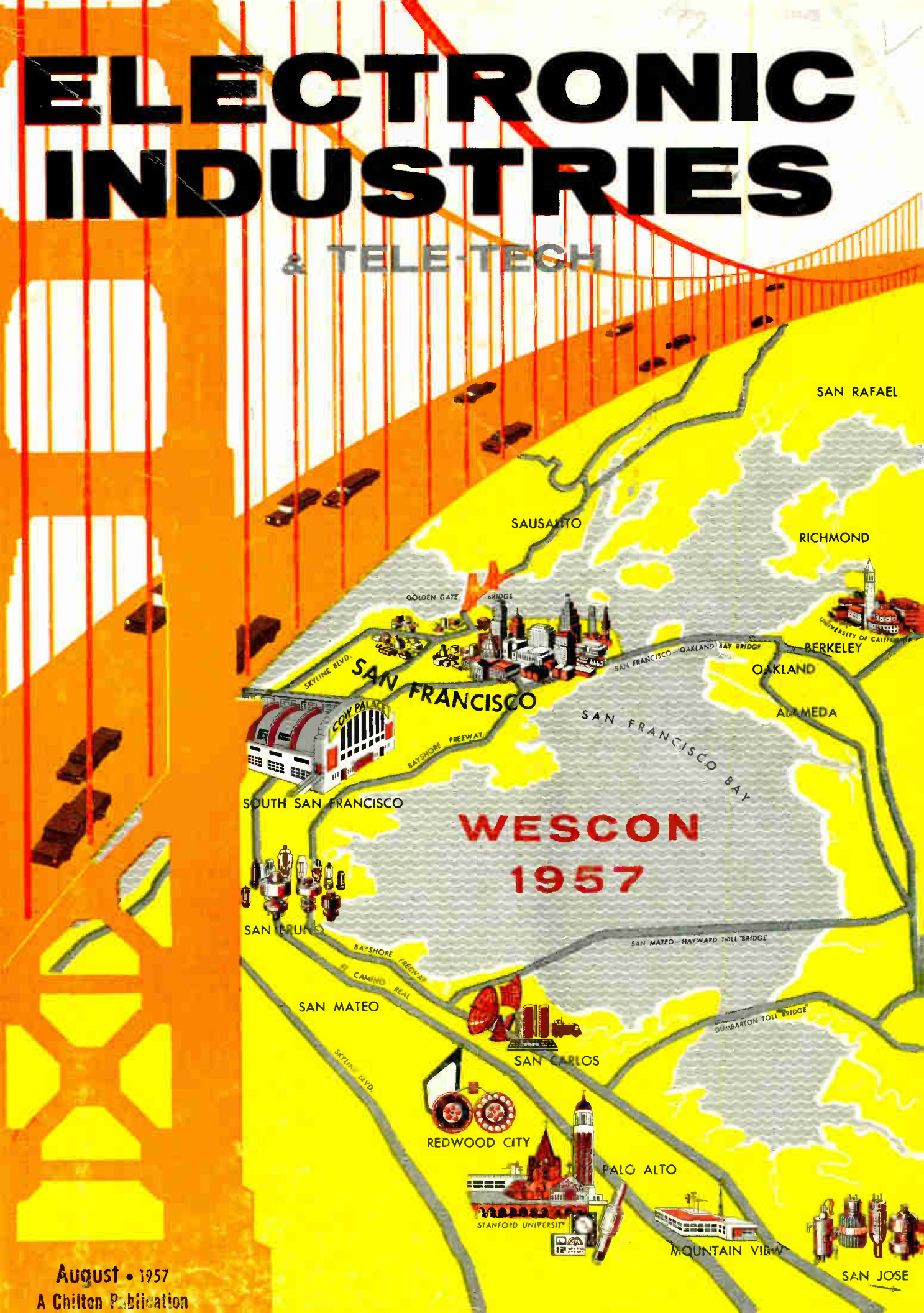
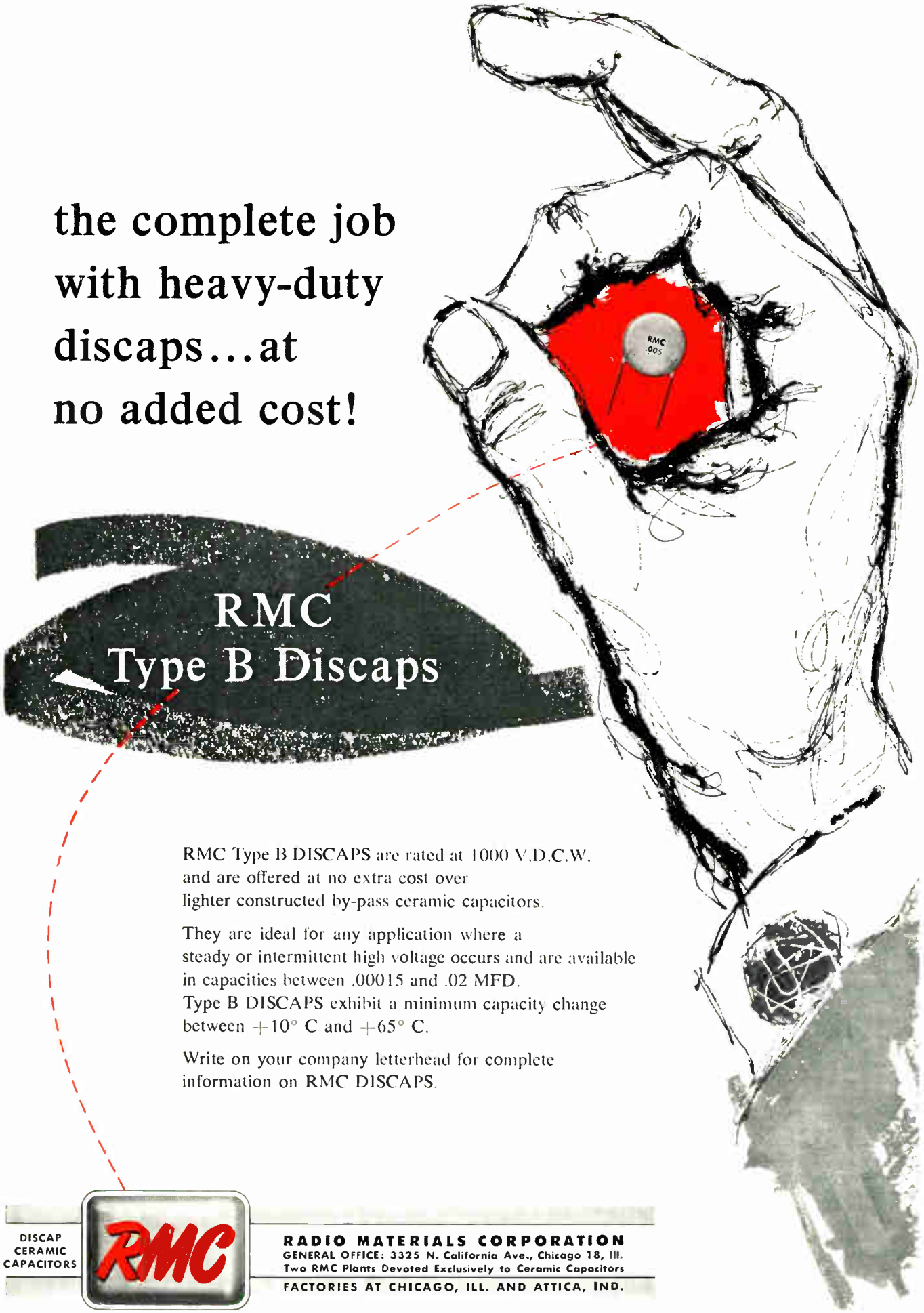
ELECTRONIC INDUSTRIES

& TELE-TECH



August • 1957
A Chilton Publication

the complete job with heavy-duty discaps...at no added cost!



RMC Type B Discaps

RMC Type B DISCAPS are rated at 1000 V.D.C.W. and are offered at no extra cost over lighter constructed by-pass ceramic capacitors.

They are ideal for any application where a steady or intermittent high voltage occurs and are available in capacities between .00015 and .02 MFD. Type B DISCAPS exhibit a minimum capacity change between +10° C and +65° C.

Write on your company letterhead for complete information on RMC DISCAPS.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Circle 1 on Inquiry Card, page 109

ELECTRONIC INDUSTRIES
& TELE-TECH

Vol. 16, No. 8 **August, 1957**

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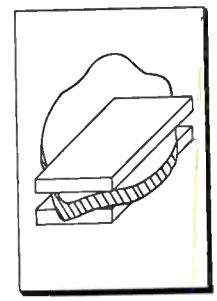
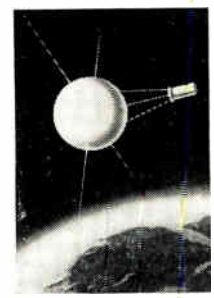
Nobel prize winner Dr. William Shockley describes his latest development, the "Four-Layer Diode," a unique bistable semiconductor.

Which P-C Board? 72



In choosing base materials for printed capacitors, dissipation factor and loss factor must be considered in addition to conventional capacitor characteristics.

Satellite Magnetometer 76



The characteristic frequency of precessing protons in a weak magnetic field serve as a measure of the earth's field. Sensing element is a coil of wire and bottle of water.

Radiation & Transistors 80

Elaborate facilities have been constructed to test electronic components under nuclear environments. First reports are now available on semiconductors.

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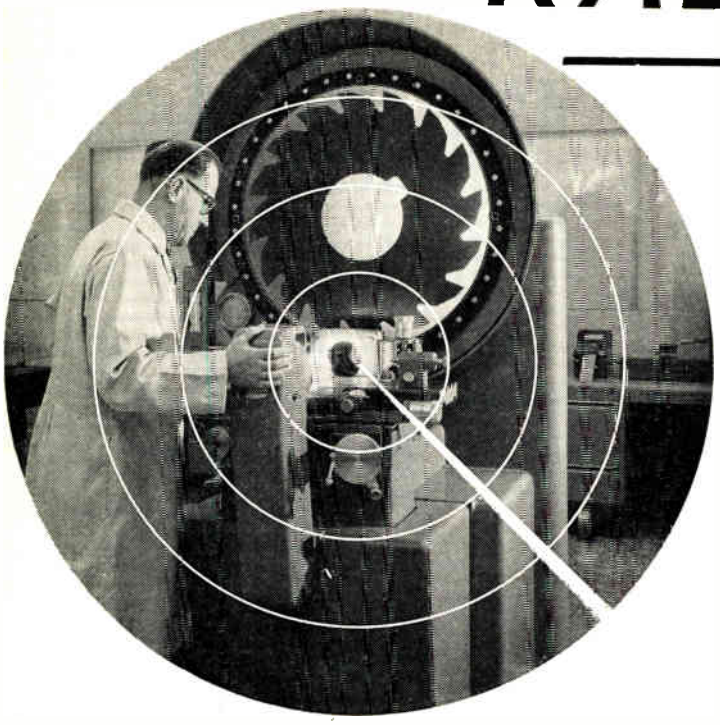
RADARSCOPE



CONTOUR PROJECTOR

A variety of large pieces with intricate shapes may have their profiles or surfaces enlarged for examination as much as 100 times with this 30-inch-screen Kodak contour projector at IT&T Standards Laboratory.

"SOLION" CHALLENGES TRANSISTOR by performing many of the functions now handled by tubes and transistors. This Navy-developed, electrochemical device depends on ion movement in a solution, instead of in a gas, vacuum, or solid. The ions flow in an iodine solution. A fascinating characteristic of the new device is that current through it can be altered directly by changes in temperature, pressure, light, sound, acceleration, or radiation. Early military applications are predicted by Naval Ordnance Laboratory workers, who see possibilities of cheaper, smaller, and simpler electronic control systems.

GIANT RADIO-TELESCOPE is being completed in England. It is the largest steerable radio-telescope in the world, is valued at more than $2 million. The reflector is 250 feet in diameter, weighs 750 tons, towers 215 feet above the ground. Tracking rate of this mammoth telescope is great enough to track the earth satellites to be launched during IGY.

BREAKER POINTS are eliminated in the new ignition system developed by Commonwealth Engineering Co., of Ohio. The new device is reportedly inexpensive, and small enough to be installed beneath the dash of present vehicles without requiring any major changes in other equipment.

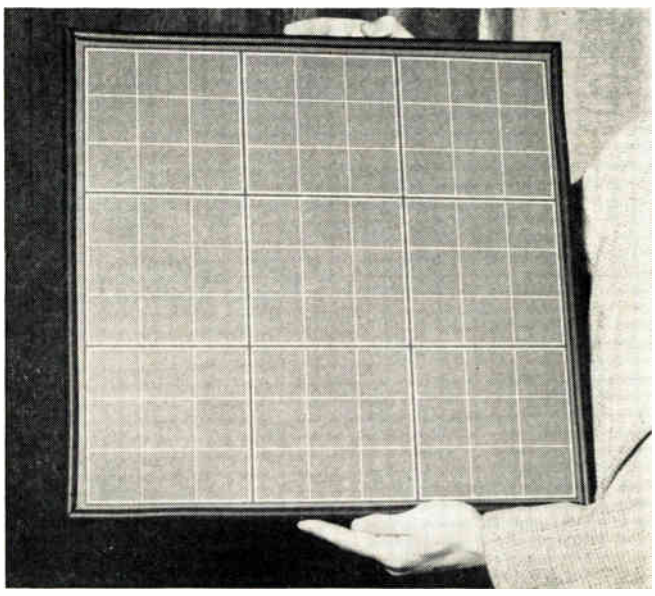
NEW TV BROADCAST PACKAGE offered by Hallamore Electronics Co., a division of the Siegler Corporation, Anaheim, California, is a complete one-man TV program center. Included in the center is all equipment necessary to telecast live, filmed, or remote programs. The $15,000 package includes a master console, with combined audio and video control equipment; both film and slide projection equipment; audio and record turntable facilities; one or more cameras, which can be operated by remote control from the master console; and all necessary transmitting circuitry. It is specifically designed for one-man operation, including controls so one man can operate cameras remotely—turning them on himself for commercial, news, or other announcements.

HYDROGEN FUSION PROGRESS is reported by Swedish scientists. Researchers at Uppsala University have attained brief high-current discharges in deuterium, an essential step in proposed fusion reactors, with technical equipment costing only $1,200.

TAPE-STORED ADDRESSES will be a feature of a new automatic addressing system to be announced soon by a major business systems manufacturer. Names and addresses will be placed on magnetic tape rather than the usual steel address plates. The tape is prepared and played back on an Ampex digital tape recorder.

SILICON SUN BATTERY

New 18 by 18 inch sun battery developed by International Rectifier Corporation, El Segundo, California, converts solar energy to electrical current for a wide variety of applications. The large battery will be demonstrated at this month's WESCON conference.



MORE VERSATILE ENGINEERS are needed for the growing technical revolution, says Willard F. Rockwell, Jr., president of Rockwell Manufacturing Company. The successful engineer of today must deal with sales, marketing, cost accounting, public relations, and other company functions. Among the personal attributes for which the engineer must strive is objectivity in his dealings with company management. He must be ready to dissent if engineering facts are at odds with management decisions.

NEW MEMORY MATERIAL has been developed at Bell Labs. The chemical, triglycine sulphate, has a rectangular voltage hysteresis loop making it useful for ferroelectric applications such as switching and memory devices. The new material has a lower coercive field (220 v/cm) than previously discovered ferroelectrics and can be formed into thin slabs which can be switched with about 20 volts. Such low voltages make the new memory material suitable for use in transistorized circuits. One promising technique involves evaporating matrixed electrodes on opposite sides of a 5- to 10-mill slab of triglycine sulphate, resulting in a memory or switching device capable of storing 900 or more bits/square inch.

COMMUNICATIONS

NEW SYSTEM of communication by light beam that under appropriate conditions will permit the transmission of single or multiple channels of voice communications, or a complete television channel, has been developed and demonstrated by Baird-Atomic Inc. In a demonstration at Boston, Mass., a local TV program was picked up on a conventional receiver. At the same time, the video-signals from the receiver were also sent to an electro-optical system which was directed at a remotely-positioned photo multiplier tube. The signal picked up by the tube was then led into the video section of a second TV receiver. The two pictures were compared and it was seen that the light beam transferred all signals just as efficiently as the conventional system. Dr. Walter Driscoll, V. P. in charge of research for Baird-Atomic Inc., explained the significance. "Because of the small point source," he said, "a mirror can direct a narrow light beam over a distance of several miles with no detectable or wastable light energy outside the beam. Further, if either transmitting or receiving portions of the optical link are not fixed points but are on mobile mounts, wider angular beams can be provided using broad light sources and/or multiple receiving transmitting optics."

See You at WESCON!

This year ELECTRONIC INDUSTRIES & Tele-Tech will occupy booth 3011. R. E. McKenna, Publisher; B. F. Osbahr, Editor; B. W. Olson, Regional Manager, Los Angeles; D. May, Regional Manager, San Francisco, are among the staff members scheduled to be in attendance. We welcome the opportunity to meet our readers personally and we hope you will visit us while you attend the show!

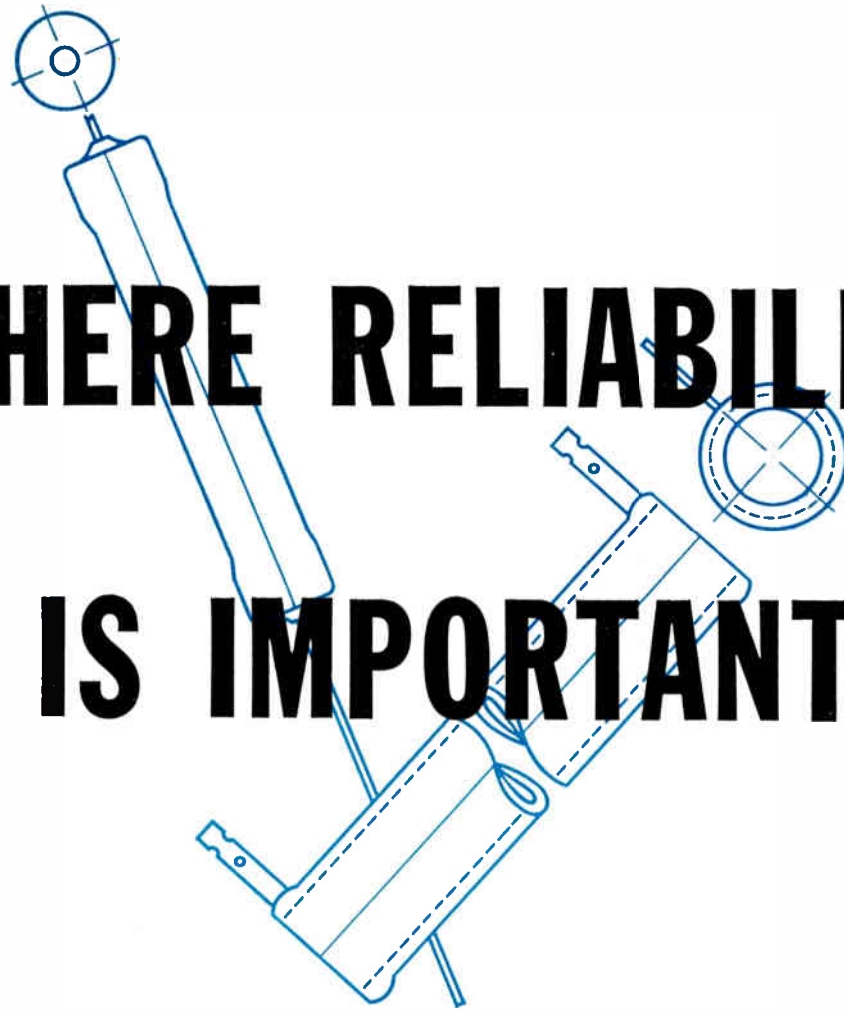
AUTOMATIC CIRCUIT ANALYZER developed by Republic Aviation Corp. can check aircraft electrical circuits at a rate of twenty per second. In practice, the set can check out 1,200 circuits in less than a minute. If there are no short circuits, the set zips through its test routine and stops. If a short, open, or wrong connection is detected, the set halts and flashes a light representing that circuit on the control panel. After the ailing circuit is noted, the operator pushes an override button to continue the test.

TRANSPARENT MAGNETIC TRACK can be superimposed on full-width optical track without interference. The Signal Corps has discovered that the iron-oxide magnetic stripe is highly transparent to infra-red light, enabling red-sensitive photo-cells to

(*Continued on page* 14)

HYDROGEN FUSION RESEARCH

Giant bank of capacitors being assembled at GE's research lab in Schenectady, N. Y., will store large amounts of energy and discharge in short, sharp shocks during research into fusion power. A substantial research program to seek safe and inexpensive power from the fundamental process of the hydrogen bomb has been undertaken.



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Blue Jacket®

WIRE-WOUND RESISTORS

Vitreous-enamel power wirewound resistors have been proven to be extremely reliable units by both the military services and the communications industry. Sprague Blue Jacket resistors are among the most outstanding resistors of this type. They can be counted on to withstand the most severe duty cycles!

In the manufacture of Blue Jacket resistors, selected resistance alloys are wound on special steatite cores. The expansion coefficient of the vitreous-enamel coating is closely matched to that of the steatite base in order to ensure positive protection of the resistance winding. The terminal bands are made of an alloy which also closely matches the steatite base in expansion characteristics.

Sprague furnishes a wide range of sizes and power ratings in these reliable resistors, both in axial-lead and tab-terminal designs. For complete details on commercial types, write for Engineering Bulletin 111B. Military styles are shown in Sprague Catalog 101.

Sprague deliveries are prompt! Prices are right! Send your next power resistor order to:

Sprague Electric Co.
233 Marshall Street
North Adams,
Massachusetts.

SPRAGUE®
the trademark of reliability

RESISTORS • CAPACITORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • HIGH TEMPERATURE MAGNET WIRE • PULSE NETWORKS • PRINTED CIRCUITS

As We Go To Press...

NEW DISPLAY DEVICE

Sylvania Electric's Dr. Keith Butler demonstrates the new electroluminescent "Sylvatron," which can convert electric or optical signals to dots of light. The flat, luminous display can be held or erased at will, has military significance.

Bendix Launches Air-Crash Study for ARDC

An aircraft-collision-avoidance research program aimed at the development of a practical anti-collision device has been started by the Radio division of Bendix Aviation Corporation.

The program, scheduled for completion in March, 1958, with delivery of a flight-tested research model to the Wright Air Development Center, Dayton, O., involves a study of the over-all collision-avoidance problem as it applies to both commercial and military aviation.

First State Sponsored Educational TV System

The nation's first state-sponsored educational closed-circuit television system is being installed by RCA for the Georgia Dept. of Education.

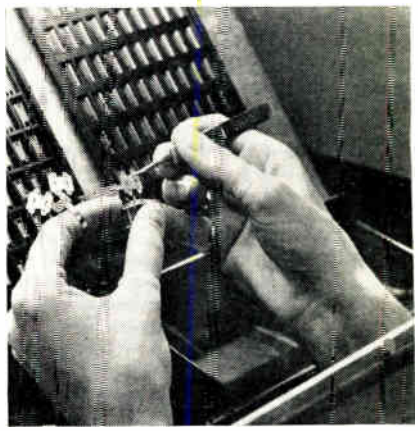
The RCA educational TV system will be installed in The Conley Hills Elementary School, Fulton County, and will go into classroom operation in September. It will serve primarily as a "laboratory" installation for Georgia educators who are studying the practicability of statewide teaching-by-television.

The Conley Hills TV system will be a multi-channel installation, embracing four RCA TV camera chains linked by closed-circuit with twenty-six RCA Victor TV receivers installed in classrooms throughout the school. Film and live educational TV programs will be originated from a centralized TV studio now under construction within the school.

Counterfeit Tubes New RETMA Target

Receiving tube counterfeiting, estimated at $100 million, is the target of a proposed new RETMA program. The program would be spearheaded by a hard-hitting motion picture dramatizing the evils of tube counterfeiting, would be backed up by public relations and advertising campaigns based on the theme, "You never get something for nothing."

ENGINEERING INGENUITY



Little things make a big difference. Here, a simple permanent magnet ring speeds assembly of tiny precision parts by 12 per cent at G. E.'s Owensboro, Ky. plant.

Hydrogen Fusion Power Goal of GE Research

GE's vice president, Dr. Guy Suits, has revealed the existence of a substantial research program to study the fusion process, the basic reaction of the H-bomb. Although Dr. Suits warns that research on fusion has so far been more productive of hope than power, significant research progress has been made in the U. S. England, Sweden, and Russia.

Perhaps the most important single concept so far is that of magnetic containment, making a magnetic "bottle" that will hold a bit of cosmic plasma heated to 100 million degrees so that it will not touch and immediately destroy physical walls. This problem is one where the basic skills of scientists in the electrical industry are expected to make significant contributions.

German Car Radio

Blaupunkt-Blue Spot Hi-Fi AM-FM car radios, made by veteran West German producer Robert Bosch Corporation will be distributed on a national scale in the American market. Prices will range from $92.50 to $192.50. The sets feature coaxial speakers, separate amplifiers, and are available for either 6 or 12 volt systems.

MORE NEWS ON PAGE 7

PORTABLE FACSIMILE

Polaroid picture is slipped into Army's new facsimile set and flashed to headquarters where companion receiver reproduces picture. Total time, click to pic, 5 minutes.

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& Tele-Tech

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As We Go To Press

Scientists Seek To Crack "Human Barrier"

A team of Lockheed Aircraft Corp. scientists, assisted by 10 specialists from the nation's leading colleges, are preparing an experiment which seeks to crack aviation's "human barrier."

Psychologists, biologists, electronics and communications engineers, an endocrinologist, and a physician are setting up a project to test the endurance of pilots and crew members on extended flights.

Such flights could include those in the unlimited range of the potential nuclear airplane, which is under development study — and also possible flights into outer space.

Having broken the "sound barrier," approaching the "heat barrier" and the "range-and-endurance barriers" in the progress of aviation, aeronautical scientists are turning their attention toward the remaining barrier — the "human barrier."

With the development of aircraft capable of sustained flights of long duration, at supersonic speeds, high altitudes and under environmental conditions heretofore not encountered, greater consideration must now be given to the associated human factors.

NEMA MEN VISIT USSR

NEMA's Semiconductor Rectifier Section sent delegates E. A. Harty, GE; and I. R. Smith, Westinghouse (seated, left to right) to Russia's International Electrotechnical Commission meeting in Moscow. Here, they discuss the trp with Section members, Gordon L. Nord, Schauer Mfg. Corp., and W. F. Bonner, Federal Telephone and Radio Co. (standing, left to right).

MORE NEWS ON PAGE 11

ELECTRONIC SHORTS

A microwave radio demonstration unparalleled in the privately-owned communications industry—the transmission of voice intelligence 3000 mi. over a private system from Houston, Texas, to Linden, N. J., and return—was the feature attraction at a recent General Electric Co. exhibit. Using standard 2000 MC Quadriphase microwave equipment, Type UA-1-D, conversations originating at one telephone extension traveled nearly 1500 mi. to Linden over one microwave circuit and came back via another, terminating at a second telephone extension 16 ft. away. The intelligence was repeated 100 times en route.

The HAWK, the new air defense weapon system designed to reinforce the low-altitude capability of our air defenses, will carry a lethal, modern war-head and be capable of destroying attackers flying at even the lowest altitudes at ranges insuring effective protection of defended areas. Raytheon Mfg. Co. is the prime contractor for the production of the entire weapon system which will complement the defense against high-altitude air attack provided by the Army's NIKE system.

"Made in U. S. A." is the theme of the U. S. Government exhibit at the 26th Industrial Fair in Poznan, Poland. Lighting and television products of Sylvania Electric Products, Inc., are representing those American industries at the fair. The American exhibit, under the direction of the Commerce Department's Office of International Trade Fairs, covers an area of 30,000 sq. ft.

The nation's first commercial "bouncing microwave" system to achieve reliable communications over a 40-mile distance by using huge mirror-like reflectors to relay intelligence, instead of regular repeater stations, has been developed by General Electric engineers for El Paso Electric Co. It is capable of handling private conversations, printed material, and remote control signals.

"Weather-Vision" provides push button weather briefings for USAF pilots at McGuire AFB, N. J. The Dage Television communication system provides continuous, simultaneous weather briefings and display of general weather information at many widely scattered areas at the base. The system will be made immediately available for civilian use.

Techniques of automatic prediction of radar failure have been revealed by AMF's Electronics Div. An automatic failure predictor detects probable failures in a radar system before they occur and alerts the operator to take preventative action by replacing or repairing an assembly or components as indicated by the device. Use of the predictor will not only eliminate the radar failure but will also reduce maintenance costs for America's far-flung radar picket line.

National Television Week, Sept. 8-14, will springboard an autumn public relations program under the co-sponsorship of RETMA, NARDA, NARTB, and TvB (Television Bureau of Advertising).

National distributing organizations for industrial electronic equipment are beginning to take shape. The Avnet Corp., has been appointed national sales division for Harvey Hubbell, Inc., Interlock Electronic Connector Dept. The firm is an integrated national distributor of electrical, electronic, avionic, nucleonic components.

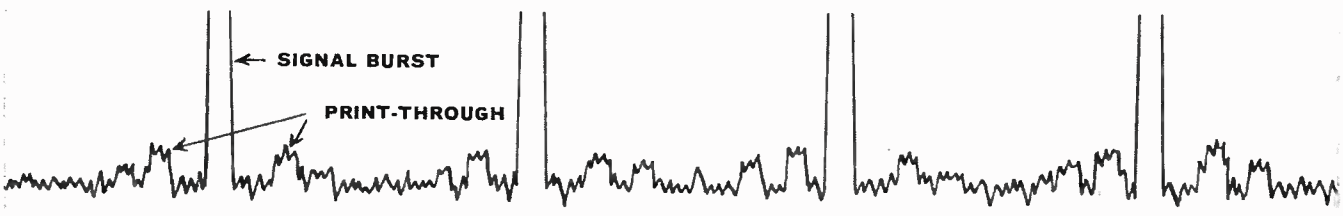
For the Univ. of Manchester, a new 2,000-ton radio telescope will come into service shortly at Jordell Bank in the English county of Cheshire. The great size of the 'scope will make it the most sensitive short wave radio receiver yet constructed, and also the most far reaching transmitter.

A 500-ft. fixed paraboloidal radio antenna is proposed by the Naval Research Laboratory. Design consists of concentric rings of telephone poles supporting flat panels. A math analysis shows that approx. 90 panels, 20 ft. in the longest dimensions, in each of 12 rings would be required for an antenna suitable for a minimum wavelength of 16 cm.

The airframe industry must embrace electronics completely to keep pace with industry development and changes in Government procurement according to Robt. E. Gross, Chairman of Lockheed Aircraft Corp. Infrared specialists are being sought by his firm for work on the F-104 Starfighter.

LOW

New



CONVENTIONAL TAPE

Strip chart clearly shows print-through signals before and after 1-second, 1-kc tone bursts on a conventional tape stored 5 minutes.

PRINT

Another 3M first! gold seal professional tape cuts print level 8 db!

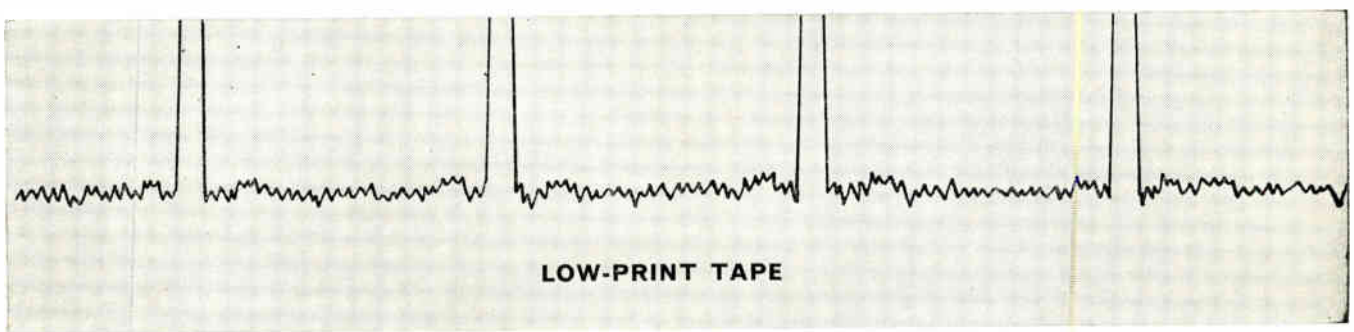
Is print-through a problem with you? Even the most carefully made tape recordings can be marred by print-through . . . layer-to-layer signal transfer in tape wound on rolls. Solve your problem by using new "Scotch" Brand Low-Print Magnetic Tape with the lowest print level of any tape on the market.

New gold seal Low-Print Magnetic Tape gives you 8 db lower print level. It's the first and only tape to reduce print-through to a point below noise level on most professional machines. First tested commercially a year ago, this new tape is the product of 8 years of intensive research in 3M Company laboratories.

Superb recording characteristics are another feature of new "Scotch" Brand Low-Print Magnetic Tape. New oxide construction provides increased potency, greater sensitivity. Available in widely used 2400 ft. length, as well as 1200 and 4800 ft. lengths.

Today—buy new "Scotch" Brand Low-Print Magnetic Tape in the box with the bright gold seal. Sure sign of quality!

SCOTCH BRAND Magnetic Tapes



Strip chart with same signal proves that new "Scotch" Brand Low-Print Tape stored for same time has greatly reduced print-through.

For quick bonding, turn to turn, with a single application of heat or solvent . . .

Specify

PHELPS DODGE BONDEZE®

MAGNET WIRE

These successful uses of Bondeze suggest unlimited new redesign possibilities, often at overall savings.

COILS Random-wound, layer, paper-section and solenoid coils for brakes and clutches, instruments, television, radio and other applications.

TRANSFORMERS Paper-section, random-wound, oil-filled, air-cooled and high voltage for distribution, current, X-ray, television, radio and other applications.

MOTORS Windings for shaded pole, series fields, instruments, induction and others.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

FIRST FOR LASTING QUALITY— FROM MINE TO MARKET!

PHELPS DODGE COPPER PRODUCTS CORPORATION

INCA MANUFACTURING DIVISION

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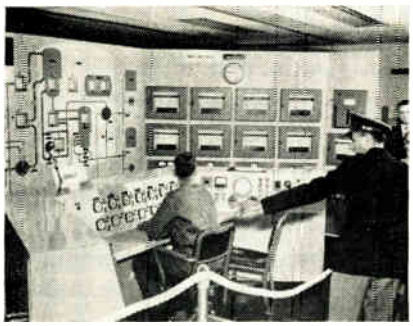
Visit our Booth No. 1111 at WESCON Show, August 20-23, 1957

As We Go To Press . . .

ARMY REACTOR CONTROL



Army operators are trained to operate the Army's 2,000-kw Packaged Power Reactor with this Honeywell-designed control panel. Panel simulates control system operation.

First Actual Vanguard Rocket Delivered

Official opening of IGY found the first prototype satellite launching vehicle undergoing tests at the Vanguard launching center in Cape Canaveral, Florida. Ground tests were expected to take approximately six to eight weeks. This will be the first of the actual Vanguard launching rockets to be test fired—the two previous tests used modified Vikings to simulate the first of the rocket's three stages.

A further development in the satellite program is the announcement by the Army Signal Corps that successful solar cell experiments have been completed, proving that solar power for satellite instruments is practical. Glass-protected clusters of solar cells were attached to the skin of an Aerobee-Hi rocket, which was then fired to an altitude of 190 miles, approximating satellite conditions. The silicon solar cells functioned perfectly.

Telemetered data showed the cells provided continuous electrical output from the time of the firing until the rocket's radio ceased functioning on re-entering dense atmosphere. Electrical output varied only slightly, depending on exposure to various degrees of direct or reflected sunlight.

The Navy revealed that further tests of solar cells as the primary satellite power supply will be conducted during early satellite launchings.

MORE NEWS ON PAGE 16

Coming Events

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

Aug. 1-4: 11th Annual Conv. sponsored by Air Force Association; at Sheraton Park & Shoreham Hotels, Washington, D.C.

Aug. 6-10: National Aviation Mtg. by IAS; at U. S. Grant Hotel, San Diego, Calif.

August 12-16: Analog-Digital Conversion Techniques, by Mass. Inst. of Tech.; at M.I.T., Cambridge 39.

Aug. 19-30: Management Sciences and Computer Tech. Courses, by Univ. of Mich.; at Ann Arbor, Mich.

Aug. 20-23: Western Electronic Show & Conv. (WESCON), sponsored by IRE and WCEMA; at Cow Palace, San Francisco.

Aug. 22: 12th General Assembly, the International Scientific Radio Union at Boulder, Colo.

Aug. 23-25: Annual Conv. & Seminar, sponsored by National Alliance of TV & Service Assn's; at Sheraton Hotel, Chicago.

Aug. 28-30: Pacific General Meeting by the AIEE; at Pasco, Wash.

Aug. 28-30: International Symp. on Gas Chromatography by ISA; at Kellog Center, East Lansing, Mich.

Aug. 30-Sept. 1: ARRL National Conv., sponsored by American Radio Relay League; at the Palmer House, Chicago.

Sept. 4-6: Conference on Magnetic Amplifiers, sponsored by IRE & AIEE, at Penn Sheraton Hotel; Pittsburgh, Pa.

Sept. 9-13: Instrument-Automation Conf. & Exhibit, by ISA; at Cleveland, Ohio.

Sept. 9-13: 3rd Annual Titanium Conf. at New York University, New York City.

Sept. 13-15: 6th Annual Chicago Hi-Fi Show, at the Palmer House, Chicago 2, Ill.

Sept. 16-19: 62nd Annual Conv., by International Municipal Signal Assn.; at Hotel Fountainebleau, Miami Beach, Fla.

Sept. 17-18: Electronic Control & Data Processing Symp., by RETMA; at Ambassador Hotel, Los Angeles, Calif.

Sept. 23-25: 6th Annual Mtg., by Standards Engineers Society; at Hotel Commodore, New York.

Sept. 23-25: ASME Fall Mtg.; at Statler Hotel, Hartford, Conn.

Sept. 23-27: X-Ray Diffraction School, by Philips Electronics, Inc.; at Sir Francis Drake Hotel, San Francisco, Calif.

Sept. 24-25: Conf. on Industrial Electronics, by IRE & AIEE; at Morrison Hotel, Chicago, Ill.

Sept. 27-28: 7th Annual Symp., by IRE (PGTBS); at Washington, D.C.

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

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

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: IRE Canadian Conv., sponsored by IRE; at Toronto, Canada.

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

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

Oct. 27-29: East Coast Conf. on Aeronautical and Navigational Electronics, by IRE; at Lord Baltimore Hotel & 7th Reg Armory, Baltimore, Md.

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

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

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

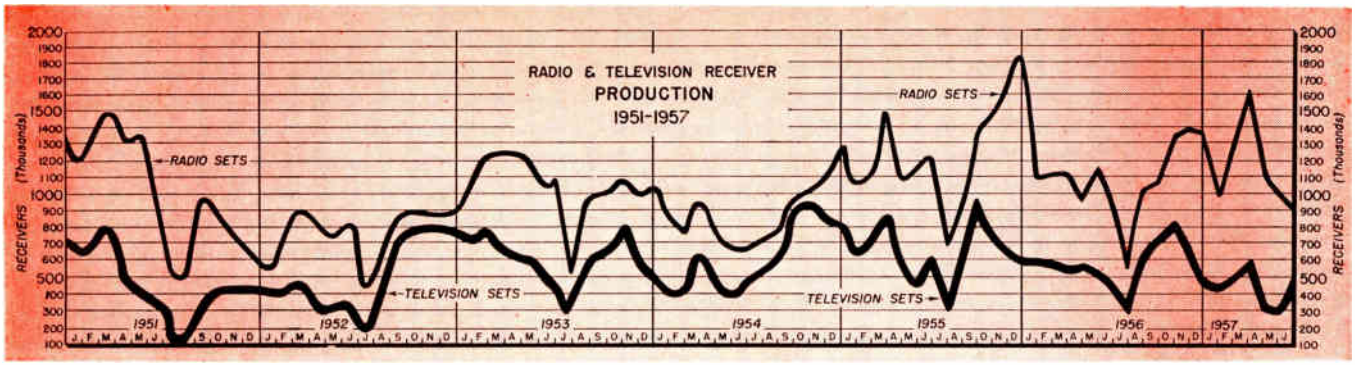
Nov. 25-26: IAS International Meeting, by IAS; at Canadian Aeronautical Inst., Canada.

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.
ARRL: American Radio Relay League
ASME: American Soc. of Mechanical Engineers
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
RETMA: Radio-Electronic-Television Manufacturers Assoc.
SAMA: Scientific Apparatus Makers Assoc.
SMPTE: Society of Motion Picture & TV Engineers
WCEMA: West Coast Electronic Manufacturers Assoc.

TOTALS



INDUSTRY SUMMARY

YEAR	RECEIVERS	PARTS*	INDUSTRIAL EQUIPMENT	MILITARY	TOTAL
1950	$1.50 billion	$250 million	$350 million	$500 million	$2.6 billion
1951	1.40 "	350 "	450 "	1.3 billion	3.5 "
1952	1.3 "	400 "	500 "	2.2 "	4.4 "
1953	1.4 "	500 "	600 "	2.5 "	5.0 "
1954	1.3 "	650 "	650 "	2.4 "	5.1 "
1955	1.5 "	750 "	750 "	2.5 "	5.5 "
1956	1.4 "	850 "	950 "	2.7 "	5.9 "

* *Replacement parts sales only.*

—1957 RETMA Fact Book

COMPARISON OF WESTERN INDUSTRY TO TOTAL USA

TOTAL—Electronics Industry —11 Western States, 1956

1. No. of Electronic firms..	641
2. Employment	112,000
3. Sales	$1,690,000,000

TOTAL—Electronics Industry —USA, 1956

1. No. of Electronic firms...	4,200
2. Employment	610,000
3. Sales	$9,700,000,000

COST OF RECRUITING

In comparison to commercial firms, government contractors spent:

- 14 times more for help-wanted advertising;
- 5 times more for recruiting expenses;
- 10 times more for travel expenses of new applicants;
- 26 times more for moving expenses;
- 8 times more for educational benefits;
- 9 times more for recruitment costs;

As a result of the above, they:

- hired 6 times more engineers;
- ran 60% higher costs per new hire;
- lost one engineer in 11 as compared to one in 15 for commercial firms.

Defense contract firms used 11,700 engineers per billion dollars worth of business as compared to 3,600 by the commercial firms.

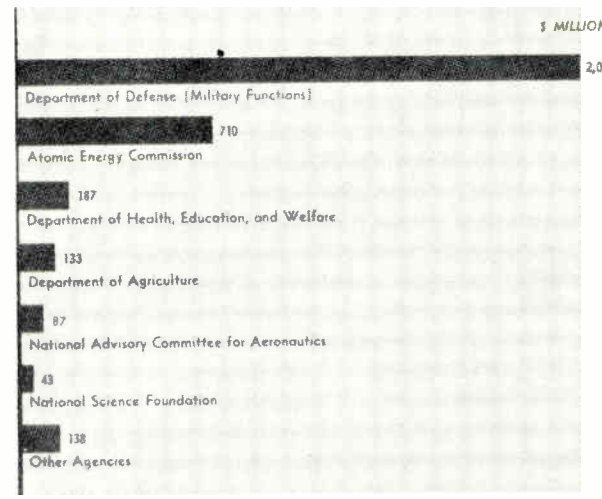
—Honorable James C. Davis, Chairman, Manpower Utilization Subcommittee.

PROCUREMENT EXPENDITURES

(Million Dollars)

Fiscal Year Ending June 30	Guided Missiles	Aircraft
1951	$ 21	$2,412
1952	169	4,888
1953	295	7,417
1954	504	8,335
1955	718	8,037
1956	1,168	7,146
1957E	1,506	6,786
1958E	2,039	6,737

E Estimate.



AIR FORCE PLANNED OBLIGATIONS IN FISCAL 1958

	Number	Percent of Total Number	Total Cost (in Millions)	Percent of Total Cost
Bombers	121	8	$ 999.4	36.4
Fighters	697	46	1,167.0	42.5
Transports	212	14	462.1	16.8
Trainers	485	32	118.4	4.3
TOTAL	1,515	100	$2,746.9	100.0

*—"Aviation Facts and Figures", Aircraft Industries Assoc. of America.

GOVERNMENT'S R & D BUDGET

Graph above shows 1958 estimated expenditures.

—The Federal Budget in Brief

TV MANUFACTURERS

1950	140	1951	110
1952	94	1953	90
1954	83	1955	72
1956	51		

—1957 RETMA Factbook

DIRECT DISPLAY CATHODE RAY

STORAGE TUBES BY HUGHES

TONOTRON*

Halftone Storage Tube...for Radar PPI Display or Closed-Circuit TV.

Such distinct advantages as controllable long persistence and ability to cover the entire grey spectrum contribute to the versatility of the Hughes TONOTRON direct display storage tube. Because the TONOTRON electron tube has an over-all length of only 11⅜" (±⅜"), it can be installed in many existing radar indicator housings in both military and commercial aircraft. Brilliance of 1000 foot-lamberts at 10 kv enables the pilot to view radar presentations in full daylight without using a vision-restricting viewing hood. When used in narrow band, slow scan television, the TONOTRON storage tube eliminates need for costly coaxial cables or microwave transmitters and receivers, since pictures can be transmitted over conventional radio channels or telephone lines.

Brilliant halftone presentation in weather radar.

Maximum contrast makes ground radar read "like a map."

Resolution of 80 lines per inch in narrow-band TV.

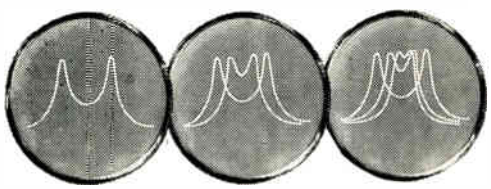
Action can be frozen for subjective examination.

MEMOTRON®

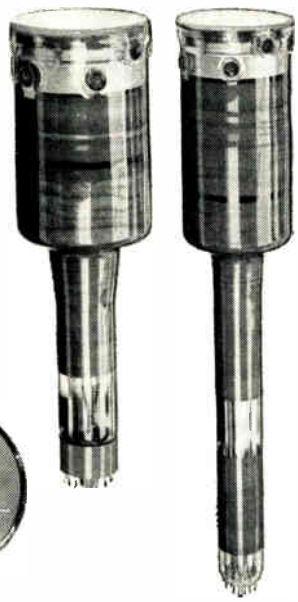
Oscillograph Storage Tube ...for Retaining Displays of Electrical Phenomena.

Traces and transients may be visibly retained on the face of the Hughes MEMOTRON direct display storage tube as long as desired—and successive waveforms can be displayed and retained for analysis and comparison without needless photography.

When permanent records are required, photographs may be taken with a single camera exposure setting, since all displays occur at the same brightness regardless of differences in writing speeds.



A technique for plotting a family of curves, representing a coupled circuit with varied parameters.



TYPOTRON®

Character-Writing Storage Tube ...for Use as a Read-Out Device for Computers.

When used in such digital computer applications as programming aid, solution read-out and trouble-shooting, the Hughes TYPOTRON direct display storage tube effectively monitors a problem as it goes through various phases toward a solution.

A choice of 63 characters is available for presentation of data in words, numbers or symbols at speeds of at least 25,000 characters per second. Written information remains visible indefinitely without fading or blooming until intentionally erased.

Presentation of printed data is displayed with ⅛-inch characters.

You are invited to see demonstrations of Hughes direct display storage tubes at Booths 2910-11-12-13, Western Electronics Convention, San Francisco, August 20 through 23. For additional information, write to: HUGHES PRODUCTS • Electron Tubes, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

**Trademark of Hughes Aircraft Company*

Radarscope *(continued)*

"see" through the magnetic track and pick up the optical sound track. The discovery is of major importance, because use of half-width tracks on films with both optical and magnetic sound causes loss of quality and higher maintenance costs due to uneven head wear. Only minor modifications will be required to adapt most present equipment to the superimposed tracks.

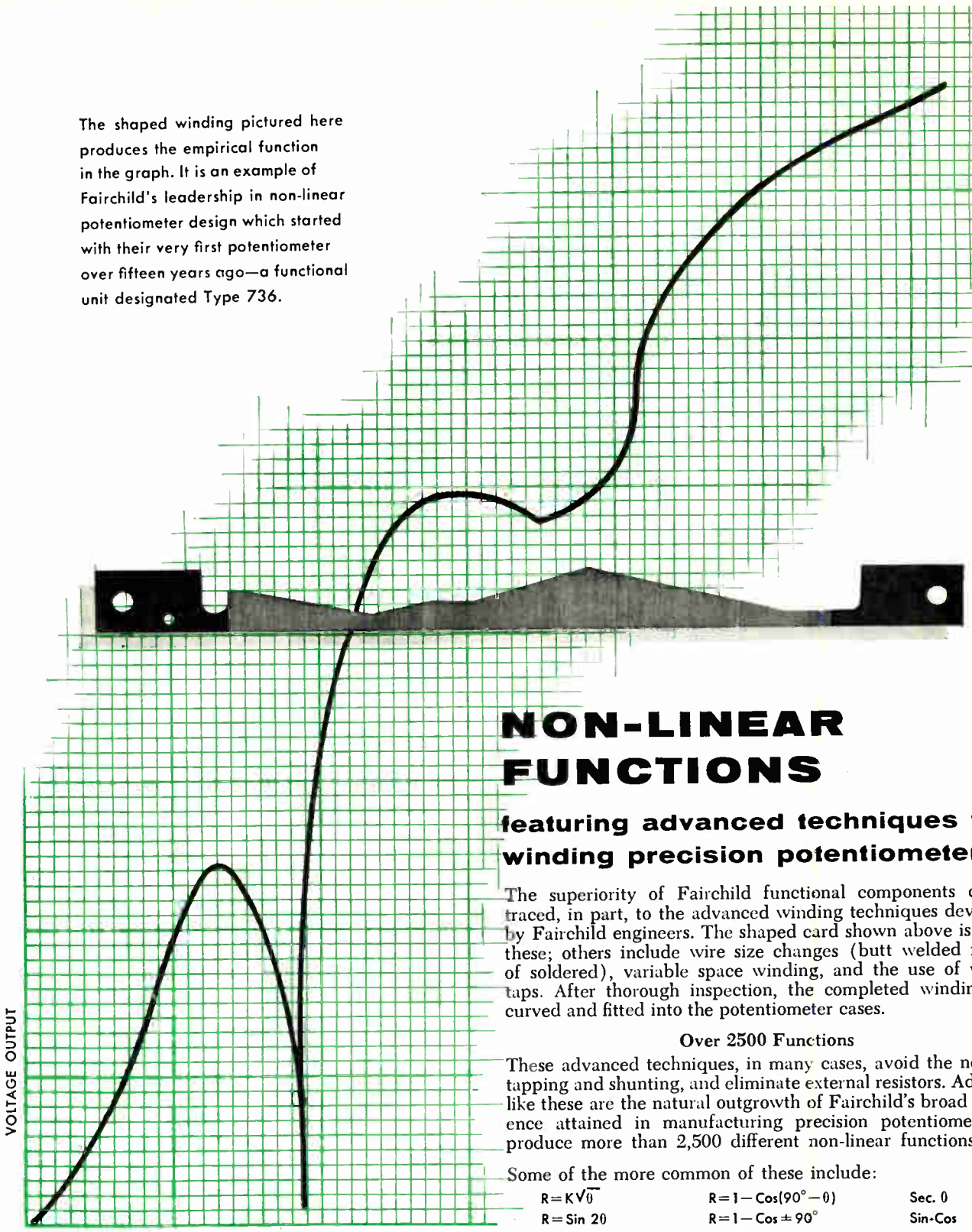
NEW DEVELOPMENTS at Bell Labs include ferrite materials which, by addition of small amounts of copper, are given improved porosity and uniformity. This results from lowered firing temperatures. Another important development is torsional wave delay lines with delay times per unit length as much as 25 times greater than those of conventional lines. The chief advantage is the small space required for a given delay. The delay lines are machined from solid brass rods, have cutoff frequencies near 50 kc.

EDUCATIONAL TV CUTS SCHOOL COSTS in Pittsburgh to such an extent that Ed-TV station WQED wants to put a second educational TV station on the air in the same area. A Channel 47 permit is requested. The proposed station would cost about $149,500, and would make possible teaching two TV classes at once. Operation of WQED has saved tax money by taking over summer school work; the station is seen as a necessary answer to the ever-growing shortage of classrooms and good teachers.

SPECIALIZATION in the electronics industry is graphically illustrated by the automatic processing and computation center just installed in General Electric's Missile and Ordnance System Department in Philadelphia, Pa. Component suppliers for the system read like a roster of the electronic industries, illustrating the degree of specialization developed during recent years. The installation will be used for processing data received from missile flight tests, and tests of missile environments and components, and scientific computations needed for advanced studies.

SECURITY CONSIDERATIONS have led to suspension of two employees of RCA Communications, Inc., for refusing to answer certain questions before the Senate Internal Security Subcommittee in Washington. In a formal statement, the company says, "If within 60 days they appear in public hearings before a Congressional Committee or other Governmental body or authority and testify fully on all questions asked them regarding alleged Communist activities and are not found to be admitted Communists, RCA Communications will reinstate them promptly without loss of seniority, service credit, or pay; otherwise they will be discharged."

The shaped winding pictured here produces the empirical function in the graph. It is an example of Fairchild's leadership in non-linear potentiometer design which started with their very first potentiometer over fifteen years ago—a functional unit designated Type 736.



NON-LINEAR FUNCTIONS

featuring advanced techniques for winding precision potentiometers

The superiority of Fairchild functional components can be traced, in part, to the advanced winding techniques developed by Fairchild engineers. The shaped card shown above is one of these; others include wire size changes (butt welded instead of soldered), variable space winding, and the use of welded taps. After thorough inspection, the completed windings are curved and fitted into the potentiometer cases.

Over 2500 Functions

These advanced techniques, in many cases, avoid the need for tapping and shunting, and eliminate external resistors. Advances like these are the natural outgrowth of Fairchild's broad experience attained in manufacturing precision potentiometers to produce more than 2,500 different non-linear functions.

Some of the more common of these include:

$R = K\sqrt{\theta}$	$R = 1 - \cos(90° - \theta)$	Sec. θ
$R = \sin 2\theta$	$R = 1 - \cos \pm 90°$	Sin-Cos
$R = K \frac{\sin^2\theta}{2}$	$\%R = \%\theta^2$	1.875 log
		2 cycle log

These functions can be provided in many standard types ranging from 7/8" to 3", as well as an infinite variety of specials. Call on this vast experience the next time you have a problem involving non-linear functions—or *any* precision potentiometer problem. Write to Dept. 140-89E, 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 8 on Inquiry Card, page 109

Electronic Industries' News Briefs

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

EAST

CLAROSTAT MFG. CO., INC., Dover, N. H., has begun construction of additional space to house and facilitate the expansion of the Plating Dept. The new construction consists of a wing added on the present Clarostat five-story building.

SCINTILLA DIV., BENDIX AVIATION CORP., has announced a $5-million plant expansion program, scheduled for completion in stages by 1961. It will add about 200,000 sq. ft. to the present 560,000 sq. ft. of plant space.

THE MARTIN CO. is the new corporate name of The Glenn L. Martin Co. The name change does not in any manner alter the identity or character of the corporation.

PAGE COMMUNICATION ENGINEERS, INC., has been awarded a $3.5-million contract for the design, procurement, installation, and test operation of a duplex multichannel ionospheric-scatter communications system linking Paris, Naples and Izmir.

DATAMATIC CORP. has begun expansion of production facilities. The firm has acquired an additional 75,000 sq. ft. of factory space to enlarge its production of its electronic "brain" systems.

TUNG-SOL ELECTRIC INC. has purchased Chatham Electronics Div., Gera Corp. It becomes a fifth separate division of Tung-Sol.

ELECTRONIC PLASTICS, INC., a new company engaged in extruding high temperature plastic insulated wire and a custom molding of electronic component parts, has been formed in Matawan, N. J. Sales office address: 521 Fifth Ave., New York 17.

SPERRY RAND CORP. has begun construction on a $2-million electronics facility for the development of advanced radar instrumentation. Over $1-million in instruments, equipment and test facilities will be installed before operations begin late this year.

DU PONT CO. will expand its production facilities for Teflon in a program which will eventually more than double capacity. The company will also build a plant to produce an experimental product, Teflon 100-X perfluorocarbon resin.

MINNEAPOLIS - HONEYWELL REGULATOR CO. will produce the "Idiot II"—Instrumentation Digital On-Line Transcriber. The equipment was designed and developed by the Rocketdyne Div. of North American Aviation Inc.

THE PRESIDENT'S COMMITTEE ON SCIENTISTS AND ENGINEERS is the new official identification of the National Committee for the Development of Scientists and Engineers. The original name had been interpreted as limiting the committee's function to educational problems.

GE'S MISSILE AND ORDNANCE SYSTEMS DEPT., which has just received a $158-million USAF contract to develop nose cones for the Atlas ICBM and the Thor IRBM, pays out more than ½ of the total dollar value to GE suppliers and sub-contractors for material and services.

AVION DIV., ACF INDUSTRIES, INC., has introduced a new and complete Magnetic Component Service which was born of necessity to meet Avion's own requirements for both standard and specially designed units.

BLONGER-TONGUE LABS, INC., has moved to a larger building at 9-25 Alling St., Newark 2, N. J. The new phone is Market 2-8151.

THE DEPT. OF DEFENSE has announced that the Navy and the Ryan Aeronautical Co. have developed an "Automatic Navigator" to meet requirements of high speed, jet-powered flight. The new instrument, APN-67, provides continuous navigational information to pilots automatically.

MID-WEST

TRIONICS CORP., a new laboratory which offers research and development services on a contract basis, has been established in Madison, Wisc.

LITTON INDUSTRIES, INC., has chosen Salt Lake City as the cite for its eleventh plant location. The Salt Lake City facility will manufacture magnetrons, klystrons, and other electronic microwave tubes.

FRANK R. COOK CO. has been awarded an order for an undisclosed number of self-activated primary batteries for "The Hustler," a detachable pod carried by Convair's supersonic B-58 strategic bomber.

OHMITE MFG. CO. has started construction of a sizable addition to its plant at Skokie, Ill. The new addition will increase manufacturing facilities by 42,000 sq. ft. The expansion is the third in 15 years for the company.

MOTOROLA COMMUNICATIONS & ELECTRONICS INC. will provide mobile 2-way radio, and fixed and portable base station equipment to nine divisions of the Ohio Highway Dept. A total of 1200 mobile, and 110 base stations will be installed.

P. R. MALLORY & CO., INC., and **RADIO MATERIALS CORP.** have agreed on a merger, or pooling of interests. R.M.C. will operate separately as a Mallory Division under the management of its present officers.

FOREIGN

FISCHER AND PORTER CO., Hatboro, Pa., has announced the signing of a license agreement with the Hokushin Electric Works of Tokyo, Japan. Hokushin will begin to manufacture substantially all of the products now manufactured by Fischer and Porter, including data reduction and automation equipment.

NUCLEAR DEVELOPMENT CORP. OF AMERICA (NDA), White Plains, N. Y., and **SOCIETE GENERALE DES MINERALS**, of Brussels, are the principal owners of **INDA EUROPE**, a new corporation formed in Brussels to provide for rapid atomic energy development in the 6 Euratom countries and their colonies, possessions, and territories.

CANADIAN NATIONAL AND CANADIAN PACIFIC TELEGRAPHS have inaugurated Telex, a new service for business communication providing instant printed conversations with other subscribing firms across Canada or around the world, 24 hours a day.

GEORGE KENT LTD., Luton, Bedfordshire, England, has introduced a new self-balancing electronic recorder, known as the Commander KE, which is interchangeable with Commander range instruments of auxiliary units (control, integrator, etc.)

WEST

GENISCO, INC., West Los Angeles test equipment and instrument manufacturer, has been awarded a contract to design and manufacture an ultra-precision centrifuge for subjecting critical inertial-type missile guidance-system components to simulated operational acceleration forces.

FISHER/BERKELEY, a new electronics firm recently formed, will be located in a 5,000 sq. ft. building at 4224 Holden St., Emeryville, Calif.

ELECTROFLOR, INC., with main engineering and sales offices in Hollywood, Calif., has been organized as a Corporation of Pennsylvania.

BENDIX COMPUTER DIV., BENDIX AVIATION CORP., the nation's fourth largest manufacturer of electronics computers, recently doubled the size of its main plant at 5630 Arbor Vitae St., Los Angeles, Calif. A feature of the new addition will be 2 Bendix G-15D General Purpose Computers and 2 Bendix DA-1 Digital Differential Analyzers to be available on a rental basis.

AEROJET-GENERAL CORP., Azusa, Calif., has changed the name of its Electronics and Guidance Div. to Avionics Div. The firm is active in infrared, guidance, and search devices. Manager of the division is J. S. Warfel.

RUTHERFORD ELECTRONICS CO. has moved its administrative offices, development laboratories, and manufacturing operations to a new 8,000 sq. ft. building at 8944 Lindblade St., Culver City, Calif.

BABCOCK RADIO ENGINEERING, INC., in opening its new and modern facility at 1640 Monrovia Ave., Costa Mesa, Calif., provides 25,000 sq. ft. of plant area for the consolidation of all the divisions of Babcock in a central location.

APPLIED RADIATION CORP. (ARCO) has recently begun manufacture of high power electron linear accelerators for processing foods, drugs, and chemicals and for nuclear research. The new facilities cost over $500,000.

PAR PRODUCTS CORP. has moved its entire facility to an attractive modern plant at 602 Colorado Ave., Santa Monica, Calif. The firm of optical engineers specializes in design and manufacture of optical data recording systems for many varied applications.

LOCKHEED'S MISSILE SYSTEMS DIV. is building a specially constructed facility for the design and testing of very advanced missile antennas and radar devices. The 10,000 sq. ft. building will be located near the bay at the division's Sunnyvale site.

INTERNATIONAL BUSINESS MACHINES CORP. installed the first model of a high speed memory storage unit which will more than double the effectiveness of the IBM 704 electronic computer on many problems at Rand Corp., Santa Monica, Calif. The expanded storage unit—"738"—was designed and developed by IBM at its laboratories in Poughkeepsie, N. Y.

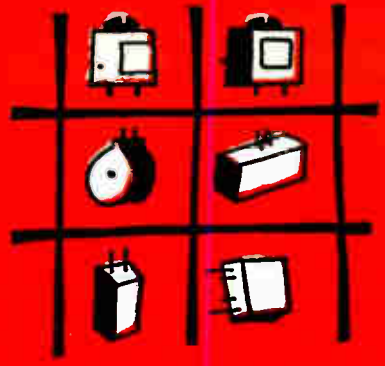
OPTICS DIV. AND INDUSTRIAL INSTRUMENTATION DIV., TEXAS INSTRUMENTS INCORPORATED, formerly Wm. I. Mann Co., and Houston Technical Laboratories, respectively, will exhibit at the WESCON show for the first time in their new roles.

HIDDEN TREASURE!

. . . the engineering skill in every component by Burnell. Burnell files contain thousands of special designs in regular and subminiature filters.

TOP OF THE LADDER . . .

Burnell products incorporate the highest standards of engineering know-how and precision manufacturing in toroids, filters and related networks.



CROSS-SECTION OF A HUGE SELECTION!

Burnell has over 8,000 filter designs in stock, including subminiature filters for aircraft and guided missiles, communications filters for receivers, and side-band filters for carriers . . . in addition to an array of other new, specialized components.

WHICH AD DO YOU LIKE BEST?

they all tell the same basic story

WANT JAM ON IT?

Burnell supplies the **extras** in service, courtesy and sheer engineering value. Your inquiries on toroids, filters and related networks will be handled promptly.

HOW ABOUT SOME ICING?

Burnell provides the "top layer" that makes all the difference. Your toroid and filter problems are solved by the most advanced engineering in the field—by Burnell.

LIKE THE GRAVY TOO?

Burnell success depends on meeting your exact needs. If the toroidal component you require is not already on our files, we will make it to your exact specifications.

BEFORE YOUR WIRES GET CROSSED . . .

. . . consult Burnell about your networks problems. Or write for technical information and catalog, without cost or obligation, with details of our toroidal components in regular down to subminiature sizes.

CREAM COSTS NO EXTRA

Depend on Burnell for toroids, filters and related networks whether you require standard components, or special, custom-designed equipment.

Burnell & Co., Inc.

PELHAM MANOR, NEW YORK, Dept. T-57
TELEPHONE: PELHAM 8-3600

PACIFIC DIVISION
720 MISSION STREET, SOUTH PASADENA, CALIF.
TELETYPE: PASADENA 7578
TELEPHONE: RYAN 1-2841

First in toroids, filters and related networks

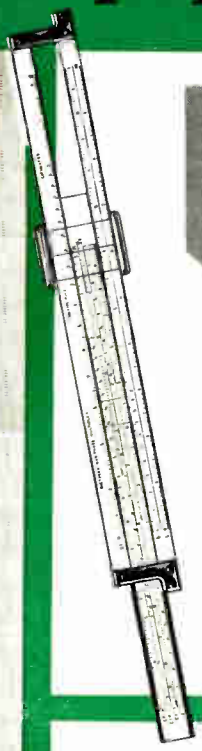
You are cordially invited to visit our booth, #3101, at the WESCON Show.

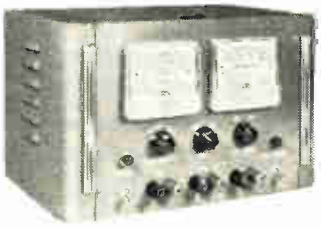
Here they are!

WESTERN GEAR answers to your electrical equipment problems...

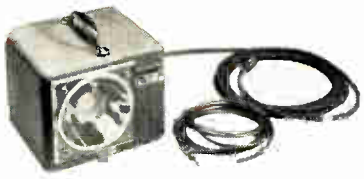
Pictured above are only a few of Western Gear's complete miniature motor line, ranging from 1/500th to 4 HP. Choose from cycle ranges of 50 to 400 at any voltage required. Furthermore, if our basic designs do not meet your particular requirements, our engineers will be glad to work with you on your rotary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

SEE US AT THE WESCON SHOW IN SAN FRANCISCO—BOOTHS 2401 and 2402



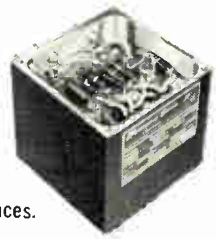


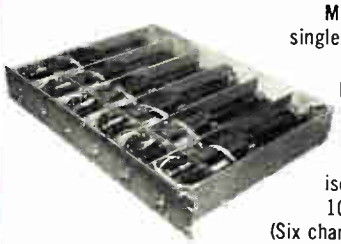
LABORATORY-TYPE POWER SUPPLY— New from Western Gear, Electro Products Division, is this lab-type, voltage-regulated power supply, available in either cabinet or rack type mounting. Input voltage is 105 to 125 volts at 50 to 60 cycles per second. Three output voltages are available . . . continuously 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.





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.

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_____

Address_____

City_____ State_____

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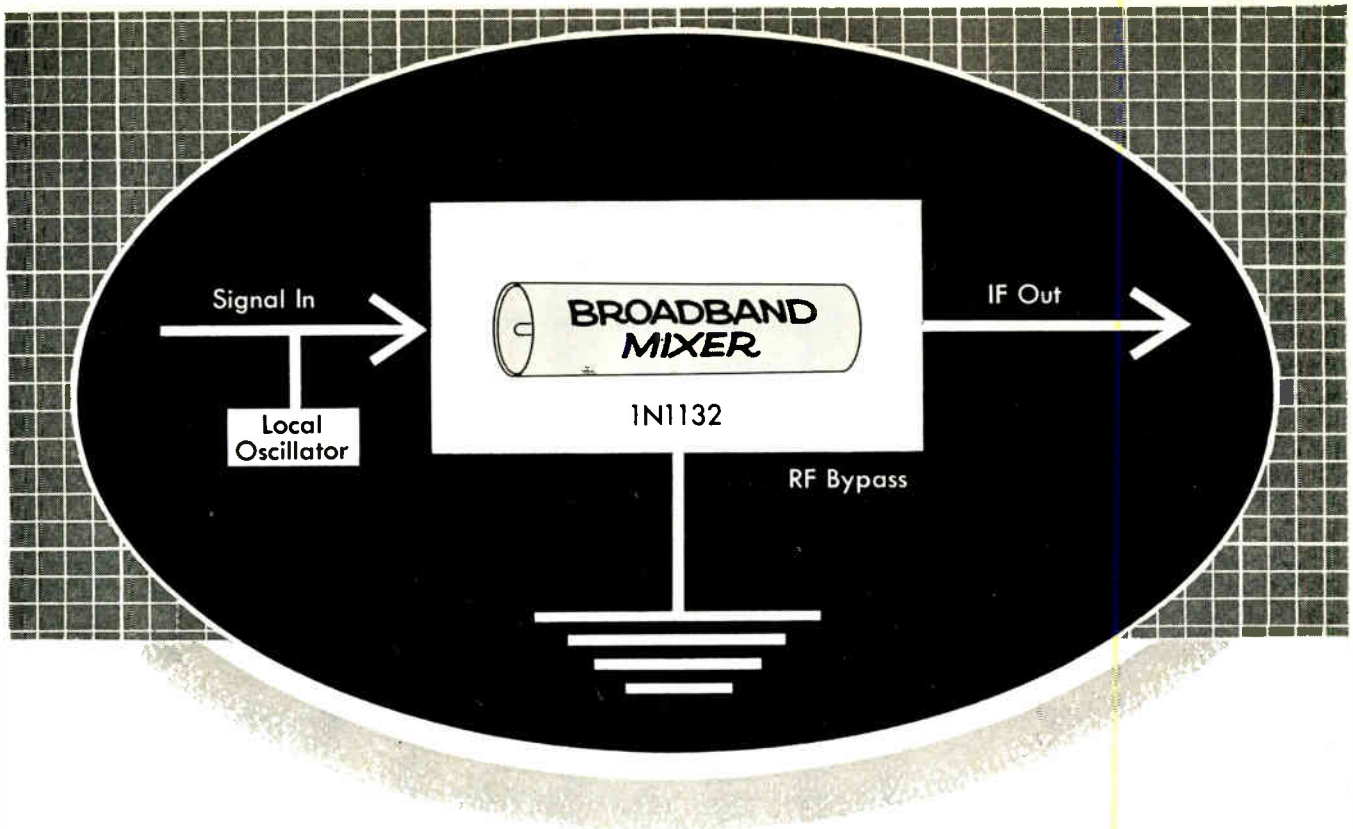


Now—in Sylvania's exclusive Tripolar Design...

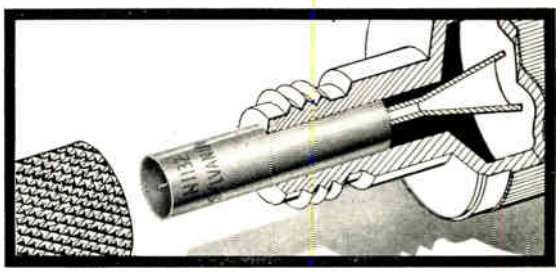
New Broadband Mixer Diode

Sylvania's new tripolar mixer crystal covers the frequency range from 3 kmc to 12.4 kmc in a single coaxial holder. The new 1N1132 matches the inherent broadband characteristics of coaxial cable for simplified front-end design.

The new broadband crystal diode which is the mixer counterpart of the low-level tripolar video detector offers these five features:

- **Input covers any frequency from S through X-band**
- **Built-in RF bypass capacitor**
- **Separate output terminal for IF eliminates RF chokes**
- **Simplified low-cost mount design**
- **Low Noise Figure over broadband**

These features of the 1N1132 contribute to simplified, more compact radar applications. Other broadband video types are available. Contact your Sylvania representative for information on the full line. Write for Sylvania's new four-page booklet covering the ratings, characteristics and applications of microwave crystal diodes.



(Specifications 25° C)

Frequency Range	3–12.4 kmc
Overall Noise Figure (max.) (1, 2)	9.5 db
IF Impedance (2)	100–200 ohms
RF Impedance (VSWR max.) (2)	2.0
Ambient Temperature	—40°C to +70°C

Note 1. Measured as follows: $NF = L\,(N_{IF} + N_r - 1)$ where $N_{IF} = 1.5$ db

Note 2. With local oscillator input of 1.0 milliwatt, d.c. bias current of 0.75 ma, dc load resistance of 100 ohms and ac load impedance of 150 ohms. A holder which provides a transition from 50-65 ohms has been designed for use with this unit.

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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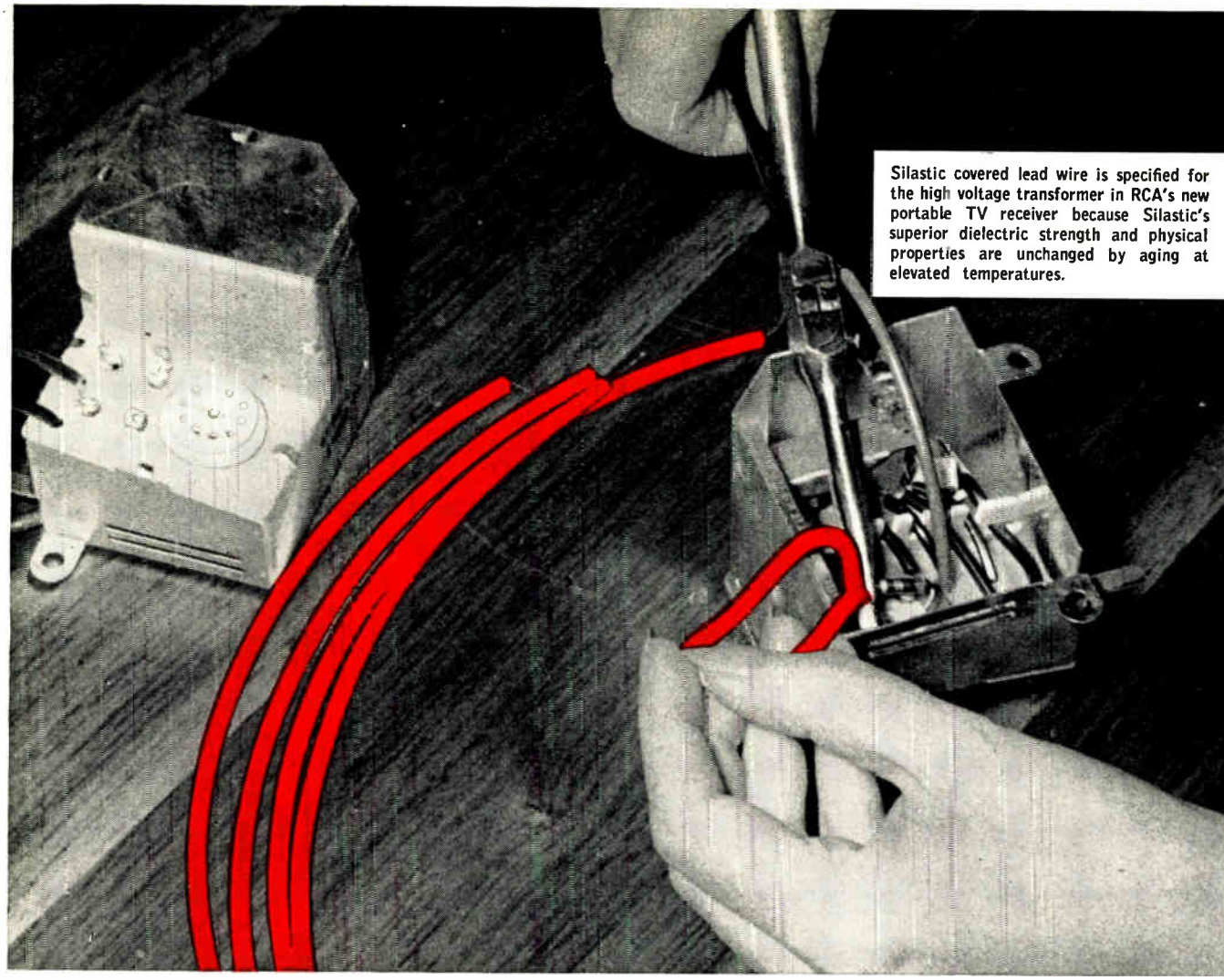

Silastic covered lead wire is specified for the high voltage transformer in RCA's new portable TV receiver because Silastic's superior dielectric strength and physical properties are unchanged by aging at elevated temperatures.

SILASTIC
SILICONE RUBBER
covered wire withstands high temperatures

Even after repeated exposure to temperatures as low as −130 F or as high as 500 F Silastic*, Dow Corning's silicone rubber, retains its flexibility, dielectric strength and resistance to ozone, weathering, moisture, certain hot oils and corrosive atmospheres. That's why Silastic, employed as a covering for all types of electric wire and cable, assures the ultimate in reliable service. Ask any leading rubber fabricator.

Get latest data on Silastic

Mail coupon today

Dow Corning Corporation, Dept. 1620
Midland, Michigan
Please send me latest data on Silastic

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*T.M.REG.U.S.PAT.OFF.

Typical Properties of Silastic for Wire and Cables

• Temperature range, °F	−130 to 500
• Tensile strength, psi	600 to 900
• Elongation, %	150 to 300
• Insulation Resistance, megohms/1000 ft.	1000 to 3000
• Dielectric strength, volts/mil	300 to 500
• Dielectric Constant, 10^2 cycles per second, nominal	3.2

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones — DOW CORNING SILICONES

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

EHF MICROWAVE GENERATORS AND SOURCES

18,000 to 50,000 mc with PLUG-IN TUNING UNITS

Now, with the Polarad plug-in interchangeable tuning unit feature you can equip your laboratory with Extremely High Frequency generators and sources covering 18,000 to 50,000 mc permitting wide flexibility of operation at minimum cost. Each of the various tuning units requires no further adjustment after plug-in — all voltages and controls are automatically set for proposed operation.

These new Polarad self-contained instruments operate simply with direct reading, wavemeter dials. They provide cw or modulated signals of known frequency for field, production line and laboratory testing of microwave equipment, components and systems.

Write to Polarad or your nearest representative for complete information.

EHF Microwave Signal GENERATORS

- 7 plug-in r-f tuning units cover the frequency range from 18,000 to 39,700 mc.
- Direct-reading calibrated attenuator output, accuracy ±2 db.
- Frequency calibration accomplished by a ±0.1% direct-reading wavemeter.
- Internal 1000 cps square-wave modulation.
- Capable of external modulation, both pulse and fm.
- Equipped with integral electronically-regulated power supplies.

EHF Microwave Signal SOURCES

- 9 plug-in r-f tuning units cover the frequency range from 18,000 to 50,000 mc.
- Internal 1000 cps square-wave modulation.
- Capable of external modulation, both pulse and fm.
- Equipped with integral electronically-regulated power supplies.
- Frequency calibration accomplished by a ±0.1% direct-reading wavemeter.

SIGNAL GENERATORS Basic Unit Model HU-2		FREQUENCY RANGE	SIGNAL SOURCES Basic Unit Model HU-1	
Plug-In Tuning Unit Model No.	Power Output Calibrated		Plug-In Tuning Unit Model No.	Power Output Average
G1822	—10 to —90 dbm	18,000 — 22,000 mc	S1822	10 mw
G2225		22,000 — 25,000 mc	S2225	10 mw
G2427		24,700 — 27,500 mc	S2427	10 mw
G2730		27,270 — 30,000 mc	S2730	10 mw
G3033		29,700 — 33,520 mc	S3033	10 mw
G3336		33,520 — 36,250 mc	S3336	9 mw
G3540		35,100 — 39,700 mc	S3540	5 mw
		37,100 — 42,600 mc	S3742	Approx. 3 mw
		41,700 — 50,000 mc	S4150	Approx. 3 mw
Model SG-1218, Signal Generator and Model SS-1218 Signal Source are available to cover the frequency range 12,400 to 17,500 mc.				

MODULATION:

Internal modulating:
Frequency ..... 1000 cps square wave.

Requirements for external pulse modulation:
Pulse repetition frequency.... 100 to 10,000 pps.
Pulse width rate..... 0.5 to 10 microseconds.
Pulse amplitude..... 10 volts peak, minimum
Pulse polarity..... Positive.

Requirements for external frequency modulation:
Waveform ..... Sawtooth or sine wave
Frequency ..... 50 to 10,000 cps.
Amplitude ..... Approx. 10 volts rms, to produce 40 mc deviation.

Reliable maintenance service throughout the country is an important part of the Polarad instrument.

The first all ceramic Klystron tube for 1600 to 6500 mc
POLARAD ZV1009

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43-20 34th Street, Long Island City 1, N. Y.

REPRESENTATIVES: Albany, Albuquerque, Atlanta, Baltimore, Boston, Chicago, Cleveland, Dayton, Denver, Englewood, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, Rochester, St. Louis, San Francisco, Schenectady, Stamford, Syracuse, Washington, D. C., Winston-Salem, Canada: Arnprior, Ontario.
Resident Representatives in Principal Foreign Cities

Tele-Tips

THE PROFESSIONAL ENGINEER is one who carries high individual responsibility; applies special skill to problems on a distinctly intellectual plane; has a motive of service beyond mere profit, and of self-expression resulting in joy and pride in his work; has self-imposed standards of excellence; and has a conscious recognition of social duty to be fulfilled—he "goes the second mile."

FOREIGN TV EXPERTS from twenty-four countries have been looking over American broadcasting under Department of State sponsorship. They are impressed and envy our equipment. We might ponder over the comment of the man from Ghana, "You have a tremendous weapon here."

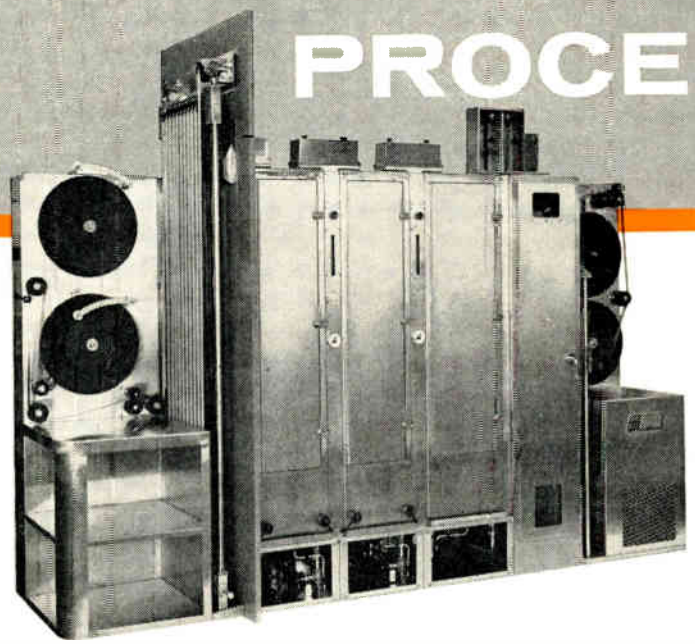
QUALITY COUNTS in the recent FCC examiner's decision to continue WNYC's broadcast hours despite interference at night with WCCO. Said the examiner, of WNYC, "No other station provides as much live music, gives as much time to American artists and composers, or presents as many new, unusual, or experimental compositions."

'LECTRONIC STENO, all brains and no body, is Stromberg-Carlson's Charactron computer readout. The Charactron, to be built for use with the Remington Rand LARC computer, will give readout recording at the rate of 15,000 characters per second.

COMPUTER SPEEDS are limited now by pulse travel times through cables sometimes as long as 100 feet. Increasing speed by 10 means cutting cable lengths within the computer to 10 feet. At MIT, they're aiming at a thousand-fold increase in speed—this means interconnections of only 0.1 feet! And they may make it at that—the new cryotron computer element can potentially be reduced to a width only a few Angstroms wide.

(*Continued on page* 26)

RAPID 16/35MM SPRAY PROCESSOR



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Dry To Dry Cycle—Less than 5 Minutes!

Most Compact Unit Available—10'4" Long!

Check these additional outstanding features:

■No changes or adjustments required for 16/35mm change-over. ■Infinitely variable speed adjustment range extending from 25 to 150 f.p.m. for negative/positive film. ■Five solution-tight, vapor-tight compartments each contain independent spray system; developer, water rinse, fix, second rinse, and wash. ■Design flexibility permits great versatility. Spray chambers may be added or removed to suit any processing procedure. ■Entire processing and drying section designed for daylight operation. Load table and accumulator in dark room. ■Ample access panels and doors provided in front and rear for threading, inspection, and maintenance. ■All stainless steel construction, highly corrosion resistant. ■Loading and take up spindles equipped with automatic/manual film locks. ■High speed jet impingement drying cabinet. ■Color coded valves, pumps, lines, inlets and outlets minimize operator error. ■Temperature control system brings solutions up to operating temperature in minutes.

For complete details send coupon for catalog Today!

