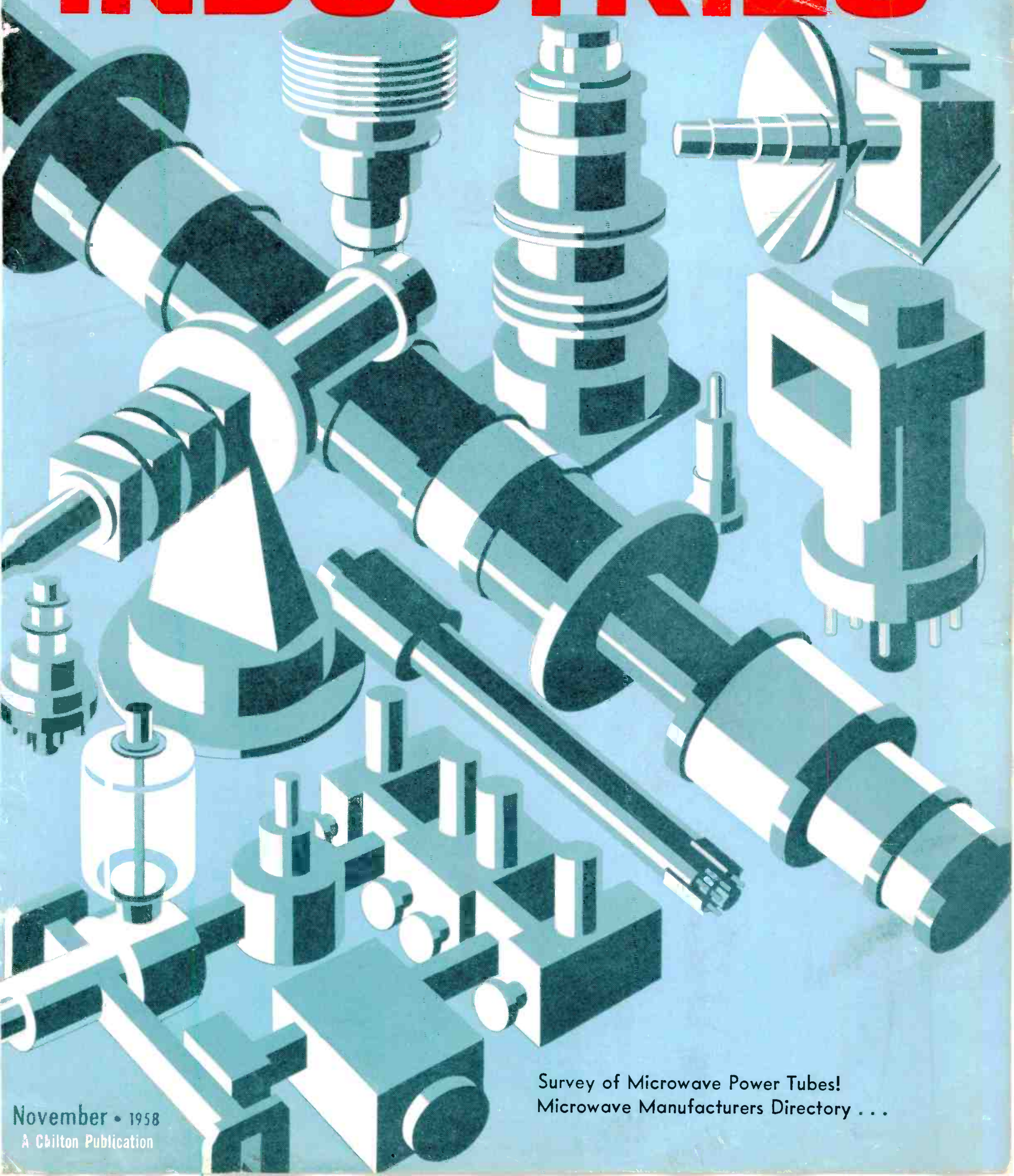
ELECTRONIC INDUSTRIES

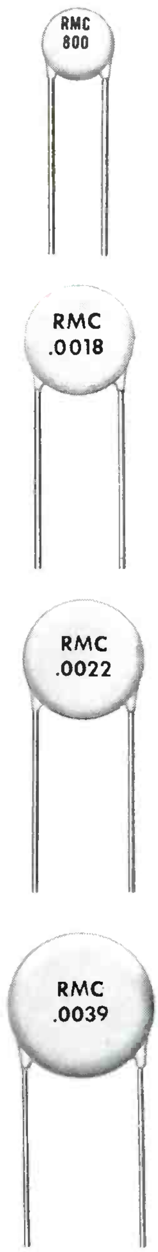


Survey of Microwave Power Tubes!
Microwave Manufacturers Directory . . .

November • 1958
A Chilton Publication

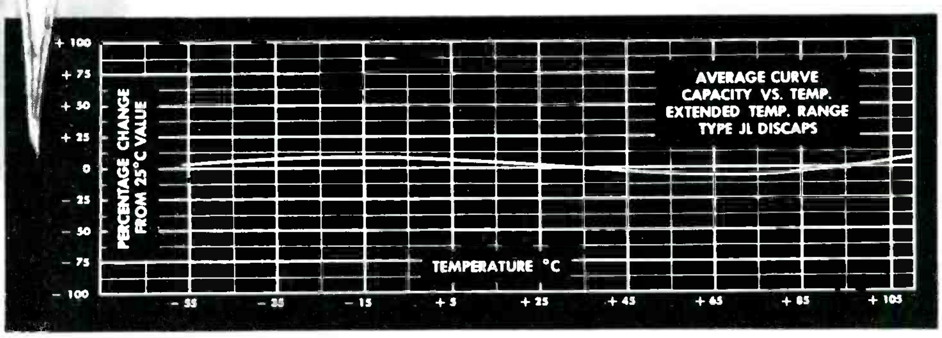
TEMPERATURE STABLE

RMC Type JL DISCAPS



Type JL DISCAPS should be specified where the application calls for capacitor with great stability over an extended temperature range. Between −55° C and +110° C, Type JL DISCAPS show a change of only ±7.5% of capacity at 25° C.

Type JL DISCAPS are a quality replacement for paper or general purpose mica capacitors at a savings in cost. Write today on your letterhead for information.



SPECIFICATIONS

LIFE TEST: As per E.I.A.-RS-198
POWER FACTOR: 1.5% Max. @ 1 KC (initial)
POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
CAPACITY TOLERANCE: ±10% ±20% at 25° C.

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 149

ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR

EIC —A Reality!

ELECTRONIC manufacturers will be interested to know that work on the EIC (Electronic Industries Classification) program has now been completed. As a result, industry for the first time will have a practical tool that will enable a rapid determination of such things as: (a) market potential for a new electronic product (b) potentials by geographical areas (c) sales performance by local sales offices or by manufacturers representatives (d) technical data on competitive electronic products, etc.

Essentially what has been done here is to transfer the product information contained in our Annual Directory—All Reference Issue onto some 70,000 IBM cards. The name and address of each company has been recorded on a plant by plant basis and each plant has been given a separate identification number. Each address has been defined with the official U. S. county and metropolitan area codes. The number of employees at each plant together with the number of engineers (where available) is also included. Each address has been classified to indicate whether the installation involved is a manufacturing plant, a branch manufacturing plant, a combination sales and manufacturing facility, a sales office only, or a warehouse.

The data that has been tabulated involves 4,694 individual electronic manufacturers. Open fields have been left in the cards for the inclusion of additional data. In our own operations we shall be using open fields for such things as circulation control and for the development of industry statistical data.

For the use of electronic manufacturers, a second, basic market research deck involving some 35,000 IBM cards has been developed. This deck contains the same information listed above except for the open field data that we have in the master deck. By leaving fields open in the basic market research deck, manufacturers will now have an opportunity to punch in their own private sales or statistical data.

Since all of this data has been tabulated on IBM cards and since many organizations have punching and sorting equipment in their plants already, EIC market research deck can be readily accommodated. For organizations that do not have equipment, the IBM Service Corp. maintains service centers in some 83 principal cities throughout the U. S. that can process our cards. Thus all electronic manufacturers interested in market research and statistical data can now avail themselves of EIC.

The information in the EIC basic market research deck is also available in printed form. A new book has been produced called the Electronic Industries Marketing Guide. In this volume the data is presented on a state-by-state basis. Accompanying maps show locations of counties and metropolitan areas. Related statistical data by state, such as population, metalworking, and dollar income figures, as well as an overall analysis of types of electronic products produced by manufacturers is also included.

The development of the EIC basic market research deck and the Electronic Industries Marketing Guide stems from the need created by the lack of a valid SIC in the industry and by the lack of comprehensive industry statistical data. There is also the fact that the electronic industries are maturing. More and more companies are adding marketing manager posts to their staffs.

Until now there has been no real workable tool for determining market data. These new marketing tools embody sixteen years of directory publishing experience coupled with more than one year of concentrated effort by all members of the E. I. staff and Chilton Company's Research Division. We know that neither the EIC basic market research deck nor the EI Marketing Guide will resolve all problems but we do feel that they will go a long way toward establishing practical criteria. We feel too that extensive use of this data will establish an experience factor which in turn can be employed to extend present horizons even further. We are proud to announce the availability of these marketing tools which we have developed in the interest of better service to our industry.

ELECTRONIC INDUSTRIES, October, 1958. Vol. 17, No. 10. A monthly publication of Chilton Company. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila. 39, 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. $18.00, 2 yrs. $30.00.

ELECTRONIC INDUSTRIES

Vol. 17, No. 11 November, 1958

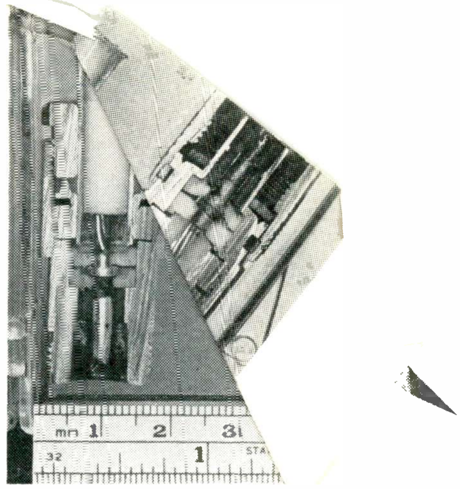
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

Highlights

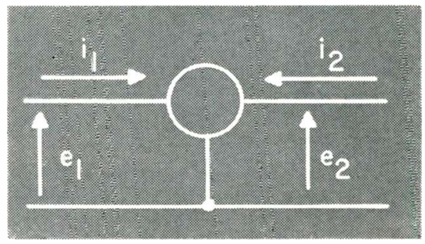
Of This Issue



Coaxial Cable

Capabilities of Coaxial Cable! page 55

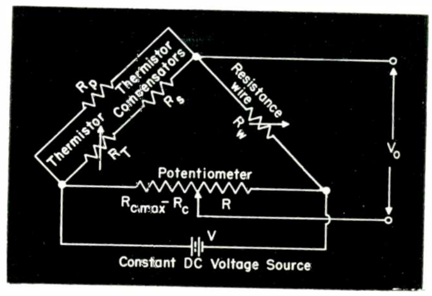
An Air Force sponsored survey investigated potentially high-temperature-resistant 50 ohm coaxial cable. Six different types were tested. The extensive tests, conducted impartially, revealed that a number of types showed capabilities even beyond their manufacturers' specifications.



"Jacobians"

Predicting Radar Range page 58

The range performance of a new radar can be predicted from the measured performance of another radar, preferably one operating at the same frequency. But unless all the parameters are known, this comparison can be misleading. The range can be most accurately and quickly calculated from a chart based on known equipment parameters.



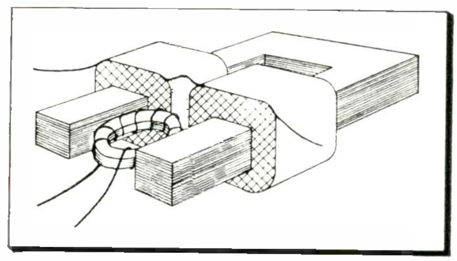
Thermistor Thermometers

Thermistors For Linear Temperature Readings page 66

A thermistor may be used with a thermostat consisting of a linearly calibrated potentiometer, or a linearly calibrated non-linear rheostat, to obtain a voltage signal which varies linearly with the difference between actual and desired temperatures.

Jacobians—For Converting Transistor Parameters! page 69

Converting transistor parameters from their common base or common emitter h-parameters can involve difficult and lengthy calculations. There are 6 types of parameters for each of the 3 circuit configurations, or 300 in all and not all can be accommodated. Jacobians reduces this complexity to a simple operation involving just two tables.



Magnetism and Ferrites

Magnetism and Ferrite Temperature Coefficients page 74

When ferrites are subjected to a magnetic field a pronounced change takes place in their temperature coefficient of permeability. Just how and why this takes place has been investigated with two commercially available ferrites—with some surprising results.

Radar Performance

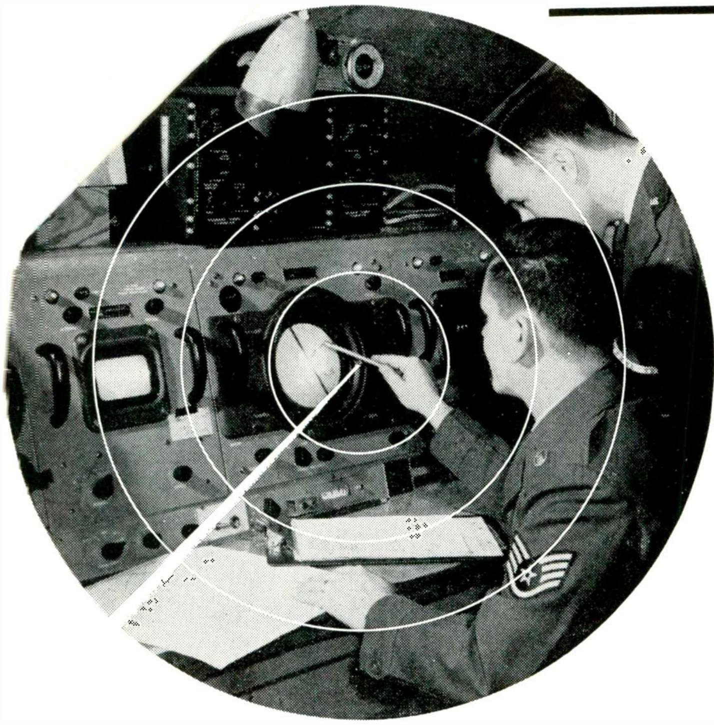
Spark Gaps In Pulse Modulators page 78

Magnetrons do misfire, and they do arc back—and this problem is always facing the designer. How to protect the pulse modulator, and more specifically the pulse transformer, is the subject of this question-and-answer type discussion on the ways that spark gaps can solve the problem.

Microwave Power Tubes—A Survey! page 101

Spearheading the move into the upper frequency bands has been the very considerable improvements and new designs in microwave tubes. Over 800 tubes are now available covering the microwave spectrum, including the long-established klystrons and magnetrons, and the family of wave tubes, traveling wave and backward wave. Here are the technical specifications on all, with introductory information to guide the engineer in evaluating each parameter.

RADARSCOPE



STORM DETECTOR RADAR

Air Force Weather Service personnel check dangerous storms up to 300 miles away using Raytheon's new AN/CPS-9 storm detector radar to provide more accurate, better forecasting and safer flying.

AIRCRAFT AND MISSILE spending for Fiscal Year 1959 will fall behind the FY 1958 figure by about $30 million, despite an estimated increase of about $2 billion in expenditures by the Defense Dept. The total Defense spending in FY 1959 will be about $40.9 billion compared with $39.0 billion in FY 1958. Expenditures for aircraft and missile will be $10.9 billion, as compared with $11.2 billion in the previous year.

DON'T LOOK FOR any immediate solution to the "frequency allocations" problem. Last month a special study group told the Senate Commerce Committee that the FCC is unable to solve the VHF-UHF TV problem, and suggested a completely new one-to-three-year study to reconsider all aspects including the commission's legislative authority and its budget.

AT THE STEREO SHOW the word was that the supply of stereo phonos is finally catching up with the availability of stereo discs, eliminating one of the most ridiculous imbalances that the electronic field has seen in many a moon.

PRODUCTION RATE of the average American at work will have to double by 1978 if present gains in education, leisure and living standards are to continue at the rate they have in the past. The prediction comes from Henry B. du Pont, of the du Pont Co., by way of pointing out the need for automation.

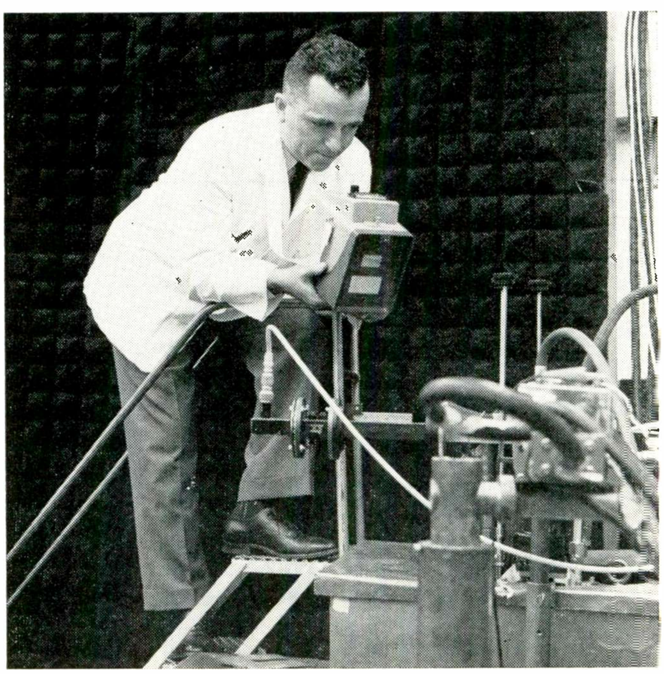
THE AIR FORCE is nothing if not optimistic. They are now speaking of the "LTO"—Lunar Theater of Operations.

SMALL BUSINESS FIRMS will receive less than 2% of the prime contract dollars being spent this year in the $5 billion missile procurement program—and the Senate Small Business Committee is becoming increasingly concerned. Among the measures that they are recommending: break missiles down into small contractual purchase items for production re-orders; make more information available to small firms with respect to security clearance procedures, types of contracts being used, the items desired and the funds to be expended; encourage prime contractors to break down their subassembly requirements so that they can be distributed among small firms.

REEL - TO - REEL magnetic tape recorders got a strong vote of confidence from the Magnetic Recording Industry Assoc. Some doubt has been raised about the future of reel-to-reel units with the new cartridge type playback design hitting the market. MRIA discounted the threat, pointing out that the tape recorder is a recorder first, a means of playing music second. The recording feature is what the public wants and will buy, whether dual track monaural or four track stereo.

MICROWAVE LEAK DETECTOR

At Sperry Corp. a radar specialist is using a new lightweight meter to survey for high power microwave leakage. With new multi-megwatt radar developments the laboratories are isolated in absorbent-lined test room for fire and safety requirements.



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

U. S. TRANSISTOR INDUSTRY is worked up over the skyrocketing imports from Japan, and will shortly ask the government for a full-scale investigation. At last report, Japan shows a manufacturing potential of 80 million transistors a year against the U. S.'s 40 million. If even 20% of that 80 million were exported to the U. S. it could seriously cripple the U. S. transistor industry, with particularly harmful effects to our defense capabilities. Most of the Japanese transistors coming in are in portable radios. The transistors are reportedly both low in price and high in quality.

DARK HORSE in the closed-circuit TV field is the "business meeting" link-ups, tying together the country-wide operations of the nation's larger business firms, for sales meetings, stockholder gatherings, etc. One source estimates that industry spends upwards of $500,000,000 annually on centralized business meetings, that at least 10% of that figure could be captured by closed-circuit.

STANDARDS COMMITTEE of the Institute of High Fidelity Manufacturers is nearing final action on standards for high fidelity tuners. They will soon be circulated to all tuner manufacturers throughout the country, and acceptance by a majority will constitute adoption. The standards will then move on to IRE, AES and EIAA for acceptance by these organizations as well.

ELECTROMAGNETIC INTERFERENCE continues to be a vital problem in the national defense picture —and, if anything, is worsening. The military complains that interference is not getting enough attention in the design stages, that applying interference reduction measures after the equipment has been designed is "truly the hard, inefficient, costly and often impossible way."

NATIONAL SCIENCE FOUNDATION announces that English translations of Soviet scientific and technical journals are being turned out at the rate of about 60,000 pages a year. There are now available 53 English editions of Russian journals, four extensive series of scientific abstract translations and four series of partially translated Russian journals.

GUIDED MISSILE FLIGHT PATHS through space are plotted in flight by small radio station in the missile's nose. Device is so accurate that it can plot trajectory to within two yards of target at distance of 30 miles. Setup includes ground transmitter linked to three receivers paralleling missile's route. By measuring time lapse of three-cornered radio transmission observers compute and plot trajectory from launching to impact.

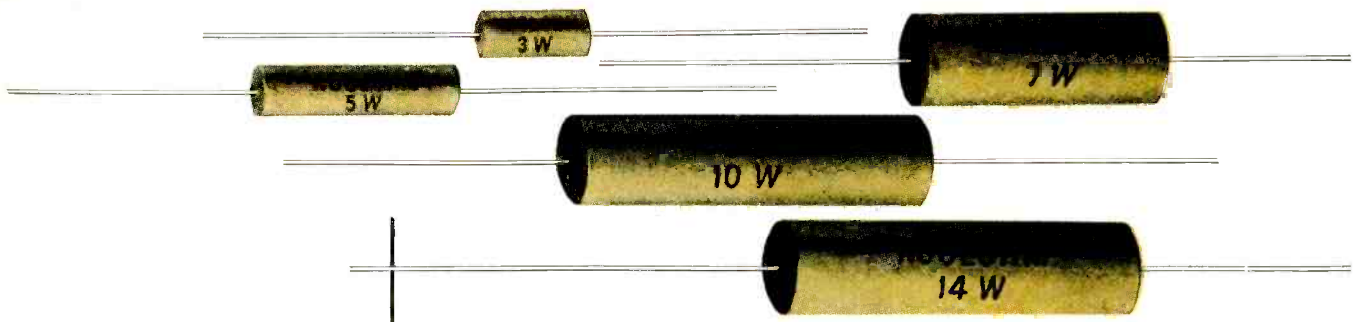
FIRST FM STEREO MULTIPLEXING ... operation last month at WFUV-FM, Ford... versity. The developments will be closely wa... broadcasters around the country.

HIGH COSTS of aircraft R&D and production is ...flected in reports from five firms that have recen... delivered turbojet and turboprop aircraft. The expenditures amounted to $1.6 billion, before the first craft was delivered.

TEST-YOUR-OWN-TUBES business is getting its first big name—Raytheon. The Waltham, Mass., tube and equipment manufacturer has arranged for local radio-TV service dealers to install and service do-it-yourself tube checkers in their local drug stores, hardware stores and other retail outlets. The tube checker will remain the property of Raytheon, and naturally, the only tubes sold will be Raytheon also. At a quick glance it seems to be a very logical step for a major tube manufacturer to make. Most important it will, we hope, squeeze out the operators selling seconds and rejects through the check-them-yourself scheme.

THERMOELECTRIC MATERIALS

In this special furnace at Westinghouse Research Labs a whole new class of thermoelectric materials is being created capable of converting heat directly into electricity.



ILLUSTRATED IN ACTUAL SIZE

KOOLOHMS

NEW SMALLER SIZE KOOLOHM® RESISTORS

with improved performance

Sprague's new smaller size Koolohm Resistors are designed to meet modern industrial requirements for insulated-shell power wirewound resistors that will perform *dependably* under the severe duty cycles encountered in heavy duty industrial electronic equipment.

NEW CONSTRUCTION IMPROVEMENTS

1. Leads are welded to drawn metal cap ends.
2. Ceron (ceramic insulated) resistance wire wound under controlled tension on special ceramic core. Makes possible multi-layer non-inductive windings as well as very high resistance value conventional windings.
3. Finished resistance elements are given unexcelled mechanical protection by non-porous ceramic outer shells—sealed with high temperature silicone end cement.
4. Insulated shell permits mounting in direct contact with chassis or "live" components.
5. *Aged on load* prior to final test and inspection to stabilize resistance value and assure outstanding performance on load-life tests!

The advanced construction of these improved Koolohm Resistors allows them to operate at "hottest spot" temperatures up to 350°C. You can depend upon them to carry maximum rated load for any given physical size.

SEND FOR ENGINEERING BULLETIN 7300—SPRAGUE ELECTRIC COMPANY
233 MARSHALL STREET • NORTH ADAMS, MASS.

SPRAGUE®
THE MARK OF RELIABILITY

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

As We Go To Press . . .

Japanese Radio Exports Expand

Japan's transistor radio exports, particularly those destined for the United States, have grown rapidly in the past few months. At mid-1958 total exports were at an annual rate of over 1 million units, recording to the U. S. Dept. of Commerce.

Exports to the United States during March-May 1958 have been estimated at 50,000 to 70,000 units monthly and industry sources indicate that they hope to sell about 100,000 units monthly before too long.

Production of transistor radios at mid-1958 was at an annual rate of 1.8 million units and production capacity at about 2 million units. Of approximately 40 companies manufacturing transistor radios, 7 firms produce about 70% of the total Japanese output.

The transistor manufacturing industry was unable to keep up with domestic demand during much of 1957; this difficulty has been overcome and it is estimated that current output is about 2 million transistors monthly.

Japanese production, total exports, and exports to the United States of transistor radios, for April 1957-March 1958 were as follows:

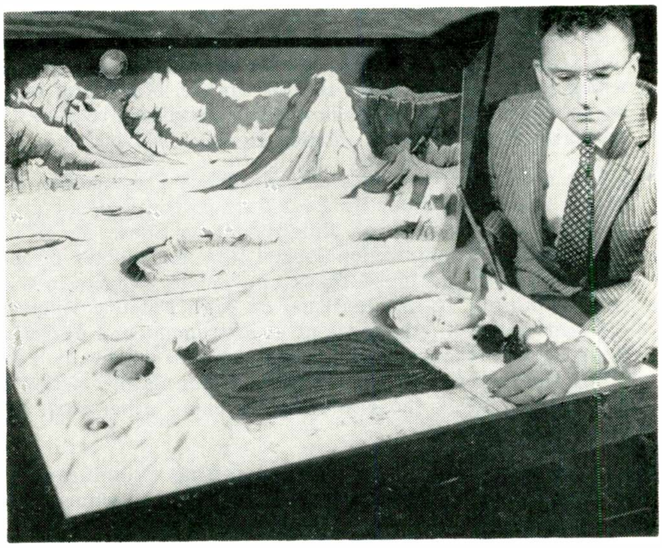
[Quantity in units]

1957	*Production*	*Total exports*	*Exports to U.S.*
April	20,000	2,470	855
May	30,000	2,600	21
June	44,263	8,068	1,740
July	67,466	15,100	11,352
August	77,931	15,591	9,156
September	77,281	22,162	9,749
October	98,472	38,992	27,811
November	105,718	25,923	12,842
December	94,959	40,916	28,714
1958			
January	90,898	39,716	26,309
February	104,493	46,126	27,583
March	134,549	104,853	71,525
Total, 12 months	946,030	362,517	227,657
April-Sept. 1957	316,941	65,991	32,873
October 1957-March 1958	629,089	296,526	194,784

Note: Official Government statistics are not available; the above data were supplied by the Electronics Industries Association of Japan and the Japan Machinery Exporters Association.

The rise in the ratio of exports to production is expected to continue, as there is some evidence that domestic sales may soon reach a saturation point.

MOON POWER STATION



Westinghouse scientists are demonstrating this working model of a moon power station to show how their revolutionary generating unit would be powered by light from the sun.

Narrower Bandwidth Key To Space Radio

Communication between the earth and Mars is well within reach, according to William F. Main, manager of the electronics research division of Lockheed Missile Systems division in Sunnyvale, Calif.

He told a meeting of the American Rocket Society and I.R.E. that while it is "fairly obvious" that the moon now is within radio communication range, it would take "little extension of present techniques" to communicate with a space vehicle in the neighborhood of Mars, some 35 million miles away.

"This corresponds to a range increase of some 140 times over that to the moon," he said.

To attain this interplanetary range, Main said, would demand a 20,000 times increase in transmitter power over that required to communicate with the moon which would result in "a clearly unreasonable power level."

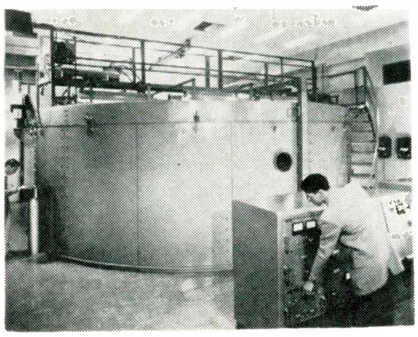
But significant extensions of range could be achieved without a proportional increase in power, he said, by utilizing a narrower bandwidth for the communication link.

Since the rate of information transmission is directly related to the bandwidth used, if one was willing to transmit more slowly the bandwidth could be reduced proportionately with a resultant savings in power requirements.

"Similarly," he said, "if one is willing to send less total data the bandwidth could be further reduced."

But, he added, it is far more important to work toward reducing redundancy or extraneous data rather than less data.

PRECISION CENTRIFUGE



Delicate accelerometers for TITAN inertial guidance systems will be tested in new Genisco G-460 Ultra-Precision Centrifuge at American Bosch Arma Corp., Garden City, N. Y.

That's Shootin', Son!

While cruising the Pacific the skipper of one of the Navy's missile carrying submarines was pressed for details on the accuracy of their Regulus missile. "Well," he said, "we're 1200 miles from Los Angeles, but I have no doubt that we could drop one of these 'birds' in the Los Angeles Coliseum," He added as an after thought, "Not in the $4.50 seats, perhaps, but certainly somewhere in the ball park."

More News on Page 8

ELECTRONIC SHORTS

▶ The next city scheduled to receive Missile Master protection against air attack will be Philadelphia, Pa. Missile Master is the Army's electronic control system which coordinates the operations of Army defense weapons such as the Nike-Ajax, Nike-Hercules and the Hawk. The first metropolitan area to receive Missile Master protection was Washington-Baltimore, which became operational at Fort Meade, Maryland, last December. Other areas where the system is now being installed are New York City, Buffalo-Niagara, N. Y.; Boston, Mass.; Seattle, Wash.; and, Detroit, Mich.

▶ The necessity for a code of Fair Trade Practice for the high fidelity industry was pointed out by Paul Butz of the Federal Trade Commission at the 1958 New York High Fidelity Music Show. Mr Butz stated that five years ago the Commission looked into the matter of misuse of the term "high fidelity" and found that not even the experts in the field could agree on a definition. "If the Institute of High Fidelity Manufacturers' membership can agree on standards of measurement and presentation of specifications in advertising to which the industry generally subscribes," he said, "then there would be a possibility of regulatory action by the FTC upon complaint against those advertisers using other than the accepted standards."

▶ A new data-processing system costing "significantly less" than comparable equipment now available has been introduced by Bendix Aviation Corp. The CA-2, an accessory for the low-priced G-15 digital computer, gives punched-card data-processing capabilities to the computer—capabilities fomerly offered only by far more expensive machines. The complete system may be leased for approximately $2500 per month.

▶ The relaying of congratulatory messages to American Legion National Commander Preston J. Moore at his official homecoming in Stillwater, Okla. officially inaugurated the AL's National Amateur Radio Network. Guthrie, Okla.'s, amateur radio station W5MQK, operated by R. B Phillips, handled the avalanche of greetings for relay to Commander Moore.

▶ The University of Michigan's 85-ft. wide steerable radio telescope—one of the world's best for mapping radio waves from the universe in fine detail—is nearing completion. Though workmen are assembling the saucer-shaped aluminum solid "dish" reflector, there remains installation of a building to house the receiver which will chart radio waves of only a few centimeters in length from distant galaxies in the universe. Full operation is expected no later than early next spring

▶ Civil Aeronautics Administration has purchased nine scan conversion systems to provide air traffic controllers with television type displays of radar information suitable for use in well lighted rooms. The systems will be supplied by Intercontinental Electronics Corp. of Mineola, N. Y., under a $1.6-million contract. The air route traffic control centers at Idlewild International Airport, New York City, Washington National Airport, and Chicago (Midway) Airport, will get the first three scan conversion systems.

▶ A revised edition of the FCC's compilation, "Use of Broadcast Facilities by Candidates for Public Office" is now available in pamphlet form for distribution to broadcast licensees, on individual requests, and other interested groups and individuals. The publication is of particular aid to broadcasters handling various questions which arise under Section 315 of the Communications Act concerning broadcasts by political candidates.

▶ The EIA Conference on reliable electrical connections, to be held at the Statler-Hilton Hotel, Dallas, Tex., December 2-4, 1958, will feature men instead of papers No papers will be read at the conference. Instead they will be published in book-form well ahead of December and anyone may purchase a copy. There will be no conference proceedings or recordings. Participants can speak freely as individuals, and not as company representatives. Consequently, no fears of being quoted in conference publications.

▶ According to the latest information tabulated by Air Force authorities charged with investigation of unidentified objects, 1270 new UFO reports were investigated during the 13-month period ending July 31, 1958. More than 84% of the reported UFO sightings were definitely established as natural phenomena, hoaxes, birds, or man-made objects. Insufficient data was available to thoroughly analyze and evaluate 14% of the reports and less than 2% were classified as unknown.

As We Go To Press . . .

Missile Delivers Ammo, Rations To Army Units

A system for delivering supplies by ballistic cargo missile has been developed for the U. S. Army by Convair (San Diego) Division of General Dynamics Corp.

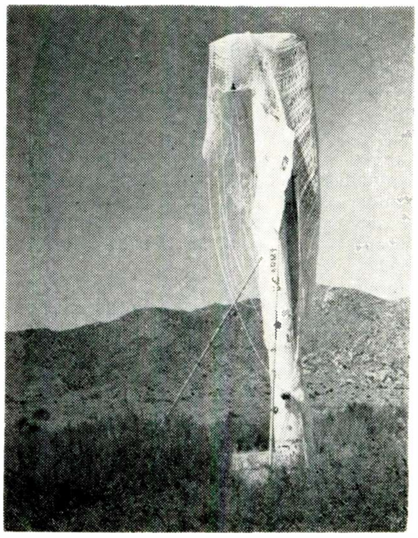
The missile, which Convair calls Lobber, can deliver rations, ammunition, medicines, communications equipment or other vital supplies accurately and in quantity to front-line troops, wherever and whenever needed. The missile and its launcher can be handcarried, if necessary, by a team of three men in the field.

Quick-disconnect Lobber payload sections can be pre-loaded at the supply depots, and at least 70% of every missile will be recoverable and can be re-used. Normally, however, it would be an expendable item of equipment.

Maj. Gen. A. T. McNamara, quartermaster general of the army, was credited with sparking development of the new missile system by Convair-San Diego.

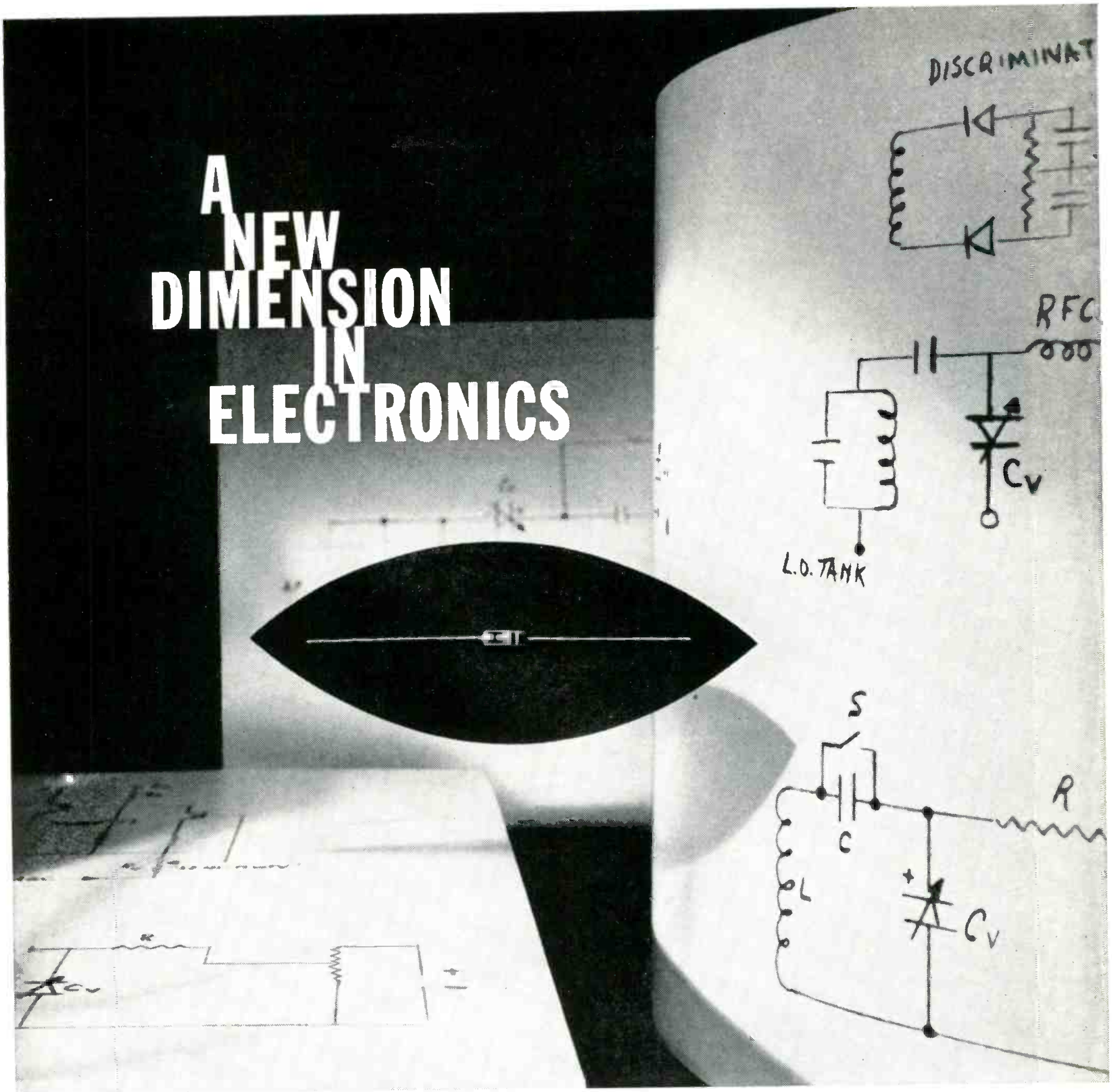
McNamara's foresight was based on a WWII situation wherein besieged elements of the First Army, cut off during a German counter-attack at Mortagne in August, 1944, were supplied with food and other emergency materiel packed into 105-mm. Howitzer shells and fired over the enemy's head into American-held territory.

"SHOT DOWN"



Intercepted and blasted out of the sky by Talos guided missile this Lockheed Kingfisher will be resurrected for still another target mission. Its recovery system consists of a parachute and a long nose spike.

More News on Page 12



The Hughes silicon capacitor is a new kind of device whose full impact upon semiconductor electronics has yet to be determined. Most certainly, the silicon capacitor uncovers an entire realm of possibilities. Desirable equipment not now existing can be made for the first time. And, in every instance, bonus benefits of reduced size and weight plus greater simplicity result.

Our brochure, "The Hughes Silicon Capacitor," discusses this series and many of its applications in detail. For your copy, please write:

Hughes Products, Marketing Department,
International Airport Station, Los Angeles 45, Calif.

Some Suggested Applications:

Non-Mechanical Tuning: The effect upon tuned circuit design is tremendous. Hughes silicon capacitors replace bulky air condensors and permit remote-control tuning at the end of a long wire. With these capacitors, instantaneous and non-mechanical "signal seeking" features can be designed into tuned circuits.

Automatic Frequency Controls: Here the silicon capacitors replace a reactance tube. Output voltage from the discriminator varies the voltage on the silicon capacitor—hence, the local-oscillator frequency—to correct for any frequency drift.

Dielectric Amplifiers: Operation is based on the amplitude modulation of a high-frequency carrier source by a Hughes silicon capacitor, and on the subsequent demodulation and filtering at the output.

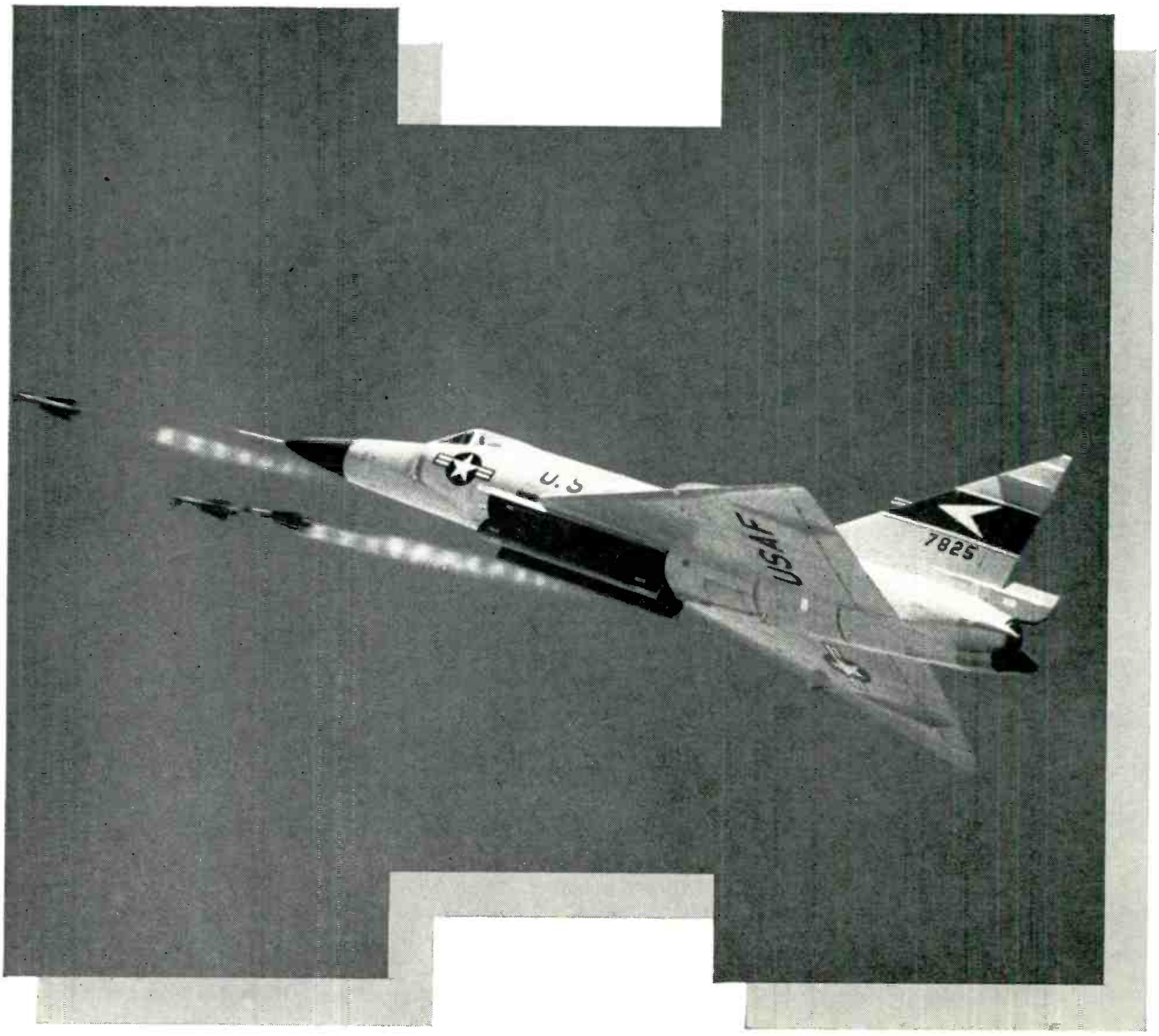
Also: Pulse Circuits, Frequency Modulation, RC Oscillators, Modulators, Electronically Controlled Filters.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

Circle 36 on Inquiry Card, page 149

Sharpening



Circle 501 on "Opportunities" Inquiry Card, page 151

Coming Events

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

Oct. 30-Nov. 1: Electronic Devices Mtg., IRE; Shoreham Hotel, Washington, D. C.

Nov. 6-7: 5th Annual Nuclear Science Mtg., IRE; Villa Hotel, San Mateo, Calif.

Nov. 10-14: NEMA Annual Conv.; Hotel Traymore, Atlantic City, N.J.

Nov. 16-21: Conference on Scientific Information, AFOSR/Directorate of Research Communication, NAS, NSF, ADI; Mayflower Hotel, Washington, D. C.

Nov. 17-19: Atlanta Section Conference, IRE; Atlanta-Biltmore Hotel, Atlanta, Ga.

Nov. 17-18: 6th Annual Conv., Soc. of Tech. Writers & Editors; Shoreham Hotel, Washington, D. C.

Nov. 17-20: Conf. on Magnetism & Magnetic Materials, AIEE, APS, IRE, AIME & ONR; Sheraton Hotel, Philadelphia, Pa.

Nov. 17-21: National Plastics Conf., SPI; International Amphitheatre, Chicago, Ill.

Nov. 17-21: ARS Annual Mtg.; Hotel Statler-Hilton, New York, N. Y.

Nov. 18-20: 9th National Conf. on American Standards, American Standards Ass'n; New York, N. Y.

Nov. 19-20: N. E. Research & Eng'g Mtg. (NEREM), IRE; Mechanics Bldg., Boston, Mass.

Nov. 19-21: 11th Annual Conf. on Electrical Techniques in Medicine & Biology, IRE, AIEE & ISA; Nicollet Hotel, Minneapolis, Minn.

Nov. 19-22: Annual Convention, National Electrical Contractors Assoc; Dallas, Texas.

Nov. 20-22: 56th Mtg. Acoustical Society of America, with IRE; Chicago, Ill.

Nov. 20-23: Midyear Mtg. of Industrial Instrument Sect., SAMA; The Cloister, Sea Island, Ga.

Nov. 28-Dec. 4: Electronic Computer Exhibition & Symp.; Olympia, London, England.

Nov. 30-Dec. 5: Annual Mtg, American Society for Mechanical Engineers; Hotels Statler & Sheraton-McAlpin, New York, N. Y.

Dec. 2-4: 3rd EIA Conf. on Reliable Electrical Connections; Dallas Tex.

Dec. 2-4: 7th Annual Wire and Cable Symp., U. S. Army Signal Engineering Labs. & Industry; Berkeley-Carteret Hotel, Asbury Park, N. J.

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

Dec. 3-5: 2nd National Symp. on Global Communications, IRE & AIEE, St. Petersburg, Fla.

Dec. 4-5: PGVC Annual Mtg., IRE; Hotel Sherman, Chicago, Ill.

Dec. 5: Annual Banquet, The Radio Club of America, Inc.; Columbia University Club, New York, N. Y.

Dec. 7-9: Instrumentation Conf., IRE-Instrumentation Group; Atlanta, Ga.

Dec. 9-11: Mid-America Electronics Convention, IRE; Municipal Auditorium, Kansas City, Mo.

Jan. 11-13: Annual Convention, National Appliance & Radio TV Dealers Assoc.; Conrad Hilton Hotel & Merchandise Mart, Chicago, Ill.

Jan. 12-14: 5th National Symp. on Reliability & Quality Control, IRE, AIEE, ASQC, & EIA; Bellevue Stratford Hotel, Phila., Pa.

Jan. 21-23: Southwest Electronic Exhibit; Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 23-25: Michigan State Conference, American Women in Radio & TV; Detroit, Mich.

Jan. 26-29: 27th Annual Meeting, Institute of Aeronautical Sciences, Hotel Astor, New York, N. Y.

Feb. 1-6: Winter General Meeting, AIEE-Technical Operations Dept.; Hotel Statler, New York, N. Y.

Feb. 2-4: 7th Regional Tech. Conf. & Trade Show, IRE, University of New Mexico, Albuquerque, N. M.

Feb. 2-7: Committee Week, ASTM; Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 3-5: 14th SPI Reinforced Plastics Div. Conf., SPI; Edgewater Beach Hotel, Chicago, Ill.

Feb. 5-8: 1959 San Francisco High Fidelity Music Show, Institute of High Fidelity Manufacturers, Inc.; Cow Palace, San Francisco, Calif.

Feb. 12-13: Transistor & Solid State Circuits Conf., IRE, AIEE, & University of Pennsylvania; Univ. of Penna., Phila., Pa.

Abbreviations:

ACM: Association for Computing Machinery
ADI: American Documentation Institute
AIEE: American Inst. of Electrical Engrs.
AIME: American Institute of Mining & Metallurgical Engineers
APS: American Physical Society
ARS: American Rocket Society
ASQC: American Society for Quality Control
EIA: Electronics Industries Assoc.
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NAS: National Aeronautical Society
NEMA: National Electrical Manufacturers Assoc.
NSF: National Science Foundation
ONR: Office of Naval Research
SAMA: Scientific Opparatus Makers Ass'n.
SPI: Society of Plastics Industry

As We Go To Press . . .

AMB/CAA To Develop Low Cost DMET Gear

The Airways Modernization Board and the Civil Aeronautics Administration are sponsoring a project to develop low-cost, light-weight, airborne distance measuring equipment for "private flyer" and "general aviation" types of aircraft.

The project is being undertaken to further increase the utility of the common civil-military short distance VORTAC navigation aid adopted as standard for the U. S.

Development of the TACAN-compatible distance measuring airborne equipment (DMET) will be supported with funds allocated in fiscal year 1959 to the CAA "VORTAC in-service improvement" program. Development of the equipment will be done through contract with private industry.

Rubber and Plastics Firms Need Electronics

The rubber and plastics industries are waiting for electronic instrumentation firms to produce equipment tailor-made to meet their needs, H. G. Shively of B. F. Goodrich Co. said in a paper recently presented at the 13th annual ISA instrumentation - automation conference.

According to Shively, a ready market is assured for the firm which can produce equipment for such operations as temperature measurement in high frequency heating applications, non-destructive testing, chemical analysis, ply separation detection and complex cross-section extrusion measurement.

1959 COMING EVENTS

Feb. 19-21: Winter Meeting, National Society of Professional Engineers; Dinkler-Tutweiler Hotel, Birmingham, Ala.

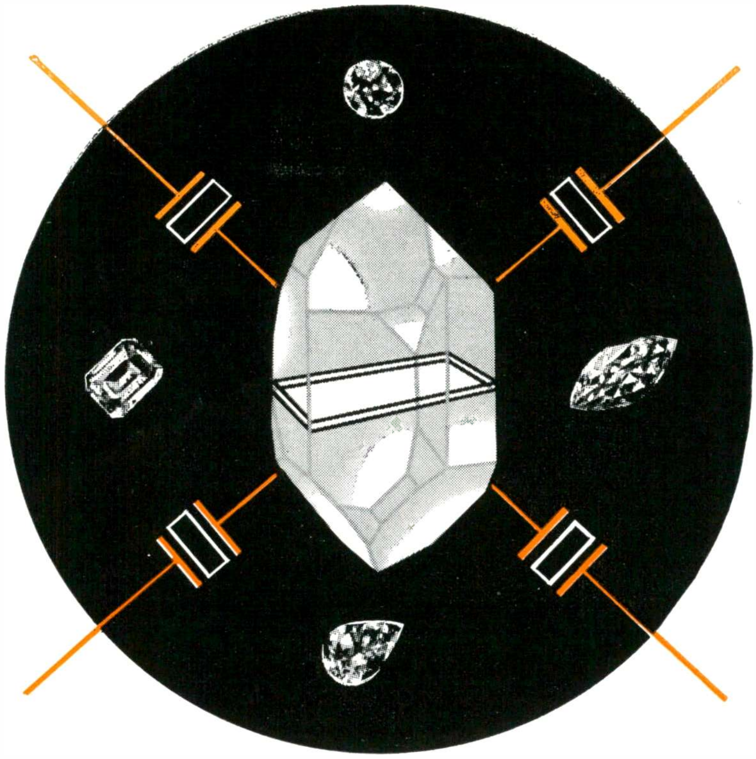
Mar. 2-6: Western Joint Computer Conf., IRE, AIEE & ACM; at Fairmount Hotel, San Francisco, Calif.

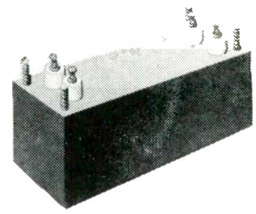
March 23-26: IRE National Convention, IRE; New York City.

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.





HOW TO SIMPLIFY CIRCUIT DESIGN WITH BURNELL CRYSTAL FILTERS

Through advanced crystal filter production techniques and circuitry by Burnell & Co.,it is now possible to overcome numerous design problems formerly believed insoluble with even the best individual toroidal components.

FREQUENCY RANGE EXTENDED

Depending on band width and frequency, filters may be composed entirely of crystals or in complex networks, combine quartz crystal elements with stabilized toroidal coils to produce the desired band width and shape factor. Frequency has been extended from low range up to 20 megacycles.

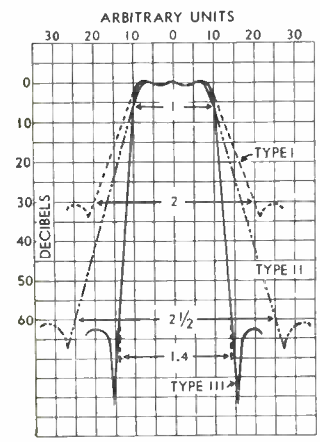
TRANSISTOR TO PENTODE OPERATION

Economy is achieved with standardized complex designs of lattice networks and their three terminal network derivatives. Packaging encompasses a wide range in standard, miniature and sub-miniature sizes with considerable latitude in permissive impedance range from transistor usage to pentode operation.

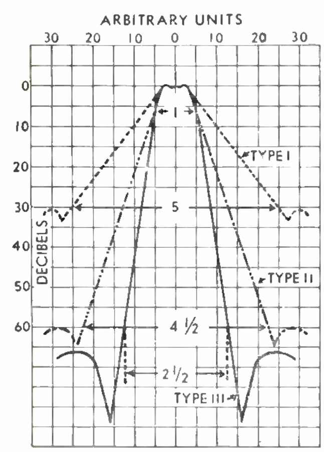
STANDARD DESIGN OR CUSTOM ENGINEERED

Whether you need crystal filters of standard design or custom units engineered to specifications of center frequency, band width, selectivity and impedance level, the facilities of Burnell & Co. are at your disposal. Write for new Burnell Crystal Filter Bulletin XT-455.

TYPICAL RESPONSE CURVES INDICATING THE VARIOUS SHAPE FACTORS AVAILABLE IN STANDARDIZED BURNELL CRYSTAL FILTERS



WIDE BAND CRYSTAL FILTER



NARROW BAND CRYSTAL FILTER

Burnell & Co., Inc.

PIONEERS IN TOROIDS, FILTERS AND RELATED NETWORKS

Dept. EI-11

EASTERN DIVISION
10 PELHAM PARKWAY
PELHAM, N. Y.
PELHAM 8-5000
TWX PELHAM 3633

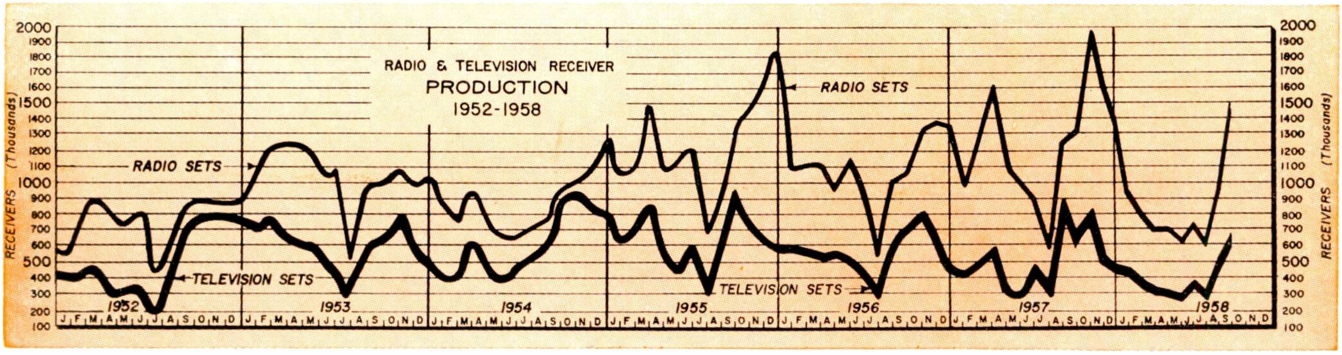
PACIFIC DIVISION
720 MISSION STREET
SOUTH PASADENA, CALIFORNIA
RYAN 1-2841
TWX PASACAL 7578

Circle 37 on Inquiry Card, page 149

Precision reel available as optional extra-cost accessory in 10½″ and 14″ diameters.

 Circle 38 on Inquiry Card, page 149

TOTALS



ELECTRONICS OUTPUT—1923-1958 [1]

(Millions of dollars)

Year	Total	Home-type radio and television receivers, and related products	All other electronic equipment except tubes and components	Electron tubes	Electronic components other than tubes
1958	6,900[e]	1,350[e]	3,250[e]	760[e]	1,540[e]
1957	7,000	1,500	3,100	800	1,600
1956	6,500	1,470	2,800	780	1,450
1955	6,200	1,500	2,500	800	1,400
1954	5,900	1,420	2,470	710	1,300
1953	6,300	1,593	2,503	734	1,470
1952	5,500	1,340	2,330	690	1,130
1951	3,400	1,296	843	473	788
1950	3,300	1,687	473	443	697
1947	1,750	810	469	122	349
1939	340	186	40	39	75
1937	350	182	54	43	71
1935	240	135	31	32	42
1933	135	73	14	27	21
1931	220	125	30	29	36
1929	465	275[2]	8	82	100
1927	200	95[2]	4	22	79
1925	180	93[2]	3	23	61
1923	54	13[2]	1	10	29

e—Estimate.

[1] Data cover manufacturers' shipments in 1947 and later years, and production in 1939 and earlier years. The totals represent the factory value of production or shipments (output) of electronic products, whether incorporated in other products or used in maintenance and repair of end equipment.

[2] Includes all radio receivers, commercial as well as home-type.

Sources: Based on data contained in the Census of Manufactures, the Annual Survey of Manufactures, releases of the Electronic Industries Association Marketing Data Department, and other sources.

—*U. S. Chamber of Commerce*

GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Antennas & Accessories	812,590
Amplifiers	1,351,642
Amplifiers, R. F.	30,044
Amplifiers, Synchro	49,156
Attenuators	33,868
Batteries, Dry	42,340
Computers & Access.	192,632
Connectors	39,723
Cable Assemblies	42,985
Coder-Decoder	108,655
Electronic Equipment	261,856
Filters	54,360
Gyros & Gyroscopes	343,455
Intercom. Equipment	145,536
Kits, Modification	486,920
Kits, Radio Modification	29,024
Loudspeakers	105,338
Meters	87,732
Meters, Amp.	60,625
Radio Equipment	530,805
Radio Receivers	47,569
Radio Transmitters	73,990
Radar Equipment	393,460
Radio Transceivers	315,356
Radomes	30,968
Recorders & Access.	142,134
Recorders-Reproducers	152,724
Rectifiers	47,815
Relays, Solenoid	29,631
Single Sideband Equipment	694,824
Spare Parts	3,430,661
Switch, Electronic	35,995
Switches	108,659
Tape, Recording	582,617
Telemetering, Radio	299,950
Telephone Switchboards	52,654
Test Equipment (various)	25,514
Test Sets	85,916
Test Sets, Radar	33,428
Transformers	182,635
Tubes, Electron	1,619,619
Telemetering Equipment	403,998
Wire & Cable	41,594

DEFENSE ELECTRONICS BUYING FOR FISCAL YEAR 1958

Budget Category	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
Aircraft	$340	$346.0	$359.0	$401	$1,446.0
Ships-Harbor Craft	23	25.0	24.0	27	99.0
Combat Vehicles	1	—.2	—.1	1	1.7
Support Vehicles	1	.7	.6	2	4.3
Missiles	273	299.0	319.0	377	1,268.0
Elec. & Comm.	204	214.0	183.0	274	875.0
Research & Dev.	73	74.0	75.0	96	318.0
Miscellaneous	11	9.0	9.0	9	38.0
TOTAL (FY 1958)	$926	$967.5	$969.5	$1,187	$4,050.0
TOTAL (FY 1957)	$637	$876.0	$938.0	$1,055	$3,506.0

—Electronic Industries Association

Circle 42 on Inquiry Card, page 149 ⟶

PULSE

GENERATION

Five plug-in pulse generators provide any code—1 to 5 pulses — with completely independent adjustment of width and delay for each pulse.

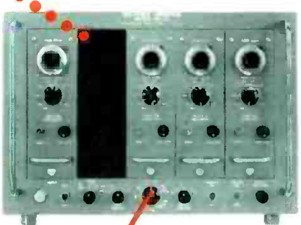
PULSE DELAY:
variable 0 to 300 microseconds

PULSE WIDTH:
variable 0.2 to 2 microseconds

PULSE TIME MODULATION:
Sensitivity, 2 volts RMS per microsecond

CODED MULTIPULSE GENERATOR

Model MP-1A



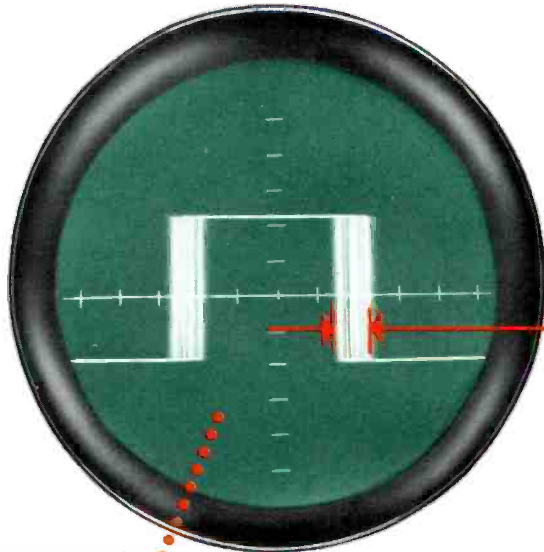
RISE AND DECAY TIME:
0.1 microsecond

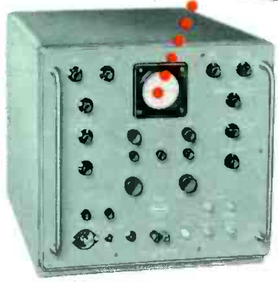
GROUP REPETITION RATE:
10 to 10,000 pps

Used to modulate r-f signal generators with coded pulse groups. Internal or external sync; square wave output, 10 to 10,000 pps. Pulses can be independently pulse-time modulated by external signal.

APPLICATIONS: Design and testing of missiles, radar, beacons, IFF, telemetry, etc.

TESTING



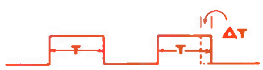


PULSE JITTER TESTER

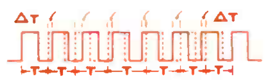
Model PJ-1

Displays the magnitude and waveform of pulse jitter (time deviation) in rate generators, pulse width modulators, encoding devices and precision time generators.

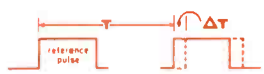
MEASURES:



PULSE WIDTH JITTER: Peak-to-peak time deviation (ΔT) at the half-amplitude points, between the leading and trailing edges of a recurrent pulse having a nominal width represented as "T" in the diagram at left.



ABSOLUTE JITTER: Time deviation (ΔT) at the half-amplitude points, from leading edge to leading edge of successive pulses (of duration "T" in the diagram) in a pulse train.



RELATIVE JITTER: Peak-to-peak time deviation (ΔT) at half-amplitude points of the leading edge of one pulse to the leading edge of a reference pulse. The time difference between the two is "T" in the diagram.

Repetition Rate Jitter: 5 millimicroseconds to 100 microseconds full scale. **Relative or Width Jitter:** 5, 10, 100 millimicroseconds.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

MAIL THIS CARD
for complete specifications.
Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

POLARAD ELECTRONICS CORPORATION

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

Representatives in principal cities

POLARAD ELECTRONICS CORPORATION:

Please send me information and specifications on:

POLARAD

EDN

- ☐ Model MP-1A Coded Multi-Pulse Generator
- ☐ Model PJ-1 Pulse Jitter Tester
- ☐ Model VS-2 Rapid-Scan Ratio-Scope (see reverse side of page)
- ☐ Model ESG Electronic Sweep Generator (see reverse side of page)

My application is:________________________

Name________________________

Title____________ Dept.____________

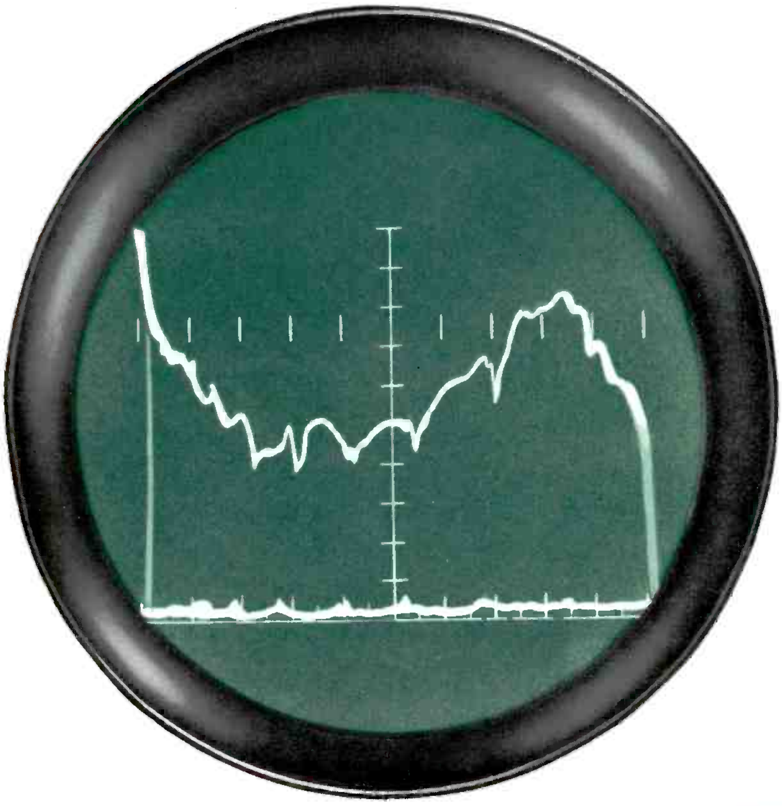
Company________________________

Address________________________

City____________ Zone____ State________

INSTANTANEOUS MICROWAVE ANALYSIS

SINGLE FREQUENCY OR OVER A FULL OCTAVE



Complete VSWR pattern of a microwave component over an entire frequency octave is displayed on a calibrated 7" CRT.

Saves Engineering Manhours

1,000 to 15,000 mc

ELECTRONIC SWEEP GENERATOR

Model ESG 1,000-15,000 mc

Sweep width continuously adjustable, single frequency to an entire octave.

RAPID SCAN RATIO-SCOPE

Model VS-2

Displays the ratio of two input signals; gives visual plot of VSWR as a function of frequency.

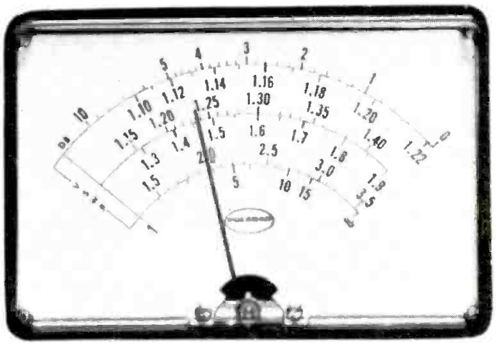
Measure and Analyze:

VSWR, transmission and reflection coefficients, gain and attenuation, image rejection, sensitivity, selectivity, bandwidth and filter characteristics, antenna patterns, etc.

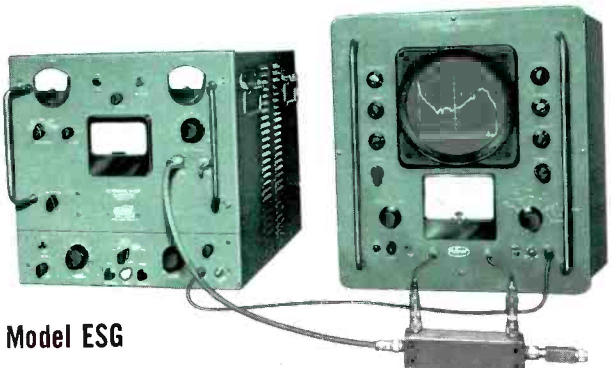
Microwave Components:

Radars, receivers, beacons, waveguides, antennas, pads, terminations, couplings and hybrid junctions, attenuators, crystal mounts, preselectors, amplifiers.

Instantaneous measurements at a single frequency or over an entire swept frequency range can be obtained with an Electronic Sweep Generator and a Rapid-Scan Ratio Scope



VSWR at any single frequency is indicated on the Ratio-Scope front panel meter.



Model ESG

Model VS-2

Typical set-up for measuring VSWR of a microwave component. Directional coupler outputs feed incident and reflected signals separately into the Ratio-Scope. Scope displays the pattern of the ratio between the two inputs over the entire frequency range swept.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 18, Long Island City 1, N.Y.

POLARAD ELECTRONICS CORP

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

POLARAD

MAIL THIS CARD for complete specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

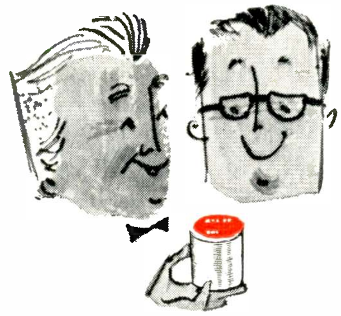
FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

POLARAD ELECTRONICS CORPORATION

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

Representatives in principal cities

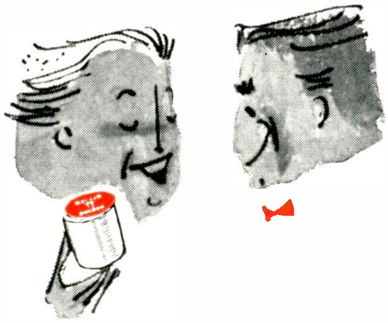
"We are sold on Kester '44' Resin-Core Solder, Jim. It's the fastest acting solder we have ever seen."



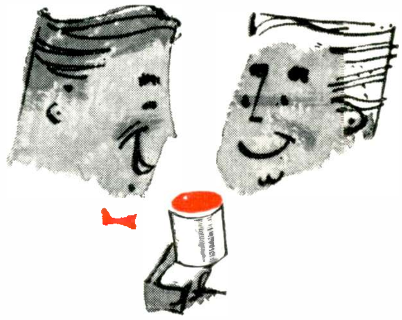
"Been using Kester Flux-Core Solder for almost half a century, Tom; nothing like it."

"Kester Solder spools are always marked with the exact alloy, Joe; no code markings."

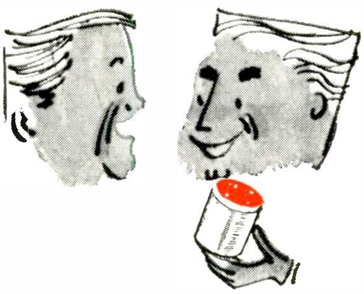
"Nothing like Kester Solder, Fred, for keeping costs in line."



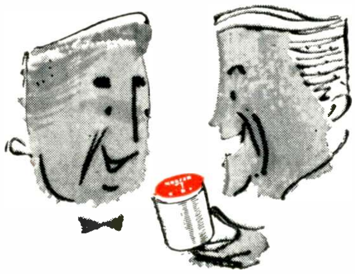
"Our girls swear by Kester, Bert; they claim soldering is much easier."



"Kester 'Resin-Five' Core Solder is the choice for our production, Paul."



"Our work goes much faster now, Bill, since we switched to Kester Solder."



"We had a tough soldering job, Harry, but Kester engineers licked it in a hurry."

SEND TODAY for your free copy of the Kester book, "Solder . . . Its Fundamentals and Usage". . . 78 pages of technical information.

HOW THE WORD GETS AROUND

You hear comments like these everywhere informed people in the electronics industry get together to "talk shop." It's a fact . . . there is nothing quite like Kester Solder. And that's why it's so universally popular.

KESTER SOLDER

Company 4210 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

"TAKE ME TO YOUR - - -"

According to Dymec Inc. this is a "precision waveguide attenuator"—and they should know, because they made it. But we can't resist this other view that looks to us like an out-of-the-world character with a book under his arm. (For more on the technical specs, see page 87)

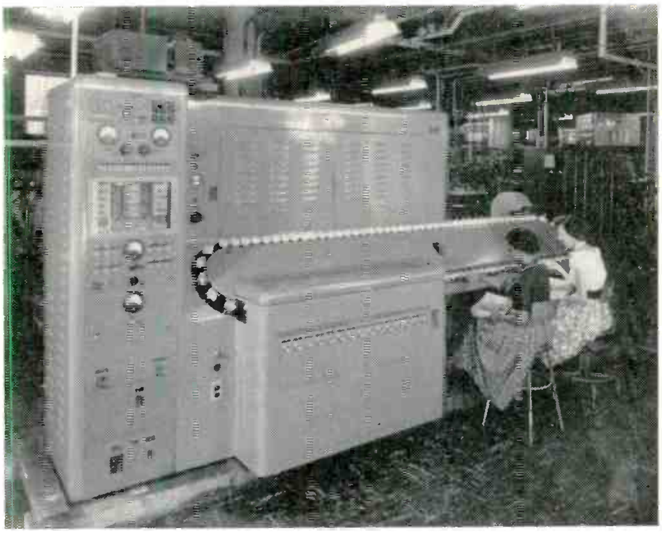
Snapshots of the Electronic Industries

INERTIAL GUIDANCE

Sperry engineers check out an experimental auxiliary inertial "stable table" and astro-tracker for the supersonic B-58.

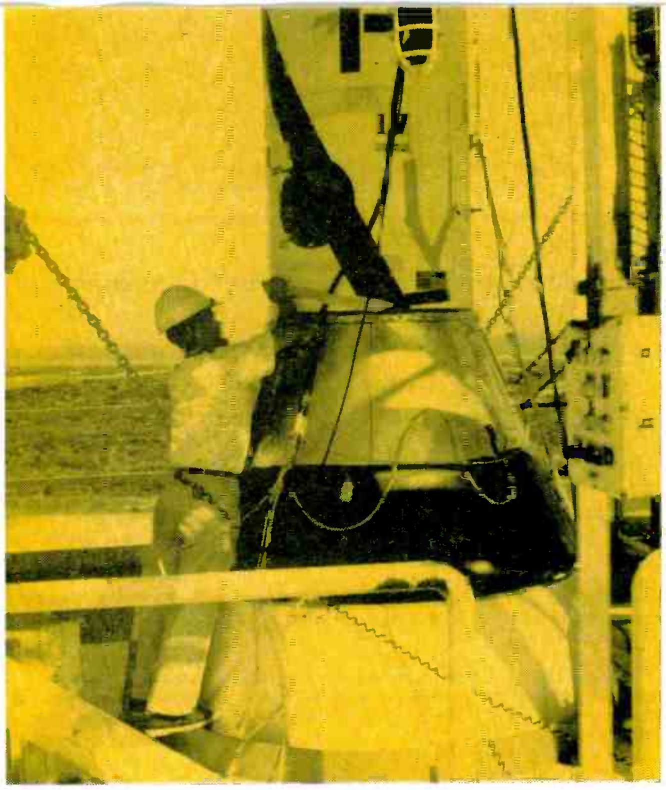
ICE-BREAKING BY TV

On ice-breaking duty in the Arctic the U.S.S. Glacier shown near Thule, Greenland uses a television camera mounted in a helicopter to find the best route through the ice fields.



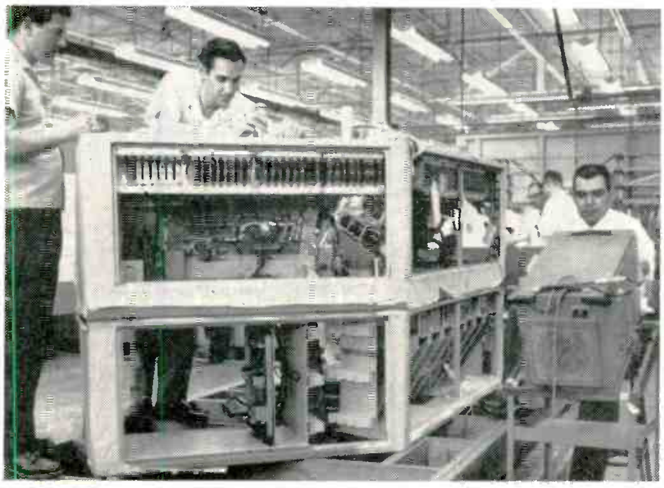
AUTOMATIC TESTING

Raytheon's Industrial Tube Division is now using this automatic tester for checking their line of subminiature tubes.



CHECKING THE MOON ROCKET

Final checks are shown here being made on "Pioneer" the lunar probe rocket that set the world's altitude record.

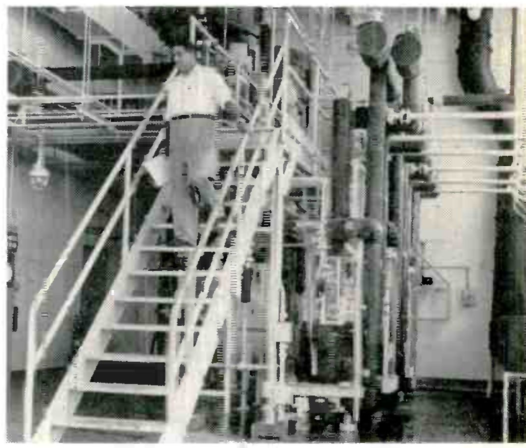


MISSILE CONTROL

At Burrough's Corp.'s Detroit plant, technicians install components in a missile control console for the AF Atlas ICBM.

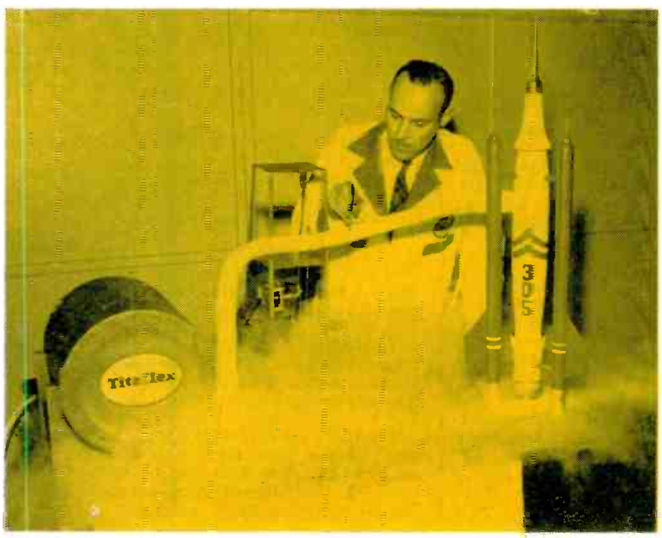
ULTRA-PURE SILICON

At Merck & Co., Danville, Pa. these new tanks are used to purify raw materials used in the production of ultra-pure silicon.



SIMULATED MISSILE

Titeflex, Inc. used this realistic demonstration of a missile launching to display their Springfield "400" teflon hose.



"FOR OUTSTANDING CONTRIBUTIONS"

Leonard Bernstein receives Inst. of High Fidelity Manufacturers award from pres. J. N. Benjamin for "music contributions."

Electronic Industries' News Briefs

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

EAST

KLEINSCHMIDT LABORATORIES, INC., a subsidiary of Smith-Corona Marchant, Inc., will be consolidated with the parent company and operated as the Kleinschmidt Div.

CORNING GLASS WORKS and **ROHM & HAAS CO.** have developed a new method of protecting the front face of TV picture tubes. The new assembly consists of a glass panel contoured to fit the surface of the tube and permanently bonded to the face by means of an acrylic resin.

CBS-HYTRON is nearing completion of the consolidation of its mechanical and electronic equipment design, development and production facilities.

SANGAMO ELECTRIC CO., special Apparatus Dept., has assumed full responsibility for the marketing of all products developed by the D. G. C. Hare Co., New Canaan, Conn. The Hare Co. is a subsidiary of Sangamo.

KEARFOTT CO. has synthesized polycrystalline Yttrium-iron garnet for microwave applications. The compound is a relatively high density nonporous material consisting of tiny tightly bonded sintered crystallites whose crystal structure is identical to that of natural garnet.

A. B. DU MONT LABS, INC., completed the conversion of a former base hospital to a 50,000 sq. ft. modern general office and laboratory facility for the Airways Modernization Board's new National Aviation Facilities Experimental Center in 60 days. The site is the former Naval Air Station in Atlantic City, N. J.

NARDA MICROWAVE CORP. supplied bolometers, waveguide terminations, and filters which were incorporated in the microwave systems used for guidance and tracking of the Atlas ICBM.

PHILCO CORP.'S GOVERNMENT AND INDUSTRIAL DIV. has formed a new Advanced Weapon Systems Group (AWS). Hayden N. Ringer will serve as manager of the new group.

RAYTHEON MFG. CO. recently broke ground for a $1.7-million super-modern flight test facility at Bedford, Mass.

STROMBERG-CARLSON, Special Products Div., is building and installing two-way radios in all the busses in Rochester (N.Y.) Transit Corp. The system will be the first installed by any urban transit company in the United States.

RADIO CORPORATION OF AMERICA can now provide through its Radiomarine Sales a fuel-saving auto pilot steering system that keeps vessels on course even in rough weather.

SEQUOIA WIRE & CABLE CO. has established new regional offices in New York City to provide facilities for handling its expanding volume of business in the East. W. Edward Macbeth, Eastern Sales Manager, will be in charge of the New York offices.

BENDIX AVIATION CORP.'S participation in the USAF'S Dyna-Soar (dynamic soaring) project to develop the first piloted space ship will be headed by the Systems Div.

SYLVANIA ELECTRIC PRODUCTS INC. has begun construction work on a new 70,000 sq. ft. computer products plant at Muncy, Pa.

WESTINGHOUSE ELECTRIC CORP. now has available a new Hall Generator, for use in instrument applications as an analog computer element.

SHIELDING, INC., of Riverton, N. J., has contracted with Continental Mining and Oil Corp. to permit the latter to purchase the majority interest of the interference enclosure manufacturer.

ALPINE ELECTRONIC COMPONENTS CORP. is the name of a new firm in Waterbury, Conn. It is engaged in the manufacture of components and parts, including insulated standoff terminals, feedthroughs, and panel and chassis hardware.

TRANS-SIL CORP. has been awarded a U. S. Patent covering methods and equipment used in growing semiconductor materials.

ITEK CORP. has purchased approximately 43 acres, adjacent to Bedford Airport, near Route 128 in Lexington, Mass.

AMERICAN MEASUREMENT & CONTROL, INC., of Waltham, Mass., is manufacturing electrohydraulic servovalves which are used in the Terrier Missile Launchers. The firm is one year old and employs fifteen people.

VITRO CORP. OF AMERICA and **KOPPERS CO., INC.,** have signed a joint venture agreement which will enable them to team in undertaking weapon systems work.

NUCLEAR PRODUCTS-ERCO, div. of ACF Industries, Inc., will build the first USAF full-mission capability flight simulator. It will be used to train pilots for the Republic F-105 Thunderchief.

MID-WEST

FARNSWORTH ELECTRONIC CO., Ft. Wayne, Ind., and **FEDERAL TELEPHONE AND RADIO CO.,** Clifton, N. J., have been consolidated by International Telephone and Telegraph Corp. the parent company.

KELLOGG SWITCHBOARD AND SUPPLY CO. gained a singular distinction when the firm surpassed the mark of 3,000,000 man hours work without a disabling injury.

GE'S LIGHT MILITARY ELECTRONICS DEPT. has been awarded a $5-million contract for a forward surveillance radar, designated AN/APS-81 for the B-52 bomber. Contract could reach $14-million when completed.

TEXAS INSTRUMENTS INCORPORATED will manufacture the transistors to be used in International Business Machine Corp.'s first all-transistorized medium-sized electronic data processing system.

BURROUGHS CORP. built the data processing systems which were formally accepted by the USAF as the first portion of the Michigan part of the SAGE system of air defense. The systems operate at Battle Creek and Port Austin as well as at Selfridge AFB.

POTTER & BRUMFIELD, INC., is publishing the papers presented at the Sixth National Conference on Electro-Magnetic Relays at Oklahoma State University. This marks the sixth consecutive year the firm has provided this service to the industry.

WEST

LEAR, INC. has been awarded U. S. Army Signal Corps contracts totaling more than $716,000 for modified Lear F-5 automatic flight control systems for the deHavilland DHC-4 and the Beechcraft L-23 Twin-Bonanza. The Army designation for the Lear F-5 is the ASN-22.

INTERNATIONAL BUSINESS MACHINES CORP. will install at 305 RAMAC in the Ventura County (Calif.) office to speed handling of the county's growing governmental accounting and engineering chores.

SPRAGUE ELECTRIC CO.'s, SPECIAL PRODUCTS DIV. has opened a west coast branch at the new Sprague plant in Visalia, Calif. Robert P. Sheehan will serve as chief engineer of the Visalia department.

GENERAL ELECTRIC CO. has opened an expanded electronic tube and components sales office at 442 Peninsular Avenue, San Mateo, Calif.

BENDIX AVIATION CORP., COMPUTER DIV. has been awarded a contract for the electronic computing unit of the missile impact prediction system at Cooke Air Force Base, Calif.

DATA-CONTROL SYSTEMS, INC. has relocated their Western District Manager, Field Services and Marketing, Mr. Charles J. O'Lone, to 16366 Ancep St., Whittier, Calif.

LING ELECTRONICS, INC. has acquired all the common stock of the Calidyne Co., Inc. Both companies are leading manufacturers in the field of electronically driven vibration testing systems.

BELL AIRCRAFT CORP., NIAGARA FRONTIER DIV. has opened a west coast office to represent the company's Avionics, Rockets and Space Flight and Missiles Divisions. The new office is located at 6505 Wilshire Blvd., Los Angeles.

DIGITRON, INC. is the recipient of a contract to develop a high-speed electronic function plotter for Holloman Air Development Center.

LITTON INDUSTRIES has opened the first unit of its new 60,000 sq. ft. tube plant at Salt Lake City, Utah. The plant will be managed by Vinton D. Carver.

EPSCO, INC. has set up a west coast division at Anaheim, Calif. Wallace E. Rianda has been designated Vice-President and General Manager of Epsco-West, as the new division is called.

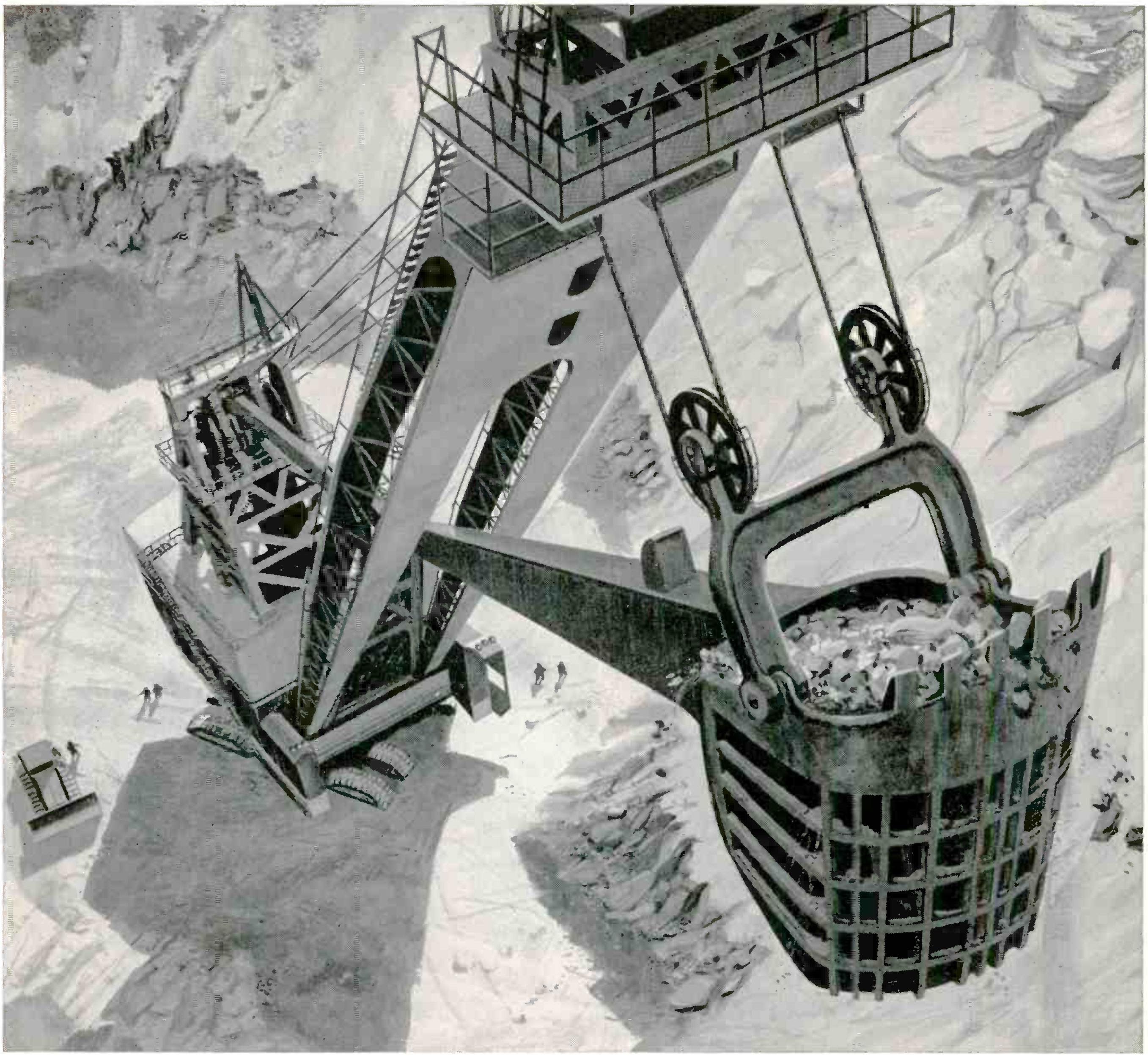
JOBBINS ELECTRONICS has purchased Western Coil Products Co., Palo Alto. The latter, specializing in small coils for local electronics manufacturers, will continue as a division of the parent company.

GENESYS CORP. is now located at 10131 National Blvd., Los Angeles. The new modern brick structure contains 10,000 sq. ft. of floor space.

TAMAR ELECTRONICS INC. has been awarded a contract by the Ramo-Woolridge Corp. for specialized electronic components. The amount of the contract was undisclosed.

HEWLETT-PACKARD CO. has acquired 80% of the outstanding stock of the F. L. Moseley Co. The latter will continue to operate as an independent corporation and Mr. Moseley will remain as president.

Circle 9 on Inquiry Card, page 149



World's Biggest Eater Dines Without Interruption

Typical insulator and insulating bolts used on power shovels.

You are looking at 3 million dollars' worth of power shovel, a 14-story monster capable of biting off 70 cubic yards of dirt at a clip.

Continuous operation is essential because downtime on a shovel of this size could top 500 dollars an hour. Reliability is shared by many interrelated parts. Some are made of Synthane laminated plastics.

Why Synthane? Because Synthane laminated plastics have the right combination of properties—dielectric strength, mechanical strength, and ease of machining. And Synthane uses only first-quality raw materials, watches every step in the production and fabrication of the laminate, is deeply concerned about delivery requirements.

Good materials, competent people, excellent tools and workmanship may not guarantee reliability but they're strong assurance of it.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative near you.

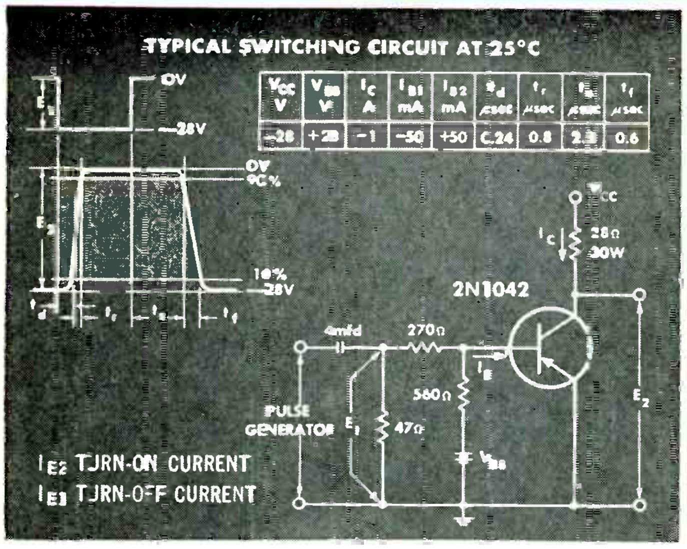
SYNTHANE

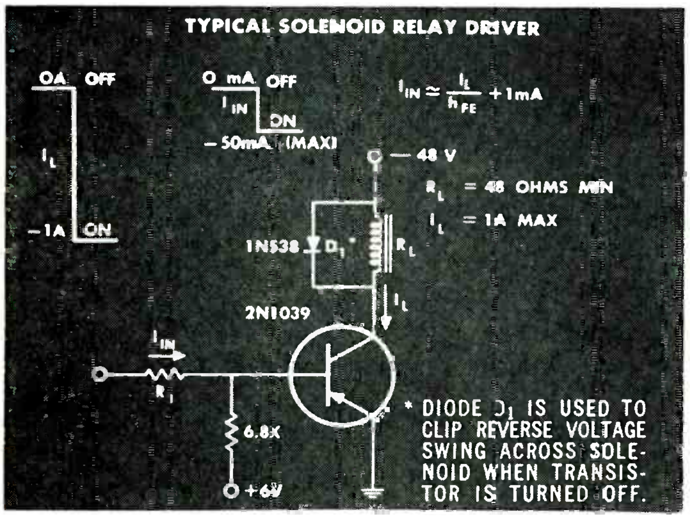
S

SYNTHANE CORPORATION, 11 RIVER RD., OAKS, PA.

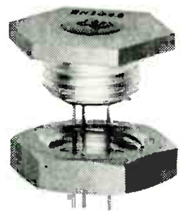
Circle 18 on Inquiry Card, page 149

INDUSTRY'S BROADEST LINE OF





NEW POWER SWITCHING TRANSISTORS



(ACTUAL SIZE)

NEW P-N-P germanium power switching transistors *guarantee* 5.5 W dissipation at 25°C with voltage ratings of 40, 60, 80, and 100 volts for optimum design flexibility. The functional design of the heat sink assures rapid installation requiring only one mounting hole through the chassis. You get *guaranteed* 20-to-60 beta spread and a low 0.16 ohm saturation resistance at the 3A maximum collector rating. In addition, a maximum 125 µA collector reverse current is *guaranteed* at one-half rated breakdown voltage with TI 2N1042, 2N1043, 2N1044, and 2N1045 alloy junction transistors.

These new devices are well suited for your switching circuits . . . relay drivers . . . audio and pulse amplifiers.

NEW MEDIUM POWER SWITCHING TRANSISTORS

(ACTUAL SIZE)

NEW P-N-P germanium medium power transistors give you switching times as low as 1.1 µsec. TI 2N1038, 2N1039, 2N1040, and 2N1041 alloy junction transistors provide 800 mW dissipation in free air at 25°C, 450 mW at 55°C . . . with voltage ratings of 40, 60, 80, and 100 volts. In addition, *guaranteed* 20-to-60 beta spread and low 0.2 ohm saturation resistance assure reliable performance for your high speed switching circuits . . . relay drivers . . . low power audio and pulse amplifiers.

		Type	Dissipation at 25°C	Collector Voltage-V max	Collector Current A max	Beta min	Beta max	Collector Reverse Current I_{CO} max µA	V	Saturation Resistance Ohm
computer power	pnp	2N1046	15W	−80	−3	40	70 (Avg)	−1mA	−40	0.75
medium power		2N1038	800mW	−40	−1	20	60	−125	−20	0.2
	pnp	2N1039	800mW	−60	−1	20	60	−125	−30	0.2
		2N1040	800mW	−80	−1	20	60	−125	−40	0.2
		2N1041	800mW	−100	−1	20	60	−125	−50	0.2
power		2N456	50W	−40	−5	30@5A avg.		−2mA	−40	0.048
	pnp	2N457	50W	−60	−5	30@5A avg.		−2mA	−60	0.048
		2N458	50W	−80	−5	30@5A avg.		−2mA	−80	0.048
		2N1021	50W	−100	−5	23@5A avg.		−2mA	−100	0.08
		2N1022	50W	−120	−5	23@5A avg.		−2mA	−120	0.08
		2N1042	5.5W	−40	−3	20	60	−125	−20	0.16
		2N1043	5.5W	−60	−3	20	60	−125	−30	0.16
		2N1044	5.5W	−80	−3	20	60	−125	−40	0.16
		2N1045	5.5W	−100	−3	20	60	−125	−50	0.16

IMMEDIATELY AVAILABLE IN PRODUCTION QUANTITIES OR . . .

TEXAS

WORLD'S LARGEST SEMICONDUCTOR PLANT

Tele-Tips

TV's OR BATHTUBS? Which is more important? If one believes in the value of statistics, then the nod has to go to television. The latest "Television Factbook" lists 42,400,000 U. S. homes, or 84% of the total, with one or more TV sets. But only 41,500,000 have bathtubs.

ARMY'S MISSILE CENTER at Huntsville, Ala., uses between 7½ and 8 miles of roll paper each day to produce copies of drawings.

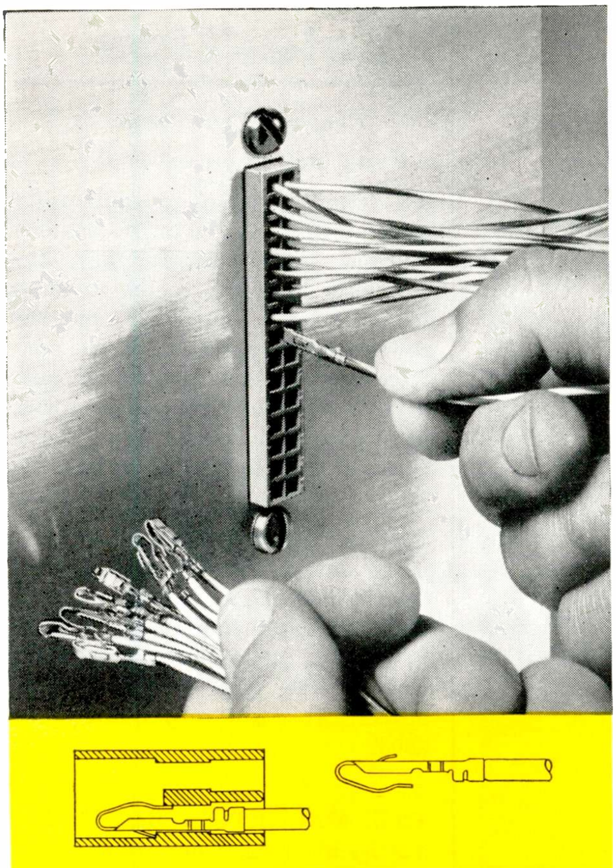
IT'S NOT THE HEAT, it's the humidity! The time-honored moan of summer sufferers may be on its way out. At the Univ. of Michigan researchers have come up with a "discomfort index" that indicates exactly how uncomfortable a day really is. Designed for the benefit of the air conditioning industry and power companies, the procedure takes two measurements, the dry bulb temperature of a Fahrenheit thermometer, and the wet bulb temperature (derived by putting a piece of wet muslin around the bulb and whirling it around). The second reading will be lower because of the evaporation. The sum of the two readings is multiplied by .4 and added to 15. The result is the discomfort index.

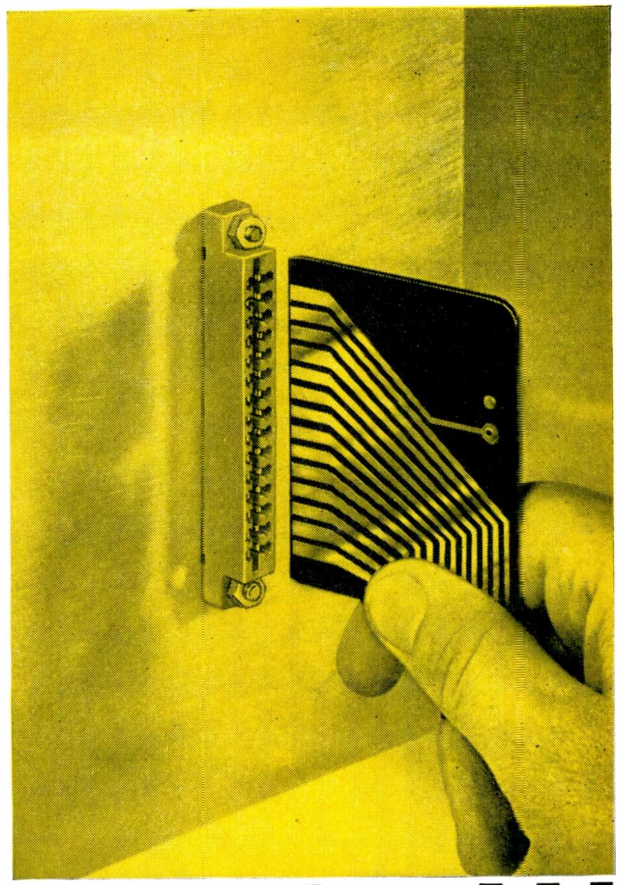
THE LATEST CENSUS figures, based on the 1950 census, turns up these interesting facts:

- 109,820 electrical engineers, of which 108,516 were male.
- 207,497 mechanical engineers, of which 205,529 were male.
- 16,757 radio operators, of which 15,215 were male.

CLOSED-CIRCUIT TV was installed at one California Super Market to prevent shoplifting and yielded an unexpected bonus. It not only chased away shoplifters, it also attracted many, many new customers intrigued by the prospect of seeing themselves on TV. In fact the daily receipts swelled steadily to $500 over normal.

