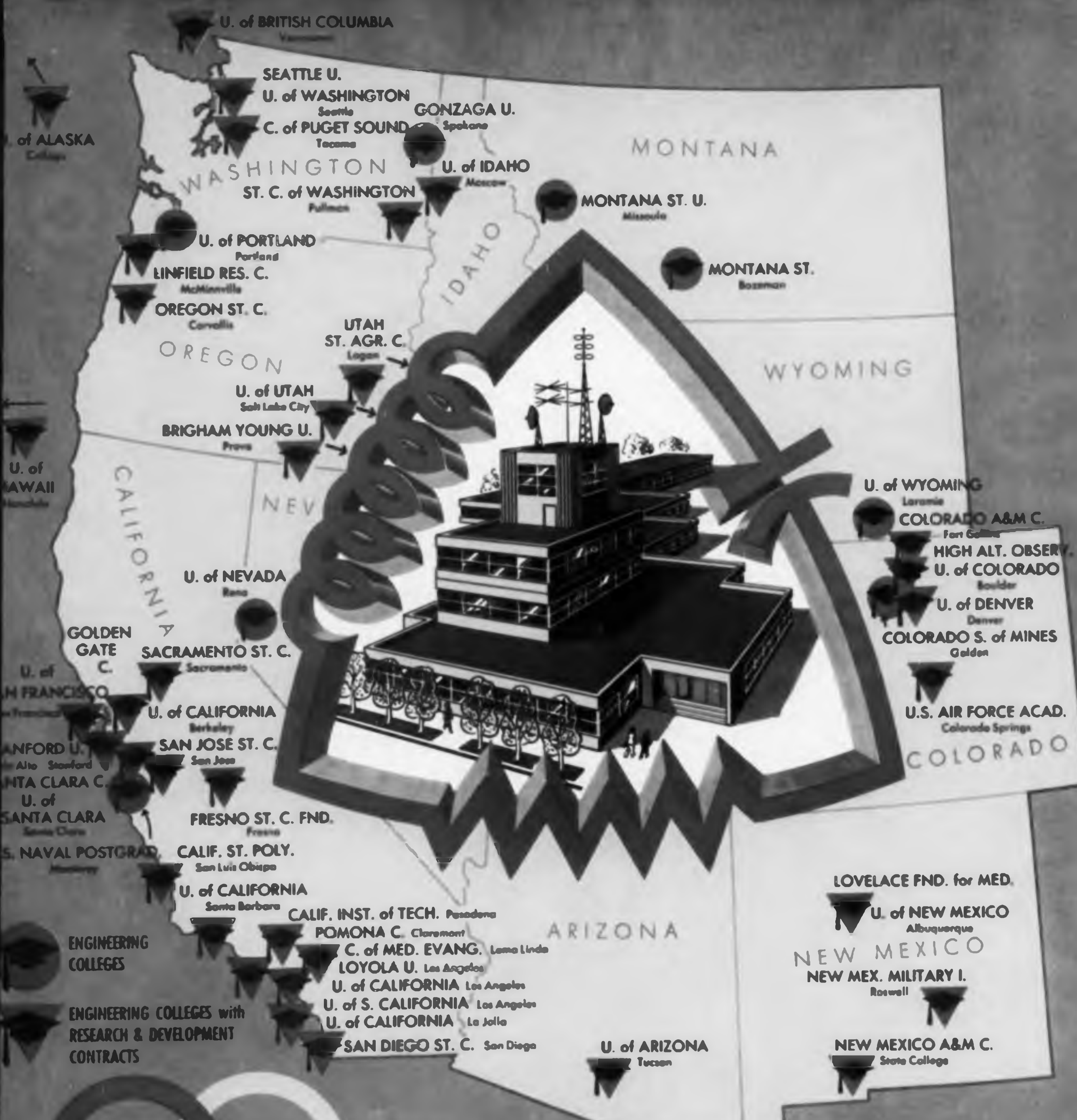
ELECTRONIC INDUSTRIES



WESCON 1958

The "Mesa" Transistor—See *page* 55

August • 1958

Manufacturing, Design & Operations Edition

A Chilton Publication

FREQUENCY STABILITY

WITH RMC DISCAPS

TYPE JF DISCAPS

Type JF DISCAPS are especially designed for applications requiring a ceramic capacitor with superior frequency stability. These DISCAPS extend the available capacity range of the EIA Z5F type capacitors between +10° and +85°C and meet Y5S specifications between −30° and +85°C. Now manufactured in capacities between 150 MMF and 10,000 MMF, Type JF DISCAPS exhibit a change of only ±7.5% between +10° and +85°C.

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

DISCAP CERAMIC CAPACITORS

RMC

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

Circle 1 on Inquiry Card, page 97

ELECTRONIC INDUSTRIES

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

PROJECT AMMO.

WHEN the U. S. Army unveils its missile and rocket arsenal, heretofore highly classified, and invites about 400 observers comprising U. S. and NATO military leaders, high-ranking governmental personnel, representatives of the firms producing these missiles and the press, it is an unusual occasion. But this actually happened. In the desert at White Sands Missile Range, N. M., June 30-July 1 there were nine spectacular firings and one of the editors of ELECTRONIC INDUSTRIES was there to observe, report and to bring you editorial comment.

During these briefings and demonstrations, referred to as PROJECT AMMO, the firms connected with each missile bore the major expense of entertaining and transporting the non-military visitors. These firms were: Firestone, Douglas, Western Electric, Gilfillan, Northrop, Martin, Curtiss-Wright, Raytheon, Chrysler, Sperry-Rand, RCA, Sikorsky, U. S. Steel and Thiokol. Presidents, or other representatives of these companies were on hand to take a bow and receive the well-deserved applause of the crowd during the briefing on their missile. Enthusiasm and applause mounted as missile after missile was successfully fired, bringing down target after target.

It was an unusual crowd that assembled, field glasses in hand, on the prepared stands that overlooked the firing pads or positions. Among the 160 military men were more generals than had ever been seen together before! Yet rank was forgotten. A 4-star general stopped to show a reporter from Birmingham how to adjust his field glasses. In preparing for lunch in the desert the generals lined up with the rest of us to fill, use, then empty and wash out their wash basins and later consume fried chicken from a box lunch. Everyone's thoughts and conversation had a single point — wonderment, wonderment concerning the smooth operation, the supersonic flight, the tremendous impact and destruction of the target by these new tools of war. It seemed they could not miss with the electronic brain telling the missile where to follow as the evasive target plane maneuvered. Warfare, it was clear, had taken on "a new look." Old-fashioned artillery was superseded. A quote from President Eisenhower: "Four battalions of CORPORAL missiles are the equivalent in fire power to all the artillery used in World War II on all fronts."

Before mentioning individual weapons, we should list some of the notables present: Secretary of the Army Brucker; Gen. Twining, Joint Chiefs of Staff; Gen. Taylor, Army Chief of Staff; Gen. Hasselman, NATO; Gen. Medaris, Army Ordnance Missile Command; Mr. Stans, Bureau of the Budget; Mr. Allen, Dir. of U.S. Information Agency; Mr. Harlow, adm. asst. to the President; Dr. Foote, Res. & Eng., Off. Sec't'y of Defense; Dr. Martin, Res. & Dev., Off. Sec't'y of Army; Mr. Hood, pres. U.S. Steel; Mr. Adams, pres. Raytheon; Mr. Wege, RCA; Mr. Miles, pres. Gilfillan; Mr. Smith, V.P. Western Electric, and Dr. Pickering, Jet Propulsion Lab. Caltech. Several of the officers mentioned made short talks. Dr. Pickering had the honor of being the only civilian technical speaker. He told about our satellite EXPLORER and predicted that JUPITER would be the first-stage booster for our moon rocket.

With missiles advancing daily into nearly everyone's life it is almost a "must" to learn their names and their uses. This information, for the Army missiles, follows in skeleton form: SURFACE-TO-SURFACE. HONEST JOHN, a supersonic, unguided artillery rocket, now with troops in Europe; LITTLE JOHN, baby brother to Honest John, transportable by helicopter; LACROSSE, accurate, guided missile, fired from truck-mounted launcher; DART, smallest missile, for guided anti-tank use; CORPORAL, ballistic missile fired from mobile launcher, range 75 miles, atomic warhead, now overseas. (The following Army missiles were not fired

(*Continued on page* 170)

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

CREIGHTON M. MARCOTT
Managing Editor

RICHARD G. STRANIX
JOHN E. HICKEY, Jr.
Assistant Editors

ORESTES H. CALDWELL
Editorial Consultant

DR. ALBERT F. MURRAY
Contributing Editor

ROLAND C. DAVIES
Washington News

MARIE T. McBRIDE
Directory Editor

ELMER KETTERER
Art Editor

CHARLES F. DREYER
Cover Designer

EDITORIAL CORRESPONDENTS

Washington—1093 National Press Bldg.
GEORGE BAKER
RAY M. STROUPE
N. R. REGEIMBAL

San Francisco—1355 Market Street
EUGENE R. TARNOWSKY

BUSINESS DEPARTMENT

WALTER M. DeCEW
Promotion Manager

ELMER DALTON
Circulation Manager

GORDON HERNDON
Production Manager

REGIONAL SALES MANAGERS

Philadelphia Office—
56th & Chestnut Sts.
SH 8-2000
JOSEPH DRUCKER

New York Office—100 East 42nd St.
Phone OXford 7-3400
GERALD B. PELISSIER
Metropolitan N. Y.
MENARD DOSWELL III
New England

Chicago Office—360 N. Michigan Ave.
RAndolph 6-2166
GEORGE H. FELT

Cleveland Office—930 Keith Bldg.
SUperior 1-2860
SHELBY A. McMILLION

Los Angeles—198 S. Alvarado St.
DUnkirk 7-4337
B. WESLEY OLSON

San Francisco Office—1355 Market St.
UNderhill 1-9737
DON MAY

Atlanta 9, Ga.—1371 Peachtree St. NE
Trinity 6-4110
JOHN W. SANGSTON

Dallas—Meadows Bldg., Expressway at Milton
EMerson 8-4751
HAROLD E. MOTT

JOS. S. HILDRETH, Board Chairman
G. C. BUZBY, President

Vice Presidents: P. M. Fahrendorf, Leonard V. Rowlands, George T. Hook, Robert E. McKenna; Treasurer, William H. Vallar; Secretary, John Blair Moffett; Directors: Maurice E. Cox, Frank P. Tighe, Everit B. Terhune, Jr., Russell W. Case, Jr., John C. Hildreth, Jr. Washington Member of the Editorial Board, Paul Wooton.

Comptroller, Stanley Appleby.

ELECTRONICS INDUSTRIES, July, 1958. Vol. 17, No. 7. A monthly publication of Chilton Company. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila., Pa. Accepted as controlled circulation publication at Phila., Pa. 75¢ a copy; Directory issue (June), $3.00 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $5.00; 2 yrs. $8.00. Canada 1 year, $7.00; 2 yrs. $11.00. All other countries 1 yr. $10.00, 2 yrs. $30.00.

ELECTRONIC INDUSTRIES

Vol. 17, No. 8 **August, 1958**

FRONT COVER: Much credit for the astonishing growth of the West Coast electronic industry goes to the close cooperation between electronic manufacturers and the local engineering colleges and universities. Shown are all the institutions offering electrical engineering degrees, and the high percentage handling research and development contracts. (At press time we learned of another, Arizona State College at Tempe, Ariz., which now also offers a B.S. degree in electrical engineering)

MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

Highlights

Of This Issue

The "Mesa" Transistor! page 55

Newest development in the semiconductor art is a micro-miniature construction that permits higher frequency operation and higher power handling capabilities. The first commercial models are now being introduced, in a low level UHF amplifier and an ultra high-speed switching unit capable of switching speeds to 10 μ.sec.

Cooling Power Transistors page 66

The role of temperature in the operating life of transistors and the need for avoiding "thermal runaway" has focussed attention on the need for proper heat dissipation of transistors. An exhaustive series of tests has turned up one "best" design of heat dissipator that outperforms all others.

Systems Development Engineering page 61

The "system concept," and systems engineering, has seen wide application to the aircraft industry and military weapons planning. Systems development engineering is now being extended to many other fields as well, particularly in the line of digitally controlled milling machines, and automated petrochemical processing plants.

Oscilloscope Camera-Positioning page 70

A system has been devised for taking multiple sweep exposures on each print. The technique involves a Polaroid Land camera and the DuMont camera mount. The system is made an integral part of the equipment and uses only assembly holes existing in the camera and mount.

Wide-Band Microwave Tubes page 72

New methods of beam focussing and new circuits for high power wide-band amplifiers are among the most active areas of microwave tube research and development. They are discussed here with data on the limitations on power output, tuning range, bandwidth and noise figure.

1958 Directory of West Coast Electronic Manufacturers page 101

A comprehensive listing of the approximately 600 companies comprising the West Coast electronic industry. Territory includes Arizona, California, Colorado, Idaho, Montana, Oregon, New Mexico, Utah, Washington, Wyoming and Nevada. Information includes phone number, name of the individual in charge of sales, the firm's principal proprietary items and avionic items; also whether the firm is a West Coast subsidiary of mid-western or eastern firms and whether the firm is a WESCON exhibitor.

COMING NEXT MONTH—"HOW TO SPECIFY FILTERS!"

Filter design is a highly specialized field and with its own nomenclature and distinctive test methods. As a guide to engineers this article will provide an a-to-z treatment on the subject, explaining the calculation of insertion loss, how to measure insertion loss, or voltage transfer constant, the difference between insertion loss and attenuation, the significance of impedance and phase-shift characteristics. Sample orders of filters will be included, spelling out the significant characteristics. DON'T MISS IT!

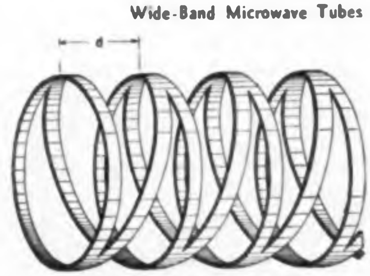
The "Mesa" transistor!

Cooling Power Transistors

Systems Development Engineering

Oscilloscope Camera Positioning

Wide-Band Microwave Tubes



RING-STRAPPED BIFILAR HELIX

RADARSCOPE

POLARIS CHECK

Telemetering unit of Polaris test missile is checked out as Lockheed's S. W. Burris and Navy Capt. W. A. Hasler look on. After complete system checkout missile will be shipped to Lockheed's Polaris test facility, Cape Canaveral 1, Florida.

NEW MIDGET MICROPHONE, developed by RCA for TV and movie sound pickups, is a new type, called electrostatic uniangular. It measures 1¼ in. in diameter and 3 in. long, and is extremely lightweight—3 oz. compared to 4½ lbs. for the old pickup. It is also claimed to be more sensitive.

MISSILE PROGRAM will get a healthy shot in the arm from a new series of government moves to cut the red tape standing between industry and government procurement offices. In one clean cut, Defense Chief Neil McElroy killed off 133 standing committees, and asked Congress to centralize the development of new weapons under a proposed Director of Defense Research and Engineering. As a result of these and other moves, the Air Force hopes to cut by at least 50% the number of reports and drawings companies must file to keep military men informed of progress. One outstanding result, government officials claim, will be a speed-up in the construction of the Air Force's 2000 mile-an-hour B-70 "chemical" bomber now under development by North American Aviation Inc. It is expected to take to the air by 1962, some 18 months earlier than originally scheduled. Other beneficiaries are expected to include the Convair B-58 medium bomber and North American's new F-108 interceptor.

GOVERNMENT'S R & D SPENDING totaled an estimated $2,782,000,000 during the fiscal year ending June 30, 1958. According to the National Science Foundation the spending of each R & D dollar broke down as follows: 67 cents for the physical sciences—mathematical and engineering sciences; physics and chemistry; 29 cents for the life sciences—biology, medicine and agriculture;—and 4 cents for social sciences—cultural anthropology, economics, history, sociology and political sciences.

THE EIA'S Tube and Semiconductor Division has compiled a comprehensive report on the increased importation of foreign tubes, calling attention to the threat of extensive import of Japanese transistors at an early date.

IN FIVE YEARS, according to authorities in the metal working field, between 40 and 50% of all new machine tools sold will be equipped with numerical control. There are more than 30 different numerical control systems, both American and Foreign, already announced. While the raps have been taken off only the larger systems so far, the smaller discreet positioning type tools promise the widest application. One of the beneficiaries of the trend to numerically controlled tools will be the computer industry; as the use of NCMT increased there will be increased demand for computers and computer time.

HANDS-OFF HELICOPTER

Vertol 44 helicopter is precisely stabilized in hands-off flight by Sperry Gyroscope Co.'s new automatic flight control system. The 40-lb. system provides great flight precision needed for anti-submarine search missions, and assures passenger comfort and safety.

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

EXPERIMENTAL AUTOMATIC AIR-GROUND-AIR COMMUNICATIONS SYSTEM (AGACS) is being developed by RCA for the Airways Modernization Board. The objective of the automatic communications project is a system that reduces human handling of routine communications, saves time and radio spectrum, and gives greater reliability and coordination between the air environment and the ground base air traffic control system. The AMB will experiment to determine how, in an air traffic system using automatic communications, AGACS equipped aircraft can be electronically queried for information about their flights. The program calls for answers that are automatic, without intervention of the pilot for routine questions. This system is expected to be available about July 1, 1959.

MORE FUNDS must be made available to the local service airlines to enable them to introduce modern aircraft, according to Stanley Gewirtz, Vice President of the Air Transport Association of America. The negative earning record of the airlines is bringing them a cool reception at the banks. The urgent need is for operating economies and traffic promotion that the modern aircraft would produce.

COMMUNICATIONS-WISE the Russians are running far behind the U. S. New statistics from the Reader's Digest point out that Russia has approximately 2 million telephones against 64 million in the United States; eight million radio receivers, plus 23 million wired speakers that insure against listening to unauthorized programs, compared with 140 million radios in the U. S.; and 2 million TV sets compared with 47 million in this country.

SIMULTANEOUS OPERATION OF TWO TV STATIONS from a common antenna was successfully conducted by RCA at Quebec City. Using a "quadruplexer" 4 transmitters, 2 aural and 2 visual, were fed to an antenna feed system with no interaction among transmitters. Details of the installation were delivered to the summer general meeting of the AIEE.

NEW TELEPHONE SERVICE—citywide personal paging by radio—has been working so well in Bethlehem and Allentown, Pa., for the past year, that it is being expanded in scope. In operation it runs this way: If someone wants a lawyer or doctor who subscribes to the special service, they call his office, which in turn calls a certain number in the telephone company and the operator sets 4 dials on a memory bank. The memorized code is scanned electrically and the code is broadcast. It activates a receiver in the pocket of the doctor or lawyer if he is within range of the transmitter. The code causes a whistle only in his receiver. The whistle is a signal to call his office by telephone. The system has a capacity of 3200 receivers.

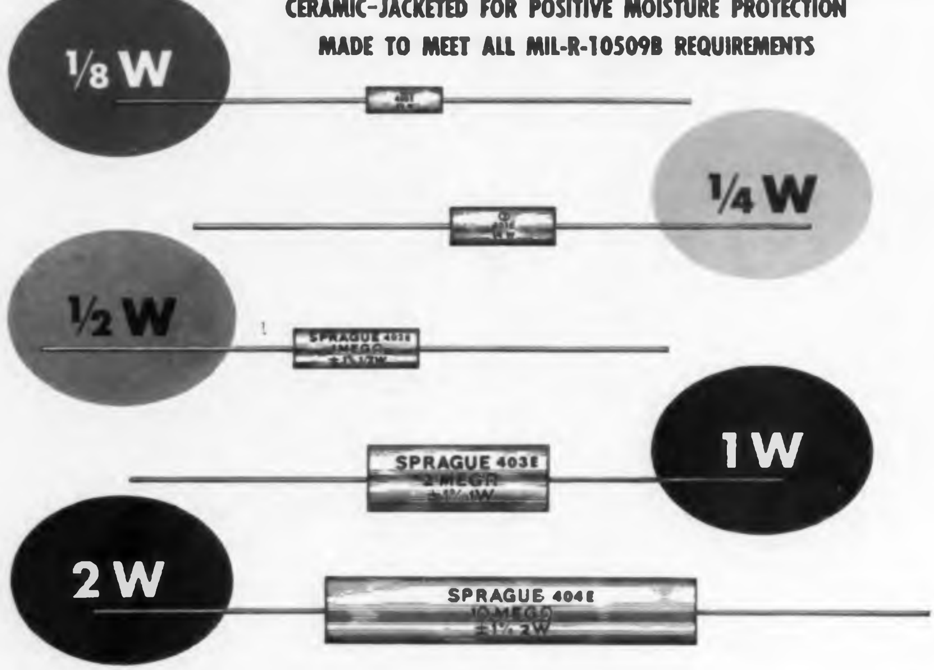
THE FCC'S ACTION in creating a manufacturers radio service which provides protective frequencies to use by industries in material handling, supervisory control, security and fire prevention, can be expected to greatly increase the equipment used by non-broadcast field. The new service will allow the manufacturers to use 60 watts of power. It wipes out antennas restrictions, and allows companies to use radio in their vehicles that travel from plant to plant in areas where materials handling is interwoven. Then new service is being set up from frequencies made available by the commission's split channel program.

TELECOMMUNICATIONS NETWORK extending from the United States through Mexico in the countries of Central America has been recommended by a group of U. S. Senators as a first step in bolstering the relations with our Southern neighbors. None of the presently existing h-f radio circuits are capable of carrying radio programs service or TV. Wideband microwave circuits are recommended which would carry telephone, telegraph, facsimile, telemetering, computer data, as well as radio and TV programs.

MAGNETIC BEADS FOR COMPUTER

F. G. Kimball prepares a stack of trays containing ferrite cores for baking in an electric furnace at RCA plant, Needham Heights, Mass. Cores are subjected to 1,100 to 1,350°C., then strung on fine wires to form a computer "memory" unit.

CERAMIC-JACKETED FOR POSITIVE MOISTURE PROTECTION
MADE TO MEET ALL MIL-R-10509B REQUIREMENTS



FILMISTOR☆

CARBON FILM RESISTORS IN RATINGS FROM 1/8 TO 2 WATTS PROVIDE THE STABILITY YOU WANT UNDER THE TOUGHEST LOAD AND HUMIDITY CONDITIONS

WRITE FOR BULLETIN NO. 7010A • SPRAGUE ELECTRIC COMPANY
233 MARSHALL STREET • NORTH ADAMS, MASSACHUSETTS

SPRAGUE
THE MARK OF RELIABILITY

☆ TRADEMARK REG.

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

As We Go To Press...

SOLAR-POWERED TOY

One of the features of Alcoa's "Forecast" program, showing the future uses of aluminum, is this imaginative display of motion and sound, powered by solar cells supplied by International Rectifier Corp.

Market Analysis Key to Missile Business

To get missile business long-range rather than just as a depression filler, a company must be prepared to spend time on market analysis; retain its sales engineers; and get men on the road to learn this new industry.

This was the advice of procurement and sales chiefs from major missile-making concerns in the Connecticut Missile Sales Conference, attended by 250 company representatives, largely from New England. The forum was sponsored by the Hartford Chamber in cooperation with the Association of Missile and Rocket Industries.

AMRI is concentrating on market research and information for its member companies, according to Kendall K. Hoyt, executive director, without duplicating the work of any other association or of the trade press.

Color Sets Featured In Packard-Bell Line

Packard-Bell's new 1959 line of television receivers includes 3 color models.

Packard-Bell thus becomes one of the few manufacturers in the color market. Westinghouse has also announced it is also making a bid for a share of the color business. For the past few years RCA has been virtually alone in the color field.

The Packard-Bell line also includes 6 radio-phono combinations, a hi-fi phono, a TV-hi-fi stereo combination. Five of the 14 new TV models are also equipped for stereo.

Pre-Recorded Tapes to Compete with Discs

Technical developments within the next two years may bring the cost of pre-recorded tapes down to where they will be competitive with both monaural and stereo records, according to Victor Machin, vice pres. in charge of sales for Shure Brothers, Inc.

Pre-recorded tapes are now more costly to manufacture than records, which can be mass produced by a pressing process.

Tapes are individually reproduced by passing over a recording head.

The solution to making tape prices competitive with records is in a "packing factor," according to Machin.

He revealed that Shure engineers have been working for some time on two technical advances, each of which will double the present "packing factor."

Originally, Machin explained, all tape recorders were "full-track"; the full quarter-inch width of the tape was used for a recording. Later, it became possible to utilize "half-track" recording and playback heads.

In standard stereophonic playback, where two channels are required, the tape can be played in only one direction.

However, the four-channel system, developed by Shure, makes it possible to record two complete stereo performances on a standard reel of quarter inch tape. Or, if desired, it can be used to play four monaural channels on a single tape.

GUIDED TOUR

Dr. A. B. DuMont learns of working of the launching control room at Pt. Mugu, Calif., from Lt. Cmdr. J. B. Pardue during recent visit. Looking on are DuMont's M. H. Kline and Lt. Cmdr. J. F. Hewson, of the USNAMTC staff.

3 STARS FOR CSigO

First Chief Signal Officer to be elevated to Lieutenant General P. D. O'Connel (r) receives his new star from Lt. Gen. C. B. Magruder.

New Flight Control Aid for Air Traffic

A new airborne system of air navigation has been designed to simplify the problem of air traffic control and reduce the hazard of mid-air collisions.

Called the High Density Air Navigation (HIDAN) method of flight control, it includes fully-automatic, self-contained navigational and control equipment to be carried in the airplane itself.

The HIDAN equipment has two main components.

One is an airborne, automatic navigator called RADAN, an 89-pound device which supplies continous ground speed and drift angle. Such equipment has been produced since 1948 by General Precision Laboratory for the Air Force. In the more than 50,000 hours of flying time during which they have been used, the ground speed element has been accurate to within 0.3% and the drift angle measurement has been accurate to within .1°.

The other component of the system instantly indicates the position of the aircraft and, when programmed for a flight, continuously calculates the divergence of the actual position of the aircraft from its planned position. This divergence is shown instantaneously on an indicator in the cockpit.

If the pilot fails to say on flight program or gets off his course, his HIDAN instruments immediately show what he must do to get back on plan.

ELECTRONIC SHORTS

▶ An additional 19 airport surveillance radar units, costing almost $6-million have been purchased by the CAA from Texas Instruments, Inc. The contract brings to 35 the number of radar units on order from the Texas firm, 16 having been purchased late in 1957. The ASR-5 equipment will be identical to the ASR-4 now on order and will have altitude coverage up to 27,000 ft. This is an improvement of 4,000 ft. in altitude coverage over the ASR-3 equipment now in use at major airports. A $2.5 million program to improve the performance of 50 CAA operated airport surveillance radar (ASR) units, has been inaugurated. CAA will be provided with 50 kits to modernize earlier manufactured ASR-2 and ASR-3 radar equipment which has been in operation for some time. Improvement kits will provide a better moving target indication (MTI) which will eliminate from the radar scope all but moving targets. The first equipment will be installed by TI, the remainder by CAA radar engineers and technicians.

▶ For the installation and operation of an automatic data processing system at Fort Huachuca, Ariz., the Army Electronic Proving Ground, the Ramo-Wooldridge Corp. of Los Angeles has been awarded a $13.5-million contract. The firm will provide technical assistance and conduct field testing of automatic data processing systems for operational suitability and aceptance.

▶ More than 400 scientists from all parts of the country are expected to attend the conference on Electronic Standards and Measurements at the Boulder Laboratory of the National Bureau of Standards this month. Thirty-seven papers presented by leading men in this field will deal with new principles of measurement in the entire spectrum of radio frequencies, the development of frequency and time interval standards, the relationship of standards to physical constants, and the most effective methods of organizing a standards laboratory.

▶ Forty-nine U. S. industrial companies plus the U. S. Atomic Energy Commission will participate in the commercial exhibition to be held September in Geneva, Switzerland, in conjunction with the second United Nations International Atoms for Peace Conference. The U. S. portion of the exhibit will occupy approximately 32,000 sq. ft. in the recently enlarged Palais des Expositions in downtown Geneva. Comparable space will be occupied by the United Kingdom and France; smaller exhibits will be presented by 9 other countries active in atomic energy development and utilization.

▶ The Army Research Office has been moved from Ft. Belvoir, Virginia to Arlington Hall Station, Arlington, Va., to facilitate closer contact with the Office of the Chief of Research and Development. The Army Research Office, established in March, guides the efforts of the Army's Technical Services, which continue to direct actual research projects in their respective fields.

▶ A contract estimated at over $400,000 for maintenance, fueling, inspection, servicing and repair of aircraft at the National Facilities Experimental Center of the Airways Modernization Board at Atlantic City, N. J. has been awarded to Lockheed Aircraft Service International, Inc., Jamaica, N. Y.

▶ A 50% immediate price cut on preproduction samples of silicon-controlled rectifiers has been announced by General Electric Co.'s semiconductor product department. The company said increasing output from its engineering development pilot line makes the price slash possible.

▶ Using a single side band communication system, recently approved for the Strategic Air Command, a communications officer cruising above the North Pole chatted with Navy signal forces at the South Pole's Operation Deep Freeze. The system virtually eliminates static and other interference and will reach half-way around the world.

▶ Citing unofficial reports that a number of Vanguard satellites are "missing," Sen. Olin D. Johnson (D., S. C.) has asked the Navy Research Laboratory for a full inventory of Operation Vanguard. In a letter to Capt. Peter Horn, Laboratory Director, the Senator asked whether contractors were penalized for imperfections in delivered rockets used in the Vanguard operation.

As We Go To Press . . .

EIA Reorganizes Reliability Group

Associate Director of the EIA Engineering Department, Virgil M. Graham has announced the reorganization of the Reliability Committee (EAR) to provide a more dynamic coverage of the field of reliability in keeping with fast-moving and fluid problems of modern electronic weaponry and allied fields.

The Committee becomes the Military Electronic Applications Committee (M-7). L. M. Clement, of Avco Manufacturing Co., will continue as chairman.

In addition to the redesignation, M-7 subcommittees have been established and their new chairmen announced by Graham as follows:

"Reliability" (M-7.1) — L. M. Clement.

"Maintainability" (M-7.2)—Maj. Gen. F. L. Ankenbrandt, of RCA.

"Value Engineering" (M-7.3)—Rear Admiral R. S. Mandelkorn (USN-ret.), of Lansdale Tube.

A further breakdown of the Reliability Subcommittee (M-7.1) into a sub-sub committee (7.1.1) on Standards and Definitions, with C. M. Ryerson, of RCA, as chairman, and Reliability Education, with Craig Walsh, of McGraw-Hill, as chairman, completes the reorganization.

NEW CORES

Rigid structure of the cap of these new "Polly Cap" tape wound bobbin cores by Magnetics Inc. will not distort with temp. changes, allows easy handling during assembly.

More News on Page 14

new performance levels set by Hughes precision crystal filters

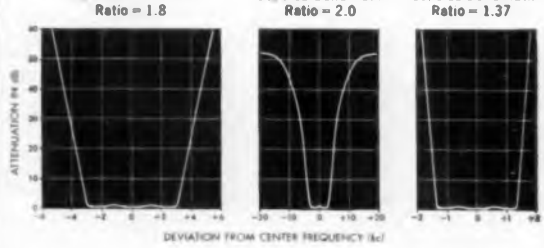
Hughes Products now offers high performance crystal filters previously available only for special military developmental contracts and Hughes-built systems. Utilizing unique design and advanced manufacturing techniques, these Hughes crystal filters provide a degree of performance previously unattainable.

With center frequencies of 30 kc to 30 mc and fractional bandwidths of 0.01% to 6%, these crystal filters have seven distinct advantages:

1. High frequency filtering
2. High selectivity
3. Low passband ripple
4. Low insertion loss
5. Small size and weight
6. Excellent temperature stability
7. Excellent shock and vibration stability

SPECIFIC PERFORMANCE CHARACTERISTICS FOR TYPICAL FILTERS

Filter No. 1	Filter No. 2	Filter No. 3
60/6 db Bandwidth Ratio = 1.8	50/6 db Bandwidth Ratio = 2.0	60/6 db Bandwidth Ratio = 1.37



	No. 1	No. 2	No. 3
Center Frequency	1.75 mc	10 mc	1.75 mc
6 db Bandwidth	6 kc	70 kc	2.7 kc
Maximum Insertion Loss	6 db	< 2 db	6 db
Maximum Passband Ripple	± 1 db	< 0.25 db	± 1 db
Stopband Attenuation	> 60 db	> 50 db	> 60 db

For further information please write HUGHES PRODUCTS, Crystal Filters, *International Airport Station, Los Angeles 45, Calif.*

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

WESCON EXHIBIT booths 1401-2

Circle 10 on Inquiry Card, page 97

The Hughes Memo-scope® oscilloscope, just over a year old, already has gained wide acceptance throughout the industry. Over 400 leading firms have purchased this "transient recorder with a memory." Here are just a few of them . . .

accep

BOEING

SHELL

CONOCO

MARTIN
DENVER

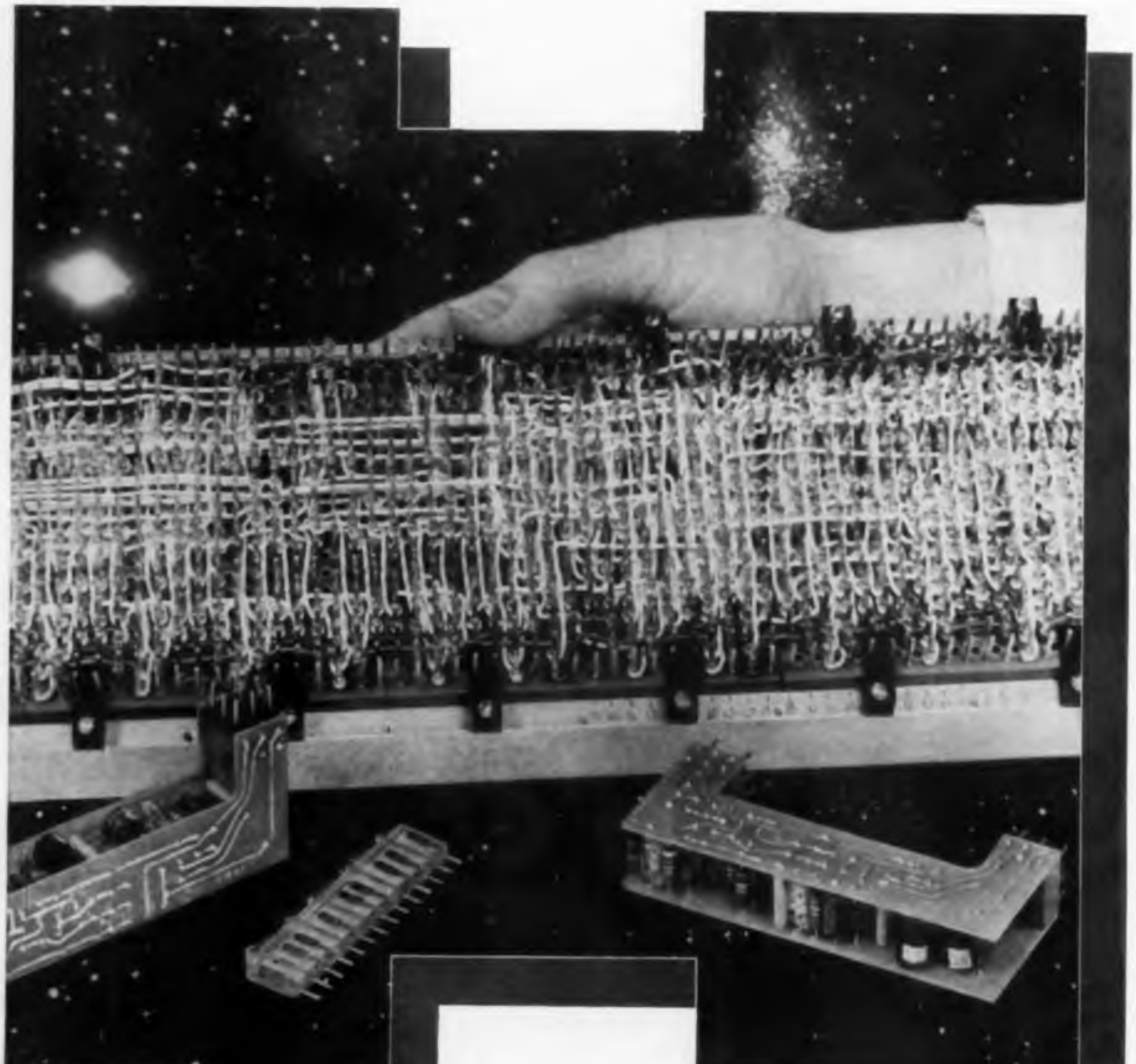
FORD INSTRUMENT CO.

NORTHROP AIRCRAFT, INC.

WESCON EXHIBIT of the Memo-scope oscilloscope at booths 1401 and 1402.

Circle 11 on Inquiry Card, page 97

LIFELINE FOR



THE LEAP INTO OUTER SPACE

Our only link with outer space is the advanced Communications System. Our progress in space technology has become dependent on solving the vast network of new problems which the Space Age has imposed on the field of Communications.

To meet these problems the Hughes Communications Systems Laboratories is drawing upon its continuing efforts in the field of Global Airborne Communications. Such newly devised Hughes hardware, at left, for example, illustrates the use of high-reliability wire wrapping to replace soldered connections and the use of inexpensive miniaturized "cordwood" circuit modules to make possible high component density.

New methods, such as Hughes-pioneered digital techniques, are being formulated to achieve the long-range goal of developing communications systems capable of deflecting their signals from meteors, artificial satellites, and even the moon. Still other methods are being developed for systems which will transmit intelligence through media impervious to radio frequencies by modulating frequencies far up the electromagnetic spectrum.

Advanced thinking, diversification, and expansion are also taking place in other areas of the Research & Development Laboratories, of which Communications is a part . . . in Hughes Products, the commercial activity of Hughes . . . in Hughes Fullerton, where three-dimensional radar systems are under development . . . in Hughes El Segundo, the manufacturing facility for complex electronics systems . . . and in Hughes Tucson, where guided missiles are manufactured.

Never before have the opportunities at Hughes been more promising!

New commercial and military contracts have created an immediate need for engineers in the following areas:

Nuclear Electronics	Field Engineering
Microwaves	Vacuum Tubes
Communications	Crystal Filters
Reliability	Systems Analysis
Circuit Design	Computer Engineering

Write in confidence to Mr. Phil N. Scheid,
Hughes General Offices, Bldg. 6-V, Culver City, California.

Electromagnetic positioning of cutting edges is directed by this etched metal bar, a significant innovation which aided in the Hughes Products development of the first all-electronically controlled machine tool line.

Data processors under development at Hughes Fullerton will monitor the action of hundreds of aircraft and store the changing tactical situation in electronic memories for high-speed assignment of defense weapons. ►

the West's leader in advanced electronics

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton and Los Angeles, California
Tucson, Arizona

Wescon show. Visit our booths 1401, 1402, 1812, and 1813 or the Hughes recruiting suites at the Chapman Park Hotel.

Coming Events

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

Aug. 6-8: Special Technical Conference on Non-Linear Magnetics & Magnetic Amplifiers, AIEE & IRE; Hotel Statler, Los Angeles, Calif.

Aug. 13-15: Conference on Electronic Standards of Measurements, NBS, IRE & AIEE, NBS Boulder Labs; Boulder, Colo.

Aug. 15-17: ARRL National Convention, Washington, D. C.

Aug. 19-22: Wescon, IRE & WCEMA, Ambassador Hotel, Pan Pacific Auditorium; Los Angeles, Calif.

Aug. 19-22: Pacific Meeting, American Institute of Electrical Engrs.; Sacramento, Calif.

Aug. 22-24: Annual Convention & Seminar, Nat'l Alliance of TV & Electronics Service Assn.; Congress Hotel, Chicago, Ill.

Aug. 25-28: Rocky Mountain Electronic Parts Reps Conf., The Representatives; Colorado Hotel, Glenwood Springs, Colo.

Sept. 3-10: 2nd International Congress on Cybernetics, International Assoc. for Cybernetics; Namur, Belgium.

Sept. 8-10: 1st National Conf. & Exhibit on Application of Electrical Insulation, AIEE, Hotel Pick-Carter, Cleveland, O.

Sept, 8-13: First International Congress, Int'l Congress of the Aeronautical Sciences; Palace Hotel, Madrid, Spain.

Sept. 12-13: Communications Conf., IRE; Sheraton Montrose Hotel, Cedar Rapids, Iowa.

Sept. 12-14; 7th Annual Chicago High Fi Show; Palmer House, Chicago.

Sept. 15-17: International Power Industry Computer Application Conf., AIEE; King Edward Hotel, Toronto, Canada.

Sept. 15-19: 13th Annual Instrument & Automation Conference & Exhibit, Instrument Society of America; Convention Hall, Phila., Pa.

Sept. 16-18: Fall Quarterly Conference. EIA; St. Francis Hotel, San Francisco, Calif.

Sept. 22-24: Symposium & Exhibit on Telemetry & Remote Control, IRE; American Hotel, & Patrick AFB, Miami Beach, Fla.

Sept. 24-25: Industrial Electronic Conference, IRE & AIEE; Rackham Memorial Bldg., Detroit, Mich.

Sept. 28-Oct. 2: Fall Meeting, Electrochemical Society; Chateau Laurier, Ottawa, Canada.

Sept. 30-Oct. 4: High Fidelity Show, Institute of High Fidelity Mfrs.; New York, N. Y.

Oct.: Western Regional Conference, Nat'l Community TV Ass'n; Portland, Ore.

Oct. 1-2: 4th Conf. on Radio Interference Reduction, Armour Research Foundation; Museum of Science & Industry, Chicago, Ill.

Oct. 1-2: Engineering Writing & Speech Symp., IRE; New York City.

Oct. 2: Section Meetings Calender-Wichita Sect., Institute of Aeronautical Sciences; Innes-Colonial, Room 121 S. Broadway, Wichita, Kans.

Oct. 2: Section Meetings Calendar— Phila. Sect., Institute of Aeronautical Sciences; Penn-Sherwood Hotel, Phila., Pa.

Oct. 6-7: Symp. on Extended Range & Space Communications, IRE & G. Washington Univ.; Lisner, Washington, D. C.

Oct. 8-10: 14th Annual Mtg., Canadian Electrical Manufacturers Assoc.; Sheraton Broch Hotel, Niagara Falls, Canada.

Oct. 8-10: Canadian IRE Conv. & Exposition; Automotive Bldg., National Exhibition Grounds, Toronto.

Oct. 13-15: National Electronics Conf., IRE, AIEE, & EIA; Hotel Sherman, Chicago, Ill.

Oct. 13-15: International Systems Mtg.: Penn-Sheraton Hotel, Philadelphia, Pa.

Oct. 19-24: 84th SMPTE Conv.; Sheraton-Cadillac Hotel, Detroit, Mich.

Oct. 20-22: URSI Fall Mtg., IRE; Penna. State Univ., University Park, Pa.

Oct. 27-28-29: Radio Fall Meeting. EIA; Sheraton Hotel, Rochester, N. Y.

Dec. 3-5: Eastern Joint Computer Conference, IRE, AIEE & ACM; Bellevue-Stratford Hotel, Phila., Pa.

Abreviations:

ACM: Association for Computing Machinery
AIEE: American Inst. of Electrical Engrs.
ARRL: American Radio Relay League
EIA: Electronic Industries Assoc.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
WCEMA: West Coast Electronic Manufacturers Assoc.

As We Go To Press . . .

Space Ship Effect on Humans Studied

The Air Force's Air Research and Development Command has been directed to proceed with the letting of two contracts for study of the ecological aspects of housing human beings in a capsule for long periods of time in outer space.

This study will be an extension and reorientation of previous Air Force studies concerned with manned capsule ejection from supersonic high altitude aircraft. The new contracts which will total about $400,000, represent work necessary toward an ultimate capability to launch a man into space.

Wanted . . . Technical Papers

The 1959 Electronics Components Conference, sponsored by the AIEE, IRE, EIA, and WCEMA, is soliciting papers on the subject of electronic components and materials. A 150 to 200 word abstract together with title and authors names should be sent to the Technical Program Chairman:

Brig. Gen. Edwin R. Petzing
AGEP Secretariat
University of Pennsylvania
200 S. 33rd Street
Philadelphia 4, Pa.

The deadline for abstracts is October 4, 1958.

The theme of this informative conference, to be held at the Benjamin Franklin Hotel in Philadelphia on May 6, 7, and 8, 1959, is "New Concepts for Space Age."

1959 COMING EVENTS

Jan. 12-13-'59: 5th National Symposium on Reliability & Quality Control, IRE, AIEE, ASQC & EJA; Bellevue-Stratford Hotel, Phila., Pa.

Mar. 2-6: Western Joint Computer Conf., IRE, AIEE & ACM; at Fairmount Hotel, San Francisco, Calif.

March 23-26: IRE National Convention, IRE; New York City.

Apr. 5-10: 5th Nuclear Congress, IRE & EJC; Cleveland, Ohio.

May 4-6: National Aeronautical Electronics Conference, IRE; Dayton, Ohio.

May 6-8: Electronic Components Conf., IRE, AIEE, EIA & WCEMA; Ben Franklin Hotel, Philadelphia, Pa.

Minisig SENSITIVE INDICATOR

. . . operates directly from low-level signals

THE LATEST FROM EECO

ACTUAL SIZE

NOT JUST ANOTHER INDICATOR

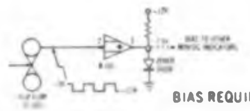
The EECO Minisig Sensitive Indicator is definitely *not* "just another Indicator." It occupies no more panel space than a conventional indicator . . . BUT—

1. It incorporates a built-in *high-sensitivity* transistorized driver circuit.
2. It gives on-off indication where the signal excursion is *too small* for direct operation of neon or incandescent lamps.
3. Its operating characteristics are *adjustable*.
4. It will accommodate a *wide range* of input signal conditions.

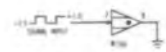
APPLICATIONS

The principal use of Minisigs is to indicate signal levels or the state of flip-flops, switching circuits, and storage elements. Here are two typical applications of the Neon Minisig.

TYPICAL NEON MINISIG APPLICATIONS



BIAS REQUIRED



NO BIAS REQUIRED

Note that a positive-going Minisig Neon Indicator (Model R-101) is used to display the "1" state of an EECO T-Series Flip-Flop, because the T-Series "1" level is more positive than the "0" level. A bias voltage of −7.5 volts is used. This is conveniently derived from the −12-volt supply and is regulated by a zener diode. The other application does not require a bias supply.

The schematics in the box below show other typical applications of Minisig Neon Indicators. Though these applications are to three of the principal EECO plug-in circuit "families," Minisigs can be applied with equal effectiveness to *any* system designed for small signal excursions.

For example, the signal voltage swings of these EECO circuits are as follows:

	Peak-to-peak Excursion
T-Series—Germanium transistor circuits: "1" = −3 volts; "0" = −11 volts.	8 volts
W-Series—Silicon transistor circuits: "1" = +6 volts; "0" = +16 volts.	10 volts
Y-Series—Two-tube computer circuits: "1" = −20 volts; "0" = 0 volts.	20 volts

LENSES

Minisig lenses are of high-impact polystyrene with plain, flat face. Lense configuration permits wide angle of visibility. Lenses with numerals, letters, etc., are also available on special order.

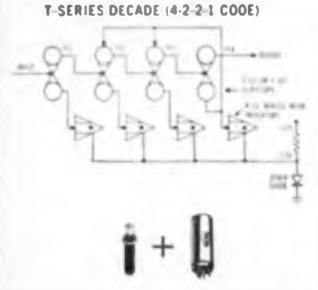
LOW PRICE

The economical price of Neon Minisigs ranges from $8.50 per unit (in sample quantities of 9 or less) to $6.55 per unit in quantities from 200 to 499. Prices for larger quantities and for Incandescent type available on request.

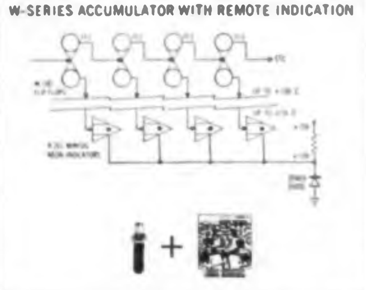
TWO TYPES

Minisig Sensitive Indicators are available in two types: neon glow tube and incandescent lamp. Both types include models for positive-going or negative-going signals. Neon Minisigs have a maximum sensitivity in the order of two volts, peak-to-peak, and bias range limits of −10 volts to +10 volts. Specifications on incandescent-type Minisigs are in design and will be released soon.

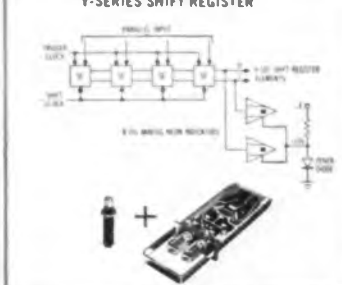
T-SERIES DECADE (4-2-2-1 CODE)



W-SERIES ACCUMULATOR WITH REMOTE INDICATION



Y-SERIES SHIFT REGISTER



WESCON

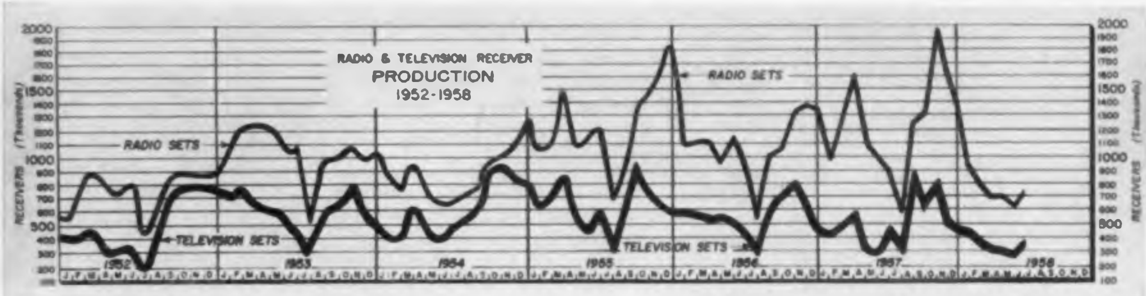
See our Minisig Sensitive Indicator, as well as EECO Germanium and Silicon Transistor Plug-in Circuits and one- and two-tube Vacuum-Tube Plug-in Circuits at WESCON . . . BOOTH 970

ENGINEERED ELECTRONICS Company

ENGINEERED ELECTRONICS COMPANY
(a subsidiary of Electronic Engineering Company of California)
506 East First Street • Santa Ana, California

Circle 12 on Inquiry Card, page 97

TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in June, 1958.

Amplifiers	394,906
Amplifiers, r-f	99,500
Analyzers	369,212
Analyzers, spectrum	33,550
Antennas & accessories	3,149,700
Battery chargers	442,730
Batteries, dry	1,879,230
Batteries, storage	833,778
Beacon equipment, radio	936,731
Cable assemblies	384,690
Cable sets, interconnecting	37,467
Calibrators	181,941
Communication systems	35,367
Computers & accessories	271,012
Computers, airborne	313,995
Connectors	281,822
Converter equipment	285,891
Co-ordinate data equipment	3,497,702
Countermeasures equipment	320,000
Delay lines	25,886
Dummy loads	158,191
Facsimile equipment	45,259
Generators, signal	310,775
Headsets	203,041
Headset-microphone	266,511
Identification sets	120,000
Indicators	4,591,971
Indicators, radar	562,569
Infrared equipment	372,525
Kits, fire control mod.	61,382
Kits, modification	1,433,462
Kits, radar modification	240,014
Kits, radio modification	34,411
Meters, field strength	56,847
Meters, frequency	1,650,296
Meters, volt	27,749
Modulators	260,400
Multimeters	428,587
Multiplexers	1,224,769
Navigational systems & equip.	2,336,260
Networks	26,250
Oscillators	620,837
Oscillographs	32,370
Oscilloscopes & accessories	728,107
Power supplies	361,442
Radar equipment	8,355,553
Radio direction finders	59,415
Radio receivers	752,820
Radio receivers-transmitters	197,667
Radio set control	126,649
Radio sets	11,940,804
Radio transmitters	259,562
Radiosonde equipment	1,089,261
Recorders & accessories	449,476
Recorders-reproducers	420,159
Relay assemblies	28,840
Relays	211,648
Relays, solenoid	116,901
Resistors	161,869
Resolvers	310,275
Semiconductor diodes	123,095
Simulators	49,927
Spare parts	697,059
Switches	227,582
Synchros	561,910
Tape, recording	138,949
Telemetering equipment	141,701
Television equipment	88,074
Test equipment (various)	292,935
Testers	141,305
Test sets	1,125,695
Test sets, radar	2,025,350
Test sets, radio	1,177,815
Transducers	34,995
Transponder sets	75,000
Tubes, electron	8,581,802
Wire & cable	965,324

GOVERNMENT RESEARCH & DEVELOPMENT SPENDING

(In Millions)

Year ending June 30	Total	Research and Development	Activities Supporting R & D	Development, Test and Evaluation
1955	$3,520.3	$1,349.6	$344.3	$1,826.4
1956	3,814.6	1,539.0	445.5	1,830.1
1957	5,088.3	1,651.4	633.0	2,803.9
1958 est.	5,602.5	1,886.7	424.6	3,291.2
1959 est.	6,219.1	2,588.1	444.5	3,186.5

Aircraft Industries Association

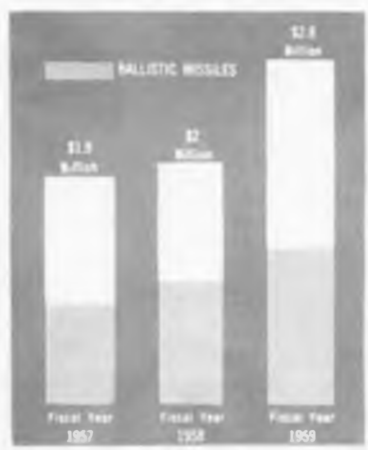
DEFENSE BUYING

Budget Category	1st Quarter	2nd Quarter	3rd Quarter	FY 1958 to date:
Aircraft	$340	$346.0	$359.0	$1,045.0
Ships—Harbor Craft	23	25.0	24.0	72.0
Combat Vehicles	1	—.2	—.1	.7
Support Vehicles	1	.7	.6	2.3
Missiles	273	299.0	319.0	891.0
Elec. & Comm.	204	214.0	183.0	601.0
Research & Dev.	73	74.0	75.0	222.0
Miscellaneous	11	9.0	9.0	29.0
TOTAL (FY 1958)	$926	$967.5	$969.5	$2,863.0
TOTAL (FY 1957)	$638	$876.0	$938.0	$2,451.0

Electronic Industries Association

USAF MISSILE PROGRAM

(Including launch & support equipment)



Ballistic missiles in Fiscal Year 1959 will account for approximately one-half the $2.8 billion scheduled for all Air Force missile programs. This amount does not include research and development or construction requirements.

—Aircraft Industries Association

Circle 13 on Inquiry Card, page 97 →

Personals

Cyril E. McClellan has been elected Vice President of Engineering at California Technical Industries Div. of Textron, Inc.

George S. Brown, Jr., has been named Manager of Engineering and Manufacture for the Santa Barbara Div. of Western Design & Mfg. Corp.

Dr. Manfred Mannheimer has been appointed to the engineering staff of Astron Corp. He will be working exclusively in research and development and has an extensive engineering background with more than 30 years' experience as a physicist, chemist and electronic engineer.

Mannheimer

Busignies

Henri Busignies, President of Federal Telecommunication Laboratories has just received the honorary degree of Doctor of Science at the 42nd commencement exercises of Newark College of Engineering. He is the eighth person to have received the degree since the college first granted honorary doctorates in 1919.

Dr. Saul Rosen has been named to the newly created position of Manager, Programming Research and Development for Philco Corporation's "Transac" computers. He was formerly with the Burrough's Corp.

Price Wickersham, Instrumentation Engineer, has joined the Electronic Instrumentation Co., a division of The Ramo-Wooldridge Corp. in Denver, Colo.

Dr. Alan M. Glover has just recently been elected Vice President of RCA Semiconductor and Materials Div.

A. W. Orlacchio has been appointed Chief Engineer of the Glennite Instrumentation Div. of Gulton Industries.

Robert N. Wagner has been appointed Chief Electrical Engineer for Aluminum Co. of America.

Dr. Sidney J. Stein has just been appointed Director of Engineering and Research for the International Resistance Co. of Philadelphia.

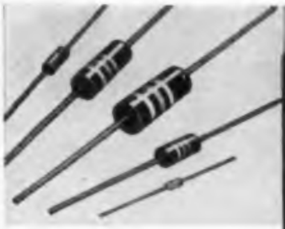
Albert Diamond has been appointed Project Engineer, Advanced Design at Norden-Ketay Corp., Precision Components Div.

Circle 21 on Inquiry Card, page 97

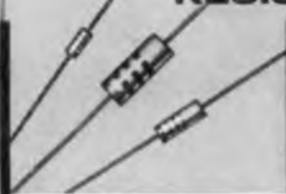
ALLEN-BRADLEY electronic components

The standard of quality for long life and dependable performance

RESISTORS

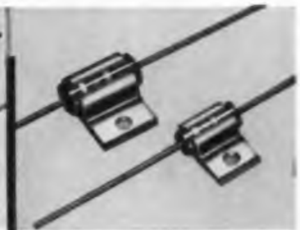


HOT MOLDED COMPOSITION RESISTORS—Quality standard of the industry. Rated at 70°C, in 2, 1, 1/2, 1/4, and 1/10 watts. Res. to 22 meg. Tol: 5, 10, and 20%.



HERMETICALLY SEALED in ceramic tubes. Solid, hot molded resistor. Less than 1% resistance change after 250 hr, 95% rel. hum., 40°C. Resistance values to 22 megohms.

METAL GRID PRECISION RESISTORS—Hermetically sealed. Non-inductive. 1, 1/2, And 1/4 watts at 100°C. Tolerances 0.1% to 1.0%. Temp coef. ± 25 PPM/°C.



COPPER CLAD—Metal panel mounting, insulated composition resistor supplied in two ratings: 3 and 4 watts at 70°C, and 4 and 5 watts respectively at 40°C.

POTENTIOMETERS

INDUSTRIAL—Type H with solid, hot molded resistor element. Quiet, improves with use. Life over 100,000 cycles. Rated 5 watts, 40°C; and 3 watts, 70°C.

STANDARD—Type J. Solid molded element. Quiet, reliable. Rated 2 watts, 70°C. Values to 5 meg.—less than 10% change in 100,000 cycles. Exceeds MIL-R-94B.

HIGH TEMPERATURE—Type K. Similar to Type J but rated 3 watts, 70°C; 2 watts, 100°C; and 1 watt, 125°C—derate to zero at 150°C. Many types and tapers.

MINIATURE—Type G. Solid molded element. Only 1/2" in diam. Plain or lock bushing; also with line switch. Rated 0.5 watt at 70°C. Values to 5 megohms.

FERRITES

TV CORES, including lightweight flared yokes; U, L, and O cores for color convergence; U and E flyback cores; and others. All have uniform magnetic properties.

FILTERS

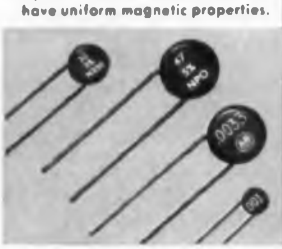
HIGH FREQUENCY low pass cascaded ceramic filters for elimination of radiation. Max ratings: 500 v DC at 125°C; RF current 0.25 amp; DC or LF current 5 amp.

POTENTIOMETERS

PRINTED CIRCUIT TYPE—Solid molded element. Rated 1/4 watt at 70°C. Type F is only 1/2" in diam. Screwdriver adjustment. Total resistance values to 5 meg.

THIN TYPE—Uses molded cover as actuator. Type T has solid molded element. Rated 1/2 watt at 70°C. Life in excess of 50,000 cycles. Total values to 5 megohms.

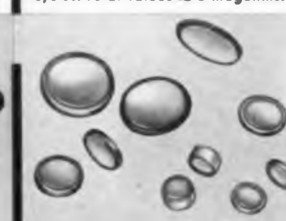
CAPACITORS



CERAMIC DIELECTRIC capacitors of superior quality, in a wide variety of types—GP (single and dual) — with no "rundown" on leads. Also, as TC and stable.

CERAMIC ENCASED capacitors for use where reliability and superior performance at high temp are important. Rated 500 v DC at 150°C. Tol: 5%, 10%, and 20%.

FEED-THRU & STAND-OFF discoidal capacitors for VHF and UHF range. No parallel resonance effects at 1,000 Mcps or less. Nominal values 4.7 to 1,000 mmf.



BARE DISC ceramic capacitors for direct mounting in printed circuit boards. Mechanically strong to avoid breakage in handling, installing, and soldering.

Allen-Bradley Co.
1342 S. Second St.
Milwaukee 4, Wis.

In Canada:
Allen-Bradley Canada Ltd.
Galt, Ont.

ALLEN-BRADLEY

QUALITY

ELECTRONIC COMPONENTS

Circle 17 on Inquiry Card, page 97

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-2. 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-2 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

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

Please Refer to Dept. 201

Electronic Industries' News Briefs

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

EAST

ITT COMPONENTS DIV., INTERNATIONAL TELEPHONE & TELEGRAPH CORP., has started construction on an ultra-modern, 1-story plant for the manufacture of special-purpose vacuum tubes at Roanoke, Va. The building, rising on an 18-acre site, will comprise 58,000 sq. ft.

MOTOROLA, INC., has completed the first successful all-over water installation of microwave for the military on the missile range at the USAF Missile Test Center, Fla. Operating in the 7,125-8,000 MC. band, it covers a total of 80 miles in the Bahama Islands.

A. B. DU MONT LABORATORIES, INC., has been awarded a $184,500 research and development contract from Sperry Gyroscope Co. for CCTV system to be used for radar boresighting and tracking of aerial targets.

MAGNETIC METALS CO., Camden, N. J., has been informed that its products comprised the majority of the magnetic core material in the Jupiter C Rocket which successfully placed the Explorer I in space.

RAYTHEON MFG. CO. has received contracts totaling about $15-million for powerful radio communications relay sets. The award was made by the Navy's Bureau of Ships. The sets are intended for Marine Corps use.

SPERRY GYROSCOPE CO. has been awarded an U. S. Army contract for follow-on production of "silent sentry" portable radar sets designed to provide mobile advance forces with the ability to detect enemy movements despite smoke, darkness, or fog.

WESTINGHOUSE ELECTRIC CORP.'s Ordnance Dept. has received a $600,000 contract from the Navy for torpedo motors quieter than a small household electric fan. Motors will be used to drive the Navy's Mark 37 torpedo.

MAGNETICS, INC., has announced an across-the-board price decrease on all sizes of permalloy powder cores, stabilized and unstabilized.

GENERAL ELECTRIC CO.'s Capacitor Dept. has reduced the prices on cylindrical foil Tantalytic capacitors by approximately 8%. The reduction applies to all ratings in the cylindrical foil lines.

SYLVANIA ELECTRONICS SYSTEMS has announced plans for the construction of a 70,000 sq. ft. manufacturing plant at Williamsport, Pa. The new plant will produce computer components and special computer devices which are presently carried on in leased facilities in that city.

CORNING GLASS WORKS has received contracts totaling over $350,000 for guided missile radomes made of Pyroceram, a super-strength ceramic introduced to industry a year ago.

BLAW-KNOX CO. has received government orders for the design, fabrication and installation of missile and satellite tracking antennas 85 ft. in diameter. Engineering and fabrication will be done at the Equipment Div., Blawnox, Pa.

BENDIX AVIATION CORP., Computer Div., announces that Palmer and Baker Engineers, Inc., Mobile, Ala., and Tudor Engineering Co., San Francisco are using digital computers to determine future traffic load and control, in addition to determining location and traffic on future highways.

MID-WEST

BURROUGHS CORP. has been awarded a USAF contract for $17.5-million for the construction of 24 coordinate data processing systems to be used in SAGE. Another contract for $1.7-million has been received from AC Spark Plug Div. of General Motors for design and fabrication of pre-launch data computers to be used in the Navy Regulus II missile program.

AMERICAN LAVA CORP. now has available machinable Grade A Lava in block form for model making or experimental designs . . . or fabricated into precision parts to customer's specifications.

STROMBERG-CARLSON has supplied the multiplexing equipment which will be used in the new Northern Illinois Toll Road.

MINNESOTA MINING AND MFG. CO. has developed a radical new "sandwich construction" magnetic tape for computer and instrumentation use that eliminates oxide-rub-off, extends equipment life and outwears conventional instrumentation tapes by 10 times or more.

COLORADO RESEARCH CORP. has opened its new modern laboratory at Broomfield Heights, Colo. The firm is engaged in research in the fields of electronics and applied physics.

FOREIGN

NARDA MICROWAVE CORP.'s European distributor appointments: Kostas Karayannis, Karitzie Square, Athens, Greece, and P. N. Biorn, Tollbodgt. 4, Oslo, Norway. The firms will service Greece and Norway respectively.

CONSOLIDATED ELECTRODYNAMICS CORP., GmbH, has been formed by the American parent to serve as a central sales and service facility in Western Europe and the United Kingdom. The company is located at Weisfrauenstrasse 3, Frankfurt am Main.

ELECTRONICS CORPORATION PAN AMERICA has been established as an affiliate in Puerto Rico by Electronics Corporation of America, Cambridge, Mass. The new firm will manufacture industrial electronic controls for the transportation industry in a 21,000 sq. ft. branch in Rio Piedras, a suburb of San Juan.

RADIO CORPORATION OF AMERICA has received a contract from the British Overseas Airways Corp. to equip that firm's intercontinental jet air fleet of 15 Boeing 707 Intercontinentals with the RCA AVR-200 all transistorized Marker Beacon Receiver. The device enables a pilot to position his aircraft properly on approach and while awaiting directions to land.

BOURNS LABORATORIES, INC., has authorized Douglas Randall Ltd., Scarboro, Ont., Canada, to manufacture and market in that country the Bourns lead-screw type potentiometers.

PORTO RICO TELEPHONE CO., a subsidiary of IT&T Corp., has converted from manual to dial operation in Ponce, Puerto Rico's second largest city. The equipment was supplied by Kellogg Switchboard & Supply Co.

WEST

NORTH AMERICAN AVIATION'S MISSILE DIV. has delivered the first completed units of equipment for the Weapon System 131B, or GAM-77 air-to-surface missile, program. The unit will be used to provide simulated barometric pressures.

AUTO DEVICES, INC., RECTIFIER DIV., has lifted the shrouds of secrecy surrounding the cutting of silicon crystal for rectifier production. The event was in celebration of its millionth unit.

SYLVANIA ELECTRIC PRODUCTS, INC., has received a $2.6 million contract award from the U. S. Army Signal Research & Development Laboratory for a continuation of a development work in electronics.

PHELPS DODGE CORP. has announced another 20% decrease in current mining production in Arizona—the fifth cut in 18 months. The cumulative reduction in one year and a half is in the range of 40%.

PACKARD-BELL'S ELECTRONICS CORP. contract with Douglas Aircraft Co., Inc., for ground support equipment for the IRBM "Thor" has been increased by over $7 million. This brings the total contract in force to over $14-million. In another award Packard-Bell received a $1-million contract from Chance Vought Aircraft for additional electronic equipment for the F8U "Crusader," the U. S. Navy's first-line operational fighter plane.

CONSOLIDATED ELECTRODYNAMICS CORP. and **GRAYBAR ELECTRIC CO.** have signed a non-exclusive distributor agreement authorizing Graybar to stock and market CEC's Alectra line of portable test instruments. Other CEC news: a $226,000 contract has been received from Boeing Airplane Co. for instrumentation in the new B-52G flight-test program; two 57,500 sq. ft. buildings for the Systems and Transducer Div. in Monrovia, Calif., have been completed.

AEROLAB DEVELOPMENT CO. has acquired a new building with 15,000 sq. ft. of floor space adjacent to the main Aerolab plant at 330 W. Holly St., Pasadena, Calif. It will be used for high altitude research missiles.

BECKMAN INSTRUMENTS, INC., has completed installation of an electronic data processing system designed to maintain peak efficiency in the production of high-octane gasoline at the Ponca City, Okla., refinery of Cities Service Oil Co.

GULTON INDUSTRIES, INC., has established a new Digital Devices Dept. that will apply semi-conductor techniques to data acquisition and reduction in analog and digital systems. The new department has been assigned to CG Electronics Corp., Albuquerque, N. M., a wholly-owned subsidiary.

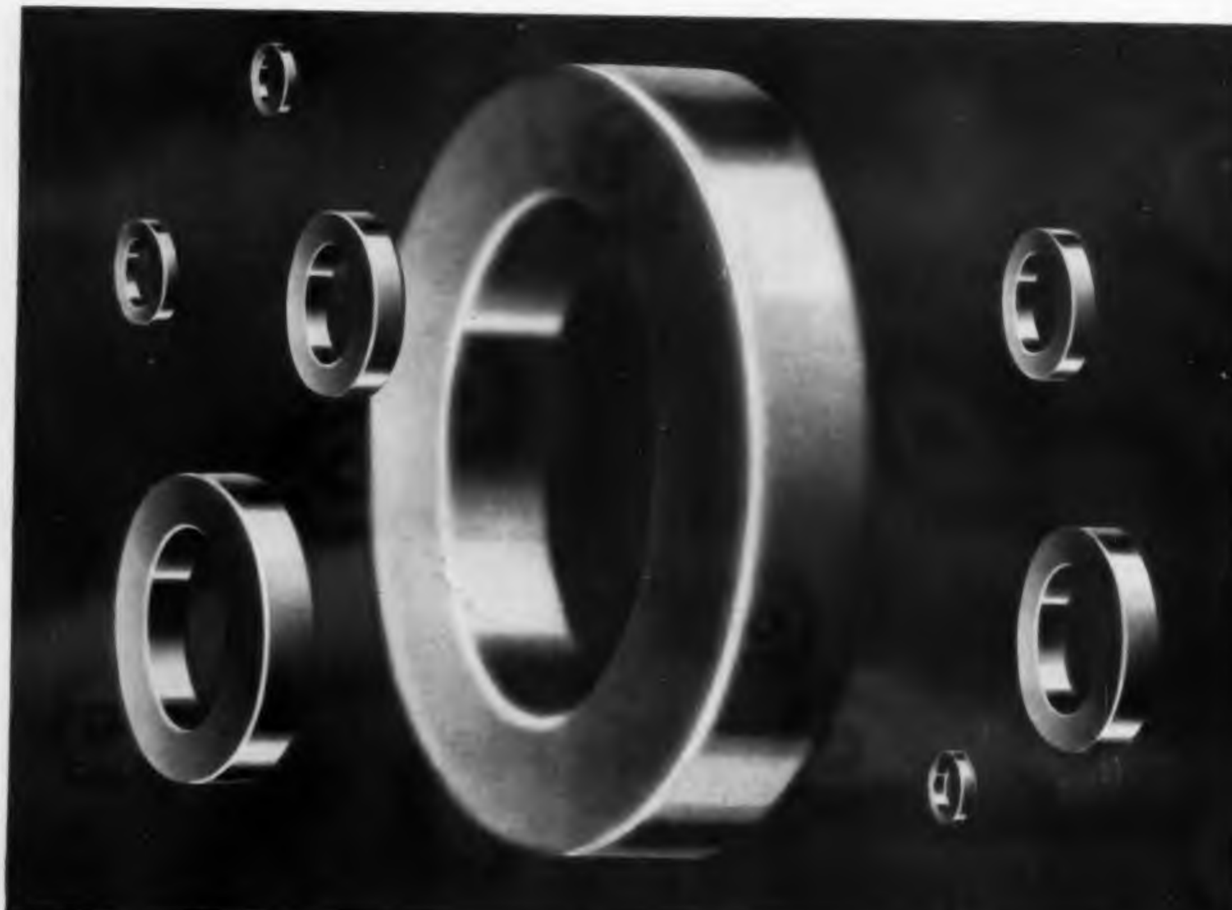
BENDIX AVIATION CORP., PACIFIC DIV.'s production of components and systems for U. S. missiles will account for more than half of 1958 sales of that firm.

AIR-MARINE MOTORS, INC., has transferred the operations of its West Coast Div. to 2221 Barry Ave., Los Angeles 64, Calif. Phone number will remain GRanite 9-8818 and BRadshaw 3-6489.

PACIFIC SEMICONDUCTORS, INC., has announced a price reduction on Varicaps of up to 40%. Also a new series of high voltage silicon rectifiers has been made. The new series is of the "wire in" tubular configuration.

IT'S NEW AND NEWS from ARNOLD

Arnold Tape-Wound Cores now offer you
every feature you've been looking for
...at no added cost to you



1

NEW COMPACTNESS in Aluminum-cased Cores

Now you can build your designs around the last word in improved tape cores of high-permeability materials. Arnold 6T Cores incorporate a new type of aluminum core box construction, with overall dimensions smaller than older types of aluminum cases, and comparable in size with ordinary plastic-cased cores. *Result:* along with the distortion-free strength of the aluminum case, that resists winding stresses, you now get the compactness and miniaturization possibilities you've wanted.

2

HERMETICALLY SEALED, with Built-in Protection against Shock and Vibration

Magnetic properties of Arnold 6T Cores have the most complete protection available on the market. The cores are surrounded by an inert shock absorbent inside the cases, and then hermetically sealed: your best assurance of trouble-free performance, a strong consideration where the service involves long periods of standby. Inherent in the design, of course, is the further guarantee that you can vacuum-impregnate your coils.

3

1000-VOLT BREAKDOWN GUARANTEED!

The revolutionary new type of core box construction developed for Arnold 6T Tape Cores employs a strong, inert covering for which 1000-volt breakdown is guaranteed. This covering possesses a hard gloss finish, and gives a suitable radius on all corners. The elimination of sharp corners insures against cutting through the insulation of the winding wire. The hard, non-cold-flowing finish protects against the wire cutting through the case covering, a double guarantee against shorted wiring.

4

MEETS MILITARY "SPECS" for Operating Temperatures and Temperature Rise

Arnold's new type of hermetically-sealed aluminum core box construction fully meets the requirements of military specifications Mil-T-5383 or Mil-T-7210, wherever applicable. This involves a positive guarantee that the case construction will withstand ambient temperatures to 170°C, and a 25°C temperature rise.

Arnold 6T Tape Cores will be available in all standard sizes, and special sizes may be made to order... all guaranteed for size, hermetic seal, dielectric strength and temperature of operation.

WSW 7250

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

Boston: 49 Waltham St., Lexington Los Angeles: 3450 Wilshire Blvd.

New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

Circle 9 on Inquiry Card, page 97

ONLY ONE POTENTIOMETER THIS SMALL GIVES YOU THESE 5 FEATURES

Mount 16 units per square inch—cross-section only 0.190" x 5/16"

1. High temperature operation—to 175°C.
2. Humidity-proof—new plastic molding technique makes possible a smaller, fully-sealed potentiometer exceeding specifications of MIL-STD-202A, 10 days.
3. Power rating: one watt at 70°C.
4. Standard mounting holes on one-inch centers.
5. Easier, more accurate settings—25 turn screw driver adjustment gives you 33 times the adjustability of single-turn potentiometers, easy repeatability. Settings are stable and self-locking.

SEE US AT THE WESCON SHOW, BOOTH 1104

SEE US AT THE WESCON SHOW, BOOTH 1104

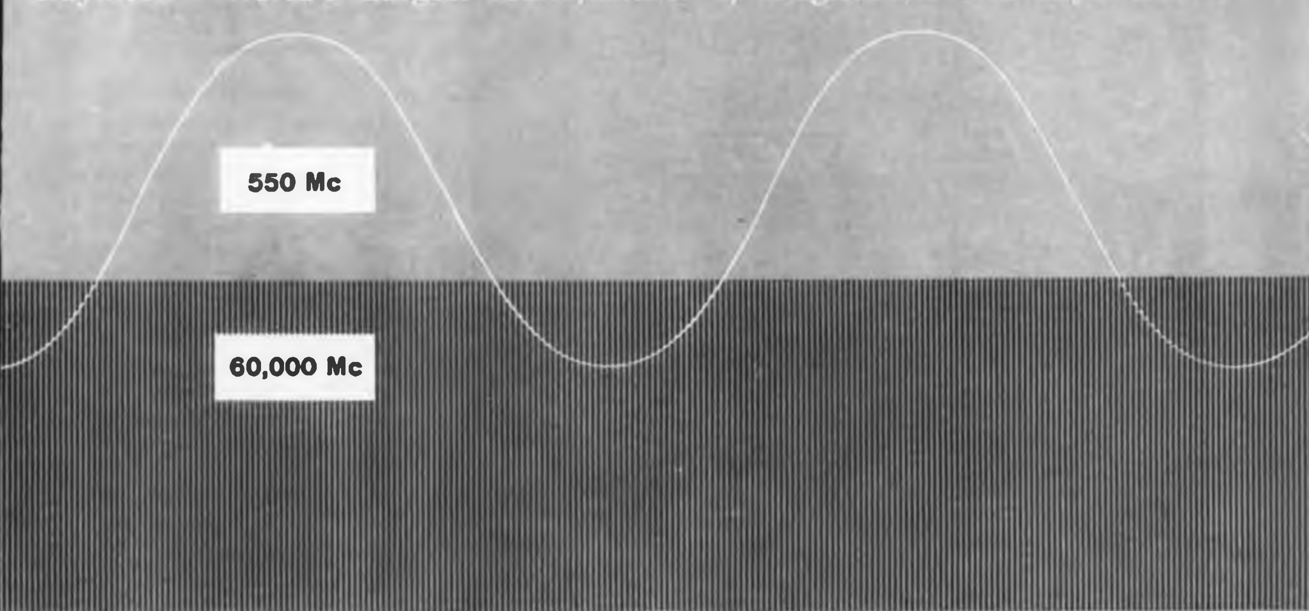
IT'S THE NEW BOURNS TRIMPOT® MODEL 224

Available immediately from factory or distributors' stock with insulated stranded leads, solder lugs or printed circuit pins. Resistances: 100Ω to 50K. Exceeds military shock and vibration specs. For data on the new Model 224 TRIMPOT write to:

BOURNS *Laboratories, Inc.* P.O. Box 2112F, Riverside, California

EXCLUSIVE MANUFACTURER OF TRIMPOT® AND TRIMIT® • PIONEERS IN POTENTIOMETER TRANSDUCERS FOR POSITION, PRESSURE AND ACCELERATION

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons



RAYTHEON REFLEX KLYSTRONS

from 550 to 60,000 Megacycles

More than 70 Raytheon reflex-type klystrons for local oscillator, signal generator and transmitter applications.

Raytheon produces more reflex klystrons than all other manufacturers in the world combined . . . one important reason why Raytheon klystrons have established a matchless record for reliability and proved performance in thousands of installations.

Equipment designers are welcome to call on our Application Engineer Service. Write for consolidated data booklet presenting comprehensive characteristics of the *complete* line of Raytheon klystrons, magnetrons and special tubes. There is no cost, or obligation.

3 TYPICAL RAYTHEON REFLEX KLYSTRONS

RK-5721 — Velocity variation oscillator designed for use with a coaxial cavity in CW or pulsed operation over the 4290 to 11,000 Mc range for signal generator and special local oscillator applications.

Heater Input @ 0.58 A	6.3 V
Reflector Voltage Transit Mode	2¾ cycles
Frequency Range	4290-8340 Mc
DC Resonator Input @ 20 mA	1000 Vdc
DC Reflector Voltage	-50 to -625 V
Electronic Tuning (Half Power) Frequency Change	12 Mc min.
Reflector Modulation Sensitivity (8340 Mc)	0.1 Mc/volt
Power Output (Average CW)	160 mW

RK-6116 — A ruggedized thermally tuned oscillator of the integral cavity type designed for CW operation in the 8500 to 9660 Mc range with an average power output of 30 mW.

Heater Input @ 0.52 A	6.3 V
Tuner Heater Current	0.80 A
Frequency Range	8500-9660 Mc
Resonator Input @ 23 mA	300 Vdc
Reflector Voltage (max. Po @ 8550 to 9660 Mc)	-60 to -145 Vdc
Thermal Tuning Time 8500-9660 Mc	2 seconds
Electronic Tuning Range @ 9080 Mc	100 Mc
Power Output 8500-9660 Mc	26 to 34 mW

QK-422—A mechanically tuned velocity variation oscillator designed for CW operation in the 7125 to 8125 Mc range in microwave relay systems.

Heater Input @ .44 A	6.3 V
Frequency Range	7125 to 8125 Mc
DC Resonator Input @ 32 mA	300 Vdc
DC Reflector Voltage (max. Po @ 7125 to 8125 Mc)	-130 to -210 Vdc
Power Output 7125 to 8125 Mc	100 mW min.
Electronic Tuning (to half power points) @ 7600 Mc	25 Mc min.
Modulation Sensitivity @ 7600 Mc (10 V pk. to pk. mod. volt.)	.5 Mc/V min.

RAYTHEON MANUFACTURING COMPANY

RAYTHEON

Excellence in Electronics

Microwave and Power Tube Division, Section PT-52, Waltham 54, Mass.

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois. 5236 Santa Monica Blvd., Los Angeles 29, California

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Miniature and Sub-Miniature Tubes, Semiconductor Products, Ceramics and Ceramic Assemblies

Tele-Tips

BINARY SYSTEM, according to its inventor, C. E. Shannon, has its roots in the Bible. With somewhat of a tongue-in-cheek he quotes Matthew 5-37: "Let your communication be yea, yea, nay, nay, for whatsoever is more than these cometh from evil."

ALL CAA air traffic control facilities are now using Greenwich Mean Time. Standardized time will be much more easily and successfully used in the electronic computers with which the CAA is starting to equip air route traffic control centers.

CANADIAN TV has reached a 75% of saturation, with an even higher level in the major Eastern areas. In the French-speaking provinces, particularly, telecasters have virtually a captive youth market. Youngsters under 16 are prevented, by law, from attending motion pictures.

SUN-POWERED refrigerator has been developed by two Israeli engineers. The appliance, which operates solely on power derived from the sun, is connected by a pipe to a radiation-collector installed on the roof of the owners house.

THE 1960 CENSUS will include a question on radio—how many in each household. Nearly every household reported a radio set in 1950, but there may still be significant differences from area to area as well as changes in some areas since that time.

IGY PROGRAM may provide information that will eventually lead to control of the weather. The U. S.'s share of the $500 million dollar program comes to $41 million. 66 nations and 10,000 scientists are participating.

COLOR TV is being installed in every guest room of the Tuscany Hotel, New York City, making it the first hotel in the country to earn the distinction.

Tele-Tips

THE ARMY reviewed the late developments in nuclear warfare and reluctantly agreed that bows and arrows are out of date. The Pentagon de-classified its 2-part report on "Silent Flashless Weapons," an arsenal of bows and arrows, some of them having 100-yard range, which were planned for behind-the-lines activity in 1944.

MISSILE RELIABILITY problem is highlighted in these figures compiled by Standard Pressed Steel Co. In order for an Atlas missile to hit its target 9 times out of 10 each of its 300,000 parts must have an average reliability of 99.99996% !

JET POWER is pointed up in this set of statistics from the CAA: To increase the speed of a conventional air transport to 600 miles an hour would take 30 engines, and maintenance and fuel costs would increase so much there wouldn't be enough seats to make it pay so the wings and fuselage would have to be enlarged. Then 10 more engines would have to be added to carry the extra weight. Finally, the cost would be prohibitive and at least one engine could be expected to fail on almost every flight. The power of these 40 engines is packed into the 4 jets on a Boeing 707!

YOUTH SCIENCE CORPS is being proposed as a means of uniform instruction in the various branches of technology for youngsters.

THE GOVERNMENT is urging all firms dealing in exports to label their packing crates with "United States of America." Three-color, 15x20 in. posters are being displayed at freight forwarders, customhouses, Ports of Exit bearing the reminder: "Tell the World about our Free Enterprise System —Label Your Exports United States of America."

Circle 23 on Inquiry Card, page 97

Books

Applied Mathematics for Engineers and Physicists

By Louis A. Pipes. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 723 pages. Price $8.75.

This text, designed for the general advanced mathematical course offered to applied scientists, covers a wide range of topics in the advanced calculus fields. It gives the engineer and applied physicists the principal mathematical techniques they need to analyze the usual mathematical problems that arise in practice and to understand important current technical papers.

The text covers: Infinite series, complex numbers and complex variable, Fourier Analysis, the Laplace transform theory, Vector and Tensor analysis, partial differential equations, modern algebraic methods including matrices, integral equations, the calculus of variations, and ordinary non-linear differential equations.

The Exploration of Space by Radio

By R. Hanberry Brown and A. C. B. Lovell. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 207 pages. Price $6.50.

The results and possibilities of the investigation of the universe by radio methds are the main theme.

The authors deal with the astronomical background, some properties of radio waves, techniques of radio astronomy, dilactic and extra dilactic radio emissions, dehydration line, the scintillation of the radio stars, solar radio waves, meteors, radio and the aurora borealis, the Jodrell Bank radio telescope, and radio investigations of the moon, planets, and the earth's satellite.

Electronic Measuring Instruments, 2nd Edition Revised

By E. H. W. Banner. Published by the Macmillan Co., 60 Fifth Ave., New York 11. 512 pages. Price $7.95.

This book is a broad survey of the principles of electronic instruments; the principal types and component devices. Vacuum and cathode ray tubes are described, followed by two sections on measuring instruments embodying these elements. Instruments covered include industrial, scientific and medical. Of especial interest to the engineer engaged in nuclear research is the section on radiation measurement.

Non-Linear Control Systems

By Robert Leen Cosgriff. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 328 pages. Price $9.00.

This unique text book is the first to treat in detail the many non-

(*Continued on page 30*)

Reduce | Core losses / Core weight, size / Copper requirements

of high frequency equipment With Armco Thin Electrical Steels

Exceptional magnetic qualities, extensive design data create opportunities to improve performance, cut costs of 400 to 200,000 cycle magnetic and electronic components.