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New Houston Fearless Rapid Spray Processor Catalog

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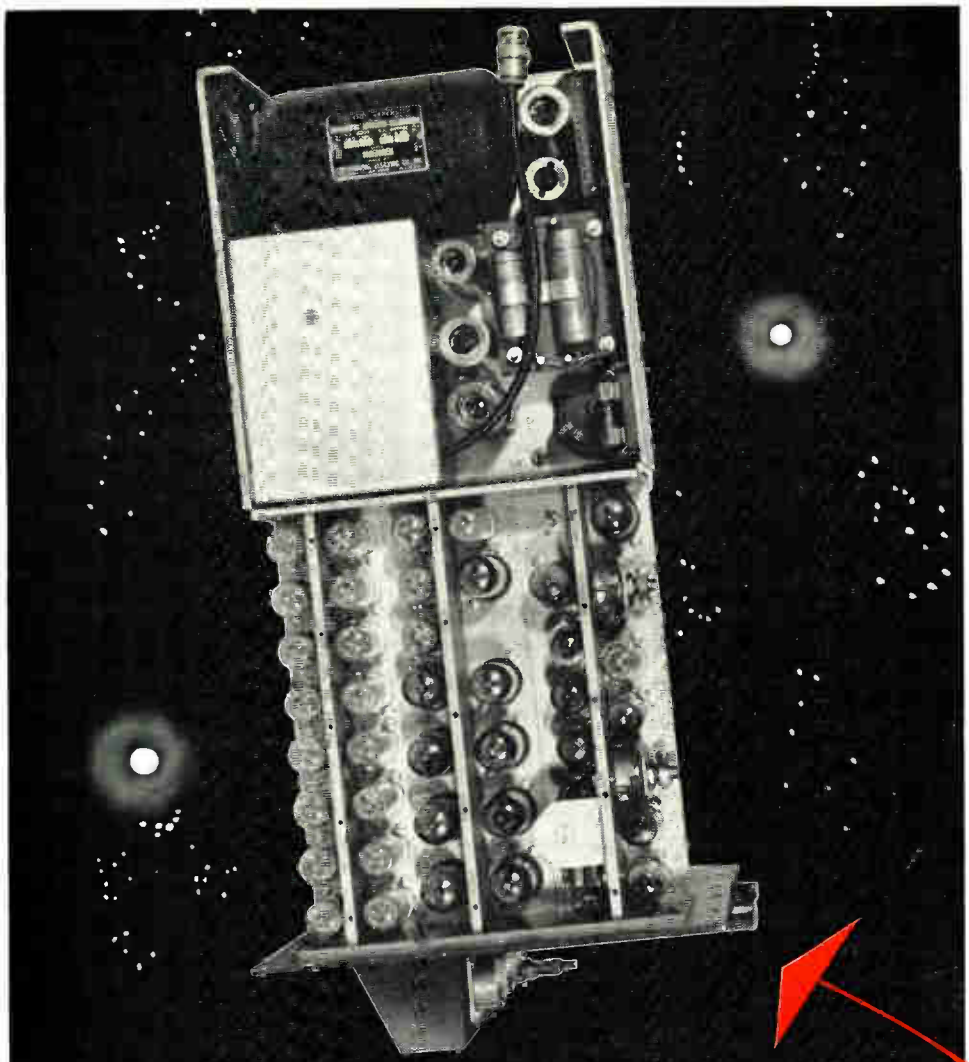
MICROFARAD METERS
FREQUENCY METERS

Certified
TRANSFER STANDARDS

Universal favorites for precision test requirements, the Weston Model 310 series represents the most complete line of *matched* portable precision test instruments available. All are true electrodynamometer type (except the frequency meter). The voltmeters, ammeters and milliammeters are rated within ¼ of 1% accuracy, full scale. Certificate with each instrument gives its individual electrical characteristics. For complete data on these instruments, including ranges, prices, etc., see your local Weston representative, or write, Weston Electrical Instrument Corporation, Newark 12, N. J.

WESTON
Portable
PRECISION INSTRUMENTS

A DAYSTROM UNIT



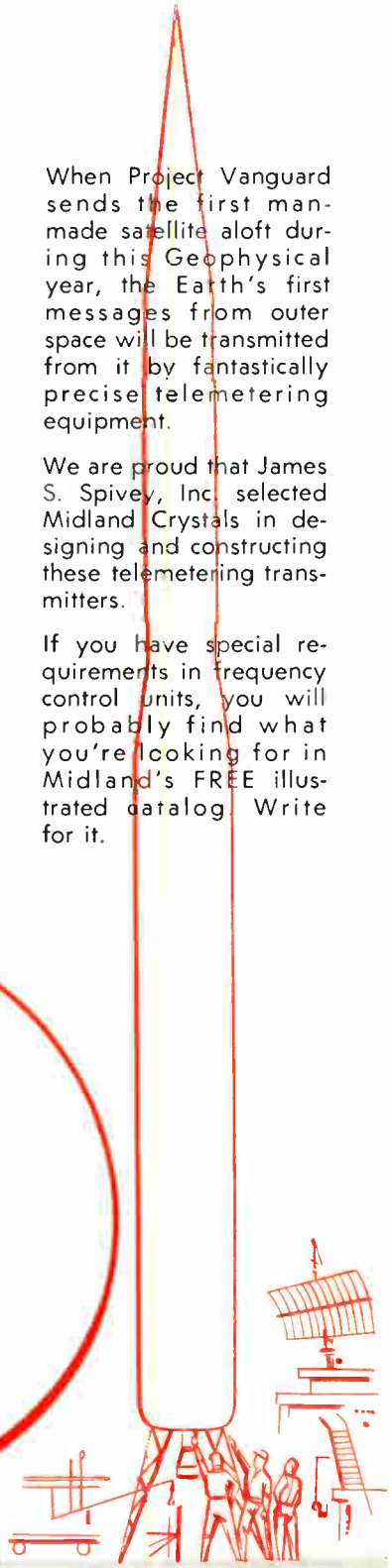
first message from outer space...

WITH FREQUENCY CONTROL
BY MIDLAND CRYSTALS

When Project Vanguard sends the first man-made satellite aloft during this Geophysical year, the Earth's first messages from outer space will be transmitted from it by fantastically precise telemetering equipment.

We are proud that James S. Spivey, Inc. selected Midland Crystals in designing and constructing these telemetering transmitters.

If you have special requirements in frequency control units, you will probably find what you're looking for in Midland's FREE illustrated catalog. Write for it.



Midland MANUFACTURING COMPANY
3155 Fiberglas Road, Kansas City, Kansas

World's Largest Producer of Quartz Crystals

Tele-Tips

(*Continued from page* 22)

LOOK MOM, NO HANDS—in fact, no driver at all is required by the automatic trains which traverse three miles of guided-tractor system at Kelly Air Force Base, San Antonio, Texas. Buried or overhead conductors guide the train, push-button remote controls direct it to twenty separate stations and control it when it stops.

MACH 1 SPEEDS aren't really so phenomenal. Men have run the mile in less than 4 minutes—and this is less than Mach 1 by a mere factor of 40.

PERPETUAL MOTION? Induce a current in a closed ring cooled to its superconductive state and what happens? A long time later the induced current is still flowing merrily around the superconductive loop. Engineering Ripleys will be interested to hear that in one large lab they are already trying to use superconductivity to create a perfect transformer—zero resistance windings and zero flux loss.

DON'T BE FOOLED by early descriptions of the Cryotron as a switch. It is that, and much more. Cryotrons can be built which will give linear control—or any other curve defining control vs controlled currents. Cryotrons can be built which will automatically quantize an input, give output in steps with smoothly increasing input. As for speed, the theoretical switching limit is in the KMC region. Some engineers see a time when computers will control automatic construction of the simple devices to meet circuitry needs within the computer.

STAR POWER won't be much of a challenge to modern power plants. Professor Lovell at Manchester University informs us the energy of all the space signals received over all the surface of the earth is only one-millionth the power required by a flashlight bulb.

Cannon Audio Connectors are standard on practically all top-ranking microphones

LESS NOISE!

Get quiet, continuous operation
Use **CANNON PLUGS**
for all modern audio equipment

You'll find exactly the type and size you need in the extensive Cannon Audio Line . . . standard of the industry . . . constantly improved and modernized.

Nine basic Series . . . with hundreds of layouts and contact variations. In cord, rack/panel/chassis, audio and low level, portable, hermetically sealed, miniature and sub-miniature, and power supply types.

Microphone connectors with the famous Cannon "Latch-Lock" feature.

More than 200 Cannon-Diamond Co-Axial types, plus accessories.

All designed to give you what you want . . . **Less Noise . . . Quiet, Continuous Operation . . . Quick Disconnect . . . Years of Service!**

Write for Audio Bulletin PO-7. For information on co-axial connectors ask for Bulletin DC-2.

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

Full information in Bulletins PO-7 and DC-2

CANNON ELECTRIC COMPANY, 3208 Humboldt Street, Los Angeles 31, California. Factories in Los Angeles, Salem, Massachusetts, Toronto, Melbourne, London. Manufacturing licensees in Paris and Tokyo. Representatives and distributors in all principal cities.

◆ RF Co-Axials

one of the most complete lines available anywhere

X, XK, XKW

for low level circuits
10-15 amp. contacts

P, O

with famous "Latch-Lock."
2—3—4—5—6—8 contacts

BRS

special sealed connectors
for extreme moisture conditions
3 or 6 contacts

UA

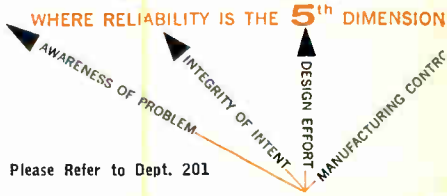
built to RETMA standard specifications.
Gold plated contacts

XLR

audio cord type.
Latest development. Modern and quiet in all respects

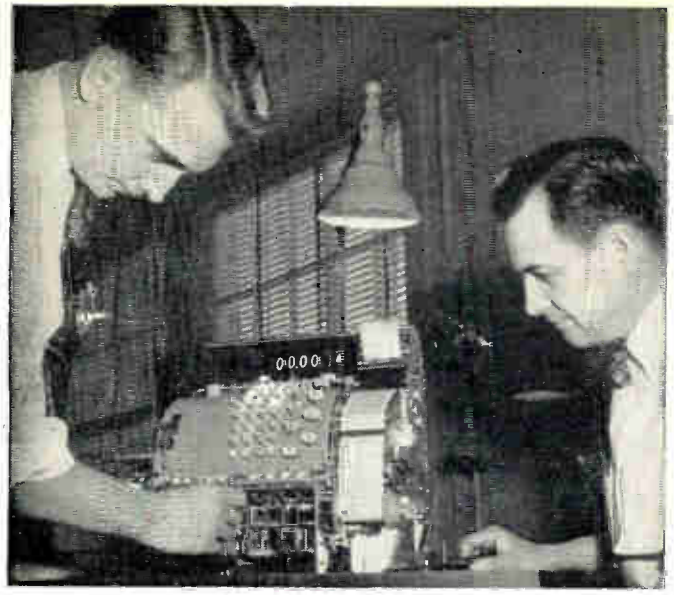
CANNON PLUGS

WHERE RELIABILITY IS THE 5th DIMENSION

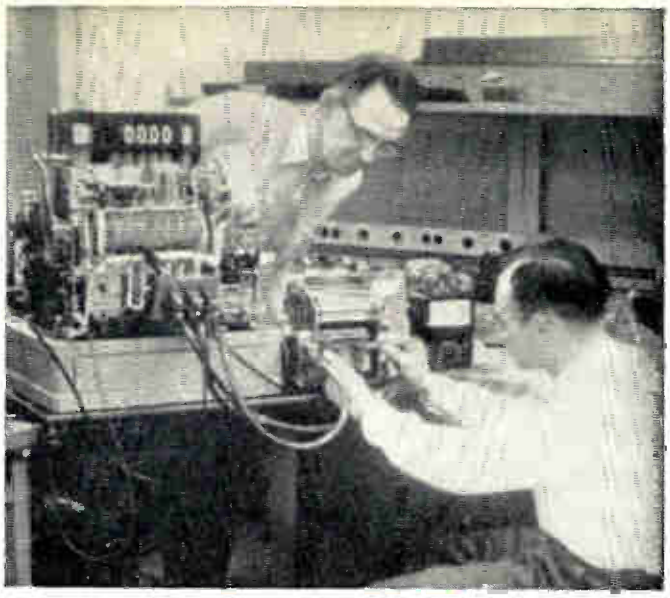


Please Refer to Dept. 201

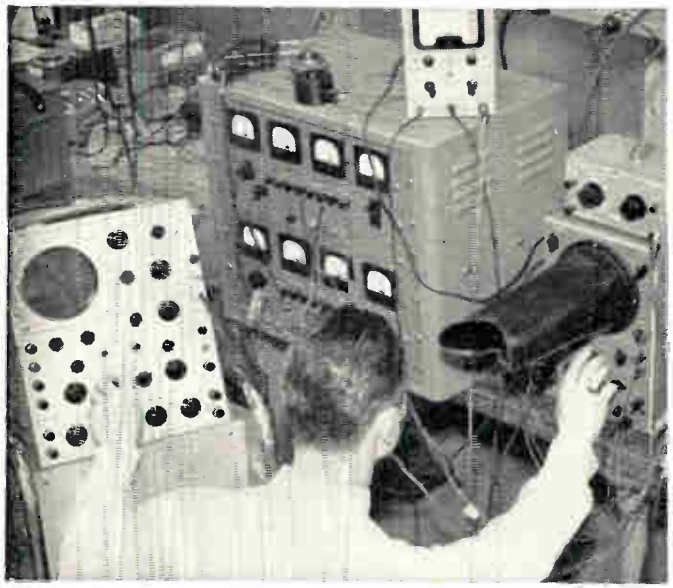
Circle 19 on Inquiry Card, page 109



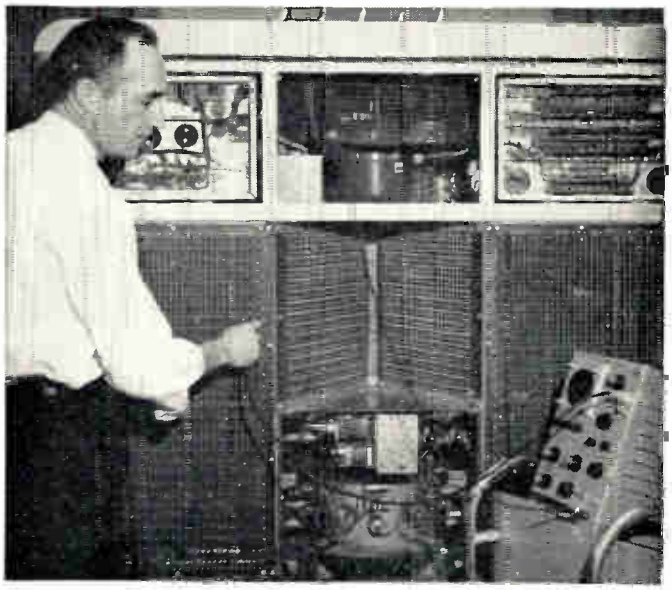
MECHANICAL ENGINEERS are using their skills in the design and development of new mechanisms required for business machines and for those mechanical products which are associated with electronic data processing equipment.



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.

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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

Books

Alcoa Aluminum Bus Conductor Handbook

Published 1957 by Aluminum Co. of America, General Offices, Alcoa Bldg., Pittsburgh 19, Pa. 269 pages.

Probably the most comprehensive handbook of its type, this work deals with the properties and uses of aluminum bus conductors.

In recent years, aluminum has been used in increasing quantities for the manufacture of bus conductors. As a result. a need has arisen for a handy reference book to help electrical engineers to determine accurately the properties and characteristics of aluminum as bus conductor material. Aluminum buses are also finding increasing use in a wide variety of manufacturing, chemical, and electrical installations.

In a personal interview with the chief editor, L. T. Guess, ELECTRONIC INDUSTRIES was informed that this book took over 5 yrs in the making. Having approached such representatives of industry as General Electric and ITE Circuit Breaker Co., the editors found that they had approximately 90% of the information that industry desired. The problem remaining was to put the material in the form desired by industry and also to come up with the additional 10% of information. Arranging the material was simple. The additional information required research and development projects which Alcoa undertook at its own expense. The data was obtained and presented in the handbook.

This handbook offers the most up-to-date information on aluminum bus conductors.

Magnetic-Amplifier Circuits, Basic Principles, Characteristics, and Applications

By William A. Geyger. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36.

Here is a practical treatment of the fundamental principles, characteristics, and applications of magnetic-amplifier circuits. It develops logically the various kinds of basic and more complex circuit arrangements, emphasizing experimentally observed phenomena and avoiding extended mathematical considerations and cumbersome proofs.

Written for the circuit designer in government, industrial, or academic research laboratories, its material has been classified according to circuit functions. Thus it enables you to prepare various circuits for accomplishing a particular function and to select the one best suited to the solution of your special problem.

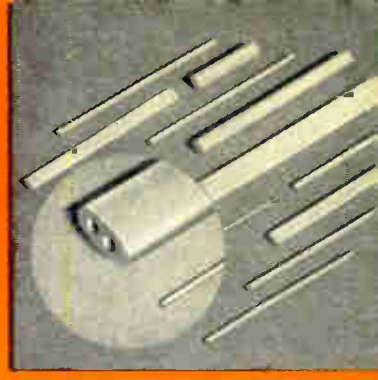
(*Continued on Page 42*)

Abrasion Resistant

Blast Nozzles. Spray Nozzles. homogeneous, long-lived. Suited most exacting uses.

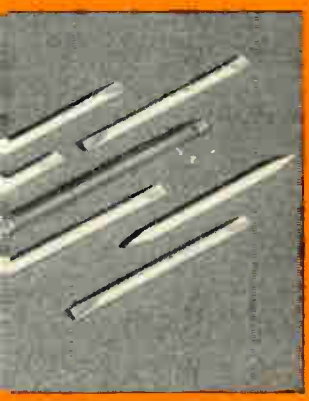
ALSiMAG®

DATA FOR DESIGNERS



Precision Tolerances

Minute, yet strong tubing of AlSiMag Alumina. Parts in inset magnified three times (smaller one .013" OD); others approximate actual size.



Non-Inductive

ent Tool Blades. Non-metallic, ısitive machine and instrument —other demanding applications.

NEW!

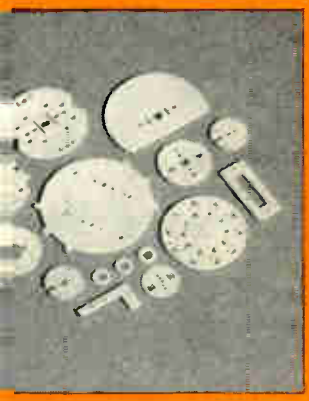
AlSiMag Alumina Ceramics open new fields for designers . . . permit designing to higher temperatures, higher frequencies, greater strengths.

Designers are generally familiar with the plus values of AlSiMag technical ceramics for standard industry applications. However, recent developments—particularly in new, high-strength, high-temperature AlSiMag Aluminas—have greatly enlarged their range of usefulness.

Do you need a material with such versatile characteristics as shown on this page? AlSimag technical ceramics have helped many designers solve problems . . . may help solve yours. Send blueprint with complete operating details for our recommendations.

Hard

AlSiMag Tool Tips for cutting and machining strongest alloy steels.



Thin . . . Strong

Tube Spacers as thin as .009" markable strength. Similar parts olve other application problems superior insulation is needed.

AMERICAN LAVA CORPORATION

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A subsidiary of Minnesota Mining and Manufacturing Company

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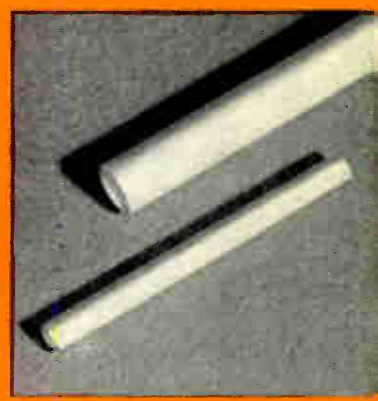
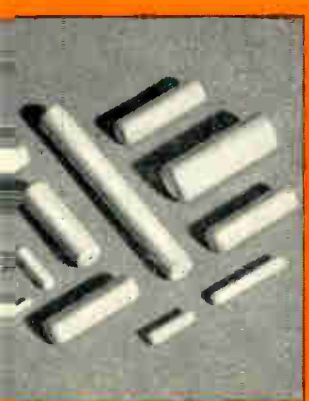


Durable

Rollers for flattening inductance wire—a new application for AlSiMag.



Precision Finishes

, easily coated AlSiMag Cores , Metal Film and Carbon De-Resistors.

Heat Resistant

Support Rings for Heat Treating Fixtures. Welding Jigs. Hold-down Jigs for heat applications.

Acid Resistant

Rotary Seals and Plungers. Extraordinary wearing qualities. Surface finishes to most exacting specifications.

FORMULA for LONG LIFE

$$I = \frac{E}{\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}} \qquad Z = \sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2} \qquad f = \frac{1}{2\pi\sqrt{LC}}$$

THE KEY COMPONENT

El-Menco Dur-Mica CAPACITORS

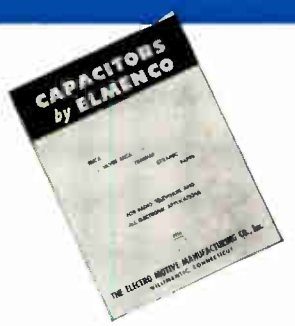
Rugged Endurance up to 18 years!

A series of the toughest trials prove El-Menco Dur-Mica DM15, DM20 and DM30 capacitors outlast all others under accelerated conditions of 1½ times rated voltage at ambient temperature of 125° centigrade. Can be used at higher operating temperatures with slight voltage derating. Longer life and greater stability made possible by specially treated phenolic casing.

ACTUAL SIZE

DM 42
Up to 45,000 mmf at 300 WVDC
Up to 40,000 mmf at 500 WVDC

El-Menco Dur-Mica Capacitors meet all humidity, temperature and electronic requirements, including military specifications.



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

El-Menco Dur-Mica DM15, DM20, DM30, DM40 and DM42 Capacitors Provide:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY — SILVERED MICA
5. PEAK PERFORMANCE

Take Your Own Word For It by making your own test of El-Menco Capacitors. Write for Free Samples and Catalog.

WITH NEW CRIMPED LEADS.

Improved parallel leads for greater rigidity and faster assembly. These parallel leads simplify use on miniature printed circuit boards in television, guided missiles, hearing aids, electronic brains, air conditioning and other government and civilian applications.

El-Menco Capacitors

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

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CONNECTICUT • mica trimmer
• tubular paper • ceramic • silvered mica films.

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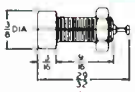
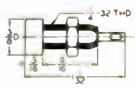
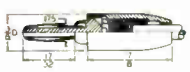
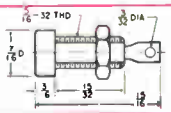
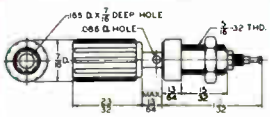
UNITS SHOWN ACTUAL SIZE

a complete line of nylon jacks, binding posts, and solderless plugs!

more for your connector dollar!

- Shock-proof nylon construction—won't chip or crack with the hardest usage.
- Provides high voltage insulation—voltage breakdowns up to 12,500 volts DC.
- Highly resistant to extremes of heat, cold, and moisture.
- Plugs designed for simplified, solderless connection of up to 16 gauge stranded wire.
- Available in 13 bright colors for coded applications. (See chart below.)
- Economical—simple, functional engineering design gives you top quality at low cost.

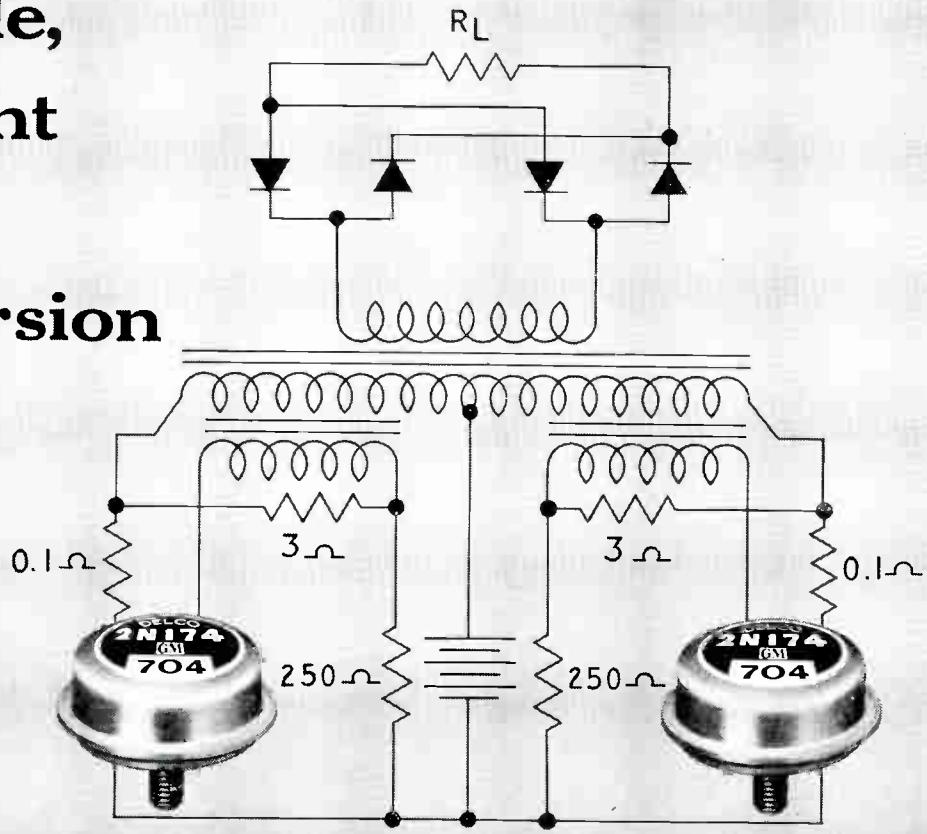
CONNECTOR TYPE	DIMENSIONS	DESCRIPTION
 105-301 to -313		**NYLON TIP PLUG** (Patent Pending) Completely insulated, sleeve is molded of tough nylon and will not chip or crack even when subjected to extreme temperature changes. Recessed metal head prevents exposure of metal surfaces when engaged in any standard tip jack. Current rating: 10 amps. Metal parts are nickel-plated brass. Designed for solderless connection of up to 16 gauge stranded wire.
 105-601 to -613		**NYLON TIP JACK** (U.S. Pat. No. 2,704,357) Completely insulated nylon body with machined beryllium copper contact. Current rating: 10 amps. Voltage breakdown: 11,000 volts DC. Capacity to 1/8" panel: 2.0 mmf. Contact is silver-plated—recessed in head. Solder terminal is hot tin dipped. Single 1/4"-32 nut furnished for mounting—no auxiliary mounting hardware needed. Mounts in 17/64" dia. hole.
 105-701 to -713		**NYLON JACK AND SLEEVE** (Jack—U.S. Pat. No. 2,704,357) Complete assembly includes a standard nylon tip jack less mounting nut with an inside threaded, molded nylon insulating sleeve. Ideal for patch cords, this assembly is also excellent for panel mounting where an insulated rear connection of a panel mounted tip jack is desired.
 105-801 to -813		**NYLON TIP JACK** New low cost insulated tip jack. Body molded of tough, low-loss nylon. Formed silver-plated phosphor bronze contact. Current rating: 10 amps. Voltage breakdown: 9,000 volts DC. Capacity to 1/8" panel: 2.0 mmf. Single 1/4"-32 nut furnished for mounting—no auxiliary mounting hardware needed. Mounts in 17/64" dia. hole or double flat hole.
 108-301 to -313		**NYLON BANANA PLUG** (Patent Pending) Compact, high voltage insulated plug for a wide variety of applications. Current rating: 10 amps. Easy solderless connection of up to 16 gauge stranded wire. Nylon insulating sleeve retains strength and low-loss characteristics over a wide range of temperatures. Body and pin are of one-piece nickel-plated brass with high grade nickel-silver springs.
 108-901 to -913		**NYLON BANANA JACK** Completely insulated, molded nylon body. Current rating: 10 amps. Voltage breakdown: 12,500 volts DC. Capacity to 1/16" panel: 1.5 mmf. Insert is cadmium-plated. Accommodates banana plugs of a nominal diameter of .175". Single 5/16"-32 nut furnished for mounting—no auxiliary mounting hardware needed. Mounts in 21/64" dia. hole.
 111-101 to -113		**NYLON BINDING POST** (Patent Pending) Compact, completely insulated, pre-assembled 6-way binding post. Molded nylon body. Shank is silver-plated brass—thumb nut is self-captivated and cannot be removed. Insulation resistance greater than 200 meg. after MIL-T-54228 humidity test. Voltage breakdown: 8,000 volts DC. Current carrying capacity: 15 amps. Capacity to 1/8" panel: 3.3 mmf. Single 5/16"-32 nut furnished for mounting—no auxiliary mounting hardware needed. Mounts in 21/64" dia. hole, "D" hole, or double-flat hole.

COLOR CODING BY CATALOG NUMBER All nylon connectors are available in the colors indicated at right. Catalog numbers ending in 1 (for example 105-301) indicate white; 2—red; 3—black; 4—dark green; 5—light blue; 6—orange; 7—yellow; 8—brown; 9—light green; 10—dark blue; 11—ivory; 12—violet; 13—grey.

other connectors: Johnson also manufactures a complete line of standard connectors in addition to the nylon line illustrated above. For complete information on these as well as other quality Johnson electronic components write for your free copy of our current component catalog.

E. F. Johnson Company
116 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

Reliable, Efficient DC Conversion



Industry's Highest Power Transistors

Low saturation voltage of Delco Radio 2N173 and 2N174 opens new opportunities for converter economy, efficiency and reliability

The excellent electrical characteristics of Delco High Power transistors permit the conversion of *low* DC voltage to *higher* DC voltage—with a high degree of efficiency—in a wide range of applications. This proved performance offers greater reliability than will be found in corresponding vibrator circuits.

The low saturation voltage of Delco 2N173 and 2N174 transistors also reduces their internal power dissipation in conversion applications to an insignificant degree so that little self-heating is apparent. The result is an overall economy which permits converters of smaller size . . . important in many applications.

TYPICAL CHARACTERISTICS

	2N173	2N174
Properties (25 C)	12 Volts	28 Volts
Maximum current	12	12
Maximum collector voltage	60	80
Saturation voltage (12 amp.)	0.7	0.7
Power gain (Class A, 10 watts)	38	38
Alpha cutoff frequency	0.4	0.4
Power dissipation	55	55
Thermal gradient from junction to mounting base	1.2°	1.2°
Distortion (Class A, 10 watts)	5%	5%

DELCO RADIO DIVISION OF GENERAL MOTORS KOKOMO, INDIANA

Circle 26 on Inquiry Card, page 109

FOR ELECTRONICS...
a new order of
chemical purity...

HF M. W. 20.01

Meets A.C.S. Specifications

Assay (HF)	49.00±0.25%

Maximum Limits of Impurities

Fluosilicic Acid (H_2SiF_6)	0.05 %
Residue after Ignition	0.001 %
Chloride (Cl)	0.0005 %
Phosphate (PO_4)	0.0003 %
Sulfate (SO_4)	0.0005 %
Sulfite (SO_3)	0.001 %
Arsenic (As)	0.000005%
Copper (Cu)	0.00005 %
Heavy Metals (as Pb)	0.0001 %
Iron (Fe)	0.0001 %
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):

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Barium Acetate
Barium Nitrate
Calcium Nitrate, Tetrahydrate
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	SIZE 8	SIZE 10	SIZE 11	SIZE 15	SIZE 18
Oster Type	8-5001-00	10-5052-00	11-5101-00	15-5153-00	18-5201-00
Electrical Characteristics:					
Frequency (cps)	400	400	400	400	400
Torque at Stall (oz. in.)	.15	.30	.63	1.45	2.35
No Load Speed (rpm)	6500	6500	6500	5200	5200
Speed at Half Torque (rpm)	4000	4000	4000	3200	3200
Time Constant (sec.)	0.03	0.015	0.016	0.017	0.013
Reversing Time (sec.)	0.051	0.025	0.028	0.030	0.022
Theo. Acceleration at Stall (rad/sec²)	22500	45000	41500	31000	40000
Operating Temp. Range (°C.)	−54 to +125	−54 to +125	−54 to +125	−54 to +125	−54 to +125
Slot Effect	1.6v/26v	1.0v/36v	1.0v/40v	1.0v/40v	1.0v/40v
Duty Cycle	Cont.	Cont.	Cont.	Cont.	Cont.
Fixed Phase					
Voltage	26	115	115	115	115
R (Stall) Ohms	196	1270	1250	490	280
X (Stall) Ohms	183	1560	1780	890	610
Z (Stall) Ohms	268	2210	2175	1030	640
P.F. (Stall)	0.73	0.57	0.58	0.49	0.45
Effective R (Stall) Ohms	366	3840	3800	2160	1466
Parallel Tuning cond. for unity P.F. (Stall) Mfd.	1.0	0.13	0.15	0.33	0.55
Control Phase					
Voltage	40/20	40/20	40/20	40/20	40/20
*R (Stall) Ohms	480	124	145	58	39
*X (Stall) Ohms	445	215	204	103	77
*Z (Stall) Ohms	660	248	250	118	86
*P.F. (Stall)	0.73	0.50	0.58	0.49	0.45
*Effective R (Stall) Ohms	910	495	430	240	190
*Parallel Tuning cond. for unity P.F. (Stall) Mfd.	0.4	1.4	1.3	2.9	4.1
Mechanical Characteristics:					
Rotor Inertia (gm. cm²)	.47	.47	1.07	3.3	4.0
Weight (oz.)	1.2	2	4.5	8	14
Mounting Type	Synchro	Synchro	Synchro	Synchro	Synchro
Motor Length	.863	.672	1.703	1.625	2.03
Type Shaft	Pinion	Pinion	Plain	Plain	Plain
Shaft Extension	.375	.218	.437	.540	.540
Outside Diameter	.750	.937	1.062	1.437	1.750
Type Connection	Leads	Terminals	Terminals	Terminals	Terminals

*For 40v connection

Size 8

Size 10

Size 11

Size 15

Size 18

This complete line can be varied by Oster specialists to your precise requirement. Write today for further information, enclosing detailed data on your needs.

Other products include motor-gear-trains, synchros, AC drive motors, DC motors, servo mechanism assemblies, motor tachs, servo torque units, reference and tachometer generators, actuators, motor driven blower and fan assemblies and fast response resolvers.

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Your Rotating Equipment Specialist
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Engineers For Advanced Projects:
Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Zelazo, Director of Research, in confidence.

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ALECTRA *line . . .*

portable test instruments

. . . with laboratory precision

ALL-TRANSISTOR CIRCUITRY ON PRINTED WIRING

Now, for the first time, you can order precision instruments from a *complete, lightweight line* of miniaturized units of identical size. Salient features are battery operation, transistor circuitry, printed wiring. Rubber feet and collapsible leather handles guarantee easy, practical stacking. Also readily adaptable to standard rack mounting, these units assure instant stable operation with no warm-up time. *Contact your CEC field office, or write* today for Bulletin CEC 7000-X3.

MODEL 10A, A-C ELECTRONIC VOLTMETER
Self-contained battery power. All-transistor circuitry on printed wiring. Unique sensitivity and stability are ideal for field or bench testing of modern communication and data-handling equipment. Measures voltages from 1 mv full-scale to 300 volts full-scale. Frequency range from 20 cycles to 500 kilocycles. Size 6"x8"x6¼"; weighs only 5 lbs. Trouble-free operation. Competitively priced.

MODEL 25A
TEST OSCILLATOR (TELECOMMUNICATIONS)
8 preset frequencies (pushbutton)
Balanced output—600 ohms impedance

MODEL 15A
MULTI-RANGE A-C VOLTMETER
Balanced input—30 cps to 300 kc
1 mv to 300 v full-scale

MODEL 14A, TRUE-RMS A-C VOLTMETER
0.5 mv full-scale
Response: 10 cps to 500 kc

MODEL 20A
TEST OSCILLATOR
15 cps to 150 kc
0.5-ohm output impedance

MODEL 21A
TEST OSCILLATOR (PUSHBUTTON)
8 preset frequencies
15 cps to 150 kc

MODEL 11A, DBM/DBA METER
For bridging 600-ohm circuits
Balanced input—50 cps to 25 kc

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CARRIER FREQUENCY ATTENUATORS
0.2 db accuracy, d-c to 600 kc
1-db steps to 82 db

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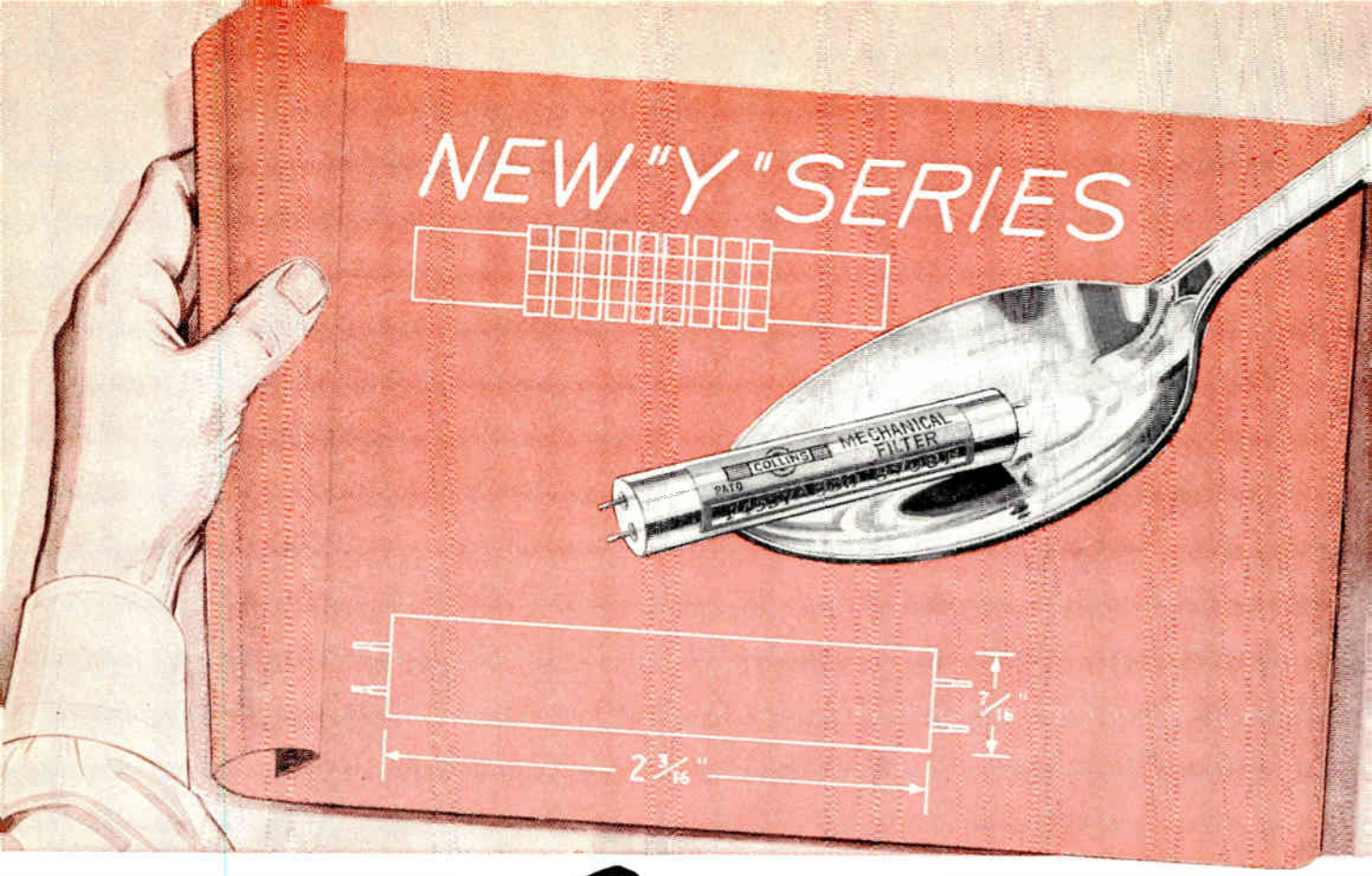
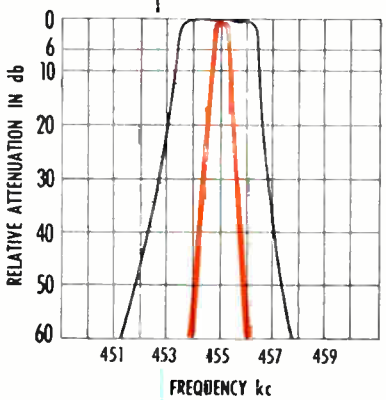


Collins MECHANICAL FILTER MINIATURIZED



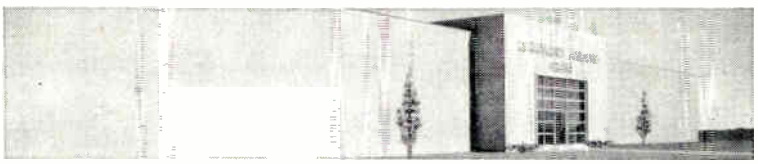
Receiver design engineers—are you having a feeding problem with your *"new baby"*? You no longer have to *spoon-feed* your I. F. problems. Use the just-announced Collins "Y" series filter. Its response characteristics are identical to the previous styles of Collins mechanical filters (the older models are still available from stock, of course, in series "A"—"Z"—"F"—"H"—"J" and "K").

Note the "Y" series advantages . . .

1. Smaller size!
2. Standard performance!
3. Lowest priced mechanical filters yet!
4. Ideal for transistorized printed circuit applications!
5. From stock! Center frequencies of 455kc and 6db bandwidths of 2.1kc (F455Y-21), 3.1kc (F455Y-31), 4.0kc (F455Y-40), 6.0kc (F455Y-60), 8.0kc (F455Y-80), 12.0kc (F455Y-120), 16.0kc (F455Y-160), and 35.0kc (F455Y-350). Other bandwidths available soon.
6. Tooled for quantity production!

Sample orders:
Quantities of 1 to 4,
through F455Y-60—$30.00 ea.

Technical data sheets are available.



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A Subsidiary of Collins Radio Company

A reel masterpiece

Audiotape on the new C-Slot reel provides easiest threading and finest reproduction

Just drop the tape into the slot and *start your recorder;* that's all there is to it!

With Audiotape's amazing new C-Slot reel, the tape-end anchors itself automatically. There's no need to keep one finger on the tape and turn the reel by hand. No more loose ends of tape to stick up and break off.

In addition, the C-Slot reel provides the ultimate in strong, non-warping construction. And, it eliminates wear and tear on the tape. Through the use of the most modern molding techniques, all sharp edges have been eliminated — including those on the inner surface where so much tape abrasion takes place on ordinary reels.

Ask your dealer for a demonstration of the C-Slot reel. It's now standard on all 7-inch reels of Audiotape, *at no extra cost.* At the same time, listen to Audiotape's superb quality of sound reproduction. It's the finest magnetic recording tape made today.

You can't get a better combination than Audiotape on the C-Slot reel.

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Inside these New Mallory Vibrators...

New performance for your power supply

New advances in contact design—based on more than a quarter century of Mallory pioneering in the vibrator field—give today's Mallory vibrators even better performance than ever.

Count on these new Mallory models for up to 100% longer life... for faster starts... for extremely low mechanical hum ... for greater consistency of output throughout their life. Arcing, erosion, contact transfer and variations in spacing have been greatly reduced. Heat dissipation is higher.

A complete series of models, incorporating new ideas in contact technology, covers practically any vibrator power supply requirements you may have for new equipment on your drawing boards. Check the table shown here, and call a Mallory vibrator specialist for a consultation on your application.

	Series	Description	Applications
Interrupter types	1600	light to medium duty, shunt drive	automotive, electronics
	1500	medium to heavy duty, separate drive	communications, electronics
	1700	heavy duty, separate drive, split reed	cammunications, electronics
	1750	heavy duty, separate drive, duplex operatian	communications, electronics
Self-rectifying types	1800	nominal duty, shunt drive	electronic equipment—for high efficiency, small space
	1850	nominal duty, separate drive	

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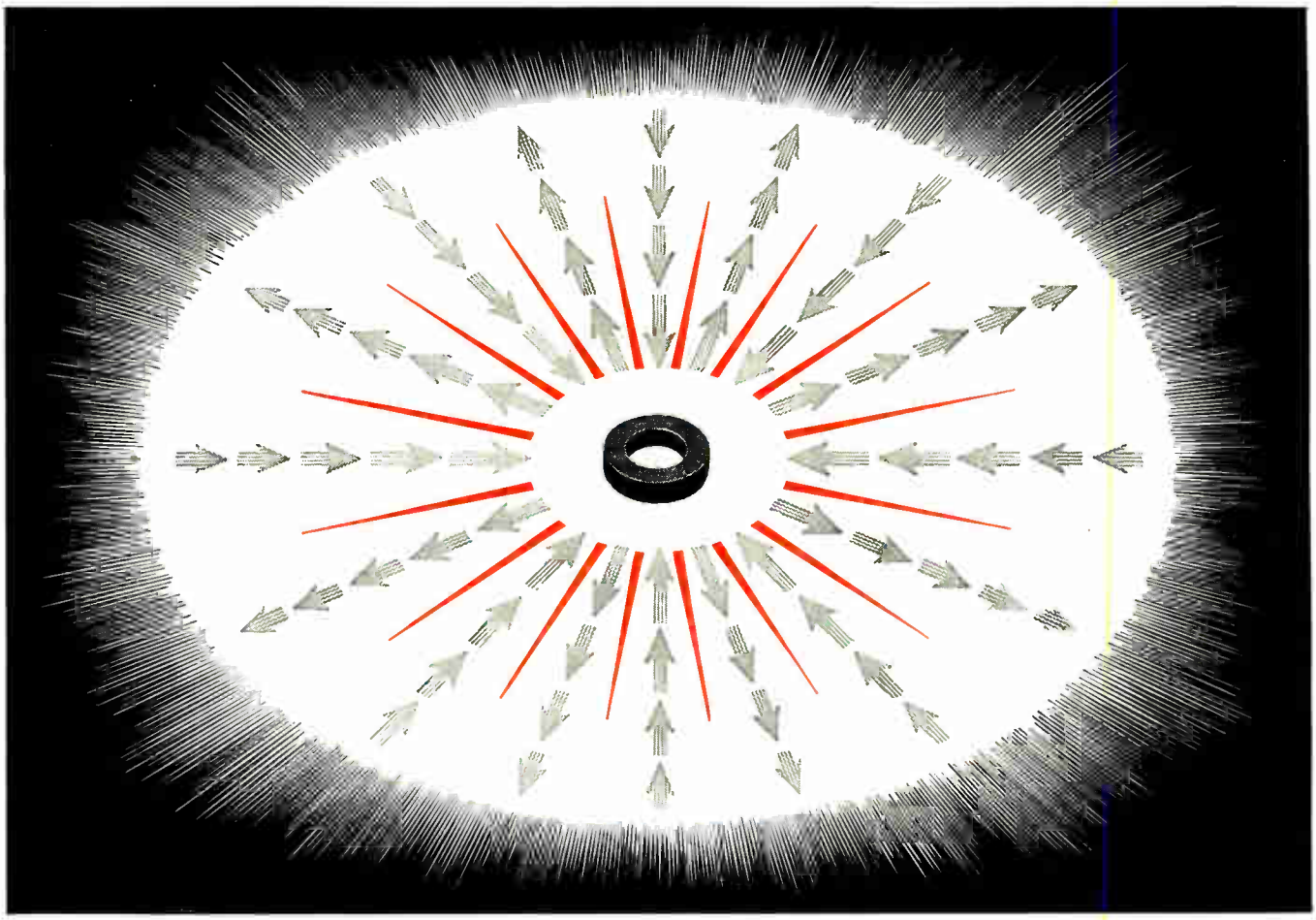
Transistorization of computers now a reality!



NEW...RCA 222M2 FERRITE MEMORY CORE

FASTER turnover time . . . HIGHER output signal . . . LOWER drive requirements

Faster turnover . . . higher output . . . all of this with an .080" O.D. core which operates with driving currents in the range of 300-500 milliamperes!

The RCA 222M2 is comparable to high drive cores in its ability to withstand large disturbing current pulses without reversing its flux state.

Write today for technical data and availability information on samples.

RCA TRANSFLUXORS . . . a developmental memory device utilizing a ferrite core with two apertures and exhibiting a nearly rectangular hysteresis loop. It can control the transmission of ac power according to a level established by a single setting pulse and furnishes an output determined by the stored pulse for *an indefinite length of time*. Once set, the TRANSFLUXOR does not require an input command to furnish output intelligence.

RADIO CORPORATION of AMERICA

COMPONENTS DIVISION — CAMDEN, N. J.

Books

(*Continued from page* 30)

On Human Communication

By Colin Cherry. Published 1957 by the Technology Press, Massachusetts Institute of Technology and John Wiley Sons, Inc., 440 Fourth Ave., New York 16. 333 pages, xiv pages. Price $6.75.

This work is a volume in an informal series, Studies in Communication, which will survey the general field of communication from various points of view including those of the anthropologist, the linguist, the logician, the telecommunication engineer, and the social psychologist, among others.

The work is intended as a review, a survey, and a criticism—nothing more.

An Encyclopaedia of the Iron and Steel Industry

By A. K. Osborne, A. MET. Published 1956 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 558 pages, xii pages. Price $25.00.

The book is intended as a work of reference, not in any sense a text book; but the specialist might usefully look to it for information on subjects bordering his own. In particular, it is the authors hope that the book will prove of value to those smaller firms in the iron and steel and engineering industries which have not yet attained sufficient size to warrant maintaining a library of their own.

Books Received

Servicing TV AFC Systems

By John Russell, Jr. Published 1956 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 119 pages, vii pages, paper bound. Price $2.70.

Radio Servicing Pocketbook

Edited by E. Molloy and J. P. Hawker. Published 1955 by George Newnes Ltd., Tower House, South Hampton St., Strand, London, W.C. 2. 212 pages, x pages. Price 10S. 60.

How to Use a Tape Recorder

By Dick Hodgson and H. Jay Bullen. Published 1957 by Hastings House, Publishers, New York 22. 216 pages, xii pages. Price $4.95.

Science and Engineering in American Industry

Published 1956 by the National Science Foundation. 119 pages, vii pages, paper bound. For sale by the Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C. Price $.70.

A final report on a 1953-1954 survey.

Part I. Research and development costs and personnel.

Part II. Factors affecting company expenditures for research and development.

Proceedings of the Second Retma Conference on Reliable Electrical Connections

Published 1957 by Engineering Publishers, GPO Box 1151, New York 1. 103 pages, paper bound. Price $5.00.

Having your ups and downs?

. . . if they involve Deposited Carbon Resistors

DALOHM has the answer!

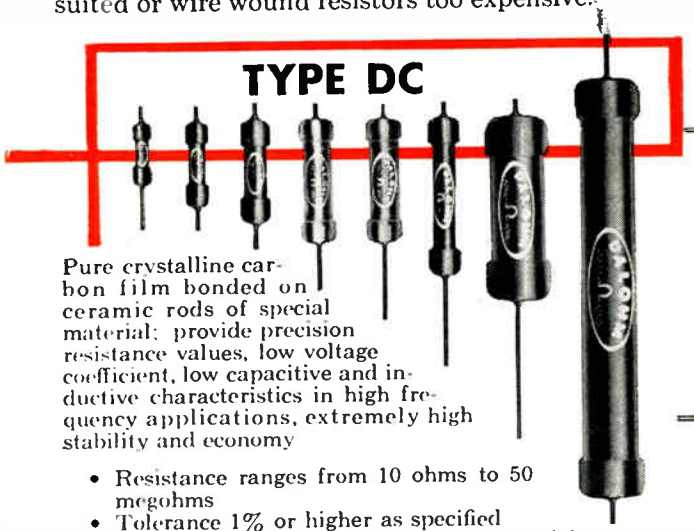
All Dalohm products are carefully designed and skillfully made to assure you of supreme quality and dependability, plus the widest versatility of application.

Outstanding examples of the Dalohm line are these deposited carbon resistors, made for accurate performance where carbon composition resistors are not suited or wire wound resistors too expensive.

You Can Depend On

DALOHM Ω ®

TYPE DC



Pure crystalline carbon film bonded on ceramic rods of special material; provide precision resistance values, low voltage coefficient, low capacitive and inductive characteristics in high frequency applications, extremely high stability and economy

- Resistance ranges from 10 ohms to 50 megohms
- Tolerance 1% or higher as specified
- Five wattages—⅛, ¼, ½, 1 and 2; eight physical sizes

Write for Bulletin R-24A

TYPE DCH

Essentially the same as type DC except hermetically sealed in a non-hydroscopic ceramic envelope to provide absolute protection against thermal shock, salt water immersion and humidity.

Write for Bulletin R-27A

TYPE DC-5

For extremely high resistance where maximum stability is a prime factor in high voltage applications. Powered at 5 watts; high voltage up to 20,000 VDC; resistance range 1 megohm to 200 megohms; tolerance 1% or up to 10% on request.

Write for Bulletin R-28

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Circle 35 on Inquiry Card, page 109

. . . SENDUST POWDER CORES

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- **Cores for filter coils**
- **Transformer cores for voice and carrier frequencies**

Write for a copy of the Sendust Core Bulletin SDC-110, containing data on standard core sizes, electrical and magnetic properties, standard permeabilities, etc.

ADDRESS DEPT. T-78

Arnold sells SENDUST Powder Cores in this country under exclusive license from The Tohoku Metal Industries Co., Ltd., of Japan. They are available in a wide selection of sizes, ranging from .800" O.D. to 3.346" O.D.—and in permeabilities of 10, 13, 25, 30, 50 and 80, although not all sizes are available in all permeabilities.

SENDUST cores possess magnetic properties that are generally superior to iron powder cores, but inferior to Mo-Permalloy powder cores in the audio and carrier frequency range. The eddy current loss for SENDUST cores is lower than that of Mo-Permalloy powder cores, but the hysteresis loss of SENDUST cores is substantially higher, and they also have higher values of electrical resistivity. In other characteristics of powder cores, the two types are somewhat similar, but SENDUST cores contain *no scarce or strategic materials and can offer a core source in times of alloy shortage.*

Sample SENDUST cores as well as production quantities are available from stock. *For more detailed information, send for technical data sheet* SDC-110.

WSW 6320

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Leave it to a child to get to the heart of the matter quickly. No gobbledygook or double-talk is going to turn him aside from his single-minded objective.

It's like that with solder. No meager test dependent upon a "sample" or even a "one-line operational test" is going to prove conclusively the merits of a "Johnny-come-lately" solder from that second source of supply. The wise buyer knows that the solder used on his production line must do the job he requires day-in and day-out without question.

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That's what we mean by "old pro," Sonny!

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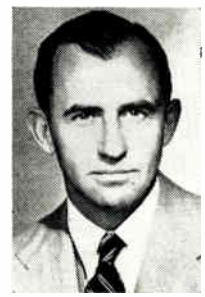
Industry News

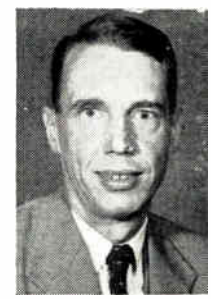
Daniel Echo has been appointed to the newly created post of Assistant Manager of the Industrial Tube Sales Dept., A. B. Du Mont Labs., Inc. Prior to his promotion, Mr. Echo was Eastern Regional Sales Manager of the dept.

Frederick E. Stote has been named Manager of Manufacturing for the Semiconductor Div. of the Federal Telephone and Radio Co.

Frank Pace, Jr., has been elected President of General Dynamics Corp. Mr. Pace has had a distinguished public career serving as Secretary of the Army and Director of the Budget.



F. Pace, Jr.



E. C. Wagner

Edward C. Wagner has been appointed to the new post of Assistant to the Vice-President for Engineering at Ford Instrument Co.

Robert J. Seymour has been named Manager of Product Planning at Ford Instrument Co. Mr. Seymour retains the post of Administrative Assistant to the Vice-President for Sales.

Sidney Wiesner is now Director of Quality Control at General Transistor Corp.

John C. Howe will now serve as District Sales Manager in the Dayton office of GE's Light Military Electronic Equipment Dept.

Jack Kuhner has been elected Vice-President of Hughey and Phillips, Inc., Burbank, California mfg. firm.

Kent V. Faulkner is now Manager of the Publications Special Dept. of International Business Machines Corp. Mr. Faulkner will supervise sales activities and planning of applications of IBM equipment in the publishing field.

Ronald Smelt has been named first Director of the New Design Office in the Research and Development Branch of the Lockheed Missile Systems. Div.

William M. Hawkins, Jr., is now Sales Manager of the Electronic Industries Div., Consolidated Electrodynamics Corp.

Richard Ochs has been appointed Production Manager, Instruments Div., Philips Electronics, Inc.

C. C. Carroll has assumed the duties of Research Coordinator for the United States Radium Corp.

John H. Chiles, Jr., and **B. M. Brown** have been elected Vice-Presidents of the Westinghouse Electric Corp.

Horace R. Delaney has recently been assigned Sales Manager of Crowley Div., Aerovox Corp.

William W. Bartell has assumed the position of General Sales Manager, Waters Mfg., Inc., Wayland, Mass.

William V. Crowley has been named Sales Manager for the Western Div. of ALWAC Corp.

A. E. Abel will now serve as General Manager of the Radio Division of Bendix Aviation Corp.

A. E. Abel

J. F. Bishop

John F. Bishop has been named to head three divisions, Scientific Instruments, Process Instruments, and Berkeley, all of Beckman Instruments, Inc., as General Manager.

William W. Stifler has been elected Vice-President of Aladdin Indusries, Inc. Mr. Stifler will continue to direct the activities of the Aladdin Electronics Div.

Howard W. Merrill, Director of Operations at the Martin Baltimore Div. has been named Vice-President of the Martin Co. and General Manager at Baltimore.

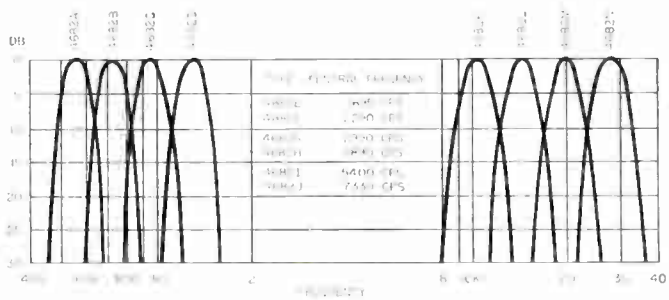
Vernon I. Weihe has joined the Avionic Div. of General Precision Laboratory, Inc. Mr. Weihe was formerly technical assistant to the Vice-President in Charge of Engineering at Melpar, Inc.

OUR MILLIONTH FILTER SHIPPED THIS YEAR...

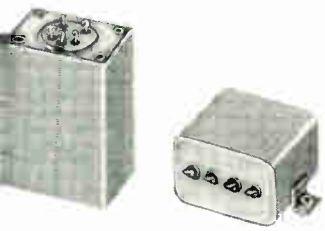
FILTERS
FOR EVERY APPLICATION

TELEMETERING FILTERS

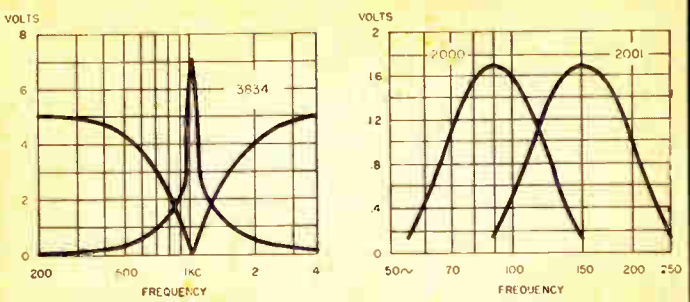
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.



Dimensions:
(4682A) 1½ x 2 x 4"



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16".
(2000, 1) 1¼ x 1¾ x 1⅝".



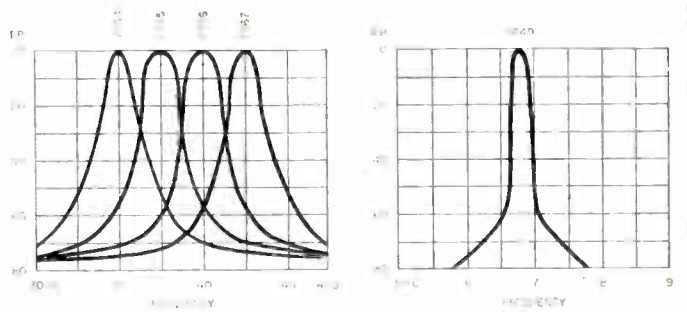
AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

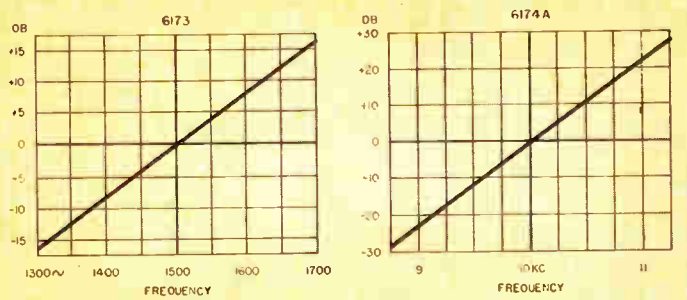
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



Dimensions:
(7364 series) 1⅝ x 1⅛ x 2¼".
(9649) 1½ x 2 x 4".

DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:
(6173) 1-1/16 x 1⅜ x 3".
(6174A) 1 x 1¼ x 2¼".

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

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News of Reps

EMSCO (Electro-Mechanical Sales Co.), Cedarhurst, N. Y. has just been formed to provide technical and sales coverage for the Greater New York area.

R. L. Pflieger Co. will have booths 408-409 at WESCON to display their various firms merchandise.

I. R. Stern and Co. are now jobber representatives for Astron Corp. in Southern California and Arizona area.

Ray Perron and Co., Boston, Mass. will represent the Industrial Condenser Corp. in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

Joseph F. Soldaro Co. will represent the Tel Instrument Electronics Corp. in the state of California.

Marvin H. Kirkeby and Associate, Minneapolis, Minn. has been appointed as Upper Midwest Rep for the Semiconductor Products Div. of U. S. Dynamics Corp.

James E. Haney has been appointed Midwest factory representative for the Diehl Mfg. Co.

Mel Foster, Minneapolis rep, has been named to represent Weller Electric Corp. in Minnesota, North and South Dakota and western part of Wisconsin.

Joseph S. Howell, Jr. of the Tex-O-Koma Sales Co., **Grand Prairie, Tex.,** has recently been appointed field engineer for Eitel-McCullough, Inc. Howell will cover the states of Arkansas, Oklahoma, Louisiana and Texas.

Caldwell A-V Equipment Co. Ltd. will handle Canadian sales for the Dage TV Division of Thompson Products.

Frank W. Taylor Co. of DeWitt, N. Y. will be upstate New York rep for the Christie Electric Corp. of Los Angeles.

Charles L. Thompson Ltd., North Vancouver, B. C., are now sales reps in Western Canada for David Bogen, Inc. and Presto Recording Corp.

Long & Associates has been organized to serve the electronic-electrical industry of Northern California, Western Nevada and Hawaii. They are located at 1210 Canterbury Dr., Burlinghame, Calif.

G. S. Marshall Co., San Marino, Calif. has been appointed by Edcliff Instruments to represent them in California and Arizona.

Gene French Co., Albuquerque, New Mex., are now sales engineering reps in Arizona, New Mexico, Utah and Colorado for Magnetic Research Corp.

R. C. Merchant & Co., 18411 W. Nicholas, Detroit have been appointed sales reps for Reeves Soundcraft Corp. in the state of Michigan.

Philco's Government and Industrial Div. has added 5 more regional sales representatives. They are **Sol J. Levy,** Bradley Beach, N. J. He will cover Connecticut, New York, Central and Western Pennsylvania; **Carl A. Stone Associates, Inc.,** Los Angeles for the territories of Arizona, California and Nevada; **Foster Electronics,** Escanaba, Mich. has Wisconsin and Michigan; **Private Television Systems,** Indianapolis, has the territories of Kentucky and Indiana; and **Exec-U-Phone Systems, Inc.** are covering Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

E. V. Roberts & Associates has moved its Northern California offices from Redwood City to larger facilities at 1560 Laurel St., San Carlos, Calif.

The Hood Co., 175 Fifth Ave., New York 10, N. Y. are sales reps in New York state, including Westchester and Rockland Counties and New Jersey for the Victor Electric Wire and Cable Corp.

W. K. Hile is now representing the Gibson Electric Co. in the southeastern states. Their new office is located at 117 E. 3rd St., Charlotte 7, N. C.

Samuel N. Stroum Co., 2401 Smith Tower, Seattle, Wash. will handle sales in all of Washington and Oregon for Electronics Div. of Elgin National Watch Co.

James W. Caswell is now the Southeastern rep for the Socket Screw Div. of the Bristol Co.

HUGHES GERMANIUM DIODES

with high conductance and quick recovery, together

Never before have the properties of high conductance and quick recovery been combined to this extent in one diode. For the first time, Hughes offers this unusual combination in a new series of germanium point-contact devices. They have the famous glass package created at Hughes, the same rugged construction which enables all Hughes diodes to withstand shock, vibration, and severe environmental conditions. But inside there are changes. And these changes, painstakingly developed and meticulously introduced into the manufacturing process, impart to the diodes their unusual characteristics—make them fill a need long recognized in the industry.

APPLICATIONS:
These diodes make possible advanced, higher speed circuits in which recovery from a forward pulse must be achieved in a minimum of time. Their low forward voltage drop combined with the fast recovery make them ideal for transistorized computer circuits and similar applications.

SPECIFICATIONS AT 25° C

Type	Forward Voltage Drop @ 10mA	Maximum Reverse Current @ −50V	WIV	Forward Current @ +1V
HD-2762	0.80V	50μA	80V	20mA
HD-2763	0.80V	100μA	80V	20mA
HD-2764	0.67V	50μA	80V	50mA
HD-2765	0.67V	100μA	80V	50mA

All types recover to 100 Kohms in 1 μsec when switched from 30 mA forward to −35V reverse in the modified IBM "Y" test circuit.

If you plan to be in San Francisco for the Wescon show, please visit our booths (#2910-11 and #2912-13). Perhaps we can discuss the new diodes there and determine how to use them most effectively in your circuits. Or, if you prefer, ask for a visit from one of our sales engineers. Please write:

SEMICONDUCTOR DIVISION • HUGHES PRODUCTS • *International Airport Station, Los Angeles 45, California*

Creating a new world with ELECTRONICS

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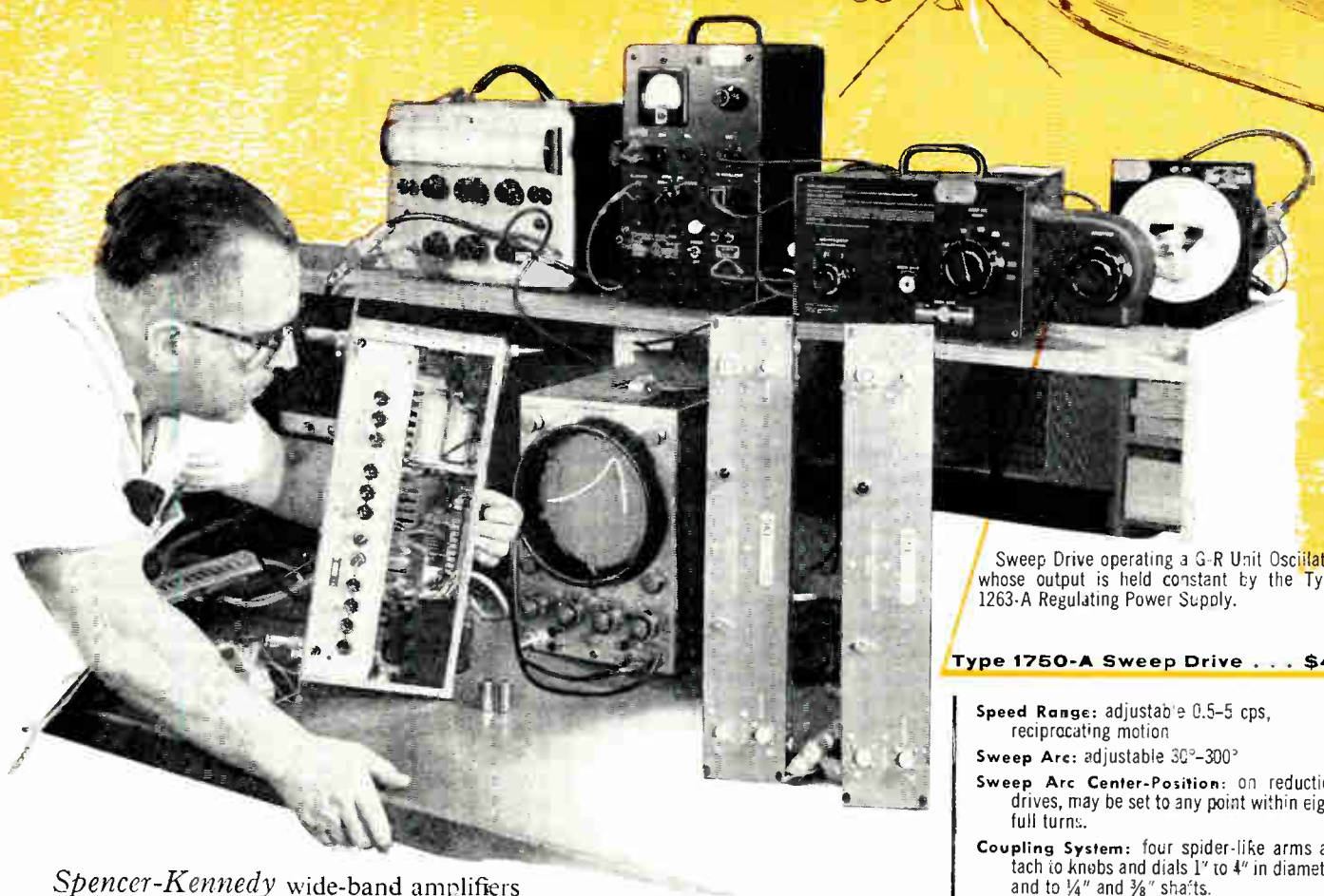
HUGHES SEMICONDUCTORS

Breaking Production Bottlenecks

with Automatic Sweep



Sweep Drive operating a G-R Unit Oscillator whose output is held constant by the Type 1263-A Regulating Power Supply.

Spencer-Kennedy wide-band amplifiers for community TV distribution systems required tedious and time-consuming checks at many points to insure acceptable gain and response uniformity. Standard test procedure called for checks at 15 different frequencies, and if any adjustments were made, it was usually necessary to repeat the entire set of measurements. Test time was about an hour per unit and would often cause severe production bottlenecks.

Engineers at SKL successfully broke the bottleneck with the G-R Type 1750-A Sweep Drive. The response characteristic, now displayed on an oscilloscope, is instantly obtained over the entire band from 54 to 216 Mc. Adjustment effects are observed easily and immediately. Average testing time is now cut by 50 percent with no loss in accuracy — the bottleneck is eliminated with a considerable saving in production costs.

The Sweep Drive can help you. It's more than just a labor saver. It can be attached to a wide variety of manually-operated instruments to make them sweep devices, thus extending their usefulness and versatility.

By simply substituting a higher frequency Unit Oscillator SKL found they could also test their new ultra-wide-band amplifier with the same Sweep Drive setup.

Type 1750-A Sweep Drive . . . $4

Speed Range: adjustable 0.5–5 cps, reciprocating motion

Sweep Arc: adjustable 30°–300°

Sweep Arc Center-Position: on reduction drives, may be set to any point within eight full turns.

Coupling System: four spider-like arms attach to knobs and dials 1" to 4" in diameter and to ¼" and ⅜" shafts.

Limit Switch Circuit: disconnects and brakes the motor if preset limits of shaft travel are accidentally exceeded.

CRO Deflection Circuit: voltage proportional to shaft angle is provided for application to oscilloscope horizontal deflection plates.

Blanking Circuit: eliminates the return CRO trace and produces a reference base line.

Rated Maximum Torque: 24 oz.-in.

Used in combination with G-R's popular line of Unit Oscillators, the Sweep Drive makes available sweep generators for the frequency ranges 500 kc-to-50 Mc, 50 Mc-to-250 Mc, 55 Mc-to-500 Mc, 250 Mc-to-920 Mc, and 900 Mc-to-2000 Mc. The Drive can be coupled to either the oscillator's slow-motion drive for sweeping over small ranges or coupled directly to the main shaft to take advantage of the extremely wide frequency ranges offered by G-R Unit Oscillators.

The Type 1263-A Regulating Power Supply has been especially designed to hold oscillator output constant for sweep-type presentation. Regulation is held to within ±2% of the preset output level, independent of frequency.

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All G-R Products are now covered by a *2-Year Warranty*

Circle 42 on Inquiry Card, page 109

ELECTRONIC INDUSTRIES
& TELE-TECH

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

Western Electronic Industries in 1957

IN this, our sixth annual West Coast issue, we are pleased to report that continued growth and expansion are the terms most descriptive of the present state of the western electronic industries. Equipment for the military still plays a predominant role although many organizations are making concerted efforts to develop more proprietary interests. These interests, however, are aimed at commercial or industrial type products rather than to products for consumer use. A number of organizations are undergoing "change" because of the accentuation now on guided missiles rather than on tactical aircraft. The annual WESCON show (details of which follow in this issue) also continues to increase in size and technical stature. More than 30,000 visitors are expected for the Aug. 20-23 event at the Cow Palace in San Francisco. Some 500 manufacturers will have their products on exhibit and 225 especially selected technical papers will be presented.

The principal areas of electronic manufacturing continue to be Los Angeles and San Francisco, Calif., with San Diego rising rapidly. Electronic R&D and manufacturing is significantly on the increase in other western areas such as Los Alamos and Albuquerque, New Mexico; Phoenix, Arizona; Boulder and Denver, Colo.

In order to portray a true composite picture of the state of the art, we are happy to present here and on the following pages a series of seven guest editorials from outstanding and well-known Western electronic leaders. Major General Bernard A. Schriever writes on "Ballistic Missiles and Manned Aircraft"; Dr. Simon Ramo comments on "Missiles Electronics and Systems Engineering," and Rear Admiral Charles F. Horne (Ret.) discusses "Engineering Recruitment 1957."

WCEMA leaders review electronic activities in their respective areas. Here Calvin K. Townsend speaks for the San Francisco Bay Area, Hugh P. Moore for the Los Angeles area and Richard T. Silberman for the San Diego area. For the 7th region IRE, co-sponsor of WESCON, M. Liefer in the San Francisco Bay area is the contributor.

Ballistic Missiles and Manned Aircraft

By Maj. Gen. Bernard A. Schriever
Air Force Ballistic Missile Division
Hq., Air Research & Development Command
Inglewood, Calif.

I REALIZE that the rather stringent security which surrounds the details and objectives of the guided missile programs probably has caused some apprehension on the part of manufacturers now engaged in producing electronic equipment for manned aircraft. Without any detailed discussion of the missile programs, I believe I can allay most of these apprehensions by pointing out logically that the transition from the manned aircraft to the ballistic missile era is certain to be an evolutionary rather than a revolutionary process, and by suggesting approaches by which it appears manufacturers can continue with development for manned aircraft and develop the capacity for phasing into the guided missile programs in an orderly manner.

One should not infer that ballistic missiles, or guided missiles of any sort will cause manned aircraft to be abandoned. For many years the high performance aircraft now in being and on the drawing board will continue to be a major factor both in the commercial and military fields. This is true in virtually every category of military aircraft—strategic bombardment, tactical aircraft, fighters, transport, and rescue types.

Aircraft associated with transport will undoubtedly become increasingly important because of the guided missile programs. I am thinking particularly of the necessity, due to urgency and high costs, of reducing the number of units in the pipeline and supply channels of the missile inventory. A reduction of this sort can be accomplished only by more efficient handling procedures and by using more expeditious forms of transportation rather than the slower rail, motor, and sea modes.

Electronic Needs

This means of course that electronic gear for communications, control, and navigation purposes for manned aircraft will still be greatly in demand and may even increase in importance. Also, in order to reduce supply inventories and cut down pipeline requirements,

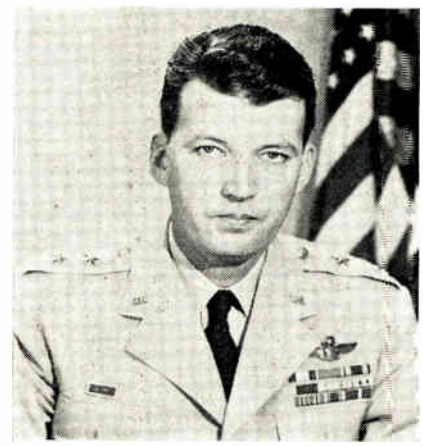
the use of automatic sorting and processing devices for logistical purposes may increase to a very marked degree, resulting in greater demand for ground based electronic gear. As a natural consequence of the increased speed and traffic density of both military and commercial aircraft, the increased demand for more reliable and more fully automatic communication, navigation, and traffic control devices seems to be quite apparent.

Large military headquarters, depots and installations, and commercial concerns handling logistics for guided missiles will require electronic computers and sorting devices which will be a relatively new source of demand for electronic gear such as digital computers.

Another important point which should be noted in the trend of aircraft and missile development, is the increased amount and complexity of electronic gear required for operation of these weapons. Due to the limited time available for decisions and reactions, more and more tasks in the air and on the ground are being performed by electronics. It is also true that much of the electronics for missiles is closely related to that used in manned aircraft. For example, the control systems used in missiles are definitely an evolution of autopilots currently used in aircraft. Many of the guidance components have evolved from radar and inertial devices utilized in aircraft bombing—navigation systems or from air defense fire control systems.

Missile Era

I do not wish to minimize the need for electronic manufacturers possessing vision and imagination to prepare for increasingly important roles in the guided missile era. There is no doubt that missiles of the most advanced types and space vehicles have reached major program stage. It therefore appears desirable that I make some suggestions concerning planning which interested concerns should make for participating in these new programs. Such planning must be imaginative but very much down to earth. The down to earth aspect is necessary because of the large cost of the present missile development programs and because of very stringent requirements in weight and reliability for devices used in these more advanced missiles.



Major General Bernard Adolph Schriever was born in Bremen, Germany, on 14 September 1910; came to the United States with his parents in 1917; and was naturalized a U. S. Citizen in 1923. He received his early schooling in San Antonio, Texas, and graduated from Texas A&M, College Station, Texas, in 1931 with a Bachelor of Science Degree. His Master of Science Degree was received in 1942 from Stanford University in Palo Alto, California.

General Schriever began his military career in 1931 after receiving a reserve appointment in the Field Artillery upon graduation from Texas A&M. In July 1932 he entered flight training, earning his wings and commission as a 2nd Lieutenant in the Air Corps Reserve in June 1933 at Kelly Field, Texas.

General Schriever was assigned to Army Air Force Headquarters in January 1946 as Chief, Scientific Liaison Section, Deputy Chief of Staff, Materiel. He held this position until August 1949 when he entered the National War College. Following his graduation in June 1950, he returned to Headquarters, USAF, to become Assistant for Evaluation, Office of the Deputy Chief of Staff, Development. Assistant for Development Planning (an outgrowth of the Evaluation Office) was his next assignment in January 1951. In May 1954 he became Assistant to the Commander, Air Research and Development Command in Baltimore, Maryland. In August 1954, though retained as Assistant to the Commander, ARDC, General Schriever assumed command of the Western Development Division, Headquarters, ARDC, located in Los Angeles, California. As Commander, WDD, General Schriever has immediate control and supervision over all aspects of the Air Force Ballistic Missile Program.

His awards and decorations include the Distinguished Service Medal, Legion of Merit, Air Medal, Purple Heart, and two Unit Citations. He is rated a Command Pilot.

I believe some imaginative but practical thinking concerning the problem of simplifying and making guidance systems more reliable is of utmost importance. The need for more advanced thinking extends not only to the people having systems responsibility, but to the very roots of the problem including those supplying both large and small components. I refer to revolutionary changes which simplify electronic devices and reduce the cost and weight not only of the devices themselves but perhaps of power supplies, and other peripheral equipment necessary to support their operations. For example, the application of transistor circuitry able to stand the missile environment, to replace heavier vacuum tube devices is the sort of revolutionary approach which I suggest.

New Emphasis

The problem of building to the missile environment is a most important one. In most instances rather special packing and environmental test equipment are required. Forward looking electronic concerns now in the manned aircraft programs can assist by developing rugged electronic packages light in weight but capable of withstanding very severe shock, vibration, and temperature conditions. Here radical new approaches reducing weight at the same time increasing reliability are to be favored over more conventional heavy brute force type approaches.

Summarizing, I might say that I foresee no diminishing requirement in the military electronics field for either manned aircraft or guided missiles. On the contrary, it appears that there will likely be increased demands for development and production of electronic gear by capable firms willing to commit first rate personnel and facilities to our problems. The need for ingenuity will be considerably greater than before, due to more stringent requirements concerned with weight and environment plus a need for economy on our part.

Engineering Recruitment—1957

By Rear Adm. Charles F. Horne (Ret.)
Convair, Pomona, Div. of General Dynamics Corp.

TO those of us in the electronics industry the problem of engineering recruitment is one of primary concern. In the past five years the competition among us for first-rate engineers has become razor-keen. We all have read stories about the engineer-recruiter who left for an Eastern convention and never returned because he had been recruited by a rival company. Too often we have heard college placement officers refer to our recruiters as "flesh buyers."

Many of us know that this problem has become a monster of our existence. Statistics appear to prove quite conclusively that our engineer shortage is not unreal and that supply and demand will not come into balance before 1970. We all need first-class talent, and this problem becomes even further accentuated when we hear the cries of our governmental and educational leaders who also are searching for competent engineers and scientists.

Now the rhetorical question that we might well ask ourselves is: "Where is this competition going to lead us?" As individuals presumably trained in the "scientific method," when are we going to begin using our reason, and when will we place our emotional reactions in the background?

Let us consider the problem of engineering recruitment within our own industry. Whenever we hire a competent engineer from one another, we are in reality "robbing Peter to pay Paul." I will grant you that we all need first-class individuals, but when we recruit from one another we are merely increasing the rapid personnel turnover which ultimately is reflected in the increased cost of our products. The turnover of engineers has taken on another vicious characteristic. As a result of high offers and inflationary competition, we in management have created a small force of professional engineers whom I would classify as "drifters." These individuals "drift" from one company to another, and their movement is premised entirely upon how much better an offer they can obtain from each succeeding company. Often these engineers do not stay in one position long enough to justify their base salary, let alone the increase we so magnanimously give them. The tragedy is that within this group is a highly competent core of professional people we all need. Their services are non-existent quantities, and in the long run they are only kidding themselves.

Charles F. Horne, Rear Admiral U. S. Navy (Ret.) electronics engineer and former Civil Aeronautics Administrator, has been Division Manager of Convair-Pomona (California), a Division of General Dynamics Corporation, since 15 July 1953. In February 1957 Mr. Horne was elected a Vice President of the Convair organization.

He was born in New York City in 1906 and attended public elementary and high schools there. He was graduated from the United States Naval Academy at Annapolis in 1926. He attended the Navy's post-graduate school in communications and electronics and in 1935 received a Master of Science degree in communications and electronics from Harvard University.

Mr. Horne is a senior member of the Institute of Radio Engineers. He is chairman of the latter's Professional Group on Engineering Management. In addition, he is active in the Radio-Electronics-Television Manufacturers Association and is West Coast advisor to the Radio Technical Commission for Aeronautics. Recently Mr. Horne was appointed chairman of the Los Angeles Chamber of Commerce Committee on Engineering Development. This committee is studying the problem of shortage of engineers and scientists in the Southern California area. Mr. Horne also is President of the Aero Club of Southern California and a member of the Aircraft Owners and Pilots Association.

Now I realize that there is no easy solution to this problem. We all have a selfish streak, and we do need engineers. Yet, we in management must sit down and face up to this problem realistically, because at present only we are the losers.

The competition in the college area is just as extreme. Our offers this year have been from fifty to seventy-five dollars higher than they were three years ago! This increased salary scale has created many inequity problems for our people in Industrial Relations. Because of this "creeping paralysis," we now find that newly recruited graduate engineers are earning a comparable salary to those we recruited a year ago! And those we recruited a year ago have a year's solid experience with our companies!

How are we solving this problem? Almost all of us have re-established our salary alignment for the experienced engineer. We are making more frequent and lucrative salary reviews. These practices may be sound from a salary administrative point-of-view, but in the long run, they are inflationary and costly. Again, this cost is reflected in our products.

