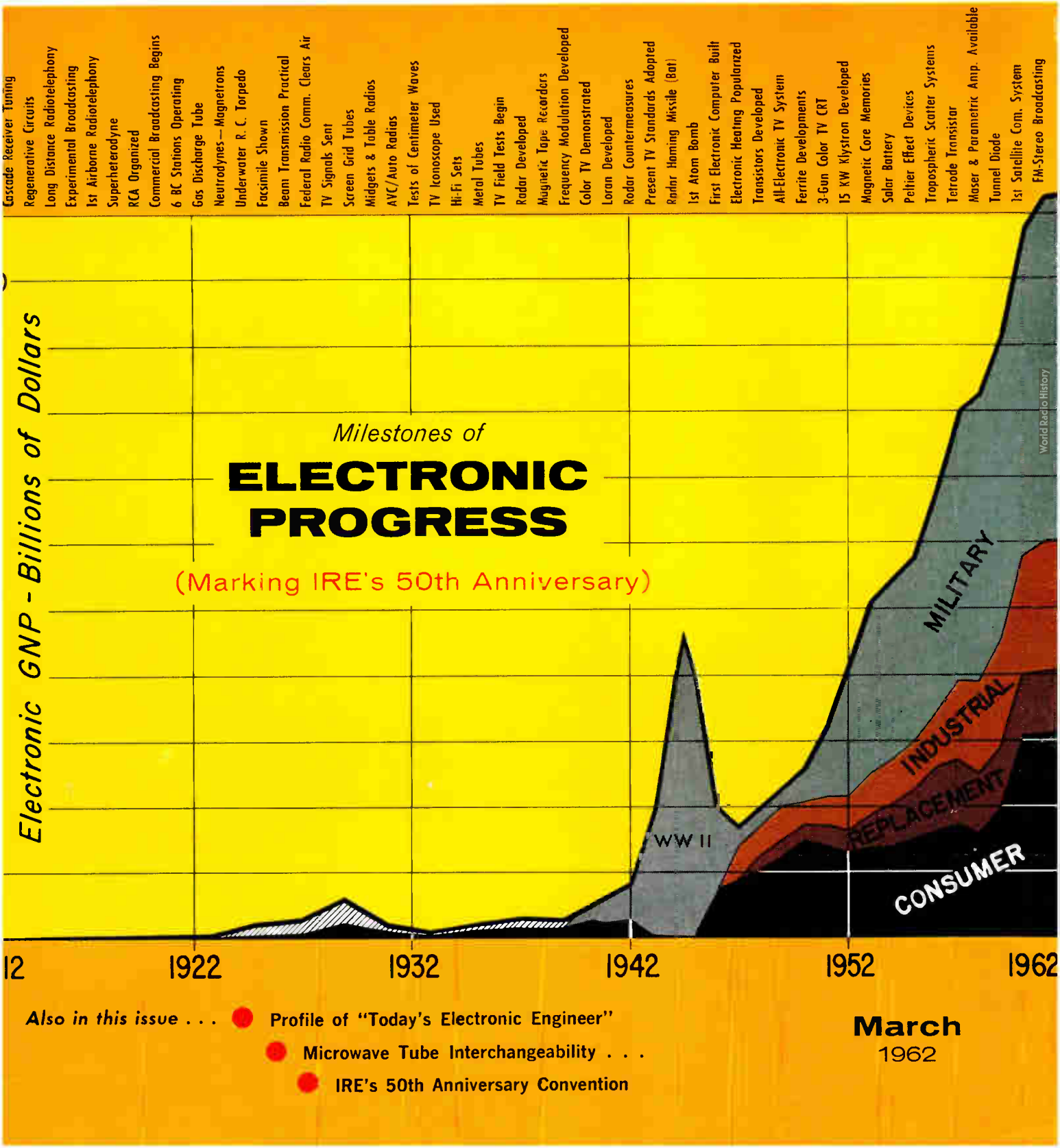
ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION



Also in this issue . . .

- Profile of "Today's Electronic Engineer"
- Microwave Tube Interchangeability . . .
- IRE's 50th Anniversary Convention

March
1962

TYPE C

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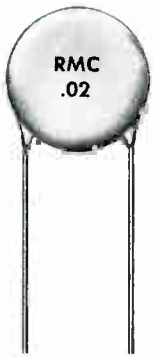

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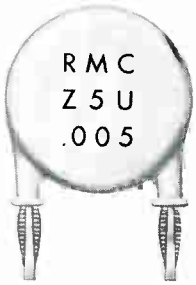

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ELECTRONIC INDUSTRIES

SHELBY A. McMILLION, Publisher • BERNARD F. OSBAHR, Editor

Engineering Needs "Status"

OUR May 1960 editorial, "Support for Education," pointed to the decline in our engineering enrollments and compared it with the corresponding upsurge in the USSR. At that time, we stressed the need to impress on high school students the importance and desirability of pursuing engineering careers. And we expressed the hope that our professional societies would give some attention to the problem.

In the nearly two years that have gone by, part of our hopes, at least, were realized—professional societies did step up their guidance counseling activities. The "Engineers Council for Professional Development," for instance, last year discussed engineering with more than 100,000 high school students, at approximately 1,500 meetings.

But in spite of these efforts, engineering enrollments are still falling off. It seems time to ask ourselves—What is missing?

Could it be that engineers are not adequately recognized in public eyes? Could it be that engineering, instead of reflecting glamour and excitement to our youth, appears as lacklustre career?

We offer this little essay on the meaning of engineering as written by E. C. Easton, Dean of Rutgers College of Engineering:

"Recently the names of Gagarin, Shepard, Grissom and Titov were featured prominently in the American press. All four had been passengers in vehicles designed, built and operated by others. Despite their relatively passive roles in their respective adventures these men were hailed and feted as though each has performed the miracle of Space-flight singlehandedly. . . .

"Let us have at least a faint cheer for the engineers who designed, built, launched and controlled the vehicle in which these space passengers rode. Let's be sure that the public knows that the real heroes were engineers, not scientists or astronauts. The scientific principles which govern space flight are few and simple. The engineering applications of those principles to accomplish a successful flight are incredibly complex.

"An engineer told Shepard exactly what to expect at every instant of that flight. He told Shepard that he would experience so many G's within 15 seconds; that at such a time, the periscope would come down; that at a given time, the rotating rocket would fire and that, at a specified time, the retrograde rocket would fire. . . .

"This ability to design a complex vehicle and to predict its performance before it leaves the ground is the most exciting feature of space flight. It is the most sophisticated talent ever possessed by the human race, and it is the mark of the engineer."

It seems to us that Dean Easton has captured a spirit here which we should set about promoting to the public in every possible way. We should be describing the vital roles that engineers play in designing and developing systems and equipment that are used by government, commerce and industry, and in the home. This might appear difficult because of the technical quality of engineering, but the medical profession has succeeded quite well in this connection over the last twenty years.

Many of the larger manufacturers in this country spend millions of dollars annually in an attempt to build corporate images. For the most part, however, they seem to have overlooked the value of promoting their engineering personalities, as well as the meaning and values that their engineers' technical contributions have for the general public.

The activities of the professional engineering societies are also woefully inadequate in this area. The societies always seem to be introverted rather than extroverted, and never controversial. Compare this, for example, to the public image of the A.M.A.

Much of our technological product today is for the military and government. Here, however, need-to-know security smokescreens some of the truly great engineering breakthroughs from the public. It seems paradoxical that little if anything has been done from this quarter to develop an engineering status symbol since our future is so dependent on continually advancing technology. What a creative opportunity this would be for Madison Avenue where much of the best talent is now concentrated on selling aspirin tablets, soap and detergents, cigarettes and beer!

Finally, in this vein, all of us will be interested in the 1962 edition of "Today's Electronic Engineer." It starts on page 218 in this issue. It is a most interesting geographical and statistical portrayal of personal engineer characteristics and qualities of the men who make our multi-billion dollar industry of today click!

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ELECTRONIC INDUSTRIES

Vol. 21, No. 3 **March, 1962**

FRONT COVER: This year The Institute of Radio Engineers celebrates its 50th anniversary. In keeping with this great occasion we have graphically illustrated the growth of the electronic industries since the IRE started in 1912. Above the graph significant technological developments over the past 50 years have been indicated. These are principal events that have helped shape our industry into the billion dollar business it is today. See p. 126 for additional details.

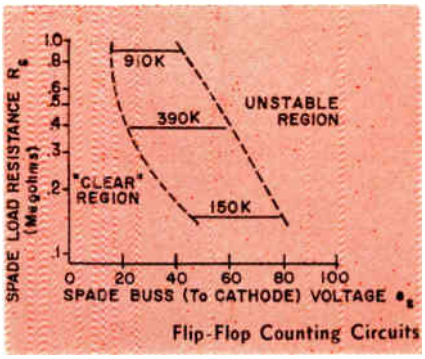
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

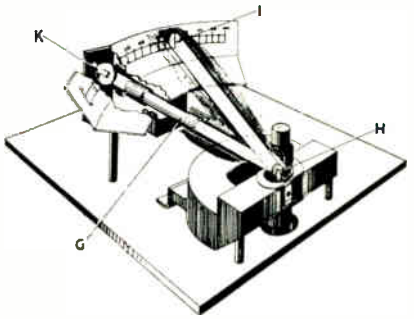
ELECTRONIC INDUSTRIES, March, 1962. Vol. 21, No. 3. A monthly publication of Chilton Company. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila. 39, Pa. Controlled circulation postage paid at Philadelphia, Pa. $1 a copy; Directory issue (June), $5.00 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $10.00; 2 yrs. $18.00. Canada 1 year, $12.00; 2 yrs. $20.00. All other countries 1 yr $18.00; 2 yrs. $30.00.

Highlights of this issue



Flip-Flop Counting Circuits

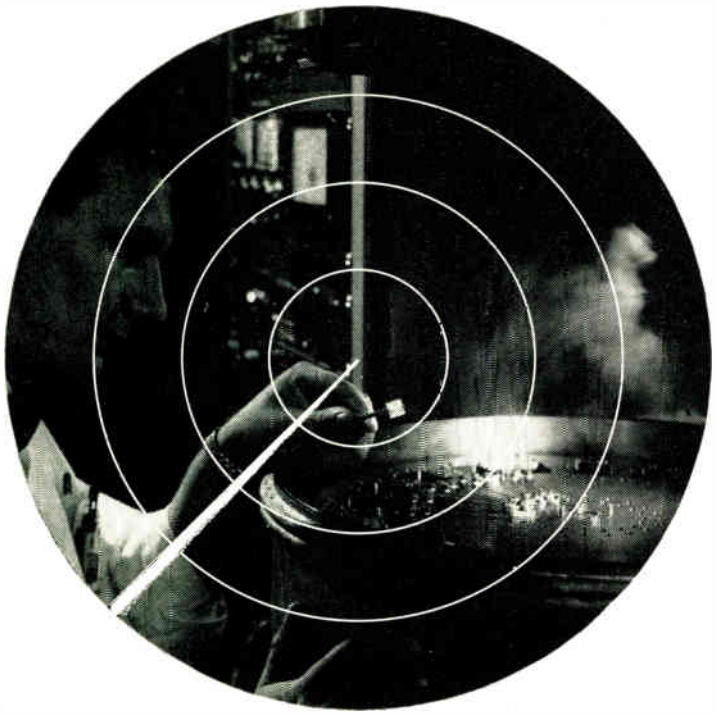

Severe Potentiometer Applications



Meter Movement Suspension

DISCOM

RADARSCOPE



MICROCIRCUITRY

At Lear Inc., technician removes a tiny completed microcircuit from a newly developed semi-automatic high vacuum deposition machine.

FIRST USE OF A COMPUTER to analyze hospital records will be conducted in Ann Arbor, Mich., by the Commission on Professional and Hospital Activity. The records of 2.5 million patients discharged from hospitals in 1962 will be analyzed on a Honeywell 400 computer. This is the first large scale use of an electronic data processing system for analyzing hospital records. Doctors and surgeons will be able to compare their practices with physicians in hospitals across the country.

A NEW STRESS ANALYSIS TECHNIQUE developed at Armour Research Foundation is called "acousto-elasticity." The technique employs ultrasonic energy in much the same way as polarized light is used in photo-elasticity. Experimental work with aluminum shapes indicates that acousto-elasticity should permit direct application of analysis to actual structural materials in the field.

AN INFORMATION SCIENCE DIRECTORATE has been established by the Air Force Office of Scientific Research. It marks the first time that a Federal agency sponsoring basic research in information sciences will have both the research function and an operational function capable of testing the results of research under the control of one individual.

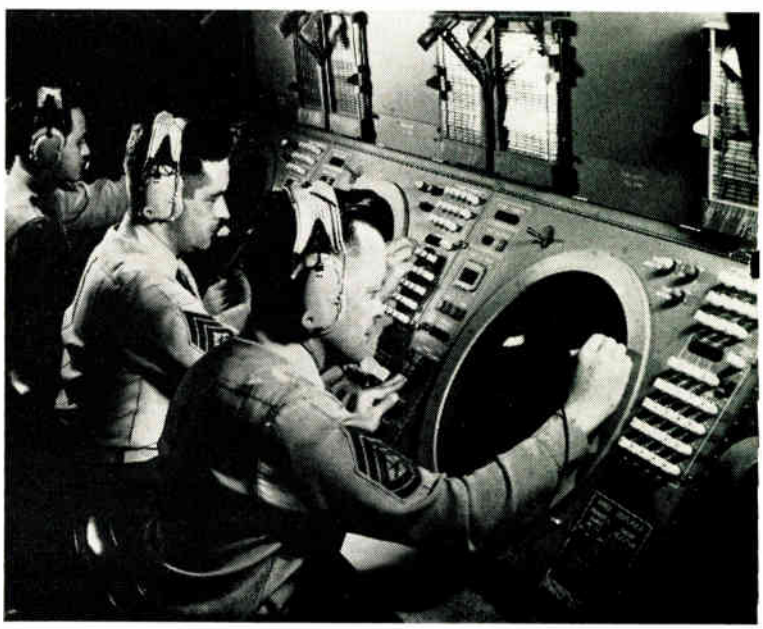
SUPER POWER LASER with a peak power of more than 3 million watts has been developed by scientists at the U. S. Army Signal Research and Development Lab., Ft. Monmouth, N. J. The 3-megawatt laser is 300 times as powerful as lasers in general lab use. Signal Corps scientists achieved the increase in power by using a rotating mirror that limits the pulse peak power to less than 1 millionth of a second. Thus one immensely powerful and short peak is achieved, rather than longer series of gradually declining power as in ordinary lasers.

THE CURRENT R&D in scientific documentation is described in a new directory put out by the National Science Foundation. This issue includes description of 271 projects in 156 organizations, an increase of 76 projects and 34 organizations in the past six months. Included are all pertinent activities on which information could be obtained in the U. S. and 18 other countries.

MEDICINE OFFERS a "wide range of opportunities for engineers," Dr. William B. Kouwenhoven, lecturer in surgery at Johns Hopkins University told the AIEE's Winter General Meeting. Dr. Kouwenhoven, who is one of the inventors of the portable defibrillator, a device which prevents heart failure due to operative shock, said that the engineer should be willing to cooperate and to appreciate the medical viewpoint and problems." He added that "there are many more variables in medicine than in engineering."

TACTICAL AIR CENTER

Air Operations Center, developed by Litton for the Marine Corps Tactical Data System, is being evaluated at the Corps' Air Facility, Santa Ana, Calif. Center is installed in a complex of 8 integrated helicopter-transportable huts.



GOVERNMENT STUDY indicates that industry pays approximately $4,000 more to engineers and scientists in the $15,000 to $19,000 pay grades. An additional obstacle that the Government is finding in their attempts to recruit is that engineers see restricted opportunity to participate in decision making, and the necessity for filtering through blocks of subordinates to communicate with top officials. Government is making a strong effort to analyze its weaknesses as an employer, and White House action is expected in the near future to alleviate some of these problems.

THE FINAL SOLUTION of the satellite communications problems seems to lie in an arrangement where the satellite itself will be jointly owned by a dozen or so of the nation's largest corporations and will be launched by the Government's missile facilities. The extended debate over the public vs. private ownership of the satellites is thus settled without creating a serious monopoly problem, and yet making full use of the Government's missile capability.

FCC CHAIRMAN Newton N. Minow is pressing his case for all channel UHF-VHF television sets, capable of receiving all 82 TV channels; 70 UHF as well as 12 VHF channels. He listed this as the FCC's No. 1 legislative goal during the new session of Congress. Minow said that, "what this country needs is more television, not less."

THE EIA has notified the House Ways and Means Committee that they are overwhelmingly approving reaffirmation of the EIA position, strongly supporting the administration's proposal for an 8% tax credit as an investment incentive. EIA Tax Committee Chairman, David Flower, Jr., said the proposal deserves the full support of American industry in view of Treasury Dept. plans to modernize present rates of which business is permitted to make tax deductions to allow for plant equipment depreciation.

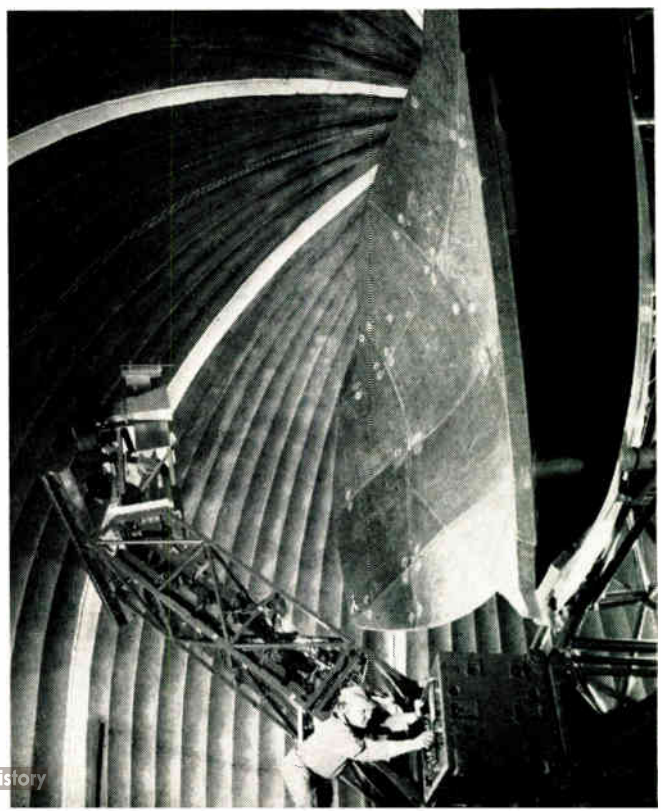
SMALL BUSINESSES are expected to get an increased share of the Government's subcontracting opportunities through new regulations issued by the Dept. of the Defense and the General Services Administration. The new subcontracting program, supervised by the Small Business Administration, and under the agency's Deputy Administrator for Procurement and Technical Assistance, Irving Maness, will enable small businesses to actively participate in a number of formally "forbidden" procurements. SBA may now obtain from any government procurement agency the information and records concerning subcontracting by the Procuring Agency's prime contractors. And, in addition, government prime contractors must consult with SBA through the appropriate purchasing agency when requested to do so to provide subcontract opportunities for small business suppliers.

NEW HELICOPTER CONTROL device which allows a helicopter pilot to take his hands off the controls in flight has been delivered to Army field units. The new system, developed by Sperry Pheonix Co., under an Army Signal Corps contract, provides full automatic landing approaches and enroute navigation when coupled electronically to existing instrument landing and navigation systems.

NEW MEASURES to meet "the alarming shortage of semi-professional technicians, which will become increasingly acute in engineering and space technology," has been recommended by a bipartisan House advisory group. The group warned that enrollments in American colleges and universities is expected to double in this decade and recommended a 5-year program of loans and matching grants at the rate of 300 million a year for the construction of classroom, laboratories and libraries for institutions of higher education. The report also noted that "professional engineers and scientists will be in short supply in the forseeable future" and that the nation needs large numbers of engineering technicians with approximately two years of college level training "to assist our engineers and scientists and multiply their effectiveness." The group noted that "experts maintain that we should be training at least one engineering technician for each graduating engineer, but at present we are producing about one technician for every four engineers."

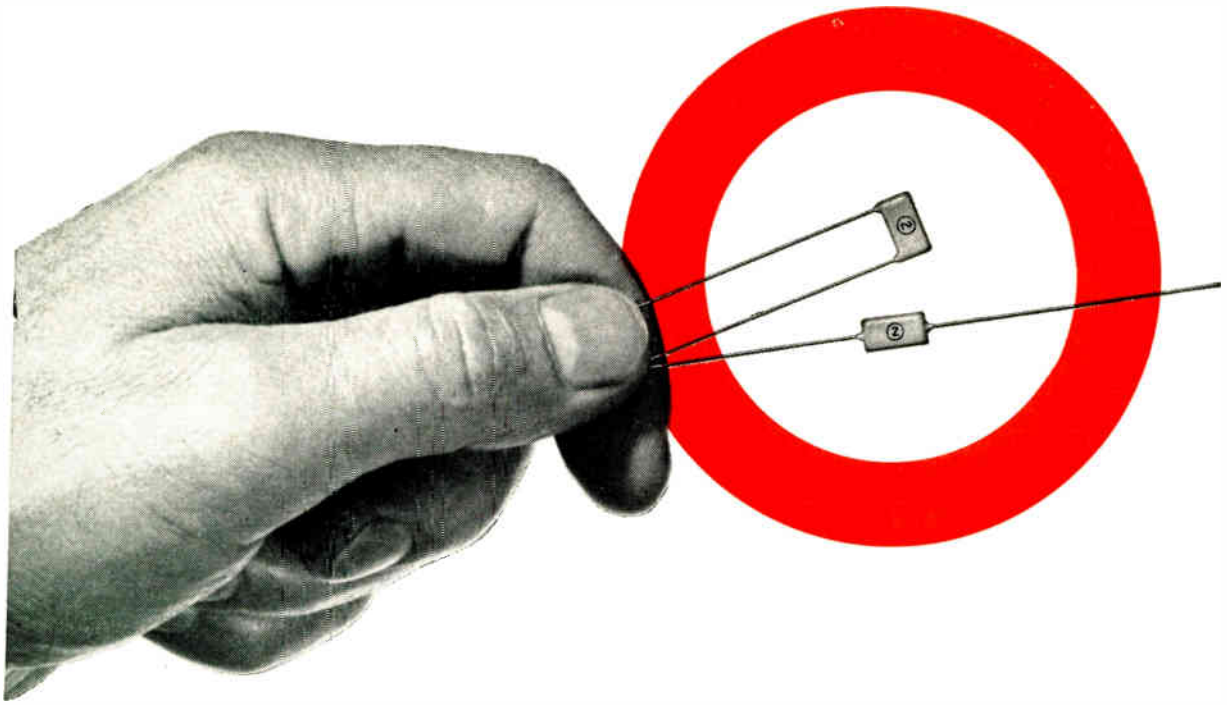
TACTICAL 3-D RADAR

New mobile system, developed for the Marine Corps by Sperry, provides target information in three dimensions of range, azimuth and elevation. The Corps will use the AN/TPS-34 radars to detect supersonic planes at close range.



New from Sprague!

SEE THEM AT IRE SHOW BOOTH 2416



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In addition to single-section capacitors, MONOLYTHICS can also be obtained as multiple-section units, allowing circuit designers to replace several conventional capacitors with a single compact device. The availability of these tiny yet highly stable units with either axial or radial leads offers further flexibility to the circuit design engineer.

Cumulative test data prove the low failure rate of these epoxy or phenolic coated capacitors in service—established by thousands of life, moisture resistance, shock, and vibration tests.

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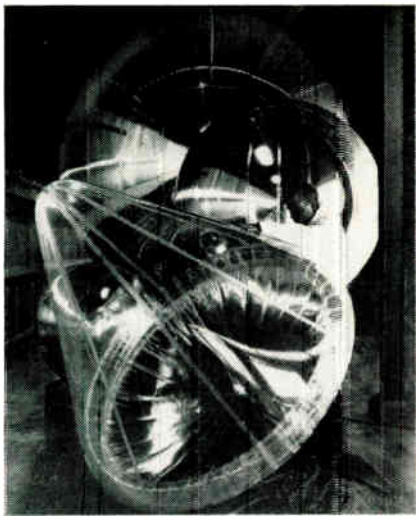
As We Go To Press...

SPACE MIRROR



Inflatable space structure is the prototype of a new rigidized solar collector able to serve as a satellite or space vehicle piggy-back power generating device. Developed by Viron, a division of Geophysics Corp. of America, Bedford, Mass., is designed to be inflated outside of a satellite or space vehicle. Other inflatable structures in the background are plastic balloons built for use as ground, air, and rocket-launched target spheres.

Automatic Programming Method Offered Industry

For the first time since its inception, an Aerospace Industries Assoc. developed method of automatic programming for numerically controlled machine tools will be offered to all U. S. industries. The announcement was made by the Armour Research Foundation of Illinois Institute of Technology at a recent press conference.

Designated as APT (Automatically Programmed Tools), the program, until now, has been restricted to only those industries in the aviation and aerospace manufacturing fields.

APT is a computer routine which translates English language directions for numerically controlled machine tools into a sequence of instructions on perforated tapes, which can be accepted directly by the tool. Thus, completely automatic production of critical metal parts is possible with the system.

America's Biggest Radio Telescope "Dish" Erected

America's biggest radio telescope "dish" has been erected on the Stanford University campus. A $350,000 research instrument designed and built by Stanford Research Institute scientists under support of the Air Force Office of Aerospace Research and the Defense Atomic Support Agency, the dish is the first of three such radio telescopes in the U. S.

Riggers used two large cranes for the delicate job of easing the 70-ton, 150-foot steel and aluminum parabolic antenna into place on its mount after removing pie-shaped sections to get a better grip on it. These sections and the big center tripod will be replaced later. Scientists hope to use the dish for radar and radio explorations of the solar system before the end of the year.

Mounted, the near-half-acre aluminum mesh surface of the dish will stand 160 feet at its highest and can point to any sector of the heavens. Because of the joint SRI-Stanford project's importance to radio and radar astronomy, Stanford trustees passed a special resolution exempting it from their long-standing ban on visible structures among the University's foothills.

NAB's TV Chairman Urges More Self-Regulation

E. K. Hartenbower, Chairman of the Television Code Review Board of the National Association of Broadcasters, speaking before a regional meeting of the American Women in Radio and Television, said that broadcasters must redouble their efforts at self-regulation to prevent more extensive federal controls.

Mr. Hartenbower, who is executive vice president and general manager of station KCMO-TV, Kansas City, said that although a majority of broadcasters are guided by "decent ethics and good taste" the entire industry must demonstrate that it will "faithfully fulfill our responsibilities" of public service.

He said his experience as TV Code Review Board Chairman has convinced him that a majority of broadcasters are conscientious and reject "commercial expedience."

"They make decisions," he said, "on the side of decent ethics and good taste in spite of the dollar bills that may be waved before their eyes." Yet, he continued, more federal controls are inevitable unless there is a greater effort at self-regulation.

New TV Center Opened

Theatre Network Television, Inc. (TNT) recently announced the public opening of its Technical Center for research and development of closed-circuit TV. Center is located in Woodside, L. I., N. Y.

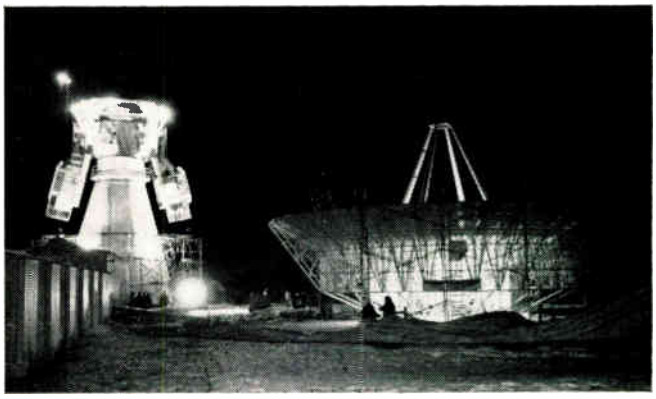
More on Page 9

NASA Plans Two-Man Rendezvous Spacecraft

NASA is extending its Project Mercury effort to produce a two-man spacecraft capable of docking with another vehicle in Earth orbit. Rendezvous in orbit is one way of carrying out later Project Apollo manned lunar landing missions. Another possibility is the direct-flight approach using a multi-million-pound thrust Nova booster. Both methods will be explored in order to meet a national goal of a manned lunar landing by 1970.

"ADVENT" ANTENNA

Nine-ton ADVENT "dish"-type antenna rests on ground prior to being hoisted atop its three story pedestal at Fort Dix, N. J. Sylvania Electric Products, Inc., is responsible for the development and installation of the operations facilities for ADVENT ground stations of both Fort Dix and Camp Roberts, Calif., with the exception of communications and telemetry electronics.



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Yes, Florida is a Solid State in Electronics. Already the sun, Mother of Life, shines on over sixty thriving electronics firms in our busy state.

Cape Canaveral is here, too, with its massive, awesome missiles blasting off to make space history. Electronics makes possible every thrust into the universe. Every hope of getting to the moon depends upon electronics—and the first American to the moon will definitely soar to history from Florida.

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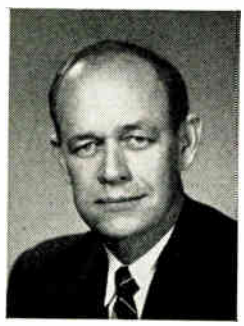
Governor, State of Florida



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New Army System Tracks Missiles and Satellites

The Army has developed a rugged new space tracker. The electro-optical system, named the Precision Instrument Mount, was developed by the U. S. Army Signal R&D Lab., Ft. Monmouth, N. J,. and the American Machine and Foundry Co., Stamford, Conn.

Tracker, known as PIM, has the basic features of phototheodolites, using a sighting telescope and camera to record the course of objects in space. PIM, however, provides new capabilities in both optical and electronic tracking, including TV.

Even under adverse conditions, PIM records the position of objects to an angular accuracy of 180th of a degree and marks the time within .001 sec. It tracks missiles and satellites moving several miles a sec., and keeps equally close track of manned and drone aircraft, meteorological or special-purpose balloons, and any other moving target.

Objects unseen by the operator are tracked when heat-sensing infrared or radar sensors are used. PIM tracks automatically, semi-automatically or manually.

Control Study Awarded to PRC

Problems involved with ground control and servicing of as many as 20 satellites all orbiting simultaneously on different paths around the earth will be probed by Planning Research Corp., Los Angeles, Calif. Work will be done under contract to the Lockheed Missiles & Space Co., Sunnyvale. PRC will seek to determine the optimum utilization of ground stations in a multi-satellite situation.

It will investigate methods to avoid conflicts between satellites requesting simultaneous servicing from the same ground stations. It will also investigate methods to minimize the total waiting time for service when the satellite "sees" that the next station it will pass over is incapable of performing the desired service.

Satellite control and servicing method developed by PRC will be capable of being programmed on a digital computer which will be used to evaluate satellite system capabilities and satellite equipment requirements to resolve optimum schedules.

(*Continued on page* 15)

Electronic SHORTS

▸ Successful attainment of 20 joules output of coherent optical radiation from a ruby LASER system, operating at room temperature, has been announced by Dr. T. H. Maiman, Director of the Applied Physics Lab, Quantatron, Inc. Emission consisted of a very uniform subpulse structure having approximately 200 kc repetition rate. This energy magnitude was reached by optimization of ruby quality and fabrication, along with developing improved pumping techniques. Further increases in output, to 50 joules and more, are expected with cooling to liquid nitrogen temperatures.

▸ USAF Ballistic Systems Div., has awarded General Precision, Inc., a $2 million award for production and testing of a Stellar Inertial Guidance and Control System for a long range missile. Using the stars as reference points, the missile-borne guidance system employs a celestial sensor integrated with a miniature inertial guidance system to deliver the missile to its target.

▸ Electro-Optical Systems, Inc., under contract to NASA, will conduct a feasibility study for a "substantially improved" radiation resistant solar cell with efficiency of at least 11%. Major feature of the improved cell will be its graded base structure. This new base structure is expected to reduce the minority carrier lifetime requirement to approximately 1μs. or less and provide a drift field in the base region approximately 100 microns deep.

▸ Page Communications Engineers, Inc., Washington, D. C., has been awarded a $7,373,000 contract for the construction of the Voice of America's new mid-African relay station to be located near Monrovia, Liberia. The new station, which is scheduled to go on the air next year, will pick up Voice of America broadcasts beamed from the U. S., and rebroadcast them to Africa, parts of Central Europe, and the Middle East on six 250 kw. and two 50 kw. transmitters. Total cost of the new facility is estimated at over $13 million.

▸ A contract by Reeves Instrument Corp. for closed-circuit TV systems to be used with mobile Radar Bomb Scoring Systems has been awarded General Precision, Inc. Systems are used to score SAC crews on simulated bombing runs. The TV cameras will be mounted on the radar antennas, allowing operators to see where the radar is pointing with respect to the aircraft, and detect errors in their radar tracking.

▸ Aluminum "space panels" on which thousands of tiny photoelectric solar cells will be mounted to furnish power for the Mariner R Venus probe are being constructed at Ryan Aeronautical Company's Aerospace plant in San Diego. Nine panels, 29 in. wide and 60 in. long will be built under contract to the Calif. Inst. of Technology Jet Propulsion Lab. Of these, five will be test units and four will be flight hardware in the two Venus probes scheduled for flight this summer.

▸ A closed loop refrigeration system for MASER cooling has been developed by The Garrett Corp.'s AiResearch Mfg. Div., Los Angeles. Developed under a contract issued by the Air Force's Aeronautical Systems Div., the refrigerator uses a simple two-loop cryogenic refrigeration system and has a cooling capacity of 1w. total at 4.2K. Designed for ground operations, it uses helium and neon as refrigerants.

▸ A controlled environment facility to be installed at the General Electric Company's Space Technology Center, Valley Forge, Pa., is being built by Shielding, Inc. of Riverton, N. J. The facility, an 8,500 square foot superclean area, largest single installation of its kind, is now under construction at the 131 acre G.E. site.

▸ Ryan Aeronautical Co. will design and build a new jet vertical take-off and landing research aircraft for the U. S. Army to demonstrate the lift-fan propulsion system. The aircraft will be powered by G.E.'s VTOL lift fan system. It will be capable of taking off vertically, then entering conventional flight at speeds of more than 500 mph. Ryan was selected as winner of a design competition for this aircraft, sponsored by the Army's Transportation Research Command.

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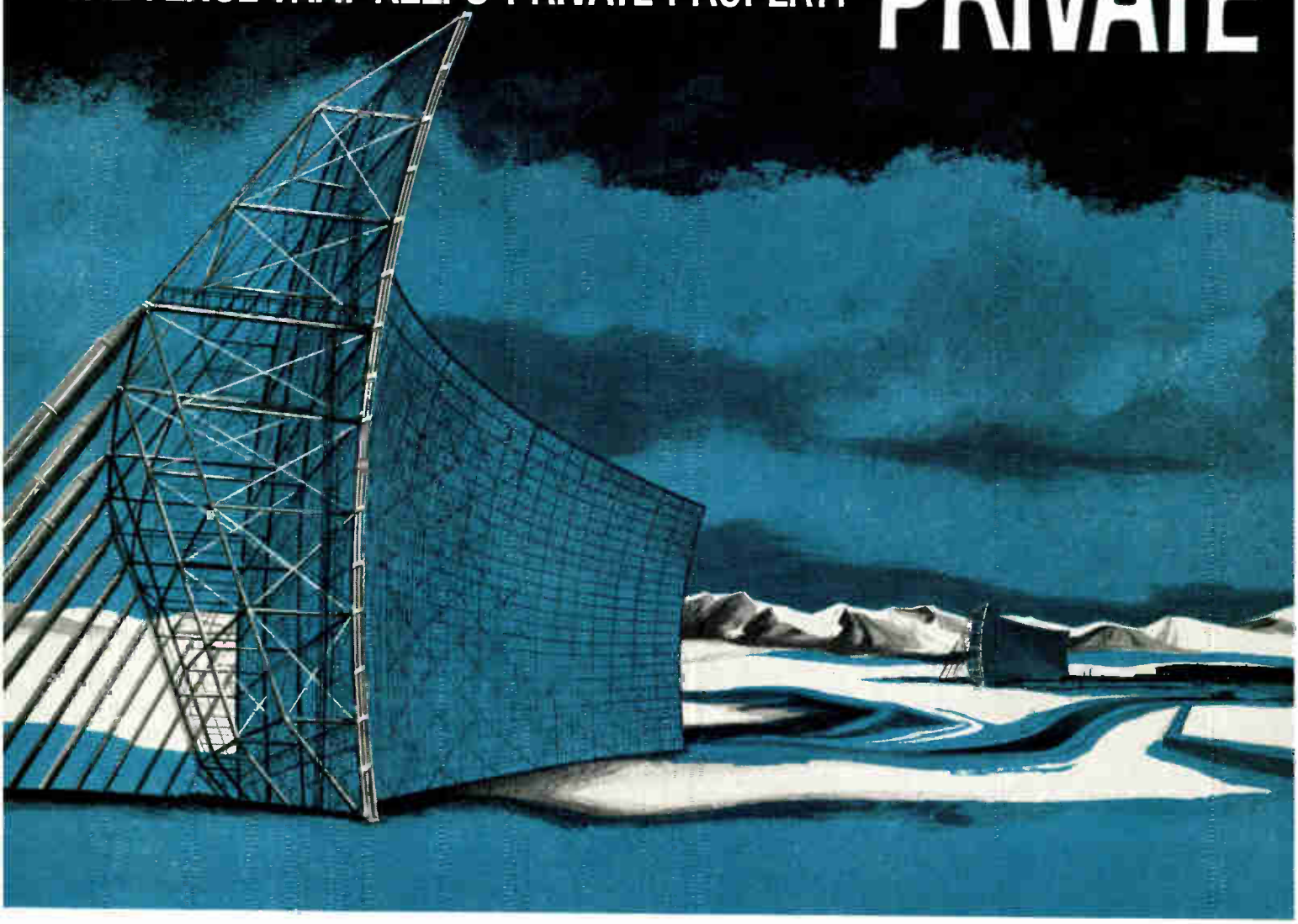

TYPE A. Hermetically Sealed, Semi-Enclosed. Equal or exceed Specs MIL-E-5272C, MIL-T-5574A, MIL-STD-202A. Bulletin 3000-1.

TYPE MX. Hermetically Sealed, Semi-Enclosed. Standard differentials 2° to 6°F; 1° to 4°F special. Bulletin 6100. Also TYPE AX. Hermetically Sealed, Semi-Enclosed. Similar to above but to close on temperature rise. Bulletin 3200.

STARK. Bone-chilling cold. Silent. Except for gales that shriek across the barren tundra. Here are located ballistic missile early warning radars that hold up electronic fingers to guard our Back Door.

Their operation is a rugged, brutal test of men. And of equipment that must maintain unfailing, around-the-clock vigil. Nothing is left to chance.

Components specifications must be clear, precise, exact. Like Stevens *Certified* Thermostats for sensing, control and communications circuits. For Stevens *Certified* Thermostats are the product of creative engineering . . . are backed by the most stringent environmental-test and quality-control programs in the industry.

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STEMCO® THERMOSTATS

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Coming Events in the electronic industry

Mar. 10-13: Int'l. Watchmakers and Mechanical Instrumentation Congress; Hotel Commodore, New York, N.Y.

Mar. 13-14: 2nd Symp. of Parkaging of Chemical Products, MCA(CPC); Chase-Park Plaza Hotels, St. Louis, Mo.

Mar. 14-16: EIA Mtgs.; Statler Hilton Hotel, Washington, D. C.

Mar. 14-16: 12th Annual Conf. on Instrumentation for the Iron & Steel Industry, ISA; Hotel Roosevelt, Pittsburgh, Pa.

Mar. 19-26: 9th Annual Spring Conv., AES; Ambassador Hotel, Los Angeles, Calif.

Mar. 20: Annual AEP&EM Mtg.; Chicago, Ill.

Mar. 20-25: 1962 Los Angeles High Fidelity Music Show, IHFM; Ambassador Hotel, Los Angeles, Calif.

Mar. 20-29: 14th Mtg. of the American Chemical Soc., Washington, D. C.

Mar. 22-24: Radio Tech. Comm. for Marine Services (RTCM) Assembly Mtg.; Claridge Hotel, Atlantic City, N. J.

Mar. 25-29: March APS Mtg.; Baltimore, Md.

Mar. 26 - 29: IRE Int'l. Conv., IRE; Coliseum & Waldorf-Astoria Hotel, New York, N. Y.

Mar. 27: 11th Annual SSB Hamfest & Dinner, SSBARA; Statler - Hilton Hotel, New York, N. Y.

Mar. 27-29: American Power Conf., ASME; Sherman Hotel, Chicago, Ill.

Mar. 28 - 29: Carbide and Ceramic Tooling, ASTME; Conrad Hilton Hotel, Chicago, Ill.

Mar. 28-31: 11th Biennial Electrical Industry Show, Electrical Maintenance Engrs. Assoc. of Calif,; Shrine Exposition Hall, Los Angeles, Calif.

Mar. 29: 7th Annual Materials Handling & Packaging Conf.; Stanford Univ., Palo Alto, Calif.

APRIL

Apr. 1-4: NAB Annual Conv.; Conrad Hilton Hotel, Chicago, Ill.

Apr. 1-4: Annual Congress of American Radium Soc., New York, N. Y.

Apr. 3-5: Cement Industry Conf., AIEE; St. Louis, Mo.

Apr. 4 - 6: So. Central Distr, Mtg., AIEE; Hotel Peabody, Memphis, Tenn.

Apr. 5-6: Management Eng'g. Conf., ASME, SAM; Statler Hilton Hotel, New York, N. Y.

Apr. 7-8: ARRL New England Div. Conv.; Swampscott Hotel, Swampscott, Mass.

Apr. 9-10: Rubber & Plastic Industries Conf., AIEE; Sheraton Hotel, Akron, Ohio.

Apr. 9 - 10: 4th Nat'l. Chemical & Petroleum Instrumentation Symp., ISA; Wilmington, Del.

Apr. 9 - 13: The Business Equip. Expos., BEMA; McCormick Place, Chicago, Ill.

Apr. 10-12: 43rd Annual AWS Mtg. & Welding Show, AWS; Cleveland Auditorium, Cleveland, Ohio.

Apr. 10-13: 1962 Annual Tech. Mtg. & Equipment Expos., Institute of Environmental Sciences; Sheraton Towers Hotel, Chicago, Ill.

Highlights '63

IRE Int'l. Conv., Mar. 24-28, 1963 (tent.); Coliseum & Waldorf-Astoria Hotel, New York, N. Y.

Western Electronics Show & Conf. (WESCON), Aug. 21-24, 1963; Memorial Sports Arena & Statler-Hilton Hotel, Los Angeles, Calif.

Nat'l. Electronics Conf. (NEC), Oct. 8-10, 1963; Exposition Hall, Chicago, Ill.

Northeast Research & Eng'g. Mtg. (NEREM), Nov. 12-14, 1963; Boston, Mass.

Apr. 11-12: High Energy Rate Forming, ASTME: Brown Palace Hotel, Denver, Colo.

Apr. 11-12: S. W. IRE Conf. (SWIRECO) & Electronics Show, IRE; Rice Hotel, Houston, Tex.

Apr. 11-13: Annual Tech. Mtg. & Equip. Expos. of the Inst. of Environmental Sciences; Sheraton Towers Hotel, Chicago, Ill.

Apr. 11-13: Spring Textile Eng'g. Conf., ASME; N. C. State College, Raleigh, N. C.

Apr. 12: Color & Coloring of Plastics, Rochester Sec. SPE; Univ. of Rochester, Rochester, N. Y.

Apr. 13-14: ARRL Mich. State Conv.; Pantlind Hotel, Grand Rapids, Mich.

Apr. 15-19: Oil & Gas Power Conf. & Exhib., ASME; Shoreham Hotel, Washington, D. C.

Apr. 16-18: Aerospace Systems Reliability, IAS; Salt Lake City, Utah.

Apr. 17: Polypropylene's Expanding Position, Phila. Sec. SPE; Sheraton Hotel, Phila., Pa.

Apr. 17 - 19: Rural Electrification Conf., AIEE; Ft. Shelby Hotel, Detroit, Mich.

Apr. 17-19: ASM Reg. Conf. & Exhib.; Shamrock Hotel, Houston, Tex.

Apr. 17-20: Conf. on Sector-Focused Cyclotrons, U. of C.; Los Angeles, Calif.

Apr. 18-20: Great Lakes District Mtg., AIEE; Hotel Van Ormon, Ft. Wayne, Ind.

Apr. 21-Oct. 21: 1962 World's Fair, Seattle, Wash.

Apr. 23-25: 1962 Powder Metallurgy Show & 18th Annual Powder Metallurgy Tech. Conf., MPIF; Sheraton Hotel, Phila., Pa.

Apr. 23-26: Spring APS Mtg.; Washington, D. C.

Apr. 24: Joint Mtg. AEP&EM with Distributors & Representatives; Chicago, Ill.

Apr. 24-26: 10th Nat'l. Conf. on Electromagnetic Relays, NARM, Okla. State Univ.; Student Union Bldg., Oklahoma State Univ., Stillwater, Okla.

FOREIGN

Mar. 20-23: Spring Mtg. of the Institute of Metals, including Discussion on Uranium & Graphite, IM; London, England.

Mar. 26-27: Symp. on High Energy Nuclear Physics; Imperial College, London, England.

Mar. 27-30: Symp. on Aetiology of the Late Somatic Effects of Ionizing Radiations, IAEA; London, UK.

Apr. 4-6: Symp. on the Physics of Graphite-Moderated Reactors, IP, PS, BNEC; Bournemouth, England.

Apr. 9-13: 4th Inter-American Symp. on the Peaceful Application of Nuclear Energy; Mexico City, Mex.

Apr. 10-11: Railroad Conf., AIEE, ASME, EIC; King Edward Hotel, Toronto, Ont., Canada.

Apr. 16-20: Symp. on Reactor Safety and Hazards Evaluation Techniques, IAEA; Vienna, Austria.

Apr. 28-May 5: 2nd Int'l. Exhib. of TV Equip.; Montreux, Switzerland.

Apr. 24-26: Production Eng'g. Conf., ASME; Van Curler Hotel, Schenectady, N. Y.

Apr. 25-26: Symp. on the Mathematical Theory of Automata, IRE, AIEE, U. S. Defense Research Agencies; United Engineering Center, New York, N. Y.

Apr. 25-29: Space Age Industries & Eng'g. Expos./Conf.; Cow Palace, San Francisco, Calif.

Apr. 26-27: Conf. of the ASME Nucleonics Heat Transfer Committee; Argonne, Ill.

(*Continued on page* 12)

Coming Events

(*Continued from page* 11)

Apr. 26-27: 3rd Nat'l. Pulp & Paper Instrumentation Symp., ISA; Jacksonville, Fla.

Apr. 29-May 4: 19th Conv. of the SMPTE; Ambassador Hotel, Los Angeles, Calif.

Apr. 30-May 2: AIEE Mid-America District Mtg.; Hotel Chase, St. Louis, Mo.

Apr. 30-May 2: 8th Nat'l. Symp. on Instrumentation Methods of Analysis, ISA; Daniel Boone Hotel, Charleston, W. Va.

Apr. 30-May 2: Manned Space Flight, IAS; St. Louis, Mo.

Apr. 30-May 3: Design Eng'g. Conf. & Show, ASME; McCormick Place, Chicago, Ill.

"CALL FOR PAPERS"

1962 Western Electronic Show & Conv. (WESCON), Aug. 21-24, 1962; Memorial Sports Arena and Statler-Hilton Hotel, Los Angeles, Calif. The following materials should be submitted by **April 15, 1962:** 100 to 200 word abstract, including title of paper, name and address of author; 500 to 1,000 word summary; and an indication of tech. field in which paper falls (use IRE PG classification). Forward to: WESCON Business Office, c/o Technical Program Chairman, 1435 S. La Cienega Blvd., Los Angeles 35, Calif.

Joint Int'l. Conf. on Creep and Fracture, Aug. 25-28, 1963, Hotel Biltmore, New York, N. Y. Papers to cover Fundamentals of Creep and Fracture, Design Techniques for Creep and Fracture, and Service Experience in Creep and Fracture. **Forward** abstracts of not more than 250 words **by June 1, 1962,** to Mr. N. L. Mochel, Conference Secretary, Westinghouse Electric Corp., Steam Div., Lester Branch P. O., Phila. 13, Pa.

ENGINEERING EDUCATION

Short courses at leading institutions.

Electronic Packaging

Engineering Extension and Physical Sciences Extension, Univ. of Calif., is offering a 2 week (80 hour) short course "Electronic Packaging For Design Engineers." **Dates: Mar. 26 through April 6, 1962.** The course will present the state of the art and will answer the necessary fundamentals and new developments. It is orientated toward, and will emphasize, Military Specifications. Prerequisite: practicing engineer with some design experience. For further information contact: Dept. K, University Extension, Univ. of California, Los Angeles 24, Calif.

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A PRIVATE INSTRUCTOR IN
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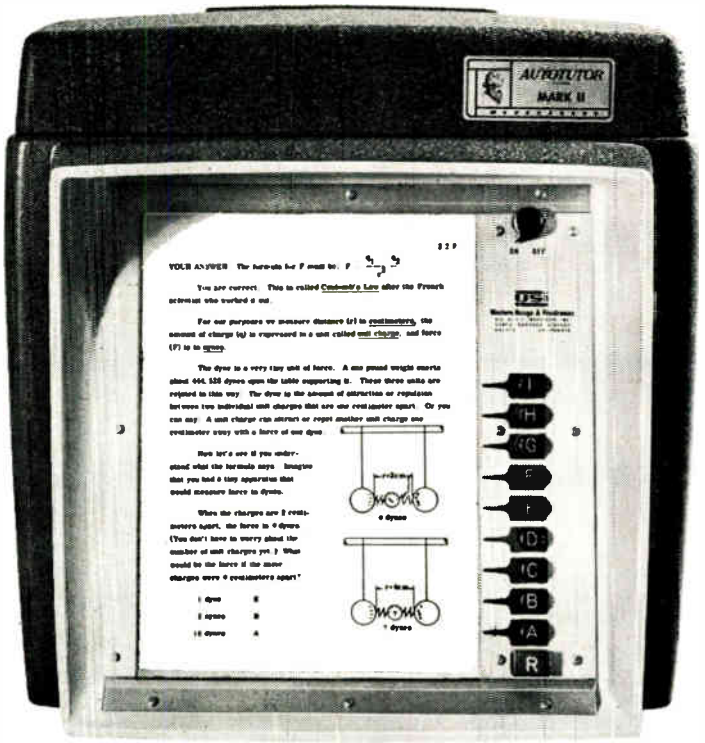

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THE AUTOTUTOR PROGRAM IN BASIC ELECTRONICS ■ electron theory ■ electron movement and measurement ■ power ■ circuits ■ Kirchhoff's laws ■ magnetism and electromagnetism ■ capacitors ■ inductors ■ transformers ■ vacuum and special-purpose tubes ■ transistors . . . and all other components of a full-year course. It has been used with highly satisfactory results—achieving a substantial decrease in learning time—by the armed forces, industry and educational institutions.

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E-1

New from Sprague!

SEE THEM AT IRE SHOW BOOTH 2416

The Most Widely-Used Logic Transistor, Type 2N1499A, Now Has a Smaller Brother...

TYPE 2N979

LOW-COST LOGIC TRANSISTOR

Here is a new Sprague Transistor that is smaller in size, yet identical in performance with the well-known 2N1499A Logic Transistor.

Designed for use in saturated switching circuits, this low-cost, hermetically-sealed MADT® Transistor is capable of switching at frequencies in excess of 10 megacycles.

In addition to computer applications, this rugged transistor is ideally suited for data processing and instrumentation equipment.

There are two major reasons why The Sprague 2N979, as with the 2N1499A, is earning a high level of acceptance:

1. DEPENDABLE PERFORMANCE — Specifically designed with parameters intended for logic circuits, these transistors consistently show low storage time, low saturation voltage, high beta, high switching speed. Their cases are cold welded to insure reliability.

2. ATTRACTIVE PRICE — Available in production quantities, these transistors are first-run devices, *not* "fall-outs". They are produced on FAST (Fast Automatic Semiconductor Transfer) lines with direct in-line process feedback, especially programmed to insure high production yields.

Here are some key parameters:

I_{CBO}	1 μa typ.
BV_{CBO}	20V min.
BV_{CES}	20V min.
f_T	100 mc min.

For application engineering assistance without obligation, write Transistor Division, Product Marketing Section, Sprague Electric Co., Concord, New Hampshire.

For complete technical data, write Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

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TRANSISTORS	INTERFERENCE FILTERS	HIGH TEMPERATURE MAGNET WIRE
CAPACITORS	PULSE TRANSFORMERS	CERAMIC-BASE PRINTED NETWORKS
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RESISTORS	PULSE-FORMING NETWORKS	FUNCTIONAL DIGITAL CIRCUITS

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THE MARK OF RELIABILITY

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As We Go To Press . . .

Weathermen See Both Ends Of Runway Electronically

Equipment package, known as a duplicate precision - approach weather-observation facility, puts weather instruments in approach and landing areas. It is used for USAF aircraft landing by radar or automatic instrument-landing systems. Eighty-seven installations are planned for USAF bases and some civilian airports which are used for military flying.

Included in the package are wind-measuring equipment (GMQ-11), visibility-measuring equipment (transmissometer) (GMQ-10) and cloud - base height-measuring equipment (rotating-beam ceilometer) (GMQ-13).

Dual equipment is located at each end of the all-weather runway. Each set gives instantaneous information on touchdown wind direction and velocity, landing visibility and approach ceiling (cloud height).

Signal Corps Unveils Communications System

New communications system, Switched Circuit Automatic Network, or SCAN, has been developed by a team of communications engineers and technicians from the Army Signal Corps and Bell Telephone System. It will operate as an element of the Defense Communications System.

The system combines several manually operated communications networks into one automatic system. This single arrangement of facilities is also capable of initially handling three types of services—voice, data and facsimile, with teletype to be added in the near future.

CORONA "HUNTER"

Aiming an ultrasonic "gun" at a high-voltage transmission line, W. E. Pakala of the Westinghouse research labs tests the line for electrical leakage, or corona. If present, corona produces high-frequency sound waves which are received by the "gun" and made audible through electronic circuitry. A telescopic rifle sight built into the instrument pinpoints the corona sources.

Philco's Allen Heads EIA's Photo Section

A. E. Allen, Product Planning Manager for the Consumer Products Div. of Philco Corp., has been appointed Chairman of the Phonograph Section of the Electronic Industries Assoc.'s Consumer Products Div. by Division Chairman, E. R. Taylor. Mr. Allen was nominated for the position by the Phonograph Section after it accepted the resignation of L. M. Sandwick, of Pilot Radio Corp., who became Staff Director of the EIA Consumer Products Div.

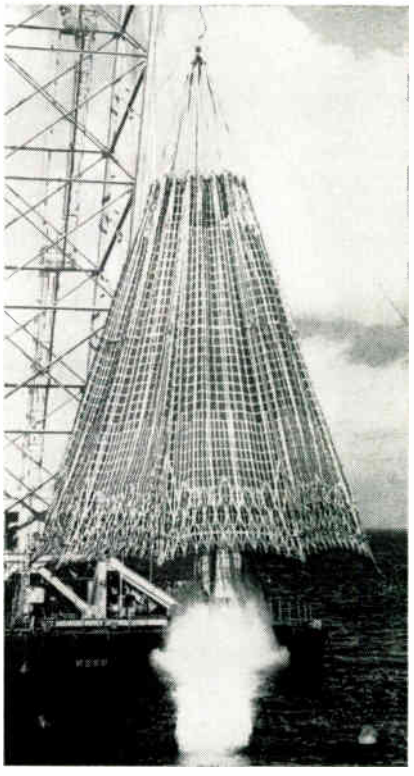
Scientists Look At Van Allen Belt

Scientists recently took a detailed look at the lower Van Allen radiation belt from instruments carried abroad an Atlas missile.

Shot should add to knowledge about forces operating in space near the earth, and the kinds of radiation that will be found there. It will help determine what sort of shielding against this radiation scientists must provide for astronauts.

Scientific sounding shot was made under auspices of the Air Force Cambridge Research Labs, Bedford, Mass. Effort is part of the independent research program of Lockheed Missiles & Space Co. scientific labs in Palo Alto, Calif. Instruments were built with Lockheed funds. Atlas carried radiation counters several hundred miles high, into the lower portions of the belt.

"GRAB-BAG"



Set up off the coast of California, huge "grab-bag" catches a 15-ton test vehicle as it breaks the surface after being launched from a tube on the ocean's floor. Special draw strings snap the bag shut as the Polaris enters. This enables Lockheed Missiles & Space Co. engineers to study missile's underwater performance, and prevents damage to the "sea-bird," permitting repeated use of the test vehicle.

Environmental Testing Facility Opened at AMF

American Machine & Foundry Co. has opened a new Environmental Laboratory to test components for aerospace ground equipment and for missile and aircraft operations. The facility will be available to other defense contractors, as well.

The new facility is located at Stamford, Conn., and is a part of the Greenwich Engineering Division of AMF's Government Products Group.

The laboratory provides a complete testing, analyzing and evaluation service that fulfills military test requirements. Its facilities are now being used to test components for Minuteman missile storage, erection and launching mechanisms.

The test facility can simulate extremes of sand and dust, salt spray, sun and rain, heat and cold, and humidity and aridity. Induced environments such as shock, acceleration, vibration and RFI are produced by special instruments and machines. Other special devices will allow combinations of natural and induced environmental testing to take place at the same time.

Some of the classes of components which may be tested in the laboratory are: electronic, hydraulic, pneumatic and mechanical.

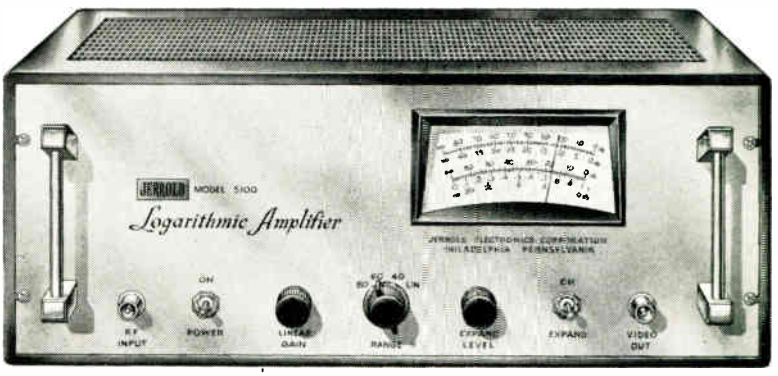
announcing

NEW JERROLD®

rf LOGARITHMIC AMPLIFIER

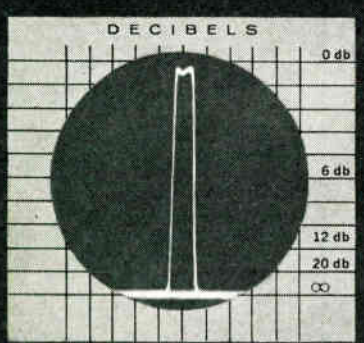
Model LA-5100

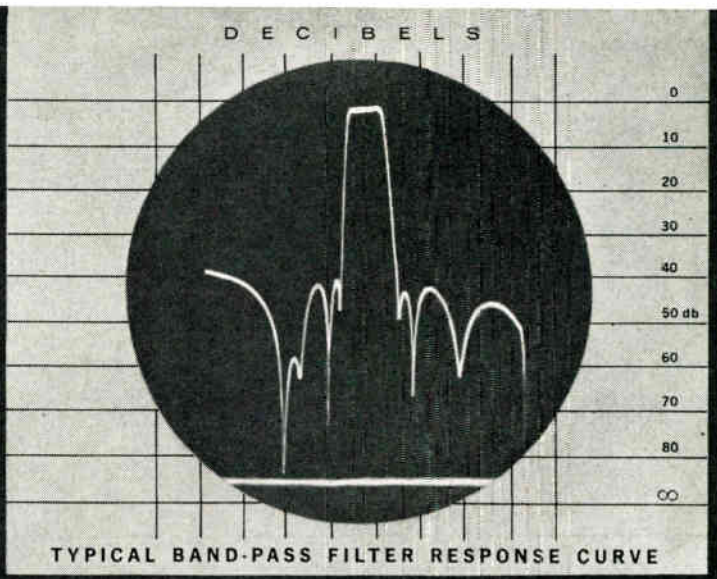
500kc to 100mc



Accurate to within ±1db over 80-db dynamic range

Below is band-pass filter response curve without benefit of log amplifier. At right, same curve after amplification by LA-5100.





TYPICAL BAND-PASS FILTER RESPONSE CURVE

This extremely accurate log amplifier enables exact measurements of attenuation in networks, filters, amplifiers, and other devices exhibiting dynamic operating ranges down to 90 db. Total rf response of device under test can be displayed in a precise logarithmic ratio on a standard dc-coupled oscilloscope. Write for complete technical data.

- Gives true log presentation over frequency range 500kc-100mc, with flatness better than ±½ db.
- Four calibrated ranges: Logarithmic 0-40, 0-60, 0-80 db (readable to 90 db) and one linear range 0-20 db (variable gain).
- Continuously variable log-expand control permits uncompressed presentation of first 5 db of each range.
- Direct-reading meter for point-by-point measurements.
- Oscilloscope output jack for sweep display measurements.
- Designed for rack mounting: 7" x 14½" x 19".

$795.00

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How much does it cost your company to issue a purchase order?

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Robert E. Svobodo, President, Amphenol Distributor Division

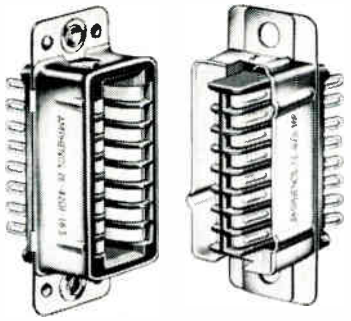
The easiest way to use fewer purchase orders is to do business with someone who has the stock to take care of most of your electronic component needs in one stop. An AID (Amphenol Industrial Distributor), for instance.

Here are just three examples of the product variety you can expect when you deal with an AID. Best of all, these components are stocked in depth, ready for off-the-shelf delivery.

Amphenol Blue Ribbon® Connectors

Amphenol Blue Ribbons are probably the most widely used of all rack and panel connectors, and for good reason. They mate smoothly and easily, yet have high mated contact pressure.

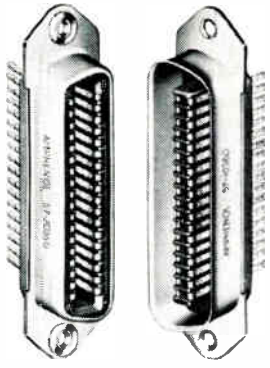
Blue Ribbons' smooth mating action is especially valuable in "blind" applications. The feeling of correct mating is unmistakeable—even to inexperienced operators. This means that there's less chance of



connectors being damaged because of misalignment. Further protection is provided by float bushings which can compensate for alignment errors (in any direction) as great as .030".

Amphenol Micro Ribbon® Connectors

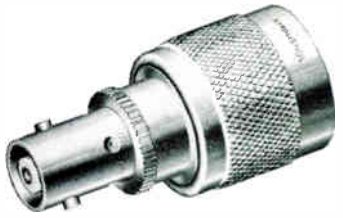
Micro Ribbons retain the same advantages of Blue Ribbon connectors, but do it in as little as half the space. Like Blue Ribbons, Micro



Ribbon rack and panel connectors have diallyl phthalate dielectrics, a material noted for its dimensional stability and high insulation resistance under high temperature and high humidity conditions. For the engineer who must crowd rack and panel connectors into tiny spaces, the Micro Ribbon is probably the answer.

In betweens

In addition to an extremely broad line of Amphenol and *ipc* RF connectors, your AID carries the widest range of between-series RF adapters available. For example, there are adapters which allow



you to couple a BNC plug to a Type MB receptacle, or a C plug to an HN receptacle—etc. In other words, if you can't find the adapter you need in either the Amphenol or *ipc* line, it probably isn't made.

Need more information?

Just check a box and drop me a line.

- ☐ IEC-4 Quick-Reference AID Catalog
- ☐ List of Amphenol Industrial Distributors

Bob Svoboda

President
Amphenol Distributor Division, Broodview, Illinois

AMPHENOL ***Distributor Division*** / Amphenol-Borg Electronics Corporation

2875 South 25th Avenue, Broadview, Illinois, COlumbus 1-2020, Area Code 312, or TWX: Maywood 1069

Be fussy

Two things determine whether or not a particular printed circuit connector is "right" for your application:

1. How the printed circuit board mates with the connector, and

2. How the connector connects to the rest of the system.

Take mating, for example. Besides having the correct number of contacts, a printed circuit connector must hold the board securely whether the board happens to fall at the high or low end of thickness tolerances.

IT TAKES THREE

These considerations convinced Amphenol engineers that no single contact design could satisfy the requirements of a wide range of applications. So they designed three contacts that will.

One, used in Prin-Cir* connectors, looks a lot like a tuning fork with lips. The circle lip design makes contact overstressing or "setting" impossible —even after repeated insertions. The contact's long spring base also enables it to accommodate boards that range in thickness from .055″ to .073″, while doing an excellent "wiping" job.

EASY DOES IT

But not every application requires the Prin-Cir "bite." For this reason, Amphenol engineers designed connectors with ribbon contacts that mate with a gradual wedge-like force. In blind mating applications, gradual mating makes the feeling of *correct* mating unmistakable. (Just the thing when your equipment may eventually be maintained by less-skilled and less-concerned personnel.) Ribbon contact wedge action also makes it possible for connectors using these contacts to accept the same wide range (.055″ to .073″) of board thicknesses as do Prin-Cir connectors.

Finally, advances in micro-miniaturization (like Amphenol-Borg's Intercon® pre-fabricated circuitry) meant that tinier-than-ever-before connectors were needed. Amphenol's answer was the Micro-Min® receptacle and printed circuit board adapter. Micro-Min contacts are actually tiny springs of beryllium copper wire, formed in a precisely designed arc to assure firm circuit board retention. This unique design makes it possible to space contacts on .050″ centers and crowd 19 connections into a little more than an inch of space.

TERMINATIONS COUNT, TOO

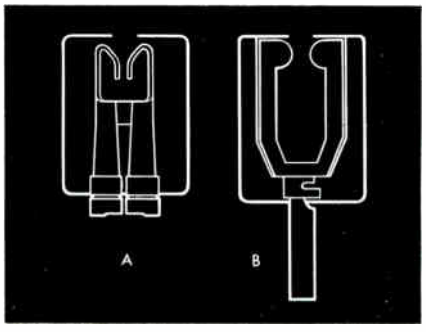
"How to connect connectors to the rest of the system" also merits a good deal of consideration. In some cases, hand soldered terminations will do just fine. In others, higher volume requirements call for high production rate methods like dip soldering and wire-wrapping. Some engineers prefer taper pin terminations.

Our printed circuit connectors are available with contact tails designed for each of these termination methods. In addition, adapters are available for use in connecting printed circuit boards at right angles to each other or in modular arrangements. We make printed circuit connectors with hermetically sealed contacts — still others with coaxial contacts.

Take your choice.

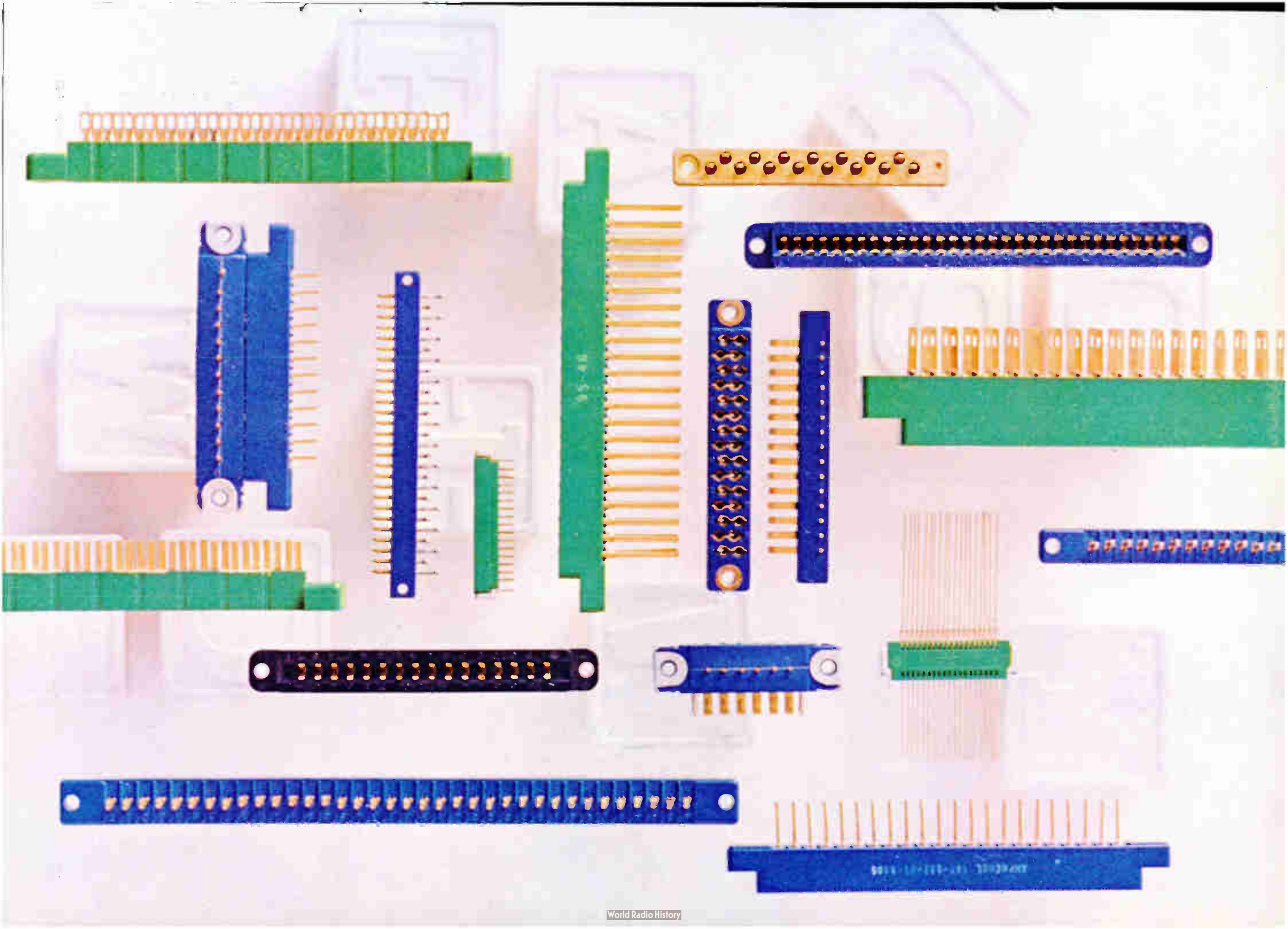
Any Amphenol Sales Engineer or authorized Amphenol Industrial Distributor will be happy to discuss printed circuit connectors (ours) with you. Or, if you prefer, write directly to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

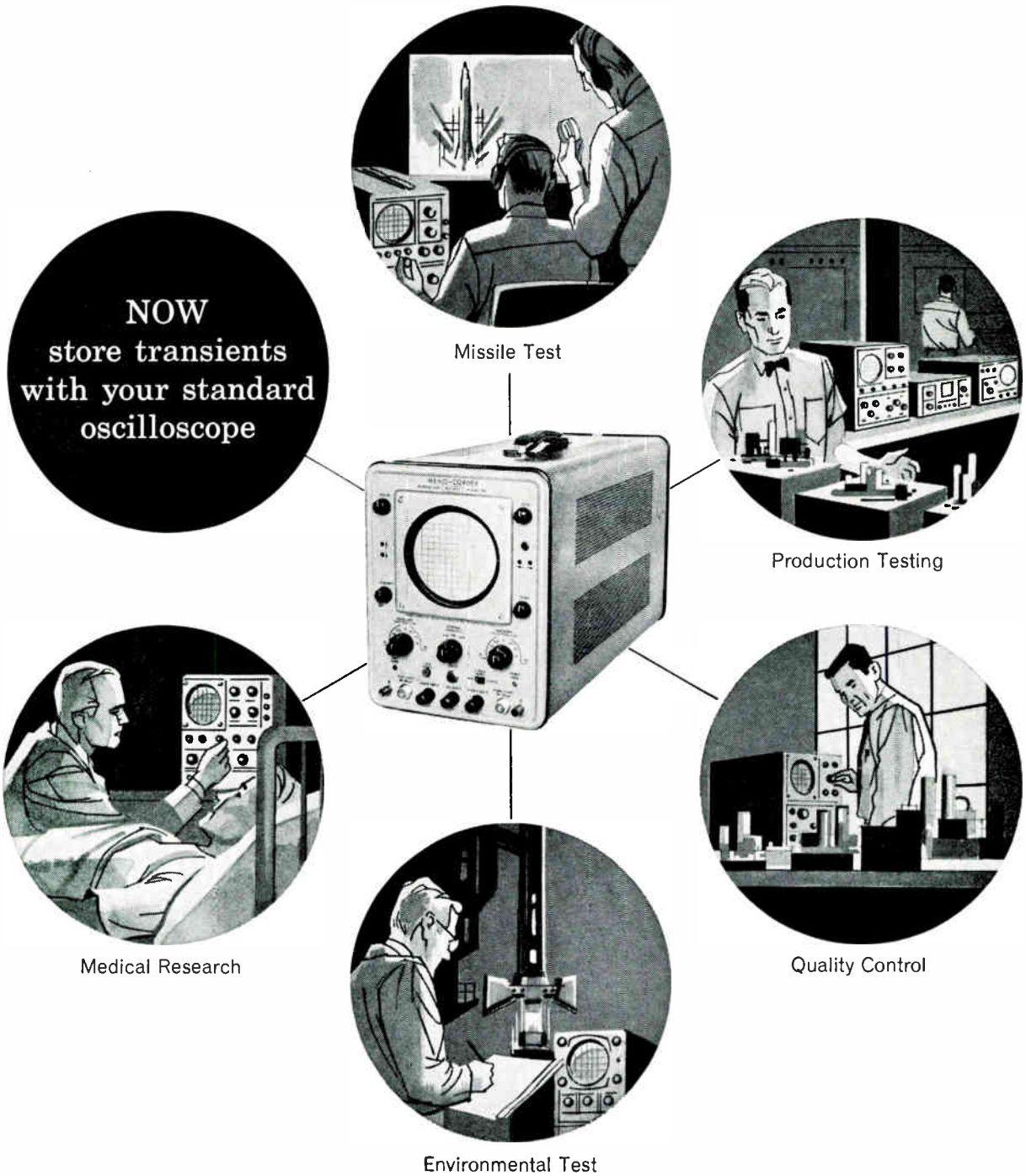
*T.M. Amphenol-Borg Electronics Corp.



Wedging action of Amphenol ribbon-type (A) and long spring base of Amphenol Prin-Cir connectors (B) assure firm printed circuit board retention, whether board happens to fall at low (.055″) or high (.073″) end of thickness tolerance.

AMPHENOL **Connector Division** / Amphenol-Borg Electronics Corporation





Use a HUGHES MEMO-CORDER* Storage Instrument

Most oscilloscope users find applications where the ability to store traces of fleeting, non-recurring transients would save much time, effort and expense. Until now, oscillographic storage capability required investment in larger, more expensive storage instruments for which only limited use might be found.

The new HUGHES MEMO-CORDER multifunction storage unit changes all this. A precision instrument for laboratory or production use, it is compact and highly portable. You can use it anywhere. The MEMO-CORDER indicator is readily connected and adaptable to most conventional oscilloscopes. Gives you oscillographic storage when and where you want it. And best of all is its moderate price.

Added capability! Matched amplifiers make the Hughes MEMO-CORDER indicator an ideal instrument for X-Y plotting. Excellent as a read-out or display device for systems applications.

Ask Hughes for full information on how you can add storage capability to your present oscilloscopes with the MEMO-CORDER storage unit. Write, wire or telephone today! **HUGHES INSTRUMENTS, VACUUM TUBE PRODUCTS DIVISION**, 2020 Short Street, Oceanside, California.

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

OPERATING CHARACTERISTICS

Sensitivity: 0.25 v/div.
Bandpass: DC to 1.25 MC +
Rise Time: less than 0.27 μs
Writing Speed: 10^6 in/sec.
Erase Time: less than 150 ms

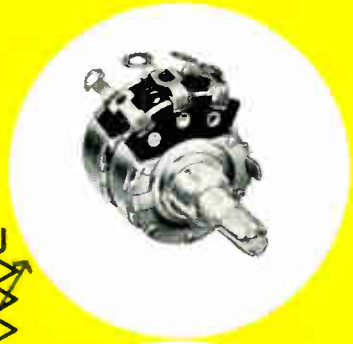
*TRADE-MARK, HUGHES AIRCRAFT COMPANY

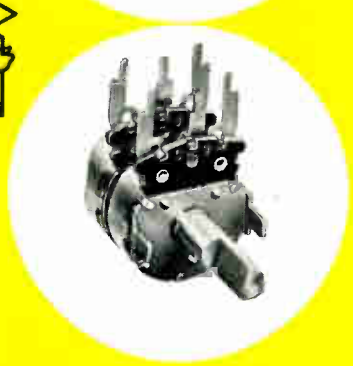
Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIVISION

An 8-Fold Improvement In Stereo Controls





1. **High Stability SURETRAK* Elements** — the first **inherently stable** carbon composition elements. Less than 3% resistance change from 20°C to 105°C . . . less than 7% change under 95% RH for 240 hours at 40°C . . . negligible change with age and mechanical wear. Excellent load life at 70°C.

2. **Controlled Characteristics** assure that whatever resistance changes do occur will be of similar magnitude and direction in both front and rear SURETRAK elements.

3. **Automatic Element Matching** for maximum uniformity between front and rear elements.

4. **Zero Backlash** between shaft and both sections.

5. **Precise Mechanical Assembly** assures uniform electrical and mechanical performance.

6. **Velvety Smooth "Feel"** available if desired for professional quality stereo equipment.

7. **Tailored Attenuation** — Linear over **all** or only a **portion** of the attenuation curve as needed.

8. **Precision to Fit Any Budget** — Degree of tracking limited only by price considerations . . . as close as ½ db tracking now possible.

Here's the kind of variable resistor performance that pays off in greater circuit design freedom . . . in continued customer satisfaction. Thanks to their new high stability SURETRAK* elements, these new Stackpole single-shaft dual controls stay within initially close tolerances throughout years of use or disuse — and with minimum derating.

To learn more about this basic advance in variable resistors for stereo, ask your local Stackpole sales engineer about Type LST (bushing mount) or Type LST-T (twist-tab mount), or write: Electronic Components Div., Stackpole Carbon Co., St. Marys, Pa.

*Trademark

STACKPOLE VARIABLE composition RESISTORS

COLDITE 70+® FIXED COMPOSITION RESISTORS • SLIDE AND SNAP SWITCHES • CERAMAG® FERRITE CORES • FIXED COMPOSITION CAPACITORS • CERAMAGNET® CERAMIC MAGNETS • BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT ELECTRICAL CONTACTS • GRAPHITE BEARINGS, SEAL RINGS, ANODES • HUNDREDS OF RELATED CARBON AND GRAPHITE PRODUCTS

6 NEW PHILCO DEVELOPMENTS BROADEN THE DESIGNER'S

HORIZONS

1 AMP. TUNNEL DIODE

For Tunnel Diode motors, power converters, and current surge limiters. TO-18 package. Tight peak current control.

EPOXY-PACKAGED TUNNEL DIODE

New low cost, 5 ma high speed tunnel diode for logic and memory applications. Subminiature package mounts like a resistor.

OPTICAL EPITAXIAL SILICON PLANAR TRANSISTOR

Responds to both electrical and light signals. High switching speed (t_{on} = 25 nsec max.). High photosensitivity (1 μa/ftc).

2 Kmc MADT*

Amplifier, oscillator and mixer for UHF and microwave. Available in both TO-18 and coaxial packages.

400 mc POWER AMPLIFIERS AND OSCILLATORS

Guaranteed power outputs: 0.5 w at 160 mc (min. eff. 42%); 0.2 w at 240 mc (min. eff. 29%); 0.055 w at 400 mc (min. eff. 10%).

VIDEO AMPLIFIER TRANSISTORS

For driving CRT's and other high level ($V_{out} \geq 120$ V) wideband (to 5 mc) video requirements.

Philco complements its complete line of transistors with developments for new circuit possibilities. We welcome your comments and questions on these new Philco devices. Design samples and data are available now. Write Dept. EI362.

SEE THESE NEW DEVICES AT THE I.R.E. SHOW BOOTHS 1302-1308

*Micro Alloy Diffused-base Transistor

LANSDALE DIVISION

PHILCO

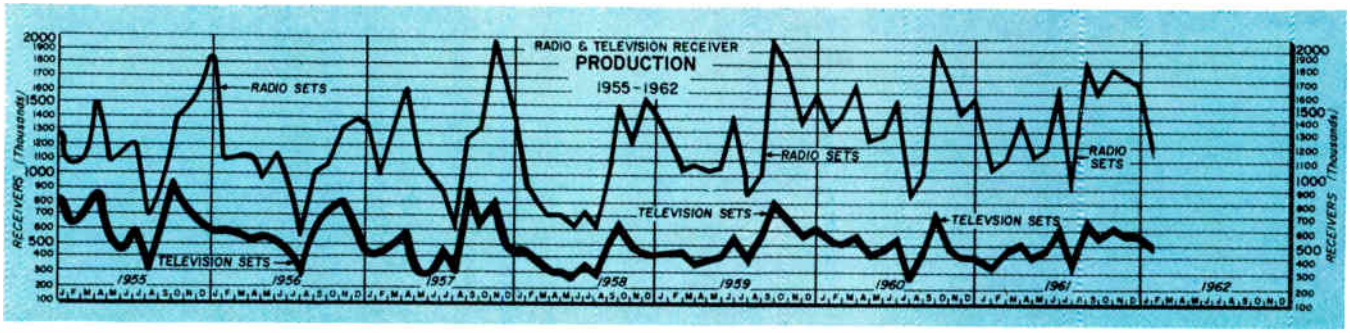
A SUBSIDIARY OF *Ford Motor Company*

LANSDALE, PENNSYLVANIA

Circle 13 on Inquiry Card

SOLID-STATE CENTER U.S.A.

ELECTRONIC INDUSTRIES TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in January, 1962.

Amplifiers	807,755
Antennas	105,454
Attenuators	59,350
Batteries	292,533
Cable assys.	135,428
Cable, RF	43,010
Cable, telephone	25,948
Calibration equipment, celestial	84,943
Calibrators	89,883
Cavity, tuned	48,969
Chopper, electronic	43,194
Communication satellite mobile ground stations	5,000,000
Communication system	140,600
Computers	19,893,351
Connectors	106,249
Converters	99,135
Coupling units	254,968
Detectors, magnetic azimuth	177,441
Detectors, wind direction & speed	102,864
Digital system	296,954
Discriminator system, subcarrier	36,959
Dynamic demonstrators	99,022
Filters	725,271
Fire control system	4,000,000
Gyroscope equipment	1,616,196
Headsets	1,469,078
Indicators	2,034,697
Intercomm system	40,364
Measuring systems	6,990,774
Meters	528,175
Monitors, RF	76,804
Multicouplers	333,932
Oscillators	122,700
Plotting system, digital	54,960
Printers	84,101
Public address system	57,558
Radar	15,404,770
Radiac sets	431,470
Radio sets	16,431,877
Radio terminal sets	5,293,790
Receivers	3,398,673
Record reproduce mechanism	51,000
Recorder/Reproducer	417,744
Recorders	763,906
Recording oscillograph system	37,169
Relay armature	79,007
Relays	251,432
Resistors	108,227
Semiconductor devices	26,001
Servo equipment	130,049
Shelters, electric equipment	1,592,779
Signal generators	33,100
Simulators	996,372
Sonobuoys	4,769,433
Switches	160,375
Tape, magnetic recording	55,076
Tape transports	51,000
Telemetering equipment	367,368
Test equipment	8,398,427
Timer	69,850
Trainers	2,899,169
Transceivers	981,167
Transducers	1,324,500
Transformers, discriminator	59,394
Transformers, isolation	229,387
Transmitters	29,862
Transponders	315,000
Tuning units	818,197
Tubes, electron	702,958
Tubes, TWT	343,365
X-Ray equipment	184,338

NASA 1963 ESTIMATES

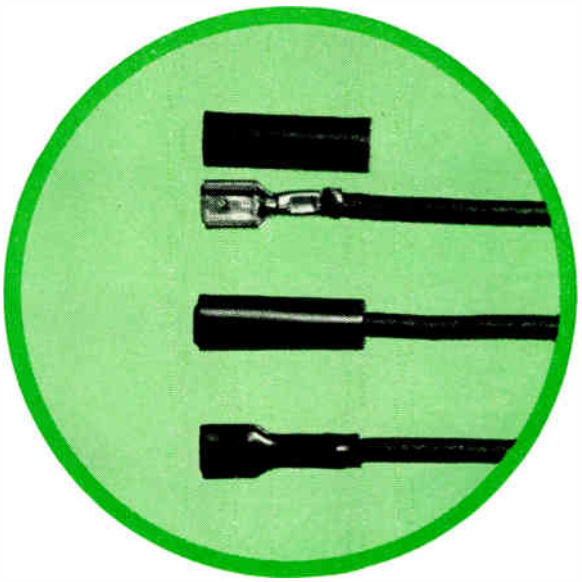
PROGRAMS	Fiscal 1961	Fiscal 1962	Fiscal 1962 Supplemental	Fiscal 1963
Mercury	$124,330,000	$ 68,278,000	$	$ 13,259,000
Advanced Manned Space Flight	6,266,000	147,242,000		863,628,000
Saturn C-1	173,908,000	282,193,000		249,237,000
Advanced Saturn	623,000	27,762,000	50,000,000	335,172,000
Nova	297,000	6,322,000		163,574,000
Meteorological Satellites	19,610,000	54,310,000		51,185,000
Communications Satellites	33,833,000	48,477,000		85,377,000
Sounding Rockets	12,330,000	14,261,000		19,157,000
Scientific Satellites	54,398,000	117,618,000		175,165,000
Lunar and Planetary Exploration	91,019,000	169,964,000		273,560,000
Scout	9,652,000	8,206,000		8,947,000
Delta	10,479,000	2,927,000		268,000
Centaur	64,673,000	65,840,000	9,000,000	66,664,000
Spacecraft Technology	27,126,000	37,145,000		54,084,000
Launch Vehicle Technology	13,851,000	23,080,000		31,690,000
Launch Operations Development	100,000	1,789,000		21,486,000
Electric Propulsion	7,164,000	17,581,000		30,647,000
Liquid Propulsion	72,726,000	103,901,000	26,000,000	163,102,000
Solid Propulsion	1,899,000	4,297,000		7,944,000
Space Power Technology	8,913,000	14,644,000		20,172,000
Nuclear Systems Technology	25,050,000	50,234,000		122,962,000
Aircraft and Missile Technology	37,857,000	41,479,000		52,588,000
Tracking and Data Acquisition	44,330,000	94,844,000		158,410,000
TOTAL PROGRAM	$840,434,000	$1,402,394,000	$85,000,000	$2,968,278,000
Appropriated and Requested NASA Funds	$838,773,000	$1,487,394,000		$2,968,278,000
Transfer from Dept. of Defense	1,661,000	—		—
Anticipated Transfer from NASA Construction of Facilities 1962 Supplemental	—	22,261,000		—
TOTAL FUNDING	$840,434,000	$1,509,655,000		$2,968,278,000

Source: Aerospace Industries Assoc. of America, Inc.

PVC

radiation crosslinked heat-shrinkable polyvinylchloride tubing

1. Thermofit tubing
2. Disconnect
3. Tubing positioned
4. After heating



IN 3 SECONDS

THERMOFIT

The Tubing With A Memory

Snap-on Disconnect Terminals can be insulated in less than three seconds with Thermofit heat-shrinkable tubing. The terminal may then be engaged and disengaged repeatedly without damage to the tubing. Thermofit provides reliable, outstanding lifetime insulation and is an economical solution for a difficult insulating problem.

A SUBSIDIARY OF
RAYCHEM
CORPORATION

RAYCLAD TUBES
INCORPORATED

OAKSIDE AT NORTHSIDE REDWOOD CITY • CALIFORNIA

News Briefs

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

EAST

GENERAL INSTRUMENT CORP., SEMICONDUCTOR DIV., Hicksville, L. I., N. Y. has announced formation of a Microelectronics Department. The new department is located at the Hicksville, L. I. facility of the Semiconductor Div.

LINK DIV., GENERAL PRECISION, INC., Binghamton, N. Y., has been awarded a contract for approximately 2 million dollars to build 2 more C-130 Cargo Transport Flight Simulators for the U.S.A.F. The LINK C-130 simulator will be used by TAC and MATS.

Stockholders of **SCHLUMBERGER LTD.,** Houston, Texas, petroleum and gas industries service organization, and **DAYSTROM, INC.,** Murray Hill, N. J. have approved, at separate meetings, the acquisition of the business and assets of Daystrom by Schlumberger. Daystrom shareholders will receive one share of Schlumberger stock for each two shares of Daystrom. Daystrom will operate as a wholly-owned subsidiary.

The **AMERICAN OPTICAL CO.,** Southbridge, Mass., has received contracts totaling $1,004,000 from the Boston, Mass., Ordnance District for production of infra-red periscopes. Work on the prime contract will be done at American Optical's Keene, N. H. plant.

VITRO ENGINEERING CO., DIV. OF VITRO CORP. OF AMERICA, N. Y. C., N. Y., has been awarded a design/engineering contract for a $6-million nuclear rocket engine facility. The engine maintenance, assembly, and disassembly building (E-MAD) will be situated at the National Nuclear Rocket Center, Jackass Flats, Nevada.

WESTON INSTRUMENTS DIV., DAYSTROM, INC., has announced the establishment of a new district office at 1224 E. Colonial Drive, Orlando, Fla.

SANDERS ASSOCIATES, INC., Nashua, N. H. has announced construction of a new 43,000 square-foot plant in Manchester, N. H. This is Sander's fourth new plant in a little more than a year. Completion is expected in mid-April.

INTERNATIONAL RESISTANCE CO., Phila., Pa., has announced purchase of the business and assets of **FRONTIER ELECTRONICS CO.,** Div. Designers for Industry, Inc., Cleveland, Ohio, in an all-cash transaction. Frontier will be operated as a div. of IRC.

RAYTHEON CO., Boston, Mass., has received contracts totaling nearly $27 million for anti-missile and anti-aircraft defense programs. Included is: $1.4 million for anti-missile efforts in Project ARPAT; $14,834,259 for continued production of high power illuminators by Raytheon's **AERO/WEAPONS DIV.,** plants at Andover, Mass. and Bristol, Tenn., and $1,170,325 for electron tube production by the Microwave & Power Tube Div., Waltham, Mass.

GENERAL ELECTRIC CO., ORDNANCE DEPT., Pittsfield, Mass., has received a $23,000 contract extension for continuing development work in the field of cryogenic accelerometers. The contract was awarded by the NASA-George C. Marshall Space Flight Center.

BULOVA WATCH CO., INC., INDUSTRIAL and MILITARY PRODUCTS DIV., Jackson Heights, L. I., N. Y., has received contracts totaling about $3,500,000 from the **SANDIA CORP.,** Albuquerque, N. M., for the production of several types of miniature electromechanical timers for use in various weapon systems.

RADIO CORP. of AMERICA, ASTRO-ELECTRONICS DIV., DEFENSE ELECTRONIC PRODUCTS, Princeton, N. J., has begun construction of a new 23,000 square-foot laboratory wing. The facility is expected to be completed in March and will house approximately 200 employees, primarily for engineering activities.

Stockholders of **ARCO ELECTRONICS, INC.,** Garden City, N. Y. have voted approval of a plan to merge Arco with **LORAL ELECTRONICS CORP.,** Bronx, N. Y. The merger is on a basis of one share of Loral common stock for each three shares of Arco common. Loral will be the surviving company, but Arco will continue to operate under its own name, management and functional identity.

AMERICAN ELECTRONIC LABS., INC., Colmar, Pa., has announced receipt of new contracts totaling $1,761,066. For production of 176 Pulse Analyzers, AN/ULA-2, $1,170,515 from the U. S. Army Signal Supply Agency, Ft. Monmouth, N. J. From BuShips, development contract increase of $121,000. Classified contracts totaled $469,551.

JERROLD ELECTRONICS CORP., Philadelphia, Pa., has acquired **PILOT RADIO CORP.,** L. I. C., N. Y., in an all-cash transaction. Purchase price was not disclosed. Pilot will continue to operate as an autonomous company.

GPL DIV., GENERAL PRECISION, INC., Tarrytown, N. Y., has received a contract for more than $375,000 for computer systems to be used in Doppler navigational equipment, for the USAF's F-100 Super Saber jet.

NASA has awarded a $2,118,600 contract to the **BENDIX CORP.,** Teterboro, N. J. for a key portion of the inertial guidance system to be used in the Saturn space rocket. The Saturn will be used to boost a three-man spacecraft into earth circling orbit and later launch the Apollo spacecraft to the moon.

WESTINGHOUSE ELECTRIC CORP., Pittsburgh, Pa., has been awarded a contract to supply specially designed explosion-proof electrical equipment for a new Saturn launch complex at Cape Canaveral. The equipment is to be used in various locations at Canaveral's Complex 37.

A contract totaling more than $4 million for production of gyroscopes for Polaris missile guidance systems has been awarded to **MINNEAPOLIS-HONEYWELL'S AERONAUTICAL DIV.,** St. Petersburg, Fla. by the Navy Special Projects Office. The contract calls for manufacture of reference and pendulous gyroscopes, with deliveries to start early in 1962.

ADLER ELECTRONICS, INC., has been awarded a $1,755,000 contract, for the production of radio sets, by the U. S. Army Signal Supply Agency, Phila., Pa.

MIDWEST

MODELING ENGINEERING AND MANUFACTURING CORP., Huntington, Ind., has acquired the Deposited Carbon Resistor Div. of **TECHNOLOGY INSTRUMENT CO.,** Acton, Mass. All equipment and facilities are being moved to the Huntington, Ind., plant and will be merged with their **TRU-OHM DIV.**

ZENITH RADIO CORP., Chicago, Ill., has received a letter contract from the U. S. Army Ordnance Corps. for production of a safety-arming device (fuze) for the Army's M-72 LAW (light antitank weapon) rocket grenade.

ELGIN NATIONAL WATCH CO., Elgin, Ill., has secured a contract for approximately $500,000 to develop and manufacture an electronic communications system for the Navy.

C. P. CLARE & CO., Chicago, Ill., has acquired control of **VACUUM CERAMICS, INC.,** Cary, Ill. Vacuum Ceramics manufactures hermetic seals. The acquired company will be known as **CLARE CERAMICS, INC.**

WEST

TELECOMPUTING CORPORATION's TELECOMPUTING SERVICES, INC., Los Angeles, Calif., has received a contract in excess of $1,900,000 from the Army Ordnance Corps to provide data reduction for daily missile firings at White Sands Missile Range, New Mexico.

CONTINENTAL ELECTRONICS MFG. CO., sub. of **LING-TEMCO-VOUGHT, INC.,** has received a $1,250,000 contract to manufacture and install a 1-MW standard broadcast radio transmitter for the United Arab Republic. The contract follows closely on the winning of a $10,500,000 pact to design and construct a NATO fleet communications radio station in England, and another contract to design, for Pacific Fleet communications, an installation similar to the $70,000,000 Atlantic Fleet radio station at Cutler, Me.

SYLVANIA ELECTRIC PRODUCTS, INC., Mountain View, Calif., has received a $2 million contract for development and production of TWT's for use in the ECM systems of the U.S.A.F.'s B-58 Hustler. The contract was awarded by **GENERAL DYNAMICS/FORT WORTH, DIV., of GENERAL DYNAMICS CORP.,** prime contractor for the B-58.

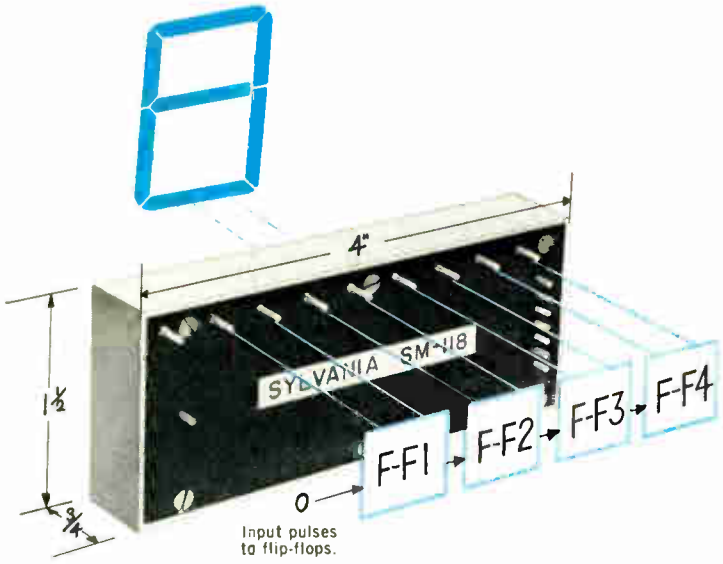
MOTOROLA, INC., has announced the formation of a new company division to be known as the **SOLID STATE SYSTEMS DIV.,** with headquarters at the company's facility at 3102 N. 56th St., Phoenix, Ariz.

CUBIC CORP., San Diego, Calif., has launched a major expansion move, with the receipt of a classified aero-space tracking contract totaling several million dollars. Construction of new facilities will include a new plant, bringing Cubic's total floor space (exclusive of TEMEC) to 161,000 sq. ft.

UNITED TESTING LABORATORIES DIV. of UNITED ELECTRODYNAMICS, INC., Monterey Park., Calif., has received $800,000 in contracts from the **ASTRONAUTICS DIV. of GENERAL DYNAMICS** for the establishment and operation of 6 permanent and 3 mobile chemical labs. at various Atlas missile bases throughout the U. S.

TRANSISTOR DEVICES, INC., Los Angeles, Calif., has changed its corporate name to **MERLIN INDUSTRIES, INC.**

AIRBORNE INSTRUMENTS LABORATORY, Div. CUTLER-HAMMER, INC., has been awarded a $4 million contract, for the design and production of a Ground Data Handling subsystem of the AN/USD-7 electronic reconnaissance program. The award was made by the Aeronautical Systems Div., USAF Systems Command, Wright Patterson AFB, Ohio.



NEW!

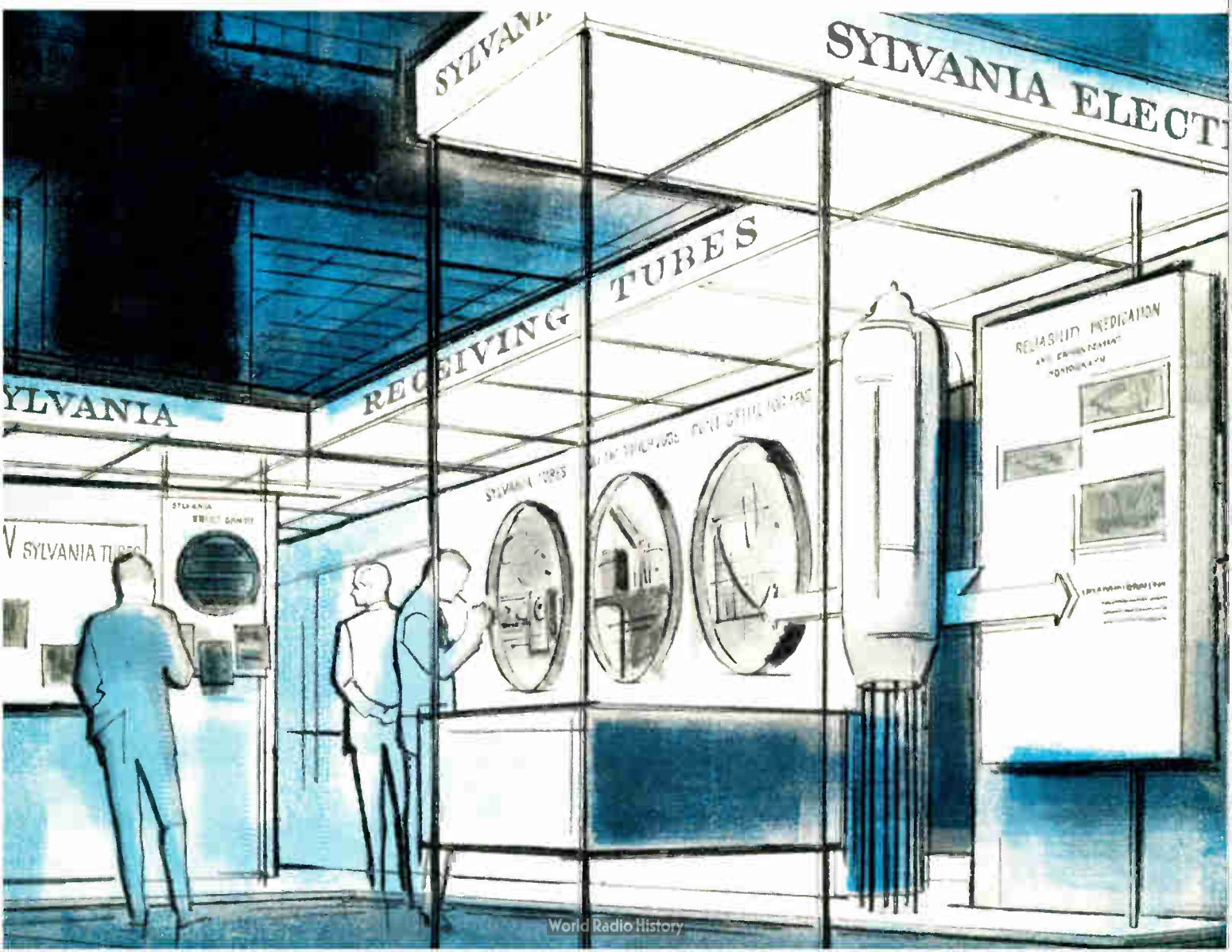
Binary to numeric switching matrix for EL readouts

Sylvania SM118, neon-photoconductive translator, can decode logic from 1-2-4-8 decimal coded binary counter and directly drive PANELESCENT® EL numerics without additional amplification. SM118 is capable of driving ¾", 1", 1½" EL numerics . . . offering compactness, exceptional life and simplified circuitry with its inherent reliability. In addition to SM118, Sylvania can provide decoding matrices to convert from any of the popular binary codes to numeric indication.

▶ See it at the Sylvania Exhibit—plus numeric and alpha-numeric PANELESCENT readouts, X-Y grid panels with cross suppression for position-plotting displays, binary dot and "bit 'n bar" matrices for use in coding film.

®Panelescent is a registered trademark

Products to see! Ideas to note!



Sylvania helps you pinpoint the elusive reliability factor

. . . with specific aids for determining tube failure rates under actual application conditions. Based on data obtained from many authoritative sources, these aids to enhanced reliability are fully documented and may well answer your most critical reliability problems.

Here are a few of the highlights of the Sylvania reliability program:

• Base failure rates of popular tube types! • Effects of power dissipation, temperature and heater voltage on tube life! • Radiation—how much can a tube withstand? • Test results of 9 years' storage! • Tubes—temperature-insensitive components! • Effects of mechanical shocks!

▶ In addition, here are a few of the products on display—photoconductors, strap frame grid subminiature tubes, counter tubes, plus many new industrial/military types.

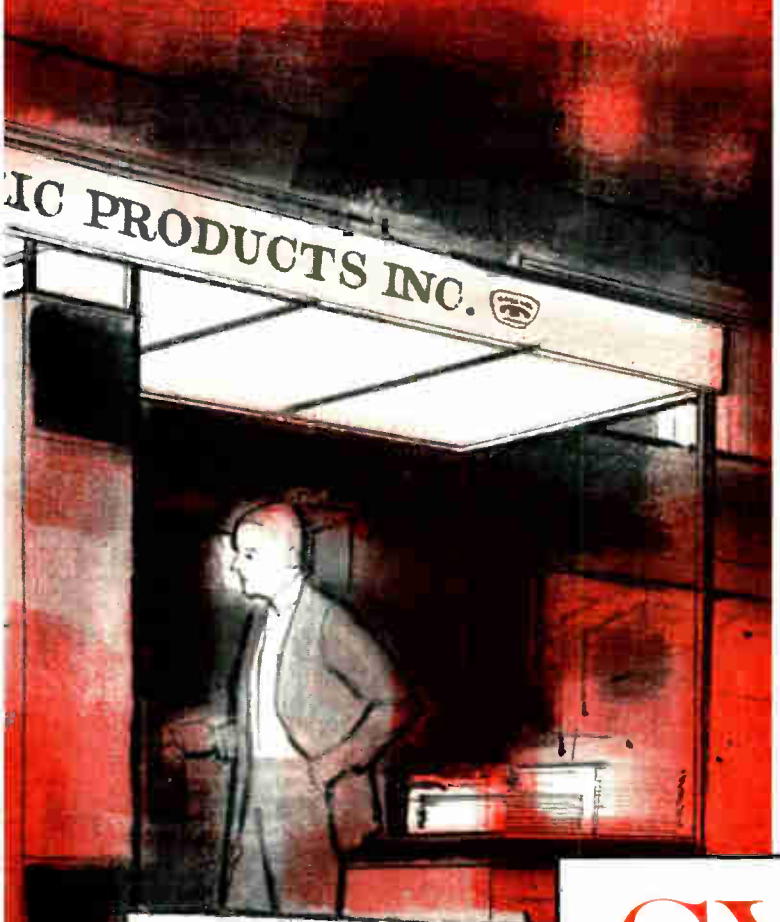
NEW!

Developmental 5″ CRT offers ultra-high deflection sensitivity and high efficiency heater

Sylvania SC-3351, flat-face CRT with electrostatic focus and deflection, offers these unusual performance features for scope designs, especially portable equipment. For one, design data indicates extraordinary sensitivity, with deflection factors for 1D2 of 30Vdc/inch, and 3D4 of 6.5Vdc/inch (at 7cm of scan) . . . representing better than a 2 to 1 improvement in deflection sensitivity over the best commercially available scope tubes at a slight increase in length (20″ max. length). For another, SC-3351 offers, as an option, the unique Sylvania-designed low power heater requiring only 1.5V, 140mA. With an operating voltage of 10KV and high efficiency phosphor, the writing speed and accuracy are extremely high.

▶ Also on display are—fiber optic CRT's, multi-gun radar display tube, electrostatic printing tube, high-resolution photorecording CRT's—plus many other advanced-design types.

At IRE Booths #2415-2425



Ka-Band Fixed Frequency Magnetron Sylvania M-4064

FEATURES: 125KW peak power over 34.700 to 35.000 Gc. Less than 9-lb. weight. Wide pulse width and duty cycle ranges. Improved starting stability. Improved drift characteristics. Rugged, reliable, proven design.

Sylvania M-4064 provides an unusually broad range of pulse widths—from 40 nsec to 1 μsec, and duty cycles—from .00007 to .0008. (Investigation indicates that pulse widths of less than 40 nsec, peak power to 140KW, are practicable.)

First proposed in 1959, Sylvania M-4064 has been the object of intensive refinement and testing. New techniques for improved cathode and anode processing, outgassing of parts and exhaust procedures have increased tube efficiency, life expectancy (not more than 20% power drop-off during life) and pulse stability over life. M-4064 can exceed vibration specs of 20g to 2000 cps, shock of 50g in 3 planes over 11 msec, and 1000-hour life tests at 1.0 μsec.

▶ M-4064 is but one of the many remarkable microwave products on display—you will also find hydraulically tuned X-Band magnetrons, coupled-cavity TWT, backward wave magnetrons, and solid state devices including tunable parametric amplifier.

Can't make the I.R.E. show this year?