Armco Thin Electrical Steels offer you all the advantages of thin laminations plus exceptional magnetic properties. Armco's precise processing and control provides high permeability, low hysteresis loss, high lamination factor, and minimum interlamination energy loss.

Grades and Gages for Your Needs

Three different grades enable you to make maximum use of the advantages of Armco Thin Electrical Steel in your products. Armco TRAN-COR® T (7 and 5 mils) has good permeability in all directions. It is designed for rotating and other equipment where flux disposition is random.

Armco ORIENTED T (4, 2 and 1 mil) is "oriented" with best permeability in the direction of rolling.

Armco ORIENTED TS (4 mils) provides exceptionally high permeability in the rolling direction. A super-oriented steel for 400 cycle service.

Design Data Available

The latest edition of the catalog "Armco Thin Electrical Steels" gives you 39 pages of design curves plus other basic information. With this data you can make the most effective use of the materials' magnetic properties and select the grade and gage for most efficient balance of performance and cost.

For your copy of this useful design manual on Armco Thin Electrical Steels, just fill out and mail the coupon.

ARMCO STEEL CORPORATION
1898 Curtis Street, Middletown, Ohio

Send me a copy of "Armco Thin Electrical Steels"

Name ____________________

Company ____________________

Street ____________________

City ____________ Zone ______ State ________

ARMCO STEEL CORPORATION

1898 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

Circle 18 on Inquiry Card, page 97

Books

(*Continued from page 28*)

linear phenomena which arise in the area of control systems. Because all control systems are non-linear in nature, this book will give both the student and the practicing engineer valuable insight in tools for the analysis and design of control systems.

The selections of material are such that the reader does not need an extensive background. Only those methods and techniques which are practical from an engineering standpoint have been included. All mathematics beyond calculus is developed in the text.

Circuit Analysis of Transmission Lines

By John L. Stewart. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 197 pages. Price $5.50.

This book offers a short, unified treatment of the science and analysis of ordinary transmission lines. The approach is analytic, although the more important graphical techniques are discussed. Special attention is given to radio frequencies and measurements. The author examines matching devices and the design of resonators and transmission cavities. The text also provides a discussion of the standing wave ratio and an introduction to the principles and applications of the Smith chart.

Transistor Technology, Volume I.

Edited by H. E. Riggers, J. A. Scaff, and J. N. Shive. Published 1958 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 698 pages. Price 7.50.

While transistor technology is still evolving, this book of principals brings to scientists and engineers, as well as advanced students of applied solid-state science, an invaluable aid to the understanding of present day transistor capabilities and potentialities.

Introduction to the Theory of Transistor Circuits

By J. J. Hupert, PhD. Published 1958 by Communication and Electronics Foundation, 606 Forest Ave., River Forest, Ill. 50 pages, paper bound. Price $3.00.

This work is intended as an orientation for persons on BS levels in science and engineering, whose syllabus of college study did not include courses on transistors. A certain degree of familiarity with matrices, the Laplation transformation, the theory of linear electric circuits, etc. is taken for granted. The presentation is limited to small signal analysis and is intended to emphasize topics which are peculiar to transistor circuits or which gain in importance when applied to transistor circuits.

(*Continued on page 34*)

VALUABLE FREE FOLDER

Contains important technical information for everyone concerned with use of chemicals in the production of semiconductors and other electronic parts and equipment.

Prepared by a leading manufacturer of special chemicals for electronics, this helpful folder describes the Baker & Adamson line of high purity "Electronic-Grade" chemicals. Their uses and advantages. How they can help you. Lists specifications for many products and their applications.

Mail coupon now for your free copy!

BAKER & ADAMSON® Electronic-Grade Chemicals
GENERAL CHEMICAL DIVISION
Allied Chemical Corporation
40 Rector Street, New York 6, N.Y.

Please send free copy of your folder, "Chemicals for the Electronic Industry."

Name ____________________

Title ____________________

Company ____________________

Address ____________________

City ____________ Zone ______ State ______

EI-88

Circle 19 on Inquiry Card, page 97

A plane's best friend is Reliability

Aircraft parts of Synthane laminated plastics combine light weight, strength and electrical insulating properties.

Almost anyone who flies spells "Reliability" with a capital "R". Which is one reason why the aviation industry is a good customer for Synthane laminated plastics. There are other reasons.

Synthane is a material with many useful properties in combination. It's light in weight (half the weight of aluminum). It's an insulator with high dielectric strength, low dielectric losses, excellent insulation resistance. It's easily machined and resistant to chemicals. You'll go far to find one material with all these desirable characteristics.

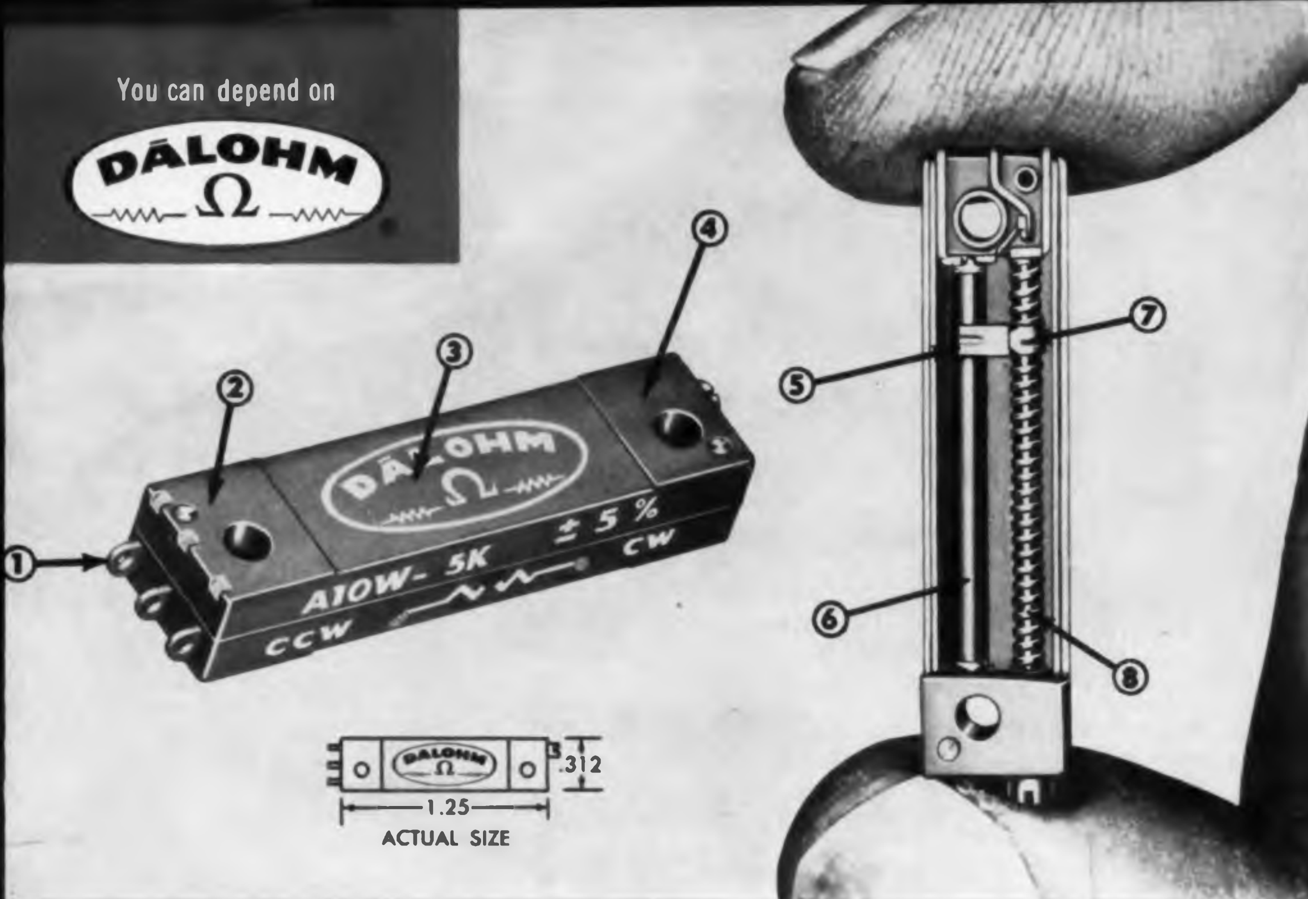
But Synthane is more than a material. It is an investment in reliability. Quality control from the raw materials to the finished product assures you of uniformity and rigid compliance with your most exacting requirements.

Synthane is people. People who have grown up with our company and take pride in turning out a first-class job. People to whom promises of delivery mean something. People who are specialists in working with laminated plastics. In short, people you can count on. What does all this cost you? Little or no more than you are now paying for other plastic laminates.

If you are interested in a reliable source of laminated plastics, you might remember that after "R" for Reliability comes "S" for Synthane . . . and Service.

SYNTHANE

SYNTHANE CORP., 11 RIVER ROAD, OAKS, PA.



Dalohm A10-W Trimmer assures 100% reliability!

1. Three terminal types available: Standard solder lug type shown above, printed circuit type, and with insulated wire leads. All terminals are treated to facilitate easy soldering.
2. Mounting pads, an integral part of case, provide secure mounting base on uneven surface. Mounted with two #2-56 screw holes for either stacked or multiple arrangements.
3. Legible markings and dimensional uniformity.
4. Case and unit are built to withstand severe shock, vibration and acceleration.
5. Novel slider design assures good contact.
6. Precision winding by the most advanced techniques assures excellent resolution and long life.
7. Trimmer adjustment has a unique design, providing self-locking action to assure stable settings under extreme environmental conditions.
8. Trimmer adjustment screw, which can be adjusted throughout a 25 turn range, is completely insulated from circuit. Special safety clutch prevents internal damage from over-excursion during adjustment.

- Rated at 1 watt up to 70° C. ambient temp.
- Resistance range: 10 ohms to 30K ohms.
- Standard tolerance ±5%, closer tolerance available.
- Resolution as low as .07%.
- Sub-miniature size and space saving configuration.
- Mounted individually or stacked assemblies with standard 2-56 screws.

B11-W Trimmer Potentiometer

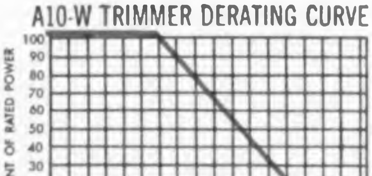
This is a commercial grade DALOHM trimmer potentiometer, retaining the desirable characteristics of the A10-W, at economical cost.

- Rated at 1 watt, derating to 0 at 150° C.
- Standard resistance range: 10 ohms to 100K ohms, with forty standard values.
- Standard tolerance: ±10%.
- Sub-miniature size: .220 X .312 X 1.250 inches.

Exceeds trimmer potentiometer specifications as required by MIL. SPECS.: MIL-R-19A, MIL. STD.-202A, MIL-E-5272A and MIL-R-12934A.

Request bulletin R-32 for complete information.

A10-W TRIMMER DERATING CURVE



JUST ASK US...

DALOHM line includes a complete selection of miniature precision power resistors (wire wound and deposited carbon), precision wire wound miniature trimmer potentiometers, and collet fitting knobs. Write for free catalog.

If none of DALOHM standard line meets your need, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production. Just outline your specific situation.

DALE PRODUCTS, INC.
1304 28th Ave.
Columbus, Nebr., U.S.A.

Books

(*Continued from page 30*)

Introduction to the Theory of Random Signals and Noise

By William B. Davenport, Jr. and William L. Root. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 393 pages. Price $10.00.

This book introduces the reader to the statistical theory underlying a study of signals and noises in the communications systems.

It contains a introduction to probability theory and statistics, a discussion of the statistical properties of the Gaussian random process, a study of the results of passing random signals and noise through linear and non-linear systems, and finally an introduction to the statistical theory of the detection of signals in the presence of noise.

Parts of probability theory and the modern theory of random processes are developed in a way suitable for an engineer.

Notes on Analog—Digital Conversion Techniques

Edited by Alfred K. Susskind. Published 1958 jointly by The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 417 pages. Price $10.00.

This book offers a detailed exposition of both the theory and design. The authors have stressed fundamental concepts and have expressed these concepts in quantitative terms where possible. Inherent engineering limitations are taken into consideration and relative merits of various approaches are weighed. The subject matter is divided into three parts. The first pertains to systems aspects of digital information processing that influences the specifications for analog-digital and digital-analog conversion devices. In the second part, a detailed engineering analysis and and evaluation of the variety of conversion is presented. The third part is devoted to a case study based on development work done at the Servomechanisms Laboratory of the MIT Dept. of Electrical Engineering.

High Quality Sound Reproduction

By James Moir. Published 1958 by The Macmillan Co., 60 Fifth Ave., New York 11. 605 pages. Price $14.00.

Practically the whole sound reproducer field is covered from personal experience of each of the subjects discussed. The mathematical sections have been kept as simple as possible and are generally concentrated into an appendix for each chapter, so that readers interested in the "why and how" but not in the actual design may read without being interrupted by mathematical insertions.

Engineered by Tinnerman...

NEW CAPACITOR SPEED CLIP® SNAPS IN, ELIMINATES RIVETING OR WELDING!

Speed up the assembly of capacitor clips to electronic equipment with this new Tinnerman SPEED CLIP. The "heel-and-toe" fastening feature permits the clip to slide into locking position in holes punched in metal, fiber or plastic as easily as your foot slides into a shoe. Once locked in place, the clip stays put, yet can be easily removed and reused over and over again. No riveting, welding or special tools required—no screws to start, no parts to loosen under vibration!

SPEED CLIPS can be provided in various sizes to hold capacitors and other cylindrical parts from ⅜" to 1½" in diameter and to fit a wide range of panel thicknesses.

Samples and prices of these SPEED NUT brand fasteners are available from your Tinnerman sales engineer. If he isn't listed in your Yellow Pages, write to:

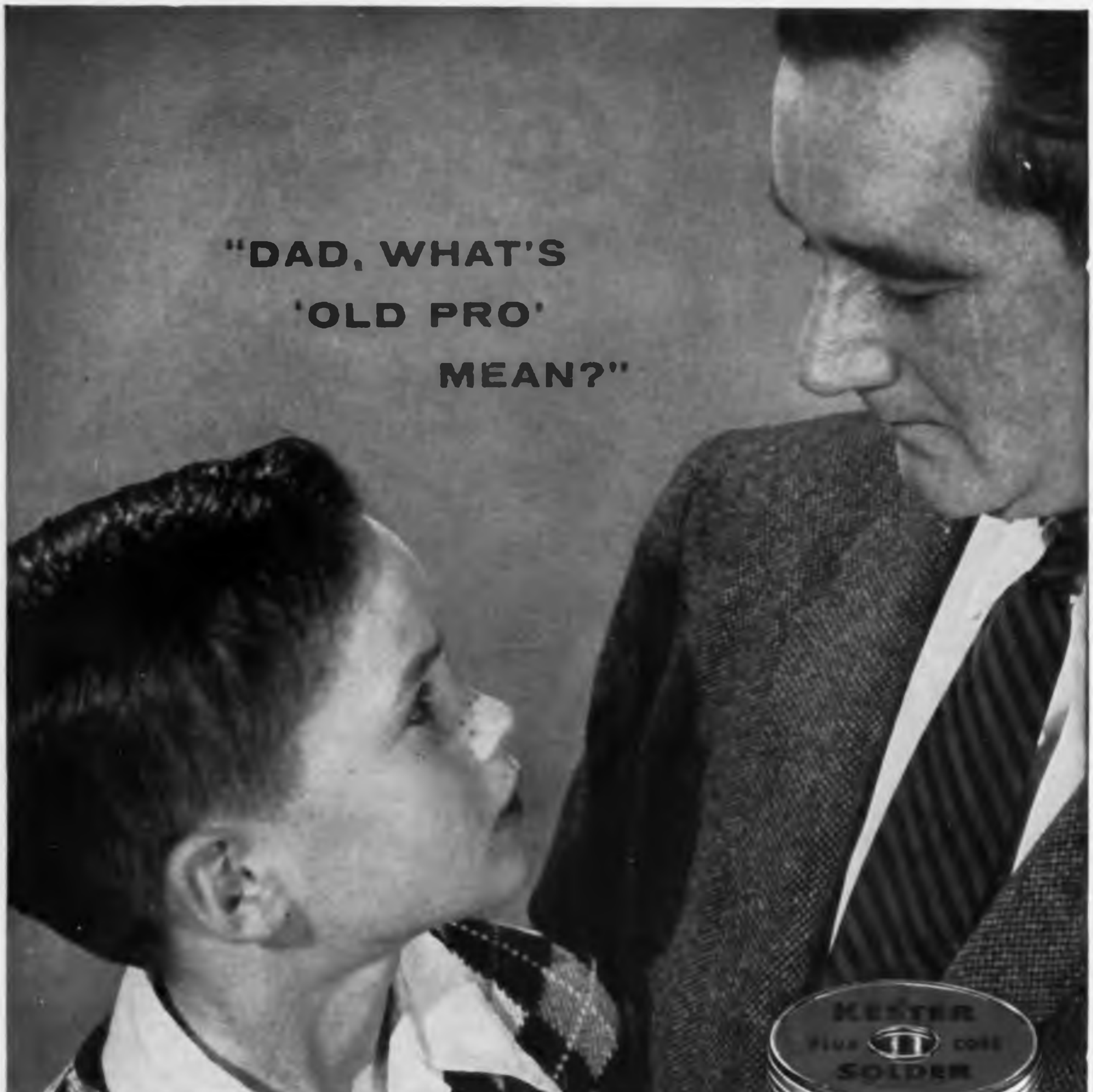
TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: [illegible] GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: [illegible] Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

Circle 29 on Inquiry Card, page 97



KESTER FLUX-CORE SOLDER

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.

And KESTER SOLDER has been time-tested and industry-proved for over 50 years.

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

SEND TODAY for your copy of the 78-page Kester textbook, "Solder . . . Its Fundamentals and Usage." It's free!

KESTER SOLDER *Company*

4210 Wrightwood Avenue, Chicago 39, Illinois

Newark 5, New Jersey • Brantford, Canada

 Circle 31 on Inquiry Card, page 97

Letters

to the Editor

"All-Reference Directory"

Editor, ELECTRONIC INDUSTRIES:

Your 1958 Directory and All-Reference Issue is certainly just what its name implies. I am sure this volume will find its way into the reference files of each recipient.

I'd like to find out whether the lists of semiconductor diodes and transistors are separately available. I have extracted previous years lists for inclusion with my transistor specifications and files, but don't want to dismantle this omnibus copy. If such separate lists are available I'd appreciate receiving one of each.

R. F. SHEA
Consulting Eng.

General Electric Co.
DIG Power Plant Eng.
Rm. 123B, Bldg. A-1

Ed: Thanks for those kind words—and, yes—individual copies of the semiconductor charts are available!

"Thanks!"

Editor, ELECTRONIC INDUSTRIES:

This is to notify you that I recently had a change in my mailing address. Below you will find listed for your convenience my old mailing address.

Though I seldom express my appreciation of your magazine, I would like at this time to express that "THANKS" briefly. In this rapidly changing electronic field, it would not take long for an engineer to fall far behind the field if it were not for magazines such as yours to help us keep current with the field. Your feature articles provide good and informative reading upon receipt and when properly filed they provide good reference material. In the course of a year's time, these articles often stimulate new ideas or help nourish existing ones.

Besides offering feature articles, between the covers of your magazine there are informative columns—columns such as new products, new ideas, information about companies and individuals. All these help to keep us current with this snowballing electronic industry.

In conclusion I wish to thank you again for your past services and I hope that before too long a time, your magazine will begin arriving at my new address.

GEORGE R. BOISVERT

The Bristol Co.
Waterbury 20, Conn.

Ed: And thanks to you, too!

Circle 28 on Inquiry Card, page 97

RELIABLE SUBMINIATURE TUBES

averaged one-third the rejection rate of all other tubes used in a Missile Guidance System at MOTOROLA INC.

WESTERN MILITARY ELECTRONICS CENTER
Phoenix, Arizona

Raytheon *Flat Press* Reliable Subminiature Tubes averaged 0.9% removals in critical Terrier missile system tests compared to 2.8% for all other types. Raytheon *Flat Press* construction provides superior mechanical features including:

- longer and stronger glass-to-lead wire seal
- no burned leads
- complete lead tinning
- optimum lead arrangement for wiring, socketing or dip soldering
- maximum seal reliability for operation and shelf storage

Raytheon Reliable Subminiature Tubes possess the electrical ratings and specifications that assure top performance as well as reliability. They have always been designed and constructed to assure reduced vibration output after shock, tighter limits for important characteristics and greater resistance to shock, fatigue and other environmental factors. The latest refinements are embodied in a new family of Reliability Plus Subminiature Tubes for which types and typical characteristics are listed below.

RAYTHEON RELIABLE SUBMINIATURE TUBES For Guided Missile, Military and All Other Critical Applications
TYPICAL CHARACTERISTICS

TYPE	DESCRIPTION	Vibration Output* (maximum) mVac	Vibration Output** peak to peak mv	Heater Volts	Heater mA	Plate Volts	Plate mA	Cathode Bias Resistor ohms	Screen Volts	Screen mA	Amplification Factor	Mutual Conductance µmhos
CK5702WB	Video Amplifier, Pentode	50	240	6.3	200	120	7.5	200	120	2.6	—	5000
CK5703WB	High Frequency Triode	10	50	6.3	200	120	9.4	220	—	—	25.5	5000
CK5704WA	High Frequency Diode	—	25	6.3	150		Max. inverse peak = 460 volts; max. I_o = 10 mA					
CK5744WB	High Mu Triode	15	75	6.3	200	250	4.2	500	—	—	70	4000
CK5783WB	Voltage Reference	20	—			Operating voltage approximately 85 volts between 1.5 and 3.5 mA						
CK5784WB	RF Mixer Pentode	75	300	6.3	200	120	5.5	230	120	4.1	—	3200
CK5787WB	Voltage Regulator	20	—			Operating voltage approximately [illegible] volts between 5 and 25 mA						
CK6247WA	Low Microphonic	2.5	25	6.3	200	250	4.2	500	—	—	60	2650
CK6533WA	Low Microphonic Triode	1.0	15	6.3	200	120	0.9	1500	—	—	54	1750

Each type is electrically and mechanically interchangeable with earlier versions of the same basic type.
Developed under Navy sponsorship.

Bulb temperature ratings to 265°C

*15g, 40 cps, fixed frequency
**15g, 30 to 1000 cps sweep

RAYTHEON

INDUSTRIAL TUBE DIVISION

Reliable Miniature and Subminiature Tubes • Filamentary Tubes
VR Tubes • Rectifiers • Thyratrons • Cathode Ray Tubes

Newton, Mass.............55 Chapel St., Bigelow 4-7500
New York:..................589 Fifth Ave., PLaza 9-3900
Chicago: 9501 Grand Ave., Franklin Park, NAtional 5-6130
Los Angeles: 5236 Santa Monica Blvd., NOrmandy 5-4221

Visit RAYTHEON Booths 639-640, WESCON, Los Angeles

Circle 116 on Inquiry Card, page 97

Industry News

Richard H. Gorman has accepted the position of Manager-Product Planning for GE's Distribution Assemblies Dept. Three District Sales Managers have also been appointed by General Electric; **Samuel R. McConoughey** to the new microwave office in Dallas, Tex.; **Ralph W. May** to GE Microwave in Redwood City, Calif.; and **A. E. Sinclair** to GE Microwave in Atlanta, Ga.

Roy E. Mullin will now serve as General Sales Manager of D. W. Onan & Sons, Inc.

R. E. Mullin

D. O. Schwennesen

Donald O. Schwennesen was recently elected Vice President of Magnetic Metals Co., Camden, N. J.

Westinghouse Electric Corp., Semiconductor Dept. made the following appointments: **D. S. Templeton** to Manager of the Product Engineering Section; **Dr. H. W. Henkels** to Manager of the Advanced Development Engineering Section; and, **Dr. E. H. Borneman** to Manager of the Process and Design Engineering Section.

Recent Consolidated Electrodynamics Corp. appointments: **Robert E. Stanaway** becomes Manager of the Spectron Dept., Transducer Div. and **Harold S. Davis** Sales Manager of the DataTape Div.

Richard H. Chamberlin is Manager of the newly-created Product Design Dept. at Eitel-McCullough, Inc.

The latest Ampex Corporation's promotions: **Robert A. Miner** to Manager of the newly-created Market Planning Dept., and **Nairne F. Ward, Jr.** to Market Research Manager. Both positions are in the Professional Products Div.

R. E. Carson has joined Kierulff Sound Corp. as General Sales Manager.

(Continued on page 46)

NEW SANDWICH TAPES!

Recommended specifically for digital recording and most AM, FM and PDM applications

"SCOTCH" BRAND Sandwich Instrumentation Tapes eliminate ruboff and head buildup—reduce head wear—last longer

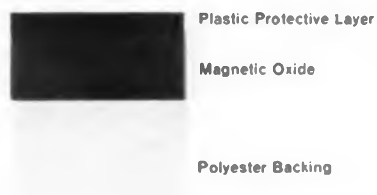
Here's the solution to the problem of excessive wear and ruboff—"SCOTCH" BRAND Sandwich Instrumentation Tapes. These tapes have a thin layer of plastic over the magnetic coating. This layer protects the iron oxide to produce a smooth, low-frictional head-to-tape operation that eliminates ruboff, head buildup and connected problems.

The addition of this protective layer (50 micro-inch thickness) naturally modifies the magnetic properties of the tapes somewhat. This amounts to a slight (but not critical) reduction in the high frequency or short wave length response. The medium and long wave length responses are completely unaffected. In all applications where extremely high frequency response is not required, "SCOTCH" BRAND Sandwich Tapes offer the ultimate in performance, combined with new freedom from maintenance problems.

Three Sandwich Tapes are now available:

- **#188**—For applications requiring standard output level. 1.5 mil polyester base, 0.35 mil magnetic coating, 50 micro-inch protective layer.
- **#186**—For instrumentation and computer applications higher than standard output. 1.5 mil polyester base, 0.50 mil magnetic coating, 50 micro-inch protective layer.
- **#189**—Standard output level with 50% more recording time. 1.0 mil polyester base, 0.35 mil magnetic coating, 50 micro-inch protective layer.

WRITE TODAY for illustrated brochure on Sandwich Tapes. Special reels, end-of-reel sensing items and other accessories required for digital computer operations are also available. Address: Instrumentation Tape Division, 900 Bush Avenue, St. Paul 6, Minn.



REG. U.S. PAT. OFF.
SCOTCH
BRAND
Magnetic Tapes

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

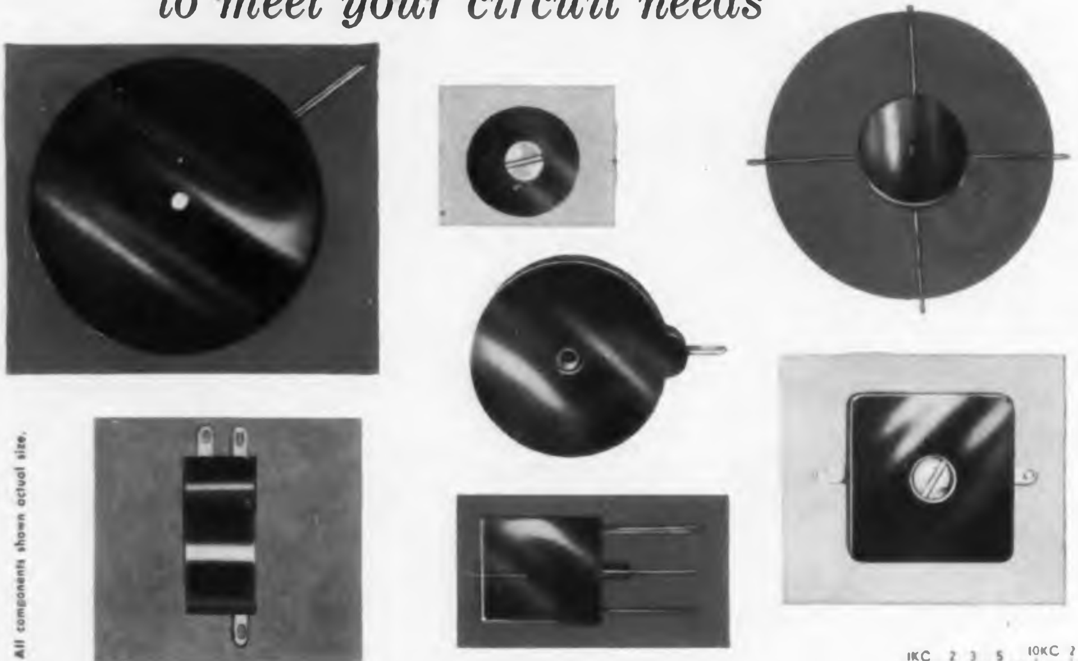
3M COMPANY

 Circle 125 on Inquiry Card, page 97

Burnell offers

THE MOST

complete line of encapsulated toroids to meet your circuit needs



All components shown actual size.

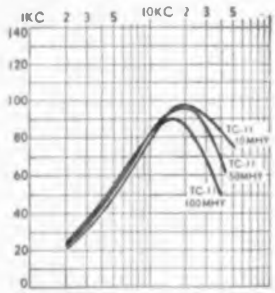
Burnell & Co., pioneers in the development of toroids, filters and related networks now offer the most complete—the most reliable line of encapsulated toroids.

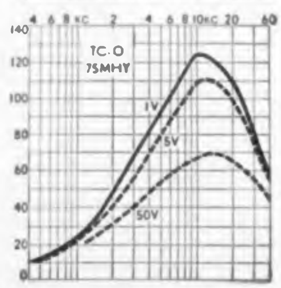
Burnell encapsulated toroids include the only encapsulated adjustoroids available anywhere—satisfy the toughest circuit demands in serviceability—light weight—miniaturization.

Burnell encapsulated toroids are particularly useful in guided missile and similar miniaturization fields where space and mounting are highly critical factors. Send for free, new Catalogue No. 104 covering scores of applications with schematics and performance curves.

COIL CHART

TYPE	NOMINAL UNCASED DIMENSIONS	WEIGHTS UNCASED (OUNCES)	MOULDED DIMENSIONS
TC 0	1" x 13/32"	5/8	1 1/16" OD x 1/2" H
TC 1	1 5/8" x 5/8"	less than 3	1 3/4" OD x 3/4" H
TC 2	2 9/32" x 15/16"	10	2 3/4" OD x 1/8" H
TC 3	1 1/2" x 5/8"	2 1/2	1 3/4" OD x 3/4" H
TC 4	1 7/32" x 19/32"	less than 2	1 5/16" OD x 23/32" H
TC 5	1 7/32" x 19/32	less than 2	1 5/16" OD x 23/32" H
TC 6	1" x 13/32"	5/8	1 1/16" OD x 1/2" H
TC 7	1" x 13/32"	5/8	1 1/16" OD x 1/2" H
TC 8	1 9/16" x 5/8"	less than 2	1 3/4" OD x 3/4" H
TC 9	1" x 3/8"	less than 1/2	1 1/16" OD x 1/2" H
TC 10	1 3/32" x 15/32"	1	1 1/4" OD x 5/8" H
TC 11	5/8" x 9/32"	1/4	3/4" OD x 1/2" H
TC 12	5/8" x 9/32"	1/4	3/4" OD x 1/2" H
TC 13	5/8" x 9/32"	1/4	3/4" OD x 1/2" H
TC 14	5/8" x 9/32"	less than 1/4	3/8" OD x 1/2" H
TC 15	1 7/8" x 7/8"	5	2" OD x 1" H
TC 17	1 3/32" x 15/32	less than 1	1 1/4" OD x 5/8" H
TC 20	1 3/32" x 15/32"	1	1 1/4" OD x 5/8" H
TC 27	1 9/16" x 11/16"	2 1/4	1 3/4" OD x 3/4" H



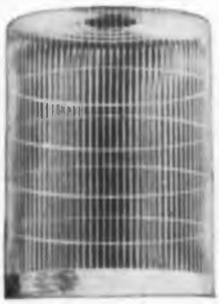


CHEMICAL
DIVISION

FOR INDICATION OF O_2 OR H_2

MINOXO® INDICATOR . . . measures traces of molecular oxygen in other gases—from 1 to 10 parts per million, and from 1 to 100 PPM. High sensitivity and rapid speed of response enable it to be used for laboratory investigation and production quality control. SUPER-SENSITIVE DEOXO® INDICATOR . . . measures oxygen or hydrogen present as impurities in other gases—from 2 to 200 parts per million oxygen and 4 to 400 parts per million hydrogen. Dual range permits measurement up to .25% oxygen or .50% hydrogen.
Chemical Division, 113 Astor Street, Newark 2, N. J.

Circle 32 on Inquiry Card. page 97



BAKER
PLATINUM
DIVISION

FOR VACUUM TUBE GRIDS

PLATINUM CLAD TUNGSTEN WIRE . . . Because of its superior physical properties at elevated temperatures, tungsten provides the more rigid, refractory core material required by high power tubes; it also exhibits lower interaction with platinum. Platinum clad tungsten is readily hot stretched to take a permanent setting and lends itself to fabrication into grids employing conventional fixtures and spot welding procedures. Available in diameters from .001" and up.
Baker Platinum Division, 113 Astor Street, Newark, N. J.

Circle 33 on Inquiry Card. page 97

CHEMICAL
DIVISION

24K GOLD IMMERSION SOLUTION

ATOMEX® . . . For depositing a thin layer of 24 Karat Gold by means of a simple bath. Such items as clock assemblies and metallized plastics receive a dense, uniform deposit of gold. Printed circuits protected in this manner retain their solderability for 12 to 18 months under ordinary storage conditions. More permanent than electroplating of comparable thickness, yet much simpler and cheaper. Expensive analytical control is unnecessary.
Chemical Division, 113 Astor Street, Newark 2, N. J.

Circle 34 on Inquiry Card. page 97

ENGELHARD INDUSTRIES, INC.

113 ASTOR STREET
NEWARK 2, NEW JERSEY

Industry News

(Continued from page 42)

Hal A. Skutley has been named North Central Regional Engineer of Kellogg Switchboard and Supply Co. **J. O. Smith** . . . Division Sales Manager of the Western region.

Cecil Covington has transferred to the Central Control and Finance staff of Texas Instruments Inc. as Manager of Government Contracts Administration. **Rear Adm. Chester W. Nimitz, Jr. USN (Ret.)** succeeds him as Controller of the Apparatus Div.

Dr. C. L. Register is the new Manager, Ballistic Missile Div., at Burroughs Research Center, Paoli, Pa. Dr. Register joined the firm last year after retiring as a Colonel in the U. S. Army. At the Burroughs home office, Detroit, **Clarence Dunlop** has been appointed Vice President—Manufacturing Facilities Planning.

Myron Bakst will now serve as Project Manager for the White Alice integrated civilian-military communications system in Alaska, representing Federal Electric Corp.

Harvey R. Butt has been named Manager, Radiomarine Marketing, Communications Products Dept., RCA.

H. R. Butt

E. J. Cousin

Edward J. Cousin will now serve as Manager of space and missile programs for A. B. Du Mont Labs., Inc. Mr. Cousin was formerly with Servo Mechanisms, Inc.

At Tinnerman Products, Inc., **John E. Potter** has been elected Vice President and Treasurer; **Chester A. Jones**, Secretary.

Peter M. Maler has been appointed Sales Manager of Skottie Electronics.

Pinckney B. Reed has been named to the newly-created post of Vice President, Educational Electronics, RCA.

At Airborne Instruments Laboratory, **Malcom J. Rowe** has been appointed to position of Manager of Marketing.

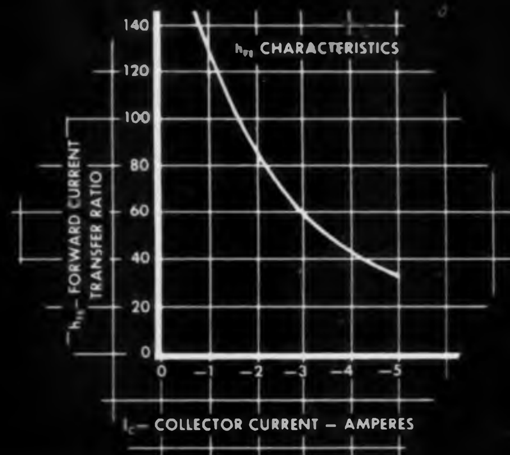
(Continued on page 185)

HIGH
BETA
130 at 1 amp
30 at 5 amps
V_{CBO} -40V, -60V, or -80V

LOW
I_{CO} 2mA max at rated voltage
R_{CS} less than .05 ohms

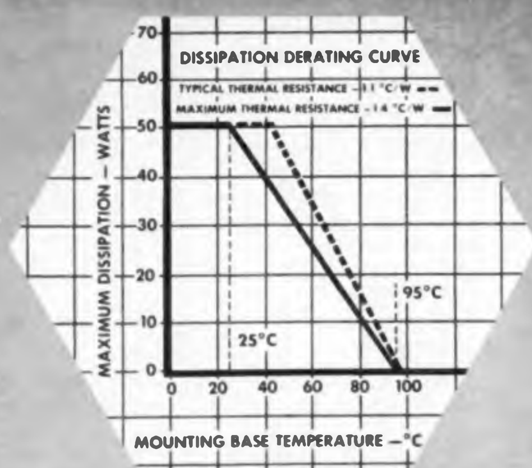
T/I GERMANIUM POWER TRANSISTORS

You get high current gain and power output with linear transconductance and extremely low distortion when you specify TI PNP germanium power transistors. Assurance of performance as specified results from checking I_{CO} at half as well as full rated voltage and by checking beta again at low voltage ($V_{CE} = 1.5V$) and at two current ratings (1 amp and 5 amps). Ideally suited for your audio amplifier, current switching, and power conversion applications, TI 2N456, 2N457, and 2N458 germanium power transistors dissipate 50 watts with −40, −60, and $-80V_{CBO}$ ratings . . . BV_{CBO} ratings average 20 volts higher for each transistor.
Check the specifications below for the unit most appropriate to your particular requirements.



maximum ratings at 25° C*		2N456	2N457	2N458	unit
V_{CBO}	Collector to Base ($I_C = -2.0mA$)	−40	−60	−80	V
V_{CEX}	Collector to Emitter ($V_{BE} = +0.2V$, $I_C = -2.0mA$)	−40	−60	−80	V
V_{EBO}	Emitter to Base ($I_E = -2.0mA$)	−20	−20	−20	V
	Total Dissipation†	50	50	50	W
I_C	Collector Current	5	5	5	A
I_B	Base Current	3	3	3	A
T_j	Junction Temperature	95	95	95	°C
typical characteristics at 25° C*					
BV_{CBO}	Collector to Base Breakdown Voltage ($I_C = -10mA$, $I_E = 0$)	−60V	−80	−100	V
h_{FE}	Forward Current Transfer Ratio ($I_C = -1.0A$, $V_{CE} = -1.5V$)	130	130	130	—
	($I_C = -5.0A$, $V_{CE} = -1.5V$)	30	30	30	—
R_{CS}	Common-Emitter Saturation Resistance ($I_C = -5.0A$, $I_B = -1.0A$)	0.048	0.048	0.048	Ohm
	Thermal Resistance from Collector Junction to Mounting Base	1.1	1.1	1.1	°C/W

* Temperature is measured on mounting base.
† For operation at higher temperatures refer to the Derating Curve.



AVAILABLE NOW IN PRODUCTION QUANTITIES

NEW 310,000 sq. ft. SEMICONDUCTOR-COMPONENTS DIVISION HOME

ADVANCED FACILITIES FOR THE MOST ADVANCED COMPONENTS . . . TO MAKE YOUR GOOD PRODUCTS BETTER

TEXAS INSTRUMENTS
INCORPORATED
SEMICONDUCTOR-COMPONENTS DIVISION
POST OFFICE BOX 312 • DALLAS, TEXAS

TAKE YOUR PICK FROM . . .

THE SPRAGUE TRANSI-LYTIC* FAMILY

of tiny electrolytic capacitors

for every requirement in entertainment electronics . . . pocket radios, wireless microphones, miniature tape recorders, auto receivers

LITTL-LYTIC* CAPACITORS

Sprague's new Type 30D hermetically-sealed aluminum-encased capacitors are the *tiniest* electrolytic capacitors made to date . . . and their performance is better than ever. Their remarkable reliability is the result of a new manufacturing technique in which *all the terminal connections are welded. No pressure joints . . . no "open circuits" with the passage of time.* And check this for ultra-low leakage current: for a 2 μf, 6 volt capacitor . . . only 1.0 μa max.; for a 300 μf, 6 volt capacitor . . . 3.5 μa max.! Engineering Bulletin No. 3110 gives the complete story. 85°C standard.

VERTI-LYTIC* CAPACITORS

These space-saving Type 89D 'lytics are designed for easy manual upright mounting on printed wiring boards. Keyed terminals assure fast mounting and correct polarity. No reworking on the assembly line. Sturdy pre-molded phenolic shell with resin end-fill gives excellent protection against drying-out of the electrolyte or the entry of external moisture. The phenolic case eliminates the necessity for additional insulation. Reasonably priced for mass production receivers. Engineering Bulletin No. 3060 lists standard ratings with performance data.

*Cera-lytic** CAPACITORS

The ideal capacitor for applications where low cost is the primary consideration is Sprague's new Type 31D. Capacitor sections are housed in a dense steatite tube with resin end-fill to provide protection against mechanical damage and atmospheric humidity. This construction results in excellent capacitor performance for all miniature electronic circuits. Size for size, they're the smallest the industry has produced in a ceramic-cased aluminum electrolytic. Engineering Bulletin No. 3010 details standard ratings and gives performance data.

*Trademark

FOR ENGINEERING BULLETINS on the industry's first complete line of subminiature aluminum electrolytic capacitors, write Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

SPRAGUE®
the mark of reliability

SPRAGUE COMPONENTS:

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

WESCON—1958

For our seventh annual West Coast issue, exclusive statements from the area's outstanding leaders trace growth patterns and strength of Western electronic manufacture.

The West Begins To Realize Its Electronic Destiny

L. W. Howard
President of Triad Transformer Corporation and Chairman of the Board, WESCON-1958

TO get a good viewpoint of the electronic industry in the West one should cast a backward glance at growth trends over the past few decades. Some of us who first entered the industry in the Los Angeles area in 1930 need only to refer to well-established memories. Then we were congregated in a few small companies building radio sets and perhaps three or four even smaller firms building components for them. It was in 1930 that the "midget" set was originated in Los Angeles and their manufacturers enjoyed a brief boom before the eastern interests caught on and stimulated some heady competition. In the fall of 1930 there were close to a hundred radio set manufacturers in Los Angeles.

Over the next few years, attrition set in; there were failures and consolidations, some companies fled the radio business. Presently, only two of the 1930 roster remain and these are successor companies with strong, integrated and well-financed operations and which do not confine themselves to radio as a product.

Since 1930, the trend has been for engineers with a good product idea to start a manufacturing enterprise. The mortality has been high, due to lack of financial and production know-how and, too frequently, to lack of adequate working capital. However, enough of these have survived, through sheer grit, daring and lessons-learned, to be considered the pioneering corps of an electronic complex which now accounts for a respectable 24% of the vastly expanded national electronic output.

One of the salient features of the western electronic economy has been the lack of competition, relatively, between manufacturers of electronic equipment. (Some of us wish we could say the same thing about components, particularly

(Continued on page 86)

The WEST—A Professional Environment For Electronic Progress

Bruce S. Angwin
Western Regional Manager, General Electric Co., and Chairman of the Executive Committee for WESCON-1958.

A FEW years after Kitty Hawk, on the Atlantic Coast, the Age of Electronic Communication was given its first auspicious introduction on the West Coast through the work of De Forest, Elwell and some few other hearty pioneers who, still hale and interested, are around to witness the return of the national emphasis on professional achievement to the western regions of the U. S. There is gathering evidence that the major movement of tech-

(Continued on following page)

WESCON—1958

(*Continued from preceding page*)

nical competence is toward the promise offered by the explosive growth of the western electronics industry as it undertakes a major role in the nation's economy and defense.

Prior to World War II, the West Coast was moderately active in electronic equipment design and production. Many young technicians and future engineers passed through Western training centers on their way to various Pacific theatres during the war. They apparently liked what they saw and eventually returned to make their peacetime living. As a result, the West Coast boasts the greatest proportional concentration of scientific engineering talent of any area in the nation and its climate, renowned educational centers, and major electronic activities make its continued future growth a certainty.

As aircraft became more sophisticated in design, larger, heavier, and able to operate at fantastic speeds, they also became more dependent on electronics to provide the control functions which required strength and decision-making abilities far beyond the inherent abilities of man. It was only natural then that these two great industries, aircraft and electronics, would amalgamate into an even greater industry, making possible the gigantic high speed military and commercial aircraft, as well as the multitude of rockets and missiles that are such a vital key to our social and economic future. The nerve center of airborne electronics, in the form of our most able, talented, and largest Research and Development organization, can be found in the Western States.

Perhaps the greatest area for future electronic growth exists in commercial electronics. Here, too, the West is nursing a giant of the future. Nearly every major Eastern and Mid-Western electronics corporation has established a Research and Development activity in the West to tap the fertile supply of visionary brainpower. At

(*Continued on page* 88)

Don Larson
Business Manager
WESCON

Bigger Is Not Necessarily Better

WESCON, whose initials for the Western Electronic Show and Convention have realized a main identity with the West's largest trade show and technical congress, is a unique organization whose dynamic role in reporting and observing the progress of electronics each year bespeaks the cooperation and interdependence of the industrial and professional interests it was designed to further.

The uniqueness of WESCON lies principally in the evidence of closeness of purpose demonstrated by its co-sponsorship by the West Coast Electronic Manufacturers Association and the Seventh Region of the Institute of Radio Engineers.

WCEMA, which operates the year around from two permanent California offices in behalf of western electronics manufacturers, brings to the operation of WESCON management skill and policy guidance unparalleled in similar promotions of industrial trade. Presently WCEMA's membership represents 90% of the annual volume of the electronics industry in the West.

The Seventh Region of the IRE, through its San Francisco and Los Angeles Sections, supplies the leadership and professional judgments that keep the level of the convention at a quality consistent with the achievements of the IRE's international membership, upon which it draws for the technical program and a large share of WESCON's attendance.

These two organizations contribute *people* to WESCON. And *people make WESCON* . . . this year almost four hundred of them. They make up the operating committees which form in January and devote untold extra-curricular hours through August to carry out the many-sided affair which brings to Los Angeles and San Francisco, in alternating years, their biggest influx of convention visitors.

The 1958 WESCON will be the largest trade show ever held in the West by any known comparisons. It will occupy 192,400 square feet of floor space, forcing the addition of canvas pavilions to the Pan Pacific Auditorium and almost doubling the capacity of the permanent structure—which is still the largest exhibit hall in Southern California. Allocated have been 901 standard 10-foot booths, the absolute maximum and much to the disappointment of some fifty companies unable to obtain exhibit space.

The convention portion of WESCON has also had to be designed by space restrictions. The Ambassador Hotel, which will house the technical sessions, is the largest in Los Angeles from the standpoint of meeting rooms. With an eye to comfort and convenience and another toward the anticipated attendance, the decision groups cast

(*Continued on page* 90)

Electronic Spotlight On WESCON—Aug. 19

Four-day show and convention at Los Angeles' Pan-Pacific Auditorium and Ambassador Hotel will feature forty-two technical sessions, including two special programs. Products will be exhibited by more than 700 different companies.

For WESCON
Technical Papers Program
See page 159

WESCON, sponsored jointly by the Los Angeles and San Francisco sections representing the Seventh Region, IRE, and members of the West Coast Electronic Manufacturers Association, will host technical and industry delegates from across the nation at two major Los Angeles locations, the Ambassador Hotel and the Pan-Pacific Auditorium.

Forty-two technical sessions, including two special programs, are on the four-day agenda August 19 through 22. They will be held in all five major meeting rooms of the Ambassador Hotel concurrently each morning and afternoon. Combined capacity of the meeting rooms is 4700 persons.

For the first time, 1958 technical program speakers will be guided by a special booklet on presenting papers before WESCON audiences, prepared this year. It is a concise series of suggestions on how to achieve the most effective presentation.

In the first of two special sessions, six speakers will discuss "Biological Measurement Problems of Space Travel," under chairmanship of Dr. Robert Tschirgi of UCLA on Wednesday evening (August 20). That afternoon, an invited-paper session on "Industry Looks at Fusion Power" is scheduled.

The exhibit at Pan-Pacific, first sold out early this spring, then expanded and sold out again, will present about 900 electronic exhibits by more than 700 different companies.

The big auditorium will be augmented by four pavilions to accommodate the show, and even that expansion will not cover all applications for exhibit space.

In a new facet of the show presentation, one entire pavilion will feature electronic production materials and equipment exclusively. Persons interested primarily in this field will find all production equipment in one place.

Throughout the show, wider aisles—10 feet—have been provided to insure easier viewing of exhibits and the elimination of "traffic jams."

Housed also in a Pan-Pacific pavilion will be the Future Engineers' show, with outstanding student-scientists exhibiting their work. Invitations for participation

(*Continued on page* 158)

Officers of the WCEMA: Seated, S. H. Bellue, C. K. Townsend, D. C. Duncan, St. G. Lafitte, C. Van Rensselaer, D. E. Root; standing, R. B. Leng, P. L. Gundy, S. Ferguson, G. L. Osborne, J. A. Chartz, R. L. Paullus, H. P. Moore, E. H. Lockhart, A. N. Curtiss.

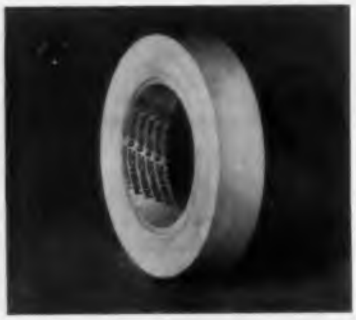
WESCON Product Highlights

FREE SPACE ROOM

Low cost prefabricated free space room for all types of UHF-VHF microwave antenna or radome testing is available. Room consists of 4 x 4 ft. wooden frames supplied predrilled with hardware. Any type of absorbing material can be supplied. McMillan Laboratory, Inc., Booth 903.

Circle 234 on Inquiry Card, page 97

ELECTRICAL TAPE



A new, thin "2-in-1" Flatback Paper Electrical Tape Permacel 272 with an extremely high resistance to electrolytic corrosion has just been released. It has an overall thickness of only 5 mils. In its uncured state it is highly pressure sensitive. Permacel - LePage's Inc., Booth 126.

Circle 235 on Inquiry Card, page 97

MINIATURE COMPONENTS

Miniature components include i-f transformers, dials, knobs, dial locks, shaft locks, flexible couplings, ceramic terminal strips, binding posts, gear drives and insulated mountings. They are approximately 2/3 size of standard units. James Millen Mfg. Co., Booth 1324.

Circle 236 on Inquiry Card, page 97

CONDUCTIVE ADHESIVE

Eccobond Solder 58 C is a one-component conductive epoxide based adhesive with at least a one year shelf life at room temperature. It is used in applications where tin-lead solder is impractical. When cured, resistivity is below 0.1 ohms/cm. Emerson & Cuming, Inc., Booth 326.

Circle 237 on Inquiry Card, page 97

LAMINATE PRODUCTS

Products in 4 special exhibits are (1) di-clad printed circuit materials, (2) wide range of supported and unsupported Teflon materials, (3) high-heat resistant laminates and molded products, (4) flame retardant laminates. Continental-Diamond Fibre Corp., Booth 331.

Circle 238 on Inquiry Card, page 97

H-F MOTOR GENERATORS

Small light weight motor-generators for the missile and aircraft industry are available. A series of models are available operating from a 400 cps, single or multi-phase supply and delivering 250 w. of continuous power at frequencies from 1000 to 5000 cps. D & R, Ltd. Booth 635.

Circle 239 on Inquiry Card, page 97

MODULAR ENCLOSURE SYSTEM

An expanded, improved Emco Modular Enclosure System, made more versatile to meet the broadening needs of America's electronics, instrument, and automation industries is available. Demonstrated is the "erector set" features. Elgin Metalformers Corporation, Booth 1538.

Circle 240 on Inquiry Card, page 97

SUBMINIATURE POTENTIOMETERS

Series 341 ten-turn potentiometers are the smallest available on standard order. Only one-half inch in diameter by one inch in length. Double wipers are used, and backlash is eliminated. Resistance values from 1 K to 200 K are available. Daystrom Pacific, Booth 704.

Circle 241 on Inquiry Card, page 97

WESCON Product Highlights

CABLE TESTER

Complex, branching circuits are simultaneously high potted, tested for continuity, and measured for leakage resistance between each circuit and all others by the Cable Tester. Checks at a rate of 5 wires per second automatically. California Technical Industries, Booth 1213.

Circle 242 on Inquiry Card, page 97

PRECISION GEARHEAD

A precision gearhead for their size 10 servo motors is available. It is also available with size 11 mounting dimensions. Overall length of the gearhead is less than 1 in. Ratios from 6:1 to 274:1 are available. Meets MIL-E-5272A. Clifton Precision Products Co., Booth 749.

Circle 243 on Inquiry Card, page 97

AUTOMATIC VOLTAGE REGULATOR

Stabiline Automatic Voltage Regulator type EMT4104U automatically regulates fluctuating ac power lines to maintain a constant output voltage regardless of line or load changes. Compact assembly is suited for control of loads up to 35 a. The Superior Electric Co., Booth 1365.

Circle 244 on Inquiry Card, page 97

PC COMMUTATION SWITCH

Switch uses Supramica 560M ceramoplastic commutator plates. It is designed for telemetry, sampling, data handling, and automatic control applications. Motor driven switch is available in multi-pole configuration with up to 180 segments. Mycalex Corp. of America, Booth 1400.

Circle 245 on Inquiry Card, page 97

H-F GERMANIUM TRANSISTOR

An all new high-frequency germanium transistor is now available for production. The transistor oscillates above 500 megacycles and will deliver 10 db gain at 200 megacycles. It is referred to as the Mesa transistor. Motorola, Incorporated, Booth 268.

Circle 246 on Inquiry Card, page 97

HOOK-UP WIRE

Four new Work Bench Hook-Up Wire Dispenser Kits of Teflon insulated Type E, MIL-W-16878-B Hook-Up Wires are being introduced. Each KIT contains ten different colored 25 foot spools of either 20, 22, 24 or 26 AWG wire, plus a metal dispenser rack. Belden Manufacturing Co., Booth 1114.

Circle 247 on Inquiry Card, page 97

MINIATURE CONNECTORS

Removable contact connectors, the new DS series, are miniatures with silicone inserts and "snap-in" contacts. Crimp-type terminations replace the solder pots. Also a wide range of miniature connector modifications will be shown for the first time. Deutsch Co., Booth 949.

Circle 248 on Inquiry Card, page 97

TRANSISTORIZED POWER SUPPLIES

Solid state regulated power supplies cover both the high current-low voltage ranges as well as the high voltage ranges with ratings in excess of 10 KV. These models (TR 32 Series) feature all-semiconductor designs. Electronic Research Associates, Inc., Booth 1640.

Circle 249 on Inquiry Card, page 97

WESCON Product Highlights

METER KITS

Two basic meter movements can be used with separate Dial-Component sections to give a complete line of dc voltmeters, milliammeters, ammeters, and rectifier type for ac volts. No opening of dustproof movement, no soldering or wiring is required. Triplett Electrical Instrument Co.

Circle 250 on Inquiry Card, page 97

DATA PROCESSING & DISPLAY

The Digitron is an advanced simplified data processing and display system now being produced. This system provides a high intensity display of letters, numerals, symbols and patterns on the face of a conventional cathode ray tube. Associated Missile Products Co., Div. of AMF.

Circle 251 on Inquiry Card, page 97

UTILITY LINE DRIVER

An all purpose complete utility amplifier with self-contained power supply for broadcast and TV makes a good single channel remote amplifier, a high gain, low noise turntable preamplifier, a line, repeater or program amplifier or stand-by unit. Gates Radio Co.

Circle 252 on Inquiry Card, page 97

DELAY LINE DRIVER

Delay line was developed and manufactured according to requirements of SAGE Air Defense data processing equipment. It has multiple tap outputs which are free of the signal distortion and attenuation normally encountered in multi-section delay lines. Packard-Bell Electronics Corp.

Circle 253 on Inquiry Card, page 97

TRANSISTORIZED DIGITAL COMPUTER

A problem is fed into RECOMP II, portable, general-purpose, all-transistor, digital computer. Operational in office, lab, or field, it has a multitude of uses in engineering, manufacturing and various businesses and industries. Operates from wall outlet. Autonetics.

Circle 254 on Inquiry Card, page 97

RADIO FREQUENCY VOLTMETER

A true RMS responding, direct-reading voltmeter, Model RFV, for the precision checking and calibration of oscillators, signal generators, electronic voltmeters and similiar apparatus or as an ac-dc transfer standard is now available. Sensitive Research Instrument Corp.

Circle 255 on Inquiry Card, page 97

SERVOPOT

The servopot is an integral combination of a two-phase instrument servomotor, gear reduction, slip clutch, and precision potentiometer. It eliminates the present burden of mounting, testing, and aligning separate units. Has built-in slip clutch Diehl Manufacturing Co.

Circle 256 on Inquiry Card, page 97

SINE-COSINE POTENTIOMETER

Capable of accurately generating Sine-Cosine functions, the 1¾ in. dia. Model 1750-21 Potentiometers feature high resoution and are suitable for airborne applications. Conformity to the desired sine or cosine function is within ±1% of peak amplitude. G. M. Giannini & Co., Inc.

Circle 257 on Inquiry Card, page 97

The "Mesa" sets a new high in miniaturization

Higher frequency of operation, higher power handling capabilities, and exceptional reproducibility are the features of this new micro-miniature transistor, the smallest being commercially manufactured.

New Transistor Design— The "Mesa"!

By C. H. KNOWLES,
Semiconductor Product Division, Motorola Inc. Phoenix, Ariz.

RECENT developments at several locations have resulted in a new line of VHF-UHF Transistors.[1, 2, 3] We will refer to this new line of transistors as Mesa Transistors. The significance of the new design can hardly be overestimated. The impact of the Mesa Transistor will be immense in both high frequency and high power electronics.

This article will describe the first two commercially available Mesa Transistors. The first is a VHF low level amplifier transistor. The second is an ultra high speed switching transistor.

The Mesa Transistor gets its name from its physical configuration, shown in Fig. 1. A basic part of its structure is the "Mesa," (Spanish name for "table"), which is the active region of the transistor.

The advantages of the Mesa Transistor over other transistors as it appears here and elsewhere[1, 2, 3] are striking. These are:

1. Potentially Higher reliability
2. Higher degree of manufacturability
3. Higher frequency of operation
4. Higher power capability
5. More rugged
6. More reproducible
7. Higher temperature of operation
8. Lower susceptibility to nuclear radiation
9. Microminiature.

Reliability

Examination of Fig. 1 reveals three reasons for the higher potential reliability of the Mesa Transistor over other transistor designs. First, the highest purity techniques known are used to form the junctions (Fig. 1): vapor diffusion of a gas (antimony in a hydrogen carrier gas) into solid germanium to form the base-collector junction, and high vacuum evaporation—alloying to form the emitter-base junction.

Second, the lowest melting component in the entire transistor is about 350°C. The unit can therefore be subjected to the high temperature, high vacuum bake out that has long been used in vacuum tube technology to achieve long-term stability.

Third, the critical power dissipating junction is

Table 1

High Powers Require:	Corresponding Necessary Physical Quantity within the Transistor:	Resulting High Frequency Characteristic:
High Current	Thin Base	High f_α
	Narrow Emitter	Low r_b'
	Heavily doped base	Low r_b'
	Aiding Field in base	High f_α
	High current densities	Low emitter time constant
High Voltage	Wide collector depletion layer	Low C_c
High Power Handling	Low internal dissipation	High efficiency
	Low series resistance	Low RC time constants
	Short switching times	High frequency response

A REPRINT

of this article can be obtained by writing on company letterhead to

Editor,
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

The "Mesa" *(Continued)*

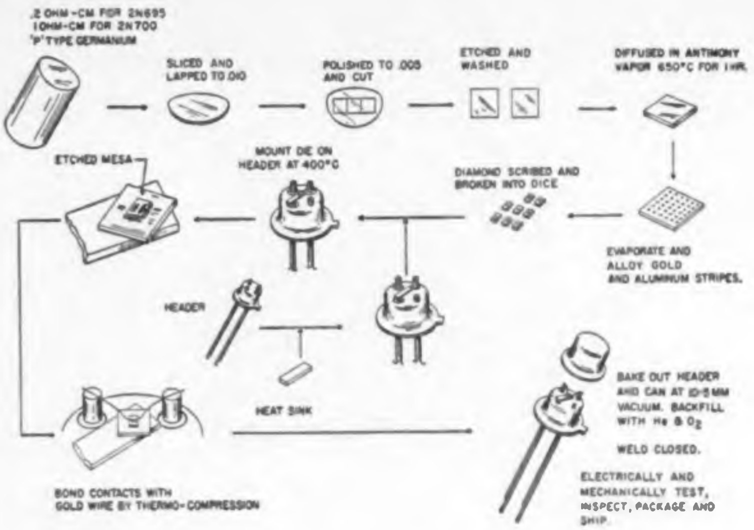


Fig. 2: Step-by-step process in manufacturing "Mesa" units

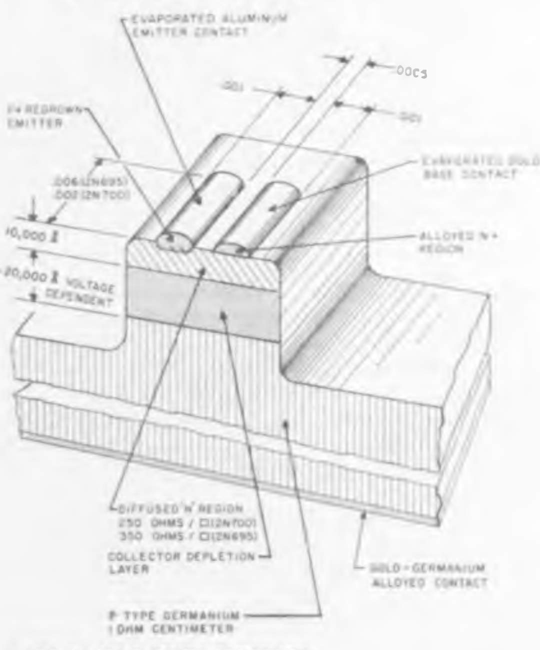
entirely germanium. That is, there are no alloys involved in the formation of the collector junction. Thus, thermal runaway in power dissipation modes of operation is far less dangerous.

High Degree of Manufacturability

Fig. 2 shows a process for manufacturing Mesa Transistors. The basic steps are:

1. Germanium Preparation
2. Diffusion of N-type base region
3. Evaporation and alloying the emitter P region and base contacts (see Fig. 3)
4. Dicing
5. Mount Dice onto headers

Fig. 1: Construction of new "Mesa" transistor



6. Etch Mesa
7. Bond contacts and clean
8. High Vacuum bake out and weld can
9. Test.

Note that all the junctions are completely formed during steps 2 and 3. Both diffusion and evaporation alloying are designed to handle large numbers of units (the order of 1000 to 10,000 per run). Both diffusion and evaporation alloying are inherently easily and highly controllable. The operations from the assembler standpoint are very simple. The subsequent control on collector capacitance is in area, not in the critical thickness of the depletion layer. The thickness of the depletion layer in the Mesa Transistor technique is determined by the resistivity of the starting P-type material. Therefore the collector capacitance in the Mesa Transistor technique is inherently easily controlled.

Another important characteristics of the Mesa Transistor is that the entire impurity distribution in the transistor is controlled from one surface. The emitter and collector junction placement, so very critical in transistor design, are thus more readily controlled. Precise control over base impurity distribution is also obtained.

Control of the transistor impurities from one side only is analogous to the old carpenter's rule: "Always use the same plank as a reference length."

The resulting increase in precision of placement of all the impurities within the transistor is very important in *designing* for optimum frequency response. The precision is also important in controlling the manufacturing process. This manufacturing control is to be discussed later in this paper.

Thus, all the important transistor parameters are determined by large batch processes which, when properly done, are very precisely controllable.

Higher Frequency

Microminiaturization is a basic requirement of high frequency transistors. A rule of thumb is that the frequency response of transistors goes up directly as

TABLE 2: TYPICAL CHARACTERISTICS OF 2N700 UHF Amplifier Transistor

Collector to Emitter Breakdown Voltage (100 μa)	35 volts
Emitter to Base Breakdown Voltage (100 μa)	0.5 volts at 100 μa
Max. Collector Dissipation in Free Air Derate 1.0 mw/°C above 50°C	50 mw
Collector Cutoff Current (Vcb = 10V)	0.7 μa
Collector Capacitance (Vce = 5V, Ie = Oma)	1 μμf
Small Current Gain at 100 mcps, hfe (Vce = 6V, IE = 2ma)	5
Small Signal Current Gain, hfe (Vce = 6V, Ie = 2ma, f = 1 KC)	20
Base Connection Resistance, rb′	50 ohms

size goes down. The transistor shown in Fig. 1 is the smallest transistor this author knows of, that is in production. Therefore in the various designs that have evolved from the basic structure of Fig. 1 each has a higher frequency capability than other designs.

The basic technique used as shown in Fig. 2 is capable of producing transistors which can amplify the 10 to 20,000 MC range.[4,5]

Higher Power

It is fundamental in properly designed transistors that the basic physical parameters which yield high frequency operation also lead to high power capability. That is, high frequency operation and high power operation are not only compatible, but are complementary. Table I shows the complementary nature in some detail. From this, one can see that in every important respect the transistor frequency in power designs are closely linked in an advantageous way.

Quite certainly, very shortly Mesa Transistors will be developed which will provide considerable power at hundreds of megacycles. The 2N537, reported elsewhere[3], available only to Government Contractors was designed to produce 200 milliwatts at 200 MC. In several years, Mesa Transistors will undoubtedly be providing tens of watts at hundreds of megacycles.

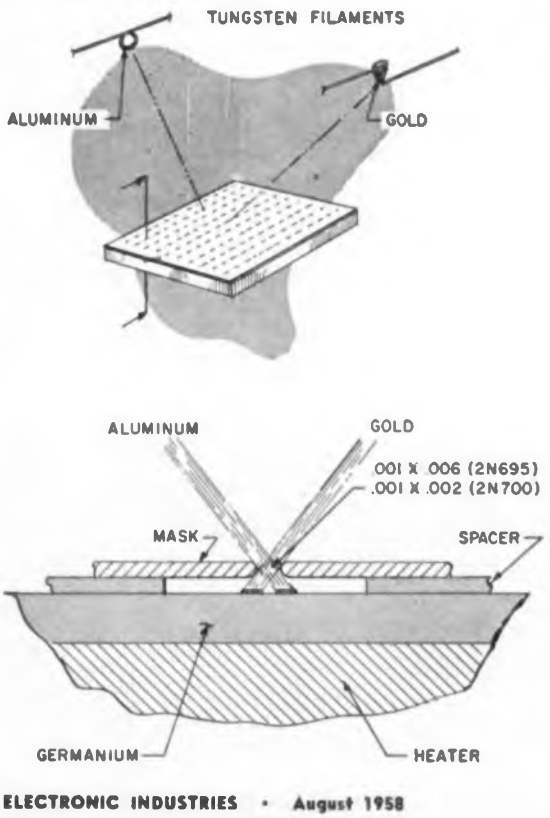


Fig. 3 (left): Schematic of evaporation process

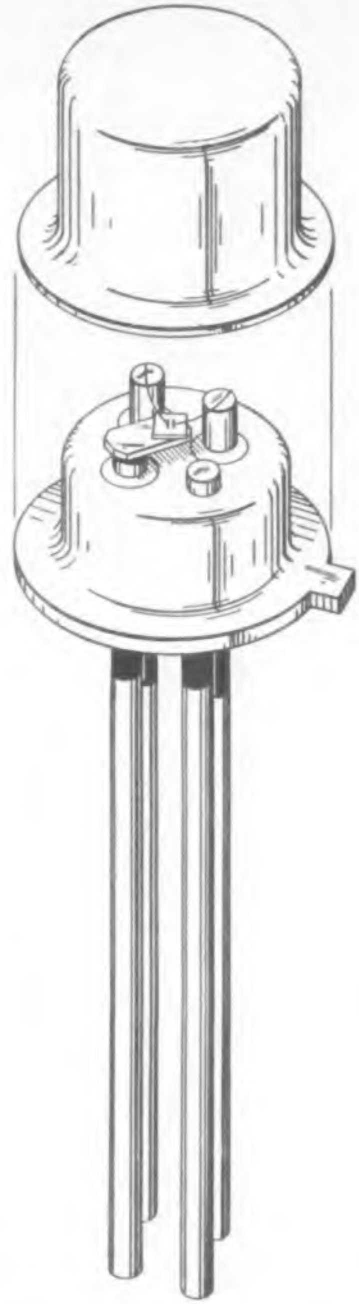


Fig. 4 (right): Mounted transistor, designed to withstand 50,000 G's.

Fig. 5: Photo close-up. Shock limit is determined by the .04 mil gold wire.

The "Mesa" *(Continued)*

Rugged

Examination of Fig. 1 shows that in a basic transistor configuration there are no fragile parts. The mounted transistor die for the units to be described later is shown in Fig. 4 and in Fig. 5. This unit is conservatively designed to withstand 50,000g. The limiting member in the structure is the 0.4 mil gold wire; it must support itself only. The thermal compression bond holding each end of the gold wire has been found to be as rugged as the wire itself.

Reproducibility

Analysis shows that the electrical characteristics of the Mesa Transistor are determined by:

1. The resistivity of the initial P-type material
2. The depth and distribution of the N-type base layer diffused impurities.
3. The areal geometry of the emitter
4. The distance of the base stripe from the emitter
5. The area of the Mesa.

It is to be noted that the only individually mechanical controlled dimension is No. 5, and that being simple to control. All the critical physical parameters are controlled in very large batch processes through basically simple techniques.

Higher Temperature

The Mesa Transistor as shown in Fig. 1 has a higher temperature capability than other types of germanium transistors. The very heavy impurity concentrations in the critical emitter and base regions are the cause for the temperature capability. That is, the thermal changes in the electron and hole mobilities and lifetimes are greatly reduced in heavily doped germanium.[6] Hence, the critical high frequency parameter f_{α}, collector capacitance, and base resistance are little changed.

The usual increase in I_{co} with temperature occurs in Mesa Transistors as in other units; however, the resulting slight drop in output impedance does not affect a properly designed VHF circuit.

Fig. 6 shows the temperature dependence of the gain of a 160 MC amplifier. From room temperature to 90°C there is 1 db drop in gain; from room temperature to −10°C there is an increase in gain of 2db.

The broad temperature capability of Mesa Transistors has also been observed at Bell Telephone Laboratories and the Western Electric Company. Measurements were made on prototype 2N509 and 2N537 Transistors from −150°C to +100°C. These measurements indicate satisfactory operability of VHF Amplifiers over the entire temperature range.

Electrical Properties of Mesa Transistors

We now turn to the electrical properties of the first commercially available Mesa Transistors, the 2N695 and the 2N700. It should be remembered that these two transistors are but the first of a complete potential line of units including both high power and high frequency. Two other Mesa Transistors having higher power capability than the two reported here have been previously reported.[3]

New Header Design

The 2N695 and the 2N700 are assembled on an entirely new header. The header used provides for a miniature completed unit. The dimensional outline of the unit complies in general with the package recommended by Jetec Committee 14 as the Jetec 20 package. There are two exceptions to the preliminary recommendations of the Jetec Committee; these are:

(a) There is a fourth pin
(b) Shorter leads are provided

Fig. 6a (below): For this 160 MC amplifier from room temp. to 90°C., at 1 db drop in gain

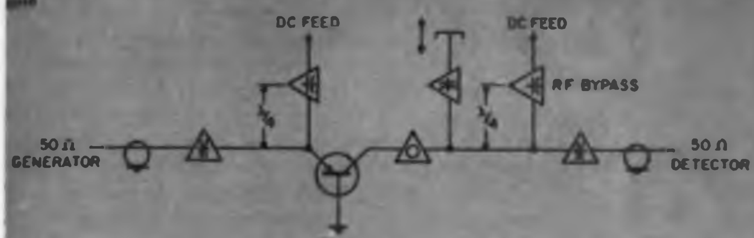
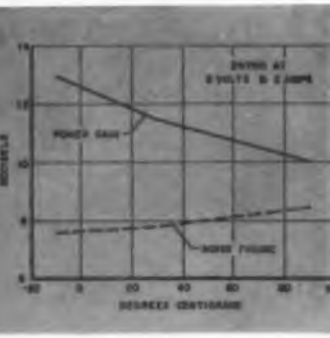


Fig. 6b (r): Power gain and noise figure vs. temperature for the "Mesa" transistor



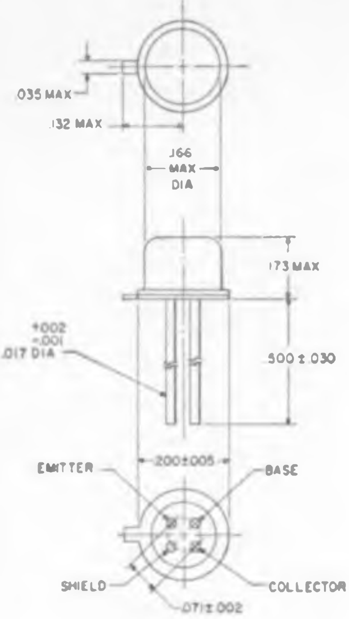
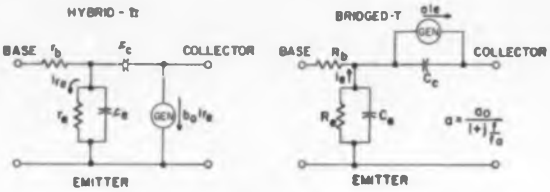


Fig. 7 (left): Physidal dimensions of "Mesa"



TYPICAL PARAMETERS AND OPERATING CONDITIONS

DC COLLECTOR-TO-EMITTER VOLTAGE (V_{CE}) = 6 VOLTS

DC EMITTER CURRENT (I_E) = 2ma	C_e = 15 μμf
r_b = R_b = 50 OHMS	R_e = 15 OHMS
c_c = C_c = 1 μμf	b_o = 25
c_e = 20 μμf	a_o = 0.96
r_e = 500 OHMS	f_a = 400 Mc/sec

Fig. 8 (right): Equivalent circuit for the 2N700

This new header configuration was necessitated in order to improve the electrical and mechanical properties.

Electrically, a larger header configuration such as the Jetec 30, has excessive inductance in the lower UHF range. The 2N695 and the 2N700 have quite useful inherent amplification in the lower UHF range. Therefore, the smaller header is desirable from the electrical design standpoint.

Mechanically, the smaller header with a smaller more compact internal structure will withstand higher shock and acceleration.

The fourth lead connected to the metallic case is equivalent to the screen grid of a vacuum tube. It is used to reduce the inter-electrode feedback capacitance. With this configuration, the circuit engineer can ground either the emitter, base, or collector, inserting a dc bias circuit if desired.

The designer will still have the tremendous advantage of capacitive isolation through grounding the metallic case.

TABLE 3: TYPICAL CHARACTERISTICS OF
2N-695 Ultra High Speed Switching Transistor

Collector Breakdown Voltage, 100 μa	−20 volts
Emitter Breakdown Voltage, 100 μa	− 4 volts
Collector Cutoff Current (V_{CB} = 5 volts)	0.7 μa
Collector Capacitance (V_{CB} = 5 volts)	4 μμf
Saturation Resistance (I_C = 10ma, I_B = 1ma)	25 ohms
Saturation Current gain (I_C = 10ma)	30
Rise time; circuit dependent	~10 mμsec
Storage Time circuit dependent	~10 mμsec
Fall Time	~10 mμsec

The short leads are necessitated by the reduction of inductance, as well as for manufacturing convenience. The ½-in. leads are long enough to allow complete flexibility in wiring at the printed circuits.

The resulting header—transistor configuration, shown in Figs. 4, 5, and 7 is calculated to withstand 50,000g acceleration.

The 2N700

The 2N700 is a PNP transistor designed to operate as a low level (50 mw maximum power) amplifier in the VHF Range. Typically as a 70 MC amplifier, it will give 23db of neutralized power gain. Mechanically, it is designed to exceed the Mil-T-19500-A Military Specifications.

Table II shows the general electrical characteristics of the 2N700. Fig. 10 shows the power gain and noise figure of a typical 2N700 as a function of frequency. Note that the power gain falls off at about 8 db per octave. This 8 db falloff is a result of 6 db per octave decrease in current gain with frequency, and a net 2 db falloff per octave in impedance gain.

An equivalent circuit for the 2N700 is shown in Fig. 8. Fig. 8 shows the usual bridged Tee equivalent network for a transistor. The advantage of the bridged Tee is that it allows a device designer easy access to the transistor internal physical parameters. Circuit designers, however, usually prefer the Hybrid Pi representation shown in Fig. 9. Examples of circuits using the 2N700 are shown in Figs. 6, 10 and 11.

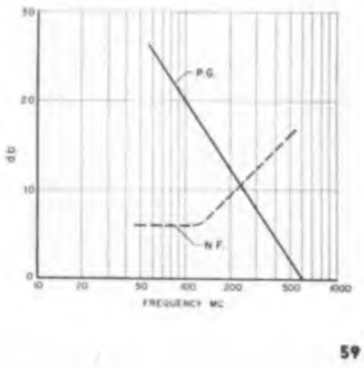


Fig. 9: Neutralized power gain and noise figure vs. frequency

The "Mesa" *(Concluded)*

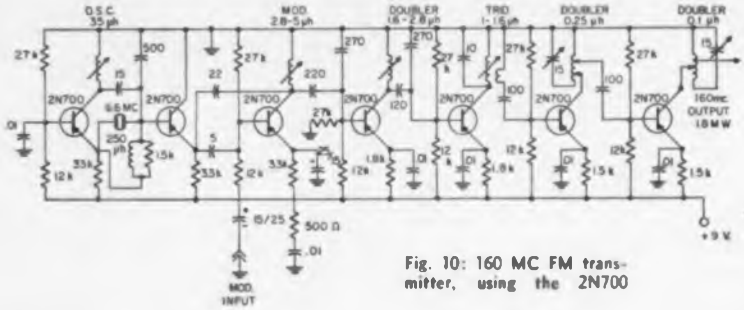


Fig. 10: 160 MC FM transmitter, using the 2N700

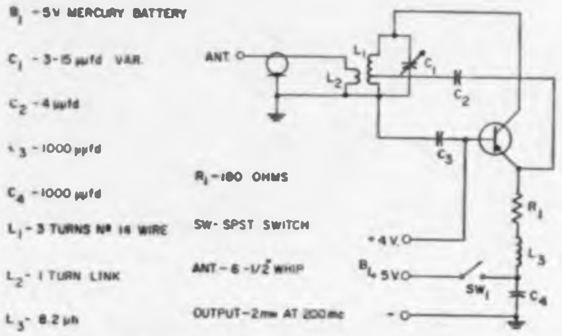
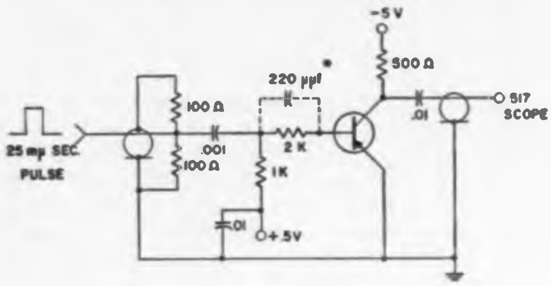


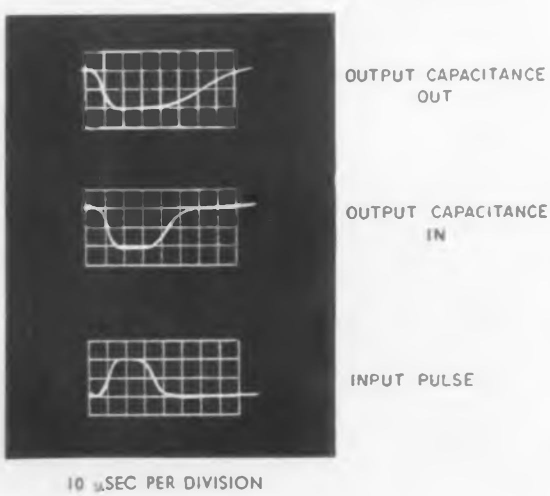
Fig. 11: 200-300 MC variable frequency oscillator



*CAPACITOR ADDED FOR STORAGE AND FALL TIME MEASUREMENT

Fig. 12a: Circuit for switching characteristics

Fig. 12b: Switching speeds of 2N695 in saturating circuit



Two excellent examples of the use of Mesa Transistors are given by Saari[7] and Giguere.[8] Saari designed and built a 70 MC IF Amplifier. The IF Amplifier gave 90 db of gain with a 15 MC bandwidth. The IF Amplifier had a 5 db noise figure, and consisted of 7 stages of amplification.

Giguere designed and built a completely transistorized 150 MC FM Receiver. The sensitivity of the receiver was 1.0 µv (open circuit) for 20 db of quieting. The noise figure for the tuner was approximately 10 db.

The 2N695

The 2N695 is a germanium PNP transistor designed for ultra high speed switching service. Typical switching times for the 2N695 are about 10 µsec for saturating circuits and the order of 1 to 2 µsec for non-saturating circuits. The external design of the 2N695 is exactly the same as the 2N700. The only differences are internal, as shown in Fig. 1. Fig. 12 shows an example of the switching speeds of the 2N695 in a saturating circuit. The switching speeds are seen to be beyond the resolution of the fastest conventional oscilloscope available, i.e., below about 7 µsec.

Acknowledgments

The VHF-UHF Transistors that are described herein are the results of the labors of many people. The author takes pleasure in acknowledging the tremendous aid of his former colleagues at the Bell Telephone Laboratories and the Western Electric Company. The author's associates at the Semiconductor Products Division of Motorola are due acknowledgment for the tremendous job of production mechanization of the Mesa Transistors.

References

1. Lee, C. A., A High Frequency Diffused Base Germanium Transistor, Bell System Tech. Jour., Jan., 1956.
2. Early, J. M., Military Reports Concerning S.C.E.L. Contract DA-36-039-sc-64618.
3. Knowles, C. H., and Temple, E. A., 1,000 mc Cutoff Frequency Transistors, *Electronic Design*, July 9, 1958.
4. Early, J. M., Paper presented at the Brussels Fair, June, 1958.
5. Morton, J. A., and Pietenpol, W. J., The Technological Impact of Transistors, *Proc. I.R.E.*, June, 1958.
6. See for example Conwell, E., *Proc. I.R.E.*, November, 1952.
7. Saari, V., Paper presented at the Solid State Device Circuits Conference, Univ. of Penn., February, 1958.
8. Giguere, W. J., A Transistorized 150 mcps FM Receiver, *Proc. I.R.E.*, April, 1958.
* S. C. Rogers, Bell Telephone Laboratories, Private Communication.

Systems Development Engineering

In The Western Area

The 'system' concept, and systems engineering, has seen wide application to the aircraft industry and military weapons planning. Systems development engineering is now being extended to many other fields, as well, particularly in the line of digitally controlled milling machines, and automated petrochemical processing plants.

By JOHN HOLLAND
Systems Engineer, Nortronics, Division of Northrop Aircraft Inc.

THE West is rapidly becoming a major center of systems development work in the United States. Before attempting to investigate the reasons for this growth, it might be well to define exactly what is meant by system and by systems development. A system, for the purposes of this paper, is defined as a group of units, each of which has a separate identity, which have been so arranged as to perform a set of operations which cannot be performed by these same units alone. Systems development is that science—or more properly, art—of selecting and combining units so as to produce a well-integrated system. An interesting feature of integrated systems is that, in a manner of speaking, the whole is greater than the sum of its parts.

The development of integrated systems can exist at various levels of complexity. The most complex level is the integration of an entire weapons system, or equivalently a complete factory. On a slightly lower level of complexity one may consider the integration an aircraft treated as a single entity. In non-aircraft operations, the equivalent level would be the integration of a production line. At still lower levels, systems integration may cover sections of the aircraft such as navigation systems, communication systems, etc. Here, the equivalent might be the design of a single automated machine. The principles of systems integration may be extended to the level of what might be called units of the larger system. For instance, the principles of systems integration might be used to optimize a radar unit which in turn will become a component in a navigation system, and so

Systems Development Engineering *(Continued)*

on in increasing orders of complexity until finally the radar becomes a very small sub-unit in an entire weapons system.

Snark System

An excellent example of a well integrated weapons system is the Snark, developed by Northrop Aircraft. This system, including missile, ground support and ground handling equipment, was conceived as a single unit. In designing the system, much thought was given to the optimum distribution of functions by the ground equipment and the missile. When such a distribution had been made, equipment was designed for both ground and airborne systems which would fulfill the requirements imposed by the systems designers. At the same time, the servicing problem was considered and the necessary testing and servicing equipment was designed as an integral part of the system. The result of this design effort is a system which performs within its preassigned specifications and which may be serviced by technicians with a minimum of previous experience.

The success of a system, such as the Snark, requires that a team of systems engineers be employed in its design and development. A systems engineer can best be described as a specialist in the general.

Computers are the heart of much systems planning. Here, at Raytheon, an engineer threads "Raydac" tape-handling mechanism

It is necessary that he possess a broad background in many phases of engineering and physical sciences. Normally he will be an electrical or mechanical engineer who has done advanced work, either formally or as a part of his employment, in many other phases of engineering or science. Often, he is a physicist who is interested in applied mechanics and electronics. In either case, he has a better than average background in applied mathematics and a knowledge of computers and computational processes.

