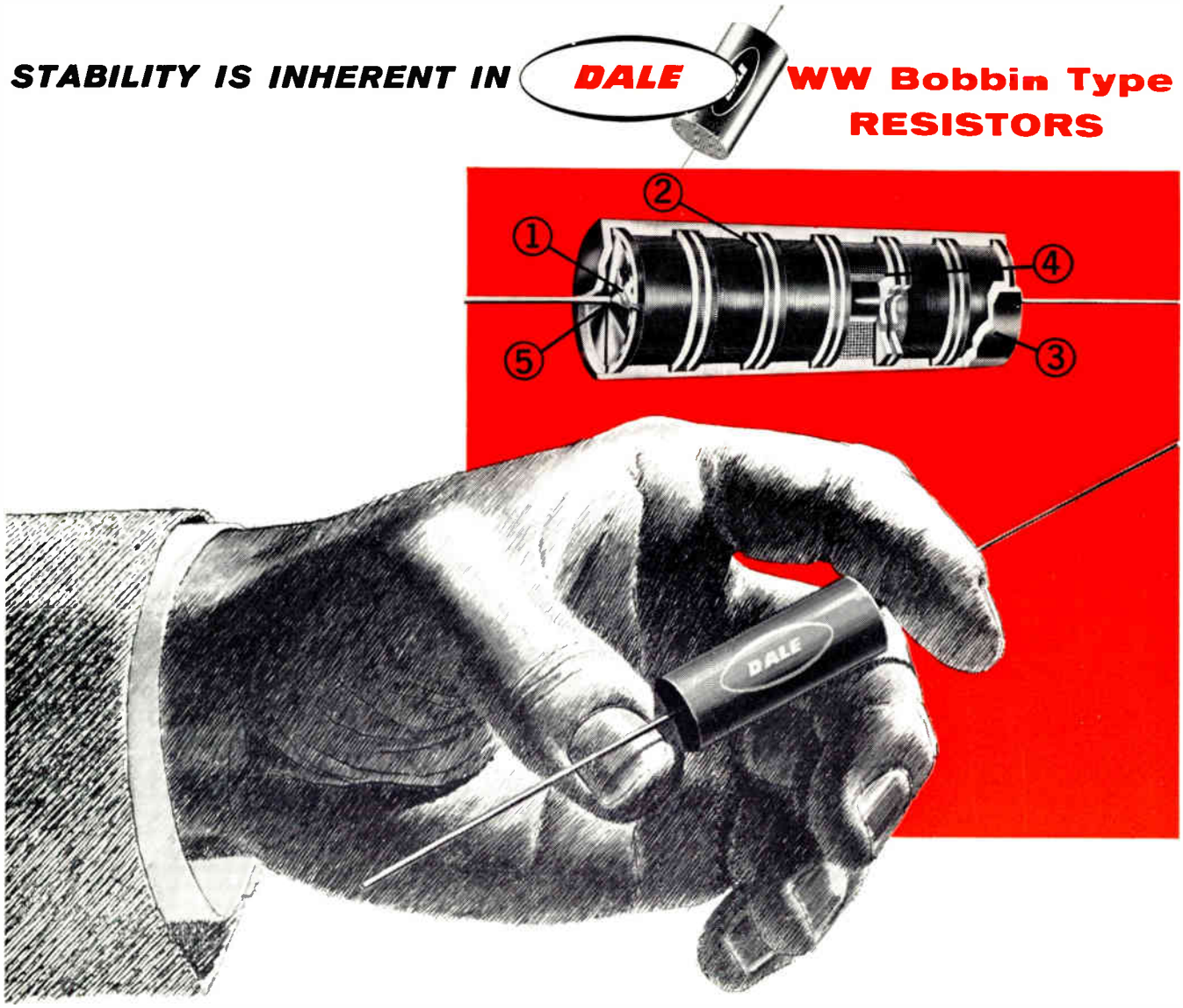
ELECTRONIC INDUSTRIES

AUGUST 1962

11th annual western issue

featuring WESCON 1962

STABILITY IS INHERENT IN DALE WW Bobbin Type RESISTORS



Non-inductive precision resistors encapsulated in a material with very high dielectric strength. Completely protected against salt spray, moisture, corrosive gases and vapors and other environmental factors.

SPECIFICATIONS

- Meet requirements of MIL-R-93C. characteristic C.
- Eight physical sizes rated at 0.1, 0.15, 0.2, 0.25, 0.3, 0.4 watt.
- Resistance range from 10 ohms to 1.5 megohms.
- Tolerance 1% standard.
- Operating temperature range -55° C. to 145° C.

Write for Dale Resistor Catalog A

HERE'S HOW DALE "BUILDS IN" RELIABILITY

TERMINATION METHOD using new terminal disc prevents breakage of terminating wire, and changes in resistance values due to strain when leads are bent or subjected to outside mechanical forces. The terminal disc is welded to the lead and firmly bonded to the end of the bobbin. Termination of the last pi winding can be made at any point on the periphery of the terminal disc, allowing a more accurate calibration.

WINDING METHOD employs twin disc winding separators, removing the need for insulating tape to prevent shorting between pi's.

ENCAPSULATED in a material with very high dielectric strength. Resistor completely protected against moisture and mechanical damage.

RESISTANCE WIRE is procured to rigid specifications (analysis of each melt required).

COMPLETE WELDED CONSTRUCTION. Welds tested on sample basis to destruction.

COMPLETE TESTING PROGRAM: Resistance check: 100% final and 100% during processing; 100% Hipot test; complete military specification environmental test on sampling basis.

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DALE ELECTRONICS, INC.

1304 28th Avenue, Columbus, Nebraska

DALE *A subsidiary of* THE LIONEL CORPORATION

Also Made and Sold by Dale Electronics Canada, Ltd., Toronto, Ontario, Canada

SEE OUR SPECIFICATIONS IN VSMF THE MICROFILM CATALOG FILE

Circle 98 on Inquiry Card

ELECTRONIC INDUSTRIES

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

Our New Look

ELECTRONIC INDUSTRIES has a new front cover this month. It is the start of a complete restyling program. We believe it is appropriate to unveil our new cover on the occasion of our eleventh annual WESCON issue.

This cover design is called a photogram and is developed through a combination of photographs and art techniques. The illustration is based on a photograph of the Memorial Sports Arena, in Los Angeles, where this year's WESCON will be held. (See page 131 for complete program details.)

ELECTRONIC INDUSTRIES is now 21 years old. During this period it has undergone a number of styling changes. The last such change in ELECTRONIC INDUSTRIES was initiated more than five years ago. The publishing industry, like the electronic industry is dynamic and changing. New art and production techniques, coupled with new type styles, offer publishers the opportunity to improve the readability and usefulness of their magazines.

Only the cover on this issue has been changed to provide a preview of things to come. You will see a completely new layout and typography with the September issue of ELECTRONIC INDUSTRIES.

As you can well imagine, the complete restyling of a magazine such as ELECTRONIC INDUSTRIES involves a major publishing decision as well as considerable expense. It is not a mission to be embarked upon lightly, but rather comes about because of evolutionary changes and a continuing desire to improve the product. This present program has been under study and in development for the past nine months. Lester Beall, one of America's foremost designers, has been retained as a consultant, and is providing the guidance for our new look.

Although the appearance of ELECTRONIC INDUSTRIES will be completely different, there will be no change in editorial content or concept. All of our regular departments will be retained, as will our editorial staff study programs along with selected editorial features on the most timely and helpful topics from contributing authors.

What Price R&D?

Many bombshells have been dropped by the Kennedy administration in the 18 months of its existence, but few are likely to have such long time reverberations as the recommendation by Budget Director David Bell last month that the salaries of executives of firms holding government R&D contracts should be limited to $25,000 per year.

With this one statement, industry's long-time fear that the government would step beyond its proper boundaries to become an administrator of private business has become crystallized. For many firms in the electronic industry, it means a drastic review of their objectives, a look at new markets, perhaps complete re-orientation of their efforts. The implications are that serious.

It is apparent now that the government considers every one of its contractors as an extension of its own R&D facilities. No longer is the government a "buyer"—it is now a financier, a gigantic administrator. The old concept of competitive free-enterprise becomes a mamby-pamby "you can work for us if you will do what we tell you."

We suspect that this statement by Bell is simply an opening move on the government's part—a serving notice of what is to come. Certainly the figure of $25,000 is ridiculous; even the government itself admits that 70% of the executives who would be affected now have higher incomes.

We will have to wait for the final form that the government's proposal will take. In advance, we can be certain that profits in the research and development field in the U.S. are due for some severe slashes.

The West Coast, in particular, is likely to suffer the most from this development. The number of engineers in the West has grown from 17,000 to 34,000 in just the last 5 years. And a very large percentage of these engineers are employed in government-defense sponsored R&D work. (See page 219.)

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ELECTRONIC INDUSTRIES

Vol. 21, No. 8 **AUGUST, 1962**

FRONT COVER: This unique treatment of the Los Angeles Memorial Sports Arena, site of this year's WESCON, has been achieved by the "phatagram" process. EI readers will see more of this unusual technique in graphic arts on the covers of subsequent issues. As for news of WESCON itself—and this is our 11th Annual WESCON issue—a comprehensive review of the activities, exhibits, and products begins on page 131 of this issue.

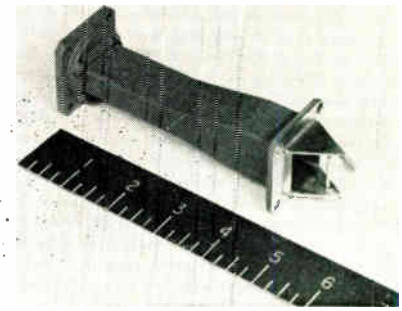
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

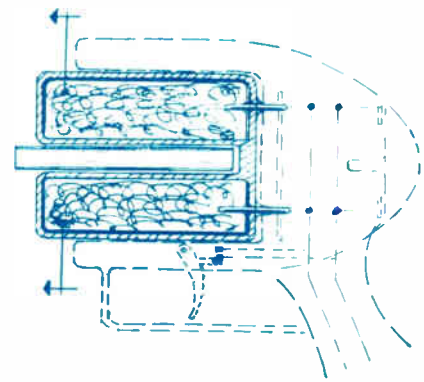
DEPARTMENTS

ELECTRONIC INDUSTRIES, August, 1962. Vol. 21, No. 8. A monthly publication of Chiltan 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. Possessians: 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

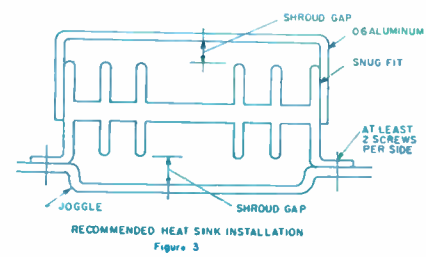


X-Band Aircraft Antennas



Directed Energy Weapons

Storage Methods

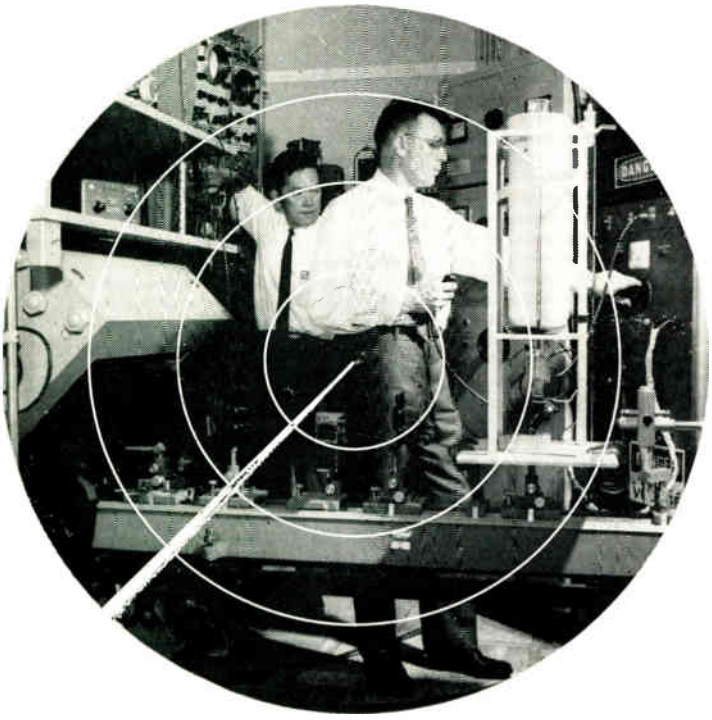


RECOMMENDED HEAT SINK INSTALLATION
Figure 3

Heat Sink

TELSTAR

RADARSCOPE



LASER-PUMPED MASER

Scientists at Hughes Aircraft Co.'s research laboratories have developed and successfully demonstrated a laser-pumped maser which fills a broad gap in the electromagnetic spectrum. D. P. Devor, (r.) sets voltage on laser power supply and prepares to push the button which initiates the laser action in the laser crystal, sending coherent optical radiation through the system. C. K. Asawa (background) adjusts the magnetic field.

BILL IN CONGRESS that would allocate $40 million annually for five years to provide college level facilities for training engineering and scientific technicians is reported to have strong bipartisan support. The present industry-wide ratio is placed at .73 technicians-per-engineer. The bill would eventually provide from one to five technicians-per-engineer.

JAPANESE EXPORTS of electronic products to the U. S. totalled nearly $120 million during 1961 compared with $94 million in 1960. The 28% increase parallels the increase in total Japanese exports of electronic products to all countries—from $196 million in 1960 to $248 million in 1961. Radio receivers of all types accounted for 62% of the total Japanese electronic exports to this country in 1961, compared with 74% in 1960.

IMPORTS OF ELECTRONIC PRODUCTS from the United Kingdom to the U. S. reached a record total of $22.3 million in 1961, a 14% advance from 1960. This compared with 1961 U. S. electronic shipments to the U. K. totaling $23.6 million, exclusive of the "special category" items which are classified information. Exports of record playing mechanisms accounted for 49% of the total value of the sales to the U. S.

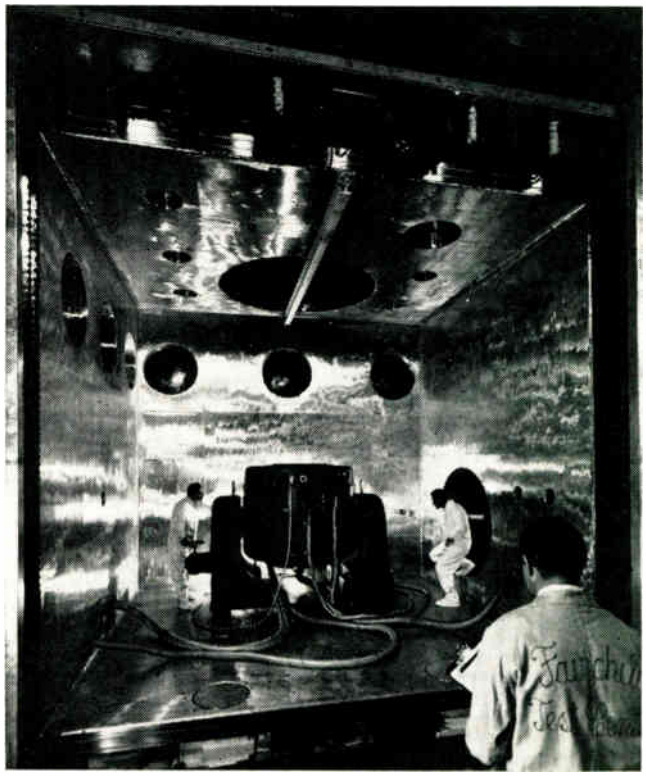
COMMON ENGINEERING VOCABULARY for information retrieval purposes is one step closer. ASTIA (Armed Services Technical Information Agency) has begun editorial preparation of a draft second edition of the "Thesaurus of ASTIA Descriptors." More than 300 volunteers from 60 organizations participated in this revision, working with ASTIA staff and contractor personnel.

DENVER'S PAY-TV TRIAL of the Teleglobe System is looking for an initial 2,000 subscribers. Planned operation will have station KTVR transmitting subscription programs at least 14 hrs. a week, between 6 p. m. and midnight. Only video will be transmitted; the audio portion will be received over telephone lines together with "secret scanning interrogations of subscribers' speakers." The scanning technique reportedly provides a performated tape report which is converted into metering and billing information.

THE FCC seems well aware that it has a dangerous concentration of power in its new authority to order production of only "all-channel" TV sets. At the EIA consumer electronics symposium in New York, Sen. Gale W. McGee (D., Wyo.) assured the set manufacturers that the Commission would avoid "extreme regulations and requirements" in carrying out the law.

HIGH ALTITUDE CHAMBER

At Fairchild's Space Environments Lab, technicians prepare 15-ton vibration exciter for test inside 3,000 cubic foot high altitude temperature chamber. Entire 15-ft. wide wall has been lowered to permit movement of shaker into chamber by rail-mounted gantry.



FEASIBILITY of building giant radio telescopes—with signal-catching surfaces of around 90 acres that could be expanded further as research required—is being studied at Stanford. National Science Foundation is providing $222,000 for the study. An "echelon" antenna design has been proposed, resembling a huge venetian blind, as a promising answer to radio astronomy's critical need for better "resolving power" or focus in radio telescopes.

LASER that reduces by ten times the amount of energy required by present types to generate powerful beams of infrared light has been developed by RCA. The new device is built around a calcium fluoride crystal containing traces of a rare earth, dysprosium. Where conventional solid-state lasers require intense light input, the new laser achieves amplification using ordinary light.

NUMERICALLY CONTROLLED MACHINE TOOLS will be developed by the Manufacturing Equipment Committee of the Aerospace Industries Association on a specific request of the Air Force. The tools will include combination boring, milling and drilling machines, jig borers, turning equipment and tube benders.

THE 15% PERCENT CEILING on "overhead costs" of research carried on by universities and colleges under DOD grants, approved by the House, was sharply criticized by Sen. T. H. Kuchel of California. The action, he says, would place heavy financial loads on educational agencies "which have been performing essential work for the Armed Services and in the interests of national security, scientific progress and a posture of readiness for any emergency."

THE FEDERAL GOVERNMENT calls upon up to 4,000 outside engineers and scientists each year for services not available on Federal staffs. The non-government activities of many of these consultants has congressmen and other Federal officials expressing increased concern over the conflict-of-interest possibilities.

SIGNIFICANT ADVANTAGES are claimed for a unique component packaging technique called "amplas,"—apparatus mounted in plastic. At the Summer General Meeting of AIEE, two Western Electric engineers, described it as "a method of mounting components as contrasted with those also providing wiring. A metal mold is used to make a plastic mold into which components are subsequently positioned. Epoxy resin is poured into the mold and cured to create a hard but flexible board. The final product is a board which holds a number of components by their leads with the end portions of the leads extending beyond the board to provide terminals for wiring and soldering."

ELECTRONIC COMPUTERS are opening up "entirely new avenues for diagnosis and treatment of cancer," says Dr. T. D. Sterling, director of the Biomedical Computing Center at the Univ. of Cincinnati. When computers plan x-ray applications for cancer sufferers, "the treatment of all patients has improved immensely." The computer helps shape the maximum dose of radiation into the afflicted area, and cuts down on the amount of radiation hitting surrounding healthy tissue.

From Philadelphia, too, comes news that one of the major hospitals is installing two IBM computers. Expected to be ready by Fall, these computers will provide a prescription and a course of treatment for a patient whose symptoms are fed into it.

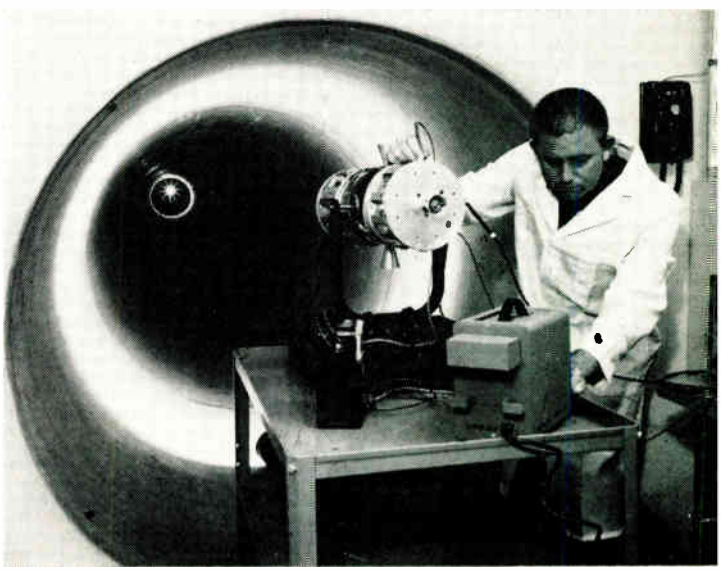
Thousands of ailments will be classified for treatment. All the patient's significant measurements, pulse, respiration, blood count, blood pressure, temperature, plus his aches and pains, will be recorded in the computer. When thousands of cases have been tabulated, the individual variations will be minimized, providing a general description of the symptoms, and following up with recommended treatment.

For the first time, there will be made available to physicians the total accumulated knowledge of medicine, within easy reach, and almost literally within seconds.

INSTITUTIONAL GRANTS for use at the discretion of colleges and universities to help meet their needs in science were announced by the National Science Foundation. Funds totalling $3,730,634 will be provided to 302 colleges and universities.

ADVANCED COMPONENTS

Scientist is shown testing infrared tracker system in a 100-ft. underground tunnel which provides uniform temperatures and permits the simulation of targets that are about a square meter in cross section, and 1,000 mi. from tracker. Autonetics designed the system.



Capacitors for Power Supplies

(and other applications requiring extremely large values of capacitance)

WHICH DO YOU NEED--
FINE...or... SUPERFINE?

POWERLYTIC® CAPACITORS

for 65 C Operation

With metal cases ranging from 1⅜" diameter x 2⅛" lang to 3" diameter x 4⅝" lang, Type 36D capacitors pack the highest capacitance values available in these physical sizes. Their maximum capacitance values range from 150,000 μF at 3 volts to 1000 μF at 450 volts.

COMPULYTIC® CAPACITORS

for 85 C Operation

The Type 32D Series offers the ultimate in reliable long-life electrolytic capacitors for computer service. With case sizes similar to those of Type 36D, these higher-temperature units have maximum capacitance values ranging from 130,000 μF at 2.5 volts to 630 μF at 450 volts.

Both Powerlytics and Compulytics have all of the qualities you expect from Sprague electrolytic capacitors—low equivalent series resistance, low leakage currents, excellent shelf life, and high ripple current capability. They are available with tapped terminal inserts, often preferred for strap or bus bar connections, as well as solder lugs for use with permanently wired connections.

☆ ☆ ☆

Popular ratings of Type 36D Powerlytics are now available for fast delivery from your Sprague Industrial Distributor.

For complete technical data on Type 36D Powerlytics, write for Engineering Bulletin 3431. For the full story on "blue ribbon" Type 32D Compulytics, write for Bulletin 3441B to the Technical Literature Section, Sprague Electric Company, 233 Marshall St., North Adams, Mass.

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43-416

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As We Go To Press . . .

Government Research Reports Indexed by OTS

Publication of a new index designed to make it easier to get government research reports was recently begun by the Office of Technical Services, U. S. Commerce Dept. "Keywords Index to U. S. Government Technical Reports (Permuted Title Index)" is funded by the National Science Foundation.

Use of the keywords of titles in the publication is based on recently devised computer techniques. Reports will be listed under an average of six subject key words.

"Keywords Index" will be distributed twice monthly to all subscribers of "U. S. Government Research Reports" (An OTS semi-monthly publication, $15 a year). Non-subscribers may obtain a gratis review copy by writing OTS, U. S. Dept. of Commerce, Washington 25, D. C.

Portable Electronic Equipment Use Authorized

Use of portable electronic equipment — standard radios, recorders, dictating machines, etc.—by passengers on board United Air Lines aircraft has been authorized, with two exceptions.

The two exceptions are: FM receivers may not be used at any time; and, the captain may request passengers to refrain from using other electronic equipment during periods when instrument flying conditions prevail.

The ban on FM radios is spelled out in government Civil Air Regulations. Three years of testing determined that FM radios with local oscillators operating within or near the VHF omnirange band (108 to 118 MC) can interfere with an aircraft's VHF navigational system.

ACM Unit Elects Officers

At its June meeting the Washington, D. C., chapter of the Association for Computing Machinery elected the following officers for the coming year: Sol Rosenthal, Chairman; George Heller, Vice Chairman; Richard Lemons, Treasurer, and Billie Manring, Secretary. All except Heller are serving their second term.

FLORAL COLOR TV TUBE

RCA officials examine floral replica of RCA color TV tube at recent Electronic Parts Show in Chicago. From left are: Harold F. Bersche, Manager, Distributor Products Dept., Electron Tube Div.; W. W. Watts, Group Executive Vice President; and Douglas Y. Smith, Vice President and General Manager, Electron Tube Div. More than 1,600 red, green, blue and white flowers were used in display.

Characteristics of 3-D System to be Evaluated

A contract to evaluate the visual characteristics of ITT's three-dimensional display system has been awarded ITT Federal Laboratories, Nutley, N. J., by the U.S.A.F.

The contract calls for the company's Human Factors group to conduct a series of experiments investigatng the ability of individuals to distinguish between targets in the 3-D display.

Operators will be tested to determine how well they can judge the nearness of targets to one another, the target positions relative to each other and similar visual perceptions.

IRE, AIEE Merger Effective Jan. 1, 1963

Members of the Institute of Radio Engineers have overwhelmingly approved plans to merge with the American Institute of Electrical Engineers to form the Institute of Electrical and Electronic Engineers on January 1, 1963.

The IRE approval was by a 7-1 margin, almost identical with the margin by which AIEE members approved the same merger at their annual meeting June 18. Some 63% of the 66,152 IRE members eligible voted, with the actual count being 36,221 for and 5,489 against.

A 14-man committee, composed of seven men from each parent organization is now at work fashioning details of the merger. The committee will cease to exist when the merger takes place.

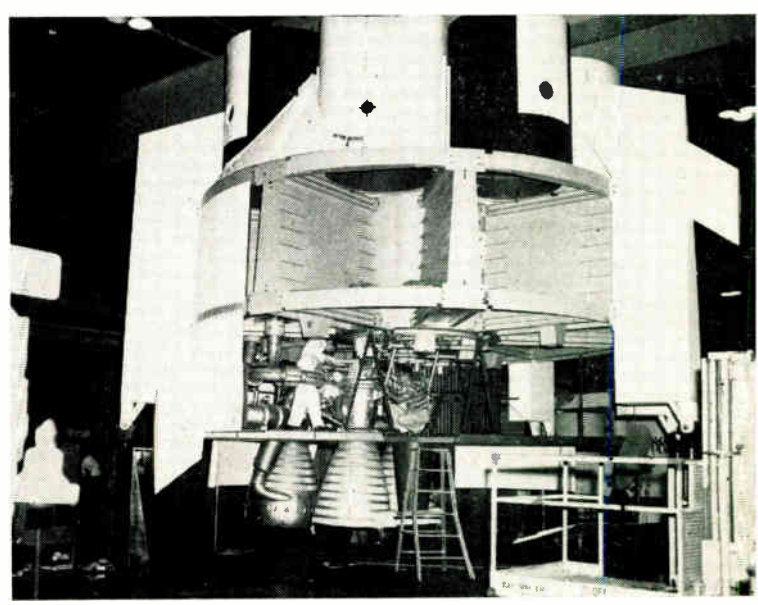
The new society will be the world's largest professional engineering society, with more than 160,000 members in over 80 countries.

