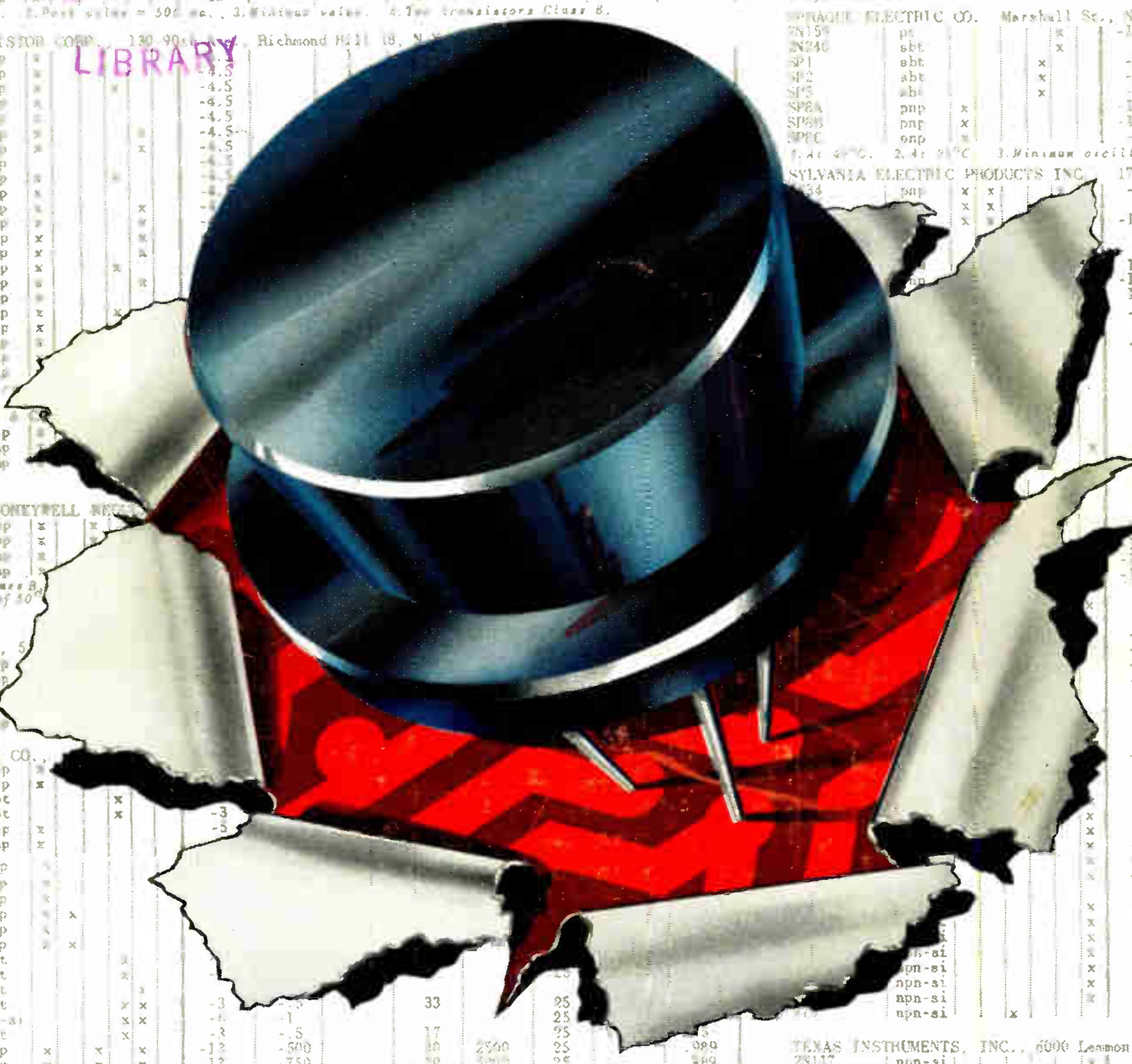
ELECTRONIC INDUSTRIES

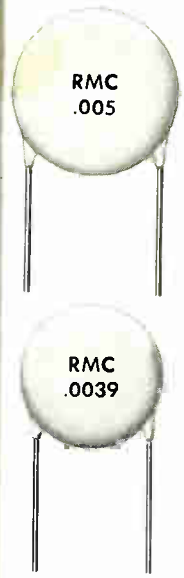
& TELE-TECH



TRANSISTORS IN 1958

← page 85

October • 1957
A Chilton Publication



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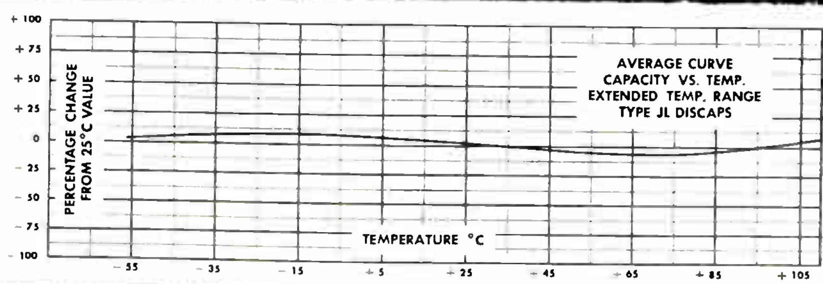

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LIFE-TEST: As per RETMA REC-107-A
POWER FACTOR: 1.5% Max. @ 1 KC (initial)
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WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
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Circle 1 on Inquiry Card, page 107

ELECTRONIC INDUSTRIES
& TELE-TECH

Vol. 16, No. 10 **October, 1957**

FRONT COVER: A transistor mounted on a printed circuit, bursts through a page from Electronic Industries' annual listing of transistor specifications to emphasize the transistor's impact on industry. This year's listings, covering almost 500 transistors, begin on page 85 of this issue.

MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

ELECTRONIC INDUSTRIES & Tele-Tech, October 1957, Vol. 16, No. 10. A monthly publication of Chilton Company. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila., Pa. Accepted as controlled circulation publication of Phila., Pa. 75¢ a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $5.00; 2 yrs. $8.00; 3 yrs. $10 00 Canada 1 yr. $7.00; 2 yrs. $11 00; 3 yrs. $14 00. All other countries 1 yr. $10 00; 2 yrs. $16.00.

RADARSCOPE

"SILENT SENTRY"

New Signal Corps mobile radar is capable of spotting an enemy a half-mile away in total darkness. Problem of providing quiet, portable power is answered by a new fuel cell developed by National Carbon Co., div. of Union Carbide Corp.

FIRST FIGURES should soon be available on the public acceptance of toll-TV. The country's first system went into operation in Bartlesville, Okla. last month, using a closed-circuit cable system installed by the Jerrold Corp. and piping in movies from local movie houses. The cable also handles TV programs from three neighboring network stations. The movies were provided free through the month of Sept. as an introductory offer. Subscribers will pay a flat monthly fee of $9.50, for a package of 13 first-run motion pictures.

ENGINEERING SPECIALIZATION will soon move to the graduate area, and it will not be too long before a graduate degree is the minimum requirement in engineering, predicts Dr. John T. Rettaliata, president of Ill. Inst. of Technology. The need, he said, is for engineers with training in both the sciences and humanities, men capable of creative thinking.

NEW APPROACH is being tried at Battelle Institute to correlate variations in electrical properties with structural changes in semiconductors. It has been found that the electrical properties of the semiconductor, indium antimonide, undergo extreme changes when defects are introduced into its crystal structure.

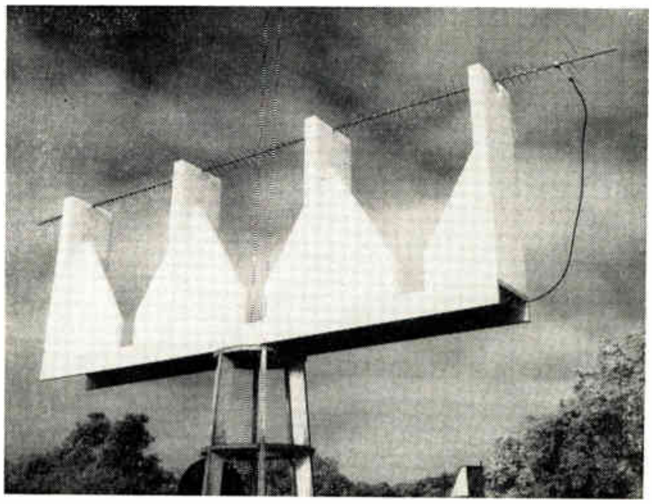
PRESENT POOL of full- and part-time science teachers is around 75,000, with approximately the same number for mathematics. For 1956-57 the college class produced 4,320 graduates fully prepared to teach science, but only 59.4% took teaching positions.

TRANSISTOR SALES will top $1-billion in 1967, predicts James H. Sweeney, Manager of Marketing for G.E.'s Semiconductor Products Dept. He said that the transistor industry has been expanding three times as fast as the electron tube industry, and that the military has been a great factor in this growth. Semiconductor sales have continually outstripped even the most optimistic market projections, he pointed out, and even this $1-billion figure may be even a little low. Sales of semiconductors will probably exceed $140,000,000 this year, an increase of 82% over the $77,000,000 rung up in 1956.

GOVT. AIR OFFICIALS are hopeful that the air traffic control problem may be solved by running out simulated conditions on an electronic digital computer. Specifically they are investigating the effect of changes in the route structure and rules of the control system on air traffic capacity. The problems are being undertaken at Armour Research Foundation, Ill. Inst. of Tech, sponsored by the U. S. Army Signal Engineering Labs, Ft. Monmouth and the Air Navigation Development Board, Washington, D. C. With airline pilots reporting an average of four near-misses each day a great deal of pressure is being applied to come up with a workable solution in the very near future. The particular area being investigated in this problem is that surrounding New York, Washington and in between.

SPIRAL "YAGI" ANTENNA

Scientists at Stanford Research Inst. have discovered that by twisting the rods of a "Yagi" antenna gradually along the supporting axis much longer, and much higher gain, antennas can be designed than have previously been available.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

MANUFACTURERS of precision mechanical components are now talking in terms of measurements to one-ten-millionth of an inch. What is needed is an improved form of interferometer. Present units will measure down to one-millionth of an inch.

VALUABLE DATA on radiation contamination will be picked up by the network of radiation detectors which Army scientists have installed in tanks, balloons and underground at the current Nevada atomic tests. The new equipment, developed by U. S. Army Signal Corps Engineering Labs. Ft. Monmouth, N. J., keeps a continuous record of radiation hazards in the test area after a blast.

LOOK FOR increased efforts on the part of government and industry circles toward attracting top Japanese physicists and electronic scientists. The Japanese have been right up at the front in many of the developments of the past few years, and their abilities are highly regarded by scientists here. The first recruiting expeditions have already been made but no information is available on the results.

FIRST DIRECT CONVERSION of the chemical energy of gases into electricity for practical application has been developed by scientists at the Research Laboratories of National Carbon Co. Div. of Union Carbide Corp. The first significant application of the new fuel cells is in providing silent electrical power for the U. S. Army Signal Corps' new "Silent Sentry," reportedly the world's smallest known radar. Dr. C. E. Larson, National Carbon's research vice-president, said, "Secret of the new fuel cell's success is the chemically treated, hollow, porous carbon electrodes through which the gases enter the cell, and which also conduct the electricity produced by the electrochemical reaction."

"CLEANER" TRANSISTORS are promised by the new system of washing out contaminants developed at Bell Labs. The new techniques have been developed from tube techniques. When used on transistors, the new methods resulted in significant improvements in breakdown voltage, "sharpness" of voltage-current characteristics, saturation current, and emitter reverse impedance. The method compares the conductivity of distilled water before and after it has been washed over the parts being cleaned.

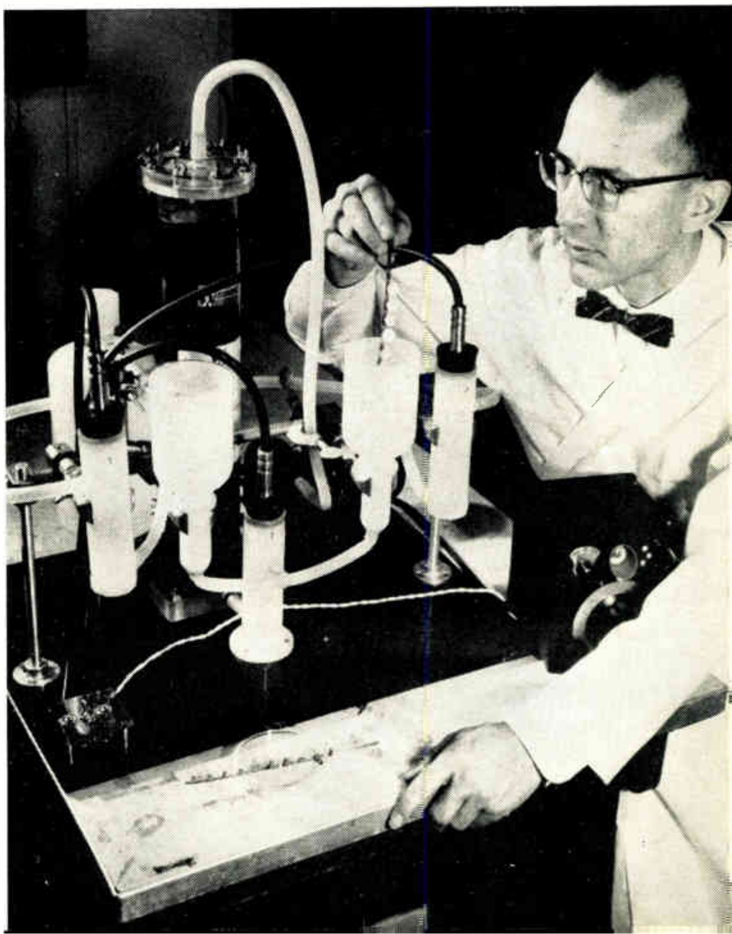
TRADE SHOWS are becoming increasingly expensive. The latest Electronic Industries Assn. (formerly RETMA) report shows that the cost per show for the average exhibitor increased by 14% from $1,712 in 1955 to $1,916 in 1956. There are signs, too, that most of the exhibitors would like to hold the number of shows down. Most of the manufacturers favor two trade shows per year. Only 13% favored more than four shows per year.

FAST-GROWING FIELD of application for electronic test instrumentation is in analyzing engine performance. In the space of a year development has progressed from a relatively simple ignition analyzer to complex equipment that uses ignition, vibration and pressure data. In one unit five sensing pick-ups are used and all can be connected without stopping the engine. First application is expected to be for complex industrial engines.

GREAT STRENGTH OF RADIO is shown by continuing increases in set production, presently 10 per cent ahead of last year. Listener habits are changing, but public interest remains high. The increasing variety of color, styling, shape, and function has stimulated sales—and present sets are more compact and reliable than ever. The clock radio set a record last year with production reaching 2.3 million sets, and auto radios are showing gains this year, with current production running nearly 20 per cent ahead of last year.

WASHING TRANSISTORS

Miles V. Sullivan of Bell Labs. inserts a number of transistors into the new semiconductor washing machine. Purity is measured by comparing the conductivities of distilled water before and after washing.



As We Go To Press . . .

NRL Bounces Radio, Radar Signals Off Moon

After six years of experimentation Naval Research Lab scientists report that the moon can be reliably used for radio relay. The discovery grew out of efforts to bounce radar signals off the moon's surface.

First experiments involved sending pulses of electrical energy to the moon and back, using 10 μsec pulses, from a 1 megawatt transmitter, operating at 200 MC. The antenna consisted of a parabolic hole 250 feet in diameter, scooped out of the earth.

With this installation the scientists discovered, in 1951, that the moon's surface was comparatively smooth to radar waves, and so might serve as a relay station for radio communication.

It is believed now that many types of communication can be carried on via the moon.

PIONEER BALLOON FLIGHT

ELECTRONIC INDUSTRIES took an active part in Donald Piccard's historic balloon flight last week. EI's Arnold Look was one of the three-man team that helped ready the unique craft for its early-morning test flight.

The flight proved the effectiveness of Piccard's new cylindrical polyethylene bags and the valveless venting system he has devised. The balloonist was able to exercise accurate control of his altitude, pointing to possible use of the new technique for instrumented research balloons.

Navy Contract To GE For Missile Launcher

The Navy has awarded a $5,000,000 contract to General Electric for further development of the handling and launching system of the Navy's long-range surface-to-air guided missile TALOS.

The complex handling and launching system for TALOS weighs more than 350 tons and requires a space large enough for 10 freight cars. The system is designed to store, load, train, elevate, and launch the guided missiles, which weigh 3000 lbs. and are 20 ft. long.

NEW UTILITY JET

The "Sabre Liner," a 500 mph utility craft, will be built by North American Aviation for the military. Power will be supplied by two GE J-85 turbo jets, on aft fuselage

ICBM Missiles Are "Flown" In Computer

The Martin Company's Denver Division plant demonstrated last month how they are "flying" their ICBM Titan missile over distances up to 5000 miles and landing them with great accuracy precisely on the target.

The flights are simulated on an IBM 704 computer. Into the computer is programmed the information to mathematically account for the changing gravitational attraction during a missile's climb and descent. The answers to the problem are printed at the rate of 150 lines per minute.

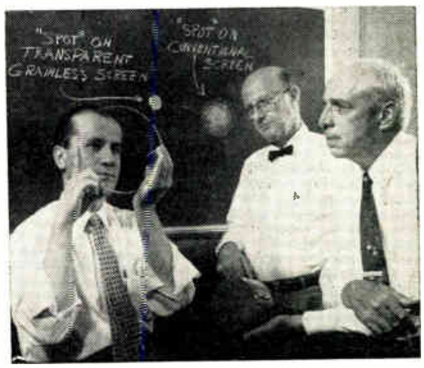
"Hi-Fi" Television Tube Uses Extra-Thin Screen

At the WESCON show General Electric displayed a new type of television tube that may be the key to "hi-fi" viewing in specialized applications.

By using an extremely thin layer of transparent phosphor much thinner lines can be traced. Conventional phosphor powders tend to scatter the light, bouncing it from particle to particle; the new thin layer, less than one ten-thousandth of an inch thick, keeps each point of light concentrated in a small spot.

In another application of this principle, G.E. also developed a two-color tube, utilizing two layers of different phosphors. The changes in color are produced by changing the operating voltage, limiting the penetration of the beam to the appropriate layer.

At GE Research Lab., D. Cusano, Dr. L. Koller and Dr. F. Studer discuss the new transparent screen for TV tubes



MORE NEWS ON PAGE 8

ELECTRONIC INDUSTRIES
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For an interesting discussion of the broad subject of "Reliability," write for Cannon Bulletin R-1.

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CANNON PLUGS

WHERE RELIABILITY IS THE 5TH DIMENSION

AWARENESS OF PROBLEM — INTEGRITY OF INTENT — DESIGN EFFORT — MANUFACTURING CONTROL

As We Go To Press . . .

SPECIAL DELIVERY

Westinghouse's East Pittsburgh plant now has its own heliport and chartered helicopter to take care of emergency shipments. First shipment was a lightning arrestor

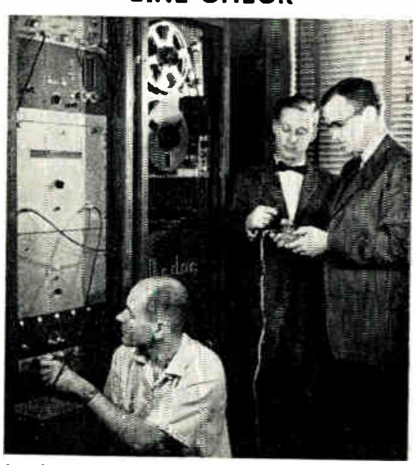
Improved Radar Beacon Aids Inflight Refueing

A new airborne "homing beacon" developed for the Air Force makes it simple for fuel-hungry airplanes to rendezvous with flying tankers day or night, or in any kind of weather. The range of the beacon is reportedly several hundred miles.

The beacon is installed on designated rendezvous aircraft. Aircraft wishing to "home" on the beacon use interrogating radar to send out pulses of a specific type to trigger the beacon. The beacon transmits a coded reply.

Designated the AN/APN-69, the beacon was developed jointly by ARDC's Wright Air Development Center and Sperry Gyroscope Co.

LINE CHECK



At Bell Telephone Labs, engineers M. V. Matthews, E. E. David Jr. and H. S. McDonald check out new Modac equipment designed for Bell by Airborne Instrument Labs to simulate complex phone network

MORE NEWS ON PAGE 12

ELECTRONIC SHORTS

▶ Ten special radar sets, built to specifications developed by the Geophysical Institute of the University of Alaska, and built under contract by Levinthal Electronic Products, Inc., Palo Alto, California, will shortly be delivered to operating points in Alaska and the northern states of the U. S. as a part of the IGY program. This equipment will be directed to the task of studying the northern lights or aurora borealis during the IGY.

▶ A simplified, compact and relatively inexpensive radar set has been designed to reveal paths through squall lines for USAF aircraft normally not equipped with radar. The "dwarf" weather avoidance radar, designated the AN/APS-69, will be wing pod mounted on aircraft such as the C-45, B-25, and T-6.

▶ An engineering study aimed at increasing the coverage and efficiency of CAA-operated airport surveillance radar will be undertaken for the Government by Airborne Instrument Laboratories. Limitations of existing airport radar surveillance will be investigated and it is hoped that suggestions will come up as to how best to increase the altitude and range of the equipment.

▶ The first tactical Lacross missile has come off the production line at the Martin Company, Orlando, Florida, plant. These improved versions of models test-fired at White Sands Proving Ground will be used by the Army for testing, training, and with operational units.

▶ Launching vehicle tests for scientific earth satellites are being conducted by the Naval Research Laboratory at Patrick AFB, Cape Canaveral, Florida. The tests are designed to allow orderly evolution from a single-stage rocket to the three-stage launching vehicle required for placing a satellite on orbit to gather upper atmosphere scientific data.

▶ Electronic chemicals will be the new field for Merck & Co., pharmaceutical manufacturer. The division will make a high grade of polychrystalline silicon for use in the production of transistors and rectifiers. Production should begin early next year. A recent license between Merck and the West German concerns, Siemans & Halske and Siemans-Schurckertwerke permits Merck to use the German silicon producing process.

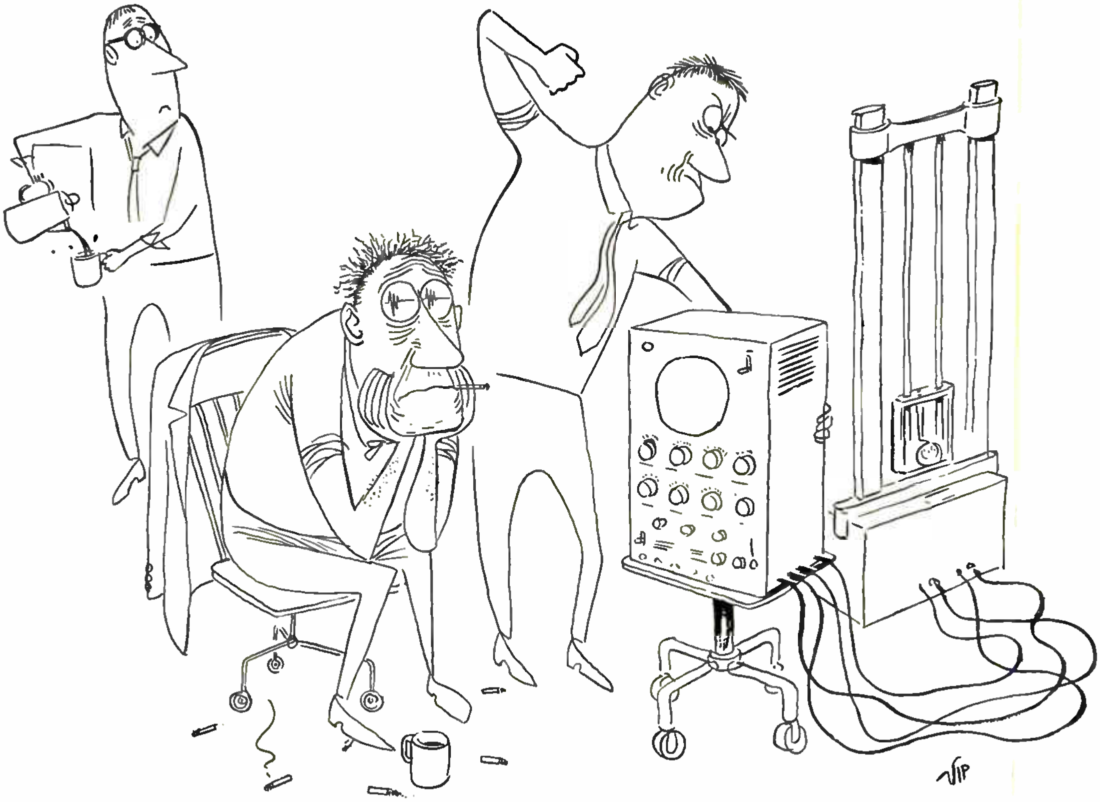
▶ An X-ray instrument, smaller than a matchstick, has been developed by Dr. Leonard Reiffel, Armour Research Foundation physicist. The tiny radiation generator, coupled with an image intensifier, could be carried in a physician's bag for on-the-spot X-rays of fractures. The instrument is operated with an isotope stronger than Strontium 90 with tungsten or lead as a target. Other isotopes have too short a life to be practical.

▶ TV has really stolen the scene from radio, according to a British Broadcasting Corp. survey. During the last three months, over 1,000,000 listeners have deserted radio for TV programs. Nightly radio audience has dropped from 8.000,000 in June 1952 to 3,500,00 this year. TV audience is now 6,000,000. Radio hopes to make a comeback by increasing its daily news broadcasts from 13 to 26.

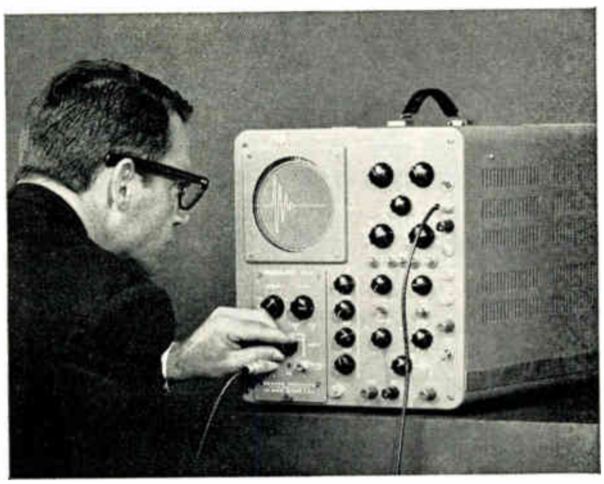
▶ "Whistlers," audible radio waves generated by lightning, gave the idea to Drs. R. A. Helliwell and D. Gehrels, Stanford University Radio Propagation Laboratory, to use very low frequency signals to communicate from one hemisphere to another. The radio energy at 15.5 KC was sent from Annapolis, Md., to Cape Horn, Chile, along the "magneto-ionic duct," a distance of about 6,000 miles.

▶ Forward scatter link using 2180 MC has been operated successfully in tests in 124-mi. path from transmitter at Cedar Grove, N. J. to receiver at Somers, Conn., DuMont Labs reports. Transmitter capable of 72 voice channels with 2.5-mc bandwidth has dish 18 feet wide mounted on 24-foot tower, utilizes Eimac 1-kw klystron tube. Receiver has two 10-foot dishes on 25-foot towers.

▶ Three new 110° and one aluminized picture tube have been added to Raytheon's Replacement Picture Tube line. Types added were 14ASP4, 17BZP4, 21CBP4A, and 21CEP4.



PROBLEM: Transients—Capture and Study



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Frequency Response: DC to 700 KC down 3 db at 700 KC.

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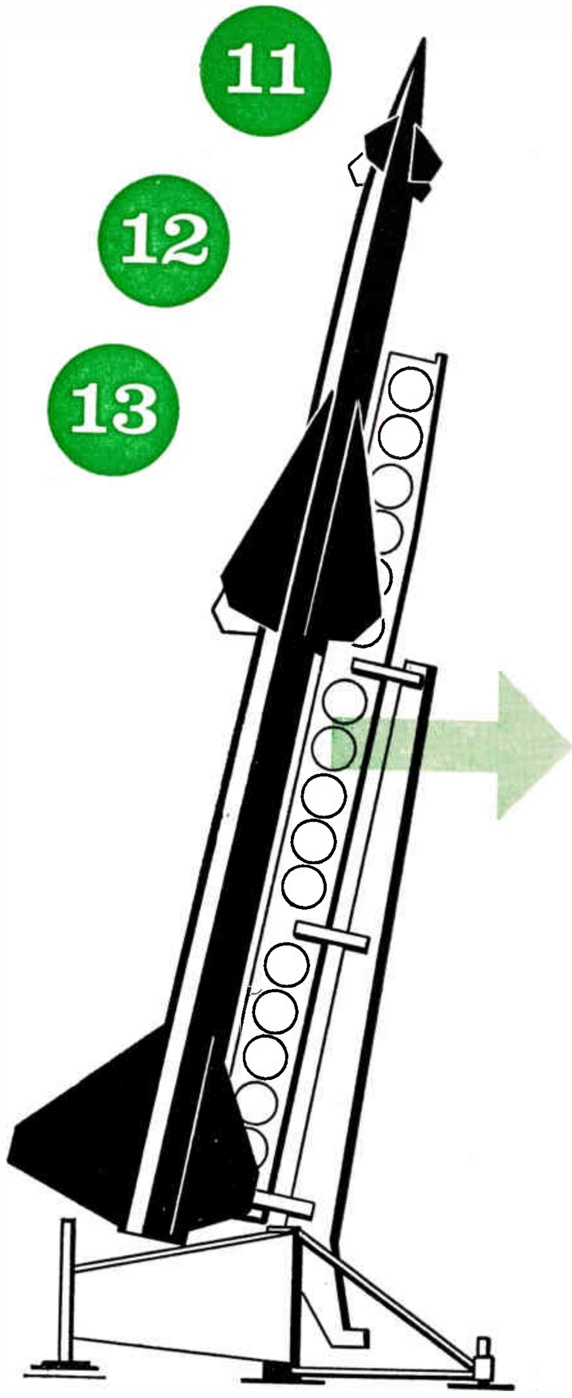
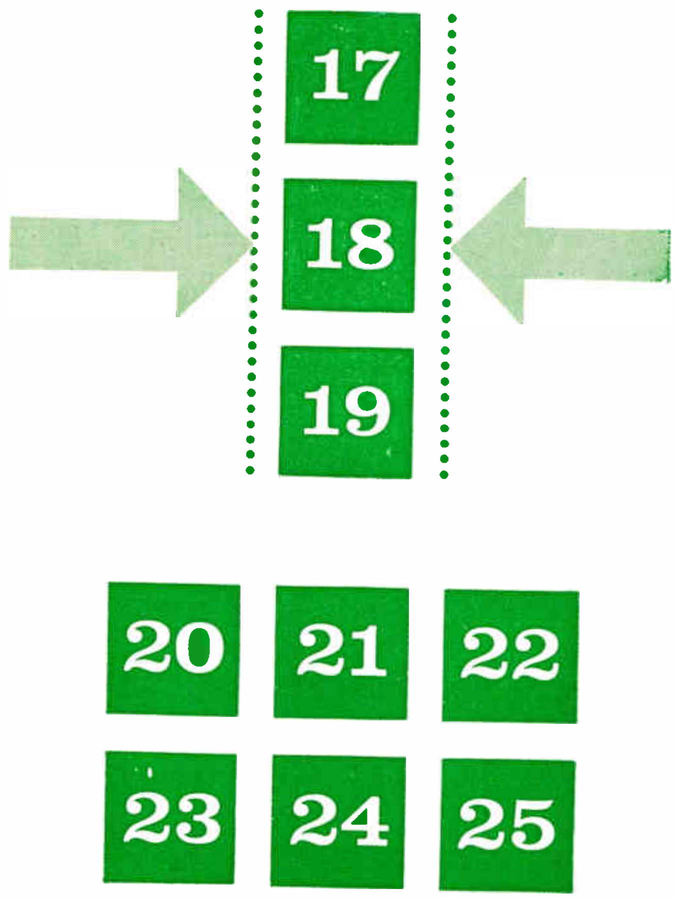
Circle 5 on Inquiry Card, page 107

FOR MICROWAVE SPECIFY SPERRY MICROLINE





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Circle 6 on Inquiry Card, page 107

As We Go To Press . . .

Data Processing System For Insurance Group

One of the largest installations of data processing systems ever made, a network of four stations, integrated through a single System Central, will be made for The Travelers Insurance Co., Hartford, Conn., by Radio Corp. of America. The system will reportedly be the nation's first commercial network installation of integrated electronic "brain" systems.

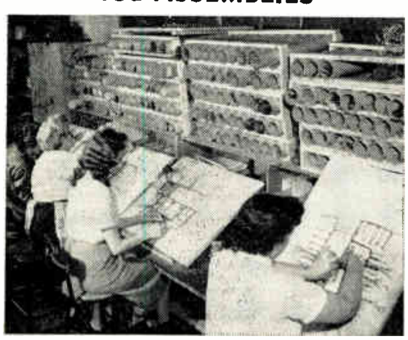
The system will consist of four separate RCA Bizmac units, each with its own computer. When the installation is completed, in 1963, it will include more than 270 units of twelve different basic pieces of Bizmac equipment. Work is scheduled to begin early next year.

10 MIT Engineers Break, Form Own Corporation

Ten staff members of the Dynamic Analysis and Control Lab, Mass. Inst. of Technology, resigned last month to form their own firm, Hydel Inc., as an independent research and development organization. The new venture will have the financial backing of American Brake Shoe Co.

Emery St. George Jr., former assistant director of MIT's Dynamic Analysis and Control Lab, and president of the new firm, said, "Hydel Inc. was organized for the purpose of providing engineering service to industry in the field of automatic control. We intend to offer, in addition, new control components and systems of our own design and manufacture."

SUB-ASSEMBLIES



Wiring of intricate harnesses is one of the sub-assembly production techniques employed at Telectro Industries Corp., L.I.C., N. Y. Harness shown is for tape transport.

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period October to December that are of special interest to electronic engineers

Oct. 4-9: 82nd Semi-annual Conv., by SMPTE; at Sheraton Hotel, Philadelphia.

Oct. 6-12: Semi-annual Meeting, by The Electrochemical Society; at Buffalo, N. Y.

Oct. 7-9: National Electronics Conf., sponsored by IRE, AIEE, RETMA & SMPTE; at the Hotel Sherman, Chicago.

Oct. 7-11: Fall General Meeting of AIEE; at Hotel Morrison, Chicago.

Oct. 9-11: 4th Symp. on Vacuum Technology; at Hotel Somerset, Boston, Mass.

Oct. 9-11: Fall Assembly Mtg., Radio Technical Commission; at Ambassador Hotel, Los Angeles.

Oct. 9th Regional Seminar, by NEDA; at Grossinger, N. Y.

Oct. 9-12: Audio Technical Session, sponsored by Audio Engineering Society; at N. Y. Trade Show Bldg., 8th Ave. & 35th St., New York.

Oct. 10-11: National Noise Abatement Symp., sponsored by Armour Research Found.; at the Sherman Hotel, Chicago.

Oct. 16-18: Conf. on Computers in Control, by AIEE; at Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Oct. 16-18: IRE Canadian Conv., sponsored by IRE; at Toronto, Canada.

Oct. 18-19: 2nd Annual Symp. on Digital Computers, IRE; at O'Henry Hotel, Greensboro, N. C.

Oct. 20-22: Symp. on Aeronautical Communications, by IRE; at Utica, N. Y.

Oct. 21-26: International Conf. on Ultra High Frequency Circuits & Antennas, by the "Societe des Radioelectriciens"; at Ave Pierre-Larousse, Malakoff (Seine), France.

Oct. 21-26: IRE Conv., sponsored by Australian IRE; at the Hotel Australia, Sydney.

Oct. 24-25: Computer Applications Symp., by Armour Research Found.; at the Sherman Hotel, Chicago.

Oct. 27-29: Radio Fall Meeting, by IRE; at Sheraton Hotel, Rochester, N. Y.

Oct. 28-30: East Coast Conf. on Aeronautical and Navigational Electronics, by IRE; at Lord Baltimore Hotel & 7th Reg. Armory, Baltimore, Md.

Oct. 28-31: 1957 Trade Fair of Atomic Industry; at the New York Coliseum, N. Y. C.

Oct. 30-Nov. 1: National Assoc. of Educational Broadcasters Conv.; at Statler Hotel, St. Louis, Mo.

Oct. 31-Nov.1: Annual Conf. on Nuclear Science, by IRE; at Henry Hudson Hotel, N. Y. C.

Oct. 31-Nov.1: Electron Devices Meeting, by IRE; at Shoreham Hotel, Washington, D. C.

Nov. 6-8; 3rd Annual Symp. on Aeronautical Communications, by IRE; at Hotel Utica, Utica, N. Y.

Nov. 8-10: Hi Fi Show; at New Washington Hotel, Seattle, Wash.

Nov. 11-13: Radio Fall Mtg., by IRE; at King Edward Hotel, Toronto, Canada.

Nov. 11-13: Conf. on Numerical Control Systems for Machine Tools, by RETMA; at King Edward Hotel, Toronto, Canada.

Nov. 11-13: 3rd Instrumentation Conf., by IRE; at Atlanta, Ga.

Nov. 13-14: Mid-America Electronics Conv., by IRE; Municipal Auditorium, Kansas City, Mo.

Nov. 15-16: New England Radio-Electronics Meeting, by IRE; at Mechanics Hall, Boston, Mass.

Nov. 18-20: Conf. on Magnetism & Magnetic Materials, by AIEE, APS, AIMEE, IRE, & ONR; at Hotel Sheraton Park, Washington, D. C.

Nov. 25-26: IAS International Meeting, by IAS; at Canadian Aeronautical Inst., Canada.

Dec. 1-6: Annual Meeting of ASME; at Hotels Statler, Sheraton & McAlpin, New York.

Dec. 4-5: Annual Vehicular Communications Mtg., by IRE; at Statler Hotel, Washington, D. C.

Dec. 8-11: Eastern Joint Computer Conf., by IRE, ACM, and AIEE; at Park Sheraton Hotel, Washington, D. C.

Abbreviations:

ACM: Association for Computing Machinery
AIEE: American Inst. of Electrical Engrs.
AIMME: American Institute of Mining and Metallurgical Engineers
APS: American Physical Society
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
ONR: Office of Naval Research
RETMA: Radio-Electronic-Television Manufacturers Assoc.
SMPTE: Society of Motion Picture & TV Engineers

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Nickel (Ni)	0.00005 %

NOW! B&A OFFERS "ELECTRONIC GRADE" CHEMICALS

. . . with metallic and other impurities held to lower limits than ever before!

Typical of B & A's special line of extremely pure "Electronic Grade" chemicals is its Hydrofluoric Acid. Note the specifications above . . . the carefully controlled assay, within plus or minus 0.25% . . . and the remarkably low limits on metallic and other undesirable impurities.

With products such as this, Baker & Adamson serves the needs of the electronic industry for chemicals of a new order of purity. And as the country's leading producer of laboratory and scientific chemicals, it is geared to work closely with the industry's engineers and chemists in developing other products to meet their most stringent requirements.

Now available are the following B & A "Electronic Grade" chemicals:

For semiconductors (small packages):

Acetone
Acid Hydrofluoric, 48%
Alcohol Methyl, Absolute (Methanol) Acetone Free
Alcohol Propyl, Iso
Carbon Tetrachloride
Ether, Anhydrous
Hydrogen Peroxide, 3%
Hydrogen Peroxide, 30%
Hydrogen Peroxide, 30% "Stabilized"
Sodium Carbonate, Monohydrate
Trichloroethylene

For radio receiving, black and white TV tubes (available in bulk):

Aluminum Nitrate, Crystal and Basic
Barium Acetate
Barium Nitrate
Calcium Nitrate, Tetrahydrate
Strontium Nitrate

Other special purity chemicals can be custom-made to meet your needs.

Write for free folder! Contains information on electronic chemicals for semiconductors, tubes, printed circuits; sulfur hexafluoride for gaseous insulation; selenium metals and selenides; metallic compounds for ferrite production. Lists exact specifications for "Electronic Grade" small package chemicals. Write for your copy today!

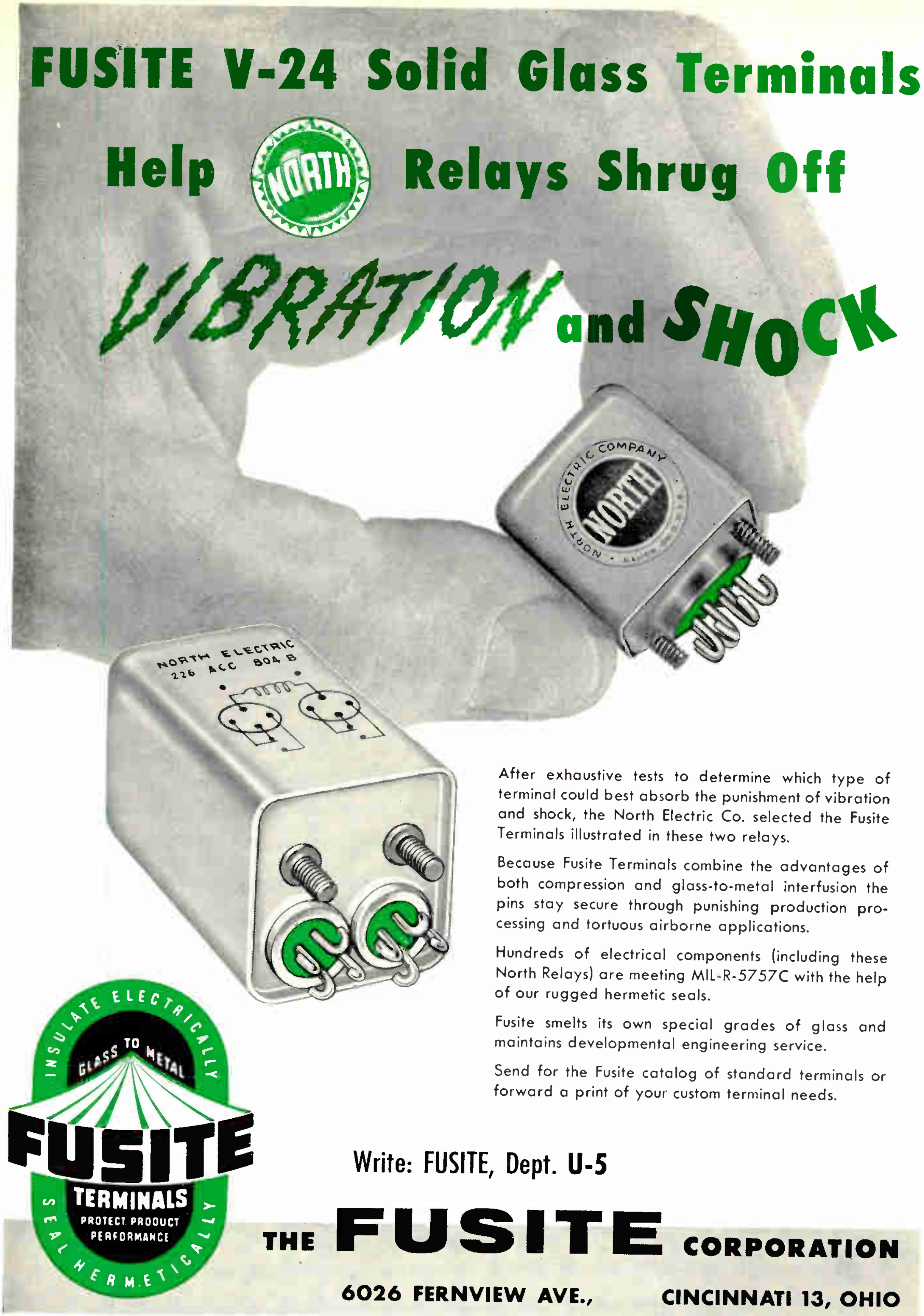
BAKER & ADAMSON®
"Electronic Grade" Chemicals

75 YEARS OF LEADERSHIP IN CHEMICAL PURITY
1882-1957

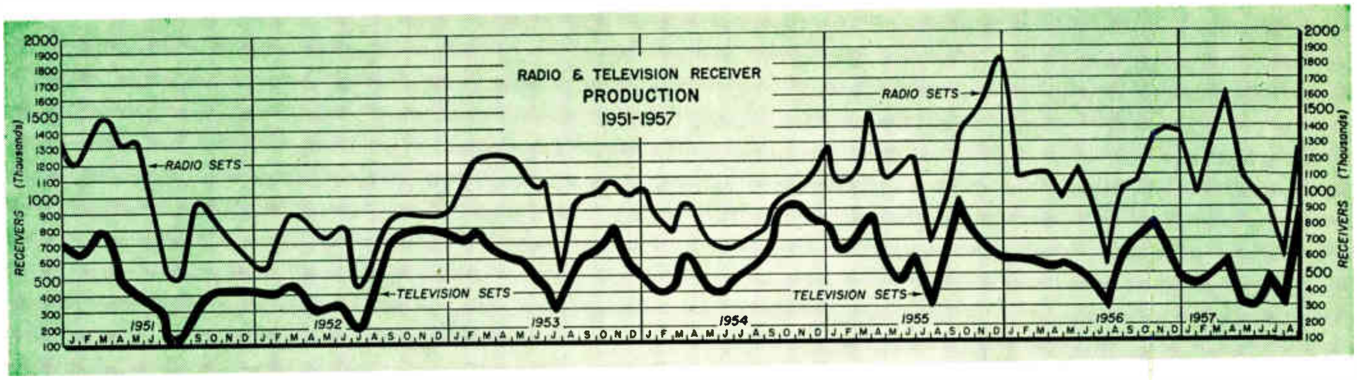
GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Offices: Albany • Atlanta • Baltimore • Birmingham • Boston • Bridgeport • Buffalo • Charlotte • Chicago • Cleveland (Miss.) • Cleveland (Ohio) • Denver Detroit • Houston • Jacksonville • Kalamazoo • Los Angeles • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • Providence • San Francisco Seattle • St. Louis • Yakima (Wash.) In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

 Circle 7 on Inquiry Card, page 107

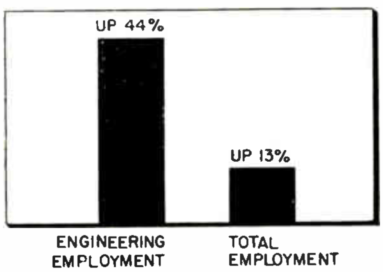

FUSITE V-24 Solid Glass Terminals
Help NORTH Relays Shrug Off
VIBRATION and SHOCK
NORTH ELECTRIC COMPANY
NORTH
NORTH ELECTRIC
226 ACC 804 B
After exhaustive tests to determine which type of terminal could best absorb the punishment of vibration and shock, the North Electric Co. selected the Fusite Terminals illustrated in these two relays.
Because Fusite Terminals combine the advantages of both compression and glass-to-metal interfusion the pins stay secure through punishing production processing and tortuous airborne applications.
Hundreds of electrical components (including these North Relays) are meeting MIL-R-5757C with the help of our rugged hermetic seals.
Fusite smelts its own special grades of glass and maintains developmental engineering service.
Send for the Fusite catalog of standard terminals or forward a print of your custom terminal needs.
INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY
Write: FUSITE, Dept. U-5
THE FUSITE CORPORATION
6026 FERNVIEW AVE., CINCINNATI 13, OHIO

TOTALS



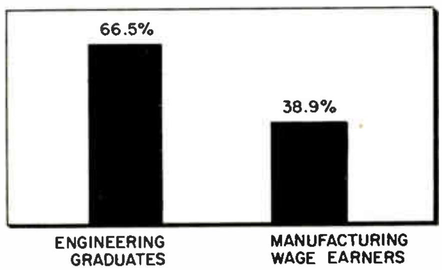
ENGINEERING EMPLOYMENT

Engineering employment increase is compared to increase of total employment, 1950-1957.



STARTING SALARY INCREASE

Engineers starting salary increase compared to manufacturing workers increase, 1950-1957.



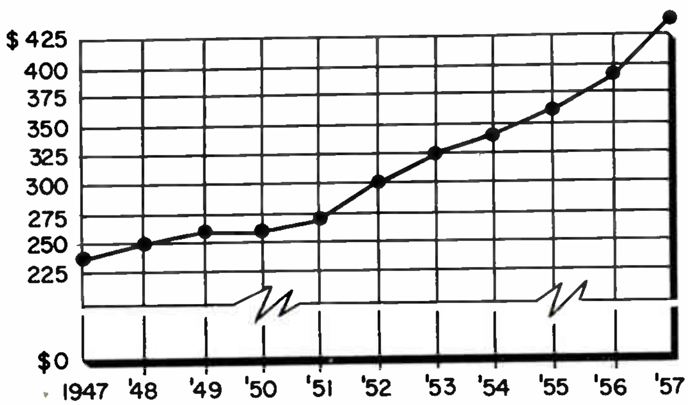
AIRCRAFT INDUSTRY DATA

	SALES (Millions)	EMPLOYMENT (Thousands)	FLOOR SPACE (Millions)
AIRFRAME	$5,554	512.0	101.5
AIRCRAFT ENGINES	2,035	165.2	34.1
AIRCRAFT PROPELLERS	136	16.1	2.8
OTHER PRODUCTS	1,771	110.8	NA

—Aircraft Industries Association

ENGINEERING SALARIES

Chart shows engineering graduates average monthly starting salaries.



TABLE

1947	$244
1948	250
1949	261
1950	260
1951	270
1952	305
1953	325
1954	345
1955	361
1956	394
1957	433

—Deutsch & Shea, Inc., "The Supply and Demand of Engineers, 1950-1960"

APPROPRIATIONS AND EXPENDITURES FOR MILITARY AVIATION

(Millions of Dollars)

	U. S. Air Force		Naval Aviation	
Fiscal Year	Total Cash Appropriations	Expenditures	Total Cash Appropriations	Expenditures
1939	$ 71.1	$ 83.4	$ 48.2	$ 47.9
1944	23,656.0	13,087.7	4,583.7	4,490.1
1949	939.8	1,059.2	588.3	875.1
1953	22,076.2	15,089.6	4,873.0	3,061.3
1956	15,681.3	16,748.8	1,711.7	2,836.1
1958 (estimate)	16,481.0	17,383.3	2,810.0	2,710.0

—Aircraft Industries Association of America, Inc.

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in August 1957.

Antenna Towers & Supports	37,699
Attenuators	37,618
Coils	41,036
Computers & Accessories	309,147
Generators, Signal	696,130
Headset-Microphone	333,608
Intercom Equipment	69,557
Meters, Frequency	40,922
Multiplexers	35,211
Networks	28,525
Radio Equipment, SSB	59,975
Radio Receivers	504,406
Rectifiers	41,230
Relays	76,079
Rheostats	36,191
Spare Parts	98,641
Switches	37,557
Switching Assemblies	50,123
Syncros	44,168
Test Sets, Radar	404,839
Test Sets, Radio	570,153
Tubes, Electron	552,015
Wire & Cable	740,950

Electronic Industries' News Briefs

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

EAST

ELSIN ELECTRONICS CORP., Brooklyn, N. Y. has become a subsidiary of General Transistor Corp.

GULTON INDUSTRIES, INC., has been awarded a license for the production of Laminagage, a production tool used for checking platings and coatings on metals and other electrically conductive materials. General Motors Corp. holds the patent rights.

WESTON ELECTRICAL INSTRUMENT CORP. has relocated its instrument service division in a new building at Polk St. and Jefferson Ave., off highway 22, Union, N. J.

EMPIRE DEVICES PRODUCTS CORP. have moved its operations to a new plant in Amsterdam, N. Y.

AMPEREX ELECTRONIC CORP. will manufacture special purpose, premium-type, miniature electron tubes at the company's Hicksville, N. Y. plant.

PHILCO CORP. has announced price decreases on its high frequency micro alloy (MAT) transistors and its entire line of power transistors.

POTTER INSTRUMENT CO., INC. has opened a new factory office building on Sunnyside Boulevard, Plainview, New York.

ECLIPSE-PIONEER DIV., Bendix Aviation Corp. has been awarded a $1.1-million contract by Convair to equip the new '880' jet airliner with PB-20 automatic flight control systems.

STACKPOLE CARBON CO. has opened large-scale magnet production facilities in a new 37,000 sq. ft. plant in Kane, Pa.

UNITED STATES GASKET CO., Plastics Division, has placed in operation a new Nylon-Teflon extrusion plant.

NARDA MICROWAVE CORP. is the new corporate title for the Narda Corp. The new name was chosen to better reflect the firm's greatly increased activities in the field of microwave and UHF equipment, such as the recent acquisition of Kama Instrument Corp., and a general expansion of the company's research and production facilities.

WHEELER INSULATED WIRE CO., INC., will discontinue the manufacture of all types of enameled and yarn insulated magnet wire. The move is to provide for further expansion of the company's major activity in transformers, coils, wiring harnesses, and electronic chassis assemblies.

WARREN CORP., Pittsburgh manufacturers and designers of industrial laboratory equipment, X-ray accessories, and photographic equipment, has opened its new Lustra Line Division plant at Clarion, Pa.

LUNDY MFG. CORP. has purchased certain laboratory and research equipment of the Ryan Industries Div. of Detroit from Textron, Inc.

RADIO CORPORATION OF AMERICA has opened a business office for Bizmac electronic data-processing systems and equipment at 1625 K St., Washington 25, D. C.

GENERAL ELECTRIC has presented its 35 millionth 5-star receiving tubes to Donald A. Quarles, deputy secretary of defense.

PHILIPS ELECTRONICS, INC., has shipped a special Norelco X-ray unit to Eastman Kodak Co. This automatic X-ray spectrograph was specially-designed to detect the mass concentration of silver in the emulsion on unprocessed film.

VISIRECORD, INC., is now producing a new, visible system for rapidly filing and finding long punched paper tapes, millions of which are now used by automated offices and factories.

MID-WEST

RADIO INDUSTRIES, INC., Chicago, announces a new copper plating process for manufacturing ceramic disc capacitors. The process is resulting in increased adhesion and freedom from migration.

MICRONICS DIV., Elgin National Watch Co., has been awarded three R & D contracts covering guided missile components totaling $500,000.

FRANK R. COOK CO. has received a contract totaling $100,000 to build 1,000 miniature batteries for drone airplanes.

FANSTEEL METALLURGICAL CORP.'s $6.5-million tantalum-columbium plant is nearing completion at Muskogee, Okla.

MOTOROLA, INC. announces a 15% across-the-board reduction in the price of its auto radio power transistors.

BELDEN MANUFACTURING CO. is now offering hook-up wire conforming to MIL spec 16878-B.

MINNESOTA MINING & MANUFACTURING CO. has opened a new branch office and warehouse at 4835 Para Drive, Cincinnati, Ohio.

CHICAGO AERIAL INDUSTRIES, INC. has formed a Components Div. to manufacture and market precision electronic components.

FOREIGN

FIAT, S. P. A., one of Italy's largest manufacturers, has agreed to build and sell full-scale atomic power plants under license from the Westinghouse Electric International Co.

COLLINS RADIO CO. OF CANADA, LTD., has been awarded an $8.3-million contract for UHF airborne transceivers by the Canadian Department of Defense Production.

MARCONI'S WIRELESS TELEGRAPH CO. LTD. has just added to its range of Doppler Navigators, a completely new lightweight civil airline version, known as the AD.2300. The Dopler Navigator has been supplied to the RAF and to the air forces within the British Commonwealth for the past three years.

AEROMAPAS SERAVENCA has been formed in Caracas, Venezuela, by the Photographic Survey Corp., Ltd., of Toronto, and its Venezuelan associates.

WESTINGHOUSE ELECTRIC INTERNATIONAL CO. has announced its largest sale of X-ray equipment, valued at over $800,000 to equip Venezuela's new 1000-bed military hospital in Caracas.

WEST

GERTSCH PRODUCTS, INC. has completed a move from its former West Los Angeles location to new facilities at 3211 So. La Cienega Blvd., Los Angeles, Calif.

ALTSHULER ASSOCIATES, Los Angeles, has prepared a new sales managing planning guide, listing all of the activities involved in a successful marketing program.

LING ELECTRONICS, INC. has acquired American Microwave Corp. of North Hollywood, Calif.

DEJUR-AMSCO CORP. has opened new general offices and warehousing facilities to cover eleven Western States at 11650 West Olympic Blvd., Los Angeles, Calif.

HUGHES AIRCRAFT CO. awarded its trophy, a silver-and-gold punch bowl, to the 512th Fighter Interceptor Squadron based in England in recognition of its attainment of outstanding air defense squadron.

LOCKHEED MISSILES SYSTEMS DIV. is seriously investigating the use of nuclear power to propel missiles. The studies will be further advanced with a powerful new atom smasher which has recently gone into use at the Lockheed Nuclear Laboratory.

LEAR, INC. has established a patent incentive plan whereby its inventor-employees may receive cash payments ranging from $25 to more than $20,000 on each of their inventions.

ELECTRONIC ENGINEERING CO. OF CALIFORNIA has purchased 530,000 sq. ft. of land in Santa Ana, Calif. for the expansion of its facilities and for the construction of a new plant for its subsidiary, The Engineered Electronics Co.

BECKMAN INSTRUMENTS, INC. honored seventy-nine employees, whose plans for doing jobs better will save the company an estimated $70,000 a year, at a company banquet at the Disneyland Hotel in Anaheim.

BJ ELECTRONICS, BORG-WARNER CORP. has introduced a digital data processing and recording system capable of sampling inputs from 100 Vibrotron Digital Transducers, at rates of up to 100 per second.

SERVONIC INSTRUMENTS INC. has expanded to a new location in Costa Mesa, Calif.

MERIDIAN METALCRAFT, INC., has established a new and separate production test section for commercial and military lightweight magnesium microwave devices.

DEUTSCH CO. has opened a new model shop for the fabrication of protype electrical connectors for special applications.

SPERRY PHOENIX CO., DIV. OF SPERRY RAND CORP. has begun production in its new permanent home in Phoenix, Ariz.

U. S. SEMICONDUCTOR PRODUCTS INC. began operations in its new multi-million dollar electronics plant in Phoenix, Ariz.

AIROJET-GENERAL CORP. has established a new Astronautics Research Laboratory under Y. C. Lee, Director of Research, Liquid Engine Div.

APPLIED RADIATION CORP. has moved into new quarters at 2404 N. Main St., Walnut Creek, Calif.

Early European Glass Blower

when you have ken✱ you can!

ESC HAS THE KNOW-HOW AND EXPERIENCE REQUIRED TO PRODUCE CUSTOM-BUILT DELAY LINES TO YOUR EXACTING SPECIFICATIONS.

1st in sales!

1st company devoted *exclusively* to the manufacture of delay lines!

1st in research, design and development of custom-built delay lines!

1st to submit the most definitive laboratory reports with all custom-built delay line prototypes!

✱ **ken**—vision, knowledge, perception... as, ESC has the ken to produce the finest custom-built delay lines in use today.

Exceptional employment opportunities for engineers experienced in pulse techniques.

®

ESC CORPORATION

534 Bergen Boulevard, Palisades Park, New Jersey

Circle 9 on Inquiry Card, page 107

Tele-Tips

ELECTRONIC BIRD-CALLING will be prohibited during the 1957-58 hunting season. A new Dept. of Interior ruling forbids "the use or aid of recorded bird calls or sounds or recorded or amplified imitations of bird calls or sounds." Hunters have been so singularly successful in luring migratory game birds with recorded sounds that the supply of waterfowl will be seriously depleted if allowed to continue.

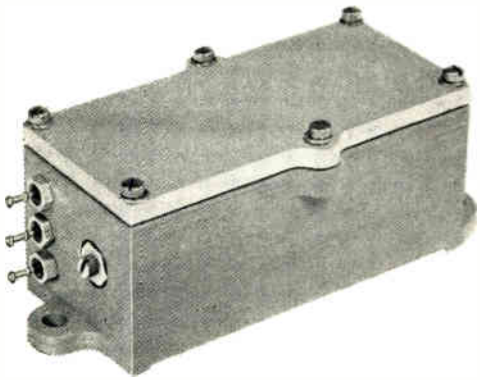
EXECUTIVES are not taking as much time off from their jobs as they should. A recent study by the American Management Assn., covering 96 members of top management, reveals that 46 used less than the total amount of vacation time allocated to them. Four of the 46 took no vacation at all, and only four took longer vacations than were assigned to them.

HOW HOT can a man be and still function? An ASME report shows he might last a minute and a half in air at 900°F—if he had centimeter-thick clothes. Without protective clothing he might last that long at 300°F.

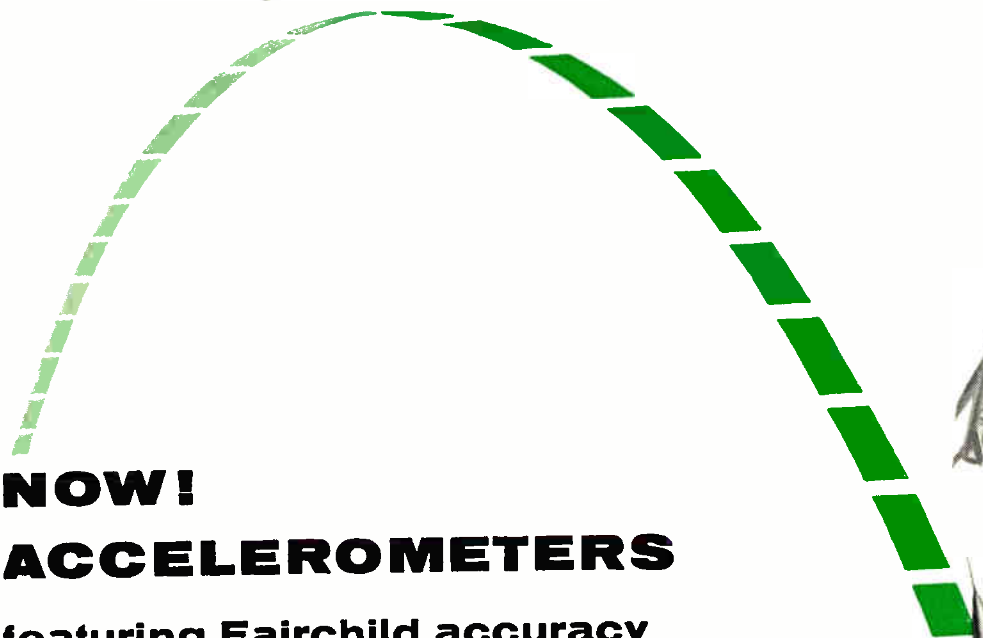
FCC field engineers ran into a strange case of interference in Minnesota. An airfield reported disruption to aircraft communication over a radius of 50 or more miles. A mobile unit dispatched to track down the culprit found the cause to be a common electric doorbell half a mile from the airport. Its transformer contained a temperature-control strip with contacts which had become so pitted that the connection alternately went on and off.

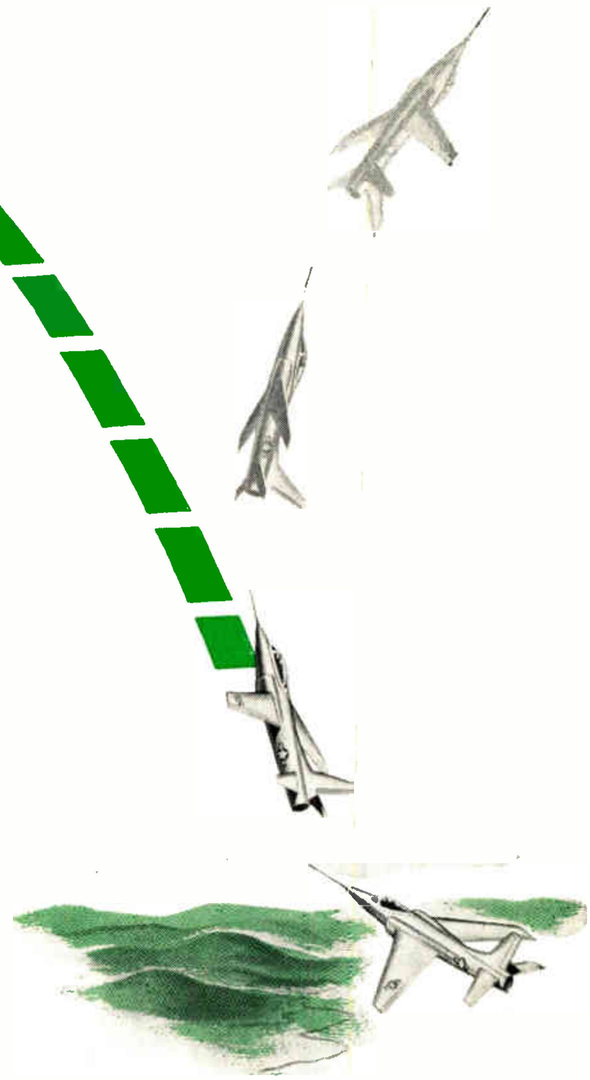
BROADCAST STATION in Fairbanks, Alaska experienced jamming on its remote pickup frequency. An FCC mobile unit traveled the streets, going from door to door, until they finally stopped in front of a tavern. The neon sign was turned on but the gas in it was not illuminated. And that was the cause of the radiation.

(Continued on page 24)



A line of accelerometers has been announced by the Components Division of Fairchild Controls Corporation. The unit shown—designated Type 940—is now being built for a toss bombing control system for the U.S. Air Force. These accelerometers have been developed with the same exceptional accuracy and reliability found in the complete Fairchild line of precision components: pressure transducers; linear and non-linear, single and multi-turn potentiometers; FilmPots® and trimmers.





NOW! ACCELEROMETERS

featuring Fairchild accuracy and reliability

Fairchild's new line of accelerometers will accurately measure a wide range of static or uniformly-varying types of acceleration. Applications include flight testing, air-borne telemetering and computing, and measurement of maneuvering accelerations of missiles and aircraft. Variations of conformation, G-range, natural frequency and damping can be developed to meet special customer requirements. Damping is accomplished by the viscous shear action of the mass in an oil medium.

Over-all accuracy, including linearity, hysteresis and repeatability, is better than 1.5%. The Type 940 (shown above) will operate under ambient temperatures of –55°C to 100°C and will withstand vibration in the order of 10-55cps .030″ double amplitude and 55-500cps at 5G in each of the three axes. Whatever your precision component requirements, whether potentiometers, pressure transducers or accelerometers, you can rely on Fairchild's complete line and advanced engineering for the best answer. For information, write to: Dept. 140-87E, Fairchild Controls Corporation, Components Division.

EAST COAST	WEST COAST
225 Park Avenue	6111 E. Washington Blvd.
Hicksville, L. I., N. Y.	Los Angeles, Calif.

FAIRCHILD
PRECISION POTENTIOMETERS and COMPONENTS

Circle 11 on Inquiry Card, page 107

Shown at Bell Laboratories, Murray Hill, N. J., are, left to right, F. J. Herr, S. T. Brewer, L. R. Snoke, E. E. Zajac and F. W. Kinsman.

They're wiring the seas for sound

These five Bell Labs scientists and engineers may never "go down to the sea in ships." Yet, they're part of one of the most exciting sea adventures of modern times. Along with many other specialists, they are developing the deep-sea telephone cable systems of the future.

Here's how they join many phases of communications science and engineering—to bring people who are oceans apart within speaking distance.

F. J. Herr, M.S., Stevens Institute, is concerned with systems design and analysis. He studies the feasibility of new approaches and carries out analysis programs to select optimum parameters for a proposed system design.

S. T. Brewer, M.S. in E.E., Purdue, communications and electronics engineer, explores new designs for sea-bottom amplifiers needed to step up power of hundreds of simultaneous telephone conversations.

L. R. Snoke, B.S. in Forestry, Penn State, is the team biologist. He investigates the resistance of materials to chemical and microbiological attack in sea water. Materials are evaluated both in the laboratory and in the ocean.

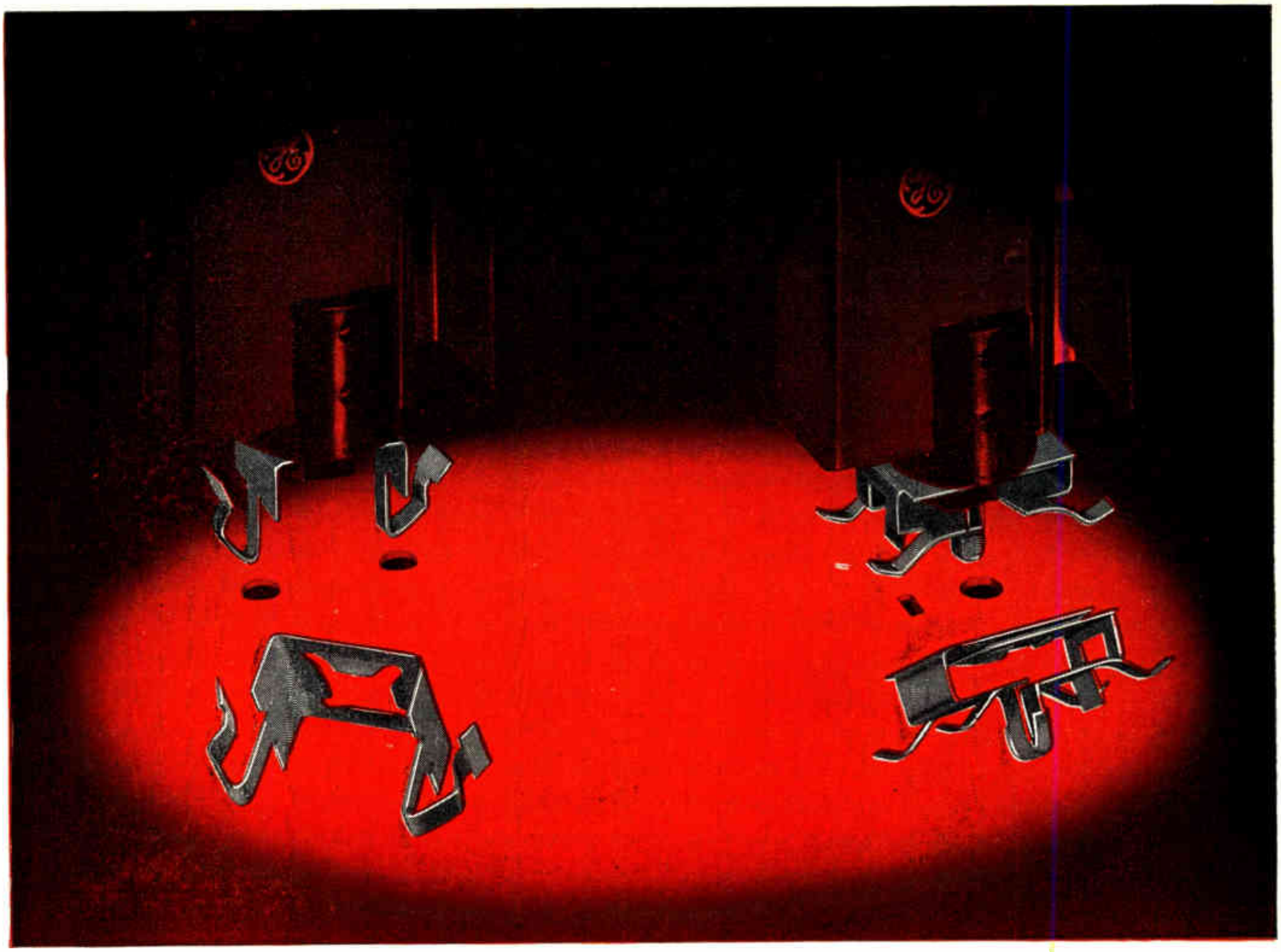
E. E. Zajac, Ph.D. in Engineering Mechanics, Stanford, is a mathematician. He studies the kinematics of cable laying and recovery. Cable's dynamic characteristics, ship's motion, the mountains and valleys in the ocean bottom—all must be taken into account.

F. W. Kinsman, Ph.D. in Engineering, Cornell, solves the shipboard problems of storage, handling and "overboarding" of cable. New machinery for laying cable is being developed.

Deep-sea cables once were limited to transmitting telegraph signals. Bell Labs research gave the long underseas cable a voice. New research and development at the Labs will make this voice even more useful.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



Engineered by Tinnerman . . .

On the assembly line...and in the field plug-in **SPEED CLIPS**® simplify rectifier installation

At General Electric, two variations on a single Speed Nut® principle are being used to make things easier for production-line assemblers and for electronics servicemen.

The basic idea of the Tinnerman front-mounting Speed Clip is incorporated into the sockets of GE germanium rectifiers made by GE's Semiconductor Products Department, Syracuse, for industrial electronics applications.

On the TV production line, the Tinnerman Speed Clip permits rapid, tight, and simple installation of rectifiers. In the field, merely by unplugging the original equipment rectifier and plugging in its germanium replacement, the serviceman can quickly get a unit back in service.

Working together, General Electric and Tinnerman engineers developed the two types of Speed Nut parts that are fabricated right into the rectifier shells.

Unusual applications of the Speed Nut principles to scores of different products are developed every day at Tinnerman. That's why over 9,000 different forms of Speed Nut Brand Fasteners have been designed for all leading manufacturers.