The type of engineering judgment which is exercised at the various levels of systems integration is not the same. For example, those responsible for the integration of an overall weapons system are concerned primarily with broad policy decisions which determine a system philosophy. That is, the function of the systems development engineers on the weapons system level is to decide the broad question: What shall be the operational concept of this system? The resolution of this question in turn leads to decisions as to the general form of the sub-systems which make up the weapons systems.

At the next level, for example, the aircraft treated as a single entity, the systems engineer is required to determine, in a general way, the configuration of the various sub-systems within the aircraft. In making this decision he treats the airframe, engines, control system, etc., as components in his overall system. An attempt is then made to optimize the performance of the entire aircraft system in the light of its operational assignment by the weapons system designers. In carrying out this optimization, the general form of the various sub-systems such as flight control, navigation, and fire control is determined. These data are supplied to the various systems designers.

It is at the level of the aircraft sub-system design that systems development work ceases to be primarily a conceptual operation and becomes an engineering design effort. The aircraft systems development engineer examines the function of, say, the navigation system as it was assigned by the weapons system designer in the light of available components. He then proceeds to assemble a system, making modifications in equipment where necessary, which will fulfill the design objectives. In so doing he attempts to maximize the best features of the available hardware while, at the same time, minimizing any deleterious effects which the units might otherwise have upon the system's operation.

The concept of integrated design may also be applied to sub-units entering the overall system. When this approach is used, the engineer utilizes his best engineering judgment in the selection and combination of the various individual components which make up the unit in question. The available mathematical tools may then be utilized in order to combine these components in an optimum manner.

Development of Systems Engineering

The concept of integrated systems is one which has been necessarily adopted by the industry because of increasingly stringent demands for higher performance, greater reliability, and simpler operation. As the speed of aircraft has increased from relatively slow subsonic aircraft of World War II to the supersonic aircraft of today, designers have been faced with ever-increasing problems of stability augmenta-

Editor's Note:

For computer controlled steel mill see ELECTRONIC INDUSTRIES March, 1958 page 115 and computer produced aircraft parts see ELECTRONIC INDUSTRIES April, 1958 page 106. Both are examples of the application of systems to complex industrial processes.

tion and impaired aircrew response brought about by the higher speeds.

As an example, the pre-war concept of an autopilot was that of a relatively simple device operated from crude sensors which controlled the attitude and altitude of the craft in which it was installed. This device was considered an adjunct to the aircraft rather than an integral part of it. As the demands for greater and greater speed were placed on the designers, they soon discovered that a design which would meet the requirement of speed was aerodynamically unstable at some point in the craft's flight profile. In many cases, the truly advanced designs were unstable at all speed and altitude regimes. In order to combat this instability, the aircraft designers were forced to resort to stability augmentation systems which were designed to be integral parts of the aircraft.

Similarly, with the increase in speed came a reduction in the reaction capability of the pilot and crew. At high speeds the reaction time of a man is such that he cannot respond in time to a presented stimulus. Thus, designers of weapons systems were forced to design equipment which would reduce the need for rapid crew reaction. In the more advanced systems of today, pilot and crew have been integrated into the system in such a manner that use is made of their decision-making capability without requiring that they react rapidly to presented stimuli.

In order to produce useful weapons in the face of these trends, designers have been forced to resort to evermore complicated electronic systems within the aircraft. Obviously, if each of the electronic systems were designed separately and installed in the aircraft as was the custom in previous years, the aircraft would become so large and cumbersome that it could not fulfill its mission. Thus, it was necessary for aircraft designers to develop the concept of an integrated system which would maximize the amount of information handled by the electronics while at the same time minimize the space and weight allotted to it. This led to the concepts now utilized in the design of integrated weapons systems.

Another reason for the development of integrated weapons systems is the desire of the designers to incorporate as many automatic checking features as is possible in order to minimize the amount of crew

The use of a computer allows the systems engineer to combine his various components in the optimum manner

The 5,000-mi range Snark, like other guided missiles, is a prime example of the technique known as systems development

loading and also to minimize the level of skill required of those who must service the system. With proper thought on the part of the designer, the servicing of even the most complex system can be reduced to a routine operation which can quickly be taught to technicians who have a minimum of training in the various fields involved.

Growth in the Western Area

From what has been said before, it is clear that the concept of integrated systems first came into widespread application in the aircraft industry. Thus, one one of the major reasons that the Western area has become one of the centers in the development of integrated systems concepts has been the existence of an active and aggressive aircraft industry. A second reason is climate, and, still a third, is the existence of many centers of higher learning in the Western area. These three factors, all of which are closely interrelated, have been the source of the growth of this phase of the electronics industry.

The aircraft industry first entered this Western area because of the climate, which presents relatively long periods of clear stable air and uninterrupted flight operations, both of which are needed in the design, development, and testing of manned aircraft. The climate, too, attracted a large labor force, a second requirement for a growing industry. The climate in this area has frequently been a deciding factor in the relocation of other plants since many surveys have indicated a strong preference by engineers and skilled technicians for the climatological features offered by the Western states.

The aircraft companies have helped the growth of the systems development industry first by becoming some of the major systems development firms themselves. Many of the major firms engaged in this business began as sections, and later divisions, of the aircraft companies. Others sprang from the personnel originally in the aircraft industry who entered this new and growing field. The second way in which the aircraft companies assisted the growth was by their very existence in this area. Large electronic firms found it expedient to open offices near one of their major sources of revenue. At first these were merely sales offices, but as the problems became more complex it was necessary to develop large staffs of skilled engineers who could be at hand. Eventually this led to the development of branch engineering

Systems Development Engineering *(Concluded)*

offices, which in some cases have become divisions of the parent company.

The centers of higher learning in the Western area have helped and been helped by the existence of the electronics industry. The development of systems requires well trained personnel with broad backgrounds in many phases of engineering and science. It requires consultants of great repute in many of the more esoteric phases of engineering, mathematics and science. Such consultants can best be obtained by employing the staffs of large universities. The industry in turn has aided the schools by grants-in-aid, by the establishment of fellowships and the erection of engineering facilities. Both industry and the universities have cooperated in the establishment of in-plant and on-campus training courses for engineers in order to develop many of the skills which are not readily obtainable in graduates. The existence of these programs have in turn made the area more attractive to prospective employes, and in this manner has encouraged the establishment of more divisions of large companies and the growth of many smaller companies in this area.

The effort of the major systems development contractors in the Western area is directed primarily to the development of military weapons systems. Companies are engaged in the development of overall weapons systems concepts. Other companies are engaged in the development of aircraft systems, missile systems, and ground support and handling systems which implement these proposed weapons systems. In addition to the companies engaged in large scale systems development work, many companies have under development major sub-systems such as navigation and missile guidance systems, aircraft and missile control systems, and communications and telemetering systems, for installation in proposed or existing aircraft and missiles. In some cases these sub-systems are being designed with a particular aircraft or missile in view. In others, the design is of a more general nature and intended for installation in whatever aircraft or missile develops a need for the system.

Other Systems

In addition to the military aircraft and missile systems development work, many of the companies are beginning to apply systems development concepts to commercial and industrial products such as digitally controlled machine tools, automatic chemical processing equipment, and automatic or semi-automatic assembly processes for electronic equipment. In many cases these developments were begun in order to facilitate production within the developing company or to improve the company's product. When the development has proved successful, many of these units have become important products of the company.

The future of systems development work is indeed a bright one. With the continuing development of aircraft with ever higher performance, the need for integrated systems will continue to grow, and, as the reliability and cost of these systems is improved, new fields in commercial aviation will be opened to them. In the field of missiles, systems integration reigns supreme. In fact, it may safely be said that had not the concept of integrated system been developed, missiles would not be flying today. The need for integrated systems will grow in the development of present unmanned satellites and will become even more important when man first ventures into the realm of space.

At Hughes Aircraft these precisely machined parts are turned out on a numerically controlled machine tool

Applications of systems integration concepts are being extended into fields other than aircraft at the present time. The recently formulated idea of automation is, in reality, an application of systems engineering to manufacturing processes. Several recent examples of the application of systems engineering to manufacturing processes may be seen in the recently developed digitally controlled milling machines, automatic engine block production lines, and fully automatic petrochemical processing plants. As time goes on, this will be a field of continuing importance to the systems development engineers, and, because of the ascendency of the Western area in the field of systems integration, the area will continue to grow as new applications are found for it.

In looking ahead to ways that the systems approach may apply, Walter E. Peterson, director of electronics engineering of Radioplane Division of Northrop Aircraft, recently said:

"Present weapons systems and their peacetime and commercial offshoots are about 50% electronic and 50% aeronautical. It would seem that what will eventually emerge as an efficient company will be a 'spacecraft company' . . . a 'missile system company' . . . or a 'satellite company.' In each case, there would be companies without prejudice for or against any part of the system, with technical know-how and a balanced team of aeronautical, electronic and business experts."

Page from an Engineer's Notebook

#44—Temperature Conversions

A quick means of converting one measure of heat to another measure is provided.

By RUDOLPH WELLSAND
Engineer, Guided Missile Div.
Convair, Pomona, Calif.

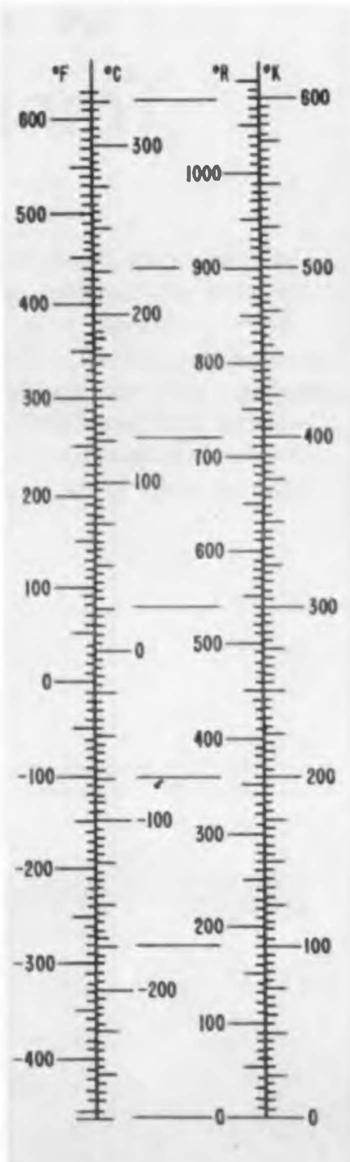
OFTIMES a rapid comprehension of a specified unit of heat is needed in terms of other (and perhaps more familiar) values. The scales provided will suit just such a purpose to within an accuracy of 3°F or 3°R. For greater accuracy, the formulas in Table 1 may be used.

The four scales are: (°F) Fahrenheit, (°C) Centigrade, (°R) Rankine and (°K) Kelvin, respectively. They are arranged so that a horizontal straightedge may be placed directly across from one scale to the next, thereby indicating the equivalent values on each and every scale.

For all practical purposes, the value of 5/9 in Table I is equal to 0.555, and that of 9/5 is equal to 1.8, thus simplifying computation.

Examples of the manner in which the scales are interrelated and used are as follows: Semiconductor diode and transistor barrier voltages are computed with values from the Kelvin scale. Military requirements specify component operating temperatures from the Centigrade scale. The Fahrenheit scale is most familiar in the United States, generally displayed by every household thermometer. The Rankine scale is the equivalent Fahrenheit scale set adjacent to the base Kelvin. Zero degrees Kelvin is also known as Absolute zero, since this is the lowest temperature possible to achieve.

Thus the wide range displayed by the scales in this side-by-side arrangement, promote a better understanding of the temperature range wherein component electronics must function.



References

1. A New Evaporative Cooling Technique, R. Berner, *Electronic Design*, 15 Oct. 1957, p. 43.
2. A Voltage Gain Nomogram for Transistor Circuit Design, R. Wellsand, *Electronic Design*, 15 July 1957, p. 56.

Table 1

Unknown Temp.	Known Temperature °F	°C	°R	°K
°F	......	9/5°C + 32	°R − 459.68	9/5°K − 459.68
°C	5/9(°F − 32)	......	5/9°R − 273.16	°K − 273.16
°R	°F + 459.68	9/5°C + 491.68	......	9/5°K
°K	5/9(°F + 459.68)	°C + 273.16	5/9°R	......

Increased Cooling For Power Transistors

The role of operating temperature on the life span of transistors and the threat of "thermal runaway" is focussing new attention on the methods of dissipating heat. Experimentation with a wide variety of shapes indicates that one "best" unit proves most effective in keeping operating temperature at maximum power below recommended ceilings.

By C. BOOHER,
Industrial Division,
Birtcher Corp.
4371 Valley Blvd.
Los Angeles 32, Calif.

Fig. 1: Power transistor with optimum "radiator," developed during tests, is shown mounted on phenolic base.

PROGRESS in the miniaturization of components has been attended by complications arising from the concentration of power in small space. Heat, is, of course, a function of voltage and resistance, so there is no sidestepping the problem. In the past, the dissipation of power-generated heat was a partial function of the envelope, the glass or metal skin of a tube, and later, the retention and cooling device wrapped around this envelope. Transferring heat to the chassis and to the ultimate heat sink, the atmosphere, was the basic requirement of this type of "radiator" and its design was straightforward and rather uncomplicated . . . with the exception of metallurgy. Recently, however, a critical stage unknown to the older style tube has been arrived at. This stage in operation of power transistors has been termed "thermal runaway."

Thermal runaway occurs when an increase in operating temperature brings an increase in cutoff current, causing an increase in collector current and raising the power dissipation at the collector junction. This in turn raises the junction temperature and the cycle starts anew. Designers of transistors must reckon with this fact and a formula[1] has been presented which will enable advance calculations to be made. The use of circuitry "tricks" using the collector current of one transistor to bias another, etc., can solve certain given problems, as well, but in many instances the circuit designer is forced into a mold, so to speak, and has no more tricks at his disposal. He may be obliged to use a certain diode on a given non-conductive chassis in a cramped area, for example. In such a case, and in others far less extreme, he finds it necessary to provide a rapid-dissipating adequate heat sink.

C. Booher

Junction Temperature

Operating junction temperature of a power transistor should not exceed 85°C based on life tests.[2] It will also be noted that manufacturers electrical characteristics are usually given at 25°C—ambient and that efficiency falls off in a direct linear relation to a temperature rise above that figure. Actually, the useful life of a transistor is dependent on the temperatures to which it is subjected and the closer to the manufacturer's recommended temperature it can be held, the better are its chances for a long life. Apparently the life span is subject to shortening from externally applied, or ambient, heat as well as internally derived heat, but since this is a function of chassis and closure design, we have no room for its consideration at this point. In order not to exceed so-called ideal temperature (between 25° and 85°C) heat-drainage from the transistor must be consistent with its maximum power.

There are two paths of heat dissipation: By radiation from the exposed surfaces of the case and by conduction to the chassis where it is radiated into the atmosphere. (Properly, by a combination of convection and radiation.) In the ordinary diode, for example, there is an almost negligible radiating surface inherent in the case itself, so the major share of the dissipation load falls on the contact between case and chassis. The amount of heat flow here can be determined by the formula:

$$q = \frac{\Delta T}{L/kA}$$

when q is rate of heat transfer.

k is thermal conductivity of the material.

A is cross sectional area of heat conductor.

L is length of heat path.

T is temperature difference between source and conductor.

and the rate can be quickly plotted in theory.

Test Set-Up

Mounting instructions of a typical manufacturer state "it is very important that a power transistor be provided with a good heat dissipating facility." In the absence of recorded experimental data gathered under operating conditions, however, our test setup was first dedicated to determining actual junction, case and chassis temperatures under such conditions. A common diode (IN248) was mounted on a simulated aluminum chassis, put under controllable load from a regulated power supply and temperature readings were taken from thermocouples and a Leeds-Northrup bridge. Fig. 2 represents the elevation (ambient 27°C) in junction temperature (1) and the rise in chassis temperature (2) with a diode mounted on a metal chassis with a mica washer. The chassis temperature stabilized about 20 mins. after the beginning of the test at 55°C, but the diode junction reading climbed right off the graph, reaching maximum allowable temperature in 5.6 mins. and crossing 100°C in 8.0 mins. A "runaway condition."

Fig. 3 is the curve attained at the junction when the mica washer was removed and the diode was in direct contact with the chassis. Temperature stabilized at 78°C after approximately 1 hr. of operation.

The three curves of Fig. 4 represent: (1) diode mounted on phenolic with no forced air, (2) 200 fm forced air, (3) 1000 fm forced air. These simple tests established that there is negligible radiation dissipation and that the vital heat drainage from the base can be partially blocked by a insulating washer or obviated by mounting on a non-conductive chassis.

The next step was obvious: Take the heat from the base and provide a direct radiating mechanism to the atmosphere. Our previous experience in cooling devices related to tubes gave us a starting place in design and metallurgy, but we soon encountered an interesting situation which left no recourse other than a "cut-and-try" method. Mathematically, using the formulae of heat flow by conduction, convection and radiation, we arrived at an extremely wide choice of shapes! Most of these configurations were quite possible to put into volume production, many of them suitable for chassis placement under most conditions. To arrive at a single "best" unit, we made models of a dozen or more styles, after eliminating a great number at the drafting board, and repeated our original

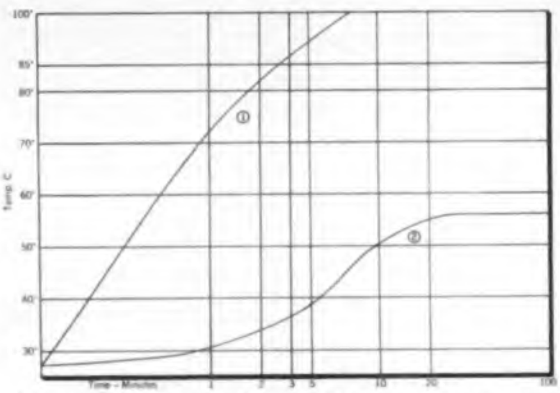


Fig. 2 (above): Diode mounted on metal chassis with mica washer.

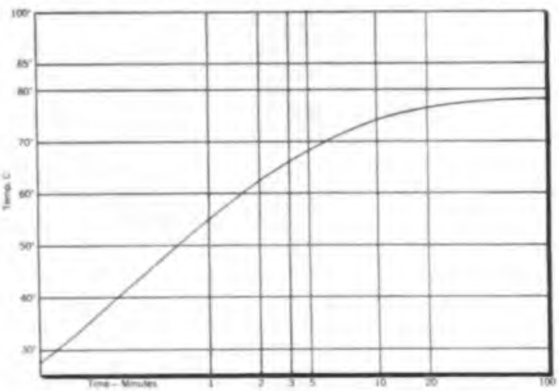


Fig. 3 (above): Temp. curve with diode mounted directly to chassis.

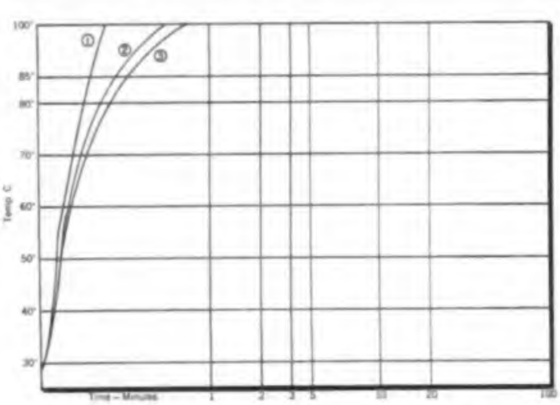


Fig. 4 (above): Diode mounted on phenolic, with/without air cooling.

Fig. 5: Test set-up to find operating junction and chassis temp.

Transistor Cooling

(Continued)

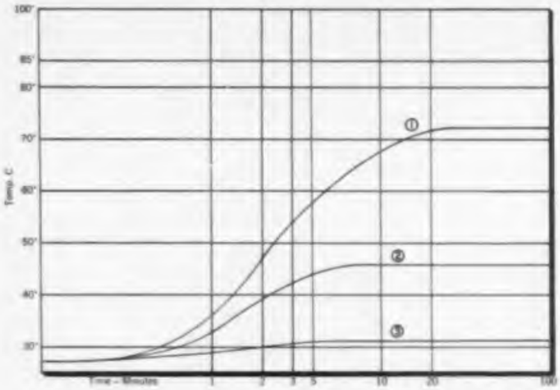
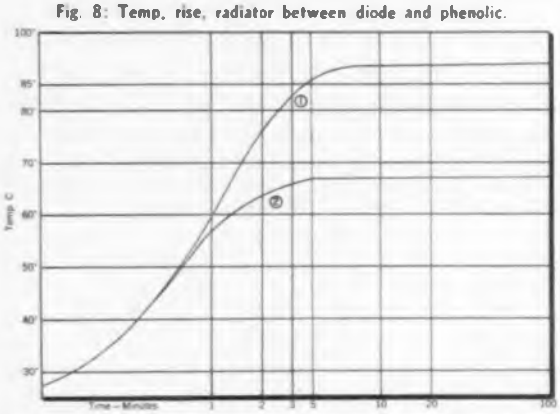


Fig. 6: Temp. curves for radiator regarded most nearly perfect.

Fig. 7: Various designs exhibited different cooling capacities.

Fig. 8: Temp. rise, radiator between diode and phenolic.



tests. We soon weeded out several by merely handling them under field conditions. The rest were evaluated strictly on performance: Keeping the transistor cool.

Fig. 6 shows three curves established with a radiator of the configuration regarded as most nearly perfect on a metal chassis with mica washer. Line No. 1 represents the temperature readings at the junction in still air (No. 2) with 200 fm of forced air and (No. 3) with 1000 fm forced air. Fig. 8 records the temperature rise when the radiator was interposed between the diode and a phenolic. (No. 1) 200 fm and (No. 2) 1000 fm.

Radiator

The radiator, a series of metallic fins superposed on a base which accepts the diode and does not interfere with mounting, proved effective in keeping operating junction temperature at maximum power below recommended ceilings and to prevent runaway under

these conditions: Diode mounted on metal chassis with mica washer in still air; with 200 fm forced air and 1000 fm forced air; Diode mounted on phenolic with 200 fm forced air and 1000 fm forced air.

The tests established a need for a cooling device to radiate power generated heat to the atmosphere via the base of the transistor and indicated that a tower of metallic fins is the optimum shape for such a device in point of efficiency, handling and installation ease.

References

1. See "Protecting Power Transistors from Thermal Runaway"—Paul Penfield, Jr., *Electronic Industries*, February 1958.
2. See "Heat Transfer in Power Transistors"—By Ioury G. Maloff, *Electronic Industries*, December 1957.

X-Ray Movies

A NEW dimension has been added to environmental testing, X-ray movies of sealed or enclosed components during test programs. Rototest Laboratories in Lynwood, California, have developed equipment and techniques for making such movies. Their laboratory facilities can be used to take X-ray movies of the internal operation and failure of components during test. This new dimension in environmental testing can eliminate much of the present cut-and-try approach to testing.

What's New . . .

Isolated coil circuit allows switching of many independent circuits within one unit.

A Relay . . . with No Moving Parts

THE industry has long awaited an electronic device that would perform all the functions of a standard relay and yet not inherit many of the problems encountered in vibrations, shock, contact bounce and contact arcing, etc.

Pendar, Inc. has just recently, after extensive research, designed and developed an all electronic relay with no moving parts.

The electronic coil circuit operates on 28 vdc, pulls in at 18 v. and drops out at 7 v. or less with a positive snap action operation. The coil circuit is completely isolated from the electronic switching circuit, making one coil circuit capable of switching many independent circuits within one unit.

The relay is completely potted and will withstand any shock or vibration problems now being encountered with today's present designs. The unit will switch either ac or dc, has a transfer time of less than 50 μ sec and no contact bounce.

With no arcing or contact contamination, the life expectancy of this relay would be in the millions of cycles; years of reliable operation and shelf life could be expected.

To draw a schematic diagram of the circuit for a relay with no moving parts, it was necessary to design a new symbol. This new symbol will be submitted to the American Standards Associations, Inc., as well as various other interested parties, for official adoption.

Further development is being continued to reduce the operating power required and to increase the contact rating.

Working Under TENSION

TENSION is a parameter which affects all wire preparatory operations. Frequently neglected, it influences the winding of precise coils, potentiometers, magnetic tape, and condenser foils.

Over-stretching wires narrows their cross-section since the amount of material remains constant. This causes local overheating called "hot-spots," and irregularities of electrical resistance, and "crazing" of insulation. It also is one of the factors in electrical break-down. Tension, furthermore, changes the physical size of the coils. This influences the filling of a cavity in a rotor, say for instance, of a precise gyro with the proper number of windings and with no ends protruding into a limited airgap. Tension changes the capacity of an electric condenser since the distance between the conductive windings is influenced by the force with which the conductive foils are pressed upon each other.

Now, winding tensions can be kept under close scrutiny with a line of tension meters developed at Tensitron, Inc., Harvard, Mass. With the meters, a safe tension can be maintained during all phases of winding operations; and by providing closer control, higher safe winding speeds are made possible.

A line of tension meters like this provides close control and permits higher safe winding speeds.

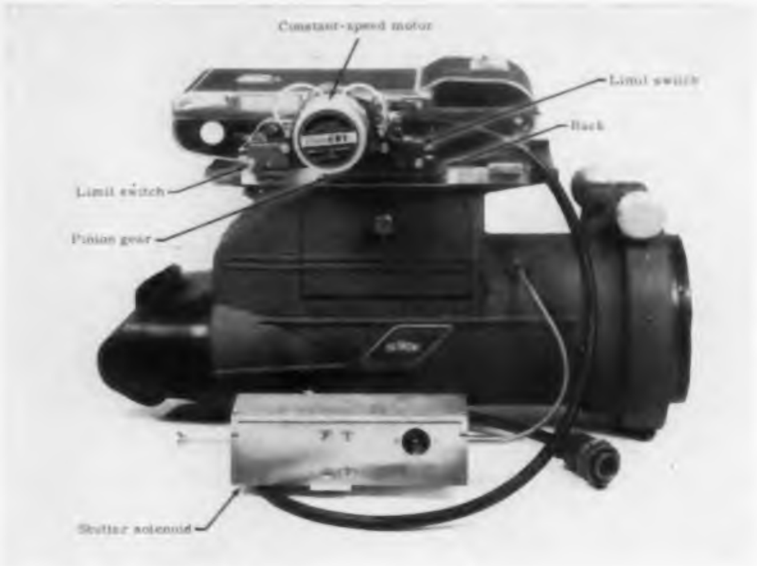


Fig. 1: Complete camera positioning system is shown. A Polaroid-Land camera and DuMont camera mount are used.

By PAUL L. KERLEY
Sandia Corp.
Albuquerque, N. M.

A System for . . .

Oscilloscope

THE positioning system adapts the Polaroid-Land camera and the DuMont camera mount to permit the taking of multiple sweep exposures on each print. (Fig. 1.) It consists of a timer, timer selector, motor drive, rack and pinion gear, limit switches, shutter solenoid, and a power supply. The system is made an integral part of the equipment and uses only assembly holes existing in the camera and mount.

Operation

The sequence of operation is as follows (Fig. 2): The desired number of sweep exposures per print is set up on the position selector (1). A trigger signal from the instrumentation START pulse is fed into the timer (2) and opens the camera shutter (3) for a prescribed exposure time. When the shutter closes, a signal from the timer (2), acting under the control of the selector switch (1), allows the power supply (4) to energize the constant-speed motor (5) which advances the camera for the amount of time necessary to move it a prescribed distance.

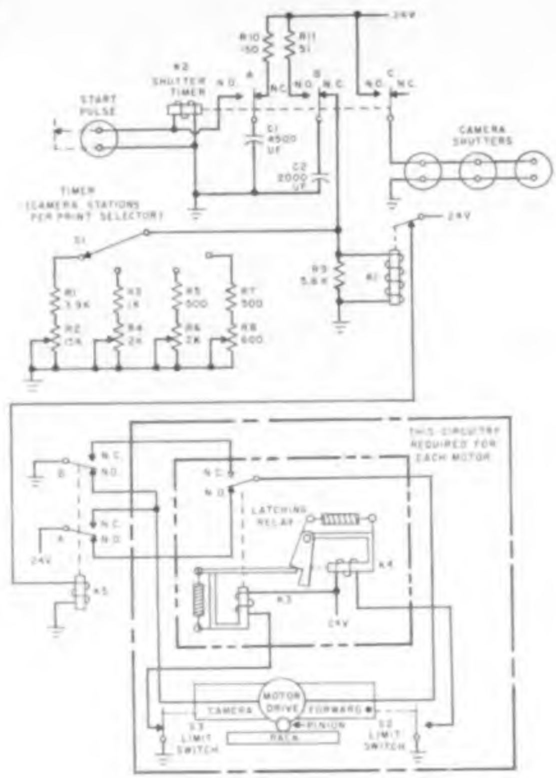
The system is then at rest until another trigger signal is received. The sequence is then repeated. When the selected number of sweep exposures has been made, the camera continues to move forward until a limit switch is actuated to reverse the camera drive motor (5) and return the camera to the start position. When the camera returns, it actuates another limit switch which stops the motor and resets the circuit to a "forward" position. The camera is then ready for the next series of sweep exposures. The exposed film is pulled manually into the print position and removed according to the standard procedure for Polaroid-Land Camera.

Detailed Circuit Operation

A start pulse closes relay K2 which makes contact (through its normally open contacts K2A) between K2 winding and C_1 which has been charged to 24 volts from the power supply (Fig. 3). An electrical-latching circuit of capacitor C_1 and relay K2 is thus formed. The capacitance of C_1 and the resistance of

Fig. 2: Block diagram of the camera positioning system.

Fig. 3: Schematic diagram shows camera timer circuit



A system for taking multiple sweep exposures on each print is described. Complete information is given for the construction and operation of such a system.

Camera-Positioning

K2 winding provide the time constant to hold the relay closed for approximately 2 seconds. This part of the circuit is referred to as the "shutter timer." During the relay closure, normally open contacts of relay K2B cause capacitor C_2 to be charged to 24 volts through resistor R_{11}. Contacts of relay K2C, normally open, pass current to energize the shutter solenoids holding them open for the 2-second time interval. When relay K2 drops out or is deenergized, the normally closed relay contacts K2B cause capacitor C_2 to discharge through the winding of relay K1 and its shunt resistors. By switching in various values of shunts through selector switch S1, the time constant of timer C_2-K1 can be varied.

The normally open contacts of relay K1 pass current to relay K5, closing its normally open contacts. This current operates the constant-speed drive motor, providing discreet steps in the camera's travel. Each step is referred to as a camera station; therefore, switch S1 is labeled "Camera Stations Per Print" selector. As many stations per print (or sweep exposures) as desired may be had by proper switching of shunt resistors. With relay K5 energized as shown, current passes through K5A to its normally open contact and to the normally open contact of relay K3 and on to the drive motor. From the other terminal of the drive motor, current passes through normally open contact "b" of relay K5 to ground. This circuit condition operates the drive motor in the forward direction.

The drive motor continues to run until the timer composed of K1 and C_2 permits K1 and K5 to deenergize. The system is then at rest until another start pulse repeats the sequence and advances the camera to another station. When the last step of the selected number of stations in the forward direction is completed, the camera actuates limit switch S2, which resets the mechanical latching relay (labeled K3 and K4). This reverses the current to the drive motor and returns the camera to the start position. A limit switch, S3, is actuated at the limit of the reverse travel (or start position) which sets the latching relay K3, K4 in the "forward" drive position to await the next series of sweep exposures.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES • Chestnut & 56th Sts., Phila., Pa.

Among the most important areas of microwave tube research and development are the new methods of beam focusing and the new circuits for high power wide-band amplifiers. New data are available too on the present limitations on power output, tuning range, bandwidth and noise figure.

New Developments In

Wide-Band Microwave Tubes

By Dr. D. A. DUNN,
Stanford University,
Stanford, California

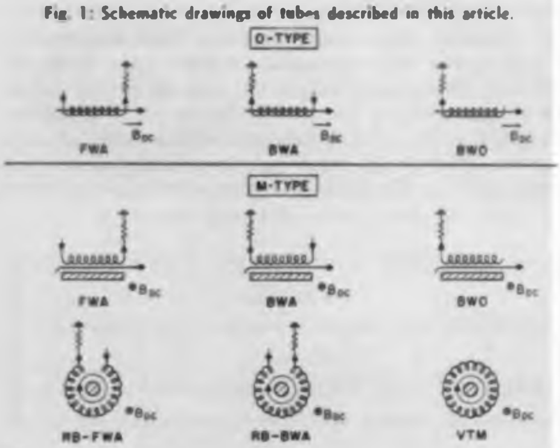
THE scope of this article is limited to microwave tubes for frequencies from slightly below 100 MC to about 100 KMC. Only tubes with greater than a 10% bandwidth or electronic tuning range have been included, and all tubes that require mechanical adjustments to accomplish tuning, such as klystrons and conventional magnetrons, are excluded.

The types of tubes to be discussed are shown schematically in *Fig. 1.* The O-type tubes are those in which there is no dc electric field in the interaction space. As indicated, there is a magnetic focusing field, B_{DC}, in the direction of beam travel. Three types of O-type tubes are considered: (1) The forward-wave amplifier, FWA, with the rf input at the left and the output at the right, the load being indicated by the resistor with one side grounded; (2) the backward-wave amplifier, BWA, with the direction of rf power flow reversed with respect to the direction of beam travel; (3) the backward-wave oscillator, BWO, which is a BWA operated above starting current and without any rf input.

The corresponding M-type tubes are indicated below with the magnetic focusing field indicated into the paper. A dc electric field is not shown, but is considered to exist between the sole, the shaded element in each figure, and the circuit, here indicated as a helix in all cases. Most practical M-type tubes are actually not arranged in the linear form indicated, but are wrapped up around an axis into the paper to reduce magnet weight. In this form it is straightforward to close the beam on itself to produce the recirculating beam, RB, devices indicated in the bottom row in Fig. 1. Both forward and backward-wave amplifiers with recirculating beams are possible, as indicated, RB-FWA and RB-BWA. It is also possible to close either a forward or backward-wave circuit on itself, either in combination with a recirculating beam or a non-recirculating beam. The practical tube of this type has a recirculating beam and a backward-wave circuit and is the voltage-tuned magnetron, VTM. Its load is best visualized as being distributed uniformly around its circumference. Of these types, the most work in the past has been done on the O-FWA, O-BWO, M-BWO, and VTM, but there is considerable present activity on the three BWA types, particularly the RB-BWA or Amplitron.[1]

One of the most significant recent developments in

Fig. 1: Schematic drawings of tubes described in this article.



these types of tubes is the fact that a considerable variety of O-BWO and O-FWA tubes are now commercially available. One VTM and one RB-BWA are now also commercially available.

The author has attempted to compile a complete list of all unclassified commercially-available tubes manufactured in the U. S. of these types. This list is given at the end of the text. It includes a total of 77 different tubes. In the next section a brief discussion of these tubes will be given and two charts showing where most of them lie in the power-frequency plane will be described.

Commercially Available Tubes

Quite a wide variety of O-type FWA and BWO tubes are now commercially available. Most of these tubes use solenoids to provide the magnetic field for focusing, although some recently introduced commercial tubes use permanent magnets. Typically, these tubes sell for around $1,000 with the solenoid being an extra $300. None are in real quantity production, and it appears that the price would drop considerably, if a large order were involved. Most of these tubes are designed to produce a few watts or lower output. A number of low-noise amplifiers are available. A complete list is given at the end of this article. A definition of *commercially available* is roughly as follows: a commercially-available tube is one for which the manufacturer's sales department was willing to quote a definite price and to commit itself to making delivery and for which a definite, but perhaps tentative, set of specifications was available.

A chart type of representation of the power and frequency range of these tubes is given in Figs. 2 and 3. Fig. 2 applies to O-type FWA tubes and Fig. 3 applies to O-type BWO tubes. In these figures solid lines refer to tubes that are presently commercially available and that appear in the list. The length of the horizontal line between the short vertical lines indicates the nominal frequency range and the ordinate at which the line is positioned indicates the nominal power output.

In addition to plotting the commercial tubes on these charts, a few developmental tubes are plotted on the charts as dotted lines. (Since this article was written, a commercial service has become available through which an up-to-date listing of commercially available tubes can be obtained. This service is provided by Derivation and Tabulation Associates, 67 Lawrence Ave., West Orange, N. J.)

A shaded outline of what in the author's opinion is the area in power and frequency within which O-type FWA and BWO tubes are *easy* to build is indicated. As used here the word *easy* means that the design of these tubes involves only well known circuits, beam focusing techniques, and construction techniques, and that cathode density requirements are not excessive in terms of the stage of the art in this field. It does not imply that all tubes within this area are necessarily cheap, simple tubes. It is inevitable that the high power tubes will be more costly to develop and produce than the lower power tubes, but within this area most of the problems have previously been solved by someone in some way, at least.

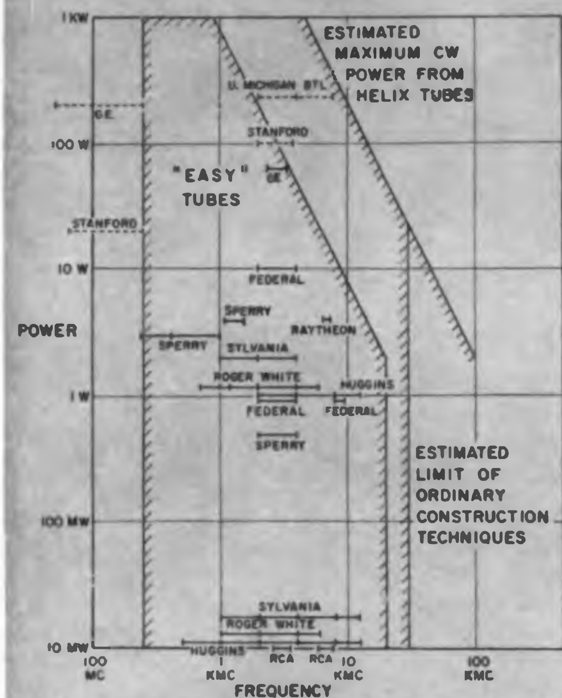


Fig. 2: Power vs. frequency for O-type forward wave cw amplifiers. Commercially available tubes are indicated by solid lines.

Fig. 3: Power vs. frequency for O-type backward wave cw oscillators. Commercially available tubes are indicated by solid lines.

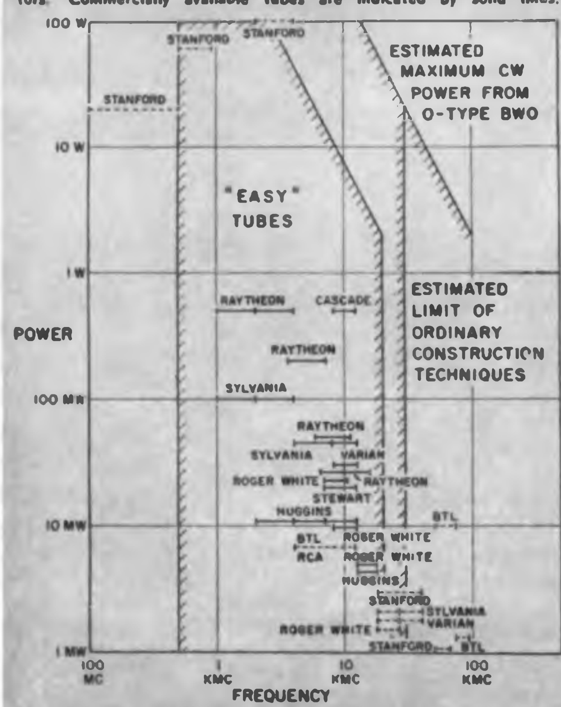


Table 1

Unclassified Commercially Available Wide-Band Amplifiers and Voltage-Tunable Oscillators Manufactured in the U. S. A. as of May 1957

This list represents an attempt by the author to compile a complete list of commercially-available amplifier and oscillator tubes with a *wide* bandwidth or tuning range. For purposes of this list *wide-band* was applied to any tube for which the manufacturer specified the performance over more than a 10% frequency range. Mechanically tunable tubes such as klystrons and magnetrons have not been included. The term *commercially-available* has been applied to tubes for which the manufacturer had some sort of data sheet and specifications and for which a definite price and delivery was quoted.

The specifications in crude form for each tube are indicated along with the price, tube type, and manufacturer's designation. For exact information it is highly recommended that the manufacturer's data be consulted directly. FWA means backward-wave amplifier, BWA means backward-wave amplifier, and BWO means backward-wave oscillator. Pulsed tubes are indicated by the fact that the power output is noted as peak and the allowable duty cycle is included. As noted in the text, an up to date listing of this type has become available recently from Derivation and Tabulation Associates, 67 Lawrence Ave., West Orange, N. J.

Manufacturer	Tube Type & Mfr's. Designation	Nominal Frequency Range (KMC)	Nominal Power Output	Gain (DB)	Maximum Voltage (Volts)	Noise Figure (DB)	Price ($)
Federal Telephone & Radio Co.	O-FWA F-6658	2.0-4.0	1 MW	25	1200	...	550
Federal Telephone & Radio Co.	O-FWA F-6825	2.4-3.6	1 KW (Pk) (.005 Duty Cycle)	30	7100	...	1080
Federal Telephone & Radio Co.	O-FWA F-6826	2.8-3.6	750 W (Pk) (.005 Duty Cycle)	27	7800	...	1280
Federal Telephone & Radio Co.	O-FWA F-6867	8.5-9.6	0.2 W	25	1560	...	950
Federal Telephone & Radio Co.	O-FWA F-6868	2.0-4.0	10 W	30	1500	...	800
Federal Telephone & Radio Co.	O-FWA D-55	2.0-4.0	0.1 W	25	600	...	1000
Federal Telephone & Radio Co.	O-FWA D-79	8.0-9.6	1 W	25	3300	...	1075
General Electric	VTM Z-5112	2.0-4.0	500 MW	...	2000	...	175***
Huggins Labs.	O-FWA HA-1	2.0-4.0	10 MW	30	450	...	650
Huggins Labs.	O-FWA HA-2	2.0-4.0	1 W	30	1050	...	650
Huggins Labs.	O-FWA HA-3	4.0-8.0	10 MW	30	700	...	750
Huggins Labs.	O-FWA HA-4	8.0-12.4	10 MW	30	1150	...	750
Huggins Labs.	O-FWA HA-20	8-12.4	10MW	30	1150	...	1600*
Huggins Labs.	O-FWA HA-5	1.0-2.0	10 MW	30	300	...	750
Huggins Labs.	O-FWA HA-6	4.0-8.0	500 MW	30	1400	...	850
Huggins Labs.	O-FWA HA-7	0.5-1.0	10 MW	30	130	...	750
Huggins Labs.	O-FWA HA-9	8.0-12.4	1 W	30	2300	...	1050
Huggins Labs.	O-FWA HA-21	8-12.4	1 W	30	2300	...	3000*
Huggins Labs.	O-FWA HA-12	2.0-4.0	1 W	30	950	...	850
Huggins Labs.	O-FWA HA-13	8.0-12.4	1 W (Pk) (.1 Duty Cycle)	20	2100	...	950
Huggins Labs.	O-FWA HA-15	8.0-12.4	5 MW	25	1200	15	850
Huggins Labs.	O-FWA HA-17	1.0-2.0	10 MW	30	200	20	850
Huggins Labs.	O-FWA DA-1	2.0-4.0 (Voltage Tunable over this Range)	10 MW	20 (At the Gain Peak)	2400	...	650
Huggins Labs.	O-FWA DA-2	1.0-2.0 (Voltage Tunable over this Range)	10 MW	15 (At the Gain Peak)	1000	...	750
Huggins Labs.	O-FWA DA-3	0.5-1.0 (Voltage Tunable over this Range)	10 MW	13 (At the Gain Peak)	1100	...	750
Huggins Labs.	O-FWA HA-10	8.0-12.4	100 MW	25	2100	...	850
Huggins Labs.	O-FWA HA-11	2.0-4.0	10 MW	30	450	15	750
Huggins Labs.	O-BWO HO-1A	2.0-4.0	10 MW	...	3400	...	1000
Huggins Labs.	O-BWO HO-3A	3.75-7.0	10 MW	...	5400	...	1000
Huggins Labs.	O-BWO HO-2B	7.0-14.0	10 MW	...	850	...	850
Huggins Labs.	O-BWO HO-4B	12.4-18.0	10 MW	...	2000	...	1500
Huggins Labs.	O-BWO HO-6B	8.2-12.4	10 MW	...	1050	...	1000
Huggins Labs.	O-Frequency Multiplier HA-16	2.0-3.0 Input 10.0-15.0 Output	1 MW	0	1050	...	750
Huggins Labs.	O-FWA HA-19	1.6-2.6	10 MW	30	300	20	750
Huggins Labs.	O-FWA HA-22	1.6-2.6	10 MW	30	500	...	750
Raytheon	O-BWO QK522	2.0-4.0	500 MW	...	1500	...	750**
Raytheon	O-BWO QK523	3.5-7.2	200 MW	...	1800	...	1650 ‡
Raytheon	O-BWO QK529	6.0-11.0	55 MW	...	1700	...	1650**
Raytheon	O-FWA QK525	6.4-7.2	1 MW	20	1400	...	300
Raytheon	O-FWA QK526	6.4-7.2	100 MW	23	1200	...	300

Microwave Tubes

(Continued)

Two other shaded lines are indicated in each figure, the estimated maximum cw power that can be obtained and the frequency above which ordinary construction techniques can no longer be used. In the O-type FWA, the power limitation is intended to apply to helix type tubes only and a higher power line probably applies to all metal tubes. However, there are no known all-metal circuits for FWA tubes with 2 to 1 bandwidth. In the BWO figure the power line applies to all metal circuits. Both lines are really just guesses and are primarily intended to convey a general impression of the area within which it will be likely that future tubes will be built. Also both lines are likely to move as the stage of the art changes. The maximum power lines apply to tubes with equal peak and average power; if the peak power is higher than the average power, it is probable that the average power can be higher than if peak and average powers are equal. A low frequency limit to easy tubes has been drawn at 250 MC, not because it is particularly difficult to build traveling-wave this frequency, but because it is difficult to build - traveling - wave tubes that are competitive with conventional tubes below this frequency.

As indicated above, most of the commercially available tubes use solenoids for beam focusing and most employ non-convergent beams, so that the entire tube can be immersed in the confining magnetic field. Recently, it has been found that for some tube types it is possible to directly replace the solenoid with a permanent magnet designed to produce the same field as the solenoid. Such a configuration is used in the Varian O-BWO for X-band, as shown in Fig. 4. Such an arrangement can most simply be compared with a solenoid of equal weight (which can always be designed to produce the same field over the same volume), and the net saving can then be expressed in terms of the weight equivalent of the solenoid power supply that is eliminated by use of the permanent magnet.

A few commercial O-FWA tubes are now available with periodic magnetic focusing, and several others are about ready to be introduced. Fig. 5 shows two X-band amplifiers using periodic focusing that were developed at Stanford.[2] Commercial tubes were used to test the focusing scheme and commercial versions of the entire assemblies are now available.[3] The solenoid focused versions of these tubes used solenoids weighing about 20 lbs.

Neither M-BWO nor VTM tubes have been included in these charts. Only one VTM is commercially available,[4] but the tube type is of great potential importance. Fig. 6 is schematic drawing of one of the recent G.E. versions of this tube employing a cathode outside the interaction space so that no cathode back-bombardment occurs. It appears from recent reports that most of the previous objections to this type of tube have been overcome by this change in the cathode arrangement. In view of this improvement, it is the author's present opinion that this type of tube will ultimately replace the O-BWO for low power applications below X-band, partly as a result of the tube's small size and partly because of the fact that less voltage change is required to accomplish the same frequency change in comparison with the O-BWO. This latter feature may permit operation over wider tuning ranges than are customarily specified at the present time. In developmental tubes at the G.E. Research Labs at Schenectady, greater than 10 to 1 frequency ranges have been covered with a single tube[5] operating into a balanced output of the sort shown in Fig. 6. This increased tuning range is obtained with a sacrifice in efficiency, but that does not seem too vital in low power tubes. The power output is much more constant over a wide range than in the case of the O-BWO because the dc power is more constant.

The M-BWO appears to offer the best method of obtaining efficient voltage-tunable high power below X-band. The fact that a high beam current is drawn by the electrode to which modulation (for changing frequency) is applied is the most serious disadvantage of this tube type. Its competition is primarily from O-FWA tubes following VIM or O-BWO tubes rather than from other voltage-tunable oscillators, at high power levels below X-band.

Fig. 7 is a sort of diagram of the above statements, indicating how the author thinks these voltage-tunable oscillators will ultimately divide the power-frequency spectrum.

Table 1 *(Continued)*

Manufacturer	Tube Type & Mfr's. Designation	Nominal Frequency Range (KMC)	Nominal Power Output	Gain (DB)	Maximum Voltage (Volts)	Noise Figure (DB)	Price ($)
Raytheon	O-FWA QK623	6 4-7 2	3 W	15	1200		300
Raytheon	O-BWO QK535	7 5-16 0	30 MW		1500		1650**
Raytheon	O-BWO QK546	1 0-2 0	[illegible] MW		1500		1650**
Raytheon	M-BWA QK520	1 2-1 35	[illegible] KW (Peak)	10	40,000		?
Roger White	O-FWA TC-S1W	2 0-4 0	1 W	25	1000	25	600
Roger White	O-FWA TC-S1M	2 0-4 0	1 MW	30	400	20	700
Roger White	O-FWA TC-C1W	4 0-6 0	1 W	25	2000	25	700
Roger White	O-FWA TC-C1M	4 0-6 0	1 MW	30	800	20	700
Roger White	O-FWA TC-P1W	0 8-1 2	1 W	25	600	25	800
Roger White	O-FWA TC-L1W	1 0-2 0	1 W	25	600	25	800
Roger White	O-FWA TC-L1M	1.0-2 0	1 MW	25	300	20	825
Roger White	O-BWO BW-K1-10M	12 0-18 5	5 MW		1700		1000
Roger White	O-BWO BC-X10M	8 0-12 4	10 MW		1500		900
Roger White	O-BWO BW-H10M	7 0-10 4	60 MW		1800		900
Roger White	O-BWO BW-K2-10M	18 0-26 0	2 MW		[illegible]		1000
RCA	O-FWA 6861	2 7-3 5	1 MW	25	[illegible]	6 5	750
Sperry Gyroscope Co.	O-FWA STP-120	25-5	3 W	30	800		980
Sperry	O-FWA STP-122	5-1 0	3 W	35	800		980
Sperry	O-FWA STL 111	1 1-1 6	4 W	30	900		†
Sperry	O-FWA STL 114	1.1-1 6	7 KW (Pk) (.005 Duty Cycle)	35	14,000		†
Stewart Engr. Co.	O-BWO OG-7-13	7-12 4	20 MW		1450		800
Sylvania Electric Products	O-FWA 6753	1 0-2 0	15 MW	40	400		700
Sylvania	O-FWA 6493	2 0-4 0	10 MW	40	400		700
Sylvania	O-FWA TW-612	4 0-8 0	5 MW	40	750		900
Sylvania	O-FWA TW-613	8 0-12 5	5 MW	40	1100		1000
Sylvania	O-FWA 6494	2 0-4 0 (Voltage Tunable over this Range)		15	2300		595
Sylvania	O-FWA 6495	2 0-4 0	7 MW	30	1000	11	1450
Sylvania	O-FWA 6752	1 0-2 0	2 W	33	800		650
Sylvania	O-FWA 6558	2 0-4 0	2 W	33	1000		695
Sylvania	O-FWA 6699	2 0-4 0	1 KW (Pk) (.001 Duty Cycle)	25	6200		1575
Sylvania	O-BWO 6699	1 0-2 0	500 MW		750		1100
Sylvania	O-BWO 6496	2 0-4 0	250 MW		1400		925
Sylvania	O-BWO BW-623	4 0-8 0	100 MW		2500		900
Sylvania	O-BWO 6902	17 5-27	10 MW		2100		2500
Sylvania	O-BWO P-1757	26 5-41	5 MW		2100		2500
Sylvania	Wamoscope 6762	2-4	Visual Display Tube		15,000		2500**
Varian Assoc.	O-BWO VA-161	8 2-12 4	30 MW		600		2950*

*Price includes permanent magnet focusing. No solenoid power supply required.

**Price includes solenoid.

***Price includes magnet but not capsule.
In all other cases the price includes capsule with dc plug and rf connectors, but does not include solenoid or magnet. Most solenoids are priced in the $200-$500 range.

Some Active Areas of Microwave Tube Research

One important current problem is that of making high cw power with broad bandwidth, for example, several hundred watts of cw power near X-band with perhaps somewhat more than 50% bandwidth. If this can be done, a number of similar tubes of interest can

Microwave Tubes *(Continued)*

be built with the same technique. The problem is primarily one of rf losses causing excessive circuit heating. An all-metal structure, if available, would be an excellent answer, but none exists with sufficient bandwidth. A single helix is a satisfactory circuit, if it can be cooled through a heat path that includes only dielectric materials. One solution that has been attempted at Bell Telephone Laboratories[6] is indicated in Fig. 8. A hollow cylindrical electron beam travels outside the helix. A good solution to this problem appears to be near at hand, and when found will probably form the basis for the construction of a wide range of tubes using the single helix and similar structures. Many other similar areas of improvement of a construction technique nature seem likely to take place now that this type of tube is approaching quantity production.

One limitation on O-type FWA tubes, in addition to the limitation on cw power resulting from not being able to make a wideband all-metal circuit, is the limitation imposed by single helix circuits on high voltage operation. Single helix tubes can be made with 20 or 30 kv. beams, but serious current density limitations result at high frequencies in such tubes. A pulsed X-band 10 kw. tube poses many problems, if 50% or more bandwidth and consequently a single helix is required. At a sacrifice in bandwidth, the cross-wound helix[7, 8] can be used to advantage in this type of tube, to reduce the current density requirement with a consequent reduction in magnetic field and solenoid weight. Another circuit with almost identical properties is shown in Fig. 9. This circuit consists of two identical helices wound in parallel and tied together every half turn by rings. A closely related circuit is the bar-strapped bifilar helix shown in Fig. 10 in which the ring straps have been replaced by bars across the diameter, and alternate straps are broken in the center to cause a *stop-band* in the unwanted mode. This circuit offers an even greater current density reduction than the cross-wound and ring-strapped-bifilar helices, and in addition has much greater bandwidth than either of these, being almost identical in performance to the single helix insofar as bandwidth is concerned.[9] It

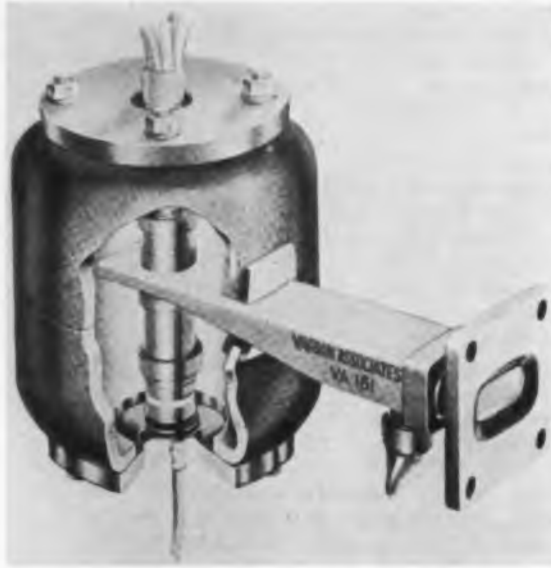


Fig. 4: Commercial O-type X-band BWO employing PM focusing.

requires the use of a hollow beam outside the helix instead of a solid beam. This type of circuit improvement is typical of current activity in many areas of traveling-wave tube circuit research. One very active area of study recently has been in the field of all-metal megawatt level pulsed-power circuits where wider bandwidth is also a major objective, but where 20% bandwidth is typically considered wide enough. At lower power levels there are already quite satisfactory 20% bandwidth all-metal circuits[10, 11] and, as noted above, good possibilities for 2 to 1 bandwidth helix-like circuits for power levels up to 10 kw. or so.

Another area of current interest is worth mentioning in connection with O-FWA tube noise figures. It now appears that it will be possible to build tubes with noise figures below 4 db at particular frequencies by using high current density beams.[12, 13] It also appears from theoretical design calculations that at least 2 to 1 bandwidth tubes with nearly constant noise figures over that bandwidth are obtainable, although not with as low a noise figure over the entire band as would be possible in a narrow band tube.[14] Of

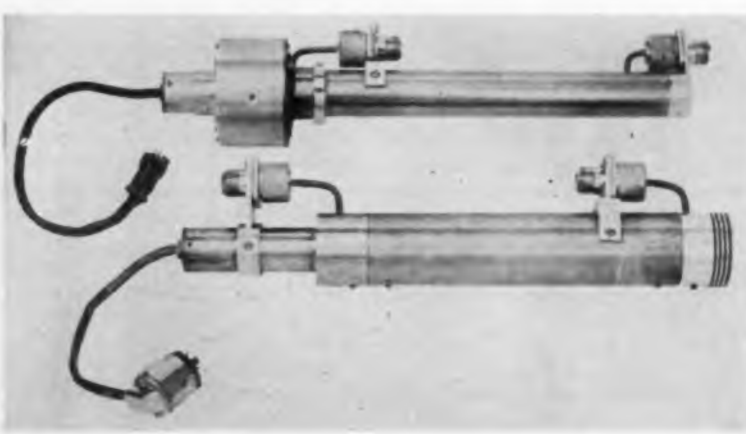
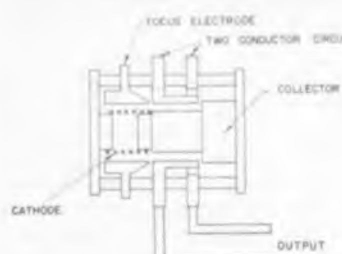


Fig. 5: (l) Two O-type X-band forward wave amplifiers, using periodic magnetic focusing.

Fig. 6: (below) External cathode voltage-tuned magnetron, type developed by GE Co.



great importance is the fact that there is now a clear understanding of how to make good low noise tubes and of how the noise figure variation with frequency can be controlled over wide bandwidths.

Another area of some interest in the improvement of the simple single helix O-type FWA involves the limitation on gain and power bandwidth. For most applications other than countermeasures and instrumentation, a 2 to 1 bandwidth is not only adequate, but is far greater than needed. Most single-helix tubes have had their gain vs. frequency characteristics limited by the rf matches between the tube circuit and the input and output transmission systems, commonly coax or rectangular waveguide. In tubes in which wider band matching to coax has been used, it has been found that more than a 3 to 1 frequency range can be covered with less than ± 5% total variation in gain in db from the midband value.[15, 16] By careful attention to the loss vs. frequency characteristics over wide frequency ranges, still greater bandwidths can be obtained. Very little has been done to explore ultimate bandwidth limits, because, even without anything fancy, more than 3 to 1 and probably 4 to 1 frequency ranges in single helix tubes appear possible, insofar as gain variations are concerned. Power output also varies as a function of frequency, generally with a steadily falling characteristic as frequency increases. Here the limit is normally set by the high frequency performance and it is irrelevant in low power tubes that there is a considerable variation in the maximum power, as long as it is always above some minimum value. In such situations, a useful 3 to 1 frequency range may be practical. It is the author's opinion that more than 2 to 1 bandwidth will soon be available in this type of amplifier for low and medium power applications.

An entirely new approach to the problem of size and weight reduction in these tubes has been taken as the result of work on beam focusing by L. A. Harris.[17] Harris flow is a type of beam flow quite similar to M-type flow except that no magnetic field in the drift region is required. As in M-type or crossed-field tubes there is a dc electric field perpendicular to the electron path, but in Harris flow the beam maintains a stable orbit as a result of an initial spin received before entering the main drift region, rather than as a result of the action of the magnetic field. In other words, centrifugal force replaces the force caused by the magnetic field in an M-type tube. Fig. 11 shows two forms of Harris flow[18, 19] tubes in which the beam receives an initial spin as a result of traversing a region of transverse magnetic field. Fig. 12 shows two other similar schemes,[20, 21] the lower one being of special interest in that the spin is obtained electrostatically, so that no magnetic field is required even in the gun region. Much more remains to be done in this area and many other related types of focusing schemes are possible,[22] only a few of which have been evaluated in any way.

A further step that can be taken in utilizing this type of spinning beam traveling in a dc electric field is to build a circuit around the beam that will permit rf interaction and energy exchange with the transverse dc electric field. In other words, energy can be extracted from the potential energy of the electrons rather than from their kinetic energy, just as in a magnetron or other M-type device. This possibility was first suggested by Versnel and Jonker[23] and by Harris and Lear.[24] Further work on this idea of an E-type tube has been done by Heffner and Watkins.[25] If this sort of device is successful, it may permit the high efficiency operation of the M-type tube without the heavy magnet. Some experimental data has been obtained on such a device by Wada and Watkins.[26]

One difficulty, from a design standpoint, with both the E-type and M-type devices has been the complexity of the interaction process as compared with

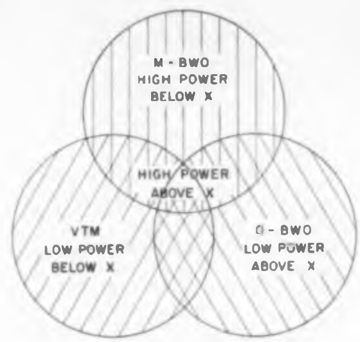


Fig. 7: Educated guess how power-frequency spectrum will ultimately be divided

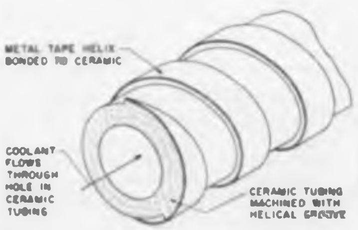


Fig. 8: Properly cooled tape helix circuit yields high cw power and wide bandwidth

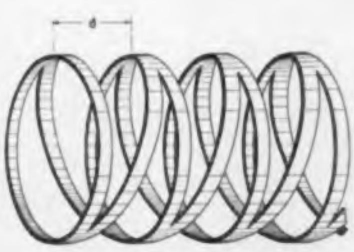


Fig. 9: Ring-strapped bifilar helix offers advantages over single helix at high voltages

Fig. 10: Diametrically strapped bifilar helix (with gaps) with alternate straps broken

Microwave Tubes (Concluded)

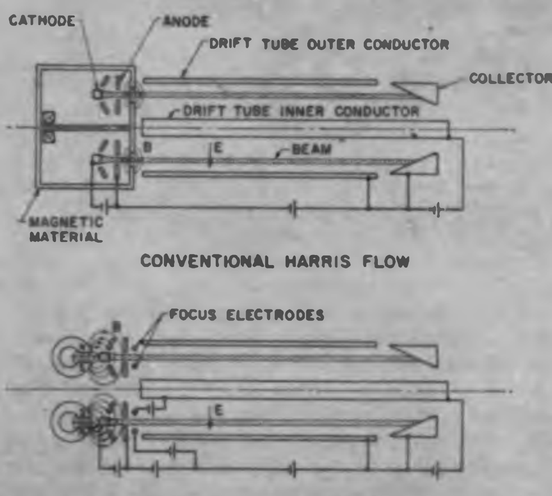


Fig. 11: Promising line of development in beam focusing involves the Harris flow and improved modifications by Cook.

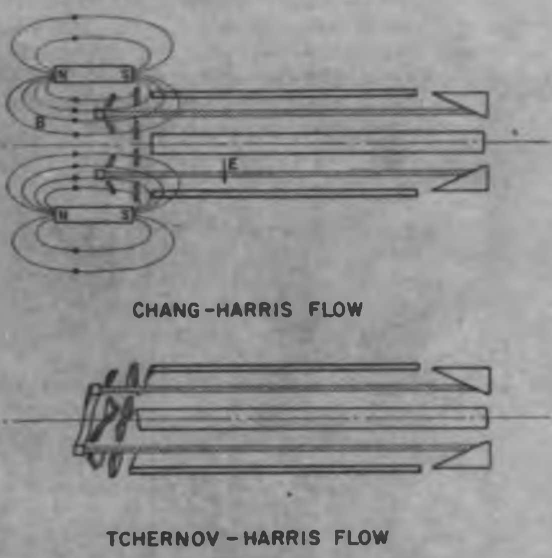
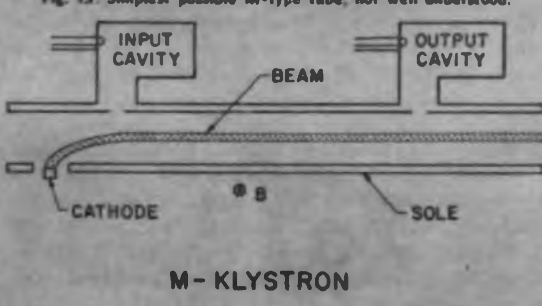


Fig. 12. Modifications of basic Harris flow. Arrangement shown in lower figure requires no magnetic field at all.

Fig. 13: Simplest possible M-type tube, not well understood.



the O-type tube. This problem hasn't prevented getting high efficiency and excellent performance[27] from these tubes, but it has interfered with making rapid design changes, because so many cut and try variations are required. A lot of theoretical and experimental effort of a rather fundamental nature has been put into understanding these tubes recently and more is required. An extremely simple tube built at Stanford recently[28] is shown schematically in Fig. 13. It gave gain in a fashion that is quite different from the process encountered in an ordinary klystron, the signal in the beam being of an exponentially increasing nature. Several theories exist that may account for this phenomenon in detail, but more of this type of work needs to be done to obtain a clear understanding of the M-type device. Probably it will be possible to make some significant improvements in these tubes when such an understanding is obtained.

References

1. Raytheon trademark.
2. G. A. Caryotakis and H. Heffner, *Periodic magnetic focusing for tubes with parallel-flow guns*, Stanford Electronics Laboratory Technical Report No. 454-1, January 1956.
3. Huggins Laboratories types HA-20, and HA-21.
4. General Electric type Z-5112.
5. Unpublished work by P. H. Peters and D. A. Wilbur.
6. Unpublished work by C. C. Cutler and J. T. Mendel.
7. M. Chodorow and E. L. Chu, *Cross-wound twin helices for traveling-wave tubes*, *J. Appl. Physics*, vol. 26, pp. 33-43, January, 1955.
8. C. I. Birdsall and T. E. Everhart, *Modified contra-wound helix circuits for high-power traveling-wave tubes*, *Trans. I.R.E.*, vol. ED-3, pp. 190-204, October, 1956.
9. Unpublished work by D. G. Dow, D. A. Dunn, R. P. Lagerstrom, and D. A. Watkins.
10. M. E. Hines, unpublished work.
11. B. Arfin, *A traveling-wave tube using coupled coaxial cavities*, Stanford Electronics Laboratory Technical Report No. 220-1, October, 1956.
12. P. K. Tien and J. Moshman, *Monte Carlo calculation of noise near the potential minimum of a high frequency diode*, *J. Appl. Physics*, pp. 1067-1078, September, 1956.
13. A. E. Siegman and D. A. Watkins, *Potential Minimum noise in the microwave diode*, *Trans. I.R.E.*, vol. ED-4, pp. 82-86, January 1957.
14. L. D. Buchmiller, R. W. DeGrasse and G. Wade, *Design and calculation procedures for low noise traveling-wave tubes*, *Trans. I.R.E.*, vol. ED-4, July, 1957.
15. D. A. Dunn, *Traveling-wave amplifiers and backward-wave oscillators, for VHF*, *Trans. I.R.E.*, vol. ED-4, July, 1957.
16. W. A. Harman, *A CW UHF TWT power amplifier of extended bandwidth*, paper presented at the National Conference on Aeronautical Electronics, Dayton, Ohio, May, 1957.
17. L. A. Harris, *Axially symmetric electron beam and magnetic-field systems*, *Proc. I.R.E.*, vol. 40, pp. 700-708, June, 1952.
18. The conventional Harris flow scheme was tested experimentally and the results reported by C. B. Crumly, *A UHF traveling-wave amplifier tube using an electrostatically focused hollow beam*, *Trans. I.R.E.*, vol. ED-3, pp. 62-65, January, 1956.
19. E. J. Cook, *Experimental studies in the initiation of Harris flow*, paper presented at the Conference on Electron Tube Research, Boulder, Colo., June, 1956.
20. The Chang launching scheme was actually proposed in connection with a periodic electrostatic focusing system, but applies equally well to Harris flow. See K. K. N. Chang, *Confined electron flow in periodic electrostatic fields of very short periods*, *Proc. I.R.E.*, vol. 45, pp. 66-73, January, 1957.
21. Z. S. Tchernov, *The Spiratron, a traveling-wave tube with centrifugal electrostatic focusing of the electron beam*, paper presented at the Congress International Tubes Hyper-frequencies, Paris, May, 1956.
22. See, for example, the Chang paper referred to in note 20 above.
23. A. Versnel and J. L. H. Jonker, *A magnetless magnetron*, Philips Research Reports, vol. 9, pp. 458-459, December, 1954.
24. W. E. Lear, *Analysis of the spiral beam traveling-wave magnetron*, Technical Report, U. of Florida, November, 1954.
25. H. Heffner and D. A. Watkins, *On the practicality of R-type devices*, *Proc. I.R.E.*, vol. 43, pp. 1007, 1008, August, 1955.
26. G. Wada, "The helitron oscillator," Stanford Electronics Laboratory Technical Report No. 31, April, 1958.
27. R. R. Warneck, P. Guenard, O. Doehler, and B. Epsztein, *The M-type carcinotron tube*, *Proc. I.R.E.*, vol. 43, pp. 413-424, April, 1955.
28. D. J. Harris and H. Heffner, *An investigation of amplification along electron beams under crossed field conditions*, Stanford Electronics Laboratory Technical Report No. 385-1, November, 1956.

New Products . . . West Coast

10 KW KLYSTRON

A wide-tuning range 10 kw amplifier klystron suitable for forward scatter communications and UHF television is available. The VA-833A delivers in excess of 10 kws over a

1.4/1 range of frequencies from 685 to 985 MC. It is a 4 cavity amplifier klystron requiring about 1 w of drive power. The 4 internal cavities tune with individual drive shafts. It needs only a dc power supply, cooling and mounting magnet to form a complete microwave amplifier unit. Varian Associates, Palo Alto, Calif.

Circle 258 on Inquiry Card, page 97

VOLTAGE DIVIDER

The Dekatran is a new compact panel mounted ac voltage divider having linearity rivalling elaborate laboratory standard dividers. It employs a special tapped toroidal transformer,

coaxial switches and the ESI Dekadial. Four coaxial dials give a simple straight line reading to 5 significant figures. Overall linearity is better than 0.002%. It offers negligible phase shift and good frequency response. Electro Measurements, Inc., 7524 S. W. Macadam Ave., Portland 1, Ore.

Circle 260 on Inquiry Card, page 97

MEASURING EQUIPMENT

A transistorized, high-sensitivity version of miniature temperature-measurement subsystems is available. Applications are missile and aircraft flight testing. The TME-1 SD and

TME-2 SD are for use with fast-response, 100-ohm-resistance temperature transducers to produce a full 5 volt output for a span of only 75° F. TME-1 SD is a single-channel unit; TME-2SD, a dual-channel unit. They meet Specification MIL-E-5272A. Arnoux Corp., 11924 W. Washington Blvd., Los Angeles 66, Calif.

Circle 262 on Inquiry Card, page 97

MOMENTARY SWITCH

A single pole, double throw pulse switch for use in applications where only a momentary contact on either the make or the break is required is available. Depressing plunger, a contact is either momentarily opened or closed for approximately 10 μsec in duration. Upon return of the plunger to its normal position, no contact is

made. Electrical rating is 3a. inductive and 4 a. resistive at 30 vdc. Actuation force is approximately 1.5 lbs. Switch-Lock Inc., 7131 Vineland Ave., N. Hollywood, Calif.

Circle 259 on Inquiry Card, page 97

REMOTE ATTENUATOR

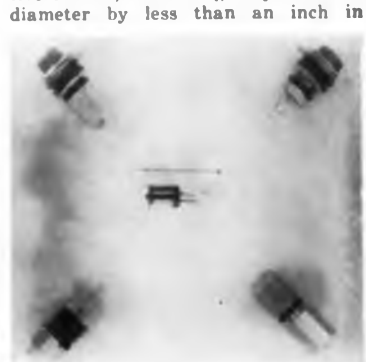
The model 200 VHF remote telemetering attenuator, designed to overcome the problem of receiver blocking at lift-off is available. Consisting of two units, the attenuator and control chassis, it is a low insertion loss (less than 0.2 db), non-contacting, continuously variable attenuator. Both units are compact. The attenuator unit is

inserted in the transmission line between the receiving antenna and receiver. The frequency range is 210-250 MC. Rantec Corporation, P. O. Box 18, Calabasas, Calif.

Circle 261 on Inquiry Card, page 97

SUBMINIATURE LAMP

The NE2R subminiature neon lamp eliminates the need for a series resistor or for external ballast of any kind. This is accomplished by incorporating current control as an integral part of the internal lamp structure. The new lamp is diminutive in size, measuring only ¼ in. in diameter by less than an inch in



length. It has a midget flange base and will be interchangeable in many assemblies and sockets. Circon Component Corp., Santa Barbara Municipal Airport, Goleta, Calif.

Circle 263 on Inquiry Card, page 97

New Products . . . West Coast

MODULATION TRANSFORMERS

Matched modulation transformers and reactors for AM broadcast transmitter applications, incorporating an entirely new patented design concept are available. Available in units for

250w, 500w, 1kw, 5kw, 10kw and 50kw transmitters, the new design permits size and weight reductions with highest reliability in performance. Response within 1 db from 50 to 10,000 cps. with under 2.5% distortion is obtained without feedback. Electro Engineering Works, Inc., 401 Preda St., San Leandro, Calif.

Circle 264 on Inquiry Card, page 97

POWER KLYSTRON

An external-cavity power amplifier klystron covering the 1700 to 2400 MC range is available. Designated the 4KM50, 000SG, it is rated at 10 kw CW power output with less than 1

watt drive—a power gain of 10,000 times at an efficiency of 35-40%. It incorporates a modulating anode which allows simple, continuously variable control of power applied to the tube, and which permits shaped-pulse and amplitude modulation as well as CW operation. Eitel-McCullough, Inc., San Bruno, Calif.

Circle 266 on Inquiry Card, page 97

DUAL-BEAM SCOPE

The Type 551 is a dc-to-25 MC dual-beam oscilloscope with a Plug-In Feature. All Type 53/54 plug-in units can be used in both vertical channels, providing a high degree of signal-

handling versatility. Risetime of the two main vertical amplifiers is 0.012 µsec, and both have 0.2 µsec signal-delay networks. The Type 551 sweep is common to both beams. It has 22 calibrated direct-reading sweep rates. Amplitude calibrator has 18 fixed steps. Tektronix, Inc., P. O. Box 831, Portland 7, Ore.

Circle 268 on Inquiry Card, page 97

TOROIDAL TRANSFORMER

A miniature toroidal signal transformer (Series 791) for low-level applications where user requires high impedance, low phase shift, and minimum pickup is available. These units are used with input voltages as low as ½ µv. Turns ratios range from 1:1 to 1:1000. Weight is 0.5 oz., and temperature range −55° C to +100° C. Units withstand extreme shock,

and are fully encapsulated and hermetically sealed to meet MIL-E-5272A and MIL-T-27A specifications. Arnold Magnetics Corp., 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 265 on Inquiry Card, page 97

DIODE SUBSTITUTION

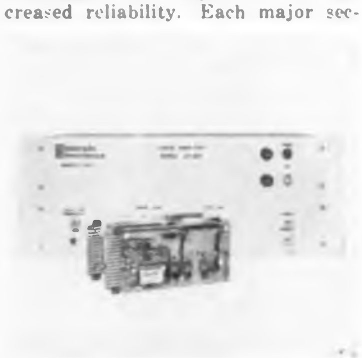
To aid the design engineer in rapid selection of zener diodes for experimental breadboard circuits, the Zeniac, a diode substitution box offers a selection of 11 basic one watt silicon zener diodes covering the range from 3.6 to 30v. The decade-type substitution box is housed in a compact, easily portable unit which may be inserted into any breadboard cir-

cuit. A turn of the selector switch rapidly determines the exact diode required. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Circle 267 on Inquiry Card, page 97

LINEAR AMPLIFIER

An improved non-overloading type of linear amplifier designated as the Model LA-600 is now available. Preserving the good operational characteristics of the original Oak Ridge DD-2 design, the LA-600 offers additional improvements and features to provide greater flexibility, ease of modification and expansion, and increased reliability. Each major sec-



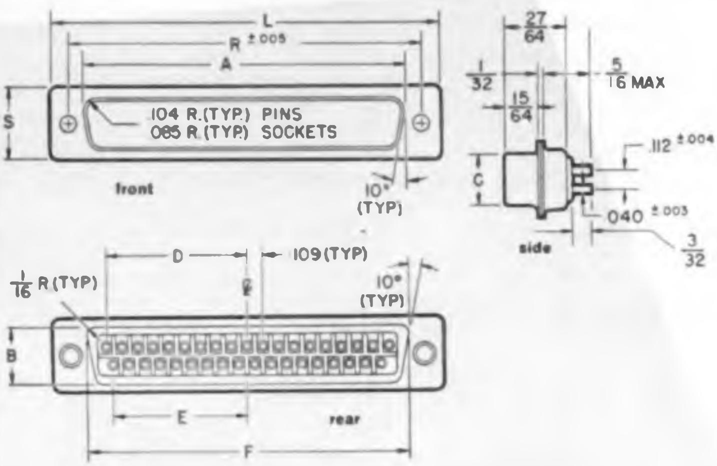
tion of the instrument is packaged as a plug-in element. Plug-in pulse height selectors, ratemeter circuits, scaler units, etc., may be added. Eldorado Electronics, 2821 10th St., Berkeley, Calif.

Circle 269 on Inquiry Card, page 97

D-SUB-MINIATURES:
PRINTED CIRCUIT PIN AND SOCKET INSERTS (RIGHT)

NEW PRINTED CIRCUIT SUB-MINIATURE CONNECTORS BY

CINCH



D Sub-Miniature plugs and sockets with printed circuit pin and socket inserts are now available as listed for immediate delivery.

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.

DIMENSION TAB

SIZE	A	B	C	D	E	F	L	R	S
DE-9P-1	45/64	27/64	23/64	.216	.162	49/64	1-13/64	63/64	31/64
DE-9S-1	41/64	27/64	5/16	.216	.162	49/64	1-13/64	63/64	31/64
DA-15P-1	1-1/64	27/64	23/64	.378	.328	1-3/32	1-17/32	1-5/16	31/64
DA-15S-1	31/32	27/64	5/16	.378	.328	1-3/32	1-17/32	1-5/16	31/64
DB-25P-1	1-9/16	27/64	23/64	.652	.598	1-5/8	2-5/64	1-55/64	31/64
DB-25S-1	1-33/64	27/64	5/16	.652	.598	1-5/8	2-5/64	1-55/64	31/64
DC-37P-1	2-13/64	27/64	23/64	.978	.928	2-9/32	2-23/32	2-1/2	31/64
DC-37S-1	2-11/64	27/64	5/16	.978	.928	2-9/32	2-23/32	2-1/2	31/64
DD-50P-1	2-7/64	17/32	15/32	.933	.870	2-11/64	2-5/8	2-13/32	39/64
DD-50S-1	2-5/64	17/32	27/64	.933	.870	2-11/64	2-5/8	2-13/32	39/64

CONDENSED DATA

SHELL MATERIAL — Steel with cadmium plate finish
CONTACT MATERIAL — Copper alloy with gold over silver plate
INSULATION MATERIAL — nylon or Diallyl-phthalate
POLARIZATION — keystone shell shape
CURRENT RATING — 5 amperes
WIRE SIZE — #20 AWG
NUMBER OF CONTACTS — 9, 15, 25, 37, or 50
VOLTAGE — D's will withstand a test voltage (60cps ac rms) of 1300 volts and show no evidence of breakdown. The test voltage is applied for a period of 1 minute between the contacts and between the contacts and the shell.

Manufactured by Agreement with Cannon Electric Company

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

Cinch ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Circle 65 on Inquiry Card, page 97

What's New . . .

Teflon Tubing

Flexible harness of 70 to 80 wires insulated with Teflon tubing can be easily opened by applying a hot soldering iron to the lacing.

IN miniaturizing the computation system of an airborne doppler navigation system, Kollsman Instrument Corp., Elmhurst, N. Y., was faced with a number of mechanical as well as electronic problems.

The Teflon "spaghetti" is not affected by the heat from the soldering iron.

One of the major mechanical problems was the production of a compact, yet flexible harness containing as many as seventy to eighty 600-volt wires. Specially processed Polypenco Teflon* spaghetti tubing was finally chosen for insulation. The tubing has a minimum dielectric strength of 7500 volts RMS, a dielectric constant of 2.0 to 2.1 from 60 to 10^8 cycles and a volume resistivity of greater than 10^{10} megohm-cm.

With this superior insulating quality, thin wall insulation can be used. Wire insulation is substantially reduced so that the entire cable of 70 to 80 wires is less than three-quarters of an inch in diameter.

The Teflon spaghetti tubing, man-

(Continued on page 92)

*DuPont trademark.

 Circle 96 on Inquiry Card, page 97

Actual Size

TYPE H-151

Single turn
Net weight: 2 oz.
Rotation: 350° + 4° —0°
Rating: 3 watts
Resistance: 15 to 100,000 ohms
Linearity: Std. ± 0.5%; Special to ± 0.2%
Terminals: Turret type

Actual Size

TYPE H-751

Single turn
Net weight: 1 oz.
Rotation: 345° ± 5° std. (others available)
Rating: 1 watt
Resistance: 50 to 25,000 ohms
Linearity: Std. ± 1%; Special to ± 0.5%
Terminals: Turret type

There is a difference in
MINIATURE PRECISION POTENTIOMETERS
... and CIRCUIT makes the difference!

Economy without compromise of quality, precision and ruggedness . . . that's the *real difference* in CIRCUIT single turn potentiometers.

These miniature units give design engineers the precision they need for miniaturization programs, plus the ability to withstand rigorous environmental conditions of humidity, temperature cycling, vibration, etc. High temperature versions available on request.

The reason is CIRCUIT INSTRUMENT'S approach to potentiometer design and production. CIRCUIT is *large enough* to pace the field in advanced designs and special features . . . but *small enough* to offer you unusual production flexibility and quick delivery and service. Let's discuss *your* needs soon.

Write for data sheet 6580

Now Available From Authorized Circuit Distributors

SEE US AT WESCON
BOOTH NOS. 1147-1148

IRC
INTERNATIONAL RESISTANCE COMPANY

CIRCUIT INSTRUMENTS INC.
Dept. 353, 2801 Anvil Street, North
St. Petersburg, Fla.

FOR ALL PRECISION POTENTIOMETER REQUIREMENTS: MINIATURE • SUB-MINIATURE • MOISTURE-SEALED • HERMETICALLY-SEALED • BALL BEARING • HIGH PRECISION • HIGH TEMPERATURE

Circle 78 on Inquiry Card, page 97

WASHINGTON

News Letter

EXPANDED MOBILE RADIO—Beginning August 1, increased benefits to the nation's industrial economy through the expanded use of mobile radio communications facilities became possible under the terms of a sweeping revision in the administrative policies and rules of the Federal Communications Commission with respect to industrial activities in that mobile radio field. The FCC established a "business radio service" open to virtually any U. S. citizen engaged in a legitimate business pursuit; a "manufacturers radio service" available to the country's manufacturing industry; and a "telephone maintenance radio service" for communications common carriers rendering telephone service to the public for hire.

MANUFACTURERS' RADIO—Victor G. Reis, Chairman of the Committee on Manufacturers' Radio Use of the National Association of Manufacturers, lauded the FCC for its establishment of the new manufacturers' radio service. He declared that "The new service will open up the use of radio in industry to such an extent that production increase will go a long way toward maintaining America's number one position in world commerce," and "In many areas it will revolutionize production techniques."

TV ALLOCATIONS REAPPRAISAL — Because of the exigencies of the uhf-vhf television situation, the FCC is engaged in a comprehensive reappraisal of its TV allocations philosophy and policies. Its staff was directed by the Commissioners to analyze the current quandary and problems between vhf and uhf competition and operations. The Commission also directed the commencement immediately of a complete review of the technology, the social and economic philosophy of TV allocations. The bulk of the FCC staff study is slated to be completed by fall, but its survey of the situation will be integrated with the final report of the Television Allocations Study Organization on propagation factors and potential developments in equipment which is scheduled to be made by the end of this year.

FOUR YEARS OF INACTION—Senator John Pastore, Rhode Island Democrat, who heads the Senate Interstate Commerce Committee's communications-television subcommittee has taken to task the FCC for not taking some concrete action during the last four years to alleviate the plight of uhf television stations. Sen. Pastore who has followed television matters closely during his eight-year Senate career feels that the Commission should reach an agreement or a compromise in deintermixture TV markets and speed up its final determination of allocations of television either all in vhf or in uhf spectrum assignments.

COMMUNITY ANTENNA TELEVISION—The establishment of approximately 25 independent common carriers furnishing television transmission service to community antenna systems throughout the United States by the FCC was depicted before the Senate Interstate & Foreign Commerce Committee as providing more and better TV service in rural areas. E. Stratford Smith, General Counsel for the National Community Television Association, told the Senate committee television broadcast industry spokesmen opposing the CATV service had falsely charged that the establishment of private intercity relay facilities for community antenna television systems "was a reckless act on the part of the FCC."

FREQUENCY ASSIGNMENT LISTS — Provisions for the public sale of the FCC's semi-annual "Frequency Assignment Lists" have been made under the sponsorship of the Electronic Industries Association and purchases of the various frequency lists with assignments for the various services can be made through EIA headquarters in Washington. Participation by EIA in the project is on a non-profit basis. The action makes the frequency lists available for the first time for general public distribution to radio user organizations and radio-electronics engineers.

COURT CATV TEST—The National Association of Broadcasters has decided to support broadcast TV stations in any future court tests on piracy of telecasters' signals by community antenna systems. Any such court tests would be the first full scale attempt, the NAB pointed out, to resolve the question in the history of United States broadcasting.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

Where can you use this improved TEFLON HERMETIC SEAL TERMINAL?

