anode Forward Voltage	Peak Cathode Current
7559	18KV	1500A
7568	25KV	800A
7605	25KV	2500A

TUNG-SOL®

Circle 21 on Inquiry Card

Tele-Tips

(*Continued from page* 44)

RED CHINA has started production of an 18-tube TV receiver. The 5-channel set uses tubes manufactured in China, except for the picture tubes, which are imported.

RADIO SETS in the world, outside the U. S. and Canada, totalled 165,667,000, at the end of 1959. This was an increase of 12,000,000 sets during the previous 12-month period. The biggest rise, 3,300,000 sets, to a total of 26,520,000, occurred in Communist Eastern Europe, half of it in the Soviet Union.

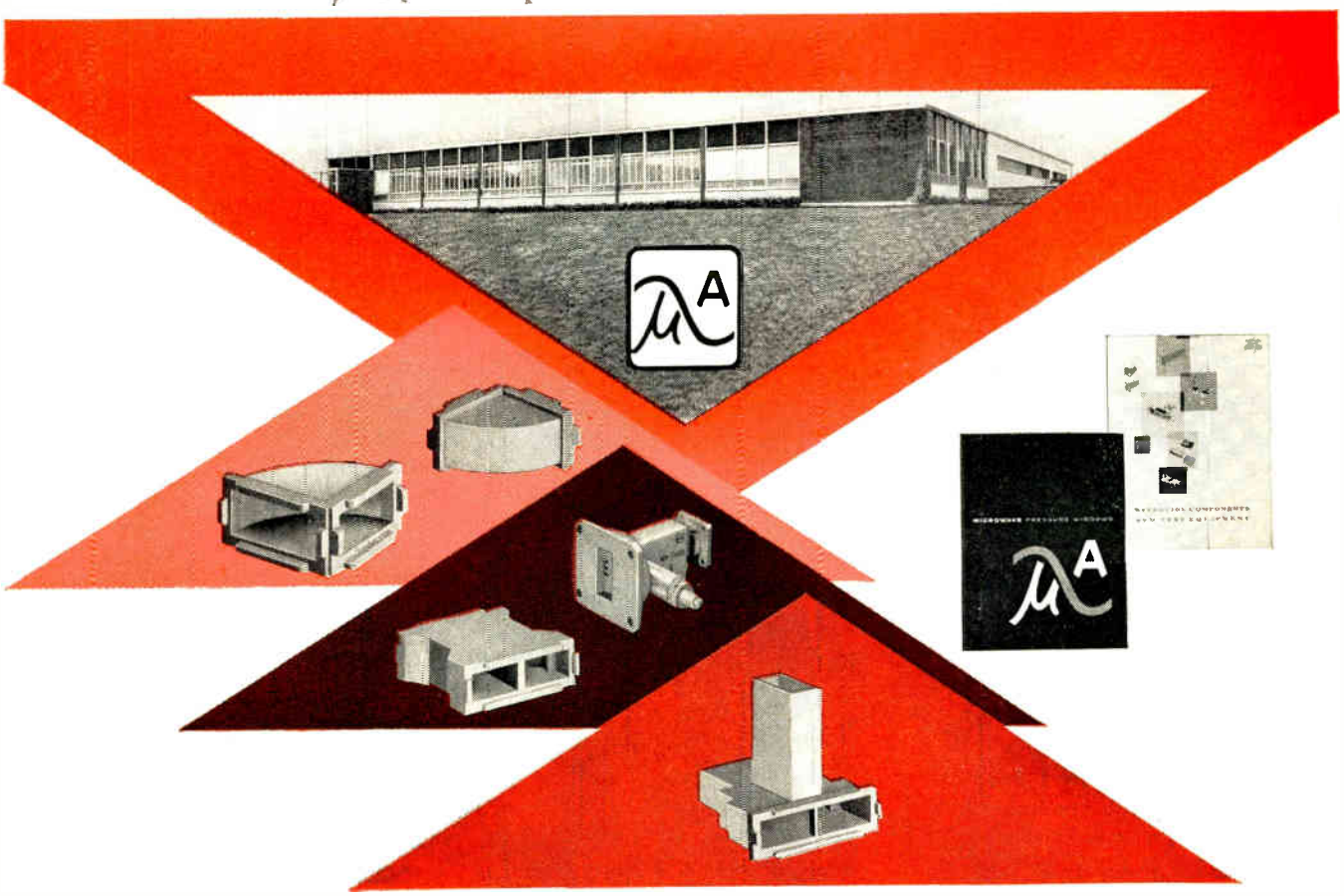
REPLACEMENT TV market may be larger than expected. A survey by Storer Broadcasting Co. found that 50% of all sets are at least five years old. A surprising 15% are ten years old or older.

DREAM ANALYZER. An Illinois Bell Telephone staff engineer reports progress on a subvocal interpreter, a dream analyzer that can codify speech that can not be heard from a sleeping person. The instrument measures lip movements and vocal cord vibrations and translates them into symbols for interpretation.

CLOSED-CIRCUIT TV is being installed in one New York City apartment house to keep an eye on the self-service elevator, to protect passengers against muggers. A Dage TV camera in the elevator car is connected to a screen in the lobby so that the lobby attendant can take immediate action in case of trouble. A 2-way sound system is included in the installation.

FCC ENGINEERS are playing a hand in the Cuban troubles, diligently monitoring illegal transmitters in the Florida area beamed at the Cuban mainland. One illegal transmitter has already been seized at Tavernier in the Florida Keys. The two operators, a man and a woman, were arraigned in Miami for violating the sections of the Communications Act dealing with illegal operations of transmitters.

COMPREHENSIVE MICROWAVE COMPONENT CAPABILITIES



This modern three-quarter-acre plant has significantly expanded the services and production capabilities of Microwave Associates' experienced Waveguide Components Division. This new research and production facility is one of the most completely equipped on the east coast. A large 3′ x 2′ capacity dip-brazing unit as well as complete plating and other shop facilities are now handling both large volume and custom-engineered orders. Components are precision-machined and produced in beryllium-copper, cast and fabricated aluminum, and cast magnesium.

Over 500 microwave components for applications from 1.12 to 90.0 kMc/s are standard items. Our Sales Engineers will gladly discuss current work in sophisticated components and RF packaging with you.

A FEW OF THE MANY COMPONENTS MANUFACTURED HERE

New High-Power Varactor Harmonic Generators — excellent suppression of unwanted harmonics and record power levels are available from these solid-state harmonic generators.

New Cast Bends — Zero bend radius — 90° E and H plane bends in S through Ka bands... Each bend is compensated to a VSWR of 1.05 over its entire waveguide band.

Sidewall Hybrid Couplers (3db) and H-Plane Folded Hybrid Tees — Cast in aluminum and beryllium-copper are available in S through Ka-band models.

Two New Catalogs — Waveguide Components Short-form Catalog (CSF-60) gives data on over 500 items of waveguide components and test equipment.

Pressure Window Catalog (12 pages) contains electrical and mechanical data on a complete line of glass-kovar, mica, and special pressure windows plus valuable installation and testing tips.

MICROWAVE ASSOCIATES, INC. Burlington, Mass. • Western Union FAX • TWX: Burlington, Mass. 942 • BRowning 2-3000
Export Sales: Microwave International Corporation, 36 West 44th St., New York, New York

Letters to the Editor

"New Product Program"

Editor, ELECTRONIC INDUSTRIES:

In accordance with our planned expansion, we have set up a New Product Program for the purpose of seeking additional new products to manufacture, or new product ideas to develop, or existing companies for acquisition or merger.

As you well know, B&K in just a few years has become one of the largest test equipment manufacturers in the country. This has been due to a fresh and practical approach in the electronics servicing field.

The New Product Program is aside from our own regular product research and development engineering. It opens up an unusual opportunity to individuals or companies with products or ideas.

However, we are not limiting our scope to the test equipment field. We will consider consumer products as well as other service and industrial items. Naturally, in any submission of products or ideas, there is no obligation either way.

Carl Korn
President
B & K Manufacturing Company
1801 W. Belle Plaine Ave.
Chicago 13, Ill.

"Designing Microwave Printed Circuits"

Editor, ELECTRONIC INDUSTRIES:

I am attaching to this letter a request from the Navy Department for a reprint from my recent article as indicated. Please send them a copy if one is still available.

For your information, I have been writing magazine articles for about fifteen years and I have never seen a response from readers as great as the one I received from this article. I have long since exhausted my supply of reprints and I have received correspondence and telephone calls from many people expressing interest in the article. This is an excellent measure of the coverage and value of your fine magazine.

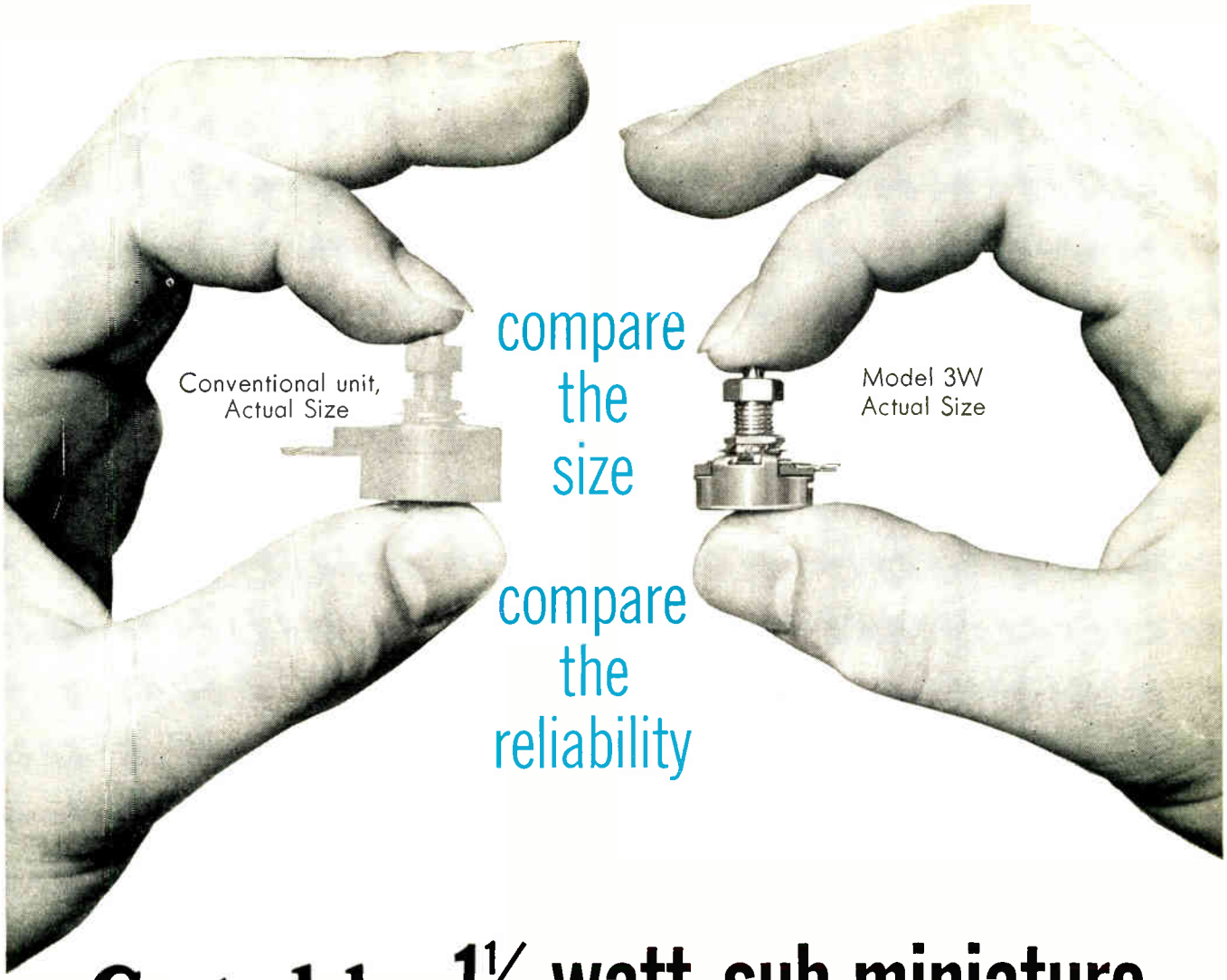
Allan Lytel, Manager
Defense Marketing Publications
Avco Corporation
Crosley Division
Cincinnati 25, Ohio

"EI at ARDC"

Editor, ELECTRONIC INDUSTRIES:

It was a pleasure to hear from you again after a lapse of so many years since you published my last article—I believe on Equipment Reliability. I must agree that the fault

(*Continued on page* 50)



Centralab's 1½ watt sub-miniature Wirewound Variable Resistor

CENTRALAB'S Model 3W is the smallest 1½ watt variable resistor on the market—⅓ smaller than otherwise similar units! Designed especially for high reliability applications, it meets the environmental and electrical specifications of MIL-R-19. The Model 3W is recommended for high temperature operation up to 125°C. Its completely closed construction is designed for sealing or potting.

SPECIFICATIONS:

Dimensions: 11/16" maximum diameter over encapsulation. 5/16" depth.

Shaft: 0.125" diameter stainless steel.

Terminals: Gold-plated nickel silver.

Resistance range: 4 ohms to 30K ohms ±10%, linear taper.

Rating: 1½ watts at 40°C.

Complete specifications on the Model 3W variable resistor are given in CENTRALAB Technical Bulletin EP-891. Write for your free copy.

Centralab
B-6016

SEE US AT WESCON, Booth 664
The Electronics Division of Globe-Union Inc.
938H E. Keefe Ave. • Milwaukee 1, Wisconsin
Centralab Canada Ltd. • Ajax, Ontario

Circle 25 on Inquiry Card

Letters to the Editor

(*Continued from page 48*)

has been all mine.

Electronic Industries has a good circulation in the newly-formed, autonomous Communications Laboratory under the reorganization of Wright Air Development Division. I find it most valuable for keeping current with advances in the state of the electronic art and often refer articles to subordinate engineers for further investigation. All of us appreciate the job your periodical is doing and hope for an even brighter future along with the snowballing advances in technology today.

George H. Scheer
Chief, Basic Techniques Branch
Communications Laboratory
Wright Air Development Division
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio

"Human Factors—"

Editor, ELECTRONIC INDUSTRIES:

It would be appreciated if you forwarded to me a reprint of the article, "Celent, C. Human Factors—Newest Engineering Discipline, Electronic Industries, 19, 2, 86-100."

I would like to draw your attention to the following errors in the article:

(1) p. 95 *Randolf* A. F. Base for *Randolph* A. F. Base.

(2) p. 99 *Electrol Minescesne*, for *Electro-luminescence.*

(3) p. 99 The simulation room provides sound attenuation *of at least 30 db at 125 cycles*, instead of the simulation room provides sound attenuation *down to 30 db SPL at 125 cycles.*

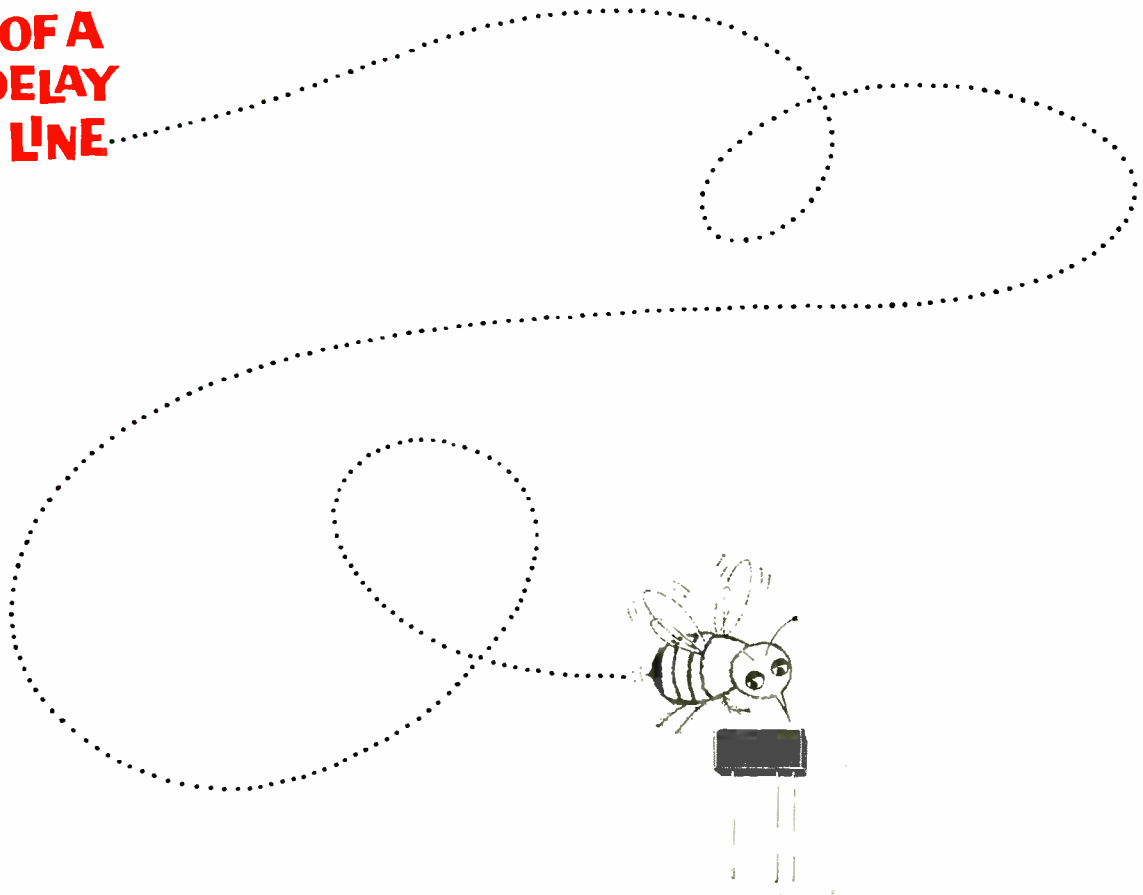
(4) p. 100 Under reference #9. *Allowed auditory signal* for, a *loud auditory signal.*

As implied in the article, the *total* human factors work for the new SAC control system (p. 95) is not being done by the System Development Corporation. International Electric Corporation, the System Manager for Contract 465L, has its own human factors staff and counts SDC (for system training) as only one of many sub-contractors in this effort.

Dr. John J. O'Hare
Systems Engineering Group
International Electric Corporation
Paramus, N. J.

Ed: Dr. O'Hare is quite right on items (1) and (2). But item (3) is correct as printed in the article. As for item (4), what can we say . . .

A HONEY OF A DELAY LINE



ESC'S NEW SUBMINIATURE LUMPED CONSTANT DELAY LINE*

Model 16-92 is the latest example of creative versatility from ESC, America's largest producer of custom-built and stock delay lines. The specifications: 1/10 usec. delay, 1,600 ohm impedance, ¼" x ¼" x ½" dimensions. Only ESC produces so many different delay lines, for so many varied applications. From the largest to the smallest, ESC has the best, most economical answer to your particular delay line problem. Write today for complete technical data.

*shown actual size

ESC

See You at the Wescon Show — Booth #906

exceptional employment opportunities for engineers experienced in computer components... excellent profit-sharing plan.

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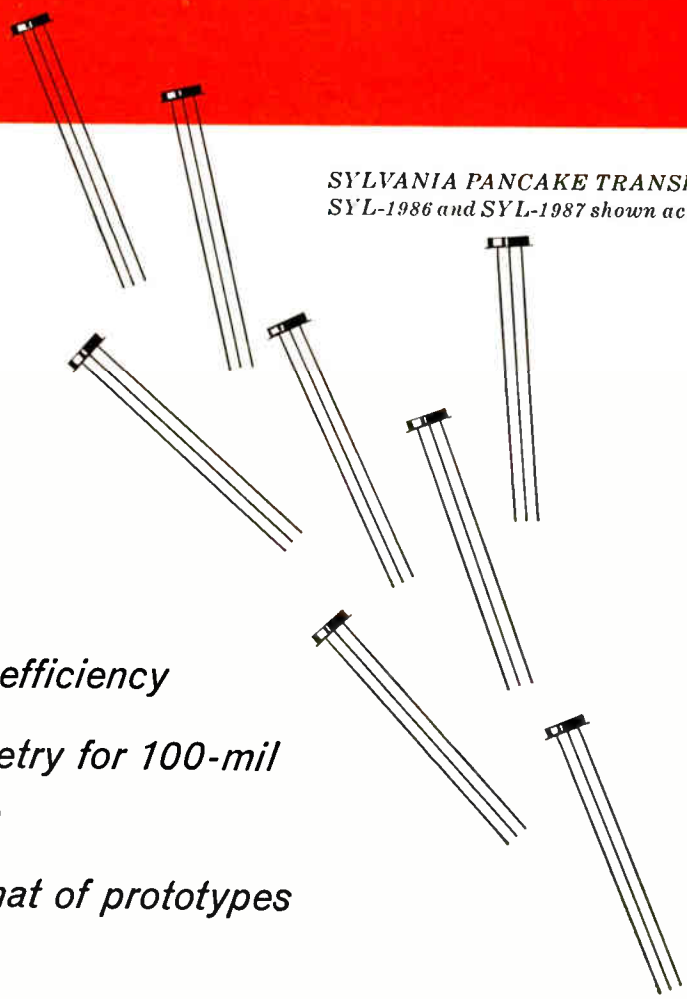
Distributed constant delay lines • Lumped constant delay lines • Variable delay networks • Continuously variable delay lines • Step variable delay lines • Shift registers • Video transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

Sylvania introduces
a new concept in

MICROMINIATURIZATION

• wafer thin! • feather light!

"PANCAKE" TRANSISTORS



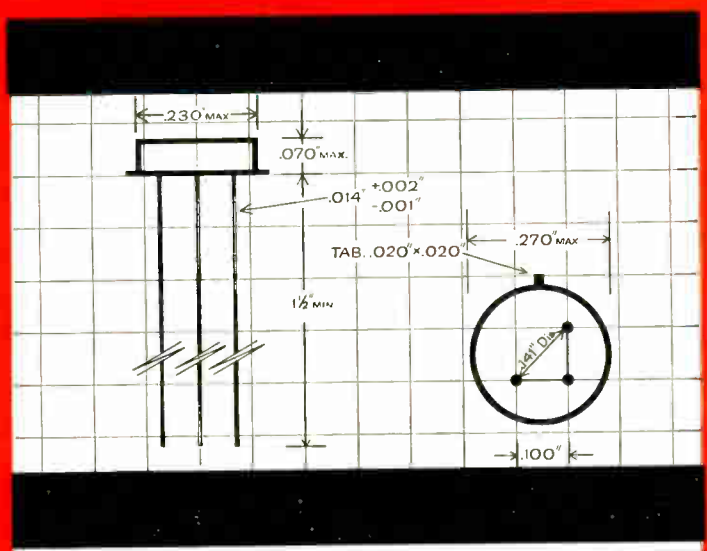
SYLVANIA PANCAKE TRANSISTORS
SYL-1986 and SYL-1987 shown actual size

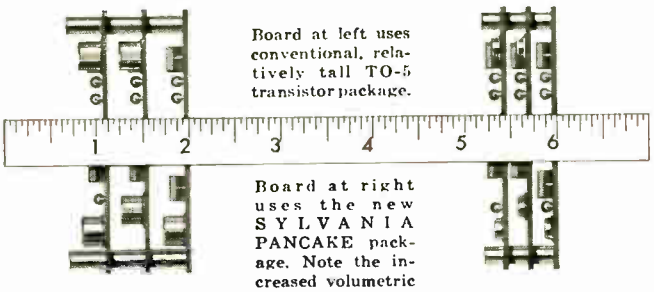
Now...
a new dimension in packaging that offers...

- *exceptional volumetric efficiency*
- *correct pin-circle geometry for 100-mil automation grid-system*
- *performance equal to that of prototypes*
- *increased ruggedness*

PANCAKE TRANSISTORS - a SYLVANIA development—herald a new era in the art of designing subminiaturized electronic equipment. PANCAKE TRANSISTORS are 85% smaller, 85% lighter in weight than their larger electrical counterparts. PANCAKE TRANSISTORS are shorter in height than the diameter of conventional ½-watt resistors. flatter than conventional silvered-mica capacitors.

PANCAKE TRANSISTORS are equipped with leads spaced to fit the 100-mil grid-system for automated installation. PANCAKE TRANSISTORS feature clear-glass stress-free matched seals, true chemical bonds that offer exceptional hermetic reliability and strength, excellent resistance to thermal shock. PANCAKE TRANSISTORS withstand atmospheric pressure as high as 200 p.s.i., enabling high-pressure leakage tests for military and industrial quality-assurance.





Board at left uses conventional, relatively tall TO-5 transistor package.

Board at right uses the new SYLVANIA PANCAKE package. Note the increased volumetric efficiency.

SYLVANIA launches its PANCAKE program with two germanium alloy switching types: PNP type SYL-1986 (electrically similar to 2N404) and NPN type SYL-1987 (electrically similar to 2N388). Many other types utilizing drift, mesa, and alloy-junction techniques are under development at Sylvania.

FOR CONSULTATION on PANCAKE transistor value to your circuit developments, contact your Sylvania Representative. For technical data, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 198, Woburn, Mass. Sylvania PANCAKE TRANSISTORS also available through Sylvania franchised Semiconductor Distributors.

Tentative data

MAXIMUM RATINGS AT 25°C	SYL-1986	SYL-1987
Collector to Base Voltage	−25V	25V
Collector Current	100mA	200mA
Power Dissipation	100mW	100mW
Temperature Range	−55°C to +100°C	−55°C to +100°C
Alpha Cutoff Frequency (min.)*	4Mc	5Mc

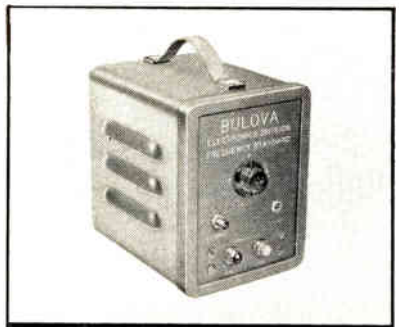
*(V_{cb} = 6V, I_e = 1.0mA) (V_{cc} = 6V, I_c = 1.0mA)

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Circle 30 on Inquiry Card

BULOVA PORTABLE FREQUENCY STANDARD

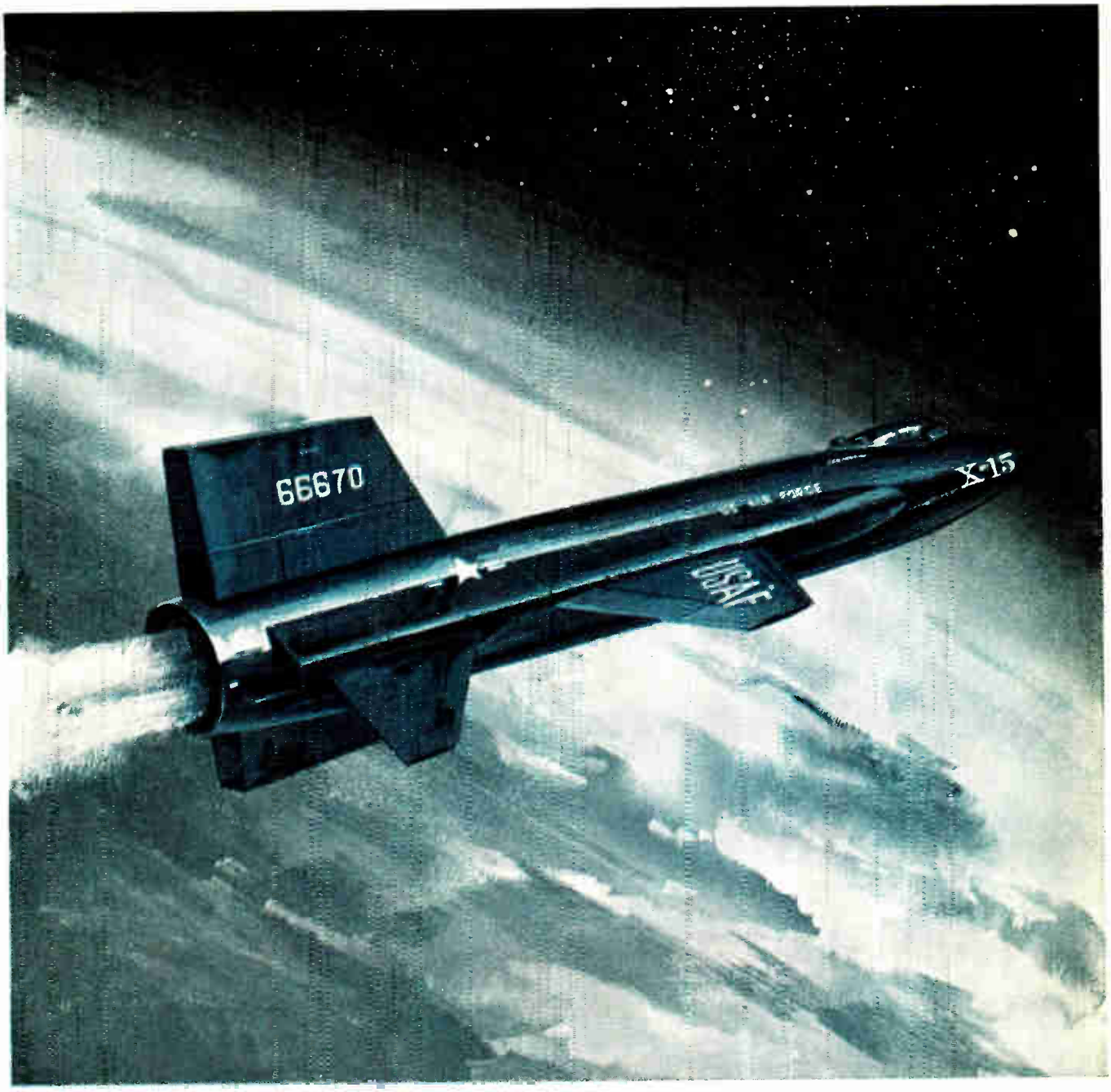


Whatever the beat you wish to "equal" or check out, you'll find the Bulova portable lab and field standard assures an uncompromised balance between stability and reliability.

For instance, the FS-100 will hold to $\pm 1pp10^7$ in the 10kc thru 20 mc range... or to $\pm 1pp10^8$ in the 50kc thru 10 mc group—for a full twenty-four hours. Its output is 1v P to P into 1K, sine or square wave, in either rating, with a 115v ac input or with its own self-contained, rechargeable power pack. Though it measures only a scant 6 x 8 x 8 inches—power supply and all—the advanced design and transistor construction of the FS-100 underwrites a life expectancy of over 25,000 hours.

For more information on how the Bulova FS-100's portability, reliability and stability can assist you in pulling more accurate on-the-spot checks, write Department 1672, Bulova Electronics, Woodside 77, New York.

BULOVA
ELECTRONICS
DIVISION



Spark for the edge of outer space:

BENDIX IGNITION ON NORTH AMERICAN'S X-15

The X-15 project is a truly national research effort by the Air Force, Navy, and National Aeronautics and Space Agency. In manned flight, the X-15 will scorch through uncharted skies at speeds of more than 4,000 miles an hour.

This edge-of-space craft will take its pilot closer to the stars than any human has ever dared to venture. 50,000 pounds of thrust will be provided by the most powerful single-chamber rocket engine ever built for manned flight. The ignition system was specially designed and produced for this installation by Bendix® . . . foremost name in ignition.

Scintilla Division
SIDNEY, NEW YORK

THE Bendix CORPORATION

Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien B'vd., Montreal 9, Quebec. Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

Circle 32 on Inquiry Card

VARI-COLORED EMBOSSED LABELS

ACTUAL SIZE TAPES

MADE ON-THE-SPOT WITH...

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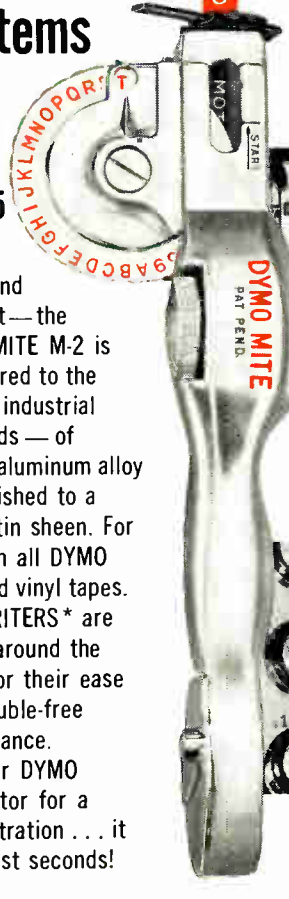
A DYMO TAPEWRITER

a new dimension in identification systems

DYMO MITE M-2

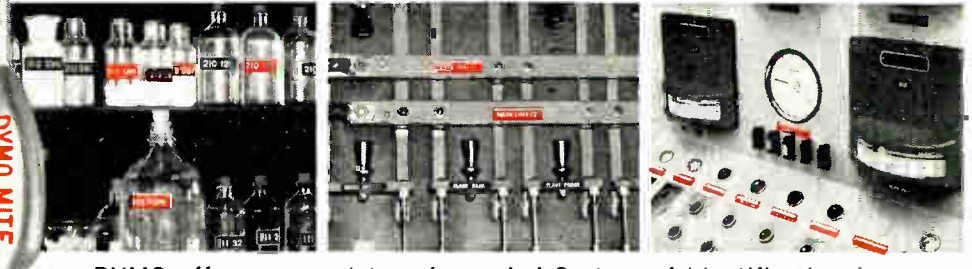
34.95

LIGHT and compact—the DYMO MITE M-2 is engineered to the highest industrial standards — of rugged aluminum alloy and polished to a high satin sheen. For use with all DYMO patented vinyl tapes. TAPEWRITERS* are known around the world for their ease and trouble-free performance. Ask your DYMO Distributor for a demonstration . . . it takes just seconds!

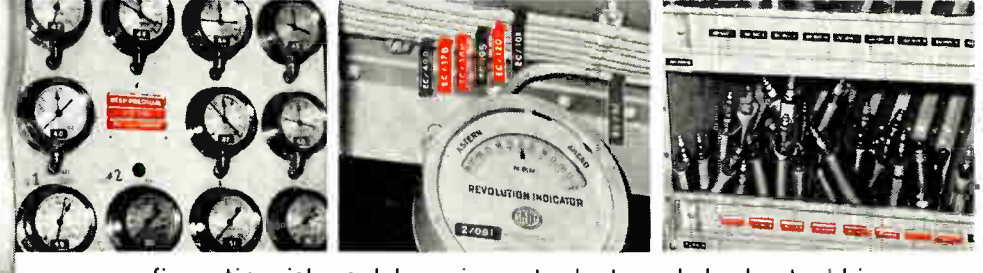


ANYONE can make perfect raised-letter labels that stick anywhere—with the DYMO MITE M-2 TAPEWRITER*. Just spin out your letters on the easy-to-read dial and gently press the handle, that's all! A built-in trimmer cuts off your *finished* label. Look for the mark of DYMO.

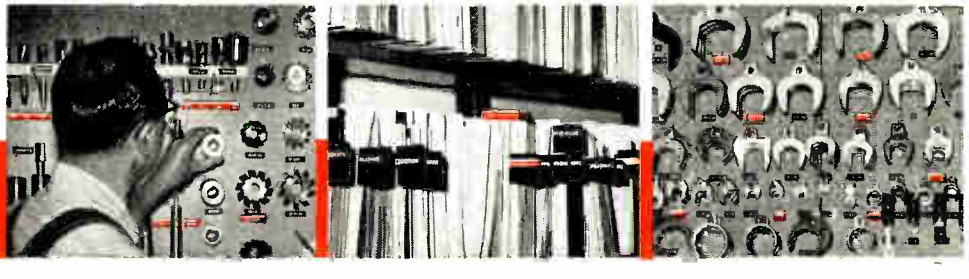
RAISED LETTER LABELS (for Pennies) BY ANYONE IN SECONDS!



DYMO offers a complete **color coded** System of Identification for correspondence files, shelves, storage labels, chemical marking, panels, aircraft controls, camera equipment, golf clubs, hardhats, libraries, hand tools, computer dials, lockers, meters, layouts.



. . . fire extinguishers, lab equipment, plants and shrubs, tool bins, industrial equipment, file cabinets, inventory control, switches, conduit, pipes, mailboxes, vending machines, nametags, telephones, circuits, parts cabinets, wiring diagrams, prices and many more.



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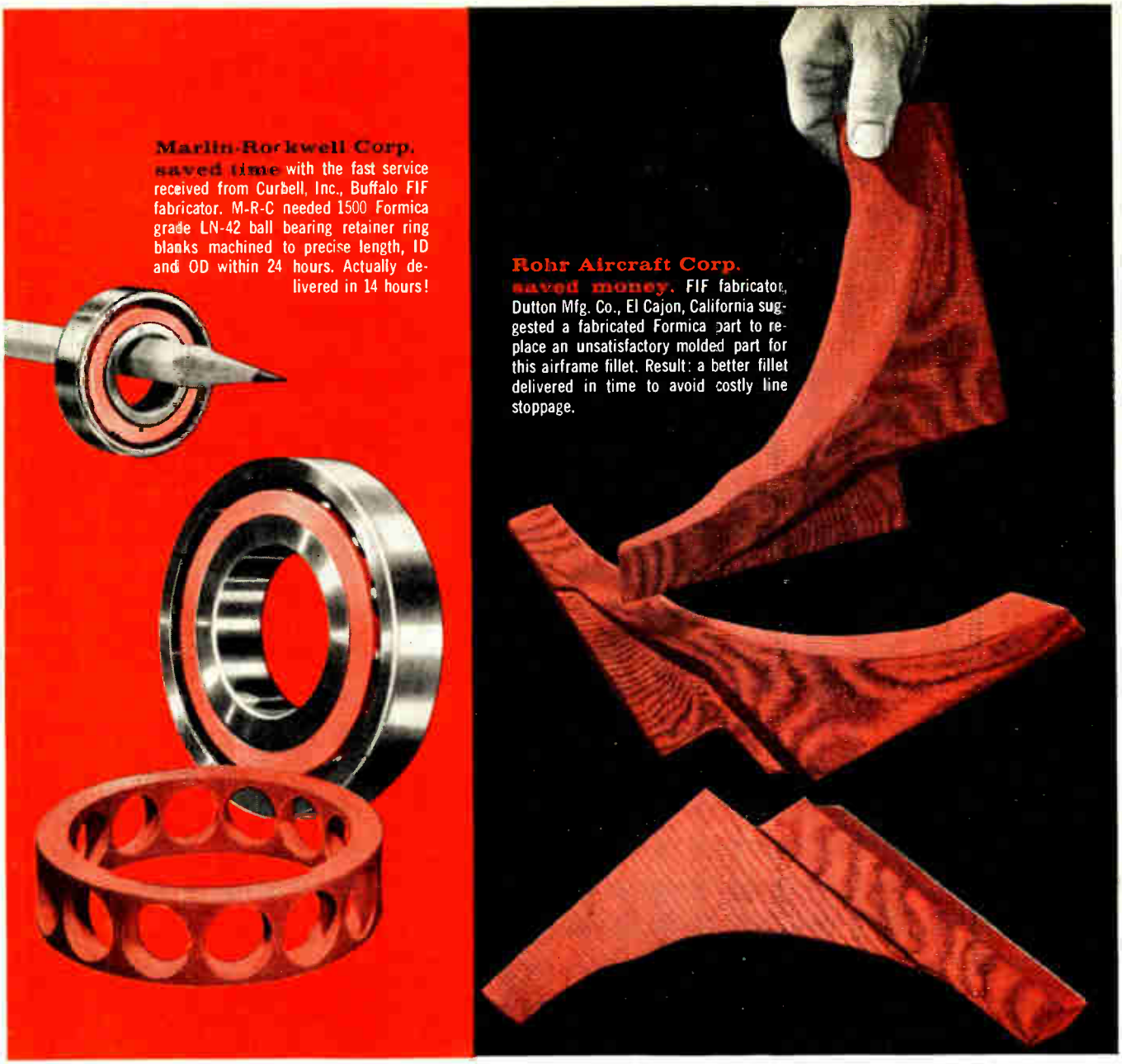

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Rohr Aircraft, Marlin-Rockwell and many other leading manufacturers now save time and money on the new and dependable parts service offered by their local Fabricators of Industrial Formica laminated plastics.

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So, for *better* parts *faster,* be sure to contact your local FIF fabricator. Phone your Formica district office for his name and address, or write Formica Corporation, a subsidiary of American Cyanamid, 4536 Spring Grove Ave., Cincinnati 32, Ohio.

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Brand new concept in the presentation of laminated plastic properties and application data. Valuable aid to designers, production engineers, purchasing agents. Send today for your free copy.

*FIF *This seal identifies your local Fabricator of Industrial Formica. Remember: FIF for the fastest parts service, Formica for the finest laminated plastics.*

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Personals

Foto-Video Electronics, Inc., has appointed Robert D. Hamilton as Head of the Systems Engineering Dept. at the Cedar Grove, N. J., operations. He was formerly Consulting Engineer with IBM Corp.

William Goldman was appointed Research Supervisor of Engineering Equipment for Keuffel & Esser Co. He was formerly a Research Chemist for K&E.

Beryl L. McArdle has been appointed Scientific Advisor on the staff of Dr. Royal Weller, Vice President for Engineering of the Stromberg-Carlson Div., General Dynamics Corp., Rochester, N. Y.

A. B. Buchanan has established an independent engineering consultant business. The address is 2000 Second Ave., Detroit 26, Mich.

Dr. William L. Firestone has been appointed Director of Engineering for Motorola's Communications Div., Chicago, Ill. He was Chief Engineer of the Applied Research Dept. for Motorola in 1956.

Dr. W. L. Firestone

Dr. Henry T. Minden

Dr. Henry T. Minden has been appointed a Physicist at the General Electric Advanced Semiconductor Laboratory at Electronics Park, Syracuse, N. Y.

Donald S. Elkort has joined Narda Microwave Corp., Mineola, L. I., as Microwave Engineer. He was formerly Associate Project Engineer with the Microwave Electronics Div. of Sperry Gyroscope Co.

Richard C. Landis has been promoted to Chief Engineer and Quality Control Manager at Printronics Corp., Palo Alto, Calif.

Gustave A. Bleyle has been appointed Vice President in Charge of Engineering Activities at Arthur D. Little, Inc., Cambridge, Mass.

Lawrence T. Garnett has joined Robertshaw-Fulton's Aeronautical and Instrument Div., as Sr. Development Engineer. He was formerly Assistant Chief Engineer of the Electronic Control Div. of Manning, Maxwell & Moore, Inc.

TAPCO ELECTRICAL POWER COMPONENTS

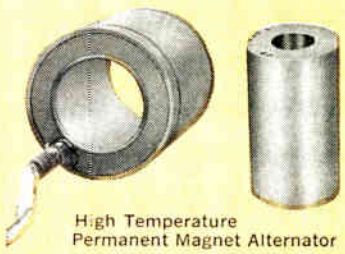
TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high-temperature, liquid metal vapor, zero-G and vacuum.

Below are typical TAPCO components now available for integration into systems for such applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electromagnets and solenoids, nuclear reactor rod drive controls, static inverters, voltage regulators and electronic power conversion devices.

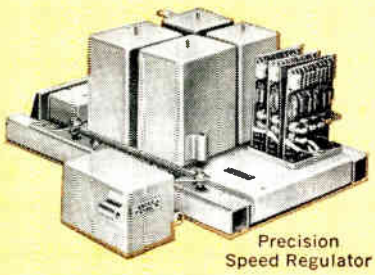
ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000°F.

PERFORMANCE DATA: TYPICAL ALTERNATOR—**Power Rating:** 3 kw, 0.8 pf lagging. **Ambient Temp.:** 700°F. max. **Operating Speed:** 40,000 rpm. **Output:** 115v, 2000 cps. **Inherent Voltage Regulation:** ±5%. **Harmonic Content:** 5% total. **Efficiency:** 85%. **Weight:** 9 lbs w/o shaft and bearings. **Size:** 3⅜" OD, 5⅛" long. **Special Conditions:** Operates in mercury vapor.



High Temperature
Permanent Magnet Alternator



Precision
Speed Regulator

VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are system speed and voltage controls for extremely accurate frequency and voltage regulation. The unit shown is adaptable to many drive systems.

PERFORMANCE DATA: TYPICAL SPEED REGULATOR: **Frequency Stability:** 1 part in 100,000 integrated over minimum 1 hour period. **Input:** 115v, 400 cps. **Output:** 0-10v, 400 cps (phase reversing). **Feedback:** Valve position 0-57.5v, 400 cps. **Environmental Conditions:** −65 to +200°F, 50g shock for 11 millisec., vibration 0.1" double amplitude from 3 to 23 cps, 10g from 23 cps to 10 kc. **Weight:** 10 lbs. **Size:** 12" x 6" x 5".

LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction-producing rotating seals and provides exceptional reliability and life.

PERFORMANCE DATA: TYPICAL ELECTROMAGNETIC PUMP—**Fluid:** Sodium. **Fluid Temperature:** 1000°F. **Capacity:** 20 lbs/min. **Driving Speed:** 40,000 rpm. **Pressure Rise:** 3 psi. **Weight:** 3 lbs. **Size:** 2¾" diam. flange bolt circle, ½" nominal pipe size.

Electromagnetic Sodium Pump

Tapco Group Export Representative:
American Avitron Inc. • Mamaroneck, N. Y.

Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Personnel Supervisor.

TRW

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Books

Mathematical Methods for Digital Computers

Edited by Anthony Ralston and Herbert S. Wilf. Published 1960 by John Wiley & Sons, Inc., 440 Park Ave., South, New York 16. 293 pages.

This book is of value to anyone who is interested in or has contact with digital computers. For such a reader the book offers mathematical analysis and derivations of commonly used techniques of digital computation; and detailed, step-by-step discussion of the actual processing of complex mathematical and physical problems.

Each chapter of the book has been contributed by a man in close contact with the latest developments in his field, and each deals with an important and representative mathematical problem. In each case the chapters follow a standard format—giving in order the purpose of the program, a mathematical analysis of the problem under consideration, the calculation procedures to be used, a detailed flow chart, a description of the flow chart, the memory requirements, an estimate of running time, and a list of references.

Photo Chemistry in the Liquid and Solid States

Edited by L. J. Heidt, et al. Published 1960 by John Wiley & Sons, Inc., 440 Park Ave., South, New York 16. 174 pages. Price $6.00.

This book is based on a symposium sponsored by the National Academy of Sciences and the National Research Council. It contains the contributions of outstanding authorities in the field of photo chemistry.

The authors present the basic principles of photo chemistry storage, survey the field of photochemical reactions, and state the requirements for reaction types which might prove useful for storing solar energy. The book also presents basic research findings, and suggests those areas for further research which can and will lead to the use of the sun as an important and inexpensive source of energy.

The Relay Guide

By Raymond N. Auger. Published 1960 by Reinhold Publishing Corp., 430 Park Ave., New York 22.

Now it is possible to find the ideal relay for any particular requirement in one convenient source.

Where one relay has many variations, the book provides tables or listings of them next to the basic model. A relay which belongs to more than one type is classified into the most specialized chapter in which it fits.

The guide presents application data, relay circuits, arc suppression information, relay definitions and terms in addition to relay descriptions. Custom made relays for which no specific de-

(*Continued on page* 68)

Another New Achievement from El-Menco

A New Smaller Size Dipped Silvered Mica Capacitor

El-Menco's SUB-MINIATURE DM-10 Mica Capacitor...

Approx. 5/16" long...

1/4" wide...

1/8" thick!

Smaller than a 1-carat diamond!

Sets New Standard in Miniature Reliability!

This sub-miniature DM-10 Mica Capacitor retains the same superior electrical characteristics of silvered mica capacitors as found in much larger sizes. It assures a high order of performance in extreme miniaturization applications — missiles, printed circuits and all compact electronic equipment. Parallel leads provide greater versatility. Tough phenolic casings protect against physical damage and penetration of moisture.

Capacity and Voltage Ranges

Working Voltage	Capacity Range
100 WVDC	1 MMF thru 360 MMF
300 WVDC	1 MMF thru 300 MMF
500 WVDC	1 MMF thru 250 MMF

Operating Temperature: *up to 150° C.*
Characteristics: *C, D, E and F, depending on capacitance value*
Leads: *#26 AWG (.0159") Copperweld wire*

EL-MENCO'S DM-10 MEETS ALL THE ELECTRICAL REQUIREMENTS OF MILITARY SPEC. #MIL-C-5B AND EIA SPECIFICATION RS-153

Other sizes also ideal for miniaturization applications —
DM-15 . . . up to 820 mmf at 300 VDCW, up to 400 mmf at 500 VDCW.
DM-19 . . . up to 5400 mmf at 300 VDCW, up to 4000 mmf at 500 VDCW.

WRITE FOR SAMPLES OF EL-MENCO DM-10 CAPACITORS and brochures describing El-Menco's complete line of capacitors.

EL-MENCO'S SUB-MIDGET DM-10 . . . THE NEW SMALLER MINIATURE MICA CAPACITOR

El-Menco Capacitors

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors
WILLIMANTIC CONNECTICUT

• molded mica • dipped mica • mica trimmer • dipped paper
• tubular paper • ceramic • silvered mica films • ceramic discs

Arco Electronics, Inc., 64 White St., New York 13, N. Y.
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To Serve West Coast Electronics...

General Chemical announces LARGE NEW PRODUCTION FACILITIES at Los Angeles, California

To meet the West Coast's increasing demands for highest quality electronic chemicals, General Chemical has established extensive new production and packaging facilities in the Los Angeles area at its El Segundo Works.

Now, in full scale operation, these facilities supplement the company's long established plant for manufacture of "C.P." acids at Bay Point, California, as well as its modern warehouses in San Francisco and Los Angeles which maintain extensive stocks of all chemicals for electronic use.

Now, for the first time, the West Coast will have a *complete major local source of supply* for the nation's highest quality line—Baker & Adamson® "Electronic-Grade" Chemicals. The new product center at Los Angeles also assures *same day delivery* or overnight shipment.

This new supply source helps assure uninterrupted production schedules ... eases your warehousing problems ... and gives you immediate service you can count on in emergencies.

For a listing of products, specifications and uses, write for our new booklet, "B&A Electronic Chemicals." Company letterhead please. If you would like to have a representative call, write or phone our Los Angeles or San Francisco office.

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Circle 42 on Inquiry Card

NEW CBS DIFFUSED SILICON DIODES

featured in more efficient economical switching block

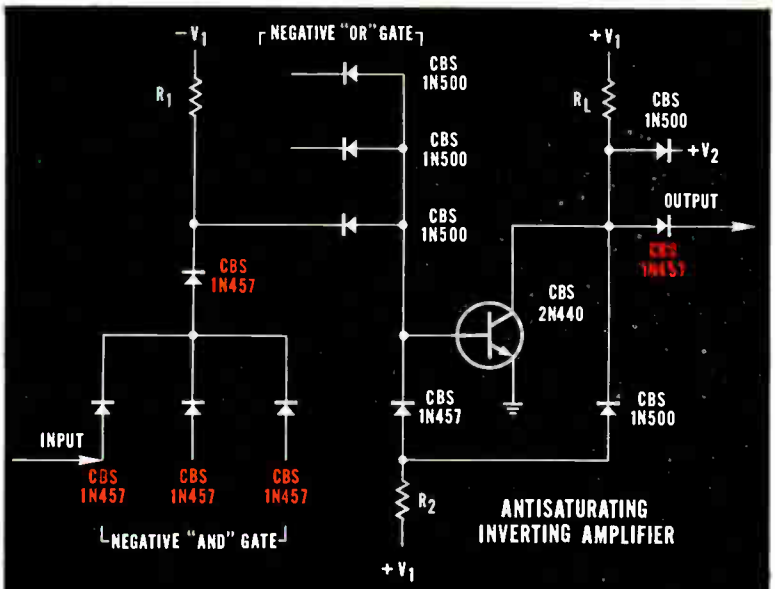
New CBS high back-resistance diffused silicon diodes for positive switching now join CBS high-conductance and fast-recovery types. Efficient and flexible switching is made possible (see circuit). CBS diffusion techniques offer three major advantages over the alloying method: Close process control of all parameters, great uniformity, and high reverse voltage through the graded junction.

The new CBS 1N456, 1N457, 1N458, 1N459 are particularly designed for efficient computer operation in missiles, rockets, airborne and industrial equipment. Typical applications include: switching, pulse, flip-flop, modulator, demodulator, discriminator, clamping, gating, and detector circuits. Write for data sheet E-387. Order direct, from your local sales office, or MWD distributor.

ADVANTAGES OF CBS 1N456, 1N457, 1N458 AND 1N459

Efficient computer switching
High back resistance
Sharp back-voltage characteristic
Excellent forward conductance
Low current saturation
Wide storage and operating temperature ranges

More Reliable Products through Advanced Engineering



This single building block for computer switching achieves increased efficiency, flexible cascading, and simple maintenance. New CBS high back-resistance diffused silicon diodes used in the "And" gate assure positive switching. The relatively large voltage drop developed by these current switching devices drives the phase inverter transistor efficiently at high switching speeds and minimizes cooling problems.

Check These Characteristics

Type	Min. Rev. Voltage @ 100 μa (volts)	Min. Forward Current		Maximum Reverse Current @ 25°C		Maximum Reverse Current @ 150°C		Avg. Rect. Fwd. Current
		I_F (mA)	E_F (volts)	I_R (μA)	E_R (volts)	I_R (μA)	E_R (volts)	(mA)
1N456	−30	40	1.0	0.025	−25	5	−25	90
1N457	−70	20	1.0	0.025	−60	5	−60	75
1N458	−150	7	1.0	0.025	−125	5	−125	55
1N459	−200	3	1.0	0.025	−175	5	−175	40

Other CBS Diffused Silicon Types

Type	Min. Reverse V @ 100 uA	Min. Avg. Forward @ 1V mA @ 25°C	Bulletin
	High Conductance Types		
1N482	−40	100	E-373
1N483	−80	100	E-373
1N484	−150	100	E-373
1N485	−200	100	E-373
	Fast Recovery Types		
1N625	−35	20	E-374
1N626	−50	20	E-374
1N627	−100	20	E-374
1N628	−150	20	E-374
1N629	−200	20	E-374

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CBS semiconductors

Books

(Continued from page 62)

scriptions are available are covered in a separate section. An appendix presents complete information on relay testing techniques.

Books Received

Silicon Controlled Rectifier Manual

Published 1960 by General Electric Semiconductor Products Dept., Charles Bldg., Liverpool, N. Y. 225 pages, spiral bound. Price $1.00.

Fundamentals of Semiconductors

By M. G. Scroggie. Published 1960 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 160 pages, paper bound. Price $2.95.

Transistor Projects

Published 1960 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 160 pages, paper bound. Price $2.90.

Basic Ultrasonics

By Cyrus Glickstein. Published 1960 by John F. Rider Publisher Inc., 116 W. 14th St., New York 11. 144 pages, paper bound. Price $3.50.

Marine Radio for Pleasure Craft

By Harold McKay. Published 1960 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 160 pages, paper bound. Price $2.95.

Understanding Microwaves, Abridged Reprint

By Victor J. Young. Published 1960 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 403 pages, paper bound. Price $3.50.

The Theory of Heat Radiation

By Max Planck. Published 1960 by Dover Publications, Inc., 180 Varick St., New York 14. 224 pages, paper bound. Price $1.50.

Principles of Quantum Mechanics

By William V. Houston. Published 1960 by Dover Publications, Inc., 180 Varick St., New York 14. 288 pages, paper bound. Price $1.85.

Microwave Transmissions

By J. C. Slater. Published 1960 by Dover Publications, Inc., 180 Varick St., New York 14. 309 pages, paper bound. Price $1.50.

Tensors for Circuits

By Gabriel Kron. Published 1960 by Dover Publications, Inc., 180 Varick St., New York 14. 250 pages, paper bound. Price $1.85.

Hydromagnetic Channel Flows

By Lawson T. Harris. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, and the Technology Press, Massachusetts Institute of Technology. 90 pages. Price $2.95.

Physics for Students of Science and Engineering, Part II

By David Halliday and Robert Resnick. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 510 pages. Price $6.00.

1960 United States Aircraft, Missiles, and Spacecraft

Published 1960 by Aerospace Industries Association, 610 Shoreham Bldg., Washington 5, D. C. 153 pages, paper bound. Price $1.00.

The Other Side of the Moon

Translated from the Russian by J. E. Sykes. Published 1960 by Pergamon Press, Inc., 122 E. 55th St., New York 22. 36 pages. Price $2.50.

(Continued on page 72)

Reeves
INSTRUMENT CORPORATION

proudly presents the

ZERO·ONE

IFG-300
Integrating Floated Gyro

See our display at WESCON — Booths 919-920

CONSISTENT RELIABILITY

in production-quantity **miniature** floated gyros

with trimmed drift rate of

ONE HUNDREDTH DEGREE per **HOUR**

Designed-in reliability and the most precise production techniques have combined to produce the new ZERO-ONE Gyro. The first in a new series of IFG-300 integrating floated gyros, the ZERO-ONE is a proud achievement in the long line of gyro developments by REEVES.

The combination of high reliability and extreme accuracy make the ZERO-ONE Gyro the ideal choice for guidance and stabilization systems where guaranteed performance is paramount.

For complete specifications, write for data file 308.

Qualified engineers seeking rewarding opportunities in these advanced fields are invited to get in touch with us.

TYPICAL SPECIFICATIONS

Trimmed Drift Rate: 0.01 degrees/hr

Angular Momentum: 300,000 c.g.s. units

Damping: 300,000 c.g.s. units

Nominal Signal Generator Sensitivity: 10 mv/mr @ 50 ma, 400 cps

Torque Generotor Sensitivity Range: 0.05 to 3.0 degrees/hr/ma^2

Time Constant: As low as 0.4 msec.

Mass Unbalance: 0.4°/hr/g

Anisoelasticity: 0.003°/hr/g^2

Dimensions: 1.8 in. x 2.75 in.

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INSTRUMENT CORPORATION

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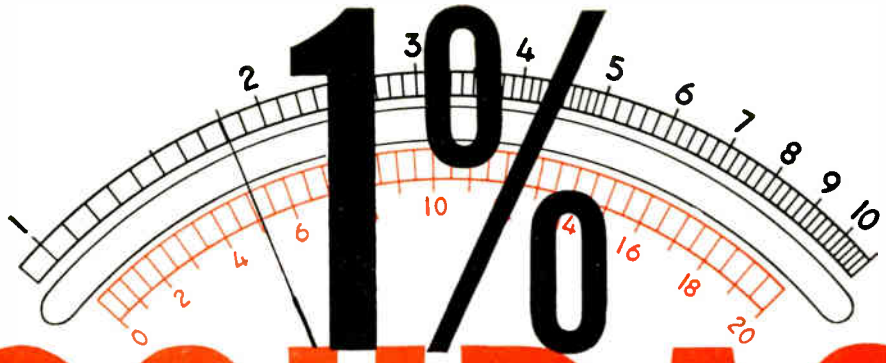
7RV60



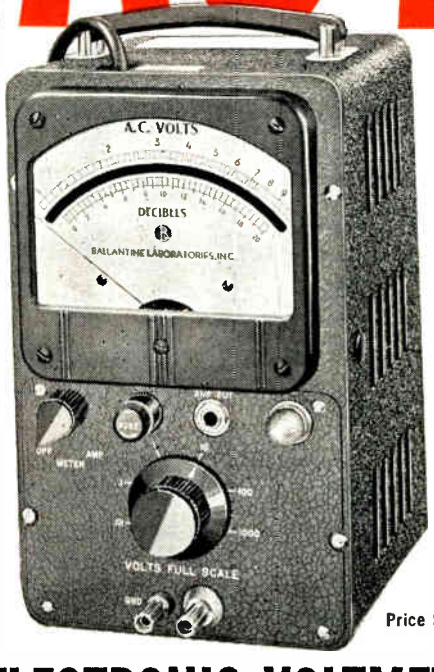
ACCURACY

over ENTIRE METER SCALE!

1 mv – 250 v, 20 cps – 20 kc

22 years of experience in designing and producing laboratory-type Electronic Voltmeters has made possible this new Ballantine Model 300-G. This is the most precise instrument in our entire line of sensitive wide-band Electronic Voltmeters.

NEW



Price $315

BALLANTINE Model 300-G SENSITIVE ELECTRONIC VOLTMETER

- Top accuracy of 1% over entire meter scale from 1 mv to 250 v and over the band of 20 cps to 20 kc. Better than 2% to 1,000 volts and for the wider band of 10 cps to 250 kc.
- High input impedance: 2 megohms shunted by 15 pf, except 25 pf on lowest voltage range.
- Long life: Several thousands of hours of operation without servicing or recalibration.
- Does not require stabilized input voltage. Less than ½% change in indication with power supply change from 105 v to 125 v.
- Five inch, mirror-backed, easy-to-read meter. Only two scales with mirror between. One is 1 to 10 for volts, and the second is 0 to 20 for decibels.

Also available in 19 inch relay rack Model 300 G-S2 at $325.

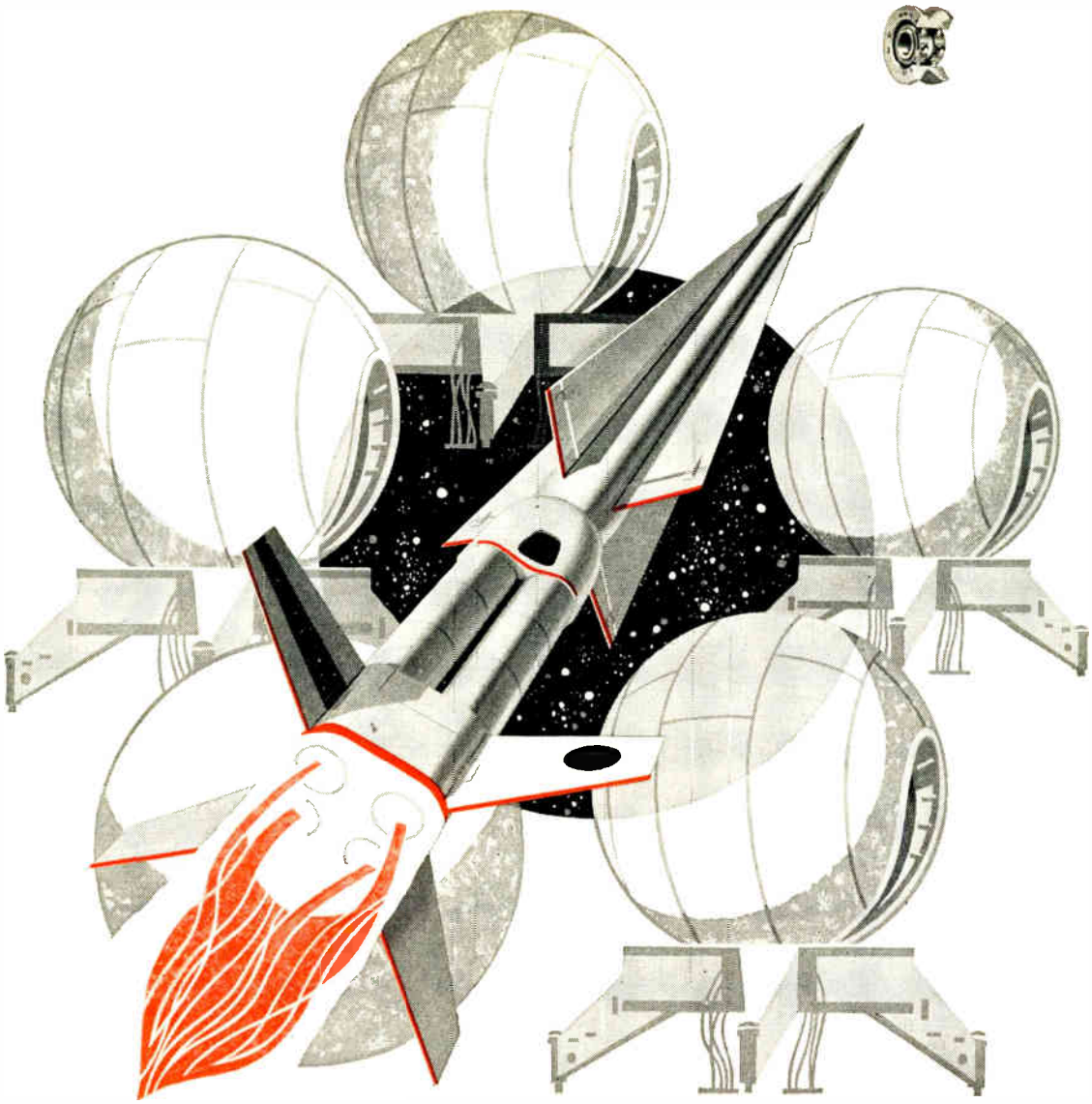
Write for brochure giving many more details.

— Since 1932 —

BALLANTINE LABORATORIES INC.

Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES.



THOR
MACE
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ATLAS
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BOMARC
NIKE ZEUS
SPARROW I
SPARROW II
SPARROW III
NIKE HERCULES
SIDEWINDER
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N/D Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!

Helping customers *simplify* instrument assembly is a specialty of the N/D engineering group. How? Through *creative* Miniature/Instrument ball bearing application and design. Often, a new ball bearing design will produce assembly savings in excess of its additional costs. Integral ball bearings, too, very often cut down difficult and costly hand assembly of shaft and parts.

A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile ground support. Here, *special* N/D Instrument ball bearings are now used in precision potentiometers. New Departure engineers recommended eliminating two *single row* instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They replaced this assembly with a *special* N/D *double row* high precision instrument ball bearing with integral outer race guide roller . . . and shaft mounted with a nut. This one recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the potentiometer selling price to the government. What's more, the New Department Instrument Ball Bearings improved potentiometer reliability!

You can look to minimum assembly costs and unsurpassed *reliability*. Include an N/D Miniature/Instrument Bearing Specialist in your early design level discussions. For immediate information or assistance, call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

NEW DEPARTURE

MINIATURE & INSTRUMENT BALL BEARINGS

proved reliability you can build around

Books

(Continued from page 68)

Proceedings of the 1960 Electronic Components Conference

Published 1960 by AIEE, EIA, IRE, and WEMA. 162 pages, paper bound. $6.00.

Proceedings of the 1959 Institute in Technical and Industrial Communications

Published 1960 by the Institute in Technical and Industrial Communications, Colorado State University, Ft. Collins, Colo. 130 pages, spiral bound. Price $5.00.

Unclassified Proceedings of the 5th Conference on Radio Interference Reduction and Electronic Compatibility

Published 1960 by Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill. 691 pages, paper bound.

Proceedings of the 1959 Symposium on Low Temperature Nuclear Process Heat (TID-7580)

Available from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C. 73 pages, paper bound. Price $.75.

15th Annual Technical and Management Conference, Reinforced Plastics Div.

Published 1960 by the Society of the Plastics Industry, Inc., 250 Park Ave., New York 17. Price $7.00.

Digest of Technical Papers of the 1960 Solid State Circuits Conference

Published 1960 by the IRE, 1 E. 79th St., New York 21. 100 pages. Copies available from H. G. Sparks, Moore School of Electrical Engineering, University of Pennsylvania, Phila. 4, Pa. Price $5.00.

Practical Statistics in Experimental Design

By Dr. A. W. Wortham and T. E. Smith. Published 1960 by Dallas Publishing House, P. O. 30143, Dallas 30, Tex. 128 pages. Price $3.50.

Proceedings of the 1959 Eastern Joint Computer Conference

Published 1960 by IRE, AIEE, ACM. 260 pages. Price $3.00.

Information Processing

Published 1960 by International Publications Service, 507 Fifth Ave., New York 17. 600 pages. Price $25.00.

Proceedings of 1959 National Electronics Conference

Published 1960 by National Electronics Conference, 228 N. LaSalle St., Chicago 1, Ill. 1089 pages. Price $10.00.

Advanced Magnetism and Electromagnetism

Edited by Alexander Schure, PhD. Published 1959 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 104 pages, paper back. Price $2.25.

Magnetism and Electromagnetism

Edited by Alexander Schure, PhD. Published 1959 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 80 pages, paper bound. Price $1.80.

Circle 48 on Inquiry Card

Circle 49 on Inquiry Card →

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Mark II ..

anyone
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in writing
anywhere

There is no direct writing recorder on the market that approaches the compact Mark II in sheer usefulness. It is a completely integrated engineering tool that can be operated by anyone . . . in the shop or in the field . . . for countless research or design requirements. Every function necessary for uniform, crisp, easily reproduced readouts is "built-in". The Mark II gives you two analog channels plus two event markers; 4 chart speeds; DC to 100 cps response with 40 mm amplitude; 10 mv/mm sensitivity; high input impedance. Immediate shipment from stock. Call, write or wire for complete details.

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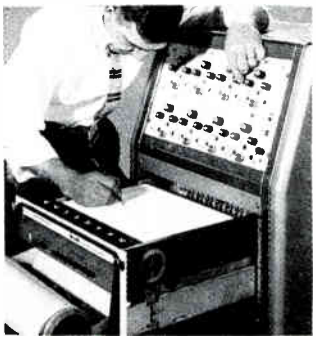
DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

for direct writing recording systems no one is as qualified as Brush



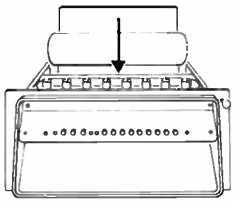
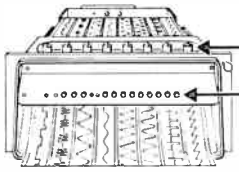
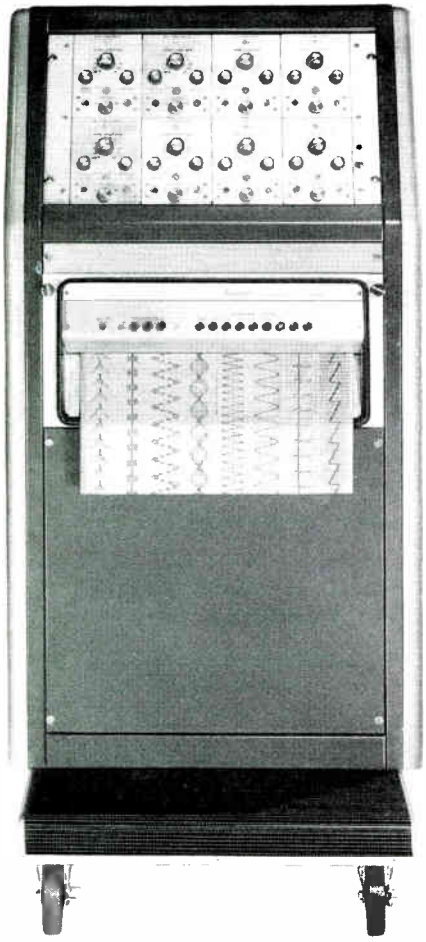


Chart paper loads from top



Trace contrast control

Simple pushbutton speed selection



Why? Simply because Brush recording systems such as this 6-8 channel unit incorporate all of the known refinements in the art of recording by direct writing. No comparable system in existence today is as compact . . . as simplified . . . as reliable . . . as versatile. Note slide-mounted oscillograph and interchangeable "plug-in" signal conditioners that provide four vital functions in addition to amplification: high input impedance, zero suppression, attenuation and calibration.

Instantaneous rectilinear presentation gives clear, uniform and reproducible traces for precise readout of telemetry, computer, ground control and other data gathering operations. Further, this functionally designed system has a "pull-out" horizontal writing table for convenient annotation and reading . . . without turning off the recorder! Check these and many other advanced features for yourself and you'll see why *no one* is as qualified as Brush. Call, write or wire for complete details.

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Next month

• UNCONVENTIONAL POWER CONVERTERS

Another in the series of EI's editorial staff studies. This feature reviews state-of-the-art advances in several electronic and allied disciplines—solid-state, high temperature plasma etc.—and new power requirements of the Military and Space Agencies. New methods include fuel cells, magnetohydrodynamic generators, thermoelectric and thermionic generators and solar cells.

• ELECTRONIC COUNTERMEASURES REQUIRE BINARY TO ANALOG CODE CONVERSION

Binary stored information, used in ECM receivers, is often needed in analog form for processes requiring a dc control voltage. The advantages of circuitry and packaging of such a device are presented here.

• MAPPING SMALL MAGNETIC FIELDS

As magnetic tape is used more and more in computers and other business machines, the quality of recording is required to go higher and higher. What actually occurs at the recording head? Here is a new technique for proper investigation.

• STORING WITH THIN FILMS

The so-called fast ferrite core storage unit has actually been the limiting factor in computer speed. All other central computer circuits are capable of operating at least ten times as fast. A memory using thin film techniques is presented which offers high potential.

• CONTROLLING RFI SUSCEPTIBILITY IN RECEIVERS

With good design it is usually possible to produce receivers that have low susceptibility to undesired signals. Some of the factors to consider in the receiver's design are sensitivity, selectivity, spurious responses, intermodulation, and cross-modulation as well as standard shielding considerations. Part VI in the continuing RFI series in Electronic Industries.

Plus all our other regular departments

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, EI Totals, Snapshots of the Electronic Industries, EI International, News, Briefs, Tele-Tips, Books, Representatives News, International Electronic Sources, Personals, etc.

Watch for these coming issues:

***NOVEMBER**
Microwave Issue

***JANUARY**
Industry Review

***MARCH**
Annual IRE Issue

←——Circle 50 on Inquiry Card

Things to Come . . .

Two Guest Editorials That Scan Some New Western Electronic Horizons

Where Are We Going With Semiconductors And Molecular Electronics?

BY HARPER Q. NORTH

President, Pacific Semiconductors, Inc.

EVERY semiconductor device which employs principles not developed to full advantage until the time of its emergence arouses considerable controversy. The varactor diode fell into that category because of the required pump power and initial narrow band characteristics. By now all will agree that it will probably be with us from now on in mixing frequency multiplication, and perhaps duplexing applications.

The Esaki, or tunnel, diode is still a controversial device because of the low voltage at which the negative resistance appears and because of the high capacitance of the unit. This remarkable component seems to have found its way, however, into use in microwave oscillators of modest amplitude. It should become increasingly important in computer circuits, particularly if a third electrode can be added.

The solid-state circuit, on the other hand, is in a somewhat different class. It is a composite circuit element consisting of an assembly of devices—diodes, transistors, resistors, and voltage variable capacitors all formed within a single block of semiconductor material, preferably silicon (for the present, at least).

The solid-state circuit is a wonderful concept but it has been badly degraded by over-publicity and is about to experience retardation, I think, as a result of over-optimism. It is certainly true that computer circuitry is becoming exceedingly complex and space technology is crying for an absolute minimum in the weight and space requirements of such circuitry. Ultimate reliability calls for redundancy of components which cannot be achieved until such components have been reduced to elemental form. The real stumbling blocks in the way of solid-state circuitry lie in the technology of semiconductors themselves, both with respect to yield of devices with closely defined characteristics, and with respect to the reliability limitations imposed by surface phenomena.

It is not quite true, but almost, that the yield of good semiconductor circuits is a product of the yields of the individual components comprising those circuits. If the yield of a sophisticated individual component is, say, 50%, that of circuits with four such components is $(.5)^4$, or about 6%. I worry about the economics of producing circuits to this kind of yield except where size is of ultimate importance, as perhaps in satellites where the market, to say the least, is rather small.

Isn't it better at this stage of limited technology to weld together micro-components, each of which has been proved through prolonged life tests before being introduced into the required micro-circuit?

Reliability has been touted as a compelling reason for solid-state circuits. Perhaps if we know how to protect such circuits well, this is an achievable virtue. We are getting there and can do it, but the yield is modest even on individual components.

For what it is worth, my opinion is that desire is ahead of technology in solid-state circuits. We had better set about improving technology before talking about the wild blue yonder of "molecular circuits," even though solid-state circuits may be produced at low yields in modest quantities. In the recently publicized "molecular circuit," molecules of semiconductors are supposed to be laid down in such a manner as to tailor circuit paths at will and to produce distributed components rather than lumped components familiar to most circuit designers. For such fancy tailor work each molecule of semiconductor or impurity must be dropped into place within tolerances far beyond those achievable by any known technique. I am sure that publicity is well ahead of technology; it's a somewhat easier field, and much less expensive to pursue.

In my opinion, a manufacturer of micro-components has several years to enjoy a market for his products before he is superseded by solid-state circuits, to say nothing of molecular circuits. Solid-state circuits are on their way and work on them is well advised. Five

to ten years from now I would guess they will be in mass production. In this period they will begin to take over and when they do, we'll see a brand new type of computer with redundant components and of incredibly small size. Meanwhile, it seems to me that much miniaturization is to be done successfully with Micro-Diodes and Micro-Transistors as these components become more readily available. There are several reasons for this guess:

1. Cost — known production techniques make a high yield of Micro-Diodes and Micro-Transistors possible. Only thoroughly tested devices need be assembled into final micro-circuits.

2. Design flexibility—solid-state circuits, when available, will require major changes in processing techniques to accommodate minor changes in circuit connections or component characteristics. Micro-components can accommodate design changes immediately. Moreover, replacement of elements in the testing phase of micro-circuitry permits salvage of remaining components which must be scrapped in solid-state circuits if one element fails.

3. Micro-components offer the circuit designer an opportunity to become acquainted with the eccentricities of micro-circuits. Cross-talk and heat dissipation, for instance, become major problems in micro-circuit design.

4. Reliability is an important consideration which should ultimately be decided in favor of the solid-state circuit. Today, however, the micro-circuit seems more reliable. Active components in micro form have attained reliability seldom reached by other semiconductor components of standard size. It will be some time before the same degree of reliability can be demonstrated in solid-state circuits.

5. Microminiature components are available in quantity today and at a cost equal to or approaching that of standard components.

Work being done on solid-state circuits today is certainly well advised. The enormity of their potential is attested by the large number of companies engaged in such work. I would argue only with the irresponsible type of publicity which forewarns of an early demise for the misguided component manufacturer and an immediate success for solid-state and "molecular" circuits.

The Search For New Electronic Markets

BY ROLLIN M. RUSSELL

Executive Vice-President
Electronic Specialty Co.

THE search for new markets for the burgeoning array of products and services of the maturing Electronic Industry challenges the ingenuity of every member of the team of this dynamic business. Marketing, Research, Engineering, Manufacturing and Service, working together, can bring about the gains expected in the industrial, commercial and military markets. Few industries have been faced with as rapid growth and as explosive an opportunity. The industry must look to truly serving the markets' needs while improving performance in development, engineering, reliability, cost and productivity.

New industrial markets do not materialize quickly. These markets develop gradually as designs are shaken down and performance is proved. When reliability is assured, lower costs and increased productivity over previous methods become apparent. The Electronic Industry that has itself had to learn the bitter lesson of careful cost control can hardly expect the industries it serves to be unmindful of the costs involved in commercial and industrial use of the new electronic tools. Computers must pay their way in engineering and finance or suffer the same scrutiny and ultimate "reduction in force" as any other unwarranted element of cost. The glamour of tape controlled machine tools quickly tarnishes if costs soar and planned production gains are not realized.

Markets for new ideas must be planned, tested and developed. Development of devices from the laboratory model into saleable products must be carefully and wisely scheduled. Such areas as molecular electronics, electro-luminescence, deposited circuitry, light amplifiers and the like offer just such possibilities but profitable markets are probably somewhere down the road and should be planned for accordingly.

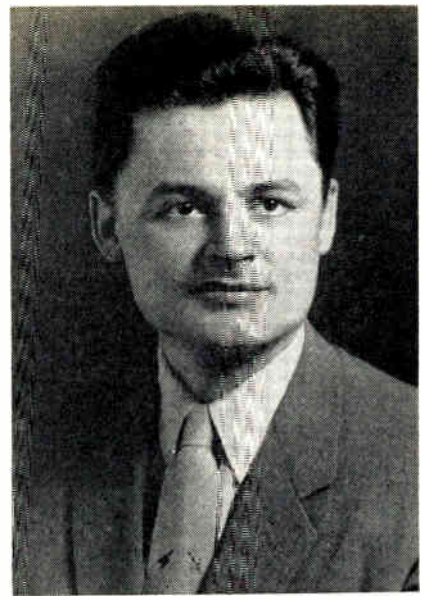
In the search for new electronic markets some organizations have followed the merger path. This may result merely in summing the markets of the merged organizations. The wiser combination produces a multiplication of markets brought about by the catalyst of aggressive engineering, sales, production and management thinking.

The need to protect existing markets for present products is fundamental. It becomes the sales goal

(*Continued on page 228*)

Mr. Russell is commenting on a subject which has long been of continuing interest to ELECTRONIC INDUSTRIES. In EI's October 1959 issue the lead editorial, "Ideas—Insure the Future" described just this problem. Last month, Assoc. Editor Jack Hickey, in his article, "New Electronic Markets," reviewed the requirements of a wide variety of industries which might be solved by electronics. And in this issue, Assoc. Editor Dick Stranix describes the many applications of electronics to agriculture in "Electronics and the Future of Agriculture." (page 91)

Walter E. Peterson
Chairman of the Board, WESCON



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Bruce S. Angwin
Convention Director—WESCON

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Chairman, WESCON Industrial Design Comm.

WESCON—Showcase

ALL the conveniences of the nation's newest and most luxurious amphitheater, plus major additions made specifically for WESCON, will provide a unique setting for the big show and convention August 23-26.

The Memorial Sports Arena, just past its first birthday, has already achieved national attention for its air-conditioned comfort and flexibility. The Arena has already been the site of circuses, professional basketball, tennis, and ice hockey, home shows and track meets — and, only a month ahead of WESCON, the scene of the Democratic convention.

For WESCON, the Arena will gain six new "rooms" for technical sessions, an open-air restaurant, and 56,000 square feet of new, air-conditioned exhibit space.

The technical session rooms are being constructed in the seating area of the sweeping audience concourse of the Arena. Designed to provide optimum acoustical and visual conditions, they consist of double draped walls surrounding 600-seat sections of upholstered theater type seats, with a stage and podium at the front. Screens for projection of slides will be 15x20 ft. hung above the heads of speakers, at eye-level to viewers.

The restaurant, shaded by the Arena's central pedestrian "bridge," will be established in a beautifully landscaped area, and will include colorful umbrella-tables and deck furniture for relaxing during the show.

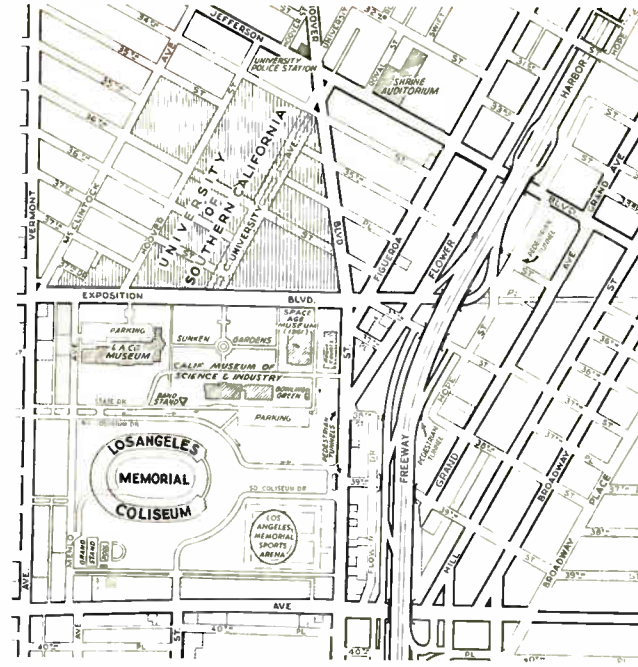
WESCON's 56,000-square-foot annex may be the most unusual structure ever built for such a short "life." Measuring 140 by 400 ft., it will be fully air-conditioned.

A Los Angeles-based firm with a national reputation in the field of specially designed air-conditioning equipment, has designed and manufactured a 150-ton, twin compressor unit that will serve the annex.

More than 200 nationally recognized authorities in the field of electronics and related technical areas will participate in the 40 convention sessions of WESCON.

Presentation of new developments in technical fields will take a range of forms, including contributed papers, tutorial papers,

Four-day show and convention opening August 23 in Los Angeles' Memorial Sports Arena expects a record turnout of engineers and scientists. More than 200 nationally recognized authorities in the field of electronics will participate in the 40 convention sessions.



# of Western Electronic Industry

symposiums, panel discussions, invited speakers, and workshop sessions.

New innovations in registration, issuance of guest badges, and the tallying of attendance will keep traffic flowing smoothly and information up-to-the-minute.

Electronic counters in the registration area will give a constant count of registration by day and cumulatively.

Exhibitors ordering complimentary WESCON cards in bulk in advance need pay only for those that are actually used, and, for the first time, they will receive a roster of those guests who do use the cards.

Nonlinear Systems Inc. is providing the card counters and readout displays. Registration cards are IBM cards, and guest cards are precoded by exhibitor company, so that a positive check can be made on guest attendance.

The annex will have solid walls inside into which air-conditioning ducts will be built. Its roof will be double-canvas, with only 22 vertical supports in the entire structure —about half those required in a conventional tent structure.

WESCON's sixth annual Distributor - Representative Conference will attract more than 600 persons to the Ambassador Hotel.

The conference, to be held on Monday, August 22—a day ahead of the official opening—will bring together distributors, factory sales managers, and sales representatives from throughout the West for a day-long series of bedrock business discussions.

The second Industrial Design Awards program has officially invited about 1000 electronics companies to participate.

Two kinds of awards are presented for winning designs. The WESCON award of Excellence will honor the product designs judged to be superior, and the Award of Merit will be given to all products selected for display in the exhibit. Purposes of the program are to encourage good design throughout the industry, to single out examples of outstanding design, and to point out corollaries between good design and successful products.

A "Hauoli Wahine Hou," which means "Happy Time for Women" in Hawaii will be featured for the wives.

Four days of special activity just for women-at-WESCON, all planned under a colorful polynesian theme, will show off the attractions of southern California and entertain feminine visitors with a series of unusual social events.

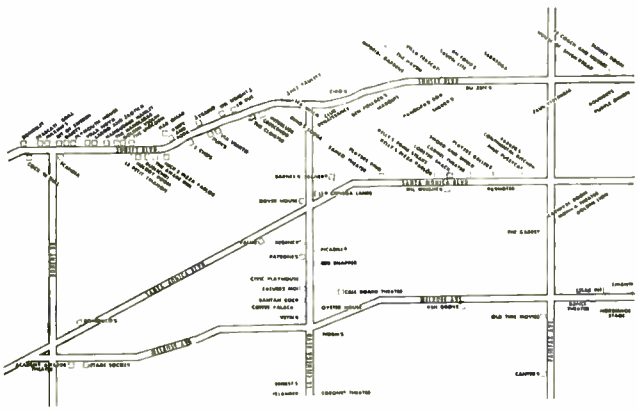
(*Continued on p.* 80)

Don Larson
WESCON Business Manager

Western Show & Convention (Cont.)

As an added attraction and a 'first" for WESCON, the women's activities committee is cooperating with the convention's technical program committee in presenting a regular program session for women (and men as well). Its intent is to examine some of the factors affecting the technical man "away from the job."

"RESTAURANT ROW"—LOS ANGELES



In their moments of leisure visiting engineers will want to visit these famous restaurants in the Sunset Blvd., Santa Monica Blvd., La Cienga Blvd. neighborhood.

TECHNICAL PROGRAM

Tues., Aug. 23—A.M. Sessions

SYSTEMS AND MAINTAINABILITY

"A Systematic Approach to Complex Electronic Equipment Maintenance," J. J. Brown, J. H. Chin, G. W. Jacob, Sperry Gyroscope Co.
"Economy Models for System Design Engineer," E. S. Winlund, General Electric Co.
"Precision Film Potentiometers," H. Adise, Computer Instruments Corp.
"Engineering Contribution to Product Quality," W. C. Kraft, Sandia Corp.

PULSE-HANDLING TECHNIQUES

"A Theory of Enhancement Filters," Allen Norris, Varian Associates
"Pulsed RF Storage in Long Delay Broadband Closed Loop Systems," Oscar A. Huettner, International Telephone and Telegraph Lab.
"The Problems and Solutions in the Navy's Program for Standardization of Video Processing and Distributing," L. T. Rhodes, Naval Research Laboratories.
"A Solid-State Video Processor with Pulse-for-Pulse AGC," Robert E. Segal, Packard-Bell Electronics Corp.

COMMUNICATIONS: NEW SOLUTIONS TO SOME OLD PROBLEMS

"Effect of Link Elimination in Data Transmission Systems," A. Machi, J. Hoffman, System Development Corp.
"Optimum Antenna Pattern for a Signal Burst Communication System," H. M. Swarm and David D. McNelis, Univ. of Washington.
"Linear Cancellation Technique for Suppressing Impulse Noise," Elie J. Baghdady, Research Laboratory of Electronics, Massachusetts Institute of Technology.

MANAGEMENT OF MANNED MACHINE SYSTEMS

Chairman: Arnold Small, Hughes Aircraft Company, Fullerton, Calif.
"Systems Management Appraisal of the Functions of Human Engineering," Thomas Eason, Stramberg-Carlson Co.
"Human Factors Contribution to Management Control Procedures," Stanley Deutsch, Douglas Aircraft Co., Inc.

SEMICONDUCTOR DEVICES AND TUBES

Chairman: Norman J. Golden, Hoffman Semiconductors, Inc., El Monte, Calif.
"Power Output and Efficiency of Thermionic Converters," I. T. Saldi, General Electric Co.
"High Power at 1000 MC Using Semiconductor Devices," G. Leuttgenau, M. V. Duffin, Pacific Semiconductors, Inc.
"Equivalent Circuit of a Parametric Diode at Microwaves," A. K. Kamal, K. E. Lytal, H. W. Pass, Purdue University.
"Quality Assurance Procedures for Power Transistors," J. S. Schaffner, Delco Radio Div., General Motors Corp.

Tues., Aug. 23—P.M. Sessions

PANEL DISCUSSION: WHAT ARE THE COMMUNICATION VALUES OF THE TECHNICAL SYMPOSIUM?

Chairman: L. McConnell, System Development Corp., Santa Monica, Calif.
"The Speaker," Irving J. Fang, Remington Rand Corp., Univac Div.
"The Writer," E. R. Hagemann, Space Technology Laboratories.
"The Publisher," Walker G. Stone, John Wiley & Sons, Inc.
"The Editor," Neil Hargan, The Rand Corp.

VARACTORS AND TUNNEL DIODE APPLICATIONS

Chairman: George C. Messenger, Hughes Semiconductor Div., Newport Beach, Calif.
"A Non-Linear Capacitor Harmonic Generator Suitable for Space Vehicle Applications," P. M. Fitzgerald, T. H. Lee, M. S. May, E. J. Powers and J. J. Younger, Lockheed Aircraft Corp., Missile Systems Div.
"Parametric Radio Frequency Amplifier," Alexander Szerlip, Packard-Bell Electronics Corp.
"Gain and Bandwidth Inconsistencies in Low Frequency Reactance Up-Convertar Parametric Amplifiers," A. K. Kamal, A. J. Helub, Purdue Univ.
"A Compact Tunnel Diode Amplifier for Ultra High Frequencies," Gerald Schaffner, Semiconductor Products Div., Motorola, Inc.
"Analysis and Design of the Twin-Tunnel-Diode Logic Circuit," C. H. Alford, Lockheed Aircraft Corp., Missile Systems Div.

INSTRUMENTATION

Chairman: Alvin Kaufman, Litton Industries, Beverly Hills, Calif.
"Widely Separated Clocks with Microsecond Synchronization and Independent Distribution Systems," T. L. Davis and R. H. Doherty, U. S. Dept. of Commerce, National Bureau of Standards.
"The Synthesis of Instrument Compensating Networks," R. W. Kearns, Wayne State University.
"An Automatic Servomechanism Response Plotter," David Rice, Republic Aviation Corp.
"Touch Detector," G. T. Kemp, Texas Research Associates Corp.
"Determination of Instantaneous Speed Error Data," Abner Updike, Ampex Data Products Co.

CIRCUIT THEORY

Chairman: Louis Weinberg, Hughes Research Laboratories, Malibu, Calif.
"Analysis and Design of Feedback Systems with Gain and Time Constant Variations," Kan Chen, Westinghouse Electric Corp.
"Measures of Sensitivity for Linear Systems with Large Multiple Parameter Variations," S. L. Hakimi and J. B. Cruz, University of Illinois.
"AA Sampled Data Technique for Realizing Network Transfer Functions," L. E. Franks and I. W. Sandberg, Bell Telephone Lab.
"Delay Distortion Correction for Networks and Filters," T. R. O'Meara, Hughes Research Laboratories.

SEMICONDUCTOR DEVICES

Chairman: T. W. Griswold, Continental Device Corp., Hawthorne, Calif.
"A New Semiconductor Memory Element with Non-Destructive Readout and Electrostatic Storage," V. H. Grinich and David Hibiber, Fairchild Semiconductor Corp.
"Some Device Aspects of Multiple Microwave Reflections in Semiconductors," H. Jacobs, F. A. Brand, J. Meindl and M. Benanti, U. S. Army Signal Research & Development Laboratories, R. Benjamin, Monmouth College.
"Novel Adder-Subtractor Circuit Utilizing Tunnel Diodes," R. A. Kaenel-Bell Telephone Labs. Inc.
"Base Turn-off of PN PN Switches," R. H. Van Ligten and D. Navon, Transitron Electronic Corp.
"Transistar Scaling Theary," W. E. Roach, Pacific Semiconductors, Inc.

Wed., Aug. 24—A.M. Sessions

COMPUTERS—GENERAL

Chairman, L. J. Craig, The Rand Corp., Santa Monica, Calif.
"Digital Control Techniques for Space," L. F. Jones and P. Margalin, Westinghouse Electric Corp.
"The Polymorphic Principle in Data Processing," Harold A. Heit, Thompsan Rama Wooldridge, Inc.
"An Aided Adaptive Character Reader for Machine Translation of Languages," Paul Baran and Gerald Estrin, University of California.
"A Multi-Addressable Random Access File System," Emary Cail, Librascope Div., General Precision, Inc.

STEREO MULTIPLEX BROADCASTING

Chairman: I. J. Kaar, Hoffman Electronics Corp., Los Angeles, Calif.
Panelists: Carl Eilers, Zenith Radio Corp.; William H. Beaubien, General Electric Co.; Murray G. Crosby, Crosby-Teletronics Corp.; Harold Parker, Calbest Engineering and Electronics, Los Angeles, Calif.; William Halstead, Multiplex Development Corp., New York, N. Y.
Speakers: "Requirements for FM Stereophanic Radio Transmission," R. J. Farber, Hazeltine Research Corp.
"Progress of Field Tests for FM Stereophanic Broadcast Systems," A. Prose Walker, National Assoc. of Broadcasters.

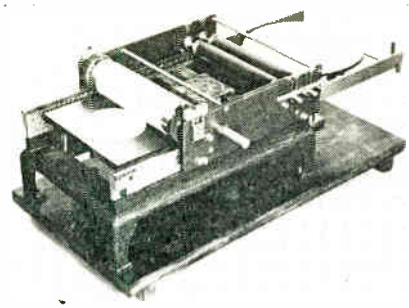
MICROWAVE THEORY AND TECHNIQUES—I: PASSIVE ELEMENT

Chairman: Harold Saltzman, Kearfott Co., Inc., Van Nuys, Calif.
"Misconceptions About Equivalent Circuits for Periadic Microwave Structures," R. M. Bevensee, Varian Associates.
"A Fast Switching X-Band Circulator Utilizing Ferrite Toroids," L. Levey and L. M. Silber, Polytechnic Institute of Braaklyn.
"Broadband Electronically-Tuned Microwave Filters," K. L. Katzebue, Watkins-Johnson Co.
"The Observed 50-90 KMC Attenuation of Two Inch Improved Waveguide," A. P. King, Bell Telephone Laboratories.
"A Non-Contracting Broadband and Rotary Joint, and Four-Way Switch," D. Alstadter and N. A. Dawson, Melpar, Inc.

ANALYSIS OF MANNED MACHINE SYSTEMS

Chairman: G. F. Rabideau, Narair Div. of Northrop Corp., Hawthorne, Calif.
"The Vocal Adaptive Controller—Human Pilot Dynamics and Opinion," D. T. McRuer and I. L. Ashkenas, Systems Technology, Inc.
"Model for Analysis of Human Decision Making," A. Sweetland, The Rand Corp.
"Methodology of Manned Machine System Analysis," Ralph W. Queal, Boeing Airplane Co.
"Optimizing Linear Dynamics for Human Operated Systems by Minimizing the Mean Square Tracking Error," T. E. Leonard, Aeronutronic Systems, Inc.