The IEEE will retain characteristics of both organizations. It will retain professional groups, similar to those of the IRE. Also, it will preserve, the corporate entity of the older society—the AIEE, which was founded in 1884. This is to retain the organization's status as a founding society.

More on Page 8

SATURN

Cutaway mock-up at NASA Marshall Space Flight Center, in Huntsville, Ala., shows workmen in engine area of SA-5 (Saturn fifth flight vehicle). Full-size mock-up enables engineers to see that transition from paper to hardware comes out right.



Electronic SHORTS

▸ **Minneapolis-Honeywell has developed a solid-state high power audio amplifier for the U. S. Navy Underwater Sound lab. Rated at 1 kw, they are for use with sonar transducers on submarines. The amplifiers are expected to find use as power converters for fuel cells, light beam communications, ship degaussing, underwater telephone, and ultrasonic cleaning and welding.**

▸ The Army has contracted System Development Corp., Santa Monica, Calif., to establish a system training program at Army Air Defense Command sites. "Packaged air raids" provided in the program will permit air defense crews to train and operate under simulated attack conditions, and at considerable cost savings compared to exercises using actual aircraft. The simulated air attacks are produced by computers and are displayed for operators to see on their scopes.

▸ **An environmental file which will enable the military services to study, predict and recommend solutions to the growing problem of compatibility of combat electronic equipment, will be compiled by Bell Aerosystems Co., Buffalo, N. Y. Types of information, known as environment file data, to be gathered by Bell engineers under the Army contract includes data about geographical locations, terrain characteristics, atmospheric effects, schedules of operation, antenna orientations and operating frequencies.**

▸ A procedures trainer that will be used for operational-readiness training of launch-control-center crews at SAC bases equipped with the Titan ICBM, will be built by ACF Electronics, Riverdale, Md., under a contract awarded by the Martin Co. Trainer provides for development and evaluation of launch crew proficiency in performing normal and emergency procedures for checkout, communications, readiness monitoring, countdown, launch hold, abort and other steps in the launch cycle.

▸ **Responsibility for development and production of the power converters to operate communications and controls aboard NASA's OGO satellite has been assigned to International Telephone and Telegraph Corp., San Fernando, Calif. Known as the "street car satellite" because of its versatility, OGO (Orbiting Geophysical Observatory) will be adaptable to a wide range of experiments. It will be capable of carrying up to 50 separate geophysical experiments on any one mission.**

▸ Contracts for over $1 million for magnetic tape recording and reproducing systems to be used in Project Vela, have been awarded Minneapolis-Honeywell Regulator Co. Project Vela is a study to determine the seismic differences between nuclear explosions and earthquakes. It is under the guidance of the Dept. of Defense. Equipment involves recorders that operate at extremely low tape speeds permitting data during a 24-hour monitoring period to be recorded on one large reel of tape.

▸ **Feasibility of applying optical correlation principles to automatically reduce aerial photographs to topographic maps will be examined by GPL Division—General Precision, Inc., Pleasantville, N. Y. Work will be done under an R&D contract awarded by the Army. The study results from the need to increase the speed with which these maps can be produced. Such work must presently be done by highly trained personnel who visually compare the photographs, or by equipment using electronic scanning principles.**

▸ Electronic Communications, Inc., St. Petersburg, Fla., has announced contracts totaling more than $2.5 million from Western Electric Co. for UHF ground station terminals for use in SAC's Airborne Command Post program. SAC maintains a command post aloft around-the-clock, assuring a command and control communication system which would survive any nuclear attack on the U. S. The ground stations tie the airborne network to the ground network at various points across the country.

▸ **Under terms of a contract with ITT Federal Labs, Daystrom, Inc., Archbald, Pa., will produce magnetic core memory units to be used in SAC's 465L Command and Control System. When completed, the system will present the SAC Commander with the current status of the thousands of SAC bombers, missiles and men, and provide for the dissemination of command orders to the entire force within seconds.**

As We Go To Press (cont.)

Ceramic Rod Generates Electricity

A simple ceramic rod which spontaneously generates electricity has been developed by engineers at the Martin Co., Baltimore, Md. Working under contract with the AEC, Martin researchers have combined two forms of the element strontium into a one-piece thermoelectric generator which serves as its own heat source.

The device is a small strontium titanate rod with strontium-90 concentrated at one end. The radioactive strontium-90 spontaneously produces heat, which is converted to electrical energy through the thermoelectric effect in the strontium titanate.

Although the efficiency of the experimental device is very low and its power output is only a fraction of a watt, the engineers hope to produce a significant increase in both by continued development.

Pentagon Communications Center Opened by Army

An Army communications center has been opened in the Pentagon, Washington, D. C. The facility includes teletypewriter and voice communications employing closed-circuit TV, message display and telephone facilities. It is part of STARCOM, the Army's world-circling communications network.

Predicts Atom Power For TV, Radio Satellites

Lightweight atom generators supplying continuous low-cost power for radio and TV satellites will be developed soon, Martin Co. scientist Dr. Jerome P. Morse predicted recently before the British Interplanetary Society.

Dr. Morse said these generators could supply the satellites with power for up to 20 years. The scientist directs the Nuclear Auxiliary Power Systems Dept. of the firm.

A 60-watt generator using plutonium-238 would weigh 65 lbs., while a strontium-90 unit would weigh 120 lbs. He said power systems using strontium-90, more readily available, could be ready in months.

The scientist estimated it would take power systems of between 50 and 350 w. to support radio and TV satellites.

(*Continued on page* 10)

shake it!

We pulled one of our standard 1N2929 tunnel diodes off the line and tied it to the business end of a jackhammer for a bit of jouncing and jarring. It not only survived this beating but went on to pass its 1000-hour life test—at voltages in excess of V_F—without deterioration of peak-to-valley ratios.

No wonder. We build these diodes to exceed the vibration fatigue requirement of MIL-S-19500C. That's 20g's at frequencies to 2000 cps. What's more, they're built to store or operate for 1000 hours at temperatures from −65°C to +175°C. They're rugged and reliable, like all Hoffman semiconductors.

We specialize in devices for control, regulation and power. You can buy them with confidence that they'll work and keep on working. Confidence that they'll be available when and where needed. That's why so many of the most successful electronics designers keep coming back to Hoffman—again and again and again. Chances are you'll do the same. Try us. Call your nearest Hoffman distributor or sales office today.

Hoffman / **ELECTRONICS CORPORATION**
Semiconductor Division

4501 N. Arden Dr., El Monte, Calif. · CUmberland 3-7191 · TWX El Monte 9735

Circle 70 on Inquiry Card

As We Go To Press . . .

RACEP Troposcatter System in Operation

Martin Company's Orlando Div. is operating its RACEP Troposcatter (over-the-horizon) communications equipment over a 100-mile distance. Concurrent voice and high-speed data transmissions are being sent between Gainesville and Orlando, Fla.

The transmission capacity equals 19 voice channels and several hundred high-speed teletypewriter channels.

RACEP is short for "Random Access and Correlation for Extended Performance." The equipment uses a modulation technique like RACEP Discrete Address units now being tested by the U. S. Army and Air Force.

RACEP breaks information into .000001 sec. "bits," codes them and converts them into radio energy, then transmits them over a wide frequency band. Pulses are accepted and decoded only by the other RACEP units set to the same code.

The 12-ft. dish antenna of RACEP Troposcatter beams its signal in a straight line parallel to the ground. As the earth curves, the beam continues straight. It is scattered within the troposphere below 25,000 ft. midway between stations.

RACEP Troposcatter improves on other over-the-horizon systems because it needs just one antenna, transmitter and receiver for each terminal. This cuts down the number of major components needed.

The Martin system covers the 100-mile distance with two stations. A line-of-site microwave relay might require four or five. The engineers calculate that distances of 250 to 300 miles could be maintained between relay stations in a transcontinental network.

A simultaneous voice and slow-speed (teletypewriter) data capability for RACEP was unveiled in February. Slow-speed data it transmitted at 100 bits per sec., high-speed data at about 30,000 bits per sec.

A 7090 computer is evaluating RACEP Troposcatter efficiency over several months.

Associate engineer Jane Lomax helps demonstrate how the spoken word can be transmitted at the same time a teletype message is being sent over RACEP.

Missile Range Radar Antenna Begins Tests

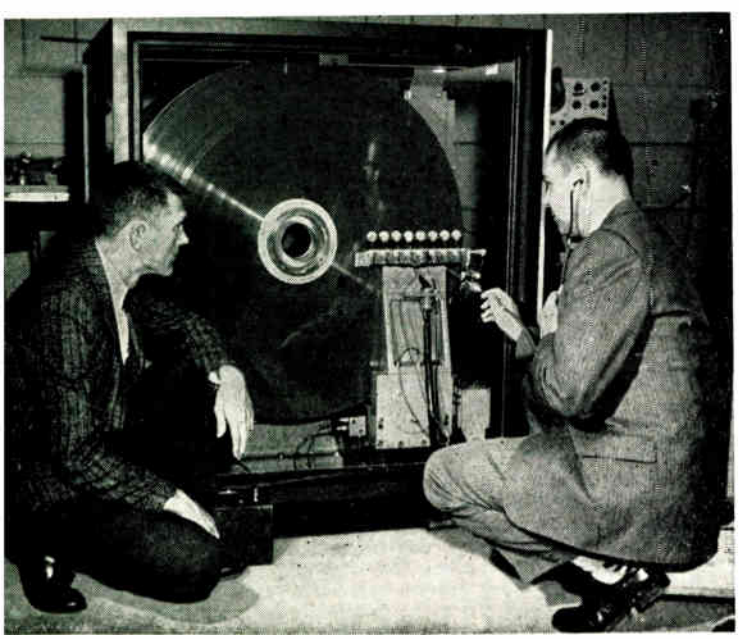
A new ton-and-a-half, three-story high antenna has gone up on a new radar range at Manorville, N. Y., for testing by Sperry Gyroscope Co.

The antenna, once it has been tested and boresighted, will become part of the MARS (Mobile Atlantic Range Station) tracking ships. These ships will help expand the the Atlantic Missile Range past the tip of Africa into the Indian Ocean, into which the U. S. will test fire its full range ICBMs.

Of all-aluminum construction, the antenna is part of the new Integrated Instrumentation Radar (IIR) developed by Sperry. Heat, wind, and ship motion will not distort it at the edge by more than sixty thousandths of an inch. It is a C-band antenna using a Cassagrainian reflector.

SPACE CRYSTAL BALL

All-pneumatic gyroscope for space navigation is shown by G. S. Spleen, physicist of ITT Federal Laboratories, which developed it. Crystal ball supported by air cushion spins on fixed axis inside second sphere. Spheres turn at same speed, but independently. Drift is small since air cushion is nearly frictionless.



DATA FILE

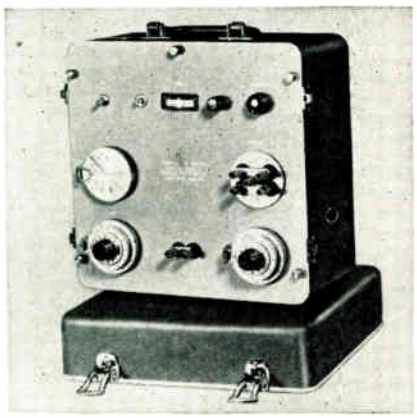
First Data Disc File delivered to RCA for 301 Systems by Bryant Computer Products, Walled Lake, Mich., is checked by H. J. McLaughlin (r), Bryant Sr. Project Engineer, and L. J. Limbaugh, RCA Project Engineer. Four standard disc file models will be offered with 301 Systems. Unit shown above is a 12-disc, 44-million-character capacity file.

Inertial System For Gemini Spacecraft

Minneapolis-Honeywell has been awarded contracts by McDonnell Aircraft Corp. for development and production of guidance and control systems for the NASA two-man Gemini spacecraft. McDonnell is the Gemini prime contractor.

Honeywell was selected to develop and produce inertial guidance platforms for Gemini. The inertial platform will be the sensor for the spacecraft's navigation system and marks the first time an inertial system has been used in a U. S. space capsule. The company was also contracted to develop and produce the attitude control and maneuver electronics for Gemini.

New Bridge Design For Safe, Accurate, Easy Measurement of Capacitors



The Sprague Model 1W1 Capacitance Bridge introduces a new concept in bridge design. Built *by* capacitor engineers *for* capacitor users, it incorporates the best features of bridges used for many years in Sprague laboratories and production facilities.

Special Features For Greater Accuracy

The internal generator of the 1W1 Bridge is a line-driven frequency converter, and detection is obtained from an internal tuned transistor amplifier-null detector, whose sensitivity increases as the balance point is approached. It has provision for 2-terminal, 3-terminal, and 4-terminal capacitance measurements, which are essential for accurate measurement . . . ±1% of reading + 10μμF . . . of medium, low, and high capacitance values, respectively.

No Damage to Capacitors

The model 1W1 Capacitance Bridge will not cause degradation or failure in electrolytic or low-voltage ceramic capacitors during test, as is the case in many conventional bridges and test circuits. The 120 cycle A-C voltage, applied to capacitors under test from a built-in source, never exceeds *0.5 volt!* It is usually unnecessary to apply d-c polarizing voltage to electrolytic capacitors because of this safe, low voltage.

Complete Specifications Available

For complete technical data on this precision instrument, write for Engineering Bulletin 90,010 to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

45-433 R3

Circle 71 on Inquiry Card

NEW . . . for "Bread-Boarding" Your Circuit Designs . . .

Contains 12 specially-selected Sprague Type 32Z miniature pulse transformers in clear, hinged-lid plastic case, complete with simple instructions.

SPRAGUE 100Z41 EXPERIMENTAL PULSE TRANSFORMER ASSORTMENT

- **Helps you choose the right pulse transformer for your specific application.**
- **Puts at your disposal 58 turns-ratio/primary-inductance combinations, providing the parameters required in most electron tube or transistorized circuits.**
- **Primary inductances from 160 microhenries to 43 millihenries.**
- **Turns ratios from 1:5 step-up to 6:1 step-down.**
- **Potted, pre-molded case construction facilitates bread-board wiring, permits frequent re-use.**

Once you determine needed transformer characteristics, it's easy to get production quantities to your exact requirements from Sprague's broad line of hermetically sealed or encapsulated pulse transformers.

For fast delivery or additional information on the 100Z41 Pulse Transformer Assortment, see your Sprague Products Co. Industrial Distributor, or write Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

45-432 R1

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Coming Events in the electronic industry

AUGUST

Aug. 13-16: Pacific Energy Conversion Conf., AIEE; Fairmont Hotel, San Francisco, Calif.

Aug. 13-16: Nat'l West Coast Mtg., SAE; Biltmore Hotel, Los Angeles, Calif.

Aug. 14-16: 1962 Int'l Conf. on Precision Electromagnetic Measurements, IRE (PGI), NBS, AIEE; Boulder Labs., NBS, Boulder, Colo.

Aug. 14-16: Cryogenic Eng. Conf., Univ. of Calif., Los Angeles, Calif.

Aug. 15-16: 1962 Low Pressure Plastics Show & Clinic, Hastings Plastics, Inc.; Santa Monica, Civic Audit., Santa Monica, Calif.

Aug. 15-17: 3rd Electronic Packaging Symp.; Univ. of Colorado, Boulder, Colo.

Aug. 16-18: Joint Western Regional Aircraft & Missiles Conf., ASQC; Benjamin Franklin Hotel, Seattle, Wash.

Aug. 20: Tech. Symp., Applications & Reliab. of Precision Potentiometers, PPMA; Statler-Hilton, Los Angeles, Calif.

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

Aug. 23-24: AEEC Summer Mtg.; Hotel Benjamin Franklin, Seattle, Wash.

Aug. 26-29: Nat'l Mtg., AICE; Denver-Hilton Hotel, Denver, Colo.

Aug. 27-29: Summer APS Mtg. in West; Seattle, Wash.

Aug. 27-29: Conf. on Metallurgy of Semiconductor Materials; Ben Franklin Hotel, Phila., Pa.

Aug. 27-31: Joint Mathematical Summer Mtg., AMS, MAA & SIAM; Univ. of British Columbia Vancouver, Canada.

Aug. 28-30: 4th EIA Conf. on Maintainability of Electronic Equip., EIA, Dept. of Defense; Univ. of Colo., Boulder, Colo.

Aug. 29-Sept. 5: 5th Int'l Cong. on Electron Microscopy; Univ. of Penna., Phila., Pa.

Aug. 30-Sept. 5: Annual Conv., APA; Chase-Park Plaza Hotels, St. Louis, Mo.

Aug. 31-Sept. 3: ARRL Nat'l Conv.; Portland-Sheraton Hotel & Memorial Coliseum, Portland, Ore.

Aug. 31-Sept. 9: 1st World's Fair of Music & Sound, 20th Century Fair of Music, Inc.; McCormick Place Expos. Ctr., Chicago, Ill.

SEPTEMBER

Sept. 1-3: ARRL Delta Div. Conv.; Jung Hotel or Fountainbleu Motel, New Orleans, La.

Sept. 4-7: 1962 ACM Nat'l Conf. & Int'l Data Pressing Exh.; Hotel Syracuse & War Memorial Audit., Syracuse, N. Y.

Highlights '62

WESCON Western Electronic Show and Conf., Aug. 21-24, IRE, WEMA; Memorial Sports Arena and Statler-Hilton Hotel, Los Angeles, Calif.

NEC, Nat'l Electronics Conf., Oct. 8-10, IRE, AIEE, EIA, SMPTE; McCormick Place, Chicago, Ill.

NEREM, Northeast Research and Eng. Mtg., Nov. 5-7; IRE; Boston, Mass.

Sept. 4-8: Reaction Mechanisms Conf., Brookhaven Nat'l Lab., Upton, N. Y.

Sept. 9-14: Nat'l Tech. Conf., IES; Statler-Hilton Hotel, Dallas, Tex.

Sept. 9-14: 142nd Mtg., ACS; Atlantic City, N. J.

Sept. 9-14: Petroleum Industry Conf., AIEE, ISA; Carter Hotel, Cleveland, Ohio.

Sept. 9-14: Semi-Annual Mtg., ASP; Chase-Park Plaza Hotels, St. Louis, Mo.

Sept. 12-15: Enamel Div. Fall Mtg., ACS; French Lick-Sheraton Hotel, French-Lick, Ind.

Sept. 11-13: EIA Mtg.; Biltmore Hotel, N. Y. C.

Sept. 13-14: Nat'l Topical Mtg. on Plutonium as a Power Reactor Fuel; Richland, Wash.

Sept. 13-14: 6th Nat'l Symp. on Eng. Writing and Speech, IRE (PGEWS); Mayflower Hotel, Washington, D. C.

Highlights '63

IRE Int'l Conv., Mar. 25-28; Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

WESCON, Western Electronic Show and Conf., Aug. 20-23, IRE, WEMA; Cow Palace, San Francisco, Calif.

NEC, Nat'l Electronics Conf., Oct. 28-30, IRE, AIEE; McCormick Place, Chicago, Ill.

NEREM, Northeast Research and Eng. Mtg., Nov. 4-6, IRE; Boston, Mass.

Sept. 13-14: Joint Eng. Management Conf., ASME; Roosevelt Hotel, New Orleans, La.

Sept. 16-20: Mtg. Electrochemical Soc.; Statler-Hilton Hotel, Boston, Mass.

Sept. 17-18: Hydrofoil & Air Cushion Vehicles, IAS; Shoreham Hotel, Washington, D. C.

Sept. 18-19: "Rectifiers in Industry," 3rd Quintennial Industry-wide Mtg., Industrial Power, Semiconductor Rectifier Committees, AIEE; Deshler-Hilton Hotel, Columbus, O.

Sept. 18-20: Ordnance Environmental Rsrch. Symp. (unclas.), Environmental Rsrch. Ofc., Chief of Ordnance, U. S. Army; El Tropicano Hotel, San Antonio, Tex.

Sept. 19-20: 11th Annual Industrial Electronics Symp., IRE (PGIE); Chicago, Ill.

Sept. 19-21: 6th Nat'l Conf. on Tube Techniques, Advisory Group on Electron Devices, Ofc. of Defense Rsrch. & Eng:; Western Union Audit., New York, N. Y.

Sept. 23-26: Petroleum Mechanical Eng. Conf., ASME; Sheraton-Dallas Hotel, Dallas, Tex.

Sept. 24-26: Nat'l Power Conf., ASME, AIEE; Lord Baltimore Hotel, Baltimore, Md.

Sept. 25-28: Power Systems Conf., ARS; Miramar Hotel, Santa Monica, Calif.

Sept. 26-29: Materials & Equip. & White Wares Div. Fall Mtg., ACS; Bedford Sprgs. Hotel Bedford, Pa.

Sept. 27: A new Look at Thermosets, Binghamton Sec. SPE; Hotel Casey, Scranton, Pa.

Sept. 28-29: 12th Annual Fall Symp., IRE (PGB); Willard Hotel, Washington, D. C.

Sept. 30-Oct. 5: 4th Pacific Area Nat'l Mtg.; Statler-Hilton Hotel, Los Angeles, Calif.

OCTOBER

Oct. 1-2: Annual Mtg., Engrs. Council for Prof. Development; Bellevue-Stratford Hotel, Phila., Pa.

Oct. 1-3: 8th Nat'l Communications Symp., IRE (PGCS); Municipal Audit. & Hotel Utica, Utica, N. Y.

Oct. 1-4: Nat'l Fall Mtg., AWS; Hotel Schroeder, Milwaukee, Wis.

Oct. 1-5: West Coast Testing Exhib., ASTM; Statler-Hilton Hotel, Los Angeles, Calif.

Oct. 1-5: Semi-annual Western Eng. Conf. & Tool Expos., ASTME; Pan Pacific Audit., Los Angeles, Calif.

Oct. 2-4: Nat'l Symp. on Space Electronics & Telemetry, IRE, (PGSET); Fontainebleau Hotel, Miami Beach, Fla.

Oct. 2-4: 3rd Symp. on Advanced Propulsion Concepts; Cincinnati, Ohio.

(*Continued on page* 15)

500:1

INCREASE IN AC RANGE IN THE COMPLETELY NEW FLUKE MODEL 803B AC/DC PRECISION DIFFERENTIAL VOLTMETER

ONLY FLUKE OFFERS an AC/DC differential voltmeter with these outstanding features:

0.2% + 25uv AC measurement accuracy extended to 1mv from 500mv.

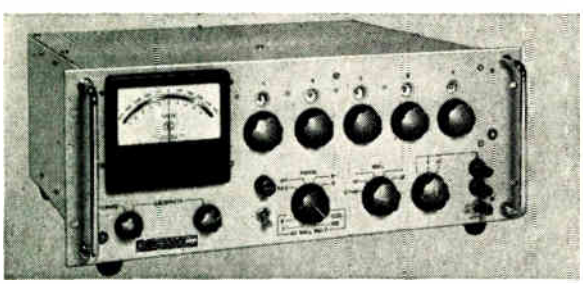
DC polarity reversal switch for negative or positive voltage measurements.

Independent built-in reference for true self calibration of 500V working reference.

Infinite input impedance at null from 0 to 500V DC to eliminate errors caused by circuit loading.

Taut band suspension meter to eliminate meter stickiness.

Extreme circuit stability eliminating need for front panel electrical or mechanical zero adjustments.



PARTIAL 803B SPECIFICATIONS

DC ACCURACY . . . . . ± 0.05% from 0.1 to 500V DC
± 0.05% + 50 uv below 0.1V DC

AC ACCURACY . 20 cps to 10 kcps
± 0.2% from 0.5 to 500V AC
± 0.2% + 25 uv from 0.001 to 0.5V AC

VOLTAGE RANGE . . . . . 0 to 500V

FREQUENCY RANGE . . . . . 5 cps to 10 KC

MAX. FULL SCALE NULL SENSITIVITY . 1mv AC; 10mv DC

REFERENCE ELEMENT . . . . . Standard Cell
(zener diode optional at extra cost)

REGULATION and STABILITY of 500V REFERENCE
± 0.0025% for a ± 10% line change
± 0.005% per hour after 30 min. warmup

PRICE . . . **Cabinet** $875.00
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FLUKE INSTRUMENTS

SEE THE ENTIRE LINE OF NEW FLUKE INSTRUMENTS / COMPONENTS AT WESCON BOOTH 562-563

Coming Events

(*Continued from page* 13)

Oct. 3-6: Annual Mtg., OSA; Manger Hotel, Rochester, N. Y.
Oct. 4-5: Fuels Conf. ASME, AIME; Penn - Sheraton Hotel, Pittsburgh, Pa.
Oct. 4-5: Weapons Systems Technical Panorama, IAS; Dallas, Tex.
Oct. 4-6: Refractories Div. Fall Mtg., ACS; Bedford Spring Hotel, Bedford, Pa.
Oct. 7-9: Basic Science Div. Fall Mtg., ACS; Battelle Memorial Inst., Columbus, Ohio.
Oct. 7 - 12: Fall Gen'l Mtg., AIEE; Pick-Congress Hotel, Chicago, Ill.
Oct. 8-10: Annual Nat'l Electronics Conf. & Exh., IRE, AIEE, EIA, Ill. Inst. Tech., Northwestern Univ., Univ. of Ill.; McCormick Place, Chicago, Ill.
Oct. 8-12: ASCE Annual Mtg. & Nat'l Transp. Eng. Conf., Statler Hotel, Detroit, Mich.
Oct. 8-12: 12th Annual Instrument Symp. & Resrch. Equip. Exh., Nat'l Inst. of Health, Dept. Health, Educ. & Welf., Bethesda, Md.
Oct. 8-12: Nat'l Aeronautic & Space Eng. Mfg. Mtg. & Exh., SAE; Ambassador Hotel, Los Angeles, Calif.
Oct. 9-11: North Central Region Conf., NACE; Detroit, Mich.
Oct. 9-12: Electronics Div. Fall Mtg., ACE; Statler-Hilton Hotel, Boston, Mass.
Oct. 10 - 11: Magnetohydrodynamics Conf.; Mich. State Univ. E. Lansing, Mich.
Oct. 10-12: 20th Annual Aerospace Electronic Expos. / Report, AES; Pan-Pacific Audit., Los Angeles, Calif.
Oct. 11-12: Southeast Regional Conf., NACE; Birmingham, Ala.
Oct. 11-12: 18th Annual SPI New England Sect. Conf.; Wentforth-by-the-Sea, Portsmouth, N. H.
Oct. 12-13: Photographic Electronic Symp., SPSE; Washington, D. C.
Oct. 12-13: Regional Conf., AIIE; El Cortez Hotel, San Diego, Calif.
Oct. 15-16: NAB Regional Conf.; Dinkler-Plaza Hotel, Atlanta, Ga.
Oct. 15-17: Conf. ou Electrical Insulation, Nat'l Academy Science & Nat'l Resrch. Council; Hershey Hotel, Hershey, Pa.
Oct. 15-17: Materials Handling Conf. ASME; Cincinnati, Ohio.
Oct. 15-18: Int'l Symp. on Space Phenomena & Measurement; IRE (PGNS); Hotel Statler-Hilton, Detroit, Mich.
Oct. 15-19: 17th Int'l Instrument-Automation Conf. & Exh., ISA; Coliseum, New York, N. Y.
Oct. 15-19: 1962 AES Fall Conv.; Barbizon-Plaza Hotel, New York, N. Y.
Oct. 15-20: Pacific Coast Regional Mtg. ACS; Olympia Hotel, Seattle, Wash.
Oct. 16-19: South Central Region

(*Continued on page* 167)

Coming Events

(*Continued from page* 15)

Conf. & Exhib., NACE; Granada Hotel, San Antonio, Tex.