How's this for something vastly better in hermetic seal terminals? Cracking and crazing have been eliminated! Extra-high surface resistivity is *guaranteed*, even under severe moisture, foreign matter and lengthy storage conditions!

IRC Type LT Terminals are molded of TEFLON FEP-fluorocarbon resin*. They are available in specifications, ratings, and types to meet all commercial and military needs . . . and are endowed with an exclusive, superior metal-to-plastic bond.

Where job conditions require high insulation resistance, high physical thermal shock resistance, high arc-over, zero moisture absorption, wide temperature range and miniaturization, these improved IRC Type LT Terminals are for you.

CONSTRUCTION FEATURES

A. Center Conductor
Solid Lead Types are Phosphor Bronze. Tubular Leads are Copper or Brass. Other materials and lead shapes are available, if required, upon request.

B. Body
LT Terminal bodies are of Molded TEFLON FEP

C. Solder Seal
232°C melting point solder

D. Copper Ring bonded to Plastic body

E. Annular Copper Ring bonded to Plastic body

F. All exposed metal is plated with 30/70 tin-lead alloy for easy soldering

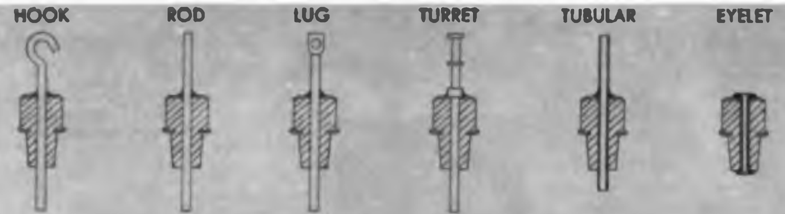
3 Standard Voltage Ratings—6 LEAD TYPES

Available in any combination

Terminal Series	Voltage Rating
LT-100	1000V
LT-200	2000V
LT-300	3000V

LARGER SIZE TERMINALS AVAILABLE UPON REQUEST

LEAD TYPES



CONDENSED SPECIFICATIONS:

	ALL TYPES
No-Leak Air Pressure Test (psig, 5 minutes)	35
Minimum Terminal Pull Test (lbs.)	10
Torque Test (in.-oz.)	10
Maximum Continuous Operating Temperature (°C)	175
Short Time Operating Temperature (°C)	225

*DuPont's Registered Trademark for its FEP-fluorocarbon resins

Write for Catalog Data Bulletin LT-1, containing full specifications, dimensions and installation recommendations.

IRC

See us at WESCON Booth Nos. 1147-1148

INTERNATIONAL RESISTANCE COMPANY • Dept. 354, 401 N. Broad St., Phila. 8, Penna. *In Canada:* International Resistance Co., Ltd., Toronto, Licensee

Circle 114 on Inquiry Card, page 97

L. W. Howard

(Continued from page 49)

transformers.) New companies are springing up to build items for which there is an unfulfilled demand and not primarily to nibble their way into an area dominated by established operations. As a result, growth has been phenomenal in new developments where the product selection has been carefully made and the competitive situation thoroughly studied. There are many such companies in WCEMA which have passed the danger point, established good organizational practices, and become financially successful. These companies, as they grow, seek new products and become competitive as they tend to duplicate the lines of others.

There is a distinct tendency in the West, as elsewhere in the electronics industry, for growth-by-consolidation. Present tax laws made it inevitable that small, closely-held companies must grow big enough to become publicly held or join forces with a publicly-held company. It seems certain that ultimately a few substantial, well-planned, efficient and large companies will take over the majority of the dollar volume in electronics. At least the current penchant for mergers points to that direction.

Despite a certain amount of "musical chairs" that characterizes the current trend toward mergers, the formula of "going into business with an idea for a saleable product" cannot fail to produce an annual crop of new companies, of which a good percentage will be successful. The West has always had a disproportionately high percentage of such companies; perhaps this is because the thinking here leads that way and because invigorating personalities such as Dr. Frederick Terman of Stanford University encourage creative enterprising among their students.

An emerging strong factor in the western growth pattern has been the direct participation of aircraft companies. Many share the opinion that the approach of setting up their own electronic branches in preference to using the know-how of established electronic firms

(Continued on page 88)

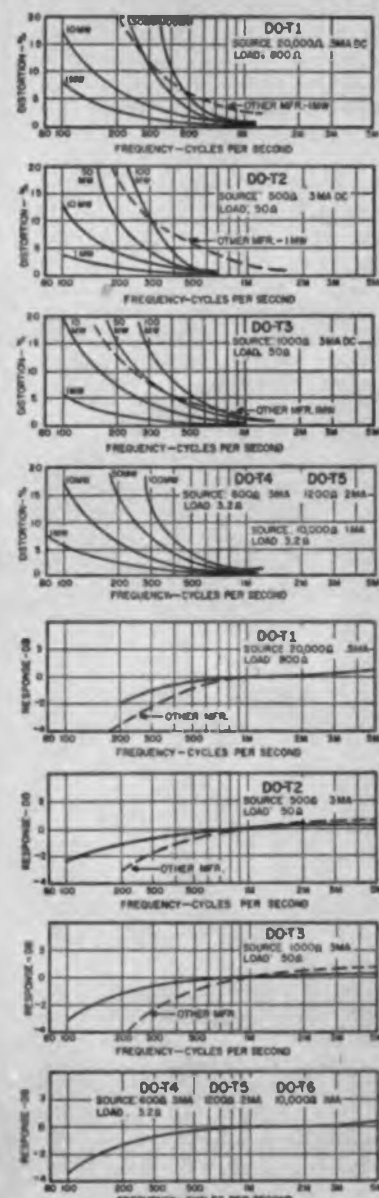
TO MAKE YOUR EQUIPMENT SMALLER YET MORE RELIABLE

REVOLUTIONARY TRANSISTOR* TRANSFORMERS, HERMETIC TO MIL-T-27A

Conventional miniaturized transistor transformers have inherently poor electrical characteristics, perform with insufficient reliability and are woefully inadequate for many applications. The radical design of the new UTC DO-T and DI-T transistor transformers provides unprecedented power handling capacity and reliability, coupled with extremely small size.

TYPICAL DO-T PERFORMANCE CURVES

Power curves based on setting output power at 1 KC, then maintaining same input level over frequency range.



DO-T

5/16 Dia. x 13/32, 1/10 Oz.

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

Excellent Response ... twice as good.

Low Distortion ... reduced 80%.

High Efficiency ... up to 30% better.

Moisture Proof ... hermetic to MIL-T-27A.

Rugged ... completely cased.

Anchored Leads ... will stand 10 lb. pull, plastic leads for printed circuits.

DI-T

5/16 Dia. x 1/4, 1/20 Oz.

To fully appreciate DO-T transistor transformers, the curves indicate their performance compared to that of similar size units now on the market. DI-T transformers are still smaller in size. Power rating and other characteristics are identical to DO-T, but low frequency response (3 db down point) is 30% higher in frequency. Units can be used for different impedances than those shown, keeping in mind that impedance ratio is constant. Lower source impedance will improve response and level ratings ... higher source will reduce them. Units may be used reversed, input to secondary.

DO-T No.	MIL Type	Application	Pri. Imp.	D.C. Ma.‡ in Pri.	Sec. Imp.	Pri. Res.	Level Mw.	DI-T No.
DO-T1	TF4RX13YY	Interstage	20,000 30,000	.5 .5	800 1200	850	50	
DO-T2	TF4RX17YY	Output	500 600	3 3	50 60	60	100	DI-T2
DO-T3	TF4RX13YY	Output	1000 1200	3 3	50 60	115	100	DI-T3
DO-T4	TF4RX17YY	Output	600	3	3.2	60	100	
DO-T5	TF4RX13YY	Output	1200	2	3.2	115	100	
DO-T6	TF4RX13YY	Output	10,000	1	3.2	1000	100	
DO-T7	TF4RX16YY	Input	200,000	0	1000	8500	25	
DO-T8	TF4RX20YY	Reactor 3.5 Hys. @ 2 Ma. DC, 1 Hy @ 5 Ma. DC (DI-T8 is 2.5 Hy @ 2 Ma.)				630		DI-T8
DO-T9	TF4RX13YY	Output or driver	10,000 12,500	1 1	500 CT 600 CT	800	100	DI-T9
DO-T10	TF4RX13YY	Driver	10,000 12,500	1 1	1200 CT 1500 CT	800	100	DI-T1
DO-T11	TF4RX13YY	Driver	10,000 12,000	1 1	2000 CT 2500 CT	800	100	DI-T1
DO-T12	TF4RX17YY	Single or PP output	150 CT 200 CT	10 10	12 16	11	500	
DO-T13	TF4RX17YY	Single or PP output	300 CT 400 CT	7 7	12 16	20	500	
DO-T14	TF4RX17YY	Single or PP output	600 CT 800 CT	5 5	12 16	43	500	
DO-T15	TF4RX17YY	Single or PP output	800 CT 1070 CT	4 4	12 16	51	500	
DO-T16	TF4RX13YY	Single or PP output	1000 CT 1330 CT	3.5 3.5	12 16	71	500	
DO-T17	TF4RX13YY	Single or PP output	1500 CT 2000 CT	3 3	12 16	108	500	
DO-T18	TF4RX13YY	Single or PP output	7500 CT 10,000 CT	1 1	12 16	505	500	
DO-T19	TF4RX17YY	Output to line	300 CT	7	600	19	500	DI-T1
DO-T20	TF4RX17YY	Output or matching to line	500 CT	5.5	600	31	500	DI-T2
DO-T21	TF4RX17YY	Output to line	900 CT	4	600	53	500	
DO-T22	TF4RX13YY	Output to line	1500 CT	3	600	86	500	DI-T2
DO-T23	TF4RX13YY	Interstage	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	850	100	DI-T2
DO-T24	TF4RX16YY	Input (usable for chopper service)	200,000 CT	0	1000 CT	8500	25	
DO-T25	TF4RX13YY	Interstage	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	800	100	
DO-T26	TF4RX20YY	Reactor 6 Hy. @ 2 Ma. DC, 1.5 Hy. @ 5 Ma. DC				2100		
DO-T27	TF4RX20YY	Reactor 1.25 Hy. @ 2 Ma. DC, .5 Hy. @ 11 Ma. DC				100		
DO-TSH	Drawn Hipermalloy shield and cover for DO-T's, provides 25 to 30 db shielding.							

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

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

SPECIAL UNITS AVAILABLE TO YOUR SPECIFICATIONS.

UNITED TRANSFORMER CORP.

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

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

Circle 117 on Inquiry Card, page 97

(*Continued from page* 86)

was not the best course some of the aircraft companies could have followed. So many readymade situations were available, either by subcontract or by purchase of a suitable company. Much time and money has been lost by starting from scratch and it is only after some fairly expensive procedures that several of the aircraft electronic divisions have begun to produce effectively. Certainly we can now recognize an air of competence which was lacking at the start of these electronic divisions. Electronic equipment is an increasingly large proportion of the total dollar investment in units of planes and missiles and it is not surprising that the aircraft people wanted to keep a certain amount of direct control.

As the aircraft companies get their feet on the ground in electronics, it seems likely that some of them will enter military and commercial fields not directly associated with planes or missiles. Diversification planning will possibly lead to exploration of business areas far afield from plane-making as new technical competence is acquired.

A considerable number of companies have entered electronics from practically every other business quarter, through consolidation or by developing an electronic subsidiary. Much of this is "grass is greener on the other side of the fence"-thinking; also, many management people are hedging against the possibility that electronics will revolutionize their present product line. It seems inevitable that electronic controls are going to become common in many lines of equipment now mechanically controlled. The superior speed and accuracy of electronic devices are certain to cause revolutionary changes in many products whose basic designs have been frozen for decades. A good example might be the automobile, where electronically-controlled ignition systems and fuel injection systems have already been developed, and where much of the production machinery is also controlled by electronic devices. The penetration of electronics in the office machinery business has only just started.

WESCON has closely followed the trend of electronics in the West, both in growth and in the type of products exhibited. The first show, in 1944, was to acquaint members of WCEMA with new techniques and products developed by member companies as a result of the war effort and to discover ways of mutual assistance in purchasing, engineering, production and post-war planning.

The 1958 show will represent a 3000% growth in number of exhibits and an equal spread in number and type of products shown over the initial effort in 1944. Attendance will be many thousand-fold higher. This, it seems to many of us, is indicative of the virility and promise of the industry in the West and the hastening of its pace to a destiny as one of the half-dozen truly important regions of industrial and professional activity in the challenging world of electronics.

Bruce Angwin

(*Continued from page* 50)

least two of the nation's largest corporations have recently transferred their electronic computer headquarters to the Coast. Systems to accurately and instantly perform such laborious manual functions as banking-accounting and department store or super-market inventory control are now coming from these fantastic machines which have already proven their military ability to analyze a potential enemy attack, determine the best offensive or defensive reaction, fly the appropriate aircraft, if necessary, and then guide a missile to the enemy device and detonate it at the precisely correct moment.

It is interesting to note that at least three of the nation's leading operations, devoted exclusively to analyzing the technical complexity of military electronic systems, are situated in the West. The West's long dominance of "packaged entertainment" has also given birth to an ever-expanding branch of electronics resulting from developments in fields of audio- and video-recording for motion pictures,

(*Continued on page* 90)

(*Continued from page* 88)

radio and television.

Engineering know-how resident in the West is also busily at work developing the advanced components which make ultra modern electronic equipment and systems possible. A large proportion of the organizations that develop microwave tubes of high-power-handling capabilities and the tiny but most advanced and usable semiconductor products is located in the West. Adding to this are several leading manufacturers of electronic test equipment, communication, and navigational aids, and the military research, development, and proving grounds for advanced electronic and nuclear components and systems. The realization thus grows that, indeed, a large part of our way of life in the future is in the hands of the West.

The West, in accruing and utilizing a major share of the nation's electronic brainpower, has also recognized the resultant need for cross fertilization, as it is only by an analytical interchange of knowledge that further developments can be realized at the tremendous rate of advancement demanded by a restless and changing world. Here, too, the West is "lifting itself by its bootstraps" through WESCON.

WESCON is a communication center for the electronic industry. Through its exhibit booths, totaling over 900, the latest developments in components, systems, and services are showcased to the world. Its 40 technical sessions, covering over 200 specialized papers on the most recent advances in research, design, and engineering, provide the vital opportunity to interchange knowledge and stimulate further visionary examination of the technical future. Thus WESCON offers the scientific heart of this most important industry an opportunity of tremendous magnitude and scope specially tailored to its specific needs and desires.

Don Larson

(*Continued from page* 50)

the meeting into forty sessions (five running concurrently during four morning and afternoon periods), plus two "extras" which will be general-interest evening assem-

(*Continued on page* 92)

Two Type 7191's receive special "D.C. hold-off" vibration test. *All* Tung-Sol/Chatham miniature hydrogen thyratrons — 7190, 7191, 7192 — must "hold off" while subject to 15G vibration, swept from 50 to 2,000 cps in 4 minutes. Tubes also are shocked at 48° hammer angle in Navy high-impact flyweight shock machine, equal to 720G/1 millisecond shock.

Tung-Sol/Chatham miniature hydrogen thyratrons supply test-proved ruggedness for missile use!

Extensive in-factory tests assure designers Tung-Sol/Chatham miniature hydrogen thyratrons — 7190, 7191, 7192 — can withstand the severe shock and vibration met in missile flight. Performance of these tubes in several operational missiles gives in-use proof of their ruggedness.

In radar modulators and tracking beacons, these compact tough tubes supply 10 KW, replace bulkier types. Broad range of pulse repetition rates widens design choice . . . zero bias simplifies circuitry and triggering requirements. Tubes hold off high voltage, pass high peak current with low tube voltage drop. Three types available: 7190 — pin base, 7191 — top anode connector, 7192 — flexible leads.

Tung-Sol, only producer of miniature hydrogen thyratrons for missiles, can supply you immediately. For complete data on these types . . . on special-purpose tubes of all types, phone or write. Tung-Sol Electric Inc., Newark 4, New Jersey. Commercial Engineering Offices: Bloomfield and Livingston, New Jersey; Culver City, California; Melrose Park, Illinois.

7190 7191 7192

TUNG-SOL®

Circle 46 on Inquiry Card, page 97

(Continued from page 90)

blies.

When plans were first made for the 1958 WESCON, by the eight-man board of directors, the size was anticipated and the physical limitations appreciated. In addition to the well-known inducements to Southern California, the developing importance of the industry in the national military electronics picture engenders a special attraction to the area. Southern California's long-established aircraft industry, which has moved its orientation steadily toward increased activity in research, development and production diversity (with mounting dependence on things electronic), is an important observer of the WESCON "showcase."

Since the WESCON board was assured of full-house patronage, it turned its main attention to qualitative considerations in building the 1958 structure. Every mounting of WESCON has stressed quality, from the show and convention aspects through the more social concerns. There have been no sacrifices in achieving what are hoped to be the finest accommodations to the visitor's purposes of seeing, meeting and learning. Being well-versed in management and professional practices, the executives and committeemen of WESCON have insisted on quality-control of all details ensuring a successful convention.

There will be some innovations and improvements to classical services: a separate, air-conditioned lounge for exhibitors; a closed-circuit TV paging system with twelve monitor stations; a tabulated registration of all visitors by company and hotel location; a display atop the central message center presenting a 28-foot model of a missile on a simulated launching platform; two streamlined registration areas to speed processing visitors at all hours; and a special telephone installation in the auditorium with 350 private lines into exhibitor booths and operating locations.

WESCON-1958 has been planned and will be executed with every concern for quality, including comfort and convenience. We hope our visitors agree with the effort and will benefit from their participation.

Teflon Tubing

(Continued from page 82

ufactured by The Polymer Corp., Reading, Pa., has outstanding flexibility. The combination of flexibility and thinness of wall makes it possible to easily bend the completed harness into and around the corners of the various "black-boxes" used in the computer without affecting its electrical properties.

Soldering within the miniaturized components can be a real problem because of the number of wires in the limited space and the necessity of insulating the wires completely between connections. In assembly, it is practically impossible to solder the wires without touching the insulation. The soldering iron heat would peel and split vinyl wire coating, exposing the wire. Teflon wire covering neither splits nor peels under the heat from the soldering iron. Even soldering directly against the wire covering does not cause it to lose any of its insulating characteristics.

Electronic Surveyor Being Tested by Army

A lightweight electronic distance measuring device that eliminates the laborious and time-consuming taping method used in surveying is under test by the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va.

Called the Tellurometer, the device consists of a master and a remote or "slave" station set up at opposite ends of the line to be measured.

Equipment for each station weighs approximately 90 lbs. and can be backpacked by two men. In operation the master station transmits a microwave signal which is received and transmitted back to it by the remote station. On receipt of the retransmitted signal, the master station measures the travel time of the radio waves. The measurement is read and controlled by the master operator. The remote operator merely performs switching and tuning operations at the command of the master. A built-in duplex radio telephone circuit permits the operators to communicate.

CLOSES SWITCH WITH **ONE PUSH** • • • • **NEXT PUSH** OPENS SWITCH

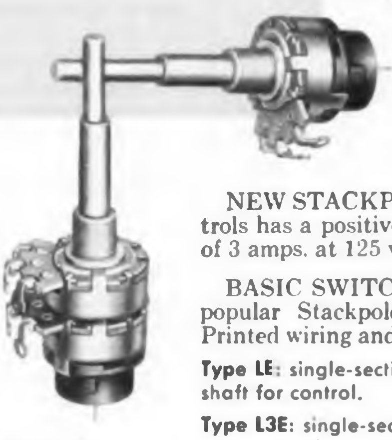
NEW PUSH-PUSH SWITCH CONTROLS

. . . take the waiting out of warm-up time!

TURN
SHAFT FOR VARIABLE RESISTANCE CONTROL

Here's real operating convenience and added sales appeal for TV and radio receivers, phonographs and instruments!

Three new Stackpole controls combine pushbutton switching with rotary control of volume, tone, contrast or similar functions. "Waiting for the warm-up" before making final adjustments is a thing of the past. Just one push and the circuit is "on" and adjusted to the last selected setting of the variable resistor.



NEW STACKPOLE TYPE "E" SWITCH used on these controls has a positive, SP-ST snap-action. It carries a UL rating of 3 amps. at 125 volts ac-dc or 1 amp. at 240 volts ac-dc.

BASIC SWITCH/CONTROL COMBINATIONS using the popular Stackpole **L-type** control are available as follows. Printed wiring and wire-wrap terminals obtainable on each:

Type LE: single-section, single-shaft. Push shaft for switch, turn same shaft for control.

Type L3E: single-section, dual-shaft. Push inner shaft for switch, turn outer shaft for control.

Type LXE: dual-section, dual-shaft. Push inner shaft for switch, turn inner shaft for rear control, turn outer shaft for front control.

NEW DATA SHEET

Containing complete specifications and dimensions sent on request.

STACKPOLE

VARIABLE COMPOSITION RESISTORS

Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pa.

Coldite 70+® fixed composition resistors • Snap and Slide Switches • Ceramag® ferromagnetic cores • Iron cores • Ceramagnet® ceramic magnets • Fixed composition capacitors • Brushes for all rotating electrical equipment • Electrical contacts • Hundreds of related carbon, graphite and metal powder products.

Circle 89 on Inquiry Card, page 97

First From **MOTOROLA**

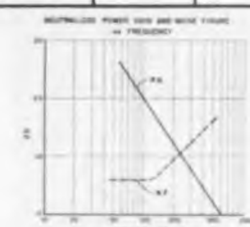

New Motorola Mesa Transistor, with can removed, is shown at right 15 times actual size.

UHF MESA TRANSISTORS

2N700 LOW-NOISE HIGH-FREQUENCY AMPLIFIER					
TYPICAL CHARACTERISTICS					
TYPE	f max	Power Gain	BV_{cb} @ $100\mu a$	NF @ 200 mcs	Max Power
2N700	600 mcs	12 db @ 200 mcs	33 volts	9 db	50 mw

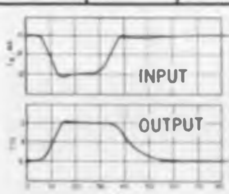

actual size

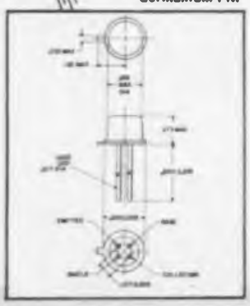
Operating Temperature
100°C case temperature with 12 mw dissipation
Germanium PNP



2N695 ULTRA HIGH-SPEED SWITCH					
TYPICAL CHARACTERISTICS					
TYPE	BV_{cb}	I_{co} @ 5 volts	β sat. at 20 ma	I_c max	P_c
2N695	20 volts	$.8\mu a$	30	20 ma	50 mw

Operating Temperature
100°C case temperature with 12 mw dissipation
Switching Times
in the order of 10 mμsec
Germanium PNP





FOR COMPLETE TECHNICAL INFORMATION
concerning Motorola Mesa Transistors contact the nearest Motorola regional office; or wire, write or phone
MOTOROLA, INC.,
5005 East McDowell Road, Phoenix, Ariz.
BRidge 5-4411 Teletype PX80.

the beginning of an exciting new transistor family

- Extreme reliability — only high temperature materials used, process carefully controlled.
- Higher operating temperatures.
- Rugged — withstands 50,000G acceleration.
- New header design provides effective interelectrode capacitance isolation . . . smaller inductance.
- Low nuclear radiation susceptibility.
- Modified JETEC 20 case . . . hermetically sealed.
- Meets or exceeds mechanical and environmental requirements of MIL-T-19500A.
- High uniformity — "Normal" instead of "selected" distribution.

A Revolutionary New Family
These are only the first of a wide variety of germanium Motorola Mesa Transistors coming your way soon.

"DEPENDABLE QUALITY IN QUANTITY"

MOTOROLA SEMICONDUCTORS

MOTOROLA, INC.
5005 E. McDOWELL
PHOENIX, ARIZONA

ON DISPLAY AT WESCON | BOOTH 628-9

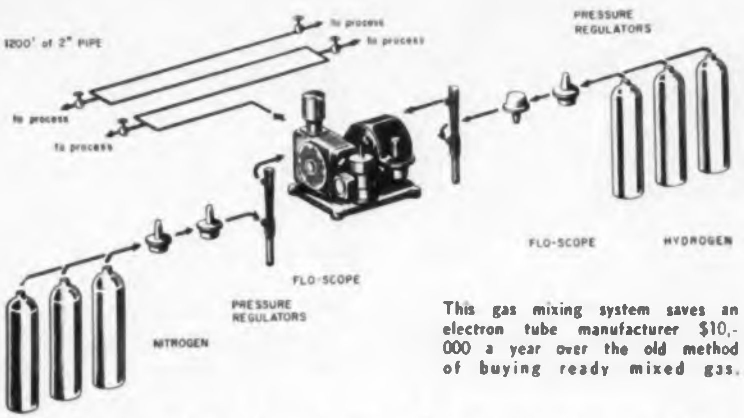
REGIONAL OFFICES

RIDGEFIELD, NEW JERSEY
540 Bergen Boulevard
WHitney 5-7500

CHICAGO 44, ILLINOIS
4900 West Flournoy Street
EStebrook 9-5200

HOLLYWOOD 28, CALIFORNIA
6555 Sunset Boulevard
HOllywood 5-3250

Circle 81 on Inquiry Card, page 97



This gas mixing system saves an electron tube manufacturer $10,-000 a year over the old method of buying ready mixed gas.

Self-mixed Forming-Gas

THE use of a Selas Gas Combustion Controller as a proportioning pump has reduced the cost of forming-gas by more than 57% at the RCA tube plant at Harrison, New Jersey.

This plant uses 150,000 cu ft of forming-gas per month in the sealing of miniature vacuum tubes in about 20 Sealex sealing machines. In these machines, the forming-gas is introduced into the electronic tubes during the evacuation and subsequent sealing cycle. The reducing atmosphere of the gas inside the heated tube prevents oxidation of the metal tube parts.

Forming-gas was formerly purchased already mixed in standard 275 cu ft cylinders, which were delivered to the tube sealing machines. This mixture, consisting of 70% nitrogen and 30% hydrogen, is generally available in the required purity at $9.75 per 1000 cu ft.

Pure nitrogen, however, is available at $3.78 per 1000 cu ft in trailer loads, while hydrogen can be manufactured on the premises at low cost, or purchased at $5.00 per 1000 cu ft. On this basis, the cost of the mixture is $4.15 per 1000 cu ft in the 7:3 ratio used for forming-gas.

Providing that the correct ratio and required purity could be maintained, it would be more desirable, therefore, to mix the gases at the plant gas house and pipe it to the points of use. By permitting the bulk purchase of the hydrogen and nitrogen separately, such a system reduced the cost of forming-gas by $5.60 per 1000 cu ft with a saving of $840.00 a month, or more than $10,000 a year at the normal consumption of 150,000 cu ft per month.

The actual plumbing which is used in conjunction with the proportioning pump.

MEETING MIL-T-19500A
Military Specification For Transistors

Stringent military requirements demand that transistors do not fail in operation.

The tests described below are performed on all General Transistor types to insure continuous, high quality performance. Every production lot is sampled on a daily basis. The criterion for these tests is MIL-T-19500A, Military Specification for Transistors.

Prior to, and upon completion of each of the mechanical tests described below; collector cutoff current, emitter cutoff current, and D. C. current gain are measured and recorded. The end point valves of these critical electrical parameters must not exceed the limits as set forth in the applicable military specification.

1. **Physical dimensions**—The transistor is examined to verify that all physical dimensions are as specified.

2. **Lead solder test**—The leads of the transistor are immersed for 10 seconds in molten solder, at 230°C, to a point of 1/16 of an inch from the case of the transistor.

3. **Temperature cycling test**—The transistor is subjected to five temperature cycles:—65°C minimum temperature for 15 minutes, room ambient temperature for 5 minutes, and 85°C maximum temperature for 15 minutes.

4. **Glass strain test**—The transistor is completely immersed in water at 85°C for 15 seconds and, immediately thereafter, in water at 0°C for 15 seconds.

5. **Moisture resistance test**—The transistor is subjected to varying temperature and humidity cycles: 25°C with 50% relative humidity, 65°C with 90-95% relative humidity, and then back to 25°C with 50% relative humidity. One cycle is 8 hours in duration, and the test consists of 10 cycles.

General Transistor's JETEC 30 Case

6. **Shock test**—The transistor is subjected to five blows from each of four different orientations, each with an acceleration of 500G and a duration of 1ms.

7. **Centrifugal acceleration test**—The transistor is restrained by its case. A centrifugal acceleration of 20,000G is then applied to the transistor for one minute in each of three different orientations. The acceleration is then gradually decreased to zero.

8. **Vibration, fatigue test**—The transistor is rigidly fastened on a vibration platform and is subjected to a simple harmonic motion at a single frequency between 40 and 100 cps, for 32 hours in each of three orientations, with a constant peak acceleration of 10G.

9. **Salt spray (corrosion) test**—After 100 hours of salt spray, the transistor is washed, brushed, air blasted, and then permitted to dry for 24 hours at 40°C. The transistor is then examined for any destructive corrosion or loss of plating which interferes with mechanical or electrical performance.

10. **Lead fatigue**—Any two consecutive leads on each transistor are selected. A pull of 16 ounces is applied to each lead, for three 90° arcs of the case. The transistor is then examined for broken leads.

11. **Storage life test**—The transistor is stored at a temperature of 85°C for a period of 1000 hours. During this test, measurements are made at intervals of 0, 250, 500 and 1000 hours.

12. **Operation life test**—For a period of 1000 hours and at a temperature of 25°C, the transistor is subjected to the operation life test. During this test, measurements are made at intervals of 0, 250, 500 and 1000 hours.

Write for transistor Application Note 3-58 "The Effects of Long Term Aging on Computer Transistors."

GENERAL TRANSISTOR CORPORATION

91-27 138th PLACE • JAMAICA 35, NEW YORK

ALPHABETICAL LISTING OF

CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

47 **Acme Electric Corporation**—Voltage stabilizers and filament transformers
121 **Aetna Life Insurance Corporation**—Corporation life insurance
92 **Aircraft Radio Corporation**—Ceramic insulated connectors
57 **Air-Marine Motors, Inc.**—Sub-fractional H.P. motors, blowers and fans
53 **Alford Manufacturing Co.**—TV antennas
17 **Allen-Bradley Co.**—Resistors, potentiometers, ferrites, filters & capacitors
50 **Allied Control Co., Inc.**—Subminiature toggle switches
13 **American Lava Corporation**—Alumina ceramics
24 **Amphenol Electronics Corp.**—Miniature connectors
18 **Armco Steel Corporation**—Thin electrical steels
9 **Arnold Engineering Company**—Aluminum-cased tape cores
58 **Artos Engineering Co.**—Wire lead finishing machine
113 **Astron Corporation**—Miniature capacitors
55 **Augat Brothers, Inc.**—Component cradles and clips
25 **Barker & Williamson, Inc.**—Sub-miniature toroids
63 **BJ Electronics Borg-Warner Corp.**—Data acquisition systems
60 **Blaw-Knox Company**—Tracking antenna
119 **Bomac Laboratories, Inc.**—Microwave tubes and components
61 **Borg Equipment Div., The George W. Borg Corp.**—Systems components
62 **Borg Equipment Div., The George W. Borg Corp.**—Trimming micropots
15 **Bourns Laboratories, Inc.**—Trimmer potentiometer
106 **Brocker Laboratories**—Automatic noise figure meter
120 **Bruno-New York Industries Corp.**—"Pigtailoring" machine
10 **Brush Instruments Division of Clevite Corporation**—8-channel rectilinear recording system
38 **Burgess Battery Company**—Dry batteries
115 **Burnell & Co., Inc.**—Encapsulated toroids
39 **Bussmann Mfg. Division McGraw-Edison Co.**—Fuses and fuseholders
94 **Caledonia Electronics & Transformer Corp.**—Electronic packaging
11 **Cannon Electric Company**—Connectors
66 **Canoga Corporation of California**—Blade antennas
64 **Centralab A Division of Globe-Union**—Feed-thru capacitor
112 **Chicago Standard Transformer Corp.**—Transistor transformers
65 **Cinch Manufacturing Corp.**—Printed circuit sub-miniature connectors
68 **Clevite Electronic Components Division of Clevite Corp.**—Multi-channel magnetic heads
102 **Connecticut Hard Rubber**—Silicone sponge rubber
111 **Consolidated Electrodynamics, Alectra Div.**—Portable test equipment
67 **Corning Glass Works**—Printed circuit board
98 **Cutler-Hammer, Inc.**—Synchronous timers
123 **Dade County Development Department**—Economic study of Metropolitan Miami
26 **Dale Products, Inc.**—Trimmer potentiometer
70 **Delco Radio Division of General Motors**—High-frequency power transistor
69 **Dialight Corporation**—Miniature indicator lights
103 **Diamond Antenna & Microwave Corp.**—Microwave catalog
101 **Dimco-Gray Company**—Snapslide fastener
31 **DuMont Laboratories, Inc., Allen B., Instrument Div.**—Vacuum-tube voltmeter
2 **Dymec, Incorporated**—Instrumentation systems
71 **Eitel McCullough, Inc.**—Ceramic tubes
41 **Electrical Communications, Inc.**—Selective control devices
3 **Electro-Measurements, Inc.**—Impedance bridges and decade units
72 **Electro-Motive Mfg. Co., Inc.**—Mica capacitors
21 **Electronic Tube Corporation**—Rack panel oscilloscope
73 **Elgin National Watch Company, Electronics Div.**—PC type relays
32 **Engelhard Industries, Inc.**—Oxygen or hydrogen indicator
33 **Engelhard Industries, Inc.**—Platinum clad tungsten wire
34 **Engelhard Industries, Inc.**—24K gold immersion solution
12 **Engineered Electronics, Inc.**—Sensitive indicator
27 **Erie Resistor Corp., Electronics Div.**—Miniature tuning capacitor
513 **Fairchild Semiconductor Corp.**—Engineering personnel
22 **Fansteel Metallurgical Corp.**—Rectifiers
23 **Fansteel Metallurgical Corp.**—Sub-miniature tantalum capacitors
75 **Fluocarbon Products Inc.**—Teflon insulated sockets
74 **Freed Transformer Co., Inc.**—Inductance bridge & Megohmmeter
76 **Gates Radio Company**—Speech input console
15 **General Chemical Div., Allied Chemical Corp.**—Electronic industry chemical catalog
502 **General Electric, Missile Guidance Sect.**—Engineering personnel
511 **General Electric, Missile & Ordnance Systems Dept.**—Engineering personnel
124 **General Transistor Corp.**—Transistors
56 **Gertsch Products, Inc.**—Complex ratio bridge
39 **G-L Electronics**—Tape wound and bobbin cores
105 **Graphic Systems**—Visual control panel
44 **Hallamore Electronics Company**—Industrial CCTV camera
4 **Hewlett-Packard Company**—Oscilloscopes
107 **Horlick Co., Inc., William I.**—400 cps motor-generator
77 **Houston Fearless Corp.**—TV camera mounts
10 **Hughes Aircraft Company**—Precision crystal filters
11 **Hughes Aircraft Company**—Storage type oscilloscope
501 **Hughes Aircraft Company**—Engineering personnel
92 **Illinois Condenser Company**—Sub-miniature electrolytic capacitors
78 **International Resistance Co.**—Miniature precision potentiometers
114 **International Resistance Co.**—Teflon hermetic seal terminal
509 **International Telephone & Telegraph Corp.**—Engineering personnel
80 **Jennings Radio Manufacturing Corp.**—Vacuum relays
37 **Jerrold Electronics Corp.**—Sweep generators and accessories
130 **Johnson Co., E. F.**—Variable capacitors
51 **Jones Div., H. B., Cinch Manufacturing Corp.**—Plugs & sockets

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **AUG. 1958**

Please send me further information on the items I have circled below. 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

YOUR NAME .... TITLE....................

FIRM ....

FIRM ADDRESS ....

CITY or TOWN .... ZONE......... STATE..........

FIRST CLASS
PERMIT NO. 36
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

ELECTRONIC INDUSTRIES

P. O. BOX 73, VILLAGE STATION

NEW YORK 14, N. Y.

ADVERTISERS IN THIS ISSUE

ADVERTISERS FROM WHOM YOU DESIRE FURTHER INFORMATION

121 Kearfott Co., Microwave Div.—Radar test set
26 Kester Solder Company — Flux-core solder
5 KinTel, A Division of Cohu Electronics, Inc.—Digital voltmeters
109 Klein & Sons, Mathias—Midget pliers
118 Kleinschmidt Laboratories, Inc. — Teleprinter communications equipment
42 Kulka Electric Corp.—Toggle switches
122 Lemen, Mr. Paul H.—Industrial plant for rent or sale
43 Magnetic Metals Company — Magnetic alloys for higher permeability laminations
504 Martin Company, The—Engineering personnel
505 Melpar Incorporated A Subsidiary of Westinghouse Air Brake Co.—Engineering personnel
125 Minnesota Mining & Manufacturing Co. —Instrumentation tape
81 Motorola Semiconductors, Motorola, Inc. —Germanium PNP transistors
53 Narda Ultrasonics Corporation—Ultrasonic cleaning or chemical processing unit
512 National Cash Register Company, The—Engineering personnel
83 National Lead Company—Solder and solder technology
84 National Vulcanized Fibre Co.—Copper clad laminates
126 Neely Enterprises—Electronic Manufacturers representatives
88 New Hermes Engraving Machine Corp. —Engraving machines
65 Oster Manufacturing Co., John, Avionic Div.—Frequency discriminator & servo driven correction loop
44 Panoramic Radio Products Inc.—FM analyzer
30 Patwin, A Division of The Patent Button Co.—Digital readout indicator
127 Phelps Dodge Copper Products—Coaxial cables
510 Phillips Electronics Inc. — Engineering personnel
192 Radio Cores, Inc.—Iron cores
1 Radio Materials Company—Ceramic capacitors
87 Rheem Mfg. Co., Electronics Div.—Universal meter.
122 Rohn Manufacturing Corp.—Communications towers
116 Raytheon Industrial Tube Division—Subminiature tubes
16 Raytheon Microwave & Power Tubes—Reflex klystrons
6 Sanborn Company, Industrial Division—Rectilinear recording systems, preamplifiers
24 Sangamo Electric Company—Subminiature capacitors
34 Sarkes Tarzian, Inc., Rectifier Division —Silicon rectifiers
88 Sarkes Tarzian, Inc., Broadcast Div.—Video level control unit
96 Scintilla Division, Bendix Aviation Corp.—Miniature connector
90 Shockley Transistor Corp., Beckman Instruments, Inc.—4-layer transistor
8 Sprague Electric Company—Carbon film resistors
36 Sprague Electric Company — Miniature electrolytic capacitors
89 Stackpole Carbon Company—Push-push switch controls
110 Stainless, Inc.—Concrete foundations
108 Stewart Corporation, F. W.—Flexible shaft coupling
128 Stromberg-Carlson Div., General Dynamics Corp.—Relays
508 Sylvania Electric Products, Inc. — Waltham Laboratories — Engineering personnel
20 Synthane Corporation—Laminated plastics
98 Syntronic Instruments, Inc.—Yokes
42 Tensolite Insulated Wire Co. — High temperature hook up wire
35 Texas Instruments Incorporated — Germanium power transistors
29 Tinnerman Products, Inc. — Capacitor clips
91 Transitron Electronic Corporation—High speed switching diodes
45 Tung-Sol Electric Inc.—Miniature hydrogen thyratrons
117 United Transformer Corp. — Transistor transformers
506 U. S. Air Force—Engineering personnel
49 U. S. Semiconductor Products, Inc.—Axial lead rectifier
194 Ungar Electric Tools, Inc. — Soldering pistol
7 Varian Associates—High vacuum pump
507 Westinghouse Baltimore — Engineering personnel

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 175 of this issue.

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted **AUG. 1958**

PROFESSIONAL ENGINEERING OPPORTUNITIES

Please send me further information on the engineering position I have circled below.

501	506	511	516	521
502	507	512	517	522
503	508	513	518	523
504	509	514	519	524
505	510	515	520	525

YOUR NAME ....TITLE............

HOME ADDRESS ....

CITY or TOWN...ZONE.........STATE.........

NEW Subscription Order

Please enter a new complimentary subscription to ELECTRONIC INDUSTRIES **AUG. 1958**

Company Name:

Name: Position

Company Address:

City: Zone State

Specific Products Manufactured

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **AUG. 1958**

Please send me further information on the items I have circled below. 3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

YOUR NAME ....TITLE............

FIRM ....

FIRM ADDRESS ....

CITY or TOWN ....ZONE..........STATE..........

New Products and Technical Data—August '58

237 Adhesive, conductive—Emerson & Cuming, Inc.
269 Amplifier, linear—Eldorado Electronics
285 Antenna—Noms-Clarke Co.
261 Attenuator, remote—Rantec Corp
284 Capacitor—Fansteel Metallurgical Corp.
287 Coil—Syntronics Instruments
286 Components, miniature—James Millen Mfg.
248 Connectors, miniature—Deutsch Co.
271 Controls, stereo—Clarostat Mfg.
251 Data processing — Associated Missile Prods.
254 Delay line—ESC Corp.
253 Delay line driver—Packard-Bell
254 Digital computer—Autonetics
267 Diode substitution—International Rect.
252 Driver—Gates Radio
240 Enclosures—Elgin Metalformers
276 Fuses—Bussman Mfg
242 Gearhead—Clifton Precision
238 Laminate products — Continental-Diamond
263 Lamps—Circon Component Corp.
262 Measuring equip.—Arnoux Corp.
250 Meter kits—Triplett
280 Microwave equip.—Motorola
289 Microwave radio—RCA
279 Mobile radio—DuMont Labs
287 Motor—Dale Products
239 Motor generators—D & R Ltd.
281 Multicoupler—CGS Labs.
270 Oscilloscope—DuMont Labs.
268 Oscilloscope, dual-beam—Tektronix
273 Oscilloscope, panel—Waterman Products
257 Potentiometers—G. M. Giannini
241 Potentiometers—Daystrom Pacific
277 Power supplies—Beta Electric
249 Power supplies — Electronic Research Assoc.
282 Power supply—IT&T
278 Relay, ac—Weston Instruments
274 Screen-printing—Colonial Process Supply Co.
256 Sorensen—Diehl Mfg.
234 Space room—McMillan Labs.
290 SSB equip.—Barker & Williamson
259 Switch, momentary—Switch-Lock Inc.
245 Switch, commutation—Mycalex Corp.
283 Tachometer generator—Carter Motor Co
235 Tape, electrical—Permacel-LePage
242 Tester, cable—Calif. Technical Ind.
275 Toroid, variable—Burnell & Co.
264 Transformers, modulation—Electro Eng'g.
265 Transformer, toroidal—Arnold Magnetics
246 Transistor—Motorola Inc.
258 Tube, klystron—Varian Assoc.
266 Tube, klystron—Eitel-McCullough
272 VTVM—Simpson Electric
260 Voltage divider—Electro Measurements
244 Voltage regulator—Superior Electric
255 Voltmeter, r-f—Sensitive Research
247 Wire, hook-up—Belden Mfg.

FIRST CLASS
PERMIT NO. 36
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

ELECTRONIC INDUSTRIES

P. O. BOX 73, VILLAGE STATION
NEW YORK 14, N. Y.

FIRST CLASS
PERMIT NO. 36
PHILA., PA.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

ELECTRONIC INDUSTRIES

CHESTNUT & 56th STS.,
PHILADELPHIA 39, PA.

Chilton Company

FIRST CLASS
PERMIT NO. 36
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

ELECTRONIC INDUSTRIES

P. O. BOX 73, VILLAGE STATION
NEW YORK 14, N. Y.

NEW TECH DATA

231 Accelerometer calibration—Endevco Corp.
207 Antennas & systems—Andrew Corp.
230 Automatic devices—Brocker Labs.
204 Cable caliper—Zippertubing Co.
181 Cast components, precision—Alitron
187 Ceramics, vacuum—Vacuum Ceramics
170 Clutches & brakes—Autotronics, Inc.
164 Components—Richards Electrocraft
222 Computer programming—Bendix
232 Computer translator—Electronic Eng'g
206 Connector publication—Cannon Electric
181 Deflection systems—RCA
211 Delay lines, constant—Orbitran Co.
186 Delay lines, ultrasonic—Bliley Electric
223 Electrometer—Applied Physics Corp.
167 Environmental equipment — Cincinnati Sub-Zero Products
218 Gears, precision—Western Gear Corp.
220 Hardware, electronic—Lerco Electronics
195 Indicators—Union Switch & Signal
205 Instrumentation—Consolidated Electro-Dynamics
165 Instrumentation equipment—Radiation
182 Instruments & systems—Panoramic
219 Instruments, nuclear lab.—BJ Electronics
185 Laminates—General Electric
169 Laminates—Northern Plastics Corp.
189 Laminates, copper-clad—National Vulcanized Fibre
202 Magazine subscription—ElectroData
192 Magnets—Indiana Steel Products
197 Maintenance hints—National Electronics
174 Mountings, avionic—Lord Mfg. Co.
233 Oscilloscopes—Advanced Electronics
172 Pilot lights—Dialight Corp.
176 Plastics—Synthane Corp.
162 Products & facilities—Thompson Products
196 Potentiometer, portable—Technique Assoc.
201 Potentiometers—Fairchild Controls
216 Potentiometers—Bourns Labs.
213 Power sources, ac—Behlman Eng'g.
198 Power supplies—John Fluke Mfg. Co.
203 Power supplies—American Electronics
168 Racks & cabinets—Par-Metal Products
208 Radiating systems—Electronic Specialty
229 Radiation equipment—Tracerlab, Inc.
210 Recorder, modular—Ampex Corp.
217 Recorder, strip-chart—Varian Assoc.
183 Regulators, automatic—Superior Electric
178 Regulators, magnetic—Sorensen & Co.
173 Reactors, switching—Magnetics, Inc.
168 Resin coatings—Isochem Resins Corp.
215 Resistors, precision—Ultronix, Inc.
188 Resistors, precision—Chicago Telephone Supply Corp.
212 Resistors, wire-wound—Cinema Eng'g.
228 Servomotors—Beckman/Helipot Corp.
199 Slip rings—Slip Ring Co. of America
171 Standards, frequency—Ernst Norrman
190 Switching circuits—Hoffman Electronics
180 Tapes, polyester—Minnesota Mining & Mfg.
227 Technical notes—G. M. Giannini & Co
226 Test equipment—Hewlett-Packard
200 Test equipment—Sierra Electronic Corp.
191 Test equipment, microwave—F-R Machine Works
163 Thermistor catalog—Fenwal Electronics
193 Thermostats, bimetal—Stevens Mfg.
224 Transducer—Technology Instrument
214 Transistors & diodes—Texas Instruments
209 Tube catalog—Eitel-McCullough
228 Tube catalog, electron—Litton Industries
184 Tubes, decade counter—Sylvania Electric
175 Tubes, industrial—Westinghouse
179 Tubes, microwave—Bomac Labs.
194 Tubes, power—I T & T
177 Ultrasonic cleaners—Narda
221 Wall chart, engineering—Perkin Eng'g

1958 ELECTRONIC INDUSTRIES'

DIRECTORY

OF THE

WESTERN ELECTRONIC MANUFACTURERS

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.

A

△AC Electronics Inc 11706 Mississippi Ave Los Angeles 25 Calif—Edwin L Alme

*Acme Electric Corp 1375 W Jefferson Blvd Los Angeles Calif—Jack Hall—RE 4-3194 (p & a) Audio Chokes, Filter Chokes, Power Supplies, Transformers

△*Acoustica Associates Inc 11601 W Jefferston Blvd Culver City Calif—Ralph Reynolds—TE 0-8152 (p) Ultrasonic Amplifiers (a) Telemetering Systems, Transducers

△Advance Relays Electronics Div Elgin National Watch Co 2435 N Naomi Burbank Calif—Eric Firth

Aero Electronics Corp 1657 W 134th St Gardena Calif—B E Taylor—FA 1-2196 (p & a) Trimming Potentiometers, Precision Resistors

*Aerojet—General Corp Avionics Div 6325 N Irwindale Ave Azusa Calif—R D Foley—CU 3-6111 (a) Infrared System

*Aeronautical & Instrument Div Robertshaw-Fulton Controls Co 401 N Manchester Anaheim Calif—F W Weisel—KE 5-8151 (p) Automatic Checkout Equipment

Aerophysical Development Corp Sub Curtiss-Wright Corp P O Box 689 Santa Barbara Calif—D W Bollay—WO 2-9135 (a) Missile Guidance Systems

△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 McDonald—OR 8-9211 (p & a) Air Data Components, Air Data & Servo Systems

△*Air Marine Motors Inc 2055 Pontius Ave Los Angeles 25 Calif—T W Yeakle—BR 2-6489 (p) ACInduction Motors, Fans & Blowers

Ajax Condenser Corp 10905 Chandler Blvd N Hollywood Calif—B Polayes—ST 7-1385 (p) Capacitors

Alac Inc 365 W Arden St Glendale Calif—Milton Terkla—CI 4-7261 (p & a) Electronic Hardware, Terminal Boards

△Aladdin Electronics Div Aladdin Industries 380 E Green St Pasadena Calif—Charles L. Freel

△Alfred Electronics 897 Commercial St Palo Alto Calif—P N Fulton—DA 6-6597 (p) Travelling Wave Tube Amplifiers, Microwave Oscillators, Sweeping Power Supplies

△*Allied Control Co 1326 Flower St Glendale 1 Calif—A L Oxford—CH 5-5757 (p & a) Relays

Allied Electronic Equipment Co 868 San Mateo Ave San Bruno Calif—J C Aldige—JU 8-4042 (p & a) Cable Assemblies, Wiring & Soldering Electrical Assemblies

Allied Eng'g & Production Corp 2421 Blanding Ave Alameda Calif—W E Miller Jr—LA 3-6556 (p) Automation Machine Control Systems

Alpar Mfg Corp 2910 Spring St Redwood City Calif—R V Laustrup—EM 8-4701 (p) Communications (tower & masts), Parabolic Antennas

△*Altec Lansing Corp 1515 S Manchester Ave Anaheim Calif—R J Carrington—PR 4-2900 (p) Acoustic Products, Transformers (a) High Intensity Sound Analysis Equipment, Transformers, Pollic Address-paging

Alto Fonic Music Systems Inc 935 Commercial St Palo Alto Calif—D W Clark—DA 6-5280 (p) Tape Reproducing Equipment

△Alto Scientific Co Inc 855 Commercial St Palo Alto Calif—D Cherry—DA 4-4733 (p) Transistorized Power Switches, Time Delay Relay Checkers & Power Supplies

Alwac Corp 13040 S Cerise Hawthorne Calif—A Y Baker—OR 8-7108 (p) Data Processing Equipment

Amelco Inc 2040 Colorado Ave Santa Monica Calif—(a) Connector Soldering Clamps

American Avionics Inc 11513 W Washington Blvd Los Angeles 66 Calif—Harold Moss—EX 1-5749 (p) Audio Amplifiers, Transistor Amplifiers (a) Communication Systems

*American Communications Corp 1415 S "A" St Las Vegas Nev—G A Meyer—DE 4-2795 (p) Radio Systems, Antennas Systems, Public Address Systems

American Electronics Inc Electric Machinery Div 2112 Chico Ave El Monte Calif—H A Remer—CU 3-5331 (p) Magnetic Amplifiers & Static Devices, Ac & Dc Power Supplies, Motor Alternators (a) DC Power Supplies, AC Line Regulators, Static Inverters

American Electronics Inc 655 W Washington Blvd Los Angeles 15 Calif—W Moffett Jr—RI 9-5361 (p & a) Motors, Recordata Systems (a) Ground Support Equipment

American Microwave Corp 11754 Vose St N Hollywood Calif—F W Bailey—PO 5-9041 (p & a) Microwave Relay Systems

△American Television & Radio Co 2837 W Pico Blvd Los Angeles 6 Calif—F A Emmet

Ampex Corp 934 Charter St Redwood City Calif—Ralph Whitaker Jr—EM 9-1481—Magnetic Recorders, Magnetic Tape (a) Mobile, Airborne & Miniature Recorders

△Anatran Div Endevco Corp 165 E California St Pasadena Calif—B Minteer—RY 1-9495 (p) Electro-Mechanical Counters

△*Andrew Calif Corp 941 E Marylind Ave Claremont Calif—J D Montgomery Jr—NA 6-3505 (p & a) Antennas, Coaxial Cables, Waveguides

Angle Computer Co Inc 1709 Standard Ave Glendale 1 Calif—E D Wilson—CI 2-4915 (p) Double Axis Angle Computer & Controller, Supplies

*Applied Electronics Co Inc 213 E Grand Ave S San Francisco Calif—B H Ballard Jr—PL 6-4100 (p) Marine Radiotelephones, Direction Finders, Automatic Pilots

Applied Magnetic Corp P O Box 425 Goleta Calif—H R Frank—WO 7-2016 (p & a) Magnetic Recording Heads, Special Application Tape Transports, Inductive Components

Applied Physics Corp 2724 S Peck Rd Monrovia Calif—S C Danforth—HI 6-7181 (p & a) Vibrating Reed Electrometers (a) Recording Spectrophotometers

Applied Radiation Corp 2404 N Main St Walnut Creek Calif—W W Thulin—YE 5-2250 (p) Electron & Positive Ion Accelerators, High Power Klystrons, Precision Electromagnet System

*Applied Science Corp of Princeton 15551 Cabrito Rd Van Nuys Calif—C E Haefener—ST 2-7030 (p & a) Pulse Width Telemetering Equip, Transmitting Multicoding Equip. Receiving & Decommutation Equip

*A R F Products Inc Raton N M—Sally M Hubert—Raton 995 (p) Electronic Door Operator, Test Equip (a) Glide Slope Receiver, ECM & Homing & Standard Test Equip

△Armour Electronics Inc 15002 Oxnard Blvd Van Nuys Calif—D R Porter

Arnold Magnetics Corp 4613 W Jefferson Blvd Los Angeles 16 Calif—J Batte—RE 1-6344 (p & a) Miniature Toroidal Transformers, Transistorized Power Supplies (a) Toroidal Winding Machines

1958 Directory of Western Electronic Manufacturers

•Arrowhead Products Div Federal-Mogul-Bower Bearings Inc 2300 Curry St Long Beach 5 Calif—H Wright—GA 3-5473 (p & a) Ducting & Ducting Components for Cooling Electronic Units

Asquith Co S A 427 W Chevy Chase Dr Glendale 4 Calif—J W Keith—CI 3-2878 (p & a) Precision Potentiometers, Speed Reducers

△•Associated Missile Products Co 2709 N Garey Ave Pomona Calif—M L Parmiter—LY 3-1311 (p) Modular Automatic Test Equip, Data Processing & Visual Display Devices, Radar Beacons, (a) Radar Training Sets, Ground Support Equipment, Synchros Testers

Atchley Inc Raymond 2340 Sawtelle Blvd Los Angeles 64 Calif—R Atchley—GR 9-8626 (p) Servoamplifier Transistors & Vacuum Tubes, Power Supplies (a) Electro-Hydraulic Servovalves, Torque Motors

△Atlas E-E Corp 47 Prospect St Woburn Mass—A S Mowatt—WO 2-5390 (p & a) Chassis Accessories

△•Audio Devices Inc 620 E Dyer Rd Santa Ana Calif—G Eannarino—KI 5-8341 (p) Silicon Rectifiers

Audio Electronics 15858 35 NE Seattle 55 Wash—A W Johnson—EM 3-1613 (p) Switchboard Test Equipment & Specialized Equipment for Telephone Industry

Automation Instruments Inc 401 E Green St Pasadena 1 Calif—H J Behymer—SY 3-8169 (p & a) Ultragraph, Permagauge, Lithium Sulphate Transducers

△Autonetics Div North American Aviation Inc 9150 E Imperial Hwy Downey Calif—N D Smock—LU 3-6111 (p) General Purpose Digital Computers, Automatic Checkout Equipment, Numerical Tape Control Positioning Systems (a) Automatic Navigation Systems, Antenna Radar, Automatic Control Systems

△Avion Div ACF Industries Inc 5333 Supelveda Blvd Culver City Calif—Fred Davis—EX 7-4747 (a) Fire Control Systems, Missile Guidance Systems, Power Supplies

△Avnet Corp 8966 National Blvd Los Angeles 34 Calif—M G Newberger

B

Babcock Radio Eng'g Inc 1640 Monrovia Ave Costa Mesa Calif—N E Cima—LI 8-7705 (p) Amplifiers, Control Equipment (a) Transmitters, Transceivers

Babcock Relays Inc 1640 Monrovia Ave Costa Mesa Calif—L A Dow—LI 8-7705 (p) Sealed Subminiature, Polarized & Latching Relays (a) Crystal Can & Subminiature Power Relays

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 Inc 921 E Broadway Glendale 5 Calif—W H E Barwood—CH 5-4063 (p & a) Adaptors, Footswitches, Transformers

Beattie-Coleman Inc 1000 N Olive St Anaheim Calif—J A Wilcox—PR 4-4503 (p) Punched Mylar Tape Programer, Oscillotron Recording Systems, Intervalometers (a) Punched Mylar Tape Programer, Delcer Timers

Beckman Instruments Inc Systems Div 325 N Muller Ave Anaheim Calif—R A St Onge—PR 4-5490 (p) Industrial Logging, Computing & Control Systems, Missile Checkout, Timing & Counting Systems (a) Telemetered Data, High Speed Logging & Missile Checkout Systems

Beckman Instruments Inc Scientific Instruments Div 2500 Fullerton Rd Fullerton Calif—T V Park—LA 5-8341 (p) Measuring & Recording Instruments

Beckman Instruments Inc Process Instruments Div 2500 Fullerton Rd Fullerton Calif—A O Beckman—OW 7-1771 (p) Control Equipment, Instruments for Electrical Measuring & Graphic Recording

Beckman Instruments Inc Shockley Semiconductor Labs 391 S San Antonio Rd Mountain View Calif—H S Schuler—DA 6-1970 (p) Shockley Four-Layer Transistor Diodes

△Beckman-Berkeley Div Wright Ave & S 23rd St Richmond Calif—R Schweitzer—LA 6-7730 (p) Electronic Counters & Timers, Digital Voltage & Frequency Meters, Analog Computers

△Behlman Eng'g Co 2911 Winona Ave Burbank Calif—J M Schroeder—VI 9-4475 (p) Invertrons (AC Power Supply)

Bekey Electric Co Inc 1327 S Main St Los Angeles 15 Calif—E Bekey—RI 9-0830 (p) Hyspersyn & Servo Motors (a) Special (custom-made) Rotating Equip

Belleville-Hexem Corp 638 University Ave Los Gatos Calif—J Hexem—EL 4-1379 (p) E-I-R Meter, Wide Range Ammeter

△Bendix Aviation Corp Pacific Div 11600 Sherman Way N Hollywood Calif—M P Ferguson—ST 7-2881 (p) Electronic Computers, Data Processing Equipment, Automatic Control Systems

△•Bendix Computer Div Bendix Aviation Corp 5630 Arbor Vitae St Los Angeles 45 Calif—W McGuicklin—OR 4-3641 (p) Computers, Computer Accessories (a) 3-Axis Flight Systems Simulator

Bennett Labs Inc 2700 Bay Rd Redwood City Calif—A E Bennett—EM 6-6845 (p) Intercommunication & 2-Way Radio Equip

Benson-Lehner Corp 11930 W Olympic Blvd Los Angeles 64 Calif—D B Prell—BR 2-3484 (p & a) Data Reduction Equipment

Berndt-Bach Inc 6926 Romaine St Los Angeles 38 Calif—A N Brown—HO 2-0931 (p & a) 16MM Motion Picture Cameras

Biggs Co Inc Carl H 2258 Barry Ave Los Angeles 64 Calif—C H Biggs—GR 8-0461 (a) Bonding Agents, Potting Compounds, Coatings

△Birtcher Corp Industrial Div 4371 Valley Blvd Los Angeles 32 Calif—C J Birtcher—GA 2-9101 (p) Tube Clamps

△BJ Electronics Borg-Warner Corp 3300 Newport Ave Santa Ana Calif—D J Sadler—KI 5-5581 (p & a) Digital Systems & Components

△Blaine Electronics Inc 14757 Keswick St Van Nuys Calif—R F Blaine—ST 2-6303 (p) Antenna Radiation Pattern Measurement Tower

Boeing Airplane Co-Pilotless Aircraft Div 4734 E Marginal Way P O Box 3925 Seattle 24 Wash—K Calkins—JU 6-2121 (a) Bomarc Flight Control Equip, Special Test Equip, Electronic Power Supply

Booth Co Arthur E 263 S Alexandria Ave Los Angeles 4 Calif—A E Booth—DU 1-2161 (p) Electrical Test Equip, Power Supplies

•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 P O Box 2112 Riverside Calif—S H Stoetzel—OV 4-1700 (p & a) Potentiometers, Absolute & Differential Pressure Potentiometer-type Transducers, Accelerometers & Acceleration Potentiometer-type Tranducers

1958 Directory of Western Electronic Manufacturers

Brooks & Perkins 11655 Vanowen St N Hollywood Calif—D L Erickson—ST 7-9665 (p) Reflectors, Antennas, Ground Support Equipment (a) Fire Controls, Radar Reflectors

Brubaker Electronics Inc 3652 Eastham Dr Culver City Calif—K Raub—TE 0-6441 (p) Marker-Pulser Pulse Generators, Delay Lines, Pulse Networks (a) IFF-Equip & Study Programs, Pulse Coding & Decoding Systems, Air Traffic Control-Equip & Systems

•Brush Instruments Div Clevite Corp 1960 S LaCienega Blvd Los Angeles 34 Calif—C D Bacon—TE 0-7517 (p) Oscillographs & Event Recorders, Amplifiers, Accessories & Supplies

△Burnell & Co 720 Mission St S Pasadena Calif—Frank Edmonds—RY 1-2841 (p) Chokes, Delay Lines, Filters

△•Burroughs Corp Electrodata Div 460 Sierra Madre Villa Pasadena Calif—C D Behm—SY 3-6121 (p) Electronic Data Processing Systems, Desk-size Computers

•Butcher Co L H 3628 E Olympic Blvd Los Angeles 23 Calif—J A Raskin—AN 2-4101 (p) Rectifiers, Rheostats, Switches

By-Buk Co 4314 W Pico Blvd Los Angeles 19 Calif—D L Lenzi—WE 6-6151 (p & a) Printed Circuit Drafting Aids, Tape (Pressure-sensitive), Component Leads Bending Block

C

•Cadre Industries Corp Western Div 565 University Ave Los Gatos Calif—Geri Langsner—HO 2-2353 (p) Portable Phonographs, P A Systems

Calbest Electronics Co 4801 Exposition Blvd Los Angeles 16 Calif—I Dubin—RE 1-7291 (p) Hi-Fi Components, Intercoms (a) Ground Support Equipment

California Chassis Co 5445 E Century Blvd Lynwood Calif—H P Balderson—NE 6-7777 (p & a) Chassis & Accessories

California Computer Products 3927 W Jefferson Blvd Los Angeles 16 Calif—Robert C Morton—RE 5-8355 (p) Digital Graph Plotters

△•Calif Technical Industries Div Textron Inc 1421 Old County Rd Belmont Calif—Carl Trost—LY 3-8466 (p) Tape-programmed, Automatic Circuit Testers, Microwave Measuring Instruments, Card-programmed Component Testers (a) 3-Axis Flight & Dynamic Altitude Simulators, Automatic Radome Measuring Systems

△Calif Magnetic Control Corp Calmag Div 11922 Valerio St N Hollywood Calif—M B Leskin—ST 7-1104 (p) Magnetic Amplifiers (low level), Precision Transformers & Reactors, Power Supplies (a) Special Transformers & Reactors, Airborne Power Supplies, Solidstate Inverters & Converters

Cal-Lee Mfg Co 6759 W Boulevard Inglewood Calif—C C Howard—OR 8-9456 (p) Audio Amplifiers, Tuners

Cal-Met Electronics 5860 Spring Oak Dr Hollywood 28 Calif—Sidney Richardson—HO 7-5332 (a) Printed Circuit Connectors

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 Voltmeters (a) Airborne Equipment, Ground Support Equipment & Communications (Power Supplies)

Caltron Products Co 3518 W Pico Blvd Los Angeles 19 Calif—C P Bennson RE 4-2420 (p) Solenoid Valves, Solenoids (a) Magnetizers

Calvideo Tube Corp 5222 W 104th St Los Angeles 45 Calif—Art Nelson—OR 8-3995 (p) TV Picture Tubes

△Cannon Electric Co 3209 Humboldt St Los Angeles 14 Calif—H G Schubert—CA 5-1251 (p) Connectors, Solenoids

Canoga Corp of Calif 5955 Sepulveda Blvd Van Nuys Calif—P H Ryckoff—ST 6-9010 (p) Radar, Microwave & Test Equip (a) Commercial Antennas, Transistorized Supply, Radar Scanners

Capitol Eng'g Corp 8609 W 3rd St Los Angeles 48 Calif—F A Fetsch—CR 6-3028 (p & a) Printed Circuits, Wire Harnesses

Carad Corp 2850 Bay Rd Redwood City Calif—Geo Glatthar—EM 8-2969 (p) Delay Lines, Filters, Transformers

Cardinal Instrumentation Corp 4201 Redwood Ave Los Angeles 66 Calif—R Lavine—TE 0-6731 (p) Resistance Probes for Temperature Measurement, Temperature Measuring Systems, Thermocouple Reference Junctions (a) Airborne Temperature Transducers, Airborne Temperature Measurment Systems, Tachometer Transducers

Carruthers & Fernandaz 1501 Color St Santa Monica Calif—F C Fernandaz—TE 0-3698 (p) Coil Winding Bobbins, Brushings, Coils, Solenoids

Carstedt Research 2501 E 68th 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 Systems

•CG Electronics Corp 15000 Central E Albuquerque N M—Harold L Poulsen—AL 6-9858 (p & a) Digital Devices, Antenna Design & Production, Telemetry Equipment

Chemalloy Electronics Corp Gillespie Airport Santee Calif—Samuel Freedman—HI 4-7661 (p & a) Calorimeters (microwave), Loads (RF liquid), Solder (fluxless) (a) Calorimetric Microwaves

•Chicago Telephone of Calif Inc 105 Pasadena Ave S Pasadena Calif—S E Rigby—CL 5-7186 (p) Variable Resistors, Coils & Transformers, Compression Molding

△Christie Electric Corp 3140 W 67th St Los Angeles 43 Calif—R A Lind—PL 3-2607 (p) Automatically Regulated & Manually Controlled EC Power Supplies, Automatic Battery Chargers

Chromatic TV Labs 1476 66th St Emeryville Calif—L W Alberez—OL 8-3831 (p) Color Radar Cathode Ray Tubes

△•Cinch Mfg Corp Graphik-Circuits Div 200 S Turnbull Canyon Rd LaPuente Calif—S L Glaspell—ED 3-1201 (p) Etched Printed Circuits, Flexible Etched Printed Cables, Electrical Assemblies (a) Flexible Etched Printed Cables

•Cinena Eng'r Div Aerovox Corp 1100 Chestnut St Burbank Calif— J L Fouch—VI 9-5511 (p & a) Precision Wire Wound Resistors, Instrument Switches

Cinematic Developments 2125 32nd Ave San Francisco 16 Calif—Miriam W Helsem—MO 4-2435 (p) Condensers, Wire, Pots

Circon Components Corp Santa Barbara Municipal Airport Goleta Calif—M Ainworth—WO 7-1113 (p & a) Indicators & Panel Lamps, Precision Miniature Hardware, Connectors

△Clare & Co C P 6047 Hollywood Blvd Los Angeles 28 Calif—J R Stone

Clark Electronic Labs Box 165 Date Palm Dr Palm Springs Calif—D B Clark—FA 8-2210 (p) Solid State Pressure Cells, Barometric Transducers, Pressure-Sensitive Transducer Paint (a) Rectifiers, Transducers

CUSTOM-ENGINEERED

INSTRUMENTATION SYSTEMS

from **DYMEC** *Incorporated, Palo Alto, California*

DYMEC INC.

.........combining the finest standard laboratory instruments with custom-designed assemblies for your *specific application.*

● Automated Test Systems

for . . .

- programmed testing of electronic equipment
- multi-step process analysis and control
- go/no-go testing and measurement
- digital comparison and classification
- statistical analysis of equipment performance

Dymec DY-5158 Automatic Subcarrier Oscillator Test Set

● Data-Logging Systems

Multiple inputs: Flow rates, rpm, pressures, temperatures, voltages.

Outputs: Visual digital displays, punched tape, punched cards, graphic and printed records, computer data.

Dymec DY-5150 Data Scanning/Recording System

● Radar Simulator Systems

Used primarily for dynamic testing of radar systems, these versatile signal-generator/modulator assemblies simulate to a high degree of accuracy the numerous types and combinations of modulated signals produced by moving radar targets. Flexibility and high-performance are achieved through use of traveling wave tubes employing advanced modulation techniques.

Dymec DY-5017 Radar Signal Simulator

Investigate the technical and economical advantages of DYMEC Custom Instrumentation Systems for your particular operation. Write for technical data and name of your nearest DYMEC engineering representative. DYMEC technical representatives are at your service in 35 sales offices throughout the United States and Canada.

DYMEC INC.
(formerly DYNAC, Inc.)

DYMEC, Incorporated
395 PAGE MILL ROAD, PALO ALTO, CALIFORNIA
TEL: DAVENPORT 6-1755

Custom-Engineered Instrumentation Systems

Represented by NEELY ENTERPRISES in California, Arizona, Nevada & New Mexico

1958 Directory of Western Electronic Manufacturers

Clear Beam Antenna Corp 21341 Roscoe Blvd Canoga Park Calif—Bob Raynor—DI 7-2255 (p) TV Antennas, TV Telescoping Masts

CMG Industries-Ideas Inc 214 Ivinson Ave Laramie Wyo—W M Mallory—FR 5-2597 (p) Electriduct, Flexiduct

Coast Coil Co 5333 W Washington Blvd Los Angeles 16 Calif—C Harris Adams—WE 6-6188 (p & a) Toroidal Winding, Precision AC Voltage Dividers, Decade Inductors

△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 Doetz—TH 5-1751 (p) Amplifiers, Antennas, Power Supplies (a) Communication Systems, Computers

•Colorado Research Corp Denver-Boulder Toll Rd Broomfield Heights Colo—Harvey J Christensen—HA 9-3501 (p) Data Handling Equipment, Analog Computers & Components, Special Radio & Television Systems (a) Jet Aircraft Flight Planning Computers, Navigational Systems, Electronic Air-Conditioning Controls for Jet Aircraft

△•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 L Cassingham—ST 7-0401 (p & a) Electronic Digital Counters & Timers, Digital Printers, Inline Readouts

Com-Tronics Inc 3409 Venice Blvd Los Angeles 19 Calif—J B McKinley—RE 4-6338 (p & a) Delay Lines, Pulse Transformers, I F Transformers

Con-Elco 1711 S Mountain Ave Monrovia Calif—E J O'Leary—EL 8-4571 (p & a) Trimming Potentiometers, Variable Resistors

Connector Corp of America 3223 Burton Ave Burbank Calif—R R Thomas—VI 9-2129 (p) Waveguide Flanges, Connectors (RF 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 300 N Sierra Madre Villa Pasadena Calif—George H West—RY 1-8421 (p) Data Processing Systems, Analytical & Control Instruments, Testing & Recording Instruments (a) Magnetic Tape Recorders & Reproducers, Transducers, Recording Oscillographs

Convair (Pomona) Div General Dynamics Corp P O Box 1011 Pomona Calif—C O Cornell—NA 9-5111 (p) Missile Components, Test Equipment

Cook Co Frank R 36 S Santa Fe Dr Denver 23 Colo—Frank R Cook—SH 4-1753 (p & a) Self Activating Missile Batteries, Primary & Secondary Silver-Zinc Batteries

△Coors Porcelain Co 600 9th St Golden Colo—Charles S Ryland

△•Cornell-Dubilier Electric Corp 4144 Glencoe Ave Venice Calif—Paul M Kueffer—TE 0-6681 (p & a) Radio Noise Filters, Capacitors, Radio Noise Testing

Crescent Eng'g & Research Co 5440 N Peck Rd El Monte Calif—Elliott Michener—GI 4-0528 (p) Extensometer Micrometers, Instrument Translators, Transducers (a) AC Transducers, Pressure Indication Systems

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—Terry R Burton—BR 7-6780 (p) Transistorized Digital Voltmeter Systems, Klystron Power Supply, Calorimetric Wattmeter (a) Angle Measuring & Distance Measuring Equip, Range Safety Instrumentation

D

•Dale Electronic Corp 2530 Ontario St Burbank Calif—D S Walters—VE 9-3313 (p) Trimmer Potentiometers

Dallons Labs Inc 5066 Santa Monica Blvd Los Angeles 29, Calif—A Dussing—NO 4-1951 (p & a) Crystals, Delay Lines, Sonar

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 D Bingham—LY 1-1414 (a) Airborne Radar Scanners, Detection Devices, Devices (Servo Controlled)

Datran Electronics Div Mid-Continent Mfg Inc 1836 Rosecrans Ave Manhattan Beach Calif—Allen J Edwards—OS 5-7131 (p & a) Pressure Transducers, Resistance Bridge Indicators, Telemetering Oscillators

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 LaJolla Blvd La Jolla Calif—Chalmer E Jones—GL 4-0421 (p) Translation Equipment (a) Check-Out Equipment

Decimeter Products Co 730 Hooker St Denver 4 Colo—Harvey L Waters—MA 3-0726 (p & a) Decals for Electronics, Solder-Fluxs, Decal Adherents

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 Equipment (p & a) Microwave Components

•Detroit Controls Div Amer-Standard Research Dept 1650 Broadway Redwood City Calif—C R Newman—EM 6-8214 (p & a) Commutation Switch & Precision Location Thermocouples, (p) Control Instrumentation

△Deutsch Co 7000 Avalon Blvd Los Angeles 3 Calif—H E Schwank—PL 1-4131 (p) Miniature Electrical Connectors, Rack & Panel Environmental Connectors (a) AN & MS Connectors, AN Clamps, Conduit Fittings

△Deutschmann Corp Tobe 4144 Glencoe Ave Venice Calif—Robert Hart

Digitran Co 45 W Union Pasadena Calif—W J Barmore—RY 1-9667 (p & a) Electro-Visual Counter, Bi-Directional Stepping Motors, Digital Switch

Dilectron Div Gude Co 2669 S Myrtle Ave Monrovia Calif—Jesse F Gudeman—RY 1-8631 (p) Ceramic Capacitors, Ceramic Dielectric, Time Delay Relays

Dollar Co Robert Communications Equip Div 50 Drumm St San Francisco 11 Calif—R W Bunce—YU 2-4314 (p) Radio Transmitters, Pocket Receivers

Don-Lan Electronics Co 1101 Olympic Blvd Santa Monica Calif—Donald H Lanctot—EX 4-0718 (p) Coaxial Connectors, Coaxial Lobing & Waveguide Switches (a) Widjets, Double Stub Tuners, Antenuators

△Donner Scientific Co 888 Galindo St Concord Calif—Victor B Corey—MU 2-6161 (p) Transistorized Linear Servo Accelerometers, Electronic Analog Computers, Electronic Test Instruments (a) Transistorized Linear Servo Accelerometers, Inertial Control & Stabilization Equip, Transistorized Angular Servo Accelerometers

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 Blvd Los Angeles 44 Calif—K H Brust—PL 8-4194 (p) TV & Radio Broadcasting Towers (a) Noise Antenuation Systems

△•Driver Co Wilbur B 2378 Westwood Blvd Los Angeles 64 Calif—Roger A Featherston—GR 8-0359 (p & a) Resistance Wire

△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 Dr Beverly Hills Calif—Richard C Dudek—BR 2-8097 (p & a) PEM Fasteners, Anton Connectors & Tubes (p) Palnuts

△•DuMont Labs Inc Allen B 11800 Olympic Blvd Los Angeles 64 Calif—David T Schultz—BR 2-6394 (p & a) Telemetering Systems, Automatic Checkout Equipment

Durson Co 10416 National Blvd Los Angeles Calif—W F Durst—VE 7-1072 (p) Transistor Test Equipment

Dymec Inc 395 Page Mill Rd Palo Alto Calif—H B Schultheis—DA 6-1755 (p) Radar Simulator Systems, Data-Logging Systems, Automated Test Systems (a) Photo-Electric Tachometer

Dynalysis Development Labs Inc 11941 Wilshire Blvd Los Angeles 25 Calif—W E Hinds—GR 7-6786 (p) Servo Multipliers, DC Computing Amplifiers, (a) Signal Converters, Precision Power Amplifiers

Dynamics Research Assoc Div of Universal Match 4518 Roosevelt Way Seattle 5 Wash—EV 1685 (p & a) Magnetic Amplifiers, Servo Motor Amplifiers, Frequency Converters & Inverters

△Dynac Inc 395 Page Mill Rd Palo Alto Calif—G F Climo

Dynavia Eng'g Corp 860 Fabian Way Palo Alto Calif—Robert Haskins—DA 6-9110 (p & a) Analog Computers, Servos

E

△Edcliff Instruments 1711 S Mountain Ave Monrovia Calif—H R Gillespie Jr—EL 8-4571 (p) Angle of Attacks, Accelerometers, Potentiometers (a) Pressure Instruments, Accelerometers, Inertia Instruments

△Eitel-McCullough Inc 798 San Mateo San Bruno Calif—W W Eitel—JU 8-1212 (p) Capacitors, Rectifiers, Switches

Eldorado Electronics Co 2821 10th St Berkeley 10 Calif—J H Werlin—TH 1-4613 (p) Multichannel Pulse Height Analyzers, Time Interval Measuring Devices, Industrial Control Systems

Electrical Communications Inc 765 Clementina St San Francisco Calif—I Herman—KL 2-1947 (p & a) Selectors, Controls

△Electrical Specialty Co 158 11th St San Francisco 3 Calif—L L Gribble—H E 1-8450 (p) Insulators, Lugs, Plastics

Electro-Ceramics Inc 2645 S 2nd W Salt Lake City 15 Calif—Edmond P Hyatt—HU 5-8081 (p) Piezoelectric Materials, Ultrasonic Transducers, High Alumina Components (a) Liquid Level Sensors

•ElectroData Div Burroughs Corp 460 Sierra Madre Villa Pasadena Calif—A Pearce—SY 3-6121 (p) Data Processing Systems, Digital Computers

Electro Development Co 14701 Keswick St Van Nuys Calif—R Vaccarello—ST 6-3660 (p) Slip Rings, Brushholders, Miniature Rotary Switches, (a) Custom Precision Plastic Molding & Highspeed Switches

△Electro Eng'g Works 401 Prada St San Leandro Calif—Rex Brooks—LO 9-3326 (p & a) Transformers

Electro-Etched Circuits Inc 3140 W Florence Ave Los Angeles 43 Calif—Donald Jones—PL 2-6111 (p & a) Special Antennas, Printed Circuits

Electrofilm Inc 7116 Laurel Canyon Blvd N Hollywood Calif—J A Drege—PO 5-4420 (p) Solid Film Lubricants, Film Type Heating Elements, Wire Mesh Heaters

Electroflor 7356 Santa Monica Blvd Hollywood Calif— J R Alburger—HO 7-1443 (p) Light & Color Control, Data Storage, Digital Indicators

△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 18th St Santa Monica Calif—J K Gossland—TE 0-6401 (p & a) Coaxial Microwave Switches

△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 Amplifier, Oscillators, Oscilloscopes, Telemetering Systems

△Electro-Mechanical Specialties Co Inc 1016 N Highland Ave Los Angeles 38 Calif—Ray Rhodes—HO 2-0793 (p & a) Relays, Stepping Switches, Stepping Motors

Electronic Contractors Inc 2101 S E 6th Ave Portland 14 Ore—H K Lawson—BE 4-3515 (p) Power Network Computer, Analyzers

•Electronic Control Systems 2136 Westwood Blvd Los Angeles 25 Calif—E P Spandau—GR 8-4266 (p) Machine Tool Control Systems, Automatic Test & Inspection Systems Special-Purpose Computers (a) Telemetering Display Systems, Data Processing Systems

△Electronic Eng'g Co of Calif 1601 E Chestnut Santa Ana Calif—R L Lander—KI 7-5501 (p) Computer Language Translator, Analog-to-Digital Tape Systems, Industrial Parts Counter (a) Digital Data Recording Systems, Airborne Time Code Generators, Missile Timing Systems

Electronic Instrumentation Co Div Ramo-Wooldridge Corp 4800 Ramo-Wooldridge Rd P O Box 8405 Denver Colo—J Warren Gillon—PY 4-4311 (p) Missile & Microwave Test Equipment, Airborne & Ground Telemetry Equipment, Transistorized Transformers, Power Supplies & Inverters (a) Telemetry Subcarrier Oscillators, Transistorized Power Supplies & Inverters, Magnetic Tape Scanning Devices

Electronic Organ Arts 4878 Eagle Rock Blvd Los Angeles 41 Calif—R L Eby—CL 6-6888 (p) Electronic Organ Parts

Electronic Processes Corp of Calif 2190 Folsom St San Francisco 10 Calif—A F Hogland—UN 1-9595 (p) Temperature Control Equip, Dielectric Heat Sealing Equip

Electronic Production & Development Inc 139 Nevada St El Segundo Calif—M J Haddad—OR 8-3963 (p) Power Supplies, Encapsulation Cups, Sealing & Potting Compound

Electronic Products Corp 322 State St Santa Barbara Calif—D F Barr—WO 5-8505 (p) Dip Soldering Machines (a) Molded Cables & Harnesses, Test Equipment & Precision Assemblies

Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif—C R Harmon—CH 5-3771 (p) Time Delay Relays, Airborne Antennas, Frequency & Voltage Sensors (a) RF Airborne Transmission Components, ECM Systems, Relays

Electronics Development Co 3743 Cahuenga Blvd N Hollywood Calif—D W Baisch—ST 7-3223 (p) Telemetering & Sound Diplexing Equipment, Television Broadcast Transmitters (a) Television & Telemetering Transmitters

Electronics Int'l Co 145 W Magnolia Blvd Burbank Calif—John E Markley Jr—VI 9-2481 (p) Precision Power Oscillators, Electronic Power Generators (a) Airborne Precision Power Oscillators

Electron Products Inc 430 N Halstead St Pasadena 8 Calif—J Stevens—RY 1-0666 (p) Capacitors, Filters, Transformers esi

IMPEDANCE BRIDGES and DEKA-LINE COMPONENTS

Model 291 Universal Impedance Bridge

Model 250-DA Portable Impedance Bridge

Model 230-R Laboratory Resistance Bridge

Model 270-R Capacitance Bridge

Model 260 Comparison Bridge

Model DT-45 Dekatran Decade Voltage Divider

Model DB-655 Dekabox Decade Resistor

Model 10 Esiac Algebraic Computer

MODEL 291 UNIVERSAL IMPEDANCE BRIDGE

Outstanding accuracy combined with simplicity of operation. Dc and ac impedance measurements covering seven decades of inductance, capacitance, resistance and conductance, and three decades of D or Q. Four place readings; accuracy to 0.1%. Complete with line operated ac and dc generator-detector units designed specifically as companion units for the bridge. Mounted in an attractive case with operating instructions in the cover and an insulating platform for supporting components under test. Price: $775.00*

MODEL 250-DA PORTABLE IMPEDANCE BRIDGE

A rugged and compact bridge for precision measurements of inductance, capacitance and resistance, and D or Q, with self-contained line operated ac and dc generators and detectors. Price: $495.00*

MODEL 230-R LABORATORY RESISTANCE BRIDGE

A precision, high resolution Wheatstone bridge. Five place readings; initial accuracy 0.01%, long term accuracy 0.02%. Human engineered controls provide simple operation and direct in line readings with automatic decimal point location. Internal guarding permits accurate measurements to 12 kilomegohms. Price: $450.00*

MODEL 270 CAPACITANCE BRIDGE

Capacitance measurements at audio frequencies with accuracy approaching primary standards. Provision for absolute calibration against known standards. Resolution 0.01%. No zero capacitance correction. Seven decades of capacitance range and three decades of dissipation factor. Available for either bench or rack mounting. Price: $455.00*

MODEL 260 COMPARISON BRIDGE

A precision bridge for comparing resistive, capacitive or inductive components against suitable standards to 0.01% in terms of both magnitude and phase angle. Self-contained audio-frequency generator and detector with dual electron ray tube null indicator. Clearly identified controls and convenient in line reading. Price: $445.00*

MODEL DT-45 DEKATRAN DECADE VOLTAGE DIVIDER

A precision transformer type voltage divider for use throughout the audio frequency range. Five place readings; linearity 10 parts per million. A compact unit for panel mounting. Price: $275.00*

DEKAPOT® AND DEKAVIDER® DECADE VOLTAGE DIVIDERS

Resistive voltage dividers using the Kelvin-Varley circuit. High resolution and accuracy. For use from dc through audio frequencies. Linearities to 25 parts per million. Model DP Dekapot for panel mounting, Model DV Dekavider for bench use, Model RV Dekavider for rack mounting. Models from $59.00 to $465.00*

DEKASTAT® AND DEKABOX® DECADE RESISTORS

Adjustable resistance standards of high accuracy containing one or more decades of precision fixed resistors. Some models include an interpolating rheostat. Accuracies to 0.005% initial, 0.02% long term. Temperature coefficient less than 0.002% per degree Centigrade. Model DS Dekastat for panel mounting, Model DB Dekabox for bench use, Model RS Dekastat for rack mounting. Models from $48.00 to $425.00*

DEKAPACITOR® AND DEKABOX® DECADE CAPACITORS

Adjustable, low loss decade units. Hermetically sealed polystyrene capacitors except below 1000 micromicrofarads where high quality ceramic or mica capacitors are used. Accuracy 1%. Model DK-30 Dekapacitor for panel mounting, Model DC-40 Dekabox for bench use. Prices: $170.00 and $195.00*

*All prices f.o.b. Portland, Oregon.