(Continued on p. 248)



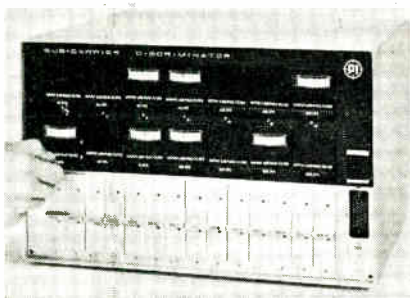
Scale Printer

Model R1 for printing meter scales, circuit boards, etc., employs the dry offset method and has high accuracy. It is a hand operated machine but is available in motor driven and 3-color presses. The 3-color models apply the 3 colors in one pass of the machine. International Eastern Co. **Booth 204.**

Circle 250 on Inquiry Card

Telemetry Discriminator

All-solid-state portable telemetry sub-carrier discriminator, the MINI TEL a pulse-averaging discriminator,



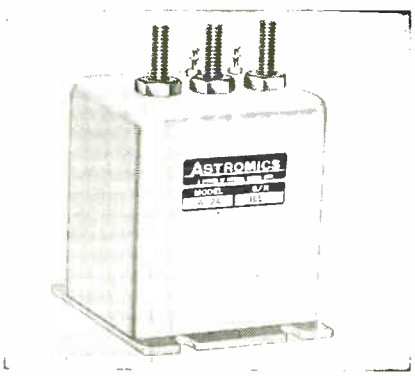
accommodates 14 standard IRIG channels. Power requirements are under 3 w per channel. DC linearity is better than 0.05% of best straight line. Precision Instrument Co. **Booth 440.**

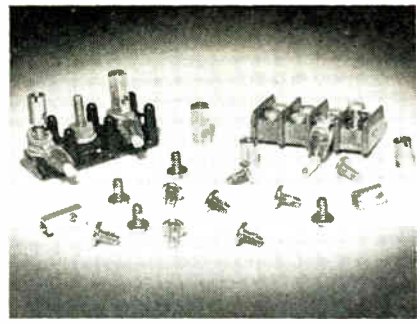
Circle 251 on Inquiry Card

Latching Relay

Non-magnetic latching relay, A-2A, mechanically locks in either open or closed position, and requires a new command pulse each time before it can be re-activated or moved in any way. It permits a load up to 20 a at 26.5 vdc (resistive). Astromics Div., Mitchell Camera Corp. **Booth 838A.**

Circle 252 on Inquiry Card





Fasteners

Self-locking fasteners provide a positive method of retaining wire leads to terminal blocks where shock and vibration conditions exist. The fasteners meet all applicable military specifications. The NYLOK Corporation. **Booth 218A.**

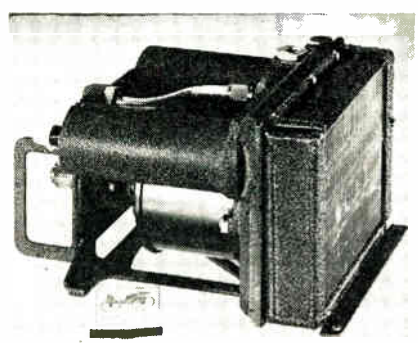
Circle 253 on Inquiry Card

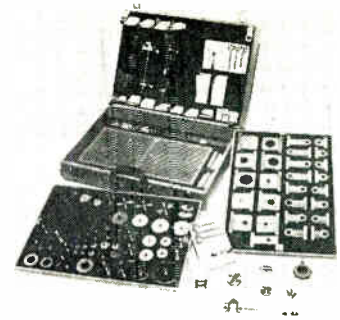
See These Products At WESCON

Cooling System

Cooling system, Model E/HT-100, Type 100, provides OS-45 coolant heat sink for an Airborne Electron Tube of 250 w dissipation. It meets MIL-E-5400 for Class II equipment. It weighs 3.9 lbs. and requires only 95 va under continuous operation. Eastern Industries, Inc. **Booth 2054.**

Circle 254 on Inquiry Card





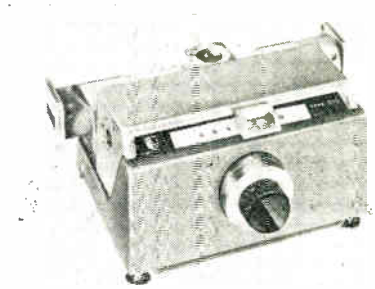
Breadboard Kits

Series of Master Breadboard Kits, in Precision 1, 2 and 3 tolerances in ⅛, 3/16, and ¼ in. shaft dia. Kits contain over 2,000 different precision items, such as precision gears, speed reducers, differentials, limit stop assemblies, and other precision components. PIC Design Corp. **Booth 311.**

Circle 255 on Inquiry Card

Probe Carriage

The PRD 230 Universal Probe Carriage is built to operate with the PRD 231 Waveguide Slotted Lines. They



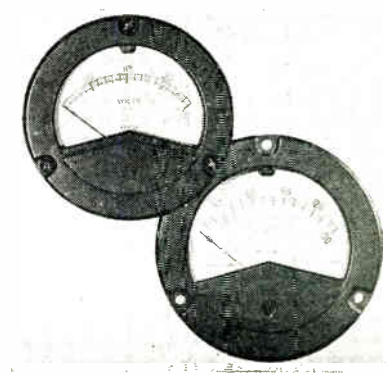
are used for making accurate standing wave and impedance measurements on all types of waveguide components in the frequency region from 8.2 to 40 KMC. Polytechnic Research & Development Co., Inc. **Booth 2633.**

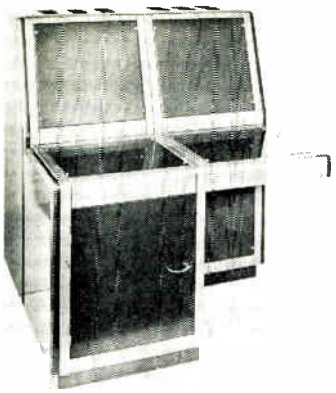
Circle 256 on Inquiry Card

Voltmeters

Voltmeters offer increased readability and precise indication of true RMS values. The new expanded scale instruments are Model 1761 ac commercial and Model 2531 ac ruggedized voltmeters. Weston Instruments Div., Daystrom, Inc. **Booths 1042-1044.**

Circle 257 on Inquiry Card





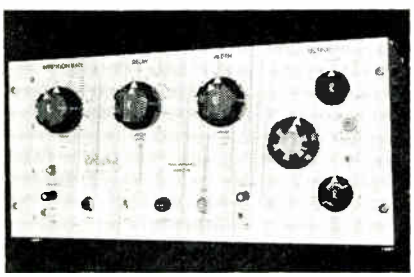
Electronic Housings

Line of electronic housings combines all of the functional characteristics required, such as ease of wiring, installation of equipment, mobility and loading capacity, with beauty in design. Uses two-tone light and darker grey metallic paint. Stantron, Div. Wyco Metal Products. Booths 523-524.

Circle 258 on Inquiry Card

Pulse Generator

High repetition rate, Pulse Generator, Model B-7B, is rack mountable and compact. Amplitude is 50 v. de-



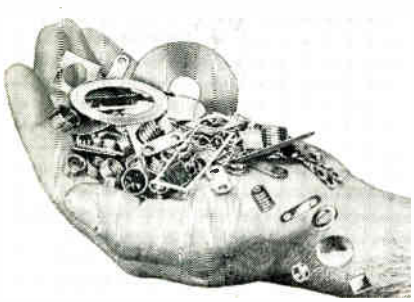
livered into a 50 ohm load; delay with respect to Sync. Out: 0—10,000 μs; width: 0.05 μs—10,000 μs; repetition rate: 20 c to 2 mc. Rutherford Electronic Company. Booth 635-636.

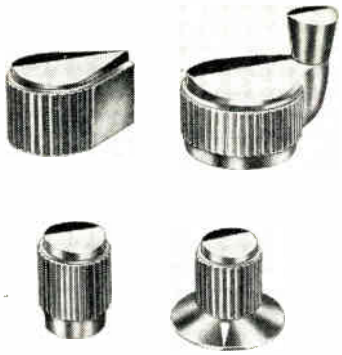
Circle 259 on Inquiry Card

Solder-Flux Preforms

Preformed solder and flux combined in washers, discs, and also in any other unusual shapes, and in all sizes or dimensions are for use in automated assembly of electronic products such as transistors, germanium diodes and other applications. Kester Solder Co. Booth 320.

Circle 260 on Inquiry Card





Control Knobs

Line of instrument control knobs, designed to MS-91528 specs, Series 500, knobs are in 6 types, including rounds, skirted rounds, dial-skirted rounds, plain and skirted pointers, and crank-types. Six different sizes are provided in mil-spec matte black finish, and also in mirror finish. Lerco Electronics, Inc. Booth 2504.

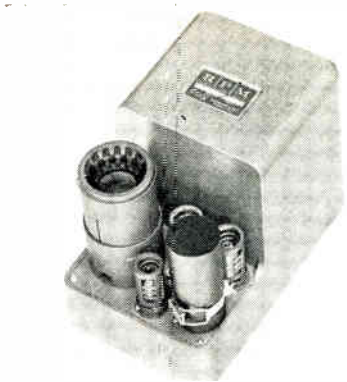
Circle 261 on Inquiry Card

See These Products At WESCON

Jack Panels

Aluminum Jack Panels, Model 2800, meet requirements for strength and lightness. Weight is approx. 25% less than Phenolic Panels. Double row jack panels mount 24 jacks per row —48 per strip. Offset ground terminal for easy connection to common terminals. Switchcraft, Inc. Booth 2843.

Circle 262 on Inquiry Card



Power Modules

Regulated Power Modules (RPM's) in a new militarized series, designed to meet MIL-E-1640B and developed to operate under more stringent environmental conditions. Featured is a life expectancy of 5 years, the unit will operate up to 65°C in continuous use. ACDC Electronics, Inc. Booth 2230.

Circle 263 on Inquiry Card

Banana Plug

Model 1325, Solderless Molded Single Banana Plug features unbreakable molded plastic insulation,

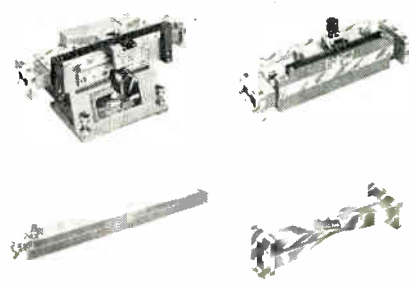
125°C. Ten colors available: red, black, green, yellow, orange, blue, brown, gray, white and violet. Beryllium copper one-piece heat treated spring and top stacking. Pomona Electronics Co., Inc. Booth 2303.

Circle 264 on Inquiry Card

Waveguide Components

New line of measurement equipment and components for D9 double ridged waveguide systems in the 4.75 KMC to 11.0 KMC band includes an impedance meter, a slide screw tuner, a directional coupler, and a 90° axial twist. The Narda Microwave Corp. Booth 822.

Circle 265 on Inquiry Card



Filter

A 4-channel filter of the type used in the Polaris Missile Guidance System. It withstands shock of 50 g's. Temp. range is −65° to +160°F. Also delay lines and a 3,000 v. power supply for photomultiplier tubes. Regulation for the supply is 0.1% for a 5% voltage and a 1% frequency variation at 115 v. 2,000 CPS input. Palo Alto Engineering Co. **Booth 514.**

Circle 266 on Inquiry Card

Capacitors

New ME, WE, and DE series of epoxy cases, metallized paper and metallized Mylar capacitors, in a

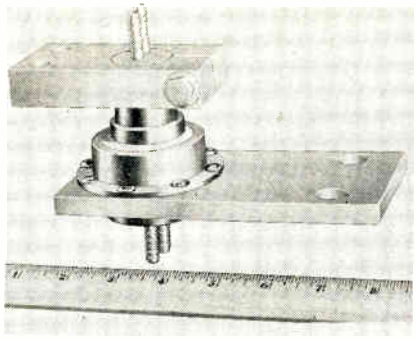
complete range of capacity and voltage to meet MIL-C-25 temp. cycling and immersion testing and MIL-STD-202, Method 106. Also: a 0.5 mfd., 10,000 v., wrap and fill capacitor. Electronic Products Div., Marshall Industries. **Booth 621.**

Circle 267 on Inquiry Card

Size 8 Geared Servo Motor

Size 8 servo motors are characterized by high torque and low inertia. Centered-shaft gearheads available in 28 ratios from 7.62:1 to 1254:1, and eccentric-shaft gearheads can be provided in ratios from 7.62:1 and 903:1. Geared servo motor operates in amb. temp. of −54° to +105°C. Kearfott Div., General Precision Inc. **Booth 626.**

Circle 268 on Inquiry Card



Water Cooled Rectifier

A 1000 amp water cooled rectifier. Voltage range from 50 to 200 piv. Also: a line of 1 w and 10 w zener diodes. Voltage range from 2 to 200 v., and a line of subminiature silicon rectifiers. Hermetically sealed. Rating 200 to 600 v. peak inverse. Sarkes Tarzian Inc., Semiconductor Div. **Booth 811.**

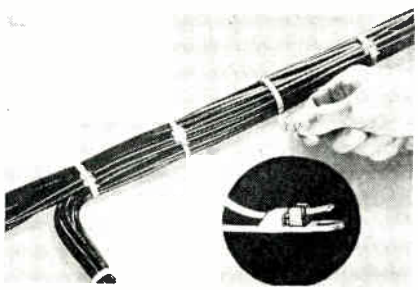
Circle 269 on Inquiry Card

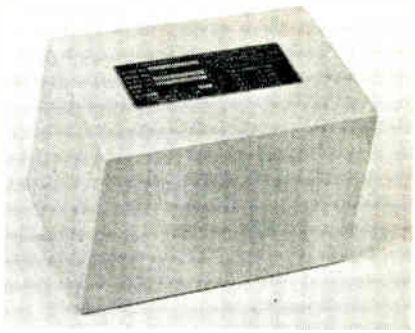
See These Products At WESCON

Cable Clamps

"Lok-Strap" Nylon Cable Clamps and Cable Ties incorporate a miniature quick-release tab which holds the band of the clamp or tie securely and tightly around wires — but which opens instantly with a few ounces of fingertip pressure. This tab also allows almost infinite adjustment to accommodate wire harnesses from ⅛ to 2 in. dia. Panduit Corp. **Booth 346.**

Circle 270 on Inquiry Card





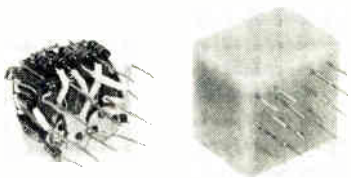
Static Converter

Model 3078, 60 CPS to 28 VDC for missile checkout systems, fire control systems, computer power and general instrumentation. Also: Demodulator & Phase Detector, Model 1806, for data transmission, error sensing, and servomechanisms. An Operating microcircuitry transmitter will also be exhibited. Varo Mfg. Co., Inc. **Booth 2332.**

Circle 271 on Inquiry Card

Computer Modules

Digital "building block" modules for use in computers, digital data systems, digital frequency dividers and



frequency standards, telemeter data handling, digital test equipment, logic decision networks, and other applications. Ten basic types and 15 variations of modules are offered. Delco Radio Div., General Motors Corp. **Booth 2345.**

Circle 272 on Inquiry Card

Transistor Chopper

Type 6025 transistor chopper with self-contained drive transformer, has SPDT switching action for operation over a chopping range from 50 to 5000 CPS. It may be used as a replacement for some electro-mechanical choppers in operational amplifiers, dc measuring instruments and servo systems. Airpax Electronics, Cambridge Div. **Booth 711.**

Circle 273 on Inquiry Card

Binistor, a new semiconductor device, developed for switching and storage circuits, has many of the properties of the flip-flop.

By NICHOLAS DeWOLF
Chief Electronic Engineer
Transistron Electronic Corp.
168-182 Albion St.
Wakefield, Massachusetts

The Binistor— A New Semiconductor Device

New semiconductor device—the Binistor—
developed for switching and storage circuits
has many of the properties of a flip flop.
It depends largely on an external voltage supply
for its negative resistance characteristic
and is remarkably stable and uniform.
A successful ring counter has been built
for use in test equipment.
Simple binistor stages may be used as elements
of a non-destructive coincident memory.

THE binistor[1] is a new semiconductor device developed for switching and storage circuits. An integrated device, it has many of the properties of a flip-flop. The binistor depends largely on an external voltage supply for its negative resistance characteristic and is consequently remarkably stable and uniform. The signal and output swings are compatible with present transistor and diode circuits and present no serious problems. High gains and circuit simplicity give definite economic advantages. Although there are many possible binistors, a silicon NPN tetrode will be described.

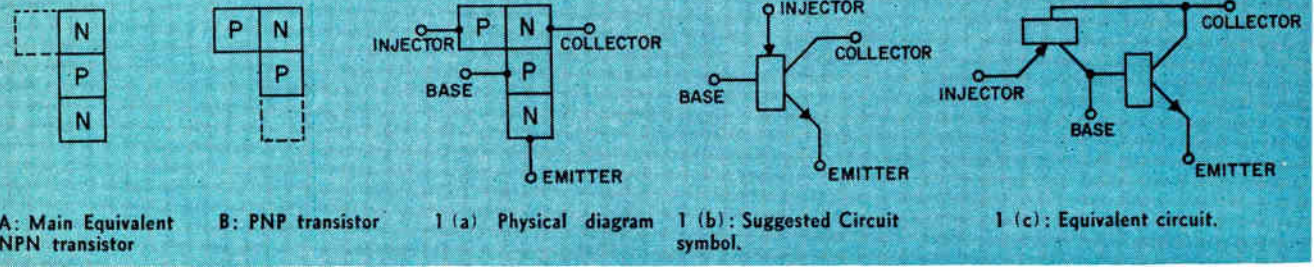
1. The name binistor has deliberately not been registered in the hope that it will become a generic term rather than a trademark.

Design and Use

The binistor resembles a four-layer switch (Fig. 1a), but a major difference exists in the design and use of this structure. The output current is taken from an intermediate layer and the upper junction serves only as a "latch" to hold the device on when in the conducting state. The main equivalent NPN transistor A is designed for a high alpha, and PNP transistor B is designed to have an emitter breakdown voltage at least as high as the collector breakdown voltage of transistor A. Fig. 1b is a recommended circuit symbol and Fig. 1c an equivalent circuit for the binistor.

The collector, emitter, and base are used like a normal transistor (Fig. 2). Initially, it is recom-

Fig. 1: Binistor Equivalents



A: Main Equivalent NPN transistor. B: PNP transistor. 1 (a) Physical diagram. 1 (b): Suggested Circuit symbol. 1 (c): Equivalent circuit.

mended that the base be back biased with a stabistor clamped current supply to prevent emitter breakdown and to effect complete cutoff of the binistor. Where circuit simplicity and economics are important, the stabistor (Xb) may be omitted and the emitter permitted to break down with limited dissipation. The injector is biased with a current source clamped to a voltage that should be greater than 2 volts and less than the collector supply voltage. Then, the binistor will have two stable states—either fully cut off or fully conducting and saturated.

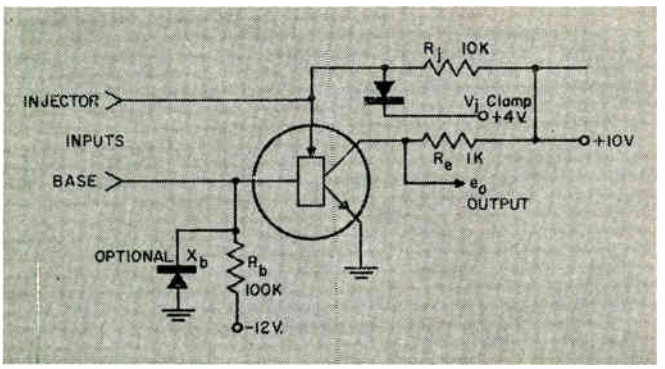


Fig. 2: Circuit for bistable operation and maximum tolerance allowances.

The "OFF" State

In the "off" or nonconducting state (Fig. 3), the main transistor A is cut off and its collector is near the supply voltage. This provides inverse base bias for latching transistor B and fully cuts it off. The emitter of transistor B, the injector, is restrained from rising above the injector clamping voltage by the injector clamping diode Xc. Thus, the collector current is very low and all junctions are reverse biased. The leakage currents are not multiplied by transistor gains because both transistors are off and the base cutoff supply provides sufficient current, if necessary, to maintain transistor A fully nonconducting.

The "ON" State

In the "on," or conducting state, (Fig. 4), the collector of the main transistor A has dropped below the injector clamping voltage. This permits latching transistor B to conduct. The emitter current of B is provided by the injector current source and is fixed by the external circuit. The main transistor A then receives more than adequate base current for saturation from the collector of latching transistor B. This current is almost equal to the injector supply current, and easily overrides the base cutoff current.

Thus it may be seen that the operation of the binistor involves the gating of base current to the main transistor through the latching transistor. This gating in turn depends primarily on the collector voltage and the injector clamping supply voltage. If the collector is cut off, it will remain cut off, and if saturated will remain saturated. An E-I output characteristic is shown in Fig. 5.

Switching

With the binistor's bistability established, switching from one state to another will be demonstrated. One method is to "brute force" the collector. It is relatively simple to pull the collector below the injector voltage to turn the binistor on. But once on, it may require a very large amount of collector current to force the collector out of saturation. Then the collector voltage may be increased above the injector clamp. Once over this point, the injector will very rapidly cut off and the collector will then be cut off. This brute force method does not yield power gain and is expected to be rarely used deliberately.

The injector may be used to effect switching with power gain. If the injector is carried above the collector when the binistor is off, the latching transistor will begin to conduct and the collector will drop, carrying the injector back down with it. This is a basis for a very simple one-shot multivibrator. However, the injector must be free to drop in voltage, or a very large injector current will flow and may destroy the binistor. Incidentally, this method will cause the collector to conduct in the forward direction and to switch on only when the injector current exceeds the "holding current" of the device used as a Shockley diode or controlled rectifier.

If the binistor were conducting, the injector supply may be reduced and the latching will cease, causing the binistor to switch off. Several effects enhance this mode of switching off. One is the base cutoff supply and another is the non-linearity and relatively low alpha of the latching transistor. The binistor will switch off when the injector current is lowered to about twice the base current cutoff supply. This value we have called I_j crit. If the injector voltage is decreased below .6 volt, the binistor will switch off.

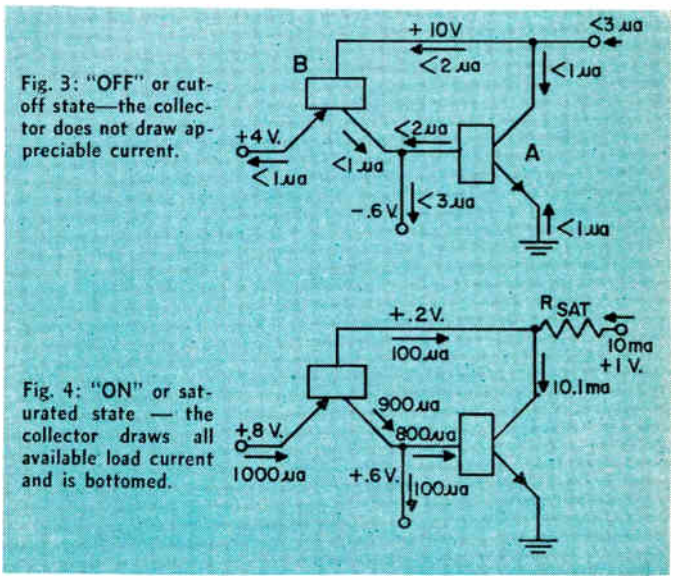


Fig. 3: "OFF" or cutoff state—the collector does not draw appreciable current.

Fig. 4: "ON" or saturated state — the collector draws all available load current and is bottomed.

The Binistor *(Continued)*

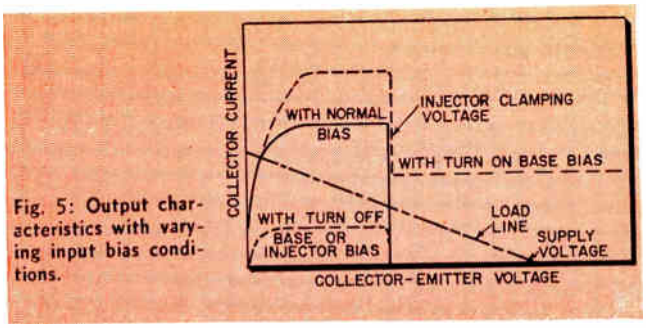


Fig. 5: Output characteristics with varying input bias conditions.

Use of the injector as the control element results in significant current gain but requires a slightly greater total voltage swing than the output can deliver. However, by selecting the injector clamping voltage, a significant voltage gain may be realized in one direction or the other. If capacitance coupling between stages is used, and duty cycles are low, binistors can communicate via their injectors alone. Thus triode binistors lacking the base connection may be used, but the inability to provide complete cutoff would restrict their temperature range, stability, and reliability.

Control by Base

The most interesting control element is the base. If the binistor is off, it may be turned on by base current of the same order as a normal transistor. The current gain may easily be of the order of 100. Since the collector voltage need only decrease below the injector clamp voltage before regeneration occurs, the turn-on gain will be increased by a high injector clamp supply but will be adequate even with a minimum injector clamping voltage.

The binistor may also be turned off by an inverse base current. If this is large enough, it will override the injector latching current. Once the collector has risen above the injector clamp, regeneration will rapidly turn off the binistor. By adjusting Ii and Ic the turn-off current gain may be made almost infinite, but in practice can easily be of the order of 100.

Thus, control of the binistor by the base provides the highest gain both in current and voltage. In some binistor types a high inverse series base resistance may make control of turn-off at the injector desirable, while turn-on is usually best accomplished at the base.

Control by Emitter

To complete a coverage of control modes, the emitter may also be used. To turn off a conducting binistor, the emitter may be raised within a volt of the injector clamping supply and regenerative cutoff will occur. To turn the binistor on, the emitter must be lowered below the base voltage to cause the main transistor to conduct. Emitter control offers voltage gain without current gain and is considered secondary to base and injector control.

Operating Ranges

The binistor will operate over a wide range of bias levels. Provided that sufficient injector current is supplied, the maximum collector current is limited only by saturation and dissipation. If the injector current exceeds I_j crit, any collector current down to microamperes may be switched. Voltage swings allowable may be somewhat smaller than for normal transistors. The maximum swing is limited by collector breakdown, which is somewhat lower than many silicon transistors due to the low collector resistivity. Minimum collector swings are determined by the injector clamping limits and are in the order of 2 volts.

In addition to this desirable flexibility, the temperature range over which bistability is practical is greatly extended over normal four-layer devices. The first experimental binistors would operate from −70 to +250°C. Maximum temperature limits will be determined more by storage life degradation than by characteristics or parameters. The reason that so much improvement over the usual four-layer device occurs is that the upper transistor B serves only as a "latching" transistor, and not as a "locking" transistor. The limited injector current prevents excessive regeneration and consequent turn-off problems. In

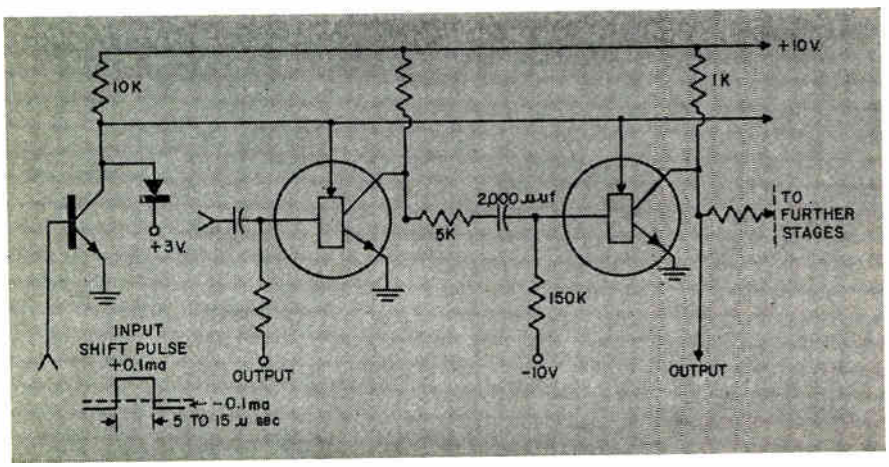


Fig. 6: Ring counter—one "ON" stage is propagated down the ring by the shift pulse.

addition, the only key parameters semiconductorwise are the inevitable I_{co} and B. The current gain is determined by an A x B rather than B^2 and is therefore far less temperature dependent. Because of the integration between transistors, the minimum injector current required for latching (I_j crit) is well below the "holding current" and has a far smaller temperature coefficient.

Speed

At this time, the speed of the first binistor type is adequate for most general purpose switching circuit needs. They are somewhat slower than the basic transistor from which they were designed. Further development is leading to considerably faster binistors. Since the latching transistor operates in the grounded base mode, its alpha cutoff frequency need be only one-tenth as good as the main transistor to prevent slowing it down appreciably. Because the collector junction is commonly the collector of both transistors, the total capacitance is one-half that of two transistors.

In practical circuits, the injector may be supplied from a low voltage source to economize by eliminating the injector clamping diode and supply. The injector voltage is very low when the binistor is on, which permits a low voltage supply as the injector current source.

Compared With a Flip-Flop

It is interesting to compare a binistor stage with a flip-flop. A flip-flop has the advantage of two outputs and two inputs but has many commutating and coupling problems. A flip-flop requires at least two transistors, seven resistors, two capacitors, two diodes, for a total of 28 solder connections. High speed carefully designed flip-flops usually require far more components. A binistor stage requires only one binistor and three resistors, for a total of ten solder connections. This simplicity results in far less "deck space." Also, the manufacturing effort is simplified and reliability difficulties reduced.

Some Applications

A ring counter, built for use in test equipment (Fig. 6), was immediately successful. Many other simple circuits have been built by engineers only briefed on how to use the binistor. One application that may prove very important is the use of simple binistor stages as elements of a non-destructive coincident memory. Although the magnetics are far more economic for large capacity memories, the driving, sampling, regenerating, checking, strobing, regulating and amplifying circuits required make small magnetic memories very unwieldly and costly per bit. The flip-flop's complexity, cost, and size make reasonably high density storage very difficult. The binistor may well be very useful in this application (Fig. 7).

In this coincident memory, a word is cleared by lowering the injector supply thereby switching off all the stages in that word. A given stage is turned on by coincidence of the word write and bit input lines via resistor logic at the base. Readout is accomplished by raising the word select bus to deliver the bit outputs through diode logic. The zero-to-one ratio exceeds 10,000. Readout is only capacitance limited and may be accomplished in less than .05 μsecs. Clearing and writing will require more time. The wide operating temperature range and the lack of critical tolerances or timing are favorable factors. Diode logic at the inputs will increase the tolerances still farther.

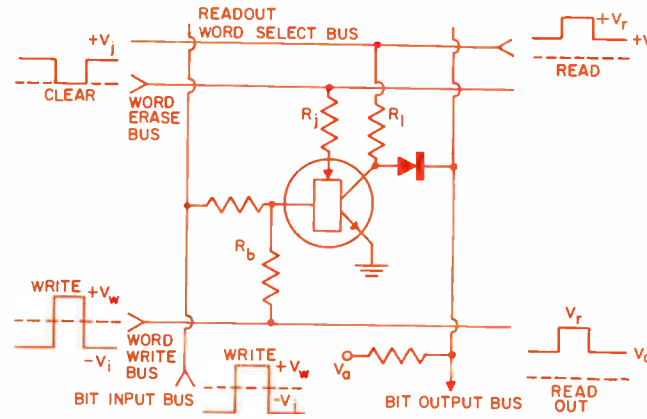


Fig. 7: A Binistor Coincident Non-Destructive Readout Memory.

Individual Tolerances (provided others are at bogey values)

		Min.	Bogey	Max.
V_c	Collector Supply Voltage	+5v	+6v	Vr-1
R_l	Collector Lead Resistance	2.5K	6K	10K
V_r	Readout Voltage	+6v	+9v	+15v
V_j	Injector Supply Voltage	+3v	+4v	+5v
R_j	Injector Resistor	500	1000	1500
V_w	Write Voltage	+2	+3	+5
V_i	Input Voltage	−4	−6	−10
R_b	Write Logic Resistor	60K	100K	150K

Small-Signal Negative Resistance Device

Although we have not seriously considered the use of the binistor as a small-signal negative resistance device, applications may arise. If the collector is carried through the injector supply region, oscillations occur unless a load impedance of less than 10 ohms is used! When the collector saturation resistance is higher than this, it is impossible to completely trade the output characteristic. When the collector is in the negative resistance region, capacitance at the injector will also cause oscillation. For this reason commercial transistor curve tracers are very difficult to use in tracing output characteristics. In addition, output characteristics are not of great interest by comparison to the input criteria for bistability. It is recommended that input currents and voltages versus output current or voltage be used for testing and evaluation purposes.

* * *

What's New . . .

LASER—
Coherent Light Source

LASER is an acronym derived from the first letters of the principal words of the phrase, "Light Amplification by Stimulated Emission of Radiation." The laser amplifies and generates coherent energy in the optical, or light, region of the spectrum; for this reason the laser is sometimes called an "optical maser,"

The laser, developed at the Hughes Aircraft Company's research laboratories in Southern California, is similar in size to a glass tumbler.

A solid state device, it is being used to generate coherent light in those laboratories.

Achievement of the laser marks the culmination by American industrial research of efforts by teams of scientists in many of the world's leading laboratories. Some of these are privately and some publicly supported, some are working under defense contracts, some not. At Hughes the work was with the company's own funds.

Laser projects the radio spectrum into a range some ten thousand times higher than that which was previously attainable. The laser jumps the gap from 50 KMC to 500 TC (500 teracyles = 500 $\times$ 10^{12} CPS); as such, it opens the way for a great many important applications.

For the first time in scientific history, true amplification of light waves has been achieved. Light may even be projected into very high-intensity beams for space communications. Available communications channels may also be increased enormously. High light concentration offers possibilities for industrial, chemical and medical purposes.

Light is electrical in nature—it is a form of electromagnetic energy.

The properties of electromagnetic energy at higher and higher frequencies changes in the sense that the techniques of generating, amplifying, and detecting it depend essentially on this frequency.

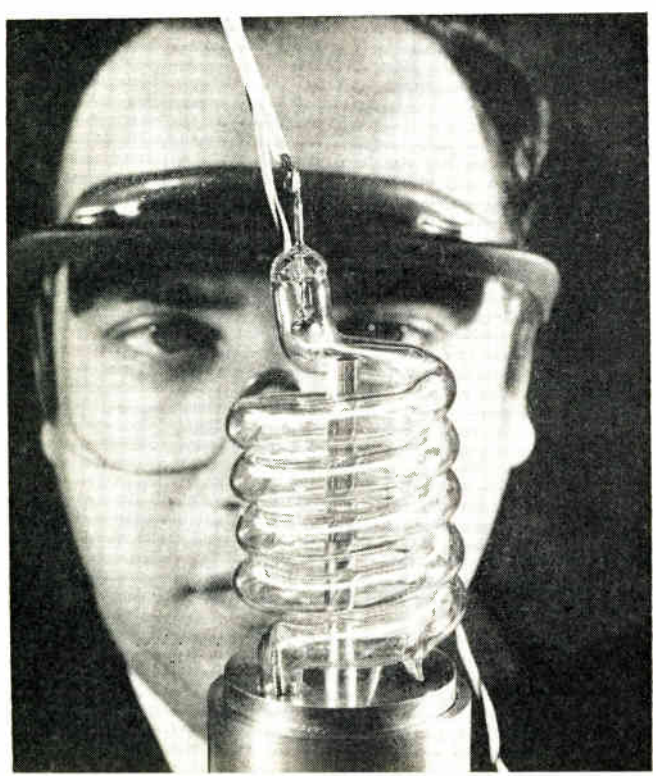


Fig. 1: The laser's main parts are a light source surrounding a rod of synthetic ruby crystal through which excited atoms generate the intense beam.

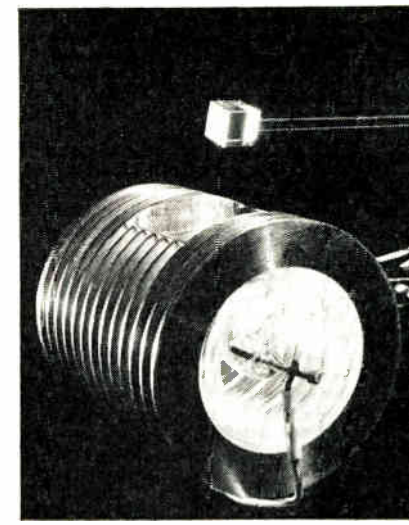


Fig. 2: Synthetic ruby crystal glows with absorbed light. Light source in the glass tumbler size cylinder pours "random" waves of light into the ruby, exciting the gem's tightly-packed atoms. Stored energy then reradiates light in a sharp beam.

Throughout the entire radio spectrum it has been possible to generate energy which can be characterized or specified to be of almost one definite, or single, frequency. The band of frequencies, or indefiniteness of specification, can be quite small, sometimes a fraction of one cycle per second. This band of frequencies, or portion of the electromagnetic spectrum over which any particular source generates energy, is often referred to in terms of its "coherence"; the smaller the band in which energy is radiated, the more "coherent" the source.

Previous sources of light energy such as incandescent lamps, are "incoherent" sources since they simultaneously generate energy over a relatively large part of the electromagnetic spectrum. Radio frequency sources, on the other hand, are very coherent.

The advantages of a coherent source are many. It can be used, for example, for communications purposes because each one occupies only a small part of the spectrum.

Scientists have recognized for years that if coherence at much higher frequencies could be achieved, i.e., in the infrared and optical spectral regions, many worthwhile things could be accomplished.

Progress in extending the avail-

Semiconductors by Vapor Growth

IBM research staff member Patricia McDade is unloading an open tube furnace after a vapor growth run. With this new method of "growing" semiconductors, iodide vapors are used to transport the semiconductor material.

SCIENTISTS of the International Business Machines Corporation can "grow" electronic components with a new technique of arranging atoms of one material on another—a kind of "atomic bricklaying."

The fabrication process, which the scientists call vapor growth, is a new advance in solid-state technology.* It has been used already by IBM to produce a variety of experimental semiconductor devices, including Esaki tunnel diodes and transistors. It does this in one continuous operation. In conventional semiconductor device fabrication, many separate operations are required to form the active parts of the device. The vapor growth process makes practical for the first time a special type of growth—epitaxial—of a layer of one semiconductor on another, such as germanium on gallium arsenide. This means the top layer automatically duplicates the same crystal structure as the one beneath it.

The vapor growth process used takes place through the intermediary of semiconductor iodide vapors. These pick up the semiconductor (e.g. germanium or silicon) from a piece of this material at a high temperature. The vapors then move into a cooler zone where the semiconductor "grows" from the vapor onto a suitable single crystal seed. The process can be carried out in two types of apparatus. In one, a continuous flow of gas carries the vapors in one end of a furnace and out the other. Alternatively, a closed tube is used and the vapors recirculate, carrying the semiconductor from the hot end to the cooler end. It is possible to incorporate selected impurities in the growing semiconductor at the cooler end during the growth process.

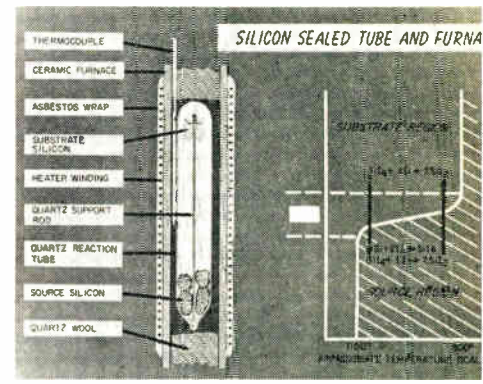
The vapor growth method of growing semiconductor materials is in marked contrast to the usual process involving growth by appropriately freezing the molten semiconductor. This is carried out in complex apparatus at a white heat, by processes known as zone levelling, crystal pulling or dendritic growth and offers only a limited opportunity for controlling impurity content and distribution in the growing crystal.

Semiconducting devices such as transistors or Esaki tunnel diodes consist of layers of semiconductor of positive or negative conductivity type determined by suitable "doping" impurities with "junctions" between them. Such devices are presently made from melt grown material by cutting it up into minute pieces and introducing the desired series of impurities by separate operations of alloying or diffusion, followed by careful hand assembly under the microscope.

Vapor growth introduces a new system of device fabrication in

(*Continued on page* 90)

Method for "growing" epitaxial multilayers of silicon is illustrated. Experimentally, the reaction is carried out in a sealed, evacuated tube placed in a two-zone furnace. The disporportionation of SiI_2 is used to transport silicon from high-temperature source zone to lower temperature substrate zone.



* *IBM Journal of Research and Development*, Vol. 4, No. 3, July 1960.

able coherent spectrum has been slow. At World War II's end the highest frequency that we could easily generate was in the microwave area at about 10 KMC. In the intervening 15 years we have been able to go up only by a factor of 5 to about 50 KMC.

Properly designed masers, taking advantage of the natural properties of atoms or molecules in interacting with electromagnetic radiation, amplify or generate electromagnetic energy. Although masers operate in the microwave region, it was clear from the start that the basic principle could be used to generate and amplify energy at much higher frequencies, perhaps up into the optical region.

The laser represents the result of a research program in the optical spectral region at the Hughes Research Laboratories. Instead of jumping a gap in the spectrum by 5 as has been done in the last 15 years, the laser represents a jump by a factor of 10^4.

The essential steps in the op-

(*Continued on page* 222)

Semiconductors

(*Continued from page* 89)

which the device is grown in one operation layer by layer from the vapor. Layer by layer growth is only possible because it is carried on at a low temperature. Growth from the melt, alloying and diffusion all are carried out at high temperatures and this has the result that one layer is disturbed by the treatment necessary to form another. Complex structures are thus difficult to make by conventional means.

Quality is a prime requisite in semiconducting materials. Vapor grown material compares very well with semiconductors grown from the melt. The purity is very good and, although it might be expected that a large amount of iodine might be incorporated, radioisotope measurements have shown that the crystals contain as little as 1 part in $1x10^8$ of iodine and this has no effect on their electrical properties. The crystalline perfection is excellent. It has been possible to grow germanium free of dislocations. This high quality is in marked contrast to semiconductors grown by vacuum evaporation of the material itself, where the purity and perfection are poor even when the process is carried out at high temperature.

Impurities have been introduced in sufficient concentrations to make Esaki tunnel diodes. It seems likely that the low temperatures used may make it possible to incorporate more of some desired impurities than is possible in growth from the melt. Devices which have been fabricated by this method include simple diodes, variable capacity diodes and Esaki tunnel diodes, both singly and in arrays and transistors. This is the first time that such Esaki tunnel diodes have been made by a method other than alloying. The interface between layers of different semiconductors (heterojunctions) can form wide gap emitters which are important for improved transistor performance at high current levels.

Typical epitaxial growths, ranging in thickness from 25 to 800 microns, deposited on the (111) surfaces of silicon substrates are shown at a magnification of 400.

Quicker Than You Can Wink an Eye . . .

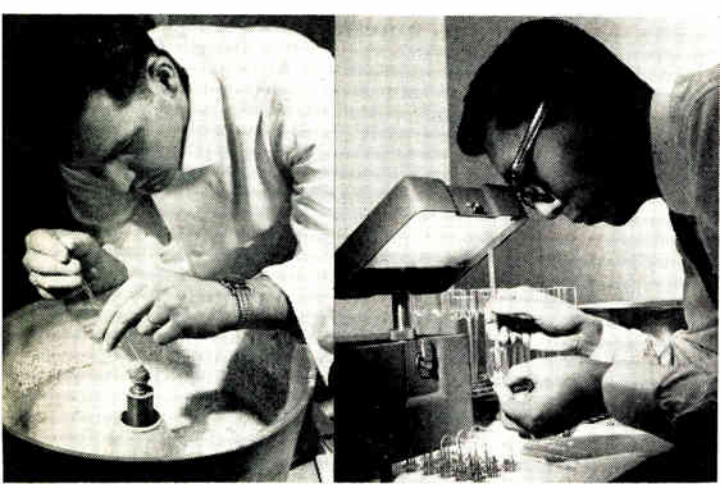
HIGH-SPEED electromechanical glasses, developed and constructed to protect the eyes of the wearer from burns or flashblindness caused by exposure to high-intensity flashes (nuclear explosions), are evaluated in an Air Force report, PB 151924, recently released by the Office of Technical Services, U. S. Dept. of Commerce.

A signal, generated at the onset of the flash by a photodetector, is amplified and actuates the shutters on the goggles, shutting out the light. The shutters are actually alternate opaque vertical bars and transparent strips. When open, the light transmission is 30%; closed, less than 0.01%. Closing time is less than 500 microseconds—20 times faster than the eye can blink.

The development was performed by the Wayne-George Corp., Boston, Mass.

Copies of the report may be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. The price is 75¢ and the report contains 29 pages.

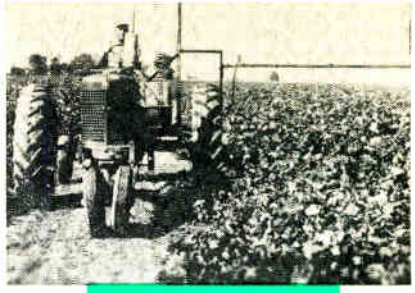
The Boston firm performed the work under a contract awarded by the Aero Medical Laboratory, Wright Air Development Center, USAF, Wright-Patterson Air Force Base, Ohio.

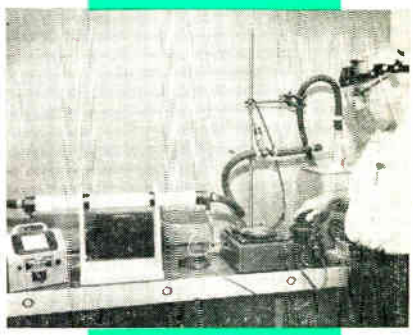


Polyoptic Sealing

A SEALING technique adapted from optical manufacturing processes will substantially increase tube reliability and life according to Chatham Electronics, Livingston, N. J. Bulb polishing (left) gives the bulb the precise contour to mate exactly with the critically fashioned button stem. Monochromatic helium light (right) is used to determine exactness of bulb and stem fit. With this light, fringe patterns appear as pink "stripes" separated by black bands, where the light waves interfere due to the presence of foreign particles between mating surfaces or surface irregularities.

ELECTRONIC INDUSTRIES
A CHILTON PUBLICATION

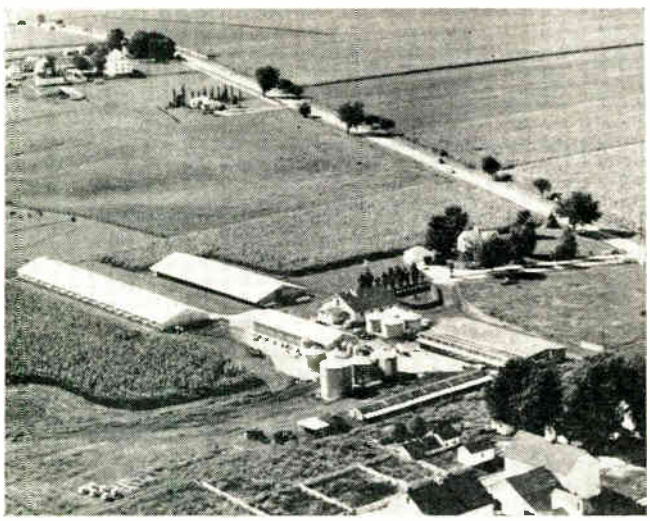


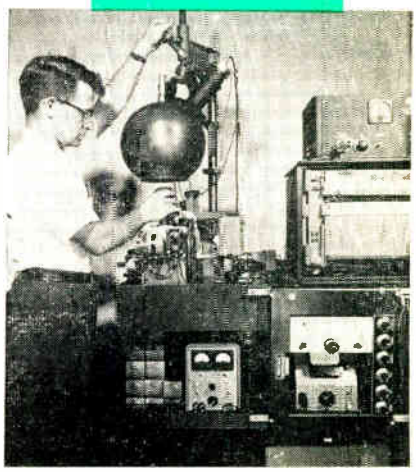


Electronics and the Future of Agriculture

An Editorial Staff Report

Second in a Series on New and Expanding Electronic Markets





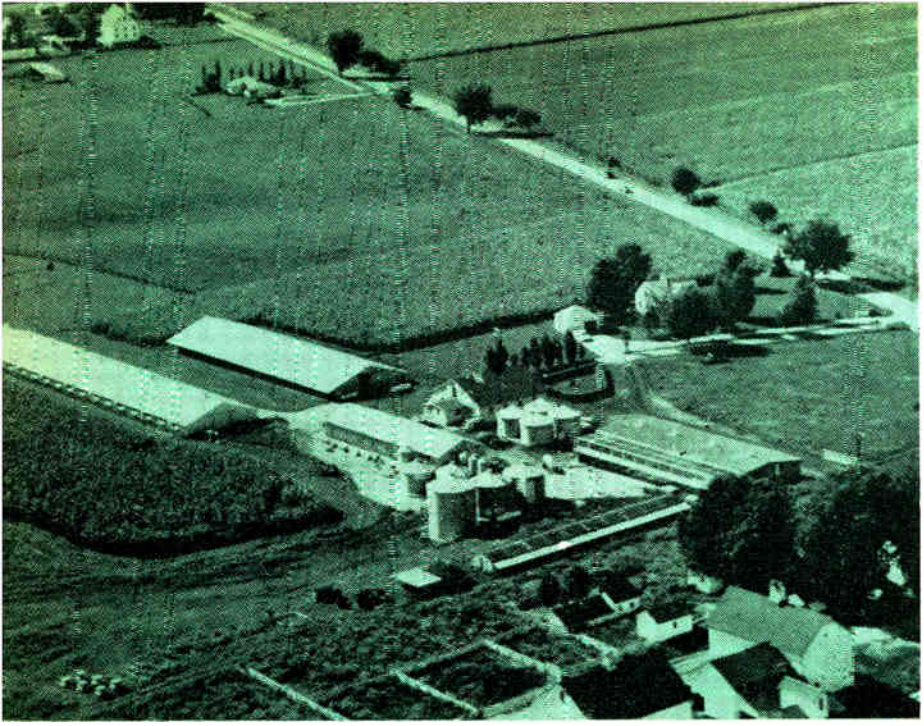


Fig. 1: On this farm, owned by W. T. Frye, Peoria County, Ill., the complete handling of poultry feed is automatically controlled. Feed is stored in bulk bins (cylindrical structures in center). Unloading, storage, and processing is performed in the central building. The feed then moves through pipes to the turkey and poultry houses at left.

By RICHARD G. STRANIX
Associate Editor
ELECTRONIC INDUSTRIES

Second of a Series

Electronics

HOW did your tomato juice look this morning? Off color? Or the bacon? Too fatty? Egg albumen blood-specked? Chances are none of these annoyances occurred.

But why did they not occur? Mainly because continuous, expensive human decisions were made during the processing. Sure, some of the work has been automated, but not the decision-making part—except for physical size.

As another expanding market for electronic manufacturers, we investigated the possibilities of agriculture. This industry grossed over $85-billion* in 1959.

For quite a while, a few private research labs, several agricultural colleges, and numerous State Experiment Stations have been doing work on the adaptation of electronics to agriculture. Most of the work has been done in cooperation with the U. S. Dept. of Agriculture (USDA) which has also been doing its own experimentation.

At its Beltsville (Maryland) Experimental Station, USDA is acting both as a clearing house for this type of information as well as a research and development center.

R. G. Stranix

Various branches of two of USDA's services—Agricultural Research Service (ARS) and Agricultural Marketing Service (AMS)—are doing extensive work in their respective fields.

A rather simplified breakdown of activities would give the actual application of electronics to the farm itself to ARS; in particular, to the Farm Electrification Research Branch of the Engineering Research Division, ARS. The use of electronics after the product leaves the farm is a function of the Instrumentation Research Laboratory of the Market Quality Research Division, AMS.

Eggs and Bacon

Let's get back to the bacon and eggs.

Sure, we know about egg candling! And bacon's bacon! But, do they have to be so expensive? They do, as long as human decision-making on each unit has to be performed. Why can't electronic equipment be substituted? The truth is, in many cases, it can, and has been; but, not extensively. One reason for the slow acceptance has been the high initial cost of equipment. Obviously, mass production techniques could considerably lower these costs.

Here are examples of what's been done with egg candling and hog fat measurements.

A spectrophotometric method of detecting blood in white eggs,[2] developed by USDA engineers, decreased the error in detection about 90% when tested on a commercial grading line. The detector, Fig. 3, which can scan 7,200 eggs per hour, is sensitive to the color of blood and automatically diverts eggs in which it is present, Fig. 4. Till recently, brown eggs could not be tested with this device because that pigment

* This figure represents the retail value for food, tobacco, liquor, and clothing.

Editor: This is the second in our continuing series on new and expanding markets for electronic manufacturers.

Agriculture embraces much more than food and the farm. Tobacco, liquor, clothing, textiles, and shoes—all are included. Processing and production of these items make it truly one of America's greatest industries.

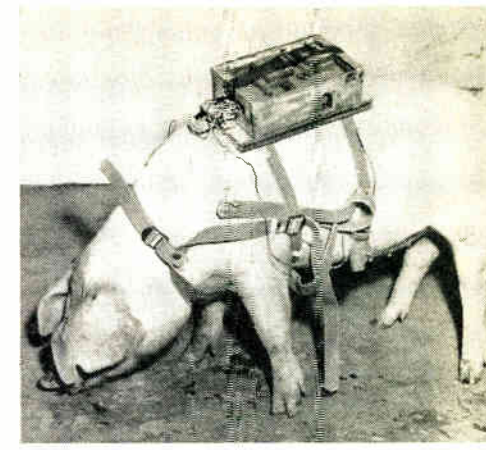


Fig. 2: Radio - electrocardiograph equipment as used in the study of jet aircraft noise, 135 db max., effects on farm animals.

and the Future of Agriculture

Electronic techniques offer great savings throughout the production-distribution chain, which brings goods to the consumer. How widely these techniques are applied will depend upon the awareness of both the electronic and agricultural industries.

represents nearly the same color as blood. However, this difficulty has been overcome.

Using the same eggs, licensed graders missed 3.9 blood spot eggs per thousand; the detector missed only 0.38.

Radiation measurements, Fig. 5, are now being used to get an objective measurement of the proportion of lean to fat tissue in livestock and poultry.[3] Counting the minute natural gamma ray emission always given off by animal muscle tissue, biologists can translate the impulses into an estimate of the proportion of fat to lean meat. The present device can handle 70 pounds of meat and works so quickly that a frozen cut can be measured for composition and returned to the freezer without danger of thawing. With modifications, the machine could estimate fat in live animals to help breeders select the most desirable animals.

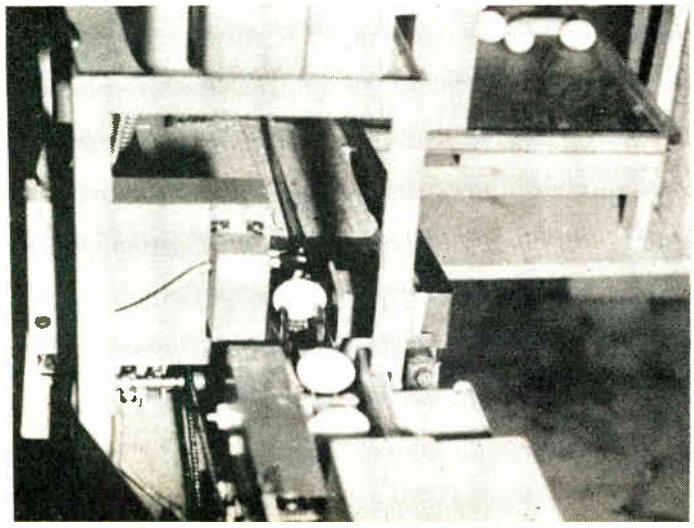


Fig. 3 (left): Blood spots in eggs can be detected by this device which scans 120 eggs per minute.

Fig. 4 (right): When a blood spot is detected, a tripping device diverts the egg from the pack. The three eggs on the left have been rejected; the others are ready for packing.

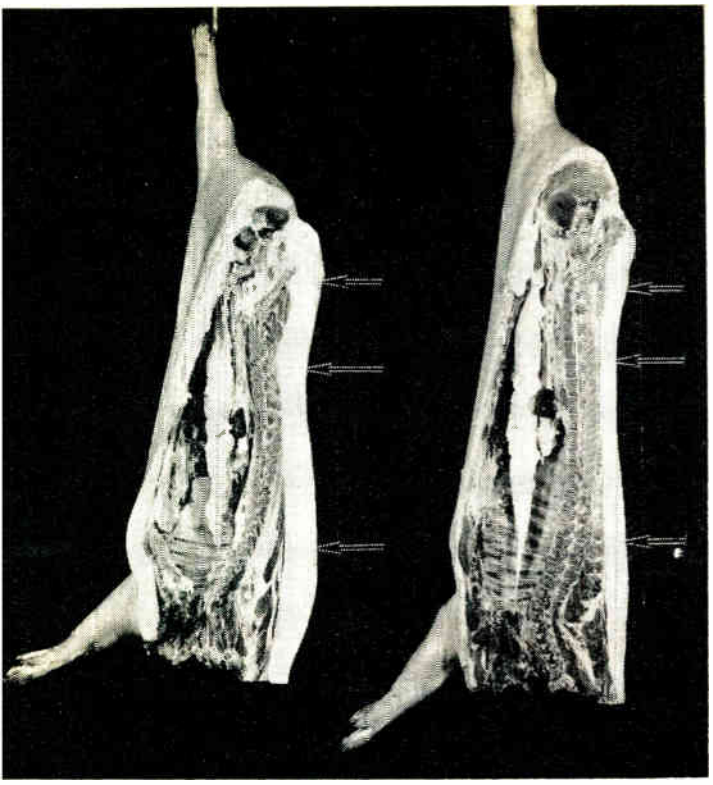


Fig. 10: Arrows indicate points of measurement with an ultrasonic transducer. Carcass at left is from high-line hog; that at right from a fifth-generation low-line, developed to improve lean-to-fat ratio.

Agricultural Electronics

(Continued)

calibrate and check the display sweep of the apparatus.

The average difference between the live ultrasonic and carcass ruler measurements was 0.20 in. with a standard deviation of 0.26 in. ($\pm$0.26).

One difficulty of establishing absolute accuracy is the variation which may occur in ruler measurements. Aside from the human element, soft flesh is somewhat difficult to measure more closely than to the nearest 1/16 in. Measurements in hanging position are believed to deviate from the standing position, Fig. 14.

The total fat pip on the visual display is usually easily distinguished on the loin and ham measuring points, while the shoulder measurements usually yield a more complicated pattern. However, the reliability of the shoulder measurements compared closely with the reliabilities of the ham and loin measurements, in spite of these complications.

Although we quoted a figure of sound velocity in animal fat of 1.44 x 10^5 cm/sec., there is disagreement among authorities on the precise velocity of sound in tissue. This fact along with animal movement and fluctuations in hand pressure on the transducer are the major sources of error.

Chickenfeed

No threat of labor trouble on the farm due to automation. Distribution of feed can be a laborious and time consuming task—not to mention costly. A completely automatic feed handler is now in operation on a Peoria County, Ill., farm, Fig. 1. It was developed by H. B. Puckett, a USDA agricultural engineer, in cooperation with the Illinois Agricultural Experiment Station scientists and an Illinois farmer.[10]

The electro-mechanical system, which also involves pneumatics, maintains a constant supply of feed in the poultry houses. This is how it works.

Bulk feed, blended and ground, is moved to the poultry houses by a pneumatic conveyor as easily as water is piped—up, down, and around corners, Fig. 12.

The conveyor, actually a one inch pipe, carries the feed to small storage bins at discharge stations in the houses. At set time intervals, the feed is then distributed by automatic feeders.

The entire system can be controlled by a bin switch at each feeding location. The type of mix to be delivered to each location can be controlled from the master control panel at the hammermill, Fig. 13. Three-way pinch valves, located at several places throughout the system, route the feed to the proper location. The valve, Fig. 11, was specially designed by Mr. Puckett. It consists of a metal tube with a collapsible rubber liner. The tube and liner work like a milking-machine teat cup and liner. Compressed air is injected between the tube and the liner, forcing the liner to collapse and divert the feed to the other outlet.

This low-volume, medium-pressure, pneumatic conveying system is growing in popularity because of the small size of the pipe required, the ease of installation, the automatic controls, and the small amount of dust generated at discharge stations.

Artificial Chick

A new control, responsive to radiant heat, auto-

Fig. 11: Three-way pinch valve is suitable for direction controls of feed. It is operated by compressed air and electronically controlled.

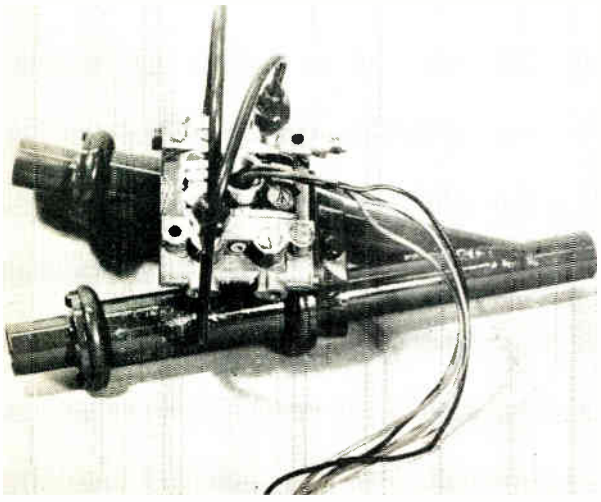
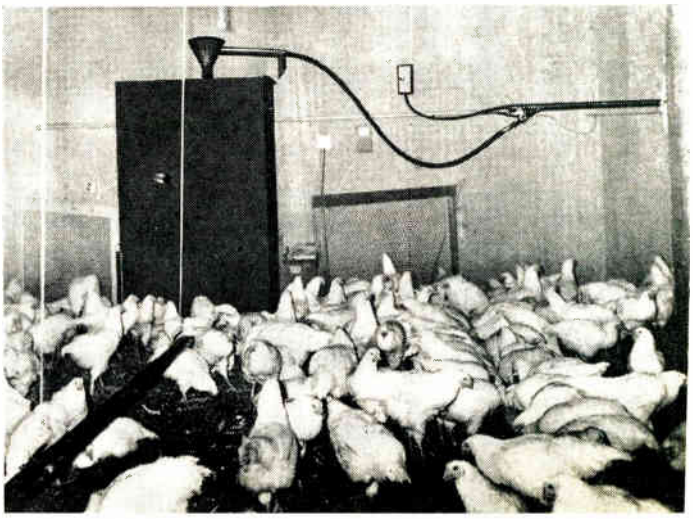


Fig. 12: Pipe at right carries feed to 3-way pinch valve which may direct it to the storage bin at left or route it to another point.



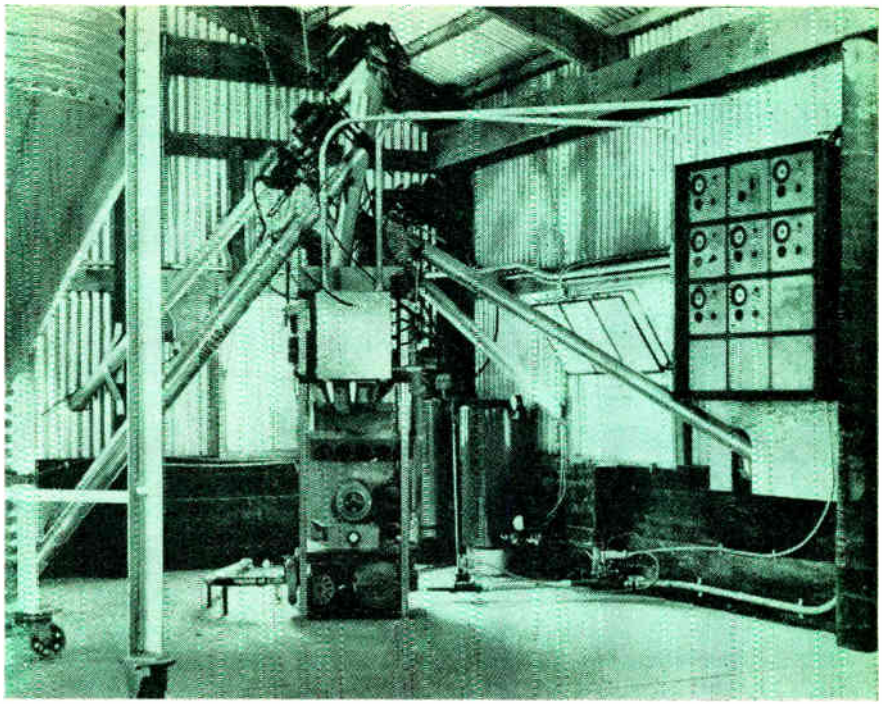


Fig. 13: Distribution control panel at right contains a subassembly for each feeding location. After grinding and blending, feed can be automatically moved by compressed air to the selected discharge point.

matically controls infrared brooder lamps according to chick needs.

The heat sensing element of this control is a sort of imitation chick. It operates under a brooder near chick's body temperature and reacts as they do.

The device[12] is a 4 in. black globe that loses heat by radiation and convection in much the same way that the chicks lose heat to their surroundings. Thus, a temperature change affecting the chicks also affects the control. Basically the globe contains a thermistor for sensing temperature and a resistance heating element to supply internal heat. It also contains a transistor amplifier, Fig. 15.

A brooder regulates the rate of a chick's heat loss by controlling environmental temperature, or by supplying radiant energy to the chicks from sources such as infrared lamps. The device operates without greatly raising the temperature of the surrounding air.

The black globe is located just above the litter under the brooder lamp. Fig. 14. The globe's 105°F temperature is maintained with heat from two sources —some continuously through the electrical resistance heating element inside the globe; the rest, intermittently, by the infrared brooding lamps.

As they grow older, chicks produce more heat by eating more feed and they become better insulated with feathers. Consequently, they require less external heat from the lamps.

Naturally, the globe cannot grow feathers. Yet to perform its job efficiently it must obtain this warmth, or heat, from some other source. This is accomplished through the internal heating element. A simple adjustment of a rheostat is all that is required. Increasing the globe's internal heat in proportion to chick age allows this device to maintain its internal temperature in progressively cooler surroundings without any additional heat from the infrared brooder lamps.

In controlling infrared lamps, it is best to keep the "off" periods as short as possible, to keep chicks from getting chilled. This is done through a proportional-time-cycle principle.

The thermostat setting continually sweeps back and forth across a band of about 3°F every 15 sec. Thus, when the sensing sphere's temperature is within this 3° range, the lamps are turned on for a portion of the 15-sec. cycle. The length of the "on" period decreases as the sphere's temperature approaches the upper limit of the 3° range. Quite naturally above this range, lamps are off continuously; below, they are on continuously.

There are a few disadvantages to this new control. The fairly large sensing element occupies space under the brooder and must be protected from the birds. Moreover, present cost of the device is high, limiting it to large installations where one unit could control several brooders. It is possible that mass production of this device could bring the cost of it within the reach of all poultry farmers.

Farm Research

Considerable research has been done with electronics for improving operating conditions on the farm and also for testing the effects of environment upon animals. Most of these equipments will never

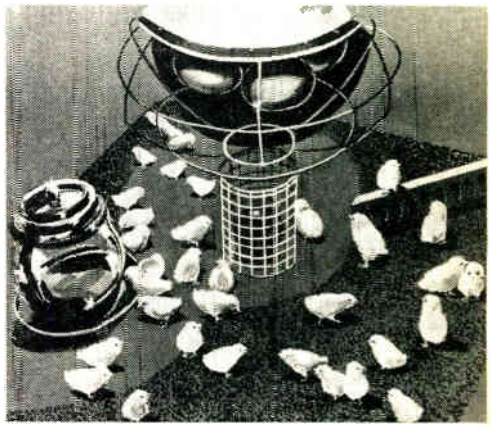


Fig. 14: Radiant heat from infra-red lamps keeps chicks warm. Artificial chick — small enclosed black globe — automatically turns on lamps when the chicks need more heat.

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dielectric loss factor, electrical conductivity, sonic energy absorption, and spectral reflectance, transmittance and fluorescence are the quantities of greatest value in indicating the quality of agricultural products.[20]

Appearance

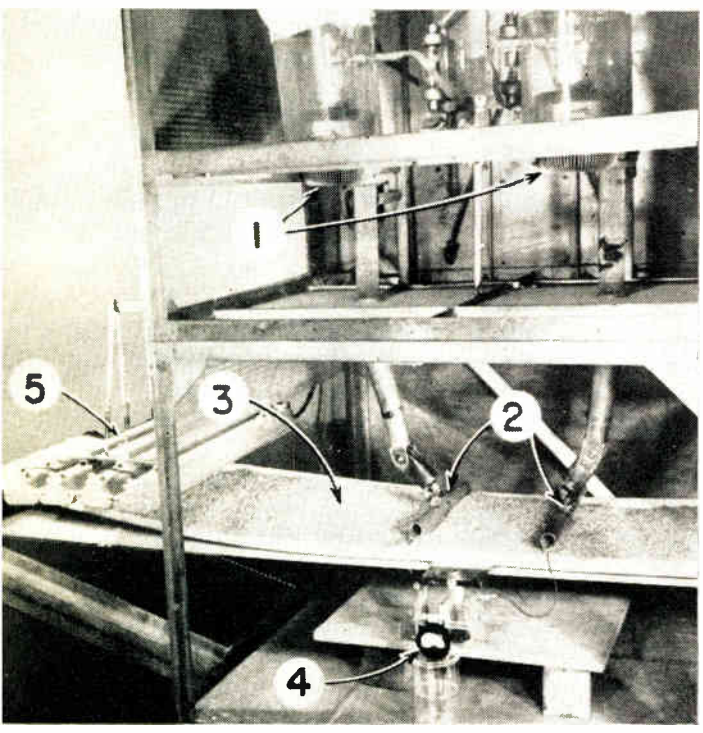
The appearance of a good product, as viewed by the human eye, is one of the most important quality factors to be measured. Also it is the quality factor most often measured by physical methods. In addition to size and shape, the appearance of the product is determined by its color and gloss.

In most cases it is not necessary to specify completely the color of a product because the variation of one sample to another is only in the lightness to darkness or in the intensity of a given color. In such cases, one- or two-filter reflectance photometers can adequately measure the color variation. Such instruments have been successfully applied to tomatoes, corn, tomato products, lemons, eggs, beans, peas, cotton, peanuts, and other materials.[21-26] For many of these products, automatic color-sorting equipment is available.

Rheological Properties

Rheological properties are those which determine the consistency, toughness, hardness, and other characteristics generally evaluated by the consumer with his sense of feel. These properties lend themselves to objective measurement by mechanical devices. In general, the measurements are destructive to the product, and it is often highly desirable to have a non-destructive test. Such non-destructive tests are possible using sonic energy or electro-magnetic energy measuring techniques.

Fig. 18: Experimental apparatus used in Nebraska tests for dielectric-heat treatment of infested wheat consists of (1) radio-frequency oscillators, (2) heating electrodes, (3) belt conveyor, loaded from left, to move wheat through electrical field, (4) r-f voltmeter to measure field strength, and (5) infrared units that speed up process by preheating grain.



Consistency can be indicated by the absorption of ultrasonic energy; meat texture can be related to the absorption of radio frequency energy; and, rheological properties related to the absorption of light or of ionizing radiations. In these measurements, the rheological property is not measured directly; but rather the density, fiber content, or other compositional factor which determines the properties of the material is measured.

Moisture Content

The moisture content is definitely an important quality characteristic of practically every agricultural product. Much work has been done on the development of physical methods for measuring moisture content, and many successful methods are in use.

Electrical conductivity is used to measure the moisture content of wood, grain, hay, cotton, and many products where the moisture content of importance is within the range of 6 to 40%.[27-33] Radio frequency measurement of dielectric constant is also used for this same class of material.[34-37]

Recently, nuclear magnetic resonance has been applied to the measurement of moisture content of materials ranging in moisture content from 5 to 100%.[38, 39] This method shows promise of offering an absolute method of measurement.

By suitable control of thickness of sample, density can be measured to give a measure of moisture content.

Maturity and Ripeness

A direct method is not available for measuring maturity and ripeness; but it can be indicated by a variety of indirect methods. For some products, such as tomatoes, the external color is a good index of maturity. For other products, e.g., peas and beans, tenderness measurements give the best indication of maturity.

For those products where color gives a good index of maturity, instruments are available to measure maturity by making a reflectance or transmittance measurement. For many other products, moisture content gives a good index of maturity and this can be measured as indicated above. On other products rheological properties are measured to indicate the maturity.

Defects

In food products, defects most often consist of dark spots, decayed areas, or other discoloration. The presence of some material foreign to the product may also be classed as a defect. The complexity of the types of defect that occur in agricultural products makes the problem of indicating these defects very difficult.

External discoloration can be detected by reflectance photometry if the discoloration is large enough. The chief difficulty in detecting these defects is that of scanning the entire sample for a sample that may vary greatly in size and shape. Various techniques have been used to solve this problem: lemons have been dropped through a ring of filtered phototubes to give a view of as large a surface as possible; speci-

Fig. 19: Spout-type automatic sampler draws samples of peanuts as they flow by gravity through the discharge spout of a belt and bucket elevator.

mens have been placed in the center of a ring of filtered phototubes; and, beans have been placed inside an integrating sphere.

Since external defects are readily detected by subjective evaluation, the problem of replacing this method by physical techniques is even more difficult.

Internal defects are also difficult to detect; but here, physical methods can be most readily applied, and other techniques cannot compete. X-ray units are now being used to inspect grain for the detection of insects within the kernel. Similar techniques can also be used to detect internal defects in fruits and vegetables. The possibilities for much wider application of X-ray inspection are very good. The transmission of visible light through agricultural products can also be used to indicate defects.[40]

Fluorescence measurement can be used to indicate the internal as well as surface defects. Many of the common decay-producing organisms produce chemicals which fluoresce when exposed to ultraviolet light. Unfortunately, many chemicals common in agricultural products also fluoresce; but it is possible in many cases by proper choice of excitation wavelength and by spectral analysis of the fluorescence, to distinguish the decay from the natural material.

Other physical methods such as measurement of dielectric constant, electrical conductivity, heat conductivity, and ultrasonic energy absorption can also be used for detecting specific defects in materials.

As we increase the number of automatic operations in our food processing and handling, it becomes more important to reduce the amount of subjective evaluation involved. Therefore, it is expected that the future development in this field will be very extensive.

Peanut Sampling

Dependent upon the rating given to a farmer's peanut crop, so goes the price that is affixed for his product. Most of the grading equipment has been automated starting with an electrically operated sampler placed near the head of a belt and bucket elevator, Fig. 19, where samples are drawn at specified time intervals as the peanuts pour into the storage bins.[41] Where belt and bucket elevators are not used, but rather where samples are drawn from the farmer's truck, a suction-type sampler has replaced the old sampling probe. Even the pre-sizing, shelling, and splitting has been mechanized. Naturally, the sample drawn now is more representative of the lot than those obtained by human means.[42]

The part of the sample that has not been split is then counted and weighed. Coming off a vibrating spiral the shells interrupt a light beam as they pass down a shoot, Fig. 20. The known sample quantity is then weighed and an average figure of number of nuts per pounds is obtained. From this figure, the rate to be paid the farmer for his crop is determined. High moisture content of nuts would account for weight and consequently there would be less nuts per pound.

The Rephobiospect

Regardless of the amount of picking, squeezing, thumping and color examination of tomatoes, cantaloupes, watermelons, etc., the consumer can never really be sure what the fruit is like inside until they cut it open. Neither are the wholesalers, processors, and handlers.

Light absorption techniques offer a possible solution to this unhappy situation. The light transmittance characteristics of a sample can be related to the maturity and ripeness. Commercial instruments of suitable design were not available when the initial work was done. Consequently, USDA developed its own instrumentation.

The main problem in attempting to measure the spectral transmittance properties of an object such as an apple or a tomato, is the problem of collecting sufficient energy from the transmitted signal. Such samples contain a large quantity of scattering material. The light is not transmitted in a straight line through the object, but rather is reflected and scattered many times. As a result the light emerges from all parts of the sample.

If we had phototubes in the shape of a sphere which would completely surround the sample, the problem would be simple. The nearest thing that approaches this condition can be obtained by enclosing the sample in a light-integrating sphere with a phototube viewing a small port in the sphere to measure the brightness of the sphere's surface. Nearly all the transmitted light can be collected by this arrangement regardless of where it emerges from the sample.

A few details of the Rephobiospect[43, 44]—Recording Photometer for Biological Spectral Transmission—shown in Fig. 21, are in order.

The integrating sphere must be coated internally with a material having a high diffuse reflectance over the spectral region to be covered. High-quality flat white paints are suitable for wavelengths from 500 to

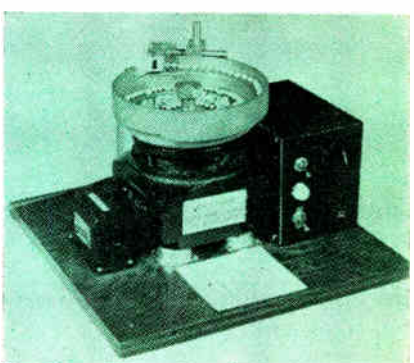


Fig. 20: Seeds are counted as they drop off the top of spiral and break the light beam to a photocell.

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1000 mμ, but their reflectivity falls off rapidly for shorter wavelengths. Titanium dioxide paint has been adequate for most agricultural commodity applications because the transmittance of such materials—peaches, apples, tomatoes, etc.— is so low for wavelengths below 500 mμ that the transmitted energy cannot be measured.

If measurements below 500 mμ are required, the interior surface of the sphere may be smoked with magnesium oxide, which has a high reflectivity down to 250 mμ.

For maximum signal response, the sphere size, the sample, and the phototube port must bear a certain relationship to each other. The mathematical analysis of this relationship is too complex for solution without the use of a high-speed computer.

In the equipment, end-window multiplier phototubes having a flat cathode 1½ in. in diameter measure the light so that the phototube port is also 1½ in. in diameter. A 12 in. diameter sphere was chosen as the proper size for use with samples as large as 3 in. in diameter. A 24 in. diameter sphere was selected for larger samples.

To make matters more difficult, for maximum signal response the sphere should be as small as possible, but it must be large in comparison with the sample to prevent reflectivity effects from the surface of the sample. Experience indicates that the best choice is probably a sphere diameter about 5 times the maximum dimension of the sample. The phototube port should be about 1/10th the diameter of the sphere.

The transmittance measurement should be made with a spectral bandwidth narrow enough to define the absorption bands present in agricultural commodities. This requires a bandwidth of 5 mμ or less in many cases. It is possible to attain this requirement without using an unreasonably large energy source by using multiplier phototubes and a high-gain amplifier. To attain the maximum signal-to-noise ratio, a narrow-bandwidth tuned amplifier and a chopped light beam are essential. This system provides a much greater zero stability and greatly reduces the noise fluctuations generated in the phototube.

Construction

The light source used is a ribbon-film, 100 watt tungsten lamp. The source beam is chopped by a sector disc rotating at 1700 rpm. This disc, containing 12 uniformly spaced circular openings, produces a chopped beam at 340 cps. A lens system images the lamp filament on the entrance slit of the monochromator. Provision is included for insertion of filters to reduce stray light when necessary, Fig. 22.

The light beam is dispersed by a Bausch & Lomb grating monochromator. A synchronous motor and quick-change gear train driving the wavelength drum provides wavelength drive speeds of 35.5, 75, 150, 300, 600, 900, and 1200 mμ per min. Mounted beneath the integrating sphere, the exit beam of the monochromator is vertical.

Mounted on the top of the sphere are two end-window photomultiplier tubes each with a 1½ in. diameter port. Two tubes are used to obtain as wide a spectral response as possible. The output signals on the two tubes are added by connecting the anodes together. Separate high voltage power supplies provide dynode voltages to the phototubes. Each power supply is highly regulated and adjustable from 500 to 1500 v. The use of independent power supplies permits convenient adjustment of the sensitivity of each tube.

Fig. 21: Tomato is placed in Rephobiospect to record its spectral transmission curve. Basketball type object is the integrating sphere.

One of the phototubes has an S-1 photocathode surface and the other an S-11. Together they provide a useful spectral response from 350 mμ to 1100 mμ.

Operation

The anode signal is fed to a narrow-bandwidth tuned amplifier. This amplifier has a maximum gain of 20,000 with an input noise level of less than 1 μv. With an input impedance of 10 megohms it is thus possible to measure anode currents as low as 10^{-13} amp.

The output, rectified and filtered for indicating, is fed to a recorder. Two types of recorders have been used: an adjustable span, 1 to 20 mv, strip-chart recorder, and an X-Y recorder. The response time of the system is one second for full-scale travel at the fastest speeds. It can be increased to 5 sec. for reducing noise fluctuations for low-speed recording.

Calibration of the strip chart recorder is quite simple since the wavelength drive of the monochromator gives a linear wavelength change with time. A marker pen is activated every 100 mμ.

To enable recording of any desired spectral interval on a convenient length of paper, a quick-change gear train is also used on the strip-chart drive.

As already mentioned, the use of two phototubes provides a wide spectral response, but this response varies with wavelengths. Therefore, the recorded transmittance curve for a sample is not a true trans-

mittance curve. For most applications, however, it is not necessary to have a true curve, because the curve for one sample can be compared with the curve for another sample to determine the significant differences.

If the true transmittance curve is desired, it is a rather simple task to accomplish. The system response is recorded on the X-Y recorder using conducting ink. Using the curve-tracing attachment for this recorder and the built-in transmitting slide wire, the system response curve can be played back at will and the transmitting slide wire substituted for the span-adjusting potentiometer of the strip-chart recorder. Thus, by maintaining the wavelength synchronization between the recorders and the monochromator, the system response can be cancelled out and a flat response obtained.

Performance

Typical transmittance curves as recorded on the X-Y recorder are shown in Fig. 23. For these curves the S-11 photocathode surface tube was operated at 600 v. and the S-1 tube at 900 v. The slit width of 0.5 mm gives a bandwidth of 3.3 mμ. Curve A is for a mature Jonathan apple, Curve B for a less mature apple, and Curve C represents the system response.

No importance should be given to the transmittance value at any one wavelength because for each curve the sensitivity of the amplifier was adjusted to give a full scale reading at the wavelength of maximum energy. However, the curves may be compared with each other, or one wavelength may be compared with another on a given curve.

Apple A shows evidence of absorption bands at 840 mμ, 760 mμ, 675 mμ, 630 mμ, and a general absorption of all wavelengths below 550 mμ. Apple B shows absorption bands at 840 mμ, 760 mμ, 650 to 690 mμ, 630 mμ, 560 mμ, and a general absorption of all wavelengths below 510 mμ. The absorption band of 760 mμ corresponds to a water band and that at 675 mμ to chlorophyll. The other absorption bands have not been identified.

The curve for apple B shows a much higher absorption than apple A in the chlorophyll region, indicating that its chlorophyll content is probably much greater. Also, B shows less absorption than A in the 550 mμ region, indicating that the pigment causing this absorption must be lower in apple B. From an external appearance, apple A appeared to be more mature than apple B—it is to be expected that the more mature apple would contain less chlorophyll. However, the extreme difference in the transmittance curves is surprising, because the chlorophyll content is known to be quite low in an apple.

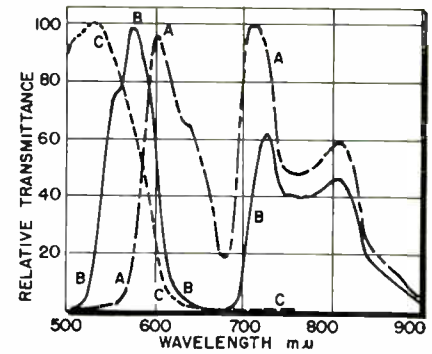


Fig. 23: Relative transmittance for two apples. A is for a mature apple; B for a less mature one. Curve C is the system response with no sample.

It is quite possible with this system to make measurements at a speed sufficient to permit automatic sorting.

In practical application the recorder would not be needed, and the monochromator would be replaced by two or more small interference filters.

This system should eventually enable the corner grocer to present higher quality produce to the consumer, and should enable the processor to pay the grower more nearly to the proportion to the quality of his product.

Potatoes

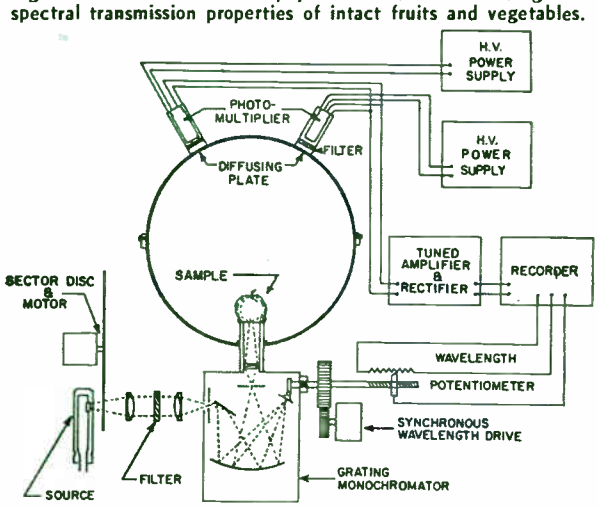
The rephobiospect has been modified to record on a logarithmic energy scale and a new method of presenting the sample has been developed.

The use of an integrating sphere to enclose the sample for recording spectral absorption curves of biological materials has proven satisfactory for most applications; however, in a case of detecting hollow heart, one of the major defects of potatoes, the direct phototube mount is better. This apparatus, Fig. 24, measures only the light passing through the center of the tuber giving the technique more sensitivity to small discolored areas located near the center of the tuber.[45] The potato is oriented in the instrument so the light passes through the shortest dimension of the potato. The phototube housing is mounted on a vertical shaft so that this portion of the assembly can be raised to insert a potato for measurement. A telescoping housing encloses the potato to exclude all ambient light. The phototube housing rests on the potato while the measurement is made; thus, the vertical position of the phototube is an indication of the size of the potato. A scale is placed at a convenient location so the size of the potato can be recorded when the transmittance measurement is made.

In measuring the transmittance of agricultural products, the ratio between the energy incident on a sample and the energy transmitted is a function of size as well as composition. Information can be gained about the composition of the sample by using an index which indicates the shape of the absorption curve.

Though this discussion on marketing was started

Fig. 22: Features of the equipment used for recording the spectral transmission properties of intact fruits and vegetables.



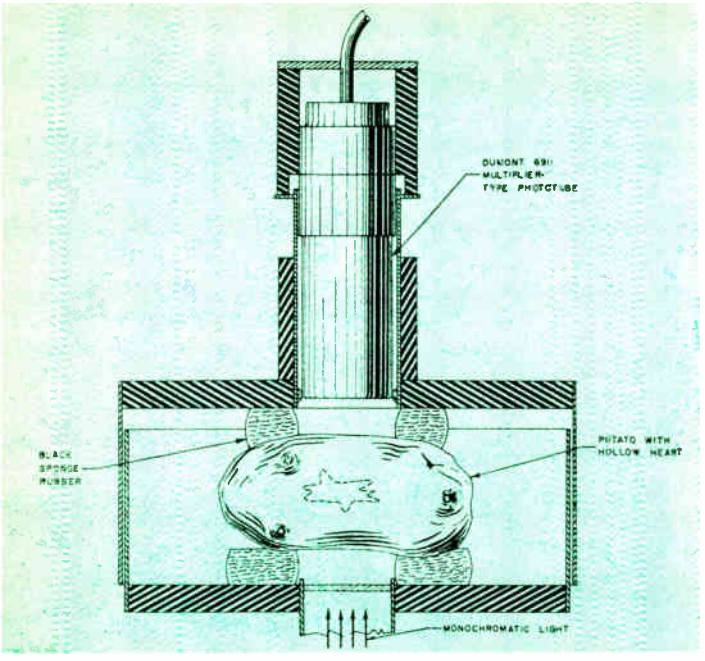


Fig. 24: Direct mount designed for detecting hollow heart. Note that defect appears directly between light source and the photctube.

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with a reference to the inspection by the USDA, many of the equipments will be placed, or have been placed at the processor's plant, because this is where inspection usually takes place. Consequently there should be a fairly large market for some of the systems described in this section.

There are several other applications of electronics in the marketing or processing side of the story. Most of these are concerned merely with the control of a process, but we shall review some of them at this point.

Hog Slaughtering

Humane slaughtering of hogs is becoming a practice of the meat packing industry. This is due to a law recently passed by Congress. The law requires humane slaughtering of animals for meat sold under government contract.

The most successful and approved procedure for slaughtering hogs renders them unconscious with CO_2 before they are bled.[46] This system uses a conveyor belt which carries the hogs through a steel tunnel. The tunnel has a dip, filled with CO_2 in its center. As the hogs pass through the CO_2, they are made unconscious by the shortage of oxygen.

An analyzer-controller measures and controls the gas content in the tunnel. The amount of CO_2 is critical. Hogs will remain conscious if there is not enough; an excess will kill them and cause improper bleeding. In a typical installation, a 72% CO_2 concentration is desirable. When the concentration drops to 70%, the hogs are conscious when they leave the tunnel.

The system consists of a sensing head, a calibration and power supply box, and a recorder-controller. The sensing head is mounted on the tunnel wall while the recorder-controller and power supply are contained in a remotely mounted panel.

The sensing head converts the detected amount of CO_2 to an electrical signal. This signal is then sent to the recorder-controller. With this method of analysis, the system has little dead time and gives a smooth control.

The system is simple to use. A few minutes before the slaughtering begins, a switch is closed to place the analyzer-controller system into operation. The tunnel is automatically filled to the preset concentration of CO_2. There is very little overshoot at the set point.

If the operator finds that the hogs have not been subjected to the correct amount of CO_2, he may quickly change the concentration by turning a knob in the recorder. This assures proper slaughtering with a minimum amount of CO_2.

Electronic recorder controllers are also used extensively throughout the processing industry for temperature and humidity control of the environment along with temperature control of cooking batches, conductivity, and viscosity of liquids, and in many other areas.

Computers

Up to this point we have not mentioned that area which means electronics to many people outside of the industry. That is the computer. Most of us in the electronic industry could readily see how computers would be a valuable asset in the field of wholesale inventory, distribution to local retailers, shelf stocking in the supermarket, and cost tabulation of items selected by a consumer. This last item requires only a suitable indicator on the item and detector at the checkout station, e.g., magnetics or optics.

Given sufficient raw data, computers in a centralized location could also be used to determine proper planting time, quantities, harvesting time, fertilization requirements, water supply and transportation costs.

Pesticides

As already mentioned, detection of pesticide residues offers some difficult problems. Farm products in a particular area are grown by scores of farmers—each using different types and amounts of bug killers. Heretofore, no rapid, quantitative method was available for identifying various pesticides in the presence of one another. The tester had to have a prior idea of what compounds are present before he could detect and measure the residue. A different identification procedure was necessary for every compound and each procedure was lengthy and complicated, involving elaborate equipment and highly trained technicians.

A new test device is now on the market that can be used to determine the nature and amount of pesticides on a sample in a very short period of time.[47] A concentrated sample is injected into the device, and within minutes the pesticide content can be read on a chart.

The first step in the new procedure is to run a small sample of the vegetable through a food chopper. Then it is extracted with suitable organic solvents and concentrated by evaporation. At this point, it is ready for injection into the analyzer.

The sample passes first into a gas chromatographic

column where a helium carrier gas pushes the individual components along at different rates according to their volatility—thus separating them. From the column, the compounds enter a combustion furnace one after another, and the combustion products move on into a detection cell.

In the cell, silver ions are generated electrolytically and titrate with chloride from the sample. The amount of silver ion generated is measured electrically and recorded on a strip chart. The more organic chloride that is present in the sample, the more silver ion generated, so that the measurement for silver ion is also a measure of the chloride.

Thus, when a decomposed chloride-containing component enters the detection cell, a peak appears on the strip chart. The time, in minutes, after injection that the peak occurs is determined by the rate at which the particular compound went through the chromatographic column—in other words, by its volatility. Hence, time of appearance on the chart is characteristic and will identify the compound. The area under the peak on the chart is measured, and this indicates the amount of the component in the sample. Then, the peak for the next compound, if present, appears and is measured and so on.

Less than an hour is required to chop, extract, and

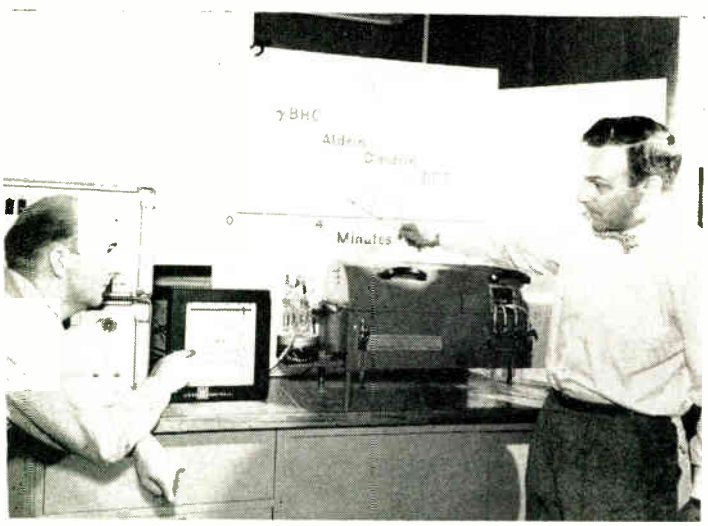

Fig. 25: Dr. Dale Coulson (right) indicates pesticide concentration detected by the Stanford Research Institute analyzer. Leonard Cavanaugh points to the corresponding peaks recorded by the analyzer.

concentrate the sample, and only a few minutes passes between injection in the test device and recording the test results. Consequently, the new method should prove useful in testing laboratories concerned with food purity.

Chlorine or Sulfur

The analyzer is designed primarily to detect pesticides containing clorinated hydrocarbons because these compounds are those that are retained the longest in the vegetable or in animal tissue.

Many pesticides, however, are sulfur-containing thiophosphates. The analyzer can be arranged to detect them also.

In this case, a stream of hydrogen is added in the combustion furnace. Hydrogen sulfide is formed if sulfur is present, and this compound can be titrated with silver ion, producing peaks on the chart in the

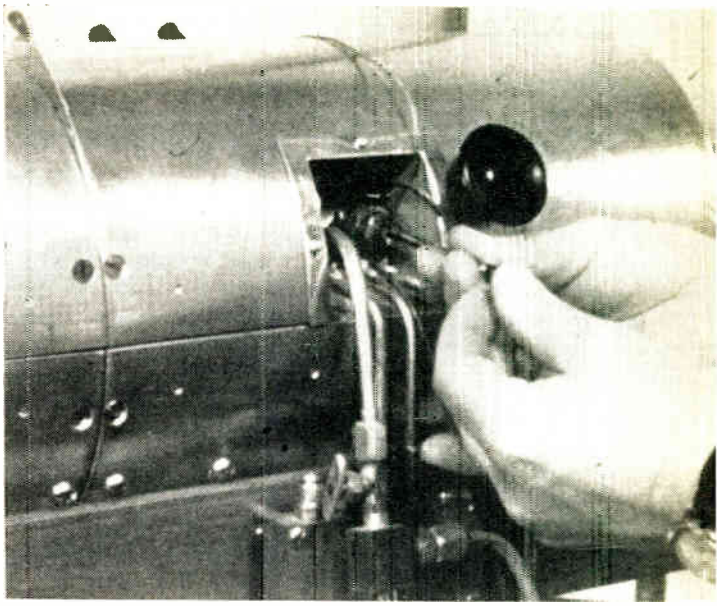

Fig. 26: Technician injects a sample of vegetable concentrate into the SRI pesticide analyzer. Within minutes contents will be known.

same manner as chloride-containing pesticides.

The analyzer, which is far more rapid than any previous method, has an added advantage.. A single procedure may be used for a variety of pesticides. This eliminates the need for chemists trained in the use of all of the individual procedures customarily used.

Still another advantage is that the analyzing equipment, though not designed for field use, is small and contained, and large laboratory facilities are not necessary.

As for sensitivity, the procedure can detect chlorine or sulfur in as small amount as 1/10 part per million. This equals the highest allowable level for some of the more toxic pesticides. Therefore, the analyzer represents an important step in protection for the public.

Tractors

Electronic systems and controls which will make the operator of farm equipment a button pusher are rapidly becoming economic necessities for this type of equipment.[18]

These controls can automatically guard against abuse or overloading of expensive equipment, speed up operation of the equipment, and cut down on the operator training needed.