Your fastener problem can probably be solved quickly by a call to your Tinnerman sales representative. If his name isn't in your telephone directory, write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

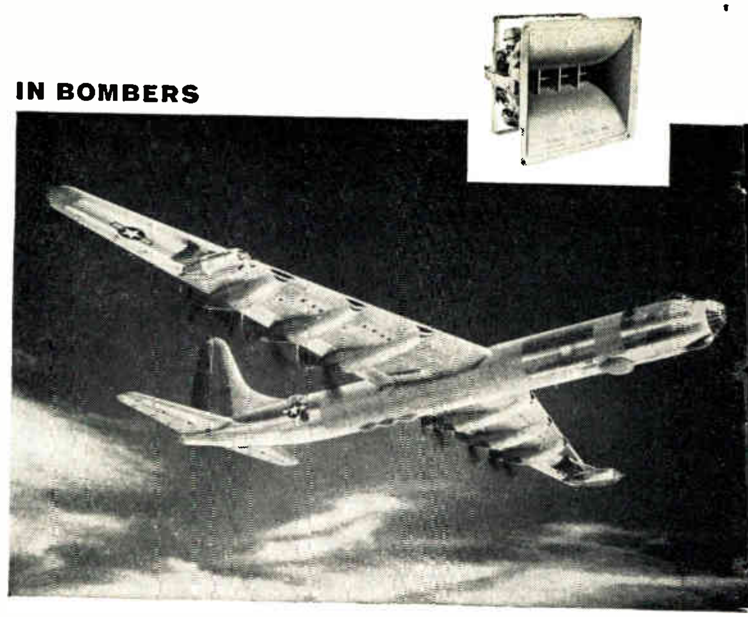
TINNERMAN
Speed Nuts®
FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

Circle 12 on Inquiry Card, page 107

AT CONVENTIONS

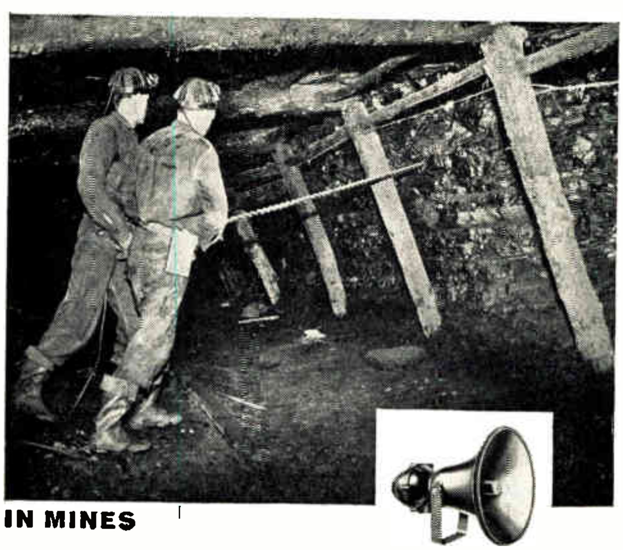
IN BOMBERS



UNIVERSITY ACHIEVEMENT

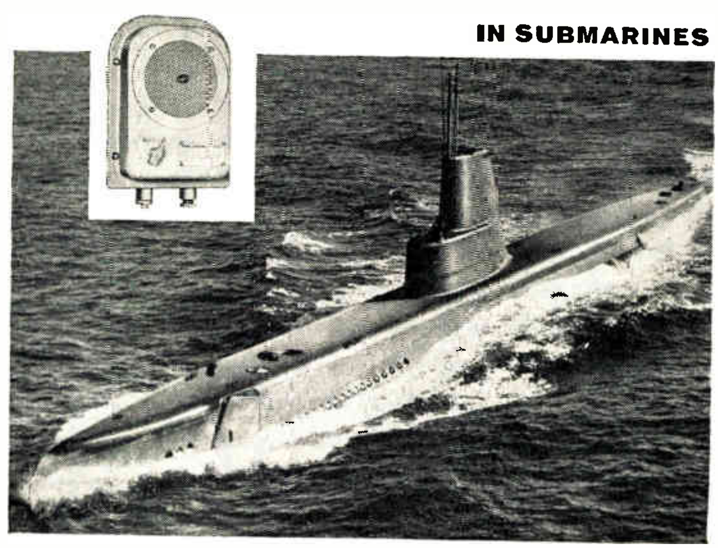
...as the largest supplier of loudspeakers to the military and industry...

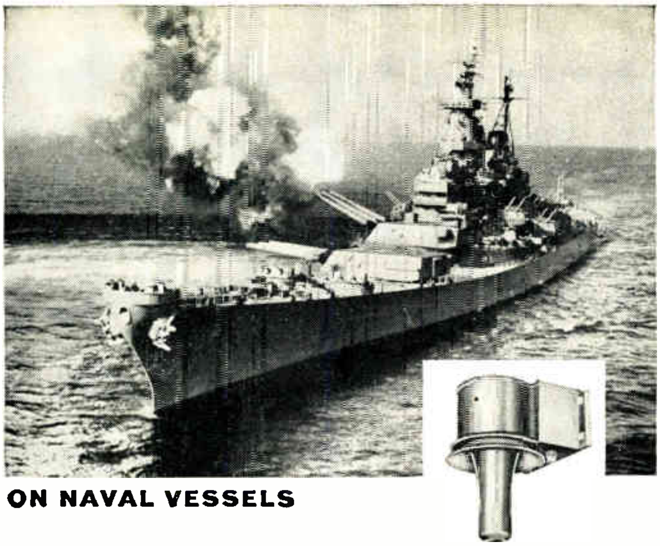
WHAT IT MEANS TO YOU



IN MINES

IN SUBMARINES





ON NAVAL VESSELS

. . . it means that just "know-how" and mere claims count very little in the *making* of quality speakers. University achievements speak for themselves.

. . . it means that the high precision techniques and specialized engineering skill acquired in meeting the exacting requirements of military and industrial reproducers are applied to the design and production of high-fidelity speakers.

. . . it means that University's meticulous system of quality control guarantees that all speakers of a given type be identical in every minute detail. A speaker is rejected at the slightest variation from rigid specifications.

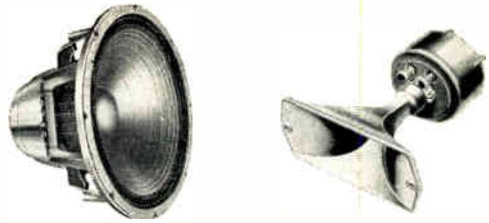
. . . it means that the immense resources of the University organization make it possible to offer the highest quality speaker possessing unique and exclusive University features . . . at the lowest possible price.

. . . more than all this, it means that the integrity of University, into which the U.S. government and the greatest industrial names have put their confidence, is your guarantee of a superior product.

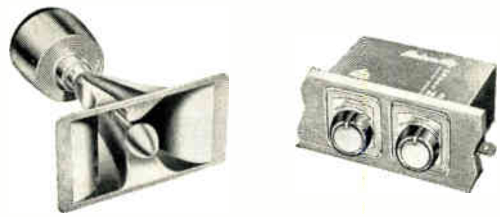
Yes, University sounds better, because it *is* better.

IN TANKS

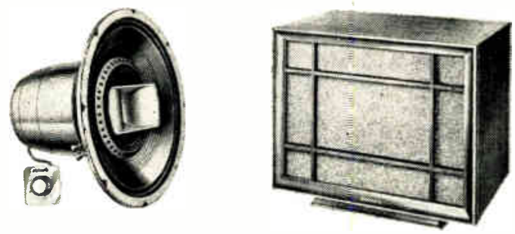
A FEW OF UNIVERSITY'S MANY



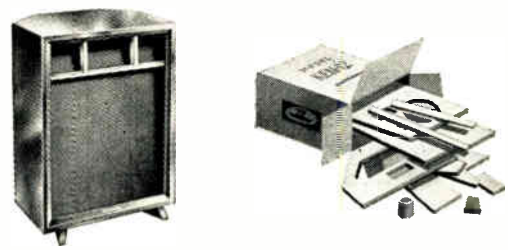
WOOFERS AND TWEETERS,



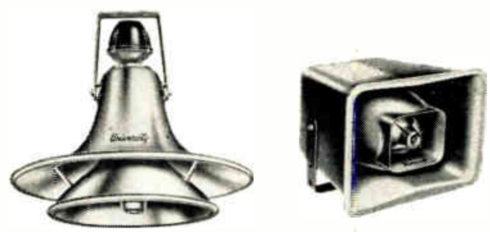
MID-RANGE AND NETWORKS,



DIFFAXIALS AND SYSTEMS,



ENCLOSURES AND KWIKITS



AND PUBLIC ADDRESS

FROM THE WORLD'S LARGEST SELECTION TO GRATIFY EVERY NEED AND BUDGET

Free copy of latest Product Catalog available upon request. Write Desk G-1, University Loudspeakers, Inc., 80 So. Kensico Avenue, White Plains, N. Y.

LISTEN... *University sounds better*

Circle 13 on Inquiry Card, page 107

Tele-Tips

(*Continued from page* 18)

TAPE RECORDER introduced at Britain's National Radio Show last month is extremely versatile. It has the three conventional speeds, a built-in sound mixer; a self-contained multi-band radio; and a means of reproducing phonograph records.

IRE TRANSACTIONS, started several years ago to cover the activities of the IRE Professional Groups, now totals 70 issues annually, with over 5.000 pages of valuable technical material in 26 different branches or radio-electronics.

CLOSED-CIRCUIT TV solved the seating problems for the overflow crowds at the Bethel Lutheran Church in Madison, Wis. Late arrivals are now ushered to choice seats in an adjoining chapel where services are viewed on two 24-in. TV receivers.

ENGLISH SENTENCES can be put together in almost infinite basic ways. Analyzing structures of 550 English sentences, NBS researchers found about the same number of new basic patterns in each batch of 50.

HI-FI EQUIPMENT need not be discounted if sales personnel are both technically competent and also can properly appraise the customer's needs or desires. This is the conclusion of Altshuler Assoc. after shopping interviews through the Southern Calif.-Arizona area. The firm reported that discounting was used as a sales incentive in almost 50% of the stores contacted.

PATENT OFFICE finally got around to issuing the basic patent for radar under which the government has a royalty free license. The inventor was Col. William R. Blair, retired Signal Corps scientist. Col. Blair conceived the pulse-echo method of direction finding and ranging prior to 1930.

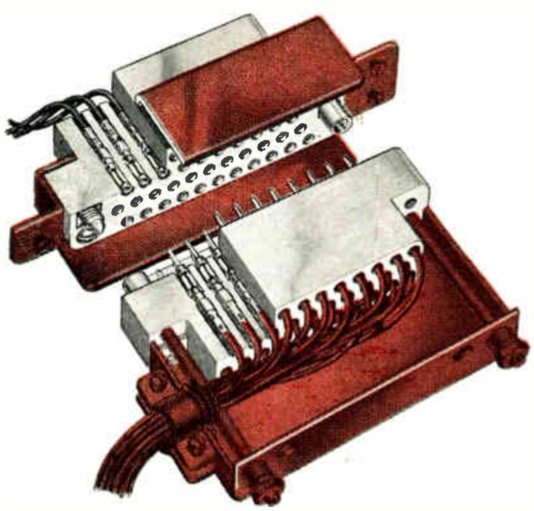
Another CEC first...

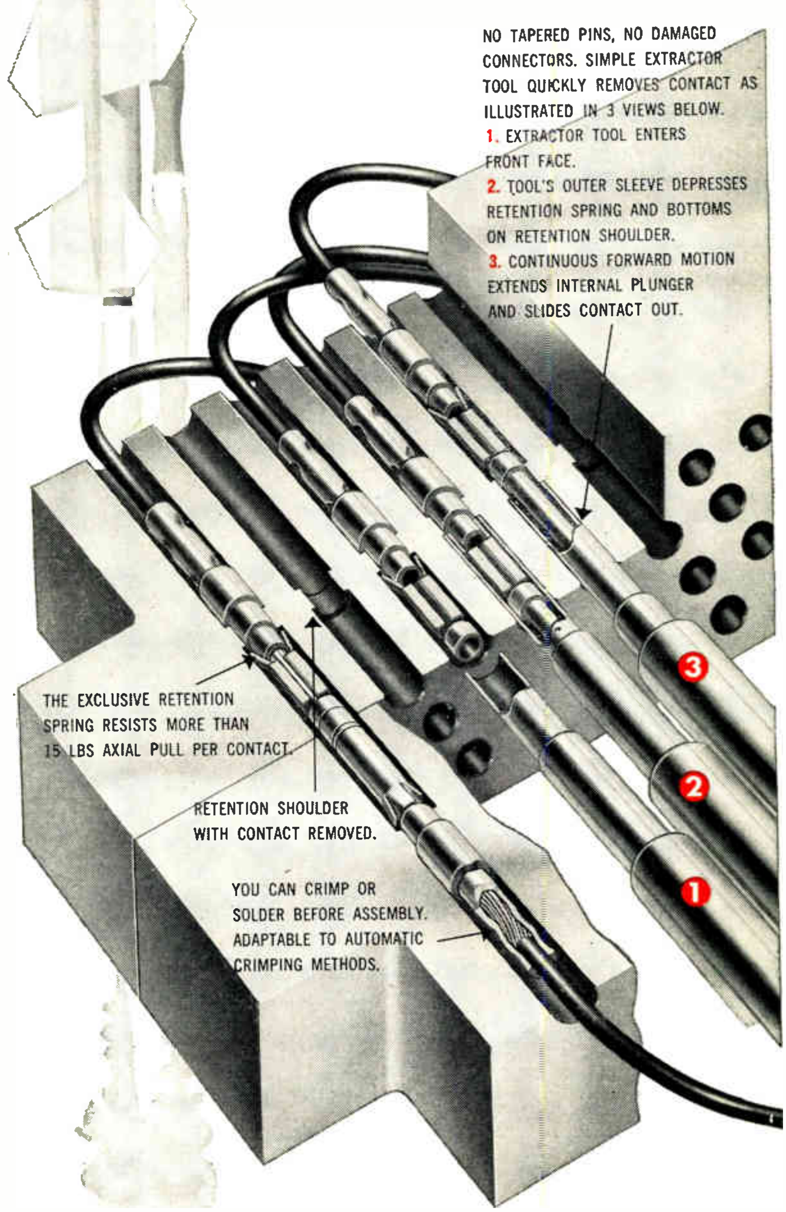
a new rectangular connector with exclusive

snap-in contacts

First in the field, CEC's exclusive snap-in contacts *lock* in place, yet can be removed quickly, easily as illustrated. The advantages of this new concept are unexcelled: Wire can be attached to contacts by crimping or soldering before assembly. You can capitalize on semi- or fully automatic crimping methods. Pins and sockets are interchangeable in the same connector body. Exclusive split hood is rigid, has fewer small parts, speeds assembly, facilitates inspection. You make *big savings* in time and money, drastically cut assembly and field maintenance costs.

MEETS MIL-C-8384A Specifications. Also physically interchangeable and will mate with ordinary connectors having similar contact arrangements.





EVALUATION UNITS available from stock in October —*Order now*. For complete information, write today for BULLETIN CEC 4004-X4.

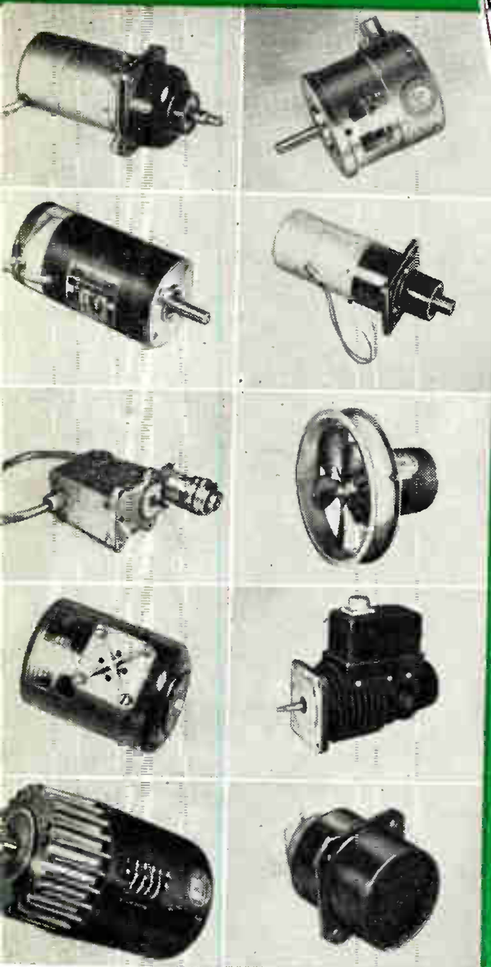
Consolidated Electrodynamics

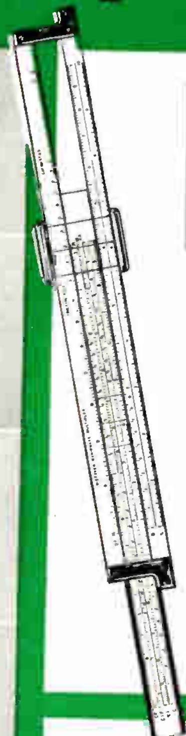
Glendale Division *740 Salem Street, Glendale 3, California*

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

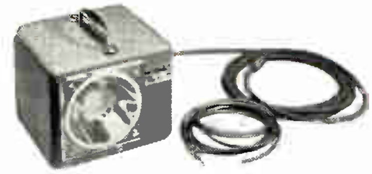
Circle 15 on Inquiry Card, page 107

Here they are!
WESTERN GEAR answers to your electrical equipment problems...



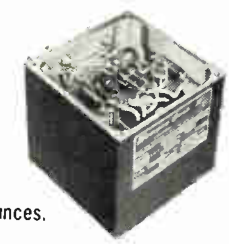


LABORATORY-TYPE POWER SUPPLY— New from Western Gear, Electro Products Division, is this lab-type, voltage-regulated power supply, available in either cabinet or rack type mounting. Input voltage is 105 to 125 volts at 50 to 60 cycles per second. Three output voltages are available . . . continuously variable 0 to 300V DC at 150 MA; continuously variable 0 to negative 150V DC at 5 MA; and 6.3V AC at 8 amperes. For full information, use the coupon below.

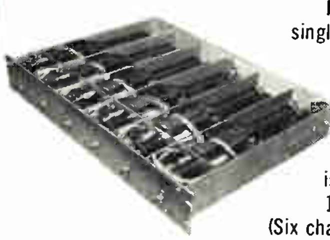


STROBOSCOPE UNIT— Now available, a reasonably-priced, compact, true-color stroboscope for viewing rotary, reciprocating or repetitive motion, as designed and manufactured by Western Gear's Electro Products Division.
SPECIFICATIONS: Flash duration, 10 microseconds; light output, 5 Lumen seconds per flash; repetition rate, 0 to 100 pulses per second; dimensions, 6″ wide, 5″ high, 5¾″ deep.
For complete information, mail the coupon below.

TRANSISTORIZED VOLTAGE REGULATOR— Rugged conditions are made to order for this precision unit, especially where performance, space and weight are of extreme importance.
The circuitry employs a shunt power transistor and a temperature-compensated Zener diode reference voltage. Input voltage is 31V DC plus or minus 4V. Output of the 7VR12 is 5V DC at 100 to 200 MA. Regulation less than plus or minus .1 per cent for combined variations of input voltage, load current, temperature, drift and vibration. Dimensions 2 x 2 x 2. Weight 8.5 ounces.
For more of the story, check and mail the coupon below.



Pictured above are only a few of Western Gear's complete miniature motor line, ranging from 1/500th to 4 HP. Choose from cycle ranges of 50 to 400 at any voltage required. Furthermore, if our basic designs do not meet your particular requirements, our engineers will be glad to work with you on your rotary electrical problems WITHOUT OBLIGATION!



MULTIPLE CHANNEL STRAIN GAGE POWER SUPPLY— Model 7P01 single or multiple channel strain gage power supply, 115 V, 60 cycle input, 10V DC output, adjustable from 9-11V DC with a 10-turn potentiometer. Output voltage changes less than plus or minus .05% due to temperature change from 0 to 45°C; output voltage changes less than .1% due to 2% change in load current. Output ripple is less than 300 microvolts RMS, isolated from ground as follows: insulation resistance to ground, 10,000 megohms; AC pickup voltage to ground, 5 microvolts peak. (Six channel unit shown.) For complete information, mail coupon below.

CLIP AND SAVE

Glenn Malme • WESTERN GEAR CORPORATION • P.O. Box 182, Lynwood, California

Please send information checked:

- ☐ Motor Catalog No. 254-A
- ☐ Data sheet on Voltage Regulator
- ☐ Data sheet on Strain Gage Power Supply
- ☐ Data sheet on Lab-type Power Supply
- ☐ Data sheet on Stroboscope Unit

Name____________________

Title____________________

Company____________________

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WESTERN GEAR *Corporation*

ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.) SEATTLE AND HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES

Circle 17 on Inquiry Card, page 107

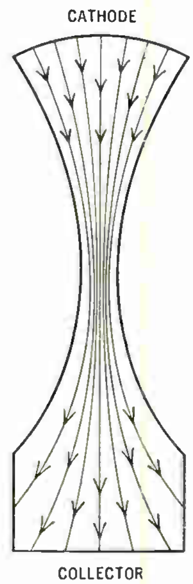
IMMEDIATE DELIVERY

15kw S-Band Amplifier Klystron has **no heavy magnets**

Exclusive Space-Charge Focus cuts weight to only 6½ lbs.

SAS-61 SPECIFICATIONS

Frequency Range	2700 to 2900 mc
Heating Time	90 sec.
Peak Power Output	15kw
Maximum Drive Power	30w
Power Gain	30 db



New Space Charge Focus principle of beam control is shown in diagram. New Sperry tube design utilizing this principle reduces size, weight, power consumption and cooling needs.

Available for immediate delivery, Sperry's new S-band transmitting tube is a 3-cavity pulse amplifier of high gain and extra-long service life.

Exclusive Sperry Space-Charge Focusing design eliminates heavy, cumbersome magnetic structures—a feature of prime importance in equipment design. Although the SAS-61 weighs only 6½ lbs., its sturdy construction withstands extreme vibration and environmental conditions.

Main applications for the SAS-61 are as an output tube in low-power radars, or as a driver for higher-powered klystrons in radar and linear accelerator systems. Its unusually long service life, however, makes it highly desirable for any application requiring 15 kw in the S-band. The SAS-61 with its internal tunable cavities is a *complete* microwave unit. No external equipment is required.

Sperry can deliver SAS-61 tubes in quantity at once. Write or phone your nearest Sperry district office.

ELECTRONIC TUBE DIVISION

SPERRY GYROSCOPE COMPANY

Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

CLEVELAND • NEW ORLEANS • BROOKLYN • LOS ANGELES • SAN FRANCISCO • SEATTLE • IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

Circle 16 on Inquiry Card, page 107

miniaturization with reliability for UNIVERSAL ATOMICS®

Achieved by

GENERAL TRANSISTOR

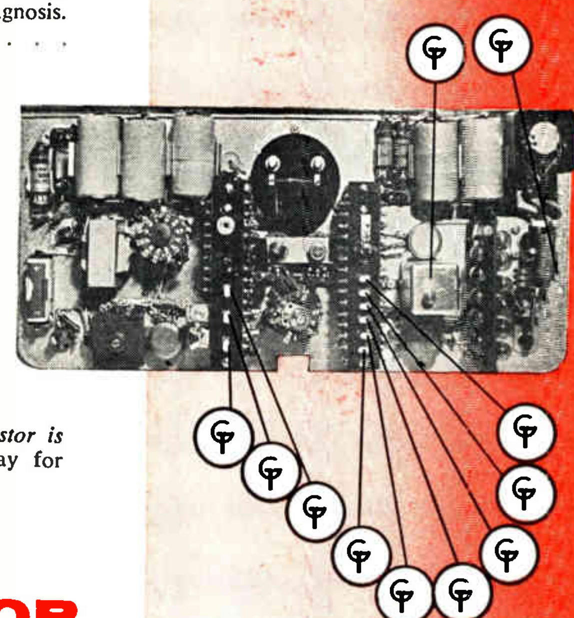
VERSATILE, TRANSISTORIZED UNIT ENABLES FASTER, MORE RELIABLE MEDICAL ANALYSIS

The design problem confronting Universal Atomics, for the UAC 522 Ratemeter, was to produce a completely miniaturized, compact portable unit using low-power consumption at a realistic price. The unit is intended for use in both clinical and medical radioisotope research and diagnosis. A reliable miniaturized circuit was essential . . . GT was called in.

General Transistor's engineering department recommended the GT-20 P-N-P type. This reliable audio transistor offered a current gain range of 35-50, maximum noise figure of 16 db., and a collector-base voltage of 25 volts. The equipment using these transistors continued to perform with extreme accuracy, even when exposed to severe environmental conditions.

All GT transistors must pass strict quality controls, production line testing plus a 100% final inspection . . . your assurance of a completely reliable product.

This is just one more example why *General Transistor is the fastest growing name in transistors.* Send today for Bulletin G-110.



GENERAL TRANSISTOR CORPORATION

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FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE JAMAICA 35, NEW YORK

PHOTO COURTESY OF UNIVERSAL ATOMICS, A DIVISION OF UNIVERSAL TRANSISTOR PRODUCTS CORP.

Personals

Albert A. Sorensen, Edward J. Robb and **Dow C. Pruitt** have joined the Guided Missile Research Div. of The Ramo-Wooldridge Corp.

Dr. Thomas H. Johnson, Atomic Energy Commission research director has been appointed manager of the Raytheon Mfg. Co.'s research division. He resigned from the AEC October 1.

Dr. Dean Allen Watkins of Stanford University has been named recipient of the 1957 Electronic-Achievement Award of the Seventh Region, Institute of Radio Engineers. The citation for Dr. Watkins' award is for "his basic contributions in reducing noise in microwave electron tubes.

Dr. D. A. Watkins

S. L. Pearl

Stanley L. Pearl now Project Engineer for the ESC Corp. His responsibilities will include supervision of design, development, and new processing of delay lines, pulse forming networks, and related pulse equipment.

Dr. Daniel Alpert, associate director of the Westinghouse Research Labs. has accepted an appointment as research professor of physics and technical director of the control systems laboratory at the University of Illinois.

Dr. Sholom Arzt, research physicist has joined the Universal Transistor Products Corp.

N. N. White and **H. J. Cornyn** have been added to the field engineering group of the RCA Semiconductor Div.

Arthur A. Washton, formerly chief engineer of Radalite Corp. has joined Kahn Research Labs. as a research engineer.

Richard Hougton has been named chief engineer of Waters Mfg., Inc. He was formerly in charge of the missile instrumentation group at Sanders Associates.

Circle 20 on Inquiry Card, page 107

CHATHAM 6528

MEDIUM MU, HIGH CURRENT TWIN POWER TRIODE

PROVIDES NEW STANDARDS OF PERFORMANCE FOR SERIES REGULATOR SERVICE

Requires Fewer Passing Tube Sections

Permits Lower Range Control Circuits

This Chatham Twin Power Triode provides both low internal drop and excellent control sensitivity. Series regulators have previously had to compromise these characteristics. The very low-mu triodes provided adequate low tube drop while the high sensitivity control characteristics could be obtained only from beam power tubes. Where both performance features were demanded it was often necessary to resort to parallel operation of a large number of tubes, or by complicated control amplifier circuits.

Circuitwise, the 6528 may be used with both triodes in parallel for one high current output, or they may be separated to provide two different regulated outputs. The possibilities for circuit simplification, space conservation and production economies are, of course, apparent.

For more information about the 6528, or for help with any special tube problem, write Commercial Engineering Section, Chatham Electronics, Division of Tung-Sol Electric Inc., Livingston, N. J.

DESIGN FEATURES

For reliable long life operation the 6528 features:

1. Hard Glass Envelope—permits tube to be more fully out-gassed in manufacture and to run at higher temperatures during life without gas evolution—more resistant to thermal shock.

2. Graphite Anodes—zirconium coated to provide one of the best "gettering" agents known—graphite undergoes virtually no expansion with temperature changes.

3. Extra Rugged Grids—gold plated molybdenum lateral wires supported by massive chrome copper side rods.

4. Oversized Cathodes—provide adequate emission reserve—no deterioration on standby.

5. Rugged Construction—mount is supported by six flexible metal snubbers and ceramic stand off insulators—heavy button stem has widely separated support leads.

RATINGS

Max. Plate Dissipation per tube	60 watts
Max. Plate Dissipation per section	30 watts
Max. Steady State Plate Current per section	300 ma
Max. Plate Voltage	400 volts
Max. Heater Cathode Voltage	300 volts
Amplification Factor*	9
Transconductance per section*	37,000 µmhos

*Average characteristics at Eb = 100v, Ec = —4v, Ib = 185 ma.

TYPICAL VALUES FOR REGULATOR SERVICE

Current per Triode Section	Range of Tube Voltage Drop	Minimum Tube Drop	Grid Voltage Swing
200 ma	65 v.	70 v.	10 v.
150	120	60	20
100	225	45	35

Write for Complete Technical Information

CHATHAM

Designers and Manufacturers of Electron Tubes, Selenium Rectifiers, Aircraft Conversion Equipment and Custom Components.

CHATHAM ELECTRONICS
division of
TUNG-SOL ELECTRIC INC.
General Offices and Plant: Livingston, N. J.
SALES OFFICES:
CHICAGO, DALLAS, LIVINGSTON, LOS ANGELES

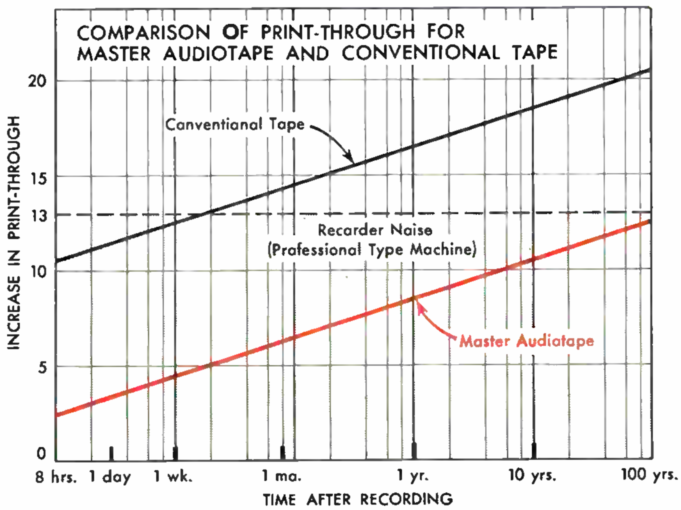
Circle 21 on Inquiry Card, page 107

Master Low Print-Through audiotape

The FIRST and FINEST low-print tape . . .
Cuts "magnetic echo" by 8 db

What Is Print-Through?

Print-Through is the magnetic "echo" effect induced in adjacent layers of tape by any recorded signal. It continually increases with time while the recorded tape is in storage. To keep print-through from being too objectionable, conscientious recordists have heretofore had to lower recording levels as much as 6 to 8 db, with reduced signal-to-noise ratio and sacrifice in tone quality.



0 = 63 db below 3% distortion at 1 kc, peak bias

How Is It Eliminated?

In Master Low Print-Through Audiotape, print-through has been reduced 8 db, by the use of specially developed magnetic oxides and special processing techniques — *without changing any other performance characteristics.* The curves at the left show the remarkable improvement obtained. Since print-through of Master Low Print-Through Audiotape remains well *below* the machine noise, it is "eliminated" for even the most critical ear.

▲ Master Low Print-Through Audiotape on 1½-mil cellulose acetate

Master Low Print-Through Audiotape on 1½-mil "MYLAR" polyester film ▶

Thoroughly PROVED in service, and now available in AMPLE QUANTITY!

Master Low Print-Through Audiotape has proved itself in over a year of actual service. Thousands of reels have been used by manufacturers of phonograph records and pre-recorded tapes and other top professional users. It has been in regular production since May, 1957, and is now available in ample quantity through dealers everywhere.

Laboratory studies indicate that stored Master Audiotape will take *more than 100 years* to reach the same print-through level that mars ordinary tape in one week! With an 8 db reduction in print-through, you can use higher recording levels, get better signal-to-noise ratio, and still have decades of freedom from harmful print-through effects. For a new high in hi-fi and new permanence for your priceless recordings, ask your dealer for Master Low Print-Through Audiotape. Available in 1200 and 2500 foot lengths in *two types* — on 1½-mil acetate and on 1½-mil Mylar*.

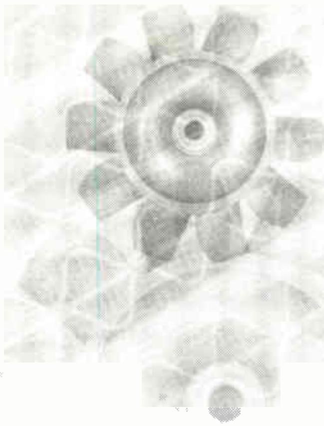
*DuPont Trade Mark

Circle 99 on Inquiry Card

audiotape TRADE MARK *it speaks for itself*

AUDIO DEVICES, INC., 444 Madison Ave., New York 22, N.Y.

In Hollywood: 840 N. Fairfax Ave.
In Chicago: 5428 Milwaukee Ave.
Export Dept.: 13 East 40th St., N.Y. 16, N.Y.
Cables "ARLAB"



Electronic Cooling Package...by AiResearch

SPECIFICATIONS OF TYPICAL AIRESEARCH COOLING PACKAGE	
Air Flow	60 CFM
Fan Air Inlet Pressure	18 PSIA
Fan Pressure Rise	1.2 inches water
Heat Exchanger Pressure Drop	1.0 inches water
Liquid	Water Methanol (70% Methanol)
Liquid Flow	0.4 GPM
Heat Rejection*	300 Watts
Fan Power	30 Watts, 110 V., single phase, 400 cycle
Package envelope dimensions	7 x 6 x 3 inches
Package wet weight	2.5 lbs.

*Assumes Class A (85°C.) electronic components, liquid inlet temperature to heat exchanger, 55°C. Includes heat from fan motor.

This high performance AiResearch package cools sealed and pressurized electronic equipment. The fan circulates air through the liquid cooled heat exchanger and over electronic components in a hermetically sealed module. Air cooled units are also available. Fan and heat exchanger are designed, built and packaged by AiResearch for matched performance. Package size is tailored to your individual cooling requirements.

The Garrett Corporation, through its AiResearch Manufacturing divisions, is an industry leader in components and cooling systems for aircraft, missiles and nuclear applications. This wide experience is now being offered to the electronics industry to provide a cooling package to meet any cooling requirement. Send us details of your problem or contact the nearest Airsupply or Aero Engineering office for further information.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

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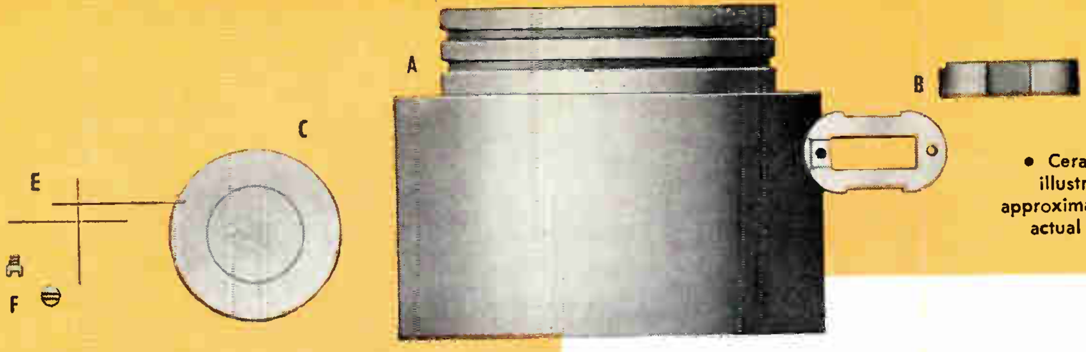
Circle 24 on Inquiry Card, page 107



• Ceramics illustrated approximately actual size.

ALSIMAG®

PRECISION CERAMICS

produced to precision tolerances

New equipment and techniques are constantly added to improve precision. Few people—few engineers—are aware of the close tolerances which are now possible. There are 3 main reasons for this progress:

COMPOSITIONS. Widest range in the industry. Some AlSiMag materials are hard as sapphire — more wear resistant than tool steel — and are non-magnetic and chemically inert. New Alumina "super ceramics" perform unbelievable feats of strength, thermal and mechanical shock resistance plus excellent electrical characteristics at ultra high frequencies and temperatures. Improved characteristics promote ruggedization, permit miniaturization.

CONTROLS. In preparation of raw materials, designing and building dies, calculating shrinkages . . . at every manufacturing step — forming, firing, inspecting. Over 55 years of experience — where precision in ceramics was pioneered!

FINISHING. Equipment plus skill. Every machine for precision finalizing. Thoroughly trained personnel who consider difficult specifications a personal challenge.

Tell us about your component problems. AlSiMag Precision Ceramics may do a better job for you. Send us a blueprint or sketch with an outline of the operating procedure for complete details.

Do you know.....

that ceramics can be supplied, in quantity: To tolerances generally associated with precision metal work.

A. Pistons and cylinders with maximum clearance of as little as .0015".

B. With faces parallel within .0005".

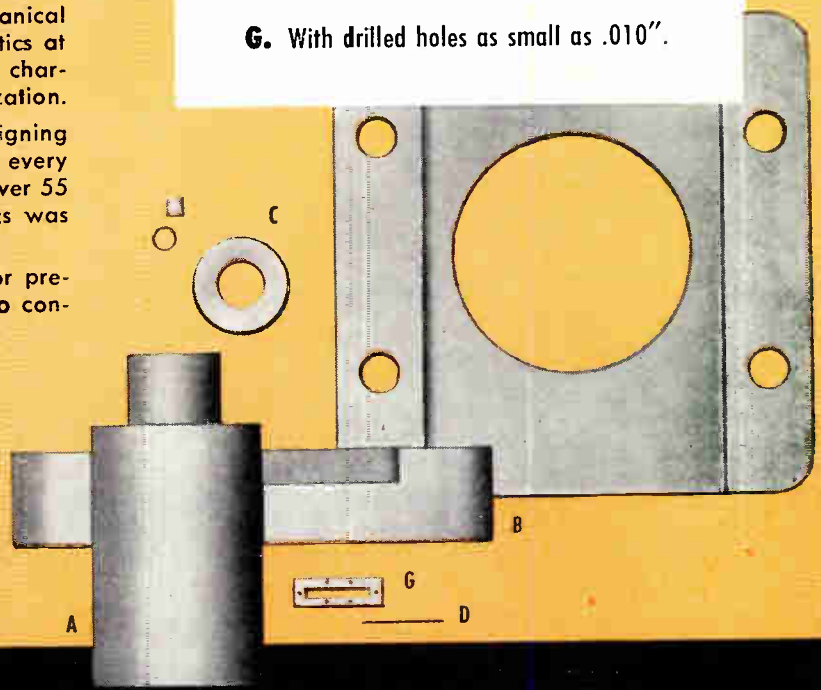
C. In flatnesses within light bands.

D. In thicknesses from .007" up.

E. In tubular form as small as .015" OD, .008" ID.

F. Threaded screws as small as 2-56 thread.

G. With drilled holes as small as .010".



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Books

Materials Handling Equipment

By D. Oliphant Haynes. Published 1957 by Chilton Co., Chestnut and 56th Sts., Philadelphia 39, Pa., 636 pages, dviii pages. Price $17.50.

Here is the first graphic presentation of materials handling equipment in a unique book designed to show specifically how each machine functions and what it actually does.

Over 2200 line drawings, made especially for this one volume, are used to illustrate the basic internal parts, showing for the first time not just the exterior, but also the internal why of materials handling machines. Readers can actually see what makes the wheels go round and why.

Referring entirely to the movements of materials in commerce and industry and materials which are semi-solid and solid, the author explains the new, up-to-the-minute method, and the basic, tried and proved systems. Because labor costs are high and uniform, and raw materials, too, cost all manufacturers approximately the same amount, only in the field of materials handling is the way still open for paring down costs and improving the competitive position.

For that reason the materials handling engineer is now regarded as a vital part of management.

Nowhere else can such a comprehensive graphic presentation of a subject be found.

Techniques of Plant Maintenance and Engineering, 1957

Published 1957 by the 1957 Plant Maintenance Show, Inc., 431 Madison Ave., New York 17, N. Y. 273 pages. Price $10.00.

The latest in the annual series of reports on the changing patterns of maintenance and engineering.

This year's report of the conference proceedings includes 29 papers presented by discussion leaders. In addition, the report on the discussion has 890 specific problems presented in the form of questions and answers.

Included are 46 charts, diagrams, tables and other illustrations.

Who's Who in Electronics

Published 1957 by Electronic Periodicals, Inc., 2775 S. Moreland Blvd., Cleveland 20, Ohio. 495 pages. Price $10.00.

This book contains over 25,000 separate listings, designed to show who makes and sells what electronic products. It further shows where these products are sold locally.

Transistor Circuit Engineering

Edited by Richard F. Shea. Published 1957 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 468 pages, xx pages. Price $12.00.

This book shows how transistor theory can be put to work in typical

(*Continued on page 40*)

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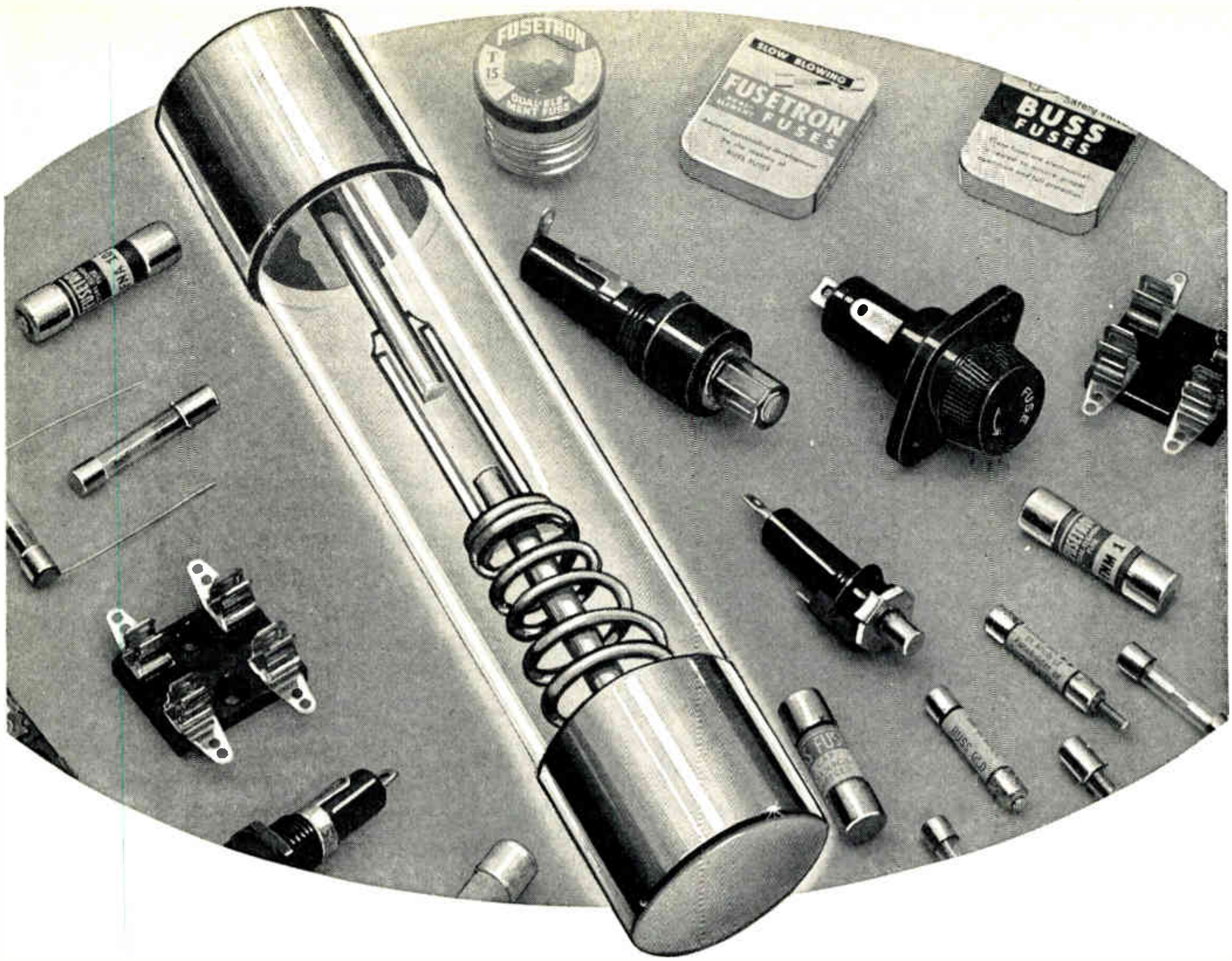

Save Time and Trouble by Standardizing on BUSS Fuses

YOU'LL FIND THE RIGHT FUSE EVERYTIME... IN THE COMPLETE BUSS LINE

By using BUSS as your source for fuses, you can quickly and easily find the type and size fuse you need. The complete BUSS line of fuses includes: dual-element (slow blowing), renewable and one-time types . . . in sizes from 1/500 amp. up — plus a companion line of fuse clips, blocks and holders.

BUSS TRADEMARK IS YOUR ASSURANCE OF FUSES OF UNQUESTIONED HIGH QUALITY

Over the past 43 years, millions upon millions of BUSS fuses have operated properly under all service conditions. Thus, BUSS fuses have earned a reputation for accurate and dependable electrical protection.

To make sure this high standard of dependability is maintained . . . BUSS fuses are tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

SHOULD YOU HAVE A SPECIAL PROBLEM IN ELECTRICAL PROTECTION . . . The BUSS fuse engineers are at your service—and in many cases can save you engineering time by helping you choose the right fuse for the job. Whenever possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be serviced easily.

Before your final design is crystallized, be sure to get the latest information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin TT. Bussmann Mfg. Division McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect—not to blow, needlessly

FUSETRON — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS

MAKERS OF A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

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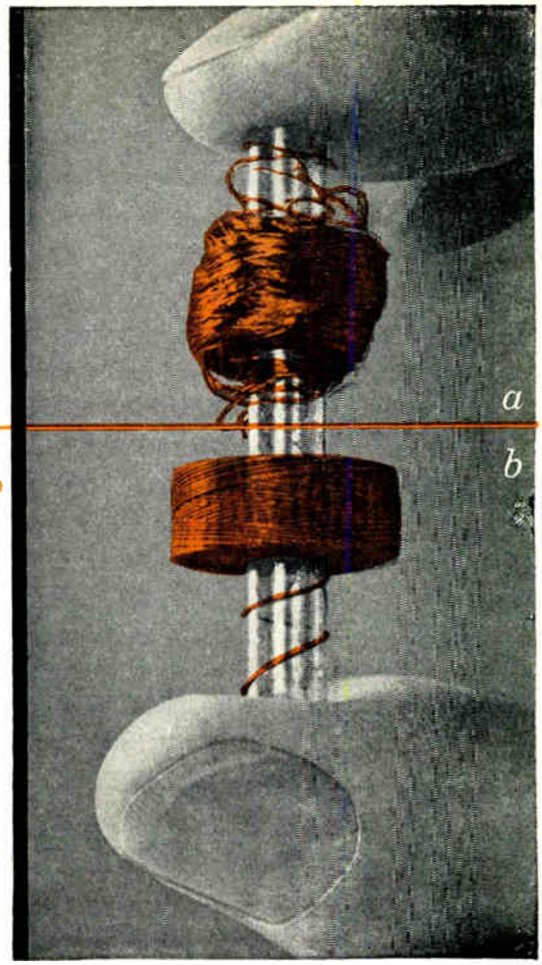

a
b

Books

(Continued from page 36)

circuits. Provides all the necessary tools for doing actual circuit designs and developing usable circuits in all potential fields of application. It enables the reader to build successful audio amplifiers, radio frequency amplifiers, etc., using available transistors. Moreover, it shows him how to combine these elements into radio receivers, television sets, and high fidelity audio systems.

Basic Automatic Control Theory

By Gordon J. Murphy, PhD. Published 1957 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 557 pages, XI pages. Price $9.00.

This timely volume presents a most modern concept of automatic controls theory. The author thoroughly describes the analysis and synthesis of linear control systems having fixed, lumped parameters and subject to specifiable input command and disturbances. He illustrates by extensive use of practical examples from several fields, including process control, inertial guidance, and fire control.

Matrix Calculus

By E. Bodewig. Published 1956 by North-Holland Publishing Co., Amsterdam, The Netherlands. Sole Agency for U. S. A., Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 334 pages, xi pages. Price $7.50.

The author operates with the true building blocks of the matrix; the rows and columns, whereas the elements disappear.

This calculus is applied to the usual matrix theory; to linear equations; to inversion of matrices (treated more extensively than usual) and to eigenproblems.

An Introduction to Semiconductors

By W. Crawford Dunlap, Jr. Published 1957 by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. 417 pages, xxi pages. Price $11.75.

This single volume on semiconductors offers a complete coverage of the subject. It includes basic concepts, properties of materials, methods of measurements, and applications. The book is designed to prepare you for active work in the field and to provide a source of general information on all phases. This is accomplished without an overwhelming mass of detail or an excess of mathematics.

Books Received

Equivalent Radio Tubes, 13th Edition

Edited by Dr. J. A. Gijsen. Published 1957 by T. H. Brans, Ltd., Antwerp, Belgium. 342 pages, paper bound.

U.H.F. Tubes for Communication and Measuring Equipment

Published 1956 by Philips Technical Library, Eindhoven, Holland. 70 pages. Price $1.50. To be ordered from your bookseller.

Call on the

Mallory

Electronic Assembly Department

for help in Missile Guidance Systems

Missile guidance systems are but one of the activities in which Mallory's Electronic Assembly Department can serve you. Extensive facilities and a highly skilled staff can produce single units or complete systems to your exact specifications.

The Electronic Assembly Department also maintains extensive laboratory programs for research and design—staffed with experienced personnel qualified to assume a major responsibility for the fulfillment of government or industrial assignments.

The development of efficient manufacturing techniques, and the extensive training of production personnel, have brought about widespread acceptance of the department's abilities, recently recognized by qualification under the U.S. Army Signal Corps' RIQAP Program. The completeness of staff and facilities also offers the prime contractor many economic advantages.

Sales engineers may be contacted through Mallory district sales offices, or direct. Write for your copy of the Mallory brochure outlining the Electronic Assembly Department's facilities—or ask your local Mallory representative.

Serving Industry with These Products:

Electromechanical — Resistors • Switches • Tuning Devices • Vibrators
Electrochemical — Capacitors • Mercury and Zinc-Carbon Batteries
Metallurgical — Contacts • Special Metals • Welding Materials

Parts distributors in all major cities stock Mallory standard components for your convenience.

Expect more . . . get more from

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

Circle 31 on Inquiry Card, page 107

News of Reps

REPS WANTED

A leading manufacturer of transistorized equipment, power supplies, amplifiers, test equipment, indicators and detectors, is seeking representation in the Kansas City and St. Louis areas for their complete line. Manufacturer is well known in the field. (Write to box R10-1.)

Alex Corbett, Jr., and Associates, 2411 Covina Way, So., St. Petersburg, Fla., have been appointed district reps for the National Vulcanized Fibre Co., covering Southern and Eastern Florida.

James K. Palmer, Daniel W. Bender and Tom Gaul have joined the Kittleson Co. as engineering reps.

Norman S. Wright and Co. have been appointed western sales reps for Peerless Electric fans and blowers. Their main office is in San Francisco.

Howard & Gould, 105 W. Adams St., Chicago, are now sales reps for the C. O. Jelliff Mfg. Corp. in Indiana, Wisconsin and Louisville and Owensboro, Kentucky.

Ross Engineering, 224 S. Michigan Ave., Chicago, has been appointed sales and engineering reps in Northern Illinois for Kahn & Co.

LeRoy and McGuire of Phelps, New York, have been appointed sales reps for Du Mont TV tubes in the state of New York except the Metropolitan New York area.

Aktiebologet Elecktroholm, Stockholm, Sweden, is now export sales rep in Sweden for Philco's G & I Div.

Peterson Co. of Denver, Colo., has been appointed sales reps in Colorado, Wyoming, Montana, Utah and parts of Idaho and New Mexico for the Instrument Development Labs., Inc.

Queisser Brothers, 110 E. 9th St., Indianapolis 2, are reps in Indiana for the Stevens Mfg. Co., Inc., and Benz Sales Co., P. O. Box 3347, Miami 24, are now their reps in Florida.

Cable & System Engineers, Inc., of 11168 Santa Monica Blvd., Los Angeles, Calif., are now exclusive reps for William Brand & Co., Inc., line of multiconductor cables.

Rodgers Associates have moved. They are now located at Chapin Road, Hampden, Mass.

Vernon R. Helmen has been named as electronic field rep in the Minneapolis area for P. R. Mallory & Co., Inc.

(*Continued on page* 46)

D O-T S

Deci-Ouncer Transformers

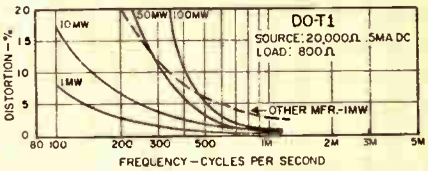
REVOLUTIONARY TRANSISTOR TRANSFORMERS

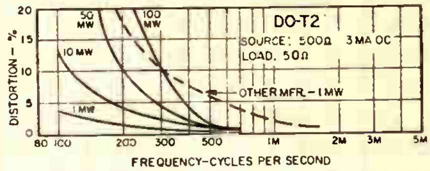
of unequalled power handling capacity and reliability

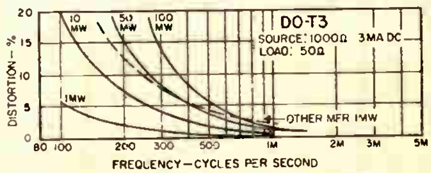
Hermetically Sealed to MIL-T-27A Specs.

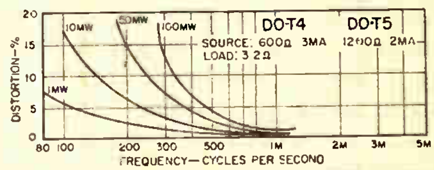
TYPICAL DO-T PERFORMANCE CURVES

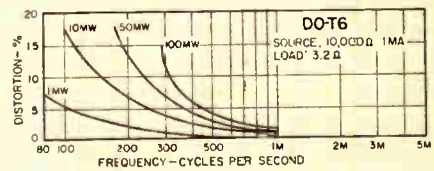
Power curves based on setting output power at 1 KC, [th]en maintaining same input level over frequency range.

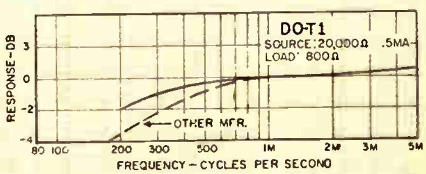


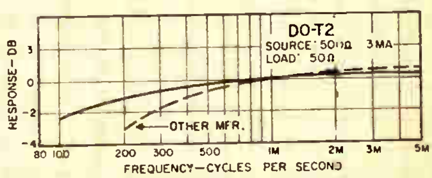


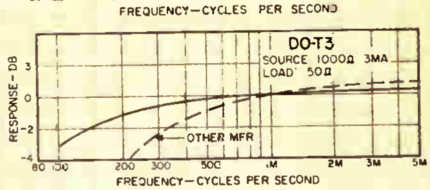


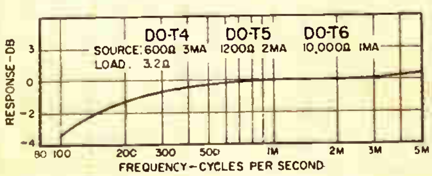












DO-T units have been designed for transistor application only . . . not for vacuum tube service. **Pats. Pending

Conventional miniaturized transistor transformers have inherently poor electrical characteristics, perform with insufficient reliability and are woefully inadequate for many applications. The radical design of the new UTC DO-T transistor transformers** provides unprecedented power handling capacity and reliability, coupled with extremely small size. Twenty-five stock types cover virtually every transistor application*. Special types can be made to order.

High Power Rating . . . up to 100 times greater.

Excellent Response . . . twice as good at low end.

Low Distortion . . . reduced 80%.

High Efficiency . . . up to 30% better.

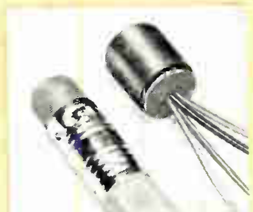
Moisture Proof . . . hermetically sealed to MIL-T-27A.

Rugged . . . completely cased.

Anchored Leads . . . will withstand 10 pound pull test.

Printed Circuit Use . . . (solder melting) plastic insulated leads.

ACTUAL SIZE



DO-T CASE Dia. . . . 5/16"
Length . . 13/32"
Weight . . 1/10th oz.

Type No.	MIL Type	Application	Pri. Imp.	D.C. Ma.‡ in Pri.	Sec. Imp.	Pri. Res.	Leve[l] Mw.
DO-T1	TF4RX13YY	Interstage	20,000 30,000	.5 .5	800 1200	850	5(
DO-T2	TF4RX17YY	Output	500 600	3 3	50 60	60	10(
DO-T3	TF4RX13YY	Output	1000 1200	3 3	50 60	115	10(
DO-T4	TF4RX17YY	Output	600	3	3.2	60	10(
DO-T5	TF4RX13YY	Output	1200	2	3.2	115	10(
DO-T6	TF4RX13YY	Output	10,000	1	3.2	1000	10(
DO-T7	TF4RX16YY	Input	200,000	0	1000	8500	2.
DO-T8	TF4RX20YY	Reactor 3.5 Hys. @ 2 Ma. DC				630	
DO-T9	TF4RX13YY	Output or driver	10,000 12,500	1 1	500 CT 600 CT	800	10(
DO-T10	TF4RX13YY	Driver	10,000 12,500	1 1	1200 CT 1500 CT	800	10(
DO-T11	TF4RX13YY	Driver	10,000 12,000	1 1	2000 CT 2500 CT	800	10(
DO-T12	TF4RX17YY	Single or PP output	150 CT 200 CT	10 10	12 16	11	50
DO-T13	TF4RX17YY	Single or PP output	300 CT 400 CT	7 7	12 16	20	5(
DO-T14	TF4RX17YY	Single or PP output	600 CT 800 CT	5 5	12 16	43	5(
DO-T15	TF4RX17YY	Single or PP output	800 CT 1070 CT	4 4	12 16	51	5(
DO-T16	TF4RX13YY	Single or PP output	1000 CT 1330 CT	3.5 3.5	12 16	71	5(
DO-T17	TF4RX13YY	Single or PP output	1500 CT 2000 CT	3 3	12 16	108	5(
DO-T18	TF4RX13YY	Single or PP output	7500 CT 10,000 CT	1 1	12 16	505	20
DO-T19	TF4RX17YY	Output to line	300 CT	7	600	19	5(
DO-T20	TF4RX17YY	Output or matching to line	500 CT	5.5	600	31	5(
DO-T21	TF4RX17YY	Output to line	900 CT	4	600	53	5(
DO-T22	TF4RX13YY	Output to line	1500 CT	3	600	86	5(
DO-T23	TF4RX13YY	Interstage	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	850	1(
DO-T24	TF4RX16YY	Input (usable for chopper service)	200,000 CT	0	1000 CT	8500	2
DO-T25	TF4RX13YY	Interstage	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	800	1(

‡DCMA shown is for single ended useage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA can [b…] any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)

UNITED TRANSFORMER CORP.

150 Varick Street, New York 13, N. Y.

PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

DELCO HIGH POWER TRANSISTORS

Now available . . .
FOUR new types!
New LOWER prices!

Typical Characteristics at 25° C

	DT100	2N441	2N442	2N443
Maximum Collector Current	13	13	13	13 amps
Collector Voltage, Emitter Open	100	40	50	60 volts
Saturation Voltage (12 amps)	0.7	0.7	0.7	0.7 volts
Power Dissipation	55	55	55	55 watts
Thermal Gradient from Junction to Mounting Base	1.2°	1.2°	1.2°	1.2° °C/watt
Nominal Base Current I_B (V_{EC} = —2 volts, I_C = —1.2 amp.)	-19	-26	-26	-26 ma
Distortion (Class A_1, 10 watts)	5%	5%	5%	5%

Delco Radio offers four new alloy junction germanium PNP transistors to meet an even wider range of applications. Like all of Delco Radio's High Power transistors, these are characterized by high output power, high gain and low distortion. All, too, are normalized to retain their fine performance characteristics regardless of age. Furthermore—these new types are all in volume production. Other types are available at new, lower prices. Data and application sheets and price lists are available upon request.

DELCO RADIO
Division of General Motors
Kokomo, Indiana

Circle 34 on Inquiry Card, page 107

on LAND
at SEA
in the AIR

El-Menco

Dur-Mica CAPACITORS

do the job ***BETTER!***

Now, Stronger Than Ever . . . give up to 18 years of sure, rugged service!

Put through a series of rough tests, these tiny, tireless workhorses of the electronics industry came up with a record-smashing performance. El-Menco engineers found that El-Menco DM-15, smallest mica capacitor in the world, DM-20 and DM-30 Dur-Mica Capacitors beat all others for long life and tried reliability. Under accelerated conditions of 1½ times rated voltage at 125° C ambient temperature, El-Menco Dur-Micas kept on going strong even after 12,000 hours . . . equal to 18 years or more of service under normal operating conditions.

MIGHTY MICAS
Do the Work
of GIANTS

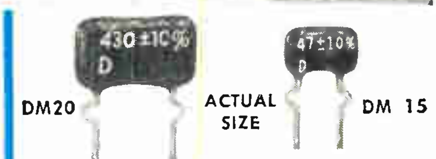
Write for FREE samples and catalog on your firm's letterhead.

El-Menco Dur-Mica DM-15, DM-20, DM-30, DM-40 and DM-42 Capacitors outlive, outperform, outshine . . .

Longer life . . . tremendous power . . . tiny size . . . terrific stability — silvered mica . . . perfect performance. Test them for yourself and see . . .

DM-15 — tiniest mica capacitor in the world . . . ideal for extreme miniaturization . . . up to 820 mmf at 300 VDCW . . . up to 400 mmf at 500 VDCW.

DM-20 — ideal for new miniatured designs and printed wiring circuits . . . up to 7500 mmf at 100 VDCW . . . up to 6200 mmf at 300 VDCW . . . up to 4300 mmf at 500 VDCW.



With newly-designed crimped leads . . . Parallel leads simplify use in TV, electronic brains, miniature printed circuits, guided missiles, and countless other applications. El-Menco Dur-Mica Capacitors meet all humidity, temperature and electronic requirements, including military specs.

El-Menco
Capacitors

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

WILLIMANTIC CONNECTICUT

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

Arco Electronics, Inc., 64 White St., New York 13, N. Y.
Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

News of Reps

(Continued from page 42)

Frank J. Pfeiffenberg is now a district rep with the **Henry P. Segel Co., Inc., Brookline, Mass.**

Henry Feldman has been appointed rep in Southern California and Arizona for the Radio Merchandise Sales Inc. and **Packard Associates** are now their reps in Oklahoma and Texas.

Robert K. Deunk & Associates, 14820 Detroit Ave., Cleveland are reps in Northern Ohio, Western Pennsylvania and West Virginia for the Marion Electrical Instrument Co. **W. E. Fry & Co., Inc.,** 406 W. 34 St., Kansas City, Mo., will represent them in Iowa, Kansas, Missouri and Nebraska.

Maury E. Bettis Co. are now reps in Nebraska, Kansas, Iowa, Oklahoma and Missouri for American Electronic Labs., Inc.

George Croft has just been added to the **Frank A. Emmet Co.,** sales reps, engineering staff.

William H. Hayes, Jr. has joined the New England rep firm of **Abbett and Hustis** of 16A Eaton Sq., Needham, Mass.

L. J. Pastor has been appointed special rep in the communications department of the International Business Machines Corp.

Gerard G. Leeds Co. will handle the Electric Tube Corporation's lines of multi-channel oscilloscopes, C-R tubes and camera equipment in Maryland, Delaware, Eastern Pennsylvania, New Jersey, New York City and surrounding urban areas.

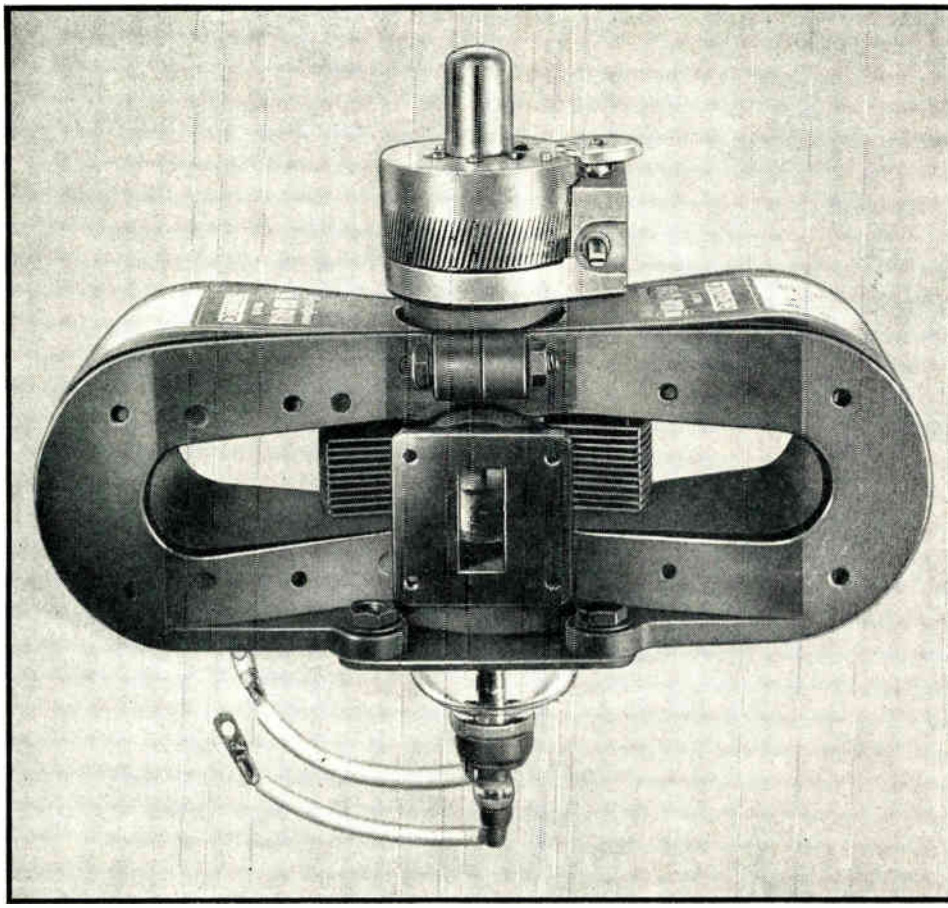
King-Moon Co., Inc., Sherman Oaks, calif., has been appointed West Coast sales engineering rep for Hubbard Scientific Lab., Inc.

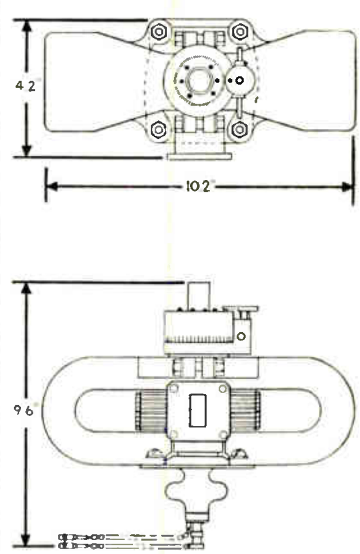
Ray Johnston Co., 11009 Evanston Ave., Seattle, Wash., now represent the Allen B. Du Mont Lab., Inc. in the Northwest in the industrial electronic tubes line.

International Electronic Research Corporation

In the August issue of *Electronic Industries* there was an error in inserting the notation that International Electronic Research Corp. of Burbank, Calif., is the subsidiary of another company. International Electronic Research Corp. is associated only with one other company, Electronics International Co., Burbank, Calif., a special products division.

New Westinghouse **WL-6249A** tunable x-band Magnetron





Highest power tunable x-band Magnetron commercially available.

Now Westinghouse brings you a new high-powered mechanically tunable x-band Magnetron designed to operate over a wide frequency range. The tube meets U. S. Air Force Specification MIL-T-8128A, and is designed for airborne radar and missile applications.

An air cooled pulsed type Magnetron with integral magnet and unipotential cathode, the WL-6249A has excellent stability during warm up and operation.

Electrical characteristics: Frequency: 8500-9600 Mc. Minimum Power Output: 200 watts average. Duty: .001

Write for detailed data sheet today. The WL-6249A can fit into your present or future design needs.

YOU CAN BE SURE...IF IT'S

Westinghouse

Electronic Tube Division · Elmira, N. Y.

HIGHER PEAK POWER VERSION UNDER DEVELOPMENT! A modification of the WL-6249A now undergoing experimental work by Westinghouse may be the answer to your need for a more powerful tunable x-band Magnetron. Westinghouse engineers will be happy to work with you on new higher power applications. Submit requirements to Westinghouse, P. O. Box 284, Elmira, N. Y. c/o Industrial Tube Sales Manager.

CLIP AND MAIL COUPON

Commercial Eng. Dept., Electronic Tube Div.
Westinghouse Electric Corp., Elmira, N. Y.

Please send me complete information on your new WL-6249A tunable x-band Magnetron.

NAME ________________

TITLE ________________

COMPANY ________________

ADDRESS ________________

Circle 37 on Inquiry Card, page 107

"Fishing... that's what I'm doing"

And if you're the man whose product needs this Tung-Sol Relay, then it's you I'm fishing for.

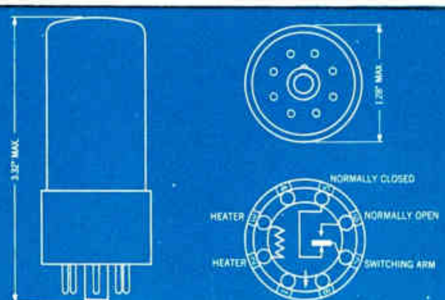
Tung-Sol makes an extensive line of relays in the general operating range typified by the No. 609. Simplicity of construction provides utmost reliability under extreme service conditions.

Snap-action principle of operating permits almost instantaneous response to current conditions. Cycling is extremely uniform. Compact and lightweight, Tung-Sol Relays are ideal for instrument, equipment and missile applications.

NOMINAL DESIGN CONSIDERATIONS

Contact capacity	1 amp 30 volt resistive
Contact arrangement	SPST (NC) or SPDT
Operating power	As low as ½ watt
Time delays	Up to 5 seconds

Operate on current differential as small as .05 amps
Operate on voltage differential as small as .3 volts



NOMINAL CHARACTERISTICS OF 609

Operating voltage	6.4 volts
Operating time	1. plus or minus .5 seconds
Release time	1. plus or minus .5 seconds
Contact capacity	1 amp at 30 volts
Contact arrangement	SPDT

For additional data write:
Electroswitch Division, Tung-Sol Electric Inc., Newark 4, N. J.
Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Montreal, P. Q.

TUNG-SOL® THERMAL RELAYS

Circle 38 on Inquiry Card, page 107

For HIGHEST ELECTRICAL & MECHANICAL Efficiency!

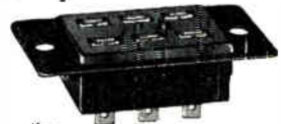
New JONES 2400 SERIES PLUGS & SOCKETS

Improved Socket Contacts. Four individual flexing surfaces. Positive contact over practically their entire length.

Both Plug and Socket Contacts mounted in recessed pockets greatly increasing leakage distance, INCREASING VOLTAGE RATING.

Plug and Socket Contacts cadmium plated. Add to appearance of your equipment. Interchangeable with Jones 400 Series.

P-2406-CCT Plug—with Cable clamp in top.
S-2406-SB Socket with shallow bracket for flush mounting.

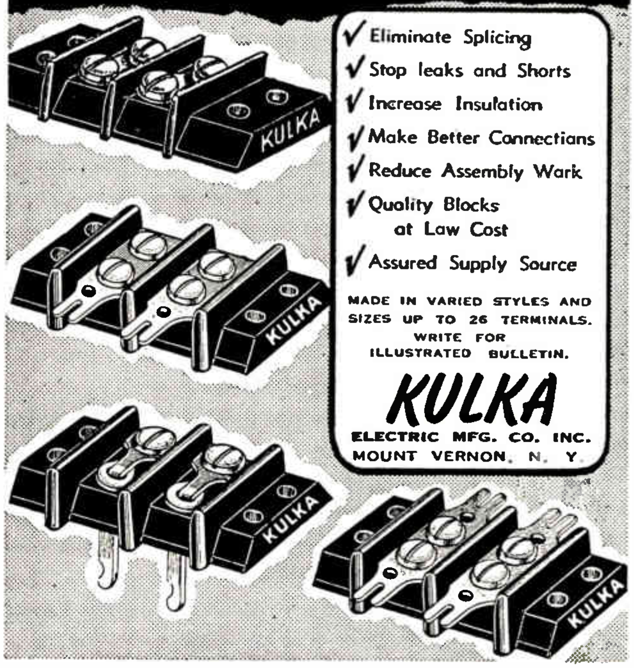


Ask for Catalog 21, Complete line Jones Plugs, Sockets, Terminal Strips.

Jones
HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

Circle 132 on Inquiry Card, page 107

7 Sound Reasons for using KULKA TERMINAL BLOCKS on your Electronic Equipment



- ✓ Eliminate Splicing
- ✓ Stop leaks and Shorts
- ✓ Increase Insulation
- ✓ Make Better Connections
- ✓ Reduce Assembly Work
- ✓ Quality Blocks at Low Cost
- ✓ Assured Supply Source

MADE IN VARIED STYLES AND SIZES UP TO 26 TERMINALS. WRITE FOR ILLUSTRATED BULLETIN.

KULKA
ELECTRIC MFG. CO. INC.
MOUNT VERNON, N. Y.