THE NEW ESIAC. A revolutionary Algebraic Computer by ESI offers a completely new design tool for engineers working in fields of servo control development, circuit analysis and systems engineering.

excellent scientific instruments esi

ELECTRO-MEASUREMENTS, INC.

7524 S.W. MACADAM AVENUE **PORTLAND 19, OREGON**

Represented by NEELY ENTERPRISES in California, Arizona, Nevada & New Mexico

1958 Directory of Western Electronic Manufacturers

Electra-Physics Labs 2065 Huntington Dr San Marino Calif—Bill Aldrich—SY 5-4304 (p) Micro Miniature Co-axial Connectors, Cable Assemblies, Fixed Attenuator Pads

△Electro-Pulse Inc 11861 Teale St Culver City Calif—Frank E Galusha—TE 0-8006 (p) Pulse Generating Equip. Magnetic Core Testing & Electronic Counting Equip

Electrosolids Corp 13745 Saticoy Panorama City Calif—Gerald J Widawsky—ST 3-3172 (p) Inverters, Transformer Rectifiers, Amplifiers

Electro-Switch & Controls Inc 5755 Camille Ave Culver City Calif—J K Brose—TE 0-4643 (p & a) Relays, Controls

Elgence Inc P O Box 45344 Airport Station Los Angeles 45 Calif—Henry Low—FR 5-4685 (p) Electronic Noise Generators

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

EMC Corp 8160 Orion Ave Van Nuys Calif—Richard G Andrew—ST 2-9901 (p & a) Printed Circuits

Endeco Eng'g Dev Co of Los Angeles 922 E Anaheim St Wilmington Calif—C W Witt—TE 5-1430 (p) Marine Radio-telephones, Antennas

△Endevco Corp 161 E California St Pasadena Calif—Bruce Minteer—RY 1-5231 (p & a) Accelerometers, Pressure Pickups (p) Force Gages (a) Amplifiers

△Engineered Electronics Co 506 E 1st St Santa Ana Calif—Arthur B Williams—KI 7-5651 (p) Digital Plug-in Circuits, D C Amplifiers, Decades (a) Digital Plug-in Circuits, Vacuum Tube, Germanium & Silicon Transistor

Engineered Instruments Inc 815 Soto St Hayward Calif—JE 7-1545 (p & a) Amplifiers, Electronic Hardware

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—George H Osborne—OR 8-5418 (p) Electronic Timers-Counters, Electronic Preset Counters, Special Systems-Instrumentation for Time Interval Measurements & Count

Erikson Specialized Tool Co P O Box 424 Pico Calif—Jerry R Erikson—OX 9-3719 (p & a) Norseman Soldering Aids, Alignment Tools

△Essex Wire Corp of Calif 1075 N Patt St Anaheim Calif—L A Bushman

△Eubanks Engineering Co 260 N Allen Ave Pasadena Calif—Edward F Eubanks

Exact Engineering & Mfg Co 2375 Canyon Dr Oceanside Calif—F J Berberich—SA 2-8503

E-Z Ways Templated P O Box 535 Reseda Calif—Warren Juran—(p) Drafting Templates

F

△•Fairchild Controls Corp 6111 E Washington Blvd Los Angeles 22 Calif—B C Rogers—RA 3-5191 (p & a) Precision Wire Wound Potentiometers, Miniature Gyros, Pressure Transducers

△Fairchild Semiconductor Corp 844 Charleston Rd Palo Alto Calif—T H Bay

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 Products 15191 Bledsoe St San Fernando Calif—W E Hunter—EM 5-3181 (p) Power Supplies, SemiConductor Converters, Industrial Communications (a) Power Supplies, Computer Equipment, Static Inverter & Converter Equipment

△Federal Telecommunications Labs Div I T & T 937 Commercial St Palo Alto Calif—W S Chaskin—YO 8-1616 (p) Amplifiers (Audio, DC, Transistor) (a) Communication Systems

•Federated Metals Div American Smelting & Refining Co 4010 E 26th St Los Angeles 23 Calif—L A Blum—AN 8-4291 (p & a) Solders & Plating Materials

△Filtron Co 10023 W Jefferson Blvd Culver City Calif—W M Lane—FE 9-2206 (p) Filters, Delay Lines, Capacitors

Fisher Berkeley Corp 4224 Holden St Emeryville 8 Calif—Robert S Fisher—OL 5-9696 (p) Intercom Equipment

Fisher Research Lab Inc 1961 University Ave Palo Alto Calif—A E Feichtmeir—DA 4646 (p) Pipe Finders, Leak & Sound Detectors (a) Multi-voltmeters

△Fluke Mfg Co Inc 1111 W Nickerson St Seattle 99 Wash—R E Florence—AT 2-5700 (p & a) Voltmeters, Power Supplies, Wattmeters

•Friden Inc 2350 Washington Ave San Leandro Calif—G F Beeten—SW 8-0700 (n & a) Special Purpose Amplifiers, Integrated Data-processing Equipment & Systems

△Furane Plastics Inc 4516 Brazil St Los Angeles 39 Calif—Julian Delmonte—CH 5-5763 (p) Insulating Resins

G

•Gavitt Wire & Cable Co 455 N Quince St Escondido Calif—John T Hall—SH 5-3181 (p & a) Cable Assemblies, Cables (all kinds)

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-American Valve Co 413 Poinsettia Corona del Mar Calif—E C Greenwood—OR 3-2326 (p & a) Tapered Orifice Valve

•General Cement Mfg Co 400 S Wyman St Rockford Ill—R D Gawne—8-9661 (p) Liquid Adhesives, Tools, Jacks & Plugs

△General Controls Co 801 Allen Ave Glendale—J F Ray

△General Electric Co 11840 W Olympic Blvd Los Angeles 64 Calif—B S Angiven—GR 9-7765 (p) Receiving & Industrial Tubes, Capacitors

△•General Electric Microwave Lab at Stamford 601 Calif Ave Palo Alto Calif—J W Nelson Jr—DA 4-1661 (p & a) Traveling-Wave Tubes, Klystrons, Backward Wave Tubes

General Precision Lab Inc 21 N Santa Anita Ave Pasadena Calif—T V LeVay—RY 1-5669 (p) Navigational Systems & Closed Circuit Television Systems (a) Military Airborne Bombing & Navigational Systems

•General Transistor Western Corp 6110 Venice Blvd Los Angeles 34 Calif—Malcolm Ross—WE 3-5867 (p & a) Magnetic Tape & Drum Heads, Magnetic Drum Assemblies

△Genisco Inc 2233 Federal Ave Los Angeles 64 Calif—K E McCarron—BR 2-2706 (p) Power Amplifiers, 3-phase Oscillators (a) Accelerometers, Centrifuges

△Gertsch Products Inc 11846 Mississippi Ave Los Angeles 25 Calif—E P Gertsch—GR 817777 (p) Capacitors, Filters, Transformers

△Giannini & Co G M 918 E Green St Pasadena Calif—R S Hanson Jr—RY 1-7152 (p) Computers (data), Potentiometers (a) Pressure Transducers, Gyros, Control & Telemetering Sub-Systems

△Gilbert Co Inc M B 1608 Centinela Ave Inglewood 3 Calif—M B Gilbert

Gilfillan Bros Inc 1815 Venice Blvd Los Angeles 6 Calif—Leonard D Callahan—DU 1-3441 (p & a) Quadradar, Corporal Missile Guidance Systems, Navigational Radar Trainer

△Girard-Hopkins 1000 40th Ave Oakland 1 Calif—A R Stack—KE 2-8477 (p & a) Capacitors, Resistors

Glass Eng'g Labs Inc 601 O'Neill Ave Belmont Calif—Hugh Hutchings—LY 3-8276

Glass Products Co 30 S Salsepuldes Santa Barbara Calif—Nathan Putiker—WO 6-1585 (p) Printed Circuits (Flush & Crossovers)

Glass Solder Engineering 4332 Temple City Blvd Rosemead Calif—J H Rice—CU 3-7224 (p & a) Connectors (hermetic sealed), Seals (glass-to-metal and hermetic)

△Globe Electrical Mfg Co 1729 W 134th 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 Young Spring & Wire Corp 801 S Main St Burbank Calif—J F Cocks Jr—VI 9-2222 (p) Amateur Transmitters & Receivers, Commercial Communications Equip, Antennas & Accessories (a) Ground to Air Communications Equip, Light Aircraft VHF Transmitter Receiver

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

△•Grant Pulley & Hardware Corp 944 Long Beach Ave Los Angeles 21 Calif—Arthur Grushin—MA 7-4851 (p & a) Industrial Slides, Thinslides, Handle & Lock Mechanism

•Gudeman Co Dilectron Div 2669 S Myrtle Ave Monrovia Calif—K B Clark—HI 6-3101 (p) Pulse Transformers, Delay Lines-Electromagnetic

Gudeman Co of Calif 190 Commercial St Sunnyvale Calif—J F Gudeman—RE 6-5471 (p) Transformers, Delay Lines, Filter Networks

H

Hadley Co Robt M 5112 S Hoover St Los Angeles 37 Calif—R M Hadley—AD 4-0131 (p) Amplifiers, Coils, Transformers

Halax Corp 17470 Shelbourne Way P O Box 425 Los Gatos Calif—Arthur E Oltz—EL 4-2720 (p & a) Special Purpose Bearing Components, Pressure Switches

△Hallamore Electronics Co Div Siegler Corp 8352 Brookhurst Ave Anaheim Calif—John R Frost—PR 4-1010 (p) Phase-Lock Discriminator, DC Amplifier, Closed Circuit TV (a) Magnetic Amplifier Autopilot, Static Inverter, Telemetry

Hallett Mfg Co 5910 Bowcroft St Los Angeles 16 Calif—S E Estes—TE 0-7094 (p & a) Radio Interference Shielding, High Temp Electrical Wire Harnesses (p) Coaxial Connectors

Hallikainen Instruments 1341 7th St Berkeley 16 Calif—E F Schimbov—LA 4-1757 (p) Temperature Controllers, Electrometer Amplifiers

Hancock Electronics Corp 2553 Middlefield Rd Redwood City Calif—W D Hancock—EM 6-8468 (p) Communication Equipment

Handley Electronics Inc 14758 Keswick St Van Nuys Calif—Bert Sanford—ST 2-5840 (p & a) Potentiometers, Temperature Indicators (a) Custom-Winding

•Handy & Harman 330 N Gibson Rd El Monte Calif—P G Deuthler—CU 3-8181 (p) Silver Alloys, Precious Metal Alloys for Industry

Hansen Electronics Co 7117 Santa Monica Blvd Los Angeles 46 Calif—H R Hansen—HO 9-3052 (p & a) Tape Resistors

Harden Co Donald 3710 Midway Dr San Diego 19 Calif—D C Harder—AC 2-5240 (p & a) Toroidal Coil Machines & Components

Harworth Mfg Co 409 El Camino Rwal Menlo Park Calif—Keith Harworth—DA 3-9965 (p & a) Electronic Metal Detectors

△Helipot Corp Newport Beach Calif—Michael York—LI 8-0611 (p & a) Precision Potentiometers, Rotation Components, Monitoring & Control Components

△•Hermetic Pacific Corp 4232 Temple City Blvd Rosemead Calif—J H Rice—GI 3-1757 (p) Glass-Metal Seals, Connectors

△Herrmann Associates P O Box 1179 Palo Alto Calif—Carl W Herrmann

△•Hetherington Inc 139 Illinois St El Segundo Calif—Ed Kaufholz—OR 8-5241 (p & a) Switches, Indicator Lights, Relays

△Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif—W Noel Eldred—DA 5-4451 (p) Oscillators, Vacuum Tube Voltmeters, Signal Generators

Hi-Shear Rivet Tool Co 2600 W 247th St Torrance Calif—John T Hales—DA 6-8110 (p) Fasteners, Blind Bolts, Blind Nuts

△Hoffman Electronics Corp 3761 S Hill St Los Angeles 7 Calif—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 Equipment (a) Airborne Communications Equipment

Holex Inc 2751 San Juan Rd Hollister Calif—Sheila LaPorte—ME 7-5306 (p) Special Electrical Harnesses, Glass to Metal Seals (a) Electrically Operated Explosive Bolts, Pressure Cartridges & Explosive Actuators

△Hopkins Eng'g Co 12900 Foothill Blvd San Fernando Calif—P W Lawrason—EM 1-8693 (p) Capacitors, Intereference Filters

•Hoover Electronics Co 1122-C San Mateo Blvd S E Albuquerque N M—Daniel Luiliter—AM 8-2459 (p) Weighing, Bridge Balancing & Batch Control Systems (a) Missile Fuel Control Systems, Center of Gravity Determining Systems

Houston Fearless Div Color Corp of America 11801 W Olympic Blvd Los Angeles 64 Calif—R C Wilcox—BR 2-4331 (p) Cameras, Lenses

Hufco Industries 2815 W Olive Ave Burbank Calif—VI 9-2118—O F Huffman (p & a) Relays

△Huggins Laboratories Inc 711 Hamilton Ave Menlo Park Calif—V D Arenborst—DA 6-3090 (a) Traveling Wave 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 A/P Sta Los Angeles 45 Calif—R M Russell—OR 2-5011 (p) Diodes, Transistors, Rectifiers

Hughev & Phillips 3200 N San Fernando Blvd Burbank Calif—J H Ganzenbuber—VI 9-1104 (p) Obstruction Lighting Equipment

Humphrey Castings, Inc 3944 Rilev St San Dieno 10 Calif—George Wilson—CY 6-6173 (p) Actuators (a) Manned Aircraft Cockpit Controls

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

I

Illumitronic Eng'g Co 680 E Taylor Ave Sunnyvale Calif—J D Guilie—RE 9-2395 (p) Air Wound Inductors

Industrial Electronic Engineers 3973 Lankershim Blvd N Hollywood Calif—John J Bylo—ST 7-0328 (p) In-line Digital & Alpha-Numeric Display Units, Binary Decode Units

△Industrial Products Co Div Amphenol Electronics Corp P O Box 1116—Gardena Calif—A W Harris

△Insul-8-Corp 1369 Industrial Rd San Carlos Calif—W E Anderson

1958 Directory of Western Electronic Manufacturers

Int'l Business Machines Corp Monterey & Cattle Rds San Jose Calif—W D Jones—CY 7-2950 (p) Computers

△International Electronic Research Corp 145 N Magnolia Blvd Burbank Calif —John E Markey Jr—VI 9-2481 (p) Heat Dissipating Tube Shields, Heat Dissapators

△International Rectifier Corp 1521 E Grand Ave Santa Monica Calif—L E Brown—TE 0-4415 (p & a) Power Supplies, Transistor Radios

International Research Associates 2221 Warwick Ave Santa Monica Calif—L E Brown—EX 4-6330 (p) Variable Frequency Power Supplies, Airborne Power Supplies, Converters (a) Direction Finders

△I T & T Components Div 815 San Antonio Rd Palo Alto Calif—R M Van Valkenburgh—YO 7-7249 (p & a) Rectifiers-selenium, Seals

Interstate Electronics Corp 875 S East St Anaheim Calif—J P Hastings—PR 4-6740 (a) Aircraft Instrumentation & Communications Equipment

△*Iron Fireman Mfg Co Electronics Div 2838 S E 9 Ave Portland Ore—O D Berry—BE 4-6551 (p & a) Gyroscopes, Relays, Slip-Rings

J

△Jack Scientific Instrument Co Bill 143 Cedros St Solana Beach Calif—C G Jack—SK 5-1551 (p) Cable Assemblies, Converters, Counters (a) Computers

James, Pond & Clark Inc 2181 E Foothill Blvd Pasadena Calif—O W Smith—SY 3-9195 (p) Vent & Breather Valves (a) Check Relief, Shutoff, Shuttle & Special Valves

Janco Corp 3111 Winona Ave Burbank Calif—J T Peterson—TH 8-5792 (a) Switches, Shunts, Resistors

Javex P O Box 646 Redlands Calif—C J Reimuller—PY 3-5752 (p) Electronic Accessories, Electrical Items

Jefferson Electronic Products Corp 322 State St Santa Barbara Calif—A K Sedgwick—WO 5-8505 (p) Amplifiers (audio & DC) (a) Guided Missile Packages

△Jennings Radio Mfg Corp 970 McLaughlin Ave San Jose 8 Calif—Don F Hamm—CY 2-4025 (p) Vacuum Capacitors, Vacuum Transfer Relays, Vacuum Switches (a) Vacuum Transfer Relays, Capacitors

Jet Electronics Corp 4426 San Fernando Rd Glendale 4 Calif—Jiame Balugo —CI 1-2689 (p & a) Deflection Yokes, Deflection Components, Transformers

Jonathan Mfg Co 1234 E Ash St Fullerton Calif—John Meyer

Johnson-Williams Inc Box 307 Station A Palo Alto 15 Calif—P L Williams —DA 3-4131 (p) Combustible Gas Indicators & Alarms, Odor Indicators (a) Icing-Severity Indicators

Jones Electronics Hiram 2313 W Olive Ave Burbank Calif—R W Snell—TH 8-6685 (p) Terminals, Insulating Material, Electronic Hardware (a) Test Jacks, Feed Throws, Stand Offs

*Jordan Electronics Inc 3025 W Mission Rd Alhambra Calif—J M Bell—CU 3-6425 (p) Monitoring Systems (a) Timers, Interrupters

K

Kaar Eng'g Corp 2995 Middlefield Rd Palo Alto Calif—N C Helwig—DA 6-5050 (p) Radiotelephones, Transmitters & Receivers (a) VHF Transmitters, Compass Locator Transmitters

Kahl Scientific Instrument Corp Box 1166 El Cajon Calif—Joseph Kahl—HI 4-5844 (a) Thermostats, Switches, Thermometers

Kaiser Aircraft & Electronics Div Kaiser Industries West Coast Electronics Lab 850 San Antonio Rd P O Box 275 Station A Palo Alto Calif—C K Perkins—YO 7-7267 (p & a) Thin Cathode-Ray Tubes, Electronic Contact Analog Display (p) 3-Dimensional Map Mold Milling Machines

Kalbfell Electronic 3434 Midway Dr San Diego 10 Calif—Mary Lou Kane—AC 3-7156 Consulting & Research

Kartron 7882 Kartron Place Huntington Beach Calif—Tom B Linton—(p) Shorted Turn Indicator

Kaynar Mfg Co Inc 7875 Telegraph Rd Rivera Calif—R H Randall—LU 9-3271 (p & a) Nuts (A/C & Missile)

△*Kearfott Co Inc Western Div 253 N Vinedo Ave Pasadena 8 Calif—William R Cummings—SY 5-7271 (p) Floated Gyros, 2-Axis Pendulous Accelerometers, Inertial Platforms (a) Gyros, Synchros, Servo Motors

△*Kearfott Co Inc Microwave Div 14844 Oxnard St Van Nuys Calif—J L Quinto—ST 6-1760 (p & a) Microwave Components Systems, Microwave Antennas, Radar Test Equipment

Kelvin Electric Co 5907 Noble Ave Van Nuys Calif—Kenneth T Eckardt—ST 3-2666 (p & a) Precision Wire Wound Resistors, Ratio Networks

△Key Enterprises 15131 Gilmore St Van Nuys Calif—Winston Key

K-F Development Co 2606 Spring St Redwood City Calif—Paul Keeler—EM 8-5670 (p & a) Precision Wire Wound Resistor, Potentiometers

Kibbey Instrument Co P O Box 50 Perkins Calif—Mead B Kibbey—GL 1-6571 (p) Uni Chassis Electronic Breadboard Kits, Instrument Leads & Fittings (a) Chassis Hardware Items

Killsman Instrument Corp Standard Coil Products Sub 715 Sonora Ave Glendale Calif—C J Adolph—CH 5-1191 (a) Synchros, Transducers, Test Equipment

Kinetics Corp 410 S Cedros Ave Solana Beach Calif—W J Bossert—SK 5-1181 (p & a) Power Changeover Switches, Static Inverters, Static (transistorized) Commutators

King Research & Development Co 1740 University Ave Berkeley 3 Calif—V J King—TH 5-4409 (p) Single Crystal Growth Apparatus & Controls, Precision Temperature Controlled Cavity Ovens, X1 & Small Component Ovens (a) Custom XL Growing Service, Precision Temperature Controls

△Kingsley Stamping Machine Co Electronics Div 850 Cahuenga Blvd Hollywood Calif

△KIN TEL Div Cohu Electronics Inc 5725 Kearny Villa Rd Box 623 San Diego 12 Calif—Henry J Pannell—BR 7-6700 (p & a) Digital Instruments, DC Amplifiers (p) Industrial Television Equipment (a) Accelerometers & Pressure Transducers

△Kittleson Co 416 N LaBrea Ave Los Angeles 36 Calif—Peg Reed

Knopp Inc 1307 66th St Oakland 8 Calif—Henry N Muller—OL 3-1661 (p) Electrical Standardizing Equipment, Plate & Filament Transformers, Phase Shifters (a) Transformers, Electrical Testing Equipment

K R F Corp 6006 W Washington Blvd Culver City Calif — Thurman D Brooms—TE 0-6955 (p & a) Cathode Ray Tubes

Kwikheat Mfg Co 3732 San Fernando Rd Glendale 4 Calif—E E Wachter—CH 5-2376 (p) Soldering Irons

L

Lambda-Pacific Eng'g Co 14725 Arminta St Van Nuys Calif—L W Mallach—ST 3-2400 (a) Microwave Links

LaMoree C D 2433 Birkdale Ave Los Angeles 31 Calif—Ben E Ley—CA 5-5666 (p) Engraving, Insulating Compounds

Lance Antenna Mfg Co 1802 1st St San Fernando Calif—Milton Mann—EM 1-8645 (p) Antennas, Cable & Cable Assemblies, Geiger Counters

Land-Air Inc Instrument & Electronic Div 2133 Adams Ave San Leandro Calif —B Pat Moore—LO 9-5841 (p) Gamma Intensity Timer Recorders, Sub-Miniature Receivers, Tritium Sniffers (a) Sub-Miniature Receivers, Airborne Engine Analyzers, Miniature Airborne Receivers

Lansing Sound Inc James B 3249 Casitas Ave Los Angeles 39 Calif—W H Thomas—NO 3-3218 (p) Speaker Baffles, Acoustical Lenses, Speakers

Larson Electronic Glass P O Box 371 2426 El Camino Real Redwood City Calif—J Palmer Larson—EM 8-7228 (p) Metal to Glass Seals

△Leach Corp Inlet Div 4441 S Santa Fe Ave Los Angeles 58 Calif—George Mayhew—LU 3-4771 (p & a) MG Sets, Power Supplies, Magnetic Amplifiers

△Leach Corp Leach Relay Div 5915 Avalon Blvd Los Angeles 3 Calif—R P McAlister—AD 2-8221 (p & a) Relays

Lear Inc 3171 S Bundy Dr Santa Monica Calif—R M Mock—EX 8-6211 (p) Amplifiers, Antennas (a) Communication Systems, Control Equipment, Direction Finders

Lee Electric & Mfg Co 2806 Clearwater St Los Angeles 39 Calif—L V Lawhead Jr—NO 3-1295 (p & a) Magnetic Amplifiers, Cable Assemblies

Lenkurt Electric Co 1105 County Rd San Carlos Calif—Frank H Russell —LY 1-8461 (p) Carrier Telephone, & Microwave Radio Equipment, Carrier Telegraph Equipment

△Lerco Electronics Inc 501 S Varney St Burbank Calif—Hugh P Moore—VI 9-5556 (p & a) Terminals, Electronic Hardware, Terminal Boards

Leupold & Stevens Instruments Inc 4445 N E Glisan St Portland 13 Ore—R J Stevens—BE 4-7423 (p) Telemarks, Water Level & Precipitation Recorders

△Levinthal Electronic Products 3180 Hanover St Palo Alto Calif—A J Morris—DA 6-1640 (p & a) Microwave Transmitters, Modulators

Lewis & Kaufman 17320 El Rancho Ave Los Gatos Calif—J Kaufman—EL 4-3540 (p) Rectifiers & Rectifier Tubes, Special Purpose & Transmitting Tubes, Tube Parts

△Librascope Inc Commercial Div 133 E Santa Anita Ave Burbank Calif—R E Hastings—VI 9-3151 (p) Amplifiers, Printed Circuits, Computers

△*Librascope Inc 808 Western Ave Glendale Calif—K J Slee—CH 5-7511 (p & a) Analog & Digital Computers

△Ling Electronics Inc 9937 W Jefferson Blvd Culver City Calif — Ernest Thornton—TE 0-7711 (p) Electronically Driven Vibration Systems, Closed Circuit Television Systems, Power Vacuum Tubes & Capacitors

△Ling Systems Inc 11949 Vose St N Hollywood Calif—F W Bailey—PO 5-9041 (p) Microwave Relay Systems, Cable & Harness Assemblies, Ground Station Telemetering Systems (a) Bulk Head Feed Thru Assemblies, Cable & Harness Assemblies, Closed Circuit Television

Linlar Inc 4101 San Fernando Rd Glendale 4 Calif—S H Ise—CH 5-5111 (p) Headsets, Speakers, Microphones (a) Transformers, Amplifiers, Adaptors

Lipps Engineering Edwin A 1511 Colorado Ave Santa Monica Calif—Edwin A Lipps—EX 3-0449 (p & a) Custom Micro-magnetic Instruments, Single & Multi-channel Magnetic Tape Recording Heads, Magnetic Test Equipment

Litton Eng'g Labs P O Box 949 Grass Valley Calif—F L Towne—1730 (p) Glassworking Lathes, Vacuum Equipment, Vacuum Tube Mfg Equipment

△Litton Industries-Electronic Display Lab 1476 66th St Emeryville Calif—A C Cooley—OL 8-3831 (p & a) Cathode-Ray Tubes & 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

△Litton Industries Components Div 5873 Rodeo Rd Los Angeles 16 Calif—H J Gray—VE 7-1228 (p) Terminal Boards, Printed Circuits (a) Precision Potentiometers, Ferrite Isolators, Rotary Joints

△Litton Industries Electron Tube Div 960 Industrial Rd San Carlos Calif—E L Rogers—LY 1-0321 (p & a) Magnetrons, Klystron, Carcinotrons

Lockheed Missile Systems Div 7701 Woodley Ave Van Nuys Calif—Reed Lawton—ST 6-4210 (a) Missile Systems

Loge 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

*Luzo Lamp Corp 464 Bryant St San Francisco Calif—M E Bergen—SU 1-3168 (a) Assembly Bench Work Lamp

Lynch Carrier Systems Inc 695 Bryant St San Francisco Calif—E B Stone —EX 7-1471 (p) Carrier Telephone & Telegraph Systems, Data Transmission Equipment, Filter, Repeat Coils, & Balance Network

Lyon Rural Electric Co 2075 Moore St San Diego 12 Calif—Jim Lyon—CY 5-4625 (p & a) Solderer & Heater for Mfrs. Wire Stripper

M

McCormick Selph Associates Hollister Airport Hollister Calif—Frank B Pollard—ME 7-3731 (p) Gas Generators, Explosive Bolts, Pressure Cartridges, (Igniters & Initiators)

McKenna Labs 2503 Main St Santa Monica Calif—A G McKenna—EX 9-8846 (p & a) Ultrasonic Equipment

MacDonald & Co 1324 Ethel St Glendale 7 Calif—D G MacDonald—CI 1-6481 (a) Sleeving Cutter, Plug Holder, Wire Strippers

MacKenzie Electronics Inc 145 W Hazel St Inglewood 3 Calif—Nat Natlez Jr —OR 8-9335 (p & a) Magnetic Tape Automatic Devices, Selective Program Repeaters, Automatic Telephone Answering Sets

Magna Electronics Co 9810 Anza Ave Inglewood Calif—F Roy Chilton—OR 8-5675 (p) Amplifiers

Magnasync Mfg Co Ltd 5546 Satsuma Ave N Hollywood Calif—Howard V Auchstetter—PO 6-1692 (p) Magnetic Film & Instrumentation Recorders, Audio Amplifiers

Magne Tec Corp 11785 W Olympic Blvd Los Angeles 64 Calif—Vern Johnson —GR 9-2257 (p) Bobbins (coil windings)

△Magnetic Amplifiers Inc 136 Washington St El Segundo Calif—Morris Beard

Magnetic Circuit Elements, Inc., 3722 Park Pl Montrose Calif—John S Conklin—CH 8-4040 (p) Ultra Stable DC Magnetic Amplifier, Instrument Sensors (Frequency & Voltage) (a) Magnetic Amplifiers, Precision Transformers

△Magnetic Research Corp 3160 W El Segundo Blvd Hawthorne Calif—John A Charlesworth

Magnuson Engineers Inc 509 Emory St San Jose 10 Calif—T J Smith—CY 2-3657 (p & a) Rotary Solenoid (p) Color Instrument, Liquid Dispenser

△Majestic Electronics Inc 9530 W Jefferson Blvd Culver City Calif—Lee Cowan

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

Masterite Ind Inc 835 W Olive St Inglewood 1 Calif—Terry Wolfenden—OR 1-3868 (p & a) Electronic Contacts & Pins, Wire Forms

△Master Mobile Mounts Inc 1306 Bond St Los Angeles 15 Calif—J J Goldfarb—RI 7-0638 (p) Mobile Radio Communication Equipment

△Menlo Park Eng'g 721 Hamilton Ave Menlo Park Calif—Harold W Harrison—DA 6-9080 (p & a) Power Supplies, Microwave Sweep Generators, Traveling Wave Tube & Backward Wave Oscillator Solenoids

△Meridian Metalcraft Inc 8739 S Millergrove Dr Whittier Calif—C W Peterson—RA 3-1508 (a) Microwave Sub-Systems, Rigid Waveguide Components, Microwave Connecting Links

ONLY KIN TEL DIGITAL VOLTMETERS GIVE YOU ALL THESE ADVANTAGES... AND FOR ONLY $2100

1. SINGLE-PLANE READOUT: KIN TEL digital voltmeters employ a simple projection system to present numbers on a readable single plane...no superimposed outlines of "off" digits...reduced possibility of error. Standard lamps give 7000 to 8000 hours of life, compared with 100 to 200 hours for ordinary readouts.

2. COMPLETE LINE OF ACCESSORIES—SPECIAL SYSTEMS: Versatile "digital building blocks" permit measurement of AC, ohms, ratios of AC and DC, automatic scanning of multiple inputs. Preamplifiers increase digital voltmeter sensitivity to 1 microvolt DC, 10 microvolts AC. Buffers permit driving typewriters, tape punches and printers. KIN TEL's Special Products Department can design and manufacture digital instruments to meet your special requirements . . . complete digital systems for data logging, missile checkout and automatic production line testing.

3. ADVANCED CIRCUIT DESIGN: Transistors employed where they contribute to performance and reliability...relay drive coils energized with DC as in telephone type service to provide long, trouble-free operation...automatic, continuous standard cell calibration. No electronic circuitry in readout allows easy remote mounting. Sensitivity control permits stable reading of noisy signals.

4. MANUFACTURING EXPERIENCE: KIN TEL has manufactured over 10,000 "standard cell accuracy" DC instruments on a true production line basis. Only by this method, by years of repeated manufacturing experience, by an over-all awareness of the accuracies and tolerances involved, is it possible to guarantee consistent accuracy and reliability...to assure real value for every dollar you invest.

5. NATIONWIDE APPLICATION ENGINEERING FACILITIES: KIN TEL has engineering representatives in every major city. An experienced staff of over 200 field engineers is always immediately available to help solve your application problems, provide technical data, or prepare a detailed proposal. Factory level service is available in all areas.

6. DESIDERATE SPECIFICATIONS (MODEL 401 DC DIGITAL VOLTMETER):

Display . . . [illegible] digit with automatic polarity indication and decimal placement. Total display area 2" high x 7½" long, internally illuminated. Individual digits 1¼" high.

Automatic Ranges . . . .0001 to 999.9 volts covered in four ranges. Sensitivity control provides fixed high sensitivities of .1, 1, and 10 mv.

Accuracy . . . ±0.01% ±1 digit.

Counting Rate . . . 30 counts per second, providing average balance reading time of 1 second, maximum balance time of 3 seconds.

Reference Voltage . . . Chopper stabilized supply, referenced to an unsaturated mercury cadmium standard cell.

Input Impedance . . . 10 megohms, all ranges.

Output . . . Visual display, plus print control. Automatic print impulse when the meter assumes balance. No accessories required to drive parallel input printers.

Input . . . 115 volt, 60 cycle, single phase, approximately 75VA.

Dimensions . . . Control unit, 5¼" high x 19" wide x 16" deep. Readout display, 3½" high x 19" wide x 9" deep.

Weight . . . Approximately 40 lb.

Price . . . $2,100

Write today for descriptive literature or demonstration. 5725 Kearney Villa Road San Diego 11, California

KIN TEL

A Division of Cohu Electronics Inc.

Represented by NEELY ENTERPRISES in California, Arizona, Nevada & New Mexico

1958 Directory of Western Electronic Manufacturers

Metal Fab Co 12321 Branford St Pacoima Calif—T R Kirkman—EM 6-8700 (p) Instrument Cases & Cabinets, Precision Metal Work

Metzner Eng'g Corp 1041 N Sycamore Ave Los Angeles 38 Calif—Will A Connelly—HO 2-2353 (p) Turntables, Tape Deck

Mica Corp 4031 Elenda St Culver City Calif—M B Grossman—TE 0-6861 (p & a) Copper Clad Epoxy Glass Laminates

△Microdot Inc 220 Pasadena Ave S Pasadena Calif—W F Cox—FY 1-1146 (p & a) Microminiature Coaxial Connectors & Cables

Microflect Co 2300 S 25th St Salem Ore—G F Kreitzberg—EM 2-3562 (p) Passive Repeaters

△Micro Gee Products Inc 6319 W Slauson Ave Culver City Calif—B J Losmandy—EX 1-1716 (p) Single Degree & 2-Degree Simulation Tables (a) Signal Simulators

Microwave Eng'g Labs Inc 943 Industrial Ave Palo Alto Calif—Perry H Vartanian—YO 7-6958 (p) Microwave Receivers, Microwave Components, Radiometers & Radiometer Components (a) Microwave Ferrite Isolators & Switches

△Miller Co J W 5917 S Main St Los Angeles 3 Calif—J W Miller—AD 3-4294 (p) Filters, Capacitors, Transformers

△Miller Dial & Name Plate Co 4400 N Temple City Blvd El Monte Calif—H R Euender—GI 4-4555 (p) Nameplates & Dials, Electronic Panels, Fotofoil (a) Panels, Nameplates

Miller Instrument Co Inc 165 E Lincoln Ave Escondido Calif—K E Miller—SH 5-4731 (p & a) Indicators, Electrical Measuring Instruments

Miller-Robinson Co 7007 Avalon Blvd Los Angeles 3 Calif—James V Robinson—PL 2-6141 (p & a) Pressure Switches

Milli-Switch Corp 1742 Berkeley St Santa Monica Calif—A A Allen—EX 4-1733 (p & a) Snap Action & Toggle Switches

•Mincom Div Minnesota Mining & Mfg Co 2049 S Barrington Ave Los Angeles 25 Calif—Robert J Brown—BR 2-8692 (p & a) Magnetic Instrumentation Tape & Instrumentation Tape Recorders

△Minn-Honeywell Regulator Co-Micro-Switch Div 6620 Telegraph Rd Los Angeles Calif (p) Switches, Semi-Conductors, Instruments

△Minnesota Mining & Mfg Co 6023 S Garfield Ave Los Angeles 22 Calif—M D Benson

Modern Industries Inc 5755 Camille Ave Culver City Calif—C D Slaten—TE 0-2020 (p & a) Transistorized Power Conversion, Units Regulated, Power Supplies

Moisture Register Co 1510 W Chestnut St Alhambra Calif—R J McLean—CU 3-31443 (p) Moisture Testing Instruments (a) Radome Moisture Register

Mole-Richardson Co 937 N Sycamore Ave Hollywood 38 Calif—Warren K Parker—OL 4-3660 (p) Specialized Lighting Equipment

△Monitor Products Co 815 Fremont Ave S Pasadena Calif—John W Blasier—RY 1-1174 (p) Quartz Frequency Control Crystals, Crystals Ovens

Moore Associates Inc 2600 Spring St Redwood City Calif—J B Bullock—EM 9-0204 (p & a) Amplifiers (D-C), Converters (analog to digital)

Moran Instruments Corp 170 E Orange Grove Ave Pasadena Calif—H E Ohanian—SY 6-7158 (p) Electronic Distance Measuring Equipment, Laboratory Calibrators, Analog to Digital Converters (a) Airborne Analog & Airborne Synchro Digitizers, Electronic Distance Measuring Equipment

Morrow Radio Mfg Co 2794 Market St N E Salem Ore—Fred J Hart—EM 3-6952 (p) Amateur Transmitters & Receivers, Power Supplies, Commercial Transmitters & Receivers

△Moseley Co F L 409 N Fair Oaks Ave Pasadena Calif—G G Swendson—RY 1-0208 (p) X-Y Recorders, Recorder Accessories, Electronic (servo-type) DC Millivoltmeters

Motorola Inc 8330 Indiana Ave Riverside Calif—John F Byrne—OV 9-3141 (p) Radar Systems (a) Electronic Countermeasures

△Motorola Semiconductor Div 5005 E McDowell Rd Phoenix Ariz—H Steven Berek—BR 5-4411 (a) Germanium Power, Audio, R F & Switching Transistors, Silicon Rectifiers, Zener Diodes

Mullenbach Div Electric Machinery Mfg Co 2100 E 27th St Los Angeles Calif—R H Olson—LU 2-5331 (p) Control Equipment, Panels, Relays

Mystik Tape Products 3730 Tyburn St Los Angeles Calif

N

Nacimo Products 2300 National Ave National City Calif—W Don Howell—GR 7-4420 (p & a) Platinum Film Temperature Transducers, Digital Tachometers, AC/DC Converters

Nadar Mfg Co 2661 S Myrtle Ave Monrovia Calif—J H Chambers—RY 1-6132 (p & a) Semi-Conductor Appliances, Transistorized Power Supply, Digital Counters

Narmco Resins & Coatings Co 600 Victoria St Costa Mesa Calif—D S Maglione—LI 8-1144 (a) Structural Adhesives, Laminating Material, Resins & Putties

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—R M Walck—PL 7-1811 (p & a) Digital Computer Systems

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

Neff Instrument Corp 2211 E Foothill Blvd Pasadena Calif—D B Schneider RY 1-5121 (p & a) DC Amplifiers & Power Supplies

Nelson Vacuum Pump Co 2133 4th St Berkeley 10 Calif—D B Webb—AS 3-2277 (p & a) High Vacuum Pumps (p) Vacuum Components

Nemeth Inc 2223 S Carmelina Ave Los Angeles 64 Calif—Ruth Dorff—GR 8-8263 (p) Air-borne Missile Control Equipment (p) Photographic Interpretation Equipment

△Network Electronics Corp 14806 Oxnard St Van Nuys Calif—H J Moch—ST 5-8805 (p) Relay Lines, Generators, Transformers

Newcomb Audio Products Co 6824 Lexington Ave Hollywood 38 Calif—M Williamson—HO 9-5381 (p) Transcription Players & Phonographs, Audio Amplifiers, Hi Fi Amplifiers & Tuners

△Non-Linear Systems Inc Del Mar Airport Del Mar Calif—Don Fairchilds—SK 5-1134 (p) Digital Voltmeters, Ohmmeters & Ratiometers, Oscillogram Trace Reader Computer, Precision Wire-Wound Resistors

Norden-Ketay Corp Western Div 13210 Crenshaw Blvd Gardena Calif—A Raines—OR 7121 (p) Amplifiers, Control Systems, Resolvers (a) Servos, Synchros

Norgren-Stemac Inc 5400 S Delaware St Littleton Colo—E L McKanna—PY 4-4271 (p & a) Name Plates

Autonetics Div North American Aviation Inc 9150 E Imperial Hwy Downey Calif—Kearme Anderson—LU 3-6111 (p) Computers, Numerical Control Systems (a) Inertial Navigational Flight Control & Fire Control Systems

North American Instruments Inc 2420 N Lake St Altadena Calif—E Bollay—SY 8-9111 (p & a) Airborne Guidance & Control Systems & Components, Test & Check-Out Equipment, Computing Equipment

△Nortronics Div Northrup Aircraft Inc 222 N Prairie Hawthorne Calif—R Sullaringer—OR 8-9111 (p) Automatic Guidance & Control Systems (p & a) Navigational Star Trackers, Digital Computers, Airborne & Ground Bases (a) Automatic Navigation Systems

Nucleonic Products Co 1601 Grande Vista Ave Los Angeles 23 Calif—A J Jolles AN 2-1187 (p) Photo & Germanium Diodes, Electrolytic Capacitors, Resistors

•Nylok Corp 133 Penn St El Segundo Calif—B B Steele—EA 2-5772 (p & a) Self-Locking Fasteners

•NYT Electronics Inc 2979 N Ontario St Burbank Calif—R L Hyder—VI 9-2414 (p & a) Inductive Devices, Power Supply Modules, R F Components

O

Olympic Plastics Co Inc 3471 S La Cienega Blvd Los Angeles 16 Calif—H M Rome—TE 0-1121 (p) Electrical Terminal Strips, Instrument Carrying Cases, Polyvials for Packaging of Small Parts (a) Custom Molding

Omega Instrument Co 103 E Altadena Dr Altadena Calif—H Rutishauser—SY 4-8814 (p) Pressure Sensors, Accelerometers, Displacement Gauges (a) Machmeter, Telemeter Systems

△Optical Coating Lab 1035 Sebatopol Rd Santa Rosa Calif—(a) Infra-red Interference Filters

△Optron Corp 3526 State St Santa Barbara Calif—G A Hotham—WO 5-8140 (p & a) Vibration Pick-ups, Optical Displacement Followers, Microwave Vibration Pick-Ups

Orbirtan Co Inc Route 1 Box 635 Lakeside Calif—R J Price—HI 3-6832 (p) Pulse Delay Generators, Delay Lines

△Oregon Electronic Mfg Co 2105 S E 6th Ave Portland 14 Ore—H K Lawson—BE 6-9292 (p) Power Supplies

Organic Development Corp (Spectra-Strip Div) 10052 Larson Ave Garden Grove Calif—John Ford—JE 7-4530 (p) Spectra-Strip Flat Cables, Low Capacitance Cables, Liquid Vinyl Adhesives (a) High & Low Temperature Cables, Test & Instrumentation Cables, Retractable Cables

△Osborne Electronic Corp 712 SE Hawthorne Blvd Portland 14 Ore—Bill Capps—BE 2-0161 (p) Light Dimmers, Precision Ratio Transformers, Saturable Reactors (a) Transformers, Potentiometers, Light Dimmers

△Oster Mfg Co John 1 Main St Racine Wisc—E Wojcile—ME 7-4445 (p) Transistorized Servo Amplifiers, (a) Servos, Synchos

△Owen Labs Inc 55 Beacon Pl Pasadena Calif—Russell E Quackenbush—RY 1-6901 (p) Strain Gage Instrumentation, Power Supplies, Voltage Standards (a) Power Supplies—DC (p) Multiverters, Dual Pultrators, Custom DC Power Supply (a) Integrated Electronics Packate, Missile Ground Support, Digital Computers

P

Pace Eng'g Co 6914 Beck Ave N Hollywood Calif—B Helfand—PO 5-0453 (p) DC Power Supplies

△Pacific Automation Products 1000 Air Way Glendale 1 Calif—F G Jameson—CH 5-6871 (p) Special Cables

Pacific Electricord Co 3217 Exposition Pl Los Angeles 18 Calif—Kurt Michael—AX 3-7205 (p & a) Cable Assemblies, Cables (all kinds)

Pacific Electro-Kinetics 329 S Vermont Ave P O Box 725 Glendora Calif—David J Ryan—ED 5-3737 (p & a) A C Tranducers

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 Equipment

Pacific Relays Inc 12027 Vose St N Hollywood Calif—N F Lee—ST 7-0209 (p) Time Delays (a) Relays

Pacific Scientific Co 6280 Chalet Dr Bell Gardens Calif—A W Reichel—LU 3-1121 (p & a) Accelerometers, Potentiometers, Gyros

△Pacific Semi-Conductors Inc 10451 W Jefferson Blvd Culver City Calif—H Q North—VE 9-2341 (p) Diodes & Transistors

Pacific Technical Co 2047 Sawtelle Blvd Los Angeles 25 Calif—Harvey F Glassner—GR 7-0455 (p) Custom Medical Electronics (a) 2-Phase AC Power Supply

Pacific Transducer Corp 11836 W Pico Blvd Los Angeles 64 Calif—GR 8-1134 (p) Audio Sweep Frequency Generators

Packard-Bell Computer Corp 1905 Armacost Ave Los Angeles 25 Calif—Vincent A van Praag—GR 3-8667 (p & a) Computers

△Packard-Bell Electronics Corp 12333 W Olympic Blvd Los Angeles 64 Calif—David M Knox—BR 2-2171

Palmer Inc M V 4108 N W Fruit Valley Rd Vancouver Wash—Martin Palmer—OX 3-0590 (p) Telephone Switchboards

△Palo Alto Eng'g Co 620 Page Mill Rd Palo Alto Calif—W N Eldred—DA 5-3251 (p) Chokes, Terminals, Transformers

Palomar Research & Development 135 S Kalmia Escondido Calif—Wm F Collison—SH 5-7432 (p & a) Cabinets, Chassis, Circuits (plug-in)

Parks Electronics Corp 12311 Bothell Way Seattle 55 Wash—Henry Francis Parks—EM 3-6190 (p) Moisturometers, Electrotimers (a) Solenoids & Relays

PAR Products Corp 602 Colorado Ave Santa Monica Calif—C R Hallowell—EX 4-4219 (p) Optical Read Heads, Vector Cardiograph Recording Cameras, Motors (a) Airplane Take-off & Landing Simulators, Optical Components, Test Equipment

Parsons Co Ralph M Electronics Div 151 S DeLacey Ave Pasadena Calif—Edson C Lee—RY 1-0461 (p) Decommutation Stations, Electronic Miss Distance Indicator Systems, FM Crystal-Stabilized Telemetry Transmitter (a) Miss Distance Indicator Systems; FM Crystal-Stabilized Telemetry Transmitter, Specialized Airborne Transmitter

△PCA Electronics Inc 16799 Schoenborn St Sepulveda Calif—C C Rubin—EM 2-0761 (a) Pulse Transformers

Pearson Electronics 707 Urban Lane Palo Alto Calif—Paul A Pearson—DA 5-3147 (p) Pulse Transformers

Pedersen Electronics 3667-a Mt Diablo Blvd Lafayette Calif—S R Pedersen—AT 3-3434 (p & a) Amplifiers (audio, power, servo)

Peerless Electrical Products 6920 McKinley Ave Los Angeles Calif—B J Carrington—PL 8-4175 (p & a) Transformers

Peerless Electronics Inc 5338 Alhambra Ave Los Angeles Calif—Robert Monroe—CA 1-5196 (p & a) Clamps, Electronic Component Parts

△Perkin Eng'g Corp 345 Kansas St El Segundo Calif—G W Mousel—OR 8-7215 (p & a) Magnetic Amplifiers, Toroidal Coils

△Perlmuth Electronic Associates 2419 S Grand Ave Los Angeles 7 Calif—J J Perlmuth—RI 7-4321 (p) Electronic Tubes, Transistors, Semi-Conductor Diodes, Transducers & Accelerometers, Variable & Fixed Resistors & Potentiometers

Permoflux Products Co 4101 San Fernando Rd Glendale 4 Calif—S H Ise—CH 5-5511 (p) Headsets, Speakers, Microphones (a) Transformers, Amplifiers, Adaptors

△Penta Labs Inc 312 N Napal St Santa Barbara Calif—R P Leonard—WO 5-4581 (p & a) Power Tubes, Hydrogen Thryantrons, Vacuum Switches

△Perkin Eng'g Corp 345 Kansas St El Segundo Calif—Geo W Mousel—EA 2-1375 (p & a) DC Power Supplies, AC Lone Voltage Regulators, Transistorized Inverters & Converters

Pfieger Co R L 1652 Laurel St San Carlos Calif—R F Pfieger

△Phoastron Instrument & Electronic Co 151 Pasadena Ave S Pasadena Calif—W A Beswick—CL 5-1471 (p) Panel Instruments, Aircraft Type Relays, Sensitive Miniature Relays

•Photo Chemical Products of Calif 1715 Berkeley St Santa Monica Calif—H G Renaud—EX 5-0919 (p & a) Finishing & Permanent Marking of Aircraft & Electronic Instruments

△Photocon Research Products 421 N Altadena Dr Pasadena Calif—P C Ganzell—SY 2-4131 (p & a) Measuring Equipment, Counters & Test Equipment

△Pioneer Electronics Corp 2235 C Carmelina Los Angeles 64 Calif—Z Goodman—BR 2-8053 (p) Cathode-Ray Picture Tubes, High Vacuum Switches, Glass Technology (a) High Vacuum Switches, Radar Tubes

Plummer Mfg Co W A 752 S San Pedro St Los Angeles 14 Calif—Lee T Ludwig—MA 4-0831 (p) Equipment Bags & Covers, Instrument Covers, Electrician Tool Bags (a) Padded Covers & Insulators, Shock Pads, Asbestos Sewn Items

△•Polytechnic Research & Development Co Inc 737 N Seward St Hollywood 38 Calif—W A Yearsley—HO 5-7181 (p) Microwave Test Equipment & Precision Transistors (a) Test Instruments & Microwave Components

Pomona Electronics Co Inc 1126 W 5th Ave Pomona Calif—Carl Wm Musarra—NA 9-9549 (p & a) Patch Cords, Tube Socket Adapters, (p) Breadboards (a) Circuit Designer

△Porter Co Don 1117 S Robertson Blvd Los Angeles 35 Calif—Don Porter

△•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) Quart Crystals

Precision Radiation Instruments Inc 5810 S Normandie Los Angeles 44 Calif—A Leonard—PL 3-3501 (p) Radiation Detection Instruments, High Fidelity Equipment (a) Scintillators

Precision Technology 66 S "B" St Livermore Calif—R Carroll Maninger—HI 7-3343 (p & a) Amplifiers (audio, D-C, power, servo, transistor)

Prescott TV Co 7352 Beverly Blvd Los Angeles 36 Calif—M Prescott—WE 3-7193 (p) Video Recorders

Printronics Corp 3159 E Camino Real Palo Alto Calif

Products Research Co 3126 Los Feliz Blvd Los Angeles 39 Calif—W A Bechtold

Pruyn-Moore Inc 1158 Cota Ave Long Beach 13 Calif—C C Moore—HE 5-7417 (p) Communications Antennas—Fixed & Mobile

•PSP Eng'g Co Induction Motors Corp 6058 Walker Ave Maywood Calif—C B Pearson—LU 3-4785 (p & a) Solenoids, Synchros, Resolvers

Pulse Eng'g Inc 2657 Spring St Redwood City Calif—Hugh B Fleming—EM 8-3331 (p) Pulse Transformers, Specialty Transformers

Q

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

R

△Radiophone Co Inc 600 E Evergreen Ave Monrovia Calif—W H Schetter—EL 8-2585 (p) Electronic Pickup Indicator & Transducers, Sound Checkout Equipment, Telemetry Systems (a) Telemetry & Remote Control Systems, Capacitative Transducers

△Radio Corp of America West Coast Electronic Products Dept 11819 W Olympic Blvd Los Angeles 64 Calif—J W DeBeau—BR 2-8841 (p) Missile Components, Navigation & Weather Radar, Electronic Countermeasures (a) Air Weather Radar, Air Traffic Control, Miscellaneous Aviation Electronic Equipment

Radioplane Div Northrop Aircraft Inc 8000 Woodley Ave Van Nuys Calif—ST 6-7020 (a) Radio Controlled Target Aircraft & Surveillance Drones, Guided Missiles and Guided Missile Systems, Parachute Decoleration & Recovery Systems

Radio Specialty Mfg Co 2023 S 6th Ave Portland 14 Ore—K C Johnson—BE 2-8123 (p) Portable Receivers

Ram Chemicals Inc 210 E Olive P O Box 192 Gardena Calif—Robert Steinman—FA 1-0710 (p) Specialty Chemicals & Resins

△Ramo-Wooldridge Corp 5730 Arbor Vitae St Los Angeles 45 Calif—Dr R P Johnson—OR 8-0311

Ransom Research Box 269 323 W 7th St San Pedro Calif—Davis H Ransom Jr—TE 2-6848 (p) Computer Elements, Analog to Digital-Digital to Analog Converters, Digital Systems

△Rantec Corp 23999 Ventura Blvd Calabasas Calif—Robert Krausz

Ratigan Electronics Inc 3614 Maple Ave Los Angeles 11 Calif—E A Hodges—AD 3-4141 (p & a) R F Coils, Delay Lines

Rayco Electronic Mfg Inc 11116 Cumpston St N Hollywood Calif—Lois Robinson—PO 3-1241 (p) Transformers, Inductors, Saturable Reactors

△•Raytheon Mfg Co 5236 Santa Monica Blvd Los Angeles 29 Calif—C Martel—NO 5-4221 (p) Silicon & Germanium Transistors & Diodes, Silicon Rectifiers, Industrial Tubes (a) Reliability & Sub-miniature Tubes, Silicon Transistors, Diodes & Rectifiers

Rea Co J B 1723 Cloverfield Blvd Santa Monica Calif—Dr J B Rea—EX 3-7201 (p) Scientific Instruments

△Rea Magnet Wire Co Inc 2837 W Pico Blvd Los Angeles 6 Calif—F A Emmet

Red Point Corp 1907 Riverside Dr Glendale 1 Calif—R Caig—TH 2-4895 (p) Impregnating & Encapsulating Machinery, Vacuum Pumps & Systems

Reed & Reese Inc 717 N Lake Ave Pasadena Calif—Clark Reese—SY 4-1188 (p & a) DC PM Gearmotors, Potentiometers, Electromechanical Actuators

Reid Enterprises 2610 E 67th St Long Beach Calif—Don M Strum—NE 6-2239 (p & a) Special Moldings of Teflon

Reiter Co F 3340 Bonnie Hill Dr Hollywood Calif—F Reiter—HO 2-2913 (p) Magnetic Tape Splicer

△Remanco 128 Broadway Santa Monica Calif—L E Gillingham Jr

△Remler Co 2101 Bryant St San Francisco Calif—L E Gillingham Jr—VA 4-3435 (p) Marine Announce & Public Address Systems, Plastics for Electronics, Electronic Assemblies (a) Aircraft Announce & Intercom Amplifiers & Loudspeakers

•Repath Pacific Div Arnold Eng'g Co 641 E 61st St Los Angeles 1 Calif—W L Murphy—AD 3-7262 (p) Silicon & Nickel Laminations

Resdel Eng'g Corp 330 S Fair Oaks Ave Pasadena Calif—Marjorie Parker—SY 5-5197 (p) VHF & UHF Wideband Amplifiers & Receiver Multicouplers, X-Band Power Amplifiers (a) VHF-UHF Antenna Amplifiers, S-Band Beacon Transponders

Research Instruments Co 7962 S E Powell Blvd Portland 6 Ore—R C Gearhart—PR 5-2323 (p & a) Potentiometers

△Resin Formulators Inc 8956 National Blvd Los Angeles 34 Calif—H E Pendergast

•Resistoflex Corp Western Div 2919 Empire Ave Burbank Calif—G G Bell—VI 9-4651 (a) Fluoroflex-T, Fluoroflex-C, Teflon Hose, Pipes & Bellows

△•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 Amplifiers, Subminiature Voltage, Airborne DC to DC Converters

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

Richmont Inc 922 S Myrtle Ave Monrovia Calif—M M Lean—EL 9-2555 (p) Hand Torque Tools & Torque Testing Equipment

Riggs Nucleonics Corp 717 N Victory Blvd Burbank Calif—John E Markley Jr—VI 9-2481 (p) Monitoring Instruments & Monitoring Multiple Channel Systems

Rinco Inc 7962 S E Powell Blvd Portland 6 Ore—R C Gearhart—PR 5-2323 (p) Impedance Inductance-Capacitance Bridges, Decade Potentiometers & Theostats, Precision Potentiometers (a) Precision Potentiometers, Precision Resistors

△•Robertshaw-Fulton Controls Co Aeronautical Div Santa Ana Freeway At Euclid Ave Anaheim Calif—F W Weisel—KE 5-8151 (p & a) Switches, Crystal Ovens, Positive Indicators

Roesch Cable Div Hall-Scott Inc 2950 N Ontario St Burbank Calif—M O Rice—VI 9-3231 (p) DC Amplifier, Analog Computer & Time Delays (a) Missile System Components, Encapsulated Cables & Lamps

△Rosan Inc 2901 Coast Highway Newport Beach Calif—S M Conforti

△Rotest Labs Inc 2803 Los Flores Blvd Lynwood Calif—J R Duncan—NE 6-9238 (p & a) Environmental Testing Facilities

△RS Electronics Corp 435 Portage Ave Palo Alto Calif—Robert K F Scal—DA 3-9063 (p & a) Radar Receivers, Static Converters (p) IF & Distributed Amplifiers

Rue Products 1628 Venice Blvd Venice Calif—Jessie I Rue—EX 8-2241 (p) Electronic Test Equipment & Power Supplies, Automotive Electrical Parts, Epoxy Encapsulated Networks (a) Radar Scope Parts, Foamed Rubber, Epoxy Encapsulated Power Supplies

△Rutherford Electronics Co 8944 Lindblade St Culver City Calif—C E Rutherford—TE 0-4362 (p) Pulse Generators, Time Delay Generators

Ryan Aeronautical Co Electronics Div 5650 Kearney Mesa Rd San Diego Calif—O S Olds—BR 7-6450 (a) Automatic Navigators, Ground Speed Systems

S

△San Fernando Electric Mfg Co 1509 1st St San Fernando Calif—Lyle R Smith—EM 1-8681 (p & a) Capacitors, Filters, Precision Potentiometers

Sargent-Rayment Co 4926 E 12th St Oakland 1 Calif—W Rayment—KE 1-5277 (p) Hi Fi Am-FM Tuners & Amplifiers

•Satellite-Kennedy Inc of Calif 4109 El Camino Way Palo Alto Calif—F W Morris Jr—DA 6-8270 (p & a) Antenna Systems

Scala Radio Co 2814 19th St San Francisco 10 Calif—Bruno Zucconi—VA 6-2898 UHF & VHF Antennas, Oscilloscope Probes

Scantlin Electronics Inc 2215 Colby Ave Los Angeles 64 Calif—John R Scantlin—GR 8-8251 (p) Special Purpose Digital Computer Equipment

Schafer Custom Eng'g Paul 235 S 3rd St Burbank Calif—P C Schafer—TH 5-3561 (p) Remote Control Systems

Schindler's 2429 Beverly Ave Santa Monica Calif—Mark Schindler—EX 9-5942 (p) Intercommunication & Sound Systems, Tubeless Power Supplies, (a) Power Supplies, Special Test Equipment

Scientific Eng'g Lab 1510 6th St Berkeley 10 Calif—Alberta Polk Proteau—LA 6-2772 (p) High Vacuum Measurement Systems, High Vacuum Control Systems, High Sealing Equipment, (a) Altitude Simulators, Controlled Atmosphere Welding Systems, Vacuum Casting Apparatus

Scientific Instr Div Beckman Instr Inc 2500 Fullerton Rd Fullerton Calif Ben Warren Jr—OW 7-1771 (p) Spectrophotometers, pH Meters, Gas Chromatographs

Seeley Electronics 1060 S LaBrea Ave Los Angeles 19 Calif—Warren M Seeley—WE 3-1183 (p) Fixed Frequency Receivers

△Sequoia Wire & Cable Co 2201 Bay Rd Redwood City Calif—L Burt Avery—EM 9-0331 (p) Electronic, Aircraft and Communication Wire, Single and Multiconductor Cables, Coaxial Cables (a) Military Specification Wire & Cable, Cable Assemblies & Systems, High Temperature Insulations

△•Servomechanisms Inc 12500 Aviation Blvd Hawthorne Calif—Ronald J Gray—OR 8-7841 (a) Air Data & True Airspeed Computers, Missile Checkout Equipment

Servonic Instru Inc 640 Terminal Way Costa Mesa Calif—Patrick S Chase—MI 6-2427 (p & a) Pressure Transducers, Rectilinear Potentiometers, Slip Rings

Shamban & Co W S 11617 W Jefferson Blvd Culver City Calif—Carl Wolff—TE 0-6877 (p & a) Teflon Spaghetti & Tape

Shand & Jurs Co 2600 8th St Berkeley 10 Calif—Eugene E Jurs—AS 3-2345 (p) Telemetering Equip, Motors & Valves (Control & Monitor), Alarm Systems for Tank Gages

Shannon Luminous Materials Co 7356 Santa Monica Blvd Hollywood 46 Calif—T Hook—HO 7-5509 (p) Electroflor Indicator Cells, Fluorescent Cements & Bonding Compounds (a) Black Light Lamps

Shrader Co F W 11623 S Broadway Los Angeles 61 Calif—G Shester—PL 6-9166 (p) Electro & Permanent Magnets, Rectifiers

△•Sierra Electronic Corp 3885 Bohannon Dr Menlo Park Calif—C A Walter—DA 6-2060 (p) Test Equipment for Carrier Frequency Applications & Power Measurements & Monitoring, Coaxial Terminations & Water Loads (a) Directional Couplers, Average & Peak-Reading Wattmeters, Low Pass Filters

Skyway Precision Tool Co 825 E Broadway San Gabriel Calif—George C Jenkin—CU 3-4181 (p & a) Torque Testers & Vacuum Test Chambers

△Slideways Mfg Co 8075 Woodley Ave Van Nuys Calif—Milton Goldman—ST 2-3393 (p & a) Attenuators, Ball Bearing Chassis Slides, Laboratory DC Power Supplies

Slip Ring Co of America 3612 W Jefferson Blvd Los Angeles 16 Calif—Robert A Felburg—RE 5-0253 (p) Right Angle Tube Sockets, Miniature Lead Forms, Slip Rings, Brushes, Commutators & HiSpeed Switches, (a) Slip Rings & Brush Accessories, Commutators & HiSpeed Switches, Plastic Molded Parts

Smith Mfg Co Nathan R 105 Pasadena Ave S Pasadena Calif—N R Smith CL 5-5141 (p) Coils, Laminations, Solenoids, Transformers

Soderberg Mfg Co Inc 628 S Palm Ave Alhambra Calif—M Stone—CU 3-4063 (p & a) Aircraft Lighting, Landing Gear Control Panels, Marine Lighting

Solar Aircraft Co 1901 Bell Ave Des Moines 5 Iowa—John C Marousek—AT 8-6521 (a) Duplicate Power Units

Solar Manufacturing Corp 4553 Seville Ave Los Angeles 58 Calif— D D Peck—LU 3-1411 (p & a) Ceramic Capacitors, Solarsonic Barium Titanate Transducers

△Southern Electronics Corp 150 W Cypress Ave Burbank Calif—G E Gansell—VI 9-3193 (p & a) Capacitors

Specific Electronics Inc 1995 N Fair Oaks Ave Pasadena Calif—F W Stark Jr—SY 4-0793 (p) Printed Circuits (a) Power Supplies

△Spectrol Electronics Corp 1704 S Del Mar Ave San Gabriel Calif—R C Stetson—AT 7-9761 (p) Linear & Non Linear Precision Potentiometers, In-line Mechanisms, Linearity Testers (a) Special Precision Potentiometers and In-line Mechanisms

△•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

Square D Co Western Div 4335 Valley Blvd Los Angeles 54 Calif—H H Zimmerman—CA 1-1171 (p & a) Circuit Breakers, Control Equipment

Stancil-Hoffman Corp 921 N Highland Ave Hollywood 38 Calif—William V Stancil—HO 4-7461 (p) Tape Recorder, Synchronous Magnetic Film Recorders, Single and Multi-channel Magnetic Recorders (a) Airborne Magnetic Recorders, Airborne Magnetic Playback Units

Standard Record Mfg Co 70 N San Gabriel Blvd Pasadena Calif—Frances Hoffman—RY 1-0573 (p) Solid Die Cast Aluminum Hubs, Precision Hubs, Standard Reels & Flanges (a) Semi-Precision Aluminum Reels, Precision Reels

Stanford Research Institute Engineering Div Menlo Park Calif—Wm G McGuigan—DA 3-9051 (p & a) Antennas & Antennas Systems

△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

Stoddart Aircraft Radio Co Inc 6644 Santa Monica Blvd Hollywood 38 Calif—H J Jarvis—HO 4-9292 (p & a) Radio Interference-Field Intensity Meters, UHF Attenuators

SPS Western 2701 S Harbor Blvd Santa Ana Calif—R Beahrling—KI 5-3911 (a) Screws & Bolts (Special Headed Prods), Self-Locking Nuts, Bolt & Nut Retainers

Stewart Eng'g Co P O Box 277 Soquel Calif—R F Stewart—GR 5-4790 (p) Vacuum Tubes, High-Temperature Controlled Atmosphere Furnaces

•Stratham Labs Inc 12401 W Olympic Blvd Los Angeles Calif—Lois D Jackson—BR 2-0371 (p & a) Pressure Transducers, Accelerometers, Load Cells

VA-1402 PERMANENT MAGNET

VA-1402 POWER SUPPLY

Used where clean high vacuums are required ... processing vacuum tubes ... evacuating accelerator sections and ionization chambers ... laboratory and industrial applications.

SIMPLICITY ITSELF—
The VacIon high vacuum pump operates entirely electronically – no moving parts.

NO OIL VAPORS—
Cold traps or vapor traps are not necessary.

ULTRA HIGH VACUUM—
Creates vacuum in excess of 1×10^{-9} mm of Hg; one trillionth of an atmosphere. This small compact unit has a pumping speed of 10 liters/second at 10^{-7} mm of Hg.

LOW POWER CONSUMPTION—
At 10^{-6} mm Hg power consumption is only 0.24 watts. No continuously running fore-pump is required.

MEASURES ITS OWN VACUUM—
The current indication on the power supply meter provides a practical measurement of pressure.

SIMPLE INSTALLATION—
Complete unit consists of the VacIon Pump shown above, a permanent magnet, and a power supply.

ONLY FROM VARIAN—
The VacIon high vacuum pump has no equal for simplicity, cleanliness, and compactness. Get the complete story in the VacIon High Vacuum Pump Engineering Bulletin — write for your copy today.

LONG LIFE— Operating life in excess of 10,000 hours at 10^{-6} mm of Hg has been obtained. Life expectancy is almost limitless at 10^{-9} mm of Hg.

THE MARK OF LEADERSHIP

VARIAN associates
TUBE DIVISION
PALO ALTO, CALIFORNIA

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

Represented by NEELY ENTERPRISES in California, Arizona, Nevada & New Mexico

Circle 7 on Inquiry Card, page 97

1958 Directory of Western Electronic Manufacturers

Stromberg-Carlson 1895 Hancock St San Diego 12 Calif—Gordon L Johnson—CY 8-8331 (p) Display Systems, High-Speed Computer Readout Equipment, Beam Tubes (a) Beacon Simulators, Damper Amplifiers

Summit Electronic Products 14706 Arminta St Van Nuys Calif—R Ball—ST 5-1581 (a) Magnetic Amplifiers

•Sunnyvale Development Center Sperry Gyroscope Co 294 Commerical St Sunnyvale Calif—A L Mayer—RE 9-2344 (p & a) Accelerometers, Analog Computers

Surco Electronics Corp 9530 W Jefferson Blvd Culver City Calif—Lee Cowan—TE 0-7355 (p) Cathode Ray Tubes

Sylvania Electric Products Inc 1401 E Orangethorpe Ave Fullerton Calif—LA 5-8211 (p) Attenuators, Solenoids, Klystron & Amplifier Tubes

△•Sylvania Electric Products Inc Electronic Systems Div 820 Favian Way S Palo Alto Calif—Samuel A Ferguson—YO 8-0051 (p & a) Complete Electronic Systems, Klystron Tubes

△Sylvania Electric Products Inc 6505 E Gayhart St Los Angeles 54 Calif—Marion Chetty—RA 3-5371 (p & a) Communication Systems

Symphony Electronics Corp 925 S Western Ave Los Angeles 6 Calif—Samuel Solat—RE 4-1173 (p) Resistors Carbon, Television Accessories, Electronic Components

△Systron Corp 950 Galindo St Concord Calif—James R Cunningham—MU 2-3650 (p) Electronic In-Line Counters, Frequency to DC Converters, True RMS Converters (a) Mil-Spec Counters, Data Processing Systems

T

△Tally Register Corp 5300 14th Ave N W Seattle 7 Wash—M Ray Dilling (p & a) Digital Computers

Ta-Mar Inc 2379 Cotner Ave Los Angeles 64 Calif—V Landis Jr—GR 8-1258 (p) Radio Remote Controls (a) Right Angle Adapters, Waveguide to Coaxial Adapters, Cable Connectors

△TA Mfg Corp 4607 Alger St Los Angeles 39 Calif—F R Betacourt—CH 5-5767 (p & a) Wire Harness Clamps, Instrument Cases

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 Cutters & Strippers, Circuit Board Fixtures

Technical Electronics Corp 4060 Ince Blvd Culver City Calif—R A Yarcho—TE 0-5461 (p) Electronic Timers, Electronic Test Equipment, Hysteresis Motors

△Technical Oil Tool Corp 1057 N La Brea Ave Los Angeles Calif—H H Peters (p & a) Accelerometers, Amplifiers

Technical Products Co Instrument Div 6670 Lexington Ave Los Angeles 38 Calif—E R Chicott—HO 4-8121 (p) Measuring Instruments, Recording Equipment, General Machine Work

△Tektronix Inc 9540 S W Barnes Rd P O Box 831 Portland 7 Ore—C D Gasser—CY 2-2611 (p) Cathode-Ray Oscilloscopes, Auxiliary Electronic Instruments

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 Equipment, Machine Tool Control Equipment

Telemeter Magnetics Inc 2245 Pontius Ave Los Angeles 64 Calif—T C Taylor—GR 7-4211 (p) Magnetic Core, Memories & Shift Registers, Digital Data Handling Systems

Tevco Insulated Wire 108-E Prospect Ave Burbank Calif—Murray Wald—VI 9-5574 (p) Special Antennas

△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 (n) Transformers, Assemblies, Switches

Thermo Materials Inc 4040 Campbell Ave Menlo Park Calif—Emo D Porro—DA 6-2780 (p) Ferrites, Industrial Ceramics (a) Ceramic-to-Metal Assemblies

△Topatron Inc 942 E Ojai Ave Ojai Calif—S E Brown—MI 6-1600 (p) Electronic Test Consoles

Topp Industries Inc 5255 W 102nd St Los Angeles 45 Calif—R F Gibeaer—OR 8-0451 (p) Airborne Transceivers & Communications Equipment (a) Air Data Computers, Machine Schedulers-Control Systems, Potentiometers

Tracerlab Inc 2030 Wright Ave Richmond Calif (p) Equipment

Transco Products Inc 12210 Nebraska Ave Los Angeles 25 Calif—S Petron—BR 2-5687 (p) Coaxial Switches, Antennas, Microwave Components (a) Pneumatic & Liquid Valves, Electro-Mechanical Equipment

Trans Electronics Inc 7349 Canoga Ave Canoga Park Calif—William J. Miller—DI 0-3334 (p & a) Power Supplies (p) Transistor Testers, Diode Testers

△Transformer Eng'g 285 N Halstead Ave Pasadena Calif—J M Gallagher—RY 1-6906 (p & a) Transformers, Reactors-Chokes, Filters

Transonic Inc 808 16th St Bakersfield Calif—C P Cushway—FA 7-5701 (p & a) Transformers, Magnetic Amplifiers, Filters & Toroids

Trans-Tel Corp 910 N Orange Dr Los Angeles 38 Calif—Samuel H Weissman—HO 2-7304 (p) Radio Intercoms, Hi-Fi Equipment

Transval 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—L W Howard—EX 7-2145 (p & a) Electronic Transformers

Tri-Dex Co P O Box 1207 Lindsay Calif—K B Howard—LI 2-4051 (a) Terminal Boards, Coils, Assemblies & Harnesses

Tri-Ex Tower Corp 127 E Inyo St Tulare Calif—Louis V Trestao—MU 6-3411 (p) Microwave Tower Reflectors & Systems, Communications Equipment, Mobil Communications

△•Triplett Electrical Inst Corp P O Box 687 Oceanside Calif—W R Triplett—AS 2-9779 (p) Indication Instruments

Tripl-T Electronics Co Box 5352 Pasadena Calif—Eric G Laue—AT 6-3689 (p) Transistorized Plug-In Pulse Circuits & Plant Cell Analyzers

Trutone Electronics Inc 6912 Santa Monica Blvd Hollywood 38 Calif—E Norman Skolnik—HO 4-8118 (p & a) Amplifiers (audio, I-F, power)

△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

Ultraudio Products Div Oberline Inc P O Box 921 Beverly Hills Calif—Oliver Berliner—CR 6-2726 (p) Professional Audio Products

Ultra-Violet Products Inc 5114 Walnut Grove Ave San Gabriel Calif—H G Porter—CU 3-3193 (p) Ultra-Violet Light Sources, Fluorescent Dyes, Additives & Chemicals (a) Special Ultra-Violet Light Sources

Ultronix Inc 116 S Bayshore Blvd San Mateo Calif—David Persen—DI 3-4700 (p & a) Encapsulated Precision Wire Wound Resistors, Sub-Miniature Trimming Potentiometers

△U M & F Mfg Corp 10929 Vanowen St N Hollywood Calif—N R Younger—ST 7-5526 (p) Breadboards

△Ungar Electric Tools Inc 4101 Redwood Ave Los Angeles 66 Calif—William C Nehrenz—EX 8-5718 (p) Soldering Irons

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

△U S Electronics Development Corp 3540 W Osborn Rd Phoenix Ariz—R A Sherman—AP 8-5591 (p) Diodes, Capacitors, Electrostatic Capacitors (a) Infrared Devices, Electrostatic 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 Plastic Rope Inc 2581 Spring St Redwood City Calif—J G Allin—EM 8-1461 (p) Ropes & Cable

•U S Radium Corp 5420 Vineland N Hollywood Calif—W C Doran—ST 7-0247 (p) Phosphors, Isotope Activated Light Sources, Edge Lighted Panels & Dials (a) Electroluminescent Panels & Dials, Isotope Activated Light Sources, Phosphors

U S Relay Co 717 N Coney Ave Azusa Calif—Lyle D Bunce—ED 4-8206 (p & a) Relays, Solenoids

•U S Testing Co Inc 1723 S Maple Ave Los Angeles Calif—E L Fish—RI 7-9264 (p) Antennas (special)

United Transformer Corp Pacific Div 4008 W Jefferson Blvd Los Angeles Calif—H C Hornichel—RE 1-6313 (p) Variable Autotransformers, Isolation Transformers (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

V

△Vacuum Tube Products Co Inc 2020 Short St Oceanside Calif—J J Sutherland—SA 2-7648 (p) High Vacuum Rectifiers, Vacuum Gauge Tubes, Special Cathode Ray Tubes (a) Resistance Welders, Timers

Valor Electronics Inc 13214 Crenshaw Blvd Gardena Calif—H E Schauwecker—DA 3-6160 (p) Pulse Transformers, Delay Lines, Transistor Checkers (a) Transistor Power Supplies, Delay Lines

Vanguard Electronics Co 3384 Motor Ave Los Angeles 34 Calif—Simon A Golbert—TE 0-7344 (p & a) R-F & E-F Chokes

△Varian Associates 611 Hansen Way Palo Alto Calif—Chandler Murphy—DA 6-4000 (p) Klystrons, Wave Tubes, High Vacuum Pumps (a) Microwave Tubes

△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

Vicon Corp 1369 Industrial Rd San Carlos Calif—Harrison Johnson—LY 3-8003 (p) Closed Circuit Television, Cameras, Controls & Monitors (a) C C Television Systems

Video Instruments Co Inc 3002 Pennsylvenia Ave Santa Monica Calif—Petter Pohl—EX 3-1244 (p & a) Audio Amplifiers, D-C Amplifiers

△Viking Industries Inc 21343 Roscoe Blvd Canoga Park Calif—Dan Derby—DI 7-8500 (p & a) Miniature Electrical Connectors, Printed Circuit Receptacles

Vought Co 8907 Melrose Ave Los Angeles 46 Calif—A D Fraser—CR 6-2621 (p & a) Photographic Recorders, Viewers, Test Equipment

W

Waco Inc 2032 Bdwy Santa Monica Calif—R M Frazer—TE0-7841 (p & a) Instrument Motors, Rotary Solenoids, Linear Solenoids

Wagner Co H A 14707 Keswick St Van Nuys Calif—Dr Georg Knausenberger—ST 6-1090 (p & a) D-C Amplifiers, Differential Amplifiers

△Walkirt Co 141 W Hazel St Inglewood Calif—W L Kirchoff—OR 8-4814 (p) Plug-In Circuitry

△•Walsco Electronics Mfg Co 3225 Exposition Pl Los Angeles 18 Calif—W L Schott—AC 3-7201 (p) Electronic Hardware, Tools, Electronic Specialty & Service Aids

Watkins-Johnson Co 3333 Hillview Ave Palo Alto Calif—D A Watkins—DA 6-8830 (p & a) Traveling-Wave Tubes, Backward-Wave Oscillators

Waugh Eng'g Co 7842 Burnet Ave Van Nuys Calif—Henry S Straus—ST 3-1055 (p) Turbine Flowmeters, Frequency-to-Voltage Converters, Transient Flow Measuring Systems (a) Overspeed Trip-Rotating Devices, Flow Recorders, Flow Totalizers

△Wave Particle Corp 876 Kaynyne St Redwood City Calif—W S Geisler Jr—EM 8-1579 (p) Backward Wave Oscillar Signal Generator, Traveling Wave Tube Amplifier, Power Supply

Waveguide Inc 14837 Oxnard St Van Nuys Calif—A R Theal—ST 3-1527 (p) Microwave Components, Electronic Devices (a) Waveguide Plumbing, Microwave Switches, Antennas

Webster Mfg Co Inc 242 Shoreline Hwy Mill Valley Calif—G B Levine—DU 8-6775 (p) Marine & Mobile Radiotelephone Antennas

△Weldmatic Div Unitek Corp 380 N Halstead Ave Pasadena Calif—G E Woods—RY 1-6761 (p) Precision Stored Energy Welders

West Coast Electrical Mfg Corp 233 W 116th Pl Los Angeles 61 Calif—R W Worthington—PL 5-1138 (p) Aircraft & Industrial Solenoids

Western Coil Products Co 969 Commercial St Palo Alto Calif—E L Peterson—DA 5-2718 (p) Coils, Chokes, Solenoid Coils

•Western Electro Acoustic Lab Inc 11789 San Vicente Blvd Los Angeles 49 Calif—Adrienne Brodsky—GR 7-9441 (p & a) Condenser Microphone Complement, Octave Band Filter Sets, Thermal Noise Source

△Western Gear Corp 2600 E Imperial Hwy Lynwood Calif—G W Malme—NE 6-0911 (p) Miniature Rotary Electrical Equipment, Power Supplies, Servo Motors (a) Complete Systems (control), Special Machinery

Western Gold & Platinum Co 525 Harbor Blvd Belmont Calif—Harry Mason—LY 3-3121 (p) Metal Parts (precious)

Western Radiation Lab 1107 W 24th St Los Angeles 7 Calif—Gordon L Locher—RI 7-8355 (p) Nucleonic Instruments, Radioisotopes, Special Electron Tubes

△•Westinghouse Electric Corp 3627 Holdrege Los Angeles 16 Calif—E A Helbig—TE 0-7491 (a) Specialty Transformers

△Westline Products Div Western Lithograph Co 600 E 2nd St Los Angeles 54 Calif—Ben Birken—MA 7-2641 (p & a) Wire Markers, Sleeve & Tube Marking Service (p) Miniature Wire Markers (a) Special Wire Markers

Westport Electric 149 Lomita St El Segundo Calif—F M Hoefler—OR 8-9993 (p) Frequency Meters & Counters, Time Interval Meter & Preset Counter, Hi-Speed Stroboscope

△Wiancko Eng'g Co 255 Halstead St Pasadena Calif—F M Cicenchell—EL 5-7186 (p & a) Pickups, Carrier Equipment, Data Systems

Wiggins Oil Tool Co Inc E B 3424 E Olympic Blvd Los Angeles 23 Calif—Robert A Wolfe—AN 9-0181 (p & a) Quick Connect Adaptors (p) Breaksman Electricals, Solenoid Operated Connectors

Williams Ship-Radio Co 4366 Mentone St San Diego 7 Calif—R R Williams—AC 3-3097 (p) Marine Radio Transmitters

Wirco Electronics Inc 11680 McBean Dr El Monte Calif—V A Werth—GI 3-1433 (p & a) Coil Winding, Encapsulation, Electronic Assemblies

•Wolfe Co Franklin Co 10567 Jefferson Blvd Culver City Calif—Rance MacFarland—TE 0-4618 (p & a) Hermetic Seals

△Wyco Metal Products 6918 Beck Ave N Hollywood Calif—T Wain—ST 7-5579 (p) Cabinet Relay Racks, Chassis, Metal Housings

Z

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


you can get the best earth instruments from NEELYLAND
HEWLETT-PACKARD COMPANY
Palo Alto, California
VARIAN ASSOCIATES
Palo Alto, California
esi
ELECTRO-MEASUREMENTS, INC.
Portland, Oregon
KIN TEL
KIN TEL
San Diego, California
SANBORN COMPANY
Waltham, Massachusetts
DYMEC, INC.
Palo Alto, California
Of course you know Neelyland covers California, Arizona, Nevada and New Mexico . . . and the earth people living there are among the happiest in the Solar system. Particularly those lucky engineers who get to work with those fantastic instruments produced by the best known electronic companies on the whole Planet.
Earth men know . . . you can depend on Neely Enterprises for complete service.
25
NEELY ENTERPRISES
electronic manufacturer's representatives
NORTH HOLLYWOOD OFFICE
3939 Lankershim Blvd.
Phone: STanley 7-0721
SAN CARLOS OFFICE
501 Laurel Street
Phone: LY 1-2626
TWX: San Carlos
SACRAMENTO OFFICE
1317 Fifteenth St
SAN DIEGO OFFICE
ALBUQUERQUE OFFICE
107 Washington St., S.E.
Phone: AL 5-5586
TWX: AQ 172
LAS CRUCES OFFICE
126 S. Water St.
OFFICE
641 E. Missouri Ave
TUCSON OFFICE
232 S. Tucson Blvd.

New Tech Data for Engineers

Precision Cast Components

Airtron, Inc., 1096 W. Elizabeth Ave., Linden, N. J., has available a 2-color, 4-page bulletin which describes their precision cast components and foundry techniques.

Circle 161 on Inquiry Card, page 97

Products & Facilities

Electronic products for military and commercial use, as well as research, testing and production facilities are described in a new 28-page brochure now available from the Electronics Div. of Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio. Included are descriptions of electronic control subsystems and components, radio frequency products, microwave components and accessories and military television.

Circle 162 on Inquiry Card, page 97

Thermistor Catalog

Fifteen different thermistor circuits are described in Fenwal Electronics Inc., Mellen St., Framingham, Mass. new catalog, EMC-2. The 16-page, 2-color brochure also gives specifications for nearly 400 different thermistors, including assemblies, matched pairs, beads, discs, washers, rods, and probes.

Circle 163 on Inquiry Card, page 97

Components

Richards Electrocraft, Inc., 4432 N. Kedzie Ave., Chicago, Ill. has just issued a new 12-page bulletin giving complete information on their line of jacks, plugs, switches and connectors. All parts are illustrated and line drawings show complete construction details. Tables list sizes and types available.

Circle 164 on Inquiry Card, page 97

Instrumentation Equipment

Short Form Catalog 1-58 describes telemetering equipment, recording systems, test equipment and data processing equipment designed and built to exacting specifications. The equipment is completely described. Radiation Inc., P. O. Box 37, Melbourne, Fla.

Circle 165 on Inquiry Card, page 97

Racks & Cabinets

Par-Metal Products Corp., 32-62 49th St., Long Island City 3, N. Y. has just issued a 28-page, 2-color booklet which describes their complete line of relay racks, cabinets, panels and other accessories. The catalog is complete with photographs and specifications.

Circle 166 on Inquiry Card, page 97

Environmental Equipment

A 12-page, 2-color booklet has been issued by Cincinnati Sub-Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio, which describes in complete detail the various equipments available for environmental testing.

Circle 167 on Inquiry Card, page 97

Resin Coatings

The Isochem Resins Corp., 221 Oak St., Providence 9, R. I. has released 2 technical bulletins which describe their new dip coatings that are geared specifically to meet the present demands of the electronics industry.

Circle 168 on Inquiry Card, page 97

Laminates

Northern Plastics Corp., La Crosse, Wisc. has just issued a 4-page, 2-color brochure which describes their printed circuits, copper-clad laminates, base laminates and fabricated parts. Complete technical information is included.

Circle 169 on Inquiry Card, page 97

Clutches & Brakes

Catalog 957A is available from Autotronics, Inc., Florissant, Mo., describes their complete line of subminiature electro-magnetic clutches and brakes. The 28-page, 2-color booklet contains drawings, photographs, graphs, tables and complete electrical and mechanical specifications.

Circle 170 on Inquiry Card, page 97

Frequency Standards

Ernst Norrman Laboratories, Williams Bay, Wisc., has issued a 4-page, 2-color brochure which describes their Model 111 Frequency-Time Standard. Brochure is complete with photographs, technical information, and electrical and mechanical specifications.

Circle 171 on Inquiry Card, page 97

Pilot Lights

A new digest consists of 16 pages of condensed technical information on a wide range of Dialco pilot light assemblies and the appropriate lamp types housed therein. All units are illustrated life-sized. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y.