(*Continued on page* 30)





SNAP IN CLIP IN

THE NEW A-MP PRINTED CIRCUIT EDGE CONNECTOR

This A-MP unit is more than new—it is the only *solderless, direct-contact* connector on the market. Designed for both commercial and military requirements, it means faster assembly, greater reliability and versatility to you—at lower cost!

You get construction of unmatched close tolerances in both the contact and the one-piece molded housing. And—because each contact is wholly enclosed within its own housing barriers, there's no need for post insulation. Contacts feature spring-lock design which assures positive contact with board—yet will not cause damage to board paths, even after repeated insertions.

Assembly is easy: An A-MP high speed machine crimps contacts to circuit wires. Contacts are quickly and completely snapped into housing, locked in place with a lance to eliminate damage from shorts, bending or strain. The printed circuit board is then inserted for unlimited circuit combinations.

Snap in . . . clip in—it's that simple to save time, money and increase quality.

Send for full product information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

Circle 14 on Inquiry Card, page 149

Tele-Tips

(Continued from page 28)

TV is pretty much a community project in most parts of Eastern Europe. At Pecs, Hungary, the television station is being financed by a lottery organized by the townspeople. In another Hungarian town, Miskolc, the inhabitants of three neighboring communities have pledged to lend a hand in the construction of the TV station.

POCKET-SIZE 2-WAY RADIO is being introduced by RCA. Called the Personalfone, the equipment operates in the 150-MC radio band. It consists of a 10-oz. transistorized receiver and a 28-oz. transmitter. It costs approximately $500.

THE MAGNETICS BUSINESS has its hazards. Ches Hammer, of Stackpole Carbon's sales staff is recounting this latest embarrassing brush which took place recently in an elevator. Seems he was carrying his new sample case of ceramic magnets and the elevator was getting more and more crowded at every stop. And as it did, a rather rotund woman standing in front of him was backing closer and closer. Then suddenly it happened! His sample case swung forward, swatted her in the rear and clung with grim determination. The magnets were being attracted by the metal stays in her — uh — foundation garment. Fortunately the elevator picked that moment to stop and Stackpole's embarrassed representative slid swiftly out, mumbling his apology.

ELECTRONICS is also making a very tidy little business for an unexpected quarter—the moving industry. Sensitive electronic gear, computers, test equipment and such, calls for delicate handling. The household furniture movers have found that their experience is particularly helpful in handling these jobs, and many of them have now set up special Electronics Moving Divisions, solely to handle this equipment.

Personals

Lynwood Cosby, Electronic Scientist at the U. S. Naval Research Laboratory, will be awarded the Navy's "Distinguished Civilian Award" for a "major breakthrough" in the field of Electronics countermeasures.

Leslie J. Ramsey, Jr. has been appointed Manager of Industrial Engineering, Electro Engineering Works according to Wallace W. Wahlgren president of the firm. Formerly Senior Methods Engineer at Friden Calculating Machine Co., he will be responsible for establishment of methods and standards, cost reduction, and machine design.

Dr. Kurt Schlesinger has joined General Electric Co's. Cathode Ray Tube department as Advanced Engineering Consultant in the Industrial and Military Section. He will be responsible for special development work and direct research.

John B. Olson is now Chief Engineer of Computer Measurements Corp. according to J. L. Cassingham, Vice President of the firm. He was formerly with Beckman Instruments, Inc.

J. B. Olson

N. L. Harvey

A. L. Chapman, President of CBS-Hytron, has announced the appointment of **Norman L. Harvey** as Vice President-Engineering of the Electronic Manufacturing Division Columbia Broadcasting System, Inc. He was formerly with Sylvania Electric Products, Inc.

Robert R. Haller, formerly with Ryan Aircraft Corp. heads a new group of twenty-five top-level space and missile engineers recently added to the staff of Southern California Aircraft Corp.

Edwin A. Fink has been promoted to Section Manager, Missile Fuse Engineering, G. & I. Div., Philco Corp. He is a former vice chairman of the Philadelphia Chapter's (IRE) Professional Group on Microwave Theory and Techniques, and a member of the sub-committee (EIA) on multiplex equipment.

Circle 16 on Inquiry Card, page 149

How You Can Cut Product Costs With Indox V Ceramic Magnets

Experience in the design and production of Indox V, for such products as the loudspeaker below, points the way to substantial savings in manufacturing costs for other products using permanent magnets.

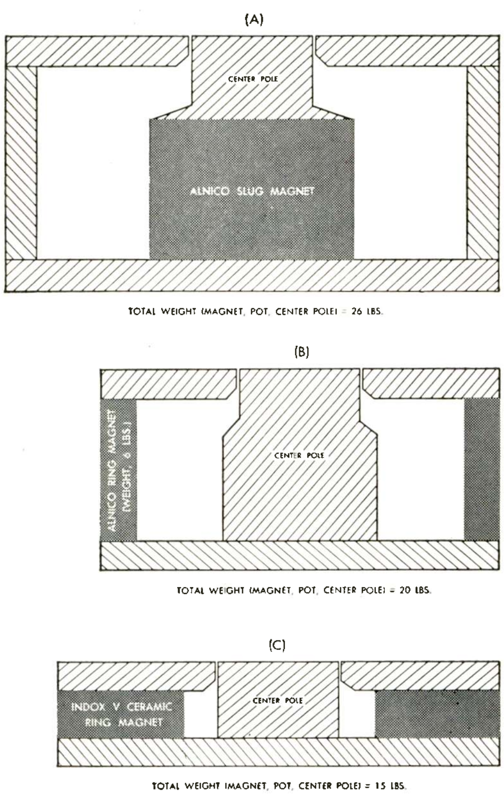
WHAT IS INDOX V

Indox V is a highly oriented barium ferrite material. Its energy is comparable, on an equivalent weight basis, to that of Alnico V—the most powerful permanent magnet material available. Indox V magnets possess unique advantages — light weight, high-electrical resistivity, great resistance to demagnetization, and inexpensive, non-critical raw materials — plus an energy product over three times that of non-oriented ceramic magnets.

NEW INDOX V LOUDSPEAKER DESIGN...

• Cuts magnet cost 20% • Saves 25% on weight • Reduces length 46%

High fidelity, permanent magnet loudspeakers normally use an Alnico slug (A) or ring (B) magnet. Assembly (C) illustrates how one loudspeaker was redesigned to use Indox V, with the results indicated. Assemblies shown in proportion.



APPLICATIONS

Indox V's excellent magnetic qualities and special properties suggest wide usage in many applications.

Among them:

D. C. Motors of Medium Size with Indox V fields have a high efficiency and show high starting and stall torques characteristic of series wound motors.

Holding Devices can take advantage of Indox V's total potential energy which, per pound of magnet weight, is appreciably higher than that of Alnico V.

Torque Drives using Indox V discs can be magnetized with multiple-pole faces.

The list of other promising applications is growing.

WHO MAKES INDOX V

Only Indiana Steel Products makes this oriented ceramic magnet, with an energy product of 3.5 million B_dH_d. And, because Indiana also produces Alnico and all other permanent magnet materials, it is uniquely qualified to recommend the *one* best material for your design. You are invited to consult with Indiana's design engineers for expert help on any application involving permanent magnets.

SEND FOR FREE LITERATURE

Write for your copy of the bulletin "Indox V Ceramic Permanent Magnets," describing magnetic properties, design considerations, and sizes and shapes available from stock for experimental work. Ask for Bulletin No. N-11.

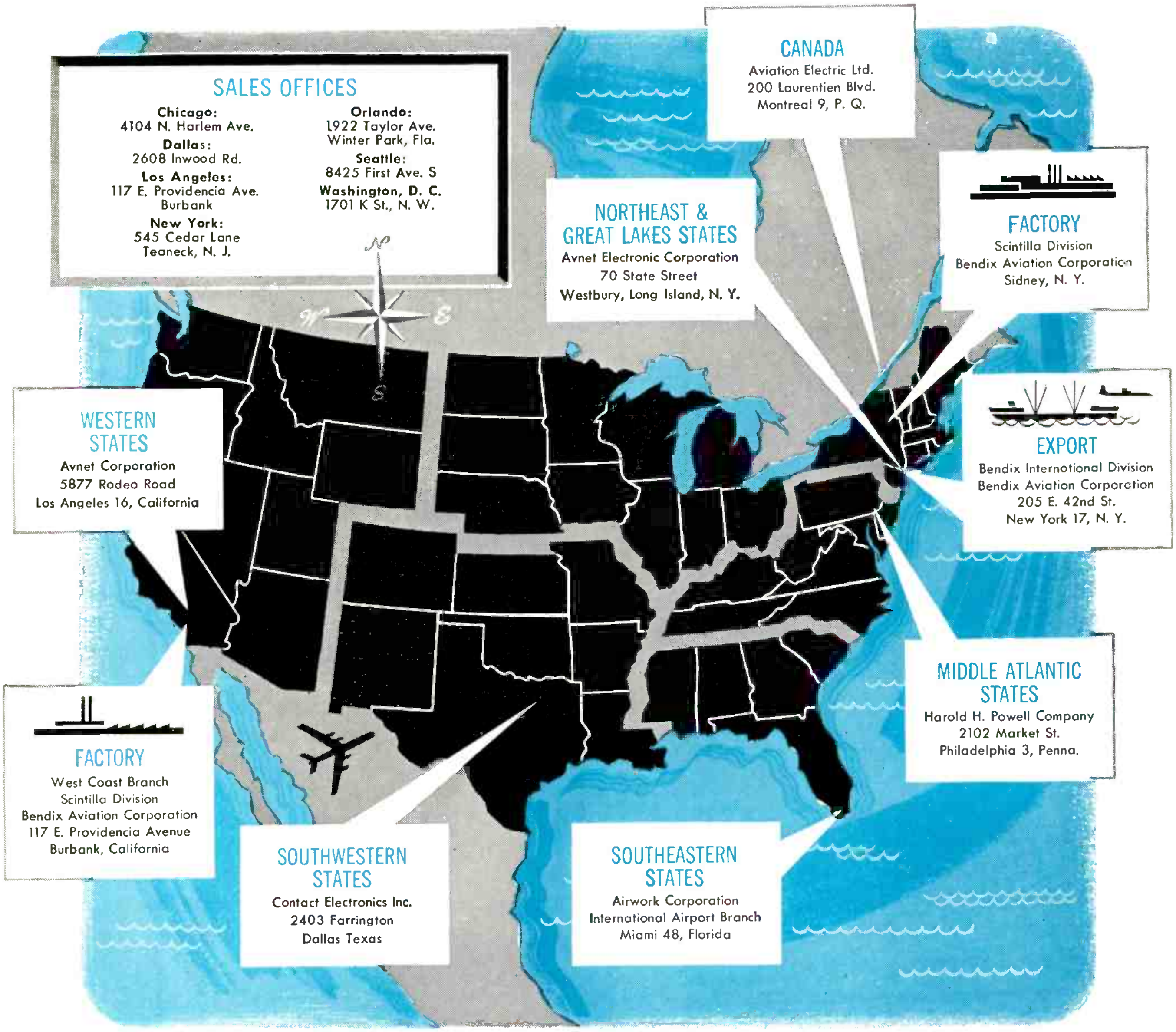
THE INDIANA STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA

WORLD'S LARGEST MANUFACTURER OF PERMANENT MAGNETS

INDIANA PERMANENT MAGNETS

IN CANADA: The Indiana Steel Products Company of Canada Limited, Kitchener, Ontario

NEW DISTRIBUTION NETWORK MAKES IMMEDIATELY AVAILABLE ALL THE IMPORTANT ADVANTAGES OF BENDIX CONNECTORS



Large inventories of Bendix® Electrical Connectors are now strategically located to assure you rapid delivery, regardless of your requirements or your location.

Each distribution center is factory-approved and inspected, and is stocked with connectors and components in an exceptionally wide range of types and sizes. Assembly and quality control facilities are maintained in complete accordance with factory standards and recommendations. Their staffs are adequate to assure not only immediate service but also reliable, efficient shipment of your order.

This expanded distribution system, combined with our greatly enlarged factory production facilities, makes available to all users the important advancements in engineering and design for which Bendix Electrical Connectors are favorably known.

We suggest you check the map now for the source nearest you.

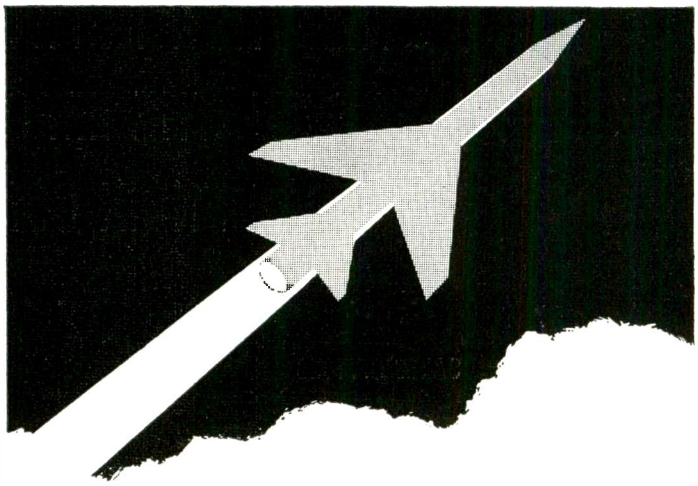
Scintilla Division
SIDNEY, N. Y.

Bendix AVIATION CORPORATION

Circle 11 on Inquiry Card, page 149

THE HIGHER THE STAKES

THE MORE YOU NEED

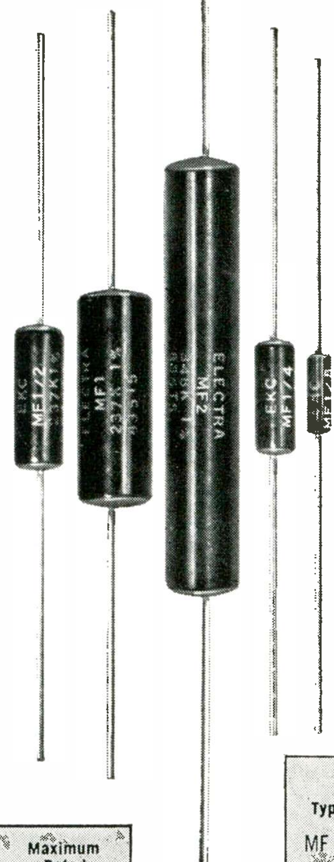


Electra's New Molded Precision Metal Film Resistor

IF YOU WANT . . .

- Low controlled temperature coefficient
- Low noise level
- Combination of high stability on load, in addition to low controlled temperature coefficient
- Close tracking of the resistance values of two or more resistors over a wide range of temperature
- High stability under severe humidity conditions
- Special resistor combinations to produce accurate ratios.

YOU WANT NEW ELECTRA MOLDED METAL FILM RESISTORS



Razor Sharp Precision, plus Amazing Stability— Here is new and greater-than-ever accuracy, coupled with new and greater-than-ever stability . . . the kind of a combination you need to meet the continuing demand for more and still more reliability. To give you this truly outstanding combination, a metallic resistive film is firmly bonded with exacting precision to an especially compounded ceramic core. This unit is then coated and molded in a compound of resins selected for the exceptional thermal stability it offers. The result is a metal film resistor that offers you performance which equals or surpasses that of a precision wire wound resistor, yet is smaller, lower in cost, also gives you better RF performance plus uniformity in size over wide resistance ranges. Here is a real "break-through" in resistor manufacturing. Why not get all the facts, **today.**

AVAILABLE IN THESE SIZES

Electra Part No.	Wattage	Resistance Range	Maximum Rated Voltage
MF 1/8	1/8	100 ohms 300 K	250
MF 1/4	1/4	100 ohms 500 K	300
MF 1/2	1/2	100 ohms 1 meg	350
MF 1	1	100 ohms 2 meg	500
MF 2	2	250 ohms 5 meg	750

TYPICAL PERFORMANCE IN % OF CHANGE UNDER TEST

Type	Temp. Cycle	Low Temp. Exposure	Short Time Overload	Solder Change	Moisture	1000 Hours @ 125°C
MF ½	.025%	.07%	.035%	.02%	.03%	.035%

TEMPERATURE COEFFICIENT — Available in three standard temperature coefficient tolerances:

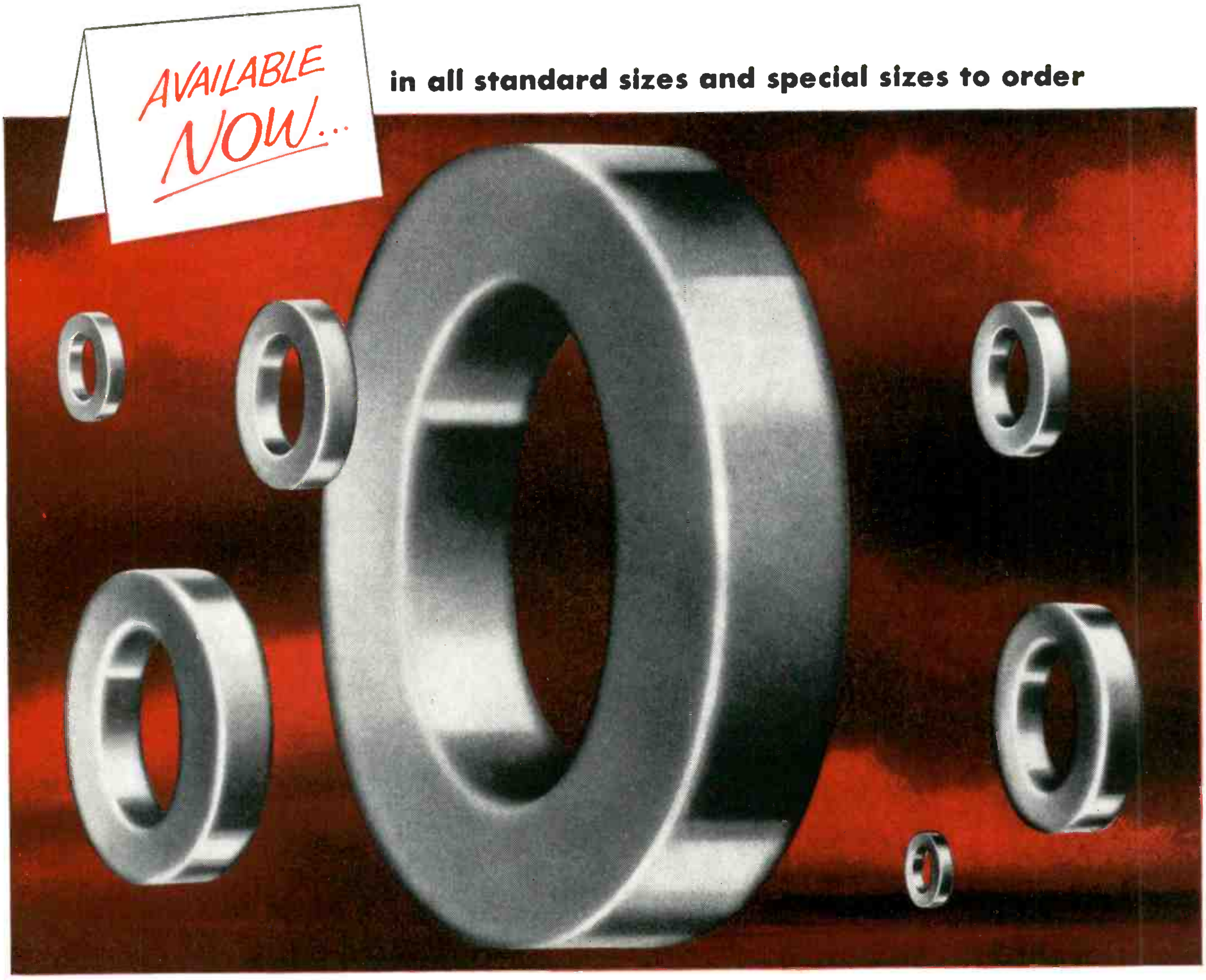
T.C.	CODE MARKINGS**
0 ± 100 PPM/°C.*	T-1
0 ± 50 PPM/°C.	T-2
0 ± 25 PPM/°C.	T-5

Proposed MIL-R-10509C specification calls for temperature coefficient measurements from —55°C to +165°C. The lowest temperature coefficient is 0 ± 50 PPM/°C. Code T-2 meets this requirement. Resistors in code T-5 are production tested over a range of +25°C to +105°C. Special temperature coefficients—Code T-3, 0 to +100 PPM, and Code T-4, 0 to —100 PPM—are available for special applications.

*Parts Per Million Per Degree Centigrade (100 PPM equals 0.01%)
**The T.C. code marking is combined with the code for the date of manufacture

Electra

MANUFACTURING COMPANY
Electronics Division
4051 Broadway, Kansas City, Mo., U.S.A., Phone: WEstport 1-6864



in all standard sizes and special sizes to order

The New ARNOLD *6T* Aluminum-Cased Tape Cores

give you 4 BIG ADVANTAGES ... *at no added cost!*

(1) NEW COMPACTNESS in Aluminum-Cased Cores permits you to design for greater miniaturization, yet retain the distortion-free strength of an aluminum case that resists winding stresses Overall dimensions are smaller than older types of aluminum cases and comparable in size with plastic-cased cores.

(2) HERMETICALLY SEALED, with Built-in Protection against shock and vibration, Arnold 6T Cores provide the most complete protection against deterioration of magnetic properties available on the market. Strain-sensitive core materials are completely surrounded by an inert shock absorbent, hermetically sealed within the cases. Trouble-free performance is virtually assured, even over long standby periods. 6T Core design further guarantees that you can vacuum-impregnate your coils.

(3) 1000-VOLT BREAKDOWN *GUARANTEED!*
The Arnold 6T Core employs a strong, inert covering with hard gloss finish which carries a 1000-volt breakdown guarantee. Suitable radii and the elimination of sharp corners insure against cutting the winding wire's insulation. Its hard non-cold-flowing finish protects the covering against cuts. Both features guarantee against shorted wiring.

(4) MEETS MILITARY "SPECS" for Operating Temperatures and Temperature Rise.
The Arnold 6T Core fully meets the requirements of military specifications Mil-T-5383 or Mil-T-7210, wherever applicable. These specifications call for case construction to withstand ambient temperatures to 170° C, and a 25° C temperature rise.

WSW 7319

Arnold 6T Tape Cores are 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.
● We'll welcome your orders for prompt delivery of pilot or production quantities.

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 20 on Inquiry Card, page 149

ELECTRONIC INDUSTRIES

International

The "Parametric Artificial Talker" has been developed in **Britain.** The machine not only creates all the sounds normally used in speaking but produces the illusion of complete words and phrases.

A 530 mile submarine telephone cable, to be in service by Oct., 1960 between **England** and **Sweden,** will provide 60 two-way circuits over a single core cable.

Old Edison phonograph records in his possession will disprove an **English Widow's** claim that her husband was the inventor of the sapphire phonograph needle claimed Karl Jensen, an American phonograph manufacturer. The English woman plans to sue some American firms for patent infringement.

The BBC and Electrical & Musical Industries Ltd., are jointly studying a system invented by the British firm for transmitting stereophonic sound over a single radio channel.

Ten Caribbean islands — Trinidad, Grenada, St. Vincent, Barbados, St. Lucis, Martinique, Dominica, Guadeloupe, Antiqua, and St. Kitts—are to be linked by a ground-to-air and inter-island VHF radio communications system covering 836 miles.

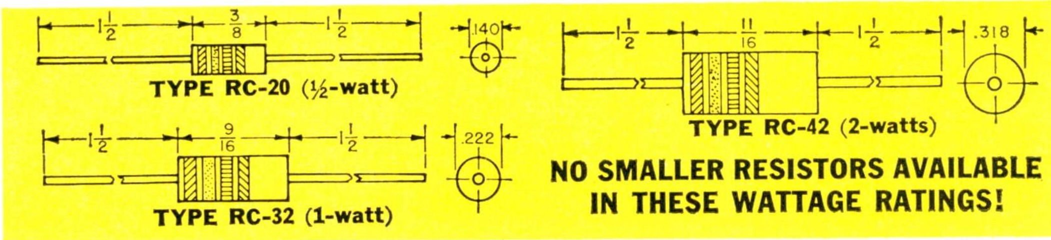
R. Haviland, internationally known satellite engineer, has called for an extension of the **International Geophysical Year.** A rocket to the sun, with an assist from the moon, was suggested as a project of extended IGY activities.

"Irish" recording tape will be featured as "representative of the best in American hi-fi" at the **Brussels World Fair.** Three young Americans have been invited to stage a hi-fi demonstration in the American pavilion.

A 6 million volt Van de Graaff "Atom smasher" will be exhibited at the Second International Atoms for Peace Exhibition **Geneva, Switzerland.** The unit is destined for the University of Strasbourg, France.

Siemens & Halske AG, **Karsruhe, West Germany,** and RCA have reached an agreement under which RCA will be the firm's American distributer. The company manufactures electronic measuring apparatus.

(*Continued on page* 40)



This is the kind of

PLUS PERFORMANCE

You get when you specify COLDITE 70+ resistors

This performance table for the RC-32 (short) 1-watt Coldite 70+ Resistors speaks for itself. Similar test data proving equally good performance for the RC-20 (½-watt) and RC-42 (2-watt) units will gladly be sent on request to: Electronic Components Division, Stackpole Carbon Company, St. Marys, Pennsylvania.

NO SOLDERING PROBLEMS! You'll get faster, better production—either manual or automatic—with Coldite 70+ than with any other resistors of their type! Hot tin dipping of leads assures real "solderability." What's more, the resistors can be supplied oriented and aligned on reel packs.

	Average Percent Resistance Change					
	10 ohms		270,000 ohms		22 megohms	
	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B
RESISTANCE-TEMPERATURE CHARACTERISTICS						
@ −15°C	1.5	3.25	2.2	7.5	6.7	12.5
@ −55°C	3.7	6.5	6.2	15.0	15.7	25.0
@ +65°C	1.6	2.5	1.1	5.0	4.0	7.5
@ +105°C	2.1	5.0	5.7	10.0	3.7	15.0
VOLTAGE COEFFICIENT per volt	Not applicable		0.0068	0.0200	0.0160	0.0200
LOW-TEMPERATURE STORAGE	0.1	2.0	0.1	2.0	1.0	2.0
LOW-TEMPERATURE OPERATION	0.1	3.0	0.2	3.0	0.5	3.0
TEMPERATURE CYCLING	0.1	4.0	1.1	4.0	0.2	4.0
MOISTURE RESISTANCE	3.7	10.0	7.4	10.0	3.2	10.0
SHORT TIME OVERLOAD	0.2	2.5	0.13	2.5	0.2	2.5
LOAD LIFE at 70°C						
after 50 hours	0.2	6.0	3.0	6.0	0.25	6.0
after 250 hours	0.4	6.0	1.9	6.0	0.9	6.0
after 500 hours	0.5	6.0	1.9	6.0	1.9	6.0
after 1000 hours	0.5	6.0	1.5	6.0	2.3	6.0
LEAD TWIST TEST	0.04	1.0	0.0	1.0	0.1	1.0
EFFECT OF SOLDERING	0.2	3.0	0.6	3.0	0.4	3.0

DIELECTRIC STRENGTH All Stackpole Type RC-32 Coldite 70+ Resistors withstand 1000 volts r.m.s. at atmospheric pressure for 5 seconds as well as 625 volts r.m.s. at 3.4 inches of mercury for 5 seconds without damage, arcing or breakdown.

TERMINAL SECURITY All Stackpole Coldite 70+ Resistors withstand the standard 5-pound pull test.

STACKPOLE
Coldite 70+®
fixed composition resistors

Setting the standards by which other resistors will be judged.

FIXED AND VARIABLE COMPOSITION RESISTORS • SNAP AND SLIDE SWITCHES • CERAMAG® FERROMAGNETIC CORES • FIXED COMPOSITION CAPACITORS • IRON CORES • CERAMAGNET® CERAMIC MAGNETS • BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT • ELECTRICAL CONTACTS • AND HUNDREDS OF RELATED CARBON, GRAPHITE AND METAL POWDER PRODUCTS

Circle 22 on Inquiry Card, page 149

TYPE 543
DC-to-30 MC OSCILLOSCOPE

This new fast-rise oscilloscope with the Tektronix Plug-In Feature is extremely versatile and easy to operate. With a single Type 53/54 fast-rise plug-in preamplifier the Type 543 handles the usual applications in the DC-to-30 MC range. Many other inexpensive plug-in units are available for the more-specialized jobs, including one for transistor rise, fall, delay and storage time testing.

MAIN CHARACTERISTICS

VERSATILITY
Nine Available Plug-In Preamplifiers—Wide Band, Dual Trace, Low Level, Differential, and others for specialized applications.

HIGH PERFORMANCE
DC to 30 MC with fast-rise plug-in units.
DC to 24 MC with dual-trace plug-in unit.
0.02 μsec/cm to 15 sec/cm sweep range.

EASY OPERATION
24 Calibrated Direct-Reading Sweep Rates.
Sweep Magnification—2, 5, 10, 20, 50, and 100 Times.
Preset Triggering—Eliminates triggering adjustments in most applications.
Single Sweep Operation—Lockout-Reset Circuitry for one-shot recording.

HIGH WRITING RATE
250 cm/μsec. 10-kv accelerating potential assures bright trace for operation in single-sweep applications, and with low sweep repetition rates.

ENGINEERS—interested in furthering the advancement of the oscilloscope? We have openings for men with creative design ability. Please write Richard Ropiequet, Vice President, Engineering.

TYPE 543 PRICE, without plug-in units **$1200**

Type 53/54K Fast-Rise Unit	**$125**
Type 53/54C Dual-Trace Unit	**$250**
Type 53/54R Transistor Test Unit	**$300**

Prices f.o.b. factory.

Please call your Tektronix Field Engineer or Representative for complete specifications and, if desired, to arrange for a demonstration at your convenience.

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albertson, L. I., N.Y. • Albuquerque • Bronxville, N.Y. • Buffalo Cleveland • Dallas • Dayton • Elmwood Park, Ill. • Endwell, N.Y. • Houston • Lathrup Village, Mich. • East Los Angeles • West Los Angeles • Minneapolis • Mission, Kansas • Newtonville, Mass. • Palo Alto, Calif. • Philadelphia • Phoenix • San Diego • Syracuse • Towson, Md. Union, N. J. • Willowdale, Ont.

TEKTRONIX ENGINEERING REPRESENTATIVES: Arthur Lynch & Assoc., Ft. Myers, Fla., Gainesville, Fla.; Bivins & Caldwell, Atlanta, Ga., High Point, N.C.; Hawthorne Electronics, Portland, Ore., Seattle, Wash.; Hytronic Measurements, Denver, Colo., Salt Lake City, Utah.

Tektronix is represented in 20 overseas countries by qualified engineering organizations.

Announcing

An Important New Addition to B&A's line of "Electronic Grade" Chemicals

B&A supplies ingots of intrinsic or first reduction metal individually wrapped in polyethylene, six to a corrugated shipping box. Germanium dioxide is packaged in standard screw-cap bottles.

B&A BAKER & ADAMSON QUALITY

Special High Purity

GERMANIUM

Dioxide   First Reduction Metal   Intrinsic Metal

Now Baker & Adamson offers the electronic industry a dependable, domestic source for high purity germanium and germanium dioxide—part of America's leading line of electronic chemicals.

You get all these advantages with B&A Germanium:

Dependable, domestic source: Why rely on uncertain foreign sources for this key raw material when B&A has it—*domestically produced, always readily available!* By using B&A as your source for both raw material and scrap reclaiming you can cut inventory requirements, effect other economies.

Lower volatile! B&A Germanium Dioxide contains about 0.5% less volatile than many other oxides . . . will thus yield about 0.5% more metal when reduced.

Dustless! B&A Germanium Dioxide is free from fine particles. Dust losses, often a problem, are sharply reduced.

Higher bulk density! The bulk density of B&A Germanium Dioxide is 60% to 70% higher than many other oxides. Therefore the boats which carry oxide through the reducing furnace will yield about 60% more metal for each furnace pass.

Save on scrap tolls! B&A can handle all grades of scrap with lower toll charges on low assay material.

Investigate all these advantages of B&A Germanium *now.* Call your nearest B&A sales office.

BAKER & ADAMSON®
"Electronic Grade"
Chemicals

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

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Circle 24 on Inquiry Card, page 149

ELECTRONIC INDUSTRIES

International

(*Continued from page* 36)

Communist China doubled its propaganda broadcasts to Western Europe and Latin America, and Communist broadcasts to the Arab world increased 17% during the first six months of this year according to the U. S. Information Agency.

The Hamann Division of the **German Telephone Works and Cable Industry** has been acquired by Smith-Corona Marchant, Inc. A new company has been formed to manage the Hamann operation.

Lead-screw type potentiometers will be made in Western Europe and Australia by firms in those areas under licenses of Bourns Labs. Inc.

Over 73 new foreign TV stations have been put into operation this year with the areas of greatest growth in **Japan, W. Germany,** and **Italy.** The most increase has been made in those countries where commercial advertising is permitted.

Yugoslavian authorities have ordered equipment from Marconi Ltd. for the establishment of a television link between Belgrade and Ljubljana.

A 20 mev microwave linear accelerator has been sold to **Japan** by High Voltage Engineering Corp. The linear accelerator will be installed at the Japan Atomic Energy Research Institute, Tookaimura.

Jordan has ordered a high-power broadcasting transmitter to increase the scope of the country's broadcasting activities. The transmitter will be installed in Amman.

The U. S. Air Force radar base at **Kasatoriyama, Japan** has been turned over to the Japanese forces for self operation. U. S. Forces have been training Japanese in the techniques needed to operate the site.

Corning Glass Works has established a plant in **Australia** for the manufacture of television bulbs. The move was prompted by the increased production of television sets in Australia.

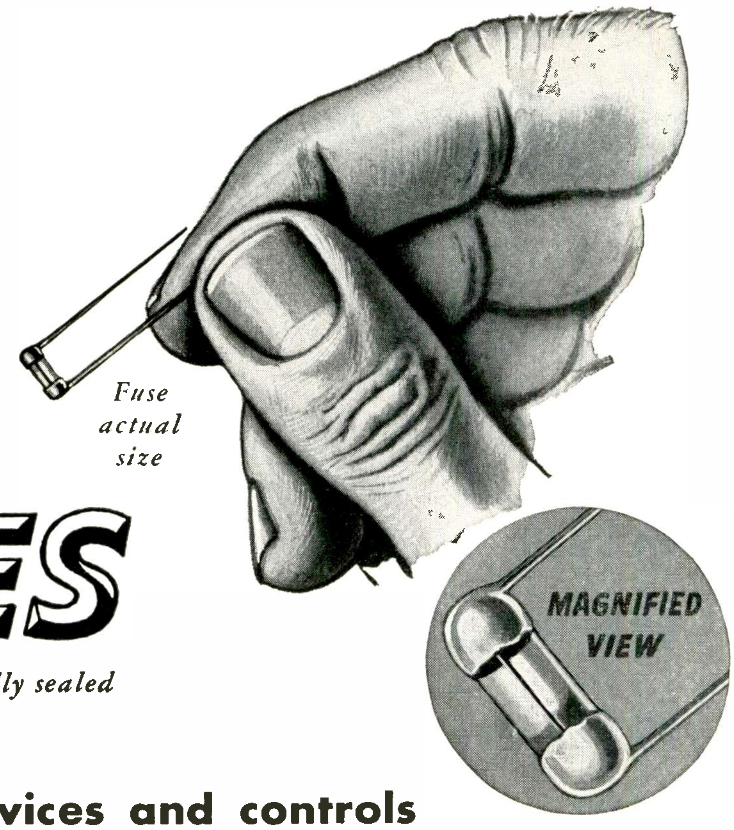
Mandrel Corp. has formed a new subsidiary in **Paris.** The French firm will produce electronic instruments for seismic exploration.

Kelvin Hall, Glasgow will be the site of the Third Scottish Industries Exhibition to be held during Sept., 1960. The exhibition will feature nuclear and electronic industries.

Circle 26 on Inquiry Card, page 149

Another outstanding development by the makers of BUSS fuses

TRON FUSES



Sub-miniatures — hermetically sealed

Designed to protect miniature devices and controls

TRON fuses make it possible to have the fuse as an integral part of miniaturized circuits, controls, electronic devices, and electrical equipment. There is no need to sacrifice space to provide built-in protection.

TRON fuses have such small physical dimensions that they can be easily incorporated into miniaturized devices or components.

The fuse element is hermetically sealed in a glass tube. Contact is made by pig-tail lead-in wires.

TRON fuses are not affected by atmospheric or surrounding conditions because the hermetic seal protects the fuse element from contact with them.

This means — TRON fuses may be potted or encapsulated, if desired, without any danger of the potting or surrounding material affecting the operation of the fuse.

Or TRON fuses can be installed anywhere in the circuit as they are self-protecting and operate without exterior flash or venting.

Likewise, TRON fuses may be teamed in one capsule or replaceable unit with such components as resistors — or anywhere that sensitive protection is desired.

TRON fuses are made in two types. GLN TRON fuses, made to carry 100% load indefinitely and to open within 10 seconds at 200% load. Available in 1/20 to 1/2 amperes.

GLX TRON fuses made to carry 100% load indefinitely and to open within 10 seconds at 150% load. Available in 2/10 to 5 amperes.

Both GLN and GLX TRON fuses will operate properly on circuits of 125 volts or less capable of delivering 50 amperes or less. The fuse body measures .140 x .300 inches. Standard pig-tails are one inch long of No. 24 copper wire.

When designing an electrical or electronic circuit — where space is of importance — consider the many advantages of TRON fuses. Send us the details of your requirements and our fuse engineers will gladly work with you.

BUSSMANN MFG. DIVISION, McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

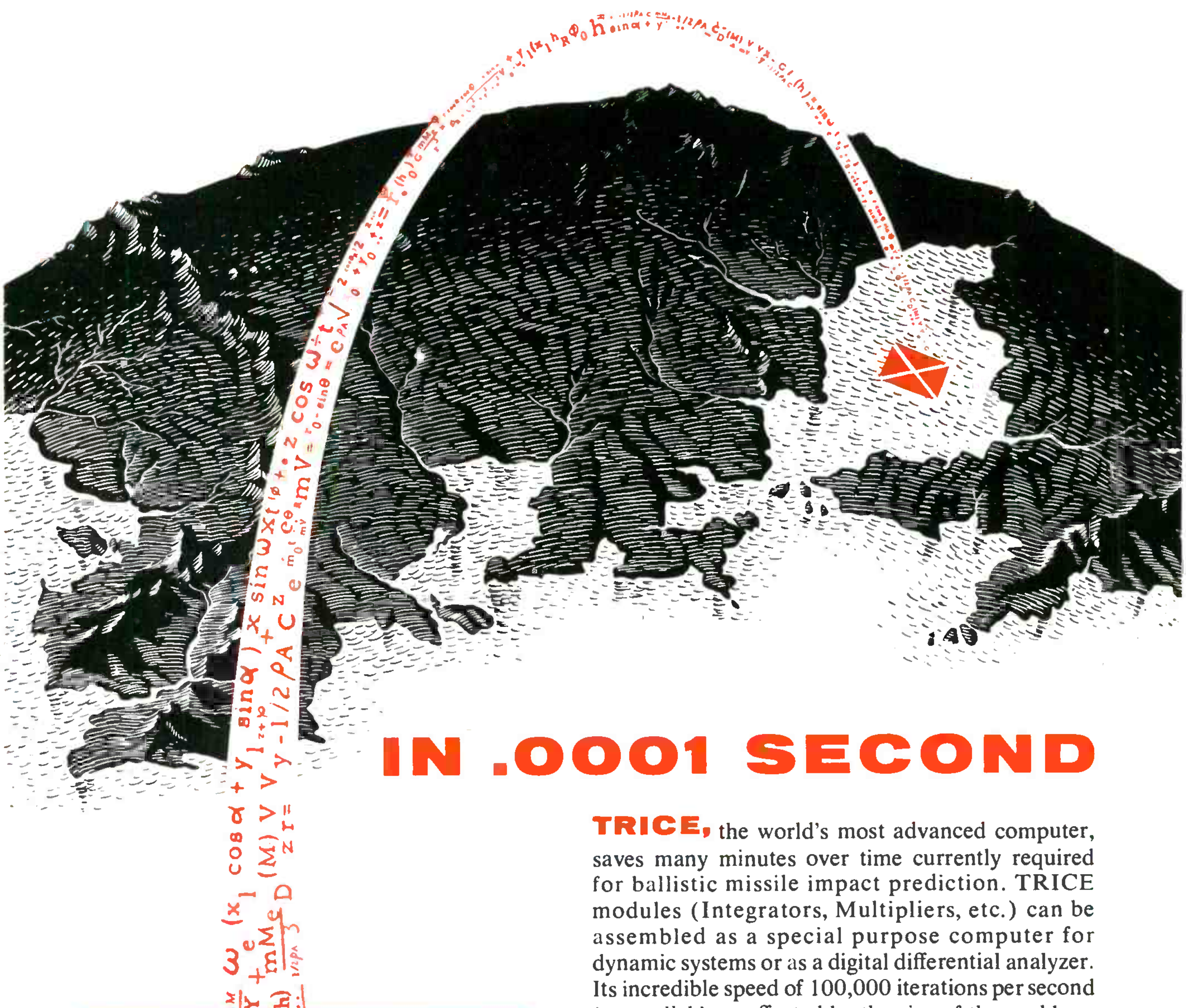
1158

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

BUSS makes a complete line of fuses for home, farm, commercial electrical, automotive and industrial use.

FUSETRON · TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION · BUSS · McGRAW EDISON · BUSSMANN MFG. DIVISION · St. Louis 7, Mo.

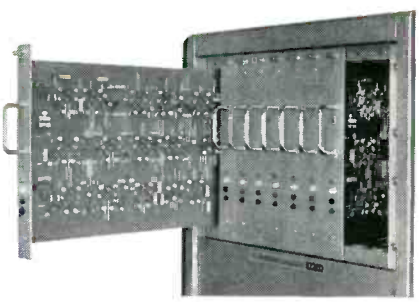
MISSILE IMPACT PREDICTION



IN .0001 SECOND

TRICE, the world's most advanced computer, saves many minutes over time currently required for ballistic missile impact prediction. TRICE modules (Integrators, Multipliers, etc.) can be assembled as a special purpose computer for dynamic systems or as a digital differential analyzer. Its incredible speed of 100,000 iterations per second *in parallel* is unaffected by the size of the problem. The first model is in operation at the U.S. Army Ordnance Missile Command, Huntsville, Ala.

Write for literature describing TRICE and its many uses: aerodynamic stability, control system stability, impact prediction, stable platform calculations, satellite orbit predictors and others.



ENGINEERING BEYOND THE EXPECTED

TRICE (Transistorized Realtime Incremental Computer, Expandable) is the first computer to combine the accuracy and repeatability of a digital computer with the speed, flexibility and ease of programming of an analog computer.

PACKARD-BELL COMPUTER CORP.

a subsidiary of

PACKARD BELL ELECTRONICS

12333 W. Olympic Blvd.
Los Angeles 64, Calif. BR. 2-2171

Circle 28 on Inquiry Card, page 149

A Statement By
I. D. DANIELS, GENERAL MANAGER
RECEIVING TUBE DEPARTMENT
GENERAL ELECTRIC COMPANY

TODAY'S TV-

For further information, phone nearest office of the G-E Receiving Tube Department below:

EASTERN REGION
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

CENTRAL REGION
3800 North Milwaukee Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

Circle 29 on Inquiry Card, page 149

Books

Engineering Electromagnetics

By William H. Hayt, Jr. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 328 pages. Price $8.50.

The book introduces electromagnetic theory in a way that enables ready understanding of more advanced text. Thus it gives the reader a broader view of the physical faces on which electrical courses depend. The material includes electrostatics, the steady magnetic field, time varying field, and Maxwell's equations, and concludes with a number of examples illustrating the application of Maxwell's equations. Vector analysis is used throughout.

Principles of Noise

By J. J. Freeman. Published 1958 by John Wiley & Sons., Inc., 440 Fourth Ave., New York 16. 299 pages. Price $9.25.

The book acquaints the reader with enough of the principles, facts, and techniques used in noise analysis to take him to the level where he can read the literature with enough ease to use it as a professional tool.

The author deals with such topics as probability, stationery random processes and their transformation, tower spectra, noise and factor of various circuits. He explains the relationship of one concept to another, why each concept was created, what its usefulness is, and what its limitations are.

Closed-Circuit Television Systems, Color and Monochrome.

Published 1958 by RCA Service Co., Government Service Dept., Camden 8, N. J. 348 pages. Price $4.50.

This book is a valuable source of information on the many aspects of closed-circuit TV applications, particularly for management personnel who must do the planning and for technical personnel who must do the system engineering. It is divided into three parts: the first on basic portions deals entirely with monochrome, or black and white television; the second part is the color supplement; and the third contains addenda describing and illustrating specific examples of closed-circuit systems now in use.

Handbook of Automation Computation and Control, Volume I.

Edited by Eugene M. Grabbe, Simon Ramo, and Dean E. Wooldridge. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 1020 pages. Price $17.00.

In addition to general mathematics, this volume includes sections on operations research and numerical analysis for digital computation. The major section on feedback control consolidates available information in the subject. Other sections present pertinent material on information theory, smoothing, filtering, and data transmission.

(*Continued on page* 48)

Books

(*Continued from page 46*)

Logic Machines and Diagrams

By Martin Gardner. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 259 pages. Price $5.00.

A complete survey of mechanical and electrical machines designed to solve problems in formal logic, and of geometrical methods for doing the same is presented. The book begins with the eccentric logic of the Spanish mystic, Raymon Lull; goes through the fascinating history of logic diagrams and machines; and concludes with the complex, efficient electrical machines of today.

Electronic Engineers Reference Book.

Edited by L. E. C. Hughes. Published 1958 by the MacMillan Co., 60 Fifth Ave., New York 11. 1311 pages. Price $18.00.

This reference book provides suggestions and possibilities to be taken into consideration when problems are examined from various points of view; physical, chemical, production, safety, reliability, maintenance. The editor has gathered together a great deal of useful information from the origin of the various effects indicated under the general definition of the term electronics to the practical realization of devices based on the neutralization and integration of these industrial plants.

Economic Operation of Power Systems

By Leon K. Kirchmayer. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 260 pages.

This book discusses computer methods utilized by electrical utilities to provide economy in production. The book emphasizes theoretical developments and computer use in dealing with and solving system problems. It shows how matrix methods are employed to derive transmission loss formulas, which in turn are the basis for computation procedures applied to computers. The proper use of analog and digital computers to obtain transmission loss formulas and generation schedules is also described.

Electronic Digital Computers

By Franz L. Alt. Published 1958 by Academic Press, Inc., Publishers, 111 Fifth Ave., New York 3, N. Y. 336 pages. Price $10.00.

This book is a complete, up-to-date survey of the techniques available for using electronic computers. It describes machines from a functional standpoint, concentrating upon aspects of interest to the potential user, and discusses all phases of problem formulations and analysis, programming, coding, and machine operation.

(*Continued on page 50*)

ELECTRONICS IN BRITAIN

PEAK CURRENTS UP TO 2 AMPS WITH THIS SMALL THYRATRON

EN32 (6574)

This new inert gas filled thyratron by Mullard is ideally suited for use in compact electronic control equipment. In addition to its small size and high current capacity, it has the advantage of quick heating time, high permissible grid resistance, negative control characteristics, and the ability to operate over a wide ambient temperature range. The combination of a Xenon gas filling and the modern Bantal construction contribute to long life of the tube, and permit it to be mounted in any position.

Brief technical details of the EN32 are given here; for further information write to one of the distributors listed below.

TECHNICAL DATA

Maximum average cathode current	0.3	(A)
Maximum peak cathode current	2.0	(A)
Maximum peak inverse anode voltage	1300	(V)
Maximum peak forward anode voltage	650	(V)
Cathode type	Indirectly heated	
Heater voltage	6.3	(V)
Heater current	0.95	(A)
Minimum valve heating time prior to conduction	15	(sec)
Maximum seated height	2¾ inches	
Base	Octal	

Supplies available from:

In the U.S.A.

International Electronics Corporation
Dept. EI-10, 81 Spring Street, N.Y.12, New York, U.S.A.

In Canada

Rogers Electronic Tubes & Components
Dept. MJ, 116 Vanderhoof Avenue, Toronto 17, Ontario, Canada.

Mullard

ELECTRONIC TUBES used throughout the world

"Mullard" is the Trade Mark of Mullard Ltd., and is registered in most of the principal countries of the world.

MULLARD OVERSEAS LTD., MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND

MEV 71

Circle 33 on Inquiry Card, page 149

Books

(*Continued from page* 48)

Computability and Unsolvability

By Martin Davis. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 210 pages, xxv pages. Price $7.50.

This is an introduction to the theory of computability and non-computability, usually referred to as the theory of recursive functions. It is concerned with the existence of purely mechanical procedures for solving various problems.

Principles and Applications of Random Noise Theory

By Julius S. Bendat. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 431 pages, xxi pages. Price $11.00.

This work is a systematic development of fundamental topics, explaining the basic ideas of random noise analysis and optimum filtering techniques in understandable terms. Physical meanings and mathematical restrictions are emphasized. The book is especially written for use by research scientists and the practicing engineer. The author shows how to formulate certain difficult noise problems, derive their solutions, and obtain proper physical design and interpretations.

Every effort has been made to blend the basic fundamentals with material on probability and statistics to illustrate the importance of applying these factors conjunctively in the analysis of random noise.

Books Received

The University Technilog on Loud Speakers

Published 1958 by University Loud Speakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. Price $1.00.

Bibliography on Medical Electronics

Published 1958 by Professional Group on Medical Electronics, Institute of Radio Engineers, 1 E. 79th St., New York 21. Price $2.50. Over 2200 items in the numerical index.

Microwave Transmission Design Data

By Theodore Moreno. Published 1958 by Dover Publications, Inc., 920 Broadway, New York 10. 248 pages, ix pages. Price $1.50.

Microwave Measurements.

Published 1958 by Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y. 27 pages. Price 50¢.

Electrical Estimators Manual.

Published 1958 by Kast's Manual, P. O. Box 183, Wyncote, Pa.

Photosensitive Devices and Cathode Ray Tubes.

Published 1958 by Radio Corporation of America, Electron Tube Div., Harrison, N. J. 32 pages. Price 30¢.

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APECO copies are error-proof, legally-acceptable, just like the original

Apeco Uni-Matic Auto-Stat produces copies that look exactly like the original. Whites are copied white—blacks are copied black—and middle tones in grays of matching intensity. It makes clear sharp copies of anything—copies that will last indefinitely—copies that you will be proud to send out as representative of your firm. Find out about this sensational new machine today.

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It shows, in detail, the many money and time saving applications for Apeco Uni-Matic Auto-Stat copying in your business. Tear off and mail the postage-paid reply card.

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PERMIT NO. 226
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No postage stamp necessary if mailed in the United States

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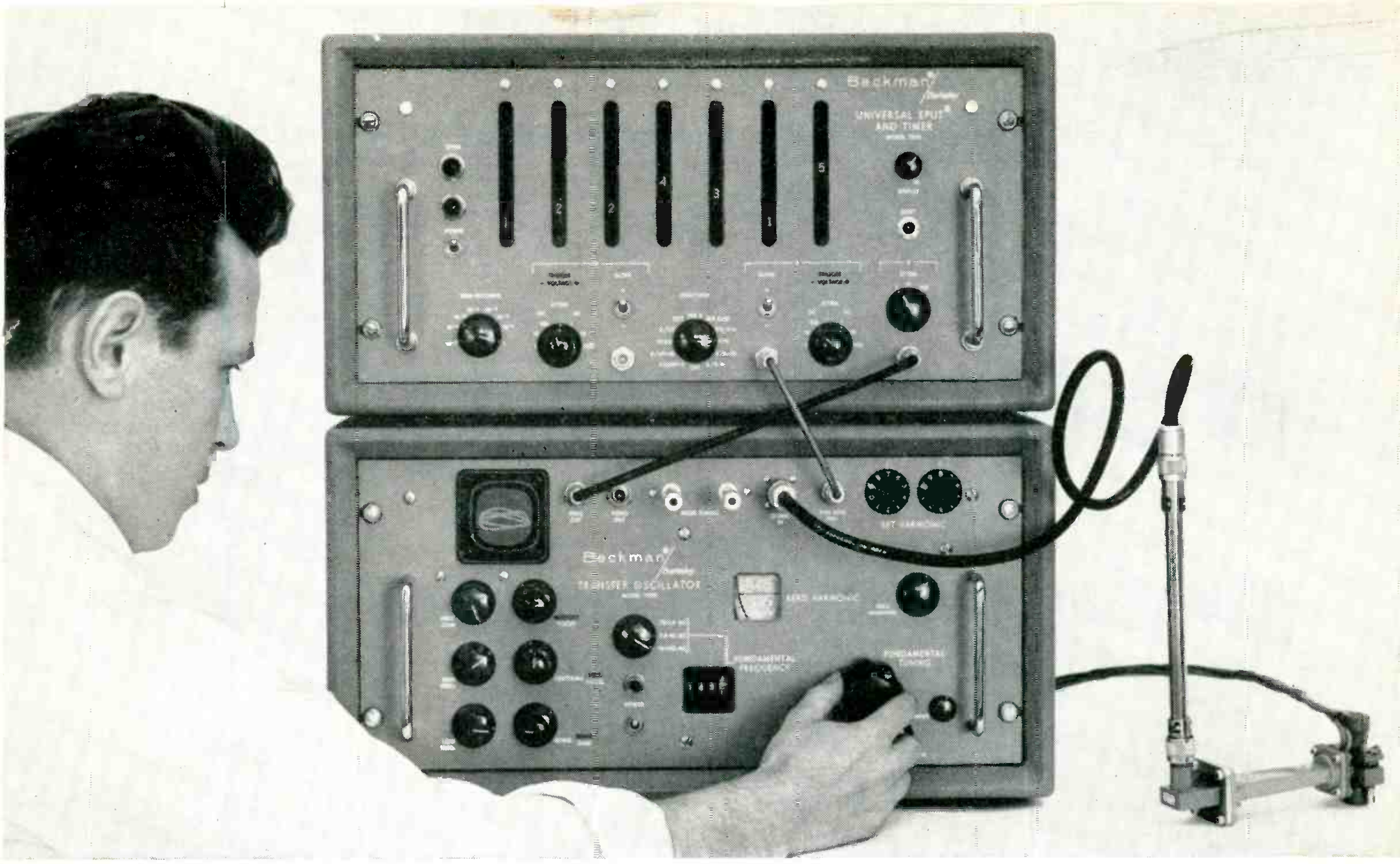
Evanston, Illinois



12,000 Mc

directly displayed by a counter

Model 7580 Transfer Oscillator (bottom cabinet) with Model 7370 EPUT and Timer (top cabinet):

Frequency measuring range	dc to 12 K Mc
Types of signals accommodated	CW, AM, FM pulsed r-f
Sensitivity	100 mv rms
Input impedance	50 ohms
Accuracy	up to ± 3p in 10^7
Fundamental range of trans. osc	75 to 150 Mc & 7.5 to 15 Mc
Harmonics available	Up thru 80th
Stability of fundamental	.0001%/min

Four-step operation:

1. Tune to two adjacent zero beats identified by built-in oscilloscope display.
2. Read harmonic number on calculator dial.
3. Set rotary switches to harmonic number.
4. Read frequency indication directly from counter.

Prices: Model 7580 Transfer Oscillator . . . $1650
Model 7370 10 Mc EPUT & Timer . . . $1975
Model 7360J 2 Mc EPUT & Timer (price $1325) may also be used with the transfer oscillator.

Used in combination with the computing transfer oscillator in the cabinet beneath it, the 10 Mc EPUT® and Timer creates a *direct* decimal display of 12,243.15 megacycles generated by the small klystron at the right. How? The transfer oscillator contains a computing device which automatically calculates the harmonic number of a harmonic brought to zero beat with the frequency under test. Then, the gate time of the counter is multiplied by the harmonic number to produce a counter indication of actual klystron frequency. By eliminating all manual computations, the entire operation commonly takes less than one-fifth the time required using equipment previously available.

This assembly of two independent units, compatibly designed, offers an unprecedented combination of range, accuracy and convenience. The transfer oscillator can also be used with either of two other BECKMAN/Berkeley EPUT Meters currently in wide use.

158

For more information on this and other recent advances in digital frequency measuring techniques, write for the new Data File 111. Address department F-11.

Beckman®

Berkeley Division

2200 Wright Avenue, Richmond 3, California

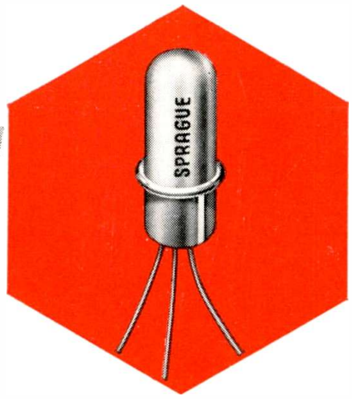
a division of Beckman Instruments, Inc.

Circle 39 on Inquiry Card, page 149

micro-alloy transistors from SPRAGUE*

surface barrier transistors

NEW



2N393

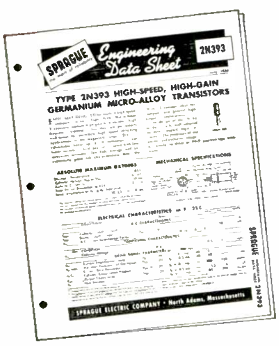
	Min.	Typ.
h_{fe}	40	155
f_{max}	40	60

HIGH-SPEED, HIGH-GAIN 2N393 TRANSISTORS

for modern computer circuitry

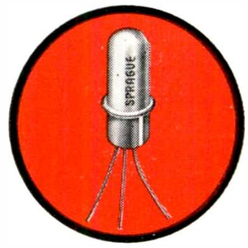
Type 2N393 Micro-Alloy Transistors combine high gain with excellent high frequency response to meet demands of high-speed computer switching applications in the megacycle range. Low saturation resistance, low hole storage, and exceptionally good life characteristics make micro-alloy transistors top performers in general high frequency applications, as well as computer circuits.

D-C β is remarkably linear up to 50 milliamperes collector current. The design of the 2N393 is particularly well adapted to direct-coupled logic circuitry. The polarities of the emitter and collector voltages are similar to those of PNP junction-type transistors.



Both micro-alloy and surface barrier transistors are now being made in Sprague's completely new semiconductor facility. Quantity orders for the popular types shown here are shipped promptly. Or get fast delivery on small quantities from your local Sprague Industrial Distributor.

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



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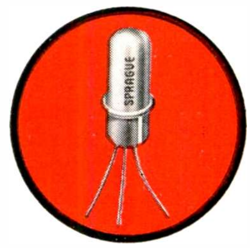

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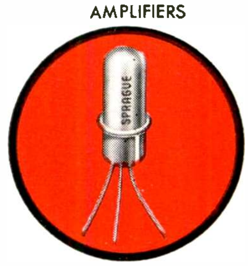

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By E. T. PFUND, Jr., W. F. CROFT, and BARD SUVERKROP

Extreme Environmental Testing Determined

Capabilities of Coaxial Cable

As a part of an Air Force sponsored world-wide survey of potentially high-temperature resistant 50 ohm coaxial cable, six different types have been tested. The extensive tests, which were conducted impartially, exceeded the manufacturers' specifications in an attempt to find rugged co-ax cable. Some of the findings are enlightening.

Part One of Two Parts

THE environmental demands on coaxial cables are becoming increasingly severe as the speed, acceleration, and operational altitude of manned and unmanned aircraft and guided missiles steadily increases. Problems such as temperature extremes and vibration place demands on dielectric and conducting materials not previously associated with electronic applications.

To determine which commercially available non-military approved coaxial cable designs might be capable of operation at elevated temperatures while exhibiting relatively low losses, a world-wide survey of potentially high temperature resistant 50 ohm coaxial cables was accomplished and six different solid-sheathed-outer-conductor designs were procured from domestic manufacturers.

The selection of cables for investigation in this program was determined by the materials employed and by the type of construction. In order to provide comparison measurements between aluminum-sheathed solid, semi-solid, and air-spaced coaxials, an aluminum jacketed Teflon version of RG-87A/U, O.D. of 0.325 in., an aluminum jacketed ceramic beaded type cable, O.D. of 0.375 in., and an aluminum jacketed threaded-core (Teflon) type cable, O.D. of 0.445 in., were selected for test. In addition, a copper sheathed ceramic beaded cable, was chosen in order to provide comparison measurements with its aluminum counterpart.

Finally, two experimental cables were procured. A special irradiated mixture of polyethylene and undisclosed additives, is employed as the dielectric in solid and foamed, 0.225 in. O.D., coaxial versions. (A Copperjak cable became available from Amphenol in the closing days of the test program. The same is true of a Teflon Spirafil cable now offered by Phelps Dodge. Consequently, it was not possible to include these cables in the test program.)

Thermal shock, high-altitude corona, cold bend, attenuation, vibration, capacitance, dielectric strength and heat exposure tests (for the most part in excess of the manufacturer's ratings) are now described.

(*Continued on the following page*)

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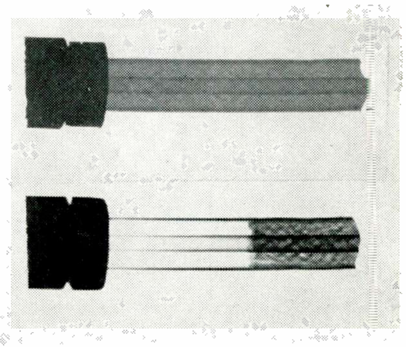

Fig. 1: X-rays of threaded core coaxial cable before and after thermal shock. Upper view shows cable ends before exposure to cycling. Lower picture clearly depicts contraction of threaded Teflon core from cable ends after 50 cycles of thermal shock.

Co-ax Capabilities *(Continued)*

Thermal Shock

Nominal 2 ft samples of the 2 beaded cables, and the 2 Teflon cables, were subjected to 50 cycles of thermal shock, each cycle consisting of two hours at +250° ±2°C and two hours at −65° ±2°C. VSWR measurements at 500 MC/s, x-rays, and physical measurements, were taken before and after test. The inner conductor of all cables maintained continuity throughout the test, and no detectable change in length was observed.

X-ray techniques showed no noticeable change in dimensional stability of the cables with the exception of the Teflon samples. The connector ends of the solid Teflon and threaded-core Teflon cables were dissected, and contraction of the cable cores was observed as shown in Figs. 1 and 2. This contraction is apparently due to stress relief. In the threaded core cable, it was serious enough to materially contribute to the change in VSWR encountered (1.15:1 to 1.38:1 since the contraction was in the order of inches at each end. The solid cable core contraction was limited to a small portion of the connector volume as shown, resulting in very little increase in the measured standing-wave ratio.

The connector did not loosen on the solid core coax, while the connector employed on the threaded core samples, as well as the UG-1149/U and UG-1150/U types employed on the beaded cables, did become loose after thermal shocking contributing to the increased VSWR's noted. In addition, male connector UG-1150/U in all cases had a burned and charred gasket (Fig. 3).

The connector used with the threaded core cable employs a self-threading pin which threads into the

Fig. 2: Core contraction after a thermal shock test.

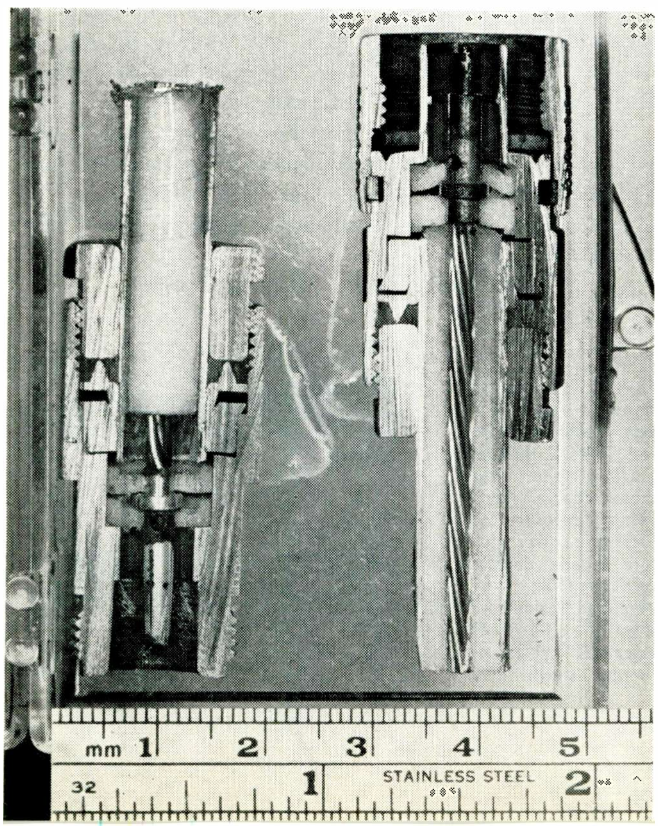

Table 1

60 CYCLE CORONA AT ROOM ENVIRONMENT

Cable	Initiation	Extinction
Beaded Aluminum	2035V	1768V
Beaded Copper	2125V	1816V
Solid Teflon	3790V	2902V
Threaded Core	5228V	3393V
Solid Irradiated	2681V	2035V
Foamed Irradiated	1700V	1500V

60 CYCLE CORONA AT 80,000 FT. (SIMULATED)

Cable	Initiation	Extinction
Beaded Aluminum	480V	449V
Beaded Copper	447V	424V
Solid Teflon	990V	864V
Threaded Core	536V	511V
Solid Irradiated	650V	574V

hollow inner conductor of the cable. This eliminates the requirement of utilizing soft solders to join Teflon-insulated cables and connectors. The solid Teflon core was movable in the perpendicular plane to the cable, within its aluminum jacket. (The overall diameter of the jacket apparently increased some 10 mils during thermal cycling.) The increased outer diameter was probably due to the expansion and contraction of the solid Teflon core at the temperatures encountered. As a result, the core returned to its original O. D. of 0.280 in. while the O. D. of the aluminum sheath was stretched some 10 mils. The core was then easily removable from the jacket due to the play provided by thermal cycling. Such a loose jacket could be a source of noise,[3] especially in a vibration environment. Similarly, the possibility of corona is increased with loose jacketing.

Corona

A 60 cycle RMS voltage was applied to one foot samples of each cable and increased gradually until the initiation of corona. The voltage was then continuously reduced to the corona extinction point as indicated on an oscilloscope. The ends of the outer sheath of the samples were flared away from the center conductor to increase the air gap and so limit corona to the interior of the specimen.

Table 1 shows the results obtained at room environment and simulated 80,000 feet.

In a coaxial transmission line, the maximum voltage gradient occurs at the surface of the inner conductor. Bead insulators can cause higher gradients in their vicinity resulting in premature voltage breakdown[4] in the form of either corona or arcover, particularly when they fit loosely on the inner conductor (as was the case here).

Minute cavities, in the form of either discrete bubbles or films in the neighborhood of the conductor, are often present in solid dielectric cables.[5] These cavities are the seat of electrical discharges when a certain critical voltage swing is exceeded.

In a theoretically perfect air-dielectric coaxial structure, breakdown or arcover will occur without corona if the characteristic impedance of the line is less than some 60 ohms.[4] However, practically manufactured coaxials seldom present perfectly smooth surfaces without points[6] so that corona will, in fact, occur as measured.

Cold Bend

Three specimens of each cable were cut to a length somewhat exceeding 150 times the diameter of the cable concerned. One end of the test specimen was clamped circumferentially at two points, approximately 45° apart, to a mandrel having a diameter 10 times that of the test specimen. The specimen was then wrapped around the mandrel for one full turn. The mounted specimen was then conditioned for 20 hours at —65° ±2° C. During this conditioning period, the specimens were each kept reasonably straight. After this conditioning, but while the specimens were still in the cold chamber at the conditioning temperature, the specimens were wrapped for three close turns around the mandrel at a uniform rate of 15 ±3 RPM, by an electrically driven motor. The cable was guided in each case by a free moving sheave or transversing device, in intimate contact with the cable at the initial point of bend.

Each cable, in turn, was subjected to the above test and then removed from the cold chamber and x-rayed for evidence of cracks or fractures in the dielectric or jacket (except at clamping points).

The ductility of the cable materials remained sufficient to prevent damage to the cables during cold bend, with the exception of the threaded-core samples (Fig. 4). The outer conductor of the latter cable wrinkled irregularly on the inner bending radius as shown. In addition, both Teflon cable cores contracted some 1/16 in. from each end.

Contraction of the irradiated polyethylene solid core occurred at room temperature whenever the core was cut through and was not related to cold bend but to stress relief.

Attenuation

The attenuation of coaxial cables is temperature dependent and related to conductor losses and dielectric losses. The latter are directly proportional to frequency, loss tangent and square root of the dielectric constant. Conductor losses are directly proportional to the square root of frequency and dielectric constant but inversely proportional to the square root of the conductivity. Table 2 depicts the measured attenuation, at specific frequencies, of the Teflon and beaded cables from 10 MC/S to 10,000 MC/S. The VSWR of these beaded coaxials increases above 1,000 MC/S due to reflections caused by the beads. Both beaded cables are described in Fig. 5 for operation above 6.5k MC. Various patterns of bead spacing[7] can provide low losses over selected bands of frequencies, however, by shifting the existing resonance conditions.

Cox[8] points out that although concave beads increase the flashover ratings of beaded coaxials, such a bead design is just the opposite of what is needed for low-loss constant impedance operation at UHF.

(To be continued next month)

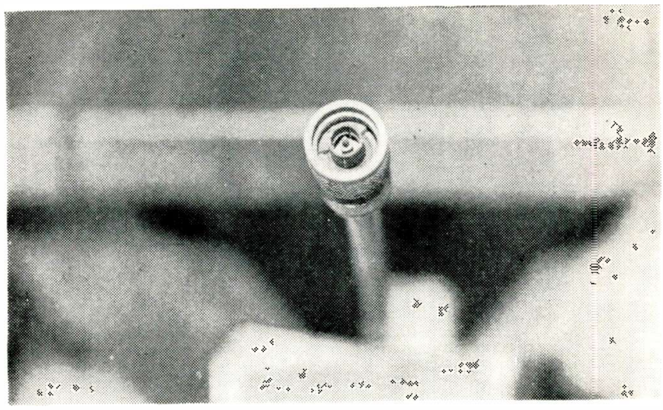

Fig. 3: Connector after test showing charred washer insert.

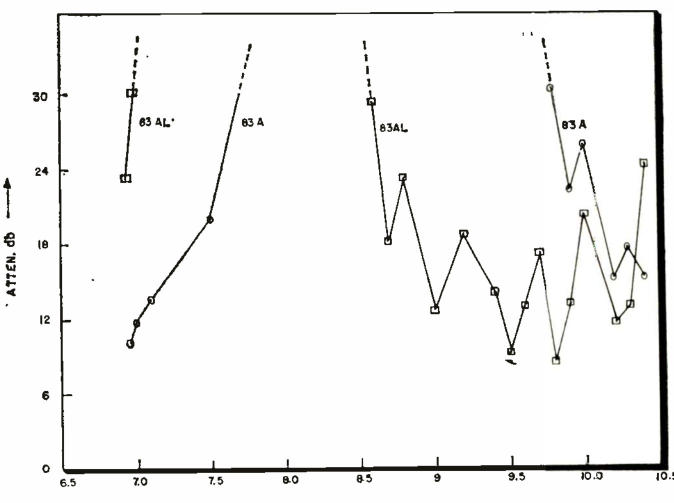

Fig. 5: Typical operation of beaded coaxial cables at discrete frequencies above 6,500 MC/S showing resonance effects.

Fig. 4: Section of coax after cold bending at —65°C shows wrinkling of outer conductor on inner radius.

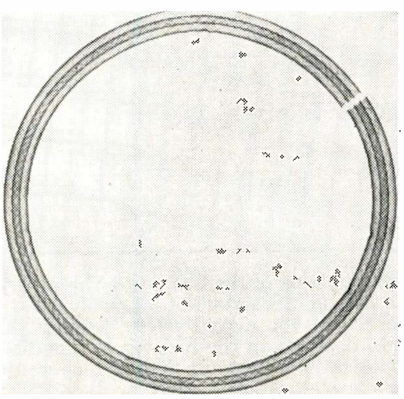

Table 2

COAXIAL CABLE ATTENUATION vs. FREQUENCY

Freq. Mc/s	10	100	300	400	1000	3000	6000	10,000
Aluminum Beaded	0.35	1.12	2.19	2.63	4.46	13.45	22.75	19.1*△
Copper Beaded	0.36	1.11	2.08	2.285	3.61	11.62	16.10	25.7*△
Solid Core	0.55	1.75	3.07	3.285	5.48	10.95	17.25	23.25
Threaded Core	0.45	1.28	2.45	2.92	4.38	8.44	12.5	20.65

* See Figure 5.

△ Approximately one quarter wavelength at 10k Mc was cut off sample and no appreciable change in attenuation was observed.

Predicting

The range performance of a new radar can be predicted from the measured performance of another radar, preferably one operating at the same frequency. But unless all the parameters are known, this comparison can be misleading. The range can be accurately and quickly calculated from a chart based on known equipment parameters.

THE maximum range R obtainable with a pulse radar equipment scanning in azimuth is determined by the following parameters:

P_t = Transmitter pulse peak power.

G = Antenna power gain in beam maximum, assumed to be the same on transmit as on receive. If separate antennas are used to transmit and to receive, G is the geometric mean of their respective gains.

λ = Radar wavelength.

N = Receiver noise figure.

k = Boltzmann's Constant, = 1.37×10^{-23} watt-seconds per degree Kelvin per cycle.

T = Equivalent noise temperature seen by receiver input terminals, usually assumed[a] to be 290 °K.

kT = 4×10^{-21} watt-seconds per cycle, if T = 290 °K.

τ = Pulse length.

B = Receiver pre-detection bandwidth. (The video bandwidth is assumed adequate to pass the echo pulse without distortion.)

L = Loss factor taken as a power ratio and greater than unity.

L = $L_t\ L_r\ L_p\ L_a\ L_o$

where

L_t = Transmission line and duplexer loss during transmission.[b]

L_r = Transmission line and duplexer loss during reception.[b]

L_p = Antenna pattern loss, taken as 1.45 (1.6 db). See Reference 2.

L_a = Atmosphere attenuation factor = $10^{(0.2\ \alpha\ R)}$, α being the atmospheric attenuation in db per unit length. This is normally negligible.

L_o = Observer loss. Flight test data indicates that L_o lies between 1 and 1.7 (0 to 2 db). This probably represents conditions of maximum observer efficiency.

H = A factor giving the effect on range of specifying various probabilities of detection, with either non-fluctuating or fluctuating targets.

F = Pattern propagation factor, taken greater than unity. F = 1 for free space propagation. F is increased due to reflections from the ground or sea, but is always less than 2.

σ = Mean radar cross section of equivalent isotropically re-radiating target. A typical value for a small jet plane at microwave frequencies is 1 square meter.

V = Visibility factor, taken greater than unity. It is the product of two factors, V_1 and V_2 which are obtained from Fig. 1.

V_1 is a function of n and C_1, where

n = Number of pulses per beamwidth[c], taken between the 3 db points of the one-way pattern,

$$C_1 = \frac{m}{2\ \tau_{\mu\ sec}} + 1, \text{ with}$$

$\tau_{\mu\ sec}$ being the pulse length in microseconds, and

m = Number of nautical miles per inch of display tube.

V_2 is a function of n and C_2, where

$$C_2 = \frac{B\ \tau}{1.2}.$$

$$(4\ \pi)^3 = 1984$$

Radar Range

Define the "base range" R_o by

$$R_o^4 = \frac{P_t\ G^2\ \lambda^2\ \sigma}{(4\ \pi)^3\ (kTN)\ (1.2/\tau)} \qquad (2)$$

Then the radar range is given by

$$R^4 = \frac{R_o^4\ F^4}{LHV} \qquad (3)$$

---

[a] More accurately, if the antenna noise temperature is T_a and the transmission line is matched and at a temperature T_b, then[1] replace kTN in equation (2) by

$$k \left\{ \frac{T_a + (L_r - 1)\ T_b}{L} + (N - 1)\ 290\ ^\circ\text{Kelvin} \right\}$$

[b] L_t is strictly speaking a function of the transmitter also when the line and antenna are not reflectionless. L_t may be defined as the ratio of P_t to the actual power leaving the antenna. Similarly, L_r depends on the receiver in this case. L_r may be defined as the ratio of the noise figure which would be seen at the antenna space terminals, to N.

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Accurate Radar Ranges

The radar range R as given by equation (3) is such that when H is set equal to unity, the probability of detection ("Blip-scan ratio") is 50%, and the probability of false alarm is 1 in 10^{10}, with a non-fluctuating target. Both probability of detection and probability of false alarm are defined in terms of a threshold amplitude which, if exceeded, is construed by the observer as a signal. For other cases, see Table 1.

The visibility factor V is given by

$$V = V_1 (n, C_1)\ V_2 (n, C_2) \qquad (4)$$

defined above and obtained from Fig. 1, which was computed from the several curves given in Reference 3. These are based on certain premises, expressed as an "integration loss" for a large number of pulses (n) per beamwidth, a sampling loss of too large an i-f bandwidth B, and a "collapsing ratio" due to a minimum resolvable spot size on the display tube (assumed to be 1 mm[d]) ; a square law detector is also assumed.

Example

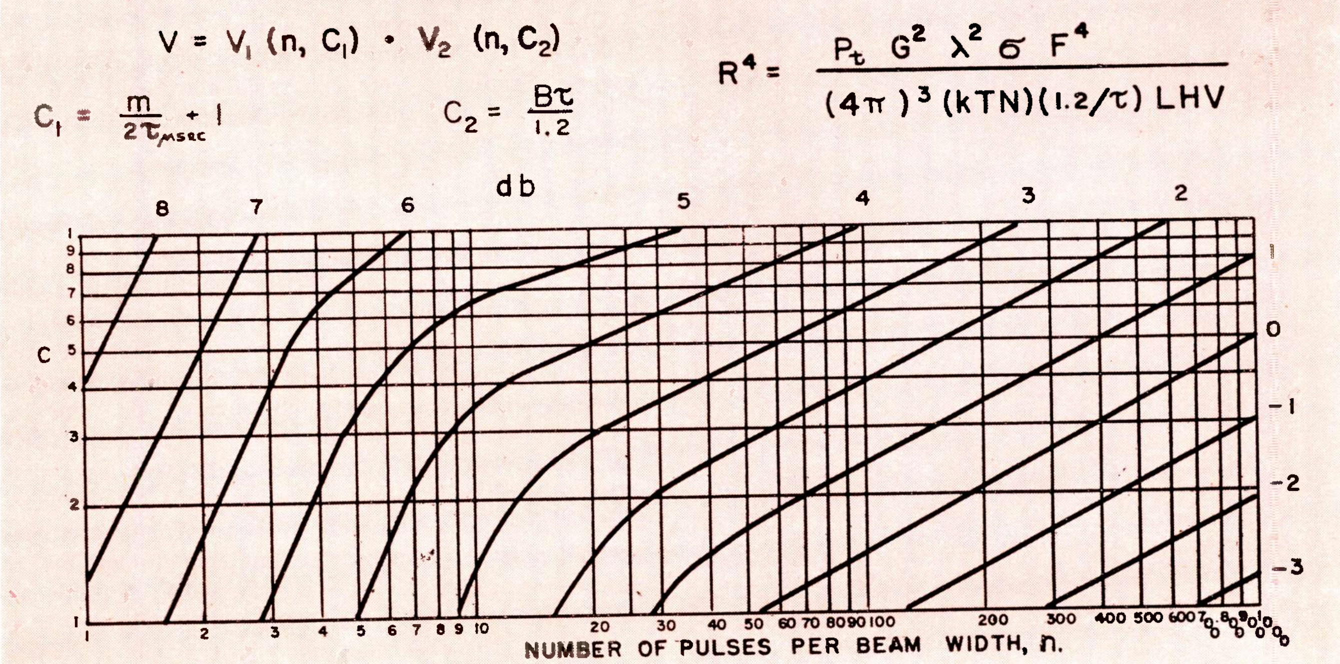
Calculate the free space range of a radar having the following parameters (assume a non-fluctuating target to begin with).

P_t = 1 megawatt.
G = 562 (27.5 db).
λ = 0.23 meters.
L_t = 1.4 (1.5 db).
L_r = 1.8 (2.5 db).
L_p = 1.45 (1.6 db).

[c] $n = \dfrac{\text{(Beam width in degrees)} \times \text{(Radar pulses per second)}}{6 \times \text{(Antenna revolutions per minute)}}$

[d] If the spot diameter is greater than 1 mm and equal to d mm, then replace m in the expression for C_1 by the product md.

Fig. 1: Chart is used to determine the visibility factor, V.



Radar Range *(Continued)*

$L_a = 1$ (0 db).
$L_o = 1$ (0 db).
$H = 1$ (0 db).
$F = 1$ for free space range.
$\sigma = 1.6$ square meters.
$N = 6.3$ (8 db).
$kT = 4 \times 10^{-21}$ watt-seconds per cycle.
$\tau = 4.2$ microseconds.
$B = 475$ kilocycles per second.
$m = 30$ nautical miles per inch.
Horizontal beamwidth $= 1.4°$.
Pulse repetition rate $= 360$ pulses per second.
Scan rate $= 6$ RPM.

$$\text{Hence } n = \frac{1.4 \times 360}{6 \times 6} = 14 \text{ pulses per beamwidth.}$$

Therefore,

$$R_o^4 = \frac{(10^6)\,(562)^2\,(0.23)^2\,(1.6)}{(1984)\,(4 \times 10^{-21} \times 6.3)\,(1.2 \times 10^6/4.2)} = \text{meter}^4$$

$$= 1.89 \times 10^{21} \text{ meter}^4$$

Now, $L = L_t\, L_r\, L_p\, L_a\, L_o$

$L\text{ (db)} = (1.5 + 2.5 + 1.6)\text{ db} = 5.6\text{ db}$

Hence $L = 3.63$

To obtain $V = V_1 V_2$,

$$C_1 = \frac{m}{2\,\tau_{\mu sec}} + 1 = \frac{30}{2 \times 4.2} + 1 = 4.57$$

From Fig. 1, for $n = 14$ and $C = 4.57$,
$V_1\text{ (db)} = 4.1$ db

Also, $C_2 = \frac{B\,\tau}{1.2} = 1.67$

From Fig. 1, for $n = 14$ and $C = 1.67$,
$V_2\text{ (db)} = 2.6$ db

Hence $V\text{ (db)} = 6.7$ db
or $V = 4.68$

$$\text{Therefore } R^4 = \frac{(1.89 \times 10^{21}) \times (1)}{(3.63) \times (4.68)} \text{ meter}^4$$

$$= 1.11 \times 10^{20} \text{ meter}^4$$

$$R = 1.03 \times 10^5 \text{ meters}$$

$= 55.6$ nautical miles,

since 1 nautical mile $= 6076.10333 \cdots$ feet[4]
$= 1852$ meters

Radar systems must perform under all kinds of conditions. This surface-search radar antenna is mounted on a ship mast.

Probability of Detection

The range of 55.6 nautical miles computed in the above example applies to a 50% probability of detection, with a false alarm rate of 10^{-10}, under ideal conditions for a non-fluctuating target in the absence of ground or sea reflections. Still assuming an observer at his best, free space conditions, and the same false alarm rate, the effect on range of various probabilities of detection for both non-fluctuating and fluctuating targets (the latter applying to targets large in terms of a wavelength) is given in Table 1, where[3]

H_n = Factor to be used in equation (3) for a non-fluctuating target.

H_f = Factor to be used in equation (3) for a fluctuating target.

Thus in the example, if target fluctuations are taken into account, H_f (db) = 1.3 db, and the range is reduced to 51.6 nautical miles, which is yet for a 50% probability of detection.

One may more explicitly write:

$R_{50\text{ pct}}$ = 51.6 nautical miles for a fluctuating target. Similarly from the table one could find:

$R_{70\text{ pct}}$ = 43.1 nautical miles for a fluctuating target.

Experimental Results

One of the first difficulties encountered when testing the theory in a practical situation is that usually the decision whether or not a target has appeared on the display is made by a man, not a machine, and that as a result the concept of threshold detection becomes difficult to apply rigorously. The "probability of detection" can reasonably be identified with "blip-scan" ratio, but the probability of false alarm, especially when it is set as low as 10^{-10} (corresponding to one false alarm in 3 hours for one microsecond pulses), becomes a condition impossible to enforce in practice. One is, therefore, frankly reduced to forego this refinement of the theory. It is hoped that the observers quoted here and elsewhere are all equally alert.

In an extensive and carefully conducted series of flight tests of a Westinghouse radar, coverage diagrams were constructed for various constant blip-scan ratios. Ground reflection was small in this case and could easily be eliminated as a factor by averaging through the regular peaks and troughs in the antenna elevation pattern. Using the best available information on target area, and allowing L_0 to absorb any differences between "theoretical" and observed maximum range, L_0 turned out to be 0 db. Less extensive tests on another Westinghouse radar, with flights over a smooth sea, indicated $L_0 = 1$ db. In this case, the vertical free space radiation pattern was known from scale model measurements, and 100% reflection from the sea was assumed for the horizontally polarized radar in calculating the propagation factor F.

Hall[3] suggests a figure of $L_0 = 2$ db. In both the tests referred to, the general location of the target plane was known to the observer before he could see it. A considerable degradation in performance must be expected, when neither the place nor time of appearance of the target is known in advance, so long as a human operator is the last stage in the detecting process.

Often, the range performance of a new radar is predicted from the measured performance of another radar, preferably operating at the same frequency, Unless all the parameters are known, this comparison can be misleading. Generally, the one parameter at once most difficult to measure and yet having a very great effect on range is the pattern propagation factor F, which can double the free space maximum range. This corresponds to 12 db improvement in maximum range performance (at the expense of "holes" in the radar coverage). For the effect of ground and sea reflections, see Reference 5. Two radars having the same free space maximum range may behave very differently over a reflecting surface, if one has a round-nosed beam spilling power into the ground, and the other has a blunt beam with a sharp cut-off above the ground.

Appendix

Minimum Detectable Signal: A comparison of the radar range equation (3) with the maximum range expressed in terms of the "minimum detectable signally" S_{min} shows that

$$S_{min} = kTN\left(\frac{1.2}{\tau}\right) HV. \quad (5)$$

kTN and τ are well defined quantitied for the radar; H equals unity for a 50% Blip-Scan ratio, or else is given by Table 1; and V is again obtained from Fig. 1.

Recommendation: Radar maximum range is not uniformly expressed in terms of any particular probability of detection (or blip-scan ratio). Fifty per cent, 70%, 75%, 90% and probably other percentages have been used. Nor is it sometimes clear whether a fluctuating or non-fluctuating target should be used to find the H-factor. This depends on the target shape, the direction of polarization in the case of long thin targets, and the magnitude of the appropriate target length to wavelength ratio. Many of these uncertainties can be removed or minimized by specifying a 30% probability of detection, as can be seen from Table 1, since then H_n and H_f very nearly coincide. In view of the experimentally unconfirmed nature of the ratios in Table 1, and the relatively low value of a 30% probability of detection, it is recommended that all radar ranges be expressed in terms of a 50% probability of detection.

Decibels Into Range Ratio: Table 2 converts between db and range ratio. This conversion can be applied directly to any of the parameters P_t, N, L, H, V, in equations (2) and (3). Since G enters both on transmit and receive, and, therefore, appears squared in equation (2), a change in db of antenna gain must first be doubled before referring to Table 2.

Table 1

Probability of Detection	H_n (db)	H_f (db)
5%	−2.6 db	−4.9 db
10%	−1.8 db	−3.7 db
30%	−0.8 db	−0.9 db
50%	0	1.3 db
70%	0.8 db	4.4 db
90%	1.6 db	9.8 db
99%	2.6 db	20.0 db

Table 2

db	Range Ratio	Voltage Ratio	Power Ratio	db	Range Ratio
0	1.00	1.00	1.00		
1	1.06	1.12	1.26	21	3.35
2	1.12	1.26	1.59	22	3.55
3	1.19	1.41	2.00	23	3.76
4	1.26	1.59	2.51	24	3.98
5	1.33	1.78	3.16	25	4.22
6	1.41	2.00	3.98	26	4.47
7	1.50	2.24	5.01	27	4.73
8	1.59	2.51	6.31	28	5.01
9	1.68	2.82	7.94	29	5.31
10	1.78	3.16	10.00	30	5.62
11	1.88	3.55		31	5.96
12	2.00	3.98		32	6.31
13	2.11	4.47		33	6.68
14	2.24	5.01		34	7.08
15	2.37	5.62		35	7.50
16	2.51	6.31		36	7.94
17	2.66	7.08		37	8.41
18	2.82	7.94		38	8.91
19	2.99	8.91		39	9.44
20	3.16	10.00		40	10.00

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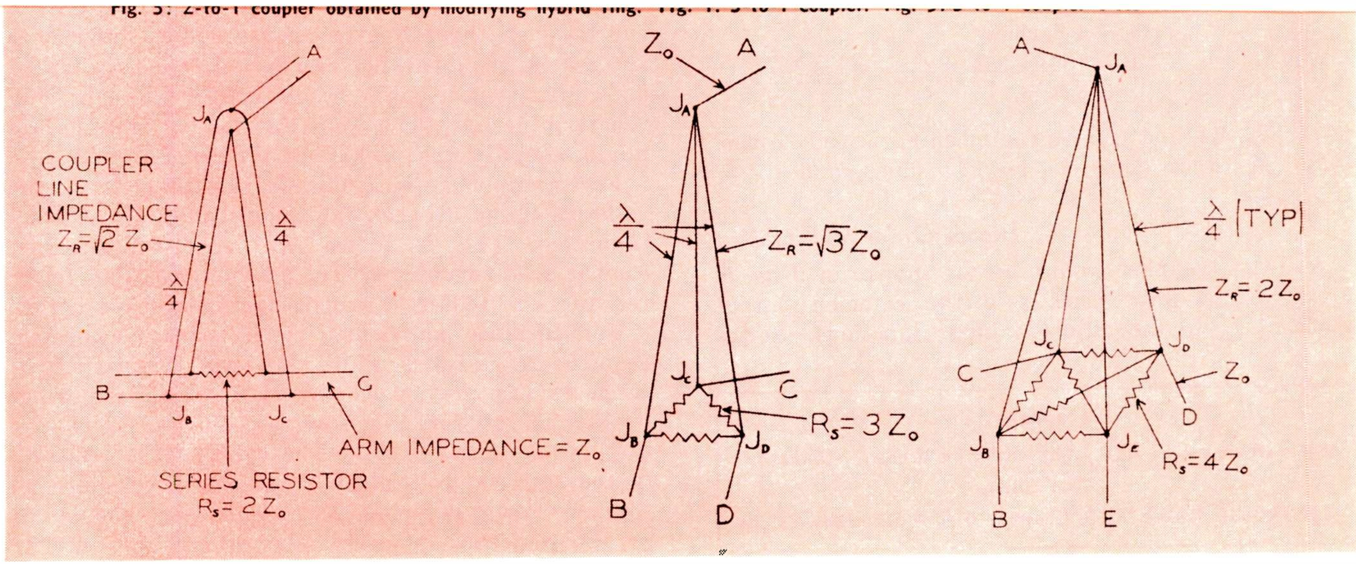
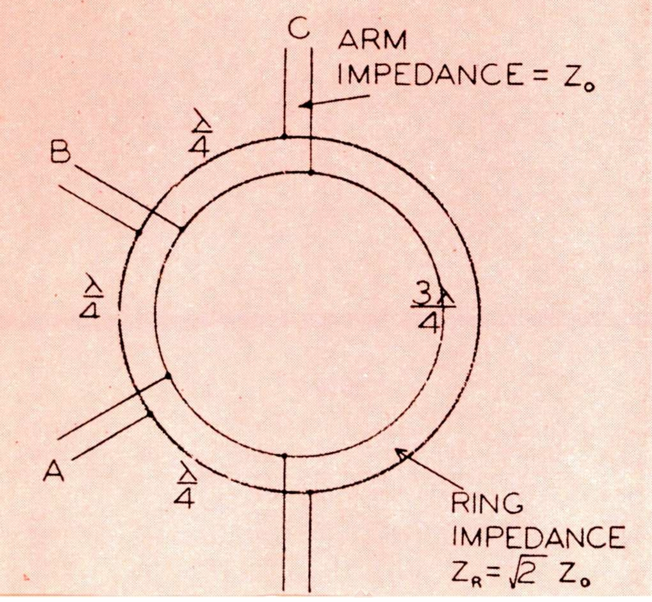
Fig. 5: 2-to-1 coupler obtained by modifying hybrid ring.





Microwave Multiplexing

Multiplexing Circuits
(Continued)

case the return conductor is assumed to be present although not shown.

As a matter of fact such a 3-to-1 coupler or triplexer will work successfully. Power entering at one of the input terminals, say J_B, splits evenly three ways. One-third proceeds to J_A, and the remainder divides evenly into the resistance paths to J_C and J_D. In a manner similar to that described for the duplexer or 2-to-1 coupler, voltage zeros are created at J_D and J_C, effectively isolating arms C and D from arm B. These shorts are transformed to very high impedances across the line at J_A. The result is that all the power leaving J_B for J_A proceeds out the matched arm A while practically none is dissipated in the very high impedances at J_A offered by the lines to J_D and J_C. In a similar manner power entering the triplexer from any input arm B, C, or D, is effectively isolated from the other input arms while losing two-thirds of its initial value in passing to the ouput arm A.

This behavior as described occurs only when the correct value of resistors are used and the quarter wave lines are of the correct characteristic impedance. If the input and output terminals of the coupler are all to be matched to a real impedance of Z_o ohms, then the unknown parameters can be determined as follows. The impedance looking into the coupler at J_B must be Z_o ohms. As there is an even three-way power split at this point, each of the three paths must have an input impedance at J_B of 3 Z_o ohms. Since there are apparent shorts across the line at J_D and J_C to power entering at J_B, the two resistive paths to these points will have an input impedance of 3 Z_o each when the resistors each have a value of 3 Z_o. The quarterwave line connecting J_B to J_A is terminated at the latter point by Z_o, yet must have an input impedance of 3 Z_o at J_B. The characteristic impedance of the line then will be given by the square root of the input and terminating impedances.

To summarize: for a 3-to-1 coupler,

$$Z_R = \sqrt{3}\ Z_o \text{ ohms}$$
$$R_S = 3\ Z_o \text{ ohms}$$

While $$L = 10 \log_{10} 3 \text{ decibels} = 4.78 \text{ db}$$

where Z_R, R_S, and L have the meaning already given. For a Z_o of 50 ohms, Z_R = 86.5 ohms, and R_S = 150 ohms.

Higher Order Multiplexing

A 4-to-1 coupler would be as shown in Fig. 5. Four quarter-wave lines join the common output junction J_A to the different input junctions. Series resistors connect all input junctions. The parameter values for optimum performance are as follows:

$$Z_R = 2\ Z_o$$
$$R_S = 4\ Z_o$$

Where Z_o is 50 ohms, the quadruplexer line impedance is 100 ohms, and the series resistances are 200 ohms each. The minimum theoretical loss from any input junction to the output is given by

$$L = 10 \log_{10} 4 = 6.02 \text{ decibels.}$$

The isolation between inputs should be over 30 decibels.

An N-to-1 coupler could be constructed along similar lines to connect N inputs to a single output. The isolation between inputs should remain above 30 decibels, while the insertion loss from any input to the output would be given by

$$L = 10 \log_{10} N \text{ decibels.}$$

The coupler line impedance would be given by

$$Z_o \sqrt{N},$$

while the series resistors would be equal to Z_o N.

Any of the series resistors can be replaced by a full wavelength of line of characteristics impedance $Z_o \sqrt{N}$, with a parallel resistor of value Z_o placed one-quarter wavelength from either end. In any practical design some substitutions of this nature might simplify the packaging problem.

For multiplexers of a higher order than 2-to-1, the resistive paths between input junctions can be star-connected. This is shown in Fig. 6 for a 4-to-1 coupler or quadruplexer. The advantage is that fewer resistors are required, and packaging is made easier.

For instance an N-to-1 coupler, star connected, requires N resistors while the same coupler cross-connected as previously described would require a number of resistors given by the sum 1 + 2 + 3 + 4 + — — — — + N-1. The value of the resistors in the star connection can be quickly determined as follows. Power entering the coupler at J_B should see an apparent short at every other input junction. For

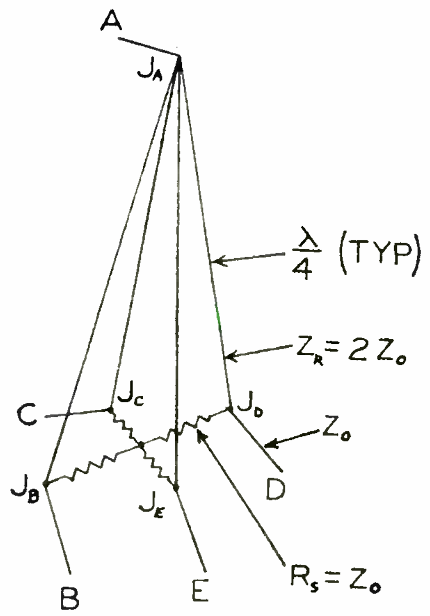


Fig. 6: Four-to-one coupler star connected

this to be the case N-1/N of the input power at J_B must go into the resistive network, while 1/N of the power proceeds to J_A. This will take place and the impedance at J_B will match Z_o, if the impedance at J_B of the line to J_A is N Z_o, if the impedance at the resistive network is $\frac{N Z_o}{N-1}$. Then if the resistors each have a value given by R_S, the

$$\frac{N Z_o}{N-1} = R_s + \frac{R_s}{N-1}$$

Solving for R_S we get

$$R_s = Z_o.$$

So for the 4-to-1 coupler illustrated in Fig. 6 the resistors would have a value of 50 ohms each, in the case where the arm impedances were also 50 ohms.

A Practical Application

A three to one coupler like the one shown in Fig. 4 was constructed for the purpose of connecting three telemetering transmitters to a common antenna. The three transmitters operated at fixed frequencies in the neighborhood of 220 MC with frequency spacing between adjacent channels of 4 MC, and 2 MC. It was desired to have a minimum of 20 db of isolation between transmitters, with the loss from any transmitter to the antenna kept as small as possible. The design was intended for a missile application and had to perform satisfactorily over a typical range of missile component environmental temperatures. It can be readily imagined that constructing such a coupler by using frequency sensitive elements, or filters, could lead to a bulky, expensive item, requiring close machining tolerances and temperature compensation.

Since the system in this case could tolerate the 4.8 db loss inherent in the 3-to-1 coupler of Fig. 4, this type of design was decided upon. The close frequency proximity of adjacent channels was no longer a problem with this circuit. The wide bandwith of the coupler made it relatively insensitive to temperature variations.

Since the coupler was to connect 50 ohm transmitters to a 50 ohm antenna, 150 ohm resistors and 86.5 ohm quarter wave lines should be used. The transmission line actually used was a 90 ohm teflon dielectric miniature coaxial cable. This was found to perform quite satisfactorily. Fig. 7 shows insertion loss and isolation obtained on this coupler as a function of frequency. Fig. 8 shows the VSWR of both an input arm and the output or antenna arm, again as a function of frequency.

Impedance Transforming Capabilities

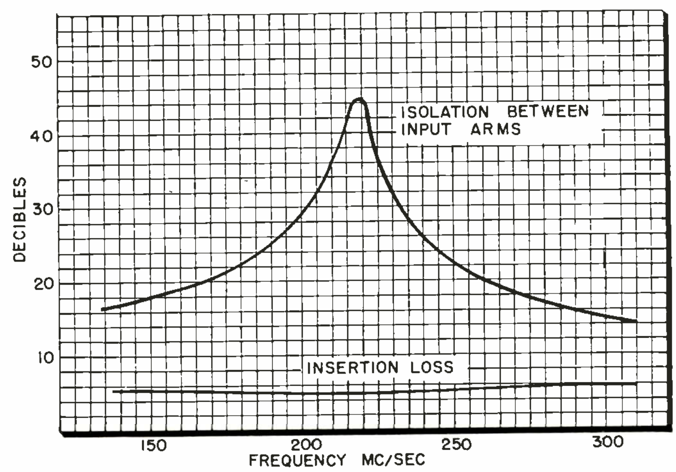
The multiplexers so far described need not be limited to devices connecting N inputs of Z_o ohms impedance to an output of the same impedance. The multiplexer can also serve as an impedance transformer without changing its isolation and insertion loss characteristics. For instance, assume it is desired to connect N inputs of Z_o ohms (real) to a common output of Z_T ohms, also real. Power entering the multiplexer and arriving at an input junction must split as previously described for the star connected coupler. For this to be the case, the resistors must have the value previously determined, that is, $R_S = Z_o$.

The matching to Z_T is accomplished in the quarter wave lines joining each input junction to the output junction. These now have the job of transforming Z_T to N_{Zo}, the required input impedance of the quarter wave lines at the input junctions. Thus the lines will all have a characteristic impedance, Z_R, given by

$$Z_R = \sqrt{N Z_o Z_T}.$$

It is conceivable that multiplexer designs can often result in an impedance for the quarter wave lines not commonly available in coaxial cable. At some frequencies, and for some applications, these quarter wave lines can be made of stripline. Control over the strip width and ground plane spacing gives one the ability to fabricate lines of any characteristic impedance, within reasonable limits. Graphs relating stripline impedance to line cross-sectional dimensions are given in the literature.[3].

Fig. 7: Insertion loss and isolation as function of frequency



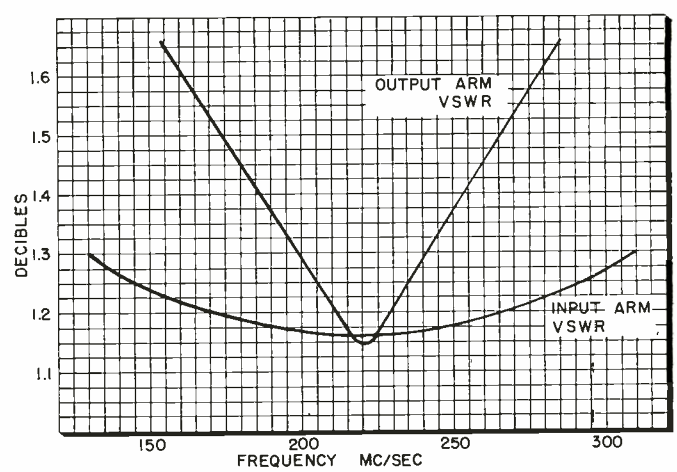


Fig. 8: VSWR of an input arm and the output of antenna arm

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Thermistors for Linear Temperature Readings

A thermistor may be used with a thermostat consisting of a linearly calibrated potentiometer or a linearly calibrated non-linear rheostat to obtain a voltage signal which varies linearly with the difference between actual and desired temperatures.