Oct. 18-19: Regional Conf., AIIE; Hotel Lafayette, Buffalo, N. Y.

Oct. 18-19: NAB Regional Conf.; Biltmore Hotel, New York, N. Y.

Oct. 21-26: Semi-Annual Conv. & Equip. Exhib., SMPTE; Drake Hotel, Chicago, Ill.

Oct. 22-23: NAB Regional Conf.; Edgewater Beach, Chicago, Ill.

Oct. 22-24: East Coast Conf. on Aerospace & Navigational Electronics (ECCANE), IRE, PGANE; Baltimore, Md.

Oct. 24-25: Computer Applications Symp., ARF; Morrison Hotel, Chicago, Ill.

Oct. 25-26: NAB Regional Conf.; Statler - Hilton Hotel, Washington, D. C.

Oct. 25-27: 1962 Electron Devices Mtg., IRE (PGED); Sheraton-Park Hotel, Washington, D. C.

Oct. 26-27: Midwest Quality Control Conf., ASQC; Statler-Hilton Hotel, Denver, Colo.

Oct. 29-31: 15th Conf. on Electrical Techniques in Medicine & Biology, ISA, AIEE, IRE; Edgewater Beach Hotel, Chicago, Ill.

Oct. 29-31: Mtg. Soc. of Rheology; Johns Hopkins Univ., Baltimore, Md.

Oct. 29-31: Sym. "Dynamics of Manned Lifting Planetary Entry," AF-OSR; Phila., Pa.

Oct. 29-Nov. 2: World Metal Show & 44th Nat'l Metal Congress, ASM; Coliseum, New York, N. Y.

Oct. 29-Nov. 2: Annual Conv., Soc. for Nondestructive Testing; Hotel Commodore, New York, N. Y.

Oct. 30-31: Nat'l Spaceborne Computer Eng. Conf., IRE (PGEC); Disneyland Hotel, Anaheim, Calif.

INTERNATIONAL

July 22-28: 8th Int'l Cancer Congress, IUC; Moscow, USSR.

Aug. 5-11: 2nd Int'l Cong. of Radiation Rsrch., ARR; Harrogate, Yorkshire, England.

Aug. 26-Sept. 1: 10th Int'l Cong. of Radiology, ISR; Montreal, Quebec, Canada.

Aug. 27-Sept. 1: 2nd Int'l Cong. on Information Processing, IFIPS; Munich, Germany.

Aug. 27-Sept. 1: 3rd Int'l Cong., ICAS; Stockholm, Sweden.

Sept. 7 - 12: Int'l Conf. on Crystal Lattice Defects (including section on radiation damage), PSJ; Kyoto, Japan.

Sept. (date not specified): Conf. on Components for Microwave Circuits, IEE (British); Savoy Place, London, England.

Sept. 3-7: Int'l Symp. on Information Theory, IRE (PGIT); Free Univ. of Brussels, Brussels, Belgium.

Sept. 10-19: 1st Int'l TV Program & Equip. Fair, Lyons Int'l Fair, R.T.F.; Lyons, France.

Sept. 13-14: Symp. on Advanced Gas-Cooled Reactors, BNEC; London, England.

"CALL FOR PAPERS"

3rd Quantum Electronics Conference, Feb. 11 - 15, 1963, Paris, France. Resumes of papers to be submitted by **November 1, 1962,** to: Madame Cauchy, Secretaire 3eme Congrès d'Electronique Quantique; 7, Rue de Madrid—Paris VIIIe. Manuscripts themselves should be given the first day of the conference.

1963 PGMTT (IRE) Nat'l Symp., May 20-22, 1963, Miramar Hotel, Santa Monica, Calif. Papers should represent original contributions in the field of microwave theory and techniques. Only papers not published or presented prior to the symposium will be considered. Any approval necessary from cognizant authority must be granted prior to submission of the paper. The following materials should be submitted by **Jan. 5, 1963:** a 100-word abstract, in duplicate, with title, name and address; a 1000 - word summary, in duplicate, with title, name and address. Forward to Dr. Irving Kaufman, Chairman, Technical Program Committee; Space Technology Laboratories, Inc.; 1 Space Park, Redondo Beach, Calif.

ENGINEERING EDUCATION

Short courses of interest to engineers.

Maintainability Conference

The Fourth EIA Conference on Maintainability of Electronic Equipment will take place **Aug. 28-30** at the University of Colorado, Boulder, Colo. Theme of meeting is "Design Guidance for Maintainability." Workshop sections will be featured. A field trip to the Boulder Laboratories. National Bureau of Standards, will be held Aug. 27, the day preceding the conference. For additional information, write: Engineering Office, Electronic Industries Association; Room 2260, 11 W. 42nd St.; New York 36, New York.

Miami Survey Available

The second edition of the "Economic Survey of Metropolitan Miami," covering every conceivable item of interest to the industrialist, has been completed by the Dade County Development Dept. and is now available.

The book, with 31 different sections and more than 400 pages, is 25% larger than the first edition published in 1959.

To obtain it, send $3.50 to the Dade Development Dept., 345 NE 2nd Ave., Miami, Fla. Cost is $3 if requested in person.

RNF Flexible — FLAME RETARDED — Irradiated Modified POLYOLEFIN.

RF Flexible — CLEAR — Irradiated Modified POLYOLEFIN.

CRN High Strength — SEMI-RIGID — Flame Retarded — Irradiated Modified POLYOLEFIN.

CR High Strength — SEMI-RIGID — CLEAR — Irradiated Modified POLYOLEFIN.

TFE High Strength — NON-FLAMMABLE — Clear — Modified FLUOROCARBON.

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NT Flexible — THERMALLY STABILIZED — Cross-linked — Modified NEOPRENE rubber.

ST Flexible — FLAME RETARDED — Cross-linked — Modified SILICONE rubber.

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News Briefs

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

EAST

GENERAL ELECTRIC CO's. MISSILE and SPACE VEHICLE DEPT., Philadelphia, Pa., has been awarded a USAF incentive contract totalling $16,750,000 for production for operational re-entry vehicles (nose cones) for the Titan II ICBM.

METRIC SYSTEMS CORP., Fort Walton Beach, Fla., has purchased the assets of the **SOUTHERN DIV. of CANOGA ELECTRONICS CORP.**, of the same city. Metric will continue work in tracking radar systems, digital data systems, timing and telemetry.

ACCURACY, INC., has occupied its new 15,000 sq. ft. plant on Route 129 in Chelmsford, Mass. The plant will be used to manufacture precision rotary components.

INTASPACE CORP. has moved to a new location, 715 Fairfield Ave., Kenilworth, N. J. The new location more than doubles their old production area at Bloomfield, N. J.

ITT FEDERAL LABORATORIES, Nutley, N. J., has opened a southeastern regional sales office at 400 N. Orlando Ave., Cocoa Beach, Fla.

RAYTHEON CO's. SURFACE RADAR and NAVIGATION OPERATION, Wayland, Mass., will develop specialized radar equipment for the Navy's hydrofoil submarine chaser, under a $200,000 sub-contract from the **BOEING CO.**, Seattle, Wash.

SPRAGUE ELECTRIC CO., N. Adams, Mass., has acquired, as a wholly-owned subsidiary, **SKY-BORNE ELECTRONICS**, Santa Fe Springs, Calif. The transactions was for an undisclosed amount of Sprague stock. Sky-Borne produces delay lines, low-pass and special filter, and custom inductors.

AMERICAN ELECTRONIC LABORATORIES, INC., Colmar, Pa., has begun construction on a new plant which will increase total plant area at Colmar to 84,000 sq. ft. Completion of the new facilities, expected late this fall, will more than double present plant area.

SEALECTRO CORP. has completed a plant expansion program which increased manufacturing and administrative space by more than 30%. Sealectro's main plant at Mamaroneck, N. Y., was expanded to 20,000 sq. ft.

AMERICAN OPTICAL CO's. RESEARCH CENTER has received a $82,265 contract for applied research in optical masers from the Boston Ordnance District.

WEINSCHEL ENGINEERING, Kensington, Md., has broken ground for a $750,000 plant in the Metropolitan Grove Industrial Park, Gaithersburg, Md. The one-story structure will contain over 35,000 sq. ft. when completed.

THE BENDIX CORP., ECLIPSE-PIONEER DIV., Teterboro, N. J., has received a $429,599 sub-contract for production of angular accelerometers used in the Minuteman ICBM, from **AUTONETICS, A DIV. OF NORTH AMERICAN AVIATION, INC.**, Downey, Calif.

MICROLAB, Livingston, N. J., has completed a 15,000 sq. ft. addition to their present plant. The new section will be used by the Engineering Dept., the laboratory, and for executive offices. This is the third expansion in three years.

NASA is negotiating a $1,066,000 contract with **WESTINGHOUSE ELECTRIC CORP.**, Pittsburgh, Pa., for the construction and testing of spacecraft prototype and flight models for the S-52 satellite project. The S-52 will be the second of 3 satellites in the cooperative international program between the United States and the United Kingdom.

SUPERIOR TUBE CO., Norristown, Pa., has announced completion of a 15,000 sq. ft. addition at its Norristown plant which will house its nondestructive testing center. Also nearing completion at its main plant is a 15,000 sq. ft. building to house its **NUCLEAR PRODUCTS DIV.**

VITRO LABORATORIES, DIV. of VITRO CORP. OF AMERICA, Silver Spring, Md., has been awarded 2 contracts totaling $697,380 for work on the U. S. Navy surface-to-air guided missile weapons systems, Terrier and Tartar. The first contract, $499,856, is for system engineering and related services connected with installation, check-out and test of the Terrier; the second contract, $197,524, is for a training program on the Tartar.

DOUGLAS MICROWAVE CO., INC., Mt. Vernon, N. Y., has received a contract from the Aviation Supply Office, Dept. of the Navy, for it's Model #502 Bi-Directional Power Monitors.

MELPAR, INC., Falls Church, Va., has transferred its **APPLIED SCIENCE DIV.** from Watertown, Mass., to recently completed research facilities in Fairfax County, Va.

BULOVA RESEARCH and DEVELOPMENT LABORATORIES DIV. of BULOVA WATCH CO., INC., Woodside, N. Y., has received contracts of nearly $1 million from **BOEING AIRPLANE CO.**, Seattle, Wash. The contracts are for the development of a special safety switch which will be used as a final link for ground control of the Minuteman ICBM before it is launched.

MIDWEST

COOK ELECTRIC CO., Chicago, Ill., has received a sub-contract totalling $300,000 for tape programmer units, from Autonetics, A Div. of North American Aviation, Inc. of Downey, Calif.

MOTOROLA, INC., Chicago, Ill., has formed a wholly-owned sales subsidiary, **MOTOROLA INSTRUMENTATION and CONTROL, INC.**, Phoenix, Ariz. The subsidiary will market the lines of instrumentation, supervisory and process control equipment and systems developed and produced by Motorola's **SOLID STATE SYSTEMS DIV.**, Phoenix, Ariz.

CLEVITE ELECTRONIC COMPONENTS, DIV. of CLEVITE CORP., Bedford, Ohio, has announced a more than $1,000,000 expansion program to double existing manufacturing facilities in Bedford. The addition of 32,000 sq. ft., to be used for office and engineering spaces, is scheduled for completion late this fall.

MATHIAS KLEIN & SONS, INC., Chicago, Ill., has announced plans for an addition to their present building of 21,000 sq. ft. The increased area will be used for machine shop and forging facilities.

BRUSH INSTRUMENTS, Div. of Clevite Corp., Cleveland, Ohio, has established a new district sales office at 1921 N. Harlem Ave., Chicago, Ill.

WEST

AMERICAN MICRO DEVICES, INC., Phoenix, Ariz., has begun production of silicon glass packaged computer diodes in its new 23,500 sq. ft. facilities.

ARNOLD MAGNETICS CORP., Los Angeles, Calif., has merged with **SONITHERM CO., INC.**, Monterey Park, Calif. Sonitherm will continue to operate as a division of Arnold.

FAIRCHILD CAMERA and INSTRUMENT CORP., DEFENSE PRODUCTS DIV., Syosset, L. I., N. Y., has opened a new manufacturing facility in the Stanford Industrial Park, Palo Alto, Calif. The 10,560 sq. ft. facility will be known as the **DEFENSE PRODUCTS DIV.-PALO ALTO.**

HUGHES AIRCRAFT CO., Culver City, Calif., has opened a new field office for engineering representation in Houston, Tex., at Room 1109, in the Texas National Bank Building.

ELGIN NATIONAL WATCH CO's. ELECTRONICS DIV., Burbank, Calif., has changed its name and will now be known as the **CONTROLS DIV., INDUSTRIAL GROUP.**

HOFFMAN ELECTRONICS CORP., MILITARY PRODUCTS DIV. has announced plans to build a million-dollar manufacturing plant in El Monte, Calif. Part of the division will move to the new 105,000 sq. ft. facility, but the major portion of the operations will remain in Los Angeles, Calif.

PERKIN ELECTRONICS CORP., El Segundo, Calif., has received a $120,000 contract from the Radio Corp. of America, for computer-type dc power supplies.

RADIO CORP. of AMERICA, DATA SYSTEMS DIV., Van Nuys, Calif., has received a sub-contract for $350,000 for production of components used in Minuteman's aerospace ground equipment, from Autonetics, A Div. of North American Aviation, Inc., Downey, Calif.

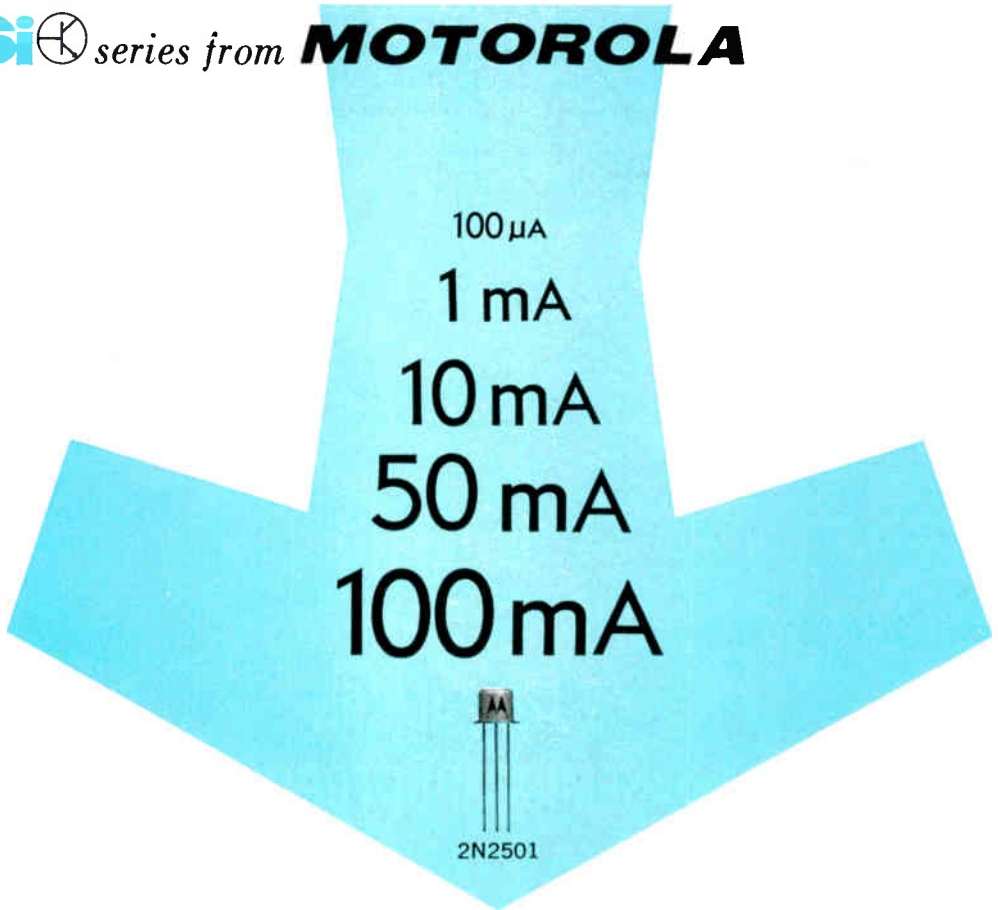
ADCOM CORP., has commenced manufacturing operations at their new facilities, located at 9732 Cosycroft Ave., Chatsworth, Calif. Incorporated in California, November, 1961, the new company will operate in the field of analog-to-digital conversion and digital communications techniques, and will produce high density digital data transmission and recording devices.

SYNTHANE CORP., SYNTHANE-PACIFIC DIV., has announced expansion plans, which will double the size of it's fabricating and warehousing facilities at Glendale, Calif. An increase in fabricating equipment is also included.

GENERAL ELECTRODYNAMICS CORP., Garland, Tex., has received a contract in excess of $1 million from **AIRCRAFT ARMAMENTS, INC.**, Cockeysville, Md. The contract is for scan conversion units, which convert video information from digital form into a PPI format.

PRD ELECTRONICS, INC., SUB. of HARRIS-INTERTYPE CORP., has moved its West Coast headquarters to new facilities at 1945 S. Figueroa St., Los Angeles, Calif. PRD sales offices and warehouse facilities will be housed in the new headquarters, as will be the Los Angeles personnel of Harris-Intertype's other divisions.

another Si *series from* **MOTOROLA**



the most *completely specified* silicon epitaxial planar logic switch!

Whether you're designing switching circuits at 100 μA or as high as 100 mA, you can design with confidence using the new Motorola 2N2501 NPN silicon epitaxial planar logic switch.

This new high-gain transistor is characterized over its optimum usable current range, with beta specified from 100 μA to 100 mA, including measurements at 1, 10, and 50 mA.

And, with the specified active region time constant and total control charge parameters, you can more closely predict performance at various operating conditions (using a standard formula) than ever before.

In addition, saturation voltage is specified at 10, 50, and 100 mA, with extremely low values for these critical ratings.

The Motorola 2N2501 (TO-18 package) is specifically designed for low-level logic switching in the 100 μA to 100 mA region, and is supported by fuller, more definitive specifications than available in any present device.

Units are immediately available to meet your production requirements, or if you have a present application in which you would like to evaluate this new type, contact your nearest Motorola District Office. An engineering representative will advise you how you may obtain free samples.

MOTOROLA 2N2501* PERFORMANCE SPECIFICATIONS

BV_{CBO}	40 volts (min)					
BV_{CEO}	20 volts (min)					
BV_{EBO}	6 volts (min)					
h_{FE} @ V_{CE} = 1 V	I_C = 100 μA	I_C = 1 mA	I_C = 10 mA	I_C = 10 mA @ −55°C	I_C = 50 mA	I_C = 100 mA
	20 (min)	30 (min)	50 (min) 150 (max)	20 (min)	40 (min)	30 (min)
$V_{CE(SAT)}$ @ I_C = 10I_B	I_C = 10 mA 0.2 V (max)			I_C = 50 mA 0.3 V (max)		I_C = 100 mA 0.4 V (max)
τ_S @ I_C = I_{B1} = I_{B2} = 10 mA	15 nsec (max)					
τ_A (Active Region Time Constant)	2.5 nsec (max)					

*TO-18 Package

The following Motorola silicon epitaxial logic transistor types are also available from your nearest Motorola Industrial Distributor or District Office:

2N834 2N835 2N744
2N914 2N706 2N753
2N708

For your copy of the complete electrical specifications on the new Motorola 2N2501 transistor, call or write Motorola Semiconductor Products Inc., Technical Information Department, 5005 East McDowell Road, Phoenix, Arizona.

MOTOROLA
Semiconductor Products Inc.

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2007

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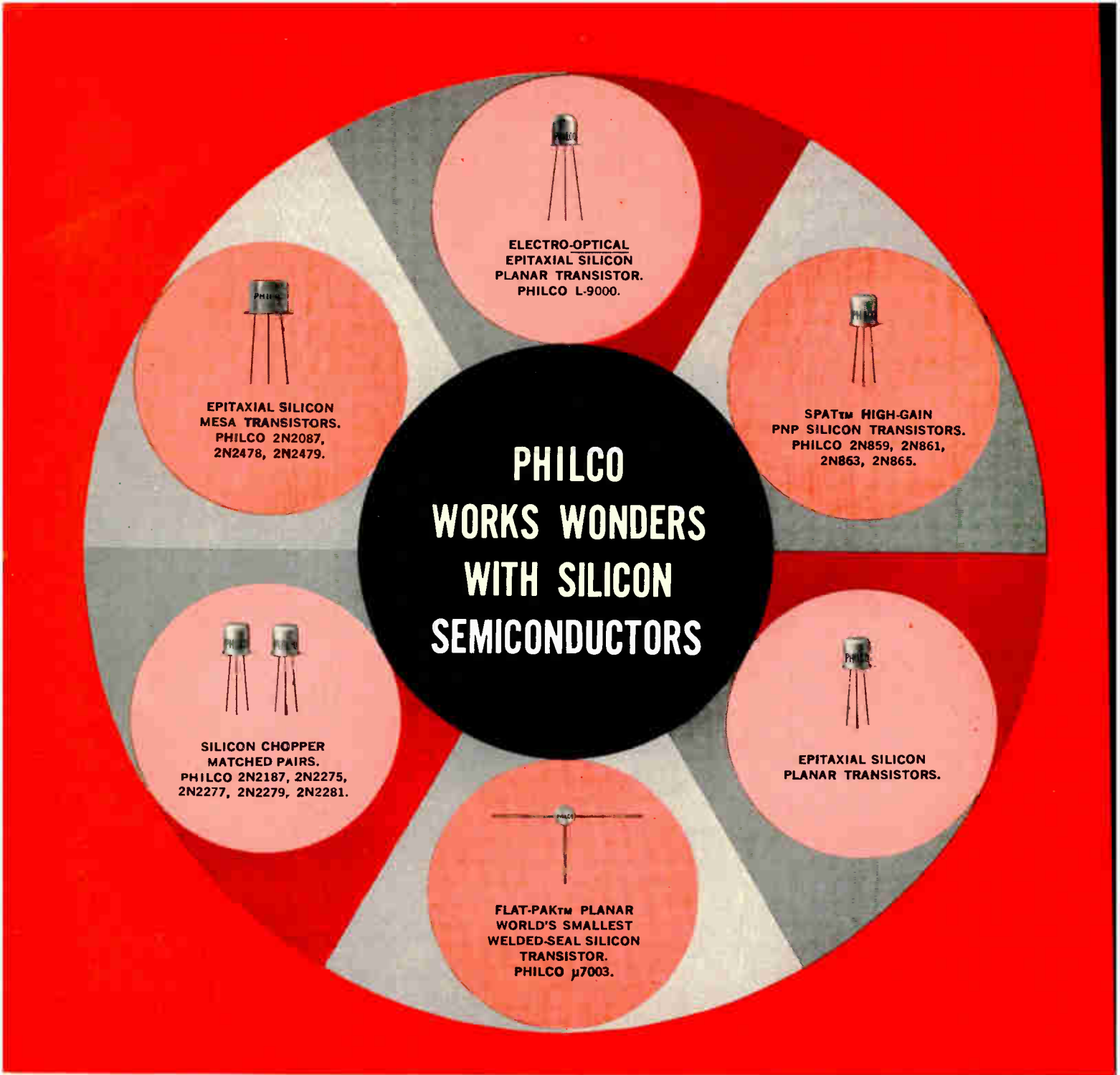


Philco silicon transistors do new jobs in every realm of circuit design. Faster switching, optical switching, tinier switches and better matched low-level (chopper) switches—all follow Philco's firm foundation of component uniformity and reliability.

You expect Philco to deliver extras in transistor design and reliability. Philco has earned this expectation in germanium transistors—both in communications and switching types. Look for these extras in Philco *silicon* transistors, too.

For data and application assistance in specific silicon transistor categories, write on your letterhead to Dept. EI 862.

DISCUSS THESE
NEW SILICON SEMICONDUCTORS
WITH PHILCO ENGINEERS AT
WESCON, BOOTHS 3401 and 3402.

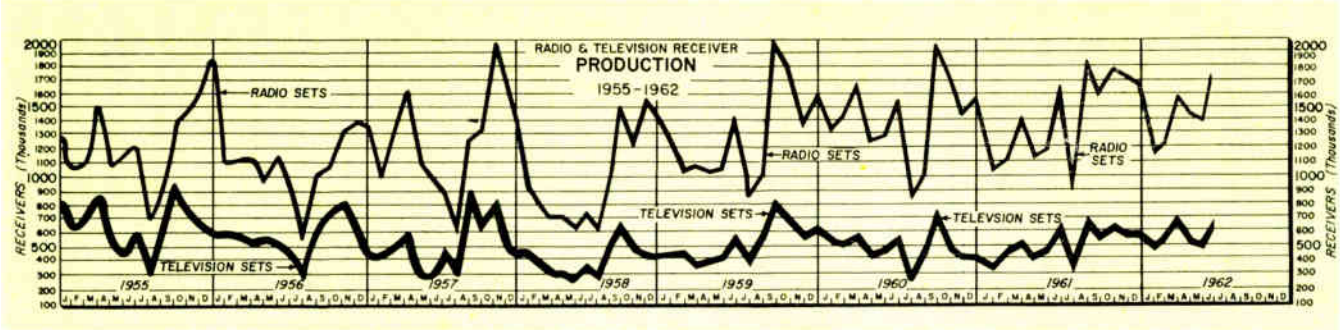
PHILCO®

A SUBSIDIARY OF *Ford Motor Company*

LANSDALE DIVISION, LANSDALE, PA.

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 June, 1962.