Fortunately, the extreme competition of the past two years seems to be levelling off. There is increasing evidence that many companies realize we cannot "buy" our way out of these difficulties.

Certainly I am not suggesting that healthy competition among ourselves is a bad thing. Because of this competition, some of us have been forced to revamp and strengthen our personnel programs. In the Pomona division of Convair, I know that we are spending more time in getting acquainted with a new engineer as an individual. We are spending more effort in our personnel follow-up to see that we have placed the right man in the right

job. Certainly the professional engineer has profited both in salary and in prestige. What I am suggesting is that we have reached the "point of diminishing returns" in our extreme competitive zeal. Now is the time for somber revaluation.

While we revaluate, I would suggest that we keep two points in mind. First, we must bend every effort to help our public and private schools at all levels to increase the quality of their work in the sciences and mathematics. Secondly, we in industry must take a long and penetrating look at the problem of improved utilization of our engineers and scientists.

We have heard that our shortage of top flight engineers and scientists will continue for another twelve to fifteen years. We also have heard about the deficiency in science and mathematics training in our schools. I would agree that we have failed our nation and its young people by not emphasizing science and mathematics training in its proper perspective. We probably have lost thousands of competent young people who might have joined the engineering profession because of the academic inadequacies of the past twenty years. But why cry about this now? Our job today is to encourage those youngsters, particularly in the junior high schools, who may have the engineer potential we will need in 1965 and 1970. Through science demonstrations, science fairs, and summer employment for our teachers, we can make a positive contribution in this area. We are in a position to help our school officials and to contribute substantially to the alleviating of the engineer and scientist shortage.

The problem of improved utilization is much less obvious and much more thorny. The sixty-four-thousand-dollar question is: "When is an engineer or scientist NOT being properly utilized?" Most of us are prone either to beg this question or to ignore it completely. But we can no longer afford this luxury. There is no blinking at the fact that this is a real problem we must face squarely. We must answer the question of whether we haven't tended to "stockpile" or hoard engineers in the past few years. Further, we have the problem that if an engineer does not go into a primary administrative position, he reaches a salary plateau about twelve or fifteen years after graduation. We must make certain that there is incentive and motivation for our engineers to continue to be good engineers rather than mediocre administrators.

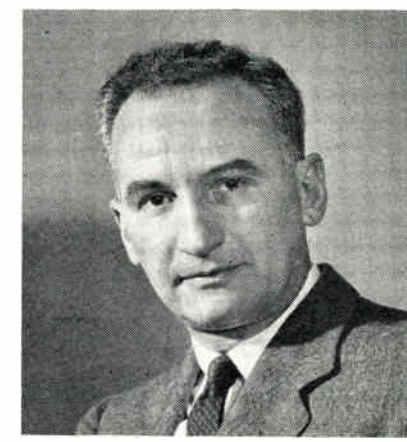
I would not be foolish enough to suggest that I have tailor-made answers to these problems. Yet, these are questions for which we must find answers in a sane and objective manner.

Recently the Los Angeles Chamber of Commerce established a committee on Engineering Development to study the problem of shortage and utilization of engineers in the Southern California area. This study is projected over a ten-year period. I am the chairman of this committee, and I can assure you that we are giving high priority to the aspect dealing with utilization. I would hope that each of you, in your own companies, would parallel our regional efforts. In the long run I am convinced that utilization is probably the paramount issue.

Throughout my discussion of this question I have emphasized the "long-run" solutions as opposed to the "short-run" panaceas. We must think of the future of our companies, but more important we must remember the future of our country. The ideological struggle with Communism will continue for many decades. If we are to be successful, we must work together in solving the problems I have outlined above. These problems are an integral part of our quest for continued scientific and ideological supremacy. As we seek answers to these questions, we might remember Daniel Webster's words from his famous "Bunker Hill Address" delivered in 1825: "Mind is the great lever of all things; human thought is the process by which human ends are ultimately answered."

Missiles Electronics and Systems Engineering

By Dr. Simon Ramo,
Vice President & Executive Director
The Ramo Wooldridge Corp., 5730 Arbor Vitae, Los Angeles 45, Calif.



THE major electronics activity in the West is sponsored by the military, and the largest share of this military electronic business is directly or indirectly associated with guided missiles. For the electronics engineer, this has presented an opportunity and a challenge. It has also been responsible for a major change in the role of the electronics engineer and in detailed make-up of his every day work.

Guided missile applications have broadened the spectrum of frequen-

cies used, and greatly increased the sophistication and quantity of electronics circuits and assemblies used in a specific application. The electronics engineer has a new and healthy respect for the importance of mechanical engineering to attain the ruggedness and subminiaturization required of electronics in guided missiles. Missiles have furnished new applications for every technique that belongs in the category "electronics."

But the guided missile has done something much more important for electronics engineering than any of these. It has brought the electronics scientist and engineer into much more intimate contact with a large number of other specialized branches of science and engineering and made the electronics engineer a prime candidate for that growing specialty—which is not a specialty at all, because it is the engineering of the whole—systems engineering.

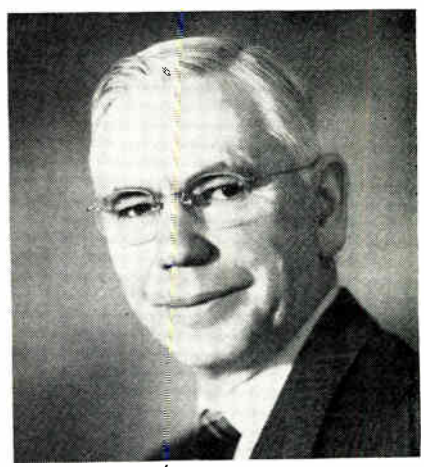
The electronics engineer is more often involved with systems engineering than his fellow engineering specialists, because, by the very nature of electronics, it is concerned with control and communication amongst that whole complex of apparatus that makes up the system. True, the electronics engineer still oftentimes provides only a specialized black box which can be highly isolated as to its performance requirements from the rest of the system; frequently such separation is cleaner than the relationship between, say, propulsion and aerodynamics. However, generally it is the electronics that provides the multitude of feedback loops that at once create and satisfy the larger problems of system stability, and that dominates the over-all precision of the system.

The electronics problem is that of transferring and processing information throughout the system, controlling the changes of energy from one form to another, storing and delaying data as required, providing the orders and the automatic operations that determine the overall effectiveness of the guided missile system. By analogy, the brain and nervous system of the human body are the equivalent of the overall control and communication left to the electronics engineer in the guided missile system. Electronics seems to participate in every "subsystem" and is present in virtually every interaction amongst system components.

Ultimately, perhaps, systems engineering may be thought of as a separate discipline. It may be common to train systems engineers, both in the universities and in industry, providing young graduates with the tools and the concepts that will enable them to assist experienced systems engineers and gradually grow into experts. Today, systems engineers are largely specialized graduates, most often with advanced degrees, coming from various branches of engineering and science. Electronics engineers do not and should not constitute the entire systems engineering staff on any major guided missle project. But the electronics profession should be proud of the major part that the electronics engineer is playing in systems engineering and in management of the large guided missile projects of the nation.

Guided missile development, under military sponsorship, has as its aim to insure the nation's security. In the process, tremendous advances in aerodynamics, nucleonics, propulsion, and materials are taking place that will advance our nonmilitary, peaceful capabilities on many fronts. Of these advances, the most significant may be in the electronics phases. The growing ability to extend and replace man's brains and senses by electronic apparatus is the equivalent of elevating our population and increasing its brain power.

By Calvin K. Townsend,
President
West Coast Electrical Manufacturers Association (WCEMA)
Chairman, San Francisco Council



In the San Francisco Bay Area . . .

WHAT of Electronics in the San Francisco Bay Area? No segment of the Electronic Industry is isolated from the overall situation, but this area is one of great specialization and its growth, percentage wise, has been much more rapid since the last WESCON Show here two years ago than the national average. The reason for this growth is inherent in this very specialization.

In the last two years twelve Eastern companies have opened up research and development laboratories. Why? First, because there was more research and development going on in this area in the specialized fields of their interest than anywhere else. The very real second advantage is the great interest that trained engineers have in coming to this area because of its ideal climate and its most outstanding electronic educational facilities. Also the local universities have served as a fine source of engineering talent and consultation services among these companies.

Lockheed Aircraft Corporation

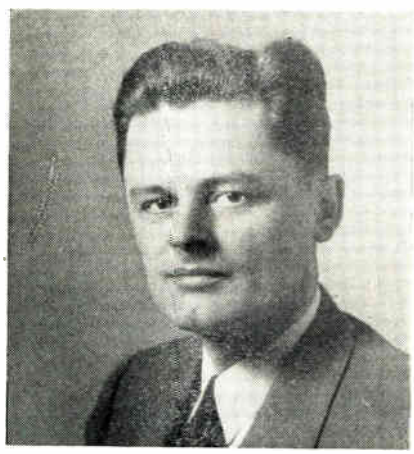
has opened a large missile research center as well as a much larger missile production facility. In the new IBM Electronic Computer plant, this area has its largest facility which will employ over 5,000 in research, development and production of electronic computing machines. Some of the other companies involved are: Federal Telephone & Radio Company, Philco Corporation, Sperry Rand Corporation, General Electric, Atomic Laboratory, Atomic Computor, Zenith Radio, Firestone Tire, Carade Corp., Farnsworth, Sandia Corporation and IBM.

The great influx of companies plus the new companies formed locally has greatly increased the number of companies, but the greatest increase in facilities has come through the tremendous expansion of the indigenous companies and branches already here. Through the last two years the plant area and total employment has more than doubled and the technical staff has been increased by a factor of three.

The San Francisco Bay Area has been fortunate in having this large number of indigenous companies. Through this independent research and development they have created products so unique that they could flourish in spite of their distance from the primary market. It is this characteristic that is the basic reason for the continued growth of these companies and also the primary reasons these new branch plants and laboratories are coming into the area.

The space limitation of these comments prohibits any specific mention of the hundreds of new devices and products that have been brought out by the Bay Area Electronic Manuafcturers in the past two years. But you will be astonished as you walk through the WESCON exhibit hall in San Francisco at the great development that has gone on here and, of course, throughout the whole electronic industry.

What of the future? Each firm is confident that its rate of growth will continue at least at a level as high or higher than the last two years. Can you envision where that is taking us? I find it difficult.



In the Los Angeles Area . . .

By Hugh P. Moore,
Vice President
West Coast Electrical Manufacturers Association
Chairman, Los Angeles Council

THE electronics industry of Greater Los Angeles (Los Angeles & Orange Counties) is continuing to grow at a rapid rate . . . spurred on by the increased activity in the missile and astronautics programs.

A recent WCEMA year-end survey showed a total of 470 electronic firms in the Los Angeles area, employing 73,000 people with an annual payroll of over 300 million and an annual billing of $1 billion (excluding broadcast and service revenue). This accounts for 11.2% of the national firms; 11.9% of its employment and a whopping 15% of its sales volume.

The West's aircraft industry, using an increasing quantity and variety of electronic devices, has certainly been a major factor in the development of the local electronics growth, and the technical experience and "know-how" developed thus far by electronic firms will greatly assist the local industry in participating in the stepped-up missile, astronautic and atomic programs. All of these programs require a great deal of research and development activity and "electronic know-how." We must constantly push back the frontiers of our physical sciences. The Los Angeles electronics industry is especially fortunate in being able to draw upon the greatest engineering population (per captia) in the nation, and scientific skills ranging from glass blowers to nuclear physicists. While the Nation's defense effort has, and will continue to be of major priority and importance to the local electronics industry . . . commercial and industrial electronic applications are being actively developed that will lead to many human benefits beyond our military needs . . . and in fact . . . open "new horizons" for the industry.

Electronic firms are quietly developing commercial and industrial items without much fanfare, in an effort to be less dependent on military business and at the same time build a sound foundation for continued growth ad prosperity. The aircraft companies who have built up their in-plant electronic activity have followed a similar pattern of developing commercial and industrial electronic items.

Significant in the local growth picture is the number of larger, nationally established electronic firms that have located in or adjacent to the Los Angeles area in the past five years. The availability of technical manpower (from local educational institutions and in-migration of engineers) and advanced technological activity has encour-

(*Continued on page* 158)

Western Leaders

In the San Diego Area . . .

By Richard T. Silberman
Chairman, San Diego Council, WCEMA

SAN DIEGO is witnessing a growth of electronic companies. The business climate created by Convair, Convair - Astronautics, Stromberg-Carlson, Ryan, the Navy Electronics Laboratory, and General Dynamics Corporation has been conducive to the establishment of many new technical organizations.

Convair-Astronautics is the center for the Atlas ICBM program. Local subcontracting from this activity alone has amounted to millions of dollars, being especially heavy in the fields of flight and test stand instrumentation. Convair currently operates a major test facility at their Sycamore base, which is a few miles north of the center of San Diego.

The continuous influx of vendors to the city has created an awareness of San Diego's very attractive year-round climate and smog-free environment. A number of small firms have been started in the area by technical personnel formerly affiliated with local major industrial concerns. Typical of these are Cubic Corporation, Humphrey Inc., Kin Tel, Non-Linear Systems, and Electro Instruments. These companies manufacture a wide range of products, covering the spectrum from Kin Tel's accurate DC amplifiers to Cubic's high - frequency missile tracking systems.

An extremely important facet in the growth of the San Diego electronic industry is the support provided by the community itself. Industrial sites have been made available at both the Kearny Mesa industrial area slightly north of the center of town, as well as in the northern county areas of Solano Beach and Oceanside.

Outstanding educational facilities are available at San Diego State College and Scripps Institute of Oceanography. Off-campus graduate courses are provided in the city by the University of California.

In addition to the impetus supplied by the aircraft firms, San Diego's electronic industry is also heavily "endowed" by the activities of the Navy Electronic Laboratory. This facility, which has played a major role in the development of underwater detection, has been the spawning ground for many technical developments which are now manifested in products produced in this area.

The broad technical labor pool, the equitable climate, the wide variety of cultural and educational activities and opportunities, and the generally high standard of living all serve to create an ideal environment for the electronics industry.

For the 7th Region IRE . . .

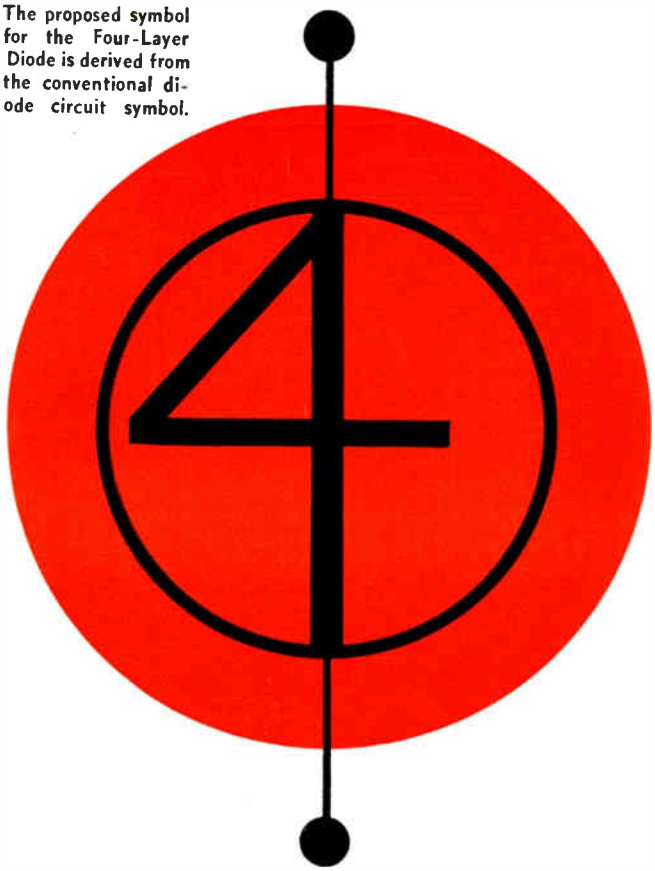
By Meyer Leifer,
Chairman
IRE, San Francisco Section

THIS year the Western Electronic Show and Convention (WESCON) is being held in San Francisco. This affair is held alternately in Los Angeles and San Francisco and is sponsored by the West Coast Electronic Manufacturers Association (WCEMA) and the 7th Region of the Institute of Radio Engineers represented by the Los Angeles and San Francisco sections. We, in the San Francisco section, in the position of one of the hosts for the technical aspects of the convention, extend our greetings to all those members of the Institute and other visitors who will be attending this year's WESCON.

The opportunity which a meeting of this magnitude presents to the members of the Institute in this area represents but one of the several unique features which characterizes the activities of the San Francisco section. The aims of this section are, as they should be, the aims of the National Society; namely, to advance the professional interests and opportunities for training and expression of the radio engineers in this area. The major activities of the San Francisco section which are directed towards these objectives are the technical meetings of the section, the two subsections and the various profes-

(*Continued on page* 158)

The proposed symbol for the Four-Layer Diode is derived from the conventional diode circuit symbol.



Unique Properties of

The Four-Layer Diode

By DR. WILLIAM SHOCKLEY

Director, Shockley Semiconductor Laboratory
Beckman Instruments, Inc.
391 South San Antonio Rd.
Mountain View, Calif.

A new bistable, two-terminal semiconductor device is added to the growing list of electronic components. Early applications include self-excited saw-tooth oscillators, high input impedance pulse-generators, ring circuits.

THE four-layer diode is a very versatile circuit element which will have extensive use in electronics. Basically, it is a two-terminal device which can exist in either of two states—an "open" or low conductance state corresponding to 10 to 100 megohms and a "closed" or high conductance state corresponding to 3 to 30 ohms. Quantities pertaining to the low and high current conditions will be identified by the subscripts "b" and "h."

The diode is switched from one state to the other by controlling the voltage and current through it. If the voltage exceeds the "breakdown" voltage V_b, the device will change from open to closed, provided sufficient current is available to hold it in the closed state. The necessary current is called the holding current and denoted by I_h. If the current falls below I_h the diode will switch back to open.

In general, the subscript "b" for "breakdown" will be used for quantities corresponding to breakdown itself (or to "open" conditions leading up to breakdown) and the subscript "h" for "holding" will be used for quantities corresponding to the minimum-current holding condition (or to "closed" conditions following breakdown).

The principal parameters of the device are described in Fig. 1. The suggested symbol represents

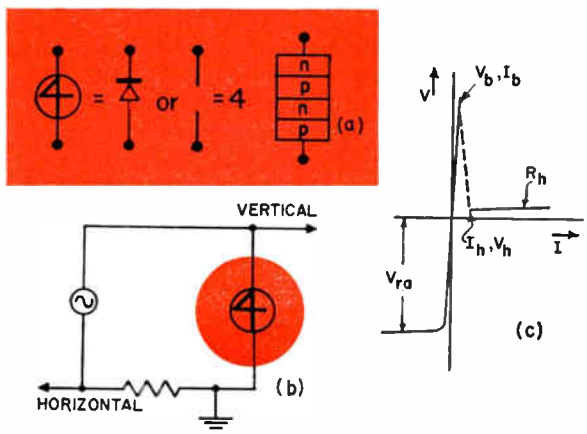
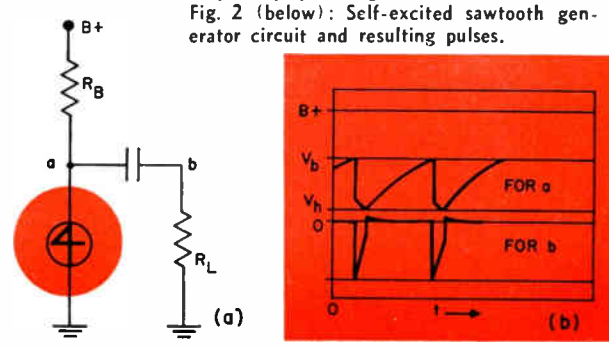


Fig. 1 (left): AC test circuit and typical scope display during test of new diode.
Fig. 2 (below): Self-excited sawtooth generator circuit and resulting pulses.



a combination of a diode and an open circuit, the diode being poled so as to represent correctly the direction of current flow in closed condition.

A typical 60 cycle test circuit is shown in Fig. 1b and the appearance on a scope in Fig. 1c. In the open condition, voltage limiting action is observed in the reverse direction at a voltage denoted by V_{ra}, the subscripts implying "reverse avalanche."

The two most important parameters are the breakdown voltage V_b and the holding current I_h; in general, the switching from open to closed occurs when the voltage exceeds V_b and from closed back to open when the current falls below I_h.

In order to understand the nature of the switching characteristic of the four-layer diode in detail, the complete current-voltage characteristic, including certain negative resistance portions must be considered. Furthermore, the effects of rate-dependent processes must be included. For a discussion of the V-I characteristic the reader is referred to the article by Moll, Tanenbaum, Goldey, and Holonyak cited below. In terms of the V-I characteristic it is found that quantities such as V_b, I_b, V_h, and I_h should be regarded as determined not only by the device but also by the constants of the test circuit. For most practical purposes, however, the dependence on the test circuit is unimportant, and these constants may be used for circuit design purposes.

The sustaining voltage V_h is also of importance and so is R_h, the slope of the V-I characteristic for high currents. Another important parameter is I_b. This is the "switching current." In some circuits, the switching action may be controlled by this current.

Four-layer diodes made at the Shockley Semiconductor Laboratory have typical values for V_b and R_h of 1 to 2 v. and 1 to 20 ohms. A low resistance unit may carry 50 ma or more without excessive dissipation. This approaches the limit of devices made without special provisions for cooling.

A typical value of V_b is 30 v. The value of V_b may be varied by controlling the fabrication process. Values as low as 10 v. or as high as 100 v. can be achieved if needed. Typical values of I_h are a few hundred μa; however, values of several milliamperes are also available.

It is appropriate to say something of the history of this device. A device having three layers and a third junction formed by a metal contact has been published in a patent, No. 2,655,608, issued to L. B. Valdes and assigned to Bell Telephone Laboratories. A composite structure involving a conjugate pair of transistors and an avalanche diode is covered by

patent No. 2,655,609, issued to W. Shockley and also assigned to Bell Telephone Laboratories. This circuit is similar in theory to the four-layer diode. The characteristics of diodes similar to the Shockley four-layer diode have been discussed by J. L. Moll, M. Tanenbaum, J. M. Goldey, and N. Holonyak, all of Bell Telephone Laboratories, in the Proc. I.R.E.,

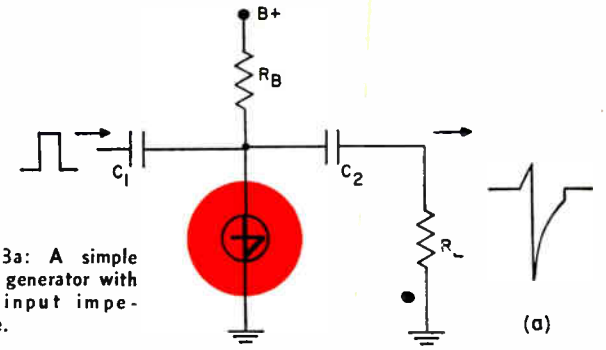


Fig. 3a: A simple pulse generator with low input impedance.

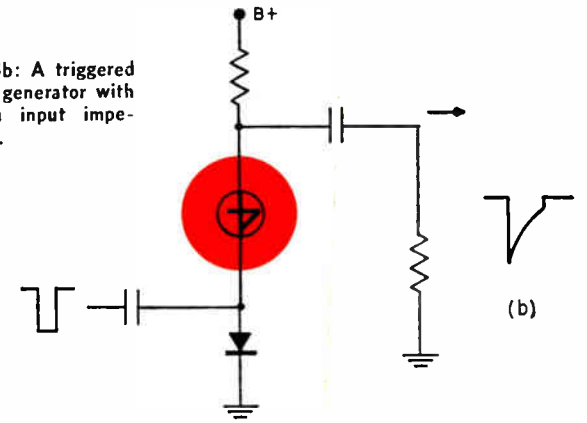


Fig. 3b: A triggered pulse generator with high input impedance.

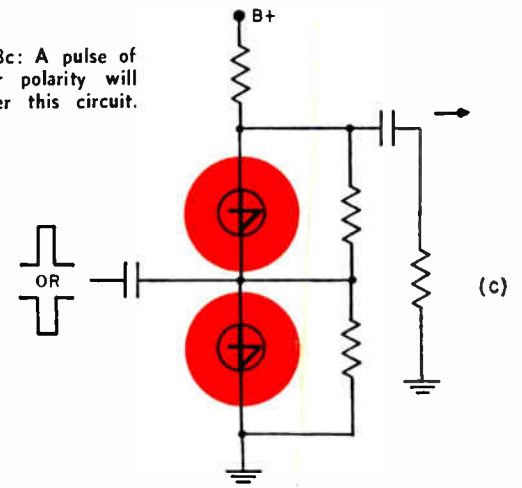


Fig. 3c: A pulse of either polarity will trigger this circuit.

Vol. 44, p. 1174, September 1956. In a later section of this article, the improved theory of silicon junction devices is discussed. This interpretation follows from original work at the Shockley Semiconductor Laboratory carried out by C-T Sah, R. N. Noyce, and W. Shockley.

One of the simplest circuits to which the four-layer diode can be applied is the self-excited, sawtooth generator. One possible form of the circuit is shown in Fig. 2a. The voltage supply, B+ should exceed the breakdown voltage V_b for the four-layer diode. Under these conditions, the four-layer diode will break down. The series resistance R_B should be large enough that it limits the current to a smaller value than I_h, the holding current.

Fig. 2b assumes that at time zero, the diode is in the open condition and the voltage is rising. When

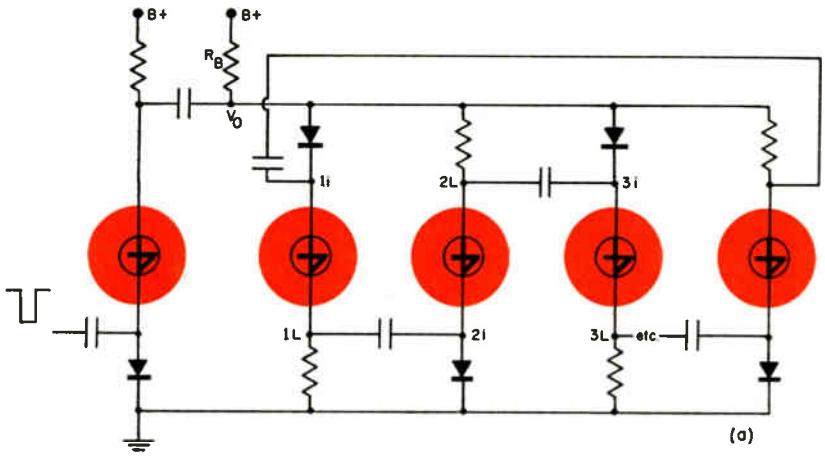
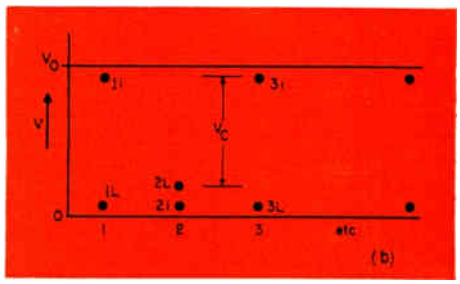


Fig. 4a (left): Four-Layer Diode ring circuit and input stage.
Fig. 4b (below): Voltage distribution with element No. 2 conducting; coupling condenser stores charge to fire No. 3.



Four Layer Diode *(Continued)*

the voltage reaches V_b, the diode breaks down into the closed condition and before the charge in the capacitor has time to change, a voltage approximately equal to V_b-V_h appears across the resistor R_L. The capacitor then discharges through R_L and the diode until the current through the diode falls below I_h. At this point the diode returns to its high impedance condition and the capacitor is recharged through R_B and R_L. This leads to the voltage wave form shown in Fig. 2b.

Saw-tooth wave forms up to several MC can be produced with four-layer diodes. The turn-on pulse is very sharp so that the rise time across the resistance R_L may be as small as 10 to 100 mμsec.

The high frequency performance of the four-layer diode is controlled by different internal parameters from those that control the low frequency parameters described in connection with Fig. 1. In particular, the breakdown voltage depends upon the rate of application of voltage and may be reduced for high rates of application. These parameters can, however, be controlled by fabrication techniques if the need warrants the development effort.

Pulse Generators

In Fig. 3 several pulse generators are shown which may be triggered by an input pulse. The simplest of these shown in Fig. 3a has a relatively low input impedance. For this circuit the supply voltage B+ must be below the breakdown voltage V_b. An input trigger pulse fed to the circuit by the condenser raises the four-layer diode above its breakdown voltage after which it transfers from the open to the closed condition generating a pulse in the manner discussed in connection with Fig. 2. It is evident in this case that the impedance seen by the incoming pulse will be that of the resistance R_B in parallel with the R_L, C_2 combination and any impedance of the four-layer diode itself.

A high input impedance circuit is shown in Fig. 3b. In this case, the four-layer diode is in series with a similarly poled conventional diode. Again the voltage B+ is below the breakdown voltage V_b. The input impedance seen for a negative pulse is that of a conventional diode biased in the reverse direction and the four-layer diode in the open condition. This impedance will be very high until the diode reaches the breakdown voltage. At this point the turn-on current (referred to in connection with Fig. 1) I_b must be supplied by the input circuit. This shows how under some circumstances the turn-on current may be an important and controlling factor in the use of the four-layer diode.

Once the four-layer diode is switched to the closed condition, the voltage across it drops to V_h plus R_h times the current. The conventional diode is then biased forward so that the voltage drop across it is small. Thus the output capacitor is discharged through its resistor and the two diodes in series.

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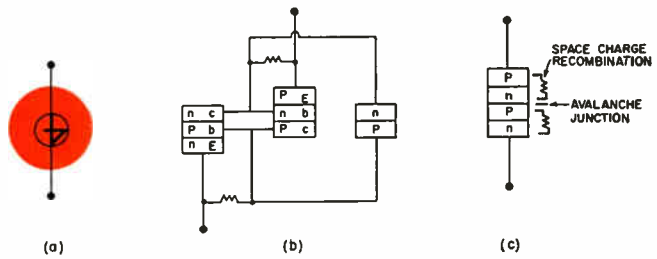
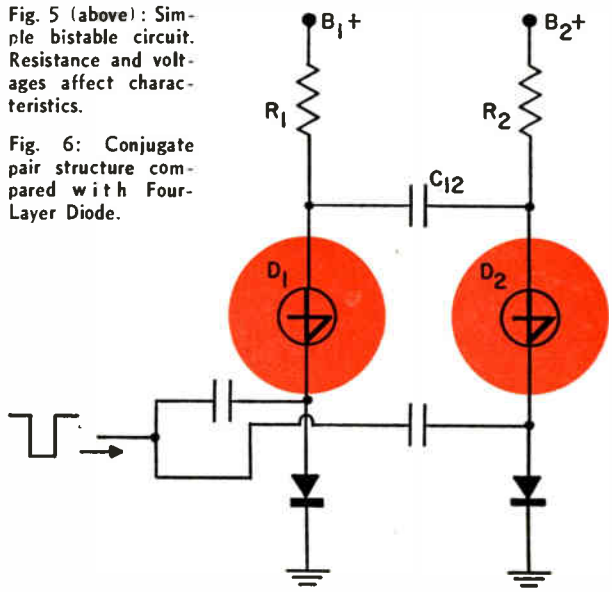


Fig. 5 (above): Simple bistable circuit. Resistance and voltages affect characteristics.

Fig. 6: Conjugate pair structure compared with Four-Layer Diode.



By JOSEPH T. CATALDO
International Rectifier Corp.
1521 East Grand Ave.
El Segundo, Calif.

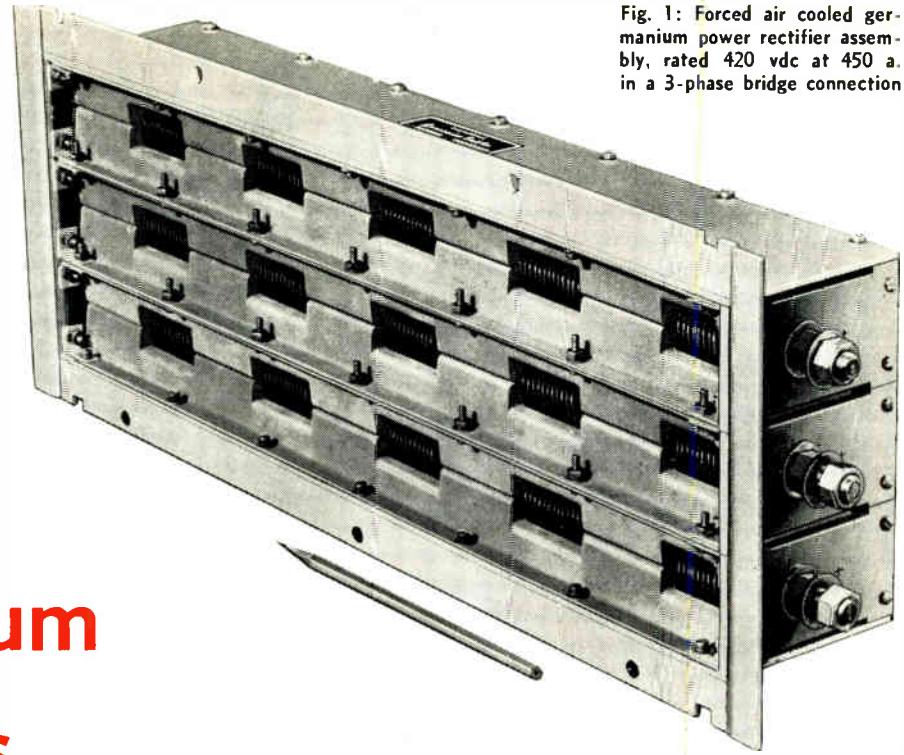


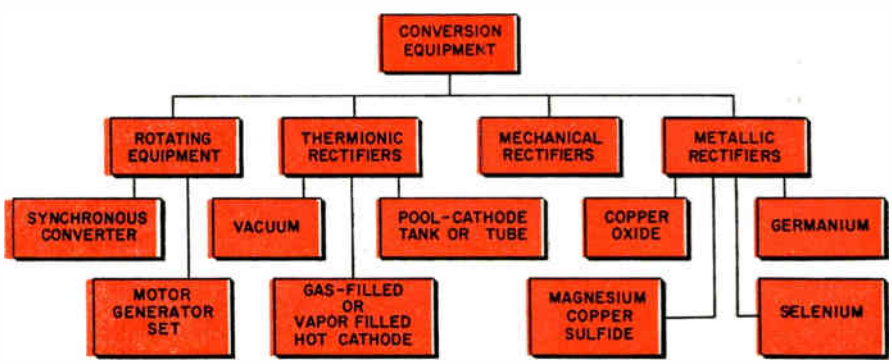
Fig. 1: Forced air cooled germanium power rectifier assembly, rated 420 vdc at 450 a. in a 3-phase bridge connection

Germanium Rectifiers As Electronic Components

Circuit designers are offered significant advantages by germanium rectifiers in terms of increased efficiency, small size and absence of aging. The design aspects also to be considered include the methods of cooling, overload characteristics and surge voltages

WITH the production and availability of germanium power rectifiers in the last several years, a new concept for power conversion equipment has been made possible to industry. This new concept is due to the advantages of germanium rectifiers over other types of metallic rectifiers. As a result, they are being used in equipment for both the electronic industry as well as the heavy electrical industry.

Fig. 2: Principal methods employed in the U. S. for ac-to-dc power conversion



The principal methods employed in the United States for conversion of ac and dc power may be generally grouped into 4 classes as shown in Fig. 2.

Ideal Rectifier

In the development of new rectifiers, attempts were made to develop units approaching the ideal rectifier, i.e., zero forward resistance and infinite reverse resistance. The newest and nearest approach to date for high power conversion is the germanium power rectifier. Although other earlier types of converters have equivalent efficiencies, certain disadvantages preclude their continued use.

Three years ago fan-cooled germanium power rectifiers were put into mass production. A typical unit rated to deliver up to 420 vdc at 1350 a. when connected as a 3-phase bridge shown in Fig. 1. Other types of air-cooled and

Germanium Rectifiers *(Continued)*

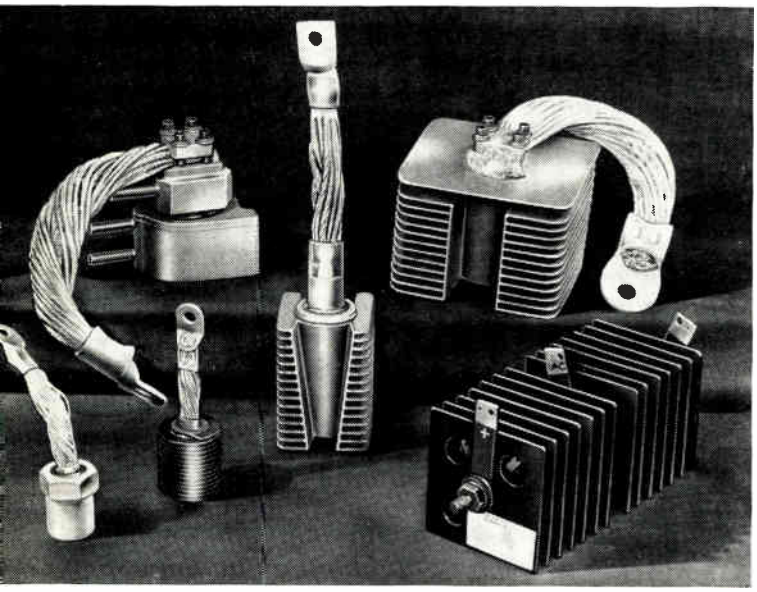
liquid cooled germanium power junctions are shown in Fig. 3. The ratings of these units range from 167 a. to 667 a. (half-wave). They are available for input voltages of 20, 26, 33, 42, 52, 66 and 85 v rms.

Advantages

Major advantages of germanium rectifiers are their high efficiency, which is in the vicinity of 98.5% for the junctions alone. Rectifier circuits using germanium elements, therefore, operate very close to the theoretical values of an ideal rectifier. High efficiency also permits cooling with a small amount of air, allowing use of small blowers, filters and simplified duct work.

If recirculation is desired (in areas of high air impurities) the heat exchangers required are very small, e. g., much smaller than for mercury-arc rectifiers. Except for the transformer voltage drop, the germanium rectifier has almost no regulation, assuring an unchanging output voltage for varying loads.

Another advantage of germanium rectifiers is the absence of aging. Rectification is accomplished in a single crystal which does not change with age or storage. A third advantage is the small size and weight of the germanium rectifier junction. Being a small device, the cooling method is much different than for larger devices of the same capacity which



are convection cooled, or cooled by a relatively slow air flow in a large space. Germanium rectifiers require a small volume of air flowing in a small duct at high speed.

Characteristics

Germanium power rectifiers have superior characteristics over other types of metallic rectifiers for high current and medium voltage range. The low leakage current and low forward voltage drop are illustrated in Fig. 4. These characteristics explain the high efficiencies attainable with germanium power rectifiers.

Other outstanding features are small size and unlimited life. No measurable increase in forward voltage drop or reverse current has been noted after 24,000 hr. of continuous operation at rated current and voltage. This is indicative of the non-aging properties of germanium power rectifiers and is equivalent to 3,000 working days (approx. 10 yrs.) of operation at 8 hr. 1 day.

Surge Voltages

The maximum applied ac voltage to the germanium rectifier junctions should not exceed the rated rms voltage of the unit, even for short durations. Care should be exercised in the design of rectifier equipment to prevent voltage surges above this value. It is therefore recommended that input voltages should be approximately 10% below the rated rms voltage. However, each installation should be investigated in regard to power line fluctuations.

The rms rating is based upon sine wave voltage forms, therefore, when a high peak wave form is involved, the peak of the ac voltage applied should not exceed the rated rms voltage multiplied by $\sqrt{2}$. If the peak voltage of the transient surge exceeds the dielectric breakdown voltage of the junction, the junction will be destroyed. Surge voltages of lesser magnitude will, of course, have no ill effect on the germanium rectifier junction in use.

This destruction by transient surge voltages can be prevented either by the elimination of transient

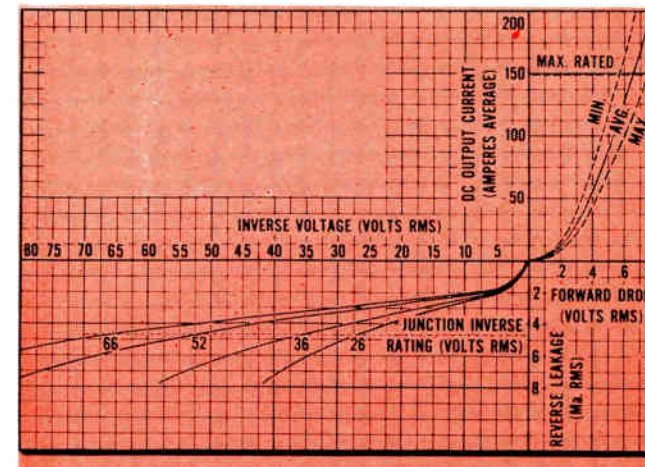


Fig. 3 (left): Air-cooled 20-500 a., and liquid cooled 667 a. units

Fig. 4 (above): Typical dynamic characteristics for 167 a. junctions

voltage surges at their source or by providing a by-pass around the junction to neutralize the surge. Surge voltages caused by interwinding capacity of the transformer can be substantially reduced by the use of capacitors connected directly across the secondary transformer terminals.

Transient surges having a higher total energy content than caused by inter-winding capacitance, may be effectively reduced by the use of non-linear resistors. Silicon carbide resistors with non-linear properties are commercially available as thyrites.

Cooling

Germanium power rectifiers are produced for both air and liquid cooling. As previously mentioned, air-cooled types require a small volume of air flowing at a fast rate. The range of the air volume recommended is 75 to 250 cu. ft./min. at a static pressure drop of 0.75 to 1.0 in. of water. It is obvious that only a small blower is required.

The liquid-cooled germanium rectifier junction is designed to operate with many of the commercial coolants. Liquid cooling should be supplied to the special heat exchanger assemblies at inlet coolant temperatures not exceeding 30°C and at flow rates of approximately 3 gal./min. for water. The flow rate for other coolants such as trichlorethylene and butyl alcohol is dependent on the specific heat, thermal conductivity and viscosity.

Germanium power rectifiers are thermally rated like most electrical and electronic components. Consequently, if the ambient temperature exceeds 35°C for forced convection-cooled units, or coolant inlet temperatures exceeds 30°C for liquid cooled units, the manufacturer should be consulted.

Overloads

The forced air cooled and liquid cooled germanium power rectifiers are applicable for all types of dc load requirements except those requiring heavy surge currents and those subject to heavy intermittent overloads or occasional short circuits.

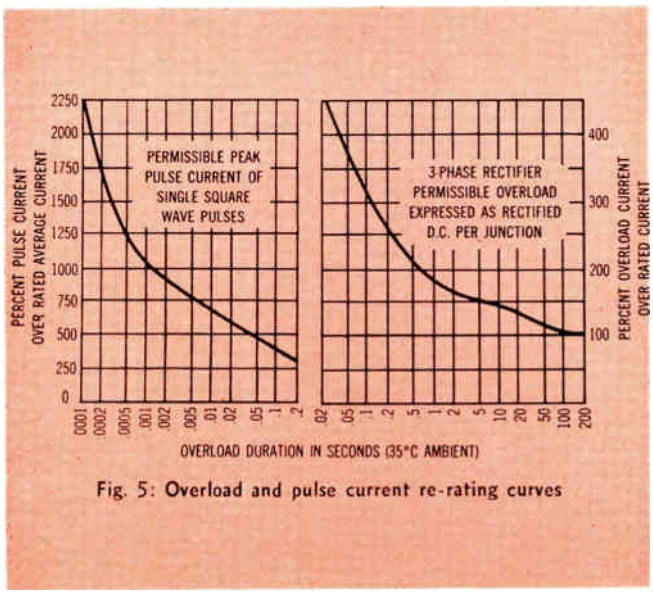


Fig. 5: Overload and pulse current re-rating curves

Intermittent overloads on forced air cooled and liquid cooled germanium power rectifiers are permitted up to the limiting values indicated by the curves in Fig. 5; but not in excess of these limiting values.

Where the overloads are repetitive they must be thermally evaluated to insure that maximum operating temperatures are not exceeded. Unlimited operating life can be expected over a temperature range of —55°C to 45°C maximum when equipment is designed to operate within specified voltage, current and temperature rise ratings. This temperature range provides ample safety factor for all normal industrial and commercial applications.

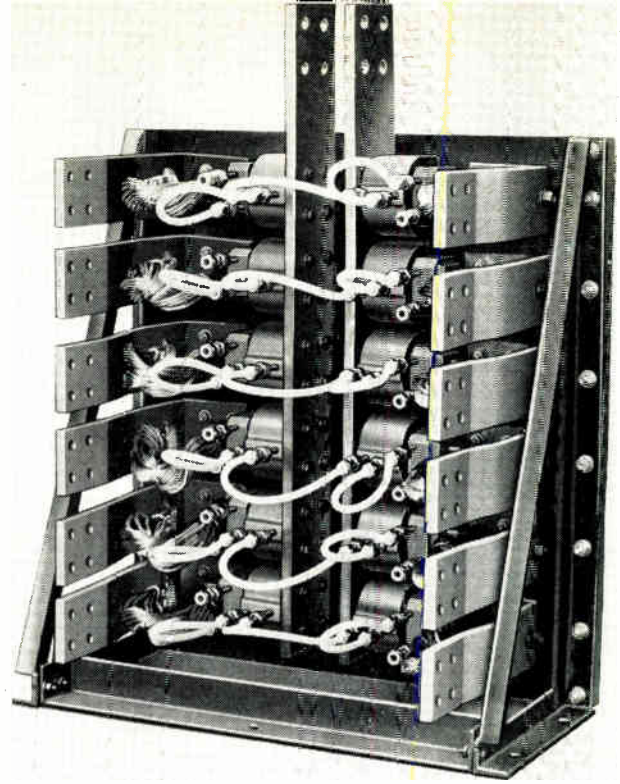


Fig. 6: Typical liquid cooled assembly used to supply filament power for large vacuum tubes. Measures approximately 26½ x 24 x 13

Applications

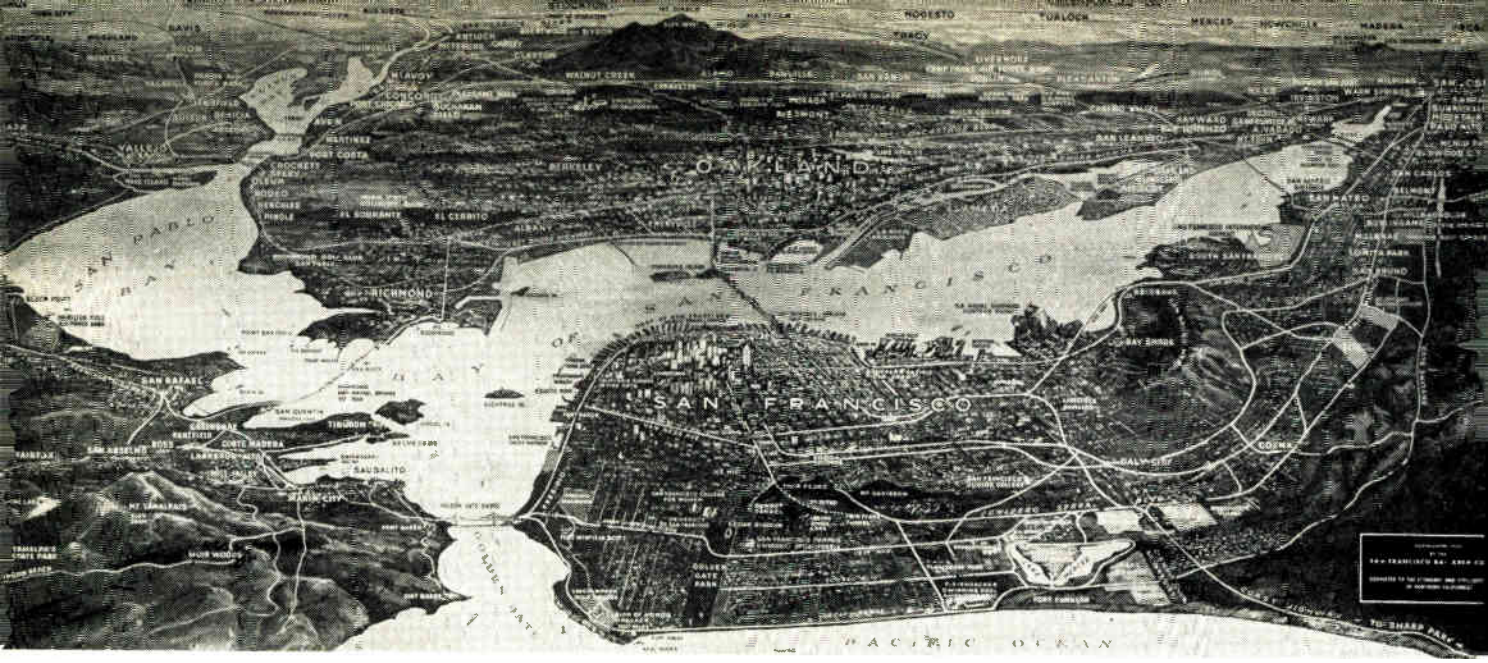
Contrary to original prediction, the germanium power rectifiers are not necessarily replacing selenium rectifiers. By far the largest volume of germanium is being used to replace M-G sets, mercury arc rectifiers and mechanical rectifiers. A few of the end uses of this dc equipment are: vacuum refining of metals, reduction of aluminum, and production of such chemicals as hydrogen peroxide, caustic soda and chlorine, to name a few.

Germanium is, however, also being used for electroplating and anodizing equipment. This equipment has been designed using both the air cooled and liquid cooled germanium shown in Fig. 3.

A typical example of a liquid cooled germanium rectifier assembly is shown in Fig. 6. The circuit of this configuration is a triple diametric with 2 junctions in parallel per arm using paralleling reactors. This assembly is designed to deliver 8,700 a. at 10 v to 25 v, depending on the voltage rating of the junctions used. A similar unit is being used to supply dc power for the filament of large radio transmitting tubes.

Analysis of various germanium power installations indicates a material saving in weight of the equipment and volume it occupies over mercury arc rectifiers. For example, a comparison of a 1,000 kw, 250 vdc germanium unit with a mercury arc unit of the same rating shows approximately a 4 to 1 saving in weight and a better than 16 to 1 saving in cubic

(*Continued on page* 168)



Electronic Spotlight On WESCON—Aug. 20

Displays by more than 500 electronic manufacturers and a technical program of 225 papers are expected to attract close to 30,000 engineers and scientists to the Western Electronic Show and Convention at San Francisco's Cow Palace, August 20-23.

The show and convention is being jointly sponsored by the San Francisco and Los Angeles Sections of the Institute of Radio Engineers, and the West Coast Electronic Manufacturers Assoc.

This year's show, the ninth in WESCON's history, far outstrips their previous conventions in both the number of exhibitors and in the number of papers to be presented.

Electronic products will be displayed in 753 exhibition booths, or 42 more than were available at last year's record turnout at Los Angeles' Pan Pacific Auditorium.

The technical program, which will be held in specially constructed sound-proof halls constructed within the Cow Palace, will feature the presentation of 225 papers. Forty-eight technical sessions will be held during the 4-day convention. Among the special sessions will be one on "Controlled Nuclear Fusion Research," and its engineering aspects.

The entire area of the Cow Palace, 175,000 sq. ft., will be occupied by WESCON. Both the show and convention are being held under the one roof.

An elaborate schedule of field trips and social activities has been arranged for engineers and their families.

On Tues., Aug. 20 there will be two tours of military defense facilities, to a U. S. Army NIKE installation near San Francisco and to the U. S. Naval Radiological Defense Lab, Hunter's Point, San Francisco. Other field trips will cover Eitel-McCullough, Litton Industries, Ames Aeronautical Lab, Univ. of California Radiation Lab, Ampex, Lenkurt Electric, Mare Island Naval Shipyard, Bank of America Data Processing Center, Lockheed and Stanford Univ.

Highlight of the social proceedings, the All-Industry Cocktail Party, will be held the evening of Aug. 20 at the Sheraton-Palace.

TECHNICAL PROGRAM

TUESDAY, AUG. 20

"Transistor Circuits" (9:30 AM to noon)

"A New Method of Designing Low-Level, High-speed Semiconductor Logic Circuits," W. B. Cagle and W. H. Chen of Bell Telephone Laboratories.

"A Wide-band Transistor Feedback Amplifier," R. P. Abraham of Bell Telephone Laboratories.

"Bose Current Feedback in Transistor Powder Amplifier Design," F. Boxall of Lenkurt Electric Co.

"Randomly Selected Transistor Output Pairs," W. F. Palmer and A. Anouch of Sylvania Electric Products.

"A Multi-stage Video Amplifier Design Method," J. J. Spilker, Jr. of Stanford University.

Session on "Microwave Components" (9:30 AM to noon)

"Microwave Applications of Gas Discharges in a Magnetic Field," O. T. Fundingsland of Sylvania Microwave Physics Laboratary.

"3-db Strip-Line Directional Couplers," J. K. Shimizu of Stanford Research Institute.

"Waveguide to Stripline Couplers," P. J. Sferrazza and H. Perini of Sperry Gyroscope Co.

"A New Type of Directianal Coupler for Coupling Coaxial Line to TE-10 Waveguide," R. F. Schwartz af the University of Pennsylvania.

"Coupling of Rectangular Waveguides Having o Common Broad Wall Which Contains Uniform Transverse Slots," J. A. Barkson of Hughes Reseorch Laboratories.

"Nonlinear Automatic Control Systems" (9:30 AM to noon)

"On the Design and Comporison of Contactor Control Systems," I. Fiugge-Lotz ond E. H. Lindberg of Stanford University.

"Phase-Plane Trajectories as a Tool in Analyzing Nonlineor Attitude Stabilizotion for Space Missile Application," J. L. Halvorsen of Lockheed Missile Systems Division.

"An Analysis of the Effects of Certain Non-

Four-day show and convention at San Francisco's Cow Palace will feature displays by more than 500 manufacturers and the presentation of 225 technical papers. Attendance may top 30,000.

Donald B. Harris
Chairman

Norman H. Moore
Show Vice-Chairman

lineorities on Servo-Mechanism Performance," C. L. Smith and C. T. Leondes of the Universitly of California at Los Angeles.
"Optimalizing Control-Design of a Fully Automatic Cruise Control System for a Turbojet Aircraft," William K. Genthe of John Oster Manufacturing Co.
"A General Method for Analyzing ond Synthesizing the Closed Loop Response of a Lineor and a Nonlinear Servomechanism," H. H. El-Sabbagh of Case Institute of Technology.

"Component Part Design and Performance" (9:30 AM to noon)

"Designing Reloys for High Reliability," D. H. Cunningham, Radio Corporation of America.
"A Stacked Ceramic Vacuum Relay," J. W. Doniels, Jennings Rodio Manufacturing Co.
"Development of a Guided Missile Program Timer," B. F. Hubbard, Hubbard Scientific Laboratories.
"Molded Metal Film Resistors," C. Wellard and S. J. Stein, International Resistance Co.
"Vitreous Enamel Dielectric Capacitors—A Key to Reliability," B. L. Weller, Vitramon, Inc.

"Electronics Research Abroad" (9:30 AM to noon)

"Wave Propagation Research at the University of Sydney." V. A. Bailey, Univ. of Sydney, Australia.
"Electronics Research at the University of Adelaide," L. G. H. Huxley, Univ. of Adelaide, Australia.
"Electronics Research in the Philips Laboratories," D. B. H. Tellegen and H. Rinia, Philips Laboratories, Eindhoven, Holland.
"The Electronics Research Program at Siemens and Halske," W. Veith Siemens and Halske, Munich, Germany.
"New Developments of the Strophotron," H. Haggblom and S. Tomner, Svenska Elektronror, Stockholm, Sweden.

"Information Theory" (9:30 AM to noon)

"The Information Rate of the Human Channel," J. R. Pierce, Bell Telephone Laboratories.
"Communication as a Game," N. M. Blachmon, Sylvania Electronic Defense Laboratory.
"Information Theory in the USSR," Paul Green, Lincoln Laboratory.
"A Coded Facsimile System," W. S. Michel, W. O. Fleckenstein and E. R. Kretzmer, Bell Telephone Laboratories.
"List Decoding for Noisy Channels," Peter Elios, Mass. Inst. of Technology.

"Models for Systems," Circuit Theory Symposium I (2 to 4:30 PM)

"Representation of Nonlinear Operators," L. A. Zadeh, Columbio University.
"Propogotion of Statisfics in Systems," Bernard Widrow, Mass. Inst. of Technology.
"Mixed, Distributed and Lumped Systems," O. J. M. Smith, University of California at Berkeley.
Ponel discussian, authors above and Brockway McMillan of Bell Telephone Laborotaries and W. K. Linvill of the Institute of Defense Analysis.

"Microwave Ferrite Devices" (2 to 4:30 PM)

"Multi-Element Ferrite Devices," Beaumont Division, Case Institute of Technology.
"Mixing in Ferrites at Microwave Frequencie P. H. Vartanian, Microwove Engineering Laboratories and E. N. Skimal of Sylvania Microwave Physics Laboratory.
"Viewpoints on Resonance in Ideal Ferrite Slabloaded Rectangular Waveguides," Harold Seidel, Bell Telephone Laboratories.
"Microsecond Ferrite Microwove Switch," Lawrence A. Blasberg and Harold Saltzman, Hughes Aircraft Co.
"Ferrite Switches in Radar Duplexers," A. H. McEuen and Jorgen P. Vinding, Cascade Reseorch Corp.

"Computer Systems" (2 to 4:30 PM)

"System Organization of the Mobidic Computer," John Terzian of Sylvonia Electric Products.
"The Nordic Computer," W. D. Rowe and T. A. Jeeves of Westinghouse Electric Corp. Research Laboratories.
"Interrogation in the Bizmac System," O. H. Propster, Jr. of Radio Corp. of America.
"A Reliable Character Sensing System for Documents Prepared on Conventional Business Devices," D. H. Shepard, P. F. Bargh and C. C. Heasly, Jr. of Intelligent Machines Research Corp.
"Optimum Character Recognition System Usin Decision Function," C. K. Chow of Burroughs Corporation.

"Component Part Design, Control and Assembly (2 to 4:30 PM)

"Circuit Components for High Voltoge DC Power Supplies," Victor Wouk of Beta Electric.
"Planning Your Components Process for Moximum Capability," O. H. Jensen of Sylvanio Electric Products.
"An Investigation of the Effects of Humidity ond Temperature on XXX-P Printed Wire Boords," John Spaulding of General Electric Co.
"Design Considerations for Ceramic Printed Circuit Packaging," J. H. Fabricius of Sprague Electric Co.
"A Study of Dielectric Absorption Test Methods for Capacitors to be Used in Differentiotin Integrating and Time Constant Application," R. W. France of U. S. Electronic Development Corp.

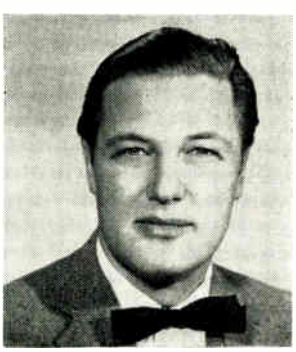
"Engineering Management (2 to 4:30 PM)

"Engineering Management in Brazil," Allen H. Schooley of Naval Research Laboratories.
"Evaluating Scientists and Engineers for a Reseorch ond Development Activity," Robert A. Martin of Hughes Research ond Develapment Laborotories.
"Your Self-Development into Supervision ond Management." H. M. O'Bryan of Sylvania Electric Products.
"The Transition from Engineer to Supervisor," Herbert M. Elliott of Radio Corporotion of America.
"Systems Engineering," Isaac L. Auerbach of Burroughs Corp.

"Antennas and Propagation" (2 to 4:30 PM)

"The 'Quarter-Wave Dipole'," Bengt Josephson of the Research Institute of Nationol Defense, Stockholm, Sweden.
"General Design Considerations for Transponder TACAN Antenna," E. G. Parker and A. Casobona of Federal Telecommunication Laboratories.
"Reflections from a Convex Surface," J. J. Brandstotter of Stanford Research Institute.
"Summary of Tropospheric Path Loss Measurements at 400 Mcps Over Distances of 25 to 830 Miles," J. H. Chisholm, W. E. Morrow, J. F. Roche ond A. E. Teachman of Massochusetts Institute of Techrology.

Bernard M. Oliver
Convention Vice-Chairman



Bruce S. Angwin
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Hugh P. Moore
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H. Myrl Stearns
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C. Frederick Wolcott
Board Member

Don Larson
Business Manager

Jeanne W. Jarrett
Recording Sec'y.

"Effects of Super-Refractive Layers on Tropospheric Signal Characteristics in the Pacific Coast Region," A. P. Barsis and F. M. Capps of the National Bureau of Standards.

WEDNESDAY, AUG. 21

"Semiconductor Devices" (9:30 AM to noon)

"A Silicon PNP Fused-Junction Transistor," Arthur L. Wannlund and Warren P. Waters of Hughes Aircraft Co.
"Complementary High Speed Power Transistors for Computer and Transmission Application," R. W. Bestberg and T. R. Robillard of Bell Telephone Laboratories.
"Transistors by Grown-Diffused Technique," Boyd Cornelison and Willis A. Adcock of Texas Instruments.
"A 5-Watt, 10-Megacycle Transistor," J. E. Iwerson, J. T. Nelson and F. Keywell of Bell Telephone Laboratories.
"Diffused 50-Watt Silicon Power Transistors," Robert Anderson and Elmer Wolff of Texas Instruments.

"Electronics in High Speed Flight" (9:30 AM to noon)

"Electronics in the B-52 Bomber," Raymond L. Shahan of Boeing Airplane Co.
"Electronics in Aeronautical Research," James A. White of Ames Aeronautical Laboratory.
"Role of Electronic Trajectory Measurement Systems in Missile Test," Vernon Miller of White Sands Proving Ground.
"Missile Aerophysics Phenomena of Electronic Import," Daniel Bershader of Lockheed Missile Systems Division.

"Sampled Data Control Systems" (9:30 AM to noon)

"Optimal Nonlinear Control of Saturating Systems by Intermittent Action," R. E. Kalman of Columbia University.
"Additions to the Modified z-Transform Method," E. I. Jury of the University of California at Berkeley.
"Additional Techniques for Sampled Data Feedback Problems," G. M. Kranc of Columbia University.
"Signal Flow Reductions in Sampled-Data Systems," John M. Salzer of Magnavox Research Laboratories.
"Conditional Feedback Systems Applied to Stabilization of Missile Pitch Attitude," D. R. Katt of Lockheed Missile Systems Division.

"Communications Systems Engineering" (9:30 AM to noon)

"A Detailed Description of the Synchronous Detection Process," John Webb of General Electric Co.
"Design Principles of High Stability Frequency Synthesizers for Communications," N. H. Young and V. L. Johnson of Federal Telecommunications Laboratory.
"Microwave Systems—Pipeline Style," F. Vinton Long of Texas Eastern Transmission Corp.
"An Experimental Data Transmission System Speed Translator Using Magnetic Tape," W. A. Malthaner of Bell Telephone Laboratories.

"Military Research Requirements in Electronics (9:30 AM to noon)

"Role of Basic and Applied Electronics Research in the Defense Program," J. M. Bridges of the Office Assistant Secretary of Defense.
"Air Force Requirements in Basic and Applied Electronics Research," L. O. Hollingsworth of Air Force Cambridge Research Center.
"Army Requirements in Basic and Applied Electronics Research," Harrison J. Merrill of the Signal Engineering Laboratory.
"Navy Requirements in Basic and Applied Electronics Research," Arnold Shostak of the Office of Naval Research.

"Microwave Antennas" (9:30 AM to noon)

"Mutual Coupling in Two-Dimensional Arrays," J. Blass and S. J. Rabinowitz of W. L. Maxson Corp.
"Scattering of Microwaves by Figures of Revolution," J. S. Honda of Stanford Research Institute.
"Pulsed Operation of Traveling-Wave Monopulse Arrays Utilizing Phase Comparison Techniques," C. E. Phillips of Convair.
"Feed Optimization in Multi-Feed Antennas," J. A. Kuecken of General Electric Co.
"Note on a Technique for Analyzing Three-Dimensional Scanning Antenna Performance," F. J. Gardiner of I-T-E Circuit Breaker Co.

"Semiconductor Devices" (2 to 4:30 PM)

"Resistance of Silicon Transistors to Neutron Bombardment," R. C. Gillis and J. W. Tarzwell of Autonetics.
"Medium Power Silicon Rectifier," Raymond J. Andres and Earl L. Steele of Motorola.
"Diffused Silicon Diodes—Design, Characteristics and Life Data," Paul Zuk, J. H. Wiley and H. E. Hughes of Bell Telephone Laboratories.
"Some Silicon Junction Diode Recovery Phenomena," Thomas E. Firle of Hughes Aircraft Co.
"The Nesistor—A Semiconductor Negative Resistance Device," Robert G. Pohl of The Rauland Corp.

"Microwave Instrumentation" (2 to 4:30 PM)

"Phase Stabilization to Microwave Frequency Standards," E. F. Davis of Jet Propulsion Laboratory.
"The Theoretical Sensitivity of the Dicke Radiometer," L. D. Strom of Texas Instruments.
"Homodyne Generator and Detection System," G. C. Mathers of Hewlett-Packard Co.
"Frequency Translation by Phase Modulation," Elizabeth M. Rutz and Jack E. Dye of Emerson Research Laboratories.
"Equipment and Techniques for the Measurement of Radar Reflections from Model Targets," Peter D. Kennedy of Ohio State University.

"Statistical Methods in Feedback Control" (2 to 4:30 PM)

"Control System Optimization to Achieve Maximum Hit Probability Density," G. S. Axelby of Westinghouse Electric Corp.
"Statistical Analysis of Sampled Data Systems," G. E. Johnson of IBM Corp.
"Non-Linear Amplitude-Sensitive Control Systems with Stochastic Inputs," D. W. C. Shen of the University of Pennsylvania.
"Gain Modulation in Servomechanisms," J. F. Buchan and R. S. Raven of Westinghouse Electric Corp.

"Crystal Filters," a Symposium (2 to 4:30 PM)

"Historical Notes on Crystal Filters," A. R. D'Heedene of Bell Telephone Laboratories.
"Present Design Approaches," D. I. Kosowsky of Hycon-Eastern.
"Test Procedures and Instrumentation," Alvin Strouss of Bulova Watch Co.
"Present Performance Limitations." W. R. Ives and D. L. Hammond of Scientific Radio Products.
"Future Design and Performance," L. Storch of Hughes Aircraft Co.

"TV and Radio Broadcasting" (2 to 4:30 PM)

"Traveling Wave VHF Television Transmitting Antenna," M. S. O. Siukola of Radio Corporation of America.
"Video Tape Recorder Symposium," Participants: Ross Snyder and Charles Ginsburg of Ampex Corp. and representatives of networks using the recorders.
"Understanding the Artist's Problem in Telecasting," William Wagner of KRON-TV, San Francisco.
"A Compatible Single-Sideband System Designed for the Broadcast Service," Leonard R. Kahn, Research Laboratories.
"A Stable Precision Television Demodulator," Herb Hartmen of KCRA-TV, Sacramento.
"Operation, Maintenance and Field Tests of Quadrature-fed Antennas," Harry Jacobs of KGO-TV, San Francisco.

"Data Handling Devices" (2 to 4:30 PM)

"Magnacard—A New Concept in Data Handling," R. M. Hayes and J. Wiener of The Magnavox Research Laboratory.
"Magnacard—Mechanical Handling Details," A. M. Nelson, H. Stern and L. Wilson of The Magnavox Research Laboratory.
"Magnacard—Magnetic Recording Studies," J. Burkig and L. Justice of The Magnavox Research Laboratory.
"A Very High Speed Punched Paper Tape Reader," A. M. Angel of National Cash Register Co.
"An Air-Floating Disc Magnetic Memory System," W. Farrand of North American Aviation.

"Controlled Nuclear Fusion" (8 to 9:30 PM)

Discussions on controlled nuclear fusion, to be led by Luis Alvarez of the University of California, Berkeley, and featuring a paper by Herbert York of the Livermore Laboratory of the University of California.

THURSDAY, AUG. 22

Session on "Computers in Network Synthesis" (9:30 AM to noon)

"Digital Computers and Network Theory," T. R. Bashkow and C. A. Desoer of Bell Telephone Laboratories.
"Network Analysis and Synthesis by Digital Computer," W. Mayeda and M. E. Van Valkenburg of the University of Illinois.
"Computers in R-C Network Synthesis," S. Mason of Massachusetts Institute of Technology.
"Digital Computers as Tools in Designing Transmission Networks," D. T. Bell of Bell Telephone Laboratories.

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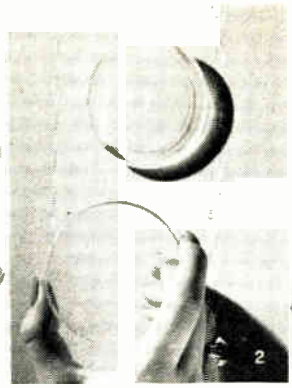
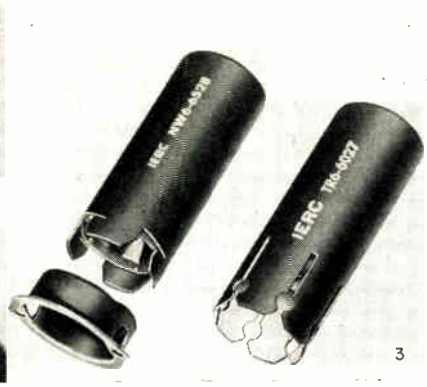
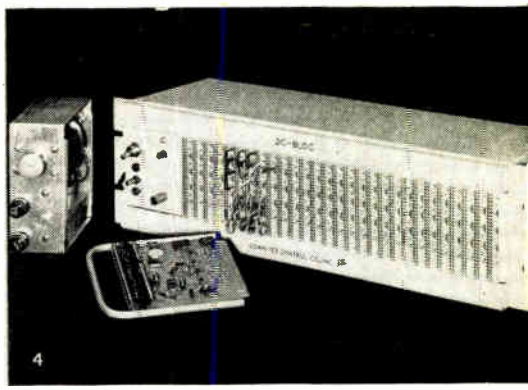
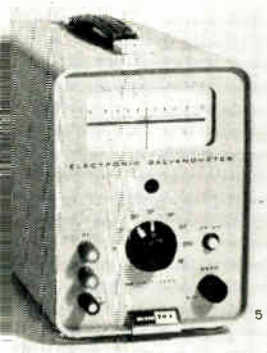


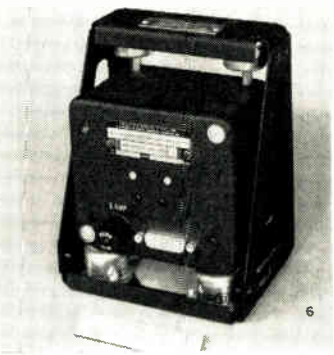


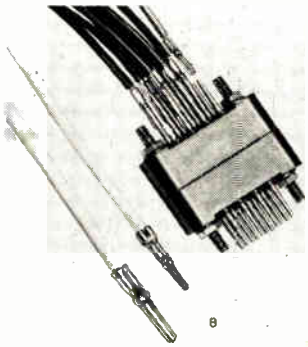


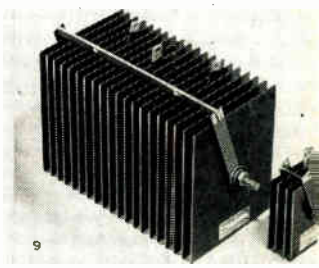
See These Products At WESCON

Displays by more than 500 exhibitors will feature the 4-day show at San Francisco's Cow Palace









1—Variable Transformer

Powerstat variable transformer Type LW 136 is a double wound assembly with an isolated secondary on a single core. The Superior Electric Co. **Booth 2109.**

Circle 219 on Inquiry Card, page 109

2—Sapphire Disk

The 3 in. crystal-clear disk is 175 carats of synthetic sapphire. It is similar to the ones which are part of numerous infra-red systems. Linde Company. **Booth 2204.**

Circle 220 on Inquiry Card, page 109

3—Heat Dissipating Shields

Type NW-6528 shield was designed especially for the Bendix 6094 tube. Shield will lower the temperature more than 60°C. International Electronic Research Corp. **Booth 602.**

Circle 221 on Inquiry Card, page 109

4—Plug-in Modules

The series T line of universal transistorized 1 MC dynamic logical plug-in modules is for digital systems. Has available 29 plug-in positions. Computer Control Co., Inc. **Booth 117.**

Circle 222 on Inquiry Card, page 109

5—Electronic Galvanometer

Model 204A is a combination dc null detector linear deflection indicator, microvoltmeter, micro-microammeter, and low level dc amplifier. KinTel (Kay Lab). **Booth 603.**

Circle 223 on Inquiry Card, page 109

6—Antenna Selector

Uninterrupted in-flight communications are assured by this automatic miniature, transistorized antenna switch. Autonetics, div. of North American Aviation, Inc. **Booth 2617.**

Circle 224 on Inquiry Card, page 109

7—Germanium Diodes

These new units have the properties of high conductance and quick recovery combined. All types are packaged in a fusion-sealed glass envelope. Hughes Products. **Booth 2912.**

Circle 225 on Inquiry Card, page 109

8—Taper Pins

Miniature taper pin receptacle eliminates tedious, costly operations of soldering leads to miniature connectors. Pins available for wire sizes 24-12 AWG. AMP, Inc. **Booth 2319.**

Circle 226 on Inquiry Card, page 109

9—High Current Selenium

Individual rectifier plates are capable of handling twice the current of conventional plates of the same dimensions. International Rectifier Corp. **Booth 1502.**

Circle 227 on Inquiry Card, page 109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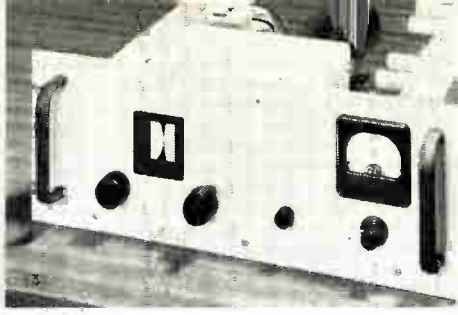
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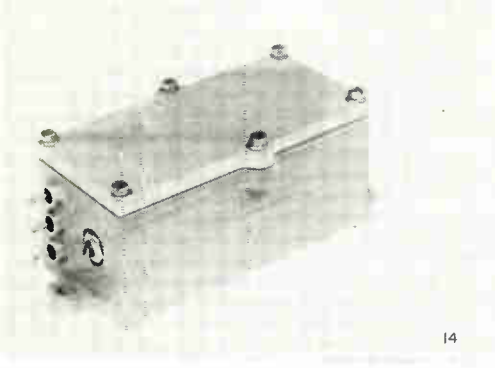
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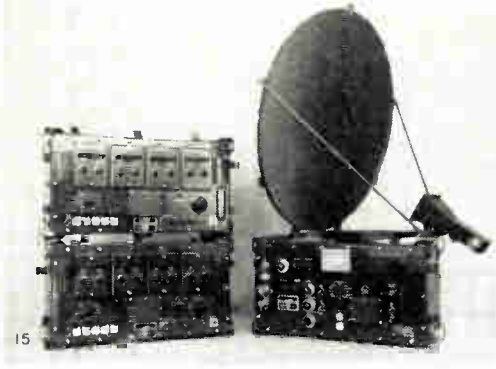
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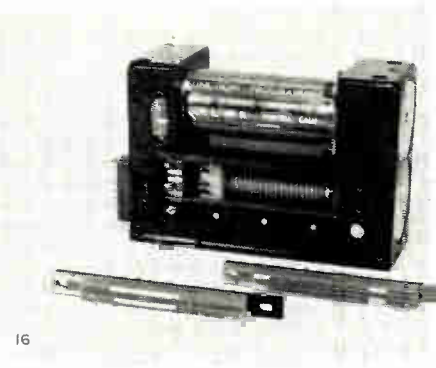
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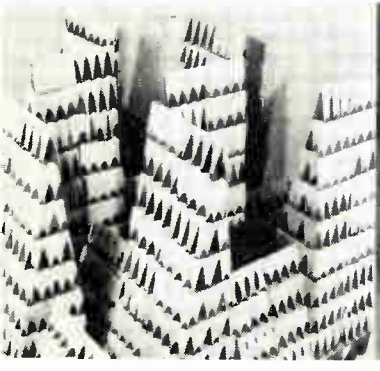
See These Products At Wescon

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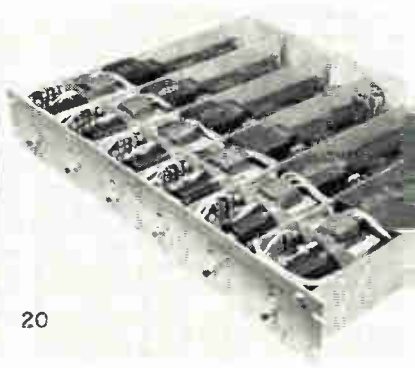
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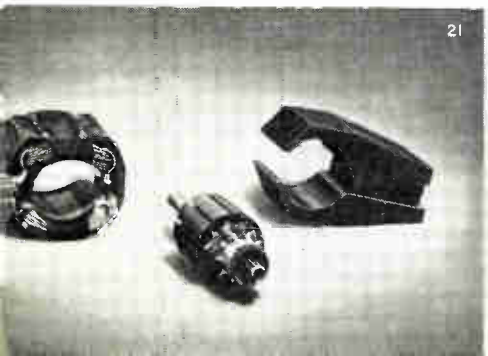
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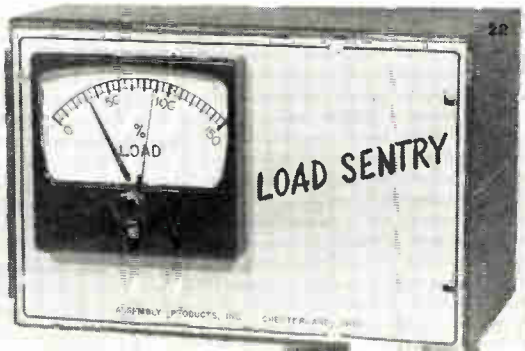

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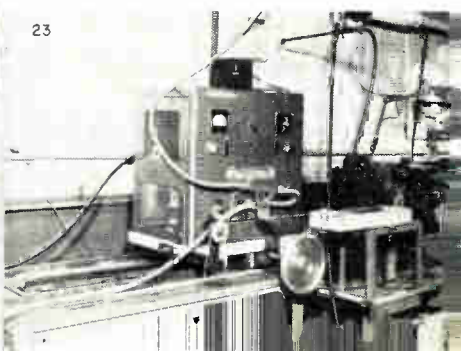
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10—Servo-Ratio Multimeter

A highly accurate computer test instrument designed to measure ac-dc ratios, absolute ac-dc voltages, and resistance. Union Switch & Signal. **Booth 810.**

Circle 228 on Inquiry Card, page 109

11—4-Millimeter Klystron

The DX151 is a waveguide-output reflex klystron tunable over a minimum of 6 KMC. in the range from 65.5 to 77.5 KMC. Electrostatic focusing. Amperex Electronic Corp. **Booth 3206.**

Circle 229 on Inquiry Card, page 109

12—Dual Frequency Fan

Fans will operate on either single or 3 phase power, any specified voltage and in accordance with mil specs. Fans deliver from 75 to 115 cfm at 60 cps. Rotron Mfg. Co. **Booth 2813.**

Circle 230 on Inquiry Card, page 109

13—1 MC Signal Source

Ultra Stable Oscillator offers good frequency stability at a frequency of 1 MC. Useful for precise frequency control or time measurements. Hycon Eastern, Inc. **Booth 815.**

Circle 231 on Inquiry Card, page 109

14—Accelerometers

They are designed to cover a wide range of varying types of accelerations. Potentiometer pick off is used for electrical output. Fairchild Controls Corp. **Booth 3021.**

Circle 232 on Inquiry Card, page 109

15—Radio Set

Radio Set AN/TRC-27 is a miniaturized eight-channel microwave relay system which performs all the functions of a powerful communications ctr. Raytheon Mfg. Co. **Booth 2903.**

Circle 233 on Inquiry Card, page 109

16—Function Programmer

This electro-mechanical device provides up to 32 switching and potentiometer functions in relation to time. Designed for missiles application. Hubbard Scientific Labs. **Booth 2130.**

Circle 234 on Inquiry Card, page 109

17—Microwave Absorber

The type BL-48 microwave absorber is made of an inert plastic foam material and can be used for both indoor and outdoor applications. McMillan Industrial Corp. **Booth 518.**

Circle 235 on Inquiry Card, page 109

18—Galvanometer Amplifier

Model 307-A is a low-drift amplifier for use with wire strain gages, transducers, thermocouples, etc. It will drive most galvanometers. Allegany Instrument Co., Inc. **Booth 3306.**

Circle 236 on Inquiry Card, page 109

19—Electromechanical Parts

Control system design, experimental and developmental work can be facilitated by the use of these standard breadboard parts. Beckman/Helipot Corp. **Booth 1406.**

Circle 237 on Inquiry Card, page 109

20—Strain Gage Supplies

Model 7P01 specifications are 115 v., 60 cycle input; 10 vdc output, adjustable from 9-11 vdc with a 10-turn potentiometer. Western Gear Corp. **Booth 2401.**

Circle 238 on Inquiry Card, page 109

21—Ceramic Permanent Magnets

Indox V is highly-oriented, barium ferrite permanent magnet. It is hard, brittle, and much lighter in weight than metallic magnets. The Indiana Steel Products Co. **Booth 2003.**

Circle 239 on Inquiry Card, page 109

22—Overload Control

The new electro-mechanical control is intended for use whenever overload of any kind may be registered on an electric motor. Assembly Products, Inc. **Booth 2919.**

Circle 240 on Inquiry Card, page 109

23—Wire Stripping Equipment

Wire stripping technique reduces wire preparation costs by over 50 per cent. All hand retwisting and retinning operations are eliminated. Reeves Electronics, Inc. **Booth 2206.**

Circle 241 on Inquiry Card, page 109

24—Indicating Fuseholder

The HKA fuseholders can activate a visible or audible signal when used in combination with a BUSS GLD indicating fuse in addition to indicating lamp. Bussman Mfg. **Booth 1817.**

Circle 242 on Inquiry Card, page 109

25—Miniature Relays

Miniature relays were designed for aircraft and missiles. Weight, size, contact capacity, shock, vibration and most important, sensitivity are good. Pacific Relays, Inc.

Circle 243 on Inquiry Card, page 109

26—Multi-Control Relay

Miniature telephone-type multi-contact relays are especially suited for aircraft guided missiles, data processing and 2-way radio. Phillips Control Corp. **Booth 419.**

Circle 244 on Inquiry Card, page 109

27—Waveguide Frequency Meter

The model X532A gives direct frequency readings in the X Band range with an accuracy of 0.8 per cent. No calibration is necessary. Hewlett-Packard Co. **Booth 1621.**

Circle 245 on Inquiry Card, page 109

28—Transistorized Packaged Circuitry

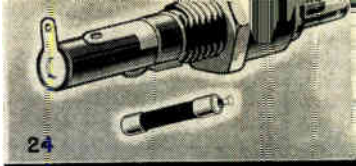
This plug-in P series has been designed to fit a standard 7 pin miniature socket with a shield base and can be retained conveniently. The Walkirt Co. **Booth 501.**

Circle 246 on Inquiry Card, page 109

29—Electronic Breadboarding

Individual plate-modules, which are easily removed for layout modifications. Panels then can be assembled to form a standard chassis. U.M & F. Mfg. Corp.