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IN an earlier paper[2] we showed how thermistors (ceramics whose electrical resistance decreases exponentially with increasing temperature), may be compensated so as to obtain a signal which varies linearly with temperature.

Here we shall show how thermistors may be used to obtain a signal which varies linearly with the difference between actual and desired temperature, when the desired temperature is indicated by a manually preset thermostat consisting of a linearly calibrated potentiometer or a linearly calibrated non-linear rheostat. The error signal may be fed to a system for control of temperature.

Potentiometer Circuit

Consider the temperature differential circuit of Fig. 1. The output voltage V_o is

$$V\left[\frac{R_w}{R_{TC} + R_w} - \frac{R_c}{R_{c\ max}}\right],$$

where $R_{TC} = R_P(R_S+R_T)/(R_P+R_S+R_T)$ is the resistance of the thermistor compensated by constant resistances R_P and R_S so as to approximate[1, 2] linear decrease of R_{TC} with increasing temperature.

Let R_w be the resistance of a coil of resistance wire, increasing linearly with increasing temperature according to the formula

$$R_w = m\,T + K,$$

where m is a positive slope, K a constant resistance, and T actual Kelvin temperature (centigrade + 273°).

Let R_c be the tapped resistance of a manually preset potentiometer whose maximum resistance is $R_{c\ max}$.

Let $T_{min} \leq T \leq T_{max}$ and $t_{min} \leq t \leq t_{max}$ define the ranges of actual and desired temperature, respectively.

For linear calibration of the potentiometer we have

$$R_c = \frac{R_{c\ max}(t - t_{min})}{t_{max} - t_{min}}.$$

Define $$M = \frac{R_{c\ max}}{t_{max} - t_{min}},\quad \delta = M\,t_{min}.$$

Then $$R_c = M\,t - \delta.$$

By proper choice of the constant resistors R_S and R_P (either removed from the varying temperature area, or else, like the Weston vamistor, having zero temperature coefficient in the range T_{min}, T_{max}); the resistance R_{TC} of the compensated thermistor may be made to approximate $-m\,T + K_o$, (T_{min}, T_{max}), where K_o is a constant resistance.

Then the output voltage is approximately

$$V_o \approx V\left[\frac{mT + K}{K_o + K} - \frac{Mt - \delta}{R_{c\ max}}\right].$$

Take $$\frac{m}{K_o + K} = \frac{1}{t_{max} - t_{min}}.$$

Consequantly
$$V_o \approx \frac{V}{t_{max} - t_{min}}\left[(T - t) + \left(\frac{K}{m} + t_{min}\right)\right].$$

which is linear in the temperature differential (T-t), as desired.

To prevent self-heating of the thermistor, the current through it must not exceed the manufacturer's rating i_r. (Caution: Self-heating, not destruction.)

Thus we require that

$$R_P\,V\,/\,[\,(K + K_o)\,(R_P + R_S + R_T)\,] < i_r$$

for all T in the range (T_{min}, T_{max}).

Since R_T decreases with increasing temperature, it is sufficient to satisfy this inequality at T-T_{max}.

Potentiometer Application

The slope m and constant resistance K are given by the coil of resistance wire.

The key Kelvin temperatures T_{min}, T_{max}, (actual), and t_{min}, t_{max} (desired), are given by the operating conditions.

Take $R_{c\,max}$, the maximum resistance of the control potentiometer, arbitrary.

The self-heating rating i_r is given by the thermistor manufacturer.

The thermistor resistance R_T is given by the thermistor (catalog graph, table, or formula).

The constant resistances R_P, R_S, K_o are chosen by[1, 2].

Take $t_{max} - t_{min} = (K_o + K)/m$.

The applied constant dc voltage V is chosen so that

$$V < (K + K_o)(R_P + R_S + R_T)\, i_r / R_P \text{ at } T = T_{max}.$$

Rheostat Circuit

Consider the rheostat circuit of Fig. 2, with output voltage signal V_o.

The current i through the constant resistance R_L is.

$$V \Big/ \left[R_L + 1 \Big/ \left(\frac{1}{R_c} + \frac{1}{R_{TC}}\right)\right],$$

where

$$R_{TC} = [\,(AB + AC + BC) + (B + C)R_T] \,/\, [\,(A + B) + R_T]$$

is the resistance of the thermistor compensated by constant resistances A,B,C so as to approximate[2] linear increase of the conductance $1/R_{TC}$ with increasing temperature.

Let $T_{min} \leq T \leq T_{max}$ and $t_{min} \leq t \leq t_{max}$ define the ranges of actual and desired temperature, respectively.

Let R_c be the resistance of a manually preset non-linear rheostat, such as a Vari-Ohm, calibrated linearly.

Let the non-linear construction of the rheostat be expressed by

$$R_c = \frac{1}{m\,(k_o - t)},$$

where k_o and m are positive constants.

By proper choice[2] of the constant resistors A,B,C (either removed from the varying temperature area, or else, like the Weston vamistor, having zero temperature coefficient in the range T_{min}, T_{max}); the conductance $1/R_{TC}$ of the compensated thermistor may be made to approximate

$$\frac{T}{K^2} + \frac{k}{K^2},$$

throughout the range (T_{min}, T_{max}), where k and K^2 are constants.

Take $m = 1/K^2$.

Then $i \approx V \Big/ \left(R_L + 1 / [m\,(k_o - t + T + k)\,]\right)$.

When $R_L\, m\,[\,(k + k_o) + (T - t)\,]$ is small compared to unity,

$$i \approx V\, m\,[\,(k + k_o) + (T - t)\,],$$

which is linear in the temperature difference $(T - t)$.

Hence the output voltage signal $V_o = R_L\, i$ varies linearly with $(T - t)$, as desired.

To prevent self-heating of the thermistor, the current through it must not exceed the manufacturer's rating i_r. (Caution: Self-heating, not destruction.)

Let R_L be small compared to R_c.

Thus we require that

$$BV \,/\, [BC + (A + R_T)(B + C) + R_L\,(A + B + R_T)\,] < i_r$$

for all T in the range (T_{min}, T_{max}).

Since R_T decreases with increasing T, it is sufficient to satisfy this inequality at $T = T_{max}$.

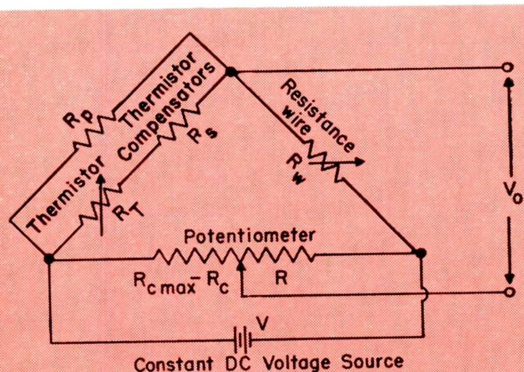
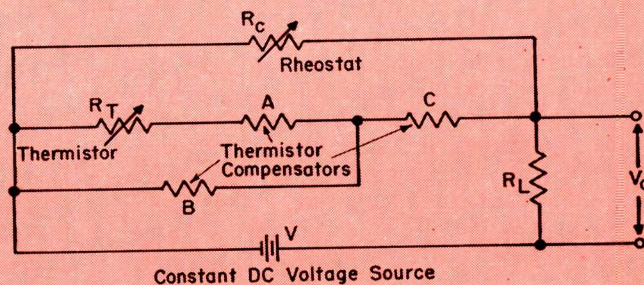


Fig. 1: (l) Temperature differential circuit

Fig. 2: (below) Rheostat circuit



Rheostat Application

The key Kelvin temperatures T_{min}, T_{max}, (actual) and t_{min}, t_{max}, (desired), are given by the operating conditions.

The self-heating rating i_r is given by the thermistor manufacturer.

The thermistor resistance R_T is given by the thermistor (catalog graph, table, or formula).

Take $m = 1/K^2$ and $k_o > t_{max}$, with $m(k_o - t_{max})$ small compared to $1/R_L$; and $R_L m[(k + k_o) + (T - t)]$ small compared to 1.

Calibrate the rheostat so that the resistance corresponding to desired temperature t is $1/[m(k_o - t)]$.

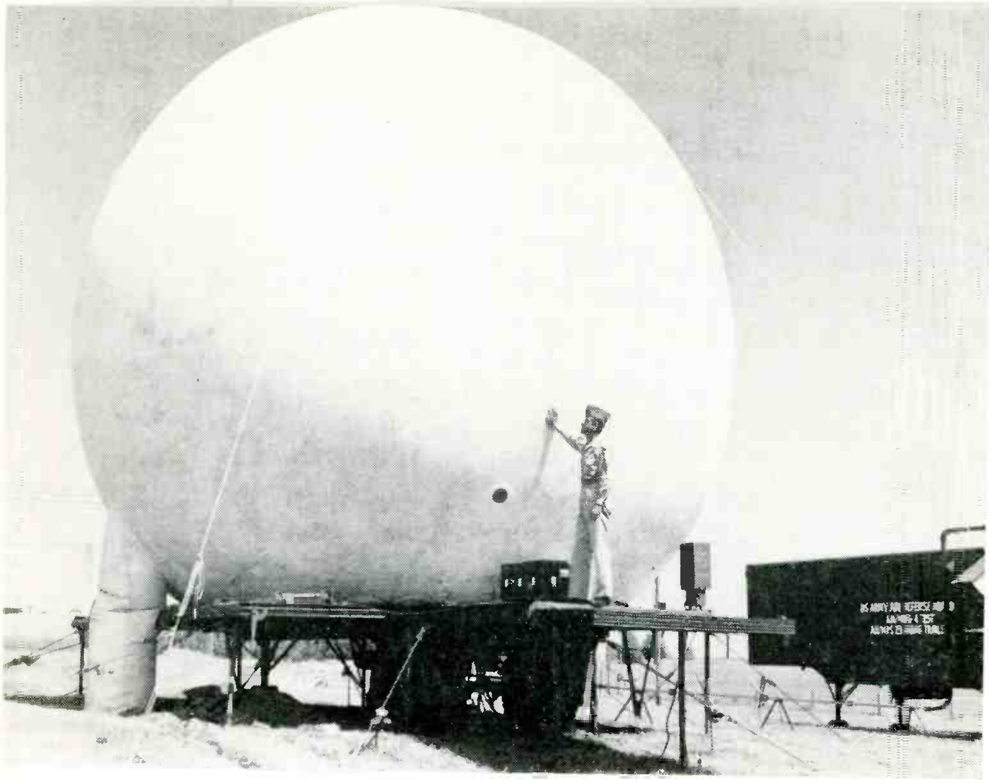
The applied constant dc voltage V is chosen such that

$$V < [BC + (A + R_T)(B + C) + R_L\,(A + B + R_T)\,]\, i_r \,/\, B \text{ at } T = T_{max}.$$

References

[1] F. Bennett, Designing Thermistor Temperature Correcting Networks Graphically, *Control Engrg.* Nov. 1955.

[2] A. B. Soble, Thermistor Compensation of Resistance and Conductance, *IRE Trans.* on Components, Sept. 1957.



Entire console section (above) of 3-dimensional radar slides out on rollers for easy testing and quick replacement of parts.

Plastic balloon (left) forms a protective housing for Frescanar antenna. Both are transported in the mobile trailer shown.

"Frequency Scanning Radar"

The Army's new "three-dimensional" radar detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing and altitude.

Called Frescanar, the new radar, developed by the Hughes Aircraft Co., is the eyes of "Missile Monitor," an Army air defense guided missile fire distribution system for mobile use with a field army and is ready for operational use with air defense missile batteries.

The new radar and its electronic system is considered one of the most important advances made in electronic detection since the development of radar. Five basic advantages of the new "3-D" system over conventional radars were cited:

1. Range performance. All available power is concentrated in sharp pencil beams.

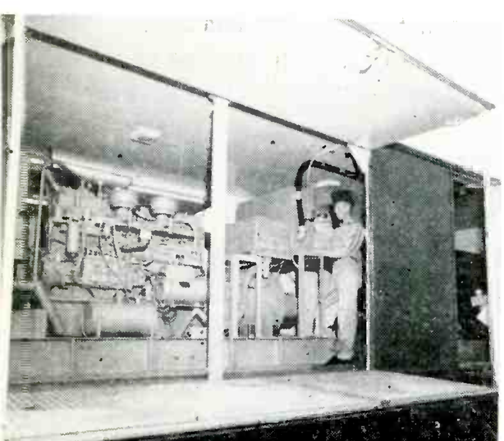
2. Single antenna and operator. Conventional systems need two or more radars, operators and master consoles to achieve similar results.

3. Triple function. Frescanar computes range, bearing and altitude at the same time.

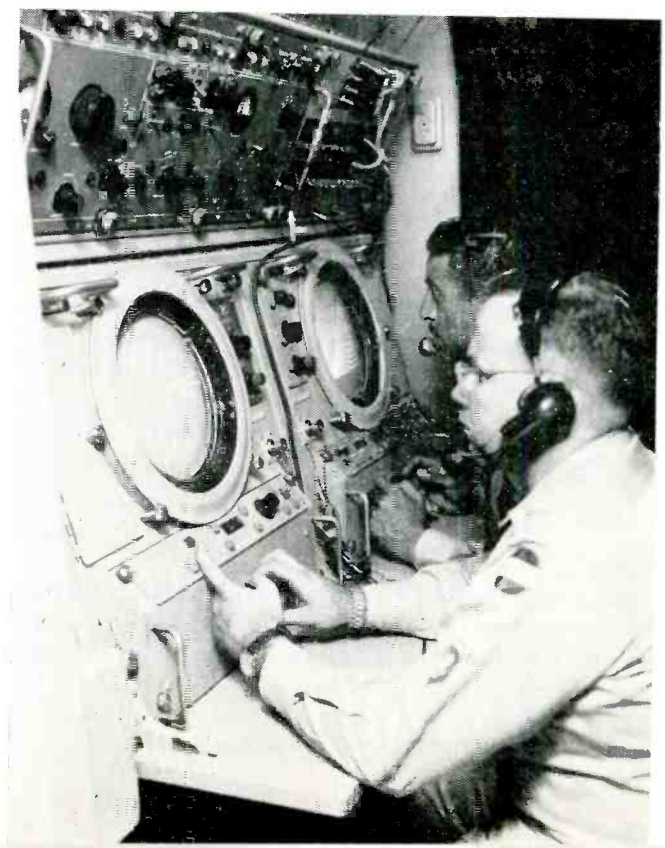
4. Greater speed.

5. Sees more targets clearer. Electronic beam scans rapidly and greatly increases number of targets which can be tracked at the same time, provides better separation of closely-spaced targets with minimum of ground clutter, and pinpoints targets faster.

Two scopes (right) display all information necessary for tracking. Scope at left displays range and bearing, that on right, altitude. Data is instantaneously transmitted to AA batteries.



(Left) Sideflaps peeled back, power truck is ready to supply power to Frescanar under field conditions.



For Converting Transistor Parameters

Jacobians — A New Computational Tool

Conversion from one to the other of the six types of parameters for each of the three circuit configurations involved lengthy calculation. The use of this new system reduces this burden to a simple operation.

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T. R. Nisbet


W. W. Happ

ONE of the interesting things about Jacobians is that one need not know anything about them to be able to use them successfully in transistor work.

Most of today's transistors are specified by their common base or common emitter h-parameters, and most of today's text-books give tables for the conversion of those parameters to other commonly used parameters. Quite a lot of calculation is involved. Also, not all types of conversion can conveniently be accommodated, for there are 6 types of parameters for each of the 3 circuit configurations. This is a total of over 300 different types of conversion. The use of Jacobians reduces this complexity to a simple operation involving Tables 1 and 2.

Identification

The Jacobians in this article are printed in bold type: they are not to be confused with the transistor parameters which bear the same letters, but with subscripts $_{11, 12,}$ etc.

Table 1 shows, without any reference to the meaning of the Jacobians themselves, that

$$z_{12} = -\mathbf{b}/\mathbf{z} = -\mathbf{b}/\mathbf{h} \div \mathbf{z}/\mathbf{h} = h_{12}/h_{22}$$

Similar manipulations yield the formulas for any required parameters in terms of any other parameters, provided that both refer to the same circuit configuration.

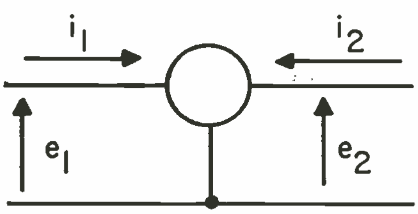


Fig. 1: Generalized circuit of transistor which is used in the theoretical considerations. All possible Jacobians are specified by six symbols.

Identification Example

Knowing the h-parameters, assess the curve of input impedance vs. load impedance, using the fact that z_{in} varies from h_{11} to z_{11} as the load varies from z_{22} to g_{22}.

Table 1 shows that

$$z_{11} = \mathbf{g}/\mathbf{z} = \mathbf{g}/\mathbf{h} \div \mathbf{z}/\mathbf{h} = \Delta^h/h_{22}$$

$$z_{22} = \mathbf{h}/\mathbf{z} = 1/h_{22}$$

$$g_{22} = \mathbf{y}/\mathbf{g} = \mathbf{y}/\mathbf{h} \div \mathbf{g}/\mathbf{h} = h_{11}/\Delta^h$$

where $\Delta^h = h_{11}\,h_{22} - h_{12}\,h_{21}$

Inserting values of the h parameters gives the asymptotes of the required curve.

Conversion Facility

Table 1 is a general table, which refers to any circuit configuration. In Table 2, the Jacobians are given subscripts to denote the circuit to which they refer. The columns have been arranged to facilitate conversion between the parameters of the different circuit configurations, common base, common emitter and common collector. The method by which the table is used is shown in the example below, which incidentally points out at once the terms which can be neglected in a practical calculation. The only thing that need be known about Jacobians at this stage is that, since they are in the nature of derivatives, any one Jacobian in the set can be given an arbitrary numerical value. If the common base z-parameters are known, it is convenient to set the Jacobian $\mathbf{z}_B = 1$, or if the common emitter h-parameters are given, let $\mathbf{h}_E = 1$.

Jacobians *(Continued)*

Conversion Example

Given the common base h-parameters, find the common collector y-parameters.

Given $h_{11B} = 32\ \Omega$, $h_{12B} = 3 \times 10^{-4}$, $h_{21B} = -0.95$,
$h_{22B} = 1 \times 10^{-6}$ mho

Calculate $\Delta^{h_B} = h_{11B} \cdot h_{22B} - h_{12B} \cdot h_{21B} = 3.17 \times 10^{-4}$

Set $\mathbf{h_B = 1}$. From line 4, Table 1, $\mathbf{y_B = 32}$, $\mathbf{b_B = -3 \times 10^{-4}}$,
$\mathbf{a_B = 0.95}$, $\mathbf{z_B = 1 \times 10^{-6}}$, $\mathbf{g_B = 3.17 \times 10^{-4}}$

From Column 2, Table 2,

$\mathbf{a_C = 0.9997}$, $\mathbf{b_C = -0.05}$, $\mathbf{g_C = 1}$, $\mathbf{h_C = 500.17 \times 10^{-4}}$,
$\mathbf{y_C = 32}$, $\mathbf{z_C = 1 \times 10^{-6}}$

From line 5, Table 1,

$y_{11C} = 1.562 \times 10^{-3}$, $y_{12C} = 1.56 \times 10^{-3}$,
$y_{21C} = -31.24 \times 10^{-3}$, $y_{22C} = 31.25 \times 10^{-3}$

Current trends in transistor manufacture indicate a continuing improvement in predictability and a tightening of tolerances. The ease with which given parameters can be converted to required parameters is an important factor in the economics of circuit design, for it tends to govern the number of transistors which a designer will consider for a particular stage in his design.

With the advent of improved, and perhaps standardized transistors, more elite design methods may become popular. These will no doubt demand a much greater degree of freedom than is in evidence today in transferring from one set of parameters to another.

Theoretical Considerations

In the generalized circuit of a transistor, Fig. 1.

$$z_{11} = \left.\frac{\partial e_1}{\partial i_1}\right|_{i_2}$$

by interposing an arbitrary variable, k, this can be written

$$\left.\frac{\partial e_1}{\partial i_1}\right|_{i_2} = \frac{\left.\frac{\partial e_1}{\partial k}\right|_{i_2}}{\left.\frac{\partial i_1}{\partial k}\right|_{i_2}} \text{ or } \frac{(e_1, i_2)}{(i_1, i_2)}$$

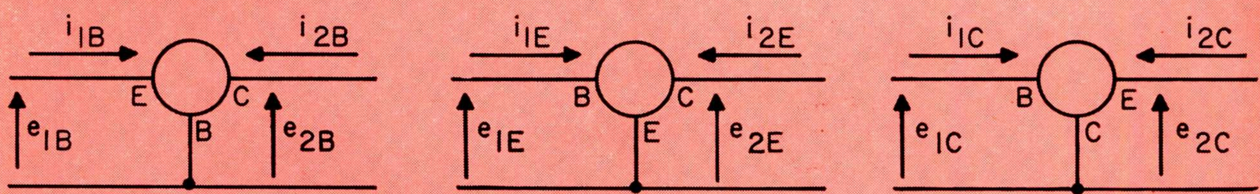


Fig. 2: Upper case subscripts denote the three types of circuit configuration: B, common base; E, common emitter; and C, common collector.

On the right is shown the Jacobian form of writing this partial derivative. Numerator and denominator behave in the same manner as algebraic symbols, and for convenience a single letter is chosen to represent each. Thus

$$(e_1, i_2)/(i_2, i_2) = \mathbf{g/z}$$

A negative sign applied to a Jacobian can be transferred to either component, so that, for example,

$$-\mathbf{g} = -(e_1, i_2) \equiv (-e_1, i_2) \equiv (e_1, -i_2)$$

It can be shown[1] that (e_1, i_2) is the same as $-(i_2, e_1)$. This equivalence is a general one, and by making use of it, we can specify all possible Jacobians for Fig. 1 by 6 symbols:

Jacobian.	Denoted by
(e_2, i_2)	**a**
(e_1, i_1)	**b**
(e_1, i_2)	**g**
(i_1, e_2)	**h**
(e_1, e_2)	**y**
(i_1, i_2)	**z**

What has been done for z_{11} can be done for all the remaining types of parameters, and this information appears in Table 1.

Inter-relation

It can be shown[1] that the 6 Jacobians are inter-related by the formula **ab + gh = yz**, and this enables the determinants, Table 1, to be calculated, e.g.,

$$\Delta^z = z_{11}\, z_{22} - z_{12}\, z_{21} = (\mathbf{g/z})\,(\mathbf{h/z}) + (\mathbf{b/z})\,(\mathbf{a/z}) = \mathbf{y^2/z^2} = \mathbf{y/z}$$

Table 1

Transistor Parameters	Subscripts 11	12	21	22	Determinant
a	$\frac{g}{a}$	$-\frac{y}{a}$	$\frac{z}{a}$	$-\frac{h}{a}$	$\frac{b}{a} = \Delta^a$
b	$-\frac{h}{b}$	$\frac{y}{b}$	$-\frac{z}{b}$	$\frac{g}{b}$	$\frac{a}{b} = \Delta^b$
g	$\frac{z}{g}$	$\frac{b}{g}$	$\frac{a}{g}$	$\frac{y}{g}$	$\frac{h}{g} = \Delta^g$
h	$\frac{y}{h}$	$-\frac{b}{h}$	$-\frac{a}{h}$	$\frac{z}{h}$	$\frac{g}{h} = \Delta^h$
y	$\frac{h}{y}$	$\frac{b}{y}$	$-\frac{a}{y}$	$\frac{g}{y}$	$\frac{z}{y} = \Delta^y$
z	$\frac{g}{z}$	$-\frac{b}{z}$	$\frac{a}{z}$	$\frac{h}{z}$	$\frac{y}{z} = \Delta^z$

In Fig. 2, subscripts are used to denote the circuit configuration. Conversion of the Jacobians from one to another is done by re-defining the individual voltages and currents involved. It may be noted that, by definition, a Jacobian such as (e_1, e_1), which contains only one term, is equal to zero. The following examples illustrate the method:

$$h_C = (i_{1C}, e_{2C}) = (i_{1E}, -e_{2E}) = -h_E$$

$$y_B = (e_{1B}, e_{2B}) = (-e_{1E}, e_{2E} - e_{1E}) = -(e_{1E}, e_{2E}) = -y_E$$

$$b_E = (e_{1E}, i_{1E}) = (-e_{1B}, -i_{1B} - i_{2B}) = (e_{1B}, i_{1B}) + (e_{1B}, i_{2B}) = b_B + g_B$$

$$g_B = (e_{1B}, i_{1B}) = (e_{2C} - e_{1C}, -i_{1C} - i_{2C}) = (-e_{2C}, i_{1C}) - (e_{2C}, i_{2C}) + (e_{1C}, i_{1C}) + (e_{1C}, i_{2C}) = h_C - a_C + b_C + g_C$$

Application of this method results in the information given in Table 2.

References

1. W. W. Happ, I.R.E. Convention Record, P.G.C.T., 1954.
2. G. L. Mattoei, I.R.E. Circuit Transactions, Sept. 1957.
3. Hunter, *Handbook of Semiconductor Electronics*, s.18-4, with g parameters replacing m parameters.

Table 2

JACOBIAN CONVERSIONS
(Subscripts Denote Circuit Configuration)

C. Base to C. Emitter

$a_E = a_B - g_B$
$b_E = b_B + g_B$
$g_E = -g_B$
$h_E = -h_B - b_B + a_B - g_B$
$y_E = -y_B$
$z_E = -z_B$

C. Base to C. Collector

$a_C = b_B + h_B$
$b_C = -h_B + a_B$
$g_C = h_B$
$h_C = b_B + h_B + g_B - a_B$
$y_C = y_B$
$z_C = z_B$

C. Emitter to C. Base

$a_B = a_E - g_E$
$b_B = b_E + g_E$
$g_B = -g_E$
$h_B = -h_E - b_E + a_E - g_E$
$y_B = -y_E$
$z_B = -z_E$

C. Emitter to C. Collector

$a_C = -h_E + a_E$
$b_C = b_E + h_E$
$g_C = -b_E - g_E - h_E + a_E$
$h_C = -h_E$
$y_C = -y_E$
$z_C = -z_E$

C. Collector to C. Base

$a_B = b_C + g_C$
$b_B = a_C - g_C$
$g_B = h_C - a_C + b_C + g_C$
$h_B = g_C$
$y_B = y_C$
$z_B = z_C$

C. Collector to C. Emitter

$a_E = -h_C + a_C$
$b_E = b_C + h_C$
$g_E = -b_C - g_C - h_C + a_C$
$h_E = -h_C$
$y_E = -y_C$
$z_E = -z_C$

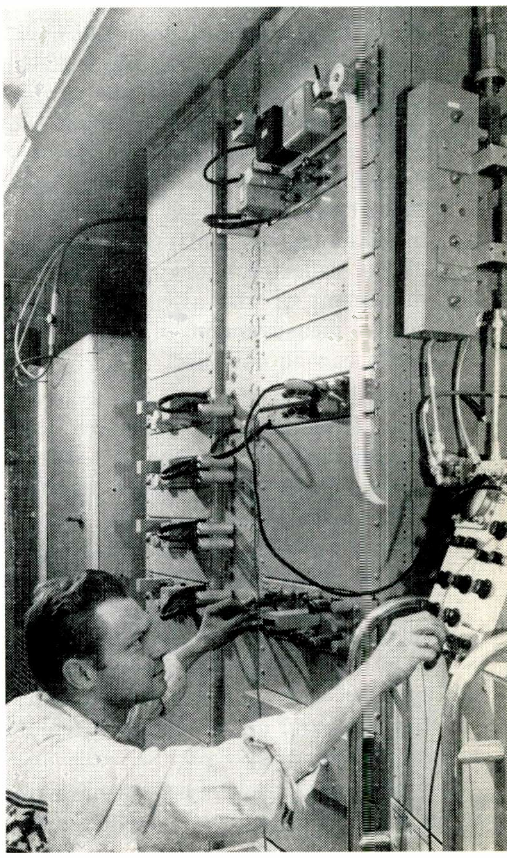
What's New

Law Enforcement Microwave

ON the uptrend nationally is interest by law enforcement agencies in microwave for communications expansion purposes. State police agencies and sheriff's patrols particularly lean toward microwave because it provides sufficient channels to handle considerable essential traffic which often crowds mobile radio systems.

Shown here is a maintenance technician for the Colorado State Patrol, Denver, Colo., working on system equipment. General Electric Quadriphase equipment employed in the system features swing-out panels for easy servicing.

Electric utilities are also showing interest in Microwave communications systems. An example is the El Paso Electric Company. Included in the El Paso system is the longest reflected microwave hop in private industrial use in the United States. Huge mirror-like reflectors, 20 ft square, relay intelligence eliminating the need for repeater stations. An 80 watt amplifier is used to provide the high gain necessary to meet path margin requirements.



Technician working on the Denver, Col., police multichannel microwave system.

What's New . . .

CW Doppler Radar

Dipped sonar mission is made possible by Ryan CW velocity indicator which permits hovering at any altitude down to zero.

CONTINUOUS wave (CW) radar is superior to other types for airborne Doppler navigation systems because it provides lighter, simpler, more reliable and more compact equipment for comparable flight requirements. Ryan Aeronautical Company, San Diego, Calif., is demonstrating these advantages in producing CW radar navigators for Army and Navy aircraft, and hovering systems for Navy helicopters.

Continuous wave and pulse type Doppler navigators use the "Doppler effect" to obtain essential navigational data for an aircraft in motion. This requires the transmission of radar energy from the aircraft and the reception of the reflected waves which bounce back from the earth or sea. By measuring the apparent shift in frequency of the reflected energy, due to the movement of the airplane, an accurate measurement of ground velocity can be obtained.

Continuous wave radar systems can transmit and receive this energy simultaneously and continuously. Pulse type radars cannot. They must transmit radar energy in short pulses, or "bursts," then stop to "hear" the returning echoes. This means that CW systems receive data 100% of the time—contributing to highest accuracy. Pulse systems have a lower data receiving rate, and under certain altitude conditions receive none at all.

Inherently, CW systems have no altitude limitations, operating efficiently from zero altitude to above 70,000 ft. This capability makes Ryan systems uniquely useful for low altitude helicopter anti-submarine missions. These hovering operations require precisely patterned flights, usually at altitudes below 200 ft.

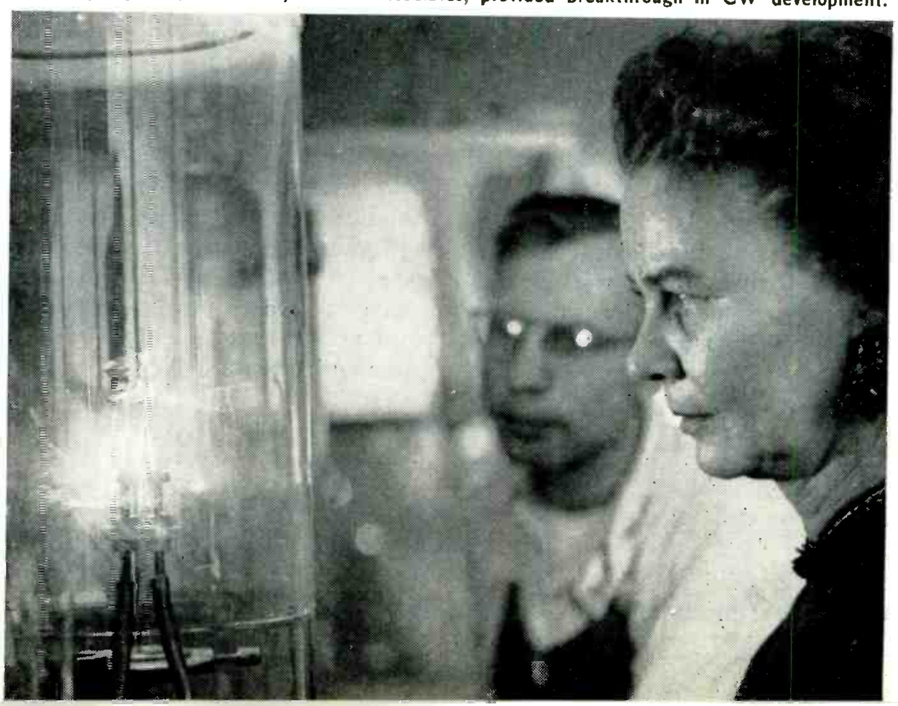
Pulse type systems cannot operate at very low altitudes, or below 200-300 ft, because they cannot transmit and receive at the same time. At these low altitudes, the transmitted pulse is reflected back so quickly that it arrives while the transmitter is operating and the receiver is shut down. The receiver, then, is "blind" to this echo energy. These dead areas of reception are called "altitude holes." They occur at successive higher altitudes whenever the time required for the transmitted pulse to go from the aircraft to ground and return coincides with the intervals between pulses, or multiples of them.

Broadly speaking, there are two ways by which the efficiency of pulse type systems can be increased. One method is to increase the "peak power" of the transmitter. This creates a stronger signal, but requires more power. The other means is to increase the pulse width, in an attempt to approach the CW concept. This method also requires more power, and the efficiency level is still below that of a CW system, which is operating continuously.

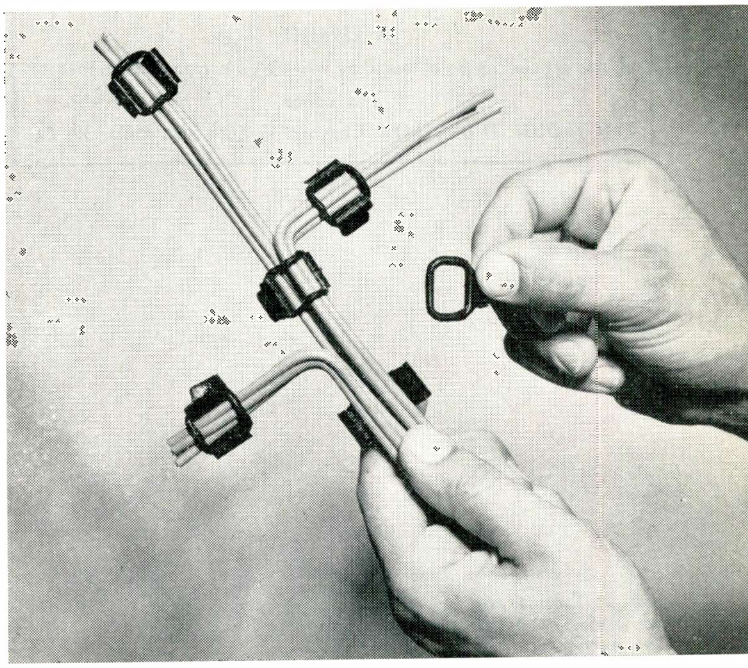
The Ryan CW direct-to-audio detection technique employs a microwave crystal mixer and a Doppler amplifier. In addition to the received signal, a small portion of the transmitter energy is coupled into the crystal for proper excitation. Thus, the difference frequency, or Doppler signal, is obtained directly from the crystal output. Intermediate frequency re-

(*Continued on page* 190)

This tiny klystron, created by Varian Associates, provided breakthrough in CW development.



Missile Wiring Fastener



Easy application, adaptability to various sizes, and neatness of this new "Viton" cradle clip wiring fastener are demonstrated on this model.

A NEW fluorine-based elastomer which resists oils, fuels, and solvents at high temperature, has been adapted to a recently developed wiring fastener, making it useful for missiles and high-speed aircraft. A synthetic rubber manufactured by Du Pont, it is called "Viton."

The fastener consists of a U-shaped nylon cradle and a flexible clip of "Viton" which cinches across the open end of the cradle and locks under inverted lips, holding a bundle of wires securely in place. Not only does this fastener provide a neater and more secure wire bundle than tape, string, or wire wrapping, but it can be installed in about half the time.

The fastener was designed originally with a clip of neoprene synthetic rubber. This combination of materials still is available and will give excellent service under most conditions. But with temperatures as high as 300°F., accompanied by the presence of lubricants, aromatic fuels, hydraulic fluids, and other strong oxidizing agents, "Viton" is required for the clip material. "Viton" has the further advantage of being even more resistant than neoprene to ozone, sunlight, and weather. Four sizes are available to accommodate bundles of wire from ¼-in. to 2 ¼-in. in diameter. If an anchoring system is used, the cradles may be screwed to supporting members before fastening the wire bundles.

The fastening system, marketed as "Insuloid Cradle Clip System" (U. S. patent applied for), is manufactured in both the United States and Canada and sold by Electrovert Inc., 124 East 40th Street, New York 17, New York.

An Improved Audio-Frequency Volt-Ammeter

ACCURATE voltage and current measurements are now possible over a frequency range from 5 to 50,000 cps with a self-contained, portable volt-ampere converter recently developed at the National Bureau of Standards. The increasing use of audio frequencies, especially in airborne devices, has made necessary the development of special equipment and transfer standards for tests of instruments operating in this range. As the primary electrical units are maintained by dc standards, all ac measurements of voltage, current, and power are actually based on transfer instruments, which are standardized on direct current and then used on alternating current.

The instrument was designed and constructed for the NBS Electronic Calibration Center at Boulder, Colo. It has 12 voltage ranges from 0.5 to 600 v. and 11 current ranges between 7.5 and 20 amp. These ranges may be used either for dc or ac measurements with a 1.5 v. potentiometer or for ac-dc transfer tests of instruments.

The improved volt-ammeter utilizes a thermal converter as the sensitive component. This consists essentially of a conductor, heated by the ac to be measured, and a thermocouple, thermally attached near the center of the heater. The heater is connected in series with appropriate resistors for voltage measurements and in parallel with appropriate shunts for current measurements.

The output emf produced in the thermocouple is first balanced against the voltage from an internal dc "bucking circuit." Then the heater is switched to an internal dc circuit, which is adjusted to give the same output emf and therefore equivalent heater current and voltage drop. A simple multiplication of the voltage measured across a portion of this dc circuit yields the unknown alternating voltage or current. The 7.5 ma thermal converter used has excellent transfer characteristics, its ac-dc difference being less than 0.01% at audio frequencies.

Changes in heater resistance are compensated by connecting additional resistors in the circuit. The accuracy of the instrument is dependent only on the potentiometer used to measure the voltage and on the highly stable internal resistors.

Relatively simple switching permits the same resistors and shunts

(*Continued on page* 190)

Reversing Ferrite Temperature Coefficients

The presence of a dc magnetic field produces changes in the temperature coefficient of incremental permeability of ferrites and garnets. A thorough investigation, and its results, are presented here.

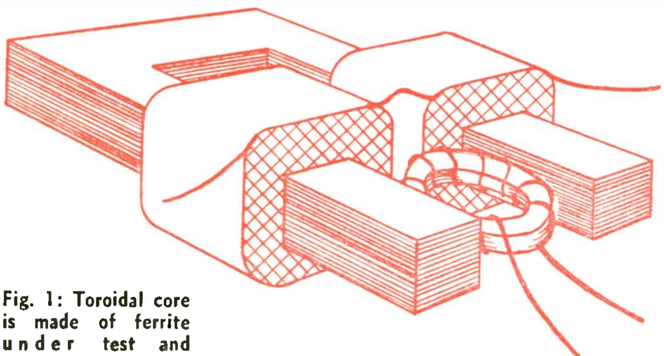
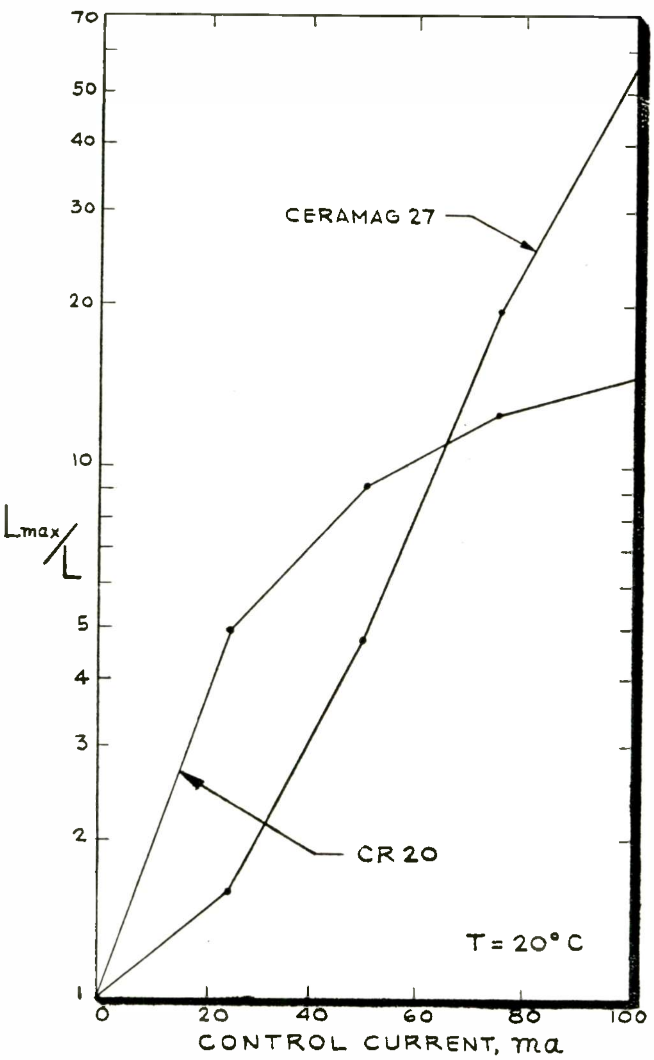


Fig. 1: Toroidal core is made of ferrite under test and wound with the r-f coil.

Fig. 2: Effect on r-f winding when the magnetizing force is changed.



By ANDRZEJ B. PRZEDPELSKI
Senior Electrical Engineer
A. R. F. Products, Inc.
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DURING the development of ferrite saturable core reactors in our laboratory, a pronounced change in the ferrite temperaturs coefficient of permeability was noticed in the presence of a magnetic field. It was decided to investigate this phenomenon more closely. The results of the investigation are described here.

Ferrites Tested

Two ferrite materials were chosen for extensive tests: Ceramag 27 made by Stackpole Carbon Co. and Croloy CR-20 made by Henry L. Crowley & Co.

Ceramag 27 material has very high permeability (920) and is suitable for frequencies up to approx. 1.5 MC (for a minimum Q of 20). It has a very low temperature coefficient of permeability in the absence of magnetic fields, Fig. 4, which is fairly constant down to —60° C.

The CR-20 material has medium permeability (150) and is suitable for frequencies up to approx.

8 MC. It also has a low temperature co-efficient, Fig. 3, and is satisfactory for operation down to —60° C.

Procedure

The materials used were of a toroidal shape and were assembled in laminated yokes, Fig. 1. The r-f coil was wound on the ferrite toroid and the two control coils of 368 turns each, placed on both legs of the U-shaped yoke, provided the magnetomotive force.

The change in inductance of the r-f winding, with changes in magnetizing force, was measured at room temperature of 20° C. The curves for both materials are shown in Fig. 2. For simplicity the current in the control windings is used instead of the actual magnetizing force. The difference between the two is approximately constant, depending on the number of turns in the control winding and the length of the magnetic flux path. It can be seen from these curves that at 100 ma. the CR-20 material is approaching saturation, while the Ceramag 27 material still changes inductance rapidly.

Findings

Fig. 3 shows the change of inductance, or permeability, with temperature for different flux densities. The material tested was CR-20 ferrite. It can be seen that the positive temperature coefficient of permeability, usually associated with ferrites, applies only at very low flux densities. At high flux densities the coefficient changes polarity and becomes negative. The numerical value of the coefficient increases with flux density until saturation of the ferrite is approached.

Fig. 4 illustrates the effect of flux density on the temperature coefficient of permeability for the Ceramag 27 ferrite. The same trend is apparent. As expected, the temperature coefficient is larger, because of the very high permeability.

Both of these materials were chosen because of their comparatively high stability in their respective ranges. They do not exhibit any discontinuities in their characteristics in the commonly used temperature range of —60° C to +80° C, which were common in the early high permeability ferrites.

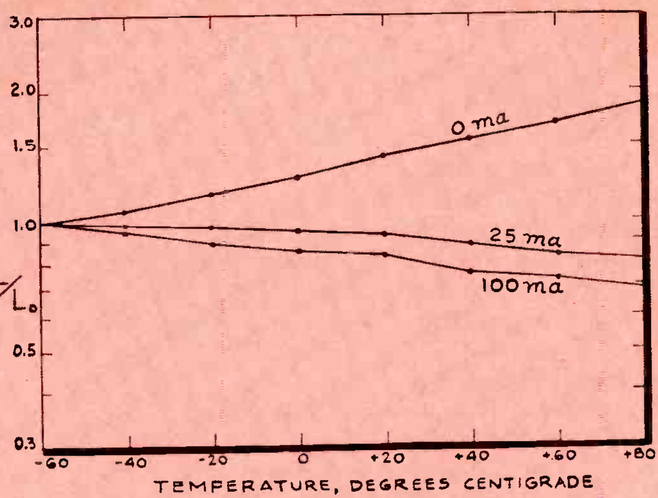


Fig. 3: Change of inductance for different flux densities when testing CR-20.

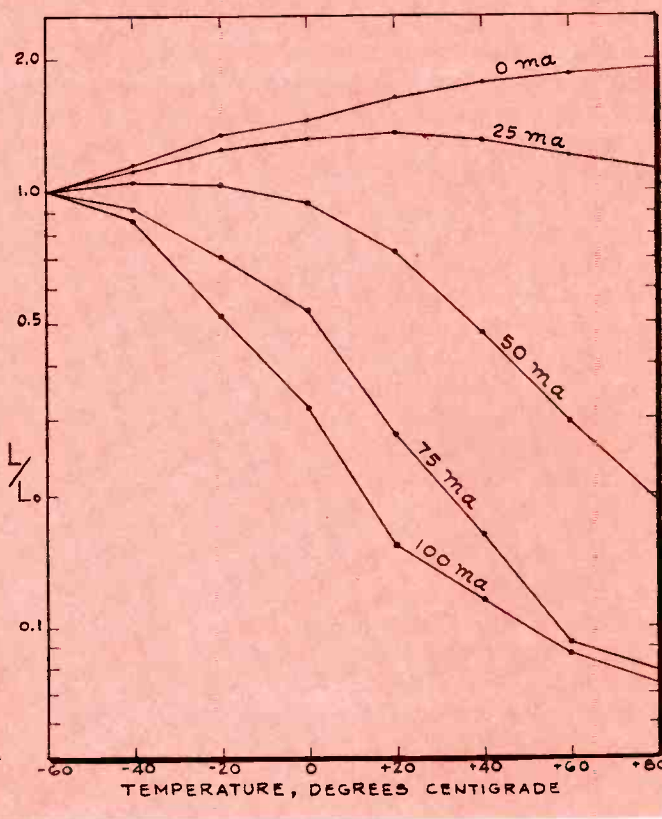


Fig. 4: For Ceramag 27 the effect on the inductance is much greater at the higher flux densities.

Garnet Test

For comparison, tests were made on a sample of Yttrium garnet obtained from Microwave Chemicals Laboratory, Inc. As far as we know, this is one of the first applications of this materal for saturable core inductors at low radio-frequencies. This material is usually used to replace ferrites in the microwave range.

Because of the different applications for which the garnets were developed some of their characteristics, applicable to the low frequency saturable core inductor use, are not known. Initial tests on the available sample indicate that its low frequency permeability is approx. 400. The material used was suitable for initial frequencies up to approx. 1.5 MC and was rather easy to saturate.

Fig. 5 indicates the change in inductance with the magnitude of the saturating field. Unfortunately this figure cannot be compared directly with the curves for the two ferrites tested, since a different physical configuration had to be used to accommodate the shape of the available garnet. The number of turns of the control winding was 4000, but the efficiency of the saturating field structure was lower than previously. The maximum inductance change can also be increased by using a more favorable shape of the garnet.

The effect of magnetic field on the temperature coefficient of permeability of the garnet is presented in Fig. 6. The behaviour is as expected and is very similar to that of the higher frequency ferrites, but the permeability is considerably higher. Without any magnetic field applied, the temperature coefficient is positive. As a magnetic field is applied the temperature coefficient goes through zero and then becomes negative. Its value increases with the applied field. The temperature coefficient of the coil does not increase at very high saturation levels since then the total inductance is mainly determined by the coil alone and not by the garnet.

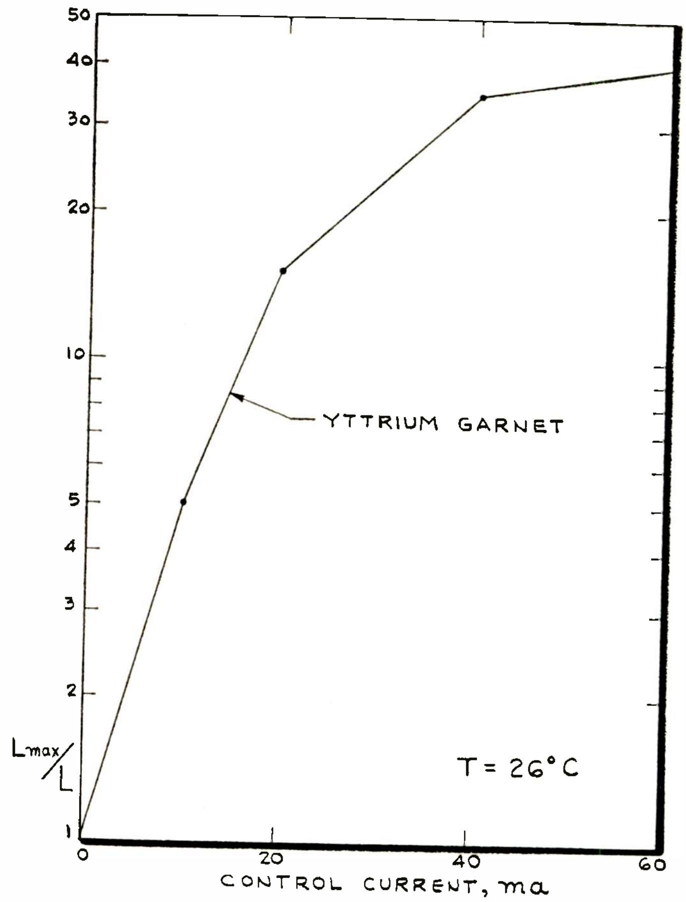


Fig. 5: This curve can not be compared with that of the ferrites because a different physical configuration had to be used.

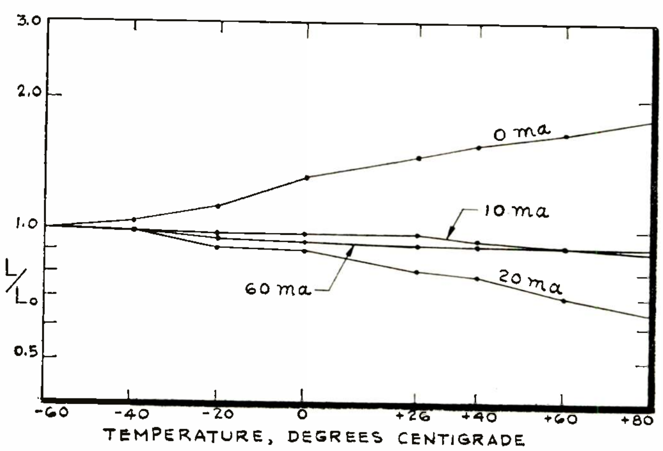


Fig. 6: Magnetic field effect on garnet's temperature coefficient of permeability.

Applications

Numerous samples of ferrites were tested during this investigation and the results were very consistent. In view of this, several interesting applications become obvious. One of the more important ones would be a zero or adjustable temperature coefficient coil. Since the change of polarity of the coefficient occurs at rather low saturation levels, most of the initial permeability is still available. Therefore, high inductance coils with a specified low positive or negative temperature coefficient can be constructed. Since the required fields would be low, a permanent magnet could be used to supply the necessary field.

While our experience with the garnets at these frequencies is rather limited at the present time, the preliminary results indicate that their stability with temperature is better than that of ferrites of comparable high permeability. It is therefore possible that they are inherently more stable and thus more suitable for applications which require swept frequency circuits. Otherwise, in performance, they are very similar to comparable ferrites for low frequency applications.

It should be pointed out that the temperature coefficient of the coil was neglected in this discussion, since it is at least an order of magnitude lower and would be rather difficult to measure. Slight waviness of the curves may be attributed to the accuracy (10% or better) of test equipment used and to measuring techniques since the readings were taken every few hours to allow the coils to stabilize.

Acknowledgment

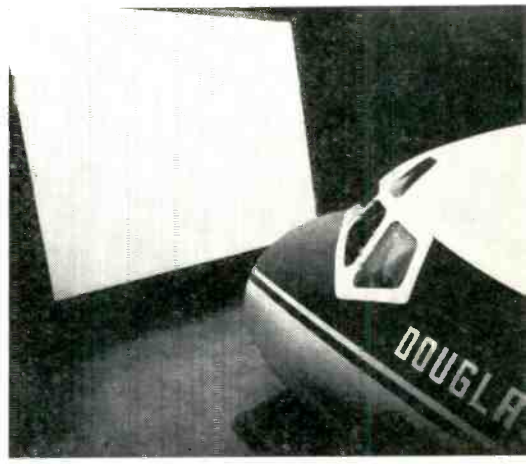
The measurements were made by Messrs. Bernard Sommer and Richard Jenkins in the A.R.F. Products, Inc., laboratory.

Reference

1. Przedpelski, A. B., "Simple Circuit Stabilizes Ferrite FM Modulator," *Electronic Industries*, Feb. 1958.

DC-8 Flight Simulator

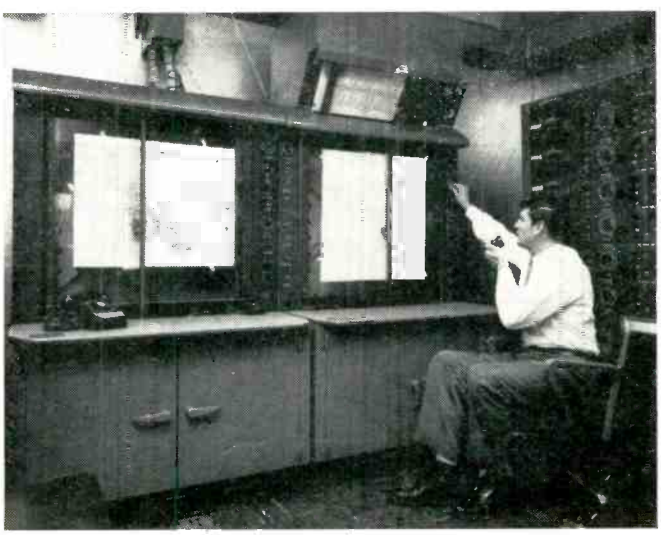
A miniature relief map, built to a 300:1 scale, is scanned by a TV camera on a travelling crane (center) in the "map room" of the Douglas DC-8 Simulator. Movement of the camera is governed by the electronic response of the simulated Jetliner to the pilot's controls, and an enlarged image is projected on a large screen in front of the simulator cockpit.



External view of the simulator cockpit and 12 x 15 ft. screen on which TV image is projected. Pilot can then see his position and altitude in relation to an airport.

Pilots learning to fly the DC-8 will have their first "check out" in this simulator produced by Link Aviation, Inc. A portion of the cockpit and some of the projected image of a landing field are shown.

Course of simulated flight is traced on these maps in the control room. Operator makes appropriate tower and check-point communications. Radio and navigational signals introduced by controls at right.



Pulse Modulation Designers,

Treat Spark Gaps as Components

The design of spark gaps has advanced to the point where these devices, formerly a second thought of the designer, now deserve prime consideration as protective components. Questions of critical importance are answered here.

By KEITH W. OLSON
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IN the past, spark gaps have generally been considered for use principally as brute force devices. They were used in protection against very high power surges, as high power energy transfer devices, and, in some cases, as very jittery driver tubes for early modulators. As a laboratory device large sphere gaps have been used as high voltage "meters." In general, all of these units have been cumbersome, and with few exceptions highly specialized in their application.

In the last 10 years, much progress has been made in the design and process control of hermetically sealed spark gaps. Now information may be supplied to the systems designer to enable him to consider the spark gap as a protective component.

Considerations

In general, a pulse modulator systems designer initially considers the use of the usual components per his rated electrical requirements. Frequently, he may consider a clipper diode across the PFN but no further protection. In airborne systems, or systems in which at least part of the modulator is remote from the operator, size is a very definite consideration. Further, most modulators drive magnetrons.

Unfortunately, the present state of the art of magnetron construction is such that magnetrons do misfire and they do arc back. With this thought in mind, the systems designer, by not considering a protective device, could be faced with a paradox. The bulk of the totality of components could force his system to be larger than the physical space available, if he were to rate all components high enough to be assured of not losing them at the first fault condition.

Let us consider various features of the pulse modulator from a protective standpoint. The questions and answers given are of critical importance to the systems designer. We will concentrate principally on protection of the pulse transformer. Throughout, the terms "normal operating voltage" and "operating voltage" will be used in referring to the voltage appearing at the pulse transformer secondary when the magnetron is firing normally. The term "insulation rating" will refer to the insulation breakdown rating of that secondary.

Missing Pulse

1\. Q. *For a missing pulse, which could occur for any of several reasons but particularly because of magnetron misfire, what is the open circuit voltage that appears across the secondary of the pulse transformer?*

A. Frequently at the secondary of a pulse transformer the open circuit voltage, when the magnetron misfires, may be 5-10 times the normal operating voltage. In the past, pulse transformers generally have been built with insulation ratings adequate to handle such open circuit voltages. It is a fair approximation that the size and cost of a pulse transformer would be linear with its insulation rating.

Pulse Transformer

2. Q. If it would be necessary to rate the pulse transformer and PFN at a sufficient insulation breakdown to protect against open circuit voltages, what additional size and cost would be necessary?

A. Present applications demand much smaller and generally less costly pulse transformers so insulation ratings can drop to about 200% of operating voltage. More recently, units with insulation ratings of 170% of operating voltage are being used, and projected units may have ratings of 150% of operating voltage. To the systems designer this means that he must protect because he cannot over-rate. His question then is "How can I protect?"

Successive Missing Pulses

3. Q. In the case of successive missing pulses, what voltages appear on the PFN, on the magnetron, and on the thyratron.

A. Before the systems designer can decide on any particular kind of protection, he must be assured that the protective devices are available over the appropriate voltage ranges. Production gaps are available in the range of 400 to 50,000 v.

Transformer Insulation

4. Q. Even if an occasional missing pulse spike does not puncture the transformer insulation, how many spikes and what amplitude can the pulse transformer stand?

A. Assurance must be had that the tolerances on the protective devices are adequate to guarantee that the device always will fire when the fault condition exists and never will fire during normal operating conditions. This assurance is guaranteed by the following procedure:

Pulse testing of present gaps is divided into two tests. The first test is the Initial Pulse Breakdown. If unloaded pulses of increasing amplitude are applied, at the repetition rate specified, to the gap after the gap has not been operating for a period of the order of minutes or more, the initial pulse breakdown is the first breakdown. The second test value, called the Repetitive Pulse Breakdown, is the amplitude of the pulse appearing across the gap as the gap is firing at the rate specified. In general, the initial pulse breakdown is higher than the repetitive pulse breakdown because of the finite deionization times of most existing units.

With these considerations in mind, present production units are being built to Initial Pulse Breakdown specifications of a common center value ±13% and Repetitive Pulse Breakdowns around a different, lower, center value also with a tolerance of ±13%. In general, these ranges overlap. Consequently, this implies a total spread of ±20-25% around some nominal center for the overall gap performance.

For example, in Fig. 1 we see schematically the voltages of importance to the systems designer. The ordinate is plotted in units of the normal operating voltages. The left half of the figure shows various voltages which could appear at the pulse transformer

(*Continued on page* 185)

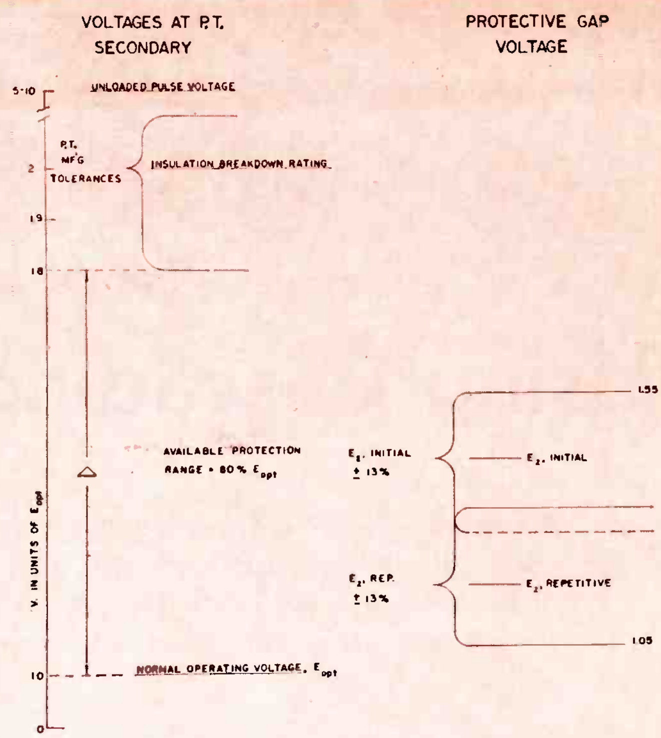
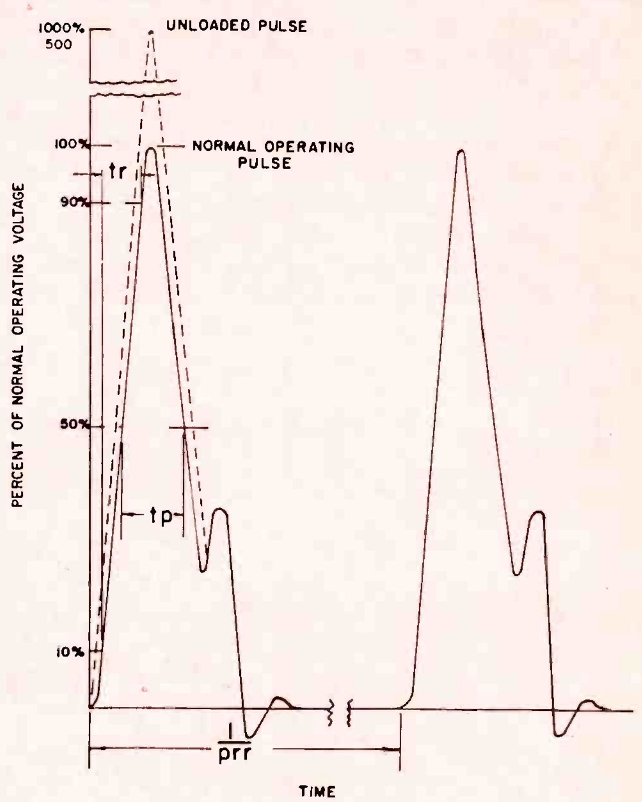


Fig. 1: The relative voltages at the pulse transformer secondary.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

Fig. 2: The three important pulse characteristics are: t_r, rise time; t_p, pulse width at 50% amplitude; and, prr, pulse repetition rate.



For the Designer . . .

Using Cascading Charts

Presented with the required voltage gain and bandwidth, the circuit designer can now readily determine the number of transitionally-coupled double-tuned interstages needed. Results are given for equal and one-sided damping.

By HARRY URKOWITZ
Research Division
Philco Corporation
Tioga & C Streets
Philadelphia 34, Pa.

TWO types of transitionally-coupled (maximally flat) double-tuned amplifier interstages are considered in this article. In both types, Fig. 1, the primary and secondary resonant frequencies (each measured with the other side shorted) are equal. In Type I, the primary and secondary dampings are equal, but in Type II, all the damping is on one side, so that the other side has a large value of Q. The damping may be placed on either side—the choice is dictated by practical considerations. At high frequencies, however, the grid side is considered to be the better choice. The capacitances, C_1 and C_2, consist only of the distributed capacitances.

Interstages such as those shown in Fig. 1 can be used as building blocks to design broadband, high-gain amplifiers. The charts provided eliminate the guess work and trial and error involved in determining the number of stages required in a cascade to obtain a given center - frequency voltage gain and a given 3-db bandwidth.

Using the Charts

The data usually supplied to a designer are the required voltage gain and the required bandwidth. From Figs. 2 and 3 the designer can determine the number of double-tuned interstages needed to meet these requirements. Fig. 2 is to be used for Type I interstages; Fig. 3 for Type II.

The type of vacuum tube to be used must first be chosen. Then the gain-bandwidth product, or figure of merit, F, of the tube must be determined. This is given by:

$$F = \frac{g_m}{2\pi\sqrt{C_1 C_2}}$$

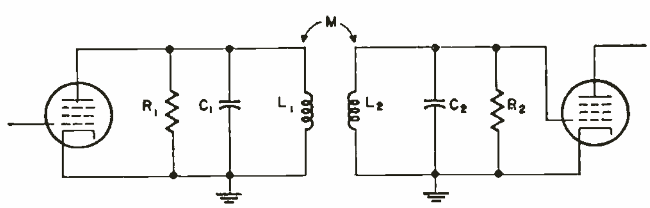
where g_m is the transconductance and C_1 and C_2 are the output and input capacitances, respectively, of the tube including all distributed capacitances when actually wired into the circuit.

The next step is to determine the normalized bandwith, which is the ratio of the required bandwidth to the figure of merit. That is,

$$\beta = \frac{B}{F}$$

where β = normalized bandwidth
B = required bandwidth
F = tube figure of merit

The charts are entered with β



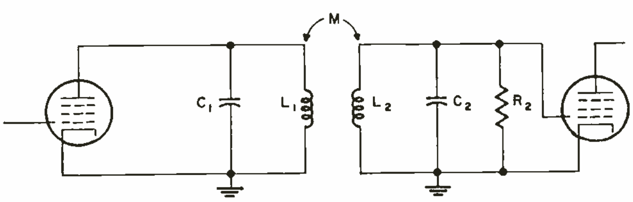


Fig. 1: Both of these interstages have equal resonant frequencies; Type I has equal damping, Type II unilateral.

and the voltage gain in decibels as coordinates. Any line lying above the point so defined represents a satisfactory solution; the most economical solution is represented by the nearest line above the defined point. The value of n given on the line is the number of stages necessary.

Example

It is desired to determine the number of transitionally-coupled double-tuned stages to achieve a 3-db bandwidth of 10 MC and a center frequency voltage gain of 63 decibels.

The tube to be used has a g_m of 3000 micromhos, and the circuit capacitances are: $C_1 = C_2 = 10\ \mu\mu f$. From the values given, it is found that:

$$F = \frac{3 \times 10^{-3}}{2\pi \times 10 \times 10^{-12}} \approx 48 \text{ mc}$$

Then

$$\beta = \frac{10}{48} = 0.208$$

The dotted lines in Figs. 2 and 3 indicate the solutions: 6 stages of Type I; or, 4 stages of Type II.

Derivation

Valley and Wallman[1] give the following formulas for transitionally-coupled double-tuned interstages: The gain-bandwidth product of n identical cascaded stages is:

$$A_1B = \sqrt{2}\,(2^{1/n} - 1)^{1/4} \frac{g_m}{2\pi\sqrt{C_1 C_2}}$$

$$= \sqrt{2}\,F\,(2^{1/n} - 1)^{1/4} \qquad \text{(Type I)}$$

$$A_1B = 2\,(2^{1/n} - 1)^{1/4} \frac{g_m}{2\pi\sqrt{C_1 C_2}}$$

$$= 2\,F\,(2^{1/n} - 1)^{1/4} \qquad \text{(Type II)}$$

where

A_1 = center frequency voltage gain of one stage

B = over-all 3-db bandwidth of n stages.

The voltage gain for n stages becomes:

$$A_n = \left[\frac{\sqrt{2}\,(2^{1/n} - 1)^{1/4}}{\beta}\right]^n, \text{ Type I}$$

$$A_n = \left[\frac{2\,(2^{1/n} - 1)^{1/4}}{\beta}\right]^n, \text{ Type II}$$

1. G. E. Valley, H. Wallman, *Vacuum Tube Amplifiers,* M.I.T. Rad. Lab. Series No. 18, McGraw-Hill Book Co., N. Y., 1948, p. 211.

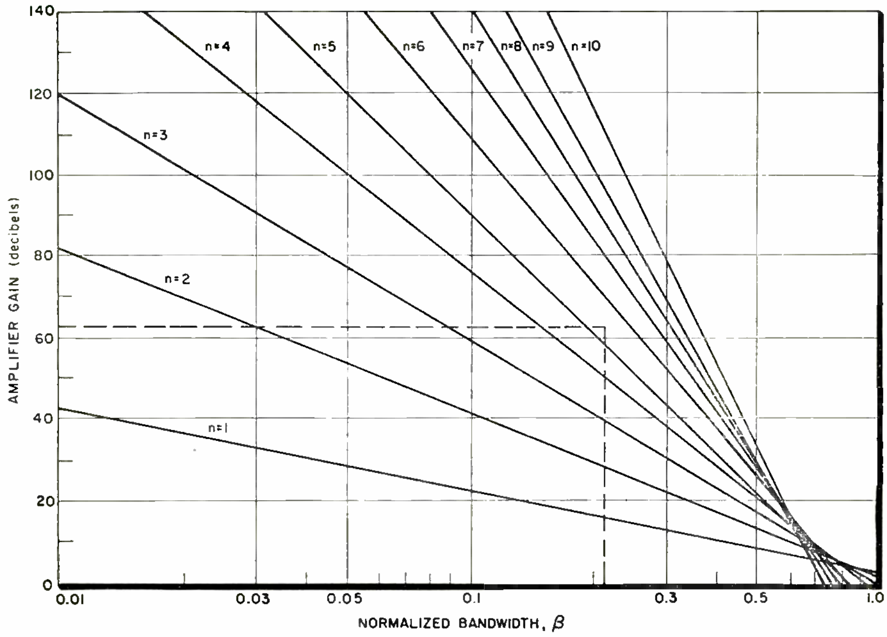


Fig. 2: Curves for n cascaded Type I, equal damping, maximally-flat interstages.

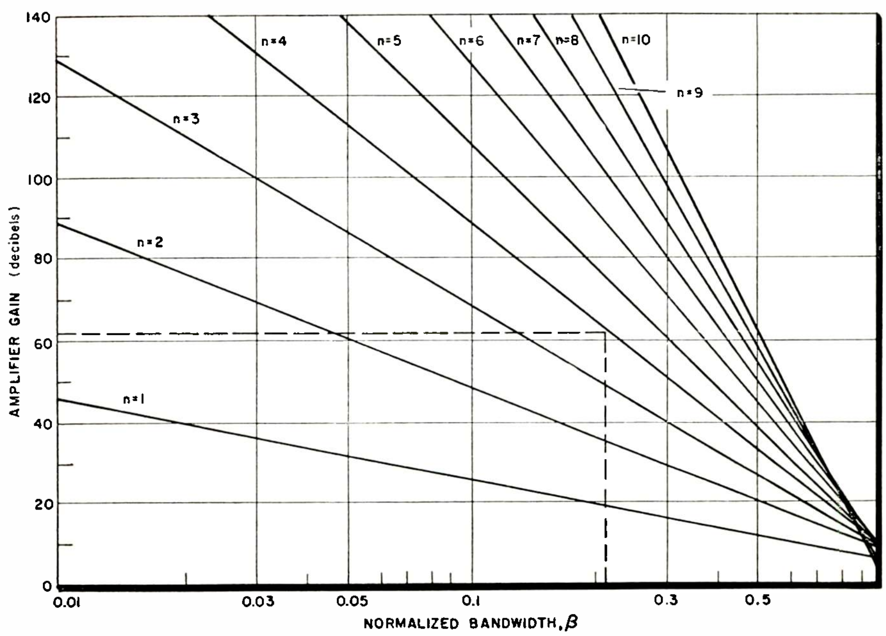


Fig. 3: Curves similar to Fig. 2 except for use with Type II amplifier interstages.

A_n can be expressed in decibels by taking 20 $\log_{10} A_n$. The results are:

$$A_n\,(\text{db}) = 3n + 5n \log_{10}(2^{1/n} - 1) - 20n \log_{10}\beta, \qquad \text{Type I}$$

$$A_n\,(\text{db}) = 6n + 5n \log_{10}(2^{1/n} - 1) - 20n \log_{10}\beta, \qquad \text{Type II}$$

If β is plotted horizontally on a logarithmic scale, and A_n(db) is plotted vertically, each value of n will determine a straight line. Families of such lines are plotted in Figs. 2 and 3.

The credit for using a logarithmic horizontal scale and a decibel vertical scale to get straight line plots must go to B. A. Wightman[2] who drew such lines for cascades of maximally flat amplifiers, each amplifier consisting of stagger-tuned single-tuned circuits. Wightman also gives the formulas for A_n without deriving them and without providing charts for the double tuned circuits.

2. B. A. Wightman, "A Graphical Method for Determining the Number and Order (N) of N-uples in Stagger Tuned Amplifier Design," Report ERA-212, National Research Council of Canada, Radio and Electrical Engineering Division, December, 1951.

* * *

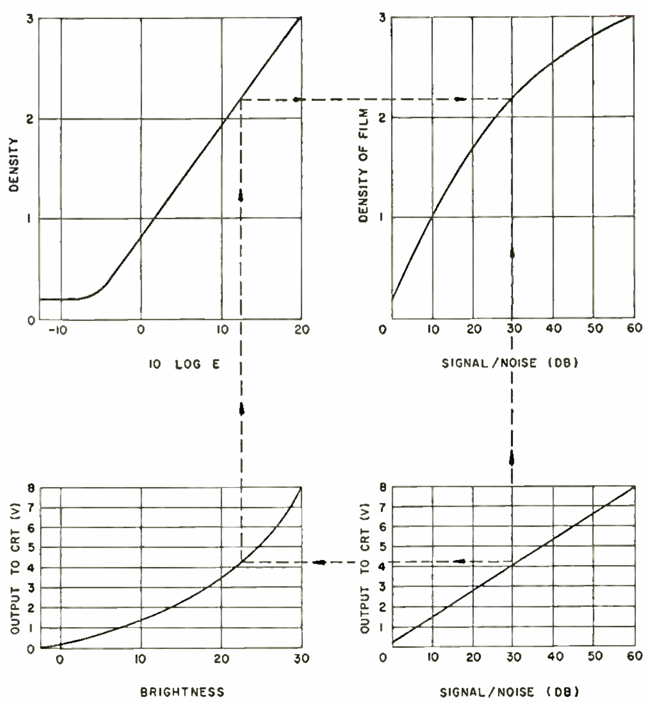
By **DR. DANIEL LEVINE**
Consulting Engineer
3826 North 55th Drive
Glendale, Arizona

Selection of the dynamic compression curve for a radar receiver is a system problem influenced by several factors. A discussion of some of these factors is included with a graphical analysis of the different types of receivers.

Dynamic Compression for Radar Receivers

Part Two of Two Parts

Fig. 8: The procedure for determining the film density.



Photographic Recording

a. General—The discussion of the preceding was devoted to receiver performance in terms of CRT brightness. The implication was that a human observer was utilizing the displayed information. If, however, the output of the CRT is to be recorded on film, the characteristics of the film must be taken into account.

b. Linear Density Receiver — The procedure for determining film density is illustrated in Fig. 8, which is drawn for the lin-log receiver discussed earlier. The H and D curve in the upper left quadrant has 10 log (exposure) for its abscissa rather than the usual log (exposure); thus, its units match those of the brightness scale in the lower left equadrant.[7f] The basis for this correlation of scales is the equation

$$\begin{aligned} 10 \log (\text{exposure}) &= 10 [\log (\text{intensity}) + \log (\text{time})] \\ &= \text{brightness} + 10 \log (\text{time}). \end{aligned} \quad (25)$$

Consequently, if the signal duration is independent of its intensity, the scales can be matched. In Fig. 8 the density of 3.0 was arbitrarily set to coincide with a brightness of 30, and the curve was drawn to scale according to Eq. 25[g] Since many measurements of radar films developed to realize this H and D curve have shown a peak density of 2.2, some justification of this step is necessary. The higher value of density,

[f] Since the standard H and D curve does not include the effect of camera flare, Jones and Condit employ a modified curve in their analysis of photographic images (*e. g.*, Fig. 324, p. 916). Since a suitable flare factor has not been determined, this refinement was not included.

while admittedly arbitrary, can be approached by the following means: (1) employing a lens having a wider aperture, (2) using faster film, and (3) increasing the anode potential, since intensity is given by Lenard's equation,[8h] light intensity $\propto$ $I(V - V_o)$, where I is the anode current, V is the anode potential, and V_o is the lowest anode potential at which phosphorescence is observed. Of course, a different film type or an increase of anode potential would change the curves of Fig. 8, and the details of this discussion would be altered. These considerations emphasize the "systems" nature of the problem of specifying dynamic compression.

Using the method outlined above, density curves for the receivers described earlier were prepared (Fig. 9). The toe of the H and D curve depresses the low-signal ends of these curves as compared with the low-signal ends of the curves shown in Fig. 7.

A new receiver, the linear density receiver, appears as a straight line between the end points of the lin-log receiver. By performing in reverse order the steps indicated in Fig. 8, the dynamic compression curve for this receiver may be obtained.

To apply photographic recording methods to a system, it is necessary to obtain both CRT- and film-characteristic curves. Neither curve is readily

[g] After completion of this section it was realized that a more reasonable procedure would be to associate points at the low density portion of the film, or else to position the H and D curve so that both toe and shoulder are within the range of the exposure interval. Consequently, the statement in the summary of this report is in accordance with this footnote rather than with the main text.

[h] See Eq. 15.18, p. 427.

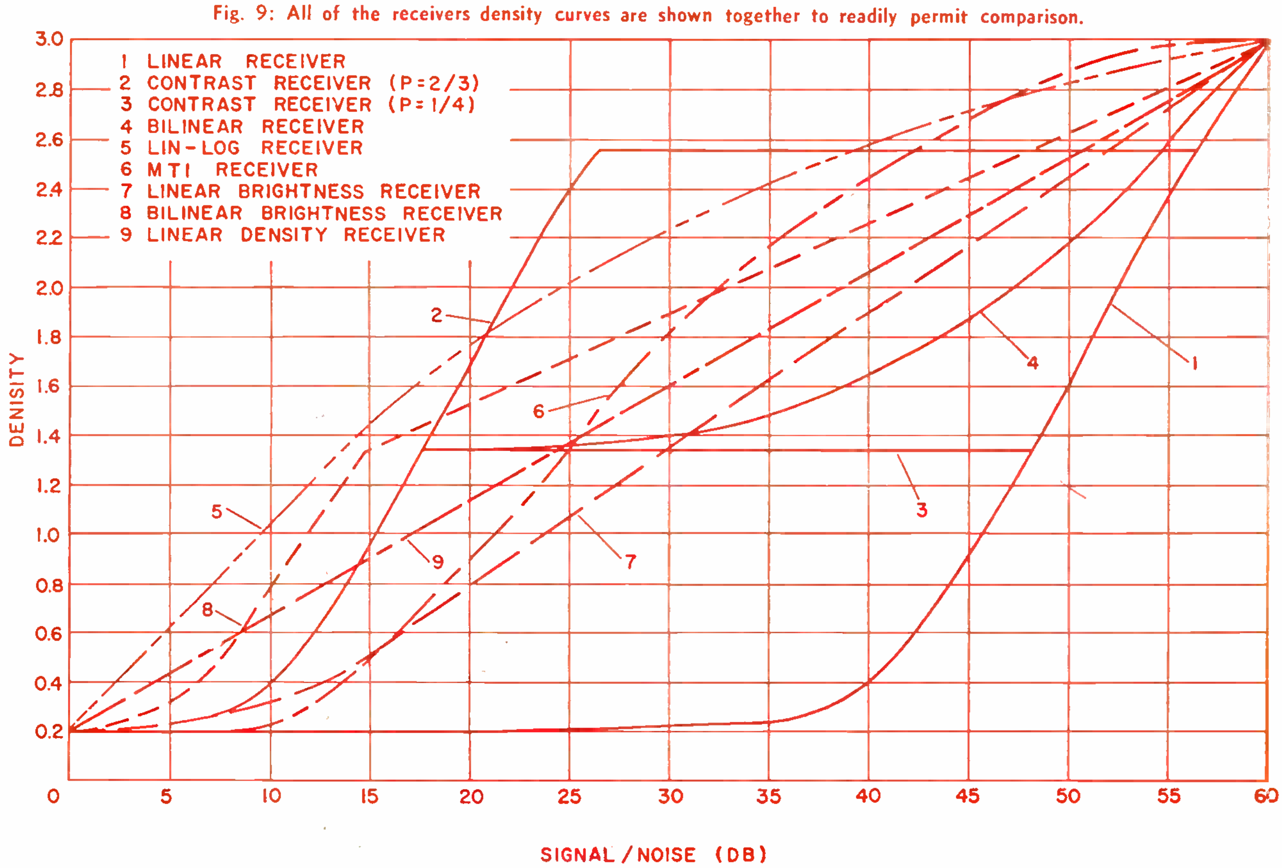
List of Symbols

- D = dynamic range of the input signal, expressed in db above noise of the maximum signal level.
- G_L = voltage gain in a linear receiver.
- I = anode current.
- P = plateau level in contrast receiver, expressed as voltage ratio $v_{oM'}/v_{oM}$.
- V = anode voltage.
- V_o = lowest anode voltage at which phosphorescence is observed.
- v_i = input voltage to receiver.
- v_{ic} = input voltage at the crossover from linear to logarithmic compression of a lin-log receiver.
- v_{iM} = maximum input voltage.
- $v_{iM'}$ = maximum input voltage before "plateau saturation" of a contrast receiver or for change of slope of a bilinear receiver.
- v_{iN} = input noise voltage to receiver.
- v_o = output voltage of the receiver measured at the cathode-ray tube.
- v_{oc} = output voltage at the crossover from linear to logarithmic compression of a lin-log receiver.
- v_{oM} = maximum output voltage, determined by saturation of the crt.
- $v_{oM'}$ = output voltage for "plateau saturation" of contrast receiver.
- v_{oN} = output noise voltage.

measured, and their association also offers difficulty. All problems of this type disappear if measurements of CRT grid voltage against film density are made directly, with use being made of the actual indicator and optical system for the installation. If measurements are made in this way the influence of spectral response, reciprocity failures, periscope mirrors, sweep speed, pulse-repetition rate, scan speed, lens aperture, *etc.*, are all included in the result.

(*Continued on following page*)

Fig. 9: All of the receivers density curves are shown together to readily permit comparison.



Dynamic Compression *(Concluded)*

When the receiver performance has been carried through to include the negative there is no difficulty in extending the analysis to cover a positive print or transparency. Since this subject has been treated[7] it will not be discussed here. With the background of a linear brightness and a linear density receiver it is obvious that no difficulty would be experienced in describing a receiver that is linear in terms of the print characteristics.

Summary

Selection of the dynamic compression curve for a receiver is a system problem influenced by the strength of important targets and their relative frequency of occurrence, as well as by whether the display is to be viewed by a human observer or recorded on film, and whether an image on the negative is to be analyzed directly or printed on film or paper. In short, system compression must be selected before the receiver compression can be decided.

If, for the purposes of this summary, it is assumed that the desired system behavior is that of a linear density type, the following steps must be taken to obtain the receiver dynamic compression curve:

1. A set of curves must be obtained for density vs. grid voltage applied to the CRT for different development times, using the following: (1) the specified indicator (or equivalent), phosphor, sweep speed, prf, and scan speed; (2) the specified optical system, including periscope mirrors, filters, and camera lens; and (3) the specified film, developer, and developing procedure.
2. From the set of curves obtained, one is selected on the basis of having a satisfactory range of densities, with the lowest usable density occurring at a fairly low drive voltage. If no curve is suitable, it is necessary to redesign the indicator or the optical system before proceeding to the next step. The curve selected is placed in the upper left quadrant (Fig. 10).
3. With selected minimum and maximum densities, the linear density system response may be drawn in the upper right quadrant, based on the specified dynamic range of signals.
4. The mean noise voltage is computed, based on the receiver specification. The difference between this value and the voltage corresponding to the minimum density is the bias voltage to be applied to the CRT. This information permits the drawing of the lower left quadrant of Fig. 10.
5. The receiver compression curve follows by simple point plotting, with the final result being placed in the lower right quadrant.

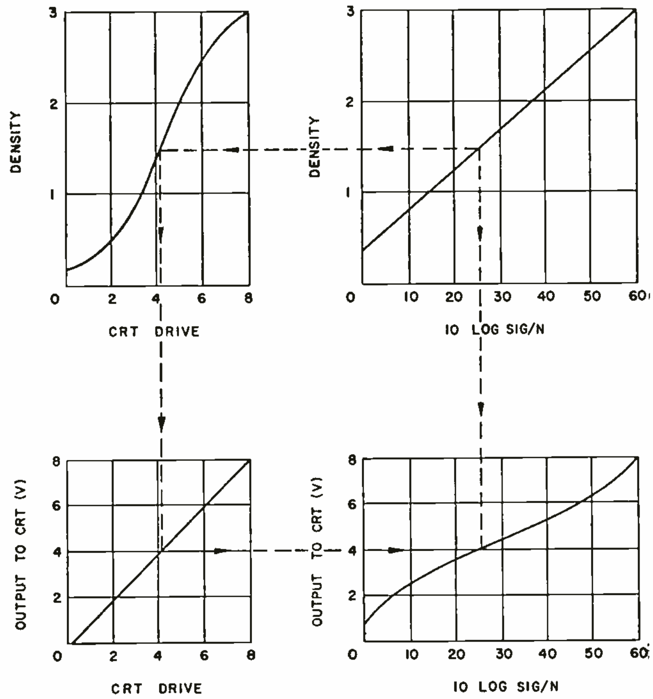


Fig. 10: Finding receiver compression for a linear density receiver.

References

1. Kober, C. L.: *Theory of Airborne Radar Receiver Characteristics.* Display Section report No. DU-49, WADC, January 1953.

2. Ranken, H. B.: *Determination of Width and Luminance of a Cathode-Ray-Tube Trace.* Tech. report No. 52-258. WADC, September 1952.

3. Sweet, A. L.; and Bartlett, N. R.: "Visibility on Cathode-Ray Tube Screens," *Journal of the Optical Society of America,* April 1948; vol. 38, pp. 329-337.

4. Haines, J. H.: "Contrast in Cathode-Ray Tubes," *Tele-Tech and Electronic Industries,* June 1953.

5. Van Voohis, S. N.: *Microwave Receivers,* MIT Rad Lab Series No. 23. New York, McGraw-Hill Book Co., Inc., 1948.

6. Cedrone, N. P.: *Study of Radar Receiver Gain Characteristics.* Speech delivered at IRE Airborne Electronics Conference, Raytheon Manufacturing Company, Dayton, O., January 1952.

7. Mees, C. E. K. (ed.): *The Theory of the Photographic Process.* 2nd ed., New York, The MacMillon Company, 1954.

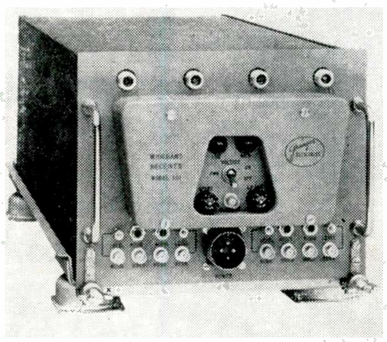
8. Spangenberg, K. R.: *Vacuum Tubes.* New York, McGraw-Hill Book Co., Inc., 1948.

CLOSED-CIRCUIT TV as a teaching aid is encountering mixed reactions. The report on the first year of a three-year experiment in Chicago City Junior College enthusiastically recommends closed-circuit TV, points out the students were hardworking and enthusiastic and appear to be more strongly motivated than the regular in-class students. Their average age was 35, sixteen years beyond the average age of day students. The college courses were being offered over open-circuit television. One of the significant points in the report was that college instruction was being made available to students who normally would be unable to attend college classes. Another experiment, at Los Angeles City College, and using closed-circuit TV for classroom instruction has been termed "a costly failure." It was a complete reversal from a preliminary find made last fall after the first year of the 3-year pilot study. The report by the City Board of Education said that the system had "devitalized teaching" and did not help to alleviate the teacher shortage. In the experiment a single instructor was simultaneously lecturing to 500 students. The monitor, however, was present. The report suggested that the detached classroom would have been better off if the monitor had been employed in active instruction.

New Products . . . for the Electronic Industries

WIDE-BAND RECEIVER

The Model 301 is a high-sensitivity receiver for intercept and analysis of pulsed signals over wide frequency ranges. Comprised of 4 traveling wave tube pre-amplifier-crystal video

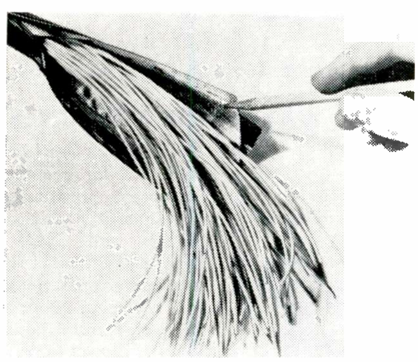


channels, the receiver provides coverage of the 1000 to 12,000 MC spectrum. Total frequency coverage is divided in three 2:1 bands and one 1.5:1 band. Each channel provides a stretched (300 µsec) output for recording and aural monitoring, and an unstretched output for pulse width and prf analysis. Granger Assoc., 966 Commercial St., Palo Alto, Calif.

Circle 203 on Inquiry Card, page 149

ZIPPERTUBING

A copper shielding method which supplies a copper shield and a jacket for wires in a single operation is now available. Copper shielded zipper-tubing is closed by a plastic or metal zipper track and thus may be zipped around wires and cables. For regular r-f shielding, either the copper or an aluminum foil is laminated to a vinyl saturated fiberglas to provide grounding of r-f interference. For magnetic shielding, Co-netic

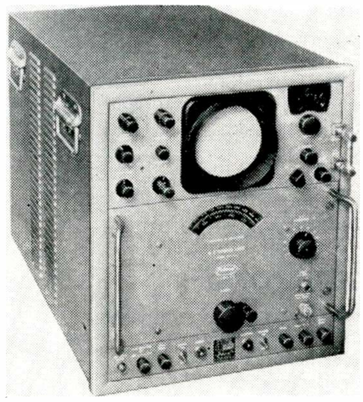


steel laminated between layers of insulating materials is also available. Zippertubing Co., 752 S. San Pedro St., Los Angeles, Calif.

Circle 204 on Inquiry Card, page 149

SPECTRUM ANALYZER

A new microwave analyzer having wide dispersion has been developed. The Model TSA-W permits visual analysis of microwave pulse signals in the 10 to 44,000 MC range. It

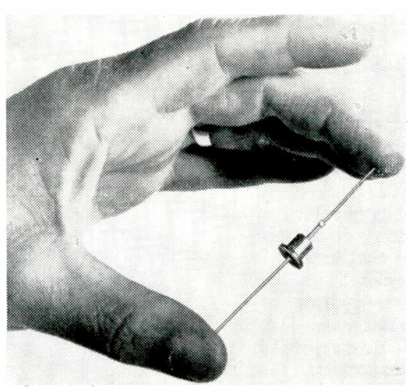


analyzes pulses as short as 0.1 microseconds. The instrument provides frequency dispersion up to 70 MC. It may be used for all microwave spectrum analysis work. For wide pulse analysis the instrument provides a narrower display bandwidth with 7 KC resolution. It features a logarithmic amplitude display. Polarad Electronics Corp., 43-20 34th St., Long Island City, N. Y.

Circle 205 on Inquiry Card, page 149

SILICON RECTIFIER

The addition of a new member to their low current silicon rectifier family has been announced. Designated as the "H" series, this "top hat" type hermetically sealed silicon rectifier features a welded case and extra heavy duty junction for high reliability. Ratings range from 100 to 600 peak inverse volts and 750 ma at 55° C. In addition to its small size, the low price resulting from mass production, and availability from

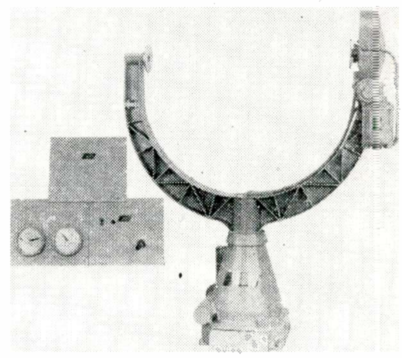


stock of many ratings should make this a popular low current rectifier. Sarkes Tarzian, Inc., Bloomington, Indiana.

Circle 206 on Inquiry Card, page 149

ANTENNA ROTATOR

A high speed, power-driven rotator for microwave antennas, the VAR Variable Speed Antenna Rotator, is now available. The device accommodates antennas up to 200 lb. It will

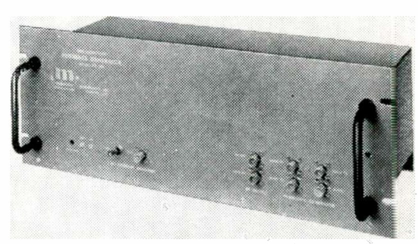


simultaneously tilt the antenna up to 180° and rotate 370° at variable speeds up to 30° per second. The rotator is remotely operated by means of a variac control and joy stick. Position indicators for both azimuth and tilt are in the control panel. It is built for service under severe weather conditions. Houston Fearless Corp. 11813 W. Olympic Blvd., Los Angeles, Calif.

Circle 207 on Inquiry Card, page 149

REFERENCE GENERATOR

The Manson Model RD-170 generates both sinusoidal frequencies of 100 MC and 1000 MC and harmonic signals covering a major portion of the microwave spectrum. Output frequency stability is governed solely by the stability of a 1 MC signal which it uses for a reference. The unit is intended for use as a precise source for reference, monitoring, or calibrating purposes. The power delivered is 100 mw across 50 ohms.

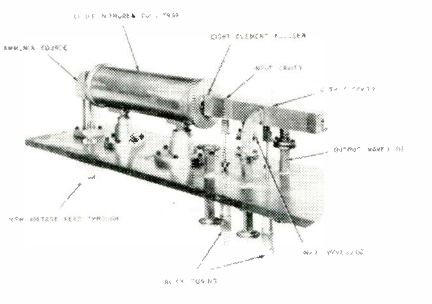


The generator employs crystal synthesizer design techniques. Manson Labs., Inc., P. O. Box 594, Stamford, Conn.

Circle 208 on Inquiry Card, page 149

New Microwave Products

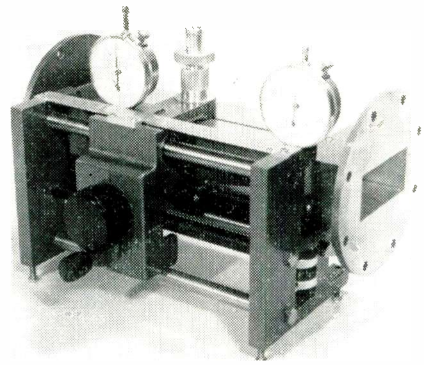
"ATOMIC" AMPLIFIER



The "atomic" amplifier, shown demonstrates the possible uni-lateral (one-way) gain in microwave energy of two electrically isolated cavities which are connected only by a beam of neutral ammonia gas molecules without aid of electronic effects. Philco Corp.

Circle 161 on Inquiry Card, page 149

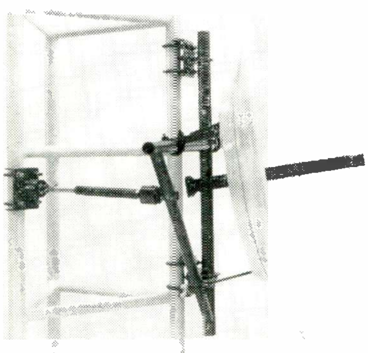
SLOTTED LINE



Designed primarily to cover 2600 to 40,000 MC using one carriage and appropriate slotted sections, the instrument features speed and ease of measurement at the testing bench. The carriage accommodates slotted sections ranging from Ka through S-Band. Sage Labs., Inc.

Circle 165 on Inquiry Card, page 149

"A" FRAME FOR REFLECTORS



A 3-point suspension mounting frame for spun aluminum parabolic reflectors can be adjusted independently. The 3 load points absorb equal wind forces and offer maximum resistance to antenna twisting with minimum tower reaction stresses. Gabriel Electronics Div.

Circle 162 on Inquiry Card, page 149

WAVEGUIDE WATERLOAD

A broad-band, power absorbing, waveguide waterload, the B-570, absorbs up to 400 watts of CW power over the frequency range of 4.95 to 10.5 KMC, and the VSWR is under 1.20 over this range. This represents a reflected power of under 1%. Bomac Laboratories, Inc.

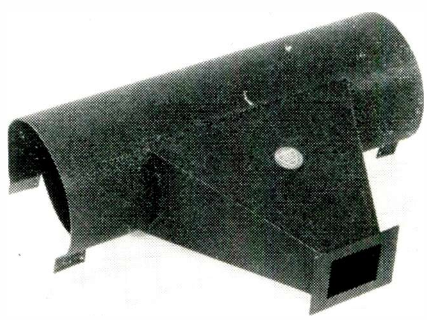
Circle 166 on Inquiry Card, page 149

IMAGE-REJECTION FILTER

Compact, single-section, dual mode filter designed for lower power use in X-band systems, employs two orthogonal TE_{111} modes. Filter provides performance equaling that of a two-section filter. Insertion loss is less than 1.0 db and VSWR is less than 1.20. Airtron Inc.

Circle 163 on Inquiry Card, page 149

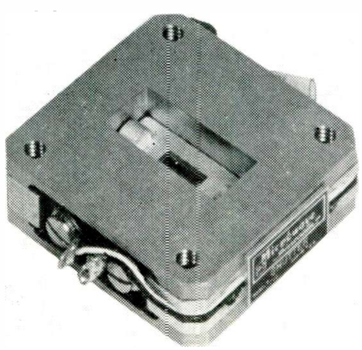
TRAVELING WAVE TUBE SHIELD



A ducted Netic traveling wave tube shield which directs the magnetic field developed by the enclosed solenoid structure, acts as a diversionary shield for fields originating in associated equipment, and provides more uniform cooling. Magnetic Shield Div. Perfection Mica Co.

Circle 167 on Inquiry Card, page 149

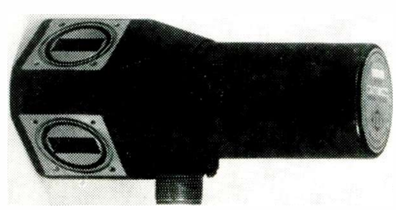
ROTARY WAVEGUIDE SHUTTER



Rotary waveguide shutter for use in RG-52/U X-band, exhibits greater than 30 db attenuation over the band. In the closed position, shutter sharply attenuates radar leakage power from nearby radars thus preventing degradation or burnout of diodes in radar receiver. Microwave Associates, Inc.

Circle 164 on Inquiry Card, page 149

WAVEGUIDE SWITCHES



Rotary waveguide switches for general purpose applications. These switches, No. 39375 and 39475, are designed for standby operations or reversing direction of transmission. They have 4 arms, one of which can be terminated in a dummy load. N.R.K. Mfg. & Engineering Co.

Circle 168 on Inquiry Card, page 149

New Microwave Products

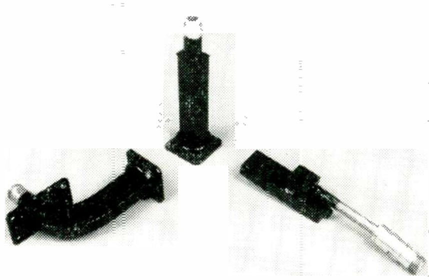
PRECISION WAVEGUIDE ATTENUATOR

Specifications for the Model DY 5029, which may be used as a laboratory or production instrument, include 0-100 db attenuation, ±2% accuracy, and an 8.2-12.4 KMC frequency range. The SWR is less than 1.15, max. power is 10 w average and 5 kw peak. Dymec, Inc.

Circle 169 on Inquiry Card, page 149

COAX TO WAVEGUIDE ADAPTERS

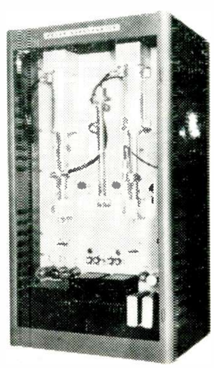
Adapters are for special applications where insufficient space is available for standard transitions. Illustrated are an "H" plane transition with a maximum height of ⅝ in. and an "E" plane transition with a maximum height of 1⅛ in. Temco Aircraft Corp.



Circle 170 on Inquiry Card, page 149

HETERODYNE REPEATER

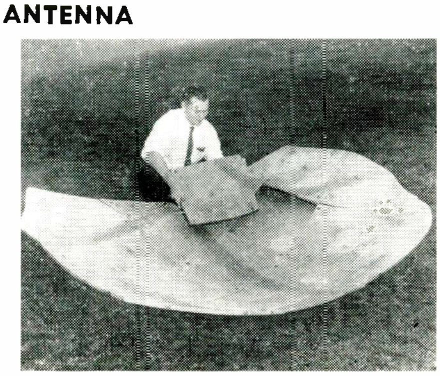
Heterodyne techniques are used in the 10 w RT-3 for TV intercity relaying, remote pickups, and TV-STL. The repeater relays visual and aural portions of a TV signal without demodulation and features crystal control. Meets color and monochrome standards. Adler Electronics, Inc.



Circle 171 on Inquiry Card, page 149

"TEW" RADAR ANTENNA

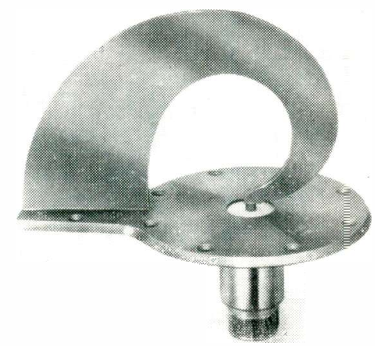
A scale model of the U. S. Marines' "TEW" (Tactical Early Warning) system antenna. The new system, one-quarter the size and weight of previous systems, has extended detection range and accuracy to pick up supersonic targets at extreme ranges. Sperry Gyroscope Company.