Some electrical control systems that 10 years ago would have been considered radical or ridiculous were offered as optional equipment on 1959 models. More systems will be offered and will become standard in the future as the designers "zero in" on the specific environmental demands of this type of equipment.

A number of components are now available which make feasible remote control of transmissions, engines, and emergency automatic systems; electrical actuation of brakes, throttle control, and other protective functions; central control of multiple engine installations; and, eventually, fully automatic and remote control vehicles.

Practical application of fuel cells as a power source for electrical powered vehicles is indicative of a trend

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toward such energy sources. Efficiency levels are now so high as to command attention from all builders of prime movers.

Electrical controls and actuators can give a big assist to hydraulic systems by shortening line length, simplifying and making more versatile for the designer the location and arrangement of controls and valves.

There are several reasons electrical, not to mention electronic, controls and actuators have been slow in acceptance by farm equipment manufacturers:

1. Lack of reliability and operational features providing emergency mechanical override provisions.
2. High incidence of trouble with mandatory electrical equipment such as regulators, generators, and cranking motors.
3. Cost for environmental design requirements.
4. Service—lack of technical knowledge in the field on theory and function.

Acknowledgments

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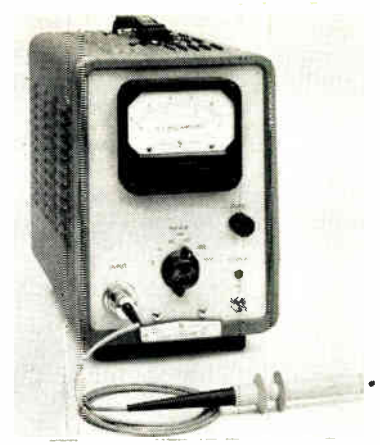

Fig. 1: Clip-on DC Milliammeter has two main parts. The probe is a second harmonic fluxgate type of magnetometer for sensing dc flux. Electronic section amplifies and rectifies signal.

The slow, inconvenient, and often inaccurate methods of measuring dc using voltage-resistance measurements spurred the development of a clip-on type of milliammeter. The instrument used the fluxgate principle. The principle is now being extended to other applications including the measurement of ac fields, varying dc, and in a Magnetic Ink Tester.

New Uses for Fluxgate Principle

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CLIP-ON type probes have long been used for ac measurements in the power field. These generally depend on transformer action and are not applicable to dc type measurements. However, now clip-on type devices can be made which are sensitive to the magnetic field surrounding a wire carrying dc current. They convert the magnetic field information to a suitable dc current which can be read on a common dc front panel meter.

The development of this technique has spurred the development of other devices using the principle. Many devices have been proposed and several have been developed. Before discussing these new devices, let us examine the basic operating principle as illustrated in a Clip-on DC Milliammeter.*

General Description

The instrument has two main parts: the probe and the electronic section. See Fig. 1. The probe clamps around the wire carrying dc and produces an ac signal proportional to the current. The electronic section amplifies and rectifies the ac signal and presents its amplitude on an indicating meter. This section also serves auxiliary functions such as excitation of the probe, and range switching, and negative feedback to provide high accuracy.

The probe head is a second harmonic fluxgate type of magnetometer used for sensing the dc flux around the wire. Its principle of operation may be simulated by the mechanical model shown in Fig. 2. The main parts are the magnetic yoke, rotating armature, sensing coil N_2 and the one turn N_1 of the wire being measured.

The flux in the magnetic circuit may be described by:

$$\phi = \frac{M}{R}$$

where ϕ = the total flux around the magnetic circuit, M = the magneto motive force and R = the path reluctance.

Since:

$$M = 0.4\pi N_1 I_{dc}$$
$$= 0.4\pi I_{dc}$$

for $N_1 = 1$, with:

$$R = \frac{l}{\mu A}$$

where l = the path length, A = the cross sectional area and μ, the permeability is a function of 2ω since the gate closes twice for every rotation of armature

*The instrument described here is the Model 428A, Clip-on Milliammeter made by Hewlett-Packard Co., Inc., 1501 Page Mill Rd., Palo Alto, Calif.

Fluxgate Principle *(Continued)*

which is spinning at the speed ω, and if we let $\frac{1}{A}$ = constant, K_1, then:

$$R = \frac{K_1}{f(2\omega)}$$

Now:
$$\phi = 0.4\pi\, I_{dc}\, f\,(2\omega) \,/\, K_1 = K_2\, I_{dc}\, f\,(2\omega) \qquad (1)$$

where $K_2 = \frac{0.4\pi}{K_1}$. Since the signal voltage (e_s) induced in N_2 is described by

$$e_s = N_2 \frac{d\phi}{dt}$$

Then differentiating equation (1) above:

$$e_s = K_2 N_2 I_{dc} f(2\omega)$$

Thus, the ac output is proportional to the direct current, the output turns and the rate of gate closure. But the frequency of gate closure $\frac{\omega}{2\pi}$, and output turns N_2 are fixed, so the ac signal output is thus a voltage proportional to the dc being measured and at twice the gating frequency.

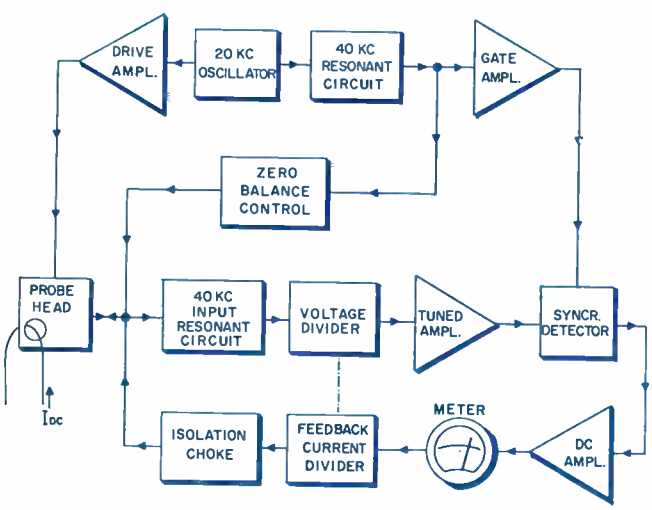
In the actual head, the gating action is accomplished by periodic saturation of part of the magnetic path with an alternating current. The frequency of the gating current is 20 KC; the ac output signal resulting from the measured dc is essentially 40 KC.

To provide overall gain stabilization, a negative feedback system involving the head is used.

Circuit Description

Fig. 3 is a block diagram of the circuit. The probe head is excited by the 20 KC oscillator and drive amplifier. The 40 KC second harmonic voltage from the cathode of the oscillator serves two purposes. First, it drives the synchronous detector through the gate amplifier. Second, it balances out any residual 40 KC signal from the head and allows zero adjustment on the front panel.

Fig. 3: The 20 KC oscillator excites the probe head. The 40 KC second harmonic voltage drives the synchronous detector and also balances out any residual 40 KC signal from the head.



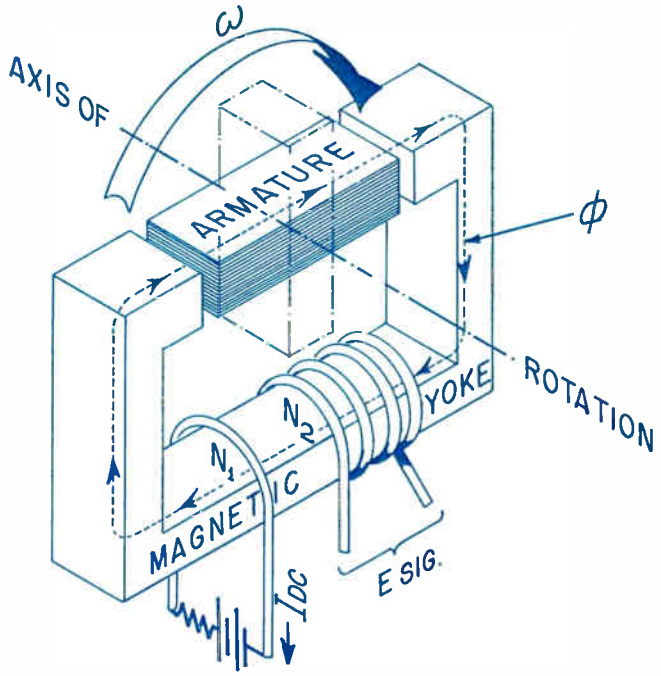


Fig. 2: Mechanical model shows operation of the probe head. Gating action comes from periodic saturation of part of the magnetic path with ac.

The 40 KC signal from the probe head, is fed through a resonant circuit and voltage divider to the tuned amplifier. The chief purpose of the input resonant circuit and tuned amplifier is to filter out harmonics, other than the 40 KC signal, which are generated in the head. The output of the tuned amplifier drives the synchronous detector to give a dc output whose phase is dependent on the phase of the 40 KC signal and hence, the polarity of the dc being measured. A stage of dc amplification follows the synchronous detector to drive the meter and the current divider which supplies the negative feedback current back to the head through an isolation choke.

The range switch provides the proper amount of feedback current and proper voltage division at the input of the signal amplifier for the various ranges. Approximately 40 db of feedback is maintained on all ranges.

Feedback System

The negative feedback loop is shown in Fig. 4. The head, which acts as the error detector, performs two functions. First, it subtracts the flux due to the negative feedback current from the flux due to the direct current being measured to obtain the difference flux. Second, it serves as a magnetic chopper to produce an alternating voltage (40 KC) proportional to the difference flux. In actual operation, the chopper voltage is developed across the same winding that is used for the feedback current. An isolation choke is used to separate these two signals. The output voltage from the head is amplified by a tuned amplifier and rectified by a synchronous detector. The dc output of the synchronous detector is amplified to provide the negative feedback current which also drives the meter. When the loop is closed, the differ-

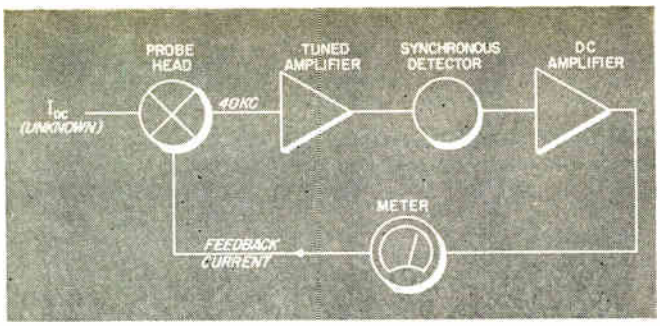


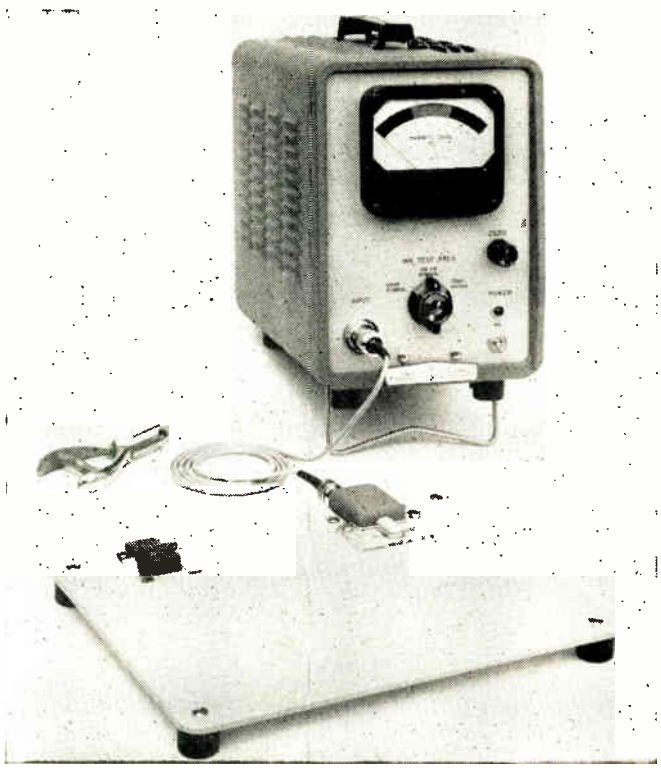
Fig. 4: Feedback System. The dc output of the synchronous detector is amplified to provide the negative feedback current which also drives the meter.

ence flux becomes 1/100 of that before closure. In other words, the feedback factor is 40 db. If the gain in the loop (for example, the tuned amplifier) drops by 50%, the overall error that results with 40 db of feedback is only 1%. Since the feedback loop encompasses all the primary sources of variations in the system, a high degree of overall accuracy and stability is achieved.

Some Applications

The technique offers a convenient means for measuring dc currents without breaking circuit leads and without any significant loading of the circuit under test. Also, dc currents can be measured in the presence of ac currents. Although the instrument indicates on a dc panel meter, the instrument circuitry ahead of the meter circuitry has an ac response up to approx. 100 CPS.

Fig. 5: Magnetic Printing Tester. It measures the magnetic strength of printing. It can be used for incoming quality control in preparation for computer handling.



Measuring DC Currents

A common application for this instrument is in transistor measurements because of the convenience of current measurement. Also, the absence of circuit loading is important in many low impedance transistor circuits.

Other common applications are in computer work where many current determinations are required. There is also the capability of measuring sums and differences of currents in separate wires by including both wires in the probe. The instrument is also suited for short circuit tracing. (Just look for the wire with the short circuit current which can be provided by another current source such as an ohmmeter.) Also dc ground currents may be readily determined.

An important application where time saved is an important element is in missile count-downs. Here the instrument is used before firing to monitor dc currents in the missile. The clip-on feature makes this measurement rapidly because it eliminates the necessity of resoldering of the circuit when a standard ammeter is employed. Instead the probe is merely removed from around the wire. Information is given

REFERENCE PAGES
The pages in this section are perforated for easy removal and retention as valuable reference material.
SOMETHING NEW HAS BEEN ADDED
An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

on missile circuits right up to the final stages of firing.

Another important application currently being investigated involves some modification of the instrument just described. This is the measurement of electrolysis currents. These measurements are important, for example, in telephone work where cables are buried in the earth and electrolytic corrosion is a problem. Since electrolysis currents are dc currents, measurement is rather straightforward. The modification is in the probe—its size is increased to about 2½ in. to accommodate the pipe or current carrying wire.

Sensitivity to Magnetic Fields

Hewlett-Packard has developed a Magnetic Ink Tester (Model HO6-428A). See Fig. 5 for testing magnetized ink used for printing bank checks. The tester is used to make fast, reliable tests during the printing process to control magnetic ink intensity well within computer requirements. The Ink Tester allows measurements of the average magnetic strength of printing while normal visual inspection determines quality of the imprint. The ink tester responds to the average magnetic intensity of the sample. This includes area of ink surface, amount of magnetic material in the ink, and amount of ink deposited.

The instrument includes a table on which is mounted a permanent magnet and the sensing head of the instrument. The sample printing is simply slipped in and out of the magnet, slipped into the sensing head and the meter needle indicates whether or not the static magnetic intensity is within toler-

Fluxgate Principle

(concluded)

ance. The instrument measures three printed symbols. Two of these symbols, the Dash Symbol and the On Us Symbol, are from the E-13B Printing Specifications accepted by the American Bankers Association. The third symbol is a solid test patch ¼ in. x 5/32 in.

Transistor Currents

Clip-on instrumentation for measuring ac currents is usually limited to measurements above 50 or 60 CPS. Experiments indicate that the 428A will measure currents from dc to at least 100 CPS. This technique should make it possible to measure transistor currents in the dc to 50 cycle range without breaking into the circuit.

Varying DC Currents

Many dc currents are not really dc at all for all time. Rather they are dc for some period of time and then they change for a period of time. The frequency of the dc change depends of course upon the application. This technique, modified for ac current measurements, should be ideal for measuring these currents. Typical currents are servo currents, transformer currents, strain gauge currents, low frequency amplifier currents, and square-wave currents. Here it is possible to see the current waveform on an oscilloscope.

There are a number of other uses. For example, it makes possible the measurement of currents in very low resistance circuits such as transistor emitter and certain types of thermocouple circuits. Since overloading does not harm the unit, safe measurements of low currents may be made in circuits where extremely high overload is likely to occur accidentally. In addition, by looping more turns through the probe, the current sensitivity may be increased. A 1,000 turn coil in the probe makes the lowest range 3 microampere.

Recording DC Currents

Adding 2 resistors and a condenser to the Model 428A adapts it to dc graphic recorder operation. This capability makes possible permanent records of dc current.

AC Current Measurements

Since the DC amplifier in the Model 428A has a DC-100 cps bandwidth, work has been done to adapt the 428A to ac current measurements. It is possible to derive an ac output from the 428A and make it compatible with common devices such as oscilloscopes and voltmeters. This ac capability makes the 428A useful for investigating low frequency ac currents such as power line currents, ac ground currents, ac transistor currents, servo currents, transformer currents and strain gauge currents.

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Determining

A LOAD line and constant power curves can be plotted on the transistor characteristics. The maximum power curve will touch the load line at the half voltage point.

The Half Voltage Criteria

The half voltage criteria can be established by considering the transistor as a variable resistor in a voltage divider network connected to a constant voltage source. The circuit is shown in Fig. 1.
Solving for the power dissipation in R_1:

$$P = \left(\frac{V}{R_1 + R_2}\right)^2 R_1 \qquad (1)$$

To determine when the power is a maximum in R_1 equation (1) is differentiated:

$$\frac{dP}{dR_1} = \frac{V_2\,[(R_1 + R_2)^2 - 2R_1(R_1 + R_2)]}{(R_1 + R_2)^4} \qquad (2)$$

For a maximum point, the derivative is zero when the numerator is zero and, since the voltage is not zero:

$$-R_1 + R_2 = 0 \qquad (3)$$

So: for maximum power to be dissipated in R_1, R_1 must equal R_2 which means that the voltage across R_1 is one-half the supply voltage.

Safe Power Level

It has been proposed that the safe power level for transistor circuits can be determined from $(E_{cc})^2$-$4R_LP_C$.[1] Solving for P_c:

$$P_c = \left(\frac{E_{cc}}{2}\right)\left(\frac{E_{cc}}{2R_L}\right) = \left(\frac{E_{cc}}{2}\right)\left(\frac{I_{c\ max.}}{2}\right) \qquad (4)$$

This shows that the maximum power for a resistive load is dissipated when the voltage on the transistor is one-half the supply voltage and the current is

For a transistor operating in the common emitter circuit, maximum power will be dissipated at the collector when the load voltage equals the collector to emitter voltage. This permits determining the minimum load resistance for a given supply voltage.

Transistor Power Dissipation

one-half the maximum possible current with the transistor shorted.

It is in the form of the maximum power transfer relationship—maximum power is dissipated in the load when load and supply impedances are equal.

If the transistor is considered as a generator and resistor as the load and maximum power is delivered to the load when the power of the source is a maximum, it is apparent that the half voltage relationship is true.

The half voltage criteria permits determining the minimum safe load resistance that can be used without exceeding the maximum power specified for a given transistor.

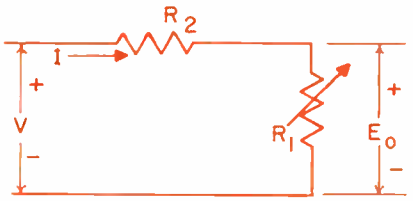

Fig. 1: The transistor is considered as a variable resistor in a voltage divider network, connected to a constant voltage source.

Minimum Load Resistance

The maximum power is given and with a given supply voltage, the minimum load resistance can be determined as follows:

$$R_{min.} = \frac{E_{cc}^2}{4\,P_{max.}} \qquad (5)$$

If the maximum current allowed is given, equation (5) becomes:

$$R_{min.} = \frac{P_{max.}}{4\,I_c^2{}_{max}} \qquad (6)$$

Power Dissipated

The load line can now be constructed since the minimum resistance is known.

This relationship provides a simple means to determine the power dissipated in existing circuits. The resistance and the supply voltage are known and equation (5) can be solved for the power dissipated.

Where the supply voltage may vary and the change in power dissipation must be considered, it can be determined as follows:

$$P = \frac{(E_{cc} + \Delta E_{cc})^2}{4R_L} \qquad (7)$$

$$\Delta P = \frac{\Delta E_{cc}}{4\,R_L}\,(2\,E_{cc} + \Delta E_{cc}) \qquad (8)$$

where ΔP is the change in power dissipation, ΔE_{cc} is the change in supply voltage.

An Example

As an example of the half voltage criteria, assume a 100 mw transistor is to be operated from a 12 v supply. The minimum load resistance must be found. This load resistance is the sum of the resistance in the emitter and collector circuits.

The minimum resistance can be found from equation (5)

$$R_{min.} = \frac{(12)^2}{4 \times .100} = 360 \text{ OHMS}$$

If the supply voltage increases by a volt, the increase in power dissipation can be found from equation (8)

$$\Delta P = \frac{1^2}{4 \times 360}\,(2 \times 12 + 1) = 17 \text{ mw}$$

The total power could also be calculated using equation (7)

$$P = \frac{(13)^2}{4 \times 360} = 117 \text{ mw}$$

References

[1] A. Oliver, Determination of Safe Power Levels in Transistor Circuits, *Electrical Design News*, November 1959.

Recent advancements in multi-channel recording make use of FM and analog techniques combined in what is called the add mode. The use of these techniques permits wide-band multi-channel recording at relatively low tape speeds with high fidelity.

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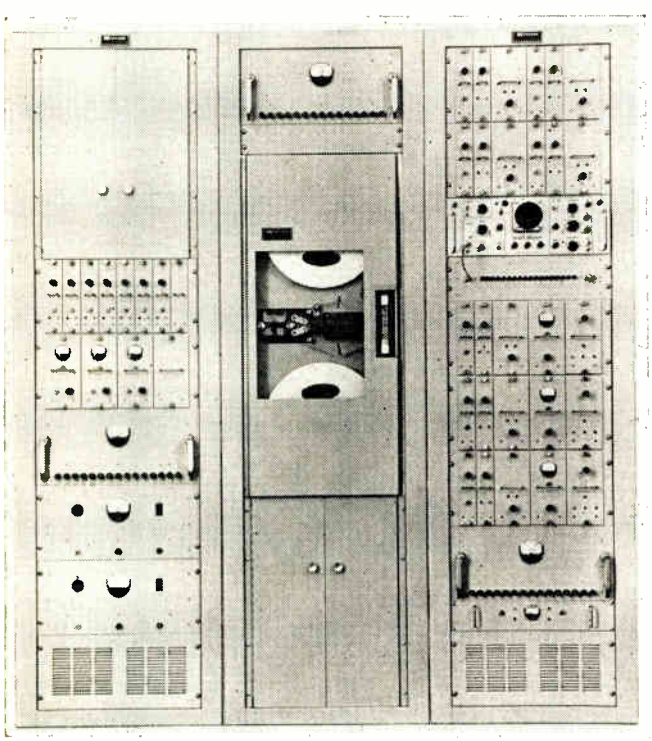
Multi-Channel System for

Recording From DC to 1 MC

SINGLE-CHANNEL recording at video frequencies in the past has been accomplished through switching techniques using rotating heads. High degrees of fidelity have been achieved, but unwanted transients due to switching have been inherent in these systems. The use of new techniques, using stationary heads, makes possible wide-band multi-channel recording at relatively low tape speeds with greater fidelity.

Fig. 1: Multi-channel recorder handles frequencies from DC to 1MC



The most commonly used methods for wide-band recording today are analog, pulse duration modulation, pulse code modulation, single carrier FM, and video recording. A recent advancement is the use of analog and FM techniques in combination in what is called the "Add" mode.

In the Add mode, six tracks are recorded to provide three separate, simultaneous channels of information. Each of these may cover the frequency range of dc to 1.0 MC. In addition, a seventh track provides one channel of 400 CPS to 1.0 MC. It is necessary to employ two tracks to provide one channel covering dc to 1.0 MC. One of these tracks uses analog methods to cover the frequency range from 400 CPS to 1.0 MC. The other operates by FM and covers the range from dc to 100 KC. On playback, the information on both tracks is combined to effect coverage of the complete frequency range. This combining technique represents a major achievement in magnetic recording since it results in excellent phase and frequency fidelity. (See Fig. 2.)

Figure 3 is a signal flow diagram showing the over-all functioning of the three modes of operation of this recording/reproducing system. As indicated in the diagram, tracks 1, 2, 6, and 7 are normally the Analog tracks; tracks 3, 4, and 5 are normally the FM tracks; and tracks 1+3, 1+4, and 7+5 constitute the Add tracks when the system is in the Add mode of operation. The adder units are completely by-passed in either the Analog or FM mode of operation and become part of the circuits only when the recorder/reproducer is in the Add mode. The FM modulators and demodulators on tracks 3, 4, and 5 also can be readily by-passed, providing a maximum of seven Analog tracks.

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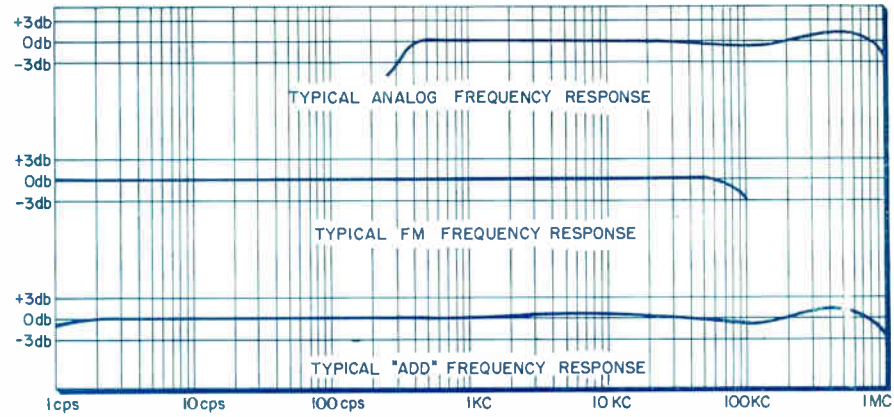

Fig. 2: Recorder responses are compared

Analog Tracks

A typical signal may be applied at any of the recording inputs 1 through 7 when the unit is set for analog operation on all 7 tracks. This signal is first amplified by a video amplifier whose low-noise circuits permit amplification of signals having an input level from 0.25 to 3 volts peak to peak. The signal from the video amplifier is applied directly into an amplifier which is designed to provide a constant current to the record heads, irrespective of frequency. A 7.0 MC bias is also supplied to the heads from an auxiliary supply not shown in Fig. 3. This signal is then recorded on tape and reproduced by specially designed heads.

The playback heads, which scan the tape to reproduce the signal, are capable of reproducing up to 8600 cycles per inch. Because the signal level is extremely low at 8600 CPS/in., the signal must be preamplified by the most advanced low-noise circuitry. The output from the heads is therefore fed into a preamplifier which is located close to the playback heads. This amplifies the signal to a sufficient level to be fed into the playback video amplifier. This in turn brings it up to a usable working level.

Up to this point, the amplifiers merely provide over-all gain but incorporate no equalizing circuits. Because of tape and head losses, the output of the second amplifier shows a poor frequency response characteristic. Hence, a phase and frequency equalizer is included in the succeeding circuits to provide the necessary equalization. The waveform that appears at the output of the video amplifier is equalized by this unit to restore its original shape before it appears at the output.

The distortion in the unequalized system can be attributed generally to the fact that low frequencies and high frequencies require different amounts of amplification to obtain the same level at the output. Hence the low frequencies are separated from the high frequencies in the equalizer unit and separately amplified to obtain a uniform output level. To make sure that the high and low frequencies arrive at the output at the same time (to reproduce the waveform with the same shape as at the input), correction is provided in the phase and frequency equalizers so that the signal appearing at the output of the unit is a faithful reproduction of the input signal.

FM Tracks

In this system it is possible to have a maximum of three FM tracks. The FM circuits used are of the conventional type. The FM modulator uses a multivibrator circuit and the detector is a pulse counter type. These circuits have been modified to obtain the extended FM range suitable for this application.

The signal applied at the input of track 3, 4, or 5 must have an input level of 1.0 volt peak to peak. After amplification, this signal modulates a 425 KC carrier in the FM modulator unit with a wide degree of linear deviation. The modulated signal is then recorded, reproduced, preamplified, filtered, amplified, and equalized as described for the Analog tracks. The equalized signal, which up to this point is still the modulated 425 KC carrier, is then demodulated and fed to the output via the adder unit. The adder function is inoperative when the controls on the front panel are set for FM operation, and the demodulated signal is passed directly through the unit for observation at the output terminals.

Add Techniques

The techniques used to achieve this mode make possible the faithful reproduction of a complex waveform comprised of frequencies from ½ cycle to 1.0 MC without noticeable distortion. This is done by using the high frequency capabilities of the anolog channels

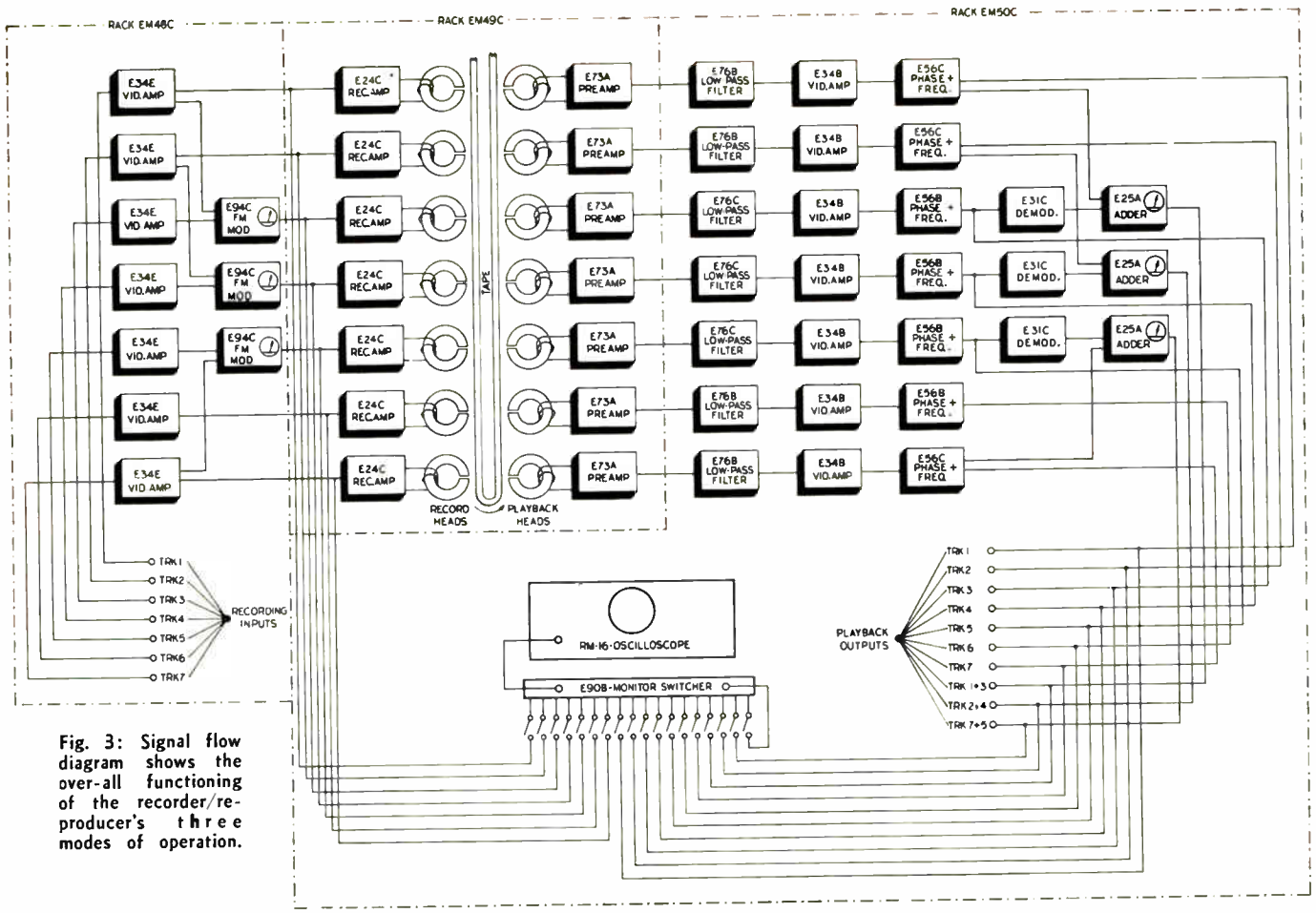

Fig. 3: Signal flow diagram shows the over-all functioning of the recorder/reproducer's three modes of operation.

Multi-Channel Recording *(Continued)*

and the low frequency capabilities of the FM channels.

For illustration, let us assume that a square wave is applied at the input of track 1 and the front panel controls are set for the Add mode of operation. (See Fig. 4A.) The square wave goes directly on track 1 and is recorded, reproduced, and amplified by the analog circuits described above, before it is phase and frequency equalized in the appropriate equalizer. It must be remembered, however, that a filter is provided in the phase and frequency equalizer which allows only the high frequencies to be applied to the adder. Hence the waveform appearing at the input of the adder is not a square wave but of the form shown in Fig. 4B. This signal is fed into the "highs" section of the adder.

The original signal at the output of the recording video amplifier of track 1 also is applied to the FM modulator of track 3 which contains a low-pass filter. This permits only the low frequencies to modulate the FM modulator. The filtered low frequency information appears as shown in Fig. 4C. The modulated carrier is recorded on the tape and in reproduction it is made to pass through the circuits described under FM operation. The demodulated signal then appears as shown in Fig. 4D. This signal is fed into the "lows" section of the adder where the high and low frequency signals are combined. Due to the different time delays encountered in the high and low frequency circuits, the adder is provided with delay

(*Continued on page* 250)

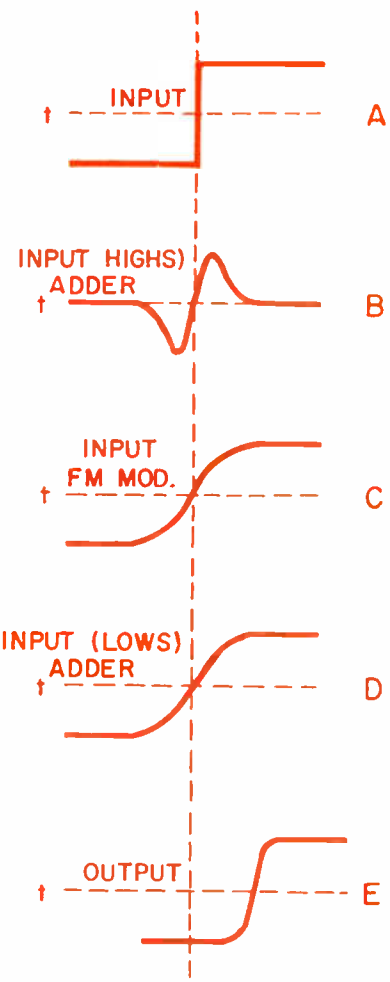

Fig. 4: The important waveforms of the recording system are illustrated

Page from an Engineer's Notebook

#55 Conversion Chart— Decimal to Binary to Gray Code

By JOHN G. KOCH
Electronic Project Engineer
Motorola Inc.
Western Military Electronics Center
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THERE is frequently a need to convert decimals to binary and/or gray-code in a simple direct manner without the effort involved in repetitively solving standard equations. This is particularly true when decimal fractions must be converted since there is rarely an exact binary solution for a decimal fraction.

This conversion chart simplifies the translation from one system to another. A linear presentation of the familiar code disk is used in a manner analogous to an analog-digital converter.[1] The dimensions of the chart have been selected so that the sheet may be cut into two long strips which may be glued one to each side of an inexpensive slide-rule, the hair-line serving as the index. This will increase its utility to the serious student or practicing engineer. Both positive whole numbers and decimal fractions can be converted; limited by space to seven bits each side of the decimal point.

The conversion process is carried out in two steps:

(a) The whole number to the left of the demical point is located on the scale. A horizontal line (or the slide rule hair-line) is drawn across the chart intersecting various heavy vertical lines each representing the presence of a bit in the binary or gray code. Read from left to right the presence or absence of a bit in the code and record the result. If the horizontal line intercepts a vertical bit bar at its bottom, i.e., the entire bit lies above the line, include this bit in the code.

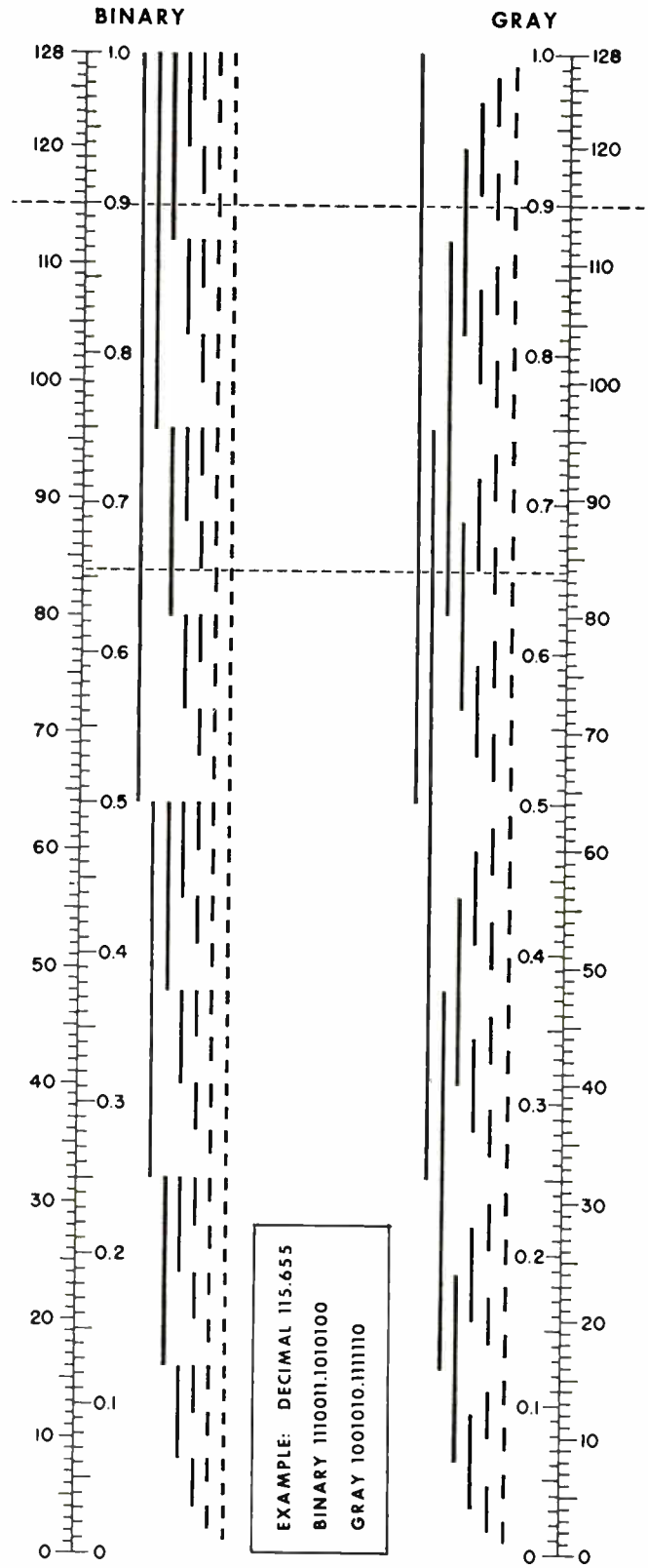
(b) The decimal number to the right of the decimal point is located as accurately as possible, interpolating if necessary, on the decimal scale. A horizontal line (or the slide-rule hair-line) is again drawn intersecting the code bits present in the binary or gray code equivalent for this decimal fraction. Once again record the bits from left to right with the most significant bit first.

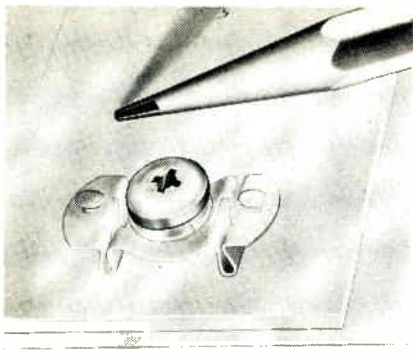
In summary, if the horizontal hair line intercepts a given vertical code bit line, record as a 1. If the line does not intercept a given vertical code bit, record as a 0.

The cyclic gray code used here is derived as follows from the binary code

Write the binary code	1011011
Shift each bit one place to right	0101101(1)
Add, ignoring all carries	1110110

[1] H. J. Gray, P. V. Levonian, M. Rubinoff, "An Analog to Digital Converter for Serial Computing Machines," Proc. IRE, Page 1462, October, 1953.





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Circle 290 on Inquiry Card

DC Power Supply

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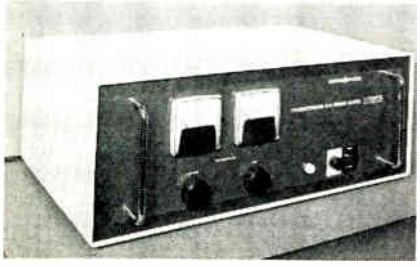

NEMA MR-2-1958 Standards, have defined voltage regulation requirements, and have optional features available for inclusion in the standard line shown above. General Electric Co. **Booth 2145.**

Circle 291 on Inquiry Card

Reducers—Gearheads

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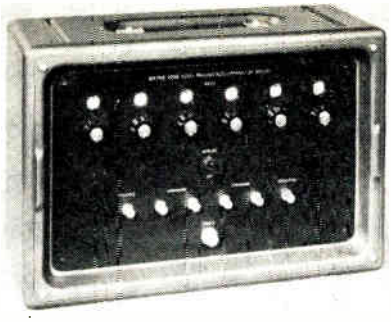
Circle 292 on Inquiry Card



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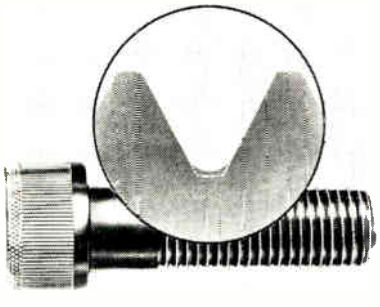

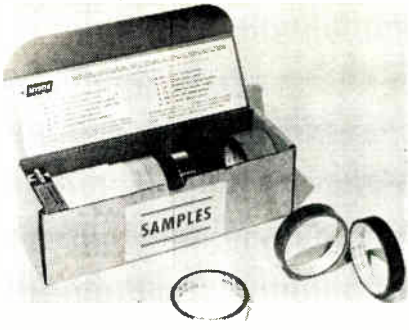

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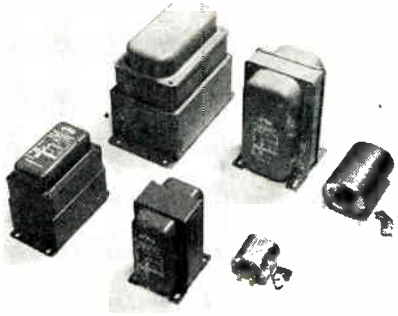

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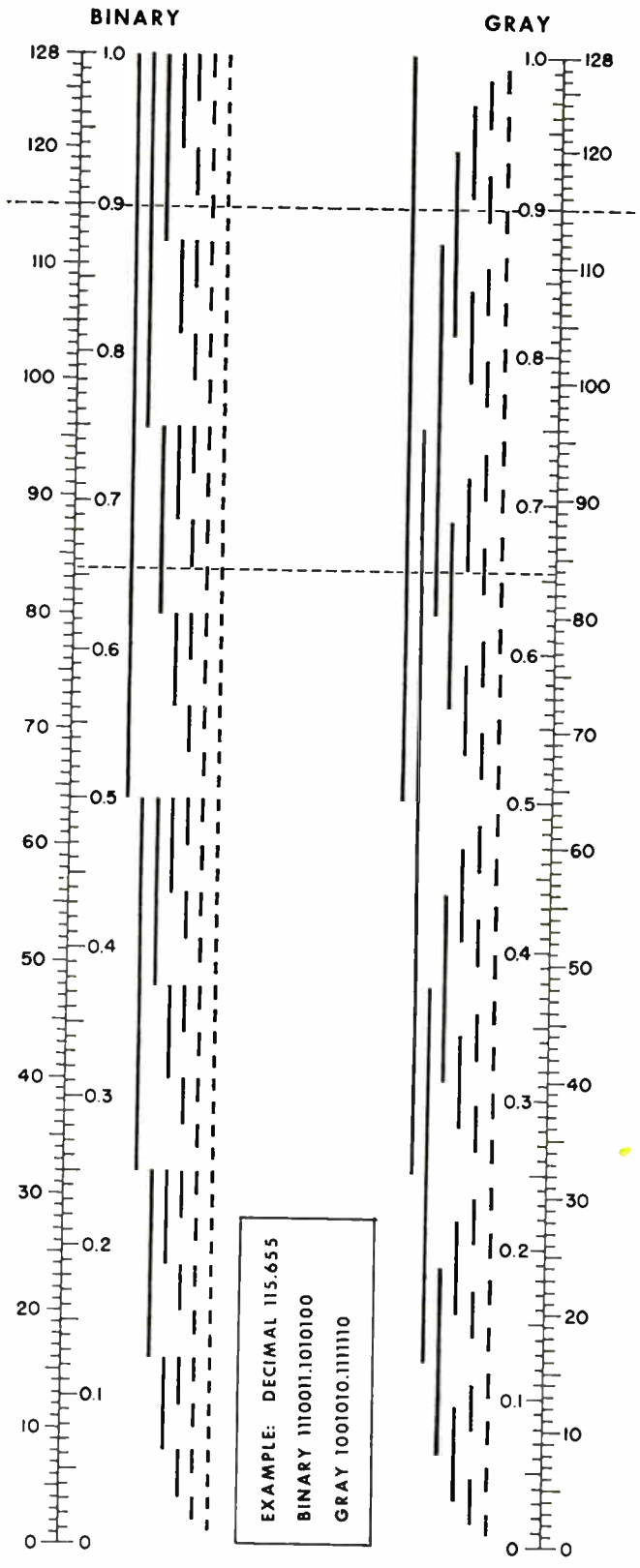
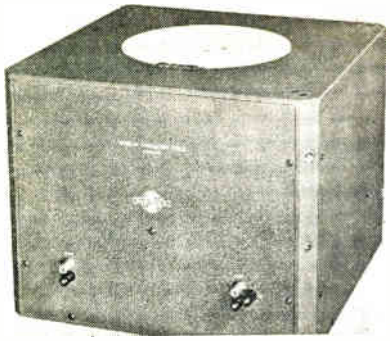




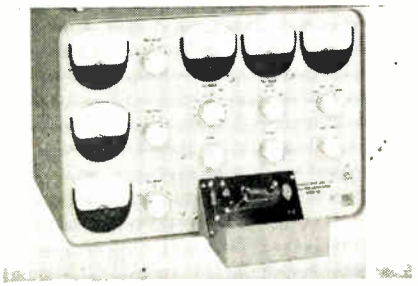
Angular Oscillating Table

Model 61A for subjecting gyros, accelerometers and guidance systems to smooth sinusoidal motion for precise frequency response tests. A rate pickoff provides instantaneous rate information for presentation on an oscilloscope or recorder. Input may be from any good audio, dc power, or shaker amplifier over the range of 0 to 100 CPS. Micro Gee Products, Inc. **Booth 2624.**

Circle 274 on Inquiry Card

Transistor Noise Analyzer

Model 310 Transistor Noise Analyzer measures noise simultaneously at separate frequencies of 100 CPS, 1000 CPS and 10 KC. Low frequency bandpasses are necessary for the



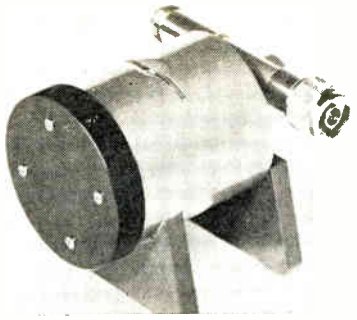
measurement of 1/f, or fluctuation noise, whereas the higher frequency bandpass is a measure of "shot" noise, thus providing a 3-point spectrum analysis of the transistor noise characteristic. Quan-Tech Laboratories. **Booth 1029.**

Circle 275 on Inquiry Card

VHF Phaser

The 2260 VHF Phaser provides relative phase adjustment of 65° at 100 MC to 270° at 400 MC with no change in the physical length of the phaser. Input and output terminals are type "N" 50 ohm coaxial. Impedance match maintains over the entire range of adjustment and frequency. Unit shown is calibrated for 332 MC and rated at 200 w CW. Meridian Metalcraft, Inc. **Booth 2519.**

Circle 276 on Inquiry Card



Microwave Line

Coaxial Frequency Meter, Model N414A, with a range from 3.95 to 11 KMC. It absorbs power only at the resonant frequency of a half wavelength resonant cavity. Also: a line of broadband waveguide and coaxial ferrite isolators, Series 157 and two coaxial broadband bedirectional couplers for measuring VSWR by the incident and reflected power technique. FXR Inc. **Booth 2325.**

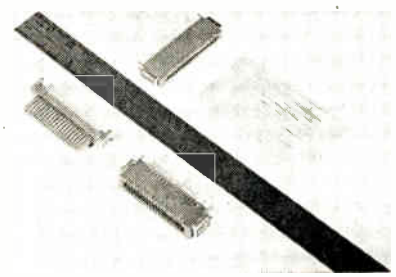
Circle 277 on Inquiry Card

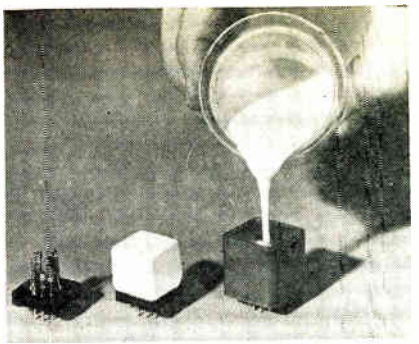
See These Products At WESCON

Connectors

"Micro Min," and "Micro Mod," series of micro-miniature connectors. "Micro Min,' available in 19 contacts, single side and 38 contacts, double side, is for flat form packaging. "Micro Mod" provides interconnection and quick removeability for "stick" or module packaged circuits. Two versions available. Amphenol Connector Div., Amphenol-Borg Electronics Corp. **Booth 848.**

Circle 278 on Inquiry Card





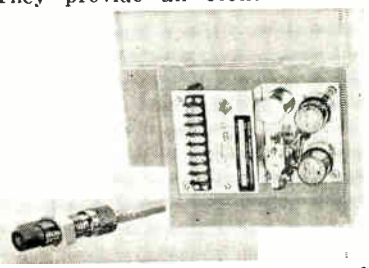
Casting Resin

Stycast TPM-4C is a 1-part casting resin which features extremely low dissipation factor and excellent high temp. properties. Dissipation factor is below 0.0003 over the frequency range 10^2 to 10^{10} CPS. It has excellent thermal stability up to 400°F. At this temperature, it remains completely rigid. Thermal shock characteristics are outstanding. Emerson & Cuming, Inc. **Booth 120.**

Circle 279 on Inquiry Card

Proximity Transducers

Proximity transducer systems provide a means of sensing moving or stationary ferrous and nonferrous metal work pieces without contact. They provide an economical means



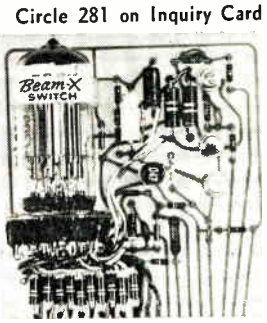
of automating a wide variety of industrial processes from the control of vibratory bowl parts feeders to sorting work pieces of varying sizes. Electro Products Laboratories, Inc. **Booth 2117.**

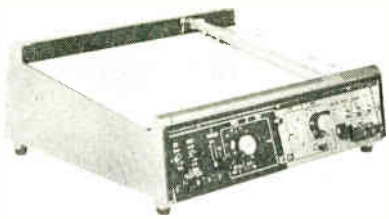
Circle 280 on Inquiry Card

Electronic Counter

Miniature Decade Counter Module, the DC-111, combines the BEAM-X switch, Type BX-1000, with transistors. Circuit can resolve pulses at 110 KC. Also: Model D-9000 Distributor Module for sequencing, sampling, multiplexing, etc., and BEAM-X Switch Type BX-1000, a multiposition switching device with a 24-electrode structure per position. Burroughs Corp. **Booth 2132.**

Circle 281 on Inquiry Card





X-Y Recorder

The Model 2D Autograf X-Y Recorder is designed to plot cartesian coordinate graphs from dc electrical information. It will also plot functions of time, accept ac input data, and operate with a variety of accessories, including punched tape and card converters, keyboards, logarithmic converters, and curve followers. F. L. Moseley Co. **Booth 660.**

Circle 282 on Inquiry Card

Volume Level Indicator

Transistorized version of 924 series Volume Level Indicator Panels, TR-924-C, measures the power level on

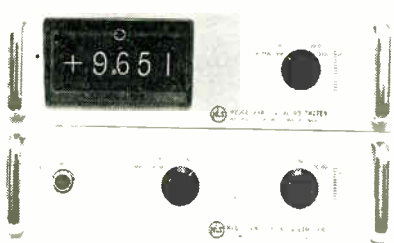
600 ohm audio transmission circuits within the range of −40 to +20 dbm. Frequency response is ±0.1 db from 50 to 10,000 CPS and ±0.25 db from 20 to 20,000 CPS. Temperature range is −25° to +65°C. Not affected by ±10% line changes. The Daven Co. **Booth 444.**

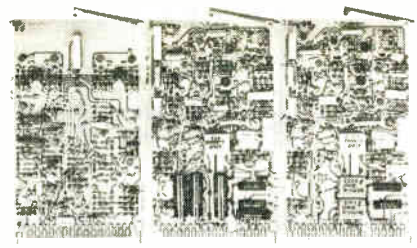
Circle 283 on Inquiry Card

Digital Voltmeter

All-electronic digital voltmeter, the V44 makes 200 readings/sec. in ranges of ±9.999/99.99/999.9 vdc. Accuracy is ±1 digit and input impedance is 10 megohms. The instrument eliminates the need for periodic adjustment of trim pots in decade circuits. Balancing time of 5 msec permits high-speed measurement of transient data. Non-Linear Systems, Inc. **Booth 2815.**

Circle 284 on Inquiry Card





AC to DC Conversion

For automatic instrumentation. method combines high accuracy, reliability, and speed with long-term stability. It is emplemented with all solid-state precision amplifiers and semiconductor switches. The circuitry used is essentially an "averaging" technique (normally calibrated to read rms) for flexible choice of self-synchronous or phase sensitive measurement of ac signal. Adage Inc. **Booth 537.**

Circle 285 on Inquiry Card

See These Products At WESCON

Motor Tachometers

Temperature compensated motor tachometers, Model 15A23D-01C. Output voltage is 2.75 v./1000 RPM held to ±0.25% from 0° to 70°C. Guaranteed adjustability is ±0.01% from 60° to 80°C. Maximum sensitivity change between 60° to 80°C. from the value at 70°C. is ±0.05%. Linearity ranges as low as ±0.01%. Guaranteed linearity 3600 RPM is ±0.07%. American Electronics, Inc. **Booth 2349.**

Circle 286 on Inquiry Card

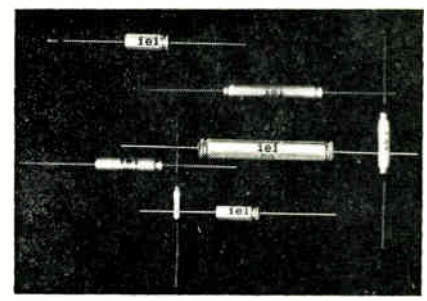
Traveling Wave Tubes

Addition to line of traveling wave tubes, the HA-70, operates with a noise factor in the 1 to 5 mw power range. It is focused in a 750 Gauss Solenoid: it has a noise figure of 7 DB max., 25 DB gain min., 1 mw saturation power output min. frequency range of 2300 to 3400 MC. Min. of 70 DB back attenuation. Tube is 22.4 in. long and 1 in. in dia. Huggins Laboratories. **Booth 820.**

Circle 287 on Inquiry Card

Tantalum Capacitors

Manufactured to MIL-C-3965, tantalum capacitors are available in either polar or non-polar type plain



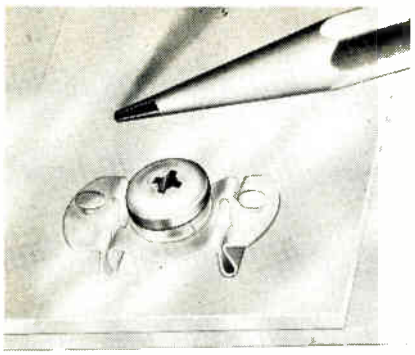
or etched foil. They operate over a temp. range from −44° to +85°C without voltage derating, in a voltage range from 3 to 150 wvdc and carry a dc surge rating of 116% of rated working voltage. International Electronic Industries, Inc. **Booth 107.**

Circle 288 on Inquiry Card

DC Multimeter

Transistorized Dc Multimeter is a battery-operated portable instrument which can be used in both conventional tube and transistor applications. It has 9 voltage, 12 current measurement and 5 resistance measurement ranges. Full scale readings are from 100 mv to 1,000 v., from 1 μa to 300 ma and from 10 to 100,000 ohms. Motorola Inc. **Booth 605.**

Circle 289 on Inquiry Card



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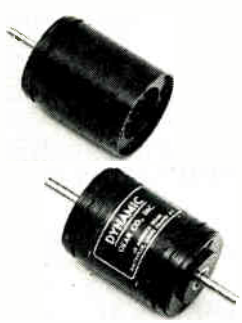

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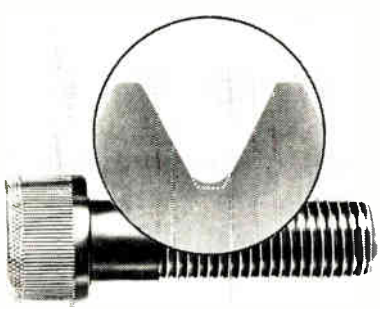

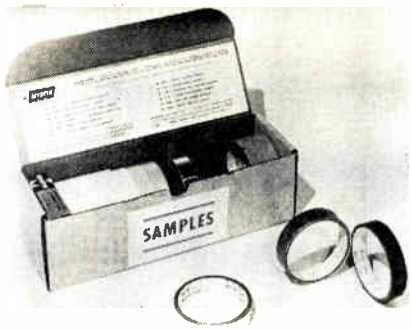

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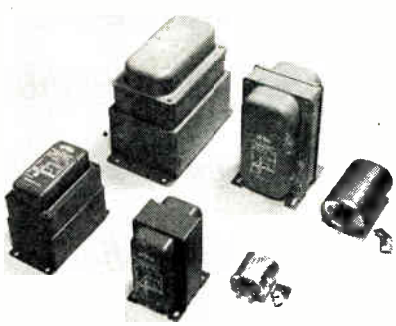


High Fidelity Headset

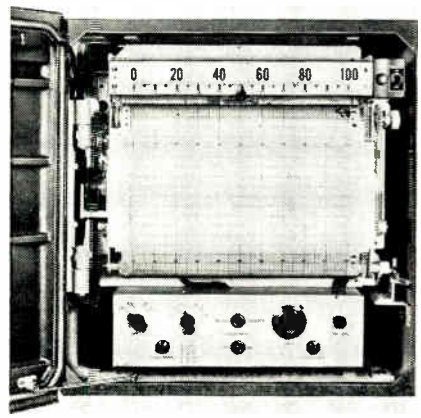
The Dyna-Twins, for language learning, stereo listening, etc., where fidelity is important. It weighs 9 oz. (not including cord) and provides 50-15,000 CPS response. Standard impedance is 12 ohms for binaurel and 6 ohms for monophonic applications. Sensitivity is 80 db above 0.000204 dynes/sq cm per mw input. Communications Accessories Div., Telex, Inc. **Booth 721.**

Circle 298 on Inquiry Card

Potentiometer Recorder

Dynamaster Potentiometer Recorder input signal selection switches and span adjustments provide flexibility. A 4-position input selector provides for mv., v., μa., or ma. input. A 5-position span selector offers ranges 0-2, 0-5, 0-10, 0-25, and 0-50. A continuously adjustable span from 0-2 and 0-50 also available. The Bristol Co. **Booth 701.**

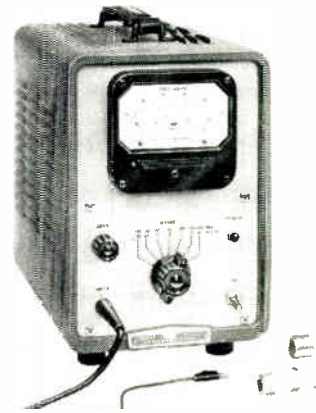
Circle 300 on Inquiry Card



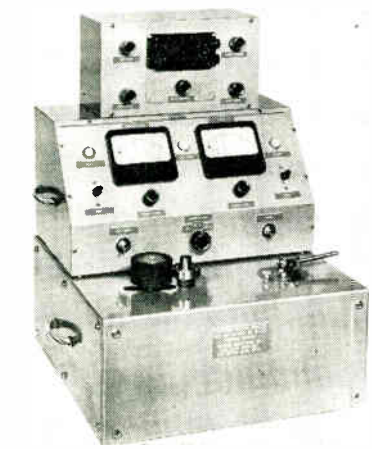
Millivolt Voltmeter

A 1,000 mc, 1 mv voltmeter and a newly-designed 10 to 1,000 mc oscilloscope, Model 185A, which has full 10 cm vertical deflection and dual channel input for waveform and time comparisons. Model 411A voltmeter has a voltage range of 1 mv to 10 v. It measures small voltages to 1,000 mc, and includes a linear scale for maximum resolution and high accuracy Hewlett Packard Co. **Booth 651.**

Circle 302 on Inquiry Card



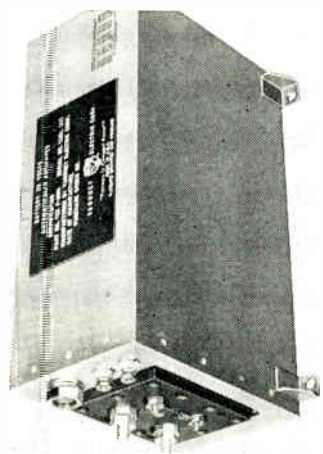
See These Products At WESCON



Circle 299 on Inquiry Card

Bearing Analyzer

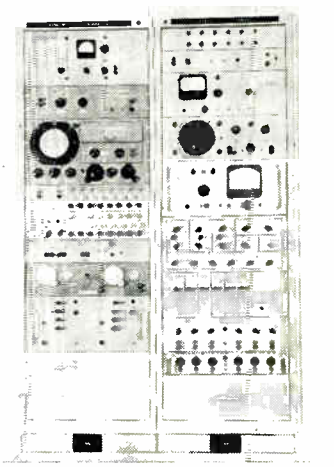
Model BA-20 Electronic Bearing Analyzer checks bearing serviceability. It is especially for analyzing the quality of anti-friction bearings and identifies unserviceable bearings both visually and audibly. Unit will analyze bearings from the smallest instrument sizes up to 10 in. O.D. Bearing Inspection, Inc. **Booth 105.**



Circle 301 on Inquiry Card

Missile Battery

Model P-3001, Silvercel Silver-Zinc Battery offers continuous discharges of more than 60 times nominal. Nominal capacity is 4 amp-hrs. It can be discharged at 250 a, at 25 v., for 1 min., or pulsed at currents up to 1500 a. Typical discharge ranges from 66 a to 178 a, at 30 to 24 v., for 2 min. Yardney Electric Corp. **Booth 551.**



Circle 303 on Inquiry Card

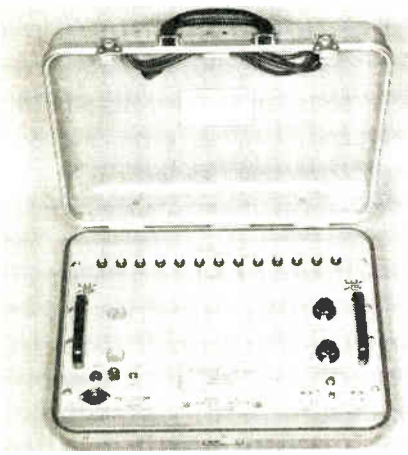
Vibration Control System

Model A1011, random Vibration Control System is compatible with any power amplifier and electro-dynamic shaker combination. System may be switched from one mode of operation to another without adjustment. "Mix" of two signals may be varied while test is in progress. Genisco, Inc. **Booth 842.**

Encoder Display Test Set

Encorder Display Test Set, TS-13. Also the RD-17 and the RD-13G shaft position encoder. The shaft position encoders are of the optical (non-contacting) types. They are used to convert an analog shaft position to a cyclic binary code number in the form of electrical pulses usable by a computer. Wayne-George Corp. Booth 2032.

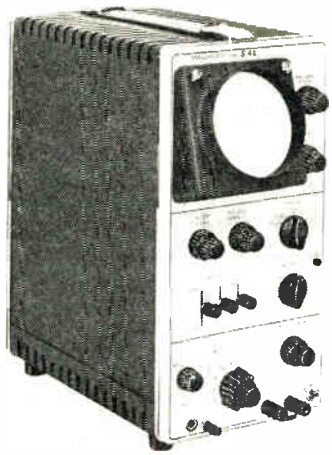
Circle 304 on Inquiry Card



Portable Scope

Model S42 uses a 4 in. CR tube with extremely fine focus. Operating at 3.7 KV, brightness is such that a 1 μsec "single, shot" pulse can be seen and photographed. Balanced low-drift amplifiers have bandwidth of dc to 6 mc up to 100mV/cm and a high gain facility gives 10mV/cm sensitivity with bandwidth limited to 500 kc. The Scopes Co., Inc. Booth 2210.

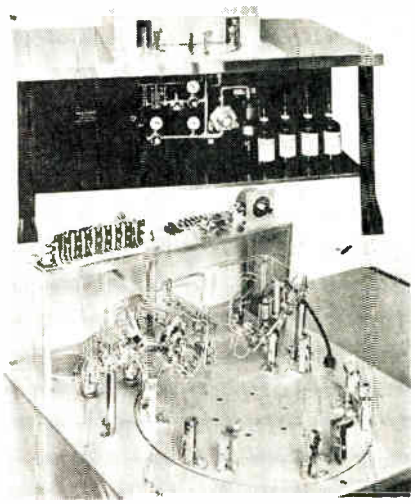
Circle 306 on Inquiry Card



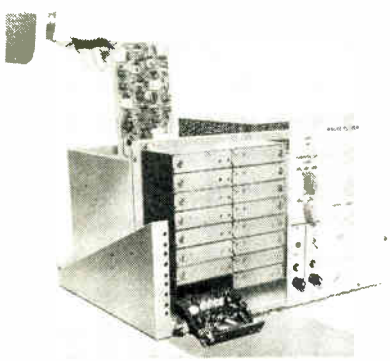
Spray Cleaner

High-velocity spray-cleaning equipment, Model RT-R-13-5, will critically clean crystal case relays and other precision components at the high production rate of 900 parts/hr. Removes oil, grease, silicone lubricants, rosin flux, finger-prints, lapping compounds and other soluble and insoluble contaminants. Cobehn, Inc. Booth 104.

Circle 308 on Inquiry Card



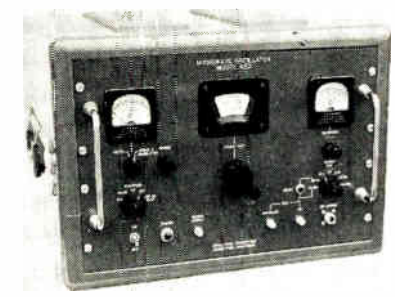
See These Products At WESCON



Circle 305 on Inquiry Card

Multiplexer

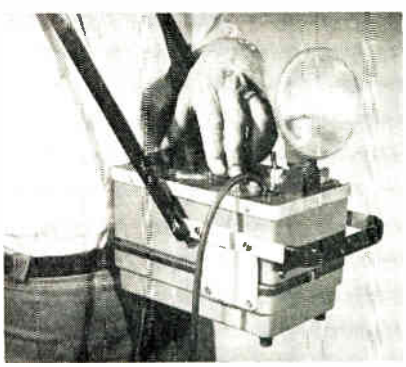
Using miniature high frequency (500 KC) Magnetic amplifiers for input sensor on each channel, solid state device, the Magne-Plexer, can handle thousands of channels of strain gage and thermocouple inputs at rates up to 20,000 samples/sec. without preamplifiers. It is for millivolt level commutating applications needing reliability, stability, continuous operation, and high performance. San Diego Scientific Corp. Booth 2157.



Circle 307 on Inquiry Card

Microwave Signal Source

Model 944 Constant Power Microwave Signal Source for analysis of active and passive microwave networks and devices. Features include: swept frequency operation to 100 CPS over the 8.2 to 11.0 KMC range. Output power is 10 dbm min. Also: a permanent magnet focused TW tube amplifier, Model TA-36, operating in the UHF band with 30 db gain and 10 dbm output power, and a low noise microwave amplifier, Model TA-23. Menlo Park Engineering. Booth 835.



Circle 309 on Inquiry Card

Stroboscopic Tachometer

A new version of the stroboscopic tachometer, Type 1531-A, is for the measurement and study of machine speeds of up to 250,000 RPM. Also an impedance comparator (Type 1605-A) for the measurement of small semiconductor capacitances of the order of 1 or 2 pf and a transfer-function and immittance bridge (Type 1607-A) measuring the R, L and C parameters of tunnel diodes at ultra-high frequencies. General Radio Co. Booth 957.

Latest Western Literature for Engineers

Diode Chart

Germanium Diode Chart, a study of specific applications of selected subminiature diodes to reduce selection time of germanium diodes for specific applications or general purpose use; high reverse voltage; high voltage detection; high reserve resistance; high conductance; and for computer use. Nucleonic Products Co., Inc., 1601 Grande Viste Ave., Los Angeles 23, Calif.

Circle 162 on Inquiry Card

Analog Computer

Details on the CM-3 Analog Computer, which provides continuous "real time" solutions for mathematical computations and "real time" control of variables, available from Southwestern Industrial Electronics Co., a division of Dresser Industries, Inc., 10201 Westheimer, P.O. Box 22187, Houston 27, Texas. Featuring all solid state electronics, it contains a single CM-3 cabinet, contains a max. of 12 amplifiers, however there is no electronic limit to the number that can be used. Any number of amplifiers, square root and logarithmic networks may be specified according to functional requirements. Two or more units can be used with their programming boards interconnected.

Circle 163 on Inquiry Card

Coil Data

A new 8-page publication, "The Coil Forum" issued by the J. W. Miller Co., 5917 S. Main St., Los Angeles 3, Calif., is edited for the electronic equipment experimenter. It deals with information on circuits and theory and supplies data for selecting coils. The first issue deals with how to build a transistorized FM receiver. Complete data is given on circuits, construction, testing, and alignment. Sketches show locations of components, AFC layout, and ratio detector layout.

Circle 164 on Inquiry Card

Limit Sensor

Single-page bulletin from General Automatics, Inc., 2443 Ash St., Palo Alto, Calif., describes the Company's Limit Sensor. Applications include diode sorting, thickness gauging, weighing, or any application where the measurement is converted to a voltage. Some specs: Operation, actuation with signals from 0 to −250 v, unresponsive to signals from 0 to +250 v; Hysteresis, less than 250 mv at 25°C; Input impedance, 100K ohms; Reaction time, less than 50 msec.; Output, two sets of SPDT contacts, rated at 5 a, 28 vdc or 115 vac for 100,000 cycles. Circuit diagrams and outline drawings are included.

Circle 165 on Inquiry Card

Solving Quadratics

Illustrated brochure outlines step-by-step programming and solution of quadratic equations (such as: $ax^2+bx+c=0$) on the DE-60 computer. Programming of repetitive problems on the computer as shown on the coding sheet and wiring on a plugboard are described in detail. Instructions to the computer can be written and executed by non-technical personnel. The DE-60 is a low-cost, compact general-purpose all-transistor digital computer. Clary Corp., San Gabriel, Calif.

Circle 166 on Inquiry Card

Transistor Tester

Bulletin No. 124C, from Sierra Electronic Corp., 3885 Bohannon Dr., Menlo Park, Calif., describes their Model 219A Transistor Tester. The tester can measure the Beta parameter without unsoldering the transistor from its surrounding circuit. It does this by electronically isolating the transistor under test. It can measure transistor leakage current (I_{CO}) and Beta out of the circuit. The single-page bulletin gives principle of operation (with block diagram) and physical and electrical specs. Also available is Bulletin No. 127A describing Model 201B, UHF FM Signal Generator. An external signal of 0.4 v peak-to-peak amplitude with a bandwidth of 500 KC can produce deviations of 2MC peak-to-peak with better than 1% linearity.

Circle 167 on Inquiry Card

Instrument Cases

Twelve-page booklet, No. 403-C, gives details on TA Standard Instrument Cases. It covers features, sizes, colors, and standard hardware. TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

Circle 168 on Inquiry Card

Recorders/Reproducers

The RA 1500 series of magnetic film recorders and reproducers is described in a 4-page illustrated brochure from Wextrex Recording Equipment Dept., 6601 Romaine St., Hollywood 38, Calif. The series consists of precision recorders, reproducers and recorder/reproducers for film used in the motion picture and broadcast industries. Specs included.

Circle 169 on Inquiry Card

AC Motors

Alternating current motors meeting government specs for aircraft and missiles are described in a catalog from Electro-Mechanical Div., Lear, Inc., P. O. Box 688, Grand Rapids 2, Mich. Information includes horsepower, torque, speed, duty cycle, weight and size.

Circle 170 on Inquiry Card

Resin Selector Chart

Bulletin 121 from Plastic Associates, 185 Mountain Rd., Laguna Beach, Calif., contains selector charts for potting compounds, coatings, foams, and bonding agents. Definitions are provided for such terms as casting, encapsulation, impregnation, and coating. Metals, glass, ceramics, plastics and other materials are arranged along both vertical and horizontal borders. Intersections show the bonding agent that can be used to join the materials indicated.

Circle 171 on Inquiry Card

Waveform Synthesizer

Four-page brochure from Exact Electronics, Inc., P.O. Box 552, Portland 7, Oregon, describes the Type 200 Waveform Synthesizer and Plug-In Generators. General Specs. include: No. of increments, 10, 20, 30, 40, or 50; Increment position, indicated by neon bulbs; Power required, 105-125 v, 50 — 60 CPS, 425 w.; Weight, 58 lbs. Brochure gives full details on the instrument which is used for computer programming, basic research, servo design and test, PCM—PTM systems, spectrum simulation, radar pulse coding, speech and sound synthesis, telemetering channel synthesis, etc.

Circle 172 on Inquiry Card

Laminate

A new epoxy laminate, Grade EG-761-T, developed primarily for the "plated-through" process is described in Tech Data from The Mica Corp., 4031 Elenda St., Culver City, Calif. "Micaply" is a non-adhesive, all purpose laminate exhibiting no significant "weave telegraph" and retaining the best electrical, mechanical and machining properties. The important feature of this material is the elimination of any transfer of fabric weave pattern through the copper surface, providing a glass-smooth finish for satisfactory and durable electro-plating.

Circle 173 on Inquiry Card

Storage Tubes

Literature on 2 direct viewing storage tubes developed by the Vacuum Tube Products Div., Hughes Aircraft Co., 2020 Short St., Oceanside, Calif. Spec brochure describes the 5-in. H-1027 tube which features potting of high voltage leads to prevent corona at extremely high altitudes. Another brochure gives details of the 21-in. H-1019 Typotron tube which writes 25,000 letters, numbers or symbols/sec. Images may be retained at high brightness levels for 2 min. The large view screen stores up to 17,000 characters.

Circle 174 on Inquiry Card

Latest Western Literature for Engineers

Tracking Cameras

Synchronization of satellite tracking cameras spaced 200 mi. apart to within 0.1 msec is described in a technical paper on "Ballistic Camera Synchronization System" available from the Electronic Engineering Co. of Calif., 1601 E. Chestnut Ave., Santa Ana, Calif. The Ballistic Camera Synchronization System was designed for the Army Ordnance Corps and developed and built by EECo. The system consists of a central camera control station and 2 remote control stations. Also available: A description of a system for the digitizing of radar position information in a technical paper on "Precision Data Recording System for Instrumentation Radars." The paper details the design and development of systems now in operation at the Air Force Flight Test Center, Edwards, Calif., in conjunction with X-15 rocket research airplane tests and other high-speed flight tests.

Circle 175 on Inquiry Card

Electronic Ceramics

An 8-page brochure describes the activities of the Lockheed Electronics Co. in the field of electronic ceramics. It discusses ferrite cylinders and ultra thin-walled toroids; toroidal tape recorder heads; and rectangular hysteresis loop memory cores. Applications include description of multi-aperture devices; read selector module assemblies; shift registers; logic module assemblies; memory cores and planes; and recording heads. Lockheed Electronics Co., Avionics & Industrial Products Div., 6201 E. Randolph St., Los Angeles 22, Calif.

Circle 176 on Inquiry Card

Capacitors

Engineering data sheet, DE, covers metallized Mylar capacitors. Complete specs of the new epoxy-cased capacitors are presented, including temp. characteristics, curves (insulation resistance, dissipation factor, derating); capacitance, physical dimensions, and part numbers for 200, 400 and 600 vdc models. Electron Products Div., Marshall Industries, 430 N. Halstead St., Pasadena, Calif.

Circle 177 on Inquiry Card

Oscilloscope

A 4-page pamphlet gives a detailed presentation of the new transistorized, battery-operated, portable, Type 321 oscilloscope. It includes specs, block diagram, and performance details. Some features are: A high-performance, light-weight instrument in the dc-to-5 MC range. It operates on batteries on dc power systems or on any standard ac system. Operating temp. range from 30° to 120°F and at altitudes to 20,000 ft. Tektronix, Inc., P. O. Box 500, Beaverton, Ore.

Circle 178 on Inquiry Card

Servomotor

A 4-page folder shows performance data for Model 8 SM 461, Size 8 Servomotor. Servomotor is 0.840 in. in length, and wound for 115 v. operation. It shows dimensional outline drawings and torque-speed curves for the unit. Also, construction features and electrical and mechanical characteristics. Helipot Div. Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Circle 179 on Inquiry Card

Controlled Atmospheres

Brochure describes a line of "Controlled Atmosphere Systems for the Manufacture of Semiconductors." The Heliarc welded enclosures can be constructed of stainless or carbon steel and can be used for dry gas, dry air, and dust and oil free atmospheres. Kewaunee Scientific Equipment, 4012 Logan St., Adrian, Mich.

Circle 180 on Inquiry Card

Transistor Modules

Loading Manual contains loading rules and a load chart for T-Series germanium transistor circuit modules. The load chart can be used to determine the max. load, each T-Series unit can drive and the loading rules present additional information concerning loading requirements and capabilities of the units. Manual is a supplement to EECO Catalog 859—Also available. Engineered Electronics Co., Dept. C, 1441 E. Chestnut Ave., Santa Ana, Calif.

Circle 181 on Inquiry Card

Index—Application Notes

A complete index of some 40 available "Application Notes" issued by the company over the past several months. It presents an abstract of each of the articles which cover electronic measuring instruments. They describe electronic theory, measurements, and applications of Hewlett-Packard instruments. Typical topics covered are traveling wave amplifiers, solid state devices, masers, various frequency, microwave and current measurements: and applications for oscilloscopes and oscillators. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Circle 182 on Inquiry Card

Boxes and Covers

A new 24-page catalog "B60" from Zero Mfg. Co., 1121 Chestnut St., Burbank, Calif., lists over 12,000 standard deep drawn aluminum boxes and covers. Standard sizes range from 7/8 x 1 5/8 in. to 20 1/8 in x 32 1/8 in. Wide range of heights available in each box size.

Circle 183 on Inquiry Card

Resistance Measurements

Issue No. 2 of Design Ideas, ESI quarterly technical bulletin, presents Part I of a detailed discussion of ways to make high accuracy resistance measurements with minimum effort and calculations. Described are resistance measuring systems incorporating 3 and 4-terminal measurement methods and their applications. Issue No. 3 will further develop and complete the discussion. Electro Scientific Industries, Inc., 7524 S. W. Macadam Ave., Portland 19, Ore.

Circle 184 on Inquiry Card

Planar Diodes

An 8-page, 2-color brochure/catalog No. SL-201/1 introduces more than 200 Planar Diodes. Listings include 115 standard 1N series and 103 FD series diodes with essential data. Featured diodes are FD-100 (ultra fast switching computer diode) and FD-200 (high conductance, ultra fast "universal" type) with complete specs and performance graphs. Fairchild Semiconductor Corp., 4300 Redwood Hwy., San Rafael, Calif.

Circle 185 on Inquiry Card

X-Band Switch

Data sheet describes X - Band Switch by Waveguide, Inc., Costa Mesa, Calif. The switch is a precision built single pole, double throw, manually operated device for laboratory use. It permits convenient switching from a slotted line to a reflectometer; or for switching from one signal source to an alternate source for gain measurements. Specs included.

Circle 186 on Inquiry Card

Power Supplies

Bulletin SE-102, 2-pages, describes line of silicone dc power supplies, magnetic amplifier controlled. Units are rated from 100-1500 a, 14-36 v. Transients are 1% max. on ratings to 500 a and 2% for 500-1500 a. Max. drift is 0.05% after 15 min. warmup. Ripple is 0.1% on ratings to 500 a and 0.5% for the 500 to 1500 a range. Sprague Engineering Corp., 19300 So. Vermont Ave., Gardena, Calif.

Circle 187 on Inquiry Card

Electronic Hardware

A 32-page catalog of electronic terminals and hardware. Included are more than 380 standard part numbers. Complete specs and ordering information are contained for standard and molded insulated terminals; terminal boards; eyelets, stand-offs, shaft locks and miscellaneous hardware; handles and control knobs; and custom engineering facilities. Also a new line of instrument control knobs, designed to MS-91528 specs. Catalog 32, Lerco Electronics, Inc., 501 S. Varney St., Burbank, Calif.

Circle 188 on Inquiry Card

Latest Western Literature for Engineers

Measurement Device

The Model 302 Inside Diameter Measurement device, which measures inreactor internal diameters within a variation of ±0.035 in. under water and at high temperatures, is described in a 3-page technical manual. The unit operates at the end of a 14 ft. rod (or longer) and is electrically connected to a digital readout unit. Included is a drawing of the measurement device showing the sensor, measuring jaws, and electrical connection. Physical Sciences Corp., 389 N. Fair Oaks Ave., Pasadena, Calif.

Circle 189 on Inquiry Card

Instruments

Three data sheets from Vidar Corp., 2107 El Camino Real, Palo Alto. Calif., describes a voltage-to-frequency converter (Vidar 240A); a frequency meter (Model 311A); and frequency-to-dc converter (Model 320A). Each data sheet includes principles of operation, descriptive data and tech specs.

Circle 190 on Inquiry Card

Crystal Can Relays

Three-page bulletin describes the MV series crystal can relays including those meeting USAF specs. Details of the specs involved are included as well as comparative characteristics. The MV series described includes coil resistance from 30 up to 15,000 ohms. Elgin National Watch Co., Electronics Div., 2435 N. Naomi St., Burbank, Calif.

Circle 191 on Inquiry Card

Silicon Rectifiers

Data sheets on 10 new very high voltage silicon rectifiers available from Pacific Semiconductors, Inc., 10451 W. Jefferson Blvd., Culver City, Calif. Types 1N3052 through 1N3061 are rated at 12,000 to 30,000 v. respectively and are of the "wire-in" coaxial lead configuration. All types are ½ in. dia. and range from 4 to 8 in. in length according to voltage. No voltage derating is required up to 175°C. They are suited to radar modulator and power supply applications where light weight and high reliability is important.

Circle 192 on Inquiry Card

Coaxial Latching Switch

Solenoid actuated Coaxial Latching Switch requires no holding power. It operates from 28 vdc and draws 3.2 μa hr. Switching time is 10 msec. The 50 ohm switch is make-before-break. Weight is 8.7 oz. Freq. range extents to 11 KMC with typical specs at 7 KMC of: VSWR, 1.4; insertion loss, 0.4 db.; crosstalk, 30 db. Full information from Transco Products, Inc., 12210 Nebraska Ave., Los Angeles 25, Calif.

Circle 193 on Inquiry Card

Ratio Transformers

A 4-page, 2-color brochure gives tech. data on line of sub-miniature, coaxial ratio transformers. Units are for use where min. panel space and light weight are required. The text describes two types: a 2½ in. dia. unit qualified to Mil Specs, and a 3½ in. dia. unit for commercial applications. Included are specs., complete dimensions on 6 models, and photographs. RatioTrans feature 0.011% accuracy and linearity, and up to 6-place resolution. Gertsch Products, Inc., 3211 S. La Cienega Blvd., Los Angeles 16, Calif.

Circle 194 on Inquiry Card

Delay Lines

An 18-page booklet describes the advantages, disadvantages and limitations of different types of delay lines including High density, Lumped constant. Distributed constant, Magnetostrictive, and Ultrasonic delay lines. Factors to consider when establishing specs for a special delay line and their effect on the cost of the line is explained. The influence of the delay-to-rise-time-ratio on the cost and size of a delay line is emphasized. Valor Instruments, Inc., 13214 Crenshaw, Gardena, Calif.

Circle 195 on Inquiry Card

Reinforced Plastics

Reinforced plastic parts for aircraft, missiles, and space vehicles are described in a catalog sheet from Horkey-Moore Associates Plastics Div., 24660 Crenshaw Blvd., Torrance, Calif. Parts include: rocket nozzles, radomes, rocket motor cases, pressure vessels, and launching tubes.

Circle 196 on Inquiry Card

Connectors

A 30-page catalog describes a new line of electrical fittings and accessories to be known as "Bronco-Grip Connectors." The line includes connectors for both copper and aluminum wires. The types initially offered are split bolt, vise grip, service entrance, various clamps, parallel connectors, aluminum compression sleeves, solderless terminal lugs, ground clamps and straps. Bronco-Grip Connectors, Western Insulated Wire Co., Los Angeles 58, Calif.

Circle 197 on Inquiry Card

Gas and Liquid Control

Over 2,500 components for control of gas or liquid over a temp. range of —320° to 1500°F and pressures to over 3500 psig are covered in a catalog from AiResearch Mfg. Co., 402 S. 36th St., Phoenix, Ariz. Major items available for aircraft, missile or process industry applications include: Fuel control systems, Pneumatic and electrical valves, Actuators, Air motors, and Thermostats.

Circle 198 on Inquiry Card

Recording Oscillograph

Type 5-123 Recording Oscillograph is illustrated in an 8-page bulletin 1623 from Electro Mechanical Instrument Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. The rack-mounting oscillograph is designed for reliability, flexibility, ease of installation, operation, and maintenance.

Circle 199 on Inquiry Card

Pulse Generator

A two-page data sheet, describing a high voltage pulse synchronizing generator (10 kv peak) with a pulse of 100 nanosec., is available from Electro - Optical Instruments, Inc., 2612 East Foothill Blvd., Pasadena, Calif. System description, Applications, Specs., and Typical pulse and wave form illustrations are included.

Circle 200 on Inquiry Card

AC Motor

Catalogs on AC Multi-Shielded Motors includes pricing and dimensional data on motors ranging from ¼ to 200 hp. A special section deals with motor selection and application. Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.

Circle 201 on Inquiry Card

Electronic Cables

Brochure, DM - S - 6015, highlights specialized electronic wire and cable line. It details a variety of basic materials available for conductors, insulations, shields, jackets, and armors. Sequoia Wire & Cable Co., 2201 Bay Rd., Redwood City, Calif.

Circle 202 on Inquiry Card

Profile Monitor

Model 201, Profile Monitor, is described in tech data sheet PM2-917 from Advanced Technology Laboratories, 369 Whisman Rd., Mountain View, Calif. The instrument provides an accurate, easily interpreted, visual display of any phenomena measurable by an electrical output (temperature, pressure, strain, velocity, etc.). Tech specs are included.

Circle 203 on Inquiry Card

Resistor Elements

Wafer-like, metal-film resistor elements used in micro-module circuit assemblies are described in Engineering Bulletin 1007. These tiny elements, each of which can carry 4 precision resistors, offer a packaging density of as high as 600,000 parts/cu. ft. Ohmite Mfg. Co., 3678 Howard St., Skokie, Ill.

Circle 204 on Inquiry Card

WASHINGTON News Letter

ACTION DELAYED—The FCC proposals contemplating a 30-channel or a 50-channel VHF television system are to be delayed for a final answer from the executive branch of the government until the early part of August. The proposed system would be accomplished through an exchange of UHF spectrum space for the VHF portions which are occupied by the military services.

REPLY NOT YET PREPARED—Commission Chairman Ford notified the Senate committee that the FCC now has been informed "that it has not as yet been possible for the executive branch (working through the Office of Civil & Defense Mobilization) to prepare a properly staffed and coordinated reply to the commission's proposals" on the VHF television system.

DIM OUTLOOK—Government officials expressed the view privately to Electronic Industries' Washington bureau that there was virtually no chance to secure the additional VHF space for commercial television from the military services. The complexities, particularly equipment costs, involved in shifting military and non-broadcast users of this VHF portion of the spectrum have been stressed. The armed services also feel the move would be harmful to the national defense.

FULL COMPLEMENT—The FCC now is to have a full complement of seven Commissioners. Commissioner Robert E. Lee, who began serving on the FCC Oct. 6, 1953, after a broad background with the FBI and as an expert with Congressional committees, was confirmed by the Senate for a new seven-year term. Vote was 64 to 19 after a 20-minute debate. To complete the unexpired term of resigned Chairman John C. Doerfer which expires July, 1961, President Eisenhower has nominated Charles H. King, Dean of the Detroit College of Law. The latter's nomination is expected to be resubmitted by the President as a recess appointment after the adjournment of Congress.

AIRLINE'S REQUIREMENTS—A program of basic requirements for air-ground-air radio automatic communications has been issued by the Air Transport Association for the nation's scheduled airlines. The ATA statement stressed that the automatic communications system is "a matter of considerable operational urgency," particularly in air traffic control. The ATA stated that the AGACS combining the best features of the Radio Corporaiton of America and Stromberg-Carlson systems "is most likely to be correct." The airlines participating in the meeting declared that planning for this system and all other data link services "suffers seriously from the lack of established operational requirements."

ROBOT MICROWAVE—The Hughes Aircraft Company has asked the FCC for a frequency allocation of 100 MC in the high microwave regions of the spectrum, approximately within the 13,000-35,000 MC range, to give added mobility for its "Mobot," its mobile robot equipment for remote control operation. The Hughes "Mobot" equipment can handle dangerous materials, fight forest and petroleum fires, harvest crops, aid in the design of nuclear "hot cells" and test reactors and a myriad of other functions. The "Mobot" equipment is now actually in use on a cable-controlled basis, but this method seriously limits the effectiveness of the equipment.

National Press Building *ROLAND C. DAVIES*
Washington 4

NASA FUNDS—The National Aeronautics and Space Administration has been voted approximately $621.5 million for research for the fiscal year that just begun.

The Federal Aviation Agency will receive $163 million for air navigation facilities; National Science Foundation is getting $175 million; and the Federal Communications Commission will receive $13 million, including $2 million to evaluate UHF television facilities.

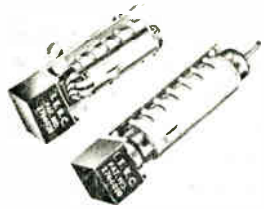
SURPLUS PROPERTY—The U. S. House of Representatives, by a vote of 124 to 61, defeated H. R. 9996. H. R. 9996 was a bill to permit wide-open importation of U. S. surplus property from overseas. A large portion of this property was said to be electronics.

DOD BUYING MANUAL—The 1960 edition of the Department of Defense's Armed Services Procurement Regulations (ASPR) is now available. It is the guide for military procurement and is available from the Superintendent of Documents, Washington 25, D. C., for $18.00.

The 1960 edition contains all of the material in the 1954 issue plus the revisions issued since 1954. It is being sold as a subscription service consisting of the basic manual and about two years of supplementary service for future revisions.

SUBMINIATURE AND MINIATURE HEAT DISSIPATING SHIELDS:

At Booth No. 2605
WESCON SHOW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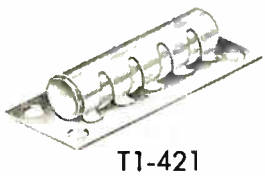
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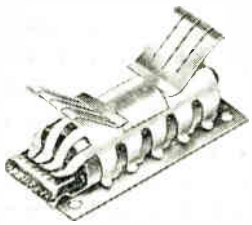
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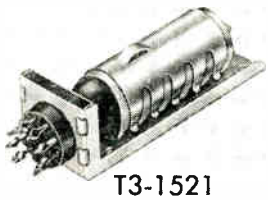
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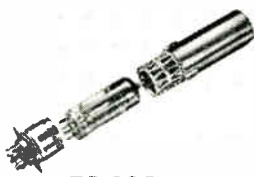
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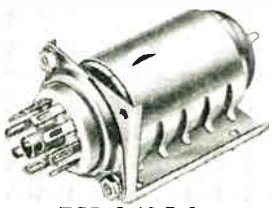
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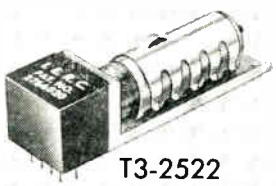
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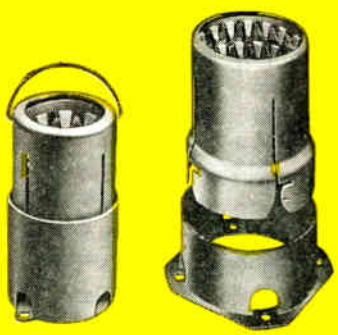
☆ CINCH

HEAT DISSIPATING TUBE SHIELDS

for Miniature, Subminiature, Octal and Power Tubes.


T5 and T6


TR5 and TR6


OCTAL and POWER SHIELDS

The 7 and 9 pin Miniature Series, T, TR and NW Series are covered by Military Specifications:

MIL-S-9372B (USAF)
MIL-STD-242B (Ships)
MIL-S-19786A (Navy)
SCL-6307/2 (Signal Corps)

In the Octal and Power Series, the shields are covered by Redstone Arsenal and Signal Corps approval.

☆ Manufactured under license agreement with International Electronic Research Corporation

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California; St. Louis, Missouri

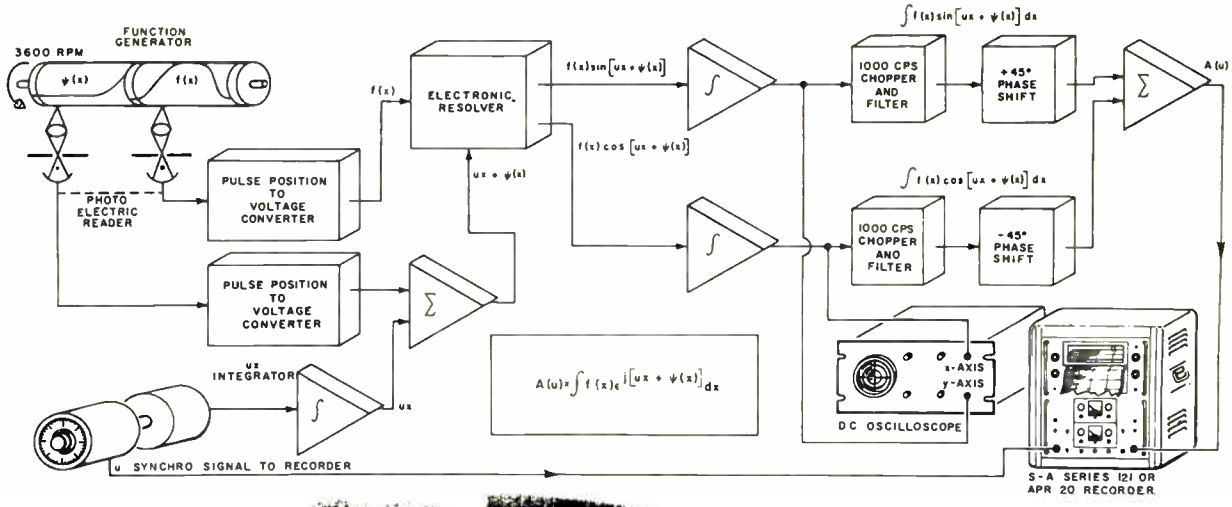
Cinch ELECTRONIC COMPONENTS

ELECTRONIC DOT ASSEMBLIES

CINCH MANUFACTURING COMPANY
1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.

Circle 53 on Inquiry Card

Simplified block diagram of Model CF-1. Amplitude and phase input functions are plotted on graph paper for presentation. Integration is observed on a dc oscilloscope. Absolute magnitude is recorded on any S-A Series 121 or APR 20 Antenna Pattern Recorder with a logarithmic response. Time of solution is 15 to 25 minutes.