Ask your Sylvania Sales Engineer for product information or write for data on specific types to: Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

SYLVANIA

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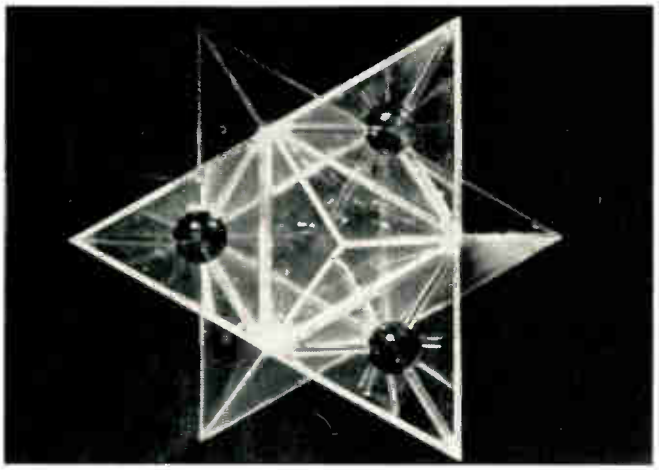
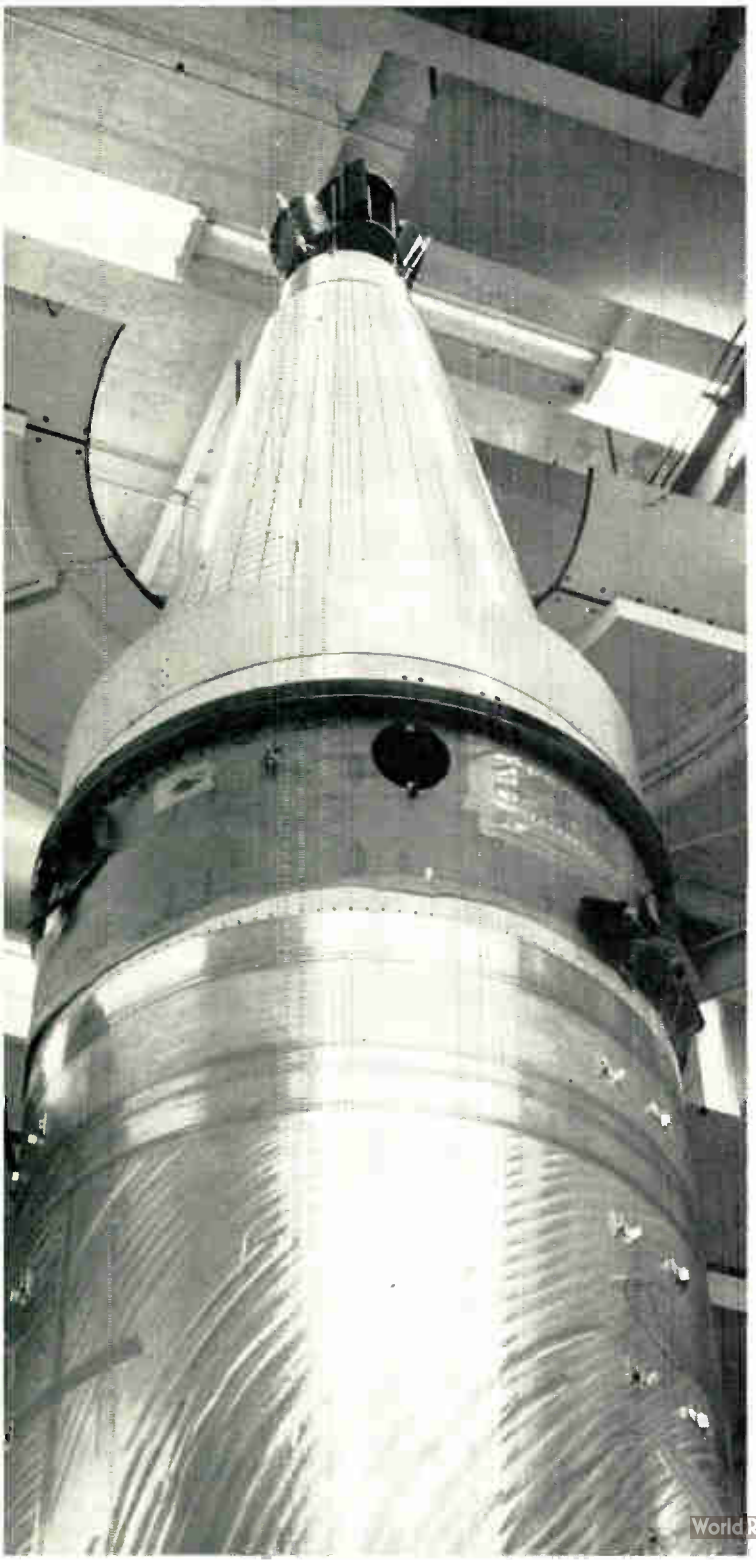
GENERAL SYSTEM



DIAMOND CRYSTAL

Clear lucite tetrahedral and octahedral building blocks have been developed by MIT scientists for constructing models of more than 80% of crystal structures found in nature. Moduledra building blocks are available in sets. Made by Therodyne Corp., Cambridge, Mass., they are also available pre-assembled as permanent crystal models of germanium, silicon and most refractory and rare earth metals.

Snapshots . . . of the Electronic Industries

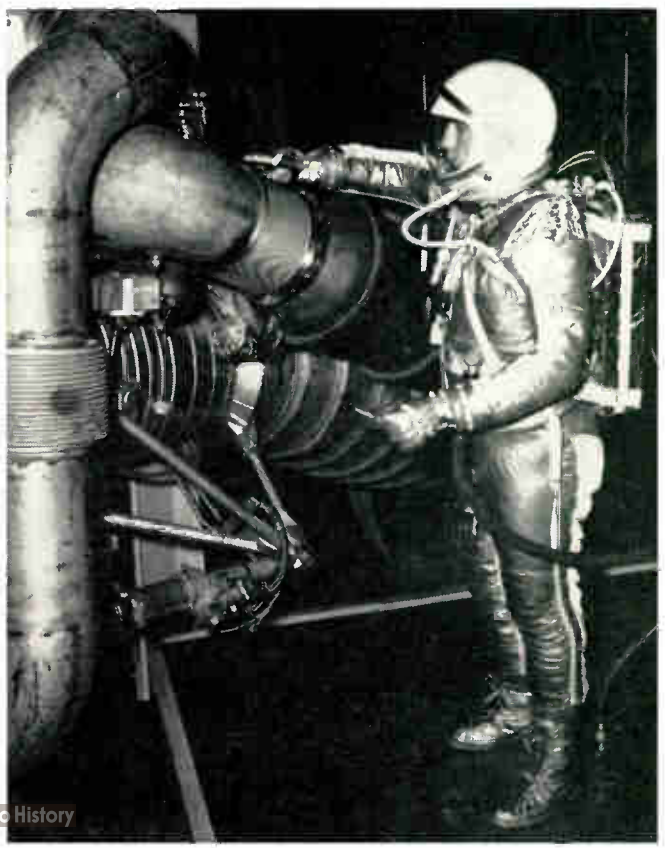


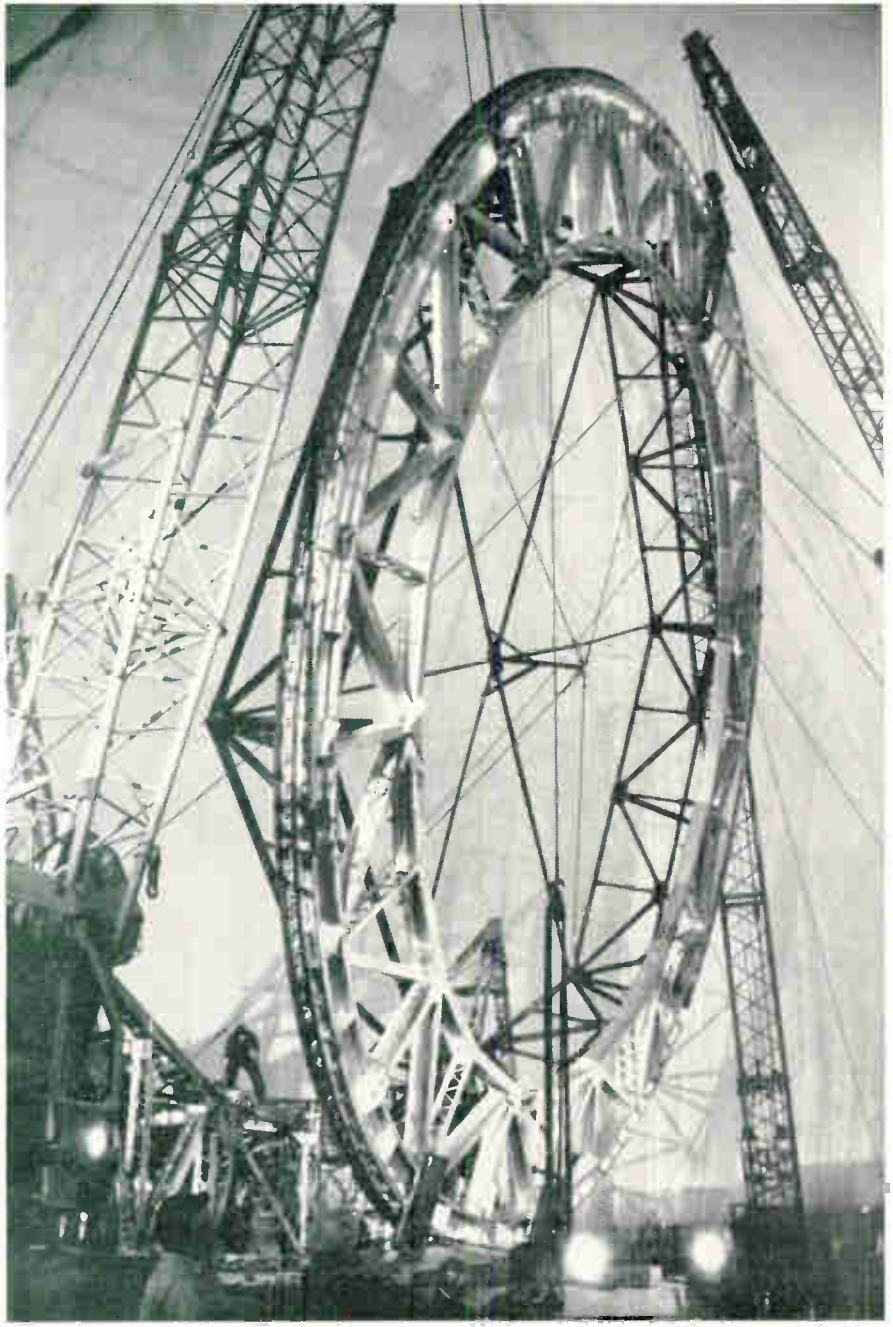
"SNAPSHOT"

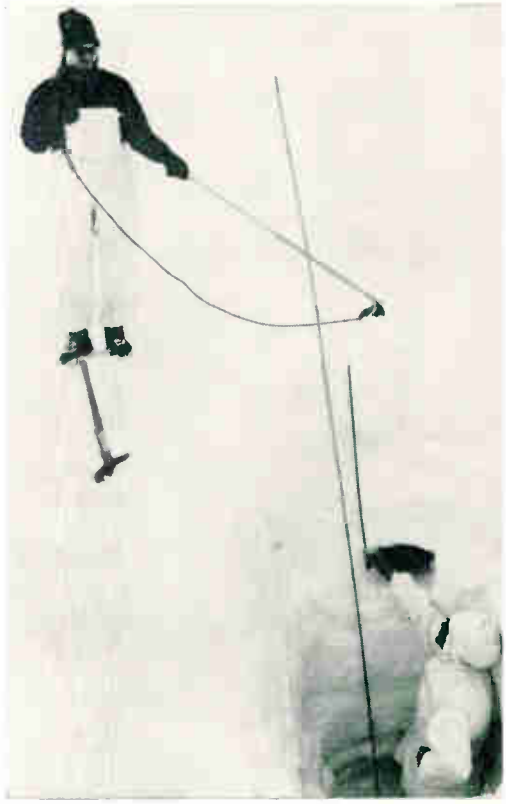
Mockup of SNAP 10A payload atop AF Agena satellite which will be used as the orbiting vehicle in SNAPSHOT project tests of nuclear-electrical power systems. Agena is made by Lockheed, Sunnyvale, Cal.

SPACE ENGINEER

Engineer, in a pressurized space suit, works on a Saturn H-1 engine in one of a series of simulated environmental tests being conducted jointly by NASA's Manned Spacecraft Center and Marshall Space Flight Center at the latter's Huntsville, Alabama, facility.







"PEOPLE FINDER"

Research scientists from Varian Associates, Palo Alto, Calif., demonstrate a new method of finding skiers buried in snow avalanches. Man at left uses a portable magnetometer to locate a buried ski boot. A cigarette-size magnet has been built into the boot heel.

PRECISION WHEEL

Giant 70 ft. wheel is craned into vertical position at Bell System's satellite station in Andover, Maine. Wheel will be used to point a huge antenna for experiments in satellite communications, beginning this spring.

"TUBELESS TUBE"

Lab technician inspects new tubeless electron tube, developed by IT&T, Fort Wayne, Ind. Tube is for use in outer space where there is no air—hence no envelope is needed.

PLANET SIMULATOR

Ten-inch, twenty-pound germanium lens blank is inspected in Quality Control Dept. at Barnes Engineering Co. Completed lens will be used in an artificial planet simulator.

"LADY TRIMMER"

Solder application machine at RCA's Lancaster, Pa., plant spreads a ribbon of glass sealing solder to edge of the funnel of a TV tube envelope while it is being rotated.

The case for Fenwal thermistors in a nutshell:

With Fenwal Electronics has more experience than anyone else in the field of thermistor design and development. We offer the most complete line anywhere. We are the only supplier offering a line of thermistors which can be supplied with *identical* resistance-temperature curves to permit complete interchangeability. We offer a complete thermistor custom-engineering service. *Who else offers so much?*

For up-to-the-minute information on how to put thermistors to work in high precision circuitry — for temperature control and measurement, liquid level measurement, time delay, remote control, or any of a literally infinite number of critical applications, you should have Fenwal's new Catalog EMC-4 in your file. Why not write today?

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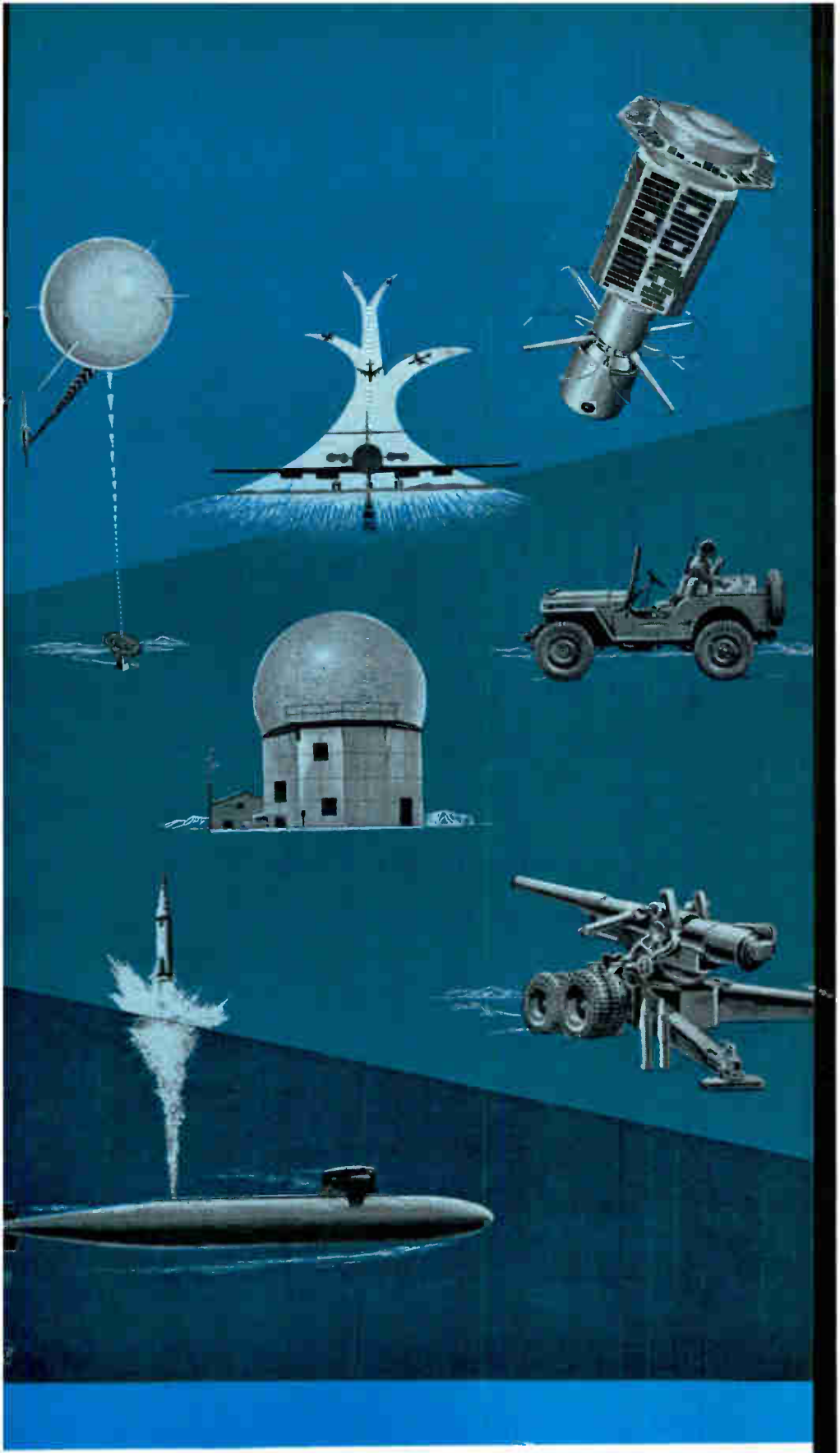

From Avco... advances in electronics and ordnance

Tiny radios that tell space vehicles what to do . . . radar that pinpoints distant planes . . . devices that arm and fuze missiles . . .

These are only a few of the products from Avco Corporation's Electronics and Ordnance Division, prime contractor to each of the armed services and to NASA.

Satellite communications. Now in orbit aboard Explorer XI is an Avco receiver that converts NASA signals into impulses that switch satellite equipment on and off.

Infrared. Avco is a pioneer in infrared. One development is a tracking-scanning device that picks up heat emitted by missile nose cones or the exhaust of jet planes, while they are many miles away.

Air traffic control. Avco is a leader in air traffic systems. For example: Avco's AN/GSN-11, built for the Air Force, can direct 120 takeoffs and landings per hour in any weather, automatically.

Height-finder radar. Avco units, 3 stories high, can "see" planes while they're hundreds of miles away. These units are now on duty with the Air Defense Command.

Front-line communications. A new Avco radio, one-seventh the size of units it replaces, lets a combat commander direct troops, trucks, tanks and aircraft. Other features: 920 channels, push-button tuning.

Missile arming and fuzing. Working with the Naval Ordnance Laboratory, Avco designed and is making arming and fuzing kits for the Polaris Fleet Ballistic Missile. Avco is a major source of arming and fuzing devices for all the armed forces.

Ordnance. To cope with brush-fire wars, Avco is producing classified material for new weapons. Avco helps to keep our armed forces up to date—and *ahead* of date.

For further information about Avco capabilities in electronics and ordnance, write: Avco Corporation, Electronics and Ordnance Division, Cincinnati 41, Ohio.

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS . . . REGARDLESS OF RACE, CREED, COLOR OR NATIONAL ORIGIN . . . WRITE AVCO/ELECTRONICS AND ORDNANCE TODAY.

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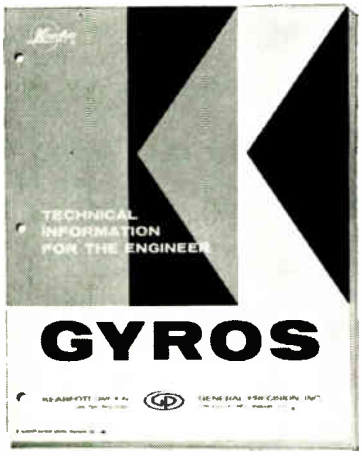
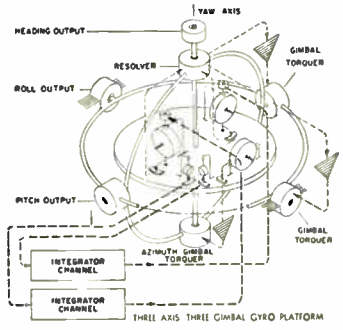
kearfott technical information report

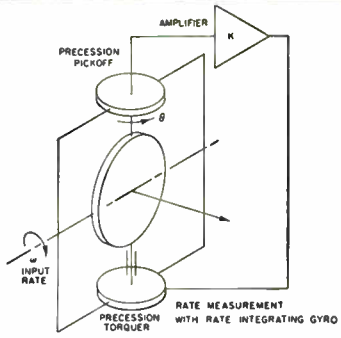
GYROS



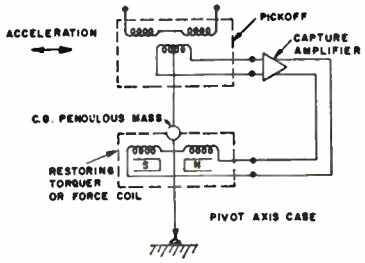
This 60-page reference book describes the theory, application and testing of gyros, platforms and accelerometers. It also discusses, with some reservation to protect our proprietary interest, several sophisticated concepts now being developed at Kearfott. It includes, for your convenience and ours, a tabulation of the equipment we produce in these various product areas. A copy of this book is available to you free of charge. Just drop us a note, requesting your copy.



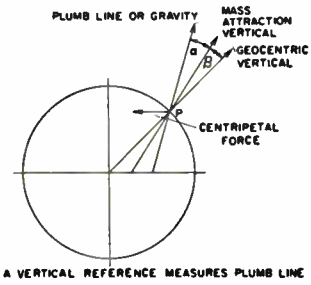
Stable Platforms. Essentially a cluster of gyros mounted within gimbals and utilizing acceleration sensing components, stable platforms perform the important function of having the gyro out-puts control the gimbals by means of a servo loop. By manipulating various arrangements of gimbals and gyros, a variety of platform types can be produced. They are used as reference elements and to stabilize accelerometers, star trackers, and similar devices in space.



Floated Rate Integrating Gyros. Floated Rate Integrating Gyros are used where exceptionally high-level performance is required. Should the rotor mass of a gyro wheel having an angular momentum of 1.0×10^6 gm. cm.^{2}/sec. shift by as little as one micro-inch, a drift of 0.1°/hr. could result. The difficulty in achieving ultra-high precision and accuracy is apparent, and the necessity for obtaining low drift gyros is of paramount importance.



Inertial Accelerometers. A typical force balance pendulous accelerometer utilizing a differential transformer pickoff, a high gain capture amplifier, and a DC permanent magnet force coil is illustrated. This type of accelerometer, together with its amplifier, is a high-gain null-seeking servo in which the current flowing through the force balance coil, measured as voltage across a resistor in series with the coil, is directly proportional to the acceleration applied.



Vertical Sensing Elements. The Vertical Sensing Element is essentially a high accuracy single or two axis electrical plumb bob providing an electrical signal proportional to its displacement from the local gravity vertical. Effectively a form of accelerometer, it is suited for applications not affected, to a major extent, by external accelerations acting upon it. Since it is a first order open loop device, unless stabilized within a gimbal structure, it will sense lateral accelerations, producing a signal representing the resultant of gravity and these spurious forces.

Inertial Reference Platform. Designed for ballistic missiles, the three-gimbal configuration of the SD510 Platform has undergone rigorous flight and sled tests, thoroughly proving its accuracy and ruggedness. Three Kearfott inertial navigation gyros (KING) form the core of a velocity servo-mechanism which provides dynamic isolation of the inertial reference from external inputs. Three inertial-quality accelerometers are mounted on the isolated inner cluster. The resulting platform is a hermetically sealed cylinder 10 inches in diameter by 14 inches in height.

King Floated Rate Integrating Gyros. Designed primarily for missile system applications, the gyro makes possible the superior performance of the SD510 platform. Distinguished by outstanding mass stability, eliminating the need for daily trimming, and an extremely low drift rate of 0.003°/hr., this gyro has all capability of being torqued at rates up to 22,000°/hr. An optimum combination of characteristics permits tight gimbal control. A low impedance pick-off and DC torquer virtually eliminate noise problems.

Inertial Single Axis Accelerometer. This single axis, fluid damped accelerometer is a DC torquer-restrained device possessing a useful dynamic measuring range of greater than twenty g's. The sensitive element consists of a symmetrically-located differential transformer pick-off and a pair of force coils mounted in common on the instrument measuring axis. The high degree of symmetry of both force coils and pick-off coils minimize the resultant errors which might otherwise occur during vibratory inputs. Transistorized amplifiers, such as the Kearfott type S3503-03A, are available.

Typical characteristics include: Range of measurement . . . 20 g when using S-3503 amplifier . . . Bias and Zero Stability . . . 0.00002 g day to day . . . Threshold . . . 2 x 10^{-7} g . . . Natural Frequency . . . 220 cps.

Vertical Sensing Element. A frictionless, wire-suspended pendulum acts as the moving portion of two orthogonally mounted differential transformers to provide phase-sensitive ac output signals proportional to the tile angle. A typical application is initial alignment of a gyro platform. The unit has exceptional repeatability to vertical, high sensitivity, and low null voltage.

Design features include a balanced signal generator for minimum null shift with temperature or excitation – and for fluid filling for damping and resistance from shock or vibration.

Typical characteristics include: Linearity . . . 5% of 3 arc minute – Threshold . . . 0.5 arc seconds max., Null Repeatibility (long term) . . . Within 2 arc seconds.

KEARFOTT DIVISION | GENERAL PRECISION INC., LITTLE FALLS, NEW JERSEY

GENERAL PRECISION

EI's International News

ENGLAND

Tape Recorders Aid Aircraft Noise Study

Bristol Siddeley Engines Ltd. are using magnetic tape recorders supplied by EMI Electronics Ltd. in a research program aimed at modifying aircraft engine designs to reduce noise levels. One stage of the program is to investigate the distribution of noise around an engine at various distances and to determine what ranges of frequencies predominate. Tests have recently been taking place at an RAF airfield in Gloucestershire. This airfield was selected for its remoteness from residential areas and for the comparative absence of extraneous noise.

After an engine has been tested at various speeds and the resultant noises recorded, the tapes are sent to the Bristol Siddeley laboratories at Coventry. There they are analyzed, and, among other things, the various component noises are related to their respective sources within the engine. The design can then be modified, where practicable, to reduce the noise level.

Noise from aircraft in flight at various heights and speeds after taking-off from London Airport have also been recorded and analyzed.

Licensing Agreement Signed

Acoustica Associates, Inc. of Los Angeles, has signed a licensing agreement with Elliott Brothers, Ltd. of London. Agreement grants Elliott Brothers exclusive rights to manufacture and distribute Acoustica's ultrasonic cleaning equipment in the United Kingdom, the European Free Trade area, the British Commonwealth (excluding Canada), and the Middle East.

CANADA

Jensen Mfg. Co. Signs Agreement

Jensen Mfg Co., a div. of The Muter Co., Chicago, Ill., loudspeaker manufacturer, has entered into an agreement with Radio Speakers of Canada, Ltd., who will act as licensee to manufacture Jensen loudspeaker products for Canadian distribution. Radio Speakers, located in Toronto, Ont., will also represent Jensen's entire line of products throughout Canada.

Sprague Electric Expands

A controlling interest in the Telegraph Condenser Co. Ltd., Toronto, Canada, has been acquired by the Sprague Electric Co., North Adams, Mass. TCC-Canada was previously a subsidiary of the Telegraph Condenser Co. of London, Eng.

Sprague-TCC (Canada), Ltd. will continue to handle the sale of TCC electronic components manufactured in England, and will also sell Sprague Electric products to the electronic and equipment market in the Dominion.

DENMARK

British Equipment To Danish Airfields

Kustrup Airport, Copenhagen and other airfields in Denmark are to be equipped with British communicatoons equipment. This is the result of a contract awarded to Cossor Communications Co. Ltd., by the Danish Civil Aviation Administration.

Contract is for Cossor Type 109 VHF Communications Receivers which are to be installed early this year, partly as replacements and also in extension of present ground-to-air VHF communications systems.

SPECTROPHOTOMETER

Infrared grating spectrophotometer scans complete wavelength range from 1 to 25 microns and permits continuous recording of spectra without change of components. Model 125 instrument was developed by Perkin-Elmer Corporation's West German affiliate, Bodenseewerk Perkin-Elmer & Co. G.m.b.H.

GERMANY

Munich Studio Orders Latest EMI-TV Cameras

Riva Film and Television Studios, Munich, Germany's largest independent TV studios, have placed an order with EMI Electronics Ltd. for four complete 4½ inch image orthicon camera channels and ancillary equipment. It represents the first sales of British TV studio cameras to Western Germany for six years.

Most of the equipment was sent to Munich some months ago so that the customer could judge the performance of the cameras under actual production conditions. Features of the EMI equipment are good resolution, signal-to-noise ratio, grey-scale, and central coordination of camera by simple "joy-stick" controls.

West German Army Gets British Radar

First Green Archer mortar-locating radar has been delivered to the West German Army by EMI Electronics Ltd. Similar equipment has been ordered by the British and Swedish armies.

EMI's Green Archer is able to pinpoint the mortar's position by a technique using radar in conjunction with an electronic computer. This information can be used immediately for artillery counterfire.

D.E.M. Microanalyzer Shipped to Germany

Elion Instruments, Inc. (OTC), Burlington, N. J., has shipped a D.E.M. Microanalyzer to Germany. This makes them the first U. S. firm to export this type of equipment, according to H. A. Elion, President.

(*Continued on page* 36)

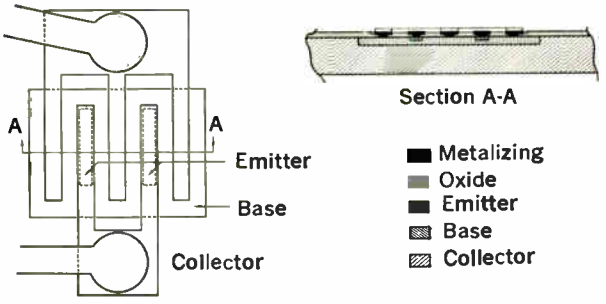
FAIR EXHIBIT

Visitors to U.S. pavilion at the Indian Industries Fair examine a model of an atomic-powered weather station built for the U.S. Atomic Energy Commission by Martin Marietta Corp. Station is on a Canadian island near the North Pole. Its automatic reports were relayed to the New Delhi Fair every three hours as part of the Dept. of Commerce Exhibit.

FAIRCHILD ANNOUNCES A NEW TECHNOLOGY:

Booths 2705, 2707 at IRE

μPLANAR*



*A Fairchild Semiconductor trade name

RATINGS AND CHARACTERISTICS

V_{CBO}	Collector to Base Voltage			40 Volts	
V_{CEO}	Collector to Emitter Voltage			15 Volts	
V_{EBO}	Emitter to Base Voltage			4.5 Volts	
			Min.	Max.	Units
V_{CEO} (sust)	Collector to Emitter Voltage I_C = 10 mA (Pulsed), I_B = 0**		15		Volts
V_{CE} (sat)	Collector Saturation Voltage I_C = 10 mA, I_B = 1.0 mA			0.25	Volt
V_{BE} (sat)	Base Saturation Voltage I_C = 10 mA, I_B = 1.0 mA		0.7	0.85	Volt
h_{fe}	High Frequency Current Gain I_C = 10 mA, V_{CE} = 10 V, f = 100 mc		5.0		
C_{ob}	Output Capacitance V_{CB} = 5.0 V, I_E = 0			4.0	pf
C_{IE}	Open Circuit Input Capacitance V_{EB} = 0.5 V, I_C = 0			4.0	pf
h_{FE}	D.C. Pulse Current Gain I_C = 10 mA, V_{CE} = 1.0 V	2N2368	20	60	
		2N2369	40	120	
h_{FE}	D.C. Pulse Current Gain I_C = 10 mA, V_{CE} = 1.0 V, −55° C	2N2368	10		
		2N2369	20		
t_s	Charge Storage Time Constant I_C = 10 mA	2N2368		10	nsec
		2N2369		13	nsec
T_{on}	Turn on Time I_C = 10 mA	2N2368		12	nsec
		2N2369		12	nsec
T_{off}	Turn off Time I_C = 10 mA	2N2368		15	nsec
		2N2369		15	nsec

**Pulse Width = 300, μSec, Duty Cycle = 1%

...AND TWO MICROPLANAR DEVICES:

2N2368 2N2369

- ultra-high speed, high current switching
- ideal for reliable computer logic applications
- now available in volume
- practical in cost

μPLANAR is the first technology ever to combine the Planar process, metalizing over oxide, the Epitaxial process and interdigitated geometries.

The combination of the Planar process with metalizing over the oxide makes possible a device which is electrically small, but at the same time physically large enough for normal, reliable lead bonding techniques. Protected junctions provide for lower leakage and noise, wider h_{FE} ranges, and stability for all surface dependent parameters.

Large metalized lead bond areas are evaporated over the oxide protected junctions (a Fairchild patent), allowing for normal lead bonding to micro-size devices.

The Epitaxial process results in lower saturation voltage and greater breakdown voltage. Optimized interdigitated geometries provide faster switching speeds and higher frequency response without severe current limitations.

FAIRCHILD

SEMICONDUCTOR

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

Circle 18 on Inquiry Card

International News

(*Continued from page* 34)

The microanalyzer, which performs microscopic analysis of both organic and inorganic materials with an electron beam, was sent to Institute Fur Eisenhuttenwesen in Aachen, Germany. It will be used for research in iron and steel alloys for Germany Ruhr Valley industries.

ITALY

Missile Range Contract Awarded

Vitroselenia, an Italian-based electronics company, has been awarded a $15 million contract to design and manage installation of a missile test range on the island of Sardinia. The company is owned jointly by Vitro Corp. of America and Selenia, S.p.A., a Raytheon Co. subsidiary.

The Sardinia range is expected to be in partial operation by June of this year and will serve present missile needs of the Italian Air Force and ultimate NATO programs.

University of Naples To Receive Bendix Computer

A high-speed Bendix G-20 computing system will be installed early next year at the University of Naples. It will be the first G-20 installation in Europe. Machine will provide teaching and research support to the University's engineering school and will be used by students and faculty for studying aspects of civil engineering, electronics, hydraulics, naval engineering, chemistry and aeronautical engineering.

Purchase of the computer has been financed by the Italian government's Ministry of Public Education as part of a long-range expansion and improvement program for the country's institutions of higher learning.

JAPAN

Automatic Accumulator To Tinplate Producer

Toyo Kohan Co., Ltd., Japanese tinplate producer, has purchased an automatic data inspection accumulator from International General Electric for a 38-inch electrolytic tinning line at the Kudamatsu plant.

The GE 302 data inspection accumulator system will work in conjunction with the normally used line sensors and will provide for manually inserted coil data in addition to other tabulations. A permanent record of the quality and length of each coil, with complete coil identification in typewritten form, will be immediately available to the operator.

* * *

HIGH GAIN

LOW $V_{CE\ (SAT)}$

Two New POWER TRANSISTOR Types developed for lower-loss converters and inverters and more efficient series regulators.

Motorola's two outstanding new series of germanium power transistors feature: the industry's HIGHEST GAIN (h_{FE}), for series regulator applications . . . LOWEST SATURATION VOLTAGE ($V_{CE\ (sat)}$), for converter and inverter applications . . . PLUS collector current ratings of 30 and 60-Amps.

Packaged in Motorola's low silhouette TO-36 case with COLD-WELD SEAL, these new devices also offer users a wide variety of other advantages, such as . . . thermal resistance of only 0.5°C/W . . . 110°C maximum junction temperature . . . power rating of 170-WATTS.

These revolutionary high-gain, low-saturation-voltage power transistors are immediately available from stock at the factory or your local Motorola distributor. Reliability-assured Meg-A-Life versions, with complete life test data, are also available. For more complete technical information, contact your Motorola Semiconductor district office, or call or write the Technical Information Department at Motorola.

SEE THE NEWEST SEMICONDUCTORS AT IRE BOOTH 1117•1118

MOTOROLA DISTRICT OFFICES:
Belmont, Mass. / Burlingame, Calif. / Chicago / Cleveland / Clifton, N. J. / Dallas / Dayton / Detroit / Garden City, L. I. / Glenside, Pa. Hollywood / Minneapolis / Orlando, Fla. / Phoenix / Silver Spring, Md. Syracuse / Toronto, Canada.

High Gain for more efficient series regulators		
Collector Current (Ic)	**2N2152-9 Series**	**MP500-7 Series**
5 A	50-100 and 80-160	—
15 A	25 min. and 40 min.	30-60 and 50-100
25 A	15 min.	—
50 A	—	12 min.
Low $V_{CE\ (sat)}$ for low-loss converter and inverter circuits		
Collector Current (Ic)	**2N2152-9 Series**	**MP500-7 Series**
5 A	0.1 V max.	—
15 A	—	0.2 V max.
25 A	0.3 V max.	—
50 A	—	0.45 V max.
Other Unique Advantages		
	2N2152-9 Series	**MP500-7 Series**
Current Rating	30 Amps	60 Amps
BV_{CES}	45-90 Volts	45-90 Volts
θ_{JC}	0.5°C/Watt	0.5°C/Watt
T_J	−65° to 110°C	−65° to 110°C
P_C	170 Watts max.	170 Watts max.

MOTOROLA
Semiconductor Products Inc.
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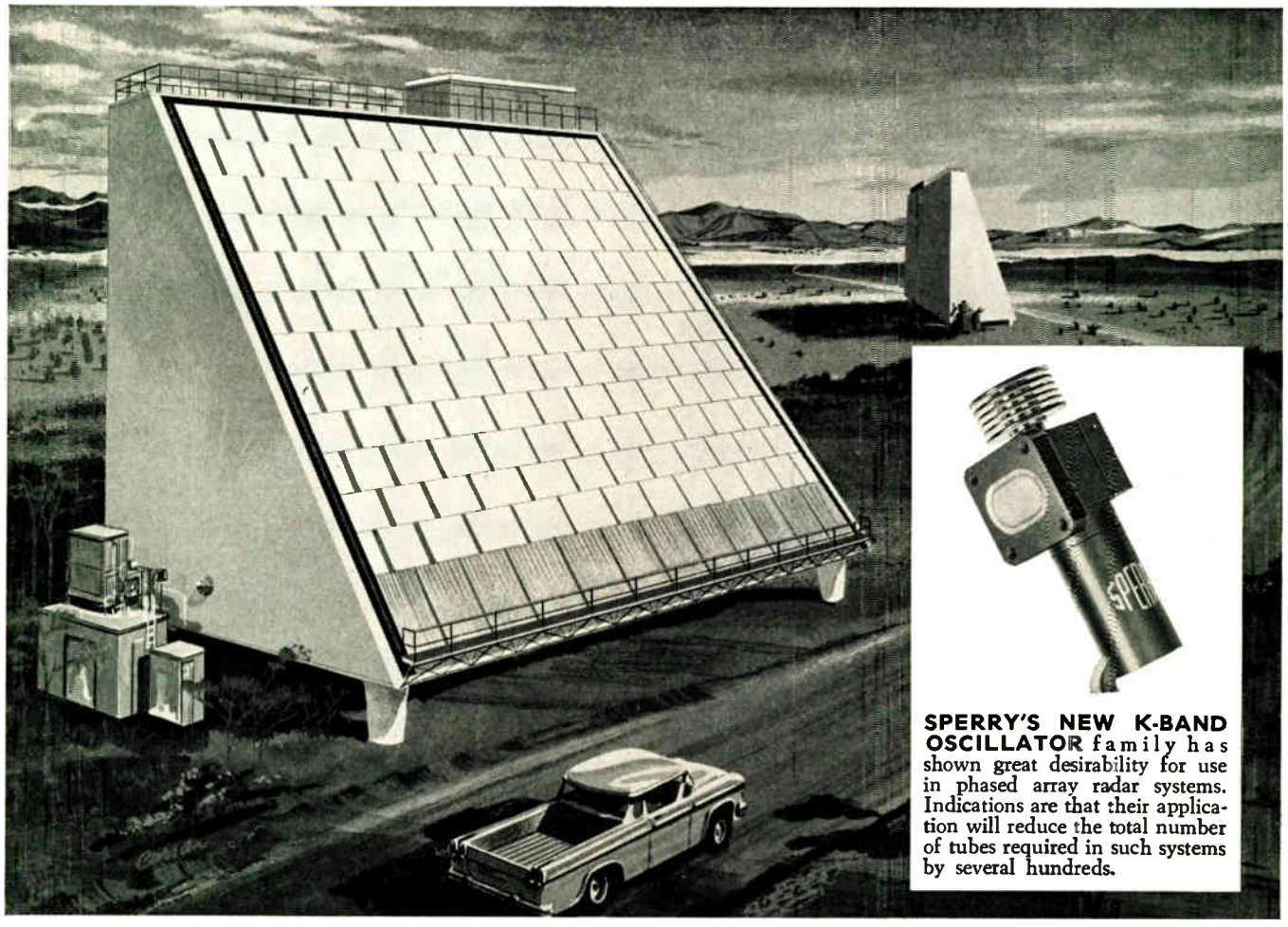
SPERRY microwave memo



SPERRY'S NEW K-BAND OSCILLATOR family has shown great desirability for use in phased array radar systems. Indications are that their application will reduce the total number of tubes required in such systems by several hundreds.

Production-ready K-band oscillators deliver 600 mW over a 20 Mc bandwidth

A new family of K-band two-cavity oscillators is now production-ready at Sperry Electronic Tube Division, Sperry Rand Corporation, Gainesville, Florida.

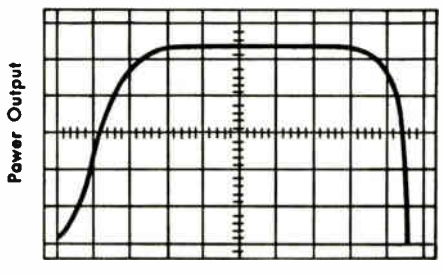
The new tubes show particular promise for parametric amplifier pumping applications because of their inherent amplitude stability and high power output levels at K-band frequencies (18-26.5 Gc). Depending on voltage mode of operation, power levels from 200 to 600 mW are available. While the lower level is highly promising for single amplifier pumping, the higher outputs offer tremendous possibilities in applications where several amplifiers must be pumped simultaneously. In fact, one tube—operating on the mode which delivers 600 mW minimum power output—will pump 10 or more parametric amplifiers.

COMPONENT SAVINGS POSSIBLE

The capability of these new tubes to pump several parametric amplifiers will greatly reduce the number of tubes required in many systems. In phased array radars, for example, a net saving of several hundred tubes may result when a switching network is coupled with multiply pumped parametrics.

DESIGN ECONOMIES REALIZED

Dramatic reductions in system design costs are indicated when the new Sperry Tubes are used in doppler radars, FM communications systems, and other K-band applications. Operating in a flat-top mode these tubes have an amazing 20 Mc bandwidth. This characteristic permits tremendously increased latitude in the specification of other parts. The system designer, freed from the tedious necessity of closely matching components, works more quickly, more efficiently, and more economically.



A typical main mode, adjusted for optimum flat-top operation

FREE K-BAND BROCHURE

A NEW, FREE BROCHURE DESCRIBES THE CAPABILITIES OF THE NEW SPERRY K-BAND OSCILLATOR FAMILY IN GREATER DETAIL. FOR YOUR COPY, WRITE TO SPERRY ELECTRONIC TUBE DIVISION, SEC. 115, GAINESVILLE, FLORIDA.

Since the new Sperry family is ready for volume production, you can start specifying them *now*. Unit price is $2,995. Cain & Co., which represents Sperry Electronic Tube Division nationally, has a salesman near you. He'll be happy to help you work out the details. Call him today!

SPERRY ELECTRONIC TUBE DIVISION

GAINESVILLE, FLA. / GREAT NECK, N. Y.
SPERRY RAND CORPORATION

Only "KEMET"

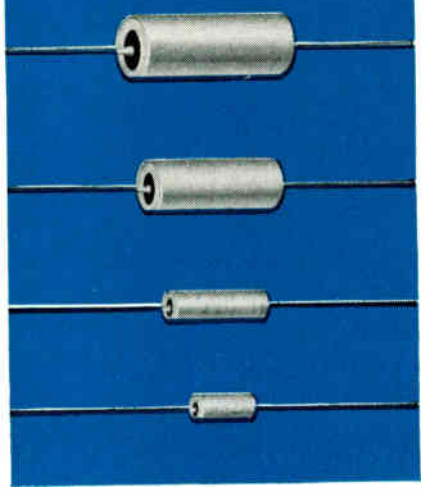
The SPECIALIST in SOLID TANTALUM CAPACITORS

has the widest choice of high-voltage types

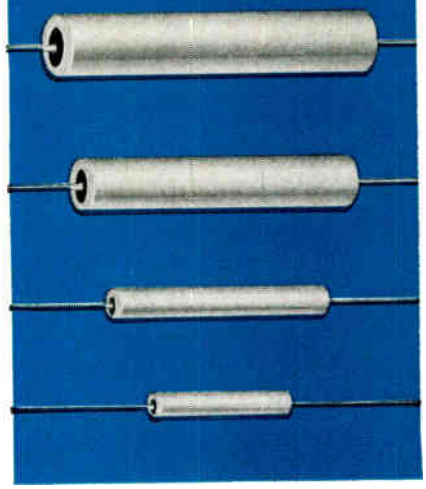
—also available in low capacitance values!

75 V
60
50
35
20
15
10

J-SERIES
(Polar Type)
.0047 to 330
MICROFARADS
Temperature Range:
−55 to +125° C



N-SERIES
(Non-Polar Type)
.0024 to 160
MICROFARADS
Temperature Range:
−55 to +105° C



J-Series meets or exceeds MIL-C-26655A

KEMET offers you the only full line of high-voltage solid tantalum capacitors for a multitude of military/industrial applications. J-Series and N-Series are available in working voltages of 75, 60, 50, 35, 20, 15, 10, and 6—in standard E.I.A. values with ±5%, ±10%, and ±20% tolerances. Low leakage characteristics are excellent. Four J-Series case sizes conform to MIL-C-26655A—with or without insulating sleeve. Leads are solderable and weldable. All KEMET capacitor types have passed approved environmental tests. Whatever your solid tantalum capacitor needs, meet them with KEMET's complete line! Kemet Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio.

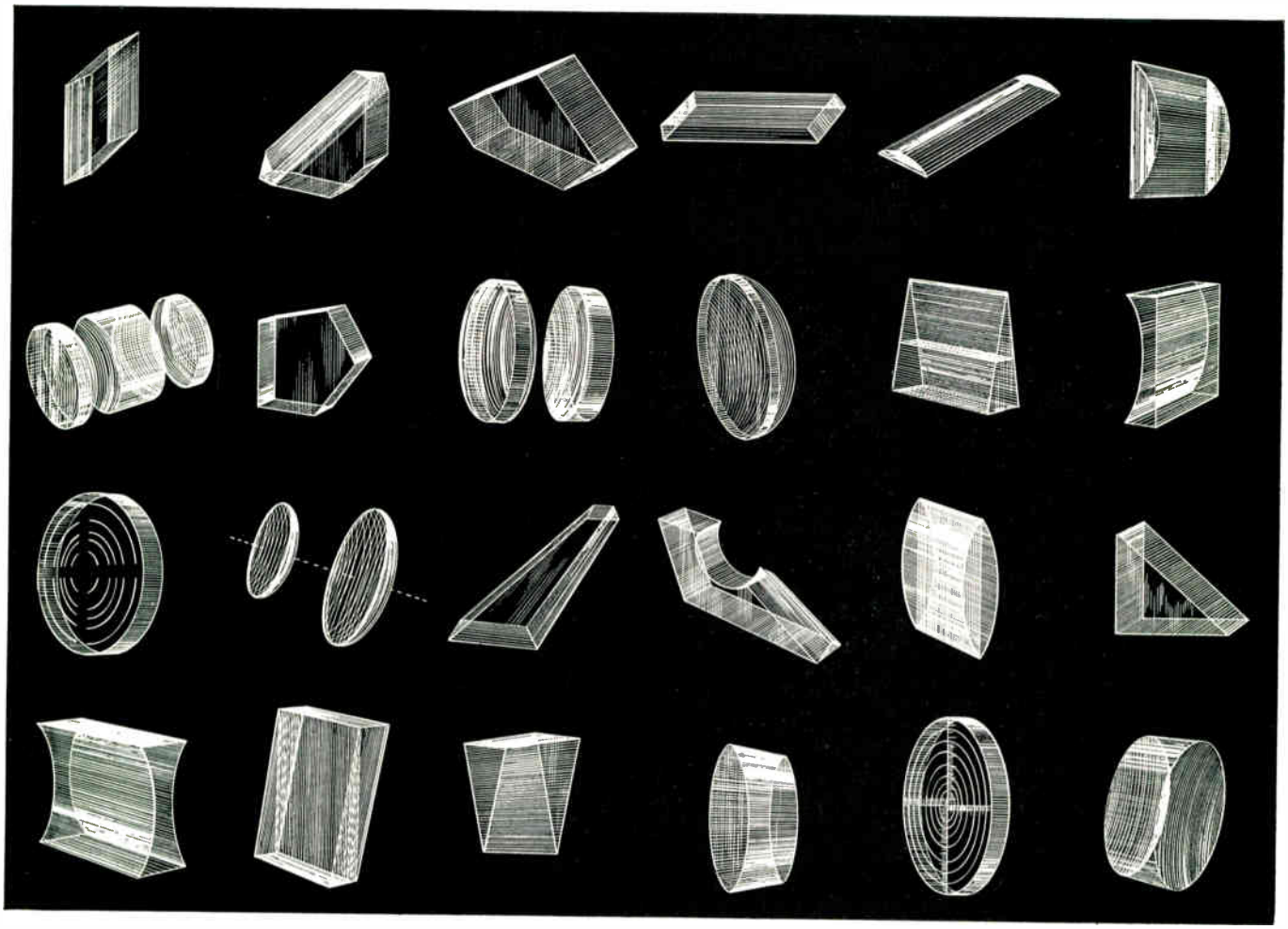
Write for technical data on the complete line of "KEMET" Solid Tantalum Capacitors!

"Kemet" and "Union Carbide" are registered trade-marks for products of

KEMET COMPANY

UNION CARBIDE

Circle 22 on Inquiry Card



OPTICS FOR ELECTRONICS . . .

Components and systems for visible, ultraviolet, and infrared radiation. GEC's Astro-Optics Division specializes in design, development, and manufacturing of optical components and systems for the ultraviolet through infrared spectrum.

Here are a few of the optical components you can order from Astro-Optics: prisms, flats, spherical, aspherical and parabolic surfaces, reticles, information choppers, encoders, precision vacuum coating, and optically polished synthetic crystals.

Also available from Astro-Optics are infrared and optical-electronic systems.

For complete information regarding your precision optical requirements, write today to:

ASTRO OPTICS DIVISION

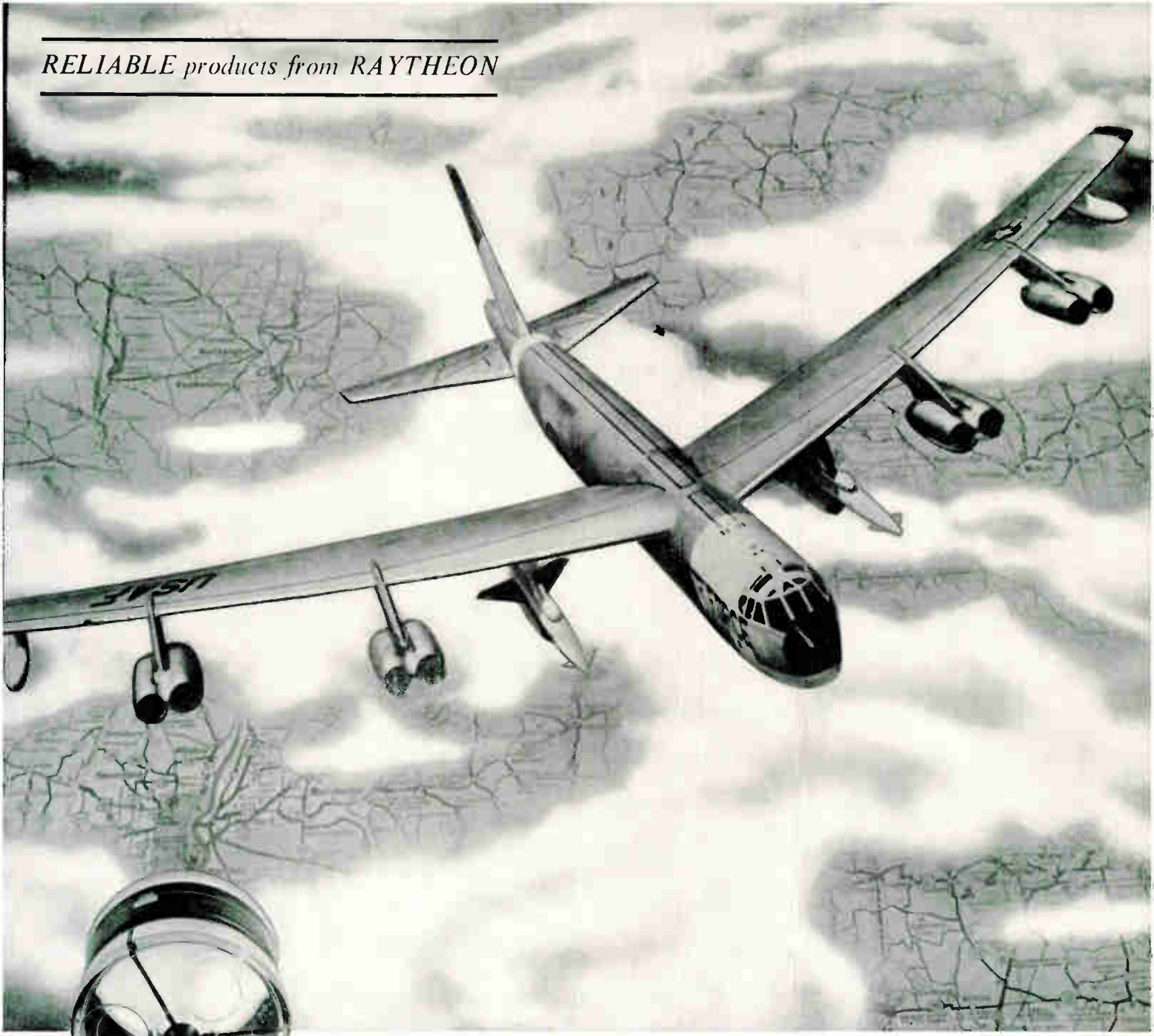
. . . precision optics at work

GENERAL ELECTRODYNAMICS CORPORATION

4430 FOREST LANE • GARLAND, TEXAS

Circle 23 on Inquiry Card

RELIABLE products from RAYTHEON



"Three-eye" CRT maps and films targets

Raytheon's unique "3-eye" radar display tube has two optical windows in its sides which permit:

- A moving map of the target area to be projected onto the screen in conjunction with radar target sightings.
- A permanent photographic record of the composite picture for later analysis by air intelligence.

These 10-inch "3-eye" tubes, now in use by the Air Force, are an example of Raytheon's capabilities in development and production of specialized equipment.

We also make a very reliable line of display devices, such as the metal-envelope 16ADP, in both radar and infrared-stimulable phosphor types. For complete details, please contact: Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

Send for the Electron Tube Data File

Circle 24 on Inquiry Card

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION

RAYTHEON

Tele-Tips

GRAPHITE, it turns out, has a characteristic that is particularly valuable in these times—it gets stronger with increases in temperature. Where most other metals begin to melt below 4,000°F., graphite doesn't even reach its peak strength until 4,700°. One aerospace company has already subjected it to 5,200°.

ELECTRONIC MONITORING of hospital patients is sorely needed to relieve hard-pressed hospital staffs. Just how important it can be is seen in recent statistics which point out that there are 23,000 reported vacancies in hospitals for professional nurses. Costs in the private short-term general hospitals are at an all-time high of $32.23/day.

WOMEN ENGINEERS and women scientists together make up only about 4% of all such technologists employed by the federal government. About 7% of a total of over 166,000 registrants in the National Register of Scientific and Technical Personnel are women. The largest field for women in this register was biology and the next, psychology.

ELECTRONIC "HOAX" uncovered by the Food and Drug Administration shows how gullible the public can be. The FDA clamped down on the "Electronic Medical Foundation," marketing a line of electronic diagnostic machines, carrying such fancy names as the "Short Wave Oscillotron," the "Oscilloclast," the "Depolaray," and the "Sinusoidal Four-In-One Shortwave Oscillotron." Basic to the treatment was analysis of a drop of blood from the patient, which was sent to a central diagnostic office. FDA found that the diagnostic center could not even distinguish the blood of animals from the blood of humans, or that of the living from the dead. All 13 machines, despite their exotic names, were worthless in the treatment of human ailments, according to the FDA.

(*Continued on page* 52)

New Bourns Knobpot*—Precision Potentiometer, Dial and Knob—All in Front of the Panel!

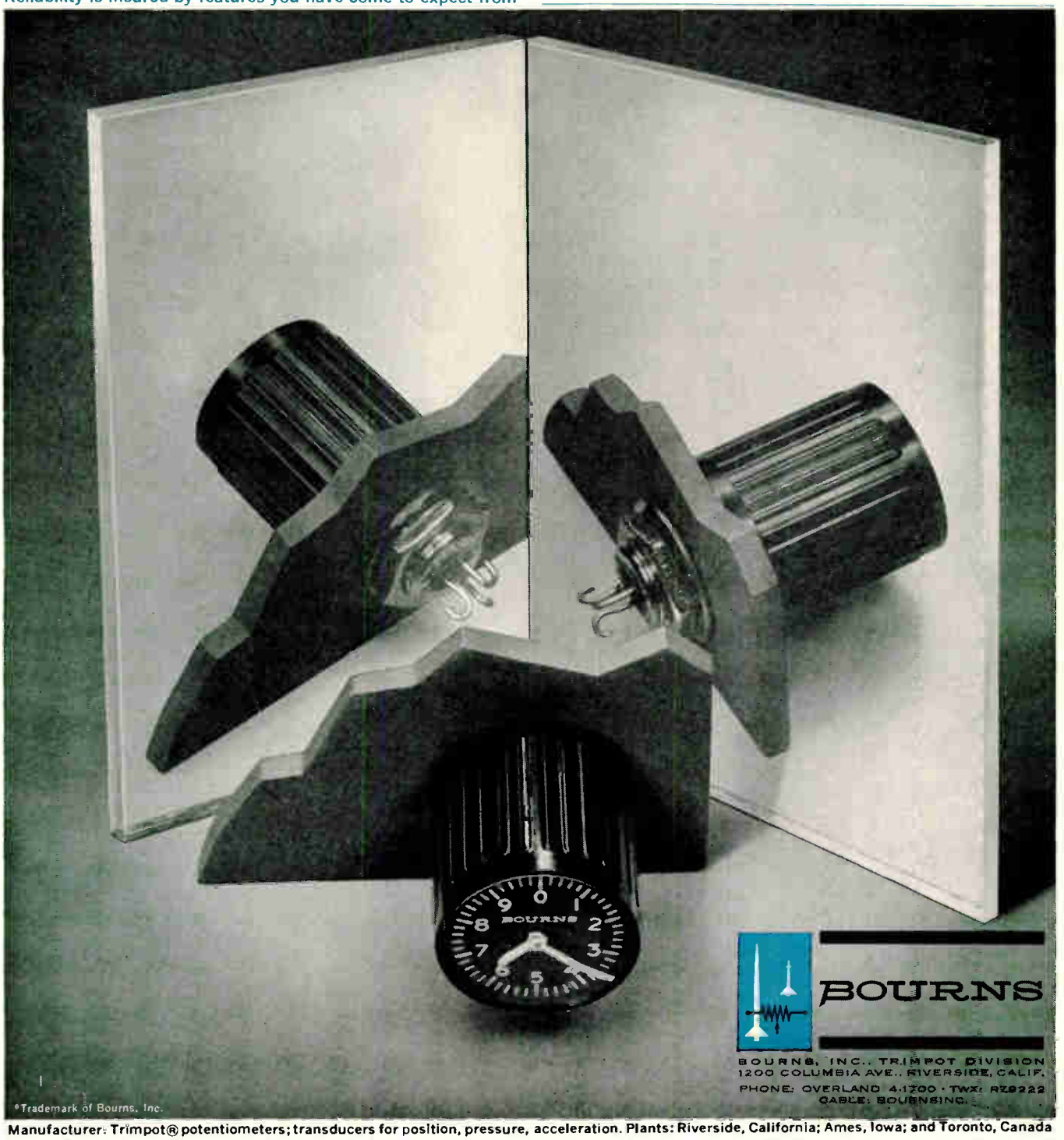
With the new Bourns Knobpot, nothing is behind the panel but the solder hooks and the bushing. Everything else is out in front, integrated into a single, compact unit. (Just ¾" in diameter by 1" long, the easy-to-mount 10-turn Model 3600 Knobpot is shorter by ½" than comparable potentiometers alone—to say nothing of the space it saves by incorporating its own turns-counting dial.)

Settings are easy to make and permanent. The clear-reading dial lets you adjust to 0.5% of the unit's total resistance value, and the knob's self-locking feature keeps your adjustment steady even under 10G vibration or 50G shock.

Reliability is insured by features you have come to expect from Bourns: exclusive, indestructible Silverweld® multi-wire termination; 100% in-process and final inspections; Bourns' Reliability Assurance Program—the most extensive in the industry. Write for complete data.

Resistances: 1000Ω to 100K std. (to 250K spl.)
Linearity: ±0.5%
Power rating: 1.5W @ 25°C
Max. operating temp.: +85°C
Mech. life: 200,000 revolutions
Humidity: MIL-STD-202, Method 103, Condition B (steady state)

SHOWN HALF SIZE



Manufacturer: Trimpot® potentiometers; transducers for position, pressure, acceleration. Plants: Riverside, California; Ames, Iowa; and Toronto, Canada

now...

CLARE introduces the

first

non-bridging Mercury-Wetted Contact Relay

FORM C HGS SWITCH ACTION

A—Mercury (shown in orange) covers armature and contact faces.

B&C—As armature moves from open to closed position, mercury filament breaks before new contact is made in a true Form C (break-before-make) action. Ruptured mercury surfaces accelerate away from each other at estimated 1500G's providing rapid breaking action.

D—Contact surfaces join. Mercury wetting dampens rebound, eliminates chatter, provides uninterrupted metallic contact.

Similar contact action occurs on release. Drawings show Form C HGS switch. Clare Form D HG, HGS and HGSS have similar mercury action, but provide make-before-break contact.

Clare HGS-5000...

the Form C Relay you'll *never* wear out!

high speed...long life...no contact bounce...no electric chatter

Where only non-bridging action will do the job, Clare's new Form C HGS Relay will give you what you need...without design compromise or expensive circuit modifications.

You get Clare reliability—with the long life and high speed demonstrated by Clare Mercury-Wetted Contact Relays in literally thousands of applications.

All ratings of Clare HGS-5000 switch elements (heart of the Form C HGS Relay) are the same as those of the HGS-1000 element, with Form D (bridging) contacts.

For information on the Form C HGS Relays, use Reader Service Card, circling number indicated below.

A switch for every design

CLARE Type HGS—Speed to 200 cps

The HGS with Form D (bridging) contacts is the fastest operating, most sensitive mercury-wetted contact switch available. Permanent magnets provide single-side-stable and bi-stable adjustment.

CLARE Type HGSS—for small space

The HGSS switch capsule is identical with the HGS and performance characteristics are comparable. The HGSS uses a shorter coil and magnetic structure and is ideally suited for use where mounting space is limited.

CLARE Type HG—Loads to 250 va

The HG switch capsule will handle contact loads as high as 5 amperes, 500 volts (250 va max.). In the HGP type it is available equipped with two permanent magnets for single-side-stable, bi-stable or chopper operation.

HGS
HGSS

HG

THE MERCURY-WETTED RELAY PRINCIPLE

The remarkably long life of CLARE mercury-wetted relays is the result of a design principle whereby a film of mercury on the contacts is constantly renewed, by capillary action, from a mercury pool. Both CLARE HGS and HG switches are sealed in high pressure hydrogen atmosphere. Certain construction differences, however, give greater speed and sensitivity to the HGS switch.

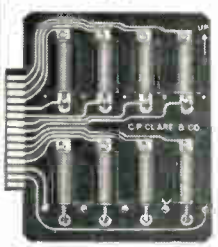
A package for every mounting

AS MODULES

CLARE HGS and HG switch capsules are available in steel-enclosed modules for convenient mounting on printed circuit boards. Excellent mechanical protection and magnetic shielding.

IN CYLINDRICAL PLUG-IN CANS

CLARE HGS switch capsules are available in single switch units in cylindrical steel containers with plug-in base. The smaller HGSS type is similarly mounted for use in limited space. HG switch capsules may be thus mounted with one, two, three or four capsules with single coil.



ON PRINTED CIRCUIT BOARDS

Printed circuit board assemblies are available with either HGS or HG switch capsules, designed to customer specifications by CLARE or mounted on boards supplied by the customer.

Circle 27 on Inquiry Card

SEND FOR DATA SHEET CPC-13

See your nearest CLARE representative or address C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. Cable Address: CLARELAY. In Canada: C. P. Clare Canada, Ltd., 840 Caledonia Road, Toronto 19, Ontario. In Europe: Europélec, Les Clayes-sous-Bois (S.-et-O.) France.

C. P. CLARE & CO.

Relays and related control components

VALUE makes the Tektronix Type 545A *your best investment*

VERSATILITY

. . . for pulse-sampling applications . . . for transistor-rise-time testing . . . for semiconductor-diode-recovery-time studies . . . for strain-gage and other transducer measurements . . . for differential-comparator displays . . . for multiple-trace work in general laboratory experiments.

. . . for single-shot or recurrent or triggered main-sweep presentations . . . for either conventional or triggered jitter-free delayed-sweep presentations.

With 16 plug-in units available, the Tektronix Type 545A Oscilloscope holds the capabilities for displaying simply and reliably almost any dc-to-30 mc signal in almost any laboratory application.

And an operational amplifier soon available will even further widen the scope of Type 545A Oscilloscope measurements—through its capabilities for integration, differentiation, amplification, summation, other operations for medium and high-frequency applications.

RELIABILITY

. . . from a company that has originated its own designs in over 50 different laboratory oscilloscopes—incorporating many special components designed and made by Tektronix to provide optimum performance and assure continuing reliability.

. . . from a company that has specialized in manufacturing ONLY laboratory oscilloscopes and associated instrumentation.

. . . from a company that has emphasized quality in design for quality in performance for 15 years.

CONTINUING ASSISTANCE

And to maintain high performance, Tektronix backs up every Type 545A Oscilloscope with comprehensive field services from 37 Field Offices and 20 Repair Centers throughout the United States and Canada. For Tektronix believes that a manufacturer's responsibility to the user of his product continues throughout the life of the instrument.

Type 545A performance characteristics include: Risetime of 12 nanoseconds—with fast-rise Plug-in Units. Calibrated Sweep Range of 0.1 μsec/cm to 5 sec/cm. Calibrated Sweep Delay from 1 μsec to 10 seconds.

Other Tektronix features include: Single Sweep (for Time Base A). 5X-Magnifier. 10-KV Accelerating Potential. Amplitude Calibrator. Electronically-regulated Power Supplies.

Type 545A (without plug-in units) $1550

Type CA Dual-Trace Plug-In Unit (as illustrated) . . . $260

U.S. Sales Prices f.o.b. Beaverton, Oregon

Call your Tektronix Field Engineer for a demonstration of the versatile and reliable Type 545A Oscilloscope in your own application.

SEE THE LATEST TEKTRONIX INSTRUMENTS AT THE IRE SHOW – BOOTHS 3502-3508

Tektronix, Inc. *P. O. BOX 500 · BEAVERTON, OREGON / Mitchell 4-0161 · TWX—BEAV 311 · Cable: TEKTRONIX*

TEKTRONIX FIELD OFFICES: Albuquerque, N. Mex. • Atlanta, Ga. • Baltimore (Towson) Md. • Boston (Lexington) Mass. • Buffalo, N.Y. • Chicago (Park Ridge) Ill. • Cleveland, Ohio • Dallas, Texas • Dayton, Ohio Denver, Colo. • Detroit (Lathrup Village) Mich. • Endicott (Endwell) N.Y. • Greensboro, N.C. • Houston, Texas • Indianapolis, Ind. • Kansas City (Mission) Kan. • Los Angeles, Calif. Area (East Los Angeles Encino • Pasadena • West Los Angeles) • Minneapolis, Minn. • Montreal, Quebec, Canada • New York City Area (Albertson, L.I., N.Y. • Stamford, Conn. • Union, N.J.) • Orlando, Fla. • Philadelphia, Pa. • Phoenix (Scottsdale) Ariz. • Portland, Ore. • Poughkeepsie, N.Y. • San Diego, Calif. • San Francisco, Calif. Area (Lafayette • Palo Alto) • Seattle, Wash. • Syracuse, N.Y. • Toronto (Willowdale) Ont., Canada • Washington, D.C. (Annandale, Va.).

ENGINEERING REPRESENTATIVES: Kentron Hawaii Ltd., Honolulu, Hawaii. Tektronix is represented in twenty-five overseas countries by qualified engineering organizations.

European and African countries, the countries of Lebanon and Turkey, please contact TEKTRONIX INTERNATIONAL A.G., Terrassenweg 1A, Zug, Switzerland, for the name of your local engineering representative. Other Overseas areas, please write or cable directly to Tektronix, Inc., International Marketing Department, P. O. Box 500, Beaverton, Oregon, U.S.A. Cable: TEKTRONIX.

LOW LEVEL SUBCARRIER OSCILLATOR

FOR FM TELEMETERING

- DIFFERENTIAL FLOATING INPUT
- HIGH COMMON MODE REJECTION
- EXCELLENT ENVIRONMENTAL STABILITY

ACTUAL SIZE

SPECIFICATIONS:

Power Input Required:	+28 ±10%, 25 ma max.
Modulation Sensitivity:	±7.5% frequency deviation with ±10 MV or 0 to 20 MV
Input Impedance:	10K (nominal).
Linearity:	Better than 0.5% DBW, best straight line.
Output Voltage:	0.5 VRMS minimum into 8K.
Output Impedance:	47 K.
Harmonic Distortion:	0.75% max.
Frequency Response:	±0.5 db (mod. index of 2.5)
Amplitude Modulation:	±0.5 db max.
Common Mode Rejection:	100 db minimum from DC to 1000 cps for common mode inputs up to 10 volts peak to peak. 140 db minimum at DC.
Drift:	±1% DBW, for 8 hours static environment
Temperature:	Center frequency and sensitivity stable ±2% DBW, 0°F to 185°F. Operational —60°F to 212°F.

The center frequency and sensitivity will not vary more than ±1% DBW under the following environmental conditions.

Acceleration:	150 G, any axis.
Shock:	100 G, 11 ms, any axis.
Vibration:	20 G, 20 to 2000 cps in 5 minute sweeps in any axis.
Altitude:	Unlimited.
Humidity:	MIL-E-5272.

NEW DORSETT MVO 20

New from Dorsett Electronics is the Model MVO-20, a realistic approach to reliability in the design of solid state, low level subcarrier oscillators.

Silicon semiconductors are used throughout a circuit which provides balanced differential input, excellent common mode rejection and stable data over a wide environmental range.

The MVO-20 is packaged in the die cast Dorsett "20" series No. 2 module compatible with other "20" series telemetry components. Distortion and intermodulation are held to a minimum through careful package design. Components aren't cramped to rob reliability. The package is small enough to meet most system configuration requirements.

If you can't afford to take chances on reliability, be sure to evaluate the Dorsett Model MVO-20 low level subcarrier oscillator for your next telemetry requirement.

DORSETT ELECTRONICS, INC.

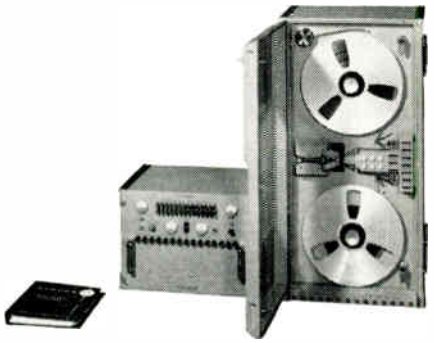
P. O. BOX 862 • NORMAN, OKLAHOMA • JEFFERSON 4-3750

Circle 29 on Inquiry Card

HERE'S OUR BABY!

MINCOM'S NEW 1.2mc COMPACT

RECORDER/REPRODUCER



MINCOM'S NEW CMP-100 is the first mobile field recorder/reproducer with wideband and predetection performance. Like Mincom's standard-rack CM-100, the new **Series CMP** records up to 1.2 mc on seven tracks at 120 ips—with the positive accuracy possible only with longitudinal recording on fixed heads. Its two major components can be placed in an over/under configuration, side by side, or separated; it is easily fitted into many airborne, shipboard or van installations. The only transportable field system with six speeds, **CMP** is wired for full remote control and has two monitor playback channels.

Mincom Series G-100—Now 600 kc at 120 ips

Bandwidth and speed are now increased in the **Series G-100,** a superb, all-purpose general instrumentation system with improved dynamic range. Performs both FM and analog testing, RF or closed-circuit data storage, with a Direct response of 300 cycles to 600 kc at 120 ips. FM response at 60 ips is dc to 20 kc (extended), dc to 10 kc (standard).

The **G-100** Recorder/Reproducer, with fourteen interchangeable analog or FM tracks in one standard rack, is reliable and simple, with plug-in card system record/reproduce modules and Mincom's exclusive DC tape transport.

Write for details and complete specifications

Two Important Facts about Mincom Recorder/Reproducers

1. Indefinitely prolonged recording time is possible with Mincom systems. An automatic transfer, with a 30-second overlap, enables any pair of similar Mincom recorders to gather consecutive information for any desired period of time.

2. Mincom's method of longitudinal recording with stationary heads assures reliable response up to 1.2 megacycles. The mechanical precision of Mincom's fixed-head assemblies is an important factor in recording continuous, uninterrupted data, as well as in ease of operation and reduction of maintenance down time.

Mincom Division 3M COMPANY

Los Angeles 25, California • Washington 4, D.C.

OCT. 11, 1745

Dean von Kleist of the cathedral of Camin, Germany, wrote a friend, "When a piece of brass wire is put into a small apothecaries' vial and electrified, remarkable effects follow..."

He had invented the Leyden jar—a clumsy, fragile, liquid-filled glass cylinder that puzzled and delighted polite society for more than a century.

MARCH 14, 1913

William Dubilier* testified before the British War Office Wireless Committee that he had developed a small mica condenser for radiotelegraphy "...that should be able to take the place of a whole battery of Leyden jars."

The Dubilier mica condenser revolutionized naval communications and was instrumental in the defeat of the German Grand Fleet in World War I.

*Still active in Cornell-Dubilier

FEBRUARY 5, 1962

Jim McHugh and Jack Greenberg, Cornell-Dubilier Managers of Mica Engineering and Reliability Assurance Engineering respectively, announce in Providence, Rhode Island, "Millions of component hours, logged on hundreds of consecutive controlled test lots of the new line of CDE dipped micas, indicate a distinct trend toward a failure rate of .001% per 1000 hrs."

Mica, the world's most perfect dielectric material, is ready for its Space Age assignments.

(whenever mica history is made, Cornell-Dubilier makes it)

There are at least nine other significant reasons why Cornell-Dubilier qualifies as the world's leading source for mica capacitors: CDE makes the smallest! Type 126D miniature dipped mica measures only .26"x.12"x.095" thk., weighs only .095 grams / CDE makes the largest! Type 77 stands 30 inches tall and has a diameter of 18 inches, is designed and built for long range transmitters / CDE makes the only line of mica tubulars! The process is proprietary, but the applications are not. Designed for automated production techniques / CDE makes the most closely controlled temperature-compensated micas! Tolerances are as close as 5 ppm per degree C of the desired normal value, in either direction / CDE is the largest source of metal-clad micas! / CDE is the only capacitor manufacturer that processes mica from the raw state! / CDE is the only source of unconventional mica capacitor shapes! / CDE has the largest, newest, most modern facility devoted to mica capacitor design, development and production! This 100,000 sq. ft. facility in Providence, Rhode Island, expresses Cornell-Dubilier's faith in mica's future / CDE has the most complete line of micas available anywhere! Dipped capacitors, molded capacitors, encapsulated miniature capacitors, pulse capacitors, resin-encapsulated capacitors . . . mica in every shape and size to suit your every need / Unprecedented capability with mica—another example of how Cornell-Dubilier Can Do more in '62 . . . for you!

CORNELL-DUBILIER ELECTRONICS, DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY, 50 PARIS STREET, NEWARK 1, NEW JERSEY

Our technical literature on mica capacitors is precise, complete and immediately available.

CDE CORNELL-DUBILIER

See you at the IRE show! Booths 2721-23-25.

the magnificent trifle

news about solders, fluxes, preforms special alloys, lead and tin products

alpha

alpha metals, inc. 56 Water Street, Jersey City, New Jersey • HEnderson 4-6778
Los Angeles, Calif. • Alpha-Loy Corp. (Div.) Chicago, Ill. • Alpha Metals, Inc. (U. K.) Ltd., London, Eng.

new bar solder cuts printed circuit joint rejects

Use of a recently developed Vaculoy® bar solder cuts printed circuit joint rejects from 1 in 500 to 1 in 5,000. The primary reason for this amazing performance is the fact that the new bar solder is significantly freer from oxide forming elements.

Here are some of the other advantages offered by Alpha Vaculoy solder:

1. Substantially less dross.
2. Increased bath life.
3. Less inherent inclusions.
4. Improved wetting.
5. Brighter joints.
6. More finished units per pound.

Alpha's new Vaculoy solder was developed specifically for electronic and computer printed circuit applications. It conforms to latest revisions of Federal Specification QQS-571 and ASTM.

Its initial cost is pennies per pound more than ordinary solders, but in terms of effective joints and man-hours, Vaculoy costs appreciably less. Full information on request.

Circle 51 on Inquiry Card

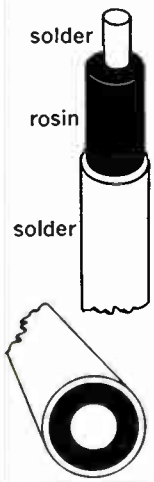
automatic soldering with solder preforms

Automatic soldering requires solder preforms of controlled alloy content, size and shape. The right preforms can increase production, guarantee product precision, cut labor costs and provide stronger, smoother joints.

Alpha's experience can help you secure the correct solder preforms for every job and achieve the maximum effectiveness and economy from automatic soldering. Alpha solder preforms are available in discs, rings, spheres, washers, pellets and an almost limitless variety of forms. Both solid and flux filled forms can be supplied. The Alpha "Guide to Automatic Soldering with Solder Preforms" is yours for the asking.

Circle 52 on Inquiry Card

Cen-Tri-Core® solder...more joints per lb.



The use of Alpha Cen-Tri-Core® "energized" rosin-filled solder results in more joints per pound as well as higher quality. Here's why:

1. No rosin voids or skips.
2. No cold joints or rejects.
3. Fast-acting, non-corrosive flux provides simultaneous "wetting flow" and "take."
4. Solders to poorly plated or oxidized parts.

Cen-Tri-Core® rosin-filled solder is available in 8 flux percentages, in diameters from .010" and in all alloys of tin and lead as well as in tin-lead-silver for soldering silver fired ceramic parts. It conforms to latest revisions of Federal Specification QQS-571, Mil Std. 6872 and ASTM. Test its superiority for yourself by writing for a generous engineering sample suitable for fifty reliable connections. No cost or obligation.

Circle 53 on Inquiry Card

wave fluxing and foam fluxing improved with activated liquid rosin flux

Even oxidized surfaces normally resistant to soldering can now be soldered quickly, efficiently and safely with Alpha's new printed circuit flux. Its instant wetting action and excellent capillarity properties are extremely important for printed circuit dip soldering, automatic wave fluxing and installations requiring foam fluxing.

Alpha's fluxes meet all government specifications. Full information on this new series of activated liquid rosin fluxes for critical soldering applications is yours on request.

Circle 54 on Inquiry Card

Tele-Tips

(*Continued from Page 42*)

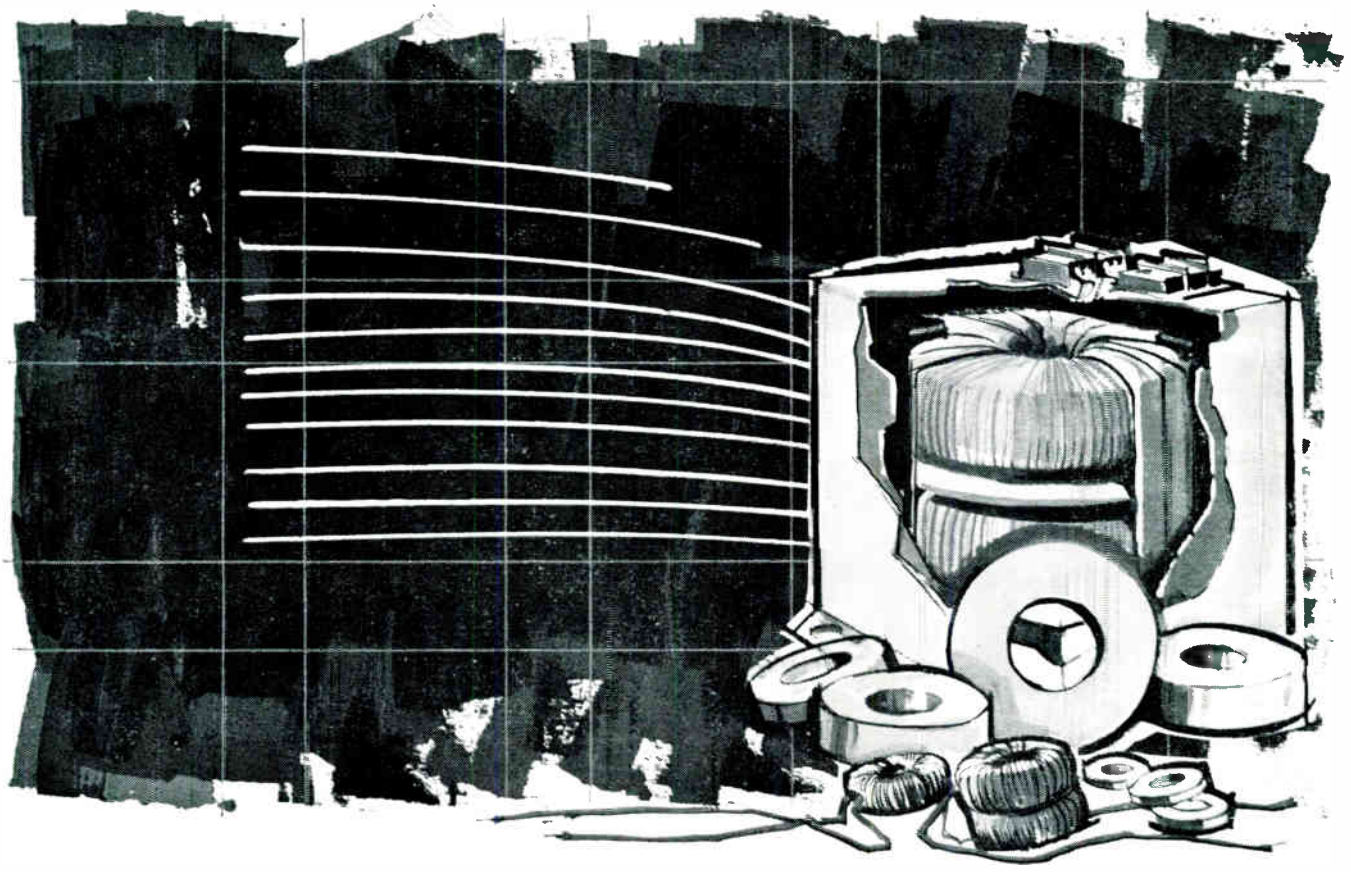
GROWTH OF THE SCIENTIFIC community is accelerating so rapidly that some 80 to 90% of all the scientists that have ever lived are alive now.

"PROJECT TURNABOUT" is a "unique" AICBM defense concocted by one D. G. Brennan, and reported in the newsletter of the PG on Information Theory. It goes: "Consider a large array of rigidly fixed rocket engines uniformly distributed in a band about the earth's equator, all pointed tangent to the earth's surface, parallel to the equator, and pointed in the same direction. Then, when an incoming enemy warhead is detected, these rocket engines are all turned on. This applies a large torque to the earth about its axis of rotation, accelerating its rotation. By suitable control of the rocket thrust, the earth can be rotated 180° between the time of detection and the time of impact. The missile would, therefore, land on the enemy's own territory, and contribute to his own destruction." And the report goes on to give the parameters of such a system.

EXPERIMENTAL "TEACHING MACHINE" project is being conducted at the Univ. of Michigan, using a local student. After 200-odd hours of lessons in "machine-taught" spoken Spanish, he has journeyed to Mexico to live among natives—and to bring back all his conversations in tape recording. The student knew no Spanish when he started, now speaks Spanish as well as, and exactly like, a 12-year-old Spanish boy.

SOUND WAVES have been found to improve the economy of evaporator operation in converting saline water to fresh water, according to a study by the Dept. of the Interior. Acoustic vibrations in electrically heated pipes and in the pipes themselves resulted in improvement in water side heat transfer coefficients varying from 450% at a Reynolds number of 540, to 16% at a Reynolds number of 16,000.

Make Cores Lighter and Smaller with less copper and lower losses by using Armco Thin Electrical Steels



New steels are born at Armco

Magnetic properties of these special Armco Steels offer opportunities to improve performance and cut costs of components for operation at 400 to 2000 cps and higher frequencies.

Armco Thin Electrical Steels offer you these advantages because they have an unusual combination of magnetic and physical properties:

- **Exceptionally high permeability**
- **Low hysteresis loss**
- **Minimum interlaminar loss**
- **High lamination factor**
- **Properties fully developed at the mill**

Electrical Steel — For better electrical apparatus

Available in three different grades, you have a wide choice of magnetic characteristics to most precisely meet your requirements.

Armco TRAN-COR T—A non-oriented grade available in 5 and 7 mils.

Armco Oriented T—Oriented grades produced in 1, 2 and 4 mils.

Armco Oriented TS—Super-oriented, very high permeability, 4 mils.

Use the advantages of Armco Thin Electrical Steel in *your* products. Write us for complete information, including design curves. **Armco Division, Armco Steel Corporation, 1742 Curtis Street, Middletown, Ohio.**

ARMCO **Armco Division**

The Oak Approach

When must contact be "Good as Gold"?

When time means harmful tarnish!

Of course gold is a *natural* wherever rotary or push-button switches must remain in any one position for months-on-end. Simply because it assures *perfect, lasting contact without care* where switches are operated infrequently.

Under other circumstances, however, contact "good as gold" may call for radically different construction, different selection of metals, as you well know. All the picky considerations so familiar in switch design are thoughtfully gone over in full *each time OAK develops a switch recommendation.* Common, ordinary silver plate may be best of all. (Generally gives outstanding results where 10,000 cycles use-life is sufficient . . . and then provides brass-to-brass contact up to 200,000 cycles of operation where a bit of circuit noise can be tolerated.)

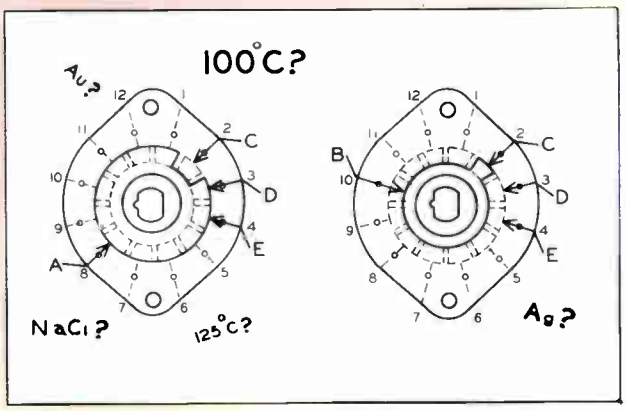
Then, perhaps, that "good-as-gold" answer will be OAK CMS-202 high-temperature alloy . . . or simply a more familiar silver alloy. OAK recognition of countless significant details helps you save by preventing over-engineered switches — as well as by safeguarding performance.

So let OAK unravel the tedious details: choice of contacts . . . make-up of metals . . . proper insulators and frame design. Creating superior switches and complete switching subassemblies is our full-time business — probably the best reason of all for making OAK *your switch-engineering "right arm."*

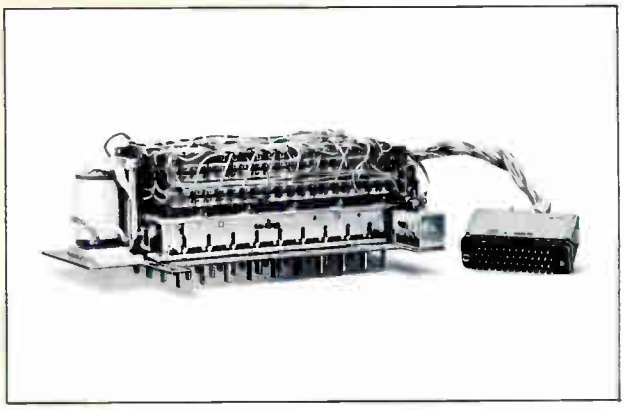
Where creativity pays practical dividends

OAK ideas cut cost of switches for countless applications — Good switch-engineering, as you know, doesn't mean designing the most expensive item to do the job, under all conditions, for a hundred years. It means creating the *lowest-cost component that can handle the job and provide proper use-life.* Be it push-button, rotary, lever or slide switch — send your performance and application data along when you order.

Although you may have been dealing with us for years — you can enable us to do a still better job for you. As a switch specialist, OAK can spot needless costs in mechanical and electrical specifications and help control or eliminate them.



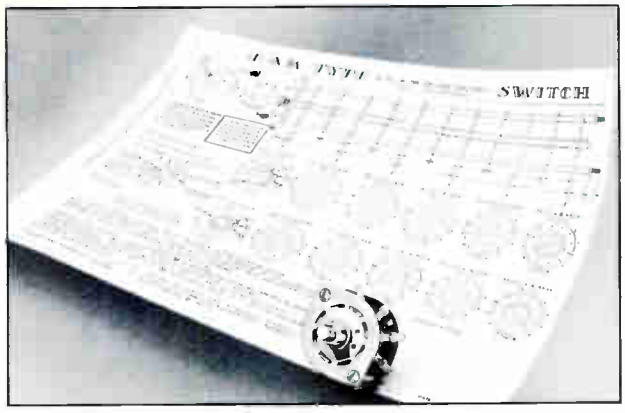
OAK assemblies can cut production costs . . . free-up manufacturing facilities — Given circuit data and opportunity, OAK will also build complete subassemblies, and can often combine switches with related circuitry to produce cost-saving "package" plug-ins. Sometimes we can even eliminate expensive components such as relays.



OAK-built components and subassemblies all are life- and environment-tested. Products subject to MIL SPECS (including 3786-A) are checked for performance under vibration, shock, salt spray, humidity, high altitude and temperature extremes.

You'll find OAK engineers eager to assist with problems. We urge that you take full advantage of their unique capabilities.

OAK schedules help speed your production efforts — Need a prototype fast? Order it from OAK: generally it's completed in 3 days! And compare our new, faster production cycle — now insured by expanded plant capacity.



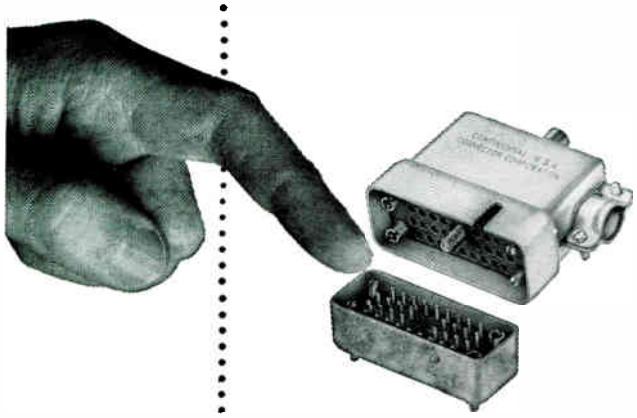
Layout sheets are readily available at no cost, to help in diagraming your switch requests. For specific information, products, or prototype service, contact your OAK representative, or OAK directly.

OAK MANUFACTURING CO.

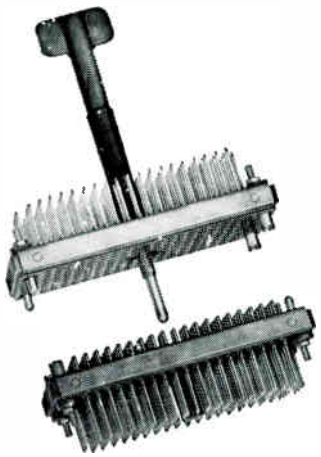
CRYSTAL LAKE, ILLINOIS • Telephone: Area Code 815; 459-5000; TWX: CRYS LK 2350-U; Cable: Oakmanco. • Plants in Crystal Lake, Illinois • Elkhorn, Wisconsin

Subsidiaries: OAK ELECTRONICS CORP., Culver City, Calif. • McCOY ELECTRONICS CO., Mt. Holly Springs, Pa.

ROTARY AND PUSHBUTTON SWITCHES • TELEVISION TUNERS • VIBRATORS • APPLIANCE AND VENDING CONTROLS • ROTARY SOLENOIDS • CHOPPERS • CONTROL ASSEMBLIES



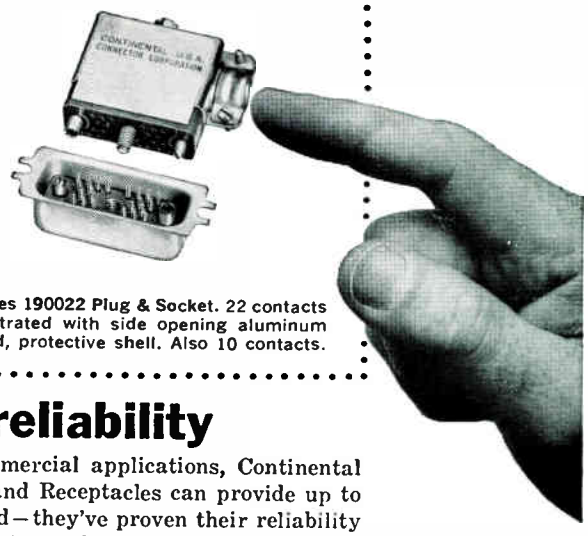
Series 190034 Plug & Socket. 34 contacts illustrated with side opening aluminum hood and protective shells.



Series 1900152 Plug & Socket. 152 contacts with wire-wrapping terminations and reinforcing stainless steel channels.

··· CENTER SCREWLOCK CONNECTORS ···

Series 190078 Plug & Socket. 78 contacts illustrated with mounting flange protective shell. Also 104 contacts.



Series 190022 Plug & Socket. 22 contacts illustrated with side opening aluminum hood, protective shell. Also 10 contacts.

small size...big reliability

Designed expressly for critical military and commercial applications, Continental Connector's Series 1900 Center Screwlock Plugs and Receptacles can provide up to 152 connections in less than 3.6 inches length! And—they've proven their reliability in hundreds of heavy duty aircraft, missile, computer and ground support installations. Features include double lead thread action center screwlocks, closed entry contacts, positive polarization, glass filled Diallyl Phthalate moldings. Standard types are available with 10 and 22 contacts for #20 wire, 34, 78 and 152 contacts for #16 wire...available with wire wrap terminals, hoods and protective shields.

DESIGNERS' DATA FILE / Continental's Con-Dex File CSL has been compiled to help you select and specify the Center Screwlock Connectors best suited to your needs. For your copy write to: Continental Connector Corporation, 34-63 56th Street, Woodside 77, New York

MICRO-MINIATURE • SUB-MINIATURE • MINIATURE • PRINTED CIRCUIT • RIGHT ANGLE PIN & SOCKET • CENTER SCREWLOCK

CONTINENTAL CONNECTORS

CONTINENTAL CONNECTOR CORPORATION • WOODSIDE 77, NEW YORK

SEE US AT THE IRE SHOW ● BOOTHS 2307-2309

Letters to the Editor

"—To Carry On My Work In Ferrite Materials"

Editor, ELECTRONIC INDUSTRIES:

I am taking this opportunity to inform you that I have reached the age and desire for complete retirement. My technical life work was devoted to high frequency magnetics, pioneering the applications of newly developed materials to now universal usage of ferroinductors, circuits, permeability tuning, loop antennas and host of other devices. With my retirement nobody is known to me to continue my remaining and expanding developments in V.H.F., U.H.F. and space propagation. Some of these are suggested in my recently published book—"High Frequency Magnetic Materials." During some thirty years I have accumulated publications, materials, presses and molds and instruments for testing. This letter may open the possibility for some institution interested in my line of work to pick up all the information, literature and physical assets at no charge whatsoever to an educational or research organization.

W. J. Polydoroff,
Consulting Engineer
927 -15th St., N.W.
Washington 5, D. C.

Reactor Facilities

Editor, ELECTRONIC INDUSTRIES:

I was interested in the list of reactor facilities which appeared on page 123 of the December issue of Electronics Industries. I do not know whether or not you intended to include small reactors of the type used in instruction and research in the engineering schools in the list of operating reactors, although I noted some small reactors in the list. We have a 10 KW Argonaut type reactor in our Nuclear Engineering Department at Iowa State University and there is a swimming pool type reactor of similar capacity at the University of Oklahoma.

Here at Iowa State University we also have a large (5,000 KW) research reactor under construction. It should have been included in your list regardless whether or not you included the small training type reactors.

George R. Town
Dean
College of Engineering
Iowa State Univ.
Ames, Ia.

(*Continued on page* 64)

NEW from Hi-G, Inc.

1300 series Voltage Sensors

Hi-G research has developed the 1300 Series Voltage Sensor as a packaged circuit which can be incorporated by Design Engineers into new and advanced circuitry and designs at attractive cost savings.

These Voltage Sensors feature:

- **Standard Accuracy of 2½%**
- **Temperature Range of −65°C to +125°C**
- **Sensed voltage may be chosen from 17 to 33 in increments of 1/10 volt**
- **Two-pole double-throw output**
- **Current drain of 15 MA maximum**
- **No auxiliary power required**
- **Exceeds MIL-R-5757D**
- **Conservative design guarantees long life and reliability**

1300 Series Voltage Sensors are standard; other DC voltages, AC voltage or current sensors custom-built on short delivery schedules.

The 1300 Series Voltage Sensors are another example of Hi-G's ability to produce time, space and cost saving devices for the electronics industry.

For more information on 1300 Series Voltage Sensors, and other Hi-G products, see your Hi-G representative, or write direct for his name.

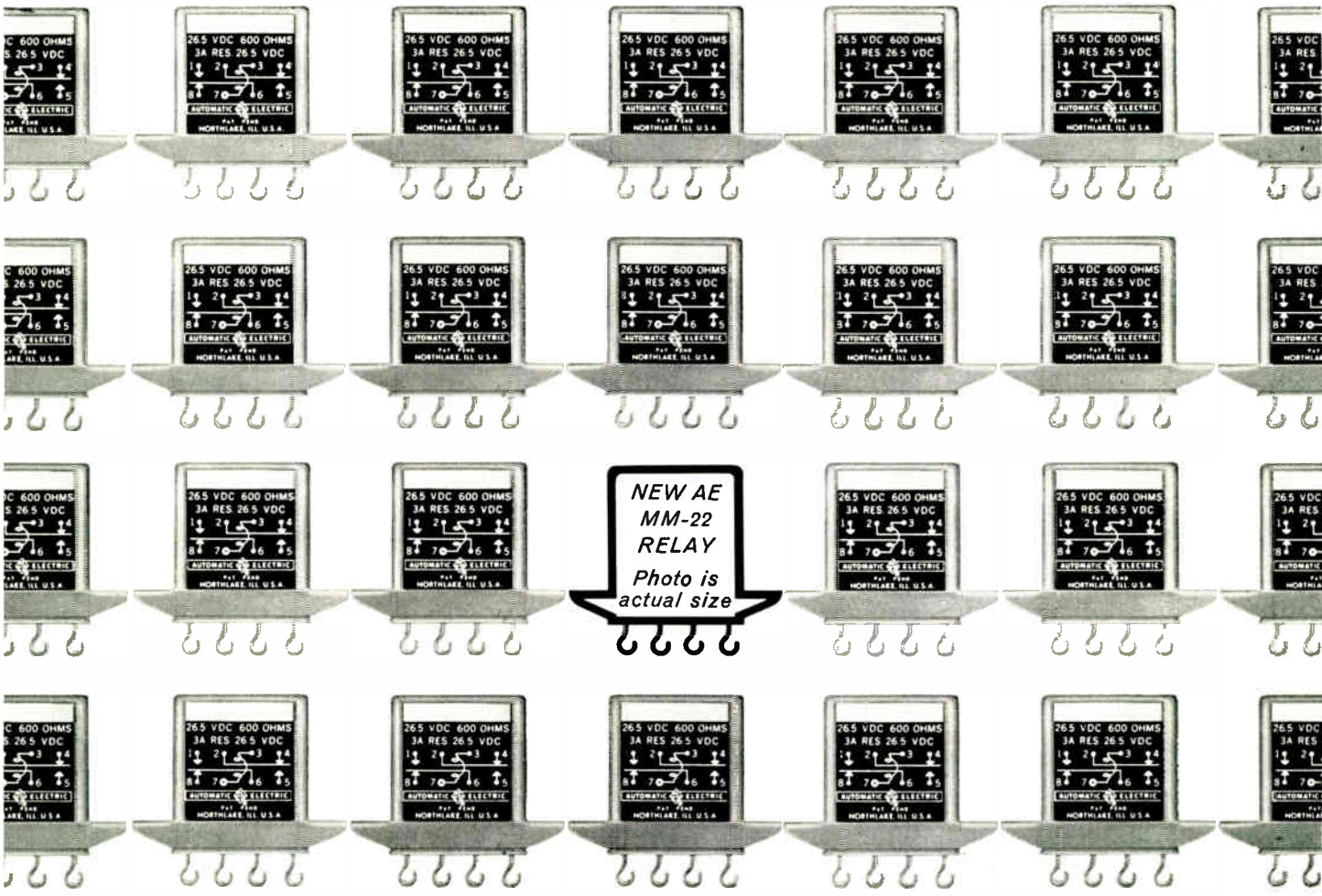
MICROMINIATURE, SUB-MINIATURE, MINIATURE, TIME DELAY RELAYS AND ALLIED PRODUCTS

Hi-G INC.

BALANCED Hi-G ROTARY

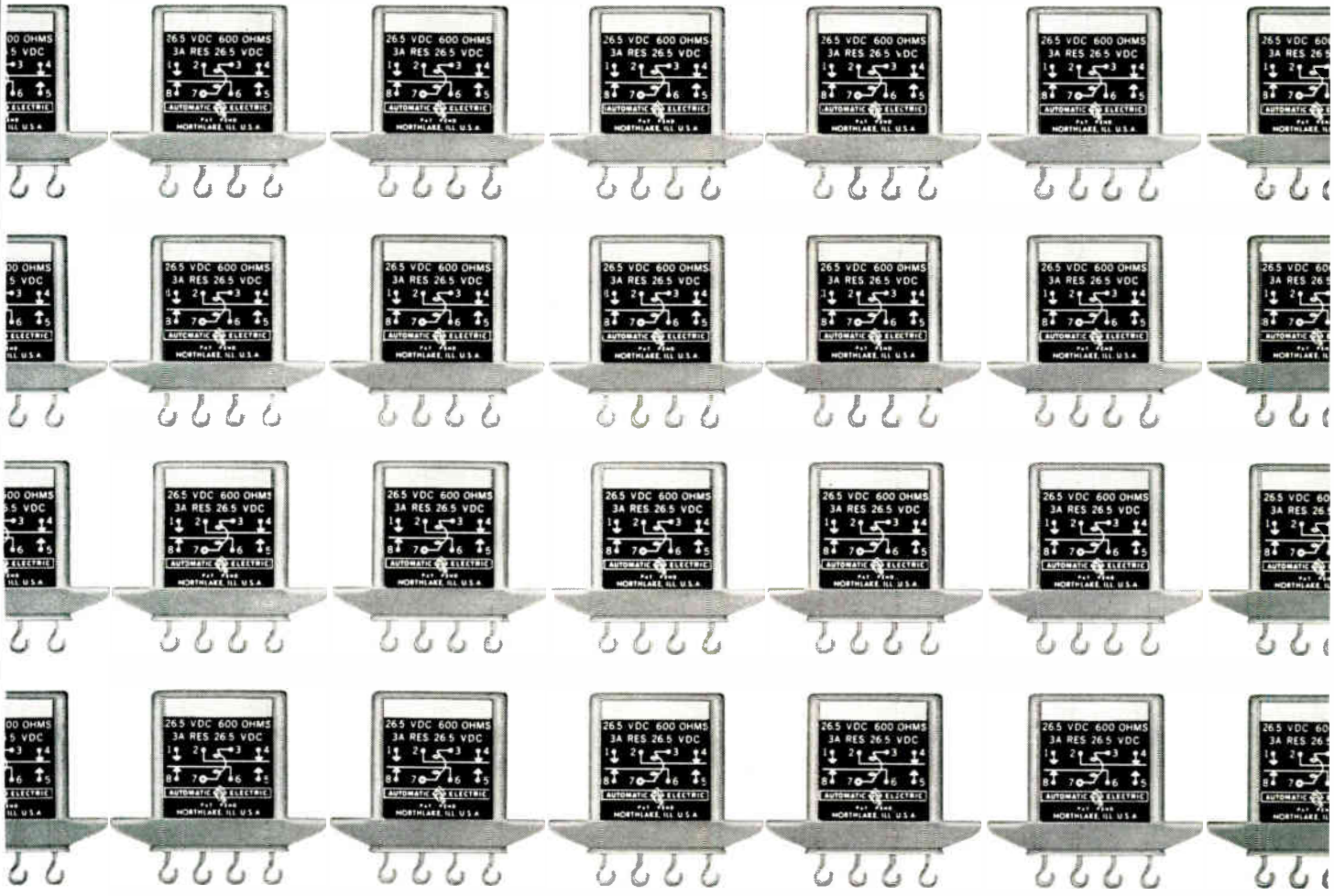
THE ONLY COMPLETE LINE OF BALANCED ROTARY RELAYS

11 BRADLEY FIELD, WINDSOR LOCKS, CONN.



AE announces...

a major breakthrough in military relay reliability



Our engineers have been developing this microminiature relay for more man-hours than we care to admit. The reason, simply enough, is the rigid objective we set forth.

For we wanted to offer you a military type relay with a reliability factor that you—in your fondest dreams—never thought possible.

To accomplish this, our engineers treated the whole manufacturing process as an integral part of the design. They, the design engineers, developed a revolutionary new type of clean room . . . so free of contamination possibilities that it makes old-fashioned clean rooms resemble the kids' sandbox. Instead of trying to eliminate unwanted particles after the relay is assembled, we assemble and evacuate in the dry and inert atmosphere that we want in the finished product.

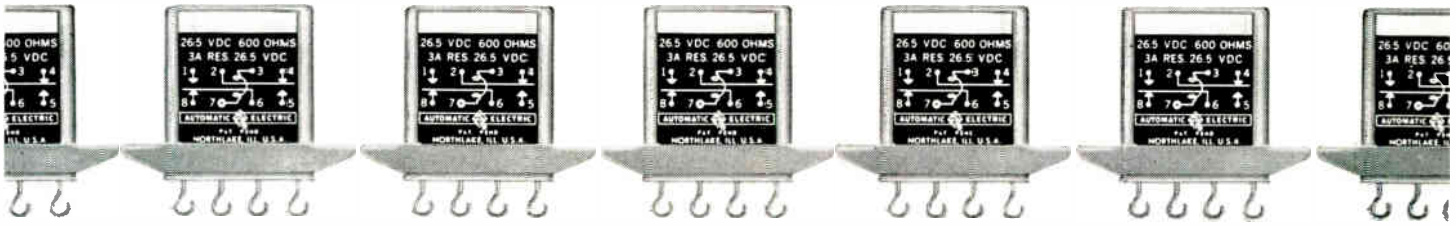
If you have had the trying experience of having to test twenty, thirty or forty MIL-R-5757/10 type relays to get but ten satisfactory ones, we proudly say this new AE MM-22 relay will prove the answer to your problems. For the complete background on the design, development and specifications, please ask for Circular 1999. Write to the Director, Military Equipment Sales, Automatic Electric, Northlake, Illinois.

AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

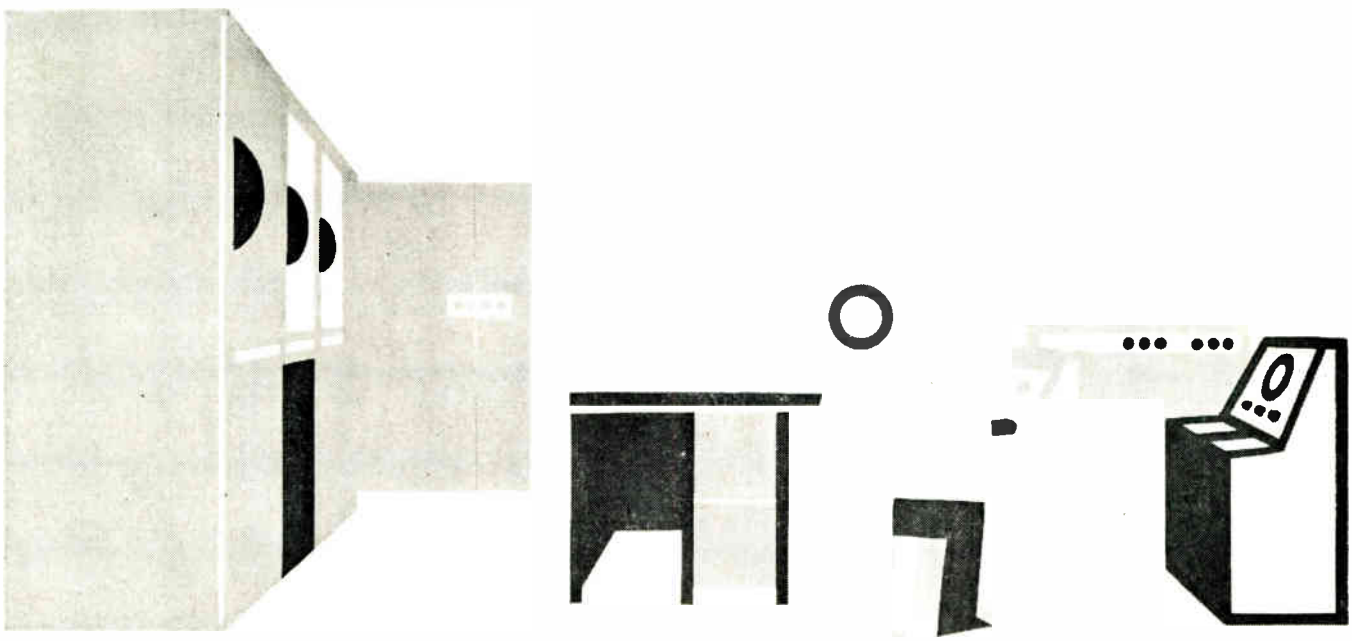


prime source for computers, too

Computers are continually being made smaller, and made to perform mathematical operations at increasingly faster speeds. ■ One important requirement of this continuing miniaturization program being met by Lionel is the production of tiny, yet highly reliable connectors that help to make assemblies "tighter," and thereby shorten the distance electricity must travel from one point to another. ■ If you are not already familiar with Lionel-Anton micro-miniature, sub-miniature, and miniature connectors, in rack and panel, and printed circuit types, we suggest that you write for complete technical data—or, better still, let us know when it will be convenient to have one of our representatives pay you a call.

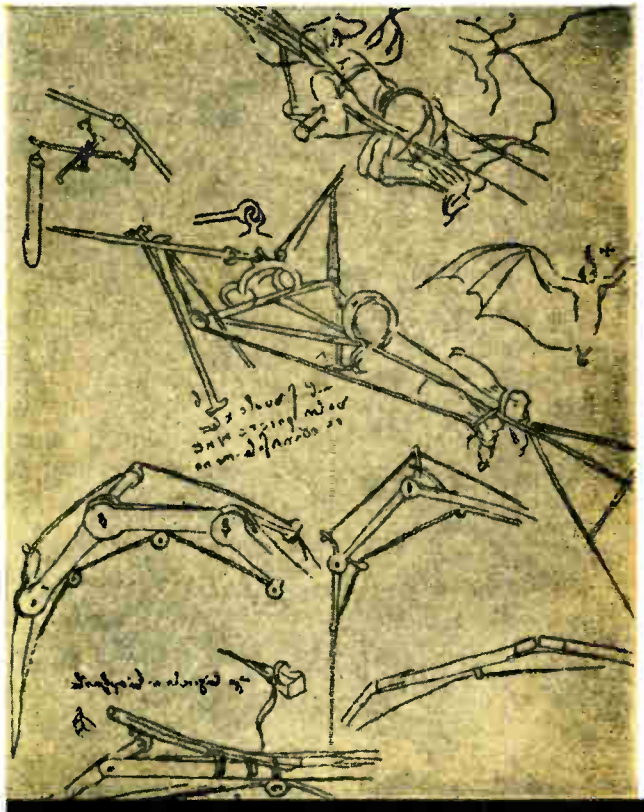
WHERE IMPORTANT CIRCUITS MEET...

LIONEL-ANTON CONNECTORS



One of many types of Lionel-Anton connectors (Series MM-22) used in computer applications. Features include Diallyl Phthalate moldings; exclusive one-piece screw-lock; bow washers to eliminate axial float; 3-48 thread on screwlocks; square shoulder in molding for fixed screwlock; strengthened "C" clip groove; controlled float in socket contact; mounting pad surrounds entire guide hole; durable phosphor bronze male and female contacts. 10 sizes: 5 contacts through 44. Meets applicable MIL specs. Materials and specifications modified to meet your specific needs. The last order for this standard item was shipped 8 days ahead of the promised delivery date.

LIONEL ELECTRONIC LABORATORIES, INC./A SUBSIDIARY OF THE LIONEL CORPORATION/1226 FLUSHING AVE./BROOKLYN 37, N. Y.



"There shall be wings!" said da Vinci. "If the accomplishment be not for me, 'tis for some other. The spirit cannot lie; and man, who shall know all and shall have wings, shall indeed be as a god." Leonardo's originality is evident in the many sketches and plans for both flying machines and parachutes in his notebooks. Though he was never satisfied with his designs and died before he could bring his work to fruition, his sketchbooks indicate a thorough study of the mechanics of bird flight and his attempts at simulating it. The remarkable da Vinci even designed a helicopter, which indicates that his grasp of aerodynamics extended well beyond bird simulation to concepts of flight we employ today.

The facsimile page presented herewith is from his original book of sketches and observations. Flying Machine models, constructed in exact accordance with Leonardo da Vinci's specifications, are on exhibition in the National Museum.

LEONARDO'S FLYING MACHINE DESIGN—1490

Letters to the Editor

(*Continued from page* 58)

Fourier Analyzer—

Editor, ELECTRONIC INDUSTRIES:

The article *Fourier Analyzer Uses the Hall Effect* on page 108 of September ELECTRONIC INDUSTRIES states that ". . . there has been no new approach to electronic Fourier analysis since 1933."

I wish to call attention to the paper of V. N. Bogomolov, "Some New Semiconductor Devices" Zh. Tekh. Fiz., 26, 1956, p. 693 and my own paper "The Hall Effect," Semiconductor Products, May 1960, p. 39, both describe essentially the same Fourier analyzer.

I very much enjoy your magazine but just want to set the record straight.

L. E. Fay III
Sr. Engineer—Magnetics
Bryant Computer Products
850 Ladd Road
Walled Lake, Michigan

"V-T Heater Materials"

Editor, ELECTRONIC INDUSTRIES:

In accordance with your instructions, please send a reprint of "Vacuum Tube Heaters" which appeared on pages 118-122 of the December issue. This is fine background material for our newer engineers in the vacuum tube industry.

May I also add that I am looking forward to your proposed series on nuclear radiation. As you have mentioned in earlier issues, the vacuum tube industry is already engaged in studies of this nature. Hopefully, your upcoming articles will provide some much needed guides for adequate ratings and satisfactory applications.

Henry B. Hagman
Manager, Applications Engrg.
Industrial Components Div.
Raytheon Company
Newton 58, Mass.

Coming Events Calendar

Editor, ELECTRONIC INDUSTRIES:

We would very much appreciate receiving a reprint of your "1962 Coming Events Calendar" which appeared in the January 1962 issue of *Electronic Industries*.

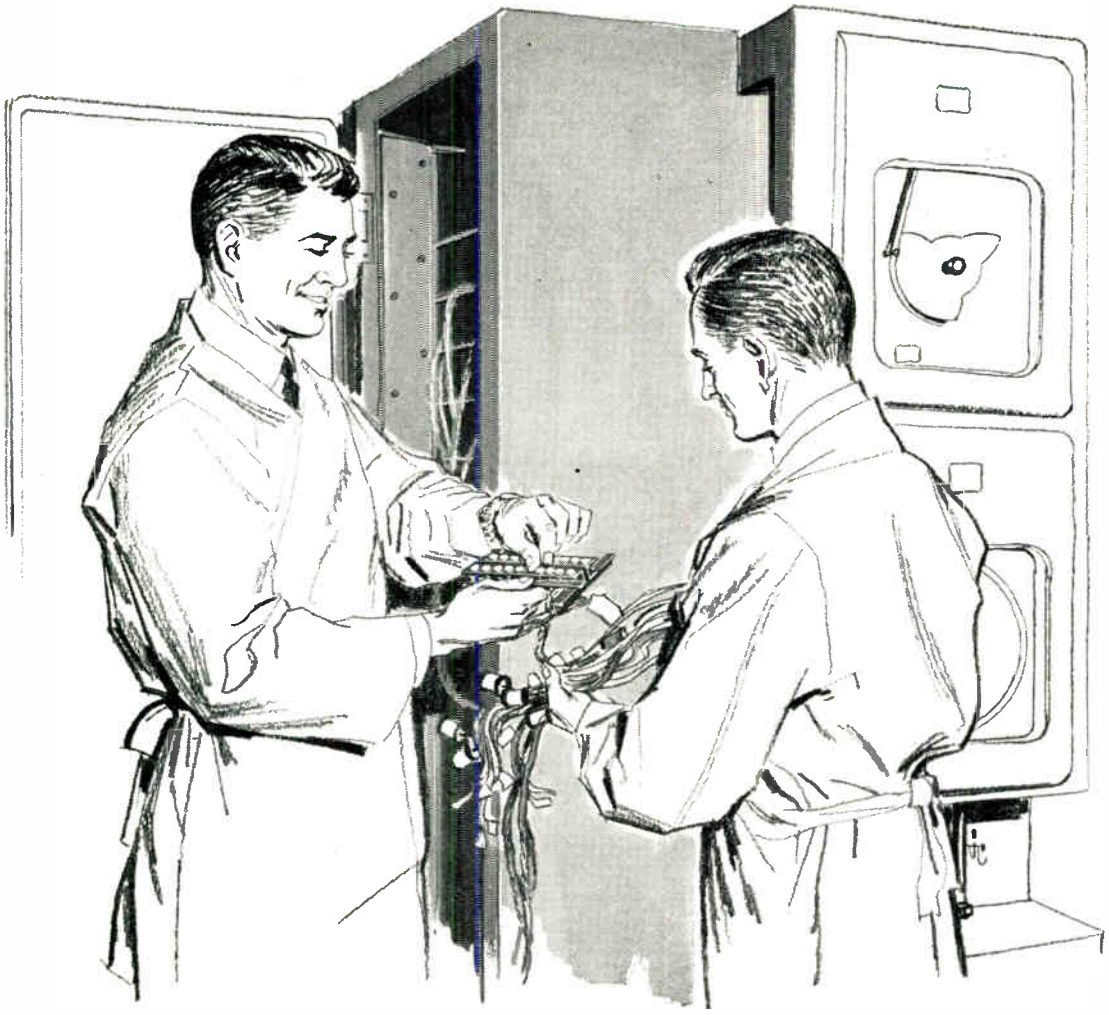
We find this a valuable reference list.

Gretchen R. Randle
Research Associate
Burroughs Corporation
Box 892
Paoli, Pennsylvania

(*Continued on page* 66)

DALE

Type MC resistors meet every environmental test



As specifications grow even more demanding . . . as environmental conditions grow even more rigorous . . . you can continue to place the utmost confidence in Dale precision resistors.

Dale resistors retain their stability because it is inherent —that is, "firmly infixed" by design and methods of manufacture. These methods have reached new levels of achievement as the result of Dale's super-high reliability development program.

SPECIAL PROBLEMS? Let us help you with your requirements for special resistance products. We make modifications of standard products, resistor networks, matched pairs, etc. Send us your specs.

PROMPT DELIVERY: Whether your need is for a short "test run" or a large production release, Dale offers prompt service, direct from the factory and through a widespread network of distributors.

Write for Dale Resistor Catalog A

DALE ELECTRONICS, INC.

DALE

1304 28th Ave., Columbus, Nebraska

A subsidiary of THE LIONEL CORP.

DALE **TYPE MC** RESISTORS

CARBON FILM • MOLDED • PRECISION

Type MC carbon film resistors are completely insulated and protected by molded housings against mechanical damage and against moisture, salt spray and other severe environmental factors. They offer outstanding stability and have excellent high frequency characteristics.

- RATED AT ⅛ watt, ¼ watt, ½ watt, 1 watt, 2 watts
- RESISTANCE RANGE from 1 ohm to 50 megohms
- TOLERANCE ±1%
- TEMPERATURE COEFFICIENT 500 P.P.M. maximum
- FULL POWER to 70° C.

Circle 98 on Inquiry Card

Letters to the Editor

(*Continued from page* 64)

"What Price Reliability?"

Editor, ELECTRONIC INDUSTRIES:

I was led to reading John E. Hickey's "What Price Reliability" in your September issue by a recent mention of it in Sealectro's "Terminology."

Ours is an old company, and we have just recently become interested in "Electronics." Modern concepts of Reliability and Quality Control are difficult to comprehend and fit into manufacturing processes that have sufficed for years.

Mr. Hickey's article is enlightening to those of us trained in the electronic field. I hope it won't impress laymen with the idea that only the relatively few organizations making "Atlas" size missiles need be so concerned with reliability. Of course this is not so, and, in fact, customers and producers of the simplest electronic devices may gain the most.

A. E.. Williams, Manager,
Special Products Division
Delta Electric Co.
Marion, Ind.

"Congratulations—"

Editor, ELECTRONIC INDUSTRIES:

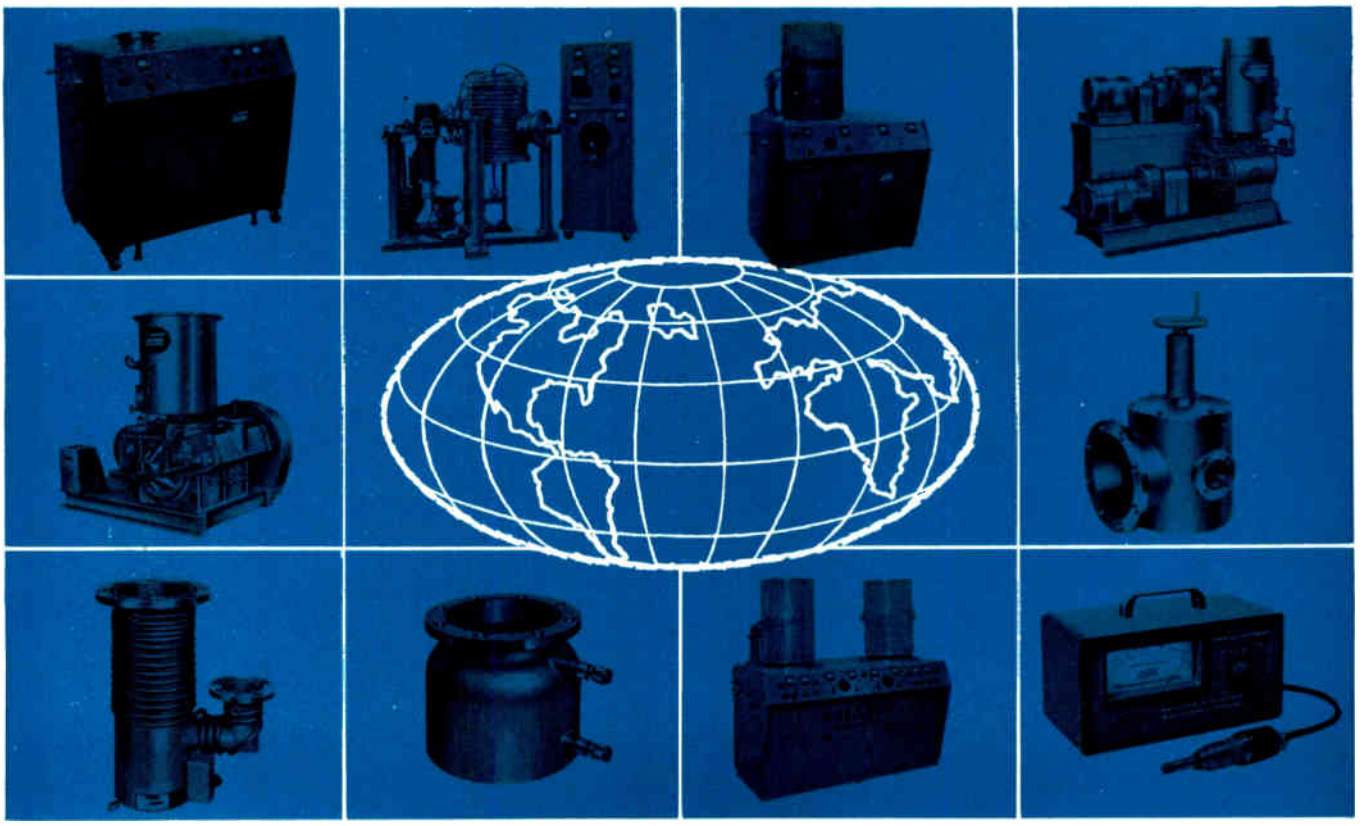
Kindly accept both my congratulations and appreciation: The congratulations for a first-rate magazine in the field of electronics, and appreciation for being on your mailing list.

The information contained in your articles is well composed, well illustrated, thorough, and abreast of a fast moving field. I will continue to read them, circulate them, and keep them as long as storage space holds out.

A. Lattin
Design Engineer
Minneapolis-Honeywell Reg. Co.
Military Products Group,
Aeronautical Division
Los Angeles 25, Calif.

Computer System to Aid Chemical Plant Operation

Celanese Corp. of America will install a digital computer system at its plant at Bishop, Texas. The system, to be supplied by Thompson Ramo Wooldridge Inc., Canoga Park, Calif., will be used to control two of the four primary oxidation units at the chemical plant. It is anticipated that the computer control system will pay for itself within two years.



LEADERSHIP

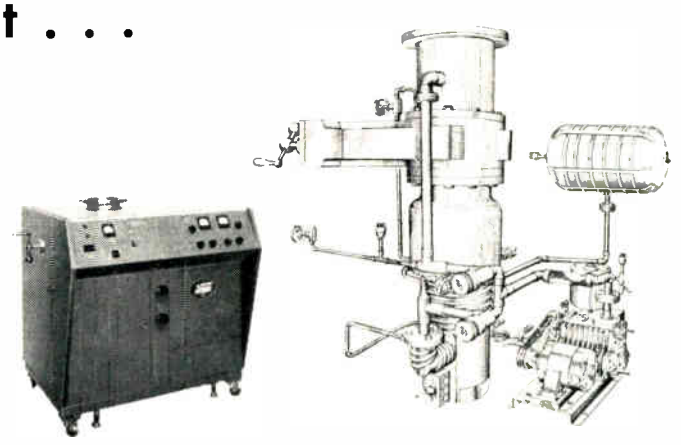
with a forward look in the field of high vacuum equipment . . .

Kinney Vacuum, the accepted leader in the manufacture of vacuum pumps is acknowledged foremost in research and development in the high vacuum industry.

This leadership is carefully guarded by constant and extensive research and development that produces the ultimate in mechanical pumps, diffusion pumps, valves, baffles, gauges, vacuum furnaces, space chambers, and complete vacuum systems.

The resources of the New York Air Brake Company and all of its divisions guarantee every Kinney Vacuum product to be efficient in operation, most modern in design, and constructed to give the maximum in service.

- PROVEN STABILITY
- EXTENSIVE RESOURCES
- DYNAMIC DEVELOPMENT



HIGH VACUUM PUMPING SYSTEM . . . KPW-6
Attractive cabinet design requires less floor space, cabinet and frames are of unitized construction with formica work surface. Accurate pressure readings on ionization-thermocouple gauge at three positions. New line of components includes high speed oil diffusion pump mated with dual-coolant ultra-high vacuum drum baffle. These components allow straight through pumping resulting in rapid evacuation to below 1 x 10^{-6} torr., ultimate pressure less than 5 x 10^{-7} torr.

KINNEY VACUUM DIVISION THE NEW YORK AIR BRAKE COMPANY
3529 WASHINGTON STREET • BOSTON 30, MASS.

Personals

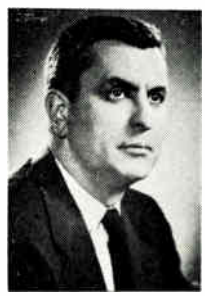
Charles E. Roessler, Jr.—named Production Manager, Omnitronics, Inc., Phila., Pa.

Morris Cohen — appointed Microwave Dept. Head, Products & Components Div., PRD Electronics, Inc., Brooklyn, N.Y.

Dr. Phimister B. Proctor—named Director of Product Assurance, Hughes Aircraft Co.'s Aerospace Group, Culver City, Calif.

William H. Hudson—named Manager, Television Products Development, Electrical Products Div., Corning Glass Works, Corning, N.Y.

Dr. H. William Welch, Jr.—appointed Head, Solid State Systems Div., Motorola Inc., Phoenix, Ariz.



Dr. H. W. Welch, Jr.

Dr. T. A. Longo

Dr. Thomas A. Longo—appointed Director of Research and Engineering, Semiconductor Div., Sylvania Electric Products Inc., Woburn, Mass.

Thomas M. O'Donnell—appointed Manager, Systems Applications Dept., Data Systems Div., Litton Systems, Canoga Park, Calif.

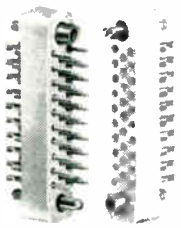
B. Cletus Kirchner—named Production Manager, Thyratron and Rectifier Div., National Electronics, Inc., subsidiary Eitel-McCullough, Inc., Geneva, Ill.

Chester Gadzinski — appointed to the newly-created staff position, Director of Quality Assurance, Transitron Electronic Corp., Wakefield, Mass.

James S. LaRue—named Program Manager, Motorola/Autonetics Minuteman Reliability Program, Motorola's Semiconductor Products Div., Phoenix, Ariz.

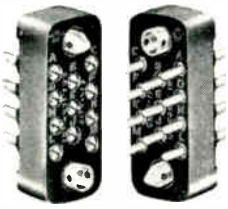
Amperex Electronic Corp., Hicksville, N.Y., announces the following appointments: **Larry May**—appointed Product Specialist, Entertainment, Semiconductor and Special Purpose Tubes; and **Martin Wolpert**—named to the position of Commercial Engineer-Semiconductors.

(*Continued on page* 72)



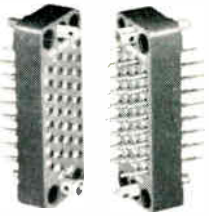
UMI SERIES. Ultraminiature Draw-Pull & Screwlock

Number of contacts
5, 7, 9, 11, 14, 20, 26, 29, 34, 44, 50
Maximum wire size .....#22 AWG wire
Current rating .....3 amps.
Also available in UMI-SL-Series



SMI SERIES—Subminiature

Number of contacts
5, 7, 11, 14, 20, 26, 29, 34, 42, 50,
Maximum wire size .....#20 AWG wire
Current rating .....7.5 amps.
Also available in SCREWLOCK SMI-SL-Series



MI SERIES—Miniature

Number of contacts
7, 12 (8-4), 14, 18, 20, 21, 26, 34, 41, 50, 75
Maximum wire size .....#20 AWG wire
Current rating .....7.5 amps.
Also available in SCREWLOCK MI-SL-Series

REMI SERIES
Standard and Screwlock

Number of contacts
7, 12 (8-4), 14, 18, 20, 21, 26, 34, 41, 42, 50, 75
Type of contact....crimp style, removable with "snap-in, snap-out" feature.
Wire sizes accommodated
#18, #20, #22, #24, #26, #30, AWG wire
REMI counterparts of our MI, MI-SL, MI-KSL, MI-BSL and MI-BMSL SERIES can be provided

the only complete source for your...

ULTRA-RELIABLE ELECTRONIC CONNECTORS

AUTOMATION
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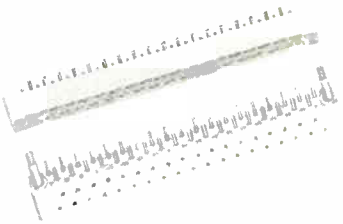
PORTABLE EQUIPMENT
PRINTED CIRCUITS
TEST APPARATUS



MPC SERIES
Printed Circuit Connector

Number of contacts 15, 23, 33, 37, 49
Maximum wire size .....#24 AWG wire
Current rating .....3 amps.

MI-BSL "FBI" SERIES
Miniature Bracket Screwlock

Number of contacts
34, 41, 50, 75, 123, 150, 225,
Maximum wire size .....#20 AWG wire
Current rating .....7.5 amps.

UPCC SERIES
Printed Circuit Connector

Number of contacts 7, 11, 15, 19, 23, 32
Maximum wire size .....#20 AWG wire
Current rating .....7.5 amps.
Also available in Screwlock UPCC-SL & UPCC-SLH Series

MH SERIES—Miniature Hex

Number of contacts 4, 5,7, 9
Maximum wire size .....#20 AWG wire
Current rating .....7.5 amps.

990 and 990S POWER SERIES
Standard and Short Contacts

Number of contacts 7, 10, 15, 18
Maximum wire size .....#16 AWG wire
Current rating .....13 amps.
Also available in Screwlock 990-SL-Series

UPCR & UPCR-D
Printed Card receptacle

Number of contacts
(Beryllium Copper) 6, 10, 15, 18, 22 per row
Current rating .....5 amps.
Type of contact—Solder type, Taper tab, Wire wrap

SPECIAL FEATURES: Side or rear cable entrance hoods available. Alkyc, Melamine or diallyl phthalate molding compounds.

- Other U.S.C. products are available such as pressure seals, adapters, mounting brackets.
- Over 7000 stock sizes and types for standard and special applications.
- Special types custom-designed to meet micro-miniaturization and performance requirements.
- All connectors meet or surpass MIL-C-8384B, MIL-C-21097A and NAS 713, 714, 715. Rigid quality control with 100% inspection and testing per MIL-Q-9858. Crimping tool meets MIL-T-22520 (WEP).

U. S. COMPONENTS, INC. 1320 Zerega Avenue, N. Y. 62, N. Y. • TA 4-1600

The above items are covered by U.S. Pat. 2,658,182; 2,761,108; 2,845,603; 2,845,604; 2,853,689; 2,933,713; 2,848,702; 2,979,689; 2,909,755; 2,953,767. Additional pats. pending.

Hughes presents a unique practical new way to

STEP INTO MICROELECTRONICS

HUGHES NOW ASSEMBLES PRE-SELECTED, MINIATURE MICROSEAL* TRANSISTORS, IN MULTIPLES OR SINGLY, IN ANY INDUSTRY STANDARD PACKAGE

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HUGHES AIRCRAFT COMPANY
SEMICONDUCTOR DIVISION

*TRADE-MARK, HUGHES AIRCRAFT COMPANY

DIODES • TRANSISTORS • RECTIFIERS • PACKAGED ASSEMBLIES • ELECTRONIC COMPONENTS

Special Pliers for the Highly Specialized Electronics Field

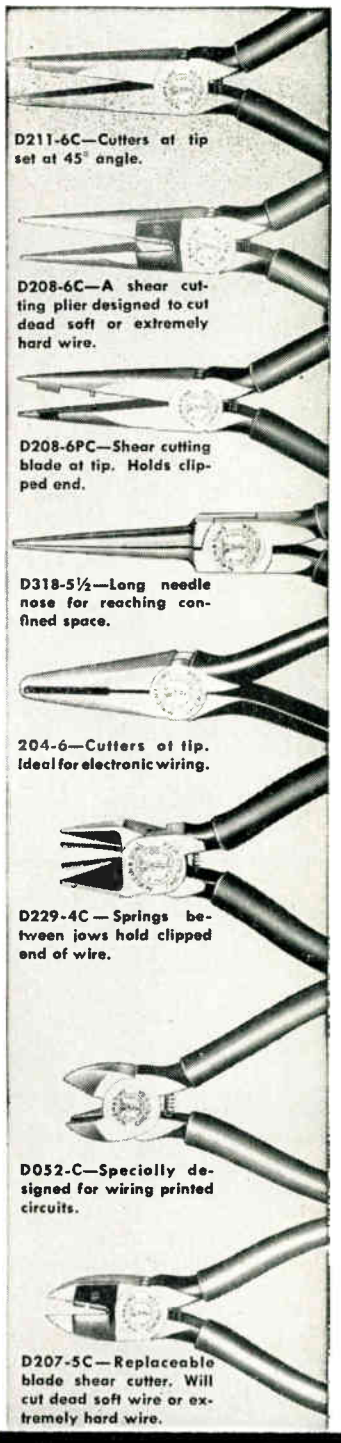
When the early transmission lines were strung in this country a century ago, it was Klein Pliers in the hands of linemen that helped do the job.

Klein has kept pace with the development of the electrical field, meeting each new challenge with tools specially designed to do the wiring job better . . . more economically.

Shown here are a few of the many highly specialized Klein Pliers carried in stock to meet the needs of electrical and electronics manufacturers.

You will find your assemblies go together more smoothly and wiring is done more rapidly when the right Klein Plier is used.

SEE YOUR DISTRIBUTOR



D211-6C—Cutters at tip set at 45° angle.

D208-6C—A shear cutting plier designed to cut dead soft or extremely hard wire.

D208-6PC—Shear cutting blade at tip. Holds clipped end.

D318-5½—Long needle nose for reaching confined space.

204-6—Cutters at tip. Ideal for electronic wiring.

D229-4C—Springs between jaws hold clipped end of wire.

D052-C—Specially designed for wiring printed circuits.

D207-5C—Replaceable blade shear cutter. Will cut dead soft wire or extremely hard wire.

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Title_____

Company_____

Address_____

City_____ State_____

Personals

(*Continued from page* 68)

Thomas Palfi—appointed Engineering Manager, Custom-Pack Div., Cornell-Dubilier Electronics, Providence, R.I.

Dr. John Doherty—named Sr. Staff Physicist, Research Section, Bendix Computer Div.'s Engineering Dept., Los Angeles, Calif.

John H. Gallichotte — appointed Product Manager, Microwave Instruments Dept., Trak Electronics Co., Wilton, Conn.

Dr. Urner Liddel—appointed Assistant Director, Research Laboratories, Hughes Aircraft Co., Malibu, Calif.

James W. Hart—named Manager, Microwave Div., Mark Products, Skokie, Ill.

J. W. Hart

F. H. Kilpatrick

Franklin H. Kilpatrick—named Manager, Electromechanical Products Div., Stackpole Carbon Co., St. Mary's, Pa.

Jefferson R. Wilkerson—named Sr. Engineering Specialist, Reconnaissance Systems Laboratory, Sylvania Electric Products Inc., Mountain View, Calif.

Dr. Nathan Schwartz — appointed Manager, Application Engineering, General Electric Co.'s Electronics Laboratory, Syracuse, N.Y.

Frank V. Summers — appointed Manager, Finishing Operations Process Engineering, Manufacturing Engineering Unit, General Electric's Silicone Products Dept., Waterford, N.Y.

Dr. Alfred J. Prommer — named Engineering Manager, Linear Beam Dept., Litton Industries' Electron Div., San Carlos, Calif.

Delco-Remy Div., General Motors Corp., Anderson, Ind., announces the following appointments: **R. J. Gilpin**—to the new post of Manager of Reliability; and **Frank M. Lucas**—named Manager, Quality Control.

Kenyon Transformer Co., Inc., Jersey City, N.J., announces the following appointments: **Walter Bein**—appointed Project Manager-filters; and **Rod Yard**—named Project Manager-delay lines.

Now available from Fairchild...

ADVANCED TEST EQUIPMENT FOR SEMICONDUCTORS

—accuracy and reliability proven by in-factory use

As a leading producer of silicon semiconductors, Fairchild has extensive knowledge of the obscure characteristics of such devices. This knowledge—combined with the day-to-day experience of solving test problems on the spot—has made it possible for Fairchild Semiconductor to produce the most advanced, practical test equipment in the industry.

SINGLE PARAMETER TEST UNITS

Beta Tester: fast, accurate, easy set-up and programming, 1μA to 10 AMP (pulsed technique). Readout range: h_{FE} from 2 to 999 (read directly). Test time of one second makes possible 100% incoming inspection.

Low Leakage Tester: go/no-go or absolute readout from digital dial settings — I_{CBO}, I_{EBO} — 1 pA to 1μA. Fast, easy operation, 1% accuracy down to 10 pA. 100% incoming inspection possible.

Automatic LV_{CEO}, $_{CER}$, or $_{CES}$ (Sustaining Voltage) Tester: Load line go/no-go. 3 tests sequentially in 100 msec. Incoming and production line inspection. Unique in the field.

EXPANDABLE MODULAR TEST SYSTEMS

Multi-Parameter Digital Tester: Starting with a digital voltmeter, power supplies and logic sections, testers may be added as needed: h_{FE} and sats, later a BV/leakage module, LV, etc. Several classifications of a single test available, such as 3 h_{FE}. 100% incoming inspection, device evaluation, circuit design studies, and reliability analysis.

AUTOMATIC SORTERS (Priority Sorting):

Transistors or diodes or combination. Fast, accurate, go/no-go, full punched card programming. Priority sorting matrix permits sorting of any combination of tests. 24 test / 1500 devices per hr. rate; increased with fewer tests. Tests include: BV, leakage, LV, V_{SAT}, pulsed DC Beta, small signal parameters, and others.

AUTOMATIC DATA LOGGING SYSTEMS

Transistor, diode, resistor, capacitor. 24 test, fast accurate, three-card punch programming. Records absolute values, including exponents. Lock-out protection. Same tests as sorters. Satisfies all requirements for quality assurance, engineering evaluation and incoming/outgoing inspection.

MICROLOGIC FUNCTION TESTER

Incorporates test modules for different types of elements tested. Go/no-go. All stages may be tested in one second.

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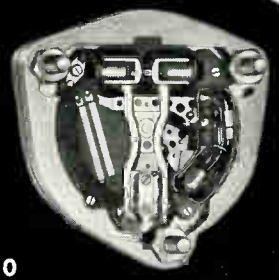
FREQ STDS

AND PRECISION FORK UNITS 1 TO 40,000 CYCLES



TYPE 10
1⅜"x1⅜"x⅜"

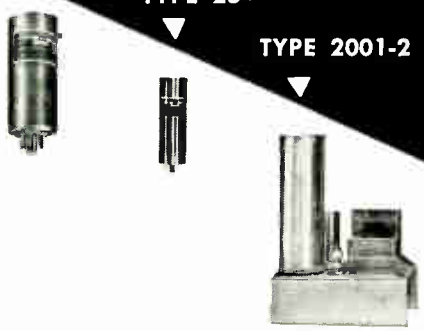
This frequency standard (360 or 400 cycles) is accurate to ± 50 parts per million at 10° to 35°C. Aging has been greatly minimized.

External power of 1.4 volts at 6 microamperes powers the unit.

TYPE 2007-6

TYPE 25

TYPE 2001-2

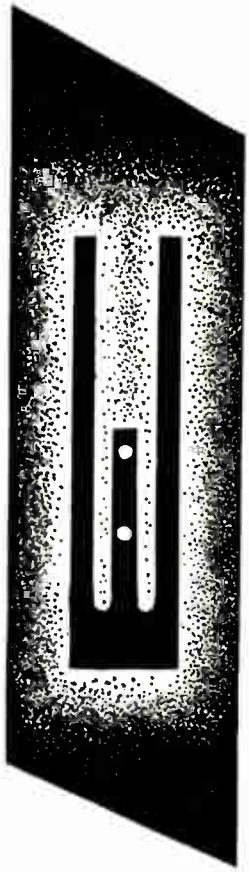


TYPE 2007-6 FREQUENCY STANDARD

Transistorized, Silicon type
Size, 1½" dia., x 3½" H., Wt., 7 oz.
Frequencies: 360 to 1000 cy.
Accuracies:
2007-6 ± 0.2% (—50° to +85°C)
R2007-6 ± .002% (+15° to +35°C)
W2007-6 ± .005% (—65° to +85°C)
Input: 10 to 30V DC at 6 ma.
Output: Multitap, 75 to 100,000 ohms

TYPE 2001-2 FREQUENCY STANDARD

Size, 3¾" x 4½" x 6" H., Wt., 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.
Accessory Modular units are available to divide, multiply, amplify and power this unit.



TYPE K-5A FREQUENCY STANDARD

Size, 3½" x 3" x 1¾"
Weight, 1½ lbs.
Frequency: 400 cycles
Accuracy: .03%, —55° to +71°C
Input: 28V DC ±10%
Output: 400 cy. approx. sq. wave at 115V into 4000 ohm load (approx. 4W)

TYPE 25 PRECISION FORK

Size, ⅜" dia. x 2⁹⁄₁₆"
Weight: 2 ounces
Frequencies: 200 to 1000 cy.
Accuracies:
R-25T and R-25V ± .002% (15° to 35°C)
25T and 25V ± .02% (—65° to 85°C)
For use with tubes or transistors.

INQUIRIES INVITED

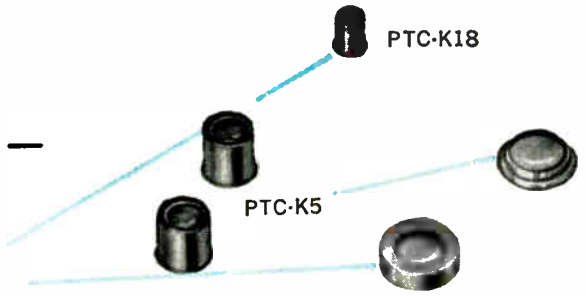
For over 20 years we have made frequency standards and precision fork units for applications where consistent accuracy and rugged dependability are vital. Shown are just a few typical examples.

Some users integrate our products with instruments of their own manufacture. In other cases we develop complete assemblies to meet special needs.

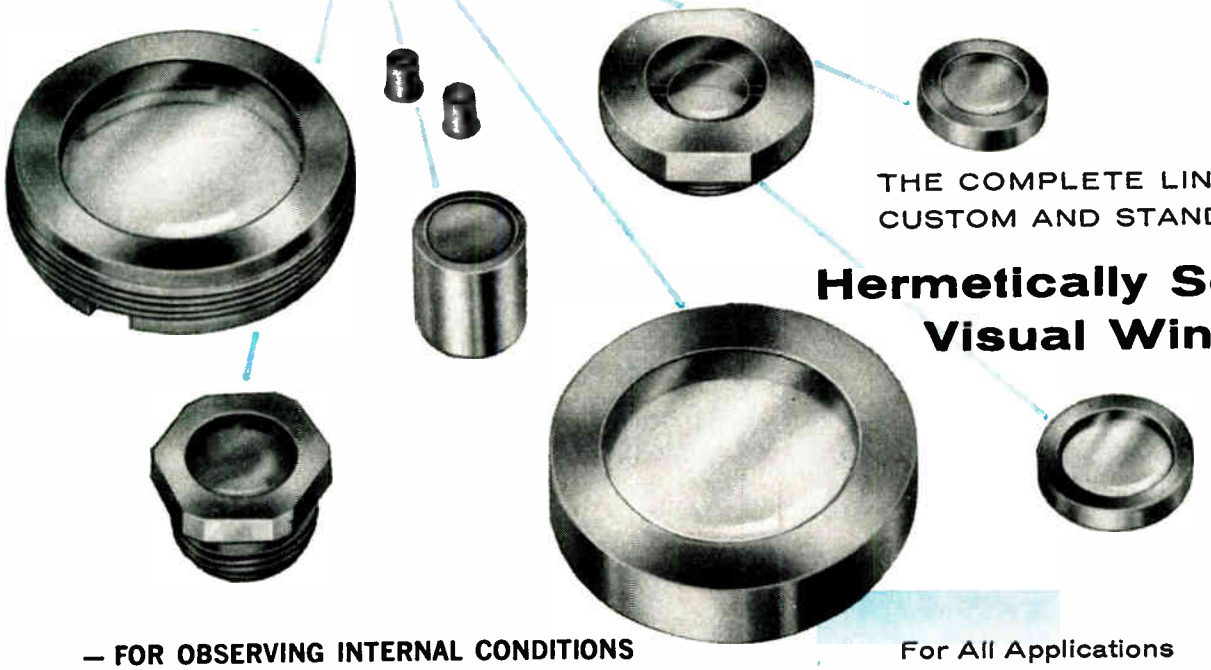
You are invited to submit any problems within the area of our activity for study by our engineering staff.

AMERICAN TIME PRODUCTS
DIV. OF BULOVA WATCH COMPANY, INC.
61-20 Woodside Ave., Woodside 77, L. I., N. Y.
WESTERN OFFICE, 234 N. LAKE AVE., PASADENA, CALIF.

New! from — E-I



CLEAR GLASS WINDOWS



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Hermetically Sealed Visual Windows

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E-I clear glass windows are manufactured to the same high quality standards that have made ELECTRICAL INDUSTRIES the industry-preferred name in glass-to-metal seals. E-I sealed windows are available in both kovar and compression types. Compression sealed windows are extremely rugged . . . meet the test of the most gruelling "space age" environments! For complete information and recommendations on specific applications, just call or write today; detailed data will be supplied to you promptly on request, without obligation.

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AIR CONDITIONERS
ENVIRONMENTAL CHAMBERS
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SPECIFICATIONS FOR STANDARD CLEAR GLASS, SEALED WINDOWS		
	MATCHED SEALS (KOVAR)	COMPRESSION SEALS (STEEL)
THICKNESS	.040" to .200"	.090" to .500"
GLASS O.D.	.150" to .300"	From .150" up

Mechanical strength up to 10,000 P.S.I. depending on design and application; various finishes available, as well as special shapes and sizes.

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Books

An Introduction to Electric Circuit Analysis

By Ralph E. Armington & Carl Volz. Published 1961 by Prentice-Hall, Inc., Englewood Cliffs, N. J. 244 pages. Price $9.00.

This is a modern, step-by-step approach to the analysis of electric circuits. Intended for use in a beginning course for electrical engineers, it establishes a firm foundation for further study in a-c circuits, electronic circuits, and network analysis. The introductory discussion of the three basic parameters leads logically through the interaction of parameters in combination, to methods of writing circuit equations, and to the solution of first- and second-order differential equations.

Electronic Digital Computers

By G. D. Smirnov. Published 1961 by Pergamon Press Ltd., Headington Hill Hall, Oxford, England. 97 pages. Price $6.50.

Translated from the Russian, this book gives an account of the mathematical fundamentals of construction of such computers as the BESM "Strela," "Ural" and M-2. Working principles are described, circuits of the individual companies and assemblies are examined and their characteristics given.

Magnetic Control of Industrial Motors, Part III: D-C Motor Controllers

By Gerhart W. Heumann. Published 1961 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 295 pages. Price $9.00.

In what is primarily an application book, controllers for industrial controllers for industrial type A-C and D-C motors are carefully analyzed and each type of motor is granted full treatment in conjunction with its associated controllers. Motor performance data for the A-C squirrel-cage, wound-rotor, and synchronous motors are presented as well as data on D-C series and shunt motors.

Semiconductor Reliability

Edited by J. E. Shwop & H. J. Sullivan. Published 1961 by Engineering Publishers, Division of the AC Book Co., Inc., P.O. Box 2, Elizabeth, N. J. 309 pages. Price $8.50.

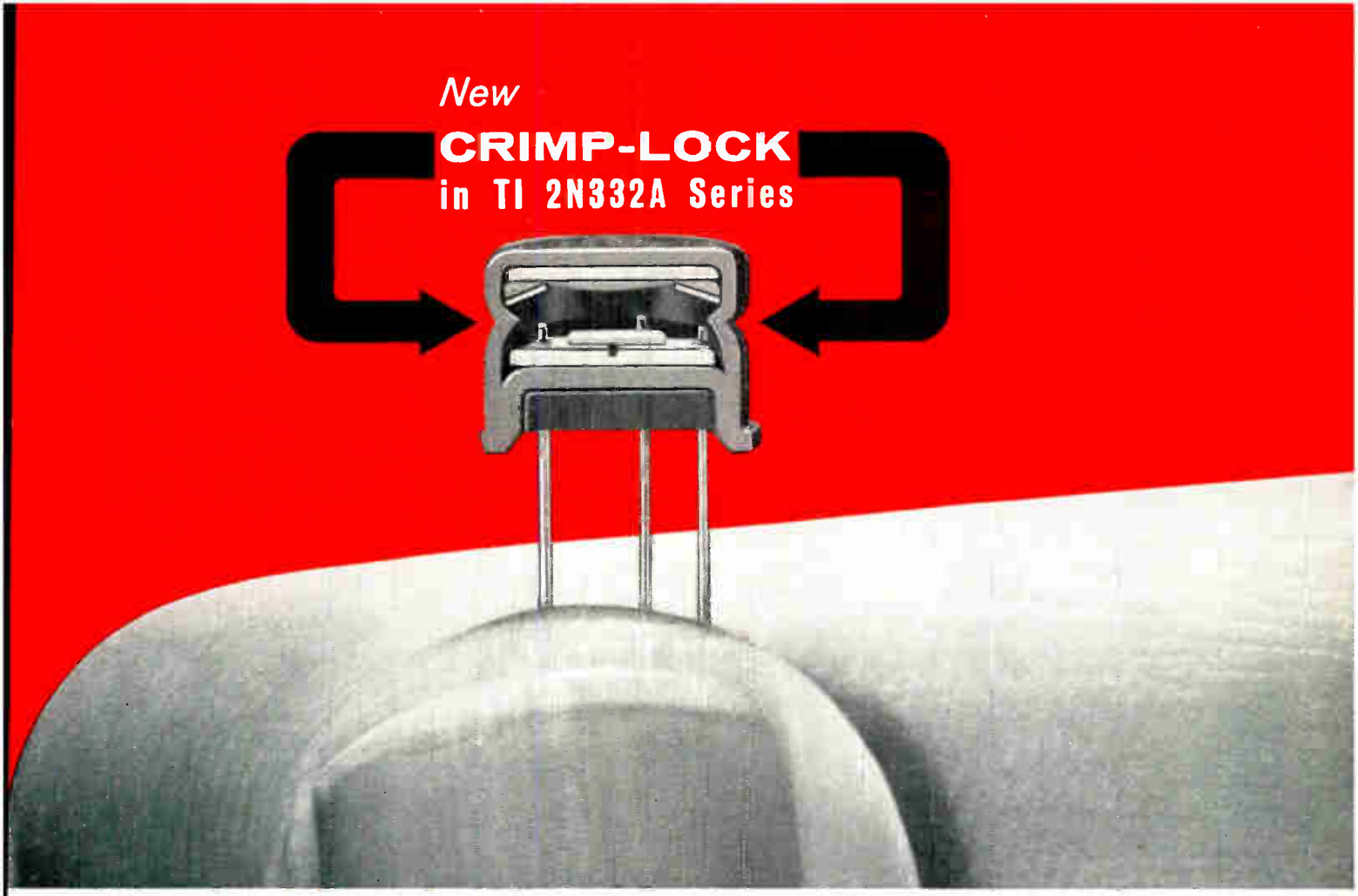
Book contents have been gathered from the laboratories of major producers and users of semiconductors. Results, analyses, and conclusions of many large scale test programs are given. The viewpoint throughout is empirical and practical, rather than theoretical.

Use of the knowledge contained here will enable engineers to specify and apply semiconductor devices with greater assurance of obtaining the required level of equipment reliability.

(*Continued on page 80*)

New

CRIMP-LOCK in TI 2N332A Series



ASSURES PROTECTION from Severe Mechanical Shock

- *Positive protection* against retaining-ring slippage is now yours with Texas Instruments 2N332A series grown-junction transistors.

The retaining ring *stays put* in TI's exclusive CRIMP-LOCK design, preventing short circuiting and assuring fail-safe performance under extreme mechanical abuse.

- *Guaranteed high-temperature stability* plus added mechanical reliability is provided with TI's ceramic base feature.
- *Immediate delivery in production quantities* . . . applications assistance . . . data sheets . . . complete statistical reliability data . . . all are yours for the asking. Call your local TI sales office or authorized TI distributor today.

TI Grown-junction Transistors with *Crimp-Lock* Design *Exceed* Military Requirements for Shock, Vibration, and Centrifuge Tests.

Improve Your Circuit Reliability with *Long-term Proven Performance* of TI Grown-junction Transistors.

- *Only TI offers over five years of life test data,* from lots that have been continuously on test for over 5 years, showing an extremely low average failure rate of less than 5×10^{-6}!
- *Over six-million life test hours* provide your greatest source for *predicting* transistor reliability.
- *Thousands of successful circuit applications* over the years testify to the *consistent* high performance of TI devices.

All at low cost, because industry's wide acceptance and use of these units enables TI to provide fast, cost-saving production in large quantities.

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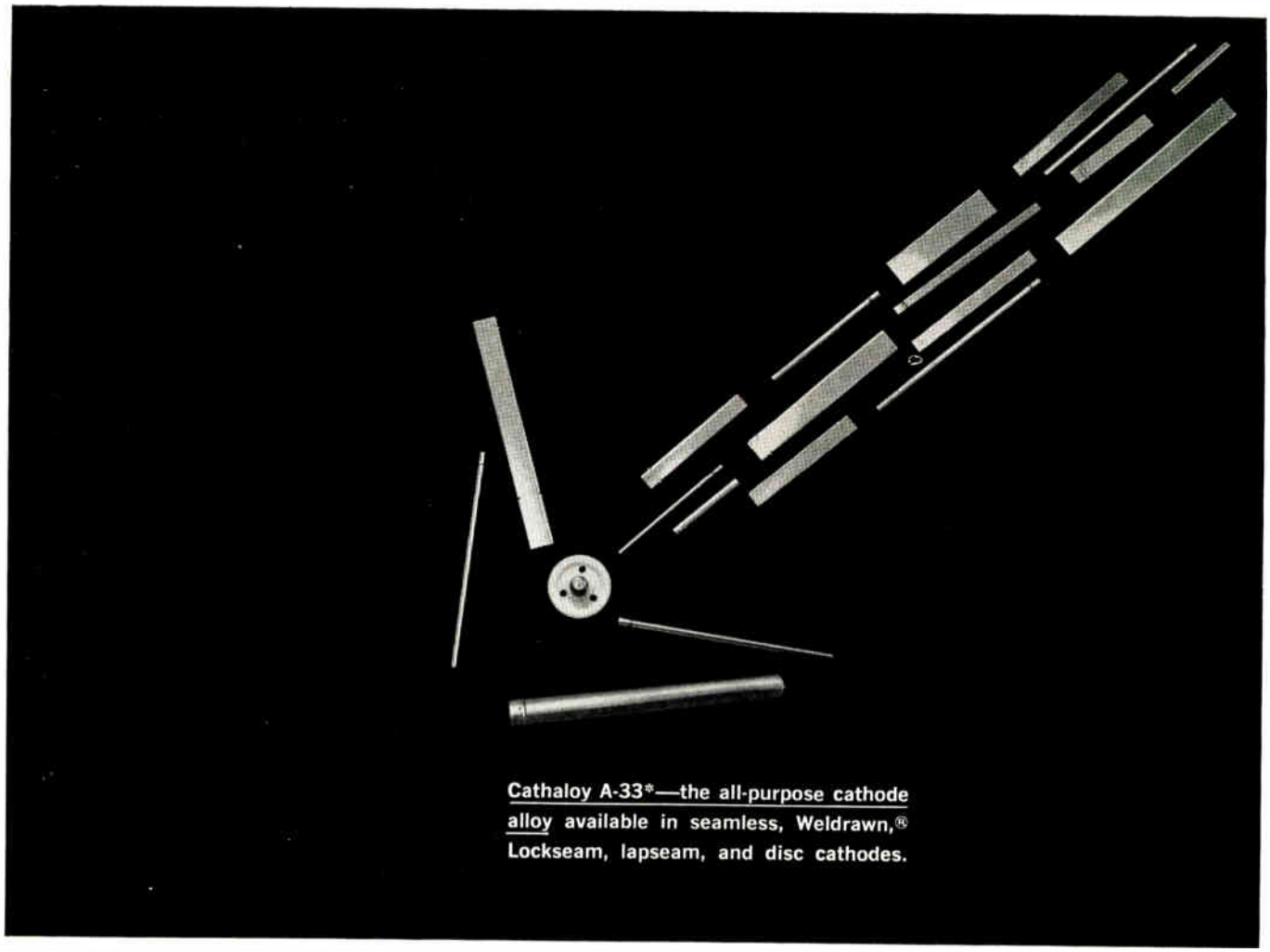

Cathaloy A-33*—the all-purpose cathode alloy available in seamless, Weldrawn,® Lockseam, lapseam, and disc cathodes.

NEW, SUPERIOR CATHALOY NAMED A-33 —PROVED IN USE FOR 2½ YEARS

Cathaloy A-33 was designed by Superior Tube to be free of the problems of interface impedance and sublimation associated with active cathode alloys and yet easier to activate than the passive cathode alloys. Laboratory tests of this tungsten-zirconium-nickel alloy proved the composition did all that was expected of it. But more evidence was wanted. So the cathode alloy was labeled experimental —X-3012. That was back in April, 1959. Since then tube-makers have tried it, confirmed the laboratory findings, and started using it in production.

Now this alloy is named Cathaloy® A-33 and is a member of Superior's family of individually controlled cathode alloys. Every heat of each Cathaloy material is tested by Superior for electron tube performance before being fabricated into cathodes for customers. Tests include activation rate, emission level, life and sublimation.

Get the complete facts on Cathaloy A-33. Write Superior Tube Co., 2502 Germantown Ave., Norristown, Pa.

*U.S. Patent No. 2,833,647 (Superior Tube Company)

Characteristics of Cathaloy A-33

1. Combines the high-emission capacity of active alloys and the long life of passive alloys.
2. Sublimation and interface impedance reduced practically to zero.
3. Twice the hot strength of ordinary nickel alloys.
4. Sustained life under high current and overvoltage abuses.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.
—an affiliated company making precision metal stampings and deep-drawn parts

High selectivity, unique convenience, extreme accuracy

hp 302A Wave Analyzer

easily convertible to a sweep oscillator-tuned voltmeter with this hp 297A Sweep Drive!

No calibration or stabilization is required with the hp 302A Wave Analyzer, a completely transistorized instrument which represents significant improvement in design. Operating as a highly selective tuned voltmeter, the instrument provides a front panel control which selects the frequency to be measured. Voltage then is read directly on the front panel meter. Basically, Model 302A separates an input signal into individual components so that each—the fundamental, harmonics and any intermodulation products—may be evaluated separately.

With the hp 297A Sweep Drive, the hp 302A is converted to a sweep oscillator-tuned voltmeter for automatic frequency response measurements, even in noisy systems. The 297A motor accessory permits sweeping the entire frequency range of the 302A, 20 cps to 50 KC; provides fast sweep for covering the spectrum rapidly, slow sweep for high resolution plot. The Sweep Drive with an X-Y recorder permits automatic plots of harmonics or intermodulation products. Model 297A attaches to the 302A panel, or may be bench mounted on an adjustable stand.

SPECIFICATIONS

hp 302A Wave Analyzer

Frequency Range:	20 cps to 50 KC
Frequency Calibration:	Linear graduation 1 division/10 cps. Accuracy ± (1% + 5 cps)
Voltage Range:	30 μv to 300 v, full scale, 15 ranges
Warm-up Time:	None
Voltage Accuracy:	± 5% of full scale
Residual Modulation Products & Hum Voltage:	Greater than 75 db down
IF Rejection:	Intermediate frequency in input signal rejected by at least 75 db down
Selectivity:	± 3½ cycle b.w. — at least 3 db down ± 25 cycle b.w. — at least 50 db down ± 70 cycle b.w. — at least 80 db down Beyond ± 70 cycle b.w. — at least 80 db down
Input Impedance:	Determined by setting of input attenuator: 100,000 ohms on 4 most sensitive ranges, 1 megohm on other ranges.
Dimensions:	20¾" x 12½" x 14½" (cabinet), 19" x 10½" x 13½" (rack mount)
Weight:	43 lbs. (cabinet), 35 lbs. (rack mount)
Price:	hp 302A (cabinet), $1,800.00 hp 302AR (rack mount), $1,785.00

hp 297A Sweep Drive

Sweep Range:	50 revolutions
Sweep Limits:	Any interval from 50 revolutions to 5 degrees
Sweep Speed with hp 302A:	170 cps/sec and 17 cps/sec
Mount:	Front panel of hp 302A or bench stand, adjustable, 4" to 12"
Price:	$275.00

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Sales representatives in all principal areas

Books

(*Continued from page 76*)

Design Manual for Transistor Circuits

Edited by John M. Carroll. Published 1961 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. 381 pages. Price $9.50.

This comprehensive manual presents a collection of tested transistor circuits which design engineers may adapt to a variety of individual applications. In nearly all cases, all component values are given, and the transistors used are commercially available.

Book contains a review of basic transistor and semiconductor theory, and discusses the use of transistors in basic circuits such as amplifiers, oscillators, power supplies and pulse circuits. There is also material on the application of transistors in equipment such as home entertainment and communications apparatus, instruments and computers. In addition, the book includes articles dealing with basic transistor circuit design philosophy, design charts and nomographs.

Books Received

Tables of Constants and Numerical Data—Vol. 12

By P. Aigrain & M. Balkanski. Published 1961 by Pergamon Press Ltd., Headington Hill Hall, Oxford, England. 65 pages.

Thermoelectricity— A Report for Business

By Graduate Students of the Harvard Business School. Copyright 1959. May be ordered from Thermoelectric Associates, 718 Garden City Drive, Monroeville, Pa. First copy $35.00. Additional copies $10.00 each.

Bibliography on Filing, Classification and Indexing Systems for Engineering Offices and Libraries

Published 1961. Order from Tonbridge Co., 39 Birchwood Rd., Glen Rock, N. J. 33 pages. Price $3.75, or $3.50 if cash or check is included with order.

Headlines and Deadlines, A Manual for Copy Editors, 3rd Edition

By Robert E. Garst & Theodore M. Bernstein. Published 1961 by Columbia University Press, 2960 Broadway, New York 27, N. Y. Price $5.00.

Transistor Electronics in Instrument Technology

Edited by Professor N. I. Chistyakov, Moscow. Published 1961 by Pergamon Press, Inc., 122 East 55th St., New York 22, N. Y. 370 pages. Price $15.00.

Progress in Ceramic Science, Vol. 2

Edited by J. E. Burke. Published 1961 by Pergamon Press, Inc., 122 East 55th St., New York 22, N. Y. 350 pages. Price $10.00.

RCA Technical Papers (1956-1960)- Index, Vol. 4

Published 1961 by RCA Review, Radio Corp. of America, RCA Laboratories, Princeton, N. J.

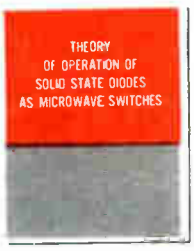
(*Continued on page 84*)

SWITCHES
> 1 watt
IN
1 nsec

PHILCO 1N3482
MICROWAVE DIODE SWITCH
IN P-901 HOLDER

Now you can design faster microwave switching, higher frequency modulation, and pinpoint-output pulsing—in smaller, more reliable packages. The Philco 1N3482 microwave diode switch—**world's fastest**—can modulate an X-Band wave or produce an extremely narrow RF output pulse.

The Philco 1N3482, as a result of the Philco microetch process, has many unusual capabilities ■ Only 100 mw turns on this 1.25W switch ■ Typically maintains 22 db isolation at 1.25W, with isolation values as high as 30 db attainable ■ Dissipation life tests show the device meets advertised performance even after 1600 hours ■ Requires **no** tuning or adjustment ■ Philco simplified holder design enables **you** to replace diodes in the same holder ■ Availability is excellent ■ For complete data on the Philco family of solid state microwave switches, circle reader service card.



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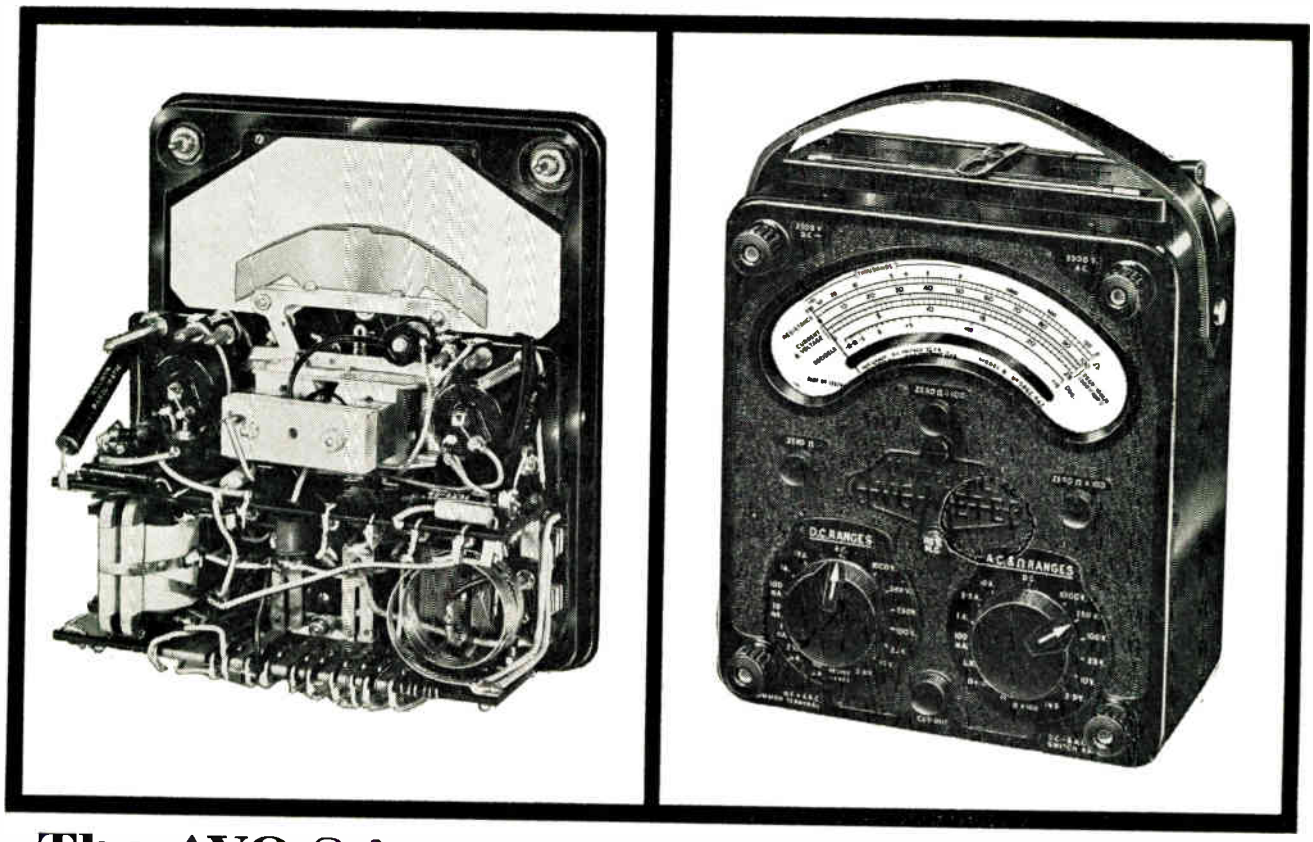

The AVO 8 is more accurate on AC, more accurate on DC–and is GUARANTEED to maintain this accuracy longer!

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SENSITIVITY

All D.C. voltage ranges are 20,000 ohms/volt and A.C. ranges 1,000 ohms/volt from the 100V. range upwards. The 25, 10 and 2.5V. A.C. ranges consume 4, 10 and 40mA., respectively at F.S.D. The P.D. measured at the terminals at F.S.D. is of the order of 0.5V. for the higher D.C. current ranges and less than 0.25V. for A.C.

ACCURACY

D.C. VOLTAGE & CURRENT

VOLTAGE: 2% of the indication from full-scale to half-scale. 1% of the F.S.D. below half-scale deflection.
CURRENT: 1% of F.S.D. over effective range.

A.C. VOLTAGE & CURRENT

2.25% of F.S.D. over effective range. (50-60 c/s). The meter maintains a high degree of accuracy for audio frequency tests up to 10 kc/s on ranges up to 250V.

RESISTANCE

3% of reading at centre scale, increasing to 10% of reading at 10% and 90% F.S.D.
D.C.–From 0.1 of scale range to full-scale value.
A.C.–From 0.25 of scale range to full-scale value.

RANGES

D.C. VOLTAGE	D.C. CURRENT	A.C. VOLTAGE	A.C. CURRENT
0–2.5 V.	0–50 μA.	0–2.5 V.	
0–10 V.	0–250 μA.	0–10 V.	
0–25 V.	0–1 mA.	0–25 V.	
0–100 V.	0–10 mA.	0–100 V.	100 mA.
0–250 V.	0–100 mA.	0–250 V.	1 A.
0–500 V.	0–1 A.	0–1,000 V.	2.5 A.
0–1,000 V.	0–10 A.	0–2,500 V.	10 A.
0–2,500 V.			

RESISTANCE (Adjustment for state of batteries is incorporated)

RANGE	FIRST INDICATION	MID-SCALE READING
0–2,000 Ω	0.5 Ω	20 Ω
0–200,000 Ω	50 Ω	2,000 Ω
0–20 MΩ	5,000 Ω	200,000 Ω

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To prove to yourself that the AVO 8 is more accurate, and maintains this accuracy longer, Avnet will send you an AVO 8 to test for 12 months under your own lab conditions. If it does not perform exactly as stated, redeliver it to us within 20 days thereafter for an immediate and full refund. Place your order immediately. Attach the coupon below to your Purchase Requisition so that your Purchasing Department will have the details of this unusual and foolproof GUARANTEE.

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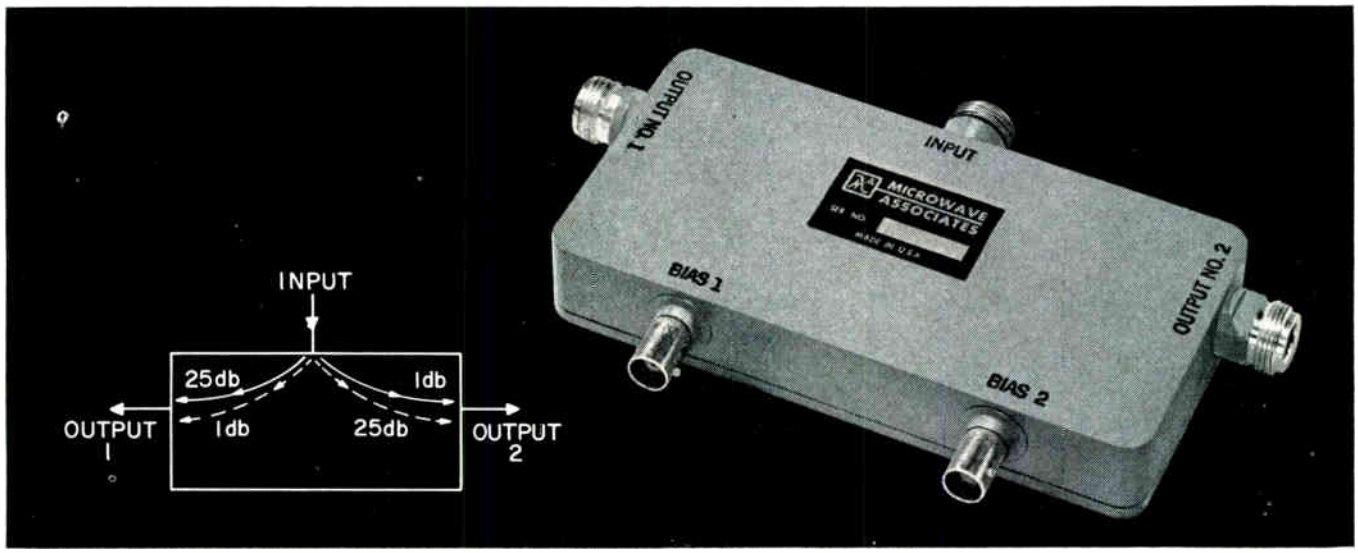

Microwave Associates has expanded its line of all-solid-state microwave devices with this new family of high power switches.

For applications at frequencies through 7 kMc, these coaxial transmission line units provide ruggedness, lightweight (units typically less than 16 oz.), and long-lived reliability which is not possible with other switching methods. The low drive power of these new units is unmatched. They provide 25 db isolation with 1 db insertion loss at 10 kw peak power, .002 duty cycle, and with typical bandwidths of 10%. Switches with higher power handling capability are currently under development.

For applications such as Antenna Lobing, Electronic Scanning of phased array antennas, High Power Modulation, and Variable Attenuation there is immediate advantage with these units.

* Since there is no magnetic field to change, these switches are inherently faster than ferrite switches. Operating temperature is from −55°C to +125°C.

Please contact Mr. Richard DiBona for specific details relating to your application.

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Books

(*Continued from page* 80)

TEACH-R-MATIC, Study Course No. TV1, Diagnoses of TV & Radio Faults

By H. G. Cisin. Published 1961 by Harry G. Cisin, Publisher, Amagansett, N. Y. Price $4.90. TEACH-R-MATIC includes study course book containing 500 multiple choice test statements on card together with scoring methods to check proficiency and progress.

Circular Slide Rule

Available from General Industrial Co., 1788J Montrose Ave., Chicago 13, Ill. free of charge. Request must be made on business letterhead. To those readers who do not qualify as an engineer or other business executive there will be a charge of $0.50.

Rod, Bar and Wire Product Information Book, 2nd Edition

Prepared by the Technical Publications Department of Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif. 388 pages. Available without cost if requested on company letterhead; otherwise a charge of $7.50 is made for each copy.

Servicing TV Remote Controls

By Sam Marshall. Published 1961 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 160 pages. Price $2.95.

Analysis of Bistable Multivibrator Operation, 2nd Edition

By P. A. Neeteson. Published 1960 by John F. Rider Publisher, Inc., 116 West 14th St., New York, N. Y. 104 pages. Price $2.90.

Computers-Key to Total Systems Control, Vol. 20

Proceedings of the 1961 Eastern Joint Computer Conference, Washington, D. C. Published 1961 by American Federation of Information Processing Societies. 380 pages. Price $12.00.

Radio Control Handbook

By H. G. McEntee. Published 1961 by Gernsback Library, Inc., 154 West 14th St., New York 11, N. Y. 304 pages, paperback. Price $4.95.

Hints and Kinks for TV, Radio and Audio

Edited by Martin Clifford. Published 1961 by Gernsback Library, Inc., 154 West 14th St., New York 11, N. Y. 128 pages, paperback. Price $2.35.

RCA Receiving Tube Manual, RC-21

Published 1961 by Electron Tube Div., RCA, Harrison, N. J. 480 pages, paperback. Price $1.00.

101 More Ways to Use Your VOM and VTVM

By Robert G. Middleton. Published 1961 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 128 pages, paperback. Price $2.50.

Data Processing Annual—Volume 3

Published 1961 by Gille Associates, Inc., 22nd Floor Book Tower, Detroit 26, Mich. 320 pages. Price $15.00.

Transistor Circuit Manual

By Allan Lytel. Published 1961 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 256 pages, paperback. Price $4.95.

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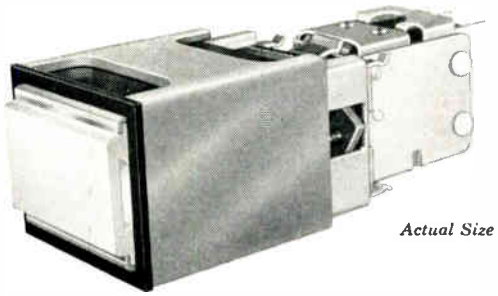

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Transient Voltages...Cause and Cure

A transient voltage can be generated whenever a magnetic component is energized, or de-energized. The peak amplitude of the spike can be many times the normal steady state peak inverse voltage, and is dependent on the amount of magnetic energy stored in the circuit and the rate of change of the collapse of the resultant flux field.

The amount of magnetic energy stored in various circuit reactances can be approximated by $L\frac{i^2}{2}$, and this energy, when current is interrupted can produce a voltage equal to $L\frac{di}{dt}$. It is apparent, therefore, that under severe load or overload conditions, a high level transient voltage with substantial energy can be generated.

In actual applications, transients are generated mainly through interruption of current by switching, although circuit characteristics and phenomena can contribute to the problem. Full advantages to be gained from silicon rectifiers are available only if they are properly applied and protected. Silicon rectifiers have low inverse voltage capabilities and thermal capacity, so any overvoltage condition, even for a few microseconds, can destroy the junction. The circuits illustrated are typical of those where problems have been found.

In addition to the three most common causes, less obvious circuits and phenomena can generate transients. Among these are minority carrier recovery, switching magnetic amplifiers, lightning or random line conditions and motor regeneration.

The problem of computing C or RC filters is complicated because of the possibility of changing circuit operating parameters or causing oscillation.

Tarzian's recently developed line of "klipvolt" selenium transient voltage suppressors, therefore, offers a relatively low cost, simply applied method of positive protection. In many applications, a "klipvolt" suppressor will reduce overall circuit cost and increase reliability. The accompanying table covers the important design factors of voltage and current that govern typical application of suppressors; however, special designs and ratings are available on request. There are two basic types of suppressors, the non-polarized for use primarily across AC components, and the polarized for use in DC load circuits. In some instances, however, it may be preferable to use non-polarized suppressors in output circuits for more positive clamping or non-interference with circuit timing or operation.

Switching in Primary—Transients are caused by interruption of "magnetic" current, or by energizing the primary and causing oscillation between inductance and distributed capacity.

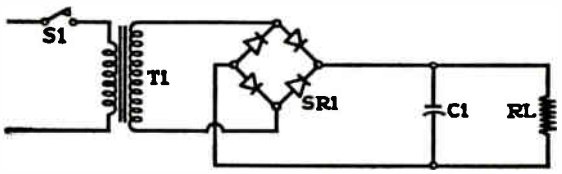


FIGURE 1

Switching Load—When the load is switched, the magnetic energy stored in the input circuit generates a voltage across the rectifiers and switch.

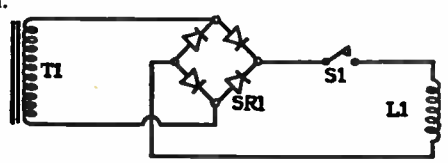


FIGURE 2

Magnetic Components on Common Line—Other magnetic components like motors, solenoids, relays or breakers can generate a transient peak when input is interrupted. The generated voltage will appear across the rectifier.

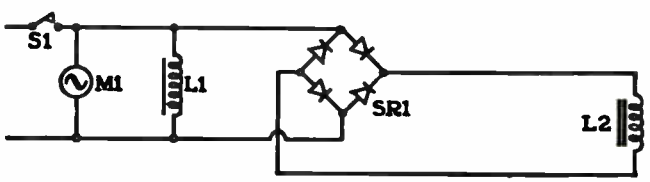
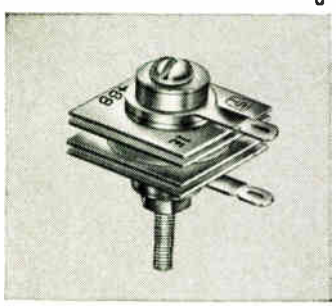


FIGURE 3

TYPICAL *klipvolt* SUPPRESSORS—SINGLE PHASE



DC LOAD CURRENT		0-35	36-55	56-100	101-110	110-200	201-350
PIV	RMS VOLTS	AMPS	AMPS	AMPS	AMPS	AMPS	AMPS
50	35	S-487	S-487A	S-487B	S-487A	S-487B	S-487C
100	70	S-488	S-488A	S-488B	S-488A	S-488B	S-488C
200	140	S-490	S-490A	S-490B	S-490A	S-490B	S-490C
300	210	S-492	S-492A	S-492B	S-492A	S-492B	S-492C
400	280	S-493	S-493A	S-493B	S-493A	S-493B	S-493C
500	350	S-494	S-494A	S-494B	S-494A	S-494B	S-494C
600	420	S-495	S-495A	S-495B	S-495A	S-495B	S-495C

TYPICAL THREE PHASE SUPPRESSORS

DC LOAD CURRENT		0-60a		61-115a		116-200a		201-450a	
PIV	RMS VOLTS	H.W.	BR	H.W.	BR	H.W.	BR	H.W.	BR
50	35	S-539	S-539	S-539	S-539A	S-539A	S-539B	S-539B	S-539C
100	70	S-540	S-540	S-540	S-540A	S-540A	S-540B	S-540B	S-540C
200	140	S-542	S-542	S-542	S-542A	S-542A	S-542B	S-542B	S-542C
300	210	S-544	S-544	S-544	S-544A	S-544A	S-544B	S-544B	S-544C

Note: All types without suffix letter use plates 1" square; with "A"—1¼", with "B"—1.6"; and with "C"—2" square. Length depends on voltage rating and varies from 1⅜" to 4¾".

Write for complete "klipvolt" application information.

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Other materials exhibited at the Arnold Booth will include Silectron C, E and O cores; tape wound cores of Deltamax, Square Permalloy, Supermendur and other high-permeability alloys; Mo-Permalloy powder cores, iron powder cores, piezo-electric and ferro-electric ceramics; and laminations, cans and shields from our Pacific Division.

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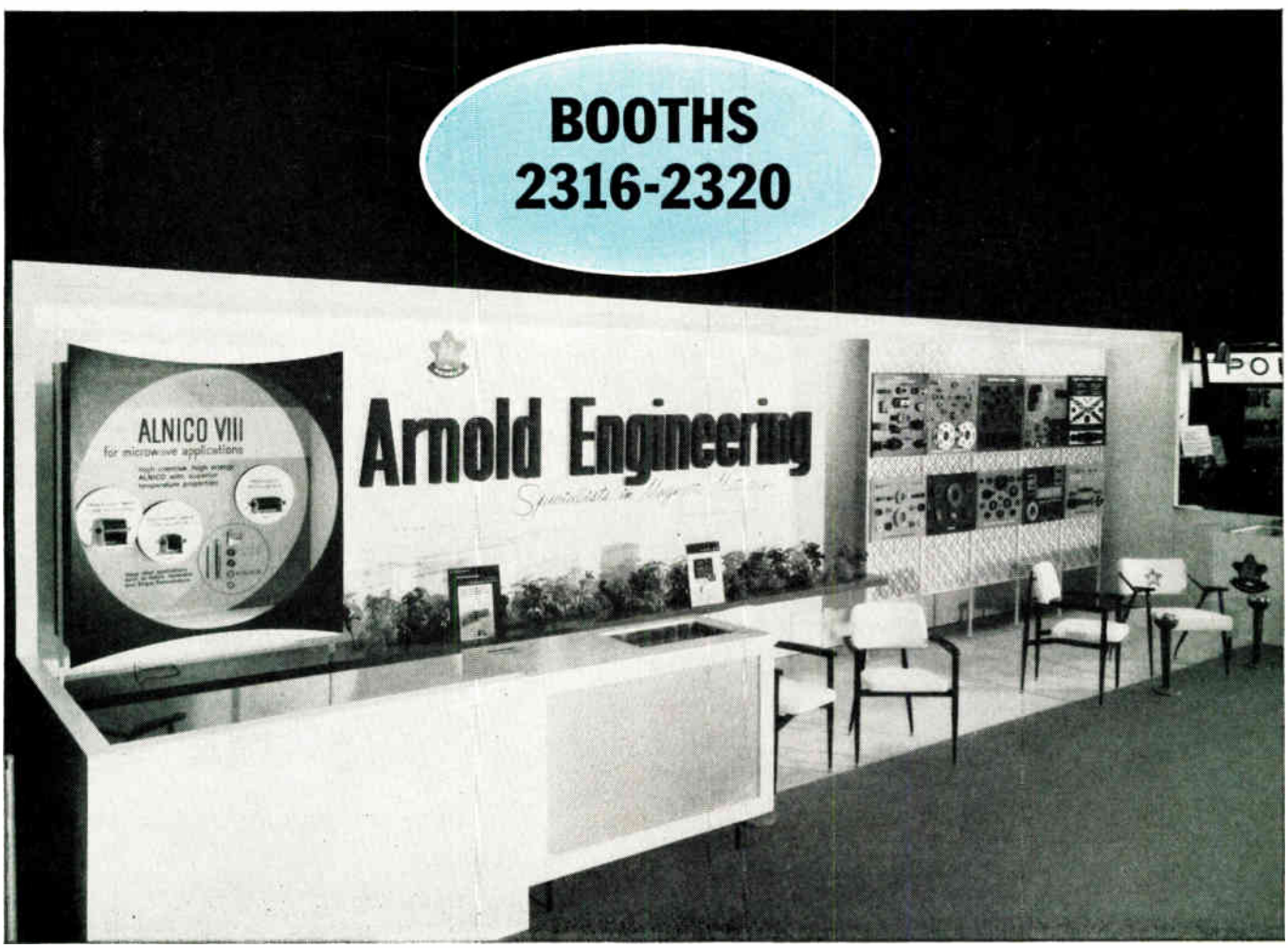

HOW 6 TRANSISTORS CAN WORK 7 TIMES HARDER WITH ONLY HALF TRYING

(a report from Delco Radio)

Sound like a riddle? Well, it was . . . almost. Here's the story.

Delco Radio engineers wanted to build a precision static inverter that was smaller, simpler, lighter, more economical and considerably more powerful than previous models.

Research hit on the idea of current feedback. Following this principle, the engineers designed an amazing inverter using only 6 transistors. Transistor utilization is stepped up 7 times, yet the transistors work at less than 50% of their capacity, run cooler, last longer.

SEE YOU AT IRE SHOW, BOOTH 1423

This new Delco 250 VA power supply converts 28 volts DC to 115 volts, 400 cps. Its circuits are a model of simplicity.

The unit is designed for continuous full-load operation at 71 degrees C. still air, yet weighs only 10 lbs., measures 6¼" x 7⅜" x 5". A minimum of components assures extra-high reliability.

The 250 VA Static Inverter is practical hardware today, awaiting your inquiry. Delco Radio may be able to solve your problem in miniaturization, modules, inverters or converters, too. Write to Delco Radio Military Sales Department, Kokomo, Indiana.

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SPLENDAR SIZE RELIABILITY

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Next month

FIELD INTENSITY METER CHARACTERISTICS

What's the difference between a field intensity meter and an ordinary radio receiver? This question is not as simple as it appears; but, this article will give the clear relationship between them, as well as detail the meter's functions and special characteristics.

EQUIPMENT DESIGN AND PACKAGING FOR NUCLEAR EXPOSURE

This is the fourth and final article in our planned series on nuclear radiation effects outside of the blast and heat zones. Answered in this report are such vexing problems as the location of susceptible items and how to properly package equipment with radiation resistant materials. Design considerations to increase immunity to radiation are also tendered.

TUNNEL DIODE AMPLIFIER GAIN

Despite the wealth of literature already published on power gain delivery by a two terminal passive device, the specific derivation of this power gain is not too readily found. This article will present that derivation for ordinary, available, and insertion power gain.

LOW COST POWER SUPPLY FOR ELECTROLUMINESCENT LAMPS

A highly efficient power supply has been developed that promises to be easier to fabricate and less expensive than previous designs. Many of the expensive and bulky components formerly used have been eliminated and low gain transistors can be used.

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COMING SOON

THE 1962 ANNUAL ALL-REFERENCE ISSUE

The fifth consecutive annual edition containing year-round technical reference material for electronic engineers. The editorial staff is already at work compiling and selecting data for this issue. Suggestions from user-readers for new topics and compilations to be included will be given careful consideration.

Watch for these coming issues:

***JUNE**
All-Reference Issue

***AUGUST**
Annual WESTERN Issue

***NOVEMBER**
Annual MICROWAVE Issue

Missiles and aircraft have made great strides in the last 10 years—but so have components! How else could the space vehicles have done it? Here's some realistic information on precision potentiometer advancements —and what you should know about stock and special units.

What to know about . . .

Severe Environmental

DURING the last decade, great strides have been made in aircraft and missiles. These gains have demanded electronic components that perform under more severe environments. Creation of these specially designed components has led to considerable improvement in the design of more standard components.

Higher operating temperature, vibration, acceleration, and shock—these are the areas of greatest environmental severity increase. This applies to precision multiturn and single-turn as well as trimming potentiometers. The ability to perform reliably in a given environment will vary among types as well as among designs. Component reliability depends very much on the basic unit design; also, it depends on manufacturing and testing processes.

Many factors should be considered when selecting a potentiometer. Let's discuss what has been achieved in the environmental area of potentiometer use. This will guide the designer in selecting standard or special units.

Operating Temperature

A decade ago the standard operating temperature was 85°C. Demands for high temperatures pushed this to 125°C for off-the-shelf pots. Special units work at 260°C.

With minor changes—high temperature lubrication, lead wires, solder, etc.—standard models operate in the 150°C to 175°C range. Some off-the-shelf trimmers operate in the 135°C to 175°C range.

The equipment designer must also consider the rise due to potentiometer power dissipation when determining maximum temperature. Normally, temperature rise/watt is stated by the maker.

Another factor: the manner in which the pot is mounted with respect to the mounting method used to determine its power rating and heat dissipating characteristics.

The most common method of mounting for precision multiturns and single-turns is on a 4 in. square, 0.050 in. thick steel plate, in still air. Some trimmers are rated by suspending them in still air without a heat sink; thus, the rating could be increased considerably if they were mounted on a good heat sink.

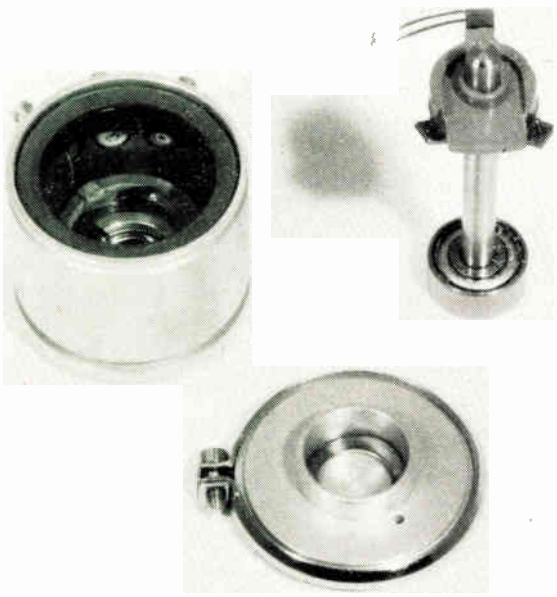
The heat sink and power rating method considerations are important when the temperature rise due to power dissipation contributes significantly to the total operating temperature. When the ambient temperature is equal to, or nearly equal to, the total operating temperature, these considerations diminish in significance.

Where very high operating temperatures are required for short periods, the manufacturer should be consulted. A complete knowledge of the materials and processes used in a component is necessary to make such judgments.

Vibration, Acceleration, and Shock

The increase in vibration, acceleration, and shock has been dramatic. Vibration frequency requirements have changed from 10-55 CPS to 10-2000 CPS with accelerations as high as 20 g's. Shock accelerations have increased from 15 g's to 100 g's in some cases. Acceleration requirements were extremely rare a dec-

Fig. 1: The contact, though a single piece, is designed to have two or more contact points with the resistance element. This helps to increase reliability of noise free operation in all environments.



This report is one of a series being developed by the Reliability and Applications Committee, Precision Potentiometer Manufacturers' Assn., 27 East Monroe St., Chicago 3, Ill.

By JOHN ARNOLD
Engineering Manager-Components
Borg Equipment Division
Amphenol-Borg Electronic Corp.
120 South Main St.
Janesville, Wisc.

Potentiometer Applications

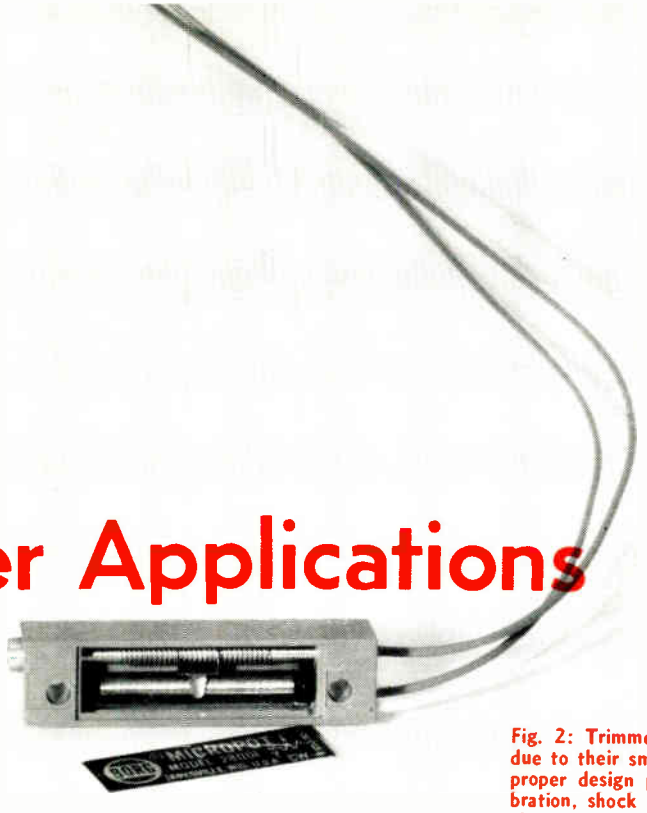


Fig. 2: Trimmers such as this, due to their small size and the proper design possess good vibration, shock and acceleration characteristics.

ade ago. Now, 50 g to 100 g requirements are common. Designing for reliable performance under these conditions has presented many problems. The main one was electrical contact maintenance during exposure.

The button type contact does not perform well in such environments due to the great mass suspended at the end of the contact spring. When a resonant condition of the spring arm is met in scanning the vibration frequency range, a contact bounce is experienced which produces electrical noise. This contact design is usually limited to 200 CPS and 10 g's. For more severe vibration requirements, the contact is usually an integral part of the contact spring arm. It is frequently made from a platinum-palladium alloy which has very good spring properties, corrosion resistance, and wear characteristics. However, it is usually more expensive to make than the button and spring arm types.

The single piece contact is often designed so two or more contact points are made with the resistance element. This multiplicity of contacts increases the reliability of noise free operation in all environments throughout the life of the potentiometer, Fig. 1.

The same rules apply to the contact design at the pickoff. This contact's function is to pick off the output signal from the rotating member. A resonance in this contact system would produce electrical noise just as the resistance element contact would; thus, its design is equally as critical. A multiplicity of contact points is recommended.

In more severe vibration uses, the shaft and its associated rotating components by resonating can induce a contact bounce resulting in electrical noise. A sufficient preloading of bearings, or otherwise restricting end play, will usually eliminate this problem.

Another source of induced contact bounce is sometimes found in the gearing used to drive the pot. The low mass contact and preloaded rotating member will give better performance in such uses also.

The method used to position the resistance element is also important.

The element should be well mounted along its entire length, preferably so that no movement of turns or elements is possible.

Trimmers, rectangular and square, by virtue of their small size are generally designed with low mass contacts, preloaded moving parts, and securely mounted resistance elements. These units thus possess good vibration, shock, and acceleration characteristics. Many standard models perform reliably at 10-2000 CPS, 20 g's vibration, and 50-100 g's shock and acceleration, Fig. 2.

Humidity and Moisture Resistance

Several test methods are used to determine the ability of a component to withstand prolonged exposure to high temperature and humidity. The *steady state type tests* are designed to show deterioration of insulation resistance due to moisture absorption by hygroscopic materials. They are accelerated tests accomplished by the continuous exposure of the specimen to high relative humidity at elevated temperatures.

Cycling Humidity Test — Temperature cycling is added to the high humidity to alternate periods of condensation and drying. This tends to accelerate the development of the corrosion by-products and also produces a breathing action of moisture into partially sealed units. Low temperature and vibration subcycles are added to accelerate deterioration caused by freezing moisture. The vibration tends to widen any cracks or fissures.

Insulation material degradation is shown by a measure of the insulation resistance and dielectric withstanding voltage. Electrical noise tests reveal the presence of corrosion effects on the resistance element.

Moisture Resistance Tests—To the cycling humidity is added a polarizing voltage across the insulation

Potentiometers

(Concluded)

Table 1

Thermosetting	% Absorption
Phenolic	4% - 0.1%
Melamines	4% - 0.5%
Polyesters	1.5% - 0.5%
Diallyl Phthalate	0.7% - 0.5%
Silicone	0.5%

1 Data from Mil-M-14F requirements

Table 2

Thermoplates	% Absorption
Type 6 Nylon	1.9% - 3.3%
Type 6/6 Nylon	0.4% - 1.5%
Polychlorotrifluorethylene (Kel-F)	0.00% -
Polytetrafluoroethylene (Teflon)	0.00% -

1 Modern Plastics Encyclopedia, 1962 issue

to study the effects of electrolysis; electrical loading is specified to determine the resistance of current carrying components, especially fine wires and contacts, to electro-chemical corrosion. This test is intended to stimulate in an accelerated manner the high humidity and heat conditions typical of tropical environments.

Effects of Humidity Tests on Potentiometers—The effect of the steady state tests on unsealed multiturn and single-turn pots is to decrease the insulation resistance as the length of exposure is increased. The most rapid degradation takes place early in the exposure period. Generally, it tends to approach a limit as the length of exposure increases. This limit is characteristic of the materials and length of insulation leakage paths of a particular design. The insulation materials used are normally the major factor; the moisture absorption of the material the important characteristic. Tables 1 and 2 show the relative water absorption characteristics of commonly used insulating materials. Variation in filler materials accounts for the water absorption range.

A protective coating of moisture and fungus resistant varnish is often used to improve the electrical characteristics of the more hygroscopic materials during exposure to humidity.

The steady state humidity test usually presents no major difficulty to the standard off-the shelf multiturn and single-turn pots using good design and materials.

Temperature cycling and vibration sub-cycles do not normally effect the ability of the standard units to reliably withstand the conditions of test. Sometimes, difficulty is encountered if a particular design is nearly, but not completely, sealed. This can result in the breathing in of the heated humid atmosphere. The somewhat restricted escape causes the condensation of the atmosphere during the cooling phase of the cycle. Thus, after repeated cycling, the component tends to fill with water. There are two solutions to this problem. They are: either open the unit so that sufficient breathing takes place; or, seal it so that no intake of the humid atmosphere occurs.

To open the unit, just refrain from attempting to seal around the control shaft and normal case seams. This permits sufficient breathing and prevents accumulation of condensed moisture within the component. This is normally the most desirable solution.

When a polarizing voltage is added to the humidity cycling test, the most reliable approach is to seal the component. If the unit is sufficiently sealed so that there is no evidence of leakage when immersed in a liquid, temperature about 100°C, it will reliably pass the polarizing voltage cycling humidity test.

Immersion in the heated liquid causes the air, sealed within the unit, to expand. This increases the inside pressure by about 3.7 psi. Pressure is now sufficient to force air through improperly sealed joints and seams. The test takes little time and insures proper sealing of each unit.

"O" rings, or similar devices, seal around control shafts. This usually increases the starting and running torque. For motor driven pot uses where the operating torque must remain lower than that permitted by the "O" ring, we suggest the entire assembly be within a sealed container. If this is not feasible, it is at least desirable to have the shaft seal provided by the gear box to which it is mounted—the remainder of the pot and the gear box being sealed.

Quality and Reliability

Quality control of production units intended for severe environmental application is of prime importance.

Statistical methods can be used for this purpose in quantity produced items. For small quantity special units, the sample size becomes economically unreasonable to follow this plan. We have approached this problem by making an analysis of the probable failure modes based on design and use.

The character of potentiometer failure is mainly one of infant mortality, i.e., most units that fail do so early in their service life. Units which pass this point will with high reliability continue to function until a wear out condition is approached. Thus, to increase reliability where a few units are concerned, the elimination of infant mortality failure would be most productive. To serve this purpose on two specific uses, tests simulating the actual operating environment were set up for 100% of the production units. Test duration was set so errors in manufacture would show without sacrifice of the long-term life expected.

Both units were designed for high temperature and vibration in flight vehicles. Here, the similarity ceases; one to be used in an aircraft turbine engine where the environment would be experienced for thousands of flight hours; the other for a missile for which the entire flight time would be well under one hour.

The acceptance tests were similar in that both were subjected to vibration scanning more severe than would be encountered and to high temperature exposure. The high temperature in one case was coupled with the vibration testing and, in the other, with a short period of life cycling. Complete electrical and mechanical functional tests were made after completion of the environmental tests to assure no degradation occurred.

This type of testing has been very successful in exposing units that vary from the level of quality required and thus could otherwise have been subject to failure during their operational life. As a result of our experience with these programs, we highly recommend this method of acceptance testing for severe environmental components.

Here is a method of designing flip-flop counting circuits without resorting to logical equations or switching algebra. A simple step-by-step procedure is given for a complete counter using a bistable multivibrator as a building block.

A Simplified Method of

Designing

Flip-Flop Counting Circuits

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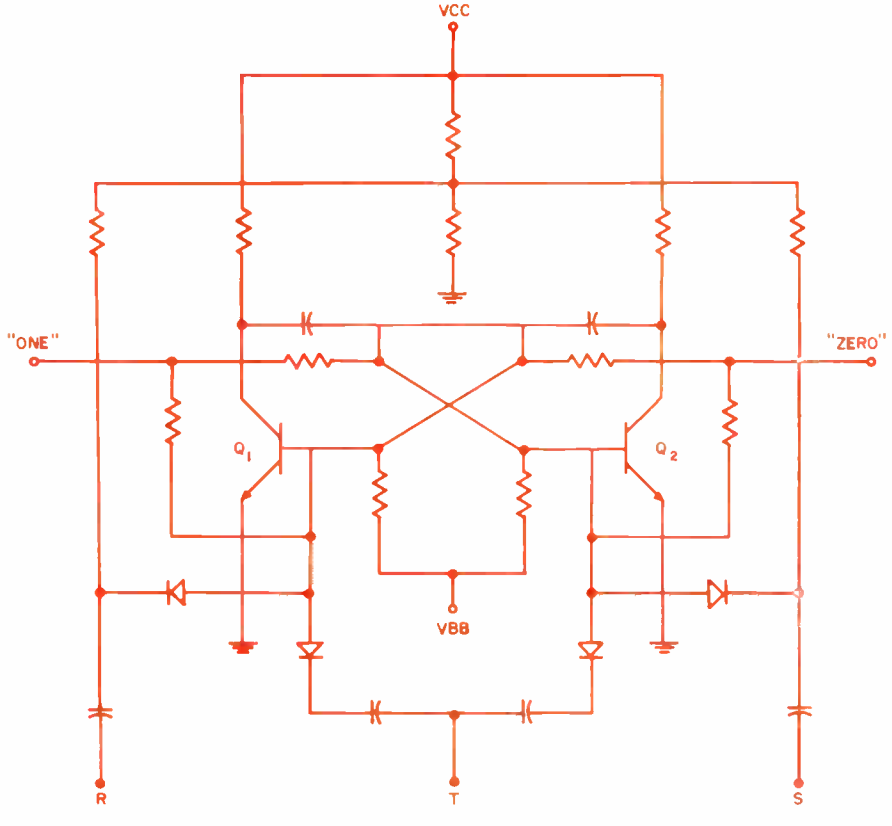
Fig. 1: Schematic of a typical transistor flip-flop suitable for use in counting circuits.



COUNTING circuits employing bistable flip-flop stages are widely used in electronic equipment design. This article describes a method for designing flip-flop counters without resort to logical equations or switching algebra. The procedure, which is based on a standard circuit configuration, is simplified by capitalizing on the cyclic properties of a binary chain. A decade counter is analyzed to illustrate the design technique.

Counter circuits, which perform frequency division of a digital pulse train, are useful in a wide variety of electronic equipment. Our purpose is to provide a simple step-by-step procedure for designing counters, using the bistable multivibrator (flip-flop) as a building block. The discussion which follows may also be found pertinent to the design of counters using bistable magnetic devices.

A typical transistor flip-flop suitable for use in counting circuits is shown in Fig. 1. Techniques for

Flip-Flop Design *(Continued)*

designing this type of circuit are discussed in detail in recent literature.[1, 2] The various input and output terminals of the flip-flop have been labeled for future reference. The collector of Q_1 is labeled as the "one" output, while the Q_2 collector is designed as the "zero" output. Terminal T is the transfer input; a pulse train applied at this terminal will cause the flip-flop to alternate between its stable states, producing an output for every 2 input pulses. Terminals S and R are the SET and RESET inputs, respectively. A negative-going pulse at R will turn Q_1 off. Similarly, a negative-going pulse at S will turn Q_2 off.

When the flip-flop is operated as a frequency divider, a single output terminal determines the state of the device, and is used to transmit a trigger pulse to the next counter stage. In the circuits which are discussed below, the "zero" output is used for this purpose. While transistor Q_2 is conducting, the flip-flop will represent a binary "O". Conversely, when Q_2 is cutoff (Q_1 conducting) the circuit will represent a binary "1". The "O" state is indicated by a low voltage at the collector of Q_2, the "1" state by a high voltage.

To begin the design of a flip-flop counter it is first necessary to determine the number of binary stages required. For this purpose let X = the required divisor. Then the number of binary stages required is found from Eq. 1, $2^n \geq X$, where n = the number of binary stages. Obviously, if $2^n = X$, a straightforward counter can be constructed simply by cascading the required number of flip-flops. Such a counter is depicted in Fig. 2. In this case $X = 16$, and 4 binary stages are used. These stages have been numbered according to the digit represented by each flip-flop in determining the total state of the counter.[3]

In the standard configuration that has been chosen, an output is taken from the "zero" side of each flip-flop. This output is used to trigger the next stage through the T terminal. If a frequency f is applied at T_1, the output from Flip-Flop 4 will be $f/16$. The maximum input frequency (f_{max}) is determined by the switching times of the flip-flop and may reach several megacycles with proper design. The type of counter illustrated in Fig. 2 may be extended to many stages for large division ratios. However, a propagation delay is associated with each flip-flop. These individual delays are cumulative for a series connection, and the total delay may limit the number of stages which can be used without special provision for synchronizing.[4]

When the required divisor is such that $2^n > X$ in Eq. 1, a feedback counter must be used rather than the straight-through type. Feedback counters operate by using the output of one binary stage to change the state of other stages during an interval between input pulses.[5] A feedback counter can be designed by making simple modifications to a straight-through counter with the required number of stages.

To illustrate the design procedure, a decade counter will not be considered. This is a well-known circuit in which every tenth input pulse produces an output. From this definition $X = 10$ for the counter. Thus, from Eq. 1, four binary stages are required to construct the decade. A four-stage counter has already been shown in Fig. 2. It only remains to determine the modifications which will convert that circuit to a decade counter.

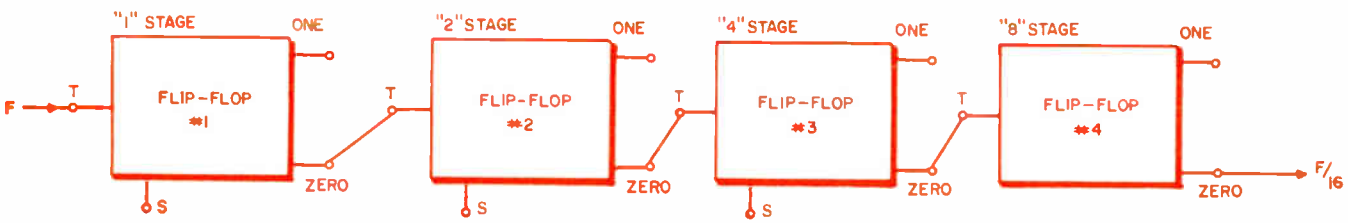


Fig. 2: Block diagram shows a straight through four-stage binary counter made possible by cascading circuit in Fig. 1.

Assuming that all 4 stages of the 16-counter (Fig. 2) are initially in the "O" state, a series of 16 input pulses will produce the sequence of internal states shown in Table 1. It can be seen that a modification which causes the counter to by-pass some of these internal states will result in a frequency division ratio other than 16. In general, the requirements for modification can be stated as follows:

$$S = 2^n - X, \text{ where: } S = \text{the number of states to be by-passed}, \quad n = \text{the number of binary states}, \quad X = \text{the required divisor} \qquad (2)$$

Since a divisor of 10 is required in the present case, $S = 2^4 - 10 = 6$. Therefore, 6 internal states must be by-passed.

The process by which internal states are by-passed is illustrated in Fig. 3. A feedback pulse is derived from the "one" side of Flip-Flop 4. This flip-flop will change from the "O" to the "1" state after 8 input pulses are received. The switching action produces a negative-going signal on the feedback line, and if

this feedback signal is applied to the SET input of the appropriate counter stages, those stages will be effectively by-passed. The last remaining step is to decide which stages should receive a feedback pulse.

To determine where feedback is needed, refer to Table 1. After the eighth input pulse occurs, the total state of the counter can be represented by the decimal number 8. By-passing 6 states is equivalent to changing the total state to 14. This can be accomplished by changing the state of Flip-Flops 2 and 3 from "0" to "1" so that the feedback line is applied to these stages. The resulting counter, Fig. 3, will now divide by ten.

From the step just completed, a simple rule can be deduced for locating the stages which must receive a SET input from the feedback line. The number S from Eq. 2 is broken into powers of two; the counter stages corresponding to those powers of two are then connected to the feedback line. In the present example, $S = 6 = 4 + 2$. Thus the "4" stage and the "2" stage are SET, as shown in Fig. 3.

Conclusion

A simple step-wise procedure for designing an X:1 divider has been described. A chain of n binary stages is constructed, where $2^n \geqq X$. When $2^n > X$, a feedback counter must be used. The feedback pulse is taken from the "one" side of the last binary stage, and this feedback pulse is used to SET stages a, b, ... p where $2^n - X = a + b + \ldots + p$ (powers of two).

Two practical circuit limitations should be noted at this point. The proper operation of a feedback counter is dependent on a minimum propagation delay in each stage, such that the feedback pulse is sufficiently delayed to arrive after preceding stages have settled in the "1" state. When fast-switching components are used, it may be necessary to add a delay element in the feedback line. The delay period must be greater than the settling time of a typical binary and shorter than the pulse repetition period of the lastest counter stage to be switched.

The last flip-flop of the counter must have a sufficiently low output impedance to trigger several preceding stages. In low-power circuits this may require the use of a buffer stage, which can also incorporate the necessary delay. Good results have been obtained by using an emitter follower driving a delay line to supply the feedback pulse.

Table 1

Sequence of Internal States for a Four-Stage Binary Counter

	Input Pulse No.	Internal States "1" Stage	"2" Stage	"4" Stage	"8" Stage	Decimal State of Counter
Initial → State	0	0	0	0	0	0
	1	1	0	0	0	1
	2	0	1	0	0	2
	3	1	1	0	0	3
	4	0	0	1	0	4
	5	1	0	1	0	5
	6	0	1	1	0	6
	7	1	1	1	0	7
	8	0	0	0	1	8
	9	1	0	0	1	9
	10	0	1	0	1	10
	11	1	1	0	1	11
	12	0	0	1	1	12
	13	1	0	1	1	13
	14	0	1	1	1	14
	15	1	1	1	1	15
End of → Cycle	16	0	0	0	0	0

Table 2

Sequence of Internal States for a Decade (Feedback) Counter

	Input Pulse No.	Internal States "1" Stage	"2" Stage	"4" Stage	"8" Stage	Decimal State of Counter
Initial → Stage	0	0	0	0	0	0
	1	1	0	0	0	1
	2	0	1	0	0	2
	3	1	1	0	0	3
	4	0	0	1	0	4
	5	1	0	1	0	5
	6	0	1	1	0	6
	7	1	1	1	0	7
	8	0	0	0	1	8
Feedback	Pulse	0	1	1	1	14
	9	1	1	1	1	15
End of → Cycle	10	0	0	0	0	0

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3. Murphy, J. S., *Basics of Digital Computers*, Vol. 2, pages 2-17. John F. Rider, Inc., New York, 1958.