Circle 172 on Inquiry Card, page 149

SCIMITAR ANTENNA

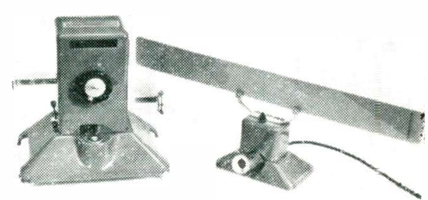
The Scimitar Antenna is a linearly polarized antenna that provides coverages in both vertical and horizontal polarizations. It is designed to handle 500 w of CW power through a broadband, low residual VSWR, high efficiency matching network. Tamar Electronics, Inc.



Circle 173 on Inquiry Card, page 149

X-BAND MICROWAVE WATTMETER

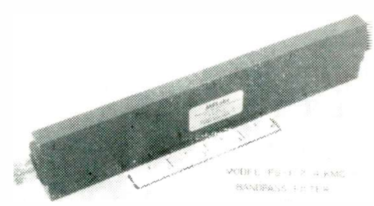
The Type U-182 is a portable, double-vane, torque-operated, feed-through wattmeter for use with X-band waveguide, size 16. Measurements can be made in the power range of 10 to 200 w over the frequency range of 8690 to 9840 MC. Wayne Kerr Corp.



Circle 174 on Inquiry Card, page 149

OCTAVE BANDPASS FILTER

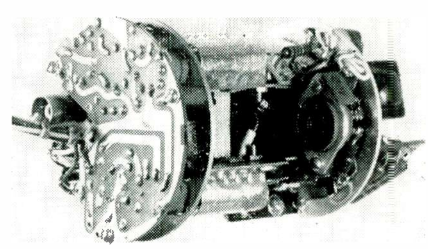
The Model FS-1 covers the 2 to 4 KMC band with less than one db insertion loss in the pass band and greater than 50 db attenuation down to dc and up through the X-band. The filter is used in broadband microwave systems, e.g., eliminating spurious outputs from TWT circuits. Melabs Inc.



Circle 175 on Inquiry Card, page 149

S-BAND MICROWAVE BEACON

A subminiaturized Radar Beacon Receiver - Transmitter is a redesigned, ruggedized version of the AN/DPN19, designed to conform to MIL-E-8189 and MIL-1-6181 and to withstand the severe environmental requirements of supersonic airborne vehicles. Resdel Engineering Corporation.



Circle 176 on Inquiry Card, page 149

ELECTRONIC INDUSTRIES'

1959 Directory of Microwave Equipment Manufacturers

Latest compilation provides names and addresses of companies who make the principal microwave products for today's markets.

AMPLIFIERS

Admiral Corp 3800 W Cortland St Chicago 47 Ill

Aeronca Mfg Corp Middletown Ohio

Aircom Inc 354 Main St Winthrop Mass

Airtron Inc 1108 W Elizabeth Ave Linden N J

Alfred Electronics 897 Commercial St Palo Alto Calif

Amerac Inc 116 Topfield Rd Wenham Mass

Amerac Inc Dunham Rd Beverly Mass

American Electronic Laboratories 121 N 7th St Philadelphia 6 Penna

American Machine & Foundry Co General Eng'g Labs 11 Bruce Pl Greenwich Conn

American Microwave Corp 11754 Vose St N Hollywood Calif.

Antennavision Inc 2949 W Osborn Phoenix Ariz

A R F Products Inc P O Box 57 Ranton N M

Andicon Electronics Inc 216 Lyon St Paterson 4 N J

Avion Div ACF Industries Inc 11 Park Pl Paramus N J

Bolton Laboratories Inc W Main St Bolton Mass

Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif

Clegg Laboratories Div Clegg Inc Ridgedale Ave Morristown N J

Collins Radio Co 855 35th St N E Cedar Rapids Iowa

Continental Electronics Mfg Co 4212 S Buckner Blvd Dallas 27 Texas

Control Electronics Co Inc 1925 New York Ave Huntington Sta N Y

Dynamic Electronics Inc 73-29 Woodhaven Blvd Forest Hills N Y

Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif

Farnsworth Electronic Co Div I T & T 3702 E Pontiac St Ft Wayne Ind

F-R Machine Works Inc Electronic & X-Ray Div 26-12 Borough Pl Woodside 77 NY

Gabriel Electronics Div Gabriel Co 135 Crescent Rd Needham Heights 94 Mass

General Electric Co Communications Product Dept P O Box 1122 Syracuse N Y

Granger Associates 966 Commercial St Palo Alto Calif

Gulton Industries Inc 212 Durham Ave Metuchen N J

Haller Raymond & Brown Circleville Rd State College Penna

Hazeltine Electronics Div Hazeltine Corp 59-25 Little Neck Pkwy Little Neck 62 N Y

Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif

International Research Associates 2221 Warwick Ave Santa Monica Calif

J-V-M Engineering Co 4633 S Lawndale Ave Lyons Ill

Kearfott Co Inc 1378 Main Ave Clifton NJ

Lambda-Pacific Engineering Co 14725 Arminta St Van Nuys Calif

Levinthal Electronics Products Inc 3180 Hanover St Palo Alto Calif

Mathis Co G E 6100 S Oak Park Ave Chicago 38 Ill

Maxson Corp W L 475 10th Ave New York 18 NY

Menlo Park Eng'g 721 Hamilton Ave Menlo Park Calif

Microflect Co 2300 S 25th St Salem Ore

Microwave Eng'g Laboratories Inc 943 Industrial Ave Palo Alto Calif

Otis Elevator Co Electronic Div 35 Ryerson St Brooklyn 5 NY

Philco Corp Tioga & C Sts Philadelphia 24 Penna

Philco Corp G &I Div 4700 Wissahickon Ave Philadelphia 44 Penna

Polarad Electronics Corp 43-20 34th St Long Island City NY

Polytronic Research Inc 7660 Woodbury Dr Silver Springs Md

Pye Telecommunications Ltd New Market Rd Cambridge England

Radio Corp of America Commercial Electronic Products Front & Cooper Sts Camden NJ

Rauland-Borg Corp 3535 W Addison St Chicago 18 Ill

Resdel Eng'g Corp 330 S Fair Oaks Ave Pasadena Calif

R S Electronics Corp P O Box 368 Sta A Palo Alto Calif

Sierra Electronic Corp 3885 Bohannon Dr Menlo Park Calif

Spectralab Instruments 404 N. Halstead Ave Pasadena Calif

Sperry Gyroscope Co Microwave Electronics Div Great Neck NY

Standard Electronics Div Radio Eng'g' Laboratories 30 & Borden Sts Long Island City NY

Stavid Eng'g Inc U S Route 22 Plainfield NJ

Technical Oil Tool Corp 1057 N La Brea Los Angeles 38 Calif

Telerad Mfg Corp Route 69 Flemington NJ

Telerad Mfg Corp 1440 Broadway New York 18 NY

Uniwave Inc 109 Marine St Farmingdale NY

Varian Associates 611 Hansen Way Palo Alto Calif

Wave/Particle Corp P O Box 252 Menlo Park Calif

Westinghouse Electric Corp P O Box 868 Pittsburgh 30 Penna

White Electron Devices Inc Roger 92 4th Ave Haskell NY

COAXIAL CABLE

Accurate Insulated Wire Corp 25 Fox St New Haven 1 Conn

Aircom Inc 154 Main St Winthrop Mass

Aircom Inc 139 E 1st St Roselle NJ NY

Airtron Inc 1108 W Elizabeth Ave Linden NJ

Alpha Wire Corp 200 Varick St New York 14 NY

American Electric Cable Co 181 Appleton St Holyoke Mass

American Super-Temperatures Wires Inc West Canal St Winooski Vt

Amphenol Electronics Corp 1830 S 54 Ave Chicago 50 Ill

Anaconda Co 25 Broadway New York 4 NY

Andrew Antenna Corp 606 Beech St Whitby Ontario Can

Andrew California Corp 941 E Marylind Ave Claremont Calif

Andrew Corp 363 E 75 St Chicago 19 Ill

Ansonia Wire & Cable Co 111 Martin St Ashton RI

Avnet Electronic Supply Co 36 N Moore St New York 13 NY

Barker Sales Co 996 Edgewater Ave Ridgefield NJ

Bart Mfg Co 315 Seigel St Brooklyn

Beam Instruments Corp 350 5th Ave New York 1 NY

Belden Mfg Co 415 S Kilpatrick Chicago 44 Ill

(Continued on page 92)

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.*

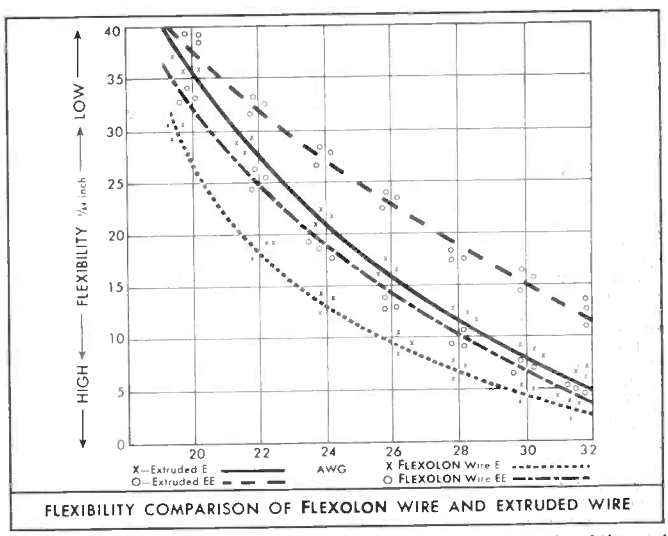
FLEXOLON hook-up wire with R/M "Teflon" tape proves most flexible

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.



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

Circle 48 on Inquiry Card, page 149

Directory of Microwave Manufacturers (cont)

Birnbach Radio Co 145 Hudson St New York 13 NY

Boston Insulated Wire & Cable Co 65 Bay St Dorchester Mass

Brand & Co William 41 North St Willimantic Conn

Budd Stanley Co 43-01 22nd St Long Island City 1 NY

Cable Electric Products 235 Daboll St Mt Vernon NY

Calcon Mfg Co 100 Oakland Ave Washington Pa

Chester Cable Corp 1000 Top St Chester NY

Coaxial Connector Co 37 N 2nd Ave Mt Vernon NY

Coleman Cable & Wire Co 3919 Wesley Terr Schiller Park Ill

Columbia Wire & Supply Co 2850 Irving Park Rd Chicago 18 Ill

Consolidated Wire & Associated Cos 1635 S Clinton St Chicago 16 Ill

Continental Wire Corp Wallingford Conn

DeMornay-Bonardi Corp 780 S Arroyo Pkwy Pasadena Calif

Diamond Antenna & Microwave Corp 2517 E Norwich St Milwaukee Wisc

Dielectric Materials Co 5315-17 N Ravenswood Ave Chicago 40 Ill

Dittmore-Freimuth Corp 2517 E Norwich St Milwaukee 7 Wisc

Douglas Microwave Co 252 E 3 St Mt Vernon NY

Electrical & Physical Instrument Corp 42-19 27 St Long Island City 1 NY

Electro-Physics Labs 2065 Hunting-ton Dr San Marino Calif

Federal Cable Div Royal Electric Corp 95 Grand Ave Pawtucket RI

F-R Machine Works Inc Electronic & X-Ray Div 26-12 Borough Pl Woodside 77 NY

Gavitt Wire & Cable Co Central St Brookfield Mass

General Cable Co 420 Lexington Ave New York 17 NY

General Insulated Wire Works 69 Gordon Ave Providence 5 RI

General Radio Co 275 Massachusetts Ave Cambridge 39 Mass

General RF Fittings Inc 702 Beacon St Boston 15 Mass

Gulton Industries Inc 212 Durham Ave Metuchen NJ

Hallett Mfg Co 5910 Bowcraft St Los Angeles Calif

Haveg Industries Inc 900 Greenbank Rd Wilmington 8 Dela

Hitemp Wires Inc 1200 Shames Ave Westbury NY

Industrial Accessories Inc Line Rd Matawan NJ

Instruments Inc 122 N Madison St Tulsa Okla

International Telemeter Corp 200 Stoner Ave Los Angeles 25 Calif

Jefferson Products Corp Pleasant Valley Rd Sutton Mass

JFD Electronic Corp 6101 16 Ave Brooklyn 4 NY

Kaiser Aluminum & Chemical 919 N Michigan Ave Chicago Ill

Kings Electronics Co Inc 40 Marbledale Rd Tuckahoe NY

Lenz Electric Mfg Co 1751 N Western Ave Chicago 47 Ill

Lewis Eng'g Co 339 Church St Naugatuck Conn

Lieco Inc 3610 Oceanside Rd Oceanside NY

Meridian Metalcraft Inc 8739 S. Millergrove Dr Whittier Calif

Microdot Inc 220 Pasadena Ave S Pasadena Calif

Microlab Okner Pkwy Livingston NJ

Microtech Inc 2975 State St Hamden 17 Conn

Mohawk Wire & Cable Corp 320 River St Fitchburgh Mass

Mutual Electronic Industries Corp 85 Beechwood Ave New Rochelle NY

N R K Mfg & Eng'g Co 4601 W Addison St Chicago 41 Ill

Okonite Co 220 Passaic St Passaic NJ

Organic Development Corp 10052 Larson Ave Garden Grove Calif

Phalo Plastics Corp 530 Boston Twpk Worcester 8 Mass

Philadelphia Insulated Wire Co 200 N 3 St Philadelphia 43 Pa

Philco Corp G & I Div 4700 Wissahickon Ave Philadelphia Pa

Plastic Wire & Cable Corp Box 486 Jewett City Conn

Precision Tube Co Church Rd & Wisasahickon Ave North Wales Pa

Prodelin Inc 307 Bergen Ave Kearny NJ

Progress Electronics Co 296 Broadway New York 7 NY

Pye Telecommunications Ltd Newmarket Rd Cambridge England

Radar Design Corp 2360 James St N Syracuse 12 NY

Radio Corp of America Commercial Electronics Products Front & Cooper Sts Camden NJ

Radio Corp of America Communications Products Dept Bldg 1-5 Camden NJ

Rego Insulated Wire Co 830 Monroe St Hoboken NJ

Revere Corp of America N Colony Rd Wallingford Conn

Rex Corp Hayward Rd W Acton Mass

Rockbestos Products Corp Nicoll & Canner Sts New Haven Conn

Sanders Associates 95 Canal St Nashua NH

Saxton Products Inc 1661 Boone Ave New York 60 NY

Sequoia Wire 2201 Bay Rd Redwood City Calif

Sperry Gyroscope Co Microwave Electronics Div Great Neck NY

Standard Wire & Cable Co 3440 Overland Ave Los Angeles 34 Calif

Super Electronics Corp 53 Worth St New York 13 NY

Superior Insulated Wire Co Route 9W W Haverstraw NY

Surprenant Mfg Co 172 Sterling St Clinton Mass

TA-Mar Inc 11571 W Jefferson Blvd Culver City Calif

Technicraft Labs Inc Thomaston-Waterbury Rd Thomaston Conn

Telegraph Construction & Maintenance Co Ltd Mercury House Theobalds Rd London W C 1 England

Telerad Mfg Corp Route 69 Flemington NJ

Telerad Mfg Corp 1440 Broadway New York 18 NY

Tenna Mfg Co 7580 Garfield Blvd Cleveland 25 Ohio

Tensolite Insulated Wire Co 198 Main St Tarrytown NY

Time Electronic Sales 373 Broadway New York 13 NY

Times Wire & Cable Co Aff Int'l Silver Co 358 Hall Ave Wallingford Conn

Union Electronics & Machine Corp 71 Broadway Wakefield Mass

Union Plastic Corp Wire & Cable Div 1627 Paterson Plank Rd Secaucus NJ

Univox Corp 102 Warren St New York 17 NY

U S Wire Cable Co Progress & Monroe Sts Union NJ

Victor Electric Wire & Cable Corp 618 Main St W Warwick RI

Victor RF & Microwave Co 36 W Water St Wakefield Mass

Walworth Co 750 3rd Ave New York 17 NY

Waveline Inc P O Box 718 Caldwell NJ

CONNECTORS

Antenna	**1**
Coaxial Cable	**2**

2—**Accurate Insulated Wire Corp** 25 Fox St New Haven 1 Conn

1—**ACF Industries Nuclear Products —Erco Div** 48 Lafayette St Riverdale Md

1—**Adler Electronics Inc** 1 Lefevre New Rochelle NY

1—**Admittance Nameo Corp** Marine St Farmingdale LI NY

1—**Ainslie Corp** 312 Quincy Ave Quincy 69 Mass

1—**Airborne Instruments Lab Inc** 160 Old County Rd Mineola NY

1—**Aircom Inc** 354 Main St Winthrop Mass

1—**Aircom Inc** 139 E 1st St Roselle NJ

1 & 2—**Airtron Inc** 1108 W Elizabeth Ave Linden NJ

1—**Alford Mfg Co** 299 Atlantic Ave Boston 10 Mass

2—**Alpha Wire Corp** 200 Varick St New York 14 NY

2—**American Electric Cable Co** 181 Appleton St Holyoke Mass

1—**American Electronic Labs** 121 N 7th St Philadelphia 6 Pa

1—**American Machine & Foundry Co** Gen Eng'g Labs 11 Bruce Pl Greenwich Conn

1—**American Machine & Foundry Co Defense Products Group** 1101 N Royal St Alexandria Va

1—**American Microwave Corp** 11754 Vose St N Hollywood Calif

2 — **American Super-Temperatures Wires Inc** West Canal St Winooski Vt

1 & 2—**Amphenol Electronics Corp** 1830 S 54 Ave Chicago 50 Ill

2—**Anaconda Co** 25 Broadway New York 4 NY

1 & 2—**Andrew Antenna Corp** 606 Beech St Whitby Ontario Can

1 & 2—**Andrew Calif Corp** 941 East Marylind Claremont Calif

1 & 2—**Andrew Corp** 363 E 75 St Chicago 19 Ill

2—**Ansonia Wire & Cable Corp** 111 Martin St Ashton RI

1—**Antenna & Radome Research Assoc** 1 Bond St Westbury NY

1—**Avion Div ACF Industries Inc** 11 Park Pl Paramus NJ

2—**Avnet Electronic Supply Co** 36 N Moore St New York 13 NY

2—**Barker Sales Co** 996 Edgewater Ave Ridgefield NJ

1—**Barkley & Dexter Labs** 500 Frankfort St Fitchburg Mass

1—**Bart Mfg Corp** 227 Main St Belleville NJ

2—**Beam Instruments Corp** 350 5th Ave New York 1 NY

2—**Belden Mfg Co** 415 S Kilpatrick Chicago 44 Ill

1—**Bell Aircraft Corp** P O Box 1 Buffalo 5 NY

2—**Birnbach Radio Co** 145 Hudson St New York 13 NY

1—**Blaine Electronetics Inc** 14757 Keswick St Van Nuys Calif

1—**Blaw-Knox Co/Blaw-Knox Equip Div** Pittsburgh 38 Pa

1—**Bogart Mfg Corp** 315 Seigel St Brooklyn 6 NY

1—**Bogart Mfg Corp/Div General Bronze Corp** 200 Central Ave Newark 3 NJ

2—**Boston Insulated Wire & Cable Co** 65 Bay St Dorchester Mass

1—**Brach Mfg Corp/Div General Bronze Corp** 200 Central Ave Newark 3 NJ

2—**Brand & Co William** 41 North St Willimantic Conn

1—**Budd Stanley Co** 43-01 22 St Long Island City NY

1—**Budelman Radio Corp** 375 Fairfield Ave Stamford Conn

2—**Calcon Mfg Co** 100 Oakland Ave Washington Pa

1—**California Technical Industries Div Textron Inc** 1421 Old County Rd Belmont 10 Calif

1—**Canoga Corp** 5955 Sepulveda Blvd Van Nuys Calif

1—**Ceramatronics Inc** 364 Highland Ave Passaic NJ

2—**Chester Cable Corp** 1000 Top St Chester NY

1—**Chu Associates P O Box** 387 Whitcomb Ave Littleton Mass

1—**Coaxial Connector Co** 37 N 2 Ave Mt Vernon NY

2—**Coleman Cable & Wire Co** 3919 Wesley Terr Schiller Park Ill

1—**Collins Radio Co** 855 35 St N E Cedar Rapids Iowa

2—**Columbia Wire & Supply Co** 2850 Irving Park Rd Chicago 18 Ill

2—**Consolidated Wire & Associated Cos** 1635 S Clinton St Chicago 16 Ill

2—**Continental Wire Corp** Wallingford Conn

1—**Convair-San Diego** P O Box 1950 San Diego 12 Calif

1—**Dalmo Victor Div Textron Inc** 1515 Industrial Way Belmont Calif

1—**Defiance Eng'g & Microwave Corp** Beverly Airport Beverly Mass

1—**Demornay-Bonardi Corp** 780 S Arroyo Pkwy Pasadena Calif

1—**Diamond Antenna & Microwave Corp** 7 North Ave Wakefield Mass

2—**Dielectric Materials Co** 5315-17 N Ravenswood Ave Chicago 40 Ill

1—**Dielectric Products Eng'g Co** Raymond Me

1—**Dittmore-Freimuth Corp** 2517 E Norwich St Milwaukee 7 Wisc

1—**Dorne & Margolin** 29 New York Ave Westbury NY

1—**Douglas Microwave Co** 252 E 3 St Mt Vernon NY

1—**D & S Mfg Co** 424 Burk Ave Ridley Park Pa

1—**Dwyer Engineering Co** Pine St Ext Nashua NH

(Continued on page 94)

Simply slide together
and lock with thumbscrew on back.

New Triplett Unimeters

Decrease Inventory Cost... Increase Flexibility

With the New Select-Your-Range Triplett Unimeters two basic meter movements can be combined with any number of Dial-Component units for a wide variety of panel meter ranges—you can even create your own ranges with available dial blanks by following simple instructions furnished.

Since the basic movement accounts for the greater part of the meter cost—you can have a much more flexible inventory by stocking the minimum number of basic meter movements and a large variety and maximum quantity of the inexpensive Dial-Components.

Unimeter features are: self-shielded Bar-Ring movements: AC and DC linear scales • extreme accuracy • dustproof construction • error proof assembly • instant conversion • standard mounting.

For complete details see your Electronic Parts Distributor, or write

TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

Three Standard Kits, too. Kit A (makes 8 ranges), Kit B (makes 12 ranges), Kit C (makes 23 ranges).

1—**Dynamic Electronics Inc** 73-29 Woodhaven Blvd Forest Hills NY
2—**Electrical & Physical Instrument Corp** 42-19 27 St Long Island City 1 NY
1—**Electronic Specialty Co** 5121 San Fernando Rd Los Angeles 39 Calif
1—**Electron-Radar Products** 4806 W Chicago Ave Chicago 51 Ill
2—**Electro-Physics Labs** 2065 Huntington Dr San Marino Calif
1—**Emerson & Cuming Inc** 869 Washington St Canton 1 Mass
1—**Farnsworth Electrics Co Div IT & T** 3702 E Pontiac St Ft Wayne Ind
2—**Federal Cable Div Royal Electric Corp** 95 Grand Ave Pawtucket RI
1—**Federal Telecommunications Labs Div IT & T** 500 Washington Ave Nutley NJ
1—**Gabriel Electronics Div Gabriel Co** 135 Crescent Rd Needham Heights 94 Mass
2—**Gavitt Wire & Cable Co** Central St Brookfield Mass
1—**General Bronze Corp** 711 Stewart Ave Garden City NY
2—**General Cable Corp** 420 Lexington Ave New York 17 NY
2—**General Insulated Wire Works** 69 Gordon Ave Providence 5 RI
2—**General Radio Co** 275 Massachusetts Ave Cambridge 39 Mass
1—**General RF Fittings Inc** 702 Beacon St Boston 15 Mass
1—**Gombos Inc Co John** 111 Montgomery Ave Irvington 11 NJ
1—**Goodyear Aircraft Corp** 1210 Massillon Rd Akron 15 Ohio
1—**Granger Associates** 966 Commercial St Palo Alto Calif
1 & 2—**Gulton Industries Inc** 212 Durham Ave Metuchen NJ
1—**Haller, Raymond & Brown** Circleville Rd State College Pa
2—**Hallet Mfg Co** 5910 Bowcraft St Los Angeles Calif
2—**Haveg Industries Inc** 900 Greenbank Rd Wilmington 8 Dela
1—**Hazeltine Electronics Div/Hazeltine Corp** 59-25 Little Neck Pkwy Little Neck 62 NY
2—**Hitemp Wires Inc** 1200 Shames Ave Westbury NY
1—**Hoover Electronics Co** 112 W Timonium Rd Timonium Md
2—**Industrial Accessories Inc** Line Rd Matawan NJ
2—**Instruments Inc** 122 N Madison St Tulsa Okla
2—**International Telemeter Corp** 200 Stoner Ave Los Angeles 25 Calif
1—**I-T-E Circuit Breaker Co Special Products Div** 601 E Erie Ave Philadelphia 34 Pa
2—**Jefferson Products Corp** Pleasant Valley Rd Sutton Mass
2—**JFD Electronic Corp** 6101 16 Ave Brooklyn 4 NY
1—**J-V-M Eng'g Co** 4633 S Lawndale Ave Lyons Ill
2—**Kaiser Aluminum & Chemical Co** 919 N Michigan Ave Chicago Ill
1—**Kearfott Co Inc** 14844 Oxnard St Van Nuys Calif
1—**Kearfott Co Inc** 1378 Main Ave Clifton NJ
1—**Kelsey-Hayes Co** 3600 Military Ave Detroit 32 Mich
1—**Kennedy Co D S** 155 King St Cohasset Mass
1—**Kings Electronics Co Inc** 400 Marbledale Rd Tuckahoe NY
1—**Lambda-Pacific Eng'g Inc** 1475 Arminta St Van Nuys Calif
1—**La Point Industries Inc** 155 W Main St Rockville Conn
2—**Lenz Electric Mfg Co** 1751 N Western Ave Chicago 47 Ill
2—**Lewis Eng'g Co** 339 Church St Naugatuck Conn
1—**Lieco Inc** 3610 Oceanside Rd Oceanside NY
1—**Mark Products Co** 6412 W Lincoln Ave Morton Grove Ill
1—**Maryland Electronic Mfg Corp** 5009 Calvert Rd College Park Md
1—**Mathis Co G E** 6100 S Oak Park Ave Chicago 38 Ill
1—**Maxson Corp W L** 475 10th Ave New York 18 NY
1—**Meridian Metalcraft Inc** 8739 S Millergrove Dr Whittier Calif
1—**Metal Fabricators Corp** 63 Pond St Waltham 54 Mass
2—**Microdot Inc** 220 Pasadena Ave S Pasadena Calif
1—**Microtech Inc** 2975 State St Hamden 17 Conn
1—**Microwave Associates Inc** Burlington Mass
1—**Model Eng'g & Mfg Inc** 50 Frederick St Huntington Ind
2—**Mohawk Wire & Cable Corp** 320 River St Fitchburg Mass
2—**Mutual Electronic Industries Corp** 85 Beechwood Ave New Rochelle NY
1—**Narda Microwave Corp** 118-160 Herricks Rd Mineola NY
1—**Nichols Products Co** 325 W Main St Moorestown NJ
1—**NRK Mfg & Eng'g Co** 4601 W Addison St Chicago 41 Ill
1—**Nuclear Products—Erco Div ACF Industries Inc** Riverdale Md
2—**Okonite Co** 220 Passaic St Passaic NJ
1—**Omega Labs Inc** Haverhill St Rowley Mass
2—**Organic Development Corp** 10052 Larson Ave Garden Grove Calif
1—**Paul & Beekman** 1801 W Courtland St Philadelphia 40 Pa
2—**Phalo Plastic Corp** 530 Boston Twpk Worcester 8 Mass
2—**Philadelphia Insulated Wire Co** 200 N 3 St Philadelphia 43 Pa
1—**Philco Corp Gov't & Ind Div** 4700 Wissahickon Ave Philadelphia 44 Pa
2—**Plastic Wire & Cable Corp** Box 486 Jewett City Conn
1—**Polarad Electronics Corp** 43-20 34th St Long Island City 1 NY
1—**Polytronic Research Inc** 7600 Woodbury Dr Silver Spring Md
2—**Precision Tube Co** Church Rd & Wissahickon Ave North Wales Pa
1—**Premier Instrument Corp** 52 W Houston St New York 12 NY
1 & 2—**Prodelin Inc** 307 Bergen Ave Kearny NJ
1—**Production Research Corp** Thornwood NY
2—**Progress Electronics Co** 296 Broadway New York 7 NY
1—**Pye Telecommunications Ltd** Newmarket Rd Cambridge England
1—**Q-Line Mfg Corp** 1562 61 St Brooklyn 19 NY
1—**Radar Design Corp** 2360 James St N Syracuse 12 NY
1—**Radiation Eng'g Labs** Main St Maynard Mass
1—**Radiation Inc** P O Box 37 Melbourne Fla
1—**Radio Activities Inc** 119 Dawson Ave Boonton NJ
1 & 2—**Radio Corp of America Commercial Electronic Products** Front & Cooper Sts Camden NJ
1—**Radio Corp of America Communications Prods Dept** Bldg 1-5 Camden NJ
1—**Ramo-Wooldridge Corp Electronic Instrumentation Div** P O Box 8405 Denver 10 Colorado
1—**Raytheon Mfg Co** 100 River St Waltham 54 Mass
1—**Raytheon Mfg Co Commercial Equipment Div** 100 River St Waltham 54 Mass
2—**Rego Insulated Wire Co** 830 Monroe St Hoboken NJ
2—**Revere Corp of America** N Colony Rd Wallingford Conn
2—**Rex Corp** Hayward Rd W Acton Mass
2—**Rockbestos Products Corp** Nicoll & Canner Sts New Haven Conn
1—**Sage Labs Inc** 159 Linden St Wellesley 81 Mass
1—**Sanders Associates** 95 Canal St Nashua NH
1—**Sarkes-Tarzian Inc** 415 N College Ave Bloomington Ind
2—**Saxton Products Inc** 1661 Boone Ave New York 60 NY
1—**Scientific-Atlanta Inc** 2162 Piedmont Rd NE Atlanta 9 Ga
2—**Sequoia Wire** 2201 Bay Rd Redwood City Calif
1—**Sperry Gyroscope Co Microwave Electronics Div** Great Neck NY
1—**Spincraft Inc** 4122 W State St Milwaukee 8 Wisc
1—**Spinform Inc** 65 Mechanic St Attleboro Mass
1—**Stainless Inc** 3 St North Wales Pa
2—**Standard Wire & Cable Co** 3440 Overland Ave Los Angeles 34 Calif
1—**Stavid Engineering Inc** U S Route 22 Plainfield NJ
1—**Summit Industries Inc** 2104 W Rosecrans Ave Gardena Calif
2—**Super Electronics Corp** 53 Worth St New York 13 NY
2—**Superior Insulated Wire Co** Route 9W W Haverstraw NY
2—**Surprenant Mfg Co** 172 Sterling St Clinton Mass
1—**Swedlow Plastics Co** 6986 Bandini Blvd Los Angeles 22 Calif
1—**Sylvania Electric Products Co Electric System Div** 100 First Ave Waltham 54 Mass
1—**Tamar Inc** 11571 W Jefferson Blvd Culver City Calif
1—**Technical Appliance Corp** 1 Taco St Sherburne NY
1—**Technical Oil Tool Corp** 1057 N La Brea Los Angeles 38 Calif
1—**Technicraft Labs Inc** Thomaston-Waterbury Rd Thomaston Conn
1—**Telectro Industries Corp** 35-18 37th St Long Island City 1 NY
2—**Telegraph Construction & Maintenance Co Ltd** Mercury House Theobalds Rd London W C 1 England
1—**Telerad Mfg Corp** Route 69 Flemington NJ
1—**Telerad Mfg Corp** 1440 Broadway New York 18 NY
1—**Temco Aircraft Corp** P O Box 6191 Dallas 2 Texas
2—**Tenna Mfg Co** 7580 Garfield Blvd Cleveland 25 Ohio
2—**Tensolite Insulated Wire Co** 198 Main St Tarrytown NY
1—**Texas Instruments Inc** 6000 Lemmon Ave Dallas 9 Texas
2—**Time Electronic Sales** 373 Broadway New York 13 NY
2—**Times Wire & Cable Co Aff Int'l Silver Co** 358 Hall Ave Wallingford Conn.
1—**Tower Construction Co** 2700 Hawkeye Dr Sioux City 2 Iowa
1—**Transco Products Inc** 12110 Nebraska Ave Los Angeles 25 Calif
2—**Union Plastics Corp Wire & Cable Div** 1627 Paterson Plank Rd Secaucus NJ
2—**Univox Corp** 102 Warren St New York 17 NY
1—**U S Testing Co** 1415 Park Ave Hoboken NJ
2—**U S Wire Cable Co** Progress & Monroe Sts Union NJ
1—**Uniwave Inc** 109 Marine St Farmingdale NY
2—**Victor Electric Wire & Cable Corp** 618 Main St W Warwick RI
1—**Victor RF & Microwave Co** 36 W Water St Wakefield Mass
2—**Warren Wire Co** Pownal Vt
1—**Waveguide Inc** 14837 Oxnard St Van Nuys Calif
1—**Waveline Inc P O Box** 718 Caldwell NJ
1—**Westbury Electronics Inc** 300 Shames Dr Westbury NY
2—**Western Int'l Co** 45 Vesey St New York 7 NY
1 & 2—**Weymouth Instrument Co** 1440 Commercial St E Weymouth 89 Mass
2—**Wirecraft Products Inc** 10 Lake St W Brookfield Mass
1—**Zenith Plastics Co** 1600 W 135 St Gardena Calif
2—**Zippertubing Co** 752 S San Pedro St Los Angeles 14 Calif

MICROWAVE COMPONENTS

Antennas	1
Assemblies	2
Attenuators	3
Bends	4
Cavities	5
Converters	6
Couplers	7
Duplexers	8
Filters	9
Flanges	10
Hornes	11
Hybrid junctions	12
Isolators	13
Joints, fixed	14
Joints, rotary	15
Mixers	16
Oscillators	17
Parabolas	18
Phasers	19

(Continued on page 96)

Circle 45 on Inquiry Card, page 149

Directory of Microwave Manufacturers (cont)

Probes 20
Shutters 21
Sliding loads 22
Slotted lines 23
Switches 24
Terminations 25
Towers 26
Transformers 27
Tuners 28
Waveguides, flexible 29
Waveguides, rigid 30
Waveguide switches 31

1-26—**ACF Industries Nuclear Prods Erco Div** 48 Lafayette St Riverdale Md

1-27-31—**Admittance Namco Corp** Marine St Farmingdale LI NY

1—**Adler Electronics Inc** 1 LeFevre Lane New Rochelle NY

26—**Aerial Tower Mfg Co** P O Box 9142 Oklahoma City Okla

1-11-14-15-18-26-30-31—**Ainslie Corp** 312 Quincy Ave Quincy 69 Mass

11-26—**Airborne Electronics Co** 6813 Troast Ave N Hollywood Calif

1-2-3-17-18—**Airborne Instrument Lab Inc** 160 Old County Rd Mineola NY

1-2-3-4-5-9-10-11-14-15-17-20-22-23-25-30—**Aircom Inc** 354 Main St Winthrop Mass

1-2-3-4-5-8-10-11-14-15-19-20-21-25-27-30-31—**Aircom Inc** 139 E 1st St Roselle NJ

1-2-3-4-5-8-9-10-11-13-14-15-16-18-19-20-21-22-23-24-25-27-28-29-30-31—**Airtron Inc** 1108 W Elizabeth Ave Linden NJ

1-3-27—**Aiford Mfg Co** 299 Atlantic Ave Boston 10 Mass

17—**Alfred Electronics** 897 Commercial St Palo Alto Calif

26—**Alpar Mfg Corp** 2910 Spring St Redwood City Calif

26—**Alprodco Inc** 540 Weakley Ave Memphis Tenn

17—**Amerac Inc** Dunham Rd Beverly Mass

17—**Amerac Inc** 116 Topsfield Rd Wenham Mass

1-9—**American Electronics Laboratories** 121 N 7th St Philadelphia 6 Pa

1-8-14-15-18-27—**American Machine & Foundry Co Gen Eng'g Labs** 11 Bruce Place Greenwich Conn

1-17—**American Machine & Foundry Co Defense Products Group** 1101 N Royal St Alexandria Va

1-3-4-5-11-13-17-18-26-29-30—**American Microwave Corp** 11754 Vose St N Hollywood Calif

10—**American Radar Components Inc** Rt 10 Whippaney NJ

26—**American Tower Co** R F D 2 Box 29 Shelby Ohio

27—**American Transformer Co Div Standard Electronics** 285 Emmett St Newark 5 NJ

1—**Amphenol Electronics Corp** 1830 S 54th Ave Chicago 50 Ill

5-8—**Amtron Corp** 17 Felton St Waltham 54 Mass

1-23-30—**Andrew Antenna Corp** 606 Beech St Whitby Ont Canada

1-18-23-30-31—**Andrew Calif Corp** 914 E Marylind Ave Claremont Calif

1-11-18-23-30-31—**Andrew Corp** 363 E 75th St Chicago 19 Ill

1-3-5-8-9-11-13-14-15-18-22-23-25-31—**Antenna & Radome Research Assoc** 1 Bond St Waterbury NY

26—**Antlab Ins** 6330 Proprietors Rd Worthington Ohio

5—**Applied Radiation Corp** 2404 N Main St Walnut Creek Calif

3-6-9-25—**Applied Research Inc** 76 S Bayless Ave Port Washington NY

9—**Ark Eng'g Co** 431 W Tabor Rd Philadelphia 20 Pa

27—**Atlas Eng'g Co** 176 Blue Hill Ave Roxbury 19 Mass

14—**Audicon Electronics Inc** 216 Lyon St Paterson 4 NJ

25—**Automatic Electric Co** 1033 W Van Buren St Chicago 7 Ill

24—**Automatic Metal Products Corp** 323 Berry St Brooklyn 11 NY

24—**Automatic Switch Co** Hanover Rd Florham Park NJ

1-2-5-8-23-27—**Avion Div ACF Industries Inc** 11 Park Pl Paramus NJ

3-5-8-9—**Avionics Ltd** P O Box 200 Niagara-on-the-Lake Ont Canada

10-29-30—**Avnet Electronics Supply Co** 36 N Moore St New York 13 NY

1—**Barkley & Dexter Laboratories** 50 Frankford St Fitchburg Mass

1-4-5-11-30—**Bart Mfg Corp** 227 Main St Belleville NJ

28—**Basler Electric Co** Box 269 Rt 143 Highland Ill

30—**Bean & Co Morris** Hyde Rd Yellow Springs Ohio

1—**Bell Aircraft Corp** P O Box 1 Buffalo 5 NY

1—**Bellaire Electronics Inc** 62 White St Red Bank NJ

26—**Bergen Wire Rope Co** 456 Gregg St Lodi NJ

27—**Berkshire Transformer Corp** Route 341 Kent Conn

1-18-26—**Blaine Electronics Inc** 14657 Keswick St Van Nuys Calif

1-26—**Blaw-Knox Co/Blaw-Knox Equip Div** Pittsburgh 38 Pa

1-2-3-4-5-8-11-16-17-22-24-25-31—**Bogart Mfg Corp** 315 Seigel St Brooklyn 6 NY

6—**Bogue Electric Mfg Co** 52 Iowa Ave Paterson 3 NJ

3—**Bolton Labs Inc** W Main St Bolton **Mass**

3-5-8-16—**Bomac Labs Inc** Salem Rd Beverly Mass

1-2-3-4-5-6-8-10-11-14-15-18-25-29-30-31—**Brach Mfg Corp/Div General Bronze Corp** 200 Central Ave Newark 3 NJ

18-30—**Brooks & Perkins Inc** 11655 Vanowen N Hollywood Calif

11-18—**Brooks & Perkins** 1950 W Ford St Detroit Mich

1-2-3-4-5-6-8-9-10-11-14-15-19-20-21-24-30-31—**Budd Stanley Co** 43-01 22nd St Long Island City 1 NY

1-8—**Budelman Radio Corp** 375 Fairfield Ave Stamford Conn

24-25—**Cable Electric Products** 234 Daboll St Providence 7 RI

1-17-23—**Calif Technical Industries Div Textron Inc** 1421 Old County Rd Belmont 10 Calif

1-2-8-11-13-15-18—**Canoga Corp** 5955 Sepulveda Blvd Van Nuys Calif

9-27—**Carad Corp** 2850 Bay Rd Redwood City Calif

5—**Cavitron Electron Oscillator Co Div Short Wave Plastic Forming** 355 N Newport Blvd Newport Calif

27—**Central Transformer Co** 900 W Jackson Blvd Chicago 7 Ill

1—**Ceramatronics Inc** 364 Highland Ave Passaic NJ

5-17—**C G S Laboratories Inc** Routes 7 and 35 Ridgefield Conn

22-30—**Chemalloy Electronics Corp** Gillespie Airport Santee Calif

1—**Chu Associates** P O Box 387 Whitcomb Ave Littleton Mass

8-17—**Clegg Labs Inc Div Clegg Inc** Ridgedale Ave Morristown NJ

1-2-3-4-8-10-18-20-23-25-30—**Coaxial Connector Co** 37 N 2nd Ave Mt Vernon NY

27—**Coil Winders Inc** 30 New York Ave New Cassel Westbury LI NY

1-9—**Collins Radio Co** 855 35th St NE Cedar Rapids Iowa

9-27—**Communication Accessories Co** U S 50 Hwy Lee's Summit Mo

10—**Connector Corp of America** 3223 Burton Ave Burbank Calif

9—**Control Electronics Co Inc** 1925 New York Ave Huntington Sta NY

29—**Co-Operative Industries Inc** 100 Oakdale Rd Chester NJ

2-3—**Consolidated Productions Inc** Broward Int'l Airport Ft Lauderdale Fla

1—**Convair-San Diego** P O Box 1950 San Diego 12 Calif

3—**Corning Glass Works** Corning NY

26—**Craig Systems Inc** 90 Holten St Danvers Mass

4-25-29-30—**Cubic Corp** 5575 Kearny Villa Rd San Diego 11 Calif

13-25-31—**Custom Components Inc** P O Box 248 Caldwell NJ

1-28-30—**Dalmo Victor Div Textron Inc** 1515 Industrial Way Belmont Calif

1-2-3-5-8-9-10-11-14-15-18-19-29-30—**Defiance Eng'g Microwave Corp** Beverly Airport Beverly Mass

1-2-3-4-5-6-8-9-10-11-14-15-17-20-21-22-23-24-25-28-30-31—**DeMornay-Bonardi Corp** 780 S Arroyo Pkwy Pasadena Calif

2-11—**Designers for Industry** 4241 Fulton Pkwy Cleveland 9 Ohio

9—**Deutschmann Corp Tobe** Providence Hwy Norwood Mass

1-2-3-4-5-8-9-10-11-14-15-17-18-19-20-22-23-24-25-30-31—**Diamond Antenna & Microwave Corp** 7 North Ave Wakefield Mass

1—**Dielectric Products Eng'g Co** Raymond Maine

1-3-10-11-14-15-20-25-30—**Dittmore-Freimuth Corp** 2517 E Norwich St Milwaukee 7 Wisc

24-28-31—**Don-Lan Electronics Co** 1101 Olympic Blvd Santa Monica Calif

1—**Dorne & Margolin** 29 New York Ave Westbury NY

1-2-3-4-5-8-9-10-14-15-20-22-23-24-25-30-31—**Douglas Microwave Co** 252 E 3rd St Mt Vernon NY

26—**Dresser-Ideco Co** 875 Michigan Ave Columbus 8 Ohio

1-8-11—**D & S Mfg Co** 424 Burk Ave Ridley Park Pa

1-18—**Dwyer Eng'g Co** Pine St Ext Nashua NH

17—**Dynac Inc** 395 Page Mill Rd Palo Alto Calif

1-9—**Dynamic Electronics Inc** 73-29 Woodlawn Blvd Forest Hills NY

2-3-5-8-10-16-23-30—**Elco Mfg Co** 137 Herrick Rd New Hyde Park NY

3-25—**Electrical & Physical Instrument Corp** 42-19 27th St Long Island City 1 NY

3-4-20—**Electro Impulse Lab Inc** 208 River St Red Bank NJ

8—**Electronics Development Co** 3743 Cahuenga Blvd N Hollywood Calif

1-5-8-9-13-31—**Electronic Specialty Co** 5121 San Fernando Rd Los Angeles 39 Calif

1-3—**Electron-Radar Products** 4806 W Chicago Ave Chicago 51 Ill

3-20-25—**Electro-Physical Labs** 2065 Huntington Dr San Marino Calif

1-3—**Emerson & Cuming Inc** 869 Washington St Canton 1 Mass

26—**Emerson-Sack Warner Corp** 85 Washington St Somerville 43 Mass

3—**Empire Devices Products Corp** 38-15 Bell Blvd Bayside 61 NY

3-16-17—**Empire Products Sales Corp** 37 Prospect St Amsterdam NY

17—**Engineering Associates** 434 Patterson Rd Dayton 9 Ohio

2-5-29-31—**Engiehard Industries Inc** 113 Astor St Newark NJ

27—**Espey Mfg Co** Congress & Ballston Ave Saratoga Springs NY

27—**Essex Wire Corp Magnetic Winding Inc** Easton Pa

26—**E-Z Way Towers Inc** 5901 E Broadway Tampa 5 Fla

1—**Farnsworth Electronics Co Div I T & T** 3702 E Pontiac St Ft Wayne Ind

1—**Federal Telecommunications Lab Div I T & T** 500 Washington Ave Nutley NJ

3—**Filmohn Corp** 48 W 25th St New York 10 NY

9—**Filtron Co** 10023 W Jefferson Blvd Culver City Calf

3-25-28-30—**Fox Co Thomas T** 95 Summit St Newark NJ

27—**Freed Transformer Co** 1718 Weirfield St Brooklyn 27 NY

5-8-9-17—**Frequency Standards Inc** P O Box 504 Asbury Park NJ

2-3-4-5-8-9-10-11-13-14-15-17-20-22-23-24-25-27-28-31—**F-R Machine Works Inc Electronic & X-Ray Div** 26-12 Borough Pl Woodside 77 NY

1-4-5-8-11-15-18-23—**Gabriel Electronics Div Gabriel Co** 35 Crescent Rd Needham Heights 94 Mass

30—**Gar Precision Parts Co** 703 Pacific St Stamford Conn

1-9-26-27—**General Bronze Corp** 711 Stewart Ave Garden City NY

3-5—**General Communication Co** 677 Beacon St Boston 15 Mass

27—**General Electric Co Apparatus Sls Div 1 River Rd** Schenectady 5 NY

5-8—**General Electric Co Power Tube Dept Bldg** 267 Schenectady 5 NY

2-25—**General Electric Co Communications Products Dept** P O Box 1122 Syracuse NY

17—**General Radio Co** 275 Massachusetts Ave Cambridge 39 Mass

1-2-3-4-5-8-10-20-22-23-28—**General RF Fittings Inc** 702 Beacon St Boston 15 Mass

3—**G & M Equipment Co** 7315 Varna Ave N Hollywood Calif

1-2-4-5-6-11-15—**Gombos Co Inc John** 111 Montgomery Ave Irvington 11 NJ

3—**Goodrich Sponge Products B F Div B F Goodrich Co** Canal St Shelton Conn

1—**Goodyear Aircraft Corp** 1210 Massillon Rd Akron 15 Ohio

1-2-4-9-18—**Granger Associates** 966 Commercial St Palo Alto Calif

1-5-18-23-26-27—**Gulton Industries Inc** 212 Durham Ave Metuchen NJ

1-17—**Haller Raymond & Brown** Circleville Rd State College Pa

3-25—**Hansen Electronics Div Hazeltine Corp** 59-25 Little Neck Pkwy Little Neck NY

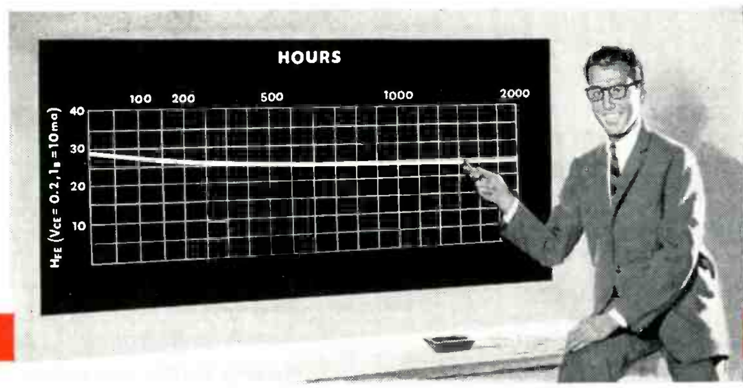
1-17—**Hazeltine Electronics Div Hazeltine Corp** 59-25 Little Neck Pkwy Little Neck NY

27—**Hermetic Seal Transformer Co** 555 N 5th St Garland Texas

(Continued on page 99)

Now! PNP SWITCHING TRANSISTORS from Sylvania

2N404
2N425
2N426
2N427
2N428



designed to give you this same reliability you've come to expect from Sylvania's full line of NPN types

HERE IS an important line of PNP switching transistors to complement Sylvania's line of NPN types. Manufacturing techniques developed for producing high-temperature stability in NPN types have been incorporated in these new PNP switching transistors. For designers this means the high reliability and stability synonymous with Sylvania NPN types, and permits circuit designs which take full advantage of the complementary aspects of NPN and PNP.

These transistors feature a new hermetically sealed inverted base TO-5 package which offers better heat dissipation to easily provide up to 150 mw at 25°C.

Electrical, mechanical, and environmental tests applied to these PNP transistors are in accordance with MIL-T-19500A.

TECHNICAL DATA

Type	V_{CB} Volts	V_{EB} Volts	V_{CE} Volts	f_{ab} min mc	h_{FE} Typical	Max. Dissipation in MW
2N404	−25	−12	−24	4.0	50	120
2N425	−30	−20	−20	2.5	30	150
2N426	−30	−20	−18	3.0	40	150
2N427	−30	−20	−15	5.0	55	150
2N428	−30	−20	−12	10.0	80	150

Temperature range −65° C to +85° C

SYLVANIA

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Circle 46 on Inquiry Card, page 149

WASHINGTON News Letter

LARGEST FOR YEAR—The largest amount spent by the military services for defense electronics procurement in a single year was recorded during the government fiscal year 1958, ended last June 30. The total was $4.05-billion, the Electronic Industries Association recently reported. The EIA based its announcement on its formula to extract the portion of military spending for electronics from all major defense procurement categories. In the fourth quarter of the 1958 fiscal year, total expenditures were $1.187-billion, a considerable increase over the third quarter buying of $969,500,000 and the $967,500,000 spent in the second quarter of fiscal year 1958.

SPECTRUM SPACE SURVEY—Despite the failure of Congress to enact legislation to create a five-man commission of experts to investigate the government and civilian uses of the spectrum which was blocked by television interests in the final days of the Congressional session, moves for the creation of such a body have been going forward in several sectors of the National Capital. The White House has under consideration the appointment of a high level spectrum analysis commission. At *ELECTRONIC INDUSTRIES'* press deadline, it was indicated the President might hold in abeyance such a step if the new session of Congress gives assurance of legislation, but, to get the spectrum survey ball rolling, an "advisory committee" of experts to the President might be established prior to the Congressional session in January.

UNIFIED CONTROL—A powerful voice in Congress, Chairman Oren Harris (D., Ark.) of the House Interstate & Foreign Commerce Committee which handles communication and radio legislation, in an address in his home state, emphasized that the time has arrived "where unified control of the spectrum space will become necessary in order to make possible the best use of available spectrum space for civilian and military purposes." Citing the legislation providing for unified control of airspace for both civilian and military planes, he stated "it may very well be that a similar program will have to be devised dealing with the spectrum problem as it was with aviation." Rep. Harris declared that "it is my hope that establishment of unified control over spectrum allocations may result in more frequencies becoming available for civilian uses." He added the availability of increased number of frequencies would make the task of the FCC in distributing these frequencies "among competing civilian applicants a less arduous one" and pressures on the FCC by TV interests would be reduced or eliminated.

CRAVEN'S VIEWS—FCC Commissioner T. A. M. Craven, the leading engineering authority of that agency, in an address before an institute of Radio Engineers' broadcasting professional group on his widely publicized plans for regrouping television frequencies into 25 or 30 channels warned that the need of other non-broadcast services for spectrum space puts non-efficient TV bands in a vulnerable spot. He stressed that TV allocation plans, advocated by certain segments of the television industry, do not give adequate consideration to the problems of non-broadcast radio services "in spite of the significant importance of these other services to the national economy." He proposed the release of some non-used uhf TV broadcast frequencies so the balance between a spectrum space assigned to entertainment and to non-broadcast services "would be more reasonable from the standpoint of the national economy and general public interest."

REAFFIRMS POSITION—The EIA has reaffirmed its position in favor of the establishment of a government commission to make a long range study of the entire radio spectrum and its administration either by the President or Congress. The EIA member manufacturing and research companies under the action would make available competent technical personnel from industry to serve on the task forces of the spectrum analysis body. At the same time, the EIA asked the FCC in its investigation of present and future uses of the spectrum between 25 and 890 MC to consider the possible expansion of subsidiary communications activities of FM broadcast stations.

INADEQUATE ON TV ALLOCATIONS—The FCC, as presently constituted, is inadequate to cope with the television frequency allocation problems which should be studied by an independent group, an advisory group created by the Interstate & Foreign Commerce Committee in 1955 has recommended to the Senate Committee. The advisory committee, headed by Massachusetts Institute of Technology Industrial Management Professor Edward L. Bowles and composed of broadcast industry, manufacturing, and FCC representatives and consulting engineers, said the FCC appears "powerless to anticipate, evaluate or deal decisively" with the television problem. The advisory group proposed that $600,000 be appropriated for the independent TV study to be made by a nationally recognized professional institution.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

Microwave Directory

(*Continued from page 96*)

3-9-13-17-22-23-25-28 — **Hewlett-Packard Co** 275 Page Mill Rd Palo Alto Calif
3-20-25 — **Holland Electronics** 772 E 53rd St Brooklyn NY
1-11-19—**Hoover Electronics Co** 112 W Timonium Rd Timonium Md
18—**Houston Fearless Div Color Corp of America** 11801 W Olympic Blvd Los Angeles 64 Calif
4-11-30—**Howard Foundry Co** 1700 N Kostner Ave Chicago 39 Ill
27 — **Industrial Transformer Corp** Gouldsboro Pa
1-2-3-4-11-23-28-30-31 — **I-T-E Circuit Breaker Co Special Products Div** 601 E Erie Ave Philadelphia 31 Pa
9-25 — **Jackson Electronics Inc** 23 Woodcrest Rd West Chester Pa
26—**Jamac Products Co** 8845 N E Sandy Blvd Portland 20 Ore
1-2-3-4-5-6-8-9-10-11-13-14-15-17-18-19-20-21-22-23-24-25-30-31—**J-V-M Eng'g Co** 4633 S Lawndale Ave Lyons Ill
1-2-3-4-5-8-13-14 — **Kearfott Co Inc** 14844 Oxnard St Van Nuys Calif
1-2-3-4-5-6-8-10-11-13-14-15-16-19-20-23-24-29-30-31—**Kearfott Co Inc** 1378 Main Ave Clifton NJ
1-2-14-18—**Kelsey-Hayes Co** 3600 Military Ave Detroit 32 Mich
16—**Kemtron Electron Products Inc** 14 Prince Pl Newburyport Mass
1-4-29—**Kennedy & Co D S** 155 King St Cohasset Mass
4—**Kent Corp F C** 64 Howard St Irvington 11 NJ
27—**Keystone Products Co** 904-6 23rd St Union City NJ
1-2-3-4-5-8-10-11-15-20-24-25-28-30-31—**Kings Electronics Co Inc** 40 Marbledale Rd Tuckahoe NY
26—**Kline Iron & Steel Co** P O Box 1013 1225 Huger St Columbia SC
26—**Kuss Industries Inc** Tacony and Lewis Sts Philadelphia Pa
2-3-5-6-13-17-19-25-28—**Laboratory for Electronics Inc** 75 Pitt St Boston 14 Mass
1-3-8—**Lambda-Pacific Eng'g Inc** 14725 Arminta St Van Nuys Calif
1-2—**La Point Industries Inc** 155 W Main St Rockville Conn
5—**Lavoie Labs Inc** Matawan-Freehold Rd Morganville NJ
30—**Leach & Garner Co Industrial Div** Leach & Garner Bldg Attleboro Mass
9 — **Leonard Electric Products Co** 67 34th St Brooklyn 32 NY
1-2-3-4-5-8-9-10-11-14-15-18-19-21-22-25-28-30-31—**Lieco Inc** 3610 Oceanside Rd Oceanside NY
13-14-15-27-30 — **Litton Industries of Calif** 336 N Foothill Rd Beverly Hills Calif
13—**Litton Industries Components Div** 5873 Rodeo Rd Los Angeles 16 Calif
26—**Lorentzen Inc H K** 391 W Broadway New York 12 NY
3—**McMillan Industrial Corp** Brownsville Ave Ipswich Mass
26—**Madigan Corp** 526 Mineola Ave Carle Place NY
26—**Magnesium Products of Milwaukee Inc** 748 W Virginia St Milwaukee 4 Wisc
8-10-30—**Makepiece Div D E Englehard Industries Inc** Pine & Denham Sts Attleboro Mass
17 — **Manson Laboratories Inc** 807 Greenwich Ave Stamford Conn
1—**Mark Products Co** 6412 W Lincoln Ave Morton Grove Ill
1-9-11—**Maryland Electronics Mfg Inc** 5009 Calvert Rd College Park Md
1-26—**Mathis Co G E** 6100 S Oak Park Ave Chicago 38 Ill
1-15—**Maxson Corp W L** 475 10th Ave New York 10 NY
1-2-3-4-5-8-9-10-15-22-24-25-30-31—**Meridian Metalcraft Inc** 8739 S Millergrove Dr Whittier Calif
1-26-30 — **Metal Fabricators Corp** 63 Pond St Waltham 54 Mass
3—**Metavac Inc** 45-68 162nd St Flushing 58 NY
3-8-9-19-22-28-31 — **Microlab** Okner Pkwy Livingston NJ
5-8-9-31 — **Microphase Corp** Box 1166 Greenwich Conn
1-2-3-4-5-6-8-10-11-14-15-19-20-21-22-23-24-25-28-29-30-31 — **Microtech Inc** 2975 State St Hamden 17 Conn
28—**Microtran Co** 145 E Mineola Ave Valley Stream NY
1-3-4-5-8-10-11-14-15-16-21-22-23-24-25-31—**Microwave Associates Inc** Burlington Mass

(*Continued on page 144*)

Circle 47 on Inquiry Card, page 149

MICROWAVE AND SPECIAL TUBE NEWS from SYLVANIA

Sylvania Klystrons offer better performance at lower cost per year

Rigid quality control extends average service life of Sylvania Microwave Relay Klystrons by thousands of hours

A random sample of 10 tubes selected from recent production have provided a total life of over 45,000 hours, more than 4,500 hours for each tube, without a single failure. This outstanding result demonstrates why cost-conscious users select Sylvania Microwave Relay Klystrons for economy.

In performance too, Sylvania Klystrons are setting the pace by maintaining exceptional frequency stability throughout life. This superiority in both performance and economy results from Sylvania's experienced know-how in rigidly controlling electron tube quality.

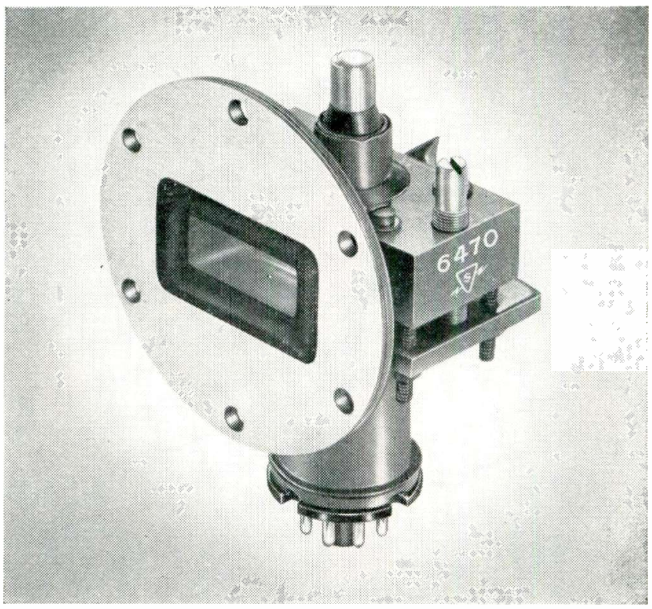
The Sylvania Klystron line covers over 20 different types from Disc Seal types to the C-Band metal types listed. Many other klystrons specially designed for specific equipments are also available. Contact your Sylvania representative or write direct for full information on the Sylvania Klystron line.

Fully specified parameters simplify equipment designs

Every Sylvania Klystron approved for shipment is *fully specified*. Beyond the information contained in ordinary data sheets, Sylvania offers full information on important characteristics such as:

- **Effective Resonator Position**
- **Beam Voltage Sensitivity**
- **Internal Noise Modulation**
- **Distortion**
- **Reflector Capacitance**

Availability of complete and exact data on every important klystron characteristic helps cut the guesswork out of design for the microwave engineer. Equipment specifications can be met accurately, confidently, and design adjustments can be avoided. Get complete information when you order Klystrons—specify Sylvania.



Sylvania Microwave Relay Klystrons

Characteristics	TYPE K-841B	K-840B	K-839B
Mechanical Tuning Range – MC	6125 – 6425	6575 – 6875	7125 – 7425
Resonator Voltage – Volts	750	750	750
Reflector Voltage – Volts	-250 to -400	-250 to -400	-250 to -400
Cathode Current – MA	80 (max)	80 (max)	80 (max)
Power Output – Watts	0.7 (min)	0.7 (min)	0.7 (min)
Heater Voltage – Volts	6.3	6.3	6.3
Heater Current – Amperes	0.8	0.8	0.8
Flange Mates with –	UG 343 A/U	UG 343 A/U	UG 343 A/U

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ELECTRONIC INDUSTRIES
STAFF REPORT

Microwave Power Tubes— A Survey

In the forefront of the move toward the higher frequencies has been the very significant improvements and new designs in microwave tubes. In addition to vastly improved magnetrons and klystrons the field now includes a wide variety of traveling wave and backward tubes.

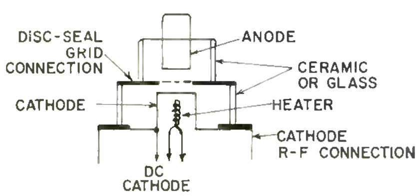


Fig. 1: Construction of the plan

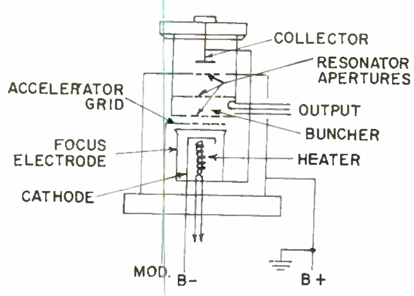


Fig. 2: Elements of the reflex Klystron

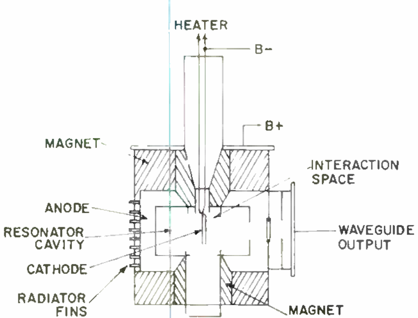


Fig. 3: The split-anode magnetron

MICROWAVE tubes employed today as oscillators and power amplifiers at frequencies above approximately 500 MC fall into two general categories in accordance with their performance characteristics and certain aspects of design.

The first group comprises the relatively narrow-band amplifiers, and consists of the planar electrode tubes, klystrons and magnetrons which require for their operation sharply resonant, high-impedance tuned circuits. Klystrons and magnetrons are characterized by high power, wide power ranges, and upper frequency limits extending well into V-band. Several planar type triodes are available with 30-40% efficiency ratings at high power levels in S-band.

The second category opens a whole new frontier in amplification over extremely wide bands of frequencies. In this group are the recently developed traveling wave amplifier tubes which usually require no resonant elements to restrict the passband. Presently available broadband types capable of octave frequency coverage are limited to power output levels of only a few watts. Present high power types require a heat dissipating structure which exhibits relatively narrow frequency response and thus restricts the bandwidth.

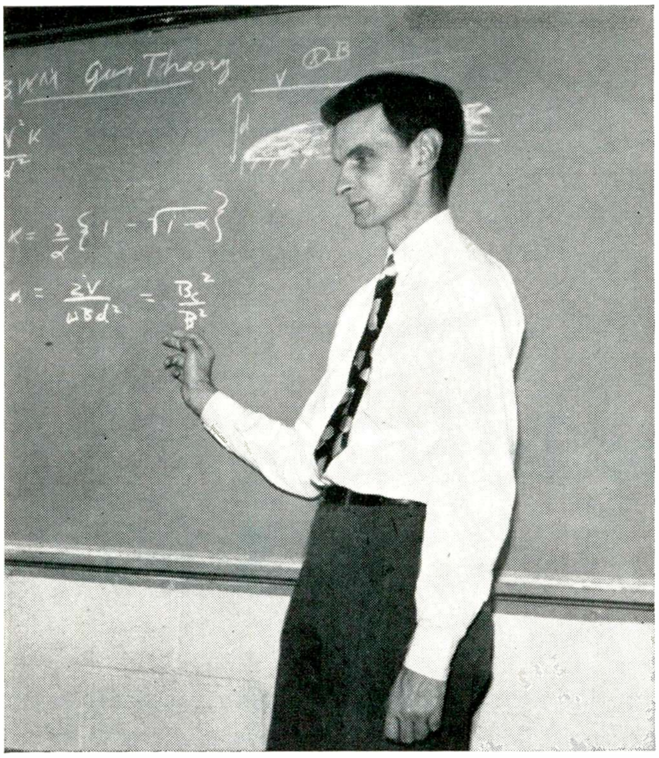
Planar Triodes

Higher measures of amplification and operating efficiency at microwave frequencies are achieved in the construction of the disc-seal triode. As shown in Fig. 1, the plate, grid and cathode of this tube are arranged in parallel planes, instead of coaxially, to permit closer spacing of elements and thus reduce electron transit time with little or no increase in interelectrode capacitance. Lead inductance and losses are lowered by the disc-seal terminals which are fused in the envelope and brought out at the sides of the tube. However, transit time effects usually limit the usefulness of these tubes to frequencies below about 5000 MC.

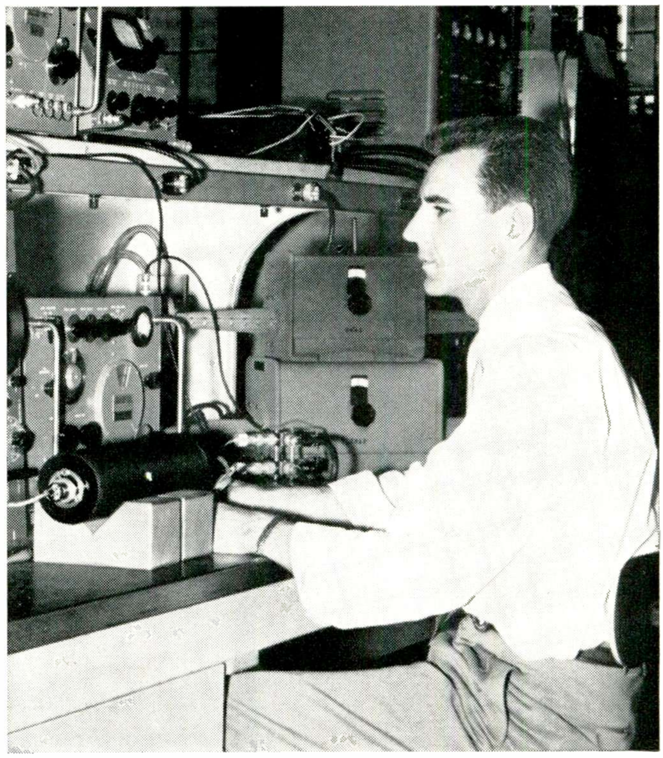
Klystron Oscillators

The klystron is a device which uses the transit time effect to ad-

(*Continued on page* 106)



SCIENTISTS at Sylvania's Microwave Components Laboratory are probing advanced concepts in magnetic ferrites, gaseous electronics, and electromagnetic wave propagation.



ENGINEERS at Sylvania's Mountain View microwave tube plant are incorporating the findings of advanced research into new microwave components for mass production.

A SPECIAL REPORT ON SYLVANIA

MEN OF MICROWAVE

TWT, BWO, BWM, TR, ATR—At Sylvania's Special Tube Operations, vital microwave components like these are the products of dedicated scientists and integrated plant facilities

ADVANCED RESEARCH AND DEVELOPMENT

Today, nearly 500 scientists, engineers and technicians in three integrated facilities make up Sylvania's Special Tube Operations. Sylvania scientists, physicists and mathematicians, all leaders in their fields, are making bold new investigations in the fields of magnetic ferrites, gaseous electron physics, electromagnetic wave propagation and microwave circuitry. Their findings are being applied to the development of advanced microwave devices to meet the increasing needs of industry and government.

Some of the important developments already made possible include PM focus Traveling-Wave Tubes, Ka Band and Backward Wave Magnetrons, Coaxial Transmit-Receive Tubes, Four-port ferrite circulators and C-Band Klystrons.

TRAVELING-WAVE TUBES

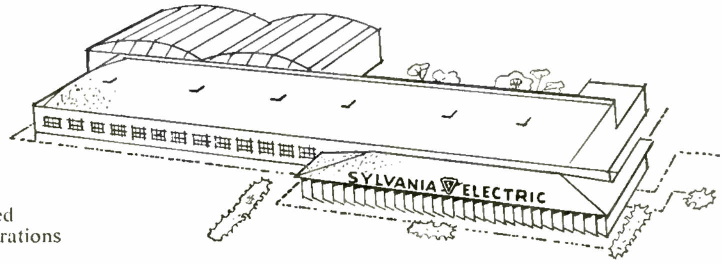
PM Focus Traveling-Wave Tubes sharply reduce size and weight and eliminate the need of a power supply. Sylvania is producing over 15 Traveling-Wave Tube types, one of the most complete lines available in terms of frequency coverage and power levels.

MAGNETRONS AND KLYSTRONS

New Sylvania magnetrons range from six-ounce miniatures and rugged Ka band types to Backward Wave Magnetrons. New BWM's have been developed for several frequency bands in medium to high power outputs. Current Klystron production includes over 20 types—from Disc Seal types to C-Band metal types.

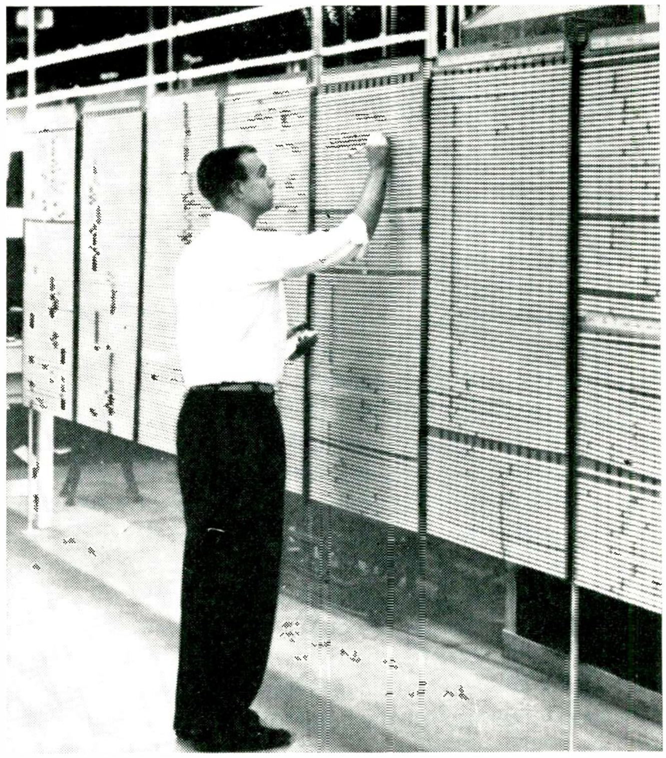
TR-ATR TUBES AND FERRITE DEVICES

Transmit-Receive Tubes in the new coaxial construction are also in production at Sylvania, along with over 20



Microwave tube plant, Mountain View, Calif.—one of the integrated facilities of the Special Tube Operations

TECHNICIANS, shown here working side by side with engineers at Sylvania's Williamsport, Pa., plant, are applying new testing techniques to mass production.



PRODUCTION engineers and specialists are developing new control techniques for better mass production of microwave components.

LETTERS

different types of Klystrons. A full commercial line of ferrite devices ranges from wave guide and coaxial isolators to variable attenuators and other ferrite devices.

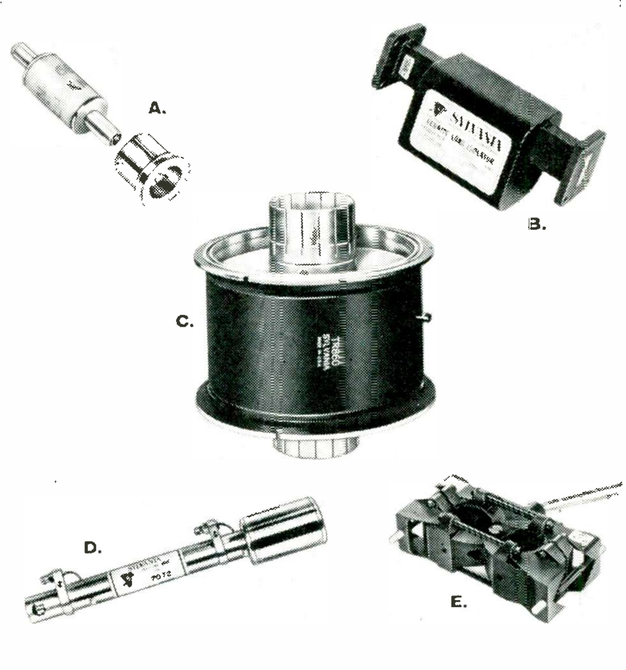
MICROWAVE DIODES

Long an acknowledged leader in microwave crystal diodes, Sylvania is continuing to add new and improved versions to its extensive line. New mixer diodes are available that can extend radar coverage by as much as 18 per cent. New dual duty S and X band types that can be used in either forward or reverse applications are also available.

OTHER S.T.O. PRODUCTS

In addition to a full range of microwave components Sylvania's Special Tube Operations also produces a complete line of counter tubes, planar triodes and trigger thyratrons.

S.T.O. stands ready to meet the industry's microwave components needs—for present production items in volume —for custom modifications—or for pure research and development in microwave electronics.



A. Microwave Crystal Diode, **B.** Ferrite Isolator, **C.** Coaxial TR Tube, **D.** Traveling-Wave Tube, **E.** Ka Band Magnetron.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
Special Tube Operations
500 Evelyn Ave., Mountain View, Calif.

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY

 Circle 58 on Inquiry Card, page 149

Microwave Tubes

(*Continued from page* 103)

vantage, and makes possible the generation of rf power at millimeter wavelengths. In the klystron, the signal voltage on the grid varies the velocity of the electron beam rather than the intensity of the beam as in negative-grid controlled tubes. The principle of operation is illustrated in the diagram of Fig. 2. Electrons emitted by the cathode are focused into a stream and directed into resonant cavities through grid-like apertures. An r-f electric field set up between the apertures and parallel to the electron stream bunches the electrons by alternately increasing and decreasing their velocity, and induces r-f currents in the resonant cavities. The electron stream is quickly retarded as it approaches the collector, which is at nearly zero potential, and finally is attracted to the anode cavity to contribute to the induced current. The resonant frequency can be varied over ranges of 0.5 to 2% by changing the electrode voltages, and over greater ranges by mechanical adjustments which change the size or shape of the cavity.

Magnetron Oscillators

The magnetron is an efficient diode oscillator (or amplifier) which requires for its operation a magnetic field parallel to the cathode. The simplest structure, as shown in Fig. 3, generally consists of a cylindrical cathode within a cylindrical anode which may be divided into two or more segments. R-F circuits are connected either between the cathode and anode, or between segments of the anode. Under non-oscillating conditions, electrons leaving the cathode are acted upon only by the dc electric field which directs them toward the anode, and by the magnetic field which directs them toward the cathode. If these forces are made equal, the electrons traverse a circular path about the cathode, failing to reach the anode and creating a space charge cloud rotating about the cathode. If the anode voltage is increased, the space charge cloud orbits outward and electrons reach the anode, causing current to flow.

However, the presence of an r-f field on the anode interacts with the electrons to cause a transfer of energy from the electrons to the electric field. This energy is applied to sustain oscillations in some types of magnetrons by subdividing the anode structure into a series of n-coupled resonant cavities.

Electrons which are pulled back to the cathode give up energy in the form of heat. Because this back-bombardment of the cathode occurs when the magnetron is started, the initial heater input power must be reduced. The operating efficiency of improved magnetrons is greater than 50% at frequencies in the V-band.

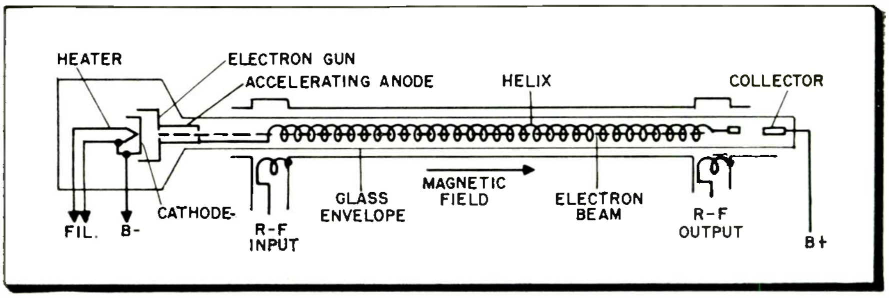


Fig. 4: Construction of the traveling wave tube

Traveling Wave Tubes

Power amplification ratios of 40db over a frequency range of 2:1 have been obtained with traveling wave tubes. One of the simplest structures for this tube is the helix type illustrated in Fig. 4. In operation, an r-f wave is sent down the helix at the input end and collected at the output connector, which can be a coaxial cable or waveguide depending on the type of tube. Because the helix is a coiled structure, r-f energy travels from the input end to the output end at some fraction of the velocity of light.

When the electron beam, formed in a gun, is directed down the center of the helix, an interaction takes place between the electrons and the field produced by the slow-wave. As a result, the electrons become bunched in accordance with the instantaneous direction of the field along the helix. Simultaneously, the r-f fields on the helix increase in magnitude as they progress down its length. The increase in energy of this wave, which grows exponentially with distance, is just balanced by a decrease in the average kinetic energy of the electrons in the beam. The form of the electron beam is maintained by a longi-

(*Continued on page* 130)

GLOSSARY OF MICROWAVE TUBE TERMS AND ABBREVIATIONS

BACK HEATING—Exclusively high cathode temperatures arising from cathode power dissipation, caused by electron "back bombardment" from space charge.

BACKWARD WAVE AMPLIFIER—A traveling wave tube in which the direction of rf power flow is reversed with respect to the direction of beam travel. This principle is also applied to recently developed types of magnetrons.

BACKWARD WAVE OSCILLATOR—A tube of special design in which the traveling wave is reflected or fed backward in the proper phase for sustaining oscillations. Also, a backward wave amplifier which is operated without rf input and at sufficiently high beam current to cause self oscillation.

COLD TUBE VSWR—The voltage standing wave ratio, or ratio of incident wave voltage to reflected wave voltage, presented by an amplifier tube with no voltages applied.

COLD INSERTION LOSS—The insertion loss in db, or measure of input signal attenuation, in a non-operating amplifier tube.

(*Continued on page 128*)

MAGNETRONS

Type	Descr. App.	Freq. Range (kmc)	Heater V.A.	Anode Volts (peak)	Anode Current (peak)	Duty Cy.	Pulling Factor (mc/s)	Type Output	Pulse Dur. (ms)	Power Output	Price
AMPEREX ELECTRONIC COMPANY, 230 Duffy Ave., Hicksville, N. Y.											
2J48	OSC	9.31-9.32	6.3	16k	16a	.002	16	Wg	1	40kw	
4J47	OSC	2.7-2.8		27k	70a	.001		Co	6.6	800kw	
4J57, 58, 59	OSC	6.27-6.57 (in 3 steps)	12.6	25k	35a	.001		Wg	2.5	210kw	
5780A	OSC mil spec	8.5-9.6	22	38k	50a	.001	16	Wg		257kw	
6507	OSC	9.3-9.4	12.6, 2.0	16k	15a	.001	13	Wg		70kw	
6589	OSC	3.3-3.5	16.0	30k	50a	.001		Wg	2.5	500kw	
BOMAC LABORATORIES, INC., Salem Road, Beverly, Mass.											
5780	tunable OSC	8.5-9.6	20, 4	30k	30a					250kw	
6551	fixed tuned OSC	23.7-24.2	5, 2.8	14k	15a					40kw	
BL212		5.4-5.9	5, 0.5	1300	0.8a					100w	
BL216		15.9-16.1	15, 3.7	20.5k	20a					100w	
BL208		16.-16.5		3500	1a					500w	
BL-218		51.5-55.5	6.3, 3	14k	7a					5kw	
BL-219		54.5-57.5	6.3, 3	15.5k	7a					5kw	
BL-220		56.5-60.	6.3, 3	14k	7					5kw	
BL-223		5.4-5.9	5, 0.7	1900	1.1a					400w	
BL-226		9.4-9.5	5, 0.5	1300	900					90w	
BL-227		8.7-9.1	5, 0.5	1300	900					90w	
BL-228		8.3-8.7	5, 0.5	1300	900					90w	
BL-230		5.4-5.9	5.0, 0.7	2800	1.9a					1kw	
BL-231		5.3-6	5.0, 0.5	1400	1a					200w	
BL-242		5.4-5.9	5, 0.7	1900	1.1a					400w	
BL-243		5.4-5.9	5, 0.5	1400	1a					200w	
BRITISH INDUSTRIES CORPORATION, 80 Shore Road, Port Washington, N. Y. (Representing General Electric Co., Ltd.)											
MAG3	air-cooled OSC	9.34-9.40	6.3,0.5	5.5k	6a	.001	15	Wg	1	10kw	
MAG5	unpackaged, air-cooled	9.36-9.46	3.0, 2.0	17k	12a	.001	15		1	60kw	
MAG7	air or liquid cooled OSC	9.2-10	2.0, 10	16k	15a	.001	15	Wg	1	80kw	
MAG8	fixed freq., pulsed	9.2-9.6	6.3, 0.2	0.95k	0.025a	.004	30		2	400mw	
CVX-370	air-cooled	9.21-9.27	6.3, 0.5	5.5k	6a	.001	15	Wg	1	10kw	
CV1482	unpackaged, air-cooled	2.95-2.98	5.0, 2.6	27k	35a	.001	35	probe	2	400kw	
CANADIAN MARCONI COMPANY, 2442 Trenton Ave., Montreal 16, P. Q. Canada											
2J42	OSC	9.3-9.4		5700	4.5a	.002				8kw	
4J34 to 4J31	OSC	2.74-2.9 (in 4 steps)		30k	70a (same as above)	.001				800kw	
ENGLISH ELECTRIC VALVE CO., LTD., Chelmsford, England											
2J30 to 2J34	fixed freq., ext. mag., forced-air	2.7-2.9 (in 5 types)	6.3, 1.5	20k	30a			Co	1.0	300kw	
			Same characteristics as above.								
2J42	fixed freq., int. mag., forced-air	9.34-9.4	6.3, 0.5	5.5k	4.5a			Wg	1.0	8kw	
4J31 to 4J35	fixed freq., ext. mag., forced-air	2.7-2.9 (in 6 types)	16.0, 3.1	28k	70a			Co	1.0	1megw	
			Same characteristics as above.								
4J43 to 4J44	fixed freq., ext. mag., forced-air	2.96-3 (in 2 types)	16.0, 3.1	28k	70a			Co	1.0	900kw	
			Same characteristics as above.								
4J50A	fixed freq., int. mag., forced-air	9.34-9.4	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
4J52A	fixed freq., int. mag., forced-air	9.35-11	12.6, 2.2	15k	15a			Wg	5.0	80kw	
4J53	fixed freq., ext. mag., forced-air	2.19-2.81	16.0, 3.1	28k	70a			Co	1.0	1megw	
4J78	fixed freq., int. mag., forced-air	9-9.16	13.7, 3.5	21.5k	27.5a			Wg	1.0	250kw	
714AY	fixed freq., ext. mag., forced-air	3.28-3.32	6.3, 1.5	20k	20a			Co	1.0	180kw	
5586	tunable freq., ext. mag., forced-air	2.7-2.9	16.0, 3.1	30k	70a			Ca	1.0	1megw	
5657	tunable freq., ext. mag., forced-air	2.9-3.1	16.0, 3.1	30.5k	70a			Co	1.0	900kw	
6027	fixed freq., int. mag., forced-air	9.34-9.4	6.3, 0.5	6.9k	7.5a			Wg	1.0	20kw	
7182	fixed freq., electro mag., water, air-cooled	2.75-2.86	12.0, 15.0	35k	157a				5.0	2500kw	
M501, M501A, M501B	fixed freq., ext. mag., forced-air.	2.94-3.06 (in 4 types)	5, 2.6	27k	35a			Co	2.0	500kw	
M502A	fixed freq., int. mag., forced-air	9.32-9.42	12.6, 2.2	21k	22.5a			Wg	1.0	180kw	
M503, M503A	fixed freq., int. mag., forced-air	9.34-9.4	6.3, 0.5	5.5k	5a			Wg	0.1	8kw	
M504	fixed freq., electro mag., forced-air	9.32-9.42	5, 43	35k	50a			Wg	0.6	750kw	
M505	fixed freq., ext. mag., forced-air	9.36-9.46	3, 3.5	11.1k	12a			Wg	1.0	45kw	
M506A	fixed freq., ext. mag., forced-air	9.36-9.46	3, 3.5	11.2k	12a			Wg	1.0	50kw	
M507	fixed freq., ext. mag., forced-air	3.23-3.38 (in 4 types)	5, 2.6	29k	40a			Co	0.5	425kw	
M508	fixed freq., int. mag., forced-air	9.21-9.27	6.3, 0.5	5.5k	4.5a			Wg	1.0	8kw	
M509	fixed freq., int. mag., forced-air	8.77-8.83	6.3, 0.5	5.5k	5a			Wg	0.4	9kw	
M513A	fixed freq., int. mag., nat. cooled	9.34-9.4	6.3, 0.5	7.5k	6.8a			Wg	1.0	18kw	
M519	fixed freq., ext. mag., forced-air	3.45-3.61 (in 4 types)	5, 2.6	27k	40a			Co	0.5	425kw	
M521	fixed freq., ext. mag., forced-air	9.6-9.7	3, 3.5	11.5k	12a			Wg	1.0	45kw	
M523	fixed freq., int. mag., forced-air	9.58-9.7	13.7, 3.2	21.5k	27.5a			Wg	1.0	250kw	
M525	fixed freq., ext. mag., water-cooled	2.75-2.85 (in 7 types)	8.5, 9	36k	70a			Wg	1.2	1150kw	
M528	fixed freq., ext. mag., forced-air	3-3.12 (in 6 types)	6, 1.2	22.5k	22.5a			Co	0.5	200kw	
M529	fixed freq., int. mag., forced-air	8.83-8.99	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M535	fixed freq., int. mag., not cooled	9.5-9.6	6.3, 0.5	5.5k	5a			Wg	0.1	8kw	
M537	fixed freq., int. mag., forced-air	8.77-8.83	6.3, 0.5	5.5k	4.5a			Wg	1.0	8kw	
M538A	fixed freq., int. mag., forced-air	9.21-9.27	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M539	fixed freq., int. mag., forced-air	8.66-8.83	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M546	fixed freq., int. mag., forced-air	9.7-9.85	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M547	fixed freq., int. mag., forced-air	9.85-10	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M548	fixed freq., ext. mag., forced-air	9-9.16	3, 3.5	13.5k	12a			Wg	1.0	55kw	
M549	fixed freq., int. mag., forced-air	8.5-8.66	13.7, 3.2	21.5k	27.5a			Wg	0.5	250kw	
M554	fixed freq., ext. mag., water-cooled	1.3-1.36	22, 13	40k	125a			Wg	5.0	2500kw	
M555	fixed freq., int. mag., forced-air	14-16.5	12.6, 2.2	15k	15a			Wg	1.0	60kw	
M543	fixed freq., int. mag., water-cooled	2.75-2.85	12.0, 13.0	35kv	157a			Wg	5.0	2500kw	
FERRANTI ELECTRIC, INC., 30 Rockefeller Plaza, New York 20, N. Y.											
VF10	OSC	9-9.5		.5k		.0015		Wg		1mw	
GENERAL ELECTRIC COMPANY, Electronic Components Div., One River Road, Schenectady 5, N. Y.											
GL-6410	Int. mag., water-cooled	2.75-2.86	8.3, 85	71k	130a	.001	15	Wg	2.2	4.5megw	
LITTON INDUSTRIES, Electron Tube Division, 960 Industrial Road, San Carlos, Calif.											
LT-4J50A	fixed freq.	9.375±30mc	13.7, 3.2	21.5k	27.5a	.001	15		1	225kw	
LT-4J52A	fixed freq.	9.375±25mc	12.6, 2.3	15k	15a	.001	13		1	70kw	
LT-6233 (L-3023)	tunable	9.28-9.345	6.3, 1.0	5.8k	3.8a	.003	20		0.5	7kw	
				Same characteristics as above.							
LT-6510	fixed freq.	9.375±30mc	12.6, 2.3	15k	15a	.001	15		1	65kw	
LT-6543, A	tunable	8.5-9.6	12.6, 2.3	15k	15a	.001	15		1	65kw	
L-3028B	tunable	9.28-9.32	6.3, 0.5	800	0.55a	.027	20		1	120w	
L-3180	tunable	9.2-9.22	(Characteristics same as above)								
L-3181	tunable	9.25-9.27									
L-3212	tunable	9.0-9.02									
L-3213	tunable	9.05-9.07									
L-3214	tunable	9.1-9.12									
L-3218	tunable	9.15-9.17									
L-3029A	tunable	9.235-9.3	6.3, 1.0	5.8k	3.8a	.003	20		0.5	7kw	
L-3029B	tunable	9.25-9.315		Same characteristics as above.							
L-3029C	tunable	9.295-9.36									
L-3030	fixed freq.	9.375	13.7, 3.2	27.5k	27.5a	.001	15		1	300kw	
L-3030B	fixed freq.	9.0		Same characteristics as above.							
L-3030C	fixed freq.	9.2									
L-3036A	fixed freq.	9.41	12.6, 2.3	15k	15a	.001	15		1	65kw	
L-3036B	fixed freq.	9.275		Same characteristics as above.							
L-3036F	fixed freq.	9.245									
L-3036E	fixed freq., ruggedized	9.375	12.6, 2.3	15k	15a	.001	15		1	65kw	
L-3036G	fixed freq. ruggedized	9.245		Same characteristics as above.							
L-3037	fixed freq.	9.375	12.6, 2.3	15k	15a	.001	13		1	70kw	
L-3039D	fixed freq.	8.8	13.75, 3.2	21.5k	27.5a	.001	15		1	225kw	
L-3039E	fixed freq.	8.86									
L-3039F	fixed freq.	8.92									
L-3039G	fixed freq.	8.98									

The FIRST and ONLY standard line of tunable Microwave Filters

S BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	27-BW	27-CW	27-DW
Type of Resonator	TE_{101} mode rectangular	TE_{101} mode rectangular	TE_{101} mode rectangular
Tuning Range	2700-3150 MCS	2700-2950 MCS	2700-2900 MCS
3 db Bandwidth	4.5-6.5 MCS	4.5-5.5 MCS	4.5-5.5 MCS
Max 30 db Bandwidth	36 MCS	18 MCS	13 MCS
Max Insertion Loss	.9 db	1.3 db	1.8 db
Price	$400.00	$535.00	$670.00
Model No.	27-BC	27-CC	27-DC
Type of Resonant Cavity	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	2700-3200 MCS	2700-3100 MCS	2700-2950 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32MCS	21 MCS
Max Insertion Loss	1.6 db	2.4 db	3.2 db
Price	$350.00	$475.00	$600.00

C BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	54-BC	54-CC	54-DC
Type of Resonator	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	5400-5950 MCS	5400-5950 MCS	5400-5750 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	2 db	3 db	4 db
Price	$360.00	$485.00	$610.00

L BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	96-BC	96-CC	96-DC
Type of Resonant Cavity	$\lambda/4$ coax	$\lambda/4$ coax	$\lambda/4$ coax
Tuning Range	960-1150 MCS	960-1100MCS	960-1050 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.2 db	1.8 db	2.5 db
Price	$370.00	$495.00	$620.00

X BAND FILTERS

Characteristics	Two (2) Section Resonator	Three (3) Section Resonator	Four (4) Section Resonator
Model No.	75-BW	75-CW	75-DW
Type of Resonant Cavity	TE_{111} mode cylindrical	TE_{111} mode cylindrical	TE_{111} mode cylindrical
Tuning Range	7500-8500 MCS	7500-8250 MCS	7500-8000 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.5 db	2.5 db	3.5 db
Price	$475.00	$625.00	$775.00
Model No.	85-BW	85-CW	85-DW
Type of Resonant Cavity	TE_{111} mode cylindrical	TE_{111} mode cylindrical	TE_{111} mode cylindrical
Tuning Range	8500-9600 MCS	8500-9300 MCS	8500-9000 MCS
3 db Bandwidth	8-11 MCS	8-10 MCS	8-9 MCS
Max 30 db Bandwidth	60 MCS	32 MCS	21 MCS
Max Insertion Loss	1.5 db	2.5 db	3.5 db
Price	$475.00	$625.00	$775.00

All of the above filters have Max VSWR of 1.5, and either a single shaft or counter dial for Tuning Control. Depending upon mode of operation, units are supplied with either Type N Connectors or Waveguide flanges.

DELIVERY IN 90 DAYS

FREQUENCY STANDARDS, INC.

A DIVISION OF NATIONAL ELECTRIC PRODUCTS CORP.

P. O. BOX 504, ASBURY PARK, N. J. Telephone: PRospect 4-0500 TWX A PK 588

MAGNETRONS

Type	Desci. App.	Freq. Range (kmc)	Heater V. A.	Anode Volts (peak)	Anode Current (peak)	Duty Cy.	Pulling Factor (mc/s)	Type Output	Pulse Dur. (ms)	Power Output	Price
LITTON INDUSTRIES, Electron Tube Division, 960 Industrial Road, San Carlos, Calif. (cont'd.)											
L-3039H	fixed freq.	9.04									
L-3039I	fixed freq.	9.1									
L-3039J	fixed freq.	9.16		(Characteristics same as above)							
L-3039K	fixed freq.	9.22									
L-3039L	fixed freq.	9.28									
L-3039M	fixed freq.	9.34									
L-3039N	fixed freq.	9.4									
L-3039P	fixed freq.	9.375	13.75, 3.2	21.5k	27.5a	.001	15		1	225kw	
L-3058	tunable	9.32-9.36	6.3, 0.5	2.8k	1.33a	.003	20		1	1kw	
L-3087A	tunable	9.28-9.32	5.0, 0.6	800	0.55a	.027	20		1	120w	
L-3187		9.25-9.27		Same characteristics as above.							
L-3103	tunable	8.5-9.6	12.6, 2.3	12.5k	10a	.002	15		1	30kw	
L-3105	fixed freq.	9.3±40mc	6.3, 0.5	800	0.55a	.01	20		1	100w	
L-3106, A	tunable	8.5-9.6	12.6, 2.3	15k	15a	.001	15		1	65kw	
L-3107	fixed freq., ruggedized	9.375±30mc	13.75, 3.2	21.5k	27.5a	.001	15		1	225kw	
L-3150	fixed freq.,	9.3±40mc	6.3, 0.5	800	0.55a	.01	20		1	100w	
L-3151	fixed freq.	9.375±30mc	13.75, 3.2	21.5k	27.5a	.001	15		1	225kw	
L-3152	fixed freq.	9.26±15mc									
L-3153	fixed freq.	9.36±15mc									
L-3154	fixed freq.	9.46±15mc		(Characteristics same as above)							
L-3155	fixed freq.	9.56±15mc									
L-3209	fixed freq.	9.16±15mc									
L-3210	fixed freq.	8.96±15mc									
L-3156	fixed freq.	9.375±30mc	13.75, 3.2	20k	16a	.002	15		0.5	112kw	
L-3157	fixed freq.	9.335±40mc	6.3, 0.5	3.4k	2.25a	.001	20		1	2kw	
L-3168	fixed freq.	9.375±30mc	12.6, 2.3	12.5k	10a	.002	15		1	30kw	
L-3182	fixed freq.	9.34±50mc	6.3, 0.5	2.8k	1.33a	.003	20		1	1kw	
L-3186	fixed freq.	9.3±40mc	6.3, 0.5	800	0.55a	.01	20		1	100w	
L-3204	fixed freq.	8.8±25mc	6.3, 1.0	800	0.2a	0.25	20		2.5	40w	
L-3211	tunable	8.6-9.5	12.6, 2.3	15k	15a	.001	15		1	65kw	
MICROWAVE ASSOCIATES, Burlington, Mass.											
2J42	(all fixed-tuned except 6229) pulsed OSC	9.34-9.4	6.3, 0.4	5.3-5.7k	4.5a	.002 .0009 .00032	15	Wg	1.0 2.2 0.4	8kw	
6270	pulsed OSC	9.5-9.6									
6272	pulsed OSC	9.4-9.5									
6273	pulsed OSC	9.1-9.2		– other characteristics same as 2J42 –							
6274	pulsed OSC	9-9.1									
6275	pulsed OSC	9.2-9.34									
2J42H*											
6817 to 6822	pulsed OSC	9-9.6		– other characteristics same as 2J42H –							
5027 (2J42A)	pulsed OSC	9.34-9.4	6.3, 0.4 6.3, 0.4	6.4-7.4k 6-7k	7.5a 7a	.001 .002	15 15		1 1	20kw 10kw	
MA-201 6027*	pulsed OSC	9.3-9.4	6.3, 0.4	7.4-7.8k	7.5a	.001 .00032	18	Wg		20kw	
MA-201-F1 to MA-201-F6	pulsed OSC	9-9.6	6.3, 0.4	7.4-7.8k	7.5a	.001	18		1	20kw	
6229	tunable OSC	8.9-9.4	5.0, 0.4	4-5k	.5a	.0005	20		.25	1kw	
MA-213		8.8-10	6.0, 0.5	450	.060a	.25	15		1	5w	
MA-215		8.8-9.6	6.3, 0.6	800	0.2a	.25	20		5	40w	
6230	OSC	8.9-9.4		5k	1a	.003				910w	
ESM-48	fixed freq., cw	9.8-10	6, .4	450	15	cw	10			1w	
6444-F1				Same characteristics as above.							
6444-F2 to 6444-F6	fixed freq., cw can be pulse modulated	8.8-9.6		(other characteristics same as 6444-F1)							
5789	fixed freq., pulsed	34.5-35.2	6, 2.4	10-13k	20a 15a 10a	.00025 .0004 .0006	40	Wg	.25 .5 1.0	40kw 30kw 20kw	
MA-200	fixed freq., ruggedized	34.7-35	12.6, 2.6	11-13k	20a	.00025	40	Wg	.25	40kw	
MA-206	fixed freq., ruggedized	34.7-35	12.6, 2.6	11-13k	10a	.0005	40		.25	20kw	
MA-207	fixed freq., ruggedized	34.7-35	12.6, 2.6	11-13k	20a	.0004			.25	60kw	
MA-210 A, B, C	OSC	34.2-35.5 in 3 steps		13k	20a	.0004		Wg		32kw	
MA-202	tunable	7.5-8.5	6.0	600	15ma	cw				1w	
MA-204	tunable	9 -10		Same characteristics as above.							
MA-208	tunable	7.17-8.5		800	0.2a					30w	
MA-209	tunable	9.3-10.0	6.3, 1	6k	4.5a	.001	20		0.5	7kw	
RADIO CORPORATION OF AMERICA, Tube Division, Harrison, N. J.											
4J50	fixed freq., pulse OSC	9.375±30mc	13.75, 3.15	23k	27.5a			Wg	6.0	240kw	
4J52	fixed freq., pulse OSC.	9.375±30mc	12.6, 2.1	15k	15a			Wg	5.0	80kw	
6521	fixed freq., pulse OSC	5.4±20mc	10.0, 3.2	15k	13.5a				2.2	85kw	
7008	tunable, pulse OSC	8.5-9.6				.001				230kw	
7110	tunable, pulse OSC	8.5-9.6				.001				220kw	
7112	tunable, pulse OSC	8.5-9.6				.001				220kw	
7111	tunable, pulse OSC	8.5-9.6				.001				220kw	
A-1127	tunable, pulse OSC	8.5-9.6				.001				280kw	
6865-A	tunable, pulse OSC	8.75-9.6				.001				220kw	
A1086-G	tunable, pulse OSC	8.75-9.6				.001				240kw	
RAYTHEON MANUFACTURING CO., Microwave & Power Tube Div., Waltham, Mass.											
QK172	OSC	9.33-9.42		30k		.001				440kw	
QK264	OSC	1.25-1.35		75k	100a	.001				2megw	
QK-313	OSC	5.4-5.8		27k	30a	.001				250kw	
QK-324	OSC	15.8-16.1		30k	14a	.0028				70kw	
QK-362A	OSC	9.3-9.5		2000	1.25a	.002				60w	
QK-366	OSC	9.2-9.28		16k	14.5a	.001				75kw	
QK-367	OSC	9.01-9.07		16k	16a	.001				40kw	
QK-389	OSC	23.8-24.2		16k	19a	.0007				50kw	
QK-390	OSC	2.42-2.47		6200	.375a	cw				800w	
QK-456	OSC	5.3-5.4		16k	20a	.001				75kw	
QK-457	OSC	5.5-5.8		2000	1.0a	.002				200w	
QK-470	OSC	1.2-1.3		75k	100a	.0012				2mw	
QK-520	pulsed ampl.	1.22-1.35		40k	35a					800kw	
2J-23	OSC	3-3.1		22k	30a	.002				240kw	
2J-24	OSC	3.04-3.07									
2J-25	OSC	3.01-3.04									
2J-26	OSC	2.9-3.0									
2J-27	OSC	2.96-2.99									
2J-28	OSC	2.93-2.96		Same characteristics as above.							
2J-29	OSC	2.91-2.93									
2J-30	OSC	2.8-2.9								240kw	
2J-31	OSC	2.82-2.86									
2J-32	OSC	2.7-2.8									
2J-33	OSC	2.74-2.87									
2J-34	OSC	2.7-2.74									
2J-36	OSC	9.0-9.1		14k	12a	.002				14kw	
2J-42	OSC	9.3-9.4		5700	4.5a	.002				8kw	
2J-50	OSC	8.7-8.9		16k	16a	.0012				40kw	
2J-49	OSC	9.0-9.1									
2J-51	OSC	8.5-9.6		16k	16a	.0012				45kw	
2J-55	OSC	9.3-9.4		16k	16a	.001				40kw	
2J-56	OSC	9.21-9.27		16k	16a	.001				40kw	
2J-66	OSC	2.8-2.9		20k	25a	.001				150kw	
2J-67, 68	OSC	2.7-2.8		20k	25a	.001				150kw	
4J35 to 4J31	OSC	2.7 to 2.9 in 5 steps		30k	70a	.001				800kw	
				Same characteristics as above.							
4J-41 to 4J-36	OSC	3.4 to 3.7 in 6 steps		30k	70a	.001				700kw	
				Same characteristics as above.							
4J-63	OSC	2.98-3.33		1500	.15a	cw				50w	
4J-64	OSC	3.3-3.6		Same characteristics as above.							
2J-70	OSC	3.0-3.1		7500	15a	.002				20kw	
2J71	OSC	3.1-3.2		5500	8a	.002				6kw	
4J30	OSC	1.22-1.23		30k	60a	.002				600kw	
2J69	OSC	2.6-2.7		20k	25a	.001				150kw	
4J43	OSC	2.9-3		30k	70a	.001				900kw	
4J4c	OSC	2.96-2.99		Same characteristics as above.							