Circle 133 on Inquiry Card, page 107

NEW! *Mincom's Magnetic Tape System*

112,000 DATA BITS PER INCH ON ½ INCH MAGNETIC TAPE

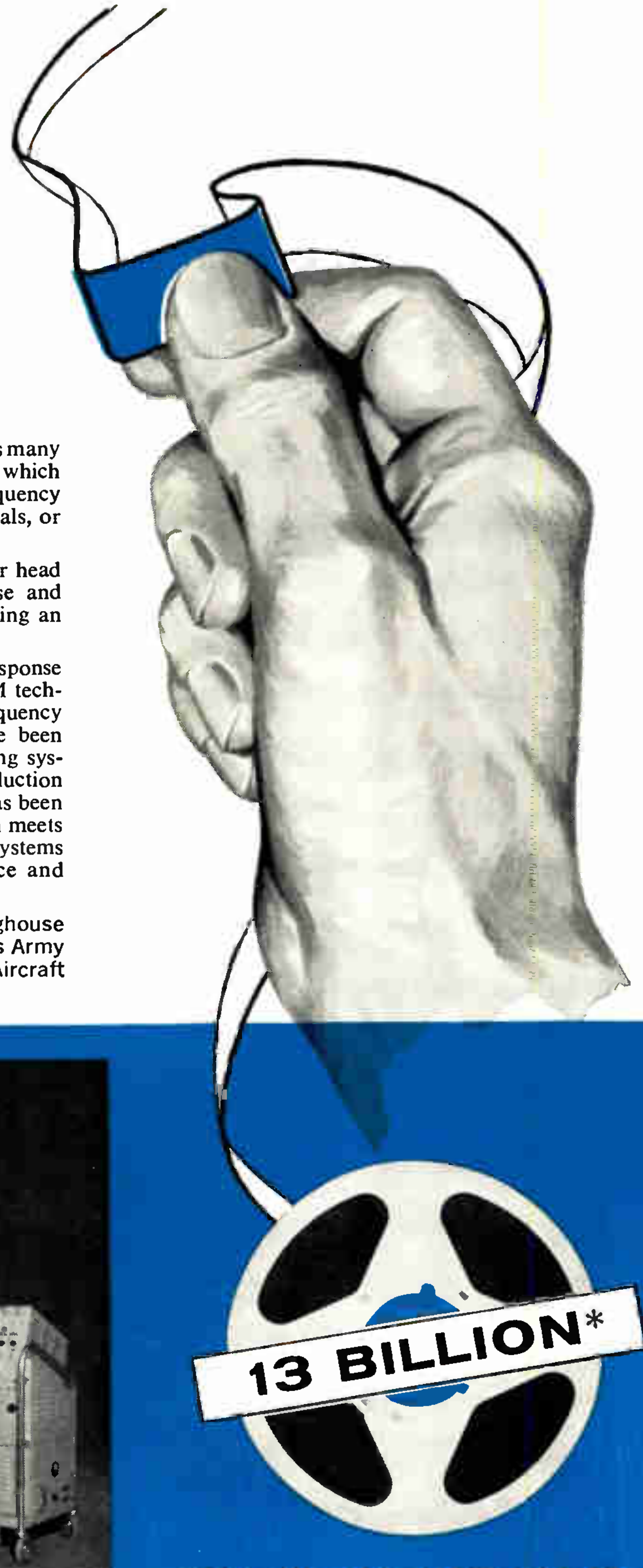
PRODUCT OF 3M COMPANY RESEARCH

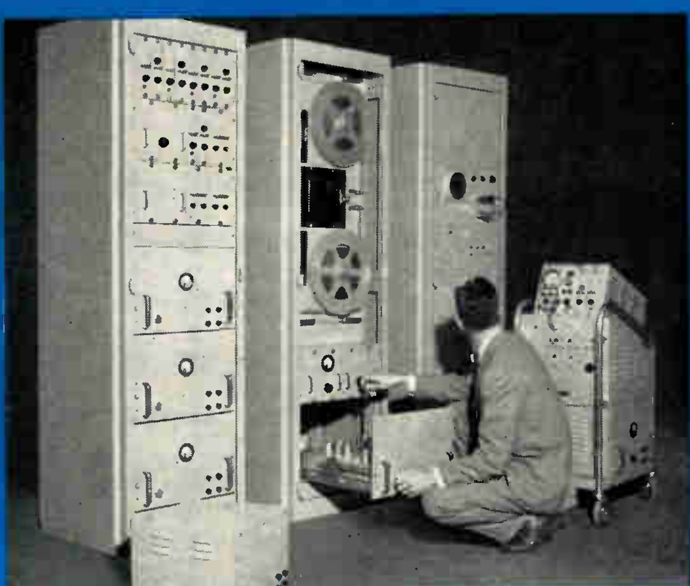
Mincom's laboratories have developed multi-channel (as many as 7 channels on half-inch tape) magnetic systems, in which each channel is capable of directly recording the full frequency response of radar video, t-v video, high speed data signals, or other similar types of data information.

Mincom's ten years of research have resulted in greater head definition, higher signal-to-noise ratios, uniform phase and frequency response—especially for organizations desiring an up-to-date system suitable for problems of the future.

Mincom's direct frequency recording is utilized for response from 200 cycles to 2.5 megacycles, and in addition, FM techniques can be used on each channel for extension of frequency response down to DC. Many special techniques have been developed to provide practically an error-free recording system, i.e., wow and flutter compensation, drop-out reduction devices, high accuracy speed control, etc. Equipment has been developed for both airborne and ground-base use which meets military requirements for ruggedness. A number of systems are in use and have proved to excel in performance and reliability.

Complete systems have been delivered to: Westinghouse Electric and Manufacturing Company • United States Army Signal Corps • United States Air Force • Temco Aircraft Corporation.





*"This reel contains 13 billion data bits of stored information."

Write for complete specifications

PRODUCT OF 3M COMPANY RESEARCH

Mincom DIVISION MINNESOTA MINING & MANUFACTURING COMPANY

2049 South Barrington Avenue, Los Angeles 25, California

Formerly Electronics Division, Bing Crosby Enterprises, Inc.

Circle 39 on Inquiry Card, page 107

Circle 40 on Inquiry Card, page 107

ELECTRONIC INDUSTRIES
& TELE-TECH

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

Electronic Industries in 1958

Beginning in January, 1958, engineers in the electronic industries will be subjected to a vastly increased amount of printed data presented from both a news and a technical viewpoint. Electronic publishers appear bent on weekly or bi-monthly issues. Without discussing the pro and con of these developments, we nevertheless believe that we should make a statement at this time to clarify our own future publishing aims and objectives.

We do not contemplate an increase in publication frequency. Obviously, as a monthly publication, we will be restricted in the timeliness of the news we publish. We will therefore modify our news presentations so as to present to our readers the complete summaries of the most important electronic happenings of each month.

Our technical articles will continue to be carefully screened. The aim here will be to publish only material having a long reference interest. The articles will be edited with a view to giving engineer readers the most rounded package possible on any given subject. Thus presentations will be more mathematical and will contain an increased number of engineering diagrams, charts, etc., to fully describe the topic at hand. In the future, too, honorariums to contributors will be on an "acceptance" rather than on a "when published" basis.

Coverage by International Electronic Sources will be both enhanced and increased. This section brings to engineers abstracts of important electronic articles appearing in publications throughout the world regardless of any competitive connotation. Copies of foreign publications are airmailed to our editorial offices as soon as published. The technical data is then abstracted and published in the current issue of ELECTRONIC INDUSTRIES. In nearly every case a report on each article is made to readers within thirty days after original publication. The reader services provided by International Electronic Sources are being expanded to encompass every important electronic engineering article published with particular emphasis on "behind-the-iron-curtain" material.

As the electronic industries expand, the need for "operations" type engineers becomes more and more important. In short, requirements now call for engineers to design and develop the equipment and systems necessary to perform an industrial function. As these are developed there will also have to be electronic engineers to operate and maintain them. Electronic Operations, the systems engineering section of ELECTRONIC INDUSTRIES, was originated to meet the requirements of the latter in January of this year. In 1958, editorial presentations in Electronic Operations will be continued and expanded!

This month heralds the appearance of a new section in ELECTRONIC INDUSTRIES — "Professional Opportunities." Again, this section is being introduced in the interest of providing a complete service for our readers. Editorially the section will contain information of professional interest to engineers as it pertains to employment and to matters of social and economic interest.

All in all, in ELECTRONIC INDUSTRIES, our aim will be to provide a publication of maximum reader service. By summarizing the important news events, predicting the things to come, providing technical material treated in depth, discussing social and economic problems as they pertain to the engineer, and informing readers as to where other material of interest is published, we feel that a great forward step in this direction will be taken.

Other sections can be added to the magazine in time to come too! These will be formed from the expressions of interest voiced by our readers and not by the "crystal-gazing" of ivory tower editors. If you have any suggestions of new features or editorial sections that you would like to see in ELECTRONIC INDUSTRIES we would greatly appreciate hearing from you!

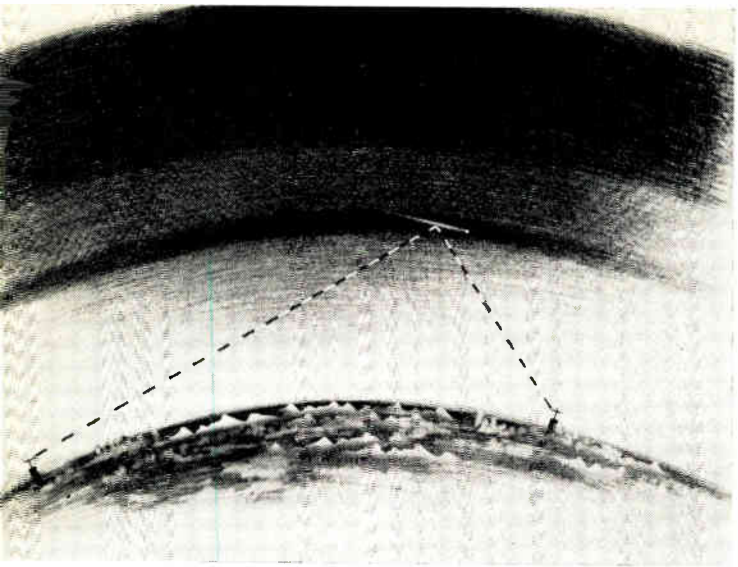


Fig. 1: Sketch of oblique meteor burst propagation.

VHF Propagation By Ionized Meteor Trails

Presented at 1957 WESCON

A two-year research program at Stanford Research Institute has demonstrated the possibilities of VHF communications by reflection from ionized meteor trails. An 820-mile link is now operating, and tests indicate possible use up to 1400 miles. In this report the authors summarize basic data for the design of a successful Meteor Burst System.

By W. R. VINCENT, R. T. WOLFRAM, B. M. SIFFORD, W. E. JAYE, & A. M. PETERSON
Stanford Research Institute
Menlo Park, California

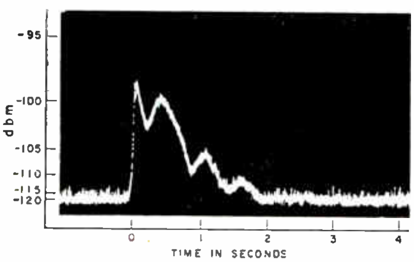


Fig. 2: Signal from specular under-dense trail with no wind distortion.

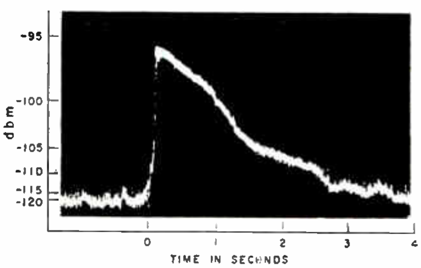


Fig. 3: Signal from specular over-dense trail with wind distortion.

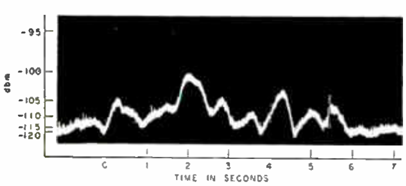


Fig. 4: Signal from non-specular over-dense trail with wind distortion.

Part One

STANFORD Research Institute has made a series of measurements in the field of radio signal propagation supported by ionized meteor trails.[1] The data presented here summarize approximately two years' findings and provide a basis for determining design parameters of the Meteor-Burst communications system to be described in Part Two of this article.

Test Facilities

Owing to the limited level of received signal when low-power transmitters (1 to 2 KW) are used, low-noise receiving sites are essential to meteor-burst communications. A receiver has been built on such a site in the hills behind Stanford University and used for the collection of data presented in this report.

Receiving equipment consisted of various types of antennas (Yagi, 30-ft co-linear arrays, 61-ft parabolic dish, and dipoles), low-noise preamplifiers, and standard communications receivers set up as IF amplifiers. Television stations transmit in the

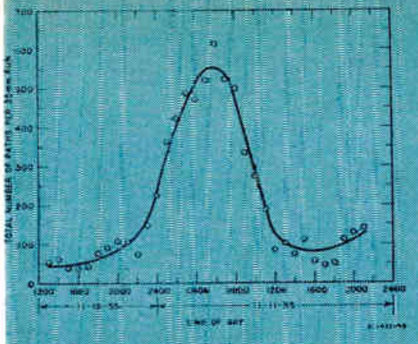


Fig. 5: Diurnal rate over oblique path.

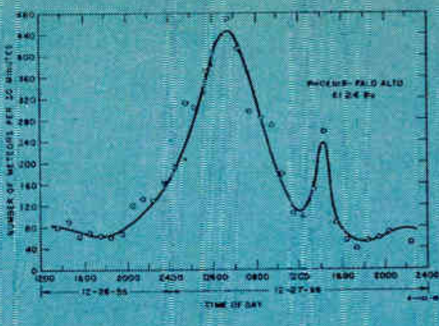


Fig. 6: Diurnal rate showing effect of shower.

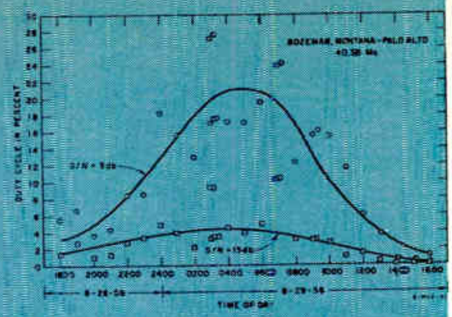


Fig. 7: Duty cycle versus time of day.

frequency range usable for meteoric propagation and were therefore used extensively as remote transmitters. Transmitting equipment in use on the meteor-burst communications link between Montana State College, Bozeman, Montana and Palo Alto, California was also put to work collecting signal propagation data.

Amplitude Time Functions

Signals are reflected from ionized meteor trails very much as light is reflected from a long narrow mirror. A favorably oriented trail will produce a sudden rise in the received signal level, as illustrated in Figs. 1 and 2. Dissipation of the trail results in an exponential decrease of received signal. This is called an underdense signal.

Often the ionized trails are distorted and broken up by winds in the higher atmosphere. This causes a fading of reception (Fig. 3) which results in a specular overdense type of signal. Occasionally a trail will be oriented in a way that inhibits propagation between two chosen points. Such a trail can be moved, by upper atmospheric winds, into a position capable of supporting signals. Trails blown into a usable orientation usually continue to fade up and down until the trail is dissipated. This produces what is called a nonspecular overdense signal. An example of nonspecular overdense trail is given in Fig. 4.

An analysis of the number of each type of received signal recorded gave the following results:

Table 1

Type	Percentage of Received Signals
Specular Underdense	44%
Specular Overdense	37%
Nonspecular Overdense	19%
	100%

It is apparent that overdense trails with their variety of amplitude time wave shapes are very important to a meteor burst communications system.

Diurnal Duty Cycle

The diurnal rate of meteors entering the earth's atmosphere has interested investigators of meteoric phenomena for many years, and the literature contains many examples of diurnal rate obtained from radar data. Figs. 5 and 6 show examples of diurnal rate over an oblique path between Phoenix, Arizona and Stanford, California.

Note, in Fig. 6, the effect of an unpredicted shower at 1400 hours. Such showers are occasionally observed while propagation data are being collected. They enhance the possibility of oblique propagation. Diurnal rate data for a North-South path have consistently shown a scatter of data points with only a gradual and erratic increase in meteor rate during early morning hours. The reason for this large scatter in data for a North-South path is not yet understood.

Fig. 8: Duty cycle versus receiver decision level, showing effect of time of day.

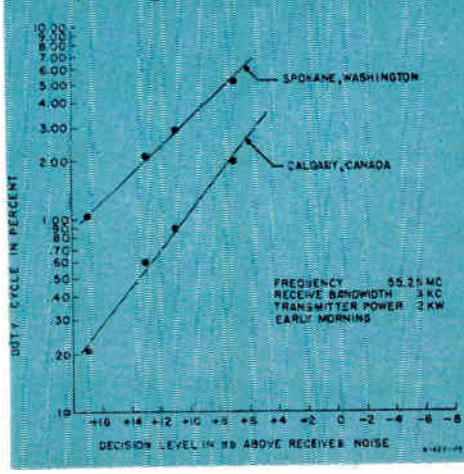
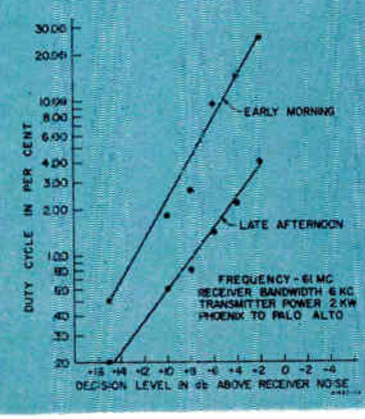


Fig. 9: Duty cycle versus receiver decision level, showing effect of change in distance.



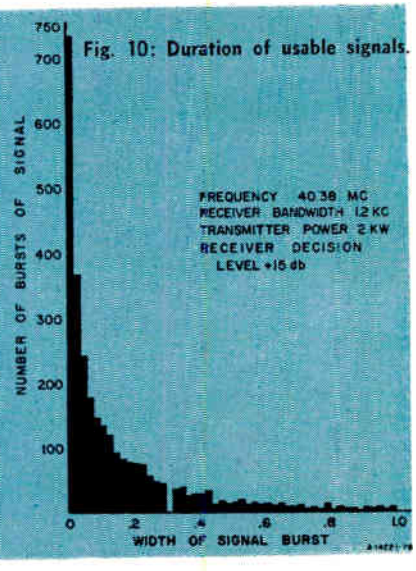


Fig. 10: Duration of usable signals.

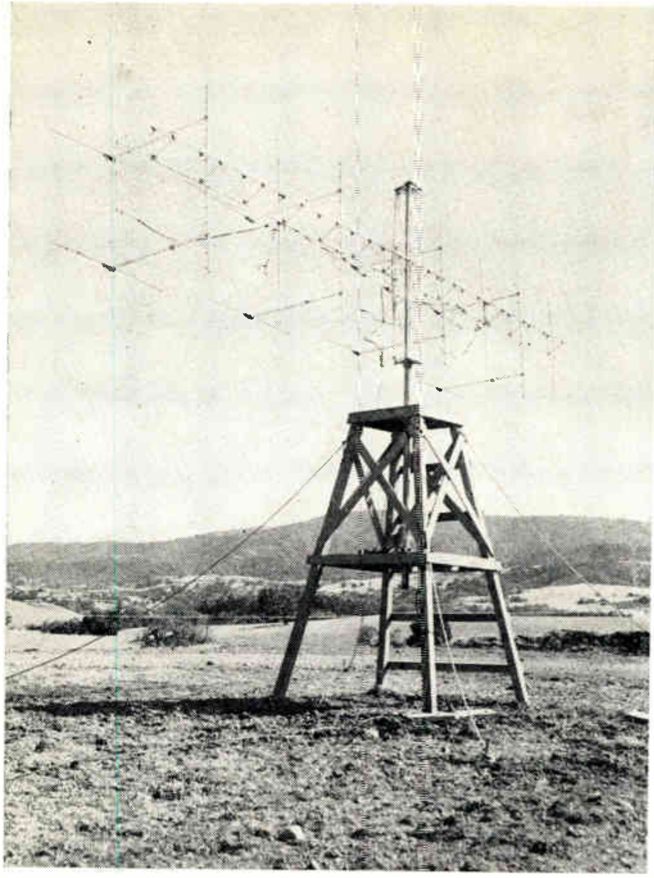


Fig. 11: Rotatable antenna array.

Meteor Trails *(Continued)*

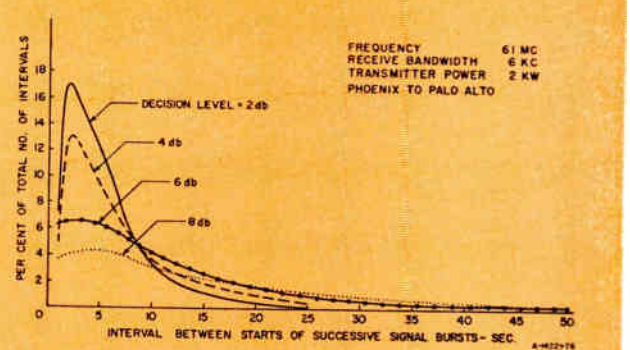
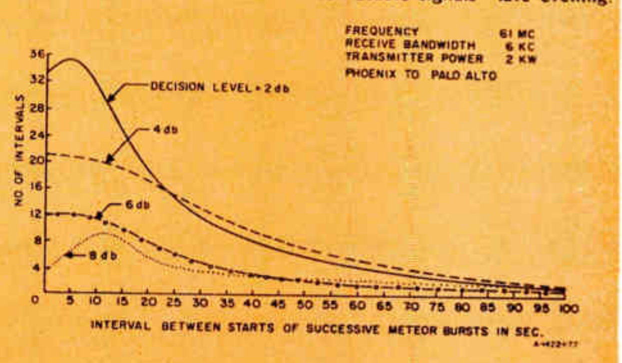


Fig. 12: Distribution of usable signals interval—early morning.

Fig. 13: Distribution of interval between usable signals—late evening.

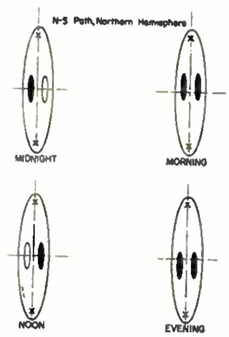


An example of the variation in duty cycle (the percentage of time a usable signal is available) throughout a 24-hour period is given in Fig. 7.

Effect of Decision Level

Duty cycle is perhaps the most important factor in the design of a communications system which makes use of ionized meteor trails. It should be pointed out here that information can be reliably transmitted only during those portions of bursts when the Signal/Noise ratio is adequate. The equipment starts the flow of information when S/N reaches a specified value, called the decision level, and stops the information when S/N falls below that level. Since finite time is required for the rise and fall of signal, the duration of transmission during a burst depends on the decision level. S/N is also contingent on transmitter power and antenna gain. Thus duty cycle depends on a combination of the receiver decision level, antenna gain, and transmitter power.

The data in Figs. 8 and 9 show results of duty cycle vs. receiver decision level measurements made



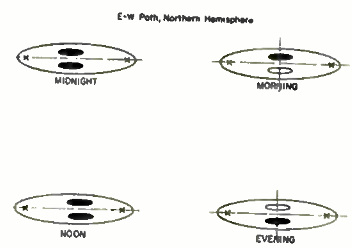


Fig. 14 (right): Favorable meteor-scatter area—spherically-uniform heliocentric distribution of parabolic meteor orbits, N-S path.

Fig. 15 (left): Favorable meteor-scatter area—spherically-uniform heliocentric distribution of parabolic meteor orbits, E-W path.

with a fixed receiver bandwidth and constant transmitter power. Fig. 8 shows how this curve changes from morning to evening; Fig. 9 indicates how the data varies with the distance between transmitter and receiver.

A 3 db increase in transmitter power or antenna gain would have the same effect on duty cycle as a 3 db decrease in decision level, hence the duty cycle vs. decision level curves can conveniently be translated to show the performance of systems requiring different threshold levels, the effect of changes in transmitter power, and the effect of various bandwidths. This can be done merely by adding or subtracting the required db change from the abscissa of the examples shown.

Interval and Duration

A frequent question—and an important one to the designer of communications equipment—is, "How long do I wait before a meteor forms a usable trail?". Since the occurrence of meteors is random in time and one meteor often supplies many usable signals (as indicated in Fig. 4), the interval between usable signals is best illustrated by the distributions shown in Figs. 12 and 13. These distributions illustrate how the interval changes from the early morning maximum in the diurnal rate to the evening minimum. Figs. 12 and 13 also indicate the effect of varying the decision level of the receiving equipment while the transmitter power and receiver bandwidth are held constant.

The duration of a meteor signal is dependent upon the size of the meteor, the speed at which it enters the upper atmosphere, its orientation with respect to transmitter and receiver, and the action of upper atmospheric winds. The net effect is to make possible a series of received signals having random duration.

An example showing the duration distribution of usable received signals is given in Fig. 10. The example shows that the signal received is likely to be one of very short duration. In fact, experience with the Stanford Research meteor-burst teletype communication system shows that the largest number of signals received are but one character in length. Fortunately the distribution also shows that signal duration of several seconds is reasonably probable. The average duration of the example shown is approximately .2 seconds.

Antenna Direction

From the studies of meteor radiants at Stanford University, Dr. Von R. Eshleman predicted that the performance of communications systems using ionized meteor trails could be improved by directing the antennas first to one side of the great circle path between receiver and transmitter and then to the other side of the great circle. Theory showed that pointing antennas along the great circle path would considerably reduce the number of meteors detected, particularly if high gain antennas were used. Figs. 14 and 15 illustrate Dr. Eshleman's prediction of North-South and East-West paths. The dark areas in these figures are so-called meteor "hot spots" or "active areas."

A series of tests were made to measure the effect of the "active areas" and to determine the extent of the off-great-circle azimuth prediction. A rotatable array of antennas was built to give a horizontal beamwidth of 20 deg at 60 MC. This array was used to receive meteor reflected signals over East-West and North-South paths from suitably located television transmitters. The antennas (see Fig. 11) were scheduled as follows (0 deg is the great circle path from Stanford to the transmitter):

Table 2

Direction	Duration of Sample
0	5 min
10 R	5 min
10 L	5 min
20 R	5 min
20 L	5 min
30 R	5 min
30 L	5 min
40 R	5 min
40 L	5 min

The sampling was repeated each hour through a 24-hr period. The number of meteors received during each period were recorded in tabnlar form from automatic counters or Brush recorder data. The data were then plotted in polar form showing the directional effects indicated in Figs. 16 and 17. An estimate of the best angle for each hour throughout a run was made and the results shown in Figs. 18 and 19.

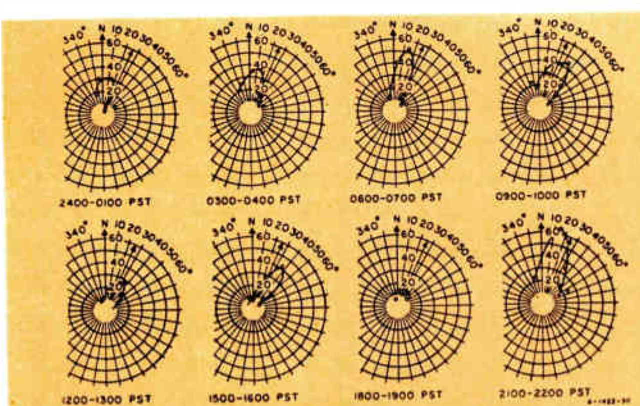


Fig. 16: Polar plots showing north-south directional effects.

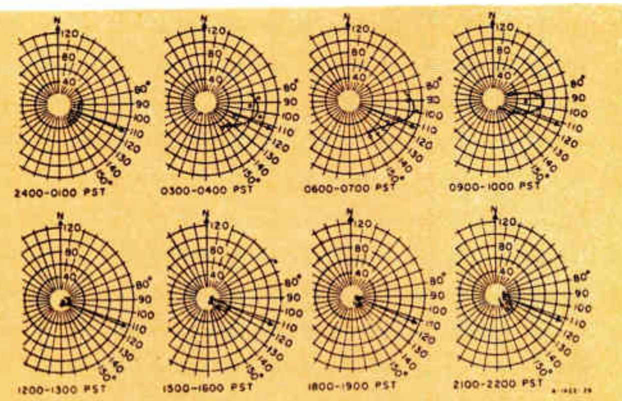


Fig. 17: Polar plots showing east-west directional effects.

The results clearly show that for an East-West path the antenna should be pointed to the south of path during afternoon and to the north of path during the morning hours. For a North-South path the antenna should be pointed to the east of path in daylight and to the west of path at night. Experimental results further indicated the off-path phenomena to be as large as 30 deg. The experimental data also appear to confirm Dr. Eshleman's prediction and tend to support the assumed spherically-uniform heliocentric distribution of meteor orbits.

Additional data displaying the extent of the off-path effect is given in Figs. 20 and 21, where the percentage increase in meteors received on the favorable side is also shown.

Fading Rates

Operation of the Stanford-Bozeman meteor burst teletype system and the examination of amplitude time records showed occasional very high signal fading rates. To study this, an oscilloscope was connected to the receiver detector and the sweep triggered each time the signal faded below a preset

(*Continued on page* 144)

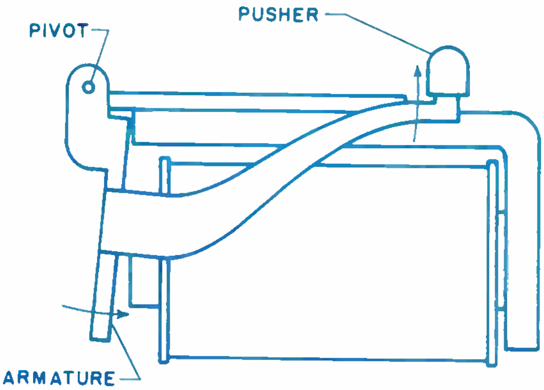


Fig. 1: Telephone type magnetic structure amplifies armature travel.

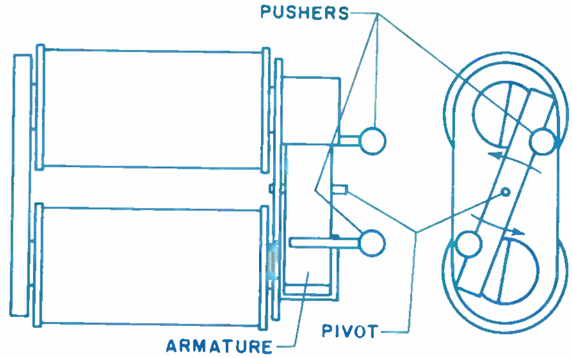


Fig. 2: Rotary armature relay suggests transistor enclosure shapes.

Design of Magnetic Circuits for Miniature Relays

Shrinking the size of relays, the designer is confronted with severe problems in achieving today's design goals. The greater efficiency of polarized relays permits relaxation of manufacturing and maintenance tolerances.

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Subsidiary of American Machine & Foundry Co.

THE age of guided missiles and supersonic flight imposes demands for still smaller relays capable of consistent performance under more extreme environmental conditions without further sacrifice of switching capacity. Only two years ago, it was believed that a relay which was able to withstand 20 G's in the frequency range up to 500 cps was by far good enough to take care of all possible requirements.

Today, the requests for the same acceleration up to 2000 cps are not unusual. There is reason to believe that we have not yet reached the end of the spiral where, for instance, the announcement of a more vibration resistant relay is followed by the request for even better performance.

The telephone type magnetic arrangement, regardless of size, has the reputation of being compartively simple to produce. (Fig. 1.) The possible movement amplification by the armature, which may produce approximately twice as much travel on its contact actuating end than above the core pole face, keeps the initial magnetic reluctance low and makes this type of design very efficient.

Telephone type structures designed into a crystal size enclosure can operate 2 SPDT contacts with approx. 8 grams NC-contact pressure each and a 0.012 in. contact gap at about one watt coil power consumption at nominal voltage. However, the inherent armature unbalance of this arrangement turns out to be a big drawback, if high operating shock and vibration performance are required.

Tests conducted on these structures indicate a possible failure free operation when accelerated at 25 G's in a frequency range up to 400 cps and 15 G's above 400 cps up to the maximum of 500 cps. The maximum shock resistance detected by testing the relays in their weakest planes, on a Haiden's shock drop tester of the spring and anvil type, was 20 G's, permitting contact openings of 100 μsec or less.

The values given here are for telephone type structures designed for good resistance to shock and vibration and able to operate a contact arrangement capable of handling 2 amps resistive load at 28 vdc for 100,000 operations minimum. Slight changes of one or more of the many variables involved in such a design will often have a strong influence on the ultimate performance of the relay and may produce rather varying results. However, the differences in performance encountered by testing basically different structures of identical size, designed with the same objectives in mind, are large enough to distinguish between them, in spite of the wide range of performances possible for one basic type of structure.

Miniature Balanced Armature

Relay structures which have to work over a vibration frequency range from 55 to 2000 cps at accelerations of 20 G's and shock values such as 50 G's or more will have to feature a strictly balanced armature, otherwise too large a force is required to compensate for amature unbalance.

Some commonly used magnetic circuit arrangements for non-polarized relays employing a balanced armature are shown in Figs. 2 through 5. The rotary armature type, Fig. 2, suggests itself for use in crystal enclosure or transistor enclosure shapes. Closer investigation and comparison with others show definite advantages of this arrangement. This leads to a rigid two-coil actuator-contact-header unit and superior efficiency.

The 3 point alignment of the armature hinge in relationship to the 2 coil pole faces presents some production problems. The solving of these problems seems to be a well spent effort, if the all-over performance of this type relay is considered. The adjustment of contacts will always be delicate on units of this size, especially so if a DPDT contact arrangement is concerned.

The initial reluctance of a rotary armature type structure in a crystal can enclosure is higher than that of the telephone type structure of identical size. The higher reluctance is caused mainly by the 2 working airgaps used in series in this setup as compared to only one on the telephone type structure. A better ratio of ampere-turns to resistance, obtained by using 2 coils in series on the rotating armature design compensates for a good part of this handicap.

A rotating armature type actuator designed into a crystal size enclosure is able to operate a DPDT contact arrangement with a 0.012 in. contact gap and 7 grams each minimum NC-contact pressure. Relays with the same contact arrangement, which were

(*Continued on page* 146)

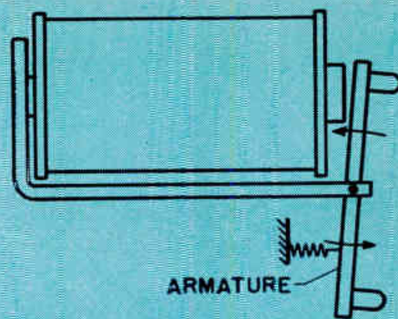


Fig. 3: Typical balanced armature design. Arrows indicate direction of motion upon coil energization.

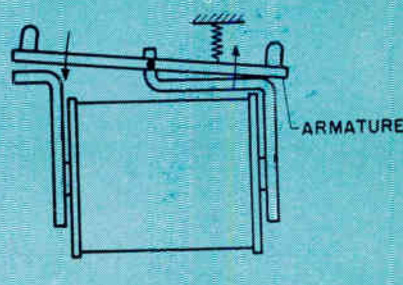


Fig. 4: Another balanced armature; this design has the spring under compression at all times.

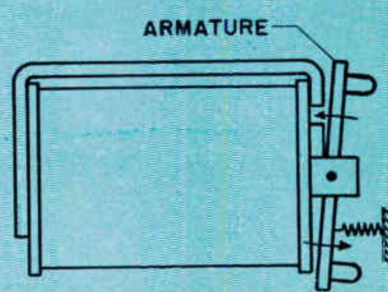


Fig. 5: A third variation of a balanced armature. Space requirements often dictate armature location.

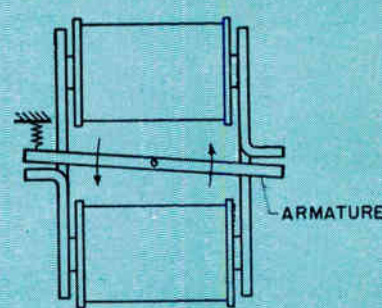


Fig. 6: This design incorporates the features of both the balanced armature and the rotary armature.

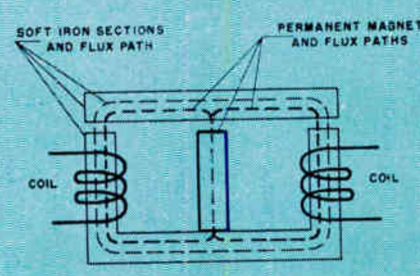


Fig. 7: Basic magnetic circuit arrangement for polarized actuator.

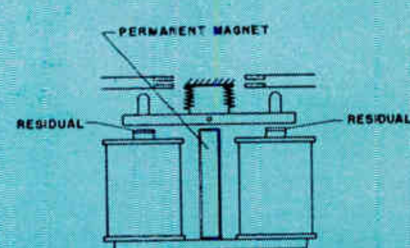
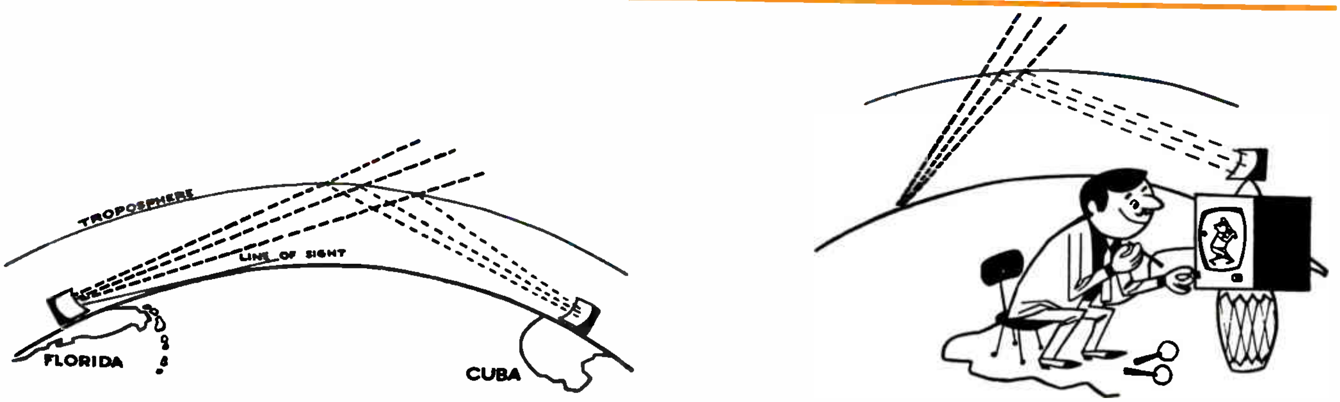


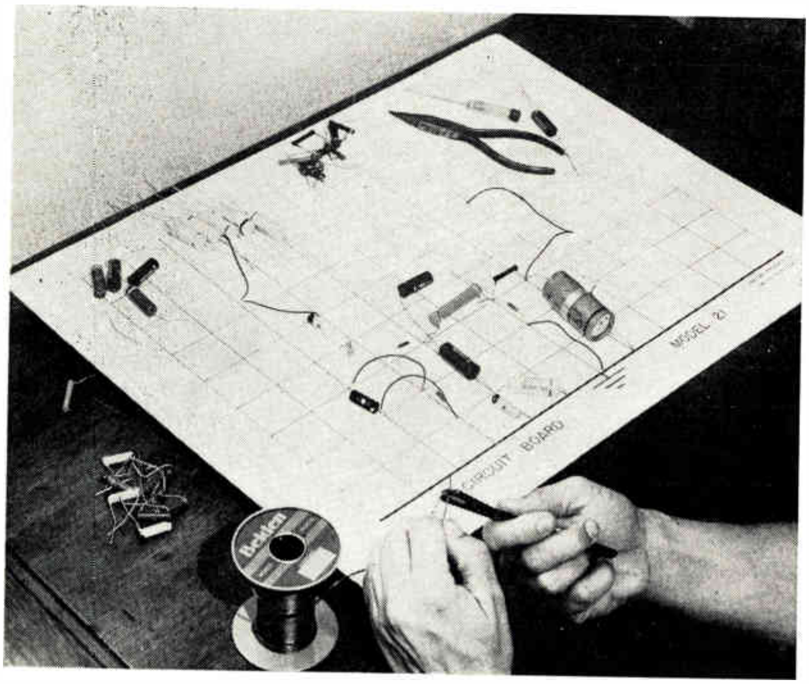
Fig. 8: Spring bias holds the armature in this polarized neutral center relay.



Mainland TV comes to Cuba via transhorizon microwave link.

Seven-League Boots for TV

THE Florida to Cuba transhorizon link has been completed, and five other major communications links using this technique are now being installed. IT&T is now bridging the Mediterranean islands of Sardinia and Minorca, providing the first direct telephone service between Spain and Italy. Other links are between Puerto Rico and the Dominican Republic, and between Spain and North Africa. The successful use of transhorizon techniques brings closer the day of worldwide TV hookups.



Elastic plastic with pockets below greatly eases lab work flow.

Clipless Clampless Breadboard

A NEW assembly technique has been developed using small cells or "pockets" of conductive material. Component leads, or the ends of jumper wires, are electrically connected simply by inserting them into the conductive cells. The result is a contact of extremely low resistance. Individual components may be replaced or reassembled without damaging leads or loosening contacts, since the only connection between components is the electrical contact through the conductive material.

One application of the new assembly method is a Circuit Board manufactured by Van-Dee Products, Laguna Beach, California. The new circuit board is made up of 130 conductive cells, into each of which four or more component leads may be inserted. The surface of the circuit board is covered with a white elastic material imprinted with a grid pattern. The grid lines serve to locate the individual conductive cells, but do not enter into the circuitry. The only exception is the line of 13 cells across the base of the grid. These cells have

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Transistorized Radiation Survey Meter[1]

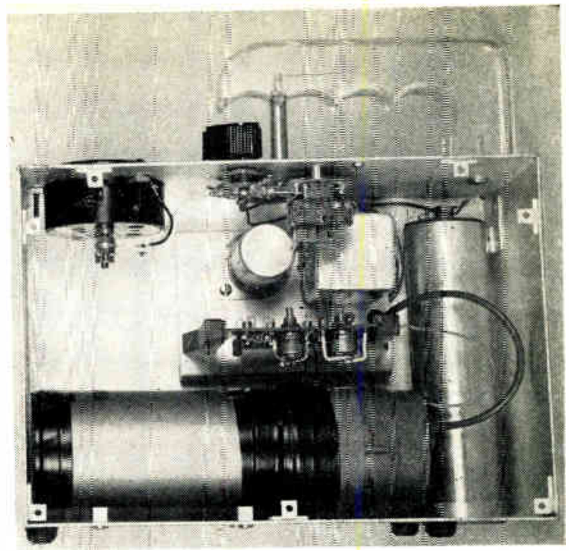


Fig. 1: Inside view of the radiation survey meter.

A SURVEY meter of extreme sensitivity has been developed at Naval Research Laboratory for laboratory source monitoring work. The instrument uses a photomultiplier and a sodium iodide crystal (½ inch x 1¾ inch) and has a gamma-ray threshold of less than 25,000 electron volts. Calibrated in counts per second, the meter's most sensitive range is about 250 counts per second full scale.

Except for the photomultiplier tube, the instrument is completely transistorized, including the high-voltage power supply for the photomultiplier. Since there is no need for filament power or high-voltage "B" batteries, the entire power requirements can be met by two standard flashlight cells. The easy replacement of these cells makes them attractive for field instruments.

Threshold

The gamma-ray threshold level is 25 kev. This limit is set by photomultiplier noise rather than by any limitation of the amplifier. The amplifier gain can be increased considerably before amplifier noise becomes troublesome. In a similar application, this amplifier was preceded by another two-stage amplifier having an additional gain of 20 times with no trouble from transistor noise.

Full-scale calibration is 250 counts per second with scale multipliers of 1, 2, 4, 10, and 20 times being provided. The maximum counting rate is thus 5000 counts per second. This corresponds to approximately 1.25 mr/hr measured with a radium source.

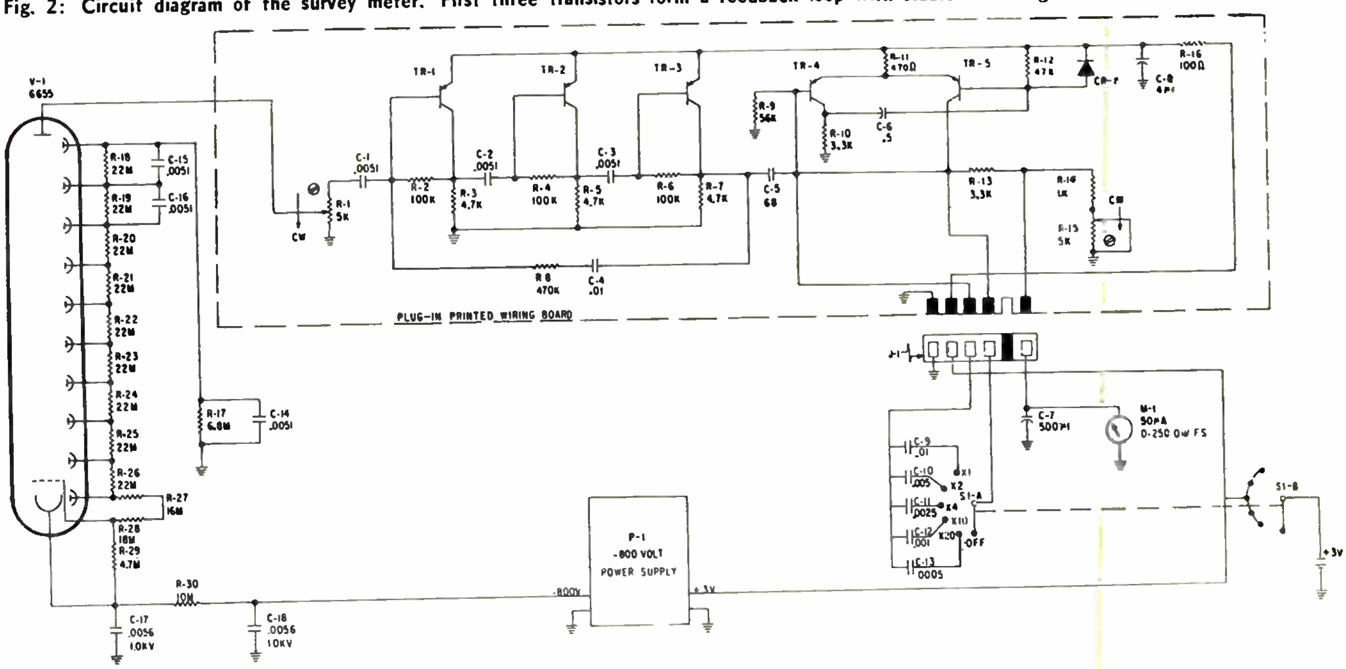
Detector

The scintillation detector comprises a canned ½-inch x 1¾-inch sodium iodide crystal with a packed magnesium oxide reflector, the crystal being optically coupled to a Type 6655 photomultiplier. Pulses from the photomultiplier are amplified by a three-stage amplifier and fed to a count-rate meter consisting of a monostable multivibrator. Range switching is accomplished by switching the timing capacitors in the count-rate meter.

Fig. 1 shows the interior arrangement of the component parts of the meter. The scintillator-photomultiplier assembly is in the lower part of the case. The sodium iodide crystal is at the left end of the assembly and is coupled to the end window of the photomultiplier

(*Continued on page* 160)

Fig. 2: Circuit diagram of the survey meter. First three transistors form a feedback loop with stable current gain of about 200.



By RICHARD B. HURLEY
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Transistor Data For Logical Circuit Design

Adequate circuit design information must include variations in characteristics with temperature, bias, interchangeability, age, radiation, etc. Essentially, the problem is whether an inadequate, oversimplified equivalent circuit should be adopted or a complicated but widely useful circuit be selected.


R. B. Hurley

The electrical properties of a transistor, from a circuit viewpoint, are significantly more complex than are those of a vacuum tube. Because of these complexities, it is questionable whether specification philosophies commonly employed for tubes are even applicable to transistors. The small-signal parameters of a tube are generally specified in terms of a relatively simple equivalent circuit, and only a very few additional limitations and large-signal conditions are listed. A similar procedure is frequently used for transistors, but such specifications often appear inadequate for satisfactory circuit design.

Tube-Transistor Data

A given vacuum triode may be sufficiently delineated for a wide variety of problems by the following characteristics (ignoring heater requirements):

1. Maximum allowable plate dissipation.
2. Maximum allowable plate voltage.
3. Open circuit dynamic voltage gain.
4. Dynamic output (plate) resistance.
5. Three interelectrode capacitances.

Similarly, a transistor is often specified by the parameters and properties listed below:[1]

1. Maximum collector dissipation at a stated ambient temperature (P_{cm}).
2. Maximum collector-base voltage for emitter open (V_{cm}).
3. Collector current for emitter open (I_{co}).
4. Three dynamic leg resistances (r_e, r_b, r_c).
5. Short-circuit current gain (α).
6. Collector-base barrier capacitance (C_c).
7. Alpha cutoff frequency ($f\alpha$).

Since the transistor, even at low frequencies, has a finite imput impedance and internal feedback ratio, and since thermal diffusion effects result in signficant transit times, it is natural to expect a few more specifications for transistors than for tubes. This "small" added complexity in itself is not the chief concern here. The questions, rather, are whether or not the data implied above are of the correct form and are adequate in scope to allow for logical circuit design.

General Problem

Adequate circuit design information for a device such as the transistor encompasses all parameters and characteristics pertinent to its performance. Furthermore, the variations of these characteristics with changes in temperature, with changes in biases (voltages and currents), with interchangeability (distribution of parameters), with age, with radiation exposure, etc.[2] must be known and specified if they are significant.

The problem is to determine which characteristics truly and completely described the electrical performance of transistors and what variations in these characteristics are important.

Maximum Ratings

Frequently a manufacturer specifies a maximum power dissipation rating for a given transistor at a particular ambient temperature. In addition, he may furnish a derating curve or formula for increased temperature operation.[3] Such information is generally "understood" by the applications engineer. The data, however, may be inadequate and of the wrong forms for truly efficient and safe design. It would appear more fundamental and generally useful to supply a maximum allowable junction temperature, a thermal resistance from the junction to some external point such as the case or a stud, and a thermal time constant.[3, 4, 5] The data in these forms may not be as familiar to an electronics engineer, but once he is acquainted with their usefulness, improved design may result.

The junction temperature appears to be a true limitation to reliable transistor performance, whereas the power dissipation is simply instrumental in raising temperatures. The thermal resistance is required in order to determine the rise in junction temperature for a given dissipation. The thermal impedance or a thermal time constant allows for the effects of a given duty cycle to be evaluated. In addition, thermal resistance or impedance is necessary to design a circuit economically but safely within thermal runaway limits.[6] In some devices or for some applications, of course, thermal data from more than one junction and to more than one external point may be required.

Breakdown

Maximum voltage ratings normally refer to a "breakdown" of a junction. Again the true limitation is probably a thermal one. Since, however, a breakdown voltage may lead to a large dissipation and temperature rise and since a breakdown represents a severe nonlinearity, its occurrence is fundamentally important.

Junctions in general may exhibit different kinds of breakdowns. A junction may have a voltage breakdown due to a Zener effect (field emission), an avalanche or Townsend effect (secondary emission), an effect of proximity to another junction (punch-through), or a surface effect (nonlinear or "mushy" surface).[4, 7, 8, 9] Furthermore, because of avalanche and transistor action or interplay between two junctions in close proximity, a given transistor may have a variety of breakdowns at each junction.

Consider, for example, the collector-base junction of a transistor in which all breakdowns are due to avalanche multiplication in the barriers or depletion layers. If surface leakages are neglected, at least three distinct collector breakdowns exist.[4, 7, 8, 9] If the emitter terminal is left open and the collector is reverse-biased,[9]

$$I_C = I_{CO} \cong M_C I_{CO}', \qquad (1)$$

where I_{CO}' = the low-voltage collector saturation current (emitter open),

and M_C = the collector avalanche multiplication factor (a function of the collector-base potential).

Here breakdown occurs at a voltage that yields $M_C = \infty$. If now the emitter is shorted to the base,[9]

$$I_C = I_{CS} \cong \frac{M_C I_{CO}'}{1 - \alpha_I \alpha_N M_C}, \qquad (2)$$

where I_{CS} = collector-base saturation current,

α_I = inverted alpha (emitter collecting),

and α_N = normal alpha (collector collecting).

Breakdown now occurs at a lower voltage for which

$$M_C = \frac{1}{\alpha_I \alpha_N}.$$

If the base lead is now disconnected,[9]

$$I_C \cong \frac{M_C I_{CO}'}{1 - \alpha_N M_C}, \qquad (3)$$

and breakdown occurs at a still lower voltage where $M_C = \frac{1}{\alpha_N}$.

In general, a voltage source, a current source, an impedance, or any combination of these items can be placed between the emitter and base terminals. Thus under reverse potential, other collector breakdown voltages are conceivable. Similar comments apply to breakdowns at the emitter-base junction.

It thus appears that fundamental information for a transistor type should include the nature of the breakdown (s) and data that will allow for the calculation of other breakdowns such as the avalanche multiplication factors of the junctions.

Maximum current ratings often indicate simply a current level at which the current gain has deteriorated to a prescribed value. If current levels have no bearing on reliability and involve no special I^2R heating problems, it may be possible to dispense with such a rating and incorporate the fall-off in gain elsewhere.

Leakage Currents

The fundamental diode saturation current associated with a given junction is most readily exposed by shorting the other two leads together. That is, the

(*Continued on page* 165)

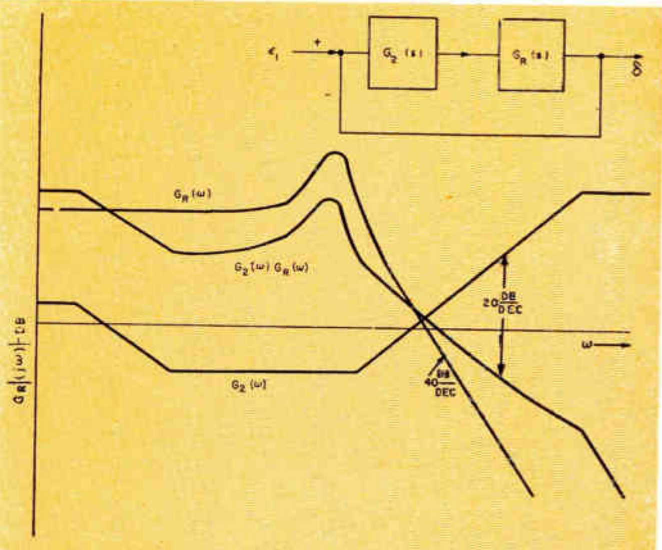

Fig. 10: Rudder loop stabilization; G_2s is a lag-lead characteristic.

Missile Control Demands Stabilization and Guidance

To score, missile angle control about 3 axes, roll, pitch, and yaw, must be accurately maintained by the autopilot; aiming signals must be developed and introduced by the radio guidance system. A hypothetical system is designed, developed, and tested; problems encountered are fully treated.

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Part Two of Two Parts

IN Part One we derived the missile transfer functions necessary to design the autopilot loops. Let us now consider the types of transfer functions necessary to stabilize these loops, starting with the rudder loop. The block diagram of this loop is repeated in Fig. 10.

Rudder Loop Stabilization

The stabilizing transfer function $G_2(s)$ is designed so the rudder loop crossover frequency is above the highest rudder resonant frequency. As shown in Fig. 10, $G_2(s)$ is a lag-lead characteristic. The lead at high frequencies is needed to provide proper phase margin for stability. The lag at low frequencies minimizes the effect of friction, backlash, etc., in the rudder actuator. With the loop crossover above the highest rudder resonant frequency, it is not necessary to vary $G_2(s)$ even though the rudder actuator transfer function varies due to changes in aerodynamic load-

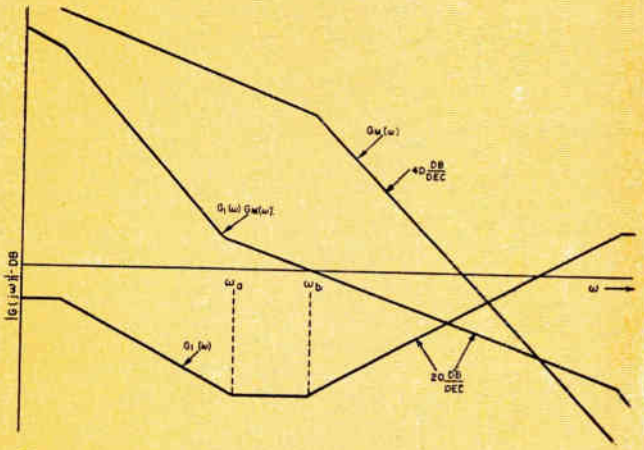
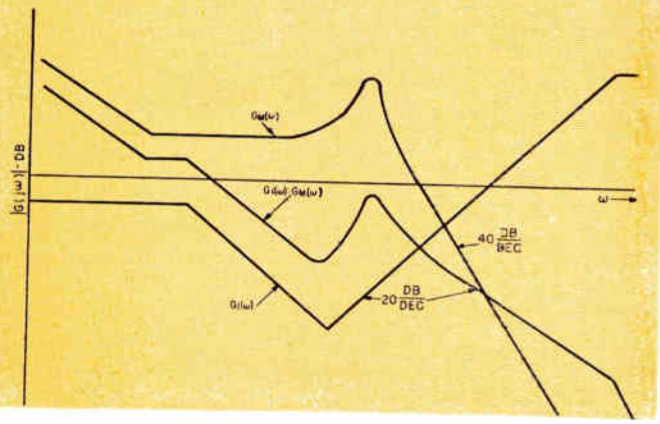


Fig. 11: (above): Roll loop stabilization; lag-lead is again used.

Fig. 12 (below): Stabilization of the pitch or yaw autopilot loop.



ing. Furthermore, variations in the actuator transfer function have relatively little effect on the response of the closed rudder loop. Even the negative hinge moments, which occur subsonically, have relatively little effect on the closed loop response, since ω_1 is much smaller than the loop crossover frequency.

Thus, since the closed loop response of the rudder loop is essentially constant, at least for small inputs, and since the crossover frequency of this loop is much higher than those of the autopilot loops, the response of the rudder loop can be neglected in discussing stabilization of the autopilot loops. In the following discussion of autopilot loop stabilization we will assume that the rudder loop has a unity transfer function. The autopilot loops are then stabilized by $G_1(s)$. The gyro gradient K_g is included as a part of $G_1(s)$.

Stabilization of Roll Autopilot

Stabilization of the roll autopilot is illustrated in Fig. 11. A lag-lead stabilizing characteristic is used here and is designed so the crossover frequency of the roll loop is considerably lower than that of the missile transfer function. The lead at high frequencies is necessary to provide sufficient phase margin for stability. The lag is required to maintain a reasonably high dc gain to reduce roll errors due to electrical drifts and mechanical misalignments. As the missile attenuation diagram varies due to changing dynamic pressure, it is necessary to vary the 2 break frequencies ω_a and ω_b.

Stabilization of Pitch and Yaw Autopilots

Stabilization of the pitch or yaw autopilot loop is illustrated in Fig. 12. The transfer function used to stabilize this loop is again a lag-lead characteristic for the same reasons as in the roll loop. In this case however, a double up-break somewhat below the missile resonant frequency ω_s is used. As varying dynamic pressure causes the missile transfer function to vary, this double break is varied to compensate. The circuit normally used to achieve this type of characteristic results in an anti-resonant dip at the frequency of the double break. This provides additional phase lead to compensate for the phase lag of the missile resonant peak when it crosses over the zero db axis.

Guidance Loop Stabilization

The radio guidance loop is redrawn in Fig. 13. As shown here, this loop includes the closed loop response $G_A(s)$ of the pitch or yaw autopilot. Before considering the stabilization of the guidance loop we must derive the lateral displacement transfer function which describes the transverse displacement of the missile's c.g.

Maneuvering of the missile is accomplished as follows: Deflection of the rudders causes a control torque to be applied to the missile. This causes the missile to turn to an angle of attack such that the aerodynamic restoring moment counterbalances the control moment. The angle of attack also results in a lift force being applied to the missile which causes a lateral acceleration. The lateral displacement is then the second integral of this lateral acceleration.

The lateral acceleration is given by

$$a_L = V\dot{\gamma} = Vs\gamma \tag{13}$$

Referring back to Eq. 7, 8, and 9, we can derive the transfer function for γ/θ by eliminating the other two variables. Thus

$$\frac{\gamma}{\theta} = \frac{\omega^1_L - \omega_D \frac{\omega_{RL}}{\omega^2_C} s - \frac{\omega_{RL}}{\omega^2_C} s^2}{s + \omega^1_L} \tag{14}$$

The 2 negative terms in the numerator of this expression result from the fact that when the rudder is deflected, initially the total lift force is in the wrong direction. From a stability standpoint this has effect only at relatively high frequencies and in most cases these terms can be ignored. With this assumption, Eq. 14 becomes

$$\frac{\gamma}{\theta} = \frac{\omega^1_L}{s + \omega^1_L} \tag{15}$$

The transfer function for lateral acceleration is obtained by combining Eq. 13 and 15. Thus

$$G_L(s) = \frac{a_L}{\theta} = \frac{V \omega^1_L s}{s + \omega^1_L} \tag{16}$$

Since displacement is the second integral of lateral acceleration, the transfer function for lateral displacement can be written

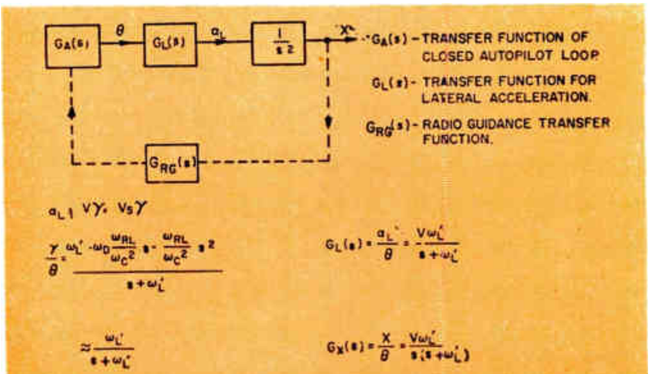


Fig. 13: Derivation of the lateral displacement transfer function.

$$G_X(s) = \frac{X}{\theta} = \frac{V\omega^1_L}{s(s + \omega^1_L)} \tag{17}$$

Typical attenuation diagram for $G_X(s)$ are shown in Fig. 14. Referring to the diagram for high q it is seen that we have a —20 db./dec. slope at low frequencies which changes to —40 db./dec. at frequency ω^1_L. As q decreases, the gain and crossover frequency also decrease. However the response of the guidance loop at low q is not important, since aerodynamic forces are too low for maneuvering anyway. Therefore this loop is designed on the basis of the high q conditions and since variation in the $G_X(s)$ transfer function is not very great in the region where maneuvering is possible, the stabilizing characteristics do not have to be varied. For high q, the

Missile Control *(Continued)*

crossover frequency of $G_X(s)$ is about 0.2 to 0.3 rad./sec.

Stabilization of the guidance loop is illustrated in Fig. 15. The attenuation diagram for $G_A(s)\,G_X(s)$ shows a break at high frequencies due to the closed autopilot loop. This is an approximation since there is actually a resonant peak at this frequency. The stabilizing network with the transfer function $G_{RG}(s)$ is a simple lead network and, as pointed out above, is not varied during flight. As the gain of $G_X(s)$ decreases at low q, the guidance loop becomes less stable but not unstable. However, since the available forces for maneuvering are small, the characteristics of the loop at low q are not important. The network which gives the $G_{RG}(s)$ characteristic is normally a part of the radio guidance ground equipment.

Peculiar Problems

A number of problems in missile control system design are not normally encountered in other control system design work. Some of these have been discussed briefly, one being the necessity of varying autopilot stabilizing characteristics in flight to compensate for variations in the dynamic characteristcs of the missile. Another problem is encountered in testing the control system. These are the 2 major system problems and will be discussed in more detail later.

Other special problems occur in the area of component design. Thus all airborne equipment must be small, compact and light. It must function satisfactorily over a wide range of altitudes and temperature ambients and must withstand the rather severe vibrations, accelerations and shocks produced by the rocket engine. Also, it must perform without surveillance or adjustment by human operators. It is very desirable that missile-borne equipment require no adjustment after the missile is shipped from the factory. If adjustments are required after the missile is mounted on the launcher, it is generally necessary that they be made remotely.

The reliability problem in missile systems is aggravated by the severe environmental conditions under which the equipment must operate and by the fact that no in-flight adjustments, repairs or replacements can be made. In general, the failure of any component will cause the whole flight to be a failure.

Even the relatively simple system described above would have a large number of components. Every one of these components must be highly reliable and must be used in a manner which optimizes reliability. One practice which aids reliability is to design the system so components normally operate well below the maximum ratings. It is also desirable to keep the control system as simple as possible, particularly the airborne part of the system.

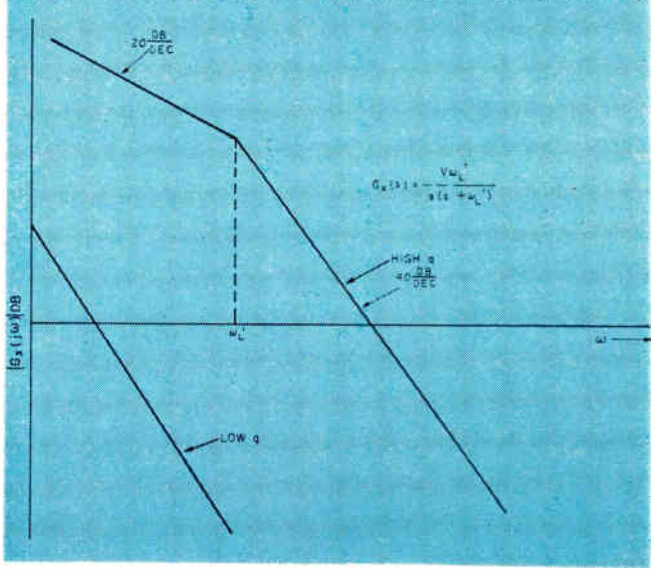
As missile control systems become more complex, in an effort to achieve higher accuracy, the reliability problem increases rapidly. Thus a compromise must be made between theoretical accuracy and reliability to optimize the probability of hitting the target. A missile of lesser accuracy which works most of the time is more valuable than one which is highly accurate theoretically but hardly ever works.

Variation of Stabilizing Characteristics

All schemes for varying the autopilot stabilizing characteristics assume that the required characteristics for the entire flight are known ahead of time for a nominal trajectory. For a successful flight, i.e., one which results in impact close to the target, the missile must fly reasonably close to a nominal trajectory which is known beforehand. Therefore, a number of measurable quantities such as time from launch, drag, or altitude can be used to adjust the stabilizing networks.

Probably the simplest method is to vary the network characteristics according to a precalculated time program. This scheme would be particularly convenient for the system described above which already requires a timer for the pitch program. The assumption that the required stabilizing characteristics are known as a function of time is quite valid for the early part of the flight, but becomes less and less accurate for later times. It is sometimes desirable to combine this method with another which gives more accurate adjustment for the latter part of the flight.

Fig. 14: Lateral displacement attenuation diagrams for high & low q.



The use of altitude measurement to adjust the networks is based on the assumption that at any given altitude the missile's dynamic characteristics are reasonably well known for a near nominal flight. The main difficulty with this method is the wide range of pressure measurement required. A similar difficulty is encountered in trying to use drag measurement for the whole flight. This approach is based on the fact that all aerodynamic characteristics are proportional to q, and thus, if one is measured, the others are automatically determined which fixes the missile transfer function. Inaccuracies also result because the variation with Mach number of all the aerodynamic coefficients is not the same.

A comparatively simple circuit for obtaining the desired frequency response variation is shown in Fig. 16. Fig. 16a shows the lag-lead characteristic with the type of variation required for stabilizing the pitch or yaw autopilot loop. A circuit for obtaining this characteristic is the parallel lag-lead circuit shown in Fig. 16b. The resulting attenuation diagram with approximate break time constants is shown in Fig. 16c. Since the lag and lead networks are in parallel, the combined frequency response is the sum of the two. For all practical purposes, the over-all characteristic is equivalent to that of the lag network at low frequencies and that of the lead circuit at high frequencies. At the frequency where the 2 cross, we get an antiresonant dip whose magnitude depends on the difference in phase shift between the 2 parallel networks. It is seen that the variation indicated in Fig. 16a can be obtained by varying resistor R_4.

All of the schemes for varying stabilizing characteristics in flight are subject to some inaccuracies and so it is necessary to design the autopilot loops to have a rather wide range of stability. There are also several other factors which make this necessary. There are manufacturing tolerances on missile dimensions, engine thrust, control components and the aerodynamic and dynamic parameters of the missile. In addition, variations in atmospheric conditions produce variations in missile transfer functions from one flight to the next. The performance of the autopilot loop must be relatively insensitive to variations in the characteristics of its component parts.

Fig. 15: Stabilization of the guidance loop; low q is unimportant.

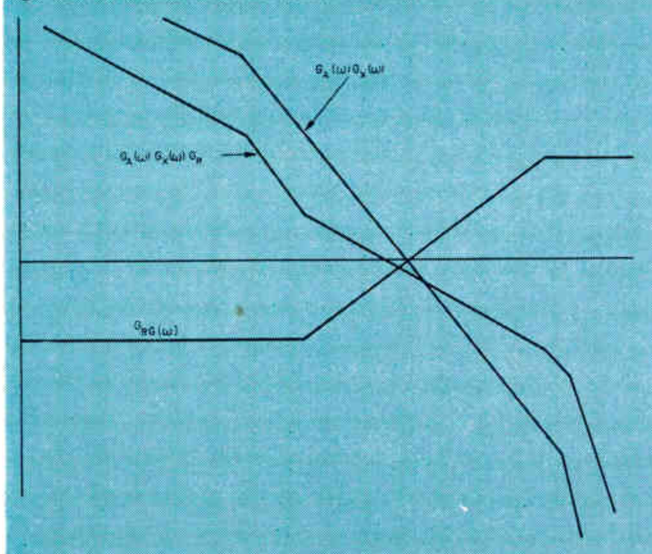
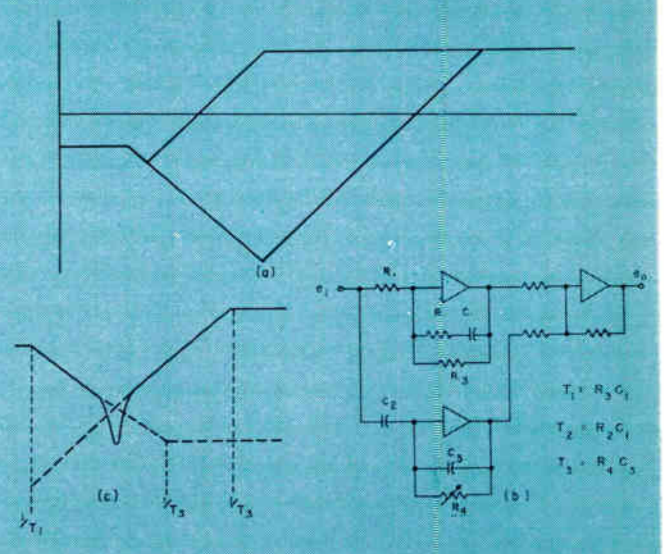


Fig. 16: Lag-lead networks for variable stabilizing characteristics.



Testing Systems

The testing of missile control systems presents a considerable problem because of the fact that the missile is an integral part of the control loops and its dynamic response must be included in any functional system test. The only complete and realistic test is the flight test, but prior to the flight test the system must be tested as thoroughly as possible in the laboratory. These tests consist of both system evaluation tests and environmental tests on components.

In laboratory development and system evaluation tests, the missile must be replaced by some sort of missile flight simulator. This is a device which has the same differential equation or transfer function as the missile in flight. Very often this simulation is accomplished by means of an electronic analog computer in which missile quantities such as path angle and missile heading angle are simulated by electrical voltages.

It is desirable to include as much actual flight equipment as possible in these tests in order to include non-linear effects such as friction, backlash, and saturation. The true effect of these phenomena can only be determined by testing the actual system.

An improvement in simulation is obtained if a platform or flight table, whose motion is controlled by the computer, is caused to reproduce the angular motion of the missile in flight. In this case sensing instruments such as gyros can be mounted on the platform and operated as part of the system. The normal procedure is to make preliminary tests using only the computer, then adding system components until the entire system is included except the missile itself.

Most simulator tests are made with missile characteristics held constant corresponding to one point on the trajectory. The entire trajectory is then covered by a series of such tests each corresponding to a different point on the trajectory. At each point, the optimium setting of the stabilizing characteristics is determined. It is necessary to do this experimentally because non-linear effects such as backlash and position and velocity saturation in the rudder actuator have a serious effect on stability. In fact, these are generally the limiting effects on the range of stability. Saturation effects are more serious in missile control systems than in other systems because of the necessity of minimizing the size and weight of the rudder actuator. After the optimum setting of the stabiliz-

(*Continued on page* 162)

Measuring Transistor "Power Gain" At High Frequencies

Maximum available power gain of the transistor becomes increasingly difficult to measure as junction transistors are applied in the HF and VHF ranges. A unique circuit has been designed which measures directly the common emitter power gain of transistors in the 40-300 MC range when driven by a resistive generator.

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THE increasing frequency range of junction transistors poses problems in measurement of transistor parameters. An important measure of the overall worth of the device is the parameter G_{av}—the maximum available power gain. This is the ratio of the maximum available output power of the transistor to the available signal power from the generator. This ratio is ordinarily expressed in decibel form. Various methods for measuring G_{av} up to 50 MC have been described elsewhere.[1]

Interpretation

Under certain terminating conditions, there are frequency ranges in which a transistor will oscillate with no external feedback loop. This makes it difficult to attach a meaning to G_{av}. These critical frequency ranges are determined by the transistor characteristics, and the circuit configuration—common base, common emitter, or common collector. Here, G_{av} must be specified under certain imposed constraints as determined by the nature of the circuit external to the transistor, so that G_{av} may have meaning.

Such constraints may be the limitation of impedance values permitted at the transistor terminations,[2c] or the use of neutralization,[4] or a combination of both.[5]

On the other hand, there are frequency intervals where a transistor may be unconditionally stable, regardless of the terminating impedances. Under these conditions, G_{av} has a definite, unambiguous interpretation.

It is the purpose of this article to describe a circuit to measure directly the common emitter G_{av} of transistors in the range 40 MC to 300 MC when driven by a resistive generator. Many transistors are stable under these conditions.[2a]

VHF Test Set

The test set, Fig. 1, receives r-f power from an external signal generator at terminals J_{IN}. The impedance looking into J_{IN} is 50 Ω which properly terminates many HF and VHF signal generators.

The magnitude of the generator resistance R seen by the transistor can be varied over a wide range (say 10-500 Ω) by means of plug-in resistors, R_o. These resistors are the HFR type (IRC) with the leads cut down to 3/16 in. length to minimize inductive effects. A special socket was made to receive these resistors in order to keep the external shunt capacitance as well as the capacitance from the resistor to ground at a low value.

No attempt was made to incorporate a number of these resistors in a switched assembly because of the error which would result from the additional parasitic capacitance and inductance.