4. Phister, M. *Logical Design of Digital Computers*, p. 261. John Wiley & Sons, New York, 1958.

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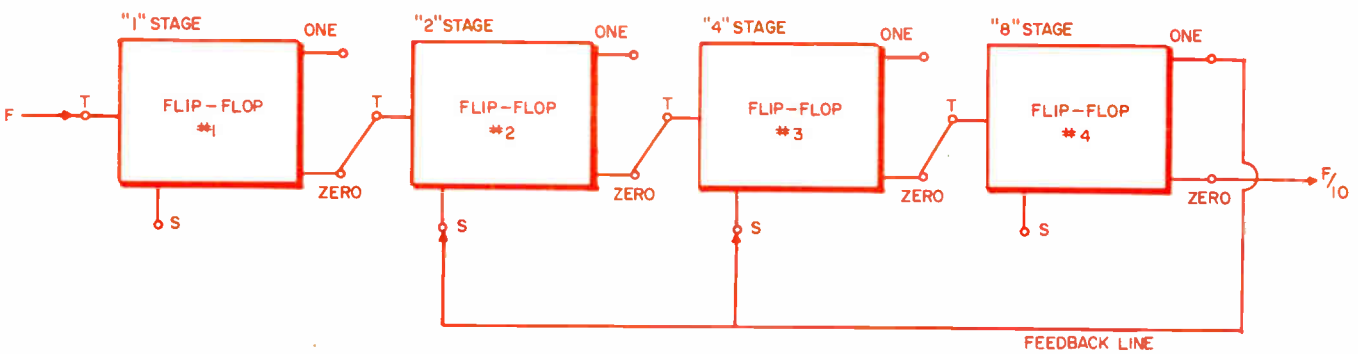
Fig. 3: Block diagram of a decade feedback counter. A process by which internal states can be bypassed is illustrated.



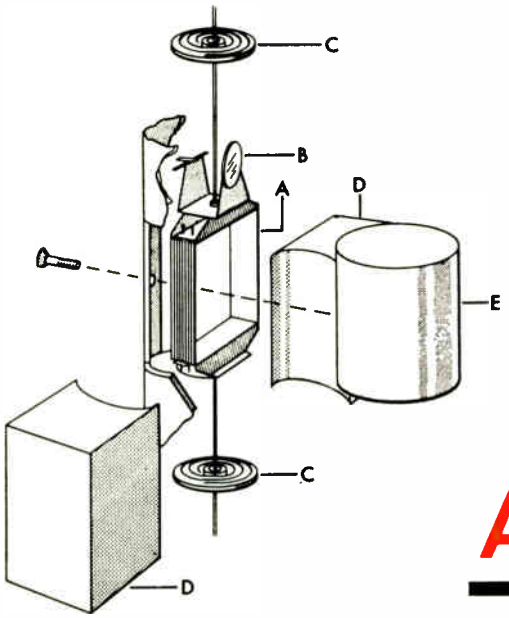


Fig. 1: Cut-away view of a bifilar meter movement showing the basic parts used. (A. Moving coil; B. Mirror; C. Disc spring; D. Pole piece; E. Core.)

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A New Suspension for

THE advent of electronics and atomic research introduced a demand for portable instruments that would measure extremely minute currents.

This requirement for extreme sensitivity brought into focus a serious limitation of the pivot-and-jewel-bearing meter movement—friction. The torques produced by very small current values are often of the same order, or only a little greater than, the torque required to overcome the bearing friction.

Thus a new approach in the design of dc measuring instruments was needed; namely, the development of a supporting system for the moving coil which would combine the merits of the friction-free suspension of d'Arsonval with the rugged and portable mounting of the Weston coil.

Bifilar Suspension

A logical solution is presented by the bifilar suspension design. As shown in Fig. 1, the moving coil is suspended on two taut wires at each end, parallel to and symmetrically disposed about the coil's axis of rotation. The opposite end of each pair of suspension wires is, in turn, precisely anchored in a tensioning spiral spring. As the meter coil rotates in the magnetic air gap, in response to the torque produced by a current flowing through the suspended coil, the bifilar wires are flexed from their parallel alignment. Such flexing of the suspension wires adds to the initial tension of the spiral disc springs as their centers move towards each other. In reverse, the tension exerted by the disc springs on the suspension wires produces a restoring torque. This tends to bring the coil back to its zero position in which the suspension wires resume their parallel alignment.

Fig. 2 shows the arrangement of the 2 suspension wires on one end of the coil, which are subject to the tensioning force F. A force, $S = F/2$ stretches each wire of the suspension. When deflected from parallel alignment, each of the 2 wires has a force component ($S \sin \delta$) in the plane perpendicular to its axis of rotation. Using the terms shown in Fig. 2, the restoring torque produced by the 4 force components is:

$$T = 4\, rS \sin\delta \cos \frac{\alpha}{2}$$

$$\text{with } \sin\delta = \frac{r \sin \frac{\alpha}{2}}{L}$$

Therefore

$$T = \frac{2Sr^2}{L} \sin \alpha$$

Here δ is the angle by which the wires are deflected from the vertical position, α is the angle of rotation of the coil, r is ½ of the distance between the suspension wires and also the radius of a circle on which the ends of the suspension wires travel.

It is thus seen that the bifilar restoring torque is proportional to the square of the distance between the suspension wires, and inversely to the suspension length L, and is a sinusoidal function of the angle α. This bifilar torque is augmented by the linear torque due to the torsional stiffness of the 4 suspension wires, which is a linear function of the angle α. For small deflections, up to 40°, the sine curve is fairly linear. Its linearity is further improved by the additional linear torsional torque of the wires. On the other hand, the sinusoidal character of the torque can be exploited to advantage in some special applications.

The sensitivity of the bifilar suspension element increases rapidly as the distance between the suspension wires is reduced, since the restoring torque is proportional to r^2. High sensitivities are attainable by close spacing of very fine suspension wires. With the absence of static friction, accurate meters with very small restoring torques can be built. Furthermore, the small coils are supported in a positive and firm manner by the suspensions, whose tension is 100 or more times the weight of the coil. The zero position of the coil is positive and independent of temperature, since

The ideal DC measuring instrument would combine the advantages of the friction-free suspension of d'Arsonval and the rugged mounting of the Weston coil—extreme sensitivity and ruggedness. A new technique—the bifilar suspension—shows promise of fulfilling this requirement.

Meter Movements

it is determined by the parallel alignment of the suspension wires. Coils supported in this manner will operate in any position.

Disc Springs

The constant tension force in the axial direction is supplied by disc springs shown in Fig. 3. These are long cantilever springs spirally folded and cut in disc form. Due to their appreciable length, these springs can have a relatively large cross section even in the most sensitive meters. As a result, they are very compliant in the axial direction perpendicular to their plane, while at the same time rigid in the radial plane. This factor permits perfect centering of the suspensions and the axis of rotation of the coil. The meter accuracy is easily maintained since it depends greatly on the constant value of the tension produced by these springs. The deflection of the springs is extremely small. The stresses are correspondingly small. Therefore, the springs never show any fatigue effects. In addition, they do not conduct any current, and therefore, cannot be affected when the meter is overloaded.

Fig. 4 illustrates the moving-coil system. Each pair of suspension wires (A) is anchored at one end to the moving coil. The other end of the wires are anchored to the disc springs, centrally located in the cylindrical housings, (B). These housings are located in the threaded tensioning units whose knurled heads, (C) are visible in Fig. 4. The cylindrical housing can be rotated for adjustment of suspension wires to

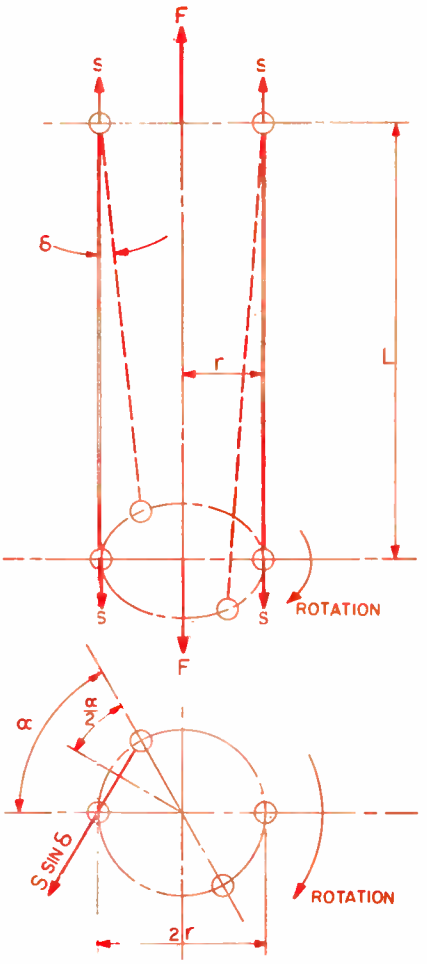


Fig. 2: The arrangement of the 2 suspension wires on one end of coil and their tensioning forces are shown.

parallelism, as well as zero adjustment of the moving coil in the meter. An exploded view is shown in Fig. 1.

Coils and Taps

The 4 suspension wires are insulated from each other and serve as 4 readily available electrical conducting leads to the moving coil. This feature permits the use of differential coils with two windings completely insulated from each other, without the use of cumbersome auxiliary conducting springs or strips, known as "ligaments." Furthermore, the moving coil can also be tapped in two places as shown in Fig. 5. This can be used to provide 3 ranges of current sensitivity without resorting to a universal shunt. Since the number of turns at each tap is inversely proportional to the full scale current corresponding to the tap, the millivolt drop across each coil section remains essentially the same for all 3 ranges.

(Continued on following page)

Fig. 3: Disc springs supply constant tension force.

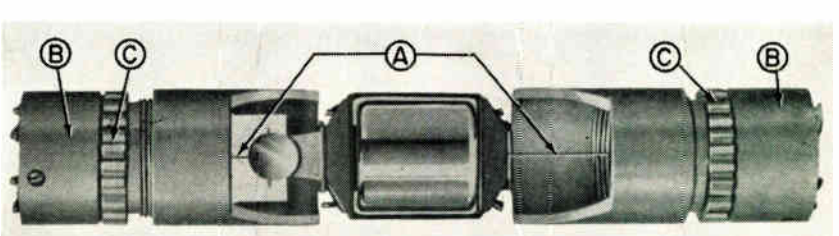


Fig. 4: The moving-coil system in its housing.

Meter Suspension *(Continued)*

This is in contrast with the condition obtained when a universal shunt across the full coil is used. Usually such shunts must have a resistance somewhat higher than the critical damping value. This value is often many times the coil resistance. In the case of highly sensitive meters, the critical damping resistance values may be several hundred times the coil resistance. When the customary universal shunt across the full coil is used to obtain additional ranges with higher full scale readings, it is provided with taps at points whose resistance is inversely proportional to the respective full scale currents. Therefore, the second and subsequent lower sensitivity ranges place a very large resistance in series with the coil (Fig. 6). In each case the full scale coil current flows through this additional series resistance and adds to the millivolt drop of the coil. Beyond the first range, all the ranges of lower sensitivity will have high millivolt drops. In the case of sensitive meters, this will be excessive, as much as 1 volt or more. High millivolt drops make current measurements in lower voltage circuits, such as transistor circuits, very difficult, often unreliable, and even impossible.

Tapped coils provide meters with 3 ranges of almost equal and very low millivolt drop. However, for meters having more than 3 ranges, where a universal shunt must be used, it can be placed across the section of the coils with the smallest number of turns, i.e., between the common and the tap with the lowest number of turns. The critical damping resistance and also universal shunt resistance are proportional to the square of the number of coil turns. Consequently, the resistance of the shunt across the smaller portion of coil will be considerably lower than that of a shunt across the full coil. If full coil current is i_1, and i_3 the full-scale current for the third step, then the respective coil turns are:

$$n_1 : n_3 = i_3 : i_1$$

and the permissible shunts would be:

$$R_1 : R_3 = n_1^2 : n_3^2 = i_3^2 : i_1^2$$

For example, if $i_3 : i_1 = 10:1$, then R_3 will only be 1% of what R_1 would have to be. Therefore, the resistance in series with the coil section for the fourth range will be approximately 1% of the corresponding resistance if R_1 were used across the full coil. The fourth range millivolt drop will be reduced to less than 10% of the drop present when the fourth tap of the shunt across the full coil is used. The comparison below, of two of the best available untapped pivot coil meters, with a tapped coil meter illustrates the advantages of tapping the meter coil. A meter with a 20 μa. full-scale sensitivity coil and ranges of: 20/100/200/500/1000 μa. full-scale has the following millivolt drops: 63/516/594/607/618/ mv. for each of the above ranges respectively. A more sensitive 5 μa. untapped coil having ranges of: 5/20/100/500/2000/10,000 μa. has the following much higher millivolt drop for each of its respective ranges: 54/1,514/1,900/1,980/1,996/2,000 mv.

On the other hand the tapped bifilary coil with full coil sensitivity of 1 μa. and taps for 3 μa. and 10 μa. and full scale ranges of: 1/3/10/30/100/300/1000 μa. has corresponding millivolt drops of: 4.8/5/5.4/38/52/56.5/57 mv. The same range sensitivity combination can be built in another model with millivolt drop starting at 1.5 mv. for the first 3 ranges, and correspondingly lower drops for the subsequent ranges.

The bifilar suspended coil type of construction can use a weightless light-beam pointer that is unaffected by overloads that would jam and ruin the conventional meter. The light-pointer provides hairline readability at any angle without parallax error. As shown in Fig. 7 a light source K, operating from a power line or from a self-contained battery, projects the light beam through an optical system G, on to mirror H mounted on the moving coil assembly. The mirror reflects the light beam as a luminous center-line oval on to the meter scale I. Sharp hairline readings are provided under any ambient light conditions, as well as in the dark.

Overload Capacity

The standard sensitive bifilary meters withstand overload surges without impairment, up to 1000 times full scale current. For extra heavy overload risk applications, a special built-in protective circuit can extend the momentary overload capacity to 10,000 times without damage.

Fig. 5: The moving coil can be tapped as shown in the drawing.

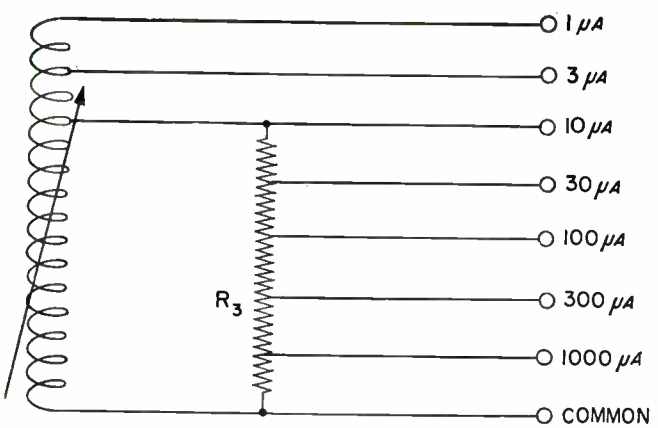
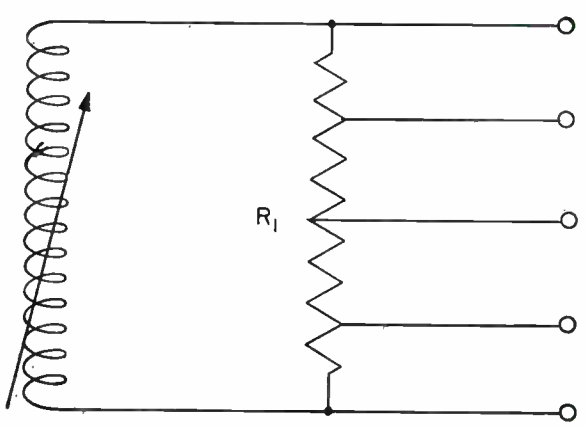


Fig. 6: Conventional meters use a large shunt across the coil.



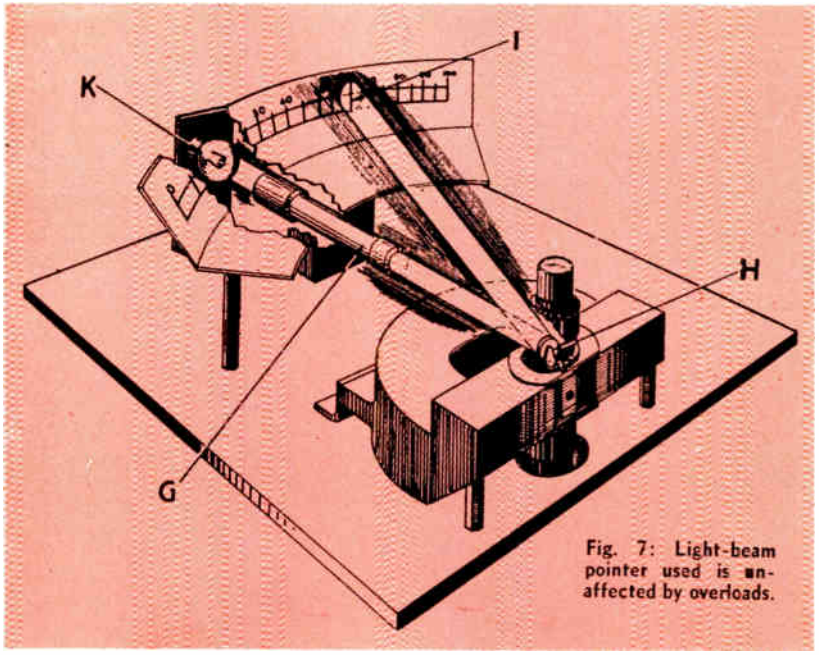


Fig. 7: Light-beam pointer used is unaffected by overloads.

As for mechanical ruggedness, the bifilar movement can take rough treatment and still deliver accurate readings. This is possible since the coil is not restrained, but limited in linear motion under the influence of shocks.

Meters with full-scale sensitivities of 1 μa. with only 1,500 ohms internal resistance can be built. The bifilar suspension is by no means limited to vertical operation. It may also be operated in the horizontal plane.

The bifilary meters with tapped coil have found very broad fields of application in research, development, production and quality control. They are especially useful in work dealing with semiconductors, such as transistors and diodes, vacuum tubes and other applications.

The high current sensitivity makes bifilar suspension meters very useful in radiation and ionization measurements. Furthermore, this sensitivity permits the building of voltmeters with very high resistance values to make them suitable in work where high accuracy, combined with very small current drain from the measured voltage source, is important. Voltmeters with resistance of 1 megohm/v up to 5 megohm/v can easily be built. The only limitation in some cases is the high cost of precision wire-wound resistors when high accuracy and stability are required.

"Miser" Ups Beam Tube Capabilities

A CONCEPT in crossed-field oscillator and amplifier design has been successfully incorporated in power tubes at Raytheon.

Called a "Beam Miser" it involves a novel type of depressed collector and circuit which permit significant increases in bandwidth, power, and efficiency without requiring extra electrodes or other changes in tube configuration or application. As such, the Beam Miser yields some of the advantages of a re-entrant electron beam in crossed-field tubes.

The device includes an electrode designed to collect a portion of the spent beam at cathode potential. Substantial improvements in the efficiency of existing types are now made possible without additional connections to the tube or additional power supplies. Operating characteristics have been confirmed by measurements on S-band tubes.

The device is also applicable to crossed-field injected-beam amplifiers (CFA's) where the improvement in efficiency can contribute to an extension of the 3-db bandwidth.

The desired Beam Miser effect is accomplished by collecting a portion of the spent beam at cathode potential, and returning it to the cathode via a conductor located inside the tube. Fig. 1 indicates function in a standard beam-type tube.

When the Beam Miser principle was designed into an M-type backward wave oscillator, the oscillator was able (under normal operating conditions) to intercept as much as 40% of the total beam current. Return of the intercepted beam current to the cathode (for a given power supply anode current) effectively increased the *total* beam current.

Raytheon's Beam Miser permits higher power output for given power input, or alternatively, lower power input for given power output.

Tubes using the Beam Miser require no external mechanical changes or additional electrical input connectors, and are directly replaceable in the same sockets as standard tubes.

Performance of an experimental Beam Miser in a BWO compares power output and efficiency obtained with and without the Beam Miser.

Similar results have been obtained with other crossed-field tubes. What is significant is that the use of the Beam Miser permits large power increases, and at the same time effectively increases

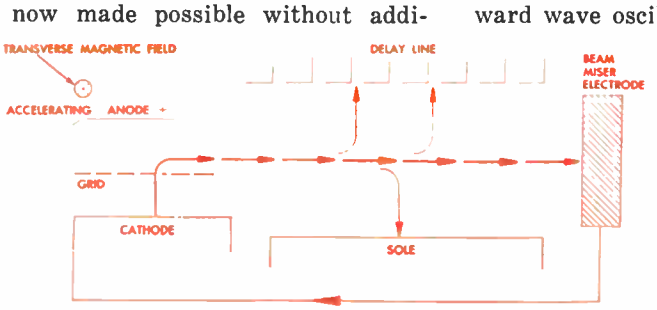


Fig. 1: Schematic of the beam miser indicates function in a standard beam-type tube.

Modern aircraft fly almost 100 times faster than the first biplanes. But most still have the same height indicator as the balloonist—a barometric altimeter. Does this meter answer all of today's needs? Or have no practical alternates been devised? Here are the answers.

Designing a CW FM Altimeter

UNFORTUNATELY, the barometric altimeter does not fulfill today's needs. And, although many electronic schemes have been devised, most have the same common failing: until now there has not been a practical transmitter tube which would perform as desired.

To understand more completely the problems encountered, let's consider the uses where accuracy is needed and the traits of various altimeters, barometric and electronic. For some flying, highly accurate height indication is paramount. For most aircraft flying at a few thousand feet, an accuracy of ± 50 to 200 ft. is reasonable. Barometric altimeters can provide this. But the pilot of a helicopter, a carrier based interceptor, a commercial jet liner, or a VTOL craft *must* know his altitude within a few feet as he nears touchdown—he may not have another chance to go around! Thus, an accuracy of ± 1 to 3 ft. at touchdown is needed.

Basic Faults

The basic fault of the barometric altimeter is that it measures air pressure, not altitude. Errors result from local variations in barometric pressure, especially during storms when the altimeter is needed most. Practical barometric instruments cannot reliably measure small pressure changes relating to a height of 2 or 3 ft. Finally, there may be a correlation error between the altimeter barometric setting and the actual pressure. All these limit the device's effectiveness even with the recent advances.

As the next choice, pulsed radar was proposed. This worked well for moderately high altitudes, 500 ft. and over, but the bandwidth needed for resolution at low altitudes is prohibitive. Since the r-f beam travels approx. 1000 ft./μsec, the total path delay at an altitude of 30 ft. is only 40 nsec. For a ± 2 ft. error or ± 10%, the time delay between the transmitted and received pulses must be identified within ± 4 nsec. This demands an i-f and video bandwidth on the order of 25 to 100 MC!

The altimeter designers then turned to FM CW altimeters. This design has proven most effective for all types of aircraft, and gives accurate readings even at touchdown. Although there have been many ingenious adaptions used, the basic FM altimeter works like this: the transmitter output is frequency-modu-

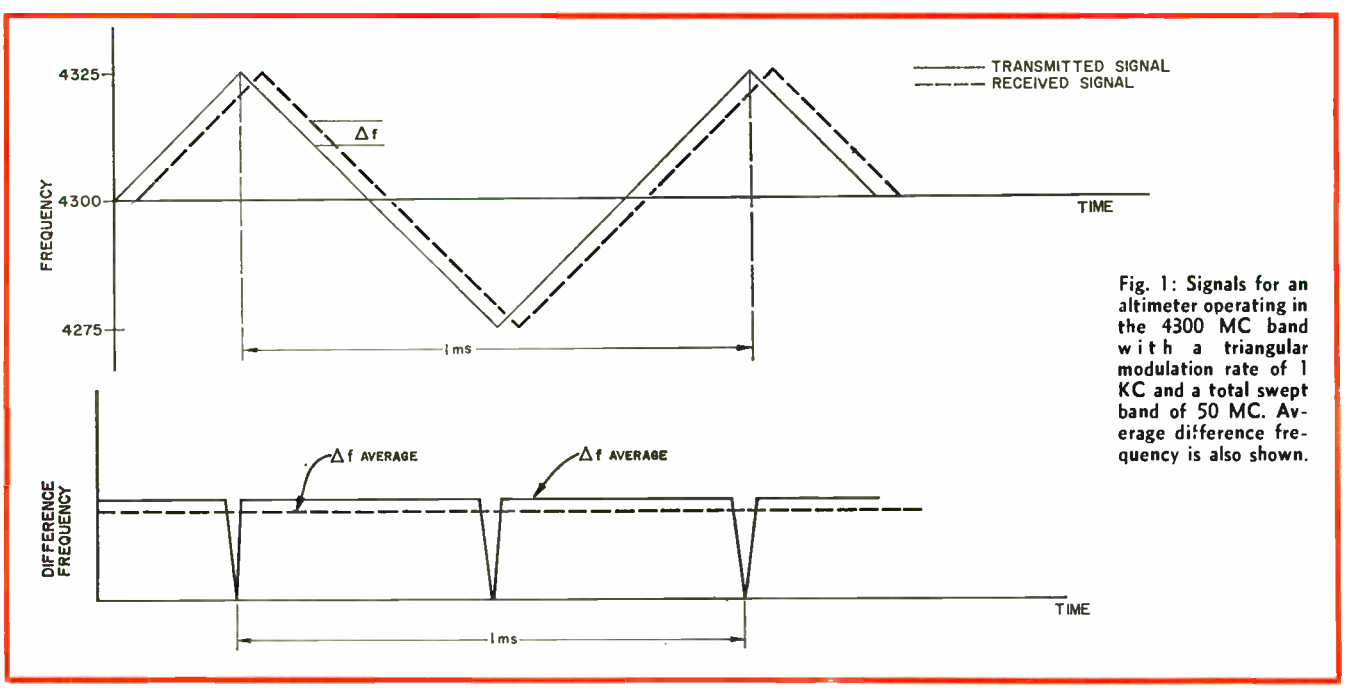


Fig. 1: Signals for an altimeter operating in the 4300 MC band with a triangular modulation rate of 1 KC and a total swept band of 50 MC. Average difference frequency is also shown.

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Transmitter

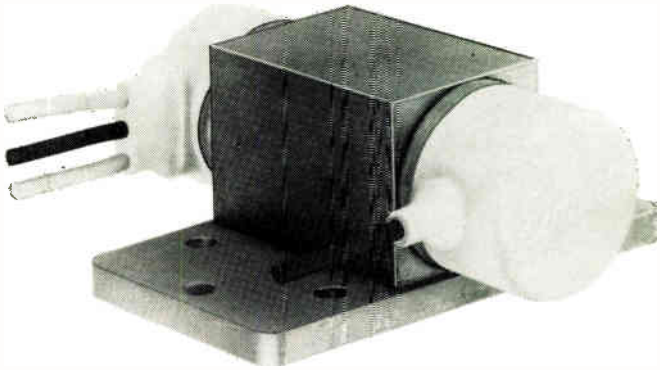


Fig. 3: This rugged, all metal and ceramic reflex klystron is fixed-tuned at 4300 MC ± 50 MC; provides 1 watt, 100 MC bandwidth.

lated in an accurately reproducible manner, usually with sine or triangular waves; then the frequencies of the transmitted and received signals are compared and the difference frequency noted. Since this difference frequency is caused by the transmitter modulation, neglecting Doppler effect, an accurate indication of time delay may be determined from the modulation characteristics, and thus the altitude found.

Other Problems

Now, let's take a closer look at the FM CW altimeter to find its problems and drawbacks. Assume an altimeter operating in the allocated 4300 MC band with a triangular modulation rate of 1000 CPS and a total swept band of 50 MC. The signals would be as shown in Fig. 1.

Feeding the received and transmitted signals into a mixer produces a difference frequency. In most designs, this difference frequency is discriminated by an averaging clipper-counter, producing the Δf_{ave} shown. This Δf_{ave} is defined as follows:

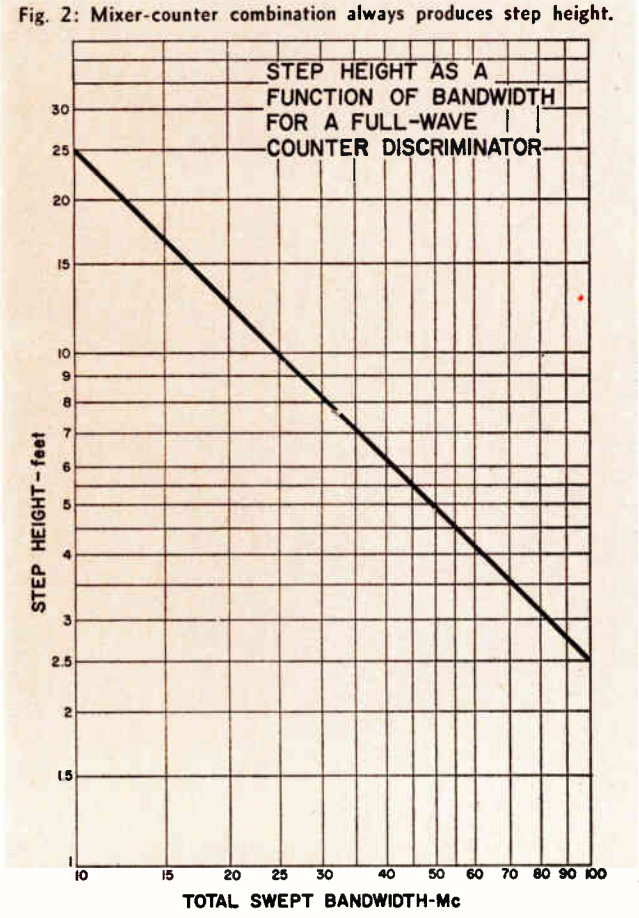
$$\Delta f_{ave} = 4 \times \frac{\text{Total Swept Bandwidth} \times \text{Mod. Freq.} \times \text{Height}}{\text{Speed of Light}}$$

If the aircraft using this altimeter were at 50 ft., the Δf_{ave} would be:

$$\Delta f_{ave} = 4 \frac{50 \times 10^6 \times 1000}{1000 \times 10^6} \times 50 = 10{,}000 \text{ cps}$$

or 200 cps/ft. of height.

Fig. 2: Mixer-counter combination always produces step height.



An important result of this design is the "step height" produced by the mixer-counter combination. Fourier analysis of this combination will show that the Δf_{ave} can increase only in multiples of the modulating frequency, in this case 1000 CPS. Since each foot of altitude corresponds to 200 CPS, this corresponds to a step height of ± 5 ft. This step height can be expressed as follows for a full wave counter discriminator:

$$h_{step} = \pm \frac{\text{Speed of Light}}{4 \times \text{Total Bandwidth}} = \pm \frac{250}{B} \text{ ft/MC}$$

This is shown in Fig. 2.

This means that the altitude readout does not increase in a continuous manner, rather it jumps in steps. In the above example, in 10 ft. steps. Thus, a step-error of this amount is always present, even if the system is otherwise completely accurate. This error is characteristic of all mixer-counter systems. It can be removed only by using some other method of continuous phase or frequency discrimination. Successful systems have been devised using such continuous discrimination, however, the basic principles are the same. The error is inversely proportional to the bandwidth. *(Continued on following page)*

Altimeter *(Continued)*

Another error can be caused by a bandwidth change, which would produce a calibration error. For example, assume that a modulation voltage of 50 volts produces the 50 MC sweep. If the modulation sensitivity changes by 10%, the bandwidth changes by 10% and the Δf_{ave} and the step-height both change. Therefore the original calibration is in error.

A final source of error is frequency jitter or "F-M'ing" of the transmitter tube, due to vibration. The instantaneous value of the difference frequency will be affected by this jitter, and if the frequency jitter is of sufficient amplitude, a change in Δf_{ave} may be produced.

Solutions

These error sources dictate the altimeter design. It must be capable of broad bandwidth, must have stable modulation characteristic, and it must be free from microphonics. All of these can be met in the modulator and receiver circuit design; but, the transmitter tube problem remains. Since the most useful and least crowded altimeter bands are in the microwave region, a velocity modulated transmitter tube is desirable. This could be a reflex klystron, a BWO, or a voltage tunable magnetron.

Unfortunately, the magnetron and BWO both have one very important drawback for an airborne system —a high-power modulator is needed. For the BWO, this problem is further compounded by the tube's exponential tuning characteristics. Since the heart of the successful FM CW altimeter is accurate modulation, these tubes would require a complex, bulky modulator. The magnetron also suffers from considerable jitter. This further limits its usefulness. As a final drawback, both tubes require magnets. This further increases the system weight.

Thus, the reflex klystron seems the logical choice. Realizing this need, we initiated a company-sponsored program to develop such a tube. The result is the Eimac 1K75 series of reflex klystrons, Fig. 3. This is a rugged, all metal and ceramic tube which is fixed-tuned at 4300 ± 50 MC. It is capable of providing 1 watt output, and has bandwidth capability up to 100 MC, depending upon the operating mode chosen.

The unique inner construction of this tube is responsible for its excellent performance. By the proper choice of materials and construction methods, an extremely frequency-stable tube was produced. The layout, Fig. 4, details the stacked-ceramic double-supported cone construction. These cones and ceramic spacers rigidly support the cathode and reflector and minimize the frequency jitter under vibration.

The use of radial-vane grids results in low transmission loss, and a high beam coupling coefficient, essential to high efficiency. Also, these grids are rigid, thus further reducing jitter due to vibration.

By properly choosing the material in the body, cones, and grid-partitions, the frequency change and the modulation sensitivity change as a function of temperature, have been controlled. The typical variation is shown in Table 1. To the equipment designer, this means reduced system error without complicated feedback networks.

Step Error Reduction

The most important trait, however, is the wide bandwidth. Electronic bandwidths up to 100 MC are

Fig. 4: Details of the inner construction of this extremely frequency-stable tube.

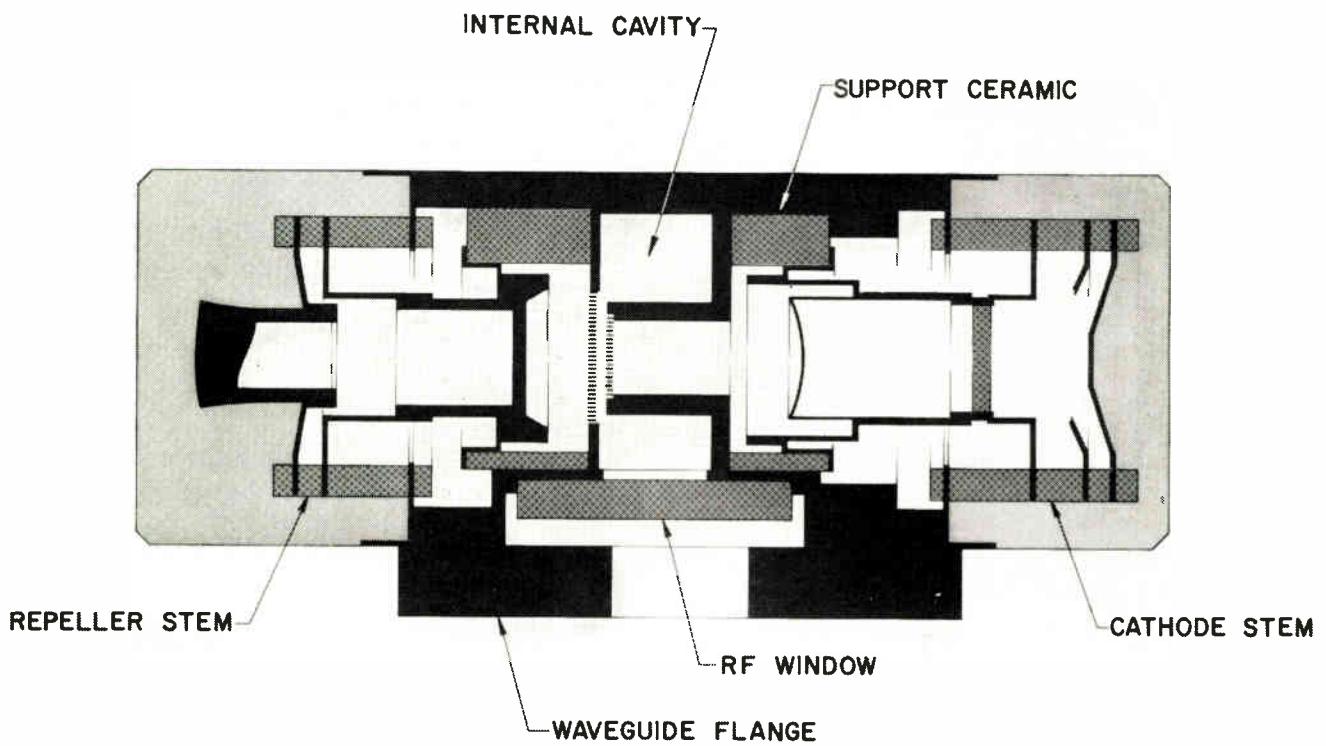


Table 1

1K75 TEMPERATURE STABILITY CHARACTERISTICS

Tube No.	Temp. °C	Freq. MC	Δ Freq. MC	Mod. Sens. MC	Δ Mod. Sens.	Refl. Volt Volts (1)
404	−55	4318	4	1.40	0.72%	130
	+25	4314	"	1.39	"	129
	+125	4315	"	1.40	"	127
391	−55	4295	3	1.25	0%	137
	+25	4297	"	1.25	"	137
	125	4298	"	1.25	"	137
399	−55	4317	2	1.39	0.73%	134
	+25	4319	"	1.38	"	134
	125	4317	"	1.38	"	134

Note (1): Reflector voltage adjusted for maximum power output at each temperature.

achievable, thus reducing the step error to ± 2.5 ft. for quantized systems. This error can be reduced by alternate discriminator designs, but the wide bandwidth available in this reflex klystron will, in any design, give a smaller total error than other narrower band devices.

To permit airborne use, careful attention was focused on the mechanical design of these tubes. The electrical connections are provided by encapsulated leads, which permit operation at any altitude without pressurization. Also, these tubes are cooled completely by conduction—either to the waveguide, or to a heat sink if coax output is used.

Finally, the conservative cathode loading and high processing temperatures permitted by the ceramic construction result in unusually long life. Although conservatively warranted for 1000 hrs., lives of many times this figure have been experienced, both in the field and on life test.

The end result? A tube capable of performing as desired in a system which uniquely fills a definite need. The potential? Estimated at up to 20,000 units for the designer who produces the best (and most economical) system. The users? Almost all commercial and military aircraft, both now and in the future.

* * *

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

OTS Provides Research Data To Engineers

One of the more significant contributions that the government is making toward the advancement of science and technology is in disseminating information.

Through the Office of Technical Services, Business and Defense Services Administration, U. S. Dept. of Commerce, the vast amounts of data obtained under government-financed research projects are being made available to engineers and scientists free of charge.

Specifically, OTS fulfills these functions:

1. Provides detailed reports of new research.
2. Prevents duplication of costly research already accomplished under Government contracts.
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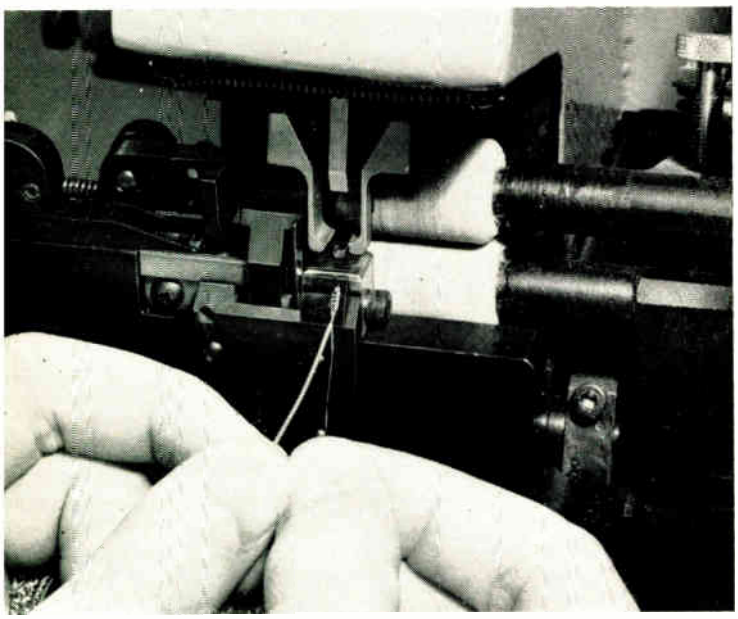
What's New



One hand positions the stripped fine wire into splice, the other hand positions pre-stripped lead wire into splice.

Fine Wire Splices . . . Faster and Better

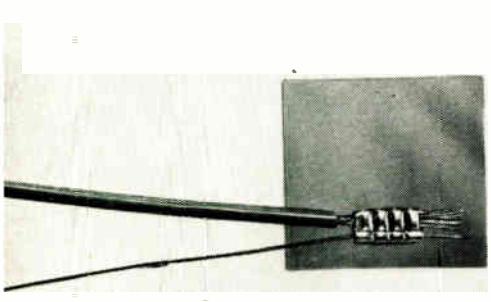
CONNECTING fine magnet wires has long plagued production engineers. When making a soldered magnet wire splice to a stranded lead wire, a rate of 150 connections per hour for wire preparation and soldering is considered excellent.

A system of joining fine wires simply, quickly, economically, automatically, precisely, and reliably was much needed.

In answer to this need, a new solderless splicing method has been devised. It uses a high-speed semi-automatic machine. Produced by AMP Inc., Harrisburg, Pa., the devise is capable of 350 fine wire connections per hour. In addition to the increased rate of production and improved quality, additional profits can be realized by a reduction in the number of rejects that are normally associated with fine wire soldering.

The FINE-Y-R splice machine is activated by both an air cylinder and an electric motor. The electric motor drives fiberglass abrasive stripping wheels for removal of the magnet wire insulation, and holds the magnet wire in position within the machine. The air cylinder is used to complete a number of sequenced events resulting in the final attachment of the magnet wire to a stranded lead wire. This splicing entails the clipping or crimping of a metallic part around the wires involved. This metallic clip (THE FINE-Y-R splice) is a small, tin plated copper part mounted on an insulating Mylar tape. The Mylar tape is 3/8 in. wide by 0.0015 in. thick and long enough to accommodate 3,000 splices. Packaging of this tape is on a throw away cardboard reel.

A 3/8-in. square of Mylar tape remains with the crimped fine wire splice and forms an insulating pad. If this tape is not desired, it can be removed with a light tug.



In making the crimped splice connection, the metallic splice must first be pre-folded around the wires. After pre-folding a straight squeeze between the serrated anvil and punch finishes the operation by imparting a wave form to the finished splice (fig. 7a). The high pressures involved make the splice connection highly reliable both electrically and mechanically.

Operator time for handling the parts (relay coil, transformer, etc.), and locating the wires within the machine might take 6, 7, or 8 seconds but once the machine is activated, the splice is completed in but a moment.

The crimping operation which heavily deforms the copper parts has been accomplished by squeezing the splice through a layer of Mylar tape. The means used for attaching the splice to the Mylar tape is a special adhesive that has been developed by AMP for this purpose. The adhesive not only holds the copper to the Mylar tape while in the machine but also holds the finished splice to the Mylar after being squeezed and deformed in the crimping operation. The square of Mylar tape remainng with the finished splice forms an insulating pad on the splice. The single-sided insulation may be used by placing the Mylar against the windings of a coil. The splice is then insulated on its top side by an outer wrap of insulating tape used around the coil. If this outer insulating Mylar tape is not desired, it may be removed from the finished splice with a light tug. The crimp is more than just a light bending of the copper parts. The stresses on the copper are high enough to cause a great deal of flow.

When using 38 gage magnet wire, machine time for making a splice is almost negligible. Naturally, rates are somewhat slower for 44 gage (0.002 in. dia.) wire, because of the understandable handling problems always encountered with very fine wire.

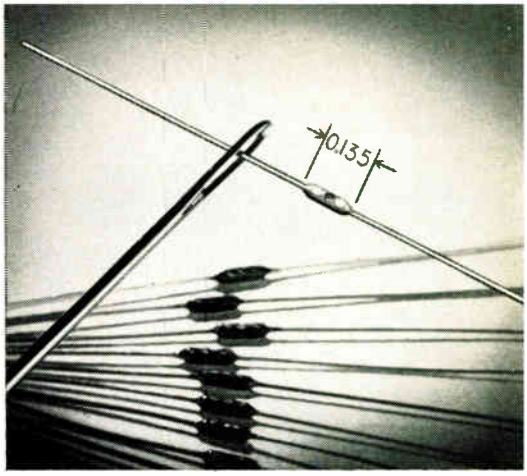
Wires down to 48 gage (0.0012 in.) may be spliced using the FINE-Y-R splice applicator but the wire must be pre-stripped before being placed in the machine. With these very fine magnet wires of less than 0.002 in. diameter, some of the speed advantages of the machine are lost, but even in this area, the FINE Y-R splice System might prove to be profitable.

* * *

The Bridge to Thin Film Circuits

PRECISION evaporated metal films have set new performance standards for precision film resistors. A process called "Noble-Met," which exhibits characteristics in accordance with MIL-R-10509D has been developed by American Components, Inc., 8th Ave., & Harry St., Conshohocken, Pa. Using this low temperature coefficient, highly stable film process, a new microminiature resistor is currently solving the needs of individual component miniaturization without sacrifice of performance. This resistor, the CE-⅛, is 0.135 in. long by 0.050 in. diameter. It has axial leads 1 in. long by 0.016 in. diameter of tinned soft copper. It is also available on special order with kovar leads 0.015 in. diameter with a 0.00005 in. gold flash for welding applications. Resistance range: 10 ohms to 110K ohms.

The device consists of a high quality special ceramic substrate, onto which is fired gold terminations. A mixed metal film, Noble-Met, is next applied; then the units have the leads attached by a high conductivity, special thermosetting material. This forms a permanent electrical and mechanical bond between the fired gold and the lead wire. The assembly is then helixed to exact range, following which multiple coats of an epoxy are applied for additional environmental protection and increased mechanical strength.



Although 3000 to 4000 of these microminiature units fit in a cubic inch, power dissipation needs would limit it to much less.

Typical performance of these resistors is shown in Table 1. These averages were based on samples of 30 for each value, subdivided in accordance with MIL test requirements. Another test program on samples of 60 for each value is nearing completion, with consistent results.

These units are finding wide application where small size and light weight, without sacrificing performance, are important.

The CE-⅛ is rated for ⅛ watt in an ambient temperature of 100°C and is derated to zero at 150°C. It

(*Continued on page* 242)

Table 1
Typical Performance Data

Type of Test	Temp. Cycle	Low Temp. Operation	Short Time Overload	Solder	Moisture Cycle	1,000 Hours Load 100° C
Charact. "C" MIL-R-10509D Limits	±0.2%	±0.5%	±0.5%	±0.1%	±0.5%	±0.5%
25 Ω	0.1	0.2	0.3	0.09	0.15	0.3
100 Ω	0.05	0.1	0.2	0.05	0.15	0.2
1K Ω	0.03	0.05	0.07	0.04	0.10	0.1
10K Ω	0.03	0.03	0.07	0.03	0.15	0.1
110K Ω	0.03	0.03	0.07	0.03	0.25	0.1

Metalworking Aided by Ultrasonics

ULTRASONIC equipment is playing an increasingly important role in the metalworking industry. This is coming about as more companies learn the values of vibrating the coolants used in virtually every grinding process.

Equipment to vibrate the coolant at ultrasonic speeds as it flows onto the grindstone has been made commercially available during the past year by Cavitron Ultrasonics Inc. of Long Island City, N. Y. The ultrasonic tool, Ever-Grind, which creates a vibrating force field within the moving coolant, results in cooler and cleaner grinding operations, retards wheel loading, reduces wheel wear and in many cases improves surface finish as much as four times. Another big plus is that the Ever-Grind equipment allows upgrading to finer and harder grinding wheels for greater material removal rates, with a minimum of dressing time. Flatter work and greater accuracy are also added benefits.

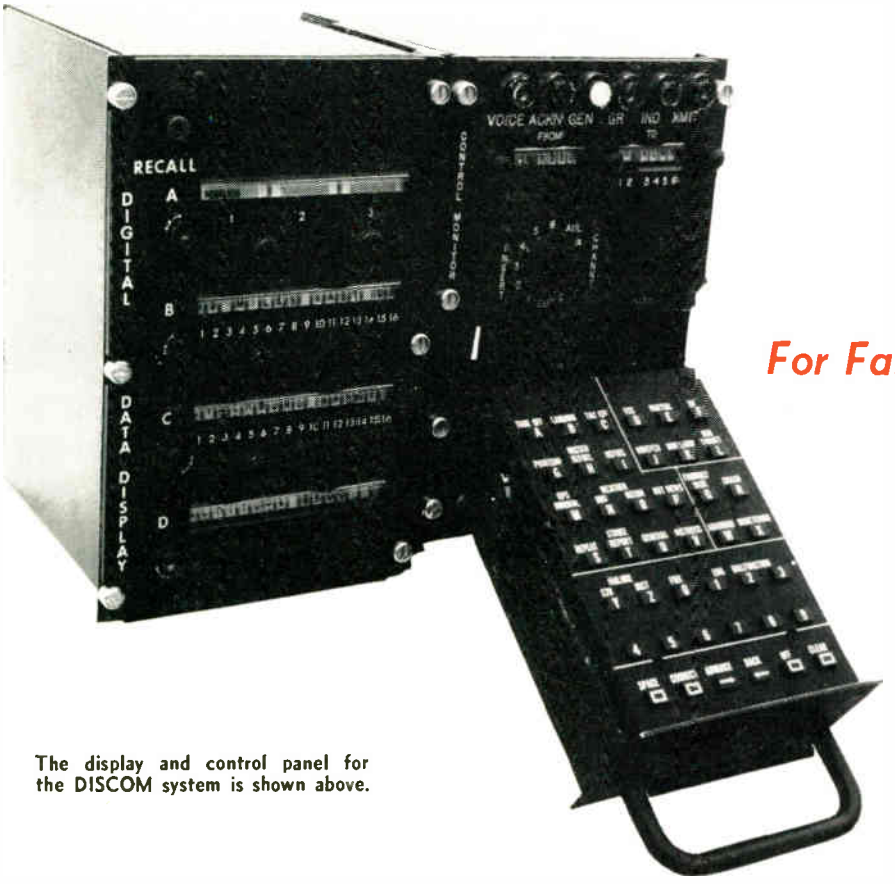
In operation, the ultrasonic unit is mounted at 0.005 to 0.010 in. from the grinding wheel and set to vibrate coolant at about 20,000 cps.

Users in industry have reported a wide variety of successful uses, including the rendering of such sticky metals as stainless steel, brass, aluminum and a number of laminates more suitable for plunge grinding.

One firm reported productivity increases of 2½ times, with dressing required only after 500 units, instead of after 50 units without the Ever-Grind. Pyrometer readings taken during these tests showed spark temperatures lowered by as much as 400° with the new ultrasonic attachment.

Technically there are no limitations to the wheel size that could be equipped with the device. The company is presently taking orders on tools up to 6 in. wide and expects to go to larger sizes eventually. The ultrasonic process is a preventive, not a cleaning process. It won't help a wheel that already needs dressing, but it will keep a dressed wheel cleaner longer. The wheel runs cleaner and cooler with no weld effect. Abrasive grains are kept hard and sharp, and heat and friction are cut down substantially.

Another advantage: no special grinding fluid is needed. The process operates with almost all commercially available fluids with no need for changes in quality or quantity.



The display and control panel for the DISCOM system is shown above.

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Project Manager
Military Systems Eng'g.
Communication Products Dept.
General Electric Co.
Lynchburg, Va.

For Fast Message Handling . . .

Digital

THE name DISCOM (DIgital Selective COMmunications) has been given to terminal equipment being designed for the Air Force. It uses digital techniques and provides for selective addressing and message processing, an important factor in high performance aircraft. A modulation adapter permits transmission over any system capable of handling voice. Communication will be maintained, however, at high noise-to-signal ratios where voice would be completely unintelligible.

One of 3 flashing lights alert the called station cn receipt of an individual, group or general call. Each of the 3 calls may be any 4 letter combination, of which there are 456,976 possibilities. When the individual light is pushed out, an acknowledge message is automatically sent. The address of the calling station is displayed, together with 2 mode characters which perform selected switching functions to process and/or identify the following message.

The selective address equipment, called the Control Monitor, also provides for address and mode character insertion, as well as channel selection for transmission. The inserted information is displayed. The Control Monitor is a complete and independent unit. It can be used to address and control any number of message processing devices. By using the mode characters, as many as 676 coded discrete messages can be sent.

The Digital Message equipment provides for the insertion and display of word messages of up to 3 words, and alpha-numeric character messages of up to 48 characters, in three lines of 16 characters each. The word messages may be selected from up to 38 previously determined possibilities. Insertion is done by means of a simple push button matrix. Selection possibilities are indicated for each position by means of controlled lighting.

A single panel displays the inserted information while a message is being composed. If another message is received, the display is cleared and the received message is shown. A recall button clears the display panel and redisplays the message being composed by recalling from storage.

Once a message is composed and the proper mode characters inserted in the Control Monitor, the message will be directed to the selected address when the transmit button is depressed.

Control Monitor

In the Control Monitor, insertion and display are mechanical. Letter wheels are manually positioned to display the desired information and held in that position by electromechanical detents. The displayed letters are read into storage by engaging the display wheels with a common gear and rotating them

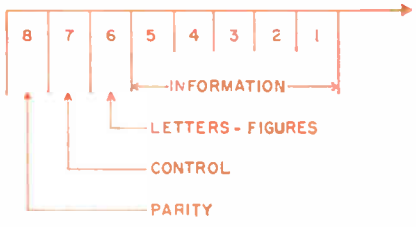


Fig. 1 (l): Field data code structure is illustrated.

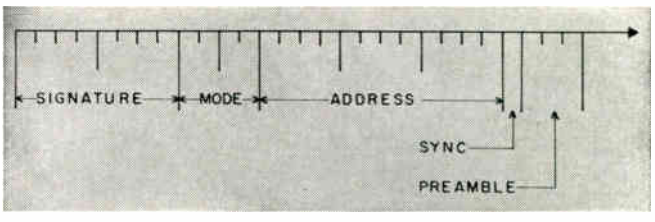
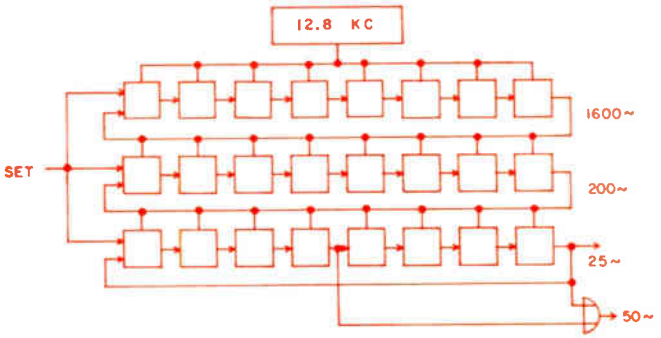


Fig. 2 (r): The transmitted signal consists of a 24 bit preamble.

Fig. 3: Timing is controlled by a clock and count down circuits.



Communications System Design

Voice transmission is cumbersome, slow and redundant, and also wasteful of frequency spectrum. The digital techniques described here permit the use of narrow bandwidths, simplified operation and selective calling.

one complete turn. Projections on the letter wheels operate sensitive switches. The switches time the reading of an analog-to-digital converter, to read the code representing the selected letter, into the proper storage block. Information is read into storage in parallel and then read out serially during transmission.

In the 8 bit field data code, Fig. 1, only the first 5 bits are stored. In the Control Monitor where only letters are used, the sixth bit is always zero. The seventh bit is a control bit not used in this system and is always one. The eighth bit is the parity bit. It is properly inserted by checking parity on the out-going letter, and providing a one or zero as required.

The transmitted signal, Fig. 2, consists of a 24 bit preamble made up of alternate ones and zeros, followed by an 8 bit sync signal. The address is repeated twice. The mode characters are repeated once. The signature of the station making the call is then sent twice.

The system operates at a rate of 50 bits/sec. Timing is controlled by a clock, Fig. 3, consisting of a 12.8 KC crystal oscillator and three 8 core counters to get down to 25 CPS. Discrete timing pulses are provided by a 16 bit ring counter, successive counts of 2 characters being gated by a 4 stage function counter.

Modulation Adapter

A modulation adapter, Fig. 4a converts the one and zero levels into tones of 1.90 and 2.75 KC respectively, for transmission over any normal voice channel. When receiving a signal, the 2 tones are selected in the modulation adapter, Fig. 4b, by 2 filters having bandwidths of 350 CPS. The additional bandwidth allows for up to 150 CPS doppler shift at UHF frequencies. The envelopes of the 2 tones are detected and then subtracted to obtain the best combined information.

Each of the 2 tones provides information to determine a one or a zero level. In the signal recognition circuits, Fig. 5, the dc reference is allowed to shift to the average between the one and zero levels so that the system will operate even if one of the tones is lost due to a selective fade. The signal is then integrated over one bit time by means of a low-pass filter, and limited to produce constant output levels.

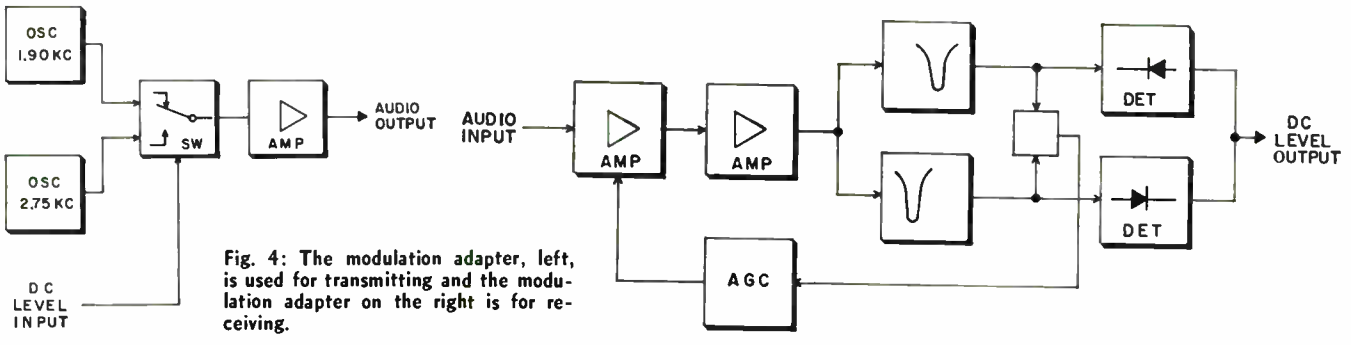


Fig. 4: The modulation adapter, left, is used for transmitting and the modulation adapter on the right is for receiving.

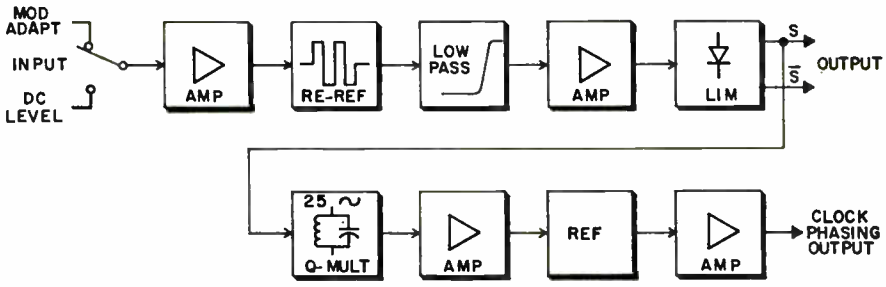


Fig. 5: The preamble is recognized by storing energy in a 25 cycle resonant circuit.

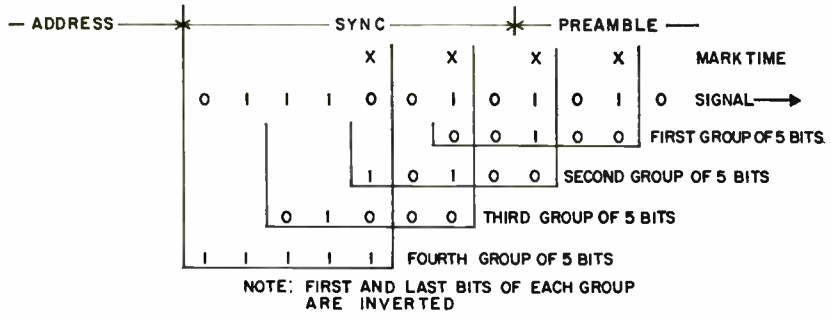


Fig. 6: Drawing shows that the first recognition of sync will be the proper one.

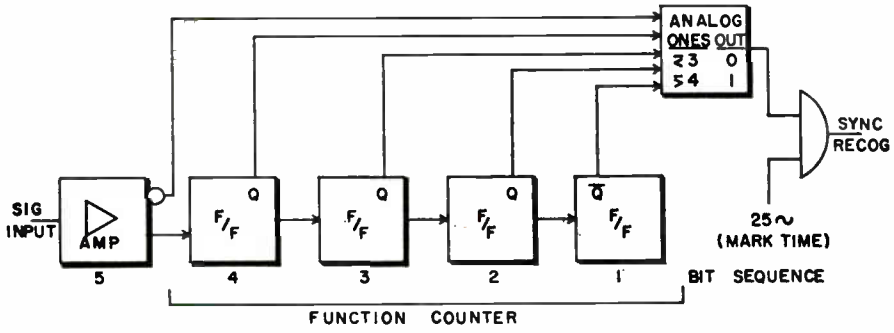
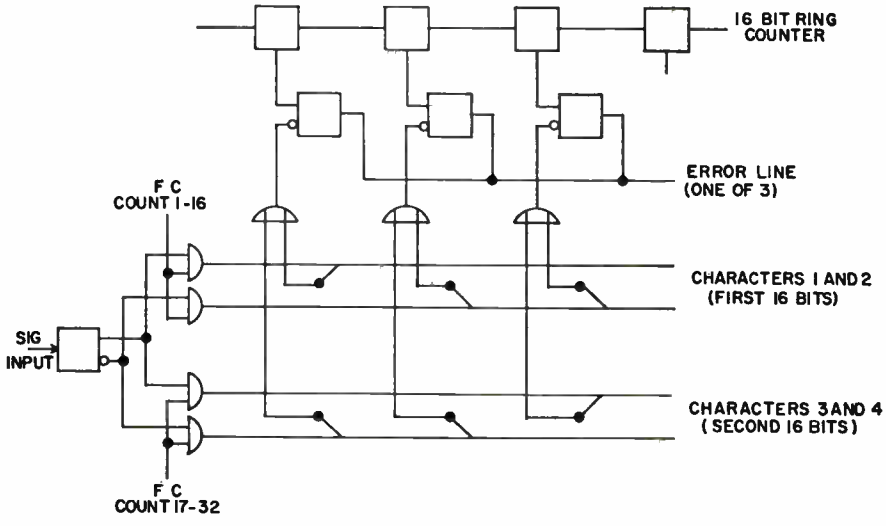


Fig. 7: The block diagram illustrates the sync recognition/function counter circuits.

Fig. 8: The four letter address from the calling station is recognized here.



The first problem in receiving a message is to synchronize the clock. The preamble is recognized by storing energy in a 25 cycle resonant circuit, Fig. 5, having an effective bandwidth of 1 to 2 cycles. When the energy in this tuned circuit reaches a certain level, the countdown is started, timing the sync recognition circuit to the incoming signal. The 8 bit sync signal is 01001110, which must be recognized in the presence of one error. Providing we sample at mark time only, as determined by the preamble, the significant bits are 01110. If the first and last bits are inverted making them all ones, there will be 5 ones with a single error reducing the number to 4. Looking at the incoming signal at mark time only as determined by the preamble, Fig. 6 shows that the first recognition of sync will be the proper one. Fig. 7 shows how the signals are sampled, as shown in Fig. 6, and summed to determine a combined level. For a level equivalent to 4 or 5 ones, a circuit is energized resetting the countdown and starting the function and ring counters to count out the message. The circuits used to sample the signal for sync recognition, Fig. 7, are converted to a binary function counter by interstage gating.

The Address

Immediately following the sync signal is the address, repeated twice. The addresses, which a particular station is to recognize, are set up on code switches. Each station will have three 4 letter combinations which it must recognize as individual, group or general calls. The incoming signal, and its complement, are fed to 2 busses as shown in Fig. 8. Counting pulses from the ring counter are connected through a transmission gate to 3 error lines. If the code switch is connected to the same buss on which the corresponding incoming signal occurs at that particular bit time, the transmission gate is closed preventing the timing pulse from getting in the error line. The first time all 4 letters are counted out without a timing pulse getting on one of the 3 error lines, the corresponding call light will start flashing. If at the end of the first 4 letters an error has been re-

ceived, the error is cleared and the circuits reset to look for correlation in the next repeat.

If an address is recognized, the signal is gated to mode storage. In Fig. 9, parity is checked on the first mode character as it is read into storage. If parity does not check, the storage is cleared. Parity is then checked on the second mode character as it is read into storage. At the same time the first mode character storage block is sampled to see if it contains a character, or has been cleared. If a character is detected, the incoming signal is closed and the character recircuited. But if a cleared condition has been detected, the next incoming signal is read into storage and parity checked. In this manner the first time each of the mode characters checks parity, they are retained. If parity does not check either time, that storage block remains cleared and will be displayed as an error.

The signal is then gated to signature storage and parity checked and stored or cleared in the same manner as the mode characters, except that there are 4 signature characters.

The mode and signature storage both use flip-flops to produce output levels. A specially designed circuit, Fig. 10, using complementary transistors, permits both transistors being either on or off at the same time. Power drain can be kept at a minimum by clearing the storage and leaving both transistors turned off during stand-by.

As soon as an address is recognized, the motor is started and the display wheels are cleared and detented to the shaft, Fig. 11, so that they turn in synchronism with the shaft position indicator. After the mode and signature have been stored, a comparison is made between the output of the shaft position indicator and the levels in storage for a particular character. When correlation occurs, a detent is dropped, stopping that particular wheel. For any storage block that has been cleared, an error symbol is displayed.

The remainder of the message depends on what mode character was received. Certain of these characters operate relays that may turn on a light indicating the calling station wishes to talk. One com-

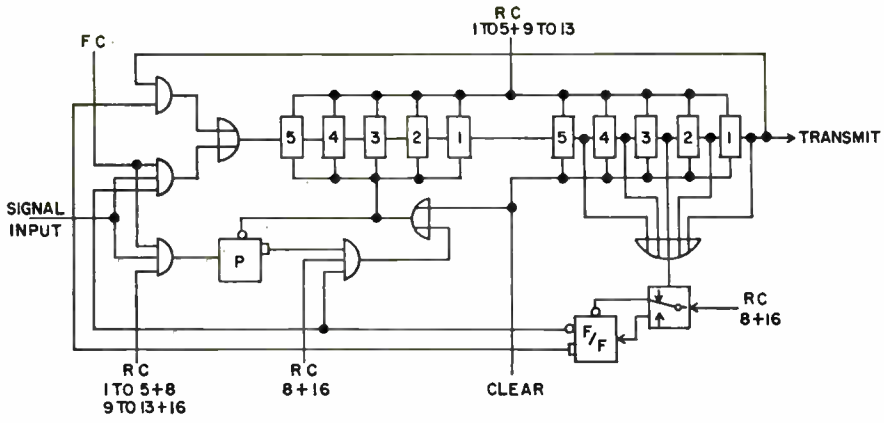


Fig. 9 (above): If the address is recognized, the signal is gated to mode storage as shown.

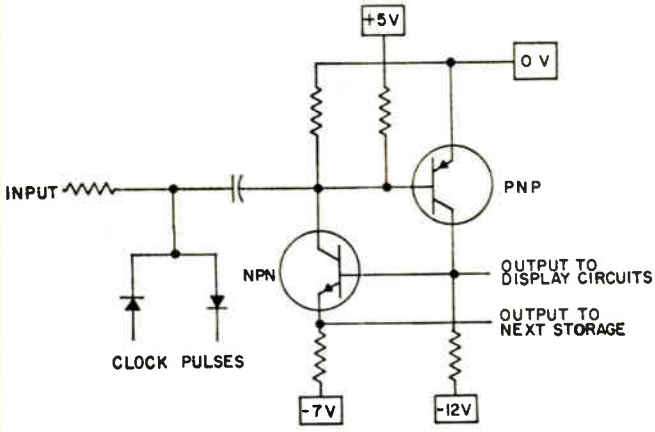


Fig. 10: Transistors are used in the storage circuit.

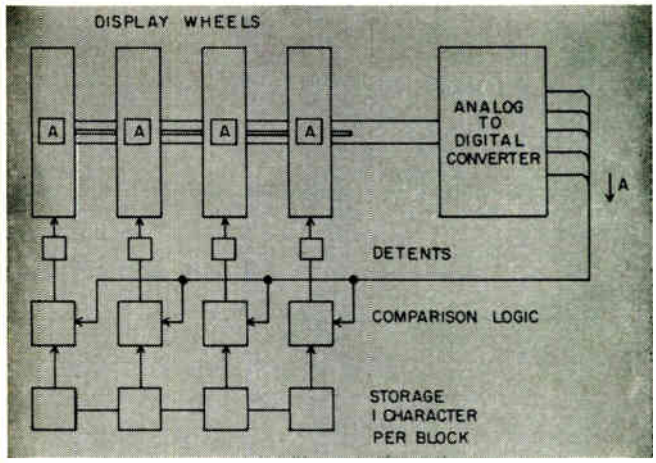


Fig. 11: The display wheels are turned in synchronism with the shaft position indicator.

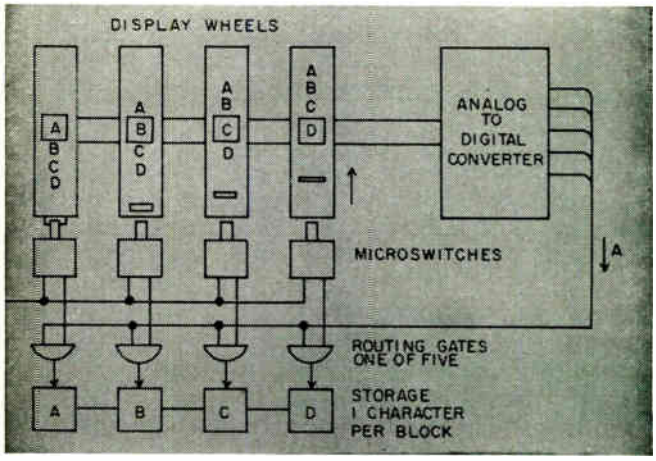


Fig. 12: Pushing transmit button transfers displayed mode and signature to storage.

Digital System *(Concluded)*

bination indicates that a digital message is to follow. In this case the digital message equipment is started and cleared for display of the received message.

The flashing call light is pushed to turn it out. If the call was an individual call, pushing out the light automatically transmits an acknowledgement signal to the address that was received into storage. A special mode is sent that turns on an acknowledge light at the originating station. Once this acknowledgement is given, mode and signature storage are automatically cleared.

To transmit a message, the Control Monitor is manually adjusted to display the 4 letter call of the selected station and the desired mode in the windows. If a digital message is to follow, the proper mode must be selected and the digital message will be covered later. A channel is selected for transmission. If the channel is active, the transmit button will be lighted. Another channel must be selected, or the operator must wait until the light goes out, showing a clear channel. Now the message may be sent by pushing the transmit button.

When the transmit button is pushed, the motor starts and transfers the displayed mode and signature into storage as shown in Fig. 12. Projections on the display wheels time the reading to the corresponding code. The 24 alternate marks and spaces are read from the ring counter Fig. 13 through a binary flip-flop. The second time through the ring counter, selected pulses are inhibited from changing the flip-flop to produce the sync signal. The output of this flip-flop is then compared with the address and mode in storage as each bit is counted out. The flip-flop is changed only if stored information does not compare with the existing state of the flip-flop. The address is repeated twice and the mode is repeated once.

In the same manner, the ring counter flip-flop output is compared with the individual coded address set up on that particular unit and the flip-flop changed when necessary to compare with the coded address, which is the signature for the outgoing message. The signature is repeated once. In each case, the first 5 bits only of each character are read in this manner. The sixth and seventh bits are always the same and they always set the flip-flop to the proper state. The eighth bit is the parity bit. It is inserted by making a parity check on the outgoing message and inserting a one or zero as required.

The message terminates when the signature has been sent twice, unless a digital message is to follow, in which case the message will

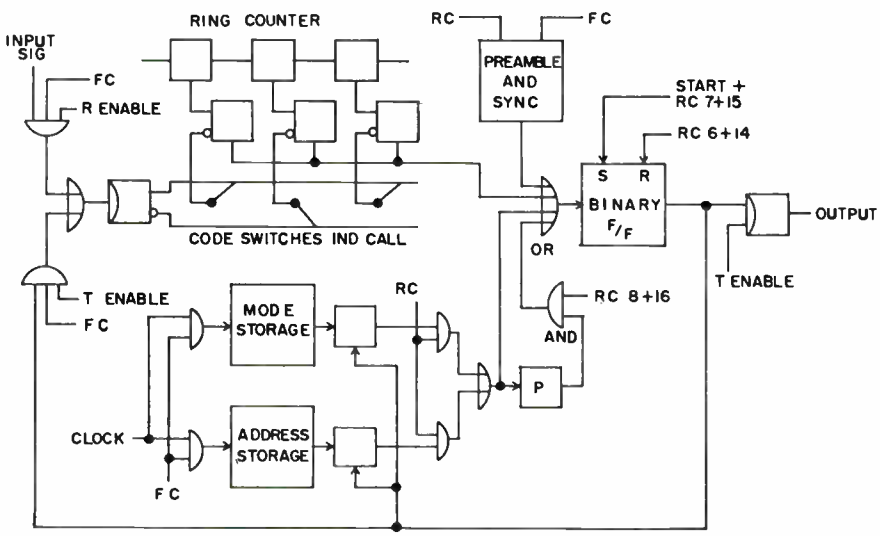
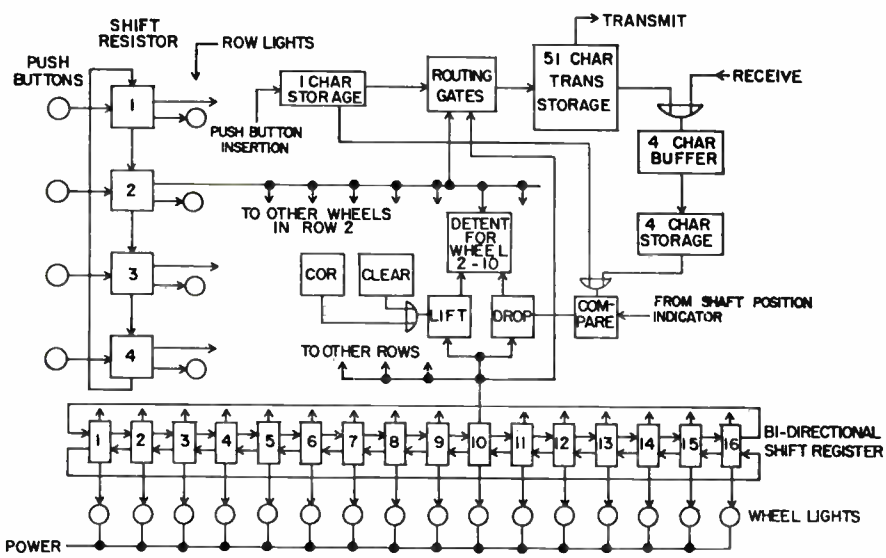


Fig. 13: The marks and spaces are read from ring counter through binary flip-flops.

Fig. 14: Wheel selection for message composition is controlled by circuits shown.



be read directly from digital data storage. A message may be repeated many times by repeatedly pushing the transmit button. Any character in the message may also be changed without affecting the rest of the message. The digital message can be up to the maximum of 51 characters.

Message Composition

Before a digital message can be read out of storage, the message must be composed. Composition is simple, requiring a minimum of effort and training. A push-button matrix is mounted in a drawer to save panel space. When the drawer is pulled out, it can be set at any angle convenient to the operator. To compose a message the operator makes a selection from only the lighted buttons, and merely pushes the button. As each button is pushed in sequence the lighted possibilities change depending on which wheel is to be set, and what was set up on the previous wheel. When the clear button is pushed, any previously displayed message is cleared and gating circuits are automatically set to route the first button selected to the first wheel. These gating circuits are controlled by two shift registers, Fig. 14. One selects the row and the other selects the wheel. These same shift registers locate the storage block assigned to that wheel. Row and wheel lights on the display panel indicate the next wheel to be set.

As each wheel is set, the shift registers automatically shift to route the next selection to the next wheel. When a button is pushed, the code for that character is read into a one character flip-flop storage, Fig. 15. The motor starts and the information in storage is compared with the shaft position indicator output. When comparison is detected the wheel is detented to display the corresponding character. The code is also read into a one character core storage, from which it is routed to the proper main storage block.

Message Changes

Any character may be changed at will. The row is selected by pushing the row button on the display panel. Back space and advance buttons on the push button matrix are then used to locate the wheel to be changed, as indicated by the numbered row of lights. Pushing the change button clears that single wheel, after which the new character can be inserted.

During transmission the one character storage blocks are all connected as a shift register and the information read out serially as shown in Fig. 20. The information is retained in storage by recirculating it back in as the message is being transmitted, thereby making repeated transmission of the same or a slightly modified message possible.

Should a message be received during the composition of a message, the display panel will be automatically cleared and the received message will be shown. The first 4 characters are read into a buffer storage and parity is checked on each one. Since this message is not repeated, those that do not check parity are cleared and displayed as errors. The 4 characters are then transferred, in parallel, into a 4 character storage where they are compared with the shaft position indicator and displayed, as were the mode and signature. While one set of 4 characters are being displayed, the next 4 are being read into buffer storage and so on until the message is complete. When the message is complete, the 4 character storage is automatically cleared. When the received message has been read, the message being composed can be recalled from storage and redisplayed by pushing the recall button on the display panel. The composition can then be continued. Any length message may be set up. When codes for 2 of the cleared wheels are detected in series in the transmitted message the message will terminate, a similar termination occurring at the receiving end.

The Control and Display panels of a DISCOM system are shown in figure on first page. The Control Monitor can be used with or without the Digital Data equipment.

Fig. 15: When button is pushed, code for selected character is read into storage

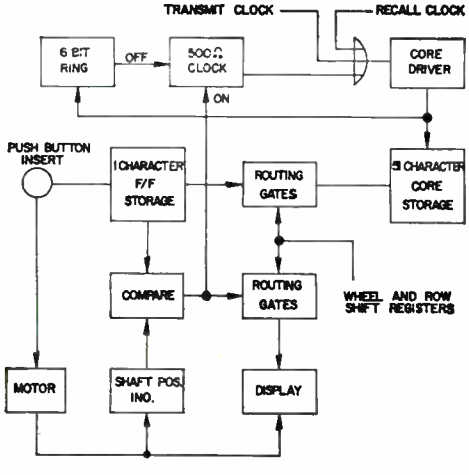
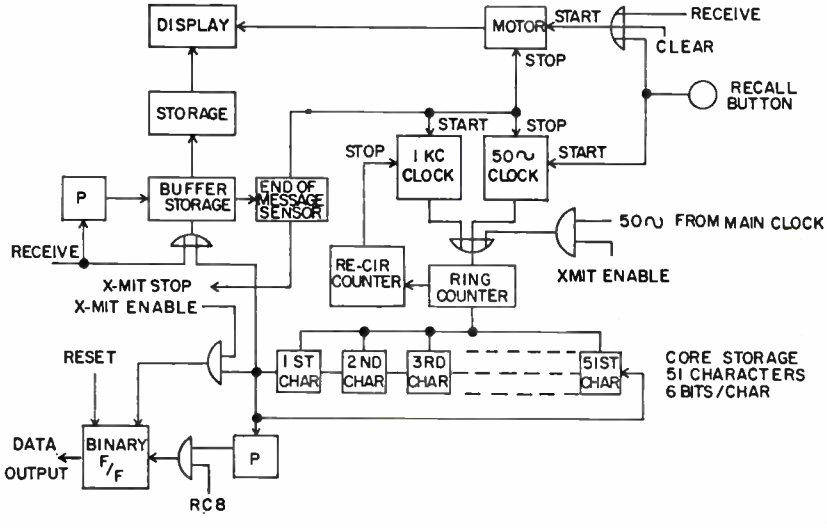


Fig. 16: During transmission, the information is read out serially.



Earlier we treated the characteristics of magnetostrictive delay lines, their use, and precautions. This final installment concerns itself with special methods of operation and various applications, but most of all, an attempt is made to treat the delay line as a logical element, or building block, for the systems engineer.

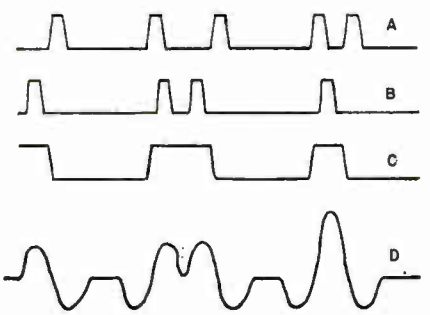


Fig. 21: The non-return-to-zero (NRZ) modes of operation. (C) is input to the line.

What to know in . . .

Using Magnetostrictive Delay Lines

By ANTHONY J. RADFORD

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Harman-Kardon Inc.
Plainview, N. Y.

Part Three of a Series

THE modulated carrier wave and return to zero pulse operating methods have been discussed in some detail. The main difference is that the carrier mode can tolerate higher capacitive tuning to modify the amplitude-frequency response and requires more careful shielding of associated equipment.

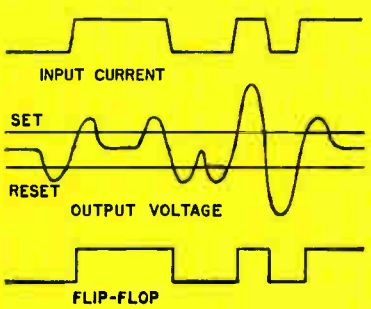
This material was prepared while Mr. Radford was a Senior Engineer with Ferranti Electric Co.

Detection Methods

In the non-return-to-zero mode, the pulse repetition rate of any given line can be doubled. An input current change can produce an output voltage change that can be identified. In Fig. 21 (C) the input current to the line is shown. A change can represent a "one"; or, the levels at which it is resting can represent "one" and "zero." Both methods give double the maximum pulse repetition rate and have their sepa-

Fig. 22 (below): NRZ flip-flop waveforms.

Fig. 23 (right): Inversion method waveforms.



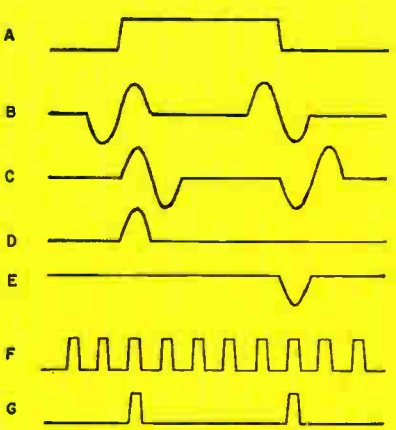
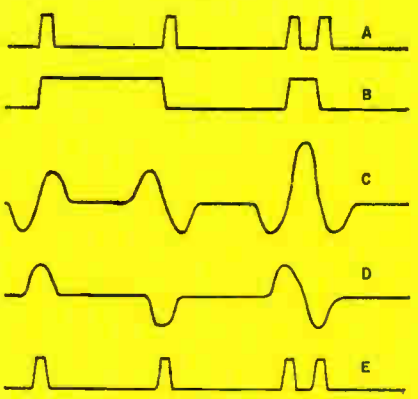


Fig. 24: Integrating method NRZ waveforms.



rate advantages. Figs. 21 (A) and (B) represent "one"s of the two methods. The amplified output, Fig. 21 (D), a combination of full and half-height positive and negative pulses can be detected by several different methods. Here are 3 such methods.

(*a*) *The Flip Flop Method*

A look at the output waveform will reveal that the information occurs every time the pulses cross the zero line. A zero crossing detector is difficult to make because of reflections and unwanted signals; and, the differentiated waveform is very noisy. However, a flip-flop can be designed to be set with the positive pulses and reset with the negative ones. This is shown in Fig. 22 where the ideal threshold bias levels are noted. But, if a phase splitter is not used to trigger each side of the flip-flop in turn, then the change in the "on" and "off" impedances will cause a loss in the signal-to-noise ratio.

This is serious because the pulses are already ¼ the return to zero size. There are two reasons for this condition: first, the dc condition of the input halves the allowable current on the same transistor for dissipation reasons; and second, half height or di-pulses are being detected. This method is presently the most popular; but, it requires careful "live" testing of the delay lines to insure correct magnet locations, welds, etc., in the user's circuit because the pulse shape is very critical.

(*b*) *The Inversion Method*

This method of N.R.Z. detection is shown in Fig. 23. The amplified output (B) is delayed one bit, inverted (C) and gated with itself for both positive and negative lobes (D) and (E). Three input "and" gates can be conveniently used with clock (F) as the output pulses are nearly twice the width of those obtained in the R.Z. mode, even if a wide clock is required for other reasons. The clocked output (G) can then trigger the input wave form (G).

(*c*) *The Integrating Method*

If the output waveform, Fig. 24 (C) is integrated by a simple R-C or L-R circuit with the correct time constant, then a waveform (D) is produced similar to the derivative of the input current (B). The positive and negative lobes can be used to reproduce the input pulses (A) directly, or by gating with clock.

Both the inversion and integrating methods require circuits that are related to the response of the delay line but can give an output directly without clocking or deriving from a flip-flop. All three methods double the information content of the line and make possible the delay of rectangular pulses of any frequency from dc to the R.Z. response of the line if a flip-flop is used on the output instead of the input.

In Fig. 25 block diagrams show the three methods for double frequency pulse delays. The blocks do not represent circuit elements as there are many ways of achieving the same result.

Two Level Recording

Double amplitude detection is simply a matter of having two switches in parallel with different bias levels. This method would also give a pulse in the video channel where the timing pulse was located but is not serious as clocking techniques can remove it if necessary. When there is no clock and the video is required to be free of the timing pulse, then the video has to be delayed slightly to be inhibited by the wider timing pulse. For a long delay line, some form of A.G.C., independent of the information content, would be required. This means that the timing pulse has to supply enough energy over the period of the line, i.e., A.G.C. loop amplification is needed. In Fig. 26 a circuit for an input amplifier for two level recording is shown.

Phase Reversal & Ternary Methods

Another operating mode involving pulses for both ones and zeros permits A.G.C. to be applied more readily for increased reliability over extreme environmental specifications. The output waveform, Fig. 27, stands full height for both ones and zeros, but with different polarities. This means that even with a 2:1 signal-to-noise ratio, ones and zeros can be gated out by the clock. Another advantage of this system is that "blanks" or the absence of a one or zero can be circulated in the line for timing or identification of word position.

A block diagram, Fig. 28, shows how logical levels can be delayed and clocked using the phase reversal method. The adjoining section of the diagram shows how a ternary level may be delayed for timing and reference purposes. The information from the lines is gated between clock pulses ($\overline{K}$) so that whenever it changes between one and zero, the output logic level DQ is changed. The ternary level (B) inhibits the input pulse and this blank is recovered by a flip-flop that gets set at the end of a clock pulse ($d\overline{K}$) and reset

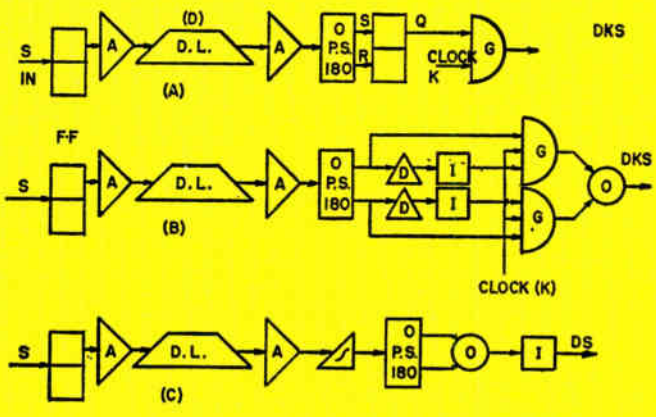


Fig. 25 (left): Three methods of recirculating information by NRZ techniques.

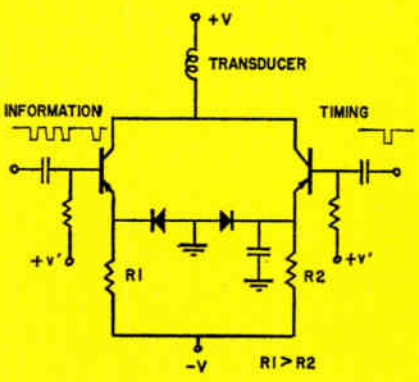


Fig. 26 (right): Input amplifier for two level recording.

Delay Lines *(Concluded)*

with every output pulse whether representing a one or a zero.

Any product KB, KQ, or $K\overline{Q}$ represents a clocked information pulse if desired in that form, with a delay variation of $\overline{K}$ minus the rise and fall time of the associated circuitry. Double flip-flop gating methods can be used to further extend this variation before an error is produced.

Video Memories

The magnetostrictive delay line is an ac device. To delay a video signal, a carrier must be used. Digits can be used to generate a staircase waveform with only one unit step per digit; but, in Fig. 29 a circuit capable of driving a delay line that can delay an analog waveform, 5 msec. with a rise and fall time of 0.5 μsec. is shown.

The output voltage of the delay line can be proportional to the input current or video voltage level. To detect the output, integrating, rectifying, and filtering methods have to be used. A center-tapped, input transducer is shown, but if two identical lines are used in parallel, double the bandwidth can be obtained with a shorter time constant filter. The carrier frequency can exceed the pulse response of the line and with further development, video memories of several megacycle bandwidths will be possible. The output amplifier has to have A.G.C. if the waveform is to be recirculated.

Time Marker Generation

Because a line can have a delay-rise time ratio of 30,000 : 1 with a temperature coefficient of ½ ppm/°C and is able to withstand severe environmental tests, a very stable time marker circuit can be made. This current can be used for target simulation, long range radar calibration, or in navigational aids.

A block diagram showing how a single pulse can be made to recirculate is shown in Fig. 30. The one shot merely inhibits any pulse after the marker has gone through.

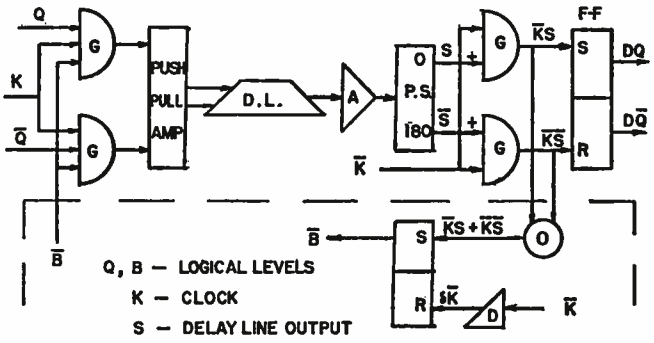


Fig. 28: Logical information delayed and clocked by phase reversal.

If a crystal-controlled clock can be used, two lines of different lengths can be preset to give very long periods and save the need for flip-flop division of the clock at the higher repetition rates.

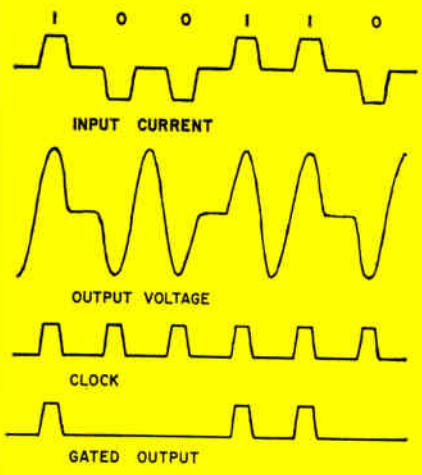
Further Uses

The most common use of the magnetostrictive delay line is in digital systems and computers. Their advantages of light weight, no moving parts, small size, low cost, and a minimum of associated equipment make them very competive with other forms of storage. In the computing modules, short lines are used as one word stores; in the high speed memory, longer lines are used in parallel much like the tracks of a drum; and, in the buffer stores, lines are used to transfer the content of paper and magnetic tapes to the high speed memories and out again to the punch or printer. The main advantage of magnetostrictive delay lines is that they are simple, require no servicing and use no extra power supply.

There are many more uses of delay lines, especially in the fields of time compression, spectrum analysis, and correlation for recognizing signals smaller than the noise, or moving target isolation. For these uses, large multi-tapped, very long, and very high speed lines are used.

Small multi-tapped lines are very useful in serial to parallel and parallel to serial conversion because the taps can be treated as inputs or outputs. In I.F.F. work, these lines can be used to generate or detect a code word.

Fig. 27: The output for phase reversal method waveform stands full height for ones & zeros, with different polarities.



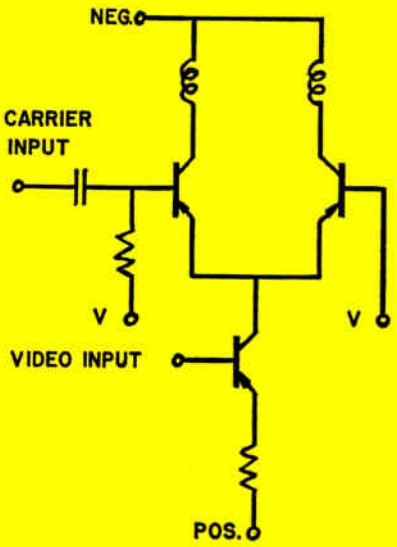
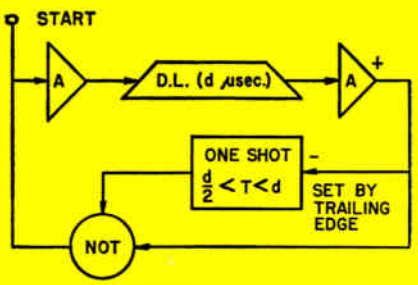


Fig. 29: Example of a video input transducer drive.

Fig. 30: Example of how a single pulse can be made to recirculate. The one shot merely inhibits any pulse after marker.



Page from an Engineer's Notebook

#61—Calculating Coating Weight

By RICHARD L. GIOVANONI

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Electronic Tube Div.
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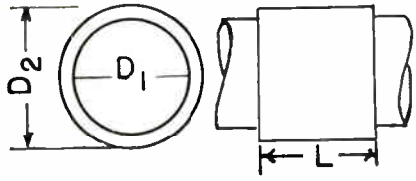
CONTROL of the amounts of coating applied to parts of electronic tubes is an important aspect of process control. Calculation of these factors is usually by weight and can involve a considerable amount of time when a large number of types or alternate solutions are being appraised at one time. To simplify and reduce the routine work content of the job, we have prepared alignment charts to do the job quicker. Another advantage is that all scales can be read in terms of units used in the specification sheets, all conversions are made within the scales themselves.

Fig. 2 shows the chart made specifically for cathodes used in receiving tubes. From the same principles we later developed the general nomograph shown as Fig. 1. which can be used for any coated round material.

In preparing such a chart, it simplifies construction to get rid of the square terms and reduce the basic formula to a linear function by expanding the squares. In our specific case we came down to a 1st power equation of the form.

$$Wgt = \frac{\pi\, dL}{2}\, T\, (D_2 + D_1) \qquad (1)$$



d = density of coating material
T = thickness of the coating
L = length of coating
D_1 = OD of base material
D_2 = Coated OD of final combination

This brings it down to terms read directly from the normal specifications. We arrived at the above Eq. 1 by the following steps:

$$Wgt = d\,(\pi\, R_2^2\, L - \pi\, R_1^2\, L) \qquad (2)$$

We can put common terms together and get:

$$Wgt = \pi\, dL\, (R_2^2 - R_1^2) \qquad (3)$$

Expanding R^2 terms we than have:

$$Wgt = \pi\, dL\, [\, (R_2 + R_1)\, (R_2 - R_1)\,] \qquad (4)$$

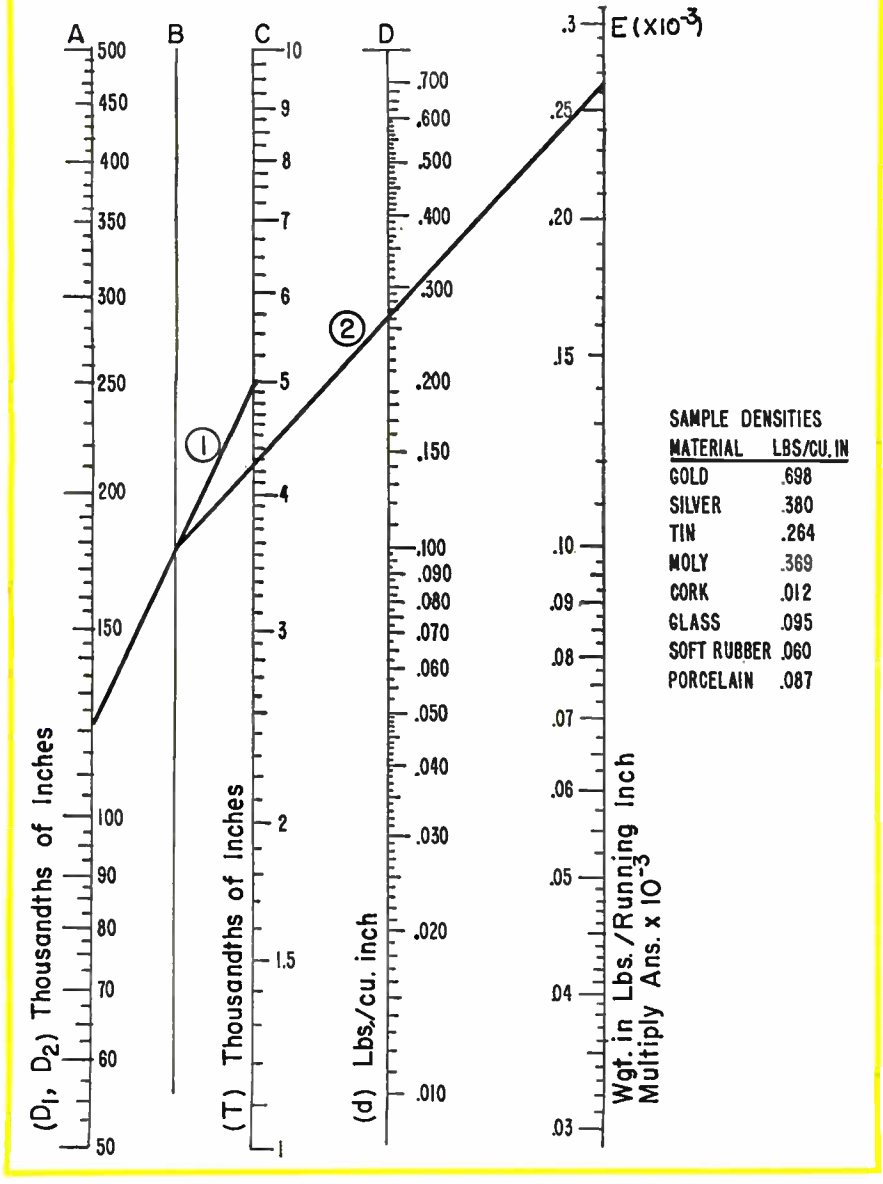
Since specifications are usually written in terms of diameter, we can substitute $D/2$ for R. We also note that $R_2 - R_1$ is actually coating thickness, therefore we get:

$$Wgt = \pi\, dL \left(\frac{D_2}{2} + \frac{D_1}{2}\right) T \qquad (5)$$

Then finally, factoring the ½ term we get Eq. 1.

In making the chart for the gen-

Fig. 1: Alignment chart for calculating coating weight for round shapes.



Coating Weight *(Concluded)*

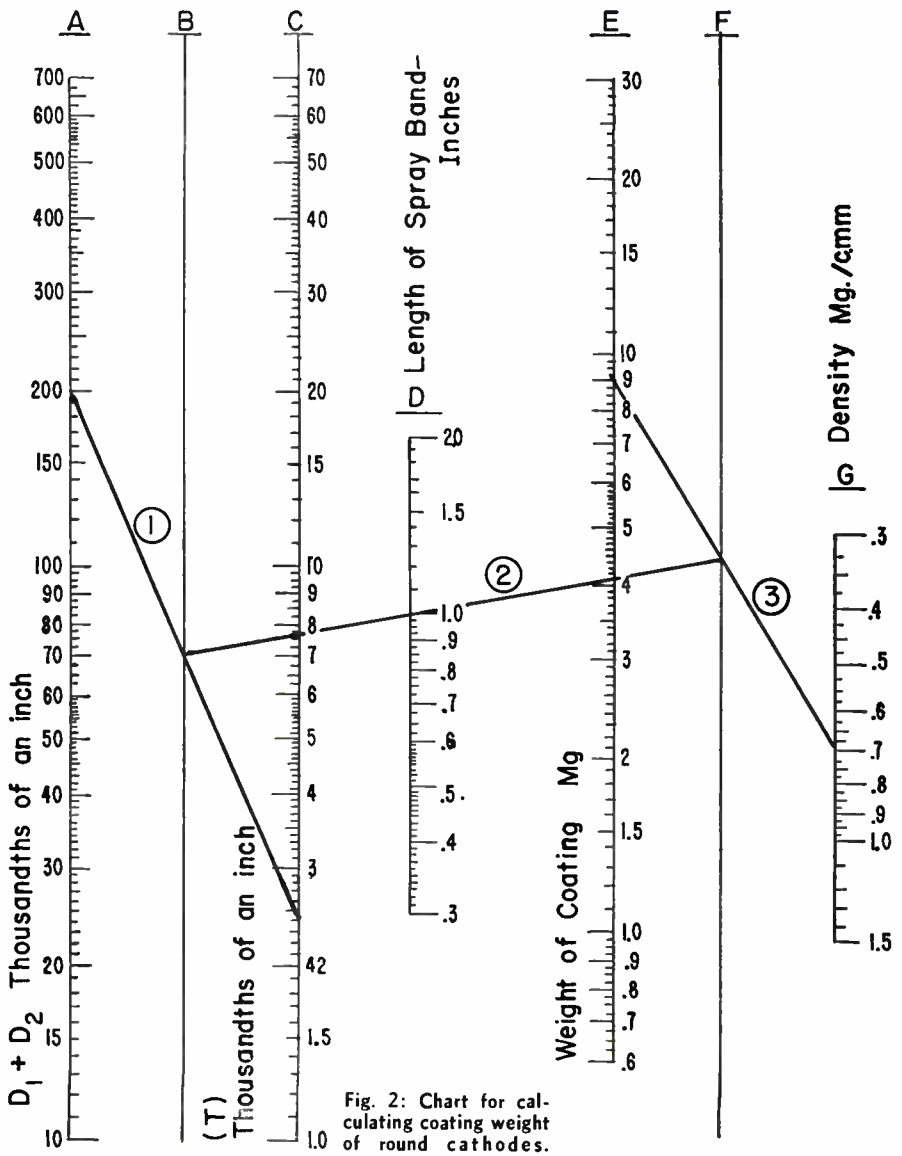


Fig. 2: Chart for calculating coating weight of round cathodes.

eral solution we have used a unit length of 1 inch and a density in terms of lb./in.^{3} Diameter and thickness are in terms of inches.

In some cases, where a standard density is employed, then a further simplification can be made where $\frac{\pi d}{2}$ is a simple constant.

Fig. 1 is used in the following manner: Line 1 is drawn from A to C. Intersection on Scale B is marked. Intersection point on B is connected to value of density on Scale D and extended to Scale E where the answer is read.

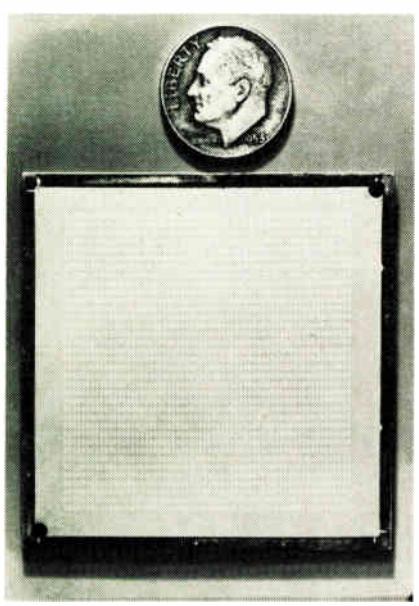
Example problem: Find weight of 0.005 in. tin coating applied to a 0.050 in. base wire.

$$D_1 + D_2 = 0.050 + 0.060 = 0.120$$
$$T = 0.005$$
$$\text{Density} = 0.264$$

Answer: 0.265 x 10^{-3} lbs. per linear inch of coated wire.

Fig. 2 is made specifically for round receiving tube cathodes and includes length of coating band so that final figure is total weight of coating on the cathode and is used as follows: Line 1 is drawn from A to C, intersection with B is marked. Length on D is connected to intersection on B and extended to F and intersection marked. Line is drawn from density on G to intersection on F and extended to E for final answer.

* * *



Memories—of Thin Film

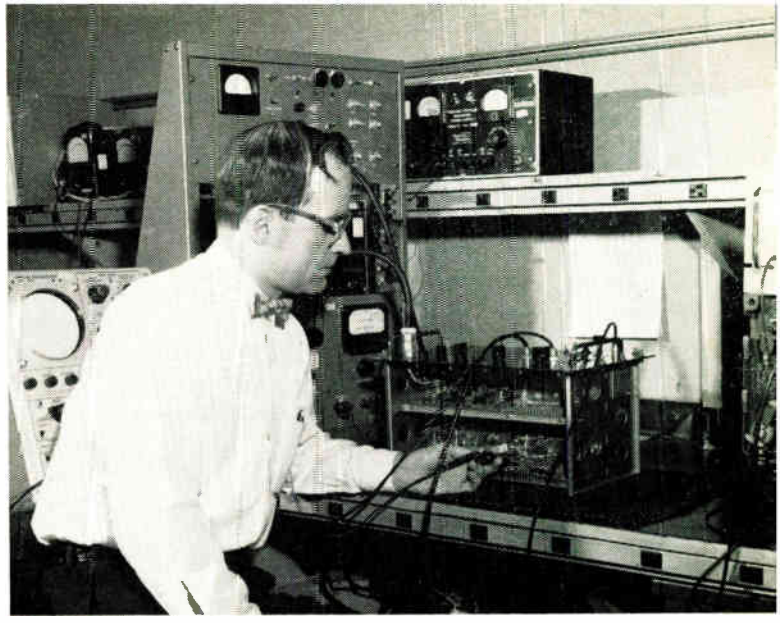
THE photo at left shows the substrate (actual size) for a magnetic thin film memory which has been developed and demonstrated at the Zurich Research Laboratory of IBM Corp. The pattern on the substrate is that of the 2304 information bits, each of which is actually a thin film.

The experimental memory contains 8 of these substrates, a total of 18,432 bits. Each bit is 0.012 by 0.026 in. They are only 2-millionths of an inch thick.

Highly polished silver planes were found to be best suited as substrate material. Polishing, and, in addition, covering the substrate with a thin evaporated layer of silicon oxide before the evaporation of magnetic material, solved the problem of reducing surface roughness.

Strip line wiring patterns for sense word and bit lines are placed on top of the magnetic array. These sheets consist of thin copper foil clad onto insulating material.

The experimental memory now under test, has been successfully operated at 100 nanoseconds read-write cycle time. First results show an access time of only 60 nanoseconds.



The author probes at a check point in the beam switching circuit of some equipment.

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Designing Beam Switching Circuitry

The beam switching tube gave the design engineer a device useful in counting and dividing operations. The Beam-X shrunk the size and removed the necessity of exterior magnets for these tubes. Here is how to design the working circuits.

THE "Beam-X" tube[1] is useful from static conditions to switching rates above 1 MC. Recent versions include high current and shielded models.

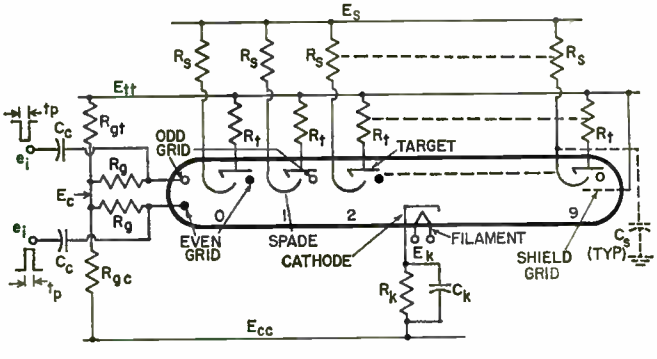
Let us interpret and tie together the steps required for a working circuit design. Many military systems use the BX-1000 and the BX-1100 (electrically identical, ruggedized version). So, let's use them as examples. We won't discuss the operating theory of these tubes to any length, since this is covered in the literature. Suffice it to say that the targets (anodes) are each made to conduct in turn, and that the total current which they conduct is available for external work, e.g., driving an amplifier or gate, lighting an indicator, or closing a relay.

The curves given here differ slightly from those in the data sheets; our changes are based on more recent data and assumed simplifications. The tube is not particularly critical. This gives the designer plenty of design latitude.