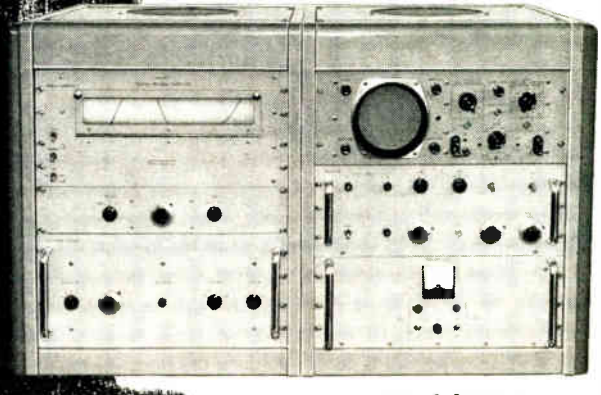


To solve

$$A(u)=\int_{-1}^{1} f(x)\,\epsilon^{j[ux+\psi(x)]}\,dx$$

investigate the new

S-A FOURIER INTEGRAL COMPUTER



Model CF-1

A sophisticated solution to the vexing problem of solving bounded Fourier integrals quickly and accurately, Scientific-Atlanta designed the Model CF-1 especially for the antenna design engineer.

The computer has broad general application including determination of the far fields of aperture antennas from the distribution of the field in the aperture, the far fields of arrays from the magnitude and phase of the currents in the elements, the frequency spectra of voltage pulses, and other physical problems involving Fourier transforms and their inverse transforms over finite limits.

PRICES

Model CF-1 Fourier Integral Computer . . . $9,000

Model APR 22 Antenna Pattern Recorder (logarithmic response) . . . $4,300

See the CF-1 and other new S-A Microwave Instrumentation at Wescon Booth 539-540

Consult your nearby S-A engineering representative for more information. Or you may write directly to the factory for complete specifications. Address Dept. 44.

SCIENTIFIC-ATLANTA, INC.

2162 PIEDMONT ROAD, N.E. • ATLANTA 9, GEORGIA

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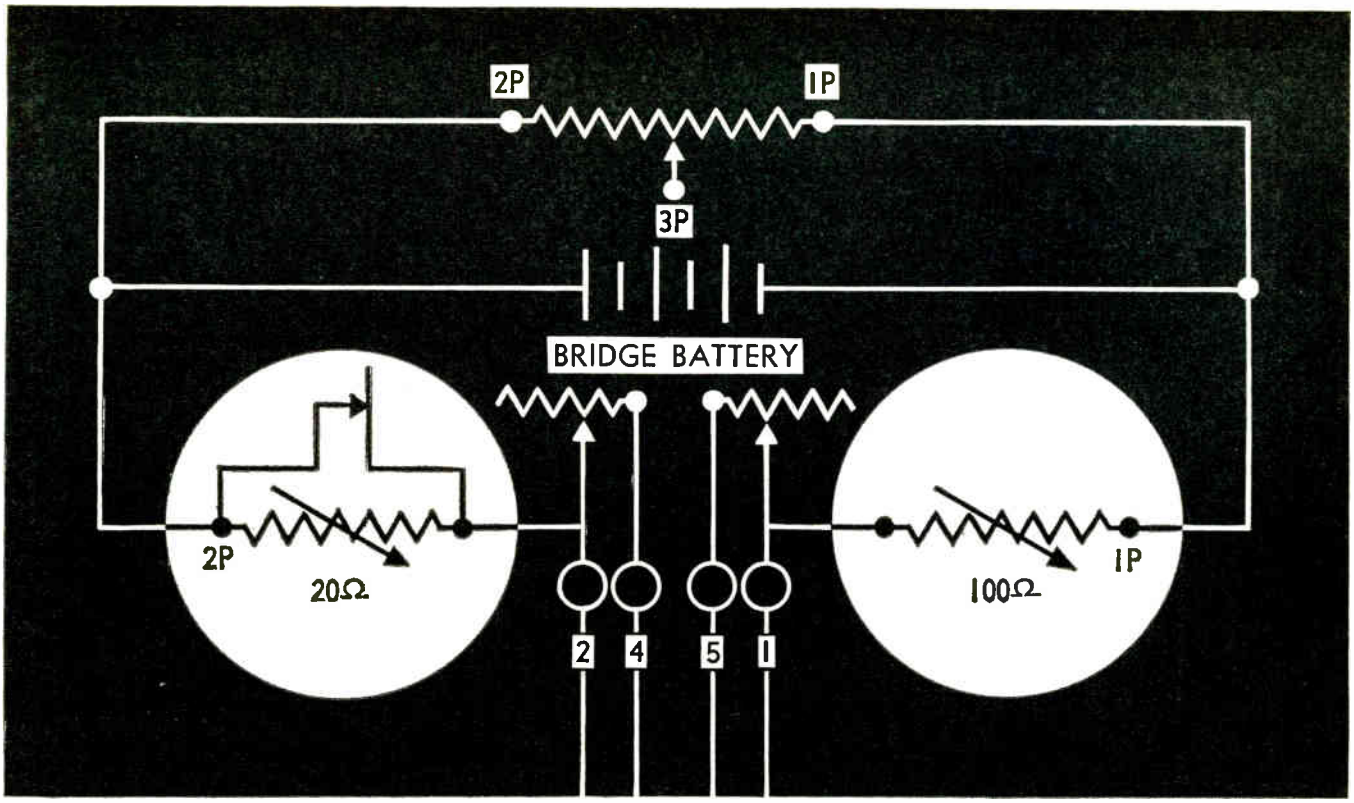

Eliminate Trimming Resistor Problems with Borg Absolute-Linearity Micropots

The above schematic illustrates how many original equipment manufacturers are eliminating trimming networks from circuits by replacing conventional potentiometers with Borg 900 Series *Absolute Linearity* Micropots. The Borg 900 Series eliminates electrical overhang . . . trimming becomes unnecessary. A further advantage is accomplished by setting the 900 Series mechanical stop to a phasing point. Field replacement of the primary potentiometer now becomes a simple mechanical process of attaching leads and phasing from the preset stop. This means you do not have to replace trimmers or resistors each time you replace the primary potentiometer. The design advantages and cost savings brought about by the *absolute linearity* of the Borg 900 Series can now be fully appreciated. With 900 Micropots, your equipment will afford greater accuracy, reliability and practicality because trimming and adjustments with auxiliary resistors are no longer required. Trained assembly personnel can now be concentrated on more profitable areas of production. Many other 900 Series advantages can help solve your potentiometer problems as they are now doing in all types of industry. The 900 Series is available in ten and three turn models with several optional features. Contact your Borg technical representative or let us put him in touch with you. *Ask for data sheets BED-A128 and BED-A129.*

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Micropot Potentiometers • Turns-Counting Microdials • Sub-Fractional Horsepower Motors • Frequency and Time Standards

Tech Data

for Engineers

Distance Meter

Catalog sheet, Bulletin WM-DM-100, gives a general description of Distance Meter, Type DM-100, applications, the operating principle, and discusses the instrument's probes and output connections. In addition, specifications and a probe dimensions diagram are included. Wayne Kerr Corp., 1633 Race St., Phila. 3, Pa.

Circle 205 on Inquiry Card

Surge Test Adapter

Data sheet 107 describes the self-contained Wallson 75 amp. Surge Test Adapter, Model 142A. The unit supplies single ½ wave sinusoidal surge currents, adjustable between 5 and 75 a at a max. repetition rate of 4/min. Wallson Associates, 912-914 Westfield Ave., Elizabeth, N. J.

Circle 206 on Inquiry Card

Low Voltage Power Supply

Data sheet from Power Sources, Inc., Burlington, Mass., describes their low voltage transistor regulated power supplies. Included are variable voltage models and fixed voltage models.

Circle 207 on Inquiry Card

Step Down Transformer

Practical data for proper size selection of Step Down Transformers is included in Bulletin, 16-B01, from Acme Electric Corp., Cuba, N. Y. Four examples of common step down transformer applications are listed. Included are illustrations, specs and dimensions on the company's line of step down and step-up transformers.

Circle 208 on Inquiry Card

Airborne Power Supplies

Bulletin GEC-1540, 2 pages, gives specs of GE's unregulated airborne transformer-rectifier, Model 6RW162-YF1, 28 v, 200 a. It included a photograph, electrical and mechanical characteristics, electrical circuit, graph, outline and schematic drawings. General Electric Co., Schenectady 5, N. Y.

Circle 209 on Inquiry Card

Infrared Components

Infrared Sections Catalog 103, 2-pages, gives information on low-cost infrared do-it-yourself oven components incorporating G-30 type infrared lamps. Fostoria Corp., Infrared Div., Dept. 45, Fostoria, Ohio.

Circle 210 on Inquiry Card

Relay Catalog

Catalog of relays includes products of over 20 leading relay manufacturers. Lines are listed with complete description and prices. A thumb-indexed table of contents speeds finding relays. Relay Sales, Inc., Box 186, West Chicago, Ill.

Circle 211 on Inquiry Card

ELECTRONIC INDUSTRIES

WESCON 1960

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New Tech Data for Engineers

IR Cooling Systems

Four new liquid nitrogen cooling systems for infrared detector devices are described in a 6-page folder F-1265, from Linde Co., Div. of Union Carbide Corp., 30 East 42nd St., New York 17, N. Y. The four types are: integrally-mounted cell; liquid feed-vacuum insulated line; liquid generator to cryostat; and liquid feed-uninsulated lines. Also: information on design features, performance data, and specs.

Circle 212 on Inquiry Card

Silicon Rectifiers

Four separate data sheets for any engineer or designer who specifies, uses or is concerned with silicon rectifiers. The sheets cover many of the technical aspects of application, heat sink requirements, surge voltage protection, parallel operation and series operation of silicon power rectifiers. Additional information is included in curves, diagrams, formulas and charts helpful in the selection and use of silicon rectifiers and rectifier circuits and in attaining optimum efficiency from them in all applications. Data sheets are numbered 6SI-101 through 104. Fansteel Metallurgical Co., Publications Dept., N. Chicago, Ill.

Circle 213 on Inquiry Card

High Alumina Ceramics

Six-page brochure from Diamonite Products Mfg. Co., Shreve, Ohio, covers data and application of high alumina technical ceramics to the electronics industry. It contains a chart of comparative properties of Diamonite materials for electronic applications. It covers all factors—physical, electrical and environmental—of the material so that potential applications can be evaluated. A graph of dielectric loss factors on a comparative scale is also shown.

Circle 214 on Inquiry Card

Vaneaxial Airmover

Engineering information on a newly developed compact vaneaxial with a "non-stall" characteristic, designed to deliver air at high pressure for cooling tightly packed electronic components and other related applications. Model BC 1607V-1, measures 3 in overall dia. and 2 5/16 in. length. Design features are: 115 v., 400 CPS, single phase, weight 15 oz. Design options include: 115/200 vac 3 phase, 310-1100 CPS, single phase—sine wave or square wave, "hi-slip" altitude varying speed motors. It meets MIL specs for environment and performance. IMC Magnetics Corp., 570 Main St., Westbury, N. Y.

Circle 215 on Inquiry Card

Resins Chart

Standard Resins chart has been completely revised and brought up to date. It is a reference for data and end-use information about epoxy and ceramic type casting and impregnating resins and adhesives. Some of the newest products from Emerson & Cuming research are presented here for the first time. Chart is in color. Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.

Circle 216 on Inquiry Card

Pre-Amplifier

Model A-10 transistorized ac preamplifier is described in data sheet from Medistor Instrument Co., 1443 Northlake Way, Seattle 3, Wash. The unit can be used to convert dc oscilloscopes or pen recorders into high fidelity instruments for the recording of electrocardiograms, electroencephalograms, and electromyograms. Some specs: Gain, 200 to 2000 in 4 steps; In phase rejection ratio, adjustable to better than 10,000: 1; Input impedance, approx. 1 megohm; calibration, 50 uv and 1 mv (±1%); Noise level, approx. 1.5 uv at 100 CPS; band pass; Low freq. response, adjustable to 0.1, 1.0, and 10 CPS—a 2 sec step function will decay approx. 5%. High freq. response, adjustable to 100 CPS, 1 KC, 40 KC.

Circle 217 on Inquiry Card

Static Control

A new control, called Static Slipsyn® starter, for low and high voltage synchronous motor starting equipment employs all static components and performs complex logic operations, including: application of motor-field excitation at both the proper speed and the most favorable rotor and stator relationship; detection and removal of excitation if the motor pulls out of synchronism; and protection of the starter or damper winding from overheating when operating at subsynchronous speed. For more information: Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Penna.

Circle 218 on Inquiry Card

Servomechanism Components

Introduction to the line of precision components for servomechanism and computing equipment from Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, New Jersey. Four-page, two-color brochure, Publication No. 603-17, describes component packaging, precision gyros, radar antenna devices, servo motors, stepper motors, tachometer generators — damping — temperature compensated and integrating—and Motor damping tachometers.

Circle 219 on Inquiry Card

Polyvariables

Polyvariable Experimentation (newly developed methods for experimentation in 10, 20, or more variables) is described along with available training programs and literature in a 4-page brochure from the Statistical Engineering Institute, 8 Fuller Road, Wellesley, Mass.

Circle 220 on Inquiry Card

Electrical Insulation

Catalog No. 36 lists "Standard Packaged" electrical insulation offered by Insulation Manufacturers Corp. 565 West Washington Blvd., Chicago 6, Illinois. Shown are prices and dimensions of stock paper and paper-combination cupped coils for motor slot insulation; crimped paper transformer insulation; fibre washer assortments; as well as motor wedges formed of Mylar® film; asbestor and glass mat laminates; hard maple wood; and formed fibre. Also included is a resume of made-to-order insulation products.

Circle 221 on Inquiry Card

Filters-toroids

Four-page catalog on toroids and filters lists various toroid types and shows typical performance curves. A new standard line of encapsulated toroids is described and illustrated. The catalog has a section on the ordering of filters, with a listing of requirements under eight general groups which cover the information necessary to develop suitable characteristics. Barker & Williamson, Inc., Canal St. & Beaver Dam Road, Bristol, Penna.

Circle 222 on Inquiry Card

Phenolic molding

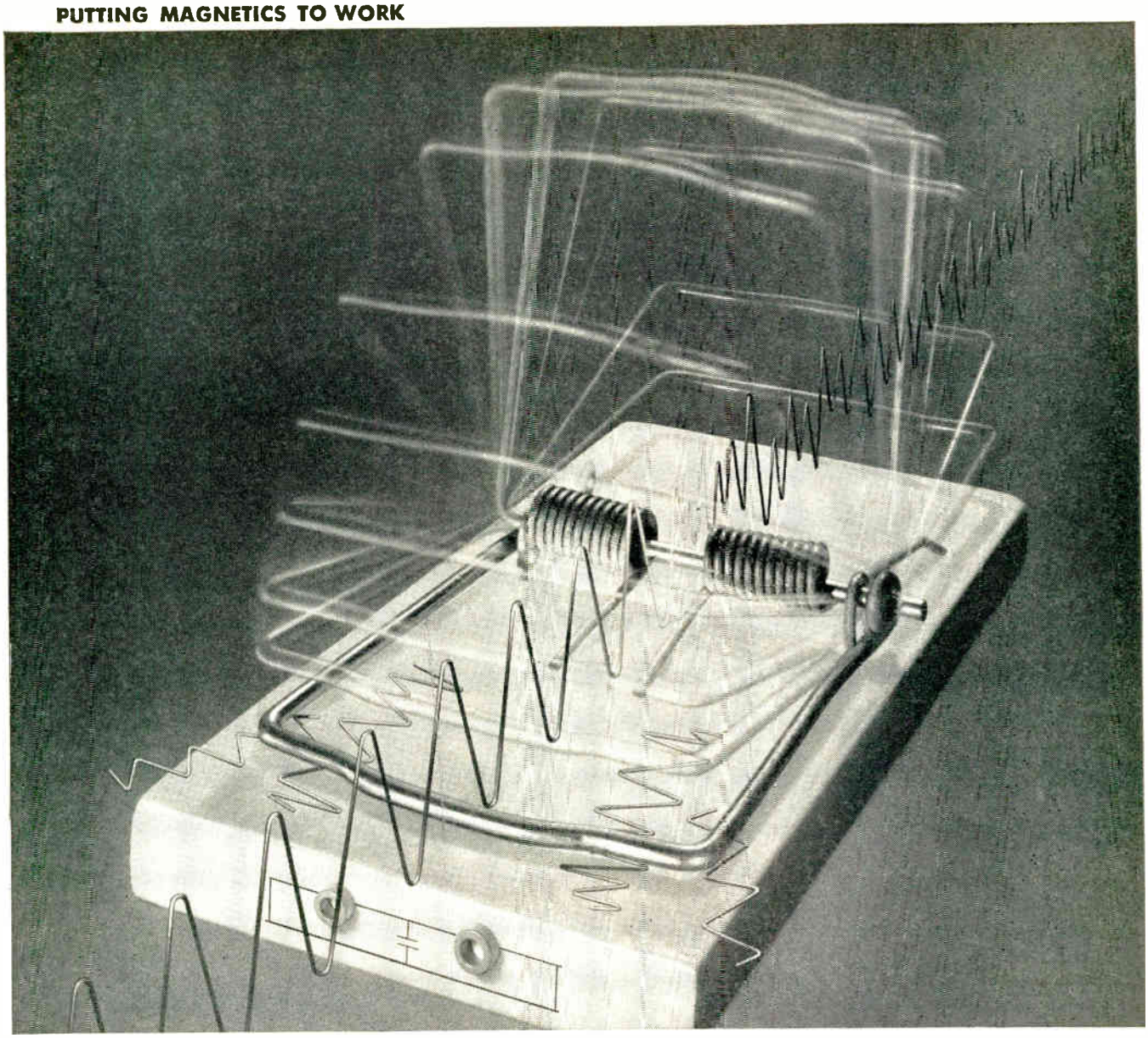
Two new Bakelite brand phenolic molding materials with fast cure times and wide molding latitudes are described in a brochure from Union Carbide Plastics Co., 30 East 42nd St., New York 17, N. Y. BMM-7001 is a dust and fines free material for fast powder automatic molding, either cold or r-f pre-heated. BMM-7002 is supplied in Stokes granulation for plunger molding with high frequency preheat.

Circle 223 on Inquiry Card

Solder Performs

Tech Data, Bulletin Z-103, a 2-page report, describes ultra-pure precision solder preforms. It lists compositions and melting points of 33 typical alloys available as preforms from the Company. Melting range is from 360° to 700° F. Accurate Specialties Co., Inc., 37-11 57th St., Woodside 77, N. Y.

Circle 224 on Inquiry Card



How to build a better (audio signal) trap!

Magnetics Inc. permalloy powder cores give filter designers new attenuation and stability standards—and miniaturization to boot!

The art of trapping unwanted frequencies has been advanced during the past year with a succession of improvements in molybdenum permalloy powder cores by Magnetics Inc. Most audio filter designers now work with smaller cores, more stable cores and cores whose attenuation characteristics are ultra-sharp. Do you?

Do you, for example, specify our 160-mu cores when space is a problem? With this higher inductance, you need at least 10 percent fewer turns for a given inductance than with the 125-mu core. What's more, you can use heavier wire, and thus cut down d-c resistance.

What about temperature stability? Our linear cores are used with polystyrene capacitors, cutting costs in half compared to temperature stabilized moly-permalloy cores with silvered mica capacitors. Yet frequency stability over a wide swing in ambient temperatures is increased!

And what do you specify when you must rigidly define channel cut-offs, with sharp, permanent attenuation at channel crossovers? Our moly-permalloy cores have virtually no resistive component, so there is almost no core loss. The resultant high Q means sharp attenuation of blocked frequencies in high and low band pass ranges.

Why not write for complete information? Like all of our components, molybdenum permalloy powder cores are *performance-guaranteed* to standards unsurpassed in the industry. *Magnetics Inc., Dept. EL-82, Butler, Pa.*

MAGNETICS inc. ®

VISIT OUR BOOTH 521-522 AT THE WESCON SHOW

Circle 61 on Inquiry Card

for Business or "Treasure"

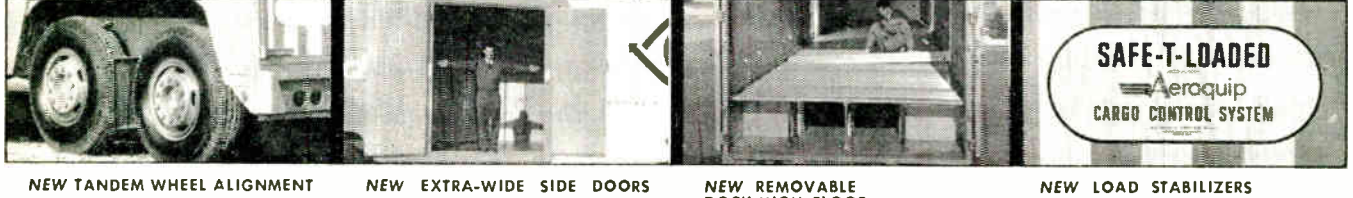
when the occasion calls for MOVING... call **United Van Lines**

Whether you're moving bulky electronic devices or priceless works of art, you'll find it safer, easier, more convenient via United's modern "Safe-Guard" service.

From nation-wide exhibit tours to "tight-schedule" deliveries of office equipment, United gears its service to *your* requirements. Spacious, specially-designed vans take tough-to-handle shipments in stride . . . including the loading of large units—*in one piece*—without costly dismantling. And because crating is not needed on most "Safe-Guard" shipments, there's an extra saving in time and expense.

For "Pre-Planned", straight-through service in exclusive Sanitized* vans, call your United Agent today. He's listed under "MOVERS" in the Yellow Pages.

YOUR SHIPMENT LOADS EASIER . . . TRAVELS SAFER IN A *United* "SAFE-GUARD" VAN



***NEW* TANDEM WHEEL ALIGNMENT**
Provides valuable inches between wheel boxes . . . more usable loading area than standard vans.

***NEW* EXTRA-WIDE SIDE DOORS**
A full 72 inches, permit easy, one-piece loading of large items.

***NEW* REMOVABLE DOCK-HIGH FLOOR**
Eliminates hoisting, provides 264 sq. ft. of clear, unobstructed loading space.

***NEW* LOAD STABILIZERS**
Hold your shipment securely in place prevent shifting or jarring enroute.

FOR YOUR FREE COPY OF *United's* "SAFE-GUARD" MOVING BROCHURE, WRITE:

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MOVING WITH CARE EVERYWHERE®

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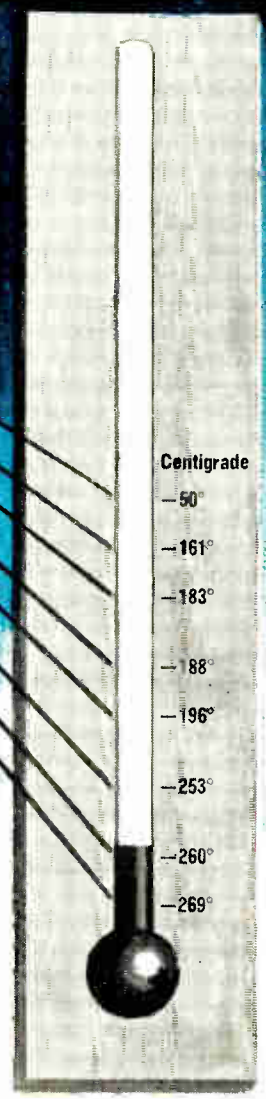
AS MISSILES GO EVER HIGHER
temperatures go down and down



Here's how the problem is met by
KEYSTONE THERMISTORS

Just as surely as missiles are going higher and higher, the demand is for Thermistors to operate at lower and lower temperatures. Sooner or later, such demands are being met by the research people at Keystone.

Ten years ago the low temperature range for Thermistors was approximately —50°C. Then a new area of interest was born—still lower temperature operation. By 1955 we had developed units that were useful down to —183°C. Today we are delivering units for applications operating at —260°C (below liquid hydrogen) for use in space as liquid level indicators or as flow control mechanisms. Our Thermistors are also working in gas liquefaction apparatus with fluorine, argon, oxygen, etc. and in the petrochemical industry with methane. New missiles, new products, and the whole new field of Cryotronics challenge us to even lower temperature response. Degree by degree we make progress toward lower temperatures and maximum reliability within the precision tolerances and wide selection of temperature coefficients in which we work.

There may be a low temperature indication or control problem in your present product, or, more likely, in a product you're thinking about for the future. Here at Keystone we're working on both today's and tomorrow's problems and we would like to hear about yours.
Glad to have you call us, anytime.

Keystone
CARBON COMPANY
Thermistor Division • St. Marys, Pa.

Circle 63 on Inquiry Card

Tech Data

for Engineers

Bobbin Winders

A 2-color catalog page illustrates and describes Model 39-AM Miniature Bobbin Winder and Model 315-AM 5000 RPM 3 in. stroke 5 in. OD Bobbin-Solenoid-Repeater-Resistor Coil Winder. Geo. Stevens Mfg. Co., Inc., Pulaski Rd., Peterson, Chicago 46, Ill.

Circle 225 on Inquiry Card

Sensing Elements

Line of sensing-element modules for closed-loop control, regulating, alarm systems is described in Bulletin SXD-5916 from Regulators, Inc., P.O. Box 266, 455 West Main St., Wyckoff, N. J.

Circle 226 on Inquiry Card

Quick-Connect Terminals

Bulletin 20 describes the different types of quick-connect terminals used on ESCO Type P, 10 amp. rotary switch. It includes photographs, dimension drawings, electrical ratings, mounting styles, as well as contact diagrams. Electro Switch Corp., King Ave., Weymouth (Boston 88), Mass.

Circle 227 on Inquiry Card

Klystrons—Planar Triodes

The characteristics and applications of a wide range of klystron oscillators and "rocket" planar triodes are described in a brochure from Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y. The booklet contains operational data on the company's complete line of disc seal and metal klystrons and Sylvania "rocket" tubes for pulse oscillator, CW oscillator and other applications up to 3,300 MC. Listed is info. on the SK-220 and SK 222 series which operate with 1 w output in the 6,125 to 8,100 MC range.

Circle 228 on Inquiry Card

Tape Perforator

New 24-page booklet describes Model GP-2 Super-Speed Tape Perforator. It can record digital data in standard perforated tape at the rate of 300 codes/sec. Booklet describes mechanical components, circuit design considerations, mechanical and electrical characteristics of the unit, as well as theory of operation. Soroban Engineering, Inc., Box 1717, Melbourne, Fla.

Circle 229 on Inquiry Card

Coaxial Cable

Catalog W3, 40 pages, provides information on Amphenol coaxial cable as well as an up-to-date RG-/U nomenclature listing and electrical and mechanical information on cable materials and performance. Amphenol Cable & Wire Div., Amphenol-Borg Electronics Corp., Chicago, Ill.

Circle 230 on Inquiry Card

"FREON"-TF SOLVENT

This magnet wire was exposed to "Freon" solvent liquid. The "Glyptal" coating on this wire is completely unaffected by "Freon"-TF.

ORDINARY CHLORINATED SOLVENT

This "Glyptal"-insulated wire was exposed to ordinary chlorinated solvent for the same length of time as the one on the left. The solvent dissolved the resin binder and softened the alkyd finish.

Comparison with ordinary chlorinated solvent proves:

FREON® solvents won't damage metal, elastomers or plastics . . . are safer for degreasing precision equipment

"Freon" solvents give you an effective and remarkably safe means of cleaning electric motors, ultra-precision mechanical and electronic equipment, and component parts. They minimize swelling of elastomers and plastics . . . will not soften paint, wire coatings or insulators. "Freon" solvents are also non-corrosive to metals without inhibitors. In addition, "Freon" solvents leave no residue when they dry and can be recovered and reused readily.

"Freon" solvents are safe for personnel, too. They are non-explosive and non-flammable. "Freon" is virtually non-toxic. Vapors are odorless and will not cause nausea or headaches.

FREE 12-PAGE BOOKLET explains the unique properties of "Freon" solvents and how they minimize cleaning hazards.

FREON®
solvents

DUPONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
"Freon" Products Division 558
Wilmington 98, Delaware

Send me your free, 12-page booklet on "Freon" solvents.

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Company _____

Address _____

City _____ State _____

Circle 65 on Inquiry Card

Circle 66 on Inquiry Card

New Tech Data for Engineers

Bridge Rectifier

A miniature open bridge assembly, the selenium rectifier Flat 155V90 is described in Bulletin F-313. The unit is rated at 90 ma dc at 155 v rms. Tech. data, circuit and dimensional diagrams, and mounting instructions are given. Dept. F, Radio Receptor Co., Inc., subsidiary of General Instrument Corp., 240 Wythe Ave., Brooklyn 11, N. Y.

Circle 231 on Inquiry Card

Inductor Wall Chart

Ready-reference wall chart on toroidal and variable inductors. The 3-color chart measures 24 x 36 in. and has metal edging. Twenty graphs provide Q versus frequency curves for several ranges of voltage or inductance. Also a table of the electrical characteristics and physical dimensions of 25 typical toroidal inductors with diagrams and sizes of a number of commonly-used hermetic and epoxy-potted metal cases. Similar information is supplied for a range of variable inductors. Burnell & Co., Inc., 10 Pelham Pkwy. Pelham Manor, N. Y.

Circle 232 on Inquiry Card

Power Supplies

Catalog, Form 3114-9, describes line of high voltage power supplies. The 8-page, 2-color bulletin pictures main components in single and dual units for operation up to 5000 v. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 233 on Inquiry Card

Handling Equipment

Condensed catalog, No. 605, of vibratory materials handling equipment, vibrating parts handling equipment, power rectification equipment, mechanical shaft seals, paper joggers and portable power tools. Lines listed include vibrators, car shakers, car rappers, packers and jolters, hopper level switches, flow control valves, feeders, conveyors, spiral elevators, dry feeders and weigh-feeding equipment, a complete line of vibrating screens, test sieve shakers, parts feeders, lapping machines, rectifiers and rectifier power units, battery chargers, shaft seals, paper joggers, paving breakers and rock drills, electric hammers and hammer drills, and concrete vibrators and floats. Syntron Co., 263 Lexington Ave., Homer City, Pa.

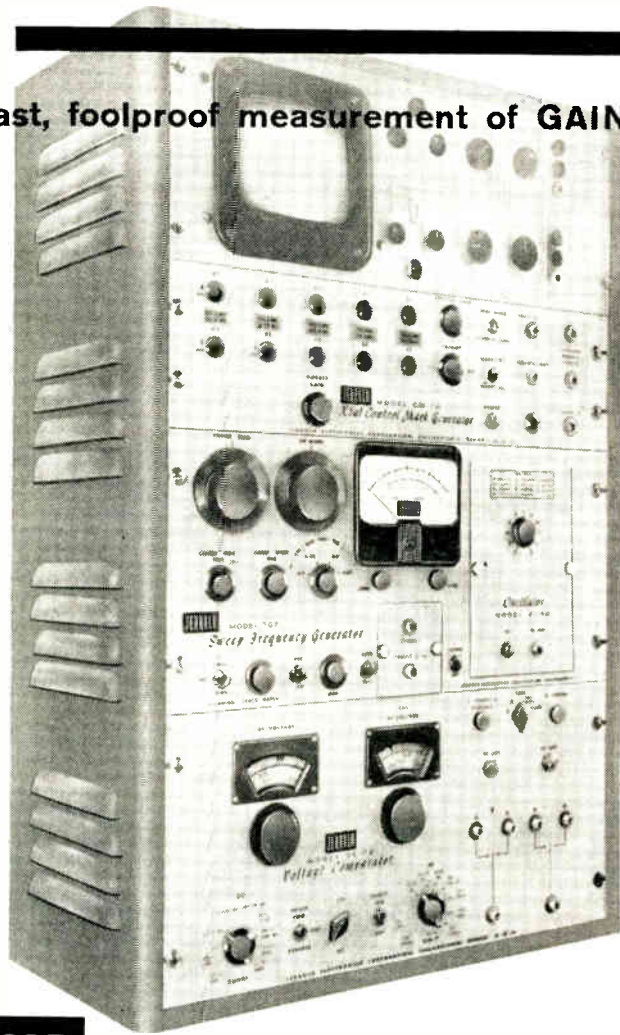
Circle 234 on Inquiry Card

Circle 67 on Inquiry Card

Circle 68 on Inquiry Card

BEST TEST SET YET!

For fast, foolproof measurement of GAIN, LOSS, VSWR, Q, X_L, X_c, Z



Crystal Controlled Marker Generator

Model **CM-10**—A 10-crystal unit producing any selected fundamental and/or harmonic frequencies. Each oscillator has its own independent amplitude control. Features built-in scope pre-amplifier and VSWR filter.

Precision Sweep Generator

Model **707**—The heart of the test set. Features an extremely flat RF output (±5/100 db) and variable rate, all electronic sweep with plug-in oscillators available covering 2 to 265 mcs. Provisioned for use with an X-Y plotter.

Accurate Voltage Comparator

Model **VC-12** — The unit that makes Measurement By Comparison possible. A 3-section instrument that contains regulated DC and RF voltage supplies and a wide band coaxial comparator for the simultaneous visual presentation of reference standards against which the test information is compared.

JERROLD **MODEL 1707**

Model 1707 Price **$1,570.00**
(Oscilloscope, rack, or recorder not included)

Complete RF TEST SET employs the **M**easurement **B**y **C**omparison technique

Interested in more than one frequency . . . an entire band, octave, or spectrum? Now it's no longer necessary to employ the slow, tedious, point-by-point method of measurement when working with a spectrum of frequencies. Jerrold's new 1707* test set will do the same measurement job *Faster*, more accurately, and with fool-proof results. Featuring the **M**easurement **B**y **C**omparison technique, the model 1707 provides a continuous visual presentation and self calibration against precision standard attenuators (and/or accurate DC and RF voltage sources referenced against a standard cell). So, whatever your laboratory, production, or field needs—Jerrold's sweep frequency **MBC** method will serve them better.

Write today for complete catalog and technical newsletter series on MBC procedures.

JERROLD **ELECTRONICS CORPORATION**
Industrial Products Division, Dept. ITE-63, Philadelphia 32, Pa.
Jerrold Electronics (Canada) Ltd., Toronto • Export Representative: Rocke International, N.Y. 16, N. Y.

*Similar test sets available for other ranges

WESCON BOOTHS 426-427

New Tech Data for Engineers

High Temp Motor

An HM-420 type high temp. motor with a working amb. temp. range from −65°F to +600°F is described in PS-8A Product Bulletin from Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N. J. Two-color, 4-page Bulletin includes performance curves, outline drawing, general engineering data and a section on special design features.

Circle 235 on Inquiry Card

Life Support Systems

Life Support system R&D for space flight plus related programs are summarized in a new booklet, PIB-D-8, distributed by General Electric's Missile & Space Vehicle Dept., 3198 Chestnut St., Phila. 4, Pa. Projects outlined include the satellite aeromedical recovery vehicle, life support systems for manned re-entry vehicles, food preservation systems for space flight, closed environmental systems for small primates, and ecological systems. Related programs on nuclear emulsion recovery vehicles, electrical power systems for space and the G. E.-MSVD Biosciences Development and Human Factors Labs. are summarized.

Circle 236 on Inquiry Card

Timers

Condensed Catalog D-31 from Automatic Timing & Controls, Inc., King of Prussia, Pa., is a reference for automation components and control systems. 30-page, 2-color publication covers timing components and linear measuring systems for industrial and military users. Also: sections devoted to electronic timers, special timers and their applications, package control systems, military components and systems and in one grouping, test equipment, switches, controllers, contactors and valves. Treated separately are differential transformers, motion transmitters, edge guide, pressure transmitters, demodulators and indicators and recorders.

Circle 237 on Inquiry Card

Test Equipment

A 28-page catalog from Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y., covers its line of stereo and mono high fidelity, test instruments, ham equipment, citizen transceivers and radios in both kit and wired form.

Circle 238 on Inquiry Card

Random-Noise Generator

Illustrated 4-page brochure describes the Type 1390-B Random-Noise Generator. Highlights are a basic schematic of the instrument, curves comparing the amplitude distribution of random noise with that encountered in active communication systems, and the amplitude-frequency characteristic of the noise generator. Typical measurement setups are shown, with a list of typical applications in electrical and acoustical measurements, environmental testing and statistical investigations. Includes electrical, electronic, and mechanical specs. General Radio Co., West Concord, Mass.

Circle 239 on Inquiry Card

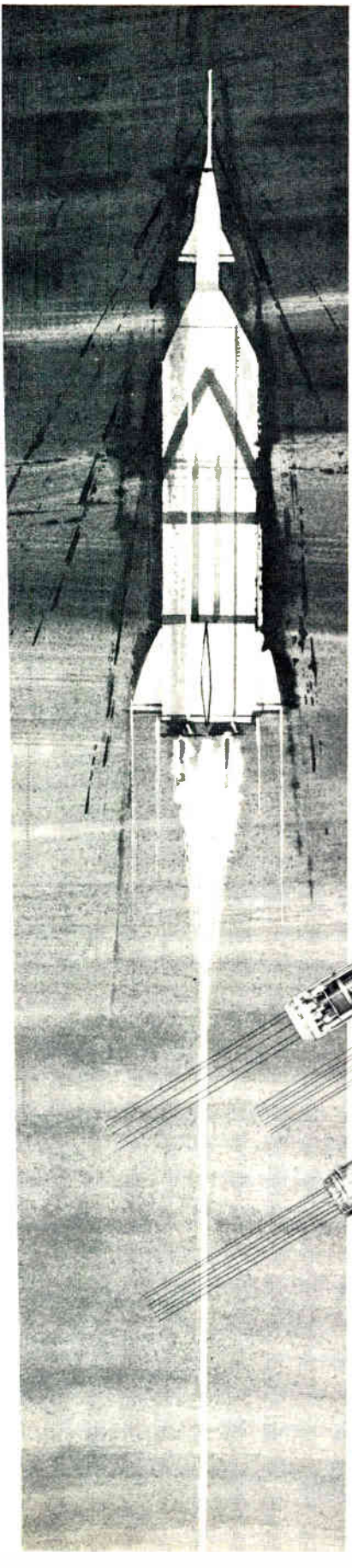
Transistor Choppers

"A Review of the Transistor Chopper" titles Vol. 1, No. 2 of the Airpax Technical Journal. Issue discusses basic, bilateral and series-shunt transistor choppers. Multiple oscilloscope photographs compare noise voltages using typical circuit configurations. Airpax Electronics Inc., Cambridge Div., Cambridge, Md.

Circle 240 on Inquiry Card

ELECTRON TUBE NEWS

...from SYLVANIA



SYLVANIA

GOLD BRAND SUBMINIATURE TUBES

add a high degree of reliability to your critical designs

...new tests prove it!

New manufacturing techniques *build* reliability *into* Sylvania Gold Brand Subminiature Tubes.

New survival rate criteria provide *quantitative definition of Subminiature Tube reliability,* aid designer compute reliability of end-equipment.

New—four Gold Brand Subminiature types—featuring *rugged-design heater for 26.5V applications*—increase versatility of line, widen designer's choice.

SYLVANIA INCREASES SHOCK TEST LEVELS!

- 750g for Gold Brand Premium Subminiature Types
- 1000g for Gold Brand Guided Missile Subminiature Types

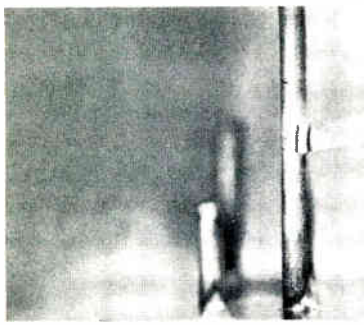
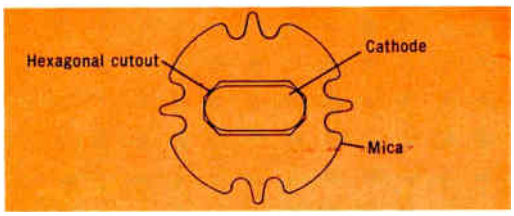


Photo shows the result of Sylvania advanced welding methods. Weld area is extremely rugged and free of weld splatter and oxidation. As a result, catastrophic failures under severe environmental conditions are minimized.



Hexagonal cutout in mica provides firm 6-point contact with cathode, offers increased resistance to shock.

Sylvania has significantly improved the design and manufacture of subminiature type tubes. Now, Gold Brand Subminiature Tubes are capable of withstanding greatly increased impact acceleration tests. For example, newly designed micas provide tight 6-point contact with the cathode. A reducing welding method produces an exceptionally sturdy, clean weld area. Special flared-lip envelopes assure that mica points are not damaged in insertion, maintain the tube structure rigidly within the bulb.

In addition to the increased shock of 1000g applied to Guided Missile Subminiature Tubes, the shock intensity pattern has been changed by eliminating the usual ½" synthetic rubber pad between the hammer and striking plate of the high impact machine. *Although shock tests are increased, rigid control of end points has not been relaxed.*

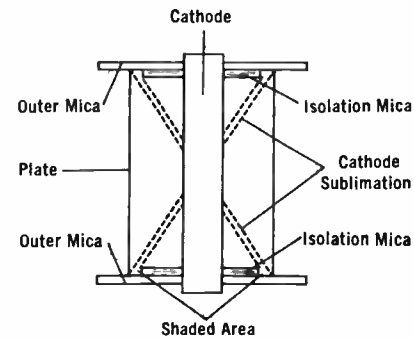
Too, low-frequency vibration tests assure low signal to noise ratio. Vibration tests for "random" or "white" noise are made over a frequency range of 100 to 5000 cps and read up to 10,000 cps to control harmonics. Additional checks include tests for low voltage stability and fatigue.

SYLVANIA INCREASES LIFE TESTS TO 1000 HOURS! NEW CONTROLS ADDED TO 100-HOUR TEST!

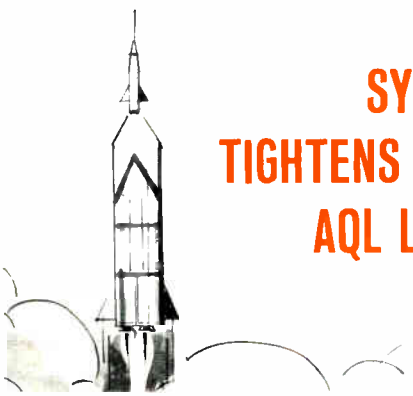
Now, Sylvania Gold Brand Subminiature Tubes are tested for 1000 as well as 500 hours. They must meet the same tight limits at 500 and 1000 hours for such end points as: inoperatives, grid current, filament current, Gm, heater-to-cathode leakage, electrical insulation, and cathode interface impedance.

These end points are controlled during manufacture by such operations as: chemically etching the cathode sleeve to provide a good bonding surface for the cathode coating which helps reduce interface impedance, provides improved electrical levels, especially at reduced voltage conditions; use of isolation micas to increase insulation resistance; coating the inside of the cathode sleeve with a nonconductive material to minimize heater-to-cathode leakage.

Further controls are included in the 100-hour life test to assure early-hour stability. For example, new specifications are added for grid current, heater-to-cathode leakage and insulation resistance. The 100-hour life test is performed at room temperature—a critical level for cathode sublimation and resultant leakage paths—and on concurrent samples at various operating temperatures.



Isolation mica "shades" outer mica from sublimation, forms laminated path and greatly increases dc resistance of leakage paths.



SYLVANIA TIGHTENS GLASS AQL LIMITS!

Sylvania has lowered the Acceptance Quality Level from 6.5% to 4% for combined glass defects. Individual glass defects must now meet a 1.5% AQL. This is made possible by increased manufacturing controls to maintain strain-free glass envelopes. Strains that may occur in manufacture are eliminated by annealing glass of Gold Brand Subminiature Tubes after envelopes are sealed. "After-manufacture" annealing is made possible by a special process that keeps the tube structure relatively cool during the annealing. Gold Brand Guided Missile Subminiature types utilize high-resistivity glass. Tubes are capable of withstanding operating temperatures of 250°C, electrolysis caused by heat is virtually eliminated.

HEATER TEST AT ELEVATED VOLTAGE ASSURES FAST WARM-UP TIME!

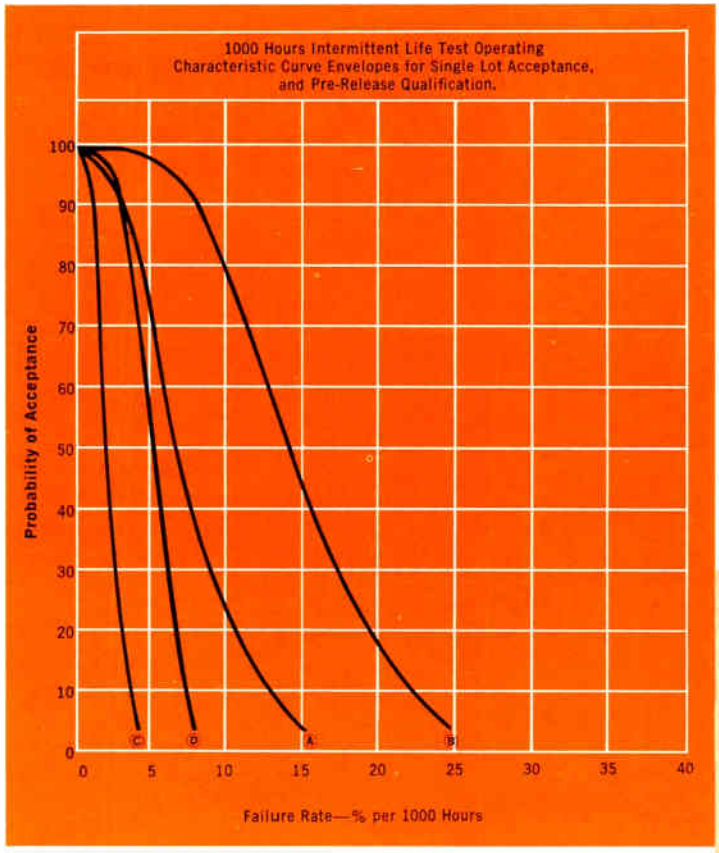
Sylvania Gold Brand Subminiature Tubes with 6-volt heaters are sample-tested at a heater voltage of 10 volts and a peak heater-to-cathode voltage of 150 volts–cycled 10 seconds "on" and 4 minutes "off" for a total of 300 cycles. In addition, all Gold Brand Subminiature types are tested at normal heater voltages cycled 1 minute "on," 4 minutes "off" for 2000 cycles. To more closely correspond to equipment variations, heaters are designed to operate in a wider voltage range. Ratings for heater voltage variations have been increased from ±5% to ±10%.

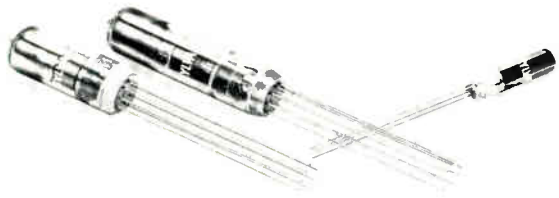
SYLVANIA ADDS INTENSE RADIATION TESTS

Gold Brand Subminiature Tubes are capable of withstanding radiation dose rates (fast neutrons) of 10^{12} NV and accumulated radiation of 10^{16} NVT – further proof of Gold Brand reliability under the most severe environmental conditions.

SYLVANIA "GLEAM PROJECT" INCREASES TUBE RELIABILITY

Initiated 15 years ago, "Gleam" is contributing to Gold Brand Subminiature Tube reliability by – welding in a reducing atmosphere to eliminate weld splatter and oxidation • use of special flared-lip bulbs to allow easy insertion of tube structure into bulb without damaging and flaking mica points • ultrasonic cleaning of critical parts • specially processed getter material which resists flaking • air-conditioning in factories • lint-free clothing, enclosed cloakrooms • individual hooded worktables • lint-free parts containers • microscopic examination of completed tubes for loose particles





SYLVANIA INITIATES NEW SURVIVAL RATE CRITERIA ON GOLD BRAND SUBMINIATURE TUBES!

Sylvania rigorous acceptance criteria is based on the average number of *cumulative* failures for a *five*-lot moving average–instead of one–tested for 1000 hours. The first five lots are tested and the cumulative number of inoperatives and combined failures are plotted with their respective bogey rates. Inoperatives and failures for the sixth lot are added to the cumulative figure and the first lot figures deleted. Sampling consists of 40 tubes per lot. The result is a more stringent control over a wide range of production as well as giving the customary lot by lot results. Too, percent failure rate in 1000 tube hours can be statistically predicted with a high degree of accuracy and provide a quantitative measure of reliability.

Acceptance Numbers for all Sample Sizes

	Inoperatives	Total incl. Inops.
Single Lot	2	5
Five-Lot Moving Sum	5	14
Pre-Release at 500 Hours:		
Five-Lot Moving Sum at 1000 Hours	4	12
Current Lot at 500 Hours	1	2

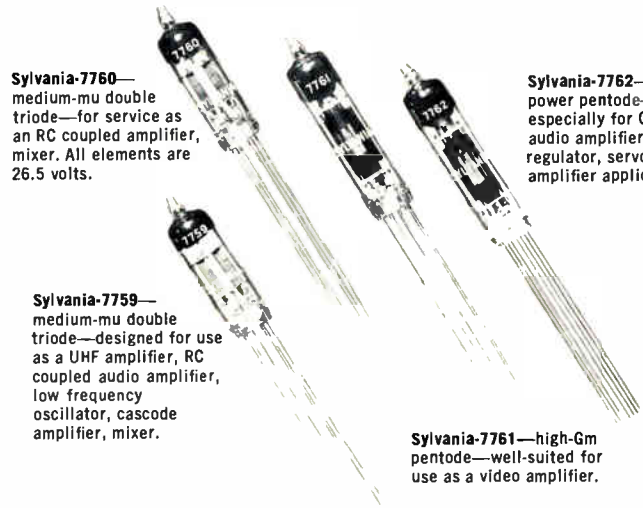
Base Scale for Exemplary Curves Shown Relates to

Single Lot Acceptance	AFR	IFR	RFR
Ⓐ Single Lot for Inops.: n=40, c=2	2.0	6.5	13
Ⓑ Single Lot for Total: n=40, c=5	6.6	14.0	22
Pre-Release Qualification			
Ⓒ Five-Lot Moving Sum for Inops. at 1000 hours and current lot at 500 hours: n=200, c=4 and n=40, c=1	.80	2.0	3.3
Ⓓ Five-Lot Moving Sum for Total at 1000 hours and current lot at 500 hours: n=200, c=12 and n=40, c=2	2.4	5.0	7.2

SYLVANIA ANNOUNCES 4 NEW GOLD BRAND SUBMINIATURE TYPES FOR 26.5 VOLT APPLICATIONS

These remarkable new Gold Brand Subminiature Tubes utilize a rugged-design heater that combines very low heater power with excellent mechanical strength. A heavy mandrel coated with a high-temperature insulator forms the base of the heater. A fine heater wire is wound over the coating and the entire assembly recoated to form a sturdy, efficient, folded coil heater. Your Sylvania Sales Engineer has complete technical data on all four types.

Average Characteristics and Typical Operation	7759 (Each Section)	7760 (Each Section)	7761 Class A Video Amplifier	7762 Class A1 (Single Tube)	Unit
Plate Voltage	100	26.5	—	110	Vdc
Plate Supply Voltage	—	—	200	—	Volts
Cathode Resistor	0.15	—	0.1	0.27	Megohms
Grid Resistor	—	2.2	0.47	—	Megohms
Plate Current	6.5	3.0	—	—	mAdc
Transconductance	5400	5000	—	—	μmhos
Amplification Factor	35	20	—	—	—
Grid Voltage for Ib=100μAdc Max.	—6.5	—	—	—	Vdc
Grid Voltage for Ib=50μAdc	—	—3.5	—	—	Vdc
Grid #2 Voltage	—	—	100	110	Volts
Signal Voltage (rms)	—	—	1.6	6.4	Volts
Zero Signal Plate Current	—	—	19	30	mAdc
Max. Signal Plate Current	—	—	18.5	29	mAdc
Zero Signal Grid #2 Current	—	—	4.0	2.2	mAdc
Max. Signal Grid #2 Current	—	—	4.5	5.5	mAdc
Voltage Output (Peak to Peak)	—	—	135	—	Volts
Load Resistance	—	—	4.7	3.0	Megohms
Power Output	—	—	—	1	Watts
Total Harmonic Distortion	—	—	—	10	%



Sylvania-7760—medium-mu double triode—for service as an RC coupled amplifier, mixer. All elements are 26.5 volts.

Sylvania-7762—beam power pentode—especially for Class A audio amplifier, series regulator, servo-amplifier applications.

Sylvania-7759—medium-mu double triode—designed for use as a UHF amplifier, RC coupled audio amplifier, low frequency oscillator, cascode amplifier, mixer.

Sylvania-7761—high-Gm pentode—well-suited for use as a video amplifier.

GOLD BRAND PREMIUM SUBMINIATURE TYPES for 26.5-Volt Applications

Type	Description
5903	UHF Double Diode
5904*	UHF Medium-Mu Triode
5905*	UHF Sharp Cutoff Pentode
5906	UHF Sharp Cutoff Pentode
5907*	UHF Remote Cutoff Pentode
5908*	UHF Pentode
5916	Dual-Control
7759	Medium-Mu Double Triode
7760*	Medium-Mu Double Triode
7761	High Gm Video Pentode
7762	Beam Power Pentode

*All elements 26.5 volts

GOLD BRAND PREMIUM SUBMINIATURE GUIDED MISSILE TYPES

Type	Description
6943	Sharp Cutoff RF Pentode
6944	Semi-Remote Cutoff RF Pentode
6945	AF Beam Power Pentode
6946	Medium-Mu Triode
6947	Medium-Mu Double Triode
6948	High-Mu Double Triode
6788	Sharp-Cutoff AF Pentode

GOLD BRAND PREMIUM SUBMINIATURE TYPES

Type	Description
5636	Dual Control Pentode
5639	Video Pentode
5641	Diode
5643	Tetrode Thyratron
5644	Cold Cathode Diode
5647	UHF Diode
5718	UHF Medium-Mu Triode
5719	High-Mu Triode
5840	UHF Sharp Cutoff Pentode
5896	UHF Double Diode
5899	UHF Semi-Remote Cutoff Pentode
5902	Beam Power Pentode
5977	Medium-Mu Triode
5987	Low-Mu Power Triode
6021	Medium-Mu Double Triode
6110	UHF Double Diode
6111	Medium-Mu Double Triode
6112	High-Mu Double Triode
6205	UHF Sharp Cutoff Pentode
6206	UHF Semi-Remote Cutoff Pentode
6308	Cold Cathode Diode
6352	Double Diode
6814	Medium-Mu Triode
7327	Medium-Mu Double Triode (Pulse Tube)
7550	Medium-Mu Double Triode (Pulse Tube)

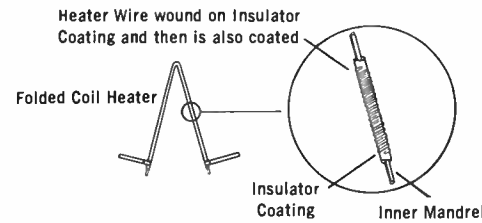


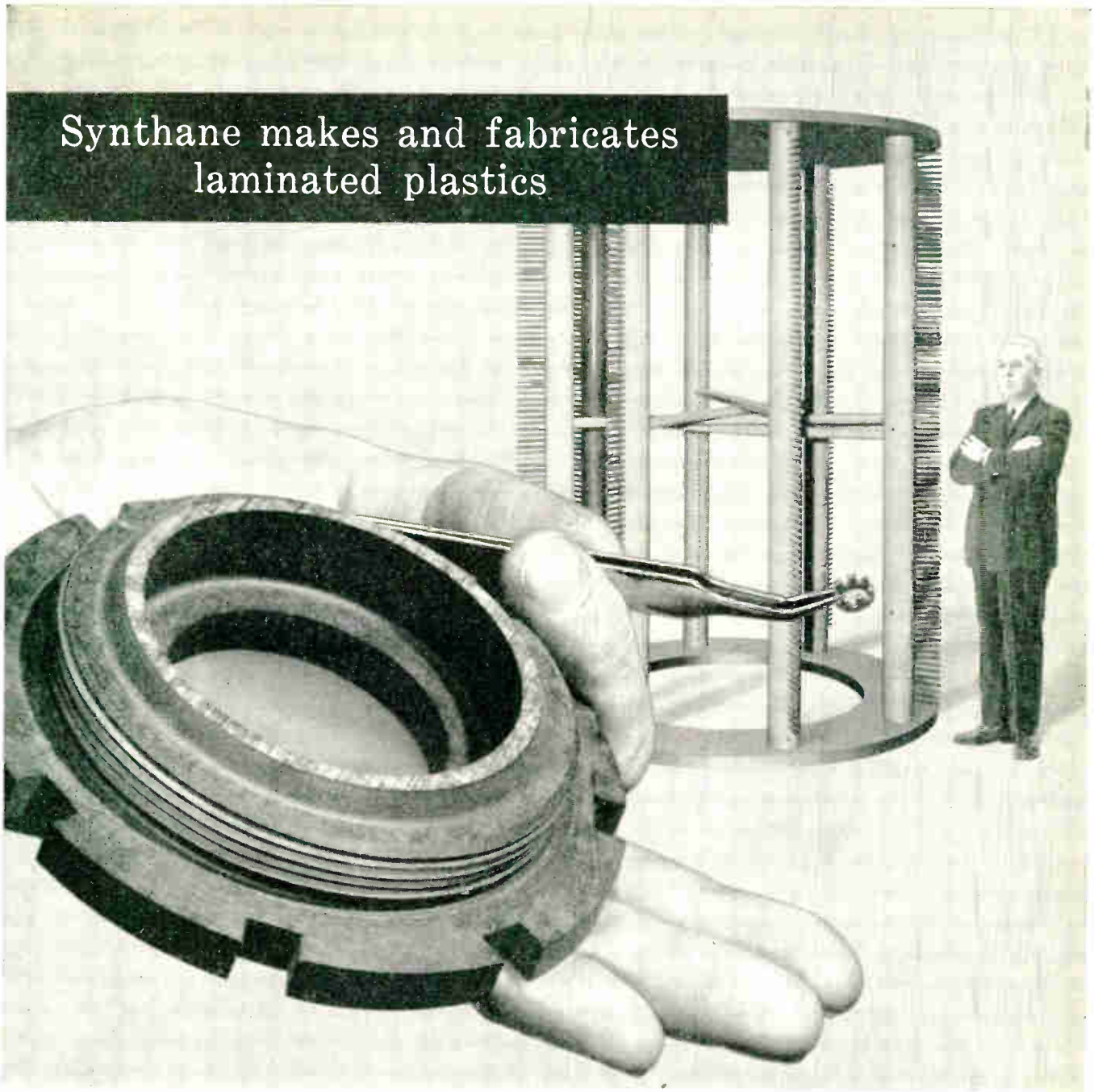
Diagram shows enlarged view of rugged new 26.5-Volt heater for Gold Brand Subminiature Tubes.

Gain the benefits of Gold Brand Subminiature Tubes in your military and industrial designs. Call your nearest Sylvania Field Office for the new specifications and delivery information. For data on individual types, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. H, 1100 Main St., Buffalo, N. Y.

See the Sylvania Exhibit at Wescon—Booth #2009-2011, 2058-2061, 2108-2111.

SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS



Large, small or in between...we make it

Size is no problem in our fabrication of Synthane laminated plastics. Whether the part fits into your palm or onto the head of a pin, or towers over you, we believe we can handle it.

Why? Because we make the material and can control it to suit the job. Our variety of machines and tools, many of them special, permit the widest freedom in the choice of a machining approach. Our skilled people have rolled up over 30 years of experience in doing the difficult and impossible. So, large, small or medium in size, let us take the production worries of your part off your mind.

Call your Synthane representative for a quotation or write Synthane Corp., 11 River Road, Oaks, Pa.

You furnish the print—we'll furnish the part

SYNTHANE CORPORATION OAKS, PENNA.

Sheets • Rods • Tubes • Fabricated Parts
Molded-laminated • Molded-macerated

Circle 73 on Inquiry Card

Circle 72 on Inquiry Card →

WILMAD...

Glass Craftsmen To The Electronics Industry

Specify Wilmad

For Precision Bore Tubing That Is Uniform In Quality And Consistently Accurate

Top quality in every component is the key to long service life and dependable operation in electronic tubes. Whether the glassware becomes a component part of vidicons, orthicons, semicons, diodes, triodes, capacitors, traveling wave tubes, planar storage tubes . . . no matter what the tube function . . . if glassware is a component part, it must be consistently accurate and uniform in quality.

Wilmad precision bore tubing is guaranteed to meet the exacting requirements of electronic use. In fact in millions of electronic tubes now in use, Wilmad tubing has been service-proved to perform satisfactorily as an important electronic tube component.

The inside diameter of our precision bore tubing is plus or minus .0002" and the outside diameter can be ground or polished to your specifications within a tolerance limit of plus or minus .0002". Special sizes and shapes can be supplied to meet your particular specifications. Tubing can be ground and polished with a concentricity of .002 T.I.R. Available in Pyrex Brand Glass and the following special glasses: 0120, 1720, 1723, 7052, 7056, 7070, 7520, 7800, Vycor and Quartz.

Send for our Bulletin 102 which gives complete details on Wilmad precision bore tubing.

WILMAD GLASS CO., INC.
BUENA, NEW JERSEY

Transitron

introduces

an exciting new device for simpler, more reliable, more economical switching circuitry

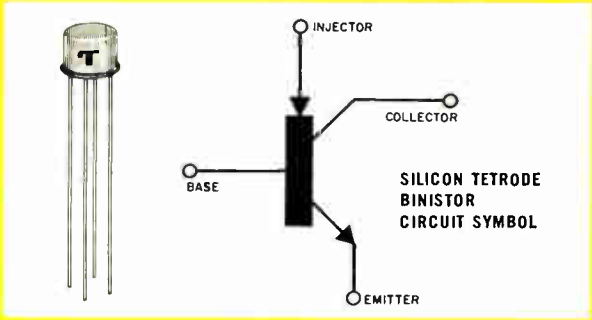
BINISTOR

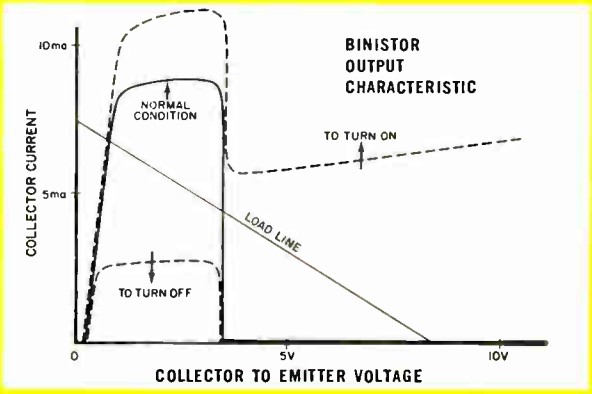
(BY-NIS-TOR)

The Silicon NPN Tetrode binistor is a new component and a new concept for the circuit designer!

The key parameters of this bi-stable, negative resistance device are determined by external circuitry in contrast to existing devices. The significant reduction of peripheral circuitry results in outstanding savings in cost, space, weight and solder connections. For example, a typical flip-flop requires at least 13 components versus only 4 in an equivalent binistor stage. Very large current and voltage gains are realized in both on and off directions. Inputs and output are compatible in level with typical transistor and diode circuits. The tetrode binistor can operate from −80°C to +200°C.

To learn more of this important new development — THE BINISTOR — and how it works — write for Bulletin No. TE-1360.





CONDENSED SPECIFICATIONS TRANSITRON BINISTOR

Typical Turn-off Current Gain	50 @ 15ma Collector Current
Operating Collector Current Range	50μa to 15ma
I_j critical	0.5ma @ 5ma Collector Current
Operating Temperature Range without Temperature Compensation	−65°C to 150°C

MEET US AT WESCON — BOOTH 2638-39

Circle 75 on Inquiry Card

Transitron electronic corporation

wakefield, melrose, boston, mass.

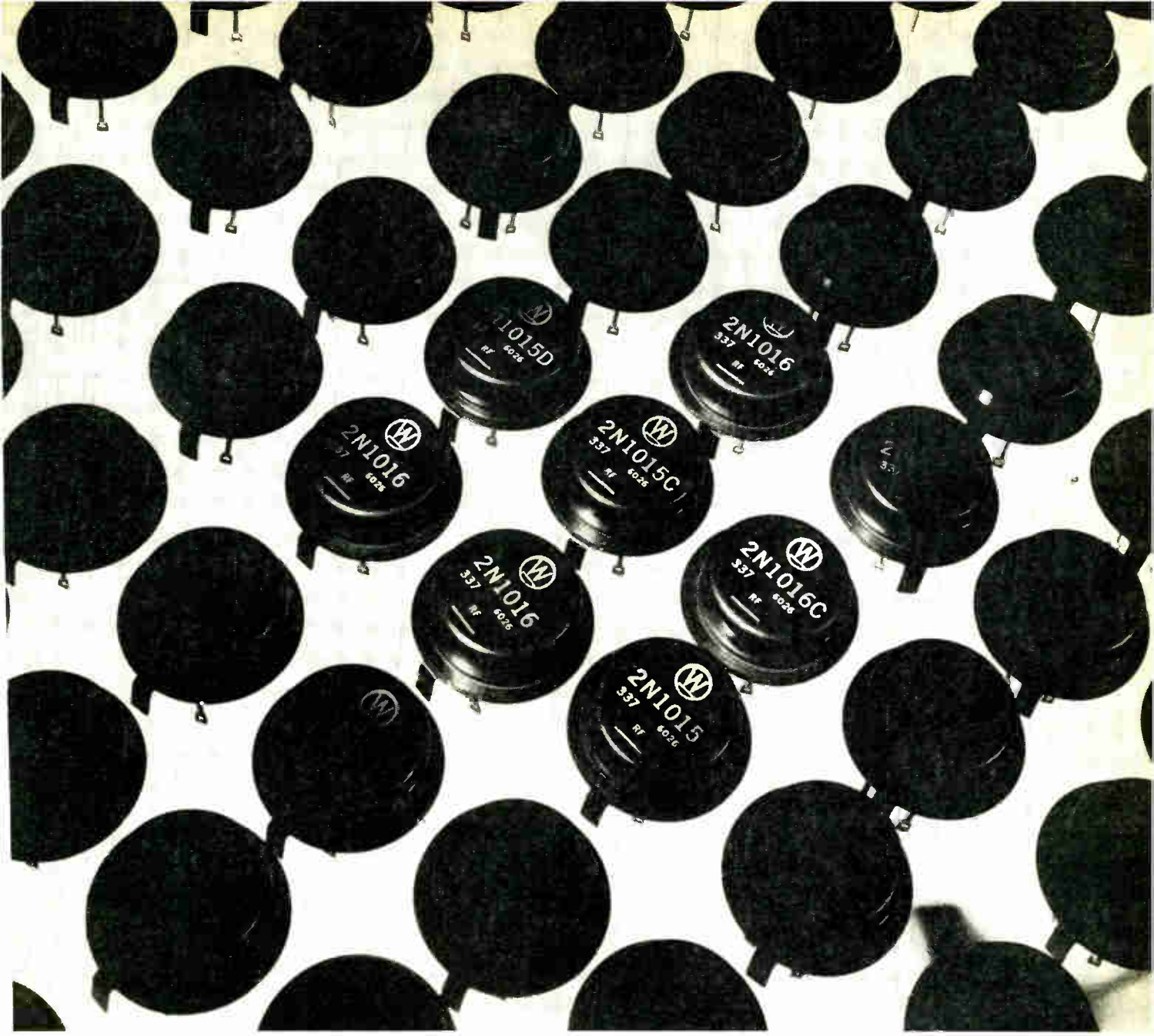
SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U.S.A. AND EUROPE • CABLE ADDRESS: TRELCO

new low prices

ON WESTINGHOUSE SILICON POWER TRANSISTORS

PRICES REDUCED UP TO 40%

AVAILABLE NOW IN ANY QUANTITY! Now you can have the prove quality and reliability of Westinghouse Silicon Power Transistors at the lowe cost yet. Types 2N1015 and 2N1016 are available in 30, 60, 100, 150 and 2(volt ratings in production quantities to meet your requirements at all time Because these transistors have **True Voltage Ratings,** they can be operat continuously at full published voltage ratings without risk of failure.



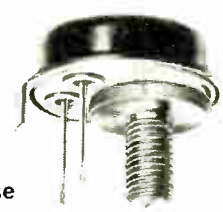
Other Westinghouse Transistor advantages include:

- **High Power . . . up to 150 watts**
- **Collector current to 7.5 amperes**
- **Junction temperature to 150° C**
- **Designed to meet or exceed MIL specifications**
- **Extremely low saturation resistance**

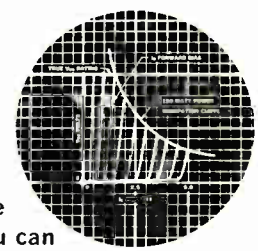
Present industrial and military applications include: Inverters · Regulators · Amplifiers · High Power Switching · Telemetry · Guidance · Power supplies.

For additional information, and quotation of new low prices, call your nearest Westinghouse representative or semiconductor distributor. Or write: Westinghouse Electric Corporation, Semiconductor Department, Youngwood, Penna. SC-1001

YOU CAN BE SURE...IF IT'S **Westinghouse**



Each Westinghouse Silicon Power Transistor is guaranteed by 100% power testing before shipment.



True Voltage Ratings—you can operate Westinghouse Silicon Power Transistors at full rating without risking transistor failure.

For immediate "off-the-shelf" delivery, order from these Westinghouse distributors:

EASTERN

CAMERADIO	Pittsburgh, Pa./EX 1-4000
CRAMER ELECTRONICS INC.	Boston, Mass. CO 7-4700
ELECTRONIC SUPPLY	Melbourne, Florida/PA 3-1441
GENERAL RADIO SUPPLY CO., INC.	Camden, N.J./WO 4-8560
KANN-ELLERT ELECTRONICS, INC.	Baltimore, Md./TU 9-4242
MILGRAY ELECTRONICS	New York, N.Y./RE 2-4400
RADIO & ELECTRONIC PARTS CORP.	Cleveland, Ohio/UT 1-6060
SCHWEBER ELECTRONICS	Long Island, N.Y./PI 6-6520

MIDWESTERN

ELECTRONIC COMPONENTS FOR INDUSTRY CO.	St. Louis, Mo./WO 2-9917
INTER STATE RADIO & SUPPLY CO.	Denver 4, Colo./TA 5-8257
LENERT CO.	Houston, Texas/CA 4-2663
RADIO DISTRIBUTING CO.	Indianapolis, Ind./ME 5-8311
SEMICONDUCTOR SPECIALISTS, INC.	Chicago, Ill./NA 2-8860
UNITED RADIO, INC.	Cincinnati, Ohio/MA 1-6530

WESTERN

ELMAR ELECTRONICS	Oakland, Calif./TE 4-3311
HAMILTON ELECTRO SALES	Los Angeles, Calif./BR 2-8453
NEWARK ELECTRONICS CO.	Inglewood, Calif./OR 4-8440

Circle 76 on Inquiry Card

Tech Data

for Engineers

Real Root Solutions

A method of real root evaluation for the approximate solution of algebraic equation is the subject of a new booklet, U1888, published by Remington Rand Div., Sperry Rand Corp., 315 Park Ave. So., New York 10, N. Y. It gives a complete program for the Univac 120 Punched-Card Electronic Computer to be used in finding Real Root evaluations. The program itself is based upon the Newton-Raphson Method and incorporates floating decimal subroutines. The program rapidly approximates, to 9 significant digits, the real roots of algebraic equations of any degree and achieves, thereby, a high level of accuracy. The booklet explains the method, algebraic equations and synthetic division and floating-decimal operations.

Circle 241 on Inquiry Card

Atmosphere Table

A 6-in. plastic ruler shows the new 1959 ARDC model atmosphere table with pressures and temperatures at altitudes up to 2 million ft. It shows temperatures in Fahrenheit, and air presure in mms and inches of Hg and also psia for altitudes from sea level to the 2 million mark. Three temp. inversions, at 90,000, 180,000 and 325,000 ft. can be clearly followed in hundredths of degrees, along with the interesting plateaus between 37,500 and 80,000 ft. and between 250,000 and 300,000 ft. Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.

Circle 242 on Inquiry Card

Cooling Equipment

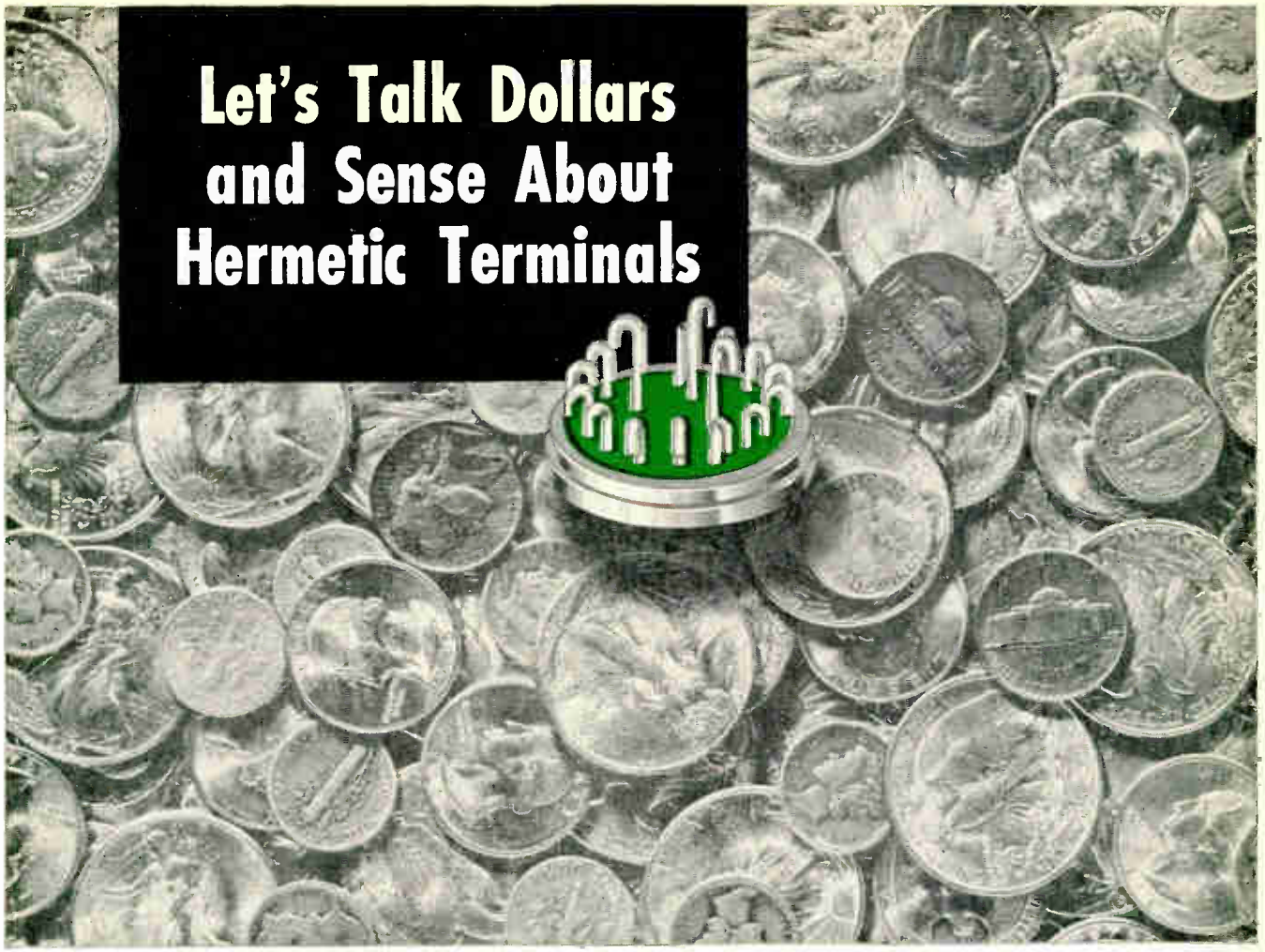
A 16-page, short-form catalog on electronic cooling equipment from McLean Engineering Laboratories, Box 228, Princeton, N. J., highlights the features and applications of a line of 19 in. rack-mounted, packaged fans and blowers. Over 80 models are included in the line with CFM's ranging from 150 to 1000.

Circle 243 on Inquiry Card

Precision Gears

Master Catalog #F-128 lists over 50,000 components. Catalog lists the entire line of miniature precision gears, including anti-backlash gears (spring loaded solid & split hub). spur gears (hub, hubless, clamp type), bevel gears (mitre & ratio), worms and mating helical gears. Also differentials, speed reducers and gearheads, and transmission with up to 15 available range of speeds from 3.3 RPM to 7812 RPM. Dynamic Gear Co., Inc., Dixon Ave., Amityville, N. Y.

Circle 244 on Inquiry Card



A manufacturer of electrical or electronic components becomes a customer for Fusite Glass-to-Metal Hermetic Terminals when the very guts of his fabricated product depend on the ability of the terminal to remain hermetic when roughly handled or when subjected to extreme thermal shock.

Only Fusite Terminals with their exclusive V-24M glass can assure an inter-fusion between the glass and metal parts that is the basis for their great ruggedness.

While Fusite Terminals are usually competitive in price, the important cost cutting opportunities they offer are in the extremely low rate of production rejections and field failures. When installed in your product, Fusite Terminals promote a high yield at the end of your production line where profits are made or lost.

The way to find out if Fusite Terminals can do your job better is to test them yourself.

Samples are yours for the asking. Write Fusite G-4.

INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION

6000 FERNVIEW AVE., CINCINNATI 13, OHIO

Woodford Mfg. Co., Versailles, Kentucky.

In Europe: FUSITE N. V. Konigsweg 16, Almelo, Holland

Tech Data

for Engineers

Thermistor Manual

Fenwal Electronics, Inc., 51 Mellen St., Framingham, Mass., has released thermistor manual—EMC-3. The 24-page book describes what thermistors are and what they do, gives several examples of how they are used, tells how to solve thermistor problems, and contains a listing and ratings of Fenwal Electronics' line of thermistors. It also includes resistance-temperature tables, and a list of aids to help solve thermistor problems.

Circle 245 on Inquiry Card

Cryogenic Gas Data

Data on the physical properties of cryogenic gases in both wallet size and full-sheet size cards from Air Products, Inc., Allentown, Pa. Information includes boiling points, critical points, triple points, specific heats and densities of most gases ranging from acetylene to xenon. Also: data on nitrogen trifluoride.

Circle 246 on Inquiry Card

Resistors—Controls

A general line catalog, 48-pages, features a complete listing of available replacement parts for the radio. TV and electronic industries. Included are detailed specs and other data on resistors, diodes, fuse resistors and controls. Distributor Div., International Resistance Co., 401 N. Broad St., Phila. 8, Pa.

Circle 247 on Inquiry Card

AC, AC/DC Testers

Data sheet describes high-voltage ac and ac/dc testers The 4-page data sheet covers Sorensen 800 Series portable ac testers, 7000 Series stationary ac testers and 8000 Series stationary ac/dc testers. Twenty-eight models are covered in all with electrical and mechanical specs. Ac output voltage of portable models ranges from 0-2000 to 2-20,000 v. Ac output of stationary testers (7000 and 8000 Series) ranges up to 0-150,000 v. and the dc output of Series 8000 to 0-300,000 v. Sorenson & Co., Richards Ave.,

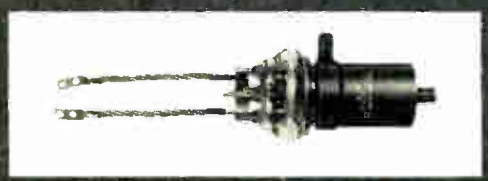
Circle 248 on Inquiry Card

Impulse Counters

A 6-page bulletin, describes the TCe Series of small electric impulse counters. Tech. data on these 3, 4, 5, and 6 digit manual or remote electrical reset types is furnished including operating information, electrical data, available types and weights, dimensional drawings. A special section is provided giving details for operation on ac. Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y.

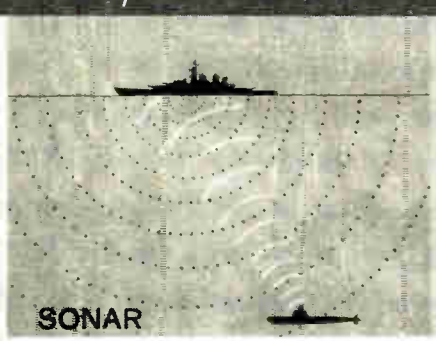
Circle 249 on Inquiry Card

AB_1



NEED 500 WATTS...OR 75,000 FOR CLASS AB_1 SERVICE?

LOOK WHERE YOU CAN USE WESTINGHOUSE HIGH POWER AB_1 AMPLIFIER TUBES:



Westinghouse high power amplifier tubes in class AB_1 service provide low distortion, high dissipation, high power gain and zero watts drive!
For specifications, or information about new applications including **Sonar** and **missile shaker tables**, call or write: Electronic Tube Division, Westinghouse Electric Corporation, Elmira, N.Y.

TYPE	Po WATTS
WL 7371	100
WL 7685	500
WL 7464	5000
WL 7540	35,000
WL 6379	75,000

YOU CAN BE SURE... IF IT'S Westinghouse

Westinghouse Electronic Tube Division, Elmira, N.Y.

Circle 80 on Inquiry Card

Tech Data

for Engineers

Instruments

Type 519, dc to 1 KMC Distributed Deflection CRT; 24 kv accelerating potential; sensitivity, 10 v/cm; rise time, less than 0.35 nsec; also Type 585, dc to 100 MC, Sweep Delay; triggered or conventional; ranging from 1 μsc to 10 sec/cm. risetime, 3.5 nsec; sensitivity, 0.1 v/cm., and Type 175 Transistor Curve Tracer High-Current Adapter; Type P6016 Current Probe, and Type C12 Tekamera for oscilloscope photography. Tektronix, Inc. Booth 817.

Circle 312 on Inquiry Card

Noise Spectrum Analyzer

The model 303 Wave and Noise Spectrum Analyzer is described in a 4-page brochure from Quan-Teck Laboratories, Boonton, N. J. Frequency range is 30 CPS to 100 KC. It has high sensitivity, wide frequency range, and variable selectivity. Full specs including curves and block diagrams are included.

Circle 313 on Inquiry Card

Particle Counter

Four-page bulletin from Royco Instruments, Inc., 365 San Antonio Road, Mountain View, Calif., describes the Particle Counter, Model PC-200A. The instrument originally designed for smog control, etc., is expected to have clean room applications in missile and electronic plants. It provides rapid and convenient analysis of complex size and frequency distribution of sub-micron and micron-sized particles (aerosols). Any of the 15 channels may be examined for 0.3 min., 1 min., 3 min., or 10 min. intervals with automatic scan cycle in all channels. Includes specs and a block diagram.

Circle 314 on Inquiry Card

Solar Measurements

The May-June issue of SPAN, from Hoffman Electronics Corp., Semiconductor Div., 1001 Arden Drive, E. Monte, Calif., has part 2 of "Understanding Solar Measurements." The concluding part of an article discussing solar cell measurements, it discusses power applications. Part 1 dealt with signal applications and appeared in the March-April issue of SPAN.

Circle 315 on Inquiry Card

Electronic Voltmeters

Eight-page bulletin from Ballantine Laboratories, Boonton, N. J., describes their line of electronic voltmeters, decade amplifiers, calibrators, capacitance meters, ac/dc converters, and dc/ac inverters. Full tech specs are included.

Circle 316 on Inquiry Card

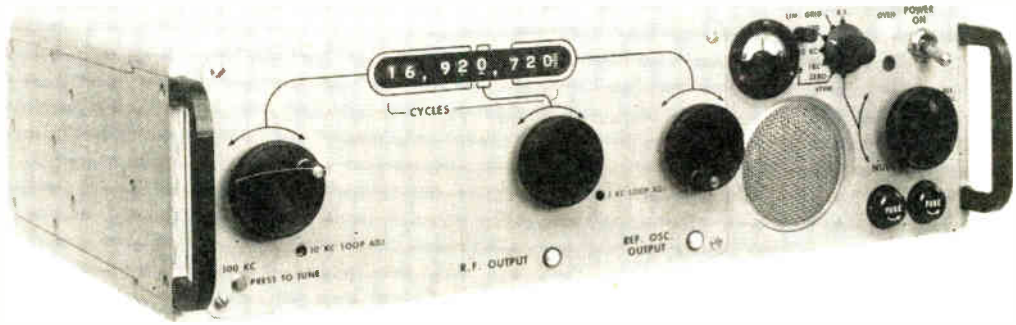
The new model RD-190 16-32 Mc Continuous Coverage Synthesizer incorporates 8 million discrete crystal frequencies to choose from.

Highly stable, continuous coverage of the 16-32 Mc spectrum is accomplished by the Manson RD-190 Crystal Synthesizer, with a single one-megacycle crystal as the internal reference. Double superheterodyne circuitry is employed in the indirect method of synthesis to discipline freerunning oscillators, the RD-190 is of unique character in that the fundamental crystal frequency is linearly tuned over a range of 62.5 parts per million — without degradation of stability — in order to offset the internal harmonic reference spectrum precisely as needed for "Cycles" accuracy.

Three variable frequency oscillators, providing tuning increments of 100 kc, 10 kc, and 1 kc, are phase-locked to the reference in an all-electronic system in which no mechanical servos are used. Pull-in and hold-in characteristics are equal and instantaneous over the entire band. The setting of frequency to cycles is accomplished by direct control of the crystal, which is capacitively trimmed to an accuracy of better than 1 part in 10^7.

Frequency readout is displayed by means of counter-type dials across the front panel, assuring zero error readability and resettability. Fast drive lever knobs permit the setting of any frequency in a matter of seconds, and since tuning condensers are linear, the unit is adaptable to remote operation.

MANSON PROVIDES EIGHT MILLION DISCRETE CRYSTAL FREQUENCIES IN ONE SPACE-SAVING UNIT!



FREQUENCY STABILITY: Better than 1 part in 10^8 per day
OUTPUT FREQUENCY RANGE: 16 to 32 Mc, continuously tunable (non-incremental).
TUNABILITY ACCURACY: Better than 1 part in 10^7.
RESETTABILITY ACCURACY: Zero error
READABILITY ACCURACY: Zero error
SPURIOUS SIGNALS: Down a minimum of 80 db, except for harmonics of the output
OPERATING AMBIENT TEMPERATURE RANGE: 0 to +50°C
OUTPUT POWER: 100 milliwatts minimum
OUTPUT IMPEDANCE: 50 ohms nominal
NUMBER OF QUARTZ CRYSTALS: One
INPUT POWER REQUIRED: 105/125 volts, 60 or 400 cps, 1 phase
DIMENSIONS: 14" W x 4¼" H; Depth 11"
MOUNTING: For rack or bench use

manson

MANSON LABORATORIES, INC.

375 FAIRFIELD AVENUE / STAMFORD, CONNECTICUT / DAvis 5-1391

Model RD-170
1000 Mc reference generator

Model RD-144
1 Mc transistorized oscillator in mercury switch oven

Model N-317
2 Mc to 34 Mc crystal frequency synthesizer

Circle 82 on Inquiry Card

Tech Data

for Engineers

Antennas

Spec sheet from Scala Radio Co., 2814 19th St., San Francisco, Calif., describes the Paraflector® Model PR 450. Over the 350-1,000 MC range it equals performance of a parabolic dish of the same aperture but weighs only 25 lb. Basically a parabolic section in one plane, it withstands 100-mile winds with a ¼ in. radial ice load.

Circle 317 on Inquiry Card

Mobile Tracking Antenna

Specs and detailed information, including antenna pattern data are reported in a 2-page bulletin describing a mobile tracking antenna system. The antenna features a folding 28-ft. reflector, tilting mast, which lowers into the self-contained trailer, and hand-operated azimuth and elevation drive. D. S. Kennedy & Co., Cohasset, Mass.

Circle 318 on Inquiry Card

Telemetry Discriminator

Details and specifications of a new all solid state, portable, telemetry sub-carrier discriminator, the Mini-Tel, available from Precision Instrument Co., 101 Commercial St., San Carlos, Calif. Unit is a pulse-averaging discriminator for reliable "quick-look" monitoring functions at test sites, in instrumentation trailers, and under many varieties of field conditions. It accommodates 14 standard IRIG channels. Power requirements are under 3w per channel from batteries or from 115 vdc. Dc drift is under 1% in 8 hr. over temp. span of 80°F. Dc linearity is better than 0.5% of best straight line.

Circle 319 on Inquiry Card

Reflectivity Measurements

Reflectivity studies and measurement facilities are discussed in "Radar Reflectivity," a 6-page brochure from Radiation Inc., Melbourne, Fla. It discusses the basic practical uses of measurement results in design of airframes and radars.

Circle 320 on Inquiry Card

Shock Mounts

Bulletin 59-04, 1 page, from Barry Controls Inc., 700 Pleasant St., Watertown 72, Mass., describes their cupmounts, series 2000, for shock and vibration isolation of loads up to 250 lb per isolator. Drawings, curves, and tech data included.

Circle 341 on Inquiry Card

Time Delays

Technical Publication No. 80 describes transistorized time delays. It contains dimensional drawings, typical curves and complete specs for Types 401 and 404 General Purpose Units covering time delays from 0.1 to 300 sec. G-V Controls Inc., 101 Okner Pkwy., Livingston, N. J.

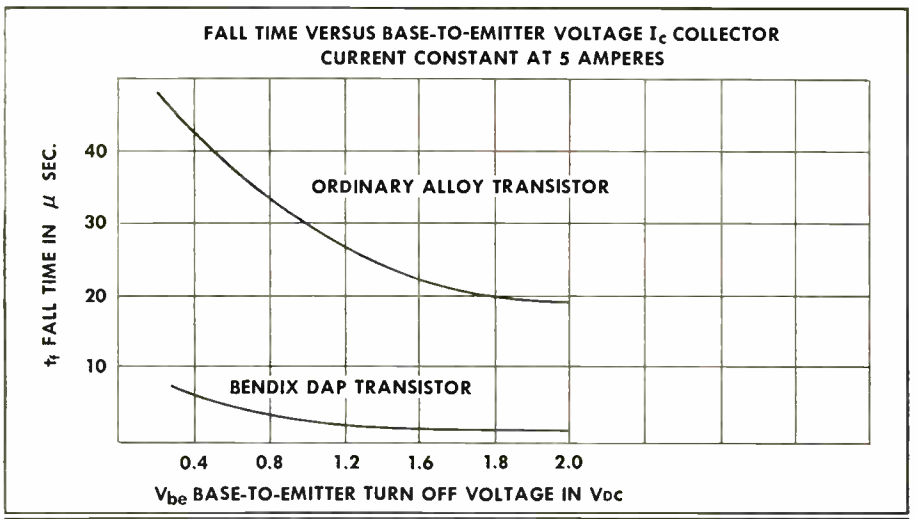
Circle 342 on Inquiry Card

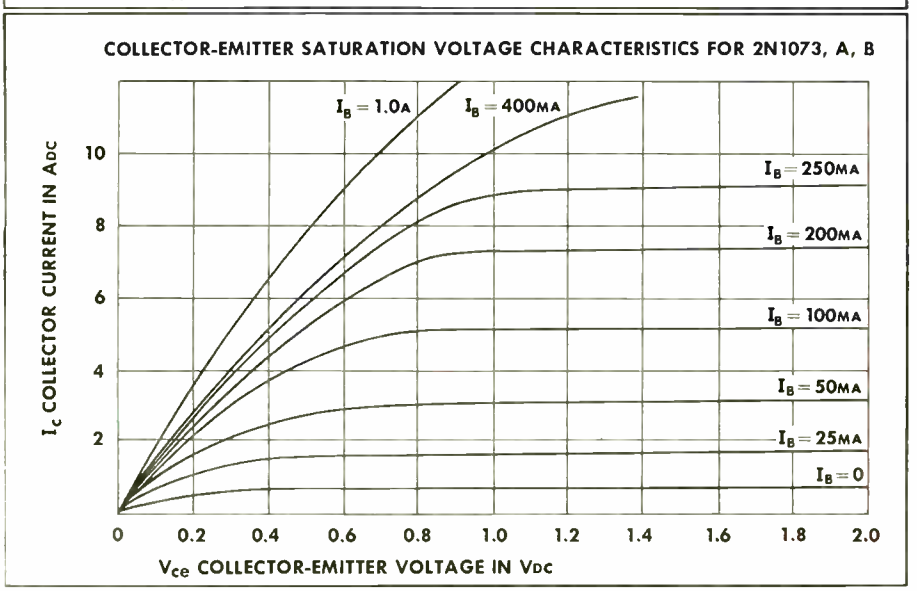
EXTRA QUALITY AT NO EXTRA COST WITH BENDIX TRANSISTORS

Bendix Bulletin

Up-to-the-minute news about transistors

NEW DAP TRANSISTORS SWITCH 5 TIMES FASTER





ABSOLUTE MAXIMUM RATINGS

TYPE NUMBERS	Vce Vdc	Vcb Vdc	Veb Vdc	Ic Adc	Pc W	T Storage °C	Tj °C
2N1073	— 40	— 40	10	10	35	−60 to +100	100
2N1073A	— 80	— 80					
2N1073B	−120	−120					

Ideal for such applications as: **ULTRASONICS • HORIZONTAL OUTPUT AMPLIFIERS FOR TV OR CATHODE RAY TUBES • POWER CONVERTERS • HIGH CURRENT AC SWITCHING • CORE DRIVERS • HI-FI**

Higher breakdown than ordinary transistors also a DAP feature.

Now design engineers are freed from many of the limitations imposed by ordinary germanium alloy transistors. Bendix* germanium PNP Diffused-Alloy-Power DAP* transistors can switch up to 10 amperes with typical speeds of a microsecond.

While maintaining high collector-to-emitter breakdown voltage—up to 120 volts—the new transistors provide lower input resistance, controlled current gain, and higher cut-off frequency. Particularly suited to high current, high frequency switching, the DAP transistor's exclusive features will suggest to the design engineer many new applications which, until now, have not been feasible.

NEW BENDIX SEMICONDUCTOR CATALOG on our complete line of power transistors, power rectifiers and driver transistors available on request.

Bendix offers many challenging opportunities in semiconductor engineering and sales. Write Personnel Manager for full details.

*TRADEMARK

SEMICONDUCTOR PRODUCTS

Red Bank Division

LONG BRANCH, N. J.

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117 E. Providencia Avenue, Burbank, California

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New England Sales Office:
4 Lloyd Road, Tewksbury, Massachusetts

Export Sales Office: Bendix International Division, 205 E. 42nd Street, New York 17, New York

Canadian Affiliate: Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ontario, Canada

Tech Data

for Engineers

Silicon Resistors

Application Note (12 pages) from Texas Instruments Incorporated, Semiconductor Components Div., P. O. Box 312, 13500 N. Central Expressway, Dallas, Tex., discusses the use of Sensitor® silicon resistors as temperature-compensating elements for bias stabilization in silicon transistor circuits. Included are sections on: "Causes and Effects of DC Operating Point Instability," Operating Point Stabilization, Compensating and Shaping Networks, Compensation for Base-Emitter Voltage Changes, etc. All math, curves, schematics, etc., included. Also spec sheets on Types 1N650, 651, 652, and 653 Gallium Arsenide Tunnel Diodes; Types TI 010, 025, and 050 Diffused Silicon PNPN switches; Types 1N2878 through 1N2925 High Voltage Diode Stacks; and Types G129 and G130 Silicon Forward Conductance Diodes.

Circle 343 on Inquiry Card

Time Code Generator

Brochures from Epsco-West Div., Epsco Inc., 240 East Palais Rd., Anaheim, Calif., describe the Models 6190 and 6160 Time Code Generators. The first generates 36-bit, 100-pps code; 28-bit, 2-pps code, and 20-bit, 1-pp code. The second supplies a continuous 1KC sine wave carrier modulated by a marker at one sec. intervals. This is followed by a 10-bit binary elapsed time identification word. Brochures include circuit description, block diagram, and complete specs. These and Model 6162 Time Code Translator can be seen at Booth 2716, WESCON.

Circle 344 on Inquiry Card

Ultrasonic "Joining"

Details on Ultrasonic Joining Unit for soldering materials such as aluminum, silicon, germanium, and ferrites, etc., from Commercial Apparatus and Systems Div., Raytheon Co., 1415 Providence Turnpike, Norwood, Mass. The unit uses sound waves at 25,000 CPS to join materials previously considered difficult or impossible to "wet" with fluxless solder or weld. Unit will be shown at WESCON Booth 2019.