A conjugate match was not provided in the input circuit in order to keep the circuit and circuit adjustments as simple as possible. A conjugate match would have provided an increase in G_{av} over that obtained with a magnitude match in the order of a decibel or less in the case of unconditionally stable transistors.[1a, 2a]

The 1-Ω resistance, R_3, is composed of ten 10-Ω. ½-w. composition resistors connected in parallel and

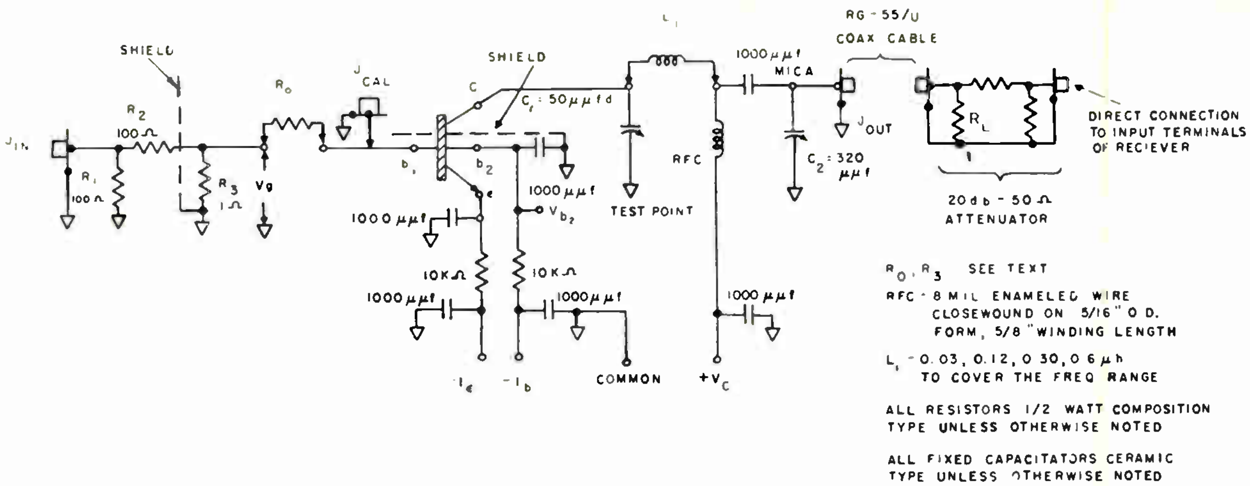


Fig. 1: Power gain test set. External signal generator is connected at J_{in}

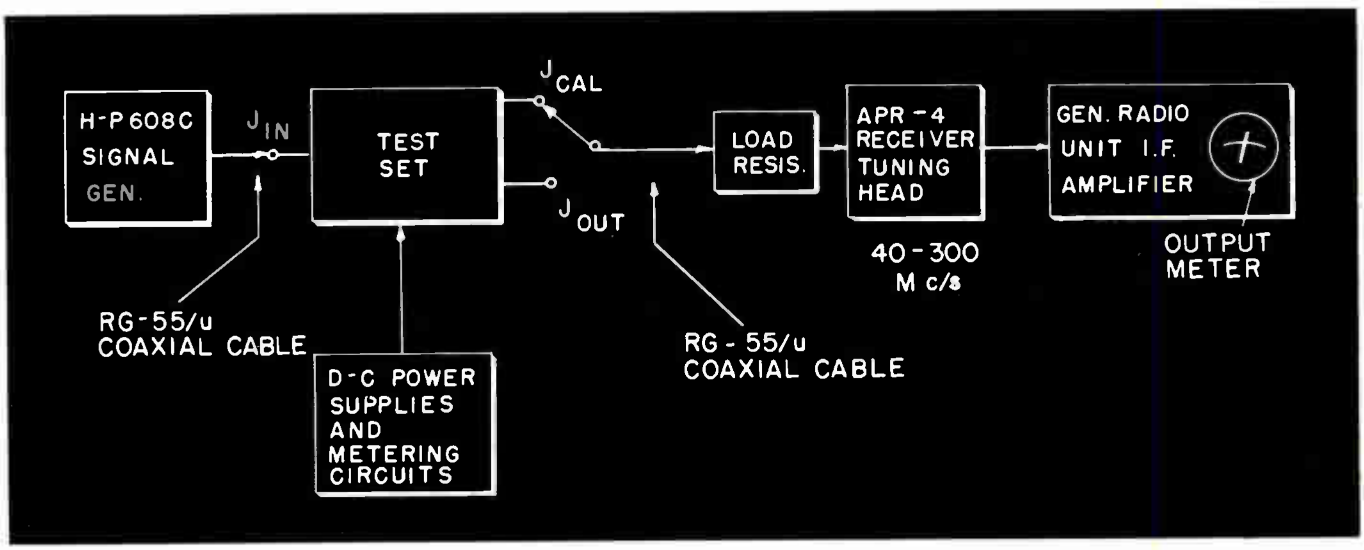
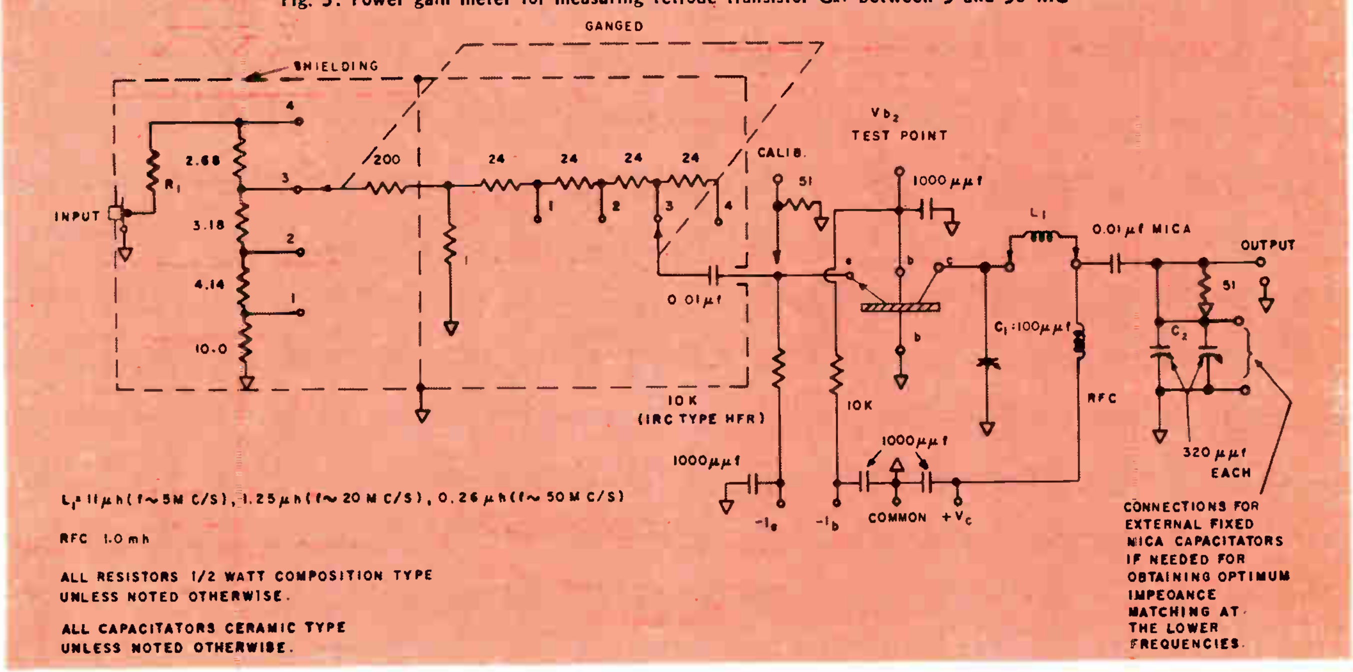


Fig. 2: Additional equipment which is used with the test set to make transistor measurements

Fig. 3: Power gain meter for measuring tetrode transistor G_{av} between 5 and 50 MC



arranged radially above a ground plane about one common connection point. With individual resistor leads of 3/16 in. or less, the reactive part of the composite resistance is kept to a negligible value. The effective generator resistance, R_g, is then 1 Ω plus the value of R_o.

A conjugate match is provided at the transistor output terminals, by means of the pi network C_1, L_1, and C_2. The r-f power developed by the transistor (as well as the available input signal power to the transistor) is delivered to the load resistance R_L. This resistance is a standard 20 db-50 Ω coaxial type attenuator. The attenuator insures a satisfactory isolation of the frequency dependent receiver input impedance and R_L.

The capacitor C_2 controls the magnitude of the conductive part of the reflected load admittance, while C_1 controls the susceptive part. The inductance L_1 is of the plug-in type to allow tuning over the frequency range in several overlapping bands.

The power lost in the output network is in the vicinity of 1-2 db, depending upon the frequency, the inductance and Q factor of the coil, and the impedance transformation ratio.

All r-f connections to the test set are made with 53-Ω coaxial cable, RG-55/U, and all cable connectors are of the BNC type, which allows cable switching to be made quickly and easily.

Measurement

Additional equipment required to use the test set is shown in block diagram form, Fig. 2. This equipment includes a Hewlett-Packard signal generator, Model 608C, the necessary dc power supply and metering circuits for the transistor, and a receiver capable of tuning over the desired frequency range.

Two tuning units, TN-16 and TN-17, from the radar search receiver APR-4, serve as front ends for a General Radio 30 MC unit i-f amplifier, Model 1216A. This amplifier is well suited for this purpose, as it is equipped with a 10 db/step, 7-step attenuator as well as an output meter M with a 0-10 db scale.

The signal generator is set to the desired test frequency, a 51-Ω resistor inserted for R_o, and the load resistance R_L connected to J_{cal}. The receiver is tuned to the test frequency and adjusted to give maximum meter deflection at M. The attenuator in the signal generator is reduced until the output meter reads 0 db.* This meter indication along with the step attenuator setting and the signal generator attenuator setting corresponds to the reference available signal power for all subsequent measurements at this particular frequency.

The transistor is inserted in its socket, biased properly, and the load resistance R_L connected to J_{out} in order to measure the power developed by the transistor. The inductance L_1 is chosen to provide a resonant circuit in the pi network. The capacitors C_1 and C_2 are adjusted to produce a maximum indication at M.

The output power is then maximized again by varying the value of R_g. When R_g is not equal to 52 Ω a correction term must be applied to the indicated output level to compensate for the change in the available signal power from the transistor generator.

Correction Factor

The available power from the generator is

$$P_{av} = \frac{V_g^2}{4R_g} \qquad (1)$$

where V_g = voltage drop across R_g.

R_g = effective generator resistance = $R_o + 1\ \Omega$

The reference available power level when $R_o = 51\ \Omega$, $R_g = 52\ \Omega$ is $P_{av_{52}} = \frac{V_g^2}{4(52)}$ and with V_g = constant

$$P_{av_{52}} = \frac{K}{52}. \qquad (2)$$

Thus the actual available signal power with $R_g \neq 52\ \Omega$ is

$$P_{av_{R_g}} = \frac{K}{R_g} \quad \text{or}$$

$$\frac{P_{av_{R_g}}}{P_{av_{52}}} = \frac{52}{R_g}. \qquad (3)$$

Thus in the case that $R_o = 24\ \Omega$, $R_g = 25\ \Omega$ then

$$\frac{P_{av_{25}}}{P_{av_{52}}} = \frac{52}{25} = 2.08 \text{ or in decibel form} \qquad (5)$$

$$P_{av_{25}}\ (\text{db}) = P_{av_{52}}\ (\text{db}) + 3.2\ \text{db}.$$

It is necessary to subtract 3.2 db from the final, indicated, value of G_{av} in db to get the correct G_{av} in db when using $R_g = 25\ \Omega$. Table I shows the correc-

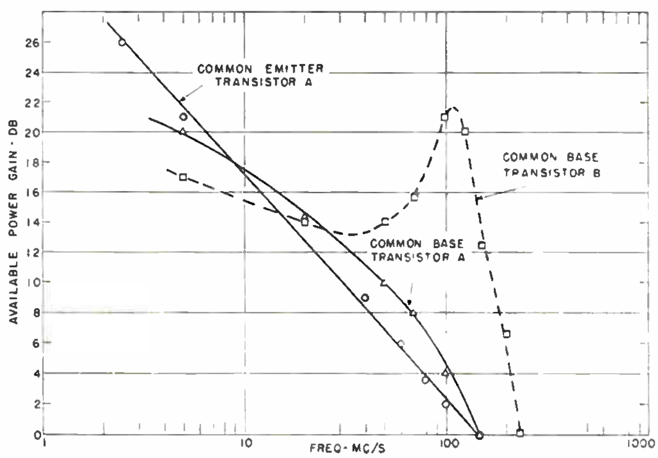


Fig. 4: Transistor available power gain as function of frequency

tion terms for different values of R_o which must be added (with due regard to sign) to the final, maximized db reading at the transistor output.

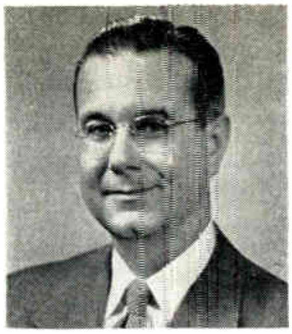
Power Gain Meter

A power gain meter suitable for measuring the common base G_{av} of tetrode transistors between 5 MC and 50 MC is shown in Fig. 3. Many transistors are stable in this configuration over this range.

The transistor is again fed from a resistance generator, and is likewise provided with a conjugate match at the output. Because of the lower frequencies involved, a constant available power pad was made

(Continued on page 167)

Howard H. Brauer
Chairman of the Board



Dr. Christopher E. Barthel, Jr.
President

John S. Powers
Secretary

J. H. Enenbach
Exec. Vice-President

Preview of the

NATIONAL ELECTRONICS CONFERENCE

Three-day conference of technical sessions and product exhibits is expected to attract more than 10,000 engineers and scientists to the Hotel Sherman, Chicago. Conference opens Oct. 7.

The top electronic show of the Midwest, the 13th Annual National Electronics Conference, opens its doors at the Hotel Sherman in Chicago on Oct. 7. The three-day conference, which is expected to attract more than 10,000 engineers and scientists, will feature a program of 101 technical papers and displays by close to 250 exhibitors.

The conference is being sponsored by the Illinois Institute of Technology, AIEE, IRE, and Northwestern and Illinois universities, in cooperation with Notre Dame, Purdue, Michigan State, Michigan, and Wisconsin universities, Electronic Industries Assoc. (RETMA), and Society of Motion Picture and Television Engineers.

President of this year's conference is Dr. Christopher E. Barthel, Jr., assistant director of Armour Research Foundation of Illinois Inst. of Technology. Chairman of the board is Howard H. Brauer and exec. vice-pres. is Joseph H. Enenbach.

The technical papers program, featuring 101 papers, has more than 80 papers devoted to the latest developments in transistor and computer research, electronic components reliability in extreme environments, and other areas of research.

One of the highlights of the conference will be a tutorial session on Oct. 7th on radio astronomy, a subject of particular interest this year in view of the International Geophysical Year studies. Three papers will be presented to provide electronic engineers and others in related fields a basis for better understanding of research conducted during IGY. The speakers will be R. J. Coates, of the Naval Research Lab., on "Interpretation of Experimental Results"; J. G. Bolton, California Inst. of Technology, on "Radio's Contributions to Astronomy" and A. Maxwell, Harvard Radio Astronomy Station, Ft. Davis, Tex., on "Solar Emissions from the Sun."

A second tutorial session, titled "Solid State," will inform engineers of new developments in solid state physics. Speakers at this session, on Oct. 8th, will be A. E. Slade, of A. D. Little, Inc., on "Superconductivity and its Applications to Electronic Industry;" H. F. Ivey, Westinghouse Electric Co., on "Electroluminescence," and K. H. Butler of Sylvania Electric Products, on "Luminescence in Solids."

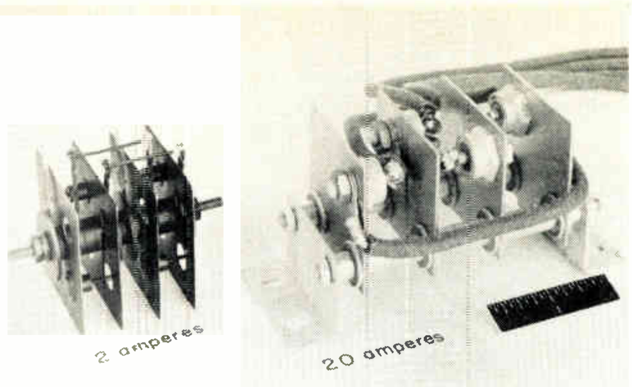
The technical sessions at the opening day's sessions will be concerned with transistor circuits, communications, servomechanism applications, audio, semiconductor devices, microwaves and circuits.

Topics at the Oct. 8 technical sessions will include transistors and transistor applications, microwaves (session II), electronic components, servomechanism theory, computers, and radar and radio navigation.

At the third session, on Oct. 9, the sessions will cover instrumentation, electron tubes, circuit theory, magnetic amplifiers, and network synthesis.

Advance registrations are being accepted. A $3 registration fee covers attendance at all technical sessions. The special advance registration rate of $20.50 covers all luncheons, the NEC annual party on Oct. 8, and the technical sessions.

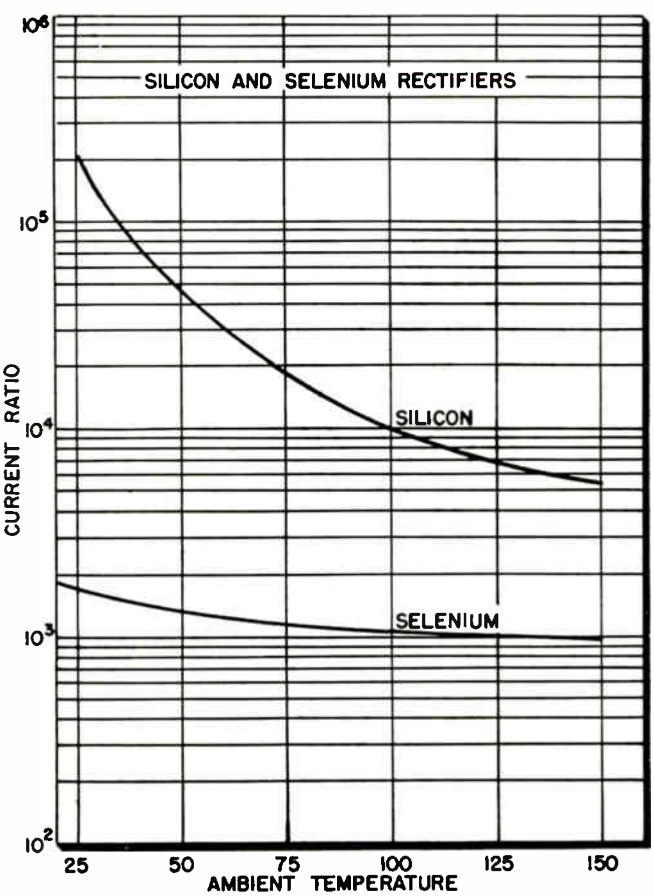
Fig. 2: Silicon power rectifier stacks. Ratings are for convection cooling.



Progress Report on

Semiconductor Rectifiers

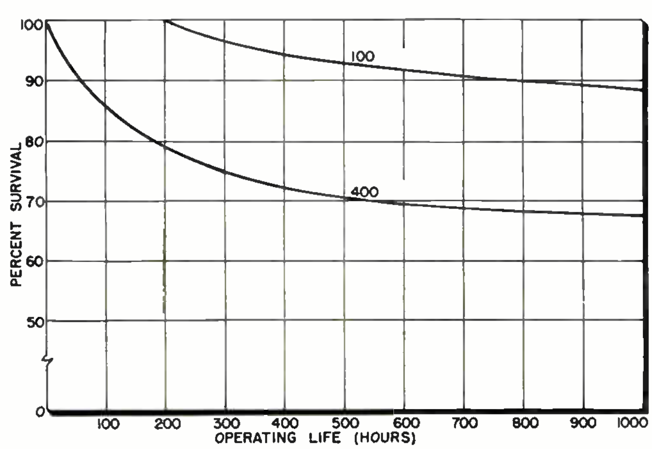
Findings indicate that silicon and germanium rectifiers are more desirable in high temperature areas while selenium retains its superiority in high current uses.



By NORMAN F. BECHTOLD
U.S.A. Signal Corps Eng'g Labs.
Fort Monmouth, N. J.

Fig. 1 (left): Dynamic characteristics of the rectifiers at 100 p.i.v.

Fig. 3: Reliability of silicon rectifiers at 100 and 400 p.i.v.



THE magic word "semiconductor" has generated an unprecedented development and production activity throughout the electronic world. Intraservice coordination groups have tried to provide a controlling influence to this activity by establishing funding priorities and avoiding duplication of technical effort. In performance of these functions a continuing review is made of proposed programs and results accomplished on current projects. The following information has been compiled for such a review and is provided to acquaint the general engineer with the current development and application trends and future considerations for one phase of the semiconductor program.

Development effort in the semiconductor power rectifier field is presently in a transition period from plate or polycrystalline (selenium) types to the single crystal junction (silicon) types by virtue of advantages offered by the latter in the categories of miniaturization, high temperature capabilities, and conservation of critical materials. The expanding silicon technology has reached the point where it can now provide specific information regarding deficiencies for future guidance in R&D programming. The following report of progress achieved outlines some of the major accomplishments and their potential effect on the future semiconductor rectifier development program.

Selenium Rectifiers

Selenium, in general, has been de-emphasized in the military development picture since the advent of silicon. The most noteworthy example of this changing development situation is in the magnetic amplifier field, where selenium plates were developed having leakages lower than 100 μa, resulting in forward to reverse current ratios of greater than 1000:1 in ambient temperatures exceeding 100°C; new requirements of a minimum 10,000:1 ratio necessitated adoption of a silicon approach, and the selenium effort has been curtailed. Representative properties from development models of these two rectifier types are shown for comparison over the high temperature range of current interest in Fig. 1.

High voltage selenium plate research has been discontinued for the present since it can offer no potential size or rating advantage over currently available silicon types.

The continued use of selenium in replacement models of existing equipments is still expected for a number of years. On this basis, the need for conservation of selenium has instigated the improvement of the vapor deposition process, which not only provides critical material saving in the neighborhood of 50% but also enhances the rectifier's high temperature and/or high current density capabilities. In this respect, a domestic firm has been licensed to use a German vacuum process in the United States, thereby providing a potential stabilizing influence to increasing costs for selenium rectifiers.

Comparisons have been made on a small scale of the radiation resistant properties of a series of components and materials. Semiconductor devices, in general, seem to be sensitive to the exposures studied to date. Large transient increases in forward resistance and decreases in reverse resistance have been experienced, which do not recover to original values even after many days of normal ambient storage subsequent to exposure. Apparently, germanium and silicon devices are sensitive to an even greater degree than selenium, possibly due to their monocrystalline structure as compared to the polycrystalline selenium. The services plan to embark upon evaluation programs to gather more data on various semiconductor types under radiation conditions particular to individual service requirements.

Silicon Rectifiers

Experimental samples of two current ranges of silicon rectifiers have been developed as a preliminary step toward solution of the magnetic amplifier problem. They are stud mounted types and have average current ratios at 200 p.i.v. of 250,000:1 at 25°C, decreasing to about 20,000:1 at 100°C. The alloy technique has provided better reverse characteristics, but is difficult to reproduce in large junctions. In contrast, the diffusion technique provides somewhat higher leakages, but reproducibility is better. A package will be developed which is consistent with present application needs and printed circuit packaging standards.

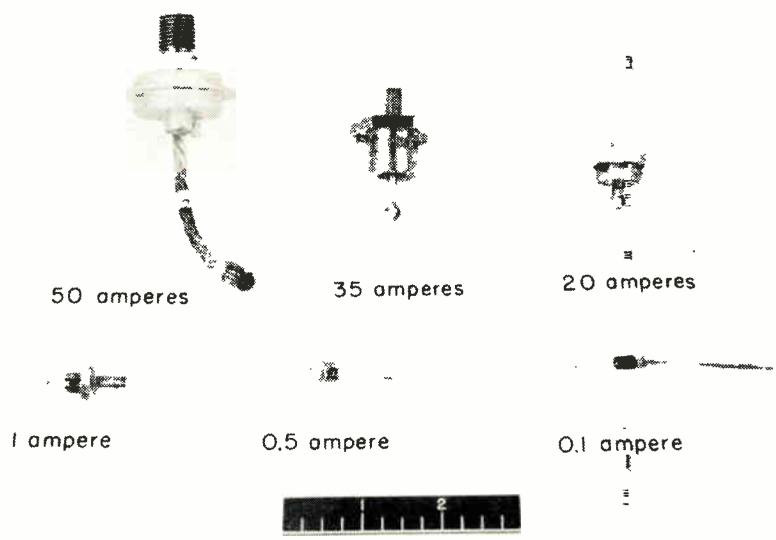


Fig. 4: Ratings are for convection cooling of silicon units on suitable heat sinks.

There are at least a dozen manufacturers now producing silicon rectifiers commercially, with basic advertised ratings up to 200 p.i.v. in 50 amp models and 800 p.i.v. in 250 ma types. This increased effort will tend to bring about better yields, greater reproducibility, and decreased cost. Fig. 4 illustrates a number of varieties presently available over the operating current range for power rectifiers. Single

(*Continued on page* 170)

A Unique Approach to Computer Versatility

Systems designers frequently need a computer which can perform a group of specialized computations, as well as general data processing functions. Such a need has led to the design of an integrated dual computer system with unique operating possibilities—a result of shared memory and input/output facilities.

By L. S. MICHELS
Project Engineer Bendix Computer Division
Bendix Aviation Corporation
5630 Arbor Vitae Street, Los Angeles 45, California

THE Bendix G-15 computer system is the result of a unique system philosophy. The system uses two integrated computers as part of one system, each performing functions for which it is best suited.

The core of this system is the G-15 general purpose computer. This medium sized, internally stored program computer performs data handling operations which can be expressed as arithmetic operations upon numerical data. These include many types of scientific, engineering, and mathematical computations.

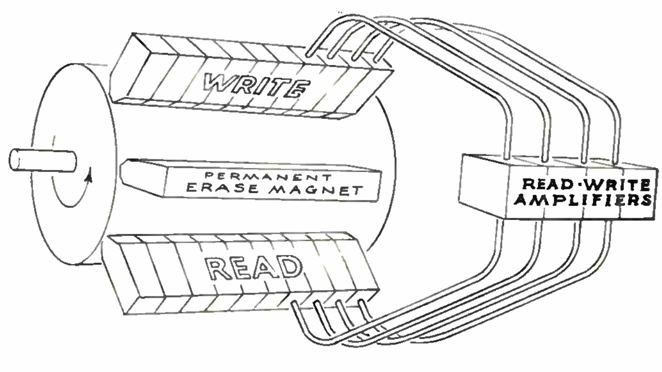
It is possible to use a general purpose computer to solve differential equations. Time requirements, however, are often excessive and a better method of solving these equations is needed. For solving such equations, the G-15 system includes a DA-1 Digital Differential Analyzer (DDA). The DDA uses a semi-fixed program which limits it to solving differential equations only. However, when used for problems which can be expressed as differential equations, the DDA offers improved programming and speed of solution over the general purpose computer alone.

Basic System Design

The two computers are housed in separate cabinets connected by cable. The G-15 general purpose computer may be operated independently of the DA-1;

Fig. 1 (left): From left to right—Bendix G-15 computer, digital differential analyzer, input output typewriter, X-Y plotter.

Fig. 2 (below): Block diagram of the G-15 recirculating memory.



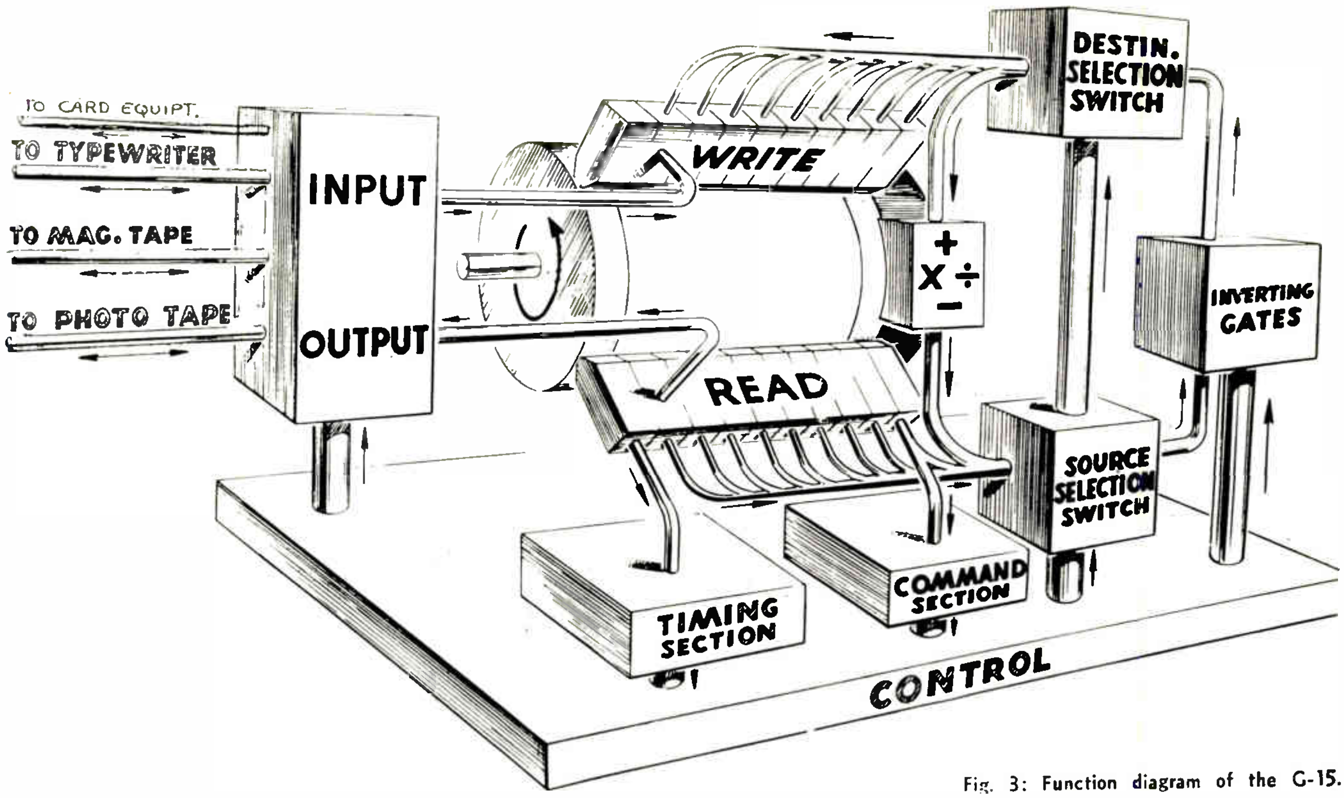


Fig. 3: Function diagram of the G-15.

however, the reverse is not true, since the DA-1 uses the G-15 memory in accomplishing its computations. Input/output for both of the computers is accomplished by using the standard input/output equipment available with the G-15.

Memory

The memory of the G-15 system is used both by the G-15 general purpose computer and by the DA-1 DDA. A magnetic drum 12 in. in diameter and 3½ in. long, turning at 1800 RPM, is used to store 2160 29-bit words on 20 tracks or channels. Thus there are 108 words per track. Each track is a recirculating type; i.e., each track has a separate read head and write head. Information is read and re-recorded continuously on all tracks.

Fig. 2 is a schematic representation of this procedure. Information is read from the drum by the read heads, passed through electronic circuits and simultaneously re-recorded with the write head. Between the read and write heads is an erase head (a permanent magnet) which erases all the old information.

Due to the physical distance between the read and write head, the actual cycle time of information is less than the drum rotation time. Although the drum rotates at approximately 30 RPS, the information cycle rate is approximately 34 RPS.

The drum is also used to store a number of short. fast access loops; some used for fast access storage and others for arithmetic registers. Since these are also recirculating tracks on memory, they are similar to the long tracks, the only difference being in length. The lengths of the short tracks are such that the read and write heads may be put between the read and write heads of the long tracks, as shown in Fig. 5. The same physical tracks on the memory are used for the long recirculating loops and the short recirculating loops. Erase heads separate the two sets of tracks.

The short tracks include five 4-word tracks, three 2-word tracks and two 1-word tracks. One of the 1-word tracks is used for machine timing and is not accessible to the programmer; one of the 4-word tracks is also not accessible to the programmer, being used for input/output buffer purposes. The long tracks are numbered from zero to 19, the 4-word tracks are numbered from 20 to 23.

Command System

The basic command is always executed by the computer in the following manner: Information is transferred from one track in the memory, a source, to another track in the memory, a destination, with simultaneous performance of certain arithmetic operations upon the information as it is being transferred.

This process may be pictured as shown in Fig. 3. The information is read by the read heads from the memory and passes to a source selection switch. This switch selects the information from one particular read head and passes it to the inverting gates which perform the arithmetic operations. From the inverting gates the information passes onto a destination selection switch which selects a particular write head on the memory for recording the information.

The operations which may be performed by the inverting gates are shown in Table 1. This char-

A Unique Approach to Computer Versatility (Cont.)

acteristic table shows the possible types of arithmetic operations on the information as it is being transferred. The particular operations are described by a numerical characteristic code. There are four possible values for this code.

Table 1

0	Transfer
1	Add
2	Absolute
3	Subtract

Characteristic "0"

The first operation, called "transfer," is merely an operation involving the simple transfer of operation through the inverting gates unchanged.

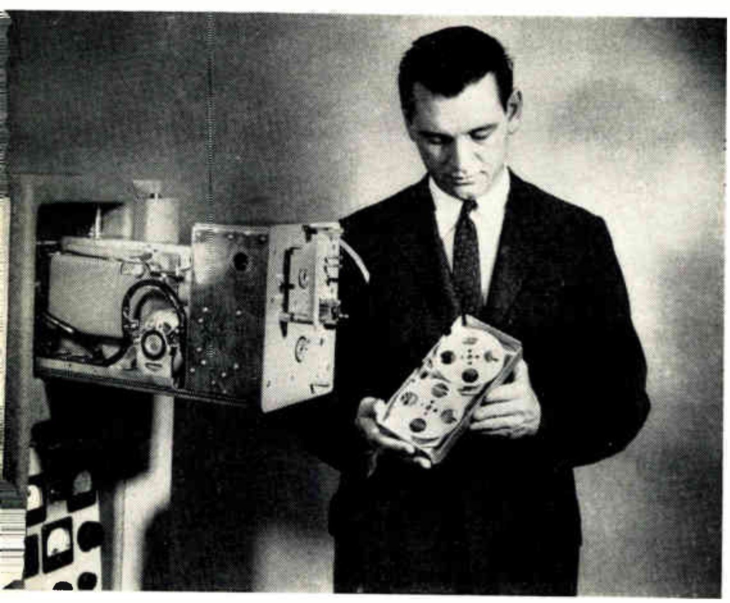
Characteristic "1"

The add operation is defined as the transfer of the information through the inverting gates unchanged if the sign of information word is positive. If the sign of the information is negative, the sign of the word is passed unchanged but the rest of the world is complimented.

Characteristic "2"

This operation, the absolute value operation, is the simple transfer of the word unchanged except for the sign, which is made positive.

Fig. 4: Interchangeable paper tape magazines form a library of routines and programs.



Characteristic "3"

The inverting gates pass the sign of a word and invert it in the subtract operation. The rest of the information is transferred through the inverting gates following the same rules as that described under the add operation (Charactertistic 1), using the inverted sign as the determining factor in complimenting or not.

Commands

The computer obeys the commands stored in its internal memory. Each command, therefore, must select the source and destination track and specify the characteristic code for the particular operation. These comprise three parts of a given command (see Fig. 7).

A five bit binary code specifies the source, another five bits specifies a destination and a two bit number specifies the characteristic. The source and destination codes are numbers which correspond to the memory tracks on the drum. These codes may refer to any of the 20 long tracks, one of the 4-word tracks, one of the 2-word registers or the accumulator register, as outlined in Table 2.

Add and Subtract

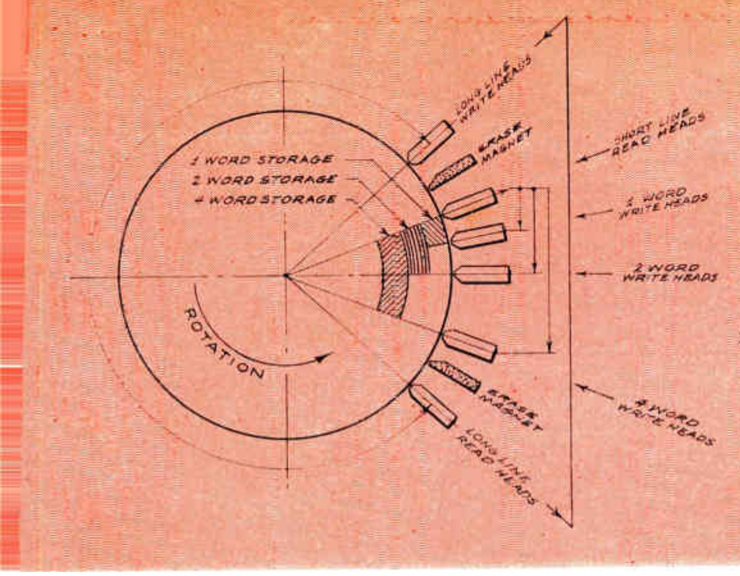
As seen in Table 2, the accumulator is specified by the source and destination code #28. (The code number 28 in binary notation is put into the command in the source or destination spot.) When destination 28 occurs, the information from the source replaces the old information in the accumulator. However, if it is desired that an addition or subtraction takes place, the destination code 29 is used which results in the information from the inverting gates being added to the information already in the accumulator. If a subtraction is required, a subtract characteristic is used and the information from the inverting gates is therefore complimented.

The PN register can be used for an accumulator for double precision numbers; hence, it operates quite similarly to the accumulator at this time.

Word Selection

It has already been mentioned that there are 108 words on a long track. A given command may occupy one word in one of these tracks, for example, track #0. The operand may occupy a particular word in this track or another track. The words in the track are numbered from zero to 107 and the location of a particular word for selection by a command as an operand must be made by a suitable coding in the command.

For example, if word 39 of track 4 is to be transferred to the accumulator, a certain code in the command called the T number (see Fig. 7), contains the binary number 39. The source code in this case would be 4. The computer then selects line 4, and when word 39 of line 4 passes under the read heads, the information is transferred through the inverting gates to the destination—the destination in this case being the accumulator. Since the accumulator is only one word long, access is made to it at every word of the long line and is always available.



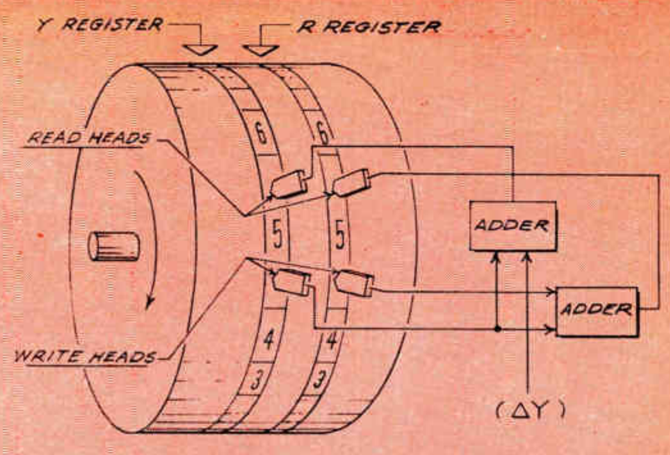


Fig. 5 (left): Cross-section of the G-15 memory drum.

Fig. 6 (above): Schematic of integrator processing system.

Commands are always taken out of a particular line on the drum until all of the commands in that line have been exhausted. The word of that line which stores the next command is specified by the code number "N" in the command being obeyed, as seen in Fig. 7.

When the commands of a given line have been all used up, a special command is executed which makes the computer select successive commands from another line on a drum

Table 2

Source Destination Table

0	Line 0
1	Line 1
2	Line 2
3	Line 3
4	Line 4
5	Line 5
6	Line 6
7	Line 7
8	Line 8
9	Line 9
10	Line 10
11	Line 11
12	Line 12
13	Line 13
14	Line 14
15	Line 15
16	Line 16
17	Line 17
18	Line 18
19	Line 19
20	Line 20 (four-word line)
21	Line 21 (four-word line)
22	Line 22 (four-word line)
23	Line 23 (four-word line)
24	MQ Register (two-word register)
25	ID Register (two-word register)
26	PN Register (two-word register)
27	
28	AR Register (one-word register)
29	Add to AR register (Destination only)
30	Add to PN register (Destination only)

Special Commands

Many operations which the computer must carry out cannot be performed by the use of these source and destination procedures. The ability to perform these operations has been built into the computer by the use of special commands. Special commands are distinguished from all other commands in that they all have the destination code 31 which does not correspond to any particular track on the drum. If the destination code of the command is 31, the operation of the computer changes from the source destination procedure heretofore described. In this case, for each of the 32 possible source codes, a particular special type operation is executed. One of these, the selection of the command line, has already been described. Some obvious special commands are for input and output; the input/output facilities will be described later.

The arithmetic operations for multiplication and division fall under the general heading of special commands. The three 2-word registers are used for multiplication and division. The two operands for these operations are placed in these registers and the answer remains in one of these registers at the completion of the operation. Transfer to and from these registers is accomplished through the source and destination procedure as seen in Table 1.

Other operations falling in the special command list are:

1. Shifting and normalizing operations which make the computer readily adaptable to floating point routines.
2. Testing operations involving testing for overflow, for negative and positive sign, and for the existence of input/output operations (input/output may occur simultaneously with computation).

Input/Output Facilities

Input/output is accomplished through the use of buffer registers and one long track on the memory. These are independent of the computation facilities. Information to be read out of the computer is recorded by the program in long line 19 of the memory. A special command for output is then issued and the information recorded in line 19 is transferred to the output device.

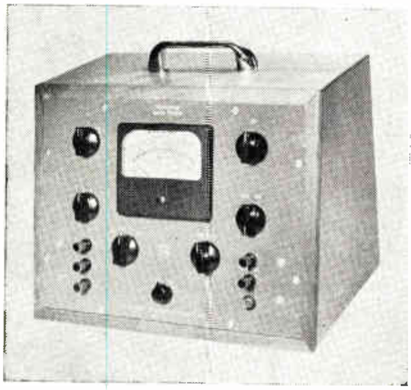
Format information stored elsewhere in the memory results in any desired format. Likewise, on input,

(*Continued on page* 112)

New Products . . . for the Electronic Industries

ALPHA TESTER

The model AT10A transistor alpha-beta tester is a direct reading instrument which automatically indicates the ac values of the alpha and beta parameters for all types of transis-

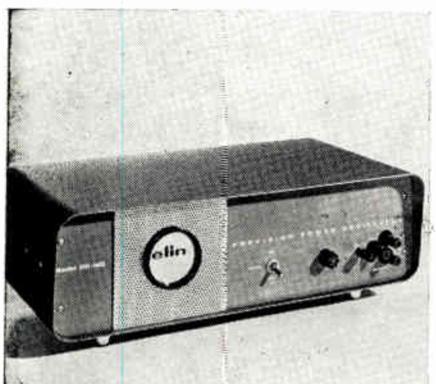


tors. The instrument provides readings of these parameters as a function of emitter and collector bias and in addition tests for alpha and beta cut off and values of alpha-beta at high audio frequencies. It is designed for both production testing and laboratory measurement. Electronic Research Associates, Inc., 67 East Centre St., Nutley 10, N. J.

Circle 167 on Inquiry Card, page 107

PRECISION OSCILLATOR

Precision power oscillators meet the performance requirements of pre-flight missile system checkouts, precision 400 cycle gyro testing, time correlation work and as special power sources for critical requirements. DK-102 is designed especially for applications where "tuning fork" frequency stability, absolute voltage values, extremely low output impe-

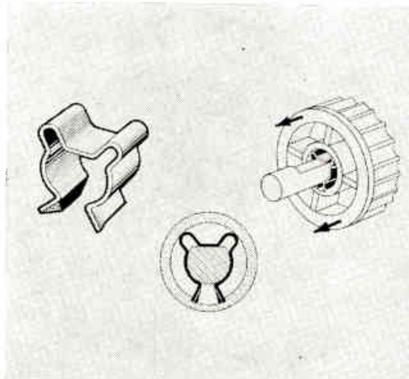


dance, ultra-low distortion and high power capacity are required. Models provide 2 and 6 w. output. Special models are available. Electronics Int'l Co., 145 W. Magnolia Blvd., Burbank, Calif.

Circle 168 on Inquiry Card, page 107

SPEED CLIP

The new speed clip is designed to secure radio and television control knobs to tuning shafts. To assemble, the spring steel clip is merely inserted into the knob recess with only

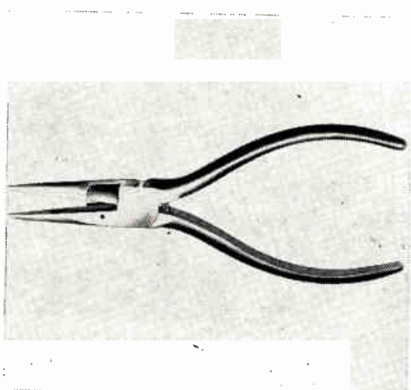


slight compression. On release, the fastener centers itself and locks firmly. Tensioning loops at the top of the clip provide evenly distributed bearing surfaces, minimizing wear on the knob. Knob with assembled fastener is then thrust over D-shaped shaft. Only slight pressure is needed to remove knob from shaft. Tinnerman Products, Inc., Cleveland, Ohio.

Circle 169 on Inquiry Card, page 107

PRODUCTION PLIERS

A long nose plier designed specifically to speed up wiring where the cut, hook and crimp method is employed is available. Acting on a shear principle, this plier cuts hard or "dead" soft wire cleanly. The shear blade is removable and may be easily replaced if it becomes worn. The reverse side has a milled section behind the knife so designed that when the

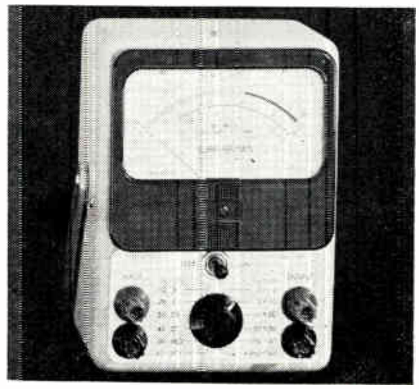


wire is cut, it is held in position and a turn of the hand forms a hook in one operation. Furnished standard with self-opening coil spring. Mathias Klein & Sons, 7200 McCormick Rd., Chicago 45, Ill.

Circle 170 on Inquiry Card, page 107

AC MILLIVOLTMETER

The Model 300 AC Millivoltmeter has the following features: completely transistorized circuitry; 2 megohms input impedance without use of vacuum tubes; battery life of 4,500

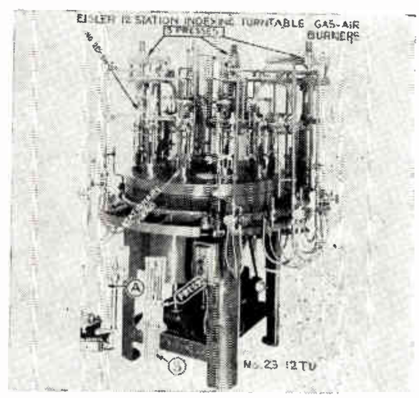


hours; twelve ranges covering 0.001 to 300 v. full scale; frequency response from 8 cps to 800 kcps; regulated power supply systems; small physical size of 5x7x5 in. with large 4 in. meter, weight of 4 pounds. The meter can be powered with either ordinary flashlight cells or with mercury cells. Burr-Brown Research Corp., Box 6444, Tucson, Ariz.

Circle 171 on Inquiry Card, page 107

STEM MACHINE

A new type of tipless stem machine has been developed. A 12 head machine makes tipless stems for the radio tube as well as the incandescent lamp industry. On larger tubes it is necessary that a number of heats and an additional number of press positions be supplied in order to make a good press. Machine #23-12TU has 3 press positions. Each one of these



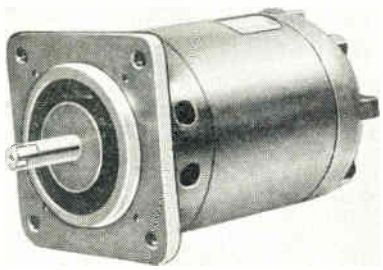
press positions is individually adjusted and thereby permits an exceptionally large stem to be pressed. Eisler Engineering Company, Incorporated, 750 South 13th Street, Newark 3, New Jersey.

Circle 172 on Inquiry Card, page 107

New Products . . . for the Electronic Industries

AC MOTOR

New ac motors, designed for induction, torque or hysteresis synchronous applications, with outputs up to 1 hp, are available. The 3800 Frame series is available with input voltages of

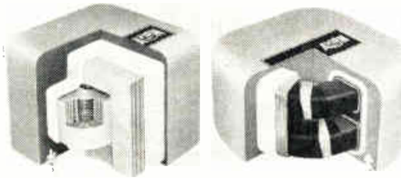


from 26 to 230 vac, 1, 2 and 3 phase; input frequency from 25 to 400 cps For induction applications, units in this series are offered in outputs to 1 hp; torque motors 10 to 200 oz. in. stall torque; hysteresis synchronous 1/200 to ¼ hp. Motors can be wound for single, dual or 3 speed, and can be supplied as self cooled with internal fan. Induction Motors Corp., 570 Main St., Westbury, N. Y.

Circle 161 on Inquiry Card, page 107

SPECIAL MAGNETICS

A new and complete magnetic component service is available for both standard and specially designed units. This service, and the related new techniques have been developed to ob-

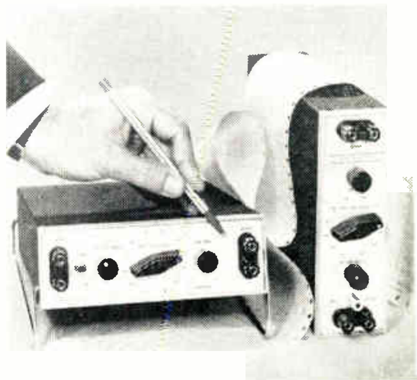


tain greater equipment reliability for components and assemblies with respect to applications such as magnetic amplifiers, modulators, voltage references, frequency multipliers, etc. The units are light in weight, compact, and well protected environmentally. New techniques for encapsulating provide maximum protection. Avion Div. ACF Industries, Inc., 11 Park Place, Paramus, N. J.

Circle 163 on Inquiry Card, page 107

DC AMPLIFIER

Completely transistorized electronically modulated dc amplifier for use with the recti-riter and other milliammeter recorders is available. Model 301 amplifier sensitivity is from 10



mvdc to 100 vdc. full scale in 12 ranges. Has frequency response up to 50 cps. Amplifier operates from line voltage or a self-contained battery. Specifications are: size, 7½ x 10 x 2½ in.; weight, 4¾ lb. Input impedance is 2.5 megohms/v.; output impedance is 39 ohms. Absolute accuracy is 2% of full scale. Texas Instruments, Incorporated, 3609 Buffalo Speedway, Houston 6, Texas.

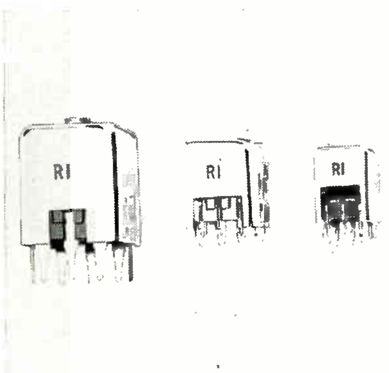
Circle 165 on Inquiry Card, page 107

SILVERED-MICA CAPACITORS

The mica used in the Type 1409 standard capacitors is carefully selected and tested so that all finished [illegible]rs have a dissipation factor [illegible]an 0.0003 at one KC. An [illegible]t ground binding post has [illegible]o they may be used either [illegible] 3 terminal capacitors. [illegible]ompletely electrostatic

I-F TRANSFORMERS

New intermediate frequency transformers in three sizes, ¾, ½ and ⅜ in., are manufactured specially for transistorized circuits. All three sizes are engineered and mass-produced to meet any specific requirements of unloaded "Q," ranging from 40 to 200 for the ¾ and ½ in. and as high as 140 for the new, smaller ⅜ in. Built-in

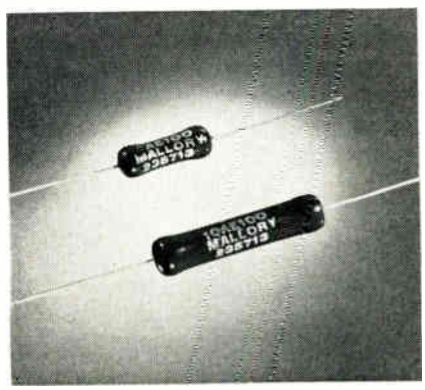


shunt capacitors provide capacities ranging from 65 to 470. Miniature oscillator coils also available. Radio Industries, Inc., 5225 N. Ravenswood Ave., Chicago 40, Ill.

Circle 164 on Inquiry Card, page 107

AXIAL-LEAD RESISTOR

The axial-lead construction of these new types offers small physical size for their dissipation ratings. The new types 3-AE, 5-AE, and 10-AE are of 3, 5, and 10 watt ratings respectively. Built of thermally matched materials, they have good resistance to thermal shock. Axial leads are welded. All three series offer high



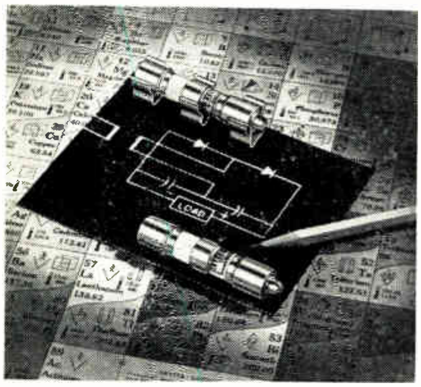
resistance to mechanical and humidity shock. The three types are made in accordance with the MIL-R-26C specifications. P. R. Mallory & Co., Inc., Indianapolis, Ind.

Circle 166 on Inquiry Card, page 107

New Products ...for the Design Engineer

SILICON VOLTAGE DOUBLERS

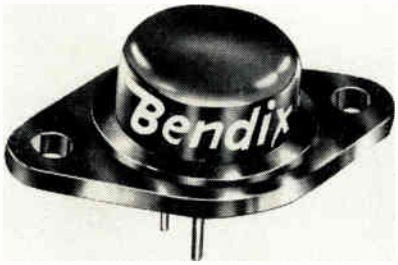
The small size, light weight, and rectifying characteristics of these silicon cartridges make them especially applicable to airborne military and industrial equipment. Hermetic sealing in metalized ceramic housings permits their use in corrosive atmospheres. Each is a voltages doubler having a maximum rating per leg of 3,200 PIV. Two units can be connected as a single-phase, full-wave bridge, capable of delivering 1,900 v. dc at 90 ma. for an input voltage of 2,240 v. rms. Mounts in a standard 30 a. fuse clip. International Rectifier Corp., El Segundo, Calif.



Circle 173 on Inquiry Card, page 107

HIGH GAIN TRANSISTOR

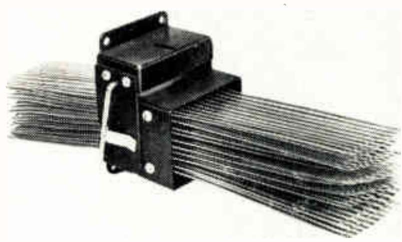
A new very high gain germanium PNP audio power transistor, the 2N285A, has current gains up to 250 at 0.5 a. collector current, 125 at 2 a. collector current, and 50 at 3 a. collector current. It has a maximum collector dissipation of 25 w. and a maximum junction temperature of 95°C. It is designed to be used in high gain audio and hi-fi amplifiers. Because of its very high gain it is especially useful in feedback circuits. Also useful in servo amplifiers and motor control circuits. Bendix Aviation Corp., 201 Westwood Ave., Long Branch, N. J.



Circle 175 on Inquiry Card, page 107

PRINTED CABLE

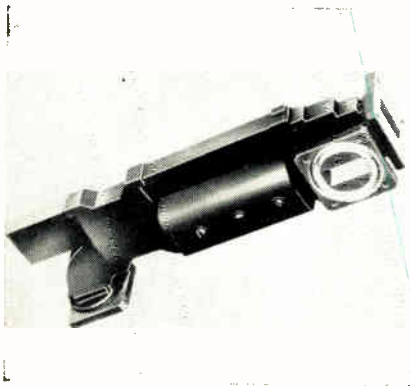
A new type flexible printed cable has been designed with wide applications in missiles, aircraft and computers. It is made of silicone rubber with or without glass reinforcement and shielding is available in the cover coat. It can be produced in any length and in various conductor patterns. Weight savings of 4:1 for signal cable and 2:1 for power cable are possible. Cable is designed for the Graphik Cable Harness System but will be engineered to individual requirements. Graphik Circuits Div., Cinch Mfg. Corp., 200 W. Turnbull Canyon Rd., La Puente, Calif.



Circle 177 on Inquiry Card, page 107

DIFFERENTIAL CIRCULATORS

A miniature ferrite phase differential circulator is designed to provide advantages of both a duplexer and a load isolator. Engineered for high power microwave systems. When used as a duplexer, it not only functions as a switching device between the magnetron, receiver and antenna, but also furnishes sufficient isolation between the magnetron and r-f energy reflected from line mismatches. It consists of a folded magic tee, the ferrite section and a short slot hybrid coupler available in waveguide sizes. Airtron, Inc., 1101 W. Elizabeth Ave., Linden, N. J.



Circle 174 on Inquiry Card, page 107

MULTIPLIER PHOTOTUBE

6810-A is a 14-stage head-on type of multiplier phototube for use in scintillation counters for the detection and measurement of nuclear radiation, and in applications involving the measurement of low-level light sources that supersedes the 6810. The spectral response of the 6810-A covers the range from about 3000 to 6500 angstroms, with maximum response occurring at approximately 4400 angstroms. It is therefore quite sensitive to blue-white light with negligible sensitivity to red radiation. Radio Corp. of America, Harrison, N. J.

Circle 176 on Inquiry Card, page 107

TOGGLE SWITCHES

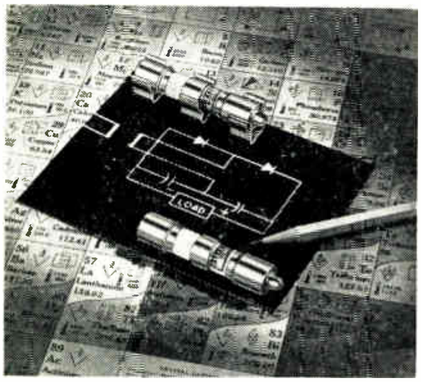
A series of 3-position toggle switches, which have safety catches to guard against accidental toggle lever movement are available. Safety catch holds the toggle lever in a "se… position and a pull of appro… 0.109 in. is required to re… lever for movement. The… cially useful in mobile, r… tronic and aircraft appli…

o… u… o…

. . . for the Design Engineer

SILICON VOLTAGE DOUBLERS

The small size, light weight, and rectifying characteristics of these silicon cartridges make them especially applicable to airborne military and industrial equipment. Hermetic seal-



ing in metalized ceramic housings permits their use in corrosive atmospheres. Each is a voltages doubler having a maximum rating per leg of 3,200 PIV. Two units can be connected as a single-phase, full-wave bridge, capable of delivering 1,900 v. dc at 90 ma. for an input voltage of 2,240 v. rms. Mounts in a standard 30 a. fuse clip. International Rectifier Corp., El Segundo, Calif.

Circle 173 on Inquiry Card, page 107

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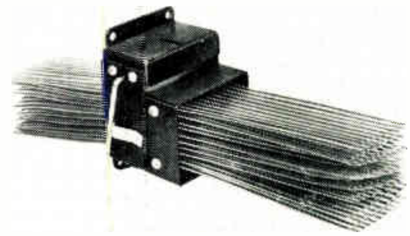

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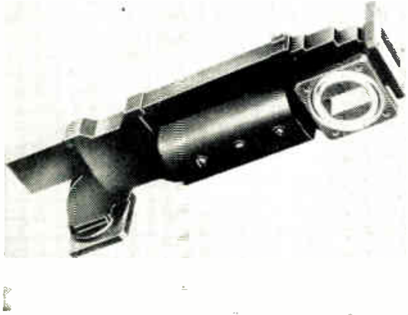

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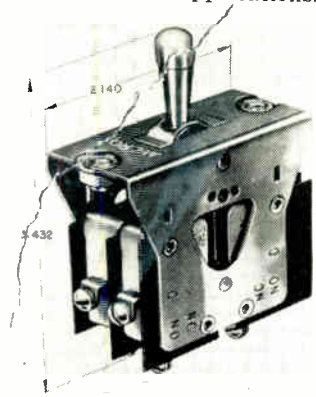


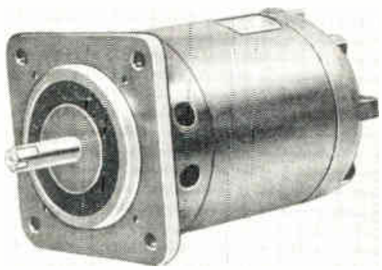
of the switches has 2 basic switching units in each assembly, while the other has 4. All have spdt arrangement. Micro Switch, Freeport, Ill., a div. of Minneapolis-Honeywell Regulator Co.

Circle 178 on Inquiry Card, page 107

New Products . . . for the Electronic Industries

AC MOTOR

New ac motors, designed for induction, torque or hysteresis synchronous applications, with outputs up to 1 hp, are available. The 3800 Frame series is available with input voltages of

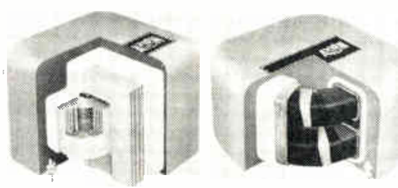


from 26 to 230 vac, 1, 2 and 3 phase; input frequency from 25 to 400 cps For induction applications, units in this series are offered in outputs to 1 hp; torque motors 10 to 200 oz. in. stall torque; hysteresis synchronous 1/200 to ¼ hp. Motors can be wound for single, dual or 3 speed, and can be supplied as self cooled with internal fan. Induction Motors Corp., 570 Main St., Westbury, N. Y.

Circle 161 on Inquiry Card, page 107

SPECIAL MAGNETICS

A new and complete magnetic component service is available for both standard and specially designed units. This service, and the related new techniques have been developed to ob-

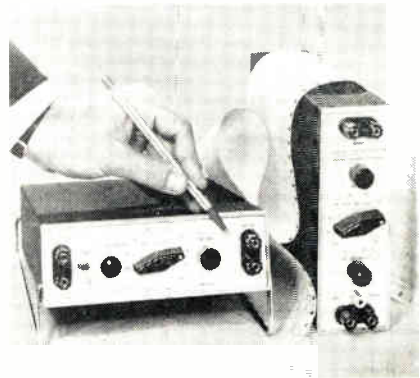


tain greater equipment reliability for components and assemblies with respect to applications such as magnetic amplifiers, modulators, voltage references, frequency multipliers, etc. The units are light in weight, compact, and well protected environmentally. New techniques for encapsulating provide maximum protection. Avion Div. ACF Industries, Inc., 11 Park Place, Paramus, N. J.

Circle 163 on Inquiry Card, page 107

DC AMPLIFIER

Completely transistorized electronically modulated dc amplifier for use with the recti-riter and other milliammeter recorders is available. Model 301 amplifier sensitivity is from 10

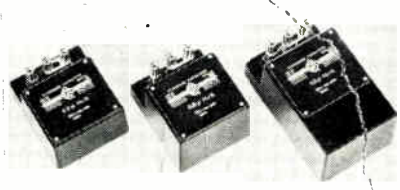


mvdc to 100 vdc. full scale in 12 ranges. Has frequency response up to 50 cps. Amplifier operates from line voltage or a self-contained battery. Specifications are: size, 7½ x 10 x 2½ in.; weight, 4¾ lb. Input impedance is 2.5 megohms/v.; output impedance is 39 ohms. Absolute accuracy is 2% of full scale. Texas Instruments, Incorporated, 3609 Buffalo Speedway, Houston 6, Texas.

Circle 165 on Inquiry Card, page 107

SILVERED-MICA CAPACITORS

The mica used in the Type 1409 standard capacitors is carefully selected and tested so that all finished capacitors have a dissipation factor of less than 0.0003 at one KC. An independent ground binding post has been added so they may be used either as a two or 3 terminal capacitors. They are completely electrostatic

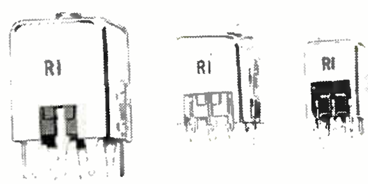


shielded. A calibration certificate is included. Available in 10 stock values from 0.001 to 1.0 microfarads. General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.

Circle 162 on Inquiry Card, page 107

I-F TRANSFORMERS

New intermediate frequency transformers in three sizes, ¾, ½ and ⅜ in., are manufactured specially for transistorized circuits. All three sizes are engineered and mass-produced to meet any specific requirements of unloaded "Q," ranging from 40 to 200 for the ¾ and ½ in. and as high as 140 for the new, smaller ⅜ in. Built-in

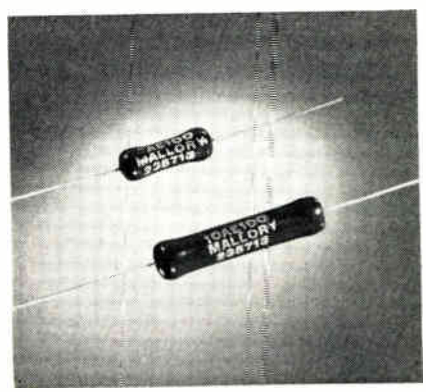


shunt capacitors provide capacities ranging from 65 to 470. Miniature oscillator coils also available. Radio Industries, Inc., 5225 N. Ravenswood Ave., Chicago 40, Ill.

Circle 164 on Inquiry Card, page 107

AXIAL-LEAD RESISTOR

The axial-lead construction of these new types offers small physical size for their dissipation ratings. The new types 3-AE, 5-AE, and 10-AE are of 3, 5, and 10 watt ratings respectively. Built of thermally matched materials, they have good resistance to thermal shock. Axial leads are welded. All three series offer high



resistance to mechanical and humidity shock. The three types are made in accordance with the MIL-R-26C specifications. P. R. Mallory & Co., Inc., Indianapolis, Ind.

Circle 166 on Inquiry Card, page 107

New Tech Data for Engineers

Antenna Measurements

The latest issue of "PRD Reports" features an illustrated technical paper titled "Antenna Pattern Instrumentation." This technical paper describes a complete microwave test equipment system for antenna pattern measurements in the frequency band from 1000 MC to 10,500 MC. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn, 1.

Circle 180 on Inquiry Card, page 107

Saturable Reactors

Control, a division of Magnetics, Inc., Box 391, Butler, Pa., has issued a 32-page catalog describing their standard lines of saturable reactors for industrial and other control uses. Catalog R-10 has graphs, photographs and several pages showing typical circuits and formulae.

Circle 181 on Inquiry Card, page 107

Voltage Regulators

"Corona Type Voltage Regulators" is the name of an 8-page booklet issued by the Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio. It describes completely the operation of these corona type voltage regulators and is complete with graphs, charts and circuit information. Booklet is specifically written for engineers not too familiar with these types of regulators.

Circle 182 on Inquiry Card, page 107

Pick-Off Pontentiometers

A new 2-color bulletin gives complete specifications and outline drawings for pick-off and sector potentiometers for use in the aircraft and missile control systems. Bulletin #415 is issued by the Norden-Ketay Corp., Commerce Rd., Stamford, Conn.

Circle 183 on Inquiry Card, page 107

Wall Chart

This new, large chart, entitled "Electrical Conductor Code Names," lists alphabetically in a general section more than 600 code names and specifies type and size of aluminum electrical conductors. More detailed information is provided in adjacent tables including data on coverings, messengers, sizes, and strandings. British as well as U. S. standard tables are included. Designed as a permanent reference, the green and white chart is printed on a washable, crack-resistant plastic paper. Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11.

Circle 184 on Inquiry Card, page 107

Aircraft Electronics

The Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif. have issued a reprint entitled "DC-8 Sets New Electronic Style." This 2-color, 8-page booklet describes, in detail, some of the electronic problems encountered in the manufacture of high speed commercial jet airliners and their solutions. Booklet contains information on connectors and antenna design problems. It is complete with photographs and drawings.

Circle 185 on Inquiry Card, page 107

Plastic Molding Machines

Newbury Industries, Inc., Newbury, Ohio has issued a 16-page booklet giving complete engineering data on their plastic injection molding machines. The booklet contains photographs, mechanical and electrical specifications and descriptive information for this equipment.

Circle 186 on Inquiry Card, page 107

Miniature Connectors

A 3-colored brochure issued by the Scintilla Div. of the Bendix Aviation Corp., Sidney, N. Y. contains complete electrical and mechanical specifications on a new line of miniature electrical connectors. The booklet is complete with photographs, specifications and tables.

Circle 187 on Inquiry Card, page 107

Copper-Clad Laminates

A new brochure contains several design suggestions for printed circuits with copper-clad plastic laminates. These suggestions are to provide aid in design production of printed circuits on copper-clad laminates. Included is a table listing properties of copper-clad laminates after etching. Also suggestions for punching along with recommended punching temperature ranges. Bulletin #20 is issued by the Richardson Co., 2777 Lake St., Melrose Park, Ill.

Circle 188 on Inquiry Card, page 107

Electronic Instruments

Gertsch Products, Inc., 3211 S. La Cienga Blvd., Los Angeles 16, has issued a short form catalog describing their precision electronic instruments. This 2-color brochure is complete with photographs and specifications. Some of the equipment described are frequency measuring equipment, standard ratio transformers, peak reading volt meters, deviation meters, special purpose transformers and bridge detectors.

Circle 189 on Inquiry Card, page 107

Sub-Miniature Connectors

A completely revised 4-color 12-page brochure on Continental Connector's has just been issued by the DeJur-Amsco Corp., 34-01 Northern Blvd., Long Island City 1, N. Y. Specifications, outline drawings, illustrations, and general information are contained in this brochure.

Circle 190 on Inquiry Card, page 107

Gold-Bonded Diodes

Technical bulletin B-215 issued by the Clevite Transistor Products, 241 Crescent St., Waltham 54, Mass. describes a complete line of subminiature glass diodes incorporating alloys of silicon and germanium. Bulletin contains complete specifications and an easy-to-read table.

Circle 191 on Inquiry Card, page 107

Panel Meters

Panel meters that meet applicable sections at JAN-1-6 and MIL-M-6B are described in the panel meter catalog issued by Waters Mfg., Inc., Boston Post Rd., Wayland, Mass. This 16-page catalog gives dimensional details and performance specifications for D'Arsonval-type ammeters, millivoltmeters, and voltmeters as well as ac rectifier-type microammeters, milliammeters, and voltmeters.

Circle 192 on Inquiry Card, page 107

Traveling Wave Tubes

Technical bulletin 1 issued by the Sperry Gyroscope Co., Great Neck, N. Y. describes in detail the theory and operation of traveling wave tubes. Included are block diagrams, drawings, cut away views and typical traveling wave tube specifications.

Circle 193 on Inquiry Card, page 107

Teflon Wire

A new Mil Spec catalog is available from the Belden Mfg. Co., 4647 W. Van Buren, Chicago, Ill. which describes their complete line of teflon insulated hook up wire. In addition, the catalog lists the Mil Spec of other wires manufactured by this firm.

Circle 194 on Inquiry Card, page 107

Potentiometer Selector

Large 8¾ in. plastic coated circular chart has an inner rotating wheel that visualizes mechanical and electrical specifications of a complete line of precision potentiometers. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 195 on Inquiry Card, page 107

New Tech Data for Engineers

Data Processing Applications

A new series of 8-page illustrated brochures, detailing industrial and engineering applications of the Datatron electronic data processing system are available from the Electro-Data Div. of Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif. The bulletins cover such items as traverse closure, pipeline design, cut and fill, bridge design, mass spectrometer data reductions, and millisadic data reduction.

Circle 196 on Inquiry Card, page 107

Clutches

Bulletins PSC-100 and OB-10 are two bulletins issued by the Curtiss-Wright Corp., 1145 Galewood Drive, Cleveland 10, Ohio describing their new line of precision spring clutches. Bulletins contain complete specifications, photographs, cut away drawings and tables.

Circle 197 on Inquiry Card, page 107

Closed Circuit TV

Catalog No. 6-42 describes a basic wired closed circuit industrial television system consisting of camera, camera control and monitor. It contains data on remotely controlled pan-tilt, iris-focus, and other camera accessories. Kin Tel, 5725 Kearny Villa Rd., San Diego 11, Calif.

Circle 198 on Inquiry Card, page 107

Checkout Equipment

"Rapid Automatic Checkout Equipment for Maintenance of Weapon Systems" is a preprint available from Microwave Electronics Division of Sperry Gyroscope Co., Great Neck, N. Y. General purpose test devices can no longer meet the demands of final checkout at the operational point. The complexity of a system plus the short time available for pre-operational tests have made automatic test equipment necessary. This paper describes a solution to the problem.

Circle 199 on Inquiry Card, page 107

Industrial Colorado

A colorful brochure and 26-page booklet is an analysis of industrial Colorado in its potential for industrial development. A complete breakdown of the industrial potentialities of the state are given. All phases are discussed and covered. Included is a relief map showing public transportation facilities in Colorado. Colorado Dept. of Development, Capitol Bldg. Denver 2, Colo.

Circle 200 on Inquiry Card, page 107

Power Reactor Systems

Bulletin GER-1384 presents a detailed picture and word description of various systems using water, gas sodium and liquid-fuel as coolants for reactor systems. This 28-page bulletin is written in an easy-to-follow manner on nuclear power reactor systems. General Electric Apparatus Sales Div., Schenectady 5, N. Y.

Circle 201 on Inquiry Card, page 107

Packaging

A 12-page brochure issued by The Celotex Corp., 120 S. LaSalle St., Chicago, Ill. describes the advantages of using celotex fiber board for electronic packaging. The booklet gives various applications and case histories with the use of this material.

Circle 202 on Inquiry Card, page 107

Rod & Sheet Plastics

Rod and sheet plastics for electronics is the subject of a new 17-page brochure issued by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. The brochure contains complete technical data, specifications and ordering information for these products.