*Modified for high altitude, unpressurized

MAGNETRONS

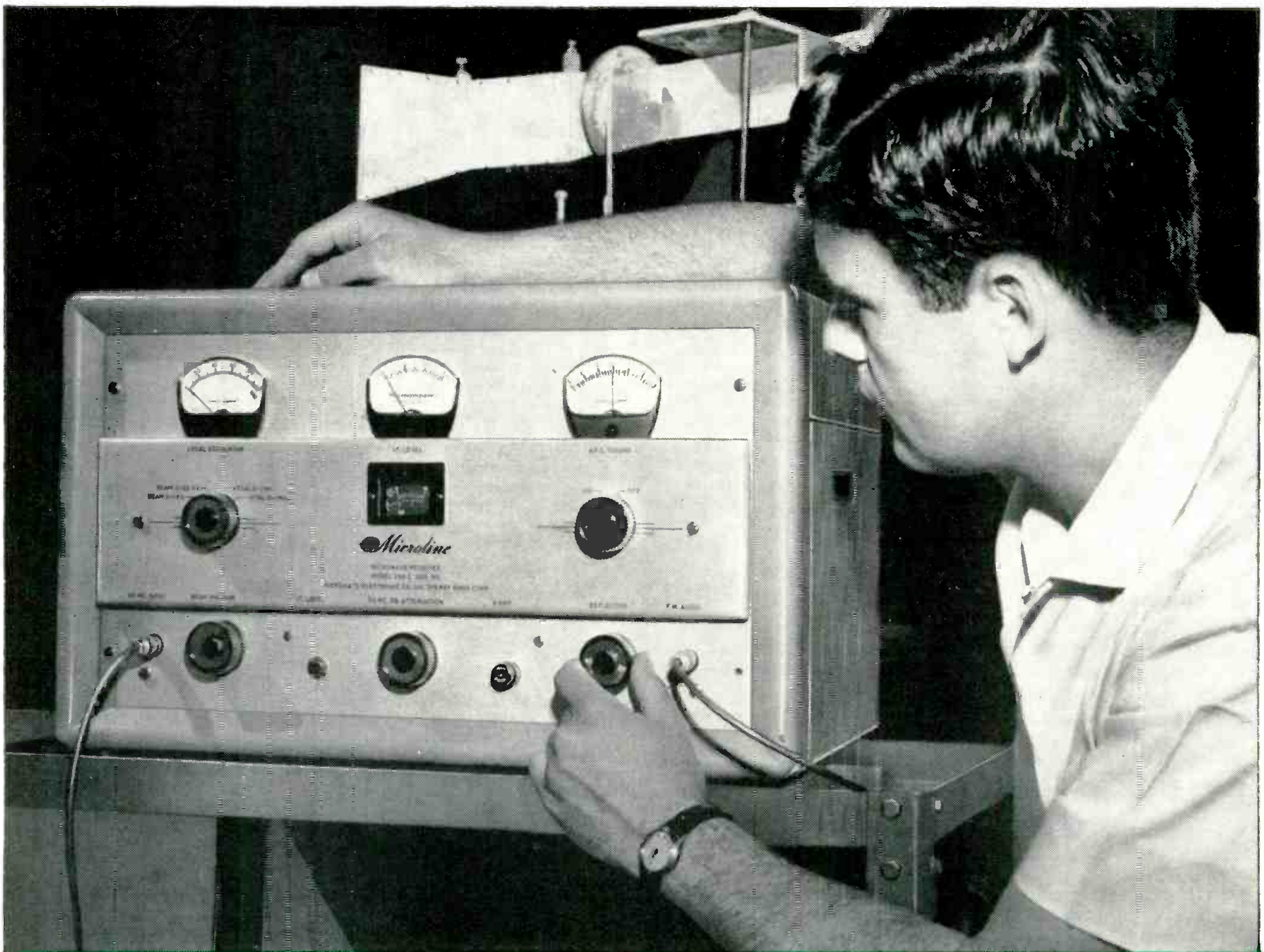
Type	Descr. App.	Freq. Range (kmc)	Heater V.A.	Anode Volts (peak)	Anode Current (peak)	Duty Cy.	Pulling Factor (mc/s)	Type Output	Pulse Dur. (ms)	Power Output	Price
RAYTHEON MANUFACTURING CO., Microwave & Power Tube Div., Waltham, Mass.											
4J57	OSC	6.57-6.47		35k	35a	.001				180kw	
4J59	OSC	6.2-6.3		25k	35a	.001				210kw	
4J58	OSC	6.3-6.4			Same characteristics as above.						
4J61	OSC	2.4-2.7		1500	.15a	cw				50w	
4J62	OSC	2.6-3.0			Same characteristics as above.						
5J26	OSC	1.2-1.3		31k	60a	.002				400kw	
725A	OSC mil spec	9.3-9.4		16k	16a	.001				40kw	
730A	OSC mil spec	9.3-9.4		16k	16a	.001				40kw	
5982	OSC	9.3-9.4		17k	14.5a	.001				75kw	
6002	OSC	9.2-9.4		30k	40a	.002				225kw	
6177	OSC	4.2-4.3		350	.035a	cw		Co		1w	
6229	OSC	8.9-9.4		5000	1.0a	.003				400w	
6230	OSC	8.9-9.4		5000	1.0a	.003				910w	
6249	OSC	8.5-9.6		29k	32a	.0013		Wg		200kw	
6344	OSC	5.45-5.825		24k	30a	.001				175kw	
6402	OSC	3.4-3.5		57k	55a	.0016				700kw	
6406	OSC	2.8-2.9		56k	95a	.0006				1.75megw	
6410	OSC	2.7-2.8		76k	135a	.001				1.5megw	
6517	OSC	1.2-1.3		70k	60a	.0013				1megw	
6518	OSC	2.7-3.0		45k	92a	.0007				1.5megw	
6841	OSC	16.4-16.6		19k	16a	.001				50kw	
6843	OSC	5.4-5.8		26k	30a	.0012				250kw	
5586	OSC	2.7-2.9		30k	70a	.001		Co		800kw	
5657	OSC	2.9-3.1		33k	70a	.001				700kw	
5609A	OSC	2.42-2.47		1.6k	0.15a	cw				80w	
6695	OSC	3.43-3.57		33k	65a	.001				650kw	
6403	OSC	3.43-3.57		65k	90a	.001				2megw	
ROGERS ELECTRONIC TUBES & COMPONENTS, 116 Vanderhoof Ave., Toronto 17, Ont.											
7090	CW OSC	2.42-2.47								200w	
7091	CW OSC	2.42-2.47								2kw	
6972	OSC	9.3-9.4								65kw	
7093	OSC	34.8-35.2								25kw	
SYLVANIA SPECIAL TUBE OPERATIONS, 100 Sylvan Road, Woburn, Mass.											
2J42	OSC	9.3-9.4		5700	4.5a	.002		Wg		8kw	
6027	OSC	9.3-9.4		7400	7.5a	.002		Wg		20kw	
6874	OSC	9-9.6		23k	30a	.0013		Wg		200kw	
5789	OSC	34.5-35.2		13k	20a	.0006		Wg		40kw	
6799	OSC	34.5-35.2		20k	40a	.00035		Wg		100kw	
7098	min, ruggedized OSC	9.3-9.5								60w	
M4064	ruggedized									70kw	
M4155	ruggedized									40kw	
M4063	ruggedized									20kw	
WESTINGHOUSE, Electric Tube Division, P.O. Box 284, Elmira, N. Y.											
6249, A	OSC	8.5-9.6		29k	32a	.0013		Wg		200kw	
6177	OSC	4.2-4.3		350	35ma	cw		Co		1w	

KLYSTRONS

Type	Descr. App.	Freq. Range (kmc)	Heater V.A.	Beam Voltage	Reflector Voltage	Beam Current (ma)	Tuning Range	Power Output	Price
AMPEREX ELECTRONIC COMPANY, 230 Duffy Ave., Hicksville, N.Y.									
DX122	2-cav. OSC	8.5-10.5	11.0, 1.2	3500		50		5w	
DX123	2-cav. OSC	8.5-10.5		5500		100		20w	
DX124	2-cav. OSC	8.5-10.5		10k		200		100w	
DX151	CW OSC	69.5-77.5		2400		16		40mw	
BENDIX AVIATION CORPORATION, Red Bank Division, Eatontown, N.J.									
6541	CW OSC	23.2-24.7		330		30		8.5mw	
6584	CW OSC	5.1-5.9		330		35		70mw	
6845	CW OSC, mil spec	8.5-9.6		350				20mw	
TE37	CW OSC	34-35.6		425		65		8.5mw	
TE60	CW OSC	23.5-24.5		330		30		8.5mw	
TE61	CW OSC	10.52		350		32		20mw	
6116/TE-39	refl. OSC	8.5-9.66							
6940/TE-58	refl. OSC	5.2-10.9							
6845/TE-59	refl. OSC	8.5-9.6							
TE-4	refl. OSC	23.5-24.4							
TE-62	refl. OSC	8.5-9.66							
TE-30	refl. OSC	23.5-24.5							
TE-38	refl. OSC	5.1-5.9							
TE-53	refl. OSC	34-35.6							
BOMAC LABORATORIES, INC., Salem Road, Beverly, Mass.									
6780/BL800	CW OSC	8.5-10.		300				10mw	
6316/BL800A	CW OSC	8.5-10.		300				35mw	
BL801	CW OSC	8.5-10.		300				100mw	
BL802	CW OSC	8.8-9.2		250				5mw	
BL803	CW OSC	8.5-10.		300				25mw	
BL806	CW OSC	8.5-10.		200				25mw	
BL807		8.5-10.5		350				50mw	
BL811		8.5-10		300				25mw	
BL812		8.5-9.6		300				120mw	
BL814		10.4-12.3		400				150mw	
BL815		9.14-9.15		200				15mw	
BL818		8.5-10.5		350				50mw	
BL819		9.192		300				40mw	
BL820		9-9.2		300				40mw	
BL824		9.2-9.5		300				22mw	
EITEL-McCULLOUGH, INC., 798 San Mateo Ave., San Bruno, Calif.									
1K015CA	CW OSC, Co	5.4-6.0		350		50		100mw	
1K015CG	CW OSC, Wg	5.4-6		350		50		100mw	
3KM4000LT	3-cav. ampl	.955-1.22		24k		3.3a		30kw	
3K3000LQ	3-cav. ampl., Co	.720-.985		9000		750		2kw	
3K50000LQ	3-cav. ampl., Co	.720-.985		20k		2.5a		13.5kw	
3K50000LA	3-cav. ampl., Co	.470-.580		20k		2.5a		13.5kw	
3K50000LF	3-cav. ampl., Co	.580-.720		20k		2.5a		13.5kw	
3KM3000LA	3-cav. ampl., Co	.375-.570		9000		750		1900w	
3K2500SG	3-cav. ampl., Co	1.7-2.4		7000		600		1420w	
6K50000LQ	6-cav. ampl., Co	.720-.980		20k		2.5a		9000w	
4K50000LQ	4-cav. ampl., Co	.720-.985		20k		2.5a		12.3kw	
4KM50000SG	4-cav. ampl., Wg	1.7-2.4		18k		2.0a		10.7kw	
4KM50,000LQ		.605-.985	8 , 40.	20k	160	2.5a		12.3kw	
4KM170,000LA	CW ampl.	0.5						10kw	
4KM3000LQ	CW ampl.	1.0						2kw	
3K2500LX	CW ampl.	0.9-1.4						1kw	
1K20XS	CW refl. OSC., ruggedized	8.5-9.3	6.3, 1.0	350	200	50	20mc	50mw	
1K20XK	CW refl. OSC., ruggedized	9.2-10.0	6.3, 1.0	350	160	50	20mc	50mw	
1K20XD	CW refl. OSC., ruggedized	10.0-10.8	6.3, 1.0	350	200	50	20mc	50mw	
1K20KA	CW refl. OSC., ruggedized	10.7-11.7	6.3, 1.0	350	200	50	20mc	50mw	
1K125CA	CW refl. OSC	3.7-4.4	6.3, 1.1	1000	1000	90	50mc	2w	
1K125CB	CW refl. OSC	4.4-5.0	6.3, 1.1	1000	1000	90	40mc	2.3w	
X639	CW ampl.	7.1-8.5		300				50w	
X563	CW ampl.	5.5-7						50w	
X576	pulsed ampl.	0.55-0.65						200kw	
X616	pulsed ampl.	0.75-1						50kw	
X632	pulsed ampl.	2.8-3.3						10,000kw	
X700	pulsed ampl.	2.4-3						20kw	

KLYSTRONS

Type *	Descr. App.	Freq. Range (kmc)	Heater V.A.	Beam Voltage	Reflector Voltage	Beam Current (ma)	Tuning Range	Power Output	Price
ENGLISH ELECTRIC VALVE CO., LTD., Chelmsford, England									
K300	refl. OSC., int. res.	9.32-9.5	6.3, 0.6	350	90-150	35	30mc	30mw	
K301	refl. OSC., ext. res.	2.5-3.5	6.3, 0.6	350	120-400	35	15mc	30mw	
K302	refl. OSC., int. res.	9.32-9.5	6.3, 0.6	350	80-165	35	30mc	30mw	
K305	refl. OSC., int. res.	9.25-9.5	6.3, 0.6	350	80-170	35	35mc	25mw	
K308	refl. OSC., int. res.	8.8-8.9	6.3, 0.6	350	140-220	35	40mc	40mw	
K311	refl. OSC., int. res.	8.5-9.5	6.3, 0.6	350	165-365	35	30mc	45mw	
K312	refl. OSC., int. res.	9.43-9.65	6.3, 0.6	350	110-180	35	30mc	30mw	
K313	refl. OSC., int. res.	9.64-9.77	6.3, 0.6	350	80-185	35	30mc	25mw	
K315	refl. OSC., int. res.	9.1-9.2	6.3, 0.6	350	150-270	35	30mc	20mw	
K317	refl. OSC., int. res.	8.2-8.3	6.3, 0.6	350	200-320	35	30mc	20mw	
K321	refl. OSC., int. res.	9.43-9.65	6.3, 0.6	350	110-180	35	30mc	25mw	
K323	refl. OSC., int. res.	9.64-9.77	6.3, 0.6	350	80-185	35	30mc	25mw	
K324	refl. OSC., int. res.	9-10	6.3, 0.6	350	250-400	35	30mc	45mw	
K328	refl. OSC., int. res.	9.55-9.68	6.3, 0.6	350	110-190	35	30mc	25mw	
K329	3-cav., pulse ampl., forced air	0.96-1.21	5.0, 40.	10k		140 (2.4a pk)		5kw	
K335	refl. OSC., int. res.	9.55-9.68	6.3, 0.6	350	110-180	35	30mc	25mw	
K336	2-res. OSC., forced air	8.5-10	6.3, 1.7	1225		145	20mc	6.5w	
K337	rug. refl. OSC., int. res.	9-10	6.3, 0.6	350	250-400		24mc	45mw	
K339	CW, 4-cav. ampl., forced-air, water	1.35-1.45	6.0, 30	1kv focus	17k - 1.8a	40		10kw	
K340	refl. OSC., int. res.	9.3-9.5	6.3, 0.6	350	90-175	25	40mc	35mw	
K342	rug. refl. OSC., int. res.	8.5-9	6.3, 0.6	350	150-275	35	35mc	45mw	
K343	refl. OSC., int. res.	12-14.5	6.3, 0.6	350	100-250	30	80mc	25mw	
				350	200-350	30	40mc	30mw	
K345	refl. OSC., int. res., forced-air	5.92-8.02	6.3, 0.8	750	250-400	72	30mc	1.2w	
K346	refl. OSC., int. res.	14.5-17	6.3, 0.6	350	50-150	30	80mc	25mw	
				350	100-250	30	50mc	35mw	
K347	3-cav., pulse ampl., forced-air	0.57-0.62	6.3, 30.	0v focus	75k, 20a			500kw	
K350	2-res. OSC., forced-air	8.5-10	6.3, 1.7	700		70	12mc	1.2w	
LM ERICSSON, Ab Svenska Electronror, Stockholm 20, Sweden (State Labs. Inc., 649 Broadway, New York 12, N. Y.)									
6811, 6812	CW OSC, Wg	2.5-5.		375		30		100mw	
FERRANTI ELECTRIC, INC., 30 Rockefeller Plaza, New York 20, N. Y.									
SY11	CW ampl., Wg	8.7-9.7		14k		850		2kw	
SY30	2-cav. CW ampl., Wg	8.5-10.5		10k		260		200w	
SZ11	CW OSC, Wg	8.7-9.7		11k		560		650w	
SZ21	CW OSC, Wg	9.4-9.5		8k		40		20w	
GENERAL ELECTRIC COMPANY, Electronic Components Div., One River Road, Schenectady 5, N. Y.									
GL-6237 to GL-6242	3-res., TV ampl.	0.47-0.89 (in 6 steps)	5.5, 35.	18k		3a Same characteristics as above.		12kw	
GL-6625	3-res., pulse ampl.	0.96-1.21	5.5, 45.	20k		6.6a		22kw	
LITTON INDUSTRIES, Electron Tube Division, 960 Industrial Road, San Carlos, Calif.									
L-3035	3-res., ampl., pulsed	1.24-1.36	16, 8	115k		78a		2.2mw	
N. V. PHILIPS' GLOEILAMPENFABRIEKEN, Eindhoven, Nederland									
2K25	CW, refl. OSC	8.5-9.66	6.3, 0.4	300	85-200	25	35mc	25mw	
723A/B	CW, refl. OSC	0.937	6.3, 0.4	300	130-185	25	40mc	30mw	
POLARAD ELECTRONICS CORP., 4320 34th Street, Long Island City 1, N. Y.									
ZV1009	CW OSC	1.5-6.0		350		35		100mw	
RADIO CORPORATION OF AMERICA, Tube Division, Harrison, N. J.									
2K26	CW OSC	6.2-7		330		35		120mw	
RAYTHEON MANUFACTURING CO., Microwave & Power Tube Div., Waltham, Mass.									
QK-246	CW OSC	15-16.2		1500				50mw	
QK-288	CW OSC	34.3-35.3		2250				20mw	
QK-289	CW OSC	27.2-30		2250				20mw	
QK-290	CW OSC	29.7-33.5		2250				20mw	
QK-291	CW OSC	33.5-36.2		2250				18mw	
QK-292	CW OSC	35.1-39.7		2250				10ma	
QK-293	CW OSC	34.9-42.8		2500				5mw	
QK-294	CW OSC	40-51.8		3000				5mw	
QK-295	CW OSC	50-60		3500					
QK-306	CW OSC	18-22		1800				40mw	
QK-381	CW OSC	4.1-4.4		250				4mw	
QK-404	CW OSC	5.9-6.4		300				120mw	
QK-412	CW OSC	5.1-5.9		300				100mw	
QK-414	CW OSC	9.6-10.2		300				20mw	
QK-422	CW OSC	7.1-8.1	6.3, .44	300				150mw	
QK-448	CW OSC	12-13.8		300				85mw	
QK-461	CW OSC	5.9-6.4		300				120mw	
QK-463	CW OSC	24.5-27.5		1800				40mw	
QK-510	CW OSC	12-13.8		300				85mw	
QK-531	CW OSC	6.5-6.8		300				110mw	
QK-532	CW OSC	6.8-7.1		300				110mw	
QK-549	CW OSC	5.9-6.4		300				120mw	
QK-623	CW OSC	7.1-7.6		300				110mw	
2K22	CW OSC	4.2-4.9		300				115mw	
2K25	CW OSC	8.5-9.6		300				25mw	
2K26	CW OSC	6.2-7.0		330		35		120mw	
2K28A	CW OSC	1.5-3.75		300				140mw	
2K29	CW OSC	3.4-3.9		300				100mw	
2K33	CW OSC	22-25		1800				40mw	
2K45	CW OSC	8.5-9.6		300				32mw	
2K48	CW OSC	4.-11.		1250				20mw	
2K56	CW OSC	3.8-4.4		300				100mw	
6BL6	CW OSC	1.6-5.5		300				75mw	
707B	CW OSC	1.5-3.7		300				140mw	
726C	CW OSC	2.7-2.9		300				100mw	
5836	CW OSC	1.6-5.5		300				75mw	
5837	CW OSC	.5-3.8		325				40mw	
5976	CW OSC	6.2-7.4		300				110mw	
6037	CW OSC	5.1-5.4		300				30mw	
6043	CW OSC	2.9-3.2		300				150mw	
6115A	CW OSC mil spec	5.1-5.9		300				100mw	
6178	CW OSC	15.7-16.2		300				25mw	
6236	CW OSC	3.8-7.6		1000				125mw	
6253	CW OSC	18-22		1800				40mw	
6254	CW OSC	22-25		1800				40mw	
6310	CW OSC	8.5-10		350		42		125mw	
6312	CW OSC	8.5-10		350		42		70mw	
6316	CW OSC	8.5-10		300				70mw	
6390	CW OSC	6.87-10.75		1250				80mw	
6940	CW OSC	8.5-9.6		300				32mw	
5721	CW OSC	2-12		1250				100mw	
5777	CW OSC	.4-2.3		400				160mw	
5778	CW OSC	1.8-4.6		300				150mw	
RK5721	CW, pulsed OSC	4.29-8.34	6.3, 0.58	1000	50-625	20		160mw	
RK6116	CW OSC	8.5-9.66	6.3, 0.8	300	60-145	25		34mw	
5981	CW OSC	1.24-1.46		225				100mw	
RK6563		15.5-17		300				25mw	
SPERRY GYROSCOPE COMPANY, Great Neck, N. Y.									
219	3-res. ampl.	9.6-12.15						37kw	
SAL81	3-res. ampl.	12.15-13.65		20k		8.5a		21kw	
SAL89	3-res. ampl.	9.6-12.15		20k		8.5a		30kw	
SAS28	3-res. ampl., CW	2.6-2.7		4k		350		225w	
SAS-60, A	3-res. ampl., CW	2.67-3.33		1000		300		25w	
SAS-60B	3-res. ampl.	2.7-2.93		1400		650		20w	
SAS-61		2.7-2.9		15k		5.5a		15kw	
SAC-9	3-res. ampl., CW	4.97-5.09		1000		175		9w	
SAC-19	2-res. CW ampl., OSC	5.8-6.42		625		160		6w	
SAC-33	3-res. ampl., CW	4.8-5.3		5400		450		500w	



MODEL 296C MICROWAVE RECEIVER

IF frequency 30 mc
Bandwidth (overall) 1.3 mc at 3 db points
Gain IF amplifier 65 db min.
Pre-amplifier 30 db min.

Attenuation range, calibrated 0-80 db ± 0.2 db above 5 db at 30 mc
Self-contained local osc. power supply 600-800v at 50 ma., beam supply
Self-contained AFC System. Constant IF type with a time constant of about 0.2 sec.

For highly accurate measurements

at all microwave and UHF frequencies...

SPERRY'S MODEL 296C MICROWAVE RECEIVER

This Sperry Microline* Receiver is a precision instrument of great accuracy enabling measurements at all microwave and UHF frequencies.

Model 296C can be used for measuring coupling and directivity of directional couplers, relative field strength, very high and very low VSWR, antenna patterns and as a general-purpose microwave laboratory receiver. In addition, this receiver was designed for use as a good secondary standard of attenuation.

A completely self-contained unit, it includes a 30-mc pre-amplifier, 30-mc IF amplifier, 30-mc calibrated attenuator, local oscillator power supply and AFC circuits. The 296C requires only the use of a local oscillator and an appropriate mixer for operation at any microwave or UHF frequency.

**TM Reg. U. S. Pat. Off.*

SPERRY MICROWAVE ELECTRONICS COMPANY
CLEARWATER, FLORIDA
Division of Sperry Rand Corporation

ADDRESS ALL INQUIRIES *to Clearwater, Florida or Sperry Gyroscope offices in New York, Cleveland, New Orleans, Los Angeles, San Francisco, Seattle.*

 Circle 60 on Inquiry Card, page 149

KLYSTRONS

Type	Descr. App.	Freq. Range (kmc)	Heater V.A.	Beam Voltage	Reflector Voltage	Beam Current (ma)	Tuning Range	Power Output	Price
SPERRY GYROSCOPE COMPANY, Great Neck, N. Y. (cont'd.)									
SAC-41	3-res. ampl., CW	3.7-4.2		750		300		30w	
SMS-27	2-res. freq. mult. 1/10	2.6-2.7		1250		70		0.5w	
SMC-11	2-res. freq. mult. 1/6	4.5-5.7		1000		50		1w	
SMX-32	3-res. ampl., freq. mult. 1/2	9.0-10.5		1000		175		3.5w	
SMK-40	3-res. ampl., freq. mult. 1/5	23.5-26.0		1500		170		0.6w	
SOC-150	3-res. CW OSC	4.91-5.01		1100		175		11w	
SOU-201	2-res. CW OSC	12.5-15.0		1700		140		15w	
SRL-7	refl. CW OSC	1.7-2.4		1000		220		10w	
SRL-17	refl. CW OSC	0.75-0.98		1000		90		3w	
5981	refl. CW OSC	1.24-1.46		250		50		0.17w	
2K41	refl. CW OSC	2.66-3.31		1250		60		2.75w	
SRC-43	refl. CW OSC	5.92-7.72		900		110		1.5w	
2K42	refl. CW OSC, mil spec	3.3-4.2		1250		60		1.5w	
2K43	refl. CW OSC, mil spec	4.2-5.7		1250		60		1.25w	
2K44	refl. CW OSC, mil spec	5.7-7.5		1250		60		1w	
SRX-53	refl. CW OSC	7.0-8.5		500		50		100mw	
SRX-92	refl. CW OSC	8.5-10.5		330		37		60mw	
2K25	refl. CW OSC, mil spec	8.5-9.66		300		–		30mw	
2K39	refl. CW OSC, mil spec	7.5-10.3		1250		60		1w	
SRU-55	refl. CW OSC	14.5-17.0		300		40		75mw	
SRU-55A	refl. CW OSC	15.7-17.0		350		35		25mw	
SRU-95	refl. CW OSC	12.4-15.5		300		40		52mw	
SRU-210	refl. CW OSC	15.7-17.0		300		45		20mw	
SRV-38	refl. CW OSC	33.0-36.0		425		40		40mw	
SRV215	CW OSC	34.2-35.4						5mw	
SRU216	CW OSC	15-17						20mw	
SYLVANIA ELECTRIC PRODUCTS INC., 500 Evelyn Ave., Mountain View, Calif.									
6BM6	CW OSC, 1¾ mode	0.5-2.3	6.3, 0.65	325	235	18		175mw	
	2¾ mode	1.1-3.0		300	200	15		70mw	
	3¾ mode	1.5-3.8		325	250	18		50mw	
6BL6	CW OSC, 1¾ mode	1.6-4.0	6.3, 0.75	325	220	28		250mw	
	2¾ mode	2.1-4.5			120	26		100mw	
	3¾ mode	3.6-6.5			220	25		60mw	
6BM6A	CW, pulse OSC., 1¾ mode	0.5-2.3	6.3, 0.65	325	235	18		175mw	
	2¾ mode	1.1-3.0		300	200	15		70mw	
	3¾ mode	1.5-3.8		325	250	18		50mw	
5836	CW, pulse OSC., 1¾ mode	1.6-4.0	6.3, 0.75	325	220	28		250mw	
	2¾ mode	2.1-4.5			120	26		100mw	
	3¾ mode	3.6-6.5			220	25		60mw	
5837	CW, pulse OSC., 1¾ mode	0.5-2.3	6.3, 0.67	325	235	28		175mw	
	2¾ mode	1.1-3.0		300	215			70mw	
	3¾ mode	1.5-3.8		325	215			50mw	
6974	CW, OSC	4.6-5.0	6.3, 0.81	800	180-410	100		2w	
6468	CW, OSC	6.1-6.4	6.3, 0.81	750	250-400	80		1.5w	
6469	CW, OSC	6.5-6.8	6.3, 0.81	750	250-400	80		1.5w	
6470	CW, OSC	7.1-7.4	6.3, 0.81	750	250-400	80		1.25w	
K-841	CW, OSC	6.1-6.4	6.3, 0.8	750	250-400	80		0.7w	
K-840	CW, OSC	6.5-6.8	6.3, 0.8	750	250-400	80		0.7w	
K-839	CW, OSC	7.1-7.4	6.3, 0.8	750	250-400	80		0.7w	
6465	ampl.	5.9-6.1	6.3, 2.0	500		115		3w	
6466	ampl.	6.8-7.1	6.3, 2.0	600		152		4w	
VARIAN ASSOCIATES, Tube Division, Palo Alto, Calif.									
X-12	refl. OSC	12.4-17.5		600	360	50		250mw	
X-13	refl. OSC	8.2-12.4		500	600	65		250mw	
X-13B	refl. OSC	7.5-11.0		Same characteristics as above.					
V-23	2-res. OSC	9.1-11.0		1350		125		6.5w	
V-24B	ampl., 0075 du. cy.	9.0-9.6		36k				40kw	
X-26	refl. OSC	5.3-7.5		750	315	70	45mc	1.2w	
V-27	2-res. ampl.	9.1-11.0		1350		125		7w	
V-27B	2-res. ampl.	8.5-10.0		1300		98		6w	
VA-28	2-res. OSC	13.35-13.65		2950		65		14w	
VA-39B, C	refl. OSC	10.0-15.5		650	200	28	16mc	50mw	
V-40B, C	refl. OSC	15.0-21.0		700	280	30	20mc	50mw	
V-42C	3-res. ampl.	0.89-0.96		18k		3a		15kw cw	
V-45	freq. mult. 1/5	9.0-10.0		1000		66		1.15w	
V-53	refl. OSC	10.7-11.7			170	32		60mw	
V-54	refl. OSC	10.5-12.2		450	370	70		225mw	
X-26 B, D, E, F	refl. OSC	5.3-7.5		750		80		1w	
V-55	refl. OSC	8.2-11.5		500	210	70		500mw	
V-58	refl. OSC	8.5-10.0		500	380	70	45mc	600mw	
V-63	2-res. OSC	8.5-10.0		1350		125		5.5w	
V-67B	2-res. CW OSC	13.35-13.65		1550		25		1w	
V-82	4-res. ampl., .025 du. cy.	9.3±0.25						7kw	
V-87B, C	4-res. ampl., .002 du. cy.	2.7-2.9		90kv		50a	±50mc	1.3megw	
VA-92	refl. OSC	14.0-17.5		600	430	50	40mc	320mw	
VA-92B		12.4-14.5		Same characteristics as above.					
VA-92C	refl. OSC	12.4-14.5		600	400	58	40mc	600mw	
VA-93	refl. OSC	13-14		300		45		20mw	
VA-94	refl. OSC	16.0-17.0		300	110	38	65mc	40mw	
VA-94B		15.8-16.2		Same characteristics as above.					
VA-96	refl. OSC	22.0-25.0		750	125	32	120mc	40mw	
VA-97	refl. OSC	34.0-35.6		400	185	35	100mc	20mw	
VA-98	refl. OSC	23.6-24.4		375		30	75mc	20mw	
VA113, 114, 115	refl. OSC	5.92-7.72						300mw	
V-151/6316	refl. OSC	8.94-9.66						25mw	
V-153/6315	refl. OSC	8.5-10.0			115	40	60mc	100mw	
V-152	refl. OSC	8.8-9.6		350		60		100mw	
V-157	refl. OSC	8.5-10		385		74		140mw	
V-154	refl. OSC	10.5-12.2		450		70		225mw	
V-155	refl. OSC	8.8-9.6		300	75	40	55mc	55mw	
VA-157	refl. OSC	8.5-10.0		385	255	60	65mc	180mw	
VA-201B	refl. OSC., rug.	8.5-9.6	6.3, 1.3	300	200	45	30mc	120mw	
VA-203B/6975	refl. OSC., rug.	8.5-9.6	6.3, 0.45	300	150	45	50mc	30mw	
VA-210B	refl. OSC	9.6-10.8		300	180	45	25mc	25mw	
VA-214	refl. OSC	8.0-11.2		300	125	30	35mc	35mw	
VA-220A, G, Z	refl. OSC	5.92-8.1	6.3, 0.9	750	400	80	35mc	1.1w	
VA-221B-G	refl. OSC	5.92-7.45	6.3, 0.5	300	101	30	48mc	43mw	
VA-221H	refl. OSC	5.25-5.56	6.3, 0.5	250	155 ·	30	35mc	40mw	
VA-222A-G-Z	refl. OSC	5.92-8.1	6.3, 0.9	750	400-700	80	35mc	1.1-2w	
V-260/6310	refl. OSC	8.5-10.0		300	160	28	48mc	70mw	
V-270/6312	refl. OSC	8.5-10.0		300	160	32	40mc	70mw	
V-290/6314	refl. OSC	8.5-10.5		350	150	60	65mc	120mw	
V262	refl. OSC	8.5-10		350		42		70mw	
VA-800	CW ampl.	1.7-2.4		15k				10kw	
VA-800C	CW ampl.	2.1-2.4		15k				10kw	
VA-804 Series	4-res. ampl.	4.4-5.8		9k		750	±75mc	2kw	
VA-805 Series	4-res. ampl.	5.8-6.4		9k		750	±25mc	2kw	
VA-806 Series	4-res. ampl.	7.1-8.5		8.5k		640	±25mc	2kw	
VA-808	4-res. ampl. .016 du. cy.	5.3-5.9		22k		3300	± 25mc	20kw	
VA-816J	5-res. ampl.	3.4-3.5		115k		80a		10kw	
VA-820 B, C	4-res. ampl.	2.7-2.9		148k		110a		10kw	
VA-821	wide band ampl. .004 du. cy.	2.7-3.0		90k		50a		1-2megw	
VA-833	CW ampl.	0.6-0.9		16k				10kw	
VA-6237 to 6242	TV-ampl. (in 6 steps)	.47-.89		17k				15kw	
6311	CW OSC	8.5-10		350		42		125mw	
VA-87B	4-res. ampl.	2.7-2.8		110k		60a		1.3megw	
VA-87C	4-res. ampl.	2.8-2.9		Same characteristics as above.					
VA-804A-E	4-res. ampl.	4.4-5.1 in 5 steps		10k		1a		2kw	

PLANAR TRIODES, TETRODES

Type	Descr. App.	Max. Freq. (kmc)	Heater V.A.	Anode Voltage	Anode Current (ma)	Grid Bias	Duty Cy.	Ampl. Factor	Power Output	Price
AMPEREX ELECTRONIC CORPORATION, 230 Duffy Ave., Hicksville, L. I., N. Y.										
2C39A	air-cooled OSC, ampl.	2.5	6.3, 1	800	90	40	cw		40	
4X150A*	air-cooled OSC, ampl.	0.5	6.0, 2.6	1250	200	90	cw		195	
4X250B*	air-cooled OSC, ampl.	0.5	6.0, 2.6	2000	250	90	cw		410	

* Tetrode

PLANAR TRIODES, TETRODES

Type	Descr. App.	Max. Freq. (kmc)	Heater V.A.	Anode Voltage	Anode Current (ma)	Grid Bias	Duty Cy.	Ampl. Factor	Power Output	Price
BRITISH INDUSTRIES CORPORATION, 80 Shore Road, Port Washington, N. Y. (Representing General Electric Co., Ltd.)										
DET22	triode OSC	3.33	6.3, 0.4	350	40				3.5w	
DET29	triode OSC, ampl.	4	6.3, 0.5	450	40	0.4v			10w	
GENERAL ELECTRIC COMPANY, Electronic Components Div., One River Road, Schenectady 5, N.Y.										
GL-2C43	ampl., OSC	1.5	6.3, 0.9	500	40		cw		8w	
		3.37		3000	2.5a		.001		1.7kw	
GL-2C40-A	ampl., OSC	3.37	6.3, 0.75	250	20	5	cw		75mw	
		3		1400	1.0a		.001		300mw	
GL-2C40	ampl., OSC	3.37	6.3, 0.75	250	20	5	cw		75mw	
GL-6442	ampl., OSC	2.5	6.3, 0.9	350	35	50	cw		4w	
		4		3000	2.5	75	.001		2kw	
GL-6897	high mu ampl., OSC	2.5	6.3, 1.05	900	90	22	cw		17w	
GL-2C39	high mu ampl., OSC	2.5	6.3, 1.05	900	90	22	cw		17w	
GL-6283*	TV ampl., forced air	0.9		1600	400		cw		260w	
GL-6942*	TV ampl., forced air	0.9		4000	700		cw		1kw	
GL-6019*	TV ampl., water cooled	0.9		4000	700		cw		1kw	
GL-6182*	TV ampl., water cooled	0.9		6000	1.0a				1.5kw	
MACHLETT LABORATORIES, INC., Springdale, Conn.										
ML-2C41	pulsed OSC, ampl.	3	6.3, 1.0		10	150	.002	100	2.2kw	
ML-2C39A	freq. mult., OSC, ampl.	2.5	6.3, 1.0	1000	90	150	cw	100	40w	
ML-2C39WA	freq. mult., OSC, ampl.	2.5	5.8, 1.0	1000	90	150	cw	100	40w	
ML-6442	freq. mult., OSC, ampl.	4.0	6.3, 0.9	350	35	50		50	4w	
ML-7209	freq. mult., OSC, ampl.	3.0	6.0, 1.0	3500	3a	200	.003	100	2kw	
ML-7210	freq. mult., OSC, ampl.	3.0	6.3, 0.85	3500	2.3a	150	.0025	75		
ML-7211	freq. mult., OSC, ampl.	3.0	6.3, 1.3	1000	130	150		80		
N. V. PHILIPS' GLOEILAMPENFABRIEKEN, Eindhoven, Nederland										
EC55	CW OSC	3	6.3, 0.4	350	40	3.5		30	2.8w	
EC56	CW OSC, ampl.	4	6.3, 0.6	300	30			35	1w	
EC57	CW OSC, ampl.	4	6.3, 0.6	300	70			35	3w	

TRAVELING WAVE TUBES

Type	Descr. App.	Freq. Range (kmc)	Type Output	Heater V.A.	Helix Voltage	Mag. Field (Gauss)	Noise Figure (db)	Gain (db)	Power Output	Price
BENDIX AVIATION CORPORATION, Red Bank Division, Eatontown, N. J.										
RXB103401	CW ampl.	4-8	Co		1100		30	40	200mw	
BOMAC LABORATORIES, INC., Salem Road, Beverly, Mass.										
6651/BL850	CW ampl.,	2.1-3.5	Co					41	1kw	
BL851	CW ampl., gridded	2.1-3.5						41	1kw	
COMPAGNIE GENERAL de T.S.F., 79 Boulevard Hausman, Paris Villo, France										
CM1010	CW OSC	2.6-3.3							1kw	
EITEL-McCULLOUGH, INC., 798 San Mateo Ave., San Bruno, Calif.										
X686	CW ampl.	4-7			2300		30	50	1w	
ENGLISH ELECTRIC VALVE CO., LTD., Chelmsford, England										
6861	ampl.	2.7-3.5	Co	5, 0.5	375	525	6.5	25	1mw	
N1001	ampl.	1.7-2.3	Wg or Co	6.3, 1.6	2600	550	–	25	16w	
N1002	ampl.	1.7-2.3	Wg or Co	6.3, 0.3	580	500	9	23	1mw	
N1004	ampl.	3.8-4.2	Wg	6.3, 0.6	2350	450	–	19	4w	
N1005M	ampl.	3.6-4.2	Co	6.3, 0.3	350	450	9	20	1mw	
N1013	ampl.	1.7-2.3	Wg or Co	6.3, 0.3	680	525	20	24	200mw	
N1016M	ampl.	4.1-7.0	Co	6.3, 0.3	600	550	9	25	1mw	
N1017M	ampl.	1.2-1.4	Co	6.3, 0.3	290	500	8	22	0.3mw	
N1018M	ampl.	3.6-4.2	Co	6.3, 0.3	645	550	21	25	75mw	
N1023M	ampl.	3.8-4.2	Co	6.3, 0.6	2350	450	–	19	4w	
N1029M	ampl.	5.8-8.2	Co	6.3, 0.6	2500	600	–	20	5w	
FEDERAL TELEPHONE & RADIO CO., 100 Kingsland Rd., Clifton, N. J.										
6997	ampl., du. cy. .01	2-3.3	Co		2100			30	30w	
6658	ampl., CW	1.7-4	Co		1000		30	30	2w	
6868	ampl., CW	1.7-4	Co		1200		30	30	10w	
6825	ampl., du. cy. .01	2-4	Co		7500			30	1000w	
6826, -A	ampl., du. cy. .01	2-4	Co		7500			27, 40	1000w	
6867	ampl., CW	8-9.6	Co		1400			25	100mw	
6996	ampl., CW	8-9.6			3200			30	10w	
D-92	ampl.	8.5-9.6						30	1kw	
D-95	ampl., gridded	8.5-9.6						30	1kw	
GEISLER LABORATORIES, P. O. Box 252, Menlo Park, Calif.										
G10	ampl.	2-4					25	30	10mw	
G14	low noise ampl.	2-4					12	30	10mw	
G100	ampl.	2-4					25	30	10mw	
G100P	ampl.	2-4				pm	25	30	10mw	
G120	low noise ampl.	2-4					12	30	10mw	
G11		2-4					25	30	1w	
G110		2-4					25	34	1w	
G20, G200P	ampl.	4-8				pm	25	30	10mw	
G200	low noise ampl.	4-8					12	30	10mw	
G21, G210P	ampl.	4-8				pm	25	32	1w	
G40, G400P	ampl.	8.2-12.4					25		100mw	
G41, G410	ampl.	8.2-12.4					25		1w	
HUGGINS LABORATORIES, 711 Hamilton Ave., Menlo Park, Calif.										
HA-7	ampl., gridded	0.5-1.0	Co	6.3, 0.7	120	300	25	30	10mw	$750
HA-5	ampl., gridded	1-2	Co	6.3, 0.7	200	300	25	30	10mw	750
HA-17	ampl., gridded	1-2	Co	6.3, 0.7	200	1000	15	30	10mw	750
HA-14	ampl., gridded	1-2	Co	6.3, 0.8	525	1000	11	25	–	1500
HA-22	ampl.	1.6-2.6	Co	6.3, 0.7	800	300	–	30	10mw	750
HA-39	ampl.	1.6-2.6	Co		950		30	30	1w	750
HA-19	ampl., gridded	1.6-2.6	Co	6.3, 0.6	200	1000	15	30	5mw	850
HA-1	ampl., gridded	2-4	Co	6.3, 0.8	525	300	25	30	13-19mw	650
HA-28	ampl.	2-4	Co	7.0, 0.9	950	600	–	34	1w	
HA-11	ampl., gridded	2-4	Co	6.3, 0.7	500	550	15	30	10mw	750
PA-4	CW or pulsed, ampl., gridded	2-4	Co	7.0, 1.0	950	600	–	33, 23	1w	850
PA-3	CW or pulsed, ampl., gridded	2-4	Co	7.0, 1.0	1100	1000	–	30	10w	1000
HA-26	ampl.	4-8	Co	6.3, 0.7	800	400	–	30	10mw	750
HA-6	med pwr. ampl.	4-8	Co	7.0, 0.7	1500	1100		30	30mw	850
PA-7	CW or pulsed ampl.	4-8	Co					30	1w	950
HA-12	ampl., gridded	2-4	Co		950			34	1w	
HA-37	low noise ampl., gridded	2-4			525		10	25		
PA-1	ampl. gridded	8.2-11								
HA-4	ampl.	8.0-12.4	Co	6.3, 0.7	1250	400	–	30	10mw	750
HA-9	grid control ampl.	8-11	Co	6.3, 0.9	2400	1000	–	30	27mw	1500
HA-15	ampl.	8.2-12.4	Co	6.3, 0.9	1300	1000	15	25	5mw	850
HA-23	low noise ampl., gridded	8.2-11.0	Co	6.3, 0.8	1300	900	10	25	–	1500
PA-5	CW or pulsed ampl., gridded	8.2-12.4	Co	7.0, 0.8	2300	1000	–	33, 23	1w, 100mw	950
HA-24	ampl., gridded	12.4-14.0	Co	6.3, 0.9	1250	400	–	30	7mw	750
		12.4-15.0							7mw	
DA-3	voltage-tuned ampl.	0.5-1.0	Co	6.3, 0.7	1015	100	–	13, 33		850
DA-2	voltage-tuned ampl.	1-2	Co	6.3, 0.7	920	100	–	15, 33		750
DA-1	voltage-tuned ampl.	2-4	Co	6.3, 0.7	2280	100	–	22, 28		650
DA-4	voltage-tuned ampl.	4-8	Co	7.0, 0.8	2400	400	–	15, 25		750
HA-4B	ampl. gridded	7-14			1150			30	10mw	
HA-33	ampl., gridded	8-14			1150		15	25		

* Tetrode

TRAVELING WAVE TUBES

Type	Descr. App.	Freq. Range (kmc)	Type Output	Heater V.A.	Helix Voltage	Mag. Field (Gauss)	Noise Figure (db)	Gain (db)	Power Output	Price
HUGGINS LABORATORIES, 711 Hamilton Ave., Menlo Park, Calif. (cont'd.)										
HA-31	ampl.	1-2				pm			10mw	
HA-29	ampl.	2-4	Co	6.3, 0.8	525	pm		30	10mw	$975
HA-28	ampl.	4-8	Co	6.3, 0.7	800	pm		30	10mw	1500
HA-20	ampl.	8.0-12.4	Co	6.3, 0.9	1300	pm		30	1w	1125
HA-21	med. pwr. ampl.	8-11	Co	6.3, 0.9	2400	pm		30	1w	3000
HA-30	med. pwr. ampl.	2-4	Co	7.0, 0.9	1100	pm		30	30mw	1300
PA-6	pulsed ampl.	2-4	Co							1500
HA-34	freq. mult.	3	Co							850
HA-16	freq. mult.	1.8-9.0	Co	7.0, 0.9	1100	600			10mw	850
HA-10	ampl.	8.2-12.4	Co	7.0, 0.8	2300	1000		25	20mw	850
HA-40	ampl.	0.5-1.0			120		15	25		
HA-3B	ampl., gridded	4-8			700			30	10mw	
HUGHES PRODUCTS, Hughes Aircraft Co., 5340 W. 104 St., Int'l Airport Stn., Los Angeles 45, Calif.										
MAS-1A	ampl.	2-4		8, 4	7000	pm		33	1kw	
RADIO CORPORATION OF AMERICA, Tube Division, Harrison, ". J.										
6861	ampl.	2.7-3.5	Co	5.0, 0.6	400	525	6.5	25	1mw	
4008	low noise ampl.	2-4			700		10	20	10mw	
4009	ampl.	2-4			1000	pm	27	30	10mw	
4010	ampl.	2-4			1500	pm	30	27	1w	
4006	ampl.	2-4			2500	pm		20	10w	
4007	ampl. gridded	2-4			4000	pm		25	100w	
A-1125	low noise ampl.	1.35-1.85			250		7	25	1mw	
A-1139	low noise ampl.	1-2			750		10	25	10mw	
A-1056	low noise ampl.	1.1-1.4			250		7	25	1mw	
A-1105	low noise ampl.	2.2-2.3			500		7.5	25	1mw	
A-1079	low noise ampl.	2.5-4			500		8.0	20	1mw	
A-1085	low noise ampl.	3.3-3.7			500		7	20	1mw	
A-1088	low noise ampl.	3.5-4.3			500		8	20	1mw	
A-1141	low noise ampl.	1-2			600	pm	15	30	10mw	
A-1143	low noise ampl.	2-4			800	pm	15	34	10mw	
A-1144	low noise ampl.	4-7			800	pm	15	34	10mw	
A-1121	low pwr. ampl.	1-2			800	pm		30	200mw	
A-1094	low pwr. ampl.	1.7-2.3			800	pm		28	125mw	
A-1113	low pwr. ampl.	2-4			800	pm		35	200mw	
A-1140	low pwr. ampl.	8-12.5			2000	pm		35	15mw	
A-1122	low pwr. ampl.	5-6			1000	pm		30	200mw	
A-1124	med. pwr. ampl.	1-2			700	pm		35	1w	
A-1097	med. pwr. ampl.	2.-3.5			3500			25	5w	
A-1143	med. pwr. ampl.	8-12			3500	pm		43	2w	
A-1120	med. pwr. ampl.	7.5-11.2			7000	pm		35	50w	
A-1093	med. pwr. ampl.	1.7-2.3			2300			35	15w	
A-1136	med. pwr. ampl.	5-6			4500	pm		36	50w	
A-1134	high pwr. ampl.	2-4			9000	pm		30	1kw	
ROGER WHITE ELECTRON DEVICES, INC., 92 Fourth Ave., Haskell, N. J.										
TCC1M	low noise ampl.	4-6	Co		600		10	30	1mw	
TCL1M	ampl.	1-2	Co		300		15	25	1mw	
TCP1W	ampl.	.7-1.2	Co		700		25	25	1w	
TCL1W	ampl.	1-2	Co		600		25	25	1w	
TCS1M	ampl.	2-4	Co		400		15	30	1mw	
TCS1W	ampl.	2-4	Co		1000		25	25	1w	
TCC1W	ampl.	4-6	Co		2000		25	25	1w	
SPERRY GYROSCOPE COMPANY, Great Neck, N. Y.										
STL-111	CW ampl.	1.1-1.6	Co		800			30	4w	
STL-114	ampl., du. cy. .01	1.1-1.6	Co		15k			34	7000w	
STL-132	CW ampl.	0.5-1.01	Co		800		35	35	3w	
STS-75	CW ampl.	2-4	Co		700		30	50	1w	
STS-110	ampl.	2-4	Co		2400		30	30	20w	
STS-113	ampl., du. cyl .01	2.0-3.6	Co		8500			34	2000w	
STS-67	CW ampl.	2.5-5.0	Co		600		30	50	0.6w	
STX-76	CW ampl., gridded	7-11	Co		1600		30	57	0.5w	
STX-77	CW ampl., gridded	7-11	Co		4300		30	40	10w	
STL-70	ampl., gridded	1-2			900		25	55	2w	
STS-78	ampl., gridded	2-4			900		25	50	1w	
STP-49	ampl.	.24-.51							200w	
STL-48	ampl.	.5-1							200w	
SYLVANIA ELECTRIC PRODUCTS INC., 500 Evelyn Ave., Mountain View, Calif.										
6752	ampl.	1-2		6.3, 1.3	600	600			2w	
6753	ampl.	1-2		6.3, 0.8	200	500		35	10mw	
TW-538	ampl., du. cy. .001	1-2		6.3, 2.7	7000	600			1kw	
6493	ampl.	2-4		6.3, 0.8	400	300		35	10mw	
6559	ampl.	2-4		6.3, 1.3	800	850			2w	
6698	ampl., du. cy. .001	2-4		6.3, 2.7	7000	1160			1kw	
TW-612	ampl.	4-8		6.3, 0.8	750	500		35	5mw	
TW-613	ampl.	8-11.5		6.3, 1.3	1150	500		35	5mw	
TW-591	ampl., du. cy. .001	8-10.5		6.3, 1.5	8000	2800			500w	
6495	low noise ampl.	2-4		7.0, 1.1	500	600	11	30	15mw	
							13	40	80mw	
TW-4006	ampl.	1-2		6.3, 0.8	200	pm		35	15mw	
TW-4002	ampl.	2-4		6.3, 0.8	400	pm		35	10mw	
TW-4007	ampl.	1-2		6.3, 1.8	600	pm			1w	
7072	ampl.	2-4		6.3, 1.1	800	pm			1w	
TW956A	ampl., du. cy. .01	2.5-3.5			1000	pm			1w	
TW534	ampl., gridded, du. cy. 0.1	2-4			1000				2w	
TW620A	ampl., gridded, CW	1-2			1100				2w	
TW4007AD	ampl., CW	1-2			1100	pm			1w	
VARIAN ASSOCIATES, Tube Division, Palo Alto, Calif.										
VA-121B	ampl. du. cy. 0.01	2-4			2250			30	40w	
VA-125	liq. cooled, ampl., du. cy. .002	2.7-3.0	Wg	7.5, 33	110k			33	1megw	

BACKWARD WAVE TUBES

Type	Descr. App.	Freq. Range (kmc)	Type Output	Heater V.A.	Helix Voltage	Mag. Field (Gauss)	Noise Figure (db)	Gain (db)	Power Output	Price
BENDIX AVIATION CORPORATION, Red Bank Division, Eatontown, N. J.										
TE57	OSC	49-59	Wg		3000				5mw	
TE66	OSC	46-56								
TE67	OSC	46-56								
COMPAGNIE GENERALE de T.S.F., 79 Boulevard Haussman, Paris Villa, France										
CO315	OSC	1-2	Co		1500				1.5w	
CO210	OSC	1.6-3.2	Co						1w	
CM710A	OSC	2.5-3.1	Co		5100				250w	
CM708A	OSC	2.75-3.5	Co						210w	
CM706A	OSC	3-4	Co		5100				200w	
CO119	OSC	2.4-4.8	Co						500mw	
CO94	OSC	3.6-7.2	Co						400mw	
CO63	OSC	4.8-9.6	Co						200mw	
CM740	OSC	7.8-9.5	Wg						80w	
CO43	OSC	7-11	Co						150mw	
CM730	OSC	8.5-10.5	Wg		4600				80w	
CO42	OSC	8-16	Co		1800				100mw	
CO2012	OSC	15-23.5	Wg		2500				100mw	
CO1308	OSC	23.5-37.5	Wg		3000				250mw	
CO08	OSC	35-41							20w	

BACKWARD WAVE TUBES

Type	Descr. App.	Freq. Range (kmc)	Type Output	Heater V.A.	Helix Voltage	Mag. Field (Gauss)	Noise Figure (db)	Gain (db)	Power Output	Price
HUGGINS LABORATORIES, 711 Hamilton Ave., Menlo Park, Calif.										
BA-1	CW ampl.	2.4-3.6	Co	6.3, 1.4	1500	600		25		$1500
BA-2	CW ampl.	8.2-12.4	Co	7.0, 0.7	2400	850		25		1500
HO-13	OSC	4-8			3000				10mw	
HO-2B	OSC	7-14			3400				10mw	
HO-1A	OSC	2-4	Co	6.3, 1.2	3400	800			50mw	750
HO-3A	OSC	3.75-7	Co	7.0, 0.8	3400	800			50mw	750
HO-10	OSC	3.7-5.9	Co	7.0, 1.3	2000	1000			1mw	
HO-11	OSC	5.2-8.3	Co	6.3, 1.4	2000	1000			10mw	750
HO-14	OSC	8.2-12.4	Co	7.0, 0.8	2000	1000			1mw	750
HO-4	OSC	12-18	Wg	7.0, 0.8	2000	1000			1mw	1250
HO-4B	OSC	12.4-18	Wg		2000				10mw	
HUGHES PRODUCTS, Hughes Aircraft Co., 5340 W. 104 St., Intn'l Airport Stn., Los Angeles, Calif.										
PAS-2	ampl.	2.4-3.5		6.3, 1.3	1500	1000 pm	4	20		
LOU-2	OSC	12.4-18	Wg	6.3, 0.62	1800				60mw	
RAYTHEON MANUFACTURING CO., Microwave & Power Tube Div., Waltham, Mass.										
QK546	CW OSC	1-2			1450				1.5w	
QK544	CW OSC	1.6-3.2			1450				1w	
QK518	CW OSC	2-4			1500				1w	
QK533	CW OSC	2.4-4.8			1450				1w	
QK528	CW OSC	3.6-7.2			1450				400mw	
QK543	CW OSC	4.8-9.6			1450				200mw	
QK529	CW OSC	7-11			1500				150mw	
QK610	CW OSC	6.7-11.4								
QK535	CW OSC	7.5-15			1700				150mw	
QK536	CW OSC	15.5-24								
QK537	CW OSC	23.5-37.5								
ROGER WHITE ELECTRON DEVICES, INC., 92 Fourth Ave., Haskell, N. J.										
BCX10M	OSC	8-12			1500				10mw	
BWK10M, A	OSC	12-18			1500				5mw	
STEWART ENGINEERING COMPANY, P.O. Box 277, Soquel, Calif.										
OA3.7-5.9	OSC	3.5-5.9	Co		2150	800		6	50mw	
OA4-8	OSC	4-8	Co		2300	1000		10	10mw	
OA5.2-8.3	OSC	5.2-8.3	Co		2000	800		6	20mw	
OC6-11	OSC	6-11	Co		2200	800		6	10mw	
OE6-11	OSC	7-11	Co		2200	1000		4	50mw	
OC6-12	OSC	6-12	Co		2100	800		6	50mw	
OE6-12	OSC	7.3-10.3	Co		1150	1000		4	50mw	
OC7-13	OSC	8.2-12.4	Wg		2000	800		3	10mw	
OD7-13	OSC, gridded	8.2-12.4	Wg		2000	800		3	10mw	
OA10-15.5	OSC	10-15.5	Wg		2300	800		3	10mw	
OA12-18	OSC	12.4-18	Wg		2200	800		4	5mw	
SYLVANIA ELECTRIC PRODUCTS, INC., 500 Evelyn Ave., Mountain View, Calif.										
6699	OSC	1-2		6.3, 4.6	660	400			600mw	
6496	OSC	2-4		6.3, 2.3	1680	500			600mw	
BW-623	OSC	4-8		6.3, 1.6	2400	750			150mw	
VARIAN ASSOCIATES, Tube Division, Palo Alto, Calif.										
VA-161	OSC	8.2-12.4			650				120mw	2950

New Microwave Technical Data

Microwave Components

Line of high power rotary joints, microwave crystal holders, rotary joints and VSWR testing equipment is described in a 46 pp. catalogue from Sage Laboratories Inc., 159 Linden Street, Wellesley, Mass. Data include engineering information on microwave crystal diodes and microwave video crystals, and details on new "Cobrid"—Coaxial Hybrid—developed for use as a balanced mixer, balanced duplexer or phase shifter.

Circle 140 on Inquiry Card, page 149

Test Instruments

Fifteen test instruments manufactured by Pye Ltd. of England are described in a 1-page sales bulletin issued by their U. S. representatives, Ealing Corp., Box 90, Natick, Mass. Included are a portable wheatstone bridge, precision vernier potentiometer, galvanometer and thermocouple test set.

Circle 141 on Inquiry Card, page 149

Load Isolators

Loose-leaf file-type catalog, 8 pp., contains 8 preliminary data sheets and engineering bulletins on advance models of load isolators, circulators and duplexer switches. Cascade Research, division of Monogram Precision Industries Inc., Los Gatos, California.

Circle 142 on Inquiry Card, page 149

Null Detector

Application Notes No. 4, a series of loose leaf notes from Weinschel Engineering Co., describes in detail a Dual Channel Insertion Loss Test Set. The series tells of the development of a Differential Null Detector, which permits measurements to 20 db which can be repeated with a precision of .01 db per 10 db.

Circle 143 on Inquiry Card, page 149

TWT Theory

Hewlett - Packard Company has available two pamphlets giving the theory behind the operation of Traveling-Wave Tube Amplifiers and Helix Backward-Wave tubes.

Circle 144 on Inquiry Card, page 149

Components

A new catalogue from Alford Manufacturing Company contains descriptive data on their line of tapered reducers, slotted lines, coax switches, and transmission line hybrids. Included are formulae, electrical and mechanical characteristics, price lists and applications.

Circle 145 on Inquiry Card, page 149

Antenna Handbook

An antenna handbook from I-T-E Circuit Breaker Co., contains thirteen charts and graphs which help in estimating the performance of a given antenna or in estimating the physical characteristics required to achieve a particular electrical performance goal.

Circle 146 on Inquiry Card, page 149

Propagation Test Set

A 4-page, two-color descriptive brochure from Radio Engineering Laboratories Inc., 29-01 Borden Ave., Long Island City 1, N. Y., describes their Type 2002 M Propagation Test Set. The test set is used to survey proposed scatter transmission paths and is adaptable for use in areas having rough terain and limited access.

Circle 147 on Inquiry Card, page 149

More Tech Data on page 136

New Microwave Tech Data

Microwave Systems & Theory

Philco Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa., is offering bulletins on: Thermo-Microdome Antenna Protection Equipment; Short-Haul, Hill-Hopper, Communications Systems; Microwave Systems for Utilities, and two booklets: "Forward Scatter — Introduction" and "The Philco Method of Surveying Microwave Systems by means of the Precision Surveying Altimeter."

Circle 185 on Inquiry Card, page 149

Terminal Equipment

General Electric Co., Electronics Park, Syracuse, N. Y., has issued a brochure ECM-59 featuring their 2 KMC line. The brochure is heavy on the terminal equipment aspect of microwave systems and lists available options such as: r-f standby, alarm recording, alarm transmit, power amplifier, service channel, diversity reception, and channel unit.

Circle 186 on Inquiry Card, page 149

Radar Waveguide Components

Four pages of data, general descriptions, and applications of radar waveguide components including: wavemeters, gain horns, cross-guide directional couplers, waveguide tees, terminations and adaptors are available from Radar Design Corp., Syracuse Custom Div., 3309 James St., Syracuse, N. Y.

Circle 187 on Inquiry Card, page 149

R-F & Multiplex Systems

Two brochures describing the R-F and Multiplex equipment offered by the Collins Radio Co., Cedar Rapids, Iowa, are available. Featured are: a fixed i-f amplifier, an optional fault alarm, offset feed antenna, a long-life reflex klystron, and a ferrite load isolator.

Circle 188 on Inquiry Card, page 149

Microwave Instruments

The short form catalog of Alfred Electronics, 897 Commercial St., Palo Alto, Calif., describes their traveling wave tube amplifiers, microwave oscillators, microwave levelers, high voltage power supplies, and vacuum electronics components.

Circle 189 on Inquiry Card, page 149

Microwave Absorbents

Loose-leaf description sheets on microwave absorbents and an eight-page brochure containing applications and data are offered by the B. F. Goodrich Co., Sponge Products Div., Shelton, Conn.

Circle 190 on Inquiry Card, page 149

Tone Transmission System

RCA, Camden 2, N. J., describes the Tru-Trip, an all-transistor high speed tone transmission system, in a 6-page, two-color booklet. Designed to increase the speed and overall reliability of protective relaying systems for utilities, the Tru-Trip functions as an integral part of either microwave or wireline systems.

Circle 191 on Inquiry Card, page 149

Waveguide Tube Tools

A "Waveguide Handbook" available from the F. C. Kent Corp., 135 Manchester Pl., Newark 4, N. J., describes the stock tools used in precision tube forming and bending operations. The handbook is designed to help engineers eliminate tool changes at the design level.

Circle 192 on Inquiry Card, page 149

Rotary Joint

Described in a new bulletin, published by Special Products Div. of I.T.E. Circuit Breaker Co., Philadelphia, is a large rotary joint. The four-page bulletin furnishes details and specifications on a 6 ft high, 4 ft diameter joint produced for a new high-power, low frequency Air Force radar.

Circle 193 on Inquiry Card, page 149

Folded Hybrid T's

Microwave Development Laboratories, Inc., Wellesley, Mass., has released a 6-page, two-color catalog, No. 850, which provides an up-to-date guide for the selection of precision cast and fabricated E-Plane and H-Plane Folded Hybrid T's. Included are electrical and physical characteristics and suggested uses.

Circle 194 on Inquiry Card, page 149

High Frequency Cables

Described in this brochure of General Cable Corp., 420 Lexington Ave., New York 17, N. Y., are two types of high frequency cables in common use, namely: coaxial cables and video pair cables. Physical and electrical data on the cable are arranged in tabular form.

Circle 195 on Inquiry Card, page 149

Ceramic Components

Engineering Bulletin No. 106 from Ceramatronics Inc., 364 Highland Ave., Passaic, N. J., compares, in tabular form, the mechanical and electrical properties of typical high and low alumina ceramics vs. properties of electrical glass and glass bonded mica.

Circle 196 on Inquiry Card, page 149

Waveguide Components

A loose-leaf folder presenting fittings, bends & miters, twists, waveguide sections, feeds & horns, adaptors, directional couplers, crystal holders, duplexers, and mixers is offered by Aircom Inc., 139 E. First Ave., Roselle, N. J. Folders contain electrical and mechanical specifications, and photographs.

Circle 197 on Inquiry Card, page 149

Measurement Set-Ups

An 84-page catalog describing the company's line of microwave and UHF test equipment and components is available from Narda Microwave Corp., 118-160 Herricks Rd., Mineola, N. Y. Typical set-ups for the measurement of impedence, attenuation, and other properties of microwave components and coaxial systems are included.

Circle 198 on Inquiry Card, page 149

Spinning vs Stamping

A series of bulletins called, "Notes for an Engineer's Scrap Book," features a cost analysis of spinning versus stamping for some microwave components. Two of particular interest are: "High Voltage Static Shield," and "Corona Shields." The bulletins may be obtained from Spincraft Inc., 4122 West State St., Milwaukee 8, Wis.

Circle 199 on Inquiry Card, page 149

Microwave Equipment

A six-page condensed catalog of the Sperry Microwave Electronics Co., Clearwater, Florida, presents a wide range of microwave equipment including: components, test equipment, weapon system support equipment, ferrite devices, microwave subsystems, antennas, and basic microwave instruments.

Circle 200 on Inquiry Card, page 149

Klystron Facts

Eitel-McCullough, Inc., San Bruno, Calif., have issued a 24-page booklet which describes in question and answer form, klystron facts. Booklet is complete with photographs, drawings, and graphs along with the interesting information.

Circle 201 on Inquiry Card, page 149

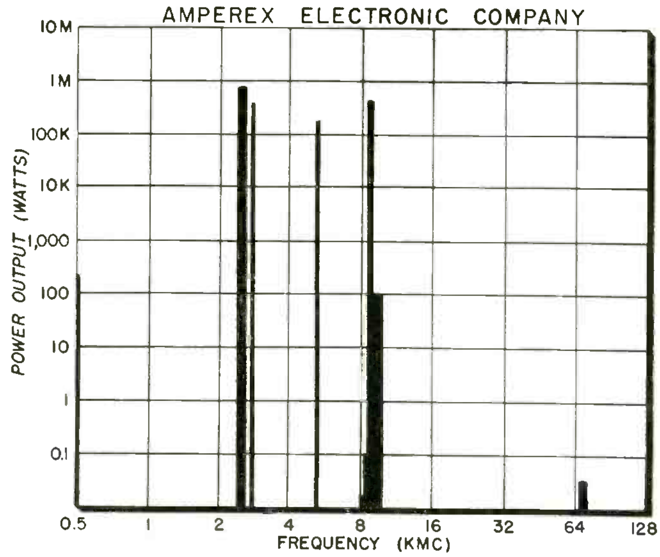
Instrumentation

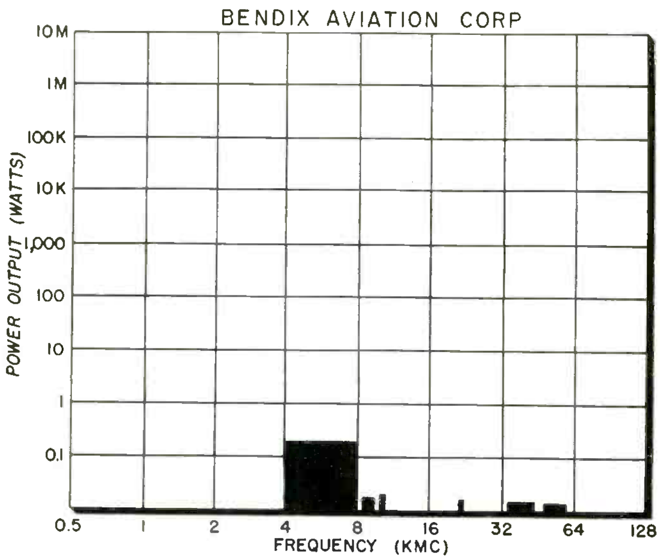
A short form brochure of Menlo Park Engineering, 721 Hamilton Ave., Menlo Park, Calif., covering their TWT & BWO solenoids, microwave frequency multipliers, TWT amplifiers, power leveling systems, and oscillators.

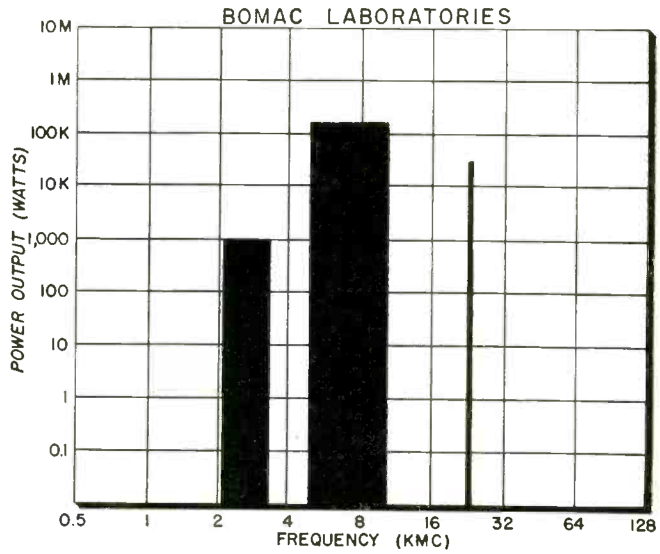
Circle 202 on Inquiry Card, page 149

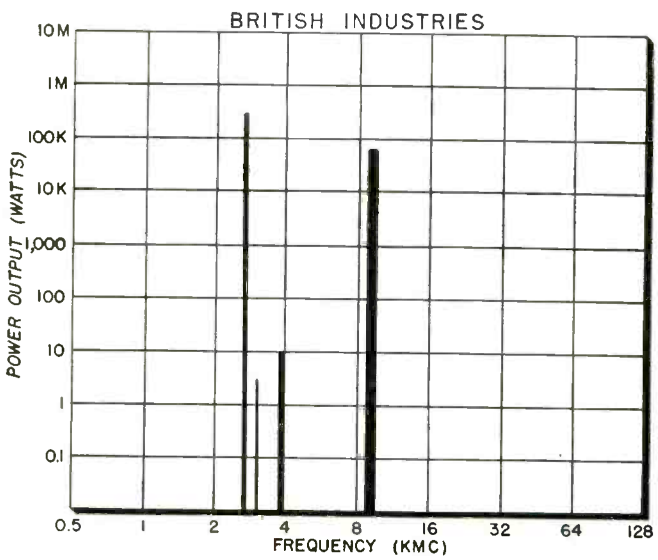
Frequency Ranges & Power Output

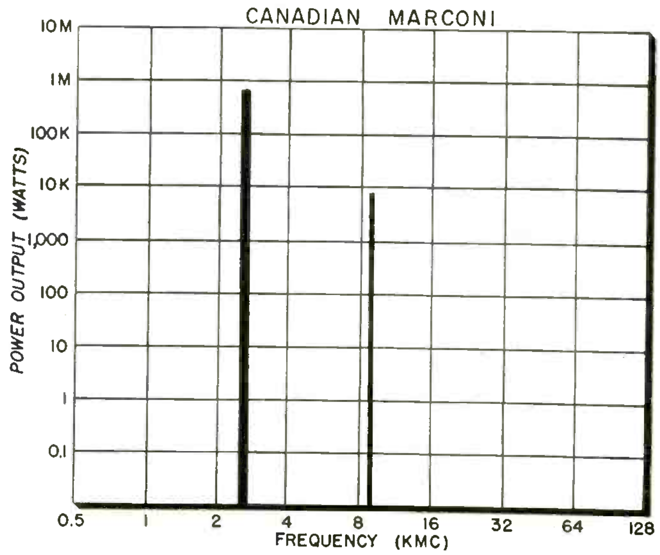
The profile charts on this and the following pages have been prepared from information on power output and frequency supplied by each of the microwave tube manufacturers. They are intended to show the principal areas in the frequency spectrum of manufacturing activity for each supplier together with the power output of available tubes. The bars represent a composite illustration of the frequency and power output ranges covered by all the types supplied by each manufacturer. Thus, the width and height of the bars are not to be taken as an indication of the capabilities of a particular type tube.











Concerned with coaxial test equipment?

Only NARDA offers you these exclusive features!

TURRET ATTENUATORS

Only Narda offers you a UHF-only attenuator. This represents a considerable savings in cost for applications in this frequency range. Each of three models offers the Designer or Development Engineer 12 steps of attenuation from d.c. to 1,500 mc with a VSWR of 1.25. Designed for bench use or mounting into test equipment packages.

One unit can give a maximum of 30 db attenuation; two units can be used in series to provide a wide range of control in small steps.

Model 705—0, 3, 6, 9, 12, 15, 20, 25, 30 db
Model 706—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20 db
Model 707—0, 3, 6, 9, 12, 15, 18, 21, INF db
Model 708—0, 5, 10, 15, 20, 25, 30, 35, 40, INF db

MODELS from **$275**

COAXIAL DIRECTIONAL COUPLERS

10, 20 and 30 DB . . . 225 to 10,000 mc.

Only Narda offers coaxial directional couplers in 10 and 30 db values, as well as 20 db. In addition, all models offer such advantages as these:

1. Flat Coupling—values with 1 db of nominal over a full octave frequency range, with calibration provided to ± 0.2 db accuracy.
2. Machined from solid blocks of aluminum—hence, more rugged.
3. Directivity exceeding 20 db.
4. Frequency Ranges: 225-460, 460-950, 950-2000, 2000-4000, 4000-10,000, mc.

$100 to **$150**

COAXIAL HYBRID JUNCTIONS

For use in duplexers, mixers, and other circuits requiring a division of power into two transmission lines. A signal into any terminal appears at the two opposite terminals. Both are equal in amplitude, but one is shifted 90 degrees in phase.

Input and output terminals are in line, permitting operation of TR tubes between a pair of hybrids. Type "N" female terminals are standard, but other types are available on request. Ruggedized construction safeguards against shock and vibration; will also withstand severe atmospheric conditions. Three models cover frequencies of 460-950, 950-2000, 2000-4000 (mc), all with 3.0 db coupling, ±0.25. VSWR: 1.2. Isolation: 20 db.

SPECIFICATIONS

Band	Frequency (mc)	NARDA Model	Coupling (db)	VSWR	Isolation (db)	Size (excl. conn)	Price
—	460-950	3031	3.0 ± 0.25	1.2	20	10½x2½x⅞	$225
L	950-2000	3032	3.0 ± 0.25	1.2	20	6½x2½x⅞	225
S	2000-4000	3033	3.0 ± 0.25	1.2	20	5x2½x⅞	225

UHF FREQUENCY METER DETECTORS . . . Direct Reading

The only direct reading frequency meter detectors available for the UHF range—and they're from Narda, of course! Absorption type meters, with 0.2 db insertion loss, each includes a resonant cavity, coaxial switch, crystal detector, current meter, sensitivity control and type N terminals.

SPECIFICATIONS

Frequency (mc)	Accuracy	Loaded Q	VSWR	Sensitivity for full scale deflection	NARDA Model	Price
200-500	0.5 mc	500	1.15	0.2 mw	804	$375
500-1500	1 mc	700	1.15	0.2 mw	805	375
1500-2400	2 mc	500	1.25	0.5 mw	806	375

Complete Coaxial and Waveguide Instrumentation for Microwave and UHF — including:

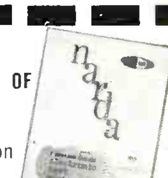
DIRECTIONAL COUPLERS	TUNERS	ATTENUATORS
TERMINATIONS	ECHO BOXES	STANDARD REFLECTIONS
FREQUENCY METERS	SLOTTED LINES	BOLOMETERS
HORNS	BENDS	THERMISTORS
VSWR AMPLIFIERS	COAXIAL HYBRIDS	LOW PASS FILTERS

200 to 90,000 mc.

the narda microwave corporation

118-160 HERRICKS ROAD, MINEOLA, L. I., N. Y. • PIONEER 6-4650

MAIL COUPON TODAY FOR FREE 1959 CATALOG AND NAME OF NEAREST REPRESENTATIVE



The Narda Microwave Corporation
118-160 Herricks Road
Mineola, L. I., N. Y.
Dept. EI-9

NAME ______

COMPANY ______

ADDRESS ______

CITY ______ ZONE ______ STATE ______

Circle 62 on Inquiry Card, page 149

TOUGH ENOUGH FOR AIRBORNE RADAR

Hughes microwave tubes

Rugged, compact, light in weight... all Hughes Microwave Tubes have withstood the most severe requirements of airborne radar systems and therefore can be applied in the most taxing of environmental problems.

KU BAND BACKWARD WAVE OSCILLATOR

The Hughes Type LOU-2 is a precision built oscillator which tunes over the frequency range of 12.4 to 18.0 kmc. Typical power output over band is 10 to 60 milliwatts. The tube is housed in a self-contained permanent magnetic focusing package so that a separate power supply for a focusing electromagnet is not required.

S-BAND TRAVELING WAVE AMPLIFIER

Periodically focused, the type MAS-1A has a peak power output of one kilowatt over a band of 2-4 kmc at duties up to 0.005. The tube has a gain of 30 to 33 db, giving an excess of one kilowatt over most of the band. When two tubes are operated in cascade, the one kilowatt output can be obtained with a drive on only one milliwatt.

S-BAND BACKWARD WAVE AMPLIFIER

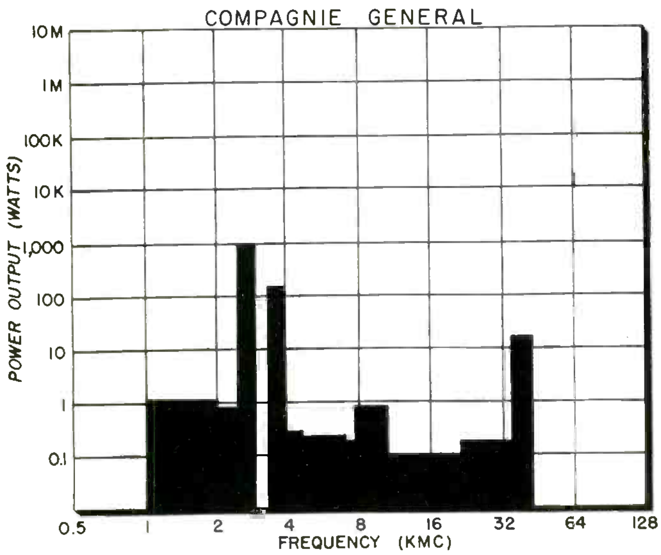
The Hughes type PAS-2 is a narrow-band, voltage-tuned amplifier that is designed for use as an r-f preamplifier stage in contemporary radar communications and other microwave receivers. Features: frequency range 2.4-3.5 kmc, insertion noise figures on order of 4½ db, tube noise figures of less than 5 db, voltage-tuned, crystal protection, spurious input signal elimination, cold isolation greater than 80 db and image rejection.

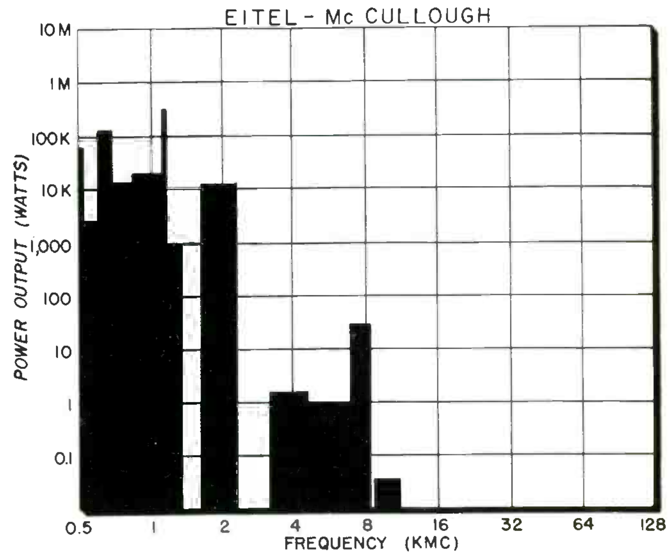
For additional information please write: Hughes Products, Marketing Department, International Airport Station, Los Angeles 45, California. Or contact our local offices in Newark, Chicago and Los Angeles.

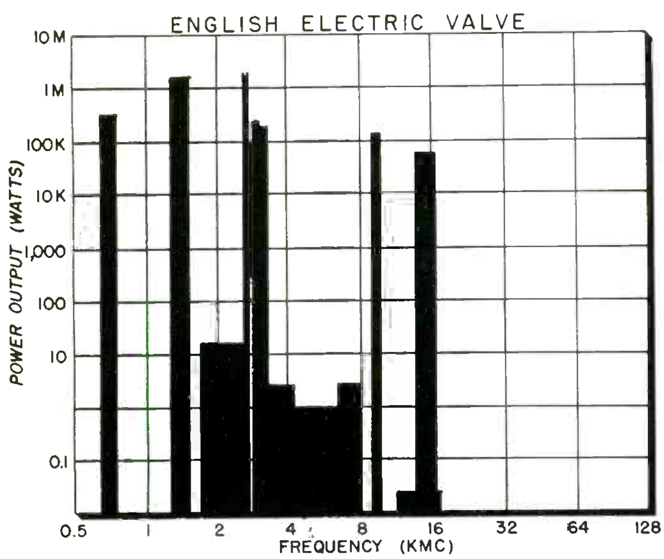
Creating a new world with ELECTRONICS

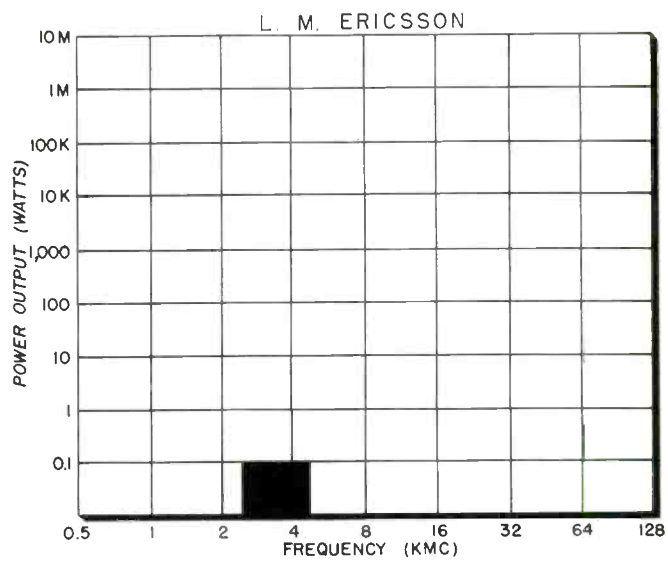
HUGHES PRODUCTS

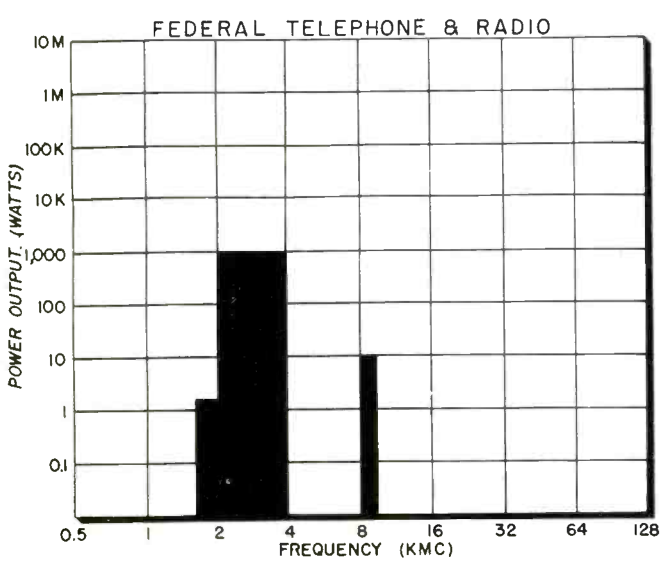
Frequency Ranges & Power Output

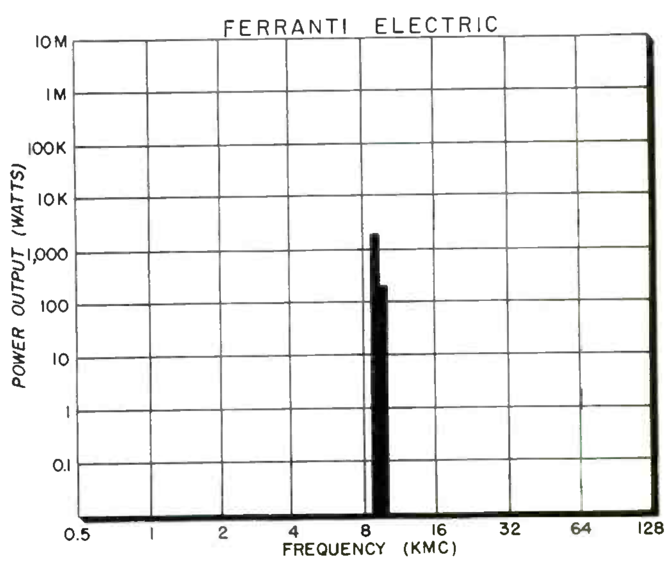


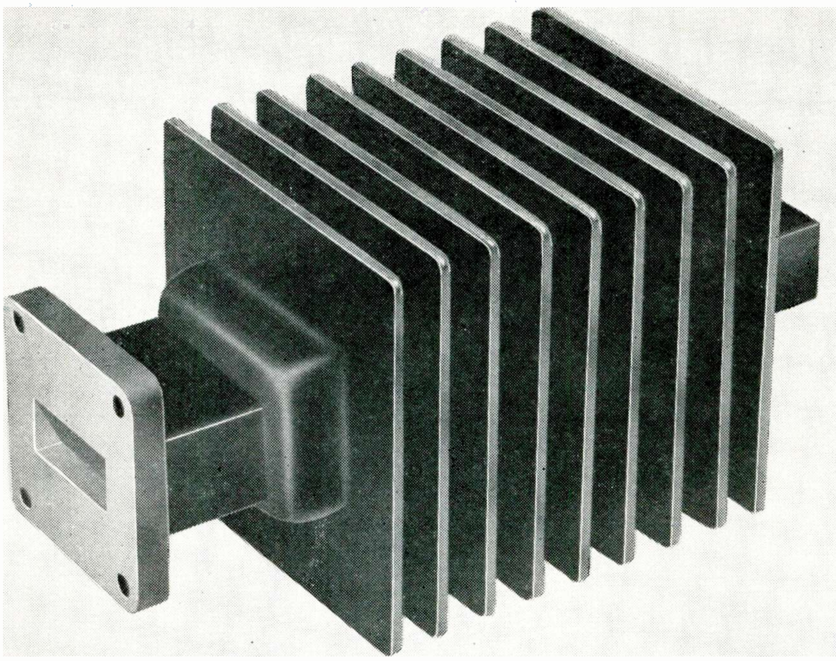












4063
VHP*
DUMMY LOADS

MODEL X4063
Equivalent to Jan DA-146/u

The Bogart Model 4063 Series of VHP Dummy Loads has evolved from a need by the Armed Forces for very high power dummy loads for both field and laboratory use. Originally developed for the Army Ordnance Fire Control Instrument Group, **the 4063 series is at this time, the only family of high power dummy loads that have been approved by all Armed Forces agencies. These units have been tested and qualified in accordance with specification MIL-D-14454 and MIL-T-945A.** Previously, these dummy loads had won wide acceptance by service branches by providing R-F silence during tuning and maintenance, ease of maintenance and standard test conditions. Designed to operate with the highest power radar systems, these dummy loads are lightweight, compact, resistant to moisture absorption and intended to last at least the life of the equipment with which they will be used. Reduced operating temperatures are obtained through the use of cooling fins. The 4063 series, as adopted by Armed Forces agencies, are provided with flanges noted in the chart. However, non-standard flanges, or adapters, are available for special applications. High temperature pressure sealing "O" rings are available as accessory equipment. All units are finished in a black enamel.

Special Applications of Bogart VHP Dummy Loads can be designed to meet your specific requirements. Our applications engineers will be pleased to discuss your particular problems with you.

Write for the Armed Forces "Report on Standardization of Dummy Loads."

For Coaxial Dummy Load requirements refer to Bogart series 4064.

*PATENT PENDING

Model No.	Equivalent JAN Nomenclature	Frequency Range (KMC/S)	Max. Peak Power (Mega-Watts)	Minimum Average Power (Watts)	Maximum VSWR	Approx. Length (Inches)	Width (Inches)	Height (Inches)	Approx. Weight (Lbs.)	Waveguide AN Type
L4063	DA-147/U	1.12-1.70	17.2	6000	1.15	33	9	11½	60	RG-103/U
R4063	Pending	1.70-2.60	6.0	5000	1.10	21½	6½	8½	20	RG-105/U
S4063	DA-145/U	2.60-3.95	3.2	4500	1.10	14	5	6½	9	RG-75/U
A4063	Pending	3.30-4.90	2.1	2200	1.10	13	5½	6½	8	WR229†
H4063	DA-149/U	3.95-5.85	1.3	2000	1.10	9½	3½	4	5	RG-95/U
C4063	DA-144/U	5-85-8.20	0.71	1000	1.10	8	3	4	2½	RG-106/U
B4063	DA-148/U	7.05-10.0	0.46	600	1.10	6½	2½	3	1	RG-68/U
X4063	DA-146/U	8.20-12.4	0.29	500	1.10	6	2½	2½	1	RG-67/U
KU4063	DA-159/U	12.4-18.0	0.16	250	1.15	4	2½	2½	½	RG-107/U**
K4063	DA-160/U	18.0-26.5	0.058	150	1.15	4	2½	2½	½	RG-121/U
KA4063	DA-158/U	26.5-40.0	0.031	75	1.15	4	2	2	½	RG-96/U**

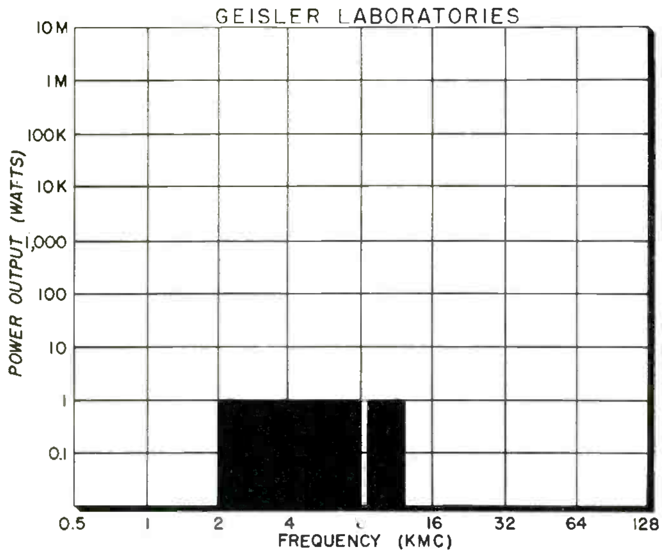
†RETMA DESIGNATION **ALUMINUM EQUIVALENT

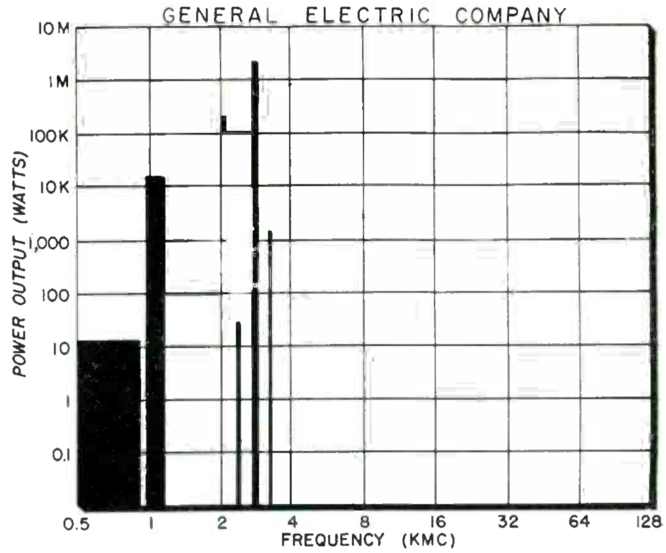
Above data subject to change without notice.

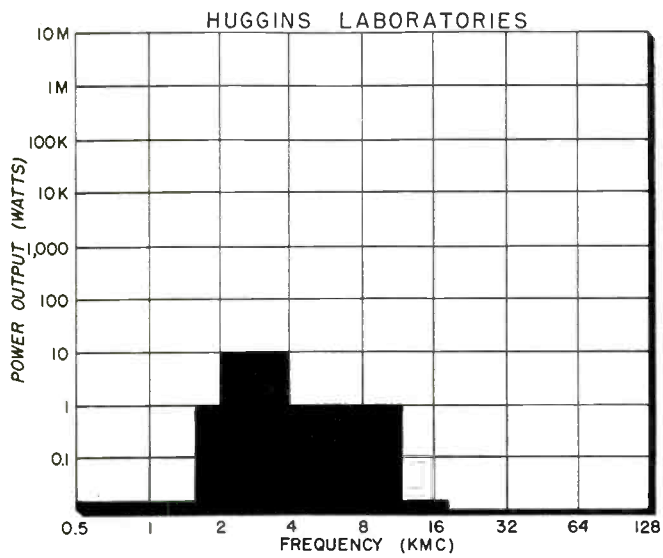
BOGART

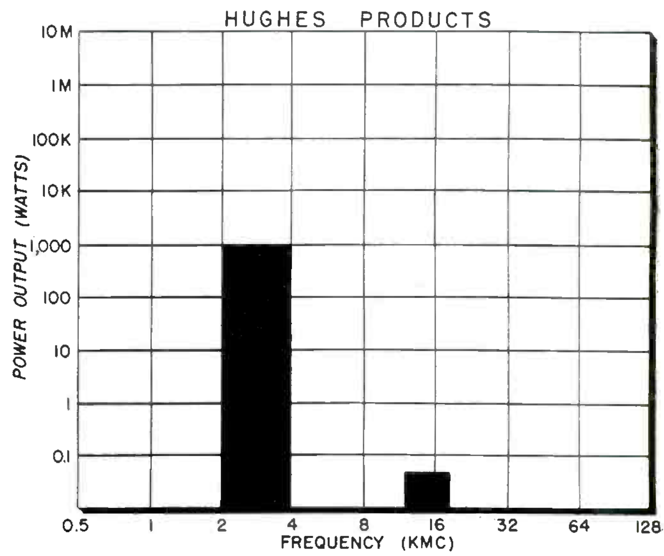
BOGART MANUFACTURING CORPORATION
315 Seigel Street **Brooklyn 6, New York**
serving the electronics industry since 1942
design • development • production

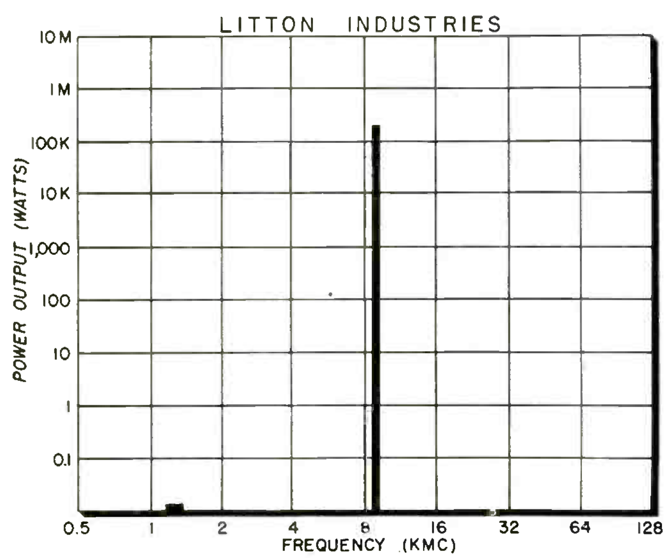
Frequency Ranges & Power Output

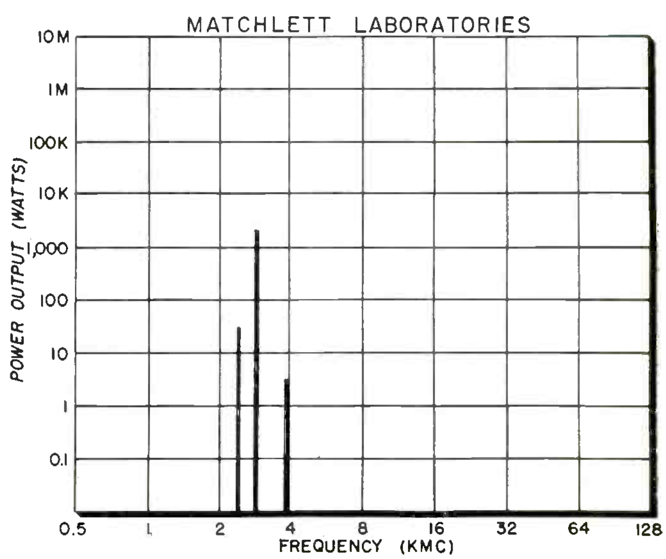






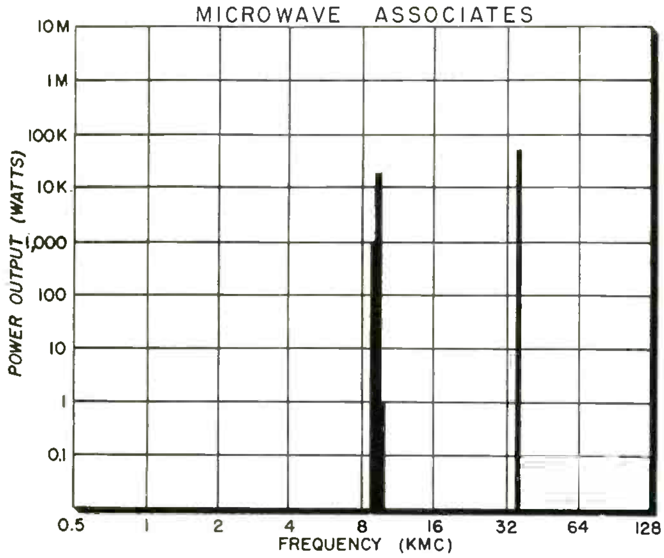


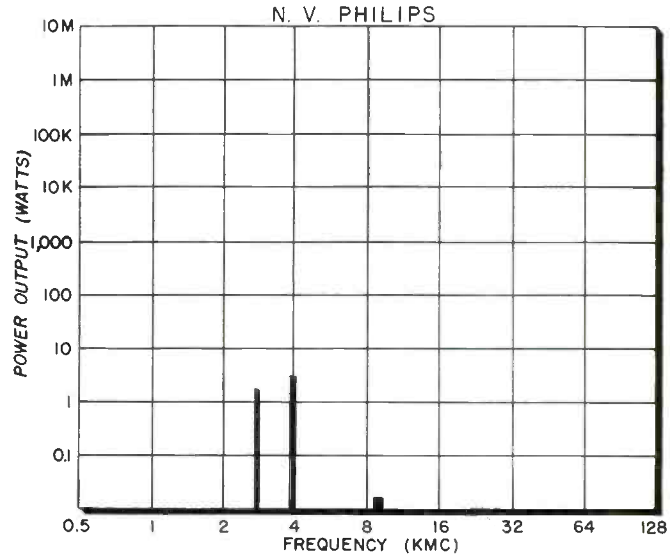


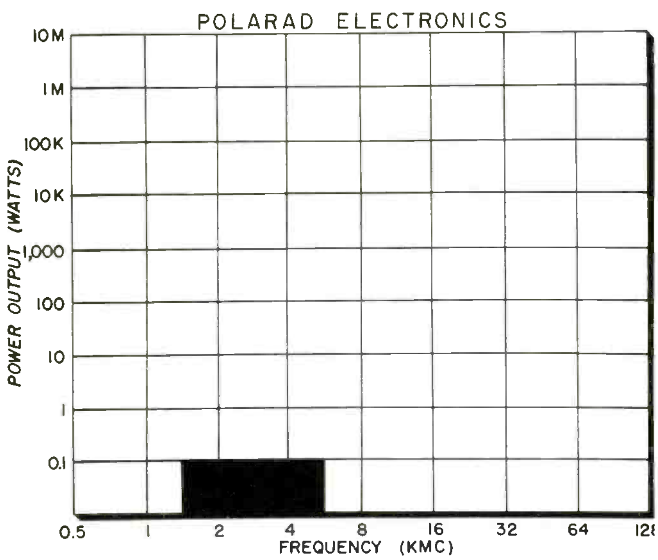


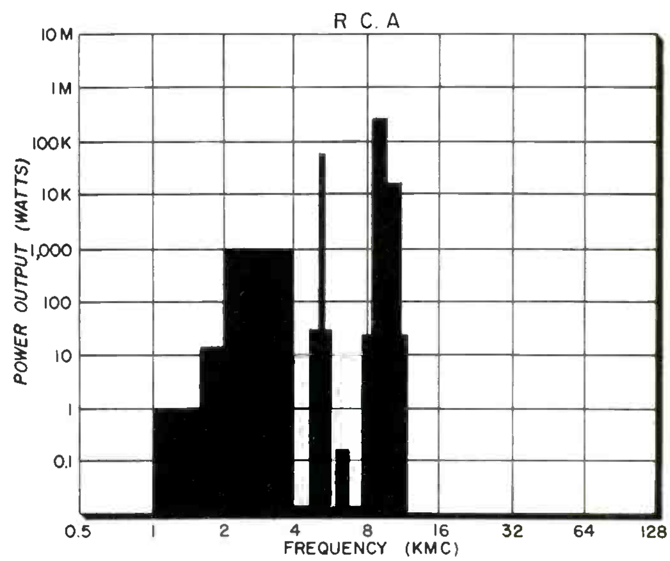
Circle 65 on Inquiry Card, page 149

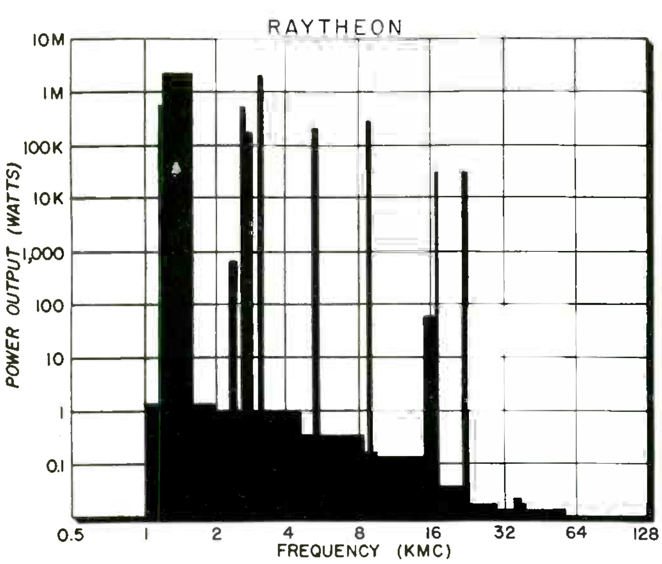
Frequency Ranges & Power Output

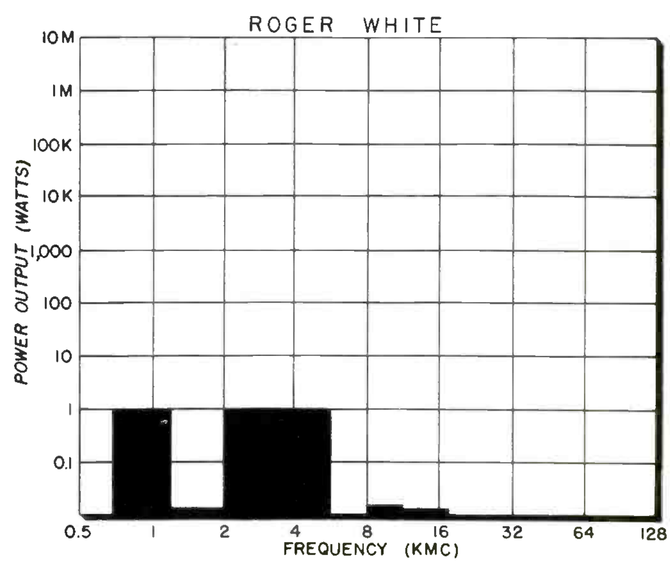












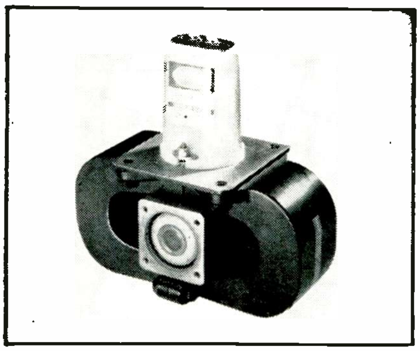
Creative Microwave Technology

Vol. 1 No. 1

Published by MICROWAVE and POWER TUBE DIVISION
RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASSACHUSETTS

NEW DEVELOPMENTS IN ELECTRONIC TUBES AND CERAMICS

Where abnormal conditions of vibration (25 to 2000 cps at 10G) are encountered, such as in advanced airborne applications, this pulsed-type X-band (9245 ± 40 Mc) air-cooled RK6967A/QK366A magnetron oscillator maintains exceptional frequency stability and operational reliability. Optimum performance is assured by a double-end supported cathode and aluminum-clad integral magnets. Nominal peak

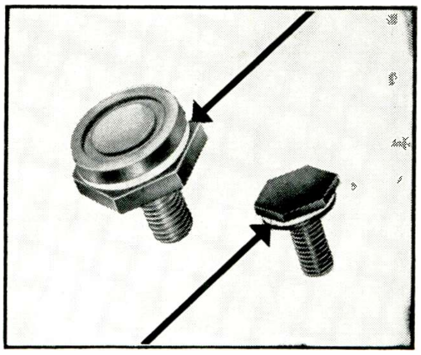


power output is 100 kw at typical pulse conditions of 0.5 μ sec. (.001 duty cycle). The tube operates at a peak anode voltage and current of 15 kv and 13.5 amp. respectively.