Circle 247 on Inquiry Card, page 109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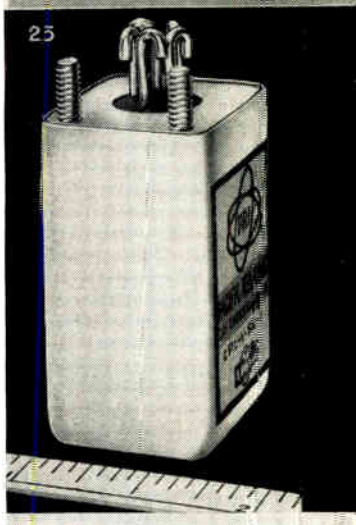
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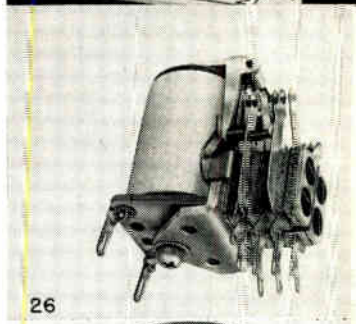
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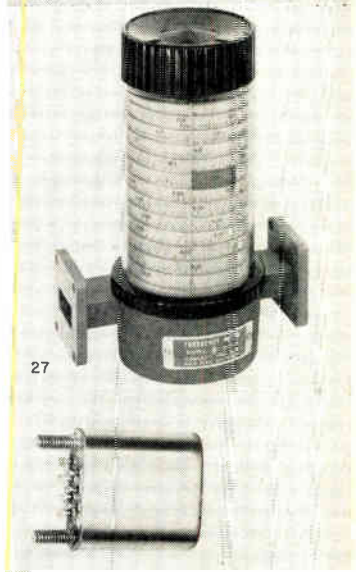
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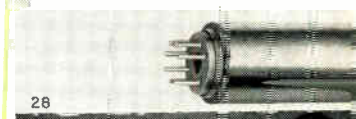
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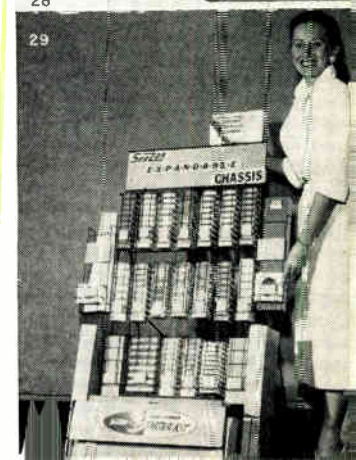

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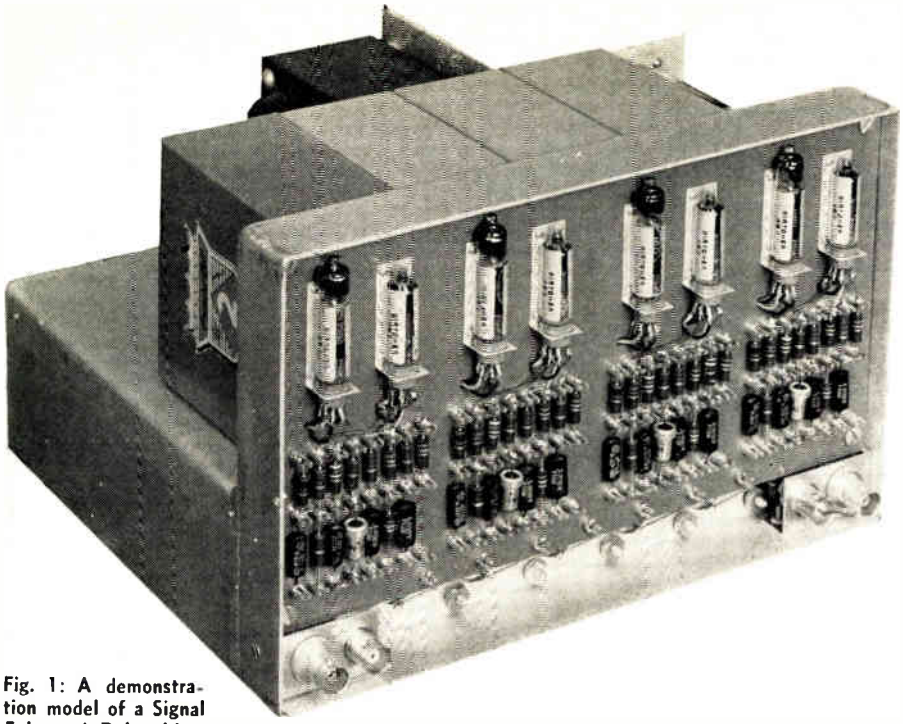

Fig. 1: A demonstration model of a Signal Enhanced Delay Line.

Signal Enhanced Delay Line

By selective amplification, high frequency response of a given line is improved to maintain pulse shape. Where narrow pulse reproducibility overshadows added complexity, this equipment will be much used.

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T. I. Humphreys

The principle we have used in our development of the Signal Enhanced Delay Line is to utilize several sections of line to achieve the total delay, and to reconstitute the pulses after every section. This will be more fully explained later. In very long (on the order of 100 μsec or more) delays, we can improve the wave shape at the end of the delay line by the use of successive repetitive sections for delays and reconstitution.

Description

We call this delay line a "Signal Enhanced Delay Line." The line consists of several sections, each composed of a delay line, an amplifier, a video transformer, a clipping diode and a cathode follower. Fig. 2 is the circuit diagram for one section.

The operation of each section is very simple. Pulse signals are passed down the delay line where they are delayed and attenuated. The signals are then fed to the grid of an amplifier. The output signals from the plate of the amplifier are inverted by a video transformer. The inverted output is fed through a diode where some clipping occurs. The output from the diode then goes to the grid of a cathode follower. The output from the cathode is used to drive the next section of line.

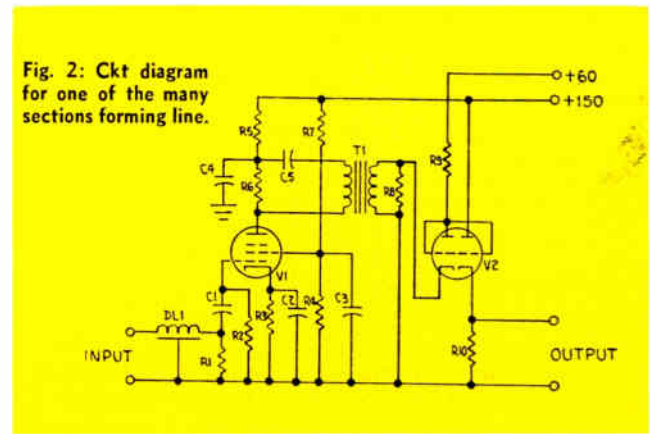


Fig. 2: Ckt diagram for one of the many sections forming line.

The attenuation of the signals going down a distributed constant delay line varies with the frequency of the signal. The high frequency components of the signal are attenuated more than the low frequency components, which tends to round off the pulse so that after a long delay the pulse may or may not have a distinguishable shape.

An example of sending a 0.5 μsec pulse down a delay line having an over-all bandpass of about 2 MC is shown in Fig. 3. Fig. 3a shows the input pulse train of 0.5 μsec pulses spaced 1.5 μsec apart. Fig. 3b shows the signal at the end of 20.3 μsec delay, using a distributed constant delay line. Fig. 3c shows the pulse after a 35 μsec delay.

The loss in pulse shape and amplitude is great; great enough, as shown in the bottom waveform to cause the pulse almost to disappear. Later we will use this same delay line with several stages of signal enhancing to show how a poor line can be made much better by this process. Fig. 4 shows the attenuation as a function of frequency for a 20.3 μsec distributed constant delay line.

Operation

In the operation of a Signal Enhanced Delay Line, pulse signals from the delay line are fed to the grid of V-1, Fig. 2. Here, by selective frequency amplification, an attempt is made to amplify the high frequency components in relation to their loss in the delay line. This is our objective. While we have not achieved complete compensation, we believe we have made considerable improvement.

Initially, we tried to use a second tube to invert the signals and to drive the next section. This was unsatisfactory due to the limited dynamic range of the grid, which caused the low level signals to be unduly amplified so that after a couple of stages the inevitable reflections from the line dominated the picture.

Since this try was not successful, a transformer for inverting the pulses was tried. Due to a large number of pulses and the varying widths of pulses which must be passed, it is necessary to have a transformer with a wide frequency bandpass. A bandpass of from a few hundred cycles to 10 MC is desirable.

Since a transformer of this type was not available, work was initiated by Mr. R. Hansen of Transonic Inc. to produce one. The resulting transformer was able to pass a very narrow pulse, such as from the Hewlett-Packard 212A, without appreciable distortion. It was also able to pass a relatively wide pulse.

Using a 500 cps square wave as the input, an output was obtained that was down 50% at the end of each square wave. The bandpass characteristics of the transformer are shown in Fig. 5. The transformer has a nominal input impedance of 1500 Ω and an output impedance of 680 Ω.

The transformer was designed to invert the signals. Its bandpass for non-inverting use is considerably poorer than for inverting use. In our use, dc is kept out of the primary winding by the use of an isolating capacitor. When considerable dc is passed through the primary winding, the low frequency response is poorer than when there is no dc present.

(*Continued on page* 165)

Fig. 3: Pulse deterioration caused by distributed constant line.

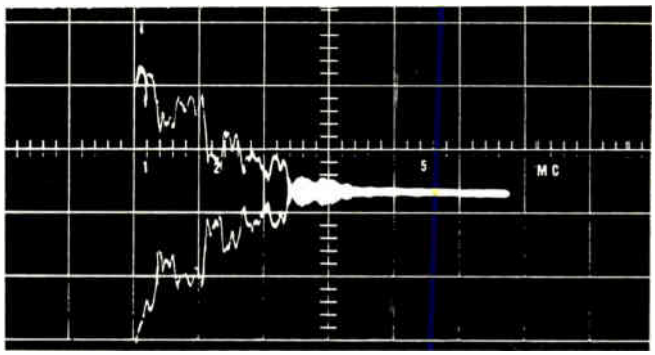


Fig. 4: Bandpass characteristics of 20.3 μsec distributed constant line.

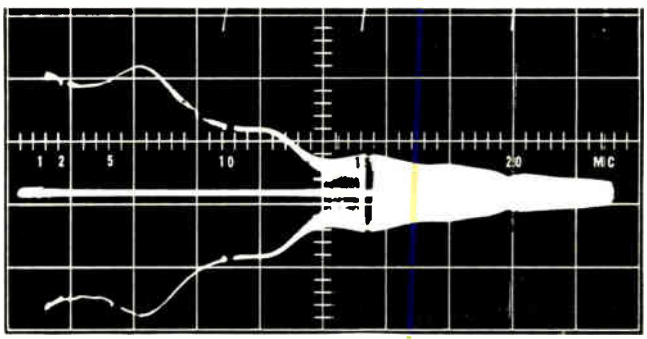
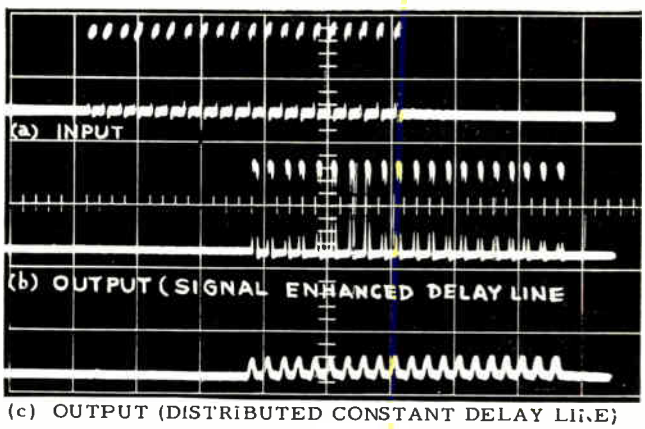


Fig. 5 (above): Bandpass characteristics of the video amplifier.

Fig. 6 (below): Input (a), enhanced output (b), and unenhanced output (c).



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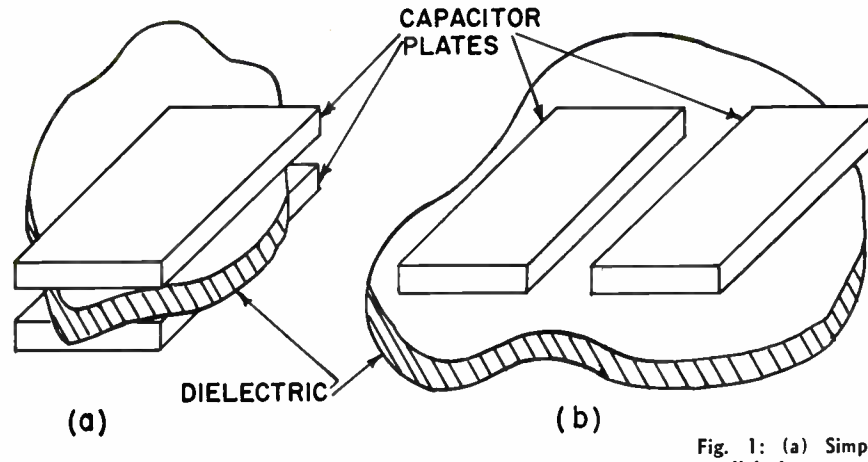


Fig. 1: (a) Simple parallel plate capacitors. (b) Strip line capacitors. Value is complex function of the dielectric constant.

Evaluating Base Materials For Printed Capacitors

Beyond the considerations of conventional capacitor design, printed circuits introduce the elements of dissipation factor and loss factor. Designers must consider these characteristics under the conditions which the circuitry will operate

WITH the advent of printed circuits, the design engineer must necessarily design his own capacitors. One of the first problems to be considered is the selection of a base material for the printed circuit. Many electronic engineers are quite familiar with such terms as dielectric constant and power factor; however, in the evaluation of base materials, one encounters terms such as dissipation factor and loss factor, which may be confusing. In this article, an attempt is made to clarify these terms and describe their importance in the selection of suitable dielectrics for printed circuit capacitors.

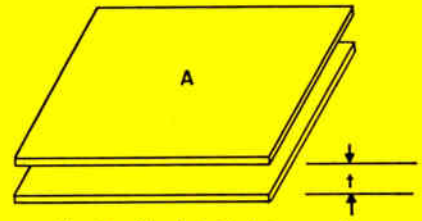


Fig. 2: Classical 2-plate capacitor.

Dielectric Constant

The dielectric constant is the property of a base material most often specified, and perhaps the most important. If fringing effects are neglected, the capacitance across the 2 plates shown in Fig. 2 may be calculated by the formula:[1]

$$C = 0.2244\ K\ A/t\ (\mu\mu f), \qquad (1)$$

where, A = face area common to each capacitor plate in square inches,
t = thickness of dielectric in inches, and
K = dielectric constant.

It can be seen from this simple relationship that when the dielectric constant of the base material increases, the capacitance also increases, provided the dimensions remain unchanged. More important, perhaps, this relationship shows that for a given capacity the required face area is decreased as the dielectric constant is increased. This is especially important in printed circuit capacitors since neither large areas nor multiple plates are practical.

The value of the typical printed circuit capacitor shown in Fig. 1a is, therefore, a direct function of the dielectric constant. Similarly the value of the capacitor shown in Fig. 1b is also a function of the dielectric constant but a much more complicated one involving not only the dielectric constant but also dimensions other than thickness. Calculating the value of capacitors of this type and other similar configurations is beyond the scope of this article.

For this discussion it is sufficient to say that the value of a printed circuit capacitor is primarily a function of the dielectric constant of the medium and the boundary dimensions. The quality of the capacitor, on the other hand, is a function of the type and quantity of losses in the base material A general

understanding of some of these losses will simplify the choice of base materials.

Dielectric Loss

The American Standards Association (ASA) defines the dielectric loss as the time rate at which electric energy is transformed into heat in a dielectric when it is subject to a changing electric field.[2] The dielectric loss, thus defined, consists primarily of leakage and dielectric absorption, the latter usually being the most important.

Since both of these factors are affected by moisture and temperature the base material must be evaluated for the extreme conditions expected in service. These 2 dielectric losses are usually lumped together and described implicitly in a dielectric power factor or a dielectric loss factor.

Because of the losses in this dielectric there will be current flow in phase with the applied voltage as well as in time quadrature with it. A vector diagram of this relationship is shown in Fig. 3a. From this diagram it is apparent that the total current through the dielectric is the vector sum of the reactive current due to an ideal capacitor and the in phase current resulting from the losses.

The dielectric may be represented by an ideal capacitor and resistance in parallel as shown in Fig. 4. It should be noted that both C and R are functions of frequency and the environment such as temperature and humidity. For any narrow range of frequencies, however, the equivalent circuit presentation is valid. The power factor can be derived from this equivalent circuit in the same manner as in elementary ac circuits.

Power Factor

Returning to the ASA, one finds the power factor defined as the ratio of active power to apparent power.[2] This ratio is given some meaning by the vector diagram shown in Fig. 3b. This vector diagram is identical to the one for the dielectric current of Fig. 3a except that the names of the vectors have been changed.

Applying basic trigonometry to the definition of the power factor reveals that the

$$\text{P. F.} = \cos\theta = \sin(90\text{-}\theta) = \sin\delta,$$

where θ is the angle between the total current and the applied voltage and δ is the angle between the reactive current and the total current. The angle δ has also been called the dielectric loss angle.

Dissipation Factor

A frequently used term, the dissipation factor, or loss tangent, has been defined as the ratio of energy dissipated per cycle to energy stored per cycle.[2] Again applying basic trigonometry to the vector diagram one finds that

$$D = \tan\delta$$

where D is the dielectric dissipation factor.

It is interesting to note that the definition of the dissipation factor is the inverse of the figure of merit, or *Q*, used in describing the quality of completed capacitors. As the angle δ becomes small, both $\sin\delta$ and $\tan\delta$ approach the angle δ itself. Thus, if the loss is small in comparison to the other quantities involved, the power factor and dissipation factor are equal.

Loss Factor

Another expression sometimes used, the dielectric loss factor, has been defined by the ASA as the product of its dielectric constant and, the tangent of its dielectric loss angle.[2]

A physical interpretation may help give significance to the expression, dielectric loss factor. Practically, the dielectric loss factor is the ratio of energy dissipated in the dielectric per cycle to the energy which would be stored if the dielectric were air.

Although this term is not used directly in calculations of capacitance quality and quantity, it is useful

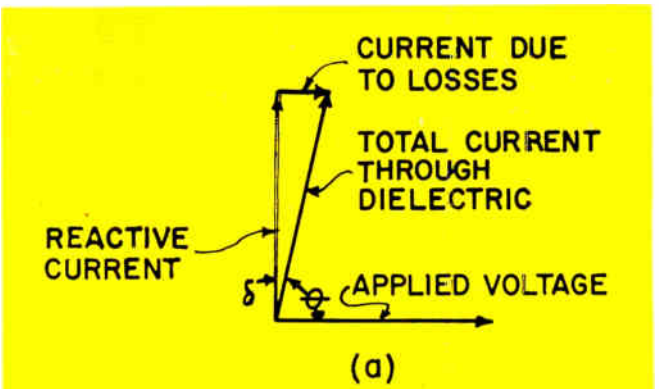


Fig. 3a: Dielectric loss current is also considered.

in some of the more complete calculations of simple components as well as distributed constant components. The definition is given here because the characteristics of some materials are specified in these terms.

Typical Design

Suppose a high Q capacitance of 5μμf was required in the circuitry of a specific piece of equipment. Further, that this capacitor was part of a 30 MC i-f

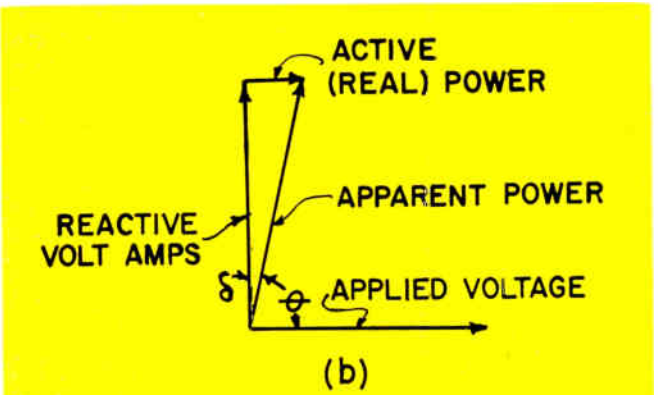


Fig. 3b: Power relationships are similar to current.

tuned circuit to be constructed separately and assembled to the main printed circuit board. This allows the design engineer to choose a base material on a basis of electrical properties rather than its mechanical properties.

Using the formula given previously for a simple 2 plate capacitor as shown in Fig. 2, the area required is given by

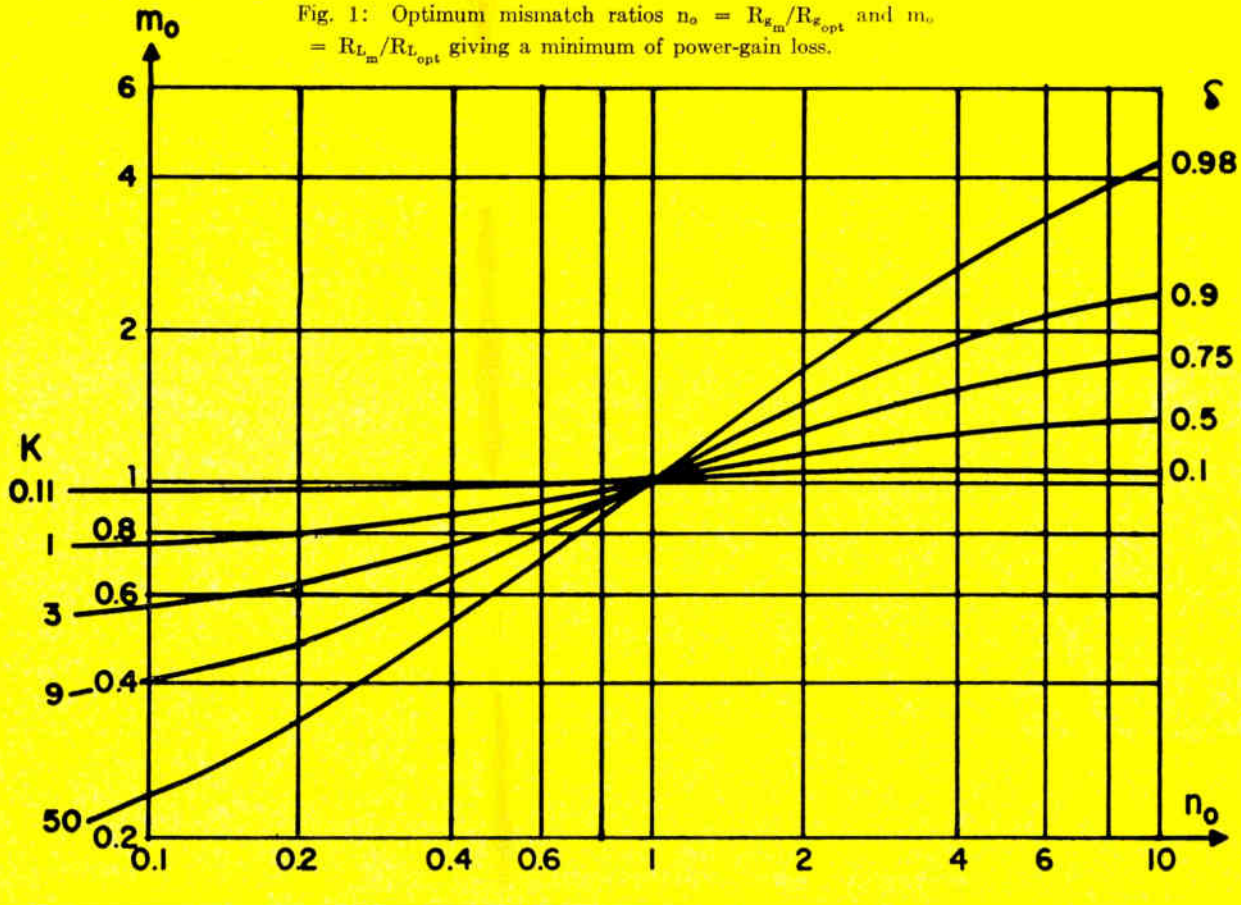
(*Continued on page* 159)

Minimizing Mismatch Loss

Mismatch of an amplifier input circuit can be compensated by a mismatch of the load, and vice versa. Simple formulas or curves give the compensating mismatch value. A second family of curves show loss of power gain below the maximum gain available with matched input and output.

By DR. HANS ERICH HOLLMANN
Consultant Physicist
Studio City, California

Fig. 1: Optimum mismatch ratios $n_o = R_{g_m}/R_{g_{opt}}$ and $m_o = R_{L_m}/R_{L_{opt}}$ giving a minimum of power-gain loss.



A PERFECT match in the input and output circuits of an amplifier is not always possible. If one mismatch condition must exist, power gain can be optimized by deliberately introducing a second mismatch in the other circuit. The conditions for optimizing mismatch gain can be derived as follows:

The general schematic of an active four-terminal circuit element such as a vacuum tube or a transistor in any one of its three configurations is diagrammed in Fig. 3. With the generator and the load included, Kirchhoff's equations can be written in the form

$$(R_g + r_{11})\, i_1 + r_{12}\, i_2 = v$$
$$r_{21}\, i_1 + (r_{22} + R_L)\, i_2 = 0$$

The matrix is

$$\begin{matrix} R_g + r_{11} & r_{12} \\ r_{21} & r_{22} + R_L \end{matrix}$$

with the determinant

$$\Delta = (R_g + r_{11})(r_{22} + R_L) - r_{12}\, r_{21}$$

The power gain is given by the formula

$$A_p = 4\, R_g R_L \left(\frac{r_{21}}{\Delta}\right)^2 = \frac{4\, R_g\, R_L\, r_{21}^2}{\left[(R_g + r_{11})(r_{22} + R_L) - r_{12} r_{21}\right]^2} \quad (1)$$

With the aid of the short-circuit stability

$$\delta = \frac{r_{12}\, r_{21}}{r_{11}\, r_{22}}$$

Eq. (1) assumes the form

$$A_p = \frac{r_{21}}{r_{12}} \frac{R_g\, R_L}{\left[\left(1 + \frac{R_g}{r_{11}}\right)\left(1 + \frac{R_L}{r_{22}}\right) - \delta\right]^2}$$

If the r-parameters are replaced with the hybrid parameters, it is convenient to introduce the number

$$K = \frac{\delta}{1 - \delta} = -\frac{h_{12}\, h_{21}}{h_{11}\, h_{22}}$$

so that the gain formula can be written

$$A_p = \frac{h_{21}}{h_{12}} \frac{R_g\, R_L\, K\,(1 + K)}{\left[\left(1 + K + \frac{R_g}{h_{11}}\right)\left(1 + h_{22} R_L\right) - K\right]^2}$$

Maximum gain requires matched generator and load resistances

$$R_{g_{opt}} = r_{11}\sqrt{1 - \delta} = h_{11}\sqrt{1 + K}$$

$$R_{L_{opt}} = r_{22}\sqrt{1 - \delta} = \frac{1}{h_{22}\sqrt{1 + K}}$$

which then gives the maximum available gain under perfect matching conditions

$$A_{p_{max}} = \frac{r_{21}}{r_{12}} \frac{\delta}{\left[1 + \sqrt{1 - \delta}\right]^2} = \frac{h_{21}}{h_{12}} \frac{K}{\left[1 + \sqrt{1 + K}\right]^2} \quad (2)$$

The circuit designer often finds that the source or load impedance is given and cannot be adjusted according to the optimum value. Nevertheless, the mismatch on one side can be compensated by a mismatch of the opposite side, in other words, a mismatched source can be compensated by a mismatched load and vice versa. In order to evaluate the relationship between the optimum mismatch values which, under the prevailing mismatch conditions, give the best power amplification, the source resistance may be expressed in terms of multiples or fractions of the optimum generator impedance

$$R_{g_m} = n\, R_{g_{opt}} = n\, r_{11}\sqrt{1 - \delta} = n\, h_{11}\sqrt{1 + K}$$

and the load resistance in terms of multiples of the optimum value

$$R_{L_m} = m\, R_{L_{opt}} = m\, r_{22}\sqrt{1 - \delta} = \frac{m}{h_{22}\sqrt{1 + K}}$$

With these values, Eq. (1) assumes the form

$$A_{p_m} = 4\frac{r_{21}}{r_{12}} \frac{n\, m\, \delta\,(1 - \delta)}{\left[\left(1 + n\sqrt{1 - \delta}\right)\left(1 + m\sqrt{1 - \delta}\right) - \delta\right]^2}$$

The derivative with respect to m becomes zero and the power gain passes an optimum if the condition

$$\left(1 + n\sqrt{1 - \delta}\right)\left(1 - m\sqrt{1 - \delta}\right) - \delta = 0$$

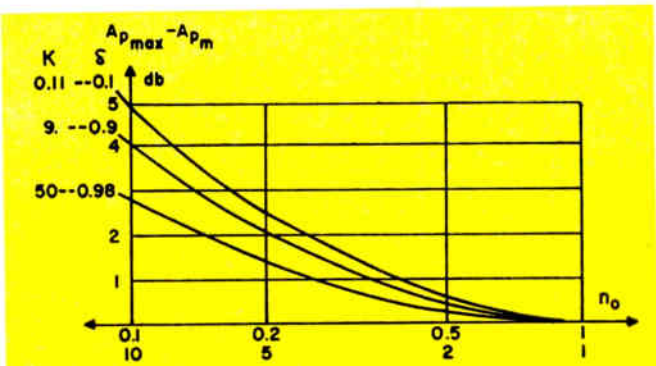


Fig. 2: The loss of power-gain as compared to the maximum available gain versus n_o with δ or K as parameter.

is fulfilled. This optimum condition can be solved for m_o or n_o thus giving

$$m_o = \frac{n + \sqrt{1 - \delta}}{1 + n\sqrt{1 - \delta}} = \frac{1 + n\sqrt{1 + K}}{n + \sqrt{1 + K}}$$

and

$$n_o = \frac{m - \sqrt{1 - \delta}}{1 - m\sqrt{1 - \delta}} = \frac{1 - m\sqrt{1 + K}}{M - \sqrt{1 + K}}$$

The curves portrayed in Fig. 1 illustrate the relationship between the optimum mismatch ratios $m_o = F(n)$ or $n_o = F(m)$ with various values δ or K as parameters.

The introduction of the compensation ratios n_o and m_o into the power gain equation results in the formulas

$$A_{p_m} = \frac{r_{21}}{r_{12}} \frac{\delta}{\left(1 + n_o\sqrt{1 - \delta}\right)\left(1 + \frac{\sqrt{1 - \delta}}{n_o}\right)}$$

$$= \frac{h_{21}}{h_{12}} \frac{K}{\left(n_o + \sqrt{1 + K}\right)\left(\frac{1}{n_o} + \sqrt{1 + K}\right)}$$

With the aid of the Eq. (2), the loss of power gain

(*Continued on page* 165)

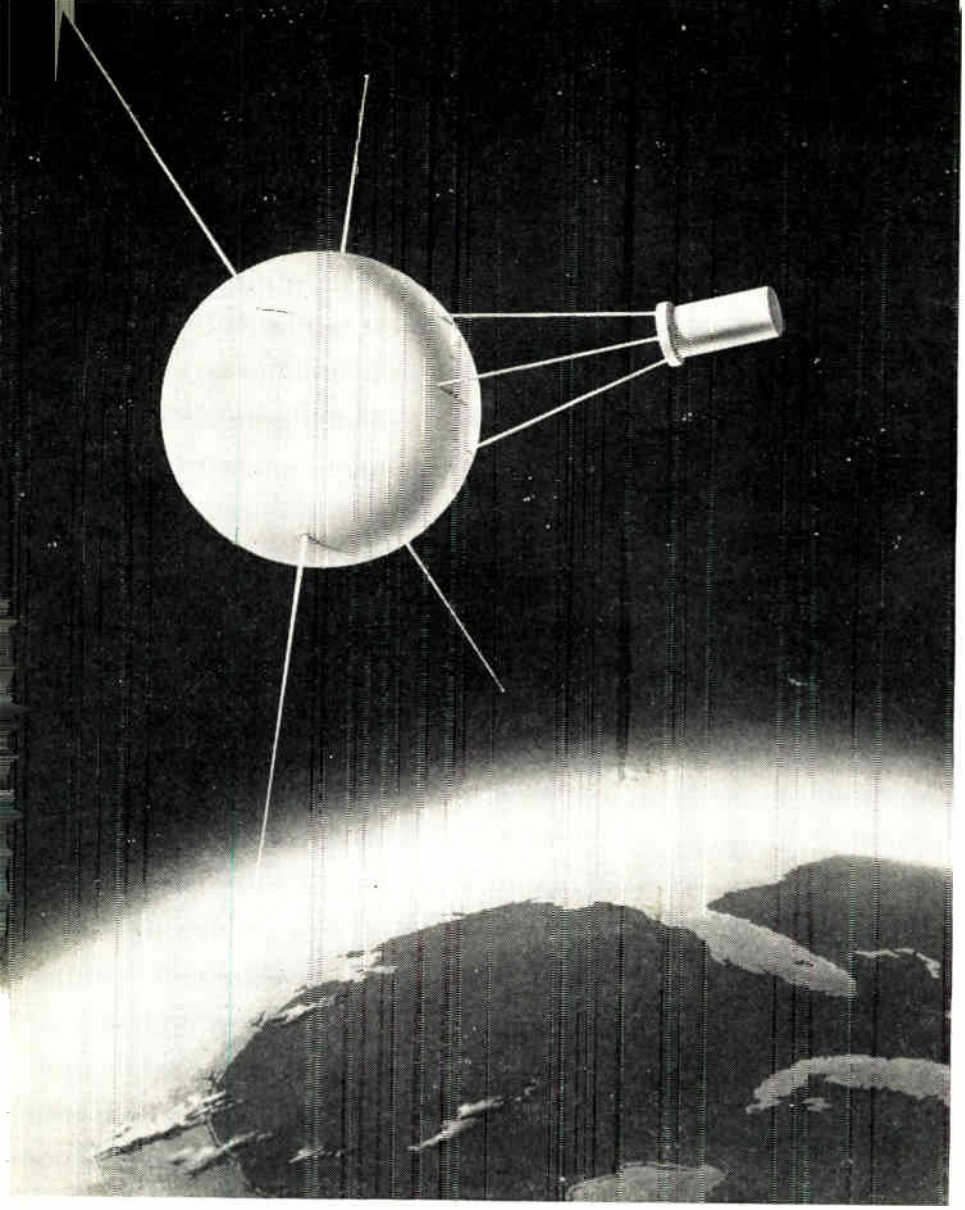


Fig. 1: Artist's conception of proton precession magnetometer mounted on a Satellite.

A Magnetometer for the Satellite

By DR. A. L. BLOOM & L. E. JOHNSON
Varian Associates
611 Hansen Way
Palo Alto, Calif.

The characteristic frequency of precessing protons in a weak magnetic field can serve as a measure of the earth's field in space. Data from rocket-borne magnetometers has been extrapolated to produce a tentative design for a satellite magnetometer.

IT is probably not possible to design an "ideal" magnetometer within the weight and space limitations of the Vanguard satellite. An "ideal" magnetometer would be one which could record, with extremely high signal-to-noise ratio, all values of magnetic field encountered by it during one trip around the earth, and would be able to regurgitate this information to the ground observer upon receipt of an interrogation signal. It can be stated at the outset that it does not appear practical at the present time,

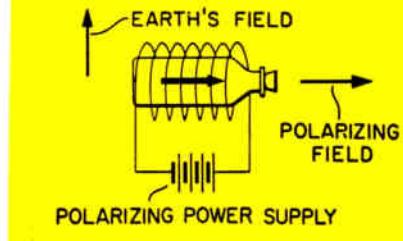


Fig. 2a: Protons in the bottled sample align to the polarizing field during polarizing pulse.

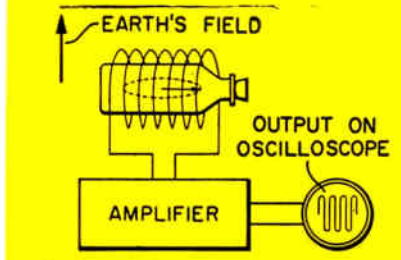


Fig. 2b: On collapse of polarizing field, weak earth field causes proton precession, generating an a-c field of characteristic frequency.

with our present knowledge of information storage devices, to accomplish such an information storage within the satellite.

A more realistic magnetometer would be one which, either continuously or upon interrogation, would be able to transmit with high signal-to-noise ratio a signal corresponding to the magnetic field of its immediate environment, in any possible value of the earth's magnetic field which it is likely to encounter. In what follows we shall make an attempt to estimate weight and power requirements for magnetometers of varying degrees of versatility approaching both "ideals."

The sensing element of a proton presession magnetometer is basically a coil of wire and a bottle of water; the remainder of the apparatus consists of a power supply, an amplifier, a relay system to connect the coil alternately to the power supply and the amplifier, and a frequency measuring system.

Basically, the instrument operates as follows:

1. The coil is connected to a polarizing power supply, (Fig. 1A). In this condition a strong field is applied to the bottle of water. This field polarizes gyromagnetic protons in the water in the direction of the applied field, which ideally should be perpendicular to the earth's field although the actual direction is not of too great importance.

2. The strong field is then removed very rapidly and the coil is connected to an amplifier (Fig. 1B). When the strong field is removed the nuclei remain initially oriented in the direction perpendicular to the earth's magnetic field. However, they immediately begin to precess about this field at a frequency ω given by the relationship $\omega = \gamma H$, where ω is the angular frequency, H is the value of the magnetic field, and γ is a constant determined by fundamental atomic constants for the proton. For the value of γ, a convenient number to remember is that in a field of one gauss the precession frequency is 4258 cps, thus in the earth's magnetic field, the precession frequency will be in the range around 1000 to 3000 cycles.

Since this precession represents a time dependent variation of magnetic moment, it can induce a voltage in a coil surrounding a sample containing protons (for example water), and this induced voltage can be measured as to frequency, and therefore as to the value of the field of precession. The induced voltage will also be proportional to the net polarization of a sample, i.e., orientation of the magnetic moments of the individual protons. This polarization is in itself proportional to applied field and described by the formula $M = \chi H$, where M is the polarization, H the field, and χ is called the nuclear susceptibility. χ is the exact analog of the paramagnetic susceptibility for substances exhibiting ordinary paramagnetism. The nuclear susceptibility, for a sample such as water at room temperature, is about 3×10^{-10} in unrationalized c.g.s units.

If we compute the signal amplitude in the earth's field due to a sample which has a polarization equivalent to that produced also by the earth's field, one arrives at a result in which the induced voltage is well below the thermal noise level of the receiving coil. This difficulty is avoided in the magnetometer by polarizing the sample initially in a much stronger field, of the order of several hundreds of gauss. A sample such as water, when placed in a strong magnetic field will have its nuclear polarization enhanced according to an inverse exponential rise-time law $M(1-e^{-t/T_1})$ where T_1 is a characteristic time known as the thermal relaxation time. In water this relaxation time is of the order of 2 seconds.

At the end of this polarizating period, one can turn off the polarizing field and have an enhanced polarization capable of inducing a signal well above the thermal noise level. The amplitude of this signal will decay according to an inverse exponential law, Me^{-t/T_2}, where T_2 is known as the transverse relaxation time. For water T_2 is approximately equal to T_1, however, experimentally it is usually observed that T_2 is less than T_1 owing to the existence of very slight inhomogeneities in the earth's magnetic field which cause certain groups of nuclei to precess at a slightly different frequency from others and thereby get out of phase.

The voltage signal-to-noise ratio of the magnetometer signal at the beginning of the free precession can for our purposes be given by the following formula:

$$\frac{V_s}{V_n} = \chi\eta \sqrt{\frac{Q_P Q_R P}{8kT\Delta f}} \qquad (1)$$

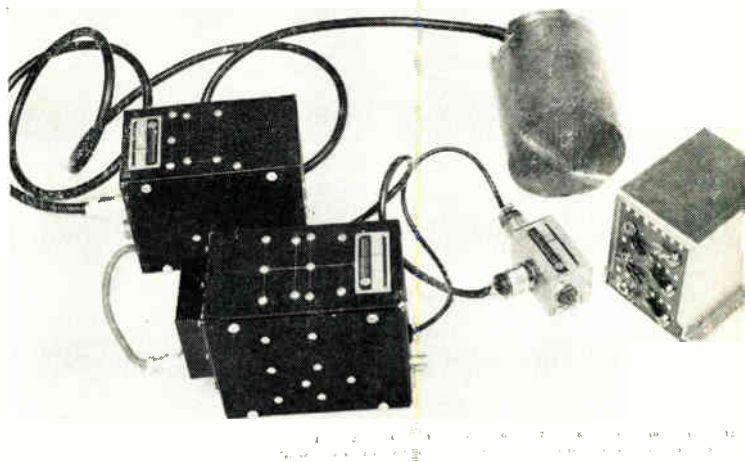


Fig. 3: Proton precession magnetometer designed for Aerobee rocket.

where
- χ is the nuclear susceptibility in rationalized MKS units (in unrationalized units use $4\pi\chi$).
- η is the "filling factor," a measure of the closeness of coupling between sample and coil. A more precise definition of η is given in Appendix B.
- P is the power expended in the coil during the polarizing part of the cycle.
- kT is the thermal energy,
- Δf is the receiving bandwidth,
- Q_R is the coil Q during receiving time, assuming a simple tuned circuit,
- Q_P is the "effective" Q during polarizing time (i.e., a numeric obtained by substituting the dc coil resistance for the ac resistance in Q_R.

If we substitute known physical values in the above formula in order to obtain the signal-to-noise ratio, the result will be slightly optimistic owing to the fact that we have neglected other sources of noise, for example amplifier noise and telemetering channel noise. Since the noise and certain quantities such as η are difficult to calculate theoretically, it is best to extrapolate from the known signal-to-noise ratio of an existing magnetometer.

Field Excursion

The total range of magnetic field values which the satellite must measure will determine the frequency range over which the instrument must receive free precession signals, and this will affect parameters in Eq. 1, particularly Q_R. In determining this range we shall assume that the satellite orbit will lie between $\pm 40°$ of the geographic equator. In addition, we assume that the ground stations will be located at selected points approximately 70° West longitude between 40° North and 40° South, and possibly at other points within the Continental United States south of 40°. We further assume that the altitude of the satellite will lie between 200 and 800 miles.

With these assumptions, and employing Vestine's calculations[1] of the earth's magnetic field, we find that the lowest field will be about 18,000 gammas, corresponding to a precession frequency of 800 cycles, and the highest field about 51,000 gammas, corresponding to a frequency of 2200 cycles. This range of fields includes the values at the ground at Palo Alto, California and at the launching station in Florida, and thus allows for testing of the satellite both at the factory and at the launching station.

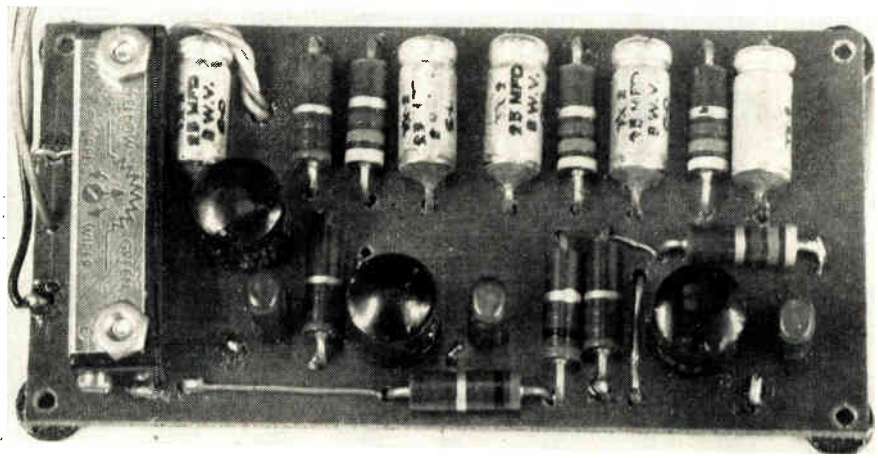


Fig. 4: Transistorized amplifier for the magnetometer.

Extrapolated Parameters

With the above information we are now ready to extrapolate the parameters of an existing design to the conditions of the satellite magnetometer. For our starting point we shall consider the magnetometer which has been installed in the Aerobee rocket. In the rocket installation each coil and sample weighs 7 pounds 2 ounces. The Q of the coil is 50; in receiving, the coil is double tuned so as to cover a total effective bandwidth of 600 cycles. The coil dc resistance is about 2 ohms, and polarizing power used is about 70 watts. For this combination, the initial voltage signal-to-noise ratio using the full bandwidth of 600 cycles is estimated to be about 12. This is the observed signal-to-noise ratio at the ground station and includes all noise sources, including such sources as amplifier and pickup noise as well as Johnson noise.

Fig. 5: Dr. Russell H. Varian, seated, and Sigurd F. Varian examine a coil designed for satellite magnetometer.

As an example, the extrapolation to satellite conditions can be made as follows:

1. The coil and sample volume shall be reduced by one-half, retaining the present type of coil and sample geometry and an unloaded coil Q of 50. The actual coil resistance and inductance will depend somewhat on the necessity for matching the coil to the amplifier input, however we shall assume as a reasonable number that the dc resistance of the coil will be 5 ohms.

2. We provisionally assume a receiving bandwidth of 600 cycles. This is equivalent to keeping Δf constant in Formula 1.

3. We assume that the satellite magnetometer will be polarizing for one second every revolution about the earth (every 90 minutes). We expect the instrument to be operated for a total of 21 days. This indicates a total polarizing time of 336 seconds while aloft. To this we shall add 164 seconds for time required in pre-launching exercises, making a total polarizing time of 400 seconds.

4. The overall frequency range required of this instrument—1400 cycles or nearly 3 times that of

(*Continued on page* 148)

What's New . . .

Splicing Video Tape

AN engineering project is currently being carried out in the Ampex Video Labs to discover a simple, convenient method for splicing recorded Videotape to facilitate techniques of editing.

In order to realize the complex problems involved in perfecting a Videotape splicing technique, one must first review the basic description of Videotape Recorder operation. A rotating drum, upon which are mounted four magnetic recording heads, whirls across a two-inch wide tape of 14,400 r.p.m. the four rotating heads as it sweeps across the tape during a time interval of 1/960th of a second. Each sweep contains 16 horizontal lines of television picture information, and every 16 sweeps describes a completed field on the video screen. A vertical synchronization pulse is recorded at the end of each field (one scan of a TV picture tube, or half of one completed frame). During each 32 sweeps of the Videotape Recorder heads, then, is one finished frame of television picture, containing four vertical synchronization pulses. All of this takes place in just 1/30th of a second, since television operates at 30 frames per second.

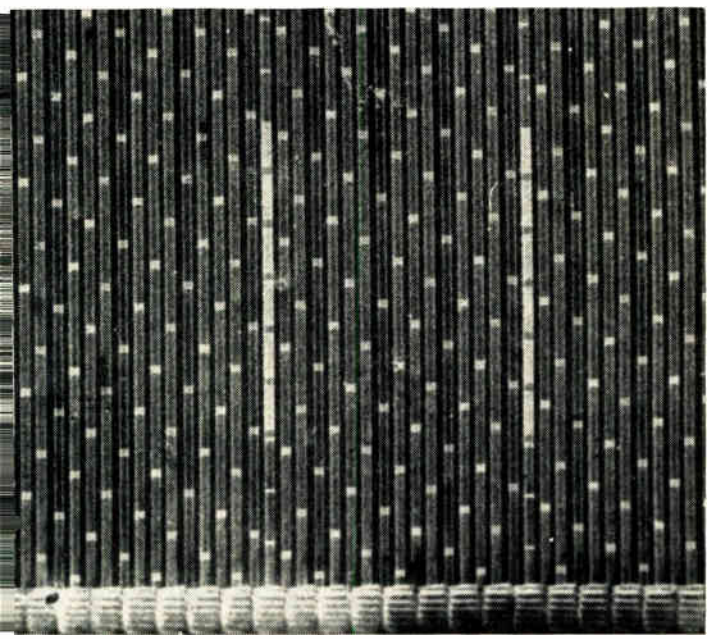


Fig. 1: Photomicrograph of video tape recording of sync pulses in the absence of video signals. This photo shows only the lower 7/10th of an inch of the tape.

The tape moves from reel to reel at a speed of 15 inches per second, just fast enough to keep the vertical recorded tracks from overlapping. The audio track is recorded horizontally along the upper edge of the tape and a control track is recorded in a stripe along the opposite edge, both in the conventional fashion with stationary heads.

Each vertical track of video information is recorded by one of

In order to pack the tremendous quantity of information represented in 30 television frames (frequency ranges approaching four million cycles per second) onto only 15 inches of tape, the individual video tracks had to be quite narrow. The width of each sweep is ten thousandths of an inch (10 mils), with a separation between them of five thousandths of an inch (5 mils).

Howard A. Chinn, Chief Engineer of CBS Television, has this to say about video tape recording: "Almost every week new specific applications for video tape are suggested and when more machines become available, we anticipate very widespread use of video tape recording. Its impact upon the television broadcasting industry will be just as great as was the introduction of sound magnetic tape on radio broadcasting—if one can remember back to the time when there was no audio tape recording.

"The VTR installation made by CBS in Television City has been in regular daily service for over five months and we have yet to experience a program failure even though we are using prototype machines."

Returning to the splicing situation, we can see that the vertical synchronization pulses which occur every 16 sweeps must be preserved in their exact relationship on the edited tape to insure an uninterrupted image during playback. This means that the tape must be cut precisely at the edge of one of these sweeps which contains the proper pulse—along a line between tracks which is only five thousandths of an inch wide —while dealing with magnetic impulses on tape which are completely invisible.

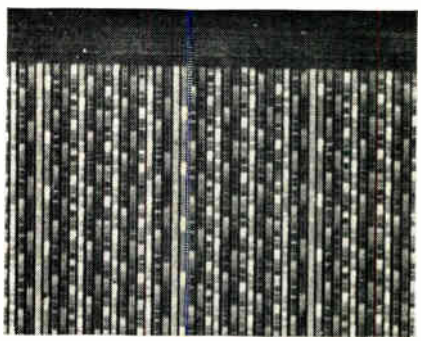


Fig. 2 (right): This photomicrograph shows a portion of recorded composite video signal.

The approach selected was to localize the particular frame to be cut by a visual readout process which can be easily applied to the tape, then develop a device of minimum complexity which will cut the tape at the proper point

(*Continued on page* 172)

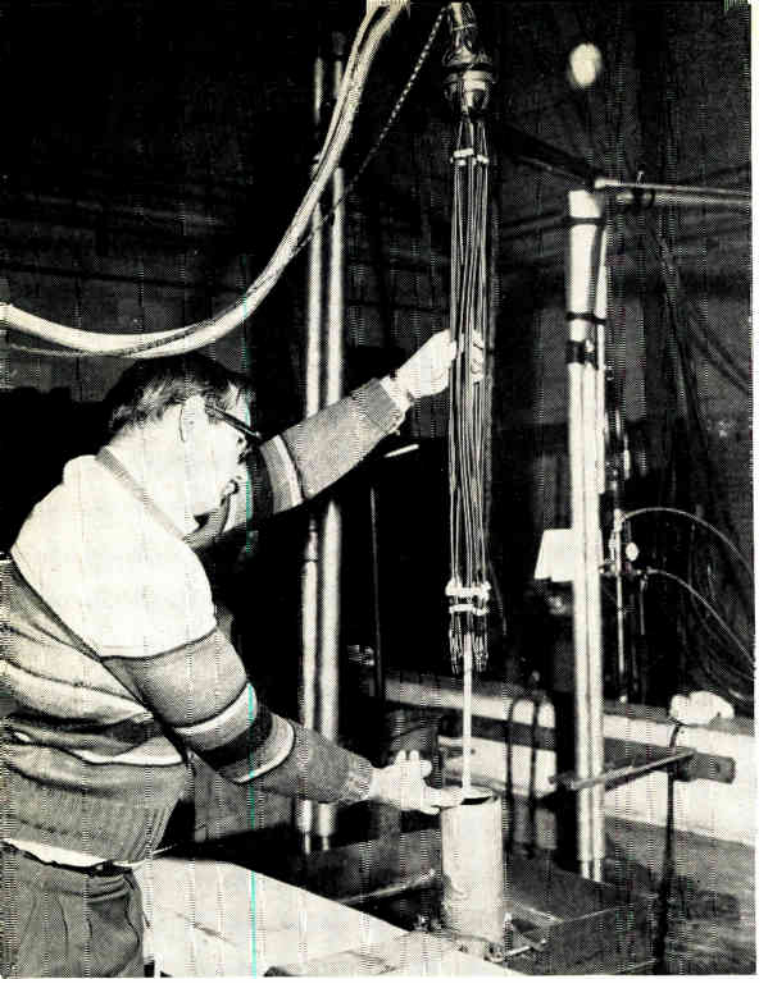


Fig. 1: Semiconductors are examined prior to radiation subjection.

Effects of Radiation on Semiconductors

Selected for study because they are the most radiation-sensitive, semiconductors were the subject of a recent nuclear study. Here is a description of an elaborate radiation test facility and the results of the program.

By DR. JOHN W. CLARK
Head, Dept. of Nuclear Electronics, Hughes Aircraft Co., Culver City, Calif.

IN attempting to evaluate the future of military electronics, one vital requirement will be ability to survive and function in a nuclear environment. The problems presented by WS-125A are considered to be merely the precursors of even more severe problems which will be presented by future aircraft and missiles.

Since it has already been well established that electronic equipment, as presently constructed, will function only briefly, if at all, in a nuclear environment, it is clear that an extensive program of development of materials, components, and assembly methods for systems is required. Such a program is being initiated at Hughes Aircraft Co.

Testing Facilities

Testing facilities are the first essential in experimentally attacking an environmental problem. The counterpart of wind tunnels, shake tables, ovens, and the like in the nuclear problem is radiation testing facilities. These must simulate, as accurately as possible, the radiation conditions anticipated in the future, and provide for combinations of temperature, vibration, etc., with nuclear radiation.

The first unit of the planned radiation facilities program is shown in Fig. 2. This is called the Culver City Radiation Facility, or CCRF. It is an underground gamma facility incorporating 3 separate, heavily-shielded caves.

The first cave contains a million-volt resonant transformer machine for accelerating electrons. The electrons may be used for radiation or may be converted to X-rays by means of a suitable target. This machine is capable of radiation rates as high as 4×10^9 r/hr., and is particularly suitable for investigation of rate and pulse effects due to radiation because of the flexibility of control possible with an electrical radiation source.

The other 2 caves are capable of containing 10,000 curies of radio-cobalt. The cobalt can be stored in subterranean vaults to permit the safe entry of personnel. The caves are sufficiently large (8 ft. square inside) as to facilitate the setting up of high-temperature ovens, shake tables, or other equipment,

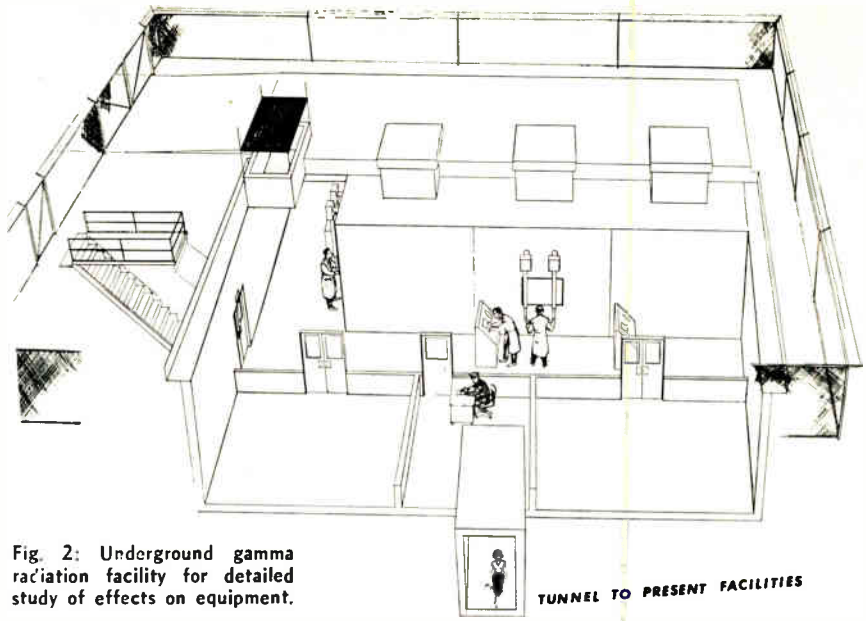


Fig. 2: Underground gamma radiation facility for detailed study of effects on equipment.

within the test region, for experiments combining nuclear radiation with other environmental factors. By the same token, elaborate instrumentation can be applied to complex electronic equipment under test.

Remote manipulators (Argonne Laboratory Model 8) are provided for placing the cobalt as desired near sensitive areas of the equipment under test. The operation is observed through a window of high-density glass and by closed-circuit TV cameras.

Flexibility

A facility is provided by means of which the cobalt can be transferred from one cave to the other. In this way, an experiment can be in progress in one cave while a second experiment is being set up in the other. This permits maximum utilization of the cobalt.

The intent in planning the CCRF has been to provide a gamma facility which is as flexible as possible, consistent with reasonable cost. It is particularly adapted for performing combined environment experiments on electronic components or subsystems. Present completion date for the CCRF is late 1957.

The CCRF is to be followed by a comprehensive radiation facility built around a reactor, specially designed to simulate the radiation flux anticipated in nuclear aircraft or missiles. This test reactor will be backed up by a complete and flexible analytical facility.

This facility will be used for evaluating the effects of neutrons and/or gamma radiation, and by auxiliary gamma and neutron sources for accomplishing experiments not suited for performance in the reactor.

Semiconductor Studies

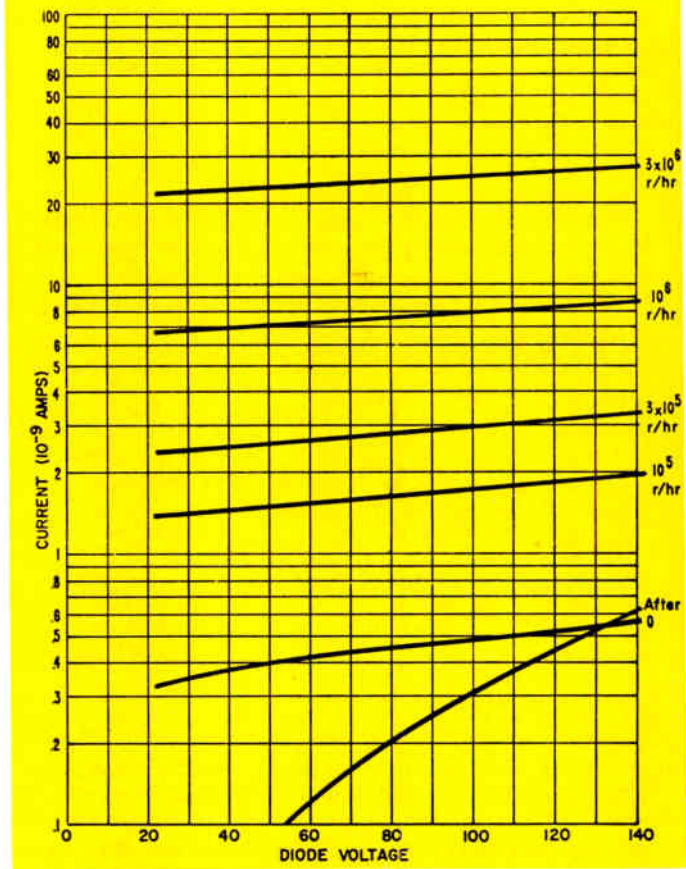
Experimental studies of radiation effects on electronics have been in progress for many months. These experiments have been concerned with radiation effects upon semiconductor devices. It is universally agreed that semiconductor devices are among the most radiation-sensitive of electronic components and, hence, form a logical subject for a first series of experiments.

The rate-dependent effects of nuclear radiation have been little studied and appear on preliminary analysis to be of some interest. The Hughes Type 6008 diode was selected as the subject for these experiments. Fig. 1 shows the experimental set-up.

This work was performed at the MTR Gamma

(*Continued on page* 169)

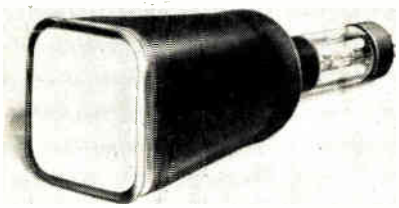
Fig. 3: Effect of nuclear radiation on semiconductor characteristics.



New Products ... for the Design Engineer

SQUARE-FACE CRT

The 3½ in. square-face design of type 41HAP single-run electrostatic focus and deflection CRT provides a raster size almost as large as a 5 in. tube of conventional round design.



Overall length of 11⅛ in. provides an additional design advantage in miniaturization. It has highly sensitive D1D2 and D3D4 deflection plates. Angle alignment between the D1D2 and D3D4 traces are held to within 1°. Grid cut-off bias is held to within 25%. Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.

Circle 260 on Inquiry Card, page 109

MOTOR-TACH GENERATOR

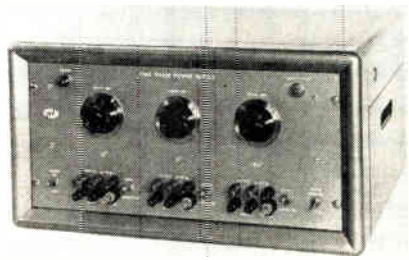
A new high temperature miniature motor-tach generator with low output to null ratio has been developed. Type 10-MTG-6229-15 operates continuously in an ambient temperature range

from −55° C to +125° C. Length is 2.131 inches, null voltage .012 volts, linearity 0.5% to 4000 rpm, output voltage 0.3 volts per 1000 rpm and excitation 18 v. at 400 cycles. Variations of voltage and shaft can be furnished to specification. John Oster Mfg. Co. 1 Main St., Racine, Wis., (WESCON Booth 914).

Circle 262 on Inquiry Card, page 109

POWER SUPPLY

The two phase power supply fulfills a growing need in the development and testing of servos, servo motors, 2 phase gyro motors, torquers, and other 400 cps components. All out-



puts are continuously variable giving extreme flexibility. Two in-phase outputs allow separate excitation of pick-offs, tachometers or motor reference phases. Total power output is over 500 va. Has provisions to insert watt-meters or ammeters. Pacific Technical Co., 2047 Sawtelle Blvd., Los Angeles 25, Calif.

Circle 264 on Inquiry Card, page 109

AVIATION BRUSHES

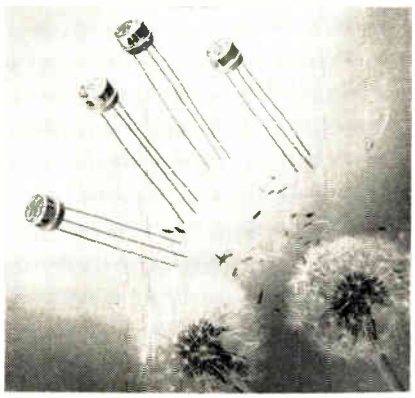
New quick-filming aviation brush grades require no sea level "break-in" filming run. Just seat the brushes properly and they are ready for immediate service at practically any altitude. Filming feature does not entail any sacrifice of other essential brush characteristics. Many characteristics have actually been improved. The special quick-filming treatment of

the brushes is non-corrosive and lends itself readily to silver-soldering rivet connections where needed. Contact drop values are uniform to close limits. Stackpole Carbon Co., St. Marys, Pa.

Circle 261 on Inquiry Card, page 109

SILICON TRANSISTORS

The new high frequency silicon transistors are made by the diffused-meltback process. Alpha cutoff frequency of the 4 transistors is rated at 25 MC, with useful gain up to about 50 MC. The computer transistor in this line has a very low collector saturation resistance rating of 40 ohms and carries a 5 v. emitter-to-base breakdown voltage rating. They



are capable of operation from 65°C. to +150°C. At room temperature, the devices are rated at 150 mw. collector dissipation. All are aged at high temperatures for at least 150 hours. General Electric Co., Syracuse.

Circle 263 on Inquiry Card, page 109

TANTALUM CAPACITORS

A new line of tantalum electrolytics known as the XTM line, have been especially designed for compact equipment where maximum conditions of temperature, humidity and mechanical shock are encountered. Manufactured in 6 capacities, from 4 to 10 mfd., at nominal working ratings from 40 to 360 v. These capacitors are designed for operation over a temperature

range of 55 to 175°C. The body diameter of the metal case is ⅝ in., with case lengths from 9/16 to 1 25/32 in. All capacitors employ a true metal-to-glass hermetic seal. P. R. Mallory & Co. Inc., Indianapolis, Ind.

Circle 265 on Inquiry Card, page 109

CANNON CONNECTORS

D SUB-MINIATURE DPA AND DPX SERIES

More than thirty years experience in the design and manufacture of standard electronic components insure Cannon Connectors by CINCH to be of the highest quality materials, fabricated to specifications to maintain consistent quality of product; highest standards throughout all operations.

DB-25S

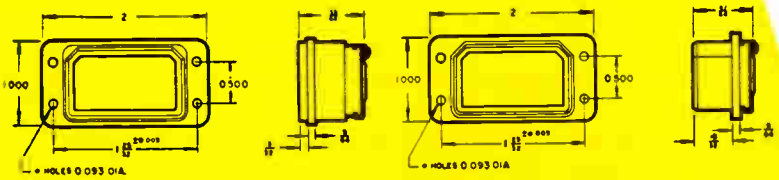
DB-25P

DPA 32-34P

DPA 32-33S

DPA CONNECTORS:

Shell with retaining plate. Pin and Socket Inserts.

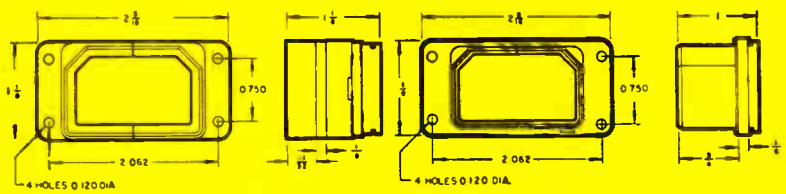


DPX 23-34P

DPX 23-33S

DPX CONNECTORS:

Split shell. Pin and Socket Inserts.



For your connector requirements—you can depend on CINCH.

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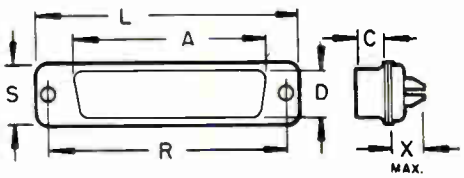
D SUB-MINIATURES:

STANDARD PIN AND SOCKET INSERTS:



size	A	C	D	L	R	S	X	weight
DA-15P	1 1/64	15/64	23/64	1 17/32	1.312	31/64	5/16	.013
DA-15S	1 3/32	15/64	5/16	1 17/32	1.312	31/64	5/16	.014
DB-25P	1 9/16	15/64	23/64	2 5/64	1.852	31/64	5/16	.023
DB-25S	1 33/64	15/64	5/16	2 5/64	1.852	31/64	5/16	.031
DC-37P	2 13/64	15/64	23/64	2 23/32	2.500	31/64	5/16	.035
DC-37S	2 11/64	15/64	5/16	2 23/32	2.500	31/64	5/16	.035
DD-50P	2 7/64	15/64	1 5/32	2 5/8	2.406	39/64	5/16	.035
DD-50S	2 5/64	15/64	27/64	2 5/8	2.406	39/64	5/16	.040
DE-9P	45/64	15/64	23/64	1 13/64	.984	31/64	5/16	.011
DE-9S	41/64	15/64	5/16	1 13/64	.984	31/64	5/16	.012

FRACTIONS ±1/64 Tolerance DECIMALS ±0.005 Tolerance

D SUB-MINIATURE SPECIFICATIONS:

Shell, including flange — steel or brass; Finish — Cadmium plate or Irridite. Contacts — No. 20, 5 ampere rating — Copper base alloy, gold plate finish.

Insert arrangements — 5 plus coaxials in 9, 15, 25, 37 and 50 contacts.

Insulation material — Zytel 101 or DIALL.

Polarization — Keystone cornered shell.

Operating temperature —67° to +310°F.

Send for illustrated Catalog No. 157 with details of "D" Sub-Miniature, "DPA" and "DPX" Series.

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

Circle 43 on Inquiry Card, page 109

WASHINGTON News Letter

FREQUENCY SPECTRUM STUDY — A comprehensive study of the use of the frequency spectrum by the government—advocated for several years by ELECTRONIC INDUSTRIES & Tele-Tech—has been called for through the establishment of a three-member commission by Senator Charles E. Potter (R., Mich.) and Rep. William G. Bray (R., Ind.) In their joint resolution presented to Congress, Senator Potter stated the proposed commission, to be appointed by the President from experts in the field of communications should conduct a thorough investigation of the radio and television frequencies allocated to the various governmental agencies to determine whether any of such frequencies may be relinquished for allocation to non-governmental purposes. The study received the support of the National Association of Radio & Television Broadcasters.

DOERFER NEW FCC CHAIRMAN — John C. Doerfer, FCC Commissioner since April 15, 1953, and the first member of the Commission appointed by the Eisenhower administration, was selected by the President as Chairman of the Commission, effective July 1, succeeding retiring chairman George C. McConnaughey who had decided not to accept reappointment to the FCC. Chairman Doerfer, who is both an accountant as well as an attorney, had served as Chairman of the Wisconsin Public Service Commission for four years before his elevation to the FCC.

NARTB CHIEF ATTORNEY — Douglas A. Anello, Chief of the FCC Safety & Special Radio Services Bureau's Law & Enforcement Division who had been with the Commission eleven years, has become Chief Attorney for the National Association of Radio & Television Broadcasters. During his FCC service he was active principally in the field of safety and special radio services, and had participated in virtually every rule action in that field, including the general mobile radio allocations hearings in 1948.

MICROWAVE LICENSING VIEWS — The Bell System and the Western Union Telegraph Co., the two nationwide domestic common carrier communications networks, have called on the FCC not to enter into a policy of unrestricted licensing of private microwave systems for general business and industrial purposes in their presentations in the FCC microwave proceeding. American Telephone & Telegraph Co. Chief Engineer Gordon N. Thayer emphasized that the Bell System believes "the future development of communications in this country will be determined in large measure by the frequency allocations and policy decisions made by the Commission in this proceeding." Both AT&T and Western Union supported continued assignments by the Commission of microwave frequencies for public safety purposes and for right-of-way companies, such as railroads, pipelines, and power companies. But, they opposed private systems for general business purposes on the basis that such systems would not only seriously impede the common carriers' ability to meet public service requirements, but would mean less efficient use of frequency space.

CLOSED CIRCUIT TV NEEDS — "The utilization of television for non-broadcast purposes (closed circuit for business and industrial purposes) has only begun to develop," AT&T Chief Engineer Thayer informed the FCC at the microwave hearing. It appears likely, he emphasized, "that television transmission will develop in the future as much as telephony has in the past half century." He predicted that this will require large numbers of broadband circuits not only between cities but in local areas, and will involve the extensive use of microwave facilities. Applications of this type will continue to grow, he stated, and there will be a large use of microwave radio facilities for short haul and light route purposes with the use of radio for short haul intercity purposes during the next decade expected to reach proportions at least as great as use of long heavy routes.

NO RIGID MICROWAVE ALLOCATION FORM— The National Association of Manufacturers through its Committee on Manufacturers Radio Use has advocated that the FCC allocate the usable microwave frequencies above 890 MC on the pattern followed in the 1947 basic allocations to the mobile services. This would involve primary allocation of frequencies for the Public Safety Services and secondary allocation of frequency to the Transportation and Industrial Services, including a Manufacturers Radio Service. The committee also proposed that the microwave frequencies now allocated on a developmental basis be finalized. The Commission should promptly establish a plan for the geographic sharing of frequencies which are suitable for mobile use but are not being used for any purpose, the committee recommended.

TV NETWORK REPORT — A staff report on TV network practices of the Senate Interstate and Foreign Commerce Committee has called for an examination and possible revision of contractual relations between the TV networks and their advertisers and affiliated stations. The staff report stated that Congress should consider seriously the problem of multiple ownership of television stations by networks and the concentration of key city outlets in the hands of these same networks. It also recommended that affiliation agreements between individual stations and networks, filed with the FCC, should be open for inspection. Copies of the report were sent by Senate Committee Chairman Magnuson to the FCC and the Department of Justice for comments and proposals.

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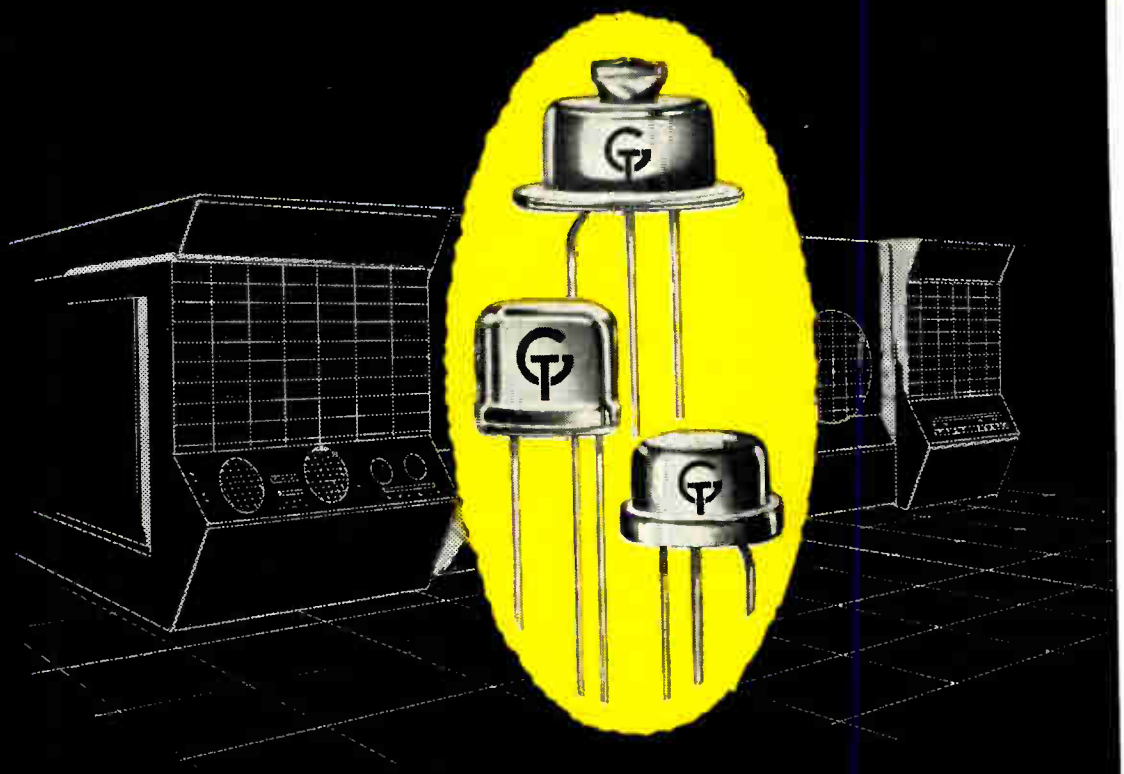
Washington Editor

VERSATILITY OF DESIGN

TRANSISTORS



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- Direct Current Switch
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- Micro and millisecond switching
- Servo driver applications
- Control lighting
- Phase detector circuitry
- Low level modulation

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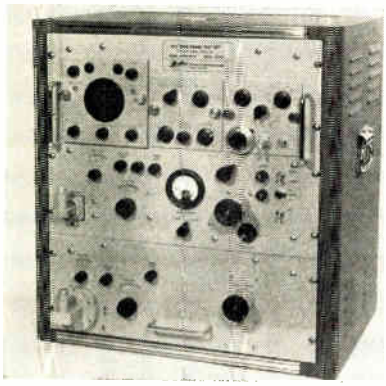
New Products . . . West Coast

RADAR TEST SET

New radar test set provides all the instrumentation necessary for complete X Band and C Band checkout of radar and other transmitters in the field, or on the production line. Unit

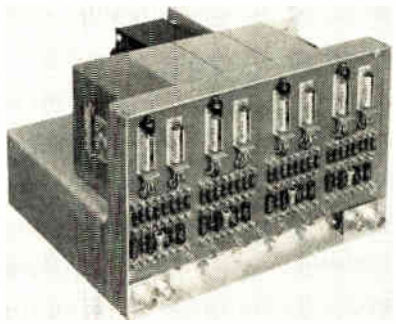


covers frequencies from 5200 to 5900 MC for C Band and 8500 to 10,000 MC for X Band. It contains a spectrum analyzer, power monitor, direct reading frequency meter and signal generator. The r-f section is constructed with umbilical cabling allowing for 8 in. clearance from main cabinet for maintenance or inspection. Kearfott Co., Inc., 253 N. Vinedo, Pasadena 8, Calif.

Circle 248 on Inquiry Card, page 109

SIGNAL DELAY LINE

The signal enhanced delay line consists of several sections, each composed of a delay line, an amplifier, a video transformer, a clipping diode and a cathode follower. Improvement

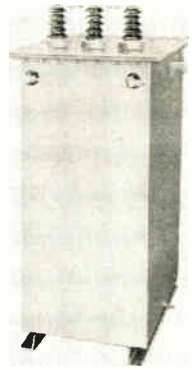


in the fidelity of pulse shape resulting from use indicates, among potentialities, an application in a demodulator for pulse code trains such as are used in air traffic control systems. Another application is the use of the delay line in computer operation where narrow pulses will permit an increase in the rapidity of calculation. Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.

Circle 250 on Inquiry Card, page 109

AUDIO TRANSFORMER

High power transformers, incorporating newly-patented design techniques that permit high fidelity performance plus savings in size and weight without increased cost, have

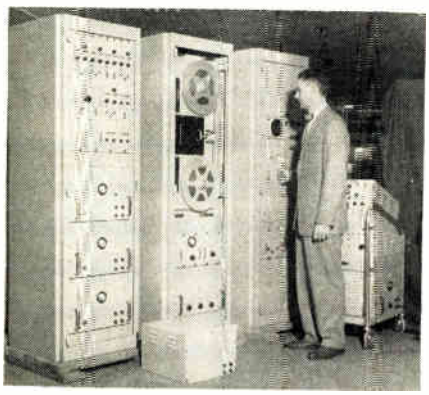


been developed. The new design has application in radio broadcast modulation transformers, output transformers for vibration testing and other equipment utilizing Class B amplifiers over 250 watts. 100 kva units operating down to 15 cps have been designed. Units custom designed to each application. Electro Engineering Works, Inc., 401 Preda St., San Leandro, Calif.

Circle 252 on Inquiry Card, page 109

TAPE SYSTEM

Pictured here is the "Minban" wide-band magnetic tape system. It is one of a number of similar machines designed and built for specific wide-band applications. Variations of the equipment can be used for the recording of radar impulses, spectrum monitoring, TV signals, telemetry, or waveform analysis. The machines are particularly noteworthy because of their abil-

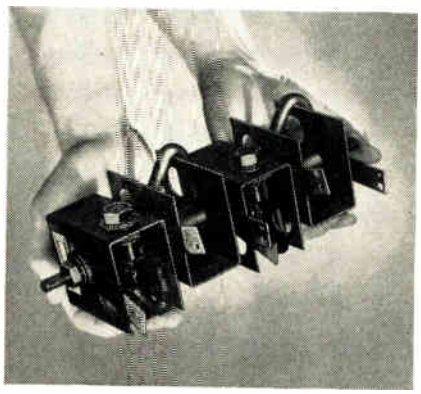


ity to record as many as seven channels, up to 2½ MC on each channel, simultaneously, on ½ in. tape. Minnesota Mining & Mfg. Co., 11701 Mississippi Ave., Los Angeles 25, Calif.

Circle 249 on Inquiry Card, page 109

BRIDGE RECTIFIERS

Compact 23 kw silicon single phase bridge rectifiers, engineered for heavy power conversion in high ambient temperatures, are designed for forced air or natural convection cooling. These units consist of 4 silicon junctions mounted on an efficient heat exchanger for optimum cooling. Rectifier stack is rated at 50 a. dc when convection cooled, and 120 a. dc when



forced air cooled. Maximum input voltage per junction is 300 piv, or 210 v rms. Efficient operation at base temperatures to 155°C. International Rectifier Corp., El Segundo, Calif.

Circle 251 on Inquiry Card, page 109

AC MILLIVOLTMETER

AC measurements to 50 microvolts are accurately made with this completely portable, battery operated, transistorized millivoltmeter. Twelve full scale ranges between 0.001 and 300 vac. are provided as well as db, coverage between 80 and 52 dbm. Useable frequency coverage is provided between 1 cycle and 5 mc. Accuracy is 3% between 5 cycles and 1 mc. Input

impedance is 22 megohms. Battery power provided 400 hours of continuous operation. Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif.

Circle 253 on Inquiry Card, page 109

New Products . . . West Coast

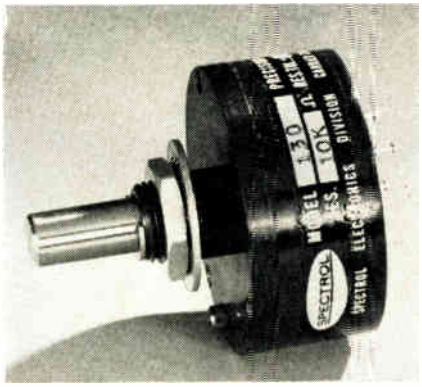
AIRBORNE TRANSLATOR

The instrument translator is a subminiaturized carrier amplifier with a number of unique features. In power and performance these instruments surpass full-sized conventional carrier oscillator-amplifier-demodulators. They receive the signals of the sensing transducer and convert this electronic intelligence into proportional ac or dc output voltage, for transmission to metering equipment or servo controls. It may use as little as ¼ w. of power, and provide gains of up to 10,000. Crescent Engineering and Research Co., El Monte, Calif.

Circle 254 on Inquiry Card, page 109

POTENTIOMETER

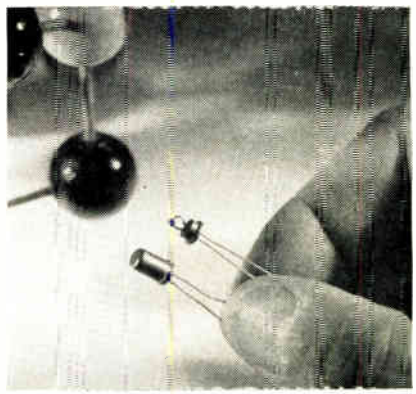
Model 130 is a new Precision 1-5/16 in. dia. single-turn potentiometer. The series meets MIL Specs NAS-710 environmental humidity requirements, and will operate in a temperature of −55°C to +85°C. Standard linearity tolerance is ±0.5%, special linearity tolerance available. Resistance range is 10 ohms to 30,000 ohms, with a tolerance of ±3%. Special resistance tolerances are available. They have a life exceeding 1 million revolutions. Multiple taps can be supplied on request. Spectrol Electronics, 1704 S. Del Mar Ave., San Gabriel, Calif.



Circle 256 on Inquiry Card, page 109

FOUR-LAYER DIODE

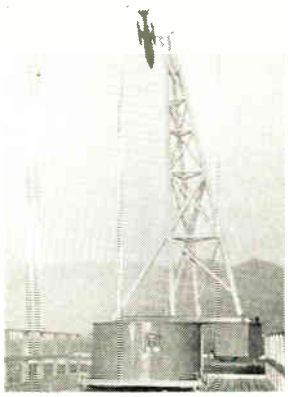
The low power 4-layer switching diode, a type invented at Bell Labs. is available. It is a 2-terminal silicon device which can exist in either of two states: An open or high-impedance state (1 to 100 megohms) and a closed or low-impedance state (1 to 10 ohms). Characteristics of the diode suggest a versatile range of applications such as self-excited sawtooth oscillators, pulse generators, bi-stable memory circuits, and ring circuits. Shockley Semiconductor Lab., Beckman Instruments, Inc., Mountain View, Calif.



Circle 258 on Inquiry Card, page 109

MEASUREMENT TOWER

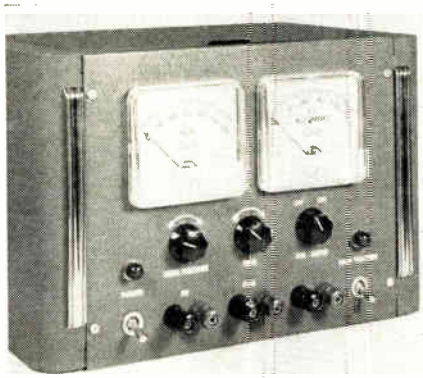
Antenna radiation pattern measurement tower has pattern accuracy through rigidity of structure, mechanical and electrical refinements. Distortion is reduced through thin-wall fiberglass tubular structure. It has increased model capacity through large glass ball bearings and nylon drive gears. Recorder position accuracy through well located selsyn masters. Complete accessibility to all parts. Interchangeability of principal mechanical and electrical sub-assemblies possible. Blaine Electronetics, Inc., 14757 Keswick St., Van Nuys, Calif.



Circle 255 on Inquiry Card, page 109

POWER SUPPLY

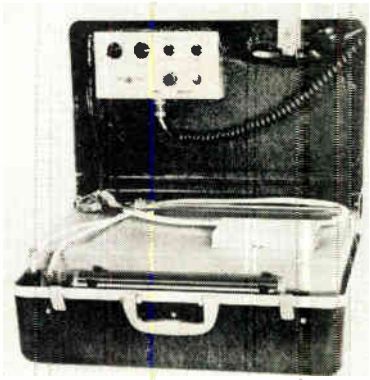
The model 7P13 is a 300 v. 150 ma. voltage regulated laboratory-type power supply. Input voltage is 105-125 v. at 50 to 60 cycles. Three output voltages are available (1) continuously variable 0 to 300 vdc. at 150 ma. (2) continuously variable 0 to −150 vdc. at 5 ma. (3) 6.3 vac. at 8 amps. High voltage regulation ±0.5% from 20 to 300 v. at 0 to 150 ma. and line variations from 105 to 125 vac. Metering is accomplished with separate voltmeter and millimeter. All adjustments and controls on front panel. Western Gear Corp., P. O. Box 182, Lynwood, Calif.