Circle 172 on Inquiry Card, page 97

Switching Reactors

Control, a div. of Magnetics, Inc., Butler, Pa. has just issued a 16-page catalog on the company's complete line of standard switching reactors for one-step, low-cost static control.

Circle 173 on Inquiry Card, page 97

Avionic Mountings

A new 8-page product bulletin describes a series of mountings available from Lord Mfg. Co., 1635 W. 12th St., Erie, Pa. These mountings are designed primarily to protect airborne electronic equipment against shock and vibration in the temperature range from −65° to +300°F. Bulletin No. 301 contains complete information on design, advantages and performance.

Circle 174 on Inquiry Card, page 97

Industrial Tubes

A new 20-page booklet, entitled "Easy-Guide for Reliatron Tubes, Industrial and Special Purpose Types" is now available from the Westinghouse Electric Corp., Box 284, Elmira, N. Y. This new edition includes sections on camera tubes, radiation detection tubes and the microwave devices now cover magnetrons. Brief data is provided in convenient form.

Circle 175 on Inquiry Card, page 97

Plastics

Synthane Corp., Oaks, Pa. has issued a new 2-color, 28-page technical plastics brochure that describes its full line in detail, including properties, characteristics and government specifications. Drawings, illustrations, text and charts give complete information on the sheets, rods, tubes, and fabricated parts produced.

Circle 176 on Inquiry Card, page 97

Ultrasonic Cleaners

The Narda Ultrasonics Corp., 160 Herricks Rd., Mineola, L. I., N. Y. has just issued a new data sheet which describes their 1500 series ultrasonic cleaners. Complete information is given.

Circle 177 on Inquiry Card, page 97

Magnetic Regulators

A new 4-page illustrated brochure available from Sorensen & Co., Inc., Richards Ave., So. Norwalk, Conn. furnishes complete technical data on their MVR magnetic voltage regulators and serves as a technical manual. It covers detailed product description, principles of operation, operating instructions, and maintenance.

Circle 178 on Inquiry Card, page 97

Microwave Tubes

Bomac Laboratories, Inc., Beverly, Mass., has released a new 6-page folder which gives a partial listing of their tubes and components. Specifications are given in an easy-to-follow tabular form.

Circle 179 on Inquiry Card, page 97

(*Continued on page* 119)

ANNOUNCING...

the newest addition to the Delco family of PNP germanium transistors! It's ideally suited for high-speed switching circuits and should find wide use in regulated power supplies, square wave oscillators, servo amplifiers, and core-driver circuits of high-speed computers. It's the 2N553!

NEW HIGH-FREQUENCY POWER TRANSISTOR BY DELCO

No other transistor offers so desirable a combination of characteristics for applications requiring reliability and consistency of parameters.

TYPICAL CHARACTERISTICS T = 25°C unless otherwise specified

Collector diode voltage V_{CB} ($V_{EB} = -1.5$ volts)	80 volts maximum
Emitter diode voltage V_{EB} ($V_{CB} = -1.5$ volts)	40 volts maximum
Collector current	4 amps. maximum
Base Current	1 amp. maximum
Maximum junction temperature	95°C
Minimum junction temperature	−65°C
Collector diode current I_{CO} (V_{CB} = 2 volts)	12 μa
Collector diode current I_{CO} (V_{CB} = −60 volts)	0.5 ma
Collector diode current I_{CO} (V_{CB} = −30 volts, 75°C)	0.5 ma
Current gain (V_{CE} = −2 volts, I_C = 0.5 amp.)	55
Current gain (V_{CE} = 2 volts, I_C = 2 amps.)	25
Saturation voltage V_{EC} (I_B = 220 ma, I_C = 3 amps.)	0.3
Common emitter current amplification cutoff frequency (I_C = 2 amps. V_{EC} = 12 volts)	25 kc
Thermal resistance (junction to mounting base)	1° C/watt

BRANCH OFFICES

Newark, New Jersey
1180 Raymond Boulevard
Tel: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel: Exbrook 3-1465

DELCO RADIO Division of General Motors
Kokomo, Indiana

 Circle 70 on Inquiry Card, page 97

New Tech Data for Engineers

Polyester Tapes

A new 4-page brochure is intended to aid designers in selecting polyester tapes. It lists physical and electrical properties of Scotch brand polyester tapes, as well as the military specifications met by the tapes. Physical and electrical data are listed in a cross-reference chart complete with recommended temperatures for curing thermosetting adhesives. Minnesota Mining & Mfg. Co., 900 Bush St., St. Paul 6, Minn.

Circle 180 on Inquiry Card, page 97

Deflection Systems

A full line of precision deflection systems, and components designed for ITV and broadcast cameras and other cathode ray tube applications are described and illustrated in a 6-page brochure just issued by Industrial & Audio Products Dept., Radio Corp. of America, Camden, N. J.

Circle 181 on Inquiry Card, page 97

Instruments & Systems

Panoramic Radio Products, Inc., 514 So. Fulton Ave., Mt. Vernon, N. Y. has just issued a new catalog digest of their complete line of electronic instruments for measurement and analysis.

Circle 182 on Inquiry Card, page 97

Automatic Regulators

Tubeless magnetic automatic voltage regulators are the subject of a 12-page, 2-color brochure issued by The Superior Electric Co., Dept. TBM, Bristol, Conn. Booklet contains photographs, outline drawings, electrical and mechanical specifications.

Circle 183 on Inquiry Card, page 97

Decade Counter Tubes

An 8-page, 2-color booklet has been issued by the Sylvania Electric Products Inc., Special Tube Operations, 1891 E. 3 St., Williamsport, Pa. entitled "Decade Counter Tubes." The booklet contains revised circuits and the latest technical information on these tubes.

Circle 184 on Inquiry Card, page 97

Laminates

A 4-page bulletin describing G-E Textolite, 11574, a new self-extinguishing, paper-base epoxy laminate with electrical, mechanical, and machining properties superior to the best NEMA XXXP paper-base laminates. It features information on applications and machineability, as well as complete technical data. General Electric Co., Coshocton, Ohio.

Circle 185 on Inquiry Card, page 97

Ultrasonic Delay Lines

A 4-page data bulletin outlining performance characteristics and design considerations for ultrasonic delay lines is available from Bliley Electric Co., Union Station Bldg., Erie, Pa. Covered are such subjects as delay medium material, transducers, bonding medium, casing and packaging.

Circle 186 on Inquiry Card, page 97

Vacuum Ceramics

Vacuum Ceramics, Inc., Cary, Ill. have just issued a new catalog which describes glass-to-metal seal (Headers). Complete information is included.

Circle 187 on Inquiry Card, page 97

Precision Resistors

Chicago Telephone Supply Corp., Elkhart, Ind. has just issued a technical bulletin which gives new detail comparative data reports showing their bobbinless precision wire fixed resistors far exceed proposed MIL-R-93B. It also describes and illustrates these resistors.

Circle 188 on Inquiry Card, page 97

Copper-Clad Laminates

A new bulletin titled "A Better Foundation for Printed Circuitry" is available from National Vulcanized Fibre Co., 1058 Beach St., Wilmington 99, Del. This 6-page, 2-color brochure describes their line of copper-clad Phenolite with charts and illustrates 11 grades of material.

Circle 189 on Inquiry Card, page 97

Switching Circuits

"High Speed Zener Switching Circuits" an application bulletin giving detailed information on high speed electronic switching necessary for missile computers, ground control computers and industrial computers has been published by the Hoffman Electronics Corp. Semiconductor Div., 930 Pitner Ave., Evanston, Ill. The 2-color, 4-page bulletin contains photographs, schematics and technical information.

Circle 190 on Inquiry Card, page 97

Microwave Test Equipment

F-R Machine Works, Inc., 26-12 Borough Place, Woodside 77, N. Y. has just issued a new short form catalog which contains information on microwave and electronic test equipment, custom modulators, and microwave training kits.

Circle 191 on Inquiry Card, page 97

Magnets

Catalog No. PR-19, describing stock permanent magnets, magnetizers and demagnetizers, has just been released by The Indiana Steel Products Co., Valparaiso, Ind.

Circle 192 on Inquiry Card, page 97

Bimetal Thermostats

Stevens Mfg. Co., Inc., P. O. Box 1007, Mansfield, Ohio, has just issued a new technical bulletin describing their line of Stemco Type S bimetal thermostats designed for use in appliances or for industrial applications. Complete technical information is given along with photographs and drawings.

Circle 193 on Inquiry Card, page 97

Power Tubes

The Vacuum Tube Dept., IT&T Components Div., P. O. Box 412, Clifton, N. J. has just issued 2 brochures about power tubes. The first is a 12-page, 2-color brochure which describes in complete detail their line of power tubes. The second brochure contains the price list for these tubes and also credit allowances for old tubes.

Circle 194 on Inquiry Card, page 97

Indicators

"Indicators for Data Display Storage and Transfer" is a 12-page, 2-color brochure issued by Union Switch & Signal, Pittsburgh 18, Pa. which describes in detail these indicators and their operation. Technical and electrical information is given along with photographs and schematics.

Circle 195 on Inquiry Card, page 97

Portable Potentiometer

A 6-page, 2-color bulletin issued by Technique Assoc., Inc., Indianapolis, Ind. describes their Thermotest I which is a portable potentiometer-pyrometer. Complete information is included along with photographs.

Circle 196 on Inquiry Card, page 97

Maintenance Hints

A new booklet on practical maintenance approach to industrial electronic equipment problems is offered by National Electronics, Inc., Geneva, Ill. Booklet gives maintenance hints for equipments using ignitrons, thyratrons, and gas filled rectifiers. Many practical suggestions as to the solution to the maintenance problems on industrial electronic equipments are covered in a practical sense in this booklet.

Circle 197 on Inquiry Card, page 97

Latest Western Literature for Engineers

Power Supplies

Short Form Catalog C-57 issued by the John Fluke Mfg. Co., Inc., 1111 W. Nickerson St., Seattle 99, Wash., describes in detail their VAW meters, power supplies, precision potentiometric dc voltmeters, and true RMS vacuum tube voltmeters.

Circle 198 on Inquiry Card, page 97

Slip Rings

A 2-color, 4-page brochure issued by the Slip Ring Co. of America, 3612 W. Jefferson Blvd., Los Angeles 16, Calif., contains information on the company's line of slip rings, brushes, and commutators of all sizes.

Circle 199 on Inquiry Card, page 97

Test Equipment

Sierra Electronic Corp., 3885 Bohannon Drive, Menlo Park, Calif., has just issued a set of technical bulletins describing their products such as frequency-selective voltmeters, wave analyzers, fault analyzers, calorimeters, calibrated RF loads, and termination wattmeters along with the various accessories available. Complete information is contained in these bulletins.

Circle 200 on Inquiry Card, page 97

Potentiometers

A 12-page, 2-color condensed components catalog describes in detail precision potentiometers and pressure transducers and accelerometers which are available from Fairchild Controls Corp., 6111 E. Washington Blvd., Los Angeles, Calif. Catalog contains photographs and technical information in easy-to-follow tabular form.

Circle 201 on Inquiry Card, page 97

Magazine Subscription

"Data from ElectroData" is a bimonthly, 8-page, 2-color house magazine published by the ElectroData Div. of Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif., which is available free. Publication is of interest to any one in the computer field.

Circle 202 on Inquiry Card, page 97

Avionic Power Supplies

Bulletin 3000.1 is a 4-page, 2-color brochure issued by the American Electronics, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif., which describes their 400 cycle and dc power supplies, magnetic amplifiers, electrical and air conditioner ground support equipment for avionics and industry.

Circle 203 on Inquiry Card, page 97

Cable Caliper

Zippertubing Co., 752 S. San Pedro St., Los Angeles 14, Calif., has just made available a handy plastic cable caliper. The caliper provides an easy method for measuring wire bundles in order to determine both the actual diameter of the cable and the zippertubing size which will insure a tight fitting, neat appearing cable jacket. It is also handy for measuring such things as hose and pipe up to two inches in diameter.

Circle 204 on Inquiry Card, page 97

Instrumentation

"CEC Recordings" is a quarterly external company publication of Consolidated Electro-dynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif., which is available free to interested engineers. Each 24-page issue contains application stories and technical articles on industrial instrumentation, process control, aviation flight testing, data-processing and high-vacuum technology.

Circle 205 on Inquiry Card, page 97

Connector Publication

The "Cannonade" is a bi-monthly publication issued free to engineers interested in connectors by the Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif. Each issue contains as much useful engineering matter as possible.

Circle 206 on Inquiry Card, page 97

Antennas & Systems

Andrew California Corp., 941 E. Marylind Ave., Claremont, Calif., has just issued booklet #8432 which is full of information on all the antennas and antenna systems and coaxial transmission lines and accessories that are available from the company. This 2-color, 132-page booklet is complete with photographs, electrical and mechanical specifications, tables, charts, and graphs.

Circle 207 on Inquiry Card, page 97

Radiating Systems

Bulletin No. RS 100 issued by Electronic Specialty Co. 5121 San Fernando Rd., Los Angeles 39, Calif., is a 32-page, 2-color booklet which describes their line of antennas, antenna arrays, coaxial switches, power dividers, filters, diplexers and multiplexers, impedance matching devices, coaxial cable assemblies and complete antenna systems. Booklet is indexed for simple location of any specific item.

Circle 208 on Inquiry Card, page 97

Tube Catalog

The new Eimac Quick Reference Catalog brings a convenient tab-indexed form summarized technical data and prices on their latest products. Eitel-McCullough, Inc., San Bruno, Calif.

Circle 209 on Inquiry Card, page 97

Modular Recorder

The Ampex Corp., 934 Charter St., Redwood City, Calif., has just issued a multi-colored 16-page brochure which describes in complete detail their model FR-100A modular magnetic tape recorder/reproducer for instrumentation.

Circle 210 on Inquiry Card, page 97

Constant Delay Lines

A 4-page, 2-color bulletin issued by the Orbitran Co., Lakeside, Calif., describes their line of lumped constant delay lines. The bulletin is complete with photographs, technical information, tables, and graphs.

Circle 211 on Inquiry Card, page 97

Wire-Wound Resistors

Completely illustrated in 20 pages, Cinema Engineer, 1100 Chestnut St., Burbank, Calif., displays its entire line of precision wire-wound resistors in catalog 14RC. A number of their resistors series have been renumbered for conformance with a new specification pattern. Complete specification detail has been covered, giving the engineer ample information to make his selection.

Circle 212 on Inquiry Card, page 97

AC Power Source

Behlman Engineering Co., 2911 Winona Ave., Burbank, Calif., has available a new technical bulletin describing their Invertron. The Invertron is a completely electronic ac power source used in research and development, production testing, test consoles or wherever ac power other than that obtainable from 60 cycle line is required.

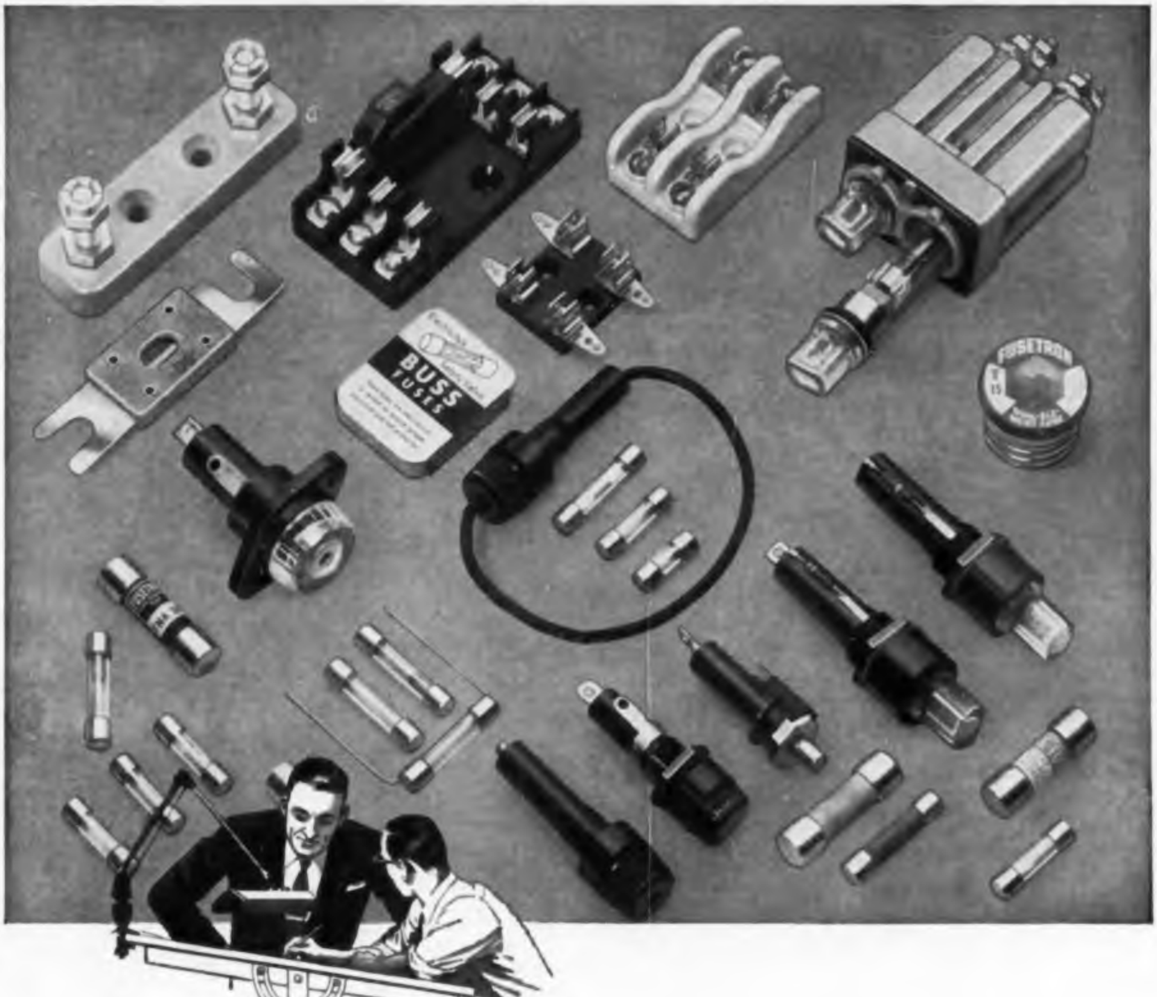
Circle 213 on Inquiry Card, page 97

Transistors & Diodes

Texas Instruments, Inc., P. O. Box 312, Dallas, Tex., has just issued a series of 4-page brochures describing their various transistors and semiconductor products. Brochures are complete with graphs, photographs, technical and mechanical specifications and easy-to-follow tables.

Circle 214 on Inquiry Card, page 97

(Continued on page 122)



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 the complete line of BUSS and FUSETRON Small Dimension Fuses and Fuseholders, write for bulletin SFB.

Bussmann Mfg. Division McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

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

858

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Buss Makes a Complete Line of Fuses for Home, Farm, Commercial, Electronic, Automotive and Industrial Use.

Circle 59 on Inquiry Card, page 97

Latest Western Literature for Engineers

Precision Resistors

A 4-page, 2-color bulletin describes Ultronix, Inc., 116 S. Bayshore Blvd., San Mateo, Calif.'s line of miniature precision wire-wound resistors. Complete technical information is included.

Circle 215 on Inquiry Card, page 97

Potentiometers

A 24-page multi-colored booklet is available from Bourns Laboratories, Inc., P. O. Box 2112, Riverside, Calif., which describes a line of potentiometers and trimmers. Brochure contains photographs, drawings, tables, electrical and mechanical specifications.

Circle 216 on Inquiry Card, page 97

Strip-Chart Recorder

A 4-page, 2-color bulletin is available from Varian Associates, Instrument Div., 611 Hansen Way, Palo Alto, Calif., which describes a small-size moderate-cost strip-chart recorder of the null-balance potentiometer type. Bulletin contains photographs, drawings, tables, electrical and mechanical specifications.

Circle 217 on Inquiry Card, page 97

Precision Gears

A new brochure illustrating many different types of fine pitch precision gears made by Western Gear Corp., P. O. Box 182, Lynwood, Calif., is available. Brochure illustrates typical applications and contains technical information.

Circle 218 on Inquiry Card, page 97

Nuclear Lab Instruments

A series of 3 bulletins describes BJ Electronics, Borg-Warner Corp., 3300 Newport Blvd., Santa Ana, Calif., linear count rate meter, linear amplifier, and precision binary scaler. Purpose and function of these instruments are contained in separate bulletins with performance specifications, dimensional and installation data.

Circle 219 on Inquiry Card page 97

Electronic Hardware

A new 24-page catalog No. 30 available from Lerco Electronics, Inc., 501 S. Varney St., Burbank, Calif., features complete lines of molded and standard terminals, diode clips, taper pins, plugs and receptacles, handles, quintlock nuts, terminal boards, swaging tools and miscellaneous hardware. More than 100 new items are cataloged for the first time.

Circle 220 on Inquiry Card, page 97

Engineering Wall Chart

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif., has just issued a large engineering wall chart which features many useful conversion tables for engineering personnel.

Circle 221 on Inquiry Card, page 97

Computer Programming

A 4-page bulletin describing the unusual features of a new programming method is available from Bendix Computer Div., 5630 Arbor Vitae St., Los Angeles, Calif.

Circle 222 on Inquiry Card, page 97

Modular Oscilloscopes

Complete specifications and prices of Advanced Electronics Mfg. Corp., 2116 S. Sepulveda Blvd., Los Angeles 25, Calif. Model 200 series of modular oscilloscopes are contained in a six-page short form catalog which also contains all technical information.

Circle 223 on Inquiry Card, page 97

Pressure Transducers

Two different pressure transducers, one designed to measure pressures in extreme environments, the other to provide high resistance pick offs and non-linear functions are described in technical information available from the Technology Instrument Corp. of Calif., 7229 Atoll Ave., N. Hollywood, Calif.

Circle 224 on Inquiry Card, page 97

Servomotor

Beckman/Helipot Corp., Newport Beach, Calif., has just issued a 4-page technical bulletin which describes in complete detail their 115-v, size 8 servomotor.

Circle 225 on Inquiry Card, page 97

Test Equipment

Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif., has just issued a 16-page, 2-color short form catalog which describes their line of test equipment. The catalog is complete with photographs, electrical and mechanical specifications and price list.

Circle 226 on Inquiry Card, page 97

Technical Notes

"Technical Notes" is a bi-monthly publication available from G. M. Giannini & Co., Inc., 918 E. Green St., Pasadena, Calif. Free subscriptions to this useful technical publication are available.

Circle 227 on Inquiry Card, page 97

Electron Tube Catalog

Litton Industries, 960 Industrial Rd., San Carlos, Calif., has just issued a 90-page catalog listing magnetrons and klystrons that are available from them for use in government equipment. Complete technical information is included along with photographs, tables, and drawings.

Circle 228 on Inquiry Card, page 97

Radiation Equipment

Tracerlab, Inc., 2030 Wright Ave., Richmond 3, Calif., has just issued a 142-page, 2-color catalog which describes their facilities, counting equipment, radiation analysis equipment, monitoring equipment, special equipment, and other products manufactured by them. Booklet contains comprehensive information on all of their products.

Circle 229 on Inquiry Card, page 97

Automatic Devices

Brocker Labs, P. O. Box 967, Sunnyvale, Calif., has just issued a 4-page brochure which describes their microwave power regulators, noise figure measurement equipment and a laboratory power supplies designed specifically for the laboratory circuit engineer. Complete information is given.

Circle 230 on Inquiry Card, page 97

Accelerometer Calibration

Methods and accuracies of crystal accelerometer calibration are featured in a 25-page manual complete with actual photos and graphs. Frequency response, linearity with temperature, mounting methods and many other topics are covered. Endevco Corp., 161 E. California St., Pasadena, Calif.

Circle 231 on Inquiry Card, page 97

Computer Translator

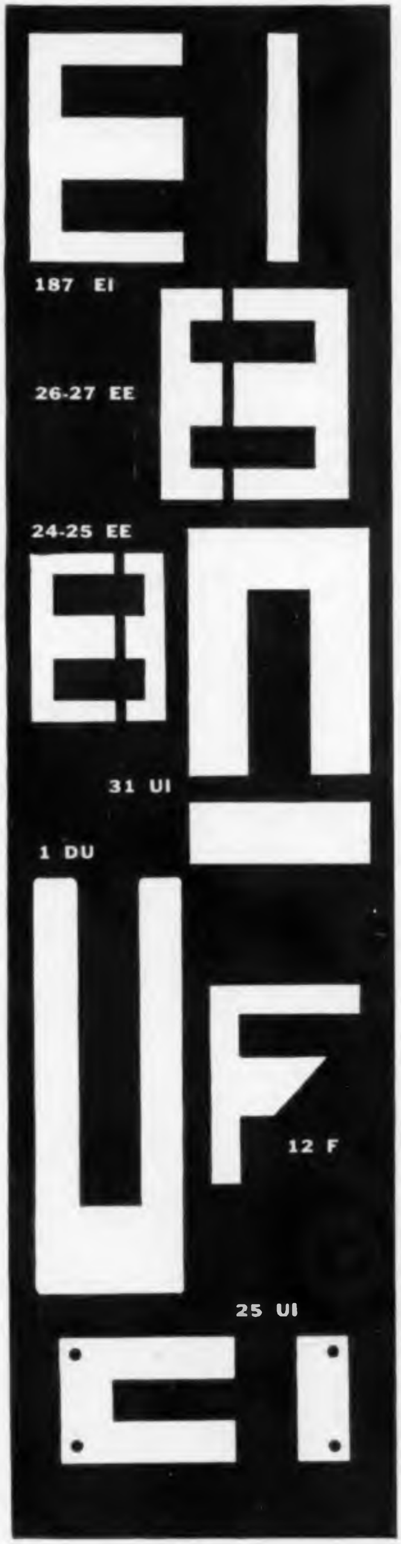
A 4-page brochure describing the Model ZA-100 Computer Language Translator is now available from the Electronic Engineering Co. of California, 1601 E. Chestnut, Santa Ana, Calif. It describes the application, operation, and economical building block design principle of the system.

Circle 232 on Inquiry Card, page 97

Electrometer

A four-page bulletin describes the Model 31 Vibrating Reed Electrometer. New bulletin discusses operation, applications, specifications and performance. Applied Physics Corp., 2724 S. Peck Rd., Monrovia, Calif.

Circle 233 on Inquiry Card, page 97



DESIGNews

Magnetic Metals Company offers a new improved HYMU "80" for higher permeability laminations

■ Through the use of newly developed magnetic alloys, recently made available to Magnetic Metals Company, laminations of the type shown here are now obtainable in both .006" and .014" improved Hymu "80". Permeability rejection levels at low inductions will average 30 to 50 percent higher for these laminations than are now in effect for standard Hymu "80" laminations.

Intensive work on the exacting details of annealing practices, as well as on melting and rolling techniques has made possible these superior characteristics. Stock will be maintained in both .006" and .014" material. Prices will be quoted upon inquiry based on quantities required.

Test set-up devised to check low induction permeability.

MAGNETIC METALS COMPANY

ELECTROMAGNETIC CORE PARTS AND SHIELDS • HAYES AVENUE AT 21st ST. • CAMDEN 1, N. J.

Circle 45 on Inquiry Card, page 97

Snapshots of the Electronic Industries

NO FLIES ON KEVIN!

Tiny object on the freckled nose of Kevin McKay is called by Minneapolis-Honeywell's Microswitch Div. the smallest precision electrical switch in the world. It weighs 1/28 oz., handles 5 a.

"MATCH BOX" TUBES

Westinghouse Electronic Tube Division (right) has come up with this unique design which uses the same electrode structure as conventional tubes, yet is highly resistant to shock and microphonics.

ARMY AERIAL OPERATIONS

At Army Flight Operations Center (left) aerial routes are outlined for a tactical operation. Mobile flight ops section was designed by Army R&D Lab., Ft. Monmouth, N. J.

POLARIS LAUNCHER

Unique launching system for the Polaris IRBM is hurling dummy missiles skyward at San Francisco Naval Shipyard. Missiles of steel and concrete land in bay a few feet away to be recovered and fired again.

LITTLE POWER PLANT

A miniature gas turbine — the smallest yet developed—delivers either 5 or 10 hp, according to designers, Propulsion Research Corp., Santa Monica, Calif.

OLDTIMER RETIRES

RCA's W. Dean (r) and GE's R. E. Gillette check over this 40-yr. old GE capacitor equipment at RCA, believed to be the oldest industrial capacitor installation in the country, and soon to be retired.

EDISON GENERATOR

M. Alan Chapman (r) presents one of the first generators built by Thos. A. Edison machine works to Herbert P. Buetow, pres. of Minnesota Mining & Mfg. Co. Built in 1891 it will be placed on display in 3M's electrical products laboratory.

NEW TV DESIGNS

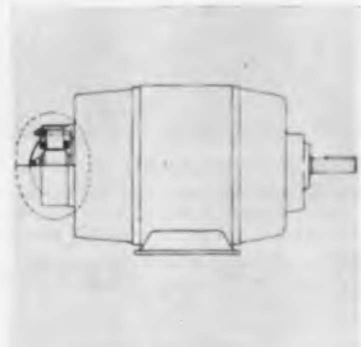
Latest Motorola TV line features this new console in the French Provincial Period. Features include 21-in. tube, 1 yr. warranty on all parts, and controlled warm-up tubes.

Philco's radically new TV line features a striking departure in this portable picture tube which is connected by 25 feet of cable to the main chassis, can be positioned where the viewer chooses.

New Products

TACHOMETER GENERATOR

The Tachometer Generator features compact size, precision construction and economical cost. It is designed for direct mounting to the driving motor without use of coupling devices.



Thus the stator bolts directly to the motor flange, while the rotor mounts to the motor shaft. AC output frequency is 4 times the fundamental motor speed, producing 240 cps. at 3600 rpm. The rotor flux is supplied by a permanent magnet. Minimum size is 4½ in. diameter and 2½ in. length. Carter Motor Co. 2760 A. W. George St., Chicago 18, Ill.

Circle 283 on Inquiry Card, page 97

DELAY LINE

Extended bandwidth Lumped-Constant Delay Line virtually triples the delay-to-rise-time ratio previously available. Its 145:1 ratio now enables computer engineers to design delay line memories with 72 bit storage capacity rather than 25. The new design, with its better figures of merit, can now be incorporated into applications previously beyond the range of

a delay line. Wider bandwidth enables it to handle closely-spaced pulse groups. The unit measures 3 x 4½ x 8½ in. ESC Corp., 534 Bergen Blvd., Palisades Park, N. J.

Circle 284 on Inquiry Card, page 97

When the U. S. Army moves up Kleinschmidt is in the van

Kleinschmidt page printers and reperforator teletypewriters receive and transmit teleprinted communications wherever a truck can roll.

As division headquarters advances in the field, it is imperative that communications with outlying units be maintained without interruption. Kleinschmidt teletypewriters and related equipment, installed in a U. S. Army cargo truck and transmitting by radio, provide a message center that meets every demand of mobility and dependable two-way communications. These Kleinschmidt units, developed in co-operation with the U. S. Army Signal Corps, furnish sender and recipient with an identical teleprinted original, eliminating misinterpretation and speeding the required action.

Research and development of equipment for transmitting and receiving printed communications has been a continuing project at Kleinschmidt for almost 60 years. This unparalleled store of experience, now joined with that of Smith-Corona Inc, holds promise of immeasurable new advances in electronic communications.

KLEINSCHMIDT LABORATORIES, INC.

PIONEER IN TELEPRINTED COMMUNICATIONS EQUIPMENT

A SUBSIDIARY OF SMITH-CORONA INC • DEERFIELD, ILLINOIS

Circle 118 on Inquiry Card, page 97

New Products

VARIABLE TOROID

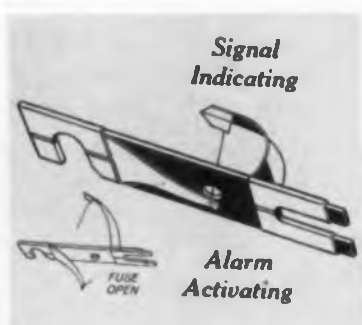
New development in the toroidal coil field offers a sub-miniature encapsulated variable toroid. Developed especially for printed circuit and similar light weight applications, it is

completely hermetically sealed. Stepless adjustment of inductance over a 10% range is provided and torque adjustment is such as to preclude possible strain on printed circuit mounting. Weighing approximately 1/8 oz. the ATE-11 and ATE-12 will find wide application in the guided missile and similar miniaturization fields. Burnell & Co., Inc., 10 Pelham Pkwy., Pelham Manor, N. Y.

Circle 275 on Inquiry Card, page 97

GRASSHOPPER FUSES

The fuses are designed to carry their rated capacity for ten minutes. The alarm spring has a sharp point on the end so that when released by the blowing of the fuse it will make positive contact with the alarm bus bar. This spring is so designed that even the minimum pressure on the



alarm bus bar will be more than sufficient to assure good contact. Bussmann Mfg. Div., McGraw-Edison Co., University at Jefferson St., St. Louis 7, Mo.

Circle 276 on Inquiry Card, page 97

New Transistorized

FREQUENCY DISCRIMINATOR AND SERVO DRIVEN CORRECTION LOOP

±0.5 ~ accuracy

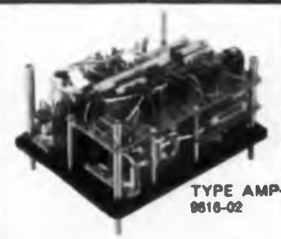
AIRCRAFT ENGINE → VARIABLE RATIO ENGINE TRANSMISSION → MAIN ALTERNATOR

Oster®

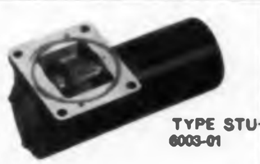
Designed for controlling a **LYCOMING** variable ratio engine transmission which drives a typical aircraft alternator at constant speed.

- ±0.125% (400 ±0.5 cycles) accuracy.
- −55°C to +125°C ambient temperature range.
- Smaller, lighter, less complex through use of semiconductors.

AUXILIARY ENGINE DRIVEN ALTERNATOR



FREQUENCY DISCRIMINATOR AND SPECIALIZED SERVO AMPLIFIER



SERVO TORQUE UNIT WITH STABILIZING GENERATOR FEEDBACK

Other types of systems can be designed to your specification. For more information contact the Oster office nearest you.

Burton Browne Advertising

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

John Oster MANUFACTURING CO.
Your Rotating Equipment Specialist
Avionic Division
Racine, Wisconsin

NEW YORK OFFICE: 237 North Main Street, Hempstead, L.I., New York; Phone: IVanhoe 3-4653; TWX Hempstead N. Y. 705

NEW JERSEY OFFICE: 517 Lyons Avenue, Irvington, New Jersey; Phone: ESsex 3-2361

WESTERN OFFICE: 5333 So. Sepulveda Blvd., Culver City, California; Phones: EXmont 1-5742, TExas 0-1194; TWX S. Mon 7671

Engineers For Advanced Projects: Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Robert Burns, Personnel Manager, in confidence.

 Circle 85 on Inquiry Card, page 97

New Products

TELEMETRY ANTENNA

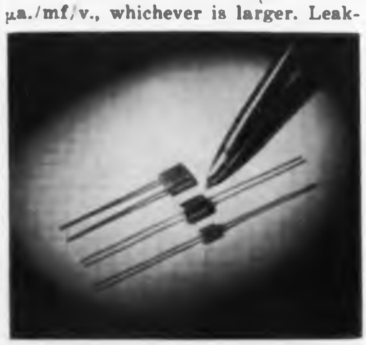
The unit illustrated, Model MAM-1000, is designed for applications where the antenna can be manually oriented to any position. It can also be supplied with a remote controlled

motor-driven mount. The unit pictured is a 4-turn helical beam antenna having an acceptance angle of approximately 50° and a gain of approximately 10 db over an isotropic source. Other antenna designs, with either remote controlled motor-driven mounts or manually operated bases are also available. Nems-Clark Co., 919 Jessup-Blair Dr., Silver Spring, Md.

Circle 285 on Inquiry Card, page 97

TANTALUM CAPACITOR

The S-T-A type solid tantalum capacitor, which contains no liquid electrolyte, has been redesigned to smaller sizes. Illustration shows the 100 Series, rated at 1.0 mfd, 35 wvdc, contrasted with two earlier models of the same rating. The length of capacitor (excluding leads) is 0.250 in.; diameter is 0.175 in. Leakage current at 25°C does not exceed 3 μa. or 9.93 μa./mf/v., whichever is larger. Leak-



age at 85°C does not exceed 8 times the 25°C value. Available in 20 ratings among 4 case sizes. Fansteel Metallurgical Corp., 2200 Sheridan Rd., N. Chicago, Ill.

Circle 286 on Inquiry Card, page 97

3 New Midget Pliers by KLEIN

Here is a new line of genuine Klein Pliers in oblique and long nosed patterns specially designed for wiring modern electronic assemblies or doing any close work in confined space.

These midgets are hardly longer than your favorite package of cigarettes and their extremely small size will simplify many small close-tolerance jobs.

Available in oblique cutting, long nose with and without knurl, and end cutting pliers.

See your distributor.

No. 257-4 Oblique Cutting Plier. Size 4 in.
321-4½ Long Nose Plier 4½ in.
322-4½ (Without Knurl) 4½ in.
224-4½ End Cutting Plier 4½ in.

Available with coil spring

No. 257-4C Oblique Cutting Plier
321-4½C Long Nose Plier
322-4½C (Without Knurl)
224-4½C End Cutting Plier

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Free Bulletin on Klein Pliers
Bulletin 758 on Klein Pliers sent you on request.

Circle 109 on Inquiry Card, page 97

New Products

AC POWER SUPPLIES

Series 7000 high-voltage ac power supplies are available in 19 models, operating on 220 or 440 v, cps, 1 Θ inputs, with output voltages ranging from 0-25 to 0-150 kv, at 5 to 100 kva.

These ruggedly constructed two-section units have a continuously adjustable automatic rate of rise in conformance with ASTM standards, so that they can be used for dielectric testing in accordance with ASTM specifications. They are furnished with two 4 in. panel instruments. Beta Electric, Richards Ave., South Norwalk, Conn.

Circle 277 on Inquiry Card, page 97

AC RELAY

The contact making instrument employs a moving iron mechanism, thereby eliminating the need for costly rectifiers or external converters. This new AC Sensitrol Relay, Model 1094, deflects in proportion to the true RMS of the impressed current or voltage. Offered with either one or two preset contacts. It finds applications in over and/or under current or voltage control and alarm.

Standard range is 5 a., with voltage ranges from 6 v. to 300 v., and current ranges from 3 ma. to 5 a. Weston Instruments, Div. of Daystrom, Inc., Newark 12, N. J.

Circle 278 on Inquiry Card, page 97

Why SHOULDN'T we be interested in close corporation insurance?

"We have to be! . . . our families' future security depends upon the future of our husbands' business."

The death of a principal stockholder in a close corporation can lead to financial chaos in the business. It can mean extreme hardship to the family of the deceased and to the remaining stockholders.

These hazards can be eliminated through a proper stock purchase and sale agreement funded by an effective business life insurance plan.

Ætna Life's Business Planning Service can be of assistance to your attorneys and accountants in setting up such a plan.

ÆTNA BUSINESS LIFE INSURANCE PLANS ARE SPECIALLY DESIGNED . . .

- To preserve PARTNERSHIP values when death comes to any partner.
- To preserve SOLE PROPRIETORSHIPS for heirs or selected employees.
- To preserve ownership values when death comes to any stockholder in a CLOSE CORPORATION.
- To indemnify any firm for the death of a KEY MAN.

Add Life to your Business with Ætna Business Life Insurance

ÆTNA LIFE
INSURANCE COMPANY

Affiliates:
ÆTNA CASUALTY AND SURETY COMPANY
STANDARD FIRE INSURANCE COMPANY
Hartford, Conn.

Ætna Life Insurance Company
Hartford 15, Connecticut
Gentlemen:
Please send me a copy of your new booklet "Will This Man Take Your Business With Him When He Dies?"

Name____________________

Address____________________

Circle 121 on Inquiry Card, page 97

New Products

MINIATURE MOTOR

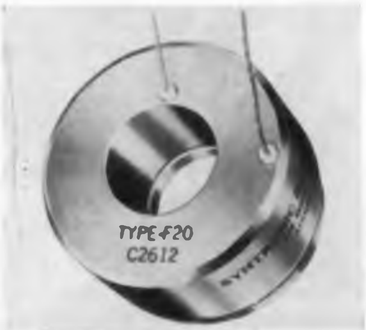
A sub-fractional horsepower hysteresis motor, although small in size, has a good low heat rise of only 20°C to 38°C depending on horsepower rating. Other features assure high

performance with long-life reliability. Horsepower ratings are from 1/200th to 1/20th, with a running torque of 2.8 in.-oz. to 28-in.-oz. Different rpm's can be selected by varying input frequency. It reaches full speed in 1 revolution and maintains synchronous speed at rated load. Motor is totally encased. Dale Products, Inc., Box 135, Columbus, Nebr.

Circle 287 on Inquiry Card, page 97

FOCUS COIL

Type F20 electromagnetic focus coil is designed for photographic, flying spot, military and other special purpose 1⅛ in. neck diameter CRT requiring short focal lengths at high (up to 25 kv) accelerating potential without overheating. Minimum spot distortion is assured by machining coil case to close dimensional tolerances. It mea-



sures 1 9/16 in. ID, 3⅛ in. OD, 1⅞ in. long and 5/16 in. front to gap center. Available in a wide range of coil resistances. Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.

Circle 288 on Inquiry Card, page 97

What happens to soldered joints at "fifty below"?

"Dutch Boy" solder specialists tell how to make sure they hold when cold

Push temperature down and lead's strength goes up – without major loss in ductility.

Not so with tin. Below −18°F, tin may suffer allotropic transformation. Gets brittle. Changes color.

Recent "Dutch Boy" research shows, as you might expect, that lead-tin solders tend to split this difference in rough proportion.

A 50-50 solder, for example, yields joints with higher tensiles at —75°F than at room temperature. But it's more brittle. At —75°F the joined metals still fail before the joint. Further down the temperature scale, joints fail first.

Increasing the lead content lowers the temperature at which joints retain good ductility. But strength does not increase as rapidly as temperatures go down.

Up to 15%, tin content has little effect on ductility. Beyond that, the loss in ductility (and in impact and fatigue resistance) that occurs as temperatures go below —18°F should be considered.

Allotropic change in tin may be inhibited with antimony

For makers of aircraft, missile and arctic electronic equipment, and for others whose products meet with extreme low temperatures, a recent proposed change in Government specs is of interest.

This proposal, which calls for 0.2 to 0.5% antimony in solders in the 40 to 70% tin range, is based on investigations showing that antimony inhibits allotropic change in tin as the thermometer falls.

Your "Dutch Boy" Solder specialist is well informed on this and other frontier areas of solder technology now under investigation at National Lead Laboratories and elsewhere. Use his specialized knowledge freely. Or write National Lead Company, 111 Broadway, New York 6, N.Y.

Dutch Boy
SOLDER AND FLUXES

Circle 83 on Inquiry Card, page 97

New Products

PANEL SCOPES

The Basic Panelscope Model P-1 consists of a Rayonic 2SPI crt having a usable screen area of 1¼ x 3 in., a high-voltage power supply, a crt escutcheon with controls and a variable

edge lighted graph screen with an ambient light filter. Assembly is encased in a high efficiency heat radiating cover. Indicator Panelscope Model P-100 consists of a Basic unit plus a selenium rectifier type low-voltage power supply for positioning and second anode adjustment only. Waterman Products Co., Inc., 2445 Emerald St., Philadelphia 25, Pa.

Circle 273 on Inquiry Card, page 97

SCREEN-PRINTING

Screen-printing equipment is used by electronic engineers for such projects as printed circuit production. The patented features of the durable, lightweight, all-metal "Fastretch" frame allow the metal mesh to be stretched tightly and uniformly, in 5 minutes, without tools or special equipment. Firmly stretching the mesh tight as a drum, to the very limits of its own tensile strength,

frame avoids stress points and eliminates the danger of tearing or distorting the mesh. Colonial Process Supply Co., 122 W. 22nd St., New York 11, N. Y.

Circle 274 on Inquiry Card, page 97

FOTOCERAM circuit board blanks are made photographically. All holes and shapes are produced by simple exposure to light, heat, and an etching operation.

This is a FOTOCERAM printed circuit

...an unusual new type of printed circuit board

Reliable through-plate holes • The good adhesion of the circuit runs applies also to the through-plate holes because both are produced with one plating operation.

Excellent resolderability • We have removed and resoldered components over twenty times on a FOTOCERAM board without damage to circuit runs or through-plate holes. And this is *without* using adhesives to bond the copper to the board.

Dimensional stability • Rigid structure of FOTOCERAM prevents unusual design considerations—eliminates problem of warp and twist.

Good adhesion • It takes 12-25 pounds to peel a one-inch copper strip from a FOTOCERAM board.

Exceptional pull strength • 1400 pounds per square inch.

No water absorption • FOTOCERAM's nonporous—zero water absorption.

Non-flammable

No blisters • FOTOCERAM never blisters. We put it through repeated 15-second cycles of copper metallizing at 500°F. and could not find a single blister or sign of peeling or failure.

Other properties:

Dissipation factor			
	1mc	@ 20°C.	0.006
		@ 200°C.	0.014
Dielectric constant			
	1 mc	@ 20°C.	5.6
		@ 200°C.	6.3
Loss factor	1mc	@ 20°C.	0.034
		@ 200°C.	0.088

For more information, write for our Data Sheet on FOTOCERAM.

Corning means research in Glass

CORNING GLASS WORKS, Bradford, Pa.

Electronic Components Department

Circle 87 on Inquiry Card, page 97

Ruggedized Solar Cells for Missiles

Ruggedized silicon solar energy cells to withstand extreme environmental conditions encountered in missile launching and outer space travel has been announced by the Semiconductor Division of Hoffman Electronics Corporation.

Assemblies of Hoffman solar cells are presently being used in the Navy's Vanguard satellite, which has one of its radio transmitters operating on direct solar power assemblies.

The new Hoffman Type "SS" cells are of the silicon P-N junction type with average conversion efficiencies of 8%, based on a solar constant of 1400 watts per square meter of collecting area under standard testing conditions and will operate at peak efficiency up to 10,000 years.

The Hoffman scientist reported that the Type "SS" cells are being developed to meet the following environmental requirements:

Vibration: will withstand 10 through 60 vibration cycles per second and return at .05 in. constant double amplitude in one minute cycles in any plane.

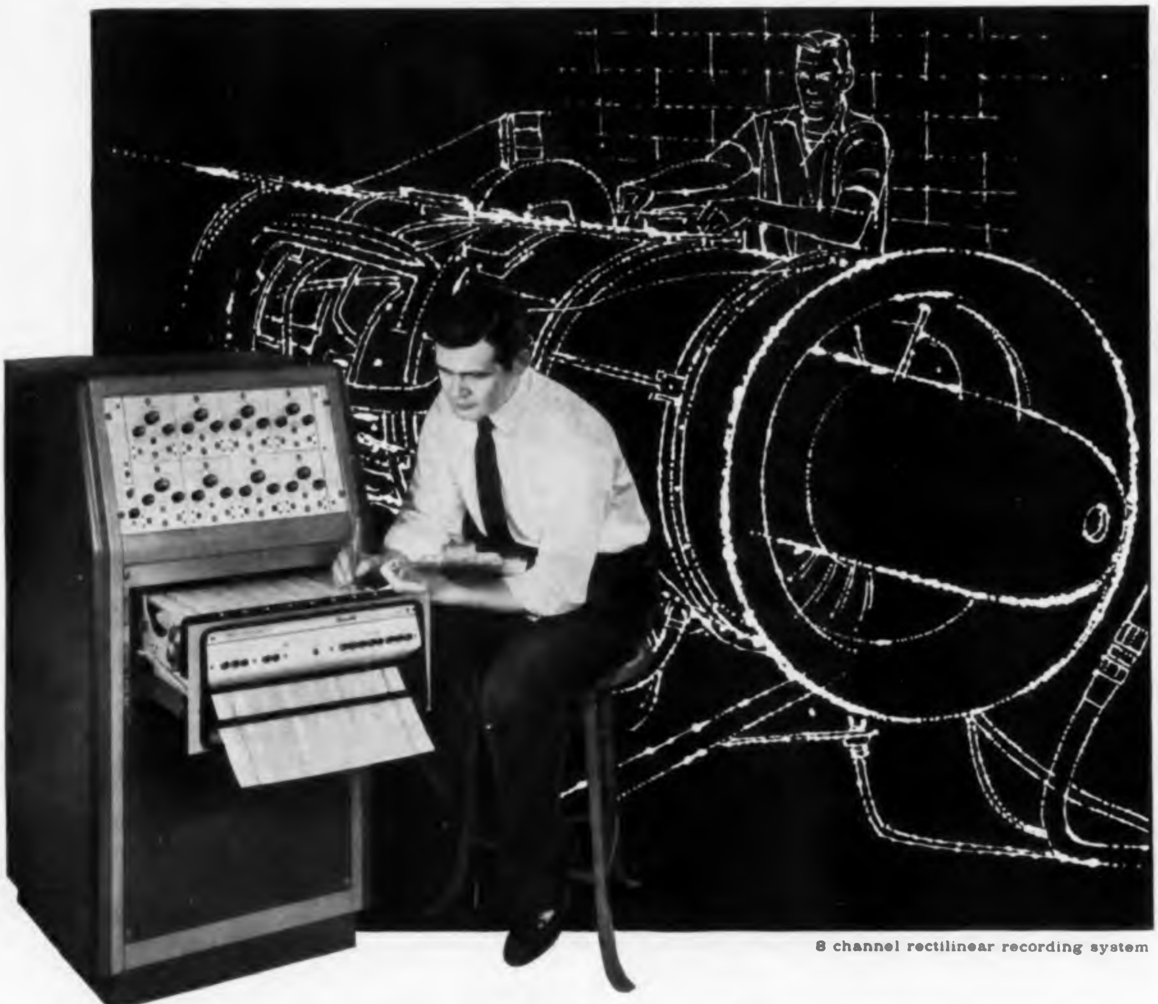
Pressure and Vacuum: will operate at peak efficiency under any and all conditions.

Gravities: will withstand up to 100 G's shock for .003 seconds in any direction. Will withstand constant up to 25 G's acceleration in any direction.

Temperature: will operate at peak efficiency under temperature conditions ranging from —190 degrees Centigrade to 500 degrees Centigrade, well within safe temperatures encountered in missile launching.

New Bridge Method for Core-Loss Measurements

THE National Bureau of Standards has developed a compensating a-c bridge method for the measurement of ferromagnetic core loss at high values of flux density. This method is an improvement over an earlier Bureau-developed technique[1] which made possible the accurate use of an a-c bridge for such measurements but required a "harmonic power" correction term. The recent modification[2] eliminates the harmonic power correction, thus simplifying the measurements



8 channel rectilinear recording system

Brush <u>ultralinear</u> recording systems

...WHEN RELIABILITY IS OF VITAL CONCERN

The circuits, mechanisms, components and materials in this 8-channel recording system have *already proved their reliability* in Brush instrumentation now in use in the most critical applications—such as radar surveillance, computer readout, missile checkout on remote test ranges . . . in extremes of temperature, humidity and other abnormal conditions. At Brush, the high reliability factor is always a basic consideration in design.

In the system shown here, trace presentation is rectilinear. Thermal writing provides clear, sharp traces, excellent for reproduction. Eight chart speeds, stepped from .4 to 100 mm/sec., operate by pushbutton controls. The system readily adapts to pertinent MIL specs.

With their wide measurement ranges, Brush *Ultralinear* Recording Systems may be used for development and checkout of industrial as well as military equipment. Factory branches, service and warehousing at Arlington, Va., Boston, Cleveland and Los Angeles; engineering representatives in all key locations.

ASK FOR NEW CATALOG
Describes 2, 4, 6 and 8 channel systems—rack and mobile—ink, electric and thermal writing.

brush INSTRUMENTS
DIVISION OF
3405 PERKINS AVENUE CLEVITE CORPORATION CLEVELAND 14, OHIO

Circle 40 on Inquiry Card, page 97

(*Continued from page* 138)

and calculations involved in loss determinations at high flux densities.

Cores of ferromagnetic material are essential to the operation of motors, generators, and transformers, but the output of such devices is often appreciably lowered by hysteresis and eddy currents. A knowledge of the magnitude of this loss in various materials is needed for the successful design and use of electric equipment.

In using a bridge for such measurements, the effect of current distortion must be considered. At high inductions the usual bridge method, always indicates larger power losses than the wattmeter method because of harmonic current components induced by the ferromagnetic core. To find the correct result, the power dissipated in the primary circuit at harmonic frequencies must be subtracted from the apparent power dissipated in the ferromagnetic material. Such a calculation involves an inconvenient determination of harmonic components of power. Thus the need for a method of automatic compensation.

Since the "harmonic power" term is equal to $I_h^2R_p$, where I_h is the h^{th} harmonic component in the exciting current and R_p is the resistance in the primary circuit (including the source resistance), the correction term would be zero if R_p were reduced to zero. The resistance value of the primary circuit cannot be reduced to zero by ordinary means such as using heavier wire, shorter leads, and lower valued bridge arms. These elements all contribute some resistance, so that the lowest practicable values of primary resistance are more than 2 ohms in most cases. However, it is possible to add enough negative resistance to make the net primary circuit resistance zero, by using an electronic power source that employs current feedback to produce a negative output resistance. A special circuit allows the magnitude of this negative resistance to be adjusted to counteract the positive resistance.

(*Continued on page* 142)

TEN-TO-ONE THE
Copper Clad Laminate
YOU WANT IS HERE!

From these ten basic PHENOLITE® Grades, you can select the base material, resin, properties and price to fit your present printed circuit need.

If your problem is finding a suitable cold-punch material, try samples of XXXP-470-1. It's designed for use in automated production equipment. If you are looking for higher heat resistance, check Grades G-10 and G-11.

Out of National's research laboratories come new advances every day. See your National Representative about new products and applications. He can keep you posted on the full line of PHENOLITE Laminated Plastic, Vulcanized Fibre and National Nylon for electronic applications across-the-board. In the meantime, write for our new "PHENOLITE Copper Clad Data" folder. Address Dept. F-8.

NATIONAL VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE

In Canada:
NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

SEE NATIONAL AT WESCON—LOS ANGELES
AUGUST 19-22—BOOTH NO. 304-305

TYPICAL TEST VALUES ON COPPER CLAD PHENOLITE

	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES				RELATIVE COST
GRADE	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance	Surface Resistance	Based on XXXP on Arbitrary Scale of 1
	10^6 Cycles	10^6 Cycles	1/16", % 24 Hrs	Psi	Degree F	Pounds to Pull 1" Strip		Secs to Blister 1" Square > Greater Than	Megohms, Etched Ratma Comb Pattern, 96 Hrs/35°C/90% RH	1/16" Thk. 1 Oz. Copper 1 Side
						1 Oz	2 Oz			
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	> 10 @ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	> 10 @ 475°F	200,000	.92
XXP-239-1 PHENOCLAD	4.2	.035	0.67	15,500	250	8	11	> 10 @ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	> 10 @ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	> 10 @ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	> 10 @ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	> 10 @ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	> 30 @ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	> 30 @ 500°F	2,000,000	3.55

Circle 84 on Inquiry Card, page 97

(Continued from page 140)

The accuracy of this method can be tested by using a Maxwell-Wien bridge; the unknown arm is an Epstein test frame containing the specimen.

To assure accurate bridge measurements the effectiveness of the resistance compensation is carefully checked before determining the unknown core resistance in the usual way. The magnitude of the fundamental current is then calculated from an accurate potentiometric measurement of the voltage drop across one of the known resistance arms.

From the values of core resistance and current, the power dissipated in the core is directly calculated and compared with the wattmeter readings. Readings made with an average-indicating voltmeter allow determination of the flux density at which each set of measurements takes place.

Measurements of this kind were made on ferromagnetic specimens weighing approximately 500 g and consisting of strips 3 cm wide and 28 cm or 30.5 cm long. Five grades of non-oriented silicon sheet and one grade of oriented-grain material were used for these tests.

The wattmeter and bridge determinations agreed within 2½ per cent, even at the highest practical flux densities. The bridge method is especially useful at high frequencies and for small test samples where accurate wattmeter readings cannot be obtained.

[1] Measurement of ferromagnetic core losses at high flux densities, NBS Tech. News Bul. 41, 60 (April 1957); Investigation of an alternating-current bridge for the measurement of core losses in ferromagnetic materials at high flux densities by Irvin L. Cooter and William P. Harris, J. Research NBS 57, 103 (August 1956) RP 2699.

[2] Improved bridge method flux densities, William P. Harris and Irvin L. Cooter, J. Research NBS (in press).

Table 1

Typical Results of Core Loss Measurement With Wattmeter and Compensated Bridge*

B K Gauss	Power Loss (w/lb) Bridge	Wattmeter	Percent Diff. (%)
10.00	0.866	0.869	−0.3
11.00	1.060	1.060	0.0
12.02	1.293	1.294	−0.1
13.00	1.553	1.560	−0.4
14.01	1.835	1.848	−0.7
15.03	2.094	2.096	−0.1
15.83	2.299	2.257	+1.9

* These results were obtained at 70 cps with a non-oriented grain sample weighing 0.744 lb.

How the man from Tensolite cuts assembly costs

Westinghouse Aero 13 Armament Control System, mounted in nose of Navy F4D Douglas carrier-based interceptor, is typical of systems using FLEXOLON *wire for faster assembly, lower production costs.*

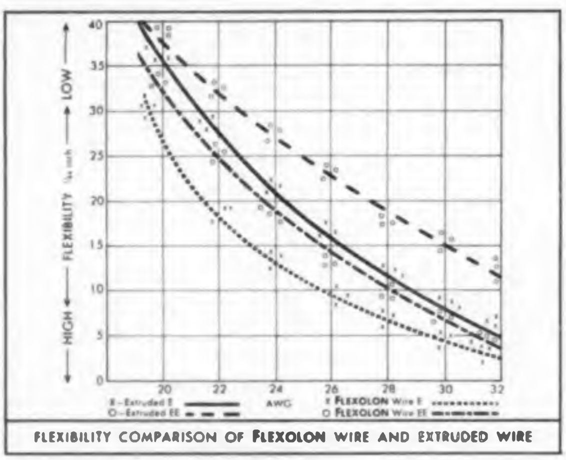
FLEXOLON hook-up wire with R/M "Teflon" tape proves most flexible

Developed and manufactured to answer industry's demands for increased wire flexibility, new FLEXOLON high temperature hook-up wire meets with ease the extra-flexibility requirements of today's most intricate circuit layouts.

FLEXOLON wire's greater flexibility was proven in a recent series of tests on the new hook-up wire and wires of other construction. In test after test FLEXOLON wire, insulated with Raybestos-Manhattan "Teflon" tape, proved consistently more flexible than all other high temperature hook-up wires tested.

The flexibility advantage of FLEXOLON wire is cutting assembly costs for many manufacturers. At Westinghouse, for example, the new hook-up wire makes an easier job of wiring intricate harnesses for armament control systems . . . assuring faster assembly and production.

Surpassing the requirements of MIL-W-16878C . . . and providing greater dielectric strength and higher average concentricity . . . new FLEXOLON hook-up wire is another example of Tensolite's continuous leadership in miniature wire development.



FLEXIBILITY COMPARISON OF FLEXOLON WIRE AND EXTRUDED WIRE

Plot of flexibility as recorded in tests proves greater flexibility of FLEXOLON *wire with R/M "Teflon" tape insulation. For complete testing data, call the man from Tensolite, or write for free* FLEXOLON *hook-up wire bulletin.*

Tensolite INSULATED WIRE CO., INC.

West Main Street, Tarrytown, N. Y. • Pacific Division: 1516 N. Gardner St., Los Angeles, Calif.

FLEXOLON is a trademark of Tensolite Insulated Wire Co., Inc.

TEFLON is a registered trademark of the DuPont Company

Be sure to see the Tensolite Exhibit at the WESCON Show

Circle 43 on Inquiry Card, page 97

Flight Op Center for Army Aircraft

A highly mobile Flight Operations Center (FOC) to control Army aircraft traffic in any combat area, has been developed by the U. S. Army Signal Research and Development Laboratory, Ft. Monmouth, N. J.

The flight control system, mounted in military vans and trailers, is for tactical use in battle zones. However, Army Signal Corps communications experts believe the system may provide new ideas for other military and civil aviation authorities as well.

The development emphasizes the important defense role of Army aviation—both fixed-wing aircraft and helicopters—for artillery fire control, observation, troop and material movement, rapid transport of wounded soldiers and many other missions.

FOCs differ from familiar air control towers since they are designed to regulate Army aircraft en route between points, rather than at landing and takeoff. In its primary role as a service to aviators, the FOC clears a pilot's flight plan before takeoff and then provides him with in-flight assistance from origin to destination.

Turns Coded Signals Into Spoken Words

A new electronic instrument which can "speak" a number of words and phrases when an operator presses the proper keys was demonstrated by Hoffman Electronics Corp.

The new instrument, called Selvox, for selective vocabulary, provides a readout of coded information in the form of prerecorded words and phrases. Triggering of the proper word may be accomplished by a relatively simple electronic signal.

Because a coded electronic signal is simpler to transmit than voice, and because it is much less affected by interference or static, the new instrument holds promise for application in solving major problems in aircraft, ground, point-to-point and shipboard communications.

The unit demonstrated has a vocabulary of 32 words. By programming additional information into the memory drum, this vocabulary can be enlarged many times.

Phonic Generator Controls Recorder Speed

INSTANTANEOUS speed changes by electronic control are made possible by the use of dc motors in the new Mincom Model C-100 wide band instrumentation tape recorder. The 14-channel system is completely transistorized in its record and playback signal circuits, and features full modular construction for versatility in applications.

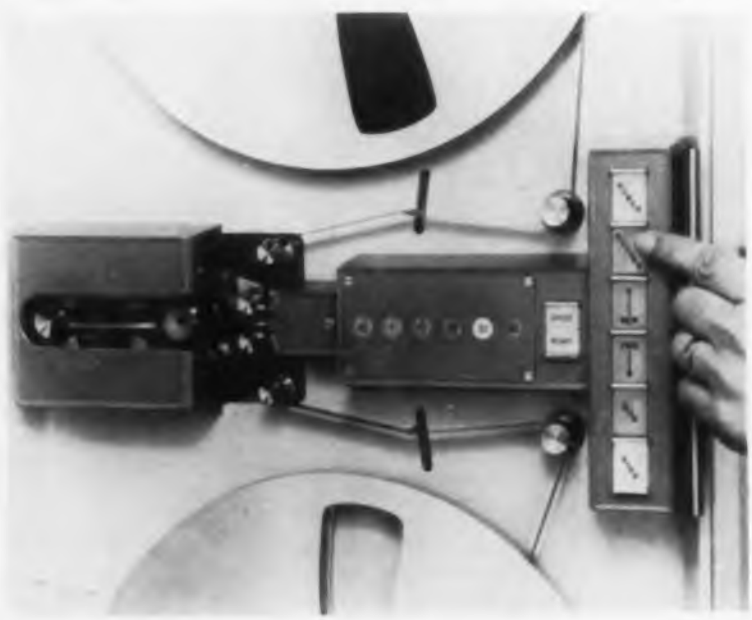
Mincom Div., Minnesota Mining & Mfg. Co., is located at 2049 S. Barrington Ave., Los Angeles 25.

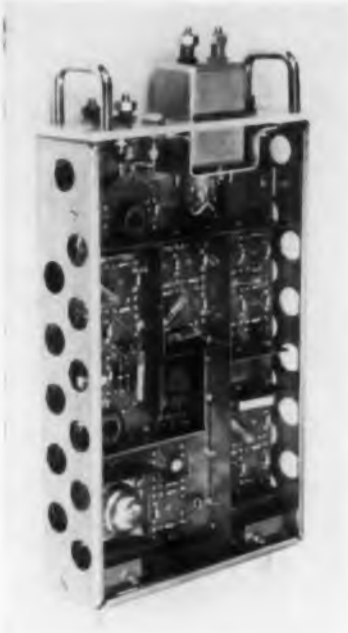
The precision machine will handle any number of data channels from 1 to 14, on magnetic tape up to 1 in. in width, ranging from 0.75 to 1.5 mils in thickness. Tape speeds are selected by push buttons; there are no belts to change. Standard speeds available on the basic machine are 3¾, 6, 7½, 15, 30, and 60 ips, but any group of precise speeds up to ten in number can be pre-set by the manufacturer.

Speed control is accomplished by monitoring the tape speed continuously with a phonic generator on the tape drive motor shaft. This speed transducer is connected to a phase detector through reference tuned circuits that are selected by push buttons. The output of the phase detector in turn feeds a power amplifier whose current output controls the speed of the dc motor to such an exacting degree that total wow plus flutter does not exceed 0.1%. This peak flutter specification guaranteed by the manufacturer includes all mixed components from 0.5 to 4000 cps, as measured at 60 ips tape speed.

Constant tape tension against the magnetic heads is assured in the recorder through the use of the unique Mincom "Isoloop" dif-

Push buttons control all operations including tape speed selection on Mincom C-100.





Unitized plug-in modules permit change from direct recording to frequency-modulated or PWM telemetering in seconds.

ferential capstan drive. This tape drive mechanism makes use of a capstan with multiple diameters. Variations in tape tension arising from rotation of supply and take-up reels normally cause serious wow and flutter. The "Isoloop" eliminates such variations. The result is improved recording and playback performance.

In addition, dynamic braking stops the tape gently without employing mechanical friction of any sort, thus eliminating troublesome mechanical brakes. Optimum tension is on the tape at all times, for better storage conditions than ever before possible. Running speed of 60 ips is achieved in 3 sec. from standstill. Stop time is less than 1 sec.

A standard 14-in. diameter reel with NAB hubs provides 24 minutes of running time at 60 ips. The same 7200 ft of 1.0 mil tape is rewound in 2 min. The recorder can be furnished to accommodate larger reels.

Use of unitized solid-state plug-in modules has produced a system that can be changed from direct recording to frequency-modulated or PWM telemetering usage in a few seconds.

★ ★ ★

Circle 62 on Inquiry Card, page 97

 Circle 60 on Inquiry Card, page 97

Tele-Tech's

ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES • August 1958

In This Issue:

Information Theory 02

The practice of communications must continually reckon with the necessity of getting the message through in spite of noise in the communications channel. A tool has been devised which enables the engineer to arrive at the statistical probability of getting a given piece of intelligence through. Here is how it works.

Transformerless Null Detector 08

A vacuum tube approach makes possible the elimination of the transformer in audio and ultrasonic bridges. The purpose is to eliminate effects of transformer winding capacitance on bridge balance.

SYSTEMS—WISE . . .

ELECTRONICS AND THE AMA

Doctors attending the AMA convention, San Francisco, witnessed a new visual education aid—color videotape recordings of surgery. An engineer operates the Ampex VR-1000, which was used in presenting the videotaped surgery programs during the 5-day convention. Ampex Corp. and Smith Kline and French Labs. cooperated in the CCTV programs.

▶ MM-9E—A compact transmitter-receiver unit for microwave radio systems provides five times the previous one-package channel availability. The new unit manufactured by Industrial Electronic Products, RCA, which can be inexpensively pole-mounted, will appeal principally to public utilities in communications and remote control operations.

▶ **KHFI, KAZZ, Austin, Texas, both FM stations, operating as Audioland, USA, are using a ROHN heavy-duty communications tower 152 ft. high. Affixed to the tower are a 4-bay Andrews and a 2-bay GE antenna. The stations play to two separate audiences with two divergent program formats, complete in stereophonic sound.**

▶ More precise synchronizing of TV programs between studio camera and home receivers will be possible with a new transistorized synchronizing generator which GE has placed into commercial production for television stations. This sync generator is the industry's first to incorporate transistors, printed wiring boards and computer circuitry.

▶ **KGUL-TV, Houston, Tex., and WVUE, serving the Wilmington, Del., and Philadelphia, Pa., area have just taken delivery on Ampex VR-1000 videotape recorders.**

▶ Bolstered by statistical data which shows that greater transmitter power is required at 450 MC to produce coverage equivalent to that achieved with 60 w. power levels in other frequency bands, GE has urged the FCC to allow two-way radio base station transmitters with 250 w. plate power output and 500 w. input to be operated in the 450 MC frequencies in the Land Transportation Services. If approved, the proposal would permit many types of businesses which can now be licensed in the 450 MC region to obtain greater talk-out coverage in reaching their mobile radio units.

▶ **The National Association of Broadcasters has urged the Federal Communications Commission to require operators of community antenna systems to obtain permission from broadcasting stations to pick up their signals. The NAB encourages competition in broadcasting on equal terms but ". . . cannot long abide a legitimatized, licensed system of unfair competition . . . the end product of the microwave-CATV linkage."**

Data Communications feel . . .

The Impact of Information Theory

Individuals have been exchanging information from the dawn of mankind. In the mid-twentieth century, a theory evolved to cover the process. That theory and its effect on communications are described here.

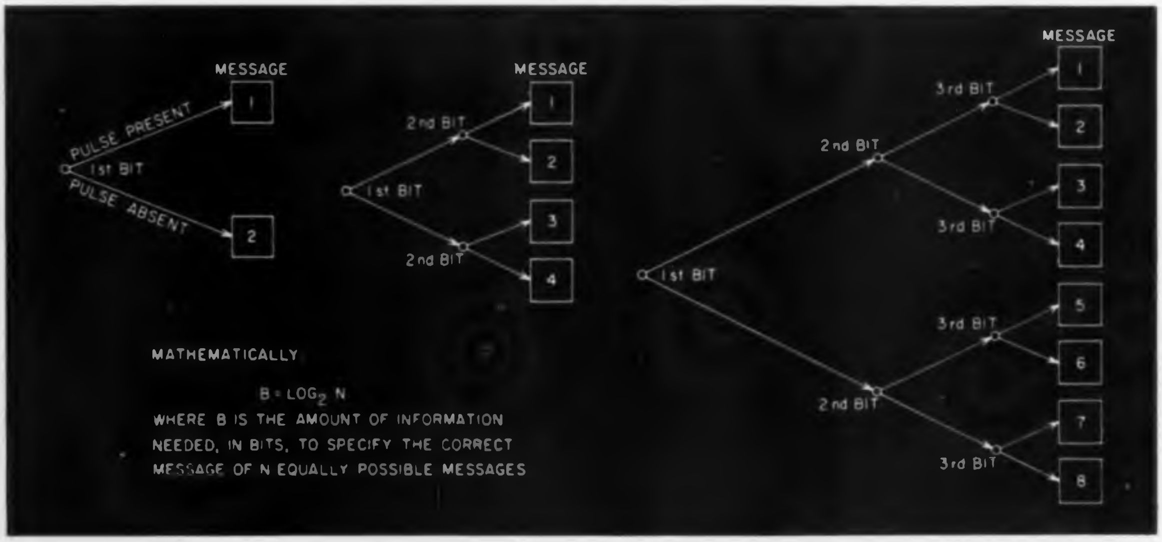
By ALAN F. CULBERTSON
Manager, Product Planning
Lenkurt Electric Co., Inc.
San Carlos, California

SCIENCE demands a method of measurement. With units of measurement, mathematical relationships can be derived. Information is a bulk commodity which assumes literally an infinite number of forms. From the time of establishment of a unit of measurement, progress has been rapid.

Work in this field is carried on largely in the mathematical language of statistics and probability. Noise, information, and messages can all be put into terms of probability distributions for quantitative analysis.

Those engaged in the practical aspects of the transmission of information expect many benefits from all this effort. Studies have already suggested possible new approaches to the electrical transmission of intelligence.

Fig. 1: Information requirements for specifying a particular message.



Unit of Measure

Any idea which can be transmitted can be broken down into irreducible atoms of information. This "atom" is defined as the answer to a question to which there can only be one of two answers; that is, where the answer is "binary." Thus, any question which can be answered by either "yes" or "no," "0" or "1," "boy" or "girl" is answered by one "bit" of information. This is a corruption and contraction of the words "binary digit."

The bit is logarithmic in nature because the amount of information built up by successive "yes" and "no" answers grows exponentially. The mathematical definition of the bit is as follows:

$$\text{Bits} = \text{Log}_2 N \qquad (1)$$

where N equals number of choices.

The manner in which information is built up, bit by bit, is illustrated in Fig. 1.

Information in a Message

Information theory provides a method for measurement of the information content of all messages. The amount of information is defined as:

$$\text{Information in Bits} = \text{Log}_2 \left[\frac{\text{a posteri probability}}{\text{a priori probability}} \right] \qquad (2)$$

where the "a posteri probability" is the probability that an event has occurred after the message about it has been received. The "a priori probability" is the amount of advance warning available at the receiver. It is the probability existing in the mind of the recipient that the event had occurred before the message was received.

Suppose that you have just received a telegram saying, "Arriving on the noon plane—Jones." It is now 1:00 PM and you have just had an angry phone call from Jones demanding to know why he was not met at the airport. The a priori probability of the event in your mind is already 100%, or 1.0, the same as the a posteri probability. The information in bits becomes:

$$\text{Info} = \text{Log}_2 \left[\frac{1.0}{1.0} \right] = \text{Log}_2\, 1.0 = 0 \qquad (3)$$

Another telegram might say "Your department wins prize for efficiency in company-wide competition." Until this moment you had not considered that your department had any more chance of winning than any of the other 512 departments in your company. Thus, the information for you contained in this telegram is:

$$\text{Info} = \text{Log}_2 \left[\frac{1.00}{\frac{1}{512}} \right] = \text{Log}_2\, 512 = 9 \text{ Bits} \qquad (4)$$

In the 2 examples, we have considered the possibility of noiseless transmission through the medium such that we have had implicit faith in the accuracy in the message as it arrived. Therefore, the a posteri probability in each case has been set at 100%, or 1.0. This equals absolute certainty that the message, as received, is correct. If, as in the second example, you are certain that your department was not in the running, then we are forced to suspect a "noisy" transmission medium which may have introduced errors in either the context of the message or in its address.

If we suspect such deficiencies in the transmission system used to convey the above message we might assign only a 90% a posteri probability to the likelihood that the event occurred, even though the message was received. Thus, the net amount of information received via the noisy channel becomes:

$$\text{Info} = \text{Log}_2 \left[\frac{0.9}{\frac{1}{512}} \right] = \text{Log}_2\,(0.9)(512) = \text{Log}_2\, 461 = 8.85 \text{ Bits} \qquad (5)$$

General application of this formula requires that the message be sufficiently long so that errors due to noise will occur on a statistically random basis.

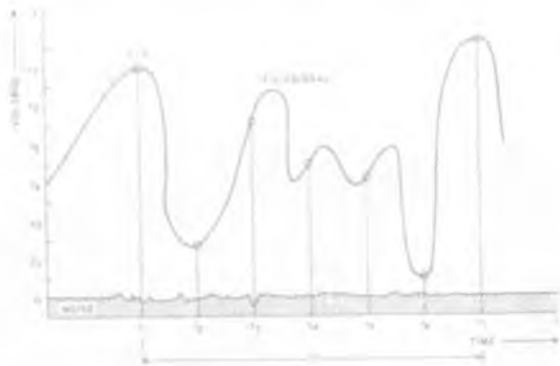


Fig. 2: The sampling levels and intervals of a continuous signal.

Communicating in the Presence of Noise

The practice of communications must continually reckon with the necessity of getting the message through in spite of noise in the communications channel. Some types of noise are man-made and some arise in the atmosphere. "Thermal noise" is present in all matter.

Fig. 2 represents a signal received as a continuous wave F(v), which contains some quantity of information that we are trying to extract. We may decode this information by carefully measuring the function with respect to both voltage and time.

The more possible values of F(v) there are, the more information we can extract from the signal. This is because the amount of information is proportional to the degree of uncertainty that existed before we received the message. However, we are limited by the number of possible values between which we can distinguish.

Fig. 3 shows the phenomenon which restricts the number of distinct values which our detector can recognize in this message. For even though F(v) assumes value v_1 at time t_1, this is not the signal which appears in the detector. Instead, the signal-plus-noise is applied, and this function can assume a *range* of values as determined by the character of

(*Continued on page* 05)

Finest line of High Frequency Cables in the communications field!

- No radiation
- Low attenuation
- Excellent frequency response
- Uniform electrical properties over wide temperature variations
- Unlimited operating life
- Continuous 1000′ lengths

Matching fittings for all cables are available from several sources.

PHELPS DODGE COPPER PRODUCTS

CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

the noise. Thus, an effective detector for this signal should not attempt to distinguish between discrete voltage values where the differences are smaller than the mean noise voltage present on the circuit at the same time.

Information Capacity and Channel Bandwidth

The signal F(v) of Fig. 2 is shown over a finite period of time T.

The amount of information which can be extracted from a continuous wave of this type is a function of the number of independent samples which can be taken in T seconds. If the samples are taken so often that they are not truly independent of one another, then the information gained from each sample is reduced.

If signal F is being received from a communications system of infinite bandwidth, this worry disappears. In such a system, an infinite number of samples may be taken, even during a finite interval such at T. We could be assured that each sample would contain information totally uninfluenced by the last.

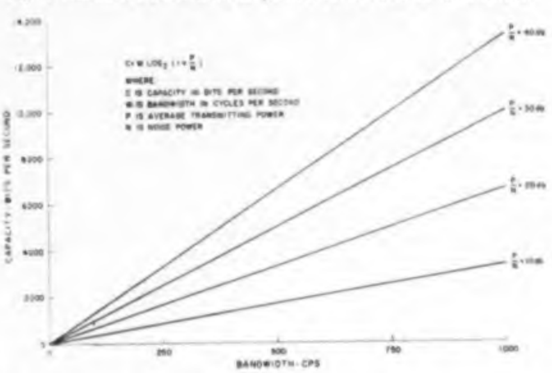
If, however, the communications system is a practical one and has only a finite bandwidth, a certain amount of time will elapse before the signal reaches a completely new value. It can be shown that this interval, for a continuous wave, is one-half cycle of bandwidth. Thus, the maximum "degrees of freedom" of a band-limited signal is 2TW, where T is the length of the signal and W is the bandwidth.

Transmission Rates

We have seen how two important characteristics of a transmission system affect information capacity. Shannon determined that the relationship between them is generally as follows:

$$C = W \, \mathrm{Log}_2 \left[1 + \frac{P}{N} \right] \qquad (6)$$

Fig. 4: Shannon's basic formula plotted as function of information.



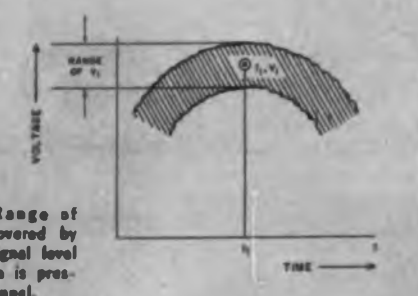


Fig. 3: Range of voltages covered by a given signal level when noise is present on channel.

where C = Communication Capacity of the channel in bits per second

W = Bandwidth in cycles per second

$\frac{P}{N}$ = Ratio of mean signal power to mean noise power

Fig. 4 is a graphical illustration of this relationship.

Eq. 6 defines a limiting condition where certain characteristics of the transmission medium are assumed. In considering its application to telephone circuits, several qualifications are necessary.

First, the formula assumes that the transmission medium has neither phase nor amplitude distortion. In everyday circuit layout, control of phase and amplitude distortion within narrow limits would be difficult to achieve. This is because of the many heterogeneous facilities in use. Telephone plant in service today ranges from microwave relay systems of the latest design to physical and phantom circuits which have been in plant for thirty years or more. It is necessary to practice random interconnection of all these types of facilities to achieve the flexibility in toll message circuit layout. Fig. 5 and 6 illustrate the range of phase and amplitude response which can be encountered on typical toll plant in service today.

Practical control of phase and amplitude distortion today is possible only on specially engineered, point-to-point circuits.

A second limitation in the application of the Shannon formula is that noise in the channel must be random. This implies equal noise power entirely across the frequency band.

Much of the "noise" encountered in telephone plant is, in fact, crosstalk. Crosstalk is the natural by-product of having many separate telephone circuits operated in close proximity. Crosstalk couplings in the plant can always be improved, but always at a price.

Crosstalk induces many types of noise into the telephone plant, but very little of it is truly random. Interference due to crosstalk includes many tones which are a part of the telephone companies' doing business; for example, dial tone, busy tone, recall supervision, and the usual 1000-cycle test tone. Power system harmonics and carrier leaks occur at discrete frequencies and refuse to spread across the

(Continued on page 06)

band as true random noise should. Crosstalk from loud talkers on other channels has its own distinctive characteristic.

A third requirement for a practice to conform to theory in the Shannon formula is the one which has proved to be the biggest stumbling block. This is the requirement that the encoding system be so complex that no possible combination of noise impulses will cause erroneous information to be transmitted.

Much work has been done on encoding systems since Shannon first propounded this theory and significant strides have been made, particularly with transmission in the microwave region. However, the instrumentation required to carry out the necessary encoding and decoding tends to become quite complex. A lot of work is going on in this field. We may expect to see some basic advances over the next few years.

Redundancy and Error Detection

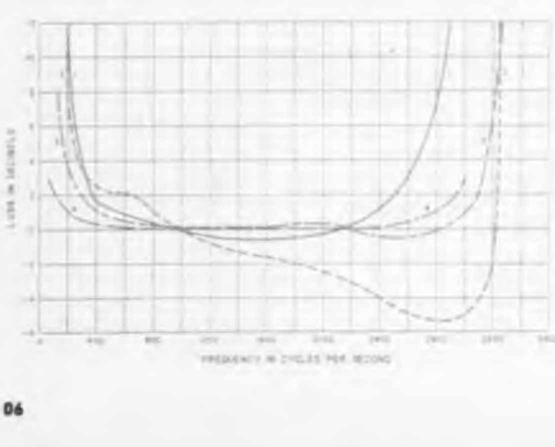
When the information in a message is encoded in the form of a language, occurrence of the various code symbols which comprises the language's alphabet is never completely random. Thus, we say that the appearance of a given letter or a given word in English is subject to "constraints" which act to modify an otherwise completely random probability of occurrence.

Every Scrabble fan tries to place his Z's and Q's as quickly as possible and earn the 10 points. E's, T's and A's at 1 point apiece are very easy to place in acceptable words, but the score earned is hardly worth the effort.

As a matter of fact, the Scrabble player who places a "Z" has gone to considerably more trouble than the scoring would indicate. Fletcher Pratt, in his book *Secret and Urgent*,[1] listed the frequency of the letter "E" as 131 per 1,000 letters. Only 0.77 "Z's" occur per 1,000 on the average. Thus, Z's should be worth 170 times as much as E's.

To get the most possible combinations from its alphabet, a language should allow its letters to fall with uniform probability. Constraints on where the

Fig. 5: Attenuation-frequency characteristics of carrier channels.



letters fall serve to introduce substantial redundancy in the transmission of information.

Anyone acquainted with English will know that the message

EPQ POGF URXTR

is probably not English, and that

CORING HOME FY TRAIM TLIGHT.
MEEQ ME AL THE STATIAN

probably was meant to be

COMING HOME BY TRAIN TONIGHT.
MEET ME AT THE STATION.[2]

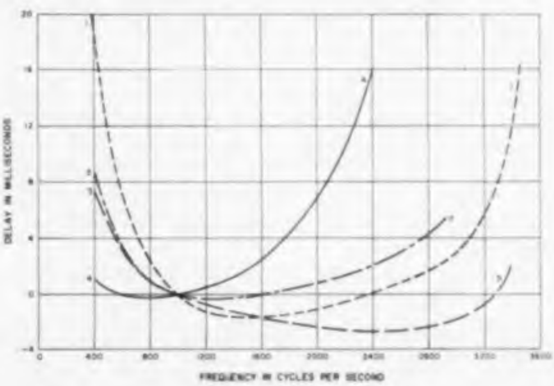


Fig. 6: The delay characteristics of some typical phone channels.

Thus, redundancy of the English language permits great liberties in the transmission of the spoken and the written word. Experts have calculated that redundancy in both spoken and written English may approach 50%.

Methods of Encoding

Machine transmissions which lack the natural redundancy of spoken English must generally have some inserted, since all transmissions occur in the presence of noise. Much of the mathematical work appearing in current literature on information theory is devoted to the study of this problem.

Redundant symbols in a code necessarily are costly, because they use up transmission time and carry no "payload." Shannon's formula tells how to interchange transmission time (or bandwidth) for transmitter power. However, transmitter power in megawatts is also costly. It is usually of little value in message telephone circuits, where crosstalk couplings quickly become controlling.

Methods of encoding often attempt to put the message in a form such that it has some statistical property which can be anticipated at the receiver. Thus a very sophisticated receiver can detect the difference between signal and noise even when there is very little choice between them.

Receivers can be made even more discriminating when they can be forewarned about the statistical nature of the noise as well as that of the signal. Certain characteristics of thermal, or "Gaussian," noise have been fairly well defined. These include its peak-to-average ratios for certain percentages of the time, and its frequency spectrum in a given communications channel.

(*Continued on page* 012)

Ahead of the times in styling, engineering, and performance

NEW GATES STUDIOETTE

For you, Mr. Broadcaster, a 100% new speech input system. The cost is modest, and yet, the new Studioette represents the ultimate in superior performance and reliability. And look at the incomparable styling of the Studioette! This is the console that will set new standards in Radio-TV stations and Recording Studios throughout the country.

SPECIFICATIONS IN BRIEF

Four channel ladder mixer accomodates four microphones into dual preamplifiers, three turntables, two tapes or projectors, network, 3 remote lines all key selected. Three unwired utility keys provided for your individual needs. High gain program amplifier, 10 watt ultra linear monitoring amplifier, dual muting and warning light relays, 4" illuminated VU meter, self contained power supply, complete cueing facilities for turntables, net, tapes and remotes, output emergency key. Reliable printed wiring, hinged down front panel, hinged up inner chassis for 100% accessibility. Knobs and keys color circuit identified. 24" wide, 8¼" high, 17" deep, panel 30° slope black anodized on gray. Space provided for third preamplifier if ever needed.