Accelerators	169,644
Accelerometer	1,463,000
Altimeter	48,396
Amplifiers	2,990,237
Analog-to-Digital conversion system	195,075
Antennas	2,086,142
Attenuators	147,167
Batteries	2,049,643
Cable assy	254,617
Cable, coaxial	38,070
Cable, instrumentation	148,425
Cable, telephone	138,438
Capacitors	80,694
Communication equipment	6,385,520
Comparator	688,770
Computers	2,956,572
Connectors	730,082
Control system	816,861
Controls	395,759
Countermeasures set	1,052,868
Counters	49,620
Data monitoring set	974,253
Dataplotter	93,645
Degaussing equipment	726,914
Demodulator	54,000
Detectors	301,713
Digital data acquistion system	220,000
Digital trainer	75,250
Digital X-Y plotter	40,871
Digital data terminal	151,848
Discriminator system	35,487
Dosimeters, radiological	6,483,279
Dummy load, electrical	31,711
Electron guns	46,000
Electronic control systems	213,260
Environmental chamber	27,860
Equalizer system	58,530
Filter	141,759
Global tracking network	215,028
Gyros	1,000,417
Handset boxes	26,880
Headset	81,350
Indicator	197,907
Infrared radiometer	284,626
Intercommunication system	121,970
Intrusion detection equipment	73,301
Laser	224,914
Loudspeaker	139,409
Magnetic core storage unit	57,720
Magnetic memory disc files	318,600
Magnetron assys	181,000
Mass spectrometer	115,432
Meteorological systems, airborne	1,072,088
Meters	5,485,315
Microphones	25,000
Microscope, electron	30,685
Navigation equipment	2,072,671
Noise measuring set	77,622
Oscillators	362,439
Oscillograph	247,200

(Continued on page 215)

British Exports of Electronic Products to the U. S., Annual 1959-1961

Product	Quantity in thousands of units			Value in thousands of dollars[3]		
	1959	1960	1961	1959	1960	1961
TOTAL	.....	.....	.....	21,974	19,645	22,339
Radio receivers, complete	9.7	7.5	2.8	292	200	81
Radio phonographs, complete	2.4	2.0	(x)	232	190	14
Speakers and microphones	.....	.....	.....	532	699	784
Phonographs, electronic, and record players	4.7	19.6	6.8	147	362	116
Phonograph parts and accessories	.....	.....	.....	1,207	727	702
Record playing mechanisms:						
With record changer	1,251.7	861.1	1,120.5	11,739	7,920	10,780
Without record changer	102.2	38.3	11.4	623	219	105
Tape recorders and reproducers	(x)	(x)	20.7	58	43	841
Tape decks	.....	.....	.....	18	21	108
Recording tapes	.....	.....	.....	88	209	190
Electron tubes:						
Cathode ray	2.5	3.2	2.8	30	80	47
"Special"[1]	.....	.....	.....	132	290	229
Other:						
50 watts and less	4,575.3	4,483.3	5,730.3	2,026	1,920	2,348
Over 50 watts	3.4	1.7	12.5	194	201	620
Electron tube parts[2]	.....	.....	.....	97	306	277
Transistors	(4)	8.9	47.3	(4)	10	50
Electronic components and parts, other	.....	.....	.....	1,243	1,458	1,564
Communications, navigation, and radar equipment	.....	.....	.....	2,178	2,813	1,675
Other electronic products	.....	.....	.....	1,138	1,977	1,808

[1] Thyratrons, hot cathode mercury vapor and gas filled rectifiers (excluding mercury-arc rectifiers), photo-electric cells (excluding photo-transistors), stabilizing and cold cathode tubes, magnetrons, klystrons.

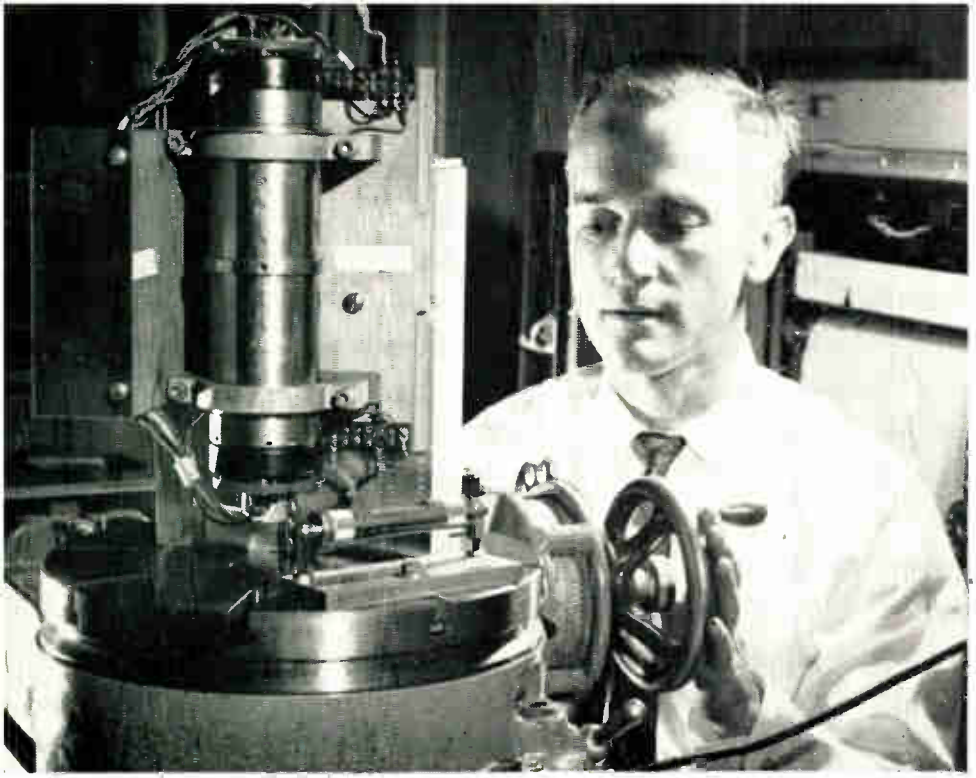
[2] Excluding glass bulbs.

[3] Converted from pounds sterling to U. S. dollar equivalents at the rate of £1=$2.80.

[4] Included in electron tubes.

(X) Less than 500.

Source: Data compiled by the British Radio Equipment Mfrs'. Assoc. from Statistics of H. M. Customs and Excise.



THERMOELECTRIC GENERATOR

Experimental thermoelectric generator, developed by RCA, produces electricity from high temperature heat. It uses thermocouples containing new RCA germanium-silicon alloy.

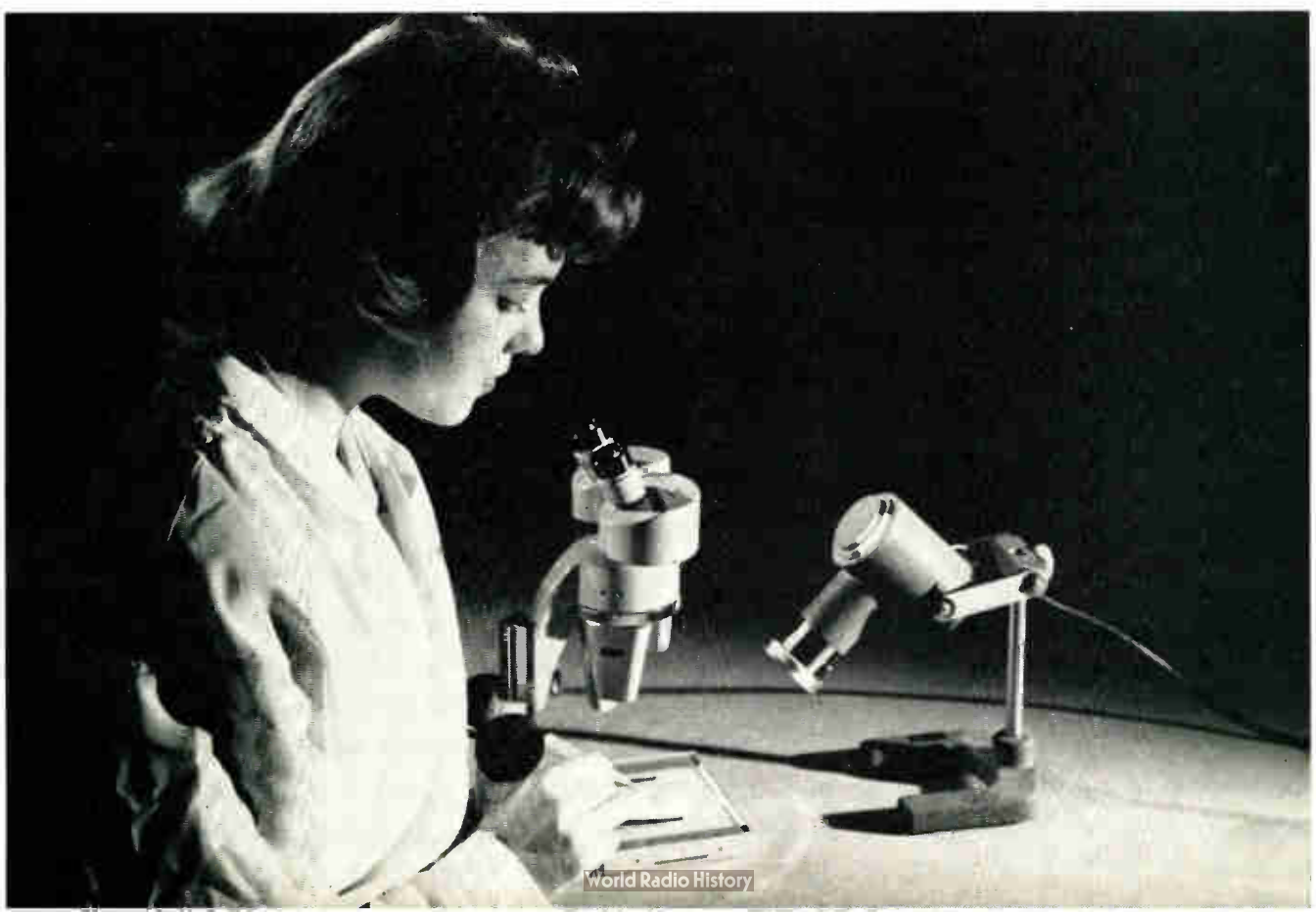
FLUID SPHERE GYRO

Heart of this fluid sphere gyro, developed by Sperry Gyroscope Co., Great Neck, N.Y. is a spinning mass of liquid confined within a hollow sphere. Liquid was substituted in place of the conventional rotating wheel.

Snapshots . . . of the Electronic Industries

"MARTEC"

Janie Lomax, an associate engineer with the Orlando division of the Martin Co., prepares a new MARTEC (Martin Thin Electronic Circuit) computer circuit for examination under a microscope. The tiny circuits are designed for space age electronic requirements.



"SPACE" MATERIALS

"Spaceman" E. Fritz stands beside chair and "igloo" which were formed from new plastic foam material developed by Hughes Aircraft Co. Forms for the lightweight structures were covered with discs that foamed into a hardened mass after exposure to solar radiation.

ASTRONOMICAL TABLES

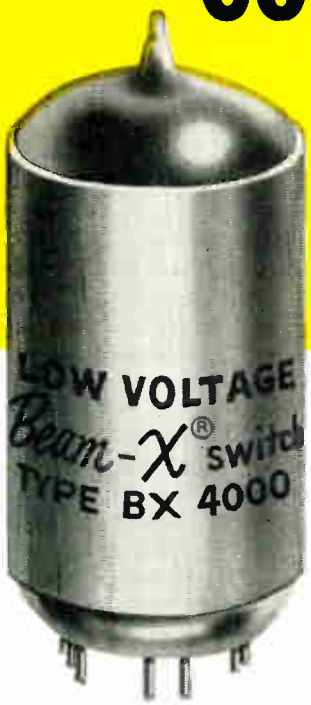
Babylonian clay tablets like these are being dated by means of astronomical information on them through use of tables produced by an IBM mathematician and an electronic computer. Tables give positions of the Planets for five or ten day intervals for the years 601 B.C. to A.D. 1—all for 7 P.M. Babylon time. Dating of fragments will then date any astronomical information on them.

DIAGNOSIS & TREATMENT

Technicians at General Dynamics Corp. in San Diego use doctor's instruments in production of radar systems. Stethoscope (l) detects potential leaks around edge of vacuum chamber. Resin is injected by hypodermic needle (r) along edge of plastic "dish" to seal defect.

what's best for LOW VOLTAGE COUNTING and TIMING?

the "Applications-Oriented" Beam-X® SWITCH



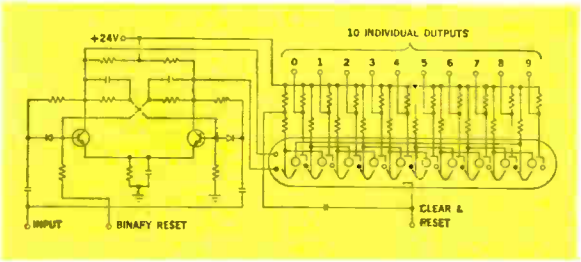


Fig. 1 BEAM-X Switch Decade Counter

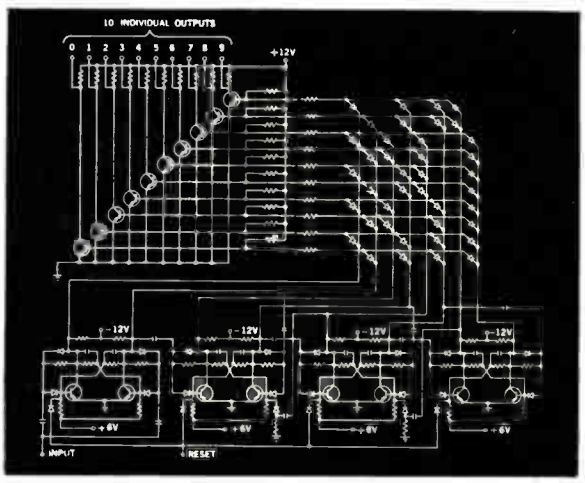


Fig. 2 Transistor Decade Counter

Now there is a BEAM-X Switch which is specifically designed and tested for low voltage systems . . . the BX-4000. Its 10 constant current outputs make the BX-4000 ideal for multiple output applications, such as timing, pulse train encoding, distributing, variable preset counting, and frequency dividing. It is one of the new series of high speed low voltage Beam-X Switches operating in the B+ range of 9 to 30 volts.

Figure 1 shows a typical Low Voltage BX-4000 circuit which utilizes only 41 components. Features of the circuit are:

- MULTIPLE OUTPUTS TO PERFORM PRE-SETTING AND COUNTING FUNCTIONS
- OPERATION FROM 24 VOLT SUPPLY
- COMPATIBLE WITH TRANSISTOR DRIVER CIRCUITRY
- GREATER RELIABILITY DUE TO CIRCUIT SIMPLICITY

Figure 2 illustrates the all solid state circuit which would be required to perform the same multi-output functions. Since transistors are "on-off" or binary devices, they require complex circuitry to perform simple decimal functions such as distributing, switching and counting. In this case, a total of 162 components are required, which increases the cost and decreases the reliability of the system.

Superior Beam-X Switch performance is available in a whole new line of "applications-oriented" tubes.

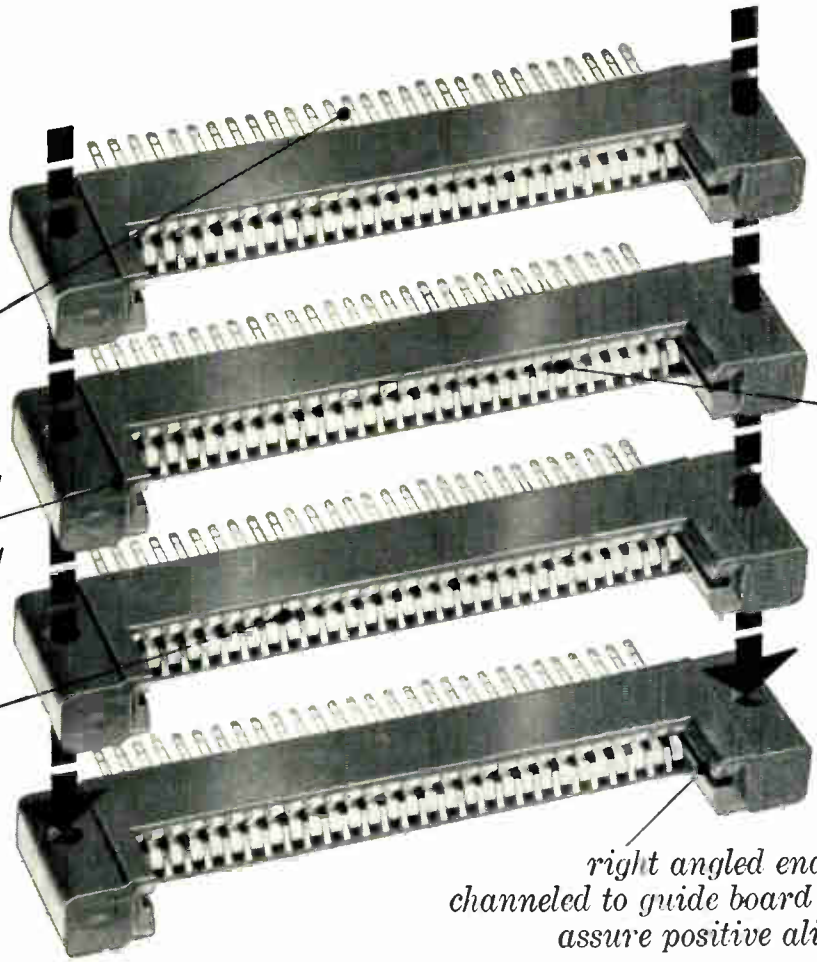
Write today for our new Circuits and Applications Brochure on "Applications-Oriented" BEAM-X Switches and Modules.

See us at WESCON Show Booth 1017 & 1018

ANOTHER ELECTRONIC CONTRIBUTION BY
Burroughs Corporation
ELECTRONIC COMPONENTS DIVISION
PLAINFIELD, NEW JERSEY

Circle 45 on Inquiry Card

NEW PC CONNECTOR



FOR HIGH DENSITY CIRCUITS

Model 600-121-29X connectors pictured here are Continental's answer to tough problems of high density printed circuit packaging. Designed for 1/16" PC board, they provide 29 dual contacts on .100 center-to-center spacing. And—their interlocking body design permits connectors to be stacked in any reasonable quantity, with less than .02" cumulative width tolerance in a stack of ten. The unique right angled ends are channeled to guide the circuit board into the receptacle, assure positive alignment and contact with minimum board insertion depth. Solder lug terminations accept #24 AWG wire.

At Continental, new high density connector designs are constantly under development. Our Engineering Department will be pleased to assist you in solving special connector problems. Simply call or write, outlining your requirements.

DESIGNERS' DATA FILE

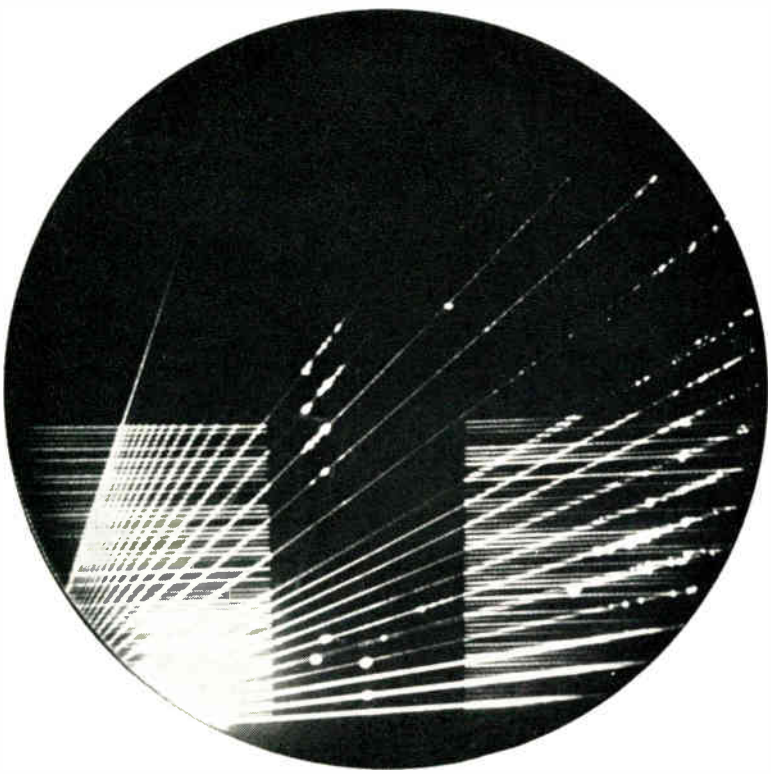
If you're designing for high density packaging you'll want to have Continental's Con-Dex File PC, compiled to help you select and specify the PC connectors best suited to your needs. For your copy, please write to: **Continental Connector Corporation, 34-63 56th Street, Woodside 77, New York, or call TW 9-4422.**

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

CONTINENTAL CONNECTORS

CONTINENTAL CONNECTOR CORPORATION • WOODSIDE 77, NEW YORK

HUGHES TONOTRON TUBES



BRIGHTER, LONGER-LASTING RANGE/HEIGHT DISPLAY

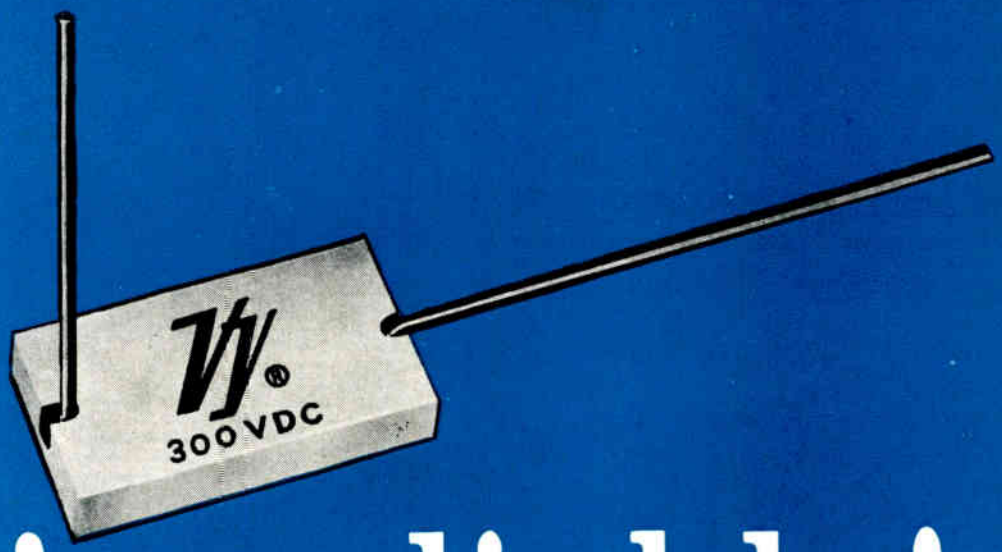
Modern command-control radar systems demand a clear and accurate presentation of second-by-second changes as they occur so that immediate action can be taken. ■ Unlike standard CRT's, Hughes Tonotron* tubes possess a storage capability which permits retention of the target trace at optimum brightness. Fading of the target or its track is controllable for periods up to 20 seconds or more. And this storage capability makes possible time-shared presentation of the basic display **plus** a moving electronic cursor. ■ Thousands of Hughes Tonotron storage tubes are in use throughout the world. For full information on how they may help solve your display presentation problems wire or write today: **HUGHES STORAGE TUBES,** Vacuum Tube Products Division, Hughes Aircraft Company, 2020 Short Street, Oceanside, California. ■ For export information, write: Hughes International, Culver City, California. *Trademark Hughes Aircraft Company

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIVISION

10,000 hours without parametric drift...



it's reliable!

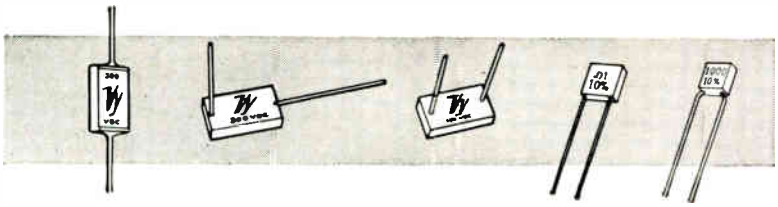
VY T.M.

solid state
PORCELAIN CAPACITORS

* low loss
* low noise
* greater stability
* wide temperature range
* impervious to humidity

−55°C to +125°C operation
0.5 mmf to 6800 mmf
50 to 500 vdc
Conforms to MIL-C-11272B

Punishing life tests under both accelerated and long term conditions have verified the reliability of "VY" Capacitors for use over extended periods of time. After an accelerated test of 10,000 hours at 125°C with 150% of rated voltage applied (equivalent to a 5-year test at maximum rated conditions) Dissipation Factor was .00203 and Insulation Resistance 10^{10}. After a long term test of 30,000 hours at 25°C and rated voltage, Dissipation Factor was .00072 and Insulation Resistance 100 ohm farads. In actual application, "VY" Capacitors designed into VANGUARD II are still performing after more than two years in orbit.



Vitramon®
INCORPORATED
Box 544 • Bridgeport 1, Connecticut

SPERRY microwave memo

Sperry offers 60-day delivery on a low-cost K band reflex klystron

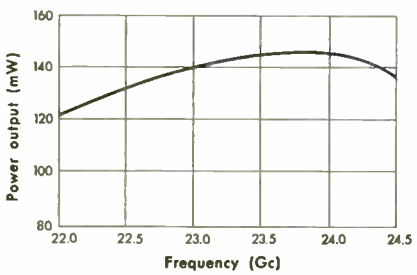
The SRK-291, a new low-cost K band reflex klystron oscillator offering dramatic cost savings in microwave systems, is now available from Sperry Electronic Tube Division within 60 days from receipt of your order! Sperry's new tube operates at frequencies ranging from 21 to 24.5 Gc. Within these frequency limits, it offers a 1½ Gc mechanical tuning range and a low temperature coefficient. The SRK-291 is priced at only $1495.

PARAMETRIC PUMPING APPLICATIONS

The SRK-291 is specially suited to the requirements of parametric amplifier pumping, since its power output — 80 mW minimum — is more than adequate for parametric amplifier pumping demands. Its low price, wide bandwidth, and inherent stability remove the technical and economic limitations that formerly hindered the use of parametric amplifiers in many systems.

OTHER APPLICATIONS

Sperry's versatile new tube also shows great desirability for application in short range communications systems, beacons, and microwave links. Extreme mechanical ruggedness, light weight (only 3½ oz.), and small size, make the tube ideal for airborne as well as ground-based installations.



SRK-291, typical P out vs. Freq.