Circle 257 on Inquiry Card, page 109

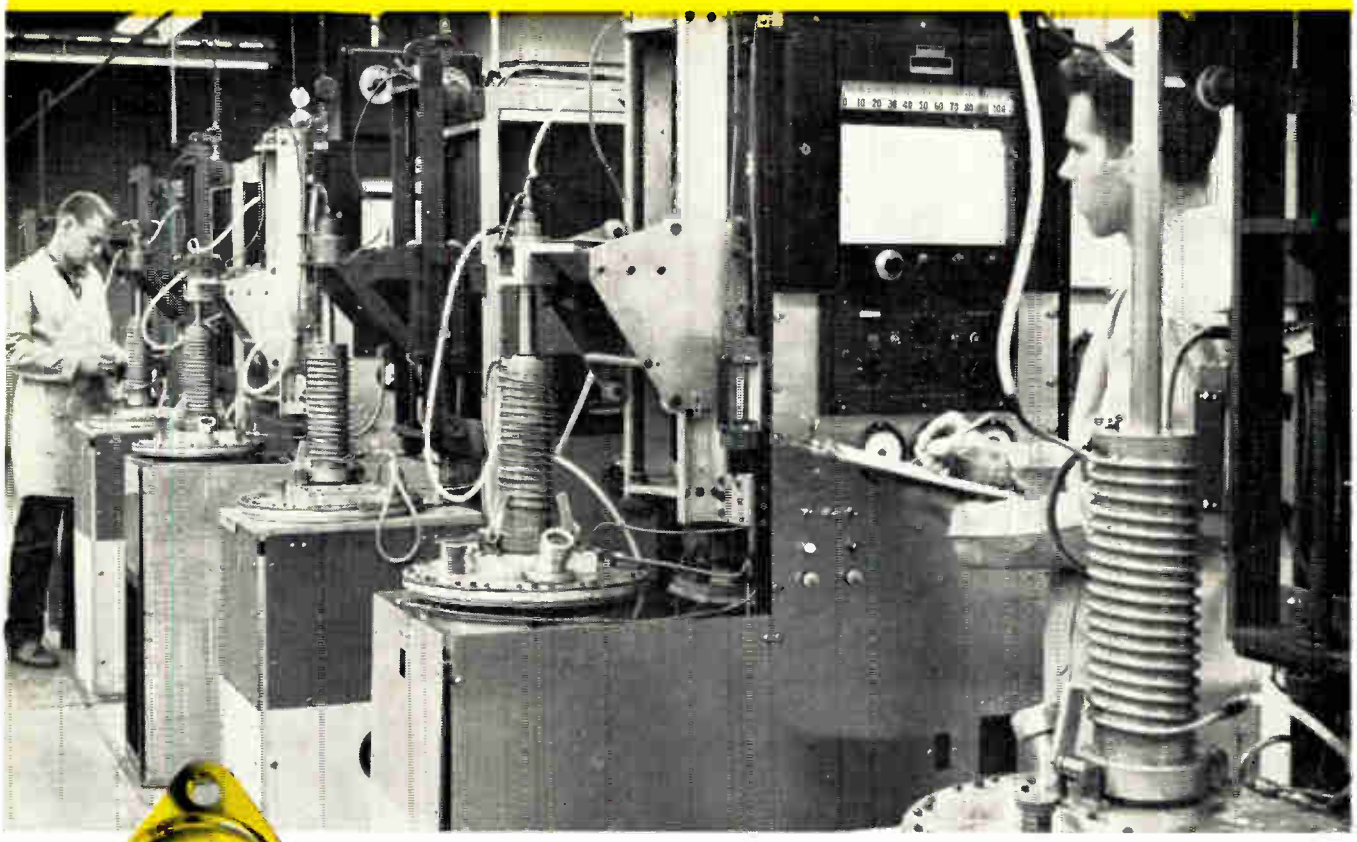
RADIOTELEPHONE

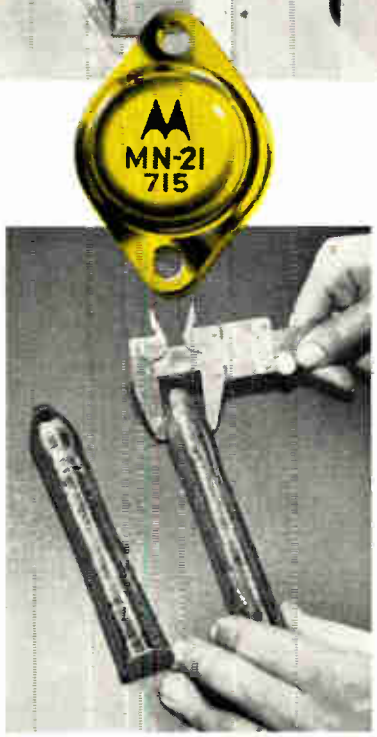
A new portable radiotelephone for geophysical applications has been introduced. The TR-247 may be used on any single frequency between 2,000 and 8,000 KC. Power output of the transmitter is from 25 to 30 w. The unit may be operated directly from a 6 or 12 v. battery. Current drain is kept low by employing quick heating tubes. The entire unit, including carrying case, weighs 52 lbs. less battery. A stripped chassis is provided on which users may add special equipment for time break circuits. Kaar Engineering Corp., P. O. Box 1320, Palo Alto, Calif.



Circle 259 on Inquiry Card, page 109

VOLUME PRODUCTION OF SUPERIOR CRYSTALS





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ANTENNAS, PROPAGATION

Some Comparitive Measurements of Propagation Conditions in the Frequency Bands II and IV, W. Knopfel. "Nach. Z." May 1957. 8 pp. Measurements of attenuation in band IV behind diffracting edges and in populated areas were performed in order to provide data for the planning of networks.

Meteor Burst Extends VHF Radio Range, P. J. Klass. "Aviation Week." June 17, 1957. 4 pp. A summary of recently announced investigations in reflected VHF transmissions using meteor-induced localized ionization in the ionosphere.

Installing Antenna Systems for AM Operations, J. Novik. "Broadcast News." June 1957 7 pp. The author reviews standard construction and installation procedures for installing both directional and omnidirectional AM antenna systems.

Problems of Antenna Pattern Synthesis, S. Pogorzelski. "Electrotechnical Dissertations." Vol. 2, No. 3, 1956. 20 pp. The problem of antenna pattern synthesis is formulated in the preliminary part of this paper. Three aspects of this problem are discerned: the synthesis of current distribution, the synthesis of the field in an aperture, and the pattern transformation. The main part of the paper is devoted to the discussion of examples illustrating the solution of this problem.

Long-Distance Tropospheric Propagation of UHF Waves (Part I), B. A. Vvedensky, A. G. Arenberg. "Radiotek." Jan. 1957. 9 pp. A comprehensive survey of the historical development of the theory associated with this subject. A summary of modern theoretical approaches is included, in addition to extensive recent experimental data.

Wide-Band Directional Systems and Special Communication Problems, "NTF." Vol. 6, 1957. 52 pp. This survey contains the following articles: Problems in the Control of Wave Propagation in the Troposphere, by Grosskopf Results of VHF Propagation Measurements, by Wille; New Knowledge Concerning the Development of Helical Antennas, by Herz and Stoehr; Directional Antennas with Specially Shaped Apertures, by Koch; Application of Ferrites at Microwaves, by Willwachter; Advantages of Narrow-Profile Wave Guides for Wide-Band Directional Systems, by Mueller; Operation and Advantages of Preemphasis in the Directional Transmission of TV Programs, by Holzwarth; Experience with Directional Channels for FM Multi-Channel Telephone and TV Systems, by Kaiser; Applications of the Surface Transistor in Circuits and Their Limitations, by Meyer-Broetz; Selective Call in Mobile VHF Lines with a Large Subscriber Group, by Schon; Measuring Technique for Linear Networks in the Meter and Decimeter Region, by Linnebach; and Radio Communication Systems in Microphone and Studio Installations of Radio Networks, by v. Rautenfeld.

An Experimental Study of Some Fading Characteristics of 10-CM Waves in the Scatter Region, D. G. Kiely, S. J. Robinson, and F. C. Chesterman. "J. BIRE." March 1957. 11 pp. The article is primarily concerned with the short-term rapid fading of 10-cm waves in the scatter region. For a 100-mile path over the Bristol Channel measured results of the fading rate and amplitude, together with the correlation of the fading pattern of signals from the same source received by two spaced aerials, are presented. The lack of correlation is illustrated by photographs of a particular type of crt presentation of the signals. Fading rates of the order of 1-5 cps over periods of a few minutes were measured, with amplitudes in excess of 25 db.

Long-Distance Propagation at 94.35 MC over the North Sea, R. A. Rowden and J. W. Stark. "Proc. BIEE." May 1957. 3 pp. A series of VHF measurements over long sea paths was made over a period of 15 months. The results suggest that, in general, higher field strengths are reached for a given percentage of the overall time than in the case of overland paths.

AUDIO

Transistorized Amplifier Design. "El. Des." June 15, 1957. 2 pp. This article describes, with circuit and component values, a three-stage transistor audio amplifier using 2N109 alloy-junction transistors.

Selective A-F Induction Signalling. L. E. Phillips. "El." June 1, 1957. 2 pp. Audio frequencies from 6 to 20 kc are used to energize an inductive signalling loop. Pulsed a-f activates a reed striker in the portable paging receiver.

CIRCUITS

***Minimizing Mismatch Loss,** Dr. H. E. Hollmann. "El. Ind." Aug. 1957. 3 pp. Mismatch of an amplifier input circuit can be compensated by a mismatch of the load, and vice versa. Simple formulas or curves give the compensating mismatch value. Curves are given for power gain loss.

A Contribution to the Synthesis of Reactance Two- and Four-Terminal Networks, W. Saraga. "Nach. Z.," Vol. 8. 14 pp. A mathematical method is introduced in which the unity points of suitably chosen rational functions constitute the primary design parameters. The values for the circuit elements are directly or inversely proportional to these unity points.

* 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 Uebertragung
ASTM Bul. ASTM Bulletin
Auto. Con. Automatic Control
Auto. El. The Automatic Electric Technical Journal
Avto. i Tel. Avtomatika i Telemekhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
Bell Rec. Bell Laboratories Record
Bell J. Bell System Technical Journal
Bull. 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 Elektroakustik
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.

International ELECTRONIC SOURCES

Sharp Cut-off, Wide-Band Quartz Filters in Branch Connections, W. Poschenrieder. "Nach. Z.," Vol. 8. 4 pp. The advantages of ladder structures are pointed out and their properties are considered. Calculations based on network synthesis are carried out. As an example, a broad-band filter with sharp cut-off is studied.

Novel Method for the Realization of Two-Terminal Network Response Curves, R. Unbehauen. "Nach. Z.," Vol. 8, 9 pp. Canonical circuits and circuits without coupling impedance are relied on in this computational method which is a generalized version of Brune's method.

A Practical Method for the Formulation of the Hurwitz Polynominal in Filter Synthesis, F. Bauhuber. "Nach. Z.," Vol. 8. 8pp. Direct and indirect methods involving the determination of the zero points of algebraic equations are explained and their advantages and disadvantages in different instances are compared.

The Design of Complex Resonators, A. I. Zhivotovsky, "Radiotek." Jan. 1957. 6 pp. The paper examines complex resonators which consist of severel sectors of homogeneous concentric lines with different wave impedances. Expressions are derived for the engineering design of such resonators.

A Self-Excited Oscillator With A Heavily Damped Tank Circuit, by A. Z. Khaikov. "Radiotek." Jan. 1957. 10 pp. The pare examines the problem involved in the dependence of the shape of the oscillations and the energy relationships in a self-excited oscillator upon the damping of the tank circuit. The optimum operating regimes are found from the points of view of the power delivered to the load and the over-all oscillator efficiency.

Synthesis of Lossless Four-Terminal Networks from Lines with Varying Characteristic Impedance, H. Meinke. "Nach. Z.," Vol. 8, 5 pp. Approximate solutions in the form of algebraic series for the impedance function along a line with varying characteristics are presented. This permits the matching of a frequency-dependent complex load impedance to a frequency-dependent complex input impedance. Examples are included.

The Transfer Factor of a Network with Prescribed Transient Response, V. Fetzer. "Nach. Z." Vol. 8. 7 pp. Laplace transform computations are used to derive the transfer constant required for a specified input function to result in a prescribed output function. Symmetrical band-pass filters and narrow band-pass filters are studied by this method. Time functions and associated frequency functions are tabulated.

Methods of Wide-Band and Pulse Amplifiers Design, W. Golde and A. Smolinski. "Electrotechnical Dissertations" Vol. 2, No. 3, 1956. 43 pp. Methods of wide-band and pulse amplifier design are considered in this article. In the first part are discussed wide-band amplifiers whose design is based on the prescribed frequency characteristics. The optimum frequency characteristics are presented, i.e. the so-called equal ripples characteristic of Tchebycheff, the maximum flat characteristic, the gaussian characteristic, the maximum linear phase characteristic; the selectivity functions corresponding to the given characteristics are determined.

Self-Excited Magnetic Amplifier with Resistive Load, R. Ladzinski. "Archives of Automation and Telemechanics" Vol. 1, No. 1-2, 1956. 29 pp. The theory presented in this paper concerns the state of natural magnetization, that is, the operation of the amplifier with neglect of the low impedance of the control circuit. A formula expressing the mean amplification of MMF is described, and nearly complete agreement with the corresponding formula given by Milnes is shown. The range of practical applicability of the results is descussed.

The Problem Of Generating Bell-Shaped Pulses, L. I. Kastalsky. "Radiotek." Jan. 1957. 3 pp. The paper describes one of the circuits which can be used to generate bell-shaped pulses. The results of an experimental investigation of the circuit are given.

A Filter Catalogue, E. Glowatzki. "Nach. Z." Vol. 8. 6 pp. A filter catalogue based on systematic filter computations on a program controlled computor is reviewed. Several thousand low-pass filters up to the fifth degree and with Cauer parameters are included.

The Design Of A Pulse Limiter, by S. N. Krize. "Radiotek," March 1957. 5 pp. The paper analyzes the operation of a video-signal pulse limiter. The special features of the analysis are the fact that the nonlinearity of the voltampere characteristic of the limiting element and the finite rise time of the perturbing pulse are taken into account.

Noise in Negative Feedback Amplifiers, C. N. W. Litting. "E&R Eng." June 1957. 5 pp. The effect of negative feedback under various conditions is considered and it is concluded that under certain conditions a great improvement in signal-to-noise ratio may be obtained by using feedback. Other methods of improving the performance are mentioned and it is shown that, in theory, similar results can be obtained without the use of feedback. The other methods are, however, less elegant and may in some cases be impracticable.

Design Considerations of Junction-Transistor Oscillators for the Conversion of Power from Direct to Alternating Current, F. Oakes. "Proc. BIEE" May 1957. 11 pp. Practical oscillator design for power conversion must take into account the non-linearity of the transistor circuit which has to be incurred in order to ensure correct amplitude limiting of the oscillator. Deviations from sinusoidal operation resulting from this as well as from other causes are considered in some detail, and graphical methods are described for the quantitive assessment of oscillator performance. These methods are based on Lienard's construction which, suitably extended, provides a convenient means of predicting the amplitude, output waveform, frequency and other performance data of the oscillator.

Simultaneous Generation of Two Frequencies in One Generator and the Stability of the Frequency Difference, W. Feist. "Nach. Z." May 1957. 8 pp. Two frequencies can simultaneously be produced in an oscillator with feed-back, when the feedback network exhibits steep enough slopes in the phase response at the frequencies of oscillations and when suitable operation conditions are chosen for the tube. The stability of "difference oscillators" is discussed with the aid of an example.

Designing Transistor Circuits . . . Automatic Gain Control, R. B. Hurley. "El. Eq." June 1957. 4 pp. The author discusses emitter-current control, power needs, tetrode control, external variable dividers, feedback.

Design of Mixers Using Conductance Curves, K. A. Pullen, Jr. "El. Des." June 1, 1957. 3 pp.

COMMUNICATIONS

***Improved Modulation Metering,** R. D. Lambert, Jr. "El. Ind. Op. Sect." Aug. 1957. 2 pp. Simple circuit changes are described which enable broadcast engineers to greatly increase the accuracy of modulation percentage readings from remote facilities.

***Audio Tone Sounds 'Conelrad' Alarm,** D. O. Cooper. "El. Ind. Op. Sect." Aug. 1957. 2 pp. The disadvantages of carrier-interrupted type alarms are overcome by having the key station transmit a 1 kc tone for alarm operation. The author describes a simple, highly selective receiver for use at the broadcasting station.

Signal Theory, "NTF," Vol. 6, 1957. 26 pp. This survey contains the following articles: Information and Signal, by Schouten; Progress in the Theory of Single Side-Band and Vestigial Side-Band Transmission in Amplitude-Modulated Systems, by Peters; Correlation and Predetermination of Signals, by Marko; Some Geometric Results in Channel Capacity, by Shannon; Code Modulation in Carrier Frequency Engineering, by Bosse; and Attempt at an Advantageous Coding of Picture Information, by Kretzmer.

Traffic and Operation in Communication Engineering, "NTF," Vol. 6, 54 pp. This survey contains the following articles: On the Problems of Defining the Operational Qualities in Communication Engineering, by Mehlis; Experience in Measuring the Operational Reliability of Telephone Installations, by Ahlstedt; Traffic Distribution and Average Traffic Design in Long-Distance Telephone Lines, by Thurmayr; Traffic Load of Subscriber Lines, by Hegner; Diagnosis, Prognosis and Therapy of the Telephone Service, by Meiel; New Results of Communication Theory for the Planning and Operation of Telephone Installations, by Rohde; Operational and Communication Problems in Modern Automatic Dialing Installations, by Domin; Operation of Inter-Continental Telewriting Equipment, by Dobermann; Subscriber Selection Across Borders, by Reheusser; Requirements of Telephone and Telewriting Communication Engineering and Transmission Engineering and Their Interaction, by Ganitta and Kreuzer; and On the Use of Codes in Telewriting and Telephone Engineering, by Oden.

Remote-Control Engineering, "Nach. Z." Vol. 7, 1957. 34 pp. This volume is devoted to the distant control of utilities. Remote control installations of electric distribution networks; of a power station group; of power supplies in Bavaria; of gas distribution; of water supply; of the German railroad; and of a new rail switch station in Frankfurt are described in seven articles.

Information Criteria For Evaluating Telemetering Systems, M. M. Bakhmet'ev, R. R. Vasil'ev. "Avto. i Tel." April, 1957. 5 pp. The paper proposes information criteria for determining the performance quality of telemetering systems.

Frequency Feedback in FM Receivers, L. Ia. Kantor. "Radiotek" Jan. 1957. 5 pp. The paper indicates the necessity of retaining the limiter in an FM receiver with frequency feedback. The pass band of the i-f amplifier in such a receiver is determined in such a manner as to insure the required stability and the specified distortion. The concept of the optimum frequency-feedback factor is introduced.

Electronic Crowbar Protects Transmitter, R. G. Wenner. "El." June 1, 1957. 3 pp. Essentially, this electronic circuit short-circuits the high voltage power supply to a tube when a flash arc occurs in the tube. Increased operating life of the power tube and reduced out-of-service time result.

The BBC Sound Broadcasting Service on Very High Frequencies, E. W. Hayes and H. Page. "Proc. BIEE" May 1957. 12 pp. This article describes the developments leading to the inauguration of the BBC VHF service on sound broadcasting in the band 87.5 to 100 MC. Included are discussions of AM vs FM, polarization, audio pre-emphasis, and channel spacing.

Certain Characteristics Of The Radiation Emitted From Cosmic Objects, A. D. Kuzmin. "Radiotek," Jan. 1957. 9 pp. A brief survey is made of those basic characteristics of the radiation from cosmic objects which are of interest with regard to radio-engineering applications.

Frequency-Modulated VHF Transmitter Technique, A. C. Beck, F. T. Norbury, and J. L. Storr-Best. "Proc. BIEE" May 1957. 14 pp. Design features of a current 10 KW FM transmitter operating in Band II are described, including a discussion of generation of the FM carrier, automatic center-frequency control, and automatic phasing of parallel final amplifiers.

Frequency-Modulated Quartz Oscillators for Broadcasting Equipment, W. S. Mortley. "Proc. BIEE" May 1957. 10 pp. Design of the circuit and of the crystal plate is discussed. Easy methods of setting-up derive from the use of an oscillator having a high Q-factor. The system has the advantages of simplicity, reliability and ease of maintenance.

Dialing Signal Converters for Use in Trunk Dialing Networks, H. Pausch. "Nach. Z." May 1957. 9 pp. Dialing signal converters, designed for transmitting switching signals on various types of lines and developed for trunk dialing networks, are described. Their unavoidable complexity is explained and the advantages of the new circuits and their design are summarized. A comparison of costs and space requirements is included.

Principles of Design of Battery Operated Frequency Modulation Receivers, R. A. Lampitt and J. P. Hannifan. "J BIRE" March 1957. 13 pp. The special requirements of battery operated receivers generally include low running cost and the maintenance of adequate performance at reduced battery voltages. The designer is faced with several major problems not encountered in the design of line-operated sets. Principles and design of the individual stages of an am/fm receiver are dealt with, including the mixer stage, if amplifier, and demodulator circuit. The remainder of the receiver follows standard practice.

Planning of Radio Link Networks Operating with Metric Decimetric Wavelengths, H. Paul. "Nach. Z." May 1957. 11 pp. A classification of radio relay links into various "grades of channel performance" on the basis of obtainable noise power per kilometer results in noise characteristics which can be combined with the path characteristics (path attenuation plus fading margin) by means of a handy slide rule.

Radio Transmitter for Ionospheric Scatter, J. L. Hollis, W. H. Collins, and A. R. Schmidt. "El." June 1, 1957. A 60 KW transmitter is described.

COMPONENTS

***Germanium Rectifiers As Electronic Components,** J. T. Cataldo. "El Ind." Aug. 1957. 4 pp. Circuit designers can gain significant advantages of efficiency, small size, and absence of aging through use of germanium rectifiers. The author considers methods of cooling, overload characteristics, surge voltages, etc.

***Signal Enhanced Delay Line,** T. I. Humphreys, "El. Ind." Aug. 1957. 3 pp. By selective amplification, high frequency response of a given line is improved to maintain pulse shape. Where narrow pulse reproducibility overshadows added complexity, this equipment will be much used.

Miniature Batteries, M. Poehler. "NTF," Vol. 6, 1957. 5 pp. A short historical introduction is followed by a discussion of lead cells capable of supplying 2½ ampere-hours at 4 volts for 10 hours and weighing about 1 lb. Sealed steel cells, based on the nickel-cadmium principle are possible through the electrochemical conversion of the developed oxygen into hydroxyl ions, preventing hydrogen development at the negative electrode and reducing the pressure to a value which can be readily handled. Some of these cells work as filters similar to a capacitor of 100,000 microfarad, and thus suitable for smoothing line-operated d.c. power supplies. The smallest cells of this type, shaped as buttons, have a capacity of 0.02 to 0.04 ampere-hours at 10 hours, weigh about 5 g. and have a volume of about 1.17 cm^3. Prism-shaped cells of this type are also available and useful for instance for transistor devices. Silver-zinc cells have a different charge and discharge curve. They have a shorter life than the lead and steel cells but their weight and volume are comparatively smaller. A silver-zinc cell for 0.5 ampere-hours has about 35.5 watt-hours per kg and about 50.7 watt-hours per liter. Cells for 0.1 ampere-hour and 100 ampere-hours have been built. The plates are usually put into transparent containers and the opening is so closed that the developed gases can escape while the electrolyte can not run out.

A New Form of Hybrid Junction for Microwave Frequencies, P. D. Lomer, and J. W. Crompton. "Proc. BIEE" May 1957. 4 pp. The principle of the branch-waveguide directional coupler has been applied to the design of a new form of hybrid junction for microwave frequencies. An equal division of power between the main and subsidiary waveguides is achieved by arranging the voltage coupling coefficients of the branch waveguides in accordance with the coefficients in a binomial expansion. Details of design and performance of such a hybrid junction are given for the 3-cm waveband.

Miniature Technique and its Components, "NTF," Vol. 6, 40 pp. This survey contains the following articles: Development Problems of Miniature Components, by Henninger; Self-Healing Capacitors, by Straeb; Contributions of Ferrites to Reduction in Size, by Heck; Miniature Batteries, by Poehler; Artificial Resins in Component Engineering, by Trietsch; Transistor and Tube, by Vith; Miniature Relays, by Darr; Printed Circuits, by Donn; Group Structures, by Stecher; and Summary and Expected Future Developments, by Schoenfeld.

Three-Dimensional Printed Wiring, E. A. Guditz. "El." June 1, 1957. 4 pp. Four collimated light sources are used to expose the photosensitive resist through holes in ferrite cores of memory planes, thus giving continuous wiring in three dimensions.

Flexible Magnetic Shielding Foil Cuts Production Costs, "El. Eq." June 1957. 2 pp. Thin magnetic foil can be wrapped around small electronic components, or used to "paper" a shielded room to produce a wide range of shielding at low weight and volume expense.

Cooling Packaged Electronic Equipment—II, Selecting the Method of Cooling, A. D. Hay. "El. Des." June 1, 1957. 3 pp. In this second of two parts, the author discusses forced air cooling, direct liquid cooling, and vaporization cooling.

Ceramic Developments Aid High-Temperature Instrumentation, A. W. Orlacchio and G. Rieber. "El Eq." June 1957. 2 pp. Advantages of recent ceramic developments are illustrated by a discussion of accelerometer design using ceramics.

Criteria for Evaluating Electromagnetic Relays, B. S. Sotskov. "Avto. i Tel." March 1957. 6 pp. The paper deals with a method for evaluating the basic properties of electromagnetic relays. This method makes possible a rational selection of a relay on the basis of its specified operating conditions.

Design Considerations in Transistor Vertical Deflection, M. J. Hellstrom. "El Eq." June 1957. 4 pp. Necessary changes in yoke design to insure operation of driver transistors within their ratings are discussed.

Modern Coil Winding Methods. "El. & Comm." March 1957. 2 pp.

Nuclear Radiation . . . How Will It Affect Electronic Parts? J. Holahan. "Aviation Age" June 1957. 4 pp. A review of known radiation effects on electronic components.

Resistor Performance Levels, R. A. Osche. "El. Des." June 15, 1957. 3 pp. This is a comparison of common types of resistor and a discussion of their applicability to high reliability equipment.

COMPUTERS

Computing the Correlation Function of a Stationary Random Process According to Experimental Data, B. N. Kutin. "Avto. i Tel." March 1957. 22 pp. The paper examines the errors involved in computing the correlation function of a stationary random process on the basis of experimental data; these errors arise due to the finite observation time. The evaluation of the errors is performed in a manner which makes it possible to use the existing forms of the autocorrelation function. Various methods of computing its approximate values from experimental data are analyzed. The formulas derived make it possible to obtain the mean-square error of computing the correlation function as a function of its argument on the basis of experimental data.

Flight Simulator Tests Fire-Control Radars, D. L. DeMyer. "El." June 1, 1957. 3 pp.

Transients in a Transistor Switching Circuit, N. I. Brodovich. "Avto. i Tel." March 1957. 7 pp. The paper examines transients in a switching circuit with a common base; the circuit is designed with one point-contact transistor. Expressions are derived for the currents, and current-variation graphs are plotted for a typical circuit with various transistor parameters in the active region of transistor operation when the circuit is subjected to a rectangular voltage pulse which throws the transistor into the "on" state. The performance rate of the circuit is evaluated, and the main requirements are formulated for point-contact transistors that are destined for high-speed switching circuits.

On Transient Responses in Transistor Pulse Systems, O. G. Iagodin. "Radiotek." Jan. 1957. 15 pp. The paper examines a method of analyzing transient responses in transistor pulse systems. The method is based upon representing the dynamic properties of the transistor by means of an approximate equivalent circuit and linearizing the nonlinear transistor characteristics. Transient responses are examined in circuits for a single-ended relaxation oscillator and a switching circuit operating with an unsaturated transistor.

Direct Coupled Transistor Logic Complementing Flip-Flop Circuits.—I, E. G. Clark. "El. Des." June 15, 1957. 3 pp.

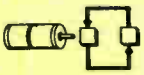
Electronic Analog Computers, B. F. Chown. "El. & Comm." March 1957. 3 pp. The article deals with the fundamentals of computer functions and reviews some of the older methods of mechanical computation.

Memory Systems in Electronic Computers, A. W. M. Coombs. "El. & Comm." May 1957. 6 pp. An elementary review of data storage systems commonly used in modern computers.

Digital Printer Boosts Readout Time, H. W. Gettings. "El." June 1, 1957. 4 pp.

High-Reliability Transistorized Counter, H. C. Chisholm. "El." June 1, 1957. 3 pp. Counting rates up to 100,000 per second are attained by using cascaded silicon junction transistor binary stages as energizers of neon lamp indicators.

International ELECTRONIC SOURCES



CONTROLS

Certain Problems Involved in the Design of Multichannel Automatic Control Systems, V. P. Kazakov. "Avto. i Tel." April 1957. 12 pp. The paper examines the circuits and design methods which can be used to construct the fundamental units of multichannel (multipoint) automatic control systems that employ time division of the channels. These design methods permit the use of contactless circuit elements.

A Multiplication-Division Unit Based upon Thyrite Resistors, A. A. Maslov. "Avto. i Tel." April 1957. 13 pp. The paper analyzes a new analytical method for determining the parameters of squaring elements which are based upon thyrite resistors. A new circuit for a multiplication unit using thyrite squaring elements is described; this circuit requires only two decision amplifiers. The results of an experimental investigation of the multiplication circuit are given.

On the Theory of a Half-Wave Magnetic Amplifier.—I, R. A. Lipman and I. B. Negnevitskii. "Avto. i Tel." April 1957. 22 pp. The available analyses of the Ramey circuit are further extended. The variation of the current in the control circuit is analyzed, and the region of applicability of the formulas derived for the load current and the voltage gain is defined; the problem of power gain is also thoroughly analyzed. Transient and steady-state conditions are investigated, and all of the theoretical conclusions are experimentally verified.

Survey of the Methods Available for Analysis and Synthesis of Non-Linear Servomechanisms. S. Demczynski. "El. Energy." May 1957. 6 pp.

Transistors Stabilize Missile Ships, R. Scheib, Jr. "El." June 1, 1957. 6 pp. Transistorized circuits serve as auxiliary controls to the hydraulic fin stabilizers now being designed for ocean-going vessels.

Analysis of the Simplest Relay Servo-System, G. V. Gerkhen-Gubanov. "Avto. i Tel." March 1957. 6 pp. The paper examines the movement of a relay servo-system in compensating the initial mismatch in the case where the system has a dead band, a return coefficient, and a relay with closure lag and release lag.

Simplified Computations of Magnetic Amplifiers with Cores Made from Iron-Nickel Alloys, N. A. Kaluzhnikov. "Avto. i Tel." March 1957. 5 pp. A simple and reliable method is given for designing medium-power magnetic amplifiers with iron-nickel alloy cores. The method is applicable for those cases in which the designer is not required to solve optimum problems.

An Analytical Expression for the Static Characteristic of the Detector Unit of a Saturable-Reactor Controller, E. Ia. Iakubaitis. "Avto. i Tel." March 1957. 6 pp. An analytical expression is obtained for the static characteristic of the detector unit in a saturable-reactor controller on the basis of a sectionally-linear approximation to the magnetization curve of the saturable reactor and the volt-ampere characteristic of the semiconductor rectifier.

Improving the Dynamic Properties of Automatic Control Systems by Means of Aperiodic Feedback Loops, S. Ia. Berezin. "Avto. i Tel." March 1957. 11 pp. The paper examines the application of aperiodic feedback loops for improving the dynamic properties of automatic control systems. Practical methods for obtaining aperiodic feedback loops are analyzed. The practicability of using aperiodic feedback loops is verified experimentally.

Automatic Synthesis of Relay Circuits, F. Svoboda. "Avto. i Tel." March 1957. 16 pp. The paper describes a semi-automatic experimental machine for the synthesis and analysis of single-cycle relay systems. The machine was developed by the Institute of Mathematical Machines of the Czechoslovak Academy of Sciences. The machine operates with indeterminate switching functions. The use of this machine together with the combinatorial method of synthesis makes it possible to synthesize circuits approximately 10 times faster than normally.

Chart for Finding the Real Frequency Characteristic from the Logarithmic Characteristics of an Open Automatic Control System, Iu. M. Astapov. "Avto. i Tel." March 1957. 2 pp. In plotting the transient response of an automatic control system by the method of trapezoidal or triangular characteristics it is first necessary to plot the graph of the real frequency phase of the system. The proposed method makes it possible to plot this characteristic if the graphs of the amplitude-frequency and phase-frequency characteristics of the system are known.

Concerning an Amplifier with Combined Feedback, I. A. Suslov. "Radiotek." March 1957. This paper discusses errors and omissions in papers written on the above subject in previous issues (specifically in "An Amplifier with Two-Channel Feedback," by M. M. Aizinov, "Radioteknika," Vol. 10, No. 7, 1955). The analysis is both general and fundamental, and some very useful new approaches are developed.

Improving the Stabilization of Automatic Controls Systems by Means of a Memory Unit When the System Employs a Servodrive of Limited Velocity, V. A. Kotel'nikov. "Avto. i Tel." April 1957. 15 pp. The paper examines the problems of designing a stable automatic control system under conditions where the velocity of the actuating mechanism is limited and the initial deviations are unlimited in size. A memory and switching unit is analyzed which satisfies the indicated requirements when the controller employs "rigid" feedback. The stability boundaries are found for such systems, and the allowable values of the controller parameters are found on the basis of these boundaries. Simulation is used to determine the transient responses of the automatic control system when deviations occur which cause the linear velocity range of the actuating mechanism to be exceeded.

Analytical Investigation of the Stability of Motion of an Electromechanical Transducing Unit, by I. M. Makarov. "Avto. i Tel." April 1957. 9 pp. The paper provides a description of the principle operation governing an electromechanical transducing unit which is used in simulators. The equations of motion for the unit are derived, and the stabiilty of its motion is investigated.

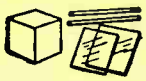
INDUSTRIAL ELECTRONICS

HF Heating in the Service of Industry. "Telonde" No. 1 1957. 13 pp. This is a review, in general terms, of the use of r-f heating techniques in French industry.

Basic Standards for Science and Industry, R. D. Huntoon. "El. Des." June 15, 1957. 3 pp. Dr. Huntoon discusses the role of standards, and the history of basic physical and temporal standards. The article will be continued to discuss derived standards, precise physical constants, and fundamental physical constants.

Transistorized Strobe Measures Shaft Torque, J. Patraiko. "El." June 1, 1957. 3 pp. A partially transistorized stroboscope is described which has high flashing rates, short flash duration, and reduced jitter. Unit is used to detect shaft distortions indicating torque in high-speed turbines.

Transistorized Radiation Survey Instruments, W. G Spear. "Nucleonics." June 1957. 2 pp. Light weight radiation survey instruments are described, included an alpha scintillation meter and a G-M-tube meter. Extended battery life and satisfactory operation from —20 to +160° F has been attained in this design.



MATERIALS

***Evaluating Base Materials For Printed Capacitors,** J. J. Logan. "El. Ind." Aug. 1957. 3 pp. Beyond the considerations of conventional capacitor design, printed circuits introduce the elements of dissipation factor and loss factor. These characteristics are considered in the light of conditions under which the circuitry will operate.

Selecting Plastic Laminates, N. A. Skow. "El. Des." June 15, 1957. 2 pp. The author discusses physical and electrical properties, as well as economic aspects of various plastic laminates for electric and electronic equipment.

Ferrites—1957, L. G. Rubin. "El. Des." June 1, 1957. 4 pp. The article deals with the composition and material properties of ferrites, and surveys the different fields of application of greatest interest today.

Pressure Resin Splice Meets Universal Needs. "El. & Comm." March 1957. 2 pp. The "Scotchcast" resin pressure splice is described. Lead, rubber, and plastic sheathed cable can be spliced. The method has worked satisfactorily on oil-saturated cable.

How Ceramoplastics Rate as Radome Structures, P. S. Hessinger. "El. Eq." June 1957. 4 pp. Among other advantageous properties are dimensional stability in molding, machinability. New designs are being evolved to utilize ceramoplastics for radomes.

MEASURING & TESTING

***A Magnetometer for the Satellite,** Dr. A. L. Bloom and L. E. Johnson. "El. Ind." Aug. 1957. 4 pp. The characteristic frequency of precessing protons in a weak magnetic field can serve as a measure of the earth's field in space. Data from rocket-borne magnetometers has been extrapolated to produce a tentative design for a satellite magnetometer.

***Effects of Radiation on Semiconductors,** Dr. J. W. Clark. "El. Ind." Aug. 1957. 3 pp. This is a description of an elaborate radiation test facility and the results of the program.

Portable Transistor Frequency Standard, D. S. Beyer. "El." June 1, 1957. 2 pp. A small, portable 200 kc oscillator is described. Output is rich in harmonics, up to 10 mc.

A Q-Probe for RF Monitoring, R. Baer. "El. Des." June 1, 1957. 3 pp. A test unit is described which was designed for the sampling of r-f signals in conjunction with an oscilloscope. The device permits undistorted display of the signal. Basically, a high-Q circuit is interposed between probe coil and oscilloscope in order to obtain sufficiently high r-f voltage to drive the oscilloscope.

The Error Involved in Determining The Figure-Of-Merit (Q) By Means Of A Q-Meter, I. S. Pavlov. "Radiotek," March, 1957. 4 pp. The paper establishes a hyperbolic error function for the process of determining the Q of a specimen from the readings of the instrument. The computation data are given in the table and in the form of a graph. The proposed formulas make it possible to draw certain general conclusions concerning the accuracy with which Q can be determined by means of a Q-meter.

BF_3 Neutron Spark Counter, M. J. Swetnick and N. G. Anton. "Nucleonics" June 1957. 1 p. The authors describe a slow-neutron detection system having a detection efficiency of 0.6% and a complete insensitivity to CO^{60} radiation at 500 r/hr.

Operating Characteristics of the Spark Counter, N. K. Saha and N. Nath. "Nucleonics" June 1957. 4 pp. This instrument displays high specificity—it is sensitive only to alphas. With a boron plate it gives 1 count for 180 neutrons/sq cm but less than 1 count/hour in a gamma field of 1 roentgen/second.

A Theoretical and Experimental Investigation of Anisotropic-Dielectric-Loaded Linear Electron Accelerators, R. B. R.-Shersby-Harvie, L. B. Mullett, W. Walkinshaw, J. S. Bell, and B. G. Loach. "Proc BIEE" May 1957. 18 pp. The general properties of linear accelerator waveguides loaded with spaced discs of ceramic dielectric are investigated theoretically and these waveguides are shown to have a higher shunt impedance than all-metal waveguides.

TELEVISION

The Aperture-Effect Characteristic in Television Viewing, G. I. Bialik. "Radiotek." March 1957. 14 pp. The paper generalizes a number of papers which have been written on the characteristics of aperture effect in television viewing. A basic characteristic is established—"the distribution law of a unit light flux." All the remaining characteristics—the frequency response, the pulse response, the transient response—are expressed as functions of the distribution law. The paper indicates the possibility of measuring the parameters of the sweep element according to the experimentally obtained pulse responses. The conclusions presented in this paper can be applied not only to television systems but also to other electron-optical systems (phototelegraphy, audiorecording).

Determining The Allowable Magnitude Of The Periodic Interference In A Television Channel, by A. P. Efimov. "Radiotek." March 1957. 8 pp. Problems involving the effects of periodic interference upon the quality of the television image have not been analyzed in Soviet literature. In this paper the allowable level of the periodic interference in a television channel is associated with certain characteristics of the channel and with certain features of human vision. The results of an experimental verification of the postulates posed in the paper are provided.

SEMICONDUCTORS

***The Four-Layer Diode,** Dr. William Shockley. "El. Ind." Aug. 1957. 5 pp. A new bistable, two-terminal semiconductor device is added to the growing list of electronic components. Early applications include self-excited sawtooth oscillators, high input impedance pulse-generators, ring circuits.

Zener-Diodes with Silicon, P. Dobrinski, H. Knabe, and H. Muller. "Nach. Z." April 1957. 5 pp. The mechanical and electrical properties of Zener-diodes are described, as well as special features and a number of possible applications.

Principles of the Light-Amplifier and Allied Devices, T. B. Tomlinson. "J BIRE" March, 1957. 14 pp. The article considers the necessary component parts of a light amplifying system and briefly points out the advantages of using solid state devices. A system is outlined which consists of a photoconducting layer in series with an electroluminescent phosphor layer. The behavior of the series combination is examined. Various practical constructions are described and attention drawn to the difficulties of manufacturing a picture reproducing device of large area.

Minority-Carrier Storage in Semi-Conductor Diodes, J. C. Henderson and J. R. Tillman. "Proc. BIEE" May 1957. 15 pp. Hole storage gives rise to transient reverse currents in diodes on the application of a reverse bias. The effects are deduced, quantitively, by solving the continuity equation with boundary conditions appropriate to the geometry and the external circuit. The analyses are tested by experiments—fair agreement is recorded between methods based on measurements of current decay at short and at long times after reverse bias application; the duration of limiting; and the decay of floating potential.

A High Input Impedance Transistor Circuit, P. J. Anzalone. "El. Des." June 1, 1957. 3 pp. This article describes a design method for increasing the obtainable input impedance orders of magnitude beyond that observed for conventional transistor circuits. Design is based on "bootstrap" configuration.

High-Frequency Circuits Use Meltback Tetrodes, D. W. Baker. "El." June 1, 1957. 3 pp. The design, fabrication, testing, and application of a tetrode transistor are discussed. The unit is designed for applications up to 100 mc, and experimental transistors have oscillated up to 1 kmc.

Determination of Transient Response of a Drift Transistor Using the Diffusion Equation, H. B. von Horn and W. Y. Stevens. "IBM J" April 1957. 3 pp.

TUBES

***New Lighthouse Tube for High Altitudes.** J. A. Jolly. "El. Ind. Op. Sect." Aug. 1957. 3 pp. Changes in tube envelope design make possible full voltage rating to 60,000 feet with the 3CX100A5 UHF triode. This ceramic tube is interchangeable with 2C39 types.

Grid-Circuit Distortion, E. Watkinson. "E&R Eng." June 1957. 8 pp. Conventional analyses of tube performance have established the dichotomy of negative control-grid operation without grid current and positive control-grid operation with grid current. This is a satisfactory convention for most tube applications, but it requires modification for some low-bias operating conditions. It is shown that operating conditions recommended by many tube manufacturers may lead to grid-circuit distortion at least comparable with that produced in the plate circuit. Conditions are recommended to reduce this distortion to negligible proportions.

Gas-Discharge Noise Tubes in the Range of High Discharge Admittances, H. Schnitger. "Nach. Z." May 1957. 5 pp. The operational range of gas-discharge tube noise generators can be considerably increased by fitting with delay lines instead of coupling to waveguides or coaxial lines as usually employed.

Heater Voltage - Current Relationships, A. Szilasi. "El. Des." June 1, 1957. 2 pp.

Heater Surge Chart, M. P. Feyerherm. "El." June 1, 1957. 1 p.

U. S. GOVERNMENT

Research reports designated (LC) after the price are available from the Library of Congress. They are photostat (pho) or microfilm (mic), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

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When an agency other than LC or OTS is the source, use the full address included in the abstract of the report. Make check or money order payable to that agency.

A Study of Permanent Magnets of the Barium Ferrite Type, K. J. Sixtus, The Indiana Steel Products Co. Aug. 1956. 53 pages. $1.50. (PB 121865, OTS) Research aimed at improving the magnetic properties of barium ferrite for its recently-developed use in ceramic permanent magnets is described.

More than 700 magnets were prepared and measured during the two years of studies. Data are provided in the report for processes for making the magnets, methods and results of physical measurements, and observations on theoretical aspects of magnetism in barium ferrite.

Among a number of advances was the attainment of crystal orientations better than 93 percent and residual inductions of nearly 4200 gauss. The energy product of barium ferrite was increased from about one million to over 3.7 million gauss x oersteds. Powder patterns were classified and a possible mechanism reversal was proposed.

Long-Resistence Three-Color Indicator Cathode-Ray Electron Tube, by C. D. Beintema, L. L. Vant-Hull, and S. T. Smith, The Hughes Aircraft Company for Wright Air Development Center. May 1956. 29 pages. 75 cents. (PB 121815, OTS) Shadow-mask multicolor storage tubes for radar and other applications with low frame rates have been constructed for the Air Force. Design of the tubes was directed towards providing long-persistence displays of high brightness, reduced flicker, and a steady picture. They also permit additional information to be superimposed on the radar display.

Electron Spin Resonance in Carbons, L. M. Matarrese, L. S. Singer, and R. E. Vander Vennen, N. R. L. Mar. 1957. 22 pages. 75 cents. (PB 121790, OTS) This study was concerned with the resonance absorption in carbons or charcoals free from inorganic impurities, using only materials whose method of preparation and past treatment were fully known. Electron spin resonance (ESR) was investigated in sucrose and other materials charred between 300 and 700°C.

Electron Transport Properties of Dilute Binary Magnesium Alloys, E. W. Kammer, N. R. L. Dec. 1956. 19 pages. 50 cents. (PB 121581, OTS) This research demonstrates that measurements of electron transport properties of dilute

magnesium alloys are sensitive to the Brillouin zone overlap phenomena deduced earlier by X-ray techniques. Matthiessen's rule and Linde's rule were found invalid. Resistivity varies linearly with composition, except for magnesium-tin alloys at higher compositions. The alloying effect upon the resistivity depends upon the valence of the solute atom and not its size. Both the Hall coefficient and the thermoelectric power may be expressed as the sum of two contributions. One contribution is directly related and therefore linear to electron concentration; the other arises essentially from everything else and may be obtained from the magnesium-cadmium data.

Nonmetallic Ferromagnetic Materials, General Electric Co. for Wright Air Development Center, Dec. 1955. This is a series of five reports reviewing research in this field for military electronics applications. Each volume is self-sustaining, reporting one project in the varied program. The reports, all carrying the same name, are listed below, with ordering information.

Part 1: Thin Films. (PB 121861 OTS) 18 pages. 50 cents. Sputtering and evaporation were evaluated for the production of thin films of ferrite materials. Sputtering proved the most promising technique. Films of magnetite and nickel-iron oxide were formed.

Part 2: Low-Loss, High-Temperature Ferrites. (PB 121874 OTS) 27 pages. 75 cents. The nickel-zinc ferrite system was most effective for development of a high-temperature, high-saturation magnetic material. Properties of a 30-20 Ni-Zn ferrite were compared with those of a high-quality manganese-zinc ferrite designed for television use. The Ni-Zn material showed remarkably high values of large signal permeability in driving fields of one oersted and in the temperature range minus 70°C to 200°C.

Part 3: Ferrite Single Crystals. (PB 121858 OTS) 23 pages. 75 cents. Single crystals were grown in order to study the commercial possibilities of their unique properties and to clarify the properties of ferrites and the phenomena occurring in them. The best crystals were grown from a feed containing 60 mole percent ferric oxide and 40 mole percent nickel oxide. Choice of growth method is discussed, along with the relationship between growth techniques and the phase equilibrium diagram.

Part 4: The NiO-Fe_2O_3 System. (PB 121869 OTS) 28 pages. 75 cents. Information gained in this study of the phase equilibrium in the system NiO-Fe_2O_3 proved valuable in the interpretation of behavior of polycrystalline materials. The phase diagram was used as a guide in crystal growing compositions, firing atmospheres, and firing schedules for sintered compacts.

Part 5: Ferrite Delay Lines. (PB 121868 OTS) 95 pages. $2.50. Radar, color television, correlators, and computers are just a few of the variety of electronic systems utilizing delay lines. A theory and design formulae are given for a ferrite delay line. The theory is applied to fabrication of a wide-band high-frequency line and a narrow-band low-frequency line. The materials development program is detailed, compositions and firing schedules are given, and observed electrical and magnetic properties are discussed as functions of processing variables.

Microwave Stepped-Index Luneberg Lenses. G. D. M. Peeler and H. P. Coleman, NRL, and M. C. Volk and W. R. Cuming, Emerson and Cuming, Inc. Oct. 1956. 21 pages. 75 cents. (PB 121561 OTS) The Luneberg lens has been considered by many workers in microoptics to be an ideal wide-angle objective because of its complete symmetry. However, materials with a continuous variation of index of refraction are necessary for construction of the spherical Luneberg, and these materials have been unavailable. This report examines an alternative design utilizing a stepped-index lenses in which the desired continuous variation of index with radius is approximated by a number of constant-index spherical shells.

Permanent-Magnet Generators. Part 1—Theory. D. J. Hanrahan and D. S. Toffolo, N. R. L. Mar. 1957. 18 pages. 50 cents. (PB 121862, OTS) The elimination in the AC generator of exciter, commutator, slip rings, brushes, and field winding make the permanent-magnet machine especially attractive for mobile applications where size, weight, and environmental requirements are severe. This report presents a simple theory of the generator. The theory is based on an equivalent magnet circuit and uses the conventional synchronous machine constants. Steady-state and transient operation are analyzed, and the demagnetizing effect of a short-circuit transient is evaluated.

Bismanol, A New Permanent Magnet. E. Adams, W. M. Hubbard, and A. M. Syeles, Naval Ordnance Lab. May 1952. 19 pages. 50 cents. (PB 121730, OTS) Bismanol is the permanent magnet of bismuth and manganese which at the time exceeded all known magnet materials in coercive force and all but a few in maximum energy product. The development grew out of an investigation into the use of compacted fine particles of ferromagnetic materials for production of new magnets containing neither cobalt nor nickel. Manganese bisulfide was chosen because it had the highest recorded magnetic crystal anisotropy constant. The resulting compacts displayed a coercive force of 3100 oersteds, a maximum energy product up to 2.9×10^6 gauss-oersteds, and a residual flux density of 3400 gauss.

Improvements To DME Interrogators And Development Of Accessories. W. E. Haworth, CAA. Jan. 1957. 16 pages. 50 cents. (PB 121880 OTS) Advances in design during the past few years have resulted in lightweight, accurate and relatively economical DME interrogators. This report reviews development of the Models DIB, DIC, and DID, the most significant of the modified devices, which weigh about half as much as earlier units, use half the number of tubes, and are considerably more reliable.

Evaluation Of The Resetting Continuous Fire-Detection System For The B-36 Aircraft Nacelle. L. E. Tarbell, CAA. Nov. 1956. 17 pages. 50 cents. (PB 121777 OTS) Flight and fire-in-flight tests which led to the recommendation of a continuous type of fire detection system for the B-36 nacelle are described. The system effectively replaced the system using unit-type fire detectors for protection of the entire nacelle.

Applications Of The Luneberg Lens. J. I. Bohnert and H. P. Coleman. NRL. Mar. 1957. 19 pages. 50 cents. (PB 121809 OTS) The ability of the spherically symmetrical microwave Luneberg lens to focus an incident plane to a diametrically opposite point on its surface has suggested numerous applications for the comparatively new development. Despite its unique advantages, however, applications have been severely limited by lack of materials and design techniques. This report reviews a number of significant attempts at making the focussing device, the limited applications which have resulted, and the potential applications once fabrication problems are overcome. Four currently used techniques are described for building small (up to five feet) two-dimensional microwave lenses. The most promising technique explored so far uses artificial dielectrics. These have been used in small two-dimensional lenses, and show promise for construction of large (to more than 100 feet) two- and three-dimensional Lunebergs for ultra high frequency operation.

Design of a 500 Foot-Diameter Faceted Paraboloidal Antenna, W. R. Ferris, NRL, Jan. 1957. 8 pages. 50 cents. (PB 121745, OTS) An inexpensive design for fixed paraboloidal radio antenna approximately 500 feet in diameter is proposed. The design consists of concentric rings of telephone poles supporting flat panels of a size easily constructed from commercial timbers or structural steel beams and covered with hardware cloth. Approximately square panels are proposed for economy of material.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Telephone Answering and Recording Device, #2,793,250. Inv. H. R. Van Deventer and P. C. Bailey. Assigned Telephone Answering and Recording Corp. Issued May 21, 1957. A control circuit, responsive to the current in the amplifier for the reproducing and recording phonographs, delays the power supply to the phonograph motor until the amplifier has reached operating conditions.

Drilling by Electrons, #2,793,281. Inv. K. H. Steigerwald. Assigned Carl Zeiss. Issued May 21, 1957. An electron beam is accelerated to high velocities and focussed into a cylindrical shape about 5 mm long and having a diameter of about 0.1 mm, the current density being high. Thus cylindrical holes having a diameter of from 0.1 to 0.001 millimeter and a length of from 5 to 0.3 millimeters can be drilled.

Apparatus for Electrostatically Recording and Reproducing, #2,793,288. Inv. Chas. F. Pulvari. Issued May 21, 1957. A multi-capacitor network comprising a plurality of small capacitors having a ferroelectric dielectric is positioned within the scanning range of a recording or reproducing electron beam. The intramolecular and intermolecular structure of this dielectric is adapted to be remanently changed, e.g., polarized, in response to an instantaneous signal while below its Curie point.

Pick-Up Tube with Induced Conductivity Target. #2,776,387. Inv. L. Pensak. Assigned Radio Corporation of America. Issued Jan. 1, 1957. The target of an electron camera tube includes a material which is normally insulating. However, this material becomes conductive when bombarded with electrons.

Pulse Sharpening Circuits, #2,793,303. Inv. H. Fleisher. Assigned International Business Machines Corp. Issued May 21, 1957. Input pulses are applied across a rectifier and an inductance in series. The base and emitter electrode are connected across the inductance to be normally nonconducting. Current reversal in the input circuit and the voltage surge across the inductance will cause a conduction of the transistor and a sharp output pulse is derived from the transistor collector electrode.

Electron Focusing Structure, #2,793,317. Inv. E. O. Lawrence. Assigned Chromatic Television Laboratories, Inc. Issued May 21, 1957. A grid of elongated linear conductors is mounted adjacent the screen of a color TV display tube. Each pair of adjacent conductors defines an aperture which is electron-optically aligned with a coordinated group of color phosphor strips. A pair of electron-permeable electrodes is positioned respectively on each side of the grid, the electrodes being of a potential opposite to that of the grid.

Phase Detector Systems. #2,793,347. Inv. E. G. Clark. Assigned Philco Corporation. Issued May 21, 1957. The color video signal and the horizontal synchronizing signal are applied to a product demodulator producing an output component having the burst frequency and amplitude variations dependent on the phase displacement between the two input signals. The ac component is fed to a bipolar detector circuit to derive a signal having amplitude variations equal to the amplitude variations of the output component fed thereto.

Electrical Delay Circuits, #2,794,123. Inv. E. L. Younker. Assigned Bell Telephone Laboratories, Inc. Issued May 28, 1957. Two mono-stable multivibrators are triggered by the leading edge of an input pulse, the period of the first mono-stable multivibrator determining the delay, the period of the second mon-stable multivibrator determining the pulse width. A bistable multivibrator is triggered on return of either mono-stable multivibrators to their stable state.

Progressive Wave Tube Comprising an Output Cavity and a Drift Space, #2,794,143. Inv. R. Warnecke and O. Doehler. Assigned compagnie Generale de Telegraphie Sand Fil. Issued May 28, 1957. A traveling-wave amplifier section is followed by a dissipating section. In the subsequent electron bunching section, which contains a drift space, the velocity modulation imparted in the traveling-wave tube section is converted into an emphasized density section. The last section is a transfer section for extracting r-f energy from the beam in a cavity resonator.

Traveling Wave Electron Discharge Devices, #2,794,145. Inv. J. H. Bryant. Assigned International Telephone and Telegraph Corp. Issued May 28, 1957. A conducting plate is positioned between the electron gun and the helix, the plate having a hole aligned with the beam. A resonant-length conducting strip is placed parallel to the plate and connecting thereto at one end for zero-voltage. The high voltage point of the strip is oppposite the hole in the plate. A suitable intermediate point on the strip is connected to the inner conductor of a coaxial line, the outer conductor being connected to the plate.

Color Kinescope Switching-Grid Capacitance Compensation, #2,794,064. Inv. N. Rynn. Assigned Radio Corporation of America. Issued May 28, 1957. Electrostatic cylindrical lenses are formed in front of the color screen by a grid consisting of two sets of parallel wires and a conductive surface at a positive potential with respect thereto. A color repetition frequency wave is applied to an inductance which is connected to be in parallel with capacitance inherent in the two sets of grid wires, their combination being resonant at the color repetition frequency.

Transistor Amplifiers, #2,794,076. Inv. R. F. Shea. Assigned General Electric Co. Issued May 28, 1957. A source of bias potential is d-c coupled to the emitter electrode of the transistor in a first amplifier stage and to the collector electrode of the subsequent amplifier stage. The collector electrode of the first transistor is directly couplead to the emitter electrode of the second transistor.

Gain-Modulated Amplifier, #2,794,077. Inv. Chas. L. Olson. Assigned Radio Corporation of America. Issued May 28, 1957. A pair of controllable resistance electron tubes is connected in series across the plate supply voltage for the gain-modulated amplifier tube, its plate being directly connected to the common junction of the pair of tubes. A gain control signal is applied in phase to the two grids of the pair of tubes to control their resistance and thus the plate voltage of the gain-modulated amplifier.

Electron-Tnbe Stabilized Amplifying Circuit, #2,790,036. Inv. B. H. Tongue. Issued April 23, 1957. The screen grid of a pentode is effectively grounded at the operating frequency. The suppressor grid is grounded over a circuit having reactance dimensioned to introduce a 180°-phase shift in the voltage fed back from the plate through the plate-to-suppressor-grid capacitance and the suppressor-grid-to-control-grid capacitance to the control grid, this phase-shift being relative to the plate-to-control grid feedback voltage effective through the inter-electrode capacity.

Variable Mu Wideband Amplifier, #2,790,854. Inv. J. C. Ward. Assigned General Precision Laboratory Inc. Issued April 30, 1957. Two branches are connected in parallel. The first branch includes a linear resistor and a comparatively large non-linear resistor, and the second branch includes a non-linear resistor and a linear resistor not larger than the non-linear resistor. The voltages across the non-linear resistor of the first branch and the linear resistor of the second branch are variable combined to afford a variably modified overall signal transfer characteristic.

Frequency Selective Transistor Amplifier, #2,790,856. Inv. B. Birkens. Assigned Motorola, Inc. Issued April 30, 1957. Primary and secondary windings of a transformer are tuned to the selected frequency by capacitors connected in parallel thereto. An untuned inductance coil is inductively coupled to the transformer secondary and the induced voltage is applied across the input terminals of a transistor; the inductance impedance is held low to match the input impedance of the transistor.

Traveling Wave Tube, #2,790,926. Inv. J. A. Morton. Assigned Bell Telephone Laboratories, Inc. Issued April 30, 1957. A plurality of insulating support rods are spaced about the outer periphery of the helix and extend parallel to its axis. A layer of insulating glaze material is provided in specified sections of the rods bonding them to the helix. The glaze material has a thermal coefficient of expansion equal to that of the helix and a high melting point; it forms fillets between each turn of the helix and the rods to attain a uniform transmission characteristic along the helix.

Transient Correcting Network, #2.790,954. Inv. M. S. Corrington. Assigned Radio Corp. of America. Issued April 30, 1957. To compensate for overshoot and resulting oscillations in a low-pass filter, a series-tuned circuit is connected in shunt across the filter; the series-tuned circuit is resonant to the frequency of the first half cycle of the oscillations.

Audio Frequency Signal Transfer Control Circuits, #2,790,970. Inv. G. T. Kodama. Assigned Sprague Electric Co. Issued April 30, 1957. Three capacitor electrodes, designed for the manual control of the proportion of an incoming signal to the output signal, are capacitively connected by high dielectric constant titanate ceramic. A specially constructed control for the movement and position of the dielectric is provided.

Transmission Cable for High Frequencies, #2,791,624. Inv. E. S. Kigler. Assigned Chester Cable Corp. Issued May 7, 1957. A pair of conductors is arranged at opposite sides inside of a flattened tubular dielectric body. Opposing sections of the flattened tubular body are connected by at spaced intervals to maintain the flattened shape of the body, to hold the conductors in place, and to provide spaced air bubbles with the tubular body and between the conductors.

Color Kinescope, #2,791,626. Inv. R. C. Hergenrother. Assigned Raytheon Manufacturing Co. Issued May 7, 1957. A blank strip is interposed between adjacent groups of recurrent color phosphor strips on a television screen. A grid comprising a series of spaced signal elements is aligned with these blank strips and positioned to intercept the scanning electron beam. Interception of the electron beam and one of the signal elements produces a control signal.

Magnetic Sound Recording, #2,791,640. Inv. W. V. Wolfe. Assigned Radio Corporation of America. Issued May 7, 1957. To record on a magnetic record medium of varying sensitivity, the signal is first recorded, picked-up and erased. The picked-up signal is compared to the original signal, and the difference signal used to control the gain of a final recording amplifier.

Push-Pull Amplifier with Complementary Type Transistors, #2,791,644. Inv. G. C. Sziklay. Assigned Radio Corporation of America. Issued May 7, 1957. Two transistors of opposite conductivity type are connected to receive identical input signals. Their base electrodes are oppositely biased and their collector electrodes connected to the same terminal of a common load impedance, whereby current flow through the load impedance occurs when one transistor conducts and in the opposite direction when the other transistor conducts.

High Input Impedance Comparator, #2,791,689. Inv. H. F. Stillwell. Assigned Collins Radio Corp. Issued May 7, 1957. A comparator circuit for operation with a low power-high impedance signal source connects the source to the plate of a first diode and the cathode of a second diode. The plate of the second diode leads through the primary of a transformer to the grid of a triode, while the cathode leads through the secondary of the same transformer to ground. The cathode of the triode is also connected to the cathode of the first diode.

Electroluminescent Color Image Reproduction, #2,792,447. Inv. B. Kazan. Assigned Radio Corporation of America. Issued May 14, 1957. A separate light-emitting cathode-ray tube for each color component is provided. The light from all tubes is projected onto a color-image producing target which consists of a layer of photoconductive material and an adjacent layer with different color phosphors arranged in a selected pattern. An ac field is applied across the target. A grid is interposed to intercept the light from the cathode-ray tubes so that the light of each tube impinges only on the areas responsive to the respective color.

Device for Stereophonically Recording and Transmitting Sound Waves, #2,792,449. Inv. A. Bottini. Issued May 14, 1957. Three channels are provided in the stereophonic recording and reproducing apparatus, each channel includes a microphone, a preamplifier, a keyer, an audio amplifier, and a loudspeaker. A pick-up head and a recording head can alternatively be suitably connected. Gating pulses are applied to the keyers providing alternate cut-off of the channels in a predetermined sequence.

Hum Reduction in Feedback Amplifiers, #2,792,458. Inv. L. H. Good. Assigned Radio Corporation of America. Issued May 14, 1957. The outputs of a single-sided amplifier and a phase inverter are fed to a push-pull stage. Distortion is reduced by an unbalanced inverse feedback from one push-pull output to the single-ended input circuit introducing hum potential. Undesirable fluctuations in the push-pull power supply are compensated by a balancing circuit connecting the power supply to the phase inverter circuit.

Crystal Controlled Marker Pulse Generator, #2,792,497. Inv. H. B. Brooks. Assigned Hughes Aircraft Co. Issued May 14, 1957. A blocking generator generates two simultaneous sharp pulses of opposite polarity which are applied across a series combination of a quartz crystal and a capacitor. The piezoelectric crystal plate will be shock excited by the pulses to produce an exponentially decaying train of evenly spaced oscillations at the common crystal-capacitor junction; the pulses of opposing polarity are cancelled at this junction.

Low-Noise Velocity Modulation Tube, #2,792,518. Inv. C. F. Quate. Assigned Bell Telephone Laboratories, Inc. Issued May 14, 1957. The electron beam is first made convergent and then collimated into a plane electron beam of a density less than one-half the density at the emissive cathode surface. A wave transmission circuit positioned along the path of the plane electron beam velocity-modulates the beam.

Color Television Tube, #2,792,522. Inv. A. B. Welch. Assigned Westinghouse Electric Co. Issued May 14, 1957. The target electrode of the color television screen is provided with a plurality of apertures and a receptor electrode is positioned to intercept the electrons passing through these apertures. A control signal derived from the receptor electrode is used to control the excitation of the different color phosphor areas on the target electrode.

New Products . . . for the Electronic Industries

INDICATING TUBE

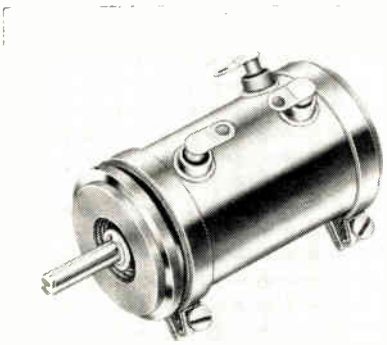
The new tube, designated the Indicoder binary decoding tube, has a 1½ in. square screen on which can be projected a numeral 1 in. high. In combination, they form an electronic

display board which will keep current, detailed information on scores of aircraft in the vicinity of an airport. Another use is to replace, on a 1:4 basis, the fluorescent lights used on most electronic computers to announce trouble or indicate the progress in a problem's solution. Can be used for digital voltmeters and other forms of data board display. Stromberg-Carlson, Rochester 3, N. Y.

Circle 278 on Inquiry Card, page 109

POTENTIOMETERS

The type 909 model is a ⅞ in. diameter multi-turn potentiometer that can easily be manufactured in a 3-turn or a 20-turn version or any degree between. Simplified ganging and

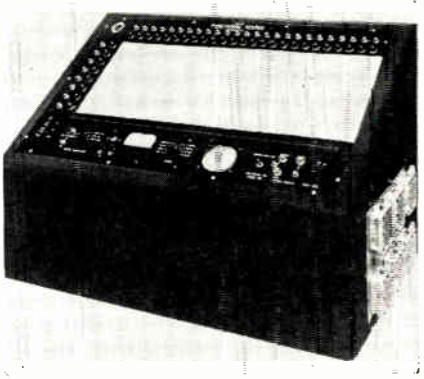


easy phasing are other features. Metal to glass type terminals are welded to the case. It can be tapped at frequent intervals. Typical resistance range is 100 ohms to 200,000 ohms for a 10-turn version of the type 909. Standard linearity is 0.5% with 0.05% available on special order. Rated at 2.5 watts at 40°C. Fairchild Controls Corp., 225 Park Ave., Hicksville, N. Y.

Circle 280 on Inquiry Card, page 109

FUNCTIONAL TESTER

The model 250 functional tester is especially designed to permit rapid, automatic tests of the most complex relay systems and associated wiring. It performs all types of continuity,



insulation resistance and short tests and features a sensitive timer which can be switched into any circuit under test to automatically measure the delay of time-delay circuits. It also has a vacuum tube ohmmeter which allows the operator to measure any circuit of the test group. One feature is its system of plug-board programming. DIT MCO, Inc., 911 Broadway, Kansas City, Mo.

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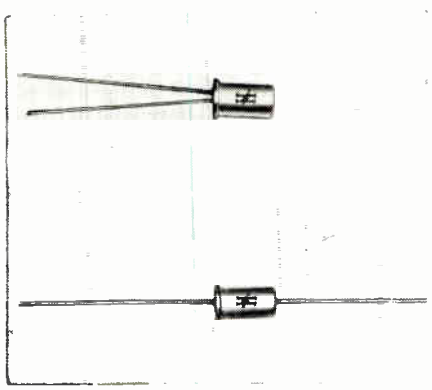
HIGH VOLTAGE RECTIFIERS

The HDMP series of high voltage medium power silicon diffused junction rectifiers are designed for applications requiring up to 1000 peak inverse working volts. Rated for operation in free air with no external heat sink, there is a choice of axial or single ended body construction. Maximum dimensions are 0.220 in. dia. x 0.360 in. lg. Has wide applications in



commercial and military equipment. The line includes ten different models at the present time. Hoffman Electronics Corp., 930 Pitner Ave., Evanston, Ill.

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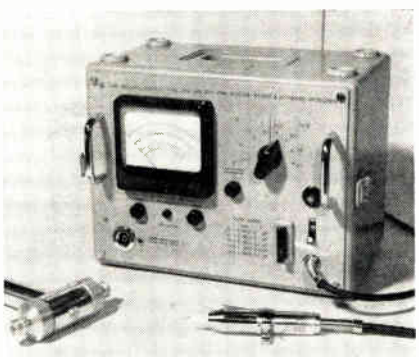
UHF MILLIVOLTMETER

The accurate UHF millivoltmeter is good for calibrating signal generators, determining exact signal levels, and measuring minute voltage levels. Designated as Type FT-URV, it has a sensitivity of 3 mv. and is usable from 1 KC to 2000 MC. It has a range of 3 mv to 10 v. and 9 v. to 500 v. (with dividers). Insertion unit has a 50 Ω characteristic impedance and the



VSWR is less than 1.2:1. Probe has input resistance between 100 kΩ at 100 KC and 3 kΩ at 300 MC. Federal Instruments Div., IT & T, 100 Kingsland Rd., Clifton, N. J.

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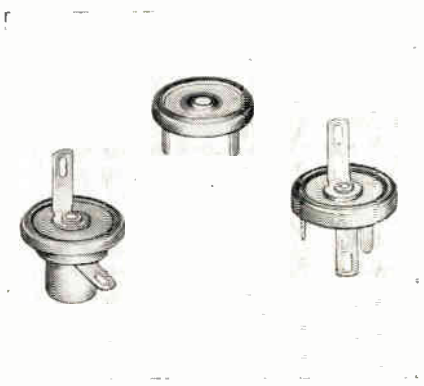
CUSTOM CAPACITORS

Custom built high temperature "Button" mica capacitors for continuous operation in the 350°C range are available. Test results over a range of —50°C to +350°C show average change in the mica capacitors of less than 4% in capacitance and power factor. They have been designed especially for high altitude missile and aircraft applications. Because of



the exacting requirements at these extreme temperatures, the new high temperature capacitors are usually custom-designed for specific application. Erie Resistor Corp., Erie, Pa.

Circle 283 on Inquiry Card, page 109

good connections can change your future!

Watch connectors made right in front of your eyes at the Wescon Show.

SEE an actual assembly line, moved lock, stock, barrel, and girls direct from Avnet's West Coast Plant.

FREE A brand new Bendix Electrical Connector with your name stamped on it.

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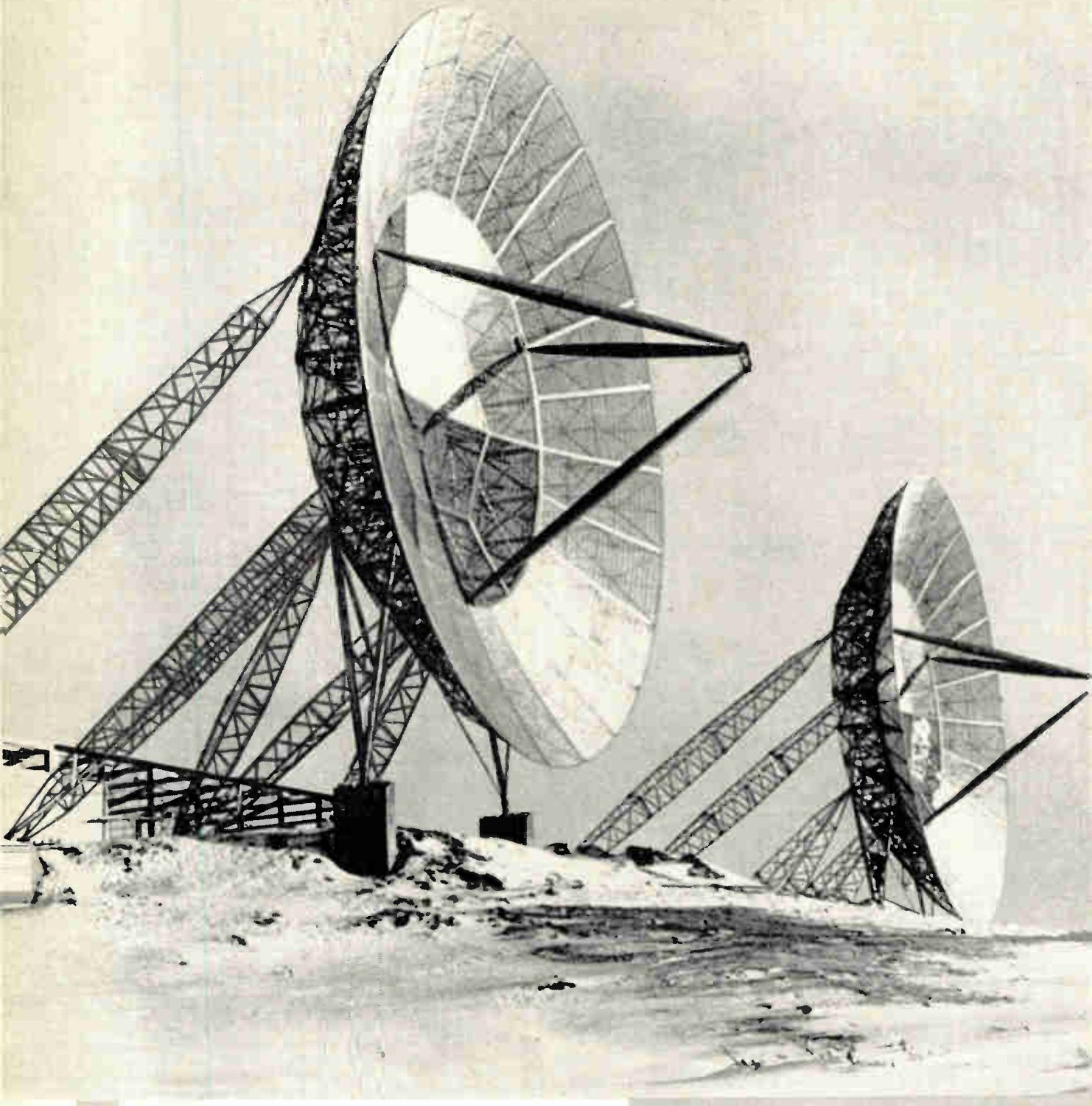
Western: 8966 National Blvd., L.A. 34, Calif. TExas 0-6141

KENNEDY ANTENNAS ...on the alert overseas



This is a 60′ Trans-Horizon antenna designed and built by Kennedy — a big "dish" with a big job.

Standing somewhere in northern Europe, it serves as an important link in the vast chain of communications that guards the perimeter of the free world.

It was built to do its job well. By means of "Scatter Propagation", it can handle multi-channel circuits over hundreds of miles with unimpaired clarity under all weather conditions. Made of lightweight, durable aluminum, it is virtually weather-proof, and features sectionalized construction for ease of transportation and erection.

Kennedy's long experience in designing and building big "dishes" for big jobs will serve you well when you have antenna problems.

Circle 47 on Inquiry Card, page 109

ANTENNA EQUIPMENT

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COHASSET, MASS. — TEL: CO4-12

Down-To-Earth **SOLUTIONS** *to*
Out-Of-This-World **PROBLEMS**

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Radio Telescopes
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Since 1922, industry's No. 1 source of standard and special electronic components

VARIABLE RESISTORS

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Miniature Rotary

Rotary-Action Flat

Rotary Power

Lever-Action

Slide

TRANSISTOR AMPLIFIERS

Single-stage

Four-stage

Unparalleled savings for parallel resistor-capacitor applications

Centralab TUBE-R-Cap*

ACTUAL SIZE

Saves Space!

Combines a high-quality ceramic capacitor and a built-in fixed resistor in the space of a tubular capacitor alone.

Saves Initial Cost!

Costs you less than an equivalent combination of individual resistor and capacitor.

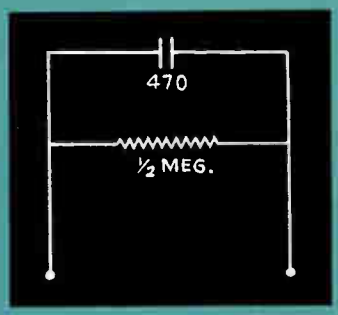
Saves Handling Costs!

Only one piece to insert, instead of two; only one piece to carry on inventory.

Provides any normal capacitor specification through 4700 mmf. and any resistance value from 100 ohms through 3 megohms (with ±20% tolerance up through 1 megohm . . . ±30% or wider above 1 megohm).

6,000,000 Tube-R-Caps are now in use, in antenna-line and many other applications. Lead spacings provided for any printed-circuit board. (See illustration below.)

Write us for further information. Or have the nearby Centralab representative tell you more. If you don't know who he is, ask us for his name.



TYPICAL EXAMPLES

DA620
Max. length, .530" — max. diam., .260"
470 mf., ± 20%, 500V
470 K ohms, ± 20%

DA625
Max. length, .810" — max. diam., .260"
1000 mmf., ± 20%, 500V
330 K ohms, ± 20%

DA632
Max. length, .900" — max. diam., .280"
470 mmf., GMV, 1500 VAC (UL rated)
.3 to 1 megohm

Available with crimped leads, for printed wiring board insertion

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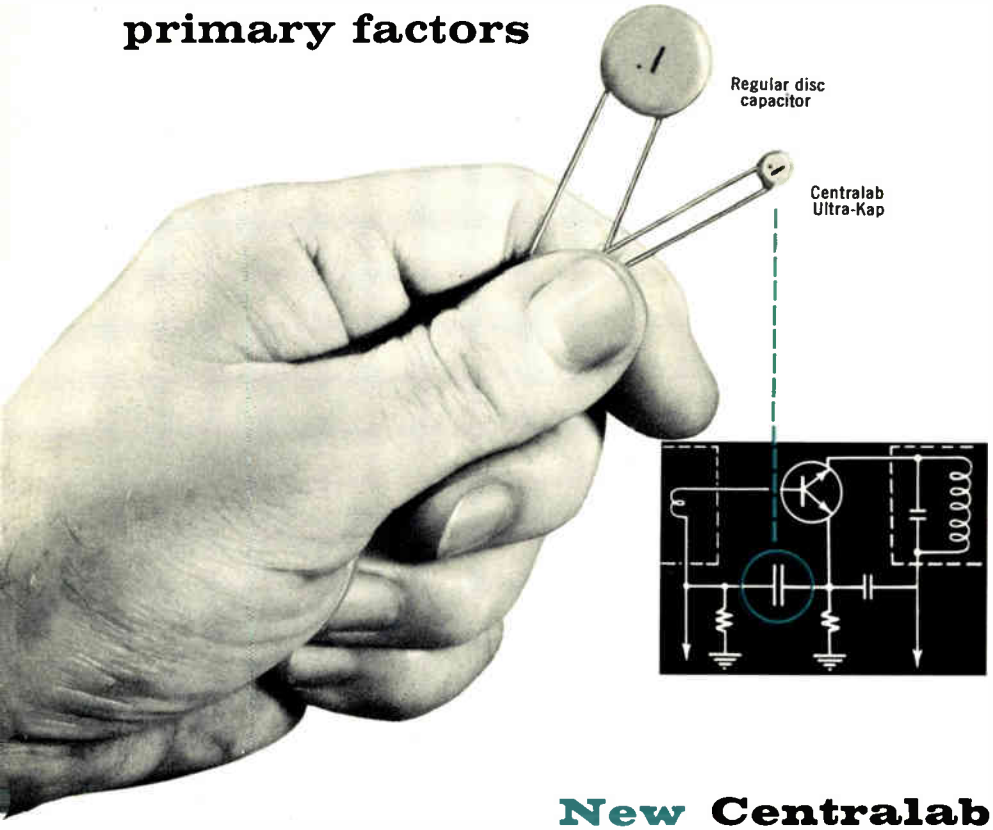
Continued on next page . . .

In transistor applications where size and cost are primary factors



New Centralab ULTRA-KAP* outperforms much larger and higher-priced components

A radically new approach to a ceramic disc capacitor that combines unusually high capacity with small physical size.

Has stable capacity curve over wide temperature range. Capacity vs. temperature: ±25% over+10°C to +85°C.

Ideal for by-pass in transistorized applications.

Costs far less than electrolytic and tantalytic capacitors of equal or greater capacity.

DIAM.	MAX. THICKNESS	CAPACITY MFD.	TOLERANCE
1/4″	.156″	.22	GMV
3/8″	.156″	.56	GMV
9/16″	.156″	1.0	GMV
3/4″	.156″	2.2	GMV

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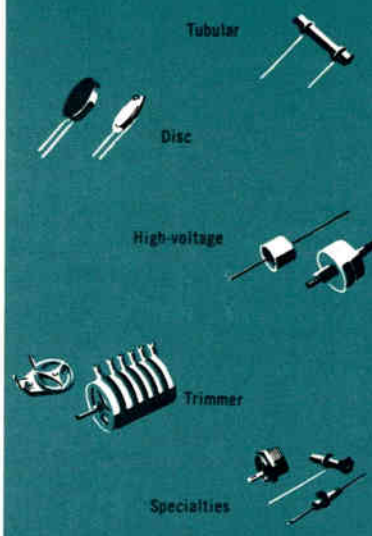
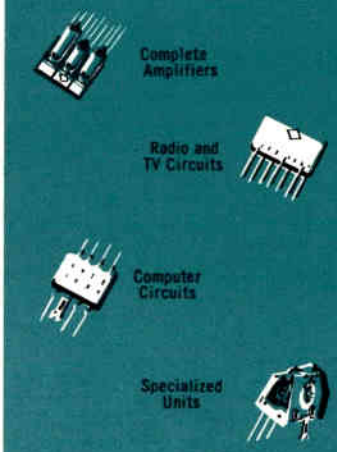
Centralab 1922 1957 35 YEARS

CERAMIC CAPACITORS



PACKAGED ELECTRONIC CIRCUITS



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ELECTRONIC INDUSTRIES'

1957 DIRECTORY of the WESTERN ELECTRONIC INDUSTRIES

This directory is an alphabetical listing of West Coast electronic manufacturers. Address, person to contact and telephone number are included to speed contacts. Principal proprietary items are indicated as (p); avionic items as (a). Triangle signifies WESCON exhibitors, and asterisk signifies Eastern and Midwestern firms with W. C. facilities.