Circle No. 3 on Inquiry Card

* * *

Integrally insulated semiconductors can now be produced by using high-alumina ceramic stem assemblies. Heat dissipating ceramic wafer (arrow) in the base insulates up to 2000 volts dc and withstands soldering temperatures as high as



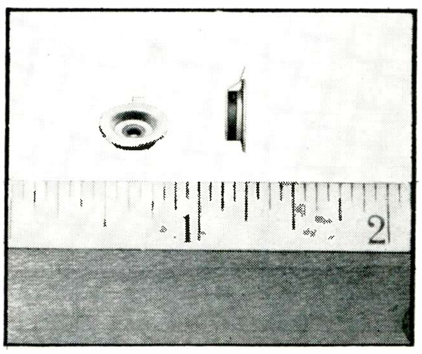
1100C. Bases can be directly mounted to chasses or cold plates. Stems are available to all semi-conductor manufacturers.

Circle No. 4 on Inquiry Card

* * *

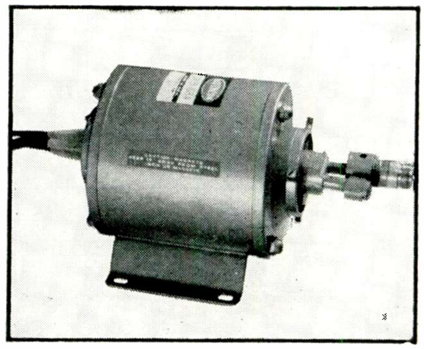
Miniature gyro feed-throughs provide take-off points from gas-filled gimbal housings. These high-alumina, vacuum-tight, R-95 ceramic assemblies can be soldered to housings at temperatures up to 1000C. They also assure positive electrical insulation with leakage less than one microampere per 500 volts dc.

Circle No. 5 on Inquiry Card



Designed for voltage tunable CW or pulsed operation over the Government X-band (8500 to 9600 Mc), the QK-684 integral magnet backward wave oscillator delivers 10 to 50 mW over delay-line voltages ranging from 215 to 325 vdc. Regulation of a special control grid facilitates pulsed or amplitude modulation to meet power and frequency requirements. Models available for coupling to standard, type "N" connectors.

Circle No. 6 on Inquiry Card



* * *

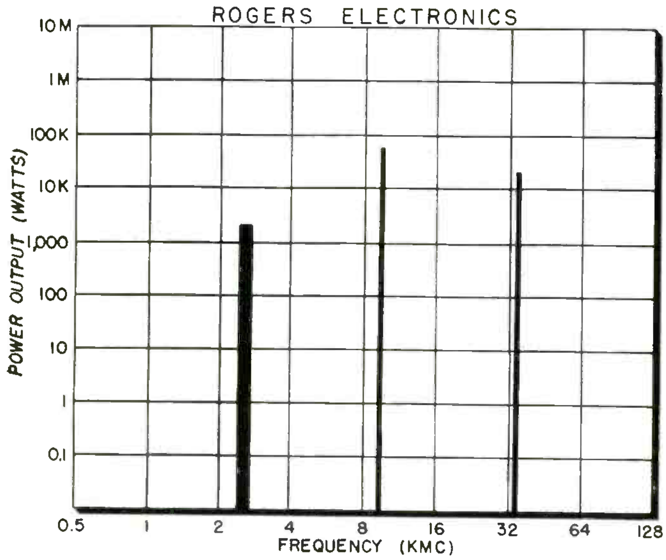
Compiled as a Raytheon service to the field, new Consolidated Data Booklet contains comprehensive information about principal unclassified magnetrons, klystrons, backward wave oscillators and special purpose tubes manufactured by Raytheon. Characteristics presented include maximum ratings, typical operating values, band or frequency ranges and other essential data for microwave engineers and purchasing departments.

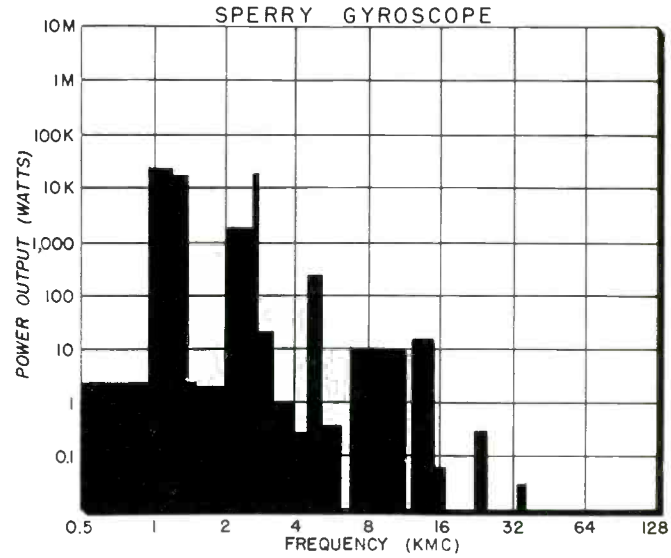
Circle No. 7 on Inquiry Card

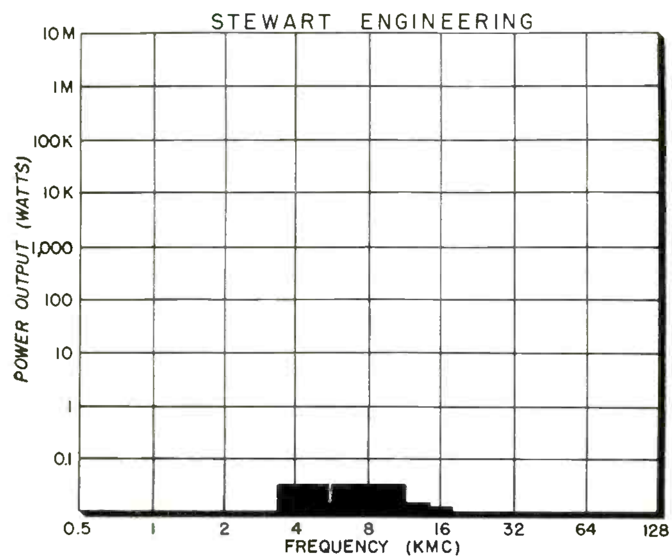
A Leader in Creative Microwave Technology

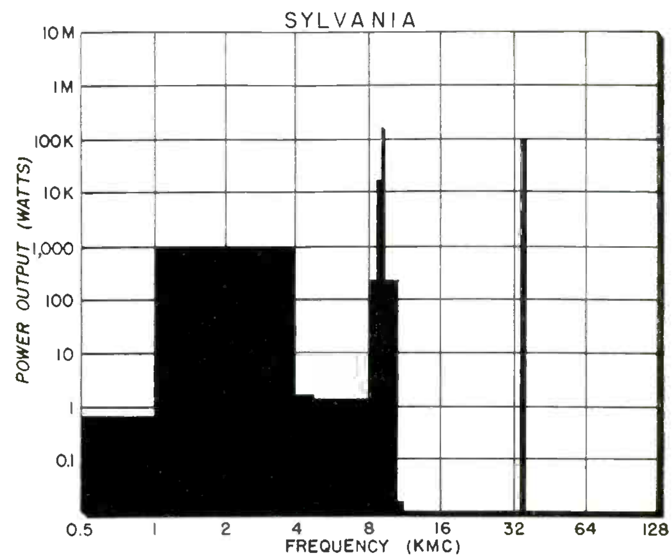
RAYTHEON

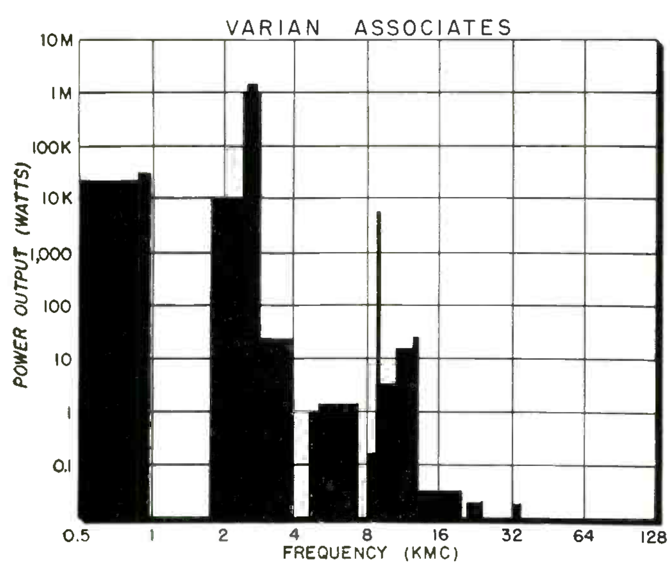
Frequency Ranges & Power Output

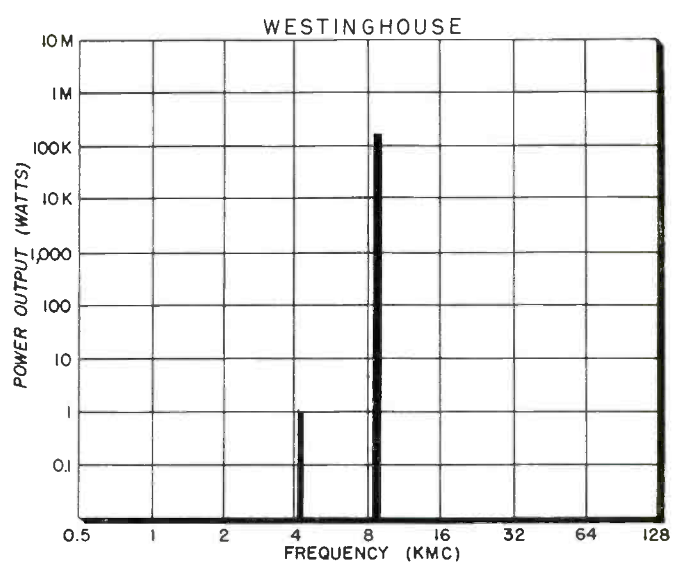












Microwave Glossary

(Continued from page 106)

DISPERSIVE REGION—Refers to an operating point on the characteristic curve of a traveling wave tube designed to amplify a relatively narrow band of frequencies.

DUTY CYCLE—The length of time that a tube is in operation during the driving pulse interval.

EFFECTIVE EXTERNAL Q—Figure of merit describing the immunity of an oscillator tube from frequency shift due to change in output loading. This figure, Q_x, is related to the pulling figure Δf as follows:

$$Q_x = 0.42\ f/\Delta f.$$

FORWARD WAVE AMPLIFIER—A traveling wave tube in which rf power and the electron beam travel in the same direction toward the load.

INTERACTION SPACE—The region in a klystron, magnetron or traveling wave tube where emitted electrons interact with an rf electric field.

LONG-LINE EFFECT—Rf-spectrum deterioration or instability in an oscillator caused by a mismatched load at the end of a long line.

MISSING LINES STABILITY—A measure of the percentage of rf pulses with energy only 30% of normal due to low amplitude, too-short pulse duration, or incorrect frequency.

MODE—A term referring to the pattern of frequency generation in the resonator of a magnetron. The "π-mode," which is the desirable condition of operation, is obtained when r-f potentials on alternate anodes are opposite in polarity. Oscillation at other than the desired frequency is often termed "moding."

NOISE FIGURE—A measure of the signal-to-noise ratio of an amplifier given by the expression: $NF = \frac{S_i/N_i}{S_o/N_o}$, where S_i/N_i is the signal-to-noise ratio at the input terminals, and S_o/N_o is the signal-to-noise ratio at the output terminals.

PHASE OF SINK—Describes that location of the voltage minimum on the guide at the output of a magnetron which causes the tube to operate in the sink region. The correct location for the voltage minimum is in the "anti-sink" region, or one-fourth the guide wave-length ($\lambda g/4$) from the phase sink.

PULLING FIGURE—The maximum frequency excursion of a magnetron produced by the changing phase of a load having a voltage standing wave ratio (VSWR) of 1.5.

PULSE DURATION—The length of the time interval between two pulses measured at points at which the current is 50% of smooth peak value.

PULSE REPETITION RATE—The frequency at which triggering or driving pulses are applied to a tube, usually expressed in pulses per second (pps).

PUSHING FIGURE—The measure of frequency change produced by a given instantanous change in anode current, under conditions of constant load and anode temperature.

RIEKE DIAGRAM—Circular load-impedance chart on which contours of constant power output and frequency are plotted. Diagram shows graphically the performance of a magnetron as the rf load is varied. Fig. 6 is a typical Rieke diagram. The radial distance from the center of the chart (center representing VSWR of 1.0) is proportional to the VSWR of the load; the angular position of the curve (periphery) indicates the phase of the load. Thus, pulling figure can be read from this chart by noting the maximum frequency excursion around the circle representing a VSWR of 1.5. The "sink" region represents too heavy loading which may cause erratic starting, and missing pulses.

SATURATION GAIN—The power gain in db provided by a trveling wave amplifier tube operating at saturation power output. This gain figure is usually lower than the maximum gain figure of the tube obtained at smaller signal levels.

SATURATION POWER OUTPUT—The maximum power output of a treveling wave amplifier tube. With constant beam current, a further increase in rf power input results in decreased gain and power output, to a point where, finally, power output falls below input power.

SCALLOPING—Changes in the interaction of the beam and helix in a traveling wave tube caused by non-uniformities in the focusing field.

SMALL SIGNAL GAIN—The power gain in db provided by a traveling wave amplifier at input power levels (usually 7 db or more(below the level required for tube saturation.

SPIRAL BEAM MODULATION—The frequency-modulation of a magnetron accomplished by an auxiliary grid-controlled electron gun to which modulation is applied.
R-R-V—Abbreviation for the rate of rise of the voltage pulse applied to a magnetron or klystron.

THERMAL FACTOR—A measure of the frequency change in a magnetron produced by a given change in anode temperature.

TRANSIT TIME EFFECT—A condition of little or no amplification encountered in a tube operated above its frequency limit, where the time required for electrons to move from cathode to anode is large compared to the duration of a cycle at the frequency.

VELOCITY MODULATION — A principle utilized in klystrons and magnetrons and other tubes where the rf signal is caused to interact with the electron stream to change its velocity rather than its intensity.

Circle 67 on Inquiry Card, page 149

Microwave Tubes

(*Continued from page 106*)

tudinal magnetic field which surrounds the tube. Velocity of the electrons is determined by the voltage difference between the cathode and the helix, and this is adjusted to give the electrons the proper velocity for interaction with the r-f waves.

By operating traveling wave tubes in the "dispersive" region of the characteristic curve, the tubes can be made to amplify at extremely high gain over only a relatively narrow band.

Backward Wave Oscillator

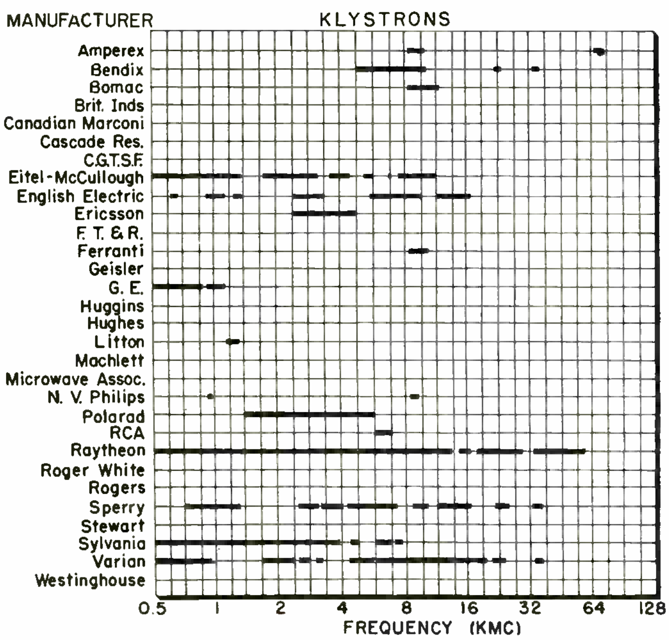
The backward wave oscillator, sometimes called the carcinotron, is a velocity modulated tube which operates on traveling wave tube principles. Although most backward wave oscillators employ the elongated structure of the traveling wave amplifier, a few commercial types are now available with magnetron structures.

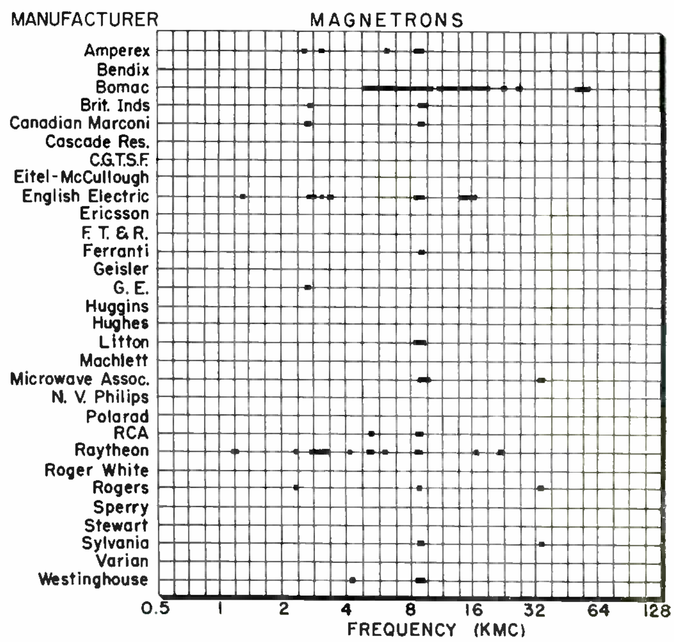
All the elements of the traveling wave amplifier including the pencil-like electron beam, magnetic focusing field and a medium to conduct the traveling wave are incorporated in the backward wave oscillator. The r-f wave medium can be the conventional helix, or it may be in the form of a transmission line folded along the axis of the electron beam. (See Fig. 5.) In the latter, the beam passes through the line at approximate half-cycle intervals, where the electrons are "bunched" by the field of the r-f wave. Passage of the bunched beam through successive openings in the line (past adjacent turns in the helix) delivers energy to the electric field. A distinguishing characteristic of backward wave tube operation is that electron bunching increases in the direction from the gun end to the collector, while the r-f power in the traveling wave increases in the reverse direction, toward the gun and tube output.

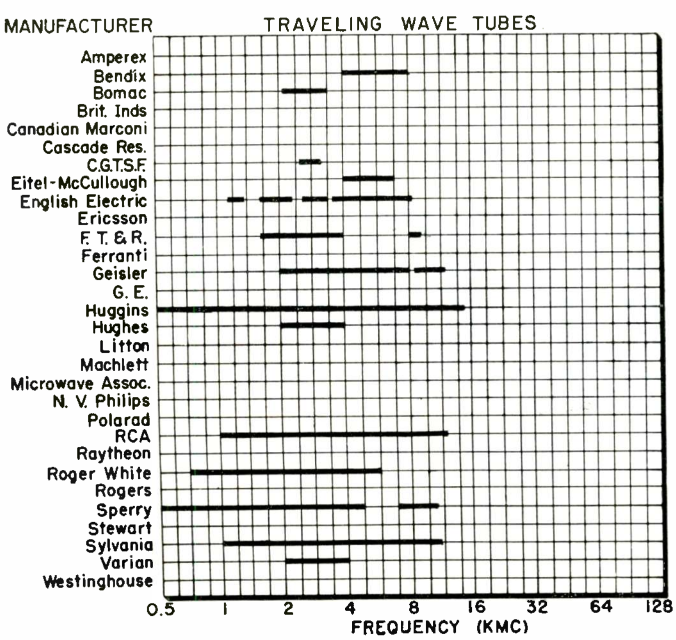
Oscillation frequency in the backward wave oscillator is controlled by the transit time of the electron beam, and thus by the anode voltage.

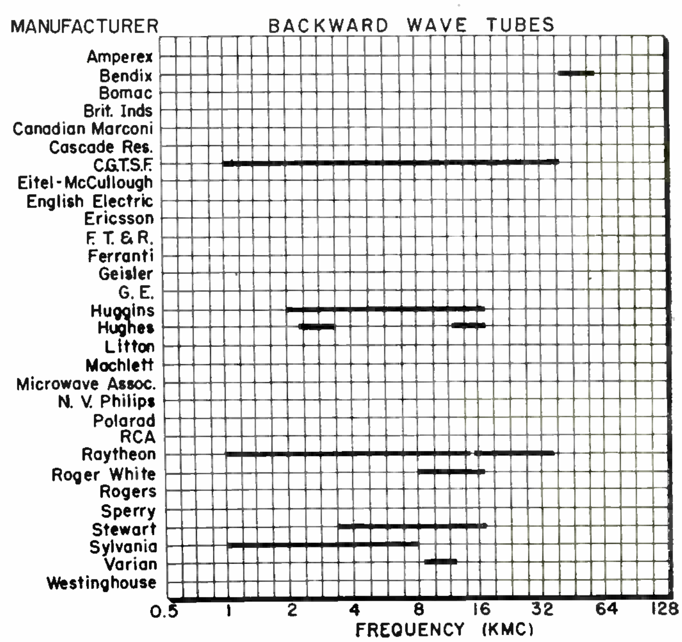
Microwave Tube Manufacturers' Frequency Ranges

The following charts are a composite of the 29 individual charts preceding. Within the four separate groupings of klystrons, magnetrons, traveling wave tubes and backward wave tubes are shown the manufacturers producing tubes for given frequency ranges. No consideration is given here to the power outputs. For this information refer to the charts on the preceding six pages. A completely detailed technical specification of the tubes will be found in the listings beginning on page 107.









AF VHF

EIMAC FIRST

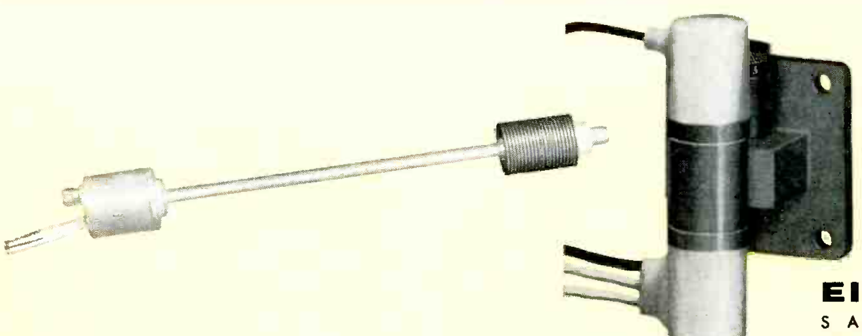
Covering the Spectrum with Reliable Ceramic Tubes

UHF

From audio into super high frequencies, Eimac covers the RF spectrum with modern ceramic tubes. This incomparable ceramic electron tube family—more than one-third of the Eimac line—includes reflex and amplifier klystrons, traveling wave tubes, negative grid tubes, rectifiers, pulse modulators, and receiving tubes. The tubes illustrated are typical of more than 40 Eimac ceramic tube types that are being selected by leading equipment manufacturers for use in all types of applications—from tropo-scatter to industrial heating, from single sideband to pulse.

The advantages of reliable Eimac ceramic tubes include: resistance to damage by impact, vibration, and heat; smaller size; and better processing techniques.

SHF



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Eimac First with ceramic tubes that can take it

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Negative Grid Tubes	Ceramic Receiving Tubes	Vacuum Pumps
Reflex and Amplifier Klystrons	Vacuum Tube Accessories	Traveling Wave Tubes
	Vacuum Switches	

Includes the most extensive line of ceramic electron tubes

Circle 69 on Inquiry Card, page 149

Industry News

Dr. Bruce P. Bogert has joined Bendix Aviation Corp. as Head of the Acoustics Dept. at the Research Laboratories Div. Dr. Bogert was formerly with Bell Telephone Labs.

Joseph D. Portanova, Vice President—Styling of the Consumer Products Div., Hoffman Electronics Corp., has been elected the 1958-59 Chairman of South California Chapter, Industrial Designers Institute.

Carl W. Cowing has been named Manager of the Air Force Advanced Development Sales Unit in GE's Heavy Military Electronics Dept.

Austin E. Olson is now the East Coast Microwave Sales Manager for Motorola Communications & Electronics, Inc.

Corbin A. McNeill is the new Director of Industrial Relations for International Telephone and Telegraph Corp.

Donald H. Preist is now Associate Director of Research at Eitel-McCullough, Inc.

D. H. Preist

R. R. Robertson

R. R. Robertson, recently named Sales Manager by Weller Electric Corp., has been elected Vice President—Sales.

Joseph P. Lynch has been named Advertising and Sales Promotion Manager for the Westinghouse Electric Corp.'s Electronic Tube Div.

Edwin B. May will now serve as Manager, Promotion, RCA Semiconductor and Materials Div.

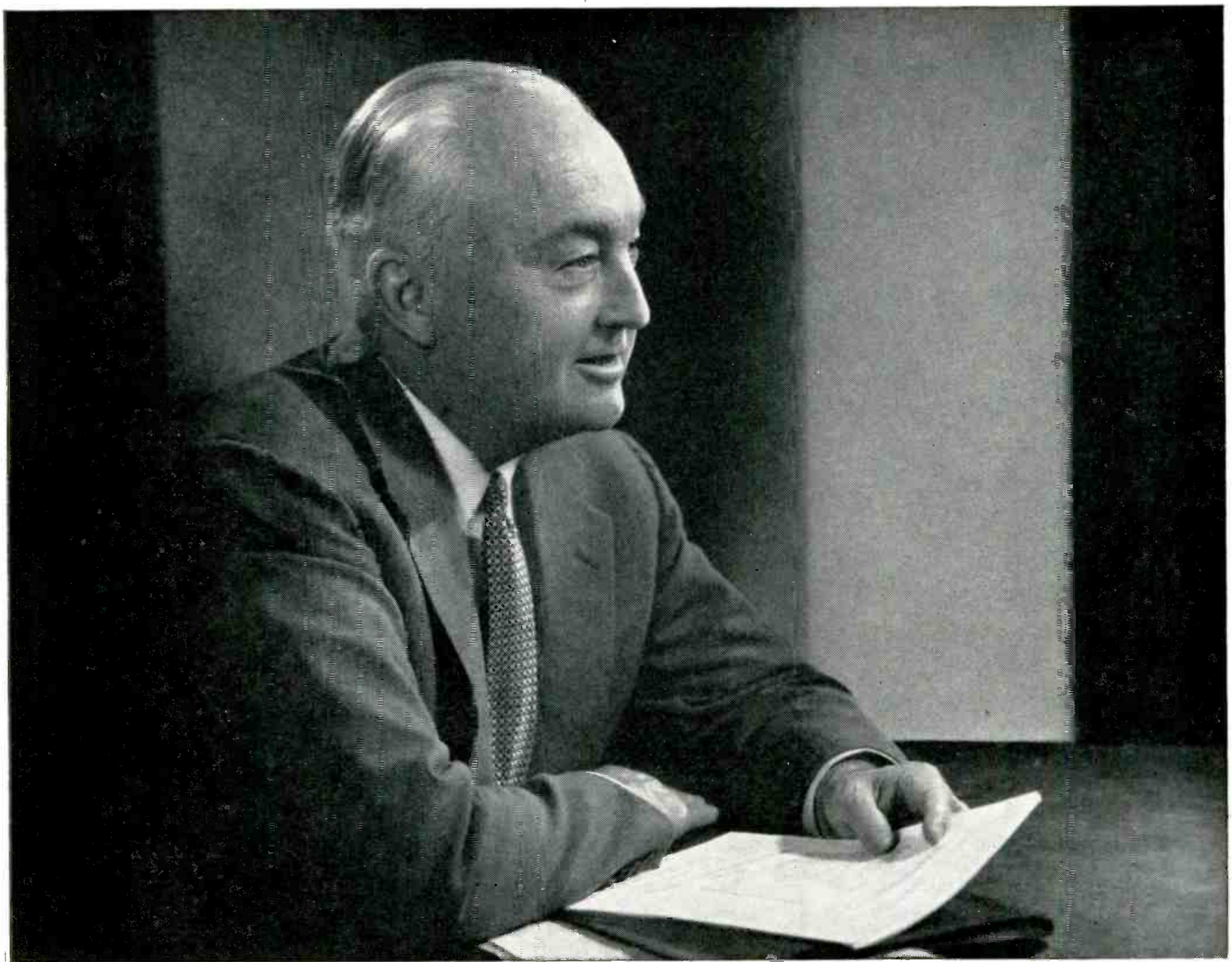
Jack Gilpin is now filling the new post of Assistant for Management Planning at Eitel-McCullough, Inc.

John T. Hickey, formerly General Manager of Motorola's Semiconductor Products Div. in Phoenix, Ariz., has been named Assistant to the President.

Alan H. Bodge has assumed the Management of the Silicon Div. of Audio Devices in Santa Ana, Calif.

(*Continued on page* 142)

Circle 70 on Inquiry Card, page 149



ROY T. HURLEY — Portrait by Bachrach

"More than 11,000 of our 19,000 employees are now buying U.S. Savings Bonds Regularly"

"We are delighted to see the steady increase in the number of our people who are buying U.S. Savings Bonds through the payroll plan. More than 59% of our employees are now enrolled.

"To enjoy the benefits of peace and freedom, we must provide for our own personal financial security and, at the same time, create the power for peace through support of an adequate defense program. Systematic savings through the Savings Bond program will keep us ahead of any potential aggressor and help insure the soundness of an economic system which encourages and permits each of us to look forward to a bright, secure future."

ROY T. HURLEY, ***Chairman and President, Curtiss-Wright Corporation***

Today there are more Payroll savers than ever before in peacetime. If employee participation in *your* Payroll Savings Plan is less than 50% . . . or if *your* employees now do not have the opportunity to build for their future through the systematic purchase of U.S. Savings Bonds, give your State Director an opportunity to help. Look him up in your phone book. Or write: Savings Bonds Division, U.S. Treasury Dept., Washington, D. C.

Electronic Industries

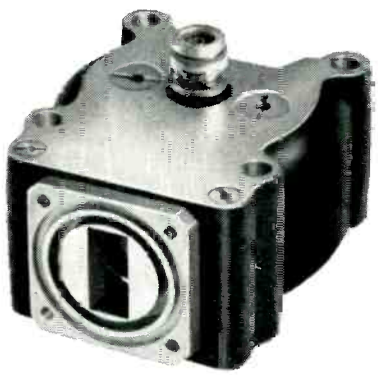
Circle 71 on Inquiry Card, page 149 →

MINIATURE PULSE MAGNETRON FOR MISSILES DELIVERS 4 KW (minimum!)

This is a Litton Industries magnetron, one of a remarkable family of *thirty* small, lightweight pulse tubes delivering up to 4 kw. The family has recorded hundreds of thousands of hours of reliable service.

The range of performance characteristics of these magnetrons has enabled them to demonstrate their reliability in navigational radar and communications, as beacon interrogators and transponders, in airborne fire control systems, in classified missile applications, and in other miniaturized systems.

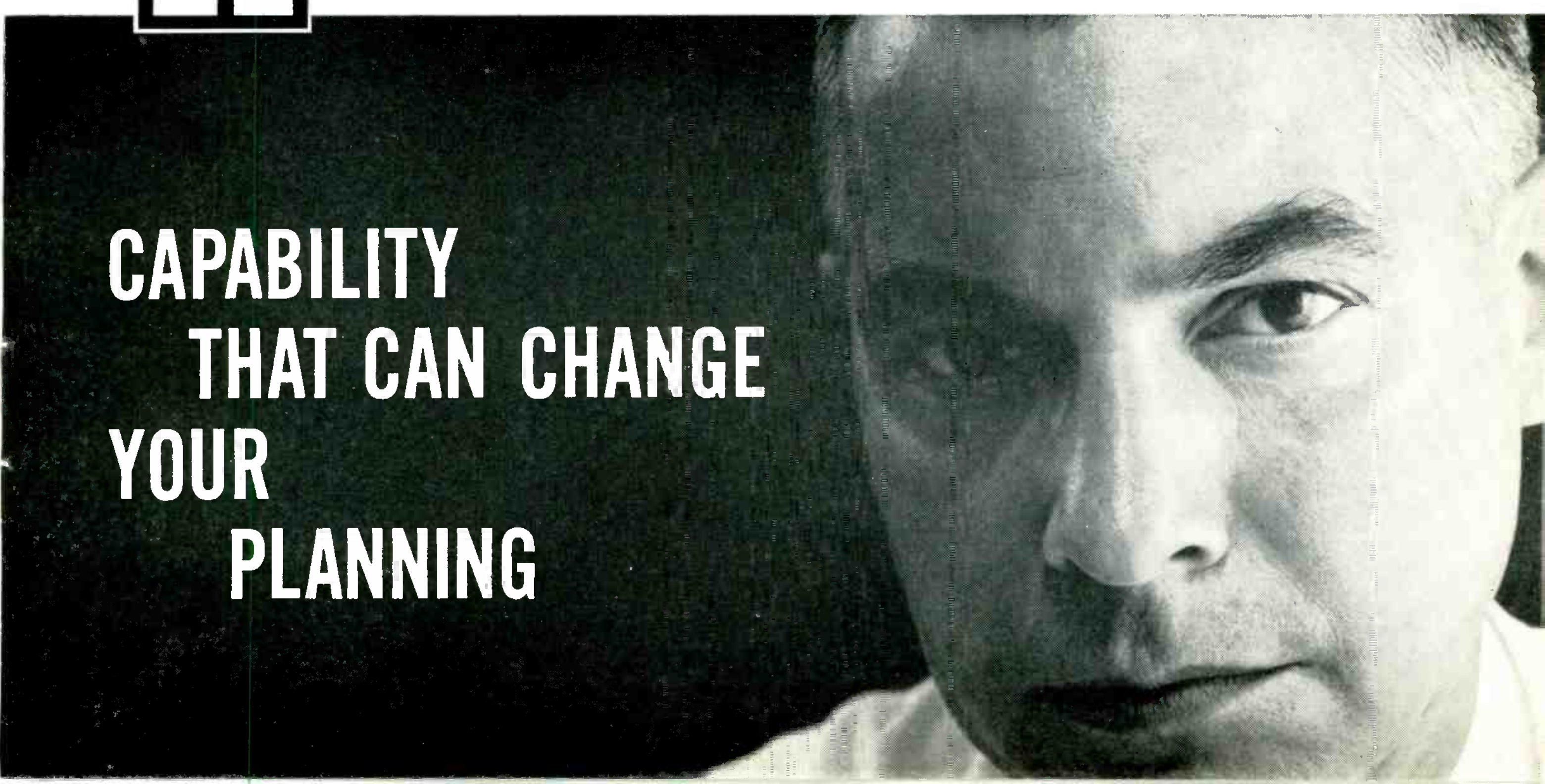
These are better tubes because of what pediatricians call TLC — tender, loving care. We put more than the normal number of man hours into the construction of each miniature magnetron. The result is a higher than normal tube yield. High yield in production has been statistically proved to produce measurably higher reliability in the field... and longer life.



If you would like more information on these and others of our wide line of electron tubes — information that may change your planning of new system designs — we have recently published a new electron tube catalog. Litton Industries Electron Tube Division, Office E1, 960 Industrial Road, San Carlos, California. If you would like information on our company as a place where you can enjoy an atmosphere wherein there are isolated areas of nearly pure vacuum — we'd like to hear from you.

LITTON INDUSTRIES Electron Tube Division

MAGNETRONS • KLYSTRONS • CARCINOTRONS • TRAVELLING WAVE TUBES
BACKWARD WAVE OSCILLATORS • GAS DISCHARGE TUBES • NOISE SOURCES



RELIABILITY IS ONE REASON WHY ENGINEERS SELECT ASTRON METALLIZED MYLAR* CAPACITORS FOR

MYLAR* METALLIZED, ASTRON TYPE RQL

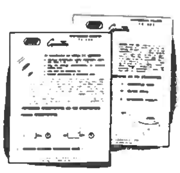
A remarkably versatile unit in a miniature, hermetically sealed, metal case . . . assured reliability at high temperatures . . . to +125° C without derating . . . designed in a variety of military type cases and mounting styles . . . far superior to conventional metallized paper capacitors. For military reliability equipment . . . missiles . . . critical industrial uses.

METALLIZED MYLAR*, ASTRON TYPE RLR

A small size, uncased durable unit in a tough Mylar* wrap with epoxy end seal . . . reliable performance at high temperatures . . . to +125° C without derating . . . low cost unit for potted and hermetically sealed assemblies . . . military high reliability equipment . . . communications . . . noise suppression systems . . . superior unit to conventional cardboard cased metallized tubulars.

WRITE TODAY FOR COMPLETE SPECIFICATIONS ON ASTRON'S RELIABILITY SERIES OF METALLIZED MYLAR* CAPACITORS, MYLAR* CAPACITORS, PAPER DIELECTRICS, METALLIZED PAPERS AND SAFETY MARGIN** ELECTROLYTICS.

ASTRON BULLETIN TYPE RQL RM-300 . . .



ASTRON BULLETIN RM-375 TYPE RLR

*REGISTERED DUPONT TRADEMARK
**TRADEMARK

ASTRON CORPORATION

255 GRANT AVENUE, E. NEWARK, N. J.

ASTRON® SKOTTIE ELECTRONICS CORPORATION PECKVILLE, PENNSYLVANIA

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ON THE WEST COAST QUICK DELIVERY OF ASTRON PRODUCTS IS AVAILABLE THROUGH AUTHORIZED ASTRON STOCKING DISTRIBUTORS.

New Tech Data for Engineers

Sealed Relays

Bulletin GEA-6628, 24 pages, offers up-to-date information on hermetically sealed relays for military and general purpose industrial applications. Photographs, circuit diagrams, coil data, and specifications for micro-miniature, sub-miniature, miniature, and high-speed relays are included. General Electric Co., Schenectady 5, N. Y.

Circle 209 on Inquiry Card, page 149

Audio Plugs

A 4-page catalog describes Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif., line of XLR connector series for use on microphones, tape recorders, amplifiers, test instrumentation computers, and other electronic instruments. Ordering nomenclature, construction details, and dimensions are also included.

Circle 210 on Inquiry Card, page 149

Alumina Ceramics

Coors Porcelain Co., 600 Ninth St., Golden, Colo., has just issued a short form bulletin giving production facilities and mechanical and electrical properties of their high alumina ceramics—"Coors Space Age Ceramics" for temperature, resistance and high strength in modern electrical and mechanical equipment. Bulletin No. 858.

Circle 211 on Inquiry Card, page 149

Capacitors

Vitramon, Inc., P. O. Box 544, Bridgeport, Conn., has information available which describes their high reliability specification S-1002 capacitors. Manufacturing process, as well as all tests and failure rates on their high reliability capacitors are included.

Circle 212 on Inquiry Card, page 149

Stampings

A compresensive booklet on new manufacturing techniques for stampings, involving savings up to 90% is available from Templet Mfg. Co., 701 Atkins Ave., Brooklyn, N. Y.

Circle 213 on Inquiry Card, page 149

Digital Control Computer

Brochure is available from The Thompson - Ramo - Wooldridge Products Co., P. O. Box 45067 Airport Station, Los Angeles 45, Calif. on digital computer control and data logging. Included in the reference bulletin is the description of the RW-300 Digital Control Computer as well as comprehensive discussions of process control, data logging, pilot plant, and test facility applications for computer control systems.

Circle 214 on Inquiry Card, page 149

Synchro Applications

Muirhead & Co., Beckenham, Kent, England, has a 64-page booklet (E-1000) available which describes in good detail, the applications and methods of use for their Magslip synchros. Booklet is complete with easy to follow technical information, photographs, drawings, tables and graphs. It is actually a form of synchro instruction book.

Circle 215 on Inquiry Card, page 149

Connectors

A colorful catalog describing features and applications of a new series of "snap-in" miniature electrical connectors with removable contacts is available from The Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif. Catalog also provides detailed specifications.

Circle 216 on Inquiry Card, page 149

Transformers

A 1959 edition of the Stancor Transformer Catalog has just been published. The 32-page, two-color catalog covers over 750 transformers for industrial, communications, television and radio applications. Chicago Standard Transformer Corp., 3501 Addison St., Chicago 18, Ill.

Circle 217 on Inquiry Card, page 149

Tantalum Capacitors

Fansteel Metallurgical Corp., N. Chicago, Ill., has just isued a technical bulletin which describes, in tabular form, their line of Blu-Cap tantalum capacitors. Complete information is given.

Circle 218 on Inquiry Card, page 149

Solenoid Controlled Actuators

Waldorf Fluid Systems of Huntington Station, N. Y., has issued a two-color data sheet (WF 1394) describing their new line of solenoid controlled actuator packages. Presently being used in the missile field, these packages are available for many hydraulic and pneumatic applications.

Circle 219 on Inquiry Card, page 149

4-Layer Diode

Data for circuit designers interested in computers, telephony, control and pulse circuitry is provided in a new technical bulletin describing the Shockley four-layer bistable transistor diode. Circuit properties, action of the four-layer diode, switching times, characteristics and test circuits are described in this brochure. Shockley Transistor Corp., 1117 California Ave.. Palo Alto, Calif.

Circle 220 on Inquiry Card, page 149

Power Resistors

Bulletin 153 available from Ohmite Mfg. Co., 3699 Howard St., Skokie, Ill. describes their line of molded precision power resistors. Complete technical information is included.

Circle 221 on Inquiry Card, page 149

Pressure Transducers

Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J., has issued a 4-page, two-color illustrated brochure (PSG-1) which describes gauge, absolute and differential pressure measurements.

Circle 222 on Inquiry Card, page 149

Semiconductor Materials

A 4-page brochure issued by Knapic Electro-Physics, Inc., 936 Industrial Ave., Palo Alto, Calif. describes their facilities for research and manufacture of semiconductor materials.

Circle 223 on Inquiry Card, page 149

Silicon Transistors

A 4-page, two-color brochure describes Fairchild Semiconductor Corp.'s, 844 Charleston Rd., Palo Alto, Calif., N-P-N Diffused Silicon Transistors (2N696). Complete electrical and mechanical specifications are included along with circuit and block diagrams.

Circle 224 on Inquiry Card, page 149

Vertical Gyro

The Electronics Div., Iron Fireman Mfg. Co., 2838 S.E. Ninth St., Portland 2, Ore. has issued Bulletin GV-1 which describes their vertical gyro. This two-color brochure is complete with photographs, electrical and mechanical specifications.

Circle 225 on Inquiry Card, page 149

Packaged Amplifier

George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass., has released tentative data on its new UPA-2 utility packaged amplifier — a general purpose utility package of good reliability for use in computer-type operations in industry and in laboratory instrumentation. The 16 pages are full of facts, figures and photos.

Circle 226 on Inquiry Card, page 149

Thermocouples

An enlarged data catalog describing AerOpak thermocouples for users in the nuclear, missile, aircraft, industrial and process fields is generously illustrated with data, charts and pictures. Aero Research Instrument Co., 315 N. Aberdeen St., Chicago 7, Ill.

Circle 227 on Inquiry Card, page 149

New Tech Data for Engineers

Potentiometers

A data sheet available from Eastern Precision Resistor Corp., 675 Barbey St., Brooklyn 7, N. Y. describes their new line of infinite resolution wire-wound potentiometers. Specifications are included.

Circle 228 on Inquiry Card, page 149

Toroids and Filters

Burnell & Co., 10 Pelham Parkway, Pelham, N. Y., has a new catalog No. 104 which stresses the importance of toroids, filters and related networks in military and industrial communications. This 16-page, two-color catalog also describes variable inductors, crystal and other types of filters.

Circle 229 on Inquiry Card, page 149

Insulating Epoxy Resins

A guide to selecting epoxy insulating resins, listing physical and electrical properties, and other application data pertaining to "Scotchcast" brand electrical insulating epoxy resins, is available from Minnesota Mining & Mfg. Co., 900 Bush St., St. Paul 6, Minn.

Circle 230 on Inquiry Card, page 149

Focus Coil

Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill., has just issued an advance technical bulletin giving dimensional drawing, electrical and mechanical characteristics, and complete technical details on its Type F 20 electromagnetic focus coil designed for photographic, flying spot, military, and other special purpose 1½ in. neck diameter cathode ray tubes.

Circle 231 on Inquiry Card, page 149

Precision Resistors

A new catalog of bobbinless precision wire wound resistors is available from General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y. In addition to technical specifications, the catalog contains basic engineering theory on precision bobbinless resistors.

Circle 232 on Inquiry Card, page 149

Phase Shifter Theory

An 8-page bulletin details the application of Theta Instrument Corp.'s, 48 Pine St., E. Paterson, N. J., line of passively constructed phase generators. The devices are used to measure phase shift with 30 min. accuracy, provide reference voltage to demodulator and modulator circuits. Complete electrical and mechanical specifications are included.

Circle 233 on Inquiry Card, page 149

Permanent Magnets

A data sheet describing a new precision permanent magnet, Model 104, is available from Schlumberger Well Surveying Corp., Ridgefield Instrumentation Div., Ridgefield, Conn. This bulletin is complete with photographs, electrical and mechanical specifications.

Circle 234 on Inquiry Card, page 149

Synchros & Resolvers

Two new reference data sheets for design engineers, covering general mechanical and electrical specifications for synchros and resolvers, have just been made available by Induction Motors of California, 6058 Walker Ave., Maywood, Calif.

Circle 235 on Inquiry Card, page 149

Relays

A 20-page handy engineering catalog includes illustrations, specifications, and dimensional diagrams of the latest developments in microminiature rotary relays as well as sensitive telephone type relays which are available. Catalog is complete with photographs, outline drawings, electrical and mechanical specifications. Magnecraft Electric Co., 3350H West Grand Ave., Chicago 51, Ill.

Circle 236 on Inquiry Card, page 149

Fibre Fabrication

A handy booklet "Why" describes in detail the fabrication of laminated plastics and vulcanized fibre parts. A 12-page illustrated booklet answers a lot of questions covering this area. Taylor Fibre Co., Norristown, Pa.

Circle 237 on Inquiry Card, page 149

Microwave Horns

Waveline Inc., Caldwell, N. J., has just issued a technical data sheet which describes a line of microwave optimum standard gain horns. Complete electrical and mechanical specifications are included.

Circle 238 on Inquiry Card, page 149

Industrial Tube Chart

Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N. J., has announced publication of a new 30-page "flip-style" chart showing electrical and physical characteristics for the most important electron tubes having industrial, special purpose and military applications. Tube chart T-24 indexes industrial tubes by class, briefly explains the use of each class, and gives technical information pertinent to each type within the class.

Circle 239 on Inquiry Card, page 149

Thermocouple Instruments

An 8-page booklet available from Sensitive Research Instrument Corp., 310 Main St., New Rochelle, N. Y., describes their Model RFV radio frequency voltmeter along with technical information on how to use the equipment.

Circle 240 on Inquiry Card, page 149

Miniature Selector Switch

Bulletins #558S2 and #558ST2 available from G. H. Leland, Inc., 123 Webster st., Dayton 2, Ohio, describes their small rotary selector switches. Bulletins contain characteristics, dimensional drawings, and wiring chart.

Circle 241 on Inquiry Card, page 149

Magnetic Amplifiers

A 12-page, two-color booklet available from the Brach Mfg. Corp., 200 Central Ave., Newark 4, N. J., describes the facilities of the primary manufacturer of magnetic amplifiers, magnetic systems and associated circuitry.

Circle 242 on Inquiry Card, page 149

Crystal Filters

A 4-page technical bulletin describes a 10.7 MC family of crystal filters, shows vacuum tube and transistor circuitry, pulse and impulse response photographs, attenuation vs. frequency curves, and block diagrams. Hycon Eastern, Inc., 75 Cambridge Pkwy., Cambridge, Mass.

Circle 243 on Inquiry Card, page 149

Acoustical Vibration Testing

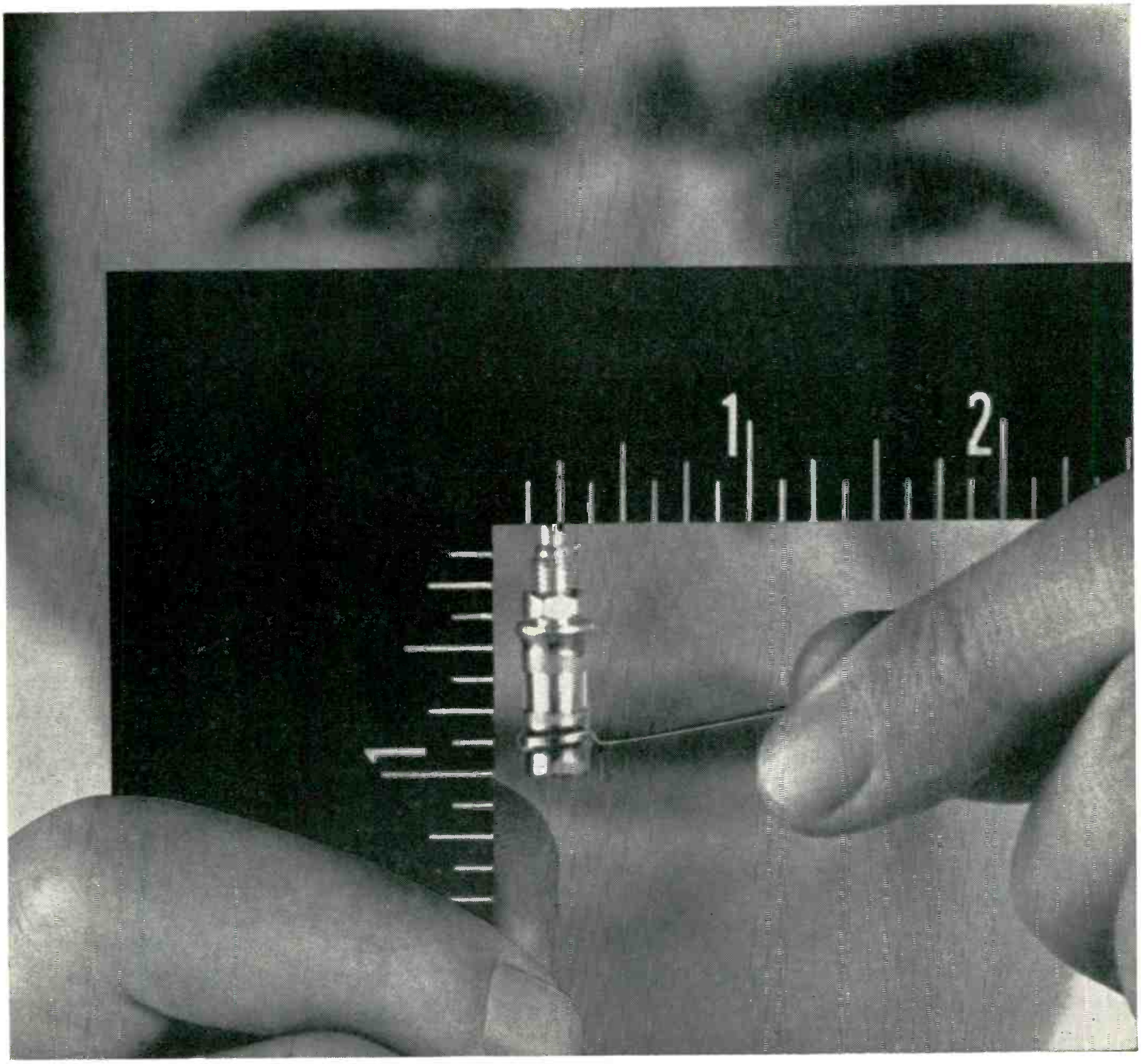
A 17-page bulletin describing high-intensity acoustical vibration testing as applied to aircraft and missile components and structures is available from Rototest Labs., Inc., 2803 Los Flores Blvd., Lynwood, Calif. Bulletin C-2 gives a complete description of the facility including 12 sound-level graphs and other information.

Circle 244 on Inquiry Card, page 149

Coil Winding Machines

44 latest model coil winding machines which rapidly wind virtually any desired coil, a wire scraper, wire insulating equipment, helpful winding formulas and 14 pages of tensions, counters, tailstocks, cams, gears and other accessories are illustrated and fully described in a new 62-page catalog No. 59 now available from Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 46, Ill.

Circle 245 on Inquiry Card, page 149



Another new miniature from Corning . . .

1 to 8 uufd direct traverse trimmer capacitor

Small but still precise, this new Corning direct traverse type trimmer capacitor meets military as well as civilian requirements.

Other features besides its size:

Silver plated hardware takes the noise out of tuning and protects the unit from corrosion even under extreme environments.

Mechanical stops at both ends of capacitance adjustment, with self-contained adjusting shaft.

Linear tuning with fine resolution. About 0.50 *uu*fd capacitance change per turn.

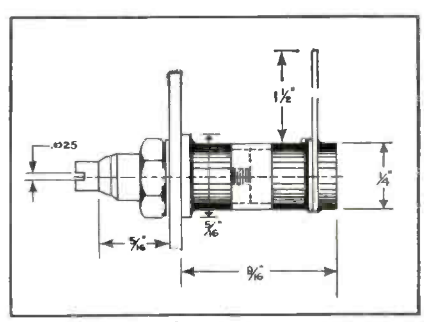
No capacitance reversals.

Glass-Invar construction.

Bushing and shaft assembly is coaxial *for low inductance, high frequency applications.*

Shock, vibration, and thermal shock resistance all excellent.

If you'd like more information, write for our new data sheet.



Corning means research in Glass

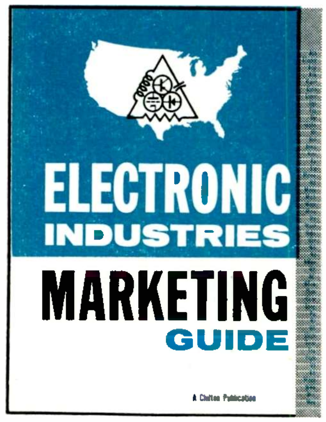
CORNING GLASS WORKS, Bradford, Pennsylvania

Electronic Components Department

A MAJOR BREAK-THROUGH

TWO POWERFUL NEW TOOLS YOU CAN USE—NOW—TO:

a. Define your market
b. Determine sales potentials
c. Measure sales performance
d. Pinpoint your prospects
e. Plot sales territories
f. Find new product markets
g. Perform market research



1. A new "EI Marketing Guide" book which supplies a state-by-state, county-by-county, product-by-product breakdown of electronic manufacturers product data. (Book in excess of 376 pages.)

2. Up-to-the-minute product data from 4,694 companies in the electronic industries available in 35,000 IBM punched cards.

The old era of dependence on government census classifications and data not suited to our industry has come to an end. ELECTRONIC INDUSTRIES' development of these two marketing tools opens up a new era for electronic market research.

These two new market research tools will enable you to spotlight the potential users of your products with a precision never before possible in the electronic industries and assist you in the marketing of your products.

Electronic products in this "EI Marketing Guide" and in the deck of IBM cards are classified under 101 major product numbers. They are further subdivided into an *average* of 20 sub product classifications under each major classification by the IBM punched cards (approximately 2,300 products).

Electronic manufacturers may acquire the "EI Marketing Guide" through a lease agreement with ELECTRONIC INDUSTRIES. A "deck" of the 35,000 IBM cards may be purchased for use on your own IBM facilities or on your local IBM Service Bureau Corp. facilities. (83 Bureaus in U. S.)

For full explanation of the content and uses of the "EI Marketing Guide" book and "EI" census data in punched form, contact any of the ELECTRONIC INDUSTRIES' Regional Managers listed below.

Chicago 1
George Felt
360 N. Michigan Ave.
RAndolph 6-2166

Cleveland 15
Shelby A. McMillion
930 Keith Bldg.
SUperior 1-2860

New York 17
Gerald Pelissier
100 E. 42nd St.
OXford 7-3400

Philadelphia 39
Joseph Drucker
56th & Chestnut Sts.
SHerwood 8-2000

New England
Menard Doswell
100 E. 42nd St.
New York 17, N. Y.
OXford 7-3400

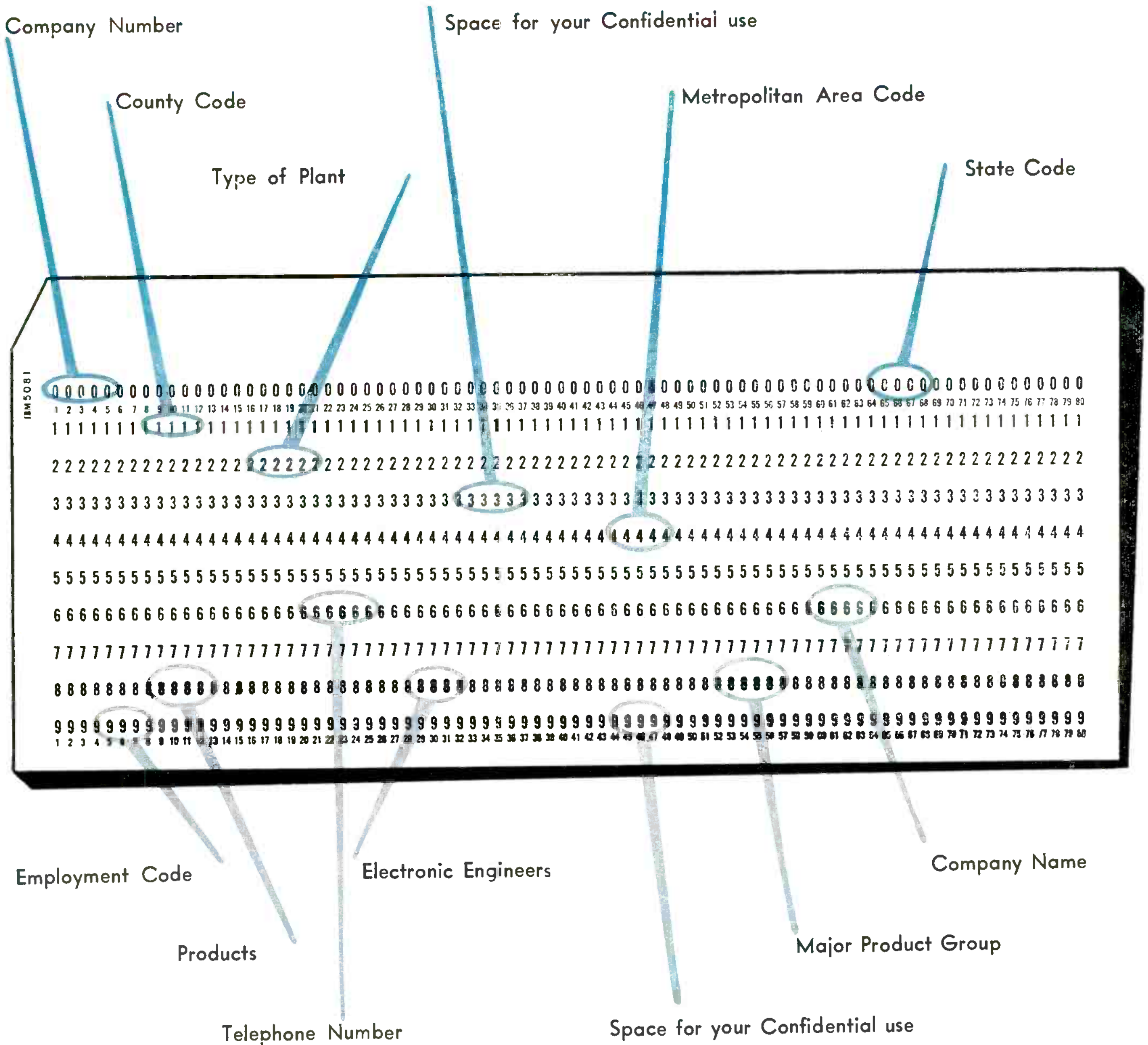
San Francisco 3
Don May
1355 Market St.
UNderhill 1-9737

Los Angeles 57
B. Wesley Olson
198 S. Alvarado St.
DUnkirk 7-4337

Dallas 1
Hal Mott
Meadows Building
Expressway at Milton
EMerson 8-4751

Atlanta 9
John Sangston
1182 W. Peachtree St. NE.
TRinity 6-4110

IN ELECTRONIC MARKETING!



ELECTRONIC INDUSTRIES

Chilton Company Executive Offices:
56th & Chestnut Sts., Phila. 39, Pa.
SHerwood 8-2000

Circle 137 on Inquiry Card, page 149

Industry News

Fred H. O'Kelley will be working with Original Equipment Manufacturers in his new position of Eastern Regional Manager for Raytheon Mfg. Co. for sales of receiving tubes, industrial tubes and semiconductor devices. Other appointments at Raytheon include **Joseph J. Grabiec,** formerly tube Sales Manager for the Lansdale Tube Co. to Marketing Manager of the Receiving Tube Div.; and **George Loomis,** formerly with Sylvania's Burlington, Iowa, Receiving Tube plant, to Manufacturing Manager at the same division.

Donald F. Wentzler and **Edward J. Felesina** have been appointed Director of Planning and Organization and Director of Public Relations and Advertising, respectively, at ITT Laboratories.

John W. Dawson has joined D. S. Kennedy & Co. as Staff Special Assistant to the President. Mr. Dawson is transferring from the Special Tube Operations of Sylvania Electric Co., Williamsport, Pa., where he was Chief Engineer.

NEREM—1958

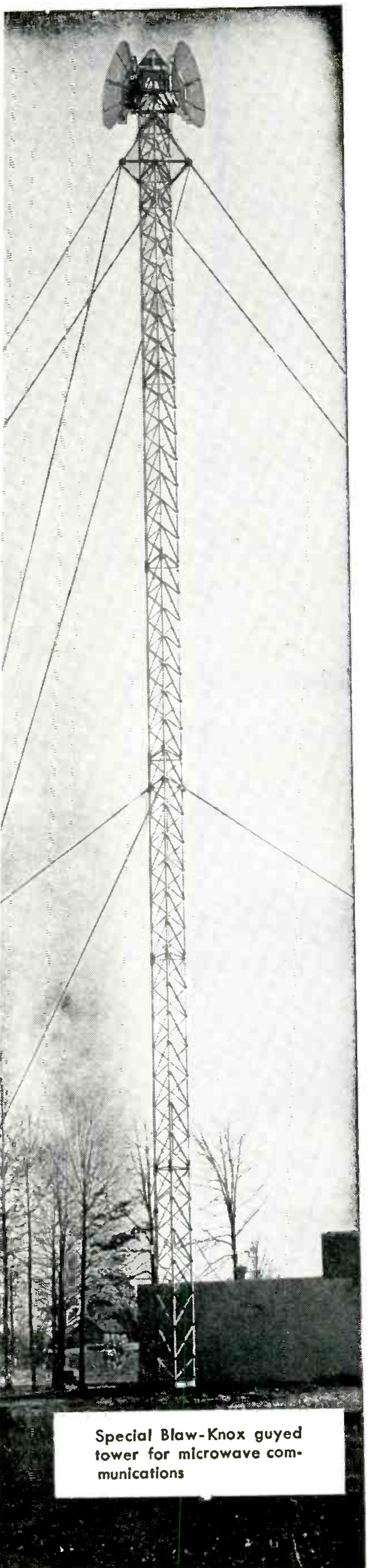
The Northeast Electronics Research and Engineering Meeting, scheduled for November 19-20 at Mechanics Hall in Boston, will feature: "Today's Electronic Developments—Tools for Tomorrow." Original papers will be given on computers, components, techniques circuits, reliability and testing, electron devices, information theory, and technical information. Of broader interest will be a session on inventions and patents from the inventor's point of view, the commercial point of view, and from the legal point of view.

Over 200 exhibitors have signed up to exhibit, and many new products, and developments promise to be on display. All of the exhibits and technical sessions will be in Mechanics Hall, and it is anticipated that over 6,000 will attend. The doors will be open from 9:00 A.M. to 10:00 P.M. on Wednesday, November 19, and from 9:00 A.M. to 6:00 P.M. on Thursday, November 20. An all-industry cocktail party will be held at the hall after the exhibits close.

NEREM is sponsored jointly by the Boston, Connecticut, and Western Massachusetts sections of the IRE.

Planning better communications?

Microwave may be the answer ...and Blaw-Knox has the towers



Special Blaw-Knox guyed tower for microwave communications

Improved service, reduced maintenance, and economy records of pioneer microwave installations are responsible for many companies planning new communications paths through the sky. Quite possibly, microwave can best answer your growth problems, and Blaw-Knox can best answer your tower questions.

Blaw-Knox Microwave Tower designs are based on more than 40 years of experience in building towers. For example:

- The first Blaw-Knox Towers, four 300′ self-supporting towers erected over 40 years ago in Alaska, still stand in good service.

- The world's first atom bomb was supported by a Blaw-Knox Tower, ushering in the Atomic Age at Alamogordo, New Mexico, in 1945.

- First electronic contact was made with outer space by a radar signal to the moon, beamed from a Blaw-Knox Tower.

From such varied experience as this, Blaw-Knox engineers are well qualified to design and engineer the type of tower system that will best meet your present and future requirements. Blaw-Knox Microwave Towers meet or surpass government standards and recommendations of the Radio-Electronics-Television Manufacturers Association for safety, wind loading and quality of construction.

Get the full story of Blaw-Knox Tower design, engineering and fabrication services. Write today for your free copy of new Bulletin 2538.

Type ML-210 Blaw-Knox self-supporting tower for microwave communications

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania

MICROWAVE TOWERS
Guyed and self-supporting Microwave Towers, custom-built for each installation ... and Transmission Towers ... Antenna Towers—guyed and self-supporting for AM-FM-TV, Radar ... parabolic antennas and other special structures

Circle 77 on Inquiry Card, page 149

Directory of Microwave Manufacturers

(*Continued from page 99*)

2-3-4-5-8-9-10-11-14-15-19-21-22-24-25-30-31—**Microwave Development Labs** 92 Broad St Babson Park Mass

9-13-31—**Microwave Eng'g Labs Inc** 943 Industrial Ave Palo Alto Calif

1-2-3-4-5-11-14-15-30—**Model Eng'g & Mfg Inc** 50 Fredericks St Huntington Ind

3-8-13-31—**Monogram Precision Industries Inc Cascade Research Div** 53 Victory Lane Los Gatos Calif

1-3-4-5-9-10-11-23-25-28—**Narda Microwave Corp** 118-160 Herricks Rd Mineola NY

27—**New England Transformer Co** 47 McGrath Hwy Somerville 43 Mass

1-10-20-23-30 — **Nicholas Products Co** 325 W Main St Moorestown NJ

27—**Nothelfer Winding Labs Inc** 5 Albermarle Ave Trenton 8 NJ

1-2-3-6-8-9-10-11-13-14-15-19-24-25-27-30-31—**N R K Mfg & Eng'g Co** 4601 W Addison St Chicago 41 Ill

1-2-10-11—**Nuclear Products-Erco Div ACF Industries Inc** Riverdale Md

9-27—**N Y T Electronics Inc** 2927 N Ontario St Burbank Calif

1-2-3-4-11-20-21-22-23-25—**Omega Labs Inc** Haverhill St Rowley Mass

27—**Osborne Electronics Corp** 712 S E Hawthorne Blvd Portland 44 Ore

26—**Parker Metal Goods Co** 85 Prescott St Worcester 5 Mass

1-2—**Paul & Beekman** 1801 W Courtland St Philadelphia 40 Pa

1-2-18-25—**Philco Corp G & I Div** 4700 Wissahickon Ave Philadelphia 44 Pa

25—**Philco Corp** Tioga & C Sts Philadelphia 24 Pa

1-2-3-5-9-17—**Polarad Electronics Corp** 43-20 34th St Long Island City 1 NY

3-4-5-8-10-13-14-15-16-17-22-23-25-28 — **Polytechnic Research & Development Co** 202 Tillary St Brooklyn 1 NY

1-2-3-4-5-6-11-17—**Polytronic Research Inc** 7660 Woodbury Dr Silver Spring Md

29-30 — **Portchester Instrument** 114 Wilkins Port Chester NY

1-2-3-4-5-8-9-11-14-15-19-24-31 — **Premier Instrument Corp** 52 W Houston St New York 12 NY

2—**Press Wireless Labs Inc** 25 Prospect Place W Newton 65 Mass

1-26—**Prodelin Inc** 307 Bergen Ave Kearny NJ

1—**Production Research Corp** Thornwood NY

26—**Pye Canada Ltd** 82 Northline Rd Toronto 16 Ont Canada

1-2-4-18-29-30 — **Pye Telecommunications Ltd** Newmarket Rd Cambridge England

1 — **Q-Line Mfg Corp** 1562 61st St Brooklyn 19 NY

1-2-3-4-5-8-9-11-17-20-22-23-24-25-28 — **Radar Design Corp** 2360 James St N Syracuse 12 NY

1-11—**Radiation Eng'g Labs** Main St Maynard Mass

1-6—**Radiation Inc** P O Box 37 Melbourne Fla

1—**Radiation Activities Inc** 119 Dawson Ave Boonton NJ

1-26—**Radio Corp of America Commercial Electronics Prod** Front & Cooper Sts Camden NJ

1-2-3-5-6-8-16-18-25 — **Radio Corp of America Communications Products Dept** Bldg 1-15 Camden NJ

8-19—**Radio Eng'g Labs** 29-01 Borden Ave Long Island City 1 NY

1-2-5—**Ramo-Wooldridge Corp Electronic Instrumentation Div** P O Box 8405 Denver 10 Colo

16—**Raytheon Mfg Co Receiving & Cathode Ray Tube Operations** 55 Chapel St Newton 58 Mass

1-27—**Raytheon Mfg Co** 100 River St Waltham 54 Mass

1-27 — **Raytheon Mfg Co Commercial Equip Div** 100 River St Waltham 54 Mass

17—**Rea Co J B** 1723 Cloverfield Blvd Santa Monica Calif

3-15—**Reeves Instrument Corp** Roosevelt Field Garden City NY

17—**Resdel Eng'g Corp** 330 S Fair Oaks Ave Pasadena Calif

27—**R-K Mfg Co** P O Box 112 Marion Ill

30—**Roflan Co** Topsfield Mass

26—**Rosten Corp** 5660 59th St Maspeth 78 NY

1-2-3-4-5-8-9-11-13-14-15-20-22-23-24-25-27-31—**Sage Labs Inc** 159 Linden St Wellesley 81 Mass

1-2-8-9-18-24-25—**Sanders Assocates** 95 Canal St Nashua NH

1-5-6—**Scientific Atlanta Inc** 2162 Piedmont Rd NE Atlanta 9 Ga

26—**Seismograph Service Corp** 6200 E 41st St Tulsa 1 Okla

25—**Sierra Electronic Corp** 3885 Bohannon Dr Menlo Park Calif

17 — **Solarton Electronic Corp Ltd** Queens Rd Ditton Surrey England

26—**Spaulding Products Co** 550 W Barner St Frankfort Ind

10-30 — **Specialty Automatic Machine Corp** 80 Cambridge St Burlington Mass

5—**Spectralab Instruments** 404 N Halstead Ave Pasadena Calif

1-2-3-4-5-8-9-11-13-14-15-18-19-20-22-23-24-25-27-28-31—**Sperry Gyroscope Co Microwave Electronics Div** Great Neck NY

1-18—**Spincraft Inc** 4122 W State St Milwaukee 8 Wisc

1—**Spinform Inc** 65 Mechanic St Attleboro Mass

1-26—**Stainless Inc** 3 St North Wales Pa

2-5-8-9-27—**Standard Electronics Div Radio Eng'g Labs** 30th & Borden Sts Long Island City NY

27—**Standard Winding Co** 44 Johnes St Newburgh NY

1—**Stavid Eng'g Inc** U S Route 22 Plainfield NJ

1—**Summit Industries Inc** 2104 W Rosecrans Ave Gardena Calif

1—**Swedlow Plastics Co** 6986 Bandini Blvd Los Angeles 22 Calif

8-13—**Sylvania Electric Products Inc** 500 Evelyn Ave Mountain View Calif

1—**Sylvania Electric Products Co Electric Systems Div** 100 1st Ave Waltham 54 Mass

1-2-4-9-13-23-24—**TA-Mar Inc** 11571 W Jefferson Blvd Culver City Calif

1—**Tarzian Inc Sarkes** 415 N College Ave Bloomington Ind

2-5—**Taurus Corp** 8 Cornell St Lambertville NJ

1-9—**Technical Appliance Corp** 1 Taco St Sherburne NY

1-2-3-4-5-8-9-11-14-15-20-21-23-24-28-29-30-31 — **Technicraft Labs Inc** Thomaston-Waterbury Rd Thomaston Conn

(*Continued on page 146*)

Microwave Directory

(*Continued from page 144*)

3-9—**Techniques Inc** 52 Jackson Ave Hackensack NJ
17—**Tele-Dynamics Inc** 51st & Parkside Ave Philadelphia Pa
1-3-8-9-17-25—**Telectro Industries Corp** 35-18 37th St Long Island City 1 NY
1-2-3-4-5-6-8-9-10-11-14-15-17-21-27-28-29-30-31—**Telerad Mfg Corp** Route 69 Flemington NJ
1-2-3-4-5-8-9-11-14-15-20-23-24-25-27-29-30-31 — **Telerad Mfg Corp** 1440 Broadway New York 18 NY
26—**Tele-Vue Towers Inc** 701 49th St St Petersburg Fla
26—**Telrex Labs** Asbury Park NJ
1—**Temco Aircraft Corp** P O Box 6191 Dallas 2 Texas
1-20—**Texas Instruments Inc** 6000 Lemmon Ave Dallas 9 Texas
26—**Thomas Mold & Die Co** 249 W Henry St Wooster Ohio
24-31—**Thompson Products Inc Electronic Div** 2196 Clarkwood Rd Cleveland 3 Ohio
27—**Thordorson Meissner Mfg Div Maguire Industries Inc** 7th & Belmont Mt Carmel Ill
29—**Titeflex Inc** Hendee St Springfield 4 Mass
1-18-26—**Tower Construction Co** 2700 Hawkeye Dr Sioux City 2 Iowa
3—**Trad Television Co** 1001 First Ave Asbury Park NJ
1—**Transco Products Inc** 12210 Nebraska Ave Los Angeles 25 Calif
17—**Transitron Inc** 186 Granite St Manchester NH
9-27—**Transonic Inc** 808 16th St Bakersfield Calif
26—**Tricraft Products Corp** 1124 W Newport Ave Chicago 22 Ill
26—**Trilsch Inc John D** P O Box 14201 Houston 21 Texas
25—**Tru-Connector Corp** 416 Union St Lynn Mass
26—**Tru-Ex Tower Corp** 127 E Inyo St Tulare Calif
26—**Truscon Steel Div Republic Steel Corp** Youngstown 1 Ohio
27—**Union Electric Products Co** 24 Edison Pl Newark 2 NY
3—**Union Electronics & Machine Corp** 71 Broadway Wakefield Mass
1-2-3-4-5-8-9-10-11-14-15-20-22-23'-25-28-30-31—**Uniwave Inc** 109 Marine St Farmingdale NY
1—**U S Testing Co** 1415 Park Ave Hoboken NJ
3-17—**Van Norman Industries Inc Electronics Div** 186 Granite St Manchester NH
27—**Varo Mfg Co** 2201 Walnut St Garland Texas
2-3-5—**Vectron Inc** 1611 Trapelo Rd Waltham 54 Mass
26—**Vesto Co** 20th & Clay Sts N Kansas City 16 Mo
1-2-3-4-5-8-9-10-11-13-16-17-20-25-30—**Victor RF & Microwave Co** 36 W Water St Wakefield Mass
2-3-4-20-22-24-25-30—**Wacline Inc** 35 S St Clair St Dayton 2 Ohio
5—**Waldorf Instrument Co Div F C Huyck & Sons** Park Ave Huntington Sta NY
2-3-4-8-10-11-15—**Walworth Co** 750 3rd Ave New York 17 NY
5—**Warren Mfg Co** Newton Rd Littleton Mass
1-2-4-9-11-15-20-24-25-28-31 — **Waveguide Inc** 14837 Oxnard St Van Nuys Calif
1-2-3-4-5-6-8-10-11-14-15-17-18-19-20-21-22-23-25-27-28-29-30-31—**Waveline Inc** P O Box 718 Caldwell NJ
17—**Wayne-Kerr Instrument** P O Box 801 Philadelphia 5 Pa
3-25—**Weinschel Eng'g** 10530 Metropolitan Ave Kensington Md
1-5 — **Westbury Electronics Inc** 300 Shames Dr Westbury NY
2-9-25 — **Westinghouse Electric Corp** P O Box 868 Pittsburgh 30 Pa
1-5-9-10-11-16-17-18-20-23-27-28-30 — **Weymouth Instrument Co** 1440 Commercial St E Weymouth 89 Mass
3-8-16—**White Electron Devices Inc Roger** 92 4th Ave Haskell NY
26—**Wind Turbine Co** E Market St & R R W West Chester Pa
1-18—**Zenith Plastics Co** 1600 W 135th Gardena Calif

RECEIVERS, MICROWAVE

ACF Industries — Nuclear Products — Erco Div 48 Lafayette St Riverdale Md
Admiral Corp 3800 W Cortland St Chicago 47 Ill

(*Continued on page 158*)

At U. S. Air Force bases of operation, Kleinschmidt page printers and reperforator teletypewriters receive and transmit printed messages at speeds up to 100 words per minute.

Instant and precise communications between Air Force bases is a prime requisite in this era of supersonic speeds. To meet this essential need, Kleinschmidt teletypewriters and related equipment, developed in cooperation with the U. S. Army Signal Corps, provide fast transmission and receipt of printed communications. There is no time-lag for interpretation, no chance of misunderstanding, since both sender and recipient have identical printed originals . . . instantly.

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.

Model 150 Page Teleprinter
Transmits and receives teleprinted messages at pre-set speeds of 60, 66, 75 or 100 words per minute. Uses roll or fanfold paper. "Semi-rev" operation, whereby shafts rotate only a half-revolution, reduces maintenance, prolongs life of unit.

Model 120 Typing Reperforator—Tape Transmitter
This versatile unit receives and transmits messages in perforated tape form and permits reproduction, editing and preparation of tape, as well as manual keyboard transmission.

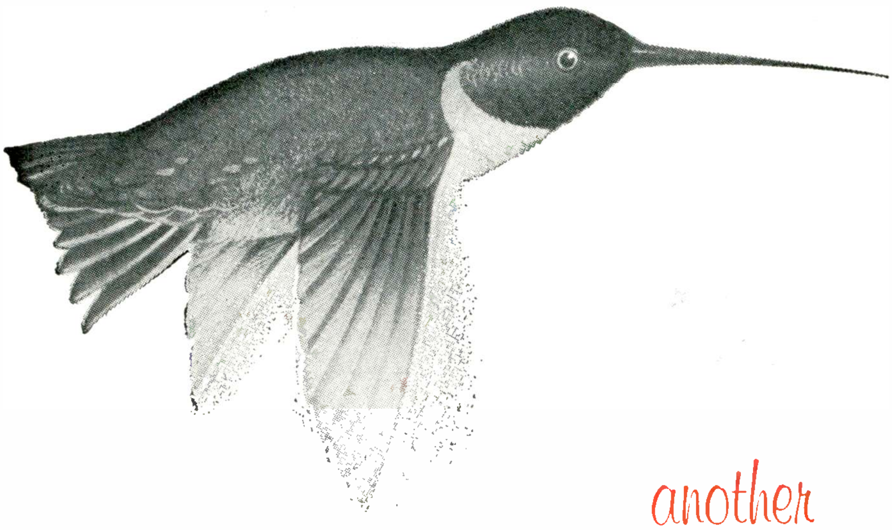
KLEINSCHMIDT

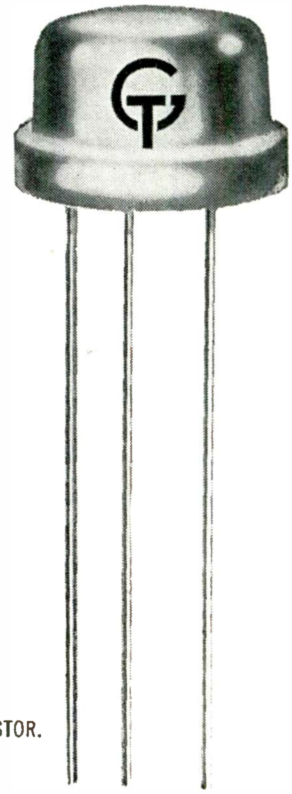
DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILL.

Pioneer in teleprinted communications systems and equipment since 1911

Circle 81 on Inquiry Card, page 149

ready to go in either direction





another

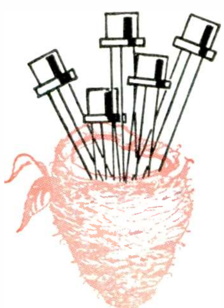
QUALITY PRODUCT FROM GENERAL TRANSISTOR.

NEW PNP AND NPN BILATERAL TRANSISTORS HAVE EMITTER AND COLLECTOR INTERCHANGEABILITY

General Transistor has developed another new transistor series —the Bilateral PNP 2N592, 2N593 and NPN 2N594, 2N595, 2N596. These germanium alloyed junction transistors have been designed to allow current to flow in either direction— valuable in medium speed switching applications as in computers, communications equipment, multiplexing devices, and for bi-directional switching and phase detection systems.

The characteristics of these transistors are guaranteed in both directions. Their symmetrical design allows extremely low saturation resistances and switching properties. Ordinary uni-directional types lack this advantage. The NPN types have an alpha cutoff frequency range of 1.5 to 10.0 megacycles.

For complete technical specifications write for illustrated brochure G-170.



GENERAL TRANSISTOR CORPORATION

91-27 138TH PLACE. JAMAICA 35. NEW YORK

In Canada: Desser E-E Ltd., 441 St. Francis Xavier, Montreal 1, Quebec
FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP. 95-27 SUTPHIN BLVD. JAMAICA 35, NEW YORK FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP. 91-27 138TH PLACE JAMAICA 35, NEW YORK

Circle 82 on Inquiry Card, page 149

GET THE FACTS!

USE THIS FREE READER SERVICE CARD

Keep up to date—get the facts about the new products and equipment as they hit the market. ELECTRONIC INDUSTRIES' advertisers will be glad to send you complete literature giving specifications and data relating to those products advertised in this issue. To help you, the new product items, new literature and advertisments in this issue are numbered consecutively, from the front to the back of the book. The extra cards are for the use of your associates with whom you share your copy of ELECTRONIC INDUSTRIES.

Mail Card Below Today For Quick Information On New Products Described in This Issue. No Postage Needed.

FIRST CLASS
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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.

Circle the item number, fill in your name, title, company; detach and mail.

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **NOV. 1958**

Please send me further information on the items I have circled below. 2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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YOUR NAME .... TITLE ....

FIRM ....

FIRM ADDRESS ....

CITY or TOWN .... ZONE .... STATE ....

ALPHABETICAL LISTING OF

CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

122 Aircraft Radio Corp.—Connectors
130 Alden Products Co.—Lighted indicating switch
126 Alford Manufacturing Co., Inc.—Impedance slotted lines
88 Allied Control Company, Inc.—General purpose relay
96 Allen-Bradley Co.—resistors
117 Alpha Wire Corp.—Lacing cords
113 Alpha Wire Corp., Alphlex Dix.—Custom tubing
34 American Electrical Heater Co.—Electric soldering iron
43 American Photocopy Equipment Co.—Copy reproducer
93 American Time Products, Inc. — Frequency standards
67 Amperex Electronic Corp.—Broadband amplifier pentode
14 AMP Incorporated—Printed circuit edge connector
98 Amperite Co., Inc.—Delay relays & ballast regulators
100 Andrew Corporation—Air dielectric cable
84 Armco Steel Corporation — Nickel-Iron magnetic alloys
20 Arnold Engineering Company — Aluminum-cased tape cores
70 Artos Engineering Co.—Wire-measuring, cutting & stripping machine
75 Astron Corporation—Capacitors
39 Berkeley Division, Beckman Instruments, Inc.—Digital frequency counter
124 Biwax Corporation—Potting compounds
77 Blaw-Knox Company—Microwave towers
64 Bogart Manufacturing Corporation — Dummy loads
118 Booker & Wallestad, Inc. — Custom-molded miniature plastic parts
103 Borg Equipment Div., The George W. Borg Corp.—Engineering research & production facilities
104 Borg Equipment Div., The George W. Borg Corp.—Microdials
127 Bruno-New York Industries Corp.— "Pig-tailoring" machine
18 Brush Instruments Division of Clevite Corporation—Recorder
37 Burnell & Co., Inc.—Crystal filters
27 Bussmann Mfg. Division, McGraw-Edison Co.—Sub-miniature fuses
94 Cannon Electric Company—Audio plugs
9 Cedco Electronics — Metallic rectifier analyzers
80 Centralab A Division of Globe-Union, Inc.—Ultra-miniature capacitors
41 Cinch Manufacturing Corporation—Subminiature connectors
13 Cleveland Container Co., The—Phenolic tubing
111 Connecticut Hard Rubber — Silicone sponge rubber
125 Columbian Carbon Company, Mapico Color Unit—Ferric oxides for ferrites
54 Conrac, Inc.—Audio-video tuner, color & monochrome monitors
73 Corning Glass Works—Trimmer capacitor
15 Dale Products Inc.—Power resistors
16 Dale Products, Inc.—Hermetically sealed resistors
72 Delco Radio Division of General Motors —High power transistors
121 Designers for Industry — Transistorized frequency standards
86 Deutsch Company, The—Miniature connectors
131 Dorne & Margolin, Inc.—Missile and aircraft antennas
134 Eisler Engineering Co.—Welding machine
69 Eitel-McCullough, Inc.—Ceramic tubes
74 Elco Corporation—Connectors, printed circuit components
19 Electra Manufacturing Co., Electronics Div.—Precision metal film resistor
109 Engineered Ceramics Manufacturing Company—Ceramics
129 Film Capacitors, Inc.—Capacitors
99 Filtors, Inc.—Sub-miniature relays
136 Freed Transformer Co., Inc.—Magnetic amplifiers
59 Frequency Standards, Inc.—Standards
24 General Chemical Division, Allied Chemical Corp.—"Electronic Grade" Chemicals
82 General Transistor Corporation — Bilateral transistors
32 G-L Electronics—Tape wound cores
119 Graphic Systems—Visual control system
95 GRH Halltest Company—Magnetic test equipment
2 G-V Controls Inc.—Thermal time delay relays
53 Houston Fearless Corporation—16 mm Black & White film processor
110 Howard Industries Inc.—Induction motor
36 Hughes Products, Hughes Aircraft Company—Silicon capacitor
63 Hughes Products, Hughes Aircraft Company—Microwave tubes
17 Indiana Steel Products Company—Ceramic magnets
47 Induction Motors Corp. — Lightweight aircraft blower
25 International Electronic Research Corp. —Heat-dissipating tube shields
108 Johnson Company, E. F.—Tip jacks
116 Jones Division, H. B., Cinch Manufacturing Co.—Terminal panels
90 Joy Manufacturing Company—Vaneaxial-type fans
8 Kester Solder Company—Flux-core solder
81 Kleinschmidt Division of Smith-Corona Merchant Inc.—Teleprinted communications systems
56 Lifschultz Fast Freight—Freight forwarding
71 Litton Industries, Electron Tube Division—Miniature magnetron
87 MacDonald & Company—Sleeving cutter
66 McMillan Laboratory, Incorporated — Microwave absorbers
120 Measurements A McGraw-Edison Division—Vacuum tube voltmeter
112 Methode Manufacturing Corporation—Printed circuits
115 Mica Importers Association—Mica
133 Microphase Corporation—Filters
38 Minnesota Mining & Mfg. Co.—Instrumentation tape
33 Mullard Ltd., Electronic Tubes—Thyratron
62 Narda Microwave Corporation, The—Coaxial test equipment
97 Narda Ultrasonics Corporation, The, Subsidiary of The Narda Microwave Corp.—Ultrasonic cleaning equipment
26 Ohmite Manufacturing Company—Precision resistors
55 Onan & Sons, Inc., D. W.—Power plant for mobile broadcasting
28 Packard Bell Computer Corp. A Subsidiary of Packard Bell Electronics—Special purpose computer
85 Panoramic Radio Products, Inc.—SSB test equipment
128 Patwin, A Division of The Patent Button Company—Digital readout indicator
49 Phelps Dodge Copper Products Corp.—Coaxial cable
114 Philbrick Researches, Inc., George A.—DC Amplifier
42 Polarad Electronics Corp.—
83 Polytechnic Research & Development Co., Inc.—Klystron power supplies
1 Radio Materials Corporation—Disc capacitors
3 Raytheon Manufacturing Company — Magnetron oscillator
4 Raytheon Manufacturing Company — High-alumina ceramic stem assemblies for semiconductors
5 Raytheon Manufacturing Company — Miniature feed-throughs
6 Raytheon Manufacturing Company — Backward wave oscillator
7 Raytheon Manufacturing Company — Microwave tube data booklet
50 Raytheon Manufacturing Company — Microwave relay system
65 Red Bank Division, Bendix Aviation Corporation—Backward wave oscillator tube
132 Rheem Manufacturing Co., Electronics Div.—General purpose meter

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Please send me further information on the items I have circled below. 1

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ADVERTISERS IN THIS ISSUE

ADVERTISERS FROM WHOM YOU DESIRE FURTHER INFORMATION

107 Rohn Manufacturing Co.—Communication tower
11 Scintilla Division, Bendix Aviation Corporation—Electrical connectors
52 Secode Corporation—Selective control devices
21 Spectrol Electronics Corporation—Converter-inverters
60 Sperry Microwave Electronics Co., Div. of Sperry Rand Corp.—Microwave receiver
35 Sprague Electric Company—Ceramic insulated resistors

PROFESSIONAL ENGINEERING OPPORTUNITIES

Circle number of company on card at right from whom you desire further information.

501 Hughes Aircraft Company—Engineering personnel
502 System Development Corporation—Engineering personnel
503 McDonnell Aircraft Corporation—Engineering personnel
505 Melpar Incorporated—Engineering personnel
507 International Telephone & Telegraph Corp., ITT Industrial Products Div.—Engineering personnel
508 Garrett Corporation — Engineering personnel

40 Sprague Electric Company—Transistors for computer circuitry
22 Stackpole Carbon Company, Electronic Components Div.—Resistors
51 Stainless, Inc.—Stock tower sections
78 Stewart Engineering Company—Backward wave oscillator tube
58 Sylvania Electric Products Inc., Special Tube Operations—Microwave components
57 Sylvania Electric Products Inc.—Microwave relay klystrons
46 Sylvania Electric Products Inc.—Switching transistors
10 Synthane Corporation—Laminated plastics
123 Syntronic Instruments Inc.—Deflection yokes
23 Tektronix, Inc.—Fast-rise oscilloscope
45 Telechrome Manufacturing Corp.—TV test signal keyer
48 Tensolite Insulated Wire Co., Inc.—High temperature hook-up wire
44 Triplett Electrical Instrument Company—Meters
12 Texas Instruments Incorporated—Germanium power transistors
81 Tung-Sol Electric Inc.—Hydrogen thyratron
30 United States Gasket Plastics Division of Garlock—Plastics parts
91 United Transformer Corporation—Filters
105 University Loudspeakers, Inc.—Loudspeaker systems
106 University Loudspeakers, Inc. — Ultra linear response systems
76 Victoreen Instrument Company, The—High voltage regulators
92 Waters Manufacturing, Inc.—Miniature precision potentiometer
68 Waveline Inc.—Microwave instruments and components
102 Westinghouse Electric Corporation, Electronic Tube Div.—VHF beam-power pentodes
136 West Texas Utilities Company—Industrial opportunities

NEW PRODUCTS

162 "A" Frame for Reflectors—Gabriel Electronics
170 Adapters, coax to waveguide — Temco Aircraft Corp.
161 "Atomic" Amplifier—Philco Corp.
184 Amplifier, TWT—Varian Assoc.
205 Analyzer, spectrum—Polarad Electronics
173 Antenna, scimitar—Tamar Electronics
172 Antenna, "TEW" radar—Sperry Gyroscope Co.
169 Attenuator, precision waveguide—Dymec, Inc.
270 Blower motor—Western Gear Corp.
178 Broad Band Ridged Horns — Diamond Antenna & Microwave Corp.
269 Calorimeter—Chemalloy Electronic Corp.
258 Capacitors, P-C—Cornell-Dubilier Electric Corp.
262 Converter, DC-DC—Communications Accessories Co.
253 Delay Lines—JFD Electronics Corp.
273 Diode, zenor — International Rectifier

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 199 of this issue.

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **NOV. 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

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YOUR NAME ....TITLE............

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New Products and Technical Data—November '58

183 Envelopes, traveling wave — Corning Glass Works
272 Fasteners—Tinnerman Products, Inc.
163 Filter, image-rejection—Airtron, Inc.
175 Filter, octave bandpass—Melabs, Inc.
180 Filter, waveguide—Hewlett-Packard
271 Gauge, miscut—Eldorado Electronics
260 Generator, hall—GRH-Halltest Co.
208 Generator, reference—Manson Labs.
254 Inverters—Varo Manufacturing Co., Inc.
177 Meters, frequency—Polytechnic Research and Development Co., Inc.
267 Microdial, lightweight—George W. Borg
176 Microwave Beacon, S-band—Resdel Engineering Corp.
264 Microvolt-Ammeter—Hewlett-Packard
179 Microwave system, multichannel—Ling Systems, Inc.
250 Modules, audio—Packard-Bell Electronics
268 Monitor, gamma-beta — Borg-Warner
265 Photometer, pollution—Phoenix Precision Instrument Co.
263 Potentiometer—Beckman Instruments
248 Power Supply—Canoga Corp.
247 Receiver, pocket—Motorola, Inc.
203 Receiver, wide-band—Granger Assoc.
206 Rectifier, silicon—Sarkes Tarzian, Inc.
171 Repeater, heterodyne—Adler Electronics
182 River Radar, X-band—Raytheon Mfg. Co.
207 Rotator, Antenna — Houston Fearless
167 Shield, TWT—Perfection Mica Co.
164 Shutter, rotary waveguide — Microwave Assoc.
165 Slotted Line—Sage Labs., Inc.
266 Slotted Sections—Waveline, Inc.
181 Switch, coaxial—Alford Mfg. Co.
256 Switch, P-C—P. R. Mallory & Co.
168 Switches, waveguide—N.R.K. Mfg. & Engineering Co.
261 Synchros with pointer—Clifton Precision Products Co.
259 Terminal blocks—DeJur-Amsco Corp.
249 Tower, antenna—Rohn Manufacturing
255 Transformers—Microtran Co., Inc.
251 Transistors—General Electric Co.
262 Transistor, silicon — Transitron Electronic Corp.
246 Transmitters, broadcast—RCA
257 Voltmeter, electronic — Consolidated Electrodynamics Corp.
166 Waterload, waveguide—Bomac Labs.
174 Wattmeter, X-band microwave—Wayne Kerr Corp.
204 Zippertubing—Zippertubing Co.

NEW TECH DATA

190 Absorbents, microwave—B. F. Goodrich
219 Actuators, solenoid controlled—Waldorf Fluid Systems
242 Amplifiers, magnetic—Brach Mfg. Corp.
226 Amplifiers, packaged—George A. Philbrick Researches, Inc.
195 Cables, high frequency—General Cable
212 Capacitors—Vitramon, Inc.
218 Capacitors, tantalum — Fansteel Metallurgical Corp.
211 Ceramics, alumina—Coors Porcelain Co.
231 Coil, focus—Syntronic Instruments, Inc.
145 Components—Alford Mfg. Co.
196 Components, ceramic—Ceramatronics
140 Components, microwave — Sage Labs., Inc.
187 Components, radar waveguide — Radar Design Corp.
197 Components, waveguide—Aircom, Inc.
214 Computer, digital control — Thompson-Ramo-Wooldridge Products Co.
216 Connectors—The Deutsch Co.
143 Detector, null—Weinschel Eng'g Co.
220 Diode, 4-layer — Shockley Transistor Corp.
200 Equipment, microwave — Sperry Microwave Electronics Co.
186 Equipment, terminal—General Electric
237 Fibre fabrication—Taylor Fibre Co.
243 Filters, crystal—Hycon Eastern, Inc.
194 Folded hybrid T's—Microwave Development Labs., Inc.
146 Handbook, antenna—I.T.E.
202 Instrumentation—Menlo Park Engineering
240 Instruments, thermocouple — Sensitive Research Instrument Corp.
189 Instruments, microwave — Alfred Electronics
142 Isolators, load—Monogram Precision Industries, Inc.
201 Klystron facts—Eitel-McCullough, Inc.
245 Machines, coil winding — Geo. Stevens Mfg. Co.
234 Magnets, permanent—Schlumberger Well Surveying Corp.
223 Materials, semiconductor—Knapic Electro-Physics, Inc.
198 Measurement set-ups—Narda Microwave
238 Microwave Horns—Waveline, Inc.
233 Phase shifter theory—Theta Instrument
228 Potentiometers—Eastern Precision Resistor Corp.
210 Plugs, audio—Cannon Electric Co.
236 Relays—Magnecraft Electric Co.
209 Relays, sealed—General Electric Co.
230 Resins, insulating epoxy — Minnesota Mining & Mfg. Co.
221 Resistors, power—Ohmite Mfg. Co.
232 Resistors, precision—General Transistor
193 Rotary joint—I.T.E. Circuit Breaker Co.
199 Spinning vs stamping—Spincraft, Inc.
213 Stampings—Templet Mfg. Co.
241 Switch, miniature selector—G. H. Leland, Inc.
215 Synchro applications—Muirhead & Co.
235 Synchros & resolvers—Induction Motors
191 System, tone transmission—RCA
188 Systems, r-f & multiplex—Collins Radio
185 Systems & theory, microwave — Philco
147 Test set, propagation—Radio Engineering Labs., Inc.
141 Test Instruments—Ealing Corp.
244 Testing, acoustical vibration — Tototest Labs.
144 Theory, TWT—Hewlett-Packard Co.
227 Thermocouples—Aero Research Instrument Co.
229 Toroids & filters—Burnell & Co.
222 Transducers, pressure — Gulton Industries
217 Transformers—Chicago Standard Transformer Corp.
224 Transistors, silicon—Fairchild Semiconductor Corp.
239 Tube chart, industrial—Tung-Sol Electric, Inc.
192 Tube tools, waveguide—F. C. Kent Corp.
225 Vertical gyro—Iron Fireman Mfg. Co.