NEW, FREE BROCHURE

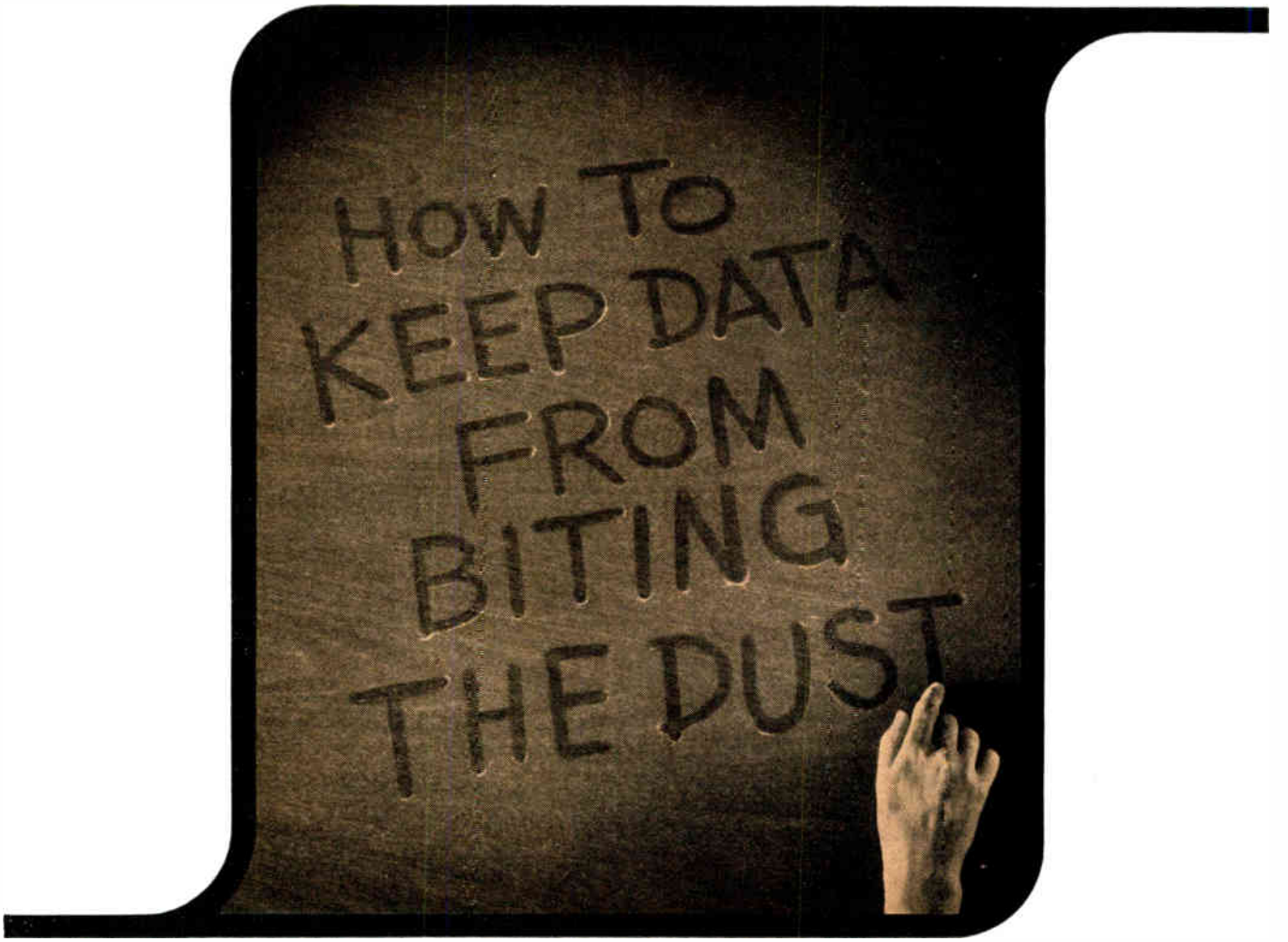
A new, free brochure describes the capabilities of the SRK-291 in greater detail. For your copy, write to Sperry Electronic Tube Division, Sec. 145, Gainesville, Florida.

Since the SRK-291 is available within 60 days, it represents an *immediate* solution to your present problems, whether you are designing a new system or concentrating on improved performance for an operational one. Cain & Co., which represents Sperry nationally, has a sales engineer near you. He'll be happy to help you work out specification details. Call him today.

SPERRY ELECTRONIC TUBE DIVISION

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

First as a matter of record . . . SCOTCH® BRAND Instrumentation Tapes



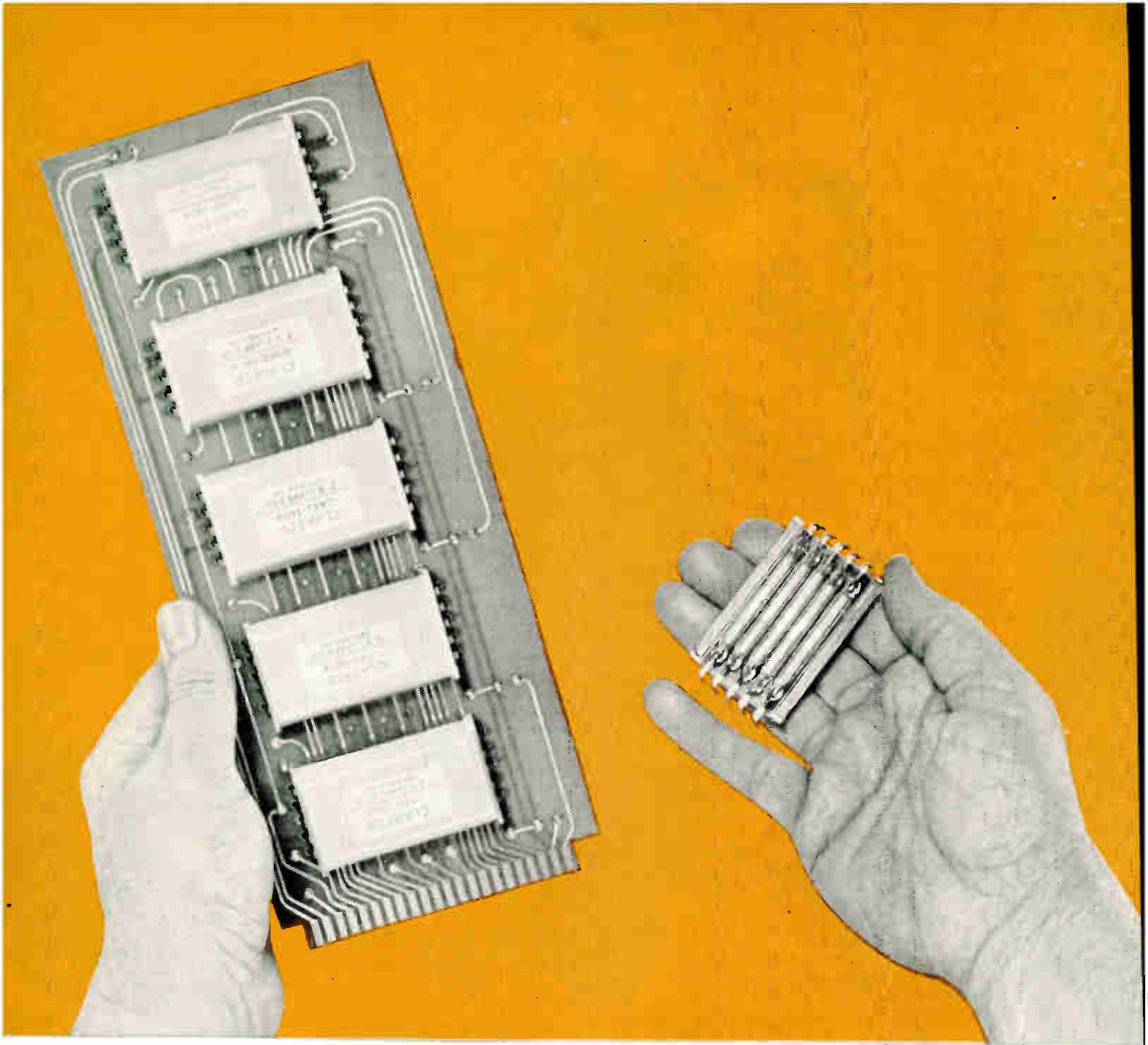
1000 times more conductive "SCOTCH" Heavy Duty Tapes drain off static-caused dust problems!

Airborne dust can be a king-size problem when it separates magnetic tape from signal, *you* from accurately recorded data. That danger mounts as today's higher tape speeds and tensions generate more and more dust-attracting static electricity. That's *one reason* why high-speed recorders need "SCOTCH" BRAND Heavy Duty Instrumentation Tapes . . . they provide 1000 times greater conductivity than ordinary tapes, drain off static charges before they cause trouble!

Electrical resistance of the heavy duty oxide coating is only 100 megohms per square or less. Static is readily dissipated to keep tape clean, prevent such other static problems as tape drag and skewing, as well as noise induced by arcing.

"SCOTCH" Heavy Duty Tapes outwear conventional tapes at least 15 times. Special binder and high-potency oxide formulation defeats head-heat buildup, withstands temperatures from -40°F to as high as 250°F! Silicone lubrication protects recorder heads and tape against wear.

16 different "SCOTCH" Heavy Duty Instrumentation Tapes offer a variety of backing and coating thicknesses, provide constructions for all high-speed applications, even for extreme high frequencies, critical short wavelength requirements. For details, call the 3M representative, or write Magnetic Products Division, Dept. MBR-82, 3M Company, St. Paul 19, Minn.



A Good Idea,

Complete isolation between input and output is essential to effective selection systems, which must handle analog or digital information.

This Clareed Selection Module provides that isolation—as well as other important advantages.

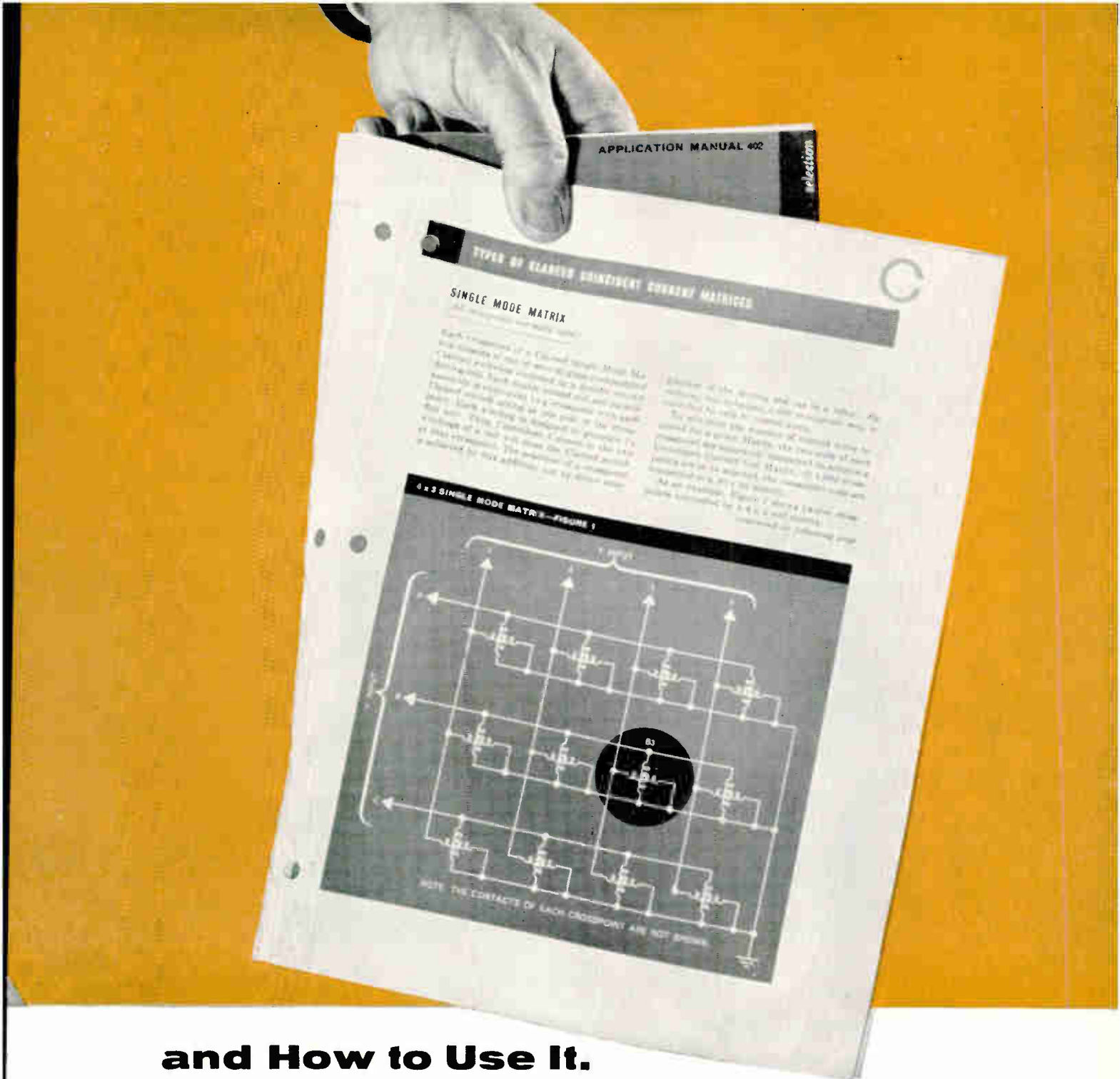
Here's how it works:

Glass-encapsulated reed switches are enclosed in multiple-wound coils. Flux addition, performed in the coils, operates the switches—providing hard contact switching, completely isolated from the input circuits. Data handling speeds up to 250 bits per second are practicable.

For selection (as for counting and logic) the Clareed Control Module has real advantages over solid state devices.

- Both input and output can be multiple, adding flexibility to the device and simplicity to circuits employing it.
- Module can handle low level analog signals, other digital signals, and AC or DC power up to 15 va.
- Interconnection of switches enables the Module to perform functions never before practicable with *any* switching device. Combinations of Modules can perform even more complex functions.

Clareed Control Modules offer interesting, reliable solutions to problems in selection, counting, and logic. For detailed analysis and engineering recommendations, indicate your needs to Application Engineering, C. P. Clare & Co., 3101F Pratt Blvd., Chicago 45, Illinois.



and How to Use It.

New systems—new problems.

That's how it goes, every time. So we figure that, in introducing the Clareed Selection Module, it's up to us to solve the problems, and share the solutions with the man who's designing working circuits. Like you.

"Selection with Clareed Control Modules" does just that. It shows some interesting, practical approaches to selection problems, producing sophisticated results with simplified circuits. These are more flexible, more reliable means of performing selection. And you'll find ways to do some jobs never before practicable.

Basically, selection is accomplished with three Clareed coincident current matrices:

- Single Mode Matrix
  (All crosspoints normally open)
- Single Mode—Memory Matrix
- Two Mode Matrix
  (Mode One: all crosspoints normally open;
  Mode Two: all crosspoints normally closed)

These matrices perform random selection at speeds much greater than those of any other random selection device. And this manual shows you how to use them.

These 10 pages may take half an hour to read—maybe an hour, if you really crawl into the circuit diagrams. You can save much, much more time than that. Valuable booklet? It sure is. Free, too.

So get your copy of "Selection with Clareed Control Modules." Just circle the appropriate number on the Reader Service Card. Or write to J. R. Stone, C. P. Clare & Co., 3101F Pratt Blvd., Chicago 45, Illinois.

Circle 51 on Inquiry Card

RELIABLE products from RAYTHEON

NOW... LOW-COST TV RADAR WITH RAYTHEON CK7702 STORAGE TUBE

Ships with just a UHF TV receiver can now be guided by a televised around-the-clock radar presentation of New York harbor — thanks to the Coast Guard RATAN system and Raytheon's CK7702. Heart of the Radar and Television Aid to Navigation system, the dual-gun CK7702, converts radar to TV scan to provide a bright display featuring target trails for course and speed indications.

This is just one example of the many application possibilities of the CK7702. Characteristics such as simultaneous write and read, variable automatic prime, and magnetic deflection of both read and write beams make possible the design of advanced systems with outstanding features. High, uniform resolution of 1200 TV lines per diameter at 50% modulation is assured through the use of magnetic focus with dynamic correction. And, the Raytheon CK7702 fully meets the requirements of FAA-R-1213b and is designated for use in many other military equipment specifications.

Unequalled capabilities for the development and production of storage and display tubes enable Raytheon to offer you a broad line of high quality standard types, as well as special tubes designed and produced to meet the requirements of your design.

For complete details please write:
Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

INDUSTRIAL COMPONENTS DIVISION

RAYTHEON

NEWTON 58, MASSACHUSETTS

tiny rheostat

rated at 12½ watts, 40°C

...and a very sizeable 8 watts at 125°C

OHMITE model E

■ Here's real power in a small package for operation at elevated temperatures where units with organic materials fail. All ceramic and metal in construction, the Model E rheostat is designed to operate at a maximum hot spot temperature of 340°C without charring, shrinkage, or deterioration. Full rating is 12½ watts at 40°C, but even at 125°C, there is still a sizeable 8-watt rating for units through 5000 ohms.

The Model E is wire-wound, yet measures only ⅞" in diameter—no larger than many one and two-watt potentiometers. Construction and materials are the same as for Ohmite's larger rheostats. Each turn is permanently fixed and insulated on a solid ceramic core by Ohmite-developed vitreous enamel or Ohmicone silicone-ceramic coating (above 5000 ohms).

Thirty-one resistance values from 1 to 15,000 ohms (linear) are stocked in both unenclosed and enclosed styles for immediate delivery from your distributor or the factory. Units with tapered windings, tandems, and many other variations are available on order. *Write for Stock Catalog 30, which lists all 11 sizes of Ohmite rheostats from 12½ to 1000 watts.*

ENCLOSED

UNENCLOSED

TANDEM

OHMITE MANUFACTURING COMPANY
3662 Howard Street, Skokie, Illinois

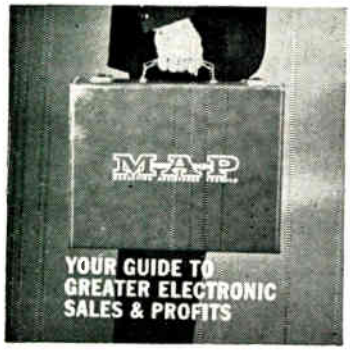
RHEOSTATS • POWER RESISTORS • PRECISION RESISTORS • VARIABLE TRANSFORMERS • TANTALUM CAPACITORS • TAP SWITCHES • RELAYS • R. F. CHOKES • GERMANIUM DIODES

← Circle 52 on Inquiry Card

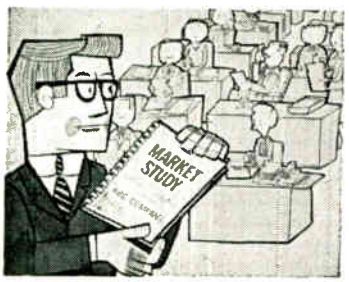
Circle 53 on Inquiry Card

ELECTRONIC INDUSTRIES M-A-P

MARKETING ASSISTANCE PROGRAM

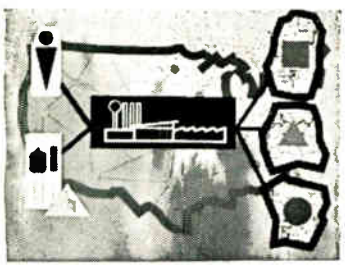


The full story of how ELECTRONIC INDUSTRIES' M-A-P (Marketing Assistance Program) can help you—is now available for viewing in a 14-minute film presentation. A phone call to your nearest "EI" Representative will bring him to your office.



A Complete Market Research Department at Your Disposal: The services of ELECTRONIC INDUSTRIES' Research Department are available to you, together with a corps of over 250 experienced, strategically located, field investigators. They can help you determine:

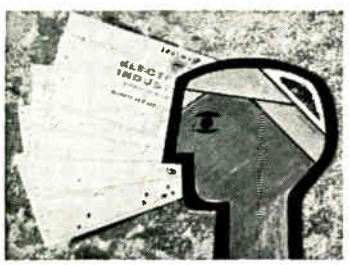
• Sales potentials by industry and territory • Buying influences • Degree of product recognition and acceptance • Relative standing of competitors • New product applications • Buyers' job interest and aptitudes . . . and virtually any other information essential to the effective marketing of your company's products.



96% of Your Market: The ELECTRONIC INDUSTRIES Census—developed and maintained at a cost of over $225,000, reports in depth on the 6100 electronic plants which account for 96% of the total annual purchase of electronic products.

ELECTRONIC INDUSTRIES' unique product classification system identifies, with complete information, plant by plant, on each industry product manufactured.

Punched on 32,000 IBM Cards: to simplify your task of isolating and organizing the precise marketing data you need, the complete findings of the ELECTRONIC INDUSTRIES CENSUS have been transferred to punched IBM cards.



What are the Characteristics of Today's Electronic Engineer?

• What is his average age? • His average income? • His net worth? • How many children does he have? • What is his education? • What are his ambitions? • What would prompt him to change jobs?

These and many other important questions about the personal and job characteristics of the electronic engineer are answered in ELECTRONIC INDUSTRIES' Profile of the Electronic Engineer—available as a handy deck of 2,000 punched IBM cards, or (in summary form) in a printed report.

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Philadelphia 39, Pennsylvania
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GERALD B. PELISSIER
(Metropolitan N. Y.)
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New York 17, New York
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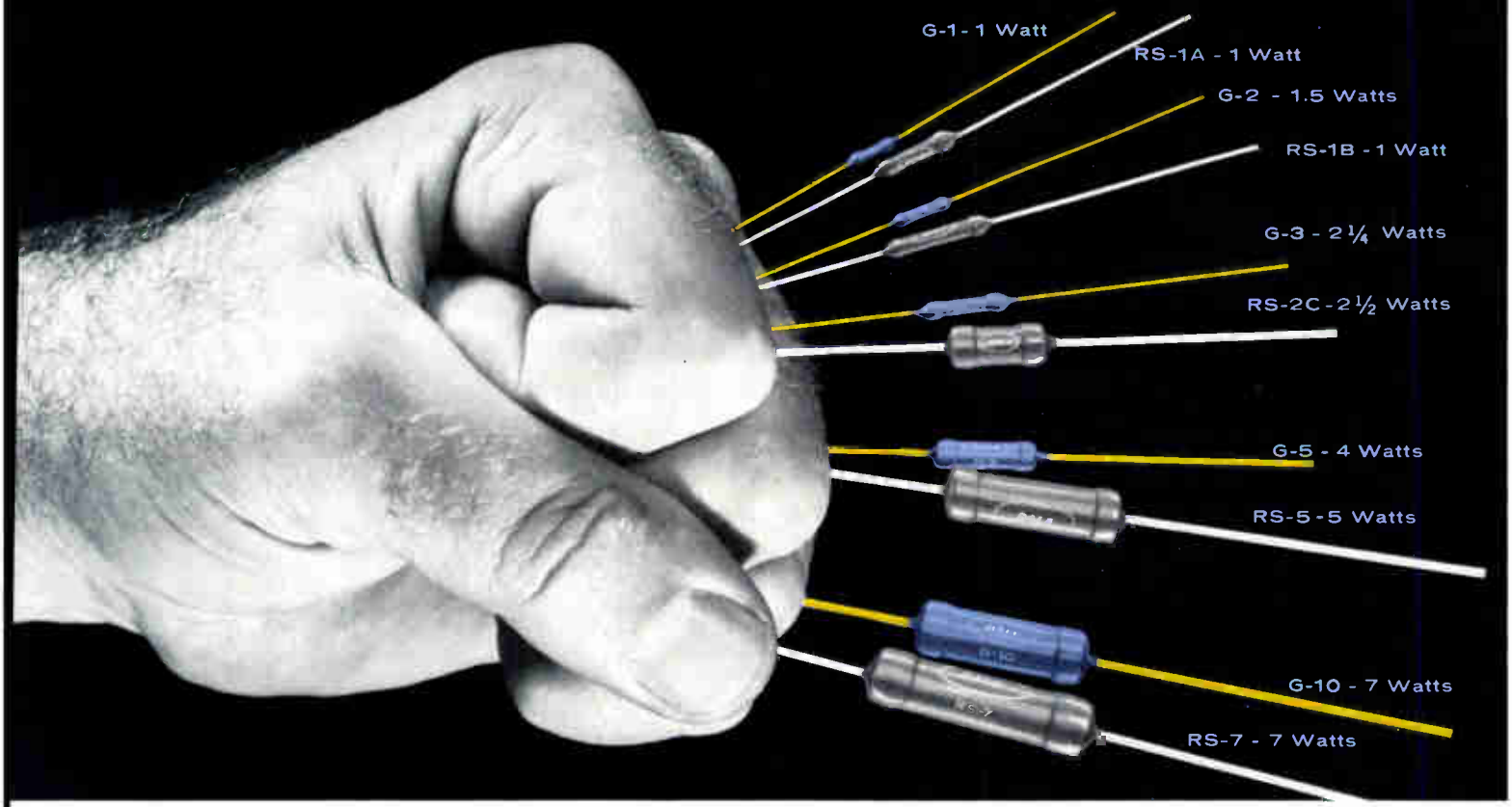
M-A-P is Exclusive with ELECTRONIC INDUSTRIES

Circle 99 on Inquiry Card →

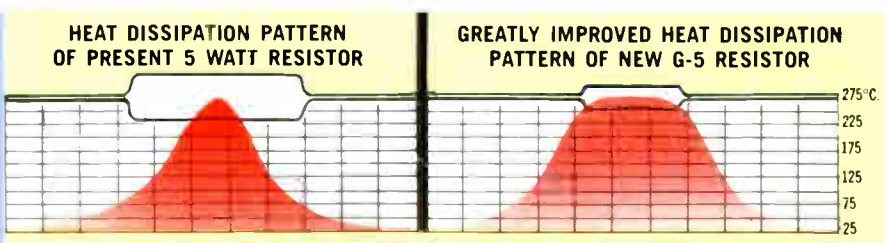
DALE ACHIEVES MAJOR POWER BREAKTHROUGH

in relation to size with NEW "G" SERIES



As precious jewels are mounted in gold to complement their value, DALE G Type and HG Type resistors are provided with gold flash copper terminations. This characterizes the craftsmanship and precision that makes this achievement possible. G Type Resistors presently available in five sizes: 1, 1.5, 2.25, 4 and 7 watts in values ranging from 10 ohms to 60K ohms, depending on size and tolerance. Available tolerances are .05%, 0.1%, 0.25%, 0.5%, 1% and 3%.

DALE TAMES THE HOT SPOT!



The above patterns are typical in a comparison between any G Type resistor and any old style resistor. **NOTE:** If G Type resistors are operated at full power, soldering with low temperature solder is not recommended.

See us at
WESCON
Booth 901-902

DALE

DALE ELECTRONICS, INC.
Columbus, Nebraska
A Subsidiary of THE LIONEL CORPORATION

SEE OUR SPECIFICATIONS IN V·S·M·F THE MICROFILM CATALOG FILE

NEW DALE HG RESISTOR

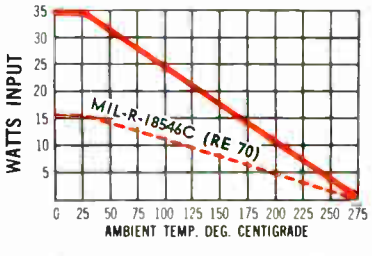
MORE THAN DOUBLES MIL SPEC POWER REQUIREMENTS

at no increase in size

The DALE HG-25 resistor meets all functional and environmental requirements of MIL-R-18546C (RE-70) plus power dissipation of more than double the Mil Spec requirement. If derated to MIL rating, the HG will give unprecedented stability (test reports available on request). Molded into a gold anodized die cast aluminum housing, an exclusive Dale process, HG-25 is available in resistances ranging from .1 ohm to 60K ohms, depending on tolerance. Tolerances are 0.5%, 1% and 3%. Terminals are gold plated copper. (Also available with 6-32 studs and gold flash dumet terminals.) If operated at rated power, soldering with soft solder is not recommended.

TYPE HG-25	
A	.719 ± .005
B	.781 ± .005
C	1 1/16 ± 1/32
D	1 15/16 ± 1/16

Based on 275° C. internal hot spot temperature and resistors mounted on standard .040 aluminum 5" x 7" x 2" chassis. Applicable only to resistors with .001" min. wire size. 1% maximum deviation after 1000 hours load life.



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A DATE TO REMEMBER

SEPT. 1

NEW FORMAT FOR ELECTRONIC INDUSTRIES MAKES BOW

■ ELECTRONIC INDUSTRIES announces an important event in publishing. Completely redesigned, cover to cover, by Lester Beall, America's foremost designer, ELECTRONIC INDUSTRIES will feature a smarter, more open format . . . more readable type faces . . . more attractive editorial layout . . . *greater advertising impact.*

■ But some things won't be changed. Advertisers will still get the same *monolithic coverage* of the 6100 electronic plants that account for over 96% of all industry purchases . . . the same *editorial vigor* . . . the *exclusive* Marketing Assistance Program.