Aerojet General Corp 6352 N Irwindale Ave Azuza Calif (a) Infra-red Devices

△Aerovox Corp Pacific Coast Div 2724 S Peck Rd Monrovia Calif—W M Owen—RY 1-5621 (p) Amplifiers, Capacitors, Filters

AiResearch Mfg Co 9851 S Sepulveda Blvd Los Angeles 45 Calif—James Macdonald—OR 8-9211 (p & a) Air Data Components, Air Data & Servo System

△*Air Marine Motors Inc 2055 Pontius Ave Los Angeles 25 Calif—T W Yeakle—BR 2-6489 (p) AC Induction Motor, Fan & Blower

△Aladdin Electronics 897 Commercial St Palo Alto Calif—A Jew—DA 4-4368 (p) Microwave Amplifiers & Oscillators

Aerophysics Development Corp Sub Curtiss-Wright Corp P O Box 689 Santa Barbara Calif—Dr W Bollay—WO 2-9135 (a) Missile Guidance Systems

Ajax Condenser Corp 10905 Chandler Blvd N Hollywood Calif—B Polayes—ST 7-1385 (p) Capacitors, Condensers, Filters

△*Allied Control Co 1326 Flower St Glendale 1 Calif—A L Oxford—CH 5-5757 (p & a) Relays, Switches, Controls

Alpar Mfg Corp 2910 Spring St Redwood City Calif—R V Laustrup—EM 8-4701 (p) Towers

△Altec Lansing Corp 1515 S Manchester Ave Anaheim Calif—R J Carrington—PR 4-2900 (p & a) Speakers, Amplifiers, Microphones, Tuners

Alto Scientific Co 855 Commercial St Palo Alto Calif—D Cherry—DA 4-4733 (p) Transistorized Voltmeters (a) Transistorized Portable Test Equip

Alwac Corp 13040 S Cerise Hawthorne Calif—A Y Baker—OR 8-7108 (p) Data Processing Equip

Amelco Inc 2040 Colo Ave Santa Monica Calif (a) Connector Soldering Clamps

△American Electronics Inc 655 W Washington Blvd Los Angeles 15 Calif—C Cesser—RI 9-7671 (p & a) Motors, Recordata Systems (a) Ground Support Equip

American Microwave Corp 11754 Vose St N Hollywood Calif—F W Bailey—PO 5-9041 (p & a) Microwave Relay Systems

△Andrew Calif Corp 941 E Marylind Ave Claremont Calif—J D Montgomery Jr—LY 6-3505 (p & a) Antennas

Anatran Div Endevco Corp 165 E California St Pasadena Calif—B Minteer—RY 1-9495 (p) Electro-Mechanical Counters

Angle Computer Co Inc 1709 Standard Ave Glendale 1 Calif—E D Wilson—CI 2-4915 (p) Double Axis Angle Computer & Controller, Supplies

Applied Research Labs 3717 Park Pl Glendale 8 Calif—Wm Whelchel—CH 5-2688 (p) Quantometer, Quantrol, Quantovac

Arnoux Corp 11924 W Washington Blvd Los Angeles 66 Calif—J F Davidson—TE 0-6756 (p & a) Temperature Measurement Systems, Probes

*Applied Science Corp of Princeton Western Dist Off 15551 Cabrito Rd Van Nuys Calif—G H Fredericks—St 2-7030 (p) Telemetering Equip, Preamplifier & Multicouplers, Sampling Switches

△*Assembly Products Inc P O Box XX Palm Springs Calif—Bradley Thompson—Desert Hot Springs 4-2453 (p & a) VHS Meter-Relays, VHS Compact Controls

△Associated Missile Products 2709 N Garey Ave Pomona Calif—Dr J Tampico—LY 4-2811 (a) Missile Ground Handling & Checkout Equip, Missile Components

△*Atlas E-E Corp 3757 Wilshire Blvd Los Angeles 5 Calif—B A Benson—DU 7-8666 (p & a) Chassis Accessories

△Avery Adhesive Label Corp 1616 S California Ave Monrovia Calif—R W TerBush—RY 1-5237 (p) Pressure Sensitized Tape

Avnet Electronic Supply Co 9866 National Blvd Los Angeles Calif (p) Components

Avion Div ACF Industries Inc 5333 Sepulveda Blvd Culver City Calif—Fred Davis—EX 7-4747 (a) Fire Control Systems, Missile Guidance Systems, Power Supplies

Baldwin Products Corp 432 E Valley Blvd San Gabriel Calif—A Barbeaux—AT 6-0988 (p) Thermocouplers

Barry Controls Inc 2821 N Naomi St Burbank Calif—D L Ammen—GI 8-6358 (a) Vibration Isolators

Barwood Electronics 921 E Broadway Glendale 5 Calif—Bernard Franz—CH 5-4063 (p) Transformers, Power Supplies (a) Adaptors, Footswitches

Scientific Instruments Div Beckman Instruments Inc 2500 Fullerton Rd Fullerton Calif—T V Park—LA 5-8241 (p) Measuring & Recording Instruments

△Beckman/Berkley Div Beckman Instruments Inc 2200 Wright Ave Richmond 3 Calif—A O Beckman—LA 6-7730 (p) Amplifiers, Counters, Transducers (a) Computers

Beckman Instruments Inc Data & Control Systems Scientific Instrument Div 325 N Muller Ave Anaheim Calif—A O Beckman—PR 4-5430 (p) Data Recorders, Computer Test Equip

Beckman Instruments Inc Process Instruments Div 2500 Fullerton Rd Fullerton Calif—A O Beckman—OW 7-1771 (p) Control Equip, Instruments for Electrical Measuring & Graphic Recording

Beckman Instruments Inc Shockley Semiconductor Lab Div 391 S San Antonio Rd Mountain View Calif—E L Peterson (p) Transistors, Diodes

△Beckman/Helipot Corp Newport Beach Calif—A O Beckman—LI 8-9361 (p) Precision Potentiometers

△Behlman Eng'g Co 114 S Hollywood Way Burbank Calif—J M Schroeder—VI 9-4475 (p & a) A C Power Supply

Bendix Aviation Corp Pacific Div 11600 Sherman Way N Hollywood Calif—M P Ferguson—ST 7-2881 (p) Electronic Computers, Data Processing Equip, Automatic Control Systems

△*Bendix Computer Div Bendix Aviation Corp 5630 Arbor Vitae St Los Angeles 45 Calif—Wm McGuckin—OR 4-3641 (p) General Purpose Computer, Flight Systems Simulators

Benson-Lehner Corp 11930 W Olympic Blvd Los Angeles 64 Calif—D B Prell—BR 2-3484 (p & a) Data Reduction Equip

Berndt-Bach Inc 6926 Romaine St Los Angeles 38 Calif—A N Brown—HO 2-0931 (p & a) 16MM Motion Picture Cameras

△*BJ Electronics Borg-Warner Corp 3300 Newport Ave Santa Ana Calif—D J Sadler—KI 5-5581 (p & a) Digital Systems & Components

Birtcher Corp Industrial Div 4371 Valley Blvd Los Angeles 32 Calif—C J Birtcher—CA 2-9101 (p) Tube Clamps

Blaine Electronetics Inc 14757 Keswick St Van Nuys Calif—R F Blaine—ST 2-6303 (o & a) Towers

△*Resinite Dept Borden Co Chemical Div P O Box 1589 Santa Barbara Calif—A W Schmidt—WO 3134 (p & a) Vinyl Insulation Sleeving & Compounds

△Borg Equipment Div George W Borg Corp 120 S Main St Janesville Calif R K Johnson—PL 4-6616 (a) Motors, Potentiometers

Bourns Labs Inc 6135 Magnolia Ave Riverside Calif—C E Calohan—OV 4-1700 (p & a) Potentiometers

*Brooks & Perkins 11655 Vanowen St N Hollywood Calif—D L Erickson—ST 7-9665 (p) Reflectors, Antennas, Ground Support Equip (a) Fire Control, Radar Reflectors

Brubaker Electronics Inc 3652 Eastham Dr Culver City Calif—G P Brubaker—TE 0-6441 (a) Radar Systems, Communication Systems, Components

△Burnell & Co 720 Mission St S Pasadena Calif—Frank Edmonds—RY 1-2841 (p) Chokes, Delay Lines, Filters

Calbest Electronics Co 4801 Exposition Blvd Los Angeles 16 Calif—I Dubin—RE 1-7291 (o) Hi-Fi Components, Intercoms—(a) Ground Support Equip

California Computer Prod 3927 W Jefferson Blvd Los Angeles 16 Calif—Robert C Morton—RE 5-8355 (p) Digital Graph Plotter

△Cal-Tronics Corp 11307 Hindry Ave Los Angeles 45 Calif—R F Feland Jr—OR 1-7694 (p) Hi-Pot—Continuity Tester, Peak Voltage Comparator, & Slide Back Voltmeter (a) Airborne Equip, Ground Support Equip, & Communications (power supplies)

California Chassis Co 5445 E Century Blvd Lynwood Calif—H P Balderson—NE 6-7777 (p & a) Chassis & Accessories

△California Technical Industries 1421 Old County Rd Belmont Calif—J M Carter—LY 3-8466 (p) Electronic Test Equip, Radome Boresight Equip, 3-Axis Dynamic Flight Simulator (a) Radar Equip, Magnetometer Equip

Cal-Met Electronics 5860 Spring Oak Dr Hollywood 28 Calif—Sidney Richardson—HO 7-5332 (a) Printed circuit connectors

Calvideo Tube Corp 5222 W 104th Los Angeles 45 Calif—Art Nelson—OR 8-3995 (p) T V Picture Tubes

△Cannon Electric Co 3209 Humboldt St Los Angeles 14 Calif—H G Schubert—CA 5-1251 (p) Connectors, Solenoids

Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif—P H Ryckoff—ST 6-9010 (p) Radar Equip, Test Equip, Microwave Components (a) Radar & Comm Antennas

△Carad Corp 2850 Bay Rd Redwood City Calif—Geo Glatthar—EM 8-2969 (p) Delay Lines, Filters, Transformers

Carruthers & Fernandaz 1501 Color St Santa Monica Calif—F C Fernandaz—TE 0-3698 (p) Coil Winding Bobbins, Bushings, Coils, Solenoids

Carstedt Research 2501 E 68 St Long Beach 5 Calif—M C Irwin—ME 3-8108 (p) Transformer Cores, Fibre Glass Tubing

△Cascade Research Corp 53 Victory La Los Gatos Calif—M B Adelson—El Gatos 4-9900 (p & a) Load Isolators, Circulators & Modulators

*Central Scientific Co of Calif 1040 Martin Ave Santa Clara Calif—V F Duensing—CH 8-1600 (p) High Vacuum Pumps, Gages

Century Engineers Inc 2741 N Naomi St Burbank Calif—Dr J S Anderson—VI 9-2114 (p) Position & Contour Control System

Chemalloy Electronics Corp Gillespie Airport Santee Calif—Samuel Freedman—HI 4-7661 (p & a) Microwave Colorimeters & Metals

Chicago Telephone of Calif 105 Pasadena Ave S Pasadena Calif—B S Turner—CL 5-7186 (p) Variable Resistors

△Christie Electric Corp 3410 W 67 St Los Angeles 43 Calif—S L Christie—PL 3-2607 (p) Converters, Battery Chargers

Chromatic TV Labs 1476 66 St Emeryville Calif—L W Alverez—OL 8-3831 (p) Color Cathode Ray Tubes, Color Radar Cathode Ray Tubes

*Cinema Eng'g Div Aerovox Corp 1100 Chestnut St Burbank Calif—J L Fouch—VI 9-5511 (p & a) Precision Wire Wound Resistors, Instr Switches

Circon Component Co Santa Barbara Municipal Airport Goleta Calif—M J Ainsworth—WO 8-2011 (p & a) Connectors, Indicators

Clark Electronic Labs Box 165 Palm Springs Calif—D B Clark—8-3011 (p) Pressure-Sensitive Resistors

△Coleman Eng'g Co 6040 W Jefferson Blvd Los Angeles 16 Calif—T C Coleman—TE 0-6931 (p) Counters (a) Aircraft Components

Collins Radio Co 2700 W Olive Ave Burbank Calif—M L Doelz—TH 5-1751 (p) Amplifiers, Antennas, Power Supplies (a) Communication Systems, Computers

△*Computer Control Co 10966 Le Conte Ave Los Angeles 24 Calif—Doug Chamorro—GR 8-8705 (p & a) Universal Logical Building Blocks

△*Computer-Measurements Corp 5528 Vineland Ave N Hollywood Calif—J K Rondou—ST 7-0401 (p) Counting, Timing & Controlling Instruments

Connector Corp of America 3223 Burton Ave Burbank Calif—R R Thomas—VI 9-2129 (p) Waveguide Flanges, Connectors (R F Coaxial Cables)

Conrac Inc 19217 E Foothill Blvd Glendora Calif—W. J. Moreland—ED 5-1241 (p) Monitors, Rebroadcast Receivers, Custom TV Chassis

△Consolidated Electrodynamics Corp 327 N Altadena Dr Pasadena Calif—Geo Clark—SY 6-6161 (p) Amplifiers, Analyzers, Converters (a) Computers

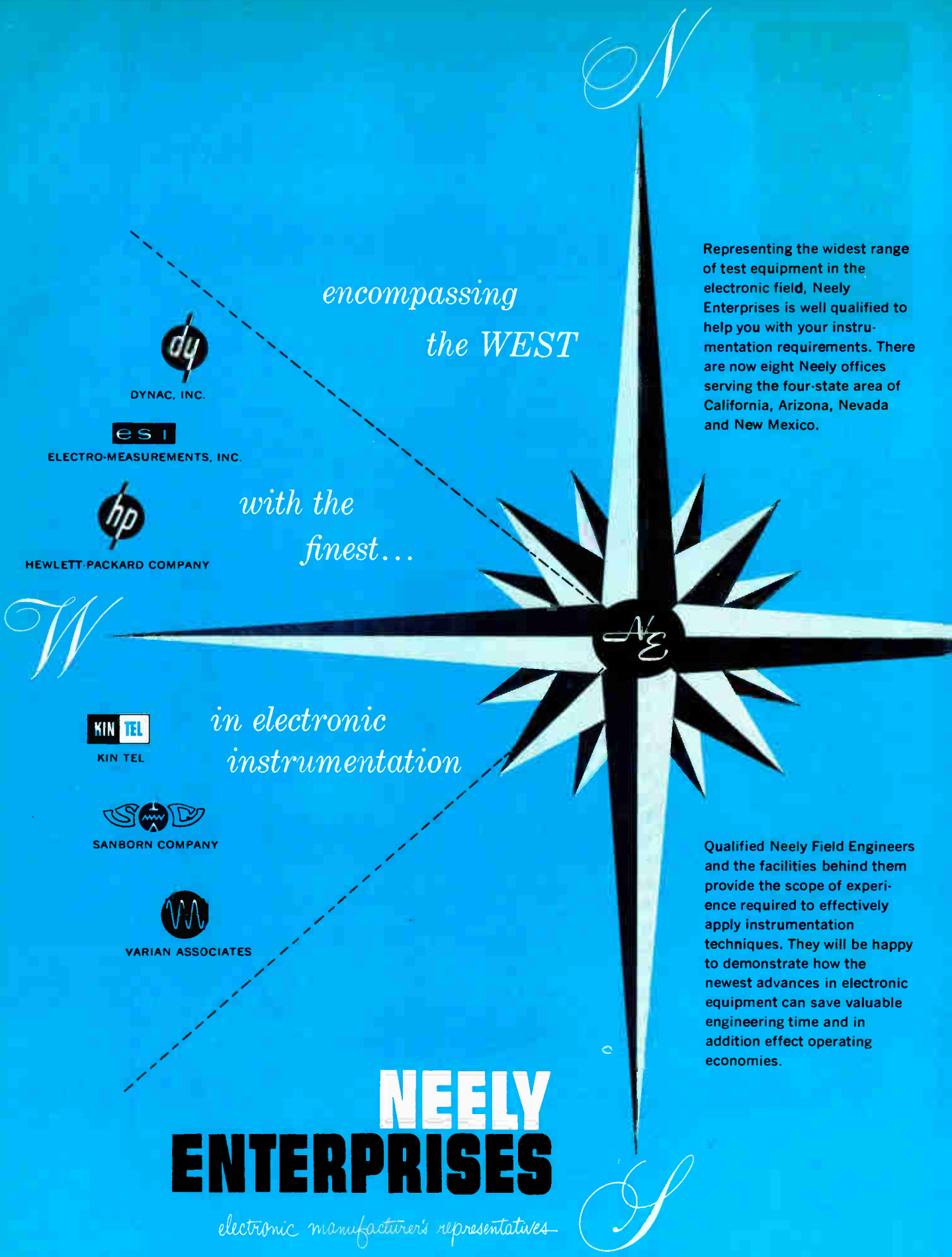
△Consolidated Electrodynamics Corp 300 N Sierra Madre Villa Pasadena Calif—H F Colvin—SY 6-9381 (p) Amplifiers, Analyzers, Converters (a) Computers

△Consolidated Electrodynamics Corp Glendale Div Glendale 3 Calif—R A Castell—CH 5-6555 (p) Amplifiers, Analyzers, Converters (a) Computers

Convair-Pomona Div General Dynamics Corp P O Box #1011 Pomona Calif—J M Glass—LY 9-5111 (a) Guided Missile Electronics

△Cornell Deep Drawing Co Div Lanes Industries Corp 621 Colo Ave Santa Monica Calif

*Cornell-Dubilier Elec Corp 4144 Glencoe Ave Venice Calif—P M Kuefler—TE 0-6691 (p & a) Filters & Capacitors



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Crittenden Transformer Works 1220 Nadeau St Los Angeles 1 Calif—Chuck Kinzy—LU 8-6173 (p) Special Purpose Transformers

△Cubic Corp 5575 Kearny Villa Rd San Diego 11 Calif—T R Burton—BR 7-6780 (p) Colorimetric Wattmeters & Transistorized Test Equipment (a) Missile Tracking Systems

△Dale Boison Co 2928 Nebraska Ave Santa Monica Calif—R G Andrew—EX 5-1087 (p) Printed Circuits, Circuit Lab Kit

△Dale Electronic Corp 2530 Ontario Burbank Calif—G H Elliott—VI 9-3313 (p & a) Potentiometers

Dalmotor Co Div Dalmo Victor Textron Inc 1375 Clay St Santa Clara Calif—Ralph Herzog—CH 3-9415 (p & a) Motors & Generators & Motor-Generators

Dalmo Victor Co Div Textron Inc 1515 Industrial Way Belmont Calif— G C Stewart—LY 1-1414 (p & a) Detectors, Radar Scanners

△Datex Div G M Giannini & Co 1307 S Myrtle Ave Monrovia Calif—G M Giannini—EL 9-5381 (p) Computers

Davis Elec Tronics Co 1011 Burbank Blvd Burbank Calif—S Spector—VI 9-5165 (p & a) Antennas (p) Communication Equipment

△*Daystrom Pacific Corp Potentiometer Div 11150 La Grange Ave Los Angeles 25 Calif—J Bamford—GR 8-3796 (p) Potentiometers

△*Daystrom Pacific Corp 3030 Nebraska Ave Santa Monica Calif—J Currie—EX 3-6755 (p) Potentiometers, Electro-Mechanical Components (a) Gyroscopes, Intervalometers

*Daystrom Systems Div Daystrom Inc 5640 La Jolla Blvd La Jolla Calif—Chalmer E Jones—GL 4-0421 (p) Translation Equip (a) Check-Out Equip

Deitronic Corp 1507 Riverside Dr Los Angeles 31 Calif—G M Urey—CA 2-0136 (p & a) Aircraft Relays

△DeMornay—Bonardi Corp 780 S Arroyo Pkwy Pasadena Calif—Norman Albone—RY 1-7416 (p) Microwave Test Equip (p & a) Microwave Components

△Deutsch Co 7000 Avalon Blvd Los Angeles 3 Calif—Alex Deutsch—PL 1-4134 (p) Hermetic Seal Connectors (a) AN Connectors

Dilectron Div Gudeman Co 2669 S Myrtle Ave Monrovia Calif—Jesse F Gudeman—RY 1-8631 (p) Ceramic Capacitors, Ceramic Dielectric, Time Delay Relays

Dirigio Compass & Instrument Co Boeing Field Box 37 Seattle 8 Wash—H V Wenger Jr—LA 5940 (a) Test Equip, Simulated Trainers

*Detroit Controls Div of Amer-Standard Research Dept 1650 Broadway Redwood City Calif—C R Newman—EM 6-8241 (p & a) Commutating Switch & Precision Location Thermocouples (p) Control Instrumentation

△Donner Scientific Co 888 Galindo St Concord Calif—D A Taskett—MU 2-6161 (p & a) Analog Computer, Accelerometer, Test Instruments

Douglas Aircraft Co 3000 Ocean Park Blvd Santa Monica Calif—(a) Airborne Instrumentation

△Dressen-Barnes Corp 250 N Vinedo Ave Pasadena Calif—T D Barnes—RY 1-0643 (p) Power Supplies, Regulators

*Dresser-Ideco Co 8909 S Vermont Los Angeles 44 Calif—K H Brust—PL 8-4194 (p) TV & Radio Bdcst'g Towers (a) Noise Antenuation Systems

D & R Ltd 402 E Gutierrez St Santa Barbara Calif—R L Dawley—WO 5-4511 (p & a) High Frequency Alternators

Dudek & Co R C 407 N Maple Drive Beverly Hills Calif—R C Dudek—BR 2-8097 (p & a) Fasteners, Connectors

△DuMont Laboratories Allen B 11800 W Olympic Blvd Los Angeles Calif—R B Austrian—GR 7-4271 Research & Development

Durson Co 10416 National Blvd Los Angeles Calif—W F Durst—VE 7-1072 (p) Transistor Test Equip

△Dynac 395 Pane Mill Rd Palo Alto Calif—G F Climo

Dynalysis Devel Labs Inc 11941 Wilshire Blvd Los Angeles 25 Calif—W E Hinds—GR 7-6786 (p) Servo Multipliers, DC Computing Amplifier (a) Signal Converter, Precision Power Amplifier

Dynamics Instrumentation Co 1118 Mission St S Pasadena Calif—G H Grey—RY 1-3319 (p) AC Voltage Amplifier, DC Grating System

*Dynamics Research Assoc Div of Universal Match 4538 Roosevelt Way Seattle 5 Wash—R Cockrell—EV 1685 (p & a) Magnetic Amplifiers, Servo Motor Amplifiers, Frequency Converters & Inverters

△Eitel-McCullough Inc 798 San Mateo San Bruno Calif—W W Eitel—JU 8-1212 (p) Capacitors, Rectifiers, Switches

Eldorado Electronics Co 1401 Middle Harbor Rd Oakland 20 Calif— J W Werlin—GL 1-3210 (p) Photometer, Photomultiplier, Multi-Channel Pulst Height Analyzers

Electrical Communications Inc 765 Clementina St San Francisco Calif—I Herman—KL 2-1947 (p & a) Selectors, Controls

△Electrical Specialty Co 158 11 St San Francisco 3 Calif— L L Gribble—HE 1-8450 (p) Insulators, Lugs, Plastics

△*ElectroData Div Burroughs Corp 460 Sierra Madre Villa Pasadena Calif—A Pearce—SY 3-6121 (p) Data Processing Systems, Digital Computors

Electro Development Co 14701 Keswick St Van Nuys Calif—R Vaccarello—ST 6-3660 (p) Slip Ring Assemblies, Brushholder Assemblies, Rotary Switches (a) Miniature Molded Components

△Electro Engineering Works 401 Preda St San Leandro Calif—R E Brooks—LO 9-3326 (p & a) Transformers

△Electro Instruments Inc 3794 Rosecrans St San Diego Calif—Bud Edelman—CY 8-6144 (p & a) Digital Voltmeters, Ohmmeters, Ratiometers

△Electromation Co Cado Mfg Div 1646 18 St Santa Monica Calif—J K Gossland—TE 0-6401 (p & a) Coaxial Microwave Switches

△Electromation Co Kinevox Hallen Div 1646 18th St Santa Monica Calif—H. Powell—EX 5-9975 (p) Magnetic Tape Recorders, Degaussers (a) Missile Recorder

△Electro-Measurements Inc 7524 S W Macadam Ave Portland 1 Ore—L A Morin—CH 6-3332 (p) Impedance Bridges. Dividers (a) Decade Voltage Dividers

Electromec Co 5121 San Fernando St Los Angeles 39 Calif—W H Burgess—CH 5-3771 (p) DC Amplifiers, Oscillators. Oscilloscopes, Telemetering Systems

△Electro Mechanical Specialties Co 1016 N Highland Ave Los Angeles 38 Calif J. Goodman—HO 2-0763 (p & a) Relays

Electronic Contractors Inc 2101 S E 6 Ave Portland 14 Ore—H K Lawson—BE 4-3515 (p) Power Network Computer, Analyzer

△*Electronic Control Systems 2136 Westwood Blvd Los Angeles 25 Calif—E P Spandau—GR 8-4266 (p) Machine Tool Control System, Automatic Test & Inspection System. Special—Purpose Computers (a) Telemetering Display Systems, Data Processing Systems

△Electronic Eng'g Co of Calif 1601 Chestnut St Santa Ana Calif— J G Stillson—KI 7-5501 (p) Tape Search & Control Unit (a) Strain Gage Oscillator. Time Code Converter

Electronic Prod & Dev Inc 138 Nevada St El Senundo Calif—W M Thomas—OR 8-9527 (p) Power Supplies (p & a) Dual Hermetically Sealed Relay

Electronic Products Corp 322 State St Santa Barbara Calif—D F Barr—WO 5-8505 (p) Dip Soldering Mach (a) Molded Cables & Harnesses, Test Equip & Precision Assemblies

Electronics Development Co 3743 Cahuenga Blvd N Hollywood Calif—D W Baisch—ST 7-3223 (p) Telemetering & Sound Diplexing Equip, Television Broadcast Transmitters (a) Television & Telemetering Transmitters

△Electron Products Inc 430 N Halstead St Pasadena 8 Calif—J Stevens—RY 1-0656 (p) Capacitors, Filters, Transformers

△Electro Pulse Inc 11861 Teale St Culver City Calif—J F Niebuhr—TE 0-8006 (p) Pulse Equip, Counters

Electroflor 7356 Santa Monica Blvd Hollywood 46 Calif—J R Alburger—HO 7-1443 (p) Light & Color Control, Data Storage, Digital Indicators

Electrosolids Co 7436 Varna Ave N Hollywood Calif—G J Widawsky—PO 5-9716 (p) Inverters, Amplifiers

△Elgin National Watch Co Electronics Div 2435 N Naomi St Burbank Calif—E C Carlson—VI 9-1446 (p) Relays, Microphones, Phonograph Cartridges

△Elgin National Watch Co 370 Fair Oaks Pasadena Calif—G Crist (p) Wire, Relays

El Ray Motors Inc 11747 Vose St N Hollywood Calif—W Forbes—PO 5-5771 (a) Sub Miniature Motors, Servo Motors

Endeco Eng'g Devel Co of Los Angeles 922 E Anaheim St Wilmington Calif—C W Witt—TE 5-1430 (p) Marine Radiotelephones, Antennas

△Endevco Corp 161 E California St Pasadena Calif—W Bradley Jr—RY 1-5231 (p) Vibration & Shock Instrumentation

△Engineered Electronics Co 506 E 1st St Santa Ana Calif—R A Bailey—KI 7-5751 (p) Plug-in Circuits & Accessories, Amplifiers & Accessories, Transistorized Plug-in Circuits

Engineered Magnetics Div Gulton Industries Inc 13030 Cerise Ave Hawthorne Calif—Dr L K Gulton—OS 5-0366 (p) Amplifiers, Power Supplies, Frequency Controls

△*Erie-Pacific Div Erie Resistor Corp 12932 S Weber Way Hawthorne Calif—G H Osborne—OR 8-5418 (p & a) Computer Sub-Assemblies, Missile & Aircraft Assemblies

△Fairchild Controls Corp 6111 E Washington Blvd Los Angeles Calif—H E Hale—WE 8-5600 (p) Potentiometers, Aerial Cameras, Commercial Cameras, Motors

△Farnsworth Electronic Co Pacific Div 815 S San Antonio Rd Palo Alto Calif—V D Carver—YO 7-7249 (p) Insulators, Terminals

△*Federal Telephone & Radio Co West Coast Prod 15191 Bledsoe St San Fernando Calif—W E Hunter—EM 5-3181 (p) Power Supplies, Semi-Conductor Converters, Industrial Communications (a) Power Supplies, Computer Equip, Static Inverter & Converter Equip

△Filtron Co 10023 W Jefferson Blvd Culver City Calif—W M Lana—FE 9-2206 (p) Filters, Delay Lines. Capacitors

Fisher Research Lab Inc 1961 University Ave Palo Alto Calif—E A Feichtmeir—DA 2-4646 (p) Pipe Finders, Leak & Sound Detectors (a) Multivoltmeters

△Fluke Mfg Co John 1111 W Nickerson St Seattle 99 Wash—R E Florence—GA 5700 (p) Differential D C Voltmeters & Power Supplies

Friden Calculating Machine Co 2350 Washington Ave San Leandro Calif—W S Johnson—SW 8-0700 (p) Amplifiers, Printed Circuits. Counters, Power Supplies

△Furane Plastics Inc 4516 Brazil St Los Angeles 39 Calif—Julian Delmonte—CH 5-5763 (p) Insulating Resins

Geisler Labs 876 Kaynyne St Redwood City Calif—W S Geisler Jr—EM 8-4227 (p) Traveling Wave Tubes, Linear Electron Accelerator, Special-Purpose Klystron

△General Electric Co 11840 W Olympic Blvd Los Angeles 64 Calif—B S Angiven—GR 9-7765 (p) Receiving & Industrial Tubes, Capacitors

△General Electric Co 951 Commercial St Palo Alto Calif—R R Johnson—YO 8-0061 (p) Digital & Analog Computers

△General Electric Co Microwave Lab 601 Calif St Palo Alto Calif—J U Nelson DA 4-1661

△*General Precision Lab Inc 21 N Santa Anita Ave Pasadena Calif—T C Le-Vay—RY 1-5669 (p) Navigation Systems & Closed Circuit Television Systems (a) Military Airborne Bombing & Navigation Systems

△General Radio Co 1000 N Seward St Los Angeles 38 Calif

△Genisco Inc 2233 Federal Ave Los Angeles 64 Calif—D J Roalsen—BR 2-2706 (p) Accelerometers

△Gertsch Products Inc 11846 Mississippi Ave Los Angeles 25 Calif—E P Gertsch—GR 8-7777 (p) Capacitors, Filters, Transformers

△Giannini & Co G M 918 E Green St Pasadena Calif—Scott Malcolm—RY 1-7152 (p) Transducers, Accelerometers (a) Air Data Systems, Control Systems, Voltage Repeater Systems

△Gilbert Co M B 1608 Centinela Ave Inglewood 3 Calif

△Girard-Hopkins 1000 40 Ave Oakland 1 Calif—A R Stack—KE 2-8477 (p & a) Capacitors, Resistors

△Globe Electrical Mfg Co 1729 W 134 St Gardena Calif—T R Staiger—(p) Printed Circuits, Panels, Components

△Goe Eng'g Co 219 S Mednik Ave Los Angeles Calif—Jack Goergl—AN 1-2183 (p & a) Chassis Accessories

Gonset Div-Layco 801 S Main St Burbank Calif—F R Gonsett—VI 9-2222 (p) Communications Equip (a) 2-way Radio Equip

Goslin Electric & Mfg Co 2921 W Olive Ave Burbank Calif—A J Goslin—VI 9-3025 (p & a) Transformers, Regulators, Amplifiers

Granger Associates 9666 Commercial St Palo Alto Calif—J V N Granger—YO 8-1648 (p & a) Radio Communications Gear, Antennas

*Graphik-Circuits Div Cinch Mfg Corp 200 S Turnbull Canyon Rd La Puente Calif—S L Glasnell—ED 3-1201 (p) Electrical Hardware, Printed Circuits

△Gudeman Co of Calif 190 Commercial St Sunnyvale Calif—J F Gudeman—RE 6-5471 (p) Transformers, Delay Lines, Filter Networks

Hadley Co Robt M 5112 S Hoover St Los Angeles 37 Calif—R M Hadley—AD 4-0131 (p) Amplifiers, Coils, Transformers

△Hallamore Electronics Co 8352 Brookhurst Ave Anaheim Calif—L G Hallamore—PR 4-1010 (p) Amplifiers, Antennas, Communication Systems

△Hall-Scott Inc Electronics Div 2950 N Ontario St Burbank Calif—M O Rice—VI 9-2341 (p) Ground Handling Equip, Missile Launching Equip

△Hancock Electronics Corp 2553 Middlefield Rd Redwood City Calif—W D Hancock—EM 6-8468 (p) Communication Equip

Hansen Electronics Co 7117 Santa Monica Blvd Los Angeles 46 Calif—H R Hansen—HO 9-3052 (p & a) Tape Resistors

Harder Co Donald C 3710 Midway Dr San Diego 10 Calif—D C Harder—AC 2-5240 (p & a) Toroidal Coil Machines & Components

△*Hetherington Inc 139 Illinois St El Segundo Calif—C L Cox—OR 8-8417 (p) Aircraft Switches & Relays

△Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif—David Packard—DA 5-4451 (p) Amplifiers, Counters, Filters

△Hoffman Electronics Corp 3761 S Hill St Los Angeles 7 Calif—H L Hoffman—RI 7-9661 (p) Amplifiers, Antennas (a) Communication Systems

△Hoffman Radio Div Hoffman Electronics Corp 6200 S Avalon Blvd Los Angeles Calif—John Stevens—AD 3-3151 (p) Television Receivers, Military Communication Equip (a) Airborne Communication Equip

△Hopkins Eng'g Co 12900 Foothill Blvd San Fernando Calif—P W Lawrason—EM 1-8693 (p) Capacitors, Interference Filters

Houston Fearless Div Color Corp of America 11801 W Olympic Blvd Los Angeles 64 Calif—R C Wilcox—BR 2-4331 (p) Cameras, Lenses

△Huggins Labs Inc 711 Hamilton Ave Menlo Park Calif—R A Huggins—DA 3-0013 (p & a) Traveling Wave Vacuum Tubes

△Hughes Aircraft Co Florence & Teale Sts Culver City Calif—J E Beam—EX 8-2711 (p) Diodes. Semi-Conductors, Transistors (a) Radar Systems

△Hughes Products Int'l Airport Sta Los Angeles 45 Calif—R M Russell—OR 2-5011 (p) Diodes, Transistors, Rectifiers

Hughey & Phillips 3200 N San Fernando Blvd Burbank Calif—J H Ganzenhuber—VI 9-1104 (p) Obstruction Lighting Equip

Humphrey Inc 2805 Canon St San Diego Calif—J H Bender—AC 3-1654 (a) Gyros Potentiometers, Accelerometers

△Hycon Mfg Co 707 S Raymond Ave Pasadena Calif—Trevor Gardner—SY 5-4241 (p) Amplifiers, Counters. Delay Lines (a) Aerial Reconnaissance Systems, Missile Guidance Systems

Hycor Div Int'l Resistance Co 12970 Bradley Ave Sylmar Calif—Warren McLeod—EM 5-3125 (p) Amplifiers. Filters, Transformers

Illumitronic Eng'g Co 680 E Taylor Ave Sunnyvale Calif—J D Giulie—RE 9-2395 (p) Air Wound Inductors

Industrial Electronic Eng'g 3973 Lankershim Blvd N Hollywood Calif—J J Bylo—PO 3-7303 (p) Digital Display Unit (a) Automatic Order Filling Machines

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△Int'l Rectifier Corp 1521 E Grand Ave El Segundo Calif—Eric Ludlow—OR 8-6281 (p) Diodes, Rectifiers

Int'l Research Assoc 2221 Warwick Ave Santa Monica Calif—L E Brown—

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Linlar Inc 4101 San Fernando Rd Glendale 4 Calif—L M Heineman—CH 5-5135 (p & a) Headsets, Transistorized Amplifiers, Transformers

Lipps Eng'g Edwin A 5485 W Washington Blvd Los Angeles 16 Calif—E A Lipps—WE 5-4141 (p) Tape Magnetic Recording Heads

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△Litton Industries-Electronic Display Lab 1476 66 St Emeryville Calif—A C Cooley—OL 8-3831 (p & a) Cathode-Ray Tubes and Related Apparatus

△Litton Industries of Calif 336 N Foothill Rd Beverly Hills Calif—C B Thornton—CR 4-7411 (p) Printed Circuits, Components, Waveguides (a) Computers, Communication Systems, Radar Systems

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Lone Sound Engineers J M 2171 W Washington Blvd Los Angeles 18 Calif—J M Loge—RE 4-9178 (p) Intercom Systems

Luther Electronic Mfg Co 5728 W Washington Blvd Los Angeles 16 Calif—C L Johnson—WE 9-5826 (a) Pulse Forming Networks

Lynch Carrier Systems 695 Bryant St San Francisco 7 Calif—E B Stone—EX 7-1471 (p) Carrier Telephone Equip

Lyon Rural Electric Co 2075 Moore St San Diego 12 Calif—Jim Lyon—CY 5-4625 (p & a) Solderer & Heater for Mfrs, Wire Stripper

△McKenna Labs 2503 Main St Santa Monica Calif—A G McKenna—EX 9-8846 (p & a) Ultrasonic Equip

Macdonald & Co 1324 Ethel St Glendale Calif—D G Macdonald—CI 1-6481 (a) Sleeving Cutter, Plug & Connector Holder

MacKenzie Electronics 3717 W 54 St Los Angeles 43 Calif—L G MacKenzie—AX 1-6200 (p) Audio Equip, Fixed Frequency Receivers, Magnetic Tape Devices

Magna Electronics Co 9810 Anza Ave Inglewood Calif—F Roy Chilton—OR 8-5675 (p) Amplifiers

Magnasync Mfg Co 5546 Satsuma Ave N Hollywood Calif—H V Auchstetter—ST 7-5493 (p) Recording & Reproducing Equip

△Magnetic Research Corp 3160 W El Segundo Blvd Hawthorne Calif—A R Hunter—OS 5-1171 (p & a) DC Power Supplies Signal, DC/Amplifiers, Magnetic Servo Amplifiers

Marco Industries Co 207 S Helena St Anaheim Calif—W W Bowles—KE 5-6037 (p) Warning Systems, Annunciator Panels (a) Aircraft Indicator Lights, Flexible Conduit & Assemblies

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△Monitor Products Co 815 Fremont Ave S Pasadena—J W Blasier—RY 1-1174 (p & a) Crystals & Crystal Ovens

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*Motorola Inc Riverside Research Lab 8330 Indiana Ave Riverside Calif—J F Byrne—OV 9-3141 (p) Communications, Relay Systems (a) Missile Guidance & Radar Systems

△Mullenbach Div Electric Machinery Mfg Co 2100 E 27 St Los Angeles 58 Calif—R H Olson—LU 2-5331 (p) Control Equip, Panels, Relays

△Mystik Tape Prods 3630 Tyburn St Los Angeles Calif

Nader Mfg Co 2661 S Myrtle Ave Monrovia Calif—J N Chambers—RY 1-6132 (p & a) Semi-Conductor Appliances, Transistorized Power Supply, Digital Counters

National Aircraft Corp Electronics Div 3411 Tulare Ave Burbank Calif (p) Amplifiers, Filters, Power Supplies

National Cash Register Co Electronics Div 1401 E El Segundo Blvd Hawthorne Calif—D E Eckdahl—PL 7-1811 (p) Auxiliary Equip for Digital Computers, Memory & Magnetic Recording Drums & Related Equip

Nat'l Electronics Corp 11815 Vose St N Hollywood Calif—Robert Sherwood—PO 5-7168 (p) Transformers, Capacitors, Transistor-Diode Ovens (a) Thermal Heaters & Blankets

Nemeth Inc 2223 S Carmelina Ave Los Angeles 64 Calif—Ruth Dorff—GR 8-8263 (p) Air-borne Missile Control Equip (a) Photographic Interpretation Equip

Network Electronics Corp 14806 Oxnard St Van Nuys Calif—H J Mock—ST 5-8805 (p) Relay Lines, Generators, Transformers

Newcomb Audio Prod Co 6824 Lexington Ave Hollywood 38 Calif—Robert Newcomb—HO 9-5381 (p) Sound Equip

Non-Linear Systems Inc Del Mar Airport Del Mar Calif—A F Kay—SK 5-1134 (p) Digital Voltmeters & Converters, Recording Systems

△Norden-Ketay Corp Western Div 13210 Crenshaw Blvd Gardena Calif—A Raines—OR 8-7121 (p) Amplifiers, Control Systems, Resolvers (a) Servos & Synchros

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Pace Eng'g Co 6914 Beck Ave N Hollywood Calif—B Helfand—PO 5-0453 (p) DC Power Supply

△Pacific Automation Products 1000 Air Way Glendale 1 Calif—F G Jameson—CH 5-6871 (p) Special Cable

Pacific Mercury Television Mfg Corp 8345 Hayvenhurst Ave Sepulveda Calif—J Benaron—EM 2-3131 (p) TV Receivers (a) Glide Slope Receivers, Cable Harness Assemblies & Ground Test Equip

Pacific Relays Inc 12027 Vose St N Hollywood Calif—N F Lee—ST 7-0209 (p) Time Delays (a) Relays

△Pacific Semiconductors Inc 10451 W Jefferson Blvd Culver City Calif—H Q North—VE 9-2341 (p) Diodes & Transistors

Pacific Transducer Corp 11836 W Pico Blvd Los Angeles 64 Calif—R S Clarke—OR 8-1134 (p) Audio Sweep Frequency Generators

△Packard Bell Electronics Corp 12333 W Olympic Blvd Los Angeles 64 Calif—R B Leng—BR 2-2171 (p) Test Equipment, Warning Systems, Analog Digital Converters (a) Avionic Control & Ground Support Equipment

Palmer Inc M V 4002 Fruit Valley Rd Vancouver Wash—M Palmer—OX 3-0590 (p) Telephone Equip, Microwave Comm Equip (a) Telemetering Control Equip

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Parks Electronics Corp 2910 Bay Rd Redwood City Calif—J W Houck—EM 8-5991 (p) Meters, Timers, & Relays

Par Products Corp 602 Colorado Ave Santa Monica Calif—C R Hallowell—EX 4-4219 (p) Motors (a) Simulators, Test Equip, Photographic Controls

△Parsons Co Ralph M Electronics Div 151 S De Lacey Ave Pasadena Calif—E C Lee—RY 1-0461 (p) Telemetering Equip (a) Telemetering Transmitter, Indicator System, & Airborne Transponders

PCA Electronics Inc 16799 Schoenborn St Senulveda Calif—C C Rubin—EM 2-0761 (a) Pulse Transformers

Pearson Electronics 707 Urban Lane Palo Alto Calif—J N DuCharme—DA 5-3147 (p) Pulse Transformers

Peerless Electrical Prod 9356 Santa Monica Blvd Beverly Hills Calif—E B Harrison—CR 5-5101 (p & a) Transformers

△Penta Labs Inc 312 N Nopal St Santa Barbara Calif—R P Leonard—WO 5-4581 (p & a) Power Tubes, Hydrogen Thyrantrons & Vacuum Switches

Perkin Eng'g Corp 345 Kansas St El Segundo Calif—P Diamond—OR 8-7215 (p) Power Supplies (a) Static Inverters

△R L Pflieger Co 1652 Laurel St San Carlos Calif—R L Pflieger

△Phaostron Instrument & Electronic Co 151 Pasadena Ave S Pasadena Calif—W A Beswick—CL 5-1471 (p) Electric Panel Meters, Carbon Deposited Resistors (a) Aircraft Relays, Test Equip

△*Photo Chemical Products of Calif Inc 1715 Berkeley St Santa Monica Calif—H G Renaud—EX 5-0919 (p & a) Finishing & Permanent Marking of Aircraft & Electronic Equip

△Photocon Research Prod 421 N Altadena Dr Pasadena Calif—P C Ganzell—SY 2-4131 (p & a) Measuring Equip, Counters & Test Instruments

△*Polytechnic Research & Development Co Inc 737 N Seward St Hollywood 38 Calif—W A Yearsley—HO 5-7181 (p) Microwave Test Equipment & Precision Resistors (a) Test Instruments & Microwave Components

Pomona Electronics Co 1126 W 5 Ave Pomona Calif—C W Musarra LY 9-9549 (p & a) Patch Cords, Test Socket Tube Adapters

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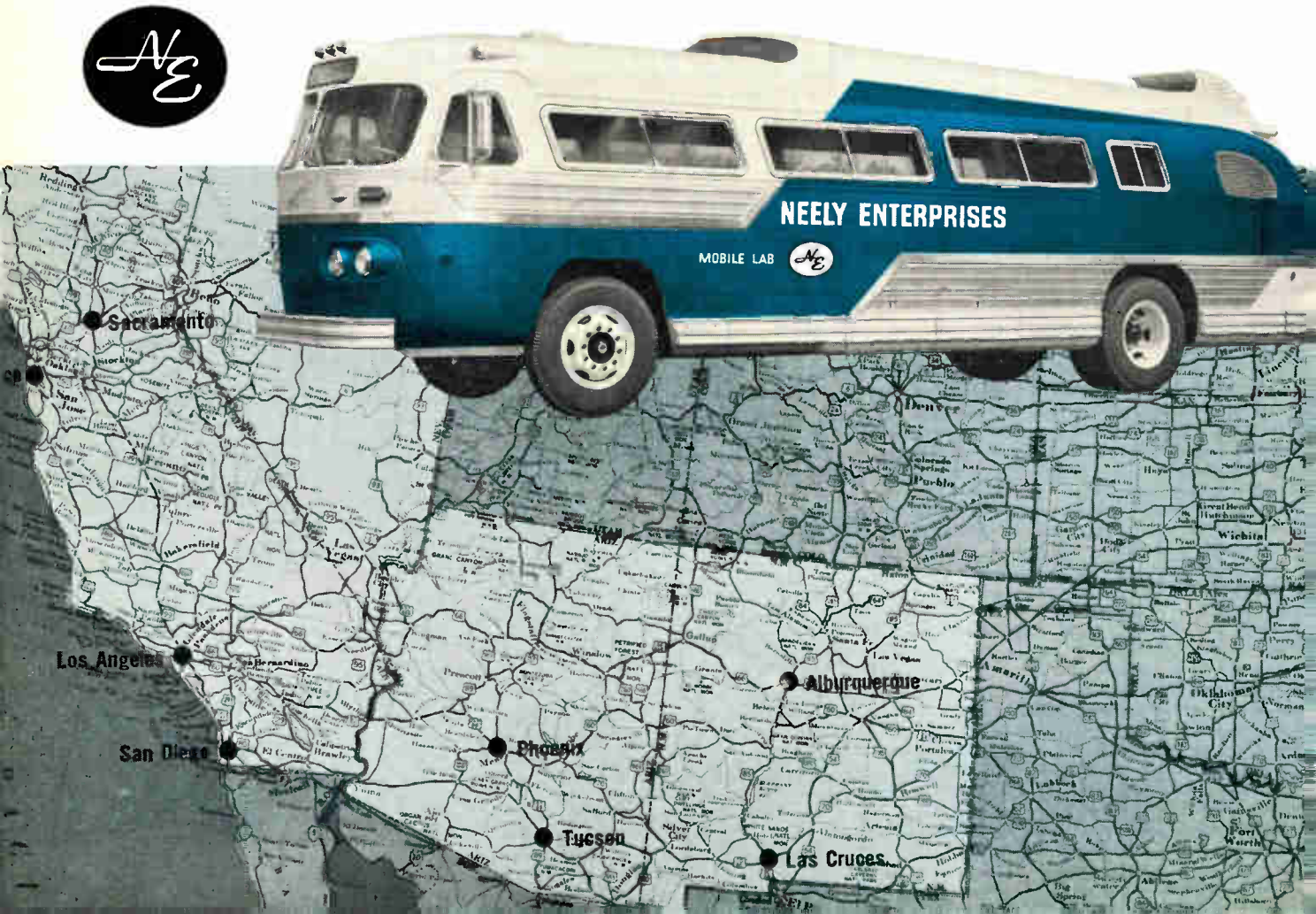

△*Potter Pacific Corp 3011 Malibu Canyon Rd Malibu Calif—D M Potter—DI 7-2760 (p & a) Flowmeter Instrumentation

Precision Crystal Lab 2223 Warwick Ave Santa Monica Calif—W Rogers EX 4-7004 (p) Crystal Ovens (a) Quartz Crystals

Precision Radiation Instruments Inc & Radio Craftsmen Div 4223 W Jefferson Blvd Los Angeles 16 Calif—L Norman—RE 1-7321 (p) Hi-Fi Consoles & Components, Radiation Measuring Equip

Prescott TV Co 7352 Beverly Blvd Los Angeles 36 Calif—M Prescott—WE 3-7193 (p) TV Receivers, Kinescope Recording Equip

△Printronics Corp 3159 E Camino Real Palo Alto Calif

△Products Research Co 3126 Los Feliz Blvd Los Angeles 39 Calif—W A Beckstead

Pruyn-Moore Inc 1338 Cota Ave Long Beach 13 Calif—C C Moore—HE 5-7417 (p) Communication Antennas Fixed & Mobile

*P S P Eng'g Co 6058 Walker Ave Maywood Calif—C B Pearson—LU 3-4785 (a) Solenoids

△Pulse Eng'g Inc 2657 Spring St Redwood City Calif—H B Fleming—EM 8-3331 (p) Transformers, Wave Filters, Inductors, & Mag-Amps

Qualitron Inc 2945 Hollywood Way Burbank Calif—J F Haussler Jr—ST 7-5963 (p) Aircraft Radio Control Panels. Junction Boxes & Custom Built Wiring Systems

△*Radio Corp of America 11819 W Olympic Blvd Los Angeles 64 Calif—A N Curtiss—BR 2-8841 (a) Airborne Navigation Equip, Missile Components & Digital Computer Equip

Radio Specialty Mfg Co 2023 SE 6 Ave Portland 14 Ore—K C Johnson—BE 2-8123 (p) Portable Receivers

△Ramo-Wooldridge Corp 5730 Arbor Vitae St Los Angeles 45 Calif—Dr R P Johnson—OR 8-0311

Ransom Research P O Box 382 San Pedro Calif—D H Ransom TE 2-6848 (p & a) Transistor Computer, Components

Ratigan Electronics Inc 3614 Maple Ave Los Angeles 11 Calif—E A Hodges—AD 3-4141 (p & a) R F Coils, Delay Lines

△*Raytheon Mfg Co Santa Barbara Lab P O Box 636 Santa Barbara Calif—B Gurney—WO 3116 (a) Electronic Equip, Flight Test Equip

△Rea Co J B 1723 Cloverfield Blvd Santa Monica Calif—Dr J B Rea—EX 3-7201 (p) Scientific Instruments

△Remler Co 2101 Bryant St San Francisco Calif—R C Gray—VA 4-3435 (p) Amplifiers, Communication Systems, Connectors

△*Repath Pacific Div Arnold Eng'g Co 641 E 61 St Los Angeles 1 Calif—L W Murphy—AD 3-7262 (p) Silicon & Nickel Laminations

Resdel Eng'g Corp 330 S Fair Oaks Ave Pasadena Calif—H K Abajian—SY 5-5197 (p & a) Doppler Radar, Subminiaturized Beacons, Microwave Pre-Amplifiers, Signal Generators (a) Doppler Radar

Research Instrument Co 7962 S E Powell Blvd Portland 6 Ore—R C Gearhart—PR 5-2323 (p & a) Potentiometers

△*Rheem Mfg Co Electronics Div 7777 Industry Ave Rivera Calif—G L Gillespie—RA 3-8971 (p) Electron Tube Characteristics Analyzer, Ratio Recorder, Cathodic Protection Power Supply (a) Power Amplifier, Subminiature Voltage, Airborne DC to DC Converter

△Rho Engineering Co 2242 Sepulveda Blvd Los Angeles 64 Calif—G L McHale—BR 2-1163 (p & a) High Voltage & Transistorized Power Supplies, & Precision Wire Wound Resistors

△*Robertshaw-Fulton Controls Co Aeronautical Div Santa Ana Freeway at Euclid Ave Anaheim Calif—F H Weisel—KE 5-8151 (p & a) Switches, Crystal Ovens, Positive Indicators

△Hall-Scott Inc Douglas Roesch Cable Div 2950 N Ontario St Burbank Calif—M O Rice—VI 9-3231 (p) D C Amplifier, Analog Computer & Time Delay (a) Missile System Components, Encapsulated Cables & Lamps

*Tele-Dynamics Inc 15016 Ventura Blvd Sherman Oaks Calif—R W Murray—ST 9-1332 (p) Telemeter Guidance & Control Systems

△Rototest Labs Inc 2803 Los Flores Blvd Lynwood Calif—A J Romano—NE 6-9238 (p & a) Component Testing

△RS Electronics Corp 435 Portage Ave Palo Alto Calif—G P Regan—DA 3-9063 (p) Amplifiers, Printed Circuits, Power Supplies (a) Radar Systems

△Rutherford Electronics Co 8944 Lindblade St Culver City Calif—C E Rutherford—TE 0-4362 (p) Pulse Generator, Time Delay Generator

△San Fernando Electric Mfg Co 1509 1 St San Fernando Calif—J B Misner—EM 1-8691 (p & a) Capacitors, Potentiometers, Filters

△Sequoia Wire 2201 Bay Rd Redwood City Calif—W W Valentine—EM 9-0331 (p) Cables, Wires

△Servomechanisms Inc Western Div 12500 Aviation Blvd Hawthorne Calif—W W Shannon—OS 5-7111 (p) Controls, Recording Instruments (a) Computers

△Shasta Div Beckman Instruments Inc P O Box 296 Station A Richmond Calif—E C Helme—LA 6-7730 (p) Test Equipment

Sargent-Rayment Co 4926 E 12th St Oakland 1 Calif—W Rayment—KE 1-5277 (p) Hi Fi AM-FM Tuners & Amplifiers

Scala Radio Co 2814 19 St San Francisco 10 Calif—B Zucconi—VA 6-2898 (p) Antennas, Oscilloscope Probes

Scantlin Electronics 11624 W Pico Blvd Los Angeles 64 Calif—J R Scantlin—GR 8-3771 (p) Digital Computers (p & a) Selective Calling Equip

Schafer Custom Eng'g Paul 235 S 3 St Burbank Calif—P C Schafer—TH 5-3561 (p) Remote Control Systems

Seeley Electronics 1060 S La Brea Ave Los Angeles 19 Calif—W M Seeley—WE 3-1183 (p) Mobile Receivers

Servonic Instruments Inc 1145 S Fair Oaks Pasadena 2 Calif—P S Chase—SY 9-1332 (p & a) Transducers, Potentiometers

Shamban & Co W S 11617 W Jefferson Blvd Culver City Calif—W S Shamban—TE 0-6877 (p & a) Stand-Off & Feed-Thru Insulators

Shannon Luminous Materials Co 7356 Santa Monica Blvd Hollywood 46 Calif—J R Alburger—HO 7-5509 (p) Black Light Lamps (a) Luminous Paints

Shrader Co F W 11623 S Broadway Los Angeles 61 Calif—F W Shrader—PL 6-9166 (p & a) Electro Magnets

△Sierra Electronics Corp 3885 Bohannon Dr Menlo Park Calif—J M Skinner—DA 6-2060 (p) Amplifiers, Filters, Generators

Signal Equip Co 2706 3rd Ave Seattle 1 Wash—J F Johnson—SE 4712 (p) Power Supplies & Transistor Amplifiers

Smith Mfg Co Nathan R 105 Pasadena Ave S Pasadena Calif—N R Smith—CL 5-5141 (p) Coils, Laminations, Solenoids, Transformers

Solar Aircraft Co 2200 Pacific Hwy San Diego 12 Calif—J M Sayre—BE 3-8241 (a) Auxiliary Power Units

Solar Mfg Corp 4553 Seville Los Angeles 58 Calif—C A Swanson—LU 3-1411 (p & a) Capacitors, Barium Titanate Crystals

△Solartron Inc 10761 Burbank Blvd N Hollywood Calif

△Southern Electronics Corp 150 W Cypress Ave Burbank Calif—G E Gansell—VI 9-3193 (p & a) Capacitors

△*Sprague Electric Co Pacific Div 12870 Panama St Los Angeles 66 Calif—G H L Norman—EX 8-2791 (p & a) Capacitors. Resistors, Filters & Transistors

△Spectrol Electronics Div Carrier Corp 1704 S Del Mar Ave San Gabriel Calif—R C Chase—AT 9-4178 (p) Potentiometers

Stancil-Hoffman Corp 921 N Highland Ave Hollywood 38 Calif—W V Stancil—HO 4-7461 (p) Magnetic Tape Recorders (a) Airborne Tape Recorders & Reproducers

Statham Labs Inc 12401 W Olympic Blvd Los Angeles 64 Calif—L D Statham—BR 2-6284 (p) Measurement Inst

△Stephen-Douglas Co 1650 21 St Santa Monica Calif

Stephens Tru-sonic Inc 8538 Warner Dr Culver City Calif—Bert Berlant—TE 0-6671 (p) Amplifiers, Filters (a) Communication Systems

Stewart Eng'g Co P O Box 277 Soquel Calif—O Connaly—GR 5-4790 (p) Travelling Wave Tubes (a) Controlled Atmosphere Furnaces

Stoddart Aircraft Radio Co 6644 Santa Monica Blvd Hollywood 38 Calif—R R Stoddart—HO 4-9294 (p) Coaxial Attenuators (a) Radio Interference & Field Intensity Measuring Equip

△Stromberg-Carlson Div General Dynamics Corp 1895 Hancock St San Diego 12 Calif—J P Graham—CY 8-8331 (p) Amplifiers, Filters (a) Communication Systems

Summit Electronic Products 14706 Arminta St Van Nuys Calif—R Ball—ST 5-1581 (a) Magnetic Amplifiers

Sylvania Electric Products Inc 1401 E Orangethorpe Ave Fullerton Calif—LA 5-8211 (p) Attenuators, Solenoids, Keystron & Amplifier Tubes

△Systron Corp 2055 Concord Blvd Concord Calif—J R Cunningham—MU 2-3650 (p) Control & Data Processing. Digital Instrumentation

Taylor Fibre Co P O Box 99 La Verne Calif—J M Taylor—LY 4-2221 (p) Laminated Plastics, Sheets, Tubing

△Technical Devices Co 2340 Centinela Ave Los Angeles 64 Calif—M K Allen—GR 7-0708 (p & a) Wire Cutter & Stripper. Circuit Board Fixtures

*Technical Electronics Corp 4060 Ince Blvd Culver City Calif—R A Yarcho—TE 0-5461 (p) Test Equip & Timers

△Technical Products Co Instrument Div 6670 Lexington Ave Los Angeles 38 Calif—E R Chicott—HO 4-8121 (p) Measuring Instruments, Recording Equip, General Machine Work

△Technology Instrument Co 7229 Atoll Ave N Hollywood Calif

△Tetkronix Inc P O Box 831 Portland 7 Ore—H Vollum—CY 2-2611 (p) Amplifiers, Oscillators, Cathode Ray Tubes

TelAutograph Corp 8700 Bellanca Ave Los Angeles 45 Calif—R C Lee—OR 4-2690 (p) Industrial & Defense Electronics (a) Communication Systems

△Telecomputing Div Telecomputing Corp 12838 Saticoy St N Hollywood Calif—G P Brubaker—(p) Inventory & Unit Control Equip, Machine Tool Control Equip

Telemeter Magnetics Inc 2245 Pontius Ave Los Angeles 64 Calif—T C Taylor—GR 7-4211 (p) Magnetic Core, Menories & Shift Registers, Digital Data Handling Systems

Texas Instruments Inc 104 E Foothill Monrovia Calif—W I Mann—(p) Recorders, Resistors, Transistors

△Thermador Electronics Div Norris-Thermador Corp 2000 S Camfield Ave Los Angeles 22 Calif—W E Cranston—RA 3-5189 (p) Transformer, Assemblies, Switches

△Topatron Inc 942 E Ojai Ave Ojai Calif—S E Brown—MI 6-1600 (p) Electronic Test Consoles

Tracerlab Inc 2030 Wright Ave Richmond Calif (p) Radiation Equipment

Trans Electronics Inc 7349 Canoga Ave Canoga Park Calif—Harvey Stump—DI -1757 (p) Power Supplies, Semiconductor Test Equip

Transformer Eng'g 285 N Halstead St Pasadena Calif—R Yates—RY 1-6906 (p & a) Transformers, Chokes

△Transformer Engrs 325 N Halstead Ave Pasadena 8 Calif (p) Amplifiers, Filters, Transformers (a) Accelerometers, Computers

Transonic Inc 808 16 St Bakersfield Calif—E J Rehfeldt—FA 7-5701 (p) Transformers, Wave Filters, Toroids

Trasval Eng'g Corp 10401 W Jefferson Blvd Culver City Calif—George Otis—VE 9-2301 (p) Switches, Testers (a) Airborne Receivers

△Triad Transformer Corp 4055 Redwood Ave Venice Calif—R Seiler—EX 7-2145 (p & a) Transformers

Tri-Dex Co P O Box 1207 Lindsay Calif—K B Howard—2-4051 (p) Terminal Boards, Etched Circuits (a) Turret Lug Style Terminal Boards, Special Coils

Tri-ex Tower Corp 127 E Inyo St Tulare Calif—L V Tristad—6-3411 (p) Comm & Microwave Towers

*Triplett Electrical Inst Corp P O Box 687 Oceanside Calif—W R Triplett—SA 2-9779 (p) Indication Instruments

Tripl-T Electronics Co P O Box 5352 Pasadena Calif—E G Laue—AT 6-3689 (p) Transistorized Plug-in Pulse Circuits

△Tung-Sol Sales Corp 8575 Washington Blvd Culver City Calif

△TurBo Jet Products Inc 424 S San Gabriel Blvd San Gabriel Calif—O N Bloom—CU 3-5191 (p) Coil Winding Bobbins, Relay Coils, Transformers

U M & F Mfg Corp 10929 Vanowen St N Hollywood Calif—N R Younger—ST 7-5526 (p) Breadboards

United Aircraft Products Inc 1101 E Chestnut St Burbank Calif—L Peltier—VI 9-4236 (p) Coils. Controls

△United Electrodynamics 1200 S Marengo Ave Pasadena Calif—M Slavin—SY 9-7161 (p) Telemetering Components (a) Power Supplies

△*United Transformer Corp 4008 W Jefferson Blvd Los Angeles 16 Calif—H C Hornickel—RE 1-6313 (p & a) Transformers, Inductors, Filters

△Unitek Corp Weldmatic Div 380 N Halstead Ave Pasadena Calif (p) Precision Electronic Spotwelders

△Universal Electronics Co 1720 22 St Santa Monica Calif (p) Regulators

*Univox Corp 4301 W Jefferson Blvd Los Angeles 16 Calif—A C Gerrish—RE 4-4163 (a) R F Transmission Line Assemblies

△U S Electronics Devel Corp 1323 Air Way Glendale Calif—H B Rothbard—CH 5-1884 (p) Capacitors

U S Eng'g Co 5873 Rodeo Rd Los Angeles 16 Calif—Harry Gray—TE 0-7346 (p) Printed Circuits, Terminals, Terminal Boards & Strips

U S Relay Co 1740 Albion St Los Angeles 31 Calif—L D Bunce—CA 2-9164 (p & a) Relays, Solenoid Contactors

△Vacuum Tube Products Co 2020 Short St Oceanside Calif—J J Sutherland—SA 2-6567 (p & a) Electron Tubees, Vacuum Gauge Tubees & Equip

Valor Electronics 13214 Crenshaw Blvd Gardena Calif—Jack Hofert—DA 3-6160 (p) Pulse Transformers

△Varian Associates 611 Hansen Way Palo Alto Calif—Sigurd Varian—DA 5-5631 (p) Communication Equip, Tubes, Electromagnet Systems

△Vaughn Co G H 2366 E Foothill Blvd Pasadena Calif

△Vector Electronic Co 3352 San Fernando Rd Los Angeles 65 Calif—H Golden—CL 7-8237 (p) Turret Sockets, Plug-in Units, Test Adapters

△Viking Industries Inc 21343 Roscoe Blvd Canoga Park Calif—F V Criswell—DI 7-8500 (p & a) Connectors

Vought Co P O Box 1350 Beverly Hills Calif—A D Fraser—CR 6-1131 (p & a) Data Recorders

Waco Inc 2032 Bdwy Santa Monica Calif—R M Frazer—TE 0-7841 (p & a) Instrument Motors, Rotary Solenoids, Linear Solenoids

△Walkirt Co 141 W Hazel St Inglewood Calif—W L Kirchoff—OR 1-0212 (p) Plug-in Circuitry, Resin Encapsulated, Sub miniaturized Circuitry

△*Walsco Electronics Mfg Co 3225 Exposition Pl Los Angeles 18 Calif—W L Schott—AX 3-7201 (p) Electronic Hardware, Tools, Electronic Specialty & Service Aids

Wave Particle Corp 876 Kaynyne St Redwood City Calif—W S Geisler Jr—EM 8-1579 (p) Backward Wave Oscillar Signal Generator, Traveling WaveTube Amplifier, Power Supply

△Western Coil Products Co 959 Commercial St Palo Alto Calif—J M Kaar—DA 5-2718 (p) R F & I F Coils, Chokes, Transformers

△Western Control Equip Co 14615 Ventura Blvd Sherman Oaks Calif

△Western Devices Inc 8930 Lindblade St Culver City Calif—W C Strumpell

△Western Gear Corp Electro Products Div 132 W Colorado Pasadena Calif—Richard Abbott—RY 1-6604 (p) Rotary Electric Equip (a) Miniature Electric Motors

△*Western Gold & Platinum Co 525 Harbor Blvd Belmont Calif—W L Hack—LY 3-3121 (p & a) Industrial Ceramics, Precious Metals, Precious Metal Alloys

Western Insulated Wire Co 2425 E 30 St Los Angeles 58 Calif—J S Monsos—LU 7-7103 (p & a) Portable Cords & Cables

△Westline Products Div of Western Litho 600 E 2 St Los Angeles 54 Calif—Maury Engle—TR 2641 (p & a) Printed Circuit Layout Tapes & Shapes, Wire Markers

△Wiancko Eng'g Co 255 Halstead Ave Pasadena Calif—L W Hart—SY 3-9164 (p & a) Pickups, Carrier Equip, Data Systems

*Wolfe Co Franklin C 10567 Jefferson Blvd Culver City Calif—Rance MacFarland—TE 0-4618 (p & a) Hermetic Seals

△Wright Eng'g Co 180 E California St Pasadena Calif—H D Wright—RY 1-8488 Sales & Service

△Wyco Metal Products 6918 Beck Ave N Hollywood Calif (p) Custom Chassis, Custom Panels

△Zephyr Mfg Co Electronics Div 201 Hindry Ave Inglewood 1 Calif

Zenith Plastics Co 1600 W 135th St Gardena Calif—R R Garrett—FA 1-2020

△Zero Mfg Co 1121 Chestnut St Burbank Calif—Joseph Daniels—VI 9-5521 (p & a) Instrument Cases

Representing the nation's leading manufacturers of electronic equipment in an area covering over 500,000 square miles requires specialized service facilities in key locations . . . experienced engineering liaison . . . and the ability to apply the latest electronic instrumentation to the complex needs of today's industry.

All of these essential services — and more — are important components in a new concept of representation pioneered by Neely Enterprises — with over half a hundred qualified personnel to serve the Western Electronic Market.

For up to the minute information, call any of the eight Neely Enterprises offices which serve the four-state area of California, Arizona, Nevada and New Mexico.

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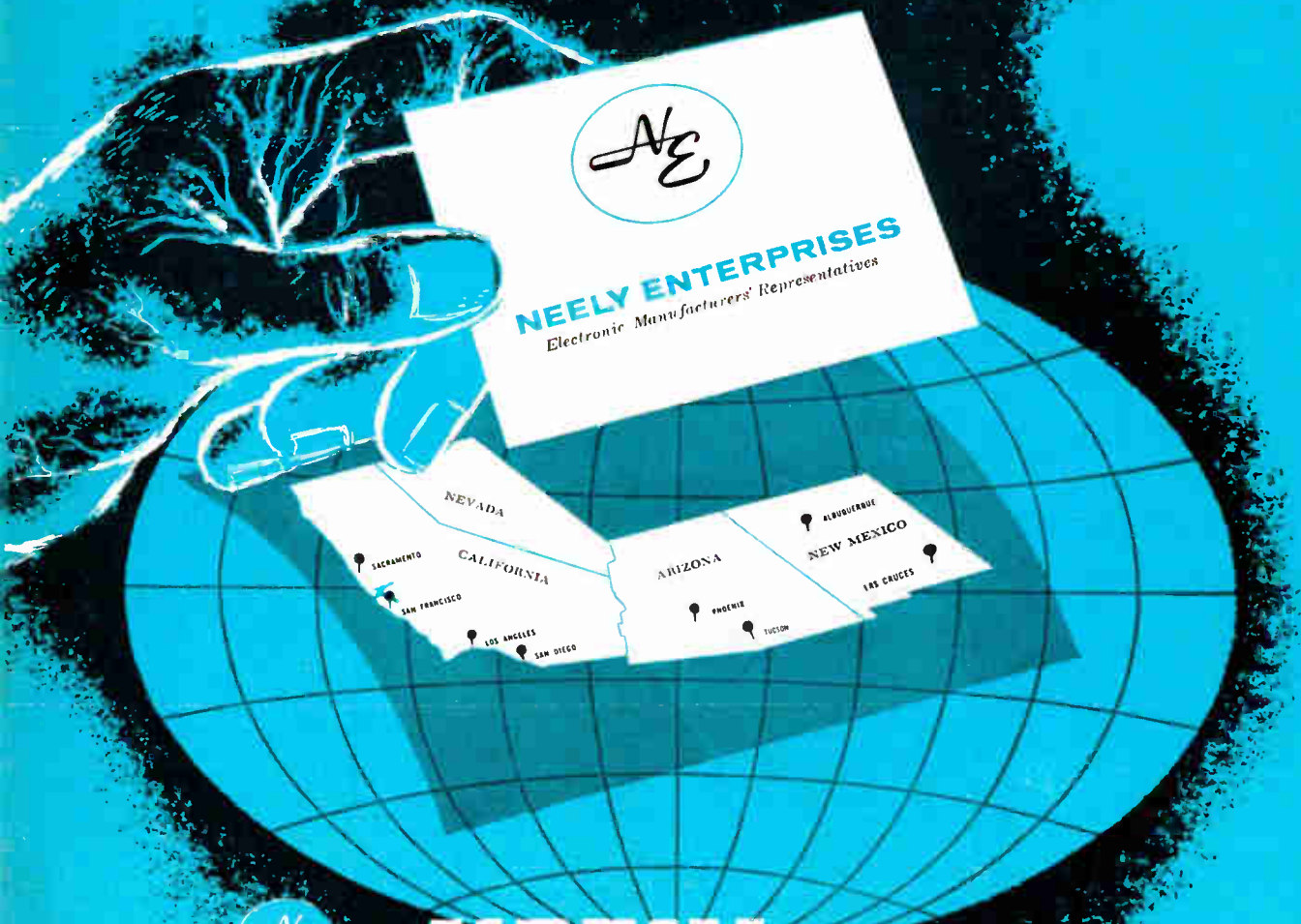

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SAN DIEGO OFFICE
1055 Shafter Street
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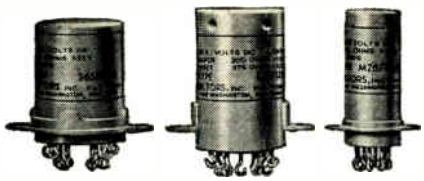
ALBUQUERQUE OFFICE
107 Washington Street, S.E.
Phone: 5-5586

PHOENIX OFFICE
641 E. Missouri Avenue
Phone: CR 4-5431

LAS CRUCES OFFICE
126 S. Water Street
Phone: JAckson 6-2486

TUCSON OFFICE
232 S. Tucson Blvd.
Phone: MA 3-2564



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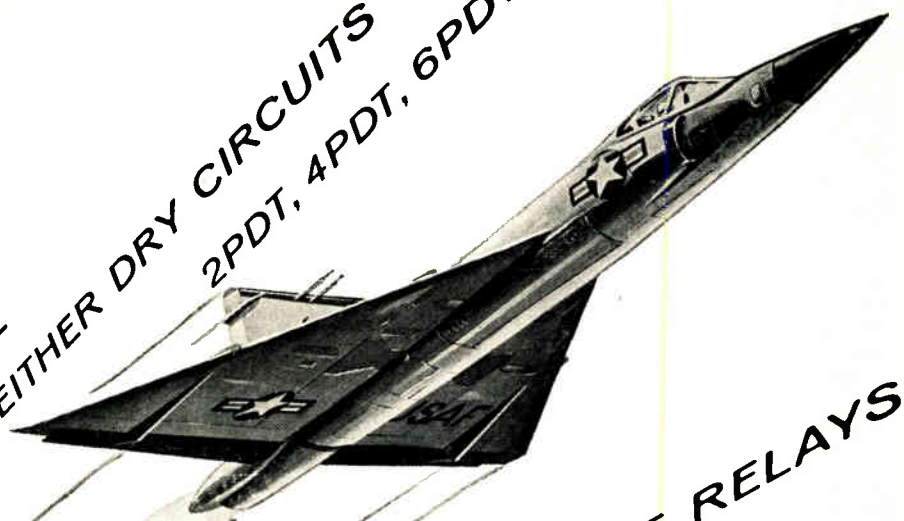
NEW! ANOTHER FILTORS EXCLUSIVE
THE SAME SUB-MINIATURE RELAY FOR EITHER DRY CIRCUITS OR POWER
HERMETICALLY SEALED
2PDT, 4PDT, 6PDT



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ALL MADE TO MIL-R-25018 (USAF) AND MIL-R-5757C
LEADING MANUFACTURERS OF HERMETICALLY SEALED SUB-MINIATURE RELAYS

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FILTORS, INC.

PORT WASHINGTON, LONG ISLAND, N.Y.
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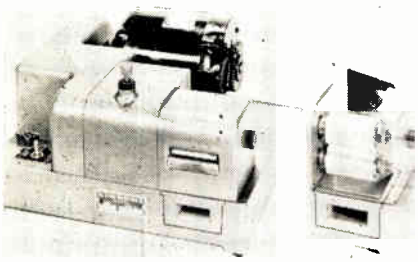
New Products ... for the Electronic Industries

WIRE SCRAPER

A new high speed wire scraper, Model 104, with waste disposal drawer conveniently located in front is now offered. Wire is cleanly stripped by passing between brushes through



a safety guard. Wire can be cleaned to within ¼ in. of coil if desired. Brush speed is 3000 rpm and scraping width of brushes is 2¼ in. when using 3 pairs of wire brushes or 2 in. when using 2 pairs. Cleanly strips synthetic type insulations such as Formvar or enamel wire. Changing brushes required only 2-3 minutes. Geo. Stevens Mfg. Co., Inc., Pulaski Rd., Chicago 30, Ill., (WESCON Booth 3208).

Circle 266 on Inquiry Card, page 109

MILITARY STYLE KNOBS

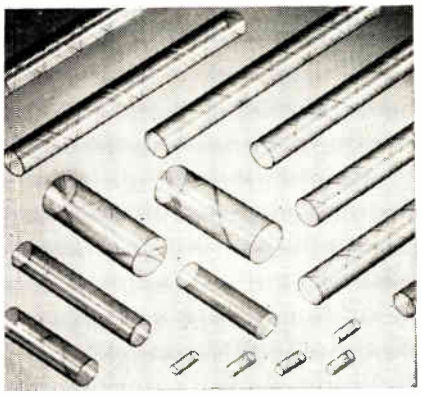
A military style fluted knob, MS 25168, with collet fitting attachment assures positive locking on shafts under extreme vibration and shock conditions. Collet is actuated by a

slotted cap screw. All possibility of inoperativeness due to loosening on the shaft is removed. Meets MIL Spec MIL-K-25049, has a 1" dia., is ¾" high, and fits on military style ¼ in. flatted shafts. The knob material is tough thermoplastic. It comes in standard gray color. A complete selection of skirts, dial plates and pointers are available. Dale Products, Inc., Columbus, Neb.

Circle 268 on Inquiry Card, page 109

COIL FORMS

A new line of DuPont Mylar thin-wall coil forms has been developed. Wall thicknesses of from .002 to .010 in. can be supplied. The new tubes are resistant to moisture, solvents and

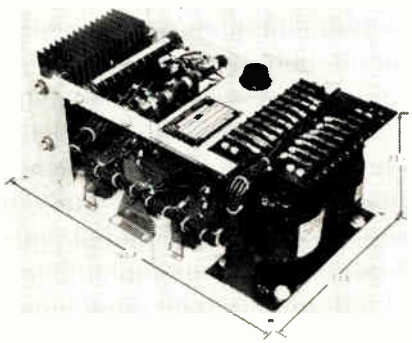


chemicals and have high dielectric strength. They provide good thermal characteristics and tensile strength. They will neither dry nor brittle with age. For large work film is combined with or wound over conventional materials to improve their dielectric characteristics. Manufacturer will fabricate to any I.D., O.D., or length. Precision Paper Tube Co., Dept. TTN 2035 W. Charleston St., Chicago 44.

Circle 270 on Inquiry Card, page 109

VOLTAGE REGULATOR

Low cost voltage regulator maintains output voltage of 60 cps alternators constant. It is completely static, with no moving parts, is a single-stage magnetic amplifier unit utilizing selenium rectifiers and wire wound resistors. Simple to install, with only 6 terminal connections. It works into a 20 to 100 ohm exciter

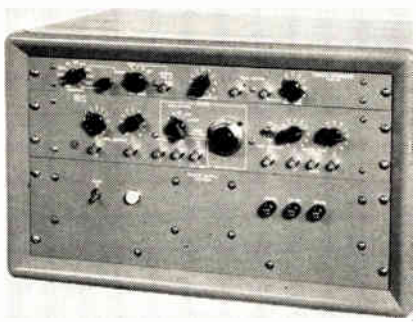


field resistance without adjustment, and supplies exciter field current within a range of 0.15 to 1.35 a. Directly connects into any 208 to 240 v alternator without need of a potential transformer. Vickers Inc., 1815 Locust St., St. Louis 3, Mo.

Circle 267 on Inquiry Card, page 109

DELAY GENERATOR

The new precision delay generator, type 6010, is designed for laboratory type applications where accurately delayed time interval pulses are required. The generator consists of 3 modular constructed units with both power and signals internally interconnected. The 3 units as follows: trigger generator type 101-provides a

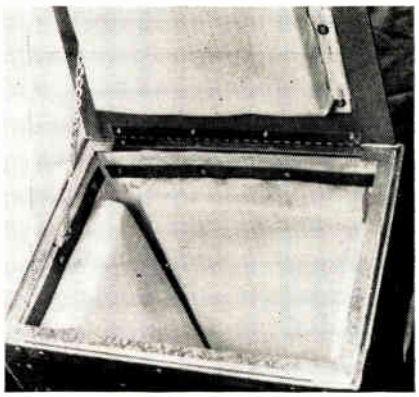


standard negative pulse output from an input signal, up to 100 kc.; delay generator type 131-triggered by the type 101 trigger generator, produces 5 outputs; power supply type 9804 is electronically regulated. Burroughs Corp., 1209 Vine St., Phila. 7, Pa.

Circle 269 on Inquiry Card, page 109

SHIPPING CONTAINERS

Reuseable vulcanized fibre shipping containers for the transportation of delicate instruments and equipment is now available. Shipping containers feature minimum weight, high strength, maximum protection to contents and long life. They insure damage-free arrival of such equipment as navigational instruments, radios,



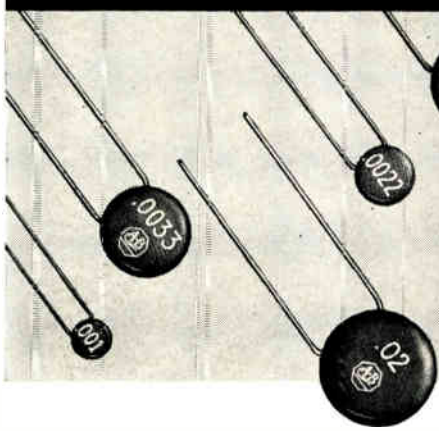
electronic apparatus and other shock-sensitive components and equipment. Maxmium protection is provided by a thick, shock-absorbing internal padding, mounted on plywood panel. National Vulcanized Fibre Co., 1057 Beech St., Wilmington 99, Del.

Circle 271 on Inquiry Card, page 109

now...
no "run-down" on the leads...

A new process, combined with a new material, eliminates run-down . . . assures proper solder flow with short leads.

Presently available in 5/16" diameter.



Allen-Bradley ceramic capacitors are furnished in five physical sizes—¼", ⅜", 5/16", ½", and ¾".

The new "no run-down" coated capacitors will soon be made available in all these sizes.

ALLEN-BRADLEY
ceramic capacitors

ALLEN-BRADLEY
RADIO, ELECTRONIC, AND TELEVISION COMPONENTS
QUALITY

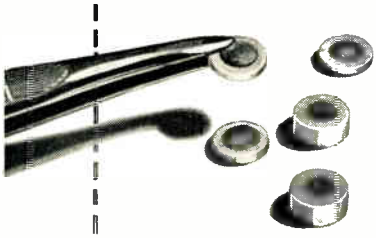
Allen-Bradley Co.
1342 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

Now you can dip solder these Allen-Bradley capacitors on printed boards . . . and be assured of proper solder flow. A new coating material, applied by a new process, prevents *all* "run-down." Lead wires are clean *without* scraping.

Allen-Bradley *quality* ceramic capacitors are available in a wide variety of types to meet different requirements. General purpose capacitors are furnished in nominal capacitance values from 10 to 20,000 mmf, with various temperature characteristics and tolerances. There are also dual type, temperature compensating, intermediate voltage, and other special capacitors in this *quality* line. The consistent reliability of these Allen-Bradley capacitors is confirmed by approvals from the leading electronic, electrical and telephone laboratories.

Call your nearest Allen-Bradley office for complete specifications, today.

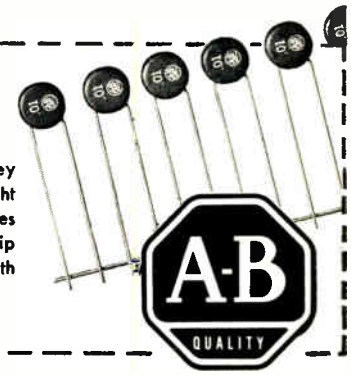
ALSO . . . BARE DISC TYPE



Here's a new ceramic capacitor for use in printed circuits. It is mounted directly in the board and dip soldered. Investigate this new convenient and low cost *quality* ceramic capacitor, today.

NEW STRIP MOUNTING PROTECTS LEADS

With this new strip mounting, Allen-Bradley ceramic capacitor leads are kept straight and uniformly spaced. Strip also provides guide for cutting to desired lengths. Strip mounted capacitors are supplied with standard 1½" tinned leads.



SUPERIOR IMPACT, SHOCK, AND VIBRATION protection is assured by IRC's specially-compounded coatings and housings. Multiple layers of special varnishes, plus molded housings combine to provide excellent insulating properties and impact resistance.

In a sense, a resistor is sim
ply a mechanical device fc
packaging ohms. So it's eas
to see why the materia
entering into the mechan
cal package are extremel
important to resistor pe
formance. That's why mo
than one-third of the 20
technicians at IRC are occu
pied in developing insula
ing coatings and housing
that give *extra* protectio

Extra IRC® resistor protection pays of

...but you pay no more for it!

EXCESSIVE HUMIDITY AND EXTREME TEMPERATURE CONDITIONS have minimum effect upon the resistance value of IRC resistors. Resistive elements and protective coatings are combined to give excellent moisture resistance and heat dissipation—properties that mean short and long-term stobility.

against mechanical damag
humidity effects, and ten
perature variations.

Out of this never-endir
activity come coatings ar
molding compounds that a
custom-tailored for each ar
every type of resistor. As
result, every IRC resist
gives far more protectic
from damage and ambie
conditions than any other
its type!

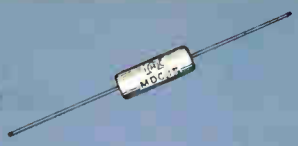
Circle 62 on Inquiry Card. page

How IRC resistors give added protection

molded resistors

TYPE BT Fixed Composition Resistors

TYPE BW Insulated Wire Wound Resistors

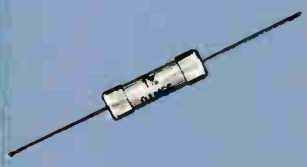


TYPE MD Molded Deposited Carbon Resistors

TYPE PW Insulated Wire Wound Resistors

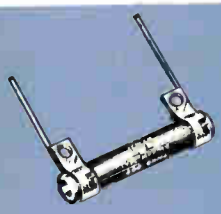
Plastic compounds used in IRC molded resistors are all specified by IRC to combine excellent insulating properties, moisture resistance, and impact resistance.

varnish coated resistors



TYPE DC Deposited Carbon Resistors

TYPE MV High Voltage Resistors



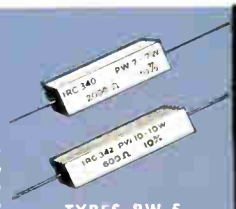
TYPE MP High Frequency Resistors

TYPE HFR High Frequency Resistors

Where mechanical damage isn't a major problem, IRC resistors give excellent protection at lower cost through the use of IRC-developed varnish coatings. Because several layers are applied and cured under specially controlled conditions, these resistors offer superior humidity and temperature characteristics.

cement insulated resistors

TYPE PWW TYPE FRW Power Wire Wound Resistors



TYPES PW-5, PW-7 & PW-10 Small Insulated Power Resistors

The special cement coatings used to insulate IRC power resistors give excellent mechanical protection. Type PWW Resistors, for example, withstand a transverse pressure of 25 pounds. These exclusive IRC cements also permit maximum heat dissipation and give superior moisture protection.

impregnated and encapsulated resistors

TYPE WWJ Precision Wire Wound Resistors

SERIES "PH" Encapsulated Precision Wire Wound Resistors

Type WWJ Resistors feature a special compound that thoroughly impregnates the winding and remains stable at varying temperatures. This compound not only gives maximum mechanical protection, but also serves as an insulating barrier and minimizes moisture effects. In IRC encapsulated resistors, the same epoxy resin is used for both the core and the outer housing, thus minimizing the effects of expansion and contraction due to various temperature conditions. This epoxy resin also imparts excellent insulating and moisture-resistant properties to the housing.

VISIT IRC
BOOTH 521-522
Wherever the Circuit Says
1957 WESCON SHOW
August 20-23
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IRC®

IRC PLANTS—Asheville, N.C. • Boone, N.C.
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Hycor Division, Sylmar, California
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INTERNATIONAL RESISTANCE COMPANY

Dept. 583, 401 N. Broad St., Philadelphia 8, Pa.
In Canada: *International Resistance Co., Ltd., Toronto, Licensee*

Please send technical bulletins describing ☐ Fixed Compositions ☐ Deposited Carbons ☐ Low Power Wire Wounds ☐ Power Wire Wounds ☐ High Voltage Types ☐ High Frequency Types ☐ Precision Wire Wounds ☐ Encapsulated Precisions

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

Latest Western Literature for Engineers

R.F. Coils and Chokes

The Miller Co. has issued a 36-page catalog on their industrial electronic, radio and television R.F. Coils. Also listed are different types of I.F. cans, tuning capacitors, loop antennas and R.F. filters. Booklet is complete with pictures, specifications and price lists. J. W. Miller Co., 5917 S. Main St., Los Angeles 3, Calif.