Typical beam switching tube circuitry is shown in Fig. 1. The terms used differ from those for vacuum tubes.

We should make brief mention of the triggering method; negative trigger pulses must be applied alternately to the two grids. One count is obtained for each negative trigger.

Fig. 1: Basic beam switching tube circuitry and terminology.



Resetting

Before applying this design method, a means of automatic resetting should be selected, if possible. Sometimes, the designer may wish to do this on the basis of the finished circuit. Then some minor circuit changes may be required to provide for resetting.

Usually resetting (beam formation) is achieved by momentarily reversing the polarity of the spade-buss-to-cathode voltage. This can be done by raising the cathode or lowering the spade buss. When a beam is not formed, electrons flow only to the shield grid. Only a fraction of a milliamp flows in this path and all electrodes assume essentially the voltages of their respective supplies.

Basic beam switching principles apply to devices for counting (subtraction), random pulsing, noise and function generating, and others. Once the engineer has designed an event counter circuit he should be able to alter the drive circuits, combine the outputs, or whatever else is needed for his problem.

Beam Switching

(Continued)

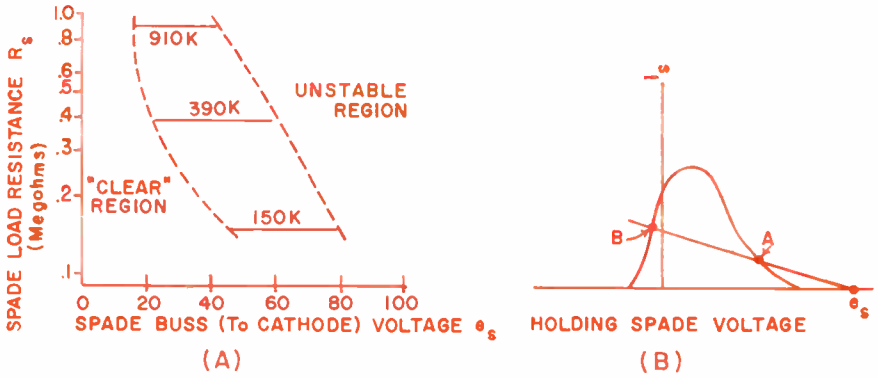


Fig. 2: The spade characteristics are used in the first step for designing circuitry.

Design Steps

The procedure for designing Beam-X circuitry is as follows:

1. Pick the spade operating point from Fig. 2a by selecting a value for the space load resistance R_s, and a value of the spade-buss-to-cathode voltage, e_s. A spade conducts when its target conducts, and at that time rides at a level below the cathode voltage. Fig. 2b shows a spade load line drawn on the characteristic curve, indicating the zero current buss voltage, e_s, an unstable operating point, A, and a stable operating point, B, at a negative level with respect to the cathode.

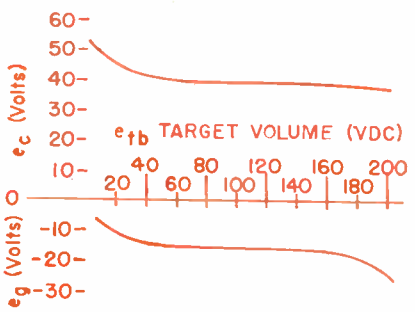


Fig. 3: The target-grid characteristics have a safety factor of 20 volts added to the data supplied by the manufacturers.

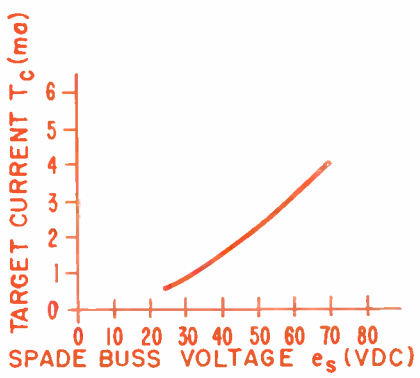


Fig. 4: The target-spade characteristics may also be used in the selection of the minimum spade-buss-to-cathode voltage.

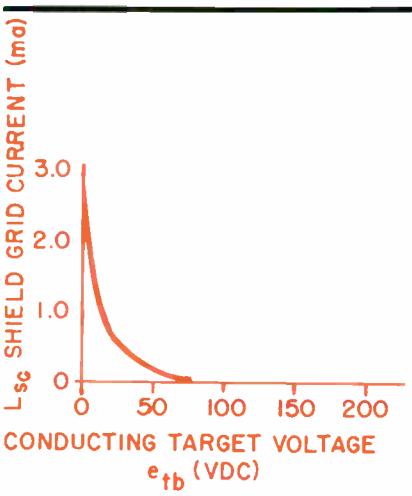


Fig. 5: The shield grid current can be found by using this target-shield curve.

The tube "spec" requires $e_s \leqslant 100$v for stable counting. A more complete "spec" is represented by the loci of the extremes in the R_s bars in Fig. 2a.

If e_s is too high, the counting will be random, even with no input signal applied. If e_s is too low, the tube will "clear," or cut off, and no counting can take place.

The useful output voltage desired (from each section) plus e_s may not exceed the voltage spread between the target supply voltage and the cathode. If a specific e_o is desired, select the target supply voltage, E_{tt}, and compute

$$e_s = E_{tt} - e_o - E_k$$

after step 3, or by use of

$$E_s = E_{tt} - e_o.$$

Fig. 4 might also be used to select a minimum e_s if a particular output current is desired.

The most frequently used value for R_s is 150K. It indirectly permits the highest target load currents; but, lower supply voltages may dictate a higher R_s to use a lower value of e_s and specify an operating point nearer the center of a resistance bar, Fig. 2.

Little can be gained by choosing an R_s other than one of the three standard values shown. Even very large changes in R_s have a negligible effect on the target current i_t, which is the tube's useful output. There is an important dependence of i_t upon the spade buss voltage e_s: higher values of e_s permit higher i_t values, Fig. 4.

Cathode Voltage

2. Pick the cathode voltage E_k. Making $E_k = E_{cc}$ is preferable if no cathode signal is required. No cathode bias is required by the tube itself, and it is best to use none unless other considerations dictate it. No generalized stability limits by R_k can be stated, since stability may also be affected adversely by a widely scattered component layout of the spade circuitry, high counting rates, and sometimes, use of the cathode for resetting. Thus satisfactory cathode impedances may be higher for some designs than for others.

If E_s has been selected in step 1, E_k is known by definition to be

$$E_k = E_s - e_s.$$

3. Assume $e_{tb} = e_s$.

4. Find e_c and e_g, using Fig. 3. A safety factor of

20 volts has been added to the manufacturer's data in deriving the e_c vs. e_{tb} curve.

5. Compute $E_c = e_o + E_k$.

6. Pick the grid bleeder current, I_{gb}, based on convenience and operating economies.

7. Pick E_{cc} and E_{tt}.

8. Compute $R_{gc} = (E_c - E_{cc})/I_{gb}$.

9. Compute $R_{gt} = (E_{tt} - E_c)/I_{gb}$.

10. Choose the grid return resistor, R_g. About 100K should do. Higher values may permit grid current leakage to set the grid voltages at a level other than the E_c determined by the bias bleeder. Lower values may be acceptable if they do not load the source of the grid triggers.

Input Drive Frequency

11. Select the input drive frequency, f, to the first counter stage. If irregular triggers are to be used, or a square wave of less than 50% duty cycle, it should be considered that $f = 1/t_p$ where t_p is the width of the fastest input drive pulse to be encountered, or the shortest time between counts.

12. Compute the input trigger pulse amplitude,

$$e_i \leqslant e_g - e_c.$$

As a rule of thumb, $e_i = e_g$.

13. Compute $C_c \leqslant 1/(3\ R_g\ f)$ or $C_c \leqslant t_p/3\ R_g$.

These coupling capacitors permit the grid to return to static conditions before application of the next trigger.

14. Compute the spade current $i_s = 1.05\ e_s/R_s$.

The 1.05 is an assumed factor. It is based on the fact that the voltage on a conducting spade drops below the cathode voltage by approx. 5% of e_s. Spade buss current will be higher than this for counting rates above 100 KC, since at these rates, one spade may not have cut off entirely before the next one conducts, and more than one spade will be conducting part of the time.

Table 1—Glossary

C_s equalizing capacitor for spades other than the reset spade
C_{ss} capacitor for the reset spade
e_c grid to cathode voltage requirement for stable operation
E_c grid to ground voltage for reliable stable operation
e_g grid to cathode voltage requirement for switching
e_i minimum grid swing required for switching
e_o target voltage swing
E_s spade to ground voltage of non-conducting spade
e_s spade to cathode voltage of non-conducting spade
e_{tb} voltage, conducting target to cathode
E_{tb} voltage, conducting target to ground
f input drive frequency
I_{gb} current in grid bias bleeder
i_s current in conducting spade
I_{sb} spade bleeder current
i_{sg} screen grid current
i_t target current
i_{tr} target current through target resistor Rt
n number of counter tubes used for full count
R_s spade resistor
R_{s1} part of spade resistor in starting section, high side
R_{s2} part of spade resistor in starting section, low side
R_{sc} spade bleeder resistor, low side
R_{sh} spade bleeder resistor, high side
t_p shortest time between counts; width of fastest drive pulse
T_r rise time of reset pulse

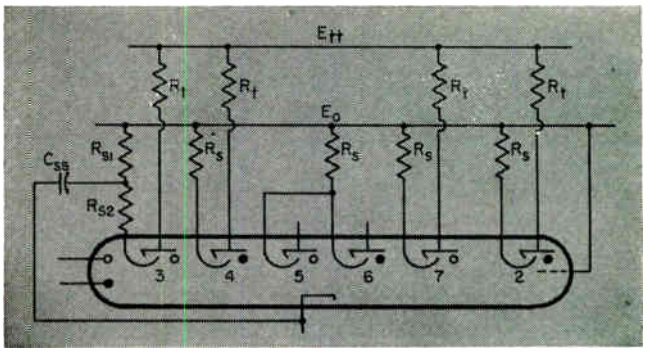


Fig. 6: Circuit used to skip pairs of counts (5 & 6), and to reset to a particular section (3). Target resistors may be desirable in skipped sections as is explained in the text in step number 22.

15. $e_o = E_{tt} - E_s$ may now be computed if not already known as a circuit requirement.

16. Find i_t from Fig. 4.

17. Compute i_{tr}.

18. Compute $R_t \geqslant e_o/\ i_t$.

19. Find the shield grid current i_{sg} using Fig. 5.

20. Compute the cathode resistor value:

$$R_k = (E_k - E_{cc})/(i_t + i_s + i_{sg}).$$

If no R_k is used, skip to step 22.

21. Pick C_k. If C_k is too low, transients may cause a tendency of the beam to "clear." If C_k is large, the duration of any reset pulse must be controlled to prevent the skipping which may occur after resetting by a pulse which is too long. 200 pf is normally adequate, less often suffices.

Number of Sections

22. Select the number of sections to be used within the tube. If all ten sections are to be used, then all will use similar impedances, i.e., a 10K resistor and a 10K relay may be considered to present similar loads. If an even number of sections less than ten is to be used, adjacent pairs of spades may be shorted together and connected to the spade buss through a common load resistor R_s, Fig. 6. Both spades thus connected will be unstable and, therefore, skipped in the counting procedure, but they must be adjacent due to the even-odd control grid arrangement. A finite switching time, 4 μsecs, is required for each section to be skipped, so this technique is limited in counting rate to about 100 KC. If more than one pair of sections is to be skipped, they should be separated by one or more useful sections unless the counting rate is proportionately lower. For some uses R_t may be deleted from the skipped sections, although such sections are susceptible to the formation of a beam when the circuit is first started. Such a circuit will count properly, but may not reset to the section desired.

If an odd number of sections is to be skipped, all but one should be skipped in pairs as above. A signal

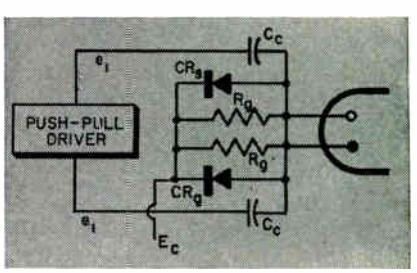


Fig. 7: This circuit provides dc restoration when the drive frequencies are too high to permit the grid network time constant to differentiate the input square waves.

Beam Switching *(Concluded)*

taken from the target of one of the normally connected sections can be fed back to the driver circuit in such a way as to deliver one extra trigger to the counter tube. This causes it to move the beam quickly to the next section. This method is subject to the same time limitations as above, although single sections can be skipped at counting rates up to about 200 KC. Normally, this is not the limiting factor, since sections are usually skipped in the last (slowest) of the tubes used. It is possible but not necessary, to count to 10^n-1 by using n counter tubes.

23. Pick the section to which the beam should form initially—the "zero point" of the count. This spade resistor may be split for reset purposes, Fig 6, but the relation

$$R_s = R_{s1} + R_{s2}$$

must be observed to prevent changes in grid triggering characteristics. R_{s2} may be reduced as low as zero within this limitation; this has been found to be a satisfactory arrangement.

24. Compute a value for the reset spade capacitor: $C_{ss} \geqslant 10T/R_{s1}$. T_r, the recovery time of the reset pulse, need only be a few nanoseconds.

25. Select the spade capacitor C_s. The maker suggests 39 pf to equalize and swamp stray wiring capacities. This writer has found that if the spade resistors are kept close to the tube socket, C_s can be neglected for drive frequencies to 100 KC and beyond.

26. If drive frequencies are too high to permit the grid network time constant R_gC_c to differentiate the input square waves, diodes CR_g should be added across the grid returns for DC restoration, Fig. 7.

27. If spade resetting, rather than cathode resetting, is to be used, E_s can be conveniently derived from a voltage divider across the E_{tt} and E_{cc} supplies to permit the spade buss to be lowered rapidly below the cathode voltage by a capacitively coupled pulse.

28. Select I_{sb}, spade bleeder current, based on convenience and dissipation economies.

29. Compute $R_{st} = (E_{tt} - E_s)/(i_s + I_{sb})$.

If $E_{tt} - R_{st}I_{sb} - E_{cc} > 100$ volts, select a higher I_{sb} and repeat step 29.

30. Compute $R_{sc} = (E_s - E_{cc})/I_{sb}$.

Summary

Tubes of this type do not conduct when initially turned on, but must be made to do so by forming an electron beam in one of the sections. This can be done manually on the bench by momentarily shorting the cathode to the spade of the section which it is desired to make conducting. Once a beam is formed, the driver circuit is then in control, and ready to step the beam from one section to the next each time a negative pulse is properly applied to one of the grids. Several more sophisticated methods for automatic beam formation and resetting have been developed, and circuit diagrams of them are available in the maker's literature.

References

1. A development of Burroughs Corp.
2. Burroughs Corp., Brochure #535, "Beam-x Switch."
3. Burroughs Corp., Data Sheet #1000.
4. Burroughs Corp., Bulletin 826A, "Decade Counters with Beam Switching Tubes and Nixie Indicator Tubes."

Gaging for Quality Control

TODAY'S computers, missiles, and control systems involve thousands of electrical connectors. A single loose or faulty one in thousands can cause malfunction and failure Many of these connections are made with solderless mechanical devices.

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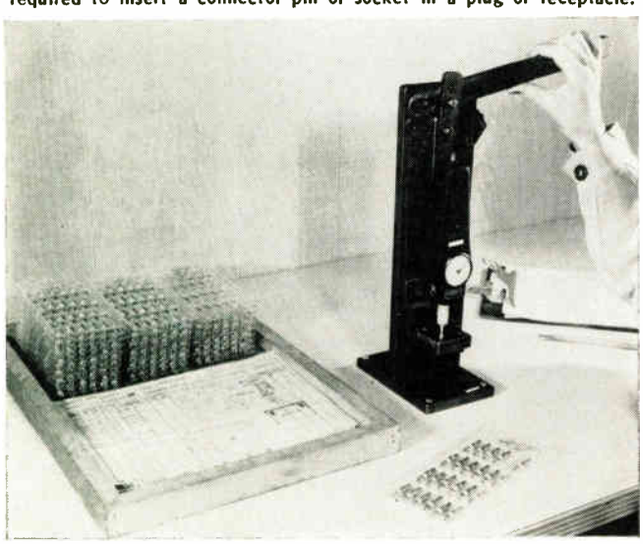

The Burndy Corp., Norwalk, Conn., makes millions of small solderless connectors per year in their Omaton Division. The Burndy Hyfen® connector, a mechanical solderless connector for wires, consisting of pins and sockets held in place by snap-lock springs, is typical.

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To check the mechanical performance of their connectors Burndy has standardized on the Hunter Mechanical Force Gage made by Hunter Spring, a division of AMETEK, Inc., Lansdale, Pa. The gage is an individually calibrated instrument employing a fully compensated precision spring system accurate to 0.5% of maximum capacity.

In most cases, statistical quality control procedures are used.

In other cases, such as when a new supplier is involved or a new machine or jig is being introduced, Burndy performs 100% inspection and analyzes the results. Evaluation of the range and distribution of test values, and the materials, machines and processes involved may suggest changes that can be made to

(*Continued on page* 214)

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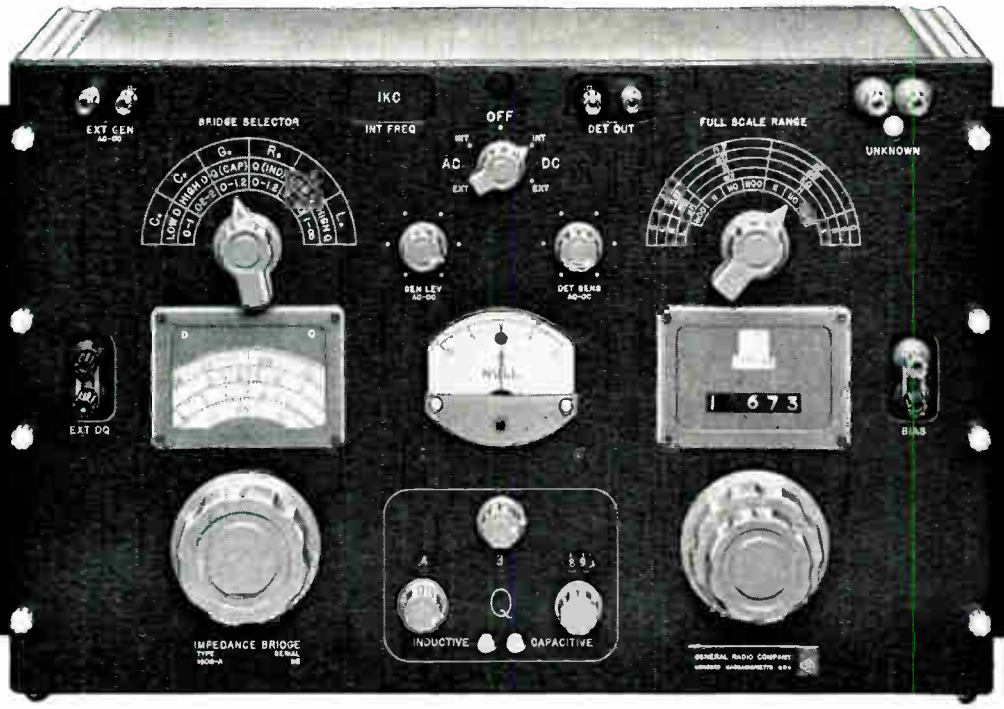

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at 1 kc: D (series C): 0 to 1 — D (parallel C): 0.02 to 2
Q (series L): 0.5 to 50 — Q (parallel L): 1 to ∞
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Accuracy (at 1 kc): ±0.1% of reading ±0.005% of full scale except on lowest R and L ranges and highest G and C ranges where it is ±0.2% of reading ±0.005% of full scale. D and 1/Q accuracy are ±0.0005 ±5% at 1 kc for L and C; ±0.0005 ±2% in Q for R and G.

Residual Terminal Impedance: R ≈ 1 mΩ, C ≈ 0.25 pf, L ≈ 0.15 μh.

Power Requirements: 105-125 or 210-250 volts, 50-60 cycles.

Type 1608-A Impedance Bridge, $1175.
For rack mounting (1608-AR) or bench (1608-AM).

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I.R.E.—And The Golden Age of Electronics

FIFTY years ago the IRE was founded—a merger of the Society of Wireless Engineers (22 members) and the Wireless Institute (25 members). In this, its golden anniversary year, the IRE is deeply engrossed in the possibility of another merger—itself (97,000 members) with the AIEE (66,000 members). The new organization which would be called the Institute of Electrical and Electronic Engineers (IEEE) would have over 150,000 members. There are a few thousand engineers who belong to both organizations already.

Could the founders—Alfred N. Goldsmith, John V. L. Hogan, and Robert H. Marriott—have had any idea on that May 13th evening in 1912 that their IRE might someday be the major contributor in the formation of the world's largest engineering society? We doubt that they could.

But the merger possibilities will be completely aired at a special session which will be held on Monday morning, March 26, in the Grand Ballroom of the Waldorf-Astoria Hotel. The discussion will be conducted by a panel comprising the eight-man joint committee which was formed by the two Boards of Directors (AIEE and IRE) to study the proposal. The audience will have an opportunity to ask questions from the floor. And, no registration fee will be required for this one session.

Technical Program

Let's look now at what might be the last IRE International Convention; for if the merger is approved, next year we will see the First IEEE International Convention and Electrical and Electronics Engineering Show.

If the attendance trend continues, this year more than 70,000 engineers will visit the Coliseum between March 26 and 29. Next year, it could reach 100,000!

A comprehensive program of 240 papers, covering the most recent developments in electronics and communications, will be presented in 54 sessions at the Waldorf-Astoria and the Coliseum. The high point of this program will be a special symposium on "Man

Do You Remember

1895—Marconi's first wireless signals at Bologna, Italy.
1899—Marconi flashed first signal across the English Channel.
1901—At Newfoundland, Marconi intercepted first transatlantic signal, the letter "S," from Poldu, England.
1906—Dr. Lee de Forest invented the audion 3-element vacuum tube.
1910—Caruso and Emmy Destinn singing at Metropolitan Opera House, broadcasted through de Forest radiophone, heard by operator on S.S. Avon at sea and by wireless amateurs in Connecticut.
1912—Through wireless, lives saved in SS Titanic disaster. David Sarnoff received signals on Wanamaker Bldg., N. Y. wireless station.
1912—IRE FOUNDED.
1913—Cascade receiver tuning.
1914—Regenerative circuit designed.
1915—Long distance radiotelephony accomplished (radio tube osc.).
1916—Station 2KC, New Rochelle, N. Y., began broadcasting music daily, except Sunday.
1916—Experimental radio broadcasting.
1917—Non-sag filament.
1917—First airborne radio telephony.
1918—Underwater radio transmission.
1918—Radio crystal oscillator.
1920—Commercial radio broadcasting begins.
1920—Station WWJ Detroit began operating a radiophone.
1920—Radio broadcasting began with KDKA Pittsburgh sending out Harding-Cox election returns.
1921—6 broadcast stations operating.
1921—Dempsey-Carpentier fight was broadcast from Jersey City through a temporarily installed transmitter at Hoboken, N. J.
1922—Telephone line used to interconnect broadcast stations.
1922—Superheterodyne receiver demonstrated by inventor, Edwin H. Armstrong.
1922—Station WEAF, N. Y., broadcast the first commercially sponsored program.
1923—Neutrodynes and magnetrons introduced.
1923—The first "chain" broadcast featured a telephone tieup between WEAF, N. Y. and WNAC, Boston.
1923—Picture of Pres. Harding was sent by the C. Francis Jenkins TV system between Washington and Philadelphia.
1923—First multiple station hookup by wire featured WEAF, N. Y.; WFY, Schenectady; KDKA, Pittsburgh and KYW, Chicago.
1924—First underwater radio controlled torpedo.
1924—Republican convention, Cleveland, and Democrat convention, New York, broadcasted for first time over nationwide networks.

HIGHLIGHTS
of IRE
Technical Program,
Page 129

and Sophisticated Communications" which will be held on Tuesday evening, March 27, at the Waldorf.

To help you better use your time at the Convention, the editors of *Electronic Industries* have thoroughly reviewed the complete technical program and have selected those papers which they feel will be the highlights. The list of these selections begins on page 129. As usual, many of the 850 firms which will be exhibiting will take this opportunity to introduce new products. A smattering of these begins on page 133. Best estimates are that over $15-million worth of the latest electronic equipment will be on display.

Social Events

General David Sarnoff, Chairman of the Board of RCA and former Secretary of the IRE, will be the principal speaker at the Golden Anniversary Banquet, which will be held on March 28 in the Grand Ballroom of the Waldorf-Astoria Hotel. Participants in the special banquet program, commemorating the fiftieth anniversary of the founding of the IRE, will include Patrick E. Haggerty, IRE President and President of Texas Instruments, Inc.; Lloyd V. Berkner, IRE Junior Past President and President of the Graduate Research Center; and Alfred N. Goldsmith, co-founder and Editor Emeritus of the IRE. Donald G. Fink, Director of the Philco Scientific Laboratories, will act as toastmaster.

During the banquet President Haggerty will present the annual IRE awards for 1962, including the Medal of Honor to Sir Edward N. Appleton, internationally renowned radio physicist and Principal and Vice Chancellor of the University of Edinburgh, Edinburgh, Scotland. The newly elected Fellows of the IRE will also be honored on this occasion, with Thomas F. Jones, Jr., Head of the School of Electrical Engineering, Purdue University, acting as spokesman for the Fellows.

Other social events will include a cocktail party Monday evening in the Grand Ballroom of the Waldorf and, for the wives, an entertaining program of tours, fashion shows and matinees.

1924–Factory built radios.
1924–Facsmile radio from London to New York carried pictures across Atlantic in 20 min. using the Ranger System.
1925–Radio direction finders.
1926–Beam transmission practical.
1926–Radio picturegrams.
1926–NBC organized, with WEAF and WJZ as key stations.
1927–Federal Radio Commission created (with Electronic Industries' founder, O. H. Caldwell, as first Commissioner).
1927–Federal Radio Commission clears air.
1927–CBS goes on the air with network of 16 stations.
1928–AC-operated radios. First TV transmission.
1929–Screen grid tubes.
1929–Dr. V. K. Zworykin demonstrated his kinescope or cathode ray TV receiver in Rochester, N. Y.
1930–Table model radios.
1930–Experimental TV transmitter W2XBS opened by NBC.
1931–AVC and auto radios.
1931–Experimental TV station W2XAB opened by CBS.
1932–Tests of centimeter waves.
1933–TV iconoscope used.
1934–Hi-fidelity sets.
1935–TV field tests begin.
1937–AFC, push-button tuning, radar used.
1938–Magnetic tape recorders.
1939–"Orthicon" developed; first TV sets sold; FM developed.
1940–Coaxial cable used in TV; Color TV demonstrated.
1941–Loran developed.
1942–Omni-directional radio range.
1942–Radar countermeasures.
1943–Present TV standards adopted.
1944–Radar homing missile.
1945–First atom bomb.
1946–First electronic computer built (ENIAC).
1947–Electronic heating popularized; PCM; traveling-wave tube.
1948–Transistors; SSB developed; dry electro-static printing.
1949–All-electronic color TV system.
1950–Intercarrier i-f's in TV receivers; ferrites developed as magnetic cores; photo-transistor.
1951–Junction type germanium transistor; 3-gun color TV crt.
1952–3 large-scale digital computers using electronic storage completed; all metal TWT; 15 kw klystron developed.
1953–Magnetic core memory; drum computer available commercially; practical color TV tubes; Project "Tinkertoy" developed.
1954–Solar battery.
1955–Peltier effect devices; TWT amplifier.
1956–Tropospheric - scatter systems; drift transistors - commercially available.
1957–Tetrode transistors.
1958–Maser (early research in 1955) and parametric amplifier commercially available.
1959–Tunnel diode.
1960–Project Echo; Thin films developed.
1961–Commercial FM-stereo broadcast.

First as a matter of record . . . SCOTCH® BRAND Instrumentation Tapes

World's widest tape selection offers heavy-duty constructions for every instrumentation need!

Today's stepped up pace for data recording calls for magnetic instrumentation tapes that stay cool despite ever-increasing transport speeds, greater tensions, high heat build-up at recording heads. And the "SCOTCH" BRAND Instrumentation Tape line, with a tape for every instrumentation requirement, now includes 16 heavy-duty constructions that conquer difficult operating environments.

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"400" series heavy duty tapes feature exceptionally long wear, excellent high and low frequency resolution. 8 constructions—.18 and .43 mil oxide coatings on .65, 1, 1.5 mil polyester backings; .56 mil coatings on 1 and 1.5 mil backings.

"500" series heavy duty tapes combine long wear, outstanding smoothness to assure sharp resolution of extremely high frequencies. 4 constructions—1 or 1.5 mil polyester backings; .18 or .43 mil oxide coatings.

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The Editors Select . .

Highlights of the Technical Program

These papers have been selected by the editors of EI as meriting your special attention. We have selected representative papers from a wide area—there are 54 technical sessions at which 240 papers will be presented.

SPACE AGE REQUIREMENTS FOR ELECTRONIC MEASUREMENTS

2.1. Space Program Requirements for Improved Electronic Measurements

Frank E. Goddard, Jet Propulsion Lab., Pasadena, Calif.

After a period of extensive study and planning, the National Aeronautics and Space Administration is launching an expanded space program which should lead to the landing of the first American on the moon about 1967. Other NASA programs include global systems of communication and weather satellites. In all of these programs the total cost, the safety of human life, and the prestige of the United States are strongly dependent upon the reliability of electronic systems. Achieving the necessary reliability will require the development of many types of improved instrumentation, measurement standards, and measurement techniques. This paper points out some areas in which increased emphasis is required.

2.4. Some problems of Improving Accuracy of Measurement

A. V. Astin, Director, Nat. Bur. of Standards, Washington, D. C.

The best information we have concerning the properties of matter and natural phenomena is quantitative information derived from measurements. The usefulness and reliability of such information increases with our ability to state it more accurately. Major elements in extending the accuracy of measurement data include better definition, isolation, evaluation or elimination of extraneous factors that invariably influence measured values as well as better sensitivity in the measuring instruments and techniques. Important also is an extension of our ability to evaluate the interrelationships among various quantitative parameters.

AEROSPACE RADAR

5.1. A New Approach to Radar Cross-Section Measurements

J. Richard Huynen, Missiles and Space Div., Electromagnetics Aircraft Corp., Sunnyvale, Calif.

Radar backscatter measurements are usually performed with two linear polarizations, such as horizontal and vertical polarization. The question arises whether this technique is adequate to define the target radarwise in a complete form. It turns out that this is not the case. This fact illustrates an inadequacy in the standard techniques of performing radar cross-section measurements since for every new state of transmitted energy a new pattern would have to be obtained. A new method is proposed which supplies complete radar target information in such a way that for any given state of transmitted energy the back-scattered return from the target is determined.

CIRCUIT THEORY

10.1. Subnetworks

P. S. Castro and W. W. Happ, Microsystems Electronics Dept., Lockheed Missile and Space Div., Palo Alto, Calif.

The logic governing the generation of subnetworks from multiterminal networks can be established by associating with each permissible network operation a suitably defined set of reductions in rank of the indefinite (or equicofactor) matrix of the network. Criteria for uniqueness and non-redundancy of subnetworks are defined and applied to evaluate representative large networks in terms of properties associated with generated subnetworks. Applications to microsystem electronics are outlined.

18.2. Coupled Mode Theory, with Applications to Distributed Transformers

V. R. Saari, Bell Telephone Labs., Inc., Murray Hill, N. J.

A set of transmission-line equations describing distributed systems which propagate two coupled modes is derived in this paper. Both uniformly distributed unsymmetrical systems and nonuniform symmetrical systems are considered. (An interesting class of solutions for second order differential equations with variable coefficients is described.) A simple three mode system is also analyzed.

Boundary conditions which specify networks having various impedance-transforming properties are applied to the general solutions, and two-port network parameters are derived. Equivalent circuits are also presented. Some practical aspects of applications in lumped-constant circuits are considered.

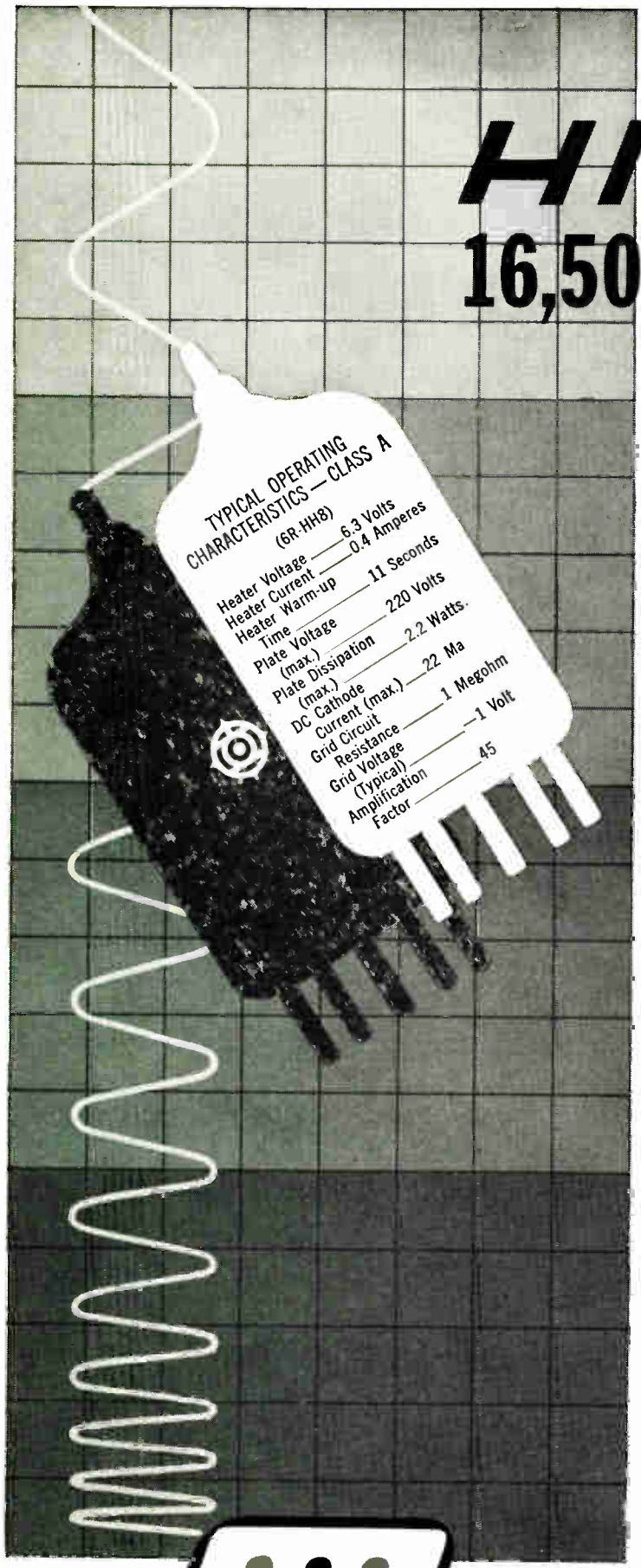
MILITARY ELECTRONICS

13.4. A Motion-Enhancement Display by Time-Compression

Munsey E. Crost, U. S. Army Signal Res. & Dev. Lab., Fort Monmouth, N. J.

To demonstrate the enhancement of detectability of moving targets in the presence of severe clutter, a display system of electronic time-compression was devised and constructed at USASRDL. Westinghouse Permachons were chosen as the storage tubes. Six cameras were arranged around a central PPI cathode-ray tube. The cameras are exposed sequentially to complete PPI scans by means of an intermittently-rotating optical system. Immediately before a new scan is to be recorded in a Permachon, the previously-stored information is erased. Simultaneously with these processes, the stored information is read-out sequentially at a much faster

(*Continued on page* 131)



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rate into a viewing monitor. The moving signals are readily visible as a series of six spots moving in the direction of the target's motion and repeating at an adjustable rate.

An electrical-input and electrical-output storage tube based on the use of a Permachon target is presently being developed to permit conversion of the system from an optical-mechanical-electronic system to an all-electronic system.

SPACE GUIDANCE

15.1. Radar System for Unmanned Cooperative Rendezvous in Space

Howard A. Reuter, Air Arm Div., Westinghouse Elec. Corp., Baltimore, Md.

Space refueling, assembly or rescue operations require terminal maneuvers for docking. To rendezvous and dock the chaser vehicle must know the range and bearing to the friendly target vehicle. Radar tracking is used to guide the space crafts during this phase of the mission.

A unique radar-transponder system, now in development, is described which can be used with unmanned satellites for long range acquisition, tracking and docking. Special circuits are described to provide improved range accuracy at very short ranges, and to coordinate angle track without conical scan or multiple receivers. The radar weighs 18 pounds and draws 30 watts.

15.5. Emergency and Routine Space Vehicle Recovery

J. B. Meyer and B. R. Mayo, GE Defense Systems Dept., Syracuse, N. Y.

The operating parameters of the electronic equipment are obtained from the accuracy with which the craft position is known at the lock-on range and the physical tolerances of the craft and crew. Frequency is chosen by weighing the need to see through rain against the need to see and communicate through the re-entry ion sheath. Tracker accuracies are dictated by the flare phase of the landing. Computer speed and storage capacity is determined by the manner in which the data must be presented to the pilot and the frequency with which new data must be available.

The salient features of a space vehicle recovery system designed to provide all-weather space craft recovery with maximum reliability are presented.

MICROWAVE DEVICES

17.2. The Multiple-Beam Klystron

M. R. Boyd, R. A. Dehn, J. S. Hickey, Superpower Microwave Tube Lab., Power Tube Dept., GE Co., Schenectady, N. Y., and T. G. Mihran, Res. Lab., GE Co., Schenectady, N. Y.

The multiple-beam klystron (MBK) is a device for extending klystron-interaction power generation capacity by a factor of ten or more. The MBK utilizes a multiplicity of electron beams in conjunction with multiwavelength waveguide circuits. The electron beams may or may not be enclosed in a common vacuum envelope. An MBK utilizing ten external-circuit klystrons has been built and tested for operation at 750 Mc. An RF power output ten times that of one klystron was measured with no loss of efficiency, gain, or band width. Individual beam drop-out tests showed no disruption of operation in case of beam failure.

17.4. The Properties of Thermo-Electric Elements as Microwave Power Detectors

S. Hopfer, N. H. Riederman, and L. Nadler, PRD Electronics, Inc., Brooklyn, N. Y.

The use of thermo-electric elements as microwave power detectors is based on the heating effect of RF currents in thin film thermopiles. The various problems such as the effect of RF vs dc on the thermo-electric output, the effect of film thickness on the thermal EMF, the optimization of the shape of the thin film elements, and the associated microwave circuit problems will be discussed. The performance of a coaxially mounted self-compensated thermopile for extremely low level power measurements will be given.

ARTIFICAL INTELLIGENCE: RECENT DEVELOPMENTS IN CONCEPTS AND HARDWARE

20.4. An Evaluation of Recent Development in the Field of Learning Machines

Oliver G. Selfridge, M.I.T. Lincoln Lab., Lexington, Mass.

The learning in a cooperative venture by man and computer is still primarily performed by the man; basically, the computer handles parameter optimization. The power of parameter optimization has been under- and over-estimated by many, and we are beginning to understand in what ways. These concepts are developed, and the contribution of the other papers in the session to the understanding and experience of such learning in computers is discussed.

MICROWAVE COMPONENTS

25.1. Superconducting Coaxial Delay Line

P. K. Shizume and E. Vaher, Air Armament Div., Sperry Gyroscope Co., Great Neck, L. I., N. Y.

This paper describes the results of work on a miniature superconducting delay line consisting of a ½-μsec coaxial line with a 0.010-inch-diameter niobium center conductor, solid Teflon dielectric, and 0.036-inch ID lead-tin alloy outer conductor. Measurement of attenuation in the line was made using both a resonant-cavity technique on short (3-inch lengths) samples of the line, and by direct measurement of attenuation through the ½-μsec length. The attenuation was found to be less than 2 db. Projected attenuation at 3 kMc is expected to be 0.3 db. Results are also given of measurements made on surface resistances of superconductors and loss tangents of dielectrics at temperatures below 4.2°K and at 9 kMc.

MICROWAVE MEASUREMENTS

33.3. Measurement of Effective Temperature of Gas Discharge Noise Sources

J. S. Wells, W. C. Daywitt, and C. K. S. Miller, Radio Standards Lab., Natl. Bur. Standards, Boulder, Colo.

This report describes a system for calibrating microwave noise sources in the range of 8.2 to 12.4 Gc. Included are a discussion of the reference standard, an error analysis of the standard source and the comparison system, and evidence of system performance. The results of measurements indicate that the excess noise ratio of a commonly used noise source is 15.6 db at 9.8 Gc. A sample calculation of the effective noise temperature at the terminal surface of the standard source is given.

DIGITAL COMMUNICATIONS

38.3. Comparative Performance of Digital Data Transmission Systems in the Presence of CW Interference

Frank G. Splitt, Cook Technical Ctr., Morton Grove, Ill.

During the last decade there has been a considerable amount of work done on the analysis of digital data transmissions in an interference environment. With few exceptions, the type of additive interference considered is normal noise. This paper treats the case where the interference consists of CW that falls within the pass band of the receiver. The results obtained can also be utilized to ascertain system performance in the presence of interference from similar systems and for certain classes of interrupted CW (ICW) interference.

SPACE AGE COMPONENTS

42.5. The Effect of Radiation Environment on Film Resistors

L. Wurzel and S. O. Dorst, Resistor Div., Sprague Electric Co., Nashua, N. H.

Molded film resistors which had been subjected to simulated space en-

(Continued on page 158)

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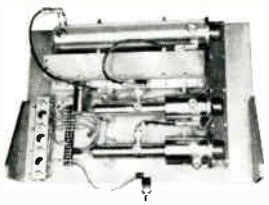
TYPE 2969X3 X-BAND HARMONIC GENERATOR — Requires 150 to 175 VDC at less than 12 ma and 6.3 V at 240 ma. One adjustment covers 8800 to 9000 Mc range with minimum of 5 mw output power.

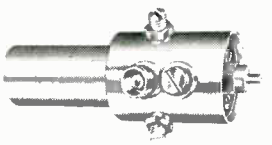
TYPE 2975 CW OSCILLATOR — Frequency 2 KMc, tuneable ± 20 Mc; power output 15 watts CW. Size 3½" by 2½" diameter. Weight 1 lb. Type 2975A CW amplifier with same specifications and power gain of 10 DB.



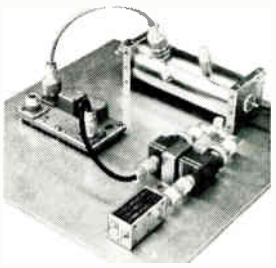
TYPE 2974 HARMONIC GENERATOR — Greater than 30 watts CW output at 942 Mc. 1 watt CW input at 157 Mc. Consists of 2974X3 tripler, 2974X2 doubler and two 2974A amplifiers. Component vol. less than 900 cubic in.

TYPE 9181 OSCILLATORS — Microminiature "C" Band for CW service. CW output up to 6.0 KMc. Tuning range of about 300 Mc. Size ⅝" diam. by 1½" approx. length. Weight 1 oz.

TYPE 9183 PULSE AMPLIFIER — 15 KW peak power output at 1030 Mc, 8 DB gain. Isolation between input and output is greater than 50 DB in OFF condition. 1 microsec. pulse at 1000 PRF.



TYPE 9182 OSCILLATORS — "L" Band plate pulsed, 1 KW min. power output. Available at frequencies from 1 Gc to 1.5 Gc, TUNEABLE about 50 Mc. Size 1½" diam. by 5" long. Weight 6½ oz.



TYPE 2971 RF ASSEMBLY — Transmitter receiver system, nominal operation frequency 1.6 KMc. Solid-state duplexer, balanced mixer, in strip-line design insures maximum reliability and small size. Typical system characteristics: 5 KW min. peak transmitter output at a duty cycle of .0033 max., receiver tangential sensitivity of —96 DBM min. (assuming 290°K antenna temp. and a 1.5 DB IF NF); system wgt. 3 lbs. max.; component vol. 100 cubic in. max.

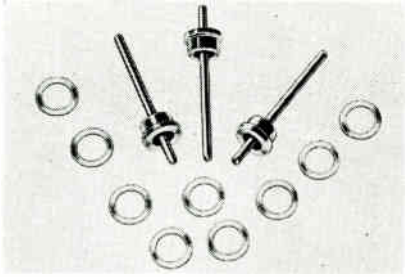
TYPE 2970 (CW) LOCAL OSCILLATORS — Power output greater than 5 mw. over entire C-Band. Temp. stability less than ± 2 Mc from —20°C to +105°C. Diameter ⅞", length 2". Weight 3 oz.

TRAK OSCILLATORS COVER 440 Mc TO 6200 Mc.

Miniature and microminiature oscillators cover all bands — from 440 Mc to 6200 Mc. These are stock items and include TYPE 2958 covering 440 Mc to 1400 Mc, TYPE 2959 — 1400 Mc to 1700 Mc and TYPE 9127 — 1700 Mc to 6200 Mc. Plate pulsed, grid pulsed or CW service. Mounting is to customer specifications.

The above will be exhibited at IRE Show — Booth 3802-04.

Specialists in Microwave Energy Sources



High Temperature Solder

Alpha 525 has a melting point of 525°C and is available in washers, discs, squares and spheres. It is useful where glass-to-metal or ceramic-to-metals are involved. Alpha Metals, Inc. BOOTH 4328.

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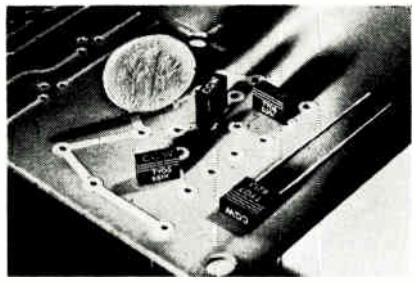


Capacitors

Glass dielectric capacitors, in insulating plastic shells to eliminate inter-component shorting, have gold-flashed radial leads 1¼ in. long and set 0.200 in. apart. Corning Electronic Components. BOOTH 2619.

Circle 239 on Inquiry Card

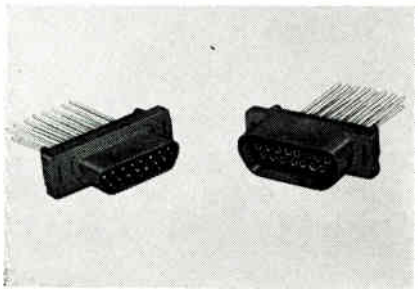
Programmable Ratio Box

Model PRB-506 (3½×1½×12¼ in.) has induction voltage dividers whose ratio setting can be externally set by Binary Coded Decimal inputs from punched tape, etc. North Atlantic Industries, Inc. BOOTH 3933.

Circle 241 on Inquiry Card

Miniature Plugs

The Micro-D series of plugs use Micropin® and Microsocket® contacts, giving contact spacing on 0.050 in.



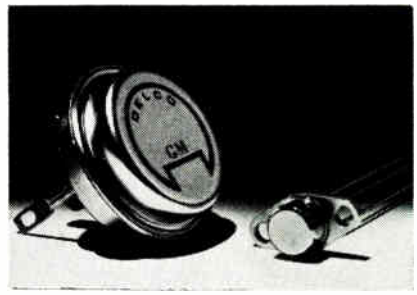
centers and max. contact density of 420 contacts/sq. in. Cannon Electric Co. BOOTH 2727.

Circle 237 on Inquiry Card

See these Products at IRE

Power Transistors

Silicon power transistors have BV_{CBO} ranging between 400-800v. Units in TO-37 package have a cur-

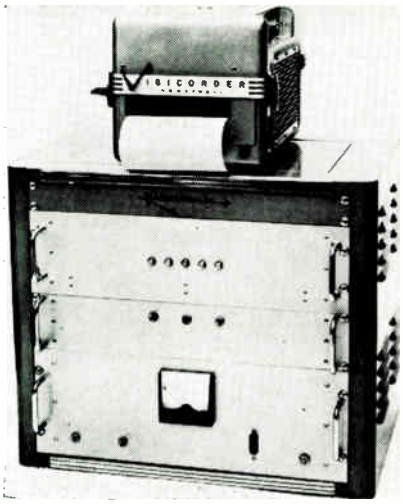


rent gain of from 40-100 @ 0.75a. Delco Radio, Div. of General Motors. BOOTH 1423.

Circle 242 on Inquiry Card

Temperature Calibrator

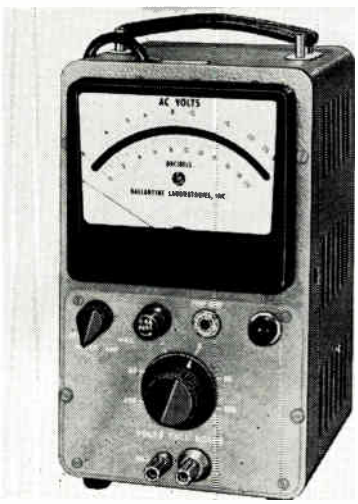
This Thermocouple Input Conditioning and Calibrating System, Model 16T-100, aids in accurately recording dynamic temp. variations. It has individual calibration resistors. B & F Instruments, Inc. BOOTH 3239.



Circle 238 on Inquiry Card

VTVM

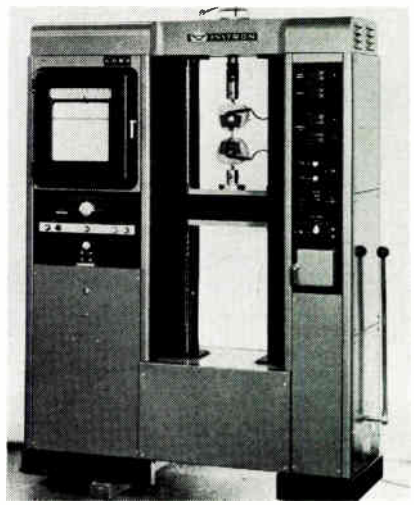
Model 300H measures voltages from 30μv to 300v, over a freq. band of 10CPS to 1MC. Accuracy is 2% to 700KC and 3% above at any point on the scale. Ballantine Laboratories, Inc. BOOTH 3402.



Circle 240 on Inquiry Card

Materials Tester

Instron, Floor Model Materials Testing Instruments are able to measure stress-strain forces at loads as low as 2 grams or to more than 10,000 lbs. Instron Engineering Corp. BOOTH 3053.



Circle 243 on Inquiry Card

Closer tolerances in your

PRECISION EQUIPMENT

FOR ONLY A FEW CENTS MORE

with **Wilrite Metalloy**

1%

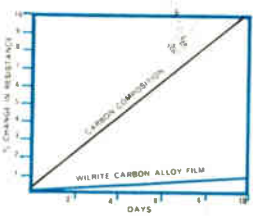
CARBON FILM RESISTORS

Greater precision and greater stability can be built into test equipment and other precision devices with the use of Wilrite's ½ watt, 1% film resistors, series CMC (Military Type RN-65). These units are only slightly higher in price than 5% carbon composition resistors, but provide greatly improved performance.

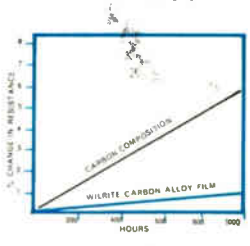
These resistors are fabricated by Wilrite's patented "Metalloy" process that deposits a hard crystalline carbon alloy film on a ceramic substrate. The film cannot scratch or rub off. This is coated with an exclusive silicone formula and cured. A resin impregnated kraft sleeve provides excellent mechanical and additional electrical protection.

The Series CMC resistors are rated at 70°C, full load, and derate to zero at 150°C. They can also be supplied to closer tolerances on special order.

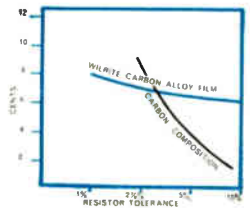
MOISTURE RESISTANCE



AGING STABILITY



COST VS. TOLERANCE



WILRITE—Film Resistors built to MIL-R-10509D

Type CMG
Hermetically Sealed—
meets MIL characteristic B
(150°C)

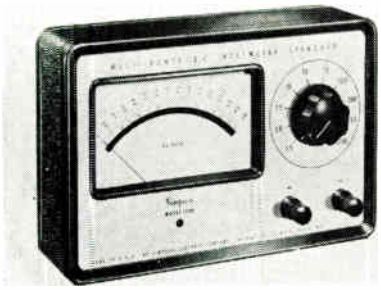
Type CMI
Silicone Resin Molded—
meets MIL characteristic D
(165°C)

Type CMH
Ceramic encased—
meets MIL characteristic G
(165°C)

W-6216

WILRITE PRODUCTS, INC.

A SUBSIDIARY OF GLOBE-UNION INC.
938C E. Keefe Street • Cleveland 11, Ohio
in association with
Centralab, the Electronics Division of Globe-Union Inc.



DC Voltmeter

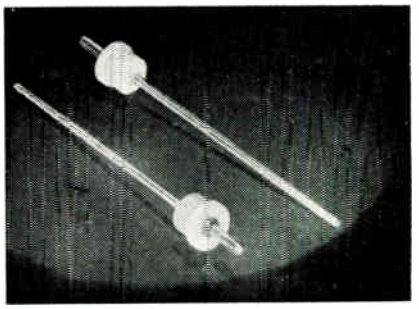
Model 1700 DC Voltmeter, is one of a new line of laboratory standards for general industrial lab. testing, plant incoming inspection and production line uses. Simpson Electric Co. BOOTH 2321.

Circle 244 on Inquiry Card

Size 5 Servo Motor

The size 5 (0.5 in. dia.) and also size 8 (0.75 in. dia.) servo motors are designed for 400CPS excitation and are enclosed in corrosion-resistant stainless steel cases. Sangamo Electric Co. BOOTH 2311.

Circle 247 on Inquiry Card



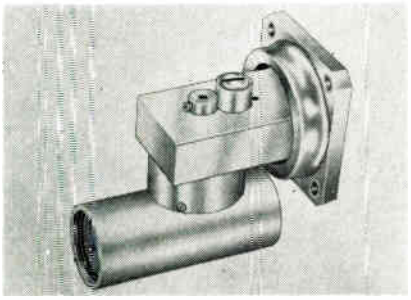
Terminals

New "Press-Fit" terminals include a series of long pigtail lead models giving a direct conductor path to a component or termination without a second soldering operation. Sealectro Corp. BOOTH 2344.

Circle 249 on Inquiry Card

Harmonic Generator

Type 2969X3 harmonic generator is suited to X-Band local oscillator uses and has a single adjustment to cover



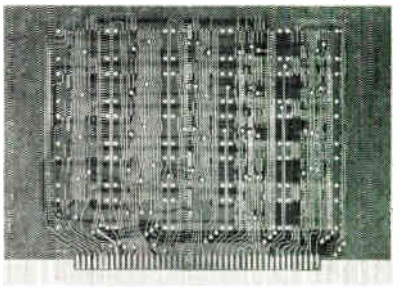
8,800 to 9,000MC with a min. of 5mw output power. Trak Microwave Corp. BOOTH 3802.

Circle 245 on Inquiry Card

See these Products at IRE

Printed Circuits

Using a miniaturization process called "Mini-Pad," printed circuit boards can be reduced considerably in

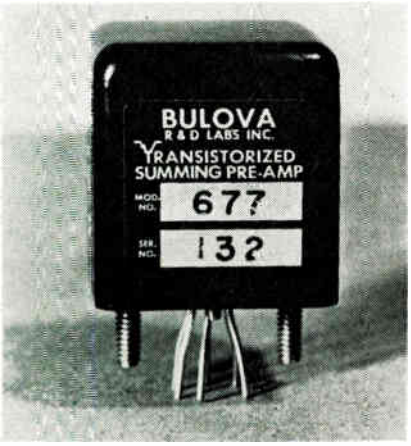


weight and up to 50% in size, without sacrificing reliability. Photocircuits Corp. BOOTH 2201.

Circle 250 on Inquiry Card

Miniature DC Preamp

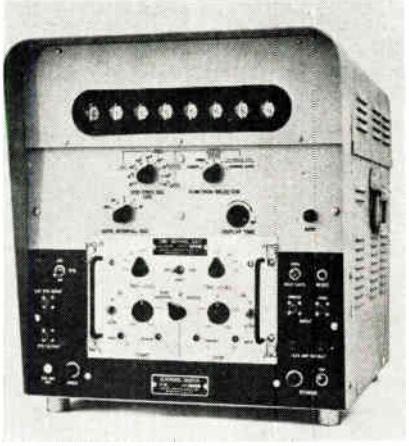
A miniature high-freq. summing "buffer" amplifier, Amp 677, is designed for airborne or missile uses, weighs 1 oz. and occupies 1 cu. in. Electronics Div. of Bulova Watch Co., Inc. BOOTH 1821.



Circle 246 on Inquiry Card

Electronic Counter

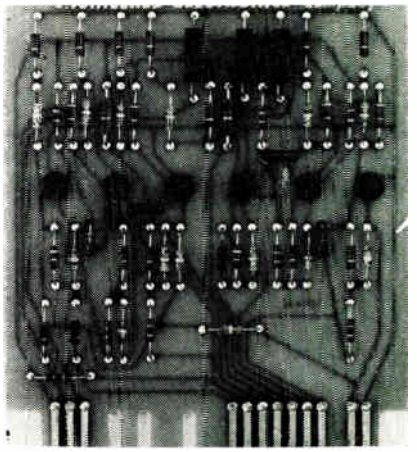
The LA-80B Electronic Counter provides in-line, 8-place readouts of measured freqs. or time intervals. The range of freqs. is from 10CPS to 10MC. Lavoie Laboratories, Inc. BOOTH 3815.



Circle 248 on Inquiry Card

Digital Modules

This family of transistor circuit modules, designated the G-series, is designed for operation at frequencies up to 10MC. Units measure 4½ x 5 x 1/16 in. Engineered Electronics Co. BOOTH 1425.



Circle 251 on Inquiry Card

Where even a water mark can cause trouble,
ultrasonic cleaning makes the crucial difference...

15 X

and in ultrasonic cleaners—

GENESOLV® D FLUOROCARBON SOLVENT

can make the clean difference!

Ultrasonic cleaning is only as good as the solvent you use! In critical precision guidance and electronic components, foreign matter 1/40th the diameter of a human hair can cause malfunction. Fingerprints, water marks, specks of dust, lint, epidermis and many other contaminants are potential trouble makers. Your ultrasonic cleaning material must itself be super clean . . . and effective against a wide range of contaminants, while non-injurious to the parent material.

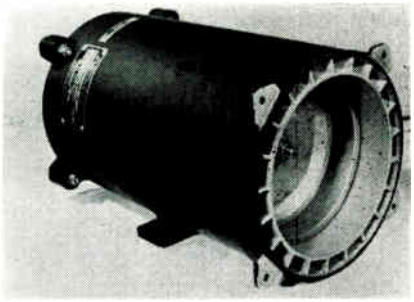
GENESOLV D Fluorocarbon Solvent offers the exceptional purity you need . . . plus these other specific advantages in ultrasonic cleaning operations:

- ✔ *extremely low undissolved and dissolved residue*
- ✔ *selectivity*
- ✔ *low toxicity*
- ✔ *nonflammability*
- ✔ *low surface tension (increased wettability, with minimum dragout)*
- ✔ *quick drying*

Find out now about GENESOLV D's special effectiveness. Our Technical Service constantly is developing new data, and would be pleased to work with you on your cleaning problems. Write or phone your nearest General Chemical Office.

Allied Chemical

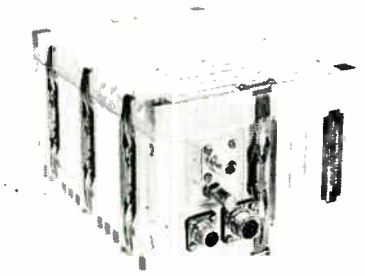
GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.



Cooling Blower

Compact 4-stage, SVA 540-14375 vane-axial blower unit, is 5.6 in. in dia. and 10 in. long, produces 120cfm against static pressure of 2.7 in. of water at 3450rpm. The Torrington Mfg. Co. BOOTH 2929.

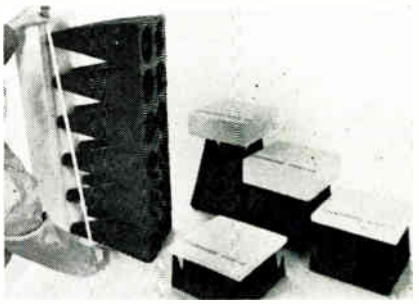
Circle 252 on Inquiry Card



Command Receiver

The ARW-62 Missile Command Receiver has receiver, decoder and power supply in a single pressurized package. It operates in the 405 to 450MC band. Avco Electronics and Ordnance Div. BOOTH 3830.

Circle 255 on Inquiry Card



Microwave Absorber

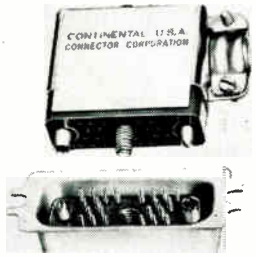
The ECCOSORB CV-B series, including CV-B 18, CV-B 12, CV-B 9, and CV-B 6, together cover the freq. range from 200MC to 50GC at a reflectivity level of —40db. Emerson & Cuming, Inc. BOOTH 4222.

Circle 257 on Inquiry Card

See these Products at IRE

Connectors

Line of center screwlock miniature connectors, Series 1900-20, available in 10 and 22 contact sizes. Both types



have a current rating of 5a continuous operation. Continental Connector Corp. BOOTH 2307.

Circle 253 on Inquiry Card

Ceramic Tube

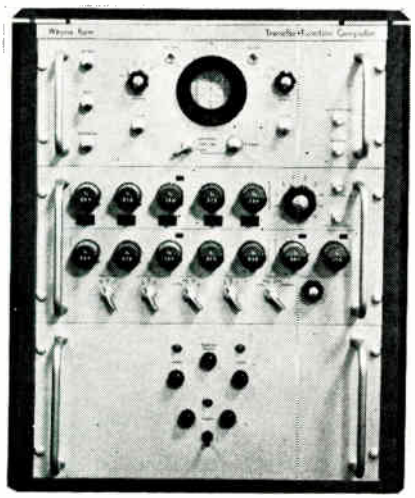
This Velocitron™, ZV 1021, is an external cavity type, reflex klystron. It operates throughout the 2 octave

freq. range, 1,000-4,000MC, giving 200mw min. power out. Polarad Electronics Corp. BOOTH 3302.

Circle 258 on Inquiry Card

System Analyzer

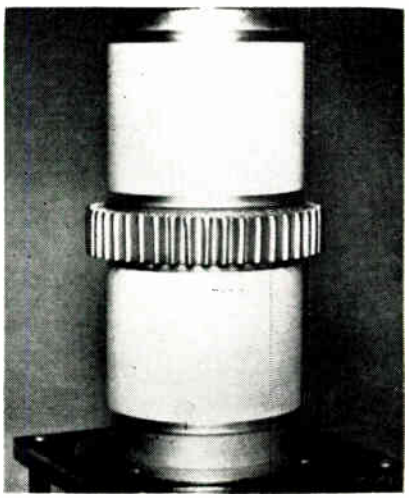
Transfer Function Computer, Type SA100, not only measures systems but also analyzes them concurrently with the measurement, providing answers in a matter of minutes. Wayne Kerr Corp. BOOTH 3634.



Circle 254 on Inquiry Card

Hydrogen Thyratron

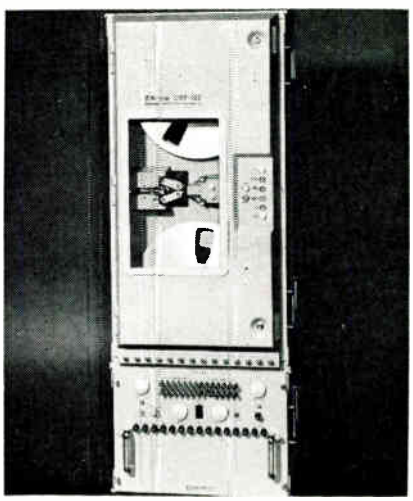
The ZT-7000 will have an average power capability of 100kw and an anode voltage of 33kv. The current capacity will be 7.0a average. General Electric Co., Power Tube Dept. BOOTH 2912.



Circle 256 on Inquiry Card

Video Tape Recorder

This transportable recorder, Model CMP-100, is designed to provide up to 1.2MC bandwidth; measures 39½ x 20 x 14 in., and weighs 277 lbs. Mincom Div., Minnesota Mining and Manufacturing Co. BOOTH 3243A.

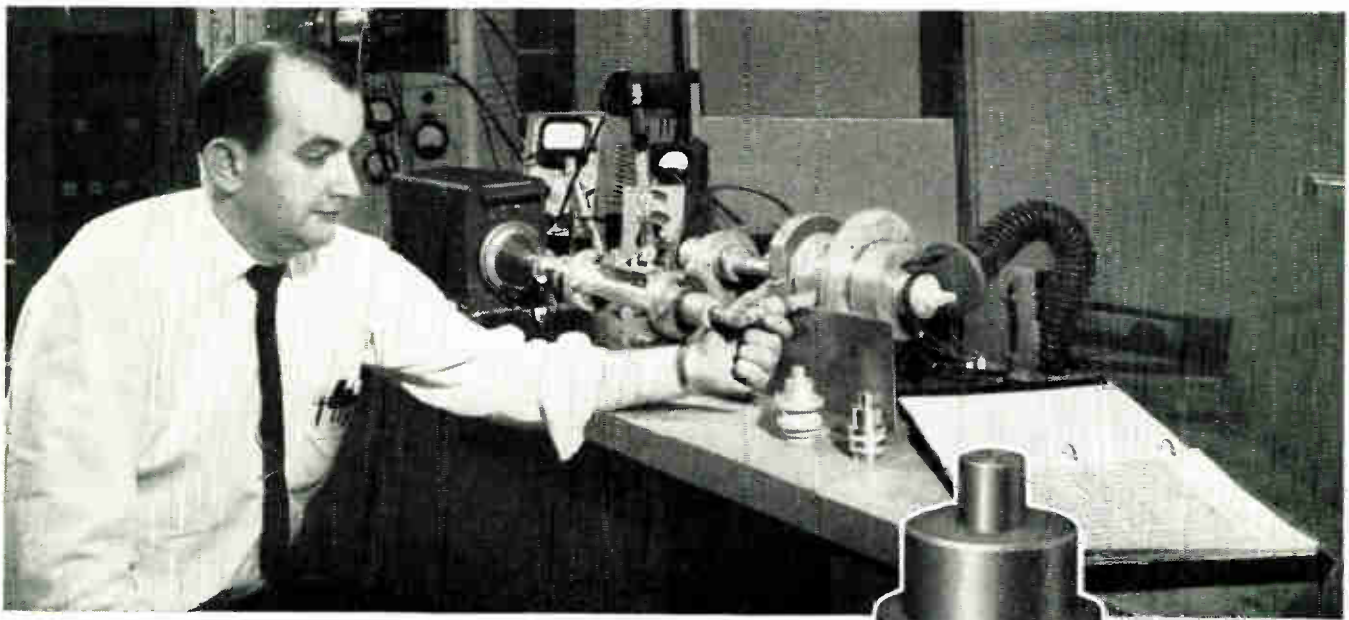


Circle 259 on Inquiry Card

ELECTRONICS
PROGRESS IN L-BAND TECHNOLOGY

G-E TETRODES AND TRIODES OFFER: . .

HIGHEST AVAILABLE POWER AND DUTY RATINGS TO MEET NEW IFF REQUIREMENTS



GL-7399 long life is proved in IFF cavity designed by Power Tube Department.

ZP-1025 (shown 2⅜" actual size) reflects design trend in G-E IFF tubes.

New General Electric metal-ceramic, negative-grid transmitting tubes permit operation at peak power levels up to 10 kw and duty cycles up to .02.

Their outstanding electrical performance and compact mechanical construction simplify military and commercial IFF equipment design, with greater reliability for airborne and ground applications.

For instance, Type ZP-1018 has gain capability up to twice that of any tube type in its class. High power gain in grid-pulsed amplifier service eliminates need for a modulator, offering space- and weight-saving opportunities in circuit design. Heat-sink conduction cooling also reduces component requirements, minimizes package size. Longer life and more reliable performance are achieved by use of a cathode area seven times that of tubes commonly employed in this service.

Type ZP-1025 features internal feedback—an industry first for a tube of its size—which simplifies cavity design for oscillator service in transponders.

TO ORDER, or obtain more information, call your Power Tube Sales Office. 265-18

TYPICAL OPERATION FOR TUBES NOW IN FAMILY

Tube	IFF Application	Service	Frequency mc	Peak Power KW	Duty
GL-7399	Ground-based Interrogator	Grid-Pulsed Amplifier	1030	10	.01
ZP-1015	Airborne Interrogator	Grid-Pulsed Amplifier	1030	10	.01
ZP-1018	Airborne Transponder	Grid-Pulsed Amplifier	1090	2	.02
ZP-1025	Airborne Transponder	Oscillator	1090	2	.02

POWER TUBE DEPARTMENT

GENERAL ELECTRIC

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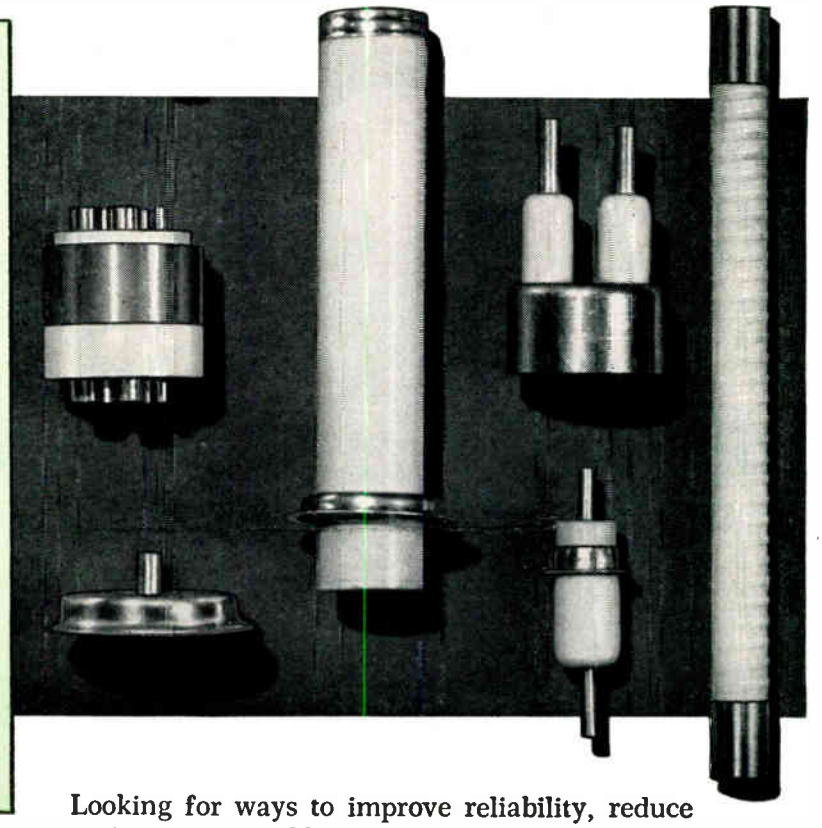
Circle 88 on Inquiry Card →

ALITE® HIGH-ALUMINA HERMETIC SEALS AND BUSHINGS

Combine...

- VACUUM-TIGHTNESS
- SUPERIOR MECHANICAL STRENGTH
- HIGH TEMPERATURE AND HEAT-SHOCK RESISTANCE
- RELIABLE ELECTRICAL CHARACTERISTICS
- HIGH RESISTANCE TO NUCLEAR RADIATION
- PRECISION TOLERANCES



Looking for ways to improve reliability, reduce maintenance problems? The unique advantages of Alite high-alumina ceramic-to-metal seals may be just what you need!

With maximum working temperatures in the range 1300°-1600°C., Alite can be metallized and brazed to metal parts to form rugged, vacuum-tight seals which, in turn, can be welded into final assemblies.

From design to finished part, every manufacturing step — including formulating, firing, metallizing and testing — is handled within our own plant and carefully supervised to assure strict adherence to specifications, utmost uniformity and reliability.

Over 100 standard sizes of Alite bushings in a range of types are available to simplify design problems and speed delivery. However, when special units are called for to meet unusual requirements, a team of Alite engineers stands ready to help you take advantage of Alite's superior properties.

Write for FREE Helpful Bulletins

Bulletin A-7R provides detailed description and specifications of Alite. Bulletin A-40 describes Alite facilities and complete line of standard bushings.

410-G

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Electronic Pliers

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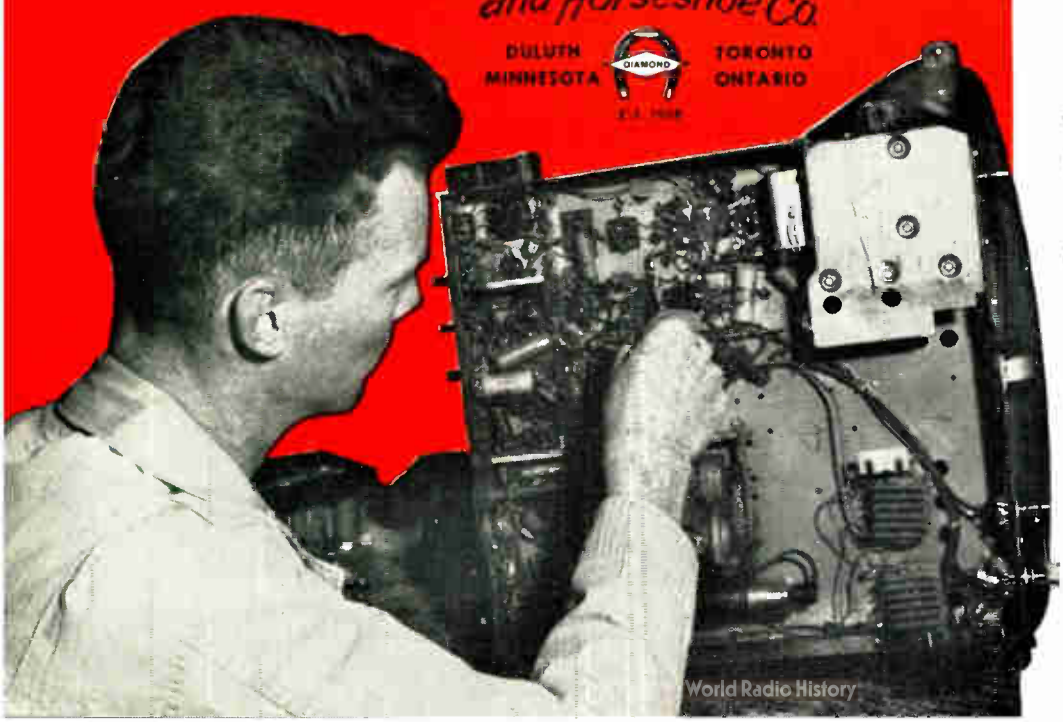
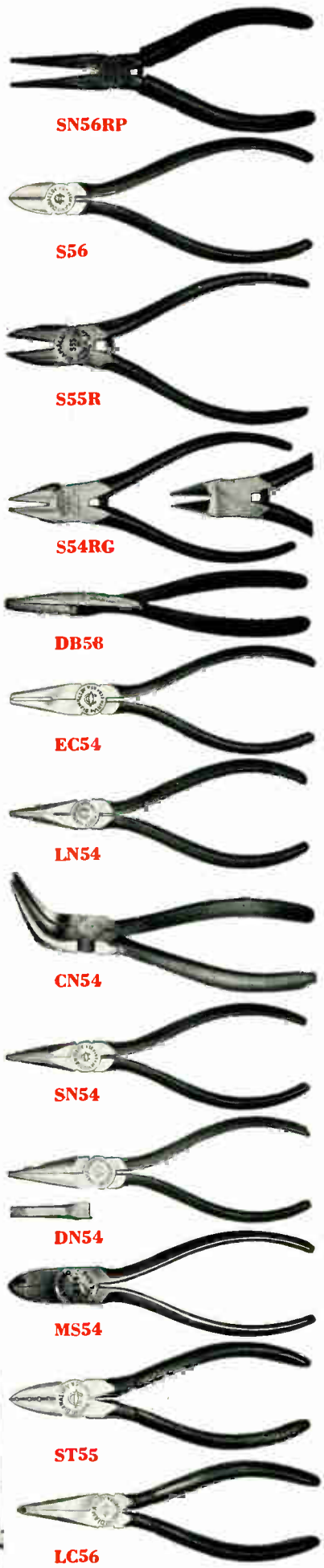
"There is nothing finer than a DIAMOND"

DIAMOND TOOL
and Horseshoe Co.

DULUTH MINNESOTA — TORONTO ONTARIO





SN56RP

S56

S55R

S54RG

DB58

EC54

LN54

CN54

SN54

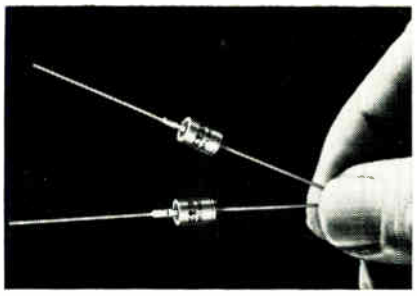
DN54

MS54

ST55

LC56

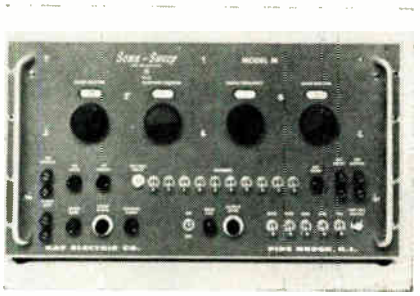
Circle 91 on Inquiry Card



Silicon Rectifiers

Ten flangeless diffused junction rectifiers, Types 10C5 thru 10C100, provide 2a dc output. Voltage range is from 50 to 1000v PRV max. peak surge current; 60a. International Rectifier Corp. BOOTH 2901.

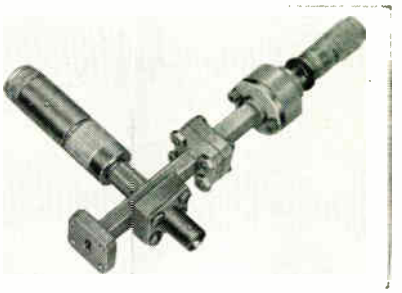
Circle 260 on Inquiry Card



Sweeping Oscillator

Sona-Sweep Model M, Cat. 142-A, an audio freq. sweeping oscillator and freq. marker covers from 20CPS to 200KC. It provides for full freq. coverage in a single sweep. Kay Electric Co. BOOTH 3512.

Circle 263 on Inquiry Card



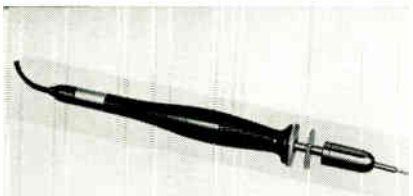
Harmonic Generators

Varacter Harmonic Generators, PRD 6611 Series, are offered in 5 types to cover from 4 to 40GC. They are tuned fundamental and tuned harmonic types of devices. PRD Electronics, Inc. BOOTH 3602.

Circle 265 on Inquiry Card

Soldering Iron

The B-2000 Microminiature Electric Soldering Iron is for soldering high-density electronic assemblies, delicate



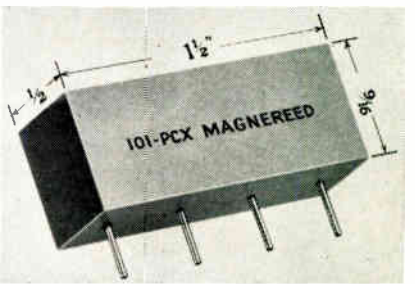
instrumentation, and strain-gauge connection. American Electrical Heater Co. BOOTH 4033.

Circle 261 on Inquiry Card

See these Products at IRE

Miniature Reed Relay

Encapsulated unit, 101-PCX Magnereed has gold contacts, SPST normally open, rated 12w resistive, 0.250a



max. or 100v max. Size: 9/16 x ½ x 1½ in. Magnecraft Electric Co. BOOTH 2523.

Circle 266 on Inquiry Card

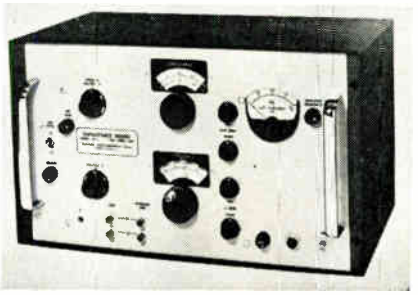
Push-Button Oscillator

A solid-state instrument with a freq. range from 10CPS to 1MC, this Model 241A Oscillator uses push-button selection of control elements to eliminate freq. ambiguity. Hewlett-Packard Co. BOOTH 3205.

Circle 262 on Inquiry Card

Capacitance Bridge

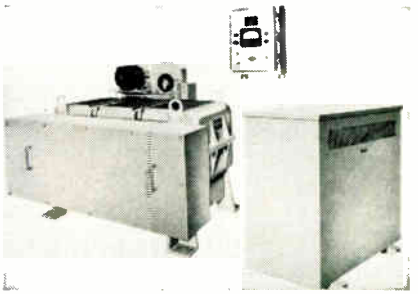
Model 75B Capacitance Bridge is a 3-terminal device having a capacitance range of from 0.00002 to 1000-pf. Parallel resistance range is 1000Ω to 100megs. Boonton Electronics Corp. BOOTH 3114.



Circle 264 on Inquiry Card

Voltage Regulators

Stabiline Automatic Voltage Regulators, EMHC Series, are for heavy duty, 50/60CPS, 3φ applications, requiring a constant output voltage with zero waveform distortion. The Superior Electric Co. BOOTH 2722.



Circle 267 on Inquiry Card

NEW!

FULL 5-DIGIT VOLT-RATIO-OHMMETER THAT STANDS ALONE IN ACCURACY, RELIABILITY AND VERSATILITY

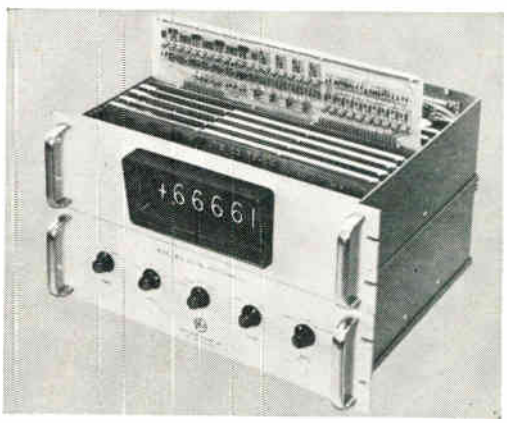
NLS M25 Measures DC Volts, Ratio and Ohms With Full 5-Digit Resolution...With Twice the Speed of Stepping Switch DVMs...With Advanced Circuitry Proved "Under the Gun" for 3 Years.

M25 meets needs of advanced R & D, missile checkout, etc.

Here is an instrument so versatile, accurate and reliable that it is virtually a complete testing center in itself. With the M25, you can measure DC volts to 5 digits . . . turn a knob and measure DC ratio to 5 digits . . . give the knob another twist and measure resistance to 5 digits . . . plug in a printer for automatic data logging . . . program any or all operations remotely . . . or measure AC or low-level DC by adding plug-in accessories. Here is an instrument that does not limit your measuring capability. *Accuracy:* the M25 provides all the benefits of full 5-digit resolution of 0.001% and an accuracy of ±0.01% of reading ±1 digit over the entire range. A unique input circuit gives exceptionally high impedance when off-null. If AC pickup affects DC voltage or ratio measurements, simply turn the input filter on — locally or remotely. *Reliability:* its transistorized circuitry is an advanced version of circuits in 4-digit M24s selected during the last 3 years by missile manufacturers after competitive life testing. Its mercury-wetted contact relays have a life expectancy of 171 years in continuous use. You'll find no fan in the M25 — it dissipates only 65 watts, half that of its highly-reliable 4-digit cousin. *Speed:* it's twice as fast as the fastest stepping switch DVM and compatible with data recorders. *Servicing:* uncrowded packaging and 99% plug-in construction reduce servicing, when required, to board replacement. Its many-sided, long-term usefulness makes the M25 a true value at $5,985 — less than some single-purpose meters. Contact NLS for a demonstration, complete data, or engineering aid for special applications.

BRIEF SPECS: *DC volts: ±0.0001 to 999.99 . . . DC ratio: ±.00001 to 99.999 . . . resistance: .1Ω to 999.99 KΩ . . . input impedance: 10 megs on volts, 1000 megs on low ratio . . . measuring speed: 1.1 sec. . . . price: $5,985 F.O.B. destination in U.S.A.*

The blue tag indicates this is an "off-the-shelf" instrument. See a demo today or take delivery on your own within 30 days.



The M25 features 99% plug-in construction.

Originator of the Digital Voltmeter

non-linear systems, inc.

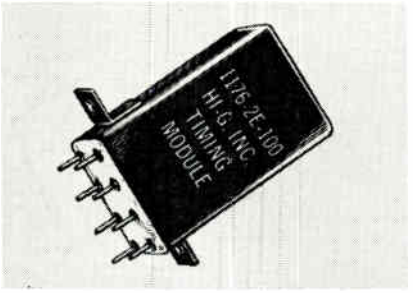
DEL MAR, CALIFORNIA

See the new NLS instruments at the IRE show.

Temperature Chamber

This low and high temperature chamber uses liquid carbon dioxide refrigeration and offers extremely close temp. control. It is for production testing. Associated Testing Laboratories, Inc. BOOTH 3927.

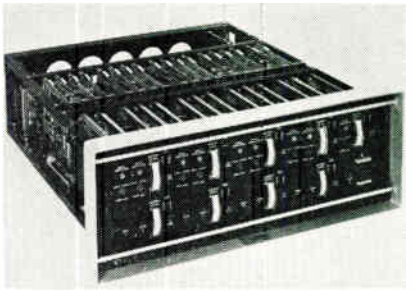
Circle 268 on Inquiry Card



Timing Module

This solid state unit, single pole construction, for dc operation has delays on "make" of 1 msec. to 30 sec. or 1 msec. to 20 sec. ±10% over the temp. range. Hi-G, Inc. BOOTH 2812.

Circle 271 on Inquiry Card



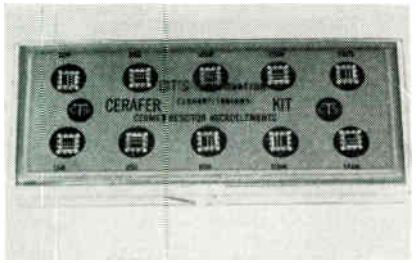
IRIG Discriminator

Designed for "quick look" applications, this solid-state unit has 9 IRIG discriminator channels with output meter for each in 7½ in. of rack space. Precision Instrument Co. BOOTH 3037.

Circle 273 on Inquiry Card

Resistance Wafer Kit

Kit contains 10 Cermet resistor micro-elements for use in micro-module experimentation. The resistance wafers, called Cerafers have 2 resistors of the same value on one side. CTS Corp. BOOTH 1400.

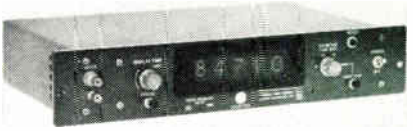


Circle 269 on Inquiry Card

See these Products at IRE

Frequency Meter

Type 1150-A Digital Frequency Meter is completely transistorized and is for measuring, setting, and monitoring freqs.; counting random events; and for industrial counting uses. General Radio Co. BOOTH 3201.



Circle 274 on Inquiry Card

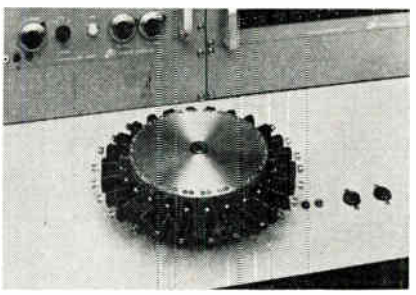
Reversing Counter

Solid-state Reversing Dual Preset Counter, Model 3302/5, can add as well as subtract pulses, and gives automatic output signals at preselected limits. Beckman Instruments, Inc., Berkeley Div. BOOTH 3515.

Circle 270 on Inquiry Card

Turret Advance

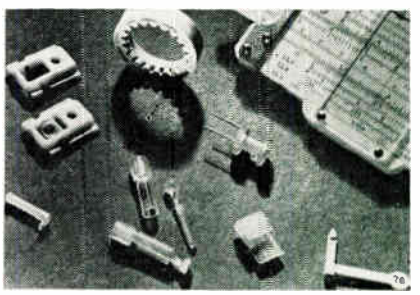
This unit moves transistors under test from operator loading position to test point and then automatically sorts them into good or reject bins. Optimized Devices, Inc. BOOTH 3036.



Circle 272 on Inquiry Card

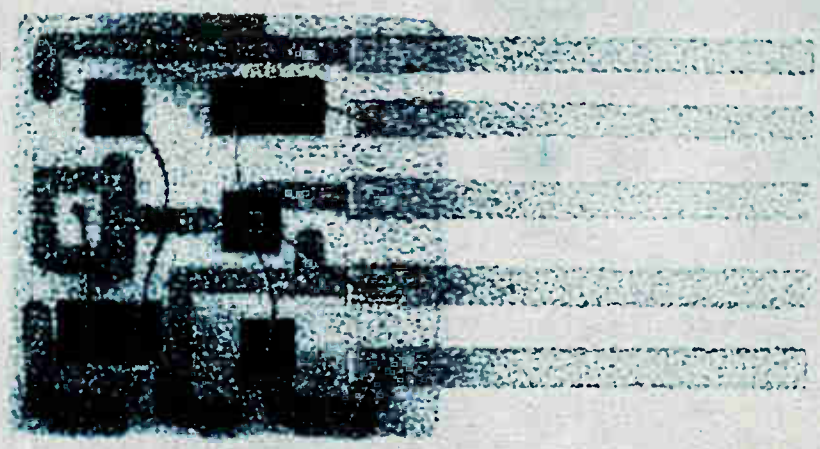
Precision Moldings

Pictured are some of a wide range of engineering thermoplastics, injection molded by Gries. Parts are used in computers, counters, motors, and tuning elements. Gries Reproducer Corp. BOOTH 4054.

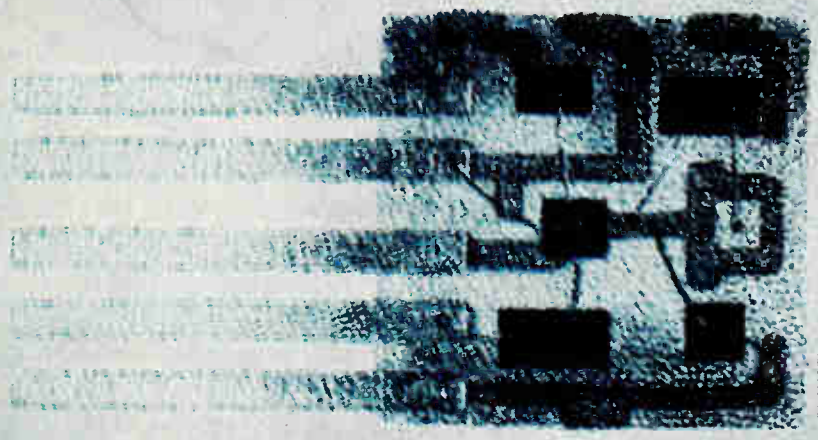


Circle 275 on Inquiry Card

Flip



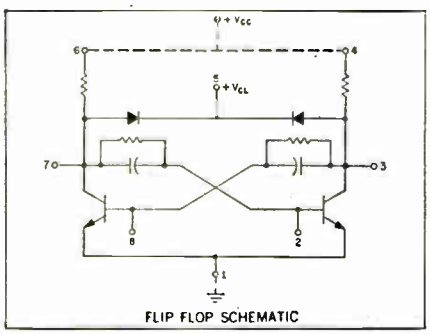
These magnified halves when combined in this actual size Flip Flop ■ contain 2 transistors, 2 diodes, 4 resistors, and 2 capacitors



Flop

New General Instrument Nanocircuits

Source for Silicon Nanocircuits. Now you can design military and industrial computer circuits with high-speed, silicon Nanocircuits whose substrates measure as little as 0.17 x 0.17 inches. Latest example of General Instrument's Nanocircuit Program, these new flip-flops utilize matched pairs of semiconducters and operate at speeds in the nanosecond range. The flip-flop schematic shown at right, typical of the many configurations available, consists of two silicon planar epitaxial transistors, two silicon microdiodes, four silicon microresistors and two silicon oxide microcapacitors. ■ Silicon Nanocircuits need no encapsulation. Each component (preselected and pretested for reliability prior to bonding to the substrate) is passivated by General Instrument's unique Molecular Shield™ process. Nanocircuits are unaffected by external ambients. The coating serves only to provide mechanical rigidity. ■ Complete details on all silicon Nanocircuits are available at the General Instrument sales office nearest you. Call or write today. General Instrument Semiconductor Division, 65 Gouverneur St., Newark 4, N. J.



FLIP FLOP SCHEMATIC

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

GENERAL INSTRUMENT CORPORATION

See us at IRE, Booth 1212

Circle 93 on Inquiry Card

ELECTRON TUBE INTERCHANGEABILITY CHART

By C. P. MARSDEN, W. J. KEERY, and J. K. MOFFITT

National Bureau of Standards
Washington 25, D. C.

Part One: Domestic Microwave Types

As part of the function of the Electron Devices Data Service of the National Bureau of Standards, these tables were prepared as a service to the engineers, procurement and service personnel engaged in the field of electronics. All information was taken from manufacturer's published specifications and every effort has been made to assure accuracy and completion. However, the Bureau cannot assume responsibility for omissions nor for results obtained with these data.

These tables will be published in three parts in subsequent issues and will include the information shown below:

	Class	No. of Types	
Part 1	Microwave Tubes	325	Domestic to Domestic
Part 2	Microwaves Tubes	36	Domestic to Foreign
		72	Foreign to Domestic
		260	Foreign to Foreign
Part 3A	Power Tubes	160	Domestic to Foreign
		240	Foreign to Domestic
Part 3B	Receiving Tubes	470	Domestic to Foreign
		370	Foreign to Domestic

No degree of interchangeability is indicated, as in most cases the geometrical shape or method of mechanical attachment vary considerably between manufacturers. In general, these types are stated as being similar to, a frequency variant of or a prototype of a given type. However, in most cases, a minor modification of the voltages, electrical connections and/or mechanical attachment will permit direct substitution of the similar type. Furthermore, old and developmental type numbers which have been assigned a new type number by the manufacturer are included.

Code:

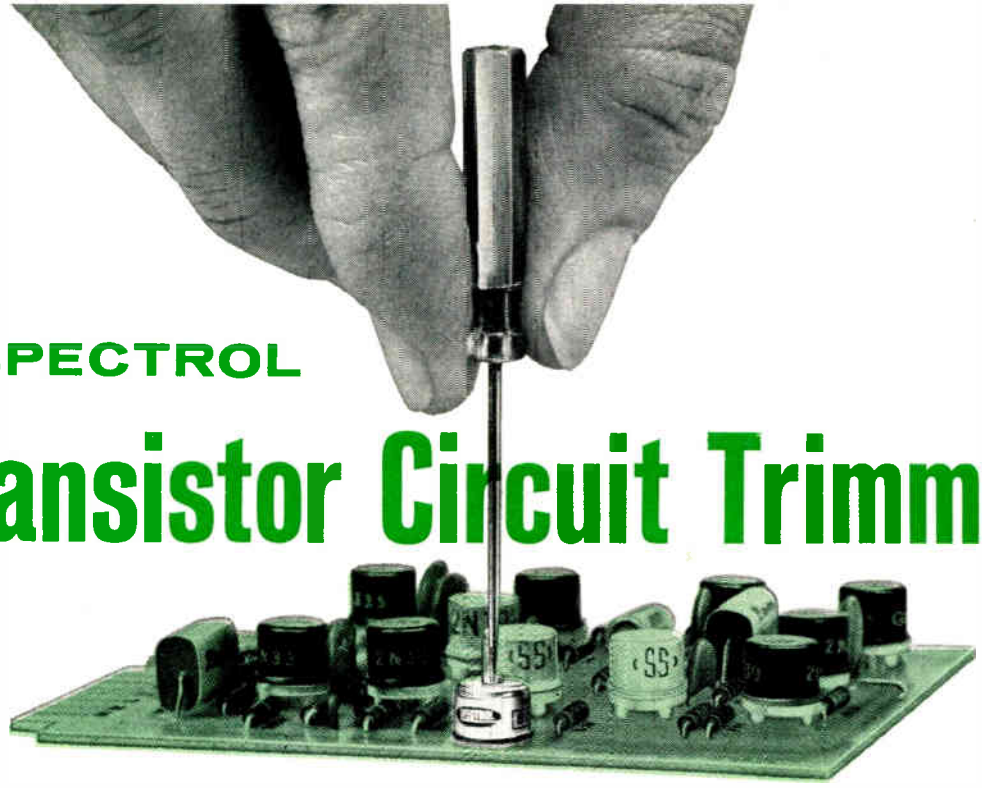
A three letter symbol in the column following the type number is used to describe the kind of tube for a given type number. These symbols are listed below:

AMA—Amplitron Amplifier or Platinotron
BWO—Backward Wave Oscillator
HEL—Helitron
KLA—Klystron Amplifier
KLO—Klystron Oscillator
MAG—Magnetron
TWA—Traveling Wave Amplifier

An additional symbol is prefixed to the type number in the first column, i.e., the lozenge, to indicate obsolete, old or developmental type numbers.

No.	Type/Similar to or Interchangeable With
*L0U-2	BWO 7267
2J30	MAG 2J31, 2J32, 2J33, 2J34
2J31	MAG 2J30, 2J32, 2J33, 2J34
2J32	MAG 2J30, 2J31, 2J33, 2J34
2J33	MAG 2J30, 2J31, 2J32, 2J34
2J34	MAG 2J30, 2J31, 2J32, 2J33
2J42	MAG 2J42A, F, H, 6027, 6271, 6817, 6818, 6819, 6820 6821, 6822
2J51	MAG 2J51A, QKH713, 7256
2J51A	MAG 2J51
2K25	KLO V261, V270, QK420, 723A/B, 6311, 6312, 6316, 6940
2K28	KLO 2K28A, 707B, 6133, 7815
2K28A	KLO 2K28
2K33	KLO QK306, 6254, 6253
2K45	KLO TK38, TK58, TK59, TK62, TK69, TK76, TK77, 6116 6845, 6940
2K50	KLO TE4, TK4
*HA3	TWA HA26
*3K20,000	KLO 3K50,000, X566
3K50,000	KLA 3K20,000, X566
*TE4	KLO 2K50, TK4
◻TK4	KLO 2K50, TE4
4J31	MAG 4J32, 4J33, 4J34, 4J35, 4J53, 5586, 5657
4J32	MAG 4J31, 4J33, 4J34, 4J35, 4J53, 5586, 5657
4J33	MAG 4J31, 4J32, 4J34, 4J35, 4J53, 5586, 5657
4J34	MAG 4J31, 4J32, 4J33, 4J35, 4J53, 5586, 5657
4J35	MAG 4J31, 4J32, 4J33, 4J34, 4J53, 5586, 5657
4J43	MAG 4J44
4J44	MAG 4J43
4J50	MAG SEE 4J50A
4J50A	MAG 4J50, 4J78, L3030, L3039, L3107, L3151, L3152 L3153, L3154, L3155, L3156, L3209, L3210, 6865 6874, 7006, 7008, 7110, 7111, 7112
4J52	MAG SEE 4J52A
4J52A	MAG L3036, L3037, L3103, L3106, L3168, 6510, 6543
4J53	MAG 4J31, 4J32, 4J33, 4J34, 4J35, 5586, 5657
4J78	MAG SEE 4J50A
6BL6	KLO ZV1009, 5836, PE7049
6BM6	KLO 6BM6A, ZV1010, 5837
6BM6A	KLO 6BM6, ZV1010, 5837
PA-7	TWA PA-8
PA-8	TWA PA-7
◻MXK10	KLO VA203B, 6975
*HA11	TWA HA74
◻MXK11	KLO BL803, 6781
◻MXK14	KLO V260, QK417, 6294, 6310
*HA15	TWA HA44
*MXK16	KLO V157, V290, 6314
*MXK17	KLO V153, VA153, 6315
*MXK18	KLO V151, BL800, 6316, 6780
HA26	TWA HA3
*TE30	KLO TK30, 6541
◻TK30	KLO TE30, 6541
*TE37	KLO TK37, SRV38
TK37	KLO TE37, SRV38
SRV38	KLO TE37, TK37
*TE38	KLO TK38, SEE 2K45
TK38	KLO TE38, SEE 2K45

No.	Type/Similar to or Interchangeable With
◻HA44	TWA HA15
◻TE53	KLO TK53
TK53	KLO TE53
V54	KLO V154
◻TE57	BWO TW0-57
TW0-57	BWO TE57
*TE58	KLO TK58, SEE 2K45
◻TK58	KLO TE58, SEE 2K45
V58	KLO V58C
V58C	KLO V58
*TE59	KLO TK59, SEE 2K45
◻TK59	KLO TE59, SEE 2K45
*TE60	KLO TK60
TK60	KLO TE60
*TE61	KLO TK61
TK61	KLO TE61
*TE62	KLO TK62, SEE 2K45
◻TK62	KLO TE62, SEE 2K45
*TE66	BWO TW0-66, TW0-67, TW0-75, TW0-85
TW0-66	BWO TE66, TW0-67 TW0-75, TW0-85
◻TE67	BWO TW0-67, TW0-66, TW0-75, TW0-85
TW0-67	BWO TE67, TW0-66, TW0-75, TW0-85
◻TE68	KLO TK68
TK68	KLO TE68
*TE69	KLO TK69, SEE 2K45
◻TK69	KLO TE69, SEE 2K45
*TE70	KLO TK70, 6037
◻TK70	KLO TE70, 6037
HA74	TWA HA11
*TE75	BWO TW0-75, TW0-66, TW0-67, TW0-85
TW0-75	BWO TE75, TW0-66, TW0-67, TW0-85
*TE76	KLO TK76, SEE 2K45
◻TK76	KLO TE76, SEE 2K45
*TE77	KLO TK77, SEE 2K45
◻TK77	KLO TE77, SEE 2K45
◻TE78	KLO TK78
TK78	KLO TE78
◻TE85	BWO TW0-85, TW0-66, TW0-67, TW0-75
TW0-85	BWO TE85, TW0-66, TW0-67, TW0-75
S0C150	KLO S0C217
*V151	KLO MXK18, BL800, 6316, 6780
*V153	KLO MXK17, VA153, 6315
◻VA153	KLO MXK17, V153, 6315
V154	KLO V54
*V157	KLO MXK16, V290, 6314
VA161B	BWO VA169
VA169B	BWO VA161B
QK172	MAG 6959
MA200	MAG MA206, MA207, 5789
◻VA203B	KLO MXK10, 6975
MA206	MAG MA200, MA207, 5789
MA207	MAG MA200, MA206, 5789
WJ207	HEL WJ208
WJ208	HEL WJ207
S0C217	KLO S0C150
SK220	KLO VA220, VA222
SK220G	KLO VA220
VA220	KLO SK220, VA222



SPECTROL

Transistor Circuit Trimmers

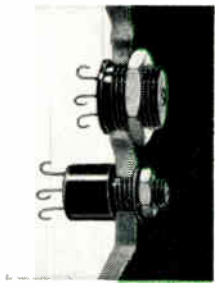
New Spectrol Model 80 single-turn trimming potentiometers in TO-9 size case... *the smallest MIL qualified trimming potentiometers available today*... give your circuits precision adjustment in ¼ of the space required for most other trimmers.

Standard MIL grid terminal spacing of the 80-3-1 transistor type simplifies installation in printed circuits. With standard transistor sockets, units of different resistance ranges can be interchanged easily for breadboarding.

Single-turn adjustment minimizes setting time, and the self-locking shaft maintains precise settings under severe shock and vibration conditions without external shaft locking. Units meet or exceed the rigid immersion requirements of MIL-STD-202B, Method 104A, Condition A (immersed in hot water) and may be completely potted, including the shaft head, without danger of leakage.

For panel or chassis mounting, two new case styles are introduced, the 10-32 threaded bushing type and the ⅜"-32 threaded case type. The threaded case has the added advantage of mounting essentially *within* the panel with virtually no projection to front or rear.

All three Model 80 trimmers are available in production quantities. Contact your nearest Spectrol distributor for immediate delivery and quantity prices. Prices for transistor circuit trimmers, in popular resistances: $6.00 each in 1-9 quantities.



Panel cutaway showing 80-5-3 ⅜"-32 Threaded Case Type

(lower) 80-5-2 10-32 Threaded Bushing Type

SPECIFICATIONS

MECHANICAL

NUMBER OF TURNS 1 • ROTATION Continuous (end stops available • SHAFT TORQUE 0.2 to 5.0 oz. in. LIFE EXPECTANCY (SHAFT REVOLUTIONS) 1,000 OPERATING TEMPERATURE RANGE −55°C to +150°C

ELECTRICAL

STANDARD RESISTANCE RANGE 50Ω to 50K • RESISTANCE TOLERANCE ±5.0% (±1.0% available) POWER RATING 1.0 watt at 50° C • VOLTAGE BREAKDOWN (ANY TERMINAL TO SHAFT AND/OR HOUSING) 500 volts RMS, 60 cps • INSULATION RESISTANCE (ANY TERMINAL TO SHAFT AND/OR HOUSING) 1,000 megohms at 500 volts dc.