■ ELECTRONIC INDUSTRIES is the starting point for any electronic advertising schedule. Make it first choice in *your* media selection as it is with over 61,000 influential readers, largest bloc of engineering decision-makers in the industry.

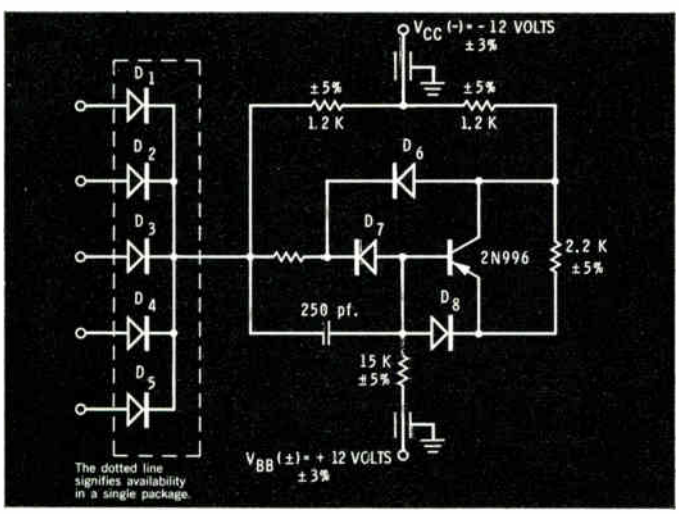
ELECTRONIC INDUSTRIES

The Source of Useful Theory and Applied Engineering

A Chilton Publication

Chestnut and 56th Streets • Philadelphia 39, Pa.

2N996
SILICON PLANAR EPITAXIAL PNP for HIGH SPEED, HIGH CURRENT LOGIC



FAN OUT MAXIMUM = 5; TYPICAL PROPAGATION DELAY = 15 nSec.
D_1 through D_8 : All FD6002.

- 60 mA High Current Operation
- 15 nSec Typical Propagation Delay
- 200° C Maximum Junction Temperature
- Direct Replacement for Many Germanium Transistors

The advantages of the Silicon Planar construction are now available in a wide variety of direct replacements for germanium. In addition, the diode gate now is available in a single package TO-5 type can (special product FSP-463) for miniaturized packaging.

	FD-6002*			2N996*	
V_F	@ I_F = 100 mA	1 V Max.	BV_{CBO}	@ I_C = 10 μA	15.0 V Min.
I_R	@ V_R = 25 V	100 mμA Max.	h_{fe}	@ f = 100 mc, I_C = 10 mA	2.3 typical
t_{rr}	@ $I_F = I_R$ recover to 10% of I_F for all I_F from 10 mA to 200 mA	4 nSec Max.	V_{CE}(sat)	@ I_C = 60 mA, I_B = 2 mA	0.3 V Max.

*OFF-THE-SHELF FROM DISTRIBUTORS

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

EI's International News

Electronic Production Booms in Holland

Holland has expanded its electronic industry significantly during the last decade. It now ranks fourth among all nations in exporting electrical and electronic equipment and products.

With 7% of total exports in these fields, the Netherlands ranks after the United States (23.5%), Great Britain (20.5%) and Western Germany (17%).

In 1960, the last year for which figures are available, the Dutch electrical-electronics industry, 210 firms in all, attained production valued at over $652,500,000. About 60% was exported, two thirds of it to other European countries.

Radio and TV sets, sound recording and reproduction equipment, amplifiers, microphones and loudspeakers led the field among electrical-electronic exports with a total value of $150,000,000. After these came electronic tubes, photo-electric cells and transistors, valued at $58,600,000. The rest of the total consisted mainly of electrical items.

Of the more than 95,000 industry employes, some 77,000 are men and 18,000 women. For every 1,000 employes there are 12 engineers who received degrees from technolgical institutes and an additional 8 university graduates, half of whom took science courses.

NORTH AMERICA

Washington, D.C. — The American Cable and Radio Corp., an IT&T subsidiary, will soon expand its transatlantic telegraph service from 53 to 97 channels.

Ottawa — Canadian National and Canadian Pacific Telecommunications have awarded RCA a $12 million contract for a 3,000-mile, 600-channel microwave system to link all major cities between Montreal and Vancouver.

Washington, D. C.—The mushrooming TV industry outside the U. S. continued its rapid expansion in 1961, with the number of transmitting stations passing the 2,000 mark and the total of TV sets numbering almost 54 million, reports the U. S. Information Agency.

Ottawa—A new extension to the Halifax, Nova Scotia, Infirmary will include a closed-circuit color and black and white TV camera system for use in any of four operating theaters.

Washington, D.C.—A great increase in exports of electronic computers and related products was the most important factor behind the large increase in U. S. business machine exports last year, reports the U. S. Commerce Dept.

Minneapolis, Minn. — Minneapolis-Honeywell has developed an improved automatic analyzer for Britain's P.1 interceptor. It completely checks out the air data computer, flight control panel, master reference gyro and navigation display panel.

AUTOMATIC ANALYZER

F-104 fighter being delivered to West Germany is checked by Minneapolis-Honeywell UG1000 Automatic Analyzer. Analyzer checks flight control system through five test connectors atop control system computer.

TRADE FAIR

U. S. electronics equipment in model classroom above was featured in recent Casablanca, Morocco, Trade Fair. Nearly 70 U. S. firms participated, and more than 625,000 persons visited American pavilion. U. S. Dept. of Commerce staged exhibit.

Washington, D.C. — Transmissions of weather data to implement exchange programs of the World Meteorological Organization are being sent throughout the world by the U. S. Weather Bureau and RCA Communications, Inc., from America's Tiros Weather Satellites.

Los Angeles—The Bendix Computer Div. has successfully invaded the foreign market with delivery of two G-20 computer systems to Japanese purchasers and one to an Italian buyer.

EUROPE

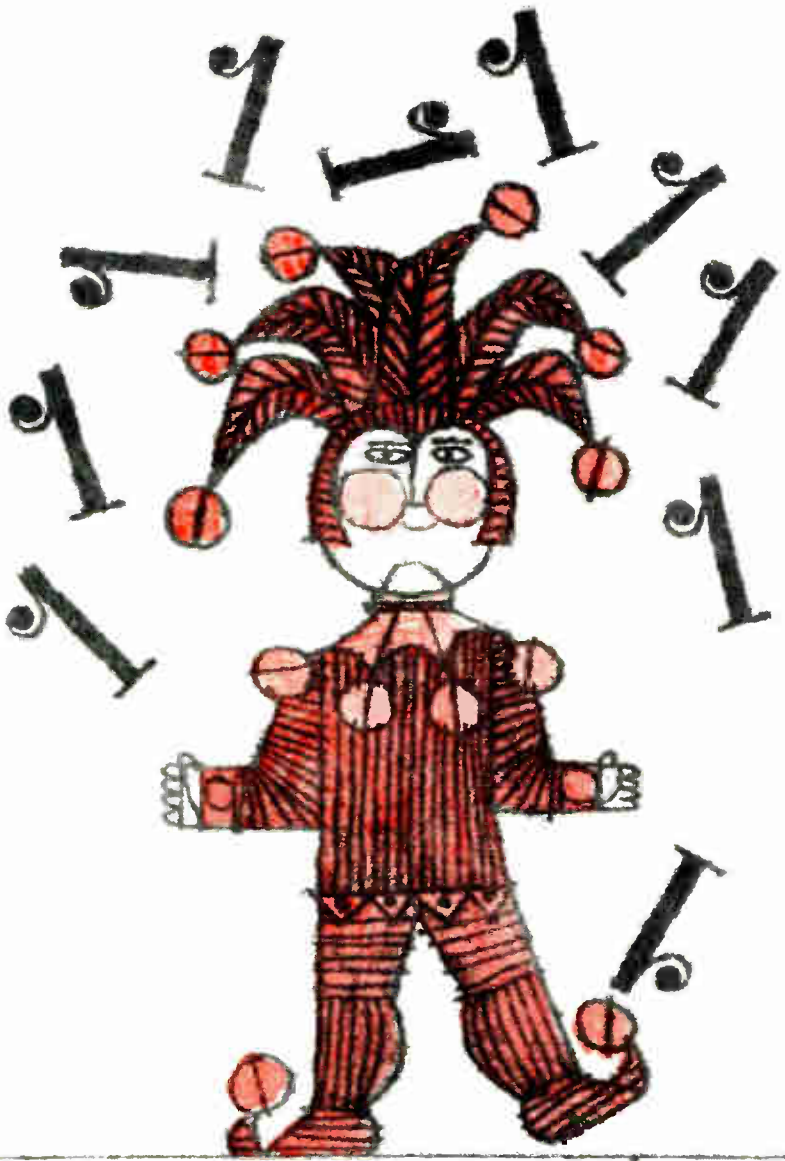
Stockholm—The Swedish Space Research Committee and America's NASA have signed an agreement for a cooperative program in space research. Four Nike-Cajun sounding rockets will be launched from Sweden's Vidsel Range late this summer to sample noctilucent clouds.

Berlin—A TV camera able to withstand temperatures of 1200°C. has been developed by AEG, of Germany. Designed for use in supervising combustion chambers of furnaces and boilers, the camera is surrounded by a triple water and air-cooling shroud.

Berlin—A contract for custom delay lines and pulse transformers for U. S. F-104 fighter control radar made in Germany by Telefunken has been signed. PCA Electronics, Inc., Sepulveda, Calif., will supply the equipment. Telefunken is the only West German firm now making radar equipment.

London — Automation recently replaced a human clock winder to keep a chime clock running in a 15th Century church in Mells Parish, Somerset. An electric motor setup devised

(*Continued on Page 41*)



HALL EFFECT MULTIPLICATION ENDS 1-JUGGLING!

We took the direct approach to multiplication and came up with a little black box that forever gets rid of the 1's. We call it a Hallefex* Model 700 Magnetic Hall Package. Actually, it's a complete multiplier assembly that performs wonders as an analog multiplier, chopper, modulator, mixer.

A new-generation Hallefex solid-state voltage generator furnishes the brains for this talent display. It's got a microns-thin film that boosts input impedance to 100-600 ohms with sensitivities 10 times greater than ever before possible. This is the secret behind all Hallefex packages. The Model 701 Real Power Watts Transducer, for instance —a handy item for instantaneous power measurement. And the Hallefex Model 080-6570-0 Real Power Wattmeter, a Model 701 glorified with its own direct reading panel meter.

Any questions? We've got a special Hallefex Applications Group standing by. You'll reach them by writing Helipot direct.

ALSO... PRECISION POTENTIOMETERS, HIGH-PERFORMANCE SERVOMOTORS, CLEAN-DESIGN METERS.

*TRADEMARK, B.I.I.

HALLEFEX

Beckman® INSTRUMENTS, INC.

HELIPOT DIVISION
Fullerton, California

International Subsidiaries: Geneva, Switzerland; Munich, Germany; Glenrothes, Scotland.

International News

(*Continued from Page 39*)

by engineers from Minneapolis-Honeywell's Micro Switch Div. here rewinds the clock's weights every three hours.

London—The $70 million contract recently signed by the Swiss government for the Bristol/Ferranti Bloodhound guided weapons system was described as the largest order of its kind ever placed in Britain by a foreign government.

Oslo — The Norwegian Telegraph Administration has built an island TV station which is operated by remote control from the mainland through a VHF radio link.

ASIA

New Delhi—Construction of India's first atomic power station should begin before the end of the year, stated a top Indian official at the commissioning of the big new hydroelectric plant at Koyna, near Bombay.

Tokyo—The fantastic TV boom in Japan hit a new peak early this year when registered set owners topped the 10,000,000 mark. This means one of every two Japanese families owns a TV set. Japan now trails only the United States (56.3 million owners) and the United Kingdom (11.6 million owners).

New Delhi—An EMI closed-circuit TV system will help speed traffic on Indian railways. The Gramophone Company, Ltd., Dum Dum, an EMI affiliate, has been awarded a contract to supply the system to the Central Railway, Bombay.

Tokyo—Sanyo Electric Co. Ltd. of Osaka, has developed a process using the human body as a source of electricity for powering a transistor radio. The process involves conversion of heat given off from the body into energy by means of thermoelectric elements.

AFRICA

Nairobi—Kenya's first TV station is due to be on the air by Oct. 1. Marconi's will supply the main items of studio and transmitting equipment. The studios will be here, while the transmitter will be 11 miles away in Limuru.

AUSTRALIA

Canberra—A remote-control radar will soon give Australians early warning of tropical cyclones. It will cover the Northeastern coast and warn of storms forming in the Coral Sea. Built for the Australian Bureau of Meteorology by Cossor Radar & Electronics Ltd., English subsidiary of Raytheon Co., it is en route here.

designers

specify crystal filters for ultra-selectivity/minimum space

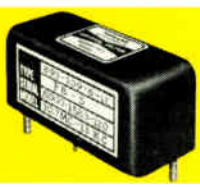
—and for your practical consideration, Midland recommends that electronic equipment be designed to incorporate a stock item wherever possible. Remember, the excellent rejection characteristics of the crystal filter, in addition to its stability and performance reliability, are achieved by many man-hours of detailed engineering and testing. Significant savings in cost and delivery time can be realized if special filters are not required. Shown below are stock items available for immediate delivery. For complete technical information, write to Midland Manufacturing Company.

TYPE NJ

Hermetically sealed, four-crystal, wide-band filters. Dimensions are 1-1/8L x 1-1/8W x 3/4H. Designed to withstand 100 g shock and 15 g to 2 KC vibration. Operating temperature range —55°C to +90°C. 40db/3db Band Width Ratio is 1.8.

TYPE	CENTER FREQ.	3db BW	40db BW	ULT. REJ.	INSERTION LOSS	INPUT-OUTPUT RES.	INBAND RIPPLE
NJ-1	7.2MC	160KC MIN.	300KC MAX.	60db MIN.	6db MAX.	13K	1db MAX.
NJ-2	7.4MC	160KC MIN.	300KC MAX.	60db MIN.	6db MAX.	13K	1db MAX.

TYPE FB

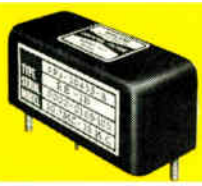


Hermetically sealed, eight-crystal, narrow-band filters. Dimensions are 2-3/8L x 1W x 1-1/32H. Designed to withstand 200 g shock and 15 g to 2 KC vibration. Operating temperature range —55°C to +90°C. 60db/6db Band Width Ratio is 1.8.

TYPE	CENTER FREQ.	6db BW	60db BW	ULT. REJ.	INSERTION LOSS	INPUT-OUTPUT RES.	INBAND RIPPLE
FB-5	10.7MC	13KC MIN.	23KC MAX.	105db MIN.	4db MAX.	1K	.8db MAX.
FB-5A	10.7MC	13KC MIN.	23KC MAX.	105db MIN.	4db MAX.	* 2K	.8db MAX.

* in parallel with 30 pf capacitor.

TYPE EB



Hermetically sealed, eight-crystal, narrow-band filters. Dimensions are 2-3/8L x 1W x 1-1/32H. Designed to withstand 200 g shock and 15 g to 2 KC vibration. Operating temperature range —55°C to +90°C. 60db/6db Band Width Ratio is 2.3.

TYPE	CENTER FREQ.	6db BW	60db BW	ULT. REJ.	INSERTION LOSS	INPUT-OUTPUT RES.	INBAND RIPPLE
EB-1B	10.7MC	15KC MIN.	37KC MAX.	70db MIN.	3db MAX.	1K	.5db MAX.
EB-2B	10.7MC	30KC MIN.	70KC MAX.	70db MIN.	3db MAX.	2K	.5db MAX.

TYPE EL-1B

Hermetically sealed, eight-crystal, narrow-band filter. Dimensions are 2-3/16L x 1W x 3/4H. Designed to withstand 200 g shock and 15 g to 2 KC vibration. Operating temperature range —55°C to +90°C. 60db/3db Band Width Ratio is 2.8.

TYPE	CENTER FREQ.	3db BW	60db BW	ULT. REJ.	INSERTION LOSS	INPUT-OUTPUT RES.	INBAND RIPPLE
EL-1B	11.5MC	32KC MIN.	90KC MAX.	90db MIN.	6db MAX.	50 OHMS	.5db MAX.

TYPE DL-1B

Hermetically sealed, four-crystal, narrow-band filter. Dimensions are 2-3/16L x 3/4W x 3/4H. Designed to withstand 200 g shock and 15 g to 2 KC vibration. 60db/3db Band Width Ratio is 6.3.

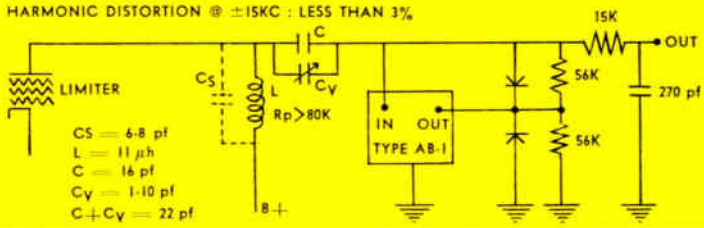
TYPE	CENTER FREQ.	3db BW	60db BW	ULT. REJ.	INSERTION LOSS	INPUT-OUTPUT RES.	INBAND RIPPLE
DL-1B	11.5MC	32KC MAX.	200KC MAX.	70db MIN.	4db MAX.	50 OHMS	.5db MAX.

TYPE AB-1 DISCRIMINATOR

Solder-sealed 1-1/8L x 1-1/8W x 3/4H case. Center frequency adjustment screw, bottom-center. Voltage output essentially linear from f_o to ±15 KC. Recommended circuit for use with Midland Type AB-1 Discriminator is shown below.

CENTER FREQ: 10.7MC
ADJUSTABLE CENTER FREQ: ±4KC
FREQ. DEVIATION: ±20KC
HARMONIC DISTORTION @ ±15KC : LESS THAN 3%

RECOMMENDED CIRCUIT



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MANUFACTURING COMPANY
3155 FIBERGLAS ROAD
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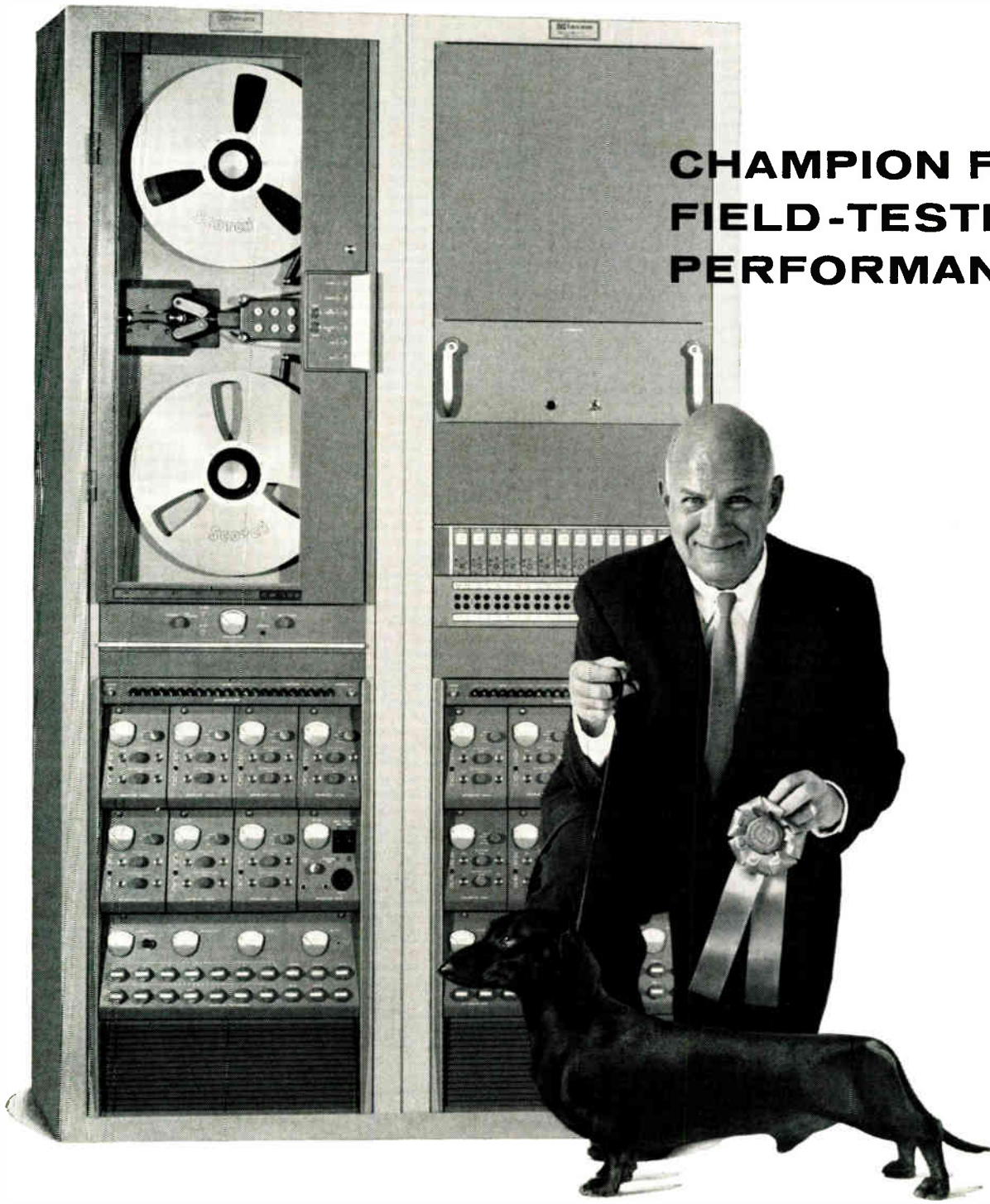
world's largest producer of quartz crystals / division of Pacific Industries, Inc.



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NEW FM RECORDING: ONE CYCLE TO 400 KC

Wideband FM recording using one-megacycle analog techniques—that's the latest exclusive news about the **Mincom CM-114 Magnetic Tape Recorder/Reproducer.** Only with this outstanding field-tested system's 1-mc capability is it possible to record and play back FM signals from 1 cps to 400 kc. Advantages: Extended low frequency response, excellent linearity, seven or fourteen FM recording tracks, dropout reduction virtually to zero. This FM performance can also be added to existing CM-Series systems. Write today for details and complete specifications.

Mincom Division 3M COMPANY

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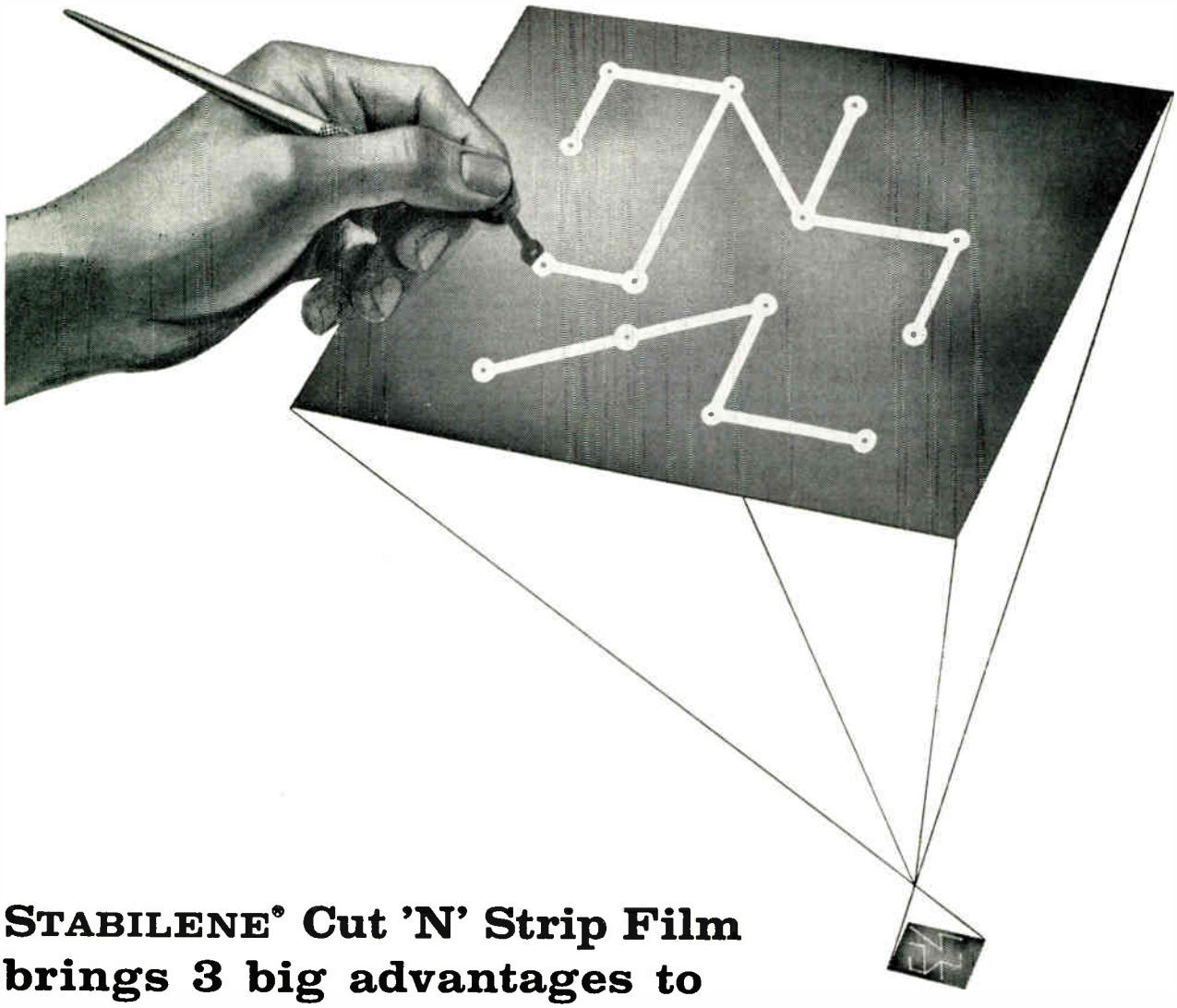
Opportunities now open for Senior Research Engineers and Scientists



STABILENE® Cut 'N' Strip Film brings 3 big advantages to SOPHISTICATED MICRO-CIRCUITRY

Take the variables out of the boards used in micro-circuitry, semi-solid or thin film deposition. The Cut 'N' Strip method gives you in unique degree the very features most important to you in preparing your masters:

Dimensional Stability of polyester-base STABILENE Cut 'N' Strip Film is far greater than that of steel or aluminum – because of a "re-stabilizing" process developed by and exclusive with K&E.

Accuracy of Line Work is needle-sharp. Thickness of path never varies, because circuit runs are cut with a precision double-bladed cutter adjustable to the path width you desire. Lands and centers are scored with a special compass-like tool – likewise unapproached by pen or pencil for unvarying accuracy.