Circle 151 on Inquiry Card, page 109

Tape Recording

"An Approach to Quantitative Methods for Evaluation of Magnetic Recording Performance" is a 12-page booklet issued by the Ampex Corp., Redwood City, Calif. Technical booklet on recording is complete with pictures, graphs and other technical data.

Circle 152 on Inquiry Card, page 109

Instrument Hardware

A 6-page booklet describes precision instrument hardware that is available from the Circon Component Co., Santa Barbara Municipal Airport, Goleta, Calif. Booklet contains specifications and description of precision screws, nuts, flat washers, lock washers and rivets.

Circle 153 on Inquiry Card, page 109

Alumina Ceramic

The Diamonite Products Mfg. Co., 1232 Cleveland Ave. N. W., Canton 3, Ohio, has issued a catalog and price list for their precision high alumina ceramic rings, tubes and rods. Specifications and price list are given in a table form.

Circle 154 on Inquiry Card, page 109

Microwave Tubes

A short-form catalog has been issued by Huggins Laboratories, Inc., 711 Hamilton Ave., Menlo Park, Calif., describing their forward wave amplifiers, backward wave oscillators and backward wave amplifiers. The brochure contains technical data and prices.

Circle 155 on Inquiry Card, page 109

Multi-Conductor Cable

Pacific Automation Products, Inc., 1000 Air Way, Glendale 1, Calif., has issued a booklet "Design Engineering Specification PAP-C-101" which applies to their neoprene-jacketed, multi-conductor electronic cable. The engineering manual describes materials, construction, specification conformance, performance, identification, reproducibility and other features for determining the correct electronic cable for specific applications.

Circle 156 on Inquiry Card, page 109

Audio Amplifiers

Magna Electronics Co., 9810 Anza Blvd., Inglewood 1, Calif., has issued a 2-color, 8-page brochure describing their complete line of Magnatone musical instrument amplifiers. The brochure is complete with photographs, specifications and price list.

Circle 157 on Inquiry Card, page 109

Aluminum Soldering

A series of reprints describing fluxless aluminum soldering are available from the Chemalloy Electronics Corp., Gillespie Airport, Santee, Calif. Reprints describe simple means of soldering aluminum without the use of flux and advantages.

Circle 158 on Inquiry Card, page 109

Printed Circuit Tapes

A brochure issued by Westline Products Div., 600 E. 2nd St., Los Angeles 54, Calif., describes printed circuit layout tapes with self-adhering backing. Tapes come in rolls and in a variety of shapes and sizes pre-cut for instant use. They can be applied to glass, papers, linens, etc. Free samples available.

Circle 159 on Inquiry Card, page 109

Precision Ratiometer

A 2-color brochure gives complete electrical and physical specifications on a precision ratiometer. Meter is designed for accurate determination of either ratios or absolute values of resistors. Cal-Tronics Corp., 11307 Indry Ave., Los Angeles 45, Calif.

Circle 160 on Inquiry Card, page 109

Computer Information

Computer Control Co., Inc., 92 Broad St., Wellesley 57, Mass., has issued a series of 3 booklets. The booklets are titled "Symbolic Logic, Binary Calculation, and 3C-PACs," "Logical Design of Digital Computing and Control Circuits with 3C-PACs" and "Transistorized Modules for Digital Systems." Booklets are technical, simplified descriptions of how computers work and have easy-to-read tables and diagrams to make the instructions easier to follow.

Circle 161 on Inquiry Card, page 109

Engineering Bulletins

"Berkeley Engineering" is available quarterly from the Beckman/Berkeley Corp., 2200 Wright Ave., Richmond 3, Calif. This quarter's issue is an easy-to-follow description of Servomultiplier Performance. It is complete with multicolored graphs and charts.

Circle 162 on Inquiry Card, page 109

Fresnel Integrals

A 7-page report entitled "Evaluation of the Fresnel Integrals by the G-15 D Computer with Accessory DA-1" has been published by the Bendix Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif. In the field of physical optics, the Fresnel integrals frequently occur. They are ordinarily evaluated by use of infinite series.

Circle 163 on Inquiry Card, page 109

Silicon Optics

O-105 is a multicolored bulletin describing manufacture of large single crystals of optical-grade silicon with impurities less than 1 part in 100,000,000. Windows, lenses and prisms of this material are fabricated for inclusion in military and commercial infrared systems. Texas Instruments, Inc., 104 E. Foothill Blvd., Monrovia, Calif.

Circle 164 on Inquiry Card, page 109

Reactor

The AGN 201 Reactor is completely described in a 10-page bulletin issued by Aerojet-General Nucleonics, San Ramon, Calif. The booklet is complete with photographs, specifications, charts and tables. Its various applications are also discussed and described.

Circle 165 on Inquiry Card, page 109

Torque vs RPM Chart

John Oster Mfg. Co., Inc., 5333 S. Sepulveda Blvd., Culver City, Calif., has just made available copies of their ounce inch torque versus RPM at stated horsepower chart. Chart is clear and easy to read and the information is presented in a tabular form. Also included on chart are engineering constants.

Circle 166 on Inquiry Card, page 109

Scientific Instruments

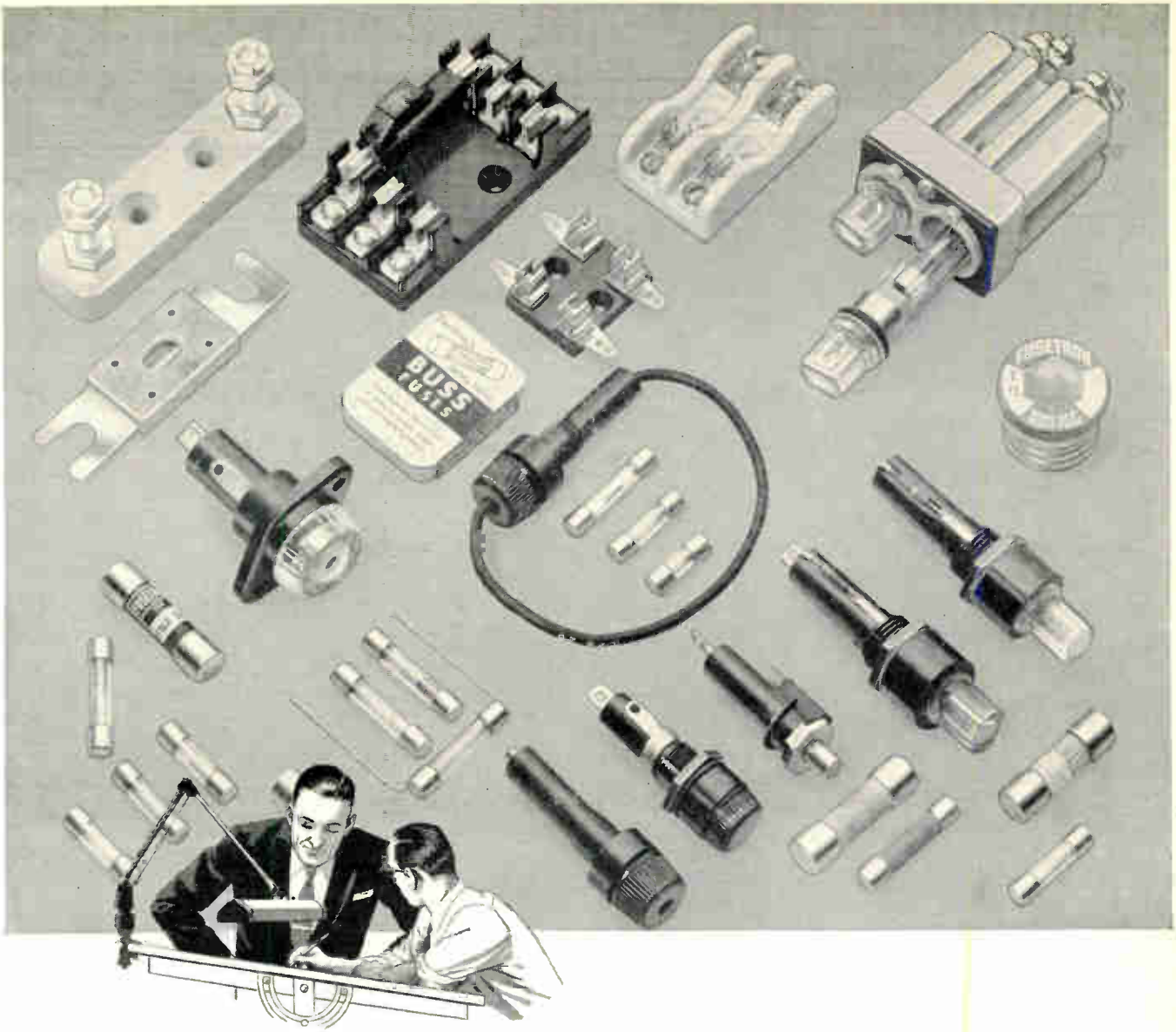
An 8-page, 2-color bulletin describes bridges and accessories, voltage dividers, decade capacitors, and decade resistors. Brochure contains photographs, complete electrical and physical specifications and manufacturer's price. Electro-Measurements, Inc., 7524 S. W. Macadam, Portland, Ore.

Circle 167 on Inquiry Card, page 109

Electron Tubes

Eitel-McCullough, Inc., San Bruno, Calif., has just issued a new quick-reference catalogue of their complete line of tubes. The 2-color booklet contains all required information in easy-to-read form.

Circle 168 on Inquiry Card, page 109



For Safe, Dependable Electrical Protection

. . . *Standardize on BUSS Fuses!*

To make sure of proper operation under all service conditions . . . every BUSS fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

This careful testing is your assurance BUSS fuses will provide equipment with maximum protection against damage due to electrical faults.

Just as important, BUSS fuses will not give a false alarm by blowing needlessly. Shutdowns due to faulty fuses blowing without cause are eliminated.

By specifying dependable BUSS fuses, you help safeguard the good name of your equipment for quality and reliability.

Complete Line—There is a complete line of BUSS fuses in sizes from 1/500 ampere up . . . plus a companion line of fuse clips, blocks and holders.

If your protection problem is unusual . . .

. . . let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse already available in local wholesalers' stock, so that your device can be easily serviced.

For more 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

857

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

Latest Western Literature for Engineers

Read-Record Heads

General Transistor Western Corp., 6110 Venice Blvd., Los Angeles 34, Calif., has issued a bulletin describing their magnetic read-record heads. Two-color brochure contains pictures and a description of the various types of heads available.

Circle 169 on Inquiry Card, page 109

High Voltage Components

An 8-page 2-color bulletin describes a complete line of high voltage variable capacitors, fixed capacitors, relays, switches, spark gaps and high voltage measuring equipment. The catalog contains photographs and complete specifications in table form. Jennings Radio Mfg. Corp., 970 McLaughlin Ave., P. O. Box 1278, San Jose 8, Calif.

Circle 170 on Inquiry Card, page 109

Microwave Tubes

A 32-page, 2-color catalog issued by Varian Associates, 611 Hansen Way, Palo Alto, Calif., describes their line of microwave tubes. Booklet contains photographs, cut away drawings, complete specifications, both electrical and physical and the frequency of operation of tubes. The first few pages describe, with cutaway views, the various types of tubes available and also contains a chart which makes it easy to locate a particular tube for a definite function.

Circle 171 on Inquiry Card, page 109

Microvolt Ammeter

The 2-color bulletin describing a DC microvolt ammeter and amplifier is available from Kin Tel, Box 623, San Diego 12, Calif. Bulletin is complete with photographs, specifications and schematic diagram.

Circle 172 on Inquiry Card, page 109

Film Recording

A booklet which requires only 12 minutes to read describes in detail how to record sound on motion picture film. Photographs show placements of the microphones used on the film recording systems. Berndt-Bach, Inc., 6900 Romaine St., Hollywood 38, Calif.

Circle 173 on Inquiry Card, page 109

Wire and Cable

A brochure has just been issued by Western Insulated Wire Co., 2425 E. 30 St., Los Angeles 58, Calif., describing their complete line of wires, cords and cables for use in the electronic industry.

Circle 174 on Inquiry Card, page 109

Panel Meters

Phaostron Instrument and Electronic Co., 151 Pasadena Ave., S. Pasadena, Calif., has issued a booklet describing their complete line of panel meters. This multicolored booklet also contains information on their test instruments, deposited carbon resistors and sensitive miniature relays. The booklet contains photographs, specifications and prices.

Circle 175 on Inquiry Card, page 109

Audio Equalizers

"Audio Frequency Equalizers," a 16-page catalog, has just been issued by Cinema Engineering, div. Aerovox Corp., 1100 Chestnut St., Burbank, Calif., with product illustrations and two dozen charts showing response characteristics, dialogue and variable equalizer diagrams. Catalog index is by subject and also by catalog identification. Also contains 8 case studies, problems and solutions from experience in actual usage.

Circle 176 on Inquiry Card, page 109

Counting Circuits

Catalog No. 11245, 26-page, 2-color booklet, describes plug-in counting circuits manufactured by The Walkirt Co., 145 W. Hazel St., Inglewood, Calif. Booklet contains complete specifications, suggest the circuits to use the equipment in and the circuits of the equipment itself. A description of how the circuits work and the glossary of terms as they apply to counting circuitry are included.

Circle 177 on Inquiry Card, page 109

Tape systems

A series of 2-color bulletins are available from the Mincom Div., Minnesota Mining & Mfg. Co., 9028 Sunset Blvd., Los Angeles 46, Calif., describing their new Mincom wide-band magnetic tape systems for closed circuit television recording, wide-band telemetering, spectrum monitoring, waveform analysis and radar recordings. Photographs and specifications are included.

Circle 178 on Inquiry Card, page 109

Cables and Connectors

A 32-page catalog has just been published by Microdot, Inc., 220 Pasadena Ave., S. Pasadena, Calif., describing electrical and physical characteristics of micro-miniature coaxial cables, nomenclature and specification on more than 200 stock plugs, right angle plugs, hermetic seal receptacles, bulkhead jacks, printed circuit receptacles, BNC adapters, module blocks and terminals along with data on several types of special cables and connectors. Information is given in tabular form along with line drawings.

Circle 179 on Inquiry Card, page 109

Meter Relays

Automatic control with miniaturized non-indicating meter relays is described in a 12-page bulletin just issued by the Assembly Products, Inc., Palm Springs, Calif. Booklet is complete with circuits, photographs and tables giving complete specifications and prices.

Circle 180 on Inquiry Card, page 109

Isolator Nomograph

The Kearfott Co., Inc., 14844 Oxnard St., Van Nuys, Calif., has just issued a useful isolator nomograph. Included with the nomograph are photographs and descriptions of a new ferrite isolator for laboratory bench use.

Circle 181 on Inquiry Card, page 109

Readout Indicators

Electroflor, Inc., 7356 Santa Monica Blvd., Hollywood 46, Calif., has just made available a bulletin describing Electroflor readout indicators which may be used for on-off indication, digital or decimal readout. Shape and size of the assembly is indicated in the brochure.

Circle 182 on Inquiry Card, page 109

High-Vacuum Equipment

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif., has just issued their latest catalog describing various types of vacuum pumps and applications in industries. The 24-page, multicolored booklet contains tables and suggested applications for the various types of pumps along with photographs and cutaway views.

Circle 183 on Inquiry Card, page 109

Cable Fault-Finder

A brochure describing Model 60A cable fault-finder describes how to quickly, accurately locate cable short circuits, open circuits, mismatches or intermittents. Complete information is included in the bulletin issued by the Radar Engineers, 401 E. 45th St., Seattle 5, Wash.

Circle 184 on Inquiry Card, page 109

Vernier Potentiometer

A brochure describes a 3-terminal construction type 49-A Verni-Pot vernier potentiometer for use in circuits having a common ground. Two turns of the control knob will cover full range of pot and resolution is equal to a 10 turn potentiometer. Research Instrument Co., P. O. Box 9168, Portland 16, Ore.

Circle 185 on Inquiry Card, page 109

first *in Audio*

first *in Video*

and first *in Instrumentation*

The "Magnetophon" German Tape Recorder—first high fidelity recording machine, subsequently improved and used to record and broadcast Bing Crosby's radio programs for over one year. The predecessor of all American Tape Recorders.

Mincom pioneered and perfected tape recording techniques for the radio and recording industry

...First Transcontinental Broadcast of a Musical Program (Bing Crosby Show) from Magnetic Tape...May 1948

Mincom pioneered the recording and reproduction of off-the-air television from magnetic tape

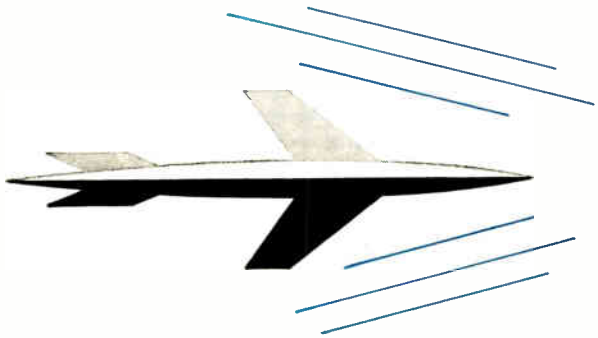
...First Demonstration of Video Tape Recording...November, 1951

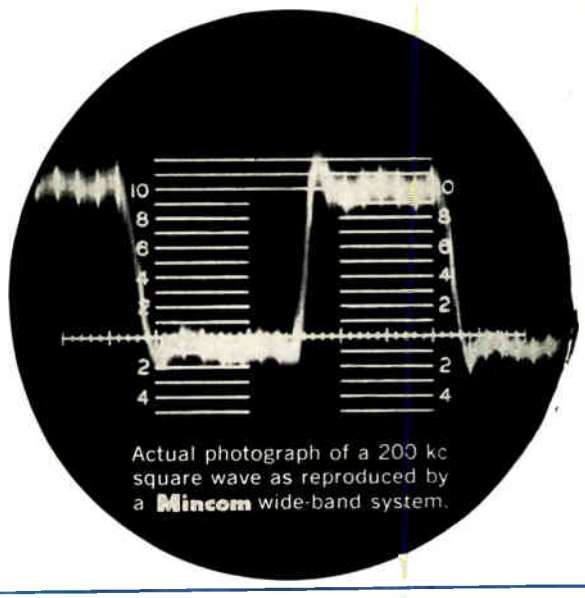
Mincom pioneered and perfected the tight-loop drive for instrumentation recording on magnetic tape

...First Tight-Loop Drive Recorder...August, 1952

And now— Mincom has perfected wide-band magnetic tape systems which can be used for: Radar Recording • Wide-band Telemetering • Waveform analysis • Spectrum Monitoring and Closed Circuit Television Recording

Recording capability: from DC to 2.5 Megacycles





Actual photograph of a 200 kc square wave as reproduced by a **Mincom** wide-band system.

Write for complete specifications

PRODUCT OF 3M COMPANY RESEARCH

Mincom DIVISION

MINNESOTA MINING & MANUFACTURING COMPANY

2049 South Barrington Ave., Los Angeles 25, California
80 Washington Street, Hempstead, New York

New Tech Data for Engineers

Transformers

Bulletin No. 531 describes many types of transformers available from Chicago Standard Transformer Corp., 3501 West Addison St., Chicago 18, Ill. Bulletin is complete with photographs and specifications.

Circle 186 on Inquiry Card, page 109

Test Equipment

Kay Electric Co., 14 Maple Ave., Pine Brook, N. J., has just issued a series of new bulletins covering some of their test equipment such as varisweep generators and transistorized instruments. Among the transistorized instruments are a miniature power supply, broad-band audio-video voltmeter, portable utility oscillator and a multi-crystal-controlled transistor oscillator.

Circle 187 on Inquiry Card, page 109

Core Design

A new 24-page booklet entitled "Type 'C' Hipersil Core Design and Application Manual" is available from Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa. This booklet is written for production and design people concerned with the manufacture of transformers and reactors. It is illustrated with photographs, diagrams, and data charts.

Circle 188 on Inquiry Card, page 109

Precision Potentiometers

Two-page illustrated catalog gives specifications, diagrams and general information on new 2-inch high resolution precision potentiometer. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 189 on Inquiry Card, page 109

Silicon Rectifiers

Two 2-color bulletins describing a line of high current silicon junction rectifiers are available from Semiconductor Products Dept., General Electric Co., Electronics Park, Syracuse 1, N. Y. Brochures contain photographs, drawings, graphs and complete physical and electrical specifications.

Circle 190 on Inquiry Card, page 109

Meter-Guard

A bulletin issued by Electronic Development Labs., 71 Nassau St., New York 38, N. Y., describes their new meter-guard. This meter-guard protects portable meters from damage due to falling objects. Complete information and photographs are supplied.

Circle 191 on Inquiry Card, page 109

Wall Chart

A reference table for Engineers and other executives in wall chart form has been published by Precision Equipment Co., 3716 N. Milwaukee Ave., Chicago 41, Ill. Included are common conversions such as inches to centimeters or watts to H.P. as well as many conversions that are difficult to locate in reference manuals.

Circle 192 on Inquiry Card, page 109

Rhodium Plating

The Sel-Rex Corp., Nutley, N. J., has just released literature on their rhodium electroplates. Literature describes how extra-heavy deposits are possible with Rhodex. Intended to increase the friction-wear resistance of Rhodium plated commutator discs and switch plates. The bulletin also describes how arrangements can be made for electrical or electronic components to be sample-plated.

Circle 193 on Inquiry Card, page 109

Industrial Tachometers

Generators, indicators, and recorders are listed in a 12-page bulletin, GEC-1258A. Described are the variety of generators and indicating or recording instruments available for measuring speed of any industrial rotating equipment, including a-c and d-c tachometer generators and hand tachometers. General Electric Co., Schenectady 5, N. Y.

Circle 194 on Inquiry Card, page 109

Plastic Tubing

A new 16-page pricing guide for plastic and coated electrical tubings is now available from Irvington Div., Minnesota Mining and Mfg. Co., 6 Argyle Terrace, Irvington, N. J. The 3-color guide gives easy access to information on the prices of every available size and type of electrical tubing as well as the properties of each type of tubing and application information for them.

Circle 195 on Inquiry Card, page 109

Nylon

Complete information is available from National Vulcanized Fibre Co., 1057 Beech St., Wilmington 99, Del., on their new line of nylon for use as cams, gears, bushings, nuts, and washers on electronic instruments.

Circle 196 on Inquiry Card, page 109

Delay lines

A series of brochures describes a complete line of continuously variable delay lines. Brochures contain photographs and specifications in table form. Advanced Electronics Lab., Inc., 249 Terhune Ave., Passaic, N. J.

Circle 197 on Inquiry Card, page 109

Speech Equipment

Collins Radio Co., 315 Second Ave., S. E., Cedar Rapids, Iowa, has just issued a 74-page catalog describing a complete line of speech equipment. This fully illustrated booklet contains schematics of the various type of units, complete specifications, price lists and accessory equipment that are available. Booklet contains other useful information such as reactance charts, telephone cable color code, db chart, conversion tables, microphone nomograph and even suggested station layouts.

Circle 198 on Inquiry Card, page 109

Pulse Calibrator

The type 1810 pulse calibrator, a new instrument designed for accurately measuring current and voltage pulse amplitudes, pulse durations and rise time, is now fully described in a technical brochure just published by the Electronic Instruments Div., Burroughs Corp., 1209 Vine St., Philadelphia, Pa.

Circle 199 on Inquiry Card, page 109

Wire and Cable

The Belden Mfg. Co., 4647 W. Van Buren, Chicago, Ill., has just released their electronic wire and cable catalog. The catalog No. 857 contains many new additions to their line, including audio cables, mike cables and hook-up wire conforming to MIL specs. Wires and cables are grouped according to use and applications for quick, easy reference. Photographs and complete specifications are included.

Circle 200 on Inquiry Card, page 109

Film Catalog

The new booklet titled "Westinghouse Sound Films" is available from Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa. The booklet is a catalog of 47 general interest films, product information films, and training films available without charge. The 16mm sound films are for use by professional, civic and business groups.

Circle 201 on Inquiry Card, page 109

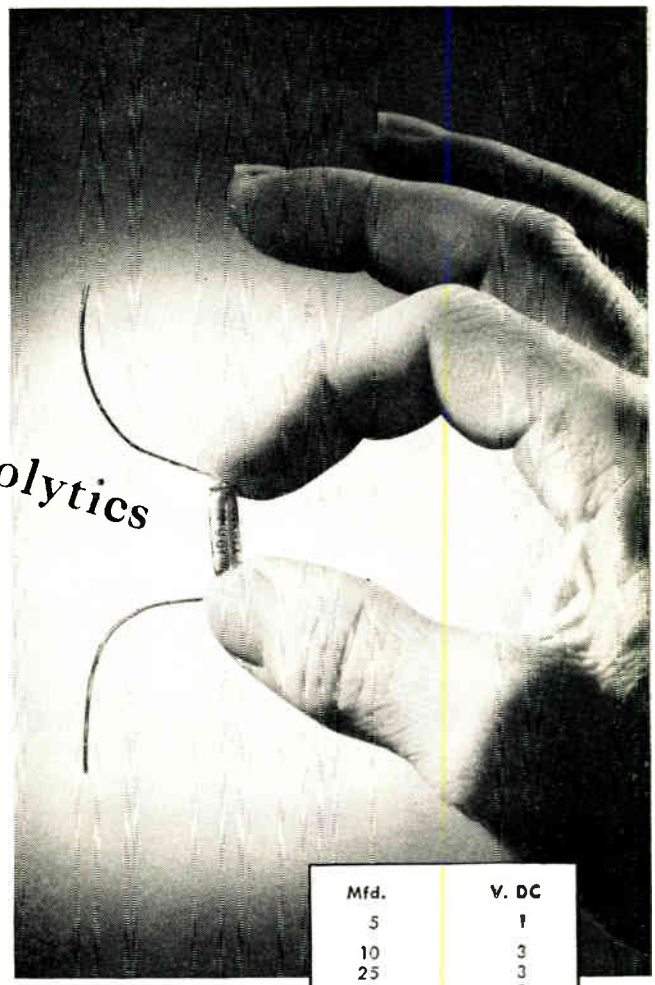
Generating Plants

D. W. Onan & Sons, Inc., Minneapolis, Minn., has just issued a revised edition of their "Blue Book" of general information concerning the selection of engine driven electric generating plants. Described in a simple, easy-to-understand language are the 3 general groups of electric plants. Plant operation for each type is thoroughly discussed.

Circle 202 on Inquiry Card, page 109

New Miniature Electrolytics

Mallory Quality at Moderate Cost



Mfd.	V. DC
5	1
10	3
25	3
40	3
110	3
2	6
5	6
8	6
10	6
15	6
25	6
30	6
40	6
50	6
60	6
15	10
25	10
1	12
2	12
5	12
10	12
10	15
20	15
30	15
5	25
8	25
15	25
20	25
5	50
10	50
20	50

Here's the newest addition to the Mallory capacitor line—a complete array of low-cost metal tubular aluminum electrolytic capacitors in miniature. Especially designed for the ever-widening field of miniature circuitry, these components are excellent for such equipment as transistorized pocket radios, midget recorders, and similar portable electronic gear.

Available in an extremely wide range of capacity and voltage ratings, these miniature capacitors are built to the same high standards of Mallory quality known the world over. Featured are the extremely small physical sizes and exceptionally low leakage current ratings—the latter, a very important factor in the design of battery powered equipment where battery drain must be held to a minimum.

The container for these miniature electrolytic capacitors is made of aluminum, with silicone rubber hermetic end seals. Capacitors can be supplied with vinyl insulating sleeves, if required. The leads are of No. 22 gauge bare tinned copper, 1¾ inches long. These capacitors have an operating range of —20 to +65°C. Actual size ranges from as little as 3/16" diameter by ½" long—to the largest, ⅜" diameter by ¾" long.

Complete data is available from Mallory—ask our representative, or write direct. Mallory engineers are available to assist on your capacitor application problems.

Expect more . . . get more from

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.

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

New Tech Data for Engineers

Power Rectifiers

A 12-page bulletin by the United States Dynamics Corp., 1250 Columbus Ave., Boston 20, Mass., describes their complete line of high temperature silicon diodes and power rectifiers. Complete data is supplied in a filing cabinet type folder.

Circle 203 on Inquiry Card, page 109

Thermostats

A new bulletin on their line of Stemco bimetal thermostats is available from Stevens Mfg. Co., Inc., 45 North Plymouth St., Lexington, Ohio. The 2-color bulletin covers most thermostats of this line which are illustrated and gives information on temperature ranges, ratings, mountings and terminal arrangements. Included is a handy temperature conversion chart.

Circle 204 on Inquiry Card, page 109

Transistors

Data sheets are available from the General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y., describing their latest transistor additions. Of particular interest are their specially selected matched pairs of PNP and NPN transistors for use in complementary symmetry circuits.

Circle 205 on Inquiry Card, page 109

Miniature Relays

A handy engineering catalog describing printed circuit relays, miniature and sub-miniature, 6PDT and power relays, snap action relays, 400 cps relays, rectified relays for quiet operation and increased reliability on AC. Magnecraft Electric Co., 3350H West Grand Ave., Chicago 51, Ill.

Circle 206 on Inquiry Card, page 109

Microwave Components

A new 12-page catalog C457 describes, illustrates and gives simplified ordering information on a full line of hybrid junctions, flanges, and adapters which, with appropriate TR tubes will form microwave duplexers to meet a wide variety of requirements. Microwave Development Labs., Inc., 92 Broad St., Babson Park, Wellesley 57, Mass.

Circle 207 on Inquiry Card, page 109

Photo Tubes

An illustrated 8-page catalog on phototubes and semiconductor lead sulfide photo-conductive cells has just been issued by Continental Electric Co., 6 N. Michigan Ave., Chicago 2, Ill. This new brochure provides full information including charts and mechanical specifications.

Circle 208 on Inquiry Card, page 109

Voltage Adjustor

A new catalog, VA 312, published by Acme Electric Corp., Cuba, New York, emphasizes the importance of maintaining a constant voltage to obtain the maximum performance from electric powered or electric driven equipment. It also briefly covers the problem of voltage drop and voltage fluctuation as a result of overloads or distribution systems. Also described are their complete line of variable voltage adjustors with specifications and photographs.

Circle 209 on Inquiry Card, page 109

Self-Locking Nuts

A new 36-page illustrated brochure, Bulletin 5711, presents ESNA's progress and status in the field of miniaturized self-locking nuts for electronic units and avionic equipment has been prepared by Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J. Twenty-four pages are devoted to standard drawings on the basic types of miniature hex, clinch, fixed and floating anchor type elastic stop nuts. Comparison charts show weight, size, temperature and material for nuts in the hex and clinch series.

Circle 210 on Inquiry Card, page 109

Toroidal Coils

A multicolored brochure has been issued by Boesch Mfg. Co., Danbury, Conn., which describes their line of coil and toroidal winding machines. Photographs and complete information are included.

Circle 211 on Inquiry Card, page 109

Miscellaneous Equipment

A new combination catalog-manual has just been issued by the A. W. Haydon Co., Waterbury, Conn. The new metal back loose-leaf system used contains an initial issue of 25 color-coded engineering bulletins. Among the units described are repeat cycle timers, time delay relays, elapsed time indicators, stop clocks, AC, DC and chronometrically governed timing motors and relays.

Circle 212 on Inquiry Card, page 109

Variable Transformers

Bulletin P257H, an illustrated 28-page bulletin, offers features, ratings and complete data on a new standard line of Powerstat variable transformers for high frequency applications, of particular interest to the aircraft, marine, missile and industrial fields. It serves as an engineering reference on variable transformers. The Superior Electric Co., Dept. 257, 83 Laurel St., Bristol, Conn.

Circle 213 on Inquiry Card, page 109

Hermetic Seals

Complete information on hermetic seal "Vac-tite" compression multi-headers and plugs is offered in a 16-page catalog condensing over 10,000 different types of hermetic seals manufactured by Hermetic Seal Corp., 29 South 6th St., Newark 7, N. J. Parts are carefully grouped to provide essential information, part numbers are simplified and dimensioning standardized for quick, easy reference.

Circle 214 on Inquiry Card, page 109

Counting and Control

Baird-Atomic, Inc., 33 University Rd., Cambridge 38, Mass., has issued a series of bulletins describing their industrial counting and control equipment. Bulletins are complete with photographs and specifications. Also described are their cold cathode glow transfer counting tubes.

Circle 215 on Inquiry Card, page 109

Electrical Tapes

"Thermosetting Electrical Tapes," is a new booklet outlining the properties, recommended application procedures and advantages of Scotch brand electrical tapes with thermosetting adhesive. A property table lists physical and electrical properties for 15 tapes with paper, cloth, film and laminated backings ranging from class A through class H temperature classifications. Minnesota Mining and Mfg. Co., 900 Bush St., St. Paul 6, Minn.

Circle 216 on Inquiry Card, page 109

TV Program Center

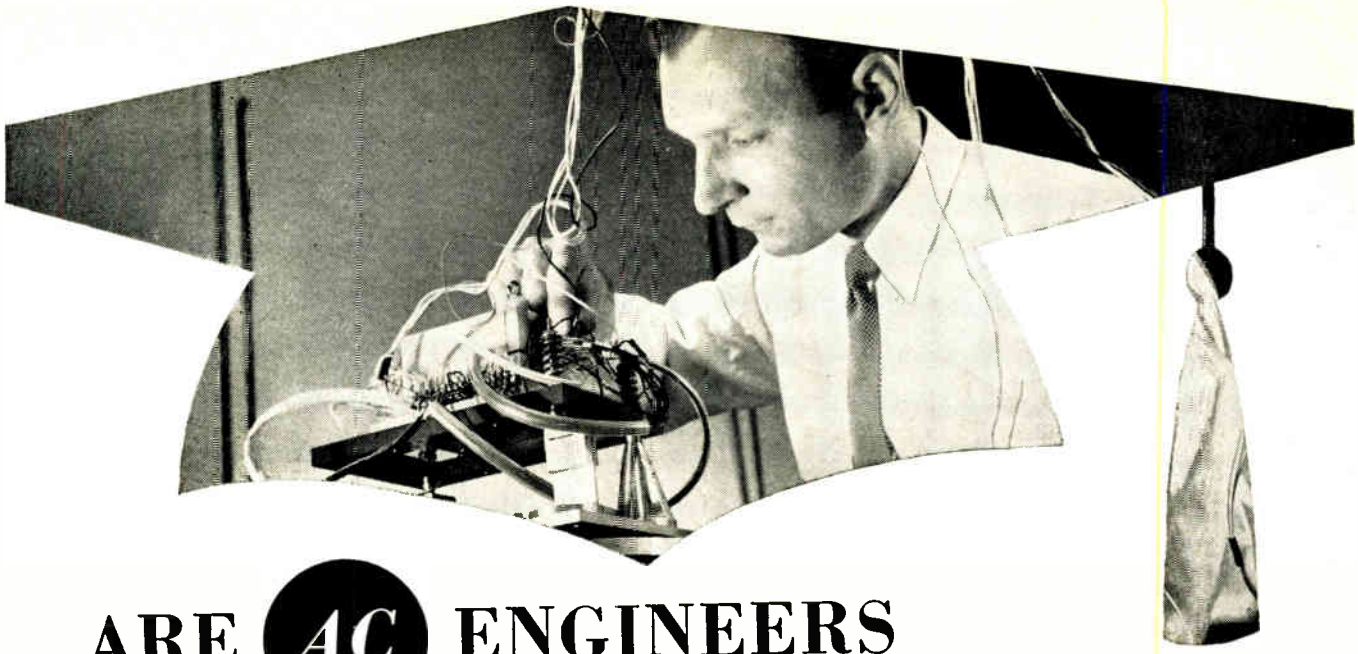
Hallamore Electronics Co., 8352 Brookhurst Ave., Anaheim, Calif., has issued 2 booklets that make use of cartoon style drawings to describe a low priced, rapidly installed packaged TV station. Station can be installed completely in less than a day by non-technical help.

Circle 217 on Inquiry Card, page 109

Insulating Materials

A new 8-page booklet discusses types, characteristics, and applications for Class A. A shellac- and varnish-coated papers, varnished fabrics, slot cell insulation and organic varnished glass. The organic varnished glass is also discussed for Class B insulation. Class H insulations discussed are silicone varnished glass, silicone rubber-coated glass cloth, and semicured silicone-treated glass cloth. Insulating varnishes, enamels, primers, finishes, and compounds are discussed by type, characteristics, and applications. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Circle 218 on Inquiry Card, page 109



ARE AC ENGINEERS really smarter?

Many are the absolute top men in their respective fields.

Currently, we are actively engaged in the fields of Avionics, Missile Guidance, (IRBM), Computers (Digital and Analog), Jet Engine Fuel Controls, Land to Air—Shore-to-Ship Communication Equipment, etc.

We are permanently dedicated to RESEARCH and DEVELOPMENT in every conceivable field of ELECTRONICS.

Opportunities for your personal development are unlimited. G.M.'s policy of decentralization creates exceptional opportunity for individual advancement. Starting wages are high, you work with the finest of equipment on challenging problems. Construction is already under way for an additional plant (225,000 square feet) in an exclusive Milwaukee suburb.

MASTER'S DEGREE GRADUATE PROGRAM

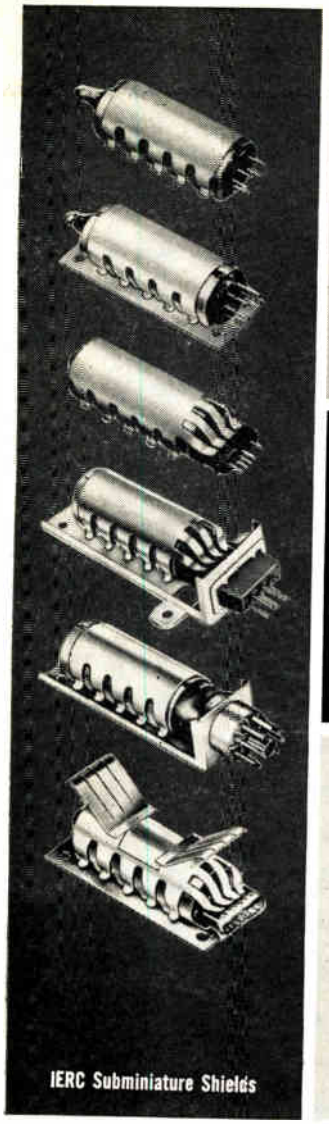
AC has worked out a Master's Degree Graduate Program (evenings) at the University of Wisconsin, Milwaukee. AC pays all tuition fees for this program.

Undergraduate programs are also available at Wisconsin, Marquette and Milwaukee School of Engineering.

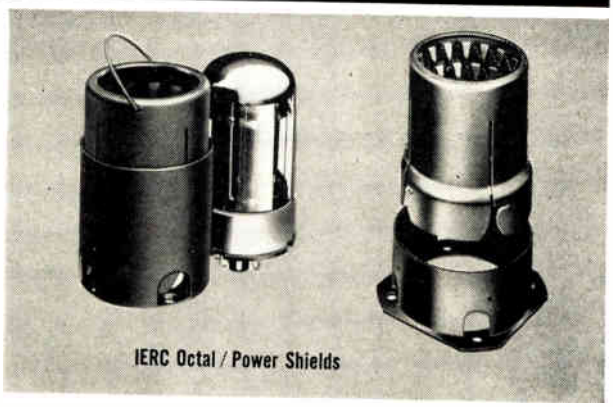
For your future's sake, you too be smart—send for complete facts and employment application form to Mr. Cecil E. Sundeen, Supervisor of Technical Employment.

AC THE ELECTRONICS DIVISION
GENERAL MOTORS CORP.

Milwaukee 2, Wis. Flint 2, Mich.



booth 602 has it!



See the *only complete line*---IERC's Heat-dissipating Tube Shields---at the Wescon show in San Francisco, August 20 thru 23, 1957

IMPORTANT PRODUCT PREVIEWS of miniature and subminiature right angle heat-dissipating tube shields for printed circuit applications will be shown for the first time at the WESCON. Other special heat-dissipating tube shields including new IERC types for the 6094 size tube will also be on display.

New IERC HEAT-DISSIPATING TUBE SHIELD GUIDE—the first informative guide of this type ever to be complied and offered to the electronic industry will be available free to visitors at our booth (#602) during the Wescon show. The IERC Guide provides practical, accurate information which helps electronic engineers get increased electron tube life and reliability through proper matching of tube and tube shield for maximum cooling, retention and protection against shock and vibration. More than 1,400 helpful combinations are included in the 20-page Guide.

If you can't be at the show, be sure to write on company letterhead for the IERC Heat-dissipating Tube Shield Guide and other IERC Technical Bulletins on heat-dissipating tube shields.

PATENTED OR PATS PEND. CROSS-LICENSED WITH NORTH AMERICAN AVIATION, INC.

International

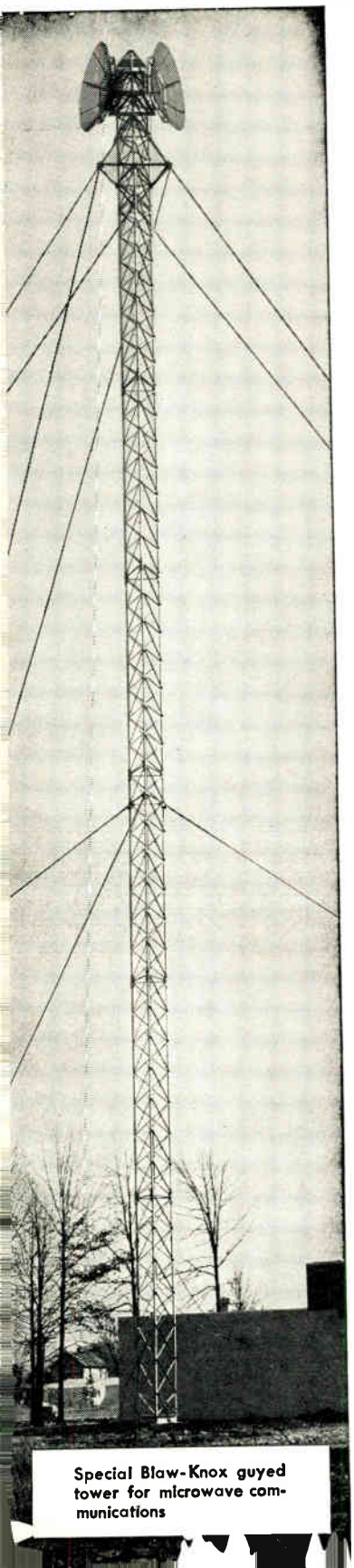
electronic research corporation

145 West Magnolia Boulevard, Burbank, California

Subsidiary of Hancock Manufacturing Co.

Planning better communications?

Microwave may be the answer ...and Blaw-Knox has the towers



Special Blaw-Knox guyed tower for microwave communications

Improved service, reduced maintenance, and economy records of pioneer microwave installations are responsible for many companies planning new communications paths through the sky. Quite possibly, microwave can best answer your growth problems, and Blaw-Knox can best answer your tower questions.

Blaw-Knox Microwave Tower designs are based on more than 40 years of experience in building towers. For example:

- The first Blaw-Knox Towers, four 300′ self-supporting towers erected over 40 years ago in Alaska, still stand in good service.
- The world's first atom bomb was supported by a Blaw-Knox Tower, ushering in the Atomic Age at Alamogordo, New Mexico, in 1945.
- First electronic contact was made with outer space by a radar signal to the moon, beamed from a Blaw-Knox Tower.

From such varied experience as this, Blaw-Knox engineers are well qualified to design and engineer the type of tower system that will best meet your present and future requirements. Blaw-Knox Microwave Towers meet or surpass government standards and recommendations of the Radio-Electronics-Television Manufacturers Association for safety, wind loading and quality of construction.

Get the full story of Blaw-Knox Tower design, engineering and fabrication services. Write today for your free copy of new Bulletin 2538.

Type ML-210 Blaw-Knox self-supporting tower for microwave communications

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania

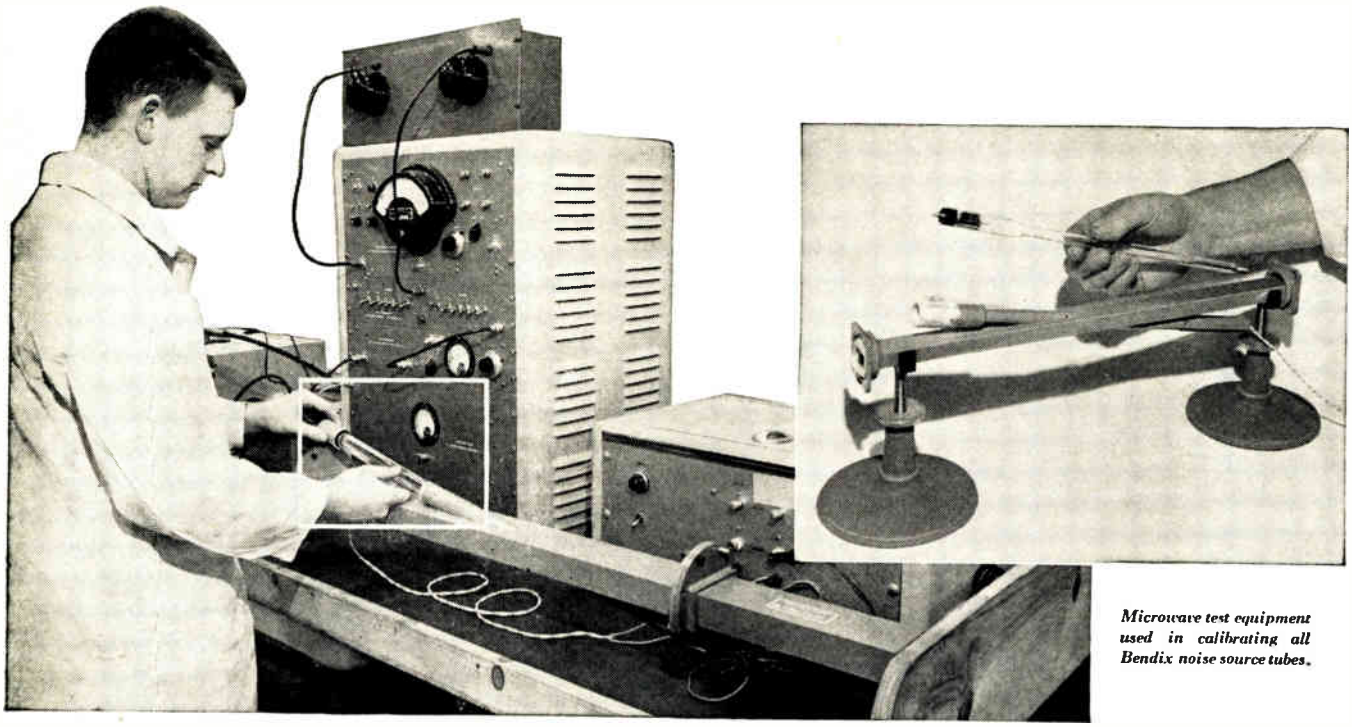
MICROWAVE TOWERS
Guyed and self-supporting Microwave Towers, custom-built for each installation ... and Transmission Towers ... Antenna Towers—guyed and self-supporting for AM-FM-TV, Radar ... parabolic antennas and other special structures

Circle 67 on Inquiry Card, page 109

Bendix Red Bank

NOISE SOURCE TUBES

Offer unusual stability plus freedom from ambient temperature corrections



Microwave test equipment used in calibrating all Bendix noise source tubes.

As measured sources of noise power in microwave equipment, Bendix Red Bank noise source tubes offer several distinct advantages.

First, temperature changes and fluctuations in noise output present no problems with these tubes, because we make them so that no correction in noise figures is necessary over the range from −55°C. to +85°C. Next, our precise quality control works to close tolerances that produce unusual stability and long life—far beyond that usually found in noise source measuring equipment.

Finally, as can be seen in the table at right, Bendix Red Bank noise source tubes cover an extremely wide range of frequencies, so that there is no difficulty in finding a type to meet any specific need.

If you have any sort of application in measuring noise and sensitivity in microwave receiving equipment, check with us for the most efficient answer. Write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, Quebec

Bendix Type	RETMA No.	Waveguide No.	Frequency KMC	Anode Current MA	Nom. Tube Drop Volts	Nom. Noise Rating db	Mount Type
TD-10	6356	RG49/U	3.95-5.85	250	70	15.2	10°E
		RG50/U	5.85-8.20				
TD-11	6357	RG25/U	8.20-12.40	200	75	15.2	10°E
TD-12	6358	RG48/U	2.60-3.95	250	80	15.2	10°E
TD-13	6359	RG53/U	18.00-26.50	200	65	15.2	10°E
TD-18	6684	RG91/U	12.40-18.00	200	70	15.2	10°E
TD-21	—	RG69/U	1.12-1.70	250	65	15.2	90°H
TD-22	—	RG48/U	2.60-3.95	250	45	15.2	90°H
TD-23	—	RG52/U	8.20-12.40	200	115	18.0	10°E
TD-24	—	WR 229	3.30-4.90	250	65	15.2	10°E

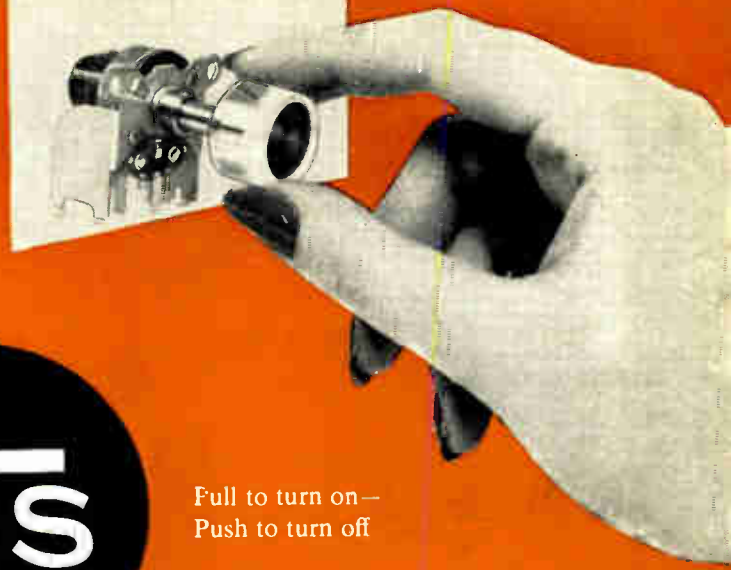
Red Bank DIVISION

Bendix AVIATION CORPORATION

PUSH-PUSH

One push on—
One push off

PULL-PUSH



Full to turn on—
Push to turn off

CTS

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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SOUTHWESTERN U.S.A.
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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.

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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.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

ELKHART • INDIANA

The Exclusive Specialists in Precision Mass Production of Variable Resistors

Burton Browne Advertisin

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- Dudek & Co Richard C 407 N Maple Dr (Beverly Hills) BR 2-8097
- *Ealy Co M D Box 238 (Northridge) ST 3-1775
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- Elecnair Co 3903 Warner Blvd (Burbank) VI 9-2874
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- Gilbert Co M B 1608 W Centinela Blvd (Inglewood) OR 8-5767
- Graham Sales Co 1200 N Sycamore Ave (Hollywood) HO 2-3552
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- Key Enterprises 15131 Gilmore St (Van Nuys) ST 0-6187
- King-Moon Co P O Box 1245 (Sherman Oaks) ST 4-5404
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- *Knight Co W Bert 10373 W Pico Blvd BR 2-5647
- Koessler Sales Co 818 N Fairfax Ave OL 3-1605
- Luscombe Eng'g Sales 17 W California St (Pasadena) SY 5-6463
- Lynch & Son C R 3307 Glendale Blvd NO 3-8236
- *Mann Assoc Martin 14751 Keswick St (Van Nuys) ST 3-2850
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- *Marshall Co G S 2065 Huntington Ave (San Marino) RY 1-6781
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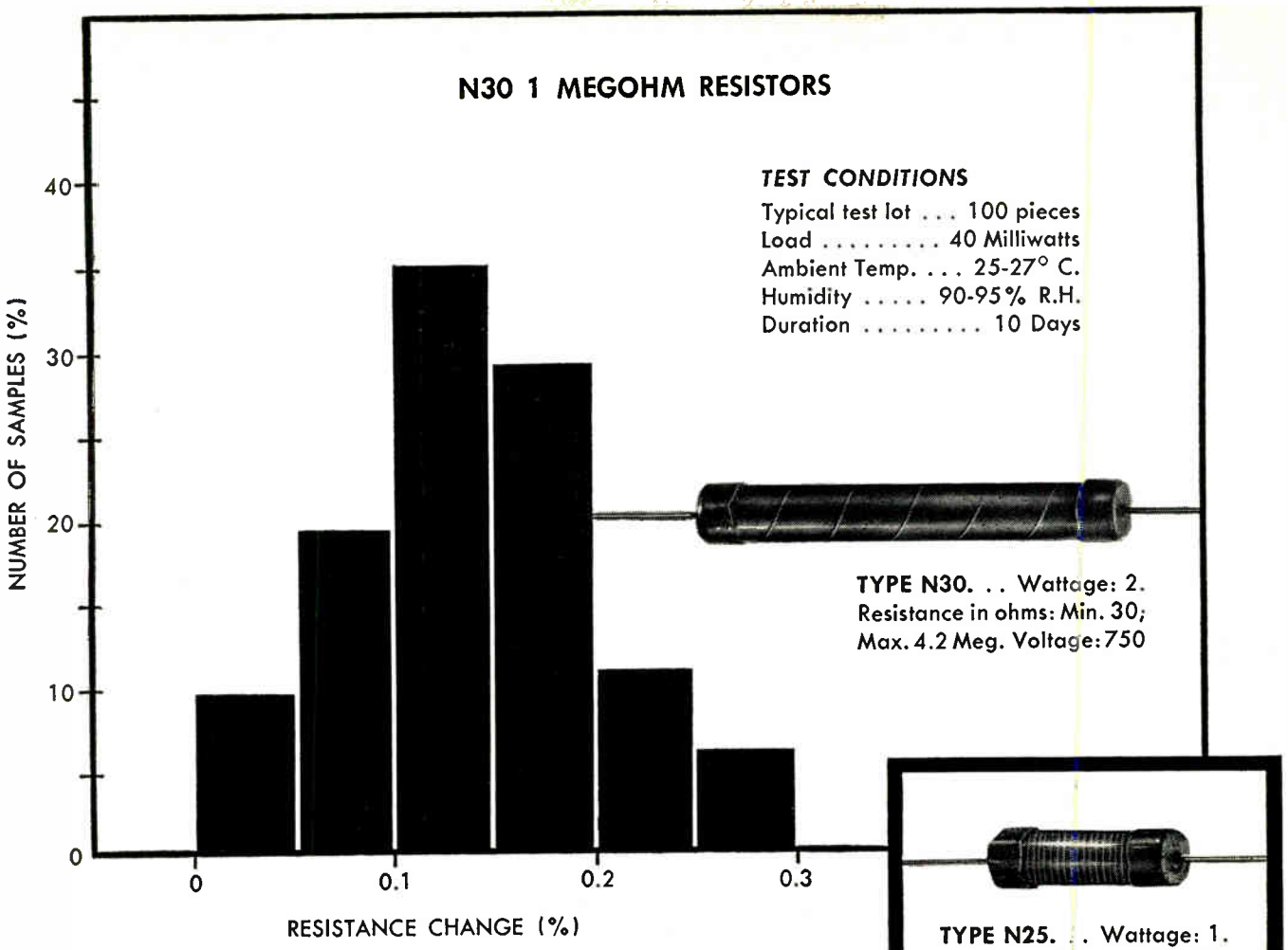
- Miller Assoc 742 S Hill St
- Mitchell Co C H 9015 Wilshire Blvd (Beverly Hills) BR 2-6635

(*Continued on page 132*)



Why Corning's Film-type Glass Resistors are unaffected by moisture

This graph gives some idea of the unusual properties that result when you fire a tin oxide film to a glass core.

Since film and core are fused into a single structure, you have a resistor that stands up under extreme humidity and moisture conditions.

Tin oxide reacts chemically with glass under heat; it actually becomes *part* of the glass.

So you have an integrated unit. One that's physically inseparable. Catastrophic failure is no problem with these rugged precision-film resistors.

You get *exceptional stability*. Less than 1.0% average change in resistance after 10,000 hours' operation at rated dissipation.

Long shelf life. Less than 0.2% resistance change after a whole year's aging under the most adverse conditions.

Low TC. Guaranteed ±300 ppm/°C. referred to 25°C. over a range of −55 to +105°C.

A last fact to shorten the long story we have to tell on our TYPE N FIXED-FILM RESISTORS:

They are guaranteed to meet, and the majority of characteristics of these resistors exceed, the requirements of MIL-R-10509B and comparable specs.

If you'd like the complete story on these amazing resistors, write for Data Sheet CD-2.00.

Keep your file up-to-date with data on these other electronic components made by Corning: Resistors: Low Power, Types S, R, H, HP, and WC-5; *Capacitors:* Fixed Glass*, Transmitting, Canned High-Capacitance, Subminiature Tab-Lead, Special Combination. Direct Traverse* and Midget-Rotary* Trimmers. Metallized Glass Inductances; Electrolytic Level Switches; Attenuator Plates; Fotoform Glass.

**Distributed by Erie Resistor Corporation*

Corning means research in Glass

CORNING GLASS WORKS, 95-8 Crystal Street, Corning, N.Y.

Electronic Components Sales Department

(Continued from page 130)

Moxon Sales G E (Culver City) Hdqrs San Mateo
Nash Co A W 2112 S Atlantic Blvd AN 9-7304
*Neely Enterprises 3939 Lankershim Blvd (N Hollywood) ST 7-0721
Olander & Co Roland 7225 Beverly Blvd WE 5-1211
Osborne R E 1757 Garfield Ave (S Pasadena) RY 1-3175
*Owens Co L H 2331 W Washington Blvd RE 5-0203
Paules & Co E G 1762 W Vernon Ave AX 3-6265
Perlmuth Electronics Assoc 2419 S Grand Ave RI 7-4321
Possner Co 1223 Venice Blvd DU 8-0508
Renz Roy E 3310 W 6 St DU 8-6545
*Rissi A J 2724 S Peck Rd (Monrovia) RY 1-5621
*Roberts & Assoc E V 5068 W Washington Blvd WE 8-2541
Ross & Co Malcolm 6119 Longridge Ave (Van Nuys)
*Rupp Co V T 307 Parkman Ave DU 7-8224
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*Saul & Assoc H M 5015 San Vicente Blvd WE 8-3591
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*Siegel Co S 1133 S La Cienega Blvd OL 5-8870
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Stern & Co I R 4109 Burbank Blvd (Burbank) VI 9-1195
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*TV Radio Supply 326 Market St EX 2-2898
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*Zack Radio Supply 1424 Market St MA 1-1424

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LEWISTON
A & J Dist Co Inc 419 Snake River Rd JA 2-2492

TWIN FALLS
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(Continued on page 134)

SHORT LENGTH-
SMALL NECK DIAMETER-
MINIATURE BASING-

Off-center neck design for sector-scanning applications.

SAVE SPACE AND WEIGHT IN AIRBORNE RADAR

Miniaturized 3" to 12" diameter radar tubes save space and weight in military and commercial installations. Ideal for use in airborne radar or *any* installation requiring high performance with miniaturization.

Du Mont miniaturized radar tubes feature short overall length and small neck diameter. Nine-pin miniature design saves base and socket weight. Reasonable power requirements aid in reduction of associated circuitry size and weight.

Detailed specifications upon request . . .

DU MONT RADAR TUBES

TABLE OF IMPORTANT SPECIFICATIONS

Type	Diameter	Length	Focus	Deflection	Neck Diameter	Voltage	Deflection Angle	Screen
B1173	3"	5⅛"	Elect.	Mag.	⅞"	7KV	70°	Alum.
K1517	3"	6⅜"	Elect.	Mag.	⅞"	8KV	Off Center Neck	Alum.
5BCP—	5"	7"	Mag.	Mag.	⅞"	8KV	70°	Reg.
B1174	5"	6⅝"	Elect.	Mag.	⅞"	8KV	70°	Alum.
B1142	7"	8½"	Mag.	Mag.	⅞"	8KV	70°	Reg.
B1175	7"	7 13/16"	Elect.	Mag.	⅞"	10KV	70°	Alum.
B1191	10"	10⅝"	Elect.	Mag.	⅞"	10KV	70°	Alum.
B1132	10"	12½"	Elect.	Mag.	1 7/16"	10KV	78°	Reg.

Industrial Tube Sales, Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J., U.S.A.

(*Continued from page 132*)

OREGON

EUGENE
*Carlson Hatton & Hay 96 E 10 St DI 4-4255
KLAMATH FALLS
RF Supply Co 509 Commercial TU 2-4451
MEDFORD
*Walker Co Verl G P O Box 1586 SP 2-4558
PENDLETON
*Harolds Radio Supply 320 S W Court Ave 1956
PORTLAND
*Central Distrs 1331 N W Couch St CA 8-0146
Connelly Co F B 905 N W 12 Ave CA 2-1755
H & R Radio Supply 5141 N E Sandy Blvd AT 7-0057
Johnson Co Lou 1506 N W Irving CA 2-9551
North Pacific Supply Co Inc 2950 N W 29 Ave CA 8-9576
Northwest Radio Supply 110 S E 8 Ave BE 4-9787
*Portland Radio Supply 1234 S W Stark St CA 8-8647
*Saelens Radio Co 1605 N W Everett CA 8-6395
*Stubbs Electric Co 33 N W Park Ave CA 7-5404
Television & Radio Supply 1335 S E Grand Ave BE 2-1104
*Tracey & Co 937 N W Gilsan St CA 3-6263
*United Radio Supply 22 N W 9 Ave CA 3-6323
West Pacific Distributing Co 5025 S E Powell Blvd BE 6-9749
SALEM
Eoff Electric Co 156 N Front EM 3-9251
*Willamette Radio Supply 2460 State St EM 2-0463

UTAH

SALT LAKE
*O'Loughlin's Radio Supply 113 E 3rd South St EM 4-5051

WASHINGTON

ELLENSBURG
*Geiger Radio W A 1101 Columbia 2-7701
EVERETT
*Pringle Radio Wholesale 2101 Colby Ave BA 2212
SEATTLE
Associated Industries 1752 Raenier Ave MI 4400
Connelly Co F B 1015 Republican SE 4155
Electronic Supply Corp 5601 Calif Ave AV 4500
Fidelity Electric Co 960 Republican St SE 5100
*General Radio Inc 100 Wall St EL 4784
Mutual Electronic Supply 307 3 Ave S MU 5974
*Radio Products Sls Co 1213 1 Ave MA 1035
*Seattle Radio Supply 2117 2 Ave SE 2345
*Western Electronic Supply Co 717 Dexter Ave SE 3200
Westlake Electronic Supply 509 Westlake Ave N MA 6601
*Zobrist Co Herb E 2121 Westlake Ave MU 2121
SPOKANE
Columbia Electric 3420 Ferry Ave KE 4-0611
Frank's Radio Supply 161 S Adams MA 4-8108
Johnson Co E M W 615 1 St RI 7-5432
*Northwest Electronics N 102 Monroe St TE 8-3177
*Taylor Distg Co E 204 Augusta Ave FA 8-8110
*Tel-Electric Dist 734 N Division St FA 7-4421
TACOMA
*C V G Radio Supply 2502 Jefferson Ave BR 2-3181
Stewart Co A T 711 Broadway BR 2-3174
*Wible Radio Supply 2360 S Fawcett Ave BR 2-8395
WALLA WALLA
Kar Radio & Electric Co 12 & Pine Sts JA 9-2242
WENATCHEE
Midstate Radio Supply Inc 611½ N Wenatchee Ave NO 2-8103
YAKIMA
Lay & Nord 112 S 2 St GL 3-5591
Yakima Wholesale Radio 506 S 1 St GL 7-4670

WYOMING

CHEYENNE
*Houge Radio & Supply Co 4012 Central Ave 2-6474

WESTERN DISTRIBUTORS

These are the names and addresses of organizations handling the distribution of radio-TV-electronic parts and equipment. Asterisk (*) indicates membership in National Electronic Distributors Association (NEDA). Telephone numbers are given to speed contacts.

ARIZONA

PHOENIX
*Radio Parts of Arizona P O Box 6345
TUCSON
*Art Electronics Supply Inc P O Box 2549
*Elliott Electronics Inc P O Box 5081
*Standart Radio Parts 218 N 1st Ave

(*Continued on page 137*)

New Hipermag* cores . . .

now up magnetic amplifier yields 35%

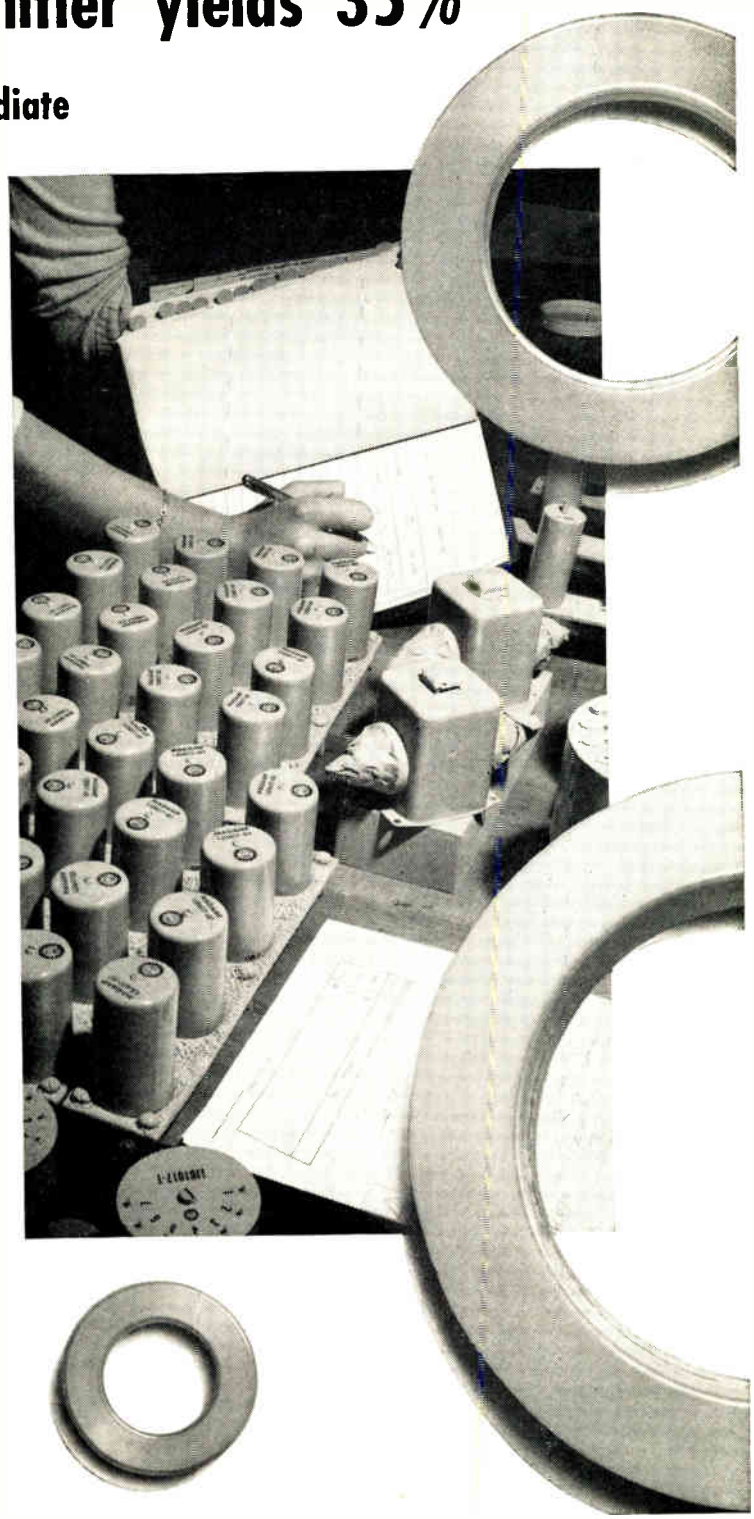
All core sizes in stock, delivery immediate

A large eastern manufacturer reports Westinghouse Roberts-tested Hipermag cores have increased Magamp* yields from 70% to 95%. Here are just three of the many reasons why.

- All the quality in Hipermag cores is proved out with the exclusive Westinghouse Roberts dynamic tester. This test provides four values actually measuring magnetic properties of cores under simulated amplifier conditions. Test values are equivalent to final core performance in your finished reactor.
- Westinghouse Hipermag toroidal cores are wound with Hipernik® V. Hipernik V is a highly oriented iron nickel alloy of exceptional temperature stability, high remanence and low coercive force, making these cores ideally suited to high-quality saturable reactors.
- For especially high shock resistance, cores can be hermetically-sealed, and their rugged nylon or aluminum cases filled with a Westinghouse-developed silicone oil. Prevents core damage. Minimizes magnetic change due to strains, pressure, shock or vibration. Provides foolproof protection when reactors are vacuum impregnated, encapsulated or resin treated.

A Westinghouse Hipermag specification will give you perfectly matched, quality cores in abundance —all sizes are in stock for delivery today! Also available in a full range are Hipersil® and Hiperthin* cores. Call Westinghouse Electric Corporation, or write Specialty Transformer Department, P. O. Box 231, Greenville, Pa.

*Trade-Mark
J-70797



YOU CAN BE SURE...IF IT'S

Westinghouse

Circle 74 on Inquiry Card, page 109

NEW SERVO-RATIO MULTIMETER

Combines all the functions of an AC-DC voltmeter, ohmmeter and AC-DC ratiometer in one compact portable unit

Here is a new, highly accurate test instrument designed to make life easier for those who work with computers and other electronic and electrical devices. It measures AC-DC ratios, absolute AC-DC voltages and resistance. You can also measure the gain of operational amplifiers using the 0° phase output provided.

The Servo-Ratio Multimeter computes voltage ratios by dividing the voltage to be measured by the reference voltage obtained from the computer. It is a high-impedance instrument and utilizes a motor-driven, position-type servo mechanism. Average time to obtain a reading is three seconds. Simplification and reliability are obtained through the use of printed circuits.

The front panel contains a four-digit illuminated drum counter for readout, phase or polarity indicating lights, function switch, ON-OFF switch, range switch, 0° phase ratio selector, input terminals and 0° phase output terminals.

The Servo-Ratio Multimeter is compact and easy to handle. It has an aluminum case and weighs only 10 pounds. The instrument can be operated in a horizontal or vertical position and has a unique carrying handle that serves as a tilt-stand when the unit is used horizontally. Write for Product Description 2005.

SPECIFICATIONS

Power Consumption: 50 Watts, 110 Volts, 60 cps. Reference Voltage: DC or 60 cps AC; ± 10 Volts to ± 100 Volts across 8.7K Ohms Load.

Functions	Range
Ratio, AC	0.001 to 1.000 ± 0.1% in 1 range
Ratio, DC	0.001 to 1.000 ± 0.1% in 1 range
60 cps AC Voltage	1 Volt to 1000 Volts full scale ± 1.0% in 4 ranges
DC Voltage	1 Volt to 1000 Volts full scale ± 1.0% in 4 ranges
Ohms	10K Ohms to 10 Megohms full scale ± 1.0% in 4 ranges
Gain	0.01 to 1000 in 4 ranges

PORTABLE AND COMPACT—Weighs only 10 pounds. Size: 7⅞" x 5½" x 11-13/16".

SIMPLIFIES TESTING—Eliminates need for many other instruments. Has digital readout counter.

See our exhibit at the Wescon Show, Booths 810-811.

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

Circle 75 on Inquiry Card, page 109

(Continued from page 134)

CALIFORNIA

ALHAMBRA
*Coast Electronic Supply 2708 W Main CU 3-4049

BAKERSFIELD
Cletes Electronic Supply 419 E 19 St FA 5-5728
*Valley Radio Supply 716 Baker St FA 7-4811

BERKELEY
Electronics Suppliers 2428 Shattuck Ave TH 8-6965
Pacific Radio Supply Inc 1940 Ashby Ave TH 3-8900

BURBANK
Burbank Radio & TV Parts 1303 W Magnolia Blvd VI 9-4515
Hagerty Radio Supply 2926 W Magnolia TH 8-2453

CATHEDRAL CITY
Wholesale Electronic Specialists 68-482 Broadway PA 8-8101

EL MONTE
Kimball & Stark 713 S Tyler Ave GI 4-2594

EUREKA
Redwood Electronics Supply 711 Summer St HI 3-3107

FRESNO
*Arbuckle Jack C 2349 Kern St AM 4-6555
*DeJarnatt Wholesale B J 223 Fulton St AD 7-2153
*Inland Electronic Suppliers 843 Divisadero AM 6-9666
*Mid Cal Distrs 1239 "F" St AM 6-9711

GARDENA
Video Suppliers 14526 Crenshaw Blvd DA 9-4053

GLENDALE
*Western Electronic Supply 809 E Broadway CI 1-0830

HOLLYWOOD
Calif Radio & Electronics 823 N Highland Ave HO 5-2131
H & H Electronics Co 7708 Melrose Ave WE 3-5586
Hollywood Radio Supply 5606 Hollywood Blvd HO 4-8321
Mfrs Electronic Service 6274 DeLongpre Ave HO 9-6226
Pacific Radio Exchange 1407 Cahuenga Blvd HO 2-1393
Western States Electronics 1509 N Western Ave HO 5-7185
Yale Radio Electric 6616 Sunset Blvd HO 5-4169

INGLEWOOD
Cook Electronics Co 210 E Hardy St OR 8-7644
Inglewood Electronic Supply 836 E La Brea Ave OR 8-1454

LANCASTER
Manley's TV Supply 4519 N Yucca WH 2-2413

LONG BEACH
Cal-Tenna Electronic Supply 363 South St NE 6-1239
Dean's Electronics 2310 American Ave GA 7-0955
*Scott Radio Supply 266 Alamitos Ave HE 6-1452
*Whitehead Radio Co 4686 Long Beach Blvd GA 2-9867

LOS ANGELES
American Electronic Supply 567 S Fairfax Ave WE 6-5181
Calif Electronics Supply 11801 W Pico Blvd GR 7-1208
Ceazan Co J N 3535 S Broadway AD 2-4161
*Federated Purchases Inc 11275 W Olympic Blvd BR 2-0831
Figart's Radio Supply 6320 Commodore Sloat Dr WE 6-6218
*Fredkin Co M S 1012 S Hill St RI 9-9682
G L Electronics Inc 1632 Venice Blvd RI 9-8188
Gough Industries 819 E 1 St MA 6-2474
Kierulff & Co 6303 Corsair St RA 3-7761
Kierulff Electronics 820 W Olympic Blvd RI 7-0271
K & L Radio Parts 1406 Venice Blvd RI 9-0553
L A Radio Supply Co 10217 Venice Blvd TE 0-5862
*Papel Brothers 4652 E 3 St AN 2-5151
*Radio Equipment Distrs 1340 S Olive St RI 9-9151
Radio Parts Sales 5220 S Vermont Ave PL 9-9178
Radio Specialties Co 1946 S Figueroa St RI 9-7271
Telcom Supply Corp 1406 Venice Blvd RI 9-8700
United Radio & Electronics 1924 S Grand Ave RI 7-0441
*Universal Radio Supply 1729 S Los Angeles St RI 9-5241

MODESTO
Inland Electronic Suppliers 501 1 St LA 4-1497
Pacific Teletronic & Radio Supply 1116 Seventh St LA 3-7751

MONTEREY
Wholesale Electronics 229 Alvarado 2-7642

N HOLLYWOOD
Arrow Sales 7460 Varna Ave ST 7-0406
No Hollywood Radio & TV Supply 4212 Lankershim Blvd ST 7-3063

N SACRAMENTO
Calif TV Supply 2454 Del Paso Blvd WA 2-0116

OAKLAND
Altshuler Co Cass 6038 Telegraph Ave OL 3-7557
Brill Electronics 610 E 10 St TE 2-6100
Elmar Electronics 140 11 St HI 4-7011
*Millers Radio & TV Supply 530 E 8 St TE 4-9185

(Continued on page 138)

(Continued from page 137)

Relco Inc 6625 Footgill Blvd LO 9-4741
*Wenger Co E C 1450 Harrison St GL 1-1020

PALO ALTO
White & Co 788 Mayview Ave DA 3-4455
Zack Radio Supply Co 1422 Market St MA 1-1422

PASADENA
Dow Radio 1759 E Colorado RY 1-6683
Empire Electronic Dist 37 E Union St RY L-7671

POMONA
Anderson-Maggs Electronics 1095 E 3 St LY 9-9669

REDONDO BEACH
Bay Electronics 2315 Redondo Beach Blvd OR 8-4668

SACRAMENTO
*Kemp Co E M 1115 R St GI 3-4668
*Sacramento Electronic Supply 219 "S" St GI 1-4821

SAN BERNARDINO
Featherstone Electronics 1010 E St TU 4811
*Inland Electronic Sply 843 Colton Ave 6-5571

SAN DIEGO
Electric Supplies Distg 435 2 Ave BE 2-8161
Electronic Equipment Dist 140 "B" St BE 2-3155
Shanks & Wright 2045 Kettner Blvd BE 9-0176
Western Radio & TV Supply 1415 India St BE 9-0361

SAN FRANCISCO
*Assoc Radio Distr 1929 Market St HE 1-0212
Basford Co H R 235 15 St MA 1-8545
*Brown Co C C 61 9 St MA 1-7000
*Eber Electronics 160 10 St
Edisco-Electronic Dist Co 630 Divisadero FI 6-6232
General Electric Supply 1201 Bryant St UN 3-4000
Heard Pacific 116 Natoma St GA 1-2086
Kaemper & Barrett P O Box 969 JU 6-6200
*Meyberg Co Leo J 33 Gough St MA 1-3400
*Pacific Wholesale Co 1850 Mission St UN 1-4843
*San Francisco Radio & Supply 1212 Market St UN 3-6000
Thorson Co 7361 Melrose Ave WE 4-1191
*Tubergen Assoc 2232 W 11 St DU 9-3173
Van Groos Co 14515 Dickens St (Sherman Oaks) ST 7-9615
Vaughn Co G H 15 N Euclid Ave (Pasadena) SY 5-4420
*Wallace & Wallace 1206 Maple Ave RI 7-0401
*Weber Co Wedge 1217 Venice Blvd DU 7-2111
*Weightman & Assoc H G 4101 Burbank Blvd (Burbank) VI 9-2435
Wesrep Corp 2022 S Sepulveda Blvd BR 2-3757
West Co Lloyd E 557 E Walnut St (Pasadena) RY 1-5281
Western Control Equip Co 14615 Ventura Blvd (Sherman Oaks) ST 7-0447
*Westron Sales & Eng'g Co 7407 W Melrose Ave WE 3-7276
Wilcox Co E A 6436 E Corvette St RA 3-6436
*Wiley Co Paul F 1632 Silver Lake Blvd NO 3-8028
*Wood Co Ash M 11938 E Garvey Ave (El Monte) CU 3-1201
Yarbrough Sales Co 2636 Mission St (San Marino) RY 1-3331
Zimmerman Co W E 407 N Maple Dr (Beverly Hills) RY 2-1181

SACRAMENTO
Neely Enterprises Hdqrs N Hollywood

SAN DIEGO
Hildebrand Gorman 3132 Tarragona Dr JU 2-4677
*Hill Co J T 1864 Bacon St AC 3-7133
Marshall Co G S 3525 5 Ave CY 8-8234
Miller Co Gerald B 1263 Rosecrans Blvd AC 2-1121
Neely Enterprises Hdqrs N Hollywood

SAN FRANCISCO AREA
*Ault C E 906 Willow Rd (Menlo Park) DA 6-1760
*Belchamber & French 1485 Bayshore Blvd JU 6-0406
Belfer William 926 Howard St SU 1-2633
Belilove Co 420 Market St YU 2-3713
*Berman Co E L 780 Natoma St UN 3-0317
Brainard W V 1010 Grosvenor Pl (Oakland) TE 2-8378
*Brandt E W 1355 Market St HE 1-0484
Cady J F 1485 Bayshore Blvd JU 5-4108
Cochrane-Barron (Palo Alto) Hdqrs Los Angeles
Dalton C R 132 El Camino Real (San Carlos) LY 1-2654
Deere Co Jerry 1809 Virginia Ave (Redwood City)
*Eichorn & Melchior 749 Bryant St DO 2-1038
Frazar & Hansen 301 Clay St EX 2-5112
*French Sherwood P 141 Walter Hays Dr (Palo Alto) DA 3-0597
*Harriss-Koetke Sales Co 383 Brannan St YU 6-1084
Heaton James S 3525 Alameda Dr Las Pulgas (San Mateo)
Held Herman E 147 10 St UN 3-4250
*Hill Co J T 1682 Laurel St (San Carlos) LY 3-7693
*Hodges & Glomb 921 Bryan St UN 1-2367
Johnson Assoc 129C Hillsdale Blvd (San Mateo) FI 5-5084
Kittleson Co Hdqrs Los Angeles
Koessler Industrionics 2830 Geary Blvd JO 7-0622
Kolans & Co Bill 3589 St MI 7-6686
*Lebell Co Frank 988 Market St GR 4-1069
*Lewis Assoc Dean 4385 Piedmont (Oakland) OL 4-0613
*Logan Sales Co 150 8 St HE 1-0692

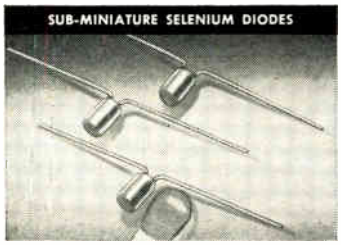
(Continued on page 140)

International Rectifiers

For all DC needs from microwatts to megawatts!