Circle 203 on Inquiry Card, page 107

Electrical Steel

The Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. has issued a revised Blue Data Sheet on electrical steel 4750. The 20-page booklet gives detailed information on this iron-nickel steel, including typical physical, mechanical and magnetic properties. Sixteen graphs are included in the data.

Circle 204 on Inquiry Card, page 107

Numerical Positioning

Bulletin GEA-6594, 8 pages describes a complete industrial system for automatic point to point positioning of machines and machine tools. Benefits are listed, the theory and operation of numerical positioning is explained and typical applications are discussed. General Electric Co., Schenectady 5, N. Y.

Circle 205 on Inquiry Card, page 107

Silicon Molding

A new brochure exclusively devoted to silicone molding compounds has just been issued by Dow Corning Corp., Midland, Mich. The 3-color brochure contains charts, graphs, field examples, and physical and electrical properties of this material.

Circle 206 on Inquiry Card, page 107

Electron Tubes

A revised and enlarged catalog provides basic data and ratings on electron tubes. Data on industrial power triodes, high vacuum rectifiers, UHF triodes and hard modulator tubes are included. This 24-page color booklet is issued by Machlett Laboratories, Inc., Springdale, Conn.

Circle 207 on Inquiry Card, page 107

Coiled Cords

A 16-page catalog describing in detail the characteristics and uses of communication and power coiled cords is currently being offered by Cords Limited Div., Essex Wire Corp., 121 Dodge Ave., DeKalb, Ill. Complete engineering data and outline dimensions are shown for the numerous rubber and thermoplastic plugs and connectors that can be molded on to these coiled cords.

Circle 208 on Inquiry Card, page 107

X-Ray Techniques

A new brochure deals with problems related to pulse height analyzers used in X-ray work. Illustrated with graphs and tables, the brochure clearly explains how to operate pulse-height units with scintillation, proportional and flow counters to obtain best results. Philips Electronics, Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.

Circle 209 on Inquiry Card, page 107

Hermetic Seals

A simplified guide for selecting and specifying hermetic seal glass-to-metal AN connectors for military and commercial applications is contained in a 16-page catalog No. 657C now available. It contains photographs, drawings of a wide range of shell sizes and insert configurations for aircraft, communications, electronic controls, and instrument applications. Hermetic Seal Corp., 29 S. Sixth St., Newark 7, N. J.

Circle 210 on Inquiry Card, page 107

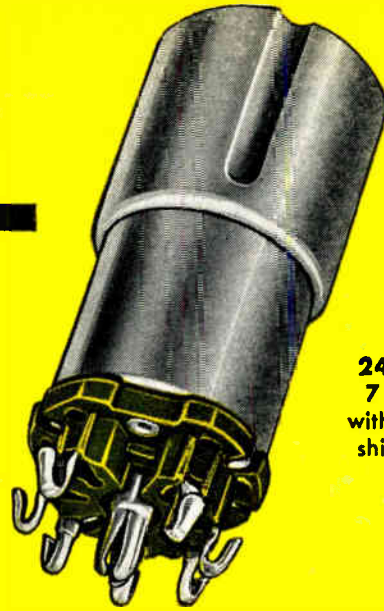
Tantalum Capacitors

Bulletin 152 discusses the distinguishing and unique characteristics of tantalum foil capacitors. Applications and limitations of the polar and non-polar types of tantalum foil electrolytics are covered. Detailed physical and operations specifications are provided as well as a handy table of many standard capacitance and voltage values. Ohmite Mfg. Co., 3655 Howard St., Skokie, Ill.

Circle 211 on Inquiry Card, page 107

☆ NEW –

MOLDED RIGID TAIL PRINTED CIRCUIT



24260
7 PIN
with telescopic shield (Shown enlarged)

CINCH SOCKETS:

24261
7 PIN
with center post
Mica

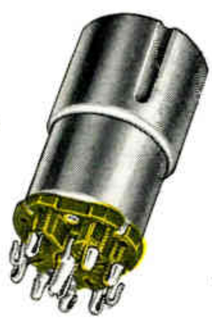
24264
9 PIN
with center post
Mica

24262
7 PIN
with ground strap c
center post Alkyc

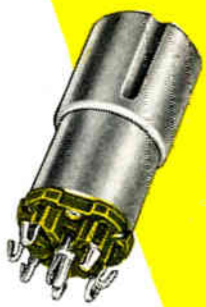
24265
9 PIN
with ground strap and
center post Alkyd

★ Snap in type contact. Can be stacked for automatic assembly. Can be furnished with integral twist lock telescopic shield. General purpose Mica or Alkyd insulation.

Quantity production of low loss mica components, finest molding machines and equipment operated under most experienced guidance and engineering supervision with adequate and unequaled facilities has advanced CINCH to the foremost in production of low loss Mica components in quantity.



24263
9 PIN
with telescopic shield



24260
7 PIN
with telescopic shield

CINCH will design, or re-design, components to fit specific needs, and will assist in the assembly of components through proven automation technique.

Cinch ELECTRONIC COMPONENTS

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; LaPuente, California; St. Louis, Missouri.

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Circle 41 on Inquiry Card, page 107

WASHINGTON

News Letter

NEW TV STATION OUTLOOK—There is every indication that economic factors will limit the growth of American TV to about one hundred additional stations, according to authoritative sources close to FCC and the networks. This would bring the present total of 504 stations up to about 609. The present number of TV stations on the air is 414 vhf and 90 uhf. Expected to be launched in years to come are 105 additional vhf stations—these comprise 58 unbuilt vhf CPs (construction permits authorized by the FCC) and 47 channels sought by 85 vhf applicants. There are, according to the FCC, 90 uhf stations operating and, while there are 123 unbuilt uhf CPs and 37 pending applications, the interest in launching uhf television operations seems to be waning, even in substantial market areas.

TAX TV RULING—The trading of television station properties, often multi-million dollar transactions, received a recent setback in a ruling by the U. S. Internal Revenue Service. The case involved the purchase of Philadelphia station WPTZ-TV. The Internal Revenue Service rejected the inclusion of intangible assets gained in the purchase of network affiliation contracts and local and spot advertising contracts as depreciable assets. These have constituted major tax deductions for purchasers of TV station properties. An appeal of the IRS ruling is being sought. There have been a number of similar TV station transactions in the past three years which could be affected.

NO ACTION ON SPECTRUM STUDY—The adjournment of Congress doomed action on the joint Congressional resolution to establish a three-member commission, comprising leading radio engineering figures, to survey the use of radio frequencies by the Federal Government, particularly the military services. But because this was only the first session of the 85th Congress, the resolution, sponsored by Senator Charles E. Potter (R., Mich.) and Representative William G. Bray (R., Ind.), will stay alive for the next session without need for re-introduction. Neither the Senate nor the House Interstate and Foreign Commerce Committees to which the resolution was referred took it up during the past session.

SPLIT-CHANNEL SEPARATION — General support for the FCC's split-channel rulemaking plan which would reduce separations between presently assignable frequencies in the 152-162 mc band was recently given by the Electronic Industries Association (formerly Radio-Electronics-Television Manufacturers Association) and by the Associated Police Communications officers in comments which are expected to set the tone for views by other organizations. EIA urged that no restriction be imposed "as to the type of intelligence that is carried on a communication system. . . . As there is further progress in the state of the art, it may well appear that voice communication is not the most effective or efficient utilization of spectrum space in the mobile service, and may well be supplemented by more effective techniques such as high-speed teletype, facsimile, tone signals, etc." APCO asked the FCC to allocate to the police radio service 40 of the new split-channel frequencies derived from the reduced separation plan because police services in all of the major population centers are now operating at the saturation point.

HUGE POWER RADIO GROWTH—The number of frequency channel assignments to licensees in the power radio service ten years from now will be "more than 2½ times the present number" and a commensurate increase in the number of frequencies presently allocated to the service, the National Committe for Utilities Radio has informed the FCC. Of the new assignments in the next ten years, the NCUR stated around 20% could be in the 450-460 mc band while the remaining 80% would be divided between the 30-50 mc and the 152-162 mc bands.

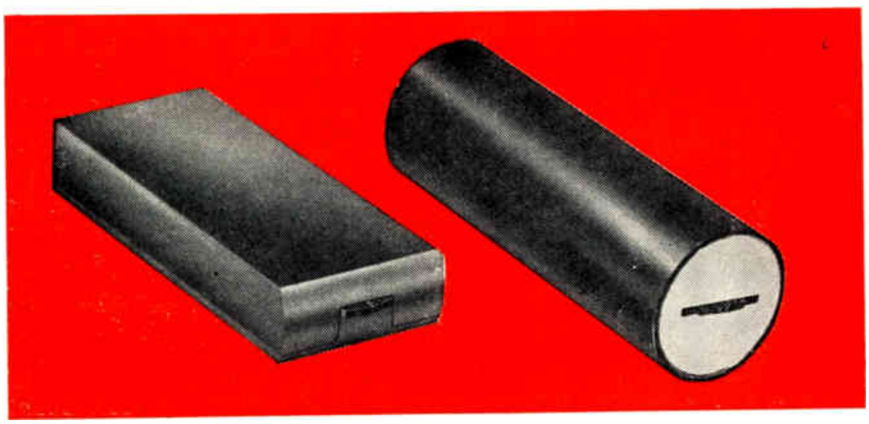
DIAL RADIOTELEPHONE SYSTEM—The Rural Electrification Administration plans for automatic dial mobile and rural subscriber radiotelephone service, which have been in the mill for around two years, were tested recently by the Central Virginia Telephone Corp., an REA telephone borrower. The equipment was designed and built by Motorola and the Automatic Electric Co. and the system will operate directly into dial telephone switching equipment. In authorizing the frequencies for the service. the FCC attached a condition that the radio-telephone system will be operated in line with Conelrad radio alert conditions.

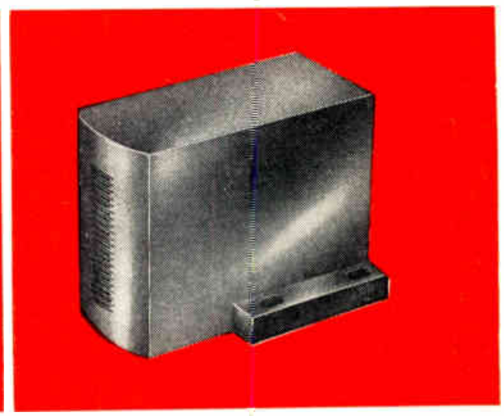
National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

now GENERAL TRANSISTOR WESTERN gives you magnetic recording heads for computers

PRECISION-MADE TO YOUR SPECIFICATIONS IN PRODUCTION QUANTITIES AT LOWEST PRICES





Micro-second recording without distortion . . . and with complete reliability. This is the only kind of recording accuracy tolerated in today's complex computers.

The magnetic recording heads used in these systems must, of necessity, give such optimum recording features. Their mechanical and electrical characteristics are calculated to exclude such recording problems as cross-talk and imperfect recording gap to achieve excellent high frequency response.

General Transistor Western Corporation will build magnetic recording heads to your own specifications . . . to adhere rigidly to these standards of perfect recording. New construction methods, devised by their staff of design and production engineers, enable GT Western to produce highest quality heads at lowest prices for you. All metal construction, laminated shielding between each channel, precision machined gaps and mounting surfaces account for their excellent reputation in the computer field.

Write now for full details.

GENERAL TRANSISTOR WESTERN CORP.

6110 VENICE BLVD. • LOS ANGELES, CALIFORNIA

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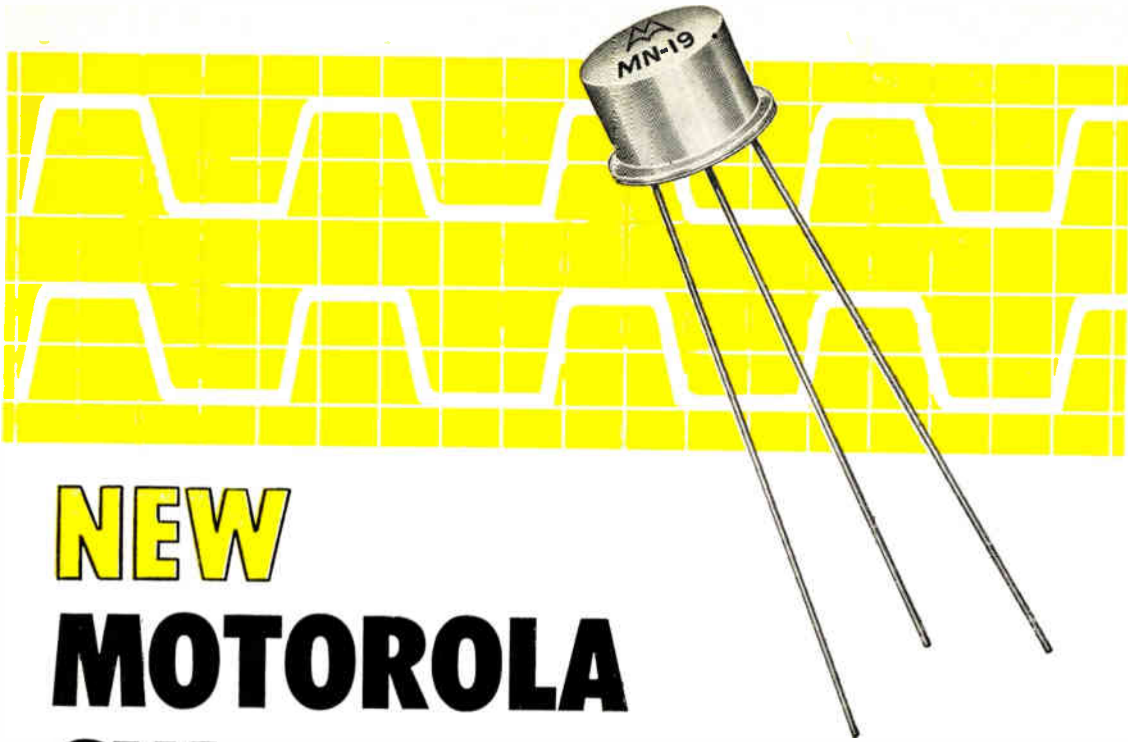
Circle 42 on Inquiry Card, page 107

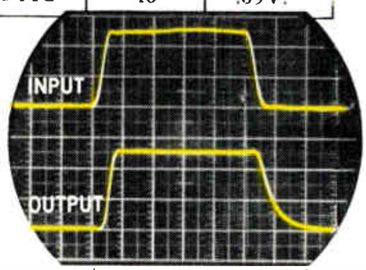


NEW MOTOROLA SWITCHING TRANSISTOR

TECHNICAL DATA MOTOROLA MN19	Maximum Ratings		Typical Values		
	V_{CB}	V_{CE}	f_{ab}	h_{FE}	V_{CS}
Test Condition	Emitter Open	Base Open	$I_C = 3$ ma $V_{CB} = 5V.$	$I_C = 10$ ma $V_{CE} = 1V.$	$I_C = 10$ ma $I_B = 1$ ma
Value	40V.	20V.	8 MC	40	.05V.

PULSE RESPONSE
in typical test circuit

Rise Time	t_r	0.1 μ sec
Storage Time	t_s	0.05 μ sec
Fall Time	t_f	0.11 μ sec



.7 microseconds

provides extreme reliability at a highly competitive price

- Very high voltage breakdown
- Very low saturation resistance
- JETEC size group 30 case
- Performance proven in stringent military applications
- Continuous life-testing and quality assurance program guarantees military reliability level
- "Productioneered"—the MN19 is engineered for extreme quality . . . in quantity. You are assured a dependable volume supply at highly competitive prices.


ACTUAL SIZE

SAMPLE ORDER—4 FOR $24.00

For complete technical information concerning the MN19 or other performance-proven Motorola Semiconductors—write, wire or phone Motorola, Inc., 5005 East McDowell Road, Phoenix, Arizona. BRidge 5-4411

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ULTRA SPEED SWITCHING TRANSISTOR TO BE ANNOUNCED SOON—Motorola's development team has many exciting new types ready for release including a switching transistor operating in the millimicrosecond range.

ELECTRONIC INDUSTRIES'

1958 TRANSISTOR DATA CHART

Complete, up-to-date technical specifications and application data for the 489 transistors now available. Included are more than 170 new types introduced during recent months.

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION							MAXIMUM RATINGS					
										V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	f_α mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_j °C	K °C/mw
AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, N.Y.																						
2N109 2N217	pnp	x		x					x	5.4	4.5	4.5	32	70	25	.35	32	32	70	125[3]	75	.4
2N279	pnp	x		x					x	4.5	5			30	25	.3	30	30	50	125[3]	75	.4
2N280	pnp	x		x					x	4.5	4.5		40	47	25	.3	30	30	50	125[3]	75	.4
2N281 2N282[1]	pnp	x		x	x				x	5.4	4.5	4.5	32	70	25	.35	32	32	125	167[3]	75	.3
2N283	pnp	x		x					x	4.5	3.5	3.5		40	25	.5	30	32	10	125[3]	75	.4
2N284	pnp	x		x				x	x	5.4	4.5	4.5		45	25	.35	32	32	250	167[2,3]	75	.3[2]
2N284A	pnp	x		x				x	x	5.4	4.5	4.5		45	25	.35	60	60	250	167[2,3]	75	.3[2]
OC44	pnp	x					x			6	.5	.4	28	100	25	15	15	15	10	100[3]	75	.5
OC45	pnp	x					x			6	.5	.4	59	40	25	6	15	15	10	100[3]	75	.5
OC65	pnp	x		x					x	4.5	5			30	25	.45	10	10	10	50[3]	75	.65
OC66	pnp	x		x					x	4.5	5			47	25	.47	10	10	10	50[3]	75	.65
1. Matched pair of 2N281. 2. With appropriate heat sink. 3. @25°C.																						
BENDIX SEMICONDUCTOR PRODUCTS, Red Bank Div., Bendix Aviation Corp., 201 Westwood Ave., Long Branch, N.J.																						
2N234 2N234A	pnp	x		x		x		x	x	6	.42a[3]		34	50	25	.3	30	30	3a	25w	90	2°C/W
2N235A	pnp	x		x		x		x		14	.42a[3]		36	80	25	.3	40	40	3a	25w	90	2°C/W
2N236A	pnp	x		x		x		x		14	.76a[3]		35	70	25	.3	40	40	3a	25w	95	2°C/W
2N285A	pnp	x		x		x		x		14	.42a[2,3]		38[1]	125	25	.4	40	40	3a	25w	95	2°C/W
2N399	pnp	x		x	x	x				14	1.5a[3]		28[1]	40	25	.3	40	40	3a	25w	90	2°C/W
2N400	pnp	x		x		x				14	1.3a[3]		35[1]	40	25	.3	40	40	3a	25w	95	2°C/W
2N401	pnp	x		x	x	x				14	1.3a[2,3]		30[1]	40	25	.3	40	40	3a	20w	90	3.5°C/W
2N419	pnp	x				x		x		14	2.2a[3]			75	25	.4	50	50	3a	25w	95	2°C/W
2N420	pnp	x				x		x		14	4a[3]			40	25	.4	40	40	5a	25w	100	2°C/W
2N421	pnp	x				x		x		14	4a[3]			40	25	.4	40	40	5a	25w	100	2°C/W
X-113	pnp	x				x		x		28	4a[3]			30-50	25	.4		80	5a	25w	100	2°C/W
X-133	pnp	x				x		x		28	4a[3]			40	25	.4	80	80	5a	25w	100	2°C/W
X-134	pnp	x				x		x		14	10a[3]			15	25	.4	40	40	12a	50w	95	1.7°C/W
X-137	pnp	x				x		x		28	10a[3]			15	25	.4	60	60	12a	50w	95	1.7°C/W
1. Two units in Class B push-pull operation. 2. Peak. 3. I_c, amperes.																						
BOGUE ELECTRIC MFG. CO. (Germ. Prod. Co. and Rad. Dev. & Res. Corp.), 100 Penna. Ave., Paterson, N.J.																						
2N97	npn	x		x	x		x	x	x	10		1[1]	20	15		1	30	30	10	50	75	.5
2N103	npn	x		x	x		x	x	x	10		1[1]	22	5		.75	35	35	10	50	75	.5
2N160	npn		x	x	x		x	x	x	20		2[1]	34	15	50	4	40	40	25	150	200	1
2N161	npn		x	x	x		x	x	x	20		2[1]	37	30	50	5	40	40	25	150	200	1
2N162	npn		x	x	x		x	x	x	20		2[1]	38	50	50	8	40	40	25	150	200	1
2N163	npn		x	x	x		x	x	x	20		2[1]	40	50	50	6	40	40	25	150	200	1
2N332	npn		x	x	x		x	x	x	20		2[1]	35	15	50	4	45	45	25	150	175	1
2N333	npn		x	x	x		x	x	x	20		2[1]	39	33	50	5	45	45	25	150	175	1
2N334	npn		x	x	x		x	x	x	20		2[1]	39	40	50	8	45	45	25	150	175	1
2N335	npn		x	x	x		x	x	x	20		2[1]	42	49	50	6	45	45	25	150	175	1
2N336	npn		x	x	x		x	x	x	20		2[1]	42.5	100	50	7	45	45	25	150	175	1
2N347	npn		x	x	x	x	x	x	x	20		3[1]	35	25	50	5	60	60	60	750	175	.25
2N348	npn		x	x	x	x	x	x	x	40		3[1]	35	25	50	5	90	90	50	750	175	.25
2N349	npn		x	x	x	x	x	x	x	60		3[1]	35	25	50	5	125	125	40	750	175	.25
X30A	npn		x	x	x	x		x	x	30		50[1]	25	15	75	2	60	60	200	10w	175	2°C/W
X31A	npn		x	x	x	x		x	x	45		40[1]	25	15	75	2	90	90	160	10w	175	2°C/W
X32A	npn		x	x	x	x		x	x	60		30[1]	25	15	75	2	125	125	140	10w	175	2°C/W
1. I_E milliamperes.																						
CBS-HYTRON, A Division of Columbia Broadcasting System, Inc., Seminconductor Operations, Lowell, Mass.																						
2N155	pnp	x				x				-14	180	60	33	40	25	180	-30	-30	-3a	8.5w[1]	85	3°C/W
2N156	pnp	x				x				-14	180	60	33	40	25	180	-30	-30	-3a	8.5w[1]	85	3°C/W
2N158	pnp	x				x				-28	140	80	37	41	25	180	-60	-60	-3a	8.5w[1]	85	3°C/W
2N180	pnp	x		x	x				x	-6	10	8	43	60	25	600	-30	-30		150	75	

GUARANTEED CHARACTERISTICS

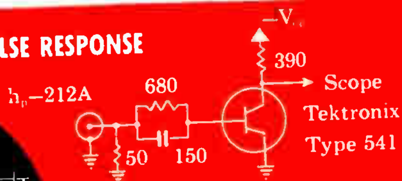
CHARACTERISTIC	CONDITION	VALUE
"ON"	$I_B = -.3ma, I_C = -2ma.$ $I_B = -2.5ma, I_C = -8ma.$	$V_{CE} = -0.07V.$ MAX. $V_{CE} = -0.10V.$ MAX.
"OFF"	$V_{BE} = -0.10V$ $V_{CE} = -4.5V$	$I_C = -150\mu a$ MAX.
HOLE STORAGE FACTOR	$I_E = 1ma, I_B = -1ma.$	$K_s = 120 m\mu$ sec MAX.*
h_{fe} (5mc Current Gain)	$V_C = -3V., I_C = -.5ma.,$ $f = 5mc.$	5 MIN.
C_{ob} (Common Base Output Capacity)	$V_C = -3V., I_C = -.5ma.$	$6\mu\mu f.$ MAX.
I_{CBO} (Collector Cutoff Current)	$V_{CB} = -5V.$	$3\mu a$ MAX.

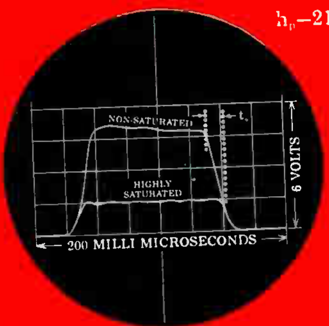
*K_s indicates total stored base charge per unit excess I_B.

MAXIMUM RATINGS

$V_{CE} = -6V.$ $I_C = -15ma.$ $P_C = 10mw$ @ 40°C.

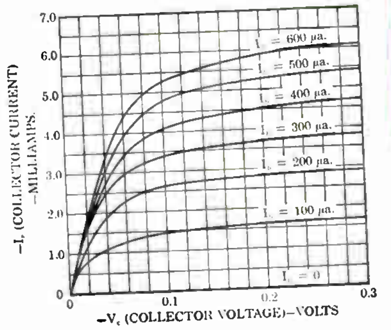
PULSE RESPONSE



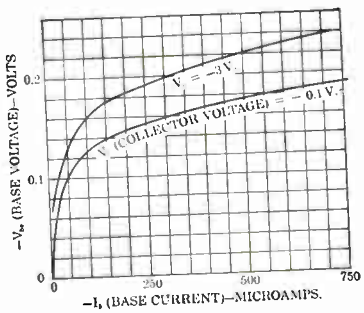


Test Conditions: V_{cc} is set to −6V and pulse input is adjusted until transistor is just in saturation. V_{cc} is then lowered to −1.5V for saturated pulse curve. t_s = hole storage time.

COLLECTOR CHARACTERISTIC IN SATURATION REGION



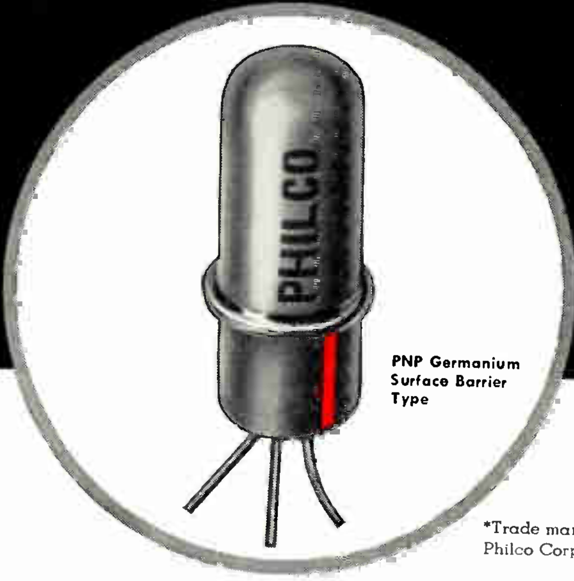
INPUT CHARACTERISTIC



PHILCO SBT*2N240

HIGH SPEED SWITCHING TRANSISTOR

with response time in millimicrosecond range



PNP Germanium Surface Barrier Type

*Trade mark of Philco Corporation

FEATURES

- Low saturation resistance
- Low saturation voltage
- Ideal electrical characteristics for direct coupled circuitry
- Extremely fast rise and fall time
- Absolute hermetic seal
- Available now in production quantities

All major computer manufacturers are using Philco Surface Barrier Transistors where highest reliability for both military and commercial electronic data processing is required. The Philco 2N240 has established outstanding performance and reliability records in high-speed switching circuitry . . . over millions of transistor hours . . . under a variety of environmental conditions.

Make Philco your prime source of information for high speed computer transistor applications.

Write to Dept. EI, Lansdale Tube Company Division, Lansdale, Pa.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION LANSDALE, PENNSYLVANIA

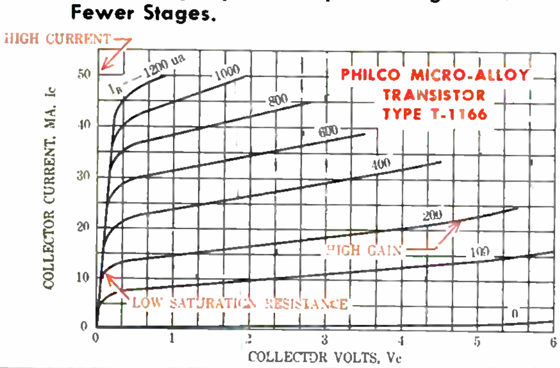
TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	MAXIMUM RATINGS V_{CE} v	V_{CB} c	I_C ma	P_C mw	T_J °C	K °C/mw
CBS-HYTRON (Continued)																						
2N181	pnp	x		x	x				x	-6	10	8	43	60	25	.600	-30	-30		250	75	
2N255	pnp	x				x				-7	180	60	19-26	30-39	25	.180	-15	-15	-3a	8.5w[1]	85	3°C/W
2N256	pnp	x				x				-14	180	60	22-29	30-39	25	.180	-30	-30	-3a	8.5w[1]	85	3°C/W
2N438	npn	x					x	x		6	10	10	29	25	25	2.5[2]	25	25		100	75	
2N439	npn	x					x	x		6	10	10	32	40	25	5[2]	25	25		100	75	
2N440	npn	x					x	x		6	10	10	35	50	25	10[2]	25	25		100	75	
1. Bolted directly to 6"x6"x1/8" aluminum sheet. 2. Minimum.																						
CLEVITE TRANSISTOR PRODUCTS, 241-257 Crescent St., Waltham 54, Mass.																						
2N257	pnp	x		x		x		x	x	-14			33@2W		50	.3	40	40	3a	30w	90	2°C/W
2N268	pnp	x		x		x		x	x	-28			35@2W		50	.3		80	3a	30w	90	2°C/W
2N297	pnp	x		x		x		x	x	-28				25-100	25	.3		60	3a	15w	90	4°C/W
CTP-1104	pnp	x		x		x		x	x	-14			26@2W		50	.3	40	40	3a	15w	90	4°C/W
CTP-1108	pnp	x		x		x		x	x	-7			24@2W		50	.3	20	20	3a	15w	90	4°C/W
CTP-1109	pnp	x		x		x		x	x	-7			30@1W		50	.3	20	20	3a	15w	90	4°C/W
CTP-1111	pnp	x		x		x		x	x	-28			30@2W		50	.3		80	3a	15w	90	4°C/W
CTP-1112	pnp	x		x		x		x	x	-28			35@2W		50	.3	70	80	3a	15w	90	4°C/W
CTP-1117	pnp	x		x		x		x	x	-14			33@4W		50	.3	40	40	5a	15w	90	4°C/W
DELCO RADIO DIV., General Motors Corporation, Kokomo, Ind.																						
2N173	pnp	x		x	x	x		x		12				80[1]		4kc[2]		60	13a	70w	95	1°C/W
2N174	pnp	x		x	x	x		x		28				60[1]		5kc[2]		80	13a	70w	95	1°C/W
2N277	pnp	x		x	x	x		x		12				80[1]		4kc[2]		40	13a	55w	95	1.2°C/W
2N278	pnp	x		x	x	x		x		12				80[1]		4kc[2]		50	13a	55w	95	1.2°C/W
2N441	pnp	x		x	x	x		x		12				48[1]		4kc[2]		40	13a	55w	95	1.2°C/W
2N442	pnp	x		x	x	x		x		12				48[1]		4kc[2]		50	13a	55w	95	1.2°C/W
2N443	pnp	x		x	x	x		x		12				48[1]		4kc[2]		60	13a	55w	95	1.2°C/W
1. Beta @ I_C = 1.2a. 2. $f_β$																						
FRETCO INCORPORATED, 406 North Craig St., Pittsburgh 13, Pa.																						
2N32	pc	x						x		-25			21	2.2	30		-40		-8	50	60	
2N33	pc	x					x			-8			22		30	40	-85		-7	30	60	1
2N34	pnp	x		x						-6			40	.98	30		-25		8	50	60	
2N35	npn	x		x						6			40	.98	30		25		-8	50	60	
2N36	pnp	x		x						-6			40	45	30		-25		8	50	60	
2N37	pnp	x		x						-6			36	30	30		-25		8	50	60	
2N38	pnp	x		x						-6			32	15	30		-25		8	50	60	
2N39	pnp		x				x			-5	-1	1		40	30		-42		-5.5	32	70	
2N40	pnp		x				x			-6	-1	1		30	30		-42		-5.5	32	70	
2N42	npn		x				x			6	1	-1		15	30		32		5.5	32	70	
2N43	pnp		x				x			-6	-1	1		40	30		-35		-8	35	70	
2N63	pnp		x				x			-6	-1	1		22	30		-35		-8	35	70	
2N64	pnp		x				x			-6	-1	1		40	30		-35		-8	35	70	
2N65	pnp		x				x			-6	-1	1		90	30		-35		-8	35	70	
FR25							x			5	10	10	40	25	8				10		25	20
FR26				x						8	24	24	30	25					24		25	80
GENERAL ELECTRIC CO., Electronics Park, Syracuse, N.Y.																						
2N43	pnp	x		x					x	-5	8	4	39	50		1	-20	-45	-300	155	100	.33
2N43A[7]	pnp	x		x					x	-5	8	4	39	50		1	-20	-45	-300	155	100	.33
2N44[7]	pnp	x		x					x	-5	8	4	38	22		1	-20	-45	-300	155	100	.33
2N45	pnp	x		x					x	-5	8	4	36	14		1	-20	-45	-300	155	100	.33
2N78	npn	x					x		x	5	1		29	40		6	15	15	20	65	85	1.1
2N107	pnp	x		x					x	-5	10		38	20		.6	-6	-12	-10	50	60	
2N123	pnp	x					x	x		-5	2	2		50		8	-15	-20	-125	100	85	.6
2N135	pnp	x		Obsolete			x		x	-5	5		29	20		4.5	-12	-20	-50	100	85	.6
2N136	pnp	x		Obsolete			x		x	-5	5		31	40		6.5	-12	-20	-50	100	85	.6
2N137	pnp	x		Obsolete			x		x	-50	5		33	60		10	-6	-10	-50	100	85	.6
2N164A[4]	npn	x		x			x[2]		x	5	1		39	40		8	15	15	20	65	85	.9
2N165[4]	npn	x		x			x		x	5	1		36	72		5	15	15	20	65	85	.9
2N166[4]	npn	x							x	5	5		24	32		5	6		20	25	50	1
2N167[7]	npn	x						x	x	5	.8	1.0		36		8	30	30	75	75	85	.8
2N168	npn	x		x			x		x		see 2N293											
2N168A	npn	x		x			x[2]		x	5	1		39	40		8	15	15	20	65	85	.9
2N169	npn	x		x			x		x	5	1		36	72		5	15	15	20	55	75	.9
2N169A	npn	x		x			x		x	5	1		36	72		5	25	25	20	55	75	.9
2N170	npn	x					x		x	5	5		24	32		5	6		20	25	50	1
2N186	pnp	x		x[1]					x	-5	12	5	28	24		.8	-25	-25	-200	75	85	.8
2N186A	pnp	x		x[1]	x				x	-5	12	5	30	24		.8	-25	-25	-200	180	85	.3
2N187	pnp	x		x[1]					x	-5	12	5	30	36		1	-25	-25	-200	75	85	.8
2N187A	pnp	x		x[1]	x				x	-5	12	5	32	36		1	-25	-25	-200	180	85	.3
2N188	pnp	x		x[1]					x	-5	12	5	32	54		1.2	-25	-25	-200	75	85	.8
2N188A	pnp	x		x[1]	x				x	-5	12	5	34	54		1.2	-25	-25	-200	180	85	.3
2N189	pnp	x		x[3]					x	-5	12		37	24		.8	-25		-50	75	85	.8
2N190	pnp	x		x[3]					x	-5	12		39	36		1	-25		-50	75	85	.8
2N191	pnp	x		x[3]					x	-5	12		41	54		1.2	-25		-50	75	85	.8
2N192	pnp	x		x[3]					x	-5	12		43	75		1.5	-25		-50	75	85	.8
2N241	pnp	x		x[1]					x	-5	12		35	73		1.3	-25		-200	100	85	.3
2N241A	pnp	x		x[1]	x				x	-5	12		35	73		1.3	-25		-200	180	85	.3
2N265	pnp	x		x[3]					x	-5	12		45	110		1.5	-25		-50	75	85	.8
2N292	npn	x		x			x		x	5	1		36	25		5	15	15	20	65	85	.9
2N293	npn	x		x			x		x	5	1		39	25		8	15	15	20	65	85	.9
2N313[4]	npn	x		x			x		x	5	1		36	25		5	15	15	20	65	85	.9
2N314[4]	npn	x		x			x		x	5	1		39	25		8	15	15	20	65	85	.9
2N319[5]	pnp	x		x[1]	x				x	-5	12	2	30	33		2.5	-20	-30	-200	200	100	.31
2N320[5]	pnp	x		x[1]	x				x	-5	12	2	31	48		2.9	-20	-30	-200	200	100	.31
2N321[5]	pnp	x		x[1]	x				x	-5	12	2	32	80		3.3	-20	-30	-200	200	100	.31
2N322[5]	pnp	x		x[3]					x	-5	12		39	48		2.9	-16	-16	-50	75	85	.8
2N323[5]	pnp	x		x[3]					x	-5	12		41	80		3.3	-16	-16	-50	75	85	.8
2N324[5]	pnp	x		x[3]					x	-5	12		43	95		3.4	-16	-16	-50	75	85	.8
2N394[5]	pnp	x					x	x	x	-5	5	5		20		4	-10	-10	-200	150	85	.4
2N395[5]	pnp	x					x	x	x	-5	5	5		25		5	-15	-15	-200	150	85	.4
2N396[5]	pnp	x					x	x	x	-5	5	5		30		5	-20	-20	-200	150	85	.4
2N397[5]	pnp	x					x	x	x	-5	5	5		30		8	-10	-10	-250	150	85	.4
2N430[4]	npn		x					x	x	5	.2					25	10	10	30	150	150	1
2N431[4,7]	npn		x				x		x	5	.2			15		23	15	30	30	150	150	1
2N432[4,7]	npn		x				x		x	5	.2			35		25	15	30	30	150	150	1
2N433[4,7]	npn		x				x		x	5	.2			60		28	15	30	30	150	150	1
2N434[4]	npn		x				x		x	5	.2			110		30	15	30	30	150	150	1
2N448[4]	npn	x					x		x	5	1		36	72		5	15	15	20	65	75	.9

F-l-a-s-h!...from Transistor Center, U.S.A.

Announcing a new transistor class...
The PHILCO Micro-Alloy Transistor (MAT)*

CHECK THESE UNEQUALLED FEATURES

- Excellent High Speed Switching characteristics.
- Low Saturation Voltage (low impedance)
- Excellent high frequency amplification.
- Excellent low-level amplifier over entire frequency range from D.C. to Megacycles.
- Exceptionally Long Life (hermetically sealed)
- Permits high speed computer design with Fewer Stages.



...world's first production transistor with exceptionally high frequency and high gain . . . plus low saturation resistance!

This newest development from Philco Transistor Center features the characteristic high frequency response obtainable with extremely precise base width control. Designed for low voltage operation, the new MAT transistor is especially well suited for high speed applications where low saturation resistance (reduced power consumption) is necessary.

To combine high gain at high currents with high frequency response, the new MAT transistor employs a gallium doped alloy junction for the emitter electrode. A special short-alloying cycle, combined with precise electro-chemical production techniques (pioneered and developed at Philco Transistor Center for production of SBT), results in the micro-alloy contact for exceptionally high injection efficiency. This new process assures higher gain, and permits operation at higher current. Beta linearity is excellent over the entire range of operating currents . . . up to 50 milliamperes.

**Patent Applied For*

Make Philco your prime source of information for high frequency transistor applications.

Write to Dept. EI, Lansdale Tube Company Division, Lansdale, Pa.

PHILCO CORPORATION
LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION							MAXIMUM RATINGS					
										V_C v	I_{CO} µa	I_{EO} µa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
GENERAL ELECTRIC CO. (Continued)																						
2N449	npn	x					x		x	5	1		36	72		5	15	15	20	65	75	.9
2N450	pnp	x					x	x	x	-5	5	5		30		5	-12	-20	50	100	75	.6
2N451	npn		x	x[1]		x		x	x	30	10 ma		25	15	25	.5	65	65	5a	85w	150	.0015
4JD1A17	pnp	x		x					x	-5	8	4	39	43		1.1	-30	-45	-300	155	100	.33
4JD1B2[6]	pnp	x		x				x	x	-5	5	5		12.5		.7	-30	-30	-1a	200	85	.33
4JD1B3[6]	pnp	x		x				x		-5	5	5		17		.7	-30	-30	-1a	200	85	.2
4JD1B4[6]	pnp	x		x				x		-5	5	5		25		.7	-30	-30	-1a	200	85	.2
1. Audio frequency output. 2. Oscillator. 3. Audio Driver. 4. JETEC housing. 5. Modified package. 6. Symmetrical switch. 7. Military versions also available.																						
GENERAL TRANSISTOR CORP., 91-27 138th Place, Jamaica 35, N.Y.																						
2N35 GT-35	npn	x						x		5	12		40	40				25	100	100	75	
2N43A	pnp	x							x	5	16		>12	32-65		>.4		45	50	150	85	
2N44	pnp	x							x	5	15		34-43	16-32		>.4		45	50	150	85	
2N311	pnp	x						x		4.5	<60			25-75				15	200	100	85	
2N312	npn	x						x			<60			25-75				15	200	100	85	
2N315	pnp	x						x		5	1			20		5		20	200	100	85	
2N316	pnp	x						x		5	1			30		12		20	200	100	85	
2N317	pnp	x						x		5	1			30		20		20	200	100	85	
2N318 6T-66	pnp	x						x		4.5	10		42	100				12	20	50	85	
2N356	npn	x						x		5	<5			30		3		>30	200	100	85	
2N357	npn	x						x		5	<5			30		6		>30	200	100	85	
2N358	npn	x						x		5	<5			30		9		>30	200	100	85	
GT-14	pnp	x		x						4.5	6		36	28				25	100	125	85	
GT-14H	pnp	x							x	4.5	6		36	28				12	50	90	75	
GT-20	pnp	x		x						4.5	6		40	42				25	100	125	85	
GT-20H	pnp	x							x	4.5	6		40	42				12	50	90	75	
GT-34	pnp	x		x						4.5	6		32	15				25	100	125	85	
GT-34HV	pnp	x						x		4.5	10		32	10				50	200	150	85	
GT-34N	pnp	x						x		4.5	<450			18				100	200	125	85	
GT-34S	pnp	x						x		4.5	15		32	15				40	200	125	85	
GT-74	pnp	x		x						4.5	6		42	75				25	100	125	85	
GT-75	pnp	x		x						4.5	6		44	150				25	100	125	85	
GT-81	pnp	x		x						4.5	6		42	75				25	100	125	85	
GT-81H	pnp	x							x	4.5	6		42	80				12	50	90	75	
GT-81HS	pnp	x		x						4.5	6		44	120				25	200	150	85	
GT-82	pnp	x		x						4.5	6		46	150				25	100	125	85	
GT-83	pnp	x						x		4.5	10		40	35-49		<.7		25	200	125	85	
GT-87	pnp	x						x		4.5	10		36	38		.5		25	200	125	85	
GT-88	pnp	x						x		4.5	10		42	80		1		25	200	125	85	
GT-109	pnp	x		x						4.5	6		44	120				25	100	125	85	
GT-122	pnp	x						x		4.5	10		42	80		1.5		25	200	125	85	
GT-123	pnp	x						x		4.5	<6			30-150		>5		>20	200	100	85	
GT-153	pnp	x						x		4.5	<5			>20				>30	200	100	85	
GT-167	npn	x						x		5	<10			>25		>5		25	200	100	85	
GT-210H	pnp	x							x	4.5	<25		>34	15-250				12	50	90	75	
GT-222	pnp	x		x						4.5	6		30	20				12	100	125	85	
GT-229	npn	x						x		5	<10			>10				>10	200	100	85	
GT-269	pnp	x						x		4.5	<4					>4		25	200	100	85	
GT-758	pnp	x						x		4.5	<5		20[1]	15		<.5		>20	200	100	85	
GT-759	pnp	x						x		4.5	<5		24[1]	20		.5 to.3		>20	200	100	85	
GT-759R	pnp	x					x			4.5	6		24[1]	25		2.5		12	100	90	75	
GT-760	pnp	x						x		4.5	1		28[1]	40		5		15	50	100	85	
GT-760R	pnp	x					x			4.5	6		28[1]	40		5		10	100	90	75	
GT-761	pnp	x						x		4.5	1		32[1]	75		10		15	50	100	85	
GT-761R	pnp	x					x			4.5	6		32[1]	70		11		10	100	90	75	
GT-762	pnp	x						x		4.5	1		34[1]	100		20		6	50	100	85	
GT-762R	pnp	x					x			4.5	6		34[1]	120		17		6	100	90	75	
GT-763	pnp	x						x		4.5	1		35[1]	120		30		6	50	100	85	
GT-764	pnp	x						x		4.5	<5			200		>25		>20	200	100	85	
GT-792	npn	x						x		5	6			37-160		4.8		20	100	100	85	
GT-903	npn	x						x			<25			35-70				20	200	100	85	
GT-904	npn	x						x		5	<25			>30		>4		20	200	100	75	
GT-905	npn	x						x			<25			20-40				20	200	100	85	
GT-947	npn	x						x			<25			>40				15	200	100	85	
GT-948	npn	x						x		5	<20			>30		>4		20	200	100	85	
GT-949	npn	x						x		5	<25			>30		>.7		30	200	100	85	
1. Freq. = 455KC.																						
SEMICONDUCTOR DIVISION, HUGHES PRODUCTS, HUGHES AIRCRAFT COMPANY, International Airport Station, Los Angeles 45, Calif.																						
HA-5001	npn	x						x		5	5	4		.984		2.5	15	30	200	400	70	.11
HA-5002	npn	x		x	x					5	6	5		.975			10	20	200	400	70	.11
HA-5003	npn	x		x	x					5	6	5		.98		1.5	15	30	200	400	70	.11
HA-5005	npn	x							x	5	7	5		.95		1	5	10	200	400	70	.11
HA-5009	npn	x							x	5	7	5		.93		2.5	5	10	200	400	70	.11
HA-5011	npn	x		x				x		5	6	5		.98		1.5	20	40	200	400	70	.11
HA-5012	npn	x		x	x					5	6	5		.977		1	10	20	200	400	70	.11
HA-5014	npn	x					x			5	8.5	6		.99		2.3	20	40	200	400	70	.11
HA-5016	npn	x		x				x		5	4	4		.975		1	20	30	200	400	70	.11
HA-5020	npn	x						x		5	5	5		70		3	15	20	800[1]	300	70	.15
HA-5021	npn	x						x		5	5	5		70		5	15	20	800[1]	300	70	.15
HA-5022	npn	x						x		15	4	3		70		3	25	25	800[1]	300	70	.15
HA-7501	pnp		x	x				x		5	.01	.01		.920		1	50	60	200	500	150	.25
1. Peak I_C for 10 µsec.																						
LANSDALE TUBE CO., Division of Philco Corp., Lansdale, Pa.																						
2N128	sbt	x					x			-3	.8[1]	.7[1]	25	.96		65[2]	-4.5	-10	-5	30[3]	85	.75
2N129	sbt	x					x			-3	.7[1]	.6[1]	35	.935		60[2]	-4.5	-10	-5	30[3]	85	.75
2N207	pnp	x		x						-5	-4ma[4]		44	100		2	-12	-12	-20	50[3]	65	.8
2N207A	pnp	x		x						Low noise version of 2N207, NF = 10db max.												
2N207B	pnp	x		x						Low noise version of 2N207, NF = 5db max.												
2N223	pnp	x		x						-4.5	-2ma[4]		34	95		.6	-18		-150	100[5]	65	.2
2N224	pnp	x		x						-6	-10ma[4]		35	75		.51		-25	-150	150[5]	75	.2
2N225	pnp	x			x					Matched pair 2N224's, Beta match typically 7% - maximum 20%.												
2N226	pnp	x		x						-6	10ma		32	55		.4		-25	-150	100[5]	65	.2
2N227	pnp	x			x					Matched pair 2N226's, Beta match typically 7% - maximum 20%.												
2N240	sbt	x						x		-3	.7[1]	.5[1]		16[6]		30[2]	-6		-15	10[7]	85	.75
2N299	sbt	x					x			-3	.7[1]	.6[1]				98[2]	-4.5	-7	-20	40[7]	85	.75

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	MAXIMUM RATINGS V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
LANSDALE TUBE CO., (Continued)																						
2N300	sbt	x					x			-3	.6[1]	.5[1]				95[2]	-4.5	-7	-20	40[3]	85	.75
2N344	sbt	x					x	x		-3	.7[1]	.5[1]		11-33		30-50[2]	-5	-5	-5	20[7]	55	.75
2N345	sbt	x					x	x		-3	.8[1]	.6[1]		25-110		30-50[2]	-5	-5	-5	20[7]	55	.75
2N346	sbt	x					x	x		-3				14		60-75[2]	-5	-5	-5	20[7]	55	.75
2N352	pnp	x				x				-13	1ma[8]		36	65		.016		-40	-2a	7w[9]	100	3°C/W
2N353	pnp	x				x				-13	1ma[8]		36	90		.016		-40	-2a	10w[9]	100	2.5°C/W
2N354	pnp		x						x	-6	-1			18		15[2]	-25	-25	-50	150[3]	140	.77
2N355	pnp		x					x		-6	-1[10]			18		25[2]	-10	-10	-50	150[3]	140	.77
2N386	pnp	x				x					5ma[11]		36	40		.007[6]		-60	-3a	12.5w[9]	100	2°C/W
2N387	pnp	x				x					5ma		36	75		.006[6]		-80	-3a	12.5w[9]	100	2°C/W
2N393	mat	x					x	x		-3	-1.5ma[1]	-2.5ma[1]		93		60[2]	-6	-6	-50	50[3]	85	.75
SB100	pnp	x					x	x		-3	.6[1]	.5[1]	33	20		45[2]	-4.5		-5	10[7]	85	.75
T0031	pnp	x									15[13]						-50	-50	-10	25[13]	65	.7
T1000	pnp	x		x						-4.5	-2ma[4]			65		.6	-18		60	100[5]	65	.2
T1001	pnp	x		x						-4.5	-2ma[4]			65		.6	-18		60	100[5]	65	.2
T1050	sbt	x					x			-3	.6[1]	.4[1]	22	.95		95[2]	-4.5		-3	30[3]	85	.75
T1164	pnp	x						x		-12	7[7]			45[14]		.5		-40	-20	150	75	.4

1. @5v. 2. F_{max}. 3. @25°C. 4. @12v. 5. @ 45°C. 6. Minimum. 7. @40°C. 8. @85°C. 9. @75°C. 10. @10v. 11. Max. @60v. 12. Max. @80v. 13. @50v. 14. DC.

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
MINNEAPOLIS-HONEYWELL REGULATOR CO., 2753 Fourth Avenue South, Minneapolis 8, Minn.																						
H3A	pnp	x			x	x		x		28	-.15ma[1]	2w[2]	21	12[3]	55			-60	-350	3w[4]	95	14°C/W
H4A	pnp	x			x	x		x		28	-.15ma[1]	3w[2]	23	15[3]	55			-60	-500	3w[4]	95	14°C/W
H5	pnp	x			x	x		x		28	-.5ma[1]	10w[2]	31	50[3]	85			-80	-3a	20w[4]	95	2.2°C/W
H6	pnp	x			x	x		x		28	-.5ma[1]	10w[2]	34	75[3]	85			-80	-3a	20w[4]	95	2.2°C/W
H7	pnp	x			x	x		x		28	-.5ma[1]	10w[2]	37	140[3]	85			-80	-3a	20w[4]	95	2.2°C/W
H10	pnp	x			x	x		x		28	-1.8ma[1]	250w[5]	26	18[3]	85			-60	-15a	65w[4]	95	.7°C/W

1. @60v. 2. Typical power output, class B push-pull. 3. DC Beta. 4. @T_M = 50°C. 5. Typical power output, DC-to-DC power converter.

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
MOTOROLA, INC., Semiconductor Products Division, 5005 E. McDowell Rd., Phoenix, Ariz.																						
2N176	pnp	x		x	x	x		x	x	12	3ma[1]		36		80[2]	5kc[3]	30	40	3a	10w[4]	90	1°C/W
MN13A	pnp	x		x	x			x	x	12	60[1]	35[1]	31		80[2]	50kc	30	40	150	350[4]	90	
MN13B	pnp	x		x	x			x	x	12	60[1]	35[1]	34		80[2]	45kc	30	40	150	350[4]	90	
MN13C	pnp	x		x	x			x	x	12	60[1]	35[1]	37		80[2]	40kc	30	40	150	350[4]	90	
MN21	pnp	x		x	x	x		x	x	28	2ma[1]		37		80	10kc[3]	60	80	3a	10w[4]	90	1°C/W
MN24	pnp	x		x	x	x		x	x	12	3ma[1]		32		80	5kc[3]	30	40	3a	10w[4]	90	1°C/W
MN25	pnp	x		x	x	x		x	x	12	3ma[1]		34		80	5kc[3]	30	40	3a	10w[4]	90	1°C/W
MN26	pnp	x		x	x	x		x	x	12	3ma[1]		36		80	5kc[3]	30	40	3a	10w[4]	90	1°C/W

1. Maximum. 2. Ambient. 3. Minimum. 4. @80°C.

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
NUCLEONIC PRODUCTS CO., INC., 1601 Grande Vista Ave., Los Angeles 23, Calif.																						
GFT 20	pnp	x		x						3	1ma	960	35	25	45	.6	15	20	20	85	75	.6
GFT 21	pnp	x		x						3	3ma	2.97ma	44	90	45	1.1	15	20	20	85	75	.6
GFT 26	pnp	x			x	x		x		6	500ma	480ma	26	25	45	.3	16	40	2a	10 W	75	5°C/W
GFT 32	pnp	x		x	x			x		3	10ma	9.85ma	33	70	45	.5	15	20	450	250	75	.2
GFT 44	pnp	x					x			6	.5ma	490	32	40	45	10	15	15	10	50	65	.8
GFT 45	pnp	x					x			6	.5ma	.485	32	100	45	6	15	15	10	50	65	.8
GFT 4012	pnp	x			x	x		x		12	400ma	392ma	33	45	45	.4	30	40	4a	20 W	75	2.5°C/W

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
RADIO CORPORATION OF AMERICA, Semiconductor Division, Somerville, N.J.																						
2N77	pnp	x		x						-4	-10		44.1	55	25	.7		-25	-15	35	50	
2N104	pnp	x		x						-6	-10		41	44	25	.7		-30	-50	35	70	.4
2N105	pnp	x		x						-4	-5		42	55[3]	25	.75		-25	-15	35	50	
2N109	pnp	x		x	x					-9[1]	-10		33[4]	75[3]	25			-25	-70	150	71	
2N139	pnp	x					x			-9	-6		37.8	48	25	6.7		-16	-15	80	71	
2N140	pnp	x					x			-9	-6		32	75	25	10		-16	-15	80	71	
2N175	pnp	x		x						-4	-12		43	65	25	.85		-10	-2	20	50	
2N206	pnp	x		x						-5	-10		46	47	25	.78		-30	-50	75		.3
2N215	pnp	x		x						-6[1]	-10		41	44[3]	25	.7		-30	-50	35	70	.4
2N217	pnp	x		x	x					-9[1]	-10		33[4]	75[3]	25			-25	-70	150	71	
2N218	pnp	x					x			-9	-6		37.8	48	25	6.7		-16	-15	80	71	
2N219	pnp	x					x			-9	-6		32	75	25	10		-16	-15	80	71	
2N220	pnp	x		x						-4	-12		43[3]	65	25	.85		10	-2	20	50	
2N247	pnp	x					x			-9	-16		45	60	25	30		-35	-10	35	71	
2N269	pnp	x						x							25	4[2]		-25	-100	120	71	
2N270	pnp	x		x	x					-12[1]	-10		32[4]	70[3]	25			-25	-150	250	71	
2N274	pnp	x					x			-9	-16		45[3]	60[3]	25	30		-35	-10	35	71	
2N301	pnp	x		x		x				-14.4	-220		30[4]	70[3]	55			-40	2w	12w	85	
2N301-A	pnp	x		x		x				Like 2N301 but has a peak col.-to-base v. of -60v.								-60	2w	12w	85	
2N370	pnp	x					x			-12	-20			60[5]	25	30		-20	-10	80	71	
2N371	pnp	x					x			-12	-20			.973[5]	25	30		-20	-10	80	71	
2N372	pnp	x					x			-12	-20			60	25	30		-20	-10	80	71	
2N384	pnp	x					x			-12	-12		30		25	100		-30	-10	120	71	
2N398	pnp	x						x		Max. Collector-to-Emitter Satur. Voltage = 0.35.							-105	-105	-100	50	71	
2N404	pnp	x						x		Like 2N269 but has smaller case, leads spaced to RETMA STANDARD R5-188.												
2N405	pnp	x		x						-6	-10		43	35	25			-12	70	150	71	
2N406	pnp	x		x						-6[1]	-10		43	35	25			-12	70	150	71	
2N407	pnp	x		x	x					-9[1]	-10		33[4]	65	25			-20	70	150	71	
2N408	pnp	x		x	x					-9[1]	-10		33[4]	65	25			-20	70	150	71	
2N409	pnp	x					x			-9	-6		37.8	48	25	6.7		-12	-15	80	71	
2N410	pnp	x					x			-9	-6		37.8	48	25	6.7		-12	-15	80	71	
2N411	pnp	x					x			-9	-6		32	75	25	10		-12	-15	80	71	
2N412	pnp	x					x			-9	-6		32	75	25	10		-12	-15	80	71	

1. Supply Voltage. 2. Minimum. 3. Large-signal DC current transfer ratio. 4. Two Transistors class B Push-Pull. 5. Common Base forward value.

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	V_C v	I_{CO} μa	I_{EO} μa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
RAYTHEON MANUFACTURING CO., 55 Chapel Street, Newton 58, Mass.																						
2N63	pnp	x		x						-6	-1ma[1]		39	22	25		-22		-10	100	85	.59[2]
2N64	pnp	x		x						-6	-1ma[1]		41	45	25		-15		-10	100	85	.59[2]
2N65	pnp	x		x						-6	11[1]		42	90	25		-12		-10	100	85	.59[2]
2N130A	pnp	x		x						-6	-1ma[1]		39	22	25		-22		-100	100	85	.59[2]
2N131A	pnp	x		x						-6	-1[1]		41	45	25		-15		-100	100	85	.59[2]
2N132A	pnp	x		x						-6	-1[1]		42	90	25		-12		-100	100	85	.59[2]
2N133A	pnp	x		x						-1.5	-.5ma[1]		36	50	25		-6		-100	100	85	.59[2]
2N138B	pnp	x		x	x					-6	-20ma[1]		42	140	25		-12		-100	100	85	.59[2]
2N327	pnp		x	x				x		-6	-1ma[1]	.005	32	14	25	.3	-50		-50	337	160	.4[2]
2N328	pnp		x	x				x		-6	-1ma[1]	.005	34	24	25	.35	-35		-50	337	160	.4[2]
2N329	pnp		x	x				x		-6	-1[1]	.005	36	50	25	.6	-30		-50	337	160	.4[2]
2N330	pnp		x	x						-6	-1[1]	.005	34	30	25	.5	-45		-50	337	160	.4[2]
2N359	pnp	x		x	x					-6	-20ma[1]		43	125	25		-20		-500	180	85	.35[2]
2N360	pnp	x		x	x					-6	-20ma[1]		40	100	25		-20		-500	180	85	.35[2]

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION							MAXIMUM RATINGS					
										V_C v	I_{CO} µa	I_{EO} µa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
RAYTHEON MANUFACTURING CO., (Continued)																						
2N361	pnp	x		x	x					-6	-20ma[1]		37	70	25		-30		-500	180	85	.35[2]
2N362	pnp	x		x						-6	-20ma[1]		44	120	25		-20		-500	180	85	.35[2]
2N363	pnp	x		x						-6	-20ma[1]		40	50	25		-35		-500	180	85	.35[2]
2N413	pnp	x					x			-6	-1ma[1]		33	25	25	3	-15	-30	-200	150	85	.4[2]
2N413A	pnp	x					x			-6	-1ma[1]		33	25	25	3	-15	-30	-200	150	85	.4[2]
2N414	pnp	x					x			-6	-1ma[1]		35	30	25	5	-15	-30	-200	150	85	.4[2]
2N414A	pnp	x					x			-6	-1ma[1]		35	30	25	5	-15	-30	-200	150	85	.4[2]
2N415	pnp	x					x			-6	-1ma[1]		39	45	25	10	-10	-30	-200	150	85	.4[2]
2N415A	pnp	x					x			-6	-1ma[1]		39	45	25	10	-10	-30	-200	150	85	.4[2]
2N416	pnp	x					x			-6	-1ma[1]		18	45	25	10	-10	-30	-200	150	85	.4[2]
2N417[4]	pnp	x					x			-6	-1ma[1]		25	75	25	20	-10	-30	-200	150	85	.4[2]
2N422[4]	pnp	x		x						-6	-20ma[1]		40	50	25		-20		-500	180	85	.35[2]
2N425	pnp	x						x		-.25	-30ma[1]			30	25	4	-20	-30	-400	150	85	.4[2]
2N426	pnp	x						x		-.25	-40ma[1]			40	25	6	-18	-30	-400	150	85	.4[2]
2N427	pnp	x						x		-.25	-55ma[1]			55	25	11	-15	-30	-400	150	85	.4[2]
2N428	pnp	x						x		-.25	-80ma[1]			80	25	17	-12	-30	-400	150	85	.4[2]
CK754[3]	pnp	x		x						-6	-20ma[1]		42	300	25		-10	-30	-100	100	85	.59[2]
CK870[3]	pnp	x		x				x		-6	-1ma[1]			12	25	.5	-25	-45	-100	100	85	.59[2]
CK871[3]	pnp	x		x				x		-6	-1ma[1]			20	25	.7	-20	-45	-100	100	85	.59[2]
1. I_C, milliamperes. 2. In air. 3. Symmetrical. 4. Low noise.																						
SPRAGUE ELECTRIC COMPANY, North Adams, Mass.																						
2N159	pc									15	.5	100		3	25	5		-50	-40	100	80	.50°C/W
2N240	pnp	x						x		-3	.5	.5		30	25	45	-5V	-5V	-5	10	55	1.5°C/W
2N344 SB101	pnp	x					x			-3	.5	.5		23	25	45	-5V	-5V	-5	10	55	1.5°C/W
2N345 SB102	pnp	x					x			-3	.5	.5		40	25	45	-5V	-5V	-5	10	55	1.5°C/W
2N346 SB103	pnp	x					x			-3	.5	.5		25	25	60	-5V	-5V	-5	10	55	1.5°C/W
PC-6	pc									8	1	100		5[1]	25	5		-80	-60	150	80	.33°C/W
8D	pnp	x		x					x	-6	1	1	42	50	25	1.5	-20[2]	-40	-50	180	80	.24°C/W
8E	pnp	x		x					x	-6	1	1	40	22	25	1.5	-20[2]	-40	-50	180	80	.24°C/W
8F	pnp	x		x					x	-6	1	1	38	13	25	1.5	-20[2]	-40	-50	180	80	.24°C/W
10A	pnp	x		x	x					-6	1	1	34	25	25	1.2	-20	-40	-200	200	80	.22°C/W
10B	pnp	x		x	x					-6	1	1	38	40	25	1.2	-20	-40	-200	200	80	.22°C/W
10C	pnp	x		x	x					-6	1	1	42	55	25	1.2	-20	-40	-200	200	80	.22°C/W
1. 02mc. 2. 1K ohms stabilization.																						
SYLVANIA ELECTRIC PRODUCTS INC., Semiconductor Division, 100 Sylvan Road, Woburn, Mass.																						
2N34	pnp	x							x	-6	5		35	.975	25	.3[2]	-25	-40	100	50[3]	75	1
2N35	npn	x							x	6	5		35	.975	25	.6[2]	25	40	100	50[3]	75	1
2N68	pnp	x				x				-12	100		23	40[4]	25	.4		-30	1.5a	2w[3]	75	12.5°C/W[5]
2N94	npn	x					x			6	5		25	.97	25	4	20	20	50	50[3]	75	1
2N94A	npn	x					x	x		6	5		25	.98	25	7	20	20	50	50[3]	75	1
2N95	npn	x				x				12	100		23	40[4]	25	.4		30	1.5a	2w[3]	75	12.5°C/W[5]
2N101	pnp	x				x				-12	100		23	40[4]	25	.4		-30	1.5a	1w[3]	75	25°C/W[5]
2N102	npn	x				x				12	100		23	40[4]	25	.4		30	1.5a	1w[3]	75	25°C/W[5]
2N141	pnp	x				x				-24	150		26	40[4]	25	.4	-30	-60	.8a	1.5w[3]	75	25°C/W[5]
2N142	npn	x				x				24	150		26	40[4]	25	.4	30	60	.8a	1.5w[3]	75	25°C/W[5]
2N143	pnp	x				x				-24	150		26	40[4]	25	.4	-30	-60	.8a	1w[3]	75	25°C/W[5]
2N144	npn	x				x				24	150		26	40[4]	25	.4	30	60	.8a	1w[3]	75	25°C/W[5]
2N155	pnp	x				x				-14	200		33	40[4]	25	.145	-30		3a	1.5w[5]	85	7.5°C/W[5]
2N176	pnp	x				x				-12	200		32	60[8]	25	.01[7]	-30		3a	10w[5]	90	10°C/W[8]
2N193	npn	x					x			6	5			7.5[9]	25	2[2]	15		50	50[3]	75	1
2N194	npn	x					x			6	5			8[9]	25	2[2]	25		50	50[3]	75	1
2N211	npn	x					x			6	7			10[9]	25	2[2]	10		50	50[3]	75	1
2N212	npn	x					x			7.5	8			10[9]	25	4[2]	10		50	50[3]	75	1
2N213	npn	x		x						9	10		42	150[10]	25		25		100	50[3]	75	1
2N214	npn	x		x						12	10		29	70[4]	25	.6[2]	25			125[3]	75	1
2N216	npn	x					x			9	10		26	7.5[9]	25	2[2]	15			50[3]	75	1
2N228	npn	x		x						6	15		26	70	25	.6[2]	25			50[3]	75	1
2N229	npn	x							x	6	15			.96	25	.55[2]	12	10	40	50[3]	75	1
2N233	npn	x						x	x	6	10			4.5[9]	25		10	10		50[3]	75	1
2N235A	pnp	x				x				-14	200		35	60[8]	25	7kc[7]		-40	3a	5w[5]	90	2°C/W
2N242	pnp	x				x				-14	200		35		25	5kc[7]	-45	-45	2a	25w[5]	100	3°C/W
2N250	pnp	x				x				-14	200		33	60[8]	25	6kc[7]	-30		2a	12w[5]	80	2.2°C/W
2N257	pnp	x				x				-14	200		30		25	7kc[7]		-40		25w[5]	85	2.5°C/W
2N296	pnp	x				x				-28	150			20[8]	25	4kc	-60		2a	25w[5]	100	3°C/W
2N306	npn	x							x	7.5	15			97[4]	25		15	20		50[3]	75	1
2N307	pnp	x				x			x	-14	250			20[4]	25	3kc	-35	-35	1a	15w[5]	75	5°C/W
2N325	pnp	x				x				-12	200		28	40[4]	25	.15[2]	-35	-35	2a	12w[5]	85	5.5°C/W
2N326	npn	x				x				12	200		28	40[4]	25	.15[2]	35	35	2a	7w[5]	85	9°C/W
2N377	npn	x					x	x		20	6		15	30[4]	25	4[2]	20	25	200	150[3]	100	.5
2N385	npn	x					x	x		20	6		15	60[4]	25	4[2]	25	25	200	150[3]	100	.5
2N388	npn	x					x	x		20	6		15	80[4]	25	8[2]	20	25	200	150[3]	100	.5
1. At rated V_{CB}. 2. Minimum. 3. In free air at 25°C. 4. DC current gain. 5. With heat sink. 6. Above 80°C. 7. Beta cutoff minimum. 8. Small signal current gain. 9. Beta @ 455kc. 10. Beta at 270 cps.																						
TEXAS INSTRUMENTS INCORPORATED, P.O. Box 312, Dallas, Texas																						
2N117 USN2N117	npn		x						x	30	10[1,2]			9-20[3]		1[4]			25	150[1]	150	.12mw/°C
2N118 USN2N118	npn		x						x	30	10[1,2]			18-40[3]		2[4]			25	150[1]	150	.12mw/°C
2N118A	npn		x						x	30	10[1,2]		35	18-90[3]		8[4]			25	150[1]	175	.12mw/°C
2N119 USN2N119	npn		x						x	30	10[1,2]			36-90[3]		2[4]			25	150[1]	150	.12mw/°C
2N145	npn	x					x			9	.2		30-33	10		2.5	20	20	5	65[1]	75	.7
2N146	npn	x					x			9	.2		33-36	15		3	20	20	5	65[1]	75	.7
2N147	npn	x					x			9	.2		36-39	15		3.5	20	20	5	65[1]	75	.7
2N185	pnp	x		x	x					-9	-8		40.5	60		.2	20	20	150	150[1]	50	
2N238	pnp	x		x						-9	-8		37-42	35		.2	20	20	100	50[1]	60	
2N243	npn		x			x				60	1			9-32					60	750	150	.6mw/°C
2N244	npn		x			x				60	1			28-90					60	750	150	.6mw/°C
2N250	pnp	x				x				-12	-.3ma		31-40				30	30	3a	25w[1]	85	1.1°C/W
2N251	pnp	x				x				-24	-.5ma		31-40				60	60	3a	25w[1]	85	1.1°C/W
2N252	pnp	x					x			-9	-5		34	30		30	16	16	-5	30[1]	55	
2N253	npn	x					x			9	.2		28-32	10		2.5	12	12	5	65[1]	75	.7
2N254	npn	x					x			9	.2		32-36	15		3	20	20	5	65[1]	75	.7
2N291	pnp	x		x	x					-12	-10		33	90		.2	25	25	200	300[1]	50	.125

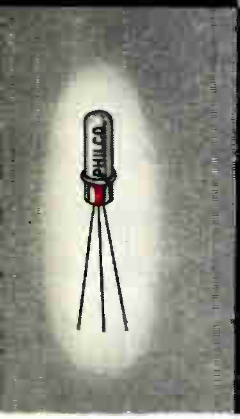
Another First... **FROM TRANSISTOR CENTER, U.S.A**

SB101

For general high frequency use, the SB101 offers a narrow, controlled Beta range—plus medium gain characteristics. Here is a good wide-band video or IF amplifier.

SB102

SB102 is a higher gain transistor, with controlled Beta range. Performs extremely well in oscillators, converters, mixers and narrow-band video.



SB103

SB103 features hi-frequency (min. f max. = 60 MC). This transistor is ideally suited to higher frequency oscillators and converters, or wherever high frequency operation is the most important consideration.

NOW... *High Frequency Transistors* for easier circuit design—unequalled reliability

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For the first time—anywhere—Philco offers a complete line of Surface Barrier Transistors for low voltage communications circuitry (1-5 volts). Now you can select the best general purpose, high-frequency transistor for each application . . . RF . . . IF . . . video amplifiers, converters, oscillators . . . and for high-speed switching circuits.

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Test . . . compare . . . specify Philco

Other Philco Surface Barrier Transistor types are available for military applications (2N128, 2N129) and for high speed switching (2N240).

	SB101			SB102			SB103		
	Min	Typ	Max	Min	Typ	Max	Min	Typ	
Current Amplification Factor, h_{fe}	11		33	25		110	10		
Maximum Frequency of Oscillation, f_{os} max	30	50		30	50		60	75	mc

Max. Ratings (SB101, 102, 103) V_{CE} = —5v., I_C = —5 ma., P_C @ 40°C = 20 mw.