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SETTING THE PACE IN KLYSTRON

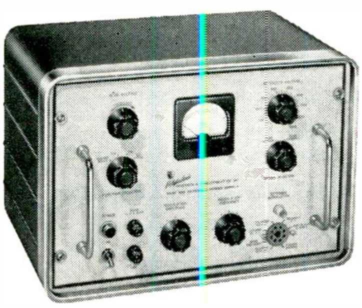
Power Supplies

on the production line or in the laboratory

a leader in the

PRD PACEMAKER LINE

For lower voltage klystron tubes, PRD type 809 Klystron Power Supply provides flexible, economical performance. Built to the same highest quality standards as type 812, this compact, low cost unit insures optimum performance of a wide variety of klystron oscillators. A clamping circuit in the reflector supply reduces the possibility of double-moding the klystron.



For use with all available klystrons in the low power range and for klystrons at power levels up to 5 watts, the completely new type 812 Universal Klystron Power Supply provides:

- widest application
- closest regulation
- greatest range
- minimum ripple and noise
- pulse, square wave, sawtooth and sine wave modulation.

PLUS THESE SPECIAL FEATURES:

- digital read-out for beam and reflector voltages.
- dual outputs for simultaneous operation of two klystrons.
- grid and reflector voltage clamped to CW level in square wave or pulse operation.
- front panel check calibration of grid and reflector voltages.
- multi-range overload protection for beam current.
- safety lock when transferring from + to – grid voltage.
- external triggering of internal pulse generator.

SPECIFICATIONS

OUTPUT		Type 812	Type 809
Beam	Volts, dc Current, ma Ripple, mv rms	200 to 3600 0-125 5 max.	250 to 600 0-65 5 max.
Reflector	Volts, dc Current, μa Ripple, mv rms	0 to —1000 50 max. 1 max.	0 to —900 50 max. 10 max.
Grid	Volts, positive negative Current, ma positive grid Ripple, mv rms	0 to 150 0 to 300 5 max. 3 max.	——
MODULATION		**Type 812**	**Type 809**
Square Wave	Frequency, cps Volts*	500 to 5000 0 to 150 (clamped)	400 to 2000 0 to 90
Pulse	Frequency, cps Volts*	500 to 5000 0 to 150 (clamped)	——
Sawtooth	Frequency, cps Volts*	40 to 120 0 to 200	60, fixed 0 to 125
Sine Wave	Frequency, cps Volts*	60, fixed 0 to 200	——

***Volts, peak to peak**

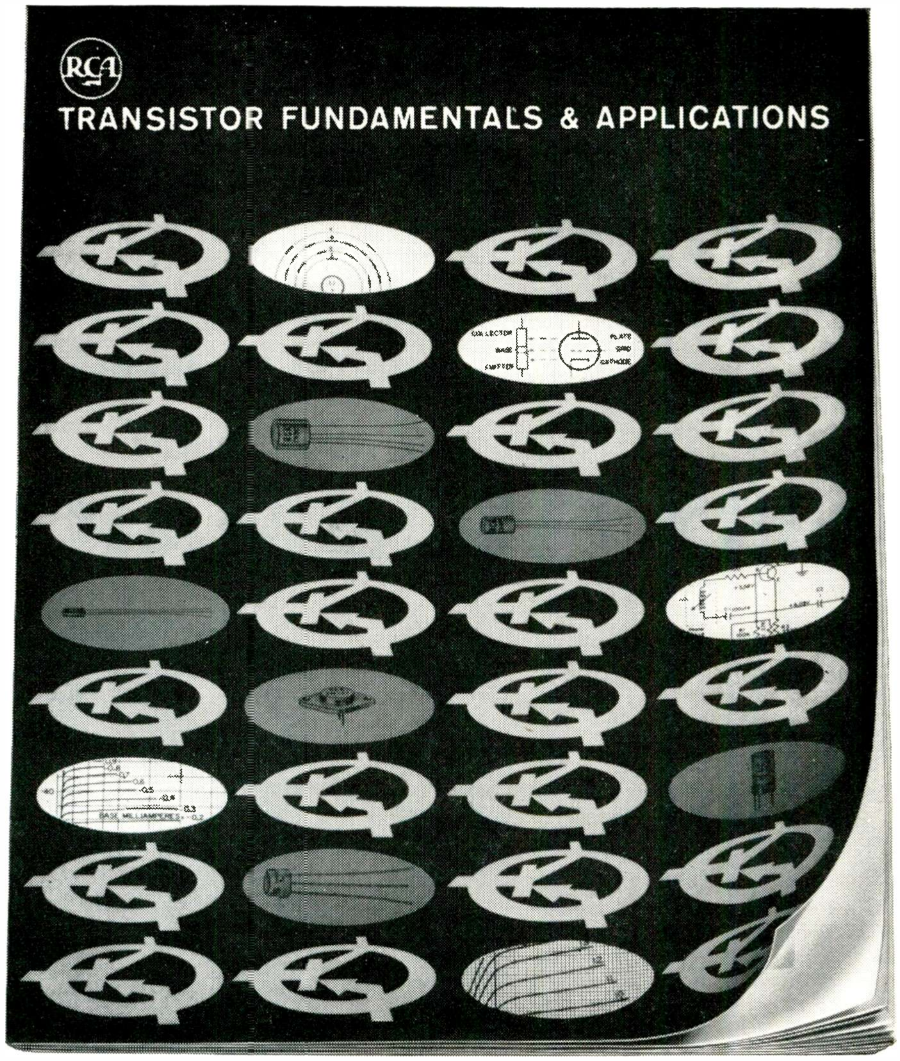
For additional details, contact your local PRD Engineering Representative or write to Technical Information Group, Dept. TIG-1.

POLYTECHNIC RESEARCH & DEVELOPMENT CO., INC.

202 Tillary Street • Brooklyn 1, N.Y.

Circle 83 on Inquiry Card, page 149

Now Available!



RCA's brand new primer...

TRANSISTOR FUNDAMENTALS & APPLICATIONS

Authoritative, condensed and easy-to-read, this new 48-page booklet contains pertinent diagrams, schematics, and tables of important technical data—all compiled in a simplified manner for busy engineers and executives who desire to broaden their knowledge of transistor theory and practice. Three quiz-pages consisting of questions and answers appear at the end of the booklet and serve as a valuable summary and review.

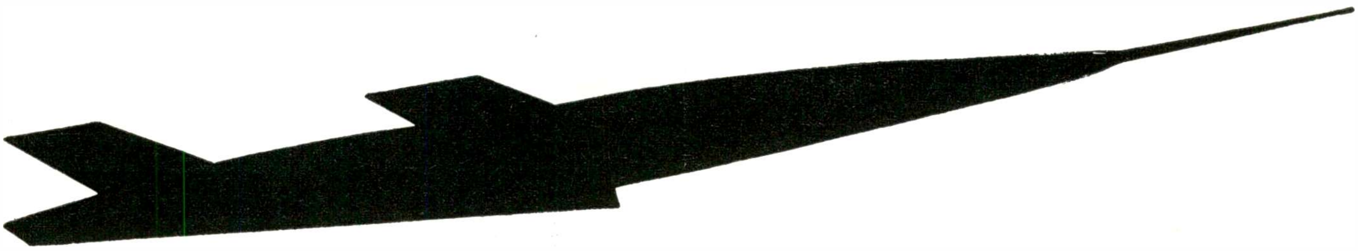
Now, for *a limited time only,* this valuable booklet will be available through your authorized RCA Semiconductor Products Distributor. See him today!

Your RCA distributor has it! (Form #4T37)

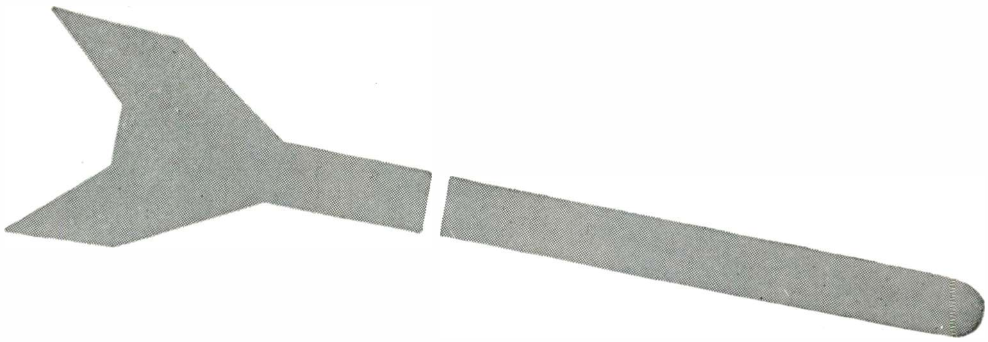
48 pages...16 sections!

1—*Introduction*
2—*Transistor Physics*
3—*The PN Junction*
4—*The PNP & NPN Junction Transistor*
5—*The Point-Contact Transistor*
6—*Transistor Characteristics*
7—*Types of Transistors*
8—*Transistor Amplifiers*
9—*Methods of Coupling*
10—*Gain Controls*
11—*Power Amplifiers*
12—*Oscillator Circuits*
13—*Power Supplies*
14—*Practical Transistor Circuits*
15—*Transistor Components*
16—*Servicing Transistor Circuits*

RADIO CORPORATION OF AMERICA
Semiconductor Products
Harrison, New Jersey



New steels are born at Armco



For Reliable Magnetic Components of Missile Guidance and Control Systems.......

Armco Nickel-Iron Magnetic Alloys

Special magnetic properties of Armco 48 Ni and 48 Orthonik assure efficient, highly reliable components for research and defense missiles and ground control units.

ARMCO 48 NI—Characterized by very high permeability at low and moderate inductions, low hysteresis loss and extremely low coercive force, 48 Ni is especially useful for gyro and synchronous motors as well as audio transformers, relays and certain types of magnetic amplifiers. It is specially processed for laminations, wound cores or special applications, and is available in 2 to 14-mil cold-reduced strip.

ARMCO 48 ORTHONIK—This special Armco Alloy combines the advantages of a rectangular hysteresis loop with very low coercive force. Precisely controlled in manufacture, cubic-structured 48 orthonik assures consistently reliable performance in magnetic amplifiers and modulators, bi-stable elements for logic circuits and reactors for electronic computers. It is supplied in the form of cold-reduced strip in thicknesses from $\frac{1}{4}$ to 6 mils.

Use the multiple advantages of Armco 48 Ni and 48 Orthonik to help assure maximum performance and reliability of magnetic components for aircraft and missiles as well as commercial and industrial electronic equipment. For hitherto unavailable design information on the 48% nickel alloys, write us for a copy of our new design manual "Armco Nickel-Iron Magnetic Alloys." Armco Steel Corporation, 2798 Curtis Street, Middletown, Ohio.

ARMCO STEEL

ARMCO

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

Circle 84 on Inquiry Card, page 149

At this year's Radio Fall Meeting in Rochester, N. Y., on October 28, 1958, the plaque above was presented to Marcus A. Acheson, Consulting Engineer, Sylvania Electric Products Co., for "his contributions in the study of reliability of electron tubes contributing to the overall reliability of electronic equipment and for his statistical studies in the field of quality control."

"Fall Meeting Awards"

SURPRISE AWARD!

At the same Radio Fall Meeting a surprise award was made to Virgil M. Graham, Director of Engineering, Electronic Industries Assn. for his long-time efforts, on behalf of the organization and as a prime mover in the industry's efforts toward standardization.

NEW! NEW! NEW!

Deutsch Miniature Connectors with "Snap-In" Contacts

300° F

NO SOLDERING

ENVIRONMENTAL

SILICONE INSERTS

QUICK DISCONNECT

Available in a wide range of shell-sizes with either pin or socket arrangements – all of them interchangeable with existing Deutsch DM5000 and DM9000 series miniature connectors. "DS" series plugs have the exclusive Deutsch designed and developed ball-lock coupling-ring . . . just push-in to connect; pull-back to disconnect.

For complete information, see your Deutsch representative or write for data file 11A.

The Deutsch Company

7000 Avalon Blvd., Los Angeles 3, Calif.

Circle 86 on Inquiry Card, page 149

Microwave Directory

(*Continued from page* 146)

Aircom Inc 354 Main St Winthrop Mass
Aircom Inc 139 E 1st St Roselle NJ
Airtron Inc 1108 W Elizabeth Ave Linden NJ
American Electronic Laboratories 121 N 7th St Philadelphia 6 Penna
American Machine & Foundry Co Defense Products Group 1101 N Royal St Alexandria Va
American Microwave Corp 11754 Vose St N Hollywood Calif
Bell Aircraft Corp PO Box 1 Buffalo 5 NY
Bolton Laboratories Inc W Main St Bolton Mass
Budelman Radio Corp 375 Fairfield Ave Stamford Conn
Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif
Collins Radio Co 855 35th St N E Cedar Rapids Iowa
Control Electronics Co Inc 1925 New York Ave Huntington Station NY
Designers For Industry 4241 Fulton Pkwy Cleveland 9 Ohio
Dynamic Electronics Inc 73-29 Woodhaven Blvd Forest Hills NY
Elk Electronics Labs Inc 333 W 52nd St New York 19 NY
Empire Product Sales Corp 37 Prospect St Amsterdam NY
Engineering Associates 434 Patterson Rd Dayton 9 Ohio
Farnsworth Electronic Co Div I T & T 3702 E Pontiac St Ft Wayne Ind
General Electric Co Communications Products Dept PO Box 1122 Syracuse NY
Goodyear Aircraft Corp 1210 Massillon Rd Akron 15 Ohio
Granger Associates 966 Commercial St Palo Alto Calif
Haller Raymond & Brown Circleville Rd State College Pa
Hazeltine Electronics Div Hazeltine Corp 59-25 Little Neck Pkwy Little Neck 62 NY
I-T-E Circuit Breaker Co Special Products Div 601 E Erie Ave Philadelphia 34 Penna
Lambda-Pacific Eng'g Inc 14725 Arminta St Van Nuys Calif
Lavoie Laboratories Inc 3171 S Bundy Dr Santa Monica Calif
Lenkurt Electric Co 1105 County Rd San Carlos Calif
Philco Corp Tioga & C Sts Philadelphia 24 Penna
Philco Corp G & I Div 4700 Wissahickon Ave Philadelpflhia 4 Penna
Polarad Electronics Corp 43-20 34th Long Island City 1 NY
Polytechnic Research & Development Co 202 Tillary St Brooklyn 1 NY
Pratt Albert 114 W Lake View Ave Milwaukee 17 Wisc
Premier Instrument Corp 52 W Houston St New York 12 NY
Production Research Corp Thornwood NY
Pye Canada Ltd 82 Northline Dr Toronto 16 Ont Canada
Pye Telecommunications Ltd Newmarket Rd Cambridge England
Radio Eng'g Laboratories 29-10 Borden Ave Long Island City 1 NY
Rauland-Borg Corp 3535 W Addison St Chicago 18 Ill
Raytheon Mfg Co Commercial Equipment Div 100 River St Waltham 54 Mass
Raytheon Mfg Co 100 River St Waltham 54 Mass
RS Electronics Corp PO Box 368 Sta A Palo Alto Calif
Scientific-Atlanta Inc 2162 Piedmont Rd NE Atlanta 9 Ga
Standard Electronics Div Radio Eng'g Labs 30th & Borden Sts Long Island City NY
Stavid Eng'g Inc U S Route 22 Plainfield NJ
Sylvania Electric Products Co Electric Systems Div 100 First Ave Waltham 54 Mass
Tarzian Inc Sarkes 415 N College Ave Bloomington Ind
Telectro Industries Corp 35-18 37th St Long Island City 1 NY
Tele-Dynamics Inc 51st & Parkside Ave Philadelphia 4 Penna
Telephonic Corp Park Ave Huntington NY
Telerad Mfg Corp Route 69 Flemington NJ
Telerad Mfg Corp 1440 Broadway New York 18 NY

(*Continued on page* 160)

FROM OUR GALLERY OF "DOUBTING THOMASES"

tall, dark, dubious, Thomas Q. Flossible

DOUBTED THAT WIRELESS EVER WAS POSSIBLE!

. . . but inventing the impossible has long been the private province of engineers like yourself. Among them are those who did help invent wireless and radio and television and automation and nucleonics.

And among them, too, was Elco — the company that invented the Varicon Connector system, which is an immeasurable contributor to all past and present electronic inventions (as well as design-stage prototypes still unannounced).

If you do not have our V2 Catalog describing the Varicon system — nor information concerning Elco's printed circuitry components (the industry's most complete and reliable), please drop us a note on your company letterhead. We will also be happy to include, upon your request, data about our tube-sockets and shields . . . plus the products shown below.

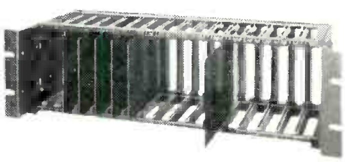
IF IT'S NEW... IF IT'S NEWS... IT'S FROM

ELCO CORPORATION

"M" St. below Erie Ave., Phila. 24, Pa., CU 9-5500

Elco-Pacific: 3260 Motor Ave., Los Angeles, Cal., TExas 0-3000

ELCO'S "VARIPAK"

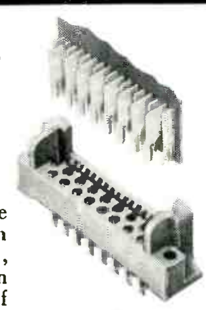


Printed circuit board enclosure for printed or etched circuitry. 78 parts may be retained with only 8 screws. For standard relay rack or standard electronic enclosure mounting. Bulletin A-1.

ELCO-PACIFIC EL SERIES

3 or 4 contact audio connector. Also available, our light-duty "B" Series. Both series are completely interchangeable with comparable units. Immediate delivery. Write for data.

ELCO'S SERIES 7000



Subminiature P. C. Varicon Connectors, for maximum number of contacts in minimum space; plus all Varicon reliability, versatility factors. Bulletin 106-B.

Circle 74 on Inquiry Card, page 149

Microwave Directory

(Continued from page 158)

Westinghouse Electric Corp PO Box 868 Pittsburgh 30 Penna
Weymouth Instrument Co 1440 Commercial St E Weymouth 89 Mass

SYSTEMS

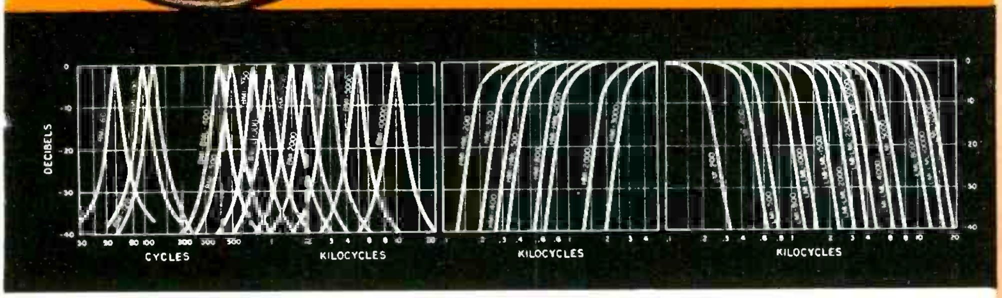
Adler Electronics Inc 1 LeFevre Lane New Rochelle NY
Airtron Inc 1108 W Elizabeth Ave Linden NJ
American Electronic Laboratories 121 N 9th St Phila 6 Penna
American Machine & Foundry Co Defense Products Group 1101 N Royal St Alexandria Va
American Microwave Corp 11754 Vose St N Hollywood Calif
Andrew Antenna Corp 606 Beech St Whitby Ont Canada
Andrew Corp 363 E 75th St Chicago 19 Ill
Antennavision Inc 2949 W Osborn Phoenix Ariz
Avion Div ACF Industries Inc 11 Park Pl Paramus NJ
Bell Aircraft Corp PO Box 1 Buffalo 5 NY
Budelman Radio Corp 375 Fairfield Ave Stamford Conn
Canadian Aviation Electronics Ltd 6214 Cote de Liesse Rd St Laurent Que Canada
Collins Radio Co 855 35th St N E Cedar Rapids Iowa
Continental Electronics Mfg Co 4212 S Buckner Blvd Dallas 27 Texas
Control Electronics Co Inc 1925 New York Ave Huntington Sta NY
Craig Systems Inc 90 Holten St Danvers Mass
Diamond Antenna & Microwave Corp 7 North Ave Wakefield Mass
Dynamics Electronics Inc 73-29 Woodhaven Blvd Forest Hill NY
Electrical Communications Inc 765 Clementine St San Francisco 3 Calif
Electronic Control Systems 2231 Barrington Ave Los Angeles 64 Calif
Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif
Empire Product Sales Corp 37 Prospect St Amsterdam NY
Fox Co Thomas J 95 Summitt St Newark NJ
F-R Machine Works Inc Electronics & X-Ray Div 26-12 Borough Pl Woodside 77 NY
Gabriel Electronics Div Gabriel Co 135 Crescent Rd Needham Heights 95 Mass
General Bronze Corp 711 Stewart Ave Garden City NY
General Communication Co 677 Beacon St Boston 15 Mass
General Electric Co Communication Products Dept PO Box 1122 Syracuse NY
Granger Associates 966 Commercial St Palo Alto Calif
Haller Raymond & Brown Circleville Rd State College Penna
Hoffman Electronics Corp 3761 S Hill St Los Angeles 7 Calif
Houston Fearless Div Color Corp of America 11801 W Olympic Blvd Los Angeles 64 Calif
Insul-8-Electronics 1369 Industrial Rd San Carlos Calif
Int'l Research Associates 2221 Warwick Ave Santa Monica Calif
I-T-E Circuit Breaker Co Special Products Div 601 E Erie Ave Phila 34 Penna
J-V-M Eng'g Co 4633 S Lawndale Ave Lyons Ill
Kearfott Co Inc 14844 Oxnard St Van Nuys Calif
Kearfott Co Inc 1378 Main Ave Clifton NJ
Lambda-Pacific Eng'g Inc 14725 Arminta St Van Nuys Calif
Lieco Inc 3610 Oceanside Rd Oceanside NY
Lenkurt Electric Co 1105 County Rd San Carlos Calif
Ling Electronics Inc 9937 Jefferson Blvd Culver City Calif
Link-Radio Corp 10 Jericho Turnpike New Hyde Park LI NY
Loral Electronics Corp 825 Bronx River Ave New York 72 NY
Mathis Co G E 6100 S Oak Park Ave Chicago 38 Ill
Maxson Corp W L 475 10th Ave New York 18 NY

(Continued on page 162)

FILTERS FOR ALL APPLICATIONS FROM STOCK

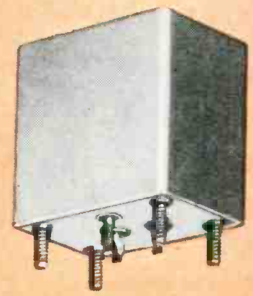
HERMETICALLY SEALED TO MIL-T-27A & MIL-F-18327

UTC INTERSTAGE AND LINE FILTERS



STOCK TYPES
(number in figure is cycles)

BMI-60	BMI-10000	LMI-800	HML-300
BMI-100	HMI-200	LMI-1000	HML-500
BMI-120	HMI-400	LMI-1500	HML-1000
BMI-400	HMI-500	LMI-2000	LML-1000
BMI-500	HMI-800	LMI-2500	LML-1500
BMI-750	HMI-1000	LMI-3000	LML-2000
BMI-1000	HMI-2000	LMI-4000	LML-2500
BMI-1500	HMI-3000	LMI-5000	LML-4000
BMI-2000	LMI-200	LMI-10000	LML-8000
BMI-3000	LMI-400	BML-400	LML-10000
BMI-4000	LMI-500	BML-1000	LML-12000
BMI-5000		HML-200	



This standardized group of filters covers most popular filter applications and frequencies. Units are in compact, drawn, magnetic shielding cases . . . 1³⁄₁₆ x 1¹¹⁄₁₆ base, 1⅝ high for BMI, LMI, BML; others 2½ high. There are six basic types:

BMI band pass units are 10K input, output to grid 2:1 gain. Attenuation is approximately 2 db at 3% from center frequency, then 40 db per octave.

HMI high pass units are 10K in and out. Attenuation is less than 6 db at cut-off frequency and 35 db at .67 cut-off frequency.

LMI low pass units are 10K in and out. Attenuation is less than 6 db at cut-off frequency and 35 db at 1.5 cut-off frequency.

HML high pass filters are same as HMI but 500/600 ohms in and out.

LML low pass filters are same as LMI but 500/600 ohms in and out.

BML band pass units are same as BMI but 500/600 ohms input, output to grid, 9:1 gain.

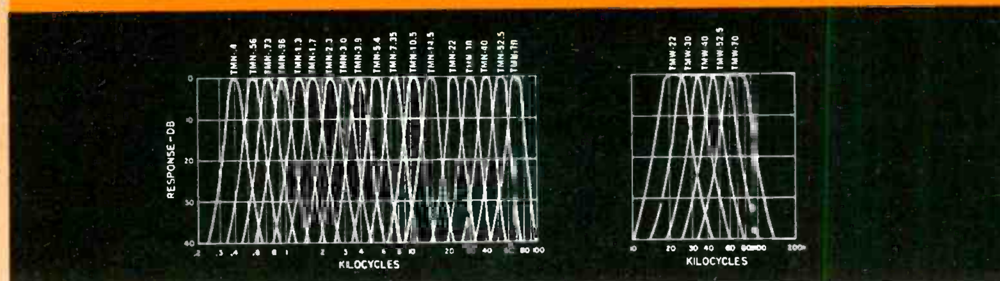
UTC TELEMETERING BAND PASS FILTERS

STOCK TYPES
(number in figure is KC)

TMN-.4	TMN-2.3	TMN-14.5	TMW-22
TMN-.56	TMN-3.0	TMN-22	TMW-30
TMN-.73	TMN-3.9	TMN-30	TMW-40
TMN-.96	TMN-5.4	TMN-40	TMW-52.5
TMN-1.3	TMN-7.35	TMN-52.5	TMW-70
TMN-1.7	TMN-10.5	TMN-70	

TMN-.4 thru TMN-1.7
1⅟₁₆ x 1³⁄₃₂ x 2 inches
Weight ....3.5 oz.

TMN-2.3 thru TMW-70
²³⁄₃₂ x ²³⁄₃₂ x 1⅜ inches
Weight ....1.2 oz.

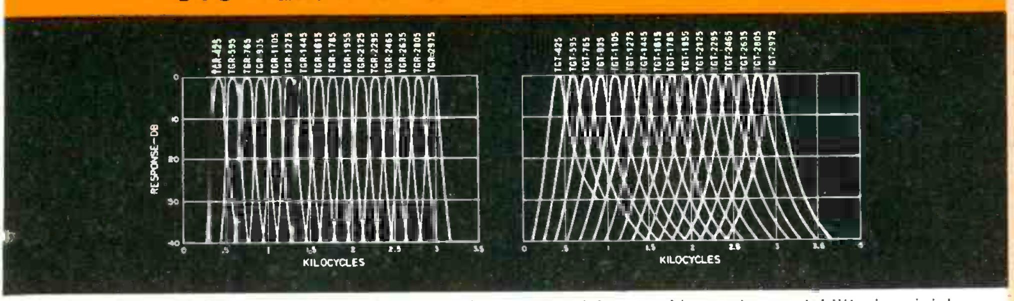


UTC standard telemetering filters provide extreme miniaturization with maximum stability, a complete set of 18 filters taking 19 cubic inches. They are 100K in and out and have an insertion loss of less than 6 db, 4 pin header for small Winchester socket.

TMN units are within 3 db at ± 7.5% of center frequency . . . down more than 18 db at ± 25% . . . more than 40 db beyond 1.75 and .58 center frequency.

TMW are within 3 db at ± 15% of center frequency . . . down more than 20 db at ± 50% . . . more than 40 db beyond 2.5 and .4 center frequency.

UTC TELEGRAPH TONE CHANNEL FILTERS



These band pass filters for multiplex transmitting and receiving provide maximum stability in miniature sizes. Both receiving and transmitting types are 600 ohms in and out, and employ 7 terminal header for sub-miniature 7 pin socket.

TGR receiving filters are within 3 db at ± 42.5 cycles from center frequency . . . down more than 30 db at ± 170 cycles . . . down more than 15 db at adjacent channel cross-over.

TGT transmitting filters are within 3 db at ± 42.5 cycles from center frequency . . . down more than 16 db at ± 170 cycles . . . down more than 7.5 db at adjacent channel cross-over.

STOCK TYPES
(number in figure is cycles)

RECEIVING

TGR-425	TGR-1785
TGR-595	TGR-1955
TGR-765	TGR-2125
TGR-935	TGR-2295
TGR-1105	TGR-2465
TGR-1275	TGR-2635
TGR-1445	TGR-2805
TGR-1615	TGR-2975

TRANSMITTING

TGT-425	TGT-1785
TGT-595	TGT-1955
TGT-765	TGT-2125
TGT-935	TGT-2295
TGT-1105	TGT-2465
TGT-1275	TGT-2635
TGT-1445	TGT-2805
TGT-1615	TGT-2975

TGT CASE
1½ x 1½ x 2½ in. 8 oz.

TGR CASE
1½ x 1½ x 4¼ in. 15 oz.

And Special Units 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 91 on Inquiry Card, page 149

Microwave Directory

(*Continued from page 160*)

M-B Communications Co 4626 Walnut St Phila 39 Penna
Meridian Metalcraft Inc 8739 S Millergrove Dr Whittier Calif
Microflect Co 2300 S 25th St Salem Ore
Microwave Eng'g Labs Inc 943 Industrial Ave Palo Alto Calif
Motorola Communications & Electronics Inc 4501 W Augusta Blvd Chicago 51 Ill
Nuclear Products Erco Div ACF Industries Inc Riverdale Md
Philco Corp Tioga & C Sts Phila 24 Penna
Philco Corp G & I Div 4700 Wissahickon Ave Phila 44 Penna
Polarad Electronics Corp 43-20 34th St Long Island City NY
Polytronic Research Inc 7660 Woodbury Dr Silver Spring Md
Premier Instrument Corp 52 W Houston St New York 12 NY
Prodelin Inc 307 Bergen Ave Kearny NJ
Pye Canada Ltd 82 Northline Rd Toronto 16 Ont Canada
Pye Telecommunications Ltd Newmarket Rd Cambridge England
Radio Corp of America Commercial Electronic Products, Front & Cooper Sts Camden NJ
Radio Corp of America Communications Products Dept Bldg 1-5 Camden NJ
Radio Eng'g Labs 29-01 Borden Ave Long Island City 1 NY
Raytheon Mfg Co 100 River St Waltham 54 Mass
Raytheon Mfg Co Commercial Equip Div 100 River St Waltham 54 Mass
Scatter-Communications Inc 4923 St Elmo Ave Bethesda 14 Md
Standard Electronics Div Radio Eng'g Labs 30th & Borden Sts Long Island City NY
Stavid Eng'g Inc U S Route 22 Plainfield NJ
Stromberg-Carlson Div General Dynamics Corp 100 Carlson Rd Rochester 3 NY
Sylvania Electric Products Co Electric Systems Div 100 First St Rochester 3 NY
Sylvania Electric Products Co 1740 Broadway New York 19 NY
Tarzian Inc Sarkes 415 N College Ave Bloomington Ind
Technical Oil Tool Corp 1057 N LaBrea Los Angeles 38 Calif
Telechrome Mfg Corp 28 Ranick Dr Amityville LI NY
Telectro Industries Corp 35-18 37th St Long Island City 1 NY
Tele-Dynamics Inc 51st & Parkside Ave Phila Penna
Telerad Mfg Corp Route 69 Flemington NJ
Telerad Mfg Corp 1440 Broadway New York 18 NY
Topp Industries Inc 8907 Wilshire Blvd Beverly Hills Calif
Tower Construction Co 2700 Hawkeye Dr Sioux City 2 Iowa
Victor R F & Microwave Co 36 W Water St Wakefield Mass
Waveguide Inc 14837 Oxnard St Van Nuys Calif
Westinghouse Electric Corp PO Box 868 Pittsburgh 30 Penna
Weymouth Instrument Co 1440 Commercial St E Weymouth 89 Mass
Warren Wire Co Pownal Vt
Western Int'l Co 45 Vesey St New York 7 NY
Weymouth Instrument Co 1440 Commercial St E Weymouth 89 Mass
Wirecraft Products Inc 10 Lake St W Brookfield Mass
Zippertubing Co 752 S San Pedro St Los Angeles 14 Calif

TEST EQUIPMENT

Analyzers, Microwave	1
General	2
Signal Generators	3
Testers	4

4—**Admittance-Nameo Corp** Marine St Farmingdale LI NY
4—**Aerotronic Associates** Box 419 Concord NH
2-3—**Airborne Instruments Lab Inc** 160 Old County Rd Mineola NY
1-2—**Aircom Inc** 354 Main St Winthrop Mass

(*Continued on page 164*)

FREQUENCY STANDARDS

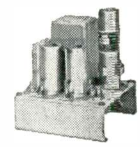
*3⅛" high
400 - 1000 cy.

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

FREQUENCY STANDARD
TYPE 50L



Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)

*3½" high
400 to 500 cy.
optional

PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

FREQUENCY STANDARD
TYPE 2005

Size, 8" x 8" x 7¼" High
Weight, 14 lbs.

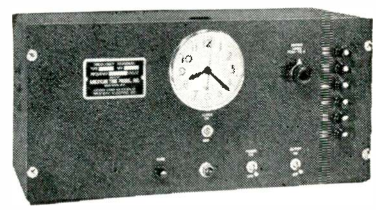
Frequencies: 50 to 400 cycles
(Specify)
Accuracy: ±.001% from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)

FREQUENCY STANDARD *NEW*
TYPE 2007-6
TRANSISTORIZED, Silicon Type

Size 1½" dia. x 3½" H. Wght. 7 ozs.

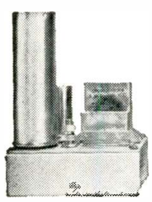
Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007–6 (± .02% at —50° to +85°C)
R2007–6 (±.002% at +15° to +35°C)
W2007–6 (±.005% at —65° to +125°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

FREQUENCY STANDARD
TYPE 2121A



Size
8¾" x 19" panel
Weight, 25 lbs.

Output: 115V
60 cycles, 10 Watt
Accuracy:
±.001% from 20° to 30°C
Input, 115V (50 to 400 cycles)

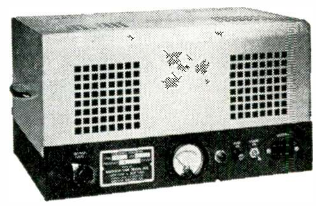


FREQUENCY STANDARD
TYPE 2001-2

Size 3¾" x 4½" x 6" H., Wght. 26 oz.

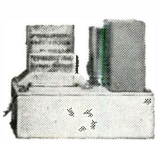
Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.

FREQUENCY STANDARD
TYPE 2111C



Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cycles
Accuracy: (±.002% at 15° to 35°C)
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.



ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies multi-vibrator type, 40-200 cy.
D—For low frequencies counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

American Time Products, Inc.

Watch Master
Timing Systems

Telephone: PLaza 7-1430

580 Fifth Ave., New York 36, N. Y.

Circle 93 on Inquiry Card, page 149

Microwave Directory

(Continued from page 162)

1-2-3—**Aircom Inc** 139 E 1st St Roselle NJ
2—**Aircraft Armaments Inc** Cherry Tree Rd Box 126 Cockeysville Md
3—**Aircraft Radio Corp** Boonton NJ
2-4—**Airtron Inc** 1108 W Elizabeth Ave Linden NJ
2—**Alford Mfg Co** 299 Atlantic Ave Boston 10 Mass
2-3-4—**Amerac Inc** 116 Topsfield Rd Wenham Mass
2-3-4—**Amerac Inc** Dunham Rd Beverly Mass
2—**American Electronic Laboratories** 121 N 7th St Philadelphia 6 Pa
2—**American Machine & Foundry Co Defense Products Group** 1101 N Royal St Alexandria Va
1-2—**American Microwave Corp** 11754 Vose St N Hollywood Calif
2—**American Optical Co Instrument Div** Box A Buffalo 15 NY
2—**Analytic Systems Co Div Research Instrument Co** 980 N Fair Oaks Ave Pasadena Calif
2—**Antenna & Radome Research Assoc** 1 Bond St Westbury NY
4—**Audicon Electronics Inc** 216 Lyons St Paterson 4 NJ
2—**Avionics Ltd** PO Box 200 Niagara on the Lake Ontario Canada
1-2—**Bolton Labs Inc** W Main St Bolton Mass
3—**Boonton Radio Corp** Intervale Rd Boonton NJ
4—**Briggs Associates** 10 DeKalb St Norristown Pa
2—**Browning Labs Inc** 750 Main St Winchester Mass
2-3-4—**Bruno-New York Industries Corp** 460 W 34 St New York 1 NY
1-2-3-4—**California Technical Industries Div Textron Inc** 1421 Old County Rd Belmont 10 Calif
1—**Canoga Corp** 5955 Sepulveda Blvd Van Nuys Calif
2—**Central Scientific Co of Calif** 1040 Martin Ave Santa Clara Calif
2—**Central Scientific Co of Canada Ltd** 146 Kendal Ave Toronto 4 Ont Canada
1-2-4—**Chemalloy Electronics Corp** Gillespie Airport Santee Calif
2-3—**Clegg Labs Div Clegg Inc** Ridgedale Ave Moorestown NJ
1-2—**Collins Radio Co** 855 35th St NE Cedar Rapids Iowa
2-3—**Control Electronics Co Inc** 1925 New York Ave Huntington Sta NY
2—**Cubic Corp** 5575 Kearny Villa Rd San Diego 11 Calif
1-2-3-4—**Demornay-Bonardi Corp** 780 S Arroyo Pkwy Pasadena Calif
2—**Diamond Antenna & Microwave Corp** 7 North Ave Wakefield Mass
1—**Douglas Microwave Co** 252 E 3 St Mt Vernon NY
3—**Dynac Inc** 395 Page Mill Rd Palo Alto Calif
1—**Elco Mfg Co** 137 Herrick Rd New Hyde Park LI NY
2—**Electrical Eng'g & Mfg Corp** 4612 W Jefferson Blvd Los Angeles Calif
1-2—**Electro Impulse Lab Inc** 208 River St Red Bank NJ
2—**Electronic Mechanisms Inc** Rt 9 Haddam Conn
4—**Electronic Specialty Co** 5121 San Fernando Rd Los Angeles 39 Calif
1-3—**Electronic & X-Ray Div** 26-12 Borough Pl Woodside 77 NY
1-2—**Electrovert Inc** 489 5 Ave New York NY
2—**Ellison Draft Gage Co** 548 W Monroe St Chicago 6 Ill
2—**Empire Products Sales Corp** 37 Prospect St Amsterdam NY
1-2-3-4—**Engineering Associates** 434 Patterson Rd Dayton 9 Ohio
2—**Ercona Corp** 551 Fifth Ave New York 17 NY
2-4—**Farnsworth Electronics Co Div IT&T** 3702 E Pontiac St Ft Wayne Ind
2—**Fox Co Thomas T** 95 Summit St Newark NJ
1-2-4—**F-R Machine Works Inc Electronic & X-Ray Div** Borough Pl Woodside 77 NY
1-2—**Frequency Standards** PO Box 504 Asbury Park NJ
2—**Gabriel Electronics Div Gabriel Co** 135 Crescent Rd Needham Heights 94 Mass

(Continued on page 166)

Filtors, the leading specialists in the development and manufacture of sub-miniature relays is proud to announce the addition of the new Powrmite micro-miniature relay to its existing line of traditionally outstanding relays.

In every field of achievement there is always one leader. In relays with highest available reliability the leader is Filtors, Incorporated. All of the experience and know how gained in attaining its position of leadership have gone into making Filtors new Powrmite micro-miniature relay *truly reliable*—again the leader in a field of many.

Leading manufacturers of hermetically sealed micro and sub-miniature relays. **FILTORS, INC.**

Main office and plant: Port Washington, N. Y., POrt Washington 7-8220
West coast office: 13273 Ventura Blvd., Studio City, Cal., STanley 3-2770

VIBRATION UP TO 30 G's AT 2000 CPS.
70 G's SHOCK • 2 AMP OR DRY CIRCUIT
−65°C. TO +125°C.

Microwave Directory

(*Continued from page* 164)

2-3-4—**General Communication Co** 677 Beacon St Boston 15 Mass
1—**General Electric Co Apparatus Sls Div** 1 River Rd Schenectady 5 NY
1-2—**G & M Equipment Co** 7315 Varna Ave N Hollywood Calif
2—**Goodrich Sponge Products B F Div B F Goodrich Co** Canal St Shelton Conn
1-2-4—**Granger Associates** 966 Commercial St Palo Alto Calif
1-2-3-4—**Grem Eng'g Co** 923 Longview Rd King of Prussia Pa
1-4—**Haller Raymond & Brown** Circleville Rd State College Pa
2—**Hallikainen Instruments** 1341 7th St Berkeley 10 Calif
3—**Hazeltine Electronics Div/Hazeltine Corp** 59-25 Little Neck Pkwy Little Neck 62 NY
2—**Hellige Inc** 877 Stewart Ave Garden City NY
2-3—**Hewlett-Packard Co** 275 Page Mill Rd Palo Alto Calif
1—**Hickok Electrical Instrument Co** 10514 Dupont Ave Cleveland 8 Ohio
1-2-3-4—**Industrial Research Labs Div Aeronca Mfg Corp** Hilltop & Fredericks Rd Baltimore Md
2—**Instrument Development Labs Inc** 67 Mechanic St Attleboro Mass
2—**I-T-E Circuit Breaker Co Special Products Div** 601 E Erie Ave Philadelphia 34 Pa
1—**Jackson Electronics Inc** 23 Woodcrest Rd West Chester Pa
2—**Jarrel-Ash Co** 26 Farwell St Newtonville 60 Mass
1-2-3—**J-V-M Eng'g Co** 4633 S Lawndale Ave Lyons Ill
4—**Kaiser Aircraft & Electronics Corp Toledo Electronics** PO Box 437 Toledo Ohio
2-3—**Kay Electric Co** 14 Maple Ave Pine Brook NJ
1-4—**Kearfott Co Inc** 1378 Main Ave Clifton NJ
2-3—**Kearfott Co Inc** 14844 Oxnard St Van Nuys Calif
2—**King Electronics Co Inc** 40 Marbledale Rd Tuckahoe NY
2—**Kost Products Co** 2335 N Cicero Ave Chicago 39 Ill
1-2-3-4—**Laboratory for Electronics Inc** 75 Pitts St Boston 14 Mass
2-3—**Lambda-Pacific Eng'g Inc** 14725 Arminta St Van Nuys Calif
2-3—**Levinthal Electronics Products Inc** 3180 Hanover St Palo Alto Calif
2—**Magnuson Engineers Inc** 509 Emory St San Jose 10 Calif
2-3—**Manson Laboratories Inc** 207 Greenwich Ave Stamford Conn
2—**Manufacturers Eng'g & Equip Corp** York Rd & Sunset Lane Hatboro Pa
2-3—**Marconi Instruments Ltd** 111 Cedar Lane Englewood NJ
3—**Maxson Instruments Div W L Maxson Corp** 47-37 Austel Pl Long Island City 1 NY
2—**Meridian Metalcraft Inc** 8739 Trowbridge St Cambride 38 Mass
2—**Mico Instrument Co** 80 Trowbridge St Cambridge 38 Mass
2—**Microlab** Okner Pkwy Livingston NJ
1-2-3—**Microwave Associates Inc** Burlington Mass
1—**Microwave Eng'g Labs Inc** 943 Industrial Ave Palo Alto Calif
2—**Mine Safety Appliances Co** 201 N Braddock Ave Pittsburgh 8 Pa
2-3—**Model Eng'g & Mfg Inc** 50 Frederick St Huntington Ind
2—**Munsell Color Co** 10 E Franklin St Baltimore 2 Md
1-2-4—**Narda Microwave Corp** 118-160 Herricks Rd Mineola NY
2-4—**Nevada Air Products Co** PO Box 2472 Reno Nevada
1-4—**Northeast Electronics Corp** Airport Rd Concord NH
2—**Omega Labs Inc** Haverhill St Rowley Mass
2—**Phoenix Precision Instrument Co** 3803 N 5th St Philadelpha 40 Pa
4—**Philco Corp** Tioga & C Sts Philadelphia 24 Pa
1-2-3-4—**Polarad Electronics Corp** 43-20 34th St Long Island City 1 NY
1-2-3-4—**Polytechnic Research & Development Co** 202 Tillary St Brooklyn 1 NY
1—**Polytechnic Research Inc** 7660 Woodbury Dr Silver Spring Md

(*Continued on page* 195)

Space Communications Highlight Symposium

The 4th National Aero-Com Symposium held in the Hotel Utica, Utica, N. Y., on October 20-21, 1958, while stressing communications in all its aspects, focused much attention on the increasinly important problem of space communications.

Representatives from industry and the military services presented papers which dealt with all facets of this field from an introduction to space communication systems design on through to communication between space vehicles and during hypersonic reentry.

Guest speaker at the luncheon on the first day was Brig. Gen. Francis F. Uhrhane, Deputy Chief of Staff, Communications and Electronics, North American Air Defense Command (NORAD). This organization, composed of representatives of the military services of the United States and Canada, is charged with the air defense of this continent. It has been in existence for little more than a year.

Closed circuit television was used to carry the technical sessions and talks by luncheon and banquet speakers to other locations within the hotel where the over-flow audiences were accommodated.

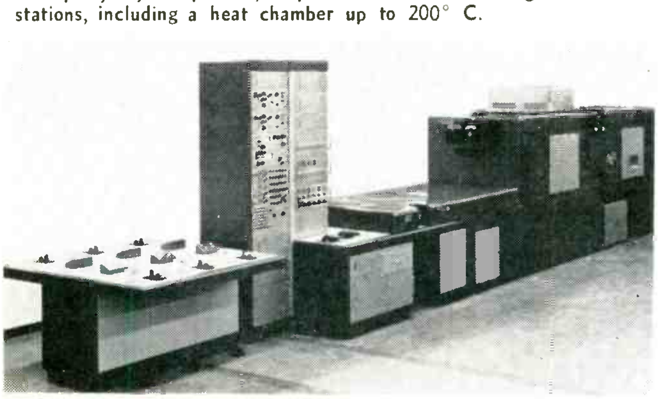
$5 Billion for Defense Communications-Electronics

Money available to the Department of Defense for communications and electronics procurement and production in fiscal 1959 which commenced July 1 would amount to $1,180,000,000 according to the hearing record on military appropriations released by Congress. This total compares with $696,000,000 for fiscal 1958. Totals for the 1959 fiscal year for the individual services would be: Army, $229,000,000; Navy, $180,000,000; and Air Force, $770,000,000.

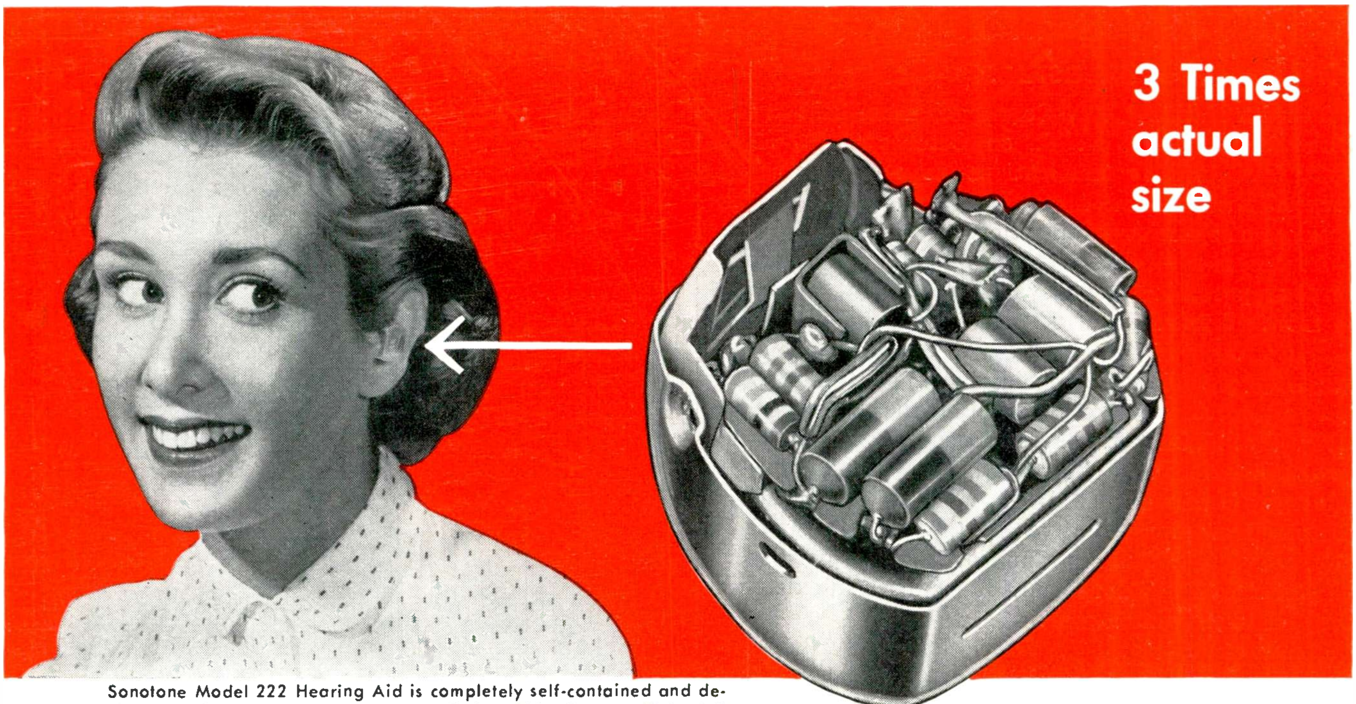
These figures do not include procurement of communications and electronics items as part of the guided missile or aircraft programs, for which component purchases are "hidden" in the overall procurement program. Defense Department sources state that if military purchases could be broken down into component categories, communications and electronics purchasing would probably add up to close to $5,000,000,000 out of the total Defense Department budget of $38 billion.

TRANSISTOR TESTER

This automatic transistor testing machine built by Stromberg-Carlson for Sperry Gyroscope Co., sequences transistors through seven test stations, including a heat chamber up to 200° C.



Circle 98 on Inquiry Card, page 149



Sonotone Model 222 Hearing Aid is completely self-contained and designed to be worn and supported entirely within the ear. Eight A-B Type TR, 1/10-watt resistors are used in the three-transistor amplifier.

SPACE PROBLEM SOLVED

with ALLEN-BRADLEY Hot Molded Resistors

Your space problem may seem impossible, but—try Allen-Bradley Type TR resistors. You'll be able to trim space requirements *way* down . . . with *no* sacrifice in quality or reliability. These unbelievably small composition resistors are made by the same basic hot molding process as is used for the larger Allen-Bradley resistors . . . assuring complete freedom from catastrophic failures. The Type TR resistors have an insulating coating that will withstand a continuous maximum voltage of 200 volts d.c.

Where higher ratings are needed . . . and quality is important . . . it's still Allen-Bradley! These larger sizes have an insulating jacket that eliminates the need for impregnation . . . yet provides reliable protection against long periods of high humidity.

Allen-Bradley makes other space-saving components, too . . . including hermetically sealed resistors, variable resistors, capacitors, and filter elements . . . all built to Allen-Bradley's *quality* standards. For detailed specifications and application data send for Publication 6024.

Allen-Bradley Co., 1342 S. 2nd St., Milwaukee 4, Wis.
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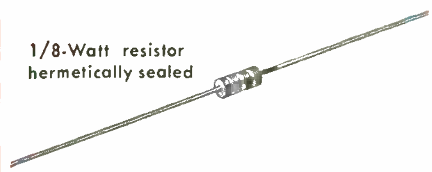
ALLEN-BRADLEY
QUALITY
ELECTRONIC COMPONENTS

A-B QUALITY

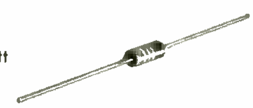
Actual Sizes

1/10-Watt resistor

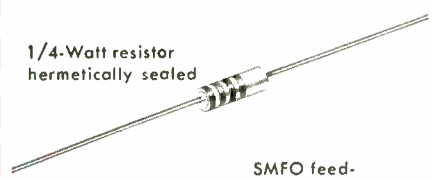
1/8-Watt resistor hermetically sealed



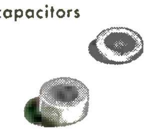
1/4-Watt resistor



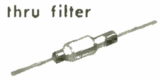
1/4-Watt resistor hermetically sealed



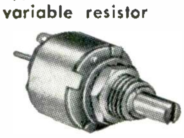
Bare disc ceramic capacitors



SMFO feed-thru filter



Type G—1/2-watt variable resistor



Type F—1/4-watt variable resistor

International

ELECTRONIC SOURCES

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ANTENNAS, PROPAGATION

Atmospheric Effects on VHF and UHF Propagation, George H. Millman. "Proc. IRE." Aug. 1958. 10 pp. This paper is mainly concerned with the effects of the troposphere and ionosphere on the propagation of vhf and uhf radio waves. Tropospheric refractive index profiles and ionospheric electron density models representative of average atmospheric conditions are presented. (U.S.A.)

Diffraction by Smooth Cylindrical Mountains, H. E. J. Neugebauer and M. P. Bachynski. "Proc. IRE." Sept. 1958. 9 pp. This paper is a contribution to the problem of diffraction of EM waves by the smooth crest of a perfectly reflecting mountain. Model experiments at K-band frequencies with mountains of various radii of curvature have been made. (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.
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* * *

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.

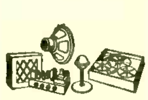
How to Eliminate Unwanted Signals in Omni UHF and VHF Antennas, A. G. Holtum, Jr. "El. Des." Aug. 6, 1958. 4 pp. Unwanted signals in vertically polarized omnidirectional uhf and vhf antennas can be eliminated. A null in the desired direction can be created by synthesizing an array with "off the shelf" antennas. Techniques employed to adjust the parameters of such an array are discussed in this article. (U.S.A.)

Telemetry Aerials for High-Speed Test Vehicles, R. E. Beagles. "J. BIRE." August 1958. 8 pp. The telemetry services in use are mentioned and the problems peculiar to propagation of these signals to and from high-speed test vehicles are discussed. A survey of typical external and suppressed aerials is made. The methods of testing commonly employed are described. (England.)

Ultrasonics Tests Undersea Propagation, Willis C. Gore. "El." August 29, 1958. 4 pp. Changes in propagation time of less than 20 sec over a direct path up to 300-feet in length are measured by ultrasonic equipment providing a 50-watt test signal. Reflected-path signals are separated from direct-path ones. (U.S.A.)

Designing Broadband Conical Helix Antenna, Milton Nussbaum. "El. Des." September 3, 1958. 3 pp. This article traces the evolution of a new type of conical-helix antenna which promises to solve the broadband, circularly polarized requirement. A conical helix having a 2:1 band-width has been converted to one with a 6:1 bandwidth by proper parameter choice. (U.S.A.)

Concentrated Filter Passbands, Part 3, LC Filters, Frederick A. Schaner. "El. Des." September 3, 1958. 4 pp. (U.S.A.)



AUDIO

The Westrex Stereo Disk System, C. C. Davis and J. G. Frayne. "Proc. IRE." October 1958. 8 pp. This paper describes the Westrex Stereo Disk Recorder which records two stereophonic channels in a single groove with a single stylus. (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 Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

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 Telemekhanika
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)

CIRCUITS

***Microwave Multiplexing Circuits**, R. E. Stone. "El. Ind." Nov. 1958. 4 pp. A theoretical and practical discussion of the hybrid ring and variations of its design, leading to a 3-to-1 coupler, a 4-to-1 coupler and various higher order multiplexing configurations. (U.S.A.)

A Laguerre Function Equaliser, H. Mumford and E. J. Osborne. "A.T.E. J." July 1958. 7 pp. The article describes a waveform corrector in which the input signal is successively differentiated, and the differentials added to or subtracted from the input. (England.)

Transistor Pulse Generators for Time-Division Multiplex, K. W. Cattermole. "Proc, BIEE." September 1958. 9 pp. Point-contact transistor circuits to generate pulses in the microsecond range are described, together with means of frequency-dividing and interlacing pulse trains and their application to time-division operation of telephone transmission and switching systems. (England.)

Ringing Amplifier, Use in Crystal-Video Transponder Receivers, S. Rozenstein and E. Gross. "E. & R. Eng." September 1958. 6 pp. In certain secondary radar applications, radar transmitters operating in the microwave bands using pulse widths of the order 0.1 microsecond are used both as primary radars and as interrogators. The design of a transponder receiver on novel lines, for applications where small size, simplicity and low power consumption are desirable, is described. (England.)

Bootstrap Circuit Technique, A. W. Keen. "E. & R. Eng." September 1958. 10 pp. The normal amplifier, the bootstrapped amplifier, the cathode-follower and the anode-follower are shown to comprise a set of four circuits related to one another by simple circuit transformations. Three methods of excitation are distinguished. Each circuit may be put into feedback form, and the four basic feedback configurations applicable to bootstrap amplifiers are given. A number of practical examples are described. (England.)

Harmonic Generation with Ideal Rectifiers, Chester H. Page. "Proc. IRE." October 1958. 3 pp. It is shown that the nth harmonic cannot be generated with an efficiency exceeding $1/n^2$. Of the power converted to dc and harmonics, at least 75 per cent is dc dissipation, and this cannot be reduced by an arrangement of selective circuits. (U.S.A.)

Designing Sequential Circuits, Part 5, Boris Beizer and Stephen W. Leibholz. "El. Mfg." September 1958. 13 pp. When a circuit possesses memory (or its state depends on "past history" as well as externally applied control), the techniques of analysis and synthesis used for combinational circuits must be augmented. Two sets of equations must be derived: one set describing each output and another describing each internal secondary (feedback) control. (U.S.A.)

Active Bandpass Filter Has Sharp Cutoff, J. Ross MacDonald. "El." August 15, 1958. 4 pp. Use of active elements results in a lightweight, adjustable R-C audio filter having Butterworth attenuation characteristics and 42 db/octave cutoff slopes. Filter supplies more than 50 volts rms output with low distortion and has dynamic range exceeding 100 db. Second-order harmonic distortion is considerably reduced by operating tube heaters at low voltage. (U.S.A.)

Concentrated Filter Passbands, Part 2, Crystal Filters, Frederick A. Schaner. "El. Des." August 20, 1958. 3 pp. Crystal filters have been used commercially for about 25 years. Here, in the second part the author describes their important properties. (U.S.A.)

How To Design Pulse Magnetic Amplifiers, Part 1—Design, Richard L. White. "El. Des." August 20, 1958. 4 pp. In this part the author gives a direct approach to designing pulse magnetic amplifiers. He winds up with a practical design procedure and a sample problem. (U.S.A.)

How To Design Pulse Magnetic Amplifiers, Part 2—Logic Circuits, Richard L. White. "El. Des." September 3, 1958. 2 pp. This article presents the foundation stones for all magnetic logical circuitry. (U.S.A.)

Design of Rectifier-Relay Combinations, P. N. Martin et. al. "El. Eq." September 1958. 6 pp. A comprehensive study of circuits for operating dc relays from ac sources. Advantages and limitations are given for each configuration, including such factors as efficiency, economy and size. (U.S.A.)

Using Transistors in Demodulator Circuits, Part 1, Albert N. DeSautels. "El. Des." May 28, 1958. 3 pp. This article discusses half-wave and full-wave phase discriminators using transistors and diodes to produce output capable of driving magnetic amplifiers, energizing relays, heating coils, and hydraulic valves. Part 2 will analyze operating characteristics and discuss power considerations and limitations. (U.S.A.)

A Parametric Amplifier Using Lower-Frequency Pumping, K. K. N. Chang and S. Bloom. "Proc. IRE." July 1958. 4 pp. This paper presents experimental verification of the lower-frequency pumping principle. In one experiment a ferrite core is used as the nonlinear reactance element, and in another, a reverse-biased junction diode. The latter, because of its greater nonlinearity, gave the better results. (U.S.A.)

British Magnetic Amplifier Developments, D. A. Ramsay and B. W. Glover. "El. Mfg." July 1958. 7 pp. The British approach to the analysis of magnetic-amplifier circuits and their practical application provides grounds for fresh thinking in a basic area. Component selection to obtain maximum performance and the physical and electrical characteristics of amplifiers actually constructed are also given. (U.S.A.)

Fast-Heating Electronic Systems, K. S. Hardin. "El. Eq." July 1958. 4 pp. High-speed availability of electronic equipment often requires that a given circuit must be operational within ten seconds after heater power is applied. Here are some circuitry and tube design hints which aid in achieving this. (U.S.A.)

Reliable Printed Wiring Without Hole Pads, G. F. Leyonmark. "El. Eq." July 1958. 3 pp. Achieved for both single- and double-sided circuitry by use of new plated hole technique. (U.S.A.)

Transistor Blocking Oscillator Circuits, Albert S. Daddario. "El. Eq." June 1958. 4 pp. A wide range of output waveform characteristics can be achieved through combined circuit and pulse transformer design, using transistors in grounded-base configuration. (U.S.A.)

Optimum Noise Performance of Linear Amplifiers, H. A. Haus and R. B. Adler. "Proc. IRE." Aug. 1958. 17 pp. This paper introduces an important new measure of the noise performance of any given type of linear amplifier. This measure takes into account not only the impedance of the source connected to amplifier input and the noise figure of the amplifier, but also the gain of the amplifier stage. (U. S. A.)

Circuit Design Using Boolean Matrices and System Synthesis Using State Coding, Part 4, Boris Beizer and Stephen W. Leibholz. "El. Mfg." Aug. 1958. 10 pp. (U.S.A.)

Stable Receiving Circuits for Remote Control, S. J. Neshyba and F. E. Brooks, Jr. "El." Aug, 1958. 3 pp. Vacuum-tubes exhibit low sensitivity to impulse noise, wide dynamic range and high gain. (U. S. A.)

Firing Circuits Trigger Airborne Machine Guns, Morris Halio. "El." Aug. 1, 1958. 4 pp. Striking accuracy of 20-millimeter guns on B-36 bombers is increased by adjusting firing rate to minimize dispersion of shells caused by gun-mount vibration. (U. S. A.)

Concentrated Filter Passbands, Part 1, Mechanical Filters, Frederick A. Schaner. "El. Des." Aug. 6, 1958. 4 pp. (U. S. A.)

Minimize Local Oscillator Drift, Part 2, W. Y. Pan and D. J. Carlson. "El. Des." Aug. 6, 1958. 4 pp. Part 1 of this article introduced an analysis of local oscillator drift. In this, the concluding part, the analysis is applied to practice in a "step-by-step" stabilization of a typical uhf and vhf local oscillator. (U. S. A.)

Cathode Follower Applications, L. F. Barditch. "El. Eq." Aug. 1958. 2 pp. Some suggested circuits and descriptions of their application. (U. S. A.)

COMMUNICATIONS

***"The Radio Spectrum,"** T. A. M. Craven. "El. Ind. Ops. Sect." Nov. 1958. 5 pp. Excerpts from a remarkable speech made by the FCC Commissioner before the IRE Professional Group on Broadcast Transmission Systems. (U.S.A.)

Effect of the Inter-Train Pause on Trunk Switching Design, H. V. Paris and W. P. Davey. "A.T.E. J." July 1958. 10 pp. The relation between trunk circuit provision and the availability given by associated switching equipment has a very important bearing on the economy of all trunk switching schemes. The authors examine the availability of the equipment as a function of the inter-train pause. With particular reference to motor uniselectors they show that a slipped-bank technique of prepositioning — called 'shadow prepositioning'—gives a considerable improvement in availability, together with an all-round gain in efficiency. (England.)

Investigation of Horizontal Drifts in the E Region of the Ionosphere in Relation to Random Fading of Radio Waves, B. Ramachandra Rao and M. Srirama Rao. "J. BIRE." August 1958. 3 pp. Regular determinations of E region wind velocities (V) and frequency of fading (N) were made from simultaneous fading records at three spaced receivers taken on two pulsed radio frequencies, 2.3 and 2.8 Mc/s respectively, between December 1954 and March 1955. (England.)

Electronic Sector Scanning, Prof. D. G. Tucker, et. al. "J. BIRE." August 1958. 20 pp. A system of scanning, or swinging, the beam of an acoustic receiver by electronic means, while the transducer itself remains stationary, is described. (England.)

Efficiency and Reciprocity in Pulse-Amplitude Modulations: Part 2—Testing and Applications, J. C. Price. "Proc. BIEE." September 1958. 8 pp. The paper is the second of two papers on efficiency and reciprocity in pulse-amplitude modulation, and experimental and practical aspects are discussed. Transmission with an overall loss of about 2 dB is achievable in practice and should be capable of improvement. (England.)

Efficiency and Reciprocity in Pulse-Amplitude Modulation: Part 1—Principles, K. W. Cattermole. "Proc. BIEE." September 1958. 14 pp. The paper forms the first part of two papers on efficiency and reciprocity in pulse-amplitude modulation. A method of converting a low-frequency signal into a modulated pulse train and back again, with low power loss, provides multiplex communication on a 2-wire basis, without amplifiers. (England.)

Solar Cycle Influence on the Lower Ionosphere and on VHF Forward Scatter, C. Ellyett and H. Leighton. "Proc. IRE." October 1958 5 pp. (U.S.A.)

Modified Transceivers Compute Distance, Harry Vantine, Jr., and Einar C. Johnson. "El." September 12, 1958. 5 pp. Two communications transceivers operating on a common frequency form a responder-interrogator combination between an aircraft and a ground station. By measurement of the time lapse between interrogator and responder pulses, distance can be measured between stations to within 0.1 mi accuracy. Precisely measured time delays at both ends of the system allow turn-around time for the transceivers. (U.S.A.)

Magnetic Modulators With Perpendicularly Superposed Magnetic Fields, F. I. Kernbnikov and M. A. Rozenblatt. "Avto. i Tel." September 1958. 13 pp. The operation and the design of magnetic modulators with perpendicularly superposed magnetic fields are considered. Formulae for first and second harmonics of the output voltage for the corresponding types of modulators are obtained. The theoretical reuslts are confirmed by experimental data. (U.S.S.R.)

The Function of the Occupancy Probabilities of a Fully Available Line Group, H. Stroemer. "Arc. El. Uber.," Vol. 12, No. 4. Apr. 1958. 4½ pp. In theoretical traffic studies, one assumes the system to be in a state of statistical equilibrium, i.e. the various states of occupancy do not depend on initial states of any kind. With the aid of a formula by J. Riordan, it is shown how the initial state of occupancy of a fully available line group at the time zero affects the state probabilities at the arbitrary time $t > o$. (Germany.)

Recent Developments in Communications Measuring Instruments, E. Garthwaite, and A. G. Wray. "J. BIRE." July 1958. 11 pp. Rapid expansion in radio communication systems has created a corresponding demand for both new and improved forms of instrumentation. The paper gives a brief summary of the present position as seen through the eyes of the instrument designer. (England.)

Measurement of Permeability at VHF Using Transmission Line Technique, J. C. Anderson. "J. BIRE." July 1958. 8 pp. The accurate measurement of the propagation constant of a transmission line, particularly in the vhf region, is severely limited by the inaccuracy inherent in the calibration of the meter used for measurement. A comparative method, due to Wieberdink, is described here, and its theory discussed. (England.)

Potential Uses for Transistors in Line Communications, J. R. Tillman. "Brit. C. & E." Aug. 1958. 7 pp. Many speculations have been made on the effect that transistor techniques will eventually have on line communications. This article surveys the possibilities of introducing transistors both into conventional telephone and telegraph networks and into newly designed networks where a fresh start might be made. (England.)

Atmospheric Noise Interference to Medium Wave Broadcasting, S. V. Chandrashekhar Aiya. "Proc. IRE." Aug. 1958. 8 pp. A brief description is given of the typical tropical thundercloud and the electrical discharges associated with it. The discharge that contributes significantly to noise in the medium waveband is described in greater detail. (U.S.A.)

Phase Multilock Communication, Cecil A. Crafts. "El. Eq." Aug. 1958. 3 pp. A 180° phase shift system which derives its reference directly from the modulated signal input to the receiver and is directly compatible with normal digital type equipment, and a system which may provide for correct receiver output polarity with no external reference required. (U.S.A.)

COMPONENTS

***Extreme Environmental Testing Determined . . . Capabilities of Coaxial Cable,** E. T. Pfund et al. "El. Ind." Nov. 1958. 4 pp. As a part of an Air Force sponsored world-wide survey of potentially high-temperature-resistant 50 ohm coaxial cable, six different types have been tested. The extensive tests which were conducted impartially, exceeded the manufacturers' specifications in an attempt to find rugged coax cable. Some of the findings are enlightening. (U.S.A.)

***Thermistors for Linear Temperature Readings,** A. B. Soble. "El. Ind." Nov. 1958. 3 pp. A thermistor may be used with a thermostat consisting of a linearly calibrated potentiometer or a linearly calibrated non-linear rheostat to obtain a voltage signal which varies linearly with the difference between actual and desired temperatures. (U.S.A.)

***Treat Spark Gaps as Components,** K. W. Olson. "El. Ind." Nov. 1958. 4 pp. The design of spark gaps has advanced to the point where these devices, formerly a second thought of the designer, now deserve prime consideration as protective components. Questions of critical importance are answered here. (U.S.A.)

On Hybrid Transformers, H. O. Friedheim. "A.T.E. J." July 1958. 11 pp. This article deals briefly with the theory of the hybrid, or differential, transformer. Design formulae are derived from basic assumptions, and the properties and some common uses of these circuit elements are discussed. (England.)

Coils For Magnetic Fields, Part 2: Weight Aspects, G. M. Clarke. "E. & R. Eng." September 1958. 5 pp. The minimization of the total weight of a coil and power supply is studied both for a linear relationship between power and supply weight and also for the law obtained when the power-supply weight is principally a transformer. It is found that aluminum-foil solenoid systems have a weight advantage over copper systems not greater than 35% when minimization calls for small radius-ratio coils, but this disappears when larger coils are required. (England.)

A High Speed Rotary Switch and Some Applications, M. Lowenberg. "El. Eng." September 1958. 4 pp. The general requirements of high speed switches are discussed with particular reference to their applications in information sampling systems. Details of a new high speed rotary switch are given and typical applications are described. (England.)

A Voltage-Sensitive Switch, K. O. Otley et. al. "Proc. IRE." October 1958. 8 pp. An investigation of the controlled dielectric breakdown of aluminum oxide films resulted in the development of a voltage-sensitive switch which may replace thyratrons and gas diodes in circuits which require single switching from a resistance in the kilomegohm range to one of the order of 1 ohm or less. (U.S.A.)

Silicon Power Rectifier—A Survey, John R. Riggs. "El. Mfg." September 1958. 11 pp. The importance of the silicon diode as a power rectifier is evidenced by the rapidly growing number of types available and manufacturers producing them. Because of the critical nature of most silicon rectifier applications, this profusion of available units creates a distinct selection problem for the design engineer. All of the important rectifier characteristics, most of which are listed here, must be carefully considered. (U.S.A.)

Synthesis of Systems with Step Selectors, G. Ioanin. "Avto. i Tel." September 1958. 9 pp. The paper deals with step selectors, their construction and action. Step selectors action is described by functions determined for multiposition elements. Some systems with step selectors are synthesized. (U.S.S.R.)

Applying Glass-to-Metal Seals, J. Comer. "El. Mfg." Aug. 1958. 6 pp. Application notes for matched and compression seals for electrical and electronic components and assemblies. Characteristics, limitations and design criteria are presented as a design aid for optimum utilization. (U.S.A.)

Microminiature Components for Electronic Circuits, Norman J. Doctor and Edith M. Davies. "El. Mfg." Aug. 1958. 4 pp. In this article the state of the art is traced. (U.S.A.)

Rectifiers in High Voltage Power Supplies, F. W. Gutzwiller. "El. Des." July 23, 1958. 4 pp. The unique advantages of semiconductor rectifiers are, by now, well known. But they have their pitfalls too. This article shows how to avoid them. (U.S.A.)

Microwave Applications of Thermistors, Part 2, Leonard I. Kent. "El. Des." July 23, 1958. 3 pp. In this concluding segment, comprehensive investigation is made of waveguide thermistor mounts. Impedance matching considerations are carefully outlined over the various frequency bands. (U.S.A.)

COMPUTERS

Fourier Analysis by a General Purpose Electronic Analogue Computer, N. S. Nagaraja. "J. ITE." June 1958. 7 pp. The paper describes a modified method of carrying out Fourier analysis which avoids the necessity of changing the frequency of the sinusoidal function which has to be generated on the computer. (India, in English.)

Electronic Digital Computer — HEC2M, Amaresh Ray. "J. ITE." June 1958. 6 pp. The article describes a number of engineering problems encountered and successfully tackled in course of operation of this computer at the Department of Electronic Compnters, Indian Statistical Institute, Calcutta. (India, in English.)

Short-Cut Multiplication and Division in Automatic Binary Digital Computers, M. Lehman. "Proc. BIEE." September 1958. 9 pp. The paper considers the application of analogues of the well-known decimal short-cut multiplication and division methods, to the control of such operations in automatic binary digital computers. (England.)

A Computer Oriented Toward Spatial Problems, S. H. Unger. "Proc. IRE." October 1958. 7 pp. A stored program computer is described which can handle spatial problems by operating directly on information in planar form without scanning or using other techniques for transforming the problem into some other domain. (U.S.A.)

A New Transistor-Magnetic Core Bi-Logical Computer Element, W. J. Dunnet and A. G. Lemack. "Auto. Con." September 1958. 7 pp. The computer world is moving toward combinations of solid state components. One new type of core-semiconductor circuitry increases the reliability and speed of a sequential-type computer system. (U.S.A.)

CONTROLS

Control Based on Principle of Self-Adjusting Program, I. I. Perelman. "Avto. i Tel." September 1958. 11 pp. Control of objects influenced by repeated disturbances is described. The disturbances can be compensated by special input response. Stability conditions are determined. Problem of stabilization of hot-rolled steel is analyzed. (U.S.S.R.)

International ELECTRONIC SOURCES

Elaboration of an Almost Optimal System by Means of an Electronic Analog, R. A. Velerstein and A. A. Feldbaum. "Avto. i Tel." September 1958. 12 pp. The paper deals with design of an almost optimal control element, as to its high-speed, for an electronic actuator of a press device in a rolling mill. The design method consists in division of the known part of the system into blocks. A simple optimal control element is elaborated for each block; input value of blocks is controlled in such a way that difference between a real input value and an optimal one approaches zero. The system in question was tested by means of an electronic analog. The system was proved to shorten (2-2.5 times) control time as compared with a linear control system. (U.S.S.R.)

On Stability and Autonomy of Automatic Control of Single Synchronous Generator Frequency and Voltage, D. P. Petelin. "Avto. i Tel." September 1958. 15 pp. The paper deals with analysis of stability and autonomy of automatic control of single synchronous generator frequency and voltage at any steady accuracy. (U.S.S.R.)

Dynamic "In-System" Specifications for Control Components, Denny D. Pidhayny. "El. Mfg." Aug. 1958. 7 pp. The system-philosophy approach to the castings of specifications is based on testing and then expressing the results in control-theory terms. The reasoning behind this approach is supported by specific examples of widely used control system elements. (U.S.A.)

Transistors Reduce Relay Servo Size, Saul Shenfeld. "El." Aug. 15, 1958. 3 pp. Relay servo system simulates on-off control device by using step-function potentiometer to provide on-off characteristic of the null detector. (U.S.A.)

Putting Potentiometers to Work in a Control Circuit, B. M. Brenner. "Auto. Con." July 1958. 3 pp. Major factors which affect the application of precision potentiometers in control circuits are covered. Description of operational details of potentiometers in servo control circuits of an aerial camera serve to put author's comments on a practical, functional basis. (U.S.A.)

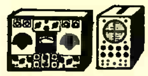
GENERAL

Accuracy Control in a File Processor, J. C. Hammerton. "El. Eng." September 1958. 5 pp. In this article the accuracy controls incorporated into a particular logical machine called a file processor are described. The methods of handling errors detected by the accuracy controls are also described. The purpose of the machine and the fundamentals of its design are outlined. (England.)

Liquid Cooling of Electronic Equipment, E. N. Shaw. "El. Eng." September 1958. 8 pp. The potentialities of liquid cooling are explored to determine the effectiveness of heat-exchangers built into electronic equipment as integral parts of an assembly. (England.)

Some Recent Developments in Medical Electronics, K. F. Hopkins. "Brit. C & E." September 1958. 4 pp. The process of instrumentation in medicine is rapidly growing, and experimental electro-medical work is being carried out in hospitals and medical research centers throughout the world. Much of this work is also now being undertaken by instrument firms. This article describes the recent work of one such firm in the fields of oximetry, foetal cardiography, ultra-short wave diathermy, electro-surgery and anesthesia instrumentation. (England.)

Control Panel Design and Human Engineering, "El. Mfg." September 1958. 9 pp. Three articles emphasizing the importance of the human engineering approach to successful control panel design. 1—Instrument Design for the Elimination of Errors in Use, R. Bilinski. 2—Five Elements of a Good Control Panel, D. R. Witt. 3—Control Knobs for Military Electronic Equipment, T. G. Nessler. (U.S.A.)



MEASURE & TESTING

A Variable-Voltage Regulated D.C. Power Supply, F. W. Cook. "A.T.E. J." July 1958. 8 pp. A regulated d.c. power unit is described that is capable of delivering up to 250 mA. at any output voltage from 0 to 1,750 volts. (England.)

Measurement of Small Time-Intervals in an Electronic Torquemeter, H. Rakshit and S. C. Mukherjee. "El. Eng." September 1958. 4 pp. The measurement of torque or twist of a rotating shaft transmitting mechanical power, in terms of time-interval and revolutions per minute is discussed. When the speed of revolution is high, the time of rotation through this twist angle becomes very small, of the order of a fraction of a microsecond. A technique for measuring such small time-intervals from a remote distance by the method of coincidence of two pulses with electrical delay circuit is suggested. (England.)

An Amplitude/Frequency Response Display Using a Ratio Method, Part 1, H. L. Mansford and K. M. I. Khan. "El. Eng." September 1958. 4 pp. A wobulator for amplitude testing often gives errors because of unwanted signal amplitude variations during the sweep cycle. Part 1 of this article outlines a new ratio method for balancing-out the errors. (England.)

Methods of Measurement of the Parameters of Piezoelectric Vibrators, E. A. Gerber and L. F. Koerner. "Proc. IRE." October 1958. 7 pp. (U.S.A.)

A Catapult End-Speed Recorder, J. R. Pollard. "Brit. C. & E." September 1958. 5 pp. The introduction of turbojet carrier-borne aircraft has demanded a greatly increased performance from the launching catapult. In the system described, this has been assisted by an elaborate electronic system of instrumentation which gives an indication and record of the launch speed reached at the end of the catapult travel. (England.)

Engineering Testing Techniques, William Perzley. "Auto. Con." September 1958. 3 pp. The test techniques described here have broad application to practically all special purpose digital computers. They can help the design engineer to develop hardware which lends itself more readily to checking of performance. (U.S.A.)

Voltage Standing-Wave Ratio Measurements, The Attenuator-Substitution Method, E. W. Collings. "E. & R. Eng." Aug. 1958. 4 pp. In certain types of standing-wave measurement, such as the measurement of the response of a cavity resonator in which the nodal position is not required, accurate standing-wave measurements can be made by substituting a short-circuited attenuator for the cavity under test and reproducing the same maxima and minima on an uncalibrated standing-wave detector. Practically all errors of the usual standing-wave measurement can in this way be eliminated. The accuracy of the method is discussed, and an example of its application is given. (England.)

L.F. Random-Signal Generator, J. L. Douce and J. M. Chackleton. "E. & R. Eng." Aug. 1958. 3 pp. This article describes a simple low-frequency noise generator having a power spectrum which is uniform from zero frequency to about 15 c/s. A new technique is employed, utilizing a conventional noise generator followed by a non-linear element. (England.)

Error Probabilities for Binary Symmetric Ideal Reception Through Nonselective Slow Fading and Noise, G. L. Turin. "Proc. IRE." Sept. 1958. 17 pp. One of two correlated, equal energy, equiprobable waveforms is transmitted through a channel during a given time interval. The signal is corrupted in the channel by slowly-varying, frequency-nonselective fading and by additive, Gaussian noise. On reception, the corrupted signal is processed by an ideal receiver, which guesses that the transmitted waveform was the one which it computes to be a posteriori most probable. (U.S.A.)

A Cathode Test Utilizing Noise Measurements, W. Dahlke and F. Dlouhy. "Proc. IRE." Sep. 1958. 7 pp. The well-known effect of full shot noise of current saturated parts of a cathode and shot-noise suppression under space-charge-limited conditions is shown to be very useful for evaluation of cathode quality. A test equipment and a practical test performance are described. (U.S.A.)

RADAR, NAVIGATION

***Predicting Accurate Radar Ranges,** Leo Young. "El. Ind." Nov. 1958. 4 pp. The range performance of a new radar can be predicted from the measured performance of another radar, preferably one operating at the same frequency. But unless all the parameters are known, this comparison can be misleading. The range can be accurately and quickly calculated from a chart based on known equipment parameters. (U.S.A.)

***Dynamic Compression for Radar Receivers,** Dr. Daniel Levine. "El. Ind." Oct.-Nov. 1958. 8 pp. Selection of the dynamic compression curve for a radar receiver is a system problem influenced by several factors. A discussion of some of these factors is included with a graphical analysis of the different types of receivers. (U.S.A.)

Missile Guidance Systems, R. I. Hughes. "G.E.C. Journal." July 1958. 5 pp. The author outlines the various methods by which a missile may be guided to its target. Most of those described depend on detecting energy radiated or reflected from the target or elsewhere, but reference is also made to a method of guiding long-range ground-to-ground missiles which is based on guidance information from the earth's gravitational field or from astro-navigational fixes. (England.)

Communications and Electronics for Gatwick Airport, R. G. Fall. "Brit. C. & E." September 1958. 7 pp. Gatwick Airport—the second of London's major airports—became operational on 30th May, 1958. The inauguration ceremony was held on the 9th June, 1958 and scheduled services to the Channel Islands operated by British European Airways and Jersey Airlines commenced on that day. (England.)

Microwave Links for Radar Networks, J. W. Sutherland. "Brit. C. & E." September 1958. 8 pp. The operational advantages to be gained by the remote presentation of radar information, the problems of microwave propagation and the parameters of practical transmission systems are discussed in detail.. A radar link is described with particular emphasis on the use of traveling-wave tubes. (England.)

Logical Design of SAGE Radar Input Monitor, Byron L. Bair. "El." August 15, 1958. 6 pp. Speed and clarity of information are prime requisites of any effective radar system such as SAGE. The monitor described accomplishes these objectives and eliminates other unnecessary data simultaneously. Logical design of the equipment and detailed circuitry show how its done. (U.S.A.)

SEMICONDUCTORS

***For Converting Transistor Parameters . . . Jacobians, A New Computational Tool,** T. R. Nisbet and Dr. W. W. Happ. "El. Ind." Nov. 1958. 3 pp. Conversion from one to the other of the six types of parameters for each of the three circuit configurations involved lengthy calculation. The use of this new system reduces this burden to a simple operation. (U.S.A.)

Thermal Turnover in Germanium P-N Junctions, A. W. Matz. "A.T.E. J." July 1958. 15 pp. The static reverse characteristics of an alloyed germanium p-n junction are analyzed, taking into account an avalanche multiplication factor. The condition for thermal stability is examined, the onset of thermal runaway is related to a thermal turnover phenomenon, and the existence of a negative-resistance region is predicted. (England.)

Capacitance Bridges for Semiconductor Measurements, N. F. Blackburne. "A.T.E. J." July 1958. 10 pp. A p-n junction admittance bridge is described that has been designed to measure the effective parallel resistance and capacitance of semiconductor p-n junctions under forward, reverse, or zero bias. (England.)

Measurement of Junction Transistor Equivalent Circuit Parameters, J. J. Sparkes. "A.T.E. J." July 1958. 12 pp. A simple theoretical derivation of the values of the elements of the junction transistor intrinsic equivalent circuit is given. A convenient method of measuring these elements, as well as significant extrinsic elements, to an accuracy of about 5%, using a hybrid parameter test set, is then described. (England.)

A Simple Transistor Amplifier for Energizing a Hall Multiplier, D. J. Lloyd. "El. Eng." September 1958. 2 pp. A Hall-effect multiplier in which the Hall plate is indium antimonide presents a low, variable resistance to the source which supplies it. Since true multiplication occurs between current in the plate and flux density, the current source should have a high impedance if the multiplication is to be accurate. The amplifier described has this property, together with low distortion and economy of power requirements. (England.)

High Voltage Transistor Regulated Power Supplies, Michel Mamon. "El. Mfg." September 1958. 4 pp. Applications for silicon and germanium transistors as voltage regulators. Circit analysis and step-by-step design procedure including considerations of temperature effects on Zener reference diodes and on transistor stability. (U.S.A.)

Designing Transistor Circuits; Combinational Circuits, Part 1, Richard B. Hurley. "El. Eq." September 1958. 5 pp. The types of logic representation applicable to combinational circuits are outlined. Detailed discussion with illustrative material is given for the "level" type of representation used for transistor and diode logic circuits. (U.S.A.)

Designing Transistor Circuits—Combinational Logic, Richard B. Hurley. "El. Eq." Aug. 1958. 4 pp. Convenient analysis of switching circuits can be accomplished by the use of logical algebra. Fundamentals of combinational logic are developed for a transistor switching circuit where the output is a function of the input and of the manner in which a group of switches are interconnected between the output and input. (U.S.A.)

Tomorrow's Transistors Depend on Better . . . Semiconductor Bulk Properties, A. D. Kurtz and C. Gravel. "El. Des." July 9, 1958. 3 pp. (U.S.A.)

Diode Packages and Junctions, J. S. Gillette and W. B. Mitchell. "El. Des." July 23, 1958. 4 pp. (U.S.A.)

With Zener Diodes, the Curves Make All the Difference, Bernard B. Daien. "El. Des." July 23, 1958. 3 pp. (U.S.A.)

Choosing Diodes for Typical Pulse Systems, Frank C. Jarvis. "El. Des." July 23, 1958. 2 pp. This article shows the advantages and disadvantages of three basic philosophies. (U.S.A.)

Transistorized High Frequency Chopper Design, Rob Roy. "El. Des." Aug. 6, 1958. 2 pp. High frequency chopping technique which balances out unsymmetrical transistor switch impedances and undesirable carrier leakage. (U.S.A.)

Analysis and Experimental Results of a Diode Configuration of a Novel Thermoelectron Engine, G. N. Hatsopoulos and J. Kaye. "Proc. IRE." Sept. 1958. 6 pp. The direct conversion of heat into useful electrical work without utilization of moving mechanical parts has been successfully achieved in a novel device called the thermoelectron engine. This device is a heat engine in the thermodynamic sense because the working fluid, an electron gas, receives heat at a high temperature, rejects heat at a lower temperature, and delivers useful electrical work to an external load. (U.S.A.)

TELEVISION

***For Vidicon Film Cameras . . . Controlling Light Automatically, Part 2,** W. L. Hurford et al. "El. Ind. Ops. Sect." Nov. 1958. 2 pp. A neutral density filter interposed between source and camera makes possible unattended operation of film chains. The complete system is detailed here. (U.S.A.)

The Protection of Colour-Television Pictures, T. Poorter and F. W. de Vrijer. "Phil. Tech." August 22, 1958. 18 pp. A projection system for monochrome television was developed in the Philips Eindhoven Laboratory over 10 years ago. Further work has now resulted in the development of apparatus for the projection of colored television pictures onto a screen. (Netherlands, in English.)

The Relation Between Picture Size, Viewing Distance and Picture Quality, L. C. Jesty. "Proc. BIEE." September 1958. 15 pp. The paper describes experiments to determine the preferred viewing distance for a number of different types and sizes of picture, including 405-line and 625-line monochrome television and a 405-line color television picture, all with varying bandwidths. (England.)

$\Delta G = \Delta G / e n_i \mu_p S$

THEORY

On the Problem of Dimensions of Electromagnetic Elements, B. S. Sotskov. "Avto. i Tel." September 1958. 6 pp. The paper treats the basic correlations in connection with the efficiency of an electromagnetic system with its magnetic, electric and heat parameters and its lifetime. (U.S.S.R.)

Noise in Maser Amplifiers—Theory and Experiment, J. P. Gordon and L. D. White. "Proc. IRE." Sept. 1958. 7 pp. This paper contains a theoretical treatment of noise in maser amplifiers and the results of experimental measurements of the noise of an ammonia beam maser. The concept of "effective input noise temperature" is defined and used. (U.S.A.)

TRANSMISSION

Guided Wave Propagation in Submillimetric Region, A. E. Karbowiak. "Proc. IRE." October 1958. 6 pp. An analysis of electromagnetic wave propagation in waveguides (in TH and TE modes) as well as in TEM transmission lines (e.g., coaxial) at frequencies in the extremely high frequency band (30 to 300 kmc) and higher is carried out. (U.S.A.)

Amplitude and Frequency of a Modulated Carrier, A. Ditl. "Hochfreq.," Vol. 66, No. 5. Mar. 1958. 8 pp. To use fully the available frequency bands, a thorough knowledge of modulation and demodulation is required. When this process can be idealized on a few points, a mathematical equation can be developed which describes the linear signal distortion. This, in turn, provides the basis for general understanding for the various types of modulation. Examples are provided for single side band modulation, with or without carrier, and amplitude modulation without carrier. The influence of disturbance signals are also discussed. (Germany.)

Radio Observation of the First Two Artificial Earth Satellites, H. Fleischer. "Nach. Z." July 1958. 8 pp. The measurements of transmissions from artificial earth satellites are a novelty. The paper contains an outline of types of measurements which can be carried out in order to obtain informations for radio transmission measurements on future satellites. (Germany.)

TUBES

The Optimum Design of Electrostatically Deflected Cathode-Ray Tubes, Hilary Moss. "J. BIRE." August 1958. 7 pp. By making use of the equations of motion in a parallel plate deflector system and an expression for limiting current density due to Langmuir, a solution is reached. (England.)

The Helitron Oscillator, D. A. Watkins and G. Wada. "Proc. IRE." October 1958. 6 pp. A new type of voltage-tuned microwave oscillator, called the helitron, is described. This device is a practical example of E-type interaction. (U.S.A.)

Unusual Tube Effects Cause Circuit Troubles, W. E. Babcock. "El." September 12, 1958. 4 pp. Survey of circuit problems effected by peculiarities in electron tubes covers sleeping sickness, blackout, d-c shift, stray emission, mica charge, spook interference, snivet interference and other phenomena not ordinarily described in literature on tubes and circuits. Causes, effects and solutions are covered for each of these unusual phenomena. (U.S.A.)

On the Use of Oscillator Triodes in HF Generators with Changing Loads, E. G. Dorgelo. "El. Rund." July 1958. 7 pp. The operation line can be obtained by registering the momentary values of grid and plate voltages of an oscillating triode in a $V_g V_a$ diagram. Changing of load impedance results in changing the position and length of this curve and with it of the HF output of the valve. (Germany.)

The Resnatron as a 200-MC Power Amplifier, E. B. Tucker, et al. "Proc. IRE." Aug. 1958. 10 pp. The tube described in this paper boasts a mighty 3.5 million watts pulsed peak power output at 200 megacycles. It stands 15 feet high, weighs 2½ tons, and its filament draws a mere 7000 amperes. The tube is called a resnatron, which denotes a type of tetrode in which the cavities and tuners are located inside the tube envelope instead of outside. (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.

Investigation of the Applicability of High Frequency Sound Waves (Ultrasonics) for Cleaning of Precision Parts, O. E. Mattiat and P. P. Zapponi, Clevite Research Center for Wright ADC. June 1957. 76 pages. (PB 131361, OTS) $2. Accessible soils of all kinds are shown to be easily removed from small precision parts by the ultrasonic systems studied. Inaccessible soils, such as steel particles in bearings and grease in blind holes, require high sonic intensities and a coupling fluid with optimum cavitating and solubility or dispersability properties for the particular soil. Low frequency systems appeared more effective than high frequency systems for removing most soils investigated. Those included greases, burnt-on carbon, lapping and buffing compounds, steel particles, and a synthetic soil. It was further observed that bearing damage resulting from ultrasonic treatment is insignificant for the short cleaning times normally required. Processes are recommended for cleaning precision parts and bearings. A coupling fluid—trichloroethylene—is shown to be best for removal of soils. The steel-removal and probe methods, two new processes for evaluating ultrasonic systems and factors, are described.

Development of a Nondestructive Test for Evaluation of Adhesion of Electrodeposits on Steel as in Silver-Plated Aircraft Bearings, A. L. Walters and S. A. Wenk, Battelle Memorial Institute for Wright ADC. Nov. 1953. 65 pages. (PB 131226, OTS) $1.75. Reliable nondestructive test methods used commercially for inspection of silver-plated aircraft bearings are discussed. Selection of the test method depends on whether a copper or nickel strike is applied to the bearing shell before silver plating. The shot peening test, in which the surface of the silver plate is lightly shot peened under controlled conditions, is used principally on bearings having a copper strike. In the bake test, nickel strike bearings are tested by heating the bearing to 950 F, followed by rough boring, or machining to size and then X-raying the bearing surface. A summary of processing operating procedures for silver plating and bond testing at one industrial plant is included, together with plating and testing data for experimental panels processed at Battelle. The report also suggests changes in an Air Force Technical Order to improve the procedure for silver plating and reduce the occurrence of poorly adherent silver plate at USAF depots overhauling aircraft engines.

Design Methods for Magnetic Amplifiers and Saturable Reactors: Supplement No. 1, J. R. Walker and M. Frank, Wayne Engineering Research Institute for Wright ADC. May 1957. 64 pages. (PB 121765S, OTS) $1.75. A portion of this supplementary report is devoted to a discussion of difficulties encountered by a subcontractor in evaluating magnetic amplifiers developed during the original research described in PB 121765. Fault was shown to be in incorrect measurements, and these amplifier designs are shown to be functional after proper adjustments. The volume also reports studies of the influence of a series line resistor, use of four cores, and importance of a quality ratio on the performance of half-wave magnetic amplifiers. Various core materials and sizes were checked to specify a sensitivity factor utilized in a simplified design procedure for full-wave amplifiers. Simplified methods of design for half-wave amplifiers were also considered. (The report of the original research, PB 121765, **Design Methods for Magnetic Amplifiers and Saturable Reactors**, July 1956, 628 pages, was released earlier and is still available from OTS, price $9.50.)

Grid-Controlled Rectifiers: An Annotated Bibliography, M. Benton, Naval Research Laboratory. July 1957. 95 pages. (PB 131126, OTS) $2.75. This bibliography was compiled after a search of the literature uncovered no comprehensive reference to grid-controlled rectifiers and their application in radio transmitters. Entries refer to literature published between 1923 and early 1957. Books, periodical articles, and unclassified research reports are included. References are listed chronologically by author. An author index and a subject index are also included.

The Modulus of Rupture of zxt 45 ADP Crystals, B. J. Faraday and D. J. G. Gregan, Naval Research Laboratory. Aug. 1957. 6 pages. (PB 131255, OTS) 50 cents. A physical property which limits the rate of generation of sound energy by a piezo electric crystal is its mechanical breaking stress. This property was investigated for the zxt 45 orientation of ammonium dihydrogen phosphate (ADP) because of the extensive application of this crystal in underwater transducers. The modulus of rupture (breaking strength) was determined by the three-point loading method. Measurements were performed with the aid of a breaking apparatus designed for the application of a constant loading rate commencing with the specimen in a zero-load condition. The measured values of the modulus of rupture agreed closely with figures previously reported for ADP crystals of arbitrary orientation. No significant variation of the modulus was observed for different crystal width-to-length ratios.

An Experimental Distributed Power Amplifier, S. K. Meads, Naval Research Laboratory. Aug. 1957. 19 pages. (PB 131164, OTS) 50 cents. Use of distributed amplification in a pulsed power amplifier was investigated as a possible method of attaining a broadband source of rf power at a level suitable for use as a final transmitter stage for radar in the vhf and uhf bands. Following a simplified procedure which is described in the report, an experimental amplifier was built which delivered a pulse power of approximately 100 kilowatts throughout a frequency band of 45 Mc, centered at 188 Mc. Within this band, plate efficiency varied from 31 to 37 percent and power gain was approximately 15 db. Fourteen 4X150A tetrodes were used. Among its advantages, the distributed amplifier's obtainable frequency bandwidth is sufficient for most conceivable applications. Each of its small tubes contributes independently to the total output, and several of them could fail without total loss of transmitter power.

Study of the Oxide Cathode in Demountable Vacuum Systems, G. A. Haas and J. T. Jenson, Jr., Naval Research Laboratory. Aug. 1957. 11 pages. (PB 131129, OTS) 50 cents. The life of oxide cathodes in demountable vacuum systems can be substantially increased by keeping the cathode above 100 C during air exposure. This not only serves to reduce flaking by preventing hydrate formation and allowing the oxide to change only to the simple hydroxide, but also decreases the pickup of deleterious gases such as CO_2 and pump-oil vapor. Tests indicated that keeping the cathode hot in air does not harm the filament. Poisoning by evaporation products on the anode was shown to be virtually eliminated by baking the tube parts. One of the main contributions to anode contamination appeared to be the initial conversion to the carbonate. Less poisoning was observed when this step was eliminated by starting the cathode from the hydroxide.

Final Report on the Detection of Small Optical Density Changes, D. G. Kilpatrick and B. Chance, Univ. of Pennsylvania for Office of Naval Research. June 1956. 11 pages. (PB 131015, OTS) 50 cents. This report deals mainly with investigation of the projection cathode ray tube as a light source for spectrophometry. The tube was found ineffective as a point source because of limited light output per unit area. As an area source, however, it was controllable with small amounts of power, it was relatively cool, and its response to a control leap was fast. Work with the 5TP4 projection kinescope on problems of area source, high voltage regulation, and the light feedback loop is described.

Environmental Requirements Guide for Electronic Parts, Advisory Group on Electronic Parts, Office of the Assistant Secretary of Defense for Research and Engineering. Oct. 1957. 11 pages. (PB 131423, OTS) 50 cents. This volume provides a guide to the research and development requirements for environmental design of electronic parts, including related test procedures. The guide was intended for use by the three military services in current and future electronic planning. A chart provides environmental requirements for 10 groups of parts, including those for use in electronic hardware items; highly specialized components; general shipboard and ground components and those under nuclear radiation; high-performance aircraft and surface-to-air and air-to-air missiles; nuclear-powered aircraft and ballistic missiles; shipboard missiles; and nuclear-powered weapons. Data are given for such environmental characteristics as temperature, pressure, moisture, vibration, shock, acceleration, explosive atmosphere, sand and dust, salt atmosphere, flammability, nuclear radiation, and fungus resistance. Also described are test procedures to determine the resistance of electronic parts to harmful effects of natural elements and the conditions of use in military equipment.

Performance of Copper-Mandrel Potentiometers in A-C Operational Amplifiers, H. H. Hosenthien, Army Ballistic Missile Agency. Sept. 1956. 35 pages. (PB 131289, OTS) $1. A simple method is described for phase error compensation for multiturn copper-mandrel potentiometers used as variable feedback resistance elements for gain setting of operational amplifiers in a-c analog computers. The potential of the copper mandrel is held close to one-third the potential of the potentiometer slider with respect to the beginning of the resistance winding. A figure of merit is established. The report discusses the stability of the operational amplifier with phase error compensation. Practical circuit configurations employing phase error compensation are presented. A study also is made of the envelope behavior of the compensated operational amplifier by means of modulation equivalent transfer matrices.

Development of Sandwich Construction Inorganic Radomes, Part 2, T. M. Giles, N. Tallan, J. O. Everhart, A. T. Chapman and P. S. Hessinger, Ohio State Univ. Research Foundation for Wright ADC. Aug. 1957. 45 pages. (PB 131406, OTS) $1.25. The mechanical properties of mechanically bloated wollastonite covered with zircon skins were investigated. Foamed wollastonite as a core material was found to have excellent electrical properties. However, its strength, thermal shock resistance, and stability were not suitable for radome applications. Study of more stable, less reactive materials such as alumina and zircon for mechanically bloated core materials is recommended. Fire-bloated shapes of pyrex glass containing small additions of lampblack were successfully fabricated. Truncated 30° cones, 13 inches high, were produced. Other bloating agents were studied and although many were found satisfactory, none were as controllable and uniform as lampblack.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Clipping and Current Limiting Circuit, #2,823,275. Inv. C. F. Ault. Assigned Allen B. Du Mont Laboratories, Inc. Issued Feb. 11, 1958. A substantially direct connection between the cathode of an amplifier and ground causes it to operate as a plate loaded amplifier, while a resistance connected between cathode and ground causes it to operate as a cathode follower. The circuit is so designed that the resistance will be substituted for the direct connection when the input signal exceeds a predetermined value, whereby the operation of the amplifier changes from that of a plate loaded amplifier to that of a cathode follower, limiting the amplifier current.

Traveling Wave Tube, #2,824,257. Inv. G. M. Branch. Assigned General Electric Co. Issued Feb. 18, 1958. The inner outer conductives helices of equal but oppositely directed helix pitch are conductively connected in parallel. The conductive connection is of limited circumferental extent and positioned between and along the length of the helices; it comprises radial segments connected between selected facing turns of the helices.

Current Control Regulator, #2,824,276. Inv. H. Stump. Assigned Hughes Aircraft Company. Issued Feb. 18, 1958. The operating curve of a transistor is selected by its emitter-base circuit. The variable load impedance, the current through which is to be maintained constant, is supplied with the collector current. The base-collector circuit of the transistor is connected to the cathode-grid circuit of a current-generating tube, whereby variations of the voltage drop across the transistor control the tube current to maintain the load impedance current constant.