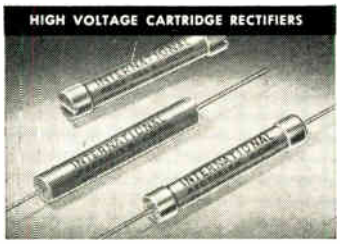
SELENIUM

SUB-MINIATURE SELENIUM DIODES



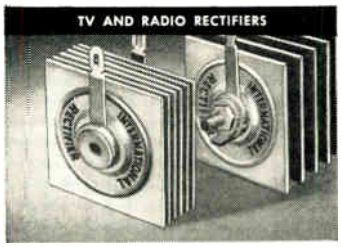
Developed for use in limited space at ambient temperatures ranging from −50°C to +100°C. Encapsulated to resist adverse environmental conditions. Output voltages from 20 to 160 volts; output currents of 100 microamperes to 11 MA. **Bulletin SD-1B**

HIGH VOLTAGE CARTRIDGE RECTIFIERS



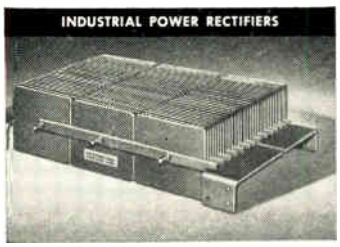
Designed for long life and reliability in Half-Wave, Voltage Doubler, Bridge, Center-Tap Circuits, and 3-Phase Circuit Types. Phenolic Cartridge and Hermetically Sealed types available. Operating temperature range: −65°C to +100°C. Specify **Bulletin H-2**

TV AND RADIO RECTIFIERS



The widest range in the industry! Designed for Radio, Television, TV booster, UHF converter and experimental applications. Input ratings from 25 to 156 volts AC and up. DC output current 50 to 1,200 MA. Write for application information. **Bulletin ER-178-A**

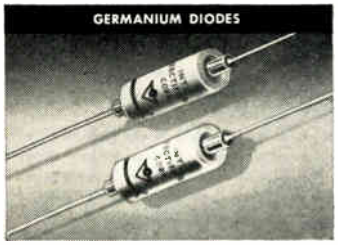
INDUSTRIAL POWER RECTIFIERS



For all DC power needs from microwatts to kilowatts. Features: long life; compact, light weight and low initial cost. Ratings: to 250 KW, 50 ma to 2,300 amperes and up. 6 volts to 30,000 volts and up. Efficiency to 87%. Power factor to 95%. **Bulletin C-349**

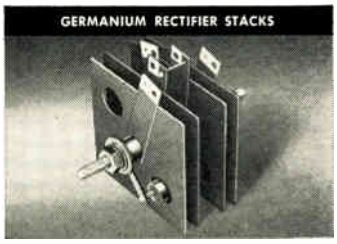
GERMANIUM

GERMANIUM DIODES



This series of general purpose, high quality point contact diodes provide excellent rectification efficiency for very high frequency applications. Special "RED DOT" series available for ambient temperatures from −55° C to +100° C. **Bulletin SR-140.**

GERMANIUM RECTIFIER STACKS



Extremely low reverse leakage values make this series ideal for magnetic amplifier applications. These units utilize 10 amp junctions—26 to 66 AC input volts rms—are available in a wide range of circuit types and DC current ratings. **Bulletin SR-148.**

AIR-COOLED GERMANIUM JUNCTIONS

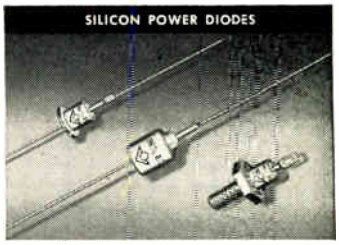
Engineered for heavy power applications, these highly efficient forced air cooled units feature moisture and corrosion resistant housings. A complete series in each of 3 current ratings: 150, 330 and 500 Amperes @ 26 to 66 volts rms. Request **Bulletin GPR-2.**

LIQUID COOLED GERMANIUM JUNCTIONS

Liquid cooled for maximum power in minimum space. Junction rating: 670 amps at 26 to 66 volts rms. Housed in high-conductivity copper cast around special steel coils. Water, oil or other accepted coolants may be used. For complete data. **Bulletin GPR-2.**

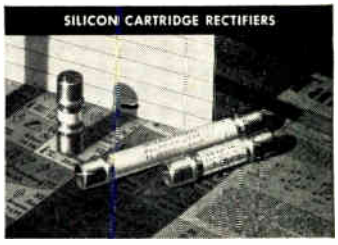
SILICON

SILICON POWER DIODES



Hundreds of types in three basic styles, for operating temperatures from −55°C to +150°C. Up to 800ma DC output current per junction over a voltage range of 50 to 1,000 PIV. Hermetically sealed. For complete information on all types. **Bulletin SR-A.**

SILICON CARTRIDGE RECTIFIERS

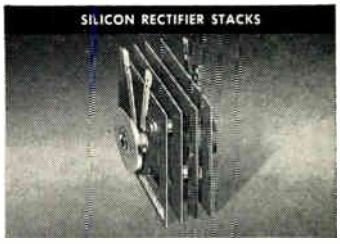


The answer to tough miniaturization problems! Ratings for high temperature applications: from 1000 volts PIV at 100ma half-wave DC output to 16,000 volts PIV at 45ma. Hermetically sealed, metallized ceramic housing. Request **Bulletin SR-139B**

SILICON MEDIUM POWER RECTIFIERS

Specifically engineered for industrial applications—the most conservatively rated silicon rectifiers in the industry! Rugged all-welded construction and hermetic sealing mean greater reliability—longer life. Types available in 3 series. Request **Bulletin SR-143B.**

SILICON RECTIFIER STACKS



These units consist of hermetically sealed junction diodes mounted on copper cooling fins, stacked to include the interconnections required for specific circuits. Junction ratings: 1.25 amps. DC output; 70 to 350 AC input volts rms. Request **Bulletin SR-137A.**

A WORLD OF DIFFERENCE • THROUGH RESEARCH •

International Rectifier

CORPORATION

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NEW YORK: 132 E. 70TH ST., TRAFALGAR 9-3330 • CHICAGO: 205 W. WACKER DR., FRANKLIN 2-3888

CAMBRIDGE, MASS., 17 DUNSTER ST. UNIVERSITY 4-6520 • IN CANADA: ATLAS RADIO CORP., LTD., 50 WINGOLD AVE. W., TORONTO, ONTARIO, RU 1-6174

THE WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS

(Continued from page 138)

Marsh Co J W Hdqrs Los Angeles
Marshall Co G S (Redwood City) Hdqrs Pasadena
Mauldin Co C W 441 W California Ave (Palo Alto) DA 4-2135
McCarthy Assoc 441 W California Ave (Palo Alto) DA 3-3270
McKnight Co 400 Monterey St EX 2-2552
*Meyer & Ross 113 10 St HE 1-0652
*Moulthrop Co F W 575 10 St MA 1-0722
*Moulthrop & Hunter 165 11 St HE 1-2625
Moxon Sales G E 422 LaJolla Ave (San Mateo) FI 5-2866
Neely Enterprises (San Carlos) Hdqrs N Hollywood
*Newman Co H L 420 Market St YU 6-3897
*Nickerson & Rudat 381 Brannan St YU 2-2982
*Nott & Co L A 1061 Howard St HE 1-4738
Penisula Assoc 2857 El Camino Real (Redwood City) EM 9-1226
Pfieger Co R L 1652 Laurel St (San Carlos) LY 1-0396
*Purdy Co W J 312 7 St UN 3-4321
*Roberts & Assoc E V Renato Court (Redwood City) EM 8-7125
*Ross Co D H 534 El Camino Real (San Carlos) LY 3-8224
Salisbury & Assoc C M 1453 7 Ave LO 6-8160
Schwarzschild Bert 105 Lake St SK 2-0846
*Sinai A A 65 9 St UN 1-6259
Striker Co John E 1047 Cherry St (San Carlos) LY 1-0736
Strassner C R (Redwood City) Hdqrs Los Angeles
Theisner W G 11161 Samedra (Cupertino) CH 3-5142
*Tompkins & Co W W 941 Newell Rd (Palo Alto) DA 3-3270
*Weightman Assoc 1436 El Camino Real (Menlo Park) DA 6-3797
White & Co 788 Mayview Ave (Palo Alto) DA 3-4455
Wilcox Co E A 277 7 St HE 1-6670

Colorado

ARVADA
Barnhill Assoc 6520 W 62 Ave HA 4-7733

ASPEN
Kettering Charles V P O Box 172 5281

BOULDER
*Golliher W B 1003 Grandview Ave HI 2-7899

COLORADO SPRINGS
*Peyser & Co 1501 N Weber St ME 4-3401

DENVER
*Bowen Co 721 S Broadway RA 2-4641
CFL Co 375 S Pearl St SP 7-4381
*Cluphf & Assoc Stan 7825 W Colfax Ave BE 3-6025
*Connors Co W H 375 Birch St BE 3-7628
Franklin Sales Co 1219 California St AM 6-1552
*Hyde Sales Co 1341 Cherokee St CH 4-7471
Hytronic Measurements 1295 S Bannock PE 3-3701
Kittleson Co Hdqrs Los Angeles Calif
*Koether-Cox Co 120 W 13 Ave MA 3-3544
*McLoud & Raymond 5528 E Colfax Ave FL 5-3525
*Nelson Co A J P O Box 5502 KE 4-6751
*Pearson & Co Mel 1011 S Josephine St SP 7-7878
Pease Fred A P O Box 1566 FR 7-2336
Richards & Assoc 2415 15 St GL 5-3651
Swan Co Edward C 232 Dahlia St EA 2-4718
*Williams Co Allen I 126 W 12 Ave MA 3-0343

FORT COLLINS
*Leeper & Assoc Wilson Box 324 3044

GREELEY
*Moss Gordon G P O Box 428 GR-770

New Mexico

ALBUQUERQUE
Bowen Co R G P O Box 3177 Sta D 5-4603
C G Electronics Corp 305 Dallas St N E 6-6121
Gates Co Hdqrs Salt Lake City
Hyde Sales Co 2229 Utah St N E 5-8360
Industrial Assoc Electronics Hdqrs Ft Worth
Kittleson Co Hdqrs Los Angeles
McClendon R E 3907 Central Ave E 6-4983
Miller Gerald B Hdqrs Hollywood
Neely Enterprises Hdqrs N Hollywood
Rupp Co V T Hdqrs Los Angeles
Shefler Co H G Hdqrs Phoenix
Williams & Assoc Hdqrs Denver

Oregon

PORTLAND
*Burcham Co Don H 510 W 19 Ave CA 7-3830
Carlson Fred W 935 Northwest 12 Ave AT 3798
Donal Co P O Box 7013 CA 2-4343
Eckersley James W 3150 S W Hamilton St CA 8-0308
Hawthorne Electronics 700 S E Hawthorne Blvd BE 4-9375
Kearns Co James L 6055 N E Glisan St
Lee Co Dave M Hdqrs Seattle
*Leng Co R R 1633 W 21 Ave CA 3-9720
McMillan Co A C 10111 S W 62 Ave CH 4-1311
*Minthorne Co L L 7521 N E Glisan St AL 3-0010
Northwestern Agencies Hdqrs Seattle
Porter Co Burt C Hdqrs Seattle
Tudor Associates J A 1004 S E Belmont St BE 2-1188
*Weber Co Dale G 234 Sherlock Blvd CA 8-5403

(Continued on page 143)

T/I PROGRESS REPORT ON

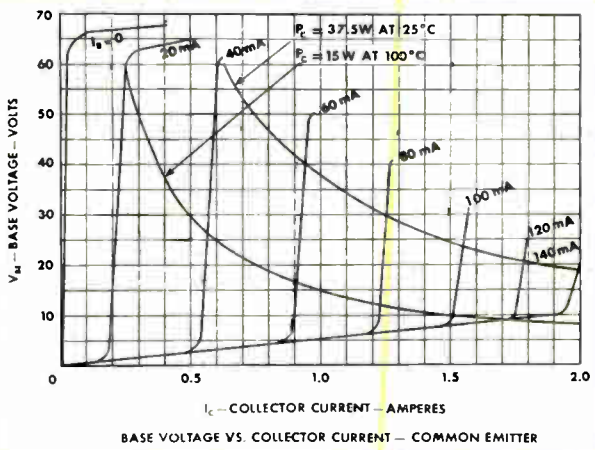
SILICON POWER TRANSISTORS

now you can get

15 watts at 100°C

NEW silicon high power transistor

For your audio servo uses – and many other applications, you can reach new transistor highs – in power, temperature and gain with low distortion and the stability and reliability you expect from silicon transistors. In Class B push-pull operation, two new TI Type 2N389 silicon diffused junction transistors provide 15 W power output at 100°C ... with distortion of less than 10% and typical beta cutoff frequency of 300 kcps. This new transistor is the first high power silicon transistor and the latest addition to the TI silicon line ... widest in the industry.



BASE VOLTAGE VS. COLLECTOR CURRENT – COMMON EMITTER

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Power Dissipation at 100°C	15	Watts
25°C	37.5	Watts
Collector to Emitter Voltage	+60	Volts
Base to Emitter Voltage	−2	Volts
Collector Current	2	Amperes
Saturation Resistance	6	Ohms
Base Current	0.5	Ampere
Storage Temperature	−65 to +150°	C

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Here G. D. Schott (right), Flight Controls Department head, discusses computer solutions of control and guidance problems with E. V. Stearns (center), Inertial Guidance Department head, and J. E. Sherman, Analog Computer Section head.

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Few fields equal missile systems flight controls in the need for original thinking. The ever-increasing performance of missiles presents problems that grow constantly in complexity. At Lockheed, weapon systems programs demand important advances in flight controls. Emphasis is on new ideas, new techniques.

Positions are open on the Sunnyvale, Palo Alto and Van Nuys staffs for engineers possessing strong ability and interest in: Research and development of advanced flight control systems for controlling missiles and rockets; system synthesis by application of control system feedback techniques; analysis and design of nonlinear servo systems; development of transistor and magnetic amplifier techniques in the design of advanced flight control systems; analysis and simulation of the dynamic performance of the guidance – autopilot – airframe combination; development of systems utilizing advanced types of inertial and gyroscopic instruments; analysis and design of hydraulic servo systems for controlling missiles at high Mach numbers; environmental and functional testing of prototype flight control systems.

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Circle 81 on Inquiry Card, page 109

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- Electronic Product Engineering
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- Inertial Guidance
- Infrared Detection Systems
- Microwave Systems
- Radar Systems
- Reliability
- Specifications Engineering
- Test Engineering
- Transducer Development
- Video Systems

M. H. Hodge and senior members of the technical staff will be available for consultation during the convention. For interview in San Francisco, phone YUkon 2-3460. Phone day or night.

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MISSILE SYSTEMS DIVISION

(*Continued from page 140*)

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(*Continued from page 66*)

"Microwave Tubes" (9:30 AM to noon)

"Methods of Increasing Bandwidth of High Power Microwave Amplifiers," W. J. Dodds, T. Moreno and W. J. McBridge, Jr. of Varian Associates.
"Wide Band Klystron Amplifiers," W. L. Beaver, R. L. Jepsen and R. L. Walter of Varian Associates.
"The SAL-89. A Grid Controlled Pulse Klystron Amplifier," Jerry D. Swearingen and C. Veronda of Sperry Rand Corp.
"A Gun and Focusing System for Crossed-Field Traveling-Wave Tubes," O. L. Hoch and D. A. Watkins of Stanford University.
"Injection of Convergent Beams Focused by Periodic Magnetic Fields," Charles Susskind and J. L. Palmer of the University of California at Berkeley.

"Computer Circuit and Logical Design" (9:30 AM to noon)

"The Transistor NOR Circuit," W. D. Rowe of Westinghouse Electric Corp.
"Flux Quantized Counter," J. R. Bacon and G. H. Barnes of the Burroughs Corp.
"Logic Design Symbolism for Direct Coupled Transistor Circuits in Digital Computers," J. B. O'Toole of Hughes Weapon Systems Development Laboratories.
"A Mathematical Formulation of the Generalized Logical Design Problem," D. Ellis of Litton Industries.
"A Five Microsecond Memory of UDOFT Computer," A. Ashley of Sylvania Electric Products.

"Automatic Instrumentation" (9:30 AM to noon)

"A New Concept for a Paper-Tape High-Information Rote Reader," Warren Welcome of California Technical Ind.
"Large Screen Bor-Graph Scope—A New Tool for Continuous Visual Monitoring of Multichannel Data," Henry O. Wolcott of Federal Telephone and Radio Co.
"Automatic Missile Check-Out Equipment," Marvin R. Beck and Robert White of Bendix Aviation Corp.
"Rapid Automatic Check-Out Equipment for Maintenance of Weapon Systems," David Y. Keim of Sperry Gyroscope Co.
"Automatic Test Systems for Production," Herbert S. Dordick of Radio Corporation of America.

"Reliability Program" (9:30 AM to noon)

"Reliability—A Practical Program," Morton Barov of Farnsworth Electronics Co.
"Research Insurance for the Future," Robert M. Barrett of Air Force Cambridge Research Center.

(*Continued on page 144*)

(*Continued from page* 143)

"Reliability and the Component Engineer," R. W. Brown of Boeing Airplane Co.
"The AQL Myth," M. A. Acheson of Sylvania Electric Products.
"Lessons to be Learned from a Unique Reliability Program," L. J. Blumenthal of Bell Aircraft Corp.

"Antennas" (9:30 AM to noon)

"Space-Frequency Equivalence," W. E. Kock and J. L. Stone of Bendix Aviation.
"Two Dimensional Endfire Array with Increased Gain and Side Lobe Reduction," H. W. Ehrenspeck and W. J. Keorns of Air Force Cambridge Research Center.
"The Split Reflector Technique for Broad-Band Impedance Matching of Center-fed Antennas without Pattern Deterioration," R. L. Mattingly, B. McCabe and M. J. Traube of Bell Telephone Laboratories.
"Coupled Waveguide Excitation of Traveling Wave Antennas," Walter L. Week of the University of Illinois.
"A New Satellite Tracking Antenna," C. J. Sletten, F. S. Holt, P. Blacksmith and G. R. Forbes of Air Force Cambridge Research Center.

"Passive and Active Circuits" (2 to 4:30 PM)

"The Design and Optimization of Synchronous Demodulatars," R. C. Booton, Jr. and M. H. Goldstein, Jr. af Massachusetts Institute of Technology.
"The Extraction of Waveform Information by a Delay-Line Filter Technique," J. H. Park, Jr. and E. Glaser of Johns Hopkins University.
"Stable Amplifiers Employing Potentially Unstable Transistors," G. S. Bahrs of Stanford University.
"Synthesis of Active RC Transfer Functions by Means of Cascaded RC and RL Structures," I. Horowitz of Brooklyn Polytechnic Institute.
"Negative Impedance Circuits," W. R. Lundry of Bell Telephone Laboratories.

"Microwave Tubes" (2 to 4:30 PM)

"Use of Multiple-Helix Circuits in 100-Watt CW Traveling-Wave Amplifiers," John L. Putz and Gerard C. Van Hoven of General Electric Microwave Laboratory.
"High Gain TWT for X-Band," Robert McClure of Sperry Gyroscope Co.
"Development and Operation of Low-Noise Broadband Traveling-Wave Tubes for X- and C-Bands," F. B. Fank and F. M. Schumacher of General Electric Microwave Laboratory.
"Shot Noise Amplification in Beams Beyond Critical Perveance," J. C. Twombly of the University of Colorado.
"Microwave Frequency Mixing and Division with Beam Type Tubes," R. W. DeGrasse, D. A. Dunn, R. W. Grow and G. Wade of Stanford University.

"The Medical Applications of Super-Voltage Radiation" (2 to 4:30 PM)

"Some Considerations in the Choice of High Energy Machines for Therapy," Craig Newman of Varian Associates.
"Medical Applications of the Linear Accelerator," Mitchel Weissbluth af Stanford Medical School.
"Biological and Medical Applications of High Energy Protons," Cornelius A. Tobias of Donner Laboratory, University of California at Berkeley.
"Medical Applications of the Synchrotron," Gail Adoms of the University of California Hospital.

"Instrumentation" (2 to 4:30 PM)

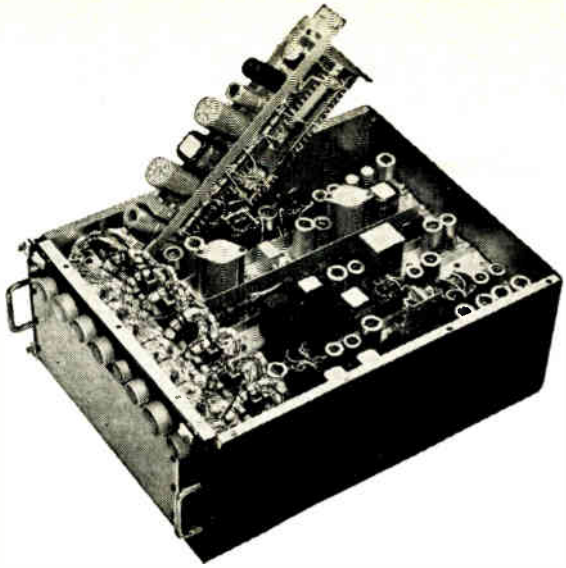
"A Survey of Equipment Used in Radioactivity Logging of Oil Wells," Cecil E. Williams of The Ramo-Wooldridge Corp.
"Millimicrosecond Photography with an Electronic Camera," E. Carroll Maninger and R. W. Buntenbach of Precision Technology, Inc.
"Instrumentation Applications of the Videotape Recorder," E. L. Keller of Ampex Corp.
"Design of a High-Speed Transistor Decimal Counter with Neon-Bulb Reod-Out," R. D. Lohman of Radio Corporation of America.
"A New Transfer-Storage Counter," Roger W. Wolfe of Burroughs Corp.

"Vehicular Communications" (2 to 4:30 PM)

"Qualitative Performance Evaluation of Land Mobile System," J. R. Neubauer of Radio Corporation of America.

(*Continued on page* 146)

Problem:



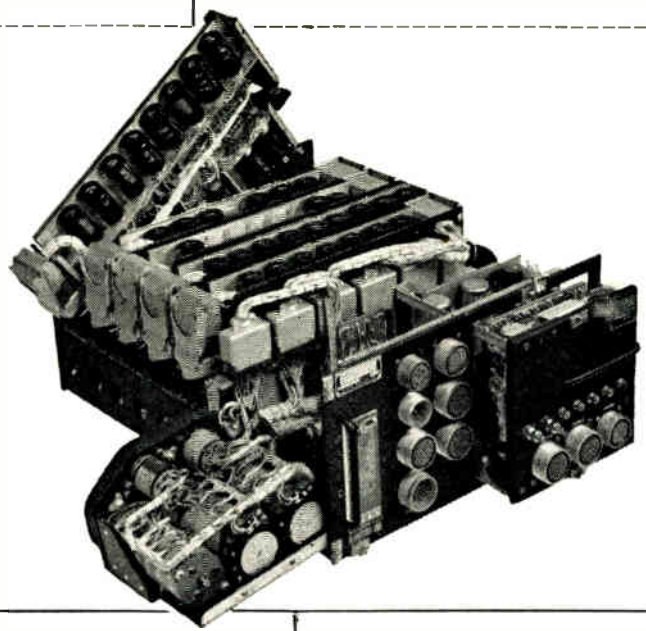
Redesign of an airborne analog computer to perform additional functions called for 20 per cent more parts— with no over-all increase in size, or change in form. At the same time, a high degree of reliability had to be maintained.

APPROACH TO RELIABILITY

Advanced radar fire control systems for military aircraft demand the highest degree of reliability under severe restrictions. These include quantity manufacturability, minimum size and weight, protection from shock and heat, serviceability, and exacting performance.

At Hughes, one objective of equipment design engineers is to maintain consistent essential performance of the systems while steadily improving reliability. Following is an example of accomplishment by Hughes engineers in this specialized area:

Solution:



By use of improved components, unique packaging techniques, and thorough environmental testing, Hughes design engineers were able to meet specifications and improve reliability as well. Result was that the new computer operated at mean internal temperatures in excess of 120°C and withstood shocks of 50 g's— as against 85°C and 30 g's for the original unit.

ENGINEERS experienced in the fields of product design, electronics packaging, miniaturization and component reliability will find outlets for their abilities in new advanced packaging and reliability problems.

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(*Continued from page* 144)

"High Power UHF Station Transmitter," Richard Ocka of General Electric Co.
"Antennas for VHF Communicatians Systems," Ralph Bykerk of Tele-Beam Industries.
"Frequency Cross Raads for the Mobile Services," Lester Spillane of San Francisco.

"Production Techniques" (2 to 4:30 PM)

"Applications of Flying Spot Scanning Techniques to Automatic Inspection," H. P. Mansberg of Allen B. Du Mont Laboratories.
"Evaluation of Etched Circuit Boards from the Standpoint of Vibration," N. R. Dunbar of Autonetics.
"Preassembled Component Modular Systems," J. D. Heibel of the Erie Resistor Corp.
"Capacitors for Automation," G. P. Smith of Corning Glass Works.
"Use of Ceramic-Metal Seals," James L. Hall of Thermo Materials, Inc.

FRIDAY, AUG. 23

"Audio" (9:15 to 11:45 AM)

"General Consideration an Phasing Two-Way Loudspeakers," John K. Hilliard of Altec Lansing Corp.
"A Wide Angle Loundspeaker of a New Type," Leonard Pockman of Ampex Corp.
"Simplified Audio Impedance Measurements," Vincent Salmon and Myles R. Berg of Stanford Research Institute.
"Multi-Channel Audio Recorders," W. M. Fujii af Ampex Corp.
"Methods of Recording Commercial Stereophanic Masters," R. J. Tinkham of Ampex Corp.

"Advance in Active Microwave Solid-State Devices" (9:15 to 11:45 AM)

"Microwave Atomic Amplifiers and Oscillators," George Birnbaum of Hughes Research Laboratories.
"Measurements on Active Microwave Ferrite Devices," K. M. Poole and P. K. Tien of Bell Telephone Laboratories.
"Maser Amplifier Characteristics for One- and Two-Iris Cavities," Malcolm L. Stitch of Hughes Research Laboratories.
"Microwave Properties ond Applications of Garnet Materials," G. P. Rodric › of Harvard University.
"L-Band Isolators Utilizing New Materials," Gerald S. Heller of M.I.T. Lincoln Laboratory.

"Analog and Digital Computer Devices" (9:15 to 11:45 AM)

"Rake, A High-Speed Binary—BOD and BCD Binary Buffer," G. F. Mooney and J. P. Hart of Rocketdyne.
"Simulation of Transfer Functions Using Only One Operational Amplifier." A. Bridgman of Sylvania Electric Products.
"Function Generation by Integration of Steps," E. H. Heinemann of Douglas Aircraft Co.
"A Transistorized, Multi-Channel, Airborne Voltage-to-Digital Converter," Robert M. MacIntyre of The Ramo-Wooldridge Corp.
"The Bizmac Transcoder." D. E. Beaulieu of Radio Corporation of America.

"Telemetry" (9:15 to 11:45 AM)

"An Airborne Filter for Low Distortion of FM Sub-Carriers," Warren Link of Lockheed Aircraft Corp.
"Development of a High-Speed Transistorized 10-Bit Coder," L. McMillian of Radiation, Inc.
"A Transistorized PCM Telemeter for Extended Environments," R. E. Marquand and W. T. Eddins of Radiation, Inc.
"A Stable Transistorized PDM Keyer," D. A. Williams, Jr. of Bendix Aviation Corp.
"Television as an Aid to Remote Sensory Perception," John P. Day of Convair.

"Vehicular Communications" (9:15 to 11:45 AM)

"900 mc.—A Potential Vehicular Communications Band," Curtis J. Schultz of Motorala, Inc.
"Providing Mobile Coverage in Isolated Desert Terrain," R. L. Brinton, T. R. Ferry and E. L. Hare of Pacific Gas and Electric Co.
"The Use of VHF Radio in Railroading," James W. Brannin of Southern Pacific Co.
"A Selective Signaling System," Don Bentley of Electrical Communications.

"New Electronic Techniques for "Industry" (9:15 to 11:45 AM)

"Industrial Applications of Vacuum Relays," Robert E. Johnston of Jennings Radio Manufacturing Corp.
"Electron Paramagnetic Resonance—A New Form of Spectroscopy," R. M. Sands of Varian Associates.
"Television in Radiography," Allan R. Ogilvia of Sierra Electronic Corp.
"Electronic Counting as an Industrial Tool," James Cunningham of Systron, Inc.

"Ultrasonic Engineering" (2 to 4:30 PM)

"A Survey of Ultrasonic Generators," W. G. Cady of Pasadena, Calif
"A Novel Magnetostrictive Ultrasonic 'Jack-Hammer' Type Rotating Drill for Boring Small Holes in Hard Materials," N. K. Marshall of Lockheed Missile Systems Division.
"Non-Destructive Tests for Structural Adhesives," C. T. Vincent of Stanford Research Institute.
"Considerations in I-F Filter Design," John S. Turnbull of Collins Radio Co.

"Television Receivers and Televisual Devices" (2 to 4:30 PM)

"Securing 110-Degree Sweep for the Public Domain," W. D. Schuster and E. O. Stone of Sylvania Electric Products and C. E. Torsch of The Rola Co.
"A Brightness-Enhanced Color Receiver Employing Automatic Decoding in the Chromatron," R. H. Rector of Litton Industries.
"21-Inch Direct-View Storage Tube," N. J. Koda, N. H. Lehver and R. D. Ketchpel of Hughes Research Laboratories.
"The Television Color Translating Microscope," V. K. Zworykin of Radio Corporation of America.
"Automatic Fine-Tuning for Television Receivers," C. W. Baugh, Jr. of Westinghouse Electric Corp.

"Ionospheric Propagation" (2 to 4:30 PM)

"Long-Range Auroral Backscatter Echoes Observed at 12 Mc/s from College, Alaska," L. Owren and R. A. Stark of the University of Alaska.
"Meteor Burst Communication; Part I—Oblique Path Meteor Propagation Results," W. R. Vincent, R. Wolfram, B. Sifford, W. Jaye and A. M. Peterson of Stanford Research Institute.
"Meteor Burst Communications; Part II—VHF Meteor Burst Communications System," Vincent, Wolfram, Sifford, Jaye and Peterson of Stanford Research Institute.
"Experimental Equipment for Communication Utilizing Meteor Bursts," R. J. Carpenter and G. R. Ochs of the National Bureau of Standards.
"High Frequency Multipath Analysis by the Short Pulse-Long Pulse Method," J. D. Lambert of Hughes Weapon Systems Development Laboratories.

"Telemetry" (2 to 4:30 PM)

"A Transistorized High-Performance FM/FM System," William Fultan of Bendix Aviation Corp.
"A Transistor-Magnetic Sub-Carrier Descriminator," George H. Barnes and Robert M. Tillman of Burroughs Corp.
"A Low-Level Magnetic Commutator," D. C. Kalbfell of Kalbfell Electronix.
"Missile Temperature Telemetering," Jay Cox of Lockheed Aircraft Corp.

"Nuclear Science" (2 to 4:30 PM)

"The Varian Free Precesssion Magnetometer," Martin E. Packard and T. L. Allen of Varian Associates.
"Radiation Effects on Silicon Diodes," John W Clark, Herbert L. Wiser and Michael D. Petroff of Hughes Aircraft Co.
"Particles and Accelerators," George C. McFarland of High Voltage Engineering Corp.
"The Electrical Aspects of the UCRL 72C-Mev Synchrocyclotron," B. H. Smith, K. H. MacKenzie, J. Reidel, Q. Kerns, W. R. Baker, C. Park and R. L. Thornton of Radiation Laboratory, University of California at Berkeley.
"The Electrical Design of a Heavy-Ion Accelerator," Ford Voelker of Radiation Laboratory, University of California at Berkeley.

* * *

Magnetometer

(*Continued from page* 78)

the rocket magnetometer—shall be considered as reducing the allowable Q_R in Eq. 1 by three.

5. All factors in Eq. 1, not otherwise discussed, such as x, η and kT, shall remain the same as in the rocket magnetometer.

The above assumptions have specified every term which goes into Eq. 1 except for the power P and the actual signal-to-noise ratio itself. Let us now assume a signal-to-noise of 12 to be satisfactory. The extrapolation can then be written as an operational equation:

$$Q_R \times P = \text{constant} \qquad (2)$$

Since Q_R has been reduced by one-third from the rocket magnetometer, this means we must increase P by a factor of three, indicating a polarizing power of about 200 watts. The total energy thus expended in polarizing power during the satellite lifetime is 200

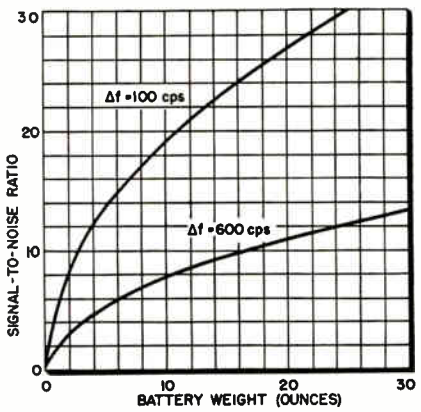


Fig. 6: Signal-to-noise ratio vs battery weight for fixed interrogation requirements.

watts times 400 seconds, equivalent to about 30 watt-hours. This number is taken to indicate the size of the battery which must be carried along with the satellite magnetometer, inasmuch as other power requirements are insignificant compared to this.

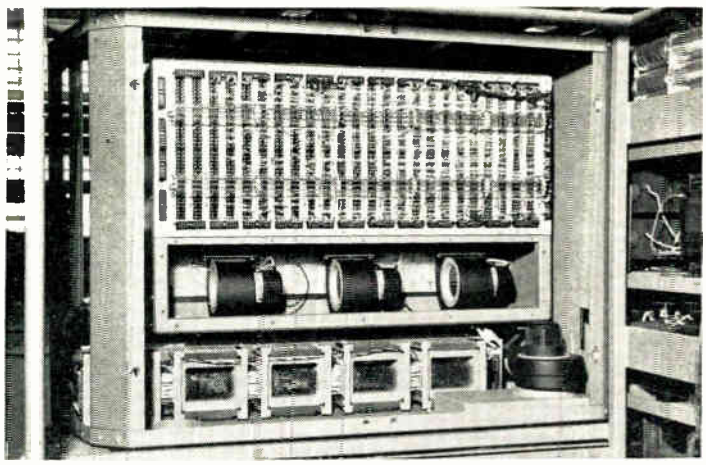
Experience with existing lightweight batteries of the storage type indicate that the battery will weigh about 1½ pounds and will occupy about 25 cubic inches, or a cube 3 inches on the side. This number will be used in the following design considerations but is probably overconservative for the following reasons:

1. If the batteries can be re-

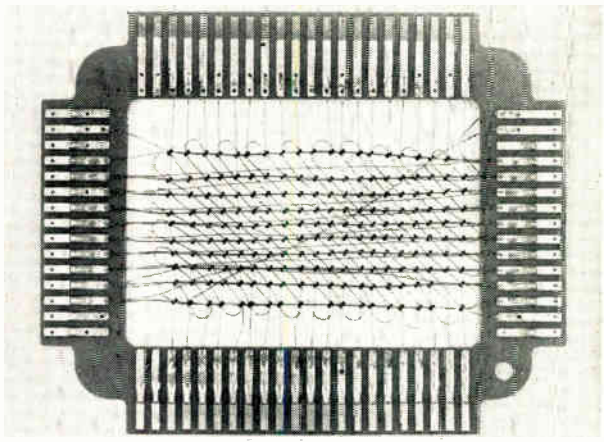
(*Continued on page* 150)

THE NATIONAL SCENE

KEEPING "ELECTRONIC BRAINS" FROM LOSS OF MEMORY. One of science's greater marvels is IBM's 705 Electronic Data Processing Machine—which makes intricate calculations and logical decisions in millionths of a second. Heart of this electronic "wizard" is its main magnetic core memory. Designed for use with the machine's high-speed printer is the IBM 760 Control and Storage Unit containing its own core memory of 1,000 positions which allows central processing to continue in the 705 while other data are being printed. Helping the 760 remember what information is to be printed is a job for PHENOLITE® Laminated Plastic. PHENOLITE's unique combination of properties makes it ideal for this application.



MOST ADVANCED FORM OF ELECTRONIC STORAGE. The 1,000-position core memory for the IBM 760 Control and Storage Unit—a portion of which is shown here—consists of pinhead size cores strung on copper-wired frames of PHENOLITE. Electrical impulses, passing through wires, alter the magnetic state of cores so that a group of them stands for a word or figure. Reversing the process recalls information from storage. PHENOLITE frames safeguard the circuit and permit stacking of core planes as shown.



PHENOLITE MEETS CRITICAL STANDARDS. Core frames like the one shown are punched out of laminated PHENOLITE by IBM. Each frame has printed circuit type terminal strips and soldered connections. PHENOLITE proves an ideal material for this application because it is mechanically strong and stiff, punches cleanly, etches well, remains flat, has high dielectric properties and withstands the heat of dip soldering.

(*Continued from page* 148)

charged by solar energy between polarizations, then this battery weight can be reduced drastically.

2. If recharging aloft is not possible, then other types of non-rechargeable batteries may be used with considerably less weight per watt hour. It appears possible that the battery weight may be reduced to as little as 1 pound.

Thus far we have allotted 2 pounds to the coil and sample, 1½ pounds to the battery. The questions then remaining in order to determine the feasibility of the instrument are, (a) can the remaining apparatus (excluding the telemetering transmitter) be contained in a unit weighing not more than 2½ pounds? (b) is the proposed signal-to-noise ratio of 12 with $\Delta f = 600$ cycles satisfactory for a field determination to within 5 gammas? On the basis of our experience with rocket-borne magnetometers, we believe the answer to both questions is "yes." On the basis of these considerations we consider that the satellite magnetometer is feasible.

Minimum-Weight Design

The following design represents the absolute minimum in weight that can be expected of a magnetometer that meets the target requirements. However, this minimum-weight design makes *no* allowance for safety factors in either signal-to-noise ratio or reliability of operation.

The minimum-weight design assumes the following:

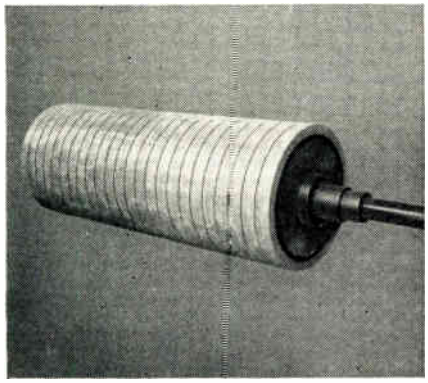
1. Broadly-tuned coil.
2. Signal-to-noise ratio of unity over the 1400-cycle bandpass of the satellite amplifier.
3. Electronic components limited only to those now known to be necessary.

If we assume the same type of

(*Continued on page* 152)

before pan or can...

Synthane laminated plastics are at work



Synthane-covered tin plate rolls last three times as long as other materials because of resistance to acids and surface toughness.

Few industries escape the multiple benefits of Synthane laminated plastics. The food industry puts Synthane to work as star wheels for bottling equipment, bread slicing guides as oil-less bearings in processing of sugar syrups and even in the tin-plating operation of metal containers.

Resistance to moisture, anti-friction characteristics, chemical and wear resistance are but a few of the reasons why Synthane is at work in this vital industry.

Synthane laminates combine in varying degrees—depending on which of the 30 or more grades you use—many mechanical, electrical and chemical properties hard to find combined in any other material.

You can buy Synthane in sheets, rods, tubes. If you prefer, your part can be supplied fabricated to your specifications. Send for our complete catalog for full information.

Synthane Corporation, 11 River Road, Oaks, Pa.

EASILY MACHINED

DIELECTRIC STRENGTH

CHEMICAL RESISTANCE

WEAR RESISTANCE

SYNTHANE ... industry's unseen essential.

SYNTHANE CORPORATION, 11 RIVER ROAD, OAKS, PA.

(*Continued from page* 150)

coil as proposed below, calculate the polarizing power and battery weight according to formulas (1) and (2), and take the known weight of existing electronic components, we arrive at the following weights:

Coil and Sample:	2 pounds
Battery:	5 ounces
Electronics:	1 pound

The total weight of the minimum instrument is therefore slightly over 3¼ pounds.

Proposed Magnetometer Design

The following design is intended for an upper weight limit of 6 pounds but probably will weigh between 4 and 4½ pounds.

The satellite installation of the magnetometer will consist of three parts: (a) The coil and sample, to be located coaxial with the rotation axis of the satellite, (b) the amplifier and programmer unit, and (c) the polarizing battery.

The coil and sample combination will have the same geometrical configuration as that now used in the Aerobee rocket, but will be one-half the volume. The windings will be made of aluminum instead of copper to conserve weight. This combination is expected to weigh about

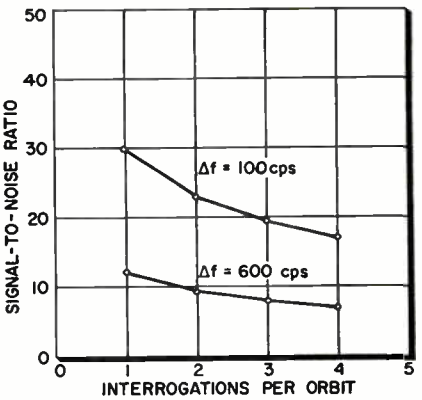


Fig. 7: Signal-to-noise ratio vs number of interrogations per revolution.

2 pounds. It is believed that a reduction in volume of the coil by one-half over the present design, without sacrifice in Q, can be achieved with a minimum of engineering effort. Over a period of time it may be possible to reduce the coil volume still farther.

The amplifier and programmer unit is expected to weigh between 1 and 1½ pounds and not more than 2½ pounds. To achieve this weight

(*Continued on page* 154)

A NEW QUALITY STANDARD...EIMAC'S CERAMIC 3CX100A5 ...SUCCESSOR TO THE 2C39 FAMILY

The Eimac 3CX100A5 Triode is Mechanically and Electrically Interchangeable With and Superior to the 2C39 Series.

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The 3CX100A5 overcomes every previous disadvantage of the 2C39 types. This planar premium quality ceramic triode withstands extraordinary thermal and mechanical shock. The long pulse cathode evaluation test guarantees electrical uniformity of every 3CX100A5. This new ceramic tube will give the lowest cost per hour of operation of any 2C39 type tube.

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TYPICAL OPERATION 3CX100A5

	CW	AM		CW	AM
DC Plate Volts	800	600	DC Plate Amps.	.080	.075
DC Grid Volts	—20	—16	Power Output, Watts	27	18

(*Continued from page* 152)

the unit will have to be completely transistorized except for one relay which must be used to physically disconnect the coil from the polarizing battery during precession, and possibly for the use of a subminiature vacuum tube instead of a transistor for the first amplifier stage.

The polarizing battery is expected to weigh 1-1½ pounds, according to the following design specifications. The problems concerning battery design and weight have been discussed in the previous section.

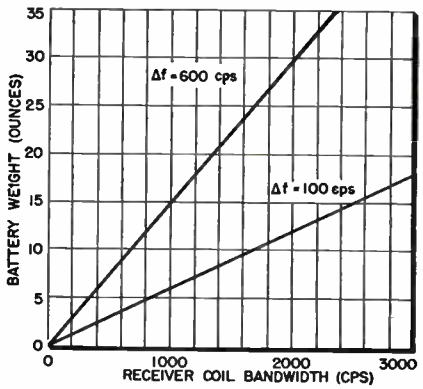

Fig. 8: Battery weight vs receiver coil bandwidth for constant signal-to-noise ratio.

The operation and characteristics of the satellite magnetometer are as follows: Upon receipt of the interrogation signal (probably a c.w. signal whose receipt through the detector closes a plate circuit relay or the like), the magnetometer will produce either a free precession signal whose mean-life (T_2) is one second or a larger number of free precessions, each of whose mean-life is less than one second, but whose total lifetime is one second. If the frequency bandpass is from 800 to 2200 cycles, and if the polarizing power is 200 watts, then the initial voltage signal-to-noise ratio of the received signal as seen at a monitoring station with a 600 cycle bandpass, will be about 12, going down to approximately 5 after one relaxation period.

If the precession frequency is better known, or estimated in advance, it may be possible to reduce the receiving bandwidth with consequent increase in signal-to-noise ratio. A signal-to-noise ratio of 12 in a 600 cycle bandpass is certainly adequate for determination of the field to within 5 gammas, provided

(*Continued on page* 156)

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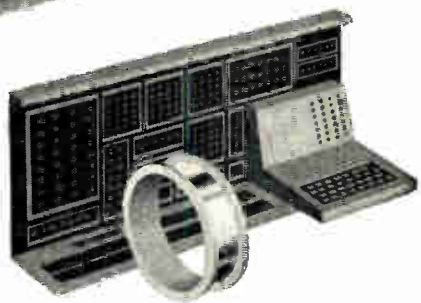

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(*Continued from page* 154)

the signal is further bandwidth-narrowed after reception.

An idea of the approximate size and appearance of the satellite magnetometer may be obtained from existing miniaturized magnetometer equipment, examples of which are shown in Figs. 1 to 3. Fig. 1 is an overall view of the Aerobee rocket magnetometer and one of its two coils. This unit is non-transistorized. Fig. 2 is a detail study of the rocket magnetometer coils showing them as they appear both shielded and unshielded. The dimensions of a coil and sample one-half the volume, as is proposed for the satellite magnetometer, are indicated. Fig. 3 shows the amplifier card of a transistorized magnetometer. The satellite magnetometer amplifier would presumably be of this type.

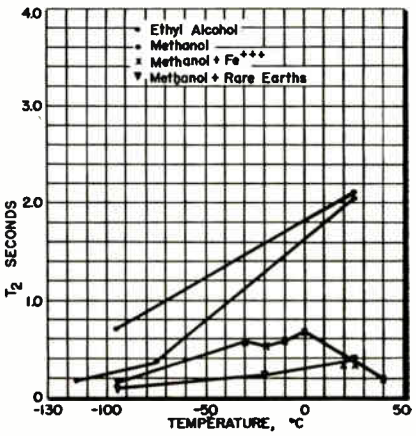

Fig. 9: Relaxation time of substances as a function of temperature.

Fig. 4, 5, and 6 are graphs which may be used to extrapolate the design data of the proposed magnetometer to operating conditions somewhat different than those assumed in this report. Fig. 4 relates battery weight to observed signal-to-noise ratio, on the assumption that polarizing power is proportional to battery weight. In addition to a receiving bandwidth of 600 cycles, a curve is also included for $\Delta f = 100$ cycles on the assumption that at most ground stations, particularly after one or two passes of a satellite has pretty well established the field value over the station, the narrower bandwidth will be more than sufficient to cover the possible range of field values.

Fig. 5 shows the signal-to-noise ratio as a function of the number of

(*Continued on page* 158)

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interrogations in each satellite revolution about the earth, assuming that the battery weight is kept constant but that polarizing power is reduced so as to maintain a constant over-all power consumption. Fig. 6 shows battery weight as a function of receiver coil bandwidth for constant signal-to-noise ratio. These curves are derived from the relationship $Q_R \times P = \text{constant}$.

[1] E. H. Vestine et al. "The Geomagnetic Field, Its Description and Analysis." Carnegie Institution, 1947.

For the 7th Region IRE

(*Continued from page* 57)

sional groups whose number is still rapidly increasing, the various technical lecture series on topics of current and future interest, the publication of the Grid, and the encouragement of the technically minded students in the various colleges and universities in the region covered by the San Francisco Section. The geographic area within the section domain is experiencing a phenomenal growth in its membership both as a result of the students being developed in the local technical schools and university departments, and from the diversity and number of members transferring to this area from other parts of the country.

Technical activity and member participation are quite noteworthy, and the Section and its subdivisions present from two to four technical sessions per week during a typical month of the active portion of the year. As Professor Terman of Stanford has pointed out, the high quality of the work in this area and the level of membership of the section is indicated by the large number of members of the fellow grade which we proudly number in our midst. The opportunity exists for the younger engineers and the upper level students at the universities to become well acquainted both socially and technically with the outstanding radio engineers in this area at our various functions and through service on our various committees. This activity is encouraged since it is a unique form of training by association which is available to a much lesser degree in other areas which are more sparsely settled or more densely populated. Our section takes very seriously the matter of the responsibility of the member engineer to maintain his knowledge and skills at a high and current level, and considers this a basic responsibility of the professional in the technical field.

These activities are so well supplemented by the WESCON Convention and Show that it seems obvious that our section supports the WESCON because of its contribution to the basic mission of the Institute of Radio Engineers. We are proud of the success of WESCON as measured by the large number of excellent technical papers and discussions, and the ever increasing number of visitors and exhibitors.

In the Los Angeles Area . . .

(*Continued from page* 56)

aged these companies to locate manufacturing and research facilities here. Company mergers, consolidations and outright purchases from within and outside of the industry are picking up, Moore stated. In

part, this reflects a spontaneous effort to strengthen the over-all management and production capacity of our local industry and it also indicates the degree of recognition and interest by other industries in becoming financially identified with the growth and future of the Electronics Industry.

There are several other areas of major electronic activity and growth in the West. The San Francisco-Peninsula electronics industry expects to double its total (1956) square feet of plant facilities by the end of '57. The Phoenix-Tucson area, with no electronic firms four years ago, now has 13 companies doing an annual business of 55 million dollars. Contrary to all popular notions about competition . . . electronic growth in these areas has stimulated the exchange of ideas and pioneering spirit among individual firms and complemented the Whole Western Electronics industry.

Base Materials

(*Continued from page* 73)

$$A = \frac{Ct}{0.2244K} \text{ (sq. in.)} \quad (2)$$

For a capacitance of 5μμf and a base material 3/64 in. thick, this reduces to

$$A = \frac{(5)\ (3/64)}{0.2244\ K} \quad (3)$$

$$= \frac{1.04}{K}$$

Consider the common XXX-P phenolic base material which, at room temperature, has a dielectric constant of approximately 4.0 and a loss tangent of 0.030. The required area of the capacitor plates is thus $\frac{1.04}{4.0}$ or 0.26 sq. in. This is equivalent to a square 0.51 in. on a side or a circle of 0.575 in. diameter.

Note, however, that these dimensions are approximate since fringing was neglected in the formula. If the size is acceptable then the quality of the capacitor should be investigated. For a dissipation factor of 0.030, the Q (neglecting

(*Continued on page* 160)

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fringe effect) is the reciprocal of the loss factor or 33. Since the circuitry required a high Q capacitor, this one may not be satisfactory.

A more desirable base material is Teflon impregnated glass fabric with a dielectric constant of 2.60 and a loss factor of 0.002. With this material, an area of 0.40 sq. in. is required. This area may be obtained with a square 0.632 in. on a side or a disk of 0.712 in. diameter.

The dissipation factor of 0.0007 is found by dividing the loss factor by the dielectric constant

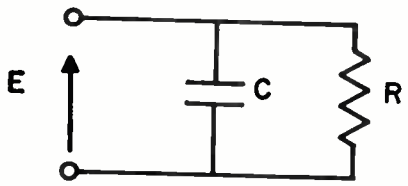


Fig. 4: Equivalent ckt of lossy capacitor.

(.002/2.6). This comes from the definition of loss factor. The Q of this capacitor, 1300, is the reciprocal of the dissipation factor. This will be a good quality capacitor.

The use of Teflon dielectric instead of XXX-P phenolic improved the quality of the capacitor by a factor of approximately 40 while the size was increased by approx. 25%.

Specific applications, cost, size, and other factors may force compromises in capacitor design. The above design problem, however, illustrates the resulting consequences, if the base material were evaluated only on the basis of material cost. Consideration should also be given to the electrical quality of the desired component.

References

1. Federal Telephone & Radio Corp., *Reference Data for Radio Engineers*, pages 45 and 90. Federal Telephone and Radio Corp., New York, 1949.
2. This definition is given in ASA Standard C42-1941. It may also be found in Knowlton, A. E., Standard Handbook for Electrical Engineers, Eighth Edition, Sec. 4, McGraw-Hill, New York, 1949.

Four Layer Diode

(*Continued from page* 60)

This discharge generates a pulse whose magnitude is approximately equal to the supply voltage B+ minus the forward drop across the two diodes.

A circuit which can be fired by input pulses of either polarity and can generate an output voltage pulse larger than V_h is shown in Fig. 3c. This circuit is very similar to Fig. 3b save that the conventional diode is replaced by a four-layer diode. Since the impedances in the open condition of the four layer diode are sensitive to temperature and may be variable from unit to unit, a high-resistance, voltage-dividing resistor combination is put across the two diodes. If the supply B+ is made slightly less than the sum of the breakdown voltages for the two four-layer diodes and the voltage divider is appropriately adjusted, either one diode or the other may be triggered into the closed condition by a relatively small input pulse. Thereafter, the circuit behavior is similar to that shown in Fig. 3b save that it is evident that the voltage of the output pulse will be larger, as discussed above.

Ring Circuit

Fig. 4 represents a more complex circuit utilizing the four-layer diode. It consists of two parts: An input pulse generator similar to Fig. 3b and a circuit of many stages shown to the right.

When the input circuit is fired, it brings the voltage V_0 on the remainder of the circuit to such a low value that the sustaining current cannot be furnished to any of the four-layer diodes through the resistors R_L.

Let us now assume that one of the diodes in the set is conducting. In Fig. 4b the situation is represented for the case in which four-layer diode No. 2 is conducting. The voltages at points 1 i (the symbol "i" is used to indicate the input point) and 1 L (the symbol "L" is used to indicate the output or load point of the element No. 1) are shown in Fig. 4b. Under these conditions the small current flowing through the four-layer diode in the open or low current state causes a small drop in voltage both across R_L and across the conventional diode so that the voltage at 1 L is slightly above ground and that at 1 i is slightly below V_0.

For the element No. 2 of the circuit, the situation is quite different because the four-layer diode is closed and most of the voltage drop appears across the load resistor. Element No. 3, like No. 1, is assumed to be in the open condition.

It is seen from Fig. 3b that there is a large positive voltage across the condenser coupling elements No. 2 and No. 3. If now the input circuit is fired, the voltage V_0 drops to zero and the second four-layer diode switches to the open condition. As the coupling condenser from the input circuit charges once more, the voltage V_0 rises, producing a voltage on the four-layer diode in element No. 3 which is larger than that on any other diode by the voltage V_c stored on the condenser. This causes element No. 3 to close.

From this description it is evident that when the input pulse circuit is fired, the closed condition will transfer one step to the right in the series of circuits shown in Fig. 3a. The last stage of the series of circuits may be capacitatively coupled to the first stage so as to close the ring.

The circuit can be designed to insure that one and only one of the four-layer diodes is closed. For this purpose it is necessary to have the diodes matched in the values of their holding currents. The requirement is that the values of R_B and R_L must be such that the four-layer diode which requires the highest holding current will remain closed once it is turned on while at the same time the two most easily sustained four-layer diodes cannot remain on simultaneously. Insight into the requirements posed by these conditions can be gained by considering the following inequalities in which subscripts 1 and 2 correspond to the most easily sustained diode, and subscript 3 to the diode requiring the largest I_h:

$$V_B - V_{d3} - V_{h3} > (R_B - R_L)\, I_{h3}$$

$$V_B - V_{d1} - V_{h1} < R_B\,(I_{h1} + I_{h2}) + R_L\, I_{h1} = (R_B + R_L)\, I_h + R_B\, I_{h2}$$

The first inequality says that when the most difficult diode to sustain is being sustained, the voltage drop across the two resistance in series with it must be supplied by the supply voltage minus the drop across the two diodes. In general, the voltage drops across the two diodes will be so small compared to the supply voltage that their sum may be neglected compared to V_B. The second inequality states that the available voltage must be too small to sustain diode No. 1 when both diode No. 1 and No. 2 are closed. If we neglect the small difference between V_{h1} and V_{h3}, then the limiting condition at which the two inequalities may both become equalities is given by the following equation:

$$I_{h3} = I_{h1} + I_{h2}\, R_B/(R_B + R_L)$$

From this equation it is evident that if R_B and R_L are equal, the maximum value of sustaining current can only be approximately 50% larger than the minimum sustaining current. On the other hand, if R_B is made substantially larger than R_L, then the maximum sustaining current may approach twice the minimum sustaining current.

For applications of the sort considered in Fig. 4, it is thus desirable to specify matched four-layer diodes having sustaining currents that differ by only ten or twenty per cent from each other.

Bistable Switching Circuit

Fig. 5 represents a circuit which may be triggered from one to the other of two conditions. Depending upon the value of the resistors and the voltage supply, the characteristics of the circuit may vary. As an interesting example, we shall consider a case in which the voltages B_1+ and B_2+ are both below the corresponding breakdown voltages. We shall also suppose that R_2 and B_2+ lead to a current substantially above the holding current of the four-layer diode D_2, and also that B_1+ and R_1 will not hold D_1 closed. Under these conditions, the combination acts as a single-pole single-throw switch

(*Continued on page* 162)

(*Continued from page* 161)

which can turn on or turn off the current driven by B_2+ through R_2.

In order to understand the operation, let us suppose that diode 2 is closed so that the current is flowing through R_2. A negative input pulse under these conditions will see a forward biased conventional diode in the second circuit and will generate only a small voltage pulse across it if the coupling condenser is small. In circuit one, on the other hand, a high impedance will be seen and the pulse will be able to close diode D_1. The voltage across the resistor R_1 will thus rapidly rise applying a negative pulse to the condenser C_{12}. This in turn will divert the current flowing through R_2 into C_{12} instead of through D_2. This will allow D_2 to switch to open so that when C_{12} is discharged, the voltage across R_2 will fall to zero and D_2 will remain in the open condition.

Application of a subsequent negative pulse at the input will fire both D_1 and D_2. Since the voltage at B_2+ may be larger than at B_1+, the current furnished by the coupling condenser in this case will tend to sustain D_2 rather than to turn it off, and the subsequent turn-off of D_1 will also tend to sustain D_2. Thus the input pulse will close the circuit that contains D_2.

By interchanging the order of the four-layer diode and the conventional diode in either circuit, a composite circuit can be made which will be sensitive to a pulse of one polarity for switching one way and to a pulse of opposite polarity for switching the other way.

Theory

The four-layer diode as made in silicon possesses all of the features in the conjugate transistor switching circuit covered by the Shockley patent No. 2,655,-609, previously referred to. Fig. 6b shows this circuit. It consists of two conjugate transistors, one an npn and the other a pnp and in addition to these an avalanche diode poled in the same direction as the two collector junctions across which it is connected. (The avalanche diode is covered by patent 2,714,702 issued to W. Shockley and also assigned to Bell Telephone Laboratories.)

In order to help the circuit engineer visualize how the four-layer diode operates, a brief description will be given here in terms of the conjugate pair example. As we shall point out below, the theory applies directly to the four-layer diode.

Attention should be directed first to the two resistances which shunt the emitter junction of the transistors. For small forward biases across the emitter junctions, the impedance of the emitter junctions is high compared to the resistors. Consequently, each transistor with its shunting resistor has a low value of alpha for low forward currents.

On the other hand, when a large forward bias is applied across either emitter junction, the forward current increases exponentially with voltage and the impedance drops. Thus a progressively larger fraction of the current flows in the transistor so that the transistor-resistor combination finally acquires an alpha essentially equal to that of the transistor alone. Thus the transistor-resistor combination will have an effective alpha which varies from a value of

a few tenths or less to a value of seven tenths or more. As we shall see, the value of 0.5 is in a sense critical since the condition separating the open from the closed condition for the composite structure corresponds to the sum of the alphas for the two transistors being equal to one, a condition which can be achieved by having the alpha for each transistor become equal to 0.5.

Let us now suppose that voltage is applied to the circuit of Fig. 6b so that the two collector junctions and the avalanche diode are effectively saturated. Let us next suppose that an additional voltage source is brought to the base connection of the npn transistor and a small current is furnished to the base. This current will be multiplied by the factor

$$\alpha_1 / (1 - \alpha_1)$$

and will appear at the collector of the first transistor. Thus it will be fed into the base of the second transistor. It will there be multiplied in the second transistor by a corresponding factor involving α_2 and this current will in turn be fed back into the base of the first transistor. If the current which results from this gain around the loop is greater than the current put in to begin with, then the circuit will be unstable and the current will build up indefinitely. If there is a series resistance in the external circuit, the voltage will then drop to such a small value that the collector junctions are no longer saturated.

The critical condition that the gain around the loop be greater than one is that

$$\alpha_1 \alpha_2 / (1 - \alpha_1)(1 - \alpha_2) = 1$$

and by elementary algebra this can be readily shown to be equivalent to

$$\alpha_1 + \alpha_2 = 1.$$

From this it is seen that a shift from the open condition to the closed condition is fundamentally dependent upon an increase in alpha with increasing current through the transistors.

The current which causes the transition from one condition to the other is avalanche current in the avalanche diode connected as shown in Fig. 6b. As the voltage approaches the avalanche voltage of this diode, the diode will produce a current which increases rapidly with voltage. If this current biases the two emitter junctions sufficiently forward so that the sum of the two alphas is equal to unity, then the current will spontaneously rise without limit unless additional series resistances prevent this.

Once the current is sufficiently large to maintain the two junctions in a condition with $\alpha_1 + \alpha_2$ equal to or greater than unity, then increase in voltage across the device causes the current through the device to increase as it would in a forward-biased diode. This conclusion is reached as follows:

Under the closed condition the theory of junction transistors shows that the flow of electrons between emitter and collector in the first transistor and the flow of holes between the emitter and collector in the second transistor is sufficiently effective to cause not only the emitter but also the collector junctions to be biased forward. This is the reason that the

(*Continued on page* 164)

(*Continued from page* 163)

device shows characteristics similar to a forward-biased single-junction diode when in the closed condition.

In the four-layer silicon diode, all of the essential features discussed in connection with Fig. 6b are simultaneously present. In the first place, the middle junction is made sufficiently abrupt that it undergoes avalanche multiplication at the desired breakdown voltage.

The proper variation of alpha for the two emitter junctions is a natural consequence of using silicon pn junctions. As schematically represented in Fig. 6c, there are, in effect, shunting resistors across the emitter junctions. It is now believed that the origin of this shunting-out effect can be understood in terms of the characteristics of recombination and generation of hole electron pairs in silicon. This subject has been investigated and published by C-T. Sah, R. N. Noyce, and W. Shockley, Bulletin of the American Physical Society, II, Vol. I, No. 8, H9, p. 382, Dec. 27, 1956, and a more complete exposition has been submitted by the same authors to the *Proceedings of the I.R.E.*

The essential feature of the explanation is as follows: The built-in voltage drop in a silicon pn junction is three or four tenths of a volt larger than in germanium because of the larger energy gap between conduction and valence bands in silicon. For this reason, injected currents, such as are ordinarily considered in the theory of pn junctions, are smaller in silicon than they are in germanium unless forward biases three or four tenths of a volt larger are applied. Thus at conditions of low forward bias the injected currents are correspondingly smaller. For this reason it is necessary to consider in silicon a current which is relatively unimportant in germanium; this ordinarily neglected current is the forward current which results from recombination of holes and electrons in the transition region of the junction where it changes from p-type to n-type. In this region the density of holes and the density of electrons are much larger than they are as minority carriers in the two regions to either side of the junction. Consequently, when forward bias is applied, the recombination current in this region is more important than injection into the base layer. This rate of recombination in the transition region is proportional to the hole density or to the electron density, whichever is the smaller. These densities in the middle of the transition region increase exponentially with applied voltage but only about one-half as fast as the injected current which diffuses deeper into the material. Consequently, as the applied voltage is increased across the junction, emphasis shifts from recombination in the transition region to injection of carriers into the base layer. It is this shift which causes the alpha of a silicon transistor to increase with increasing current. (This feature of increasing alpha is the subject of another Shockley patent application, assigned to Bell Telephone Laboratories and covering the silicon four-layer diode.)

It is thus evident that the effect of the shunting resistor of Fig. 6b is automatically performed by the

recombination centers in the silicon transistor. Thus all the essential features of the composite structure are contained in one unit in the four-layer diode.

There is, of course, a major advantage in the four-layer structure compared to the conjugate pair: No separate base connection is required. Hence, limitations due to base resistance are removed. A potential for very high power and high switching speed thus exists. The four-layer diode has indeed an exciting future before it.

Mismatch

(*Continued from page 75*)

obtained at compensated mismatch operation as compared to the maximum available amplification with perfectly matched input and output can be found as

$$\frac{A_{p_{max}}}{A_{p_m}} = \frac{\left(1 + n_o\sqrt{1-\delta}\right)\left(1 + \frac{\sqrt{1-\delta}}{n_o}\right)}{\left[1 + \sqrt{1-\delta}\right]^2}$$

$$= \frac{\left(n_o + \sqrt{1+K}\right)\left(\frac{1}{n_o} + \sqrt{1+K}\right)}{\left[1 + \sqrt{1+K}\right]^2}$$

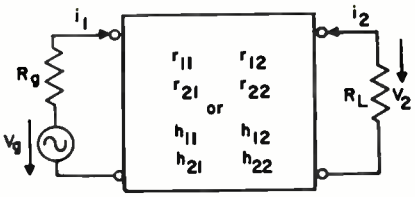


Fig. 3: General Schematic of an Active Four-Terminal Element driven by an Input Generator and loaded with R_L.

The ratio denotes an attenuation and is plotted versus n_o for various parameters δ and K, respectively, in Fig. 2.

Let a transistor be given with $\delta = 0.9$ or $K = 9$. Let the source resistance deviate from the optimum value by the ratio $n = R_{g_m}/R_{g_{opt}} = 5$. Fig. 1 then gives the compensating value $n_o = 2$ which means that the input mismatch of 5 can be compsated by a load twice the optimum load $R_{L_{opt}}$. For $n_o = 2$, the $\delta = 0.9$ or $K = 9$ — curve in Fig. 2 indicates that the best gain which can be obtained under the mismatch conditions is 2 db below the maximum over-all gain with perfectly matched input and output.

References

R. F. Shea: "Transistor Audio Amplifiers," John Wiley & Sons, New York, 1955.
W. Herzog: "Best Power Gain with Mismatched Transistors," Archiv der Elektr. Ubertrag., vol. 8, 1954, pp. 279-282 (in German).

Delay Line

(*Continued from page 71*)

After the pulse signals are inverted, they are passed through a diode to the grid of a cathode follower. The diode provides a certain amount of peak clipping which keeps the variation of amplitude small. This probably adds, to some extent, to the slight narrowing of the pulses as the number of pulses impressed on the line is increased. The output from the cathode follower is then used to feed the next delay line.

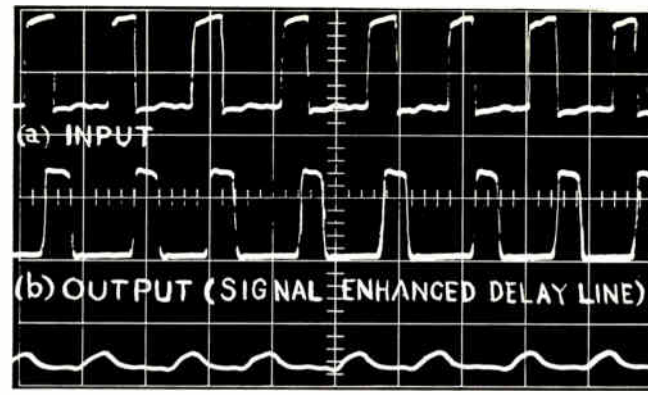
(*Continued from page* 165)

A Signal Enhanced Delay Line composed of 3 sections of 5.9 μsec delay, and one section of 2.95 μsec delay, is shown in Fig. 1. This is a demonstration model and, of course, does not represent the minimum size that can be achieved.

The pulse train shown in Fig. 6a was delayed by means of this Signal Enhanced Delay Line. The input signal to the delay line is shown in Fig. 6a, the output of the delay line is shown in Fig. 6b, and the output of the same delay line used in the Signal Enhanced Delay Line, but without the delay enhancing feature, is shown in Fig. 6c. There is considerable improvement in the fidelity of pulse shape in the case of the Signal Enhanced Delay Line.

In Fig. 7 we have an expanded view of the same waveforms. Fig. 7a shows the input pulses. Fig. 7b shows the output of a Signal Enhanced Delay Line. Fig. 7c shows the output of the same sections of delay line without the selective amplification feature between each section. The improvement in the output of the Signal Enhanced Delay Line shown in Fig. 7b over that shown in Fig. 7c is readily apparent.

We have shown an example of the improvement that can be obtained in the output from a delay line using the signal enhancing feature. It is only a demonstration of a principle, using one selection of delay sections and signal enhancement. The choice of length of delay of each section, and the bandpass of the individual delay sections, is one for the design engineer.



(c) OUTPUT (DISTRIBUTED CONSTANT DELAY LINE)

Fig. 7: Input & output waveforms (expanded).

One can use poorer delay lines and more signal enhancing sections, or use a better line with fewer enhancing sections. The number of taps desired will play an important part in the choice of the number of delay and enhancing sections.

While the original development used high impedance lines, there appears to be no good reason why low impedance lines cannot be used.

Applications

We believe the Signal Enhanced Delay Line can compete favorably where there is need for a long delay with relatively faithful reproduction of the pulse shape. One possible application would be in a demodulator for pulse code trains such as are used in the Air Traffic Control Beacon System.

By the use of a more faithfully reproduced delayed pulse, greater interleaving of replies will be possible with a resulting operational improvement. Another possible application is the use of the delay line in computer operation where the use of narrow pulses will permit an increase in the rapidity of calculation.

Acknowledgment

In conclusion I wish to acknowledge the help of the Packard Bell Electronics Corp. and its staff in supporting this development.

In particular I wish to thank the following individuals who have very materially aided this development:

Arthur M. Lueck, K. R. Jackson, E. J. Corey, F. Holmes. The continued help of Maj. Gen. E. C Langmead, USAF (Ret), in his encouragement of the project is gratefully acknowledged.

▸Closed circuit TV will soon take over a ticklish task at the GE-operated Hanford atomic plant. The camera, with remote pan and tilt controls, will patrol the rear face of an atomic reactor. It will examine pipes for leaks and observe fuel elements as they are removed during discharge operations. The monorail itself will move up or down so the camera can peer at any portion of the reactor face.

▸The rapid expansion of electron microscope use has prompted RCA Service Co. to start a three-week training course for small groups of electron microscope specialists. Each class will study construction, testing, and use of the microscopes.

Push-Button TV Tuning Introduced by GE

Ten of the new General Electric TV sets have an "Electronic Tuning" power tuning device. Located in the upper right corner of the front of the set is a round illuminated window, in which channel numbers appear. Around the window are 13 push-buttons, one for each VHF channel and one for UHF selection. Channels are selected by depressing the buttons; fine tuning is accomplished by turning the individual selector button. Remote tuning will be standard on eight of the sets, optional on the two remaining power tuning sets.

REMOTE CONTROL TRACTOR

Army developmental robot tractor can be operated up to 15 miles from radio control transmitter. Probable use will be in radioactivated zones and fire-fighting tasks.

Power Rectifiers

(*Continued from page 63*)

space requirements. The germanium unit provided 50 kw per cu. ft. of space at only 0.8 lb per cu. ft.

A 30,000 a. dc power supply for electromagnetic pumps handling liquid sodium for the atomic reactor program at Argonne National Laboratory is shown in Fig. 8. The output voltage for this application is low, being in the order of 1.5 v. This installation occupies only ⅓ the space of other power supplies that it supplements.

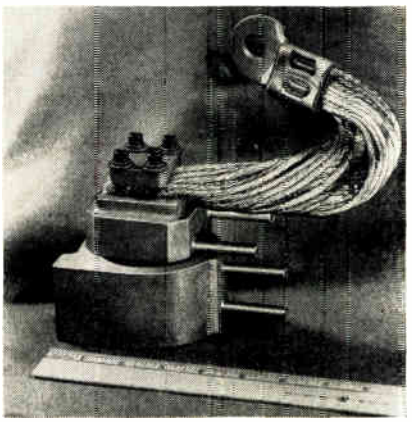
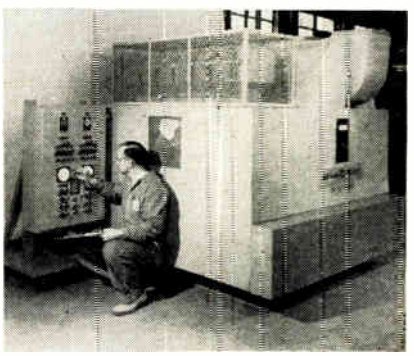


Fig. 7: Junction used in power supply (Fig. 6)

By proper circuit design, germanium power rectifier equipment may be produced to deliver up to 1-million amps or more at voltages up to 300 vdc. Germanium rectifiers offer many advantages, such as smaller size, high efficiency and lighter weight, among others. This relatively new rectifier has opened new fields for the dc power equipment manufacturer heretofore impossible with other types of metallic rectifiers.

Fig. 8: A 30,000 a. dc power supply at Argonne National Laboratory for electromagnetic pumps in the atomic reactor program.



Radiation Effects

(*Continued from page* 81)

Facility in Arco, Idaho. I would like at this time to acknowledge the cooperation of personnel of Phillips Petroleum Co., who were most helpful to us in carrying out these experiments.

The diodes were mounted on the simple handling fixture. Separate coaxial cable connections were made to each diode. Provision was made for cooling air to pass over the diodes to prevent any rise in temperature.

The experiment was performed by slowly lowering the test fixture into a caisson extending within the pool water into a space surrounded by 4 fuel rods. In this way, the radiation rate can be slowly increased and its effects upon the electrical properties of the diodes observed.

In most cases, the period of exposure was deliberately maintained sufficiently short to prevent any permanent effect upon the diodes. In other words, the effects studied were reversible and the diodes upon removal from the facility were unchanged, or nearly so.

Experimental Results

Fig. 3 shows a typical set of results from an experiment of the kind just described. This shows the reverse current vs. voltage characteristic of the diode; in the range of investigation, no perceptible effect upon forward current was observed.

The lower curve was made prior to irradiation. The next curve shows the effect of exposure to 10^5 r/hr.; the higher curve shows successive effects of increasing radiation rates. Note that the changes in back resistance due to these relatively low radiation rates are very large and can have extremely drastic effects upon operation of any circuit in which the high reverse resistance of the diode is important.

The cumulative effect of this radiation exposure is shown by the curve labeled "after." This indicates the reverse current voltage characteristic of the diode after removal from the test facil-

(*Continued on page* 170)

(*Continued from page* 169)

ity. This characteristic is but little affected by this brief exposure to radiation.

Experiments of this kind have been carried out upon almost 200 diodes, and preliminary conclusions can be drawn from the results. These are, first, that the effects due to exposure to radiation rates in the vicinity of 10^6 r/hr. are far from negligible and, indeed, many high impedance circuits may be instantly prevented from normal operation on exposure to such a rate. Variations from diode to diode are very large. This is to be expected since no attempt is made in manufacturing the diodes to control their radiation properties. This indicates that any attempt to engineer a circuit containing semiconductor diodes for radiation application can only be done on an extremely crude basis, since one must anticipate an extraordinarily large variation in diodes until such time as diodes can be made available which are manufactured to meet a radiation specification.

Diode Structure

The detailed mechanism of the radiation rate effects just described is being investigated. The complexity of the problem can be understood by considering the structure of the diode. This is shown in Fig. 4. Note the multiplicity of materials employed. All of these are affected in various ways by radiation.

Most of the effects will directly or indirectly show up as measurable changes in electrical properties. Ionization in the air surrounding the diode was shown to be extremely important. In fact, ionization currents 1 or 2 orders of magnitude larger than the current through the diode itself have been measured.

Secondary radiation produced in the glass envelope of the diode, or in the mounting structure, may be much more readily absorbed by the semiconductor material than the primary radiation. Hence, the effect of a given rate of incident radiation upon a practical diode device may be considerably more serious than that calculated by assuming the same radiation to be

incident upon an isolated piece of semiconductor material. This observation points the way to possible simple methods of improving the radiation performance of diodes by controlling the nature and location of materials of high atomic number in the device structure.

Note that the detailed mechanisms of permanent damage are probably quite different from

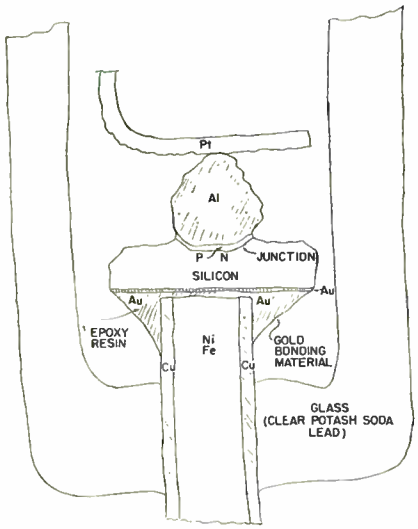


Fig. 4: The diode's many materials are affected in various ways by radiation.

those of rate effects. Correspondingly, different corrective measures may be taken to improve the dose-dependent performance of diodes.

Note also that in practice the rate-dependent malfunctions must be controlled before one can even become concerned about those due to integrated dose. Equipment failures due to component changes which depend upon rate will occur instantly upon exposure to a radiation field and, hence, one will never have any occasion to be concerned about its accumulating enough radiation dose permanently to damage the components.

Of course, after one has solved the problem of making the equipment operate in spite of rate-dependent difficulties, one must then solve the further problem of increasing the life of the component prior to its failure due to integrated dose.

Prospects

Our work to date indicates that both of these are quite manage-

(*Continued on page* 172)

(*Continued from page* 171)

able problems, but that a systematic effort directed specifically toward the objective of a detailed understanding of the mechanisms of radiation damage (both rate- and dose-dependent), followed by systematic changes in device design and in manufacturing methods, will be required to solve them.

A mere observation of the phenomenology of radiation effects can only produce interesting reports, but cannot make available to the system designer components from which an electronic system of predictable radiation performance can be assembled.

While our work to date has been concentrated mainly upon diodes, the methods and principles involved are equally applicable to transistors and, indeed, to any other electronic components. We feel that we are at the threshold of a new era in electronics and are looking forward to attacking the challenge offered by the nuclear radiation and high temperature environments which will be encountered in the advanced vehicles of the 1960 era.

Splicing Video Tape

(*Continued from page* 79)

and rejoin the ends in a durable splice. The general point at which the cut is to be made is easily determined by monitoring the tape for review and simply pressing the Videotape Recorder's "stop" button at the point in a scene where splicing is needed. The machine's start and stop characteristics allow only a predictable amount of tape in the order of a few inches to pass the head after the stop button is depressed. The tape may then simply be marked with a grease pencil for later selection of the exact frame.

In order to produce, or "develop" a visual image of the recorded magnetic impulses on the tape, a solution of some iron compound was developed which could be applied to the tape in a suspension which would allow the iron particles to precipitate onto the tape and trace out the magnetic impressions. It dries rapidly and the developed image wipes away easily after splicing.

(*Continued on page* 174)

Personals

Leland W. Brown has been appointed field engineering training manager for the ElectroData Div. of Burroughs Corp.

K. E. Weitzel has been appointed regional commercial engineer in Chicago for the General Electric Receiving Tube Dept.

Edward J. Thomas has been appointed Chief Industrial Engineer for the ESC Corp. His responsibilities will include supervision of systems, methods and operational analysis as related to the production of delay lines, pulse forming networks and related pulse equipment.

E. J. Thomas

L. S. Billman

L. S. Billman is now Chief Engineer of Cornell-Dubilier's Power Factor Capacitor Div. He has been with C-D for the past 10 years as design engineer and engineering assistant.

Walter B. Abel is now district manager of customer engineering for the Data Processing div. of the International Business Machine Corp.

Herbert Meyer former Sperry Gyroscope dept. head for ground armament systems is now chief engineer for Sperry Utah Engineering Lab.

Robert A. Wirkus has been appointed to the engineering design staff of Audio Development Co.

Kenneth A. Hall, Edwin A. Goldberg, La Rue A. Hoffman, and **Norris P. McKinney** have joined the Guided Missile Research Div., The Ramo-Wooldridge Corp., Los Angeles.

Herman P. Miller, senior project engineer at Federal Telecommunication Lab., Nutley has just received a tenure pin marking 30 years continuous service.

Miss Charline Loehrig has joined the Mechanical Engineering Department of Dalmo Victor Co. as a design engineer.

Wendell E. Phillips has been named Director of Engineering for Mack, Electronics Division, Inc.

(*Continued from page* 172)

Fig. 1 shows a photomicrograph of a developed Videotape, using carbonyl iron particles to trace the magnetic patterns. By suspending the particles in a highly volatile carrier liquid and applying the solution to the tape, this remarkably vivid image was developed and completely dried in less than three seconds. The particles hold lightly to the tape and can be wiped away instantly. The magnetic pattern in this photograph displays only synchronization pulses recorded in the absence of the video signal. The portion of tape shown is only the lower 7/10th of an inch, magnified 11½ times. The markings across the lower edge of the photo show a recorded 240-cycle wave which is used as a control track in the Videotape Recorder's system for maintaining intimate relationship between the rotating head assembly and the reel-to-reel speed of the tape. The small, square markings along the video tracks are horizontal synchronization pulses and the three vertical bars of six pulses each clearly display the beginning and ending of one complete frame.

Fig. 2 is another photomicrograph, showing the upper 7/10th of an inch of a Videotape Recording which contains the entire composite video signal. The wide stripe along the upper edge is the audio track, after passing the erase head. Although the vertical synchronization pulses are still visible every 16 sweeps among the video tracks, a new technique has been devised electronically which places a positive "blip" into the control track precisely beneath each of these sweeps which contains a synchronization pulse. Thus, the splice line will be readily indicated when only the lower edge of the tape is developed.

It is obvious that, once the exact frames of a Videotape Recording are perceptible, problems of editing are greatly narrowed. All that remains is the construction of a mechanical device which will facilitate a smooth, accurate cut in the 5-mil space next to a vertical synchronization pulse. Ampex

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is currently engineering such a device for use with production Videotape Recorders in next Fall's delivery schedule. It will be a simple mechanism which receives the developed tape, quickly locates the exact spot for cutting (probably with a carefully positioned magnifier), slices the tape and reaffixes the cut ends into a strong, permanent splice.

Vibration Testing of Relays

One of the questions currently facing the users and manufacturers of relays is whether complex waves have an application to the testing of relays for proof of their design. So far as can be determined at present, the extent of this application is relatively minor. On the other hand, in the use of the single-frequency sweep test, significant progress will be made if the frequencies of resonance or chattering are measured and published.

A relay mounted on a chassis will experience the same vibration excitation as the mounting points of the chassis in the range up to one-third or one-half of the first resonance frequency of the chassis. If the chassis is subject to a complex wave test specification, it may make some sense to apply this specification to the relay also, for this low frequency range.

On the other hand, in the frequency range in which the chassis resonates, the excitation of the relay differs markedly from that of the chassis mounting points and has a jagged spectrum even when that of the chassis excitation is smooth. It becomes difficult to devise a simple smooth specification for the relay that will guarantee proper operation on the chassis without rejecting designs that would work. The relay excitation in flight is seldom measured directly, and ordinarily too little is known of the chassis dynamics to permit computing the relay excitation from the chassis excitation. In the testing of relays for such a situation, the refinements of the complex wave shake provide little advantage and are outweighed by the complications of the apparatus required. It is better to depend primarily on a single frequency sweep like that of a standard military specification, preferably with some refinements of technique to be discussed later. The more severe the test the relay can be made to pass the better.

There are two effects, however, that might cause failure on the chassis but not show up at all in such a relay test. The first is a sensitivity to rotation produced, for example, by flexing of the chassis. A single frequency sweep test with shakers arranged to produce rotation rather than translation may be a worth while further precaution. The second effect is an intermodulation effect—a chattering produced when two frequencies are present simultaneously but not when the sum of the acclerations is applied at either frequency alone. When such an effect is likely, the complex wave shake may prove to be a convenient means of exploring it. If the frequencies of resonance of the relay are known, one or more sinusoids plus a single-frequency sweep may provide an adequate test. Otherwise, a random shake may be worth trying as a supplementary test for intermodulation.

Charles T. Morrow
The Ramo-Wooldridge Corp.
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All-Transistorized Flight Control System

The first commercial all-transistorized automatic flight control system is now in use on Trans World Airlines' new Lockheed 1649A "Jetstream Starliner Luxury Service" on the New York-Los Angeles and New York-London-Paris routes.

The PB-20B automatic flight control unit, developed by the Eclipse-Pioneer division of Bendix Aviation Corporation, was designed as an integral part of the 1649A Starliners.

Transistors and magnetic amplifiers have completely replaced vacuum tubes and the entire system is designed on a building-block or modular principle of construction. This is the first custom designed, all-transistorized system to be certificated by the CAA for commercial use.

This special test equipment — a high-power simulator — can operate at peak powers as high as 10 megawatts, using a single 500 kw magnetron as a power source. This equipment was jointly evolved by Bomac, Bendix Radio, and Rome Air Development Center.

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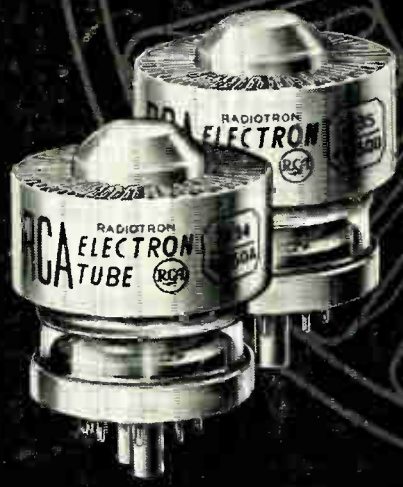
New RCA Beam Power Tubes With New High-Efficiency Radiator

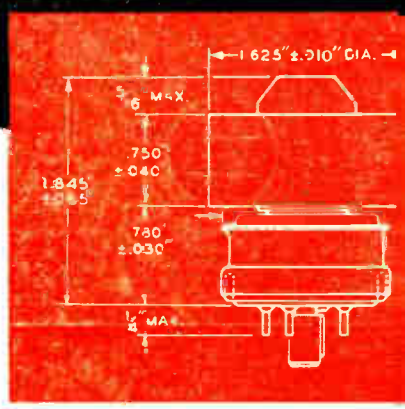
RCA-7034/4X150A

with 6V, 2.6A Heater

RCA-7035/4X150D

with 26.5V, 0.58A Heater





Higher Power Output...370 Watts up to 150 Mc

Higher Plate Dissipation...250 Watts up to 500 Mc

Unilaterally interchangeable with the 4X150A and 4X150D, these superior new RCA tubes feature a new specially designed, high-efficiency radiator which is hard soldered directly to the plate for better heat transfer. The 7034 and 7035 offer substantially higher power output capability at frequencies up to 150 Mc, and reliable operation with higher plate dissipation at frequencies up to 500 Mc.

Small and compact, the RCA-7034/4X150A and the RCA-7035/4X150D are useful as af power amplifiers and modulators, wide-band amplifiers in video applications, linear rf power amplifiers in single-sideband suppressed-carrier equipment, and class C amplifiers or oscillators.

Your RCA Field Representative at the RCA Office nearest you will be glad to give you sales information on these new types. For technical bulletin on RCA-7034/4X150A and RCA-7035/4X150D, write RCA Commercial Engineering, Section H50Q, Harrison, N. J.

TYPICAL CCS OPERATION
RF Power Amp. & Osc.—Class C Telegraphy

Up to 150 Mc.		
DC Plate Volts	1500	2000
DC Plate Ma.	250	250
Driving Power (watts)	1.5	2.5
Power Output (watts)	260	370
At 500 Mc.		
DC Plate Volts	600	1250
DC Plate Ma.	170	200
Driver Power Output (watts)	15	30
Useful Power Output (watts)	50	140

RCA Field Offices

East: HUmboldt 5-3900
744 Broad Street, Newark 2, N. J.

Midwest: WHitehall 4-2900—Suite 1181
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