Circle 345 on Inquiry Card

R-F Spectroscopy

Radio Frequency Spectroscopy Bulletin (Vol. 2 #1) from Varian Associates, Instrument Div., 611 Hansen Way, Palo Alto 4, Calif., contains full information on both N-M-R (Nuclear Magnetic Resonance) and E-P-R Spectroscopy and the complete "N-M-R at Work" series. Also information on the Varian M-49, Magnetometer including principles, applications, and equipment details.

Circle 346 on Inquiry Card

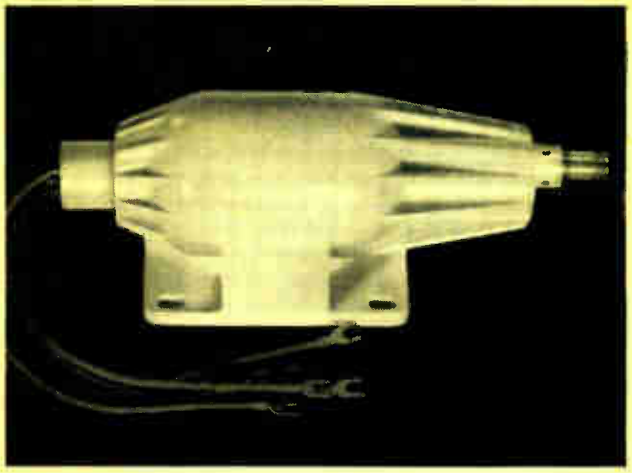
Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 2, No. 2

A TOTALLY NEW CONCEPT IN "O"-TYPE BWO CONSTRUCTION

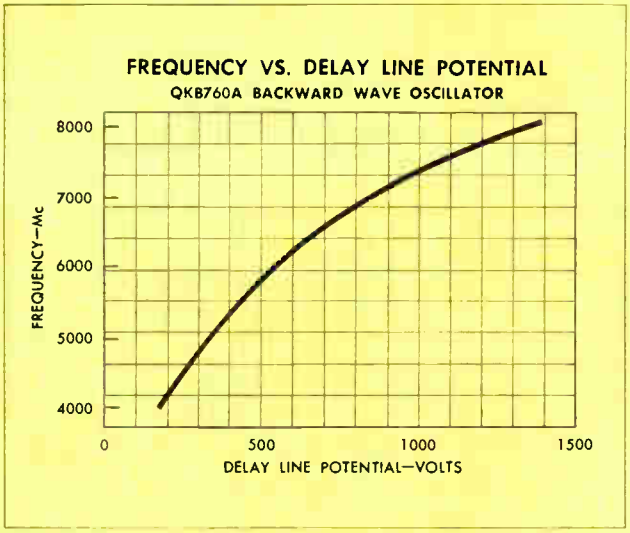
--Interdigital-type delay line affords maximum heat dissipation at high power outputs

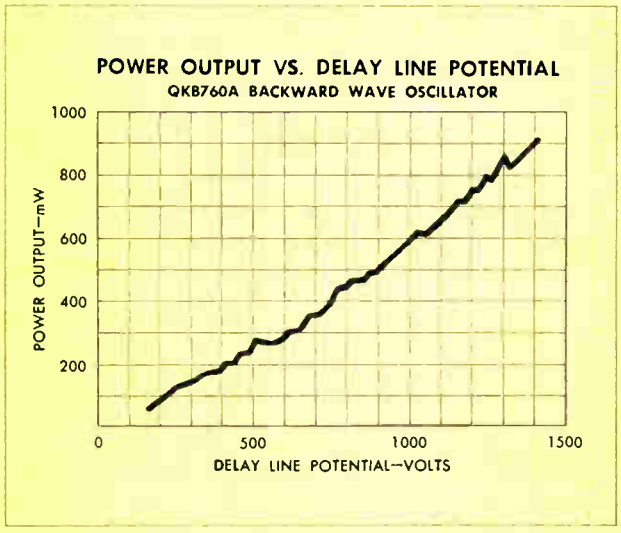
These broadband voltage tunable backward wave oscillators are the smallest, lightest and most reliable of their kind. They were developed especially for modern airborne and ground-based applications utilizing swept oscillator and frequency diversity techniques. Four compatible types are available. They cover a continuous frequency range of 1 to 12.4 KMC. They are magnetically shielded and are insensitive to the effects of external fields. They exhibit a minimum of fine-grain power output variations. Potted leads permit operation at high altitudes over a wide temperature range. Raytheon-perfected laminating techniques make possible interdigital construction which results in maximum heat dissipation. Under normal operating conditions, no forced-air cooling or protective circuitry is required. Laminate-thickness held to extremely close tolerances assures improved fine-grain frequency characteristics with optimum line matching and consistently reproducible characteristics from tube to tube.



Typical Operating Characteristics

	QKB786	QKB816A	QKB760A	QKB776
Frequency Range	1.0-2.0KMC	2.0-4.0KMC	4.0-8.0KMC	8.0-12.4KMC
Power Output	100 mW Min.	70 mW Min.	30 mW Min.	50 mW Min.
Delay Line (Tuning) Voltage	100-1500 Vdc			
Filament Voltage	6.3 V.			
Cathode Current	45 mA Max.			
Anode Voltage	60-150Vdc	100-200 Vdc	60-130 Vdc	60-130 Vdc
Control Grid Cut-off	-150 Vdc	-100 Vdc	-100 Vdc	-100 Vdc





You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Co., Waltham 54, Mass. In Canada: E. Waterloo, Ontario. In Europe: Zurich, Switzerland.

Excellence in Electronics

RAYTHEON

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

SEE THESE TUBES AT RAYTHEON'S WESCON BOOTH

Circle 86 on Inquiry Card

Tech Data

for Engineers

Binary Encoder

Single page data sheet. Bulletin No. 124, describes the E-101 Minimodule Encoder, a compact 10-bit binary encoder with built-in logic. Unit will encode and store shaft position data "on the fly" at angular velocities up to 2 RPS and provide a digial output in binary code and its complement. Specs and outline drawing included. Datex Corp., 1307 S. Myrtle Ave.. Monrovia, Calif.

Circle 347 on Inquiry Card

Moisture Measurement

Four-page pamphlet, "Moisture and Its Measurement" is available from the Henry Francis Parks Laboratory, 7544 23rd Ave., N. E., Seattle 15, Washington. After a definition of moisture. it discusses moisture vs humidity, and methods of determination.

Circle 348 on Inquiry Card

Component Dispenser

Data sheet from Schmit Engineering Co., 4062 Fabian Way, Palo Alto. Calif., describes the Bend-Amatic component dispenser which automatically or semi-automatically cuts and bends axial leads of electronic components. It has 48 in. of storage capacity in six hopper chutes.

Circle 349 on Inquiry Card

Language Translators

A 4-page leaflet, 3C Pulse No. 8, describes a large magnetic tape to magnetic tape language translator. The machine's output may be fed directly into a printer, paper tape, punch, plotter, or other devices. Computer Control Co., Inc., 983 Concord

Circle 350 on Inquiry Card

High Vacuum Pumps

Four data sheets from Ultek Corp., 920 Commercial St., Palo Alto, Calif., describe their line of electronic high-vacuum pumps: the Ulte Vac series 210, series 150, and series 318. Included are outline drawings, curves (pump current vs pressure in mmHg) and specs.

Circle 351 on Inquiry Card

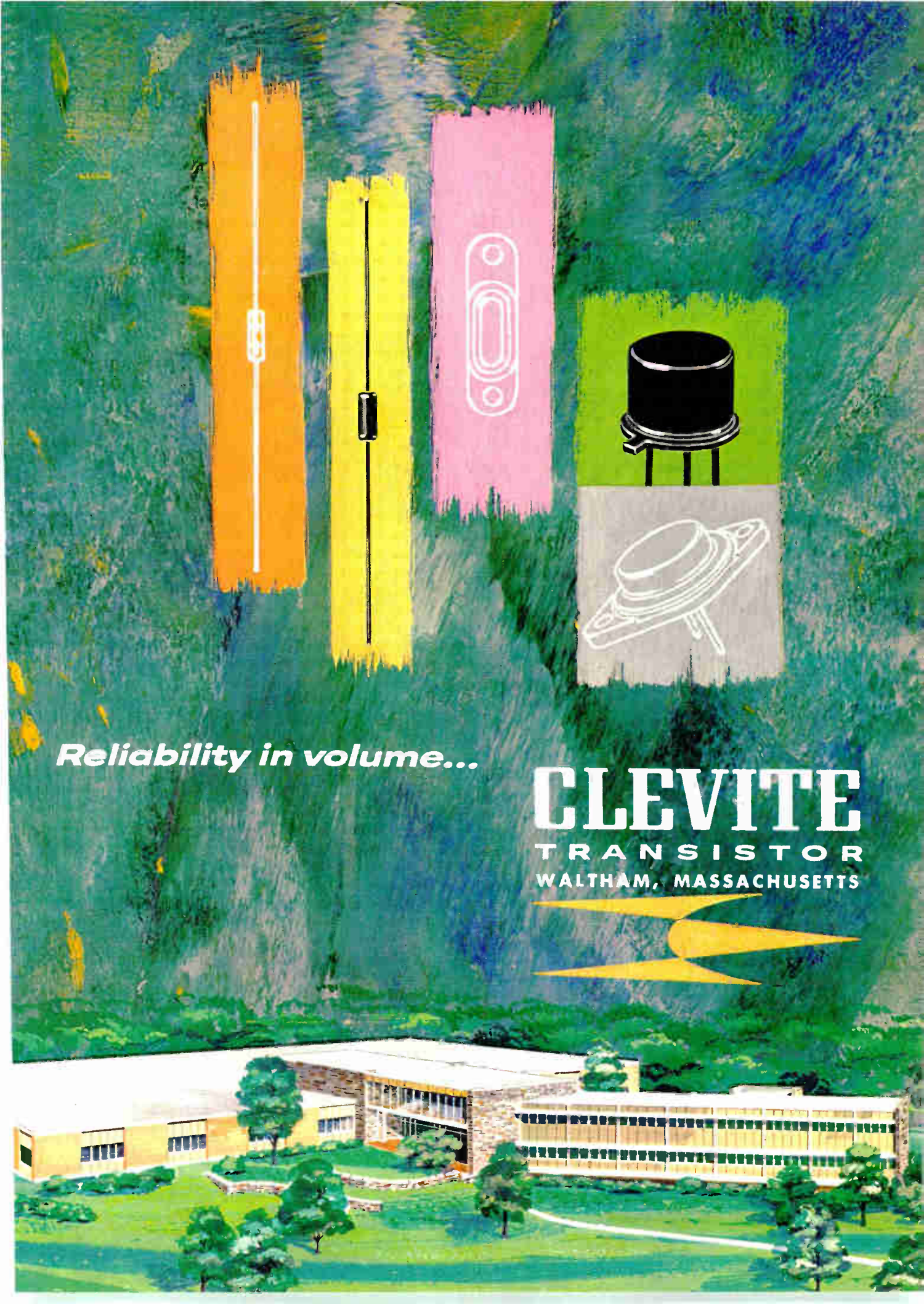
Strip Terminal Machine

Bulletin from The Kent Manufacturing Corp., 188 Needham St., Newton 64, Mass., describes the wire-dial Machine. Machine is designed for high speed production and the elimination of set-ups. Machine changes terminals from ring to spade, grip to no-grip etc. with a combination dial.

Circle 352 on Inquiry Card

Circle 87 on Inquiry Card

Circle 88 on Inquiry Card →


Reliability in volume...
CLEVITE
TRANSISTOR
WALTHAM, MASSACHUSETTS

Clevite Germanium Diodes . . .
YOUR BEST BUY FOR TODAY'S HIGH SPEED SWITCHING CIRCUITS

At voltages typical of solid state switching circuitry . . . and recovery times in the millimicrosecond range Clevite *germanium* diodes offer several outstanding advantages over costly silicon types:

Lower forward voltage drop. An especially valuable characteristic for saturated circuitry applications.

Superior forward transient response.

Reliability, availability, uniformity. Years of experience in the production and application of hundreds of millions of germanium diodes have brought these types to a high state of perfection and predictability. They take the gamble factor out of your design and production problems.

Low cost. Thoroughly developed manufacturing techniques utilizing automated processes and close controls result in high yields and high production efficiencies. This means top quality product at prices well under the present cost of comparable silicon types.

Take a close look at germanium . . . for fast switching at low voltages, it may well be your best buy!

Send for bulletin B-213-2

A DIVISION OF CLEVITE CORPORATION

Reliability In Volume . . .

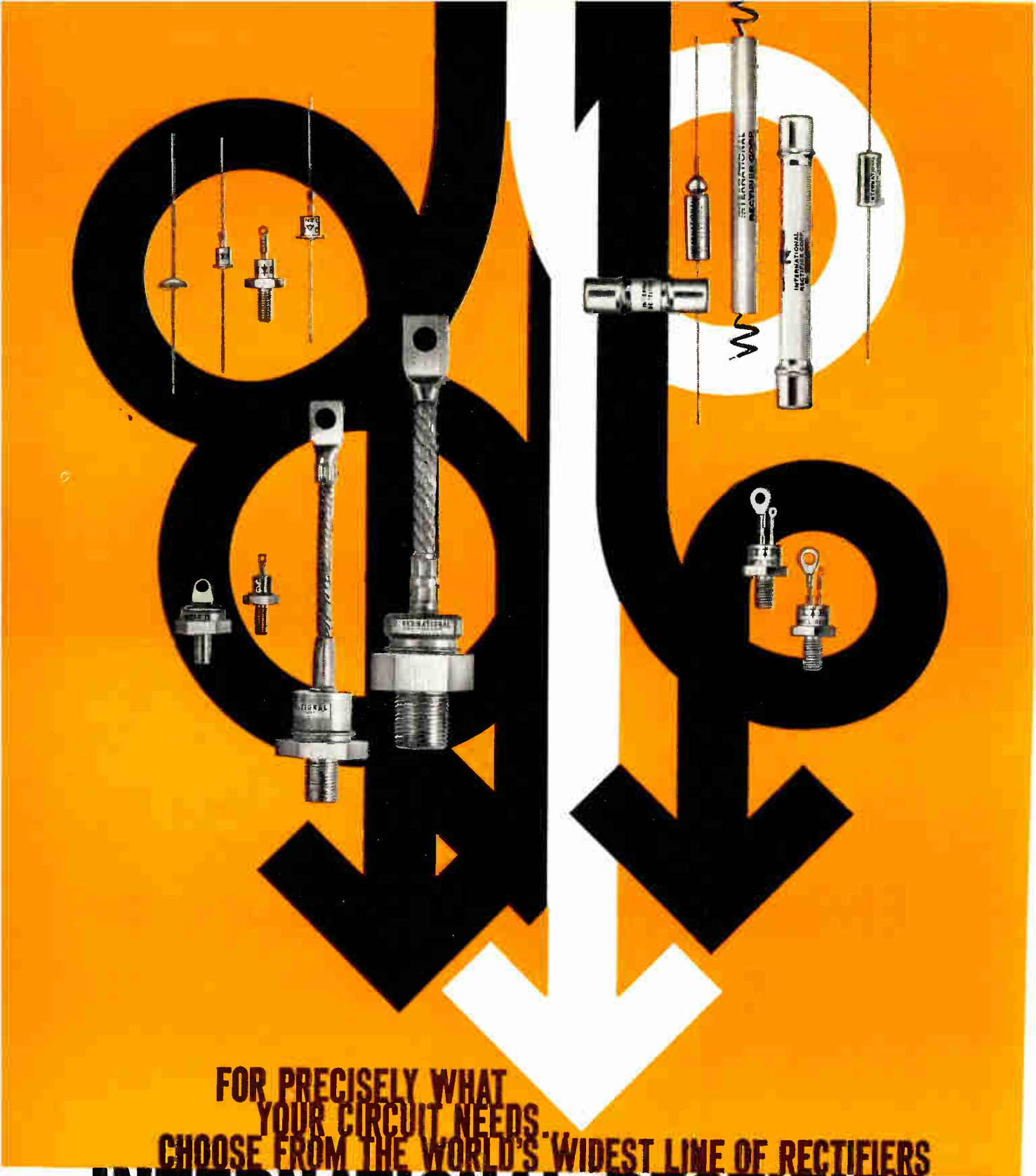
CLEVITE TRANSISTOR

254 Crescent Street Waltham 54, Mass. Tel: TWinbrook 4-9330

ELECTRONIC INDUSTRIES

1960 DIRECTORY of WESTERN Electronic Manufacturers

This directory is an alphabetical listing of Western electronic manufacturers. Address, person to contact and telephone number are included to speed contacts. Triangle signifies WESCON exhibitors; an asterisk signifies Eastern and Midwestern firms with Western manufacturing facilities.



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Circle 89 on Inquiry Card

A

△Abbott Instrument & Engineering Co 10513 Santa Monica Blvd Los Angeles 24 Calif—J F Dauber

Accurate Electronics Corp 13215 Leadwell St N Hollywood Calif—TR 7-7455—Precision Wirewound Resistors, Power Supplies, Printed Circuit Boards

△ACDC Electronics Inc 2979 N Ontario St Burbank Calif—R Hyder—App 125 Employees—VI 9-2414—Transformers, Power Supplies, Delay Lines

ACE Industries Inc Avion Div 5333 Sepulveda Blvd Culver City Calif—EX 7-4747

AC Electronics Inc 11725 Mississippi Ave Los Angeles 25 Calif—Edwin L Almo—GR 8-4288

Ackerman Gould Co Box 188 Oceanside Calif

△*Acoustica Assoc Inc 10400 Aviation Blvd Los Angeles 45 Calif—D S MacGregor—180 Employees—Ultrasonic Cleaning & Degreasing Systems, Liquid Level Gauging Switches, Continuous Liquid Level Sensing Gauges

Acousticraft Inc 14122 Aetna St Van Nuys Calif—TR 3-2520

Acroscope Engineering Co 1001 E Manchester Los Angeles Calif—LU 3-2243

Action Machine & Mfg Co 1028 W Evelyn St Sunnyvale Calif—RE 6-9656

Actuation Research Corp 416 N Glendale Glendale Calif—CH 5-6866

Adams Rite Mfg Co 540 W Chevy Chase Dr Glendale 4 Calif—C Schleeweis—175 Employees—CH 5-1095—Hardware

Admiral Coated Products Inc 2151 San Pasqual St Pasadena Calif—MU 1-3093—Roll Leaf for Wire Marking on Plastic Coated Wire, Tubing, etc

Advance Cargon & Electric Mfg Co 2505 Mariposa St San Francisco 10 Calif—Leo M Alchimisti—9 Employees—Motors, Generators & Blowers, Seals, Ray Materials

Advanced Electronics Mfg Corp 11121 Hindry Ave Los Angeles Calif—OR 4-8022—Modular Oscilloscopes, Data-Display Devices, Digital Computers

Advanced Instrument Corp 700 S 4th St Richmond Calif—Robert E Krueger 5 Employees—BE 5-5433—Computers, Military Systems Engg), Recorders (Special Purpose)

△Advance Relays-Electronics Div Elgin Nat'l Watch Co 2435 N Naomi Burbank Calif—VI 9-1446—Electrical Relays Open & Sealed

Advance Technology Lab 369 Whisman Rd Mountain View Calif

Advance Tooling & Mfg Co 2622 S Alveron Wy Tucson Ariz

Aero Electronics Corp 1745 W 134th St Gardena Calif—Steve Taylor—25 Employees—FA 1-2196 — Trimming Potentiometers (High Reliability)

Aerco Inc 1194 S 2nd San Jose Calif—CY 4-2345

Aero Guidance Corp 873 Linden Ave Carpenteria Calif—CA 9-1721

Aero Instrument Co 11423 Van Owen St N Hollywood Calif—T O Cox—ST 7-5433—Indicators, Meters (Special Purpose), Switches

Aerojet-General Corp Avionics Div 6352 N Irwindale Azusa Calif—ED 4-6211

Aerojet-General Corp Aetron Div 410 N Citrus Covina Calif

Aerojet-General Corp Nucleonics Div P O Box 77 San Ramon Calif—VE 7-5311

Aerojet-General Corp Liquid Rocket Plant P O Box 1947 Sacramento Calif—YU 5-5111

Aerojet-General Corp Liquid & Solid Plant Box 1947 Sacramento Calif—YU 5-5111

Aerojet-General Corp Ordnance Facility 11711 S Woodruff Downey Calif—SP 3-0130

Aerolab Development Co 330 W Holly St Pasadena Calif—SY 3-1184—Semiconductor Systems, Power Supplies, Sounding Rocket Systems

Aero Mechanism Inc 13918 Saticoy Van Nuys Calif—ST 2-1952

*Aeronautical & Instrument Div Robertshaw Fulton Controlls Co Santa Ana Freeway at Euclid Ave Anaheim Calif—Fred H Weisel—488 Employees—KE 5-8151—Crystal Ovens, Computers, Data Transmission Systems

Aeronutronic Systems Inc Ford Rd Newport Beach Calif—Richard P Lytle—OR 5-1234—Computers, Military Systems (Eng'g), Aviation Auxiliary Electronics Equipment

Aerophysics Development Corp Sub Curtiss-Wright Corp 6767 Hollister Ave Goleta Calif—WO 7-3411—Missile-Prime Contractor

Aeroscience Inc 3155 N Rosemead Blvd Rosemead Calif—AT 0-2112

Aertron Supply Co 3906 W 139th St Hawthorne Calif—OR 8-5423

Aero-Tronix 2049 Main St San Diego Calif—BE 9-1564

*Aerovox Corp Cinema Div 1100 Chestnut St Burbank Calif—James Fouch—Amplifiers, Capacitors, Filters

Airterra 620 Paula Ave Glendale 1 Calif Donald A Benbow—150 Employees—Connectors & Terminal

Airborne Navigation Co 2818 N Stone Ave Tucson Ariz

Air Electronics Co 7250 Hinds Ave N Hollywood Calif—TR 7-4476—Transistorized Power Supplies, Amplifiers, Aircraft Control Panels & Cable Assemblies

Aircraft Bolt Corp 701 W Garvey Blvd El Monte Calif—GI 8-7753

Aircraft Electronics 6219 S Sears Blvd Tucson Ariz—MA 4-6348

Airesearch Mfg Co Arizona Div Garrett Corp 402 S 36th St Phoenix Ariz—S D Whitaker—BR 5-6311—Motors, Generators & Blowers, Control Equipment (Industrial), Power Supplies & Converters

Airframe Mfg & Supply Co 6887 Farmdale N Hollywood Calif—TR 7-2681—Missile Ground Support Equipment, Control Cabinets

△*Air-Marine Motors Inc 2221 Barry Ave Los Angeles Calif—BR 2-6489—Electric Motors, Blowers, & Fans

Air-O-Tronics Eng'g Co P O Box 31 Lancaster Calif—S F Trush—10 Employees — WH 3-4654 — Chassis, Accessories, Fuses & Shielding, Hardware, Tools (Hand)

Airtite Products Inc 3516 E Olympic Blvd Los Angeles Calif AN 8-4137

△*Airtron Inc Div Litton Industries 336 N Foothill Rd Beverly Hills Calif—Philip J Quinn

Airtronics 2834 East Rickey Vista Tucson Ariz

Ajax Condenser Co 10950 Chandler Blvd N Hollywood Calif—TR 7-1345

A & J Mfg Co 1013 N Hillcrest Inglewood Calif—OR 8-3504

A & J Mfg Co 4212 Artesia Fullerton Calif—LA 2-6423

Akrofab 5310 Blakeslee Ave N Hollywood Calif—TR 7-5345

Alac Inc 365 W Arden St Glendale Calif—Milton Terkla—85 Employees—CI 4-7261 — Electronic Hardware (Standard & Custom)

△Aladdin Electronics Div Aladdin Ind Inc 380 Green St Pasadena 1 Calif—Chas L Freel

Aladdin Metal Craft & Plating Works Inc 2126 E Washington Phoenix Ariz

Alco Coil & Electronics Co 425 Mess Burbank Calif—VI 9-4511

Alda Plastics & Mfg Co 2601 Norton Ave Lynwood Calif—NE 6-8574

△Alfred Electronics 897 Commercial Palo Alto Calif—Paul N Fulton—47 Employees — DA 6-6496 — Traveling Wave Tube Amplifiers, Electronically Swept Microwave Oscillators, Microwave Power Supplies

All Chrome Mfg Co 2610 Willo Lane Costa Mesa Calif

Allen Engineering Co 108 Graham Place Burbank Calif—Solenoids

Allen Mfg Co 927 Industrial Ave Palo Alto Calif—Steve Allen—5 Employees — DA 1-4050 — Amplifiers, Chokes, Delay Lines

Allied Chemical Corp General Chemical Div Bay Point Calif—Chemicals

Allied Control Co Inc 1326 Flower St Glendale 1 Calif—46 Employees—CI 2-5125—Relays, Coils, Switches

Allied Engg & Production Corp 2421 Blanding Ave Alameda Calif—H E Miller Jr—78 Employees—Services (Industrial), Nuclear Products, Production Machinery & Equipment

Allied Nucleonics 2421 Blanding Ave Alameda Calif—LA 3-6556

Allied Research & Engineering Div Allied Record Mfg Co 6916 Santa Monica Blvd Hollywood Calif—HO 2-1251—Radar Waveguides & Precision Thin-Walled Tubing, Custom Electroforming Prototype & Production, Guidance Components

Allison Labs Inc 11301 E Ocean Ave La Habra Calif—R E Allison—OW 1-0115—Filters, Meters (Audio)

Allmetal Screw Products Co Inc/West Coast Div 5822 W Washington Blvd Culver City Calif—Julian Leventhal—We 3-9595—Hardware

Alpar Mfg Co 220 Demeter St Palo Alto Calif—R V Laustrup—9 Employees—DA 6-8105 — Towers, Parabolic Reflectors, Passive Reflectors

Almor Development Co Inc 2021 W 17th St Long Beach Calif—Mr Forman—HE 7-2781

Alpar Mfg Corp 220 Demeter St E Palo Alto Calif — DA 6-8105 — Custom Mfg of Aluminum Telescoping Guide Towers, Antennas, Passive Reflectors

Alpine-Atomic Labs Ltd 1610 S Nevada Colorado Springs Colo

Altec Lansing Corp 1515 S Manchester Ave Anaheim Calif—E F Grigsby—187 Employees—PR 4-2900—High Fidelity & Stereophonic Home Sound Systems, Public Address Systems, Microphone & Telephone Products

Altec Lansing Corp Peerless Elec Prod Div 6829 McKinley Ave Los Angeles Calif PL 8-4175

Alto Fonic Corp 981 Commercial St Palo Alto Calif—DA 6-5280—Sound Systems, Recorders (Audio)

Alto Instrument Corp 1357 E 14th St Oakland 6 Calif—Remy L Hudson—10 Employees—KE 4-4297—Amplifiers, Assemblies, Power Supplies

Alto Scientific Co Inc 855 Commercial St Palo Alto Calif—David D Cherry — 45 Employees — DA 1-3434 — Switches, Power Supplies & Switches, Time Delay Relays

Alwac Computer Div El-Tronics Inc 13040 S Cerise Hawthorne Calif—C A Penta—OR 8-5774—Computers

AMECO-Div Antennavision 2949 W Osborn Rd Phoenix Ariz—Malcolm Edwards—40 Employees—AL 4-5511—Distribution System Equipment, Community & Closed Circuit Television

△Amelco Inc 2040 Colorado Ave Santa Monica Calif—UP 0-5475—Amplifiers, Transistors, Potentiometers

Amerace Corp 455 N Quince St Escondido Calif—SH 5-3181

Amercoat Corp 4809 Firestone Blvd South Gate Calif—D O Lachmund—LO 4-2581—Chemicals, Coatings & Related Products, Materials

American Avionics Inc 11513 W Washington Blvd Los Angeles Calif—EX 1-5749—Cables, Harnesses, Power Supplies

American Concertone Div American Electronics Inc 9449 W Jefferson Blvd Culver City Calif—UP 0-7245—Communications & Magnetic Tape Recorders

△American Electronics Inc 1725 W 6th St Los Angeles Calif—Jack McNutt—DU 5-7401—Motors, Generators & Blowers, Computers, Measurement & Test Equipment (Special Purpose)

American Electronics Inc Nuclear Div 9456 W Jefferson Blvd Culver City Calif—UP 0-7245—Leak Detectors, Rate Meters & Spectrometers

American Electronics Inc Ground Support Div 2112 N Chico Ave El Monte Calif—CU 3-7151—Ground Support Equip

△American Electronics Inc Electro-Mechanical Div 4811 E Telegraph Rd Los Angeles Calif—AN 9-7551—Electro-Mechanical Assemblies, Blowers & Clutches

△American Electronics Inc Instrument Div 9503 West Jefferson Blvd Culver City Calif—UP 0-5581—Miniature Motors & Servomechanisms

△American Electronics Inc Precision Power Div 2112 N Chico Ave El Monte Calif — CU 3-7151 — Rotary Power Equipment, AMSTAT Solid State Devices

American Etched Circuits Co 1213 N 16th St Phoenix Ariz—BR 5-7023

American Industrial & Scientific Co 11836 Pico W Los Angeles Calif—GR 8-1134

American Machine & Metals Inc U S Gauge Div 11973 San Vicente Los Angeles Calif—GR 2-9584

American Marc Inc 1601 W Florence Ave Inglewood Calif—Frank S Hill—258 Employees—OR 7-7149—Diesel Engines, Generators, Generator Sets

American Marietta Co 3400 13th St N W Seattle Wash

American Metal Co Ltd of Calif 609 S Grand Ave Los Angeles Calif—MA 4-3421

American Microphone Co Div G C-Textron Inc 3225 Exposition Pl Los Angeles Calif—AX 3-7201

American Missile Products Co Inc Sub of the Maytag Co 15233 Grevillen Ave Lawndale Calif—Ruben H. Hundley—Services (Industrial), Missiles Amplifiers (Special Purpose)

American Semiconductor Corp 13942 Saticoy Van Nuys Calif—TR 3-4732—Silicon & Germanium Choppers, Diode Modulators, Amplifiers & Pre-Amplifiers

*American Super Temperature Wires Inc 3440 Overland Ave Los Angeles 34 Calif—John M Cooner

American Thermo-Electric Co 1023 N Fuller Ave Los Angeles Calif—A Levy—12 Employees—HO 4-1632—Vacuum Thermocouples

American Transistor Products 1540 Cassil Pl Hollywood Calif—HO 7-2131

Ampex Audio Inc 1020 Kifer Rd Sunnyvale Calif—C A Foy—325 Employees RE 6-2110—Tape Recorders, Home Music Consoles

Ampex Corp/Instrumentation Div 934 Charter St Redwood City Calif—Robinette E McCabe—3250 Employees—EM 9-1481—Mobile & Laboratory Magnetic Tape Recorders for Instrumentation Applications

△Ampex Data Products Co Dept 511 934 Charter St Redwood City Calif—Richard M Garvin

△Ampex Magnetic Tape-Orr Industries Broadway & Charter Sts Redwood City Calif—Richard M Garvin

Amphenol Western Div Amphenol-Borg Electronics 9201 Independence Ave Chatsworth Calif—James Schaefer—90 Employees—DI 1-0710—Connectors & Terminals

AMP Inc Capitron Div 3138 W El Segundo Blvd Hawthorne Calif—OS 5-1186 — Connectors, Capacitors, Transformers

Anadex Instruments Inc 14734 Arminta St (PO Box 4720) Van Nuys Calif—R M Flygare—ST 0-7911—Automatic Data Handling Equipment, Strain Gage Bridge Balance Units & Power Supplies, Transisterized Power Toggles & Static Relays.

Anaheim Electronics Co Inc 1016 Raymond Way Anaheim Calif—TR 1-1918—Punched Tape Readers, Relay Testers, Relays

Analytic Systems Co Div/Research Instrument Corp 980 N Fair Oaks Ave Pasadena Calif—James F McNamara RY 1-6634 — Industrial Electronic Equipment, Meters (Special Purpose), Analyzers

△Anchor Plating & Tinning Co Inc 9536 Rush St El Monte—CU 3-8281—Specialists Plating of Aluminum, Magnesium, Stainless Steel & All Other Metals

△Andrew Calif Corp 931 Marylind Claremont Calif—Jeff D Montgomery Jr—Antenna (Commercial), Antenna Accessories, Microwave Components

Angelus Industries Inc Phonolarm Div 10856 Burbank Blvd N Hollywood Calif—TR 7-9775

Angle Computer Co Inc 1709 Standard Ave Glendale Calif—CH 5-2983

Applegate C J 1840 24th St. Boulder Colo—M E Applegate

Appleton Co Inc Harry 136 San Fernando Rd Los Angeles 31 Calif—John B Miller—40 Employees—CA 5-5513—Antennas, Materials (Metal), Wire & Cable

Applied Electronics Co Inc 213 E Grand Ave San Francisco Calif—B H Ballard Jr—150 Employees—PL 6-4100 Marine Electronic Equipment, Radio Telephones, Depth Sounders & Direction Finders

Applied Electronics Labs 340 S Sepulveda Manhattan Beach Calif

Applied Magnetics Corp Santa Barbara A/P Bldg 304 Santa Barbara Calif H R Frank—11 Employees—WO 7-2016—Magnetic Recording Heads for Instrumentation Use, Special Magnetic Recording Devices

Applied Physics Corp 2724 S Peck Rd Monrovia Calif—HI 6-7181—Radioactivity Instruments

Applied Precision Products 1431 S La-Brea Los Angeles Calif—WE 6-0444

Applied Radiation Corp 2404 N Main St Walnut Creek Calif—A S Klein—93 Employees — YE 5-2250 — Electron Linear & Positive Ion Accelerators, High Voltage DC Power Supplies, Custom Precision Electromagnet Systems

Applied Research Labs Inc P O Box 1710 Glendale Calif—Wm E Davis—150 Employees — CH 5-5524 — Spectrochemical Analyzers, Denistometers, Power Source Units

Applied Technology Inc 930 Industrial Ave Palo Alto Calif—V Barker—6 Employees — DA 1-5135—Research, Development & Custom Fabrication

Araphow Chemicals Inc 2800 Pearl St Boulder Colo

Arco Electronics Co 111 S Vermont Los Angeles Calif—DU 8-0634

ARD Corp 2465 Lincoln Blvd Venice Calif—EX 8-8745

Aremac Associates 50 S San Gabriel Blvd Pasadena Calif—SY 5-5938

FIRST in strain measurement

SR-4 BLH BALDWIN LIMA-HAMILTON

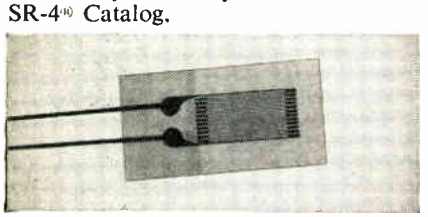
STRAIN MEASUREMENT

DATA SHEET No. 2

HOW TO MATCH THE STRAIN GAGE TO THE JOB

If your business is mechanical design, development or testing, chances are good that you have used, or will some day use, SR-4® Bonded-Filament Strain Gages. Unique in their simplicity, versatility and accuracy, they are the natural answer to a great many problems involving the behavior of materials, components and structures under load.

When the need arises, however, many engineers without specific background in strain-gage techniques find themselves on unfamiliar ground in attempting to select the best gage for the job from over 250 available types. Although it is important to the validity of the results that the gage used be properly suited to the application, selection is normally not a difficult matter and depends principally on known test conditions and on the nature of the data required. When the following criteria have been established, a suitable gage type for a specific application may be readily selected from the SR-4® Catalog.



Bonded foil gage

1. Temperature—The temperature at which the test is to be conducted is an important (frequently limiting) factor in determining suitable grid and base materials. At room and moderately high temperatures, both wire and foil gages are used. At temperatures above 350°F (and at very low temperatures), foil gages must be used. Some types are available with a backing material which may be stripped off during application, the grid alone being bonded to the test area. Such gages may be used up to 1400°F (for dynamic-type tests).

SELECTION OF GAGE MATERIALS BASED ON TEMPERATURE

Maximum Temperature (°F)	Base Material		Filament Material
180	Paper, Bakelite, Epoxy		Any
250	Bakelite, Epoxy		Any
350	Bakelite		Any
600	None	Strippable backing	Constantan or Nichrome foil
1000*	None		Nichrome foil
1400* (dynamic only)	None		Nichrome foil

*Limit imposed by available bonding adhesives

2. Test duration—For short-term tests (a few days) at temperatures below 150°F, paper-base gages are satisfactory and are usually more economical than other types. Extra-thin paper gages speed the curing of the bonding cement for fast application. For longer test periods (months or years), phenolic (Bakelite) or epoxy-base gages are usually used.

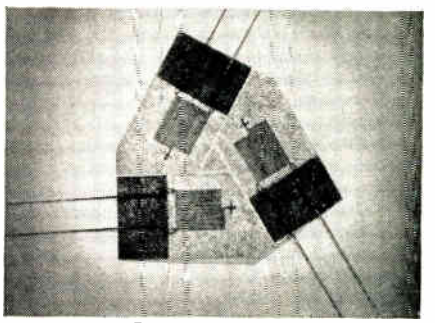
Dual-lead-type gages, with intermediate lead joints, provide good fatigue life. For better fatigue resistance and minimum hysteresis foil gages are advisable. They exhibit combined hysteresis and zero shift of less than 0.10% in strain reversals of up to ±1.5%, have generally higher fatigue resistance than equivalent wire gages.

3. Strain type and magnitude—For static strains, gages having grids of Constantan are usually used up to 600°F. For dynamic strains—particularly those of small magnitude—isoelastic gages are often recommended because of their relatively high strain sensitivity and improved fatigue resistance. Their high sensitivity to temperature change, however, limits usage to the measurement of vibratory strains unless appropriate precautions can be taken to cancel out or allow for this effect. When static strains of high magnitude (±2% to ±10%) are involved, a "post yield" gage is used.

4. Test-area geometry—Gage size depends primarily on the test space available. In general, the largest gage possible should be used. The probable strain gradient of the test area should also be considered, since the strain gage essentially averages the surface strain beneath its grid. When the test space is curved, foil gages are recommended, since they are flexible and will readily assume almost any continuous contour. When small wire gages are used, the new fine-pitch, flat-grid types are generally superior to "wrap-arounds".

5. Strain direction—Single-grid gages are used when the direction of the principal strain to be measured is known. If the strain field is biaxial and the directions are known, a 90°, 2-element rosette gage may be employed. When the strain field is unknown, a 3- or 4-element rosette may be used to determine the direction and magnitude of principal strains.

6. Output requirements—The required gage resistance and sensitivity are frequently dictated to some extent



Rosette-type gage

by the sensitivity of the measuring system to be used. Maximum gage output can be achieved by using a high-resistance gage with maximum bridge voltage.

7. Temperature compensation requirements—Strain gages are sensitive to changes in temperature as well as strain. This temperature effect on the measuring gage can often be canceled out by use of an unstressed "dummy" gage sensing identical temperatures and connected in the strain-gage circuit. In cases where a dummy gage cannot be used, some form of *self*-temperature-compensation is required. There are three general types of temperature-compensating strain gages available.

a. Self-temperature-compensating wire gages—individually compensated for specific materials and specific temperature ranges.

b. "Selected-melt" foil gages—with grids produced from a "melt" of strain-sensing material specifically selected for minimum temperature response over a specific temperature range.

c. Self-temperature-compensating foil gage—a recently developed grid design with an appropriate external circuit, which may be adjusted to provide minimum temperature response on any desired material over any temperature range.

For Engineering Assistance

When tests involve unusual conditions (e.g., high frequencies, strong magnetic or radiation fields, etc.) or necessitate special gage configurations, unusually accurate data, etc., it is advisable to consult your local SR-4® Strain Gage Sales Engineering Representative. He can also supply you with information and specific recommendations on strain-gage instrumentation (static and dynamic), cements, waterproofing compounds, and other accessories.

To obtain a free copy of the latest B-L-H Strain Gage Catalog, write Dept. 24-H

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SR-4® Strain Gages • Transducers • Force Measurement Systems

ARF Products Inc Gardener Rd Raton N M—Dave Joseph—100 Employees 995—Electronic Test Equipment, Remote Controls, Printed Circuits

Arizona Air Assoc Inc P O Box 2041 Tucson Ariz

Arizona Gear & Mfg Co 3544 E Ft Lowell Rd Tucson Ariz

Arizona Telemetering Corp 2923 E McDowell Rd Phoenix Ariz—Floyd F Lewis Jr—8 Employees—BR 5-3822—Voltage Controlled Oscillators, Sub-Contract Assembly

Arizona Tube Mfg Co 1914 E Henshaw Rd Phoenix Ariz—BR 5-3822

Arkay Eng'g Inc 255 Santa Monica Blvd Santa Monica Calif—EX 3-6959

Arkay Products Mfg Co 4111 W Jefferson Blvd Los Angeles Calif—RE 1-2501

Armour Electronics Div Cardinal Instrumentation Corp 4201 Redwood Ave Los Angeles 66 Calif—Jerry S Frank

Arnold Eng'g Co/Repath Pacific Div 641 E 61st St Los Angeles 1 Calif—R C Tehterow—Hardware, Transformers

Arnold Magnetics Corp 6050 W Jefferson Blvd Los Angeles 16 Calif—Jack Batte—UP 0-6284—Power Supplies & Converters, Transformers, Production Machinery & Equipment

Arnoux Corp 11924 W Washington Blvd Los Angeles 56 Calif—Lester Cole—75 Employees—TE 0-5371—Telemetering Decommutation Systems, Power Supplies, Temperature-Measurement Equipment

Asquith Co S A 427 West Chevy Chase Dr Glendale 4 Calif—James V Keith—25 Employees—CI 3-2878—Accelerometers, Metal Bonding, Multiturn Counting Dials

Asquith Co S A Braunson Electronics Div 427 W Chevy Chase Dr Glendale Calif—CH 5-1747—Solenoids

A-S-R Products Corp Com-Air Products Div 12D1 Rio Vista Ave Los Angeles Calif—AN 3-2171—Missile Propulsion Systems & Checkout Equipment

Astra Technical Instrument Corp 1132 Mission St Pasadena Calif—MU 2-2114—Temperature Probes, Thermocouples, DC Amplifiers

Astral Electronics Inc 14620 Arminta St Van Nuys Calif—ST 0-3270

Astravac Corp 1011-D Industrial Way Burlingame Calif—DI 2-6048—Missile Ground Support & Handling Equipment

Astro-Gear Inc 67 Yesler Way Seattle 4 Wash—Jack Cratty

△Astromics Div Mitchell Camera 611 W Harvard St Glendale 4 Calif—Victor T Carbone

Atcheley Inc Raymond 2339 Cotner Ave Los Angeles 64 Calif—John Pegram—GR 9-8626—Power Supplies & Converters, Amplifiers (Special Purpose), Control Equipment (Industrial)

Atkinson Lab Inc 7070 Santa Monica Blvd Hollywood 38 Calif—R W Reed—10 Employees—HO 9-8347—Photographic Chemicals

Atlas Electric & Engineering Co 617 7th St San Francisco Calif—KL 2-3676

△Atlee Components Inc 8220 Lankershim Blvd N Hollywood Calif—Frank McAvoy—7 Employees—TR 7-0755—Hardware, Chassis, Accessories, Fuses & Shielding

△Atohm Electronics 7648 San Fernando Rd Sun Valley Calif—G. H. Elliott—Miniature Potentiometers & Test Equipment

Atomic Engineering Corp 424 S 7th Grand Junction Colo

Atomic Research Lab 10717 Bernice Bldg Los Angeles 34 Calif—R D Finkle—TE D-1161—Radioactive Isotopes

Atomic Laboratory 3086 Claremont Berkeley Calif—OL 5001

Atomic Research Corp P O Box 205 Colorado Springs Colo

Audio Co of America 401 W Jackson St Phoenix Ariz—AL 4-5888

Audio Electronics 15858 35th N E Seattle 55 Wash—A Wallace Johnson—4 Employees—EM 3-1613—Sound Systems, Intercommunicators & Hearing Aids, Testers

Audiospeakers Labs 2209 E Alaska St W Covina Calif

Audiotronics Corp 11057 Weddington N Hollywood Calif—TR 7-0567

Austin Craft P O Box 389 Burbank Calif—VI 9-1777

Automation Industries Inc 3613 Aviation Blvd Manhattan Beach Calif—A J Edwards—150 Employees—OR 8-0808—Measurement & Test Equipment (Special Purpose), Analyzers, Industrial Electronic Equipment

Auto-Control Labs Inc 333 S Hindry Ave Inglewood Calif—OR 8-4924

Automatic Corp of America 5546 Satsuma North Hollywood Calif—TR 7-5493

Automatic Switch Co 1233 Goodrich Blvd Los Angeles Calif—RA 3-3669

Automation Controls Corp 5737 W 98th St Los Angeles Calif—SP 6-0420

Automation Electronics Inc 1500 W Verdugo Burbank Calif—VI 9-2341

Automation Inc 5959 S Hoover Los Angeles Calif—PL 3-2221

Automation Industries Inc Magnetics Div 771 Hamilton Ave Menlo Park Calif H E Wilcoxon—DA 6-7110—Amplifiers (Audio), Transformers, Power Supplies & Converters

Automation Industries Inc Industrial Park Boulder Calif—Gerald J Posakony—40 Employees—HI 2-1124—Transformers, Industrial Electronic Equipment, Medical Electronic Equipment

Automation Insts Inc 401 E Green St Pasadena Calif—Rod Klient—6 Employees—SY 3-8169—Industrial Electronic Equipment, Control Equipment (Industrial), Services (Industrial)

Automation Service Co 2123 Outpost Dr Hollywood 28 Calif—A E Klipps—HD 7-3844—Electronic Analog Computers, Function Generators, Oscilloscopes

△Autonetics Div North American Aviation Inc 920 N Nash St El Segundo Calif—J R Doudna

Autonetics/Div North American Aviation Inc 9150 E Imperial Hwy Downey Calif—C R Raferty—7000 Employees—SP 3-2233—Inertial Navigation Systems, Flight & Armament Control Systems

Autotron Inc 2413 Main St Santa Monica Calif—EX 9-8256

Autron Eng Inc 1301 Wilshire Blvd Los Angeles 17 Calif—L P Appelman—HU 3-7030—Communications Systems

Aurtonics Corp 5440 Alhambra Ave Los Angeles Calif—CA 5-4134—Aircraft Frequency & Voltage Sensors, Electronic Sequence & Time Delay

Avalon Machine Products Inc 2535 E Imperial Hwy Los Angeles Calif—LO 9-7156

Avery Adhesive Label Corp 1616 S California Monrovia Calif—EL 8-2524

Avia Products Co 7270 Beverly Blvd Los Angeles Calif—WE 6-7295

Aviation Developments Inc 210 S Victory Blvd Burbank Calif—Missile Frames & Test Equipment—VI 9-4631

△Aviel Electronics Inc 1755 Berkeley St Santa Monica Calif

Avionics Inc 2013 S Alvernon Tucson Ariz

Avionics Research Products Corp 1215 El Segundo Blvd El Segundo Calif—EA 2-5440

Avo Engg Co 5021 E 5th St Tucson Ariz

B

Babcock Engineering 618 S Glenwood Pl Burbank Calif—VI 9-2941

Babcock Radio Engg Inc 1640 Monrovia Ave Costa Mesa Calif—Norman E Cime—400 Employees—LI 8-7705—Remote Control Transmitters, Remote Control Receivers, Test Equipment

Babcock Relays Inc 1640 Monrovia Ave Costa Mesa Calif—Carl L Martin—LI 8-7705—Relays

Bach Auricon Inc 6900 Romaine Ave Hollywood 38 Calif—A N Brown—HO 2-0931—Amplifiers (Audio), Recorders (Audio), Recorders (Special Purpose)

Baldwin & Baldwin 2929 N Main Walnut Creek Calif—YE 5-0300

Baldwin Products Corp 432 E Valley Blvd San Gabriel Calif—CU 3-5634—Electronic Hardware

Ball Brothers Research Corp Industrial Park Boulder Colo—HI 2-2966

Band-It Co 48th & Dahlia Denver Colo—DU 8-4116

Barksdale Valves 5125 Alcoa Ave Los Angeles Calif—LU 7-6181—Missile Ground Support

Barrett Electronics Corp Western Div 1436 El Camino Real Menlo Park Calif—DA 6-7095

Barstow Co A G 8420 Otis Sough Gate Calif—LO 9-8125

Barton Instrument Corp 580 Monterey Pass Rd Monterey Park Calif—CU 3-6501

Barwood Electronics Inc 120 S Maryland Glendale Calif—C H 5-4063—Missile Ground Support

Basco Metal Products Inc P O Box 268 Burbank Calif

Basic Tool Industries Inc 14439 S Avalon Blvd Gardena Calif—FA 1-2665

Baskon Corp 1547 10th St Santa Monica Calif—L V Robinson—EX 3-8218—Relays, Measurement & Test Equipment (Bridges), Motion Picture Equipment

Bauer Electronic Mfg Co 3728 Southwood Ave San Mateo—Fritz Bauer—4 Employees—FI 5-0897—Transmitters

Bay Electronics P O Box 93 Cedar Ridge Calif

B & B Electronics Corp 17360 Gramercy Pl Gardena Calif—FA 1-1956—Multiconductor Control Cable & Harness Assemblies, Molded Breakouts

B & B Magnetics Co 331 E 4th Ave La Habra Calif—OW 7-8712

Beach Electronics Labs 3111 Halladay St Santa Ana Calif—KI 5-0451—Custom Test Equipment, Engineering Design & Fabrication

Bear State Transformer Co 2105 W Cowles Long Beach Calif

△Bearing Inspection Inc 3311 E Gage Ave Huntington Park Calif—LU 2-6431—Electronic Bearing Analyzers

△Beattie-Colman Inc 1000 N Olive St Anaheim Calif—T B Disson—9D Employees—PR 4-45D3—Oscilloscope Recording Cameras, "Oscillotron" Type Programmers, Electrically Operated Pulse Cameras

Beauzart Electronics Co 7459 Deering Canago Park Calif—DI 0-8792

△Beckman/Berkeley Div 2200 Wright Ave Richmond Calif—John Scheck—App 425 Employees—LA 6-7730—Digital Frequency Meters, Preset Counter-controllers

△Beckman Inst Inc Scientific & Proc Inst Div 2500 Fullerton Rd Fullerton 6 Calif—Joseph W Lewis—OW 7-1771—Control Equipment (Industrial), Analyzers, Amplifiers (Special Purpose)

Beckman Instruments Inc Systems Div 325 N Muller Ave Anaheim Calif—F J Scheufele—PR 4-5430—Amplifiers (Special Purpose), Computers, Control Equipment (Industrial)

Beckman & Whitley Inc 993 E San Carlos Calif—Myron B Baldwin—108 Employees—LY 3-7824—High Speed Cameras, Meteorological Instruments, Missile Products

Begen Co M 1683 Jerrold St San Francisco 24 Calif—Sam Blake Jr—Lighting Equipment & Accessories, Industrial Electronic Equipment

△Behlman Engg Co 2911 Winona Ave Burbank Calif—J M Schroeder—100 Employees—VI 9-5733—Electronic AC Power Supply

Bell Air Electronic Corp 6919 San Fernando Rd Glendale Calif—VI 9-1142

Bell Alarm Systems Inc Box 786 San Leandro

Belleville-Hexem Corp 638 University Ave Los Gatos Calif—Logan M Belleville—6 Employees—EL 4-1379—D-C Amplifiers, Electric Measuring Instruments, Kilovoltmeters

Bemco Inc 11631 Vanowen St N Hollywood Calif—TR 7-5339

Benbow Mfg Corp 11920 W Jefferson Blvd Culver City Calif—EX 8-5766—Missile Ground Support & Test Equipment

Benchmaster Mfg Co 1835 W Rosecrans Ave Gardena Calif—Arch C Shafer—65 Employees—FA 1-0411—Milling Machines, Punch Press, Various types of Feeding Machines

*Bendix Computer Div Bendix Aviation Corp 5630 Arbor Vitae St Los Angeles 45 Calif—450 Employees—SP 6-2220—General Purpose Digital Computers, Data Processing Systems, Flight Control Systems Simulators

△*Bendix-Pacific Div Bendix Aviation Corp 11600 Sherman Way N Hollywood Calif—Herbert Wilkinson—3500 Employees—ST 7-2881—Telemetering, Radar, Missile Guidance, Sonar & Underwater Ordnance

Bennett Labs Inc 4224 Holden St Emeryville Calif—R S Fisher—OL 5-9446—Communications, Systems, Intercommunicators & Hearing Aids

Bennett Products Mfg Co 815 S San Antonio Palo Alto Calif—YO 7-7249

Benson-Lehner Corp 11930 W Olympic Blvd Los Angeles 64 Calif—Don Press—13 Employees—GR 9-3723—Film & Oscillonram Record Readers, Automatic Plotting Machines, Photo Instrument

Bently Scientific Co 2811 7th St Berkeley 10 Calif—D E Bently—5 Employees—TH 3-6303—Distance Detector, Energizer, Angular Accelerometer

Berkeley Custom Electronics 2302 Roosevelt Ave Berkeley Calif—TH 3-4180

Berkeley-Dynamics 2831 7th Berkeley Calif—TH 3-2788—Industrial Electronic Controls

Berndt-Bach Inc 6900 Roamine St Hollywood Calif—HD 2-0931

Bertelen Products Mfg Co 114 Lomita St El Segundo Calif—DR 8-7969—Metal Cabinets, Chassis Panels, Cases (Custom or Production)

Best Speaker Mfg Co P O Box 635 Minter Village Bakersfield Calif

B-H Electronics 2022 S Sepulveda Los Angeles Calif—Dudley Cassard—2 Employees—BR 2-3757—Trimmer Potentiometers

Biederman Inc 1101 Airway Glendale Calif—CH 5-8621—Missile Checkout & Test Equipment

Bigus Co Inc Carl H 1547 14th St Santa Monica Calif—D B Lott—11 Employees—TE 0-4910—Bonding Agents, Potting Compounds, Circuit Board Coatings

Bill Jack Scientific Instrument Co 143 S Cedros St Solano Beach Calif—SK 5-1551—Counters & Mechanical Test Equipment

Birdsell Mfg Co Inc 750 San Antonio Palo Alto Calif—DA 1-0491

Bio-Rad Labs 32nd & Griffin Ave Richmond Calif—David Schwartz—TH 3-0923—Chemicals (Coatings & Related Products), Production Machinery & Equipment, Insulation Materials & Compounds

△Birthcher Corp 4371 Valley Blvd Los Angeles 32 Calif—Charles F Booher—75 Employees—CA 2-9101—Tube Devices, Transistor Retaining & Cooling Devices, Diode Closures

Bone Enorg 701 W Broadway Glendale Calif—CH 5-2638—Missile Ground Equip & Power Supplies

B J Electronics Borg-Warner Corp 3300 Newport Blvd Santa Ana Calif—Herbert G Ayers—363 Employees—KI 5-5581—Vibrotron Transducer, Miniature Tape Recorders, Nuclear Instrumentation

Blaine Electronics Inc 14757 Keswick St Van Nuys Calif—Robert F Blaine—20 Employees—ST 2-6303—Antenna Pattern Lab Equipment, Scale Models For Antenna Study, Scale Models for Technical Sales Purposes

Bodde Screen & Projector Co 11541 Bradley Ave San Fernando Calif—B M Bodde Jr—EM 5-2551—Studio Equipment, Motion Picture Equipment (Accessories), Motion Picture Equipment

Boeing Airplane Co 7755 Marginal Way Seattle 4 Wash—Wm W Coldren

Booth Co Arthur E 265 S Alexandria Ave Los Angeles 4 Calif—Arthur F Booth—7 Employees—DU 1-2161—Power Supplies for Calibrating Electrical Instruments, Relay Test Sets for Testing, Calibrating Power Systems network Protective Relays

Borg-Warner Controls 3300 Newport Ave Santa Ana Calif—H G Ayers—KI 5-5581—Nuclear Products, Measurement & Test Equipment (Special Purpose), Measurement & Test Equipment (Generators)

Borg-Warner Corp 7500 Tyrone Van Nuys Calif—TR 3-4340—Missile Propulsion System & Guidance Equipment

△Bourns Inc P O Box 2112 Riverside Calif—D P Vaughan—530 Employees—OV 4-1700—Leadscrew Actuated Potentiometers, Transducers-Pressure, Position, Accelerometers

Boymar Electrical Service Co 1271 Mission San Francisco Calif—UN 1-2245

△*Branson Ultrasonic Corp 12438 Ventura Blvd Studio City Calif—Kenneth P Haves

Braun-Knecht-Heimann Co Glass Engg Dept 601 O'Neil Ave Belmont Calif—Hugh Hutchings—20 Employees—LY 3-8276—Special Glass Apparatus, Flat Glass Fabrication

Braunson Electronics Inc 12008 Venice Blvd Los Angeles Calif—UP 0-1825

Brea Instruments 13D35 Caticot N Hollywood Calif

Broadview Labs 1811 Trousdale Dr Burlingame Calif

B & R Tool & Die Co 947 Industrial Ave Palo Alto Calif—YO 8-6141

Brubaker Electronics Inc 3642 Eastham Dr Culver City Calif—E Fredericks—220 Employees—TE 0-6441—Radar Test Equipment, IFF Equipment, Air Traffic Control Equipment

Bruce Engg Co 1633 W 134th St Gardena Calif—FA 1-2220

Bryon Jackson Pumps Inc 2301 E Vernon Ave Los Angeles Calif—LU 7-6171—Missile Ground Support & Test Equipment

Bucholz Mfg Co 909 Camelia Berkeley Calif

Bundy Mfg Co 2160 Cilorado Santa Monica Calif—EX 3-0558

Burgmaster Corp Box 311 Gardena Calif —FA 1-3510

Burklyn Co 3429 Glendale Blvd Los Angeles 39 Calif—Roland Stevens—NO 2-3111—Hardware, Production Machinery & Equipment

Burnett Radio Lab William W L 4814 Idaho St San Diego 16 Calif—Wm W L Burnett—AT 2-2740—Piezoelectric Products, Temperature Controlled Ovens Crystal Holders, Calibration & Consulting Service

△Burr-Brown Research Corp P O Box 6444 Tucson Ariz—Thomas R Brown Jr—7 Employees—AX 8-0772—Operational Amplifiers, AC Decade, Amplifier, Milivoltmeters

△*Burroughs Corp/Electro Data Div 460 Sierra Madre Villa Pasadena Calif—1200 Employees—RY 1-0471—Electronic Data Processing System, High Speed Printer System

Burton Electrical Engineering Co 111 Maryland St El Segundo Calif—OR 8-6101

Burton Mfg Co 2520 Colorado Ave Santa Monica Calif—100 Employees—EX 3-0255—Aircraft Instrument, Non Support Test Equipment, Medical Dental Lamps

△Burton Silverplating Co 8640 Alden Dr Los Angeles 48 Calif—Jerry Burton

Butcher Co L H 2050 McKinley Ave Fresno 3 Calif—J A Raskin—Chemicals (Coatings & Related Products), Production Machinery & Equipment, Industrial Electronic Equipment

By-Buk Co 4314 W Pico Blvd Los Angeles 19 Calif—Don L Lenzi—App 25 Employees—WE 6-6151—Printed Circuit Drafting Aids (Pressure Sensitive), Components Leads Bending Tool (Hand Operated), Product Finishing Masking Aids

C

Cadillac Gage Co 644 Terminal Way Costa Mesa Calif—LI 8-7761

Cadre Industries Corp 565 University Ave Los Gatos Calif—Fred J DuBois—82 Employees—EL 4-8600—Cables, Panels

Calbest Electronics Co 4801 Exposition Blvd Los Angeles Calif—Charles B Epstein—95 Employees—RE 1-7291 —Amplifiers, Audio Equipment, Baffles

Cal-Connector Co 7360 Varna Ave N Hollywood Calif—Scott L Glenn—TR 7-2623—Connectors & Terminals, Wire & Cable

Calibe Co Inc P O Box 832 Redlands Calif—PY 4-1166—Missile Materials & Metals

Calibration Standards Co 1079 Coronet St Pasadena Calif—EL 5-2982

Califone Corp 1041 N Sycamore Ave Los Angeles Calif—Robt J Margolis—65 Employees — HO 2-2353 — Phonographs, Audio Recorders, Sound Systems Training Equipment

California Aircraft Products 790 Greenfield Dr El Cajon Calif

California Chassis Co 5445 E Century Blvd Lynwood Calif—H P Balderson 50 Employees—NE 6-7777—Boxes, Cabinets, Chassis

California Computer Products Inc 8714 Cleta St Downey Calif—L L Kilpatrick—10 Employees—WA 3-1913—Incremental X-Y Plotters. Digital Systems, Multiplexers & Converting Equipment

△California Magnetic Control Corp 11922 Valerio St N Hollywood Calif—M B Leskin—100 Employees—ST 7-1104—Amplifiers, Telemetering Systems, Transformers

California Plastic Inc 221 E 4th St Los Angeles 13 Calif—Harry Simmons—MA 4-4311—Dials & Front Panel Accessories

California Scientific Glass 35 E Raymond Pasadena Calif—MU 1-6794

California Stamping & Mfg 909 E 59th St Los Angeles Calif—AD 1-5143

△*California Technical Industries Div Textron Inc 1421 Old Country Rd Belmont Calif — Carl Trost — 160 Employees—LY 3-8466—Automatic Test Equipment, Microwave Instruments, Flight Simulation Equipment

Cal-Lee Mfg Co 6759 West Blvd Inglewood Calif—OR 8-9456

Caltresin Corp 4543 Brazil Los Angeles Calif—CH 5-1079

Calmag Div Calif Magnetic Cont Corp 11922 Valerio St N Hollywood Calif —W R McPeak—TR 7-1104—Transformers, Power Supplies & Converters, Coils

Cal Tech Industries Div Textron Belmont Calif

Cal-Tronics Corp 11307 Hindry Ave Los Angeles Calif—OR 8-7141—Test Equipment, Cable & Harnesses

Caltron Products Co 3518 W Pico Blvd Los Angeles 19 Calif—C P Swanson—RE 4-2420—Production Machinery & Equipment, Control Equipment (Industrial), Industrial Electronic Equipment

Calvideo Tube Corp 18601 S Santa Fe Ave Compton Calif—NE 9-4435

Calvideo Electronics/Sub Calvideo Tube Corp 11712 Englewood Ave Hawthorne Calif

Campbell Carol Enterprises Inc 7333 Coldwater Canyon N Hollywood Calif

*Canoga Div Underwood Corp 14330 Oxnard St Van Nuys Calif—R A Potter —200 Employees—ST 6-9010—Radar Systems, Microwave Telemetry Systems, Antennas

△*Cannon Electric Co 3208 Humboldt St Los Angeles 31 Calif—Don A Drake —2900 Employees — CA 5-1251 — Multi-contact Electrical Connectors, Guided Missile Plug/Harness Systems, Subminiature Teflon Terminals

Cantania Sound 1541 4th St San Rafael Calif—GL 4-0802

Capital Engineering Corp 8609 W 3rd St Los Angeles Calif—CR 6-3028

Carad Corp 2850 Bay Rd Redwood City Calif—George E Glatthar—35 Employees—EM 8-2969—High Voltage Pulse & Miniature Pulse Transformers, Modulators, Band Pass & Low Pass Filters

Carder Co John 1624 1st St N W Box 808 Albuquerque N M

Cardinal Instrumentation Corp 4201 Redwood Ave Los Angeles 66 Calif—Jerry S Frank—52 Employees—TE 0-6731—Transducers, Power Supplies, Voltage Regulators

Carlson Co 1201 Dexter Ave Seattle Wash

Carma Mfg Co 1879 Mullin Ave Torrance Calif—SP 5-2221

Carmac Aviation 8414 San Fernando Rd Sun Valley Calif—Missile Frames & Propulsion Systems

Carruthers & Fernandez Inc 1501 Colorado Ave Santa Monica Calif—Missile Ground Support & Guidance

Carstedt Research 2501 E 68th St Long Beach 5 Calif—B K Smith—65 Employees—NE 6-9364—Magnetics

Cascade Research 5245 San Fernando Rd Los Angeles 39 Calif—Harry O'Donoghue — 90 Employees — CH 5-8625—Antennas, Microwave Equipment, Test Equipment

Carter Engineering Co 5117 W Jefferson Blvd Los Angeles—WE 3-7326—Headsets & Microphones, Intercom Systems, Mobile & Light Units

Cavitron Electron Oscillator 355 N Newport Blvd Newport Beach Calif—LI 8-6123

Caswell Electronics Corp 414 Queens Lane San Jose 12 Calif—Dwight A Caswell—11 Employees—CY 7-9333—Microwave Transmission Line Components, Ferrite Microwave Components, Microwave Subassemblies

C E S Electronic Products Inc 5026 Newport Ave San Diego Calif—AC 2-3505 — Logarithmic Attenuators, Twin-T Filter, Plug-In Preamplifiers

*C G Electronics Corp 15000 E Central Albuquerque N M—H Poulsen—93 Employees—AL 6-9858—Antennas, Converters, Resonant Reed Relays

Celco-Constantine Engg Labs Co 9593 9th St Cucamonga Calif—YU 2-2688 —Amplifiers, Chokes, Transformers.

Centimeg Electronics Inc 312 E Imperial Hwy El Segundo Calif—OR 8-4842

Central Telemetering & Control 504 E Valley Blvd San Gabriel Calif

*Century Lighting Inc 1840 Berkeley St Santa Monica Calif—Louis Erhardt —35 Employees—TE 0-6961—Electronic Dimming Control Systems, Theatrical Lighting Equipment, Architectural Lighting Fixtures

Century Machined Products Box 1073 Scottsdale Ariz

*Central Scientific Co of Calif 1040 Martin Ave Santa Clara Calif—V F Duensing — App 25 Employees — CH 8-1600—Scientific Instruments & Apparatus for Labs of Industry, Education & Research

*Central Scientific Co of Calif 6446 Telegraph Rd Los Angeles Calif—Gordon Baker—App 25 Employees—RA 3-6141 — Scientific Instruments & Apparatus for Labs of Industry Education & Research

Chadwick-Helmuth Co 42 E Duarte Rd Monrovia Calif—Wm F Cox—6 Employees — EL 8-4567 — Stroboscope Synchronizer. Stroboscopic Light, Electronic Multiplier

Champion Electronics 15100 S Broadway Gardena Calif—FA 1-4744

Chase Mfg Co 329 W Washington Pasadena Calif—W L Chase—RY 1-9800 —Tools (Hand)

Chemalloy Electronics Corp Gillespie Airport Santee Calif—Samuel Freedman—9 Employees—HI 4-7661— —Calorimeters (RF Microwave), Loads (RF Water), Solder (Fluxless Aluminum)

Chem-Ionics Inc 7834 Bothell Way Seattle Wash

Chem-Tronics Inc Bldg 9 Gillispie Field Santee Calif

Chemical Process Co Redwood City Calif

Chet Engineering Co 8140 Orion Ave Van Nuys Calif—ST 6-7226—Solenoids

*Chicago Telephone of Calif Inc 105 Pasadena Calif—R A Stackhouse—120 Employees—CI 5-7186—Variable Resistors, Coils & Transformers. Custom Compression Molded Products

△Christie Electric Corp 3410 W 67th St Los Angeles 43 Calif—E E Hughes—125 Employees—PL 3-2607 — Automatically Regulated D-C Power Supplies, Manually Controlled D-C Power Supplies, Automatic Battery Chargers

Christie Machine Works 201 Harrison St San Francisco Calif—EX 2-2187

C H Supply 415 E Beach Inglewood Calif—James C Colfer—OR 8-4181 —Dials & Front Panel Accessories

Cico Corp 9615 Glenoaks Blvd Sun Valley—TR 7-0575

CiCoil Corp 13833 Saticoy St Van Nuys Calif

*Cinch Mfg Co Graphik-Circuits Div 200 S Turnbull Canyon Rd City of Industry Calif—CU 3-8354

△Cinema Eng'g Div Aerovox Corp 1100 Chestnut St Burbank Calif—G M Smith—180 Employees—VI 9-5511 —Precision Wire-Wound Resistors, Instrument Switches, Audio Attenuators

Cinematic Developments 2125 32 Ave San Francisco 16 Calif — Thomas Rhienhart — MR 4-2435 — Motion Picture Equipment, Motion Picture Equipment (Accessories), Studio Equipment

Circon Components Corp Santa Barbara Municipal Airport Goleta Calif—M J Ainsworth—WO 7-1113—Hardware, Connectors & Terminals, Dial & Front Panel Accessories

Circuit Platers 13736 Saticoy Van Nuys Calif

Clark Controller Co 4755 E 49th St Los Angeles Calif—K D Christopher—9 Employees—LU 3-6366—Control Equipment (Industrial), Switches, Relays

Clark Electronic Labs Box 165 Palm Springs Calif—D B Clark—FA 8-2210—Control Equipment (Industrial), Rectifiers, Measurement & Test Equipment (Special Purpose)

Clary Corp 408 Junipero St San Gabriel Calif—Wm R Beall——CU 3-2724 —Computers, Recorders (Special Purpose)

Clear Beam Antenna Corp 21341 Roscoe Blvd Canoga Park Calif—Bob Raynor—75 Employees—DI 7-2255—Antennas (Home), Antenna Accessories, Insulators

Clearpoint Paper Co 1482 67th St Emeryville Calif

Clear Print Paper Co 1482 67th St Emeryville 8 Calif

Clemco Aero Products Inc 210 E Manville St Compton Calif—NE 6-8162 —Missile Guidance Equip

*Clevite Corp Western Engg Div 3336 E Foothill Blvd Pasadena Calif—MU 1-3021

Coast Coil Co 5333 W Washington Blvd Los Angeles 16 Calif—C Harris Adams — 240 Employees — WE 6-6188—Toroidial Windings

△Coast Pro-Seal & Mfg Co 2235 Beverly Blvd Los Angeles 57 Calif—J W Winkler — DU 7-5141 — Insulation Materials & Compounds

Coast Radio Co 110 University St Seattle Wash

Coastal Mfg Corp 217 Rose Ave Venice Calif

Coen Controls Co 40 Boardman Pl San Francisco 3 Calif—D H Hudson—5 Employees—Combustion Controls, Components & Systems

Cole Electric Co 8439 Stellar Dr Culver City—UP 0-4701—Electrical Connectors

Cole Instrument Co 144 Via Trieste Newport Beach Calif

△Coleman Electronics Inc 133 E 162nd St Gardena Calif—FA 1-4775—Analog to Digital Encoders, Data Recording Systems & Components, Machine Tool Control Systems

Coleman Engg Co Inc 3500 Torrance Blvd Torrance Calif—T N Tracy—FA 1-3900

△*Collins Radio Co/Western Div 2700 W Olive Ave Burbank Calif—A A Collins—700 Employees—TH 5-1751—Servo Amplifiers, Radar Antennas, Special Antennas

Colorado Research Corp Broomfield Colo —David R Miller—56 Employees—HA 9-3501—Analog Computers, Digital T V Systems, High Precision Shaft Angle Encoding Systems

Color Corp of America 11801 W Olympic Blvd Los Angeles Calif—BR 2-4331

Columbia Radio Co 17536 Ventura Blvd Encino Calif—ST 9-0781—Voltage Dropping Resistors

Com-Lab Inc 2049 Main St San Diego Calif

Comerford Mfg Co 880 S Rose Place Anaheim Calif—MA 6-3762

Communication Lab 2049 Main St San Diego Calif

Communications Measurement Lab Inc 2803 Los Flores Blvd Lynwood Calif

Communications Research Inc 9416 Ruffner Sepulveda Calif

Component Evaluation Lab 1432 Potrero El Monte Calif

Component Research Co Inc 3019 S Orange Dr Los Angeles 16 Calif—D Kellerman—Capacitors (Variable), Capacitors (Fixed), Coils

Components For Research Inc 979 Commercial St Palo Alto Calif—Ernest W Bianco — 3 Employees — DA 1-5252—Insulators, Services (Industrial), Transformers

△Computer Control Co Inc 2251 Barry Ave Los Angeles 64 Calif—R D Chamorro—GR 8-0481 — Computers, Amplifiers (Special Purpose), Military Systems (Eng'g)

Computer Eng'g Assoc Inc 350 N Halstead St Pasadena Calif—Marilyn B Holstom—38 Employees—EL 5-7121 — Direct Analog Computers. Amplifiers, Power Supplies

Computer Equipment Corp 1931 Pontius Ave Los Angeles Calif—GR 8-0856

△Computer Measurements Co 12970 Bradley Ave Sylmar Calif—J K Ronden —100 Employees—EM 7-2161—Electronic Counters & Timers, Digital Printers & Readout Equipment

Computer Measurements Corp 5528 Vineland Ave N Hollywood Calif—Roger K Stewart—ST 7-0401—Computers. Controls, Control Equipment

Computer Operations Aeronutronics Ford Rd Newport Beach Calif

Com-Tronics Inc 3409 Venice Blvd Los Angeles 19 Calif—J B McKinley—App 25 Employees—RE 4-6338—Delay Lines (Variable, Spira-Cord & Constant)

Condon Co Earl S 3450 Wilshire Blvd Los Angeles 5 Calif — Roger K Stewart

Con-Elco 1711 S Mountain Ave Monrovia Calif—E A Moore—82 Employees—EL 8-4571—Resistors, Volume Controls

Connector Corp of America 12959 Sherman Way N Hollywood Calif—Ralph R Thomas—10 Employees—ST 7-9653—Waveguide Flanges. R F Coaxial Cable Connector

△Connector Seals Corp 4224 Temple City Blvd Rosemead Calif—Don D Allen—25 Employees — CU 3-8307—Connectors

Condor Radio Mfg Co 4068 Paseo Grande Tucson Ariz

Connolly & Co Wallace E P O Box 295 Menlo Park Calif—G Connolly—DA 3-1930—Crystals (Crystal Products & Accessories), Magnetics, Coils

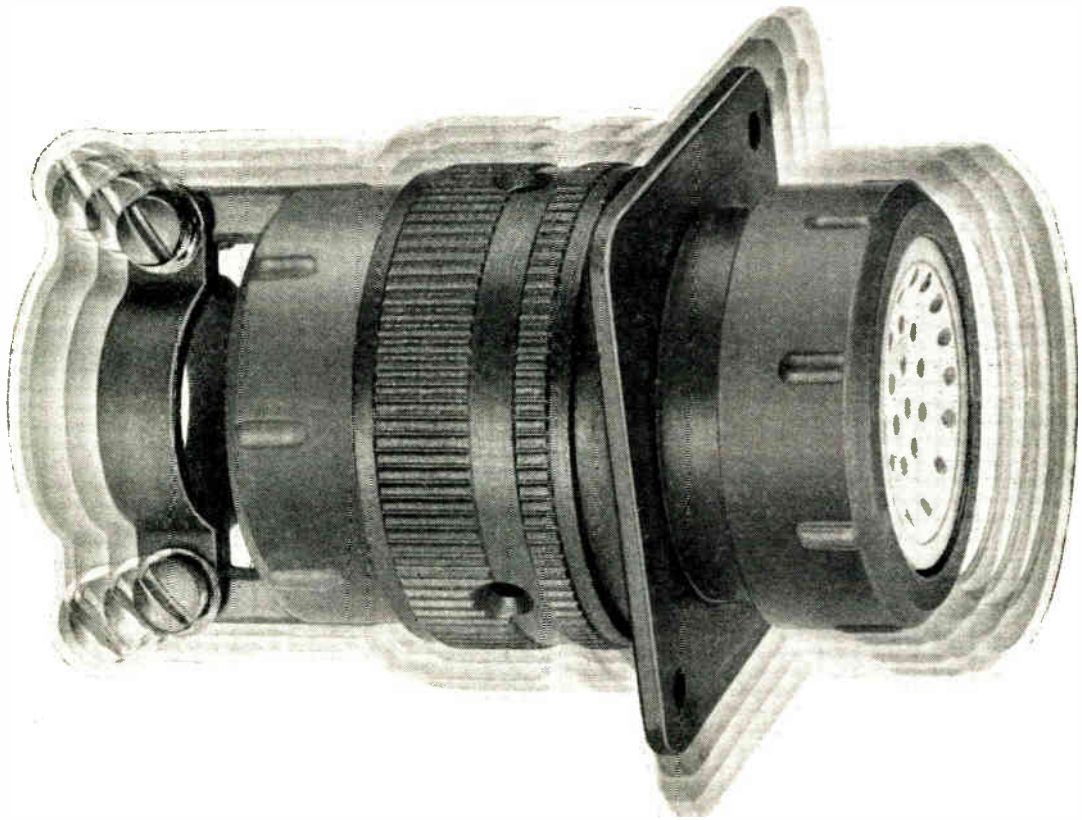
Conrac Inc 19217 E Foothill Blvd Glendora Calif—W. J. Moreland—90 Employees—ED 5-0541—TV Receivers & other Receivers, Video Monitors

*Conrad Inc 3848 E Colorado St Pasadena Calif — MU 1-0181 — Test Chambers & Equipment

Consolidated American Services Inc 9999 W Jefferson Blvd Culver City Calif—UP 0-4725

Consolidated Controls Corp 750 S Isis Inglewood Calif—J A Fontana—30 Employees—OR 1-7589—Industrial Electronic Equipment, Aviation Auxiliary Electronic Equipment, Switches

Consolidated Diesel Electric Corp 15519



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Consolidated Systems Corp 1500 S Shamrock Ave Monrovia Calif—Frank Chase—420 Employees—EL 9-8211—Data Processing Equipment—Systems Eng'g, Process Control Equipment

Constantine Engr Lab Co 9593 9th St Cucamonga Calif—YU 2-2688

Continental Device Corp 12911 Cerise Ave Hawthorne Calif—Duncan Loop—150 Employees—OR 8-4894—High Voltage Diodes, Voltage Regulators

Continental Electronics Corp 2724 Leonis Blvd Los Angeles 58 Calif—Milton Schindler—55 Employees—LU 2-8101—Tubes

Control Switch Div Control Co of America 139 Illinois St El Segundo Calif—Switches, Lighting Equipment & Accessories, Coils

Convair (Astronautics) Div General Dynamics Corp 5001 Kearny Villa Rd P O Box 1128 San Diego 12 Calif—J R Dempsey—BR 7-8900—Missiles, Missile Guidance Systems & Controls

Convair (Pomona) Div General Dynamics Corp 1675 W 5th St P O Box 1011 Pomona Calif—C F Horne—5500 Employees — NA 9-5111 — Guided Missiles, Electronic Components

△Convair/San Diego Electronics Div of General Dynamics Corp 3165 Pacific Hwy San Diego Calif—Wm R Rauth—CY 6-6611—Computers, Microwave Components, Amplifiers (Special Purpose)

Cook Batteries 3850 Olive St Denver 7 Colo—M B Winder—83 Employees—FL 5-3531—Primary & Secondary Silver Zinc Batteries (Automatically & Manually Activated)

Cook Research Labs P O Box 696 Menlo Park Calif—L H Cook—25 Employees — Em 8-3329 — Tools & Metal Components for Aircraft, Missile & Electronic Industry

△Coors Porcelain Co 600 9th St Golden Colo—L Coulson Hageman—CR 9-2536—Connectors & Terminals, Insulation Materials & Compounds, Insulators

Corbett Scientific Labs F W 3117 Venice Los Angeles—RE 3-5251

Corder Co John 1624 1st St N W Albuquerque N M

Cornell Deep Drawing Co Div Lanes Industries Corp 612-620 Colorado Ave Santa Monica Calif—Perry Smith

Costello & Co 2740 La Ciengo Blvd Los Angeles 34 Calif—Joseph D Costello

△Craig Corp 3410 S LaCienega Blvd Los Angeles 16 Calif—Howard Luray

Craig Electronics 3455 Meler St Los Angeles Calif—EX 7-8245

Crane Electronics Co 4345 Hollister Ave Santa Barbara Calif—WO 7-1193—Pulse Generators, Testers

Cratex Mfg Co Inc 1600 Rollins Rd Burlingame Calif—J C Craven Jr—Chemicals, Coatings & Related Products

Crescent Eng'g & Research Co 5440 N Peck Rd El Monte Calif—L L Noble 54 Employees—GI 4-0528—Indicators, Measurement & Test Equipment (Special Purpose), Control Equipment (Industrial)

Crescent Eng'g Co Western Astronautics Corp Div 4626 Santa Fe San Diego Calif—BR 3-7110—Electronic Components

Crittenden Transformer Works 13011 S Spring St Los Angeles 61 Calif—E C Kinzy—FA 1-4355—Transformers, Chokes

Croan Eng'g Co 2019 N Lincoln Ave Pasadena Calif—SY 8-6011

Cromer Mfg & Eng'g Inc 2138 E 88th St Los Angeles Calif—LU 2-5383

Crown Eng'g-Electronics 3821 Commercial N E Albuquerque N M

Crown Rubber Co 333 W Washington Pasadena Calif—MU 1-6465

Crown Eng'g 3821 Commercial N E Albuquerque N M——J W Hurlbut—50 Employees—DI 4-1423—Circuit Analyzer (Cable Checker), Frequency Selective Voltmeter, Contract Mfg & Eng'g Development

C T C Mfg Co 11936 Valerio St N Hollywood Calif—TR 7-0955

Cubex Co 3322 Tonia Ave Altadena Calif—Radio Antennas

△Cubic Corp 5575 Kearny Villa Rd San Diego 11 Calif—W J Thompson—300 Employees—BR 7-6780—Missile Tracking Systems, Data Translating Equipment, Digital Voltmeter & Automatic Test System

△*Curtiss-Wright Corp Municipal Airport Sta Santa Barbara Calif—WO 7-3411 — Missile Frame & Ground Support Equipment

*Curtiss-Wright Corp Electronics Div IMI Branch 4401 Lunada Ave S E PO Box 8324 Albuquerque N M—Victor V Myers — 24 Employees—AM 8-8791 — Solid State Relays & Switching Circuitry, Transistor Test Instruments & Systems, Instrumentation Systems & End Instruments

Custom Component Switches Inc 3137 Kenwood St Burbank Calif

Custom Magnetics Inc 2901 Winona Ave Burbank Calif

C-W Mfg Co Box 2065 El Monte Calif—Quartz Crystals for Frequency Control of Communications Equipment

Cycle Equipment Co 17510 Farley Rd Los Gatos Calif—EL 4-9959

Cyclotron Specialties Co P O Box 1000 Moraga—DR 6-4712

D

Dakota Eng'g Inc 4315-17 Sepulveda Blvd Culver City Calif—PL 8-6090

Daley Electric Co 1825 E Jefferson Phoenix Ariz

Dallons Labs Inc 5066 Santa Monica Blvd Los Angeles 29 Calif—Oscar Dallons — 70 Employees — NO 4-1951—Crystals, Delay Lines, Medical Equipment

Dalmotor Div Yuba Consolidated Inc 1375 Clay St Santa Clara Calif—C B O'Neal—125 Employees—CH 3-9414—Motors & Generators, Converters, Airborne Instrumentation

Dalmotron Co 534 Laurel St P O Box 741 San Carlos Calif—Paul L Beale Dalmotron & Talkmaster Intercommunication Equipment

△*Dalmo Victor Co 1515 Industrial Way Belmont Calif—Geo C Stewart—875 Employees—LY 1-1414—Airborne Radar Antenna, MAD Equipment, Sonar

Darco Industries Inc 2151 E Rosecrans Ave El Segundo Calif—J C Chapin — 156 Employees — OR 8-2251 — Gyroscopes, Aircraft Values & Actuators, Electronic Assemblies

Darling Technical Labs 1015 W Victoria St Costa Mesa Calif—LI 8-5451

Data Instruments 12838 Saticoy St N Hollywood Calif—R E Poole—250 Employees—ST 7-8181—Film & Oscillogram Reading Systems, Electro-Mech Counters, Tape Perforators & Control Devices

*Data Systems Dept Norden Div/United Aircraft Corp 13210 Crenshaw Blvd Gardena Calif—W H Saylor—120 Employees—FA 1-1775—Automatic Data Handling Systems, Machine Tool Control Systems

Data Technology Inc 1122 E San Mateo SE Albuquerque N M—Edward P Brooks — 2 Employees — Control Equipment (Industrial), Power Supplies & Converters, Amplifiers (Special Purpose)

Datex Corp 1307 S Myrtle Ave Monrovia Calif—Michael J Joncich—80 Employees — Computers, Military Systems (Eng'g)

Datran Div Automation Industries Inc 1836 Rosecrans Ave Manhattan Beach Calif—Corwin Denney—OS 5-7131—Indicators, Aviation Auxiliary Electronic Equipment, Measurements & Test Equipment (Special Purpose)

Davidson Optronics 2223 Romana Blvd W Covina Calif

Davies Moulding Co Harry 3121 E 12th St Los Angeles Calif—AN 1-0165—Mfg of Knobs

Davis Electronics 630 S Flower St Burbank Calif—VI 9-1815

Oavis Wire & Cable 2226 Santa Fe Ave Los Angeles Calif

Day-Ray Products Inc 1133 Mission St S Pasadena Calif—Willie D Adams—20 Employees—Lighting Equipment & Accessories

△*Daystrom Pacific/Div Daystrom Inc 9320 Lincoln Blvd Los Angeles 45 Calif—Alan G Richards—App 500 Employees—OR 4-7100—Potentiometers, Gyroscopes, Airborne Instruments

*Daystrom Systems Div Daystrom Inc Miramar Rd La Jolla Calif—John A Palmer—88 Employees—GL 4-0421—Digital Computers for Control & Data Reduction, Systems Engineered Digital & Magnetic Equipment

Decimeter Products Co Star Route Box 67 Littleton Colo—Harvey L Waters—NA 9-4703—Chemicals (Coatings & Related Products), Dials & Front Panel Accessories

Decker Corp 3522 Geary Blvd San Francisco Calif — SK 2-0846 — Instruments & Systems for Static & Dynamic Measurement & Control of Capacitance, Pressure, Displacement, etc

Decoursey Eng'g Lab 11828 W Jefferson Blvd Culver City Calif—W E DeCoursey—EX 7-9668—Filters, Coils, Chokes

Deeco Instruments 14737 Arminta St Van Nuys Calif—TR 3-2932

De Cuir Sample Case Co 4012 Broadway Pl Los Angeles Calif—AD 3-4185

Del Mar Eng'g Labs 6901 Imperial Hwy Los Angeles Calif—GR 8-8251

Delron Co Inc 5224 Southern Ave South Gate Calif—LO 7-2477

Delsen Corp 719 W Broadway Glendale 4 Calif—Leland E McCrory—CH 5-8517—Services (Industrial), Indicators, Measurement & Test Equipment (Special Purpose)

△Delta Design Engineers Inc 3163 Adams Ave San Diego Calif—GL 4-1185

Delta Mfg Co 1137 W Hilton Phoenix Ariz

Deltron Co 14736 Arminta St Van Nuys Calif—ST 6-3613

Dement Labs 5918 S E 72nd Ave Portland Ore—Dr Jack DeMent—PR 5-2373—Amplifiers (Special Purpose), Control Equipment (Industrial)

Demolab Corp 1550 N Highland Hollywood Calif

△DeMornay-Bonardi 780 S Arroyo Pkwy Pasadena Calif—L Della Penna—App 100 Employees—SY 2-4142—Microwave Lab Test Equipment Components

Desco Mfg Co 551 W Glenoaks Blvd Glendale Calif—CI 1-9560

Dessert Lab 3309 Clay St Newport Beach Calif

Destron Co 25914 Chalmette Rolling Hills Est Calif—Dr E St John—1 Employee — FR 8-3450 — Control Equipment (Industrial), Communication Systems, Relays

Detroit Controls Research Dept 1650 Broadway Redwood City Calif—Les Elmore

Detronic Corp 929 Baker St Costa Mesa Calif

△Deutsch Co Electronic Components Div Municipal Airport Banning Calif—Donald R Lea—PL 1-4131—Connectors & Terminals, Hardware

Deutsch Fastener Corp 14504 S Figuerea St Box 61072 Los Angeles Calif—DA 3-6640 — Missile Frame & Ground Support Equipment

Developmental Electronics Corp 4213 S Broadway Los Angeles 38 Calif—A S Jimenez—25 Employees—AD 4-7751—Delay Lines, Pulse Transformers, Chokes

Development Instrumentation Calibration Automation Inc 11645 McBean Dr El Monte Calif—CU 3-1087—Precision Electronic Assemblies, Prototypes, Pilot Orders

Devices Unlimited 1209 E El Segundo Calif—OR 8-9709

Digital Instrument Labs 152 S Atlantic Blvd Los Angeles Calif—RA 3-4214

Digitran Co/Div Endevco Corp 45 W Union Pasadena Calif—J M Reitzell—120 Employees—RY 1-5231—Digital Actuators, Switches, Counters

Dikewood Corp 4805 Menual Blvd N E Albuquerque N M—AM 8-2487—Operations Research, Systems Analysis

Dirigo Compass & Instrument Co Boeing Field Box 37 Seattle 8 Wash—H V Wenger Jr — PA 3-5940 — Aviation Auxiliary Electronic Equipment, Services (Industrial)

Disclosures Inc 11695 Bonita Dr Arlington Calif

Dollar Co Robert 50 Drum St San Francisco 11 Calif—R W Bunce—EX 2-8454—Radio Paging Transmitter & Pocket Receivers, Base Station Equipment for Civil Defense Purposes

Dondar Devices 2748 Jackson Hwy Medford Ore

Donel Co P O Box 7013 Portland Ore

Don-Lan Electronics Co 1101 Olympic Blvd Santa Monica Calif—Harold W Arlidge—EX 3-0758—Antennas (Commercial), Microwave Components, Switches

△Donner Scientific Co 888 Galindo St Concord Calif—MU 2-6161—Accelerometers, Analog Computers, Electronic Test Equipment

Doozey Co J K 3215 Western Ave Seattle Wash

Dorco Electronics 108 N Central Compton Calif—NE 6-5522

Double "E" Product Co 208 Standard St El Segundo Calif—J S Trier—30 Employees — Filters, Capacitors (Fixed), Coils

Double T Products Co 310 Arcacia Ave Hawthorne Calif—OR 8-1557

Douglas Aircraft Co Inc 3000 Ocean Park Blvd Santa Monica Calif—EX 9-9311

Dow Elco Inc 1313 W Olympic Blvd Montebello Calif—RA 3-1288—Missile Ground Support & Handling

△Dressen-Barnes Corp 250 N Vinedo Ave Pasadena Calif—P K Bennett—97 Employees—SY 5-7731—Regulated & Unregulated D C Power Supplies

Dresser-Ideco Co 8909 S Vermont Ave Los Angeles Calif—PL 8-4194—Microwave Towers

D R Ltd 402 E Gutierree St Santa Barbara Calif—B C Rogers—WO 3116—Filters, Motors, Generators & Blowers, Power Supplies & Converters

Dumont Aviation Associates 1401 Freeman Ave Long Beach Calif—Warhead & Nose Cone Equipment

*DuMont Labs Inc Allen B 11800 Olympic Blvd Los Angeles Calif—R F Feland—90 Employees—GR 7-4271—Amplifiers, Analyzers, Calibrators

Duvall Electronics Inc 1222 W Washington Blvd Los Angeles 7 Calif—C Merle Brooks

△Dymec Inc 395 Page Mill Rd Palo Alto Calif—Thomas J Smith—205 Employees — DA 6-1755 — Counters, Measurement Equip, Microwave Equip

Dymo Corp 2546 Tenth St Berkeley 10 Calif—Dials & Front Panel Accessories. Tools (Hand)

Dynachrome Labs 2939 Carlsbad Blvd Carlsbad Calif — PA 9-2215 — Printed Circuit Boards, (Design & Production)

Dynair Electronics Inc P O Box 1103 El Cajon Calif—HI 4-7737—Electronic Products & Research, Television Products

Dynalysis Dev Labs Inc 1375 Clay Santa Clara Calif

Dynamatric Inc 2955 E Colorado Blvd Pasadena Calif

Dynamic Air Eng'g Inc 7412 Maie Ave Los Angeles 1 Calif—H E Lever—LU 8-3292—Motors, Generators & Blowers

Dynamics Instrumentation Co/Div Alberhill Corp 1118 Mission St S Pasadena Calif—Nathan Brownstone—20 Employees—RY 1-3318—Instrumentation Amplifiers, D C Microvoltmeters, Electronic Filters

Dynamic Air Eng'g Inc 7412 Maie Ave Los Angeles Calif—LU 8-3292

Dynatronic Cable Eng'g Corp 128 San Fernando Rd Los Angeles Calif—CA 5-5513

Dyna-Therm Chemical Corp 3813 Hoke Ave Culver City Calif—UO 0-4751—Missile Materials & Metals

E

Eberline Instrument Corp 805 Early St Santa Fe N M—Francis S Smith Jr—135 Employees — YU 2-1881—Portable Survey Monitoring Instruments—Fixed Area Monitoring Instruments, Radiation Detection—Measuring Devices

Eckel Valve Co 1425 1st St San Fernando Calif—EM 1-6251

ECM Corp 8160 Orion Ave Van Nuys Calif—Richard G Andrew—6 Employees — ST 2-9901 — Etched Circuits, Terminal Boards

Eclipse Eng'g Co 3046 Fletcher Dr Los Angeles Calif—CL 7-3478

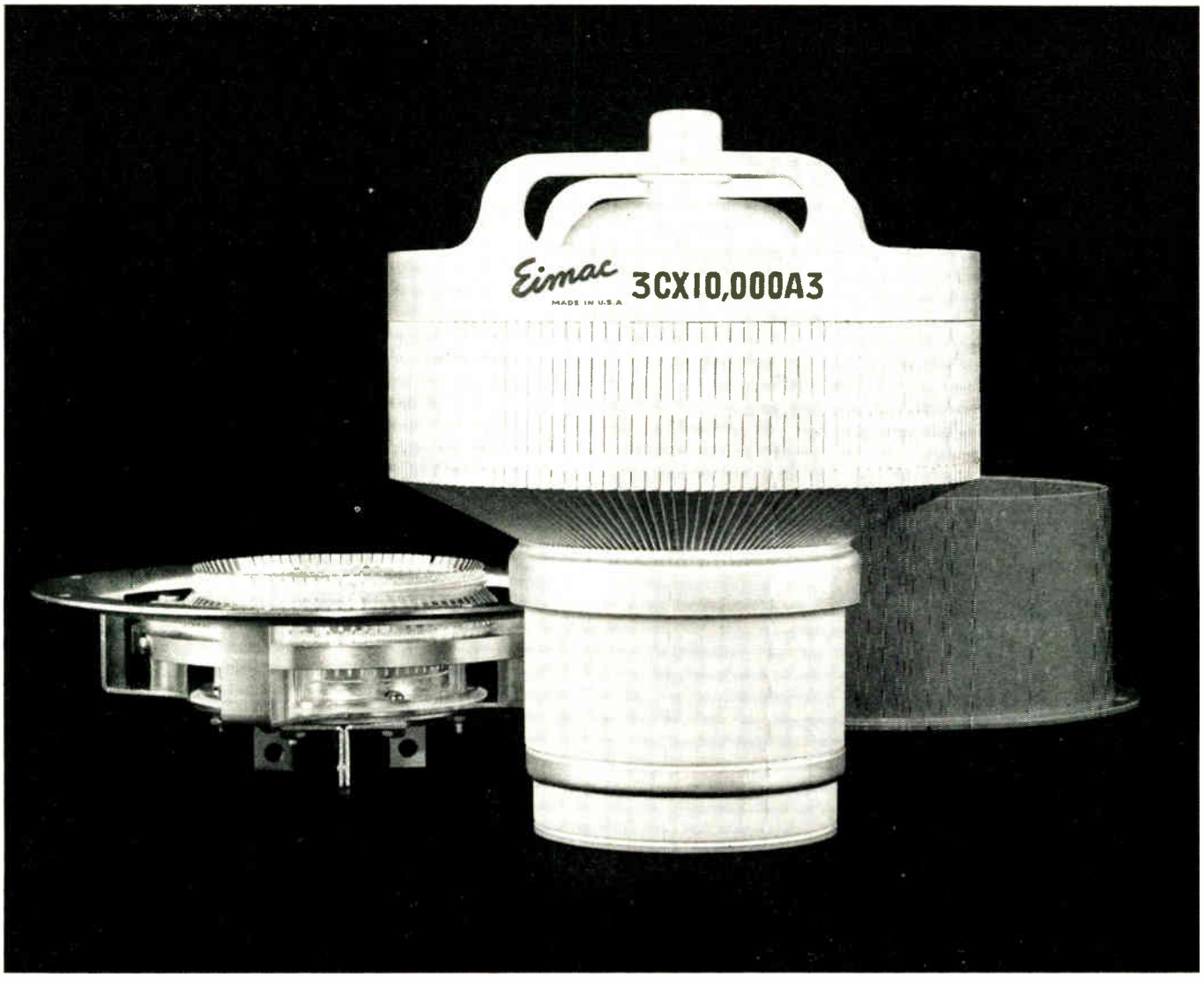
Edcliff Instruments 1771 S Mountain Ave Monrovia Calif—J R Thompson 125 Employees—EL 8-4571—Accelerometers (A C & D C), Pressure Transducers (A C & D C), Linear Potentiometers

*Edgerton Germeshausen & Grier Inc 1622 S "A" St P O Box 1912 Las Vegas Nev—Robt A Lusk—80 Employees—Nuclear Products, Measurement & Test Equipment (Special Purpose), Military Systems Engg

Ederer Eng'g Co 2943 1st Ave S Seattle Wash

△E-H Research Labs 1922 Park Blvd Oakland Calif—John C Hubbs

Eir Corp 5177 Overland Ave Culver City Calif—UP 0-7601—Voca Differen-



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A companion air-system socket and chimney, as shown above, is available with the 3CX10,000A3 to meet your specific requirements. Watch for a low mu version of this high-power triode in the near future.