Make Philco your prime source of information for high-frequency transistor applications! **Write for complete data to Dept. EI.**

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

TYPE	CLASS	Ge.	Si.	Audio	B-Amp.	Pwr.	if-rf	Sw.	Gen.	TYPICAL OPERATION							MAXIMUM RATINGS					
										V_C v	I_{CO} µa	I_{EO} µa	PG db	α or β	T °C	$f_α$ mc	V_{CE} v	V_{CB} v	I_C ma	P_C mw	T_J °C	K °C/mw
TEXAS INSTRUMENTS INCORPORATED (Continued)																						
2N308	pnp	x					x			-9	-5		39-42	30		30	20	20	-5	30[1]	55	
2N309	pnp	x					x			-9	-5		41-44	30		30	20	20	-5	30[1]	55	
2N310	pnp	x		x			x			-9	-5[1,2]		37	30		30	30	30	-5	30[1]	55	
2N332	npn		x						x	45	4[1,2]		35	9-20[3]		1[4]			25	150[1]	175	.12mw/°C
2N333	npn		x						x	45	4[1,2]		39	18-40[3]		2[4]			25	150[1]	175	.12mw/°C
2N334	npn		x						x	45	4[1,2]		39	18-90[3]		8[4]			25	150[1]	175	.12mw/°C
2N335	npn		x						x	45	4[1,2]		42	36-90[3]		2[4]			25	150[1]	175	.12mw/°C
2N336	npn		x						x	45	4[1,2]		42.5	76-333[3]					25	150[1]	175	.12mw/°C
2N337	npn		x					x		40	1[1,2]					20			20	125[1]	150	1mw/°C
2N338	npn		x					x		40	1[1,2]					10			20	125[1]	150	1mw/°C
2N339	npn		x			x				55	1[1,2]			9[3,4]					60	1w[1]	150	.8mw/°C
2N340	npn		x			x				85	1[1,2]			9[3,4]					50	1w[1]	150	.8mw/°C
2N341	npn		x			x				125	1[1,2]			9[3,4]					40	1w[1]	150	.8mw/°C
2N342	npn		x			x				60	1[1,2]			9-32[3]					60	1w[1]	150	.8mw/°C
2N343	npn		x			x				60	1[1,2]			28-90[3]					60	1w[1]	150	.8mw/°C
2N389	npn		x			x				60				10[4,5]			60		2a	37.5w[1]	150	300mw/°C
2N424	npn		x			x				60			20[4]	10[4,5]			60		2a	37.5w[1]	150	300mw/°C
3N32	npn		x				x			30	.2[1,2]		20[4,6]						10	125[1]	150	1mw/°C
3N33	npn		x				x			30	.2[1,2]		18[4,7]						10	125[1]	150	1mw/°C
3N34	npn		x				x			30	.2[1,2]		16[4,8]						10	125[1]	150	1mw/°C
903	npn		x						x	30	10[1,2]		30.5	9-20[3]		1[4]			25	150[1]	175	.12mw/°C
904	npn		x						x	30	10[1,2]		34	18-40[3]		2[4]			25	150[1]	175	.12mw/°C
904A	npn		x						x	30	10[1,2]		35	18-90[3]		8[4]			25	150[1]	175	.12mw/°C
905	npn		x						x	30	10[1,2]		36.5	36-90[3]		2[4]			25	150[1]	175	.12mw/°C
910	npn		x						x	30	10[1,2]		42.5	76-333[3]					25	150[1]	175	.12mw/°C
951	npn		x			x				50	5[1,2]			9[3,4]					60	750[1]	150	.6mw/°C
952	npn		x			x				80	6[1,2]			9[3,4]					50	750[1]	150	.6mw/°C
953	npn		x			x				120	8[1,2]			9[3,4]					40	750[1]	150	.6mw/°C
970	npn		x			x				120	10[1,2]		28[4]	3[4,5]				120	140	8.75w[1]	150	70mw/°C
1. @25°C. 2. Maximum. 3. h_{fe}. 4. Minimum. 5. h_{FE}. 6. @4.3mc. 7. @12.5mc. 8. @30mc.																						
TRANSITRON ELECTRONICS CORPORATION, Wakefield, Mass.																						
2N83	pnp	x		x	x	x				30			27	18	25	.3	60	66	2a	10w	85	6°C/W
2N83A	pnp	x		x	x	x				30			26	17	25	.4	60	66	3a	10w	85	6°C/W
2N84	pnp	x		x	x	x				22			26	21	25	.3	45	50	2a	10w	85	6°C/W
2N84A	pnp	x		x	x	x				22			25	20	25	.4	45	50	3a	10w	85	6°C/W
2N332	npn		x	x					x	30			36	9-20	100	7	45	45	25	150	175	1
2N333	npn		x	x					x	30			39	18-41	100	9	45	45	25	150	175	1
2N334	npn		x	x			x		x	30			40	18-90	100	11	45	45	25	150	175	1
2N335	npn		x	x					x	30			40	37-90	100	10	45	45	25	150	175	1
ST10	npn		x	x					x	6			37	10-25	100	8	15	15		200	175	.75
ST11	npn		x	x			x		x	6			39	20-50	100	10	15	15		200	175	.75
ST12	npn		x	x			x		x	6			40	40-100	100	11	15	15		200	175	.75
ST13	npn		x	x			x		x	6			40	30-60	100	17	15	15		200	175	.75
ST30	npn		x	x					x	20			37	10-25	100	8	30	30		200	175	.75
ST31	npn		x	x			x		x	20			39	20-50	100	10	30	30		200	175	.75
ST32	npn		x	x			x		x	20			40	40-100	100	11	30	30		200	175	.75
ST33	npn		x	x			x		x	20			40	30-60	100	17	30	30		200	175	.75
ST40	npn		x	x					x	30			37	10-25	100	8	45	45		200	175	.75
ST41	npn		x	x			x		x	30			39	20-50	100	10	45	45		200	175	.75
ST42	npn		x	x			x		x	30			40	40-100	100	11	45	45		200	175	.75
TUNG-SOL ELECTRIC, INC., Semiconductor Division, 95 Eighth Avenue, Newark, N.J.																						
2N63	pnp	x		x						-6	6		30	.958		.6	-25			100	85	.35
2N64	pnp	x		x						-6	6		33	.978		.8	-25			100	85	.35
2N65	pnp	x		x						-6	6		36	.991		1.2	-25			100	85	.35
2N242	pnp	x				x				-12	150		34	50		5kc	-45		2a	12w	85	3°C/W
2N307	pnp	x				x				-1.5	500			50		3kc	-35		1a	7.5w	75	5°C/W
2N378	pnp	x				x		x		-14	150		24	35		7kc	-40		3a	15w	85	3°C/W
2N379	pnp	x				x		x		-28	150		23	30		7kc	-80		3a	15w	85	3°C/W
2N380	pnp	x				x		x		-28	150		29	60		7kc	-60		3a	15w	85	3°C/W
2N381	pnp	x			x					-12	10	50	31	50		1.2	-25	-25	200	200	85	.2
2N382	pnp	x			x					-12	10	50	33	75		1.5	-25	-25	200	200	85	.2
2N383	pnp	x			x					-12	10	50	35	100		1.8	-25	-25	200	200	85	.2
TS 615	pnp	x		x						-45	15			.96		1	-45		50	100	85	.35
TS 630	pnp	x		x						-45	15			.98		1	-45		50	100	85	.35
TS 620	pnp	x		x						-25	15			.98		1	-25		50	100	85	.35
TS 621	pnp	x		x						-25	15			.99		1	-25		50	100	85	.35
WESTERN ELECTRIC CO., INC., Radio Division, 120 Broadway, New York, N.Y.																						
1N85[1]	pn	x		x				x	x	90	6		Photo Transistor					90	1	50		
2N21A[1]	ptc	x						x								2		-100	±40	120		
2N29[1]	npn	x		x				x	x	30	4		40	.98		2		35	100	120	85	.5
2N66[1]	pnp	x		x	x	x				-40	300	300		25		2	-40	-60	-800	5w	80	2°C/W
2N110[1]	ptc	x						x		-20	-1.3ma			3.2		5		-50	-50	200		.3
3N22[1]	npn4	x					x			10	3		18	.96		20		10		30		
GA-52829[1]	pnp	x		x				x	x	-20	-4.5	-2.5		.98		2.8	-30	-30	-50	120	85	.5
GA-52830[1]	pnp	x		x	x	x		x		-40	100	100		50		4	-20	-40	-500	500	80	24°C/W
GA-53080[1]	ptc	x						x						2		10		-100	-50	250		
GA-53111[1]	npn	x		x					x	15	8[3]			.98 to .998		3.4		30	50	85		.7
GA-53194[1]	pnp	x					x			-18	-3			.95		600		-30	-30	200		.2
GA-53233[1]	pnp	x					x	x		-18	-13			.95		500		-25	-30	200	90[2]	.2
GA-53242[1]	pnp	x				x		x		-40	100	100		50		4	-20	-40	-500	500	80	24°C/W
GA-53270[1]	npn	x		x					x	15	3.7			.983		3.4		30		85		.7
GF-45011[1]	pnp	x						x		-18	-13			.97		500		-25	-30	200		.2
1. These transistors are available only to U.S. military agencies and their contractors. 2. Used as oscillator. 3. Maximum.																						
WESTINGHOUSE ELECTRIC CORP., Semiconductor Dept., Youngwood, Pa.																						
2N59	pnp	x		x	x					-25	10		36[1]	85		.5	-20	-25	200	150	85	.25
2N60	pnp	x		x	x					-25	10		33[1]	60		.5	-20	-25	200	150	85	.25
2N61	pnp	x		x	x					-25	10		30[1]	45		.5	-20	-25	200	150	85	.25
2N402	pnp	x		x					x	-25	10		42[2]	20		.5	-20	-25	50	150	85	.25
2N403	pnp	x		x					x	-25	10		40[2]	30		.5	-20	-25	50	150	85	.25
10101	pnp	x		x		x		x		-35	5ma			100		1		35	5a		85	5°C/W
10123	pnp	x		x		x		x		-60	2.5ma			100		1		60	5a		85	5°C/W
1. Class B. 2. Class A.																						

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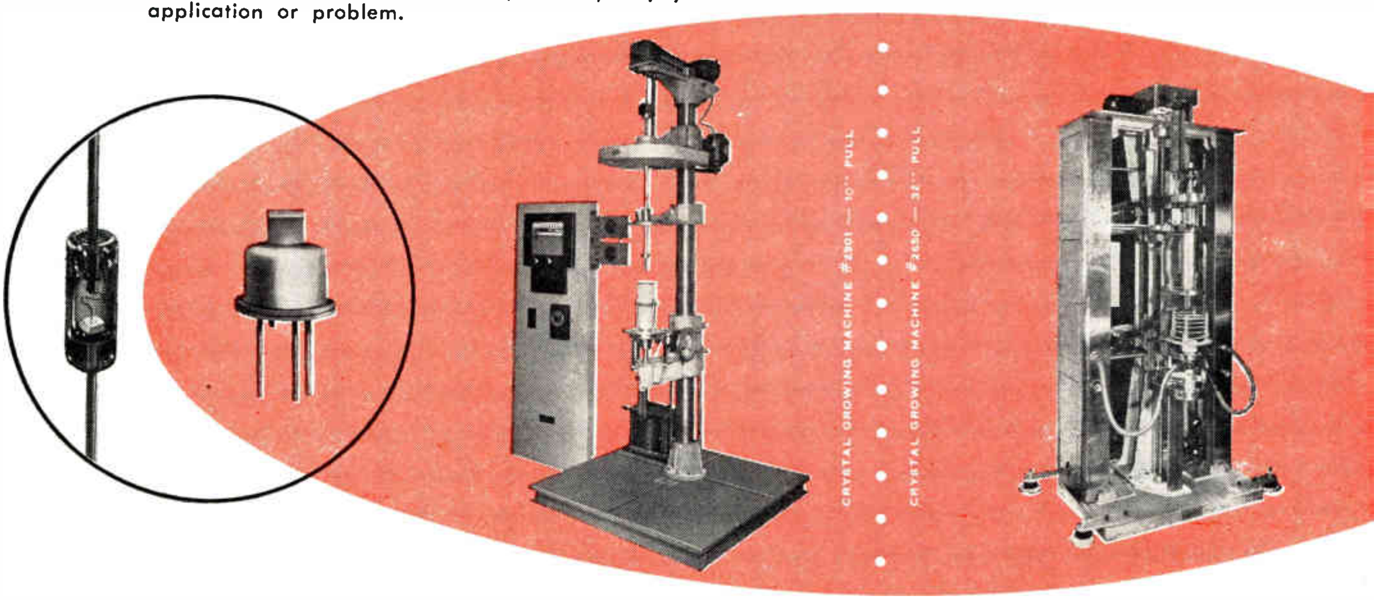

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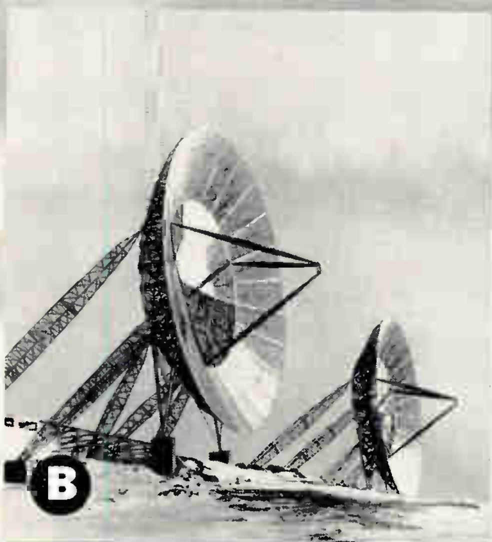
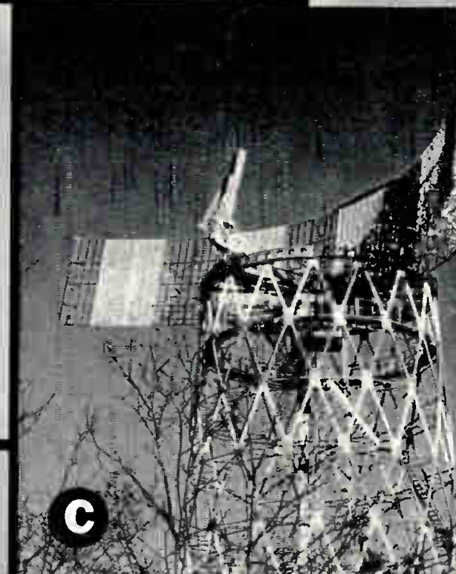
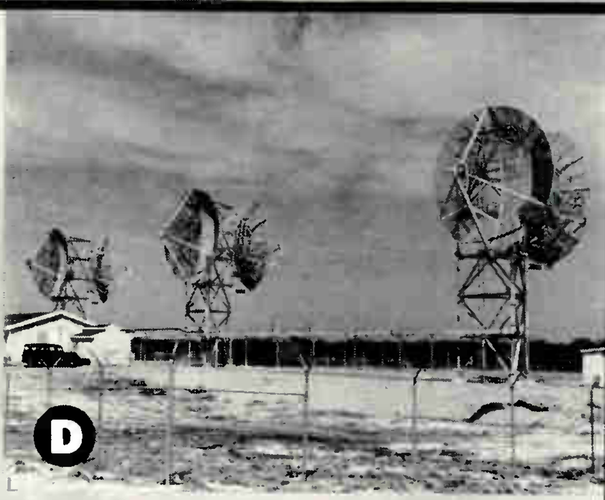
Circle 50 on Inquiry Card, page 107

ANTENNA PROBLEMS?

Ask Kennedy!







- **A** *60' Radio Telescope Harvard University*
- **B** *60' Trans-horizon Antennas Northern Europe*
- **C** *120' Radar Antenna Maine*
- **D** *28' Trans-horizon Antennas Cape Cod*
- **E** *28' Trans-horizon Antenna Texas Tower*

The solution to antenna problems begins when someone says: "Let's ask Kennedy!"

A few of the many reasons why are shown on this page. These Kennedy antennas are setting new standards for all-weather reliability and versatility wherever they serve throughout the free world.

Kennedy antennas come in many shapes, many sizes (the world's largest scatter antenna is being built here). But whatever the type, and whatever the conditions under which it must serve, Kennedy can offer a design that fully measures up to specifications. And there are additional advantages in Kennedy's advanced construction techniques — like the extra ease in shipping and handling made possible by sectionalized aluminum construction, for example.

Kennedy engineers are available to supervise installations anywhere in the world. It's a part of the complete, integrated service that is still another reason why more and more people in communications are "asking Kennedy" about antenna problems.

Circle 51 on Inquiry Card, page 107

ANTENNA EQUIPMENT

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ANTENNAS, PROPAGATION

Dimensioning of Parabolic Horn Antennas, H. Laub. "Freq.," July 1957. 7 pp. An investigation of the effects of the geometrical dimensions of parabolic horn antennas on their performance is presented. It is concluded that an exciter angle, i.e., the angle between the axis of the paraboloid and the axis of the horn, should not be less than 90°. For constant antenna height, the gain may be increased as the angle exceeds 90°. However, an angle exceeding 120° is not recommended.

A Unidirectional Attenuating Element (Directional Element) at 400 MC, J. Deutsch and W. Haken. "Freq.," July 1957, 4 pp. The directional element described is based on ferromagnetic resonant absorption. It had been developed to reduce the reflection at the transmitter-channel and the receiver-channel junctions of an FM wide-band RF system for 600 speech signals or one television signal. An attenuation of 13 db in one direction as compared to 0.5 db in the other direction has been obtained; the reflection coefficient is 1%.

The Effect Of The Mutual Impedance Due To The Neighboring Elements On The Driving Point Impedances Of A Linear Array, R. Parthasarathy. "J. ITE." June 1957. 6 pp.

Satellite Tracking. "El & Comm." July 1957. 2 pp. Antenna requirements for tracking project vanguard.

The Antenna of the TV-Transmitter Feldberg/-Black Forest, H. Mack. "Nach. Z." July 1957. 6 pp. During recent years, the use of slotted cylindrical antennas has been preferred for VHF and TV transmitters at climatically exposed antenna sites. The smooth cylindrical shape of this type of antenna forms a small area for windage and ice formation. For this reason a slotted cylindrical antenna was chosen for the TV transmitter Feldberg/Black Forest. The operation, the design and the electrical properties of this type of antenna is described in this paper.

CIRCUITS

***Duplexer for Sweep-Frequency Pulse Transmitters,** R. Silberstein. "El. Ind. Ops. Sect." Oct. 1957. 3 pp. Grids of push-pull transmitting triodes are placed across the 600-ohm transmitter output through RC coupling networks which permit the tubes to bias themselves to cut-off on transmitted pulses. Handling capacity is 10 kw of peak power with 100 μsec. pulses.

***Design of magnetic Circuits for Miniature Relays,** W. J. Richert. "El. Ind." Oct. 1957. 5 pp. A complete treatment of the subject. Advantages, and disadvantages, of the various types of relays are discussed. Problems and solutions encountered in the design process are presented.

Characteristics and Design of Video Output Stages, G. Foerster. "El Rund." Vol 11. Issue 6. June 1957. 4 pp. The article outlines the design of video amplifiers which must have constant phase shift and certain frequency characteristics, such as required for pre-emphasis.

Switchgear and Protective Circuit Diagrams, A. Salzmann. "El. Energy." August 1957. 7 pp. The problems of circuit diagrams for switchgear are discussed. It is shown that the mainstay of wiring of erection diagrams, particularly those of protective gear, is the schematic diagram of the 'detached contact type' which proves useful for planning, fault-finding and protection testing.

Transistor RC Oscillators, M. K. Achuthan. "E. & R. Eng." August 1957. 2 pp.

Transistorizing a Power Supply for Telemeters, O. J. Cooper. "ISA Journal." August 1957. 4 pp. Here is a thorough discussion of the design problems to be solved in producing a small, lightweight transistorized power supply.

On Negative Impedances, Transistors, and Feedback Circuits and Their Mutual Interdependence, T. Scheler and H.-W. Becke. "Freq." July 1957. 11 pp. An introduction on four-terminal networks is followed by a discussion of various transistor feedback circuits. The formulas for several such circuits are tabulated and the advantages and disadvantages are pointed out.

Calculation Directions for Flip-Flop-Circuits, G. Thiele. "El. Rund." August 1957. 4 pp. In the present 2nd part of the article from No. 7, p. 212, the calculation and selection of components suited for flip-flop-circuits application are dealt with. The long life tubes E 92 CC with intermediate cathode layer suppression are regarded as suited for this purpose. Anode resistance, voltage divider resistances, cathode resistance and coupling capacitance are calculated on the basis of the tube data.

Posicast Control of Damped Oscillatory Systems, O. J. M. Smith. "Proc. IRE." September 1957. 7 pp. A novel method is presented for producing dead-beat response in a lightly-damped oscillatory feedback system. Complete transient response times of the order of a fraction of the natural oscillatory period can be obtained. Excellent waveshape reproduction is achieved through a linear phase lag with frequency.

A Wideband Polyphase Frequency Changer, R. S. Sidorowicz. "ATE J." July 1957. 17 pp. This instrument was designed principally for the stroboscopic measurement of the amplitude of vibrations at frequencies, f_a, ranging from 20 c/s to 500 c/s. It uses the principle of multiphase heterodyning, and is in effect a single-sideband suppressed-carrier modulator.

*** Those articles marked with an asterisk are available as reprints to EI readers. Requests should be sent, on company letterhead, to Sources Editors, Electronic Industries, Chestnut & 56th Sts., Philadelphia 39, Pa.**

REGULARLY REVIEWED

AEG Prog. AEG Progress
Aero. Eng. Rev. Aeronautical Engineering Review
Ann. de Radio. Annales de Radioelectricite
Arc. El Uber. Archiv der elektrischen Ubertragung
ASTM Bul. ASTM Bulletin
Auto. Con. Automatic Control
Auto. El. The Automatic Electric Technical Journal
Avto. i Tel. Avtomatika i Telemakhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
Bell Rec. Bell Laboratories Record
Bell J. Bell System Technical Journal
Bul. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Comp. Computers and Automation
Con. Eng. Control Engineering
E. & R. Eng. Electronic & Radio Engineer
Elek. Elektrichestvo
El. Electronics
El. & Comm. Electronics and Communications
El. Des. Electronic Design
El. Energy. Electrical Energy
El. Eng. Electronic Engineering
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES & Tele-Tech
El. Mfg. Electrical Manufacturing
El. Rund. Electronische Rundschau
Eric. Rev. Ericsson Review
Freq. Frequenz
GE Rev. General Electric Review
Hochfreq. Hochfrequenz-technik und Electroakustik
IBM J. IBM Journal
Insul. Insulation
IRE Trans. IRE Transactions of Prof. Groups
Iz. Akad. Izvestia Akademii Nauk SSSR
J. BIRE. Journal of the British Institution of Radio Engineers
J. ITE. Journal of The Institution of Telecommunication Engineers
J. IT&T. Electrical Communication
J. UIT. Journal of the International Telecommunication Union
Nach. Z. Nachrichtentechnische Zeitschrift
NBS Bull. NBS Technical News Bulletin
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Onde. L'Onde Electrique
Phil. Tech. Philips Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers
Proc. BIEE. Proceedings of the Institution of Electrical Engineers
Proc. IRE. Proceedings of the Institute of Radio Engineers
Radiotek. Radiotekhnika
Radio Rev. La Radio Revue
RCA. RCA Review
Rev. Sci. Review of Scientific Instruments
Rev. Tech. Revue Technique
Syl. Tech. The Sylvania Technologist
Tech. Haus. Technische Hausmitteilungen
Tech. Rev. Western Union Technical Review
Telonde. Telonde
Toute R. Toute la Radio
Vak. Tech. Vakuum-Technik
Vide. Le Vide
Vestnik. Vestnik Svyazy
Wire. Wld. Wireless World

For more information, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request by writing to "Electronic Sources" Editors, ELECTRONIC INDUSTRIES & Tele Tech, Chestnut & 56th Sts., Philadelphia 39, Pa.

The design of the instrument is discussed in some detail. Block schematics and detailed diagrams of the circuits are shown.

A Wideband Oscillator, P. Kenyon. "ATE J." July 1957. 8 pp. The M1E oscillator described in this article was designed primarily for use during the testing and maintenance of 60-channel carrier systems, but it is also of general use in test room or laboratory where a stable frequency source is required. A heterodyne circuit is used, and the maximum output level is +27 db. into 600 ohms over the frequency range 300 c/s to kc/s. The choice of beat-frequency, the method of temperature compensation, and other design features are discussed.

Two-Branch Filter Structures with Three-Cut-Off Frequencies, J. E. Colin. "Cab. & Trans." July 1957. 39 pp. The relationship between the characteristic frequencies of filters offers some analogy with the case of band-elimination ladder filters. But, among the latter, only a small number are known, and difficulties are met with in their practical application, owing to the range of variation in the values of their elements. Such difficulties are avoided in structures with three cut-off frequencies, if limitation of one of the two transmitted bands is allowed.

A 70 Mc/s I.F. Amplifier for Wideband Microwave Links, L. J. Herbst and G. R. Shoubridge. "ATE J." July 1957. 8 pp. The amplifier described here uses E 180F pentodes (gm : 16.5mA/V) throughout. Two common-grid triode stages are followed by eight pentode stages. An a.g.c. amplifier is also incorporated. The maximum overall gain of the amplifier is 78 dB, and the response is flat to within ± 0.1 dB over the band 60-80 Mc/s. The noise factor of the amplifier is 8.5 dB.

Frequency Metering By Means Of Signal Time Delay, A. I. Danilenko. "Radiotek," May, 1957. 6 pp. The paper analyzes a method of frequency measurement by means of signal time delay. It is determined that the phase-difference method can be applied to obtain the phase characteristics of delay lines, for obtaining the time delay of a line as a function of frequency, for determining the temperature coefficients of the lines, etc.

Circuits For Shaping Pulses From A Sinussoidal Voltage When A Low-Voltage Supply Is Used, V. I. Zabavin. "Radiotek," May, 1957. 5 pp. An analysis is made of pulse-shaping circuits which have a number of advantages over multivibrator and trigger circuits. The proposed circuits are designed in three variants: vacuum tube circuits combined with transistors, and purely transistor circuits.

A Potentiometer-Type Phase-Shifter, A. M. Melik-Shakhnazarov. "Radiotek," May, 1957. 2 pp. A potentiometer-type phase-shifter is designed using RC elements and sine-cosine potentiometers. The phase-shifter provides smooth phase control over 360 degrees.

Angular Electrical Errors And Residual Voltages In Induction Computer Elements, Iu. M. Pul'er. "Avtomatika i Telemekhanika," June, 1957. 15 pp. The paper investigates the basic errors produced by the metering systems of induction-type computer units while taking their engineering design into account. Relationships are obtained for determining the angular and amplitude-phase errors (as well as the residual voltages of sine-cosine transformers) as a function of the air-gap irregularity while taking the losses in the steel into account. The residual voltages which occur in induction tachometer-generators due to the variable thickness of the rotor walls are computed. The mathematical method proposed makes possible a more general analysis of the effects of the structural and engineering errors of the mechanical portion of the equipment (and of the characteristics of the magnetic materials) upon the errors which arise in induction computer elements.

The Problem Of Matching "Second-Harmonic" Magnetic Amplifiers To A Load, V. N. Mikhailovsky and Iu. I. Spektor. "Avtomatika i Telemekhanika," June, 1957. 9 pp. The performance of a loaded second-harmonic magnetic amplifier is analyzed. The effect of the load upon amplifier stability is clarified and the region of unstable operation is defined. Relationships are obtained which make it possible to match a magnetic amplifier to a resistive load on the basis of the conditions governing maximum power-sensitivity for specified excitation conditions. The paper also clarifies the dependence of power sensitivity of a resistance-loaded magnetic amplifier upon the amplitude of the exciting field when optimum matching conditions obtain.

Block Diagrams For Magnetic Amplifiers With "Hard" and "Soft" Feedback, L. A. Grigorian. "Avtomatika i Telemekhanika," June, 1957. 14 pp. A method is proposed for synthesizing and evaluating the prameters of block diagrams for magnetic amplifiers with "hard" and "soft" feedback. Amplifiers are examined which operate into a R-L load through a rectifier when the oscillations of the perturbation factor are small. It is demonstrated that, depending upon the parameters of the amplifier and load, it is possible to substitute seven different block diagrams for the system. The resulting expressions determine the parameters of the block diagram both for the general case and for the case of an ideal magnetic circuit.

Computation Of Nonlinear Circuits By The Method Of Transformation (Transfiguration) And A Certain Error In The Application Of This Method, P. A. Ionkin. "Avtomatika i Telemekhanika," June, 1957. 4 pp. An analysis of the application of Wye-Delta and other transformations to the computation of nonlinear circuits. The paper discusses a common error in the use of the usual graphical method.

RC-Transistor Network Design—II, Isaac M. Horowitz. "El. Des." Aug. 15, 1957. 4 pp. This part presents the RL-RC synthesis method and gives a design example.

Three Oscillator Designs Standardize Circuitry, H. E. Gruen. "El." Aug. 1957. 3 pp. This article shows how 39 crystal oscillator circuits can be reduced to three basic designs using MIL-approved crystals and subminiature tubes.

Package Electronic Equipment for More Efficient Cooling, Oskar Giesecke. "El. Eq." Aug. 1957. 3 pp. This article describes how equipment should be arranged for proper cooling.

Designing Transistor Circuits—Tuned Amplifiers, Part 2, Richard B. Hurley. "El. Eq." Aug. 1957. 4 pp. Double-tuned amplifiers and stagger-tuned units are treated in this part.

Coupling Network Design Formulas, Anthony Paolantonio. "El. Eq." Aug. 1957. 2 pp.

Encapsulation of Electronic Circuits, Richard Calicchia. "El. Des." Aug. 1, 1957. 3 pp. Various casting resins for electronic equipment are evaluated at frequencies up to 240 MC.

RC-Transistor Network Design—I, Isaac M. Horowitz. "El. Des." Aug. 1, 1957. 4 pp. This part presents varied background and a negative impedance converter (NIC) method of design.

Direct Coupled Transistor Logic Complementing Flip-Flop Circuits—II, E. G. Clark. "El. Des." Aug. 1, 1957. 3 pp.

Balanced Concentrated-Selection Filters, S. G. Kalikhman. "Radiotek." June 1957. 8 pp. The paper proposes a circuit and a method of analysis for balanced concentrated-selection filters with any arbitrary number of sections. Quantitative relationships are derived for computing the elements of such filters. Experimental data is cited which verifies the fact that the application of such filters in radio receivers makes possible a substantial improvement in the selectivity with respect to an adjacent channel.

Characteristics of Broad Band Filters, W. Taeger. "Freq." Issue 11, Vol. 5. May 1957. 8 pp. The article discusses the various characteristics of broad band filters and emphasizes methods for phase shift corrections of filters used for video amplifiers.

Simplified Analysis Of Circuits For Self-Excited Transistor RF Oscillators, P. D. Berestnev. "Radiotek," April, 1957. 6 pp. Simplified expressions are derived for the oscillator frequency and the conditions for self-excitation for two self-excited oscillator circuits (with a common emitter and a common base) which have the tank circuit in the collector loop. The Coupling between the input and output circuits can be transformer type, autotransformer type or capacitive.

The Problem Of Synthesizing Amplifier Circuits, S. V. Samsonenko. "Radiotek," April, 1957. 13 pp. The paper describes a new mathematical method for analyzing amplifier transients. The method is used to synthesize multi-stage systems according to various signal-distortion requirements. Normanized transient parameters and expansions based upon Hermitian polynominals are used.

Smoothing Filters For Low-Power Rectifiers, L. L. Dekabrun. "Radiotek," April, 1957. 6 pp. A specific method is given for computing Pi-filter elements; the method can be widely applied in designing filters for low-power sources.

Simultaneous Oscillation At Two Frequencies In A Self-Excited Oscillator Incorporating Self Bias, by G. M. Utkin. "Radiotek," April, 1957. 3 pp. The paper examines the operation of a self-excited oscillator with grid-leak self-bias. When an oscillator with a double tuned circuit has a low-inertia grid-leak circuit it is possible to obtain stable oscillations at two different frequencies (both at multiple frequencies and at asynchronous frequencies).

Electronic Analyzer For Contact Circuits, V. N. Rodin. "Avtomatika i Telemekhanika," April, 1957. 7 pp. The paper describes the possibility of analyzing the contact networks and solving certain problems of synthesis by means of a special high-speed electronic device.

Static Transmitter For A Pulse-Frequency Telemetering System, A. M. Pshenichnikov. "Avtomatika i Telemekhanika," April, 1957. 5 pp. The paper gives a brief description of a static compensated transmitting device developed for use in a pulse-frequency telemetering system. The new device is compared with existing transmitters.

COMMUNICATIONS

***Designing a "Personal" Distress Transmitter, E. G. Homer.** "El. Ind. Ops Sect." Oct. 1957. 4 pp. The author reveals in intimate detail the experimental method he used to design a miniature transmitter for the 500 KC international distress frequency. The compact unit is crystal controlled and fully transistorized.

***VHF Propagation By Ionized Meteor Trails, Part One, W. R. Vincent et al.** "El. Ind." Oct. 1957. 5 pp. A two-tear research program at Stanford Research Institute has demonstrated the possibilities of VHF communications by reflection from ionized meteor trails. An 820-mile link is now operating, and tests indicate possible use up to 1400 miles. In this report the authors summarize basic data for the design of a successful Meteor Burst System.

Low-Loss Delay Lines Use Barium Titanate Transducers, C. A. Bieling. "El. Eq." Aug. 1957. 3 pp. This article describes the construction and performance of a series of temperature-controlled delay lines with ceramic transducers.

Automatic Changeover of Radio Transmitters, James H. Greenwood. "El." Sept. 1957. 5 pp. Described here is a method to completely automatically shift to emergency broadcast transmitter in less than 24 seconds after loss of regular transmitter carrier.

Receiver Detects Signals Below Noise Level, William L. Blair. "El." Sept. 1957. 4 pp.

Telemetering System Is Balloon Borne, Edward K. Novak. "El." Sept. 1957. 7 pp. Described here is a modified radiosonde unit which has a maximum range of about 360 miles.

Rural Carrier System Uses Transistors, B. R. Stachiewicz. "El." Aug. 1957. 4 pp. Described here is a method by which a selective calling of up to ten telephone subscribers per wire pair is possible.

The Grouping of Distortion Signals in Short-Wave Radiotelegraphy, V. M. Rozov. "Radiotek." June 1957. 10 pp. Existing concepts concerning the causes of distorted symbols during the reception of short-wave radiotelegraph messages of great length are used to evaluate the average values (per unit time) for the number of groups of distorted symbols and the average duration of a single group.

Transmitter Tuned by Distortion Indicator, C. R. Ellis, ETAL. "El." Sept. 1957. 4 pp.

Voltage Regulator Uses Multivibrators, William A. Scism. "El." Sept. 1957. 3 pp.

The Problem of the Relationship Between the Rate of Transmitting Intelligence and the Interference Rejection in a Communications System, E. L. Blokh. "Radiotek." June 1957. 12 pp. Geometric methods of analysis are used to study the relationship between the rate of transmitting intelligence and the interference rejection of a communications system for codes which correspond to the simplest and the densest distributions of signal points.

Advantages of Compatible Single-Sideband System, L. Kahn. "Wire and Radio Communications." August 1957. 3 pp.

Voice-Actuated Machines: Problems and Possibilities, E. E. David, Jr. "Bell Rec." August 1957. 6 pp.

A Suggested Plan to Standardize the Attenuation of Communication Networks as Used by Power Companies, G. Klinner. "Nach. Z."—Jahrg. 10. Issue 6. June 1957. 3 pp. With the introduction of the long distance dial system between electric power sub-stations, the attenuation of the various links in the communication paths must be standardized to assure stable operation. The suggested plan is in line with the recently accepted plans of the German Federal Postal System. The article closes by outlining a de-attenuation system when connecting a two-wire system to a four-wire system.

Essential Considerations Relating to Modern Telephone Network Plans, C. P. Vasudevan. "J. ITE." June 1957. 18 pp. The subject of the paper is to give briefly important points on each one of these aspects and show how these are taken into account while planning a national telephone network.

V.H.F. Broadcasting, R. D. A. Maurice. "E. & R. Eng." August 1957. 10 pp. The major part of the article is concerned with showing how gain in signal-to-noise ratio is achieved.

The Role of Stratospheric Scattering in Radio Communication, H. G. Booker and W. E. Gordon. "Proc. IRE." September 1957. 5 pp. It is well established that there are two distinctly different types of scatter transmission of radio waves: tropospheric and ionospheric. This paper reveals that a third type of scattering occurs in the stratosphere.

Signal Converters for Use in Trunk Dialing Networks, H. Pausch. "Nach. Z."—Jahrg. 10. Issue 6. June 1957. 6 pp. Signal converters designed for transmitting switching instructions on various types of lines, and which were developed for trunk dialing networks are described. The unavoidable complexity is explained and the advantages of the new circuits and their design are summarized. A comparison between costs, construction, and space requirements concludes the paper.

A Multiple-Element Fully Electronic Exchange, A. Davison. "ATE J." July 1957. 12 pp. This article describes the basic trunking and components for a fully-electronic telephone exchange of the "space-division" or multiple-element type. The speech-path elements are cold-cathode tubes which have low noise and loss characteristics, and the exchange uses an electronic translator giving i.d.f. facilities.

The Effect of Solar Ultra-Radiation on Radio Propagation on the 23, February 1956, B. Beckmann, P. Dietrich, and H. Salow. "Nach. Z." July 1957. 6 pp. This paper reports on the ionizing influence of solar ultraradiation in the ionosphere during and after strong solar eruptions. This influence becomes perceptible as a strong increase in attenuation in the propagation of radio waves.

The Present Knowledge in the Technique of Electronic Telephone Exchanges, K. Steinbuch. "Nach. Z." July 1957. 9 pp. The most important methods, used in the engineering of electronically operated exchanges (purely electronic low-frequency systems, time multiplex systems and electro-mechanically operated systems), are briefly described. With the present day knowledge, each of these systems permits the design of large exchange installations with technical advantages (e. g. reduction in volume, low maintenance costs, fast switching of connections).

On the Representation of Certain Classes of Signals by a Series of Samples, J. Bouzitat. "Cab. & Trans." July 1957. 13 pp. The object of this study is an extension of Shannon's sampling theorem which allows representing of limited spectrum signals by series of functions, the terms of which individually correspond to those of a series of samples, regularly spaced in time from an arbitrary origin.

Communication Management for the Aircraft. L. B. Hallman, Jr. "IRE Trans. PGANE." June 1957. 4 pp. Certain serious problems concerning air safety can be attributed to our poor management of the many ground-to-air intelligence links which terminate in the aircraft. In addition to overburdening the pilot, our present ground-to-air systems do not provide all the functions required for satisfactory aircraft traffic control. This paper describes a possible solution to these problems through a reexamination of our present ground-to-air intelligence-carrying circuits and the design of a Mission and Traffic Control Subsystem which is sufficiently flexible to be utilized in all types of aircraft.

COMPONENTS

*__Progress Report on Semiconductor Rectifiers__, N. F. Bechtold. "El. Ind." Oct. 1957. 4 pp. Findings indicate that silicon and germanium rectifiers are more desirable in high temperature areas while selenium retains its superiority in high current use.

Watchmaking Techniques, Key to Micro-Miniaturization, W. A. Sterling. "El. Des." July 1, 1957. 4 pp.

Micro-Miniaturization in Missiles, J. R. Moore. "El. Des." July 1, 1957. 2 pp.

Magnetizing Unsymmetry in Three-Phase Core-Type Transformers (Part 2), J. E. Parton. "El. Energy." August 1957. 8 pp.

A Microwave Attenuator Which Is Not Frequency-Sensitive and Has a Constant Phase-Shift Within Very Wide Limits, R. Steinhart. "Nach. Z."—Jahrg. 10. Issue 6. June 1957. 3 pp. The disadvantages of attenuators with transversely moved vanes, and T-network attenuators are discussed. A rotary attenuator is described which is not frequency-sensitive, and has a constant phase shift up to a certain limit. Values for this limit are given, and an error calculation is included.

High-Voltage Conductivity-Modulated Silicon Rectifier, H. S. Veloric and M. B. Prince. "Bell J." July 1957. 30 pp. Silicon power rectifiers have been made which have reverse breakdown voltages as high as 2,000 volts and forward characteristics comparable to those obtained in much lower voltage devices. It is shown that the magnitude and temperature dependence of the currents can be explained on the basis of space-charge generated current with a trapping level 0.5 eV below the conduction band or above the valence band.

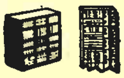
A Broad-Band Microwave Circulator, E. A. Ohm. "Bell Rec." August 1957. 5 pp. By taking advantage of the "dielectric waveguide effect," it is possible to construct a broadband ferrite circulator—a device for routing microwave energy over a variety of waveguide transmission paths.

Wiper and Bank Development on the 32A Selector, E. E. Comfort. "ATE J." July 1957. 9 pp. An article in the October 1951 issue of the Strowger Journal described major improvements to the design of the 32A Mark 2 selector: new buffered (Type 2) mechanical springsets, improved vertical and rotary interrupter springset assemblies, and an alternative inverted type of test jack. This article describes a new vertical wiper, Number 23 (with improved vertical-marking-bank fixing), and a new line wiper, Number 22, replacing wipers Numbers 13 and 12 respectively.

The Inductosyn and Its Application, H. J. Finden, and B. A. Horlock. "J. BIRE." July 1957. 15 pp. The inductosyn is a new control element manufactured in rotary and linear forms. In its rotary form it is capable of indicating angular position to an accuracy of 5 seconds of arc with a repeatability of 1 second of arc whilst in its linear form it is capable of positional accuracy better than 0.0001 in. with a repeatability of 25 micro-inches. This paper describes both forms in some detail, together with digital to analogue converters suitable for use primarily with the linear inductosyn when used as a position control device.

On a New Type of Variable Equalizer, J. Oswald. "Cab. & Trans." July 1957. 19 pp. A description of a new type of equalizer, having a constant characteristic impedance and an attenuation curve which may be represented as a function of frequency by a straight line with a constant but arbitrary slope, the value of which is determined by those of a pair of resistances with reciprocal values. More generally, this type of equalizer makes it possible to obtain an attenuation vs. frequency curve of arbitrary shape, adjustable with the aid of variable resistances and passing through a given number of fixed points, corresponding to "pivotal" frequencies.

Arc Suppression for Relay Contacts in DC Service, W. J. Godsey. "IRE Trans. PGCP." June 1957. 7 pp. Available relays for control of high-power direct current are seen to be large, heavy, and adversely affected by vibration and shock. This paper shows how commonly available components of reasonable size can be used with small vibration-resistant relays to control large direct currents at high potential.



COMPUTERS

***A Unique Approach to Computer Versatility**, L. S. Michels. "El. Ind." Oct. 1957. 5 pp. Systems designers need a computer which can perform a group of specialized computations, as well as general data processing functions. Such a need has led to the design of an integrated dual computer system with unique operating possibilities — a result of shared memory and input/output facilities.

Conditionally-Stable Controlled Systems (a Certain Class of Optimum Control Systems), A. M. Letov. "Avto. i Tel." July 1957. 14 pp. The paper examines a rigorously linear automatic control system which is asymptotically stable with respect to the obvious solution $X = 0$ and whose state can be described by the vector $x = x(x_0, t)$. It is assumed that the parameters of the system are fixed in accordance with some existing concept of an optimum linear system. Let t^* be the conditional damping time of the transient response. It is asserted that there is a value t^* ($0 \leq t^* \leq t^*$) for which a change in the speed of the actuating element will convert the original system into a different one which is conditionally stable in such a manner that its transient response is damped on the first swing and its conditional damping time is substantially less than t^*. A method of control is proposed by means of which the instant of speed-change t^* is determined as a function of the initial state and the parameters of the system. This computation is performed by means of a special computing device.

Magnetic Computer has High Speed, T. H. Bonn. "El." Aug. 1957. 5 pp. Characteristics of the Ferractor, a magnetic amplifier, are described.

Automatic Programming of Electronic Computers, B. Thuering. "El. Rund." Vol. 11. Issue 6. June 1957. 3 pp. In principle it is possible to have an electronic computer write its own program. The concept of "pseudo order" and "sub-program" are explained. Some examples are given for Remington Rand's Univac Factronic and IBM 701.

A Machine for Solving Polynominal Equations of Higher Order, G. C. Brack. "El. Rund." Vol. 11. Issue 6. June 1957. 4½ pp. Outlined is the design of an analogue computer which can determine polynominal roots with high accuracy.

Electrical Translators, K. Steinbuch and H. Endres. "Nach. Z."—Jahrg. 10. Issue 6. June 1957. 11 pp. Data-processing devices and electronic computers employ translators, coders, and multiplication tables. The article outlines typical applications, general viewpoints, and realization of such devices. The construction and application of one device for the communication field is described.

Electronic Calculators, W. Taeger. "Freq." Vol. 11. No. 6. June 1957. 7 pp. The article describes the various basic elements needed for the design of an analog computer. The author emphasizes how differential equations are solved by an electronic computer which uses nonlinear components, feedback circuits, and other elements.

The Role of Computers in High School Science Education, G. E. Forsythe. "Comp." August 1957. 6 pp.

Process-Control Problems Yield to the Analog Computer, C. W. Worley, R. W. Franks, and J. F. Pink. "Con. Eng." June 1957. 8 pp. This article shows, step by step, how a batch chemical process and a control system proposed for it were set up and solved by simulation on an analog computer. Though it did not happen in this case, the computer might have shown the need for a change in the process itself to attain satisfactory control with practical instruments.

Digital Compensation for Control and Simulation, J. Tou. "Proc. IRE." September 1957. 6 pp. This paper describes a technique for improving the performance of digital feedback control systems and operational digital simulators by making use of the computer to perform information programming or data processing.

Basic Logical Magnetic Circuits in Computors, K. Ganzhorn. "El. Rund." August 1957. 6 pp. The fundamental magnetic circuits consists of the groups A. data input, B. data storage with output function and C. data transfer function. The use of the classification system is explained with reference to examples.

"Leprechaun:" An Automatic Digital Computer the Size of a Television Set. "Comp." July 1957. 2 pp.

Airline Automation: A Major Step, C. E. Ammann. "Comp." August 1957. 5 pp.

The Development of a Business Computer System, A. St. Johnston, and S. L. H. Clarke. "J. BIRE." July 1957. 14 pp. The shortcomings of the scientific type of digital computer when applied to data processing jobs in general, and the business accounting type in particular, have led to the evolution of an electronic digital system more in tune with the requirements. The basic logical arrangement of the Elliott 405 system is outlined, followed by a more detailed description of the units. Particular reference is made to a new type of store using 35-mm film coated with magnetic oxide. Two specific applications of the use of the system are quoted as examples.

Electronic Calculators, W. Taeger. "FREQ." Vol. 11, No. 6. June 1957. 7 pp. The article describes the various basic elements needed for the design of an analog computer. The author emphasizes how differential equations are solved by an electronic computer which uses non-linear components, feed-back circuits, and other elements.

Two Programming Techniques for One-Plus-One Address Computers, S. Lipton. "J. of Assoc. for Computing Machinery." July 1957. 5 pp.

The Method of Reduced Matrices for a General Transportation Problem, P. S. Dwyer and B. A. Galler. "J. of Assoc. for Computing Machinery." July 1957. 6 pp.

Simulation Techniques for the Test and Evaluation of Real-Time Computer Programs, D. R. Israel. "J. of Assoc. for Computing Machinery." July 1957. 8 pp. This paper discusses some of the distinctive characteristics of real-time programs and suggests the use of "test equipment" in the form of computer programs—for providing simulated inputs for large real-time systems.

Computer Delay Unit Uses Semiconductors, W. A. Scism. "El." July 1, 1957. 1 p. Cascaded transistorized one-shot multivibrators are used to provide a delay of 40 microseconds per stage.

LACE, The Luton Analogue Computing Engine, Part 1, R. J. Gomperts and D. W. Righton. "El. Eng." July 1957. 7 pp. A brief account is given of the requirements and the construction of the general purpose analogue computer built at the Guided Weapons Division of the English Electric Company, Litton.

Standardized Programming Methods and Universal Coding, S. Gorn. "J. of Assoc. for Computing Machinery." July 1957. 20 pp.

Computer Selects Premium Bond Winners, R. K. Hayward, E. L. Bubb, and H. W. Fensom. "El." July 1, 1957. 6 pp. This is a description of computer ERNIE, developed by England's Post Office Engineering Dept.

Morse-To-Teleprinter Code Converter, W. R. Smith-Vaniz and E. T. Barrett. "El." July 1, 1957. 5 pp. Conversion is accomplished by a combination analog-digital computer using 92 tubes, 62 static magnetic memory units, and a conversion matrix composed of 448 neon tubes.

"Memory" Systems in Electronic Computers, A. W. M. Coombs. "El. & Comm." May 1957. 5 pp. The design and understanding of computers is inevitably complex; the capabilities and limitations of the different types of machines can best be appreciated by considering the form and operation of their "Store" or "Memory" unit. It is in respect of methods of storage that digital machines differ most widely, and are least satisfactory.

Studies on a High-Speed Electronic Differential Analyser, N. S. Nagaraja, S. Sampath and V. Rajaraman. "J. ITE." March 1957. 10 pp. This paper describes the principles of operation of high-speed electronic differential analysers called analogue computers, with particular reference to the analyser set up at the Indian Institute of Science. The potentialities of such an analyser in solving linear differential equations and also in dealing with physical systems in which several types of nonlinearities occur are discussed.

Miniature Audio Transformers for the P Carrier System, C. E. Luffman. "Bell Rec." June 1957. 3 pp. The use of carrier operation between the customer and a central office has been accompanied by development of new designs and manufacturing techniques for miniature components. These new P carrier components have been a considerable challenge to the ingenuity of design engineers.

Drum Storage and the Strowger System, G. T. Baker. "ATE J." Jan. 1957. 11 pp. This article discusses whether electronic techniques can be applied to step-by-step (Strowger) telephony, to keep it abreast of new developments, such as subscriber trunk dialling, without sacrificing its flexibility. The proposed solution is to handle signalling and metering information at high speed in an electronic common control equipment, which should for preference serve the whole exchange.

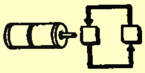
An Experimental 50-Megacycle Arithmetic Unit, R. M. Walker, D. E. Rosenheim, P. A. Lewis and A. G. Anderson. "IBM J." July 1957. 22 pp. An experimental 50-MC arithmetic unit has been built which performs a repetitive multiplication program and checks the results for errors. The unit uses pulse circuitry which has been developed to perform digital operations at a 50-MC pulse-repetition rate.

An Electronic Computer for Vector Electrocardiography, R. DeCote and W. J. Horvath. "IRE Trans PGME." July 1957. 7 pp. The application of electronic data handling methods to medicine. It performs a calculation during each heart beat which would take hours of tedious computation and photographic measurement to perform manually.

An Analog Computer Employing Network Analogy Techniques, G. E. Kaufer. "IRE Trans PGME." July 1957. 3 pp. In physiological studies of cortical activity, it is useful to know the rate of local blood flow through various portions of the brain. An equation relating this factor with a number of measurable quantities is presented and discussed.

Principles of a Magnetic Drum Register-Translator, D. Halton and J. F. Greenaway. "ATE J" April 1957. 19 pp. The article deals with the general principles of a magnetic drum data storage system. The drum 'clock' and the method of scanning subscribers' lines to pass dialled information to the drum store are described. The application of the magnetic drum as a register-translator in a director exchange, and the mechanisms of information storage and translaiton, are explained. An appendix describes the approach to system design.

Literary Data Processing, P. Tasman. "IBM J." July 1957. 8 pp. A method is presented for rapid compilation of analytical indexes and concordances of printed works, using either a conventional punched-card system or an electronic data processing machine.



CONTROLS

***Missile Control Demands Stabilization and Guidance, G. Reehl.** "El. Ind." Oct. 1957. 5 pp. This is the second and final part of an article which treats in great detail the control of guided missiles.

Servo Modulators—1, Where and Why They're Used, Characteristics of the Basic Types, B. T. Barber. "Con. Eng." August 1957. 7 pp. The first article tells how modulators work, discusses the six broad classes of control system applications, and tabulates the important performance specifications of the various types of servo modulators.

In-Process Controls to Maximize Capacitor Reliability, H. S. Herrick. "IRE Trans. PGRQC." August 1957. 20 pp.

Ten-Frequency Transmitter-Receiver For The Maintenance of Balanced Line Circuits With 12, 24 or 36 Channels, M. Louboutin. "Cab. & Trans." July 1957. 5 pp. This paper is a description of a measuring equipment for the maintenance of balanced line circuits, to be used in connection with the conventional measuring apparatus for the pilot-wave of the B-primary 12-channel group. With this equipment, maintenance is reduced to measurements effected with the help of auxiliary waves of frequencies taken in the intervals left between telephone or program channels.

An Accurate Speed Control System Applied to a Motor Driven Alternator, S. Catchpole. "El. Energy." August 1957. 3 pp. In many applications it is necessary to have a frequency stabilized power supply and in this article is described a control system in which the frequency does not deviate by more than ±0.1 per cent from nominal. Stabilization is achieved by controlling the drive motor field current, the sensing element being a form of Wien bridge.

A Method For Determining The Optimum Characteristics Of One Particular Class Of Self-Adaptive Control Systems, A. M. Batkov and V. V. Solodovnikov. "Avtomatika i Telemekhanika," April, 1957. 15 pp. The paper deals with the problem of optimum filtration (in the sense of the minimum sum of the squares of the dynamic and mean-square errors) for a class of linear systems having variable parameters in the presence of stationary random inputs. A method is proposed for realizing the resulting optimum systems in the form of self-adaptive ones, depending upon the input signal characteristics.

Stabilization Of Control Systems By Means Of A Special Signal, R. Oldenburger. "Avtomatika i Telemekhanika," April, 1957. 5 pp. Linear automatic control systems with two or more dominant lags can be stabilized by the introduction of noise or a signal of sufficiently high frequency, provided that the hunt of the system is not excessive. The amplitude of the signal must be great enough to run a bounded element (such as a governor pilot valve) through its full stroke. Single- or multiple-lag systems with optimum nonlinear controls can also be stabilized by introducing an appropriate signal. Unless the stabilizing signal is very great the response to the larger disturbances will be negligibly affected.

Pulse-Correction Of Control Relay Systems, N. A. Korolev. "Automatika i Telemekhanika," April, 1957. 14 pp. The paper describes a method of pulse-correction that increases the frequency at which self-oscillations will occur in control relay systems. Design computations are made for certain specific stabilizing circuits.

The Synthesis Of Linear Servosystems On The Basis Of The Criterion Of The Minimum Practical Limit Of The Reproduction Error, K. I. Kurakin. "Avtomatica i Telemekhanika," April, 1957. 18 pp. The optimum transfer function of a servosystem is defined for the case when the reproduced input quantity is specified as a slowly varying time function and the interference is uniformly distributed over the entire spectrum of the working frequencies. The synthesis of the servosystem is based upon the utilization of the criterion of the minimum practical limit of the tracking error. Methods are given for realizing the optimum transfer function of the servosystem by means of DC corrective networks.

A Decision Amplifier Without Stabilized Supplies, by V. M. Evseev. "Avtomatika i Telemekhanika," April, 1957. 10 pp. The paper examines a new circuit for a decision amplifier, which does not require stabilized supplies. The results of both a theoretical and experimental investigation of the circuit are provided.

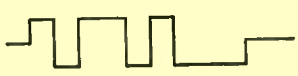
Production Pile G1 at Marcoule, M. Maurice Pascal. "Bul. Fr. El." 7th Series, Vol. 7, No. 76. April 1957. 2 pp. This is an introduction to the two articles listed below. The Director of the French Industrial Energy Commission gives the historic background and highlights various important factors of this reactor.

Control System and Safety Devices Associated with Reactor G1, M. A. Ertaud. "Bul. Fr. El." 7th Series, Vol. 7, No. 76. April 1957. 15 pp. The reactor G1 requires a large amount of complex apparatus for controlling its operation, as well as for its safety devices. Some of these devices, such as for measuring temperature, flow, and pressure, are of conventional design. Others were specially designed for the reactor. The latter ones include an ionization chamber for measuring the neutron flux and radiation.

The Electro-Mechanical Aspects of the Reactor G1, M. M. Lignieres. "Bul. Fr. El." 7th Series, Vol. 7, No. 76. April 1957. 12 pp. This article describes in detail the electro-mechanical aspects of the reactor and its remote control system.

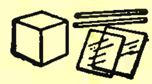
Transistorized Multiplex Radio-Teletypewriter, Phillip G. Wray. "El." Sept. 1957. 5 pp.

Demodulator-Limiter for Control System Signals, N. L. Johanson. "El." Sept. 1957. 1 p.



INFORMATION

Intelligibility of Synthetic Language, O Warens. "Freq." Vol. 11. No. 6. June 1957. 6½ pp. This article provides some information on voice communication by means of coded binary information. The author describes a "voice switch" and a "voice expander" which permits the synthetic reproduction of characters and syllables. The author estimates that it would take approximately 700 to 1100 sound elements to construct a complete synthetic language. Forty bits per second would be required for the transmission of this language. The article also contains tables which show the percentage of correctly-understood letters and words created by the device and tested on a listening audience.



MATERIALS

The Evolution of the Permanent Magnet: A Brief Review. "Phil. Tech." June 4, 1957, 3 pp. A historical development.

Aircraft Generator Insulations Compared to Standard Motor Insulations—Adaptations Possible, A. J. Wesolowski. "Insul." February 1957. 4 pp.

Switching Time of Ferrites with Rectangular Hysteresis Loop, H. van der Heide, H. G. Bruijning and H. P. J Wijn. "Phil. Tech." May 9, 1957. 11 pp. A method is described for measuring, as a function of time, the reversal of magnetization caused by the sudden application of a magnetic field to ferrite cores with a rectangular hysteresis loop. Thyratrons are used to produce the powerful current pulses needed for measurements on large ferrite rings.

Progress in Manufacturing Ceramic Insulation, H. Thurnauer. "Insul." December 1956. 6 pp.

Contribution to the Floating Zone Refining of Silicon, E. Buehler. "Rev. Sec." June 1957. 8 pp. A floating zone refining apparatus for silicon, which can operate unattended, has been assembled to assist in the production of high purity material for research purposes. Features of this equipment are a simple mechanical drive, a switching panel to recycle the apparatus, and a self-stabilizing rf heating circuit to maintain constant zone length. Silicon containing less than 1 part per billion of electrically active impurities (resistivity of 16,-000 ohm cm and lifetime of 1.2 milliseconds) has been prepared. The effect of many-pass refinings on the diameter of the sample is discussed. Surface tension effects on material transport are significant.

Vapor Pressure Data for the More Common Elements, R. E. Honig. "RCA Rev." June 1957. 10 pp.

Polarization Reversal and Switching in Guanidinium Aluminum Sulfate Hexahydrate Single Crystals, H. W. Wieder. "Proc. IRE." Aug. 1957. 6 pp. The ferroelectric switching properties of GASH $(CN_3H_6)—Al(SO_4)_2—6H_2O$ were studied under sinewave and pulse conditions. The results indicate that the polarization reversal process is analogous to that found in barium titanate single crystals.

Straight-Field Permanent Magnets of Minimum Weight for TWT Focusing—Design and Graphic Aids in Design, M. S. Glass. "Proc. IRE." Aug. 1957. 6 pp. A convenient design formula has been derived which enables one to estimate readily the minimum amount of magnetic material which will satisfy a given set of field strength requirements on the axis of a tubular permanent magnet. Such a magnet is suitable for focusing the beam of a traveling-wave tube (twt) with coaxial rf fittings if small holes are provided in the side of the magnet to admit the coaxial lines.

Molybdenum High-Heat Hope for Electronics, John Huminik, Jr. "El. Eq." Aug. 1957. 2 pp. This article, written for the non-metallurgist, describes the characteristics of the material.

Various Aspects Which Influence the Design of Cable Insulation, L. Domenac. "Bul. Fr. El." Vol. 7. No. 77. May 1957. 15 pp. The author discusses various types of cables which are used on land or submerged under water. Different types of plastics used in the construction of cables are evaluated. Comparisons are made between high-tension cables filled with oil and cables filled with gas at a pressure of 15 kg/cm^2. Described are, among others, a paper-impregnated cable operating at 425 KV, a newer cable with forced cooling operating at 500 KV, and a cable for 100 KV D.C.

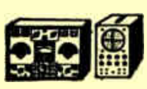
Correlation Of Absorption Coefficient Values of Acoustical Materials In The Laboratory and Studio, R. K. Vepa. "J. ITE" June 1957. 8 pp. A test chamber, set up in the Research Department of All India Radio, is described and results on some typical materials are compared with those obtained by other methods and in the field.

Changes in the Luminescence of ZnS after Excitation by H_2^+ Ions, W. Berthold "Vak. Tech."—Jahrg. 6. Issue 4. June 1957. 5 pp. H_2^+ ions with an energy from 1 to 15 KeV cause gaps in ZnS crystals and displace the lattice into the interstitial configuration. The destruction of the lattice symmetry increases the emissionless transition, and causes an increase in the decay time of the excited electrons at points of adhesion. Usually, the light yield decreases as the decay time increases. However, through ion bombardment, a change in the recombination centers can be accomplished. This in turn causes a change in color (ZnS:Cu) and in some cases increases the luminescence (ZnS:Mn).

The Submicroscopic Structure of "Ticonal" G Magnet Steel, H. B. Haanstra, J. J. de Jon, and J. M. G. Smeets. "Phil. Tech." 27 July 57. 4 pp. The metallographic structure of a single crystal of "Ticonal" G in its optimum magnetic condition is shown in terms of a number of electron-microscope photographs. By very carefully controlled polishing, etching and replica techniques, the preferred orientation is revealed with much better definition than hitherto.

Barium Titanate And Its Use As A Memory Store, D. S. Campbell. "J. BIRE." July 1957. 11 pp. The use of barium titanate single crystals for memory matrices is considered. It is shown that the discrimination between read-out "one" and rest-out "zero" on a matrix is reasonably high and that the response times and current flows involved compare reasonably with other types of store.

Pre-magnetization Of The Core Of A Pulse Transformer By Means Of Ferroxdure, H. G. Bruijning and A. Rademakers. "Phil. Tech." 27 July 1957. 10 pp.



MEASURING & TESTING

Design Features of a 100 KV VTVM, J. Daniels. "El. Eq." June 1957. 3 pp. This instrument is designed for accurate measurement of high r-f voltages in radio transmitters, and similar equipment. It utilizes a vacuum-dielectric capacitive voltage divider which reduces the voltage to a value consistent with practical voltmeters.

A Simple Direct Reading Thermistor Bridge, J. Swift. "J BIRE" March 1957. 5 pp. A simple balanced thermistor bridge is described which is direct reading and which can be used for accurate rf power measurements between about 10 microwatts and 1 milliwatt. The instrument requires no special components and incorporates a novel method of compensating for a wide variation in ambient temperature. In addition, the bridge is suitable for field work since it may be operated from ordinary dry batteries.

Bathythermometer Telemeters Ocean Data, by J. M. Snodgrass and J. H. Cawley, Jr. "El." May 1, 1957. 4 pp. Unique features of the deep-sea measuring device include a transistorized vibrating wire oscillator-transducer for pressure measurements.

Dynamic Methods of Testing Semi-Conductor Rectifier Elements and Power Diodes (part two), by A. H. B. Walker and R. G. Martin. "El. Eng." May 1957. 5 pp.

The Behavior of Modulators Feeding Complex and Selective Terminal Networks, J. Gensel. "Freq." Issue 11, Vol. 5. May 1957. 6 pp. An analysis is made of modulators used for carrier frequency modulation, where linear, as well as non-linear, distortions must be kept to a minimum. The behavior of modulators feeding complex impedances is especially important for the design of frequency converters. The article shows a mathematical analysis which permits the calculation of the linear and non-linear distortions caused by the terminating filters.

Certain Basic Relationships In Klystron Power Amplifiers, M. S. Neiman. "Radiotek," April. 1957. 10 pp. The paper examines certain basic relationships which govern the design of klystron power amplifiers. Special attention is devoted to the analysis of the limitations which obtain with regard to the pass band of the output resonant system and with regard to the minimum allowable supply voltage. Conditions are examined under which these limitation become less regid.

Approximate Methods For Computing The Field Intensity Of Ultra-High-Frequency Radiowaves While Taking The Locality Relief Into Account, A. I. Kalinin. "Radiotek," April. 1957. 11 pp. Approximate methods are given for computing the field intensity of UHF waves while taking the locality relief into account. Interference formulas are used for computing the field intensity on open routes. The field intensity on semi-open and closed routes is determined by an approximate method which is based upon approximating the obstacles along the routes by means of spheres whose radius is determined by the specific features of the obstacles, and upon an exponential relationship between the attenuation factor and the diffraction angle.

The Utilization Of A Fictitious Magnetic Current For Solving Problems Which Involve The Radiation From An Antenna Above A Plane Governed By The Leontovich Inhomogeneous Boundry Conditions, O. N. Tereshin. "Radiotek," April, 1957. 8 pp. The paper develops a rigorous theoretical method for solving the problem of the radiation from an arbitrary system of extraneous currents above a plane governed by the Leontovich inhomogeneous boundary conditions.

Certain Basic Concepts Which Are Involved In The Theory Of Signals, by V. V. Furduev. "Radiotek," April, 1957. 7 pp. Definitions are proposed for several basic concepts of signal theory; these definitions are established on the basis of time averaging. It is made clear that the defined characteristics—the correlation functions and the spectrum—obey laws which apply to a broader class of homogeneous signals than the class of processes which are stationary in the probability sense. As an example the paper examines the autocorrelation function and the spectrum of AM-signals. It is proved necessary to differentiate between the physical and statistical spectrums of the signals.

The Technique of Extremely Short Electro-Magnetic Waves Since the Days of Heinrich Hertz, F. W. Gundlach. "Nach. Z." July 1957. 12 pp.

Investigation of VHF Nonoptical Propagation between Sardinia and Minorca, J. M. Clara. "Proc. AIRE." June 1957. 9 pp.

International Geophysical Year: The World Programme, A. P. Mitra. "J. ITE" June 1957. 11 pp.

Core Tester Simplifies Ferro-Amplifier Design, R. W. Roberts and C. C. Horstman. "El." Aug. 1957. 4 pp.

Pulsed Light Tests Minority-Carrier Life, H. L. Armstrong. "El." Aug. 1957. 1 p.

Servo Amplifiers at High Ambient Temperatures, P. M. Thompson and J. Mitchell. "El. Des." Aug. 15, 1957. 3 pp. Described is a three-stage push-pull germanium transistor amplifier which delivers 3 w to a 400 cps servo motor.

Basic Standards for Science and Industry II, R. D. Huntoon. "El. Des." Aug. 15, 1957. 4 pp.

DC Overpotential Testing, Victor Wouk. "El. Des." Aug. 15, 1957. 4 pp. A description of various factors affecting high pot testing.

Voltage Stress Effects on Capacitors, Charles H. Bridenbaker. "El. Des." Aug. 1, 1957. 1 pp.

VT VM Survey—I, Sol D. Prensky. "El. Des." Aug. 15, 1957. 4 pp. A roundup of VT VM's and their characteristics.

Automatic Data Plotter for F-M/F-M Telemetering, H. B. Riblet. "El." Aug. 1957. 6 pp. A simplified automatic data plotter which provides a direct plot of function versus real time is described.

How They Cool the SAGE Computer, Samuel A. Francis, et al. "El. Eq." Aug. 1957. 6 pp.

RADAR, NAVIGATION

Platinotron Increases Search Radar Range, William C. Brown. "El." Aug. 1957. 5 pp. A new microwave tube is described and some applications given.

Vortac Beacons for Rho-Theta Navigation, P. Caporale. "El." June 1, 1957. 4 pp. A general discussion of the hybrid VOR-DME—TACAN system, "Vortac."

Copter Navigation System Maps Skyways Electronically. "El. Eq." June 1957. 4 pp. This article describes the Bendix-Decca Navigation System which provides a position fix by arbitrary index numbers of an appropriate pair of ordinates which intersect at the aircraft's position. The position is instantly and automatically displayed on a chart with a moving stylus. With this system, it is expected that helicopters can operate completely on instruments in cities, in the open country, or in remote areas.

Doppler Navigation, W. J. Tull. "El. & Comm." May 1957. 5 pp. The author presents a brief history of work done to develop Doppler ground speed and drift angle measuring equipment, followed by a short discussion of the fundamentals of Doppler radar.

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

SEMICONDUCTORS

Collector Bias, the Transistor Equivalent of Cathode Bias, and Some Applications, R. F. Treharne. "Proc. AIRE." May 1957. 11 pp.

A self-bias circuit for stabilizing the operating point of a transistor amplifier without unduly decreasing the gain at very low frequencies is discussed.

Evaluation of Transistor Life Data, J. D. Johnson and B. Van Swearingen. "IRE Trans. PGRQC." August 1957. 12 pp. Methods of testing and analyzing life characteristics are reviewed and discussed here from the standpoint of the user, with emphasis on a particular statistical approach.

***Measuring Transistor "Power Gain" at High Frequencies, W. N. Coffey.** "El. Ind." Oct. 1957. 4 pp. Maximum available power gain of the transistor becomes increasingly difficult to measure as junction transistors are applied in the HF and VHF ranges. A unique circuit has been designed which measures directly the common emitter power gain of transistors in the 40-300 MC range when driven by a resistive generator.

***Transistor Data for Logical Circuit Design, R. B. Hurley.** "El. Ind." Oct. 1957. 3 pp. Adequate circuit design information includes variations in characteristics with temperature, bias, interchangeability, age radiation, etc. Essentially, the problem is whether an inadequate, oversimplified equivalent circuit should be adopted or a complicated but widely useful circuit be selected.

Unijunction Transistor Forms Flip-Flop, E. Keonjian and J. J. Suran. "El." Sept. 1957. 3 pp.

Measuring Parameters of Junction Transistors, Roy W. Hendrick, Jr. "El." Aug. 1957. 3 pp. A test instrument which measures dynamic ground-emitter characteristics at any static collector current from 0.15 to 15 ma. is described.

Application of Transistors to Ordnance Electronics, S. H. Gordon. "El. Eq." Aug. 1957. 5 pp. Techniques used to minimize or compensate for transistor weaknesses are discussed.

Transistor Amplifier for Medical Recording, D. W. R. McKinley and R. S. Richards. "El." Aug. 1957. 3 pp. A recorder amplifier, transistorized, for coupling a heart-beat microphone to a pen recorder is described.

Pulse Generator Uses Junction Transistors, Edward J. Fuller. "El." Sept. 1957. 4 pp. Described here is a design of a pulse generator using presently available junction and surface barrier type transistors. Problems encountered and solutions are given.

Analysis of Nuclear Radiation Effects on Transistors, D. B. Kret. "El. Des." July 15, 1957. 3 pp.

Transistors in High-Frequency Amplifiers, W. Guggenbuhl and M. J. O. Strutt. "E. & R. Eng." July 1957. 10 pp. The properties of transistors and their behaviour in amplifier stages in the high-frequency region are dealt with.

Microsectioning: A Metallographic Technique for Semiconductor Devices, J. S. Hanson. "IBM J." July 1957. 10 pp. A microsectioning technique is described that enables metallographic sectioning of fragile semiconductor devices without the difficulties and specimen damage associated with the use of conventional techniques.

Frequency Division with Semiconductor Devices, A. W. Carlson. "El. Des." July 15, 1957. 4 pp. Included is a description of blocking oscillators, multivibrators, counter circuits, regenerative dividers and other means of frequency division.

Some Aspects of Transistor Progress, H. W. Loeb. "ATE J." April 1957. 16 pp. Some of the more significant developments during the last seven years are surveyed, with emphasis on interrelations between research progress and practical achievements. Transistor technology is outlined briefly, and the development of the equivalent circuit used to illustrate advances in theory.

A Study of High-Speed Avalanche Transistors, J. R. A. Beale, W. L. Stephenson and E. Wolfendale. "Proc. BIEE." July 1957. 9 pp. The discovery of an extremely fast relaxation oscillation in a junction transistor led to a study of this mode of operation. The paper describes the static and dynamic properties of transistors which operate in this mode, and discusses the design and application of such transistors.

What is the Status of Transistors, B. Reich. "El. Des." July 15, 1957. 2 pp. This is a state of the art report.

A Simple Transformer Bridge for the Measurement of Transistor Characteristics, W. F. Lovering and D. B. Britten. "Proc. BIEE." July 1957. 6 pp.

TELEVISION

Magnetic Tape Controls Projector Synchronism, James N. Whitaker. "El." Sept. 1957. 3 pp. Described here is a method in which the power-frequency control signal and movie sound share dual-track tape to synchronize picture to audio.

Video Recorder Trains Radar Observers, Ralph M. Heintz. "El." Sept. 1957. 4 pp. This article describes an airborne unit which was designed around the conventional ppi radar indicator. The unit records video output of the operating radar directly on 35-mm film.

Video Scanner Matches Photo Patterns, E. J. Oelbermann. "El." Aug. 1957. 2 pp. Described here are the results of experiments conducted to determine whether two patterns or photographs can be recognized electronically as being fundamentally identical.

Motion Minimizes Image Orthicon Burn-in, John T. Wilner. "El." Aug. 1957. 2 pp. A method of oscillating the lens board of TV camera at slow rate is described. Burn-in is reduced as much as 90%.

Video Tape Recorder Uses Revolving Heads, Ross H. Snyder. "El." Aug. 1957. 7 pp. Described here are late developments of Ampex Corp.'s video-tape recorder.

Sync Generator for Dot-Interlace TV, Francis T. Thompson. "El." Aug. 1957. 4 pp.

Design of Preamplifiers for TV Cameras, W. Dillenburger. "Freq." Issue 11, No. 5. May 1957. 6 pp. Correct frequency compensation of video preamplifiers for cameras and determination of the overall frequency response is not simple. The article describes various methods which may be used for these measurements. A TV pickup tube has a certain internal impedance which depends on the picture content. It is usually three megohms for Super-iconoscopes but much larger for Videcons. The design of the preamplifier is based on a frequency spectrum which is produced by a set of equally spaced vertical black and white lines. Scanning the lines results in current pulses of equal amplitudes. The pickup tube is assumed to be a constant voltage generator with a high internal impedance for all frequencies. The input impedance of the preamplifier must be small, compared to the generator impedance to avoid extensive phase shifts.

THEORY

Application of Inertial Guidance Principles, W. Wrigley, R. B. Woodbury and J. Hovorka. "Auto. Con." July 1957. 5 pp. Combining delicate instruments, complex electronics and elaborate engineering theory yields new system for vehicle course control. Here is an introduction to the topic by men who developed first complete system.

***Why Engineers Leave Home, M. A. Pape and N. Kaye.** "El. Ind." Oct. 1957 2 pp. A survey of how engineers feel about the public relations aspects of their company as it applies to them.

Determining an Optimum Linear Dynamic System According to a Criterion Based Upon a Particular Type of Functional Extremum, N. I. Andreev. "Avto. i Tel." July 1957. 5 pp. A method is proposed for determining a dynamic system which corresponds to an extremum of a functional which can be written as a differentiable function of several quadratic functionals of the unit-pulse transient response of the system. The necessary condition governing the extremum of the functional is derived.

The Equation Which Determines the Distribution Law Governing the Integral of a System of Ordinary Differential Equations Containing Random Parameters, B. G. Dostupov, V. S. Pugachev. "Avto. i Tel." July 1957. 5 pp. The general equation is derived for the probability density of the integral of a system of ordinary differential equations which contain random parameters, and a possible method for performing the approximate integration of this equation by means of digital computers is indicated. The method developed in the paper can be applied to differential equations which contain random functions, provided that all of the random functions entering into the equations are approximated by finite segments of their canonical expansions. The method can be used for any system of ordinary differential equations if all of the functions are continuous with respect to the unknowns and have sectionally-continuous derivatives with respect to all of the unknowns. The method is a possible starting point for developing new approaches to the statistical analysis of nonlinear systems.

The "Waveguide Mode" Theory of the Propagation of Very Low-Frequency Radio Waves, K. G. Budden. "Proc. IRE." June 1957. 3 pp.

Negative Impedances Using Transistors in Network Synthesis, H. Ebel., Vol. 8, 6 pp. A general outline of the behavior of negative impedance converters using transistors in a feedback arrangement is presented. Their use in telephone repeater circuits is stressed.

Error Analysis in Determining the Mean Value of a Random Quantity and Its Square, When the Errors Are Associated with a Finite Observation Time, A. E. Kharybin. "Avto. i Tel." April 1957. 11 pp. The paper provides an analysis of the errors which occur in determining the mean value of a random quantity and its dispersion, when such errors are associated with a finite observation time. Formulas are derived from which nomograms are computed. These nomograms make it possible to evaluate the adequacy of the observation interval selected for the random quantity which is to be subjected to static analysis, or to find the proposed mean-square errors in determining the mean value of the random quantity and its dispersion over the selected observation interval in the most typical case.

Proton Resonance and the Measurement of Magnetic Fields, 'Quantum.' "E&R Eng." June 1957. 4 pp. A review of basic principles and practices of the proton resonance magnetometer is given.

Physical Explanation Regarding the Measurements of the Residual Current in Insulators, M. J. Fabre. "Bul. Fr. El." 7th Series, Vol. 7, No. 76. April 1957. 7 pp. The author reviews various phenomena of polarization in dielectrics and calculates the energy equilibrium. He elaborates on the polarization caused by free ions. This indirectly sheds light on the micro-macroscopic structure of dielectrics.