SPECTROL ELECTRONICS CORPORATION

1704 South Del Mar Avenue
San Gabriel,
California

Adams Court
Plainview, L. I.
New York

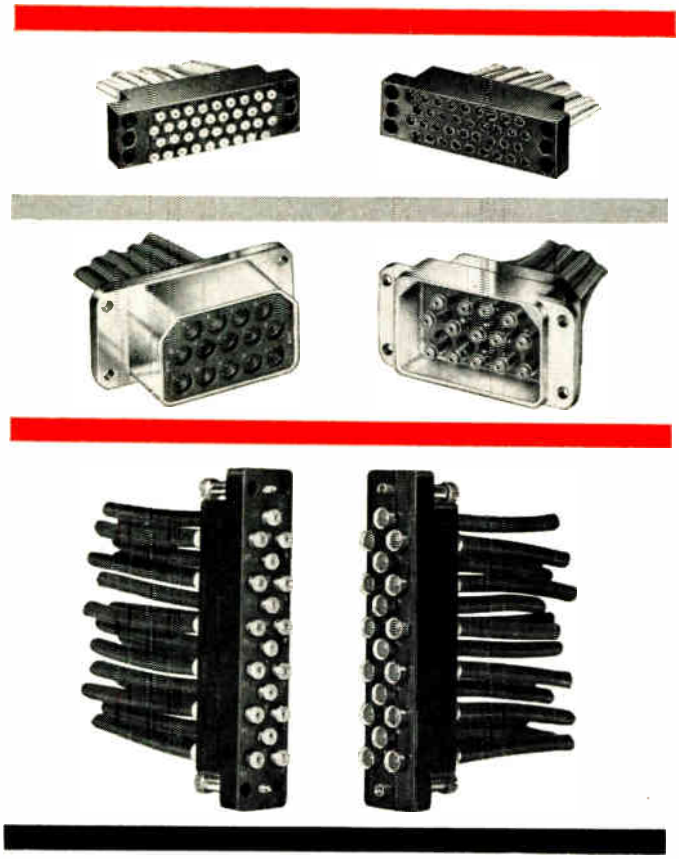
P.O. Box 130
Brampton
Ontario

See Us at the IRE—Booths 1320-22

Circle 94 on Inquiry Card

No.	Type/Similar to or Interchangeable With
SK222	KLO VA220, VA222
SK222G	KLO VA222
VA222	KLO SK222, VA220
VA220D	KLO VA222D
¤BL230	MAG 7444
SRX230	KLO SRX231
SRX231	KLO SRX230
SRX232	KLO SRX233
SRX233	KLO SRX232
*QK235	MAG 6344
*QK254	MAG 6518
¤V260	KLO MXK14, QK417, 6294, 6310
*V261	KLO 2K25, V270, QK420, 723A/B, 6311, 6312, 6316
QK264	MAG 7528
*V270	KLO 2K25, V261, QK420, 723A/B, 6311, 6312, 6316
*V280	KLO 6313
V290	KLO MXK16, V157, 6314
*QK297	KLO 6178
*QK299	MAG 6229
*QK2998	MAG 6230
304H	TWA 311H
¤QK306	KLO 6250
312H	TWA 311H
313H	TWA 312H
316H	BWO 326H
328H	BWO 326H
*QK338	MAG QKH883, 6410A, 7529
348H	BWO 346H
349H	TWA 314H
*QK358	MAG 6517
358H	BWO 356H
QK366A	MAG RK6967A
368H	BWO 366H
374H	TWA 313H
*QK417	KLO MXK14, V260, 6294, 6310
*QK420	KLO 2K25, V261, V270, 723A/B, 6311, 6312, 6316
*QK428	MAG 6406, 6406A
QK470	MAG 7484
*QK483	KLO RK6573
QKH517	MAG QK508, QKH508
*X566	KLA 3K20,000, 3K50,000
¤QK653	AMA 7577
QK665	MAG QK666
QK666	MAG QK665
¤QK702	MAG 7630
*7078	KLO 2K28, 6133, 7815
¤QKH713	MAG 2J51A, 7256
723A/B	KLO 2K25, V261, V270, QK420, 6312, 6316
QKW750	TWA QKW750A
QKW750A	TWA QKW750
QKK752	KLO QKK753
QKK753	KLO QKK752
QKK758	KLO QKK759
QKK759	KLO QKK758
¤QKS783	AMA QKS622
¤BL800	KLO MXK18, V151, 6316, 6780, BL800A
¤BL800A	KLO BL800, 6316, MXK18, V151, 6316, 6780
¤BL803	KLO MXK11, 6781
¤BL850	TWA BL851, 6651
¤BL851	TWA BL850, 6651
QKH880	MAG QKH883, 6410A
QKH883	MAG 6410A, QK338A
QKH942	MAG QK665, QKH665
QKH1000	MAG QKH1000A, QKH1001, QKH1001A, 6249A
QKH1000A	MAG QKH1000, QKH1001, QKH1001A, 6249A
QKH1001	MAG QKH1000, QKH1000A, QKH1001A, 6249A
QKH1001A	MAG QKH1000, QKH1000A, QKH1001, 6249A
ZV1009	KLO 68L6, 5836, PE7049
ZV1010	KLO 68M6, 5837
ZV1011	KLO 5721, 6390
A1056	TWA A1125
A1079	TWA A1088, A1105, 6861
A1088	TWA A1079, A1105, 6861
A1105	TWA A1079, A1088, 6861
A1125	TWA A1056
A1178A	TWA 4021
A1207	TWA 6861
¤L3023	MAG LT6233
L3030	MAG SEE 4J50A
L3036	MAG 4J52A, L3037, L3103, L3106, L3168, 6510, 6543
L3037	MAG 4J52A, L3036, 6510, 6543
L3039	MAG SEE 4J50A
L3083	MAG L3101A, L3101B, L3101C
¤L3083A	MAG L3306
L3101A	MAG L3083
L3101B	MAG L3083
L3101C	MAG L3083
L3103	MAG 4J52A, L3036, L3037, L3106, L3168, 6510, 6543
L3105	MAG L3150, L3186
L3106	MAG 4J52A, L3036, L3037, L3103, L3106A, L3168, 6510, 6543
¤L3107	MAG SEE 4J50A
¤L3150	MAG L3105, L3186
L3151	MAG SEE 4J50A
L3152	MAG SEE 4J50A
L3153	MAG SEE 4J50A
L3154	MAG SEE 4J50A
L3155	MAG SEE 4J50A
L3156	MAG SEE 4J50A
L3168	MAG 4J52A, L3036, L3037, L3103, L3106, 6510, 6543
L3186	MAG L3105, L3150
L3209	MAG SEE 4J50A
L3210	MAG SEE 4J50A
L3306	MAG L3083A
L3613	MAG 4J50

No.	Type/Similar to or Interchangeable With
¤4012	MAG 7535
4021	TWA A1178A
*K-4033	KLO SK220A
*K-4034	KLO SK220C
*K-4035	KLO SK220F
*K-4036	KLO SK220Z
*K-4160	KLO SK220B
*K-4161	KLO SK220D
*K-4162	KLO SK220E
*K-4182	KLO SK222Z
*K-4183	KLO SK222A
*K-4184	KLO SK222B
*K-4185	KLO SK222C
*K-4186	KLO SK222D
*K-4188	KLO SK222E
*K-4189	KLO SK222F
5586	MAG 4J31, 4J32, 4J33, 4J34, 4J35, 4J53, 5657
5609	MAG 5609A,
5609A	MAG 5609
5650	KLO 5981
5657	MAG 4J31, 4J32, 4J33, 4J34, 4J35, 4J53, 5586
5721	KLO ZV1011, 6390
5789	MAG MA200, MA206, MA207, 7619
5836	KLO 68L6, ZV1009, PE7049
5837	KLO 68M6, ZV1010
6002	MAG QK221
6027	MAG SEE 2J42
6037	KLO TK70, TE70
6115	KLO TK38, TK69, 6115A, 6584
6115A	KLO TK38, TK69, 6115, 6584
6116	KLO SEE 2K45
6133	KLO 2K28, 7078, 7815
6178	KLO QK297
6229	MAG QK299
6230	MAG QK2998
LT6233	MAG L3023
6249A	MAG QKH1000, QKH1000A, QKH1001, QKH1001A
6253	KLO 2K33, QK306, 6254
6254	KLO 2K33, QK306, 6253
¤6271	MAG SEE 2J42
¤6294	KLO MXK14, V260, QK417, 6310
6310	KLO MXK14, V260, QK417, 6294
6311	KLO SEE 2K25
6312	KLO SEE 2K25
6313	KLO V280
6314	KLO MXK16, V157, V290
6315	KLO MXK17, V153, VA153
6316	KLO MXK18, V151, BL800A, 6780
6344	MAG QK235
6390	KLO ZV1011, 5721
#6406	MAG QK428, 6406A
6406A	MAG QK428, 6406
6410A	MAG QK338, 7529, QKH883
6510	MAG SEE 4J52A
6517	MAG QK358
6518	MAG QK253
6541	KLO TK30, TE30
6543	MAG 6543A, SEE 4J52A
6543A	MAG 6543, SEE 4J52A
RK6573	KLO QK483
6584	KLO TK38, TK69, 6115
6651	TWA BL850, BL851
6780	KLO MXK18, V151, BL800A, 6316
6781	KLO MXK11, BL803
¤6817	MAG SEE 2J42
¤6818	MAG SEE 2J42
¤6819	MAG SEE 2J42
¤6820	MAG SEE 2J42
¤6821	MAG SEE 2J42
¤6822	MAG SEE 2J42
6825	TWA 6826, 6826A
6826	TWA 6825, 6826A
6826A	TWA 6825, 6826
6845	KLO SEE 2K45
6861	TWA A1079, A1088, A1105
6865A	MAG SEE 4J50
6874	MAG SEE 4J50
6940	KLO SEE 2K45
6959	MAG QK172
RK6967A	MAG QK366A
6975	KLO MXK10, VA2038
7006	MAG SEE 4J50
7008	MAG SEE 4J50
¤PE7049	KLO 68L6, ZV1009, 5836
7110	MAG SEE 4J50
7111	MAG SEE 4J50
*7112	MAG SEE 4J50
7208	MAG 7208A, 7208B
7208A	MAG 7208, 7208B
7208B	MAG 7208, 7208A
7256	MAG 2J51, QKH713
7267	BWO L0U-2
7444	MAG BL230
7460	MAG QKH686, RK7156
7484	MAG QK470
7484A	MAG QK470, QKH470
7528	MAG QK264
7529	MAG QK338, 6410A
7535	MAG 4012
7541	MAG 4J50
7577	AMA QK653
7619	TWA 5789
7630	MAG QK702
7785	BWO L0U2C/316H
7815	KLO 2K28, 7078, 6133



THE LINE OF LEAST APPLIED COST...

Multiple Coaxial Cable Connectors by AMP

AMP produces a full line of multiple COAXICON* connectors with standard, miniature, and subminiature contacts accommodating a range of RG/U cables with nominal overall diameter of .075″ to .250″. They all have one feature in common. All the contacts in each connector are crimped. Take away skilled hands, solder pot and soldering iron—that's your first saving! **And that's only the start!** The matching AMP crimping tool that terminates the contacts makes reliable connections of both the inner conductor and outer braid with one easy stroke of it's "Certi-Crimp"* ratchet controlled handles. Once and done! No production slow-ups as with combination solder and crimp terminations or multi-step crimping procedures. AMP COAXICON connectors and contacts save time, and that's your second saving. **Reliability?** Over the years, AMP has developed over 15,000 different electrical/electronic termination products and matching tooling for their application. Write and learn how they've done the same, reliably, for coaxial connections. Get the full story on AMP COAXICON multiple connectors today.

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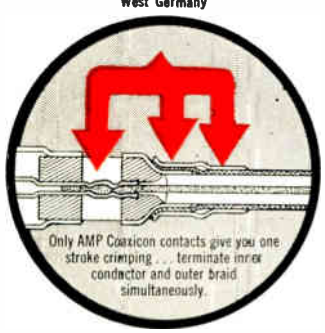
AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada England • France • Holland • Italy • Japan • Mexico West Germany



Visit us at the I.R.E. SHOW Booths 2527-31 March 26-29

*Trademark of AMP. INCORPORATED

New Tech Data for Engineers

R, L and C Standards

Resistance, capacitance and inductance decades and standards are described in a 6-page, 2-color, illustrated folder available from General Radio Co., W. Concord, Mass. Also included is a tabular review of bridges for measuring resistance, capacitance, inductance, impedance and dissipation factor.

Circle 200 on Inquiry Card

Power Transistors

Tech data is available on 3 series of pnp germanium power transistors packaged in the new, low-outline TO-36 package. Series 2N1518 thru 2N1523 feature P_T of 150w, I_C of 25 to 50a. Series 2N2075 thru 2N2082 feature P_T of 170w, I_C of 15a. Series 2N2152 thru 2N2159 feature a P_T of 170w, I_C of 30a. Semi-onics, Inc., 4 Broadway, Lowell, Mass.

Circle 201 on Inquiry Card

Chart Integrator

Tech data detailing performance capabilities of the Series 200 Disc Integrator is available from Disc Instruments, Inc., 3014B S. Hallady, Santa Ana, Calif. The precision instrument is said to integrate any variable such as flow, sun radiation, electric power or x-ray analysis at the instant it is being recorded. It automatically computes the area under a strip chart and presents this information continuously on the same chart.

Circle 202 on Inquiry Card

Miniature Capacitors

Tech data describing miniature Cerol Capacitors and including electrical and mechanical specs is available from Hi-Q div., Aerovox Corp., Olean, N. Y. They are designed for general use in by-pass-coupling, filtering, and blocking circuits.

Circle 203 on Inquiry Card

Motor Test Equipment

"Motor and Motor Generator Test Equipment" contains photographs, circuit diagrams, and specs. on 5 different motor and motor generator test units. Kearfott Div., General Precision Inc., Little Falls, N. J.

Circle 204 on Inquiry Card

Pressure Windows

A 12-page brochure describing waveguide pressure windows, their applications and installation suggestions is available from Microwave Associates, Inc., Burlington, Mass. The 2-color brochure gives electrical and mechanical specs. plus photographs and outline drawings with dimensions, for over 100 microwave pressure windows in 4 styles. The windows are available as standard units to operate in the freq. range from 2.4 to 40 GC.

Circle 205 on Inquiry Card

Klystrons

Sylvania Electric Products Inc., Electronic Tubes Div., 1740 Broadway, New York 19, N. Y., is offering a tech. brochure on part of their line of klystrons which are covered by warranties of 6000 hrs. on microwave communication oscillators and X-26 types, and 18 mos. on disc seal types.

Circle 206 on Inquiry Card

Power Resistor Decades

Clarostat Mfg. Co., Inc., Dover, N. H., is offering a new catalog on power resistor decades. Complete electrical and mechanical specs. are described. The Clarostat power resistor decade permits the accurate decading of resistance under actual heavy-load conditions in test, experimental, or component circuitry.

Circle 207 on Inquiry Card

Size 5 Servomotor

Model 9005-1501-0, is a precision control component offering high acceleration and low inertia. With rotor inertia of 0.06 gm.cm.^{2} and torque at stall of 0.085 oz. in., the motor gives 100,000 rad/sec^2 acceleration at stall. The unit weighs 0.702. and measures 0.865 in. long. This size 5 servomotor, 26v, 400CPS is described in tech data available from Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif.

Circle 208 on Inquiry Card

Trimmer Resistors

Bulletin 42-1216 is available from Centralab, The Electronics Div. of Globe-Union Inc., 900 East Keefe Ave., Milwaukee 1, Wis., containing detailed electrical and physical specs. on their line of PEC® miniature and microminiature trimmer resistors.

Circle 209 on Inquiry Card

Capacitor Chart

Cornell-Dubilier Electronics, 50 Paris St., Newark, N. J., is offering a 3 x 2 ft. "Periodic Table" type chart, in color, of selection and application data on all 18 major types of their capacitors. The chart describes each type of capacitor as to its electrical and operating characteristics, its size and cost factors. Military spec. numbers and Cornell-Dubilier's class number for each type are also listed.

Circle 210 on Inquiry Card

Transistor Brochure

An 8-page brochure on silicon planar epitaxial transistors is available from General Instrument Corp., Semiconductor Div., 65 Gouverneur St., Newark 4, N. J. Bulletin PE-15 includes characteristics, performance curves, test results and storage life reliability tests.

Circle 211 on Inquiry Card

Low Noise Transistors

Schematics, performance curves, characteristics charts and drawings are included in 4-page tech. data available from Sperry Semiconductor, div. of Sperry Rand Corp., Norwalk, Conn. These low-noise pnp silicon alloy transistors are offered in both TO-5 and TO-18 cases and for use in low-level preamplifier stages where minimum transistor noise is required.

Circle 212 on Inquiry Card

Bridge Performance

"Design Ideas," Electro Scientific Industries' quarterly tech bulletin gives a detailed discussion of a new graphical method of specifying bridge outputs and detector sensitivities, so that their combined performance can be readily analyzed for any given measurement. Electro Scientific Industries, 7620 S.W. Macadam Ave., Portland 19, Ore.

Circle 213 on Inquiry Card

Ion Pumps

Four, 2-page tech data sheets describing 4 ion pumps are available from Hughes Aircraft Co., Vacuum Tube Products Div., 2020 Short St., Oceanside, Calif. Included is information on models with pumping speeds of 0.2, 0.4, 8.0 and 50 liters per second. Dimensional drawings, rating curves, application notes and technical specs. are supplied for each pump.

Circle 214 on Inquiry Card

Ignitrons

Bulletin PT-57, gives equipment designers complete information on ignitrons in the highly specialized capacitor discharge and crowbar service. Qualified designers may obtain the comprehensive 24-page booklet by writing on company letterhead to General Electric's Power Tube Dept., Schenectady 5, N. Y.

Stator Yokes

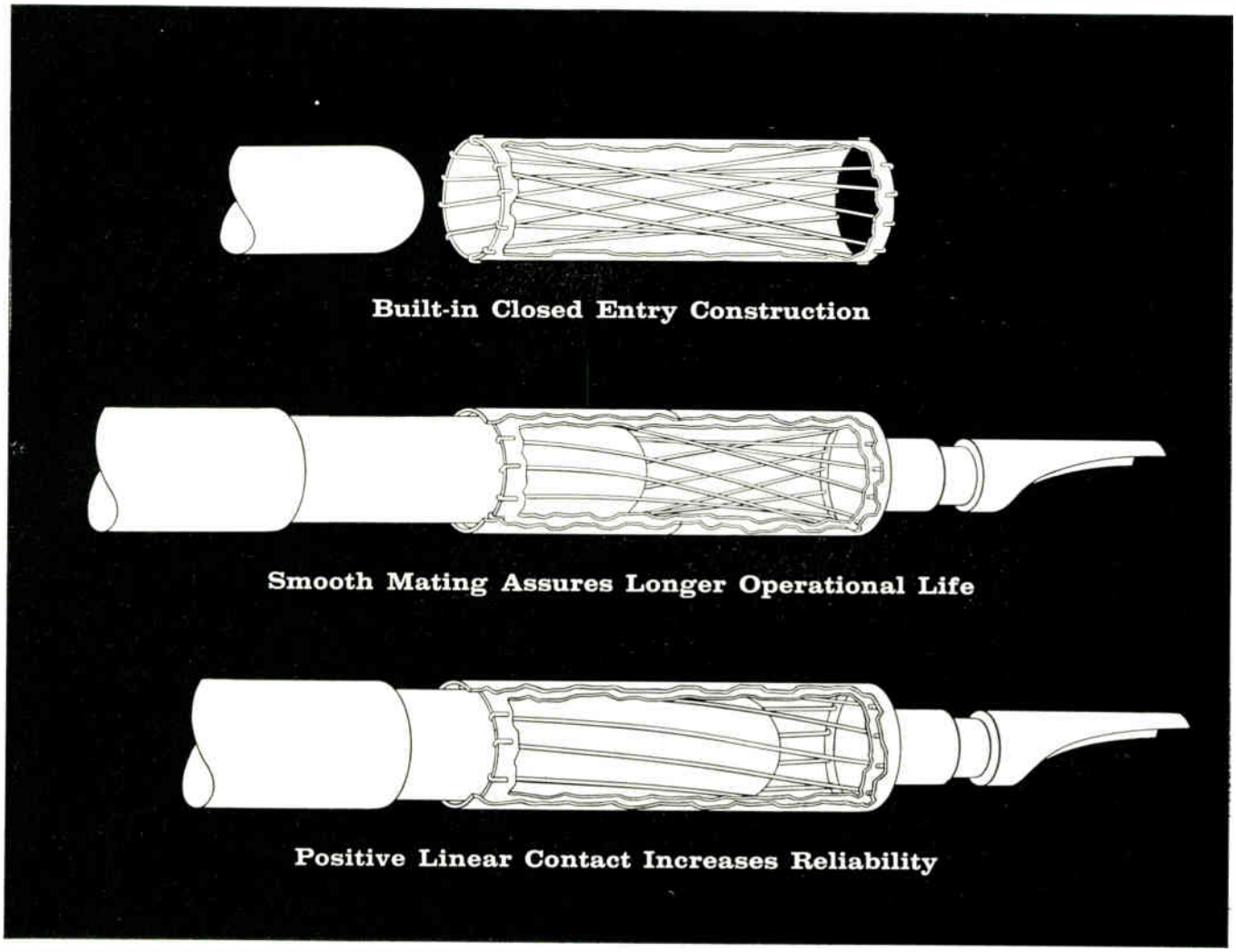
Tech. data is available from Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill., describing a line of highly efficient stator type magnetic deflection yokes for 1½ in. neck diameter CRT's in transistor or tube type circuits.

Circle 216 on Inquiry Card

Paper-Tape Recorder

Bulletin ETR-7, from Omnitronics, Inc., sub. of Borg-Warner Corp., 511 N. Broad St., Phila. 23, Pa., describes the new OMNI-DATA high-speed Electrostatic Paper-Tape Recorder. The unit produces paper tape with coded information in the form of visible black spots instead of punched holes.

Circle 217 on Inquiry Card

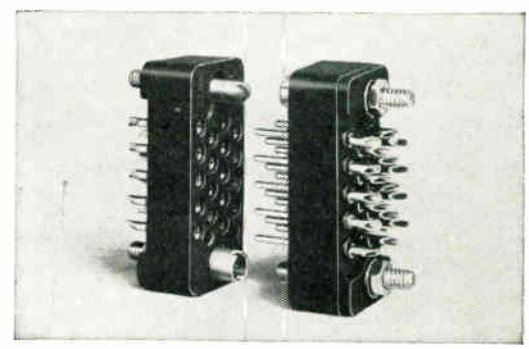


CURTAC®

New Contact Concept For Reliability In Connectors

CURTAC Connectors are completely new — in concept, design and construction — to give you reliable and consistent electrical and mechanical performance.

CURTAC positive linear contact is more reliable due to the elastic wrapping action, under tension, of each contact wire. In life tests, CURTAC contacts functioned to specification after 100,000 insertions. This multi-point contact withstands 50g shock, 20g vibration, temperatures ranging from 125°C. to −65°C. without physical damage or contact chatter. CURTAC provides normal operation after long static periods. "Floating" CURTAC receptacles compensate for misalignment of connectors — provide dependable contact pressure, low voltage drop and high current rating. Smooth mating of the CURTAC contact and solid pin eliminates friction and wear. There are no sharp edges on the sliding surface. Manual insertion of multiple-contact arrangements is easy and smooth. Built-in closed entry construction prevents damage from oversize test probes.



CURTAC design can be applied to a variety of multiple contact connector rack and panel arrangements that meet or exceed all applicable Mil. Specs.

Learn more about CURTAC Connectors at IRE. Visit us at Booths 1521-1523

Electronic Fittings Corporation

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New Tech Data for Engineers

L-F Oscillators

The Electronics Div., of Bulova Watch Co., Inc., 61-10 Woodside Ave., Woodside, N. Y., is offering tech data on a number of low freq. crystal controlled oscillators for use as high stability freq. sources of high accuracy timer references. The oscillators range from 1CPS to 20KC, stabilities from 2pp 10^6 to 1pp 10^5 for an hour's operation.

Circle 218 on Inquiry Card

Thermoelectric Devices

A 6-page catalog illustrating and describing a new line of single, 2 and 3 stage thermoelectric cooling/heating devices and a Peltier chamber, which operate on up to 90% less current than other thermoelectric devices is available from Jepson Thermoelectrics, Inc., 139 Nevada St., El Segundo, Calif.

Circle 219 on Inquiry Card

Microwave Test Set

PRD Electronics, Inc., 202 Tillary Street, Brooklyn 1, N. Y., is offering a 10-page report entitled "A Microwave Calibration Test Set For A Seven Octave Band." The equipment described is capable of making all fundamental measurements, i.e., power, frequency, VSWR, and attenuation in the freq. range from 300 to 40,000 MC.

Circle 220 on Inquiry Card

Flexible Molds

Dow Corning Corp., Midland, Michigan, is offering tech data entitled, "How to Make Flexible Molds With Silastic® RTV." This special room-temp. vulcanizing silicone rubber, Silastic RTV 885, is supplied in a fluid form that flows readily. Electron micrographs have shown that RTV 885 will produce details in gratings at 15,000 lines per inch.

Circle 221 on Inquiry Card

Magnetic Modulators

Performance, theory and use of magnetic modulators as low-level dc to ac converters in servo, suppressed carrier modulation, and other uses are detailed in a 10-page bulletin (200-1), available from Transmagnetics, Inc., 40-66 Lawrence St., Flushing 54, N. Y.

Circle 222 on Inquiry Card

Casting Capabilities

Morris Bean & Co., Yellow Springs, Ohio, is offering a brochure entitled, "Resources & Capabilities." Information included covers casting abilities of aluminum waveguide, feed horns, rotating joints, elbows and transitions; aluminum thin-wall housings for pressurized service; and chassis and frames for electronic assemblies.

Circle 223 on Inquiry Card

Magnetic Materials

Lodex[T.M.] is a permanent magnet material based on highly elongated single domain particles. Four distinct magnetic grades are available for commercial use. Lodex 31, 32, 41, 42, are all iron-cobalt particles in a lead matrix. The four types differ in their manner of processing. Included are specs. and characteristic diagrams. General Electric Co., Magnetic Material Section, Edmore, Michigan.

Circle 224 on Inquiry Card

Silicon Transistors

Series 2N2034 miniaturized high power silicon transistors are described in a 6-page bulletin covering uses and specs. The illustrated 2-color bulletin explains how the 2N2034, TO-5 package without heat sink, operationally replaces conventional silicon npn power units with 6 x 5 x 3/32 in. heat sink in identical free-air conditions. Silicon Transistor Corp., Carle Place, N. Y.

Circle 225 on Inquiry Card

Microwave Test Equipment

A booklet describing a line of microwave test equipment is now available from the Westinghouse Electronic Tube Div., Box 284, Elmira, N. Y. The 10-page, illustrated, 2-color booklet describes test sets used for testing klystrons, magnetrons, TWT's and switch tubes. In addition, traveling-wave pulser and missing-pulse-detector equipment is included. Booklet ET-6109.

Circle 226 on Inquiry Card

Oscillators

Monitor Products Company, Inc., 815 Fremont Ave., South Pasadena, Calif., is offering a new 4-page booklet on "How to Specify Crystal Controlled Oscillators." Included is a list of requirements for specifying oscillators as well as an oscillator selector chart listing the specs. of oscillators ranging in freq. from 25CPS to 20MC.

Circle 227 on Inquiry Card

Transistorized Chopper

Tech data is available from Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif., describing its Model 65 Plug-in Chopper. The unit has a transformer-coupled isolated drive network so that it can, for example, be driven from a 400CPS power line or from a drive source that is common to the dc voltage being chopped.

Circle 228 on Inquiry Card

Glass Epoxy Laminates

Fireban 1011 meets all Military and NEMA specs. for glass epoxy. It is also flame retardant and easily punched. It is described in bulletins 51.5.22 and 51.5.23 available from Taylor Fibre Co., Norristown, Pa.

Circle 229 on Inquiry Card

Monitoring Systems

Bulletin FMS-1B, describing fluid monitoring systems for measuring radioactivity in gases and liquids, is available from Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind. Included are specs. giving the sensitivity of various detectors, and a selection chart showing the equipment required to monitor each type of radiation.

Circle 230 on Inquiry Card

Power Transistors

A 12-page technical data bulletin on 30a silicon power transistors is available from the Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa. The booklet, illustrated with over 30 charts and graphs, describes the electric characteristics, test circuits, and peak pulse power capabilities. Bulletin 54-662. .

Circle 231 on Inquiry Card

Flat Flexible Cable

IRC Polystrip® is ultra-thin, flat, flexible cable containing multiple conductors protected between tough plastic sheets. The 7-page brochure includes photographs, ordering information, information on testing, inspection, quality control, an insulation parameter table, and characteristics curves and dimension tables. International Resistance Co., Plastic Products Div., 401 N. Broad St., Phila. 8, Pa.

Circle 232 on Inquiry Card

Washing Machine

A brochure on a new high pressure washing machine for the cleaning of masks employed in the spraying of mass produced products, known as the Model W-1600, is available from Conforming Matrix Corp., 839 New York Ave., Toledo 11, Ohio.

Circle 233 on Inquiry Card

Vibration Measuring

This 8-page, 2-color brochure offers tech data on a "Vibration Measuring System," which records complete data from accelerometer signals, including phase, distortion and amplitude. Chadwick-Helmuth Co., 472 E. Duarte Rd., Monrovia, Calif.

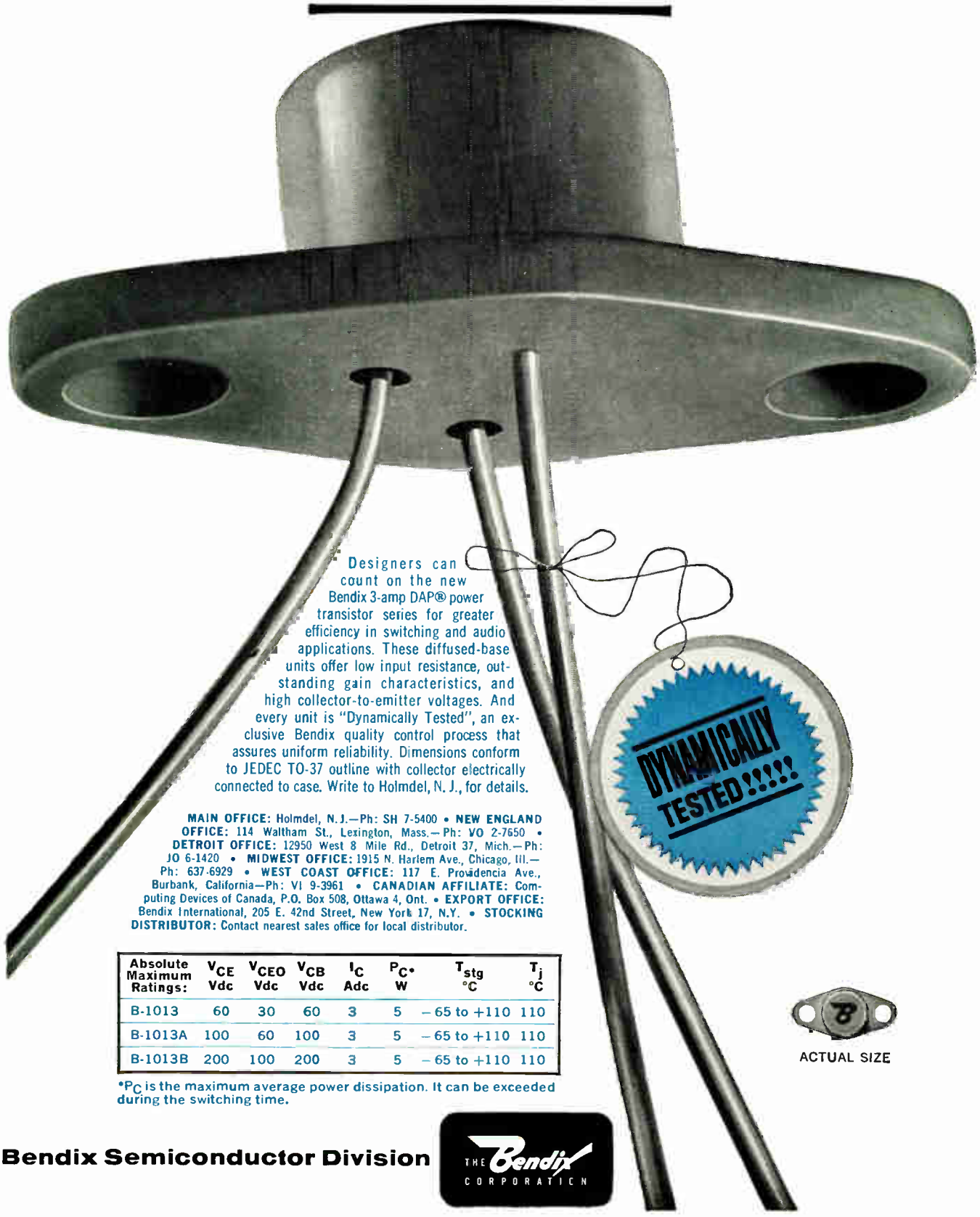
Circle 234 on Inquiry Card

Electron Tube Catalog

Litton Industries, Electron Tube Div., San Carlos, Calif., is offering their Electron Tube Condensed Catalog for 1962. The catalog contains information on Pulse Magnetrons, CW Magnetrons, M-Type BWOs, Crossed Field Forward Wave Amplifiers, BARRATRON® Transmitting Tubes, Klystrons, TWTs, Switch Tubes, Millimeter Wave Tubes, Display Devices, Equipment and Accessories, and a Tube Cross Reference. Included are photographs and tables of specs.

Circle 235 on Inquiry Card

NEW DEVELOPMENT
BENDIX®
3-AMP DAP



Designers can count on the new Bendix 3-amp DAP® power transistor series for greater efficiency in switching and audio applications. These diffused-base units offer low input resistance, outstanding gain characteristics, and high collector-to-emitter voltages. And every unit is "Dynamically Tested", an exclusive Bendix quality control process that assures uniform reliability. Dimensions conform to JEDEC TO-37 outline with collector electrically connected to case. Write to Holmdel, N. J., for details.

MAIN OFFICE: Holmdel, N.J.—Ph: SH 7-5400 • **NEW ENGLAND OFFICE:** 114 Waltham St., Lexington, Mass.—Ph: VO 2-7650 • **DETROIT OFFICE:** 12950 West 8 Mile Rd., Detroit 37, Mich.—Ph: JO 6-1420 • **MIDWEST OFFICE:** 1915 N. Harlem Ave., Chicago, Ill.—Ph: 637-6929 • **WEST COAST OFFICE:** 117 E. Providencia Ave., Burbank, California—Ph: VI 9-3961 • **CANADIAN AFFILIATE:** Computing Devices of Canada, P.O. Box 508, Ottawa 4, Ont. • **EXPORT OFFICE:** Bendix International, 205 E. 42nd Street, New York 17, N.Y. • **STOCKING DISTRIBUTOR:** Contact nearest sales office for local distributor.

Absolute Maximum Ratings:	V_{CE} Vdc	V_{CEO} Vdc	V_{CB} Vdc	I_C Adc	P_C* W	T_{stg} °C	T_j °C
B-1013	60	30	60	3	5	−65 to +110	110
B-1013A	100	60	100	3	5	−65 to +110	110
B-1013B	200	100	200	3	5	−65 to +110	110

*P_C is the maximum average power dissipation. It can be exceeded during the switching time.

ACTUAL SIZE

Bendix Semiconductor Division

THE Bendix CORPORATION

IRE New Products

Infrared Generator

Model 501, Infrared Signal Generator, has a tunable infrared source of variable wavelength from 1 to 14 microns and calibrated power to 10μw. Telewave Laboratories. Inc. BOOTH 3308.

Circle 276 on Inquiry Card

Magnetic Shaft Encoder

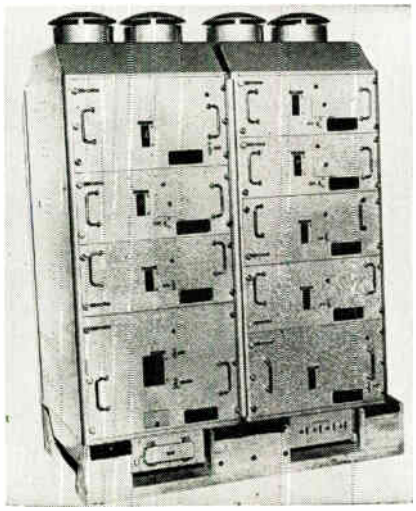
This 7-bit noncontact magnetic size 18 encoder, designated Model 887-18, features U-scan readout technique.

Readout is parallel in binary code. Librascope Div., General Precision, Inc. BOOTH 1507.

Circle 277 on Inquiry Card

Static Inverter System

Model 4350 is a modular-constructed static inverter system operating from 200vdc input. It gives both 1 & 3 ϕ power out at 60 and 400CPS. The system contains 3, 5 and 10kw inverters. Varo Inc. BOOTH 1735.



Circle 278 on Inquiry Card

Highlights

(*Continued from page* 131)

vironments were evaluated to determine if any deterioration had occurred in the resistors.

Studies were made of the molded enclosure by X-ray, infrared analysis, and hardness test to evaluate possible degradation of the molding material.

The electrical performance of the resistor elements was compared with that of control samples on life and overload tests.

Military environmental tests were also used to locate any possible derivation in resistor characteristics between the exposed samples and the unexposed controls.

RELIABILITY AND QUALITY CONTROL

45.2. Establishing Reliability Requirements

L. R. Diamond, Sylvania Amherst Lab., Buffalo, N. Y.

When a request for bid on a new research and development project is received by the contractor, work begins to develop specific reliability requirements for the particular type of equipment requested. It must be first decided whether the bid involves mission reliability, equipment reliability, or both. The criteria considered in this evaluation are detailed in the paper. The next step in the determination of the reliability requirement is to postulate the possible design solution. Lastly, a rough reliability estimate is made utilizing current prediction techniques. These steps are also covered in this paper on how to make a proposal reliability statement responsive and saleable.

52.4. Flow Graph Techniques for Reliability Engineering

J. L. Burroughs and W. W. Happ, Microsystems Electronics Dept., Lockheed Missiles and Space Co., Sunnyvale, Calif.

Essentials of flow graph techniques are concisely summarized emphasizing those aspects directly useful in reliability analysis. Illustrative examples of applying flow graphs to reliability problems include

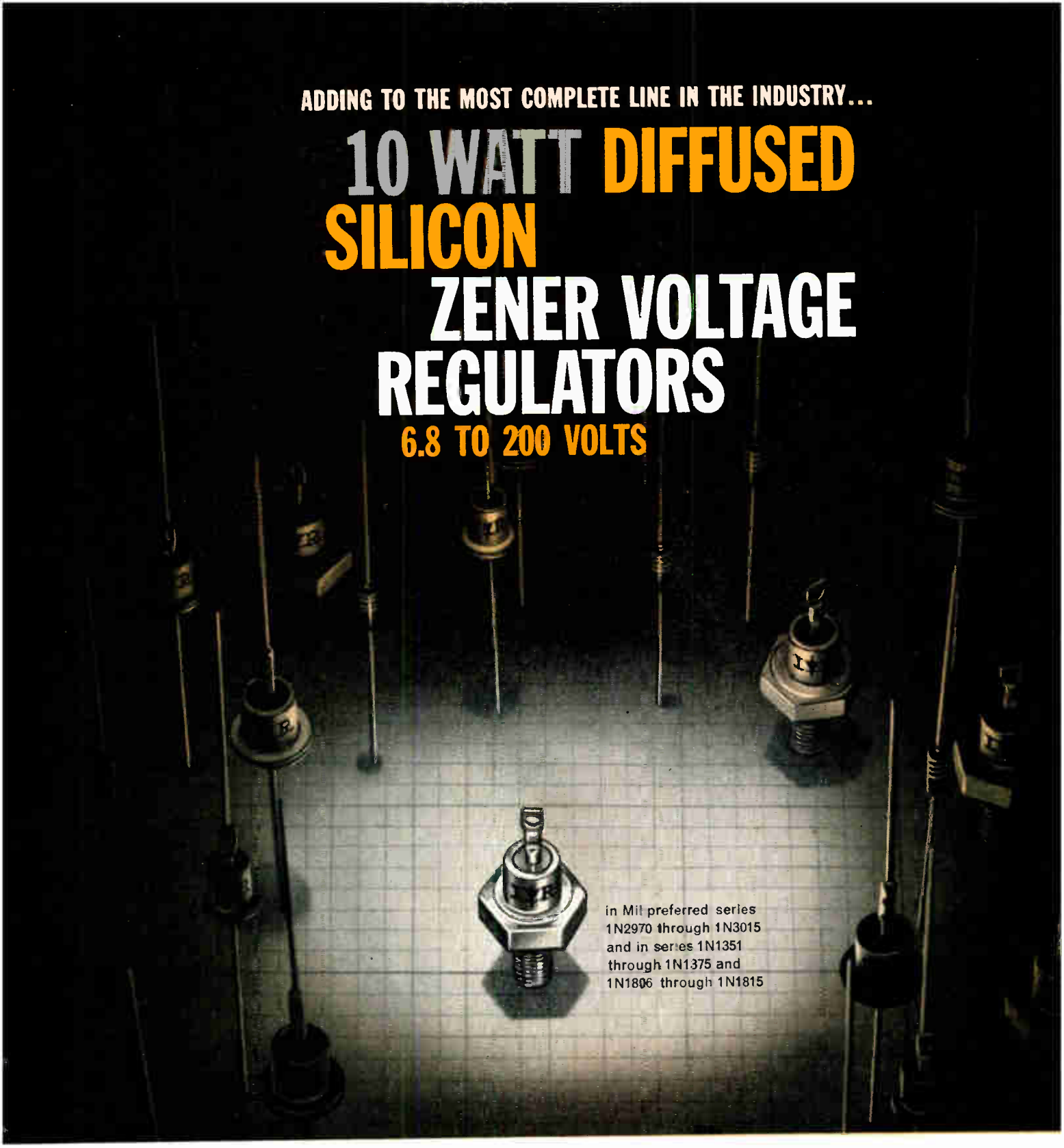
1) reliability of systems with large numbers of variables,
2) error propagation in large systems with interacting variables,
3) optimizing mission effectiveness by dynamic programming.

A survey of over 100 cited references pertinent to the application of flow graphs to reliability engineering leads to the conclusion that a large number of reliability problems can be reduced to a few basic patterns. Flow graphs clearly reveal these patterns, thereby provide a systematic approach to solve a wide range of problems by reverting to existing patterns if possible or by adapting or combining known solutions.

ADDING TO THE MOST COMPLETE LINE IN THE INDUSTRY...

10 WATT DIFFUSED SILICON ZENER VOLTAGE REGULATORS

6.8 TO 200 VOLTS



in Mil preferred series
1N2970 through 1N3015
and in series 1N1351
through 1N1375 and
1N1806 through 1N1815

The addition of these new 10 watt units, housed in the industry standard DO-4 package, rounds out the most complete line of zener voltage regulators in the industry...from 250 mw glass zener rated at 2.6 volts up to 10 watt units rated at 200 volts.

Whatever your requirements in zeners...voltage regulators, reference elements or reference packs, contact INTERNATIONAL RECTIFIER..., THE PIONEER IN RECTIFIER TECHNOLOGY.

INTERNATIONAL RECTIFIER

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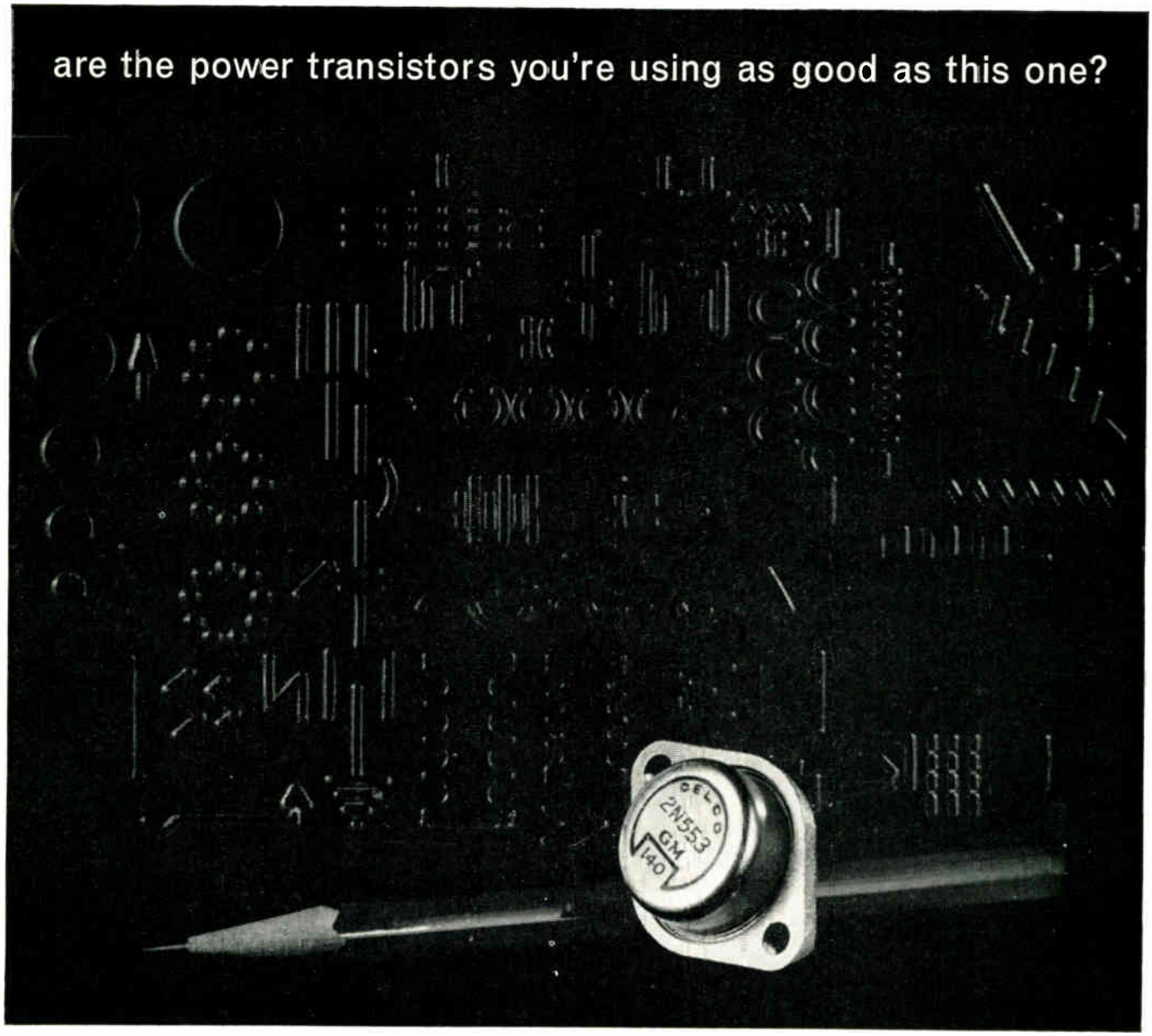
SYMBOL OF QUALITY IN SEMICONDUCTORS

Circle 101 on Inquiry Card

INTERNATIONAL RECTIFIER CORPORATION: EL SEGUNDO, CALIF. • PHONE OREGON 8-6281 • CABLE RECTUSA • REGIONAL OFFICES IN NEW YORK CITY, CHICKERING 4-0748 • FORT LEE, NEW JERSEY, WINDSOR 7-3311 • SYRACUSE, NEW YORK, HEMPSTEAD 7-8495 • CAMBRIDGE, MASSACHUSETTS, UNIVERSITY 4-6520 • ARDMORE, PENNSYLVANIA, MIDWAY 9-1428 • SILVER SPRING, MARYLAND, JUNIPER 9-3305 • CHICAGO, ILLINOIS, JUNIPER 3-3085 • BERKLEY, MICHIGAN, LINCOLN 8-1144 • LOS ANGELES, CALIFORNIA, OREGON 8-6281 • IN CANADA: TORONTO, ONTARIO, PLYMOUTH 9-7581

are the power transistors you're using as good as this one?



Meet the Delco Radio family of 2N553 high power transistors. They're the most sophisticated 4-5-amp. power transistors you can find . . . anywhere! The perfect choice for direct coupled circuits because of their extremely low collector diode bulk leakage current. Regulator applications? None better than Delco's 2N553. These units have unique thermal stability. Order a handful or a carload and you get uniform high quality. Prove it to yourself and improve your product as a bonus. Contact one of our Sales Offices listed below or your nearby Delco Radio Semiconductor Distributor.

Type	Ic (Max.)	Vcbo (Max.)	Vceo (Max.)	Max. Icbo @ Vcbo	Max. Icbo @ 30 Vcb @ T °C	Saturation Volts @ Ic (Max.)	Gain	Thermal Resistance (Max.)
2N553	4A	80V	40V	50μA @ 2V	2MA @ 75° C	.9V @ 3A	40/80 @ .5A	1.5° C/watt
2N1971	4A	80V	40V	50μA @ 2V	2MA @ 75° C	.9V @ 3A	25/60 @ .5A	1.5° C/watt
2N665	5A	80V	40V	50μA @ 2V	2MA @ 71° C	.9V @ 3A	40/80 @ .5A	1.5° C/watt
JAN2N665	5A	80V	40V	50μA @ 2V	2MA @ 71° C	.9V @ 3A	40/80 @ .5A	1.5° C/watt
2N297A (Sig. C)	4A	60V	40V	200μA @ 2V	6MA @ 71° C	1V @ 2A	40/100 @ .5A	1.5° C/watt
2N297A	4A	60V	40V	200μA @ 2V	6MA @ 71° C	1V @ 2A	40/100 @ .5A	1.5° C/watt

Union, New Jersey
324 Chestnut Street
MUrdock 7-3770

Detroit, Michigan
57 Harper Avenue
TRinity 3-6560

Santa Monica, California
726 Santa Monica Blvd.
UPton 0-8807

Syracuse, New York
1054 James Street
GRanite 2-2668

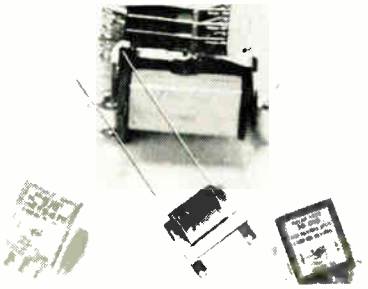
Chicago, Illinois
5750 West 51st Street
POrtsmouth 7-3500

SEE YOU AT IRE SHOW, BOOTH 1423

Division of General Motors • Kokomo, Indiana

DELCO RADIO
DEPENDABILITY
RELIABILITY

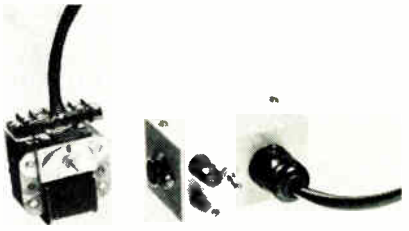
IRE New Products



Miniature Relay

Type 70 "Filip" Relay features low-cost and a min. number of parts. It weighs 6 grams and measures 0.750x 0.750x0.400 in. It is for 2a, 26.5vdc or less. Phillips Control Co. BOOTH 2340.

Circle 279 on Inquiry Card



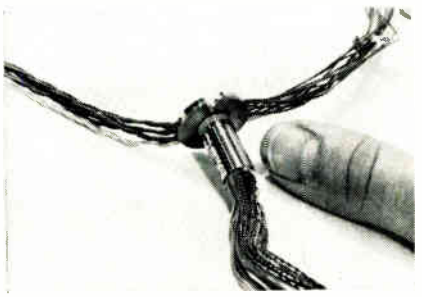
Brushless DC Motor

Type KYAD brushless dc motor, 12v, features: Amps, 2.6; No load speed, 4800RPM; Rated speed, 4200-RPM; and rated torque lb-in., 0.1. Barber-Colman Co., Motors & Components Div. BOOTH 2242.

Circle 282 on Inquiry Card

Slip Ring Cartridge

Features include: ball bearing mounted; 28-circuits total—23 circuits are rated at 1.0a continuous and 5

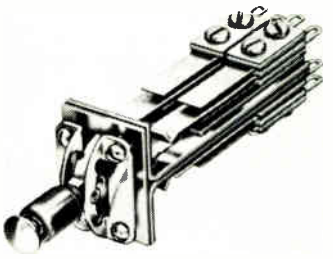


circuits are rated at 2.0a continuous; and extremely low noise. Slip Ring Co. of America. BOOTH 2308.

Circle 280 on Inquiry Card

Lever Switch

The "Lever-Lock" Telever Switch, light weight, yet rugged, guards against accidental switching due to



shock, operator fatigue, vibrations or unintentional operation. Switchcraft, Inc. BOOTH 2825.

Circle 283 on Inquiry Card

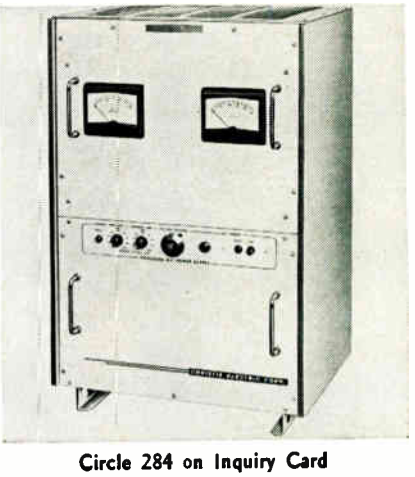
SCR Test Set

Model OA-1H, Silicon Controlled Rectifier Test Set (high current, low duty cycle) measure V_{BO}, I_S, I_R, V_F, I_H and has capability up to 800v and 100ma for leakage parameters. Baird-Atomic, Inc. BOOTH 3216.

Circle 281 on Inquiry Card

DC Power Supplies

This line of "Transient-Free" high current power supplies is rated 100a, 200a, 250a, 400a, and 600a with the dc voltage adjustable up to 36 volts. Christie Electric Corp. BOOTH 2911.

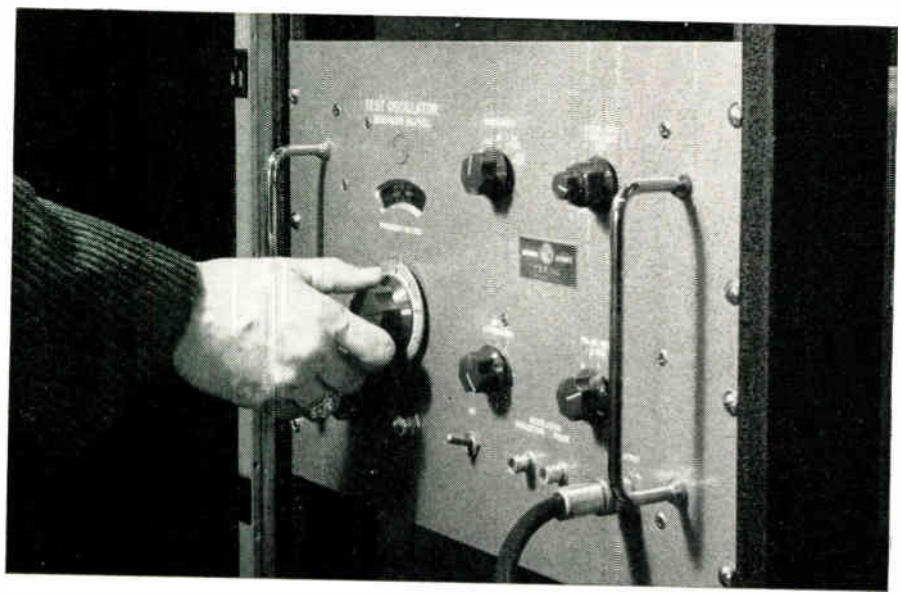


Circle 284 on Inquiry Card

☐ Rack-mounted signal sources for 900-11,000 mc.

☐ High-power coaxial cable that's really flexible

☐ New crimp-type subminiature connectors



Rack-mounted signal sources for 900-11,000 mc.

Now you can mount FXR's series 772 test oscillators in standard 19-inch racks—for use in laboratories and other permanent test applications. Like the FXR portable models, these new rack-mounted signal sources provide ample RF power in the 900 to 11,000 mc. range.

In all signal sources, power supply and klystron are combined in a single unit. This makes operations safer—exposed klystron wires are eliminated. Klystron replacement is faster and less expensive—as little as ¼ the cost of klystron replacement in separate power supply and klystron set-ups.

MODEL	FREQUENCY RANGES	PRICE	
		Portable	Rack
L772A	0.95 to 2.0 KMC	$1235.	$1250.
S772A	1.9 to 4.0 KMC	$1035.	$1050.
C772A	3.95 to 8.2 KMC	$1340.	$1355.
X772A	7.0 to 11.0 KMC	$1340.	$1355.
Power Output	10 MW to 100 MW max CW output. Power variable through use of an internal level-set attenuator.		
Modulated Outputs	Internal: CW, pulse or square wave External: Pulse, square wave or FM		
External Modulation Requirements	Pulse: Positive pulse of 30 v. amplitude across 100 K ohms. Pulse width from 0.5 microsecond to square wave. Reflector: sine wave or sawtooth FM, sensitivity from 100 to 200 kc/v.		
Connectors	RF Output: Type N jack. External pulse: Type BNC jack. Reflector modulation: Type BNC jack.		
Power Requirements	115/230 v. AC, 50 or 60 cycles, 150 w.		
Dimensions & Weight	Portable: 11" high X 16" wide X 15" deep; 45 lbs. Rack: 11" high X 19" wide X 15" deep; 45 lbs.		

Single-control tuning lets you set frequencies faster and more accurately (±1%). Frequency remains constant, no matter how you vary the power output, because the klystron reflector voltage automatically changes with the positioning of a broad-band, non-contacting tuning plunger inside the oscillator cavity.

RF power output ranges from 10 to 100 MW. It's controlled from the front panel, through a level-set attenuator.

The portable models are available from stock; the rack-mounted models are shipped within a month. *For more information, circle Reader Card Number 71.* ■

High-power coaxial cable that's really flexible

This is a new FXR product—Amphenol type RG-281/U coaxial cable. It was developed for an Air Force electronic counter measures system, where small space required a cable that bends and flexes easily without changing electrical properties. Now, it is available commercially.

Perforated Teflon tape dielectric gives this cable extra flexibility. The tape continuously supports the center conductor...keeps center and outer conductors concentric even when the cable is bent over small radii.

Teflon tape also cuts down moisture condensation at dielectric interfaces because it eliminates voids between cable and connector dielectrics.

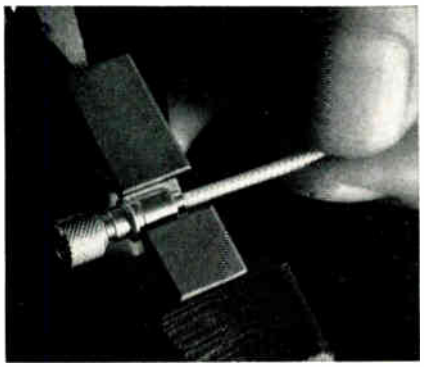
Type RG-281/U power cable gives you a VSWR of less than 1.2...a dielectric constant of 1.55...serves as general purpose RF transmission line, easy to install and operates at high temperatures. *For more information, circle Reader Card Number 72.* ■

New crimp-type subminiature connectors

FXR's new Subminax® Series 5116 quick-crimp micro-miniatures make faster, more reliable, less costly cable assemblies. And you don't have to redesign your product to use them, because Series 5116 micro-miniatures are interchangeable with competitive counterparts. In fact, the addition of this new Series to the Subminax line means that you can now specify a Subminax connector that mates with or is interchangeable with any known sub-miniature or micro-miniature coaxial connector on the market today.

The new Subminax Series 5116 has at least three major advantages over other micro-miniatures:

☐ *Faster Assembly*—Quick-crimping feature, plus standard crimping tool, makes child's play of cable assembly. For example, Series 5116 plugs and jacks have only three parts, including body assembly. Easier, less critical cable stripping. No braid soldering.



☐ *Dependable Delivery*—new FXR micro-miniatures are immediately available from factory stocks or your Amphenol distributor.

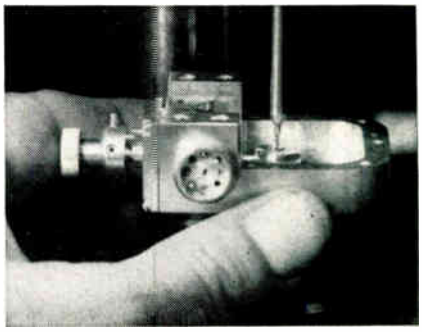
☐ *Lower Price*—Series 5116 coaxial connectors are priced substantially below current prices for competitive "equivalents."

☐ *Technical Facts:* 500 VRMS; impedance: 50, 75 or 95 ohms; gold-plated captivated contacts (solder type); Teflon* insulation; silver-plated body; screw-on or push-on coupling; color coding boots—optional. For use with coaxial cables in the .075 to .115 OD range. *For more information, circle Reader Card Number 73.* ■ *Registered trademark of DuPont

It takes a jeweler to make waveguides at new FXR facility

FXR recently expanded its microwave facilities at Woodside, New York, to meet the growing demand for millimeter waveguides. But expansion is only part of the story. Precision is the other.

The waveguides made here are used in space communications equipment. They have to be extremely small and extremely accurate. The combination calls for some of the most delicate machining operations you'll see outside a jeweler's shop. Tolerances—as small as 0.0001 inch—are so critical that FXR technicians at Woodside put parts through a final diamond-lapping operation to achieve the necessary accuracy in dimension and surface.



FXR uses Starrett Depth Gauge to check accuracy of slotted waveguide parts within ±0.0001 inch.

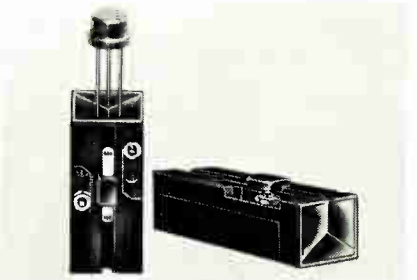
A large engineering staff supports these precision manufacturing facilities. It works with customers in developing special products for microwave applications. ■

The RF Products and Microwave Division Amphenol-Borg Electronics Corporation; 33 East Franklin Street, Danbury, Connecticut.

Visit us at IRE: Booths 1802, 1901, 1903, 1905.

FXR™

IRE New Products



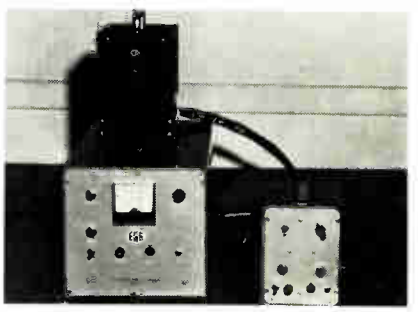
Transistor Test Socket

This "push button" socket for TO-5/TO-9 types, features: 2 independent contacts for each lead; push button loading & unloading; and weight less than ½ oz. Jettron Products, Inc. BOOTH M-10.

Circle 285 on Inquiry Card

Pulsed Power Systems

Model 530 Pulsed Power Supply features: Output, 100w-s (260μf @ 900v) selectable at 25%, 50% and



100% full power. Input is 115vac, 60CPS. Edgerton, Germeshausen and Grier, Inc. BOOTH 3244.

Circle 286 on Inquiry Card

Gaging System

This 1¼ in. Quick Change Holder with Microbar Gaging System allows any operator to make Back and End Gage settings directly to thousandths in a matter of seconds. Wales STRIPPIT Inc. BOOTH 4014.

Circle 287 on Inquiry Card

How "complete" is a complete line?

Are you as confused about all this complete line talk as we are? What, for example, is a "complete" potentiometer line? This *should* include everything from the *cheap-and-dirty* kind you'll find on a bargain table-radio to the ultra-accurate precision type shown above. By such reckoning, our line of Borg Micropot® potentiometers is far from complete.

The Borg line is "complete" in a different way. Its range of sizes, ratings, and types makes it applicable to virtually every circuit requiring potentiometers with extreme accuracy, reliability and life expectancy along with small size, wide temperature ranges, and rugged resistance to shock, vibration and atmospheric contaminents.

In other words, the Borg Micropot line *is* a complete line—of precision units for precision applications. This is as true of the new 2100 series shown above as of the many other series in the Borg line. As true of single-turns as of multi-turns. As true of commercial models as of military models.

There's a lot more to the Borg line than its completeness. It is *competitive.* Borg Micropot potentiometers are competitively priced, competitively distributed (through Amphenol Industrial Distributors), and competitively delivered. Find out for yourself. Contact your nearby Borg technical representative, Amphenol Distributor, or write to R. K. Johnson, Sales Manager.

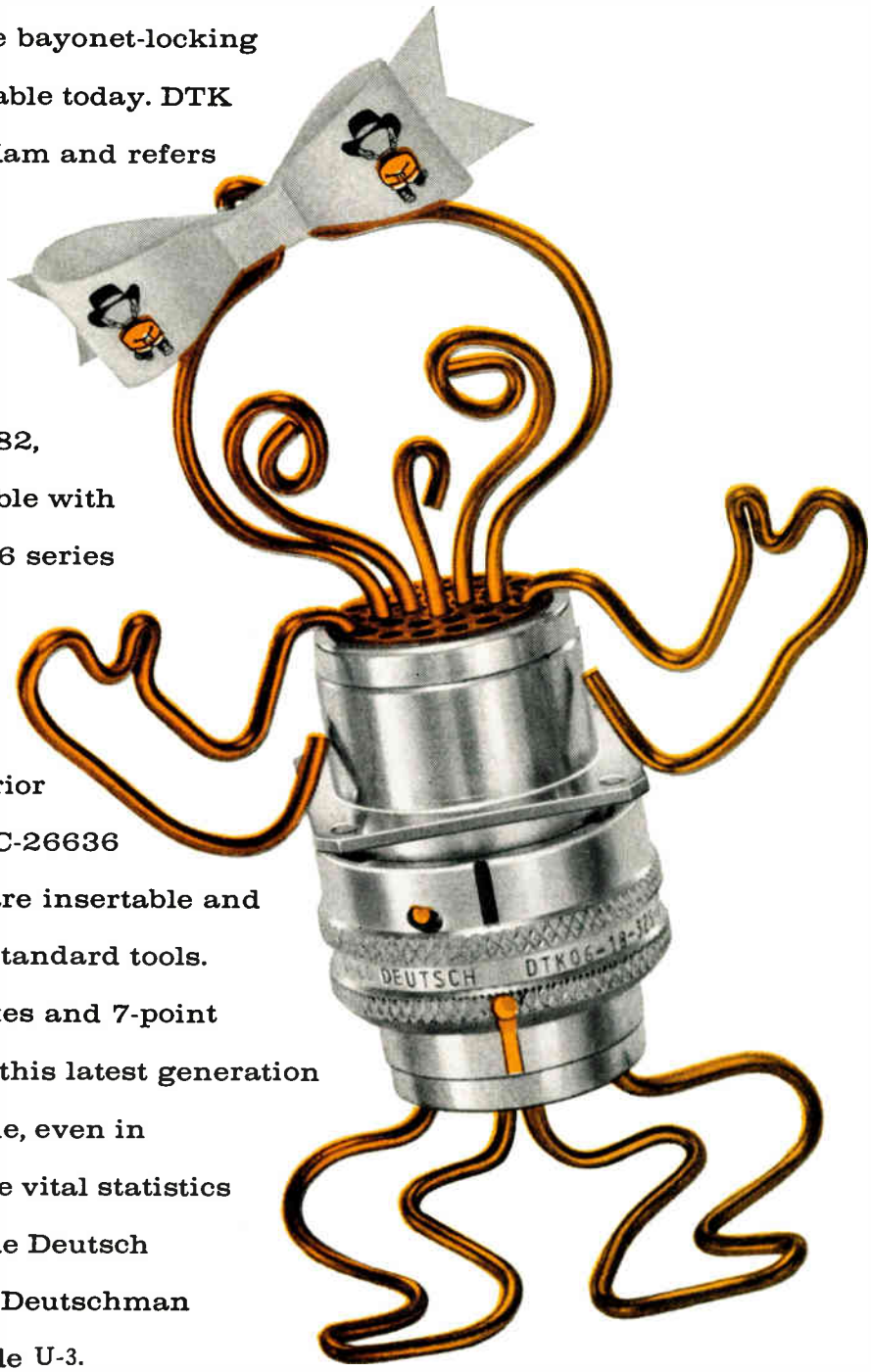
Circle 104 on Inquiry Card

BORG

BORG EQUIPMENT DIVISION
Amphenol-Borg Electronics Corporation,
Janesville, Wisconsin.

This Baby is Bayonet-Locking

Meet DTK...the best little bayonet-locking electrical connector available today. DTK is short for Deutsch Tri-Kam and refers to the triple cam coupling design that assures fast, positive engagement and lock. As a direct descendant of MIL-C-26482, this baby is interchangeable with existing MS 3110 and 3116 series connectors. The DTK also inherits many desirable features from its Deutsch ancestors including superior silicone inserts and MIL-C-26636 crimp-type contacts that are insertable and removable with military standard tools. Color-keyed mating indexes and 7-point inspection for lock, make this latest generation connector a cinch to couple, even in remote locations. For more vital statistics on the latest addition to the Deutsch family, contact your local Deutschman today or write for Data File U-3.



DEUTSCH

Electronic Components Division • Municipal Airport • Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

IRE New Products

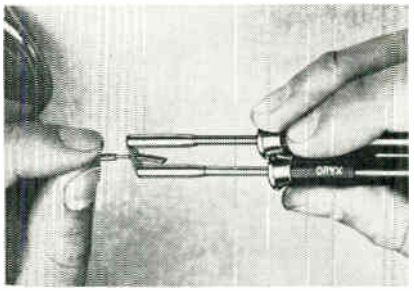
Selective Voltmeter

This solid-state Frequency Selective Voltmeter, Model 127A-Y, covers the freq. range from 2 to 350KC. Measurement accuracy is ±1db. Sensitivity is −80 to +22dbm. Sierra Electronic Corp. BOOTH 3031.

Circle 291 on Inquiry Card

Wire-Stripper

This tweezer-like compact, light weight thermal wire stripper, Model ST-6, strips all common medium temp.

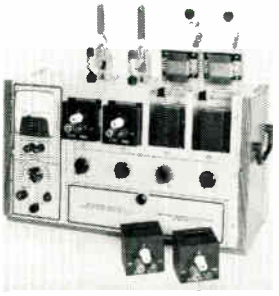


wire insulation including thermoplastics, PVC, nylon, and rubber. Oryx Co. BOOTH 4107.

Circle 292 on Inquiry Card

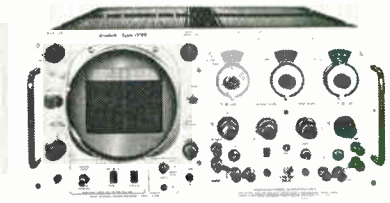
Transformer Simulator

Model TS-460 simulates single and multi-winding transformers. It has individual secondaries for 0 to 1500-vac @ 60va and wide-range freq. inputs. Electronic Research Associates, Inc. BOOTH 3820.



Circle 293 on Inquiry Card

IRE New Products



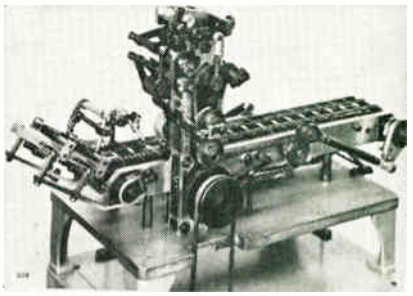
Dual-Trace Storage Scope

Designated Type 1220, the scope has a raster scan system, 1 or 2 channel presentations, to store data on a 1, 5 or 10-line display. Also included is an X-Y Recorder. Analab Instrument Corp. BOOTH 3945.

Circle 288 on Inquiry Card

Marking Machine

Model RG/3 is a high speed printing machine for capacitors, resistors, diodes, or any piece with end leads.



Speeds of 3600 to 4500 units/hr. may be attained. International Eastern Co. BOOTH 4034.

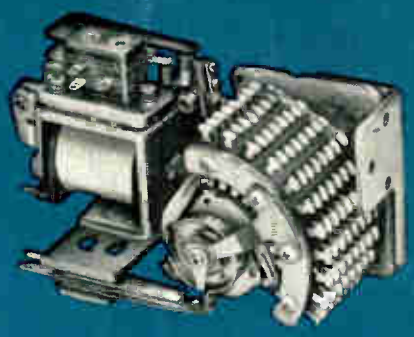
Circle 289 on Inquiry Card

Welding Power Supply

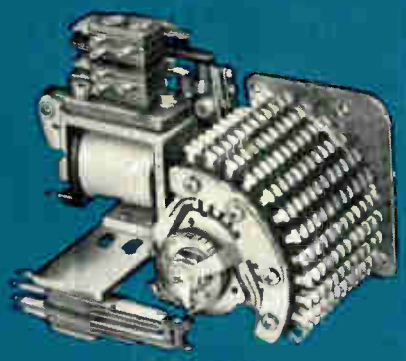
Model 1048 is a stored energy welding power supply with a range of 0.5 to 100w-sec. Regulation is ±1% from 20 to 365vdc. Discharge time is approx. 0.001 sec. Weldmatic Div./ Unitek Corp. BOOTH 4527.

Circle 290 on Inquiry Card

SPRING-DRIVEN

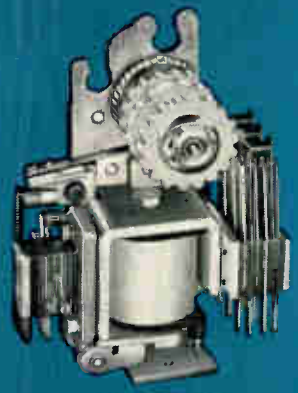


TYPE 210
Up to twelve 10-point levels
or four 30-point levels



TYPE 211
Up to twelve 11-point levels
or four 33-point levels

CAM-OPERATED



TYPE 200
Up to eight cams with 30, 32
or 36 tooth ratchets

TYPE 20
Up to sixteen 20-point levels
or twelve 40-point levels

TYPE 26
Up to sixteen 26-point levels
or twelve 52-point levels

DIRECT-DRIVE

Up to three 10-point levels

Let Clare put the exactly right stepping switch in your design

Designers who count on CLARE stepping switches as components for complex counting, totalizing and sequence-control equipment know that from the wide CLARE line they can select the exact switch their application requires. If necessary, CLARE engineering will provide special switch designs.

CLARE stepping switches are available as spring-driven, cam-operated or direct-drive switches with capacities from 10 to 52 points. All may be hermetically sealed in nitrogen or oil, or provided with dust covers.

All CLARE stepping switches are well known for their long life, high capacity and minimum maintenance through millions of precise stepping operations. For complete information write for Catalog 202.

C. P. CLARE & CO., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ont. Cable address: CLARELAY.

DAP* INSULATION STANDARD ON SPRING-DRIVEN SWITCHES

FOR—

- High insulation resistance
- Good arc resistance
- Stable insulation resistance
- Strength and stability
- Low moisture absorption

**diallyl phthalate*

C. P. CLARE & CO.

Relays and related control components

Circle 110 on Inquiry Card

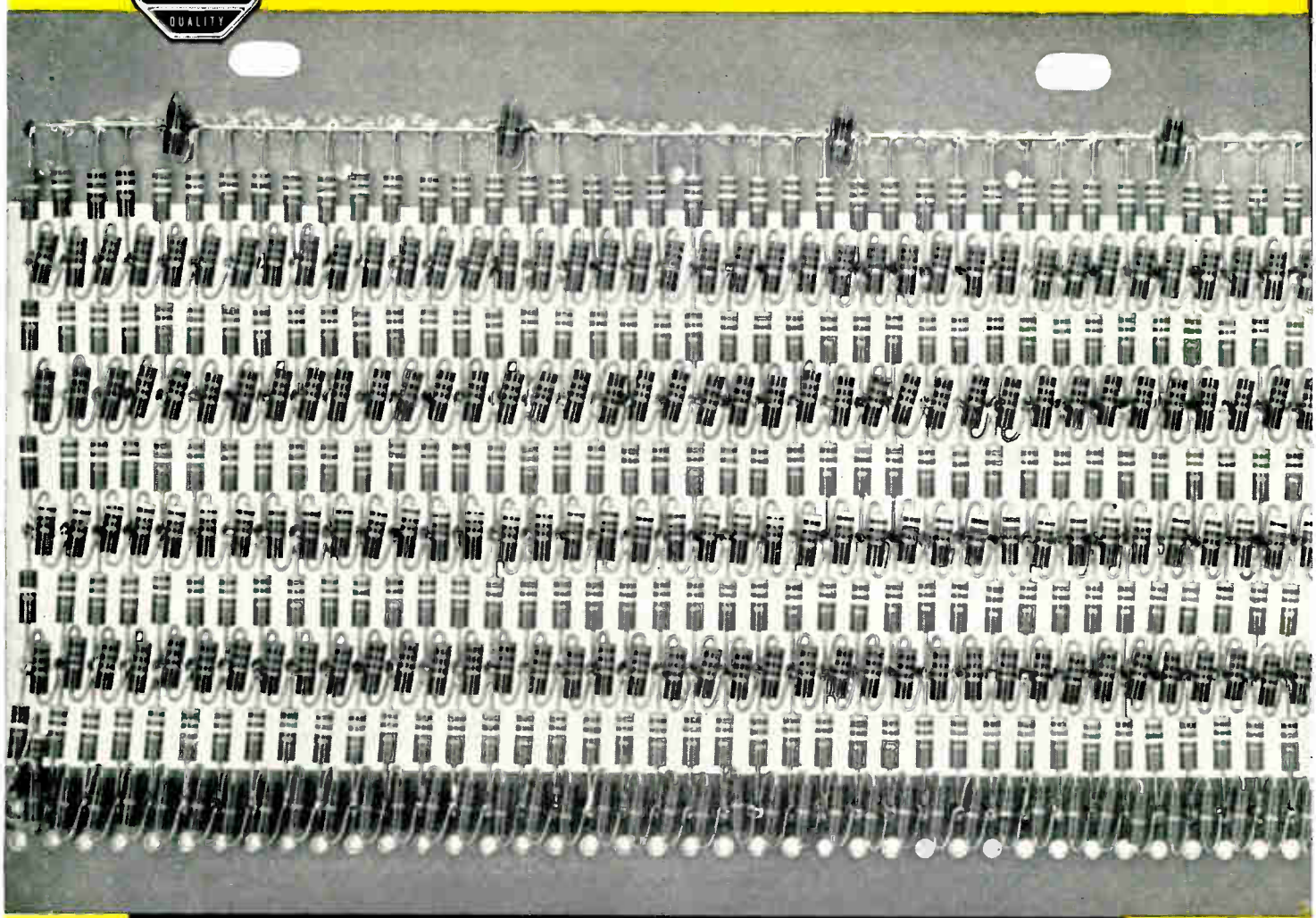
Pioneering New Oil Wells in the Laboratory...

500,000 ALLEN-BRADLEY HOT MOLDED RESISTORS HELP MAP STRATA TO FIND "PRODUCERS"

This network of over 1,000 A-B hot molded resistors is one of hundreds of similar grids developed by the Schlumberger Well Surveying Corp. for studying ground strata to locate producing zones.

The unusually large number of resistors in use per unit makes reliability of paramount importance. Therefore, Allen-Bradley resistors —with their history of *complete freedom from catastrophic failure*—were a logical selection for this unusually critical project. The *exclusive* A-B hot molding process makes possible the amazing uniformity for which Allen-Bradley resistors are famous. To eliminate the probability of resistor failure in your equipment, Allen-Bradley resistors can be your only choice.

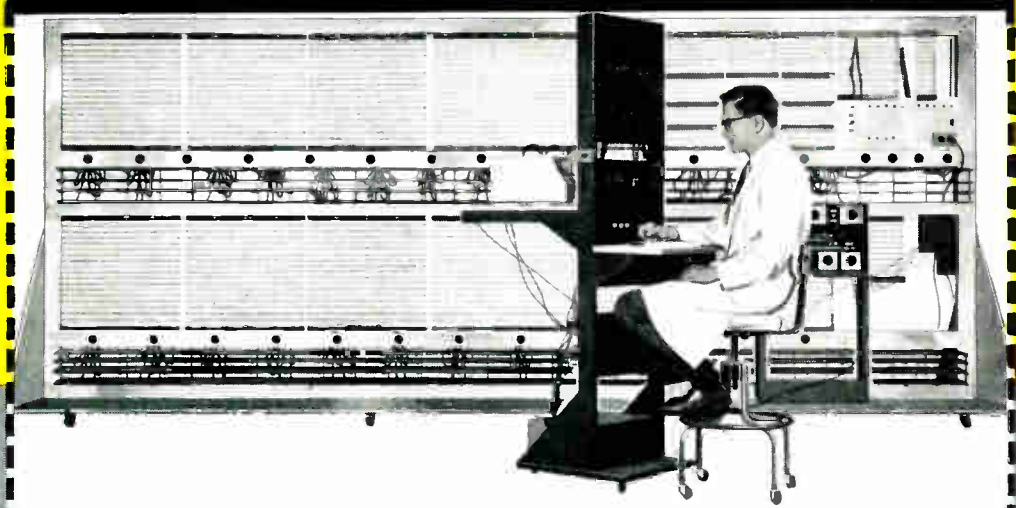
Allen-Bradley Co., 1342 S. Second Street, Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

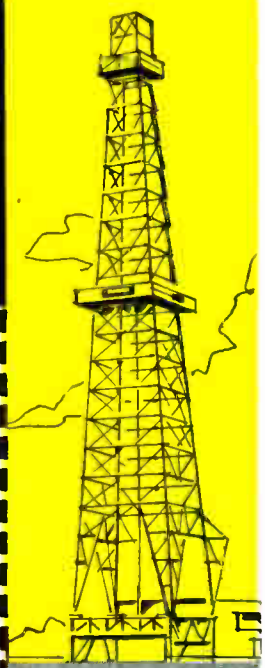


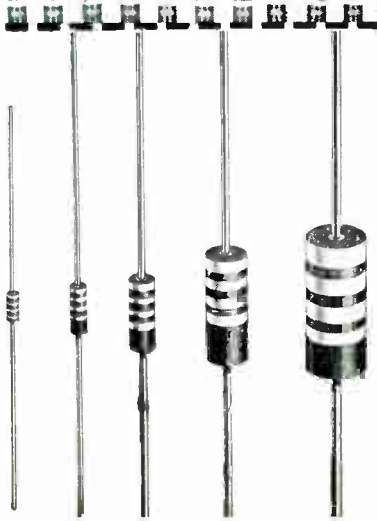
ALLEN-BRADLEY

QUALITY ELECTRONIC COMPONENTS

This complex resistor network at Schlumberger's Research Center contains in its basic assembly some 150,000 of the 500,000 Allen-Bradley hot molded resistors which they have assembled into grids simulating earth formations. By inserting interchangeable grids into the network in various combinations, it is possible to simulate the borehole and formation parameters which affect resistivity measurements. Duplication of formation characteristics permits a more precise examination and interpretation of the different resistivity logs used in locating potential gas and oil producing zones.







ALLEN-BRADLEY HOT MOLDED RESISTORS are available in all standard EIA and MIL-R-11 resistance values and tolerances. Shown actual size from left to right:

Type TR 1/10 watt (MIL Type RC 06), Type CB 1/4 watt (MIL Type RC 07), Type EB 1/2 watt (MIL Type RC 20), Type GB 1 watt (MIL Type RC 32), Type HB 2 watts (MIL Type RC 42).

A-B also makes a quality line of hermetically sealed precision resistors. Using metal grid construction, they are noninductive. Ratings are 1/4, 1/2 and 1 watt at 125° C with tolerances of 0.1, 0.25, 0.5 and 1.0%; and TC ±25 PPM.

Circle 109 on Inquiry Card

industry's most popular readout...

NIXIE® tubes!

There's a good reason . . . several, in fact . . . why Nixie Indicator Tubes are so widely used throughout the electronics industry. More manufacturers choose Nixie readouts over all others because they have • longest life (200,000 hours — 25 years) • constant brightness • best readability from every angle • lowest cost • smallest size • most rugged construction. And what's more, Nixie Tube character shapes are naturally easier to read.

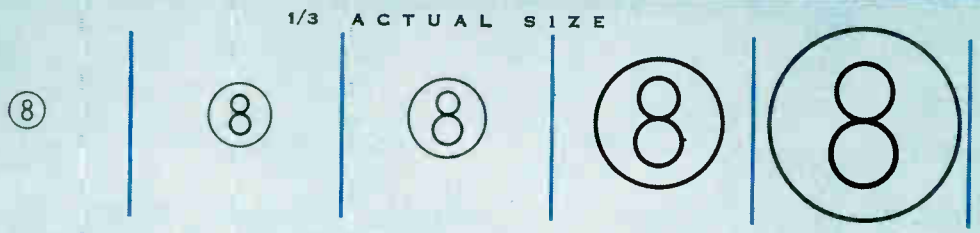
There's a Nixie Tube for every readout application. From jumbo to standard to miniature size, from special character to numeral display, the outstanding performance remains the same. It's easy to see why Nixie Tubes are the industry's favorite.

Write for complete data on the NIXIE Indicator Tube line.

ANOTHER ELECTRONIC CONTRIBUTION BY
Burroughs Corporation
ELECTRONIC COMPONENTS DIVISION
PLAINFIELD NEW JERSEY

1/3 ACTUAL SIZE

THE NIXIE TUBE LINE



NEW RECTANGULAR NIXIE TUBE

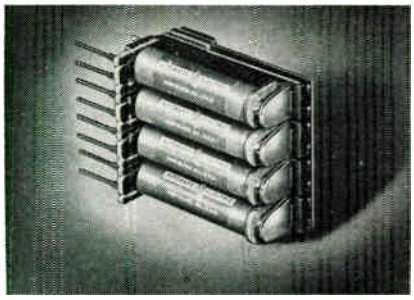
Same character size
Minimum volume for space conservation

	MINIATURE	STANDARD	SUPER	LARGE	JUMBO	STANDARD
Character Size	.3″	.6″	.8″	1.4″	2″	.6″
Viewing Distance	14′	30′	38′	60′	100′	30′

SEE US AT IRE SHOW BOOTHS 1211-1213-1215

Circle 8 on Inquiry Card for more data

IRE New Products



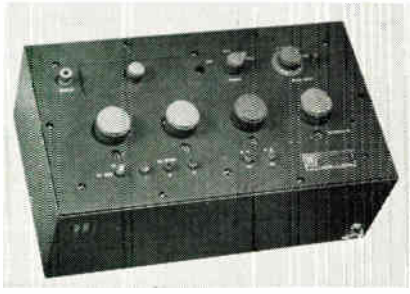
Memory Relay

The Codel Relay is for 4-element code systems. Consisting of 4 relays on a common heelpiece, it is for translating, storing and sending digital or binary information. Automatic Electric Co. BOOTH 1908.

Circle 294 on Inquiry Card

Laboratory Potentiometer

Model 2779 Low Range Microvolt Potentiometer features emf measurement in the millivolt-microvolt range

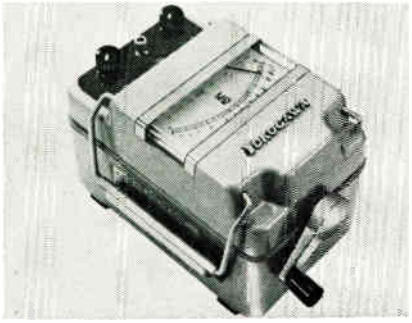


with resolution of 0.01μv. Minneapolis-Honeywell Regulator Co., Rubicon Div. BOOTH 2204.

Circle 295 on Inquiry Card

Insulation Tester

Hipot Insulation Tester, Model L-5B, governorless, silicon diode controlled, measures up to 5,000megs with extended scale giving up to 20,000megs at 2,000vdc. Yokogawa Electric Works, Inc. BOOTH 3841.



Circle 296 on Inquiry Card

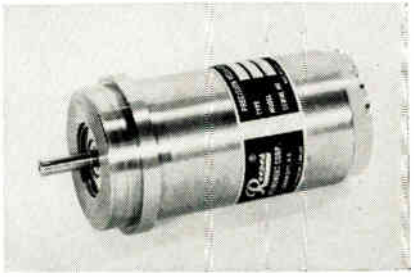
Microcircuits

Three "Nanocircuits" for computer logic applications are the NC-8C Flip-Flop, the NC-9 Flip-Flop Steering Gate, and the NC-10 Nor-Gate, in multi-lead packages with TO5 cans. General Instrument Corp. BOOTH 1212.

Circle 297 on Inquiry Card

Size 23 Synchros

New line of 30 sec. accuracy Size 23 synchros includes both transmitters and control transformers; and can be

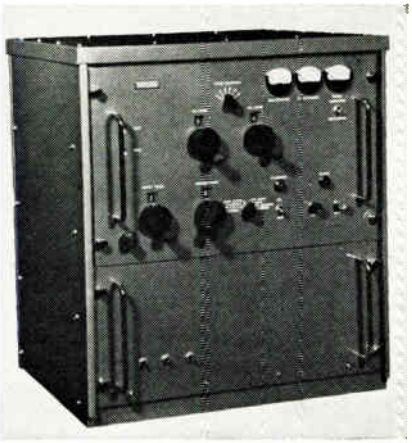


supplied for either a 60 or 400CPS input. Reeves Instrument Corp. BOOTH 1305.

Circle 298 on Inquiry Card

Linear Amplifier

HFL-1000, 1kw 2.3-30MC linear amplifier, at 1000w PEP or 1000w CW is a completely self-contained amplifier measuring 20½ x 20¼ x 23½ in. Final is operated class AB_1. Gates Radio Co. BOOTH 3608.



Circle 299 on Inquiry Card

JFD Trimmers and LC tuners help keep Transit Satellite transmitters on exact frequencies

Transit, the Bureau of Naval Weapon's all-weather global navigation system, is scheduled for operational use in 1962. Transit will provide ships, submarines and aircraft with the most precise method ever devised for fixing their positions.

The highly critical nature of the system's measurement functions demanded highest reliability, stability and exactness in the performance of its two frequency sources. JFD VC42GW trimmer capacitors were specified for each of the two crystal-controlled oscillators to help assure frequency stability of 2 to 4 parts in 10^{10}. JFD trimmers were used also in the frequency multiplier circuit to maintain required oscillator frequency outputs.

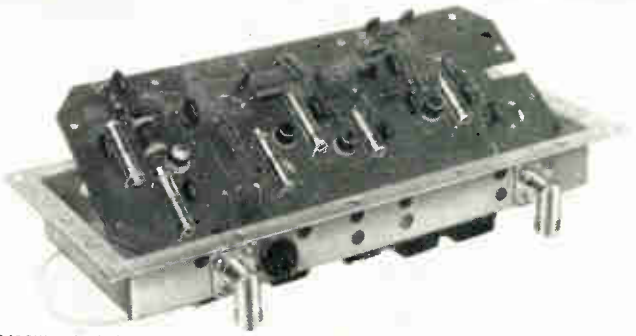
JFD LC tuners as well as trimmers were called for in both the B-system and C-system power amplifiers of the transmitter circuits and in the Transit diplexing antenna system to provide highest possible operating stability.

This is another example of how JFD precision electronic components satisfy space-challenging demands of tuning accuracy and stability under severe shock and vibration. Fewer parts, precise tolerances, patented telescoping anti-backlash adjustment are a few of the reasons why more engineers specify JFD

For complete information, contact your local JFD Field office or your local JFD franchised Industrial Distributor.

Applied Physics Laboratory of the Johns Hopkins University specified JFD Trimmer Capacitors and Tuners in the Transit 2-A Satellite.

JFD LC Tuners and Trimmers in Transit frequency multipliers and power multiplier amplifier circuits provide maximum tuning range in minimum space ... high reliability and ruggedness.



JFD VC42GW actual size
Variable Trimmer Piston Capacitor
1.0 mmf. to 21.0 mmf.

JFD LC326 LC Tuner actual size
200 to 450 mc.
self-resonating frequency

JFD

JFD ELECTRONICS CORPORATION

Components Division • 6101 16th Avenue, Brooklyn, New York • Phone DEwey 1-1000 • TWX-NY25040

JFD WESTERN
P. O. Box 3416
Van Nuys, Calif.
Phone: EMpire 4-4131

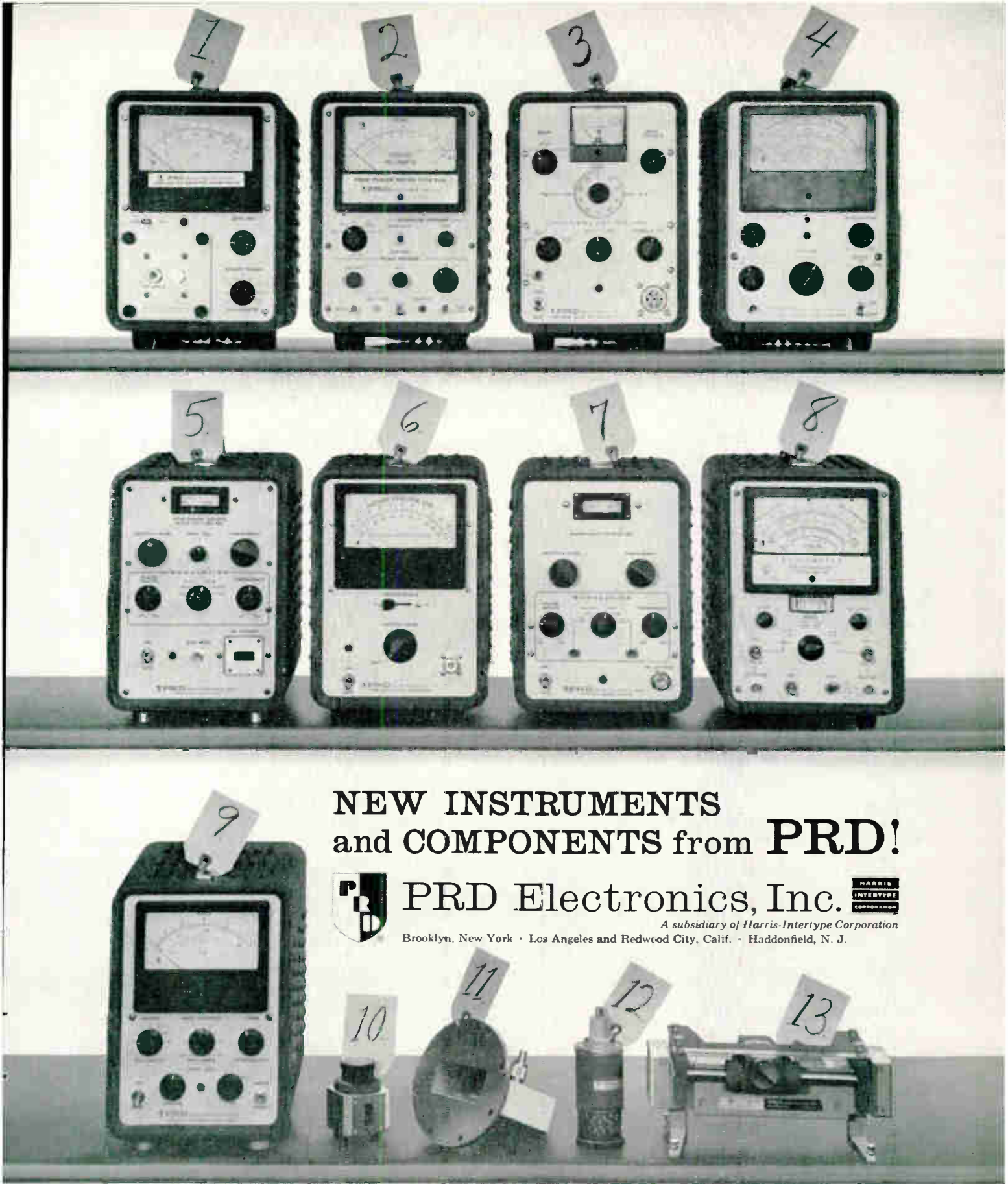
JFD MIDWESTERN
P O. B. 588
Skokie, Illinois
Phone: 675-1140

JFD NORTHEASTERN
Ruth Drive, P. O. Box 228
Marlboro, Mass.
Phone: HUntley 5-7311

JFD CANADA
51 McCormack Street
Toronto, Ontario, Canada
Phone: ROger 9-1129

VARIABLE TRIMMER PISTON CAPACITORS • FIXED METALIZED INDUCTORS • LC TUNERS • DIPLEXERS
FIXED AND VARIABLE, DISTRIBUTED AND LUMPED CONSTANT DELAY LINES • PULSE FORMING NETWORKS

BE SURE TO VISIT JFD BOOTH NO. 1226 AT THE IRE SHOW MARCH 26-29, 1962



NEW INSTRUMENTS and COMPONENTS from PRD!

PRD Electronics, Inc.

HARRIS INTERTYPE CORPORATION

A subsidiary of Harris-Intertype Corporation

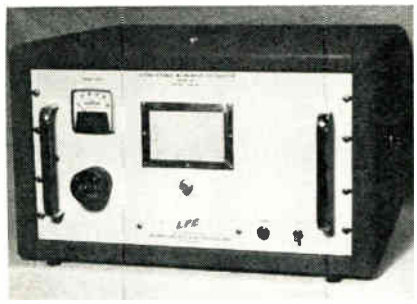
Brooklyn, New York · Los Angeles and Redwood City, Calif. · Haddonfield, N. J.

1. PRD N680 Calorimetric Power Meter 2. PRD 668 Peak Power Meter 3. PRD 809-A Klystron Power Supply 4. PRD 277-B Standing Wave Amplifier 5. PRD X712 Signal Source 6. PRD 904-A Noise Generator 7. PRD S712 Signal Source 8. PRD 279 Ratiometer 9. PRD 650-C Microwave Power Meter 10. PRD 4000 Series Waveguide Switches 11. PRD 6608 Bolometer Mounts 12. PRD 3302 Calibrated Susceptances (For PRD 219) 13. PRD 232 & 233 Slotted Line and Carriage ...and many, many more! Send for data! PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N. Y.

See us at Booth 3602-3606, IRE Show

Circle 113 on Inquiry Card

IRE New Products



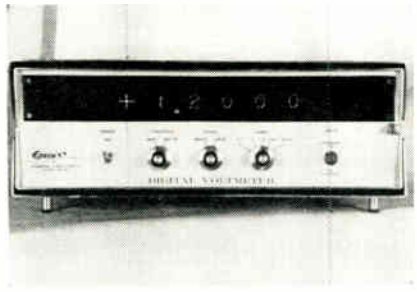
Microwave Oscillator

Model 816 series of stable microwave oscillators have short-term stability of 5 parts in 10^8 peak deviation and long-term stability of 1 part in 10^4. LFE Electronics, Instrument Div. BOOTH 3715.

Circle 300 on Inquiry Card

Digital Voltmeter

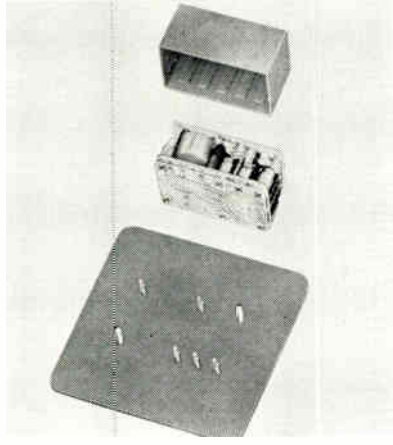
This universal voltmeter-analog to digital converter (VAD) features 1000megs input impedance, 0.01% accuracy, auto polarity, auto ranging, and 100μsec conversion. Epsco, Inc. BOOTH 3915.



Circle 301 on Inquiry Card

Micro-Module

"Modu-Con" modules are available in 3 standard sizes, consisting of a mylar wafer; plastic header; Varicon contacts; and potting shell. Modu-Con components are available separately. Elco Corp. BOOTH 1420.



Circle 302 on Inquiry Card

Thermoelectric Device Protects Gas Well

Thermoelectric generator, developed by Westinghouse, is protecting a mile-deep Texas gas well. Generator supplies electric power needed for cathodic protection, to keep the casing from being eaten away by the electrochemical reaction that occurs spontaneously in metal objects buried in the ground. Generator taps a small amount of the gas coming from the well, burns it, and converts the heat directly into electrical energy.

E. S. M. A. To Discuss Robinson-Patman Act

The Electronic Sales and Marketing Managers Association will hold a panel discussion on the Robinson-Patman Act, as it affects the electronic sales and marketing manager.

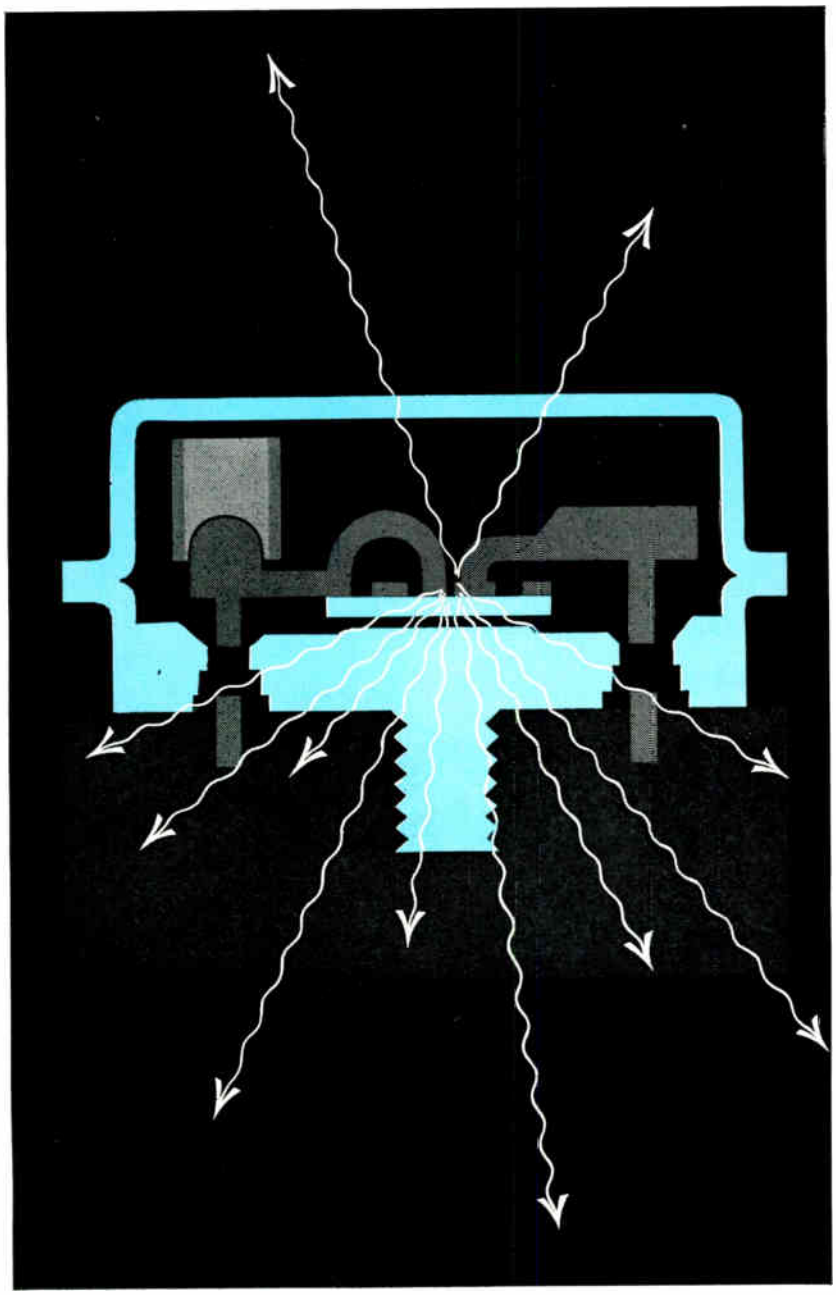
The E.S.M.A. meeting will be held on Sunday, March 25th, during the I.R.E. Show, at 4 P.M. in the Theatre of the Barbizon-Plaza Hotel, 106 Central Park South, N. Y., N. Y.

Participating in the discussion will be several attorneys regarded as experts on the Robinson-Patman Act.

For tickets and further information contact: Electronic Sales Managers Association, P. O. Box 1, Bellerose, L. I., N. Y.

NEW DISCOVERY

Dr. Leo Esaki of the IBM Research Center, Yorktown, N. Y., adjusts apparatus used in his discovery of a new physical effect in bismuth, a semi-metal. As a result of his discovery, increased research activity in this group of metals is expected which might lead to future development of speedier electronic devices.

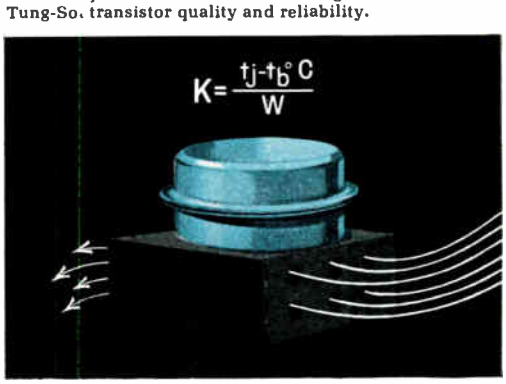


TUNG-SOL CONTROLS 'K' FACTOR

TO PRODUCE POWER TRANSISTORS THAT DELIVER FULL POWER

I_{CBO} is first measured at an elevated temperature. The transistor is then coupled, with silicone oil contact, to a copper block water-cooled to 25°C to provide an infinite heat sink. Power input is raised until I_{CBO} equals high temperature I_{CBO}. The temperature difference, divided by power, yields K in °C/watt.

This measure of a transistor's ability to remove heat from the junction is one of several significant criteria of Tung-Sol transistor quality and reliability.



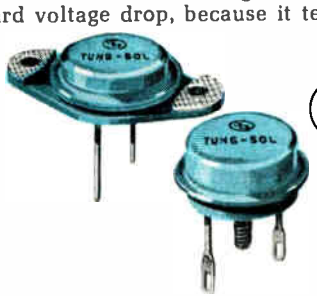
Maximum junction temperatures of 110°C, plus low K factors, enable Tung-Sol germanium power transistors to deliver full rated power under even the most adverse conditions. Design engineers can rely on full power performance because of the Tung-Sol policy of basing transistor design and specifications upon the most meaningful combinations of environmental and electrical tests.

K factor, or thermal resistance, is typical. Deceptively low K factors can be obtained by improper positioning of the external case temperature measuring device. Tung-Sol specifies junction-to-case—a more valid measure.

In monitoring junction temperature, Tung-Sol uses reverse leakage current (I_{CBO}), a parameter more meaningful to the design engineer than forward voltage drop, because it tends to reveal the effects of junction hot spots.

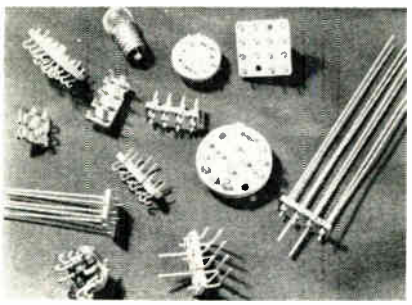
Maintaining low K factors (.5° C/watt maximum for the TO-36 configuration and .8° C/watt for the TO-3) is one of many ways Tung-Sol engineering builds an extra margin of power into transistors. In addition to 110°C junction temperatures, Tung-Sol power transistors have lower saturation voltage and higher breakdown voltages than ordinary transistors. Power transistor cases have copper-to-copper Cold Welds to prevent heat-caused contamination and damage and to assure maximum heat dissipation. Mounting surfaces are flat-ground to assure full heat sink contact.

All these quality features are available in both TO-3 and TO-36 configurations. Write for design information. Tung-Sol Electric Inc., Newark 4, New Jersey. TWX:NK193



TUNG-SOL® FULL POWER
POWER TRANSISTORS

IRE New Products



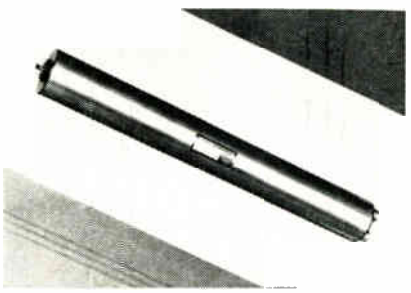
Relay Headers

Line of crystal-base relay headers is available including standard rectangular, oval, 5-pin square, and 14-pin square; also, specials (10 or 20 pins). Glass-Tite Industries, Inc. BOOTH 1628.

Circle 303 on Inquiry Card

High Gain TWT

This ruggedized, high gain version of the ppm focused HA-21 TWT amplifier offers 50db min. small-signal

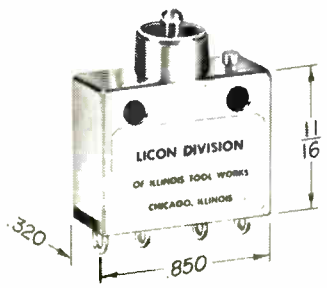


gain and 1w min. saturation power output from 8.5 to 10.0GC. Huggins Laboratories, Inc. BOOTH 2334.

Circle 304 on Inquiry Card

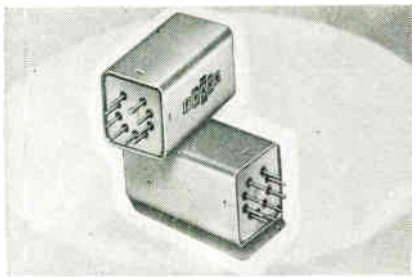
Subminiature Switch

Precision snap-action switch, type 65, is for use in corrosive atmospheres, excessive moisture or temp. extremes. It is rated at 10a, 30vdc/120vac. Licon Div., Illinois Tool Works, Inc. BOOTH 1617.



Circle 305 on Inquiry Card

IRE New Products



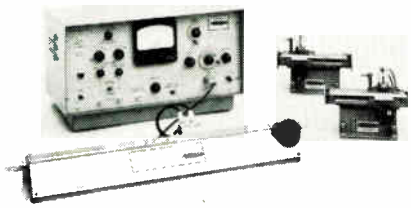
Relay

Frahm freq. sensitive relay, Type RR-300 is for Squelch Tone mobile communication equip. Features: Nominal freq. range: 67 to 300CPS; operating temp. range −50 to +100°C. James G. Biddle Co. BOOTH 3222.

Circle 306 on Inquiry Card

Phase Meter

Model 305 Phase Meter is for measuring the r-f phase during a microwave pulse. Used with an Os-



cilloscope, it permits observation of dynamic phase changes. Wiltron Co. BOOTH 3844.

Circle 307 on Inquiry Card

Power Transistor Tester

Model 1822 test set gives direct readings of the dc parameters of power transistors over a wide range of bias conditions. V_C is variable to 300v; I_C up to 100a. Dynatran Electronics Corp. BOOTH 3935.

Circle 308 on Inquiry Card

IRE New Products

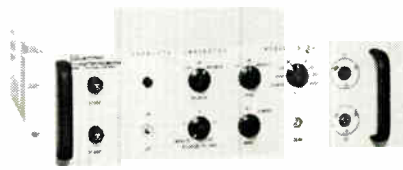
Swept Oscillators

Series of electronically swept oscillators with built-in power levelers covers from 0.5 to 40GC. For determining wide band freq. response of microwave devices and systems. Menlo Park Engineering. BOOTH 3025.

Circle 309 on Inquiry Card

Converter

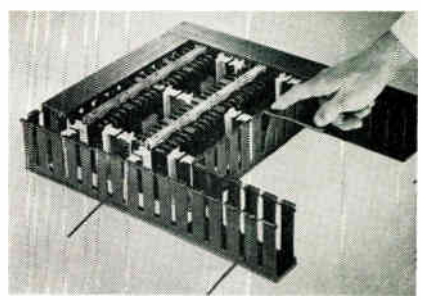
The Model 6150 is a solid state, high speed capacitance and dissipation factor to dc converter. No bridge balancing is required. Capacitance resolution: 0.01% F.S. Electro Instruments, Inc. BOOTH 3912.