For Positive or Negative Masters. Peel actinically opaque coating from *inside* the lines you've cut – you've got a negative. For a positive, strip off coating around the circuit paths. Either way, lines are razor-edged for clean, crisp reproduction down to extreme micro sizes. Touch-up is easy, too, with K&E opaquing fluid.

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See – on your own most sophisticated micro-circuitry – how STABILENE Cut 'N' Strip Film can help you turn out totally dependable micro-circuitry. See how it does away with intermediate photographic steps – sometimes *all* of them. Fill in coupon and mail it now.

KEUFFEL & ESSER CO., Dept. El-8, Hoboken, N. J.

Please send me a free STABILENE Cut 'N' Strip Film sample. plus K&E brochure "Preparing Printed Circuits on STABILENE Film."

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...for dry circuit contact resistance testing

FEATURES

- Variable automatic pulsing of actuation and test power. Actuation from 1 to 5 cycles per second.
- From 100 MV to less than 1 MV open circuit voltage; short circuit currents from 50 milliamperes down to ½ microampere. Contact resistance requirements from 1500 ohms to less than one ohm.
- Ten test stations for group testing. Individual amplifiers and read-outs for each set of contacts.
- Plug-in load networks for determination of contact test level.
- Neon-type "miss" indicators show 0 to 5 misses per test run.
- Accessories available for special power requirements on actuation and test, jigs and fixtures.

There had to be a better way of testing low level switching circuitry —so we found it. And now, this completely integrated, automatic Miss Tester system is packaged and offered as a relatively low-cost, ready-to-operate piece of equipment.

For component manufacturer and user, the Hi-G Miss Tester offers proven stability, accuracy, versatility and speed. May be used for any contact system such as relays, switches, connectors, or commutators.

Write for complete details, or arrange for a visit to our plant and see for yourself what the Miss Tester can do for you.

Hi-G manufactures a wide range of hermetically sealed relays, time delay relays, voltage sensors, and special products including static switching devices.

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THE ONLY COMPLETE LINE OF BALANCED ROTARY RELAYS

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Letters to the Editor

"Shielding An Enclosure"

Editor, ELECTRONIC INDUSTRIES:

Subject: January 1962 "Shielding an Enclosure," page 112, by Mr. Cyril P. Durnovo.

This article was sent to us by one of our customers with comments. It is the concensus of opinion of all Engineers who are familiar with the Lindgren Double Electrically Isolated room that Mr. Durnovo seems to know nothing about the Double Electrically Isolated room of the year 1962.

It is unfortunate that your Magazine has been victimized by lending dignity to a most questionable method to discredit our product. On the other hand it seems impossible that Mr. Durnovo who, according to the article, is a Senior Principal Engineer would be ignorant of the fact Erik A. Lindgren & Associates, Inc., Chicago, Illinois, is the only manufacturer of Double Electrically Isolated rooms and that the high performance of these rooms and fine quality is a matter of record and a real threat to the inferior Cell-type room.

We believe the records speak for themselves. The enclosed charts are part of Engineering reports made by five different Engineering firms who all came out with the same results.

You might also be interested to know that repeated requests from the Lindgren organization to witness tests on Cell-type rooms have systematically been turned down, yet the Lindgren organization permits anyone who is interested to witness the test on the Double Electrically Isolated rooms. *Listed below are 13 points* which are direct contradictions of known facts in reference to shielded rooms which Mr. Durnovo must know but just found convenient to ignore for reasons known only to him.

1. All Double Electrically Isolated Screen rooms built by Lindgren today have 120 DB from 15 KC to 1000 MC. (It is true that our competitors Cell Rooms have only 100 DB.)

2. The Lindgren Double Electrically Isolated sales will, conservatively speaking, top half a million dollars, year 1962. Would you call that sales of an obsolete room?

3. Why is a Lindgren 24 oz. solid copper or 24 ga. steel vulnerable to holes more than is a Cell-type room? After all, they are both the same material!

4. Mr.Durnovo states further that a Cell-type room is the most popular. Up to recently actual sales will prove that the Plywood room is the most popular, and popularity has nothing to do with scientific results.

5. The Double Shield Isolated wall offers the highest *theoretical* attenuation. This statement might have been true 1951, but today such a statement can only be classified as slander and deliberate knocking of our product. The attenuation is actual. Mr. Durnovo should explain where the theory breaks down.

6. A Cell-type room does not always have two shields. It could have one, two or three shields.

7. In practice if a tear or leak appears in a Cell-type room it is just as serious as if it happened in an Isolated room. In theory it might not be true. I am sure that no Engineer who has a tear of three or four inch hole in his Cell-type room is not interested in the theory.

8. Mr. Durnovo said also that the Cell-type room is the only room covered by Mil Spec. We can prove that the Double Electrically Isolated room is covered by specification!

9. Inside bolting is only a sales gimmick and is, in effect, half the bolting of the Isolated rooms.

10. Screws can go through either the inside or outside shield of the Isolated room as long as they are effectively grounded to either shield. The metal penetrating our shield does not degrade the attenuation.

11. Bronze screen (18 x 20—.011) in a Double Electrically Isolated room has 120 DB from 15 KC—1000 MC. The bronze screen is superior because it does not corrode as fast as the copper screen. This Mr. Durnovo just ignored.

12. Copper screen (22 x 22—.015) has 120 DB from 15 KC to 1000 MC instead of 100 DB.

13. The plywood with steel on both sides does not bend (here Mr. Durnovo knocks Shielding Inc. products). That leaves the Cell-type manufacturers product intact which he did not tear down.

In conclusion we would like to state that if you require further proof of the performance of a Cell-type room compared to a Double Electrically Isolated room, we will be glad to supply names, addresses and telephone numbers. May we have your comments.

Erik A. Lindgren
President
Erik Lindgren & Assoc.
4515 N. Ravenswood Ave.
Chicago 40, Ill.

(*Continued on page* 48)

We worked many knights to develop a closed-entry socket inner conductor for our new NDC subminiature coaxial connector. But all the jousting was worth it as the mighty men of Deutsch came up with a design that virtually eliminates VSWR problems resulting from mated contact deformation. Crimp terminated outer and inner conductors also assure ease of assembly and reliable performance. And positive coupling retention is provided by the Deutsch push-pull, quick-disconnect coupling mechanism. But to get all the facts on this new champion of RF connectors, contact your local Deutschman today or write for Data File U-8.

DEUTSCH

Electronic Components Division
Municipal Airport
Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

Circle 62 on Inquiry Card

Letters to the Editor

(*Continued from page* 46)

"Shielding—"

Editor, ELECTRONIC INDUSTRIES:

The following is a summary of the comments of Cyril Durnovo on Mr. Lindgren's letter concerning the shielding article.

1. The article was written in a scientific, academic tone with no intent to build up or discredit any particular product.

2. The article represents only the author's personal opinion.

3. It seems obvious that a leak or tear in a Cell-type screen can be repaired faster (by replacing the panel involved) and more efficiently than a leak or tear in an isolated wall screen enclosure.

4. The expression "popular" is not scientific, and should not have been used in the context of this article.

5. On page 113, there is the statement that "the highest attenuation known is *around* 100 db (within the range of 100kc to 1000mc)." Mr. Lindgren states that the figure should be 120 db. There is no apparent controversy on this point.

6. The article was written in 1959 and it did not take into account any developments between 1959 to 1961.

7. Points 6, 9 and 10 of Mr. Lindgren's letter refer to factual statements which are open to scientific discussion.

8. If the article serves to generate healthy engineering discussion on any views of the author it will lead to wider knowledge—which is the basic purpose of such articles.

9. While it would hardly be possible for the author to keep abreast of every manufacturer or shielded enclosures, the list of suppliers at the end of the article includes the Lindgren Company. He certainly would not have included them in the listing if he had any intention of "slighting" them.

If I may add a comment to point 5 of Mr. Lindgren's letter—the word "theoretical" in this context is not used as the opposite of "actual."

I hope the above comments will set the entire matter to rest.

Manny Strunin
Adler Electronics Inc.
1 Lefevre Lane
New Rochelle, N. Y.

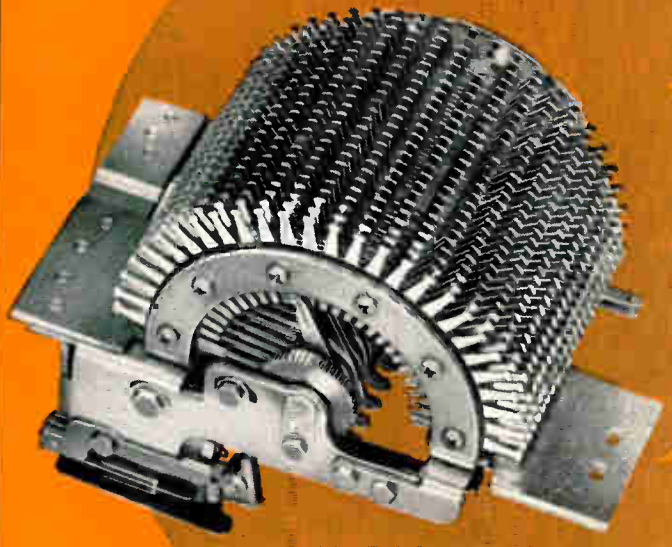
Ed.: Mr. Cyril Durnovo is now with Automatic Electric International Inc., subsidiary of General Telephone & Electronics Corp., 40 Rue du Rhone, Geneva, Switzerland.

(*Continued on page* 50)

CLARE Stepping Switches

give designers—

- *more levels per switch*
- *more levels in less space*
- *more simplified circuitry*
- *NO synchronization problem*

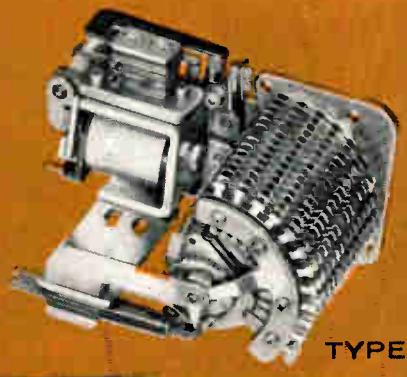


TYPE 26

Type for type, CLARE Stepping Switches provide more levels per switch . . . more levels per inch of height. The 12-level, 52-point, switch shown (CLARE Type 26), for instance, is 4 11/16 in. high. It has four more 52-point levels than comparable 52-point switches, yet it is but 13/16 in. higher than a comparable 8-level, 52-point switch. The smaller (Type 211), five-level, 33-point switch provides twice the levels of any comparable 33-point switch.

This greater working capacity per switch . . . and per inch . . . of CLARE Stepping Switches permits more simplified circuitry and avoids synchronization problems which arise when multiple stepping switches are necessary to do what is often a one-switch job with these high-capacity CLARE units.

CLARE Stepping Switches include a full line of spring-driven cam-operated or direct-drive switches with capacities from 10 to 52 points. CLARE engineering will cooperate with designers to develop special switches to meet unique requirements.



TYPE 211

For precise stepping switches famous for long life, high capacity and freedom from maintenance

IT HAS TO BE CLARE

Send for DESIGN MANUAL 202A

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C. P. CLARE & CO.

Relays and related control components

Letters to the Editor

(*Continued from page* 48)

"Shielding—"

Editor, ELECTRONIC INDUSTRIES:

The article entitled "Shielding An Enclosure" written by Cyril P. Durnovo which appeared in the January 1962 issue of *Electronic Industries* was of great interest to us. We would like to comment on it.

I believe that the more accepted term for the figure of merit of an enclosure is "shielding effectiveness" and not "attenuation," as used by Mr. Durnovo. I prefer to use "attenuation" as describing the inherent ability of a material to attenuate electromagnetic energy. For instance, copper at a specified frequency and of a definite thickness might have 150 Db of inherent "attenuation." This same copper could then be used to make a shielded enclosure whose measured "shielding effectiveness" would be 90 Db. The difference in the two figures would be due to leakage and other imperfections in the shield.

The "shielding effectiveness" of the enclosure could be improved by inserting RF gaskets at the leaky joints. The figure of merit for these gaskets would then be "insertion loss." It would describe the improvement in the overall "shielding effectiveness" of the room by the use of the gaskets.

To summarize, we suggest the following usage of the terms "attenuation," "shielding effectiveness" and "insertion loss."

A. Attenuation. This term should be used only to describe the inherent properties of a material to inhibit the propagation of an electromagnetic wave. This figure would be related to such things as frequency, wave impedance, and thickness of material.

B. Shielding effectiveness. This term should be used to describe the overall ability of an enclosure to contain or exclude electromagnetic energy.

C. Insertion loss. This term would then be used to describe the improvement (or degradation) brought about by the insertion in a shielded enclosure of an RF gasket, a ventilating panel, etc.

If agreement could be made on the usage of these terms by the "shielding fraternity," then communications among ourselves and those on the outside of our field of interest would greatly improve.

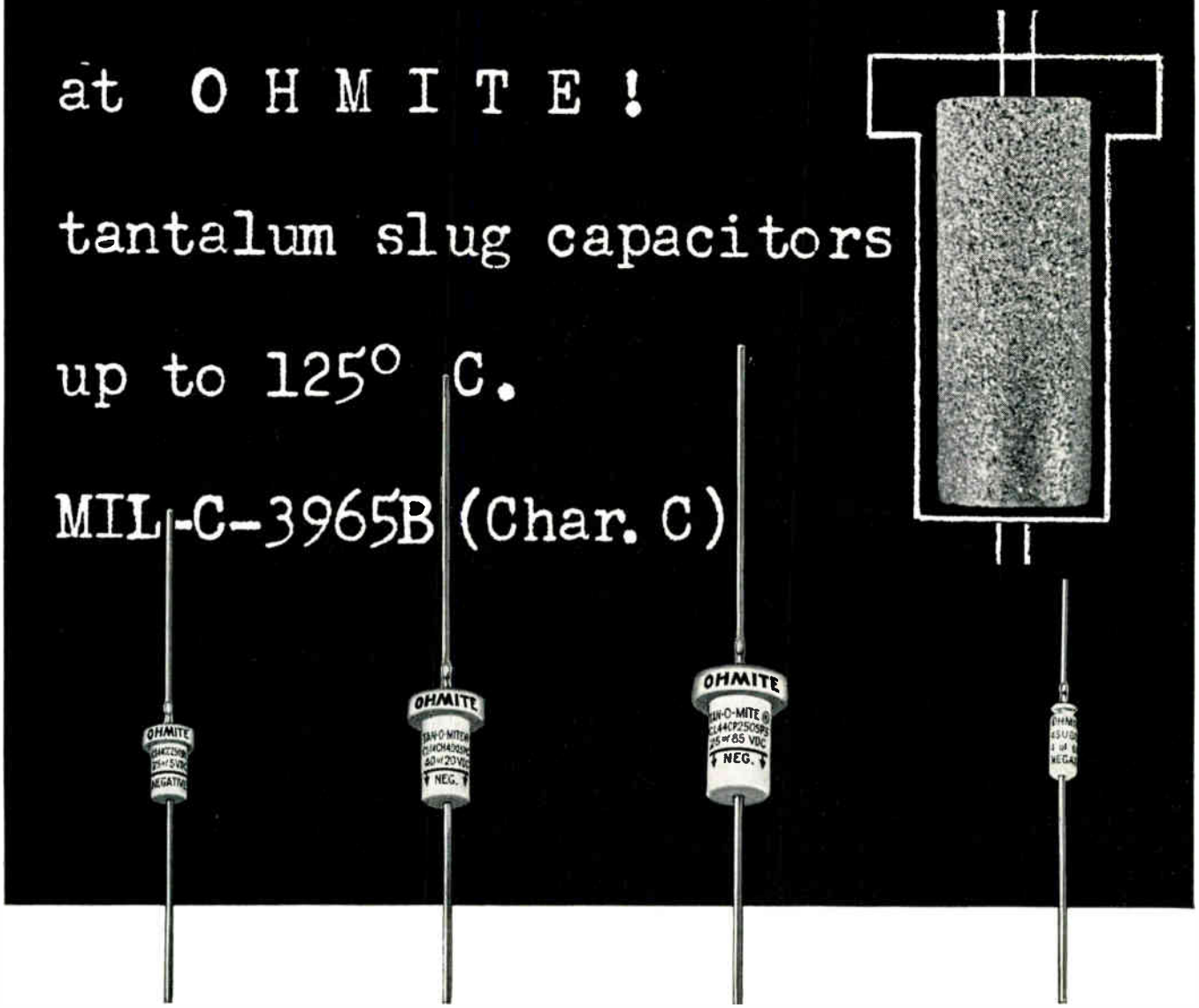
O. P. Schreiber
Vice President—Sales
Technical Wire Products Inc.
129 Dermody St.
Cranford, N. J.

P.S. You may be interested in the attached booklet "There Ought to Be a Law Against It . . ."

You can get them from stock at OHMITE!

tantalum slug capacitors up to 125° C.

MIL-C-3965B (Char. C)



MIL SIZE T1: *Stocked* in values from 1.7 to 68 mfd for 85°C and 125°C operation. Voltages from 4 to 125 volts depending on capacitance and operating temperature. Standard tolerances.

COM'L SIZE U: Same as shown above.

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COM'L SIZE F: Same as shown above.

MIL SIZE T3: *Immediate delivery* on values from 25 to 560 mfd for 85°C and 125°C operation. Voltages from 4 to 125 volts depending on capacitance and operating temperature. Standard tolerances.

COM'L SIZE G: Same as shown above.

MIL SIZE T1: *Stocked* in values from 1.7 to 68 mfd for 85°C operation only. Voltages from 6 to 125 volts depending on capacitance and operating temperature. Standard tolerances.

COM'L SIZE SU: Same as shown above.

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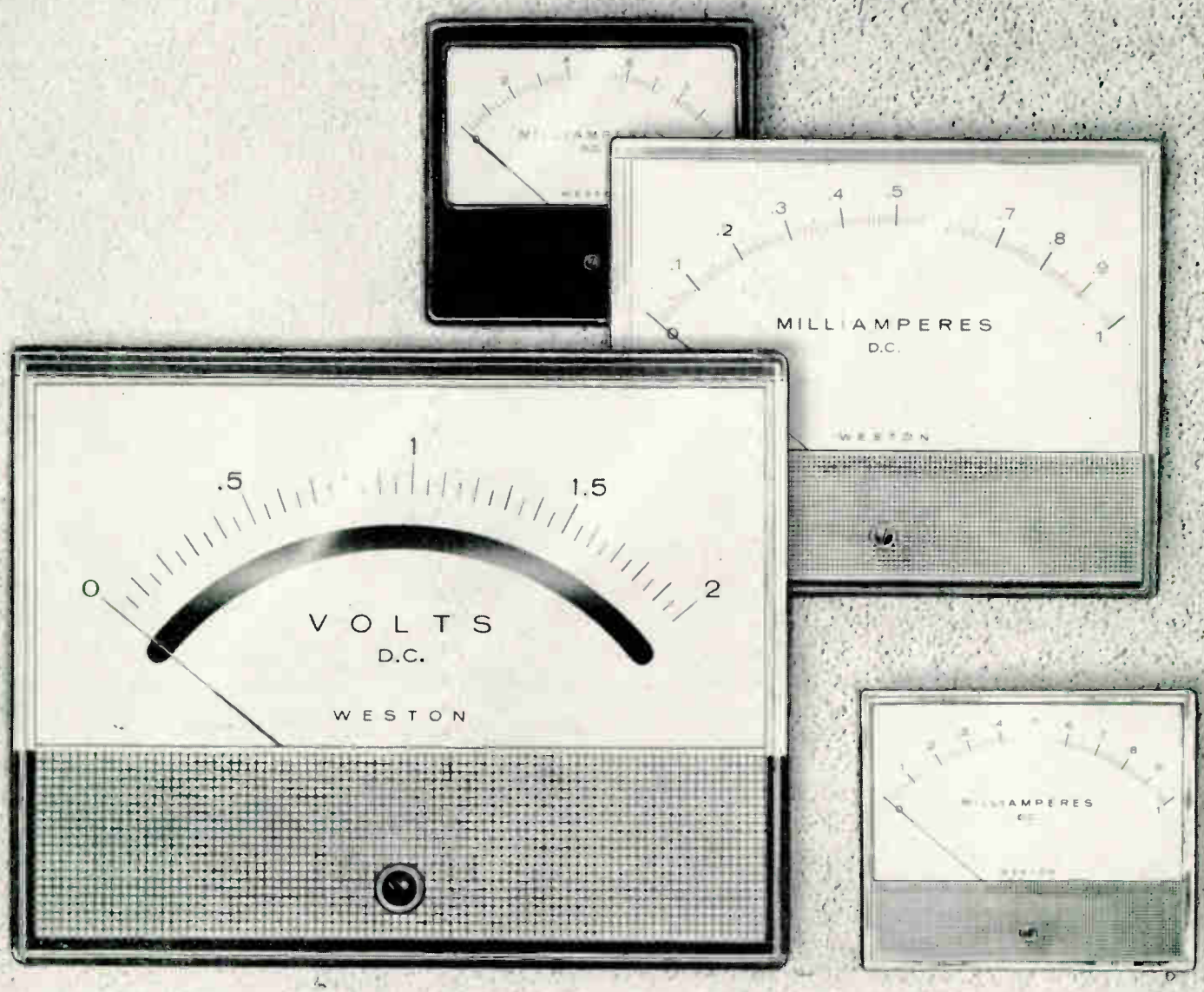

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WESTON TAUT-BAND SUSPENSION SETS NEW STANDARD FOR PANEL METERS

Weston Series 1900 is the most versatile line of panel meters ever produced for general use. Instruments with taut-band mechanisms are free from friction and inertia, and offer outstanding sensitivity, reliability and uniformity from zero to full scale. 1% and 2% accuracies are standard . . . higher on special order.

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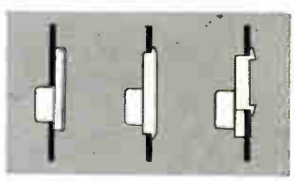

ANOTHER EXCLUSIVE: Only Weston Series 1900 Instruments can be mounted in three ways — conventional, flush, and recess with provision for internal illumination.

WESTON INSTRUMENTS *Division of Daystrom, Incorporated, Newark 14, New Jersey*

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Circle 67 on Inquiry Card

Circle 68 on Inquiry Card →

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OPTIMUM PERFORMANCE
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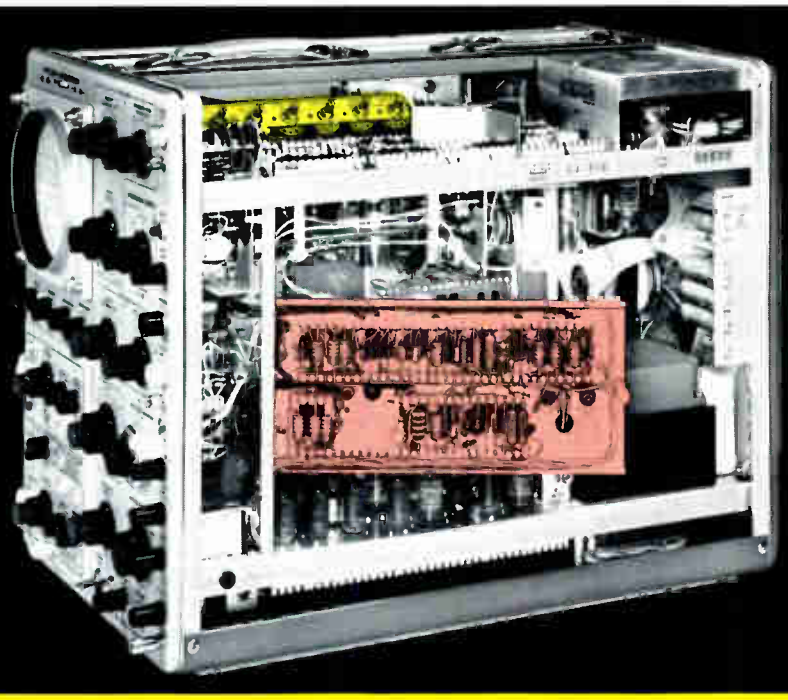
for Tektronix Oscilloscopes

In designing oscilloscopes to meet the exceptionally high standards for laboratory work, Tektronix demands equally high performance from the components they use. Here, Allen-Bradley fixed and variable resistors are a natural choice.

The exclusive hot molding process—developed by Allen-Bradley—gives A-B fixed resistors such consistently uniform characteristics that their performance can be accurately predicted over long periods of time under various operating conditions . . . and catastrophic failures are unheard of!

Allen-Bradley's famous Type J variable resistors feature a solid resistance element—also made by A-B exclusive hot molding process—that assures smooth control at all times. There are never any abrupt changes in resistance during adjustment as in wire-wound units. Also, the "noise" factor is extremely low initially, and it decreases with use.

You, too, can obtain optimum resistor performance and reliability by insisting on Allen-Bradley. For full details on the complete line of A-B quality components, please write for Publication 6024, today.



This shows the use of A-B fixed and variable resistors in the Tektronix Type 545A high-speed DC to 30 mc laboratory oscilloscope.

A-B Type J variable resistor actual size, rated 2.25 watts at 70°C. Available in standard tapers and in standard total resistance values to 5 megohms. A-B engineers will be happy also to discuss your needs for special tapers and special, as well as, higher resistance values.

Allen-Bradley hot molded fixed resistors (shown actual size) are available in all standard EIA and MIL-R-11 resistance values and tolerances.