Calculations of Resonance Frequencies for Radially Vibrating Discs and Rings, E. Traenkle. "Freq." Issue 11, No. 5. May 1957. 3 pp. In a radially resonating ring exists a circular symmetric tension pattern. The relation between radial and tangential forces and the elongation are known from the theory of stress analysis. The elastic forces are in equilibrium with the forces of inertia. From the various relations, one obtains, by an elimination process, a partial differential equation of second order. The solution of the equation can be expressed as a product of exponential functions and the sum of Bessel and Neumann functions of zero and first order. The boundary conditions express the resonance frequency. Circular shaped ferrites can be excited and made to resonate in radial direction by magneto-striction. The article outlines the relations between the mechanical and elastic characteristics and the resulting resonance frequencies of the ferrites.

A Method for Increasing the Efficiency of Monte Carlo Integration, J. H. Halton and D. C. Handscomb. "J. of Assoc. for Computing Machinery." July 1957. 12 pp. Transformations are constructed here, which are linear combinations of the values of the function at a number of points, all the parameters being completely independent of the function and of its derivatives; they are thus easy to apply in practice and avoid the numerical calculation of derivatives.

Theory Of A Half-Wave Magnetic Amplifier. II, R. A. Lipman and I. B. Negnevitsky. "Avtomatika i Telemekhanika," April, 1957. 17 pp. The paper makes a detailed theoretical analysis of a half-wave magnetic amplifier. The finite permeability of the magnetic core material and the absence of the rectifier in the control circuit are both taken into account. A relationship is established between the structural and design parameters of the amplifiers.

Graphical Determination Of The Rotational E. M. F. In Selsyn Systems, I. M. Sadovsky. "Avtomatika i Telemekhanika," April, 1957. 5 pp. The paper determines the additional emf which arises in a synchro system when the selysns rotate at constant speed. A nomogram is provided for a simplified graphical determination of this emf and for the determination of the shift in the "null" position of the selsyns which is caused by it.

The Theory Of Derivative Control In Third-Order Linear Systems, G. A. Bendrikov and K. F. Teodorchik. "Avtomatika i Telemekhanika," April, 1957. 3 pp. As we know, control which is based upon the response to the derivative of the mismatch function leads to an increase in the stability margin and to an improvement in the tracking performance in a number of cases. The mechanism of such a response can be clarified by plotting the laws governing the motion of the roots of the characteristic equation for the closed system on the plane of the complex variable (p) when the coefficient of the first power of p varies continuously.

Synchronization of Oscillators by Periodically Interrupted Waves, D. W. Fraser. "Proc. IRE." September 1957. 13 pp. This paper describes the principles, methods, circuit applications, and the theoretical basis of the synchronization of LC oscillators by interrupted wave trains. The synchronizing process is shown to depend upon the transient behavior of the phase angle between two vectors which represents, respectively, the instantaneous voltage of the oscillator and the corresponding instantaneous voltage of the injected synchronizing signal.

TUBES

IRE Standards on Electron Tubes: Definitions of Terms, 1957. "Proc. IRE." July 1957. 28 pp.

White-Noise Vibration Test for Electron Tubes, J. D. Robbins. "Sylvania Technologist." January 1957. 3 pp. Vibration of the tube is accomplished by a vibrating armature activated by a white-noise generator, the output of which is passed through shaping circuits and amplifier. The amplitude of vibration is adjusted so that the tube is subjected to an acceleration of 15g. The vibration noise output of the tube under test is measured as the voltage across a resistor in the plate circuit.

Noise Spectrum of Electron Beam in Longitudinal Magnetic Field, Parts I & II, W. W. Rigrod. "Bell J." July 1957. 47 pp. "Growing noise" phenomenon, discovered by Smullin and his co-workers at M.I.T. several years ago, is the subject of study in this paper. Its importance is considerable, in a negative way, because it has hampered the development of medium-power traveling-wave-tube devices with acceptably low noise figures.

Evaluating Tubes and Transistors in Airborne Electronic Equipment, R. C. Gillis and J. W. Tarzwell. "El. Eq." Aug. 1957. 4 pp.

The Noise Coefficient of a Superheterodyne, M. K. Belkin. "Radiotek." June 1957. 4 pp. The paper analyzes the problem of determining the noise coefficient of a linearly-operating superheterodyne receiver. The mathematical analysis is based upon the linear equivalent circuit.

Experimental Investigation of Pulse-Interference Limiters Which Incorporate Spectrum Conversion and a "Following" Threshold, A. A. Gorbachev. "Radiotek." June 1957. 5 pp. Results are cited for an experimental investigation of a pulse-interference limiter which incorporates spectrum conversion of the useful signal and the interference, and a threshold which "follows" the level of the low-frequency useful signal.

The Use of a Compensating Circuit in the Cathode Loop of a Video-Amplifier Output Stage, T. M. Agakhanian. "Radiotek." June 1957. 10 pp. It is shown that a compensating network in the cathode loop of a video-amplifier output stage makes it possible to achieve a considerable increase in the maximum output voltage of the amplifier. Graphs and formulas are given which make it possible to compute the output voltage and the amplitude of the current pulse.

An Analysis of Transient Response in Diode Detection by the Method of Low-Frequency Equivalents, L. S. Gutkin, O. S. Chentsova. "Radiotek." June 1957. 14 pp. A method is developed for analyzing transient response in a system consisting of an RF amplifier and a diode detector; this method permits a comparatively simple determination of the results while taking into account the transient responses of the amplifier tank circuits (which supply the detector) when these tank circuits are designed in various ways and when various laws govern the variation of the input signal envelope. The method is based upon a linearization of the processes which occur during detection and upon the replacement of the detector and the system of tuned circuits supplying the detector by their low-frequency equivalents.

Experimental Investigation of Low-Frequency Noise in Vacuum Tubes and Transistors, B. V. Abramov, V. I. Tikhonov. "Radiotek." June 1957. 7 pp. A method is described for measuring the spectral intensity of the low-frequency noise which arises in vacuum tubes and transistors. Comprehensive results from actual experiments are cited, and the metering circuits are fully described.

Present Status in the Development and Operation of Microwave Tubes, R. Mueller. "El. Rund." Vol. 11. Issue 6. June 1957. 3½ pp. Part I considers only density control tubes with a transit angle $W \tau \geq .3$. Described are a few special tubes, including lighthouse tubes.

Typical Operational Behavior of the Image Orthicon TV Camera Tube, R. Theile and F. Pilz. "Rundfunk."—Jahrg. 1. No. 3. June 1957. 9 pp. The paper discusses the operational behavior and shortcomings of image orthicon tubes. From a knowledge of their causes and influences on one another, instructions are developed for the optimum method of operation of the tube. However, at times these are mutually exclusive and a compromise must be adopted. Some of the transmission faults can in any case be kept within permissible limits by taking into consideration the lighting and arrangement of the scene.

Traveling Wave Tubes, F. W. Gundlach. "Nach. Z."—Jahrg. 10. Issue 6. June 1957. 11½ pp. Electron tubes based upon the design of wave guides with periodic structure are frequently used for the generation and amplification of microwaves. The periodic structure used for guiding the electron beam can have the shape of a helix, a ladder, or a comb. By dividing this network into sections, one derives a theory which is similar to the general network theory. The author gives a very thorough mathematical analysis of his theory.

The Military Reliable Tube Program, K. C. Harding. "IRE Trans. PGRQC." August 1957. 7 pp. This paper reviews some of the more significant aspects of the tube reliability efforts being carried on by the military departments.

Development Position and Operation of Microwave Tubes II, R. Muller and W. Stetter. "El. Rund." August 1957. 3 pp. The delay of waves guided in the line-systems of tubes is obtained by means described in detail, the dispersion characteristics and coupling impedance of which are considered. Referring to examples, graphical methods for the determination of group velocity using the phase velocity characteristic of the tube system given by its dispersion curve are explained.

Description and Operating Characteristics of the Platinotron—A New Microwave Tube Device, W. C. Brown. "Proc. IRE." September 1957. 14 pp. The term "platinotron" is the nomenclature given to a class of tube which, in general, comprises a circular, but nonreentrant, dispersive network matched at both ends over the frequency region of interest, and a reentrant electron beam originating from a continuously or nearly continuously coated cathode coaxial to the network.

The Influence of the Internal Correction Voltage on the Proper Ratings of Receiving-Type Tubes, G. D. O'Neill. "Syl. Tech." July 1957. 7 pp. Uncertainties in establishing rated values for the low-frequency characteristics of receiving-type tubes are discussed, and it is shown that when a measure of the internal correction voltage is ascertained by the use of generally available data, the problem is greatly simplified.

The EC 57, A Disc-Seal Microwave Triode with L Cathode, G. Diemer, K. Rodenhuis and J. G. van Wijngaarden. "Phil. Tech." May 9, 1957. 8 pp. A description is given of a disc-seal triode for microwaves, type EC 57, the dimensions and inter-electrode spacings of which are very much smaller than those of normal triodes. Mention is made of various phenomena which were discovered during the use of microwave triodes (e.g. total-emission damping and noise, and a new type of feedback) and which influenced the design.

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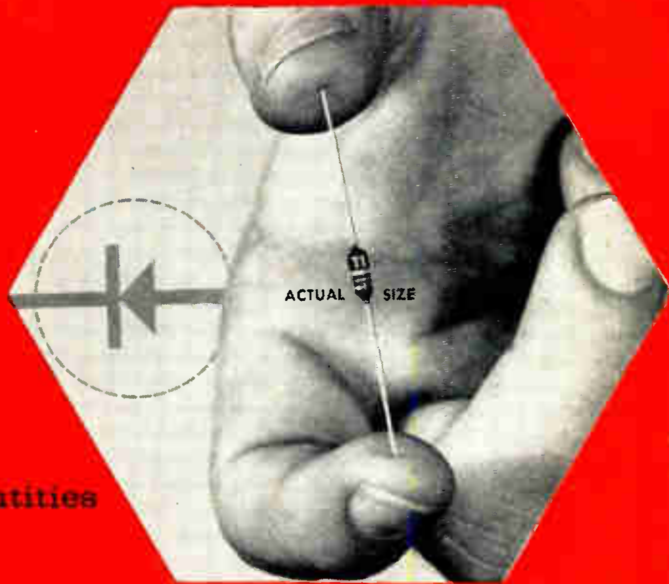

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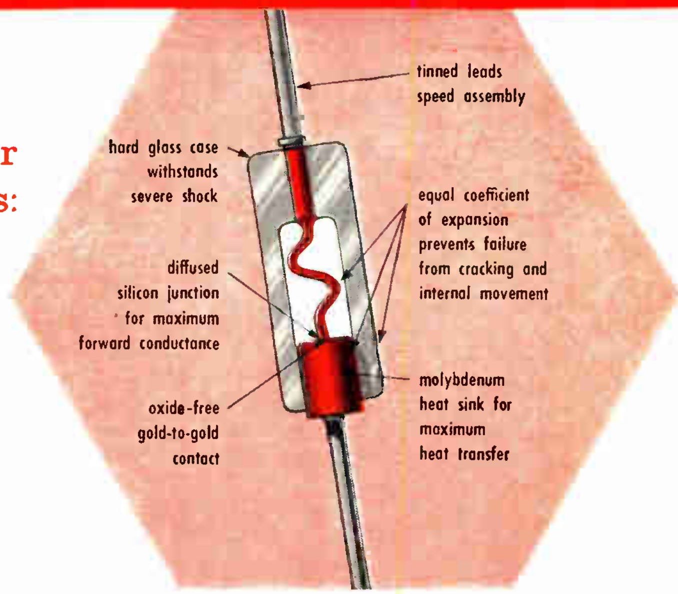

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Peak Inverse Voltage at −65 to +150°C	225	300	400	500	600	V
Average Rectified Forward Current at +25°C	400	400	400	400	400	mA
Average Rectified Forward Current at +150°C	150	150	150	150	150	mA
Recurrent Peak Forward Current at +25°C	1.25	1.25	1.25	1.25	1.25	amp
Surge Current, 1 Second DC at +25 to +150°C	3	3	3	3	3	Amp
Power Dissipation at +25°C	600	600	600	600	600	mW

specifications

	1N645	1N646	1N647	1N648	1N649	
Minimum Breakdown Voltage at +100°C	275	360	480	600	720	V
Maximum Reverse Current at PIV at +25°C	0.2	0.2	0.2	0.2	0.2	μA
Maximum Reverse Current at PIV at +100°C	15	15	20	20	25	μA
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G-15 Computer

(*Continued from page* 75)

information is read from the input device into line 19 to be secured by the computation facilities at the completion of the input operation. The computation facilities may perform testing operations to determine when a particular input or output operation is completed.

The DDA

The operational elements of a DDA are integrators, each of which is capable of approximating integration through the use of a simple quadrature scheme. Each integrator comprises two registers. For an introductory simplification, assume they take the form shown in Fig. 8.

One of the registers, the Y register, holds the instantaneous value of the accumulation of a series of small changes, $(\Delta Y)i$, in a variable Y. The quantity $(\Delta Y)i$ may take on only a limited number of values, for example, less than 16 values. It may have a sign, positive or negative, which results in the quantity being added or subtracted to the quantity Yi.

T	N	CH	S	D

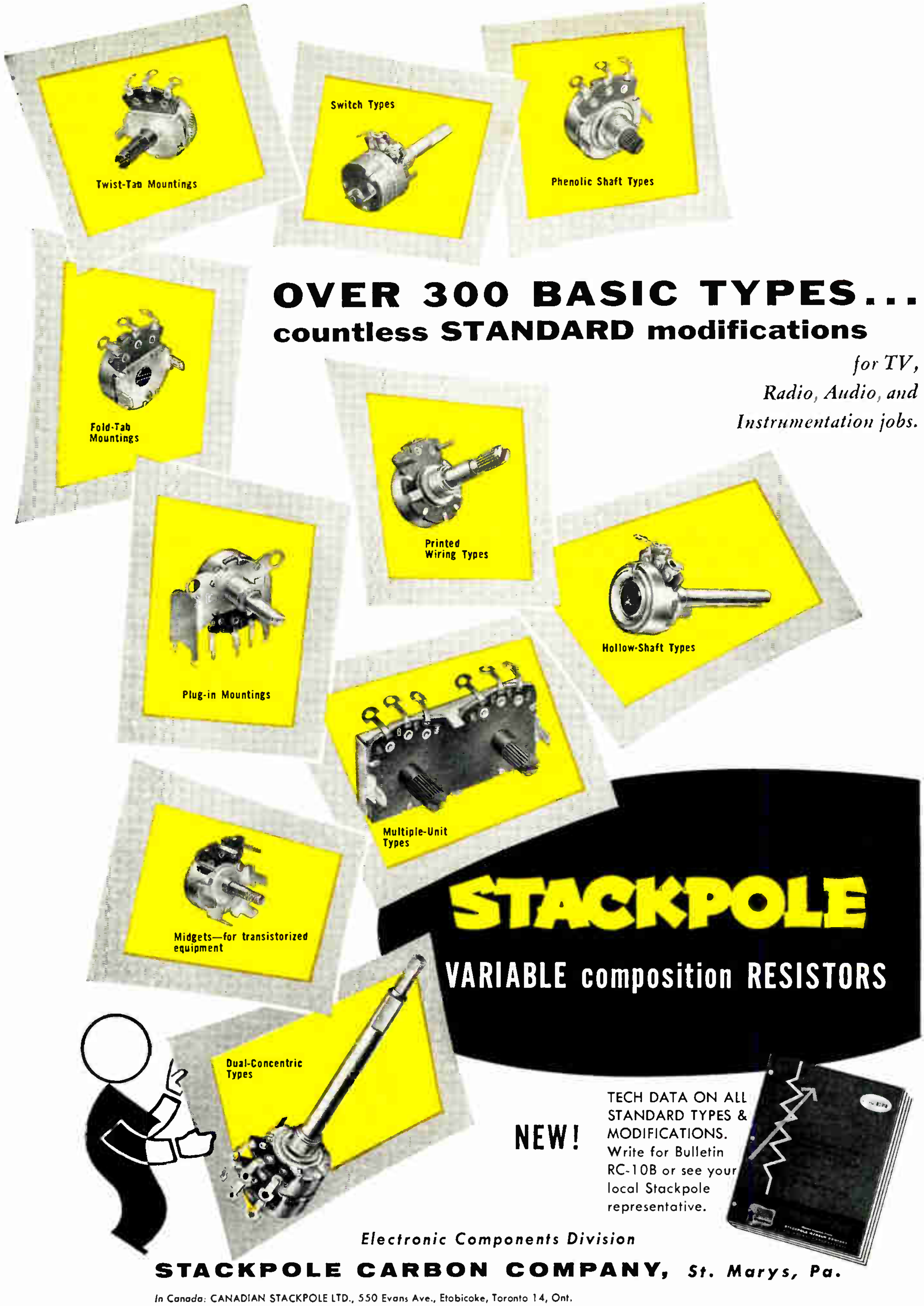
Fig. 7: Parts of a command.

The incremental changes, $(\Delta Y)i$, are created at the iteration rate of the computer. In the DA-1 this rate is 34 per second.

A second operation which occurs at each iteration of the computer is the addition of the value of Yi to a second register, the Z register, which holds the value Zi. In reality the value Yi may be added to Zi, subtracted from Zi or, indeed, nothing may happen. The determination of which operation takes place is made by a signal, $(\Delta X)i$, which may take on one of the three values +1, —1 or 0. If $(\Delta X)i$ is positive, Yi is added to Zi; if negative, Yi subtracted from Zi; and if 0, nothing happens.

It is clear that the register Z will hold an accumulation of the various Yi's, multiplied by the particular $(\Delta X)i$, if each $(\Delta X)i$ is considered to carry the value one. In reality each $(\Delta X)i$ is considered as a small incremental change in

(*Continued on page* 120)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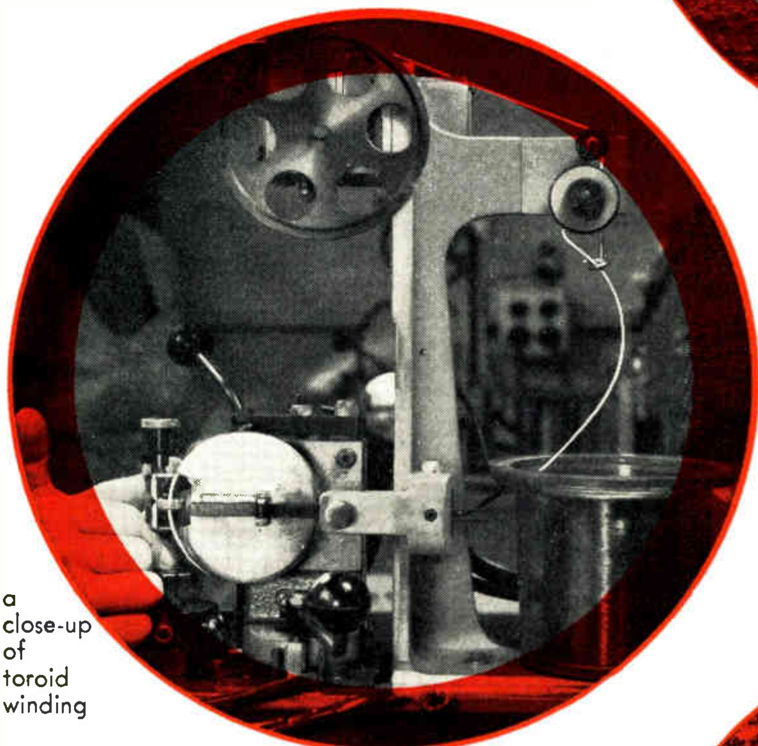

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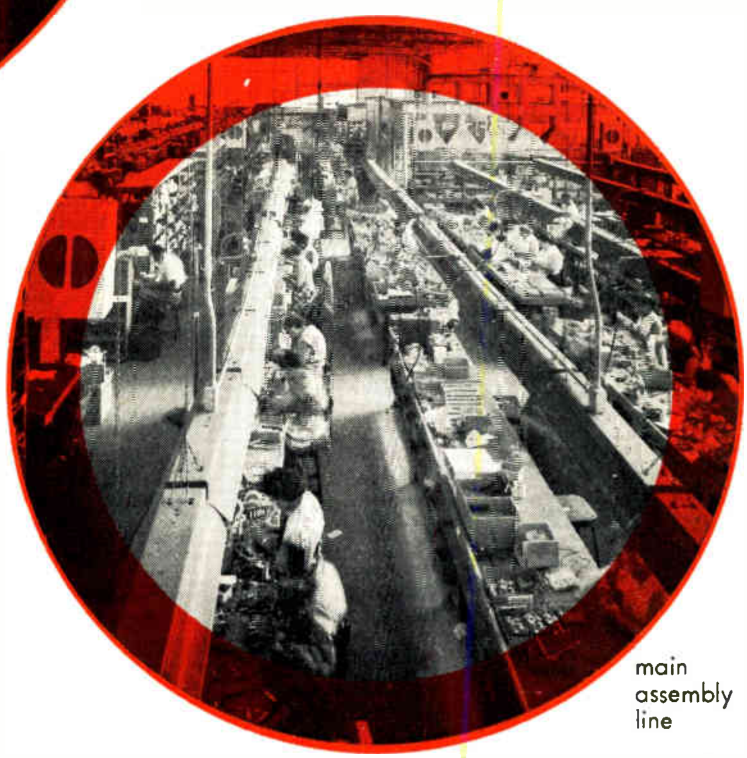

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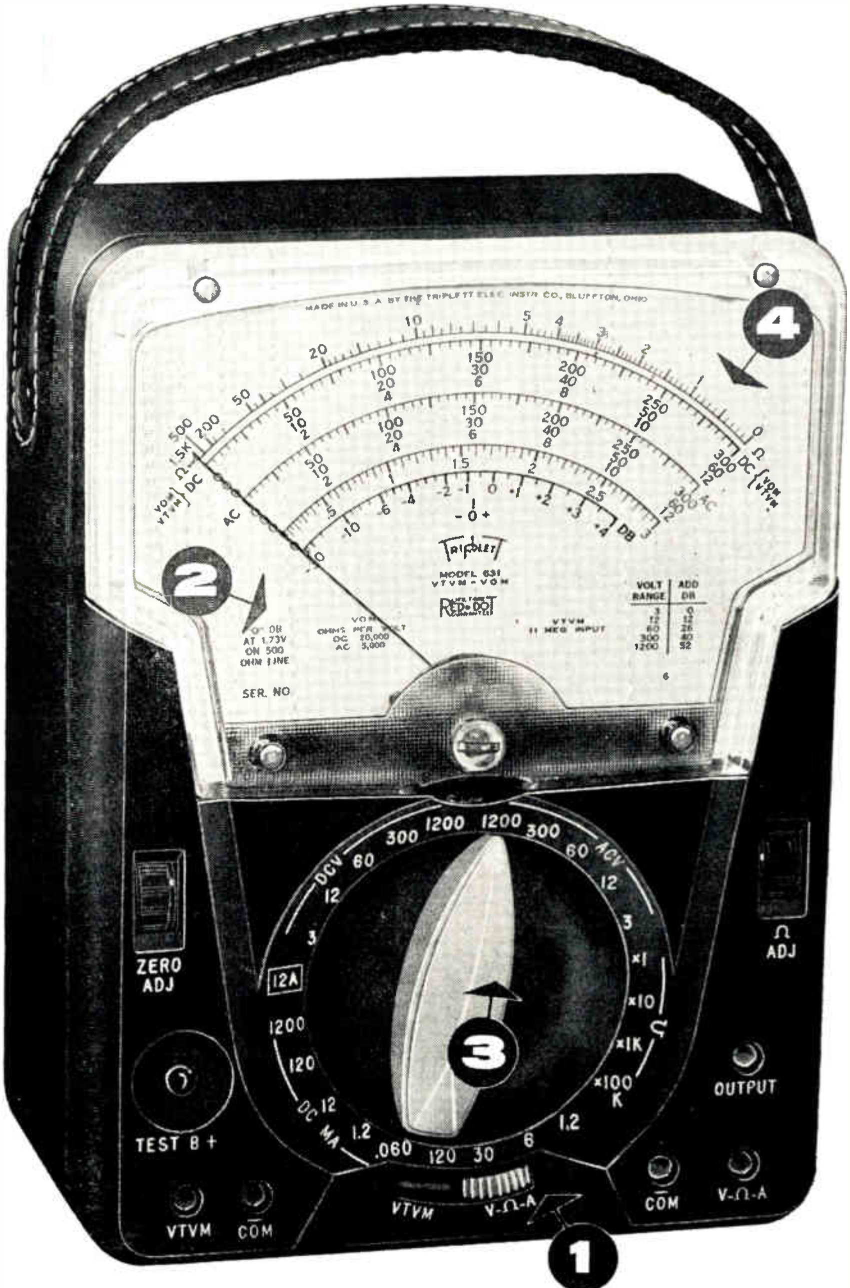

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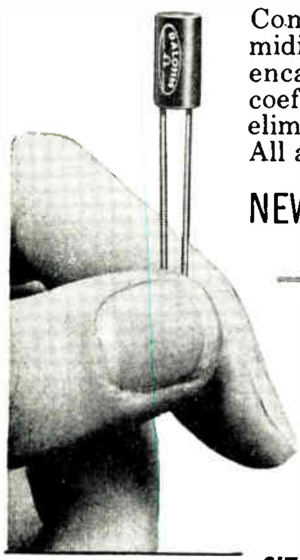

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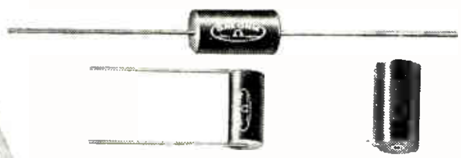

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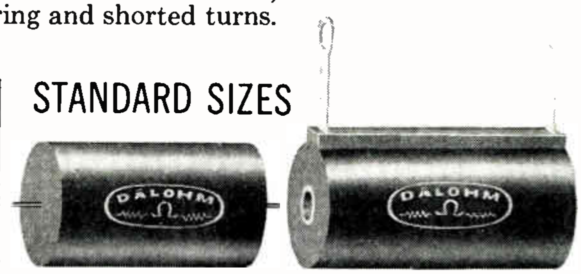
SIZES

	Length	Dia.
WWA 13	3/8″	1/8″
WWA and WWP 22	1/4″	1/4″
WWL and WWR 23	3/8″	1/4″
WWA, WWL, WWR, WWP 24	1/2″	1/4″
WWA 26	3/4″	1/4″
WWA, WWL, WWR, WWP 34	1/2″	3/8″
WWA, WWL, WWR, WWP 36	3/4″	3/8″
WWA, WWL, WWR, WWP 38	1″	3/8″

TERMINALS

WWL—lugs;
WWA—axial leads;
WWR—radial leads;
WWP—parallel leads.

STANDARD SIZES



WWA WWL

- Resistance range 0.1 ohm to 5 megohms
- Tolerances 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%
- Powered at 0.5 watt to 2 watts
- Temperature coefficient 0.00002/Deg. C
- Maximum operating temperature 125° C.

SIZES

	Length	Dia.
WWA and WWL 44	1/2″	1/2″
WWA and WWL 45	5/8″	1/2″
WWA and WWL 48	1″	1/2″
WWA and WWL 4-12	1 1/2″	1/2″
WWA and WWL 4-16	2″	1/2″

TERMINALS

WWA—axial leads; WWL—lugs.

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(*Continued from page* 112)

some value X, which results in the radix point of the Z register being in a different spot than is the radix point in the Y register. If we consider the value of (ΔX)i as being some fraction of a unit which can be expressed as $1/10^n$ and the two registers are considered as decimal registers (the DA-1 is binary, however), the decimal point of the Z register will be removed from the location of the decimal point of the Y register by "n" places.

The equation $Zi = \sum_i Yi\ (\Delta X)i$ may be approximated by the equation $Z = \int Y/dX$ if the incremental changes (ΔX)i are considered to be small in respect to the value X. If this equation is said to hold, the Z register then may be said to contain the integral of Y in respect to X.

Fig. 9 shows a modification of the scheme shown in Fig. 8. The

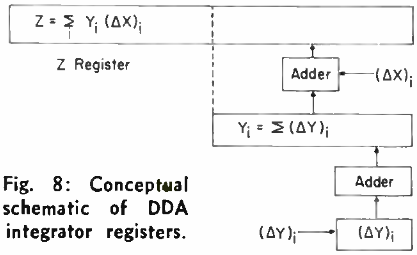


Fig. 8: Conceptual schematic of DDA integrator registers.

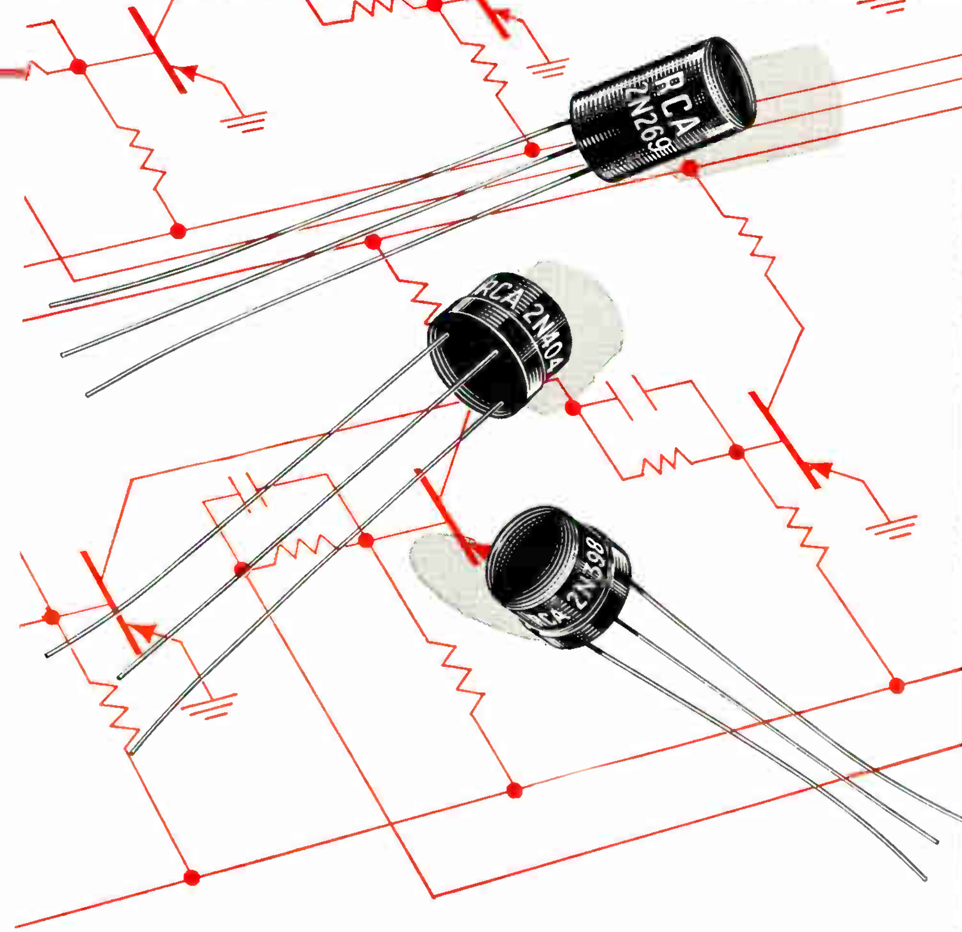
Z register has been shortened so that it is exactly the same length as the Y register; furthermore, the Z register has been renamed the R register.

In this system it can be seen that the R register will periodically overflow as the Y values are added to it. The R register will then contain the value expressed by the equation $Ri = R\ i{-}1 + Yi\ (\Delta X)i - (\Delta Z)i$, where (ΔZ)i may be considered as the carry which would occur from the most significant digit of the R register into the next most significant digit if that digit would have existed.

Indeed, one may consider a third register, the Z register to exist and the carry overflow from the R register will be added to the least significant digit of the Z register as shown in Fig. 10. A similarity between the Z register and the Y register may be seen if one considers that the Z register is the Y of another integrator.

(*Continued on page* 124)

RCA COMPUTER TRANSISTORS



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Max. Ratings	V_C	I_C	Collector Dissipation	Storage Temp.
	−25 volts	−100 ma	120 mw at 25°C 35 mw at 55°C 10 mw at 71°C	−65°C to +85°C

Characteristics* (at ambient temperature of 25°C unless otherwise specified)	Typical Values	Range Values Min	Range Values Max
Collector Cutoff Current (V_C = −12v, I_E = 0)	−2μa	—	−5μa
Collector Cutoff Current (V_C = −12v, I_E = 0, T_A = 80°C)	−45μa	—	−90μa
Collector-to-Emitter Saturation Voltage (I_B = 0.4 ma, I_C = −12 ma)	−100mv	—	−150mv
Alpha Cutoff Frequency (I_E = 1.0 ma, V_C = −6v)	12Mc	4Mc	
Stored Base Charge (I_C = 10 ma, I_B = −1.0 ma)	800 μμcoulombs	—	1400 μμcoulombs

TECHNICAL DATA—RCA-2N398

Max. Ratings	V_C	I_C	Collector Dissipation	Storage Temp.
	−105 volts	−100 ma	50 mw at 25°C 10 mw at 55°C	−65°C to +85°C

Characteristics* (at ambient temperature of 25°C unless otherwise specified)	Typical Values	Range Values Min.	Range Values Max.
Collector Breakdown Voltage (I_C = −50μa, I_E = 0)	−150 volts	−105 volts	—
Collector-to-Emitter (Punch-Through) Voltage (V_E = −1v, I_E = 0)	−150 volts	−105 volts	—
Collector Cutoff Current (V_C = −2.5v, I_E = 0)	−6μa	—	−14μa
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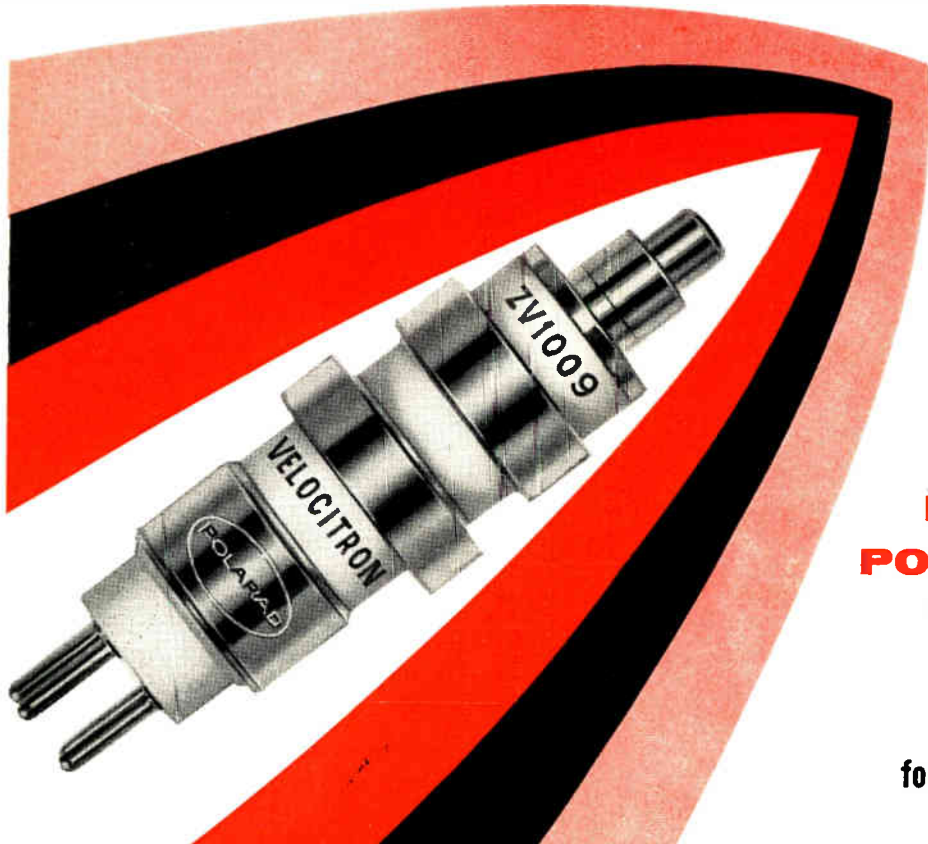

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SPECIFICATIONS: ZV1009 VELOCITRON

Reflector Mode	1¾	2¾	3¾
Cavity Mode	¾	¾	5/4
Frequency	2800	3200	5000 mc
Power Output Cutoff Voltage (approx.)	+3	+3	+3 volts
Reflector Voltage (approx.)	–220	–120	–220 volts
Resonator Voltage	325	325	325 volts
Control Electrode Voltage (Full Power Output)	+10	+10	+10 volts
Cathode Current (average)	28	28	28 ma
Electronic Tuning Range (between Half Power Points—minimum)	6	6	6 mc

Write directly to Polarad for complete data and design information.

*Registered U.S. Trademark †Manufactured under Western Electric Patents

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ELECTRONICS CORPORATION

43-20 34th Street · Long Island City 1, N. Y.

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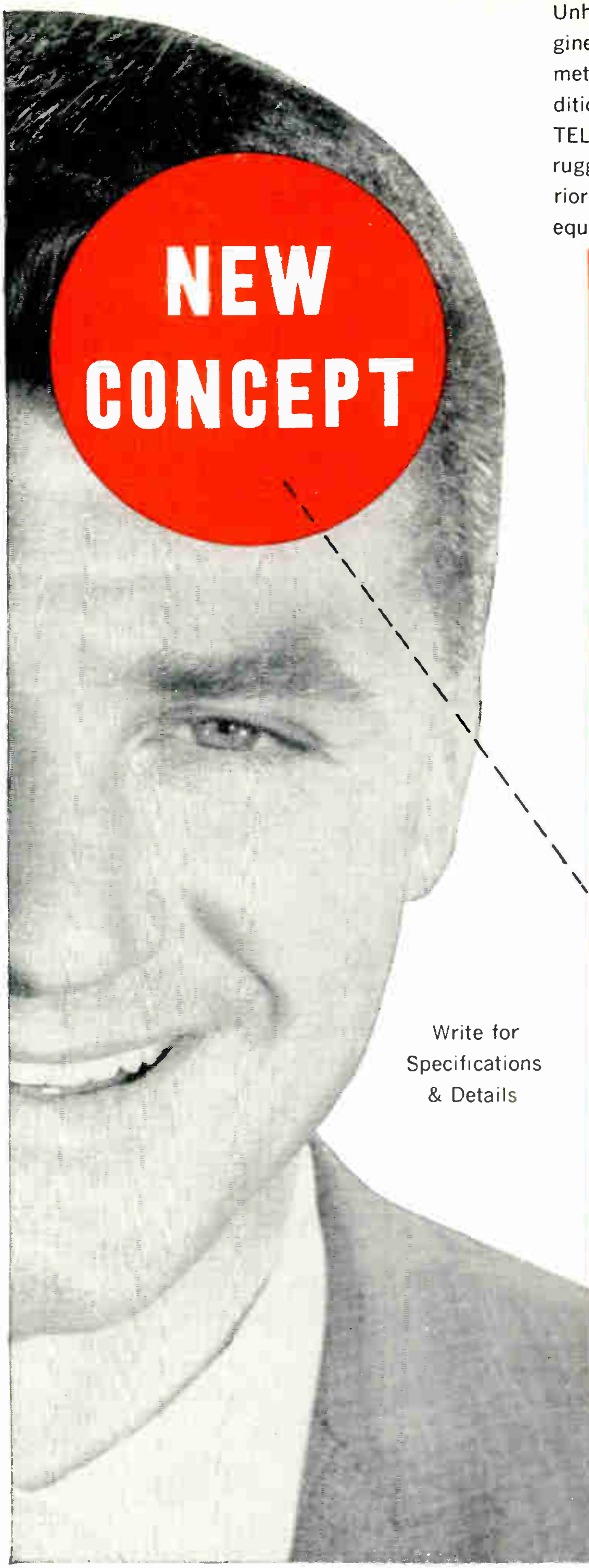
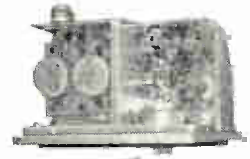
Resident Representatives in Principal Foreign Cities

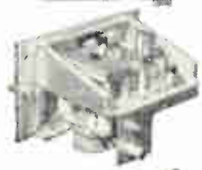


Unhampered by traditional thinking, TELECHROME engineers have developed an entirely new concept in telemetering equipment. Today's new environmental conditions and distances for missiles require new designs. TELECHROME units are unequalled in compactness, ruggedness* and dependability. Because of their superior qualities these highly efficient units are replacing equipment of other manufacture.

Direct FM Transmitters Crystal controlled 215-235 megacycles. 125kc deviation.

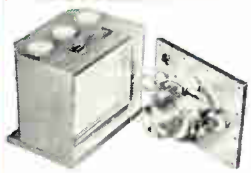


Model 1462—6" x 4 1/4" x 3 3/4"
50 to 80 Watts



Model 1463—5 19/32" x 3 13/16" x 4"
15 to 30 Watts

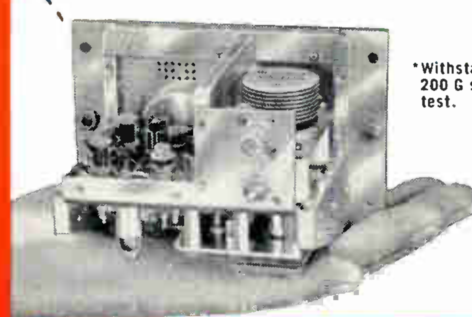
Model 1472—4" x 1.5" x 2.7"
2 Watts



Model 1460—5" x 4 5/8" x 3 15/16"
RF Amplifier
15 to 30 Watts

Model 800—4.5" x 1.3" x 1.4"

SUB-CARRIER OSCILLATOR. Deviation stability ±1% of band width. Deviation linearity less than 1% of band width under all conditions measured from a straight line drawn between end points.



*Withstands 200 G shock test.

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HIGH POWER IN SMALL PACKAGES

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The Nation's Leading Supplier of Color TV Equipment

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AMITYVILLE, N. Y.
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(*Continued from page* 120)

Each integrator then is made up of the Y and the R register and receives two inputs, (ΔY)i (abbreviated dY), and (ΔX)i (abbreviated dX). It also emits an output (ΔZ)i (abbreviated dZ).

Magnetic Drum DDA

The integrators of a magnetic drum type DDA, for example the DA-1, physically are not separable. They are said to exist separable in time. The Y registers of all of the integrators exist as separate sections of one track on the memory; likewise the R registers. The integrators are processed in sequence, one after the other, as the integrator segments of the memory drum tracks pass under the read heads. Only one set of circuits is used to process all the integrators. This may be shown schematically in Fig. 6. Since the G-15 memory tracks contain 108 words each, there is room for 108 Y registers on one track and 108 R registers on another track. This gives the DA-1 a capacity of 108 integrators.

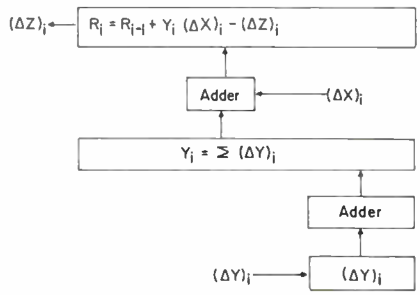
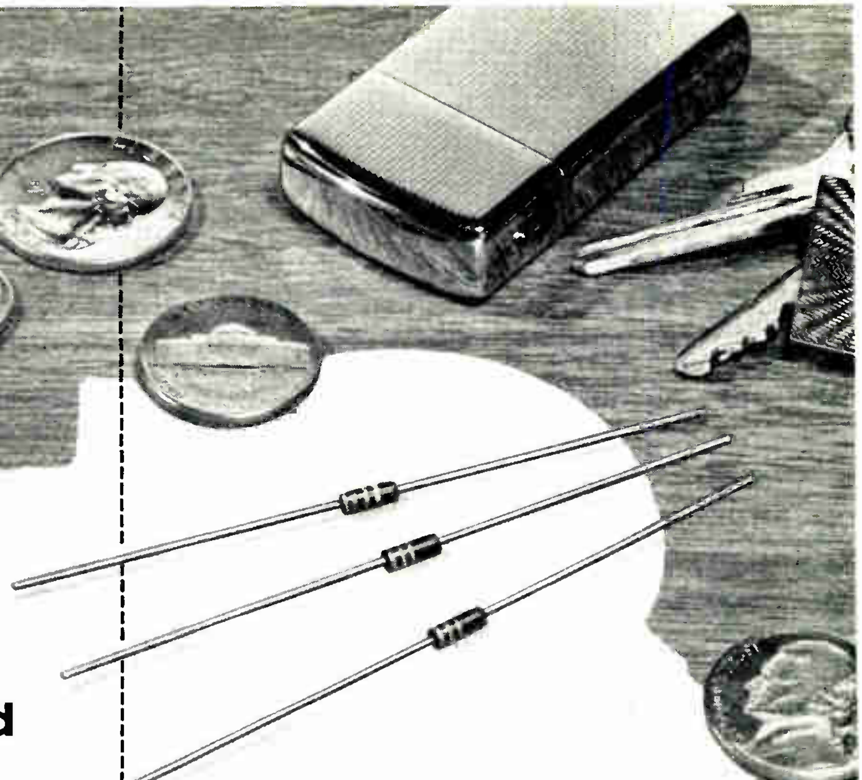


Fig. 9: Integrator schematic.

Addressing

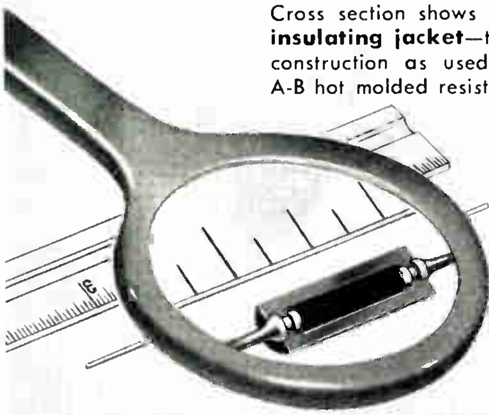
Since the integrators exist separable in time rather than separable in space, physical interconnection of the various dZ, dY and dX's cannot be done. Instead, addressing of the dZ outputs to the inputs of other integrators is done electrically through the use of address channels. The outputs of all of the integrators are stored in a 4-word track on the memory so that at each group of four integrator times the outputs of all other integrators are available. Another group of four long lines are used for addresses. At a given integrator time, pulses stored in a given address line result in a counter being operated according to information stored in the 4-word track holding

(*Continued on page* 142)



NEW!

1/4-WATT insulated hot molded composition resistor only 1/4" long!



Cross section shows **molded insulating jacket**—the same construction as used for all A-B hot molded resistors.

Here's a new ¼-watt, solid *insulated* composition resistor in a truly *small* size . . . ONLY ONE QUARTER OF AN INCH LONG . . . that provides the same superlative performance, reliability, and uniformity which have made the Allen-Bradley hot molded resistor preferred the world over.

Although exceptionally small, Allen-Bradley Type CB hot molded resistors are rated for "continuous operation" at 70°C ambient temperatures. The hot molded construction of this Type CB resistor makes impregnation unnecessary . . . it also provides the most reliable protection against extended periods of high humidity, as encountered in practical applications. Available in all RETMA resistance values from 10 ohms to 22 megohms. Tolerances: 5%, 10%, and 20%.

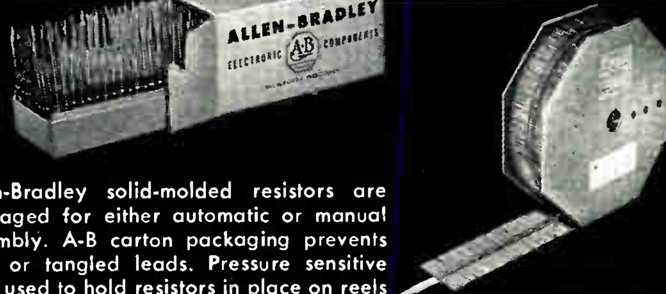
Where space is at a premium . . . and where failures would be disastrous . . . you owe it to yourself to investigate this new addition to the Allen-Bradley *quality* line. Please write today for complete specifications. Samples available for your tests.

Allen-Bradley Co.
1315 S. First St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

A-B QUALITY

OTHER HOT MOLDED RESISTORS IN THE A-B FAMILY

Allen-Bradley fixed, molded resistors rated at 70°C ambient are available in standard RETMA values from 2.7 ohms to 22 megohms in ½ and 1-watt sizes . . . and from 10 ohms in the 2-watt size. In 5%, 10%, and 20% tolerances.



Allen-Bradley solid-molded resistors are packaged for either automatic or manual assembly. A-B carton packaging prevents bent or tangled leads. Pressure sensitive tape used to hold resistors in place on reels —for most economical assembly.

ALLEN-BRADLEY
HOT-MOLDED COMPOSITION RESISTORS
QUALITY

 Circle 66 on Inquiry Card, page 107

WESTON

250° SCALE

PANEL METERS

—sizes, sensitivities, accuracy, damping,

to meet your special needs!

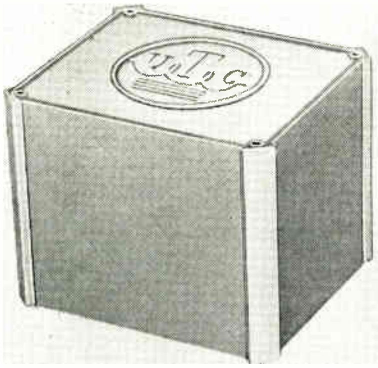
This comprehensive group of Weston d-c and rectifier type a-c panel meters provides not only increased scale readability, but higher accuracies and improved sensitivities and ballistic characteristics as well. Available in 2½″–3½″–4½″ and 5½″ sizes, in standard flanged and aircraft cases for a wide range of voltage and current indications, as well as for tachometry and temperature applications. All movements embody Weston spring-backed jewels, and are magnetically self-shielded permitting their use interchangeably on magnetic or non-magnetic panels. For the complete story, consult your nearest Weston representative, or write for literature. Weston Electrical Instrument Corporation, Newark 12, New Jersey.

A DAYSTROM UNIT

New Products . . . for Communications

OUTPUT TRANSFORMERS

Two new high fidelity output transformers are available. Type LS-35 has a 5,000 ohm center tapped primary with 43% screen taps for use with EL-34 tubes in AB-feedback.

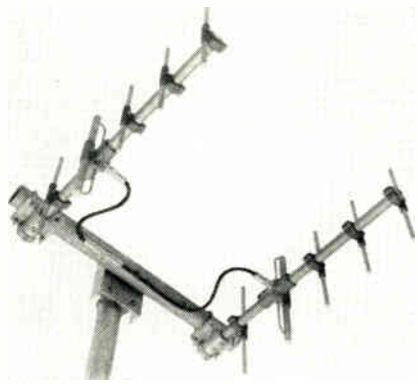


Secondary impedances are 4, 8, and 16 ohms, frequency response +1 db. from 7 to 50,000 cps., 35 w. level. The LS-65 transformer is a similar unit of 60 w rating, providing a 3300 ohm center tapped primary with 40% screen taps for 6550's in AB_1-feedback. Both units are furnished with a circuit to provide maximum fidelity and stability. United Transformer Corp., 150 Varick St., New York 13.

Circle 215 on Inquiry Card, page 107

COMMUNICATION ANTENNA

A new yagi type antenna for 450 mc, Model CA-450, has been designed for working in extreme weather conditions. Parasitic elements are 7/16 in. solid aluminum rods and driven

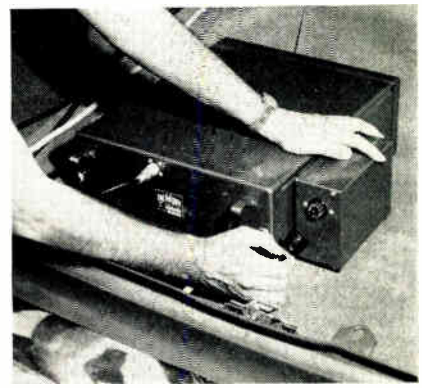


element is made of ¾-in. tube. All elements are mounted by a heavy aluminum casting. The "T" match on the dipole is fed by a Teflon insulated balun inside the antenna boom. All internal wiring is potted under pressure. Antenna is shipped with N-type connector and 2 U-bolt clamps. Other type clamps and connectors are available. Scala Radio Co., 2814 19th St., San Francisco 10, Calif.

Circle 217 on Inquiry Card, page 107

SELECTIVE CALLING

A unit, smaller than a cigar box, converts any standard two-way radio network to a fully automatic selective calling system. Called Tonicam, the unit eliminates co-channel annoyance

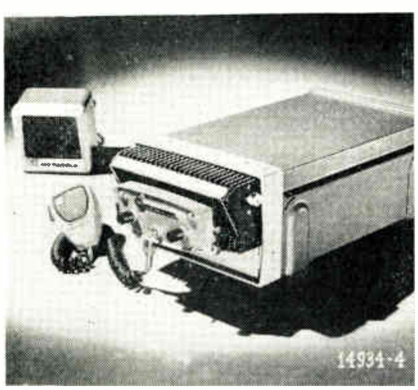


without the necessity of transmitting continuous h-f tones. The base station operator can talk with more than one mobile unit by simply calling the desired units. Those who lift their mikes from the hangup position on the mobile unit are participants in a conference call. Unless mike is picked-up, receiver is dead. A. B. Du Mont Lab., Inc., 750 Bloomfield Ave., Clifton, N. J.

Circle 219 on Inquiry Card, page 107

MOBILE RADIOS

Called the "T-Power" radiophones, the new two-way radio units incorporate a transistorized switching circuit in the power supply in place of the conventional vibrator. They offer new installation versatility. Rated at 20 and 25 watt output and available for operation in the 25-50 mc and 144-174 mc bands, they operate from 12 volt negative ground sources. Mod-

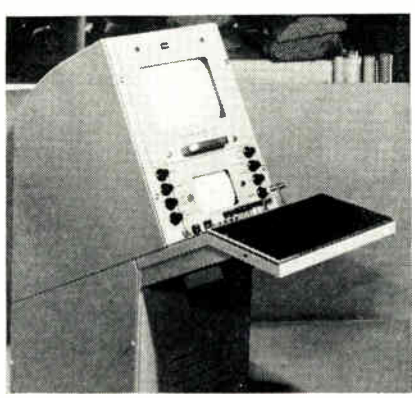


els can be supplied with either conventional squelch or as "Private-Line" radiophones. Motorola Communications and Electronics, Dept. TIC, 4501 Augusta Blvd., Chicago 51, Ill.

Circle 216 on Inquiry Card, page 107

TV MONITOR

Model ARM-13B, is a video monitor intended for use as either a camera monitor or an outgoing line monitor in broadcast TV applications. A 10 in. aluminized kinescope is employed for picture presentation. The kinescope video amplifier has an 8 MC bandpass to provide horizontal resolution in excess of 600 lines. The 5 in. flat-faced A-scope, combined with

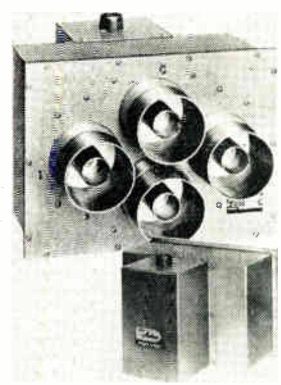


an illuminated, calibrated reticle, provides a means of setting video, sync, and pedestal amplitudes to extremely close tolerances. Kin Tel, 5725 Kearny Villa Rd., San Diego 11, Calif.

Circle 218 on Inquiry Card, page 107

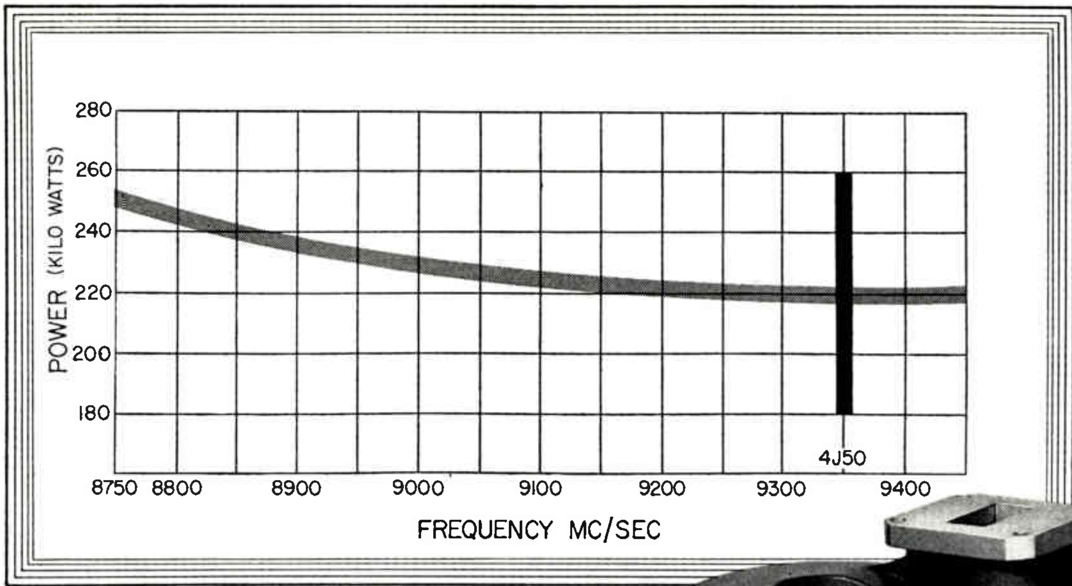
COAXIAL SWITCH

Switch, Type 6710, provides 4 sec. switching of 3⅛ in. coaxial transmission line to standby equipment at frequencies up to 1000 MC. Switch can be used in high power communication systems, as well as UHF and VHF TV stations. This remotely controlled switch is operated by an ac motor which is normally operated on 115 v., 60 cps. Other motors are avail-



able on special order. Control circuitry includes a wafer switch for use in remote position indication circuits. Andrew Corp., 363 E. 75th St., Chicago 19, Ill.

Circle 220 on Inquiry Card, page 107



Sylvania duplicates the power and package of the 4J50 in a...

Tunable Magnetron

Type 6874

Adds flexibility to existing equipment as well as to new designs

Sylvania sets the pace in magnetrons with its newest, high-powered tunable unit, type 6874, that covers the frequency range between 8800 and 9400 Mc. The tunable 6874 directly replaces the fixed frequency 4J50 magnetron. It provides rapid and inexpensive conversion of fixed frequency systems to meet latest military requirements.

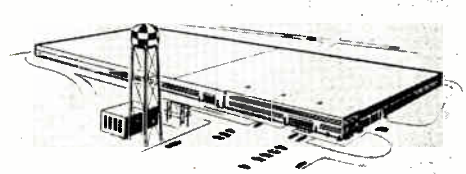
Designed for airborne radar and missile applications, the 6874 is mechanically ruggedized for severe shock and vibration requirements. Thus a very compact tunable package is provided even for very severe environmental conditions.

Typical Characteristics:

Heater Voltage (Preheat)	13.75 Volts
Heater Current	3.00—3.75 Amps
Peak Anode Current	27.5 Amps
Peak Power Output	200 KW nominal
Peak Anode Voltage	21 KV
Pulse Duration	1.0 u sec (3.34 sec max)
Duty Cycle	.001

Sylvania moves ahead in Magnetrons

With tripled magnetron production facilities now in operation at its Williamsport, Pa., plant, Sylvania meets expanding military and commercial needs. Call your Sylvania representative for full information on the complete Sylvania magnetron line.



Sylvania's Williamsport, Pa., plant houses expanded magnetron production facilities

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd. Shell Tower Bldg., Montreal

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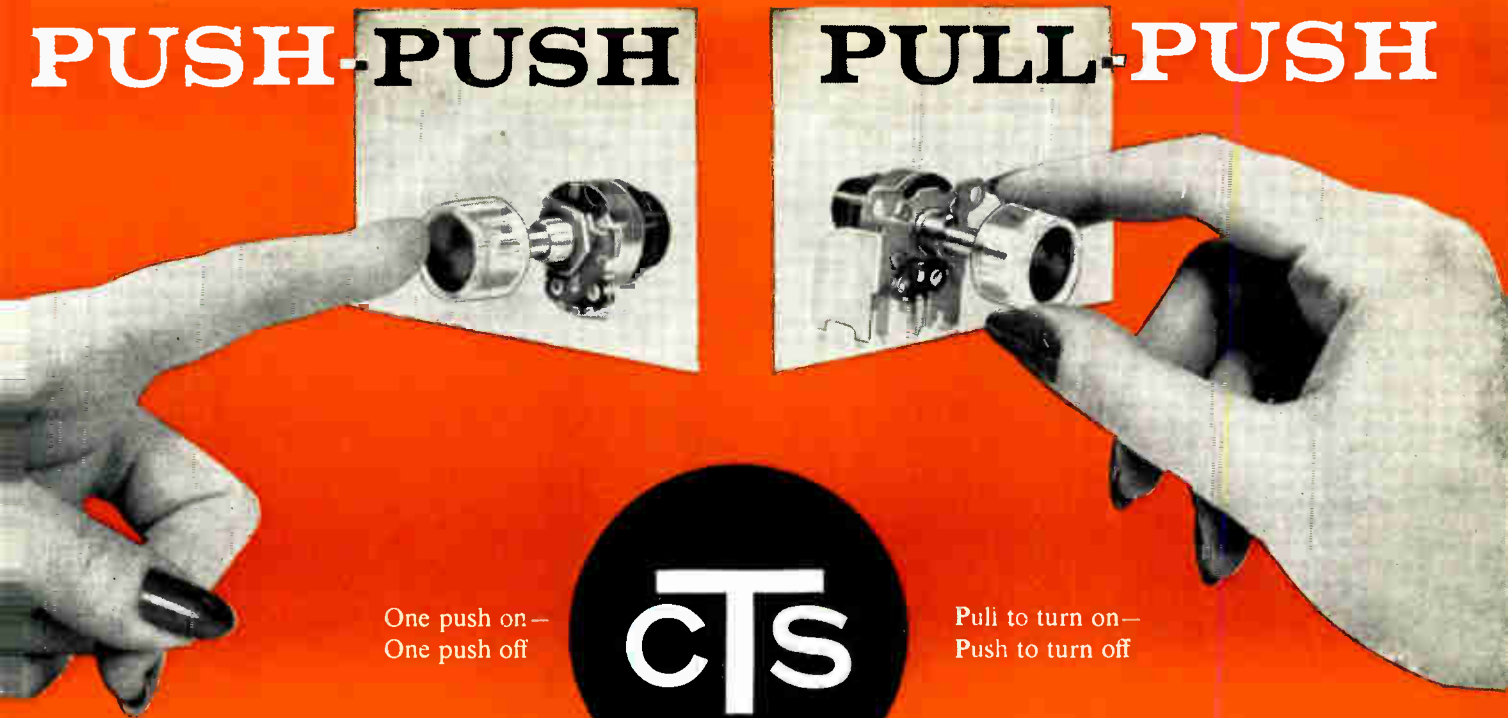

Two new switch-controls

Volume setting unaltered by ON-OFF operation

Just switch on and walk away. No coming back or waiting for further adjustment after warm-up.

Volume can be changed instantly as desired by rotating shaft . . . or can remain indefinitely at any selected setting regardless of on-off switch operations.

Push-push switch available with either 3 amp 125V rating (Type J) or 6 amp 125V rating (Type TJ). Pull-push switch available with 3 amp 125V rating (Type K). Both switches available in many special terminal and control combinations.

Write today for Data Sheets containing dimensional drawings and complete technical details.

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The most complete line of variable resistors and associated switches available is manufactured by CTS. Consult CTS Specialists on all your control problems.

WEST COAST MANUFACTURERS:
Many types of variable resistors now in production at our South Pasadena plant. Your coil, transformer and compression molding business also invited. Prompt delivery. Modern versatile equipment. L. A. phone CLinton 5-7186.

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CHICAGO TELEPHONE SUPPLY *Corporation*

ELKHART • INDIANA

The Exclusive Specialists in Precision Mass Production of Variable Resistors

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

BUILDING FOR FUTURE

Motorola's Dr. Dan V. Noble interviews a prospective employee at the "Open House" ceremonies at Motorola's new Western Area Military Electronics Center, Phoenix, Ariz.

Engineer Pay Lags Other Professions

Despite the high-powered recruiting campaigns of the past few years, and the remarkable rise in starting salaries for young engineers, the average pay for engineers still lags far behind that of other professions.

This fact has led two economists, George J. Stigler, professor of economics at Columbia University, and David M. Blank, associate economic adviser of the Columbia Broadcasting System to question whether an engineer shortage does, in fact, exist. Their report, "The Demand and Supply of Scientific Personnel," financed by the National Science Foundation, was published last month.

The economists compared the ratio of the salaries of engineers and doctors in 1929 and 1951. In 1951 the ratio of the engineer's pay to the physician's had dropped 40 per cent below the 1929 level. The ratio of engineers' salaries to the salaries of dentists was 16 per cent below the 1929 level.

During the period 1929-1954 earnings of wage earners increased more sharply than the carnings of engineers. By the 1950's the ratio of engineers' salaries to the earnings of wage and salary employees in manufacturing was about one-third lower than in 1929.

Engineer Shortage Or Not? —Depends on Who You Ask

"I advertised for a microwave engineer for four weeks, and didn't get a single reply," complains a West Coast engineering manager.

"We've had to release more than half of our engineers," says the job shop boss. "No work—."

"We're interested in any engineer who is looking for a job," says an East Coast v-p for engineering.

In reviewing the employment picture from coast-to-coast last month it seemed as though no two people had the same answer. Depending on the location and the particular branch of electronics any one of the three answers might be forthcoming. A few fairly definite trends do, however, emerge.

On one point all agree. There is everywhere a great demand for the outstanding engineer, the engineer with heavy experience in a certain field. This need is not likely to diminish for a number of years.

The West Coast is now suffering a slight case of the jitters after seeing North American Aviation hurriedly turn loose 1000 engineers following the Navaho cancellation. Indiscriminate hiring of engineers has been greatly curtailed.

Job shops, by the nature of their operation, are feeling the effects more acutely than other firms. There is some speculation as to whether a number of the larger shops will not soon begin competing directly for R & D contracts. Many of them are well-staffed and in a position to provide rugged competition to established firms. In the meantime, they have the problem of keeping the engineers they have. Many of the engineers who had looked disdainfully at the salaries offered by industrial firms are beginning to weigh more carefully the advantages of security against the difference in income.

Newly graduated electronic engineers continue to write their own ticket. Latest surveys place the average starting pay at $515 per month, though the average for

(*Continued on page* 140)

Also In This Section:

Will Recruit Engineers For Small Firms On Fee

Small firms in need of engineering or executive personnel have found it difficult to compete with the well organized recruiting staffs of large corporations. One solution to this problem is being offered now by a Lansdowne, Pa., firm.

Coll Associates, with branch affiliations in ten cities around the U. S., will make itself available as a full-time recruiting team for the personnel that the firm needs on a fixed annual fee. The charge is $3,600, and there is no limit to the number of personnel that any one firm may request.

The company believes that through its service it can slash a firm's recruiting bills by 66 per cent, as opposed to the cost of maintaining a company recruiter.

The firm's address is Coll Associates, Box 244, Lansdowne, Pa.

Why Engineers Leave Home

By **MAX A. PAPE and NIKKI KAYE**
212 Quincy Avenue
Long Beach 3, California

THE big reasons why engineers change jobs are fairly well known—money, location, job opportunity. In an effort to discover the small, correctible reasons that drive a valued employee from Company A to Company B we completed a survey of 192 engineers representing 47 companies predominantly in the electronics industry. This began as an off-the-cuff survey, i.e., no formal questionnaire, just the one question: "Do you feel you are getting adequate support from your Public Relations Department?"

We selected Public Relations hoping to pick up a catch-all of minor complaints. And there were many.

Because 9 of the first 10 engineers interviewed did not know the complete functions of a Public Relations Department, we checked the duties as listed on the organizational chart of 9 large, representative companies. Charts listed:

- Publications
- Community Relations
- Press Relations
- Advertising
- Publicity

We discarded the first 10 interviews and in the subsequent 192 asked the question: "Do you feel you are getting adequate support from your Public Relations Department?" followed by a list of the support offered.

Of the engineers interviewed, 134 were not aware of the support they were supposed to receive.

Only through the employee booklet were they even aware of the existence of a Public Relations Department—a booklet that is given the once-over-lightly in the press of a new job, and thereafter forgotten. There was sharp resentment because they had not been continually reminded—at staff meetings, through house organs or any other media—that a Public Relations Department existed that could benefit them.

"No, I'm not getting adequate support," said 58, and proceeded to air complaints that had nothing to do with Public Relations.

Granted that each duty coming under the purview of the Public Relations Department carries a multitude of responsibility, few if any seem to be carried out to the satisfaction of qualified, highly rated employees. *The handful of notable exceptions were the companies that have less turnover in personnel than the majority.*

Publications

The greatest complaint came under the heading of Publications, which was interpreted to mean Manuscripts. Of the 192 engineers interviewed, 36 had written a manuscript, paper, book or article. Of the 36, 22 had actually published. All 36 said they had no assistance in publication from the Public Relations Dept.; 23 felt that publication of any kind was actually discouraged, and in several cases hindered by the company because of the length of time it took the department to release the manuscript. They had no direct access to the Public Relations Dept., and no direct help—i.e., they had to find their own outlet, make their own contacts, actively seek editors. Eight companies took over 3 months to release manuscripts (passing on contents for security classification) by which time the manuscripts were no longer acceptable to the interested publications.

In addition to the 36 who had actually written a manuscript, paper, book or article, 19 said they wanted to write for publication but had been discouraged by the experiences of their colleagues in dealing with the Public Relations Dept.

How to Keep Your Engineers

1. Inform all personnel of the functions of the Public Relations Dept. Do this through company brochures, internal house organs, at staff meetings, by bulletin and through supervisors.

2. See that all publicity information is channeled through Public Relations — not only by department, but by employees as well. Encourage employees to boast of their accomplishments, and see that all achievements are publicized.

3. Keep the pathway open to the door marked "Public Relations."

4. Keep a photo and background data file of all new employees and use whenever and wherever possible.

5. If participation in community affairs is encouraged, make it known to the employees and actually encourage them and publicize their activities. The same applies to membership and officership in professional societies. Inform employees of company encouragement through whatever media is at your disposal. If activities cannot be publicized in any other way, do it through the internal house organ.

6. Use the house organ not only as a vehicle for all in-plant publicity, but to build warmth and unification, not to emphasize the impersonal vastness of the company. Explain departmental functions; illustrate the inter-dependency of departments.

7. Establish an active, functioning Manuscript Dept. within the framework of the Public Relations Dept. and use every means at your disposal to encourage the presentation of papers, the writing of manuscripts. After informing employees of the existence of a Manuscript Dept., offer all possible assistance in editing and placing of manuscripts. (This not only means a great deal to the engineer, but is good public relations for the company as well.) Above all establish a system whereby all articles can receive security clearance within two weeks.

8. Merchandise the advertising and circulate it among all employees so that your valued people will know what their company is doing and will be able to "point-with-pride."

9. Give individual recognition where and when it is due—externally, via publicity where possible; always internally via house organ. This includes promotions, community relations, professional activities, longevity, safety and patent awards, retirement, etc. Wherever possible, incorporate longevity of employees in company recruitment advertising.

10. Merchandise the publicity as an incentive to other employees.

The second highest complaint was publicity.

After a paper had been published, according to 12 engineers, it was ignored completely by the company in both internal and external publicity; and they didn't even get a writeup in the internal house organ.

A group of 87 engineers felt they were sufficiently known in the industry to rate a writeup in the "Who's Where Department" of various trade magazines, which writeup was not forthcoming because the Public Relations Dept. had not issued a press release.

Sixty-seven engineers interviewed had reached the 5 or 10-year longevity point with their company. Thirteen of the 67 were written up in the internal house organ, receiving no external publicity; *31 had received no recognition at all, not even in the internal house organ.* Of the 67, only 23 were given both internal and external publicity.

Recognition

In an industry that bleeds in print regularly over the continual loss of personnel, ignoring the longevity record of 31 employees seems to be more serious than mere oversight.

Seventy-four engineers complained about lack of publicity over patents, safety awards, membership and officership in professional societies. In fact, when their own employee booklets were quoted, saying, "Your company encourages membership in professional societies," the engineers interviewed were not only surprised but asked bitterly, "In what way do they encourage? By keeping it a secret?"

They were just as surprised to learn that the same booklet encouraging professional membership also encouraged activities in community affairs. Twenty-one of the engineers interviewed said they were importantly engaged in community affairs; 14 had sent the information through to Public Relations (via channels) with no visible results—not even a squib in the house organ.

None of the 192 engineers interviewed was aware of the over-all advertising done by the company —advertising that included both recruitment and product. Ninety-three knew of some of the advertising if it appeared in magazines and newspapers that they themselves read.

Grievances

From this survey came varied grievances not connected with Public Relations, but good examples of the small irritants that help an engineer leave home:

Inadequate library.

Complaints about ordering books or magazines — in many cases requiring so many endorsements the order never goes through.

Resentment and animosity over badges of various colors to denote "rank."

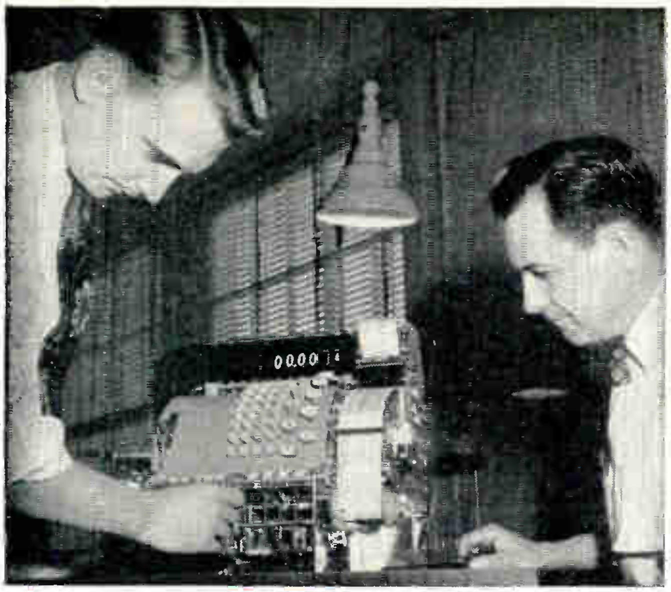
Lack of information regarding the aid available by the Public Relations Dept., or in fact any other department.