Circle 310 on Inquiry Card

Duct System

Recent addition to the Panduct line is a duct system for use with the new 10a, 300v modular industrial relays. Advantages include wire retention, accessibility and economy. Panduit Corp. BOOTH 4011.



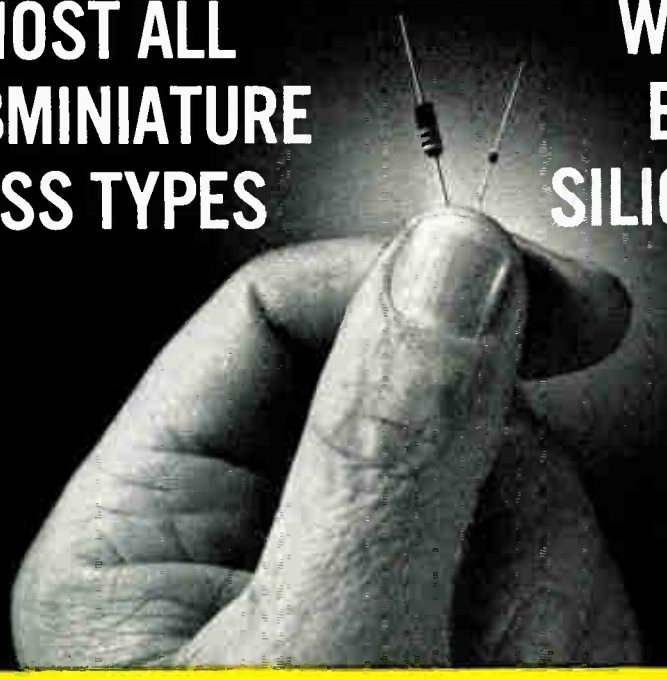
Circle 311 on Inquiry Card

WEIGHT, SPACE PROBLEMS?

REPLACE

ALMOST ALL SUBMINIATURE GLASS TYPES

WITH TRANSITRON'S EXPANDED LINE OF SILICON MICRODIODES



Since it introduced the first all-glass packaged silicon microdiode with TRUE hermetic sealing, Transitron has continued to expand its line until today it offers, in quantity, the widest variety of high-quality silicon microdiodes in the industry.

While Transitron still remains an exclusive source for micro "zeners", further developments have made possible the introduction of a series of very fast switching, low capacitance microdiodes particularly well-suited for use in extremely high speed transistorized computer circuitry. The family includes Transitron's TMD-50, and TMD-914 and TMD-916 — microequivalents of the popular subminiature glass 1N914 and 1N916.

The rugged all-glass construction and true hermetic sealing of Transitron's microdiodes provide exceptional long-term reliability over a wide range of environmental extremes. Their compatibility with conventional semiconductor circuitry can help you miniaturize your existing design through replacement of standard subminiature glass types with microdiode equivalents. All are available in quantity and are especially recommended for critical computer applications where small size, light weight and excellent stability are required . . .

For further information, write for Transitron's "Microdiode" bulletins.

Watch for still further significant developments in microminiaturization from Transitron. Soon to be announced.

RECOMMENDED REPLACEMENT CHART

MICRODIODE TYPES		SUBMINIATURE GLASS TYPES
Very Fast Switching Types		
TMD-50	replaces	1N993 (S266G)
TMD-914	replaces	1N914
TMD-916	replaces	1N916
Fast Switching Types		
TMD-24	replaces	1N625, 1N626 1N659
TMD-25	replaces	1N627, 1N658 1N662, 1N663
TMD-27	replaces	1N628, 1N629 1N661, 1N643
High Conductance Types		
TMD-41	replaces	1N456, 1N456A 1N461, 1N461A 1N482 thru 1N482B
TMD-42	replaces	1N457, 1N457A 1N462, 1N462A 1N483 thru 1N483B
TMD-45	replaces	1N458, 1N458A 1N459, 1N459A 1N463, 1N463A 1N464, 1N464A 1N484 thru 1N485B
Micro Voltage Regulator Types		
TMD-01	replaces	1N705, 1N751
TMD-02	replaces	1N708, 1N752
TMD-03	replaces	1N709, 1N753
TMD-04	replaces	1N710, 1N754
TMD-05	replaces	1N711, 1N755
TMD-06	replaces	1N712, 1N756
TMD-07	replaces	1N713, 1N757
TMD-08	replaces	1N714, 1N758
TMD-09	replaces	1N715
TMD-10	replaces	1N716, 1N759

NOTE: The MICRODIODE types listed above are similar to their conventional-size counterparts within the limitations of power dissipation . . . Transitron engineers will be glad to discuss with you comparative specifications as they affect your particular replacement designs.

MEET US AT THE IRE SHOW—BOOTHS 1720-1724

Circle 124 on Inquiry Card

1952 10 1962 YEARS LEADERSHIP IN SEMICONDUCTORS

Transitron

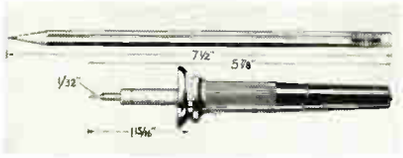
electronic corporation

wakefield, melrose, boston, mass.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U. S. A. AND EUROPE • CABLE ADDRESS: TRELCO

Circle 39 on Inquiry Card

IRE New Products



Soldering Iron

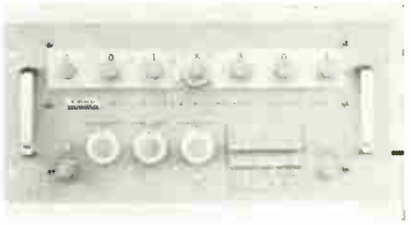
It has an overall length of 5⅞ in.; tip dia. is 1/32 in.; includes Durotherm long-life iron coated tips, available in many different point shapes. Wattage: 12w. Hexacon Electric Co. BOOTH 4002.

Circle 318 on Inquiry Card

Elapsed Time Indicator

Indicator, shown with inverter, operates from 26vdc source to provide digital time readout from 0000 to 9999 hrs, inverter provides 115v at 400CPS. Bowmar Instrument Corp. BOOTH 1508.

Circle 319 on Inquiry Card



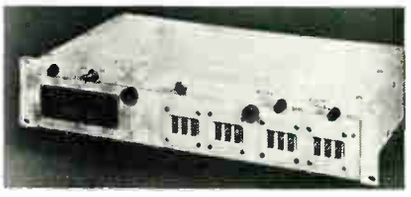
DC Voltage Standard

Seven dials control the output in microvolt steps from 0 to over ±11v, in 10μv steps to over ±110v, and in 100μv steps to over ±1100v. Cohu Electronics, Inc., Kin Tel Div. BOOTH 3605.

Circle 320 on Inquiry Card

Counter/Timer

Sequential/Interval Counter/Timer, Model S.I.C.-4/3-25, provides outputs which mark the ends of 4 successive counting cycles. Each cycle is adjustable from 0 to 999 counts. Di/An Controls, Inc. BOOTH 3006.



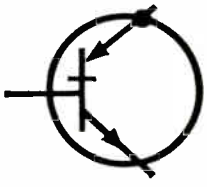
Circle 321 on Inquiry Card

Circle 40 on Inquiry Card

To Contractors and Subcontractors on U. S. Government Projects

FAST SWITCHING PNPN TRANSISTOR

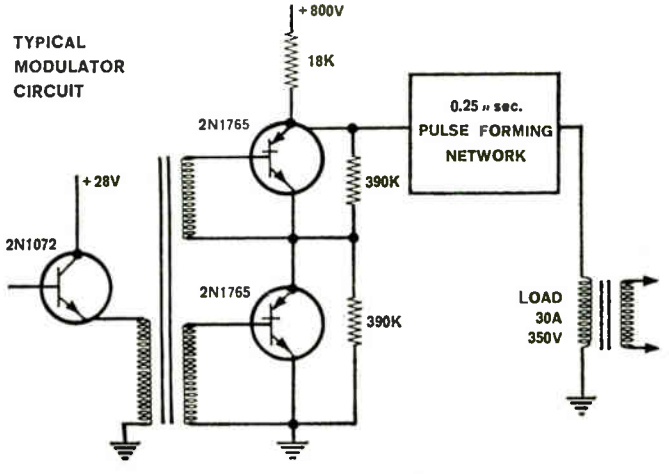
Kilowatt Switching Capability—100 Nanoseconds



2N1765

TO-5 PACKAGE

The PNPN 2N1765 is a 3-junction, 3-terminal diffused silicon transistor in a vacuum-tight enclosure suitable for fast, high-current, pulse switching. This device's rise time to 30 amperes is less than 100 nanoseconds. Turn off time is approximately 1 microsecond. It is operational at emitter currents to 50a with gate drives from 5ma to 2a.



MAXIMUM RATINGS AT 25° C

$I_{(on)}$	50a
$P_{(avg)}$	500mW

ELECTRICAL CHARACTERISTICS

$BV_{(off)}$ (min)	400V dc
V_F (max) (@ 200 nsec)	50V @ 30a
$t_d + t_r$ (max) (@ i_F=50a)	125 nsec
I_H (min)	5mA

The 2N1765 transistor may be purchased in quantity from Western Electric's Laureldale Plant. For technical information, price, and delivery, please address your request to Sales Department, Room 105, Western Electric Company, Incorporated, Laureldale Plant, Laureldale, Pa. Telephone—Area Code 215—WAlker 9-9411.

LAURELDALE PLANT
MAKER OF ELECTRON PRODUCTS

Western Electric
MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

IRE New Products

Power Amplifier

Model A10K Power Amplifier is rated at output of 10kw from 1 to 150KC and is offered with 6 output voltage taps. Communication Measurements Laboratory, sub. of Tenney Engineering, Inc. BOOTH 3118.

Circle 322 on Inquiry Card

RMS Meter

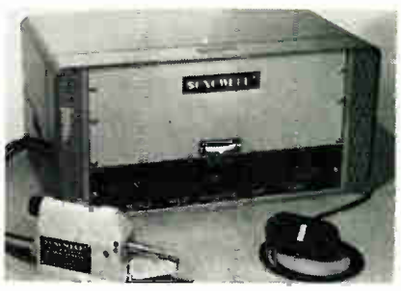
Features include the use of precision wire-wound resistors, true RMS-no amplifiers, and the use of a solid

state transducer instead of a thermocouple. Greibach Instruments Corp. BOOTH 3822.

Circle 323 on Inquiry Card

Ultrasonic Welding

Sonoweld Model W-1040-TSL, is primarily for use in the electronic field. It is used for ultrasonic welding of fine wire and thin foil by the fibratory energy. Sonobond Corp. BOOTH 4235.



Circle 324 on Inquiry Card

NEW!

Model CFI 1,000 to 10,000 mc

Model CFI 950 to 11,260 mc

TRANSISTORIZED CALIBRATED FIELD INTENSITY RECEIVER...

This is the Polarad Model CFI—the latest in field intensity measurement test equipment. It's transistorized for portability...excellent for airborne applications. The built-in impulse calibrator enables RFI measurements in accordance with latest military requirements. Plug-in tuning heads under development, will extend the frequency range beyond the present 1,000 to 10,000 mc capability.

FUNCTIONS AS A MULTI-PURPOSE MICROWAVE RECEIVER, TOO!

As an all-purpose receiver, the CFI offers AM, FM, CW and Pulse capability. These features make this the most versatile receiver you've ever used: 3 impulse bandwidths; 70 db dynamic range; sensitivity —90 dbm; direct reading meter circuits. You can use the CFI for all general laboratory and field work. Call your Polarad representative for a demonstration, or mail the card.

SPECIFICATIONS

FREQUENCY: 1,000 to 10,000 mc in four plug-in tuning units (950 to 11,260 mc as receiver)
SENSITIVITY: to —90 dbm
FREQUENCY DIAL ACCURACY: ± 1%
IMPULSE CALIBRATOR includes built-in impulse generator, RF attenuator (—60 db), IF attenuator (0—20 db), in 1 db steps
ANTENNA EQUIPMENT: 4 directive and 1 omni-directional; mounting tripod
OUTPUTS: Audio, Video and Recorder
METER CIRCUITS: Average and slideback peak, direct-reading peak and quasi-peak
INTERNAL CALIBRATION SIGNAL: Impulse type; 1 to 10 gc ±0.5 db flat output
IMPULSE BANDWIDTHS: 1 mc, 5 mc, and 8 mc
VIDEO BANDWIDTH: 3.5 mc
IMAGE REJECTION: 60 db
POWER INPUT: 12 volts DC; 115 volts AC; 50 to 420 cps

POLARAD
ELECTRONICS CORPORATION FREE LIFETIME SERVICE
43-20 34TH STREET, LONG ISLAND CITY 1, NEW YORK

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43-20 34th St., Long Island City 1, New York

POLARAD PROVEN RELIABILITY

Please send me information and specifications on:
☐ Model CFI Calibrated Microwave Field Intensity Receiver

MY APPLICATION IS _____

Name _____

Title _____ Mail Station _____ Dept. _____

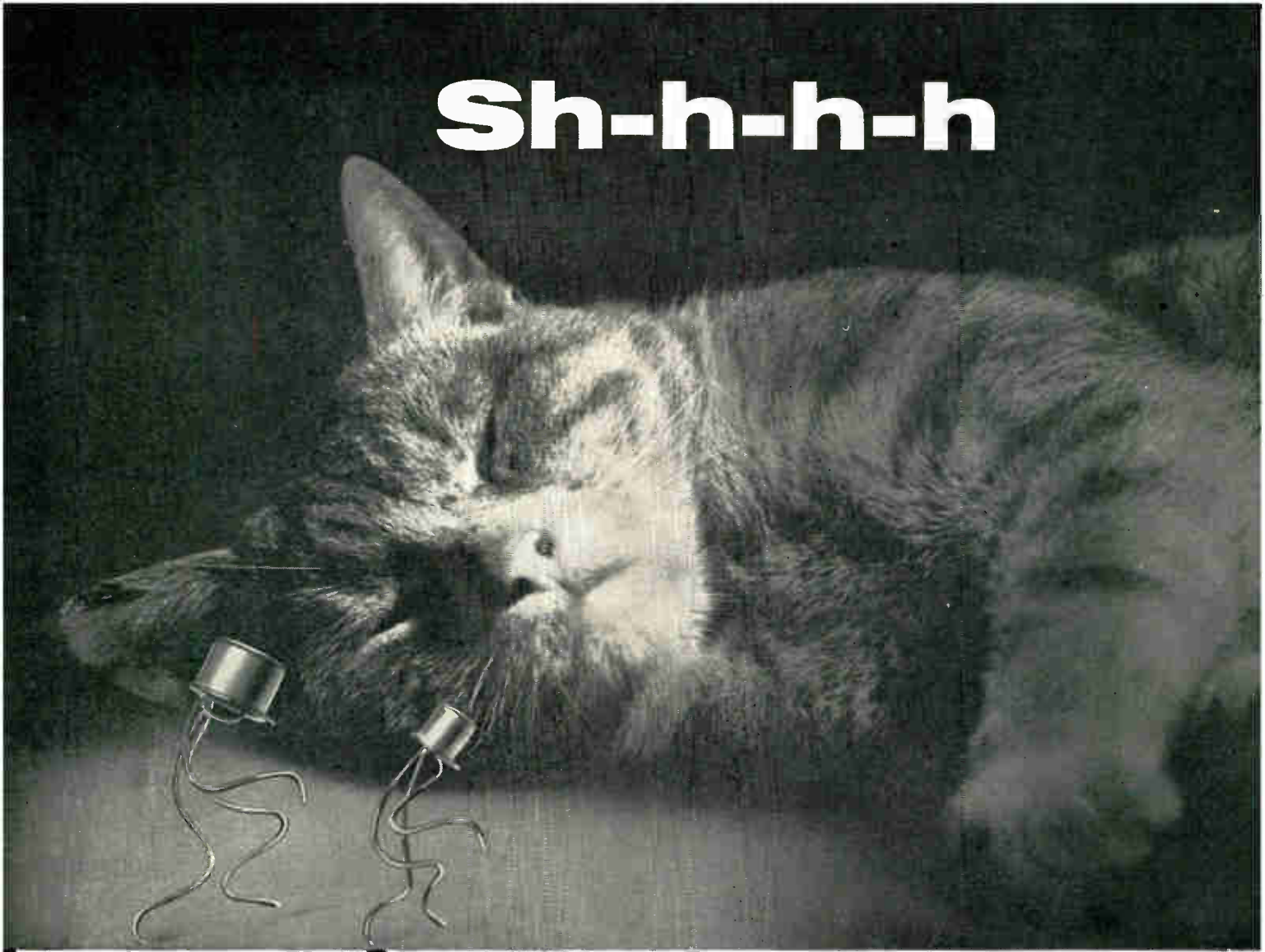
Company _____

Address _____

City _____ Zone _____ State _____

Circle 127 on Inquiry Card

Sh-h-h-h



LOW NOISE AMPLIFIERS 2N2177 (TO-5) 2N2178 (TO-18)		
h_{FE}	$I_C = -20\mu A$, $V_{CE} = -4.5$ V	30 MIN.
I_{CBO}	$I_E = 0$, $V_{CB} = -4.5$ V	1.0 mμA Max.
$\bar{e}_n$	$I_C = -20\mu A$, $V_{CE} = -1.5$ V, BW = 1-50 cps	0.18μV Max. RMS
$\bar{i}_n$	$I_C = -20\mu A$, $V_{CE} = -1.5$ V, BW = 1-50 cps	70$\mu\mu$A Max. RMS
LOW LEVEL AMPLIFIERS 2N2175 (TO-5) 2N2176 (TO-18)		
h_{FE}	$I_C = -5\mu A$, $V_{CE} = -4.5$ V	15 Min.

SPERRY

SEMICONDUCTOR

DIVISION OF
SPERRY RAND CORPORATION
NORWALK, CONNECTICUT

Circle 128 on Inquiry Card

LOW NOISE

PNP Silicon Alloy Transistors in TO-5 and new TO-18 cases feature useable amplification at very low output current levels.

This low noise unit is designed for applications where noise must be at a minimum, as in low level preamplifier stages. High current gain at low collector currents provides useful amplification while voltage and current guarantees low noise performance. Extremely low leakage currents are exhibited over the operating —65°C to + 175°C temperature range.

The new low level amplifier PNP silicon alloy transistor features high current gain at even lower currents, but with a slightly higher noise figure.

Write for complete specification.

See us at IRE Booth 2737-39

SEMICONDUCTOR INTEGRATED NETWORKS (SEMI-NETS*)
TUNNEL DIODES. MESA AND ALLOY SILICON TRANSISTORS AND DIODES
SALES OFFICES: CHICAGO, ILLINOIS; LOS ANGELES, CALIFORNIA; OAKLAND, NEW JERSEY; MEDFORD, MASSACHUSETTS; SYKESVILLE, MARYLAND; BETHPAGE, L. I., NEW YORK

SEMICONDUCTOR OPPORTUNITIES AVAILABLE TO QUALIFIED ENGINEERS

*Trade Mark, Sperry Rand Corporation

Tele-Tech's
ELECTRONIC OPERATIONS

The System Engineering Section of ELECTRONIC INDUSTRIES • MARCH 1962

SYSTEMS—WISE . . .

PACIFIC MISSILE RANGE TRACKING SYSTEM

Radome (bottom of photo) houses the newly operational long range radio tracking system GERSIS (General Electric Range Safety Instrumentation System). System was installed by G. E. Defense Systems Dept., Syracuse, N. Y., at Naval Missile Facility, Point Arguello, Calif. GERSIS can predict a missile's precise position in space with a high degree of accuracy. It will be used with ICBM boosters in testing the Nike Zeus anti-missile missile system.

▸ The Systems Div. of Beckman Instruments, Inc., Fullerton, Calif. will build 2 data acquisition systems for use at NASA's Saturn Static Test Facility, Huntsville, Ala. The work will be done under a $1,087,649 contract from AETRON-Covina Plant, a Div. of Aerojet-General Corp. The systems will be used to record performance data from rocket engine tests.

▸ The USAF Communications Service has announced completion of an Emergency Message Automatic Transmission System (EMATS) from USAF HQ to all major air commands. EMATS was developed and installed by Western Union. Hazeltine Corp., Little Neck, N. Y. packaged and manufactured the equipment. The System allows the Chief of Staff to seize existing world-wide telegraph circuits and quickly send either prepared or special messages to air force commanders merely by pressing a button.

▸ A highly reliable computer, able to run for years in outer space without maintenance, is in operation at the research labs. of Lockheed Missiles & Space Co., Palo Alto, Calif. It uses ordinary copper wire and rugged, ceramic-like cores in place of transistors. Early problems in controlling direction of information flow were solved by using cores with holes in positions related to their inherent magnetic properties.

▸ An operational version of COBOL, a common business language for computers, has been announced by IBM, New York, N. Y. The COBOL processor, a computer program that translates English phrases into a detailed machine language, was shown in operation to the executive committee of the Conference on Data Systems Languages at IBM's N. Y. Datacenter.

▸ A ruby optical maser emitting a coherent red beam was operated continuously at Bell Telephone Laboratories. The master crystal gave a pumping intensity five times greater than has been previously possible.

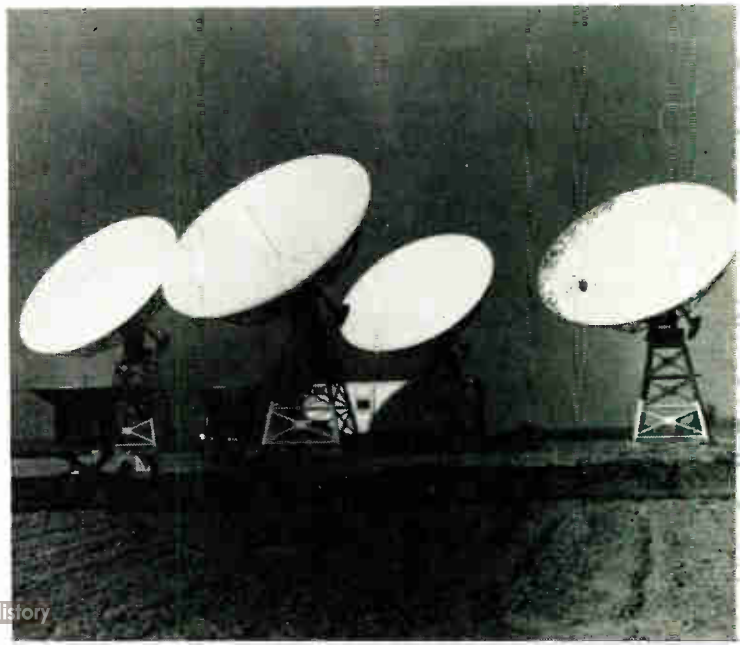
▸ Sperry Phoenix Co., Div. of Sperry Rand Corp., Phoenix, Ariz., has delivered a fully automatic landing approach system, for both fixed and rotary-winged aircraft, to the U. S. Army. The Universal Automatic Flight Control System, AN/ASW-12(V) is able to make an approach to 50 ft., where the pilot takes over manually.

▸ The New York Times will use high speed data transmission to send daily news from New York to Los Angeles for its Western Edition. Transmission will be at approximately 96,000 words in 1½ hours. An entire days news, less local news and advertising, can be sent and set in type in 2¼ hours. The Times will use a Dial-o-verter system built by Digitronics Corp., Albertson, N. Y.

▸ A high-energy power supply system, developed by General Electric Co., capable of producing dc pulses of over 100 million joules has been installed and is ready for operation at the USAF's von Karman Gas Dynamics Facility near Tullahoma, Tenn. The system will power the largest wind tunnel (velocities to Mach 20) of its type and America's first hypersonic tunnel large enough to test full-sized missile nose cones and other space vehicle components.

OSU'S ANTENNA FIELD FOR ECHO II EXPERIMENTS

This array of four 30 ft. parabolic antennas will be used by Ohio State University for communications experiments with Echo II. Signals beamed to Echo from Trinidad, British West Indies and Rome, N. Y., will be reflected to the Ohio site. The antenna positioning equipment and control systems were built for OSU by Antlab, Inc., Worthington, Ohio.



Accurate measurements are simplified by the use of this new type resolution chart. In conjunction with an oscilloscope it is a valuable tool for the precise evaluation of visual systems.

Simplified Resolution Measurements

By ROBERT J. DOYLE
Electronic Engineer
Electronic Tube Div.
Westinghouse Electric Corporation
Elmira, N. Y.

FOR many years aperture response measurements have been used to evaluate the resolving power of imaging systems, and probably the most common device for making these measurements is the RETMA* chart.

The RETMA chart resolution wedge can be imaged directly and at the point where the black and white bars are no longer distinguishable, a value is given expressing the number of TV lines resolved. It is known, however, that this number is not only a property of the device under test; but is also a function of the shape and contrast of the wedge, and the judgment of the observer. The chart can be used in conjunction with a line selector scope, but only with difficulty due to the wedge configuration.

* From the former name of Electronic Industries Assn. (EIA) which was Radio Electronic Television Manufacturers Assn. (RETMA).

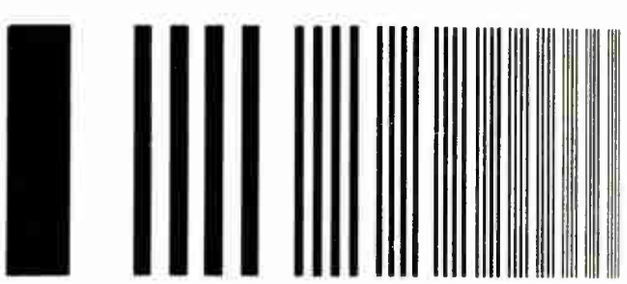
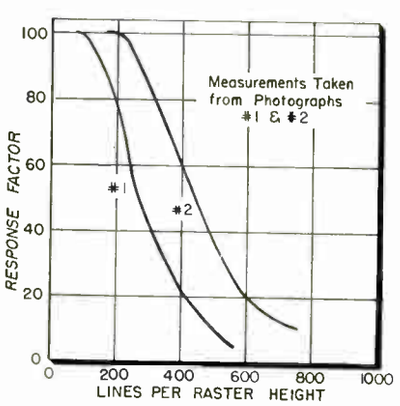


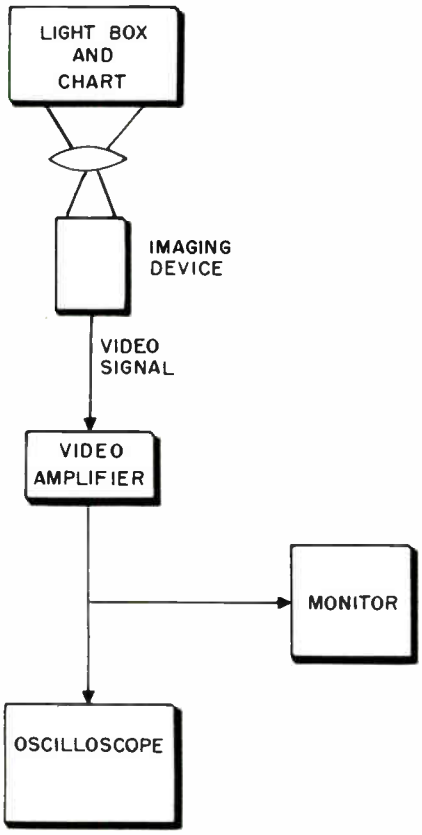
Fig. 1 (left): On the new resolution chart this pattern is displayed 9 times — 3 rows vertically, 3 horizontally. In this way, the standard aspect ratio may be retained.

New Chart

In order to simplify the taking of accurate resolution measurements, a new type of resolution chart was designed (see Fig. 1) consisting of several line-groups at

Fig. 2: These typical square-wave response curves are made from scope presentations.





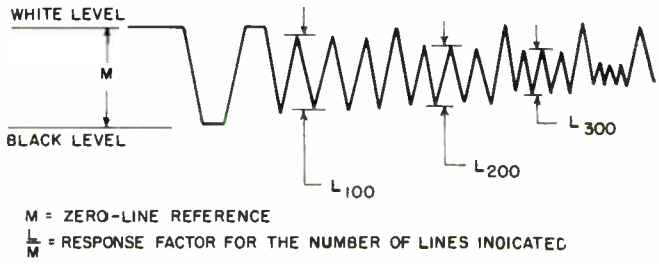


Fig. 4 (above): This is the method that is used to take data from scope trace photo.

Fig. 3 (left): This basic measuring scheme is used to evaluate image tubes. The scope presentation is photographed, then curves similar to those shown in Fig. 2 are drawn.

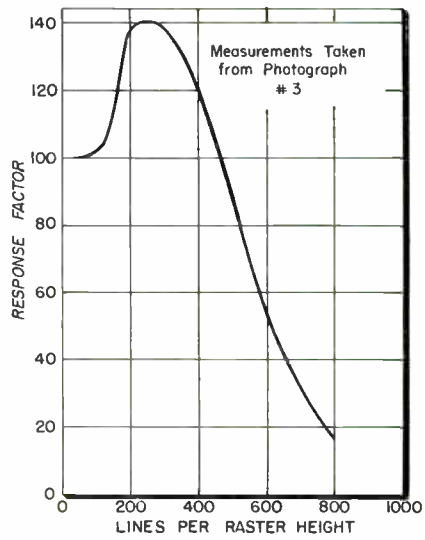


Fig. 5 (right): This is the curve for a signal from a system with "aperture boost."

various positions on the chart. Each of these line-groups consists of a wide black and white bar to represent 100% modulation (zero lines) followed by ten groups of four black and three white lines which represent 100 to 1000 TV lines in 100 line increments. This chart, which is available in varying degrees of contrast, makes it possible with one scope presentation (see Fig. 2) to obtain data for a complete square wave response curve.

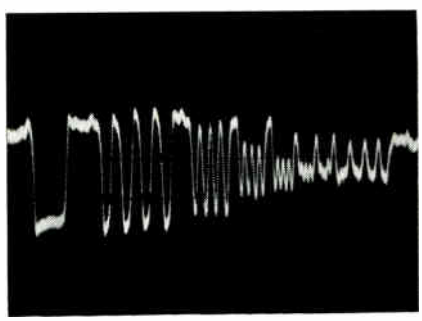
Set-up and Measurement

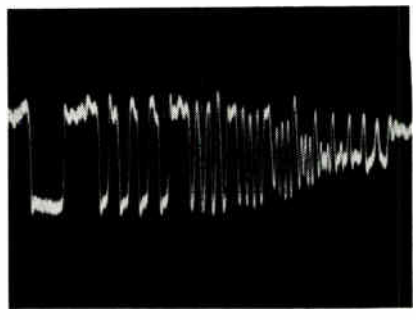
The block diagram in Fig. 3 shows a scheme that uses the chart to evaluate image tubes. The chart is set up in a light box and the tube is adjusted for optimum optical and electrical focus, while the video signal is fed into an oscilloscope with delayed sweep, such as the Tektronix 535. The scope is adjusted so the video signal from a preselected horizontal line is continuously presented on the screen, and normally this presentation is photographed and measurements taken from the print. Fig. 4 illustrates how the data are taken from a print, and although not illustrated, care must be taken so that noise components are not included in the amplitude measurements.

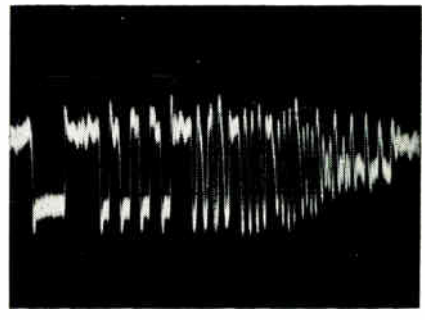
Since a zero-line reference appears with each line-group, measurements from a print are independent of amplifier gain, camera magnification, etc., as long as the frequency response of the video amplifier is flat. An example of a signal from a system with "aperture boost" is shown in Fig. 5.

This new chart in coordination with a line-selector oscilloscope is a most valuable tool for the accurate evaluation of imaging systems.

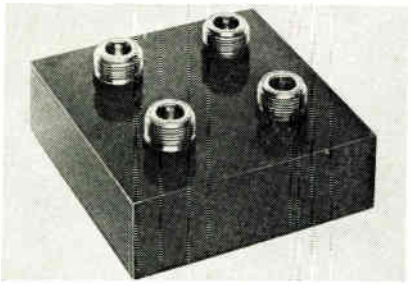
Photographs from which the measurements were taken to produce the curves in Figs. 2 & 5.







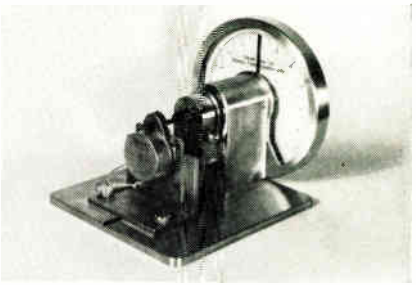
IRE New Products



Coaxial Tee

Model 773 Coaxial Magic Tee uses strip transmission techniques for a min. operating bandwidth from 2.0 to 4.0GC. Isolation is 20db min. and VSWR is 2.0 max. Sage Laboratories, Inc. BOOTH 1110.

Circle 337 on Inquiry Card



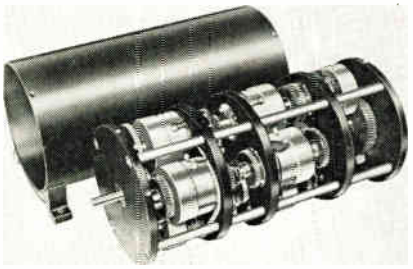
Torque Tester

The Dynamic Torque Testing Machine is a mechanical torque measuring device, which is self contained, and requires no support equipment. Falcon Div., General Thermodynamics Corp. BOOTH 3909.

Circle 340 on Inquiry Card

Transmission

With continuous running input, this transmission delivers 8 binary ratio output speeds in both directions plus



an electromagnetically actuated instant brake. Autotronics Inc. BOOTH 1111.

Circle 338 on Inquiry Card

Relay

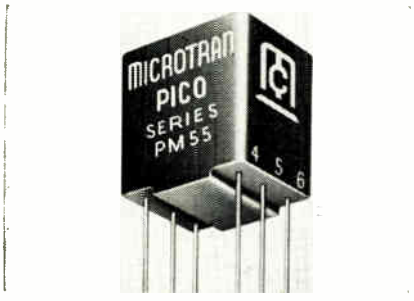
This transistor sized relay, Type JR, with solder-hook terminals is for use in computers, data processing and

airborne instruments. It measures 0.2 x 0.4 x 0.5 in. and weighs 5 grams. Branson Corp. BOOTH 2803.

Circle 341 on Inquiry Card

Miniature Transformers

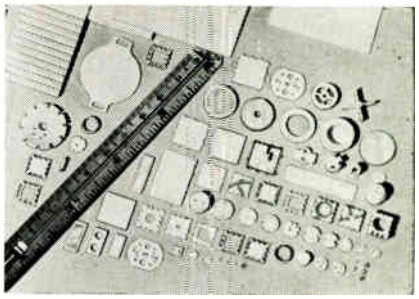
PICO line of miniaturized transformers is for miniaturized printed circuit board use. Line includes 20 different units ranging in impedance from 3.2 to 200,000Ω. Microtran Co., Inc. BOOTH 2314.



Circle 339 on Inquiry Card

Ceramics

Pictured are some of the ultra-precision AlSiMag and AlSiBase thin ceramics available. Tolerances of ±0.0001 are offered and are held throughout. American Lava Corp. BOOTH 4401.



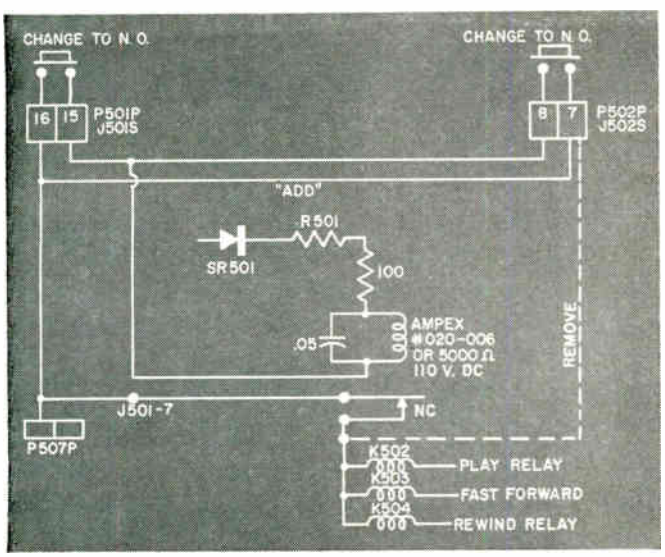
Circle 342 on Inquiry Card

CUES for Broadcasters

An Ampex 350 Modification

LAWRENCE SIBILIA, Asst. Ch. Eng.
KETV, Omaha, Neb.

One of the good features of the Ampex 350 Tape Machine is that you can remote control the unit from a number of positions. This is fine except for the series circuit for the "stop" position. When you have a bad contact in the stop circuit at any one position, the machine will not start from any position. If you should desire to add another remote control point, then you have to break into the stop circuit to series a stop for the new control point.



Relays added to "stop" circuit increases flexibility.

An easy way to get around this is to add relay contacts in the stop circuit. Then by making a contact to energize the stop relay, you open up a set of normally closed contacts in series with the units control relays. All remote position wiring can originate from one point in the tape machine plug or terminal block, with all wires being connected in parallel.

In cases where the machine may be used in an automation set up, the stop circuit can work on a pulse signal to the stop relay.

Cleaning Tape Recorder Heads

GEORGE W. SHARPE, Ch. Eng.
WEAN, Providence, R. I.

For a quick, reliable, and efficient method of cleaning the heads on the automatic tape machines, take an empty cartridge of any size and wind on one turn of head cleaner tape in the usual way, splice, and run in recorder as long as necessary to clean the heads. This will remove any foreign deposits or anything which could interfere with proper tape operation over the heads.

I have found this method an asset in keeping the operation of cartridge tapes at best efficiency.

New...from Sylvania...

Passivated
epitaxial
Silicon Planar
High-Speed Switching NPN transistor

2N784A

Small signal device.
TO-18 package.

2N784A

Electrical Characteristics at 25°C	Min.	Max.	Units
V_{CE} (Sat.) (I_C = 10 mA, I_B = 1 mA)	—	0.19	V
(I_C = 100 mA, I_B = 10mA)	—	0.65	V
BV_{CBO} (I_C = 100 μA)	40	—	V
h_{fe} (I_C=10 mA, V_{CE}=10V, f=100 MC)	3.0	—	—
h_{FE} (I_C = 10 mA, V_{CE} = 1.0V)	25	150	—
τ_s (I_C = I_{B1} = I_{B2} = 10 mA)	—	15	nsec
t_{on} (I_C=10 mA, I_{B1}=3 mA, I_{B2}=1mA)	—	20	nsec
t_{off} (I_C=100 mA, I_{B1}=3 mA, I_{B2}=1mA)	—	40	nsec

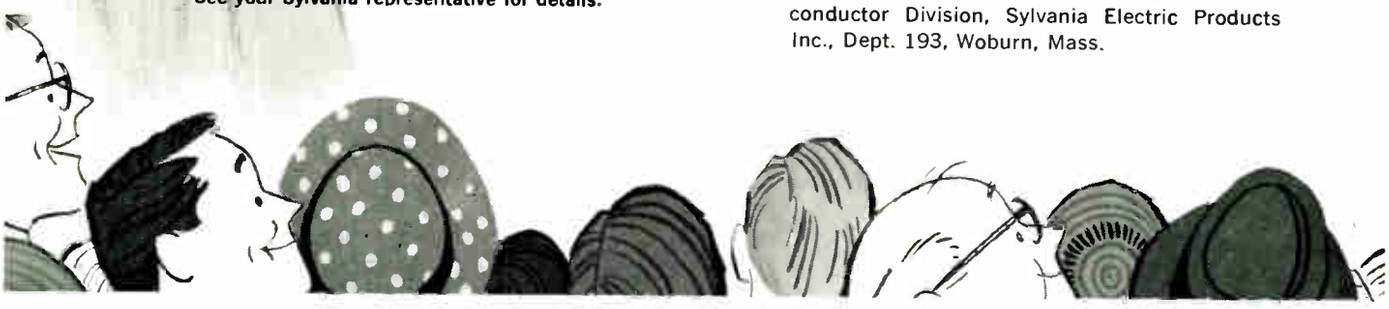
- **low saturation voltage at all currents, V_{CE} typ. @ 100 mA...0.35V!**
- **exceptionally fast typical t_{on}...14 nsec!**
- **unusually low typical C_{ob}...2.6 pfd!**
- **high typical h_{FE}...70 (I_C = 10 mA, V_{CE} = 1.0V)!**
- **high typical power gain...13 db at 100 MC!**

Designing new logic circuitry? Refining a current design? If extraordinary high-speed performance and reliability are among your objectives, investigate the benefits offered by Sylvania 2N784A. Famous Sylvania-Epitaxial process assures low saturation resistance. Planar passivated technique provides uniformity of electrical characteristics with extended life. Silicon materially adds to reliability under severe environmental conditions.

You are invited to evaluate the unique capabilities of SYLVANIA EPITAXIAL SILICON PLANAR TRANSISTORS. Contact your Sylvania Sales Engineer or Sylvania Franchised Semiconductor Distributor for details. For tech data, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 193, Woburn, Mass.

• 2N914 • 2N708

See your Sylvania representative for details.



...at I.R.E. Booths 2322, 2324

only Sylvania offers

epitaxial

Silicon Transistors

in a choice of

4 Hermetic JEDEC Packages

1. TO-51 2. TO-46

3. TO-18 4. TO-5

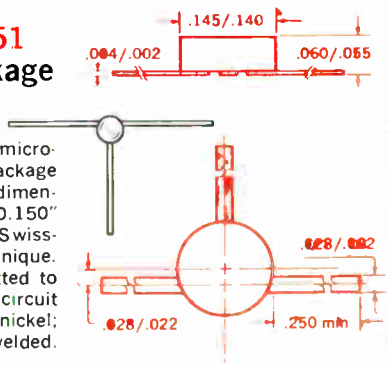
FEATURE

- high reliability hermetic packaging achieved through the use of KOVAR-matched glass-oxide seals, and resistance-welded closures.
- package dimensions held to exceptionally close tolerances.
- high heat dissipation capabilities in miniature and microminiature packages.

NEW! TO-51 Co-Planar Package

(small signal)

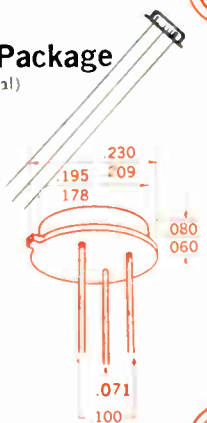
JEDEC-approved, the microminiature Co-Planar package with ribbon leads is dimensioned for insertion in 0.150" dia. hole-in-board for "Swiss-cheese" packaging technique. Or, leads may be omitted to enable leadless "dot" circuit packaging. Leads are nickel; may be soldered or welded.



TO-46 "Pancake" Package

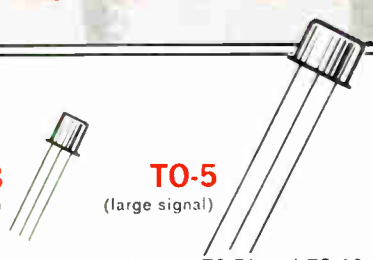
(large and small signal)

JEDEC-approved and based on a concept of geometry originated by Sylvania, the TO-46 "Pancake" combines package microminiaturization and relatively high-power dissipation capability. This permits an exceptional degree of volumetric efficiency with an extraordinary built-in reliability factor under environmental conditions of thermal and mechanical shock.



TO-18 (small signal)

TO-5 (large signal)



In addition to the microminiature TO-51 and TO-46 packages, Sylvania Epitaxial Silicon Transistors are available in the universally accepted TO-18 package as 2N783 and 2N784, in the TO-5 package as 2N1958 and 2N1959.

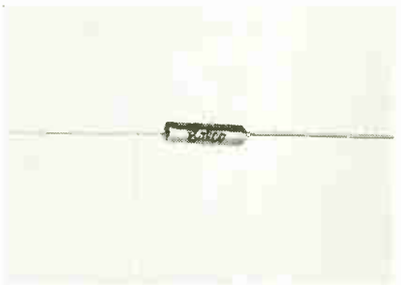
SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

IRE New Products



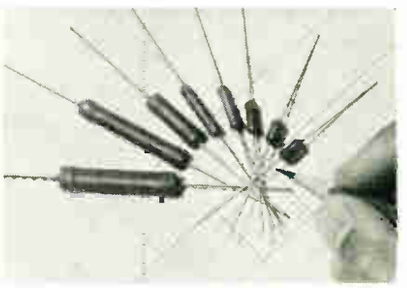
Capacitor

This stable capacitor's variation is $<\pm 0.05\%$ approx. from $-15°C$ to $+85°C$ and $<\pm 0.5\%$ approx. from $-55°C$ to $+85°C$ for long or short time intervals. Balco Research Laboratories, Inc. BOOTH 2431.

Circle 312 on Inquiry Card

Resistors

This line of silicone embedded, wire-wound precision resistors, called SYL-OHM, have resistance ranges from

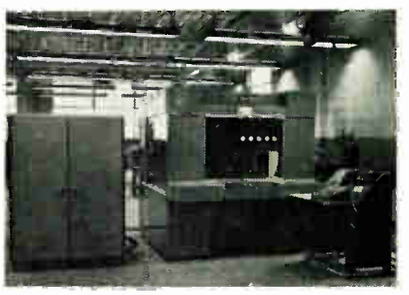


0.05Ω to 75KΩ with tolerances to ±0.05%. Ward Leonard Electric Co. BOOTH 2231.

Circle 313 on Inquiry Card

Wiring Machine

The 14F automatic "Wire-Wrap" machine automatically connects solid conductor wire to terminals. The installation is composed of the machine, a card-reader, and control cabinet. Gardner-Denver Co. BOOTH 4524.



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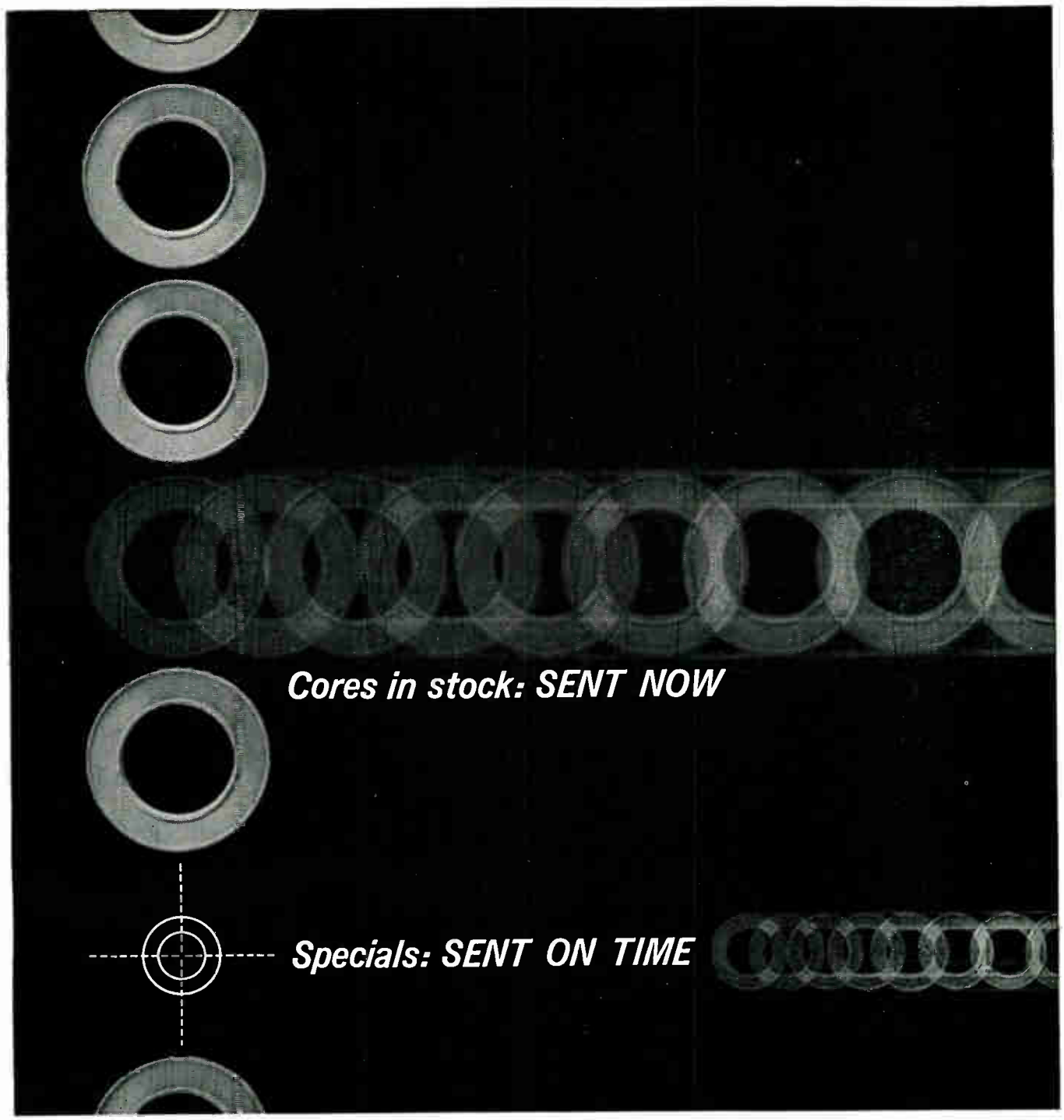

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WASHINGTON News Letter

PRESIDENT'S PLAN—Proposed satellite communications system legislation transmitted by President Kennedy to Congress appeared to be a marriage of the disparate views. These views are concerned with how United States participation in any such system should be organized. The administration bill would set up a system owned and operated by private enterprise. It would be under strict government supervision at the presidential level with a newly-created government post of a Director of Telecommunications Management to be named by the President.

PLAN'S FATE UNCERTAIN — Lengthy Congressional hearings on the subject of space communications legislation can be anticipated, so the fate of the administration measure is uncertain. Senator Robert S. Kerr (D., Okla.), chairman of the Senate Aeronautical & Space Sciences Committee, has already introduced a bill to limit participation in the proposed satellite communications system to the international communications companies. Bill puts responsibility for controlling it entirely with the FCC. A companion measure in the House has been offered by the House Science & Astronautics Committee chairman William Miller (D., Calif.). Senator Kerr is pushing for quick consideration of his measure.

"PRECEDENT" LEGISLATION—A key administration official pointed out that the administration bill for a satellite communications system could be considered as "precedent" legislation. This would be (in terms of financing) the first time a corporation of this nature has ever been set up by the government. The President's proposal would establish the new Communications Satellite Corporation. Class A stock would be open to subscription (up to a limited amount) to anyone, eligible for dividends, and with voting rights which would be available to the public generally. It specifically opens the way for equipment manufacturers to participate in the system. Class B stock would have no voting rights nor be entitled to the usual dividends and could be acquired only by communications common carriers which could include its cost in their rate bases to the extent allowed by the FCC.

AIR-GROUND SERVICE—A nationwide frequency allocation plan for the establishment of a public air-ground radiotelephone service has been proposed by the American Telephone & Telegraph Co. to the FCC. AT&T envisages the construction of ground stations at 72 locations throughout the country. It also visualizes complete clearing of six two-way radio channels in the domestic public land mobile and rural radio service operations by Jan. 1, 1963. All equipment necessary for the nationwide air-ground system has been developed and facilities providing "coast-to-coast coverage" are planned for construction for the end of this year. AT&T reported that the equipment involved has resulted from "an extensive development program in cooperation with equipment manufacturers."

ALL-CHANNEL SETS—The No. 1 legislative goal of the FCC at this session of Congress—to require TV set manufacturers to produce only receivers capable of picking up all 82 TV channels—has received support from the three networks and also reportedly from two major manufacturers. However, the Electronic Industries Association, which represents all manufacturers, has continued to oppose the legislation on the basis that it is discriminatory. EIA takes the position that the FCC should await results of the UHF tests in New York City with its skyscraper structures before determining on shifting all TV into the UHF band.

National Press Building
Washington 4

ROLAND C. DAVIES

NATIONAL ASSOCIATION OF BROADCASTERS has urged the Chairman of Massachusetts' Senate Labor and Industry Committee to support a move to exempt small market broadcasters from overtime provisions of the state's wages and hours law.

Exemption, proposed by the Massachusetts Broadcasters Association, would be similar to the one from the Fair Labor Standards Act that the U. S. Congress granted to small market broadcasters.

J. H. Hulbert, NAB's manager of broadcast personnel and economics, backed the proposal in a telegram sent to Sen. M. A. Donahue, Chairman of the State's Senate Committee on Labor and Industry. Noting the action of the U. S. Congress, Mr. Hulbert said that "granting of similar relief by the Commonwealth of Massachusetts would . . . relieve Massachusetts broadcasters from the difficulty of complying with two laws covering the same area but containing differing requirements."

SHIPMENTS OF ELECTRICAL MEASURING INSTRUMENTS by U. S. manufacturers in the third quarter of 1961 totaled approximately 32.6 million, down from the 39.1 million from the second quarter of the year. All declined in both quantity and value except for direct acting recording instruments which increased slightly in quantity while maintaining the same approximate value. Total military shipments in the third quarter declined approximately 24% from second quarter values while non-military shipments decreased by only 13% during the same period.

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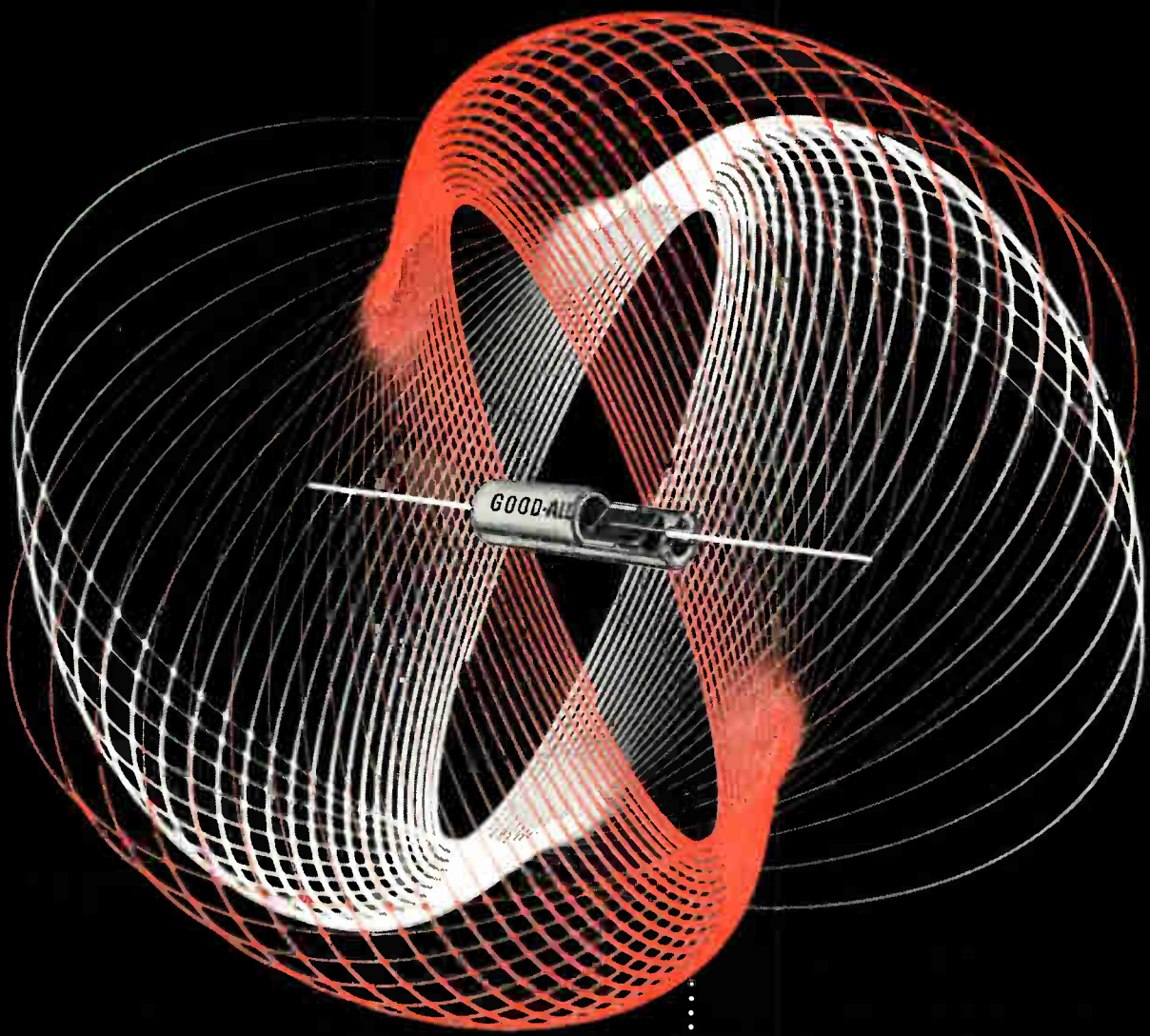

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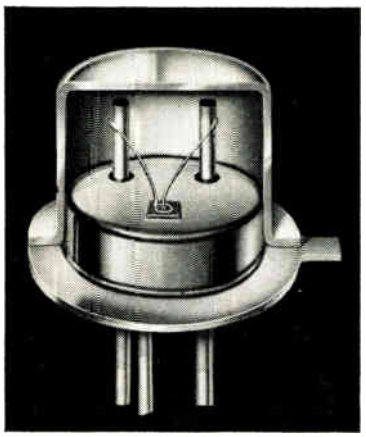
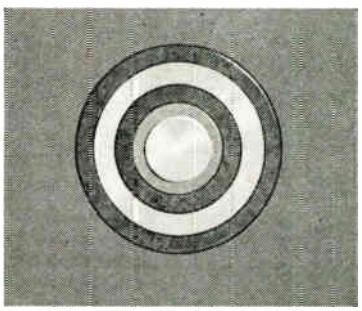
PLANAR EPITAXIAL PASSIVATED SILICON TRANSISTORS

HIGH SPEED WITH LOWEST V_{CE}(sat) RATINGS





The silicon oxide is thermally grown during the planar diffusion process. It forms a passivated surface over the junction that provides maximum protection against contamination and degradation of characteristics during the entire life of the transistor. The thin epitaxial layer on low resistivity substrate gives negligible body drop resulting in extremely low saturation resistance and increased uniformity from unit to unit.

The G-E 2192-2195 and "A" series combines three of the most advanced processes in semiconductor technology to bring you new standards of silicon transistor performance, reliability and stability. This series of PEP transistors can replace standard units without basic circuit changes.

Planar Passivated silicon transistors are also available. They feature superior h_{FE} holdup at low currents, lower I_{CBO} and I_{EBO}, and remarkable reliability of performance and stability of parameters due to planar passivation.

PEP (PLANAR EPITAXIAL PASSIVATED) TRANSISTORS

Type No.	Description	Notable Advantage
2N2192	Similar to 2N1711 (see chart below)	V_{CE} (sat) = 0.35V max. V_{CEO} = 40 V min.
2N2192A	Similar to 2N1711 (see chart below)	V_{CE} (sat) = 0.16V Typ.; 0.25V max. V_{CEO} = 40 V min.
2N2193	Similar to 2N1613 (see chart below)	V_{CE} (sat) = 0.35V max. V_{CEO} = 50 V min.
2N2193A	Similar to 2N1613 (see chart below)	V_{CE} (sat) = 0.16V Typ.; 0.25V max. V_{CEO} = 50 V min.
2N2194	Similar to 2N696 (see chart below)	V_{CE} (sat) = 0.35V max. V_{CEO} = 40 V min.
2N2194A	Similar to 2N696 (see chart below)	V_{CE} (sat) = 0.16V Typ.; 0.25V max. V_{CEO} = 40 V min.
2N2195	General Purpose Industrial Type	V_{CE} (sat) = 0.35V max. V_{CEO} = 25 V min.
2N2195A	General Purpose Industrial Type	V_{CE} (sat) = 0.16V Typ.; 0.25V max. V_{CEO} = 25 V min.

(V_{CE} (sat) ratings @ I_C = 150 ma, I_B = 15 ma)

Type Nos. — PLANAR PASSIVATED TRANSISTORS

TO — 18 Package	TO — 5 Package	h_{FE} @ I_C = 150 ma V_{CE} = 10 V	V_{CE} (sat) (max.) @ I_C = 150 ma I_B = 15 ma	V_{CER} (min.) @ I_C = 100 ma R_{BE} = 10	I_{CBO} (max.)
2N1717	2N696	20-60	1.5V	40V	1 µa @ 30 V
2N1718	2N697	40-120	1.5V	40V	1 µa @ 30 V
2N1719* 2N1719A**	2N698	20-60	5V	80V	5 mµa @ 75 V
2N720	2N699	40-120	5V	80V	2 µa @ 60 V
2N1718A	2N1613	40-120†	1.5V	50V	10 mµa @ 60 V
———	2N1711	100-300†	1.5V	40V	10 mµa @ 60 V
2N720A	2N1893	40-120†	5V	100V	10 mµa @ 90 V

† plus guaranteed minimum h_{FE}'s at several other currents
* same as 2N698 electrically except I_{CBO} = 1 µamp.
** same as 2N698 electrically except I_{CBO} = 10 nanoamp.

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GENERAL ELECTRIC

International Electronic Sources

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AUDIO

The Transducer Characteristics of the High Frequency Condenser Microphone, Von L. Schreiber, "Freq." Nov. 1961. 5 pp. After an introductory definition it is shown that the RF condenser microphone in the stricter sense (the RF operated dielectric transducer) is a passive reciprocal electromechanical quadripole, hence a genuine transducer in the sense of F. A. Fischer. (Germany.)

A Transistor 50W Audio Amplifier, F. Butler, "Elec. Eng." Dec. 1961, 5 pp. Amplifier, which operates from a.c. mains, has an overall gain of 105db and employs four power transistors in an output stage suitable for direct coupling to a 15ohm load. (England.)

CIRCUITS

An Electronic- Two-channel Integrator of High-Accuracy, A5G. Prog. #2, 1961. 3 pp. An integrator with two identical, independent integration networks is described. (Germany.)

Narrow-Band Piezoelectric Ladder Filters. Y. I. Velikin, Z. Y. Gelmont and V. Zelyakh. "Radiotek" 16, No. 11, 1961. 8 pp. Ladder circuits, consisting of piezoelectric resonators and condensers, are analyzed. These circuits may be useful in the design of narrow-band high frequency filters. (U.S.S.R.)

System of Logical Circuits Using As Its Basic Elements The "Logical Module," A. Pinet, "Onde" Nov. 1961, 19 pp. In a brief account of binary variable functions the reasons are given for the choice of the function, NOR to determine the single basic circuits in a system of logical circuits with modular elements. It is then shown, how the calculation of logical functions is made easier by the use of a symbolic operator defining the NOR function, and an application to the method of KARNAUGH for the discovery of the best system is given. (France.)

COMMUNICATIONS

Automatic Recording of Doppler-Fizeau Effect, Strength and Details of Signals from Artifical Satellite, P. B. Loom, "Onde" Nov. 1961, 7 pp. Description of equipment for reception from artificial satellites on 360, 108, 40 and 20 MC, for recording the frequency component during rotation, the strength of the received signals, and their detail. Being programmed in advance, these recordings can be made automatically. (France.)

Potential and Real Noise-Stability of Multi-Channel Systems with Channel Frequency Division Under Weak Fluctuation Noises, A. F. Fomin, "Avto. i Tel." Nov. 1961, 10 pp. Potential noise-stability of various methods of telemetering information multi-channel transmission with the channel frequency division is considered. (U.S.S.R.)

Interference-Killing Features of Communication Systems With Tone Manipulation and Ideal Reception, P. A. Konstantinoff. "Radiotek" 16, No. 11, 1961. 8 pp. Interference-killing features are analyzed in various communication systems with tone manipulation and completely known signals with two different values. Circuits for optimal receivers are determined. (U.S.S.R.)

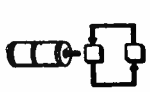
Action of Weak Harmonic Noise on FM Reception with AFC, Y. G. Rodionoff. "Radiotek" 16, No. 11, 1961. 5pp. Relations are derived, which are used to determine the extent of weak harmonic noise action on FM reception with AFC. It is shown that under these conditions reception with AFC is less affected by noise than the conventional FM reception. (U.S.S.R.)

Transient Response of FM Signals, S. J. Cotton, "El Tech", Nov. 1961, 5 pp. Article is a practical investigation of the distortion introduced by networks and lines to a signal when its frequency suddenly changes. (England.)

Linear Frequency Discriminator. U. S. Ganguly, "El Tech", Nov. 1961, 5 pp. In this article a simple method is presented for distortionless demodulation of low-frequency FM signals with large deviations, as used in multichannel communication systems utilizing the so called FM-FM method of frequency multiplexing. (England.)

Applications of Photovoltaic Cells, by J. Durant, "El. et Auto." Nov. 1961, 3 pp. Paper describes a few representative designs: transmitter and receiver for light wave communication, economy photoelectric counter, small-power motor control, automatic night-light, automatic blinking light. (France.)

Information Theory Paves Way to New Developments in Communications, Douglas A. Carruthers, "Can. Elec. Eng." Dec. 1961, 6 pp. Subject of information theory is introduced by drawing attention to recent areas of specialization. Its association with communication and modulation theory and cybernetics is considered. (Canada.)



CONTROLS

Statistical Investigation of Extreme Control Extrapolation Systems With Object Parabolic Characteristic, I. I. Perelman, "Avto. i Tel." Nov. 1961, 13 pp. Operation of the extremal control extrapolation system is analyzed which keep up an extremal signal value at the output of an inertialess object with a parabolic charateristic. An approximate expression is found for the steady mean error of the extremum tracking under random noises at the object output and its characteristic drift. (U.S.S.R.)

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
El Tech. Electronic Technology
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

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
El. et Auto. Electronique et Automatisme
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
Nach. Z. Nachrichtentechnische Zeitschrift
Rt. Regelungstechnik
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechnizne

USSR

Avto. i Tel. Avtomatika 1 Telemakhanika
Radio. Radio
Radiotek. Radioteknika 1 Elektranika
Rad. i Elek. Radioteknika 1 Eleckranika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

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Determining the Stability of Sampling Control Loops by Means of the Describing Function, von J. Ackermann, "rt" Nov. 1961, 5 pp. Equations of the describing function of the sampler and holding element are derived. With the help of some examples, the shape of the critical stability characteristic is studied. (Germany.)

Suggestions for the Elimination of Interaction in Multiple Control Loops, Von H. Schwarz. "rt." Nov. 1961. 6 pp. At the beginning, a short introduction is given into the mathematical methods used for studying multiple control loop systems. This is followed by directions for determining the most suitable kind and size of the generally rather copious decoupling elements required for obtaining conditions approaching the elimination of interaction in dual control loop systems. (Germany.)

Electro-Magnetic Control Elements, I. M. Krassov, V. N. Nikolsky, "Avto. i Tel." Nov. 1961, 4 pp. Results of developing new electro-magnetic control elements with anchor progressive motion are discussed. (U.S.S.R.)

Application of Methods of Statistic Dynamics to Design of characteristics of Some Automation Objects, S. Ya. Raevsky, N. S. Raibman, "Avto. i Tel." Nov. 1961, 9 pp. General problems of determining the operators of the automation objects according to the input and output statistic characteristics are discussed. (U.S.S.R.)

Controller Analytical Design in Systems with Random Properties III. Optimum Control in Linear Systems. Minimum of Mean-Square Error, N. N. Krasovsky, E. A. Lidsky, "Avto i Tel" Nov. 1961, 7 pp. Linear stochastic control systems are considered. The optimal law of regulation is determined according to the general method developed formerly. (U.S.S.R.)

Relay control of Linear-Asymmetric Objects, N. M. Litsyn, "Avto. i Tel." Nov. 1961, 5 pp. Relay control of an object characterized by different pure time delays or different transfer functions with closed-loop and open-loop states of relay element is considered. (U.S.S.R.)

Automatic Data Handling Equipment for Wind Tunnels, "Brit OE" Jan. 1962, 4 pp. This article describes a data handling system applied to one of the Vickers high speed wind tunnels. (England.)

GENERAL

Junction Particle Detectors, O. Smulkowski. "El. et Auto." Nov. 1961. 4 pp. This second part of a paper (first part was published in Oct.) reviews the application of junction detectors to nuclear particle detection. (France.)

A "Limited" Ferrite Rectifier. A. L. Mikaelyan and A. K. Stolyaroff, "Radiotek" 16, No. 11, 1961. 12 pp. Results of an investigation of effects in a "limiting" waveguide with a magnetized ferrite are given, which show a possibility to create a new type of rectifier. Design and experimental characteristics of such a limiting rectifier are included. (U.S.S.R.)

Action of a Complex Periodic Signal on a Self-Oscillator. E. M. Giuninnen, P. N. Zanadvorov, I. P. Kotik, G. I. Makaroff. "Radiotek" 16, No. 11, 1961. 6 pp. Article treats the problem of the action of a periodic signal in the form of a sequence of pulses—"distorted sinusoidal packets" on a self-oscillator with a high-Q tank. (U.S.S.R.)

An Audio Frequency Phase Modulator Using Pulse Techniques, W. D. Humpage, "Elec. Eng." Dec. 1961, 6 pp. Design of a modulator is discussed, in which the phase of a 1.592KC sine wave carrier may be varied in conformity with a modulating voltage. (England.)

A New Medium-size, Sound Outside-broadcast Vehicle, Von Hermann Stumvell, "Rundfunk," Dec. 1961, 8 pp. Many of the tasks involved in outside-broadcasts can be handled by the smaller or medium-sized vehicles, as they are particularly suitable from the point of view of broadcasting technique and as vehicles. The essential points of the basic design of a medium-size outside-broadcast vehicle are to be seen in a new vehicle taken into operation by the Bauerischer Rundfunk in the summer of 1961. (Germany.)

Equipment for Detecting Drop-Out Periods on Video Magnetic Tapes, Von Dietrich Waechter, "Rundfunk", Dec. 1961, 2 pp. Article describes the method of detecting drop-outs in video tapes used at present by the Bayerischer Rundfunk. (Germany.)

Directional Switch at UHF, Von Hans- Jurgen Fraisse, "Freq." Nov. 1961, 4 pp. Paper describes the intercoupling and matching of the inputs and their dependence on frequency for one of the well-known "ring lines." (Germany.)

Bakable High-Vacuum Joints, von H. Hoch, "Vak. Tech." Dec. 1961, 4 pp. Report refers to practical experiences which have been obtained on Ultra-High-Vacuum devices made of metal. (Germany.)

A Simple Phase Detector, G. S. P. Scantlebury, "Elec. Eng.", Dec. 1961, 3 pp. Article describes form of phase-sensitive detector where the reference signal and the variable signal have a common terminal, which can be grounded. (England.)

Quadrupole Resonance Spectrographs, G. Boudouris, "Onde" Nov. 1961 16 pp. After having recalled the nature of quadrupole nuclear resonance the account describes the operating and design principles of various types of quadrupole spectrographs. (France.)

$$\Delta G = \Delta G / e n_i \mu_p \mathcal{E}$$

THEORY

Maximum Principle for Optimum Systems with Distributed Parameters, A. G. Butkovsky. "Avto. i Tel." Oct. 1961. 14 pp. A problem of optimum control of the systems with distributed parameters the motion of which is described by non-linear integral equations are considered. (U.S.S.R.)

A Problem of Synthesizing Optimal Systems Under Maximum Principle, Chang Jen-Vey. "Avto. i Tel." Oct. 1961. 7 pp. Maximum principle is applied to solving a problem of optimum control synthesis. The optimality criterion is the integral of the sum of quadratic deviations. (U.S.S.R.)

On Possibility of Suppression of Noises in a Class of Dynamic Systems, M. V. Meyerov. "Avto. i Tel." Oct. 1961. 10 pp. Paper deals with the investigation of the connection between the dynamic system structure and the noise effect intensity depending on the point of the noise introduction. (U.S.S.R.)

System Design, H. O. Friedheim & H. F. L. Cameron. "ATE J." Jan. 1961. 15 pp. Subject is dealt with under the two main headings of planning for telephony only, and planning for mixed television/telephony. In each case the general problem is first discussed followed by a detailed consideration from the standpoint of the overall noise performance of the system. (England.)

Spark Suppression on Magnetic Contacts and the Calculation of the Spark Suppressing Circuits, H. Fuhrmann. "Nach. Z." Oct. 1961. 6 pp. Four possibilities for the suppression of sparks on magnetic contacts, as for example on sealed reed contacts, are explained. A mathematical derivation is given for the design data for the required spark suppression circuits. (Germany.)

A Method of Graphical Presentation for the Study of Non-Linear Control Actions, R. Kammuller. "rt." Oct. 1961. 7 pp. Following a brief explanation of the theoretical fundamentals involved, the author discusses the most important characteristics of graphs of the 2nd and 3rd order with the help of examples. (Germany.)

Applied Functional Theory, R. Starkermann. "rt." Oct. 1961. 7 pp. Application of the generalized Nyquist criterion to a dual control system of the kind found in industrial thermal process plants is discussed with a reference to the functional theory. (Germany.)

Approximation Problems in the Theory of Low-Pass RC Filters, P. Szulkin, C. Norek. "Roz. Elek." Vol. 7, #2, 1961. 46 pp. Main theme of the work is the application of several efficiently solved approximation problems (in the Tchebyshev sense) to designing of low-pass RC filters. (Poland.)

Magnetrostrictive Equations and Their Coefficients, Z. Kaczkowski. "Roz. Elek." Vol. 7, #2, 1961. 34 pp. Basic magnetic and mechanic dependences applied at examining magneto-mechanic phenomena occurring in a magneto-strictive materials have been given. Then, presuming that conditions are adiabatic (which is right in majority of cases met within practice) all possible systems of equations of the type B and J have been given. (Poland.)

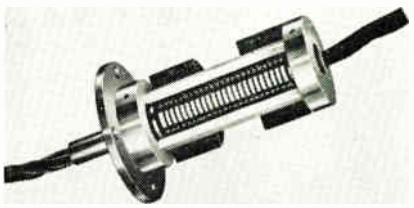
Study of the Stability of a Sampled Quantified System, G. Senquillet. "Onde." July-Aug. 1961. 17 pp. The authors studied the behavior of a second order sampled quantified system. They showed that the stability conditions of such systems are the same as for the linear sampled equivalent system. The study of the behavior of the system around its equilibrium state has been accomplished through phase plane and first harmonic methods. One condition for oscillations not to appear, when a step input is applied has been found. Results obtained from a real system behavior have shown the importance of such condition. (France.)

Filtration of Fluctuating Interference by a System with Automatically-tuned Phase of the Frequency with Various Types of Filters, V. V. Shachgildian. "Radiotek" 16, No. 10, 1961. 10 pp. This is an analysis of the filtration of external fluctuating interference by a system with automatically tuned phase of the frequency. An expression for the frequency dispersion of the synchronized oscillator is derived. Applications of RLC filters in systems with automatic phase tuning are discussed. (U.S.S.R.)

Carrying Capacity of a Multi-Beam Channel in Diversed Reception with Auto-Selection A. S. Nemirovsky. "Radiotek" 16, No. 9, 1961. 5 pp. A formula is derived, which is used to determine the carrying capacity of a multi-beam channel in diversed reception with auto-selection. The obtained carrying capacity is compared with the carrying capacity of a single beam constant parameter channel and with the carrying capacity of a multi-beam channel with nondiversed reception. (U.S.S.R.)

Pulse Analysis, R. W. Harris. "Proc. AIRE." July 1961. 8 pp. The mathematical aspects of the determination of the response of systems by pulse techniques is discussed with particular reference to many of the practical problems involved in applying the techniques. (Australia.)

IRE New Products



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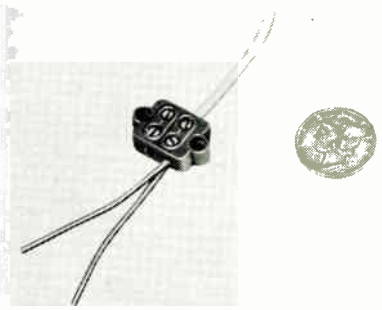
Terminal Block

Subminiature connector eliminates need for lugs, screws, or solder. The



connection is made by inserting the stripped wire into the connector and turning a cam. Camblock Corp. BOOTH 2118.

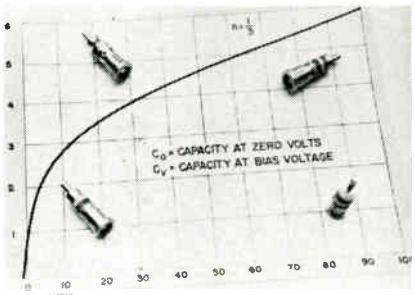
Circle 316 on Inquiry Card

Resistors

PMH Series Ultra Reliable Metal Film Resistors are leak detection tested to assure long term stability and reliability, and exceed the requirements of Mil-R-10509D. Pyrofilm Resistor Co., Inc. BOOTH 2104.

Circle 317 on Inquiry Card

IRE New Products



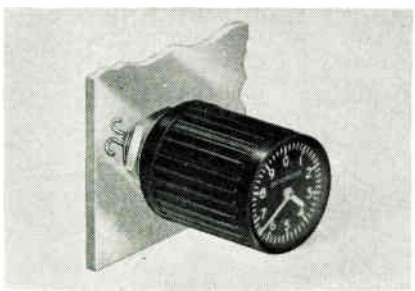
Varactors

Epitaxial units feature breakdown voltages: —6 to —120v, cutoff freqs.: 10 to 140gc (at —6v). For use in harmonic generators or modulators. Sylvania Electric Products, Inc. Semiconductor Div. BOOTH 2332.

Circle 346 on Inquiry Card

Potentiometer

The Knobpot® is a factory phased, combination 10-turn precision potentiometer, clock dial and adjustment

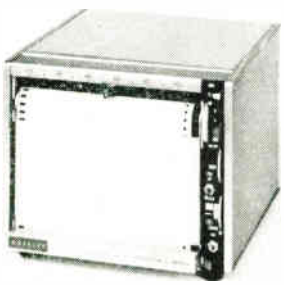


knob in one unit, measuring ¾ in. in dia. and 1 in. in length. Bourns, Inc. BOOTH 2518.

Circle 347 on Inquiry Card

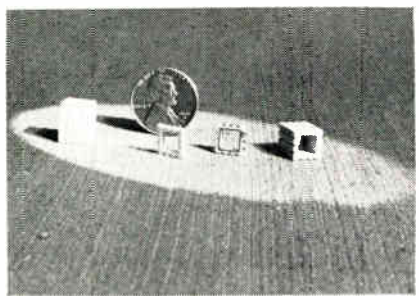
Strip Chart Recorder

Model 680 features: 1mv/in. to 20v/in. in 10 calibrated ranges; Zener reference supply; all solid-state circuitry; and pen speed—½ sec. full scale; accuracy—0.2% full scale. F. L. Moseley Co. BOOTH 3106.



Circle 348 on Inquiry Card

IRE New Products



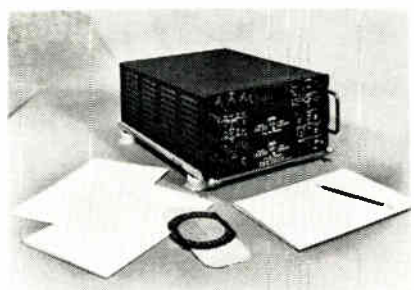
Micromodular Wafers

Metal-clad Mykroy is a dimensionally stable, non-carbonizing, non-delaminating circuit board or substrate wafer with infinite shelf life. Molecular Dielectrics, Inc. BOOTH 4204A.

Circle 343 on Inquiry Card

Loran-C Receiver

This lightweight receiving equipment weighs 75 lbs. complete and occupies 1.75 cu. ft. It requires 150w

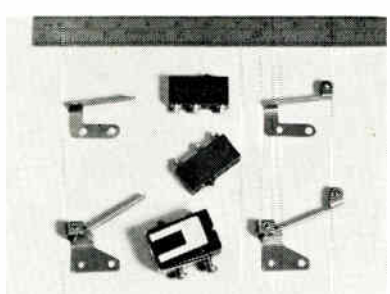


and is transistorized. ITT Federal Laboratories, Div. of ITT Corp. BOOTH 2127.

Circle 344 on Inquiry Card

Pushbutton Switches

"Cricket" switch Pushbuttons and Toggles feature only 3 or 2 moving parts respectively. New actuators are either slide lever or roller lever types. Fansteel Metallurgical Corp. BOOTH 4050.



Circle 345 on Inquiry Card

IRE New Products

Precision Punches

Lines of precision punches for electronic data processing equipment and extremely close tolerance rolls and pins for electronic and automated control equipment will be shown by the Specialties Div. of The Torrington Co. BOOTH 4118.

Circle 331 on Inquiry Card

Variable Delay Line

This series of delay lines are for continuously variable delay of radar i-f signals in tracking and ranging applications. The unit measures 6½ x 1 1/16 x 1⅝ in. and will operate up to 60 mc. Max. attenuation is less than 3db. Ad-Yu Electronics Labs., Inc. BOOTH 3609.

Circle 332 on Inquiry Card

Graphic Recorder

The Alden #419 Precision Graphic Recorder Model 9168C is a high resolution oceanographic instrument capable of 12 recording speeds corresponding to 20 fathoms to 3000 fathoms. It operates in 115vac and an input signal of 0.01v Peak to Peak. Alden Electronic & Impulse Recording Equipment Co., Inc. BOOTH 1611.

Circle 333 on Inquiry Card

Metal Film Resistors

The HRM series of deposited metal film resistors is for critical industrial and military applications. The series is currently available in ⅛w sizes and common resistance values. Electra Manufacturing Co. BOOTH 2530.

Circle 334 on Inquiry Card

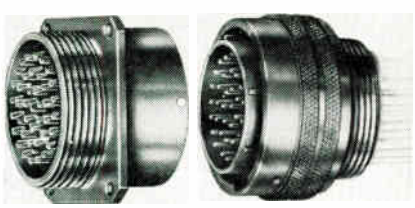
Indicator Lamp

"E'lite Type 5200" measures 1⅝ in. overall length, with a hole dia. of 11/16 in. A wide choice of styles, shapes and lens colors and Military types are available. Drake Manufacturing Co. BOOTH 2214.

Circle 335 on Inquiry Card

Connectors

Solder Bantam connectors available in 9 shell sizes and various insert configurations. They are sealed per Mil-C-0026482A(WEP) and feature positive locking bayonet coupling. Burndy Corp. BOOTH 1333.



Circle 336 on Inquiry Card

IRE New Products

Precision Casting

Using a technique called ceramic-mold precision metal casting, Shaw Process Castings turn out cast aluminum wave guides, aluminum and magnesium housings, steel connectors and die cast, molded, forged and stamped components. Avnet - Shaw Corp. BOOTH 3803.

Circle 325 on Inquiry Card

Hybrid Power Supply

Model ABC 200M, using both transistors and vacuum tubes, delivers from 0 to 200v at 100ma with 0.05% regulation and stability. Full voltage range remote programming, along with parallel, series, and slaved operation are offered. It measures 4¼ x 8 5/32 x 9⅝ in. Kepco, Inc. BOOTH 2636.

Circle 326 on Inquiry Card

Digital Voltmeter

The CH2 Clamp and Hold Digital Voltmeter offers 4 digit measurement of varying voltages in ranges of ±9.999/99.99/999.9v to an accuracy of ±0.01% ±1 digit. Also features printout connection, automatic polarity changing and plug-in modular construction. Non - Linear Systems, Inc. BOOTH 3047.

Circle 327 on Inquiry Card

Micro-modular Inductors

These micro-modular inductors and transformers are designed for printed board applications. Transformers supplied as microelements (for encapsulation in Micro-modules) can be designed to meet specific requirements. Aladdin Electronics. BOOTH 1924.

Circle 328 on Inquiry Card

Standing Wave Amplifier

Model No. B813T transistorized standing wave amplifier offers an accracy (full scale max. error) of only ± 0.05db at 5db. Calibrated range of the instrument is 75db. This is a portable, line or battery operated unit. FXR, RF Products and Microwave Div. of Amphenol - Borg Electronics Corp. BOOTH 1802.

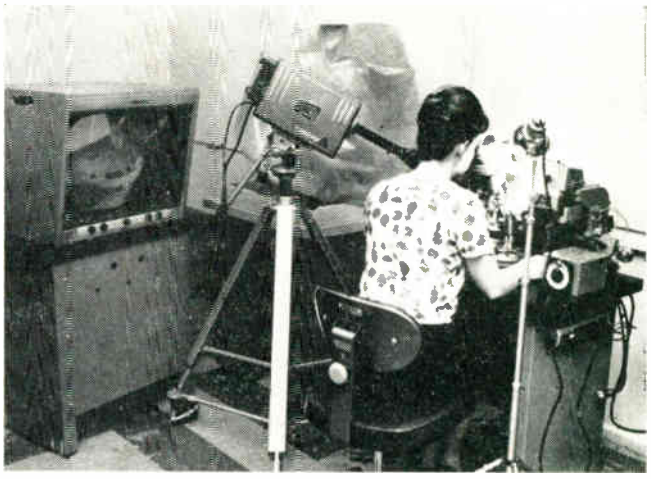
Circle 329 on Inquiry Card

Vacuum Coaxial Relay

The RC6, SPDT vacuum coaxial relay is for switching vhf coax lines. Positive latching is assured with permanent magnets. Specs. include: size —for 1⅝ coax lines; fittings—"EIA" flange type; freq. range — 0 to 150mc; actuation—24 or 48vcd; and insertion loss—0.01db max. Jennings Radio Manufacturing Corp. BOOTH 1811.

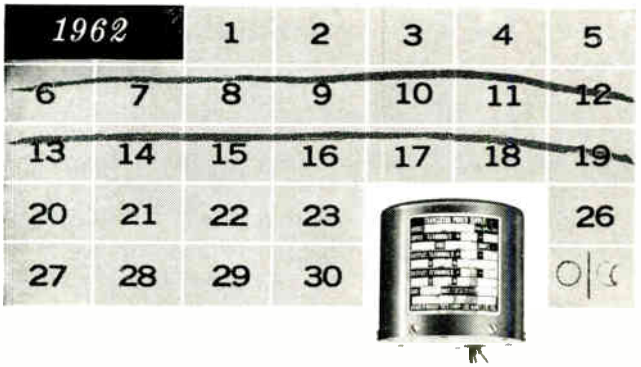
Circle 330 on Inquiry Card

TV DEMONSTRATOR



A closed circuit TV system is used by Kulicke and Soffa, Phila., to demonstrate how one of their machines operates in assembling a tiny transistor whose active area cannot be seen with the naked eye. TV equipment, made by the Dage Div. of Thompson Ramo Wooldridge, Michigan City, Ind., "sees" what the operator sees under the microscope and allows customers to observe on the monitor the moves of the precision machine. TV is also used for operator training.

A SPECIAL AMMETER which brackets the pulse current peak between two current levels has been developed by the U. S. Atomic Energy Commission. It is designed for use in an automatic testing device. A full report is described in "A Pulse Ammeter," (Order No. SCTM 181-61(13)) from OTS, U. S. Dept. of Commerce, Washington 25, D. C., for 50c.



2-WEEK DELIVERY ON ARNOLD CUSTOM DC TO DC CONVERTERS

—built to your specs, with outputs to 3.5 Kv

Stocking of modular sub-assemblies allows Arnold to meet your particular requirements *in 2 weeks*. Any combination of outputs from 5 to 3,500 volts dc at continuous duty ratings to 60 watts, total. Input voltage: 24-30 volts dc.

High reliability—no damage from "spikes" on the line, short-circuited outputs, or reversal of input polarity. Units are hermetically sealed and potted to meet military environment.

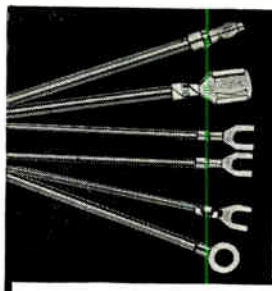
Compact size—only 3" in diameter by 3 3/16" high. Supplies same power as rotating equipment twice the size, and 5 times the weight.

Choice of terminations. Arnold units are available with A/N connectors, solder lug terminals, or flexible wire leads, out top or bottom.

Write for complete literature on the "SHZ" series.

ARNOLD MAGNETICS CORP.
6050 West Jefferson Blvd., Los Angeles 16, Calif.
VErmont 7-5313 ▪ UPton 0-6284

Circle 150 on Inquiry Card

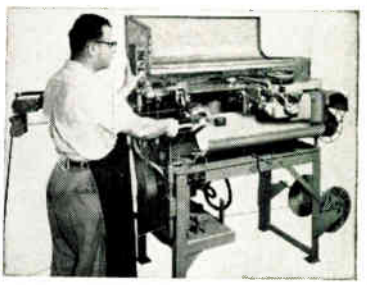


DO YOU NEED AUTOMATION for FINISHED WIRE LEADS with Terminals Attached?

NEW ARTOS TA-20-S
Performs 4 Operations Automatically!

1. Measures and cuts solid or stranded wire 2" to 250" in length.
2. Strips one or both ends of wire from 1/8" to 1".
3. Attaches any prefabricated terminal in strip form to one end of wire. (Model CS-9-AT attaches terminals to BOTH ENDS OF WIRE simultaneously.)
4. Marks finished wire leads with code numbers and letters (optional attachment).

UP TO 3,000 finished pieces per hour. Can be operated by unskilled labor. Easily set up and adjusted to different lengths of wire and stripping. ENGINEERING consultation without obligation. Machines for all types of wire lead finishing.

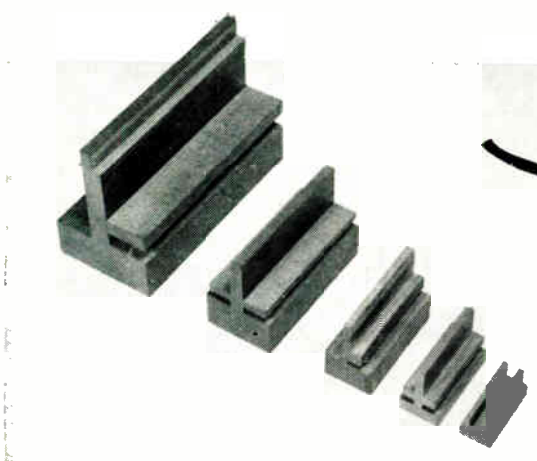


VISIT US AT BOOTH 4110 I.R.E. SHOW

WRITE for FREE Bulletin No. 655 on Artos TA-20-S

ARTOS ENGINEERING CO.
2753 South 28th Street • Milwaukee 46, Wisconsin

Circle 151 on Inquiry Card



Short TERMINATIONS

for X_s, X_l, X_b, C and S Bands

Space-savers for installations requiring maximum efficiency in minimum space, these Short Terminations offer minimum VSWR characteristics. Available for all popular frequency ranges from 2700 to 10,000 MC, with specific types covering entire specified band.

SHORT TERMINATIONS

WG Size	height	VSWR	Band Width	Custom Comp. Part No.
2650-3900 WR-284	2"	1.10	any 10% i.e. 2700-2900 mc/s	A-2328
3950-6000 WR-187	1.5"	1.10	5000-6000 mc/s	A-2334
WR-187	1.5"	1.10	4400-5000 mc/s	A-2372
WR-137	1.0"	1.10	6000-7000 mc/s	A-2377
WR-112	0.80"	1.10	7100-8500 mc/s	A-2369
WR-112	0.80"	1.10	8500-9600 mc/s	A-2379
WR-90	0.41"	1.12	8500-9600 mc/s	A-2357
WR-90/2	0.60"	1.10	8500-9600 mc/s	A-2365

1. Power handling capabilities 2 watts max.
2. Operating Temp. Range—−40°C to +125°C
3. Moisture Absorption Negligible

Write for Complete Electrical Characteristics and Dimensional Data . . .

CUSTOM COMPONENTS, INC.

P.O. Box 248, Caldwell, N. J., Telephone (201) CApital 6-3403

Circle 152 on Inquiry Card

Gaging for Quality Control

(*Continued from page* 122)

bring the greatest number of parts within the acceptable range.

Checking the force required to insert a Hyfen connector pin or socket in a plug or receptacle is a typical production inspection operation. Here the receptacle is being tested. Although the production tips are of goldplated brass the test tip is made of polished and hardened steel to reduce dimensional changes due to wear and thus minimize test variations.

The gage is mounted on a steel plate which permits it to be easily moved up or down, and the handle gives the operator additional leverage and reduces fatigue. The steel pin is held in the Hunter gage, generally with a pin-vise. The receptacle to be checked is positioned in the fixture and the pin is inserted by lowering the gage. The maximum insertion force is read directly on the gage dial.

With so much depending on testing accuracy, Burndy has established a system for regularly inspecting the gages. Each gage carries a label showing "date due." On that date, the gage is checked for accuracy with a known dead weight. The time interval between tests varies with the number of tests made, size and age of the gage. Some are checked every week and some every month. Two gages are used for most operations so that one is available whenever the other is being tested.

50,000,000 tube hours... an unusual electron tube still keeps undersea voice signals strong

Deep on ocean floors, from North America to Europe, between Key West and Havana, Florida and Puerto Rico, under the Pacific to Hawaii and Alaska—in 20,000 miles of undersea telephone cable—a special kind of electron tube is setting a remarkable record for reliability.

This four-inch-long electron tube was designed, developed and fabricated at Bell Telephone Laboratories to operate with no attention for 20 years or more. It is part of the submarine cable repeater manufactured by Western Electric which faithfully and reliably amplifies voice signals transmitted along undersea coaxial cables.

All of the 1608 tubes built into the repeaters have operated to date without failure for a total of over 50,000,000 tube hours, or an average of three-and-a-half years. The oldest have been in service since the first deep-sea repeatered telephone cable was laid 12 years ago.

Years before it was put to use, Bell Laboratories scientists and engineers began developing this undersea tube, another example of forward-looking technology that has made the Bell Telephone Laboratories the world center of communications research and development.

BELL TELEPHONE LABORATORIES

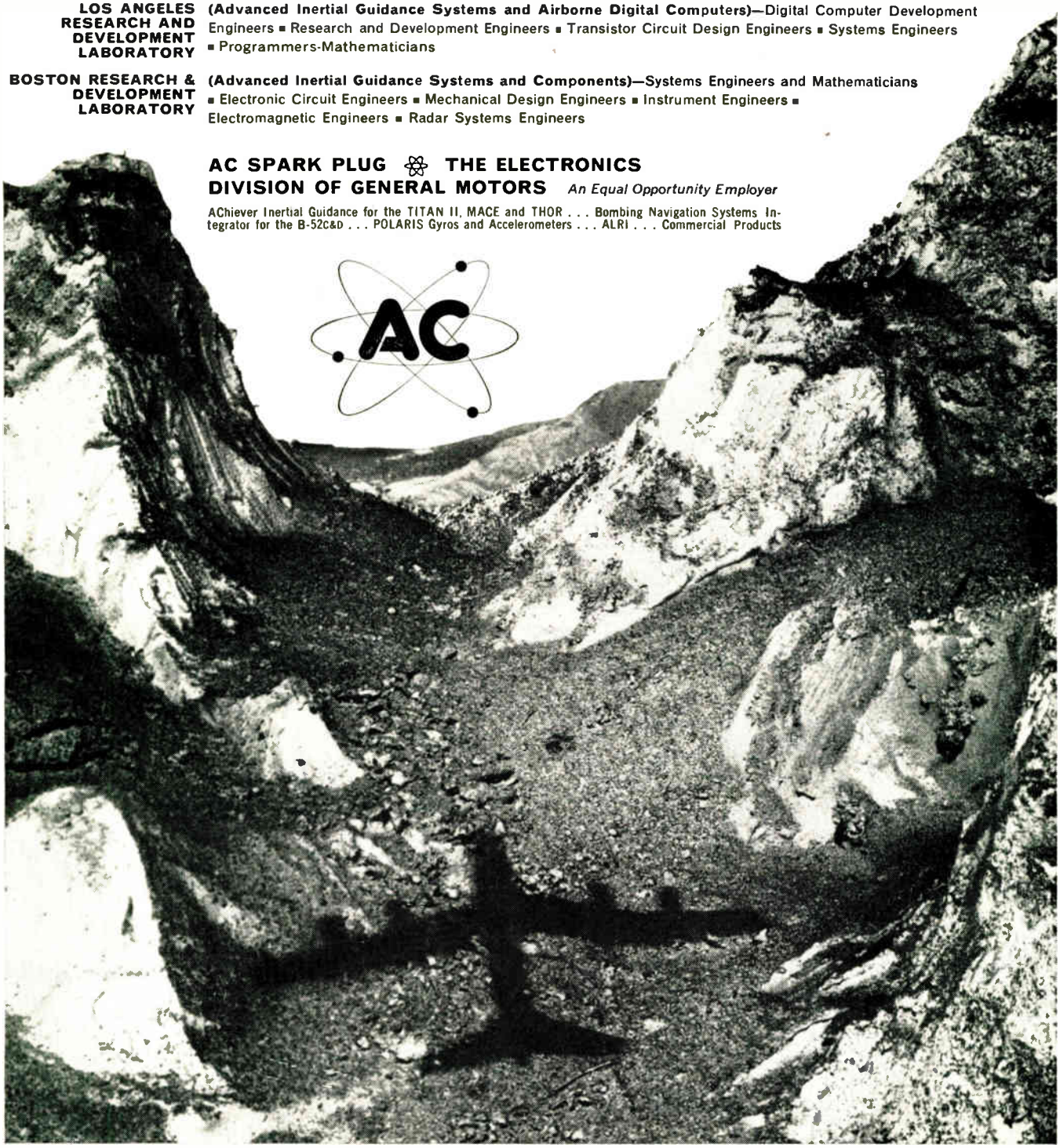
ENGINEERS GAIN A NEW PERSPECTIVE AT AC

AC, the Electronics Division of General Motors, has made a distinct contribution to technological advancement in the field of low-altitude aircraft operation. You, too, can develop and improve your career in the areas of guidance and navigation if you are an Electrical Engineer, Mechanical Engineer, Physicist or Mathematician. Current projects include: Integration and Engineering Design of AN/ASQ-48 Weapon System for the B-52C&D aircraft, Inertial Guidance System of the Titan II, and the development of Stellar Inertial Guidance System for use in long range ballistic missiles. If you have related experience and are interested in any of the following positions, please contact Mr. G. H. Raasch, Director of Scientific and Professional Employment, Dept. 5753, 7929 South Howell, Milwaukee 1, Wisconsin.

MILWAUKEE Weapon Systems Program Engineers ■ Radar Design and Development Engineers ■ Radar Systems Engineers ■ Radar Test Engineers ■ Reliability Program Engineers ■ Field Service Engineers ■ Electromagnetic Engineers ■ Supplier Contact Engineers ■ Quality Control Engineers/Analysts ■ Technical Writers and Editors ■ Scientific Programmers ■ Ceramic Engineers

LOS ANGELES RESEARCH AND DEVELOPMENT LABORATORY **(Advanced Inertial Guidance Systems and Airborne Digital Computers)**—Digital Computer Development Engineers ■ Research and Development Engineers ■ Transistor Circuit Design Engineers ■ Systems Engineers ■ Programmers-Mathematicians

BOSTON RESEARCH & DEVELOPMENT LABORATORY **(Advanced Inertial Guidance Systems and Components)**—Systems Engineers and Mathematicians ■ Electronic Circuit Engineers ■ Mechanical Design Engineers ■ Instrument Engineers ■ Electromagnetic Engineers ■ Radar Systems Engineers



AC SPARK PLUG ⚛ THE ELECTRONICS DIVISION OF GENERAL MOTORS *An Equal Opportunity Employer*

AChiever Inertial Guidance for the TITAN II, MACE and THOR . . . Bombing Navigation Systems Integrator for the B-52C&D . . . POLARIS Gyros and Accelerometers . . . ALRI . . . Commercial Products

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

Analysis Compares U. S. And Soviet Graduates

An analysis of Soviet education published by the National Science Foundation indicates that Russia is turning out two to three times as many scientific and technical professional graduates yearly as the U. S. Further, Soviet production of science and engineering professionals is expected to accelerate during the 1960's.

In Russia, about 57% of all 1959 graduates at the Bachelor degree level were in engineering, sciences, and selected applied science fields (compared with 24% in the U. S.).

Professional instruction provided these graduates was extensive in fundamentals of sciences and engineering. Even so, it was found to be directed toward narrowly defined specialties with the main purpose of equipping the individual student to perform a specific job.

New Accelerator For Univ. of Pittsburgh

A powerful new 3-stage tandem Van de Graaff accelerator is being constructed at the Univ. of Pittsburgh by High Voltage Engineering Corp., Burlington, Mass. Funds are being provided by the National Science Foundation through an initial grant of $977,000 to the University, with $796,000 earmarked for the first "injector" state of the 18-mev atom smasher.

When completed in about two years, the entire installation will cost an estimated $3 million, including $1.8 million for the 150-ft. long accelerator.

Accelerator is expected to be the new heart of an expanded nuclear physics research and teaching installation at the Univ. of Pittsburgh, replacing a 15-year-old cyclotron.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 177

CSC Authorizes Higher Minimum Pay Rates for Engineers and Scientists

Federal agencies have received a helping hand in their efforts to recruit and retain engineers. Higher minimum pay rates in pay grades GS-9 through 11 have been authorized by the Civil Service Commission.

Under law the Commission can raise pay rates within the Classification Act pay grades. This can be done when the Government is at a competitive disadvantage with private employers, and the Federal need is acute.

The Commission's action will result in the following adjustment of pay rates: Grade 9—from $6,435 (1st step) to $7,095 (5th step); Grade 10—from $6,995 (1st step) to $7,655 (5th step); and Grade 11—from $7,560 (1st step) to $8,340 (4th step).

Commission expects the adjustments to aid in recruiting about 6,300 engineers and scientists during the next year, at an estimated additional cost of $5 million. Approximately 19,000 engineers and 7,000 scientists now serving in affected positions will have their pay adjusted under the new formula. Estimated first-year additional cost is $9 million.

New rates will provide a more attractive compensation range and more realistic promotion patterns from the beginning grades 5 and 7 to the intermediate grades 9 through 11. Above-minimum recruitment rates for positions in these fields at grades 5 and 7 have been authorized since July 1960 as follows: Grade 5, $5,335 (top step), and grade 7, $6,345 (top step).

PROJECT DECISION

Instructor (r) shows subject his decisions on a machine developed for "Project Decision," a psychological research program conducted by ACF Electronics and The Catholic Univ. of America. Initial phase of program concerned itself with identifying and correlating the factors that bear on man's ability to make decisions.

Science Award To Martin Corp.

Aerospace Div. of the Martin Marietta Corp., has received the annual Industrial Science Achievement Award of the American Association for the Advancement of Science.

Award was based on the division's general excellence in the advancement of technological knowledge and the practical application of science through research. AAAS section on Industrial Science screened candidates and made the award.

Peruvian Government Honors IT&T President

Harold S. Geneen, President of IT&T Corp., was honored by the government of Peru at a reception held in his honor at the Peruvian Embassy in Washington.

Mr. Geneen was given the title of Grand Officer of the Order of Merit for Distinguished Service. The Order was established as a means for recognizing outstanding individual contributions to the welfare of Peru.

Profile of "Today's Electronic Engineer—1962"

What is the income of the average engineer? How much life insurance does he carry? How many children does he have? What is the value of his home? How much does he have in liquid assets? ELECTRONIC INDUSTRIES wondered about these personal sides of the engineer's life, and set out to find the answers. We did, from thousands of engineers across the country. Here is what they reported . . .

EXACTLY three years ago, in March 1959, ELECTRONICS INDUSTRIES published the original study in this field. That article, "Profile of Today's Electronic Engineer," was one of the very first studies ever undertaken to establish the personal characteristics of the electronic engineer.

The qustions asked in that survey were almost identical with the questions that are listed here. They dealt with salaries, aspirations, number of children, whether the engineer owned his own home, how much life insurance he carried, etc.

With these two sets of data in front of us now, it is interesting to see just how engineers' fortunes have changed. What has happened to salaries in the engineering field?

In 1959, our returns indicated that the median salary for all electronic engineers was $9,642. In 1962, the median figure has climbed —as expected—but only to $10,-417. Are there other factors to be considered here?

Certainly the number of young engineers coming ino the field influences the median figure, in spite of their comparatively higher starting salaries. Actually the higher starting salaries are not reflected substantially here. Back in 1959 the median salary for the "under 25" category was $6,750, and in 1962 the figure is almost exactly the same.

The most striking change in financial fortunes is in the age bracket of "30-34." In our 1959 survey the median salary was only $7,700—not too impressive—but here, three years later the salaries of engineers in that age group has increased by more than 33% to $10,400!

Similar increases went to the engineers who three years ago were in that $7,700 bracket. Today their median salary is up to $11,000.

Other aspects of the engineers' personal lives attracted our interest. This year we also wanted to know what percentage of engineers were divorced; and how this compared with the national average.

It was strictly no contest. Of 2,144 engineers surveyed, only an infinitesimal 6 reported being divorced.

Linked to this, we also find a taste for conservative music. The overwhelming majority of engineers prefer classical; a substantial percentage—close to 10%—even go for opera.

These data on engineers paint a very typical picture of American suburbia.

For instance, an overwhelming percentage of engineers own their own homes. In the age groups over 35, more than 85% are home owners, and over 40 the percentage goes over the 90% mark.

The number of automobiles is significant too. Of engineers in the 35-39 age bracket, there are nearly as many who own two cars as there are who own one. And over 40 the balance goes completely to the other side; a predominant percentage are 2-car families. Finally, there is a healthy optimism on all sides. Taking our group of the median age of 34 years, we find that well over half are looking forward to incomes over $15,000 within the next five years. The optimism in other age groups is similar.