Write today for Gates Audio Guide, containing complete specifications on the new Studioette plus descriptive information on four other modern speech input systems. No obligation, of course.

$795.00

Immediate delivery

GATES

GATES RADIO COMPANY

QUINCY, ILLINOIS

Subsidiary of Harris-Intertype Corporation

OFFICES — NEW YORK - WASHINGTON, D. C. - HOUSTON - ATLANTA

INTERNATIONAL DIV., 13 East 40th St., New York City — In Canada, CANADIAN MARCONI COMPANY

Circle 76 on Inquiry Card, page 97

A vacuum tube approach makes possible the elimination of the transformer in audio and ultrasonic bridges. The purpose is to eliminate effects of transformer winding capacitance on bridge balance.

Transformerless

THE effect of transformer winding capacitance on the balance of bridges in the audio and ultrasonic frequencies is well known. Only by the use of special design may this disturbing effect be eliminated, and the experimental laboratory often does not have such a unit on hand. The circuit to be described here was developed to eliminate the need for such a transformer.

The design approach was to have a system that would be simple in the extreme and inherently balanced over a broad band without the need of compensating adjustments. The basic circuit used here is well known, that of injecting a signal at the grid of a tube and at the same time placing the comparison signal on the cathode. Thus, they will cancel if both are of the same magnitude and phase. Such an arrangement constitutes a vectorial subtracting system. Due to the low impedance of the cathode input it is necessary to supply the signal at this point from another low impedance source. This is readily done by using a cathode follower as a driver and giving both a common *B*— return. Under no conditions can the simple cathode follower have unity gain which would be required to place identical signals on both grid and cathode. The commonly accepted approach to this impasse is to place an attenuator in the grid of the tube from whose plate the difference signal is taken. Such an arrangement is shown in Fig. 1. This approach solves the problem but raises two additional ones. First, the grids must be returned to ground to permit the attenuator to function, and secondly, the finite input capacitance of the tube must

Fig. 1: Conventional circuit uses attenuator in grid circuit.

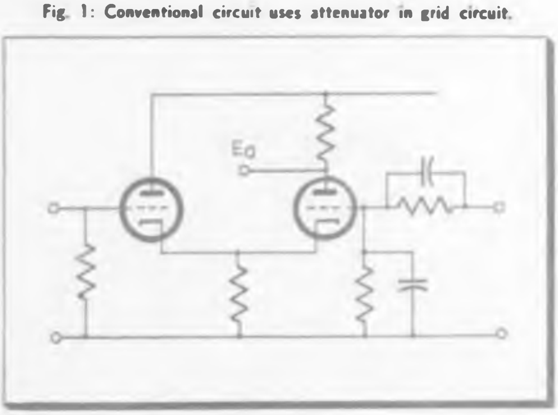
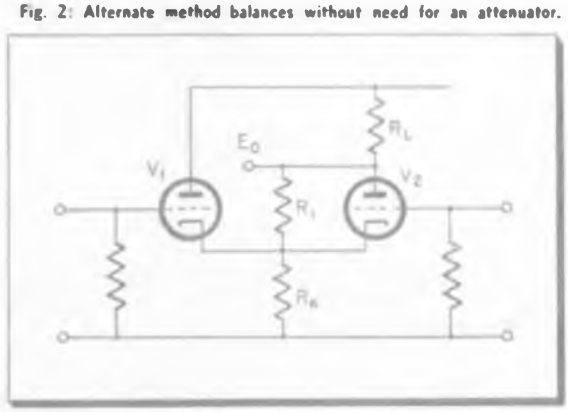


Fig. 2: Alternate method balances without need for an attenuator.



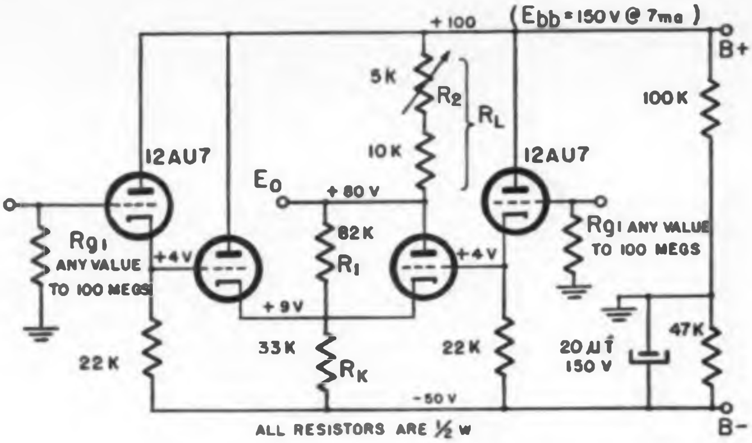


Fig. 3: Final circuit of the transformerless bridge null detector.

By C. C. STREET
2454 Darby Ave.
Reseda, California

Bridge Null Detector

be compensated for if the circuit is to be used in the upper frequency ranges. If the necessary balancing could be obtained in a manner that did not involve either grid, then a greater latitude in circuit arrangement would be possible. Such a method of compensation is shown in Fig. 2. The cathode signal is 180° out of phase with the residual on the plate, and by connecting R_1 from cathode to plate some of this signal is injected at the plate to cancel the undesired residual. If R_1 were made a variable, the capacitance to ground of the potentiometer body would disturb the balance at higher frequencies, so R_1 is made fixed and a portion of R_L is made variable. If the arm of the potentiometer is connected to $B+$ and one end to the fixed resistor the stray capacitance added will be small. The circuit as shown will remain inherently balanced up to about 0.5 MC if reasonable care is used in construction. The most sensitive lead is that of the common cathodes to ground.

To obtain good cancellation between the two signals it is necessary that both tubes be linear amplifiers over as great a dynamic range as possible. The linear behavior can be improved if a large value for R_K is used. By raising ground above $B-$ this is possible without serious loss of gain. This results from the low impedance seen by V_2 due to the cathode of V_1. The shifting of ground above $B-$ permits the final arrangement of the circuit as shown in Fig. 3. Here, cathode followers are used as input tubes and their cathodes directly connected to the grids of the mixer section. For the values shown the input grid current is approximately 5×10^{-10}a. Input capacitance, neglecting strays that are governed by construction, is less than 2 μμf. Individual tube shields should not be used, since this adds to the plate capacitance. Instead, the entire unit should be contained in a shielded space sufficiently large so that it does not interact with the circuit. If the bridge to which this circuit is connected has an internal ground return, it may be directly connected and offer at moderate frequencies an almost infinite input impedance to the bridge.

When the two inputs are tied together and a signal applied, R_2 as shown in Fig. 3 may be adjusted till the fundamental is wholly balanced out. Under these conditions there will be a small residual of second harmonic that is generated by the slight nonlinearity of the tubes. For an applied signal of:

E_s	E_o
1v	0.3mv
3v	2.0mv
10v	20.0mv

By the use of a filter this residual may be reduced to a very small value limited only by hum pickup, circuit noise, and a slight drift in the balance adjustment. The drift will usually stay within 100 μv or less for a ten-volt input. The gain per half is 2:1. This brings the full gain, for two equal signals 180° out of phase, to 4:1.

CUES for Broadcasters

Power Indicator for Fan Motor

R. E. PECK, Ch. Engr.
WREX-TV, Rockford, Ill.

In our transmitter, as in many other air-cooled rigs, several heavy duty, three-phase motors are used for blowing air through the final amplifier tubes. These motors are turned on and off by means of a three phase contactor which in turn is actuated by the "start-stop" switch.

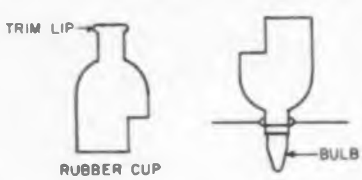
Sometime ago, one of the contacts of the motor control contactor stuck in such a manner that power was applied to one phase of the motor, though to all appearances the transmitter was off. We have no idea how long this condition existed because there was no indication of its occurring. The result was that one morning, a few minutes after sign-on, the motor in question burned out causing us considerable trouble and off-air time.

We have since taken the following precaution to prevent a recurrence of the above. Across each leg of the three phase input to the motor, we connected a neon lamp mounted on the front panel of the transmitter so that any irregularity in the operation of the contactor is quite apparent.

Bulb Remover

STAN BLITZ, TV Engr.
WCKT, Miami, Fla.

Changing a telephone base bulb in a RCA TS 20 video switcher, or similar equipment employing this type of bulb setup, can be awkward and inconvenient. It is especially when the switcher is in use.



Modification of cup simplifies bulb removal.

The following device proved to be a practical and efficient bulb remover: Take out the inside rubber cup from a standard mike plug and trim the lip of the smaller opening. The smaller opening can then slip over the bulb giving a firm grip on it for easy removal.

Stylus Saver

ELMO W. REED, Ch. Engr.
WJPG, Green Bay, Wisc.

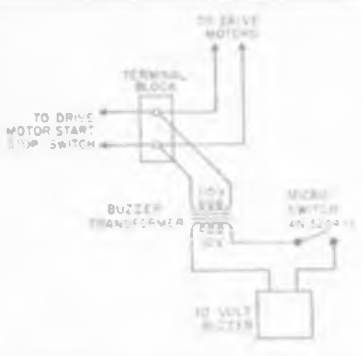
After having damaged a number of recording styli due to failure of the operator to engage the feed screw clutch before dropping the cutter head, it was decided that some form of alarm was needed. When lowering the cutting head without the feed screw operating the stylus cuts a single groove and in a matter of a few seconds it has cut through the acetate and into the aluminum thereby damaging the sapphire stylus.

Switch for alarm is mounted inside end cover plate of the feed screw mechanism.

The system described here makes use of an alarm buzzer that sounds the instant the turntable motors are started and continues to sound until the operator engages the feed screw clutch.

The heart of the system consists of the installation of a Micro-Switch inside the end cover plate of the feed screw mechanism as shown in the photo. The Micro-Switch is attached to a small "U" bracket which in turn is bolted to the inside of the housing by means of two 6-32 screws. It is necessary to drill two holes in the housing for this purpose.

To actuate the plunger on the Micro-Switch a 1 in., 6-32 machine screw is mounted in the top of the slot already existing in the clutch and pitch control mechanism. This screw is locked in place by means of a 6-32 nut and associated flat and lock washers. When the Feed Screw Drive Release Lever is in the "OFF" position the plunger of the Micro-Switch is actuated and electrical contact is made through the switch. As a result when the drive motors are started the buzzer sounds and warns the operator to engage the feed screw clutch before dropping the cutting head. By engaging the clutch lever the Micro-Switch is released and electrical contact is broken thus turning off the buzzer.



This wiring can save the recordng styli.

$$$ for Your Ideas

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is requested. Our usual rate will be paid for material used.

TOWER TIPS

Concrete Foundations

Most foundations are made of reinforced concrete. Since the concrete is in a wet plastic state when it is poured, it is necessary to confine this wet concrete until it hardens. Usually, these forms are made of wood. Sometimes in small towers, forms are dispensed with at the anchors simply by digging a hole of rectangular shape and allowing the sides of the earth to give the concrete its shape. On a large tower, the wooden forms run into a considerable amount of money.

Except for tiny foundations, concrete piers and anchors are always reinforced with reinforcing bars of the deformed type of steel. The purpose of these bars is to help carry any tensile stresses in the concrete block, since concrete is essentially a compressive load carrying material. Deformed steel is used since the deformed surfaces give a better mechanical bond to the concrete. Since reinforcing bars are universally obtainable, it is usually procured locally. The reinforcing bars should be carefully wired and placed together as called for on the foundation drawing prior to pouring the concrete. Sometimes these bars are welded together into a subassembly.

The concrete is usually obtainable from a local ready-mix plant. The foundation designer always specifies the proportions of the mix and the water-cement ratio or strength of concrete. These items should be relayed to the supplier of the concrete. A typical mix is 1-2-4, where the numbers 1-2-4 represent the proportions of cement, sand, and gravel. The water cement ratio is often expressed by specifying approximate compression strength of the concrete after 28 days. A typical strength is 2500 lb. per square inch.

As the concrete is being poured, precautions should be taken to see that the forms are filled completely. The usual method is to simply poke or churn the concrete with a pole or shovel, especially along the edges of the forms. Care should be taken to see that the steel arms which protrude from the forms are not moved or disturbed by the pouring of the concrete.

On towers where the guys are supplied with fixed lengths, it is most important to know the exact dimensions from the working points at each guy anchor. These are surveyed and determined prior to pouring of concrete. Since the concrete may disturb the steel anchor arms, it is advisable to survey the installed anchors and get a new set of readings locating these work points.

In pouring concrete under water, proper forms and a comparatively dry mix will aid procedure. Where the simple method of depositing the concrete under water directly is not possible, a coffer dam can be built. A coffer dam is a temporary wall structure out of which water is pumped so that work may be carried on in a comparatively dry area.

Frozen concrete may not suffer any visible deterioration, but its strength is greatly decreased. Some precautions must be taken during freezing weather. Fresh concrete, when frozen, is easily recognized by its white color, whereas ordinary concrete will remain a sort of slate color. One precaution is to heat the ingredients and water prior to mixing, and then cover the poured concrete with layers of hay, straw; and sometimes heat is introduced from a portable heater. Another precaution is adding calcium chloride to the mixture. This generates heat during the setting period.

There are occasions where high strength in concrete foundations at an early age is desired so that the erection of steel may begin at the earliest possible moment or to make possible early re-use of forms. In cold weather construction, high-early strength reduces the time of protection required. High strengths at early ages may be achieved by using a type III portland cement usually designated as high-early strength portland cement or by using richer mixtures of other types of portland cement. The type III cements cost more than the normal portland cement.

Since the important factors which govern the strength of portland cement concrete are the relative proportions of cement and mixing water and conditions during curing, great latitude in obtaining desired strengths at a given period can be had by adjusting these factors. Sometimes, calcium chloride is used as an accelerating admixture to increase the rate at which concrete develops its early strength. The calcium chloride is particularly effective in increasing strengths at 1 to 3 days. On the other hand, for a given water content, high-early strength cements give higher strengths than normal portland cement either with or without the accelerator at the later ages up to about one year.

Walter L. Guzewicz

 Circle 110 on Inquiry Card, page 97

Information Theory *(Concluded)*

Telephone circuits and the English Language

To communications engineers interested in offering most service per dollar, the redundancy of English is an old friend. Many intangibles enter into the planning and operation of a nation-wide public communications network. Among these are the probabilities that a given number of circuits will be connected together in tandem by switching equipment in response to traffic demands. Another is the probable type of user of the message circuit.

Overriding everything else is the customer's tolerance to error and the type of transmission he demands. These points, in turn, are influenced by the characteristics of the language he uses and the manner in which he expresses and receives ideas.

Human users of the telephone networks are content with a rate of transmission equal to that employed by them in face-to-face communication. Customer demands for improvement in transmission exist, and work constantly goes on to meet them. Nevertheless, there is still a predictable limitation upon transmission speed and accuracy which will be demanded for human use.

Mechanical Information Users

As a consequence of the high percentage of human users of the telephone network, the vast majority of toll and exchange circuits present in today's plant are geared to the needs of the transmission of spoken English with its built-in redundancy. While this has probably been achieved more by a process of elimination than by plan, it remains a central fact of our present-day public communications system. Attempts to handle transmission between machines which employ some more sophisticated alphabet than spoken English need to be approached cautiously.

Our modern telephone plant contains millions of circuit miles of channels which are generally satisfactory for communication via spoken English. As long as telephone circuits carry spoken English successfully, they are normally left up for service. As soon as customers complain of not hearing or not understanding, the circuit is turned down for repairs. This is the final criterion for circuit performance.

Precise electrical characteristics of a few of these channels by types are fairly well known. The characteristics of any given combination of facilities in the telephone plant could only be generally guessed at. To obtain a statistical sample of even a small cross section of such facilities is a monumental undertaking. Therefore, any attempt to superimpose transmission of a different language than spoken English on such a network must reckon with these circumstances.

If telephone channels were designed specifically for data circuits, strong emphasis would be placed on achieving characteristics that would permit a maximum transmission rate with minimum error. Such characteristics would include small phase distortion, freedom from impulse noise, level stability and frequency stability.

Table 1

BASIC TELEGRAPH SYSTEMS						
Type	**Number of Channels**	**Spacing**	**Type of Keying**	**Total Band Required**	**Bits per Second**	**Notes**
A.T.&T. Lenkurt Signal Corps	16	170 cps	F-M & A-M	340-3060 (16 ch)	74 per ch 1187	100 wpm/channel
Western Union Telegraph	20	150 cps	F-M	[illegible] (20 ch)	57 per ch 1136 74 per ch 1484	75 wpm/channel 100 wpm/channel
Collins Synchronous Telegraph	Up to 40	110 cps for each 2 ch.	Phase-shift	550-2750 delay equalized (40 ch)	74 per ch 2960	All channels must be synchronized. Makes use of special synchronizing signal to effectively regenerate all channels. All channels must originate and terminate together.
VOICE CHANNEL DATA SYSTEMS						
IBM Card-to-Card Transceiver	[illegible]	450 cps	A-M	650-2450 (4 ch)	100 bits/channel Transmits 11 cards per minute	Used on leased toll circuits with echo suppressors removed. Uses code which includes two error checking bits for each 6 information bits.
A.T.&T. (experimental)	1	--	F-M	700-1800	750	Designed to work over any telephone circuit which may be dialed. Error rate between 1 in 10,000 and 1 in 100,000
A.T.&T. Teletypesetter	1	--	A-M	1000-2800	510	Phase delay equalization required
SAGE	1	--	A-M (Vestigial Sideband)	500-3000	1600	Phase delay equalization required from 1000-2500 cps. Sensitive to impulse noise. Error rate of less than 1 in 100,000
Western Union Sub-band	2	1500	F-M	300-3300 (2 ch)	1800 delay equalized 1500 unequalized	Under development. For operation on same voice channels as Western Union Telegraph Systems. These voice channels are not the ordinary "dialed-up" channels but are special for W. U. Telegraph.
Signal Corps AN/TSQ-7 AN/TSQ-8	1	--	A-M Double Sideband	975-2500	750	Delay equalization required.

A REPRINT
of this article can be obtained by writing on company letterhead to
EDITOR
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

Machine transmission over the telephone network at various speeds is not new. Morse Code was the earliest form of electrical digital data transmission. The printing telegraph in various forms followed shortly after. The teletypewriter is a fairly sophisticated digital data transmitter and receiver with planned redundancy and a predictable long-term average error rate over known types of facilities.

Practical Data Transmission Systems

Despite the formidable limitations which seem to prevent us from applying pure information theory to transmission through the telephone plant, there are a number of practical digital transmission systems in use or about to be introduced. Generally these systems can be divided into three broad categories: (1) slow-speed, narrow-band systems originally designed for teletypewriter service, (2) medium-speed systems using a major part of the speech channel bandwidth, and (3) super-speed systems requiring bandwidth up beyond normal voice frequency channels and as high as the video range. The telegraph- and voice-channel-speed systems in current use are summarized in Table I.

Conclusions

While much is still to be learned about the manner in which humans exchange information, the new-found theory is already being exploited to the utmost in discovering what makes machines communicate efficiently. This communication between machines is certain to change the over-all pattern of our present-day telephone systems and has a fair chance of reorganizing business in general. It permits a tremendous increase in the degree of automation of office functions.

Real-time data processing while the equipment is on the line is a staggering concept. This, and many other startling developments are being built up around the fundamental work being done by many advanced scientists and mathematicians in this challenging new field.

BIBLIOGRAPHY

1. Fletcher Pratt, *Secret and Urgent*, Garden City, New York, Blue Ribbon Books, 1942.
2. Stanford Goldman, *Information Theory*, New York, Prentice-Hall, Inc., 1953.
3. Harold S. Black, *Modulation Theory*, Princeton, New Jersey, D. Van Nostrand Co., Inc., 1953.
4. Stanford Goldman *Frequency Analysis, Modulation of Noise*, New York, McGraw-Hill Book Co., Inc., 1948.
5. Wilbur B. Davenport, Jr., and William L. Root, *Random Signals and Noise*, New York, McGraw-Hill Book Co., Inc., 1958.
6. *Data Transmission*, Lenkurt Demodulator, Vol. 5, No. 4, April, 1956.
7. *Digital Data Transmission*, Lenkurt Demodulator, Vol. 6, No. 9, September, 1957.
8. *AM Versus FM*, Lenkurt Demodulator, Vol. 7, No. 2, February, 1958.

Based on a paper presented by Mr. Culbertson at the Industrial Communications Association Conference, May 23, 1958, San Francisco, Calif.

New Products

OSCILLOSCOPE

Type 401-A general purpose low-frequency oscilloscope offers front panel controls for calibration setting or switching from automatic to driven sweep; metric calibration and readout; externally or internally triggered "electronic shutter" for beam brightening; good sync lockout; and continuous use of X- and Y-amplifier controls without disturbing calibration. It is custom hand-wired, and

incorporates fall-away side panels for maintenance. A. B. Du Mont Labs., Inc., 750 Bloomfield Ave., Clifton, N. J.

Circle 270 on Inquiry Card, page 97

STEREO CONTROLS

For the individual or combined control of volume in dual-channel amplifiers, dual concentrics featuring a positive clutching and declutching arrangement are available. The 2 sections of control can be operated either simultaneously or, by pulling out the rear shaft ¼ in., individually. The sections are operated individually while adjusting for desired balance between the 2 amplifier channels; then, pushing in the shaft, the 2 sections become locked together for simultaneous and balanced operation. Clarostat Mfg. Co., Inc., Dover, N. H.

Circle 271 on Inquiry Card, page 97

VTVM

A vacuum-tube-voltohmmeter with an input impedance of 22.0 meghohms and other advanced characteristics has just been introduced. The dc/ac ohms probe (supplied with the unit)

features a new "Timesaver Tip." This development permits hanging the probe on a lead wire for continuous readings, and also provides positive pressure contacts for point-to-point measurements. Model 311 gives pk-pk readings of complex ac voltages, as well as sine waves. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Circle 272 on Inquiry Card, page 97

New Products

MICROWAVE RADIO

A compact transmitter-receiver unit for microwave radio relay systems that provides 5 times the previous one-package channel availability can be inexpensively pole-mounted.

The MM-9E operates with a minimum of interference from atmospheric conditions, permitting uninterrupted remote control of a pipeline system from a central point, with no threat of broken wire circuits in ice or snow storms. It provides 25 channels. Radio Corporation of America, Camden 2, N. J.

Circle 289 on Inquiry Card, page 97

SSB EQUIPMENT

The transceiver (SSB-200) is intended for use in the frequency range of 2.4 to 20 MC for commercial point-to-point or mobile service. The transmitter-receiver is adaptable to various methods of operation. It is normally used as a radio-telephone. Its power output is 200 w. (min. pk envelope power). With accessories, the

unit can be easily adapted to radio teletype transmission with as many as four receiving and transmitting channels. Barker & Williamson, Inc., Dept. 3, Bristol, Pa.

Circle 290 on Inquiry Card, page 97

Circle 41 on Inquiry Card, page 97

New Products

MOBILE RADIO

A 50-watt mobile radio unit with a completely transistorized power supply, encased in an "eight-inch" housing, is available. The MCA 101-E (25 to 54 MC) incorporates a unique

front panel 45° angle "heat sink" design to allow optimum performance whether the unit is installed horizontally, vertically, or on its side. It is available for wide band, adjacent channel, or split channel operation by means of permanent plug-in filters. A. B. Du Mont Labs., Inc., 760 Bloomfield Ave., Clifton, N. J.

Circle 279 on Inquiry Card, page 97

MICROWAVE EQUIPMENT

New microwave r-f equipment designed for duplex, multi-channel, point-to-point communications is available. Operating in the 6,000-7,000 MC band, MR-20 microwave equipment is able to utilize high gain, highly directional antennas of reasonable size, permitting reliable operation at conservative transmitter power output. Major power gain in

the antenna system, permits use of low power reflex klystron tubes in the transmitter and receiver. Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

Circle 280 on Inquiry Card, page 97

Circle 53 on Inquiry Card, page 97

New Products

MULTICOUPLER

Designed to couple one antenna to 10 receivers operating anywhere between 2 and 32 MC, the new TRAK Model 21 Multicoupler features 60 db isolation between outputs, 60 db at-

tenuation of intermodulation components, and a 6 db noise figure. Modular isolator circuits attenuate receiver local oscillator signal by more than 90 db. Degradation of weak signals by a 1 v. signal is limited to 1 db over the band. Selection between input impedances is made by patch cord. CGS Labs., Inc., Ridgefield, Conn.

Circle 281 on Inquiry Card, page 97

POWER SUPPLY

A transistorized power supply for use as a replacement for mobile transmitter-receiver power supplies of the vibrator and/or dynamotor type has been introduced. Designated as Type QU-051, it is a lightweight, compact dc-to-dc conversion unit. It requires 12.6 v. at 9.0 a. It will operate on voltages as low as 6 vdc with reduced output. Output is (1) 200 v at 80 ma.,

adjustable between 150 and 250 v.; (2) 400 v at 250 ma.; (3) —25 v at 10 ma. International Telephone & Telegraph Corp., 15191 Bledsoe St., San Fernando, Calif.

Circle 282 on Inquiry Card, page 97

International

ELECTRONIC SOURCES

ELECTRONIC INDUSTRIES' exclusive monthly digest of the world's top electronic engineering articles

ANTENNAS, PROPAGATION

Nonreciprocal Electromagnetic Wave Propagation in Ionized Gaseous Media, L. Goldstein. "IRE Trans. PGMTT." January 1958. 11 pp. The nonreciprocal propagation of electromagnetic waves in ionized gaseous media is discussed, and experimental observations are reported in this paper. (U.S.A.)

CIRCUITS

Design of Aperture-Coupled Filters, Florian Shnurer. "IRE Trans. PGMTT." October 1957. 6 pp. (U.S.A.)

- Photocopies of all foreign articles are available at 50 cents per page, remitted with order. **Unless otherwise indicated, articles appear in language native to country of origin.**
- *Articles marked with an asterisk are available as free reprints.
- A reprint of this month's 8-page "International Electronic Sources" section is available without charge.

Requests for the above should be sent, on company letterhead, to:

Electronic Sources Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts.
Philadelphia 39, Pa.

* * *

For more information on domestic articles, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request from the above address.

A Variable-Ratio Microwave Power Divider and Multiplexer, W. L. Tester and K. R. Bushore. "IRE Trans. PGMTT." October 1957. 3 pp. A microwave circuit is presented which provides continuous variation of microwave power between two outputs in any desired ratio. A typical device utilizing the circuit is described, and other uses of the circuit are discussed. (U.S.A.)

The Pentode Gyrator, Gerald E. Sharpe. "IRE Trans. PGCT." December 1957. 3 pp. A gyrator may be constructed from four pentodes, no other network element being necessary. The method is based on a theory of ideal active elements recently proposed by the author. Two physically-distinct kinds of gyrator, electric-electric and magnetic-magnetic types, may be obtained. A modification to Tellegen's gyrator symbol is proposed to distinguish these types. (U.S.A.)

Theory of the Band-Centering AFC System, J. Vlicton Samuels. "IRE Trans. PGCT." December 1957. 7 pp. A theory of the band-centering afc system for pulsed-carrier operated receivers is developed. The interaction between the afc system and the agc system of the IF amplifier is accounted for by introducing a so-called ideal agc action. (U.S.A.)

Some Properties of Three-Terminal Devices, S. J. Mason. "IRE Trans. PGCT." December 1957. 3 pp. A three-terminal device can be classified according to its deviation from three-way symmetry. Such classification offers a particularly compact and symmetrical expression of the passivity criterion and also relates the asymmetry of the device to the unilateral power gain obtainable with lossless bilateral coupling. (U.S.A.)

The Limits of Gain Attainable in Three-Terminal RC Networks with Two Capacitors, I. Cederbaum. "IRE Trans. PGCT." December 1957. In the paper some properties of the transfer function of a three-terminal RC network with two capacitors are deduced from a basic theorem concerning pure resistive four ports. (U.S.A.)

Transformations of Positive Real Functions, S. Seshu and N. Balabanian. "IRE Trans. PGCT." December 1957. 7 pp. In this paper, methods of transforming one or more positive real functions with a positive real function, resulting from the transformation, are considered. In addition to collecting the known transformations of positive real functions, this paper presents a generalization of the well-known Richards' transformation and strengthens some of the known results on transformations of driving point impedance functions of two-element type networks. (U.S.A.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El. Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electro-akustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-i Radiotechnicznego
Roz. Elek. Rozprawy Elektrotechniczne

USA

Auto. Con. Automatic Control
Av. Age. Aviation Age
Av. Week. Aviation Week
Bell J. Bell Laboratories Journal
Comp. Computers and Automation
Con. Eng. Control Engineering
El. Electronics
El. Des. Electronic Design
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES
El. Mfg. Electronic Manufacturing
IRE Trans. Transactions of IRE Prof Groups
I. & A. Instruments & Automation
Insul. Insulation
M/R. Missiles and Rockets
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Proc. IRE. Proceedings of the Institute of Radio Engineers
Rev. Sci. Review of Scientific Instruments

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

OTHER

Radio Rev. La Radio Revue (Belgium)
Kovo. Kovo Export (Czech)
J. ITE. Journal of the Institution of Telecommunication Engineers (India)
J. IECE. Journal of the Institute of Electrical Communication Engineers (Japan)
Phil. Tech. Philips Technical Review (Netherlands)
Eric. Rev. Ericsson Review (Sweden)
J. UIT. Journal of the International Telecommunication Union (Switzerland)

International ELECTRONIC SOURCES

Parallel-T RC Selective Amplifiers, J. J. Ward and P. V. Landshoff. "E. & R. Eng." April 1958. 5 pp. The most commonly used form of parallel-T selective amplifier requires that the input signal be derived at high impedance. In this article a less familiar form of the circuit, intended for use where the input signal appears at low impedance, is described. A series of equations is derived, from which the performance of the circuit as an amplifier or an oscillator can be calculated with considerable accuracy. (England.)

A Wideband Voltage-Controlled Swept-Frequency R-C Oscillator, R. S. Sidorowicz. "ATE J." April 1958. 25 pp. The instrument gives an output signal of about 5 V r.m.s., and covers the frequency range 20 c/s to 3.0 kc/s. It consists of a parallel-tuned oscillator, a sweep waveform generator, and two special control circuits. (England.)

Limited-Gain Operational Amplifiers, A. W. Keen. "E. & R. Eng." April 1958. 3 pp. The effect of finite gain in an operational amplifier can be allowed for by assuming that the amplifier gain is infinite and then adding fictitious circuit elements to the feedback network to reduce the gain to the value actually obtained. This procedure reduces the labor involved in calculating the operational error. The equivalent networks for some practical single-stage amplifiers are given. (England.)

Dekatrons and Electro-Mechanical Registers Operated by Transistors, G. B. B. Chapin and R. Williamson. "Proc. BIEE." May 1958. 6 pp. In the circuits described the Dekatron is driven by a transistor blocking oscillator which, when triggered, produces a pulse of defined amplitude and width, followed by a similar pulse of opposite polarity. For operating a mechanical register two transistors are cross-coupled in a monostable circuit. The register is in the collector circuit of one transistor, which conducts for 0.1 sec when triggered. (England.)

A Transistor High-Gain Chopper-Type D. C. Amplifier, G. B. B. Chapin and A. R. Owens. "Proc. BIEE." May 1958. 9 pp. The paper describes a modulated system consisting of a transistor input chopper, a high gain transistor a. c. amplifier, and a transistor output chopper. (England.)

Some Transistor Input Stages for High-Gain D. C. Amplifiers, G. B. B. Chapin and A. R. Owens. "Proc. BIEE." May 1958. 9 pp. (England.)

Stagger-Tuned Band-Pass Amplifiers, Design for Prescribed Overshoot, Yona Peless. "E. & R. Eng." May 1958. 4 pp. A procedure for designing band-pass amplifiers having specified gain, overshoot and either bandwidth or rise time is given. The design is limited to the narrow-band case and is based on the theory of transitional Butterworth-Thomson networks developed in an earlier paper. Detailed data covering single-tuned cascades consisting of five stages or less is included. (England.)

Magnetic Amplifiers: Basic Principles and Applications, L. W. Stammerjohn. "Bell. Rec." January 1958. 5 pp. Some of the most satisfying discoveries of all are re-discoveries. In electronics, a very significant re-discovery of the past twenty years has been the magnetic amplifier. The principles of this amplifier have been known for some time but new magnetic materials, modern circuitry and improved semiconductor rectifiers have brought this older art into new usefulness. (U.S.A.)

Tables of Networks Whose Reflection Coefficients Possess Alternating Zeros, Louis Weinberg. "IRE Trans. PGCT." December 1957. In this paper tables are presented for networks whose reflection coefficients possess zeros that alternate in the left and right half planes. The tables are classified on the basis of the parameter, which is the input-to-output resistance or conductance ratio. (U.S.A.)

Reliability Improvement by the Use of Multiple-Element Switching Circuits, W. E. Dickinson and R. M. Walker. "IBM J." April 1958. 6 pp. Physical devices used for switching have finite probabilities of failure. Circuits which make use of redundance to achieve resultant reliabilities greater than that of their elements have been proposed and have been analyzed for the case of intermittent failures. The present paper extends certain of these results to the case of permanent failures of the elements, assuming that the reliability of these elements is known. (U.S.A.)

Designing An Electronic Filter Servo, J. A. Webb. "El. Des." April 16, 1958. 3 pp. How to filter to extremely narrow bandwidths and at the same time retain good phase stability. (U.S.A.)

Simplifying Cathode Follower Circuit Design, Donald W. Moffat. "El. Des." April 16, 1958. 6 pp. The organization of cathode-circuit information as presented here should be of particular value to those engineers who have occasional use for cathode followers or related circuits and to young engineers meeting the subject in a practical way for the first time. (U.S.A.)

Transistorized Static Inverter Design, J. F. Lohr. "El. Des." April 16, 1958. 4 pp. Static inverters using high power transistors deliver large amounts of ac power with an efficiency previously considered to be unattainable. Where a typical rotary inverter might operate with an efficiency of 40 per cent, and equivalent static unit may yield 90 per cent. (U.S.A.)

Radio Waves Power Transistor Circuits, L. R. Crump. "El." May 9, 1958. 5 pp. Energy storage system supplies all power requirements for specially designed transistor circuits. Operation consists of receiving and rectifying r-f radiation, storing resultant d-c energy and releasing the energy as required to associated circuits. (U.S.A.)

Squelch Circuit Mutes Magnetic Tape Echoes, Daniel Cronin. "El." May 9, 1958. 2 pp. Biased-diode type of quieting automatic-volume-control silences audio channel whenever signal drops to 40 db below peak. (U.S.A.)

Alarm System Uses Gated Neon Warbler, Ronald L. Ives. "El." May 23, 1958. 4 pp. Two neon oscillators, alternately keyed at 2 cps in gated amplifier, provide locally generated warble alarm in Conelrad or carrier-off warning system. Modulation of monitored signal is audible only in case of alert or prolonged carrier interruption. (U.S.A.)

Active-Networks Papers. "IRE Trans. PGCT." September 1957. A series of 15 papers which includes: Survey of Some Properties of Linear Networks, E. Folke Bolinder; Active RC Networks, Richard D. Thornton; About Such Things as Unistors, Flow Graphs, Probability, Partial Factoring, and Matrices, Samuel J. Mason; Multipole Analysis of Active Networks, Lotfi A. Zadeh; Transformation Theory Applied to Linear Active and/or Nonbilateral Networks, Ernst A. Guillemin; Separation Transformations for Square Matrices, H. E. Meadows, Jr. and B. J. Dasher; The A Matrix, New Network Description, Theodore R. Bashkow; Some Simplifications for Analysis of Linear Circuits, George L. Matthaei; Negative Impedance Converters, A. I. Larky; Negative Impedance Circuits—Some Basic Relations and Limitations, W. Ralph Lundry; RC Active Networks Using Current Inversion Type Negative Impedance Converters, Takesi Yanagisawa; Design Principles for Single Loop Transistor Feedback Amplifiers, Franklin H. Blecher; Design of Conditionally Stable Feedback Systems, J. Oizumi and M. Kimura; Network Design by First-Order Predistortion Technique, Charles A. Desoer, and Synthesis of Non-PR Driving Point Impedance Functions Using Analog Computer Units, Walter J. Karplus. (U.S.A.)

Transistor A-C Amplifier Uses Multiple Feedback, Howard Lekkowitz. "El." May 23, 1958. 2 pp. Versatility and reliability are gained in transistor a-c amplifier using multiple feedback loop. Shunt and series loop used in a single stage enable such circuit properties as voltage and current gain, input and output impedance to be preselected and accurately controlled independent of variable transistor parameters. (U.S.A.)

Very Low-Noise Traveling-Wave Amplifier, E. W. Kinaman and M. Magid. "Proc. IRE." May 1958. 7 pp. Recent improvements in design and techniques are described which have lowered the noise figure of a developmental traveling-wave amplifier from 9 db to 6 db. (U.S.A.)

Magnetic Pulse Generators, J. E. Sunderlin and M. L. Weinberg. "El. Mfg." May 1958. 6 pp. Pulse generators using saturable reactors as switches overcome power limitations of thyratrons in radar applications. The general circuit principles and pulse forming network design discussed here apply to pulse generating systems such as an ignitron firing circuit. (U.S.A.)

COMMUNICATIONS

Phase Variations of 16 KC/S Transmissions from Rugby as Received in New Zealand, D. D. Crombie, et. al. "Proc. BIEE." May 1958. 4 pp. The results of approximately one year's measurement of the diurnal phase variation, in New Zealand, of the highly stable 16 kc/s transmission from GBR are given and discussed. (England.)

Atmospheric Radio Noise, Equipment for the Measurement of Amplitude Distributions, J. Harwood and C. Nicolson. "E. & R. Eng." May 1958. 8 pp. A description is given of equipment used to measure the characteristics of atmospheric noise. The measurements relate to the envelope of the noise after passage through a narrow-bandwidth receiver. (England.)

Difficulties Facing Long-Distance H. F. Communications in the Approaching Years, R. J. Hitchcock. "Brit. C. & E." May 1958. 5 pp. In this article the relationship between the performance of long-distance high-frequency point-to-point radio circuits and the sunspot cycle is discussed. The growth, development and use of these circuits in the past has coincided with a unique set of favorable solar conditions. The next few sunspot cycles are unlikely to be so favorable and serious loss of service may result. (England.)

The "MITE" Teleprinter, Bernard Howard. "W. V. Rev." April 1958. 8 pp. New, small telegraph page printers now under development by the Teleprinter Corporation weigh only 12 pounds and are entirely compatible with existing teleprinter apparatus. They embody radical innovations in design and are said to be the first practical teleprinters of their weight and size. Companion equipment will include a miniaturized transmitter-distributor and a reperforator. (U.S.A.)

Carrier-Noise Statistics for Various Carrier and Interference Characteristics, K. K. Clarke and J. Cohn. "Proc. IRE." May 1958. 7 pp. Techniques are presented for the calculation of the statistical properties of the resultant carrier-to-noise ratios of systems subject to both additive and multiplicative noise. (U.S.A.)

Theoretical Diversity Improvement in Frequency-Shift Keying, John N. Pierce. "Proc. IRE." May 1958. 8 pp. The analysis presented here determines the best methods for combining the several signals received by the several receivers under various circumstances so as to insure the most reliable transmission of the message. (U.S.A.)

Microwave Communications. "El. Eng." May 1958. A series of articles which includes:
A Survey of Microwave Radio Communication, W. J. Bray. 11 pp.
Microwave Line-of-Sight Propagation, W. Gough. 11 pp.
Tropospheric Scatter Propagation, G. Millington. 5 pp.
Microwave Link Development in the Radio Laboratories of the Post Office Engineering Department, C. F. Floyd and R. W. White. 9 pp.
Surveying for Microwave Relay Systems, L. E. Strazza and R. C. S. Joyce. 6 pp.
Microwave Radio Toll Systems, E. W. Anderson. 5 pp
Tropospheric Scatter Communication, G. L. Grisdale. 4 pp
S.H.F. Radio Links Using Travelling-Wave Output Amplifiers, G. Dawson and T. K. M. Korytko. 7 pp.
All Travelling-Wave Tube Systems, S. Fedida. 8 pp.
Portable U.H.F.-S.H.F. Links in the BBC Television Service, T. H. Bridgewater. 6 pp.
Broadband Microwave Systems Employing U.H.F. Triodes, G. W. S. Griffith and B. Wilson. 6 pp.
Travelling-Wave Tubes in Communications, R. R. Coulsoen. 8 pp.
Travelling-Wave Tube Amplifiers, D. H. O. Allen. 5 pp.
Travelling-Wave Tubes for 4,000 Mc/s, P. F. C. Burke. 5 pp.
Reflex Klystrons, A. H. Atherton. 6 pp.
Multi-Cavity Klystrons, V. J. Norris. 3 pp.
Coaxial-Line Velocity Modulated Oscillator Valves, D. E. Lambert. 5 pp.
Backward Wave Oscillators, A. G. Stainsby. 6 pp.
Triodes and Tetrodes for U.H.F.-S.H.F. Operation, C. A. Tremlett. 6 pp.
Ferrite Components in Microwave Systems, H. L. Humphreys. 5 pp.
U.H.F. Power Meter for Operation in the 2,000 Mc/s Communication Band, J. K. Murray. 4 pp.
The White-Noise Method of Measuring Cross-talk and Noise Interference in Multi-Channel Telephone Link Systems, J. F. Golding. 3 pp. (England.)

The Concept of Automatic Number Identification, A. E. Vitalo. "Bell Rec." May 1958. 4 pp. Two important goals are direct-distance customer dialing and automatic billing of all extra-charge calls. To help realize these goals, an automatic number identification (ANI) system has been developed. (U.S.A.)

Telemetering Receiving System at the Air Force Missile Test Center, H. A. Roloff. "IRE Trans. PGTRC." December 1957. 4 pp. The receiving system used at the Missile Test Range in Florida and the West Indies is described. An over-all picture of the radio-telemetering ground receiving equipment is offered including the antennas, rf distribution facilities, and demodulation equipment. (U.S.A.)

Problems in Aircraft Telemetering, E. F. Shanahan. "IRE Trans. PGTRC." December 1957. 3 pp. The development of aircraft telemetering at the Martin Company, Baltimore, Md., is described and the basic differences between aircraft telemetering as opposed to missile telemetering are discussed. Some outstanding problems, findings, and solutions are indicated. (U.S.A.)

Telemetry Standards for Guided Missiles, "IRE Trans. PGTRC." December 1957. 5 pp. (U.S.A.)

COMPONENTS

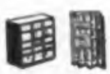
Optimum Design of Power Transformers and Saturable Reactors, Part I, T. R. Nisbet. "El. Des." April 16, 1958. 4 pp. This article, in two parts, presents a general design procedure for optimizing flux density and window shape, and hence, for providing best weight economy for transformers and saturable reactors. (U.S.A.)

Printed Circuits, N. Osifchin and J. Stockfleth. "Bell Rec." April 1958. 5 pp. Until recently, the extent to which complex electronic equipment could be decreased in size as a result of the new family of miniature devices—transistors, thermistors, semi-conductor diodes—was limited to a large degree by the physical space required for conventional wiring. This limitation has been largely overcome in many applications by the growing use of printed-circuit techniques. Considerable development work has been done in this area, particularly in fundamental studies on raw materials, and the physical and electrical characteristics of printed wiring. (U.S.A.)

Plug-In Bridge Checks VHF Quartz Crystals, Douglas W. Robertson. "El." May 9, 1958. 4 pp. Equivalent parameters of overtone crystals in range of 75 to 200 mc are rapidly measured with technique that combines desirable characteristics of both active and passive measuring systems. Bridge plugs into crystal socket of standard crystal impedance meter and crystal plugs into bridge. (U.S.A.)

Design Tips For Using High Temperature Precision Potentiometers, Robert J. Sullivan. "El. Des." May 14, 1958. 3 pp. Knowing a few basic qualities and limitations of high temperature potentiometers can help equipment designers insure best system performance. Included here are the important factors he should know. (U.S.A.)

Some General Properties of Nonlinear Elements. II. Small Signal Theory, H. E. Rowe. "Proc. IRE." May 1958. 11 pp. (U.S.A.)



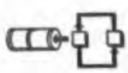
COMPUTERS

Special Purpose Computers in the Control of Continuous Processes, G. H. Amber and Paul S. Amber. "Auto. Con." May 1958. 4 pp. (U.S.A.)

Finding Zeros of Arbitrary Functions, Werner L. Frank. "J. Assoc. for Comp. Mach." April 1958. 7 pp. A method for finding real and complex roots of polynomial equations, due to D. Muller, is applied to finding roots of general equations of the form $F(z) = 0$, where $F(z)$ is analytic in the neighborhood of the roots. The procedure does not depend on any prior knowledge of the location of the roots nor on any special starting process. (U.S.A.)

The Digital Computer Makes Root Locus Easy, C. J. Doda. "Con. Eng." May 1958. 5 pp. To preserve the important link between transient response and frequency response, three programs have been written for the IBM 704 electronic digital computer. These programs will produce the complete locus of roots in a minute or two with very high accuracies. (U.S.A.)

New Applications of Impedance Networks as Analog Computers for Electronic Space Charge and for Semiconductor Diffusion Problems, G. Cremosnik, et. al. "Proc. IRE." May 1958. 10 pp. Starting from a general partial differential equation of the second order, which includes the equations of Laplace, of Poisson, and those of semiconductor diffusion problems, an equivalent equation with finite differences is discussed. (U.S.A.)



CONTROLS

The Test Operation for "Free" or "Engaged" Conditions During the Line-Finder Selection in EMD-Selector Systems, B. Braumann and R. Hannig. The "fast testing relay" for EMD selectors (motor driven selectors with contacts of precious metal) contains two magnetic systems. One of these systems has a short switching time of approx. 1 ms required for arresting the selector. The other system is available for other switching operations (for example for avoiding false testing). (Germany.)

Modular Redesign of Reactor Instrumentation, J. L. Cockrell, et. al. "Auto. Con." May 1958. 3 pp. This article describes how the basic circuitry of the reactor control instrumentation in Oak Ridge National Laboratory has been rearranged and in some cases, redesigned. (U.S.A.)

The Design and Application of Correlation Control, A. B. Chelustkin. "Auto. Con." May 1958. 3 pp. This article describes the theory, design and application of correlation computing devices. It shows how they are used with feedforward and feedback loops to produce systems with the adaptive properties. Examples are given of their use with steel strip rolling mills and pipe welding mills. (U.S.A.)

Procedures for Evaluating Dynamic Characteristics of Valve Actuators, Andrew Bremer. "Auto. Con." May 1958. 3 pp. This article discusses the procedures for obtaining the dynamic characteristics of valve operators and to point out the value of such information. (U.S.A.)

GENERAL

Single-Pulse Output from a Microswitch, E. H. Partoon. "ATE J." April 1958. 3 pp. The author describes a simple and effective method of overcoming the difficulty sometimes met in getting a single-pulse output from one of these switches. (England.)

A Solid-State Amplifying Fluoroscope Screen, B. Kazan. "RCA." March 1958. 16 pp. By using photo-conductive and electroluminescent materials, a thin solid-state panel has been developed which is comparable in form and size to the conventional fluoroscope screen. With X-ray intensities used in medical fluoroscopy, this produces a high-contrast image with a brightness of about one foot-lambert which can be viewed in moderate room light; however, seconds are required for image build-up. (U.S.A.)

Why Quickening Works, H. P. Birmingham and F. V. Taylor. "Auto. Con." April 1958. 3 pp. Rather than compete with hardware, the inclusion of a human in a high-performance control loop often necessitates more hardware—though of a special nature—to "flatter" the performance of the human operator. This article is a good introduction to the tricks of designing a system to include humans to advantage. (U.S.A.)

High-Temperature Aircraft Wires, W. F. Horstman and H. L. Wilson. "Insul." April 1958. 6 pp. (U.S.A.)

High-Resolution Magnetic Recording Structures, A. S. Hoagland. "IBM J." April 1958. 15 pp. Design concepts are established for several high-resolution magnetic recording structures, and their application demonstrated. The conventional ring head is treated and two new devices are described. A probe-type unit is discussed which shows promise in high-density vertical magnetic recording. A wire-grid array is also advanced to outline a unique conceptual approach to the achievement of higher resolution. (U.S.A.)

International ELECTRONIC SOURCES

The Automatic Creation of Literature Abstracts, H. P. Luhn. "IBM J." April 1958. 7 pp. Excerpts of technical papers and magazine articles that serve the purposes of conventional abstracts have been created entirely by automatic means. In the exploratory research described, the complete text of an article in machine-readable form is scanned by an IBM 7-4 data-processing machine and analyzed in accordance with a standard program. (U.S.A.)

Ceramic I-F Filters Match Transistors, Daniel Elders and Emanuel Gikow. "El." April 25. 1958. 3 pp. Barium titanate resonant filters used as i-f transformers provide reductions in size and cost with increased ruggedness, better skirt selectivity and lower insertion loss. (U.S.A.)

The Solid-State Maser—A Supercooled Amplifier, J. W. Meyer. "El." April 25. 1958. 6 pp. History, system philosophy, and performance described here include discussions of the following: two-level molecular maser, three-level solid-state maser, current experiments, amplifier and oscillator characteristics, noise measurement, applications and future directions. (U.S.A.)

Saturable-Reactors Fire Radar Magnetrons, H. E. Thomas. "El." May 9, 1958. 4 pp. Magnetic modulator uses saturable reactors to convert input sine wave into narrow, high peak-power output pulses. Basic action of current-pulse compression with magnetic modulators is explained. (U.S.A.)

Hot Wires Carry More Current Than You Think, John Mallinson. "El. Des." May 14, 1958. 2 pp. This article may save you wire weight and money. (U.S.A.)

Gamma-Ray Detector Aids Oil Field Surveys, F. E. Armstrong. "El." May 23, 1958. 3 pp. Transistorized probe, using Geiger-Muller tubes, detects and measures gamma radiation from radioactive tracers applied to waters and brines in petroleum reservoirs. (U.S.A.)

Transistor Chopper Drives Accurate Clock, Richard H. Williams. "El." May 23, 1958. 2 pp. Transistorized control circuit including a frequency-determining crystal oscillator feeds a voltage chopper which doubles the 28-v d-c supply and divides the driving frequency. The a-c pulsed output then drives a synchronous clock motor. (U.S.A.)

Photoformer Solves Sound Barrier Problems, Robert W. Maloy. "El." May 23, 1958. 3 pp. Photoelectric function generator provides smooth reproduction of complex curve slopes up to 90 degrees, with slopes greater than 90 degreees simulating switching with blacklash. (U.S.A.)

Simultaneous Asynchronous Oscillations in Class-C Oscillators, M. I. Disman and W. A. Edson. "Proc. IRE." May 1958. 9 pp. The concept of negative discrimination by which the authors explain the existence of asynchronous oscillations provides a new tool which might well find useful applications in predicting the behaviour of nonlinear devices. (U.S.A.)

JTAC—Ten Years of Service, Donald G. Fink. "Proc. IRE." May 1958. 4 pp. The IRE President, former member and past chairman of the Committee, reviews the activities of the Joint Technical Advisory Committee (JTAC) during its first decade. (U.S.A.)

Instrument Landing at Sea, F. Akers and F. G. Kear. "IRE Trans. PGMIL." December 1957. 8 pp. The paper is a narrative account of two years of intensive effort by the Navy and civilian engineers which, after many trying periods, achieved success on July 30, 1935, when a completely booded instrument landing was made aboard the aircraft carrier, USS Langley, 100 miles at sea off San Diego, Calif. (U.S.A.)

The Experimental Determination of System Transfer Functions from Normal Operating Data, J. G. Henderson and C. J. Pengilley. "J. BIRE." March 1958. 8 pp. It is often not possible to remove a plant or system from service in order to measure its transfer function by the usual process of applying sinusoidal or impulse test signals. Use can, however, be made of statistical data of input and output when the system is operating in normal service, since in a linear system, undisturbed by noise, the cross-correlogram between the input and output signals is given by the convolution of the system weighting function and the autocorrelogram of the input. (England.)

Electronic Developments at Very Low Temperatures, E. Mendosa. "Brit. C. & E." April 1958. 7 pp. This article surveys the present situation regarding the interesting electronic techniques that are possible at very low temperatures. Methods of achieving these temperatures close to the absolute zero are described. Several devices, employing the consequential effects of superconductivity, and their potential applications are discussed. The difficulties of operation around 4° Absolute are not necessarily formidable. (England.)

Scattering of Electromagnetic Waves by Long Cylinders, Albert W. Adey. "E. & R. Eng." April 1958. 10 pp. The field scattered by both a metal and a dielectric cylinder, when excited by an electromagnetic wave propagating in a direction normal to the cylinder axis, is discussed for both plane-wave and cylindrical-wave incidence. The radius of the cylinder is comparable with the free-space wave-length of the incident wave. (England.)

Progress in Modernization of Signaling on British Railways, H. C. Towers. "El. Energy." April 1958. 4 pp. Work is now proceeding with the provision of modern signaling on British Railways. The proposals cover the installation of multi-aspect color light signaling, track circuiting and the power operation of signals and points at large stations. The following article describes some of the works that have already been completed. (England.)

Propagation Through a Dielectric Slab. Effect on Polar Diagram of Source, T. B. A. Senior. "E. & R. Eng." April 1958. 8 pp. (England.)

Reliability of Electronic Equipment, L. J. Allen. "ATE J." April 1958. 9 pp. The article describes in simple terms how reliability can be interpreted as a statistical probability. The relation between reliability and failure is established in a theoretical consideration of the natural exponential decay law, and is compared with the mode of failure of familiar electronic components. (England.)

Some Aspects of Half-Wave Magnetic Amplifiers, G. M. Ettinger. "Proc. BIEE." May 1958. 12 pp. The paper deals with the properties of half-wave magnetic amplifiers having finite control-circuit resistance or rectifier reverse conductance. (England.)

Distortion in Frequency-Division-Multiplex F. M. Systems Due to an Interfering Carrier, R. G. Medhurst, et. al. "Proc. BIEE." May 1958. 11 pp. (England.)

MEASURE & TESTING

Telemetering Microbarometer for Determination of Vertical Displacements, W. Gunkle, G. Buss, J. King, and J. Ohman. "IRE Trans. PGI." December 1957. 4 pp. In the design of the hull structures of ocean-going vessels it is desirable to know the amount of pitch the ship will experience as it is subjected to the action of ocean waves. Measuring this pitch reduces essentially to determining the instantaneous altitude of the bow and stern above mean sea level. To measure the altitude, a reference must be used, and barometric pressure is found to be satisfactory for this purpose. (U.S.A.)

High Voltage Impulse Testing Techniques (Part I), P. R. Howard. "El. Energy." May 1958. 8 pp. This article deals with the production and measurement of impulse voltages, the testing of transmission equipment, the detection of breakdown by cathode ray oscillograph and considerations affecting the specification of wave-shapes. (England.)

'Wow' and 'Flutter,' R. G. T. Bennett and R. L. Currie. "E. & R. Eng." May 1958. 8 pp. A simple method of measuring wow and flutter is described, which can be made with the aid of a stable oscillator and a triggered oscilloscope with sweep expansion. A sine wave from the oscillator is recorded and subsequently played back, giving to voltage output which triggers the oscilloscope timebase at a particular phase of the waveform. (England.)

Detection of Pulsed Signals in Noise, H. S. Heaps and A. T. Isaacs. "E. & R. Eng." May 1958. 4 pp. An analysis is presented to determine the optimum design of a Butterworth low-pass third-order filter to detect a rectangular pulsed signal upon a background of white noise. (England.)

Analysis of Current Pulses, Application to Rectifiers and Class C Amplifiers, F. G. Heymann. "E. & R. Eng." May 1958. 3 pp. Current pulses are analyzed by an approximate method which gives results in which the errors are not more than about 5%. The resulting relations are applied to class C amplifiers and lead to simple expressions for various amplifier quantities. (England.)

Production Environmental Testing, Robert Lusser. "Environmental Quarterly." Second Qtr., 1958. 2 pp. The belief, says Mr. Lusser, that mechanical and electrical devices fresh off the assembly line have a pronounced "infant mortality," followed by a long stretch of reliable life, is a fallacy. (U.S.A.)

Environmental Endurance Testing, Key to Reliability?, A. S. Richardson, Jr. "Environmental Quarterly." Second Qtr., 1958. 4 pp. Component endurance relates directly to component performance in an environment, the author states, and is a measure of reliability. (U.S.A.)

The Functions of Guided Missile Checkout Systems, J. Tampico and A. E. Resnik. "Con. Eng." April 1958. 6 pp. As weapons systems grow more complex, the problem of satisfactorily checking them out with unskilled personnel in a tactically feasible time becomes tougher and tougher. The military is resorting to integrated automatic go/no-go test sets because they remove most of the dependence on the operator. This article describes the general functions and equipment of automatic test sets used to check out missile systems in the field. (U.S.A.)

Spectral Effects in the Comparison of Scintillators and Photomultipliers, Robert K. Swank et. al. "Rev. Sci." April 1958. 6 pp. Photomultiplier evaluation of scintillation performance is considered in the light of its marked dependence on spectral shape effects in the emission spectrum of the scintillator, in photon absorption of cell, reflector and photomultiplier window, and in the photoelectric conversion process. (U.S.A.)

R-F Permeameter Techniques for Testing Ferrite Cores, A. L. Rasmussen and A. E. Hess. "El. Mgr." May 1958. 6 pp. New r-f permeameter designs developed at the National Bureau of Standards bring increased accuracy and versatility to the measurements of toroidal samples of commercially available ferromagnetic material. (U.S.A.)

Average-Responding Instruments, H. B. Brooks and K. E. Walker. "IRE Trans. PGI." December 1957. 2 pp. The design and operation of a bridge to measure the residual reactance of wire-wound resistors is described. The bridge uses deposited film resistors as nonreactive standards. (U.S.A.)

An Automatic Power Spectrum Computer, H. W. Smith, R. M. McClure, and F. X. Bostick. "IRE Trans. PGI." December 1957. 4 pp. In recent years the power spectra of random signals have become a valuable tool of analysis. Conventional circuits and filter techniques are inadequate when the frequency range of interest extends down to 0.01 cps. An automatic power spectrum computer using active filter circuits covers the range from 0.01 to several hundred cps with almost any desired filter bandwidth. (U.S.A.)

An Improved Concept in Pulse Generation, Max Schneiderman. "IRE Trans. PGI." December 1957. 4 pp. The objective of this paper is to describe briefly various methods of producing pulses with short durations, fast transition times, and low source impedance. Conventional methods of pulse generation will be discussed, including thyratrons, mechanical switching, and spark gaps. (U.S.A.)

Data Reduction Equipment for a "Forward Scatter" Link, Donald Eadie. "IRE Trans. PGI." December 1957. 5 pp. Equipment which will extract the long time trend of the average radio signal level and at the same time determine the amplitude distribution of the rapidly fluctuating components has been put into operation at Orange Hill, New Providence Island, Bahamas, by the University of Florida group studying the phenomena. (U.S.A.)

An Automatic Phase Measuring Circuit at Microwaves, R. Mittra. "IRE Trans. PGI." December 1957. 3 pp. The paper describes a waveguide circuit assembly for the automatic measurement of phase at microwave frequencies. The apparatus is suitable for the measurement of diffraction pattern by objects, the plotting of phase pattern in the mouth of an antenna feed, and for various other applications. (U.S.A.)

Frequency Stabilization of Variable Oscillators, D. Makow. "IRE Trans. PGI." December 1957. 5 pp. A circuit is described where a single quartz crystal exercises considerable control over a range of continuously variable frequencies. (U.S.A.)

The Measurement of Spark Time Lags, J. K. Wood. "El. Eng." April 1958. 7 pp. Two methods of measuring spark time lags are described. The apparatus is described and some results quoted to indicate some of the shortcomings of the apparatus and difficulties involved in making the desired measurements. (England.)

An Automatic Swept-Frequency Impedance Meter, J. A. C. Kinnear. "Brit. C. & E." May 1958. 3 pp. The Elliott Automatic Swept-Frequency Impedance Meter (A.S.F.I.M.) promises to be for microwave measurement and development what the cathode-ray oscilloscope has been in the field of electronics. Its capabilities range from measurements of normal laboratory accuracy made at high speed over a wide frequency band, to measurements made with extreme accuracy at any spot frequency within the band. (England.)

Refractive Index Measurements of Smokes and Aerosols, C. M. Crain, J. E. Boggs, and D. C. Thorn. "IRE Trans. PGI." December 1957. 6 pp. This paper describes the apparatus used and the results obtained in the measurement of the index of refraction of aerosols of silver iodide, polystyrene spheres, iron powder, and oil smoke at a frequency of 9400 mc. (U.S.A.)

Errors in X-Ray Sorting with a Double Crystal Goniometer, A. Mann and R. Spinard. "IRE Trans. PGI." December 1957. 7 pp. Two factors affect the accuracy of the X-ray measurement of the orientation of quartz crystals. Misalignment and cutting errors produce errors in the angular measurement and poor resolution results in uncertainty as to location of peak response. The quantitative effect of the misalignment and cutting errors is given, and a physical description and formula are presented to allow insight into the mechanism of resolution deterioration. In addition, an approximate formula for reflection beamwidth is given. The results of the analyses are applied to an automatic machine for sorting quartz crystal as a function of the orientation angle. (U.S.A.)

Methods of Measuring Electrical Characteristics of Ultrasonic Delay Lines, A. H. Meitzler. "IRE Trans. PGUE." December 1957. 16 pp. This paper is concerned with methods of measuring useful electrical characteristics of ultrasonic delay lines employing piezoelectric transducers. (U.S.A.)

Ultrasonic Output Power Measurements in Liquides, George E. Henry. "IRE Trans. PGUE." December 1957. 15 pp. "Gross Acoustic Power Transfer" is defined as the time rate of delivery of acoustic energy by a transducer to a selected liquid load. This quantity is related to, but should not be confused with, the power density, the intensity, the energy density, and the gross acoustic output from the transducer. (U.S.A.)

A Theory of Pulse Transmission Along A Magnetostrictive Delay Line, A. Rothbart and L. Rosenberg. "IRE Trans. PGUE." December 1957. 27 pp. (U.S.A.)

The Electrograph, R. A. Broding, J. D. Schroeder, and J. C. Westervelt. "IRE Trans. PGI." December 1957. 5 pp. The electrograph has made possible for the first time, a photographic-type oscillograph which produces a completely processed record without the use of wet chemical development. (U.S.A.)

SEMICONDUCTORS

The Status of Microwave Applications of Ferrites and Semiconductors, Benjamin Lax. "IRE Trans. PGMTT." January 1958. 14 pp. The recent developments in the field of ferrite devices are reviewed. Emphasis is placed on the extension of nonreciprocal devices to lower microwave frequencies and high powers. The design considerations and achievements of broad banding also are covered. Fundamental principles leading to the applications of nonlinear properties of ferrites are described briefly. (U.S.A.)

The Three-Level Solid-State Master, H. E. D. Scovil. "IRE Trans. PGMTT." January 1958. 10 pp. This article gives an introduction to amplification by solid-state maser techniques. Emphasis is placed on the three-level solid-state maser. The relevant physical properties of paramagnetic salts are discussed. (U.S.A.)

Transistor Conference Papers in this Issue. "IRE Trans. PGCT." September 1957. A series of 14 papers which includes: Series Tuned Methods in Transistor Radio Circuitry, W. F. Chow and D. A. Paynter; Wide-Band Feedback Amplifiers, Fred D. Waldhauer; Some Solutions to Problems of Operating Germanium Transistor Servo Amplifiers at High Ambient Temperatures, P. M. Thompson and J. Mitchell; Bias Considerations in Transistor Circuit Design, Sorab K. Ghandhi; Thermal Stability of Junction Transistors and Its Effect on Maximum Power Dissipation, H. C. Lin; A Survey of Magnetic and Other Solid-State Devices for the Manipulation of Information, Jan A. Rajchman; Counting Circuits Employing Ferroelectric Devices, R. M. Wolfe; A High-Speed Two-Winding Transistor-Magnetic-Core Oscillator, A. J. Meyerhoff and R. M. Tillman; Millimicrosecond Transistor Current Switching Circuits, Hannon S. Yourke; Some New Transistor Bistable Elements for Heavy Duty Operation, N. F. Moody and C. D. Florida; A Decade Ring Counter Using Avalance-Operated Junction Transistors, J. E. Lindsay; Transient Response Characteristics of Unijunection Transistors, J. J. Suran and B. K. Eriksen; An Improved Square-Wave Oscillator Circuit, James Lee Jensen; A Phase-Regulated Transistor Power Supply, D. E. Deuitch and H. J. Pas. (U.S.A.)

Transient Response of Drift Transistors, R. D. Johnson. "Proc. IRE." May 1958. 9 pp. This paper analyzes the improvement in transient response caused by this built-in field, thus filling out our understanding of a type of transistor which is now coming into important use. (U.S.A.)

TELEVISION

Subjective Sharpness of Television Pictures, W. N. Sproson. "E. & R. Eng." April 1958. 9 pp. The subjective sharpness of television pictures has been measured using a comparison technique and a multi-criterion scale for assessment. Two types of degrading network were used and the subjective sensitivity to changes in equivalent rectangular bandwidth has been evaluated for both static and moving pictures. (England.)

The Modern Camera Tube and Its Limitations, A. E. Jennings. "Brit. C. & E." April 1958. 6 pp. The author discusses pickup tubes with particular reference to signal-to-noise ratio. The possibility of further development of existing types is examined. (England.)

Some New Structure-Type Targets for the Vidicon—An Analysis of Their Operation, S. A. Ochs and P. K. Weimer. "RCA." March 1958. 13 pp. Severe physical requirements are imposed on the photo-conductive layer used in the conventional Vidicon camera-tube target. In particular, its resistivity must be of the order of 10^{12} ohm-centimeters for frame storage operation and its thickness must be sufficient to prevent capacitive lag. New Vidicon targets of a complex structure permit a relaxation of these requirements on the photoconductor. Two types of targets are discussed. (U.S.A.)

Sound Signal Tunes TV Automatically, C. W. Baugh, Jr., and L. J. Sienkiewicz. "El." April 25, 1958. 5 pp. Amplitude of 4.5 mc intercarrier sound signal controls sound-to-picture ratio to provide fine tv receiver tuning automatically. Control of oscillator frequency to maintain a constant intercarrier sound signal provides effective action on the intercarrier sound level. (U.S.A.)

Airborne TV System for Military Reconnaissance, Nisson Sher and Joseph F. Fisher. "El." May 23, 1958. 5 pp. (U.S.A.)

THEORY

A Theoretical Study of Errors in Radio Interferometer Type Measurements Attributable to Inhomogeneities of the Medium, Gustavus J. Simmons. "IRE Trans. PGTRC." December 1957. 4 pp. The effects of the variation of the index of refraction of the earth's atmosphere on the angular information yielded by radio interferometers for terrestrial and near-terrestrial sources are investigated, and a second-order correction is derived. (U.S.A.)

TUBES

High-Speed Tester Checks Tubes in Groups, E. S. Gordon. "El." May 9, 1958. 3 pp. Production tube tester gives rapid indication of opens and shorts with direct-reading localization by neon lamps. Memory circuit holds indication of intermittent tap shorts. (U.S.A.)

U. S. GOVERNMENT

Research reports designated (LC) after the PB number are available from the Library of Congress. They are photostat (ph) or microfilm (mi), 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.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

Theoretical Analysis of Flat Radome Panels Utilizing Circular and Elliptical Polarization, R. E. Webster, Ohio State Univ. May 1957. 11 pages. 50 cents. (PB 131206, OTS) The fact that polarization effects constitute one source of error in various types of radar has been established. An earlier study was directed toward explicit illustration of the source and behavior of radome errors dependent on polarization. Emphasis was placed on plane-wave—plane-panel transmission coefficients and their dependence on the geometrical parameters which describe the polarization. This report contains conclusions of the investigation. A system design is called for which would minimize the required range of the incident-wave aspect and the antenna aspect with respect to the radome. The report cautions against use of the axially symmetrical radome with antenna-radome aspect varying over a wide range. A fixed antenna-radome aspect and, if possible, a two-directional wall taper designed for the anticipated polarization is recommended. One system satisfying this condition is a slot radiator placed very near and parallel to the radome wall. If adaptable to antenna requirements of particular radar systems, this radiator may aid in eliminating polarization-dependent errors, according to the report.

Static High Frequency Generator and Magnetic Amplifier, M. Frank and J. R. Walker, Wayne Engineering Research Institute. Feb. 1957. 202 pages. $5.50. (PB 131240, OTS) Early developments in the field of static frequency multipliers are described and early theories extended to include high permeability, square loop core material now commercially available. Shunt and series-fed shock circuits are analyzed, with particular attention given to the relationships between circuit power efficiency and firing angle, and input supply amplitude and circuit parameters. Development of a series-type shock circuit is described and data are given for an engineering model. A second part of the report is concerned with a study of switching circuits using a combination of transistors and magnetic cores. Among these are parallel type inverters, shunt reactance switches, combination parallel inversion and shunt reactance switching circuits, and combined inversion-conversion circuits. Development of magnetic amplifiers for use with the Moog hydraulic valve and each type of multiplier also is discussed.

Experiments With Electrostatically Focused Velocity-Jump Amplifiers, W. M. Mueller, Univ. of Calif. Mar. 1957. 66 pages $1.75. (PB 131031, OTS) Small light focusing systems are needed for high current density beams in beam-type electron tubes. This research approached the problem with tests of periodic electrostatic focusing and its application to traveling-wave tubes. It dealt mainly with the results of experiments with two velocity-jump amplifiers consisting of a helix input—the drift tubes—and a helix output. Electrostatic lenses existing between the various electrodes were used for focusing. It was established that instead of the confined flow plasma frequency reduction factors, those for ion-neutralized flow were more correct for electrostatically focused flow. Because of the long plasma wavelengths corresponding to the reduction factors, construction of this type of tube seemed impossible. Suggestions are made for development of tubes consisting of short sections of helix operating at different potentials. These could be practical for low current densities.

High Perveance Beams From Arc Cathodes, C. W. Hartman, Univ. of Calif. May 1957. 37 pages. $1. (PB 131212, OTS) This research was concerned with extraction of high voltage electron beams from D.C. and pulsed arc plasmas. A mercury arc plasma was used for D.C. extraction with the necessary high vacuum near the plasma obtained by refrigeration. Extraction from pulsed arcs was accomplished to appreciable expansion of the local arc vapor. Magnetically focused D.C. electron beams having current densities up to 14a/cm^2 were obtained at 5 to 15 kv with a maximum perveance of 50 microperves. Pulsed beams of several hundred amperes were obtained at 10 to 30 kv for several microseconds. A maximum perveance of about 175 microperves was obtained.

Effect of Nuclear Irradiation on Magnetic Properties of Core Materials, R. S. Sery, et. al. U. S. N. Ordnance Lab. Dec. 1956. 45 pages. $1.25. (PB 131014, OTS) Nuclear radiation is a new environment under which many engineering materials must be designed to operate. This volume presents information on the effects of radiation on the magnetic characteristics of seven representative core materials. Most of the data is new to the literature. Among the major results of irradiation tests, it was shown that magnetic properties of 2 V Permendur, 16 Alfenol, and 3.5 percent silicon iron cores changed only slightly and recovered almost completely after removal from the nuclear pile. Vanadium Permendur was shown to be a suitable magnetic amplifier core material at temperatures up to 500°C. Orthonol and 5-79 Mo Permalloy cores exhibited major changes. A powder core of 2-81 Mo Permalloy and a 50-50 nickel ferrite core were not appreciably changed at d-c, 60 and 400 cps. However, core loss characteristics changed greatly in the 5 to 50 kc/sec range.

Effects of Temperature on Magnetic Properties of Core Materials, M. Pasnak, U. S. N. Ordnance Lab. May 1956. 36 pages. $1. (PB 131130, OTS) Magnetic materials must operate under wide temperature variations in many applications, such as magnetic amplifiers, transformers, relays, and servo components. In each of these, temperature affects the magnetic state and properties of the core materials. This report contains data on temperature effects on the ferromagnetic alloys Orthonol; 5-79 and 4-79 Mo Permalloy, AEM 4750; 1.6 percent, 3.5 percent, and 6.4 percent silicon iron; and 11.7 and 16 Alfenol. Most cores were ring laminations, some were spiral wound tape. Temperatures ranged from 60 C to 100 C. For ring lamination, results indicated that at high induction levels, high temperature generally depresses maximum induction from its room temperature value, while low temperature elevates it. High temperature also depresses residual induction. Low temperature, however, elevates the residual in some materials, depresses it in others. Coercive force is depressed by high and increased by low temperature. The effect on a-c permeability is reversed. Results for spiral wound tape cores were erratic. Relative effects of temperature changes are also given for the silicon iron, nickel iron, and aluminum iron families of alloys.

The Dynamic Magnetostrictive Properties of Alfenol, C. M. Davis, Jr., and S. F. Ferebee, U. S. N. Ordnance Lab. Oct. 1955. 33 pages. $1. (PB 131168, OTS) This report describes successful development of Alfenol, a cold-rolled Al-Fe alloy, for magnetostrictive transducer applications. Performance of 12 or 13-Alfenol in low-power applications was equal to that of nickel, the strategic material it was intended to replace. The electromechanical coupling coefficient, approximately equal to 0.29, was comparable to that of nickel, and electrical resistivity was at least 10 times as great. The Alfenol material, in the form of toroids made from ring laminations, was evaluated by the motional impedance method. Effects of various processing techniques are described in the volume.

Preparation of a Reproducible Barium Titanate, E. J. Brajer, Clevite Research Center. July 1956. 31 pages. $1. (PB 131089, OTS) A barium titanate ceramic raw material said to be superior in piezoelectric properties to commercial grades of barium titanate powder was prepared by a method developed in this project. The method is applicable to large scale production. The report, the final one of a two-year study of barium titanate for piezoelectric uses, describes preparation of the reproducible material on a pilot plant scale. Development came after extensive laboratory study of the variables in a calcination procedure. These were raw materials, barium oxide to titanium oxide molar ratio, calcination temperature, and particle size distribution. Laboratory procedures and difficulties encountered in preparation are discussed. The powder prepared is described as useful for standard pressing techniques, although it requires higher firing temperatures—1500 C to 1550 C—than used in the commercial titanate ceramic industry.

Unilateral Attenuation in the Interdigital Circuit, L. K. S. Haas, Univ. of Calif. May 1957. 70 pages. $1.75. (PB 131257, OTS) This work was concerned with experimental observations of unilateral attenuation in an interdigital type circuit as used in traveling-wave magnetrons. Attenuation was obtained by means of ferrite samples of various geometries placed inside the circuit. The samples were saturated magnetically by the magnetic field used in crossed-field tubes for beam focusing. Working from a condensed theory of the interdigital circuit, positions of circularly polarized magnetic fields were found. The ferrite was placed at those positions for most unilateral effect. Major attention was given to attenuation due to ferrite spheres. They were shown to be impractical for unilateral attenuation unless very high frequencies or special easily-saturated ferrites are used. A ferramic rod with an estimated front-to-back attenuation ratio of 8 produced attenuation of 24 db, the maximum obtained. The report concludes that practical application of the results to crossed-field tubes would depend on the disturbance of the focusing field by the presence of the ferrite.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Sensitivity Adjusting Circuit, #2,826,717. Inv. M. Maron. Assigned Allen B. Du Mont Laboratories, Inc. Issued March 11, 1958. The two cathodes of a push-pull voltage amplifier are directly connected together and grounded over a common resistor. The grids are supplied with a balanced push-pull input and the plates supply the push-pull voltages for a C.R. tube deflection circuit. A variable resistor extends between the two plates to adjustably reduce the gain of the amplifier.

Magnetron, #2,826,719. Inv. J. S. Donald. Assigned Radio Corporation of America. Issued March 11, 1958. The magnetron consists of a main cathode and a main anode, and an auxiliary cathode and an auxiliary anode. The main cathode operates as the auxiliary anode, the auxiliary cathode being positioned adjacent the main cathode on the side opposing the main anode. The oscillations generated by the auxiliary magnetron control the oscillations generated by the main magnetron.

International ELECTRONIC SOURCES

Semiconductor Devices and Systems, #2,824,-977. Inv. J. I. Pankove. Assigned Radio Corporation of America. Issued Feb. 25, 1958. A ring-shaped semiconductor provides a closed loop for current flow from an emitter to a collector electrode in rectifying contact with the semiconductor. A base electrode is also in contact with the semiconductor.

Transistor Amplifier, #2,813,934. Inv. Chas. A. Cibelius and D. K. Schaeve. Assigned Barber-Colman Co. Issued November 19, 1957. The total signal is simultaneously and with opposite polarity applied to two transistors. Two series-connected resistors constitute the load impedance, their junction being connected to a power supply.

Lightweight Antennas, #2,814,038. Inv. C. J. Miller. Assigned Westinghouse Electric Corporation. Issued November 19, 1957. A reflector of flexible conducting material is arranged inside an inflatable nonconducting housing. The housing can be rotated or otherwise displaced to impart a scanning motion to the reflector. Alternatively, the outer wall of an inflatable structure is metallized to form an antenna reflector.

Oscillation Cut Off, #2,815,426. Inv. M. Rothstein. Assigned Radio Receptor Company, Inc. Issued December 3, 1957.

A control circuit controls the output of a high frequency oscillator. This control circuit contains a spark gap, a d.c. power source and a switch. Closing of the switch will induce conductive sparking and the high frequency generator will no longer deliver normal power to its load.

Ultrasonic Soldering Iron, #2,815,430. Inv. M. E. Weiss. Assigned Gulton Industries, Inc. Issued December 3, 1957.

An electromechanical transducer feeds vibrations to the large diameter end of a velocity transformer. The heated soldering tip is supported by the small diameter end of the velocity transducer connected by a tapering section to the large diameter end thereof.

Television Wave Trap and the Like, #2,815,-441. Inv. E. Silverman. Issued December 3, 1957.

The interference wave trap consists of a pair of high-Q tuned circuits. One side of each of these circuits is connected in parallel with a two-wire transmission line extending between the television antenna and the television receiver. The other sides of these circuits are capacitively coupled.

R. F. Circuit Selector or the Like, #2,815,448. Inv. R. A. Davis. Issued December 3, 1957.

Two tuning inductances couple a first and a second antenna, respectively, to one of two inputs of a sequential mixer circuit. Control signals are conductively coupled to the tuning inductances to induce inductive damping therein. The control signals alternating between a first and a second condition effective to respectively inductively damp one of the tuning inductances to alternately interrupt signal transmission through the two paths.

Transistor Push-Pull Amplifier, #2,816,179. Inv. R. Gittleman and J. Tellerman. Assigned American Bosch Aerma Corporation. Issued Dec. 10, 1957.

A single-ended input source is connected across the bases of two similar type transistors, their emitters being shorted for signaled frequencies. The collector current of one transistor is caused to flow through both emitters, whereby the collector currents are made equal without the necessity of matching the transistors.

Semiconductor Phase Shift Oscillator and Device, #2,816,228. Inv. H. Johnson. Assigned Radio Corporation of America. Issued Dec. 10, 1957.

A body of semiconductive material having alternating zones of different conductivity type material has a semiconductor delay line integral with one zone. The delay line includes a plurality of series connected filaments of semiconductor material and P-N junction portions.

Device for Producing Ultra-Short Waves, #2,816,245. Inv. F. Coeterier. Assigned North American Philips Co., Inc. Issued Dec. 10, 1957.

An electron beam is velocity-modulated in a first cavity resonator and energizes a second cavity resonator. A single common cavity resonator of the hollow type is individually coupled with both the first and second resonators to stabilize the ultra-short waves.

Magnetic Tape-to-Film Photographic System, #2,816,157. Inv. J. M. Andreas, W. R. Schreiber, and G. T. Inouye. Assigned Technicolor Motion Picture Corp. Issued December 10, 1957.

The color video signals for each frame recorded on a magnetic tape are applied to a cathode-ray tube; the frames are successively photographed.

Circuit Arrangement for Synchronizing the Line Deflection Circuit in a Television Receiver, #2,816,164. Inv. P. J. H. Janssen. Assigned North American Philips Company, Inc. Issued Dec. 10, 1957.

Positive synchronizing pulses are fed to the control grid of a negatively biased control tube. The periodic fly-back pulses generated by a deflection oscillator are positively applied to the plate of the control tube so phased that the trailing edges of the fly-back pulses normally overlap the leading edges of at least some of the synchronizing pulses rendering the control tube conductive. The plate of the control tube is directly connected to the frequency-determining electrode of the deflection oscillator.

Magnetic Compression Method, #2,816,175. Inv. D. L. Blaney. Assigned Radio Corporation of America. Issued December 10, 1957.

The wide-amplitude range sound signals are magnetically recorded simultaneously with a bias current to compress the higher amplitudes of the sound signals at a predetermined rate. The amplitude of the bias current is controlled by the rectified sound signal to vary the amount of compression and the point at which compression occurs.

Electrostatic Storage of Information, #2,817,-042. Inv. F. C. Williams and T. Kilburn. Assigned National Research Development Corporation. Issued Dec. 17, 1957.

Two-state storage of digital information is provided on an electrostatic storage surface of a C.R. tube. A first state of electrostatic charge distribution is set up on a discrete area of the surface in a first state of focus of the bombarding beam. The state of focus is gradually changed to a second, more sharply focused state when required by the nature of the information to be stored. The gradual change of focus requires a time interval which is at least one-fifth of the duration of the second state.

Continuous-Wave Beacon System, #2,817,082. Inv. M. Dishal and M. Rogoff. Assigned International Telephone and Telegraph Corp. Issued Dec. 17, 1957.

Three spaced antennas are fed by three transmitters, each transmitter operating at a different frequency and simultaneously energizing a pair of the antennas. Thus three directive overlapping patterns of different frequency are continuously radiated.

Broadband Antenna, #2,817,084. Inv. R. W. Clapp and T. Hudspeth. Assigned Hughes Aircraft Co. Issued Dec. 17, 1957.

A pair of substantially rectangular conductive straps are connected across the upper and lower walls of the aperture of a box-type radiating element. The straps are dimensioned and positioned to maintain the impedance of the radiating element substantially constant over a wide band of operating frequencies.

Horizontal Deflection and Audio Output Circuit, #2,816,953. Inv. W. K. Squires. Assigned Sylvania Electric Products, Inc. Issued Dec. 17, 1957.

The television receiver contains a combined horizontal deflection and audio output tube. The horizontal deflection signal as well as the audio signal are applied to a grid of this tube, and both are derived from its output.

Electronic Regenerative Repeater, #2,816,956. Inv. L. K. Wheeler and A. C. Frost. Assigned Her Majesty's Postmaster General. Issued Dec. 17, 1957.

A multivibrator circuit applies conditioning pulses to the receiving circuit, which pulses are related in frequency to the desired speed of signal transmission. A timing circuit renders the multivibrator operative immediately a start signal of predetermined duration is received, while a start delay circuit prevents the timing circuit from rendering the multivibrator circuit operative until a start signal has persisted for a predetermined minimum period.

Shunt Gating Circuit, #2,817,015. Inv. R. M. W. Johnson. Assigned Hughes Aircraft Co. Issued Dec. 17, 1957.

A shunting circuit comprising a power supply, a diode and a tube connected in series extends across a class A amplifier. A capacitor interconnects the plates of the two tubes, the output being derived from the plate of the shunting tube. Positive gating pulses are fed to the cathode of the shunting tube, rendering it non-conductive, whereby unidirectional portions of the input signal coinciding with the gating pulses appear at the output.

Feedback Intensity Control for Continuous Film Scanner, #2,817,702. Inv. R. E. Graham and Chas. F. Mattke. Assigned Bell Telephone Laboratories, Inc. Issued Dec. 24, 1957. A cathode-ray tube scanner scans the film and the modulated light is intercepted by a phototube. A second optical path connects the cathode-ray source with the phototube, this second path does not include the film. The output of the phototube resulting from the light traveling over the second path is separated and used to control the intensity of the scanning beam.

Amplifier with Tremolo, #2,817,708. Inv. C. L. Fender. Issued Dec. 24, 1957. Amplified audio signals are modulated by audio frequency oscillations provided by a voltage-responsive oscillator which alternately effective and ineffective. The audio oscillator is controlled by a transient voltage which hastens the start of oscillations.

Amplifier Having Linear and Non-Linear Amplification Ranges, Inv. F. G. Blake. Assigned California Research Corp. Issued Dec. 24, 1957. The distorting input network to an amplifier consists of a series resistor and two parallel branches across the input, each branch comprises a rectifier and oppositely poled d.c. source, the two rectifiers being oppositely poled. Thus low-level input signals are undistorted and high-level input signals are non-linearly compressed.

Cathanode Output Bridge Amplifier, #2,817,-718. Inv. R. J. Rockwell. Assigned Crosley Broadcasting Corp. Issued Dec. 24, 1957. Two opposing arms of the bridge are formed by two similarly poled tubes, the other two arms by power supplies supplying positive plate voltages. The push-pull input is applied to the grid of the two tubes. The output is derived across a high resistor extending between the cathodes of the two tubes. Statistically unbalanced currents in the bridge amplifier due to differences in the tube characteristics are compensated.

International ELECTRONIC SOURCES

Variable Gain Amplifier. #2,818,156. Inv. M. A. McCoy. Assigned Hoffman Electronics Corp. Issued November 12, 1957. The two cathodes of two tubes, each having a cathode resistor, are coupled by a series connected capacitor and variable resistor. It is contemplated to control the resistor by a servo-system.

Electron Beam Traveling-Wave Tube, #2,813,-221. Inv. R. W. Peter. Assigned Radio Corporation of America. Issued November 12, 1957. Dielectric walls are interposed between the electron beam path and the delay line and a direct current shield is interposed between the dielectric walls and the beam path. The shield is substantially transparent to a.c. fields.