Anonymity of the staff as far as the profession is concerned.

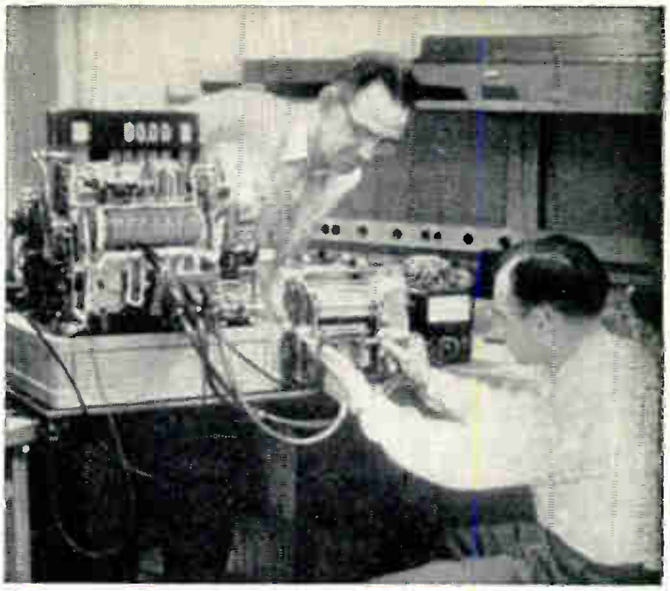
Lack of personal publicity, even internally.

Lack of in-plant facilities for purchasing drafting, engineering and miscellaneous supplies not furnished by the company. (This is a particularly loud beef in Southern California and at plants located in isolated communities far from "downtown" stores.)

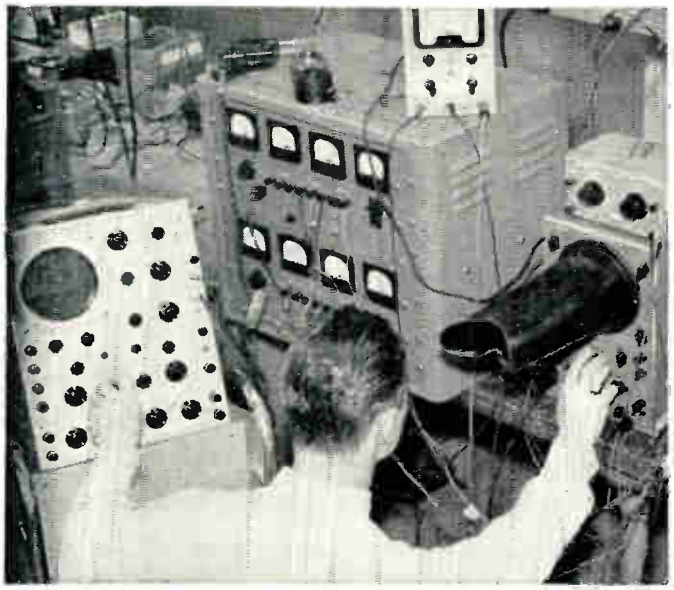
There seems to be a startling difference between what engineers expect and what they get from their Public Relations Department. It's quite possible that companies too are disappointed, and the fault might lie as much with the company as with the department.



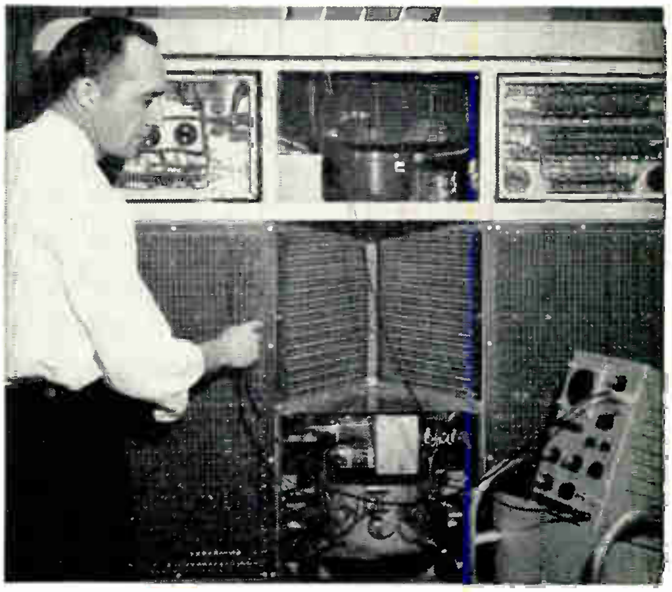
MECHANICAL ENGINEERS are using their skills in the design and development of new mechanisms required for business machines and for those mechanical products which are associated with electronic data processing equipment.



ELECTRO-MECHANICAL ENGINEERS are constantly faced with the problems of capturing information from the various input devices and converting this information into a usable form for subsequent use in data-handling equipment.



ELECTRONIC ENGINEERS enjoy an unparalleled freedom in the development of new types of circuitry and components which are necessary to maintain leadership in the competitive field of record-keeping automation.



COMPUTER ENGINEERS backed by the company's computer research since 1938 are developing an economical, flexible digital computer to meet the requirements of all record-keeping applications.

ENGINEERING UNLIMITED

AT ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

If you are looking for a challenging opportunity with an established company which has tripled its sales in ten years—one that offers excellent starting salaries as well as permanent positions . . .

Act at once! Send resumé of your education and experience to Employment Department, Technical Procurement Sec. L, The National Cash Register Company, Dayton 9, Ohio.

NCR

THE NATIONAL CASH REGISTER COMPANY

Circle 502 on Inquiry Card, page 109

Business

• • •

Merck Plans to Produce Electronic Silicon at New Chemicals Division

By a WALL STREET JOURNAL Staff Reporter

NEW YORK—Merck & Co., maker of drugs and fine chemicals, has entered a new field. Dr William H. McLean, president of the chemical division, announced the company has set up a new electronic chemicals division for production of electronic silicon and related products.

... will make the ... grade of

Wanted:

Sales & Marketing Executive

Brilliant Future With New Division

Merck & Co., Inc., needs a Sales and Marketing executive with a technical background to organize and direct the Sales and Marketing Department of the Electronic Chemicals Division. This is an outstanding opportunity for an individual interested in building a new department. He will supervise all sales, marketing, and promotional activities.

To qualify for this position, the applicant must have exceptional technical know-how and experience in electronic engineering and physics plus commercial sense and knowledge of markets.

The job will grow in direct proportion to the man's ability. Potential growth is as unlimited as that of the electronic chemicals industry.

Address résumés to: *Dept. EI-10*

G. A. Ducca

MERCK & CO., Inc., Rahway, New Jersey

Circle 503 on Inquiry Card, page 109

ELECTRONIC ENGINEERS

ZERO IN ON A CAREER IN INDICATOR DESIGN

An excellent opening for a Design Engineer exists at the G-E Light Military Electronic Equipment Dept.

The capable man will find rough problems to lick in designing indicator circuitry for landbased CIC. He will be called upon to assist in the development of complex indicators and associated equipment, for display of data obtained from high-power, long-range airborne search radar. The problems will tax his knowledge of digital computer techniques, CRT display and video indicating circuitry.

To learn more of this position in a young, growing group and the rewards it carries, fill in the coupon below and mail to us.

Mr. John Sternberg
Light Military Electronic Equipment Department
General Electric Company, French Road, Utica, N. Y.

Please send me further details on opportunities at Light Military Department.

NAME ____________ DEGREE ______

ADDRESS ____________

LMEE

LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT

GENERAL ELECTRIC

874

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Is my career moving ahead with electronics

...or am I specializing too much?

■ It comes as a shock to realize that the broad field of electronics has left you behind while you have been specializing in a narrow area. This is the age of unprecedented electronic advances. It's difficult enough to keep abreast of new developments, much less catch up.

It's a problem engineers at Lockheed never worry about. Their assignments cover virtually the entire spectrum of electronic activities. In the Electronic and Armament Systems Laboratory assignments include:

Radar, data link, communication systems, navigation, computers, IFF, IR systems, optical systems, instrumentation, telemetering, data reduction equipment, video, measurement techniques, component evaluation, circuit analysis and other related areas of development endeavor.

In the field of electronics technical management, systems openings include areas such as:

Fire control, countermeasures, inertial systems, weapons, communications, infrared, optics, sonics, magnetics, antennas and microwaves.

If you've been specializing and wish to broaden your scope, we invite you to consider our program. Please write E. B. Des Lauriers at 1708 Empire Avenue in Burbank, California.

LOCKHEED

THE CALIFORNIA DIVISION OF LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIFORNIA

Circle 504 on Inquiry Card, page 109

Industry News

Robert T. Plummer has been named Manager, Commercial Marketing for Eitel-McCullough, Inc.

Eugene J. Martin is now Special Assistant to the President at Polarad Electronics Corp.

John Messerschmitt to the post of Assistant to the Vice President and **George Elliot** is Manager of Export and Tube Industry Sales at Amperex Electronic Corp.

Robert Arany has been appointed to the post of Sales Manager, Power Factor Capacitor Div., Cornell-Dubilier Electric Corp.

Dr. Morris Rubinoff has joined the G & I Div., Philco Corp., as Manager of Digital Computer Engineering.

M. Rubinoff

A. J. Warner

Arthur J. Warner of Harlow, Essex, England, has been appointed Director of Research for Mycalex Corp. of America.

Walter B. Manson, Jr., has joined Measurements Corp. as Assistant to the President.

Walter E. Rufleth has been named Manager of Telemetering Systems Applications, and **Kenneth R. Neale** has been appointed Manager of Electronic Products Applications at the Bristol Co.

George Mucher, Jr., has joined the Distributor Sales Div. of Clarostat Mfg. Co., Inc.

Dr. Irving Kaufman has joined the Technical Staff of the Electronic Research Laboratory, the Ramo-Wooldridge Corp. Dr. Kaufman previously was a development engineer in Audio Circuits at RCA Victor Corp.

Arnold H. Henriksen has been appointed to the newly-created position of Manager of the Mountainside, N. J., plant of Beckman Instruments' Helipot Div.

Gilbert M. Davidson has joined Allen B. Du Mont Laboratories, Inc., as Market Research Manager for Instruments Sales. Mr. Davidson was formerly with Avion Division of ACF Industries.

(*Continued on page* 139)

Industry News

(*Continued from page* 138)

Robert W. Sutton is now Assistant Chief Engineer of the Electronics Engineering Dept. at the Eclipse Machine Div. of Bendix Aviation Corp.

B. A. Martin has been promoted to Weapons Systems 125A Manager of Lockheed Aircraft's Georgia Div.

James A. McCullough has been named Manager of Electronics Business Machines Sales for the International Div. of Burroughs Corp.

Joseph C. Duke has been elected Executive Vice President in charge of coated abrasives and adhesives and coatings and **Bert S. Cross** as Executive Vice President in charge of graphic products at Minnesota Mining & Mfg. Co.

Leonard T. Donnelly is now Manager of Component Sales at A. B. Du Mont Laboratories, Inc. Prior to joining Du Mont, Mr. Donnelly was associated with W. L. Maxson Corp.

L. T. Donnelly

T. E. Dinsmoor

Theodore E. Dinsmoor has been appointed Deputy Group Executive of AMF's Defense Products Group.

William W Martenis is now Manager of the semi-conductor activities of Minneapolis-Honeywell Regulator Co.

John L. Bell, Jr., is the latest addition to the Sales Staff at the Philadelphia office of International Resistance Co.

William H. Martin has accepted the appointment of President of Clevite Ltd., St. Thomas, Ontario.

Dr. Roy E. Beaton will serve as General Manager of a new section to develop and manufacture special electronic equipment by General Electric Company's X-Ray Dept.

Forrest E. Gehrke is now the Manager of the Williamsport, Pa., Microwave Power Tube Plant of Sylvania Electric Products, Inc.

Lowell H. Good has been appointed to a newly created post of Director, Engineering Utilization, Radio Corporation of America.

(*Continued on page* 140)

Circle 506 on Inquiry Card, page 109

Industry News

(*Continued from page* 139)

Charles J. Malven will now serve as Manager, West Coast Office, Industrial Camera Div. Fairchild Camera and Instrument Corp.

Norman L. Winter has been named Manager, Countermeasures, a newly organized group within the Sperry Gyroscope Co.

N. L. Winter

T. H. Armstrong

Thomas H. Armstrong will now fill the newly created post of Manager, RCA "Bizmac" Sales, Plans, and Programs. Mr. Armstrong was formerly the VP-Marketing, Underwood Corp.

B. W. Sauter is now serving as General Manager of the Westinghouse electronic tube division located in Elmira, N. Y.

Engineer Shortage

(*Continued from page* 131)

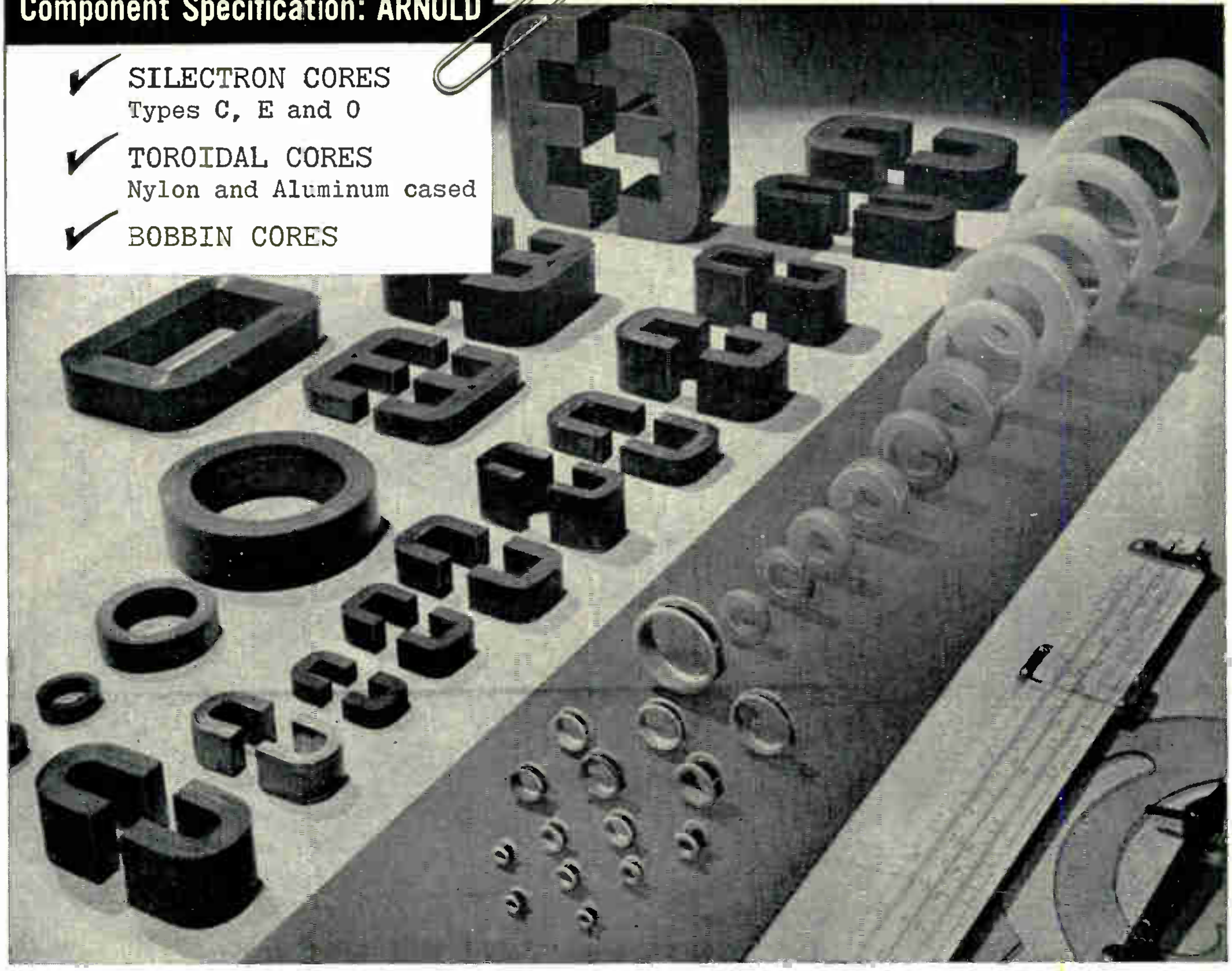
starting engineers as a whole is $473. A number of personnel people feel that the wage scale is now leveling off, that only very slight increases can be expected over the next few years.

Outwardly, the demand for engineers appears to have nose-dived. But much of the help-wanted advertising of a few months back was by government contractors who were including the advertising costs in their cost-plus totals. When the government cracked down the advertising was sharply reduced, but the reduction bears little relation to the shortage problem.

Conclusion: New graduates and engineers with heavy experience in specialized fields will be at a premium for some time to come. Other engineers will find that opportunities vary with geographical location and the specific fields within electronics.

Component Specification: ARNOLD

- ✔ SILECTRON CORES
  Types C, E and O
- ✔ TOROIDAL CORES
  Nylon and Aluminum cased
- ✔ BOBBIN CORES



The ARNOLD LINE-UP includes the TAPE CORES you need

APPLICATIONS

We'll welcome your inquiries on your Tape Wound Core requirements for Pulse and Power Transformers, 3-Phase Transformers, Magnetic Amplifiers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Reactors, Coincident Current Matrix Systems, Static Magnetic Memory Elements, Harmonic Generators, etc.

ENGINEERING DATA

For data on the various types of Arnold Tape Cores, write for these Bulletins:

SC-107—*Silectron Cores, Types C, E and O*
TC-101A—*Toroidal Cores, nylon and aluminum cased*
TC-108A—*Bobbin Cores*

ADDRESS DEPT. T-710

How to be *sure* of tape core performance and uniformity? Just specify and use *Arnold* Cores in your transformer, magnetic amplifier, reactor and computer assemblies, etc.

Here's why!

To begin with, Arnold is a fully integrated company, controlling every manufacturing step from the raw material to the finished core. Then, modern testing equipment permits 100% inspection of cores before shipment. Finally, you're matching your requirements against the most experienced and complete line of tape cores in the industry. Arnold produces Types C, E and O Silectron cores, nylon and aluminum cased toroidal cores, and bobbin cores to meet whatever your designs may require in tape thickness, material, core size or weight. Wide selections of cores are carried in stock as standard items for quick delivery: both for engineering prototypes to reduce the need for special designs, and for production-quantity shipments to meet your immediate requirements.

Let us help you solve your tape core problems. Check Arnold, too, for your needs in Mo-Permalloy or iron powder cores, and for cast or sintered permanent magnets made from Alnico or other materials.

WSW6447

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

Boston: 200 Berkeley St. Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

(*Continued from page* 124)

the dZ information. There is one counter corresponding to each of the address tracks, phased so that at each integrator time one counter has completed its 4-word cycle of obtaining the dZ information.

Memory Sharing

The use of the memory by each computer has been described. The G-15 computer, of course, has access to its entire memory consisting of 20 long lines and various short tracks. The DA-1 uses approximately 10 long lines in accomplishing its computation. These 10 long lines are part of the 20 tracks to which the G-15 has access. Thus, the G-15 general purpose computer has access to all of the information in the DA-1. This allows the G-15 to monitor the computations, to create initial conditions, to modify parameters, to modify integrator addresses and to otherwise perform operations which affect the data and answers of the DA-1. It can

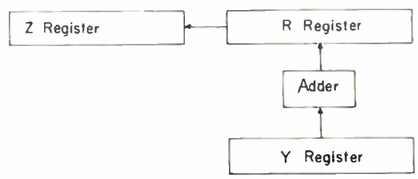


Fig. 10: Integrator interconnection.

be seen that a powerful system may be devised in which the DA-1 carries out computations more suited to its type of logic (namely solution of differential equations) and the G-15 carries out other types of computations more suited to it.

Monitoring System

As an extension of the logic which permits the G-15 to monitor the memory of the DA-1, the G-15 also has control of stopping and starting DA-1 computations, testing for overflows within the DA-1, and control of input and output conversion of the DA-1 data. To more effectively use this monitoring system, suitable service routines have been prepared for the G-15 which allow the operator to take advantage of the ease of use inherent in the DA-1. Simple techniques of addressing, of specifying initial conditions, of scaling, etc., have been devised through the use of the service routines.

When Equipment "Goes Mobile"...

Get dependable power from

Mallory Vibrators

Designing mobile electronic equipment? Portable or vehicular two-way radios, test apparatus, PA amplifiers, headlight dimmers, ultra-violet portable test lamps for geologists . . . there's practically no end to new kinds of battery-powered products that may be on your drawing boards tomorrow. And when you come to the vital power supply design, call on Mallory vibrators and Mallory engineering help.

New Mallory vibrator models, embodying a unique concept of contact engineering that comes from Mallory's 25 years of vibrator pioneering, offer even better performance than ever before. They last up to 100% longer, run quieter, and give more constant output throughout their life. A complete range of interrupter and self-rectifying types, suitable for light to heavy duty, covers any application you may have.

Profit by Mallory Assistance in engineering your vibrator power supply. We can help you not only in selection and application of the Mallory vibrator model that best fits your needs, but also in design of power supply circuitry and use of related components to get top overall performance. Write today for a consultation by a Mallory vibrator specialist.

Parts distributors in all major cities stock Mallory standard components for your convenience.

Expect more . . . get more from

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Meteor Trails

(Continued from page 55)

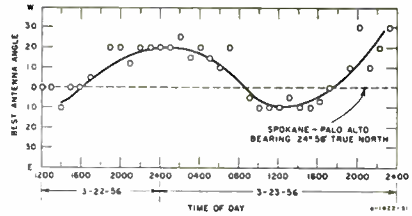


Fig. 18: Best antenna angle versus time of day—north-south.

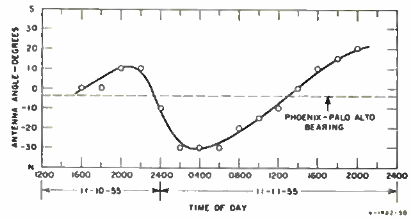


Fig. 19: Best antenna angle versus time of day—east-west.

threshold. A photograph was made of several hundred successive sweeps, and the rate of fall of the signal examined. Fig. 22 gives an example of such a measurement where fading rates in excess of 400 db/sec are recorded.

Maximum Range

If conventional calculating methods are used, and a reflection height of 100 km assumed, the

Fig. 20: Best side of path versus time of day—north-south

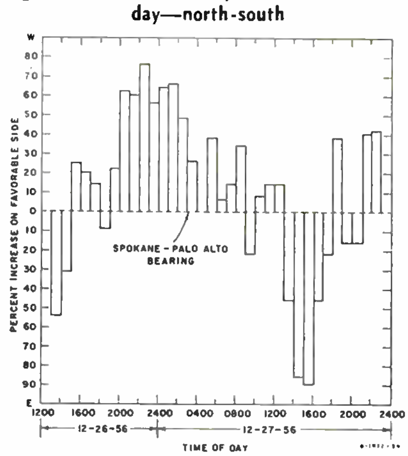
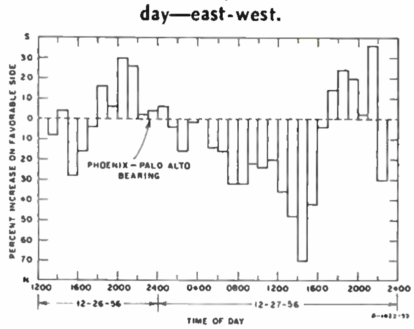


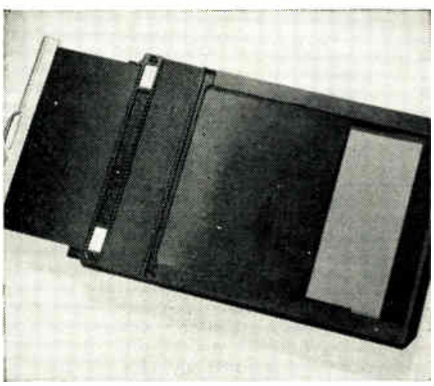
Fig. 21: Best side of path versus time of day—east-west.



(Continued on page 146)

take it in color

and you put Synthane laminated plastics to work



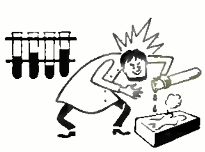
Slide for cut film holder—made from Synthane sheet because Synthane is opaque to infra-red rays.

At first glance the connection between color photography and Synthane laminated plastics may seem obscure. Actually, Synthane has long been at home in the manufacture and processing of film and in the developing of the finished picture.

Many types of rolls, loop sticks, and structural parts made of Synthane are used by the film manufacturer. Racks, film sprockets, reels and rollers employ Synthane in developing processes. In the infancy of color pictures (and ever since), racks and reels made of Synthane proved to be exactly what were needed to resist developing solutions, prevent film fogging through contamination. Film holder slides and various parts for cameras are other uses of Synthane in photography.

The photographic industry needs Synthane for its unique combination of properties. Resistance to moisture and chemicals, non-fogging qualities, its hard, smooth surface are all important characteristics. Synthane is tough, light in weight (half the weight of aluminum) and easily machined. These and many other chemical, electrical and mechanical properties make Synthane valuable throughout the length and breadth of industry.

Over 30 grades in sheet, rod or tube form or completely fabricated by us are looking for work with you. Write for information.



CHEMICAL RESISTANCE

LIGHT WEIGHT

EASILY MACHINED

MECHANICAL STRENGTH

SYNTHANE S . . . industry's unseen essential

SYNTHANE CORPORATION, 11 RIVER ROAD, OAKS, PA.

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(*Continued from page* 144)

maximum ground-to-ground communication range is found to be 2400 km (1500 mi). To check this, distant television stations were monitored. Meteor reflected signals were received from one sta-

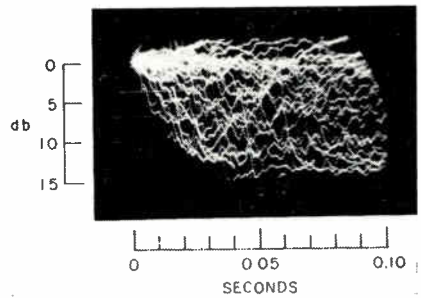


Fig. 22: Fading rate photograph.

tion at 2200 km but not from another station at 2400 km. The maximum usable range for a ground-to-ground communications system using antennas relatively close to sea level is thus considered to be 2200 km.

1. The work described in this paper was sponsored by the Air Force Cambridge Research Center, Contract No. AF 19 (604)-1517.

Magnetic Circuits

(*Continued from page* 57)

designed for a 2 amp 28 vdc resistive load and a contact life in excess of 10^5 operations, consistently withstood vibrations greater than 20 G's in the frequency range between 55 and 2000 cps.

The minimum shock values for zero opening time, when tested on the spring and anvil type Haiden shock tester, were found to be 45 G's. By permitting a contact opening of 100 μsec or less, the minimum shock resistance went up to 70 G's. The 100 G value which is the limit of this particular shock tester was exceeded by permitting contact openings of less than 2 μsec.

In the course of the designing, a notable improvement in performance under environmental conditions was achieved by attaching the coil-end of the actuator to the relay enclosure. This is accomplished by having one or two sections of the structure extend through small openings of the enclosure and secured by solder at the time the unit is sealed and evacuated. (Fig. 10.) This provides a double ended support for the actuator. The before

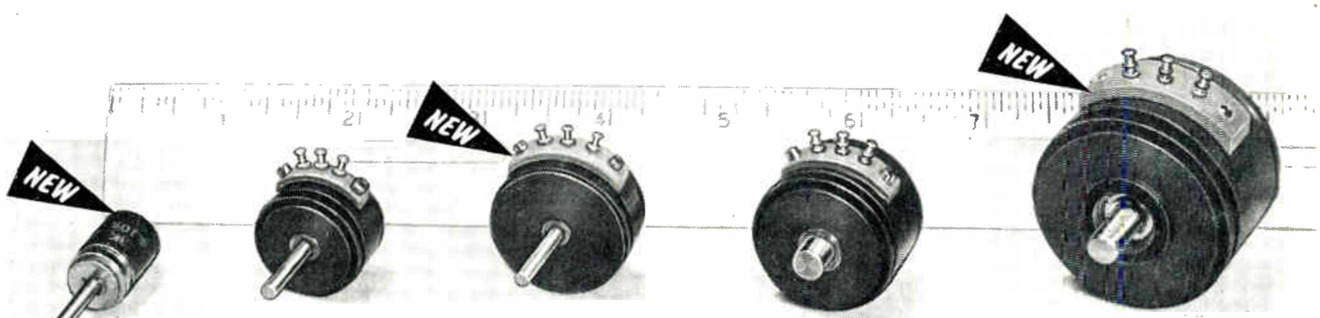
(*Continued on page* 148)

NOW! A complete single-turn-pot line from *Waters*

Built, tested, and *certified** to such rigid specifications as AIA, RETMA, JAN-R-19, MIL-E-5272A, and other applicable military specifications, this new line of pots packs reliable performance into tight spots.

**Complete test data available on request.*

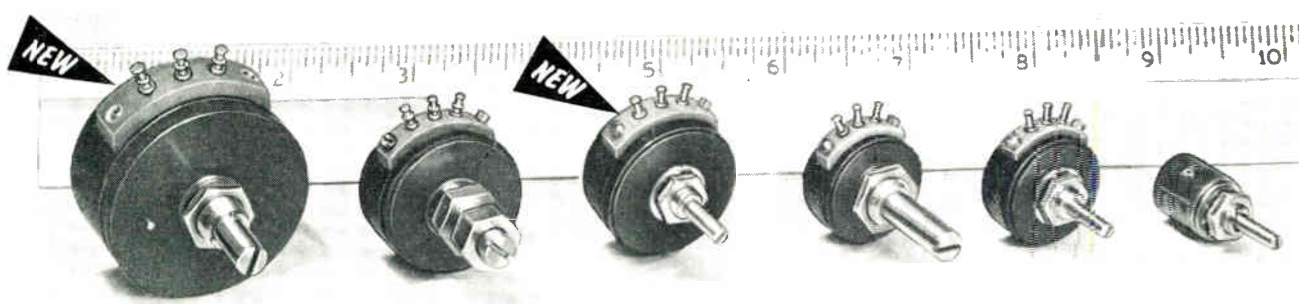
Waters PRECISION MINIATURE POTENTIOMETERS



WP ½ — WP ⅞ — WP 1 1/16 — WP 1 ⅛ — WP 1 ⅝

Sizes from ½" to 1⅝" . . . values from ½ ohm to 500K ohms . . . high-precision linear and non-linear . . . write for catalog that describes the complete line.

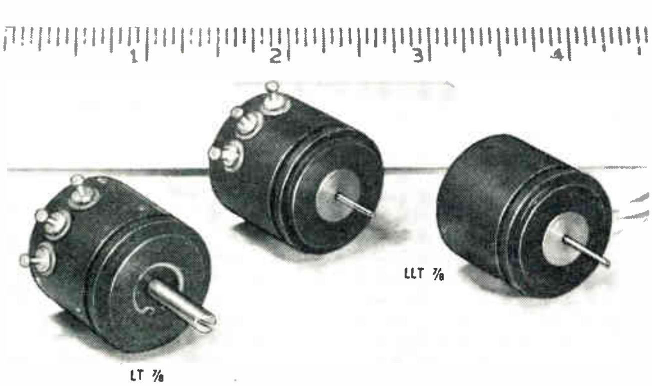
Waters ROTARY TRIMMER POTENTIOMETERS



AP 1 ⅝ — AP 1 ⅛ — AP 1 1/16 — RTS ⅞ — RT ⅞ — AP ½

. . . include the most compact half-inch pot on the market . . . resistances to 500K . . . non-linear models . . . bushing, servo, or 3-hole mount . . . solder terminals or wire leads . . . write for complete catalog.

Waters LOW-TORQUE PRECISION POTENTIOMETERS



Ball-bearing and jewel-bearing models for ultra-low torque . . . servo or 3-hole mounting . . . solder terminals or wire leads.

Check Waters first for all your single-turn-pot needs.

Big-pot performance in miniature-pot size.

Waters MFG. INC.

MANUFACTURING, inc.

Wayland, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

Circle 78 on Inquiry Card, page 107

(*Continued from page* 146)

mentioned performance values were observed on relays assembled in this manner.

Without additional support for the actuator, a strong resonance condition was apparent around 720 cps and again between 1400 and 1500 cps, lowering the vibration resistance of the unit at these ranges to a minimum of 12 G's. Similarly, the minimum shock resistance for the unsupported actuator also was found to be approximately 15 G's less than the values given for the reinforced design.

The power consumption of this rotary armature construction at nominal voltage was 1 watt, the same as was required for the previously discussed crystal enclosure size telephone type structure.

The speed of operation of this design at the specified operating voltage is below 6 μsec, with an average pull-in delay, measured at the NO-contacts, varying around 5 μsec and an average drop out delay of 1.9 μsec measured on the NC-contact. Contact bounce is usually found to be most severe on the NC-contact upon relay de-energization and can be controlled with suitable contact arm designs conforming to the available pressures and masses.

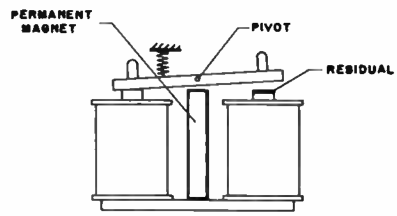


Fig. 9: Armature lightly biased in one position for pull-in drop-out operation.

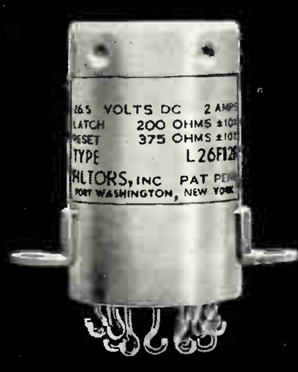
Miniature Polarized Relay Actuators

What makes the use of polarized structures so attractive for miniature actuator designs is the fact that even a small value of permanent magnet flux present in an air gap, depending on its direction, will amplify or decrease the forces produced by the coil flux. This is because the force increases or decreases as the square of the sum or difference of the flux values.

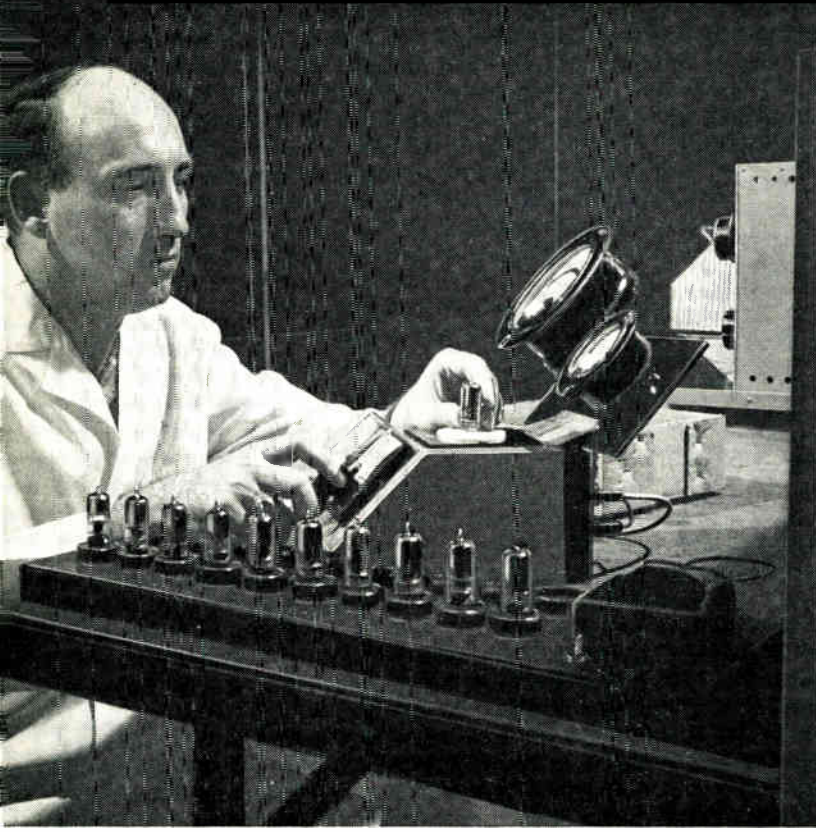
According to Maxwell's law, the force between parallel plain surfaces, for approximately uniform flux density, expressed in CGS units is:

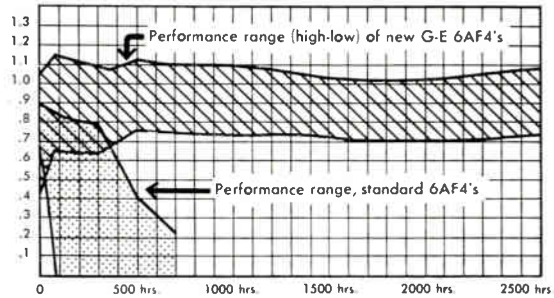
(*Continued on page* 152)

BURTON BROWNE/New York



NEW G-E LONG-LIFE 6AF4. U-H-F OSCILLATOR TRIODE





ABOVE: chart shows oscillator activity (up) versus hours of life (across) of new G-E 6AF4's and standard 6AF4's on life test. Performance of many thousand tubes is represented. Note that the oscillator activity of new General Electric 6AF4's averages a straight horizontal line, whereas standard tubes show a sharp, sudden drop. **LEFT:** rigid, frequent testing is an important factor in the new 6AF4's superiority. Here General Electric Design Engineer J. G. Tucker checks 6AF4's for oscillator activity.

GREATLY INCREASED LIFE MARKS TWO

General Electric creative tube design is source of high-level dependability.

Through creative tube design, General Electric helps television manufacturers increase public acceptance of their products. A new and outstanding example of this aid is the long-life G-E 6AF4 u-h-f oscillator tube. Fully interchangeable with other 6AF4's, it is much more dependable; gives far longer service with continuing high efficiency. The new tube enables television set manufacturers to offer u-h-f pictures that will retain their high quality . . . reduces owner complaints, cuts TV servicing requirements.

Excess snow—sudden loss of picture—owner dissatisfaction with set performance—all have occurred with earlier 6AF4's. The tube is subject to severe electrical "stresses"; must withstand current densities five to six times that of other triodes, because of the small electrodes and close spacings required by up-to-900-mc operation. Now General Electric—combining new materials usage with new manufacturing and test methods—brings you a 6AF4 that *for the first time* is fully as dependable and long-lived as other tubes.

The same greatly improved performance has been built into General Electric's new 2AF4, 2AF4-A, 3AF4-A, and 6AF4-A. Ask any G-E tube office below for full information!

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200 Main Avenue
Clifton, New Jersey

Phones: (Clifton) GRegory 3-6387
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(*Continued from page* 148)

$$F = \frac{B^2A}{8\pi} \quad \text{[dynes]}$$

which can also be written as:

$$F = \frac{\varphi^2}{8\pi A} \quad \text{[dynes]}$$

Wherein B is the flux density expressed in Gauss, A the pole face area in cm^2 and ϕ is the flux in Maxwells.

Decreasing the pull in one air gap, while simultaneously increasing the forces in a second gap, is a common operating feature of polarized relays.

The dimensions of a permanent magnet, which in a given configuration may permit a substantial increase in actuator force, can be small. In the case of a polarized actuator for the crystal enclosure, it is possible to accommodate the permanent magnet and still have more winding space available than found on the rotary armature soft iron relay of the same dimensions. This is because the armature can be arranged in a different plane allowing for longer coils.

The extent to which advantage can be taken of the forces produced by a permanent magnet depends on such factors as the suitable layout of the magnetic circuit for specific enclosure shapes and the type of operation needed in the application.

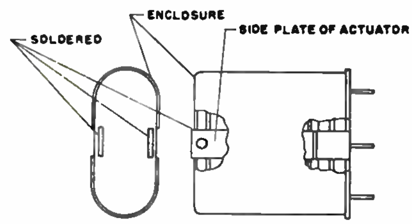

Fig. 10: Double ended support for actuator.

A basic magnetic circuit arrangement of a polarized actuator is shown in Fig. 7. While this is only one of the many possible polarized arrangements, it appears to be very adaptable to the shape of the crystal size enclosure, which was chosen for comparison because of the mounting trend to use this type unit. Basically, this magnetic circuit is the same for the two types of polarized relays as illustrated in Figs. 8 and 9.

Fig. 8 shows a SPDT-"center-off" design. Spring bias holds the armature in a neutral position. One or the other NO-contact will close

(*Continued on page* 154)

New 1000 watt ceramic tetrode for SSB . . . the EIMAC 4CX1000A

Eimac fills another important transmitting need with this air-cooled, ceramic-metal, one-kilowatt tetrode . . . the 4CX1000A. Specifically designed for single side band operation the 4CX1000A is a low-voltage, high-current Class AB_1 RF or AF linear amplifier tube, exhibiting high power gain and exceptionally low distortion characteristics. The 4CX1000A achieves its maximum rated output power with zero grid drive, thus minimizing driver stage design problems and eliminating one source of distortion.

Eimac stacked ceramic design gives the 4CX1000A excellent immunity to damage by mechanical and thermal shock. Electrical stability is assured by internal ceramic support of the tube elements and clean internal design. Ideal for applications where space is at a premium, this mechanically-rugged, electrically-reliable thousand watt tetrode measures less than 5 inches high and 3½ inches in diameter. High temperature processing, made possible by Eimac ceramic-metal design, produces an extremely clean tube. This ideal environment assures long life for the efficient oxide-coated cathode.

Efficient, trouble-free socketing and cooling is provided for the 4CX1000A by the new SK-800 Air System Socket and SK-806 Chimney.

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(Continued from page 152)

depending on the flux values and polarities on the pole faces formed by the direction of the current in the coils in conjunction with magnetic field pattern originating from the permanent magnet.

In this design the pressures of the bias springs always slightly exceed the forces of the permanent magnet in the course of the armature travel. This is to insure proper armature return upon coil de-energization. The magnet, besides giving this device the directional feature, amplifies the coil produced magnetic forces in the before discussed manner.

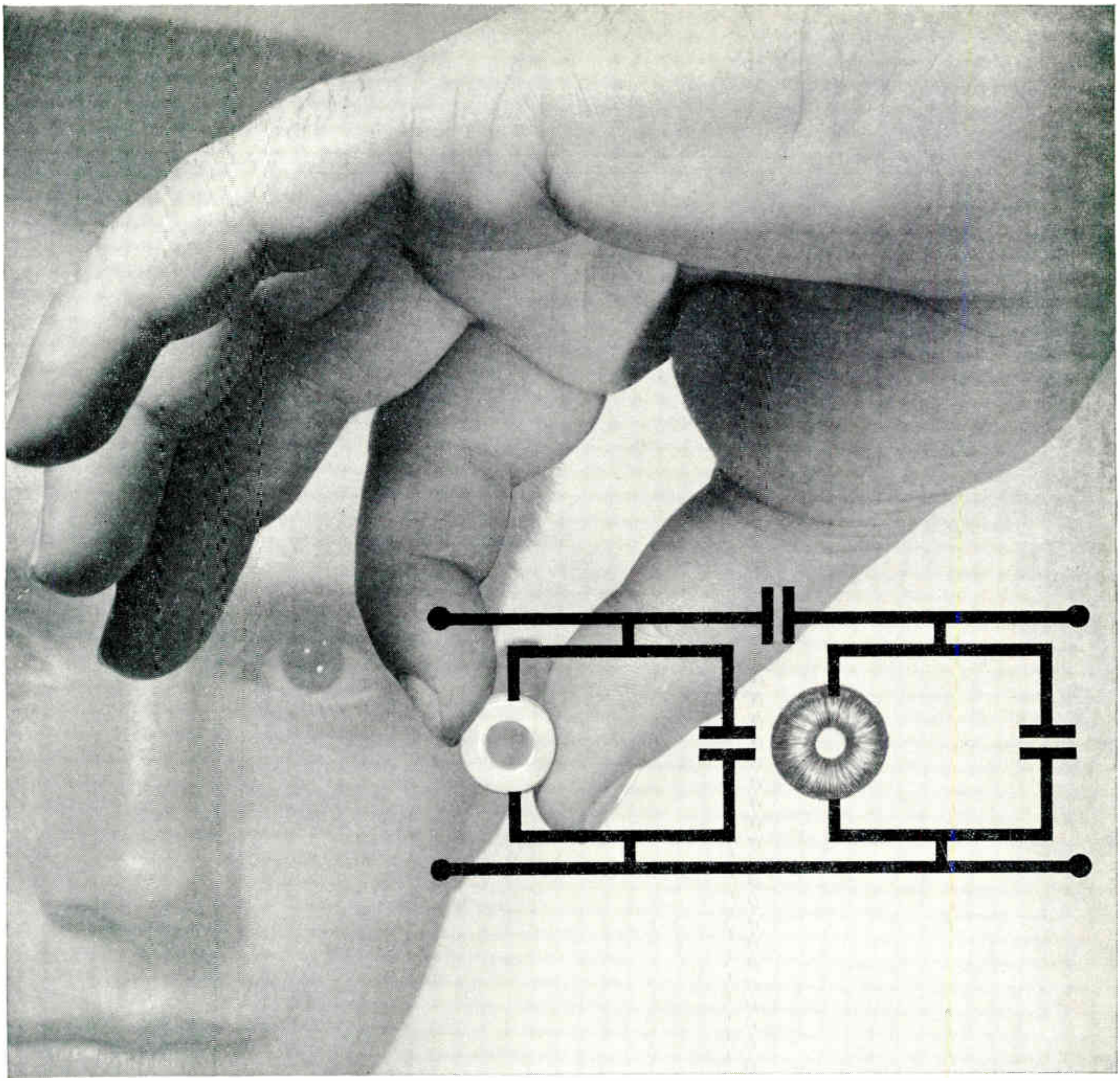
Fig. 9 is a relay requiring specified polarized coil connections, but operates like any conventional dc relay. The armature is lightly spring biased in one position. The bias spring, plus the pull formed by the permanent magnet flux, position the armature in the de-energized relay and may supply the NC-contact pressure.

Upon energizing the relay, the armature force is simultaneously reduced at the closed gap and increased on the open gap side of the structure. With the coil current removed or below an adjusted limit, the bias spring will start the armature return action.

A polarized relay arrangement as in Fig. 9 was designed into a crystal size enclosure. At 1 watt power consumption, it operates 2 SPDT 2 amp 30 vdc contacts of 12 grams minimum contact pressure each. This design withstands vibrations of more than 30 G's in the frequency range of 55 to 2000 cps. Shock tests conducted on the Haiden shock tester indicated 55 G's minimum for zero opening time and better than 90 G's for a permitted 100 μsec maximum opening time.

A short comparison of these results with the performance of the soft iron rotary armature relay shows that a 70% increase in contact pressures was possible for the same coil power consumption. In turn, the improved resistance to mechanical environment is also noticeable. If this performance is exceeding the requirements, then the use of larger contacts will permit increased switching capacity

(Continued on page 156)



Now you can use molybdenum permalloy powder cores in miniaturized circuits

When your engineering neighbor talks about "Cheerios" these days, he's apt to be discussing a new breakfast cereal-sized molybdenum permalloy powder core which has found a happy niche as a miniaturized filter component. Guided missiles, which are filling the troposphere these days, typically use these little fellows in their amplifier circuits. Small (down to .300-in. ID), they are tough and easy to use. They also provide a markedly high degree of stability with time, temperature and magnetization.

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MAGNETICS inc.

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(*Continued from page* 154)

in exchange for weaker resistance to shock and vibrations.

The manufacturing of polarized relays is known to present problems in addition to those encountered in making ordinary neutral electro-magnetic relays. For instance, depending on the particular design, the producer of polarized relays has to contend with the variations in field strength as found in quantities of commercial magnets. This may influence the operating characteristics of the finished product to too great an extent if no special adjustments are employed to correct it. Also, there is always the greater danger of contamination by iron particles which requires cleaner assembly facilities. This may discourage the idea of building a miniature polarized design where some of these problems appear to be amplified.

Actually, these problems are less pronounced on a rather simple voltage operated structure like the ones under discussion. The greater efficiency of the polarized relays also permits wider tolerances in the adjustment of contacts and a much less precision structure than commonly possible on conventional miniature neutral electro-magnetic relays of identical size. This more than justifies the use of the necessary special precautions or operations mentioned before.

COATING PRINTED CIRCUITS

Harold Robinson of Baker & Co., Inc. demonstrates how printed circuits can be quickly and economically gold-plated without electroplating. Only container and heat are needed

The new Borg 910 Series Single Turn Micropot retains its high precision characteristics through severe vibration and shock. Borg 910 Micropots were developed from the Borg 900 Series Micropots . . . long preferred in aircraft and electronic fields for accurate, long lived dependability. Let your nearest Borg "Tech-Rep" show you the many advantages offered by the new Borg 910 Series Single Turn Micropot.

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DOW CORNING CORPORATION

Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS No. 13

Reliability of Snark Instruments Assured with Silicone Rubber

Engineers at Northrop Aviation take no chances on the performance of intricate high impedance circuits in the "Snark" guided missile, the F-89 Interceptor and other Northrop projects. They virtually "seal in" top performance by completely encapsulating the brains of these units in Silastic* RTV.

A new, easy-to-apply silicone dielectric that vulcanizes into a rubbery solid at room temperatures, Silastic RTV provides positive protection for even the most delicate electronic components. All panels containing resistors, capacitors, transistors and other recording and transmitting gear are embedded in this Dow Corning silicone rubber. According to Northrop engineers, a single coating—

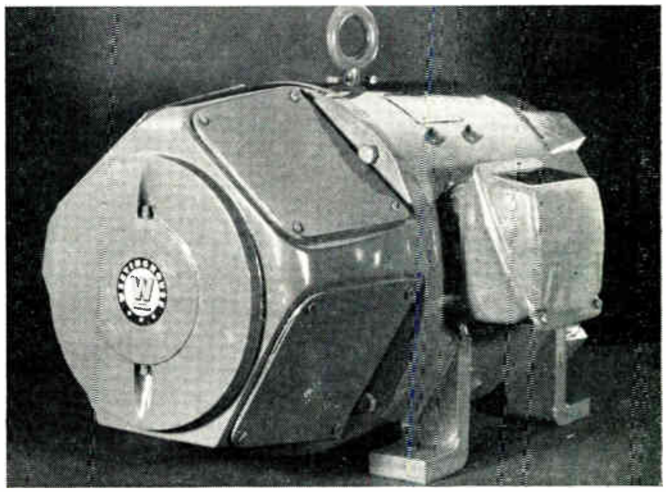
- provides an effective cushion against vibration
- assures maximum moisture resistance
- improves electrical properties, especially surface resistivity
- protects assemblies against rough handling
- may be applied with a caulking gun

Another important advantage of using Silastic RTV in this application is the ease of inspecting or replacing individual components after assembly. The silicone rubber "skin" is simply slit open to expose the component. Such openings are easily patched with more Silastic RTV.

Silastic RTV ranges from a heavy putty to a fluid-like consistency. It attains optimum physical and dielectric properties in 4 to 7 days. *No. 51*

*T. M. REG. U. S. PAT. OFF.

Westinghouse Introduces Silicone Insulated D-C Motors



While most leading manufacturers of electrical equipment build silicone insulated units for special purposes, now for the first time Westinghouse's new Life Line "H" series offers the advantages of silicone insulation in standard "off the shelf" d-c motors and generators.

Dow Corning silicones have been used in combining a high temperature insulating system with complements of copper and iron equal to those used in conventional Class B machines. As a result, these new motors and generators rated at Class B temperatures have at least 10 times longer insulation life.

In addition, Dow Corning silicones help provide extra protection against emergency overloads and abnormal ambients to reduce motor maintenance. Insulation is no longer a limiting factor to motor life. Already in production, the new dc motors span ratings from 1 to 150 hp: the dc generators are rated from $\frac{3}{4}$ to 100 kilowatts.

Life Line "H" equipment is designed to be especially useful for automated processing where insulation failure in one unit may shut down an entire assembly line throwing production schedules and costs way out of line.

The extra overload capacity provided by the silicone insulation system makes these motors ideal for conveyor, pump, blower and processing motors in mines; for drive motors in the glass, machine tool, paper and metals industries; for conveyor drive motors in material handling and many other processing industries. *No. 50*

Silicone Glass Coil Insulators Reduce Small Motor Assembly Costs

By insulating the coils of their $\frac{1}{5}$ hp, 14,000 rpm afterburner ignition actuator motors with silicone-glass laminates, Lear, Inc., have cut costs a substantial $1.50 per unit

Located next to jet engines where ambient temperatures soar to 400 F and higher, these motors have always been silicone protected. Lear originally tape-wrapped the coils by hand, but they recently eliminated this time-consuming job by switching to pre-formed glass laminates bonded with a Dow Corning silicone resin.

By reducing assembly time to an absolute minimum, the laminated insulators save Lear $1.50 per motor while still providing the maximum in insulating efficiency. The coil insulators are pre-formed in two sections by Stevens Products of East Orange, New Jersey. *No. 52*

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Survey Meter

(*Continued from page 59*)

tube. The assembly is enclosed in a numetal shield and wrapped at both ends with black plastic electrical tape to make it light-tight.

Circuit

The circuit diagram is shown in Fig. 4. The voltages required for the operation of the photomultiplier are provided from a bleeder network supplied by a commercial transistorized power supply. A corona regulator tube maintains an output of 800 volts with a regulation of ±2 per cent for battery voltages down to 2.2 volts. Operating the photomultiplier at such low voltages means greater stability and freedom from after-pulsing and excessive noise. Since the high-voltage power supply puts the greatest load on the batteries, reducing the high voltage and increasing the gain of the amplifier gives a net reduction of battery load.

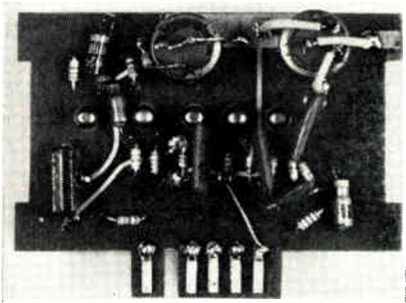


Fig. 3: Amplifier and counter circuit card.

The first three transistors form a feedback loop having a stable current gain of about 200. The sensitivity of the instrument is controlled by resistor R-1, which is normally set just below the level at which photomultiplier noise is counted. All amplifier stages are grounded emitter to give highest possible gain with the RC coupling networks.

All the transistors are Type SB-100. These transistors have a short-circuit current gain of about 20, an input impedance of about 2000 ohms, and a bandwidth of about 1 mc—all measured in the grounded emitter circuit. By connecting the base resistor of each stage to the collector instead of to ground, enough degeneration is introduced to stabilize the operating point.

The over-all gain of the amplifier is 1300 without feedback, and 200 with feedback. The over-all bandwidth of the amplifier is about .75 mc.

Transistors TR-4 and TR-5 form the count-rate meter. The first, TR-4, with its base returned to ground, is normally conducting while TR-5 is cut off by voltage developed across the common emitter resistor, R-11. Positive signal pulses are coupled from the amplifier to the base of TR-4, amplified by TR-4, and applied to the base of TR-5. If the pulse arriving at TR-5 exceeds the threshold bias developed across R-11, the circuit will be triggered into its quasi-stable state; the duration of which is determined by the particular timing capacitor in use, and R-9. During this period, the collector current of TR-5 flows through the meter circuit. The average meter current is thus proportional to the count rate.

Capacitor C-7 smooths out the random pulses of current flowing in the meter circuit. The value of C-7 was selected to provide a meter time constant of approximately 1 second. The meter shunting network, R-14 and R-15, sets the count-rate calibration.

1. Reported by G. E. Leavitt in "Report of NRL Progress," July 1957.

Breadboard

(*Continued from page 58*)

been internally connected to form a common ground.

The elastic covering is cut at each intersection point of the grid to allow easy insertion of component leads into the conductive pocket below. This arrangement prevents the loss of conductive material, and at the same time provides a method of firmly gripping the individual wires, holding the circuitry in place.

The grid lines help to organize the breadboard circuit into the two-dimensional pattern used in printed circuit design. In addition, the white surface of the circuit board may be marked by a grease pencil to show the electrical values of components. This simplifies circuit analysis, especially when more than one engineer or technician is working on the project.

Missile Control

(*Continued from page* 65)

ing circuits has been determined for each point on the trajectory, the system is then checked with parameters varying with time as they would in an actual flight.

The missile control system is also tested in functional and environmental tests on the complete missile system. Missile system functional tests are designed mainly to uncover mechanical and electrical interactions between components and sub-systems which detract from the performance of the missile. These interactions include such effects as radio and noise pickup, mechanical feedback through the missile structure and electrical interactions due to improper grounding or common power supplies.

A test which more nearly simulates flight conditions is the static firing test. In this test, the rocket engine is fired with the missile held in a test stand and with all equipment functioning. The static test gives a check on the operation of all equipment under conditions as close to flight conditions as is possible to obtain on the ground.

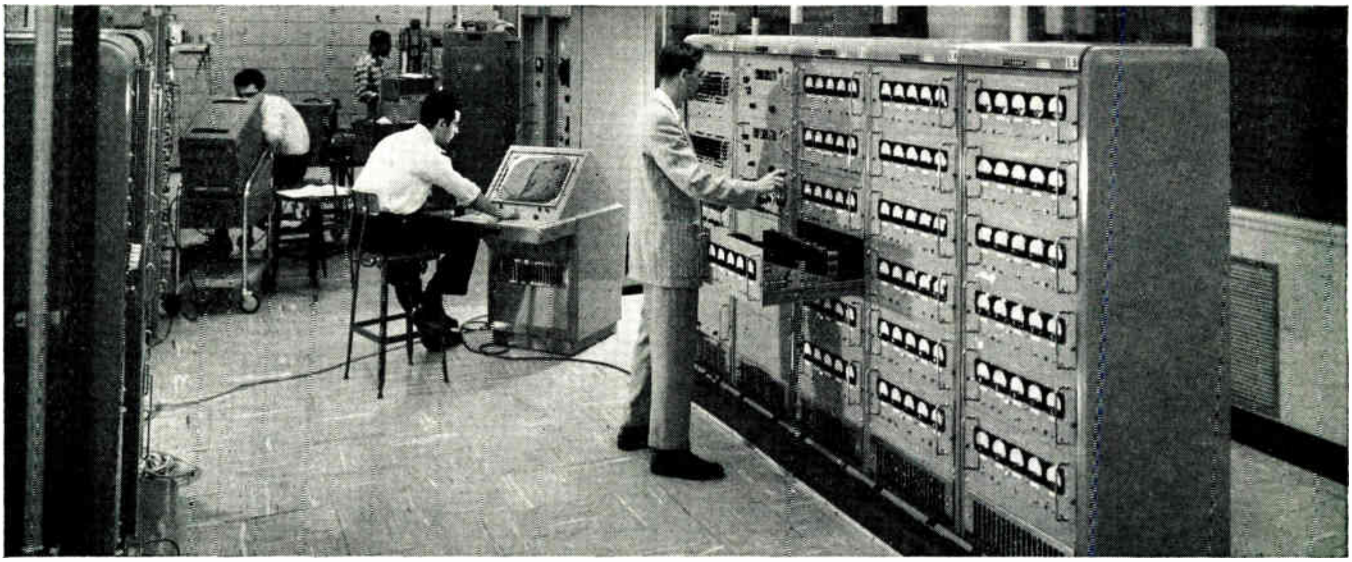
Even with all these ground tests, the performance of the system can really only be demonstrated by a flight test. Flight tests also have their limitation since obviously the engineer cannot go along to observe the performance of his equipment in flight. When a failure does occur during flight, it is sometimes difficult to pinpoint the cause. Most of the information obtained on equipment performance during flight test comes from the telemetry system. Of course, being itself a rather complicated system, the telemetry system is also subject to failure in flight although the overall reliability of modern telemetry systems is quite good.

Since the amount of telemetry equipment must be kept within reasonable bounds, the amount of information that can be obtained on control system performance is necessarily limited. Usually flight test missiles have more telemetry equipment than tactical missiles since the warhead space can be used for this purpose. Neverthe-

(*Continued on page* 164)

ASCOP

records missile "history" at giant new DATA CENTER



ASCOP M Series Ground Station at General Electric's Data Reduction Center

GENERAL ELECTRIC's new multi-million dollar Missile Data Processing Center — one of the nation's largest — is now engaged in advanced scientific computation and evaluation of missile flight tests.

This giant Philadelphia center contains the most advanced automatic data processing and handling equipment in use today. A completely integrated operation, it greatly facilitates the speed with which vital data can be made available for analysis.

Playing an important role in this strategic operation is the ASCOP PW Data Reduction System which includes monitoring facilities. An ASCOP Ground Station handles many channels of low frequency data . . . simultaneously reduces eighty-six data channels, held to a system accuracy well within 1%. This data is originally **gathered** in the missile by ASCOP airborne telemetering units.

The linearity and reliability of this ASCOP system is a major factor in the advanced performance of the entire installation. And, significantly, the modular-unit flexibility of ASCOP equipment made possible delivery of the system **months in advance** of the opening of the GE Data Center . . . one more reason why it will pay you to investigate ASCOP for your present and projected programs.

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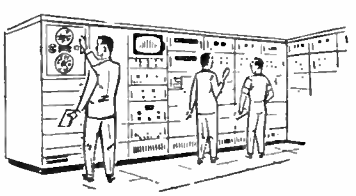
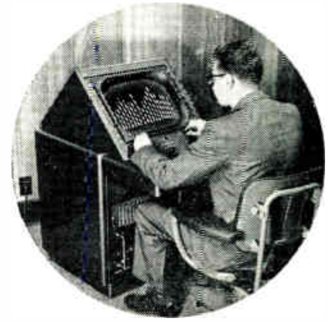


This ASCOP PW Ground Station is a complete "packaged" system for data processing. Eighty-six Channels may be reduced in real time from tape records. Utilization of zero and full scale sensitivity reference channels affords continuous automatic system calibration, avoiding frequent manual adjustment and the need for critical components. All channels may be visually monitored simultaneously. Easy access to slide mounted chassis is featured even during operation.



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ASCOP Monitor Console provides a means of rapid simultaneous inspection of all eighty-six channels. Can also be supplied with a Stripper Panel which makes possible the inspection of selective channels as desired. The ASCOP Monitor Console saves data reduction time and provides important maintenance advantages.

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(*Continued from page* 162)

less there is always a problem of deciding what signals should be telemetered to get the maximum of information. This involves predicting what is most likely to go wrong. In general, information on the control system is limited to power supply voltages and input and output signals of the major components.

Ordinarily the failures that occur are not the same for each flight. However, if the same trouble reoccurs on several flights, the allocation of telemetry can be changed to concentrate on the troublesome area and decrease instrumentation on equipment that is operating satisfactorily. After the performance of the system has been demonstrated by a number of successful flights, the amount of telemetry can be reduced although it would probably never be eliminated entirely.

Other information is also available from the flight test such as range instrumentation data from radar and optical tracking and photographic data. Although equipment is usually pretty badly mangled by the impact, information is sometimes obtained by examination of pieces recovered after impact. Thus in spite of the difficulty of observing the performance of the system in flight it is usually possible to determine what part of the system failed. By combining data from the several sources with common sense and a knowledge of the system, the cause of failure can also usually be determined.

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Reynolds Metals Company has inaugurated the nation's first industrial interstate facsimile communications network with which sales orders, originating hundreds of miles away, are reproduced instantly by facsimile telegraph.

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 Circle 100 on Inquiry Card, page 100

Transistor Data

(*Continued from page 61*)

collector-base body saturation current, I_{cs}, can be measured by shorting the emitter to the base and applying a reverse potential $\left(V_{CB} >> \frac{kT}{q}\right)$ to the collector-base junction providing surface leakage is negligible. The body saturation current, though, is an inverse function of the effective width of the base region, which in turn is a function of the collector-base voltage.[9] Therefore, I_{cs} will vary with potential. In addition, as has been seen, if the reverse potential becomes too large, avalanche multiplication as well as surface leakages (and their nonlinearities) influence measured values.

A possible compromise to the complex situation (for each junction if required) would be to make two measurements at a specified modest reverse potential (large enough to cause "saturation" but small enough to avoid avalanche). One measurement would be with the emitter open, the other with the emitter shorted to the base. The first reading should yield[9]

$$I_{C1} = I_{CO} + I_{CL}$$
$$= (1 - \alpha_I\alpha_N)\, I_{CB} + I_{CL}, \qquad (4)$$

and the second measurement should give[9]

$$I_{C2} = I_{CB} + I_{CL}, \qquad (5)$$

where I_{cl} = collector-base surface leakage. The two measurements, along with the alphas, should allow a solution for the fundamental quantities of collector saturation current and collector surface leakage at a particular voltage and temperature. Of course, proper stabilization techniques should be employed in the measurements to prevent thermal regeneration or any tendency towards thermal runaway.[6] If such precautions are not taken, the junction temperature may be considerably above ambient, further complicating the results.

Small-Signal Parameters

Most small-signal parameters specified for transistors are based on simple equivalent circuits. These parameters are generally subject to variation with frequency and are often inadequate to represent the performance of the device over its full range of useful frequencies. Considerable improvement may result from equivalent circuits employing transmission line analogies. More practical lumped-parameter equivalent circuits require of the order of sixteen parts for broadband applications.[10] Some of these parts may even be negative resistances, inductances, and capacitances.[11]

The question then is whether an inadequate over-simplified equivalent circuit should be adopted or a complicated but widely useful circuit be selected. A real solution appears to be to leave the proposition of an equivalent circuit entirely up to the individual application engineer. The testing or specification agency can accomplish this state of affairs by completely ignoring the equivalent circuit concept, and, instead, measure fundamental parameters that can serve as the basis for any equivalent circuit. For example, R. D. Middlebrook has developed a sixteen-part equivalent

(*Continued on page 166*)

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y-circuit that can be established from six carefully selected measurements.[10] These measurements cover the spectrum of a given transistor type. Some are low, some medium, and some high frequency measurements. To be sure, it may require the aid of an elaborate computer to design circuits that fully exploit the complicated "sixteen-part" transistor, but then this requirement may be a natural consequence of technological progress.

Conclusions

If one now adds considerations for large-signal parameters and special concerns for switching applications, the complexity of the transistor from a circuit application standpoint is fully apparent and established. With such a total complexity to deal with, it becomes exceedingly important to select transistor properties that are most fundamental and most widely useful for presentation or specification.

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Power Gain

(*Continued from page* 68)

using ½ w. composition resistors.

Up to 50 MC, resistors of this type with 200 Ω or less resistance are satisfactory. The principal error will arise from the inductive reactance associated with resistor leads and long switch paths. For that reason resistor lead length was kept to an absolute minimum and a miniature 2-gang ceramic rotary switch should be employed. The resistance terminating the external r-f generator can be made 53 Ω (R_1 = 33 Ω) or 75 Ω (R_1 = 56 Ω).

The range of transistor generator resistance is 25 to 97 Ω which is suitable for common base tetrode transistors. The measured accuracy of the input pad to provide a constant available signal power is ± 1.0 db.

Table 1

Power Gain Correction Term

R_o	R_g	db to be added to indicated G_{av} (db)
10 Ω	11 Ω	−6.8 db
24	25	−3.2
51	52	0
75	76	+1.6
120	121	+3.7
200	201	+5.9
270	271	+7.2
300	301	+7.6

As in the previous power gain test set, the available input power is measured by terminating the pad with 51 Ω, setting the resistance of the pad to 49Ω, and measuring the r-f voltage drop across the load resistance. This voltage (or one proportional to it) serves as a reference level for the available signal power from the generator. The transistor is inserted in its socket, properly biased, and the r-f voltage drop across the 51 Ω load resistance is measured after the optimum impedance match has been provided at input and output.

A superheterodyne communications type of radio receiver serves as the r-f voltmeter.

Since some receivers may have a limited linear dynamic range (perhaps less than 20 db), it is advisable to use an accurately calibrated step attenuator of 53 Ω (or 75 Ω) characteristic impedance between the signal generator and the test set.

To measure the power gain, the

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reference available signal power is adjusted by means of this attenuator to some convenient level, then the transistor's maximum developed power is reduced by means of the calibrated attenuator to give the same indicated reference power level. In this method, G_{av} is the amount of attenuation inserted to keep the indicated power level constant. Thus the receiver may have a very small dynamic range and still be useful in measuring much higher ratios of power level.

It may be of interest to see how the common emitter and the common base power gain vary as a function of frequency for a typical unconditionally stable transistor. The 2 solid curves, Fig. 4, show the common emitter and common base available power gain variation for such a unit, and illustrate how the power gain constantly decreases with increasing frequency.

The dashed curve illustrates the variation with frequency of the common base power gain of a unit that is highly regenerative. In this case there is a region where the gain increases with increasing frequency. Such behavior characterizes a potentially unstable transistor. Some transistors of this type will oscillate over a band of frequencies just prior to the rapid fall-off to zero db power gain.

Terminating Resistances

The input terminating resistance is the value of R_g found for maximum G_{av}. The output terminating resistance is the value of reflected transistor load resistance R_R afforded by the pi network.

The magnitude of R_R can be determined from the parameters of the pi network. If C_1 and C_2 are assumed lossless, it can be shown that

$$R_R = \frac{\left[X_L - \dfrac{X_{c_2}}{1+\left(\dfrac{X_{c_2}}{R_L}\right)^2}\right]^2 + \left[\dfrac{R_L}{1+\left(\dfrac{R_L}{X_{c_2}}\right)^2} + R_c\right]^2}{\dfrac{R_L}{1+\left(\dfrac{R_L}{X_{c_2}}\right)^2} + R_c}. \quad (5)$$

Also the pi network efficiency η is

$$\eta = \frac{\text{output power from network}}{\text{power delivered to network}} = \frac{1}{1 + \frac{R_c}{R_L}\left[1 + \left(\frac{R_L}{X_{c_2}}\right)^2\right]},$$

where

X_L = reactance of coil in pi network
R_L = load resistance terminating the pi network
X_{c2} = reactance of capacitor C_2
R_s = series loss resistance of coil = $\frac{X_L}{Q}$.

A curve can be made with R_R as a function of C_2 (at each test frequency, R_L, Q, X_L are constant). Also the ratio of power lost in the network to power delivered to the load may be computed as a function of C_2 at each test frequency. With a set of such curves for each test frequency and with the dial of capacitor C_2 calibrated in μμf one can readily find the value of R_R and the decibel power loss in the network.

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* This level should be at least 10 db above the noise level of the receiver.

Rectifier Progress

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cells of over 2000 p.i.v. have been made in the laboratory and have proven feasible for low current applications in the vacuum tube replacement market. Glass enclosed varieties of this voltage range are in process of refinement for future large scale producton.

High cost, one of the chief obstacles to the overall acceptance of silicon rectifiers, has apparently been overcome by one manufacturer who has offered them to the commercial market at a competitive price to selenium. Acceptance of these less costly items by the military is contingent on quality evaluation presently being accomplished.

Contrary to present claims, some aging trends have been noted during operation of low power silicon rectifiers. Relatively high failure rates, more prevalent on higher voltage units, have been noted under varied test conditions simulating both normal and accelerated operation. Preliminary data shown graphically in Fig. 3 indicate a rough inverse relationship between reliability and reverse voltage rating. A similar relationship, although at a lower failure percentage, exists even at normal rated conditions. Lack of junction homogeneity is apparently at fault, since failures apparently occur due to formation of junction hotspots at otherwise safe case temperatures. Immediate solution to the problem seems to be in a larger margin of safety, which can only be accomplished by current and voltage derating. Specific derating factors may be established after larger sample failure rate information has been compiled and statistical analysis performed.

"To parallel or not to parallel" with resistances still remains a question for series operation of silicon cells. Most manufacturers are now producing their low current products with sufficient uniformity to recommend exclusion of the balancing resistors. High power types (beyond a single wafer diameter of about ½ inch seems to be critical) still utilize the resistors for balance and protection. Operating silicon cells in parallel for higher currents has been avoided wherever possible by either utilizing larger single cells or separate power transformer windings. Series balancing resistors are always used when parallel cell operation is unavoidable.

Stacked silicon packages, two types of which are shown in Fig. 2, are now appearing on the market offering a variety of circuit configurations in a unit package without dependence upon external heat is presently at the discretion of the individual applications engineer; plans are underway to establish standard designs for various half wave and full wave circuit configurations. Presently, only 4 stud mounted half-wave items are included in specification MIL-E-1C, or are "JAN approved," to use more familiar terminology. Additional package types are presently being considered for approval.

Germanium Rectifiers

No further development of germanium power rectifiers is planned by the services as of this writing, chiefly due to their relatively low operating temperature capabilities. However, some low power types have been used successfully in applications below 85°C where extremely high efficiency is required. Acceptance of a few types is now under consideration by the military. It is apparent that the chief application for germanium rectifiers will be in the high power stationary equipment field, where cumbersome water cooling accessories will not detract from overall efficiency.

Titanium Oxide

Temperature capabilities apparently in excess of those offered by silicon put titanium rectifiers in the category of "future consideration" toward fulfillment of extremely high temperature requirements. In addition, the polycrystalline structure theoretically enables them to be somewhat less sensitive to nuclear radiation than the singlar crystal silicon and germanium varieties. Initiation of further research and development effort on titanium may be dependent upon potential properties

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Rectifier Progress

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offered by other semiconductors having good high temperature properties.

Intermetallic Compound

Development of these types has still not progressed beyond the materials study and evaluation stage. No devices have been forthcoming from service sponsored efforts, although at present aluminum antimonide theoretically offers high temperature capabilities beyond those of silicon. Some item in this "III-V compound" class might conceivably lead to a "breakthrough" to the extreme temperatures experienced at high air speeds.

Potential Types

Silicon Carbide — Basic materials study is progressing in the same stage of advancement with the intermetallics. No devices have been made, but a rectifier capable of operation in ambients beyond 500°C is an ultimate goal.

Silicon-Germanium Alloy—This approach offers a possible solution to the meter rectifier problem by theoretically providing the low threshold voltage of germanium coupled with improved high temperature characteristics of silicon. Work on this alloy is at present a basic materials research task, progress on which is being closely followed for adaptation to device development.

Future Considerations

The apparent versatility of silicon devices make them well suited as potential solutions to the semiconductor application problems encountered in most military equipment; consequently, the bulk of future planning is aimed at improvement of these types. An ever-increasing fund of basic materials research knowledge is expected to provide improvement in silicon purity and uniformity to bring about increases in device capabilities and decreases in cost.

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