APPROXIMATE ANNUAL INCOME—5 YEARS AGO?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	100	100.0	14	37	9	4	12	24
UNDER $5,000	98	98.0	14	35	9	4	12	24
5,000 – 5,999	2	2.0		2				
6,000 – 7,449								
7,500 – 9,999								
10,000 – 12,499								
12,500 – 14,999								
15,000 & OVER								

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 25 – 29	453	100.0	42	134	47	31	70	129
UNDER $5,000	306	67.5	29	87	28	29	43	90
5,000 – 5,999	107	23.6	8	37	13	1	20	28
6,000 – 7,449	37	8.2	5	9	5	1	7	10
7,500 – 9,999	2	.4		1				1
10,000 – 12,499	1	.2			1			
12,500 – 14,999								
15,000 & OVER								

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 – 34	594	100.0	51	166	69	33	90	185
UNDER $5,000	191	32.2	14	40	25	15	33	64
5,000 – 5,999	141	23.7	14	38	18	6	21	44
6,000 – 7,449	165	27.8	16	55	14	7	28	45
7,500 – 9,999	87	14.6	6	28	11	5	7	30
10,000 – 12,499	9	1.5	1	5	1		1	1
12,500 – 14,999	1	.2						1
15,000 & OVER								

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 35 – 39	465	100.0	51	150	57	19	62	126
UNDER $5,000	38	8.2	5	14	3	1	4	11
5,000 – 5,999	74	15.9	13	21	14	1	7	18
6,000 – 7,449	175	37.6	12	59	22	10	25	47
7,500 – 9,999	138	29.7	13	42	15	6	20	42
10,000 – 12,499	24	5.1	7	7	3		1	6
12,500 – 14,999	11	2.4	1	3		1	4	2
15,000 & OVER	5	1.1		4			1	

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 40 – 44	261	100.0	13	88	34	13	33	80
UNDER $5,000	5	1.9	1	1			1	2
5,000 – 5,999	31	11.9		12	4	4	4	7
6,000 – 7,449	64	24.5	3	14	9	4	9	25
7,500 – 9,999	90	34.5	5	30	13	3	13	26
10,000 – 12,499	42	16.1	2	16	6	1	5	12
12,500 – 14,999	22	8.4	1	12	1	1	1	6
15,000 & OVER	7	2.7	1	3	1			2

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 45 – 49	141	100.0	11	45	20	6	21	38
UNDER $5,000	3	2.1		1		1		1
5,000 – 5,999	7	5.0		1	1		1	4
6,000 – 7,449	35	24.8	4	13	6	3	2	7
7,500 – 9,999	43	30.5	3	11	6	2	12	9
10,000 – 12,499	32	22.7	2	9	4		4	13
12,500 – 14,999	13	9.2	2	7			1	3
15,000 & OVER	8	5.7		3	3		1	1

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 50 & OVER	120	100.0	14	44	17	6	13	26
UNDER $5,000	3	2.5		3				
5,000 – 5,999	6	5.0	1	2			1	2
6,000 – 7,449	10	8.3	1	2	2		2	3
7,500 – 9,999	45	37.5	7	13	8	3	3	11
10,000 – 12,499	26	21.7	3	11	2	2	2	6
12,500 – 14,999	13	10.8	1	6	3	1	2	
15,000 & OVER	17	14.2	1	7	2		3	4

APPROXIMATE ANNUAL INCOME—TODAY?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	102	100.0	14	37	9	4	14	24
UNDER $5,000	1	1.0		1				
5,000 – 5,999	7	6.8	1	3	1		1	1
6,000 – 7,449	56	54.9	8	18	7	4	7	12
7,500 – 9,999	36	35.3	5	14	1		6	10
10,000 – 12,499	2	2.0		1				1
12,500 – 14,999								
15,000 & OVER								

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 25 – 29	453	100.0	42	134	47	31	70	129
UNDER $5,000								
5,000 – 5,999	3	.7	2				1	
6,000 – 7,449	82	18.1	11	21	14	3	15	18
7,500 – 9,999	279	61.6	20	85	25	24	43	82
10,000 – 12,499	72	15.9	8	22	8	4	9	21
12,500 – 14,999	16	3.5	1	5			2	8
15,000 & OVER	1	.2		1				

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 – 34	594	100.0	51	164	69	33	92	185
UNDER $5,000								
5,000 – 5,999	5	.9		1		1	1	2
6,000 – 7,449	50	8.4	6	15	9	2	9	9
7,500 – 9,999	211	35.5	13	45	29	15	44	65
10,000 – 12,499	198	33.3	19	58	20	13	27	61
12,500 – 14,999	100	16.8	13	37	8	2	11	29
15,000 & OVER	30	5.1		8	3			19

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 35 – 39	461	100.0	51	147	57	19	60	127
UNDER $5,000								
5,000 – 5,999	2	.4		2				
6,000 – 7,449	15	3.3	2	4	1	1	1	6
7,500 – 9,999	105	22.8	8	27	21	8	12	29
10,000 – 12,499	170	36.9	22	51	21	7	21	48
12,500 – 14,999	95	20.6	12	32	10	2	19	20
15,000 & OVER	74	16.0	7	31	4	1	7	24

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 40 – 44	260	100.0	13	88	34	13	33	79
UNDER $5,000								
5,000 – 5,999								
6,000 – 7,449	7	2.7		3	1	1		2
7,500 – 9,999	37	14.2	1	11	6	1	9	9
10,000 – 12,499	84	32.3	2	21	12	7	12	30
12,500 – 14,999	53	20.4	5	20	7	2	6	13
15,000 & OVER	79	30.4	5	33	8	2	6	25

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 45 – 49	140	100.0	11	44	20	6	21	38
UNDER $5,000								
5,000 – 5,999	1	.7						1
6,000 – 7,449								
7,500 – 9,999	28	20.0	2	8	5	3	3	7
10,000 – 12,499	36	25.7	1	12	6	1	6	10
12,500 – 14,999	36	25.7	6	8	4	1	8	9
15,000 & OVER	39	27.9	2	16	5	1	4	11

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 50 & OVER	120	100.0	14	45	16	6	13	26
UNDER $5,000	1	.8		1				
5,000 – 5,999	1	.8		1				
6,000 – 7,449	1	.8		1				
7,500 – 9,999	13	10.9	2	4	3		1	3
10,000 – 12,499	36	30.0	6	9	5	2	5	9
12,500 – 14,999	26	21.7	2	12	3	2	1	6
15,000 & OVER	42	35.0	4	17	5	2	6	8

APPROXIMATE ANNUAL INCOME—5 YEARS FROM NOW?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	101	100.0	14	36	9	4	14	24
UNDER $5,000								
5,000 – 5,999								
6,000 – 7,449	1	1.0					1	
7,500 – 9,999	21	20.8	3	7	4	1	2	4
10,000 – 12,499	52	51.5	10	13	3	3	9	14
12,500 – 14,999	21	20.8	1	11	2		2	5
15,000 & OVER	6	5.9		5				1

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 25 – 29	439	100.0	42	128	46	30	67	126
UNDER $5,000								
5,000 – 5,999								
6,000 – 7,449	1	.2						1
7,500 – 9,999	42	9.6	7	9	7		10	9
10,000 – 12,499	136	31.0	14	36	17	18	21	30
12,500 – 14,999	155	35.3	13	54	14	8	20	46
15,000 & OVER	104	23.7	8	29	8	4	16	39
DONT KNOW	1	.2						1

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 – 34	587	100.0	49	163	69	32	96	184
UNDER $5,000	1	.2						1
5,000 – 5,999	1	.2				1		
6,000 – 7,449	1	.2						1
7,500 – 9,999	30	5.1	5	7	4	1	8	5
10,000 – 12,499	118	20.1	4	26	20	7	28	33
12,500 – 14,999	172	29.2	11	44	20	15	26	56
15,000 & OVER	263	94.8	29	86	25	8	28	87
DONT KNOW	1	.2						1

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 35 – 39	454	100.0	48	147	56	19	59	125
UNDER $5,000								
5,000 – 5,999								
6,000 – 7,449	2	.5		1				1
7,500 – 9,999	14	3.1		8	1	1		4
10,000 – 12,499	61	13.4	4	14	14	5	9	15
12,500 – 14,999	115	25.3	15	34	18	4	14	30
15,000 & OVER	261	57.5	29	89	23	9	36	75
DONT KNOW	1	.2		1				

Opportunities for:

Aerospace Vehicles Engineers

The Aerospace Vehicles Laboratory of the Space Systems Division has openings for nearly one hundred engineers who have experience in stress, structures, propulsion, mechanisms, control systems, equipment installation or heat transfer which can be applied to advanced aerospace weapons systems or vehicles. The Aerospace Laboratory is concerned, as a result of SURVEYOR and other contracts, with lunar and space exploration, air to air missiles and ICBM defense systems. The openings are for both junior and senior mechanical engineers, electronic engineers, physicists and aeronautical engineers. Some of the openings are described below:

Structures

Senior Dynamicist. Must be capable of performing advanced analysis in structural mechanics. Will be required to calculate response of complex elastic systems to various dynamic inputs including random excitation. Must be capable of original work in developing advanced analytical techniques.

Loads Analyst. To establish structural design criteria for advanced missiles and spacecraft. Should be capable of determining external airload and inertial force distributions.

Reliability Analyst. To perform statistical analysis of structural loads and strength properties for the purpose of establishing structural reliability criteria on a probability basis.

Stress Analyst. To perform advanced stress analysis of complex and redundant missile and spacecraft structures. Will be required to solve special problems in elasticity, plasticity, short time creep and structural stability.

Design. Experience is required in preliminary and final structural engineering and design, including preliminary stress analysis. A knowledge of the effects of extreme temperature environment and hard vacuum, plus a background in materials is desired.

Heat Transfer

Space Vehicle Heat Transfer. Basic knowledge of radiation conduction and convection heat transfer with application to thermal control of space vehicles is required. Knowledge of spectrally-selective radiation coating, super-insulations and thermal vacuum testing is of particular value.

Aerothermodynamicist. Experience in hypersonic real gas dynamics, heat transfer, abalation; re-entry vehicle design, detection; shock layer, wake and rocket exhaust ionization; and anti-missile system requirements will be most useful.

Equipment Installation

Packaging and Installation Engineer. To perform optimum packaging and installation design for missile and/or spacecraft units, considering amount and geometric shape of space available as well as weight and center of gravity distribution requirements. Must be capable of analyzing structural adequacy of unit under extreme environmental conditions.

Controls

Optical Devices. Design, development, procurement and test operations are involved. Considerable experience in the field of optical devices for space applications such as star, horizon, sun and moon trackers.

System Test. To plan and supervise the operations of a flight control system laboratory. Air bearing tables and a wide variety of optical mechanical and electrical equipment are involved.

Control System Analysis. Requires engineers at various levels of experience including senior men capable of taking over-all project responsibility in the synthesis and analysis of control systems.

Circuit Design and Development. Experience in design and development of transistorized control system circuits, including various types of electronic switching and modulation techniques is required.

If you are a graduate mechanical engineer, electronic engineer, physicist or aeronautical engineer, with experience applicable to the above openings, please airmail your resume to: **Dr. F. P. Adler,** Manager, Space Systems Division, Hughes Aircraft Company, 11940 W. Jefferson Blvd., Culver City 72, California.

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SPACE SYSTEMS DIVISION

APPROXIMATE ANNUAL INCOME—5 YEARS FROM NOW?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 40 - 44	258	100.0	13	87	33	13	33	79
UNDER $5,000								
5,000 - 5,999								
6,000 - 7,449								
7,500 - 9,999	8	3.1		4		1		3
10,000 - 12,499	25	9.7	2	7	5	1	5	5
12,500 - 14,999	62	24.0		15	11	3	14	19
15,000 & OVER	162	62.8	11	61	17	8	14	51
DONT KNOW	1	.4						1
AGE 45 - 49	137	100.0	11	43	20	6	20	37
UNDER $5,000								
5,000 - 5,999								
6,000 - 7,449	1	.7						1
7,500 - 9,999	2	1.5		1	1			
10,000 - 12,499	19	13.9	2	3	3	1	3	7
12,500 - 14,999	34	24.8		13	4	2	6	9
15,000 & OVER	79	57.7	9	25	12	3	11	19
RETIRED	1	.7		1				
DONT KNOW	1	.7						1
AGE 50 & OVER	116	100.0	14	42	17	6	13	24
UNDER $5,000								
5,000 - 5,999								
6,000 - 7,449	1	.9		1				
7,500 - 9,999	1	.9						1
10,000 - 12,499	15	12.9	2	8	3		1	1
12,500 - 14,999	27	23.3	6	6	4	2	4	5
15,000 & OVER	67	57.8	6	25	9	4	7	16
RETIRED	2	1.7		1	1			
DONT KNOW	3	2.5		1			1	1

ARE YOU MARRIED OR SINGLE?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	102	100.0	14	37	9	4	14	24
MARRIED	59	57.8	9	22	3	2	10	13
SINGLE	42	41.2	5	15	5	2	4	11
DIVORCED	1	1.0			1			
WIDOWED								
AGE 25 - 29	455	100.0	42	134	47	32	71	129
MARRIED	372	81.8	32	106	41	26	66	101
SINGLE	81	17.8	10	28	6	6	5	26
DIVORCED	2	.4						2
WIDOWED								
AGE 30 - 34	596	100.0	51	167	69	32	92	185
MARRIED	536	90.0	49	146	63	27	83	168
SINGLE	59	9.9	2	21	6	5	8	17
DIVORCED	1	.1					1	
WIDOWED								
AGE 35 - 39	467	100.0	53	149	57	19	62	127
MARRIED	442	94.7	51	142	53	18	61	117
SINGLE	24	5.1	2	7	4	1	1	9
DIVORCED	1	.2						1
WIDOWED								
AGE 40 - 44	260	100.0	13	87	34	13	33	80
MARRIED	252	96.9	13	85	34	13	31	76
SINGLE	7	2.7		2			2	3
DIVORCED	1	.4						1
WIDOWED								
AGE 45 - 49	141	100.0	11	45	20	6	21	38
MARRIED	137	97.2	11	44	20	6	21	35
SINGLE	4	2.8		1				3
DIVORCED								
WIDOWED								
AGE 50 & OVER	123	100.0	14	46	17	6	14	26
MARRIED	118	95.9	13	44	17	6	14	24
SINGLE	5	4.0	1	2				2
DIVORCED								
WIDOWED								

IN HOW MANY INDIVIDUAL PLANTS OR COMPANIES HAVE YOU WORKED SINCE LEAVING SCHOOL?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	102	100.0	14	37	9	4	14	24
ONE	69	67.6	10	26	7	2	9	15
TWO	27	26.5	3	10	2	1	4	7
THREE	6	5.9	1	1		1	1	2
FOUR								
FIVE								
SIX								
AGE 25 - 29	452	100.0	42	133	47	32	71	127
ONE	228	50.4	19	71	20	22	37	59
TWO	138	30.5	13	38	15	8	23	41
THREE	57	12.6	6	15	8	2	7	19
FOUR	20	4.4	3	5	4		3	5
FIVE	3	.7	1					2
SIX	4	.9		2			1	1
SEVEN								
EIGHT								
NINE	2	.5		2				

HOW MANY CHILDREN?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	59	100.0	9	21	4	2	10	13
0	24	40.7	3	13		1	2	5
1	21	35.6	2	5	3	1	5	5
2	12	20.3	3	3	1		2	3
3	1	1.7	1					
4	1	1.7					1	
5								
6								
7								
8								
AGE 25 - 29	372	100.0	31	106	41	25	66	103
0	76	20.4	7	25	7	5	12	20
1	111	29.8	12	33	18	4	21	23
2	120	32.3	6	35	9	10	26	34
3	50	13.4	5	10	6	4	6	19
4	11	3.0		1		2	1	7
5	3	.8	1	2				
6	1	.3			1			
7								
8								
AGE 30 - 34	534	100.0	49	145	63	27	84	166
0	58	10.9	3	15	6	2	10	22
1	95	17.8	10	31	9	6	15	24
2	193	36.1	15	56	20	5	33	64
3	114	21.4	16	28	17	7	16	30
4	45	8.4	3	10	6	4	7	15
5	22	4.1	1	3	5	2	2	9
6	7	1.3	1	2		1	1	2
7								
8								
AGE 35 - 39	441	100.0	51	142	53	18	60	117
0	38	8.6	7	15	3		4	9
1	56	12.7	7	15	7	1	9	17
2	145	32.9	15	57	13	8	20	32
3	131	29.7	13	38	18	3	17	42
4	42	9.5	6	13	4	3	4	12
5	20	4.6	1	2	5	3	6	3
6	5	.1		1	2			2
7	3	.7	2	1				
8	1	.2			1			
AGE 40 - 44	251	100.0	12	85	34	13	31	76
0	16	6.3	1	3	1		4	7
1	29	11.6	1	6	7		3	12
2	87	34.7	3	29	9	7	7	32
3	59	23.5	6	22	9	2	7	13
4	35	13.9	1	14	6	2	6	6
5	14	5.6		7			3	4
6	4	1.6		1	1		1	1
7	6	2.4		2	1	2		1
8	1	.4		1				
AGE 45 - 49	137	100.0	11	44	20	6	21	35
0	15	11.0	2	11			2	
1	24	17.5	2	4	4	1	2	11
2	54	39.4	1	18	9	3	9	14
3	27	19.7	4	6	2	1	7	7
4	9	6.6	1	4	2		1	1
5	5	3.7		1	2	1		1
6	1	.7						1
7	2	1.4	1		1			
8								
AGE 50 & OVER	117	100.0	13	44	17	6	14	23
0	16	13.7	2	5	2		2	5
1	20	17.0	1	11	4		3	1
2	38	32.5	6	14	5	3	4	6
3	22	18.8	2	8	4		2	6
4	12	10.3	1	4	2	1	3	1
5	4	3.4	1	2		1		
6	4	3.4				1		3
7								
8	1	.9						1

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 - 34	593		51	166	69	33	91	183
ONE	218	36.7	17	54	25	16	41	65
TWO	175	29.5	17	47	21	12	25	53
THREE	109	18.4	8	32	13	5	15	36
FOUR	45	7.6	4	16	4		5	16
FIVE	27	4.5	3	9	2		2	11
SIX	8	1.4	1	3	2		1	1
SEVEN	4	.7	1	1	2			
EIGHT	1	.2		1				
NINE	6	1.0		3			2	1
AGE 35 - 39	466		52	150	57	19	62	126
ONE	80	17.2	7	31	14	4	11	13
TWO	101	21.7	11	31	16	5	15	23
THREE	127	27.5	15	36	18	5	16	37
FOUR	70	15.0	8	22	7	2	9	22
FIVE	48	10.3	6	17		3	6	16
SIX	18	3.8	1	7	1		5	4
SEVEN	8	1.7		4				4
EIGHT	6	1.3	2	1				3
NINE	8	1.7	2	1	1			4

IN HOW MANY INDIVIDUAL PLANTS OR COMPANIES HAVE YOU WORKED SINCE LEAVING SCHOOL?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 40 - 44	258	100.0	13	88	34	13	33	77
ONE	34	13.2	1	15	6	1	5	6
TWO	44	17.0	3	16	6	5	3	11
THREE	59	22.9	5	20	6	2	9	17
FOUR	39	15.1	1	10	8	2	8	10
FIVE	28	10.9	1	7	2	3	4	11
SIX	19	7.4		6	2		3	8
SEVEN	16	6.2	1	6	3			6
EIGHT	7	2.7		3	1		1	2
NINE	12	4.6	1	5				6
AGE 45 - 49	140	100.0	11	45	20	5	21	38
ONE	20	14.3		12	3		1	4
TWO	18	12.9		5	4	1	3	5
THREE	18	12.9	3	6		2	4	3
FOUR	25	17.8	1	6	1		8	9
FIVE	20	14.3	1	10	3	1	2	3
SIX	13	9.3	1	3	5		1	3
SEVEN	8	5.7	1	1	2		1	3
EIGHT	8	5.7		2	1		1	4
NINE	10	7.1	4		1	1		4
AGE 50 & OVER	122	100.0	14	45	17	6	14	26
ONE	16	13.1	1	8	2		2	3
TWO	12	9.9		6	3	2		1
THREE	25	20.5	1	13		2	2	7
FOUR	16	13.1	1	3	4	1	2	5
FIVE	10	8.2	3	3	1		2	1
SIX	14	11.5	5	5	1		2	1
SEVEN	7	5.7		4			1	2
EIGHT	5	4.1	1		3			1
NINE	17	13.9	2	3	3	1	3	5

DOES YOUR COMPANY PROVIDE PENSIONS?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	101	100.0	14	36	9	4	14	24
YES	85	84.2	13	26	7	4	14	21
NO	16	15.8	1	10	2			3
AGE 25 - 29	451	100.0	41	133	47	32	70	128
YES	394	87.4	31	116	38	32	67	110
NO	57	12.6	10	17	9		3	18
AGE 30 - 34	594	100.0	51	168	69	33	90	183
YES	503	84.7	38	140	60	32	85	148
NO	91	15.3	13	28	9	1	5	35
AGE 35 - 39	466	100.0	52	149	57	19	62	127
YES	403	86.5	38	128	56	17	58	106
NO	63	13.5	14	21	1	2	4	21
AGE 40 - 44	256	100.0	12	87	32	13	33	79
YES	219	85.5	9	76	29	11	29	65
NO	37	14.5	3	11	3	2	4	14
AGE 45 - 49	139	100.0	10	44	20	6	21	38
YES	114	82.0	7	37	15	5	18	32
NO	25	18.0	3	7	5	1	3	6
AGE 50 & OVER	120	100.0	14	45	17	6	13	25
YES	104	86.7	12	40	13	5	10	24
NO	16	13.3	2	5	4	1	3	1

DOES YOUR COMPANY PROVIDE HEALTH BENEFITS?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	97	100.0	14	33	9	4	13	24
YES	21	21.6	3	6	4	3	3	2
NO	76	78.4	11	27	5	1	10	22
AGE 25 - 29	414	100.0	35	123	44	30	64	118
YES	105	25.4	6	32	17	9	17	24
NO	309	74.6	29	91	27	21	47	94
AGE 30 - 34	553	100.0	47	157	62	32	84	171
YES	159	28.8	17	34	17	11	30	50
NO	394	71.2	30	123	45	21	54	121
AGE 35 - 39	428	100.0	49	142	52	17	54	114
YES	139	32.5	17	45	17	7	18	35
NO	289	67.5	32	97	35	10	36	79
AGE 40 - 44	239	100.0	13	84	29	13	29	71
YES	88	36.8	3	25	11	7	12	30
NO	151	63.2	10	59	18	6	17	41
AGE 45 - 49	124	100.0	11	39	18	6	19	31
YES	54	43.6	6	19	8		5	16
NO	70	56.4	5	20	10	6	14	15
AGE 50 & OVER	98	100.0	12	34	12	5	13	22
YES	49	50.0	3	21	4	2	6	13
NO	49	50.0	9	13	8	3	7	9

HAVE YOU ESTABLISHED YOUR OWN PRIVATE PENSION?

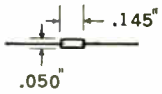
	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	102	100.0	14	37	9	4	14	24
YES	95	93.1	14	34	8	4	13	22
NO	7	6.9		3	1		1	2
AGE 25 - 29	456	100.0	42	134	47	32	71	130
YES	431	94.5	41	126	44	29	67	124
NO	25	5.5	1	8	3	3	4	6
AGE 30 - 34	595	100.0	51	168	69	33	91	183
YES	570	95.8	47	165	65	33	87	173
NO	25	4.2	4	3	4		4	10
AGE 35 - 39	466	100.0	53	149	56	19	62	127
YES	441	94.6	50	143	55	17	61	115
NO	25	5.4	3	6	1	2	1	12
AGE 40 - 44	257	100.0	13	86	34	13	32	79
YES	248	96.5	13	82	34	13	30	76
NO	9	3.5		4			2	3
AGE 45 - 49	141	100.0	11	45	20	6	21	38
YES	130	92.2	9	40	18	6	21	36
NO	11	7.8	2	5	2			2
AGE 50 & OVER	121	100.0	14	44	17	6	14	26
YES	116	95.9	14	40	16	6	14	26
NO	5	4.1		4	1			

HAVE YOU ESTABLISHED YOUR OWN PRIVATE HEALTH BENEFITS?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	100	100.0	14	35	9	4	14	24
YES	32	32.0	5	11	4	3	4	5
NO	68	68.0	9	24	5	1	10	19
AGE 25 - 29	415	100.0	37	123	45	31	62	117
YES	111	26.7	9	38	10	11	17	26
NO	304	73.3	28	85	35	20	45	91
AGE 30 - 34	537	100.0	42	153	65	30	80	167
YES	123	32.9	11	37	17	5	19	34
NO	414	67.1	31	116	48	25	61	133
AGE 35 - 39	403	100.0	43	147	50	15	52	106
YES	115	28.5	10	39	13	8	16	29
NO	288	71.5	33	98	37	7	36	77
AGE 40 - 44	228	100.0	11	81	27	12	29	68
YES	68	29.8	4	23	8	4	12	17
NO	160	70.2	7	58	19	8	17	51
AGE 45 - 49	110	100.0	11	36	17	6	19	30
YES	45	37.8	7	14	5	3	8	8
NO	74	62.2	4	22	12	3	11	22
AGE 50 & OVER	98	100.0	11	38	14	4	9	22
YES	44	44.9	3	20	7	2	3	9
NO	54	55.1	8	18	7	2	6	13

HOW MUCH INSURANCE DO YOU CARRY?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	100	100.0	14	35	9	4	14	24
$1,000 - 5,999	4	4.0		2	1			1
6,000 - 10,999	26	26.0	3	12	1		3	7
11,000 - 15,999	18	18.0	2	5	3	1	2	5
16,000 - 20,999	22	22.0	3	10	1	2	1	5
21,000 - 25,999	16	16.0	3	3	2	1	5	2
26,000 - 30,999	3	3.0		1			1	1
31,000 - 40,999	5	5.0	3	1				1
41,000 - 50,999	3	3.0			1		2	
51,000 - 75,999	1	1.0						1
76,000 - 100,999								
101,000 AND OVER								
NONE	2	2.0		1				1
AGE 25 - 29	450	100.0	42	133	47	30	71	127
$1,000 - 5,999	8	1.7	2	3	1			2
6,000 - 10,999	52	11.5	8	15	3	6	8	12
11,000 - 15,999	56	12.5	3	15	7	8	7	16
16,000 - 20,999	87	19.4	5	25	8	2	17	30
21,000 - 25,999	68	15.2	6	19	8	5	12	18
26,000 - 30,999	63	13.9	6	15	9	1	13	19
31,000 - 40,999	49	10.8	4	14	6	5	7	13
41,000 - 50,999	34	7.5	4	12	3	3	2	10
51,000 - 75,999	15	3.2	3	4	1		4	3
76,000 - 100,999	5	1.1		4				1
101,000 AND OVER	3	.6		3				
NONE	10	2.2	1	4	1		1	3
AGE 30 - 34	593	100.0	51	166	67	33	89	185
$1,000 - 5,999	13	2.2	2	6	2			3
6,000 - 10,999	42	7.1	2	13	6		7	14
11,000 - 15,999	60	10.1	5	19	9	3	12	12
16,000 - 20,999	93	15.6	7	27	10	9	12	28
21,000 - 25,999	69	11.7	3	17	6	7	10	26
26,000 - 30,999	83	13.9	10	26	5	1	16	25
31,000 - 40,999	102	17.1	9	26	14	5	19	29
41,000 - 50,999	71	12.0	5	24	12	4	7	19
51,000 - 75,999	36	6.1	6	5	3	1	6	15
76,000 - 100,999	14	2.4	1	2		3		8
101,000 AND OVER	3	.5	1					2
NONE	7	1.2		1	2			4
AGE 35 - 39	461	100.0	50	148	57	19	62	125
$1,000 - 5,999	11	2.3	3	5				3
6,000 - 10,999	25	5.4	1	5	4	1	4	10
11,000 - 15,999	45	9.7	3	15	11	1	6	9
16,000 - 20,999	57	12.3	9	16	7	2	7	16
21,000 - 25,999	53	11.4	5	17	6	3	6	16
26,000 - 30,999	58	12.5	9	22	5	3	8	11
31,000 - 40,999	74	15.9	5	25	12	1	11	20
41,000 - 50,999	50	10.8	6	13	4	3	8	16
51,000 - 75,999	49	10.6	8	17	3	3	9	9
76,000 - 100,999	17	3.6		8	1		2	6
101,000 AND OVER	2	.4					1	1
NONE	9	1.8	1	2	2	2		2
DONT KNOW	11	2.4		3	2			6
AGE 40 - 44	254	100.0	13	87	34	13	31	76
$1,000 - 5,999	3	1.2		2				1
6,000 - 10,999	14	5.5	1	4	4		1	4
11,000 - 15,999	18	7.1	1	6	3	1	2	5
16,000 - 20,999	26	10.2	2	8	4	2	4	6
21,000 - 25,999	30	11.8		12	1	5	4	8
26,000 - 30,999	30	11.8		12	4		1	13
31,000 - 40,999	40	15.7	2	13	3	2	6	14
41,000 - 50,999	36	14.2	4	13	6	2	2	9
51,000 - 75,999	32	12.6	2	9	5		6	10
76,000 - 100,999	17	6.7	1	6	4	1	2	3
101,000 AND OVER	6	2.4		2			1	3
NONE	2	.8					2	
AGE 45 - 49	140	100.0	11	44	20	6	21	38
$1,000 - 5,999	1	.7						1
6,000 - 10,999	9	6.4	1	3		1		4
11,000 - 15,999	12	8.5		3	3	1	2	3
16,000 - 20,999	13	9.2	3	5	1	1	1	2
21,000 - 25,999	21	14.9	1	10	1	2	3	4
26,000 - 30,999	23	16.3	2	6	4		7	4
31,000 - 40,999	15	10.6		4	3		2	6
41,000 - 50,999	27	19.2	1	4	5	1	6	10
51,000 - 75,999	12	8.5	2	6	2			2
76,000 - 100,999	5	2.5	1	3				1
101,000 AND OVER	2	1.4			1			1
NONE								
AGE 50 & OVER	121	100.0	14	45	17	6	14	26
$1,000 - 5,999	3	2.4	1					2
6,000 - 10,999	6	4.9		3		1	1	1
11,000 - 15,999	10	8.3		3	4		3	
16,000 - 20,999	13	10.7	2	5	2			4
21,000 - 25,999	17	14.0		5	4	1	4	3
26,000 - 30,999	13	10.7	1	3		4		5
31,000 - 40,999	26	21.3	4	14	3		2	3
41,000 - 50,999	11	9.0	4	5			1	1
51,000 - 75,999	15	12.3	1	7	1		2	4
76,000 - 100,999	3	2.4	1		2			
101,000 AND OVER	4	3.2			1		1	2
NONE	1							1



Here's an eyeful worth looking into . . .

If you're trying to pack more components into less space Clevite's new MILLIMINIATURE germanium diodes and MILLIPAK packaged circuits will give you a real breakthrough.

Now you can *really utilize* the 100 mil standard hole spacing on printed circuit boards — or even drop to 50 mil spacing — and get greater component density than ever before with Clevite's new milliminiature germanium diodes.

And Clevite's new MILLIPAK *packaged circuits using these diodes can be furnished to get even greater component density by providing vertical mounting on circuit cards.*

MILLIMINIATURE GERMANIUM DIODE

All electrical characteristics available in present "subminiature" diodes are also available in this new series. Recovery times in the nanosecond region provide extremely fast switching — about all the present state of the art can practically use. The table gives ratings of a few typical units.

The glass package and diode structure is identical in materials, construction and sealing methods to the current "subminiature" unit whose reliability has been proved through production and use of millions of diodes.

MIL-S-19500 specs are exceeded. *Only the package size has been changed!*

Price differentials over standard diode types are slight and down substantially from introductory prices of a few months ago now that high production rates have been attained. Engineering considerations alone should determine your utilization of these new diodes.

CLEVITE *MILLIPAK* CIRCUITS

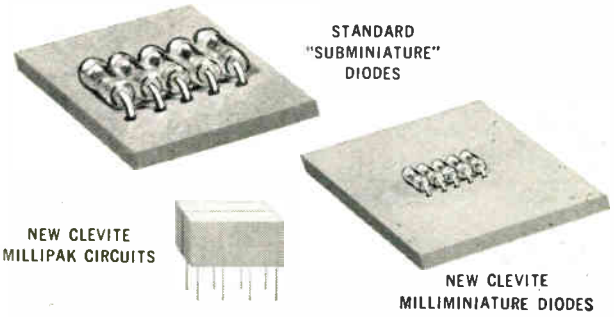
Clevite can provide milliminiature or standard diodes together with other components encapsulated in plastic to achieve the utmost in component density. All internal connections are welded for reliability.

CLEVITE TRANSISTOR

Reliability in volume

Waltham, Massachusetts

Typical circuit configurations include digital logic modules such as OR - AND - AND/OR - NAND - flip flops and various multiple gating circuits. Custom units can be provided such as bridge rectifiers, phase detectors, matched pairs and quads and various modulator configurations.



WRITE OR CALL FOR APPLICATION ENGINEERING ASSISTANCE.

See these milliminiature diodes and millipak circuits at the New York IRE show.

RATINGS AND SPECIFICATIONS AT 25°C

Type No.	Maximum DC Inverse Operating Voltage	Maximum DC Forward Current	Maximum Forward Voltage Drop @ 10mA	Maximum Inverse Current	Maximum Reverse Recovery Time
	Volts	mA	Volts	μa @ Volts	μsec
CID-205	100	25	0.5	10 @ 5 50 @ 80	—
CID-206	75	25	0.5	10 @ 5 50 @ 60	0.5
CID-207	50	25	0.5	10 @ 5 40 @ 40	0.3
CID-208	25	25	0.5	10 @ 5 40 @ 20	0.04
CID-209	15	25	0.5	30 @ 10	0.008

Types above available from Clevite Distributors

Circle 155 on Inquiry Card

IF THINKING OF JOINING ANOTHER COMPANY—PERCENTAGE INCREASE IN SALARY EXPECTED FOR A JOB IN YOUR LOCAL AREA?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	101	100.0	14	36	9	4	14	24
5%	2	2.0	1					1
7%	1	1.0	1					
8%	2	2.0			2			
10%	36	35.6	5	8	2	2	6	13
11%	1	1.0		1				
12%	6	5.9		3	1		1	1
13%	4	4.0	2	2				
14%	1	1.0		1				
15%	23	22.8	3	11	2		5	2
18%	2	2.0		1			1	
20%	17	16.8	2	7	1	2		5
22%	1	1.0					1	
25%	4	4.0		2	1			1
30%	1	1.0						1
AGE 25 - 29	453	100.0	42	132	47	32	71	129
0%	1	.2						1
1%	1	.2			1			
4%	1	.2					1	
5%	20	4.4		6	1	3	4	6
6%	6	1.3		1		1	1	3
7%	2	.4					1	1
8%	14	3.1	3	1	2		3	5
9%	3	.7		1		1		1
10%	154	34.0	11	39	13	11	20	60
11%	4	.9				1	2	1
12%	16	3.5	1	5	1		2	7
13%	8	1.8	2	4			1	1
14%	4	.9	1	3				
15%	114	25.2	11	39	15	8	23	18
17%	1	.2						1
18%	5	1.1	1	1	2			1
20%	60	13.2	11	17	8	4	6	14
23%	1	.2		1				
25%	28	6.2	1	9	4	3	5	6
30%	4	.9		2			1	1
33%	1	.2		1				
40%	1	.2		1				
50%	1	.2						1
99%	1	.2		1				
WONT LEAVE FOR MONEY	2	.4					1	1
AGE 30 - 34	587	100.0	50	164	69	33	91	180
0%	4	.7			1			3
1%	1	.2		1				
3%	1	.2				1		
4%	1	.2						1
5%	18	3.1		1	4	1	4	8
6%	5	.9			1		1	3
7%	9	1.5			1		1	7
8%	21	3.6	1	3	4	4	2	7
9%	3	.5			1	1		1
10%	192	32.7	15	45	20	14	39	59
12%	15	2.6	1	6	2		3	3
13%	5	.9	2	2				1
14%	1	.2					1	
15%	121	20.6	13	44	9	1	19	35
17%	1	.2			1			
18%	9	1.5		2	1	1	2	3
20%	108	18.4	9	40	16	4	11	28
23%	1	.2		1				
25%	33	5.6	5	9	3	3	5	8
28%	1	.2	1					
30%	17	2.9	2	6	1	2	1	5
35%	2	.3		1				1
40%	2	.3					1	1
50%	10	1.7	1	2	2	1	1	3
100%	3	.5			2			1
WONT LEAVE FOR MONEY	2	.3		1				1
DONT KNOW	1	.2						1

IF THINKING OF JOINING ANOTHER COMPANY—PERCENTAGE INCREASE IN SALARY EXPECTED FOR A JOB IN ANOTHER PART OF THE U. S.?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	98	100.0	14	36	9	4	14	21
5%	1	1.0		1				
8%	1	1.0						1
10%	8	8.2	2		2			4
12%	3	3.1	1				1	1
14%	1	1.0		1				
15%	16	16.3		7		1	3	5
17%	3	3.1	1	2				
18%	3	3.1	1	1			1	
19%	1	1.0					1	
20%	24	24.5	5	7	4	2	3	3
22%	2	2.0		2				
25%	13	13.3	1	5	1		2	4
30%	7	7.1		3	1		3	
33%	2	2.0		2				
35%	4	4.1	3	1				
40%	5	5.1		2	1	1		1
50%	3	3.1		1				2
100%	1	1.0		1				
WONT LEAVE FOR MONEY								

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 35 - 39	453	100.0	50	149	54	19	62	119
0%	2	.4			1			1
6%	14	3.1	1	1	1		2	9
7%	1	.2		1				
8%	5	1.1		2	1		1	1
9%	1	.2						1
10%	139	30.7	15	33	24	10	15	42
12%	11	2.4	1	3	1		1	5
13%	2	.4	1	1				
14%	1	.2		1				
15%	89	19.6	10	31	9	2	12	25
17%	3	.7		2				1
18%	7	1.5	2	3			1	1
20%	105	23.2	16	45	8	4	15	17
25%	36	7.9	2	15	5	1	4	9
30%	16	3.5	2	6	1	1	4	2
35%	2	.4					2	
40%	6	1.3		1			3	2
50%	1	.2		2	1	1	2	3
60%	1	.2			1			
75%	1	.2			1			
DONT KNOW	2	.4		2				
AGE 40 - 44	250	100.0	13	84	31	13	31	78
0%	2	.8					1	1
2%	1	.4				1		
5%	5	2.0		2				3
6%	1	.4					1	
7%	1	.4						1
10%	82	32.8	2	26	7	5	12	30
11%	1	.4						1
12%	4	1.6		1	1			2
13%	2	.8		1			1	
14%	1	.4						1
15%	45	18.0	4	17	7	2	6	9
17%	1	.4		1				
18%	2	.8		1				1
20%	55	22.0	4	19	8	2	5	17
25%	22	8.8	1	6	6	1	5	3
30%	11	4.4	2	5	1	1		2
40%	1	.4		1				
50%	9	3.6		3		1		5
100%	4	1.6		1	1			2
AGE 45 - 49	134	100.0	10	43	18	6	20	37
0%	6	4.5			1		2	3
2%	1	.7						1
5%	3	2.2		1				2
7%	1	.7		1				
8%	1	.7					1	
10%	32	23.9	1	8	3	1	5	14
11%	1	.7					1	
12%	3	2.2				1	2	
15%	25	18.7	3	9	1		6	6
20%	22	16.4	2	7	3	1	1	8
25%	27	20.1	1	10	9	3	2	2
30%	2	1.5	1	1				
33%	2	1.5		2				
40%	1	.7	1					
50%	5	3.7	1	2	1			1
100%	1	.7		1				
WONT LEAVE FOR MONEY	1	.7		1				
AGE 50 & OVER	98	100.0	13	35	14	5	11	20
0%	1	1.0	1					
5%	1	1.0						1
7%	1	1.0	1					
10%	28	28.6	4	5	4		2	13
12%	2	2.0	1	1				
15%	14	14.3	1	5	4	1	2	1
20%	16	16.3	3	9	2			2
25%	10	10.2	1	4	1	2	2	
30%	9	9.2		6			2	1
33%	1	1.0		1				
50%	5	5.1		3				2
70%	1	1.0		1				
100%	5	5.1	1		1	1	2	
WONT LEAVE FOR MONEY	4	4.1			2	1	1	

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 25 - 29	444	100.0	42	130	44	32	69	127
3%	1	.2						1
5%	2	.5						2
10%	39	8.8	3	10	1	5	3	17
11%	7	1.6			1	1	1	4
12%	8	1.8		2	1		2	3
13%	4	.9		1			1	2
14%	1	.2	1					
15%	79	17.8	8	19	10	4	8	30
17%	7	1.6		3	1		1	2
18%	15	3.4	2	5	1	1	2	4
20%	108	24.3	8	33	7	10	28	22
22%	8	1.8	3	2			2	1
23%	2	.5		2				
24%	2	.5			1			1
25%	75	16.9	7	31	13	4	6	14
28%	1	.2	1					
30%	32	7.2	4	9	2	2	7	8
33%	1	.2		1				
35%	11	2.5		5	3		1	2
40%	12	2.7	4	2	1	1	1	3
50%	15	3.4		2	2	3	4	4
60%	3	.7		1				2
85%	1	.2		1				
100%	3	.7		1			1	1
WONT LEAVE FOR MONEY	2	.5					1	1
DONT KNOW	5	1.1	1			1		3

IF THINKING OF JOINING ANOTHER COMPANY—PERCENTAGE INCREASE IN SALARY EXPECTED FOR A JOB IN ANOTHER PART OF THE U. S.?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 - 34	573	100.0	47	158	67	32	91	178
0%	1	.2		1				
5%	3	.5		1		1		1
10%	43	7.5	5	5	7	1	6	19
11%	3	.5			1			2
12%	7	1.2				1		6
13%	4	.7		1			1	2
14%	2	.3		1		1		
15%	87	15.2	5	15	12	7	16	32
16%	2	.3			1			1
17%	4	.7		3			1	
18%	12	2.1		4	1		3	4
20%	140	24.4	11	39	12	6	31	41
22%	7	1.2	1	2			2	2
23%	5	.9			2	1	2	
25%	90	15.7	10	31	13	4	7	25
28%	3	.5		1		1		1
30%	57	9.9	6	22	9	3	7	10
33%	3	.5		2				1
35%	19	3.3	1	8		1	6	3
40%	20	3.5	2	6	1	2	4	5
45%	1	.2		1				
50%	34	5.9	2	10	6	3	2	11
55%	1	.2	1					
60%	2	.3						2
62%	1	.2	1					
70%	1	.2						1
75%	5	.9	1	2	1			1
80%	2	.3						2
100%	6	1.0		2	1		1	2
WONT LEAVE FOR MONEY	5	.9		1			1	3
DONT KNOW	3	.5	1				1	1
AGE 35 - 39	446	100.0	49	143	56	19	61	118
0%	1	.2		1				
5%	2	.4			1			1
7%	1	.2					1	
10%	31	7.0	3	6	5	2	3	12
12%	3	.7		1			1	1
13%	4	.9		1				3
15%	55	12.3	7	13	9		8	18
16%	2	.4			1			1
17%	2	.4			1			1
18%	3	.7			2		1	
20%	106	23.8	11	31	20	7	14	23
22%	4	.9	1	2				1
23%	2	.4		1			1	
25%	69	15.5	6	32	4	3	7	17
27%	1	.2		1				
28%	2	.4					1	1
30%	53	11.9	8	21	5	3	7	9
33%	2	.4	1				1	
35%	12	2.7	3	3	1	1	1	3
38%	3	.7		1				2
40%	26	5.8	4	13	2		2	5
45%	1	.2						1
50%	37	8.3	3	11	1	3	8	11
60%	8	1.8		1	2		3	2
65%	1	.2		1				
70%	1	.2					1	
75%	1	.2					1	
100%	5	1.1			2			3
WONT LEAVE FOR MONEY	2	.4						2
DONT KNOW	6	1.3	2	3				1
AGE 40 - 44	250	100.0	13	84	30	13	31	79
5%	4	1.6			1	1		2
7%	1	.4						1
8%	1	.4		1				
10%	7	2.8		2	1		1	3
14%	1	.4		1				
15%	24	9.6		5	3	1	6	9
16%	1	.4			1			
17%	1	.4		1				
18%	4	1.6		3				1
20%	52	20.8	3	22	6	3	7	11
22%	3	1.2		1	2			
23%	1	.4					1	
25%	52	20.8	4	15	4	3	7	19
30%	33	13.2	2	10	5	3	2	11
33%	2	.8					1	1
35%	7	2.8	1	1	2		1	2
40%	16	6.4		7		1	4	4
45%	2	.8						2
50%	22	8.8	2	9	4		1	6
75%	5	2.0		2				3
100%	7	2.8		2	1	1		3
WONT LEAVE FOR MONEY	2	.8		1				1
DONT KNOW	2	.8	1	1				
AGE 45 - 49	128	100.0	9	43	17	6	19	34
0%	2	1.6			1		1	
5%	2	1.6						2
10%	9	7.0		2	2		2	3
14%	1	.8						1
15%	6	4.7		2			2	2
19%	1	.8					1	
20%	24	18.7	2	10	2	1	3	6
25%	28	21.9	2	8	1	3	4	10
28%	1	.8		1				
30%	14	10.9	1	5	2		2	4
33%	1	.8		1				
35%	7	5.5	1	3	1			2
40%	9	7.0		4	2	1	2	
50%	16	12.5	1	4	6	1	2	2
60%	1	.8	1					
75%	1	.8	1					
100%	4	3.1		2				2
WONT LEAVE FOR MONEY	1	.8		1				
AGE 50 & OVER	98	100.0	10	35	14	6	12	20
0%	2	2.0		1				1
5%	1	1.0	1					
7%	1	1.0	1					
10%	2	2.0						2
15%	4	4.1	1	1		1		1
20%	20	20.4	4	6	2		1	7
22%	2	2.0		1	1			
25%	16	16.3	1	7	4		2	2
30%	11	11.2	1	2	2	1	2	3
33%	1	1.0				1		
35%	5	5.1	1	2		1	1	
38%	1	1.0	1					
40%	3	3.1		2				1
50%	13	13.3		7	2		1	3
75%	1	1.0		1				
100%	10	10.2		4	1	1	4	
WONT LEAVE FOR MONEY	4	4.1		1	2	1		
DONT KNOW	1	1.0					1	

IF YOU WERE CONSIDERING CHANGING TO ANOTHER COMPANY BUT FINANCIAL GAIN WAS NOT THE MOST IMPORTANT REASON—WHAT WOULD BE OF PRIME INTEREST TO YOU?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	97	100.0	14	34	9	3	14	23
INTERESTING WORK	35	36.1	6	12	2	2	6	7
WORKING CONDITIONS	6	6.2	1	4				1
ADVANCE OPPORTUNITIES	23	23.7	2	11		1	3	6
SECURITY	1	1.0					1	
GEOGRAPHIC LOCATION	9	9.3	1	1	1		2	4
COMPANYS GROWTH	1	1.0			1			
COMPANYS SIZE								
COMPANYS MANAGEMENT	4	4.1		1	1		2	
JOB SATISFACTION	10	10.3	3	5	1			1
ADMIN POSITION	3	3.1	1	1				1
PERSONAL FREEDOM	5	5.2	1	1			2	1
JOB KNOWLEDGE	4	4.1	1		3			
DESIGN & DEVELOP	2	2.1	1	1				
FRINGE BENEFITS	6	6.2		3		1		2
COMPANYS REPUTATION	1	1.0	1					
RESPONSIBILITY	15	15.5	1	8	1		2	3
PROD OF SOCIAL UTILIT								
THEORITICAL WORK	3	3.1		1			1	1
RELOCATION EXPENSES								
COMPANY PERSONNEL	1	1.0		1				
PROFIT SHARING								
USE EXP EFFECTIVELY	2	2.1		1			1	
WORK NEW PRODUCTS								
HAVE ALL CURRENTLY	2	2.1					1	1
NONE OTHER THAN FINAN								
OTHER	5	5.2		1	2			2
DONT KNOW								
AGE 25 - 29	430	100.0	39	125	45	31	67	123
INTERESTING WORK	162	37.7	22	51	9	15	25	40
WORKING CONDITIONS	19	4.4	1	8		2	1	7
ADVANCE OPPORTUNITIES	96	22.3	7	33	13	6	11	26
SECURITY	12	2.8		4	3		3	2
GEOGRAPHIC LOCATION	70	16.3	6	25	9	6	4	20
COMPANYS GROWTH	12	2.8		3	3	1	1	4
COMPANYS SIZE	3	.7			1		2	
COMPANYS MANAGEMENT	18	4.2	2	7	1	1	3	4
JOB SATISFACTION	35	8.1	1	5	5	1	6	17
ADMIN POSITION	17	4.0	3	6	2	1	1	4
PERSONAL FREEDOM	22	5.1		2	2	1	2	15
JOB KNOWLEDGE	37	8.6		8	3	1	7	18
DESIGN & DEVELOP	8	1.9			1	2	4	1
FRINGE BENEFITS	7	1.6		3	1		2	1
COMPANYS REPUTATION	3	.7	1				1	1
RESPONSIBILITY	47	10.9	5	15	11	2	7	7
PROD OF SOCIAL UTILIT	2	.5	1				1	
THEORITICAL WORK	6	1.4		2		1	1	2
RELOCATION EXPENSES								
COMPANY PERSONNEL	9	2.1	1	5				3
PROFIT SHARING	2	.5					1	1
USE EXP EFFECTIVELY	4	.9	2	1			1	
WORK NEW PRODUCTS	2	.5	1				1	
HAVE ALL CURRENTLY	1	.2					1	
NONE OTHER THAN FINAN	2	.5	1				1	
OTHER	10	2.3	2	3			3	2
DONT KNOW								

IF YOU WERE CONSIDERING CHANGING TO ANOTHER COMPANY BUT FINANCIAL GAIN WAS NOT THE MOST IMPORTANT REASON—WHAT WOULD BE OF PRIME INTEREST TO YOU?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 30 - 34	572	100.0	48	159	68	33	90	174
INTERESTING WORK	174	30.4	12	55	20	12	23	52
WORKING CONDITIONS	42	7.3	1	14	3	2	7	15
ADVANCE OPPORTUNITIES	132	23.1	12	36	18	12	17	37
SECURITY	15	2.6	3	4	5			3
GEOGRAPHIC LOCATION	118	20.6	9	32	15	4	27	31
COMPANYS GROWTH	20	3.5		7	5		2	6
COMPANYS SIZE	5	.9	1				1	3
COMPANYS MANAGEMENT	36	6.3	5	14	7	2	3	5
JOB SATISFACTION	51	8.9	3	13	4	2	10	19
ADMIN POSITION	21	3.7	2	7	2		2	8
PERSONAL FREEDOM	26	4.5	5	7	3	1	4	6
JOB KNOWLEDGE	30	5.2	2	5	4	1	8	10
DESIGN & DEVELOP	3	.5						3
FRINGE BENEFITS	19	3.3	2	5		2	4	6
COMPANYS REPUTATION	8	1.4	1	2		1		4
RESPONSIBILITY	44	7.7	3	9	5	2	7	18
PROD OF SOCIAL UTILIT	7	1.2	2	1	1	1		2
THEORITICAL WORK	6	1.0			1	1	1	3
RELOCATION EXPENSES								
COMPANY PERSONNEL	23	4.0	2	10			6	5
PROFIT SHARING	2	.3						2
USE EXP EFFECTIVELY	6	1.0	1			1	1	3
WORK NEW PRODUCTS	3	.5		1	1			1
HAVE ALL CURRENTLY	4	.7		2			1	1
NONE OTHER THAN FINAN	2	.3			1		1	
OTHER	12	2.1	2	2	1	1	1	5
DONT KNOW								
AGE 35 - 39	442	100.0	50	142	56	16	59	119
INTERESTING WORK	112	25.3	16	33	15	1	15	32
WORKING CONDITIONS	29	6.6	3	9	6	1	4	6
ADVANCE OPPORTUNITIES	103	23.3	12	40	16	4	9	22
SECURITY	14	3.2	1	4	4		2	3
GEOGRAPHIC LOCATION	70	15.8	5	24	10	4	8	19
COMPANYS GROWTH	26	5.9	4	8	5	1	4	4
COMPANYS SIZE	3	.7		1				2
COMPANYS MANAGEMENT	31	7.0	2	9	3		6	11
JOB SATISFACTION	49	11.1	5	18	4	1	5	16
ADMIN POSITION	19	4.3	3	6	1		4	5
PERSONAL FREEDOM	25	5.7	3	9	2	2	2	7
JOB KNOWLEDGE	31	7.0	3	5	3	1	6	13
DESIGN & DEVELOP	6	1.4	1	1		1		3
FRINGE BENEFITS	11	2.5		5	1		1	4
COMPANYS REPUTATION	9	2.0		1	3		3	2
RESPONSIBILITY	31	7.0	6	9	2	1	8	5
PROD OF SOCIAL UTILIT	4	.9		2		1		1
THEORITICAL WORK	3	.7		2			1	
RELOCATION EXPENSES	1	.2		1				
COMPANY PERSONNEL	24	5.4	4	4	3		4	9
PROFIT SHARING	4	.9		2		1	1	
USE EXP EFFECTIVELY	5	1.1		3	1			1
WORK NEW PRODUCTS								
HAVE ALL CURRENTLY	1	.2				1		
NONE OTHER THAN FINAN	2	.3		1				1
OTHER	8	1.8	1		3			4
DONT KNOW	1	.2					1	
AGE 40 - 44	247	100.0	13	83	31	13	31	76
INTERESTING WORK	49	19.8	4	19	6	2	7	11
WORKING CONDITIONS	6	2.4		1			1	4
ADVANCE OPPORTUNITIES	67	27.1	4	21	11	3	7	21
SECURITY	7	2.8		3	2		2	
GEOGRAPHIC LOCATION	50	20.2	3	19	5	4	5	14
COMPANYS GROWTH	12	4.9	1	3	1		3	4
COMPANYS SIZE								
COMPANYS MANAGEMENT	21	8.5		7	6		2	6
JOB SATISFACTION	17	6.9	1	6	2		3	5
ADMIN POSITION	11	4.5	1	2	1	2	1	4
PERSONAL FREEDOM	18	7.3		5	6	1		6
JOB KNOWLEDGE	11	4.5		3		2	3	3
DESIGN & DEVELOP	4	1.6		3				1
FRINGE BENEFITS	9	3.6	1		2	3	1	2
COMPANYS REPUTATION	2	.8						2
RESPONSIBILITY	30	12.1	2	12	2	2	4	8
PROD OF SOCIAL UTILIT	4	1.6		1	1			2
THEORITICAL WORK	3	1.2		1			1	1
RELOCATION EXPENSES								
COMPANY PERSONNEL	10	4.0		5				5
PROFIT SHARING	4	1.6	1	1				2
USE EXP EFFECTIVELY	3	1.2		2				1
WORK NEW PRODUCTS	2	.8		2				
HAVE ALL CURRENTLY	1	.4						1
NONE OTHER THAN FINAN	4	1.6		1				3
OTHER	4	1.6	1	1			1	1
DONT KNOW								
AGE 45 - 49	125	100.0	9	43	14	6	18	35
INTERESTING WORK	25	20.0	1	9	2	2	2	9
WORKING CONDITIONS	7	5.6		3	2			2
ADVANCE OPPORTUNITIES	17	13.6	3	5	2		3	4
SECURITY	8	6.4		1	2	2	3	
GEOGRAPHIC LOCATION	20	16.0	2	8	1	1	5	3
COMPANYS GROWTH	3	2.4		1				2
COMPANYS SIZE	1	.8						1
COMPANYS MANAGEMENT	10	8.0		2		1	1	6
JOB SATISFACTION	12	9.6		4	3		2	3
ADMIN POSITION	5	4.0	1	2			1	1
PERSONAL FREEDOM	15	12.0	1	7	4		1	2
JOB KNOWLEDGE	7	5.6		2	1	1		3
DESIGN & DEVELOP	1	.8	1					
FRINGE BENEFITS	6	4.8	1	2			1	2
COMPANYS REPUTATION								
RESPONSIBILITY	12	9.6	1	5	1		1	4
PROD OF SOCIAL UTILIT	1	.8			1			
THEORITICAL WORK	2	1.6						2
RELOCATION EXPENSES								
COMPANY PERSONNEL	7	5.6		1		1		5
PROFIT SHARING	1	.8						1
USE EXP EFFECTIVELY	1	.8					1	
WORK NEW PRODUCTS	1	.8	1					
HAVE ALL CURRENTLY								
NONE OTHER THAN FINAN	2	1.6	1	1				
OTHER	5	4.0		3			1	1
DONT KNOW								
AGE 50 & OVER	95	100.0	9	36	14	5	9	22
INTERESTING WORK	19	20.0	4	7		1	1	6
WORKING CONDITIONS	5	5.3		1	1			3
ADVANCE OPPORTUNITIES	5	5.3	1		2		1	1
SECURITY	8	8.4	1	3	2	1		1
GEOGRAPHIC LOCATION	18	18.9	1	8	3	1	2	3
COMPANYS GROWTH	2	2.1						2
COMPANYS SIZE	2	2.1			1			1
COMPANYS MANAGEMENT	9	9.5	1	6				2
JOB SATISFACTION	6	6.3	1	2	1		2	
ADMIN POSITION								
PERSONAL FREEDOM	14	14.7	1	5	3	1	1	3
JOB KNOWLEDGE	4	4.2		2	1			1
DESIGN & DEVELOP	1	1.0				1		
FRINGE BENEFITS	2	2.1		1	1			
COMPANYS REPUTATION								
RESPONSIBILITY	7	7.4	1	2			1	3
PROD OF SOCIAL UTILIT	2	2.1	2					
THEORITICAL WORK	3	3.2					1	2
RELOCATION EXPENSES								
COMPANY PERSONNEL	4	4.2		1	1			2
PROFIT SHARING								
USE EXP EFFECTIVELY	3	3.2		3				
WORK NEW PRODUCTS								
HAVE ALL CURRENTLY	3	3.2	1	1	1			
NONE OTHER THAN FINAN								
OTHER	6	6.3		1	1	1		3
DONT KNOW								

WHAT IS THE PRESENT APPROXIMATE VALUE OF YOUR LIQUID ASSETS?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	102	100.0	14	37	9	4	14	24
UNDER $500	17	16.7	4	3	1	1	3	5
$500 - $1,999	41	40.2	3	16	6	3	4	9
$2,000 - $3,999	24	23.5	4	10	1		3	6
$4,000 - $5,999	10	9.8	1	4	1		2	2
$6,000 - $8,999	4	3.9		2			1	1
$9,000 - $12,999	4	3.9	1	2				1
$13,000 - $17,999	1	1.0					1	
$18,000 - $23,999								
$24,000 - $39,999	1	1.0	1					
$40,000 AND OVER								
AGE 25 - 29	450	100.0	42	132	47	31	69	129
UNDER $500	74	16.4	7	14	12	4	18	19
$500 - $1,999	169	37.6	16	41	20	12	24	56
$2,000 - $3,999	76	16.9	4	25	6	6	12	23
$4,000 - $5,999	58	12.9	5	23	4	2	9	15
$6,000 - $8,999	28	6.2	2	17	1	1	1	6
$9,000 - $12,999	18	4.0	2	4	3	1	3	5
$13,000 - $17,999	9	2.0	3	2		3		1
$18,000 - $23,999	3	.7		2		1		
$24,000 - $39,999	5	1.1	1	1		1		2
$40,000 AND OVER	10	2.2	2	3	1		2	2
AGE 30 - 34	592	100.0	51	166	68	32	91	184
UNDER $500	54	9.1	9	12	11	3	7	12
$500 - $1,999	152	25.6	19	26	20	9	26	52
$2,000 - $3,999	143	24.1	7	44	11	7	31	43
$4,000 - $5,999	88	14.9	7	28	10	4	10	29
$6,000 - $8,999	48	8.1	5	16	8	4	5	10
$9,000 - $12,999	45	7.6	2	19	3	3	9	9
$13,000 - $17,999	24	4.1		8	1	1	3	11
$18,000 - $23,999	11	1.9		4		1		6
$24,000 - $39,999	17	2.9	1	7	3			6
$40,000 AND OVER	10	1.7	1	2	1			6
AGE 35 - 39	457	100.0	47	150	55	19	62	124
UNDER $500	23	5.0	2	9	2	1	4	5
$500 - $1,999	95	20.8	11	17	17	3	12	35
$2,000 - $3,999	85	18.6	8	26	9	3	16	23
$4,000 - $5,999	77	16.8	5	30	8	4	6	24
$6,000 - $8,999	51	11.2	6	19	8	1	5	12
$9,000 - $12,999	54	11.8	5	23	7	4	8	7
$13,000 - $17,999	21	4.6	3	7			4	7
$18,000 - $23,999	12	2.5	2	3	1		2	4
$24,000 - $39,999	13	2.7	2	6		2	2	1
$40,000 AND OVER	26	5.7	3	10	3	1	3	6
AGE 40 - 44	256	100.0	13	87	34	13	31	78
UNDER $500	10	3.9	2	4			2	2
$500 - $1,999	40	15.6		12	7	4	8	9
$2,000 - $3,999	35	13.7	2	13	3	2	2	13
$4,000 - $5,999	40	15.6	2	11	8	1	6	12
$6,000 - $8,999	30	11.7	3	12	4	1	3	7
$9,000 - $12,999	28	10.9	2	12	3		2	9
$13,000 - $17,999	14	5.5		5		1	2	6
$18,000 - $23,999	14	5.5		3	3	2		6
$24,000 - $39,999	22	8.6	1	8	4	1	4	4
$40,000 AND OVER	23	9.0	1	7	2	1	2	10

WHAT IS THE PRESENT APPROXIMATE VALUE OF YOUR LIQUID ASSETS?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 45 - 49	140	100.0	11	45	20	6	20	38
UNDER $500	3	2.1	1				1	1
$500 - $1,999	11	7.9		4	2	1	1	3
$2,000 - $3,999	15	10.7		6	2	3	1	3
$4,000 - $5,999	21	15.0		4	5	1	4	7
$6,000 - $8,999	17	12.1	1	6	3		1	6
$9,000 - $12,999	21	15.0	4	8			1	8
$13,000 - $17,999	10	7.1	2	3			3	2
$18,000 - $23,999	8	5.7		3	3			2
$24,000 - $39,999	14	10.0	1	3	1		6	3
$40,000 AND OVER	19	13.6	2	7	4	1	2	3
DONT KNOW	1	.7		1				
AGE 50 & OVER	123		14	46	17	6	14	26
UNDER $500	1	.8						1
$500 - $1,999	12	9.8	1	6	1		1	3
$2,000 - $3,999	14	11.4	4	2	2		2	4
$4,000 - $5,999	11	8.9	1	4	3	2		1
$6,000 - $8,999	5	4.1	1	1	1	1		1
$9,000 - $12,999	11	8.9	1	6	1	1		2
$13,000 - $17,999	10	8.1		4	2	1	1	2
$18,000 - $23,999	5	4.1		4			1	
$24,000 - $39,999	12	9.8	1	2	1		5	3
$40,000 AND OVER	42	34.1	5	17	6	1	4	9

PLEASE CHECK ANY OF THE FOLLOWING ACTIVITIES IN WHICH YOU PARTICIPATE

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	74	100.0	7	27	8	3	12	17
CIVIC ORGANIZATIONS	4	5.4		3				1
SOCIAL WELFARE	1	1.4	1					
VETERANS ORGANIZATION	1	1.4	1					
CHURCH GROUPS	35	47.3	1	15	3	2	6	8
FRATERNAL & SERV ORGA	21	28.4	2	8		2	4	5
COUNTRY CLUBS	6	8.1	1	3			1	1
PROFESSIONAL BUS ASSO	36	48.6	3	13	5		6	9
OTHER SPORT CLUBS	25	33.8	2	11	4	1	2	5
OTHER ORGANIZATION	10	13.5	1	2	1		4	2
AGE 25 - 29	347	100.0	29	104	33	26	58	97
CIVIC ORGANIZATIONS	57	16.4	6	17	5	6	12	11
SOCIAL WELFARE	36	10.4	2	11	4	4	7	8
VETERANS ORGANIZATION	22	6.3	2	3	3	4	5	5
CHURCH GROUPS	151	43.5	10	32	15	17	41	36
FRATERNAL & SERV ORGA	80	23.1	8	34	11	2	9	16
COUNTRY CLUBS	25	7.2	2	10		2	3	8
PROFESSIONAL BUS ASSO	147	42.4	6	53	15	8	23	42
OTHER SPORT CLUBS	66	19.0	6	20	4	5	13	18
OTHER ORGANIZATION	36	10.4	5	12	5		8	6
AGE 30 - 34	482	100.0	42	130	58	25	78	149
CIVIC ORGANIZATIONS	96	19.9	14	20	14	4	19	25
SOCIAL WELFARE	58	12.0	12	24	4	4	7	7
VETERANS ORGANIZATION	38	7.9	3	10	7	1	9	8
CHURCH GROUPS	231	47.9	18	49	40	17	38	69
FRATERNAL & SERV ORGA	94	19.5	6	31	12	4	17	24
COUNTRY CLUBS	27	5.6	1	10	3	1	2	10
PROFESSIONAL BUS ASSO	221	45.8	16	70	26	7	37	65
OTHER SPORT CLUBS	96	19.9	9	26	12	3	14	32
OTHER ORGANIZATION	49	10.2	3	14	6	5	6	15
AGE 35 - 39	401	100.0	44	126	52	16	60	103
CIVIC ORGANIZATIONS	68	17.0	7	25	9	2	9	16
SOCIAL WELFARE	92	22.9	9	29	17	4	17	16
VETERANS ORGANIZATION	29	7.2	2	11	4	3	3	6
CHURCH GROUPS	201	50.1	27	57	31	8	37	41
FRATERNAL & SERV ORGA	89	22.2	8	37	12	4	12	16
COUNTRY CLUBS	33	8.2	3	14	2	1	8	5
PROFESSIONAL BUS ASSO	204	50.9	19	58	26	12	30	59
OTHER SPORT CLUBS	74	18.5	8	23	8		13	22
OTHER ORGANIZATION	50	12.5	5	11	5	2	10	17
AGE 40 - 44	230	100.0	11	77	28	12	30	72
CIVIC ORGANIZATIONS	60	26.1	3	21	8	6	12	10
SOCIAL WELFARE	55	23.9	1	26	10	1	4	13
VETERANS ORGANIZATION	16	7.0	1	3		4	4	4
CHURCH GROUPS	128	55.7	4	46	18	8	19	33
FRATERNAL & SERV ORGA	55	23.9	4	23	4	2	4	18
COUNTRY CLUBS	16	7.0		6		1	2	7
PROFESSIONAL BUS ASSO	128	55.7	9	35	11	7	17	49
OTHER SPORT CLUBS	41	17.8	3	13	8	1	5	11
OTHER ORGANIZATION	33	14.3	4	12	2	2	3	10
AGE 45 - 49	134	100.0	11	44	18	6	19	36
CIVIC ORGANIZATIONS	31	23.1	3	12	7	2	2	5
SOCIAL WELFARE	36	26.9	3	11	4	2	5	11
VETERANS ORGANIZATION	6	4.5	1	2		1	2	
CHURCH GROUPS	73	54.5	6	24	12	2	12	17
FRATERNAL & SERV ORGA	38	28.4	2	17	6	1	4	8
COUNTRY CLUBS	13	9.7	1	5	2	1	2	2
PROFESSIONAL BUS ASSO	71	53.0	7	21	11	4	8	20
OTHER SPORT CLUBS	16	11.9		6	3		2	5
OTHER ORGANIZATION	19	14.2	3	5	2		2	7
AGE 50 & OVER	113	100.0	13	45	15	6	13	21
CIVIC ORGANIZATIONS	18	15.9		7	3	2	1	5
SOCIAL WELFARE	31	27.4	2	13	6	1	3	6
VETERANS ORGANIZATION	2	1.8		1				1
CHURCH GROUPS	54	47.8	7	21	10	3	5	8
FRATERNAL & SERV ORGA	30	26.6	9	11	5	1	2	2
COUNTRY CLUBS	15	13.3		5	4		3	3
PROFESSIONAL BUS ASSO	62	54.9	9	22	9	2	7	13
OTHER SPORT CLUBS	11	9.7	3	3		1	2	2
OTHER ORGANIZATION	12	10.6	1	4		1	4	2

DO YOU OWN OR RENT?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	101	100.0	14	36	9	4	14	24
OWN	27	26.7	2	7	3	2	6	7
RENT	74	73.3	12	29	6	2	8	17
AGE 25 - 29	451	100.0	41	133	47	31	70	129
OWN	246	54.5	19	68	23	13	50	73
RENT	205	45.5	22	65	24	18	20	56
AGE 30 - 34	595	100.0	51	166	69	33	91	185
OWN	452	76.0	43	113	52	26	75	143
RENT	143	24.0	8	53	17	7	16	42
AGE 35 - 39	467	100.0	53	149	57	19	62	127
OWN	404	86.5	43	127	46	18	56	114
RENT	63	13.5	10	22	11	1	6	13
AGE 40 - 44	258	100.0	12	87	33	13	33	80
OWN	232	89.9	12	77	30	12	30	71
RENT	26	10.1		10	3	1	3	9
AGE 45 - 49	141	100.0	11	45	20	6	21	38
OWN	129	91.5	10	40	19	5	20	35
RENT	12	8.5	1	5	1	1	1	3
AGE 50 & OVER	123	100.0	14	46	17	6	14	26
OWN	111	91.2	13	41	16	6	13	22
RENT	12	9.8	1	5	1		1	4

IF YOU OWN YOUR HOME, WHAT IS ITS APPROXIMATE VALUE?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE - UNDER 25	27	100.0	2	7	3	2	6	7
LESS THAN $10,000	2	7.4		1		1		
$10,000 - $14,999	4	14.8			1		3	
$15,000 - $19,999	15	55.6	2	4	2	1	2	4
$20,000 - $24,999	3	11.1		1				2
$25,000 - $29,999	2	7.4					1	1
$30,000 - $39,999								
$40,000 - $49,999								
$50,000 AND OVER	1	3.7		1				
AGE 25 - 29	246	100.0	19	68	23	13	50	73
LESS THAN $10,000	11	4.5	2	4	1		3	1
$10,000 - $14,999	44	17.9	2	9	6	3	14	10
$15,000 - $19,999	117	47.6	12	36	11	8	21	29
$20,000 - $24,999	55	22.3	3	13	1	2	10	26
$25,000 - $29,999	12	4.9		3	4		2	3
$30,000 - $39,999	6	2.4		2				4
$40,000 - $49,999	1	.4		1				
$50,000 AND OVER								
AGE 30 - 34	452	100.0	43	113	52	26	75	149
LESS THAN $10,000	5	1.1		1	2		1	1
$10,000 - $14,999	58	12.8	2	12	5	5	19	15
$15,000 - $19,999	171	37.8	23	39	20	10	36	43
$20,000 - $24,999	132	29.3	12	38	15	5	14	48
$25,000 - $29,999	53	11.7	4	17	8	3	1	20
$30,000 - $39,999	27	6.0	2	6	2	3	2	12
$40,000 - $49,999	5	1.1					1	4
$50,000 AND OVER	1	.2					1	
AGE 35 - 39	400	100.0	42	126	46	18	56	112
LESS THAN $10,000	12	3.0		8		1	1	2
$10,000 - $14,999	48	12.0	3	12	8	3	13	9
$15,000 - $19,999	110	27.5	12	39	12	6	15	26
$20,000 - $24,999	107	26.8	13	38	13	3	9	31
$25,000 - $29,999	67	16.8	5	17	9	3	12	21
$30,000 - $39,999	42	10.5	8	8	2	1	6	17
$40,000 - $49,999	11	2.7	1	2	2	1		5
$50,000 AND OVER	3	.7		2				1
AGE 40 - 44	232	100.0	12	77	30	12	30	71
LESS THAN $10,000	2	.9			1		1	
$10,000 - $14,999	23	9.9	1	13	1		4	4
$15,000 - $19,999	59	25.4		20	7	6	10	16
$20,000 - $24,999	55	23.8	3	17	14	2	6	13
$25,000 - $29,999	29	12.5	4	9		3	4	9
$30,000 - $39,999	45	19.4	3	15	5	1	3	18
$40,000 - $49,999	11	4.7		3			1	7
$50,000 AND OVER	8	3.4	1		2		1	4

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IF YOU OWN YOUR HOME, WHAT IS ITS APPROXIMATE VALUE?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE 45 – 49	129	100.0	10	40	19	5	20	35
LESS THAN $10,000	1	.8						1
$10,000 – $14,999	7	5.4	2	2	1		1	1
$15,000 – $19,999	24	18.6		10	2	2	6	4
$20,000 – $24,999	31	24.0		10	5	1	5	10
$25,000 – $29,999	26	20.2	4	9	3	1	3	6
$30,000 – $39,999	28	21.7	3	7	7		3	8
$40,000 – $49,999	9	7.0	1	1	1	1		5
$50,000 AND OVER	3	2.3		1			2	
AGE 50 & OVER	111	100.0	13	41	16	6	13	22
LESS THAN $10,000								
$10,000 – $14,999	12	10.8	2	4	1		2	3
$15,000 – $19,999	21	18.9	3	8	3		3	4
$20,000 – $24,999	20	18.0	2	9	2	3	1	3
$25,000 – $29,999	19	17.1	3	9			2	5
$30,000 – $39,999	25	22.6	3	8	6	1	4	3
$40,000 – $49,999	8	7.2		2	3	2	1	
$50,000 AND OVER	6	5.4		1	1			4

HOW MANY AUTOMOBILES DO YOU OWN?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	99	100.0	14	34	9	4	14	24
1	88	88.9	13	31	8	4	13	19
2	9	9.1	1	2	1		1	4
3	2	2.1		1				1
4 AND OVER								
AGE 25 – 29	451	100.0	41	133	46	32	70	129
1	336	74.5	32	108	34	24	50	88
2	110	24.4	8	24	11	8	19	40
3	4	.9	1	1	1		1	
4 AND OVER	1	.2						1
AGE 30 – 34	592	100.0	51	165	69	32	91	184
1	372	72.9	29	129	49	23	54	88
2	216	36.5	22	35	20	8	37	94
3	3	.5		1				2
4 AND OVER	1	.1				1		
AGE 35 – 39	462	100.0	53	150	54	17	62	126
1	246	53.3	26	91	36	10	31	52
2	210	45.5	27	57	18	6	31	71
3	3	.6		1				2
4 AND OVER	3	.6		1		1		1
AGE 40 – 44	260	100.0	13	88	34	13	32	80
1	100	38.5	4	35	14	3	17	27
2	156	60.0	9	51	20	10	14	52
3	4	1.5		2			1	1
4 AND OVER								
AGE 45 – 49	141	100.0	11	45	20	6	21	38
1	51	36.2	3	18	5	4	6	15
2	78	55.3	6	25	13	1	13	20
3	12	8.5	2	2	2	1	2	3
4 AND OVER								
AGE 50 & OVER	120	100.0	13	45	17	6	14	25
1	55	45.8	8	24	5	3	5	10
2	60	50.0	5	19	10	2	9	15
3	5	4.2		2	2	1		
4 AND OVER								

WHICH TYPE OF MUSIC DO YOU PREFER?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	101	100.0	14	36	9	4	14	24
OPERA	5	4.9		3			2	
CLASSICAL	70	69.3	9	27	5	3	10	16
POPULAR	44	43.6	6	15	5	2	7	9
JAZZ	25	24.8	3	12	1	1	4	4
NONE								
AGE 25 – 29	452	100.0	42	134	46	31	70	129
OPERA	33	7.3	4	9	2	3	4	11
CLASSICAL	315	69.7	29	90	37	19	49	91
POPULAR	168	37.2	15	51	18	11	29	44
JAZZ	126	27.9	11	38	19	7	22	29
NONE								
AGE 30 – 34	592	100.0	51	165	69	33	92	182
OPERA	50	8.4	5	18	6	1	5	15
CLASSICAL	409	69.1	34	108	48	22	61	136
POPULAR	244	41.2	18	65	29	11	52	79
JAZZ	116	19.6	10	33	12	6	15	40
NONE								
AGE 35 – 39	464	100.0	53	148	57	19	61	126
OPERA	56	12.1	3	18	11	2	7	15
CLASSICAL	318	68.5	41	101	42	13	42	79
POPULAR	191	41.2	21	53	19	11	28	59
JAZZ	73	15.7	5	28	5	2	10	23
NONE								
AGE 40 – 44	257	100.0	13	86	34	13	31	80
OPERA	25	9.7		9	4	1	3	8
CLASSICAL	181	70.4	12	61	26	9	20	53
POPULAR	107	41.6	3	30	10	7	14	43
JAZZ	39	15.2	3	12	6		5	13
NONE								
AGE 45 – 49	140	100.0	11	45	20	6	20	38
OPERA	18	12.9	2	3	2		2	9
CLASSICAL	108	77.1	10	33	19	3	14	29
POPULAR	60	42.9	2	20	6	3	11	18
JAZZ	14	10.0	2	1	4	1	1	5
NONE	1	.7						1
AGE 50 & OVER	120	100.0	14	44	17	5	14	26
OPERA	15	12.5	1	3	4		3	4
CLASSICAL	83	69.2	9	34	12	3	7	18
POPULAR	54	45.0	6	18	6	4	9	11
JAZZ	13	10.8	2	2	4		3	2
NONE								

DO YOU ATTEND CHURCH AS OFTEN AS ONCE A MONTH?

	TOTAL NO.	%	NEW ENGL.	MIDDLE ATL.	E.N. CENT.	W.N. CENT.	SOUTH	WEST
AGE – UNDER 25	101	100.0	14	36	9	4	14	24
YES	66	65.3	13	22	7	3	9	12
NO	35	34.7	1	14	2	1	5	12
AGE 25 – 29	453	100.0	42	133	47	32	70	129
YES	287	63.4	25	75	34	27	53	73
NO	166	36.6	17	58	13	5	17	56
AGE 30 – 34	594	100.0	50	167	69	33	92	183
YES	368	62.0	34	94	54	22	61	103
NO	226	38.0	16	73	15	11	31	80
AGE 35 – 39	465	100.0	52	150	57	19	61	126
YES	289	62.1	38	83	47	12	42	67
NO	176	37.9	14	67	10	7	19	59
AGE 40 – 44	259	100.0	13	88	34	12	32	80
YES	159	61.4	8	54	24	9	22	42
NO	100	38.6	5	34	10	3	10	38
AGE 45 – 49	138	100.0	11	44	20	6	19	38
YES	96	69.6	6	33	14	3	15	25
NO	42	30.4	5	11	6	3	4	13
AGE 50 & OVER	123	100.0	14	46	17	6	14	26
YES	70	56.9	7	29	10	3	9	12
NO	53	43.1	7	17	7	3	5	14

The states included in the various territorial breakdowns are as follows: NEW ENGLAND—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut. MIDDLE ATLANTIC—New York, New Jersey, Pennsylvania. EAST NORTH CENTRAL—Ohio, Indiana, Illinois, Michigan, Wisconsin. WEST NORTH CENTRAL—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. SOUTH—Delaware, Maryland, Dist. of Col., Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas. WEST—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii.

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Company	Div. or Dept.	Title	Dates

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State any facts about yourself that will help a prospective employer evaluate your experience and job interests. Include significant achievements, published papers, and career goals.

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800 801 802 803 804 805 806 807 808 809 810

Systems and Circuits

ELECTRONIC IGNITION SYSTEM developed by Motorola uses a small magnetic pick-up system instead of the conventional method. The system has a magnetic pulse generator, a transistorized amplifier and an ignition coil. The pulse generator is a small toothed wheel which rotates past a tiny magnet without touching. Without contact there is no wear, hence no need for adjustments.

FAA BUDGET request for equipment and facilities for fiscal year 1963 was $145 million. Most of this will be spent on electronic equipment. This represents an increase of $20 million over last year.

ARTIFICIAL RUBY MASERS are expected to revolutionize communications, speed up industrial processes and serve as a powerful new medical tool. Bernard Raboy of the Orlando Aerospace division of Martin Marietta Corp. says it will be years before the maser's potential is reached. The maser could be used to communicate with the moon on less than 1 watt of power. In an experiment, a hole was burned through a razor blade with a very short pulse from a medium powered maser.

THE RELIABILITY of electronic firms as well as components and systems was questioned at the Eighth National Symposium on Reliability and Quality Control. The Army's Assistant Secretary for Research and Development, Finn J. Larsen, queried the competence of the 4,000 small electronics firms which have been started in the last five years. He pointed out that almost none of these firms has failed, whereas nearly one-third of all other new businesses had done so. Mr. Larsen's reasoning went like this: A few good engineers form a company and land a contract, but then they become engrossed in the administration of the company, and let other engineers handle the project. Often, these other engineers are not as competent as the company founders.

(*Continued on page* 234)

Alloys Improve Frequency Stability

THE problem of maintaining frequency stability in aircraft, space vehicles, outdoor radar, and other installations where extreme temperature variations are encountered is important.

The heart of the problem centers on the selection of the right materials for construction of signal producing microwave cavities and signal receiving preselectors.

Because of their wide use, this type of equipment must be able to function accurately in temperatures varying between —67°C and 180°C. Any expansion or contraction of the cavity and preselector dimensions, due to temperature, decreases power output and changes the operating frequency. This results in malfunction of the entire system. Therefore, an extremely stable material is required for the anode shell of the microwave cavities and for their plungers and inner conductor assemblies.

Brass or steel cavities are suitable for bench use where temperature variations aren't a problem. But in missile and airborne radar equipment, this isn't the case.

As a solution, JVM Microwave Co., Brookfield, Ill., uses an unusual combination of metals in the construction of cavities. Copper, silver, and gold plating are applied over Invar alloy tubing to obtain maximum frequency stability and other necessary qualities.

The copper coating, which is applied first, improves adhesion of the silver plate which follows. The silver provides better electrical efficiency to the cavity. Then gold plating is applied to protect the silver from tarnishing.

The choice of metals available for this application was limited. In the final design stages, JVM considered two possibilities for the cavity anode shell: a single length of Invar tubing or a bimetallic tube consisting of short sections of copper and steel tubing brazed together to form a single tube. The bimetallic design was rejected because fabrication was complicated and the cavities were too difficult to compensate finely.

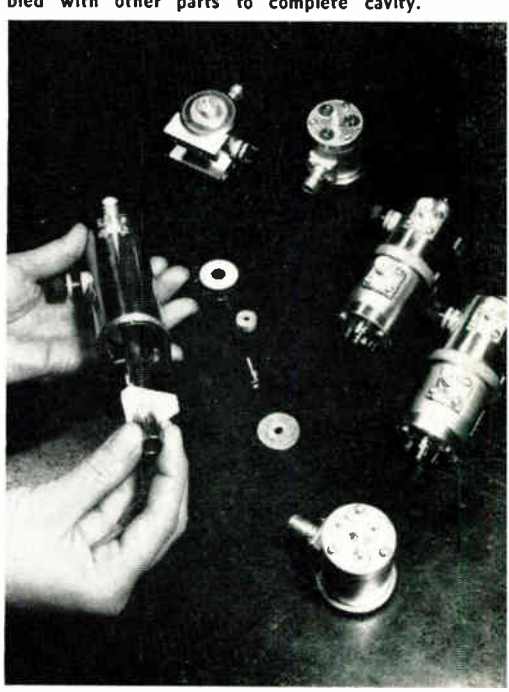
The Invar tubing and parts now used for these critical electronic components are supplied by Alloy Tube Div., The Carpenter Steel Co., Union, N. J.

Carpenter Invar is a 36% nickel-iron alloy which has a rate of thermal expansion approximately one-tenth that of carbon steel at temperatures up to 400°F. Its analysis consists of carbon, 0.12% max.; manganese, 1.00% max.; silicon, 0.35% max., and nickel, 36% max.

At JVM, the Invar anode shells are ground, milled, drilled and honed at considerably less cost than would be required to fabricate bimetallic units. The shell is honed or burnished to a 4-8 microinch finish, depending on the frequency at which the final assembly is designed to operate. After machining, the tubing is heat treated to stress relieve the metal to obtain maximum temperature stability.

Each cavity is designed to tune to ±5% around its designed center frequency. Because of the low expansion characteristics of Invar alloy components, frequency stability, linearity and resetability are held to within 0.1%.

After the Invar has been plated with copper, silver, and gold, the tubing is assembled with other parts to complete cavity.



Systems and Circuits

(*Continued from Page* 233)

R&D ON OPTICAL MASERS will get increased support this year from the Department of Defense and the armed services. This reflects mounting military interest in the potential of these devices for aerospace use. Upcoming service-supported programs will probably double the estimated $5 million already spent by military agencies on optical maser R&D.

MECHANICAL AND ELECTRICAL phases of commercial and public building operation will be completely automated within two years, predicts J. E. Haines, vice-president of Minneapolis-Honeywell Regulator Co. New impetus will come from computer-directed control systems which are just now making their first appearance in this field.

GROSS INCOME from RCA's data processing activities is expected to be in excess of $200 million in 1962, according to David Sarnoff, Chairman of The Board, RCA. Both commercial and military activities are included in this figure.

Gen. Sarnoff said that RCA's commercial data processing sales and rental income alone should increase 2½ times in 1962. Through this increase, and improved operating procedures, the company anticipates a reduction of approximately 50% in their 1962 data processing costs.

BACKWARD WAVE OSCILLATOR developed by Varian Associates will deliver 1.6 watts of CW power in the 50 to 75 GC band. Further development of techniques should lead to oscillator-amplifiers capable of hundreds of watts.

SCUBA SONAR has been developed to aid frogmen in underwater exploration. The battery-powered units will give divers greater effectiveness in opaque water. The range of about 120 yards will enable them to locate otherwise unseen objects, once the divers have been trained in identifying the returns. It will be sometime before the price is low enough for most scuba buffs.

MICROMODULES will be used in 350 AN/PRC-25 manpack radios being built by RCA under a $9 million contract. This is the first time that the army has specified the modules in tactical equipment.

ELECTRONICALLY CONTROLLED BUS is being tested by the Transit Authority of Chicago. The driverless bus will be run on an unused 1-mile stretch of road. Ten KC signals are sent through a low-voltage cable in the road and the signals are picked-up by sensing units under the bus. Modified Barrett Electronics industrial self-guiding devices control all of the bus's operations and functions.

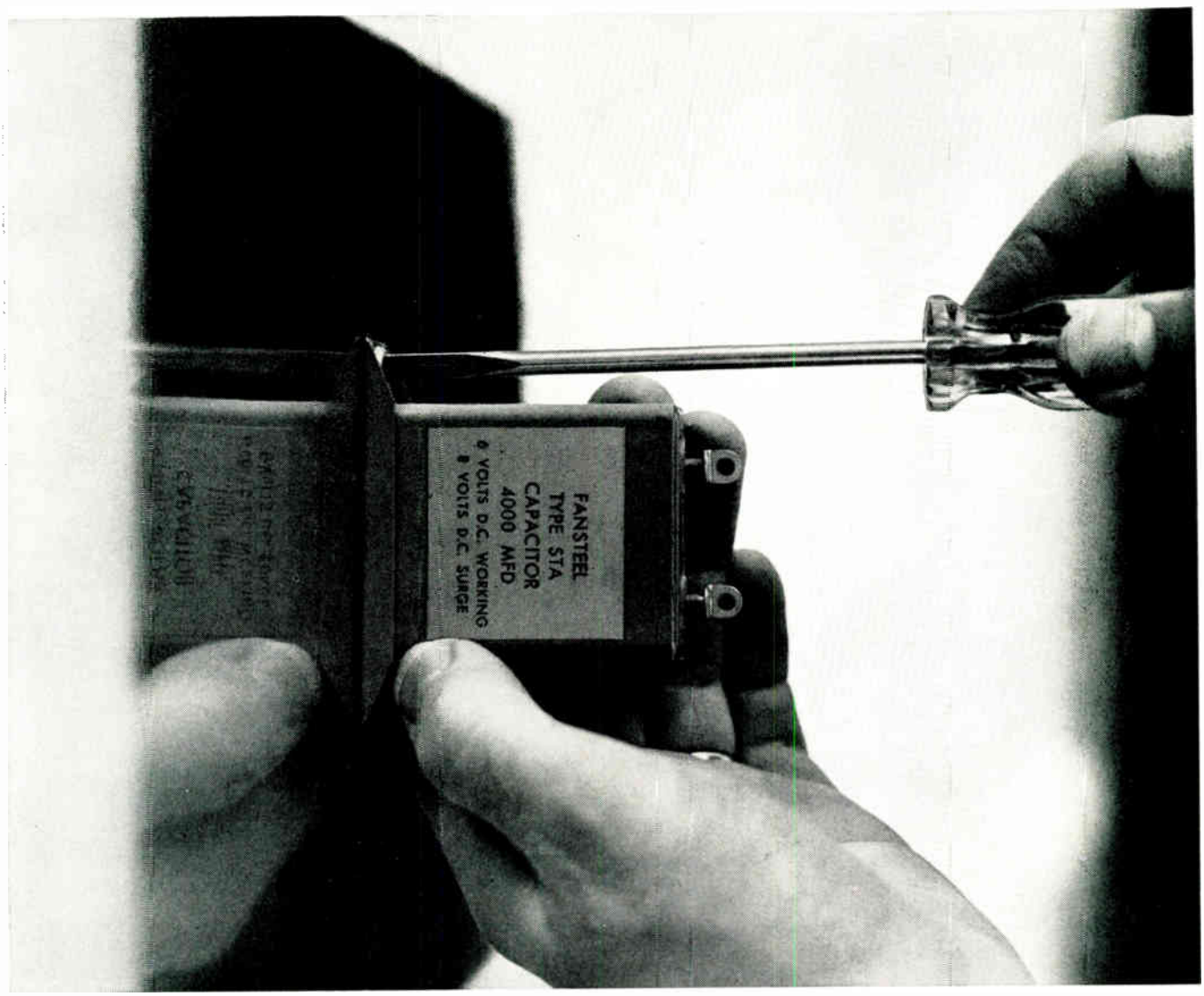
PROJECT ADVENT is moving forward briskly. The second 18,000-lb. antenna dish has been installed at Camp Roberts, Calif. (the first was at Fort Dix, N. J.). The antenna, with 360° rotation in 60 seconds and tracking accuracy to 0.024 degrees, will track the Advent satellite when it is put into a 6,000 mile high orbit later this year by an Atlas-Agena B.

SATELLITE COMMUNICATIONS system ownership plan is now awaiting committee action in Washington. It calls for the sale of 5,000 shares at $100,000 each, to set up a Satellite Communications Corp. The SCC would be owned by both domestic and international companies. NASA would supply the satellites and the FCC would control rates charged for satellite communications.

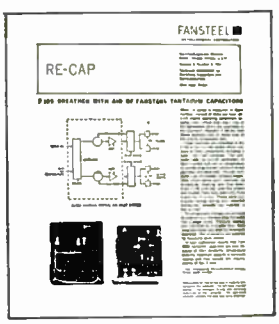
LOCKHEED'S AGENA has been named orbiting test vehicle for the Snapshot program (the testing of systems for auxiliary nuclear power). The test flights are to prove the capabilities of SNAP 2 and SNAP 10A, which differ in power levels and method of converting reactor heat.

FANSTEEL R·C
METALLURGICAL CORPORATION
RECTIFIER-CAPACITOR DIVISION

This one solid tantalum capacitor replaces 12 standards



New high-capacitance STA's, a recent Fansteel Development, deliver up to 4000 μf in a single package. A dozen standard 330 μf solid tantalum capacitors are replaced with one compact 4000 μf unit—and you require only two connections instead of twenty-four! High-capacitance solid tantalum capacitors are supplied in units from 300 to 4000 μf polar, and 150 to 2000 μf non-polar. Solid or wet, general purpose, high capacity, straight sided, polar, non-polar, feed-thru, military—whatever your tantalum capacitor requirements, Fansteel offers a complete range of sizes and types. Reliability ratings start at 0.003% per 1000 hrs. @ 85° rated voltage for standard production tantalum capacitors. For complete specifications, write the Rectifier-Capacitor Division, North Chicago, Illinois.



Latest rectifier and capacitor developments and applications are offered bi-monthly in Fansteel's Re-Cap. To receive, write Publications Department, Fansteel Metallurgical Corporation, North Chicago, Illinois.

Circle 163 on Inquiry Card

Industry News

Thomas L. Phillips—promoted to Executive Vice President, Raytheon Co., Lexington, Mass.

Neil E. Firestone — elected Vice President, Manufacturing, International Telephone and Telegraph Corp., New York, N. Y.

Frank J. Kiernan—named to the position of Director of Market Research, General Precision, Inc., subsidiary of General Precision Equipment Corp., Tarrytown, N. Y.

Alfred C. Viebranz—named a Senior Vice President, Marketing, Sylvania Electric Products Inc., New York, N. Y.

A. C. Viebranz

K. A. Waldron

K. A. Waldron—named to the post of Vice President, Marketing, FXR, RF Products and Microwave Div., Amphenol-Borg Electronics Corp., Danbury, Conn.

James P. McMahon, President of Tullamore Electronics Corp., subsidiary of The Victoreen Instrument Co., Chicago, Ill., elected a Vice President of Victoreen.

Dugald Black—elected Vice President, International Operations, The Bendix Corp., Detroit, Mich.

Radio Corp. of America, New York, N. Y., announces the following appointments: **Joseph M. Hertzberg**—named Vice President, Defense Marketing, RCA Defense Electronic Products; **L. F. Holleran**—to the post of RCA Staff Vice President, Distributor and Commercial Relations, Central Region; **J. F. O'Brien**—elected President, RCA Victor Distributing Corp.; **Paul J. Pfohl**—to the newly created post of Vice President, Staff, RCA Sales Corp.; **Delbert L. Mills**—elected Vice President and General Manager, RCA Victor Home Instruments Div.; **Sidney Sparks** — appointed Executive Vice President and Director and **Edwin W. Peterson**—named Vice President and Controller, RCA Communications, Inc.

(*Continued on page* 237)

Industry News

American Machine & Foundry Co., New York, N. Y., announces the following appointments: **Russell A. Kimes** and **Stanley E. G. Hillman**—elected AMF Vice Presidents.

Beckman Instruments, Inc., Fullerton, Calif., announces the following appointments: **Joseph W. Lewis** and **Earl C. Hanson**—named Vice Presidents.

George M. Mulhern—appointed Director of Public Relations, Lockheed Electronics Co., Div. of Lockheed Aircraft Corp., Plainfield, N. J.

Robert F. Hostage—named Manager, Advertising and Sales Promotion, Industrial Operations, Commercial Apparatus and Systems Div., Raytheon Co., So. Norwalk, Conn.

R. F. Hostage

W. D. Myers

William D. Myers—appointed General Manager, Resitron Laboratories, Inc., Santa Monica, Calif.

Robert A. Stackhouse—named Assistant Resident Manager, Chicago Telephone of California, Inc., a subsidiary of CTS Corp., So. Pasadena, Calif.

A. P. Stuhrman—appointed Trimpot® Division Manager, Bourns, Inc., Riverside, Calif.

William Kulka—elected President, Kulka Electric Corp., subsidiary Kulka Smith Electronics Corp., Mt. Vernon, N. Y.

General Electric Co., New York, N. Y., announces the following men have been elected Vice Presidents of the company: **Hershner Cross**, General Manager of Radio and Television Div.; **Dr. Charles E. Reed**, General Manager, Chemical and Metallurgical Div.; and **Charles V. Schelke**, General Manager of International Div.

Clevite Transistor, div. of Clevite Corp., Waltham, Mass., announces the following appointments: **F. Stuart Leitzell**—promoted to Midwest Regional Sales Manager, and **Thomas E. Ciochetti**—named Los Angeles District Manager.

News of Mfrs' Representatives

N. Y. Chapter Elects Officers

Lee Rocke, President, Newhope Corp., New York, N. Y., was elected President of the N. Y. Chapter of the ERA at the annual election of officers held at the Governor Clinton Hotel, N. Y. C. From left to right are: J. Hunter, retiring President; L. Rocke, newly-elected President; W. Shulan, National President of ERA; re-elected Secretary-Treasurer, N. Y. Chapter; and B. Hicks, Sr., First Vice President. J. Fields, elected Second Vice President, is not present.

Semi-Alloys, Inc., Mt. Vernon, N. Y., has appointed **Allegheny Electronic Chemicals Co.**, Canoga Park, Calif., as their representative in California, Texas and Arizona.

REPRESENTATIVES WANTED

Manufacturer of **clean room uniforms** and **small precision tools** desires representatives throughout the United States. (Box 3-1, Editor, ELECTRONIC INDUSTRIES.)

Northern California Chapter Elects Officers

The Northern California Chapter of ERA unanimously elected **Frank Lebell**, President, for a third consecutive term. Other officers elected for 1962 were: **Jack Logan**, Vice President; **Rockwell M. Gray**, Secretary; and **Ken E. Ross**, Treasurer.

The **Samuel S. Egert Co.**, manufacturers' representative, est. 1934, has incorporated as of January 1, 1962. **Samuel S. Egert** is President and Secretary and **Robert G. Bergman** is Vice President and Director of the company.

Robert E. Patton and David W. Patton have announced the formation of **Electronic Marketing Associates**, a new technical manufacturer's representative company. The company's main office is located at 11401 Grandview Ave., Wheaton, Md., and a branch office is at 125 Aylesbury Rd., P.O. Box 84, Timonium, Md.

Transistor Electronics Corp., Minneapolis, Minn., announces the following representative appointments: **Fryco Co.**, Scottsdale, Ariz., to cover Arizona and New Mexico; and the **J. E. Hall Co.**, Salt Lake City, Utah, to cover Utah and Southeast Idaho.

R. W. Mitscher Co., Buffalo. N.Y., has been appointed representative of Amperex Electronic Corp., Hicksville, L.I., N.Y., to handle OEM accounts in the upper New York State area.

Industrial Electronic Engineers, Inc., N. Hollywood, Calif., announces the following representative appointments: **Seatronics, Inc.**, Seattle, Wash., to cover Washington, Idaho, Montana, and Oregon; and **L. L. Stoakes Co.**, San Diego, Calif., to cover the San Diego area.

ITT Components Div., International Telephone and Telegraph Corp., Clifton, N. J. has announced the following representative appointments: **Murchison Marketing Associates, Inc.**, Andover, Mass., to cover the Eastern United States except the New York Metropolitan Area; John E. Boeing Co., Inc., Lexington, Mass., for New England; and **G. B. Ellis Sales Co.**, California, for the Northern area of California.

AMERICAN ZENER DIODES

USN	1N3020B	USN	1N3036B
USN	1N3021B	USN	1N3037B
USN	1N3022B	USN	1N3038B
USN	1N3023B	USN	1N3039B
USN	1N3024B	USN	1N3040B
USN	1N3025B	USN	1N3041B
USN	1N3026B	USN	1N3042B
USN	1N3027B	USN	1N3043B
USN	1N3028B	USN	1N3044B
USN	1N3029B	USN	1N3045B
USN	1N3030B	USN	1N3046B
USN	1N3031B	USN	1N3047B
USN	1N3032B	USN	1N3048B
USN	1N3033B	USN	1N3049B
USN	1N3034B	USN	1N3050B
USN	1N3035B	USN	1N3051B

All thirty-two of the listed American Zener Diodes meet the requirements of MIL-S-19500/115A (Navy).

And the new AMERSEAL process — a unique bonding and sealing technique — provides Silicon Zener Diodes with voltage tolerances of ±2% or lower which are maintained in actual operation or extended periods of "shelf time". Reliability, too, results from AMERSEALING with its elimination of lead or gold bonding at connections. Diodes are fail-proof under extremes of shock. And because AMERSEAL permits near-perfect heat dissipation across the entire diode, dissipators can be smaller, lighter, or even eliminated. Write for technical data.

THE SYMBOL OF RELIABILITY

Astronetics Inc.
Atlantic Highlands, N.J.

Circle 170 on Inquiry Card

FREE! TA'S NEW '62 CLAMP ENGINEERING CATALOG

76 Pages of Valuable Clamp Reference Information every Designer, Engineer or Draftsman should know!

Features the latest technical advances of clamp design and manufacture. Includes prints, tables, illustrations, specs, application and installation tips for ANY clamp problem . . . be it military or commercial. Sizes ⅛" to 6" dia. in aluminum, steel or stainless in complete selection of high and low temperature insulation materials. Shows all sizes and styles of loop clamps, bonding clamps, multiple clamps, center clamps, wire harness clamps, wave-guide clamps . . . plus blocks, brackets, busbars, line supports and related items.

CATALOG-AVAILABILITY OF OVER 40,000 DIFFERENT CLAMPS!
Before you design or buy, check with TA FIRST!

Send for your free copy of TA'S New Clamp Catalog 212G

TA Mfg. Co., 4607 Alger St., Los Angeles 39, Calif.
TWX 9863 Glendale, Calif. • WUX CAT L.A., Calif. phone CH 5-3748

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STAMP COMPONENTS FASTER, BETTER WITH HAVIR PRESS-RITES!

Precision construction and high speed operation make the Havir OBI Press-Rite a natural for fast, accurate production of electronic components. Extremely versatile, it's ideal for either long or short runs. It's built to do your job *BETTER*, last longer, too!

For the full, money-saving details about Havir 2 to 125 Ton Press-Rites, write . . .

HAVIR MANUFACTURING CO.
436 No. Cleveland Ave., St. Paul 4, Minn.

HAVIR

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NEW Hi WIRE CONNECTORS

BAKELITE • SCREW-ON

WITH BUILT-IN "BAND-OF-STRENGTH"

- **APPROVED UP TO 1000V**
- A real he-man's connector for No's. 18 thru 10 wires. Improved design. Coarse knurling gives good grip.

3 SIZES: Hi-3, Hi-4, Hi-6

also Ceramic "screw-on" and Bakelite "set-screw" connectors

SMALL SIZE Hi-O "LOK-ON"

For No's. 16 and 18 wires. Patented locking insert.

SEND **FREE SAMPLES** NEW WIRE CONNECTORS

NAME_____
FIRM_____
ADDRESS_____
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HOLUB INDUSTRIES, INC.
448 ELM ST. • SYCAMORE, ILLINOIS

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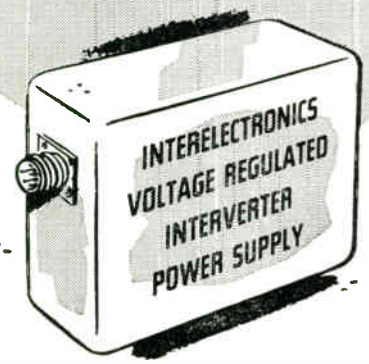
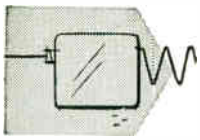
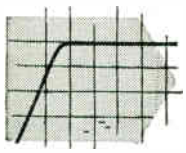
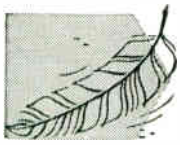
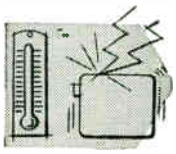
PROVEN RELIABILITY—
SOLID-STATE POWER INVERTERS,
over 260,000 logged operational hours—
voltage-regulated, frequency-controlled,
for missile, telemeter, ground support,
135°C all-silicon units available now—

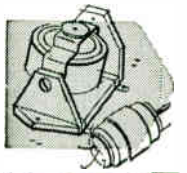


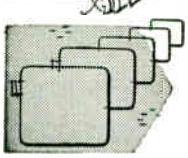












Interelectronics all-silicon thyratron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.

Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. High conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry.)

Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.)

Complies with MIL specs. for shock (100G 11 mlsc.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).

AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit or actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.

Now in use in major missiles, powering telemeter transmitters, radar beacons, electronic equipment. Single and polyphase units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how—has designed and delivered more working KVA than any other firm!

For complete engineering data, write Interelectronics today, or call LUdlow 4-6200 in New York.

INTERELECTRONICS CORP.
2432 Gr. Concourse, N. Y. 58, N. Y.

Circle 174 on Inquiry Card

REWARD!
For Information On Switch Problems

Users of switches, confronted with problems in new products under development, are receiving rewarding solutions in the form of Grayhill engineered push-button switches.

Many Grayhill developed switches are further rewarding in minimum lead-time, being variations or combinations of standard switches in the broad Grayhill line, which also includes: push-pull; rotary tap; concentric shaft; spring return; illuminated; and other miniature and sub-miniature switches. Send your specs, quantity, and delivery requirements for quotation.

GRAYHILL Silent-Action Push-Button Switches

Ultra-Miniature to Standard

GENERAL SPECIFICATIONS

Miniaturization—
Ideal for high density packaging.

Low Level Performance—
under .010 ohms contact resistance. Typical, depending on model.

High Dielectric Strength—
withstand 2000 VAC typical.

High Insulation Resistance—
20,000 megohms to 900,000 megohms depending on model.

Life Expectancy—
½ million to 1 million operations at rated load depending on model.

Standard Types—
SPST, SPDT & DPST

Delivery—
Stock to 6 weeks—depending on quantity.

Immediate Delivery of Samples for Prototypes

SEE OUR SPECIFICATIONS IN V·S·M·F THE MICROFILM CATALOG FILE

Catalog on Request

"N. Gineer"

Grayhill INC.

Area Code 312, Phone 354-1040
543 Hillgrove Avenue
La Grange, Illinois

Circle 175 on Inquiry Card

ELECTRONIC INDUSTRIES Advertisers — March 1962

This index is published as a convenience. No liability is assumed for errors or omissions

Thin Film Circuits

(*Continued from page* 107)

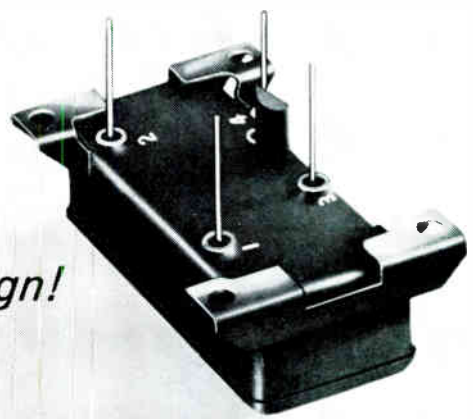
is believed that this is the smallest resistor available for its rating relative to its physical size, performance considered. It has also been used successfully as a high frequency resistor, and its performance has been determined for a standard mounting up to 250 MC. While these resistors are rated at 250 volts, the voltage is limited by power considerations in the top range of 110K to about 117 volts. However, work is currently underway to increase the range to 330K and even higher.

Standard tolerance on resistance value is ±1%, although ±½%, ±2%, and ±5% are also available.

Standard temperature coefficient of resistance is ±100 ppm/°C although ±25ppm/°C and ±50 ppm/°C are also available on special request.

It appears that for current miniaturized assemblies these microminiature components bridge the gap between larger conventional components and the ultimate perfection of functional blocks.

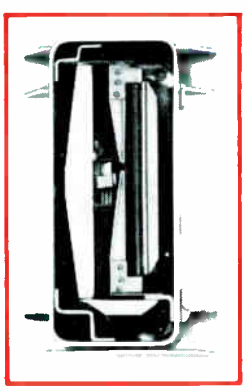
The most precise, sturdiest thermal relay ever built



. . . from the leader in thermal relay design!

Now, for missile environments and for all applications where greater precision is necessary, G-V Controls offers the revolutionary new PT Thermal Relay—the most **precise** thermal relay ever built!

And the PT's **sturdiness** is unequalled in thermal relays. It withstands missile vibration and shock far better than any other thermal relay.



SPECIFICATIONS

Time Delay: 3 to 60 seconds (Factory Set)
Setting Tolerance: ±5% (±¼ sec. min.)
Temperature Compensation: Within ±5% over −65°C. to +125°C. range (±¼ sec. min.)
Heater Voltages: 6.3 to 115 v. for delays up to 12 sec.; 6.3 to 230 v. for longer delays.
Power Input: 4 watts. Rated for continuous energization at 125°C.
Contacts: SPST, normally open or normally closed. Rated 2 amps. resistive at 115 v. AC or 28 v. DC.

Write for Product Data Bulletin #PD-1015

Insulation Resistance: 1,000 megohms
Dielectric Strength: 1000 v. RMS at sea level. 500 v. RMS at 70,000 ft.
Vibration: Operating or non-operating, 20 g up to 2000 cps
Shock: Operating or non-operating, 50 g for 11 milliseconds
Unidirectional Acceleration: 10 g in any direction changes delay by less than 5%, 50 g by less than 10% with proper orientation.
Weight: 2 to 2¼ ounces.

G-V CONTROLS INC.
Livingston, New Jersey

G-V®

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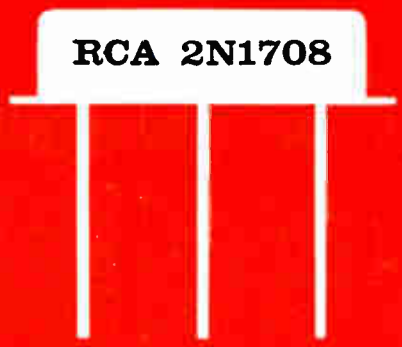
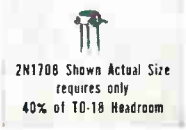
Now only from RCA



World's First Silicon PLANAR EPITAXIAL Switching Transistor in the miniature TO-46 Package



RCA announces the 2N1708, first and fastest silicon planar-epitaxial computer transistor in the TO-46 package

PLANAR CONSTRUCTION for excellent stability, high reliability. Collector cut-off current reduced by a factor of 20 to 1 over mesa types. Uniform beta over a wide current range. Maximum storage temperature—300° C.

EPITAXIAL CONSTRUCTION for low saturation voltage and improved switching times.

MINIATURE CASE for extremely high density packaging. Uses same lead arrangement as TO-18 package but requires only 40% of the TO-18 headroom.

BROAD SILICON LINE The new 2N1708 planar-epitaxial transistor is another example of RCA's advanced silicon technology, application-oriented to today's performance and miniature packaging requirements. The 2N1708 complements the other RCA silicon planar switching transistor types: USA 2N706, 2N706, 2N706-A, 2N708, 2N696, and 2N697 and new RCA epitaxial types 2N2205 and 2N2206.

For further information on RCA computer transistors and multiple switching diodes, call your RCA Field Representative. All these types are immediately available in quantity. For further technical information, write to RCA Semiconductor and Material Division, Commercial Engineering, Section C-50-NN, Somerville, N.J.

	RCA 2N1708	
CHARACTERISTICS	TEST CONDITIONS	LIMITS
I_{CBO}	V_{CB} = 15 volts; I_E = 0	.025 μa max.
I_{CEX}	V_{CE} = 10 volts; V_{BE} = 0.35 volts; Free-air Temp. = 100°C	15 μa max.
V_{CE} (sat.)	I_C = 10 ma; I_B = 1 ma	.22 volts max.
V_{BE} (sat.)	I_C = 10 ma; I_B = 1 ma	.9 volts max.
t_s	I_C = 10 ma; I_{B_1} = 10 ma I_{B_2} = 10 ma;	25 nano-seconds max.
t_{on}	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	40 nano-seconds max.
t_{off}	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	75 nano-seconds max.

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