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△Eitel-McCullough Inc 1678 Pioneer Rd Salt Lake City Utah

Ekeradio Electronic Div 650 N Fair Oaks Pasadena Calif—SY 2-5378

Elco Pacific 2200 Centinela Ave W Los Angeles 64 Calif—Leo Kagan—GR 8-0671—Connectors & Terminals

Eldema Corp 1805 Belcroft Ave El Monte Calif—J A Moore—26 Employees—GI 4-7077—Dials & Front Panel Accessories

Eldorado Electronics Co 2821 10 St Berkeley 10 Calif—H J Lewenstein—TH 1-4613—Amplifiers (Special Purpose), Analyzers, Nuclear Products

Elco-Elec Communications Co 202 Fillmore Phoenix Ariz

Elcor Products Inc 690 S Arroyo Pkwy Pasadena Calif—MU 1-9020

Eldema Corp 1805 Belcroft Ave El Monte Calif—CU 3-3498

Electrical Service Co 1271 Mission St San Francisco Calif—F M Boyce—UN 1-2245—Control Equipment (Industrial), Photoelectric Equipment, Control Equipment (Industrial)

△Electrical Specialty Co 2820 E 12th St Los Angeles 23 Calif—David E Brown

Electrical Specialty Co 158 11th St San Francisco 3 Calif—Wm T Martin

*Electric Autolite Co 505 E Rosecrans Ave Gardena Calif—FA 1-2184—Wire & Cable, Electronic Magnet, Anodized Aluminum Products

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Electric Eye Equipment Co 1518 Belleville Way Sunnyvale Calif

Electric Mfg Co Inc 1345 Howard St San Francisco Calif

Electrical Eng'g & Mfg Corp 4612 W Jefferson Blvd Los Angeles Calif—RE 3-0151

Electrical Products Corp 950 30th St Emeryville Calif—OL 5-9300

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Electro-Board In 620 Terminal Way Costa Mesa Calif—LI 9-3632

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*Electrodata Div Burroughs Corp 460 Sierra Madre Villa Pasadena Calif—R G Dee—SY 3-6121—Computers, Control Equipment (Industrial)

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Electro Development Corp 3939 University Ave Seattle Wash—ME 3-3094

Electrodyne Corp 503-a S McClay Santa Ana Calif—KI 7-6204

△Electro Engg Works 401 Preda St San Lenardo Calif—Rex E Brooks—148 Employees—LO 9-3326—Transformers, Reactors, High Voltage Power Supplies

Electro-Etch Circuits Inc 7112 S Victoria Ave Los Angeles 43 Calif—Robt Taylor—PL 2-6111—Printed Circuits, Services (Industrial)

Electro-Fabricators 11672 McBean Dr El Monte Calif—GI 3-1242

Electrofilm Inc 7116 Laurel Canyon Blvd N Hollywood Calif—Ralph E Crump—PO 5-4420—Chemicals (Coatings & Related Products) Industrial Electronic Equipment, Antenna Accessories

Electrofor Inc 7356 Santa Monica Blvd Los Angeles Calif—HO 7-5509

Electrographic Labs Box 2433 S Annex Van Nuys Calif—TR 3-4961

△Electro Instruments Inc 3540 Aero Court San Diego 11 Calif—R T Applin—250 Employees—BR 7-6590—Amplifiers, Calibrators, Circuits

Electro-Logic Corp 515 Bocaccio Ave Venice Calif—David Van Mindeno—5 Employees—Computers, Control Equipment (Industrial), Meters (Electrical Measurement)

Electrol Inc 9000 W Pico Blvd Los Angeles Calif—BR 2-6010—Missile Ground Support & Ground Handling

Electromation Co 1646 18th St Santa Monica Calif—EX 5-9975—Miniaturized Recording Equipment, Data Handling Equipment, Navigational Computers

Electro-Measurements Inc 7524 S W Macadam Portland 19 Ore—Douglas C Strain—80 Employees—CH 6-3331—Bridges & Accessories, Decade Voltage Dividers, Decade Resistors and Capacitors

Electro-Mechanical Specialties Co 407 N Maple Dr Beverly Hills Calif—James Goodman—BR 2-9459—Relays

△Electro-Mechanical Specialties Co Inc 528 W Lambert Rd Whittier Calif—James Goodman

Electrome Co 5121 San Fernando Los Angeles Calif

Electrone Corp 915 River Lane Santa Ana Calif—KI 2-0832

Electronic Assemblies Coro 421 S Pasadena Calif—SY 2-2748

Electronic Coil Co 2506 Ontario Burbank Calif—VI 9-3895

Electronic Coil Engineers 5830 Main Hollydale Calif—NE 6-4333—Precision Coil Winding

Electronic Communications Inc 4475 Vineland N Hollywood Calif—TR 7-0738

Electronic Components Div Telecomputing Corp 14706 Arminta St Van Nuys Calif—H E Wardein—60 Employees—ST 5-1581—Transformers, Power Supplies & Converters, Capacitors (Fixed)

Electronic Contractors Inc 2101 SE 6th Ave Portland 14 Ore—Dr Dolph Craig—BE 4-3515—Computers

*Electronic Control Systems 2231 S Barrington Ave Los Angeles 64 Calif—James Vrungos—50 Employees—BR 2-7711—Numerical Controls for Machine Tools, Automatic Gauging & Inspection Machines

△Electronic Enclosures Inc 3629 Holdrege Los Anoeles 16 Calif—Michael M Jacobs

△Electronic Eng'g Co of Calif 1601 E Chestnut St Santa Ana Calif—R F Lander—225 Employees—KI 7-5501—Amplifiers, Power Supplies, Telemetering Systems

Electronic Engineering Co Instrumentation Systems & Test Equipment 614 G St San Dieno Calif—BE 4-5978

Electronic Instruments Service 8907 S Vermont Ave Los Angeles Calif—PL 8-1098

Electronic Lab 1968½ Laurel Canyon Blvd Los Angeles Calif—OL 4-2921

Electronic Machine Products Inc 134 Industrial Way Costa Mesa Calif—LI 8-6701

Electronic Mfg Corp 227 W Chestnut Ave Monrovia Calif—EL 8-6149

Electronic Micromolding Co 2219 Main St Santa Monica Calif—EX 9-7890

Electronic Plastics Co Box 434 Northridge Calif

△Electronic Plating Service Inc 8723 Melrose Ave West Hollywood 46 Calif—Lee Davis

Electronic Processes Corp of Calif 436 Bryant St San Francisco 7 Calif—A F Hogland—40 Employees—EX 7-3881—Temperature Controls (Electronic On-Off & Electronic Proportional), Resistance Bulb Sensing Elements

△Electronic Production & Development 501 N Prairie Ave Hawthorne Calif—Leonard A Dodge—OR 8-7642—Chemicals (Coatings & Related Products) Industrial Electronic Equipment, Wire & Cable

*Electronic Research Assoc Inc 1760 Stanford St Santa Monica Calif—Bob Bowditch

Electronics Components Inc 12838 Saticoy St N Hollywood Calif—Roland King—52 Employees—ST 7-8181—Relays, Capacitors, Magnetic Amplifiers

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Electronics Int'l Co 145 W Magnolia Blvd Burbank Calif—J E Markley Jr—15 Employees—VI 9-2481—Precision Power Oscillators, AC Power Generators

Electronic Seals Co Inc 7327 Varna Ave N Hollywood Calif—Wendell L Mattsen—8 Employees—ST 7-7415—Glass-to-Metal Hermetically Sealed Connectors, Headers & Feed-thru Terminals

Electronics of Northern California P O Box 665 San Bruno Calif—JU 9-0181

△Electronic Seals Inc 13766 Saticoy St Van Nuys Calif—C J Lombard

Electronics Sealing Inc 5090 Alhambra Ave Los Angeles Calif—CA 5-2324

Electronic Specialty Co 5121 San Fernando Los Angeles Calif—CH 5-3771

Electronic Systems 7309 Varna Ave N Hollywood Calif—PO 5-4185

Electronic Systems Div Telecomputing Corp 12838 Saticoy St N Hollywood Calif—TR 7-8181—Pulse Coding & Decoding, I F F Radar, Reader Beacons

Electronic Systems Development Corp 1484 E Main St Ventura Calif—Charles Antoniak—50 Employees—MI 8-1827—Analogue & Digital Systems, Instrumentation & Ground Checkout, Solid State Devices

Electronic Systems 7412 Varna Ave N Hollywood Calif—Ralph B Carter—10 Employees—PO 5-4185—Sound Systems, Inter-Communications & Hearing Aids

△Electron Products Co/Div Marshall and 430 N Halstead Ave Pasadena Calif—Richard F Hastings—90 Employees—RY 1-0666—Connectors, Radio Interference & Noise Filters

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Electro-Physics Labs 2065 Huntington Dr San Marino Calif—Walter Gapik—5 Employees—RY 1-6781—Connectors & Terminals, Microwave Components, Wire & Cable

Electro Products Div Western Gear Corp 132 W Colorado St Pasadena Calif—T W Yeakle—110 Employees—MU 1-6604—Motors & Generators & Blowers, Hardware, Military Equipment

△Electro-Pulse Inc 11861 Teale St Culver City Calif—J E Niebuhr

△Electro Scientific Ind Inc—7524 S W Macadam Ave Portland 19 Ore—James Kirwan—CH 6-3331—Measurements & Test Equipment (Bridges), Resistors & Volume Controls, Capacitors (Fixed)

Electrosolids Corp 13745 Saticoy St Panorama City Calif—Gerald J Widawsky—135 Employees—ST 2-1410—Power Supplies for Missiles & Aircraft, Interphone Amplifiers, Headset Adapters

Electro-Sonic Inc 4553 Seville Ave Los Angeles Calif

Electrosonic Mfg Co 1719 Harmil Way San Jose 25 Calif—F A Butterworth—3 Employees—AN 6-6716—Special Record Players, Twin Jacks, Speaker Extension Cords

Electrosystems Inc P O Box 551 Alhambra Calif

Electro-Switch & Controls Inc 5755 Camille Ave Culver City Calif—J K Brose—40 Employees—TE 0-4643—Relays

Electro Tech Eng'g Co 308 S Hindry Ave Inglewood Calif—OR 4-4260

Electro-Winders Co Inc 854 W Front St Covina Calif—ED 2-6207—Coils, Toroids, Chokes

Elgenco 1555 14th St Santa Monica Calif—Duane E Beecher—2 Employees—EX 3-3023—Computers, Measurement & Test Equipment (Generators)

△Elin Div Int'l Electronic Research Corp 145 W Magnolia Blvd Burbank Calif—John R Foster—15 Employees—VI 9-2481—Power Supplies & Converters, Amplifiers (Audio), Measurement & Test Equipment (Oscillators)

Elliff Eng'g & Mfg Co 15342 Pimenta Ave Paramount Calif—ME 0-3000

Elliott Electronics Inc 418 N 4th Tucson Ariz

Ellison Eng'g Co 4530 San Fernando Rd Glendale Calif—CI 1-8501

Eltronics Inc ALWAC Computer Div 13040 South Cerise Ave Hawthorne Calif—OR 8-5774

El Ray Motor Co 11747 Vose St N Hollywood Calif—TR 7-3351

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Empire Tool & Eng'g Co 3125 N Castro Tucson Ariz

Empire Vacuum Products 12211 Brantford Sun Valley Calif

Emsco Mfg Box 2098 Terminal Annex Los Angeles Calif

Endeco Eng'g Development Co of Los Angeles 11148-50 Wilmington Blvd Wilmington Calif—Carl W Witt—9 Employees—TE 5-7271—Marine Radiotelephones, Antennas & Receivers

△Endevco Corp 161 E California Blvd Pasadena Calif—Warren D Hancock—100 Employees—RY 1-5231—Piezoelectric Accelerometers (Subminiature), Pressure & Force Pickups, Subminiature Amplifiers-Airborne

Enfab Inc 312 E Bokaw Rd San Jose Calif—H Paul Sherlock—50 Employees—CY 5-1801—Hardware, Chassis (Accessories, Fuses, Shielding), Insulation Materials & Compounds

△Engineered Electronics Co 1441 E Chestnut Ave Santa Ana Calif—Thomas W Gaul—50 Employees—KI 7-5651—Computers, Amplifiers (Special Purpose), Services (Industrial), Printed Circuits

Engineered Instruments Inc 22815 Sutro St Hayward Calif—George C Lydiksen—55 Employees—JE 7-1545—Amplifiers, Boxes, Cabinets

Engineering Inc 4315-17 Sepulveda Blvd Culver City Calif—PL 8-6090

*Eng'g Magnetics Div Gulton Industries Inc 13041 Cerise Ave Hawthorne Calif—James Alexakis—125 Employees—OR 8-7608—Static Inverters for Missile Applications, DC to DC Converters, AC to DC Power Supplies

Environmental & Development Labs Inc 1368 W 11th St Long Beach Calif

Eoff Electric Co 556 Charnelton St Eugene Ore

Eoff Electric Co 509 N W 10th St Portland Ore

△Epsco-West 240 E Palais Rd Anaheim Calif—Thomas Gaul

Era Engg Inc 1009 Montana Ave Santa Monica Calif—Harold D Hutchinson—5 Employees—EX 5-9995—Acceleration Switch, Material Erosion, Rate Instrument, Transport Shock Recorder

*Era Pacific Inc 1760 Stanford St Santa Monica Calif—R S Bowditch—22 Employees—EX 3-0511—Transistorized Power Conversion Devices, High & Low Voltage Supplies, High Current Supplies

Eric Engg Co 1823 Colorado Ave Santa Monica Calif—Bob Mueller—25 Employees—EX 3-9610—Amplifiers P A Systems, Tuners

△Erie Pacific Div Erie Resistor Corp 12932 S Weber Way Hawthorne Calif—G R Fryling—18 Employees—Measurement & Test Equipment (Counters), Computers, Control Equipment (Industrial)

Erickson Products Co 1906 Carroll Ave San Francisco Calif—DE 3-3447

Erikson Specialized Tool Co P O Box 424 Pico Calif—Jerry R Erikson—10 Employees—OX 9-3719—Electronic Hand Tools, Soldering Tools for Wiring, Printed Circuits

Ernitron Corp 1742 S Crenshaw Blvd Torrance Calif—Precision Synchros, Resolvers, Tachometers

ESCO Group Div Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif—T R Cataldo—CH 5-3771—Power Supplies & Converters, Aviation Auxuliary Electronic Equipment, Antenna Accessories

Escolite Corp 4217 W Jefferson Los Angeles Calif—RE 1-2230

ESI Inc 7524 S W Macadam Ave Portland 1 Ore—Laurence A Morin—80 Employees—CH 6-3331—Null Amplifiers, Attenuators, Bridges

Essex Electronics 2979 N Ontario Burbank Calif—VI 9-2414

Essex Wire Corp 1075 N Patt St Anaheim Calif

Etching Co of Calif 1208 Howard St San Francisco 3 Calif—Harry Scott—26 Employees—Dials & Front Panel Accessories, Printed Circuits, Hardware

Ets-Hokin & Galvan 218 N Avalon Blvd Wilmington Calif—E D Smith—TE 5-5601—Cabinets, Racks, Panels & Accessories, Services (Industrial), Motors, Generators & Blowers

△Eubanks Eng'g Co 260 N Allen Ave Pasadena Calif—Edward F Eubanks

Everetts Electronics 1122 Shasta St El Monica Calif—GI 3-2554

Everlube Corp 6940 Farmdale Ave N Hollywood Calif—TR 7-7101—Missile Ground Support & Handling Equipment

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Excel Transformer Co 2567 38th Ave Oakland Calif

E-Z Way Templates P O Box 535 Reseda Calif—Warren Juran—Drafting Aids for the Electronic Industry

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Faber Mfg Co 35 Stillman St San Francisco Calif—EX 2-7302

Fabrication Labs Inc 1209 E El Segundo El Segundo Calif

Fabrodynamics Inc 15524 S. Broadway Gardena Calif—FA 1-2454

*Fairchild Controls Corp 6111 E Washington Blvd Los Angeles 22 Calif—D C Manning—170 Employees—RA 3-5191—Precision Potentiometers, Accelerometers, Pressure Transducers

Fairchild Engine & Airplane Corp Stratos Div Manhattan Beach Calif

△Fairchild Semiconductor Corp 545 Whisman Rd Mountain View Calif—T H Bay—YO 8-8161—Semiconductors

Falcon Tech Products Corp 6610 Santa Monica Blvd Hollywood Calif—HO 7-8682

Farinon Electric Co 416 D St Redwood City Calif—H B Sutton—Transmitters, Receivers (Communication), Communication Systems

Farnsworth Electronics 815 San Antonio Palo Alto Calif—YO 7-7249

Fast Pak Co 1559 105 Ave Oakland Calif—NE 8-9295

Fearonics 1083 American St San Carlos Calif

Federal Equipment Co 38 Brady St San Francisco 3 Calif—R W Randolph—Approx 25 Employees—UN 3-3607—Photoelectric Traffic Counting Equipment, Printing Counter Recorder Units

Federal Mogul Bearings Inc Arrowhead Products Div 2300 Curry St Long Beach Calif—NE 6-0571

Federal Pacific Electric Co 333 Brookaw Santa Clara Calif—AX 6-8366

*Federal Telecommunication Labs Div III 937 Commercial St Palo Alto Calif—W S Chaskin—YO 8-1616—Filters, Transformers, Communication Systems

Felker Mfg Co Torrance Calif—Larry Michaux—100 Employees—FA 8-4704 — Production Machinery & Equipment, Chemicals (Coatings & Related Products), Materials (Raw)

Felthousen Audio Service 17609 Chatsworth St Granada Hills Calif—Robt A Felthousen—EM 3-1451—Services (Broadcast)

Ferro-Magnetics Co 989 Commercial St Palo Alto Calif—S J Henke—11 Employees — DA 1-5141 — Chokes, Delay Lines, Filters

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Filter-King 3310 Balboa San Francisco Calif

Filtors Inc 13273 Ventura Blvd Studio City Calif—TR 3-2770—Miniature & Sub-Miniature Relays

△Filtron Co Inc 10023 W Jefferson Blvd Culver City Calif—Wm M Lana—75 Employees—VE 9-2206—Capacitors, Chokes, Filters

*Firestone Tire & Rubber Co Guided Missile Div 2525 Firestone Blvd Los Angeles Calif—LU 3-4411

Fischer & Co R A 517 Commercial St Glendale 3 Calif—Medical Electronic Equipment

Fisher Berkeley Corp 4224 Holden St Emeryville 8 Calif—R S Fisher—OL 5-9696—Sound Systems, Intercommunicators & Hearing Aids, Amplifiers (Audio), Communication Systems

Fisher Research Lab Inc 1975 University Ave Palo Alto Calif—E A Feichtmeir—48 Employees—DA 2-4646—AC & DC Millivoltmeters, Pipe & Cable Finders, Leak Detectors

Fiske Mfg Co 1619 Pine St San Francisco Calif

Flexo Inc 7856 Salt Lake Huntington Park Calif

Flite-Tronics Inc 3312 Burton Ave Burbank Calif—TH 2-2887

Flotron Industries Inc 301 E Regent St Inglewood Calif—OR 8-0777—Chassis Holders, Card Holders, Vises

△Fluke Mfg Co Inc John 1111 W Nickerson St Seattle 99 Wash—92 Employees — AT 2-5700 — Voltmeters, Power Supplies, Electronic Wattmeters

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Food Machinery & Chemical Corp 1105 Coleman San Jose Calif

Ford Eng'g Co Inc 129 "A" St Upland Calif—YU 2-4859

Ford Motor Co Computer Div 2701 Hallady Santa Ana Calif

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*Franklin Electronics Inc/Communications & Control Div Van Nuys Calif—Dr Martin L Klein—Precision Data Systems, Language Translators, Data Logging Systems

Frederick Research Corp 2713 W Valley Alhambra Calif

F & R Enterprises 910 Valencia San Francisco Calif—MI 8-1248—Transformers

Friden Inc 2350 Washington Ave San Leandro Calif — NE 8-0700 — Data Processing Equipment & Counters

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Gabriel Co Talco Eng'g Co Div Falcon Field Mesa Ariz—WO 4-1711

Gane Bros & Lane Inc 715 Bryant San Francisco Calif

Gardiner Electronic Co 2545 E Indian School Rd Phoenix Ariz—R F Gardiner—Detectors, Nuclear Products, Medical Electronic Equipment

Gardner Neon & Ignition Transformer Inc 1010 38th Ave Oakland Calif

Garner Co T H 177 S Alexander Ave Claremont Calif—NA 6-3526—Precision Drawn Glass

Garnett Young & Co 390 4th St San Francisco Calif

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*Gavitt Wire & Cable Co 455 N Quince St P O Box 336 Escondido Calif—John T Hall—40 Employees—SH 5-3181—Insulated Electronic Hook-Up Wire, Cables & Cable Accessories

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Gaylor Products Co 11100 Cumpston St N Hollywood Calif—Russell I Hare—1 Employee—Filters

Gaylor-Rives Co 181 N Hill St Pasadena Calif—SY 6-5944

△G B Components Inc 14621 Arminta St Van Nuys Calif—TR 3-1328—Encapsulated Wire Wound Resistors, Precision Null References, Precision Voltage References

△G C Electronics Co Div Textron Inc 3225 Exposition Pl Los Angeles Calif—AX 3-7201—Hardware, Tools, Electronic Chemicals

Gearhart Electronics C B Portola Ave Point Reyes Calif—MO 3-0142

Gebbardt Ware 11840 W Olympic Los Angeles Calif

Geisler Labs Box 252 Menlo Park Calif—DA 5-2684

General-American Valve Co P O Box 444 Corona Del Mar Calif—Eugene C Greenwood — 7 Employees — OR 3-2326 — Control Equipment (Industrial)

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General Design Inc 11910 Valerie Ave N Hollywood Calif—TR 7-5067

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General Dynamics Corp Computer Lab Div 951 Commercial Palo Alto Calif

General Dynamics Corp General Atomic Div 10955 John Hopkins Dr San Diego Calif—GI 9-2310

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*General Electric Co 1034 66th Ave Oakland 21 Calif—C R Benson—60 Employees—Wire & Cable

*General Electric Co Power Tube Dept Palo Alto Calif—A H Ryan—DA 4-1661—Filters, Tubes

*General Electric Co Magnetic Materials Sec 2106 W Washington Blvd Los Angeles Calif—RE 108286

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General Sound Control Inc 11810 Center Hollydale Calif—NE 6-0133

*General Testing Labs Inc 227 W Chestnut St Monrovia Calif—Test Equipment

*General Transistor Western Corp Magne-Head Div 6110 W Venice Blvd Los Angeles 34 Calif—Martin Braude—50 Employees—WE 3-5867—Tape Head, Magnetic Computer & Audio Drum Heads

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△Gertsch Products Inc 3211 La Cienga Blvd Los Angeles 16 Calif—E W Watts—TE 0-2761—Measurement & Test Equipment (Special Purpose), Transformers, Measurement & Test Equipment (Bridges)

△Giannini Controls Corp 918 E Green St Pasadena 1 Calif—R L Lawrence—40 Employees—RY 1-7152—Air Data Instruments, Inertial Instruments, Avionic Subsystems

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Giannini Controls Corp Gyroscope Div 2275 E Foothill Blvd Pasadena Calif MU 1-9489

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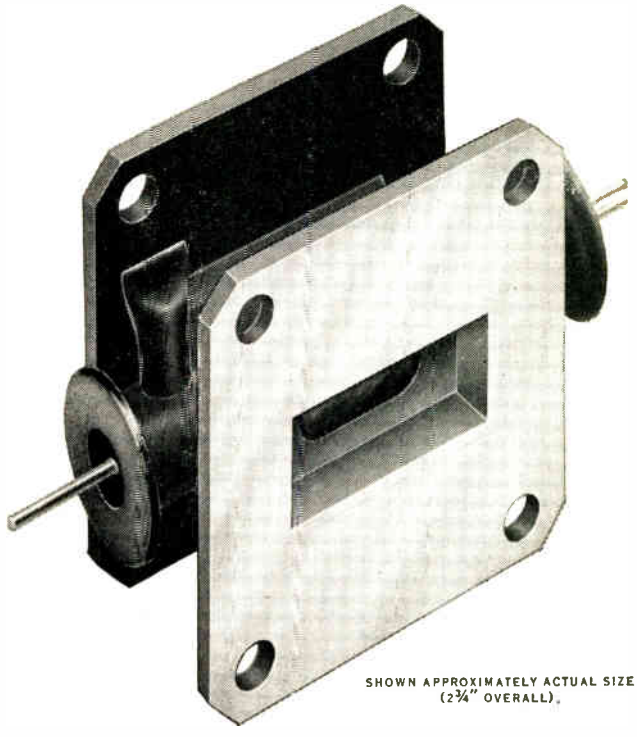

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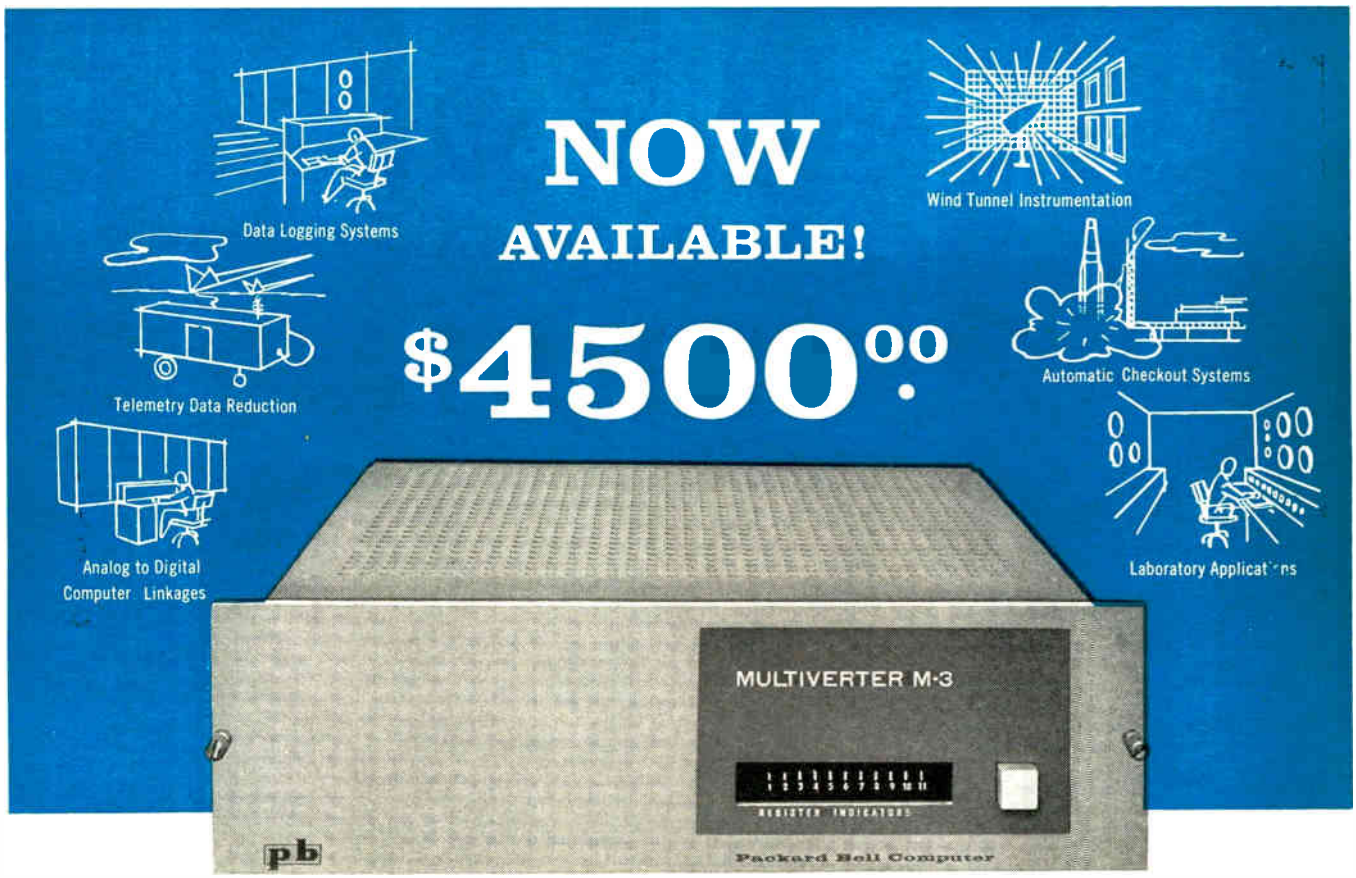

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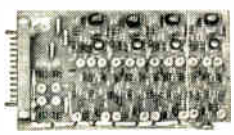
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Electro Sales, REdwood 2-7444
DALLAS, TEXAS
George W. Sickler Co., FLeetwood 1-5515
DAYTON, OHIO
Electro Sales, CH 4-5551
DENVER, COLORADO
Parrish Electronics, SKyline 6-9455
DETROIT, MICHIGAN
Electro Sales, MUtual 8-2461
INDIANAPOLIS, INDIANA
Pivan Engineering, CLifford 3-0444
KANSAS CITY, MISSOURI
Engineering Services Co., JEfferson 1-7765
LONG ISLAND, NEW YORK
Brogan Associates, Inc., Ploneer 7-3230
LOS ANGELES, CALIFORNIA
Kittleson Company, WEbster 3-7371
MELBOURNE, FLORIDA
Medco, Inc., PArkway 3-7016
MINNEAPOLIS, MINNESOTA
Murphy Associates, FEderal 9-4851
OTTAWA, ONTARIO, CANADA
Instronics, Ltd., TAlbot 8-1253
PALO ALTO, CALIFORNIA
Kittleson Company, DAvenport 6-7410
ST. LOUIS, MISSOURI
Engineering Services Co., VOlunteer 3-3660
SEATTLE, WASHINGTON
Packard Bell, MAin 4-5320
TORONTO, ONTARIO, CANADA
Instronics, Ltd., AXminster 3-7806
WASHINGTON, D. C.
S. S. Lee Associates, LOckwood 5-3066
WINSTON-SALEM, NORTH CAROLINA
S. S. Lee Associates, STate 8-0431

Johnson Co Lou 1506 N W Irving St Portland Ore

Johnson-Williams Inc 2625 Park Blvd Palo Alto 15 Calif—P L Williams—DA 3-4131—Analyzers, Detectors

Johnston Co Ray 1011 E 69th St Seattle Wash—LA 4-5170

Jo-Line Tools Inc 8442 Otis St South Gate Calif—William S Woods—25 Employees — LO 7-1489 — Tools (Hand), Control Equipment (Industrial), Indicators

△Jonathan Mfg Co Inc 720 E Walnut Ave Fullerton Calif—M Fritz Hagen

Jones Electronics Hiram 2313 W Olive Ave Burbank Calif—E W Reed—4 Employees—VI 9-5311—Connectors & Terminals, Hardware, Chassis, Accessories, Fuses & Shielding

Jones & Wettlaufer Eng'g Corp 11780 W Pico Blvd W Los Angeles Calif—GR 7-3247—Analog to Digital Converters

Joslyn-Hudson Inc 2040 Colorado Ave Santa Monica Calif

J P Mfg Co 1820 Peralta Way Calif—BA 706843

K

Kaar Eng'g 2095 Middlefield Rd Palo Alto Calif—DA 6-5050

Kahl Scientific Instrument Corp P O Box 1166 El Cajon Calif—M Kahl—HI 4-5944—Nuclear Products, Industrial Electronic Equipment, Meters (Special Purpose)

Kaiser Aluminum & Chemical Corp 1440 Broadway Oakland Calif — Robert Brown

Kaiser Aircraft & Electronics Kaiser Electronics Div 850 San Antonio Rd Palo Alto Calif—Floyd Buell

Kaiser Aircraft & Electronics 880 Doolittle Dr San Leandro Calif

Kaiser Aircraft & Electronics/Div Kaiser Industries Corp P O Box 1828 Oakland 4 Calif—R M Watt Jr—750 Employees — LA 6-4688 — Missile Preflight Testers, Contact Analog Display Systems, Thin Cathode-Ray Tubes

Kalbfell Electronix 3434 Midway Dr San Diego 10 Calif—D C Kalbfell—5 Employees—AC 3-7156—Magnetic Amplifiers

Kauke & Co Inc 1632 Euclid St Santa Monica Calif—Fran M David—6 Employees—EX 5-5246—Aviation Auxiliary Electronic Equipment, Military Systems (Eng'g), Measurement & Test Equipment (Special Purpose)

Kavamil Co Inc/Spacetronics Div 1501 W El Segundo Blvd Compton Calif—E V Miller—75 Employees—NE 6-9600 — Amplifiers, Assemblies, Bridges

Kaynar Mfg Co Inc P O Box 2001 Terminal Annex Los Angeles 54 Calif—Robert D Eklund—SP 3-3070—Hardware

*Kearfott Co Inc 500 University Ave Palo Alto Calif—DA 6-3010

*Kearfott Co Inc Microwave Div 14844 Oxnard St Van Nuys Calif—Walter K Dau Jr—250 Employees—ST 6-1760—Microwave Test Equipment, Engineering Development, Ferrite Devices

Keim Precision Mirrors Corp 1346 E Colorado Glendale Calif—CH 5-2725—Optical Coatings

Keltner Electronics 3012 W Tanforan Littleton Colo—PY 4-1730

Kelvin Electric Co 5907 Noble Ave Van Nuys Calif—Boyd Barton—128 Employees—ST 3-2666—Precision Wire Wound Resistors, Subminiature Toroidal Coils, Uncased, Plastic Encapsulated Hermetic Sealed Magnetic Amplifiers

Kennedy Co 2487 E Washington Pasadena Calif—Sy 8-4727

Kerns James L 6055 N E Glisan St Portland Ore

△Key Resistor Corp 321 W Redondo Beach Blvd Gardena Calif—Wilfred Pedde—65 Employees—FA 1-4980—Resistors & Volume Controls, Power Supplies & Converters, Filters

K-F Development Co 2606 Spring St Redwood City Calif—EM 8-5670—Precision Wire Wound Resistors, Trimmer & Wire Wound Potentiometers Produced to AIA Standards or Special Requirements

KFR Corp 6006 W Washington Blvd Culver City Calif—UP 0-6955

Kibbey Instrument Co 7701 17th Ave Sacrament Calif

Kibby Instrument Co P O Box 50 Perkins Calif—M B Kibby—GL 1-6571—Wire & Cable, Cabinets, Racks, Panels & Accessories, Kits

Kidwell Inc 7762 Burnet Ave Van Nuys Calif

Kilburn Corp James 2515 Palm Pl San Mateo Calif—FI 1-3421

Kilo Eng'g Co 2011 3rd St LaVerne Calif—J B Gach—17 Employees—Dials & Front Panel Accessories, Services (Industrial)

Kinco Mfg Co 5211 Telegraph Rd Los Angeles Calif—AN 8-1201

Kinetics Corp 410 S Cedros Solana Beach Calif—F E Matthews—90 Employees SK 5-1181 — Power Changeover Switches, Static Commutators & Inverters, Voltage Testers

King Laboratory Inc 2645 S 2nd St Salt Lake City Utah

Kingman Enterprises 4210 San Fernando Rd Glendale Calif

△Kingley Machine Co Electronic Div 850 Cahuenga Blvd Hollywood Calif—HO 9-7243

Kinsley Machine Co Electronics Div 850 Cahuenga Blvd Hollywood 38 Calif—John M Butler

△KinTel Div Cohu Electronics 5725 Kearney Villa Rd San Diego 11 Calif—Henry J Pannell

Kitcraft Products Co 4507 Brunswick Ave Los Angeles Calif—CL 3-8710

Kittel-Lacy Inc 10816 E Fawcett Ave El Monte Calif—GL 4-9567

Kit-Tronics 2315 Hendola Dr N E Albuquerque N M—Walter C Hunter—1 Employee—AX 9-1089—Testers

Kitway Electronic Products Corp Box 37205 Los Angeles Calif—PL 3-2387

Kleer-Marine-Tronics 1933 Ocean Ave San Francisco Calif

Klein Electronics Co Leo 2404 S LaBrea Ave Los Angeles 16 Calif—Harold Navis—WE 5-3119—Production Machinery & Equipment, Meters (Electrical Measurement)

Klisey Eng'g Co 4407 Union Pacific Ave Los Angeles Calif—AN 9-2265

△Knapic Electro-Physics Inc 936-38 Industrial Ave Palo Alto Calif—YO 8-4408—Semiconductors

Knopp Inc 1307 66th St Oakland Calif—OL 3-1661

Koch & Sons H P O Box 127 Corte Madera Calif—WA 4-3510

Koenig Co Fred P 3815 Atlantic Ave Long Beach Calif

KPF Electric Co 1624 E Alpine Stockton Calif—HO 4-8381—Switches

Kruger Instruments Harold P O Box 164 313 Valley San Gabriel Calif

Kurz & Root Co Pacific Div 2033 N Lincoln St Burbank Calif—VI 9-5818

Kwikheat Mfg Co 3732 San Fernando Glendale 4 Calif—Elmer E Watcher—6 Employees—Tool (Hand)

L

Lake Mfg Co 2323 Chestnut St Oakland 7 Calif—W E Howe—26 Employees—TE 2-2498—Audio Amplifiers & Equipment, Communications Systems

*Lambda-Pacific Engineering Inc 14725 Armita St Van Nuys Calif—L W Mallach—52 Employees—ST 2-1980—Microwave Relay Systems, Microwave Test Equipment, UHF Translators

Lamcor Inc 765 E Pico Blvd Los Angeles Calif—RI 9-7891

Laminair Inc 18530 S Broadway Gardena Calif—I W Love—App 20 Employees—FA 1-0545—Radomes, Antenna Structure, Structural Airborne Components of Fiberglas Reinforced Plastic

La Moree C D 2433 Birkdale Los Angeles Calif—Ben Ley—12 Employees—CA 5-5666—Dielectrics, Engraving, Insulating Compounds

Lance Antenna Mfg Co 1730-1802 1st St San Fernando Calif—Milton Mann—35 Employees—EM 1-8645—Outdoor Antennas, FM Antenna, Fringe Area Antennas

Land-Air Inc 1732 W Slauson Los Angeles Calif—AX 5-5421

△Land-Air Inc Stepper Motors Div 16226 S Broadway Gardena Calif—Clarence Adams

Land-Air Instrument & Electronics Div 2133 Adams Ave San Leandro Calif—B Pat Moore—80 Employees—LO 9-5841—Sub-Miniature Receivers, Radioactive Gas Monitors, Alpha Particle Converters

*Land-Air Inc P O Box 2327 Airport Sta Cheyenne Wyo—J T Shelton—232 Employees — 2-6481 — Missile Ground Support Equipment, Engineering & Fabrication of Aircraft Retrofit Kits for Modification of Aircraft

Landsverk Electrometer Co 641 Sonora Ave Glendale 4 Calif—D L Collins—CH 5-6687—Nuclear Products, Tubes, Meters (Special Purpose)

Lane Electronics Mfg Corp 7254 Atoll Ave N Hollywood Calif—John T Chase—22 Employees—PO 5-2413—Engineering & Production Prototypes of Electronic Units, Custom Radio Control Panels, Modification & Overhaul of Airborne Electronic Equipment

Lanes Industries Corp Cornell Deep Drawing Co Div 612 Colorado Ave Santa Monica Calif—UP 0-7970

Langert Bros Co 14 N Central Ave Phoenix Ariz

Lansing Sound Inc James B 3249 Casitas Ave Los Angeles 39 Calif—200 Employees—NO 5-4101 — Loudspeakers (High Fidelity), Loudspeaker Systems & Enclosures

Larson Electronic Glass P O Box 371 2426 El Camino Real Redwood City Calif—J Palmer Larson—4 Employees—EM 8-7228—Metal to Glass Seals, Electronic Components Sealing

Lawrence Lab 1668 Euclid St Santa Monica Calif—EX 5-8249

L & B Welding Equipment Inc 2424 6th St Berkeley 10 Calif—C F Leader—40 Employees — TH 3-5734 — Controls, Testing & Welding Equipment

Leach Corp—Communications Div 18435 Susana Rd Compton Calif—(Miss) Beverly Johnson—2 Employees—NE 6-1061 — Mobile Communications Equipment, Military Equipment, Communications Systems

^Leach Corp Inet Div 18435 Susana Rd Compton Calif—(Miss Beverly Johnson—102 Employees—NE 6-1061—Power Supplies & Converters, Control Equipment (Industrial), Motors & Generators & Blowers

Leach Corp Leach Relay Div 5915 Avalon Blvd Los Angeles 3 Calif—G F Rosewell—App 484 Employees—AD 2-8221—Relays (Over-Voltage & Under-Voltage Relays & Contactors)

Leach Corp Special Products Div 516 E Compton Blvd Compton Calif—(Miss) Beverly Johnson—11 Employees—NE 6-0683 — Amplifiers (Special Purpose, Recorders (Audio), Computers

Leaming Eng'g Inc 3743 Cahuenga Blvd N Hollywood Calif—TR 7-3233

LeBec Chemical Corp 14066 S Garfield Ave Paramount Calif—D Stapleton—10 Employees—Chemicals, Coatings & Related Products, Insulation Materials & Compounds

Leed Insulator Corp 781-793 E Pico Blvd Los Angeles Calif—Plastic Fabrication Serving U S & Foreign

Lefco Products Inc 15521 Lanark St Van Nuys Calif—TR 3-1991

Le Feill Mfg Co 3359 Packers Ave Los Angeles Calif

Leland Inc G H 4331¼ Leimert Blvd Los Angeles Calif—AX 2-9183—Rotary Solenoids, Switches, Relays & Syncramental Stepping Motors

△Lenkurt Electric Co Inc 1105 County Rd San Carlos Calif—Communications & Telemetering Systems

△Lerco Electronics Inc 501 S Varney Burbank Calif—VI 9-5556

Leupold & Stevens Instruments Inc 4445 N E Glisan St Portland 13 Ore—R J Stevens—50 Employees—BE 4-7432—Recorders (Special Purpose), Indicators

Levin & Son Louis 3610 S Broadway Los Angeles 7 Calif—Samuel Levin—AD 3-7169 — Production Machinery & Equipment

△*Leventhal Electronic Products Inc 3180 Hanover St Stanford Industrial Park Palo Alto Calif—Albert J Morris—80 Employees—DA 6-1640—Transmitters, Modulators, Power Supplies

Lewis Electronics Inc 103 W Indian School Rd Phoenix Ariz—F F Lewis Jr—CR 9-4661 — Services (Industrial), Transformers, Indicators

Lewis & Kaufman Ltd P O Box 337 Los Gatos Calif—Alfred Thompson—60 Employees — EL 4-3540—Transmitting Electron Tubes

△Librascope Div General Precision Inc Glendale Branch 808 Western Ave Glendale 1 Calif—K J Slee—1276 Employees — Computers, Amplifiers (Special Purpose), Military Systems (Eng'g)

Librascope Div General Precision Inc Burbank Branch 100 E Tujunga Ave Burbank Calif — K J Slee — 175 Employees — VI 9-6061 — Computers, Measurement & Test Equipment (Special Purpose), Recorders (Special Purpose)

Librascope Inc Precision Technology Dept 66 S "P" St Livermore Calif—Kenneth A Johnson—90 Employees—HI 7-3343—Exploding Bridgewire Ordnance Components, Proximity Scoring Devices, Image Converter Cameras

Likens Coil Mfg Co 3255 W Rosecrans Ave Hawthorne Calif—OS 6-3736

Lincoln Electronics Corp 1773 Lincoln Ave Anaheim Calif—PR 4-1107

△Ling-Altec Electronics Inc Ling Electronics Div 1515 S Manchester Ave Anaheim Calif—L E Gillingham—PR 4-2900

Ling Electronics 1515 S Manchester Ave Anaheim Calif—W S Northbridge—300 Employees—TE 0-7711—Vibration Test Systems, High Fidelity & High Intensity Sound Systems, High Power Transmitting & Industrial Tubes

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Link Aviation Inc P O Box 1318 Palo Alto Calif—Ray Rutman

Linlar Inc 4101 San Fernando Rd Glendale 4 Calif—S H Ise—CL 2-8811—Power Supplies & Converters, Amplifiers (Audio), Coils

Lipps Co Edwin A 1511 Colorado Ave Santa Monica Calif—Bernard D Lipps — EX 3-0449 — Sound Reproducing Equipment (Magnetic), Recording Accessories, Computers

Litton Eng'g Labs P O Box 949 Grass Valley Calif—F L Towne—70 Employees — GR 1730 — Glassworking Lathes & Accessories, Vacuum Pumps, Hydrogen Furnaces

△Litton Industries Inc Electronic Components Div 336 N Foothill Rd Beverly Hills Calif—Crosby M Kelly—1100 Employees—CR 4-7411—Electronic Components, Equipment & Systems

^Litton Industries/Components Div Rodeo Rd Culver City Calif—Richard Williamson—12000 Employees—CR 4-4711—Printed Circuits, Computers, Radar Systems

Litton Industries 1476 66th St Emeryville Calif—Robert H Dolbear—30 Employees—OL 8-3831—High Definition & Special Cathode Ray Tubes, Computer & Image Storage Type Cathode Ray Tubes, Color Tubes

△Litton Industries/Electron Tube Div 960 Industrial Rd San Carlos Calif—Norman H Moore—1350 Employees—LY 108411—Carcinatrons, Filters, Tubes

Litton Industries U S Eng'g Div 13536 Saticoy St Van Nuys Calif—Paul J Robichaud — App 100 Employees — TR 3-3520 — Electronic Hardware, Printed Circuits, Terminals & Terminal Boards

Livermont Inc Myrtle & Mapel Ave Monrovia Calif—EL 9-2555

LMB Co 1101 Venice Blvd Los Angeles Calif—DU 7-6995

Lockheed Aircraft Missile Systems Div 3251 Hanover Palo Alto Calif—DA 4-3311

Lockheed Aircraft Missile Systems Div 1122 Jaegals Rd Sunnyvale Calif—RE 9-9611

Lockheed Aircraft Missile Systems Div 7701 Woodley Ave Van Nuys Calif—ST 6-4210

Lockheed Electronics & Avionics Div Lockheed Aircraft Corp 6201 E Randolph St Los Angeles 22 Calif—S J Jatras—495 Employees—RA 3-8896 — Telemetry Systems, Magnetic Tape Recorders (Airborne), Miniaturized Television Systems

△Lockheed Electronics Co 2555 N Hollywood Way Burbank Calif—J F Waters

△Lockheed Missile & Space Div 1122 Jagels Rd Sunnyvale Calif — L E Root—15000 Employees—RE 9-9611—Military Systems Engineering, Missiles

Loge J M 2171 W Washington Blvd Los Angeles 18 Calif—J M Loge—29 Employees—RE 4-9178—Inter-office Communication Systems, Audio Amplifiers, Portable Public Address Systems

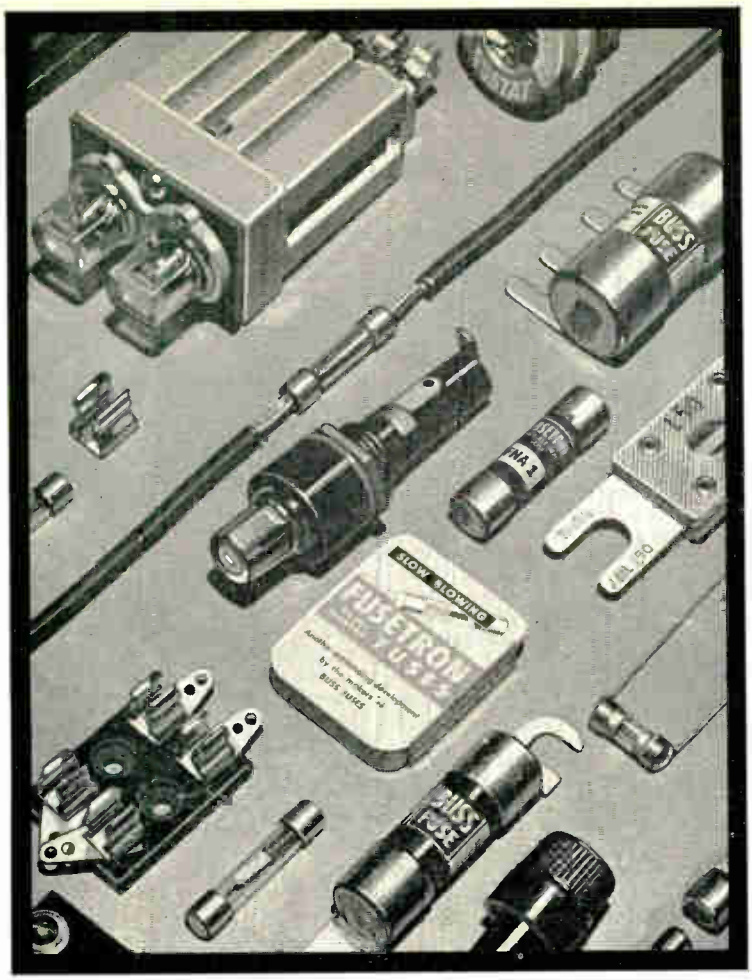
Long-Lok Corp 2681 Colorado Ave Santa Monica Calif

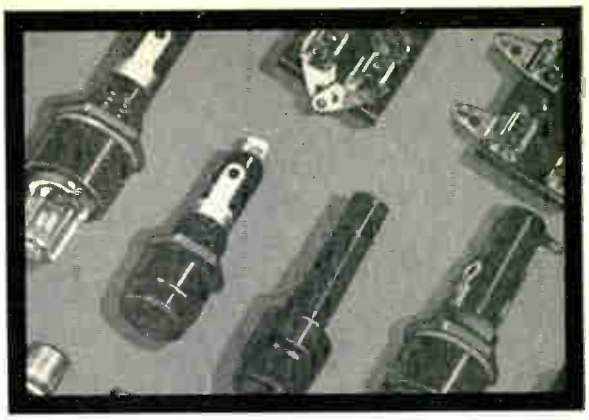
Los Angeles Plating Co 6921 Avalon Los Angeles Calif

Loyola Laboratories Box 90074 Airport Sta Los Angeles Calif—OR 8-1686

Lubeco Inc 15725 Illinois Ave Paramount Calif

Luther Electronic Mfg Co 5728 W Washington Los Angeles Calif—WE 9-5826





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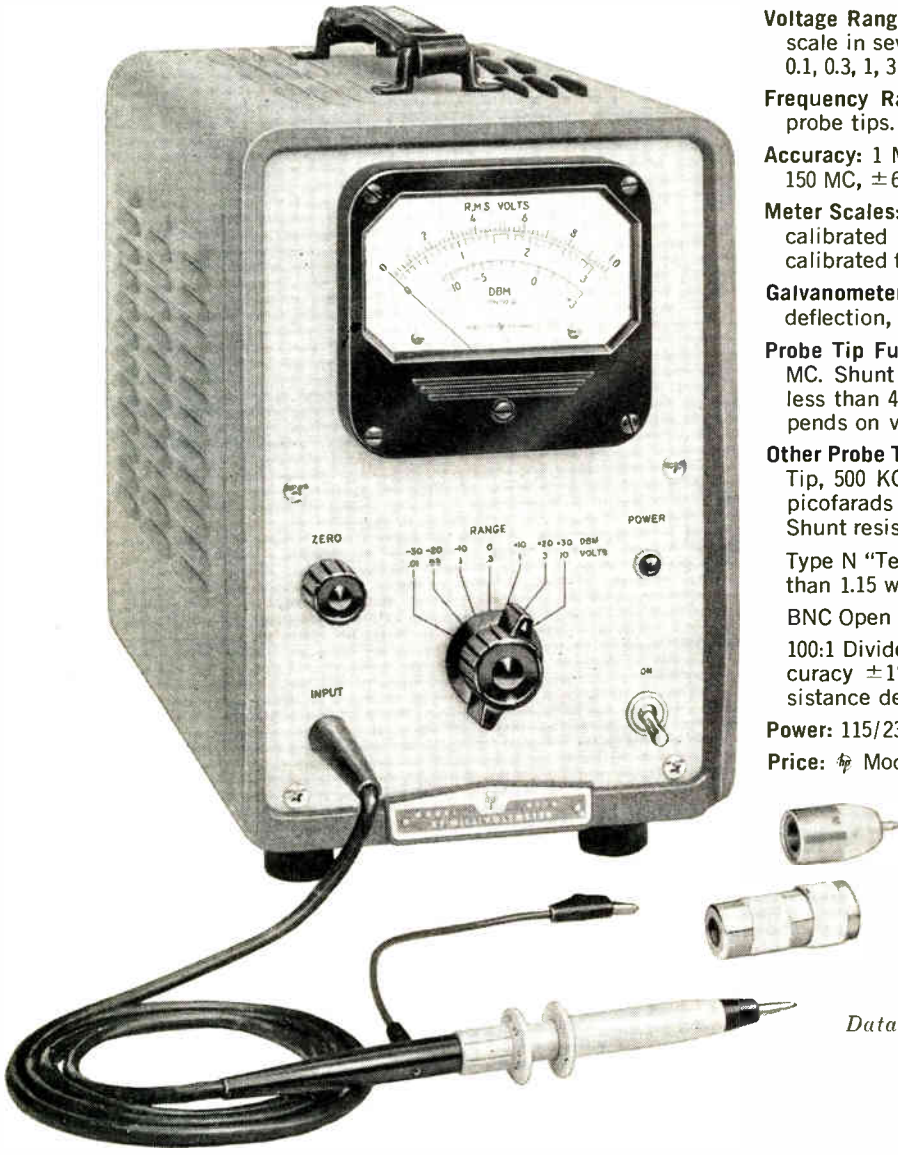

Specifications

Voltage Range: 10 mv rms full scale to 10 volts rms full scale in seven ranges. Full scale readings of 0.01, 0.03, 0.1, 0.3, 1, 3 and 10 volts rms.

Frequency Range: 500 KC to 1,000 MC with accessory probe tips.

Accuracy: 1 MC to 50 MC, ±3% of full scale; 50 MC to 150 MC, ±6% of full scale; 500 KC to 1,000 MC, ±1 db.

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Probe Tip Furnished: Pen type Probe Tip, 500 KC to 50 MC. Shunt capacity less than 3 picofarads at 1 volt, less than 4 picofarads at 10 mv. Shunt resistance depends on voltage and frequency.

Other Probe Tips Available at Additional Cost: VHF Probe Tip, 500 KC to 250 MC. Shunt capacity less than 1.5 picofarads at 1 volt, less than 2 picofarads at 10 mv. Shunt resistance depends on voltage and frequency.

Type N "Tee" Probe Tip, 500 KC to 1,000 MC. SWR less than 1.15 when terminated in 50 ohms.

BNC Open Circuit Probe Tip, 500 KC to 500 MC.

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Lynde Electronics 1526 E 4th St Long Beach Calif

Lyn-Tron Inc 5350 Riverton Ave N Hollywood Calif—Jack R Snyder—8 Employees — ST 7-9023 — Printed Circuit Hardware, Molded Products, Connectors

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M

McAlister Inc J G 1117 N McCadden Pl Hollywood 38 Calif—W A Klinger—HO 9-5317—Lighting Equip & Accessories, Studio Equipment

McCormich Selph Assoc Hollister Airport Hollister Calif—Frank B Pollard—100 Employees—Me 7-3731 Connectors & Terminals, Hardware, Aviation Auxiliary Electronic Equip

McCulloch Motors Corp 6101 W Century Los Angeles Calif — Missile Contractor

*McGraw-Edison Co Penn Transformer Div 936 Commercial Palo Alto Calif

McKnight Co Box 543 Menlo Park Calif—DA 6-3762

McKenna Labs 2503 Main St Santa Monica Calif—A G McKenna—10 Employees — EX 9-8846 — Ultrasonic Equipment

McPherson Corp 1361 S Broadway Denver 10 Colo—Dewe N Stevens 35 Employees—PE 3-2481—Hardware

△MacDonald & Co 1324 Etherl St Glendale 7 Calif—D G MacDonald—4 Employees—SY 0-1651—Sleeving Cutter, Jiffy Connector & Plug Holders, Circuit Board Holders

MacKay Research Labs P O Box 738 Benson Ariz—S H MacKay—11 Employees—Lead Sulphide Tubes, Magnetrons, Miscellaneous Type Photoconductive Tubes

MacKenzie Electronics Inc 145 W Hazel St Inglewood 3 Calif—Louis G MacKenzie — 15 Employees — OR 8-9335—Audio Equipment, P A Systems, Audio Recorders

Maghead Labs Inc 702 S Arroyo Prkwy Pasadena Calif — MU 1-0888 — Digital Computer, Magnetic Heads, Multi-Channel Modulator

△Magnasync Mfg Co Ltd 5546 Satusuma Ave N Hollywood Calif — Howard V Auchstetter—45 Employees—ST 715493—Amplifiers, Consoles, Control Equipment

*Magnavox Co Sentinel Radio Corp Div-Research Labs 2255 S Carmelina Ave Los Angeles Calif—GR 9-7796

*Magnavox Research Labs 2255 Carmelina Ave Los Angeles 64 Calif—J J Slattery—220 Employees—GR 9-7796 — Digital Data Processers, Telemetry Commutators—Switches, Digital Communication Equipment

*Magnecraft Electric Co 1157 N Western Ave Los Angeles 27 Calif—Richard A Strassner

Magne-Head Div General Transistor Western Corp 2660 S LaCienega Blvd Los Angeles 34 Calif—Martin Braude—55 Employees—UP 0-8601—Computers, Sound Reproducing Equip (Magnetic), Recording Accessories

*MagneTec Corp 7232 Eton St Canoga Park Calif—Vern Johnson—15 Employees — DI 7-4642 — Magnetic Brakes, Controls, Magnetic Clutches

Magnetic Amplifiers Inc 136 Washington St El Segundo Calif—Morris Beard—OR 8-2665—Magnetic Amplifiers, Variable Speed Drives, Motor Generator Controls & Systems

Magnetic Circuit Elements Inc 3722 Park Pl Montrose Calif—John S Conklin — 15 Employees — CH 5-2012—Magnetic Amplifier, Transformers, Instrument Sensors

Magnetic Recorders Co 7120 Melrose Ave Los Angeles Calif—E G Van-Leeuwen — Recorders (Audio), Head-phones, Power Supplies & Converters

Magnetic Research Corp 3160 W El Segundo Blvd Hawthorne Calif—John L Boethling—157 Employees—OS 5-1171 — Magnetic Components & Sub-Assemblies, Signal Conditioning Systems, Universal Temperature Measuring Systems

Magnetic Systems Inc 225 W Duarte Rd Monrovia Calif — EL 9-6631 — Toroids, Toridial Filters, Crystal Filters

*Magnetics Inc 3941 E Colorado Blvd Pasadena Calif MU 1-7487

*Magnetics Inc 1743 Maryland Ave Redwood City Calif—EM 6-1210

Magnuson Engineers Inc 509 Emory St San Jose 10 Calif — Traver J Smith—CY 2-3657—Measurement & Test Equipment (Counters), Relays, Meters (Special Purpose)

*Mallory Co Inc P R 9121 E Garvey Rosemead Calif—CU 3-5921

Mandrel Industries Inc Burbank Div 2950 N Ontario St Burbank Calif—Edward J Stephens—280 Employees—VI 9-2341—Custom Cable, Sheet Metal Fabrication & Electronic Assemblies

Mandrel Industries Inc 800 Welch Rd Palo Alto Calif—W E Wilson—DA 1-2366 — Seismic Exploration Equipment, Photoelectric Sorting Machines, Intergrating Gyroscopes

Manor TV & Electronics 109 W 25th Ave San Mateo—FI 5-3360

Manufacturers Lab 10610 Keswick St Sun Valley Calif—H P Stark—Sound Reproducing Equipment (Disc)

Mark-Line 7227 Whitset Ave N Hollywood Calif

*Marman Div Aeroquip Corp 11214 Exposition Blvd Los Angeles 64 Calif—Myra Sparkman—GR 3-0932—Pneumatic & Hydraulic Systems

Marquart Aircraft Co Pomona Div 2709 N Garvey Ave Pomona Calif—U W Richardson — 368 Employees — LY 3-1311—Trainers & Stimulators, Ground Support Equioment, Data Processing & Display Equipment

Marquardt Aircraft Co 16555 Saticoy St Van Nuys Calif—ST 5-8361—Missile Test Equip & Beacons

Marquardt Aircraft Co 1000 W 33rd St Ogden Utah—Missile Test Equip Z Beacons

Marquardt Aircraft Co/Copper Development Div 2626 S Peck Rd Monrovia Calif—MU 1-5664

△Marshall Industries 2065 Huntington Dr San Marino Calif—Gerald C Wolcott

Martin Co P O Box 179 Denver Colo

Martin Co 12250 S Hwy 75 Littleton Colo

Mason Electric Corp 3839 Verdugo Rd Los Angeles 65 Calif—L H Littlefield—50 Employees—CL 5-1431—Switches, Relays & Contactors

Master Crystal Lab Div 1342 S LaBrea Ave Los Angeles Calif—WE 3-7256

△Master Specialties Co 956 E 108th St Los Angeles—LO 4-4481—Time Delay & Phase Sequence Relays

Master Mobile Mounts Inc 1306 Bond St Los Angeles 15 Calif—Walter Watt—27 Employees—RI 7-0638—Antennas, Radio-Tel Equipment

Matticks Mfg Co 4156 E Pacific Wy Los Angeles Calif—AN 3-8771

Mattson Electronics Corp 11647 McBean Dr El Monte Calif — CU 3-3471

Mayberry Elec Co 111 S Oak Inglewood Calif — OR 8-4847 — Servo Boltmeters & Amplifiers

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Mayer Frank Engrg Co 6642 Santa Monica Blvd Los Angeles Calif

Meadows Terminal Boards 4850 El Camino Real Los Altos Calif

Meagher Electronics Co 457 Tyler Monterey Calif—FR 2-0425

Mechanical Products Inc 1226 W Olive Burbank Calif

Medistor Instrument Co 1443 Northlake Way Seattle 3 Wash—W D Hamm—ME 3-5145—Amplifiers (Special Purpose), Measurement & Test Equipment (Oscilloscopes), Medical Electronic Equipment

Meditronics Assocs 1443 Northlake Wy Seattle Wash—ME 3-5145

Mega Corp 5330 E Olympic Blvd Los Angeles—RA-5750

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△Micrometals 72 E Montecito Sierra Madre Calif—EL 5-2370

Micrometics Corp 158 N Kinnola Ave Pasadena Calif—SY 5-5941

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*Minnesota Mining & Mfg Co Zenith Plastics Co Div P O Box 91 Gardena Calif—FA 1-2020

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Mission Controls 3536 Rosemont N El Monte Calif

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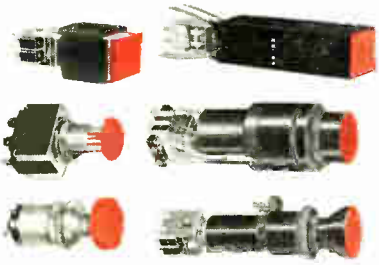

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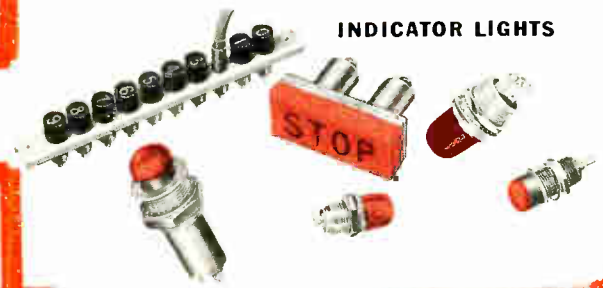

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PEK Labs Inc 4024 Transport Ave Palo Alto Calif—DA 1-2787

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Pendar Inc 14744 Arminta St Van Nuys Calif—R C Carter—65 Employees—TR 3-3136—Switches & Indicator Assemblies, Electronic Assemblies, Power Resistors

△Penta Labs 312 N Nopal St Santa Barbara Calif—R L Norton—104 Employees—WO 5-4581—Electron Tubes

△Perkin Eng'g Corp 345 Kansas St El Segundo Calif—George W Mousel—170 Employees—OR 8-7215—Static DC Power Supplies, AC Line Voltage Regulators, Inverters-Converters (Static)

Permaluster Inc 2012 Burbank Blvd Burbank Calif—VI 9-4543

Permanent Filter Corp 1800 W Washington Blvd Los Angeles Calif—RE 1-7381

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Pesco Products Div Western Branch Borg-Warner Corp 3310 Vanowen St Burbank Calif—R H Montgomery—24 Employees—TH 5-7411—Motors, Generators & Blowers, Power Supplies & Converters, Military Equipment

△Phaostron Instrument & Electronic Corp 151 Pasadena Ave S Pasadena Calif—CL 2-1471—Electric Panel Meters, Frequency Sensitive Relays, Special Products for Electronic, Electric & Aircraft Equipment

Phoenix Transformer Co 1818 E Madison Phoenix Ariz—AL 4-9747—Custom Transformers

△Photo Chemical Products 1715 Berkeley St Santa Monica Calif—Henry G Renaud—175 Employees—EX 5-0919—Electronic Chemicals, Dials, Engraving

Photocon Research Products 421 N Altadena Dr Pasadena Calif—Mrs P C Ganzell

Photo Research Corp 837 N Cahuenga Blvd Hollywood Calif—HO 2-6647

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Pickup Precision Gear Co 1926 Placentia Costa Mesa—LI 8-2225—Gears & Gearheads

Pioneer Broach Co 6434 Telegraph Rd Los Angeles 22 Calif—A E Ezor—RA 3-4536—Production Machinery & Equipment

Pioneer Electronics Corp 2235 S Carmelina Ave Los Angeles 64 Calif—Zarmond Goodman—75 Employees—BR 2-8053—Relays, Switches, Tubes

Plastic Associates 185 Mountain Rd Laguna Beach Calif—R A St Onge—HY 4-7857—Chemicals, Coatings & Related Products, Insulation Materials & Compounds, Connectors & Terminals

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Plasti-Parts Mfg Co 2774 E Walnut Pasadena Calif—MU 1-5221

P & M Electromechanical Mfg Co 13917 Saticoy Van Nuys Calif—PO 5-5199

Polytron Industries 1010 Howard Ave San Mateo Calif—DI 2-7261

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Precision Capacitors Inc 150 W Cypress Ave Burbank Calif—VI 9-3193

Precision Castparts Corp 4600 S E Harney Dr Portland 6 Ore—H H Price—150 Employees—Magnetics, Hardware

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Precision Crystal Lab 2223 Warwick Ave Santa Monica Calif—EX 4-7004

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Precision Resistance Products Co P O Box 51 West Covina Calif

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Propulsion Development Labs 236 California St El Segundo Calif—OR 8-8687

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Radar Engineers 4719 Brooklyn Seattle Wash—Electronic Test Equipment

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Radiation Detection Co 4047-49 Transport St Palo Alto Calif

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This system offers versatility in conventional operation. You can use a time-base plug-in unit with (1) a simple signal-amplifier plug-in unit, (2) a dual-trace, (3) a wide-band, or (4) a differential-input plug-in unit. In addition, you can operate the Type 561 as an X-Y oscilloscope by using identical signal-amplifier plug-in units in both the vertical and horizontal channels.

The Type 561 is designed to accept contemplated plug-in amplifier and time-base units for specialized applications in the electronic, electrical, mechanical, medical, chemical, and other fields. Unlike earlier similar instruments, it is not subject to the limitations imposed by active or passive circuitry between the plug-in units and the crt deflection plates.

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5-inch monoaccelerator cathode-ray tube.

3.5-kv accelerating potential.

New deflection blanking.

8-cm by 10-cm viewing area.

Regulated power supply, capable of both present and future plug-in current requirements.

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Calibrator—line-frequency square wave with 2-μsec rise-time, 0.2 mv to 100 v, accuracy within 3%.

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Passband—dc to 800 kc.

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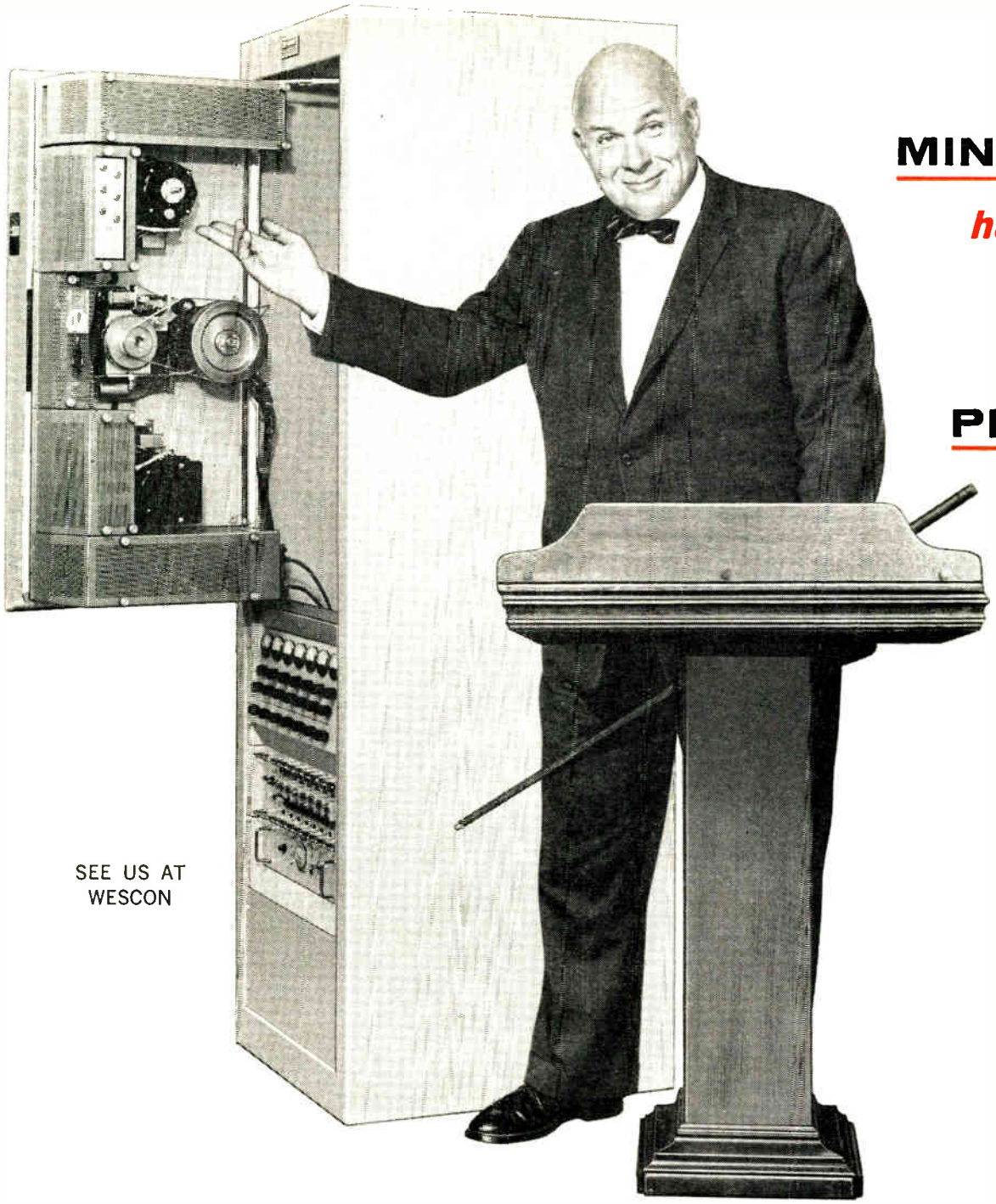

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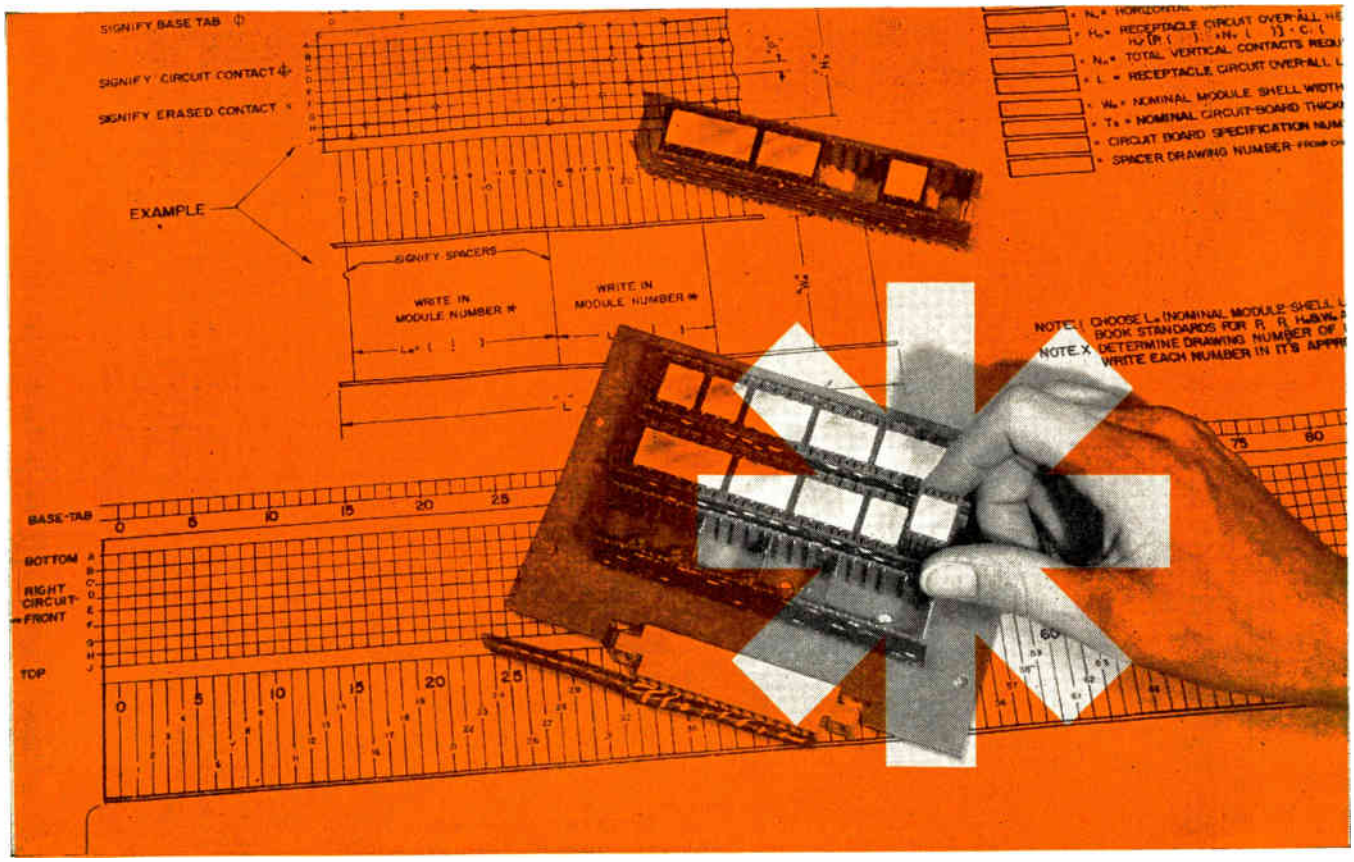

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△Western Gear Corp 2600 E Imperial Hwy Lynwood Calif—Glenn W Malme

Western Gear Corp/Electro Products Div 132 W Colorado St Pasadena Calif—R Conlisk—140 Employees—SY 6-4395—AC & DC Fractional HP Motors, Mil Spec Fans & Blowers, Aircraft Heaters

△*Western Gold & Platinum Co 525 Harbor Blvd Belmont Calif — Walter Hack—85 Employees—LY 3-3121—Hi-Temperature, Hi-Purity Alumina Ceramics, Low Vapor Pressure Brazing Alloys, Molybdenum Ribbon

Western Instrument Co 826 N Victory Blvd Burbank Calif—Albert K Edgerton — VI 9-3013 — Services (Industrial), Measurement & Test Equipment (Generators), Meters (Audio)

Western Insulated Wire Co 2425 E 30th St Los Angeles 58 Calif—John Monsos—LU 7-7103—Wire & Cable

Western Intaglio Inc 1710 W Washington Blvd Los Angeles—Dale J Messerschmitt—RE 1-7395—Printed Circuits

Western Pacific Transformer 750 San Antonio Rd Palo Alto Calif

Western Radiation Lab 1107 W 24th St Los Angeles 7 Calif—H L Locher—4 Employees—RI 7-8355—Radioisotope Sources & Nucleonia Instruments, Light Receivers, Medical GM Counter Tubes

Western Scientific Instrument Co 2431 Spring Redwood City Calif

Western Sheet Metal Co 2731 W Pico Blvd Los Angeles Calif—RE 1-8368

Western States TV Tube Mfg Corp 1504 Lemon Vallejo Calif—MI 2-1037

Western Transformer Co 618 E 11th Oakland Calif

△Westline Products Div/Western Litho Co 600 E 2nd St Los Angeles 54 Calif—Ben Birken—App 400 Employees —MA 7-2641—Wire Markers, Tubing & Sleeving, Special Labels & Markers

Westport Electric 149 Lomita St El Segundo Calif—OR 8-9993—Electronic Counting & Frequency Measuring Instruments

Westwood Cable Corp 3440 Overland Ave Los Angeles Calif—UP 0-6831—Aircraft Starting Cables, AC, DC, & Jet Telephone Switchboard, Patch & Hand Set Cords

Whittaker Gyro 16217 Lindbergh St Van Nuys Calif—D Rammage—480 Employees—ST 3-1950 Electrically Operated Gyros

△Wiancko Eng'g Co 255 N Halstead Ave Pasadena Calif—R Major—280 Employees — EL 5-7186 — Transducers, AM & FM Systems, Commutators

Wiggins Oil Tool Co E B 3224 E Olympic Blvd Los Angeles 23 Calif—Robert A Wolfe—Checkout Equip & Test Equip

Wildberg Bros Smelting & Refining Co 742 Market St San Francisco 2 Calif—Walter T Haley—DO 2-3505—Materials (Raw), Chemicals Coatings & Related Products, Services (Industrial)

Wiley Electronics Co Div Savage Industries 2045 W Cheryl Dr Phoenix Ariz—Fred Heisley—10 Employees—Antennas (Commercial), Antennas (Accessories), Filters

Wilkinson Co 1660 9th St Santa Monica Calif

Williamette Iron & Steel Co 2800 N W Front Ave Portland Ore

Wilshire Power Sweeper Co 526 W Chevy Chase Glendale Calif—CH 5-5178—Missile Ground Handling Equipment

Winkley Labs 5225 N 20th St Phoenix Ariz—M R Winkler—AM 6-5952—Analyzers, Testers

Winslow Eng'g & Mfg Co 4069 Hollis St Oakland Calif—OL 2-0288

Wirco Electronics Inc 11680 McBean Dr El Monte Calif—Vincent Wirth—11 Employees—GI 3-1433—Electronic Windings

Wiremold Co 1513 Mateo Los Angeles Calif—MA 3-3101

Wittek Products Co 14750 Keswick St Van Nuys Calif—ST 0-8265

Woodwelding Inc 355 N Newport Blvd Newport Beach Calif—LI 8-6123

World Plastics Co 3929 W 139th St Hawthorne Calif—OS 9-1585

△Wyco Metal Products Stanton Div 6918 Beck Av N Hollywood Calif—Forrest N Weiss—50 Employees—TR 7-5579—Relay Racks, Chassis, Cases

Wyle Laboratories 128 Marylind St El Segundo Calif—Elmer R Easton—300 Employees — OR 8-4251 — Environmental, Functional & Combined Testing of Missile & Aircraft Components & Systems

△Wyle Mfg Corp 133 Center St El Segundo Calif—J A Sneller—35 Employees—EA 2-0659—Environmental Test Chambers, Liquid Storage Vessels, High-Force Vibration Test Systems

Y

Young Spring & Wire Co Gonset Div 801 S Main St Burbank Calif—William E Hunter—VI 9-2222—Transmitters, Antennas (Commercial), Receivers (Communication)

Yuba Consolidated Industries 351 California St San Francisco Calif

Z

Zenith Radio Research Corp 841 Warrington Ave Redwood City Calif—EM 9-0355

Zep Aero 113 Sheldon St El Segundo Calif—OR 8-1161

Zephyr Mfg Co Inc 201 Hindry Ave Inglewood Calif — OR 8-4331 — Missile Ground Support & Ground Equipment

△*Zero Mfg Co 1121 Chestnut St Burbank Calif—Raymond A Harper—200 Employees—TH 6-4191—Container, Cases & Aluminum Fabrication

Zeus Eng'g Co Inc 635 S Kenmore Ave Los Angeles 5 Calif—H Patrusky—App 10 Employees—DU 7-7175—Transistor Index

Zinn Instruments 213 S Hawthorne Hawthorne Calif—OS 6-6055

Zip Industrial Products Inc 7282 Bellaire N Hollywood Calif—TR 7-3828

△Zippertubing Co 752 S San Pedro St Los Angeles 14 Calif—H Robert Edwards—25 Employees—MA 4-6664—Automatic Cable Making Machine & Plastic Cable Jackets

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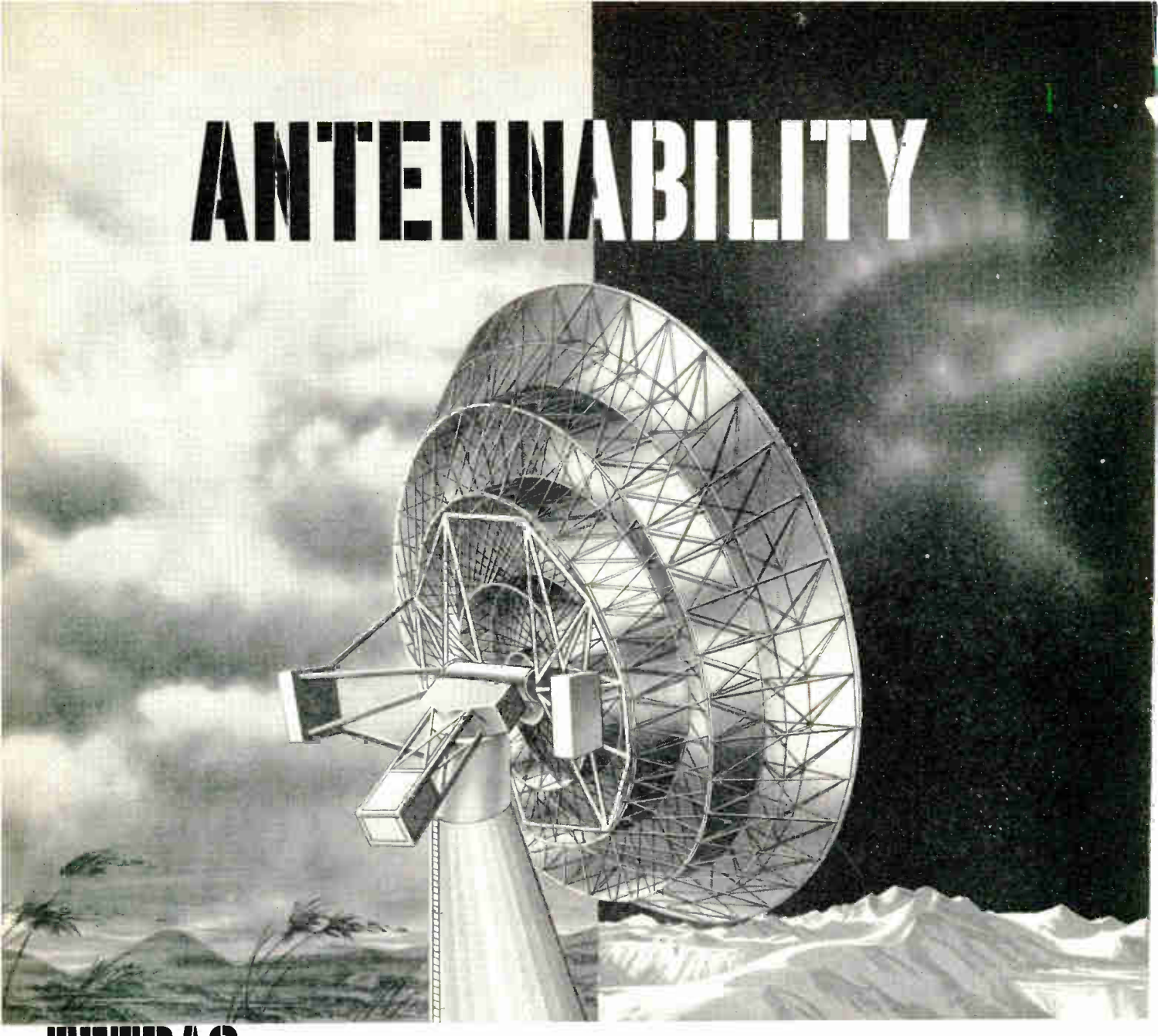

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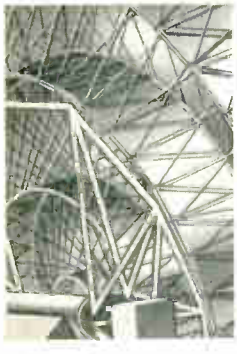

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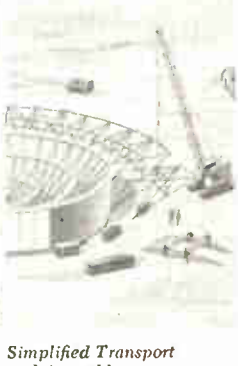

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10 Acoustica Associates, Inc. — Ultrasonic cleaning equipment
153 Adams & Westlake Company, The—Mercury wetted contact relays
85 Airborne Accessories Corporation—Stepping motor
135 Alford Manufacturing Company—Automatic impedance plotters
139 Allegheny Ludlum Steel Corporation—Electrical steels
71 Allen Avionics, Inc.—Delay lines
42 Allied Chemical, General Chemical Division—Electronic-grade chemicals
134 American Super-Temperature Wires, Inc. —Magnet wire
105 AMP Incorporated—Plug-in circuit units
12 Amphenol-Borg Electronics Corporation —Modular circuitries
158 Anderson Controls—Miniature solenoids
35 Antenna Systems, Inc.—High precision 30-foot antenna
38 ARCO Electronics, Inc.—Distributor of ELMENCO capacitors
136 Armco Steel Electrical Corporation — Electrical steels
87 Artos Engineering Co.—Wire finishing machine
83 Automatic Timing & Controls, Inc., Subsidiary of American Mfg. Co., Inc.—Differential transformers
37 Avnet Electronics Corp.—Distributor of Speery tunnel diodes

90 Baldwin-Lima-Hamilton Electronics & Instrumentation Division — Strain gages
46 Ballantine Laboratories, Inc.—Electronic voltmeter
147 Barker & Williamson, Inc. — Filters, transformers and networks
84 Bendix Corporation, The Red Bank Division, Semiconductor Products — Diffused alloy power transistors
17 Bendix Corporation, The, Red Bank Div., Tubes—Ceramic-metal terminal
32 Bendix Corporation, The, Scintilla Div. —Ignition system
132 Birtcher Corporation, The—Diode radiators
148 Biwax Corporation—"Hot melt" encapsulating compounds
124 Bliley Electric Company—Plug-in crystal oscillator
338 Bomac Laboratories, Inc.—Magnetrons
55 Borg Equipment Division, Amphenol-Borg Electronics Corp.—Absolute-linearity micropotentiometers
140 Bruno-New York Industries Corp.—Pigtailoring machine
49 Brush Instruments, Division of Clevite Corp.—Portable recorder
50 Brush Instruments, Division of Clevite Corp.—Direct writing recording systems
151 Buchanan Electrical Products Corporation—Connecting terminal blocks
31 Bulova Electronics Division — Portable frequency standard
322 Burgess Battery Company—Batteries
128 Burnell & Co., Inc.—Adjustable toroids
149 Bussmann Mfg Division, McGraw-Edison Co.—Fuses and fuseholders

70 Cambridge Thermionic Corporation — Panel handles
91 Cannon Electric Company—Vibration-proof plugs
43 CBS Electronics, Semiconductor Products—Diffused silicon switching diodes
25 Centralab, the Electronics Division of Globe-Union, Inc.—Sub-miniature wire-wound variable resistor
53 Cinch Manufacturing Company — Heat dissipating tube shields
67 Cincinnati Sub-Zero Products—Sub-zero chambers
334 Cinema Engineering, Division of Aerovox Corporation—Instrument switches
48 The Cleveland Container Company—Laminated phenolic tubing
88 Clevite Transistor—Germanium switching diodes
159 Columbian Carbon Company—Iron oxides for ferrites
11 Continental Connector Corporation — Miniature printed circuit connectors
98 Controls Company of America, Control Switch Div.—Toggle & rotary switches
99 Controls Company of America, Control Switch Div.—Push-buttons
100 Controls Company of America, Control Switch Div.—Lighted push-buttons
101 Controls Company of America, Control Switch Div.—Indicator lights
119 Corning Glass Works, Corning Electronic Components—Glass-base MIL resistors

68 Dade County Development Dept.—Economic survey of metropolitan Miami
19 Dale Products, Inc.—Wire wound, precision, power resistors
115 Davies Molding Co., Harry—Instrument knobs and handles
97 DeJur-Amsco Corporation, Electronics Div.—Potentiometers and panel instruments
142 Delco Radio Division, General Motors Corp.—Miniature modules with standard components
104 Delco Radio Div., General Motors—Power transistors
335 Delta Coils, Inc.—Variable inductors
130 Dialight Corporation—Pilot lights
361 Diamond Tool and Horseshoe Co.—Electronic pliers
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33 Dymo Corporation—Tapewriter
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33 Dymo Corporation—TAPEWRITER

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131 Eisler Engineering Co., Inc.—Welders, tips, holders, and jigs
92 Eitel-McCullough, Inc.—Ceramic triode
116 Elastic Stop Nut Corporation of America —time/delay/relay.
41 Electra Manufacturing Co. — Precision film resistor
340 Electro Switch Corp., Electro Contacts Division — Slip-ring assemblies and rotary switches
39 Electro Motive Mfg. Co., Inc., The—Sub-miniature mica capacitor
27 E S C Electronics Corporation—Sub-miniature lumped constant delay line

22 Fairchild Controls Corporation, Components Division—Gyrost sensing devices
28 Fairchild Controls Corporation, Semiconductor Div.—Planar transistors and diodes
339 Fairmount Chemical Company, Inc.—Non-corrosive soldering flux
325 Fansteel Metallurgical Corporation — Silicon rectifiers
324 Fansteel Metallurgical Corporation — Tantalum capacitor
141 Film Capacitors, Inc.—Stabilizer precision capacitors
34 Formica Corporation, a Subsidiary of American Cyanamid—FORMICA fabricated parts.
332 Freed Transformer Co., Inc.—Toroidal inductors and audio transformers
78 Fusite Corporation, The—Hermetic terminals

108 Garlock Electronic Products—TEFLON FEP electronic components.
126 General Products Corporation—Aircraft type terminal boards
13 General Electric Company, Semiconductor Products Dept.—Switching transistors
9 General Electric Company, Receiving Tubes—Ceramic tubes
127 Gertsch Products, Inc.—AC voltage divider
333 Graphic Systems—Visual control board
323 Gremar Manufacturing Company, Inc.—Miniature RF connectors
44 Helipot Division of Beckman Instruments, Inc.—Potentiometers, servomotors, and meters
96 Hewlett-Packard Company—Vacuum tube voltmeter

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502 General Electric Company, Communication Products Dept.
505 General Electric Company, Defense Systems Dept.
503 Lockheed Missiles and Space Division
501 National Cash Register Company, The
507 Radio Corporation of America, Industrial Electronic Products

110 Ideal Precision Meter Co., Inc.—Panel meters
150 Illumitronic Engineering — Plastic rod, tubing and sheet
81 IMC Magnetics Corp.—Hysteresis & Torque motors
156 Interelectronics Corp.—Solid-state power inverters
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66 Industrial Electronic Engineers, Inc.—In-line digital displays
89 International Rectifier Corporation — Silicon rectifiers
24 ITT Industrial Products Division International Telephone and Telegraph Corp.—Power supplies

20 Jennings Radio Manufacturing Corporation—Vacuum relays and capacitors
69 Jerrold Electronics Corp.—RF test set
112 Johnson Co., E. F.—Variable capacitors
160 Jones, Howard B., Division of Cinch Manufacturing Co.—Terminal panels

114 Keuffel & Esser Co.—Printed circuit masters
63 Keystone Carbon Company, Thermistor Div.—Thermistors
57 Kulka Electric Corp.—Miniature terminal blocks for printed wiring

16 Lenz Electric Manufacturing Co.—High voltage lead wire
118 Light Electric Corp.—High voltage AC power supply

120 Magnetic Shield Division Perfection Mica Co.—Magnetic shielding foils and containers
61 Magnetics, Inc. — Molybdenum alloy powder
82 Manson Laboratories, Inc.—Frequency standard
56 Marconi Instruments—Deviation meter
157 McKinstry Metal Works, Inc.—Electrical enclosures
23 Microwave Associates, Inc.—Microwave components
138 Midwest Foam Products Company — Polyurethane foam caps.
60 Miller Company, J. W.—Molded choke coils
125 Minnesota Mining and Manufacturing Company, Products Div. — Magnetic tape
103 Minnesota Mining and Manufacturing Company, Mincom Div.—Instrumentation recorder reproducer
154 Motorola Communications & Electronics, Inc., Subsidiary of Motorola, Inc.—Electronic DC multimeter and transistorized AC voltmeter

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 231 of this issue.