Antenna, #2,824,306. Inv. E. R. Praff. Assigned Admiral Corporation. Issued Feb. 18, 1958. The antenna inductance is a conducting helice disposed about a ferrite core. The spacing is adjusted to retain maximum helix permeability and dielectric absorption by the core is minimized. The spacing is determined by a formula containing an experimentally-determined constant.

Printing Control Circuits for Photoelectric Engraving Machines, #2,824,905. Inv. M. Farber. Assigned Fairchild Camera and Instrument Corp. Issued Feb. 25, 1958. A screen generator connected to the light source modulates the photocell output. An adjustable printing control is provided which adds a portion of the screen generator signal to the stylus motor, while subtracting another portion from the photocell signal. The resulting modified signals are combined and additively applied to the stylus motor.

Television System, Method and Apparatus for Multiplex Signaling, #2,824,908. Inv. R. C. Palmer. Assigned Allen B. Du Mont Laboratories, Inc. Issued Feb. 25, 1958. The timing of either the leading or the lagging edges of a pulse series is varied in accordance with a first signal. Separately the first signal is mixed with a second signal and the mixed signal delayed by a time interval equal to the time interval between successive pulses. The pulse amplitude is varied in accordance with this delayed signal.

Radio Transmitting System, #2,824,955. Inv. R. Lee. Assigned Westinghouse Electric Corp. Issued Feb. 25, 1958. The output circuit of an F.M. transmitter is coupled to the antenna tuning coil. The a.c. winding of a saturable reactor is connected in shunt with a portion of the tuning coil, while the control winding of the saturable reactor is supplied with a potential which varies with the modulating frequency, whereby the antenna is always tuned for maximum energy transfer.

Screen-Grid-to-Control-Grid Feedback Circuits, #2,824,963. Inv. P. M. Tedder, Issued Feb. 25, 1958. A first battery is connected through a first network between the cathode and the plate and screen grid of a stabilized amplifier; a second battery is connected through a second network between the cathode and the control grid of the stabilized amplifier. A resistor extends between the screen grid and the control grid, providing negative feedback. The networks, the resistor and the batteries being dimensioned to maintain the control grid negative with respect to the cathode and to provide substantially d.c. negative feedback from the screen grid to the control grid.

Semi-Conductor Oscillator Circuits, #2,824,964. Inv. H. Yin. Assigned Radio Corporation of America. Issued Feb. 25, 1958. A high-frequency oscillator comprises a transistor having an auxiliary base electrode. Energizing potentials are solely applied to the normal base, the auxiliary base and the collector electrodes to provide a negative resistance characteristic to the collector circuit. A frequency-determining circuit is connected to the collector electrode, and a coupling capacitor is inserted between the emitter and the collector electrodes.

Electro-Optical System, #2,824,975. Inv. K. D. Smith. Assigned Bell Telephone Laboratories, Inc. Issued Feb. 25, 1958. One terminal of a series circuit including a light-responsive resistor is coupled for a.c. only to the input circuit of a vacuum tube, while its other terminal is conductively coupled by means of an impedance to the input circuit.

Glow Discharge Device, #2,824,985. Inv. T. E. Foulke. Assigned General Electric Company. Issued Feb. 25, 1958. The envelope contains an inert gas at a pressure from 70 to 200 millimeters of mercury. A pair of closely spaced cold electrodes are sealed into the envelope, their electron-emissive coating containing 15 to 30 mol percent thorium oxide, 20 to 40 mol percent barium oxide, and the balance strontium oxide.

Magnetrons, #2,824,998. Inv. J. P. Molnar. Assigned Bell Telephone Laboratories, Inc. Issued Feb. 25, 1958. A circular array of cavity resonators is arranged in a conductive body. One of these resonators is larger than the majority thereof, and this resonator is coupled for energy transfer. A tuning pin is insertable into each resonator, the tuning pin for the energy-transfer resonator being larger than the majority of the coupling pins.

Pulse Time Modulation Signal Transmission System, #2,825,028. Inv. K. Kinoshita, I. Yasuda and H. Fukukita. Assigned Japan Broadcasting Corp. Issued Feb. 25, 1958. The oscillator in a pulse-time modulation system has the modulating potential applied to its grid. An independent auxiliary oscillator produces a signal of superaudio frequency which is superposed on the oscillator frequency.

Color Television Receiver, #2,825,754. Inv. P. M. G. Toulon. Assigned Moore and Hall. Issued March 4, 1958. To present a first primary color picture, the CR tube spot moves in horizontal alignment along a first and every third succeeding vertical column at frame frequency. To present the second primary color, the spot moves similarly along a second vertical column and all columns removed therefrom by an integral multiple of three. The last primary color is presented by the spot moving along the remaining vertical columns which are similarly spaced.

Automatic Gain Control of Keyed Automatic Gain Control Amplifier, #2,825,756. Inv. W. J. Gruen and R. F. Foster. Assigned General Electric Corp. Issued March 4, 1958. A variable-impedance tube, connected in a voltage dividing network, is connected to the auxiliary control electrode of the gain control amplifier to determine its operating characteristics. The video output is fed to the control grid of the gain control amplifier. The gain control voltage is fed back to the grid of the variable-impedance tube in a sense to decrease the positive voltage on the auxiliary control electrode of the gain control amplifier by an amount inversely proportional to the amplitude of the video output which is the signal to be controlled.

Magnetically Loaded Electrical Conductors, #2,825,760. Inv. A. M. Clogston. Assigned Bell Telephone Laboratories, Inc. Issued March 4, 1958. The wave guide comprises a multiplicity of elongated magnetic conducting portions spaced by insulating material, in the form of alternately magnetic conducting and non-magnetic insulating laminations. The conducting portions carry a substantial portion of the induced current. Each conducting lamination has at least one dimension transverse to the direction of wave propagation which is small compared to the skin depth, whereby the conducting medium is substantially penetrated by the electric field of the propagated wave.

Amplifying Circuit for Microwaves, Especially Millimeter Waves, #2,825,765. Inv. G. R. P. Marie. Issued March 4, 1958. A cylindrical resonator is arranged coaxially between two circular waveguides propagating the TE_{01} mode. An insulating rod having a very high magnetic permeability extends along the resonator axis. An auxiliary circularly polarized TM_{11} wave of lower frequency than the TE_{01} wave is excited in the resonator, tuned to this lower frequency which is also the ferromagnetic resonance frequency of the rod.

High Fidelity Audio Amplifier, #2,825,766. Inv. S. A. Corderman. Assigned McIntosh Laboratory, Inc. Issued March 4, 1958. A cathode-loaded driver is directly coupled to the grid of a cathode-loaded amplifier having a cathode-winding bifilarly related to a secondary winding. The driver plate supply is connected to the a.c. ground potential point of the secondary winding and the driver plate to a point on the secondary winding of equal a.c. potential with the cathode of the amplifier, providing a feedback loop. The circuit is illustrated as a push-pull design.

Intercarrier Television Receivers, #2,826,633. Inv. L. W. Parker. Issued March 11, 1958. A network, including a series capacitor-inductor arm resonant to a frequency within the frequency-modulated audio signal, is connected to the output of a television amplifier. The series arm presents a high impedance to the video band. A parallel circuit resonant at the same frequency is inductively coupled to the series-arm coil to extract the FM sound signal.

Pulse Analyzer Circuit, #2,826,648. Inv. F. Kessler. Assigned General Dynamics Corp. Issued March 11, 1958. Each digit pulse in a telephone system consists of a make portion and a break portion. In the analysis suggested complete duration of a predetermined one of the digit pulses is measured as well as the duration of either its make or its break portion. The two durations are then compared.

Cascaded Triode-Pentode Counter Circuit, #2,826,688. Inv. W. J. Anderson. Assigned Chicago Musical Instrument Co. Issued March 11, 1958. Each of a plurality of cascade-coupled stages in a musical instrument producing audio signals at octave separation consists of a triode section and a pentode section. A paying-key operated switch for each stage withdraws plate voltage from the pentode of the respective stage, the pentode plate being only electron-stream coupled to the other electrodes and not participating in the generation of the sound. Withdrawing signal voltage from one or more of the stages is possible without overloading; the octave spacing is maintained.

Free-Running Multivibrator, #2,826,694. Inv. R. L. Ropiequet. Assigned Tektronix, Inc. Issued March 11, 1958. The cathodes of two tubes are connected by a feedback circuit. The plate of the first tube is conductively connected to the grid of the second tube, while the grids are connected by a frequency-determining conductive feedback path which introduces a time delay.

International ELECTRONIC SOURCES

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Transistor Bistable Oscillator, #2,826,695. Inv. R. L. Gray. Assigned Burroughs Corp. Issued March 11, 1958. The capacitor of a series resonant circuit is inserted between the emitter and collector electrode, while the inductor of the series resonant circuit is inserted between the emitter and base electrode. The transistor is normally biased to a non-conductive state. Pulses of opposite polarity are alternately applied to the emitter to start and stop oscillations. The oscillation frequency is determined by the series resonant circuit.

Electronic Storage of Information, #2,826,715. Inv. F. C. Williams, T. Kilburn and H. J. Crawley. Assigned National Research Development Corp. Issued March 11, 1958. Numerical information selected from more than two different quantities is stored by moving a cathode-ray beam first along a first track on a charge-retaining surface to produce either zero, positive or negative charge thereon and then along another track spaced a distance from the first track which depends on the quantity to be stored to produce a different charge from the first track. A voltage is generated as the beam passes from the first track to the second track which voltage is used to regenerate the second track charge.

Beam Selection System, #2,826,716. Inv. J. T. McNaney. Assigned General Dynamics Corp. Issued March 11, 1958. A plurality of circularly disposed character-shaped electron beams is generated in a selected shaped-beam C.R. tube. A apertured selection plate positioned in the path of the electron beam passes only one of the character-shaped beams, the aperture being aligned with the circumference of the circle of the beams. The character-shaped electron beams are revolved until a desired beam passes through the plate aperture.

Cathode-Ray Scanning Systems, #2,827,591. Inv. R. McNeill Bowie. Assigned Sylvania Electric Products, Inc. Issued March 18, 1958. An index beam, simultaneously deflected with a plurality of color signal beams, cooperates with control signal generating elements alternating with different color phosphor elements on the CR screen. The signal generated each time the index beam impinges on one of the signal generating elements, maintains the index beam in contact with successive control signal generating elements.

High Purity Color Information Screen, #2,-827,593. Inv. L. R. Koller. Assigned General Electric Co. Issued March 18, 1958. The improved screen is intended for a penetron type CR tube, wherein the screen potential is switched at a predetermined rate to vary the electron beam energy. The screen comprises a plurality of uniform transparent continuous phosphor films for different colors. A spurious emission quenching field of the order of 10^4 volts per centimeter and a frequency exceeding the predetermined potential switching rate is applied across at least one of the transparent films.

Transistor, #2,827,599. Inv. P. J. W. Jochems. Assigned North American Philips Co., Inc. Issued March 18, 1958. A pair of spaced regions of one conductivity type are arranged on a semiconductive member of the opposite conductivity type. A base ohmic connection is made to the semiconductive member, while emitter and collector terminal connections are made to one of the spaced regions, respectively. A nonconductive region is arranged in the semiconductive member between at least one region and the base connection.

Transistor Demodulator and Modulator, #2,-827,611. Inv. J. W. Beck. Assigned North American Aviation, Inc. At least a pair of oppositely conducting type transistors are fed in phase by the signal. One of two oppositely poled diodes is connected in series with each of the transistors, their output being individually fed to the load. An a.c. reference source controls the current through both diodes.

Radar System, #2,827,627. Inv. F. R. Arams. Assigned Radio Corp. of America. Issued March 18, 1958. In the receiver, the returned signal is mixed with a low-frequency oscillation generated in the receiver at a desired i.f. frequency. The mixed signal is further heterodyned with the carrier frequency signal from the transmitter to obtain the desired i.f. frequency signal.

Color-Television Transmission System, #2,828,-354. Inv. J. Haantjes and F. W. de Vrijer. Assigned North American Philips Co., Inc. Issued March 25, 1958. Two of the three component color signals are each modulated onto an auxiliary carrier; the two frequency ranges of these modulated auxiliary carriers overlap at least partially. The two auxiliary carriers have a frequency which are multiples of the line repetition frequency, the multiplying factor being $n + k/4$ and $m + k/4 + \frac{1}{2}$, respectively. The receiver contains two selective demodulators, each tuned to one of the auxiliary carrier frequencies.

Clamped Synchronizing Signal Separator, #2,-828,356. Inv. A. Macovski. Assigned Radio Corporation of America. Issued March 25, 1958. A capacitor and resistor in shunt are connected between the video signal amplifier and the synchronizing signal separator. A normally non-conductive diode is also connected to the input of the synchronizing signal separator, the diode becoming conductive, and effectively shunting the input, in response to keying pulses synchronous with received recurrent control pulses.

Magnetic Reproduction System, #2,828,368. Inv. D. E. Wiegand. Assigned Armour Research Foundation of Illinois Institute of Technology. Issued March 25, 1958. The magnetic playback head is provided with an induction coil for generating a voltage which is a function of the time derivative of the signal flux linking the head. This voltage is integrated and fed to a linear amplifier. A positive feedback circuit extends from the amplifier output to a point including the integrating circuit.

High Fidelity Audio Amplifier, #2,828,369. Inv. A. M. Wiggins. Assigned Electro-Voice, Inc. Issued March 25, 1958. The positive terminal of each of a pair of d. c. voltage sources is connected to the plate of one tube, while the negative terminal is connected to the cathode of the other tube. A pair of serially connected impedances extends between the two cathodes, their midpoint being connected to a grid-biasing d.c. source. The output is derived from a transformer, the primary of which connects the two plates. Thus in the absence of signal no d.c. current flows through the transformer primary and only bias current flows through the impedances.

Signal Mixer System, #2,828,411. Inv. J. T. Bearwood, C. T. McCoy and D. E. Sunstein. Assigned Philco Corp. Issued March 25, 1958. The signal to be heterodyned is applied to more than two mixers so that the instantaneous phase relationship between the local oscillator signal and the incoming radio frequency signal increases progressively for successive mixers by equal increments of $2a\pi/n$, where a is an integer and n is the number of mixers. These n signals are combined in a network to provide substantially complete cancellation of the converted local oscillator noise signal and an uncancelled intermediate frequency signal.

Single-Sideband Receiver for Speech Signals, #2,828,412. Inv. F. de Jager and J. A. Greefkes. Assigned North American Philips Co., Inc. Issued March 25, 1958. Suppressed-carrier single-sideband signals are fed to a single-sideband demodulator including a mixer and a local carrier-wave oscillator, and an amplitude limiter. The signal is applied to the mixer through the limiter.

Self-Contained Antenna-Radio System in Which a Split Conductive Container Forms a Dipole Antenna, #2,828,413. Inv. F. K. Bowers. Assigned Bell Telephone Laboratories, Inc. Issued March 25, 1958. Two conductive containers, each having a substantially closed surface are disposed in spaced relationship and connected by an impedance element, whereby the containers act as dipole antenna coupling the impedance element to free space. The terminal stage of a r.f. translating system is disposed in these containers, the containers operating as a shield. The terminal stage is electrically coupled to the impedance element. A conductive sheet provides a fixed reactive coupling between the two containers.

Electron Beam Focussing Device, #2,828,434. Inv. W. Klein. Assigned International Standard Electric Corp. Issued March 25, 1958. An apertured disc of magnetic material is interposed between the electron beam and the magnetic focussing field which maintains the beam at a substantially uniform diameter. The beam progresses through the disc aperture. The disc shields the electron gun from the effect of the magnetic focussing field; the disc position is adjustable.

Traveling-Wave Tube, #2,828,440. Inv. W. J. Dodds and R. W. Peter. Assigned Radio Corporation of America. Issued March 25, 1958. The amplification bandwidth of the tube is limited by discontinuous means distributed along substantially the entire length of the helix for producing substantial inductance changes along the helix.

Color Television Synchronizing, #2,829,193. Inv. H. Kihn and J. Olson. Assigned Radio Corporation of America. Issued April 1, 1958. The three-electrode normally non-conductive tube is used to separate the color-synchronizing burst from the composite signal. The synchronizing pulses, preceding the burst, are coupled to the first electrode, making the tube conductive in response to their trailing edges. The first and second electrodes are connected to operate as a blocking oscillator. The composite signal is applied to the third electrode.

Combined Microphone and Telephone Pickup for Hearing Aids, #2,829,202. Inv. F. T. Spera. Assigned Philco Corp. Issued April 1, 1958. The microphone casing is at least in part of magnetic material and a telephone pickup coil is wound on this magnetic section. Thus the magnetic casing section serves as a core to enable inductive pickup by the coil from a close telephone receiver.

Narrow Band Amplifiers or the Like, #2,829,-211. Inv. L. R. Jacobsen. Assigned Hoffman Electronics Corp. Issued April 1, 1958. A composite input signal, only one frequency of which is to be selected, is applied to the grids of two tubes. The tubes have a common cathode load impedance shunted by a crystal resonant at the frequency to be transmitted. The plate of the first tube is connected to a plate supply, that of the second tube is connected to a resonant output circuit. Thus the second tube will amplify only signals of the crystal resonant frequency and will be degeneratively biased at other frequencies.

Electron Discharge Devices, #2,829,299. Inv. A. H. W. Beck. Assigned International Standard Electric Corp. Issued April 1, 1958. A magnetic field is arranged coaxial with a tunnel member to minimize divergence of an electron beam traversing the tunnel. The electron beam emitter is of materially greater cross-sectional area than the tunnel; the beam is subsequently electrostatically focused. The magnetic field is shielded so as not to affect the beam prior to its entrance into the tunnel.

Traveling Wave Device, #2,829,300. Inv. J. R. Wilson. Assigned Bell Telephone Laboratories. Issued April 1, 1958. A high resistance wire is helically wound directly upon the helical conductor of the traveling-wave tube. The wire is in continuous electrical contact with the helical conductor and has a pitch determinative of the attenuation at any point along the line to optionally increase the attenuation at any desired point or points.

IMPROVED SWITCHING CHARACTERISTICS!

DELCO HIGH POWER TRANSISTORS OFFER UNSURPASSED PERFORMANCE FOR HIGH VOLTAGE, HIGH POWER APPLICATIONS

TYPICAL CHARACTERISTICS AT 25°C

	DT100	DT80	2N174A*	2N174
Maximum Collector Current	15	15	15	15 amps
Maximum Collector Voltage (Emitter Open)	100	80	80	80 volts
Saturation Resistance	.02	.02	.02	.02 ohms
Thermal Gradient (Junction to Mounting Base)	.8	.8	.8	.8 °C/watt
Nominal Base Current I_B (V_{EC}=2 volts, I_C=5 amps)	135	100	135	135 ma
Collector to Emitter Voltage (Min.) Shorted Base (I_C=.3 amps)	80	70	70	70 volts
Collector to Emitter Voltage (Min.) Open Base (I_C=.3 amps)	70	60	60	60 volts

*Designed to meet MIL-T-19500/13A (Jan) 8 January 1958

HERE IS A LINE OF TRANSISTORS SPECIALLY DESIGNED FOR SWITCHING APPLICATIONS.

Check your switching requirements against the new characteristics of Delco High Power transistors. You will find improved collector to emitter voltage characteristics. You will find higher maximum current ratings—15 amperes. You will find that an extremely low saturation resistance has been retained.

Another important improvement is the solid pin terminal. And, as always, diode voltage ratings are at the maximum rated temperature (95°C.) and voltage.

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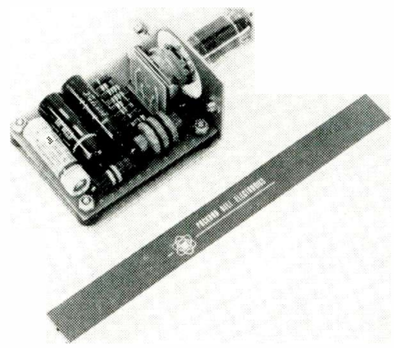
Circle 72 on Inquiry Card, page 149

New Products

AUDIO MODULES

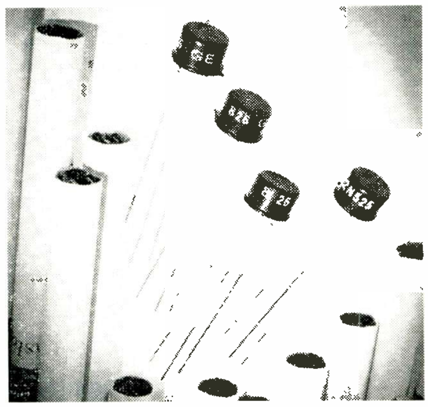
Eleven audio circuit modules can be used in various combinations to make up common circuits, reducing pre-design and breadboarding time. Trouble shooting is simplified and often eliminated. Design time can thus be concentrated on new circuitry. The modules also can be used in production of electronic equipment. They can be combined to build at least 35 complete circuits including tape recorder, broadcast, pre-amplifier, broadcast line amplifier, tape playback amplifier, public address system, control amplifiers and modulators. Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.



Circle 250 on Inquiry Card, page 149

TRANSISTORS

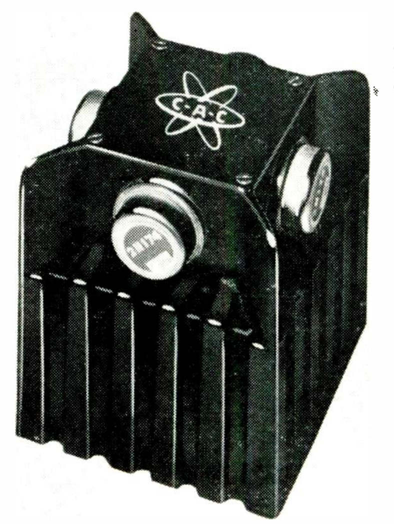
A line of 30 v., ½ amp. pnp germanium transistors for use in industrial and data processing equipment are available. They have been designed for medium power amplifier and low frequency, high current switching applications. The 4 models in this line have received JETEC designations 2N524, 2N525, 2N526, and 2N527. They have a triangular lead arrangement and are housed in the JETEC TO-5 package. General Electric Co., Syracuse, N. Y.



Circle 251 on Inquiry Card, page 149

DC-DC CONVERTER

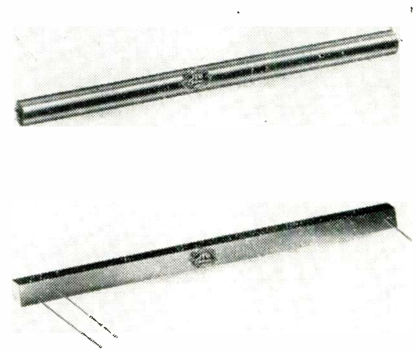
Transistorized dc to dc converters are designed for heavy duty, maximum reliability and service under the maximum adverse conditions. They convert 28 vdc to 500 vdc. They have 100 watts output at 40,000 ft. and operate at 71° C ambient temperature with no heat sink required. Converters are capable of output power up to 200 watts dc continuous. Operating range is from —55° to 71° C. Unit weighs only 2.7 lbs. Communication Accessories Co., Lee's Summit, Mo.



Circle 252 on Inquiry Card, page 149

DELAY LINES

Delay Lines, both lumped and distributed constant types, are available for printed circuit assembly or for conventional mounting. The units can also be modified or especially designed to meet individual requirements. Distributed Constant Delay Lines are recommended for applications calling for short delay intervals and offer a high ratio of delay to pulse rise time, in minimum space. JFD Electronics Corp., 1462 - 62nd St., Brooklyn 19, N. Y.

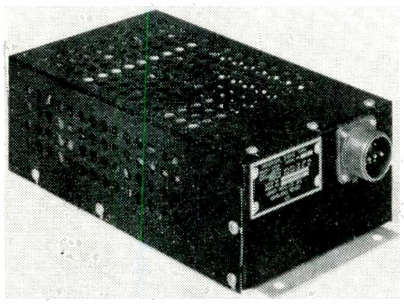


Circle 253 on Inquiry Card, page 149

New Products

INVERTERS

The Model 4309 static inverter produces both single and 3 phase 400 cycle power from 28 vdc input. A bimetallic tuning fork reference controls the frequency to 400 cps ±0.1%

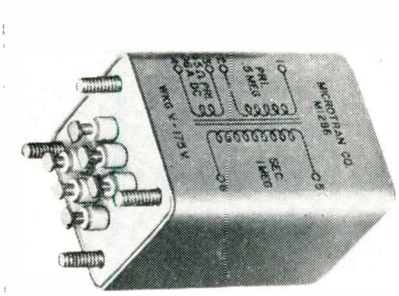


over the environmental range of —55° C to +71° C. Utilizing transistors in a bridge switching circuit for maximum reliability, 170-200 VA of single phase power and approximately 50 watts of three phase power are obtained from a unit weighing only 9½ lbs. Operates to 71° C without heat sinks or cooling air. Varo Manufacturing Co., Inc., 2201 Walnut St., Garland, Tex.

Circle 254 on Inquiry Card, page 149

TRANSFORMERS

A line of power supply transformers designed for use with silicon rectifiers is available. Output current ratings were designed for optimum utilization of the maximum current ratings of commercially available silicon rectifier types. Output voltage ranges were primarily established for powering transistor circuitry. Input voltages are 105/115/125 v., 60 and



400 cps. Supplied hermetically sealed per MIL-T-27A. They are also available on special order in epoxy molded construction. Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y.

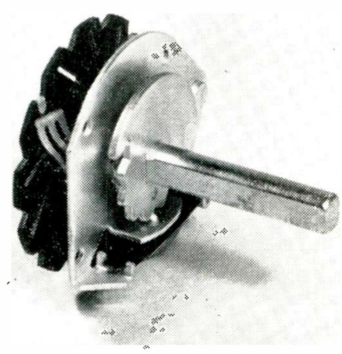
Circle 255 on Inquiry Card, page 149

Circle 104 on Inquiry Card, page 149

New Products

P-C SWITCH

A new multiple-position rotary switch is designed for mounting directly on printed circuit boards, without need for stand-off hardware or leadwires for electrical connections.



Indicated uses include switching of meter circuits, signal selection, tone selection, bias selection, circuit sampling and other applications in commercial and military equipment using printed circuitry. The switch is available in 2 to 12 position, excluding the 11-position arrangement. Current capacity is 10 a. P. R. Mallory & Co., Inc., Frankfort, Indiana.

Circle 256 on Inquiry Card, page 149

ELECTRONIC VOLTMETER

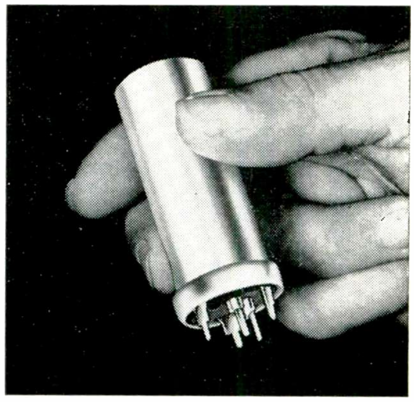
A battery-operated all-transistor dc voltmeter, developed to measure the low-level potentials inherent in transistor and diode circuitry is now available. The Alectra Model 30A D-C Electronic Voltmeter permits dc measurements in a wide variety of applications ranging from the calibration of simple thermocouples to the testing of complex computers. It features high input impedance of 2 megohms per volt and 8 ranges which

permit measurements from 0.05 to 150 v. with accuracy of ±3% full-scale. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Circle 257 on Inquiry Card, page 149

P-C CAPACITORS

With terminal and mounting ends expressly designed for practically all printed circuit requirements, this series incorporates all the features of UP twist-prong capacitors. Inser-

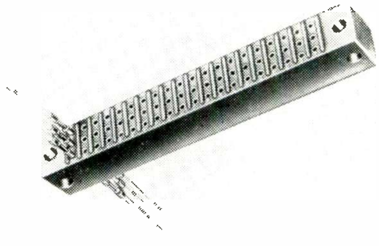


tion is fast, simple and foolproof. Offset index lug allows unit to be inserted in only the right way. Long and short pin types (UPL and UPC) are ideal for assembly operations involving average handling. They are available in literally hundreds of voltage and capacitance combinations. Cornell-Dubilier Electric Corp., South Plainfield, N. J.

Circle 258 on Inquiry Card, page 149

TERMINAL BLOCKS

A group of solderless terminal blocks in single, dual and triple row units are available. They have been designed for various computer applications and printed circuitry. They accept standard "AMP 53" solderless taper pins and are available in any combination of feed-thru individual or shorting terminals. External wiring has been eliminated by completely protected, mold-in internal buss connections between any combination of



terminals. Holes are provided for convenient stacking or right angle and perpendicular mounting. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 259 on Inquiry Card, page 149

An important announcement for everyone considering a small-space wide-range speaker system . . . monaural or stereo

ACTUAL TESTS PROVE *University* RRL*

ULTRA LINEAR RESPONSE SYSTEMS

SUPERIOR

Compared with competitive widely publicized high compliance small-space systems

AT $40 to $85 SAVING

RRL systems use a specially designed acoustic coupler to load the new University high compliance woofer, enabling it to radiate tremendous bass energy with only small cone excursions. This achieves greater linearity and virtually eliminates distortion. Tweeter response, carefully matched to the woofer's acoustic output, is smooth and flat to beyond 20,000 cps. Result: better bass, cleaner treble, smoother response than any competitive small-space, high compliance units based on totally sealed enclosures using "air spring" capacitance loading.

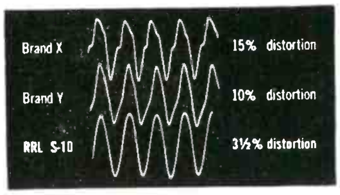
*RRL — *Radiation Resistance Loading*

PROOF OF SUPERIORITY

. . . as demonstrated by actual comparative measurements* of University Model S-10 RRL ultra linear response system . . . and widely publicized competitive brands X and Y, under identical conditions.

75% LESS BASS DISTORTION

Distortion measured at 30 cycles with equal sound output for all systems:



The highly efficient S-10 requires only ¼ of the cone excursion of Brands X and Y to produce the same sound output. Result: greater inherent linearity and 75% less distortion.

Brands X and Y reach overload conditions 4 times sooner (6 db) than the S-10. Bass distortion at higher sound levels is therefore considerably greater with X and Y than with the S-10.

WIDER FREQUENCY RESPONSE

Brand X ....7 db down at 15,000 cps
Brand Y ....2 db down at 15,000 cps
RRL S-10 ....flat to beyond 20,000 cps

Measured average acoustic energy, 7000-20,000 cps, for equal power inputs, demonstrates that Model S-10 performs . . .

5 db better than Brand X
2 db better than Brand Y

Ultra linear response systems are not handicapped by the treble deficiencies common to competitive systems. With clean program material, the remarkably flat response and exceptionally true reproduction of upper harmonics by the S-10 result in amazingly realistic reproduction without "harshness." A Program Distortion Filter is provided which can be switched into the circuit to correct for inferior radio programs, worn records, tapes, etc.

LOWER POWER REQUIREMENTS

Measured average of acoustic energy in 30-100 cps range, demonstrated that Model S-10 performed . . .

4 db better than Brand X
2 db better than Brand Y

This test shows that the S-10 is, in effect, 100% more sensitive. (The ultra linear response systems will fill any average room with sound above normal listening level, using any high quality low power high fidelity amplifier.)

NO "DAMPING FACTOR" PROBLEMS

Model S-10 RRL will work at maximum effectiveness with *any* modern (low internal impedance) high fidelity amplifier. No damping factor adjustment at all is needed, whereas both Brands X and Y require optimum settings. If an amplifier does not have this control the performances of Brands X and Y may be adversely affected.

*** HOW TESTS WERE CONDUCTED**

Frequency response was obtained in an anechoic chamber, using a calibrated Western Electric 640AA Microphone and RA-1095 Amplifier, a General Radio Model 1304B Beat Frequency Oscillator and a Sound Apparatus Model FRA Graphic Recorder.

Distortion was measured with a Hewlett-Packard Model 330B Distortion Analyzer. The speakers were driven from a Hewlett-Packard Model 200AB Audio Oscillator, feeding a McIntosh 50-watt Power Amplifier.

ALL THIS...AND MAJOR COST SAVINGS TOO!

You don't pay a premium for RRL's improved quality and performance. University's superior design and manufacturing know-how has resulted in substantial cost savings to the consumer. Compare for yourself!

Brand X .... over $180
Brand Y .... over $220
RRL Model S-10 .... $139

GREATER SAVINGS WITH STEREO!

These RRL systems incorporate an exclusive University woofer feature . . . a *dual voice coil* . . . that receives the fully separated bass energy from both stereo channels and provides authentic full bass response without need for expensive or complicated networks, *or* an additional woofer and woofer enclosure. Thus you can have a complete stereo speaker system consisting of one RRL S-10 and a matching stereo adapter (speaker system with bass response attenuated below the 150 to 200 cycle range) for approximately the same cost as a single monaural Brand X and *less* than a single monaural Brand Y.

ALREADY THE ACCEPTED LEADER

At WFUV-FM, pioneering stereo in New York City via FM-Multiplex, RRL systems have been selected for studio monitoring and public demonstrations. Fred Waring chose RRL systems for his latest nationwide high fidelity concert tour. "Research House, 1958" of Beverly Hills, California, awarded its Seal of Research Approval to the RRL systems for their beautiful design as well as quality performance. The undeniable superiority of the RRL ultra linear response speaker systems has been recognized by all authorities who *know* music and whose work *demands* the finest in speaker systems.

Hear these magnificent speaker systems at your dealer . . . soon!

LISTEN *University sounds better*

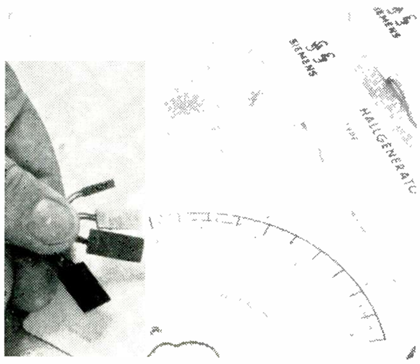
UNIVERSITY LOUDSPEAKERS, INC., 80 SO. KENSICO AVE., WHITE PLAINS, N. Y.

Circle 106 on Inquiry Card, page 149

New Products

HALL GENERATORS

Now available are Siemens Indium-Arsenide-Phosphide Hall-generators, producing a Hall voltage under load which is proportional to the magnetic field within 0.1%. Reproducibility is

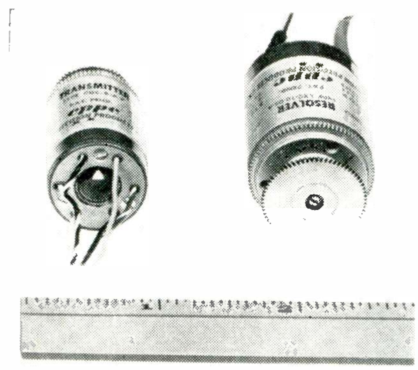


better than 0.003% and the temperature coefficient is only 0.02% per 1° C. These probes are used for controlling and measuring magnetic fields where utmost accuracy and reliability are required. GRH-Halltest Co. G. R. Hennig, 157 S. Morgan Blvd., Valparaiso, Ind.

Circle 260 on Inquiry Card, page 149

SYNCHROS WITH POINTER

To aid the design engineer in breadboarding synchro systems, synchros and resolvers with a pointer visible through a small window at the rear of the shaft are available. The engineer can tell at a glance if his system is properly phased by watching rotation of the pointers. When used with a dial, the pointers can also be utilized for system calibration. Synchros are provided with an integrally cut gear on the mounting flange for setting electrical zero

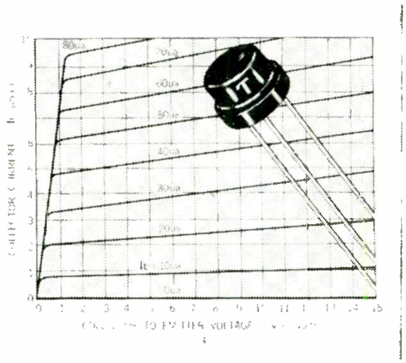


while the synchro is clamped in the system. They are available in sizes 8, 10, 11, and 15. Clifton Precision Products Co., Inc., 9014 West Chester Pike, Upper Darby, Pa.

Circle 261 on Inquiry Card, page 149

SILICON TRANSISTOR

A high-beta silicon transistor offers minimum current gain of 80. A useful beta is maintained even at reduced collector current levels and over a wide range of temperatures,



from −65° to 150° C. The 2N543, 2N542 and 2N541 operate at 45, 30 and 15 v. respectively and are good for multistage amplifier applications. Offering more gain per stage, these transistors reduce the number of amplification stages required. Transitron Electronic Corp., Wakefield, Mass.

Circle 262 on Inquiry Card, page 149

POTENTIOMETER

Series 5200, an all metal, single-turn servo-mounting precision potentiometer, 1 1/16 in. in diameter offers a standard resistance range of 250 to 100,000 ohms. Built to take punishment, the 5200 withstands 2,000 CPS at 30G's; 10 cycles NAS 710 procedure III humidity; 50G's shock and 100G's acceleration. NAS 710 requirements for salt spray, fungus resistance, sand and dust and altitude are also met or exceeded. Standard linearity tolerance is ±0.5% and tol-

erances to ±0.15% are available. Rating is 3 w. at 90° C in resistance ranges below 10K. Above 10K rating is 3 w. at 110° C. Beckman Instruments, Inc., Fullerton, Calif.

Circle 263 on Inquiry Card, page 149

Spark Gaps

(*Continued from page 79*)

secondary. The unloaded pulse voltage is indicated as five to ten times the normal operating voltage. For the purposes of this figure the insulation rating has been established at two times the normal operating voltage. This value, coupled with the pulse transformer manufacturer's tolerances, yields a protection range of 80% of the absolute magnitude of the normal operating voltage.

In the right hand half of the figure are indicated typical gap characteristics based on existing units. The initial breakdown of the gap is shown with its tolerances. The maximum initial breakdown and the minimum repetitive breakdown for the given operating conditions are indicated in units of the normal operating voltage. With such a device in the system, at no time could the unloaded pulse voltage rise to the minimum insulation rating; also at no time could the gap continue to fire after the fault conditions had been corrected and the normal operating condition was resumed.

In most cases having such a finite difference between initial and repetitive breakdowns is a distinctive advantage. The greater magnitude of the initial breakdown permits a small percentage overvoltage to appear without affecting the operation of the system. In addition, in the case of continuous faults, the lower magnitude of the repetitive breakdown keeps the operating voltage across the pulse transformer down to a value only slightly greater than it sees during normal operation. This latter action prevents continual voltages from stressing the transformer to such an extent that its insulation breakdown rating can be reduced.

Magnetron Arcing

5. Q. *At what over-voltage does the magnetron arc, and how many arcs can it stand?*

A. In addition to being available in a large spread of absolute values and with tolerances more than adequate to do the normal protection jobs, gaps can trip the current overload if "off-the-air" condition is desirable after a fault; or they can dissipate adequate wattage either if the system is to recover as soon as the fault condition corrects itself or, in the most disastrous case, if the magnetron fails completely and power continues to be fed into the modulator for the duration of operation of the system.

Typical examples of systems for which the operating voltage, insulation breakdown and gap protection characteristics are very similar to those illustrated, Fig. 1, are the Bendix Radio Type RDR-1, the RCA AVQ 50 and the Collins Type WP-101. These three systems all happen to be weather radars. In these systems for example, the Bendix Radio Type RDR-1 is a normal dc operated line type modulator in which a misfire, and subsequent gap operation, causes the set to go off the air and requires "push to reset." On the other hand, the RCA AVQ 50 is an

(*Continued on page 186*)

Spark Gaps

(*Continued from page* 185)

ac resonant charging type modulator which continues to operate during faults and even during complete magnetron failure.

In both of these cases the difference between initial and repetitive breakdowns was highly desirable because, as mentioned, there were instances in which a fault condition, such as a magnatron misfiring, occurred for minutes or perhaps even for hours. With a single protective gap which had a repetitive breakdown voltage range only 55-70% of the insulation rating there was real assurance that neither the pulse transformer nor any other component would be lost.

In addition to the production units which presently have the tolerances discussed, namely, a maximum total spread of ±20-25%, units are being built with increasingly tighter tolerances. Recent specifications, which include both initial and repetitive breakdowns around a common center ±15% in the high voltage ranges down to ±10% in the lower voltage ranges, are quite feasible, under more stringent construction conditions.

With these gap characteristics in mind, the systems designer should then know what electrical characteristics of his transformer are important to the gap manufacturer so that a quick determination can be made of a gap to fit his needs. In Fig. 2 are illustrated schematically two successive pulses. The units on the ordinate are percentages of the normal operating voltage. Again the amplitude of the unloaded pulse is indicated for reference purposes only.

In this illustration, the three principal characteristics of the pulse itself which are important from the standpoint of determining the appropriate gap are indicated. They are: (1) the rise time, tr, from 10% to 90% amplitude, (2) the pulse width, tp, at 50% amplitude, and (3) the pulse repetition rate, prr. In addition, of course, it is necessary to know the normal operating voltage and the transformer insulation breakdown voltage.

The rise time and pulse width are necessary information because these characteristics determine,

(*Continued on page* 189)

New Products

MICROVOLT-AMMETER

A dc microvolt-ammeter which measures dc voltages from 1 μv. to 1 volt and dc currents from 1 μμ a. to 3 ma. is available. Model 425A has an

accuracy of ±3% full scale. Use of a photoconductive chopper in place of the conventional mechanical vibrator helps achieve high sensitivity and reduces drift to less than 2 μv. per hour after warm-up. Noise is less than 0.2 μv. rms. It has a full-scale voltage sensitivity of ±10 μv. and a full-scale current sensitivity of ±10 μμa. Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.

Circle 264 on Inquiry Card, page 149

POLLUTION PHOTOMETER

A portable air pollution photometer for measuring and controlling outdoor and indoor air pollution is available. An application is the monitoring and control of dust free work rooms maintained by manufacturers of precision instruments and electron tubes. The meter will respond with a 20 percent deflection of full scale to a layer of dust 1/1000 in thick on a ¼ in dia. surface. It will also respond to a dust load which approximates a

fog reducing visibility to thirty ft. Phoenix Precision Instrument Co., 3803 N. 5th St., Phila., Pa.

Circle 265 on Inquiry Card, page 149

Spark Gaps

(*Continued from page* 186)

respectively, the rate of build-up of the avalanche and the total energy applied to the gap during one pulse. The pulse repetition rate is necessary information because of the finite deionization time discussed earlier.

The final information the systems designer needs to know for a component concerns the physical size and mounting styles that are available. In Fig. 3 are indicated typical gap outlines. Also pictures of a sample of each style and the voltage range available in each style are included. In general, the mounting arrangements include ferrule end caps suitable for use with tube caps and fuse clips, flat contacts for use in spring loaded pressure mounts, and in the smaller units some stud mountings.

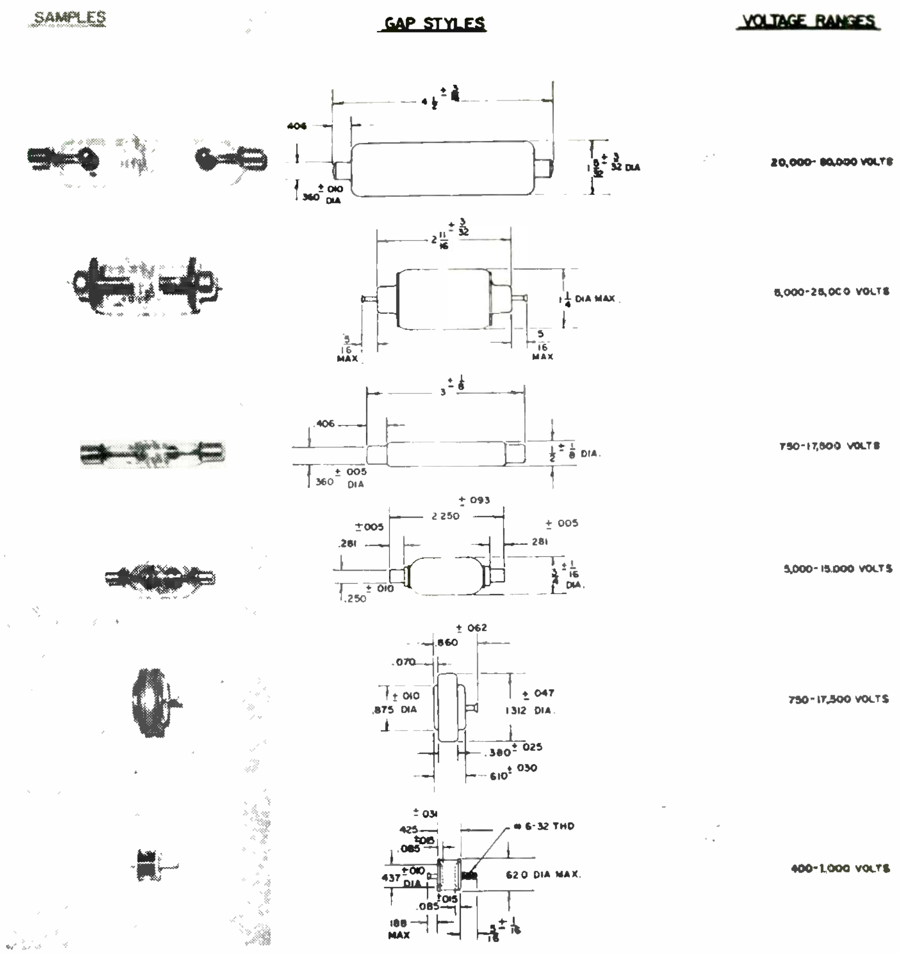


Fig. 3 (right): These typical gap configurations show variety of mounting styles.

CW Doppler Radar

(Continued from page 72)

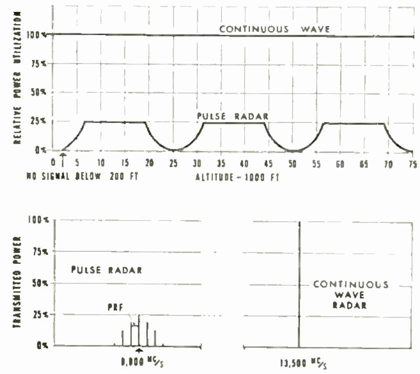
jection filters are not required, and the installed micro-wave circuitry is simple.

Ryan application of CW radar to navigational and guidance problems spans a period of more than 12 years. As a direct result, Ryan electronics engineers have made significant contributions to the advancement of CW Doppler techniques.

In 1951, after more than five years of research and development by Ryan, Varian Associates, and the Kollsman Instrument Corporation, the first Navy-Ryan CW Doppler automatic navigator (AN/APN-57) was introduced. Following Ryan specifications, Varian Associates developed the first CW Klystron transmitter.

One of Ryan's most significant achievements is the development of a simple, lightweight receiver-transmitter, which permits simultaneous transmission and reception of multiple beams of radar energy in a single compact unit. The Ryan-designed antenna is divided in the center by a partition, or septum. One side is used for transmission and the other for receiving Doppler signals. Symmetrical beams are provided by special shaping of the reflector. The simple microwave circuitry, a result of the use of CW transmission and direct-to-audio detection, has no moving parts, requires no adjustments and virtually no maintenance.

Complete Doppler data stabilization is simply achieved with the electrical analog ground speed computer. Basic computer elements consist of transformers resolvers,



Charts show the lower efficiency and loss of transmitted power at desired frequency when the radar energy is pulsed.

amplifiers and servos. This type of stabilization is less costly, lighter, and easier to maintain.

Unlike navigational equipment that depends on ground facilities or aerological data, RANAV systems are completely self-contained. This feature is a requisite for global military systems and provides greater flexibility of operation to commercial operations.

Audio-Frequency Volt-Ammeter

(Continued from page 73)

to be used for dc as well as ac measurements, thus greatly increasing the usefulness of the instrument.

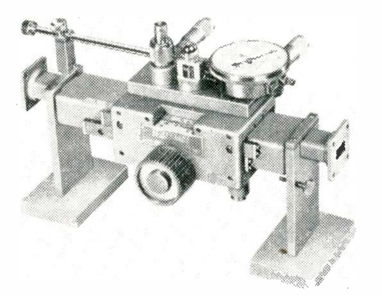
Binding posts on the panel make possible the inclusion of a milliammeter in the balancing circuit to measure the thermal converter output voltage. With these data and a converter characteristic curve, ac-dc difference tests can be made of voltmeters and ammeters with an accuracy of 0.02%. In such tests the volt-ampere converter is connected in series with the test ammeter, or in parallel with the test voltmeter. Alternating and direct current are then applied successfully to the arrangements. By using a more sensitive external galvanometer, the ac-dc difference of the test instrumentt can be obtained.

Special precautions were taken to minimize reactance. High-quality resistance cards were used for the series and shunt resistors of 1 Ω or more. Shunts of lower resistance, for the higher current ranges, were constructed of bifilar strips of Ni-Cr-Al-Fe alloy with insulation of 1-mil polyester film. In addition, rotary switches with enclosed silver contacts were used to give minimum contact resistance, inductance, and internal capacitance.

New Products

SLOTTED SECTIONS

Improved electrical and mechanical designs have been incorporated in this latest version of slotted sections and probes. Designed to provide maximum accuracy and sensitivity,

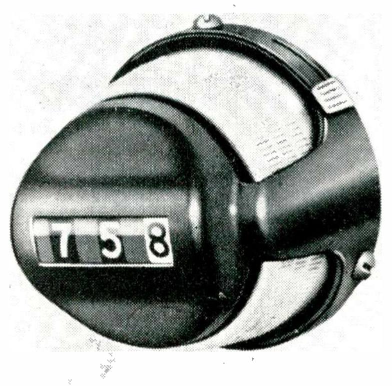


the Types 764 and 864 instruments operate over the frequencies 12.4 to 18.0 KMC/sec and 18.0 to 26.5 KMC/sec respectively. Separate tuning systems for probe and detector result in good sensitivity. Inclined dial presentations of probe position provide "Easy to Read" measurements to within 0.0005 in. Waveline Inc., Caldwell, N. J.

Circle 266 on Inquiry Card, page 149

LIGHTWEIGHT MICRODIAL

A lightweight, 3 digit, direct-reading Microdial for use where weight is a factor is available. The new dial is similar to the 3-digit Microdial except for an aluminum control knob which greatly reduces over-all weight. Three rows of knurled bands on the aluminum control knob make the new dial easy to set especially under forced-fast-setting conditions. Listed as Model No. 1310, the dial is available in a 3-digit, 10-turn version only.



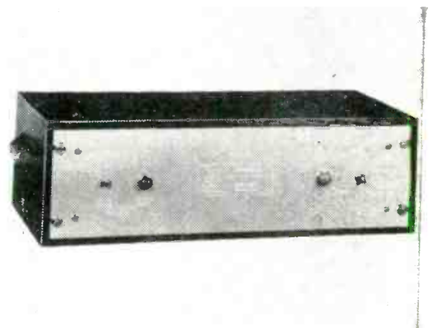
The model number changes to 1309 with the addition of a finger-tip brake which locks settings in place when desired. The George W. Borg Corp., 120 S. Main St., Janesville, Wis.

Circle 267 on Inquiry Card, page 149

New Products

GAMMA-BETA MONITOR

A compact, bench type radioactivity detector provides effective warning and environmental monitoring of beta and gamma radiation in laboratories, and in industrial radiography

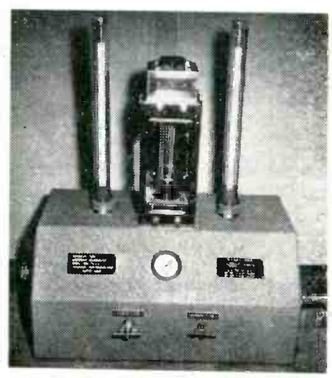


installations. The Detectolab Model DZ14 incorporates simplified plug-in design and utilizes positive "go-no-go" buzzer and lamp indications. BJ Electronics, Borg-Warner Corp., Santa Ana, Calif.

Circle 268 on Inquiry Card, page 149

CALORIMETER

The Model SME may be used as a Calorimetric wattmeter or as a waveguide dummy load. It circulates a known rate of liquid through a load transparent to r-f energy. It measures or absorbs the full natural power levels of the most powerful radars or r-f energy sources known or anticipated. Typical accuracy is between ½% and 2% depending on frequency and power level. Design provisions permit easy verification of accuracy by checking load VSWR, flowrate, thermometry, liquid quality



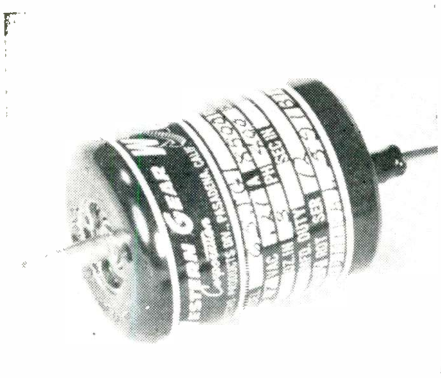
and heat radiation loss. The best accuracy exists at the higher frequencies and/or higher power levels, Chemalloy Electronic Corp., Santee, Calif.

Circle 269 on Inquiry Card, page 149

New Products

BLOWER MOTOR

A 27 volt ac, 3 phase, 400 cycle blower motor qualified to meet MIL-M-13787 Signal Corps specifications is available. The motor which measures only 1.07 inch in diameter and

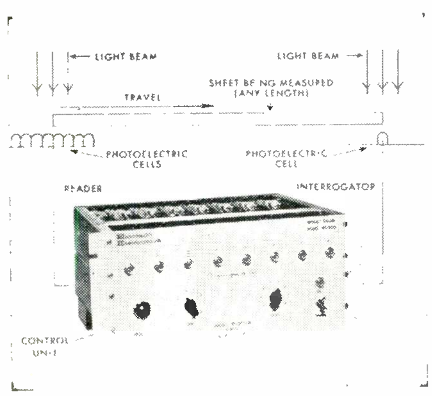


1.32 inch in length, produces 0.2 oz.-in. of torque at 10.200 RPM. It is designed for continuous duty at 87° C. with a life of 1,000 hours. The motor weighs 3 oz. It is designated Model 65JG1. Western Gear Corporation, Malme, P. O. Box 182, Lynwood, Calif.

Circle 270 on Inquiry Card, page 149

MISCUT GAUGE

A new control device for automatically measuring the length of steel sheets moving along a conveyor belt at up to 50,000 fpm and rejecting short or long sheets has been developed. Although the first unit was purchased by a steel mill, it is equally well adapted to non-ferrous metal, plastic, paper, rubber, textile or other material fabrication processes where accurate dimensional control is de-



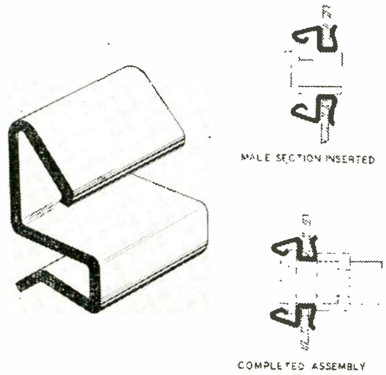
sired. Accuracy of the system is ±0.003 in. which is completely independent of the speed of the conveyor line. Eldorado Electronics, Berkeley, Calif.

Circle 271 on Inquiry Card, page 149

New Products

FASTENERS

A Speed Clip designed for through-panel application of solderless multiple-connector electrical terminals is available. Assembly is a simple operation. First, a pair of the fasteners

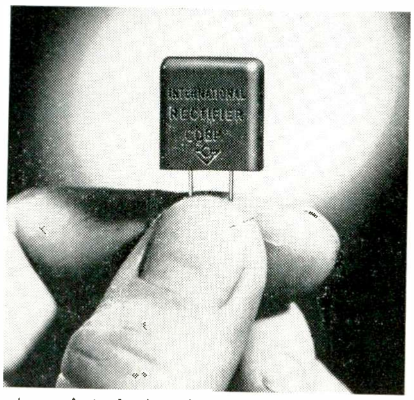


are snapped onto the panel. The male section of terminal connector is inserted into the rectangular panel hole, and as it passes through, spring legs of the clips compress and spring out again over the flanges projecting from either side of the connector. Flanges prevent the connector from passing completely through panel and clips prevent it from being pushed out when the other half of connector is applied. Tinnerman Products, Inc., Cleveland, Ohio.

Circle 272 on Inquiry Card, page 149

ZENER DIODE

This miniature device, only 0.688 in. in length (excluding leads) provides symmetrical dynamic clipping characteristics on such applications as rate feedback limiting in servo control systems, maintaining the output of a gyro pickoff at a prescribed level, oscilloscope calibration, and similar functions. Its small size and matchbox configuration make it especially suitable for automated insertion



into printed circuit boards. Providing 600 mw dissipation, it is available in zener voltage ranges from 4.3 to 30 v. International Rectifier Corp., 1521 E. Grane Ave., El Segundo, Calif.

Circle 273 on Inquiry Card, page 149

Microwave Directory

(*Continued from page 166*)

2—**Pye Canada Ltd** 82 Northline Rd Toronto 16 Ontario Canada
4—**Pye Telecommunications Ltd** Newmarket Rd Cambridge England
1-2-3-4—**Radar Design Corp** 2360 James St N Syracuse 12 NY
3—**Radio Corp of America Electron Tube Div** Harrison NJ
2—**Raytheon Mfg Co Commercial Equip Div** 100 River St Waltham 54 Mass
3—**Raytheon Mfg Co** 100 River St Waltham 54 Mass
3-4—**Resdel Eng'g Corp** 330 S Fair Oaks Ave Pasadena Calif
2—**Rubicon Instruments** Ridge Ave at 35th St Philadelphia 32 Pa
1—**Sage Labs Inc** 159 Linden St Wellesley 81 Mass
2—**Scientific-Atlanta Inc** 2162 Piedmont Rd NE Atlanta 9 Ga
2—**Scientific Glass Apparatus Co** 100 Lakewood Terrace Bloomfield NJ
2—**Sierra Electronic Corp** 3885 Bohannon Dr Menlo Park Calif
1-2—**Solartron Electronic Group Ltd** Queens Rd Thomas Ditton Surrey England
1-3—**Sperry Gyroscope Co Microwave Electronics Div** Great Neck NY
2—**Standard Electronics Div Radio Eng'g Labs** 30 & Borden Sts Long Island City NY
2—**Stoddart Aircraft Radio Co** 6644 Santa Monica Blvd Hollywood 38 Calif
1-2-3-4—**Technical Oil Tool Corp** 1057 N La Brea Los Angeles Calif
2-3—**Telechrome Mfg Corp** 28 Ranick Dr Amityville LI NY
1-3—**Telectro Industries Corp** 35-18 37th St Long Island City 1 NY
1-2-3-4—**Telerad Mfg Corp** Route 69 Flemington NJ
1-2-3-4—**Telerad Mfg Corp** 1440 Broadway New York 18 NY
2—**Thompson-Ramo-Wooldridge Corp Electronic Instrument Div** PO Box 8405 Denver 10 Colo
3—**Transitron Inc** 186 Granite St Manchester NH
1-2-4—**Uniwave Inc** 109 Marine St Farmingdale NY
2-3—**Van Norman Industries Inc Electronics Div** 186 Granite St Manchester NH
1-2-3-4—**Vectron Inc** 1611 Trapelo Rd Waltham 54 Mass
1-2—**Victor R F & Microwave Co** 36 W Water St Wakefield Mass
1-2-4—**Wacline Inc** 35 S St Clair St Dayton 2 Ohio
2—**Waldorf Instrument Co Div F C Huyck & Sons** Park Ave Huntington Station NY
1-2-3-4—**Waveline Inc** PO Box 718 Caldwell NJ
1-2—**Wayne-Kerr Inst** PO Box 801 Philadelphia 5 Pa
2-3—**Weinschel Eng'g** 10503 Metropolitan Ave Kensington Md
1-2-3—**Weymouth Instrument Co** 1440 Commercial St E Weymouth 89 Mass
2—**White Electron Devices Inc** Roger 92 4 Ave Haskell NJ

TRANSMITTERS

Adler Electronics Inc 1 Lefevre Lane New Rochelle NY
Admiral Corp 3800 W Cortland St Chicago 47 Ill
Aircom Inc 354 Main St Winthrop Mass
Aircom Inc 139 E 1st St Roselle NJ
Airtron Inc 1108 W Elizabeth Ave Linden NJ
Alfred Electronics 897 Commercial St Palo Alto Calif
Amerac Inc Dunham Rd Beverly Mass
American Machine & Foundry Co—Defense Products Group 1101 N Royal St Alexandria Va
American Microwave Corp 11754 Vose N Hollywood Calif
Amphenol Electronics Corp 1830 S 54 Ave Chicago 50 Ill
Andrew Antenna Corp 606 Beech St Whitby Ontario Canada
Andrew California Corp 941 E Marylind Ave Claremont Calif
Andrew Corp 363 E 75th St Chicago 19 Ill
Antenna & Radome Research Assoc 1 Bond St Westbury NY
Antennavision Inc 2949 W Osborn Phoenix Ariz
Avion Div ACF Industries Inc 11 Park Pl Paramus NJ

(*Continued on page 196*)

Directory of Microwave Manufacturers (cont)

(*Continued from page 195*)

Bart Mfg Corp 227 Main St Belleville NJ
Bell Aircraft Corp PO Box 1 Buffalo 5 NY
Bendix Aviation Corp Red Bank Div Rt 35 Eatontown NJ
Bogart Mfg Corp 315 Seigel St Brooklyn 6 NY
Bolton Labs Inc W Main St Bolton Mass
Browning Labs Inc 750 Main St Winchester Mass
Budd Stanley Co 43-01 22nd St Long Island City 1 NY
Budelman Radio Corp 375 Fairfield Ave Stamford Conn
Cable Electric Products 234 Daboll St Providence 7 RI
Calif Technical Industries Div Textron Inc 1421 Old County Rd Belmont 10 Calif
Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif
Clegg Labs Div Clegg Inc Ridgedale Ave Morristown NJ
Coaxial Connector Co 37 N 2nd Ave Mt Vernon NY
Collins Radio Co 855 35th St NE Cedar Rapids Iowa
Continental Electronics Mfg Co 4212 S Buckner Blvd Dallas 27 Texas
Creative Electronics Corp 94 Lincoln Ave Stamford Conn
Cubic Corp 5575 Kearny Villa Rd San Diego 11 Calif
Defiance Eng'g & Microwave Corp Beverly Airport Beverly Mass
Deltron Inc 2905 W Leithgow St Phila 33 Pa
Demornay-Bonardi Corp 780 S Arroyo Pkwy Pasadena Calif
Diamond Antenna & Microwave Corp 7 North Ave Wakefield Mass
Dittmore-Freimuth Corp 2517 E Norwich St Milwaukee 7 Wisc
Douglas Microwave Co 252 E 3rd St Mt Vernon NY
Dressen-Barnes Corp 250 N Vinedo Ave Pasadena Calif
Fisher Eng'g Inc PO Box 327 Huntington Ind
F-R Machine Works Inc Electronic & X-Ray Div 26-12 Borough Pl Woodside 77 NY
General Communications Co 677 Beacon St Boston 15 Mass
General Electric Co Communications Products Dept PO Box 1122 Syracuse NY
General Electric Co Specialty Electronics Component Dept W Genesee St Auburn NY
General Magnetics Inc 135 Bloomfield Ave Bloomfield NJ
General RF Fittings Inc 702 Beacon St Boston 15 Mass
Glaser-Steers Corp 20 Main St Belleville 9 NJ
Granger Associates 966 Commercial St Palo Alto Calif
Grem Eng'g Co 923 Longview Rd King of Prussia Pa
Haller Raymond & Brown Circleville Rd State College Pa
Hazeltine Electronics Div/Hazeltine Corp 59-25 Little Neck Pkwy Little Neck 62 NY
Industrial Research Labs Div Aeronca Mfg Corp Hilltop & Fredericks Rd Baltimore Md
Jefferson Electronic Products Corp 322 State St Santa Barbara Calif
J-V-M Eng'g Co 4633 S Lawndale Ave Lyons Ill
Kearfott Co Inc 1378 Main Ave Clifton NJ
King Electronics Co Inc 40 Marbledale Rd Tuckahoe NY
Laboratory for Electronics Inc 75 Pitts St Boston 14 Mass
Lamba Electronics Corp 11-11 131st St College Point 56 NY
Lambda-Pacific Eng'g Inc 14725 Arminta St Van Nuys Calif
Lavoie Labs Inc Matawan-Freehold Rd Morganville NJ
LEE Inc 625 NY Ave NW Washington 1 DC
Lenkurt Electric Co 1105 County Rd San Carlos Calif
Levinthal Electronic Products Inc 3180 Hanover St Palo Alto Calif
Lieco Inc 3610 Oceanside Rd Oceanside NY
Litton Industries of Calif 336 N Foothill Rd Beverly Hills Calif
Manson Laboratories Inc 207 Greenwich Ave Stamford Conn
Maxson Corp W L 475 10th Ave New York 18 NY
Menlo Park Eng'g 721 Hamilton Ave Menlo Park
Meridian Metalcraft Inc 8739 S. Millergrove Dr Whittier Calif
Microlab Okner Pkway Livingston NJ
Microtech Inc 2975 State St Hamden 17 Conn
Microwave Eng'g Labs Inc 943 Industrial Ave Palo Alto Calif
Monogram Precision Industries Inc—Cascade Research Div 53 Victory Lane Los Gatos Calif
Nevada Air Products Co P O Box 2472 Reno Nevada
NJE Corp 345 Carnegie Ave Kenilworth NJ
NRK Mfg & Eng'g Co 4601 W Addison St Chicago 41 Ill
Omega Labs Inc Haverhill St Rowley Mass.
Perkins Eng'g Corp 345 Kansas St El Segundo Calif
Peschel Electronics Inc 13 Garden St New Rochelle NY
Philco Corp Tioga & C Sts Philadelphia 24 Pa
Philco Corp Gov't & Industrial Div 4700 Wissahickon Ave Philadelphia 44 Pa
Polarad Electronics Corp 43-20 34th St Long Island City NY
Polytechnic Research & Development Co 202 Tillary St. Brooklyn 1 NY
Power Designs Inc 89-25 130th St Richmond Hill NY
Power Supplies Inc 1005 Olive St Highland Ill
Pratt Albert 114 W Lake View Ave Milwaukee 17 Wisc
Production Research Corp Thornwood NY
Pye Canada Ltd 82 Northline Rd Toronto 16 Ontario Can
Pye Telecommunications Ltd Newmarket Rd Cambridge England
Radar Design Corp 2360 James St N Syracuse 12 NY
Radio Corp of America Commercial Electronics Products Front & Cooper Sts Camden NJ
Radio Corp of America Microwave Electronics Div Great Neck NY
Radio Eng'g Lab 29-01 Borden Ave Long Island City 1 NY
Raytheon Mfg Co Communications Equip Div 100 River St Waltham 54 Mass
Raytheon Mfg Co 100 River St Waltham 54 Mass
Resdel Eng'g Corp 330 S Fair Oaks Ave Pasadena Calif
Rue Products 1628 Venice Blvd Venice Calif
Sanders Associates 95 Canal St Nashua NH
Sierra Electronic Corp 3885 Bohannon Dr Menlo Park Calif
Sperry Gyroscope Co Microwave Electronics Div Great Neck NY
Sylvania Electric Products Co Electric System Div 100 First Ave Waltham 54 Mass
TA-Mar Inc 11571 W Jefferson Blvd Culver City Calif
Tarzian Inc Sarkes 415 N College Ave Bloomington Ind
Technical Oil Tool Corp 1057 N La Brea Los Angeles 38 Calif
Technicraft Labs Inc Thomaston-Waterbury Rd Thomaston Conn
Telectro Industries Corp 35-18 37th St Long Island City 1 NY
Tele-Dynamics Inc 51st & Parkside Ave Philadelphia 4 Pa
Telephonics Corp Park Ave Huntingdon LI NY
Telerad Mfg Corp Route 69 Flemington NJ
Telerad Mfg Corp 1440 Broadway New York 18 NY
Topp Industries Inc 8907 Wilshire Blvd Beverly Hills Calif
Torwico Electronics Inc 1090 Morris Ave Union NJ
UAC Electronics Div Universal Transistor Prods Corp 50 Bond St. Westbury NY

Ultradyne Eng'g Labs P O Box 3308 Albuquerque New Mexico
Uniwave Inc 109 Marine St Farmingdale NY
Varo Mfg Co 2201 Walnut St Garland Texas
Vectron Inc 1611 Trapelo Rd Waltham 54 Mass
Victor R F & Microwave Co 36 W Water St Wakefield Mass
Waldorf Instrument Co Div F C Huyck & Sons Park Ave Huntington Station NY
Walworth Co 750 3rd Ave New York 17 NY
Waveline Inc P O Box 718 Caldwell NJ
Wave-Particle Corp P O Box 252 Menlo Park Calif
Weymouth Instrument Co 1440 Commercial St E Weymouth 89 Mass
Western Gear Corp Electro Products Div 132 W Colorado St Pasadena 1 Calif
Westinghouse Electric Corp P O Box 868 Pittsburgh 30 Pa
White Electron Devices Inc Roger 92 4th Ave Haskell NJ

TUBES

Backward Wave	1
Klystron	2
Magnetic	3
Traveling Wave	4

2-3—**Amperex Electric Corp** 230 Duffy Ave Hicksville LI NY
3—**Anton Machine Works** 1226 Flushing Ave Brooklyn 37 NY
2—**Applied Radiation Corp** 2404 N Main St Walnut Creek Calif
2—**Avnet Electronic Supply Co** 36 N Moore St New York 16 NY
2-3—**Barry Electronics Corp** 512 Broadway New York NY
1-2-3-4—**Bendix Aviation Corp Red Bank Div** Route 35 Eatontown NJ
2-3-4—**Bendix Aviation Corp** 1104 Fisher Bldg Detroit 2 Mich
1-2-3-4—**Bomac Labs Inc** Salem Rd Beverly Mass
1—**Cascade Research Corp Div Monogram Precision Industries** 53 Victory Lane Los Gatos Calif
2—**Demornay-Bonardi Corp** 780 S Arroyo Pkwy Pasadena Calif
2-4—**Eitel-McCullough Inc** 798 San Mateo Ave San Bruno Calif
4—**Frederick Co George E** Bethayres Penna
2-3—**Ferranti Electric Inc** 30 Rockefeller Plaza New York NY
4—**Geisler Labs** P O Box 252 Menlo Park Calif
3—**Genalex Div British Industries Corp** 80 Shore Rd Port Washington NY
1-2-3-4—**General Electric Co Electric Components Div** 1 River Rd Schenectady 5 NY
1-2-3-4—**General Electric Co Power Tube Dept Bldg** 267 Schenectary 5 NY
3—**General Electric Co Ltd of England** 80 Shore Rd Port Washington NY
4—**Huggins Labs Inc** 711 Hamilton Ave Menlo Park Calif
1-4—**Hughes Products Hughes Aircraft Co** 5340 W 104th St Int'l Airport Sta Los Angeles 45 Calif
2-3—**International Electronics Corp** 81 Spring St New York 12 NY
1-2-3-4—**Litton Industries of Calif** 336 N Foothill Rd Beverly Hills Calif
3—**Mackay Research Labs** R R 2 Box 401 McHenry Ill
3—**Microwave Associates Inc** Burlington Mass
1-2-3-4—**Polarad Electronics Corp** 43-20 34th St Long Island City 1 NY
3-4—**"Q" Glass Co** 470 Broad St Bloomfield NJ
1-2-3-4—**Raytheon Mfg Co Microwave & Power Tube Operations** Foundry Ave Waltham Mass
2—**Sperry Gyroscope Co Electronic Tube Div** Great Neck NY
2—**State Labs Inc** 649 Broadway New York NY
1—**Stewart Eng'g Co** Box 777 Soquil Calif
1-2-4—**Sylvania Electric Products Inc** 500 Evelyn Ave Mountain View Calif
1-2-3-4—**Sylvania Electric Products Inc** 1740 Broadway New York 19 NY
1-2-4—**Varian Associates** 611 Hansen Way Palo Alto Calif
3—**Westinghouse Electric Corp** Box 284 Elmira NY
1-4—**White Electron Devices Inc Roger** 92 4th Ave Haskill NJ

Circle 134 on Inquiry Card, page 149

Circle 125 on Inquiry Card, page 149

Circle 124 on Inquiry Card, page 149

Man-Machine Relationships—A Changing Field for **OPERATIONS RESEARCH SPECIALISTS**

Change is in the very nature of System Development Corporation's work in man-machine relationships. This work involves two major projects:

(1) *creating and conducting large-scale training programs in present and planned air defense systems;*

(2) *operational computer programming for SAGE*

In each project, the interaction of men and complex machine systems is of prime importance.

And in each project, any change that affects air defense – a new missile, a revised strategic or tactical concept, an important technical development – requires intensive effort and cooperation by Operations Research Specialists, and an unusual combination of scientists and engineers.

In effect, specialists in many fields at SDC must react technically to all changes that directly or indirectly affect air defense. Their work – whether in Operations Research, Aerodynamics, or any other area—is shaped to a great extent by possible man-machine relationships. In this respect, SDC is unique among companies.

Operations Research Specialists, Engineers, Behavioral Scientists, and Computer Programmers whose aptitude, training and intellectual capacity enable them to work in an environment of change are invited to write. Address: R. W. Frost, 2428 Colorado Avenue Santa Monica, California, or phone collect at EXbrook 3-9411 in Santa Monica.

SDC

SYSTEM DEVELOPMENT CORPORATION
Santa Monica, California

An independent non-profit organization

11-62

Circle 502 on "Opportunities" Inquiry Card, page 151

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

Pay-As-You-Go Tuition Eases College Expenses

Parents struggling with the costs of sending children to privately-supported colleges can handle the problem the same way they handle automobile or furniture purchases as another item for installment credit, through Tuition Plan, Inc., of New York.

More than 70,000 students have used the plan during the last five years. It started with 28 student customers in 1938.

Tuition Plan, Inc., handles contracts from nursery grades to the university level, and makes it possible for parents to make monthly payments on tuition, room and board, and all major fees and expenses. The operation costs the schools nothing and assists them in budgeting their income. Parents may arrange contracts for from one to four years. When a contract for two or more years is signed, the parent is covered by life insurance. If the signing parent dies, school expenses are paid through the life of the contract.

Degree Pays Double

The average adult male with four years of college earns twice as much in a year as a man with less than an elementary school education and $1,500 more than the average high school graduate, according to the National Education Assoc.

Woos Electronic Firms

Atlanta, Ga., is the latest area to launch concerted drives to attract electronic firms. The advantages of the Atlanta area are spelled out in a new 40-page brochure, "Facts and Figures About Atlanta." The information includes statistics on population, transportation facilities, telephones, postal receipts and electric power facilities.

New "Shortage" Looms As Firms Plan Record Hiring In 1959

Comparing the figures on the number of engineers graduating in 1959 with the number of engineers that industry expects to hire during the same period leads to only one logical conclusion—we are facing another severe engineer shortage, perhaps even more severe than that which plagued the industry during the past five years. And at the same time the seeds are being sown for a shortage of truly catastrophic proportions within the next four or five years.

Last month the National Science Foundation was handed a special report by the U. S. Office of Education and the Bureau of Labor Statistics that shows that industry will want nearly 50,000 engineering graduates next June, while only about 39,000 will actually be getting their degrees at that time.

The first signs of the shortage are already beginning to appear. The Labor Dept. reported a 300% increase in the number of unfilled engineering jobs in September, compared with July, of this year. And the September figure was well over September of 1957.

One of the bellwethers of the electronic industry, General Electric Co., plans to hire as many engineers in 1959 as they did in 1957—and perhaps more. Over a 10-year projection they see a need for at least 50% more engineers than they have today. Their present payroll is $20,000.

Other productions from spokesmen throughout the electronic industry foresees as much as a 100% increase in the number of electronic engineers by 1968.

But despite this optimistic outlook for graduate engineers there are increasing signs of student disinterest in the field.

The number of freshmen enrollments in engineering courses increased by 30% in 1952 over 1951. In 1953 it rose 17% again. But in 1956 engineering enrollment increased only 7% and last year only a slight 1.3%.

President's Committee Announces Staff Changes

Dr. Eugene Vinogradoff has been appointed Executive Director of The President's Committee on Scientists and Engineers. Dr. Vinogradoff was formerly Staff Director of the Committee. Other new members of the committee are: Dean William T. Alexander, of Northeastern University, who replaces Dr. Frederick C. Lindvall as president of the American Society for Engineering Education and Miss Ruth A. Stout, who succeeds Dr. Lyman V. Ginger as president of the National Education Association.

PHOSPHOR RESEARCH

This ultra-violet emission-excitation Radiometer at Sylvania's new Towanda, Pa. research labs measures the spectral energy distribution of fluorescent phosphors.

Leaders of R&D activity hold widely varying opinions. Some say reward the group as a whole, others would reward only the individual engineers. And many feel that financial rewards should have no place at all in the creative effort

Should Engineers Receive Bonuses For Patents?

By EUGENE RAUDSEPP,
Psychological Research Consultant, Deutsch & Shea, Inc., Technical Manpower Consultants

IN order that the rich resources of human talent which scientists and engineers in industry possess could be properly capitalized, special attention has to be given to the problem of motivation. Recognition is growing that proper motivation is especially important in the area of creative accomplishment and invention—these being extremely responsive to both the tangible and the intangible motivating factors in a company climate.

Of late, there has been considerable discussion about the advisability of letting scientists and engineers share more and more in the profits that accrue to a company as the result of new inventions. Some authorities have suggested that it would act as a powerful stimulus for increased creative output and dispel the widespread feeling among scientists and engineers that management often "soft-pedals or even tries to hide the true value of the creative contributions" from those responsible for them.

In spite of the fact that the incentives awards or bonus system has been one of the oldest and most obvious motivating devices for increased production among the rank-and-file workers in industry, it has not found a correspondingly widespread acceptance where scientists and engineers are concerned. There has been and still is considerable resistance to instituting a special bonus or awards system for creative research and inventions in many companies.

To find out why such a resistance to special incentive systems of this kind exists and what the present trends in this regard are, the author, under the sponsorship of Industrial Relations News, an affiliate of Deutsch & Shea, Inc., technical manpower consultants, asked 105 experts in the area of creativity to indicate whether they would favor or disfavor the establishment of special awards for invention in industry.

This article is based on a part of a comprehensive study, "Company Climate and Creativity," to be published November, 1958, by Deutsch & Shea Inc.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

The Panel

The 105 experts contacted for this study are all connected, in one capacity or another, with either investigating creativity, teaching creative thinking courses, serving as consultants to industry in the area of creative research and management, or with direction of advanced research and development work Many of the panelists have made significant contributions in extending our understanding of creativity. The sample included 32 individuals connected with various universities: 17 psychologists and social scientists, 2 psychiatrists, 7 professors of engineering and science; the others are in fields like industrial management, industrial relations, education, marketing, humanities and architecture. Eleven experts are connected with research foundations, independent research institutions and consulting organizations. The majority of the participants, however, are in industry: 33 serve as managers and directors of research and development, 16 are in charge of training and education and give courses in individual and group creative thinking techniques, 6 conduct personnel and management research and the rest are practicing engineers and scientists.

Favor Special Awards

The tabulation of panelists' answers to this problem reveals that there is only a slight margin of votes in favor of giving special bonuses or awards for invention: 50.5% of the panelists were in favor and 44.8% were not in favor.

The following table shows the major reasons why panelists would or would not grant special bonuses for creative contributions:

Table 1

	% checked
YES, special bonuses for invention should be given	50.5
YES . . .	
If fairness is exercised	11.4
Creativity needs motivation, recognition, rewards	9.5
Has been done successfully in many companies	5.7
Miscellaneous reasons	6.7
No reason given	7.6
Only to teams, not individuals	4.8
Only to individuals, not to teams	1.9
Would increase teamwork	2.9
NO, special bonuses or rewards should not be given	44.8
No . . .	
Would have negative consequences, would disrupt teamwork; fair administration of rewards is impossible	13.3
Other rewards are more important to creative people	11.5
There are other ways of recognizing creativity	7.6
Would engender secretiveness among team-members	4.8
Creative people are hired to be creative	3.8
Difficult to decide who in team is inventor	3.8
Undecided (depends on company policy)	2.8
No answer	1.9

Table 2

Ranking of motivations for creativity

	% checked
Desire to solve problems	68.6
Personal gratifications obtained by accomplishment	64.0
Desire to win scientific prestige	64.0
Desire to advance in financial position	42.0
Desire to advance in title	14.3
Desire to win in competition	12.4
Gaining special benefits (bonuses, trips, vacations, etc.)	4.8

Bonuses Breed Jealousy

One major reason for rejecting the idea of special bonuses or awards for invention is caused by industry's penchant for teamwork and the attendant difficulties of awarding bonuses equitably and fairly. It was pointed out that any real or imaginary wrong done in distributing extra compensation for ideas or inventions could easily disrupt teamwork.

Thus, fourteen panelists felt that special bonuses would interfere with or discourage teamwork in that they would engender jealousies, secretiveness and unhealthy competition:

> Professor Silvan S. Tomkins of Princeton University: "Freedom of interchange within the group requires no negative consequences—such as invidious comparisons—as a result of sharing of ideas."

> William R. Gentry Jr., Senior Development Engineer of Electro-Metallurgical Company: "It is hard to determine who in team is responsible for invention or idea and recognition or reward to wrong man will lead to jealous acts which result in poor teamwork operation. If all are rewarded the same results, as the feeling of free riding by one or more members of the group is instilled in the rest of the group."

Five panel members emphasized the dangers of secretiveness that special awards would instill in the group. Illustrative of this line of thinking are the following statements:

> W. F. G. Swann, Director, Bartol Research Foundation: "I have never felt very much in favor of bonuses or similar awards. Neither am I in favor of awards for patents, etc. Once a researcher becomes patent-minded he becomes secretive in his nature and a loss to everybody in science except himself. It may be that awards for patentable inventions may best be achieved by considering the total amount accruing to the company as a result of the inventions and subsidizing the scientific personnel as a whole to an extent which is a function of the amount of the profits."

> Professor William H. Middendorf of the University of Cincinnati: "Special bonuses can result in everyone guarding his embryonic ideas rather than discussing them with others who can contribute. I believe the successful inventor will naturally rise in compensation making special bonuses unnecessary. The $50 a patent type are, moreover, ridiculous."

Professor George P. Bush of The American University has summarized it this way: "Once a feeling has grown up in a group that each man must jealously guard his contributions and that promotions will be based only on specific ideas that are credited to him, a situation will soon exist in which, instead of a group effort, there is a series of unconnected paths being pursued with each man jealously guarding his results and ideas from his co-workers. This spirit, once it has grown in a group, is extremely difficult to overcome. In fact, it generally takes quite drastic action to remove it. Supervisors should be informed that there should be on the whole a complete interchange of ideas not only within the group but between the groups. Any knowledge acquired should be available as soon as acquired, to any person who has a legitimate need for or an interest in the information, and it should not be retained for the personal advancement of the group or individual."

Whose Idea?

Another prevalent feeling among the participants against special awards or bonuses was due to the fact that it is difficult to decide who in team is responsible for the idea or invention, with the result that fairness would be difficult to exercise. Typical of this attitude were the following comments:

Arnold R. Bone, Mechanical Engineer of Dennison Mfg. Company: "Fair administration of such rewards would be almost humanly impossible. Varying types of assignments will affect the opportunity for invention, making fair distribution of rewards difficult." A vice president in charge of research: "Many scientists function in supporting roles and, although their contributions are great, the results of their efforts find application in the inventions of others. It would be difficult to appraise the fair value of such a contribution as well as to appraise the value of one invention against another."

Many panelists among those who would favor giving special awards for invention would recommend it only if a fair system could be worked out. They still recognized, however, that this might be quite a problem.

Engineers Are Paid To Be Creative

There were also a few panelists who felt that special bonuses were unnecessary, since the engineer or scientist is hired to be creative and that he should do his duty:

J. P. Andes, Assistant Head of Transonic Tunnel Department of Cornell Aeronautical Laboratory: "If they are paid to be creative, they should be treated as any other employee. However, such arrangements as odd working hours may contribute and also may be necessary to create the proper atmosphere for creativity."

A manager of research and development: "Generally speaking, a professional man is paid for being inventive or creative."

Charles H. Clark, Consultant, Creative Thinking Courses, Inc., also pointed out that giving special rewards would result in "more attention being paid to getting in patent applications than in getting in good ones." And two participants raised the question of whether the problem of awards would be an issue at all if a proper creative spirit pervaded the entire organization.

"Money Is Secondary"

A considerable number of panelists felt that in the motivational matrix of the creative individual monetary considerations play only a minor role. A truly creative individual, according to them, has other more intrinsic and career-oriented motives that function as his prime incentives:

Professor John E. Arnold of Stanford University: "In gen-

(Continued on page 204)

New Westinghouse series of VHF beam-power pentodes especially useful in mobile communications

Now Westinghouse introduces three improved octal-based pentodes for use as VHF amplifiers and oscillators . . . also as audio amplifiers or modulators.

Their small size does not limit their excellent performance characteristics. They have high power output, low plate and grid 2 voltages, and low driving power. They are designed for effective radio frequency ground, cool operation and long life.

WL-6146—with conventional 6.3 volt heater
WL-6159—with 26.5 volt heater
(for aircraft equipment)
WL-6883—with 12.6 volt heater
(for service with 12-volt storage battery)

Write for complete information on these three new beam-power types. Westinghouse Electric Corporation, Electronic Tube Division, Elmira, New York.

YOU CAN BE **SURE**... IF IT'S **Westinghouse**

 Circle 102 on Inquiry Card, page 149

Patent Bonuses

(*Continued from page* 202)

eral, special monetary rewards should not be made for invention or creative work. I do not believe that this is a prime motivator of creative individuals."

S. L. Fahnestock, Assistant to the Manager, Market Development: "It seems to me that any person directly connected with creativeness certainly feels of himself that he has been successful in solving a problem because by solving this problem he has done more for himself than would any amount of award and/or public recognition. He is, therefore, building his character as well as his status with the company."

Dr. Fred C. Finsterbach, an educational specialist: "The really creative individual, I believe, is less motivated by monetary rewards than by other reasons."

Gordon C. Lange, Executive Director, Swarthmore Creative and Development Services: "A really creative person doesn't need that kind of incentive and the other guys have their already existing sense of superiority over-developed. Some kind of appreciation is necessary, but it would differ with each person."

There is considerable evidence that creative people are basically more internally motivated. This was also borne out in this survey. The panelists were asked to check and list the more important personal motives to creativity in the industrial situation. As is clear from the following table, the intrinsic motivations head the list:

The "write-in" motivations also fell mostly into the "intrinsic motivations" category. For example, here are some of the motivations panelists suggested on their own:

Desire to explore novelty.

Satisfaction of a natural creative urge.

Desire to control something.

Desire to shape nature into the creator's concept.

Impulse to formulate fresh insight.

Sheer love of and absorption in a scientific problem area.

Desire to meet stated objectives in terms of unique solutions.

Desire to be part of a successful operation.

Desire to contribute something worthwhile to the end result.

To gain reputation for accomplishment.

Desire for identification as an individual.

Other Rewards

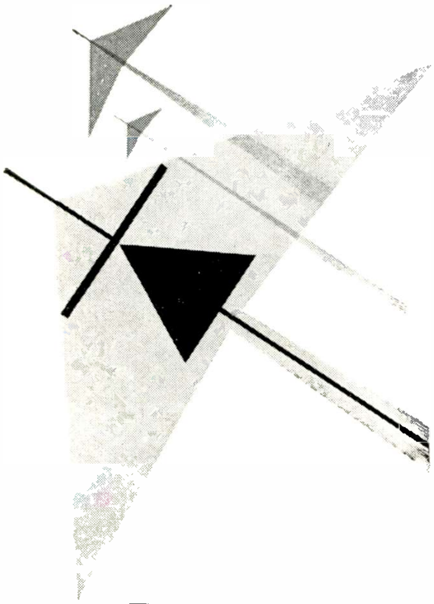
Ten panelists, cognizant of the unique make-up of the creative person felt that "there are less controversial means of impressing people with the sense of true accomplishment." They would reward creative accomplishment by proper advancement, a higher salary level and better job opportunities within, of course, the established framework for such promotions. Interest in the person's work, recognition, genuine understanding, real appreciation, increased responsibility, prestige, increased freedom, personal recognition, etc., would be the "non-tangible" rewards these participants would give to people who contribute creatively.

Rewarding Each Member

Five panel members who voted against individual rewards, nevertheless felt that rewarding each member of a team would be desirable, and that this would maintain, or even increase group cohesion and team-work. A few other participants, notably Professor Hin Brendendieck of Georgia Institute of Technology, would widen this to embrace the entire organization:

Professor Hin Brendendieck: "The bonus should not only go to the person or group which produced the idea. To create a common interest, possibly only 80% should go to the person or group to which we attach the label 'orginator.' The rest should benefit all employees disregarding their relationship to the invention (in the form of a benefit fund or something similar). The moral justification for this is the fact that all participate in a com-

(*Continued on page* 206)



Patent Bonuses

(*Continued from page* 205)

mon goal, and that often the 'inventor' is merely the formulator or materializer of what others have expressed in one form or other."

In Favor Of Bonuses . . .

The panelists who were in favor of rewards and bonuses were not as vocal in giving reasons for their feelings as were the participants who voiced opinions against it. Several, however, felt that these rewards should be within reason and that too high rewards would have a disruptive influence:

A Supervisor of Creative Engineering Program: "The rewards should be held within reason, i.e., token monetary plus personaal recognition. Too high rewards may break down the group communication and cause disruption in the overall effort."

A development engineer: "Experience has shown that bonuses do not interfere with teamwork. However, it would seem best to limit such amounts to a relatively modest figure ($100 seems to be a good maximum) and to make provisions to pay identical amounts to co-inventors."

Five panelists felt that awards would contribute to increased motivation and that they "would encourage others to not only analyze themselves in relation to their jobs, but would encourage a more conscientious attitude on the part of everybody concerned." A few panelists also pointed out that in the business environment "the profit motive becomes as real in creative people as it is in businessmen" and that this should be recognized. Professor Paul Pigors of M.I.T. added that bonuses would not interfere with team-work since "in an effective work group members know who the outstanding performers are."

Reward the Individaul

Several participants felt that our present preoccupation with the group has been exaggerated and has caused stagnation in many organizations. In their opinion, the concept of individual creativity should be re-examined, encouraged and elevated to its rightful place in the organizational set-up. These participants would, of course, reward only the individual: "Bonuses and rewards should be given to the individual with the original conception and not to the team whenever possible and *never* to the supervisor."

Six panelists reported that experience has indicated no adverse consequences as a result of rewarding individuals for their creative contributions, and that it has been done successfully in many companies. Following are panelists' reports on the systems adopted in three companies:

"Such a system has worked extremely well in Westinghouse:

a. $ 50.00 for disclosure.
b. $ 50.00 for a patent.
c. $200.00 for outstanding patent.
d. Up to $10,000 for patent commercially advantageous to company.

"At present we have a system at RCA whereby an inventor receives a nominal sum of money at the time his patent application is filed. We have found that this causes no interference with desirable teamwork within the company. Also, there appears to be no rivalry or tendency for individuals or groups to vie with each other in attempting to file more patents. I must grant, however, that if the bonus or reward amounted to $1,000.00 or more, the condition would undoubtedly change a great deal."

"Presently have managerial awards for outstanding accomplishments and awards of G.E. stock for patents. No hard feelings are apparent."

Conclusion

As is the case with many complex matters, the points of view about special awards system for patentable inventions, as indicated in panelists' comments, are numerous and often conflicting.

There is no doubt that the extremely high competition in industry at present has put a premium on creative ideas for new products and processes. This, in turn, has focused management's attention more and more on how to motivate and stimulate engineers and scientists to maximum creative effort. One of the most tangible and specific stimulation techniques for increasing the production of patentable ideas is the special bonus or awards system. The feeling is growing that in spite of the difficulties and dangers encountered in introducing such a system in a company, it still might operate as the most powerful extra incentive for increased creative output. Compared to this, some of the other incentives offered have a hollow ring. By letting the creative individual share in the profits from his ideas, several authorities have pointed out, would provide him with a *definite* stimulus for invention. There is, however, no doubt that extreme care has to be exercised and a lot of hard thought has to go into the preparation and implementation of such a system.

Maj. Gen. Frederick R. Dent, Jr., USAF (Ret.) has joined the Martin Co. as Manager of the Engineering Projects Dept. in the Baltimore Div. Gen. Dent formerly headed all R & D at the Wright Air Development Center.

Lester W. Tarr has retired from the Presidency of Cinch Mfg. Corp. but will remain on the Board of Directors and serve as a Consultant to United Carr Fastener Corp., parent corporation of Cinch.


L. W. Tarr


A. W. Miller

Arthur W. Miller has been appointed Vice President and General Manager of Ultradyne, Inc., of Albuquerque, N. M.

Dr. Alfred N. Goldsmith, has been elected to the Board of Directors of RCA Communications, Inc.

Circle 508 on "Opportunities" Inquiry Card, page 151

News of Manufacturers' Reps

A. C. Wahl Inc. of Cincinnati, Ohio will handle sales in Kentucky and Southern Ohio for Chester Cable Corp. and **R. C. Warner Sales Engineering Co.** of Sturgis, Mich. will handle sales in Indiana and Mich.

Universal Transistor Products Corp. has just appointed the following new reps: **Control Craft,** Chicago, for Northern Illinois, Wisconsin, Michigan and Minnesota; **Buthan, Inc.,** Wilmington N. C. in Virginia, North Carolina, South Carolina, Georgia, Florida, Tennessee, and Alabama; and **George J. Neuman & Co.,** Norwalk, Conn., in New England.

La Societe Technique Industrielle, 16 Rue Jean Mermoz, Paris, are now French representatives for Deltime, Inc.

Peninsula Associates have moved from 3150 Bayshore Hwy. to 1345 Hancock St., Redwood City, Calif., to larger quarters with showroom and instrument servicing facilities. They have also opened a branch office at 3215 Western Ave., Seattle, Wash.

The Bulova Watch Co., Electronics Div., has appointed the following new reps: **Comtronic Associates,** Plainview, L. I., will cover New York City metropolitan area and Northern New Jersey; **Kelly Enterprises,** Loveland, Colo., are reps in the western states of Utah, Idaho, Wyoming, Colorado and New Mexico; and **F. D. Marcy Associates** continue to service customers in Southern New Jersey, Delaware, Eastern Pennsylvania, Maryland, Washington, D. C., and Northern Virginia.

Nick J. Laub Co., Minneapolis, Minn., have been named reps for the Astron Corp.

Price Engineering Sales Assoc. has been appointed rep in Colorado, Wyoming, Utah, and New Mexico for Wyle Assoc.

The Magnetic Shield Div., Perfection Mica Co., has appointed the following new reps: **Abbott Allison Co.,** Meriden, Conn.; **J. Neal & Co.,** Miami, Fla.; **Alta Instrument Div.,** Denver, Colo.; and **Perlmuth Electronic Assoc.,** Los Angeles, Calif.

Wallace-Gluck Co., 3529 Manana Drive, Dallas, has been named sales rep for environmental chambers by Tenney Engineering, Inc.

Wayne Kerr Corp. has named the following reps: **Burlingame Assoc.; E. G. Holmes & Assoc.; Engineering Products Assoc.;** and **G. E. Moxon Sales.**

R. O. Whiesell & Assoc. has been named rep for Penta power tubes in Kentucky and Ohio.

Frank Mansur has been named military sales rep for electronics for the Lockheed Missile Systems Div.

Walter J. Brauer & Assoc. has opened an office at 9071 Old Orchard Drive, Cincinnati 30, Ohio. **Eugene Phillips** will be in charge of the Cincinnati office.

Paul Hayden Assoc. East Point, Ga., and **R. L. Pflieger Co.,** San Carlos, Calif., have been named reps for the Waterman Products Co.

Cannon Electric Canada Ltd. has been appointed rep in Canada for Advance Relays by Electronics Div. of the Elgin National Watch Co.

The Components Div. of International Telephone and Telegraph Corp. has appointed the **Anderson Sales Co.** of Boston, Mass., as rep for its line of "Federal" components.

Joseph F. Whitaker has joined the **Thomas H. Beil rep firm.** The new organization will be known as **Beil & Whitaker, Inc.,** Reading, Pa., and Bethlehem, Pa.

L & M Assoc., Inc., George Gostenhofer & Assoc., Inc., and Charles W. Fowler Co., have all been appointed reps by Eldorado Electronics.

Harold Holton of Detroit, Mich., has been named Regional Industrial and Distributor rep for the transformer products of Microtran Co., Inc.

G. S. Marshall Co. of San Marino, Calif., is now rep for Non-Linear Systems, Inc., digital voltmeters and associated products in the Southern California area.

Donald G. Vincent and **William R. Toye** have been appointed sales reps of Engineering Products Sec., Special Products Div. of I-T-E Circuit Breaker Co. of Philadelphia.

Halgin Sales Co., Mission Kans., has been appointed rep in Kansas. Missouri and Southern Illinois territory for the International Resistance Co.

E. V. Roberts & Associates, 5068 W. Washington Blvd., Los Angeles 16, Calif., have organized "Let's Have Better Mottoes Assoc." Each month a motto is selected from those submitted. The winner's motto is printed on a card and distributed. The winner is also named 30-day president of the association. The latest motto selected is: "Are you working on the solution—or are you part of the problem?"

ELECTRONIC INDUSTRIES Advertisers—November 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 149

Facts You Can Use to Identify and Sell Your Electronic O.E.M. Market

WHAT'S THE DIFFERENCE BETWEEN ELECTRONIC O.E.M. AND ELECTRONIC END-USER MARKETS?

The end-user market is where electronic Original Equipment Manufacturers (O.E.M.'s) *sell* their military, industrial and commercial products. It is an "after market," entirely distinct from the original market where O.E.M.'s *buy* their materials, components, and subsystems.

End-users—commercial, industrial and government—buy finished electronic products like broadcast transmitters, industrial controlling equipment, radar systems, computers, and missile guidance systems. The original equipment (O.E.M.) market buys tubes, semiconductors, wire, solder, plastics, pre-assembled circuits and subsystems, power supplies, relays, etc.—in production quantities—for assembly and resale to end-users.

Although these "before" and "after" electronic markets are sometimes lumped into one, the people in them differ in buying motive, selling technique, and personal identity. ***The O.E.M.'s are in the market for "producers goods"; the end-users are in the market for "capital goods."***

O.E.M. MARKET RESEARCH WITH THE NEW E.I.C. CODE

The government's Standard Industrial Classification (S.I.C.) fails to distinguish electrical from electronic manufacturers. For years this has forced manufacturers relying on S.I.C. market data to promote electronic components to electrical and electronic markets which cannot buy them in production quantities.

Now a new Electronic Industries Classification, the E.I.C. Code, has been developed to provide 101 major classifications for electronic products only. Data from an independent census of original equipment builders and suppliers are being punched on the IBM cards according to the E.I.C. Code.

Now you will be able to identify and measure your electronic O.E.M. market potentials using the E.I.C. Code, and ELECTRONIC INDUSTRIES IBM facilities. For more information contact your EI representative.

CAN ELECTRONIC O.E.M. MARKETS BE ECONOMICALLY REACHED THRU ROCKET AND MISSILE, AUTOMATION, AVIATION, AND OTHER END-USER PUBLICATIONS?

Electronic engineers working for aircraft, missile and industrial control manufacturers continue to submit most of their declassified theory and technique for publication in electronic—not end user—magazines. Here, they know, is where fellow specialists working for other aircraft, missile, and control builders will be looking for electronic progress in these fields.

You will see over 80% of the contributed articles on missile electronics, electronic controls, and avionics in ELECTRONIC INDUSTRIES, Electronics engineering edition, Electronic Design, Electronic Equipment Engineering, and Proceedings of the IRE. Each one of these magazines alone reaches more electronic engineers in missile, industrial control, and aircraft activities than any TWO of the fourteen end-user publications aimed at these fields.

. . . . and ELECTRONIC INDUSTRIES delivers you more electronic O.E.M. subscribers in missile, aircraft, and control fields than any THREE end-user magazines.

ARE ELECTRONIC O.E.M. BUYING INFLUENCES REACHED BY "TECHNICAL MANAGEMENT" WEEKLIES, OR BY ENGINEERING MONTHLIES?

Original electronic manufacturers and end-users need to interweave both engineering and cost judgments in order to buy intelligently. These cost judgments involve management participation, obviously, when the product is purchased as capital equipment. Typical examples are the financial and labor-saving calculations necessary in the purchase of electronic automation equipment by industrial and commercial enterprises.

But with the exception of such capital goods as test instruments and light production equipment, the original electronic manufacturer buys only for assembly and resale to end-users. Here cost engineering is largely outside the scope of management decision. *Cost evaluation of alternate electronic subsystems and components is accepted as a problem only for working engineers—engineers conversant with the latest ideas in the monthly technical literature.*

For these reasons, electronic ads in missile, electronic and aircraft weeklies are sometimes logical for finished electronic systems sold to end-users as capital (or military) goods. But when selling "producers goods" to original electronic manufacturers for assembly, system incorporation, and resale, engineering monthlies are the only realistic, and economical, advertising media.

WHY ELECTRONIC INDUSTRIES IS — NOW — THE MOST IMPORTANT PUBLICATION SERVING THE ORIGINAL ELECTRONIC MARKET

FIRST—by thousands—in O.E.M. circulation (see S.R.D.S. listings)
FIRST in missile electronic and avionic circulation (see S.R.D.S. listings)
FIRST in number of letterhead requests for article reprints
FIRST with new ideas in a depth usable to engineers (send for details)
FIRST in market research services (send for details)

ELECTRONIC INDUSTRIES

Chilton Company Executive Offices: 56th & Chestnut Sts., Phila. 39, Pa

AND, DEFYING INDUSTRY TRENDS, ELECTRONIC INDUSTRIES GAINED IN ADVERTISING IN THE FIRST HALF OF 1958

BPA NBP

G-V thermal time delay relays

help Waltham gyro find the vertical fast!

As part of an airborne fire control system, Waltham Precision Instrument Company's WG-2 Vertical Gyro provides vertical reference information. In achieving either initial or in-flight erection of the gyro, G-V Thermal Time Delay Relays control torque motor field currents that help find the vertical within 30 seconds!

In both military and industrial equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data and catalog material.

G-V CONTROLS INC.
LIVINGSTON, NEW JERSEY

Circle 2 on Inquiry Card, page 149