Semiconductive Device, #2,813,233. Inv. W. Shockley. Assigned Bell Telephone Laboratories, Inc. Issued November 12, 1957. A base zone of one conductivity type is positioned between an emitter zone and a collector zone of the opposite conductivity type. The collector zone is of a material having a lifetime considerably longer than the lifetime of the material of at least one of the emitter and base zones.

Electron Beam Wave Signal Frequency Converter Utilizing Beam Deflection and Beam Defocusing, #2,820,139. Inv. R. Adler. Assigned Zenith Radio Corp. Issued Jan. 14, 1958. A deflection control signal deflects an electron beam transversely to its path to provide a corresponding output at a suitably shaped and positioned output electrode. The effective transconductance of the deflection system is varied by an electron lens which normally focuses the beam onto the output electrode. A focusing control signal varies the position of the beam focus in the direction of the beam path.

Transistor Phase Detector, #2,820,143. Inv. G. O. D'Nelly and N. B. Fjeldsted. Assigned Hughes Aircraft Co. Issued Jan. 14, 1958. Two transistor-rectifier series combinations are suitably connected to a reference signal and a comparison signal. Either one of the transistors will pass the comparison signal during the time interval the reference signal is applied concurrently therewith. The resulting current charges a capacitor, whereby a d.c. voltage representative of the relative phase of the reference and comparison signal is obtained.

Device for Frequency Modulation of High Frequency Oscillations, #2,820,198. Inv. J. Caysac. Assigned North American Philips Co., Inc. Issued Jan. 14, 1958. The source of modulation voltage is simultaneously and in parallel applied to two reflector electrodes of a reflex type frequency-modulation tube. The two reflector electrodes are successively arranged in the tube.

Waveguide Modulator, #2,820,200. Inv. F. K. du Pré. Assigned North American Philips Co., Inc. Issued Jan. 14, 1958. An electrically non-conductive ferromagnetic material is positioned inside a rectangular waveguide to fill a major portion of its cross-sectional area. Current-carrying windings provide a magnetic field extending substantially along the major axis of the waveguide. The plane of polarization of a polarized electromagnetic wave propagated through the material will be rotated.

Selective Transfer Device for Microwave Energy, #2,820,201. Inv. K. Tomiyasu. Assigned Sperry Rand Corporation. Issued Jan. 14, 1958. Two adjacent longitudinal extensive openings couple two waveguides for substantial power transfer therebetween. Each waveguide has an input and an output for receiving and supplying power, respectively. An adjustable shutter is provided for selective interposition between the two openings to control the transfer of microwave power.

Four Terminal Equalizer Networks, #2,820,-950. Inv. J. J. A. Grabau and W. Saraga. Assigned Automatic Telephone & Electrical Co., Ltd. Issued Jan. 21, 1958. The network is designed for a real and constant image impedance for all frequencies within a limited range and for a driving point impedance the logarithm of whose modulus varies linearly with frequency over this range, the slope being a function of the terminating resistor. The network is composed of components which made the image phase shift equal to one of the values 45° ± n90°, n being a positive integer within the specified frequency range.

Navigational System, #2,820,961. Inv. M. Wallace. Assigned Panoramic Radio Products, Inc. Issued Jan. 21, 1958. One craft emits a pulse which is retransmitted from a fixed station, received by the craft initiating the transmission of a second pulse which is again retransmitted from the fixed station. The first and second retransmitted pulses are received on board a second craft and the time interval elapsed therebetween is measured.

Dual Polarization Antenna, #2,820,965. W. Sichak. Assigned International Telephone and Telegraph Corp. Issued Jan. 21, 1958. The open end of a waveguide is shaped to determine the space radiation pattern and provided with a grille to pass first polarized waves. The grille plane contains the focusing point of the radiation pattern. An antenna system responsive to waves polarized orthogonal with respect to the first polarized waves is disposed forward of the grille by a predetermined distance to cause the focusing point of the radiation pattern of the second waves to coincide with that of the radiation pattern of the first waves.

Miniature Super-Regenerative Radio Receiver Using Transistors, #2,821,625. Inv. H. L. Price. Issued Jan. 28, 1958. The circuit between the base and emitter electrodes of a transistor tuned regenerative detector circuit has low impedance and conducts asymmetrically. The associated tank quench oscillator tank circuit consists of an inductance in parallel with two capacitors, the base-emitter circuit being connected between the two capacitors, whereby a minimum of loading of the detector circuit by the quench oscillator and vice versa is obtained.

Balanced Sweep Circuit, #2,821,628. Inv. E. S. Purington. Issued Jan. 28, 1958. The output is taken off two plate resistors of two tubes having a common cathode resistor, the other cathode resistor terminal being connected to the two control grids over a capacitor and a resistor, respectively. The incoming pulses are fed to this other cathode resistor terminal and the capacitor is connected for discharge in response to such pulses. The capacitor-coupled grid further receives some of the output pulses over a resistor. Output voltages varying oppositely while having a substantially constant sum are thus obtained.

Multihelix Traveling Wave Tubes, #2,821,652. Inv. C. H. Robertson and E. J. Walsh. Assigned Bell Telephone Laboratories, Inc. Issued Jan. 28, 1958. A plurality of helices, each having a different mid-band frequency along its interaction region, are positioned in parallel in an envelope. A distinct beam of electrons is projected along each helix.

Electrical Storage System, #2,821,653. Inv. J. H. Dyer. Assigned Airborne Instruments Laboratory, Inc. Issued Jan. 28, 1958. An electron beam is made to scan an insulating charge storage surface. The energy level of the electrons in the beam as it strikes each unit area of the surface is controlled in accordance with the information to be stored. The electrical charges distributed at each unit area are built up by repeated scanning until the amount corresponds to the incident electron beam energy level.

Resistor, #2,827,586. Inv. R. Loosjes. Assigned North American Philips Co., Inc. Issued March 18, 1958. The positive temperature-coefficient resistor consists of an electron-producing member having connected pores in a sealed enclosure. A supply of vaporizable material partly not as vapor is contained in the enclosure, its pressure being a function of the surrounding temperature. The vapor reduces the mean free electron path in the pores.

Electronic Device, #2,821,656. Inv. L. C. Foster. Assigned Kaiser Industries Corp. Issued Jan. 28, 1958. An electron beam is delivered along a path in a direction first towards a target, deflected to a path adjacent to and spaced from a first target surface and then to a path adjacent to and spaced from a second target surface. From this last path the beam is successively deflected at different positions into impingement with various portions of the second target surface.

Magnetron, #2,821,659. Inv. J. Feinstein. Assigned Bell Telephone Laboratories, Inc. Issued Jan. 28, 1958. A plurality of hollow conductive members is circumferentially arranged so that each pair of adjacent members defines a resonant cavity. A pair of conductive elements is mounted on each of the hollow conductive members external of the resonant cavities and extending inwardly and across the hollow formed by the cavity assembly. Each pair of conductive members defines a capacitive gap between a pair of adjacent resonant cavities.

Color Television System, #2,820,844. Inv. G. L. Beers. Assigned Radio Corporation of America. Issued Jan. 21, 1958. A color television picture brightness information signal is modulated onto a first carrier and a color television picture color information signal onto a second carrier. One of the carriers is propagated as a horizontally polarized wave, the other as a vertically polarized.

High Impedance Transistor Amplifier, #2,-820,855. Inv. S. Sherr. Assigned General Precision Laboratory Inc. Issued Jan. 21, 1958. A chopper vibrator has at least one terminal connected to a resistor which carries all the base d.c. bias of a transistor. The chopper vibrator is capacitively coupled to an amplifier which feeds a vibrating rectifier. This vibrating rectifier and the Chopper vibrator are operated synchronously and in phase so that the output is representative of the amplitude and sense of the base bias d.c. current. The vibrating rectifier controls a heat exchanger maintaining the transistor temperature at a value corresponding to zero base bias d.c. current.

Delay Line Pulse Shaper, #2,820,909. R. L. Plouffe. Assigned International Telephone and Telegraph Corp. Issued Jan. 21, 1958. A delay line is inserted between the anode of a tube and the power supply. The further end of the delay line is short-circuited so that positive pulses are negatively reflected. A series resistor and semi-conductor diode combination is also connected between the plate and the power supply, terminating the delay line in an open circuit for positive pulses and in its characteristic impedance for negative pulses. The output is derived from the junction of the resistor and the semi-conductor diode. Each positive anode swing initiates a pulse which is terminated by the negative reflected pulse.

Cathode-Ray Tube Apparatus, #2,820,921. Inv. J. D. McGee, H. G. Lubszyniski and R. S. Webley. Assigned Electric & Musical Industries, Ltd. Issued Jan. 21, 1958. Signals are recorded on a charge storage target by a scanning electron beam. A second beam is adapted to scan the charge image on the target a plurality of times at a frequency to produce derived signals which are repetitions of the original signals. These derived signals are applied to a display tube and to an amplifier which again modulates the first recording beam, whereby the charge image is renewed on the charge storage screen.

CLEVITE 'BRUSH'

Multi-Channel Magnetic Heads

A BASIC DESIGN FOR STANDARD REQUIREMENTS ...CUSTOM CONFIGURATIONS FOR SPECIAL APPLICATIONS

Clevite "Brush" Multi-Channel Heads offer distinct advantages for system manufacturer and user alike . . . providing comparative ease and speed of installation, alignment and replacement . . . precise dimensional uniformity . . . extremely rigid mounting.

Clevite's basic design, in 1 to 32 channel form, meets most standard customer requirements on commercial, industrial, scientific and military equipment. Slight modifications adapt them to many special applications. In addition, Clevite supplies custom designs; several are shown below.

As an independent magnetic head specialist, Clevite provides unmatched design experience and production economy. One of our specialists will be pleased to discuss your application by detailed correspondence or personal visit. Write: Product Manager, Magnetic Heads, Clevite Electronic Components, 3311 Perkins Ave., Cleveland 14, O.

STANDARD—In 1 to 32 channels, for tape widths from ½" to 2". All-metal or epoxy faces.

REDUNDANT—Close-spaced record-reproduce head speeds data processing by reading and checking tape immediately after recording. Reduces necessary equipment and power for checking register.

GAP-MOUNTED—Multi-channel head cartridges, easily removed and replaced with no close adjustment necessary. Bracket and cartridges have lapped surfaces providing reference positions to gap perpendicularity, azimuth and contact adjustment.

INTEGRAL BLOCK INTERLACE—Provides twice the number of channels possible with a single head of the same width. Minimum cross-talk and maximum output at no sacrifice in number of tracks. Clevite builds heads of this design to telemetering standards of spacing and performance.

Conventional, high resolution or flux-responsive performance is available in any standard or special multi-channel configuration.

CLEVITE ELECTRONIC COMPONENTS

DIVISION OF

CLEVITE

MAGNETIC HEADS
TRANSDUCERS
PIEZOELECTRIC CRYSTALS, CERAMICS AND ELEMENTS

Circle 68 on Inquiry Card, page 97

WESCON Show

(*Continued from page* 51)

were extended throughout all sections in the 7th IRE region. Future engineers' special activity will include both a luncheon and an awards banquet. Scholarship and savings-bond awards will be made.

Electronic devices of historical interest will be displayed also, in a collection arranged by committee members working with Don C. Wallace, chairman.

Field trips to nine outstanding southern California locations have been confirmed by the committee. Included is a visit to a "space chamber" operation, and another to a new facility for static testing of large missiles. Also scheduled is a simulated SCA flight briefing and inspection of aircraft at March Air Force Base, and inspections of several outstanding electronic manufacturing and research centers in greater Los Angeles.

Other special events range from a cocktail party, for which three major Ambassador rooms will be transformed into one giant party room, to an art-in-electronics exhibit which promises to present more works by "Sunday artists" than ever. Auction of the paintings, drawings, sculpture and craft pieces will benefit the WCEMA scholarship fund.

The traditional all-industry luncheon will climax activities August 22 in the world-famed Coconut Grove, also to be the scene of a Distributor-Rep conference extended this year to an all-day

BIG NOISE MAKER

This 1,000-watt loudspeaker being checked by Stromberg-Carlson's R. E. Liebich and J. A. King will be used in research on the effects of high intensity sound at Convair, San Diego session. The conference will be held Thursday.

Visitors will take time off from viewing modern electronic exhibits to see an outstanding display of historic developments in the field as well.

The Historical Exhibit, fast becoming a western industry tradition, will be staged during the entire four days in a pavilion at the Pan-Pacific auditorium. One of the most popular features of the show and convention, the exhibit for this year promises to display a wider range of historically significant equipment, documents, and photos than ever before.

Private collectors, including such recognized industry pioneers as Dr. Lee de Forest, have joined such organizations as the American Radio Relay League in lending their valued materials for this special showing.

WESCON Technical Papers Program

SESSION 1 — TUESDAY, AUGUST 19
9:30 AM to NOON

Embassy Room—Ambassador Hotel

COMPUTER APPLICATIONS

Chairman: J. D. Madden, System Development Corporation, Santa Monica

1. "Data Preparation for Numerical Control of Machine Tools" by H. D. Huskey and Donald E. Trumbo, Bendix Aviation Corp., Berkeley
2. "A Library of Blip Samples for Use in the Realistic Simulation and Evaluation of Automatic Radar Data Processing Systems" by Charlton M. Walter and Helen M. Willett, Air Force Cambridge Research Center, Bedford
3. "GCA by Automatic-Voice Data Link" by John J. Fling and M. H. Nothman, Gilfillan Bros., Los Angeles
4. "A Computer Simulation Chain for Research on Picture Coding" by R. E. Graham and J. L. Kelly, Jr., Bell Telephone Labs., Murray Hill

SESSION 2 — TUESDAY, AUGUST 19
9:30 AM to NOON

Sunset Room—Ambassador Hotel

RELIABILITY I

Chairman: Bernard Hecht, B. Hecht Associates, Los Angeles

1. "Design Techniques for Upgrading the Reliability of Weapons Systems During Flight Readiness Checkout" by Melvin A. Patterson, Radioplane, Van Nuys
2. "Reliability and Engineering Colleges" by Charles A. Krohn, Motorola, Phoenix
3. "The Confidence that can be Placed on Various Reliability Tests" by Cliff Ryerson, RCA, Camden
4. "Optimum Design for Reliability — The Group Redundancy Approach" by James H. S. Chin, Sperry Gyroscope, Great Neck, L. I.
5. "Integrating Reliability Considerations Into Systems Analysis" by J. B. Heyne, Hughes Aircraft Co., Culver City

(Continued on page 160)

WESCON Papers

(*Continued from page 159*)

SESSION 3 — TUESDAY, AUGUST 19
9:30 AM to NOON

Boulevard Room—Ambassador Hotel

TELEMETRY

Chairman: Roy W. Murray, Teledynamics, Sherman Oaks

1. "Theoretical Data Acquisition Analysis and Practical Appraisal of Existing Airborne Systems" by B. M. Gordon and R. D. Jorup, Epsco, Boston
2. "A Compatible PCM/FM/System" by Paul E. Bennewitz and H. B. Barling, Gulton, Ind., Albuquerque
3. "A PAM/PDM Decommutator" by E. D. Heberling and J. M. Sacks, U. S. Naval Ordnance Lab, Corona
4. "Transistor Airborne PDM Systems" by D. A. Williams, Jr., Bendix Aviation Corp., No. Hollywood
5. "High Acceleration Telemetering" by T. D. Horning, Bendix Aviation Corp., No. Hollywood

SESSION 4 — TUESDAY, AUGUST 19
9:30 AM to NOON

Ambassador Ballroom

INFORMATION THEORY

Chairman: George Tarin, Hughes Aircraft Co., Culver City

1. "The Prediction of Derivatives of Polynomial Signals in Stationary Additive Noise" by I. Kanter, RCA, Moorestown
2. "Predictive Quantizing of Television Signals" by Robert E. Graham, Bell Telephone Labs., Murray Hill
3. "Optimum Linear Estimation as the Limit of Sampled Data Estimates" by Peter Swerling, Rand Corporation, Santa Monica
4. "Random Function Probability Distribution after a Nonlinear Filter" by Gregory O. Young, Hughes Aircraft Co., Culver City
5. "Statistical Invariance of Noise in Sampled-Data Systems" by S. A. Zadoff, Sperry Gyroscope Co., Great Neck, L. I.

SESSION 5 — TUESDAY, AUGUST 19
9:30 AM to NOON

Audio Devices Inc. Rectifier Handbook

One of the most comprehensive treatments of silicon rectifiers, their applications and manufacturing techniques is contained in a new publication by Audio Devices Inc., 620 East Dyer Rd., Santa Ana, Calif., the "Silicon Rectifier Handbook."

Compiled by vice-pres. George Eannarino, and the staff of Audio Devices, the publication provides technical specifications, diagrams and a wide variety of sample circuits.

A large section of the handbook was quoted in the article, "Silicon Semi-conductor Devices," which appeared in the June All-Reference Directory Issue of ELECTRONIC INDUSTRIES, though reference to the source was unfortunately omitted.

Venetian Room—Ambassador Hotel

MICROWAVE THEORY AND TECHNIQUES I

Chairman: Kiyo Tomiyasu, General Electric Microwave Lab., Palo Alto

1. "Mode Conversion Filters" by E. A. Marcatili, Bell Telephone Labs., Holmdel
2. "Properties of the H-guide for Microwave and Milimeter Waves" by F. J. Tischer, Ohio State University, Columbus
3. "The Effects of Mode Conversion in Long Circular Waveguide" by W. D. Warters and H. E. Rowe, Bell Telephone Labs., Holmdel
4. "A New Class of Artificial Dielectrics" by Ming-Kuei Hu and David K. Cheng, Univ. of Syracuse, Syracuse
5. "A Frequency Measuring Technique Using Paramagnetic Resonance Phenomena in the X-Band Region" by Paul A. Crandell, Sylvania Electric Products, Waltham

SESSION 6 — TUESDAY, AUGUST 19
2:00 to 4:30 PM

Embassy Room—Ambassador Hotel

COMPUTER DEVICES

Chairman: R. Stuart Williams, Telemeter Magnetic Corp., West Los Angeles

1. "Achieving Maximum Pulse Packing Densities and Transfer Rates" by Boyd W. Thompson, Ampex Corp., Redwood City
2. "An Emitter Follower Coupled High Speed Binary Counter" by Irving Horn, Burroughs Corp., Paoli
3. "Coincident Current Applications of Ferrite Apertured Plates" by W. G. Rumble and C. S. Warren, RCA, Camden
4. "Information Storage for Microspace" by Sterling P. Newberry, General Electric Co., Schenectady

SESSION 7 — TUESDAY, AUGUST 19
2:00 to 4:30 PM

Sunset Room—Ambassador Hotel

RELIABILITY II

PANEL DISCUSSION: "Contract Implications of Military Electronics Reliability Requirements"

Moderator: E. J. Nucci, Office of Assistant Secretary of Defense

Jim Allen, Ramo-Wooldridge Corp., Los Angeles—Thor Missile

Harry Powell, Ramo-Wooldridge Corp., Los Angeles—Atlas Missile

Leo Arndt, Hoffman Electronics Corp., Los Angeles

Lt. Col. J. S. Lambert, Aero-Electronics Directorate, ARDC, Andrew AFB

SESSION 8 — TUESDAY, AUGUST 19
2:00 to 4:30 PM

Boulevard Room—Ambassador Hotel

AIRBORNE ELECTRONIC DEVICES

Chairman: E. Nesbitt, Bendix Pacific, Los Angeles

1. "Broadband Shot Noise Oscillations from Airborne Electronic Devices Utilizing Semiconductor Devices" by James C. Senn, Convair, San Diego
2. "Compact L Band RF Unit for Air Traffic Control Transponder" by Robert Skar, Collins Radio Co., Cedar Rapids
3. "A Precision Digital Data Acquisition System for Instrumentation Radars" by Robert Snyder, Electronic Engineering Co. of California, Santa Ana
4. "Earth's Rate Directional Reference" by Norman Feldman, General Electric Co., Utica
5. "Digital Computer System for Terminal Area Air Traffic Control" by E. L. Braun and A. S. Gianoplus, Litton Industries, Beverly Hills
6. "A Modern Approach and Landing System" by Burton Cutler, Gilfillan Bros., Los Angeles

(Continued on page 162)

WESCON Papers

(Continued from page 161)

SESSION 9 — TUESDAY, AUGUST 19
2:00 to 4:30 PM

Ambassador Ballroom

CIRCUIT ANALYSIS AND DESIGN

Chairman: William R. Bennett, Bell Telephone Labs., Murray Hill

1. "On Topological Synthesis" by M. B. Van Valkenburg, University of Illinois, Urbana
2. "Predistorted Filter Design with a Digital Computer" by Philip R. Geffe, Audio Development Co., Minneapolis
3. "The Design of Two-Section Symmetrical Zobel Filters for Tchebycheff Insertion Loss" by W. N. Tuttle, General Radio Company, West Concord
4. "Modern Network Theory Design of Single Sideband Crystal Filters" by Milton Dishal, Federal Telecommunications Lab., Nutley
5. "Transmission through a Linear Network Containing a Periodically Operated Switch" by C. A. Desoer, University of California, Berkeley

SESSION 10 — TUESDAY, AUGUST 19
2:00 to 4:30 PM

Venetian Room—Ambassador Hotel

MICROWAVE THEORY AND TECHNIQUES II

Chairman: Theodore S. Saad, Sage Laboratories, Inc., Waltham

1. "The Power Handling Capacity of Slab Lines" by C. Badoyannis, Sperry Gyroscope Co., Great Neck, L. I.
2. "RF Circuits for a Voltage-Tunable Magnetron" by W. J. Gemulla, Electronic Defense Lab., Mountain View
3. "An S-Band Two-Phase Demodulator" by Robert B. Wilds, Sylvania Electric Products, Mountain View
4. "Some Notes on Strip Transmission Line and Waveguide Multiplexers" by D. Alstadter and E. O. Houseman, Jr., Melpar, Falls Church
5. "On the Solution of Some Microwave Problems by an Analog Computer" by Donald M. Byck, EAI Computation Center, El Segundo and Allen Norris, Varian Associates, Palo Alto

SESSION 11 — WEDNESDAY, AUGUST 20
9:30 AM to NOON

TV TILT STATION

At Westinghouse's radio-TV division, Metuchen, N. J., an air operated tilt section simplifies aligning the TV chassis with the cabinet and fastening them securely together.

Embassy Room—Ambassador Hotel

PARAMETRIC AMPLIFIERS AND MASERS

Chairman: George Birnbaum, Hughes Aircraft Co., Culver City

Introduction: H. Heffner, Stanford University, Stanford

(INVITED SESSION)

1. "Modified Semi-Static Ferrite Amplifier" by A. D. Berk, Al Kleinman, and C. E. Nelson, Hughes Aircraft Co., Culver City
2. "Parametric Electron Beam Amplifiers" by A. Ashkin, T. J. Bridges, W. H. Louisell and C. F. Quate, Bell Telephone Laboratories, Murray Hill
3. "A Parametric Amplifier Using Lower-Frequency Pumping" by K. K. N. Chang and S. Bloom, RCA, Princeton
4. "Solid State Maser Systems" by R. H. Kingston, S. H. Autler, A. L. McWhorter and J. W. Meyer, Lincoln Labs., Lexington
5. "Slow-Wave Structures for Unilateral Solid-State Maser Amplifiers" by R. W. DeGrasse, Bell Telephone Laboratories, Murray Hill

SESSION 12 — WEDNESDAY, AUGUST 20
9:30 AM to NOON

Sunset Room—Ambassador Hotel

MODERN MANAGEMENT PROBLEMS

Chairman: Richard B. Leng, Packard-Bell Electronics, Los Angeles

1. "Minimizing Employee Losses When R and D Operations Relocate" by R. F. Lander, Electronic Engineering Co., Santa Ana
2. "The Role of Industry in Science and Engineering Education" by Joe Cryden, Hughes Aircraft Co., Culver City
3. "The Sales Engineer—Human 'Catalyst' of the Electronic Industry" by H. A. Young, Packard Bell Electronics, Los Angeles
4. "Project Direction in the Development of Avionics Systems" by Charles J. Godwin, General Electric Co., Utica
5. "Does the Present Cost-Plus-Fixed Fee Contract Give the Government the Best Deal" by Burgess Dempster, Electronic Engineering Co. of California, Santa Ana

SESSION 13 — WEDNESDAY, AUGUST 20
9:30 AM to NOON

Boulevard Room—Ambassador Hotel

INSTRUMENT TOOLS

Chairman: T. R. James, Ramo-Wooldridge Corp., Los Angeles

1. "Millimicrosecond Kerr Cell Camera Shutter" by A. M. Zarem, F. R. Marshall, S. M. Hauser, Electro-Optical Systems, Pasadena
2. "A Precision Delayed Pulse Generator as a Variable Time Interval Standard" by Dexter Hartke, Marvin Willrodt, and Donald Broderick, Hewlett-Packard Co., Palo Alto
3. "Development of a Transistorized Voltage Controllable Frequency Source" by W. B. Sander and W. E. Wilke, Gilfillan Bros., Los Angeles
4. "Broadband Stabilized Microwave Generators" by J. Huie and C. Eisaman, Stromberg-Carlson, Rochester
5. "Operational Feedback and Data Processing Amplifiers" by Sverre Sem-Sandberg, Consolidated Electrodynamics, Pasadena
6. "Broadband Waveguide Bolometer Mounts" by Leonard I. Kent, The Narda Microwave Corp., Mineola

SESSION 14 — WEDNESDAY, AUGUST 20
9:30 AM to NOON

Ambassador Ballroom

CIRCUIT DESIGN

Chairman: Michael Strieby, Hughes Aircraft Co., Culver City

1. "Graphical interpretations for Frequency Transformations" by John L. Stewart, University of Southern California, Los Angeles

(Continued on page 164)

 Circle 131 on Inquiry Card, page 97

WESCON Papers

(*Continued from page 163*)

2. "Optimum Synthesis of RC Ladder Networks" by A. Paige and E. S. Kuh, University of California, Berkeley
3. "A New Design Method for Coupling Networks with Applications to Broadband Transistor Amplifiers and Antenna Matching" by Panos A. Ligomenides, Stanford University, Stanford
4. "Some Developmental Techniques Concerning Distributed Amplifiers and Virtual Delay Lines" by W. J. Judge, Allen B. DuMont Laboratories, Passaic
5. "The Synthesis of Multi-Channel Amplifiers" by B. F. Barton, Univ. of Michigan, Ann Arbor

SESSION 15 — WEDNESDAY, AUGUST 20
9:30 AM to NOON

Venetian Room—Ambassador Hotel

AUDIO

Chairman: J. C. Webster, Naval Electronics Labs., San Diego

1. "Experiments with Speech Using Digital Computer Simulation" by E. E. David, Jr., M. V. Mathews and H. S. McDonald, Bell Telephone Laboratories, Murray Hill
2. "A Survey of Speech Bandwidth Compression Techniques" by S. J. Campanella, Melpar, Inc., Falls Church
3. "The Four-Track Stereotape Magazine for Home Hi-Fi" by R. J. Tinkham, Ampex Corporation, Redwood City
4. "A Versatile Compressor-Limiter Audio Amplifier for Studio Use" by E. W. Templin, Westrex Corporation, Hollywood
5. "Audio Characteristics of Piano Tones" by J. P. Quitter, The Baldwin Piano Co., Cincinnati

SESSION 16 — WEDNESDAY, AUGUST 20
2:00 to 4:30 PM

Embassy Room—Ambassador Hotel

INDUSTRY LOOKS AT FUSION POWER

(INVITED SESSION)

Chairman: to be announced

Speakers:

1. Henry Hurwitz, General Electric Co., Schenectady
2. Samuel Cunningham, General Atomics Corp., San Diego
3. Speaker from Westinghouse Electric Corp., E. Pittsburgh

SESSION 17 — WEDNESDAY, AUGUST 20
2:00 to 4:30 PM

Sunset Room—Ambassador Hotel

TRANSISTOR CIRCUITS

Chairman: Clarence Munsey, Rheem Electronics Division, Rivera

Heat-to-Electricity

GE last month announced the development of a quarter-size working model of a thermionic converter that produces electricity from heat.

Invented by Dr. James E. Beggs, in cooperation with Dr. Harold F. Webster, it is a combination of metal and ceramic discs surrounding a high vacuum, constructed under techniques similar to those for high temperature electronic tubes.

1. "A Wide-Range Junction Transistor Audio Oscillator" by M. A. Melehy, Michigan State University, East Lansing
2. "Comparisons Between Multiple and Single Loop Transistor Feedback Amplifiers" by E. M. Davis, Stanford University, Stanford
3. "The Root Locus Design of Transistor Feedback Amplifiers" by D. O. Pederson and M. S. Ghausi, University of California, Berkeley
4. "Techniques for Stabilizing All-Transistor DC Amplifiers" by Martin Klein, Cohu Electronics, Van Nuys
5. "Squared Input Stages for Low Level Transistor Amplifiers" by K. Hinrichs and B. Weeks, Beckman Instruments, Anaheim

SESSION 18 — WEDNESDAY, AUGUST 20
2:00 to 4:30 PM

Boulevard Room—Ambassador Hotel

AUTOMATIC CONTROL

Chairman: John L. Bower, Consultant, Los Angeles

1. "Compensation of Multi-Loop Control Systems" by Don Lebell and Max Mandell, 13019 S. Cimarron, Gardena, Calif.
2. "Optimization of Compensation for Cascaded Actuators in a Common Feedback Loop" by George S. Axelby and Eugene F. Osborne, Westinghouse Electric, Baltimore
3. "Some Symplifying Additions to Basic Sampled-Data Theory" by Carl O. Carlson, U.C.L.A.
4. "Contributions to the Analysis of Nonlinear Feedback Control Systems" by S. L. Mikhail, University of California, Berkeley
5. "Enhanced Real Time Data Accuracy for Instrumentation Radars by Use of Digital Hydraulic Servos." by R. P. Cheetham and W. A. Mulle, RCA, Moorestown

SESSION 19 — WEDNESDAY, AUGUST 20
2:00 to 4:30 PM

Ambassador Ballroom

INSTRUMENT SYSTEMS

Chairman: Robert Rawlins, Dynac Inc., Palo Alto

1. "Space and High Vacuum" by J. R. Hafstrom and George C. McFarland, Scientific Engineering, Berkeley
2. "Electronic Measurements of Missile Trajectories" by George O. Perkins, White Sands Proving Ground, New Mexico
3. "Drone Tracking System with Lightweight Airborne Package" by Emil J. Walcek, Radioplane, Van Nuys
4. "Automatic Telemetering Meteorological Observation Station" by Merle H. Wittmeyer, Paul Houlay and Bernard I. Florey, University of Arizona, Tucson
5. "An Airborne Digital Tape Recorder" by Sam Cohen and A. T. Arcand, General Precision Lab., Pleasantville
6. "An Electronic Framing Camera for Millimicrosecond Photography" by George L. Clark, Space Technology Laboratories, Los Angeles

SESSION 20 — WEDNESDAY, AUGUST 20
2:00 to 4:30 PM

Venetian Room—Ambassador Hotel

MICROWAVE PROPAGATION

Chairman: John B. Smyth, Smyth Research Associates, San Diego

1. "Forward Scatter of Electromagnetic Waves by Spheres" by W. E. Kock, J. L. Stone, J. E. Clark, W. D. Friedle, Bendix Systems Div., Ann Arbor
2. "Propagation Through Random Distribution of Spheres: I. Theory and Design of Macroscopic Gas; II. Design of Range and Experimental Data," by C. I. Beard and V. Twersky, Sylvania Electronic Lab., Mountain View
3. "Surface Waves on a Wedge" by F. Karal and S. Karp, New York University, N.Y.
4. "New Concepts in the Statistical Study of Tropospheric Scatter Propagation Data" by Leang P. Yeh, Westinghouse, Baltimore.

SESSION 21 — WEDNESDAY, AUGUST 20
8:00 to 9:30 PM

Embassy Room—Ambassador Hotel

BIOLOGICAL MEASUREMENT IN SPACE TRAVEL

Moderator: Dr. Robert Tschirgi, U.C.L.A.

Prominent speakers in the field of telemetering, remote control, medical electronics have been invited to speak.

SESSION 22 — WEDNESDAY, AUGUST 20
8:00 to 9:30 PM

Sunset Room—Ambassador Hotel

SPECIAL SESSION

Topic to be announced later.

SESSION 23 — THURSDAY, AUGUST 21
9:30 AM to NOON

Embassy Room—Ambassador Hotel

ANALOG COMPUTERS

Chairman: Walter Karplus, U.C.L.A.

1. "Anticipatory Display Design Through the Use of an Analog Computer" by Lawrence J. Fogel, and Milton Dwonczyk, Convair, San Diego
2. "A Transistorized Trigonometric Function Generator" by H. Schmid, Link Aviation, Hillcrest
3. "An Analog Memory" by M. Kozak, Canadian Westinghouse Co., Hamilton, Ontario
4. "Network Solution of the Right Triangle Problem" by M. R. Winkler, Goodyear Aircraft, Litchfield Park

(Continued on page 166)

WESCON Papers

(Continued from page 165)

SESSION 24 — THURSDAY, AUGUST 21
9:30 AM to NOON

Sunset Room—Ambassador Hotel

MICROWAVE AND HIGH POWER TUBES

Chairman: H. R. Johnson, Watkins-Johnson Co., Palo Alto

1. "A New Design Approach for a Compact, Kilowatt, UHF Beam Power Tube" by F. W. Peterson, RCA, Lancaster
2. "A Low Voltage Helix Type Backward Wave Oscillator with Extended Tuning Range" by Loren L. Maninger, Sylvania Electric Products, Mountain View
3. "Are Klystron Amplifiers Inherently Noisy" by Robert Rockwell, Varian Associates, Palo Alto
4. "A New Crossed Field Traveling Wave Tube, the M-J Tube" by Curtis C. Johnson and Charles K. Birdsall, General Electric, Palo Alto
5. "Design of Traveling-Wave Tubes for Airborne Applications" by M. Nowogrodzki, RCA, Harrison

SESSION 25 — THURSDAY, AUGUST 21
9:30 AM to NOON

Boulevard Room—Ambassador Hotel

MILITARY ELECTRONICS

Chairman: Cdr. Robert Freitag, NAMTC, Point Mugu

1. "Economic Analysis in Long Term Planning of Military Communication-Systems" by R. Krzyczkowski, Westinghouse, Baltimore
2. "Will Timing Systems Become Heterogeneous or Homogeneous?" by D. R. Proctor, Electronic Engineering Co. of California, Santa Ana
3. "Automatic Missile Systems Test Considerations" by J. L. Davis, Hoffman Electronics Corp., Los Angeles
4. "Frequency Mutiplex Doppler Radar" by Janis Galejs, Sylvania Electric Products, Waltham
5. "Talos Land Based System Digital Check-out Equipment" by Francis X. Beck, RCA Moorestown

SESSION 26 — THURSDAY, AUGUST 21
9:30 AM to NOON

Ambassador Ballroom

OVERSEAS VISITOR

Prof. Jos. Mattauch (l) one of the world's foremost authorities on mass spectroscopy, recently visited Consolidated Electrodynamics Corp. as the guest of CEC vice-pres., Dr. Harold W. Washburn, director of research.

IMPROVED COMPONENT MATERIALS

Chairman: C. E. Goodell. Hughes Aircraft Co., Culver City

1. "Advances in Ceramic Components" by H. M. Schlicke, Allen-Bradley Co., Milwaukee
2. "Monolithic Structure — A New Concept for Ceramic Capacitors" by John Fabricius, Sprague Electric Co., North Adams
3. "Upgrading the Tantalum Capacitor" by W. H. Roberts, General Electric Co., Irmo
4. "The Thermally Fused Metal-to-Ceramic Varistor" by R. C. Langford, Weston Electrical Instrument Corp., Newark
5. "Factors Affecting the Formation of Deposited Carbon Film Resistors" by Edward I. Doucette, Bell Telephone Labs., Murray Hill

SESSION 27 — THURSDAY, AUGUST 21
9:30 AM to NOON

Venetian Room—Ambassador Hotel

ANTENNA ARRAYS

Chairman: Walter Fortune, WADC, Dayton

1. "Arbitrarily Polarized Slot Array" by H. H. Hougardy and H. E. Shanks, Hughes Aircraft Co., Culver City
2. "Logarithmically Periodic Antenna Arrays" by R. H. DuHamel and D. G. Berry, Collins Radio Co., Cedar Rapids
3. "Impedance Properties of Antenna Arrays" by S. Edelberg, Massachusetts Institute of Technology, Lexington and A. A. Oliner, Polytechnic Institute of Brooklyn, Brooklyn
4. "Antenna Pattern Synthesis of the Most Truthful Approximation" by Herbert P. Raabe, General Mills, Minneapolis
5. "A Rapid-Scanning Phased Array" by R. E. Miller, A. T. Waterman, Jr., G. K. Durfey and W. H. Huntley, Jr., Stanford University, Stanford

SESSION 28 — THURSDAY, AUGUST 21
2:00 to 4:30 PM

Embassy Room—Ambassador Hotel

SPECIAL ELECTRON DEVICES

Chairman: H. W. Welch, Motorola, Phoenix

1. "Voltage Sensitive Semiconductor Capacitors" by M. E. McMahon and G. F. Straube, Pacific Semiconductors, Culver City
2. "The Hall Effect Circulator—A Passive Transmission Device" by W. J. Grubbs, Bell Telephone Labs., Murray Hill
3. "Stacked Tubes in Glass Envelopes" by Charles F. Douglass, Sylvania Electric Products, Emporium
4. "A Lightweight Kilowatt Klystron Amplifier for Aerial Navigation Systems" by Robert Rockwell, Varian Associates, Palo Alto
5. "Characteristics and Control of Gas Tube Duplexers During their Recovery Time" by R. E. Hovda and E. R. Roehl, Autonetics, Downey

SESSION 29 — THURSDAY, AUGUST 21
2:00 to 4:30 PM

Sunset Room—Ambassador Hotel

HUMAN FACTORS IN ENGINEERING

Chairman: Marvin Adelson, Hughes Aircraft Co., Fullerton

1. "A Review and Summary of Tracking Research Applied to the Description of Human Dynamic Response" by Duane T. McRuer, Systems Technology, Inglewood and Ezra S. Krendel, The Franklin Institute, Washington
2. "Synthesis of a Linear Quasi-Transfer-Function for the Operator in a Man-Machine System" by Albert S. Jackson, Cornell University, Ithaca
3. "The Optimization of Man-Machine Control Systems" by H. P. Birmingham, Naval Research Lab., Washington
4. "SIBYL: A Laboratory for Simulation Studies of Man-Machine Systems" by Henry D. Irvin, Bell Telephone Labs., Murray Hill
5. "Simulation of a Human Tracking Problem on the UDEC III Computer" by H. Platzer, Burroughs Corporation, Paoli

SESSION 30 — THURSDAY, AUGUST 21
2:00 to 4:30 PM

Boulevard Room—Ambassador Hotel

MICROWAVE FERRITES

Chairman: Eric Strumwasser, Hughes Aircraft Co., Culver City

1. "Circular Electric Waves Propagating thru Circular Waveguide Containing a CircumFerentially Magnitized Ferrite CylCylinder" by N. Kumagai, Univ. of Osaka, Osaka, Japan
2. "A Wide-Band Nonreciprocal TEM Transmission-Line Network" by E. M. T. Jones, S. B. Cohn and J. K. Shimizu, Stanford Research Inst., Menlo Park
3. "Field Displacement Effects in Dielectric and Ferrite Loaded Waveguides" by Thomas M. Straus, Harvard University, Cambridge
4. "Ferrite Line Width Measurements in a Cross-Guide Coupler" by Donald C. Stinson, Lockheed Missiles Systems Division, Sunnyvale
5. "Tee Circulator" by William E. Swanson and Gershon J. Wheeler, Sylvania Electric Products, Mountain View

SESSION 31 — THURSDAY, AUGUST 21
2:00 to 4:30 PM

Ambassador Ballroom

COMPONENT PARTS

Chairman: John Fiske, Aircraft Marine Products, Arcadia

1. "A Solution to the Sampling vs. Rating Dilemna on Electronic Components" by

(Continued on page 168)

Circle 57 on Inquiry Card, page 97

WESCON Papers

(Continued from page 167)

Bernard Hecht, B. Hecht & Associates, Los Angeles

2. "Design and Performance of Static-Magnetic Regulated DC Power Supplies" by John T. Keefe, Sola Electric Co., Chicago
3. "Design of Semi-Conductor Magnetic Voltage Regulator Reference Circuits for a Wide Range of Environments" by E. Q. Carr and K. P. Worcester, General Electric Co., Ithaca
4. "Dynamic Temperature Coefficient Measurements" by A. S. Takacs & F. Baron, Vitramon, Bridgeport
5. "Development of 500 Degrees C Low Loss, High Frequency Cables" by E. T. Pfund, Jr. and Capt. Bard Suverkrop, United Electrodynamics, Pasadena

SESSION 32 — THURSDAY, AUGUST 21
2:00 to 4:30 PM

Venetian Room—Ambassador Hotel

RADIO AND TELEVISION BROADCASTING

Chairman: Theodore Grenier, ABC, Los Angeles

1. "Field Experience with the Kahn Compatible Single Sideband System Installed at KDKA, Pittsburgh, Pa." by Ralph N. Harmon, Westinghouse Broadcasting Co., New York
2. "Head Drum Stabilization for Recording the NTSC Color Signal" by Jack Kabell, Stanford Research Institute, Menlo Park
3. "Frequency Measurement in the Broadcast Field" by C. A. Cady and W. P. Buuck, General Radio Company, Cambridge
4. "Remote Control and Automatic Logging of AM, FM and TV Transmitters and Automatic Programming of AM & FM Broadcasting Stations" by Paul C. Schafer, Schafer Custom Engineering, Burbank
5. "Automatic Control of Videotape Equipment at NBC, Burbank" by Robert Byloff, NBC, New York

SESSION 33 — FRIDAY, AUGUST 22
9:30 AM to NOON

Embassy Room—Ambassador Hotel

SOLID STATE I

Chairman: J. G. Linvill, Stanford University, Stanford

1. "A Family of Diffused-Base Germanium Transistors" by H. E. Talley, Bell Telephone Labs., Allentown
2. "Millimicrosecond Diffused Silicon Computer Diodes" by J. H. Forster and P. Zuk, Bell Telephone Labs., Murray Hill
3. "Diode Recovery Time Measurements in the Millimicrosecond Region" by A. E. Bakanowski, Bell Telephone Labs., Murray Hill
4. "The Design and Characteristics of a Diffused Silicon Logic Amplifier Transistor" by L. E. Miller, Bell Telephone Labs., Allentown
5. "Switching Time Calculations for Diffused Base Transistors" by V. H. Grinich and R. N. Noyce, Fairchild Semi-conductor Div., Palo Alto

SESSION 34 — FRIDAY, AUGUST 22
9:30 AM to NOON

Sunset Room—Ambassador Hotel

PRODUCTION TECHNIQUES

Chairman: Ed Gamson, Telemeter Magnetic Corp., Los Angeles

1. "A Fresh Approach to Modular Packaging for Ground Based Electronic Equipment" by C. W. Watt, Consolidated Electrodynamics Corp., Pasadena
2. "Insulated Flexible Printed Circuits" by William Wilkens, Sanders Associates, Nashua
3. "Design and Semi-Automatic Production of Stacked Ceramic Receiving Tubes" by Richard H. Chamberlain, Eitel-McCullough, Inc., San Bruno

ALLIED'S NEW Subminiature TOGGLE SWITCHES

These new subminiature switches are particularly well suited to printed circuit, transistorized and other miniaturized equipment.

ACTUAL SIZE

SPECIFICATIONS:

Handle: Ball Type Toggle
Bushing: ¼-40 Thd.
Body: Single Pole— .520 x .270 x .320
Double Pole— .520 x .520 x .320
Terminals: Gold Flashed

Contact Ratings: Low level to 5 Amp. (Res.) 115 VAC, 24 VDC
Dielectric: 1000 volts RMS
Vibration: 10-G 10-500 cps
Shock: Specification MIL-S-901 (Type C)
Endurance: 10,000 Make and Break Cycles
Tumbling: In accordance with Signal Corps Requirements
Corrosion Resistance: 50 hour Salt Spray per Federal Spec. QQ-M-151
Humidity: 10 Cycles per Specification MIL-S-3950
Seal: Low Temperature Rubber Boot for Panel Sealing is available

WRITE FOR BULLETIN TO

ALLIED CONTROL

MINIATURE SWITCH DIVISION OF

ALLIED CONTROL COMPANY, INC.,
2 East End Avenue, New York 21, N.Y.

AL 185

Circle 50 on Inquiry Card, page 97

For HEAVY DUTY WORK! Severest Electrical Services

P-506-CE—Plug with Cap

S-506-DB
Socket with deep Bracket

JONES PLUGS & SOCKETS

500 SERIES
Proven Quality!

For 5,000 Volts, 25 Amperes per Contact Alterable by circuit Characteristics.

Socket contacts of phosphor bronze, knife-switch type, cadmium plated. Plug contacts hard brass, cadmium plated. Made in 2, 4, 6, 8, 10 and 12 contacts. Plugs and sockets polarized. Long-leakage path from terminal, and terminal to ground. Caps and brackets, steel parkerized *(rust-proofed)*. Plug and socket blocks interchangeable in caps and brackets. Terminal connections most accessible. Cap insulated with canvas bakelite.

Write for Jones BULLETIN 21 for full details on line.
See new Developments at the WESCON SHOW Booths 401-402

Jones

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

Circle 51 on Inquiry Card, page 97

NEW! *The lowest-cost ultrasonic cleaning and chemical processing unit available anywhere!*

Generator G-201, Tank NT-201

narda SONBLASTERS $175

Now, no one need put off buying an ultrasonic cleaning or chemical processing unit because of cost! Narda's mass production techniques have done it again—this time, a top-quality 35-watt unit, complete with stainless steel transducerized tank with tremendous activity, at the lowest price in the industry—and with a full 2-year warranty besides!

What do you want to clean? Hot lab apparatus, medical instruments, electronic components, optical and technical glassware, timing mechanisms—the Narda SonBlaster cleans 'most any mechanical, electrical or horological part or assembly you can think of — and cleans faster, better and cheaper. It's perfect, too, for brightening, polishing, decontaminating, sterilizing, pickling, deburring, and plating; emulsifying, mixing, impregnating, degassing, and other chemical process applications.

What's more, two tank sizes are available, and there's a duty cycle timer at only $10 additional. Couple all these advantages with the low, low price, and you'll see why you can't beat the Narda Series 200 SonBlaster (as well as the larger models) for top value. Mail the coupon now for free help in determining the precise model best for you.

SPECIFICATIONS

Generator Model No.	Tank Model No.	Interior tank size (in.)	Tank Capacity	Price
G-201	NT-201	4-5/8 deep x 3-5/16 diam.	1/8 gal.	$175
G-201	NT-202	6-1/2 deep x 4-7/8 diam.	3/8 gal.	$210
Model G-202 Generator (same as G-201, but with duty cycle timer) available with either tank above, $10 additional.				

The SonBlaster catalog line of ultrasonic cleaning equipment ranges from 35 watts to 2.5 Kw, and includes transducerized tanks as well as immersible transducers which can be adapted to any size or shape tank you may now be using. If ultrasonics can be applied to help improve your process, Narda will recommend the finest, most dependable equipment available — and at the lowest price in the industry!

The Narda Ultrasonics Corporation
118-160 Herricks Road
Mineola, L. I., New York
Dept. EI-3
Gentlemen:
Please send me more information about
☐ The complete Narda line
☐ Series 200 SonBlasters

Name______
Organization______
Address______
City______ Zone____ State______

the narda ultrasonics corporation
118-160 HERRICKS ROAD, MINEOLA, L. I., N. Y.
Subsidiary of The Narda Microwave Corporation

Circle 52 on Inquiry Card, page 97

A radio controlled target drone (an old B-17) explodes after being hit by a Nike-Ajax guided missile over White Sands, New Mexico

PROJECT AMMO.

(Continued from page 1)

during PROJECT AMMO: SERGEANT, JUPITER, JUPITER-C and REDSTONE.)

SURFACE-TO-AIR. NIKE-AJAX, supersonic, anti-aircraft guided missile, can attack high-altitude aircraft, used to protect some 23 U.S. cities; NIKE-HERCULES, successor to AJAX, greater range, velocity, altitude and range, atomic warhead, used in 3 U.S. areas now, in more later; HAWK, highly mobile, utilizes CW radar of unique design in nose to detect enemy aircraft flying in blind (low) zone of conventional radar; TALOS, supersonic ram-jet, rides radar beam, developed by Navy and now under study for Army ground use. (Army also has, but did not fire, the NIKE-ZEUS.)

What does the takeoff of a missile look like? Out in the desert you see the missile on its launcher, about 300 yards away. Overhead you see a small, red radio-controlled drone target plane, known as RCAT, flying in figure 8s in response to the radio control stick in the hands of a sergeant in front of you. As soon as the target plane reaches the desired distance and altitude, the command to "Fire" is given and the usual "count-down" begins. When the count reaches "zero" there is a burst of yellowish-white flame from the tail of the rocket and it rather slowly leaves its launcher in a cloud of smoke and dust. Seconds later the roar of the explosion reaches you. By this time the missile has rapidly gained speed and altitude and you follow it darting across the sky until the first

(Continued on page 172)

Silicone Sponge Rubber

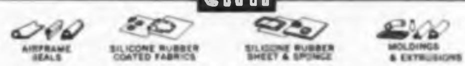
for sealing, gasketing, pressure pads, vibration dampening — 100° F to 480° F

Low density COHRlastic R-10470 silicone sponge rubber is completely flexible after 72 hrs. at 480°F, shows no brittleness after 5 hrs. at −100°F. High tensile, tear and elongation. Closed cell construction is non-absorbing. Called out on aircraft and electronic drawings and specifications. Available from stock in sheets 1/16" thru 1/2", in rod .180" thru .585". Special extruded shapes made to order.

FREE SAMPLES and folder—write, phone or use inquiry service.

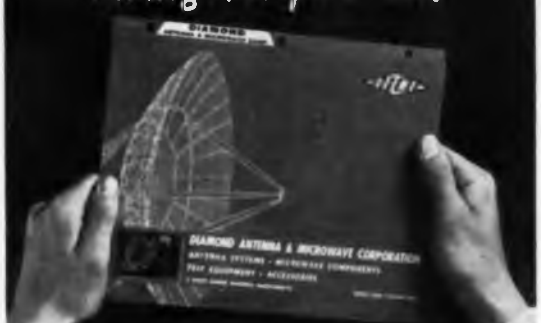
CONNECTICUT HARD RUBBER

NEW HAVEN 9 — CHR — CONNECTICUT



Circle 102 on Inquiry Card, page 97

Get Diamond's NEW microwave catalog and price list!



Diamond's handy "short-form" catalog #958 contains over 850 standard microwave items — thoroughly detailed — *all on one side*. Simple in format for efficiency in use.

Handsomely printed on coated card stock. Lacquered for extensive use without smudging or becoming dirty. Has tab for file folder use — is punched for 3-ring binder — lies flat when hung on wall, for ready reference.

Send for your free copy today!

DIAMOND
ANTENNA & MICROWAVE
CORPORATION
7 North Avenue • Wakefield, Mass.

See us at BOOTH 1426—WESCON—Los Angeles (August 19-22)

Circle 103 on Inquiry Card, page 97

The greatest advance in soldering iron design ever... developed to meet an overwhelming need!

Ungar® SOLDERING PISTOL

For On Target Soldering in Any Position

Perfectly Balanced, Cool, Lightweight, Comfortable Pistol Makes All Soldering Easier!

Comfortable pistol grip handle means easy access to any part. Pistol can be held in any position — normal, upside down or reverse upside down — with complete balanced ease. Extreme lightweight cuts down fatigue. Any of the 16 famous Ungar interchangeable tips and tiplets may be used in the pistol. Comes complete with 6' flexible cord. It's the easy way to reach those "hard-to-get-at" places and do perfect soldering.

#260 — Complete: handle and tellurium copper chisel tip, 115V, AC-DC. List .... **$4.50** each.

#660 — Handle only. Tip not included. List **$3.00** each.

Ask your distributor or write for complete details

Ungar Electric Tools, Inc.
4101 Redwood Avenue, Los Angeles 66, California

Circle 104 on Inquiry Card, page 97

Electronically controlled LaCrosse missile on its mobile launcher ready to be fired during PROJECT AMMO exercises in New Mexico's desert

(Continued from page 170)

booster separates and falls, smoking, to the ground. But the "bird" speeds on faster than sound. A voice from a speaker is now heard counting the time to impact. Seconds are ticked off. Then, far away in a slightly cloudy sky, there is a bright red flash; The missile, with the aid of its electronic brain has found and destroyed its prey. Portions of the target plane burn as they fall to earth.

Having witnessed these dramatic demonstrations of PROJECT AMMO, which were extremely well planned and executed by the Army, what conclusions do we reach? First, we endorse without reservation the Army's claim to successful, operational missiles and men trained to use them. The firing for the first day of PROJECT AMMO was done entirely by soldiers; company engineers supervised the firings on the second day when some development missiles were demonstrated. Second, the accuracy and reliability of the various missiles was amazing to us, who were

Direct hit by Dart missile destroys tank during PROJECT AMMO

familiar with guided missile development during World War II. It is believed the present superior performance was obtained partly due to the *electronic check-out system* employed. Simple lights on a panel told the operator that every part of his missile was functioning properly before firing. Such testing equipment also tests itself. This is a feature which should be built into more of our complicated commercial electronic equipments.

Third, every key worker on a guided missile should have an opportunity to watch an actual firing. Only then can the punishment inflicted on the complicated "brain" and the control equipment BY FIELD USE be fully appreciated and suitable design and manufacturing steps be taken to assure reliability.

With the realization that our Army's plans for defense, both at home and abroad, rests more and more on guided missiles, comes the knowledge that our electronic missile engineers share a larger and larger responsibility to produce military equipment of outstanding reliability and performance. Dr. Pickering, referring to the weapons mentioned above, said: "These are excellent weapons, but we must not forget that Russia can probably match them and we are *not* leading the rest of the world. Only by summoning our best talent can we close the gap." In pressing onward it is not more types of missiles that we need—we have too many now—but consolidation of military and engineering effort on the *best* types.

Albert F. Murray
Washington, D. C.

ELECTRONIC ENGINEERS • PHYSICISTS • MATHEMATICIANS

TAKE THE "ELECTRONICS HIGHWAY" WHEN VACATIONING IN NEW ENGLAND

...and visit

SYLVANIA'S WALTHAM LABORATORIES

to discuss our newest projects and your professional opportunities

Typical of the picturesque New England coast — a sturdy old lighthouse

Express artery around Boston: Rt. 128, in heart of Pilgrim Country. Going north, take Exit 42A for Sylvania (12 miles from Boston Common). Many tourist attractions are close enough for a day's sightseeing. And 128 connects with main routes to all New England.

Cruising north along Route 128 through historic Middlesex County, you'll see Sylvania's Waltham Labs high above the highway. Stop off on your way to nearby Lexington for what could be an important interview about a future in advanced electronics with Sylvania.

Big things are happening in your profession at Waltham Laboratories. This is where Sylvania engineers and scientists are developing the Data-Processing nerve-center of BMEWS (giant new program for a Ballistic Missile Early Warning System).

Work on PLATO (AMM system for which Sylvania is Weapons System Manager) is also centered here... plus development programs for other major electronic defense projects.

current opportunities at Sylvania are too good to pass by...

DATA PROCESSING LABORATORY

- Sr. Development Engineers
- Sr. Packaging Engineers
- Project Engineers
- Sr. Logical Design Engineers
- Engineers with experience in Radar Data Handling and Display

(Previous digital data processing experience is important for most assignments.)

MISSILE SYSTEMS LABORATORY

- Advanced development, VHF & UHF submonitoring complex radar systems
- Systems analysis & synthesis of complex radars, their design and simulation
- Problems in atmospheric physics, ionized gases, astronautics

AVIONICS LAB

- Microwave components design including multi-channel filters incorporating fast-acting microwave switches
- Flush-mounted broad band airborne microwave antennas
- Transistor circuit design & development

APPLIED RESEARCH LAB

- Research & Systems Application in Counter-Countermeasures, Operations Research, Analysis & Applied Physics

Interview and relocation expenses paid by Sylvania. Inquiries will be answered within 2 weeks. Convenient Saturday interviews arranged.

Send your resume to Erling Mostue

WALTHAM LABORATORIES, Electronic Systems Division

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.

100 First Avenue • Waltham 54, Massachusetts

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

**Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers**

NEW CONTRACTS

General Electric—$3,999,-291, from Rome AF Depto for radar course directing group, AN/GPA-73.

General Precision Lab—$3,971,963 supplemental contract with Airways Modernization Board for transition and terminal portion of an experimental Air Traffic Control Data Processing Central. Also, $1,343,820 contract from AMC for antennas, receiver-transmitters and computer-frequency trackers for APN-81 for B-52 and KC-135 aircraft.

Lear—$4.1 million, from Signal Corps for automatic flight control systems to be used in Army's H-34 helicopter. Also, $842,302, from Air Materiel Command for control assembly and attitude gyros for use in the F-105 and F-106 aircraft.

Lockheed—$7.5 million, for new series of recoverable target missiles (kingfisher).

Raytheon—$15 million, from BuShips for 1,365 radio communications relays sets, AN/TRC-27.

Sperry Corp—$19 million, from BuOrd for guided missile equipment, radar sets AN/SPG-55, special field test equipment, and spare parts. Also, $8 million for long lead-time items for radar sets AN/SPG-56 to be used with the Talos program.

Sylvania—$2,634,000, from Army Signal R&D Lab for "continuation of development work in electronics." Also, $320,000 contract with Air Materiel Command for ecm attachments to the AN/GPS-T2 radar target simulator.

NEW W.C. FIRM

A. P. Jacob, vice-pres., and F. G. Jameson, pres. of Pacific Automation Products Inc. (l. to r.), discuss plans of new PAP subsidiary, Space Electronics Corp., with officers, Dr. J. C. Fletcher, pres., and F. Lehan, vice-pres.

IT&T's new plant at Raleigh, N. C., is expected to employ more than 200 persons in manufacturing of carrier and microwave equipment. An initial payroll of 100 is planned for the opening in October.

Westinghouse is planning a multi-million dollar power transformer plant in Muncie, Ind., that will eventually employ 2,000 persons. The site is a 300-acre tract south of Muncie. Production will begin in late 1961.

Raytheon Mfg. Co. will lease 400,-000 sq. ft. of space in the Dighton Industries, Inc., property in North Dighton, Mass., to provide increased manufacturing capacity for its Government Equipment Division. Hiring is going on through the month of July, with employment expected to reach more than 1,000 by late Fall.

General Radio's Cambridge, Mass., plant is being leased on a long-term basis to Epsco Inc. General Radio is consolidating and expanding its operations at its West Concord plant. Epsco expects to maintain the General Radio level of employment and eventually to employ over 800.

Scientist Remarkably "Normal"—DuPont Finds

Disturbed by the extent to which the widespread negative image of the scientist discourages young people from seeking scientific careers, the DuPont Company surveyed half of the 2,400 technically trained people doing its research to get a picture of the scientist as a person. Findings:

1. 25% are between 21-29; 61% between 30-44; 14% between 45-65. They come from 44 of the 48 states, the District of Columbia, and 25 foreign countries.

2. They were educated at 258 U. S. colleges and universities and 34 foreign institutions, with Illinois, Wisconsin, Massachusetts Institute of Technology, Ohio State, Cornell, Purdue, Minnesota, Delaware and Michigan mentioned most frequently. 68% have doctorates. 19% earned all their undergraduate expenses; 69% earned all graduate expenses.

3. 88% are married, compared to 85% of the general adult population. 73% of wives attended colleges. Although 15% do not have children, average number per family is slightly more than two, compared to 1½ for the average U. S. family. Three ("who obviously don't spend all their time in the DuPont laboratories") have seven children.

4. Although the survey did not inquire into religion, approximately 75% mentioned church in listing their activities.

5. 36% participated in 64 different civic activities. 19% mentioned membership in community organizations and 7% in fund-raising groups. About ⅓ are in Parent-Teacher work.

(*Continued on page* 180)

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 99.

What prompts engineer dissatisfaction?

Do salary increases solve all the problems?

Is prestige so important?

These and many other questions are objectively treated.

Motivating Factors in Engineers

TO his job the engineer brings motivations, expectations and attitudes which have their origins as far back as childhood. His orientation is such that he sees the job situation as one in which he is constantly being evaluated as a person and a professional man.

Though he derives a great deal of satisfaction from the work which he does and is willing to put up with much inconvenience when working on a job which he finds challenging, the way in which he perceives himself to be evaluated by management greatly affects his feelings on the job.

A careful study of the available surveys and reports on job satisfactions of engineers shows that there are relatively few factors which hold the key to whether engineers are contented or discontented with their work. They are closely related, too, to the process of job selection, as well as to productivity and morale.

Pre-Employment Expectations

The opinions of engineering students and experienced engineers on matters relating to job satisfactions were significantly different in a survey conducted at Purdue University. See Table 1.

These answers reflect many of the problems to come when the student engineer enters industry.

Company recruiters have also been criticized by a number of sources as being responsible for dissatisfaction among newly hired graduates. These new engineers have often been given the impression that they will be part of management and that they will be doing advanced work. Subsequently finding themselves put to work at junior engineering jobs well below their expectations has resulted in low morale and wholesale turnover. It is likely that this disillusionment is reflected in their worklife.

Role of Salary

Salary is one of the major motivating factors in engineer job selection and job satisfaction. A number of surveys have shown that salary is currently one of the major causes of engineer discontent. The main reasons for this dissatisfaction were put forth by the Engineers Joint Council in a report on professional standards and employment conditions. The causes (confirmed by other studies) were these:

TABLE 1

ENGINEER OPINIONS

Opinion	"Yes" Responses Experienced Engineers	"Yes" Responses Engineering Students
Management recognizes the engineer as a professional	24%	31%
Engineer feels a sense of importance to the company	22%	37%
Personnel policies do not maximize engineer's contributions	37%	23%
Employee will not have the opportunity to contribute to management decisions in his area of responsibility	30%	6%
Employee will have the opportunity to use a great portion of his training as an engineer	27%	43%
Engineer seldom knows if management is satisfied with his work	28%	10%

Based on "Motivating Factors in Engineer Employment," a research report by Deutsch & Shea, Inc., 230 W. 42nd St., New York 36.

The feeling that engineer salaries were not commensurate with the fundamental contribution made by the engineer.

The complaint that the differential between the wages of skilled workers and the salaries of engineers was too small.

The fact that the salaries of experienced engineers have not been increased in proportion to the rise in starting salaries for engineers.

Objections to the wide variations of salaries paid to engineers doing comparable work in different organizations.

Dissatisfaction with merit review systems and inadequate understanding of salary administration.

An analysis of the findings indicates it is not real salary but the salary-oriented prestige factors which are the key to engineer job satisfaction in this area.

The engineer feels that, on the one hand, his essential contribution is overlooked while the more "glamorous," but to his way of thinking, less important fields of sales and management get much greater financial rewards. On the other hand, his status as a college-trained, high level employee is threatened from below as the skilled "blue-collar" worker approaches his own salary level.

If he has been on the job for several years, he sees his experience, which he considers one of his most valuable assets, discounted as newly graduated engineers start at very high salaries. In believing that salaries vary widely among companies (much less true today due to the widespread competition for engineers) he is saying, in effect, "If my company doesn't appreciate me, there are companies that will."

Merit reviews, as often as not, leave him angry and distrustful, for he still cannot achieve, he feels, the kind of salaries the sales force or the executives can command. And so strongly does he view salary as an indication of value that he may abandon the technical work which gives him much satisfaction to enter sales and administration.

Role of Recognition

As the engineer sees it, recognition comes from the top down—a reflection of his own strong respect for authority. He does not expect to be placed on a pedestal, but he wants to have a feeling of equality with other important groups within the company.

Typically, he goes to other engineers for information, but he does not rely on words alone. Instead he looks for, and is satisfied by concrete evidence of recognition in terms of new computers and a library supplied for his use.

He looks for evidence of a permissive attitude on management's part and finds it in the encouragement they give their engineers to participate in technical sessions. Again he checks words against facts—in addition to receiving "encouragement" they "actually take part"—it is not mere lip-service.

He wants outside recognition, particularly from his colleagues in the engineering world, which he again perceives as something that management can provide by seeing that engineers get work that "gives a man something to talk and write about."

Table 2

IMPORTANCE OF MOTIVATIONAL FACTORS
IN ENGINEER JOB SELECTION AS SHOWN BY SURVEYS

	Number of Surveys in Which Factor was Ranked					
Factors*	First	Second	Third	Fourth	Fifth	Sixth
Salary	5	2	4		2	1
Challenging Opportunity	3	3	2		1	
Interesting Work	3	2		1		
Opportunities for Advancement	2	4	1			
Location	1		6	3		
Type of Work	1	1	3		2	
Potential Growth of Company	1	1		3		1
Company Prestige and Reputation	1			1	1	2
Progressive Research and Development Program		1		3	1	
Regular Salary Increases		1			3	1
Job Security				2		
Opportunity for Advanced Study					1	

* In rank order

Recognition, then, is not a matter of individual concessions, but rather a complete climate, as the engineer sees it. And it is a climate controlled directly by management attitudes. Where a climate of recognition does not prevail, the engineer tends to grasp at small things as symbols of the over-all recognition he lacks, and to gripe about environment or restrictive regulations. As mentioned, he will often concentrate his drive for recognition to the area of salary alone. Recognition may be considered as a factor which underlies almost all other areas of engineer job satisfaction.

Role of Communication

Prof. H. A. Shepard of M. I. T. has called engineers "marginal men" in that they work in an area that is not quite science and not quite business, but is associated with both. They are marginal men in other ways, too, he asserts, but what is important to us here is the idea of engineers as being in some way intermediaries—even translators or interpreters between two very diverse points of view: the business and the scientific outlooks.

A major electronics company recently surveyed its own engineering staff, and found complaints about many facets of communication:

60% said they were not given as much information about the company's operations and the activities of other functions as they should have in order to do their work properly.

39% said the supervisors did not keep engineers informed about what was going on.

31% said they usually or frequently have to find things out indirectly which they should have been told about through proper channels.

30% said the company was too closemouthed about matters of information about which they, as engineers, should know.

(*Continued on page* 178)

Motivating Factors

(Continued from page 177)

An NSPE study emphasized the difference in executive and engineer outlook in the area of communications: 85% of the executives surveyed felt that the company's engineers were kept currently informed of their personal progress; only 50% of the engineers surveyed were of the same opinion.

Of 265 engineers from large companies taking part in a depth interview study, more than 30% indicated that they were not kept fully informed on company policy, and were not asked advice in matters related to engineers.

Nor is the failure of communication restricted to professional matters alone. Many studies reveal much uncertainty among engineers about their own standing and their progress on the job, which seems to reflect a breakdown in communications even on the employee-supervisor level.

The engineer's preoccupation with the technical aspects of his work insulates him to some degree from the verbal world in which he also lives. But not so much so that communication has not become a major motivational factor in job satisfactions. So vital is it indeed, that the Engineer Joint Council cites "lack of appropriate means for resolving individual problems" as a condition which has "fostered collective bargaining among engineers."

In addition, management loses both the contribution which the engineer might make were more channels open to him and the more effective use he might make of his work if he were fully conversant with the company-wide picture of needs, policies, and activities.

Role of Utilization

Utilization includes not only the daily job assignments and the type of work the individual engineer does, but also the related factors of advancement, development, responsibility, training, and the like.

Surveys on engineer attitudes and satisfactions confirm the importance of utilization. A very recent study, *A Survey of Attitudes of Scientists and Engineers in Government and Industry*, by the Committee on Engineers and Scientists for Federal Government Programs, cites as a factor of "utmost importance" to respondents in both government and industry, "interest potential of the work."

Asked, "What things about your job do you like least?" 77% of the engineers participating in an Opinion Research Corporation survey said it was too much routine non-engineering work — not enough creative work. In a PECBI study, some 53% of the engineers surveyed felt they spent more time than they should on details and routine work, and 25% felt that from 30% to 50% of their work was of this nature.

Utilization is particularly important to the engineer because it is most closely related to his most powerful psychogenic needs. His expectations of satisfaction with his work are high, stimulated by his own

(Continued on page 180)

ENGINEERS—ELECTRONIC:
ELECTRICAL:

Air Force space and operational programs offer you unique professional challenge and opportunity as a civilian

Among the myriad current and projected programs of the U. S. Air Force lies a challenge and opportunity for civilian electronic and electrical engineers with varying degrees of specialty and experience. These areas include: the research, development and maintenance essential to sustaining qualitative superiority for the operational Air Force; research and development in IRBM and ICBM fields; the projection into outer space and return of manned, piloted vehicles. Stimulating assignments now exist for qualified men in these categories.

As an Air Force Civilian Electronic or Electrical Engineer you:

WORK . . . in a fine creative atmosphere . . . with foremost men in the field . . . with most modern equipment and facilities . . . in more than one specific program . . . in geographic location of your choice.

RECEIVE . . . assured income . . . low-cost life insurance . . . promotions from within . . . excellent retirement and compensation plans . . . protection from arbitrary separation . . . liberal sick and vacation leave plans.

ENJOY . . . expanded scope of assignment . . . professional prestige and recognition . . . job satisfaction . . . participation in opening new frontiers and conquering space.

For full details mail the coupon below.

Paste on Postcard and Mail or Write to:

Air Force Civilian Personnel, Dept. I2
Box 7608, Washington 4, D. C.

Please send me further information on U. S. Air Force Civilian Personnel opportunities.

Name________________________

Degree(s)__________Specialty__________

Address________________________

City____________Zone____State______

CHALLENGE
SCOPE
CREATIVITY

U.S. Air Force

Circle 506 on "Opportunities" Inquiry Card, page 99

Motivating Factors

(*Continued from page* 178)

interest, by the educational process through which he passes and, in the case of the newer engineer, by the assurances of recruiters that he is going to do interesting work.

The young engineer is frequently disillusioned when he finds himself doing routine work; the older engineer often finds himself enmeshed in a specialization which hinders his chances for advancement and development. The complexity of many modern products means that the engineer may be doing the engineering equivalent of bolt-tightening on a production line.

Often, too, he feels held down by his supervisor or by management. A frequent complaint is that supervisors "bury good men" to keep their services, rather than seeing to it that they are given opportunities to move up.

Much of the engineer's professional standing is tied up in the work he is doing. If it is interesting, new, worthwhile work, he can, as the respondent quoted previously pointed out, write papers about it and gain recognition among his fellows. This is in addition to the intrinsic satisfaction he finds in challenging work. Accomplishments which are worthwhile fortify his own feelings of worth and value and give him a kind of justification in his interests and his choice of a career.

Routine, uninteresting and what engineers term "subprofessional" work, on the other hand, induce negative feelings not only about the work, but about the company which provides it. It is under these conditions that what ordinarily would be minor irritations become major causes for complaint and eventually high turnover and/or unionization.

Advancement, another factor rating high on job acceptance questionnaires has, of course, its overtones of recognition and increased salary. So have training and the desire for added responsibility, both of which also rank high in influencing job selection. But underlying these factors is also the feeling that advancement, training, and responsibility will make for more interesting assignments, more satisfying work, and the opportunity to use one's own ideas.

Engineers are, in general, individualistic. The more creative and the more productive engineers are literally men in love with their work, who prefer working at their chosen profession to the exclusion of almost every other consideration —even recreation. When this powerful drive is thwarted or sidetracked by improper utilization, the results in job dissatisfaction become apparent in short order.

Scientists "Normal"

(*Continued from page* 175)

6. Of the 600 completing questionnaires, 47 participated in politics, 51 in military organizations, 20 in dramatics, 76 in purely social organizations, and 112 in miscellaneous groups ranging from camera clubs to an orchid society. 22% participate in musical groups. 70% participate in 42 different sports: Golf is most popular, with bowling second, followed by fishing, softball, swimming, hunting, basketball, and sailing. Other leisure-time pursuits run the gamut from gardening through painting to sports cars.

7. One out of four decided upon his career before reaching 15. The reasons included a strong personal interest in the field, courses in elementary or high schools, influence and encouragement of teachers or members of the family, and experience with home or toy chemistry sets.

Factory-Service Dept. At Denver Reps Firm

The Lahana Service Co., 1886 S. Broadway, Denver, Colo. recently opened a complete factory-authorized, fully equipped service and calibration center to service customers in the Rocky Mountain region, particularly at Boulder, Salt Lake, Albuquerque.

A staff of factory-trained service personnel offers prompt servicing of instruments—in or out of warranty —manufactured by any of its principals—Beta Electric Co., Dynac Inc., MB Mfg. Co., Hewlett-Packard, Kin Tel, F. L. Mosely Co., Sensitive Research Instrument Corp., Sorenson & Co., Varian Assoc.

Circle 505 on "Opportunities" Inquiry Card, page 99

News of Reps

Communication Accessories Co. recently held a meeting of all their representatives at Lee's Summit, Mo. It was their first general meeting in nine years.

D-B Associates, P. O. Box 284, Syracuse, N. Y., a newly formed electronic rep firm, has been appointed exclusive reps in the territory of upstate New York for the Perkin line.

Southern Sales Co., Angola, Ind. will cover Indiana and Kentucky; and **McDowell Redlingshafer Sales Co.**, Kansas City, Mo. is covering Missouri, Kansas, Iowa, Nebraska, and Southern Illinois now for the General Transistor Corp.

Carl M. Segal Co., 14942 Aztec St., San Fernando, Calif, a new rep firm, will handle sales in Southern California and Arizona for electronic equipment manufacturers.

William I. Duncan & Associates, 5452 Charles St., Philadelphia and **John W. Richardt Co.** with offices both in East Orange, N. J. and Great Neck Plaza, L. I., N. Y. have been named reps for Trans Electronics, Inc.

Materiels et Constructions, Paris, France are now exclusive reps for Servomechanisms (Canada) Limited, throughout Europe and the British Isles.

The Hilker Co., Box 4123, Winston-Salem, N. C. has been appointed by Electro Tec Corp. as rep in North Carolina, South Carolina, Georgia, Kentucky, Tennessee, Alabama, and Mississippi.

John Francis O'Halloran & Assoc. of North Hollywood, Calif. are now reps for California, Arizona and Nevada for the Rantec Corp.

Frank Lebell is now sales rep for Phalo Plastics Corp. His territory is Northern California, Northern Nevada, and Hawaii.

Wild and Associates, Roslyn, N. Y. has been appointed sales reps in the Mid-Atlantic region of the U. S. by the Tally Register Corp.

The Components Div. of Epso, Inc., Boston, announces the appointment of **Scientific Sales Engineering Co.**, Atlanta, as field reps for Kentucky, Tennessee, Louisiana, Mississippi, Alabama, Georgia, and North and South Carolina.

Jules J. Bressler & Co., Union City, N. J., are now sales reps in Metropolitan New York for the Merit Coil & Transformer Corp.

News of Reps

Gene French Co. of Albuquerque, New Mexico are now reps in New Mexico, Colorado, Utah, and parts of Southern Nevada and Northwest Texas for the Belleville-Hexem Corp.

The Texport Co., Dallas, Tex., are now reps in Louisiana and Texas for the Astro Corp.

Russel Broman, formerly Account Executive with Charles Bowes Advertising, Inc., Los Angeles, has been appointed Executive Secretary of the Los Angeles Chapter of **The Representatives** of Electronic Products Manufacturers, Inc. Mailing address of the new reps business office is Box 74, **La** Canada, California. Phone number is RYan 1-7325.

Wallace E. Connolly, Menlo Park, Calif. will handle sales in Northern California, and **Packard Associates**, Dallas, Tex., will handle sales in Texas, Oklahoma, Arkansas and Louisiana for NYT Electronics, Inc.

Merrill Franklin Co., Minneapolis, Minn. are now sales reps in Minnesota, North Dakota, South Dakota and the western part of Wisconsin for Deltine, Inc.

Murphy & Cota, Charlotte, N. C., are representing Terado Co. in North and South Carolina, Georgia, Tennessee, Alabama and Mississippi.

Winfield Electronic Sales, North Miami, Fla. have been named by Ace Electronics Assoc. as reps in the state of Florida.

G. W. Moler, 300 Broadway, Camden, N. J. has been appointed rep for Tel-Instrument Electronics Corp.

Four new sales reps have been appointed by Clevite Transistor Products, Div. of Clevite Corp. They are **McDowell Redlingshafer Sales Co.** Kansas City, Mo.; **Ray Johnston Co.**, Seattle, Washington; **Glendon Co., Ltd.**, Toronto, and **Jack Geartner**, Miami Beach, Fla.

S. Sterling Co., Detroit, Mich. are now exclusive reps in the lower peninsula of Michigan and the six northwestern counties of Ohio for the Helipot Corp.

Gawler-Knoop Co., Roseland, N. J. are sales reps in Metropolitan N. Y., Long Island, New Jersey, Eastern Pennsylvania, Delaware, Maryland, Virginia, and the District of Columbia for the Shepard Instrument Div. of Savage Industries.

New England Area Representatives, Inc., Somerville, Mass., have been named by Filtors, Inc. as reps in the New England territory.

Circle 502 on "Opportunities" Inquiry Card, page 99

Books

Logical Design of Digital Computers

By Montgomery Phister, Jr. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 424 pages. Price $10.50.

Using synchronous circuit components almost entirely, this book describes and interprets the methods and techniques of various men in the field, and applies them to a wide variety of problems in the logical design of digital computers. The book provides the reader with the information, tools, and procedures needed to carry out the complete logical design of a general or special purpose computer.

Medical Electrical Equipment

Advisory Editor Robert E. Molloy. Published 1958 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 320 pages. Price $15.00.

The aim of this book is to provide authoritative information on the principles, operation, care and routine maintenance of medical, electrical apparatus and devices in clear terms which do not presuppose a deep knowledge of electricity.

An informative section covering the principals of the various types of small electric motors used in medical equipment is also included.

Microwave Measurements

By Edward L. Ginzton. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 515 pages. Price $12.00.

This timely work is concerned with the basic forms of electrical measurements encountered in the microwave region of the electromagnetic spectrum. Emphasis is on fundamentals, and the topics discussed provide a background for all common microwave measurements, as well as for more specialized applications.

Although primarily written for a first year's graduate course in microwave measurements, this book will also prove useful as a reference for those who have more than a routine interest in microwave measurement problems.

Basics of Digital Computers

By John S. Murphy. Published 1958 by John F. Ryder Publisher, Inc., 116 W. 14th St., New York 11. 416 pages in 3 volumes. Price $2.50 per volume . . . 3 volume set $6.95. All 3 volumes in single cloth bindings $7.95.

Numerically Controlled Machine Tools—Implications for Management

By H. S. Clifton Morse and David M. Cox. Published 1958. Available through Cox and Cox, Management Consultants, 333 N. Michigan Ave., Chicago, Ill. Price $25.00 a copy.

A brochure describing the report is available from Cox & Cox on request.

(*Continued on page 186*)

Industry News

(Continued from page 46)

Norman Hiestand is the newly appointed Manager, Product Development of Varian Assoc. Instrument Div. **Winfield Wagener** becomes Product Manager, power tubes.

Three key appointments at Minneapolis-Honeywell's Boston Div.: C. B. **Harrison** to Marketing Manager; J. A. **Vitka** to Contract Administration Manager; and, **W. A. Rote** to Director of Engineering.

Filling the new post of General Sales Manager of the Cincinnati Div., Bendix Aviation Corp. is **Henry B. Yarbrough. Milton A. Chaffe** heads the new research department devoted to space physics at Baltimore.

Marketing executive shift at General Transistor: **Jerome Fishel** elevated to Marketing Director; and **Allan Easton** to Presidency of General Transistor Distributing Corp., and General Transistor International Corp.

Dr. Allen M. Peterson heads the new Communications and Radio Propagation Group at Stanford Research Institute.

A. M. Peterson

F. W. Walker

Frank W. Walker is now Vice President and Manager, Government Sales, Motorola Communications & Electronics, Inc.

Ray B. Cox has been appointed General Manager of Hoffman Sales Corp. of Calif. Mr. Cox was formerly President and General Manager of Horn & Cox, Inc.

James Spool is now Marketing Manager of Dynacor, Inc. Mr. Spool was formerly a member of the Washington field engineering staff of the Sprague Electric Co.

Reed Vail Bontecou is now Vice President—Marketing of the Electron Tube and Semiconductor Div. of Columbia Broadcasting System, Inc. Mr. Bontecou was formerly with General Electric Co.

Dr. Robert J. Nebesar has assumed the responsibilities of General Manufacturing Manager of Zenith Plastics Co., Gardena, Calif.

(*Continued from page 184*)

Switching Circuits and Logical Design

By Samuel H. Caldwell. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 703 pages. Price $14.00.

This book deals with the methods used to handle the problems of circuit synthesis using various kinds of components, and presents the principles of switching circuit designs. It provides the fundamentals which, when mastered, will promote a knowledge of the complex applications of switching theories.

The book is not a discussion of computing machines, nor does it treat computer components as such. However, the design of computer components and their incorporation into systems, is a well-known application of switching theories. The book discusses such things as the properties and applications of the switching circuits; switching components and their characteristics, including relays and high speed components; contact networks; gate circuits; and switching aspects of codes.

Basic Feedback Controls System Design

By C. J. Savant, Jr. Published 1958 by McGraw Hill Book Co., Inc., 330 W. 42nd St., New York 36. 418 pages. Price $9.50.

This work teaches the fundamentals of servo-mechanisms theory and design by means of practical examples from the student's own point of view. The author bases the study of feedback control system design on complex frequency plane analysis—that is, the root locus. Frequency methods, such as Nyquist and Bode, are included for completeness. A wide range of servo-transducers and components are covered. While emphasis is on a linear servomechanism design, a chapter is included on non-linear servo analysis.

New Standards Cover Cables, Printed Wiring

Three new international standards recommendations covering electrical insulating materials, radio-frequency cables, and printed wiring techniques have become available in the U. S. through the American Standards Association.

The three standards recommendations are contained in the following publications of the International Electrotechnical Commission (IEC):

Publication 93, Recommended Methods of Test for Volume and Surface Resistivities of Electrical Insulating Materials;

Publication 96-1, Recommendations for Radio-Frequency Cables;

Publication 97, Recommendations for Fundamental Parameters for Printed Wiring Techniques.

ELECTRONIC INDUSTRIES Advertisers—August 1958

* In Operation Edition Only.

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

For product information, use inquiry card on page 97

Circle 119 on Inquiry Card, page 97

These 3 New RCA Low-Cost Computer Transistors Can Open New Markets For You!

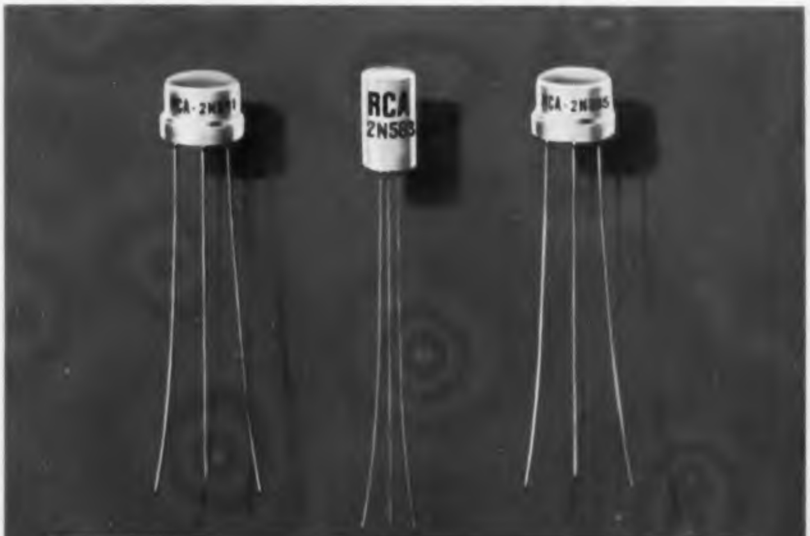
RCA now makes available low-cost high-quality transistors for reliable performance in electronic computer applications!

- Can low-priced, highly-reliable computer transistors help you expand into new markets?
- Can they enable you to profitably engage in the design of compact mass-produced computers?
- Are you looking for ways to revise your current designs to save costs?

If the highly desirable combination of *reliable performance* and *low cost* have been difficult for you to find, investigate these three new RCA units: RCA-2N581, RCA-2N583, and RCA-2N585. They are specifically designed, produced and controlled for computer applications; life-tested for dependable service; electrically uniform; available in commercial quantities; and are unusually low in price.

In addition to these three new types, RCA offers a comprehensive line of transistors for your most critical computer designs. For additional information on RCA Transistors, contact your local authorized RCA Distributor or your RCA Field Representative at the office nearest you.

For technical data on RCA Transistors, write RCA Commercial Engineering, Section H-50-NN. Somerville, New Jersey.



NEW GERMANIUM ALLOY-JUNCTION TRANSISTORS FOR MEDIUM-CURRENT SWITCHING SERVICE IN COMPUTER APPLICATIONS

RCA Type	Typical Alpha-Cutoff Frequency Mc	Typical DC-Current Transfer Ratio Value at Collector Ma.	Maximum Collector Ma.
2N581* (p-n-p)	8	30 at −20	−100
2N583** (p-n-p)	8	30 at −20	−100
2N585* (n-p-n)	5	40 at +20	+200

*Jetec TO-9 Outline (formerly referred to as Jetec Size-Group 30 Case)
**Jetec TO-1 Outline

EAST: 744 Broad Street
Newark, N. J.
HUmboldt 5-3900

MIDWEST: Suite 1154
Merchandise Mart Plaza
Chicago, Ill.
WHitehall 4-2900

WEST: 6355 E. Washington Blvd.
Los Angeles, Calif.
RAymond 3-8361

GOV'T: 224 N. Wilkinson Street
Dayton, Ohio
BAldwin 6-2366
1625 "K" Street, N.W.
Washington, D.C.
DIstrict 7-1260

RADIO CORPORATION OF AMERICA
Semiconductor and Materials Division
Somerville, New Jersey