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47 New Departure Division, General Motors Corporation—Miniature & instrument ball bearings

362 Ohmite Manufacturing Company—Tantalum wire capacitors

51 Pacific Semiconductors, Inc.—Semiconductor devices

52 Pacific Semiconductors, Inc.—Semiconductor devices

95 Packard Bell Computer, a subsidiary of Packard Bell Electronics — Analog digital solid-state converter

144 Pennwood Numechron Co. — Digital clocks

8 Philco, Lansdale Division — Switching transistor

40 Powertron Ultrasonics Corp.—Self tuning ultrasonic cleaners

107 PRD Electronics, Inc., a subsidiary of Harris-Intertype Corp. — Direct reading frequency meters

1 Radio Materials Company, Division of P. R. Mallory & Co., Inc.—Ceramic disc capacitors

122 Raytheon Company, Industrial Components Div.—Subminiature triode for telemetering equipment

86 Raytheon Company, Microwave and Power Tube Div.—Backward wave oscillators

45 Reeves Instrument Corporation, a subsidiary of Dynamics Corp. of America —Miniature floated gyros

123 Rohn Manufacturing Co.—Communication tower

59 Rondo of America, Inc.—Paper packagers

77 Sarkes Tarzian, Inc., Semiconductor Div. —Silicon rectifiers

54 Scientific-Atlanta, Inc. — Integral computer for antenna design applications

329 Sealectro Corporation—Logic programming board

113 Segal, Edward, Co.—Automatic eyeleting machine

326 Sifco Metachemical, Inc.—Selective plating process

330 Spectrol Electronics Corporation — Potentiometers

2 Sprague Electric Co.—Germanium diffused-base transistors

72 Sylvania Electric Products, Inc., Subsidiary of General Telephone & Electronics, Electronic Tubes Div.—Subminiature tubes

30 Sylvania Electric Products, Inc., Subsidiary of General Telephone & Electronics, Semiconductor Div.—Germanium alloy switching transistors

94 Sylvania Electric Products, Inc., Subsidiary of General Tel. & Elec., Special Tube Operations — Microwave switch

73 Synthane Corporation—Laminated plastics

327 Syntron Rectifier Division, Subsidiary of Link-Belt Co.—Silicon rectifiers

146 Syntronic Instruments, Inc.—Deflection yoke coils

7 Taylor Fibre Co.—Laminated plastics

102 Tektronix, Inc.—Indicating oscilloscope

145 Telecomputing Corporation Div., Electronic Components—Filters, relays and capacitors

106 Telecomputing Corporation, Division of Narmco Industries, Inc., Narmco Mfg. —Large parabola antenna

6 Texas Instruments, Incorporated, Semiconductor-Components Div. — Silicon mesa transistors

137 Thomas & Betts Co., Inc., The—Cable ties and straps

36 Thompson Ramo Wooldridge, Inc.—Electrical power components

328 Times Wire & Cable Division The International Silver Co. — High and medium temperature ribbon coax cable

29 Tinnerman Products, Inc. — Vibration-proof fastener

109 Trak Electronics Co., Microwave Components Dept. — Miniature oscillator cavities

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75 Transitron Electronic Corporation — Switching transistors

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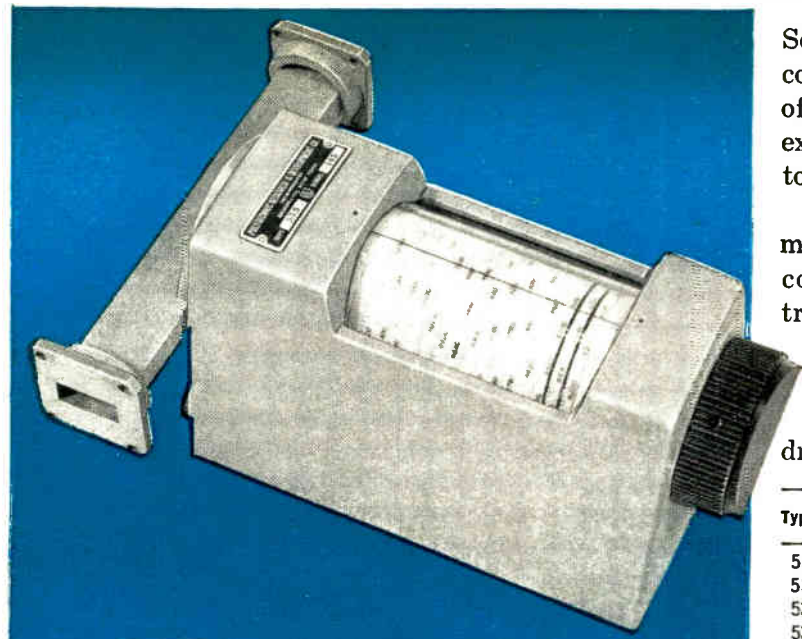

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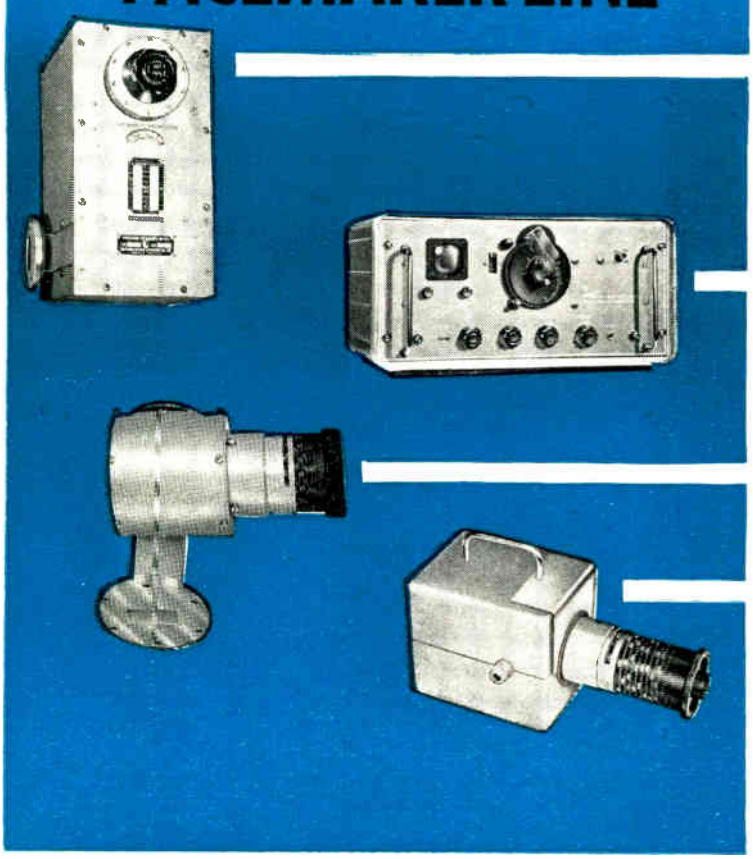

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535	8.2 to 12.4	1 x ½	UG-39/U	±.08	$175
536	12.4 to 18.0	.702 x .391	UG-419/U	±.1	$285
537	18.0 to 26.5	.500 x .250	UG-425/U	±.1	$290
537-F1	18.0 to 26.5	.500 x .250	UG-595/U	±.1	$290
538	26.5 to 40.0	.360 x .220	UG-381/U	±.2	$300
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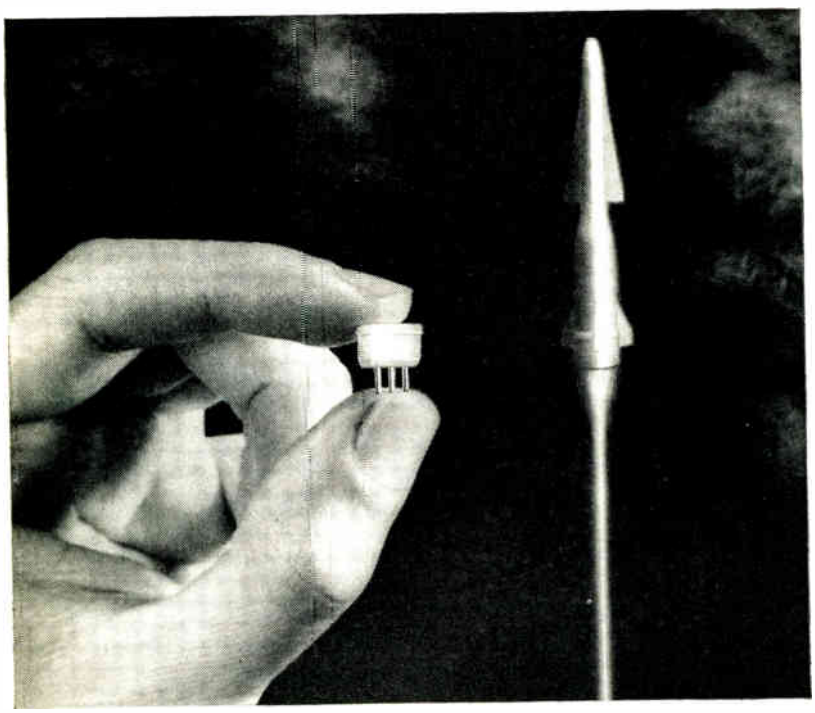

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International Electronic Sources

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AUDIO

The Usual and Necessary Behavior of Objective Sound Level Meters, H. Niese. "Hochfreq." Feb. 1960. 12 pp. Tests of the dynamic behavior of sound level meters are discussed. Eight different meters were thoroughly tested using audio pulses of different length, short duration single pulses of different amplitude, and pulse bursts of different repetition rates. Although seven meters met the "German Industry Standards" (DIN) for dynamic indication selectivity, the measured values were not in agreement. This appeared to be due to the different degrees of inertia and of overloading. Comparisons with subjective measurements showed that in no case were the objective readings the same as the subjective ones. It was found that a reserve of 20 db above the full scale deflection was needed to correctly measure certain sharply peaked noises. If the inertia of the meters is made to approach the subjective loudness response, the overload reserve could be reduced to 10 db. (Germany.)

A New, Large, Anechoic Room for Soundwaves, W. Kraak, G. Jahn, and W. Fasold. "Hochfreq." Feb. 1960. 4 pp. The large, newly built nonreflecting room at the Dresden Institute of Technology is described. The details of the frame and wall construction are given. An explanation is given of the methods of construction and of the conisderations applied in selecting and installing the sound-absorbing materials. The special provisions provided for positioning and using apparatus and test gear are discussed. Measurements of the acoustical properties of the finished room indicate that the quality of the anechoic room is comparable to ther similar sized anechoic rooms. (Germany.)

Nomogram for Determination of Audio Power in Indoor Public Address System, N. K. D. Choudhury. "J. ITE." Dec. 1959. 5 pp. The acoustical power required to establish the desired sound pressure level in a room depends on the volume of the room and also on its acoustical properties. The efficiency of the loudspeaker in the sound reinforcing system also is determined, to some extent, by the room characteristics and its location in the room. Taking all these factors in consideration, a nomogram has been evolved that can be readily used in assessing the electrical audio power output demanded from the public address amplifier in the hall. (India, in English.)

CIRCUITS

The Performance and the Design of Ring Modulators, H. Bley. "Nach. Z." Apr., 1960. 6 pp. A new quasilinear method for a lucid explanation of the performance and the design of ring modulators has been derived from an experimental basis. (Germany.)

Qualitative Analysis of a New Oscillator Circuit, St. Vojtasek and K. Janac. "Hochfreq." Feb. 1960. 6 pp. This new oscillator circuit is important because of its good frequency stability without crystal controls. The major portion of the work is devoted to the qualitative analysis of the oscillator. This analysis is done by mathematical methods and also by an analog differential analyser. Waveforms of transient conditions are presented for various values of parameters developed in the analysis. (Germany.)

A Device for the Automatic Determination of the Imaginary Part from the Real Part and Vice Versa for Minimum Phase Type Network Functions, V. Pollack. "Hochfreq." Feb. 1960. 4 pp. Mathematical hypotheses are postulated and used to develop functions that determine the imaginary part from the real part. The justification for the hypotheses are derived. The possibilities of practical applications are discussed, and a simple analog computer proposed for automatic solution of the problem. One of the many possible systems are discussed with the aid of a block diagram. (Germany.)

Notes and Additions to Kuepfmueller's Rise Time Formula, G. Wunsch. "Hochfreq." Feb. 1960. 4 pp. Kuepfmueller's theory for low pass filters is expanded and generalized. First the phase characteristics for ideal low pass filters is developed, then the generalized Kuepfmueller formula is derived. It is shown that the generalized formula is also valid for the calculation of rise time of an optimized delay line. (Germany.)

The Imaginary Part of the Characteristic Impedance in the Passband of Filter Circuits, W. Herzog. "Nach. Z." Apr. 1960. 4 pp. A simple explanation for the imaginary part of the characteristic impedance occurring in filter chains is given with the aid of a bridge conversion. (Germany.)

Transistorized Control Circuit for In-phase Synchronization of Two Shafts, K. Hamerak. "El. Rund." May 1960. 4 pp. To control phase sync, an arrangement may be used that permits contact-free measuring of the angular difference of magnitude and sign between two rotating shafts. (Germany.)

COMMUNICATIONS

Radio Spectrum Conservation, S. Silleni. "Alta Freq." Feb. 1960. 32 pp. Problems affecting coexistence of several radio systems are considered. The paper begins with a brief review of the international organization and regulations dealing with coordination of radio spectrum use. Then an ideal spectrum occupation condition is presented, together with some of its practical limitations. (Italy.)

Current Microwave Techniques in the United Kingdom, David Simpson & G. T. J. Summer. "El. & Comm." May 1960. 5 pp. The role of basic research has always been recognized in Britain and the spirit of free enquiry flourishes in the universities and government establishments. (Canada.)

A High-Speed Signalling System for Use Over Telephone Circuits, A. P. Clark. "ATE J." Apr. 1959. 16 pp. This 600-band signalling system is capable of transmitting information in binary form over any normal telephone circuit in Great Britain, and gives reliable and trouble-free operation. It uses an ampli-

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electrical Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektranika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

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Sources

tude-modulated signal in which both sidebands are transmitted. (England.)

Interference in Railway Line-Side Telephone Cable Circuits from 25 KV 50 C/S Traction Systems, A. Rosen. "ATE J." Oct. 1959. 21 pp. Experience already gained, particularly on the Continent of Europe, in the solution of the problem of interference in railway line-side telephone cable circuits from electrical traction systems is briefly reviewed. The relevant C.C.I.F. recommendations on the general problem of this type of interference are then stated. A calculation is made of the induced e.m.f. due to magnetic induction and analysis are given of the effectiveness of electromagnetic screening by cable sheath and by an external conductor. (England.)

Subscriber Line Concentration, H. V. Paris. "ATE J." Oct. 1959. 16 pp. The author first gives a resume of the economic argument for line concentration and then deals with basic principles and design considerations. The article describes briefly the original Gfeller concentrator and then deals specifically with the two types of battery-less crossbar line concentrator manufactured by A.T.E. giving an outline description and listing the facilities provided. (England.)

COMPONENITS

An Electrochemical Diode, Solion. "El. Rund." Apr. 1960. 3 pp. (Germany.)

Polystyrene Dielectric Capacitors, F. McCabe. "ATE J." July 1959. 8 pp. The requirements for a filter tuning capacitor and the application of polystyrene as a dielectric for this purpose are discussed. (England.)

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1N1351 thru 1N1375
1N1806 thru 1N1815
1N2970 thru 1N3015
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1N935 thru 1N939
1N941 thru 1N945

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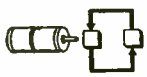
International ELECTRONIC SOURCES

Electrolytic Capacitors, D. S. Margolis & J. H. Cozens. "ATE J." July 1959. 8 pp. After discussion of the characteristics of electrolytic capacitors in a comprehensive manner, the improvements secured through the use of super-pure aluminium are given. (England.)

Special Quality Miniature Relays, N. E. Hyde. "Brit. C&E." May 1960. 8 pp. Considerable progress has been made in recent years in the design of high reliability miniature electromagnetic relays. This article reviews some of the latest advances in the field. The conclusion drawn is that electro-mechanical relays of the newer designs will for a considerable time be able to hold their own against those of the semiconductor type. (England.)



CONTROLS

Analysis of a Two-position Compensation Control System with Constant Prolonged Disturbances, A. I. Cherepanov. "Avto. i Tel." Mar. 1960. 7 pp. The simplified analytical method of calculating two-position control process (1) is shown. It can be used to analyze processes in a two-position compensation control system with constant prolonged disturbances. (U.S.S.R.)

Estimating the Interval Quantization Effect on Processes in Digital Automatic Control Systems, Z. Tsypkin. "Avto. i Tel." Mar. 1960. 5 pp. The effect of interval quantization in digital automatic control systems continuous parts which contain both constant parameters and variable ones is determined. (U.S.S.R.)

Determination of the Optimum Pulse Transient Function with Inner Noises, P. S. Matweev. "Avto. i Tel." Mar. 1960. 7 pp. The problems of (1, 2) are generalized for a case when input signals are applied to different elements of a servo system and for a case of variable parameter systems. (U.S.S.R.)

Operation of Frequency Phase Adjustment with Noises, V. I. Tikhonov. "Avto. i Tel." Mar. 1960. 9 pp. With the help of Fokker-Plank equation due to external and inner fluctuations the mean frequency of the main generator differs from that of the synchronized one is ascertained. An approximate method of calculating generator frequency overage difference and its variance is proposed. (U.S.S.R.)

Generalized Conditions of Electro-Magnetic System Proportion (Geometry of Electro-Magnetic Systems), A. S. Tulin. "Avto. i Tel." Mar. 1960. 10 pp. The problems of proportions in electro-magnetic systems are considered. Geometrical regularities connected with conditions of rational utilization of electro-magnetic energy are used. A number of optimum constructions are found. Out of which constructions, according to technical and economic requirements, one is selected for each particular case. (U.S.S.R.)

Extending the Power Range of Tirrill Regulators, W. Leonhard. "rt." Feb. 1960. 6 pp. The author surveys various possibilities of relieving the load contacts of Tirrill regulators. (Germany.)

Magnetic Devices in Control Systems, H. Bley. "rt." Feb. 1960. 5 pp. This article gives a survey of amplifying elements used in control systems which elements operate on the principle of magnetic saturation. The investigation comprises discontinuous, quasi-continuous and continuous controllers. (Germany.)

The Treatment of Non-linear Problems in Control Engineering, P. J. Nowacki. "rt." Feb. 1960. 4 pp. This contribution gives a brief comparison of the existing methods for the treatment of non-linear control problems. The author shows how, by way of iteration, the Laplace transform can be applied also for the solution of non-linear problems. (Germany.)

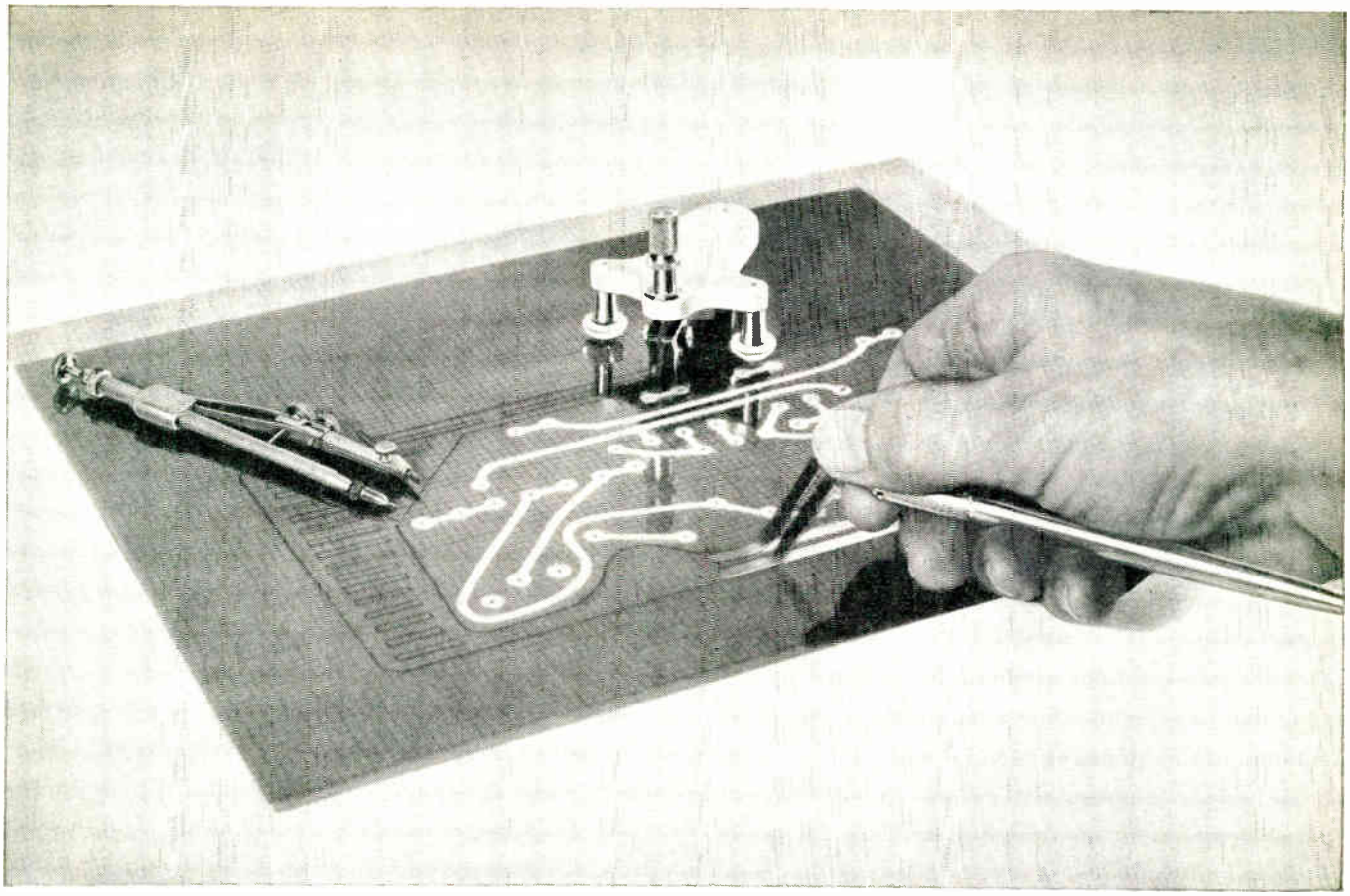
GENERAL

Transient Process and Steady State in Automatic Range Scope, F. M. Kilin. "Avto i Tel." Feb. 1960. 11 pp. Dynamic properties of an automatic range finder with an operational amplifier including integrating block and a lag are considered. Analysis of the processes in the automatic range finder with an operational amplifier requires complicated algebraic manipulations. (U.S.S.R.)

Analysis of Accuracy of Essentially Non-linear Control Systems with the Help of Equivalent Transfer Function, K. A. Pupkov. "Avto i Tel." Feb. 1960. 14 pp. The way of approximating essentially non-linear functions with the help of the equivalent frequency response based on comparing spectra of the random process of the non-linear unit input and output is considered. (U.S.S.R.)

Transistor Techniques for Reactor Control Instruments, G. G. Ballard. "El. & Comm." Mar. 1960. 6 pp. Enhanced reliability is obtained from reactor instruments incorporating transistor circuits. (Canada.)

The Problem of Minimum Description, E. L. Blokh. "Radiotek," 15, No. 2 (1960). 5 pp.



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International ELECTRONIC SOURCES

The author examines the problem of a minimum description of flat images consisting of fixed elements of different coloring, providing that the sequence of elements subject to recognition is random and is characterized by a unidimensional probability distribution. Two methods of description are mentioned, the absolute and the relative. The former recognizes images without any previous knowledge of them and the latter according to set standards. The problem of finding a minimum description is in principle reduced to that of obtaining an optimum code. (U.S.S.R.)

Reflection of a Flat Transverse-Polarized Wave from a Rectangular Comb, L. N. Deryugin. "Radiotek" 15, No. 2 (1960). 12 pp. At superhigh frequencies periodic ribbed reflectors can serve as spectrum analyzers, phasing devices for obtaining rotating polarization, etc. This article provides a technique for calculating the reflection coefficients of a flat transverse-Polarized wave from a periodically uneven surface in the shape of a rectangular comb, on the basis of a strict observance of the border electrodynamic problem. The results of calculated reflection coefficients are given and compared with those obtained on the basis of Huigens principle. The suppression of the image ray in quarter-wave resonance in depth in the comb grooves is examined. (U.S.S.R.)

Universal Functional Generator Based on Principle of Quadratic Approximation, A. V. Maslov and G. Purlov. "Avto i Tel." Feb. 1960. 8 pp. There are proposed methods of quadratic approximation when the function is given graphically or analytically. To derive the law of argument distribution, simple formulae and ratios are deduced. A diode element for getting the quadratic function is considered. (U.S.S.R.)

MEASURE & TESTING

Investigations with the Field Electron Microscope when Operating with Metal Oil Diffusion Pumps, R. A. Haefer. "Vak. Tech." Mar. 1960. 7 pp. As well known a field electron microscope (FEM) requires an extraordinarily good vacuum. Hitherto one used to generate this vacuum with two glass diffusion pumps arranged in series which are filled with Hg and are provided with liquid air traps. By the aid of the FEM it has been proved that it is possible to get a completely clean surface even with a vacuum system capable of being dismantled, having metal seals and provided with two metal oil diffusion pumps (types Diff 170 and Diff 60) arranged in series and with a water cooled baffle only. (Germany.)

Attenuation Measurement Methods and Values in Standard 2.6/9.5 mm Coaxial Pairs, R. Belus and M. Trouble. "Cab. & Trans." Apr. 1960. 21 pp. Standarization of equalization and correction equipment for coaxial systems, taking due account of C.C.I.T.T. recommendations for long distance circuits has led to the development of refined and very accurate attenuation measurement methods. (France.)

Errors Caused by Losses in the Measurement of Balanced Elements, M. Soldi. "Alta Freq." Feb. 1960. 29 pp. A detailed examination is carried on the errors which affect the measurements of balanced circuit elements by means of a composed-line balun, in the metric wave range, caused by its losses; these errors may sometimes become considerable, particularly in the case considered here of the attenuation measurement on a short sample of twin line, effected indirectly through an admittance measurement. (Italy.)

Instrumentation for a Subcritical Homogeneous Suspension Reactor, I. Reasons behind the choice of a homogeneous suspension reactor, J. J. Went. "Phil. Tech." No. 4/5, 1960. 13 pp. In the KEMA laboratories at Anaheim a one-zone homogeneous suspension-type reactor is in development. Safety and nuclear-fuel economy being major considerations in a country like The Netherlands, the choice fell on a one-zone homogeneous reactor with circulating fuel in the form of a suspension of ThO_2-UO_2 particles in heavy water. The fissile material, ^{233}U, is bred in the reactor itself from ^{232}Th. (Netherlands, in English.)

Instrumentation for a Subcritical Homogeneous Suspension Reactor, II. Measurement and Control of Operating Parameters, B. L. A. van der Schee and M. van Tol. "Phil. Tech." No. 4/5, 1960. 13 pp. In experiments on the subcritical suspension reactor at Arnheim the temperature can be kept constant within 0.1°C at any desired value between room temperature and 100°C. Since the circulation pump supplies about 5 KW to the fluid, the operating temperature is determined by the rate of cooling. (Netherlands, in English.)

TELEVISION

Preamplifiers for Vidicon Cameras with Drift Transistors, Hans Anders. "Rundfunk." Apr. 1960. 8 pp. The paper begins with a discussion of the circuit of a preamplifier for a vidicon camera, equipped with drift transistors. The choice of the input circuit and the effect of the working point on the signal-to-noise ratio is discussed. This is followed by results of noise measurements made on a fairly large number of transistors of different makes. (Germany.)

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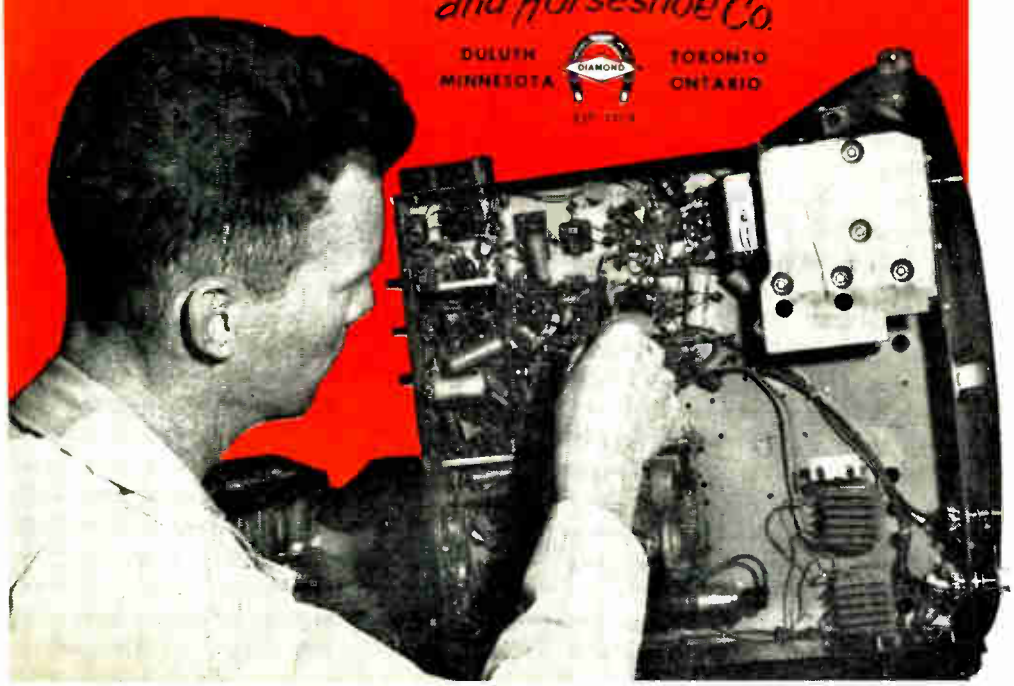

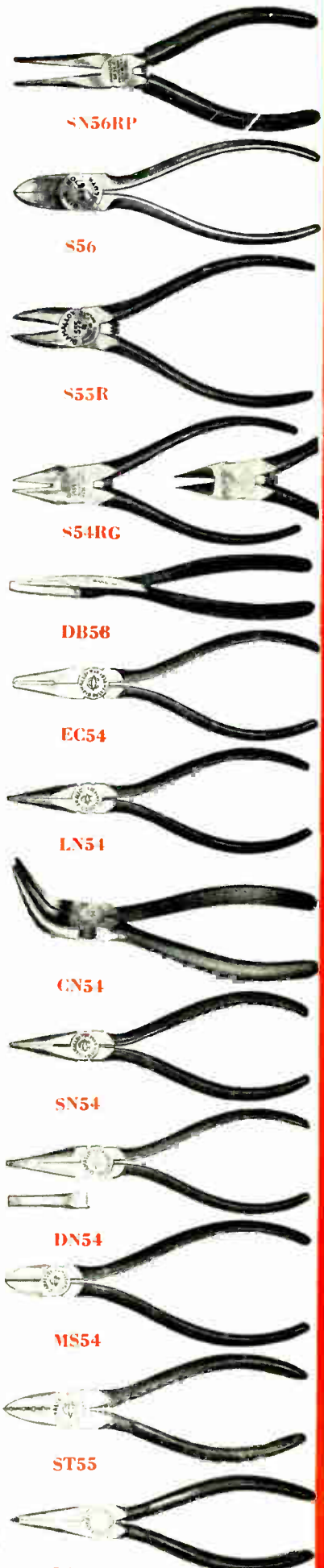

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Sources

Fundamentals of Electronic Measurements in Color TV, P. Neidhardt. "El. Rund." May 1960. 6 pp. The paper contains a description of special electronic color-TV measuring equipments required in development work apart from those known from black-and-white TV. (Germany.)

Some Aspects of Television Transmission over Long Distance Cable Links, H. Mumford. "ATE J." Oct. 1959. 13 pp. An outline of the basic properties of 0.375 in. diameter coaxial cable and the combined or alternative multi-channel telephony/television systems based on it is given. Most of the required transmission limits for such systems have now been agreed internationally and a hypothetical reference circuit evolved for which such limits can be stated. (England.)

TRANSMISSION

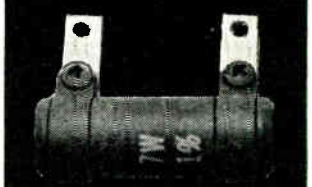
A Contribution to the Transmission Theory of AM-FM or AM and FM Carriers in Linear Networks, Part 1, E. Augustin. "Hochfreq." Jan. 1960. 8 pp. Limits are established within which the application of a simple and well known asymptotic series is valid for calculation of dynamic distortion in FM systems. It is shown that within a given margin of error this series limits the frequency deviation and the maximum rate of change of the instantaneous frequency. Assuming a reasonable margin of error and minimum phase shift, the influence of the dynamic transfer factor is within the allowable margin of error and can be neglected. If distortion is calculated for a number of stages using the asymptotic series, the situation gets more unfavorable, since the permissible frequency deviation is more limited. Part 2 of this paper will present a new mathematical method not subject to these limitations. (Germany.)

Waveguide Techniques, O. Henke and G. Stricker. "Freq." Mar. 1960. 11 pp. Correlation of electrical and mechanical demands on waveguides is described, taking into account their proposed use. Shape, dimensions, materials, precision, mechanical stability and corrosion resistance are considered. Manufacturing processes are indicated for economical production of waveguides. (Germany.)

The Microwave Circulator, E. Pivit and W. Stosser. "Freq." Mar. 1960. 7 pp. Known types of circulators are briefly reviewed, followed by a more detailed treatment of the phaseshift circulator. The necessary phase conditions are determined and using Matrices, the tolerances of the parts are calculated. Using the above results, phaseshift circulators for different frequency bands are developed. The experimental results are presented and the dimension for individual parts are given. (Germany.)

Experimental Investigations on Ferrite Resonance Isolators, R. Steinhart. "Nach. Z." Apr. 1960. 9 pp. The directional absorption and the directional phase shift of ferrites in the characteristic E and H dispositions in waveguides are investigated. (Germany.)

Feed Lines for High Power Antennas in the 10 CM Region, H. Laub and W. Stoer. "Freq." Apr. 1960. 14 pp. For establishing relatively long leads to wideband UHF antennas of high power rating, waveguides, cables, and rigid coaxial lines are particularly suitable. With some qualifications, wire guide can be used just as well. The attenuation and matching conditions are investigated on long runs of rectangular waveguide made up from many identical elements. It is shown that with full utilization of the permissible tolerances, the reflection coefficient of a waveguide built from 100 elements will remain below 5 per cent. If conversely the reflection coefficient is given, the possible line length

TYPE		SIZE	RESISTANCE (ohms)	WATTAGE	TC
NF **Fusion sealed.** Glass encapsulation is fusion sealed to leads and has zero moisture absorption. Exceeds requirements of MIL-R-10509C, Char. B.		NF60 NF65	100 to 100 K 100 to 360 K	⅛ @ 70° C. ¼ @ 70° C.	±.03%/° C. from −55° C. to +150° C., ref. to 25° C.
N **Fixed film.** Extremely low noise level. 0.1 microvolt/volt. Derating to 140° C. Average resistance change after 5000 hrs. is less than 1%. Exceeds MIL-R-10509B, Char. X specs.		N20 N25 N30	10 to 500 K 10 to 1.5 meg. 30 to 4.2 meg.	½ @ 40° C. 1 @ 40° C. 2 @ 40° C.	±.03%/° C. from −55° C. to +105° C., ref. to 25° C.
S **Fixed film: high temperature.** Less than 0.35% resistance change after 1000 hrs. of load-life tests at max. dissipation. Exceeds MIL-R-11804C, Char. P.		S20 S25 S30	10 to 500 K 10 to 1.5 meg. 30 to 4.2 meg.	120° C. / 40° C. ½ / 1 1 / 2 2 / 4	±.03%/° C. from −55° C. to +235° C., ref. to 25° C.
R **Power.** Essentially noninductive in high-frequency operations. Inherent noise level less than 0.1 microvolt per volt. Exceptional moisture resistance and overload capacity. Exceeds MIL-R-11804C.		R31 R33 R35 R37 R39	10 to 70 K 30 to 150 K 20 to 300 K 20 to 500 K 40 to 1 meg.	7 @ 40° C. 13 @ 40° C. 25 @ 40° C. 55 @ 40° C. 115 @ 40° C.	±.05%/° C. from −55° C. to +235° C., ref. to 25° C.

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Sources

is proportional to the length of the individual element. The paper describes some new waveguide components for antenna circuits and moreover reports the results of various measurements on surface-wave transmission lines. (Germany.)

A Polarization Filter with Symmetrical Exitation of the H_{11} Modes, E. Schuegraf. "Freq." Apr. 1960. 2 pp. A polarization filter converts the waves on two lines into two cross-polarized modes. An arrangement is described where the two H_{11} modes are symmetrically exited in a circular waveguide. This method offers the advantage that no rotation symmetrical modes are produced, such as the E_{01} mode. The balanced coupling can be effected by two probes facing each other in the circular waveguide. The probes are fed out of phase from the two arms of a waveguide E-plane bifurcation. (Germany.)

TUBES

High-Ratio Frequency Multiplication by Means of a Reflex Klystron. E. N. Bazarov, M. E. Zhabotinskii and E. I. Sverchkov. "Radiotek" 15, No. 2 (1960) 5 pp. In this work it is shown theoretically and demonstrated experimentally that reflex klystrons can be successfully used for multiplying frequencies by ratios exceeding 30, if the input signal is injected into the bunching space. The advantage of the proposed method of frequency multiplying is its great simplicity, reliability and an output power sufficiently high for use as a heterodyne oscillator in the three centimeter range. Simple formulas are derived for determining with satisfactory accuracy the output power and the range of the multiplier. (U.S.S.R.)

Use of Decadic Counter Tubes in Non-Decadic Counting Systems, K. Apel. "El. Rund." Mar. 1960. In decadic counter stages, a minimum of circuit components are sufficient when special counter tubes are employed. If, however, non-decadic events are to be counted, the ring or gate circuits employed are rather elaborate. The author outlines a method of substituting such circuits by the decadic counter tube EZ 10 of the cold-cathode type. (Germany.)

A Simple Apparatus for Making Photo-Electric Cathodes, K. Thiele. "Vak. Tech." Apr. 1960. 5 pp. This article describes an apparatus which has been built for making photo-electric cathodes as used in image convertors. The vacuum system is very versatile and can also be used for other types of vacuum work, e.g. for making counting tubes, etc. After baking the high vacuum portion of the equipment, the ultimate vacuum obtainable is better than 10^{-4} microns (10^{-7} mm Hg). (Germany.)

Special Amplifier Tube Type Properties and Circuit Designs, W. Geist. "El. Rund." Apr. 1960. 6 pp. Special amplifier tubes are used in communication equipments and feature properties different from radio tubes. These properties are discussed, and means to achieve them are indicated. Special amplifier tubes supplied by Valvo GmbH are listed by their features in a Table. To illustrate their application, a number of circuit designs are shown. (Germany.)

An Experimental Disc-seal Triode for 6000 Mc/s, M. T. Vlaardingerbroek. "Phil. Tech." No. 6, 1960. 5 pp. Brief description of an experimental disc-seal triode for 5 cm waves. The cathode-grid spacing is smaller than in the EC 157 and is achieved by pre-assembling these electrodes and adjusting the spacing in a precision jig. (Netherlands, in English.)

Astigmatism in Cathode Ray Tubes, N. Patla. "J. ITE." Dec. 1959. 7 pp. A new method of observation of astigmatism in cathode ray tubes precisely within ±5 v. is described. (India, in English.)

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Type Number	Peak Current
1N2928	470 μA
1N2929	1 mA
1N2930	4.7 mA
1N2931	10 mA
1N2932	22 mA
1N2933	47 mA
1N2934	100 mA

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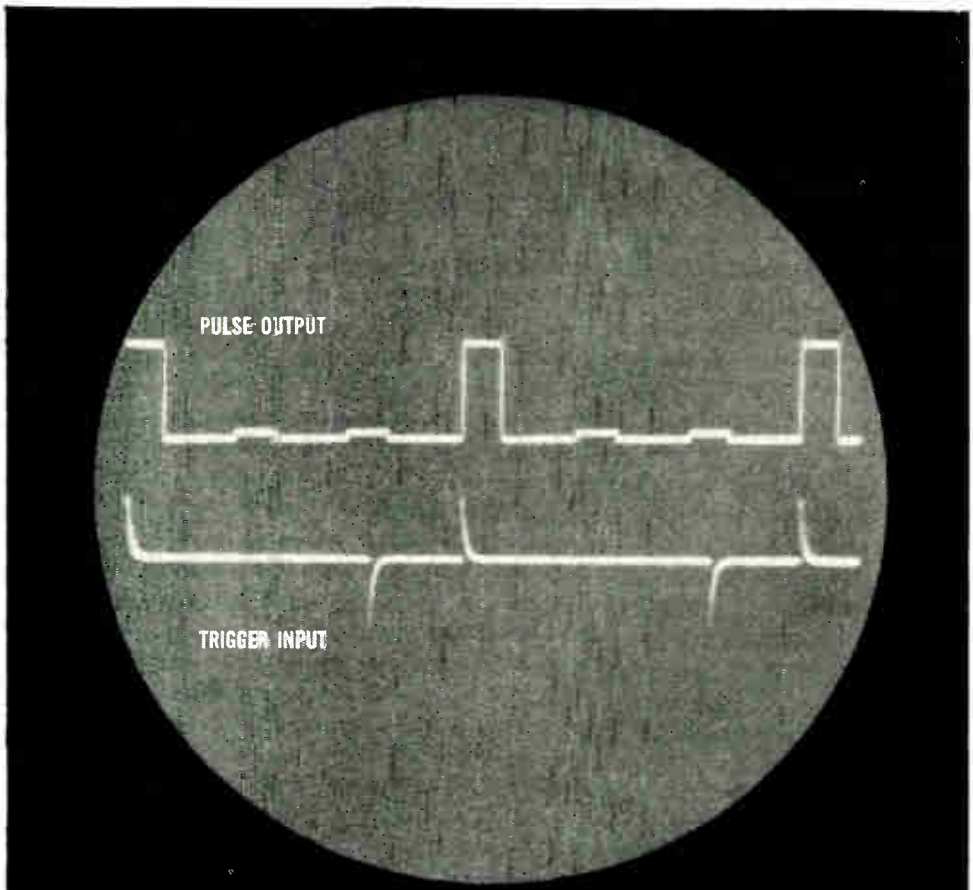
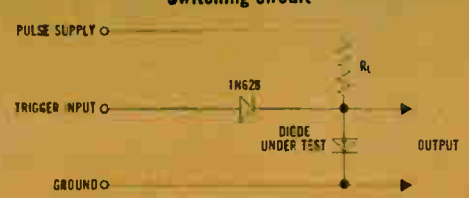
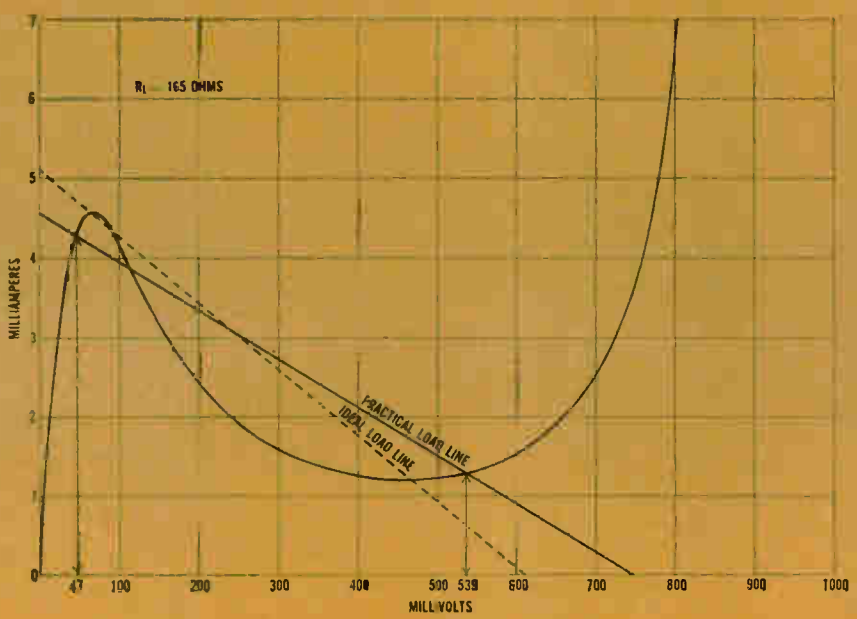


Input and output wave forms for circuit shown below

Switching circuit





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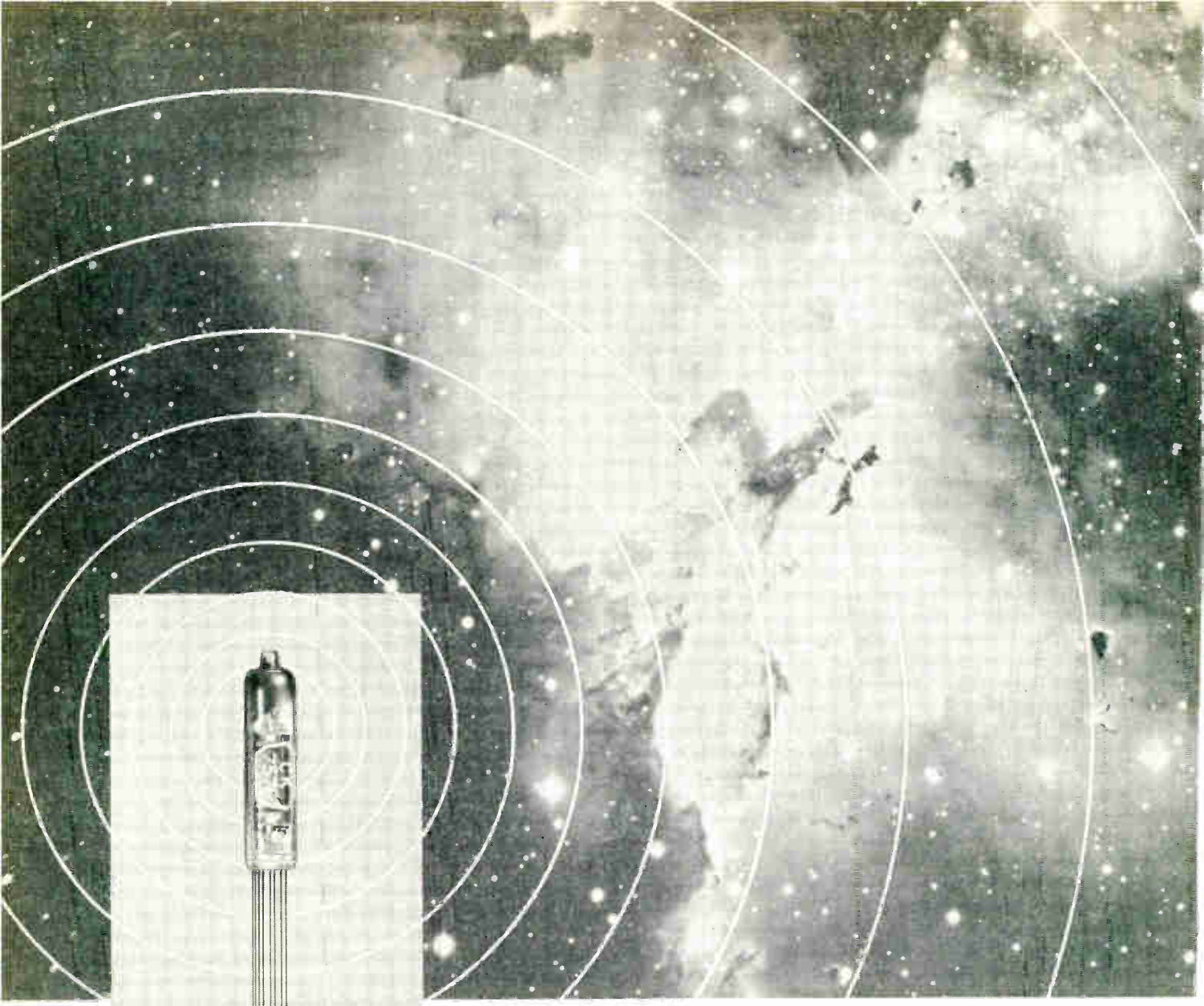

CK7576 CHARACTERISTICS AND TYPICAL OPERATION: 235Mc GROUNDED GRID RF AMPLIFIER

Filament Voltage	6.3 ± 5% volts
Plate Voltage	200 volts
Cathode Resistance	150 ohms
Peak RF Grid to Cathode Voltage	14 volts
Grid Current	10 mAdc
Plate Current	37 mAdc
RF Driving Power (Approx.)	0.5 watts
Useful Power Output	3.25 watts

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The Raytheon CK7576 is a subminiature triode providing over 3 watts output at 235Mc in grounded grid RF power amplifier service. It offers designers of spaceborne telemetering equipment the advantages of excellent isolation between input and output circuits, high transconductance, high amplification factor, and impressive power-handling capabilities.

If your area of design interests includes airborne communication and navigation applications make it a point to investigate the CK7576 as well as the other versatile types in Raytheon's full line of subminiature tubes. For technical information, please write to: Raytheon, Industrial Components Division, 55 Chapel St., Newton 58, Massachusetts.

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Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES • AUGUST 1960

SYSTEMS—WISE . . .

▸ **Mobile TV tape recording equipment is providing "live" training pictures for classroom viewing at the Army Transportation Training Command School, Ft. Eustis, Va. Other electronic educational aids include a closed-circuit TV system which links 22 classroom receivers, and two mobile units. The school has a main studio, equipped with three RCA cameras for live programming and slide and film presentations.**

▸ Data transmission in the 12,000 MC region will be explored by the Advanced Systems Development Div. of IBM Corp. An experimental microwave communication network system, with three transmission and receiving stations and a passive repeater site, will investigate path phenomena, modulation and multiplexing, non-manned repeater station operation and system considerations.

NEW COMPUTER

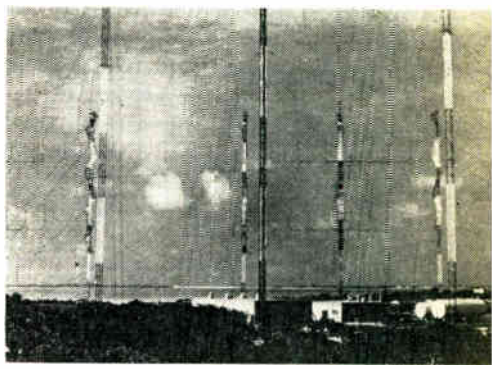
Computer Design-Consultant Penny Barbe and Project Engineer John H. Fields put the new GE-225 through its paces during tests at the company's Computer Dept. The new general-purpose computer, can add 25,000 5 digit numbers/sec. Computer use ranges from scientific applications to complex business - data problems.

▸ **Teams of Lockheed electronic specialists surveyed the Pacific area for "electronically quiet" areas to install the complex gear needed to track the Lockheed-built Agena satellites launched in the Discoverer program. They selected the wind-swept bluff of Kaena Pt., Hawaii, 35 miles from Honolulu, and Kodiak Island in Alaska.**

▸ The complete electronic-industrial team chosen to produce the Airborne Long Range Input (ALRI) system for the seaward extension of North American air defense are: Electronic Communications, Inc., St. Petersburg, Fla.; A. C. Spark Plug Div. of General Motors Corp., Milwaukee; Lockheed Aircraft Service, Inc., Ontario, Calif.; GPL Div. of General Precision, Inc., Pleasantville, N. Y.; Philco Corp., Philadelphia; Technical Products Div. of Packard-Bell Electronics Corp., Los Angeles, and Military Electronic Computer Div. of Burroughs in Detroit. ALRI will extend the air defense network seaward through airborne radar and data processing equipment. This radar information will be transmitted to land-based centers in the SAGE system which will initiate countermeasures.

▸ Space scientists of the Astronautics Div. at Chance Vought, Dallas, Tex., are simulating 25,000 mph atmospheric re-entries from lunar missions and "space taxi" deliveries to space stations with an electronic Manned Space Flight Simulator. The "astronaut" gets an accurate picture of how his space vehicle would respond to his skill during an actual re-entry or a rendezvous with an orbiting space station in outer space.

DEFENSE COMMUNICATION SYSTEM



Surrounding Pacific Scatter System station on Wake Island are 400 ft. and 200 ft. antenna arrays composed of stacked or "piggy-back" dual frequency corner reflectors. The 6,500 mi. Trans-Pacific scatter system, one of the world's largest multi-channel radio communications systems has eight interconnected stations. Designed and constructed for Signal Corps as part of world-wide Strategic Army Communications Network (STARCOM) by Page Communications Engineers, Inc., Washington, D. C.

▸ **The Sperry Co., Phoenix, Ariz., developed a microwave aerospace navigation (MAN) radar system which will automatically control and guide the descent of manned and unmanned spacecraft, landing them by remote control. Using a pulse code modulation technique, the automatic ground controls fire coded "questions," receive "answers," and issue commands to the spacecraft at 5,000 pulses/sec. Present flight monitoring and decision-making functions are man-performed, but for more advanced applications, computers will be used to make exacting split-second decisions.**

HIGH LEVEL LOOK

Plans of the new 65,000 sq. ft. AM FM TV building are scrutinized by M. Shapiro, TV Manager; J. Cooper, Director of Engineering; and G. Utley, Radio Manager, atop the Dallas, Tex. Morning News Building. Behind them is the new WFAA AM FM TV building which will cost $1.5 million. Some $2 million will also be spent equipping the studios with the latest in broadcasting and Ampex Corp. tape recording equipment.

System Analysis

THIS system analysis technique offers a useful and economical method for analying electronic systems in terms of system parameter variations. It appears especially useful for systems in which nonlinear functions make a purely theoretical analysis difficult; but, where these nonlinear functions can be approximated by empirical equations. This technique for system analysis may be summarized as follows:

1. The system to be analyzed is described mathematically. In this description, empirical equations which approximate the electrical behavior of the system are used extensively. The result is a mathematical expression which describes the system output in terms of system input, both as functions of time.
2. A set of numbers is selected which has the desired magnitude and time distribution required to represent the input signal, or more often, signal plus noise.
3. A digital computer is used to compute system output *vs* time, using the selected input number set. A particular set of constants in the mathematical equations is used to represent certain specific values of system parameters. The same input conditions are used for each computer run, but the parameters of the system may be varied by changing the values of the corresponding constants in the empirical mathematical equations. The effects of parameter changes can be evaluated from a study of computer-plotted graphical presentations of system output.

Application

To illustrate the practical application of this technique, consider the simple system of Fig. 1.

Following the steps already indicated, the block components of the system of Fig. 1 are first described by empirical equations which approximate their electrical behavior. For example, a nonlinear gain function can be approximated very closely by an expression of the form

$$E'_n = A\,[1 - \exp(-E_n/B)\,],$$

where the saturation level and the degree of nonlinearity are determined by the selection of A and B. To include the effect of AGC with an inherent one-period delay, the

Now we have a technique—useful and economical—for analyzing electronic systems. It is most applicable where non-linear functions make a purely theoretical analysis difficult, but, where these functions can be approximated by empirical equations.

By WILLIAM F. NIELSEN
Staff Member
Advanced Electronics Systems Div.
Sandia Corp., Sandia Base
Albuquerque, New Mexico

Using Digital Computers

gain expression may be modified slightly and expressed as

$$E'_n = A\left[1 - \exp\left(\frac{-E_n}{B\,(1 + f_{n-1})}\right)\right]$$

An example of an expression which closely approximates the output of a typical pulse to dc stretching circuit for AGC use, with a reference level of $k_1 E'_{max}$, is:

$$f_n = k_3 f_{n-1} + \frac{\left(\frac{E'_n}{k_1 E'_{max}} - 1\right)}{k_2}$$

where $k_2 = R_1C/T$, the charge time constant of the stretching circuit divided by the period of the input pulse repetition rate; and

$$k_3 = \exp(-T/R_2C)$$

where R_2C is the discharge time constant of the stretching circuit, and T is again the period of the input pulse repetition rate. Then, in the digital computer calculation of E'_n, the previous AGC output, f_{n-1}, is used.

The output, $E_o(n)$, of the system of Fig. 1, may be expressed for a typical RC integrator as:

$$E_0(n) = k_4 E_0(n-1) + E'_n$$

where

$$k_4 = \exp(-T/RC),$$

RC is the integrator discharge time constant, and T is the period of the input pulse repetition rate. With this set of equations, the system output can be expressed in terms of the system input, both as functions of time.

Gaussian Noise

The next step is to express the system input as a function of time. Consider the case of gaussian noise, for example. Assuming a normal distribution with a certain mean and sigma, a group of numbers may be selected with magnitudes and relative frequencies corresponding to this normal curve. Arranged in a random sequence, they represent noise input to the system as a function of time. After this input has existed for a time, it may be desired to add signal to the noise. For a linearly increasing signal which appears at time $n = n_k$, the new input to the system can be written as:

$$E_n + (n - n_k)\frac{E_s}{N},$$

where E_s = peak signal input, and N = rise time of the input signal expressed in periods of the input repetition rate.

A digital computer may now be used to compute system output *vs* time for the input number set selected. Using the same input conditions for each computer run, the constants of the equations controlling nonlinearity, AGC response time, integration time, and other system parameters, may be easily changed. The effects of changes in these parameters on such things as signal-to-noise ratio at the system output may then be evaluated from a study of computer-plotted system output graphs.

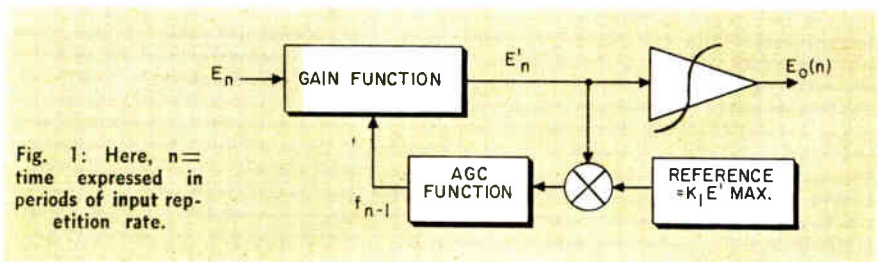


Fig. 1: Here, n= time expressed in periods of input repetition rate.

Acknowledgment

The development of this system analysis technique was based upon an original suggestion by G. W. Rodgers, Sandia Corp., Albuquerque, New Mexico.

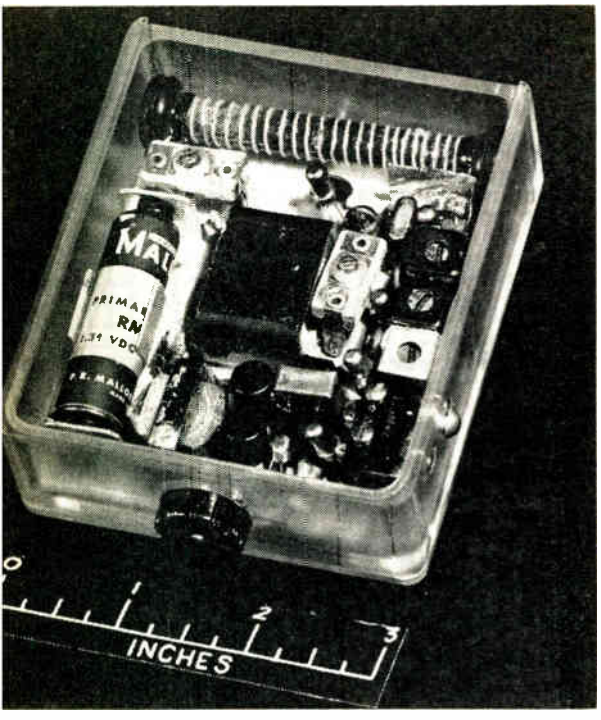


Fig. 1: Tiny WWV receiver with the cover removed shows layout

Knowledge of the exact time is often required in the field while conducting tests. Here is a compact, sensitive receiver that will meet the need quite well.

By SACHIO SAITO and FRANK R. BRETEMPS

Electronic Instrumentation Sect.
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For Accurate Timing Build a

WWV Time Signal Receiver

THIS radio receiver is designed to receive the 5 MC transmission of WWV for time signals. The photographs in Figures 1 and 3 show the comparative size and parts layout of the receiver. The receiver is housed in a plexiglass case 1 x 3¼ x 4 inches and can easily be carried in the coat pocket. Figure 2 is the circuit schematic diagram which uses nine transistors in a superheterodyne circuit. The first six stages use the inexpensive 2N588 high frequency transistor.

The front end uses a loopstick antenna and a stage of radio fre-

(*Continued on page* 216)

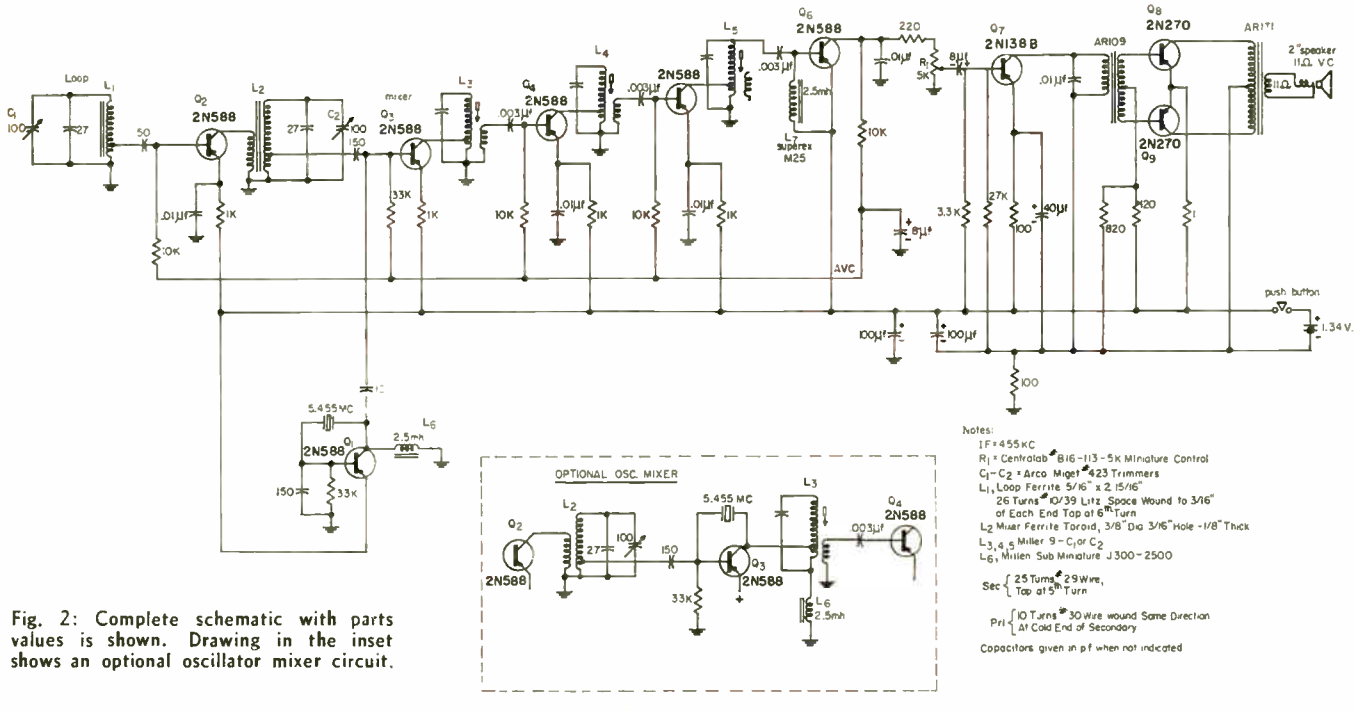
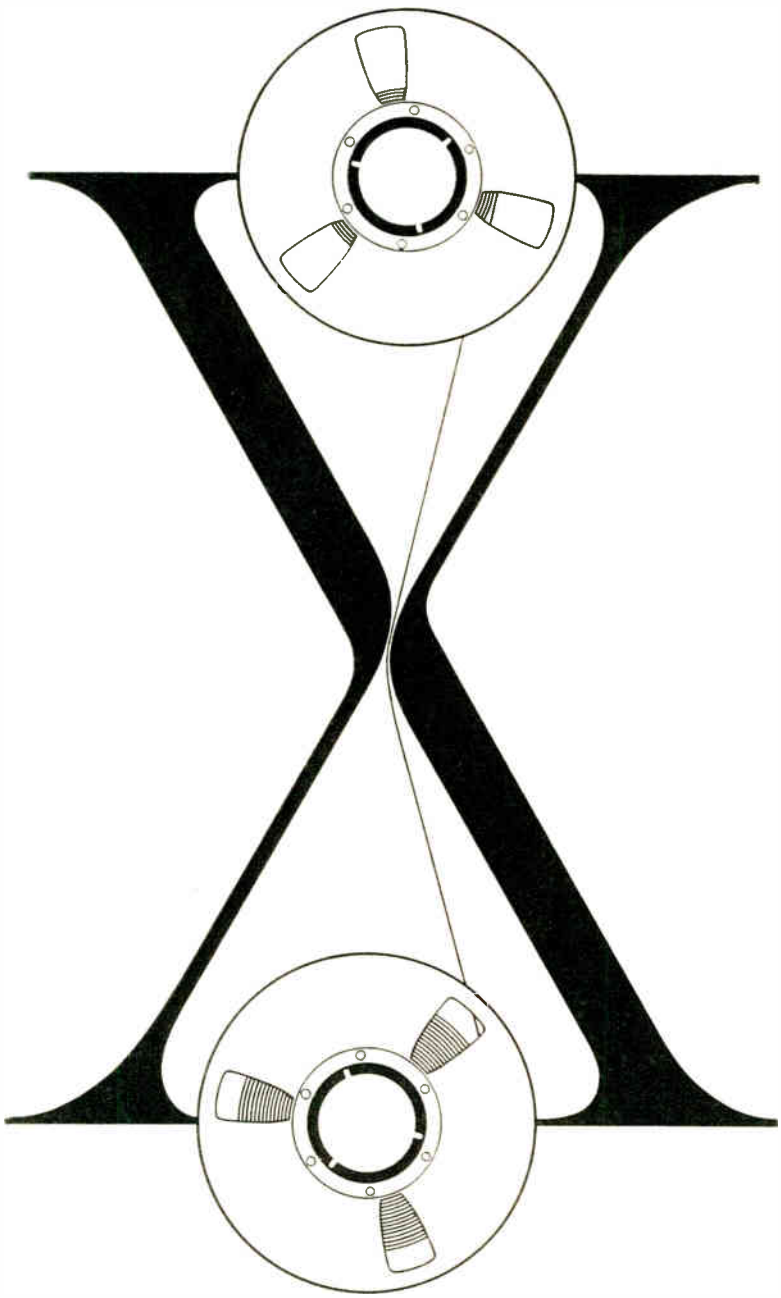


Fig. 2: Complete schematic with parts values is shown. Drawing in the inset shows an optional oscillator mixer circuit.

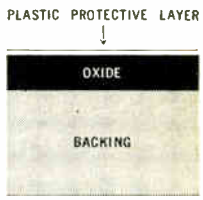
NO DOUBT ABOUT IT—

"SCOTCH" BRAND Sandwich Tapes wear 10 times as long without errors



IN THAT NARROW LITTLE LIFELINE OF DATA known as magnetic tape, a miss is magnified into a mile. A missed bit, or one picked up by error is confusing, frustrating and time-consuming. If you're in doubt about the kind of performance you're getting, perhaps "SCOTCH" BRAND Sandwich Tapes can solve some of your tape and equipment problems.

The exclusive construction of the Sandwich Tapes combats the causes of error because it eliminates the source—oxide rub-off and head build-up. Tests prove it wears a minimum of 10 times as long as ordinary tapes before it errs. As a by-product, you can rely on it to drastically reduce maintenance and replacement costs on equipment.



The Sandwich is constructed as shown in the diagram at the right. The famous "SCOTCH" BRAND high potency oxide coating is sandwiched between a tough polyester base and a 50 micro-inch layer of plastic. Since the oxide is never in contact with the head, tape movement is smooth and low in friction—easy on both tape and equipment. Oxide can't rub off and distort valuable data.

Yet, the real meat of this remarkable Sandwich is the "SCOTCH" BRAND high potency oxide coating. Even under the protective plastic, the oxide's potency is quite sufficient to pick up 500 pulses per inch—and give desirable high-frequency response in many AM, FM and PDM applications. Sandwich Tape is but one of the developments to come out of 3M research—the same research responsible for "SCOTCH" BRAND Video Tape—the first video tape in commercial use.

Whatever your application—you'll find the right tape for reliable, error-free performance in the "SCOTCH" BRAND line-up. Check them all. *High Resolution Tapes 158 and 159* pack more bits per inch, offer either standard or extra-play time. *New Heavy Duty Tapes 198 and 199* offer good resolution and exceptional life even in poor environments. *High Output Tape 128* gives top output in low frequencies, even in temperature extremes. And *Standard Tapes 108 and 109* remain the standard of instrumentation.

Your 3M Representative is close at hand in all major cities—a convenient source of supply and information. For details, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

SCOTCH BRAND MAGNETIC TAPE
FOR INSTRUMENTATION

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

WWV Receiver

(Concluded)

quency amplification Q_2, the mixer oscillator uses separate transistors Q_3, Q_1, or can be combined in a single transistor as shown in the circuit inset; however, its alignment is somewhat more difficult. The crystal is tuned to the high side of the 5MC signal to obtain the 455 KC i-f signal. Two stages of i-f are used, Q_4 and Q_5. The use of a 2N588 detector, Q_6, gives more

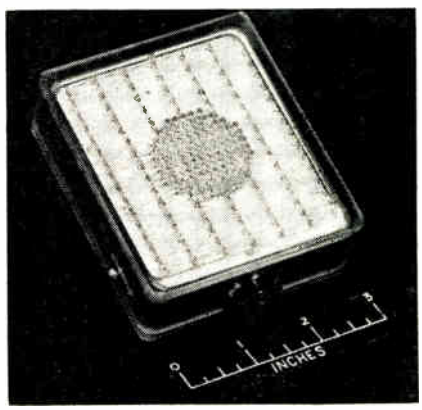


Fig. 3: WWV receiver is compact and can be carried in the pocket.

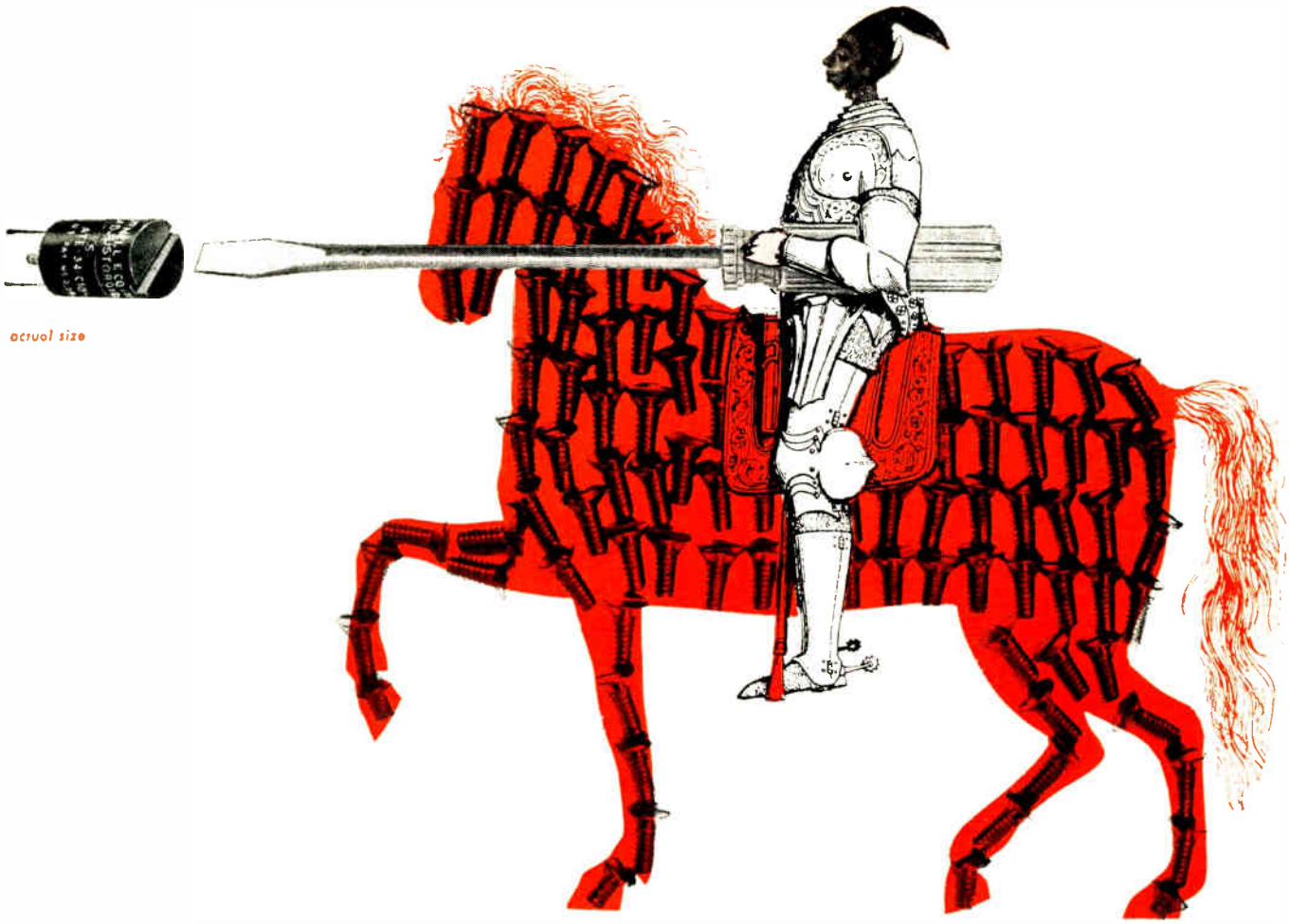
amplification than if a diode is used. The AGC voltage for all preceding steps is obtained here.

A driver and push pull class B amplifier is used to operate a 2 inch speaker at room volume. The power is supplied by a single 1.34 v mercury cell which simplifies the battery replacement problem. The current drain is about 18 ma at full signal and 6 ma with no signal. A push button switch is provided to conserve the life of the cell.

Test Machine For Teaching Electronics

The Air Force has awarded a contract to Western Design, a division of U. S. Industries, Inc., 250 Park Ave., N. Y., N. Y., for 18 automatic teaching machines. They will be tested for use in training in basic electronics.

Here is how the machine works. Similar to a microfilm machine in appearance, it presents course material to the student in a series of small, logical steps. After each step, the student is required to answer a multiple choice question based on the material he has read before he can move to the next step. Errors are explained and the student retested.



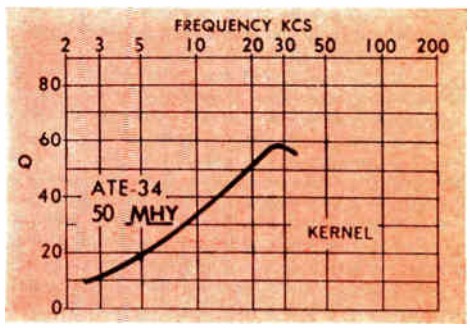
actual size

TAMING OF THE SCREW

Newest additions to the Burnell Adjustoroid® line, the microminiaturized Kernel ATE 34 and the miniatures ATE 11, ATE 0, ATE 4, represent an important contribution to printed circuit design.

These new Adjustoroids possess the exclusive advantage of flush-slotted heads which serve to eliminate adjusting screws – provide maximum economy of height – insure ease of adjustment. Besides high Q, they also offer high stability of inductance versus dc.

The new microminiature Kernel ATE 34 and the miniature ATE 11, ATE 0 and ATE 4 Adjustoroids are variable over a 10% range of their inductance. Fully encapsulated, they will withstand high acceleration and vibration environments. These Adjustoroids meet specifications MIL-T 27 Grade 4, Class R and MIL-E 15305 A as well as MIL-E 5272 for humidity and thermal shock. Write for Adjustoroid Bulletin ATE-7.



SEND NOW FOR HANDY 24" x 36" TOROIDAL INDUCTOR WALL REFERENCE CHART

Lists more than 100 types of toroidal inductors and adjustoroids. Gives performance characteristics, mechanical specifications, including case sizes, types of sealing, etc. Attach coupon to company letterhead. And if you haven't already done so – send for your free membership in the Space Shrinkers Club.

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WHY PERMANENT MAGNETS ARE PERMANENT!

Study of Remanence by Indiana Steel indicates 100% stability can be achieved

Truly permanent permanent magnets are now possible, according to scientists of Indiana Steel Products Division, Indiana General Corporation. Proof of 100% stability of remanence was gained during a special research project conducted by Indiana and supported by funds of the United States Air Force.*

Natural Stability

Materials having a high coercive force displayed the greatest natural stability. For example, a sample of non-oriented barium ferrite (INDOX I) with an H_{ci} of 4,000 oersteds was measured for natural stability over a period of more than 5,000 hours. Relative remanence was 100% ±0.1%. An oriented sample of the same material (INDOX V) with an H_{ci} of 2,030 oersteds measured 99.5% ±0.1%. The material having the lowest coercive force—ALNICO III — also exhibited the least natural stability, 97.04% ±0.05%.

A second important factor affecting natural stability was length-to-diameter ratio (L/D). It was found that rods of ALNICO V, having a greater L/D ratio, proved more stable. For example, rods with a ratio of 8.7:1 showed *no* detectable loss in remanence during a year. Rods with an L/D of 2.1:1 logged only 97.6% for the same period.

Where change in remanence was perceptible, it was found that it decreases linearly with the logarithm of time (see figure 2). This relation is expected to hold for all permanent magnets when they are undisturbed at room temperature and made of a material which does not change with time.

Test Conditions

During the study, sample magnets were kept in a special room where they were relatively free from such external demagnetizing influence as temperature variations, stray magnetic fields, short circuiting by iron contact and excessive movement or handling. Temperature was held virtually constant at 24° ±2.5°C.

The sensitive measuring apparatus was also located in the test room. Developed in 1948 by Dr. Rudolph Tenzer of Indiana Steel, this equipment permits measurements to an over-all tolerance of better than 1 in 10,000.

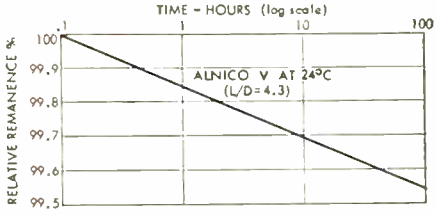
*Contract AF33 (616) — 3385 monitored by the Aero. Res. Lab., WADC.

FIGURE 1. Summary of Experimental Results

Material	L/D	Remanence Bd kilogauss	Stability Relative Remanence at 24° C 5 log cycles (10,000 hr) after magnetization	Measuring Accuracy
INDOX I	0.9	1.4	100.0%	± .1%
INDOX V	0.8	2.5	99.6	± .1
ALNICO III	3.5	4.5	98.10	± .04
	2.2	3.2	97.04	± .05
ALNICO VII	3.5	4.9	99.32	± .04
	2.2	3.9	98.96	± .06
ALNICO V (long)	8.0+	12.3	99.95	± .01
	5.8	11.9	99.81	± .02
(medium)	4.3	10.4	99.23	± .02
(short)	3.5	8.2	98.84	± .04
	2.9	6.7	98.50	± .05
	2.1	4.1	97.6*	± .07

*Extropolated 1 to 2 log cycles beyond last measurement.

FIGURE 2. Remanence decreases with time



Artificial Stabilization

Critical space-age applications often require that a magnet be completely stabilized. Many methods for achieving this were surveyed. For critical applications, methods based on repetitive processes were found superior to those based on any sudden, one-time action. Two of these proved successful, both involving artificial reduction of remanence.

1. **Temperature Knockdown.** ALNICO V magnets were repeatedly exposed to temperatures above and below the temperature of magnetization. Several cycles improved magnetic stability, while remanence was reduced somewhat as a result. Low temperature exposures, to −65° C, produced the greatest improvement in stability, as well as the greatest reduction in remanence.
2. **Knockdown by Applied AC Field.** ALNICO V magnets were subjected to a cycling diminishing field, which also caused a reduction in remanence. Depending upon the material and its use, magnets were knocked down a predetermined amount between 5 and 15% to achieve complete stability. Variations in remanence were less than ± 0.03%, which is the limit of measuring accuracy for this size sample.

Conclusions

This study indicates that permanent magnets *can* be completely stabilized. A magnet, however, that is perfectly stable under these conditions can still be affected by larger temperature variations, stray magnetic fields, vibrations or many other factors. In the case of selected magnets, stability *can* be guaranteed for a flux change no greater than 0.01% per year.

For complete information on the practical aspects of "Stability," ask for a copy of *Applied Magnetics*, First Quarter, 1959. Write Dept. N-8.

CUES

for Broadcasters

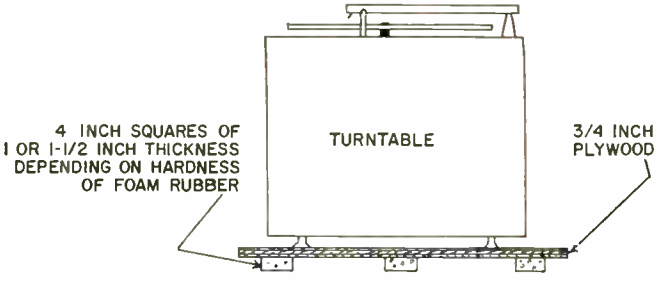
Eliminating Vibrations

JACK VINSON, Eng.
WACO, Waco, Tex.

Some radio stations may have a problem of eliminating vibration from air conditioning equipment. This vibration can be transmitted along walls and floors for quite a distance, and cause flutter or groove-jumping on their turntables, particularly on microgroove equipment. We spent several hundred dollars to little avail trying to eliminate the trouble at its source. We finally solved it by making a platform for our turntables from ¾ inch plywood and glueing 4 inch by 4 inch squares of foam rubber of proper thickness on the bottom, as feet, to support the platform.

The entire table can be then set on the platform or two turntables or more in a row may be placed on one platform. The turntable can be jarred rather violently or may be swung in a wide arc without throwing the needle out of the groove. This solution is so inexpensive and simple that it could be overlooked by someone badly in need of it.

Vibration can be eliminated by using the platform illustrated below. Use of the platform will prevent record skip due to heavy vibrations.



Tone Remote Control Drifting

L. EDWIN RYBAK, Ch. Eng.
WGPA & WGPA-FM,
Bethlehem, Pa.

After several years of operation with tone remote control equipment, here are some suggestions to other users of Gates RCM-12 and RCM-14 remote control equipment. Doubtless, the same suggestions will apply to other tone systems.

Our first experience with the tone control was excessive drift of the tones. After writing Gates Radio Company they very courteously agreed to exchange our oscillators and selective amplifiers on a one for one basis for the newer temperature compensated units.

Previously, oscillator retuning was necessary at least once a week; like

(*Continued on page* 220)

LASER

(*Continued from page* 89)

eration of the laser are these:

1. A light source, in the form of a powerful flash tube lamp, irradiates a synthetic ruby crystal which absorbs energy over a broad band of frequencies.
2. This optical energy excites the atoms to a higher energy state from which the energy is reradiated in a very narrow band of frequencies.
3. The excited atoms are coupled to an optical resonator and stimulated to emit the radiation together. This is in contrast to ordinary light sources where the atoms radiate individually at random and is responsible for the incoherence of these latter sources.

As a direct consequence of its coherence, the laser is a source of a very high "effective" or equivalent temperature. By this term we mean the temperature to which an ordinary light source would need to be heated to generate a signal as bright as the laser's at the laser's color. But, the laser is not hot, it is a "cool" source in the ordinary sense of the word and therefore does not burn up.

The color of light is a manifestation of its frequency, and the purity of a color is determined by the width of the emitted spectrum. Because light waves, in principle could be produced a million times more monochromatic, or single hued, as those from a mercury or neon lamp, lasers could generate the purest colors known. This is one more way to describe the coherence of the laser.

Another important property of a laser, indirectly a consequence of its coherence, is that it radiates an almost perfectly parallel beam. It could, in principle, generate a beam less than a hundredth of a degree of arc wide which when reaching the moon, would illuminate an area less than 10 miles wide.

The laser's use in radar and communications for space work is obvious, since there is no atmosphere in space to absorb or scatter the beams. It could be used, in effect, as a light radar.

The minimum spot size that a

(*Continued on page* 222)

New steels are born at Armco

Armco 48 Orthonik Assures Reliable Efficiency for Magnetic Control, Measurement and Amplification

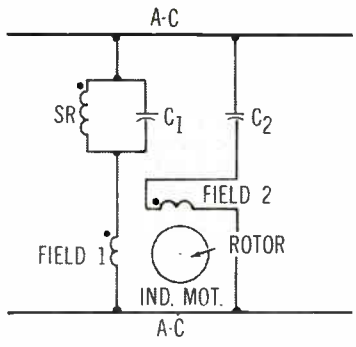
Steel

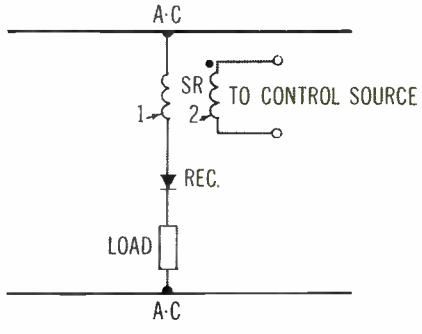
Special magnetic properties of this Armco nickel-iron magnetic alloy meet requirements for wide range of electronic components in industrial and military equipment.

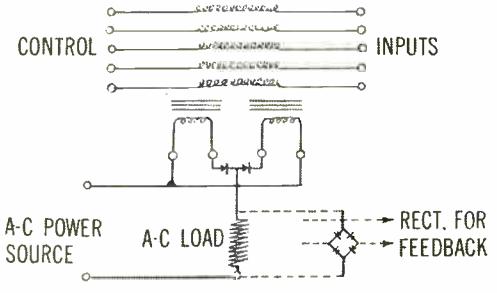
For cores that require a rectangular hysteresis loop and high permeability at low and moderate inductions, Armco 48 Orthonik offers many useful advantages that assure reliable, efficient performance.

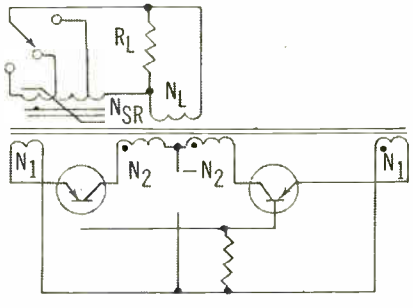
- Extremely low coercive force required permits operation with low control power.
- Very high B_r to B_m ratio at inductions near saturation results from precise mill processing.
- High saturation induction permits design of efficient power components.
- Cubic structure and controlled processing produces good magnetic properties parallel and transverse to rolling direction.
- Uniform properties assure excellent performance capabilities.
- Available in thicknesses from 6 to ¼ mils and specially processed for use in wound or laminated cores.

Where circuits call for the basic magnetic properties of a rectangular loop, nickel-iron alloy, give your products all these additional advantages by specifying cores of Armco 48 Orthonik. Complete design data is available on request; just write Armco Steel Corporation, 2540 Curtis Street, Middletown, Ohio.









ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

(Continued from page 222)

coherent energy beam can be focussed into is approximately equal to the wave length of the radiant energy. The laser emits energy where the wave length is between 15 and 30 millionths of an inch.

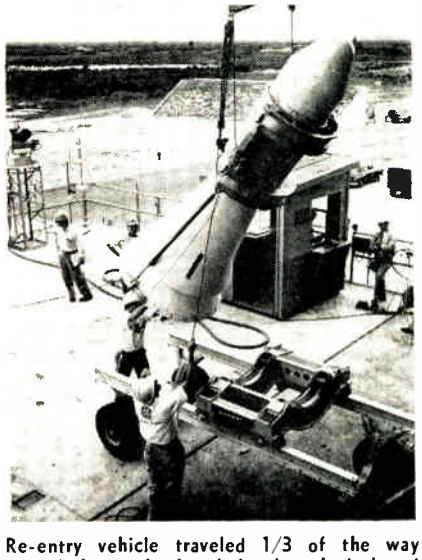
Therefore laser beams, in principle, could be concentrated to the pinpoint size of a few ten-millionths of an inch in diameter.

When energy is concentrated in such small areas, its intensity is very great and it therefore could generate intense local heat. This suggests the possibility of many uses such as sterilizing surfaces with the focussed beam. Perhaps individual parts of bacteria, small plants and particles could be vaporized. Surface areas might be modified and chemical or metallurgical change induced, and thus the laser could be useful in biology, medicine and industry.

New Hi-Fi Technique

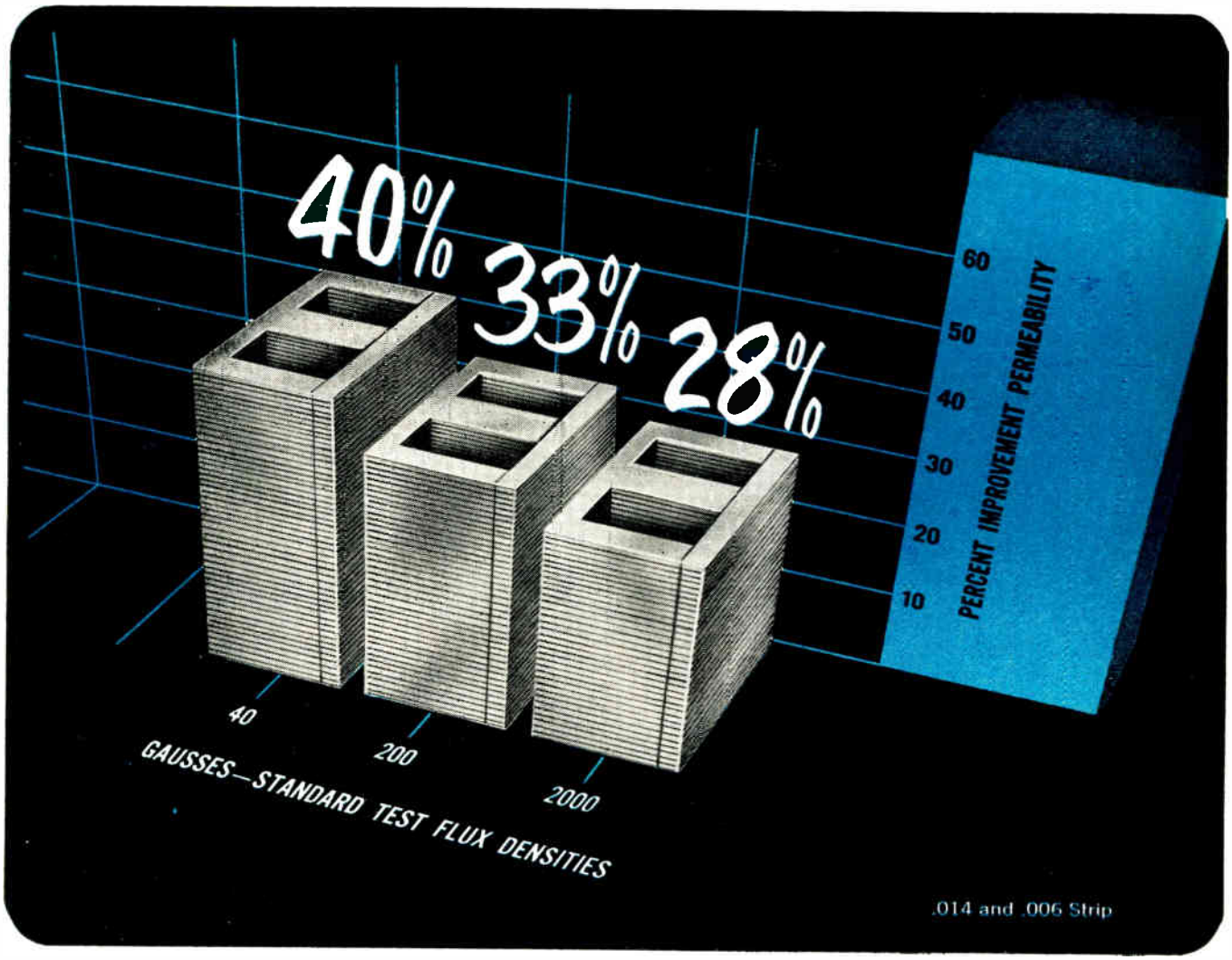
Zenith Sales Corp., 6001 W. Dickens Ave., Chicago, Ill., has described a sound reverberation development that "achieves a living, vibrant realism never heard before from high-fidelity stereo in the home." The unit, Reverba-Tone, uses "time delaying" and reverberating sound to add richness, resonance and majesty to tone. For use even in small rooms it can add to the qualities of FM and AM broadcast sound, and to monaural and Hi-fi stereo sound reproduced from records or tape.

LONG SHOT



Re-entry vehicle traveled 1/3 of the way around the earth after being launched aboard an Atlas ICBM from Cape Canaveral. The Mark 3 was developed by GE's Missile and Space Vehicle Dept., Phila., Pa. Ablation materials absorb re-entry heat.

Experience**—the added alloy in **A-L Electrical Steels



Higher permeability values now guaranteed for Allegheny Ludlum's Moly Permalloy

Means new, consistent and predictable magnetic core performance

Molybdenum Permalloy nickel-iron strip is now available from Allegheny Ludlum, with higher guaranteed permeability values than former typical values. For the buyer, this new high quality means greater uniformity . . . more consistent and predictable magnetic core performance.

This higher permeability is the result of Allegheny Ludlum's intensive research on nickel-bearing electrical alloys. A similar improvement has been made in AL-4750 strip steel. A-L continues its research on silicon steels, including Silectron, well-known grain-oriented silicon steel, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available from Allegheny Ludlum. In addition, you can be assured of close gage tolerance, uniformity of gage throughout the coil, and minimum spread of gage across the coil-width.

If you have a problem relating to electrical steels, laminations or magnetic materials, call A-L. Prompt technical assistance will be yours. And write for more information on Moly Permalloy. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

Address Dept. EI-8

WSW 7480

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from 0.06 to 20 ma and at any load voltage from 0 to 100 v. for a line change of ±10%. Also: a DC Comparator and a Transistor Test Set. Measurements Research Co. Booth 762A.

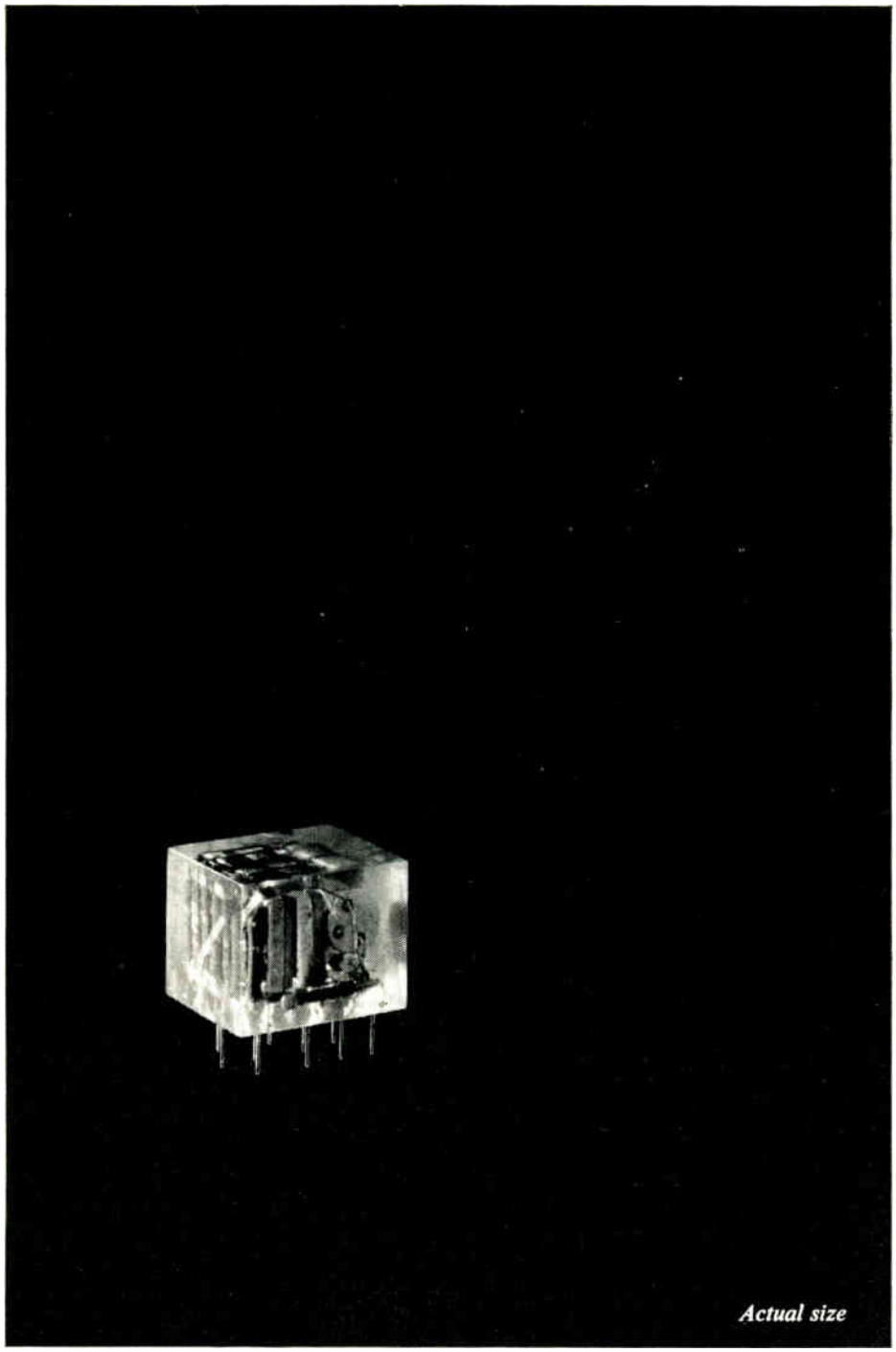
Circle 310 on Inquiry Card

DC Meter

Model 95A Sensitive DC Meter features 17 voltage ranges and 25 current ranges. Voltage ranges are 100μv to 1000v. Current ranges are

1μμa to 1a. Input resistance (voltage ranges) is 10 megohms. Accuracy is 3% of full scale (on the most sensitive ranges it is 4%). Boonton Electronics Corp. Booth 751.

Circle 311 on Inquiry Card



FROM DELCO RADIO NEW IDEAS FOR DEFENSE

MINIATURE MODULES WITH STANDARD COMPONENTS

They are *building block modules*. They are a product of Delco Radio's newly developed, three-dimensional packaging technique. They are used to build light, compact, reliable airborne and special purpose digital computers for missile control. Each module, vacuum encapsulated with epoxy resin, contains up to 35 standard components per cubic inch—averaging more than 50,000 per cubic foot. The modules perform all the standard logic functions. They meet or exceed all MIL-E-5272D (ASG) environmental requirements and will operate over a temperature range of −55°C to +71°C. They can be assembled in groups on printed circuit boards. There are 10 basic types and 15 variations of Delco Building Block Modules. With them, Delco Radio can quickly and easily build a compact, reliable computer for airborne guidance or any other military application. For complete details, write to our Sales Department. *Physicists and electronic engineers: Join Delco Radio's search for new and better products through Solid State Physics.*

PIONEERING PRECISION PRODUCTS THROUGH SOLID STATE PHYSICS

DELCO RADIO

Division of General Motors • Kokomo, Indiana

Circle 142 on Inquiry Card

Search for New Markets

(*Continued from page 77*)

with the highest priority. The means to do this are in-house programs to achieve lowered customer cost, improved performance, quality and reliability, adaptation of design and intensive customer service.

The markets we have served in the past are the principal sources of potential new business. These markets will probably exist far into the future. The glamorous new businesses such as space technology rely on some revolutionary designs but these inevitably find their way in combination with evolutionary ideas into these sophisticated new devices. Today's customers are our major source of guidance for the engineering programs that will be best for them and pay off in new products and profits for us.

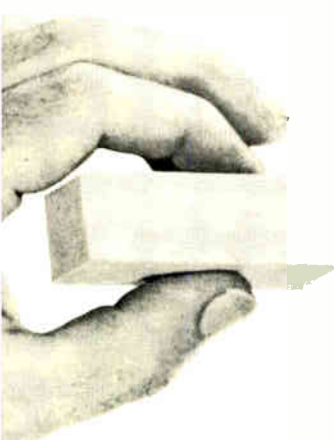
In the jungle of today's electronic markets, success is most probable for the company that can move new ideas rapidly through a streamlined engineering department, that can schedule short runs through its manufacturing facility to a good time cycle and maintain superior standards of quality with delivery at a reasonable price.

Research holds the key to long range growth. Out of research will come the new products for the markets of the 1970's. Careful selection of the areas for the expenditure of research and development funds and talent is critical. This, coupled with a vigilant and aggressive marketing program at the outset, can assure the effective multiplication of today's corporate investment in the markets of tomorrow.

We can no longer project operations on the basis of the high volume production experience of the past. We must adapt our practices to the newer missile and space programs. We must gear our sales, engineering and productive organizations to a fast reaction capability. This capability must be based on producing limited quantities of increasingly complex equipment. It will embody more and more elements pressing the state of the art. At the same time we maintain or expand our less glamorous but most profitable "standard" markets.

The stock in trade of our Electronic Industry, the stuff of which it is made, is the pressure toward horizons beyond our view. We must increase component reliability and diminish size, weight and cost. We must combine components in ever increasing permutations and combinations into systems of ever greater capability and reliability to meet the new needs of today and the anticipated requirements of tomorrow. Expanding markets lie at home and abroad and daily are challenging an ever increasing corps of technical talent. New markets are to be found everywhere for the new and better component, the new and simpler system, the more reliable device.

The endless search for new ways to do old things better and new things first, to expand old markets and create and serve new ones, will drive the Electronic Industry to new sales highs.



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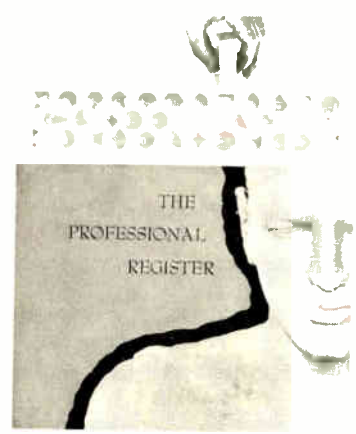

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Please complete this card, fold, staple and mail. The information you give constitutes the first phase of the Professional Register Program and will enable our professional staff to make a preliminary evaluation of your abilities. All inquiries will be answered immediately. When you complete the Program, the inventory of your talents and capabilities will be recorded on over 20 electronic data-cards available for instant use in guiding your future progress at HUGHES-FULLERTON.

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ME	☐	☐	☐		Other:___	☐	☐	☐	
Mathematics	☐	☐	☐			☐	☐	☐	

School (Highest Degree)__________

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- ☐ Electron Tubes
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- ☐ Other:_____

FUNCTIONS PERFORMED:
(please check boxes)

- ☐ Research
- ☐ Development/Design
- ☐ Technical Writing
- ☐ Project Management/Supervision
- ☐ Administrative Staff Support
- ☐ Systems Analysis
- ☐ Testing/Process Control
- ☐ Product Engineering
- ☐ Field Engineering
- ☐ Operations Research
- ☐ General Engineering
- ☐ Systems Engineering
- ☐ Other:_____

Are your talents being recognized?

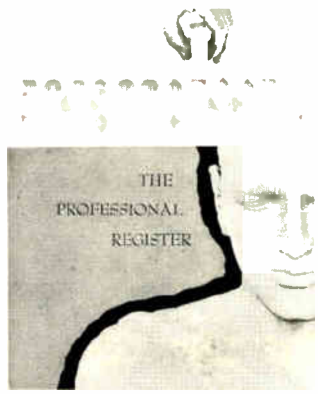
Most engineers have had to face an unpleasant fact. Often an employer will hire from outside to fill a supervisory post. Entirely qualified men "inside" are passed over. The problem is generally one of communication. The employer simply does not have adequate knowledge of his employees' abilities and promise.

Hughes-Fullerton's new Professional Capabilities Register reflects the complete engineering-orientation of this fastest-growing Hughes activity. (From 800 to nearly 6,000 people since 1957. Planned, *scheduled* growth.)

The Register makes instantly available a complete record of every individual's abilities, interests and accomplishments. Previously hidden talents can now be put to use. Often these can mean the difference when reassignments or promotions are being made. Your potentials become a very real resource of Hughes-Fullerton Research and Development Staff.

Areas covered in the Register range from language skills through patents to books and articles published. It includes teaching experience, professional affiliations. All data is kept up-to-date and handled by automatic data processing equipment for utmost efficiency.

Hughes-Fullerton's philosophy of giving precedence to the needs of engineers has worked well. Hughes-Fullerton was first with three-dimension radar...a major breakthrough in the state of the art. Other vital areas of interest include advanced data processing and electronic display systems.



These are a few reasons why you should investigate Hughes-Fullerton. Openings exist at several experience levels for a variety of engineering specialties. For full information fill out the post card and mail it today!

If reply card is missing, a postcard request will speed another to you. Write: Mr. B. P. Ramstack, P.O. Box 2097, Fullerton, Calif.

Creating a new world with ELECTRONICS

HUGHES

FULLERTON RESEARCH & DEVELOPMENT
FULLERTON, ORANGE COUNTY, CALIF.

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

What Makes Today's Engineer "Tick"?

Changes in "The Characteristics of Engineers and Scientists" are discussed in a book by Prof. Lee E. Danielson, University of Michigan (136 pp, $4.00 from the Univ. of Mich. Bureau of Industrial Relations). It is based on interviews with 44 executives, 91 supervisors, and 277 non-supervisory professionals in 10 firms having extensive research organizations.

What did he find? For one thing, while intensely interested in their work, professional scientists and engineers do not always regard a "job well done" as its own reward. They are interested in personal advancement and recognition, but they do not respond well to many traditional management practices. Their bosses think of them as a breed apart within the business organization — and they think of themselves in pretty much the same terms.

Instead of their technical and scientific training leading to increased technical contribution, it serves as a means to an end. Many follow engineering programs only so that they will be more employable. Once employed, they actively seek to move out of the technical areas and into more lucrative ones in management and sales.

Says Prof. Danielson, "many are attracted to the sciences because of the monetary and prestige lure, rather than a devotion to fundamental knowledge. No longer does the scientist have to limit himself to employment in an academic institution. He can be well paid for full-time research work with up-to-date facilities and equipment, and see the immediate application of his results.

"The number of people attracted

(*Continued on page* 243)

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 195.

WAR GAMES

Maj. Gen. T. J. Daly (Australia) is briefed on IBM Computer operations used in LOGEX 60, a logistics war game under way at Fort Lee, Va. Col. R. J. Kaufman, U.S.A.F., (Left) and Col D. P. Rinque, U. S. Army, look on. Mission simulated is to support Allied field army on a counter-offensive after start of nuclear war in Europe.

Patents Lag Research

The U. S. Commissioner of Patents, M. A. Crews, says that the large-scale research boom hasn't greatly increased patent applications. Research efforts are up 6 to 12 times while patent applications are up by only 1/6.

He gives several possible reasons for this puzzling situation. First the increasing complexity of modern technology, with invention piled on invention, may have developed to a point where the end product involves one solution of which there are other variants available, so that the motive for patenting is not so great. Then, the body of patent and technical literature is becoming greater and greater and it is more and more difficult to produce a patentably novel invention and finally, the inhospitable attitude toward patents exhibited by some courts may discourage patenting.

An interesting point brought out by Crews (he spoke at the Univ. of Michigan's College of Engineering Industry Program) was that the individual inventor is still an important factor. Independent inventors or small organizations account for about 60% of the more important contributions and about 40% of all patent applications.

How to Stop Absenteeism? Reward "Presenteeism"

A survey by Industrial Relations News, 230 West 41st St., New York, N. Y., shows that more and more companies are taking firm steps to combat absenteeism among employees.

There are two main routes companies can take to encourage employees to come to work regularly: reward "presenteeism"; or penalize absenteeism.

Rewards for good attendance take several forms. One company hands out a week's extra pay for a year's perfect attendance. Another grants an extra week's vacation. Robbins & Myers, Inc., Springfield, Ohio, hands out bonuses based on earnings to employees who show up for work regularly. JFD Mfg. Co., New York, distributes company products as attendance awards.

Penalties are becoming more common for absenteeism. These range from a demerit system (the employee may be fired when he has accumulated a certain number of demerits) to loss of seniority.

New Scholarship Program

A $25,000 aid to education program for outstanding students in six Eastern universities and colleges has been established by American Machine & Foundry Co., 261 Madison Ave., New York 16, N. Y.

The awards will be given to leading students in the fields of electrical engineering, mechanical engineering, business administration, and chemistry. Participating schools are Princeton, Harvard, Dartmouth, M.I.T., Cornell and Rensselaer Polytechnic Institute.

As part of the AMF program, the Company will give grants to each school in amounts to be determined after the scholarships and fellowships are awarded to the students.

Component manufacturing must concentrate on small, light weight items that can be shipped easily. Research & development should play a big part because the attractions that Hawaii offers—climate, recreation, low real estate values—should make it relatively easy to hire and keep top-level engineers.

The 50th State—

By CREIGHTON M. MARCOTT
Managing Editor, "ELECTRONIC INDUSTRIES"

AS the attention of the electronic world focuses this month on WESCON and the West Coast area a small piece of the reflected limelight is caught by the U. S.'s proud, new off-shore state—Hawaii!

In its newly acquired mantle of statehood, Hawaii opens new doors to investment by mainland firms, particularly to light industry, such as electronics. The islands have already won the hearts of many tourists and ex-servicemen with their scenic beauty and the happy spirits of the Hawaiian people. Now, faced with its responsibility as a state Hawaii is looking very soberly at its future as an industrial area.

Situated 2,400 mi. from San Francisco, the island state offers an unusual combination of attractions to industry. While it is too early to project its future in the electronic industry it is possible to conjecture, on the basis of the natural characteristics of the country, what type of activity can be expected.

First, a few words on the physical characteristics of the Hawaiian Islands: The Island group consists of eight islands strung out over a distance of some 1,600 miles. The five largest islands are Hawaii, Maui, Molokai, Oahu and Kauai. Roughly 80% of Hawaii's 660,000 people live on the Island of Oahu. Oahu also has 90% of the manufacturing and 95% of the tourist trade. The other Islands are occupied primarily by sugar cane plantations, pineapple growing, and cattle raising.

The present income of the Islands breaks down into—

Military	$300 million
Sugar	$150 million
Pineapple	$125 million
Tourism	$115 million

Military income is derived from the giant U. S. Naval Base at Pearl Harbor and various Army and Air Force installations, notably Schofield Barracks and Hickam Field, all in Oahu.

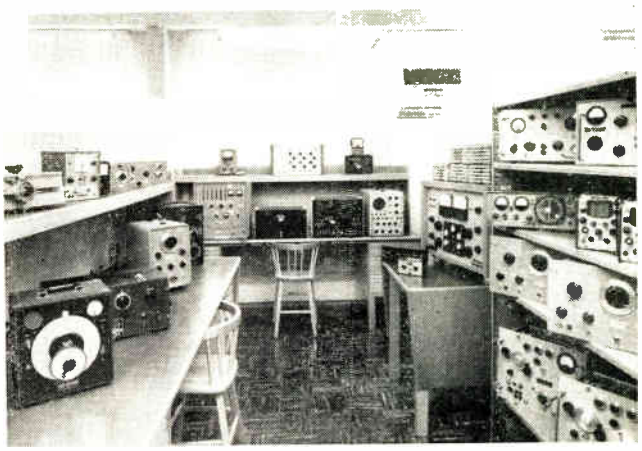
In the future plans of Hawaii only tourism can be expected to show any sizeable increase. Both the sugar output and pineapples are finding increased competition on the world market. Working against the industries are rising land costs throughout the state, coupled with severe land scarcity.

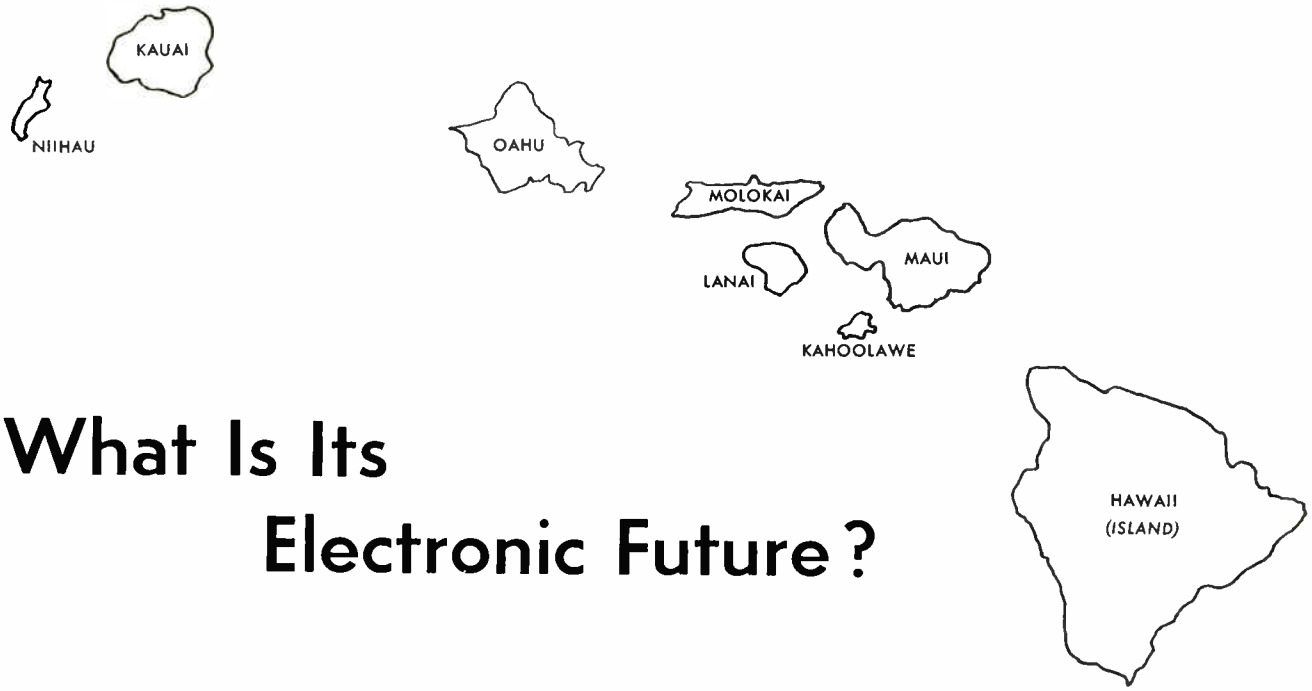
Equally uncertain is the military spending that can be expected during the immediate future. With the change of military emphasis to missiles, military spending at best becomes highly unpredictable.

With this picture of a steady decrease in their principal industries, Hawaiian business leaders are looking to new industries to pick up the slack. As the fifth largest industry in the country and fastest growing, electronics is highly regarded in the future of the Islands. The principal electronic activity in the Islands at the moment is one firm, Kentron Hawaii Ltd. in Honolulu. Kentron is essentially a servicing and calibration center. Until recently the firm also maintained a cathode-ray

NOW IN BUSINESS IN HAWAII—

Principal electronic activity in Hawaii, other than military, is Kentron-Hawaii Ltd. at 1140 Waimanu St., Honolulu. Primarily a calibration and servicing center it employs approximately 50 engineers and technicians. At one time it also produced 60% of the cathode ray tubes for Hawaii's consumer TV receivers. Among design and development projects they have handled are electronic sorting devices, and solar measuring instruments.





What Is Its Electronic Future?

tube manufacturing operation but the demand within the Islands was inadequate.

The rather limited population, 660,000 people, creates certain conditions which will greatly influence the growth of electronics in the Islands. First and foremost, it automatically precludes the manufacture of consumer items—radios, televisions, phonographs, home recorders, etc. As far into the future as can be seen, the Islands will have to depend upon the mainland for mass produced electronic gear.

The second important limitation on Hawaii's potential as an electronic center is its location, 2,400 miles from mainland of the U. S. The added burden of shipping charges—shipping raw materials to the Islands, and the finished products to the mainland—would make it extremely difficult for Hawaii to meet the fierce competition in the U. S.

These two rather serious handicaps considerably narrow the possible approaches in bringing electronics to the Islands. In a sense, however, they also simplify the problem, making it possible to concentrate on very small segments of the electronic industry.

If we divide the electronic industry very roughly into its three basic groupings — components, equipment and R&D—it is somewhat easier to project Hawaii's future in electronics. The production of components, for instance, must of necessity be limited to items in which the "value added by manufacturing" is many times the value of the raw material itself. Secondly, the components must be individually quite small, lightweight and preferably be suitable for packing in bulk.

Since the work force in the Islands is rather small, it would be difficult for Hawaii to compete in the cheap labor market, nor would the Hawaiians want to. They already pride themselves on the comparatively high level of skill that the population possesses, and their reputation for dexterity. The influx of skilled industry would mean a generally higher

35 ENGINEERS ARE NEEDED NOW

The Department of Economic Development has just completed a survey of electronic personnel requirements in Hawaii.

The results: 35 electronic engineers are needed right now.

63 additional engineers will be needed in 1961.

42 additional engineers in 1962, and 28 more in 1963; for a total of 168 by 1963.

(These figures were obtained by questionairing electronic installations in Hawaii at the present time, and do not include requirements of new firms moving to the Islands.)

Electro Technical School, 989 Dillingham Blvd., Honolulu, which trains electronic technicians, estimates the demand for technicians at approximately 1,000 over the next few years.

PROFILE OF THE HAWAIIAN ISLANDS

Area—6,435 sq. mi.

Population—660,000
- 34% Japanese
- 32% Caucasian
- 15% Hawaiian
- 11% Filipino
- 6% Chinese
- 2% All others

Principal Industries
- Sugar Cane
- Pineapples
- Coffee
- Cattle
- Tourists
- Defense

Labor Force
- In Agriculture—40,800
- Construction—12,900
- Retail Trades—28,000
- Defense—50,000 uniformed personnel
- 23,000 civilians

(One out of 4 workers in the labor force is employed in defense)

Chief Ports
- Honolulu & Pearl Harbor

Location
- 2,400 mi. from San Francisco
- 3,800 mi. from Yokohama
- 5,100 mi. from Sydney, Australia
- 6,000 mi. from Lima, Peru

Mineral deposits—negligible

Principal Cities—population
- Honolulu—321,583
- Hilo (Hawaii)—25,078
- Kailua-Lanikai—15,079

Radio & TV Stations
- Broadcast Stations—17
- Television Stations—7
- (4 are satellite stations)

standard of living throughout the Islands.

There has developed within the electronic industry, coincidentally with the coming of statehood, a rapidly developing segment which meets most of the requirements described above. The semiconductor field, and the allied field of molecular electronics, deals with extremely small units in which the level of skill and technology is above the average. The units are so small that shipping charges would represent a very small part of the total costs, and the shipment of raw material would not be a real handicap.

For the moment, however, working against the possibility of establishing a semiconductor business in Hawaii is the very fiercely competitive situation existing on the mainland. It may be necessary to await a stabilizing of the industry; a shaking out that will inevitably lead to higher margins of profits in the future. The entire industry is being threatened at the moment by foreign imports and until this threat is neutralized, it is unlikely that any manufacturers will be investing any sizeable amounts of capital in new manufacturing facilities.

The field of molecular electronics is not yet clearly defined, but on the surface it meets most of the requirements that Hawaii imposes. Units are small, technology is at a particularly high level, and unit costs are high. It remains to be seen just what direction molecular electronics will take.

Among the other components that might be considered would be precision resistors, precision potentiometers, various small capacitors, and transducers.

In the equipment field we must first eliminate the category of mass produced units. The equipment produced in the Islands will of necessity be electronic specialty items, custom units having high unit costs and requiring low volume production.

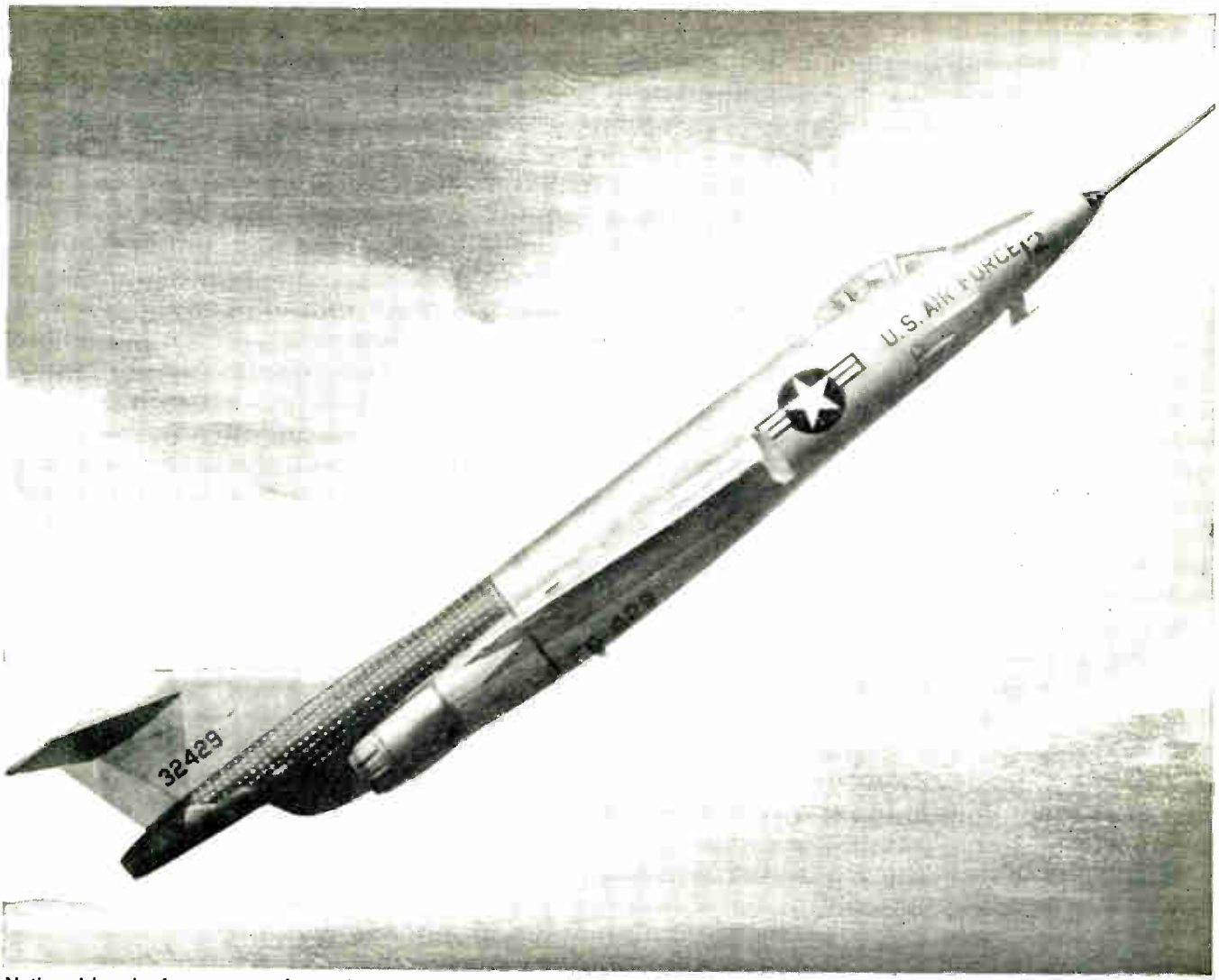
Basic to the whole problem of bringing electronics to the Islands is the establishment of facilities for providing a continuing flow of skilled manpower. While the original staffs of electronic undertakings might be lured from the mainland—in fact Hawaiian business circles are certain that this can be done—there must be established in Hawaii a source of continuing manpower. The University of Hawaii is being looked to as the answer to this problem. The University has already established an electrical engineering department, and a rather limited number of graduates are trickling through. For the moment these graduates must look to the mainland for employment, and this is a source of great concern to Hawaiian business people.

It may well be that the key to the future of the electronic industry in Hawaii will be commensurate with the ability of the University of Hawaii and whatever other educational institutions may be set up in the Islands to supply high level technical people. It has been pretty well demonstrated in the United States that progress in electronics is tied inextricably with educational institutions. The prime examples are Boston and the activity around Massachusetts Institute of Technology; the Palo Alto, Calif. area surrounding Stanford University and Stanford Research Institute; and Chicago with the Armour Research Foundation and Illinois Institute of Technology.

Electronics has now reached the stage of development where keeping at the forefront of technology requires a very intimate relationship with educational institutions, and research organizations. The most alert engineers, interested in keeping current in their various technologies, are gravitating towards areas where post-graduate courses and similar advanced studies are readily available. In some cases engineers will be lured to areas by other considerations as well, such as climate or job opportunities. It is not long, however, before advanced educational programs follow, sometimes on the initiative of the engineers themselves.

While engineers have shown

(F101, AIR FORCE PHOTO)



National has had many years' experience making significant contributions to the defense effort, including airborne components.

COMPARE THIS OPPORTUNITY

WITH WHAT YOU ARE NOW DOING!

HERE'S WHAT *National's* NEW MILITARY RESEARCH AND DEVELOPMENT PROGRAM OFFERS.

This operation will interest any engineer or scientist possessing enough self-confidence—ability and experience—to develop projects initially and carry them through to completion.

WHO WE'RE LOOKING FOR

National is looking for military-oriented scientists and engineers who hold a B.S. degree or advanced degrees. You should be working in electronic, electro-mechanical, mechanical, physics, optics, mathematics, or other related areas. Preference will be given to those who have had several years' experience dealing with prime contractors and government agencies.

As a member of National's New Military Development Team—you will be working initially with our Military Proposal Group. As proposals become specific projects, your responsibility will continue through the contractual stage for technical liaison, fulfillment of contractual obligations including hardware development, meanwhile retaining sufficient flexibility to continue your proposal efforts.

WHY YOU SHOULD INVESTIGATE

National's new Military Research and Development Program offers you unusual latitude in responsibility. It offers you the chance to participate in military projects from start to finish. Furthermore, you now have the opportunity to join an operation still in its formative stage—yet backed by one of the world's most successful . . . most reputable corporations.

COMPLETE INFORMATION is yours by sending your résumé to Mr. T. F. Wade, Technical Placement Section F9-4, The National Cash Register Company, Dayton 9, Ohio. All correspondence will be kept strictly confidential.

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ADDING MACHINES - CASH REGISTERS
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Circle 501 on "Opportunities" Inquiry Card

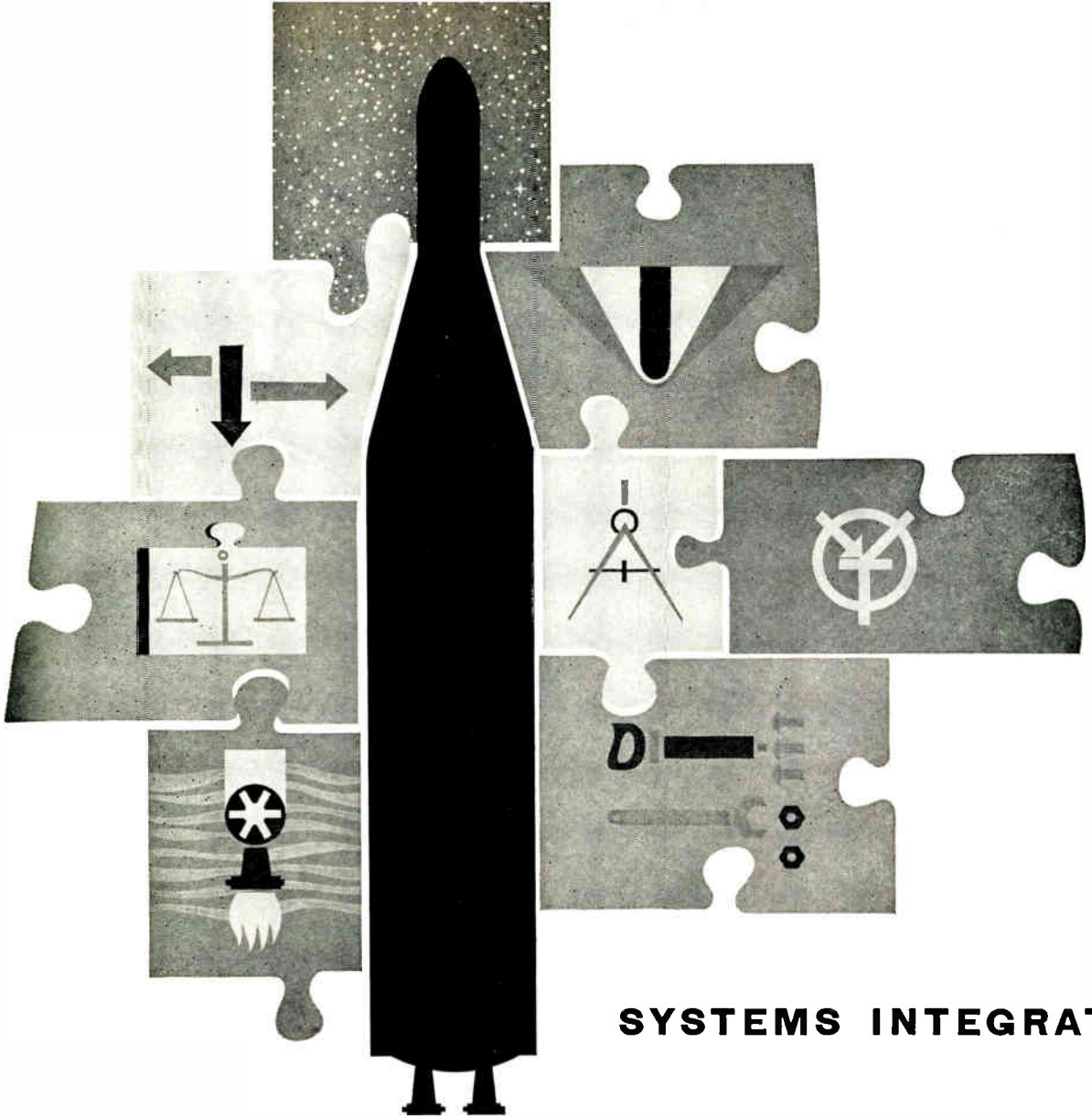
during the past few years a marked liking for the more comfortable climates—and Hawaii's is one of the finest in the world—the Islands' success in luring electronic engineers may well depend on the educational opportunities that exist there. It has been amply demonstrated that it matters very little where groups of engineers are located, so long as the basic requirements of housing, education, and recreation are available. This is perhaps a tribute to the exceptional importance that technical know-how has achieved in the industry.

One of the courses that Hawaiian business circles will most certainly follow will be in attracting research and development activities to the Islands. In perhaps no other phase of electronic activity is Hawaii so well qualified. Many of the attractions that research and development facilities are looking for are among the obvious attractions that Hawaii offers. The climate is excellent all year round, housing facilities are more than adequate, and there are many opportunities for recreation. Comparative seclusion is easily achieved and real estate values are at an attractively low level.

Transportation to and from the mainland is largely by airplane, particularly for business men. Airline schedules are extremely regular.

From the previous experiences of the Boston-MIT area and the Stanford-Palo Alto areas, it is possible to predict the pattern that electronics would take in the Islands if R&D organizations can be induced to set up there.

Inevitably, with the high-powered technical abilities that are found in research activities, there will be a good number of small R&D firms set up in the immediate neighborhood of the university or research center. We can assume for one thing that the climate will be so attractive that researchers will be reluctant to move back to the mainland, and would prefer to set up shop right there in the Islands. With R&D work this is not too much of a problem, be-



SYSTEMS INTEGRATION

Systems Integration, a major endeavor at Lockheed, involves the responsibility of establishing and maintaining composite system and subsystem characteristics within the parameters necessary for a successful development of weapon and satellite systems.

An outstanding example of this system's engineering approach is illustrated by the Navy POLARIS Fleet Ballistic Missile Weapon System. The Navy gave Lockheed Missiles and Space Division the basic overall weapon system requirements and the required operational date, and requested Lockheed to develop a missile system compatible with the other systems of the weapon system. This demanded an entirely new procedure in missile development: 1) The design had to be based on anticipated advances in the state-of-the-art to meet performance requirements. 2) Simultaneous development of missile subsystems in an independent fashion was required to meet time scale requirements. Not only is Lockheed meeting these requirements—*it is delivering an operational missile system three years ahead of the original schedule.*

Detailed functions of successful systems integration activities include: Establishment of basic system characteristics through use of preliminary design and parametric study techniques; sectionalizing the missile and defining interfaces and performance requirements for each subsystem; monitoring and counseling the design activities of subsystems and establishing interfaces and subsystem design parameters and tolerances; assuring and maintaining design compatibility of subsystems throughout the entire development of the missile into the weapon system.

From the development of advanced system proposals into the preliminary design and system requirements, on through to final missile production, demands highly trained engineers and scientists in missile and space technology concerned with the overall systems problems.

Engineers and Scientists: Work in the broad spectrum of systems integration functions provides a constant challenge at Lockheed Missiles and Space Division. If you are experienced in this area, you are invited to write: Research and Development Staff, Department H-48, 962 W. El Camino Real, Sunnyvale, California.

U.S. Citizenship or existing Department of Defense industrial security clearance required.

Lockheed / MISSILES AND SPACE DIVISION

Systems Manager for the Navy POLARIS FBM; the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO • HAWAII

Circle 503 on "Opportunities" Inquiry Card

The 50th State

cause there will be comparatively few items to be shipped. They will be selling first of all knowledge and technical know-how.

Concurrently with the establishment of R&D facilities must come a rather elaborately staffed and maintained electronic parts distributorship. This distributorship will have to be a rather large cut above the replacement parts distributor—more in the line of the large industrial distributorships, of which a few dozen exist in the United States. It will be rather important that this distributorship be well stocked because delays in procuring components could not long be tolerated. Demands in terms of quantity would be rather small. There will be a rather considerable demand in terms of variety.

The small manufacturer of electronic specialties will be a natural outgrowth of the research and development activities. And by cultivating this type of high level activity, the Islands can establish themselves as a center of technical know-how.

However, all this conjecture is almost completely dependent on the ability of Hawaii to establish an atmosphere of technical creativity. This in turn will depend on the educational facilities that are established or enlarged.

New Component Firm

Zoron, Inc., 612 West Monroe St., Chicago 6, Ill., has been organized as a manufacturer of electronic components. Line will include: miniature jacks, phono-jacks, pin-jacks and plugs, banana-jacks and plugs, microphone connectors, adapters, hi-fi cords, test leads, binding posts, hardware, etc.

Receives Award

Dr. Arnold O. Beckman, President, Beckman Instruments, Inc., has been given an award by the University of Illinois for "Leadership in the Field of Precision Instruments." The Illini Achievement Awards, instituted in 1957, recognize outstanding accomplishments by University alumni in their chosen fields.

Industry News

Appointees named by Hughes Aircraft Co., Fullerton, Calif., Ground Systems Group are: **Gerhard L. Hollander**, Manager of the newly formed General-Purpose Computer Dept.; **Marvin H. Gonsior**, newly created position of Assistant to the Director of Product Line Operations; and **Jose M. Tellez**, Manager of the Army Computer Systems Dept. In the Semiconductor Div., El Segundo, Calif., are: **Harley F. Pattison**, Western Region Manager for Field Sales; **S. Vaughan Andrews**, Personnel Manager of the Manufacturing Div., **John H. Richardson**, Vice President, Marketing, and **Elmer F. Sproule**, Head of Management, Development and Training. Industrial Relations Staff are at Culver City, Calif., Company Headquarters.

Dr. Harper Q. North has been reelected President of Pacific Semiconductors, Inc., by the Board of Directors of the Thompson Ramo Wooldridge, Inc., subsidiary. **Lawrence T. Lindgren, Dr. John W. Peterson** and **Sidney L. Spiegel** were newly elected as Vice Presidents, respectively, of Manufacturing, Research and Development, and Marketing.

Dr. H. Q. North

J. Kravetz

Jules Kravetz, former director of the U. S. Army Signal Corps West Coast Research and Development Office, has been named Director of Government Relations for Aerolab Development Co., Pasadena, Calif., wholly owned subsidiary of Ryan Aeronautical Co., San Diego, Calif. During army service he was awarded the West Coast Electronic Manufacturers Assoc. Distinguished Service Award.

Arthur A. Powell has been promoted to Product Sales Manager for Motorola Semiconductor Products, Inc., a subsidiary of Motorola, Inc.

John H. Streibel, formerly Marketing Executive for Hughes Aircraft, has been named Assistant to the Vice President, Sales, for the Houston Fearless Corp., Los Angeles, Calif.

Circle 505 on "Opportunities" Inquiry Card→

Industry News

Richard C. Erbes has been appointed Customer Relations Manager for the Scientific and Process Instruments Div., Beckman Instruments, Inc., Fullerton, Calif.

Homer F. Lewis has been appointed Vice President and Treasurer of Transval Electronics Corp., El Segundo.

H. F. Lewis

H. C. Bream

Hugh C. Bream has been named President and General Manager of Western Design, Santa Barbara Airport, Goleta, Calif., a div. of U. S. Industries, Inc.

Two Key Staff Personnel have been appointed by Knapic Electro-Physics, Inc.; **Frank M. Beeler** as Administrative Director and **Phil W. Ice** as Director of Industrial Relations. Mr. Beeler was recently elected a Vice President by the Company's Board of Directors.

Bernard Elbinger was appointed Head of the Electronic Instrumentation Section of Rheem Semiconductor Corp., Mountain View, Calif.

Eric Firth has been appointed National Sales Manager of the Electronics Div., Elgin National Watch Co., Burbank, Calif.

Recent appointments at American Electronics, Inc., of Calif. are: **Herbert S. Boring** as Vice President, Commercial Operations; **Hans Bannies** as Marketing Manager, Electro-Mechanical Div.; and **John P. Hastings** as Manager, Field Operations, Instrument Div.

Norman J. Regnier, formerly with Hoffman Semiconductor Div., has been named Program Manager of an advanced semiconductor reliability study being conducted by Motorola Semiconductor Products Div. for Autonetics, a Div. of North American Aviation, Inc., as part of the Minuteman Intercontinental Ballistic Missile Program.

Industry News

Norval E. Powell has been named Personnel Manager of The National Cash Register Co., Electronics Div., Hawthorne, Calif. The newly created position is part of an over-all expansion program.

Recent appointments at General Electric Co's Computer Dept., Phoenix, Ariz., include: **Lacy W. Goostree, Jr.,** Department Manager of Marketing; **George A. Haggerty,** newly-established position of Manager, Process Computers; and **A. T. Clawson,** Sales Manager, Government and Service Sales.

Carl C. McCallus, formerly Sales Manager of the Electro-mechanical Div. of Hoffman Electronics Corp., has been appointed Director of Marketing for the U. S. Relay-Electronics, Azusa, Calif., a Div. of American Safety Razor Co.

C. C. McCallus

Dr. A. E. Lewis

Dr. Arthur E. Lewis has been appointed a scientist, Hoffman Electronics Corp., Science Center, Santa Barbara, Calif.

Ray Knox has been named Manager of International Rectifier Corp's New England Sales Office. He replaces former Manager **Angus Scott,** who has been promoted to Silicon Products Sales Manager, El Segundo, Calif.

Dave Fourney has been appointed to the Apparatus Div., Texas Instruments Incorporated, Los Angeles, Calif., to provide customer service to government, military and industrial agencies in that area.

George Marshall has been appointed Sales Manager of Airtron's plant in Linden, N. J.; **Joel Zneimer** has been appointed as Manager of the Ferrite Materials Section of Airtron. Airtron is a division of Litton Industries.

Donald R. E. Barnaby recently joined Eitel-McCullough, Inc., San Carlos, Calif., as Manager of the newly formed Parts Div.; and **George R. Chambers III,** has been named Manager, Research and Development Marketing at the same facility.

News of Mfrs' Representatives

REPS WANTED

Manufacturer of microwave test equipment and special microwave devices desires Reps for the Chicago, Texas-Oklahoma, St. Louis-Wichita Areas. (Box 7-1, Editor, ELECTRONIC INDUSTRIES.

Richard Hollingworth has been appointed engineering representative in the Dayton, Ohio area for Sargent Engineering Corp., Huntington Park, Calif.

The Components Div. of Epsco, Inc., Cambridge, Mass. has appointed the following four new area sales representatives: **Jaeger-Corday**, Orlando, Fla., in Florida; **Asci Engineering Co.**, Dallas, Tex., in Texas; **Douglas Randall**, Canada Ltd., Scarborough, Ont., in Canada; and **Loren F. Green and Associates**, Chicago, Ill., in Chicago.

Egloff & Graper, Inc., Los Angeles, Calif., has been named sales representative, throughout California, for Webber Mfg. Co., Inc. of Indianapolis,

W. D. Trammell

E. Egloff

William D. Trammell has been appointed sales representative for the Western District of the Silicone Products Dept., General Electric Co. His office location is 6500 Cedar Springs, Dallas, Tex.

CBS Laboratories, a div. of Columbia Broadcasting System, Inc., has appointed the following representative organizations in the Middle-Atlantic, South-Atlantic and Western Territories: **The Gawler-Knoop Co.**, for New York City, Long Island, New Jersey, Eastern Pennsylvania, Maryland, Delaware, Virginia and District of Columbia; **Scientific Sales Engineering Co.**, in North and South Carolina, Tennessee, Georgia, Alabama, Mississippi and Florida; and **Charles W. Fowler Co.**, in California, Nevada, Arizona, and New Mexico.

Good-All Electric Mfg. Co., Ogallala, Nebr., has appointed **J. R. Benge** and **D. G. Brown** of Glenside, Pa., operating as "technical Representation" as representatives in Eastern Pennsylvania, Southern New Jersey and Delaware.

Today's Engineer

(*Continued from page* 231)

or guided, particularly by parents, into these professions has increased. Their motivations, attitudes, and expectations are quite different from those of the men and women who entered these professions in the past."

He places responsibility for the current emphasis on salaries partly with management, citing company advertising and recruiter's sales pitches emphasizing financial advantages like good starting salaries and payment of moving expenses.

He believes management must make a greater effort to explain the reasoning behind salary schedules, improve its procedures for appraising professional performance, and consider the possibility of opening new routes for professional advancement. He suggests that some firms might profit from promotions based solely on technical ability.

How do these scientists and engineers see themselves? Most consider themselves more responsible, objective, and involved in their work. They want greater freedom, more individualized and less routine supervision. They want more tangible and intangible rewards for their work, and feel they are more ambitious, creative, analytical, introverted, and emotional than other employees. They are interested in: seeing the results of their work; completing assigned tasks; receiving new, non-routine and challenging assignments, and obtaining personal satisfaction from their work as well as recognition from others.

New President of AIEE

Clarence H. Linder is the new President of the American Institute of Electrical Engineers. He is a Vice President and Group Leader, Electric Utility Group, General Electric Co., Eight District Vice Presidents and a Treasurer have also been elected. They are:

Treasurer, William R. Clark—Leeds & Nortrup Co.; Vice Presidents: Clair E. Gaylord—New York Telephone Co.; Robert T. Weil—Manhattan College; Fred W. Bush—Allis Chalmers Manufacturing Co.; Sim C. Wright—Southwestern Bell Telephone Co.; Henry A. Carlberg—GE; Adolph W. Rauth—Consumers Power Co.; Walter Criley—Vanderbilt Univ.; and Paul G. Wallace—Texas Power & Light Co.

News of Mfrs' Representatives

Cicoil Corp., Van Nuys, Calif., will be represented nationally, with the exception of Greater Los Angeles area, Arizona, New Mexico and Utah, by **Aerol Associates, Inc.**, Beverly Hills, Calif.

PCA Electronics, Inc., Sepulveda, Calif. has appointed the following sales representatives: **J. K. Dooley Co.**, Seattle, Wash., to cover Washington and Oregon; **Robert E. Penney, Jr.**, and **Gene Nay, Missile Accessories Corp.**, Salt Lake City, Utah, for Colorado and Utah; and **Marvin H. Kirkeby**, Minneapolis, Minn., for Minnesota, North and South Dakota.

The Advanced Instrument Corp. (ADVINCO), Richmond, Calif., has appointed **G. S. Marshall Co.**, San Marino, Calif., as sales representatives for California, Nevada, Arizona.

Conrad, Inc., Holland Mich., has appointed **Refrigeration Engineering Co.**, Seattle, Wash., representative in the state of Washington.

The Synctron Div. of Electro Powerpacs, Inc., a subsidiary of Hydra-Power Corp., Cambridge, Mass., has appointed **Andrew J. Mott, Jr.**, Los Angeles as sales and technical representative for the West Coast area.

MRC Mfg. Corp., Yonkers, N. Y. has appointed the following sales representatives: **Aertronic Associates**, Dayton, Ohio, in Ohio, Kentucky, Indiana and Michigan; **Fieldtec** (Field Engineering Service), Tustin and Berkeley, Calif., in California, Arizona, New Mexico and Nevada.

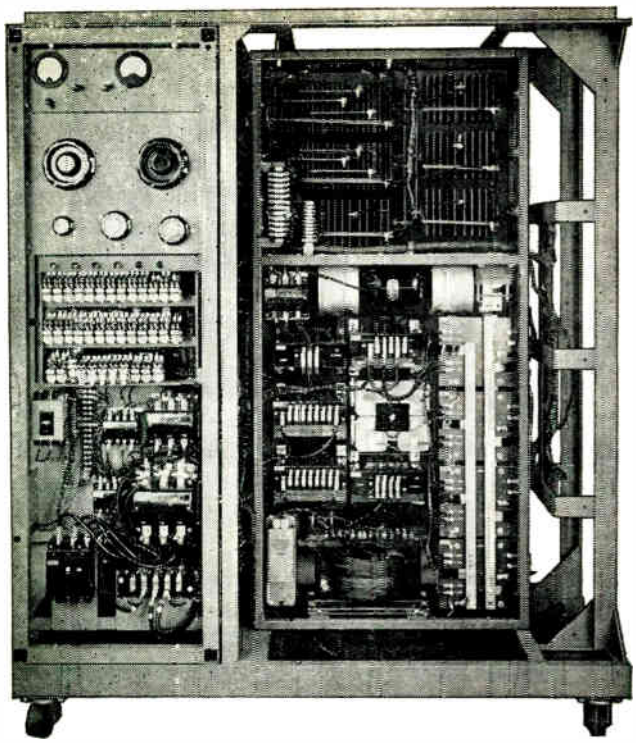
Bodnar Industries, Inc., New Rochelle, N. Y., has appointed **Frank A. Emmet Co.**, So. Pasadena, Calif., as representative in Arizona, South Nevada and Southern California.

Parker Seal Co., Culver City, Calif., has appointed **Donald L. Wilson** as representative in the Western Ohio and Eastern Pennsylvania area.

Vickers Inc., Electric Products Div., St. Louis, Mo., has appointed **Fred Gross & Co.**, Dallas, Tex., as sales representative in Dallas, San Antonio and Tulsa.

Continental Screw Co. has appointed **Arthur G. Arispe**, Mundelein, Ill., as sales representative covering Northern Illinois (including Chicago) Iowa and Wisconsin.

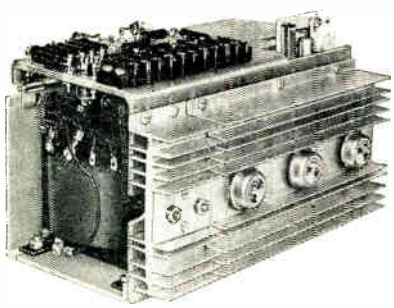
Halex, Inc., El Segundo, Calif., has appointed the **Earl S. Condon Co.**, Los Angeles, Calif., as sales representative in California and Arizona.



Regulated, multiple voltage output +250 volts, +150 volts, +70 volts, +70 volts, +250 volts, −35 volts, −50 volts, −60 volts, −70 volts, −250 volts D.C. 6.3 volts, 115 volts, A.C. Total power capacity approx. 15 KW

EXPERIENCE and SKILL are an inherent component of every ACME ELECTRIC built POWER SUPPLY

"*Know* your supplier" is pertinent advice as it applies to the design, engineering and construction of power supplies. Acme Electric not only knows the state of the art but is a recommended supply source. That's why you can expect specific advantages based on engineering experience, and backed-up by manufacturing facilities and trained manpower. If power supplies are an important part of your products, it will pay you to investigate the part Acme Electric can play in your procurement program.



Series regulated Output 120, ±1% dc @ 0-6 amps.

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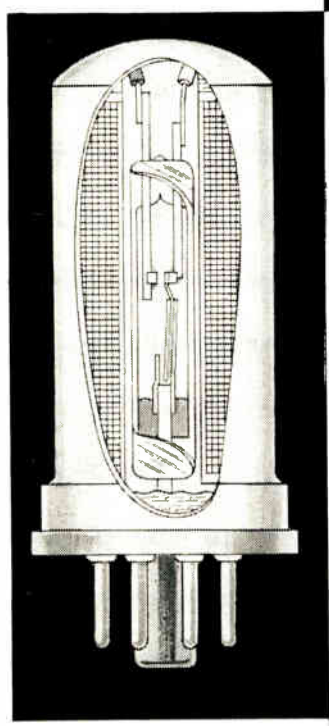

mercury contact wetted relays*

SPEEDS: Up to 100 operations per second.

CONTACT RATING: 250 volt — amperes, 500 volts maximum. 5 amperes maximum (with suitable contact protection).

LIFE: Billions of operations.

MAINTENANCE: None. All Adlake relays are maintenance free.

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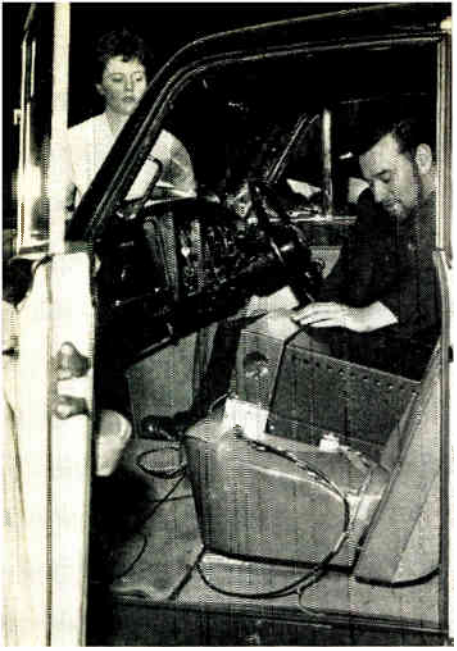
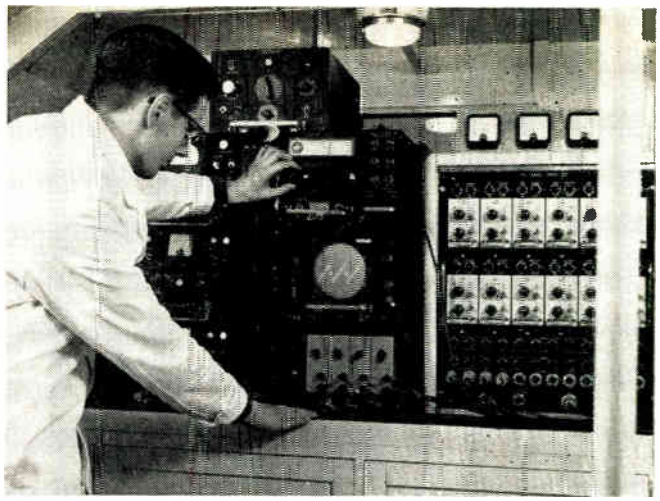
Car Testing in the Space Age



This telemetry transmitter easily fits into car which is undergoing testing. Up to 23 readings can be made simultaneously.



Receiving end of the vehicle telemetry system. Radioed results may be permanently recorded. Scope permits "on the spot" check.

SAFER cars, quieter cars, more reliable cars and, above all, cheaper cars—these could be the outcome of a revolutionary new car testing method developed by British electronic engineers and now proved under actual test conditions.

A new application of the space-age science of telemetry will cut weeks, months, even years off the time spent on testing and proving new cars.

The new method has been developed in the electronic research department of Sir W. G. Armstrong Whitworth Aircraft Ltd., Coventry, England.

Briefly the telemetry system enables measurements of various physical factors (strain, pressure, position, vibration, temperature, etc.) to be taken from up to 23 different sources on the car while it is in motion. The measurements are transmitted back to a static receiving station where they are processed and can be presented as graphs or figures to give a continuous picture of performance.

Strain gauges, force transducers, thermocouples and other measuring devices can be fitted to almost any part of the car and nearly a quarter of a million readings a minute can be taken from them.

The readings are transmitted on an ultra-high frequency, interference-free wavelength and can be received in the laboratory or design office several miles away. The prototype system on the car is operating on a very low power output and the signals are received clearly two miles away.

When received the signals are de-multiplexed and the weaker ones amplified. They can then be processed to show results (in the case of the test car) as a variable on a chart or converted and passed through a computor to give tables of figures.

This new method of testing is a great step forward from existing methods which involve carrying either bulky recording equipment in the test car, giving an unwanted weight penalty, or carrying a technician to record readings from meters, with the consequent limitation on the number of readings a human can accurately record, particularly in a bumping, swaying vehicle.

The driver is in radio contact with the receiving station so that the designers can not only tell him how and where to drive but can also warn him if the meters show that any particular part is nearing breaking point and thus avert disaster.

Two Tiny Tantalums!

Smallest Ever Made

OHMITE

Tan-O-Mite® Tantalum Wire Capacitors

Now you can scale down your circuits still further. These new Ohmite tantalum wire capacitors are the smallest of their type ever produced. And, like all Ohmite tantalum capacitors, they must pass severe performance tests in Ohmite's laboratory under conditions similar to official ASESA qualifications.

Ohmite Series TW tantalum wire capacitors provide amazingly high capacitance for their size. Compared to aluminum electrolytics, they offer smaller size, longer shelf life, better electrical stability, and superior performance under temperature extremes. The anode is specially processed tantalum wire; the cathode is a silver case which also contains the electrolyte. Operating range is −55°C to +85°C. Power factor less than 50%. DC leakage current is less than .09 ua/mfd/v for units of 0.5 mfd and up; less than 0.4 for units under 0.5 mfd. Capacitances from .01 to 80 mfds; voltage ratings to 150. Many stock sizes are available as well as made-to-order units. *Write for Bulletin 148.* Tantalum foil and slug capacitors also available.

NEW SINGLE-END TERMINATION Available on all Series TW Capacitors

NOW 13 CASE SIZES IN ALL (Shown Actual Size)

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RHEOSTATS • RESISTORS • TAP SWITCHES
RELAYS • R. F. CHOKES • TANTALUM CAPACITORS
VARIABLE TRANSFORMERS • GERMANIUM DIODES

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WESCON Technical Program

MICROWAVE TUBES

Chairman: W. H. Christaffers, Micrawove Tube Div., Hughes Aircraft Corp., Las Angeles, Calif.
"An Octave-Bondwith Ultro Law Naise Traveling Wave Amplifier," E. W. Kinaman and G. E. St. John, Wotkins-Jahnson Ca.
"Very High Canvergence Electran Guns," D. V. Geppert, Sylvania Electronic Systems.
"Cooling of the Slow Space-Charge Wave of an Electran Beam with Application to the Travelling-Wave Tube," D. C. Forster, Hughes Research Laboratories.
"Arc Discharge, Micrawave Switch Tube," S. J. Tetenbaum, R. R. Moats and D. Campbell, Sylvonia Electronic Systems.
"A Periodically Facused Backward-Wave Oscillatar," C. C. Jahnsan, Hughes Research Labaratories.
"A Faur-Cavity, Electrastatically Focused, Ku-Band Klystran Amplifier," R. G. Rackwell, Varian Assaciates.

Wed., Aug. 25—P.M. Sessions

COMPUTER CIRCUITS AND DEVICES

Chairman: George Eisler, Eisler Assaciates, Las Angeles, Calif.
"Diadeless Magnetic Care Lagic," S. B. Hachelsan, Goodyear Aircraft Carp.
"A Fractional Microsecond Cycle Time Memary Using Law Caercive Ferrite Cares," Alvin Lemack and Jahn E. Thamas, Sylvania Electranic Systems.
"Adaptive Switching Circuits," B. Widraw and M. E. Haff, Stanford University.
"25 MC Clack-Rate Computer Circuits far Operatian fram —20°C to +100°C," Charles R. Cook, Jr., Texas Instruments Incarparated.
"A Dynamic Logic Technique far Sixteen Megacycle Clack Rate," T. P. Bathwell, J. DeClue, H. H. Hill and J. R. Langland, Computer Cantrol Co.

MAGNETIC DATA RECORDING

Chairman: Warren R. Isam, Radia Carp. af America, Camden, N. J.
"Extending the Bandwidth af a Canventional Instrumentation Recarding System," A. M. Wilson, Precision Instrument Ca.
"A Wideband Magnetic Recarding System," M. E. Andersan and J. A. Granath, Armaur Research Foundatian.
"The Sensitivity af Repraducing Heads in High-Frequency Magnetic Recarding Systems," W. T. Frast, Ampex Data Products Co.
"Mechanical Design of the CM-100 Instrumentation Tape Recorder," J. T. Mullin, Mincam Div., Minnesata Mining and Mfg. Ca.
"Electrical Design and Perfarmance af the CM-100 Instrumentatian Tape Recarder," G. Nels Johnsan, Mincam Div., Minnesata Mining and Mfg. Co.
"Comparison af Wideband FM and Carrier Erase Techniques far Recarding Data fram DC ta 10 KC," George Wark and David Lewis, Leach Carp.

MICROWAVE THEORY AND TECHNIQUES—II: ACTIVE ELEMENTS

Chairman: Richard Jamisan, Hughes Aircraft Co., Culver City, Calif.
"Masers far System Applicatians," H. R. Senf, Hughes Research Labaratories.
"Design and Operatian af an S-Band Traveling-Wave Diade Parametric Amplifier," C. G. Shafer, Raytheon Ca.
"The Naise Figure af Iterative Traveling-Wave Parametric Amplifiers," C. V. Bell, Walla Walla College.
"Theary af TEM Diade Switching," R. V. Garver, Diamand Ordnonce Fuze Labaratories.
"Tunnel Diode Micrawave Oscillatars with Milliwatt Pawer Outputs," D. E. Nelsan and F. Sterzer, Radia Carp. af America.

WORKING WITH ENGINEERS

"Marketing," Glen P. Beiging, Packard-Bell Electranic Carp.
"Patent Law," W. R. Lane, Narth American Aviatian.
"Accaunting and Finance," R. T. Silbermon, Electronics Capital Carp.

VEHICULAR COMMUNICATIONS—I: RADIATING SYSTEMS

Chairman: D. L. MacDonold, Pacific Telephone & Telegraph, Los Angeles, Calif.
"Theary and Perfarmance af Vehicular Center-Fed Whip Antenna," Helmut Brueckmann, U. S. Army Signal Research & Development Labaratary.
"A Braad-Band 160 Megacycle Colinear Array," R. F. H. Yang and H. H. Hansen, Andrew Carp.
"Effects of Tawer and Guys on Perfarmance af Side-Maunted Vertical Antennas," R. F. H. Yang and F. R. Willis, Andrew Carp.
"Foamflex Caaxial Cable far Communicatians," J. Arbuthnatt, A. L. McKean and S. Trill, Phelps Dadge Capper Praducts Carp.

Thurs., Aug. 26—A.M. Sessions

PANEL DISCUSSION COMPONENT AND SYSTEMS RELIABILITY

Chairman: Walter R. Kuzmin, Packard-Bell Electronics Carp., Las Angeles, Calif.
S. Gallin, Walter Darwin Teague Assac.; S. Kukawka, Baurne Labaratary, Inc.; A. Wood, Relay Div., Leach Carp.; Carlyl C. Elrad, The Ralph M. Parsans Co.
"Using Failure Rate Data far Campanent Part Derating," Irving Dashay, Aerajet General Carp.

AIR TRAFFIC CONTROL (ATC)—SESSION I

Chairman: Vernan Weihe, General Precisian, Inc., Washingtan, D. C.
"Operatianal Cansideratians in ATC Design," Ralph F. Link, Bureau af Research & Development, Federal Aviatian Agency.
"An Airline Pilat Laaks at ATC," Capt. J. D. Smith, Air Line Pilats Assac.
"ATC fram the Aircraft Owners' Viewpaint," Victar H. Kayne, Aircraft Owners & Pilats Assac.
"The Airlines and Air Traffic Cantral," J. R. Dettman, Air Transpart Assac. af America.

ANTENNAS—SESSION I

Chairman: Lauis L. Bailin, Hughes Aircraft Ca., Culver City, Calif.
"A New Appraach ta Antenna Beam-Shaping—The 'Cake-Battle' Antenna," C. C. Phillips, Melpar, Inc.
"Applicatian af Frequency Scan ta Circular Arrays," Paul Sheltan, Aera Gea. Astra Carp.
"Law Sidelabe Interferameter Antenna Patterns," Henry Pfizenmayer and J. A. Kuecken, Avca Carp.
"Design Techniques far a Light Weight High Pawer, Spiral Antenna," L. P. Janes, P. E. Taylar and C. W. Marraw, Melpar, Inc.
"Phase Distributian af Spiral Antennas," Narman Barbana, Sylvania Electranic Systems.

SYNTHESIS AND DESIGN OF MANNED MACHINE SYSTEMS

Chairman: Cal. Lynn Baker, U. S. Army, Chief Psychalagist, Aberdeen, Md.
"Human Factars in the Establishment af System Design Requirements," R. H. Scheider, Dunlap and Assac.
"The Human Factars Labaratary as System Design Taal," Frank Marzacca, Thampsan Rama Waaldridge, Inc.
"On the Effect af CRT Transfer Functian an Detectian Threshald," C. W. Miller and W. R. Minty, Carnell Aeranautical Labaratary, Inc.
"Intraductian ta Teaching Machines," Stanley Levine, Littan Industries.

MICROMINIATURIZATION

Chairman: Ti Liimateinen, Diamand Ordnance Fuze Lab., Washingtan, D. C.
"Design and Fabricatian af a Micraelectranic IF Amplifier," J. R. Black, Matarala Carp.
"A Packaged Micramadule Labaratary far Industry," D. T. Levey, Radia Carp. af America.
"Semicanductar Packaging far High Campanent Density Applicatian," G. P. Walker, Rheem Semicanductars, Inc.
"Surface Passivatian As Applied ta Micra-Campanents," T. C. Hall, Pacific Semicanductors Inc.
"Laminar Junctian Structures: A New Cancept in Micra-Circuitry," J. Alegreti, Merck, Sharpe & Dahme.
"Salid State Micralagic Elements," L. Kattner, J. Last and J. Nall, Fairchild Semicanductar Carp.

Thurs., Aug. 26—P.M. Sessions

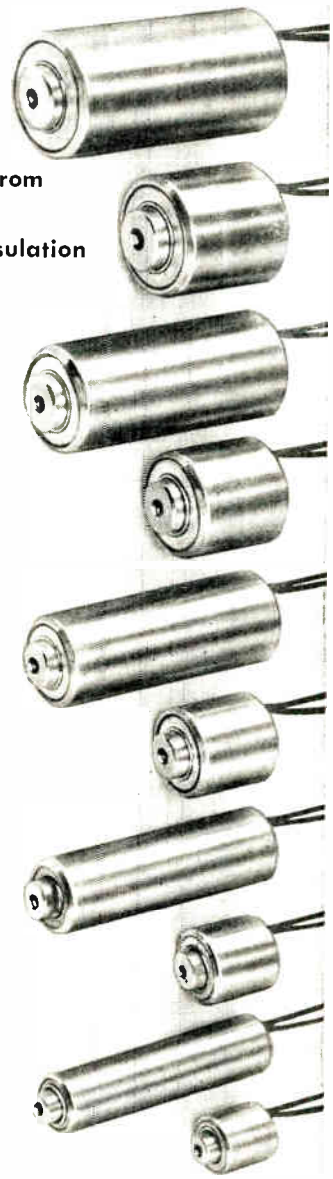
GOVERNMENT AND INDUSTRY: ENGINEERING PROPOSALS

Maderatar: Camdr. W. Ten Hagen, USN, Bureau af Weapons, Western District, El Segunda, Calif.
James Tassen, Cantracts Div., Bureau af Naval Weapans; C. E. Petrilla, U. S. Army Signal R&D Laboratory; N. Klumph, Western Development Laboratories, Philca Carp.; Ray Nardlund, Wright Air Development Div.

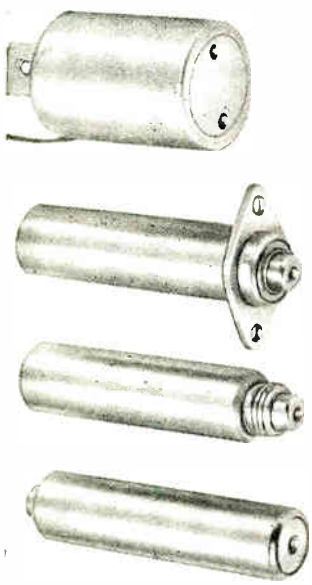
(Cantinued an page 252)

MINIATURE SOLENOIDS

Series ME
(Miniature Enclosed)



- Powerful—small in size
- Five standard types from ½" to 1" diameter
- High temperature insulation
- Pull and push types available
- Made to meet and exceed MIL specifications



- Various mounting arrangements

Designed for DC application only, these units are available with ratings up to 125 volts, unique construction meets exacting specifications, provides long life.

Write for complete information.

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anderson controls, inc.

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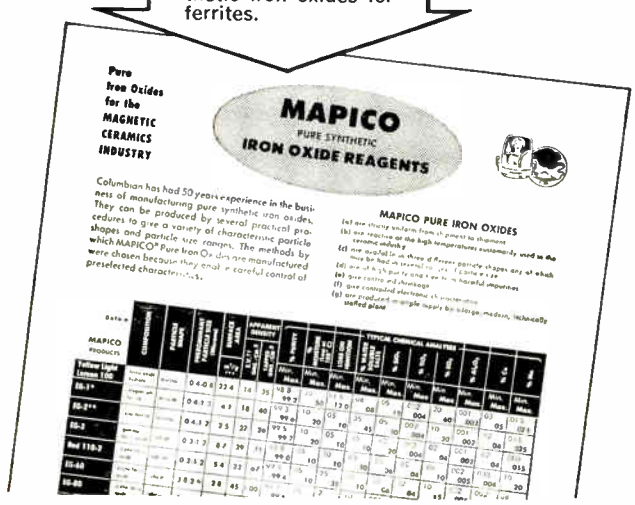
WHY YOU SHOULD THINK OF MAPICO WHEN YOU THINK OF IRON OXIDES FOR FERRITES!...

First of all, Mapico provides a wide range of pure synthetic iron oxides... unmatched for uniformity...produced through the most precise automatic production controls ...in a plant with tremendous capacity. And Mapico iron oxides are made in three typically different particle shapes, each shape available in many accurately graded particle sizes. The selection of the proper Mapico oxide assists you in controlling electronic characteristics and shrinkage.

MAPICO IRON OXIDES UNIT

COLUMBIAN CARBON COMPANY
380 Madison Ave., New York 17, N.Y.

WRITE FOR
this useful, free, informative chart on MAPICO pure synthetic iron oxides for ferrites.



Circle 159 on Inquiry Card

Multi-Channel Recording

(*Continued from page* 114)

lines to establish proper compensation for transit time of highs and lows so that they will be combined in exact time relationships. A total delay of less than 10 microseconds is encountered by such signals when compared to directly reproduced analog circuits.

Thus, the entire bandwidth of ½ cycle to 1.0 MC is recorded and reproduced within ±3 db, making possible the measurement of time intervals in the megacycle range and the recording of transient waveforms with a high degree of fidelity.

Applications

Because of advanced capabilities, this system can be utilized to serve a variety of functions. In predetection recordings, for example, intermediate frequencies of a superheterodyne receiver can be recorded for optimum data acquisition with the playback detection scheme varied at will. It can be utilized in static testing of rocket engines, and, in the FM mode of operation, for supersonic noise and vibration tests. In electronic countermeasures, unidentified signals can be recorded for later playback for identification and detailed analysis. By using a continuously variable speed playback, wide-band pulse Doppler signals can be analyzed using a single filter instead of a series covering the original bandwidth. Broader applications include radar and infra-red recording within the 1.0 MC range.

What's YOUR Portable Power Problem?

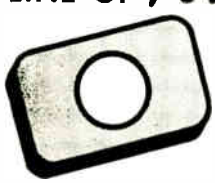
BURGESS has more than 5000 battery types to choose from:

ZINC-CARBON
NICKEL-CADMIUM MERCURY
WATER-ACTIVATED

each with the highest measure of uniform dependability! This is why 2 of 3 electronic engineers specify

BURGESS BATTERIES

BURGESS
IS THE MOST COMPLETE ONE-SOURCE LINE OF *Portable Power!*



EXCLUSIVE WAFER CELL CONSTRUCTION

. . . offers compactness, long shelf life, exceptional service life. A 30% increase in battery life at no increase in size.

TRANSISTOR ACTIVATORS

Burgess Activator Batteries for transistor circuits are smaller and more compact in size! Yet they deliver 30% more power because of the patented "Wafer-Cell" construction! Burgess Activators give you compact power, uniform performance, longer shelf life . . . all combined with modern packaging.

RESERVE BATTERIES

High energy output in a compact power source. Can be stored dry for years! Activated only when immersed in water. No handling of dangerous electrolyte, no spilling or leaking! Wide range of efficient operating temperatures. Designed for your specific applications.

MERCURY ACTIVATORS

Burgess constructionol features provide *uniform quality* and *dependable service!* Burgess *exclusive* patents offer sealed-in-steel protection, wide temperature range efficiency, controlled venting, patented inner cell connectar, and flat discharge curve.

SEALED NICKEL-CADMIUM BATTERIES

A secondary rechargeable battery system which delivers high energy output from a small package! Hermetically sealed-in-steel cells eliminate annoying maintenance and addition of liquids. Can be recharged many times, by trickle or quick charge, for long lasting economical power!

Check with your Burgess Distributor for complete local stocks of fresh BURGESS BATTERIES! Or your distributor can order from Burgess the special battery needed for your specific application!

FREE DESIGN SERVICE

For special applications, skilled Burgess Engineers offer you a FREE battery design service. Burgess will manufacture the exact battery to fit your needs, regardless of quantity required.

NEW ENGINEERING MANUAL

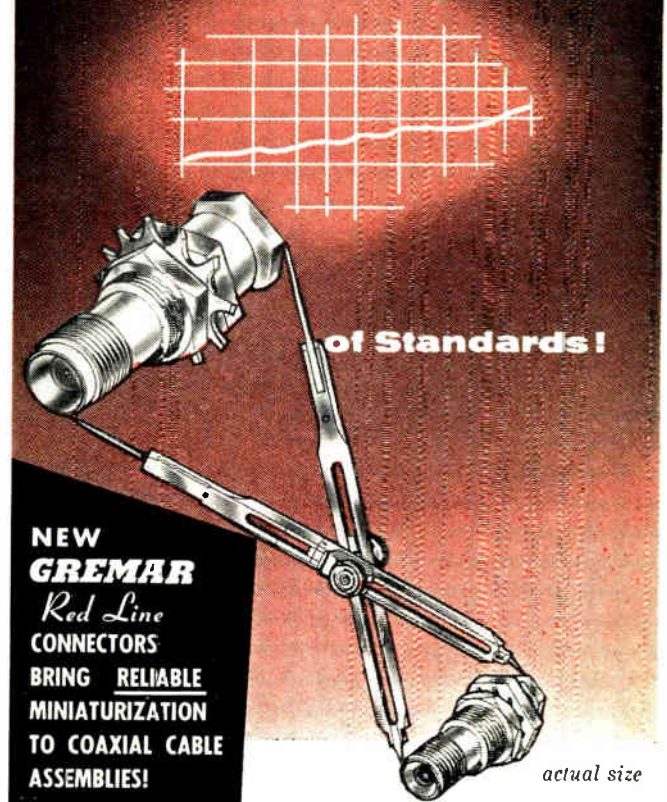
New 100-page dry battery handbook now available! Engineers engaged in the design of battery-powered equipment are invited to write to Burgess Battery Company, Dept RD Freeport, Ill., to secure a copy. Others may buy the manual for $1.00.

BURGESS BATTERY COMPANY
FREEPORT, ILLINOIS

Division of Servel, Inc.

Circle 322 on Inquiry Card

NOW...
Miniature RF Connectors Match Electrical Specs...
...of Standards!



NEW *GREMAR* *Red Line* CONNECTORS BRING RELIABLE MINIATURIZATION TO COAXIAL CABLE ASSEMBLIES!

actual size

REPLACE STANDARDS WITH MINIATURES! Now, because of GREMAR CONNECTRONICS (T), it is possible to miniaturize your RF cable assemblies and still maintain rigid electrical specs. *Red Line* Miniatures, identified by their red Teflon insulation, are half the size and weight of the reliability-proved GREMAR TNC Connectors.

DESIGNED FOR USE WITH MIL-TYPE SUBMINIATURE COAXIAL CABLES, Red Line Miniature Connectors and adapters feature:

- A new patented metal-to-metal cable clamping method which saves up to 80% of your cable assembly time while assuring a lower, more constant VSWR.
- Nominal 50 ohm characteristic impedance, 500 volts rms peak and 10,000 megacycles practical frequency limit.
- Operating temperature range: −65F to +350F.
- Meets or exceeds all applicable requirements of MIL-STD-202A and MIL-E-5272B.
- Configurations for all typical applications including adapters to BNC and TNC connectors.
- Metal parts are heavily silver plated for maximum corrosion-resistance . . . protected with Iridite to retard tarnishing. All contacts are gold-plated.
- Standard *Red Line* adapters and connectors are stocked for *immediate* delivery.

WRITE FOR BULLETIN 9 containing complete data on Gremar *Red Line* Miniatures. Literature on all other RF connectors is available for the asking.

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MANUFACTURING COMPANY, INC.
RELIABILITY THROUGH QUALITY CONTROL
Dept. E, Wakefield, Mass., CRystal 9-4580

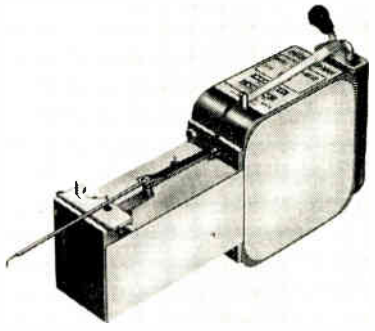
Circle 323 on Inquiry Card

WESCON

New Products

Writing Pen Motor

A 40 mm pen motor, Model OS-600, for ink writing on true rectangular coordinates, can record signals from dc to 100 CPS and over. Coil resistance: 16 ohms dc; current sensitivity: 28 ma/mm; linearity: 2% of full

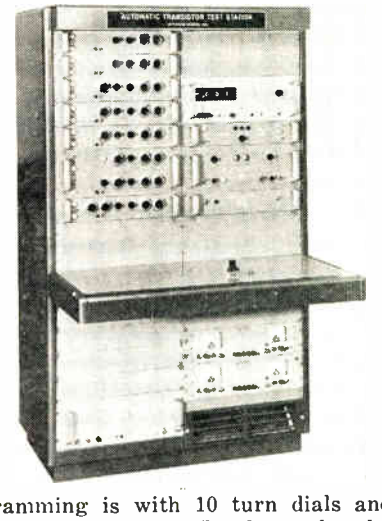


scale (40 mm peak to peak); natural frequency: 45 CPS; frequency response: dc-120 CPS (3 db down); hysteresis: less than ¼ mm; damping: acoustic damping, approx. 30% of critical. Dc resistance 40 ohms; Maximum Undistorted Amplitude: Full scale (40 mm)—dc to 40 CPS; half scale—dc to 80 CPS; quarter scale—dc to 120 CPS. Massa Div., Cohu Electronic, Inc. Booth 557.

Circle 353 on Inquiry Card

Semiconductor Tester

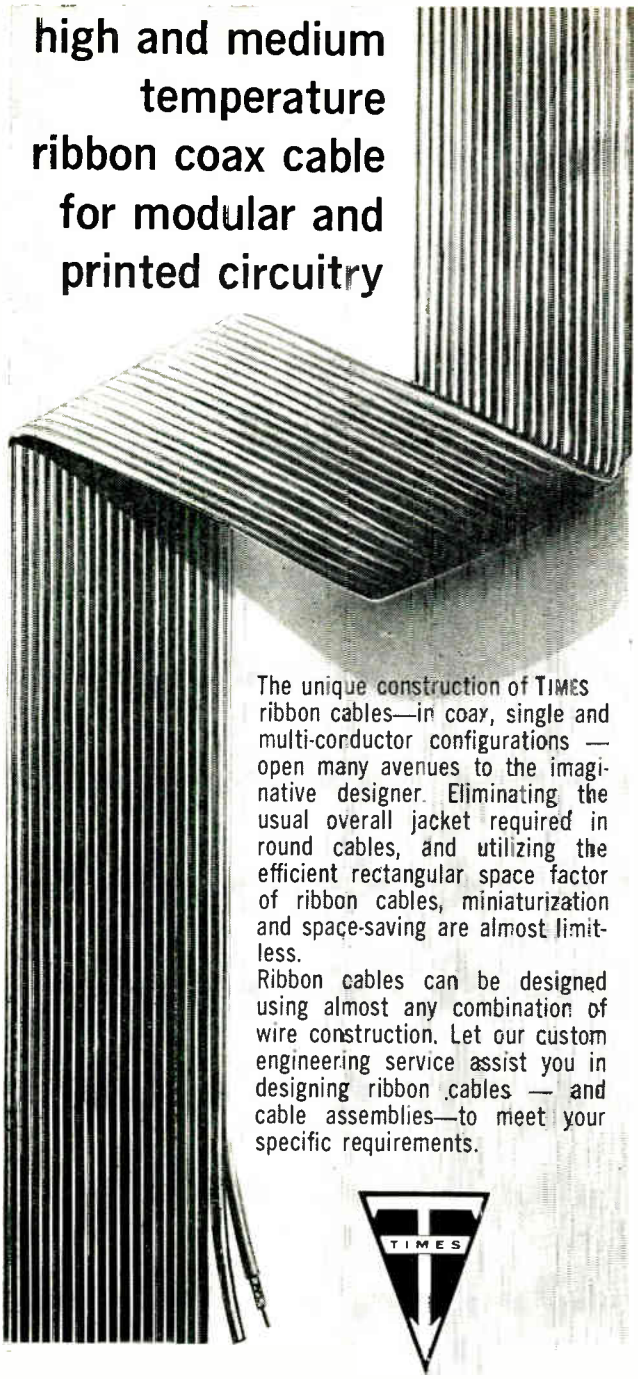
Automatic Semiconductor Test Station for high speed testing of transistor or diode performance with a precision GO, NO-GO comparator. 700 semiconductors may be tested/hr. Power ratings are from 0—100 v. and up to 3 a. Sequencing and loading may be automatic or manual. Pro-



gramming is with 10 turn dials and selector switches. Readout also by digital display, automatic typewriter printout or punch card. Test accuracy is 1%. Optimized Devices, Inc. Booth 828.

Circle 354 on Inquiry Card

high and medium temperature ribbon coax cable for modular and printed circuitry



The unique construction of TIMES ribbon cables—in coax, single and multi-conductor configurations — open many avenues to the imaginative designer. Eliminating the usual overall jacket required in round cables, and utilizing the efficient rectangular space factor of ribbon cables, miniaturization and space-saving are almost limitless.

Ribbon cables can be designed using almost any combination of wire construction. Let our custom engineering service assist you in designing ribbon cables — and cable assemblies—to meet your specific requirements.

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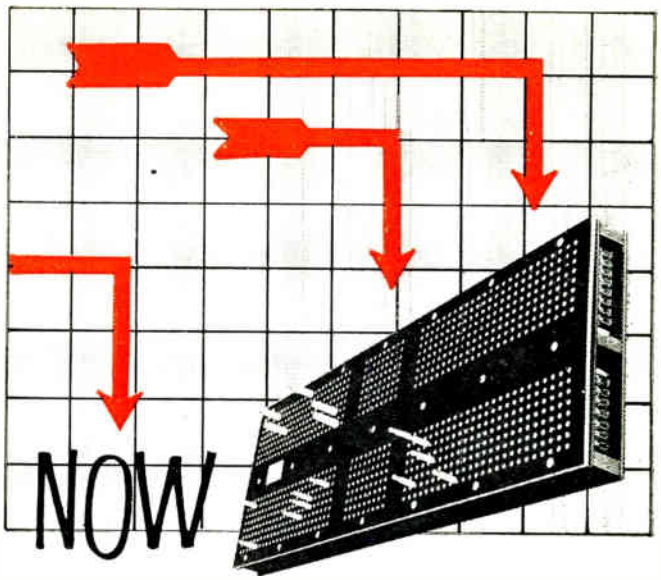
Circle 328 on Inquiry Card



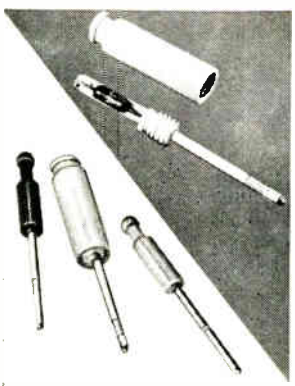
NOW PROGRAM AT THE PUSH OF A PIN!—WITH OR WITHOUT COMPONENT INTERPOSITION...

NEW

SEALECTOBOARD

X

Y



Sealectoboard pin-plugs include shorting type, diode-holder, wire lead type. Available in all EIA colors. All interchangeable.

So logical, you'll wonder why it wasn't designed before—the Sealectoboard allows complete logic programming at the simple push of a pin-plug. It offers every advantage in circuitry switching and component interposition and simultaneously eliminates all disadvantages.

ELIMINATE: Patch cords; soldering/unsoldering components; circuit-by-circuit troubleshooting; polarization roulette;

PROVIDE: Simple, fast circuitry programming without patch cords; color-coding of logic for photo-recording; push-in, automatic polarization of component interposition; miniaturization; precise, self-cleaning, low-resistance switching; low initial cost . . . **ALL WITH THE SEALECTOBOARD. WRITE FOR COMPLETE LITERATURE TODAY...** PAT PENDING

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CONHEX® RF CONNECTORS

British Branch: Sealectro Corporation, Hersham Factory Estate, Lyon Road, Walton-on-Thames, Surrey, England

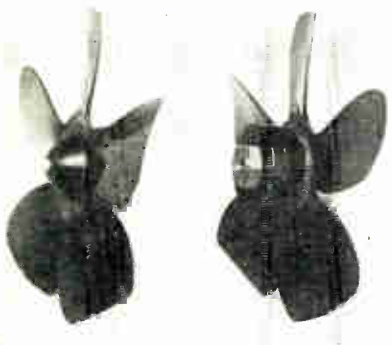
See us at WESCON Booth 954

Circle 329 on Inquiry Card

See These Products At WESCON

Constant Mass Fan

Fan and motor coupled with constant torque magnetic device provides essentially constant mass rate of air

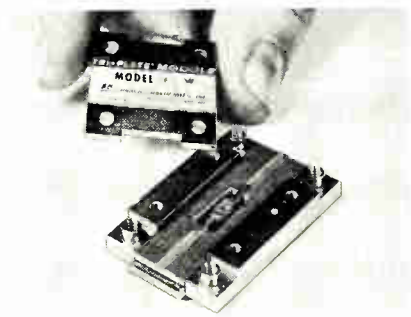


flow over the operational altitude range of cooling equipment on which assembly is applied. Coupling permits fan speed to vary directly with altitude or inversely with the square root with relative density. Eastern Industries, Inc. **Booth 2054.**

Circle 331 on Inquiry Card

Semiconductor Mounts

Tri-Plate semiconductor mounts extend breadboarding versatility in strip transmission line circuits. Modules are available for cartridge, double ended, pill, or pigtailed glass

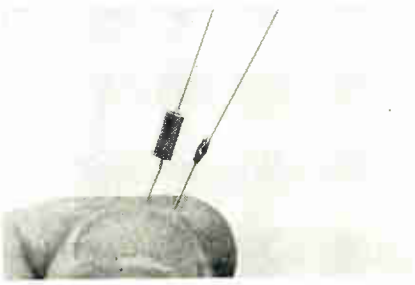


packages. Also: other Tri-Plate Modules including phase shifters, delay lines, and variable couplers and standard 50 ohm and low impedance 10 ohm Tri-Plate slotted lines with module connectors. Sanders Associates, Inc. **Booth 929.**

Circle 58 on Inquiry Card

Capacitors

A line of high-precision, ultraminiature ceramic capacitors for miniature circuitry. They are (less leads) 0.250 in. long and 0.098 in. in dia. for capacitances from 47 to 560 mmf and 0.125 in. dia. from 680 to 1200 mmf



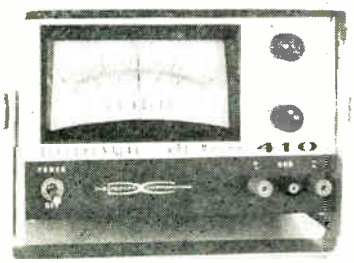
when fully encapsulated in glass. These barium-titanate capacitors are precision-tuned to ±5% tolerance to 125°C or ±10% tolerance to 150°C and meet the applicable requirements of MIL-C-11015A and EIA-SMC-1 specs. Electramics Corp., Cliff at Cedros, Solana Beach, Cal.

Circle 117 on Inquiry Card

See These Products At WESCON

Differential Voltmeter

Differential dc VTVM has 1% accuracy. Model 410 features a zero center scale with full scale ranges of ±0.3, 1.0, 3.0, 10, 30, and 100 vdc, and

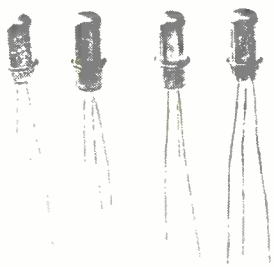


a single input impedance of 20 and 40 megohms differential. The Decker Corp. **Booth 2421.**

Circle 355 on Inquiry Card

MADT Transistors

Micro-alloy diffused transistors are extremely high-speed transistors suited to computer applications requiring efficiency and reliability.

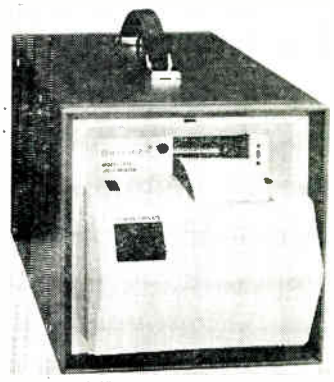


CBS Electronics, div. of Columbia Broadcasting System, Inc. Booth 2524.

Circle 356 on Inquiry Card

Speed Printer

Model 1453 can record readings of up to 12-digit numbers on a standard adding machine tape. It records samples separated by less than 200



msec. May be actuated by standard 1-2-4-8 binary code and 1-2-2-4 code. Beckman/Berkeley Div. Booth 2514.

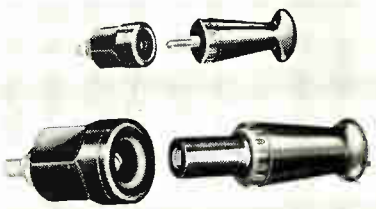
Circle 357 on Inquiry Card

WESCON

New Products

Electrical Connectors

Single-conductor plugs and receptacles in 25 and 250 ratings feature a functional "fishtail" plug design;



simplified, quick assembly; a range of 6 colors: red, white, blue, yellow, black and green. The Superior Electric Co. **Booth 1067.**

Circle 358 on Inquiry Card

Time Delay Timers

Electronic Repeat Cycle and Time Delay Timers, WC-605 operate from 24-30 vdc, cuts off power 60 sec. after

triggering cycle. Power is gated on again at the end of a second 60 sec. "off" period. Accuracy is ±5%. Webcor, Inc. **Booth 2421.**

Circle 359 on Inquiry Card

Tape Recorder

A portable magnetic tape recorder, the CP-100 reel-to-reel machine is a complete 7 or 14-channel recording

and reproducing system. It accommodates either ½ or 1 in. wide tape on 10 ½-in. reels. Ampex Corp. **Booth 2004.**

Circle 360 on Inquiry Card

WESCON

New Products

Tape Recorder

Miniature missile-borne magnetic tape recorder designed to record through a 500-mg impact deceleration and survive a 1500-g shock without loss of recorded data. It will record more than 30 sec. of critical analog data during flight of a surface-to-surface missile. Westred Recording Equipment Dept. Booth 2065.

Circle 155 on Inquiry Card

← Circle 332 on Inquiry Card

ELECTRONIC INDUSTRIES Advertisers—August 1960

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How to Talk "Computerese"

Do you know what the computer people are talking about when they use terms such as: Binary Coded Decimal, Mnemonic Code (how do you pronounce it), Binary Digit, Binary Scale, and Radix. Do computer people use normal English words like: Address, Drum, Gate, Bit, and Patch in a confusing manner? What you need is the dictionary of Computerese compiled by Minneapolis - Honeywell Regulator Co., Industrial Div., Philadelphia, Penn.

The booklet, called "Do You Talk 'Computerese'?" 32-pages, pocket-sized, is a glossary of computer language. It defines over 82 commonly used computer terms.

For example: *Mnemonic* code is a list of computer instructions written in a form which can be remembered easily by the persons who program them; a *Binary Coded Decimal* is a system of representing decimal numbers, a *Binary Scale* is a numbering system and *Radix* is the numbering system's base. A *Bit* is short for *Binary Digit* (0 to 1) used in converting a decimal number into a binary number.

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Life — over 700 hours reported
Peak power available — more than 10 kw. (More power than you can get from any other device at this frequency)
Duty cycle — up to 0.001. (For the BL-221, it is 0.00055)
Vibration — will survive 10 g's
Shock — 50 g's at 4 millisec
Lightweight — 7.25 lbs
Mounting — mates to modified standard flange
Ruggedized — Ceramic and metal construction
Fixed tuned

Band	Tube Type	Frequency Range (MC)	Minimum Peak Power (KW)	Output Mates with
V	BL-235	51,000-54,000	10	UG385/U
V	BL-236	54,000-57,000	10	UG385/U
V	BL-237	57,000-60,000	10	UG385/U
V	BL-221	69,000-70,500	10	UG385/U

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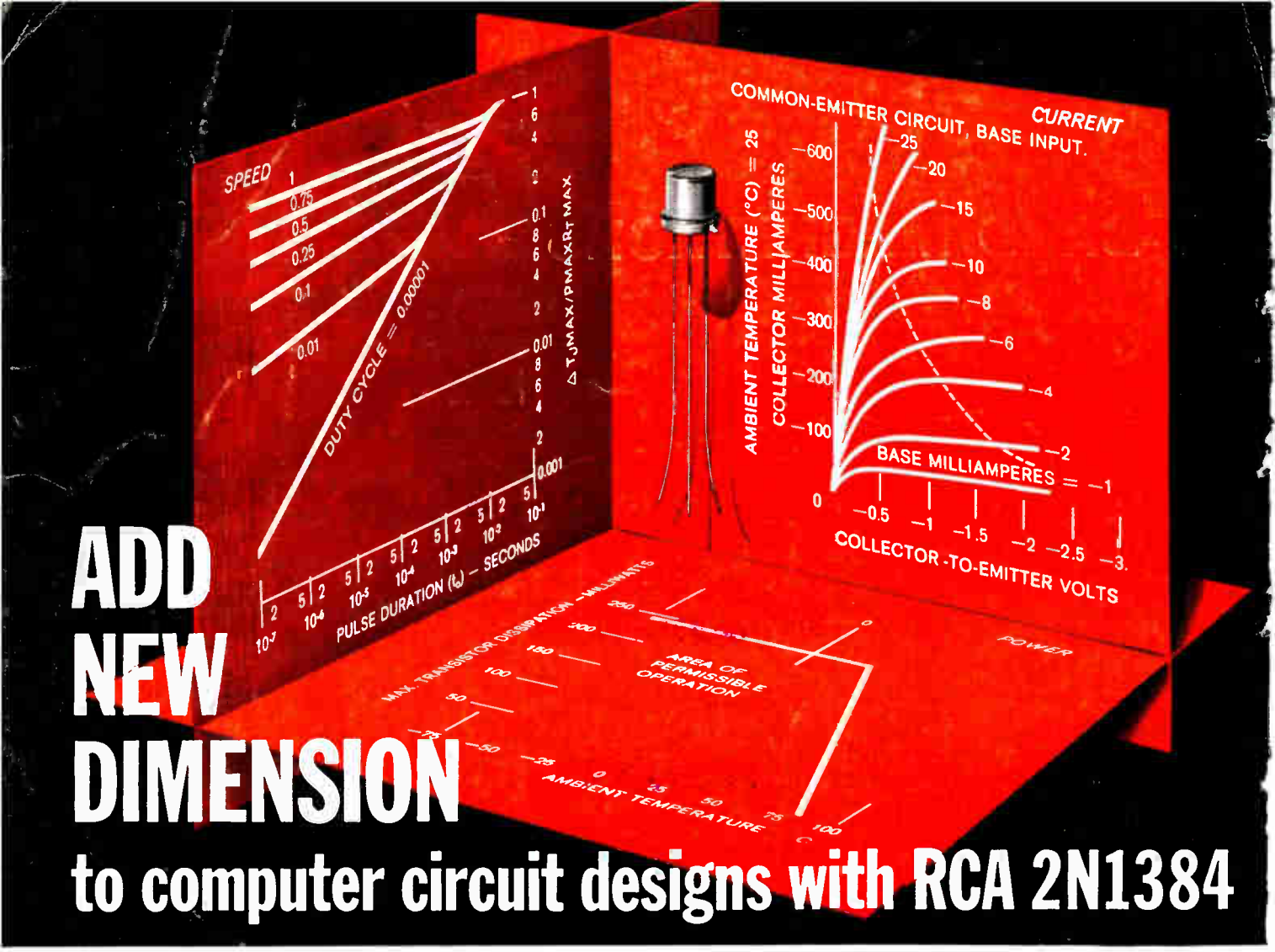
Circle 338 on Inquiry Card



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- *Exceptionally High Collector-Current Rating*—Maximum collector-current rating is 500 ma
- *High Dissipation Capabilities*—Maximum transistor dissipation rating is 240 mw at an ambient temperature of 25°C
- *Ultra High Speed*—Rise time of the 2N1384 in an inverter circuit at 25°C ambient is 0.08μsec. Typical gain bandwidth product of 35 Mc.
- *Broad Application*—New, high current, speed, and dissipation capabilities make the RCA 2N1384 applicable in a wide variety of saturated switching circuits such as memory-core driver, pulse-amplifier, inverter, flip-flop, and logic power gates.
- *Immediately Available*—and priced for your mass production requirements.

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RCA 2N1384

Maximum Ratings, Absolute-Maximum Values:

COLLECTOR-TO-BASE VOLTAGE	–30 max. volts
COLLECTOR-TO-EMITTER VOLTAGE	–30 max. volts
EMITTER-TO-BASE VOLTAGE	–1 max. volt
COLLECTOR CURRENT	–500 max. ma
EMITTER CURRENT	500 max. ma
TRANSISTOR DISSIPATION:	
At an ambient temperature of 25°C	240 max. mw
At an ambient temperature of 55°C	120 max. mw
At an ambient temperature of 71°C	56 max. mw
AMBIENT-TEMPERATURE RANGE:	
Operating	–65 to +85 °C
Storage	–65 to +85 °C

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