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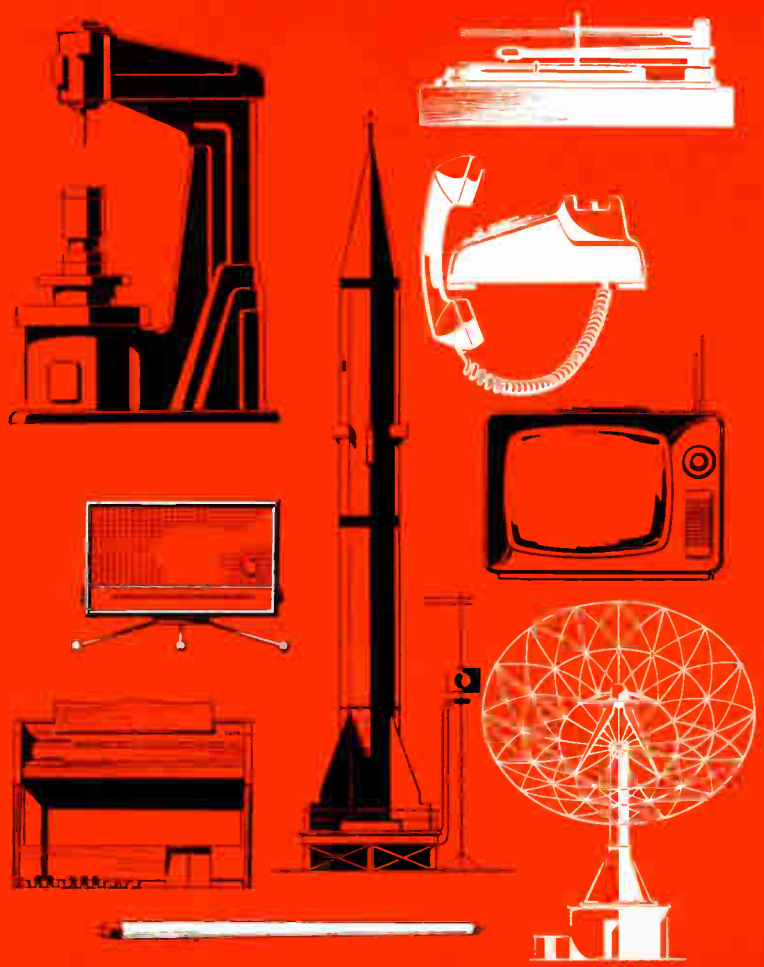

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APPLICATION	A-B FERRITE	PREFERRED CHARACTERISTICS
TELEVISION, RADIO Deflection Yokes	W-03 W-01	High permeability High resistivity
Flyback Transformers	W-04	Low losses, high Bmax, high permeability, high Curie temp
Convergence Cores	W-01	Low residual with large gap
R.F. Tuning Coil (fixed or permeability tuned)	R-02	Low losses. Temperature stable permeability, minimum hysteresis for permeability tuning
TELEPHONE SYSTEMS Interstage and Matching Transformers	W-03	High permeability, low losses
H. F. FLUORESCENT LIGHTS Loading Reactors	W-07	High flux density
Transformers	W-04	High permeability, low losses, high Bmax
ELECTRIC ORGANS AND HI-FI STEREO Oscillator Inductors	W-03	High permeability, temperature stable, linear B vs H
Output Transformers	W-04	High permeability, high Bmax, low losses
AUTOMATIC MACHINE TOOLS Magnetic Amplifiers	R-03	Rectangular hysteresis loop, high Bmax
Logic elements for high-power levels	R-03	Rectangular hysteresis loop, high Bmax
Matching Transformers	W-04	High permeability, low losses, high Bmax
MOBILE POWER SUPPLIES Static Inverters	R-03	Rectangular hysteresis loop, high Bmax
RADAR, MISSILES Pulse Transformers	W-04 R-02 (for short pulses)	High pulse permeability, high Bmax, low losses
PERMANENT MAGNETS Segments for D.C. Motors and Generators. Holding Magnets, Bias Magnets, Clutch Drives	M-05C M-01 M-01C	Good mechanical strength, high energy factor, high coercive force

■ From the broad line of Allen-Bradley *quality* ferrites, more and more designers are finding they can obtain the exact characteristics to meet their specific needs. Allen-Bradley's precise quality control methods insure continuously uniform electrical and mechanical properties—and A-B has the facilities for supplying ferrites in quantity. Listed to the left are a number of areas in which A-B ferrites have helped the manufacturer to reduce the product size, weight, or cost, and frequently the performance has been improved. If you have problems along this line, please let our engineers work with you in solving them.

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Loudspeaker Makers Plan R&D Foundation

Loudspeaker and speaker parts section of EIA approved creation of an R&D foundation at the section's recent semi-annual meeting.

Projects include: a public information program to promote sales of American-made loudspeakers, an industry R&D center, improved industry-wide credit policies, increased standardization of loudspeakers and parts, and a new marketing data program.

Center will conduct confidential studies for individual firms. It will also evaluate new ideas and distribute them to the industry. Library will include U. S. and foreign patents and all available technical information.

Financing of the center was started with pledges from Hawley Products and Arnold Engineering.

New Radios Boost Police Car Mileage

Transistorized two-way radio equipment has lengthened the life of a police car in Punta Gorda, Fla., by more than 10,000 miles a year.

City Manager C. Clifford Ryan found Punta Gorda now gets 52,000 miles of initial use without major repairs from a police car equipped with a G. E. transistorized mobile radio.

He points to substantial improvements in the vehicles themselves, but attributes the major share of the difference to the low battery drain of the new radio. It is no longer necessary for the car's engine to be running up the battery for good radio reception, he says.

SATELLITE AMPLIFIER

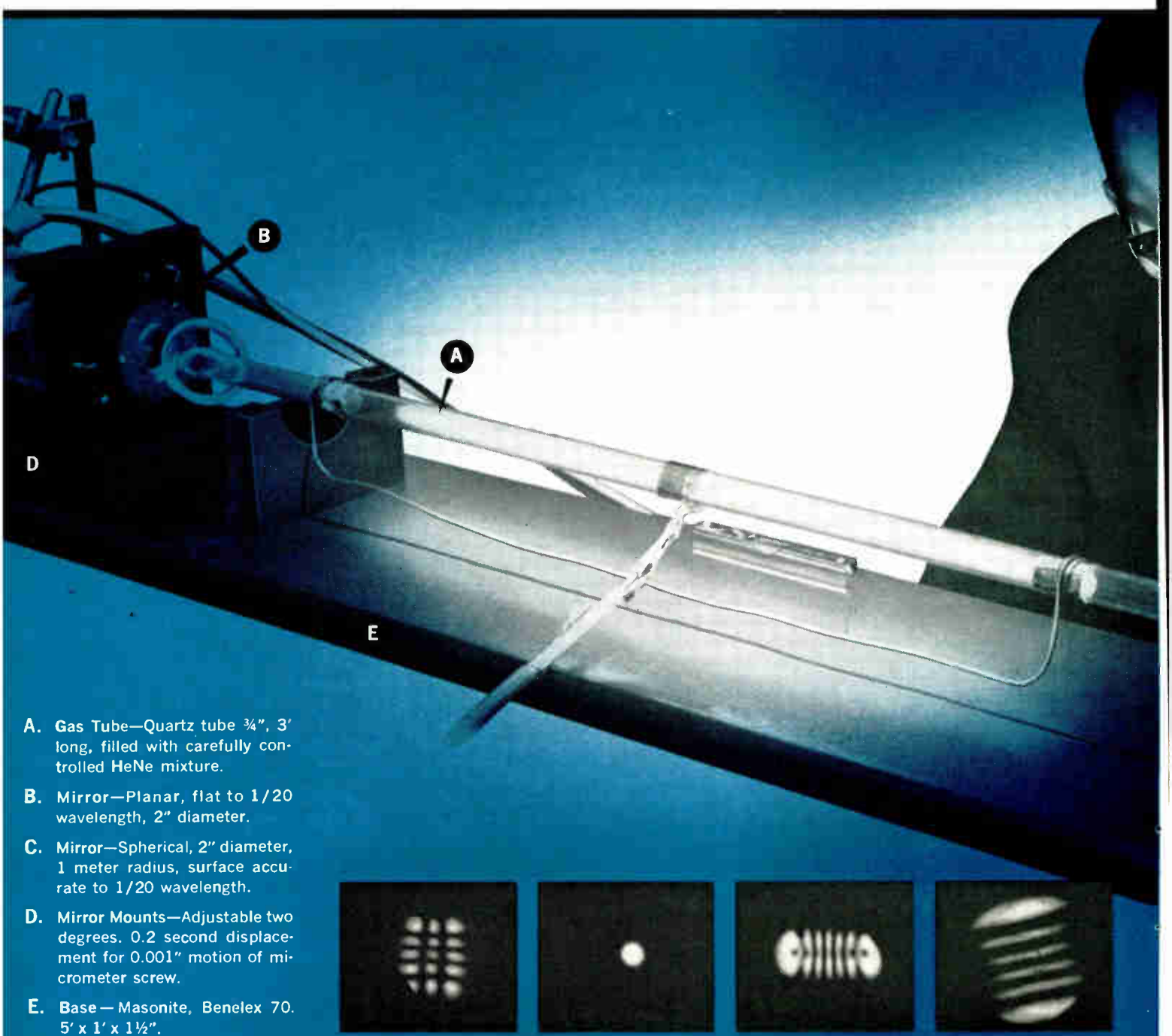
Maureen O'Donnell of RCA's Electron Tube Div., examines a traveling-wave tube that will amplify signals for NASA's relay communications satellite. The 150-lb satellite will be used to investigate global TV.

Sylvania helps you put a handle on laser phenomena

Investigating the laser principle and its application in communications, ranging, surveillance? The exciting study of this new area of electronics can be more rewarding if you consider the role these Sylvania products can play.

They provide new facility and handling ease not only in generating stable, reproduceable modes, but in detecting and measuring laser phenomena as well.

Sylvania can be of further help, too, if your program requires modifications of these products or if you'd like to talk over a special problem. Perhaps Sylvania's broad experience, which includes gas discharge, solid state physics, microwaves, luminescence and material synthesis, can bring a quick solution. Write Microwave Device Division, Sylvania Electric Prods. Inc., 1100 Main St., Buffalo 9, N.Y.



A. Gas Tube—Quartz tube ¾", 3' long, filled with carefully controlled HeNe mixture.

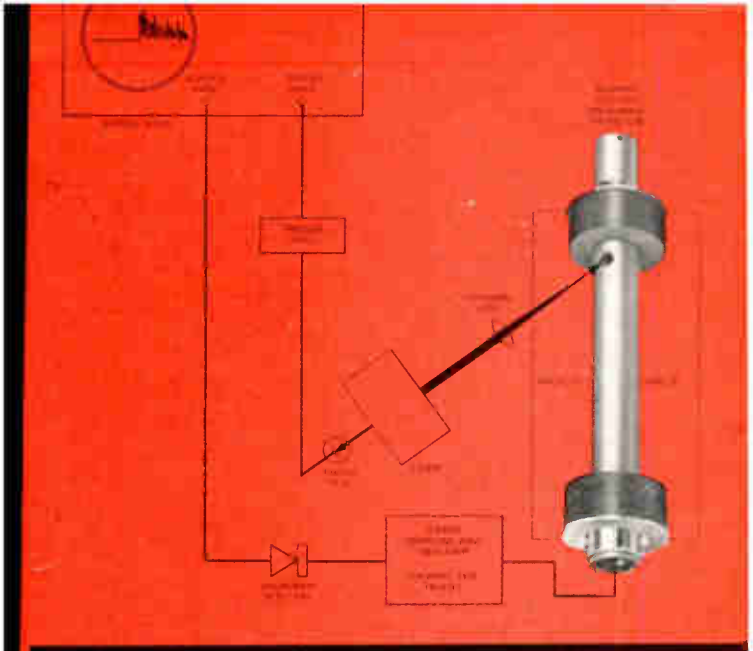
B. Mirror—Planar, flat to 1/20 wavelength, 2" diameter.

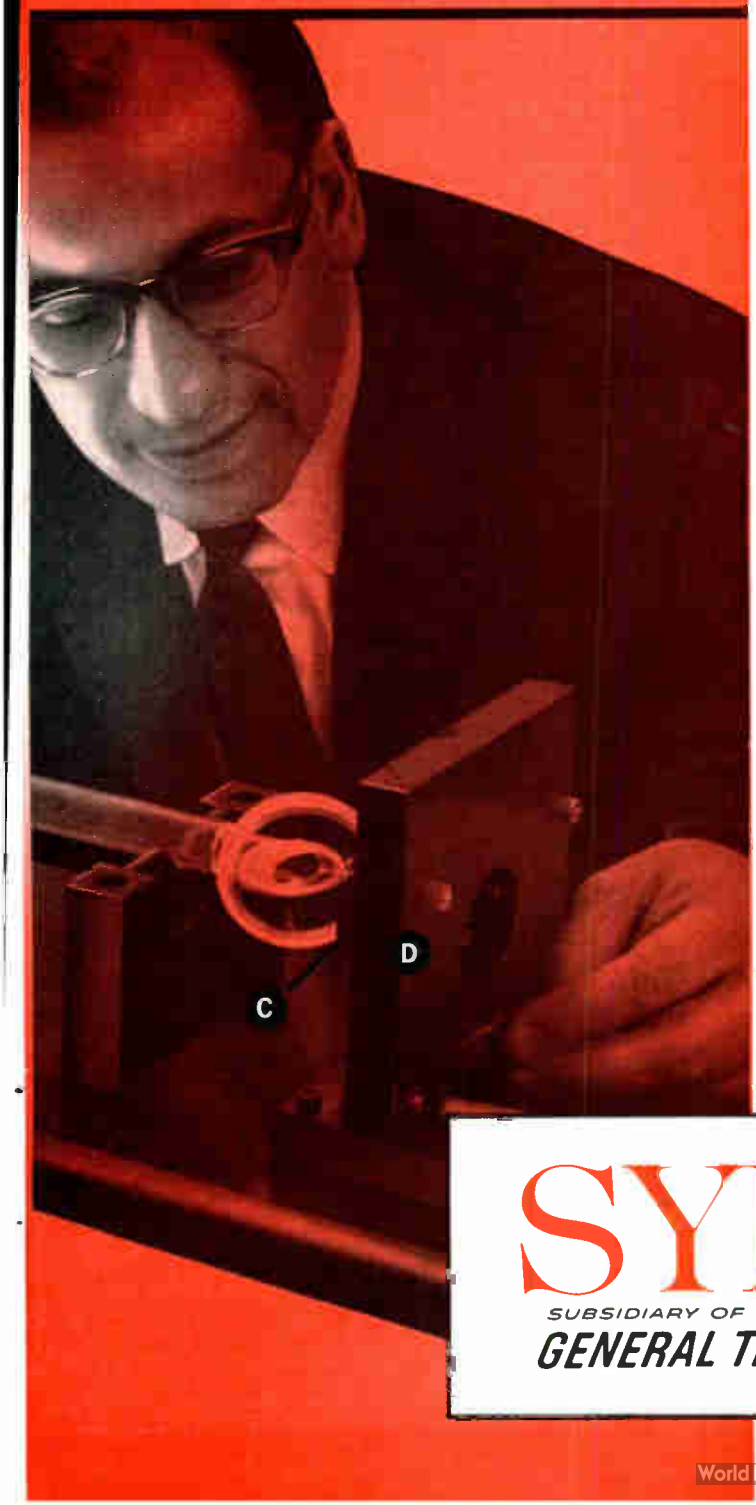
C. Mirror—Spherical, 2" diameter, 1 meter radius, surface accurate to 1/20 wavelength.

D. Mirror Mounts—Adjustable two degrees. 0.2 second displacement for 0.001" motion of micrometer screw.

E. Base—Masonite, Benelex 70. 5' x 1' x 1½".

Photographs of simple standing wave modes set up on the GL-6211. Patterns are stable and reproduceable.





First Practical Device for Laser Detection

The Sylvania SYD-4302 Microwave Phototube fills the important need for receiving light-transmitted microwave modulation in the 1.5Gc to 4.5Gc bandwidth.

Broadband Optical Receiver Use

Capable of response to amplitude modulated light signals, either coherent or incoherent, with a corresponding reproduction of modulation at the output. SYD-4302 makes practicable measurement of natural modulation, multimoding, frequency pulling and spectral width of coherent light.

Optical Superheterodyne Receiver Use

When used with a laser local oscillator, SYD-4302 can serve as the mixer and microwave IF sections of the receiver to detect and demodulate coherent light signals.

This totally new concept in laser reception can deliver sufficient RF power output to drive a low level (10-50mW) TWT such as Sylvania TW-4261. It uses an extremely durable photosensitive-thermionic cathode material and a broadband slow wave helix. Cathode responds to light in the red region of the spectrum and yields up to 0.5mA of photocurrent. It can operate on photocurrent alone or with a low filament voltage for increased output. In addition to this remarkable development for S-band frequencies, Sylvania is currently working on L, C and X-band microwave phototubes.

SYD-4302 Typical Operation

Conditions		Characteristics	
Helix voltage (approx.)	445 Vdc	Cathode current	400 μA*
Grid #1 voltage	0 Vdc		
Grid #2 voltage	445 Vdc	*Measured with approx. 3V on heater and no light energy from laser	
Heater voltage	3 Vac		

FOR INFORMATION CIRCLE READER SERVICE NUMBER 12

New Sylvania Gas Laser

Here is new experimental flexibility for researchers and engineers. A product of Sylvania's accrued knowledge in the field of lasers, the GL-6211 Gas Laser combines outstanding features with unique flexibility.

The GL-6211 provides a continuous output in the milliwatt range at 11,530 Angstroms. Because it employs external optics, the GL-6211 can be adjusted readily to produce simple reproduceable mode operation. Experiments can be made with optical configuration and cavity geometry. Access to the resonant cavity outside the laser tube makes possible easy study of this interesting region of the laser. Optics can be changed without disturbing the laser tube or its fill; confocal, concentric or plane optics can be employed.

This new handling ease can add considerably to research productivity; gaining knowledge and understanding of laser phenomena can be accelerated. At the same time, the GL-6211 offers practical advantages. Its inherent flexibility will not easily be outgrown.

Stability of the GL-6211 is enhanced by its sealed quartz tube, extremely clean gas fill, Brewster angle windows, and good heat dissipation, which virtually eliminates thermal expansion.

FOR INFORMATION CIRCLE READER SERVICE NUMBER 13

See us at WESCON Booths 3301-3306 (Annex-Tent)

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Video System To Guide Fair Visitors

Visitors to the New York 1964-65 World's Fair will be able to receive instant directional information in any language through a unique combination of TV and telephone. Video Information Service Co., Inc., of Hempstead, N. Y., will supply the unique system.

In a closed-circuit arrangement 150 videoguides will be placed at principal points throughout the 646-acre exposition grounds. Each Videoguide will consist of a 19-in. TV screen equipped with telephone handset, loudspeaker for bystanders and six language selector buttons.

The visitor desiring location information simply picks up the phone, presses a button, and an attractive young lady appears on the screen, seated before a large map of the Fair. She routes the visitor to the desired location. Only queries regarding Fair locations will be answered.

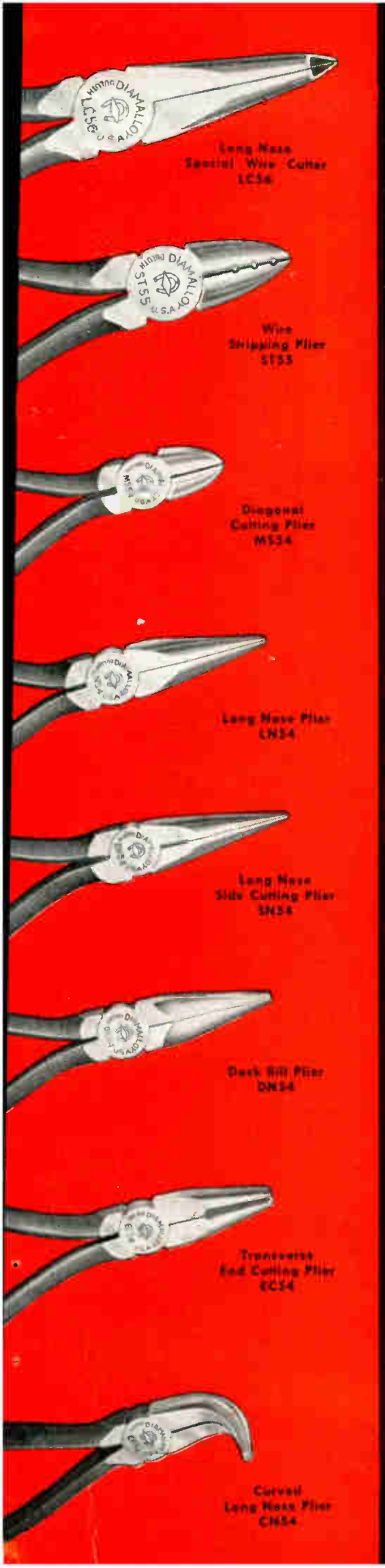
Atlantic Research Will Test Solid Fuel Concept

The Atlantic Research Corporation's new gel-solid booster fuel concept will be tested under an Air Force contract at the firm's soon-to-be-constructed rocket facility on the Atlantic coast of North Carolina. The firm recently acquired the site for the facility, to be located near Corolla, about 40 miles north of Nag's Head.

In addition to its work in developing and testing large gel-solid space boosters, the firm anticipates the facility will be used for testing even more advanced rockets and military vehicles.

NASA COMPUTERS

NASA's Dr. Helmut Hoelzer (l) and Charles Bradshaw (r) show G.E. Vice Pres. Harold Strickland print-out from one of four new G-E 225 computers installed at NASA's George C. Marshall Space Flight Center, Huntsville, Ala. Computers will perform data analysis on design of the Saturn booster vehicle.

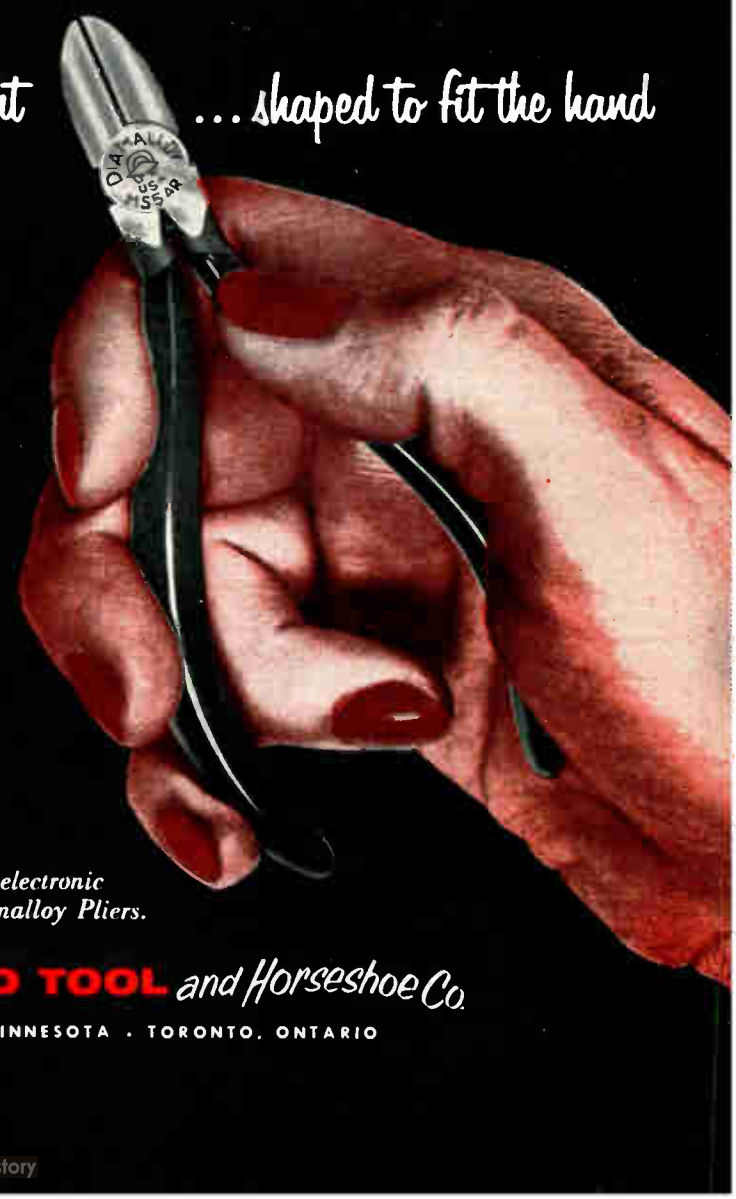


Designed to the requirements of industry

A variety of precision pliers built to stand up under the continuous use of production workers.

Little DIAMOND® Electronic Pliers

Light weight ... shaped to fit the hand

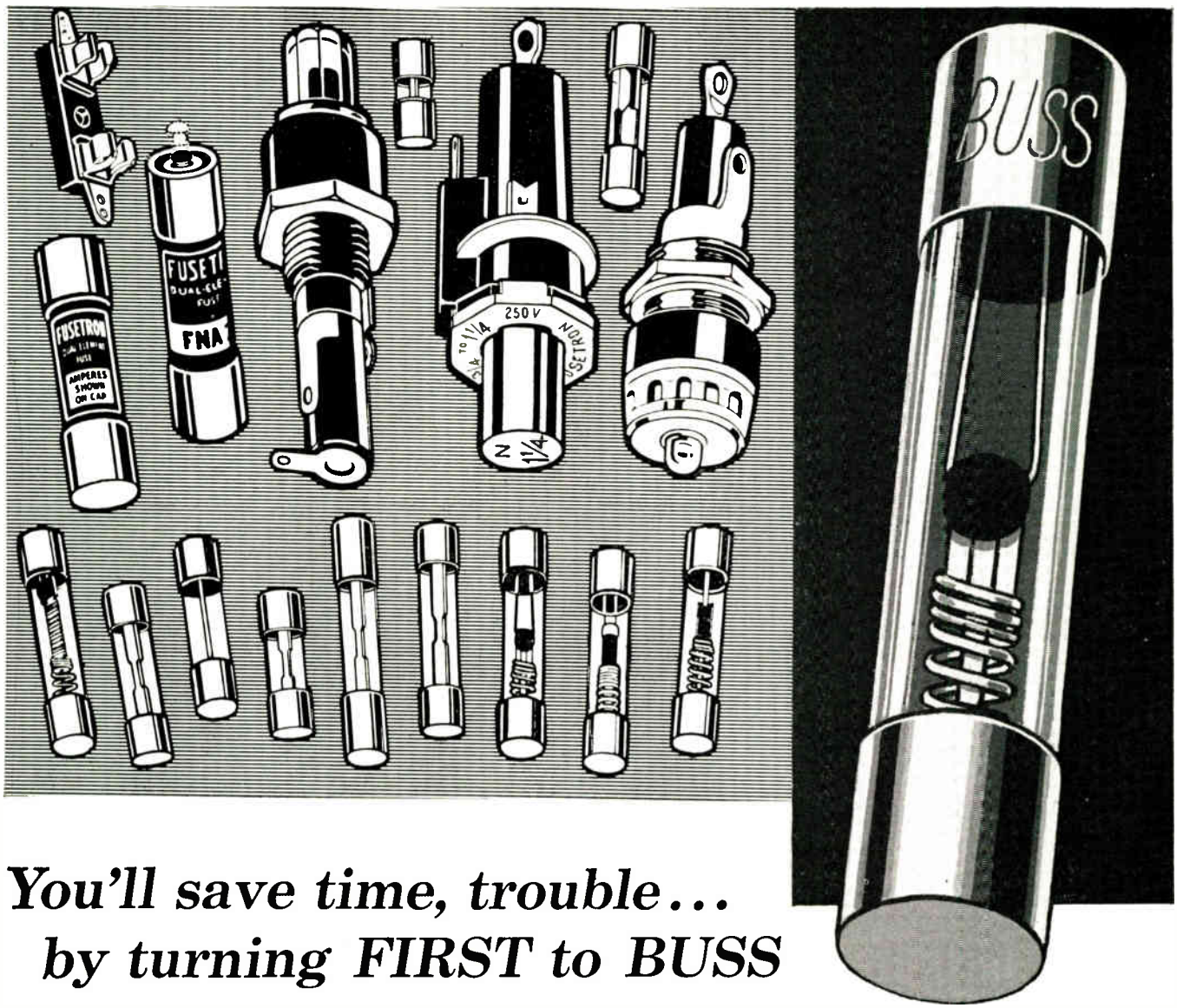


Ask your favorite electronic distributor for Diamalloy Pliers.

DIAMOND TOOL *and Horseshoe Co.*

EST. 1908

DULUTH, MINNESOTA · TORONTO, ONTARIO



You'll save time, trouble... by turning FIRST to BUSS

for fuses of unquestioned high quality

By relying on BUSS as your source for fuses, you can quickly and easily find the type and size fuse you need. The complete BUSS line of fuses includes: dual-element "slow-blowing", single-element "quick-acting" and signal or visual indicating types . . . in sizes from 1/500 amp. up—plus a companion line of fuse clips, blocks and holders.

BUSS fuses are made to protect—not to blow needlessly

When you specify BUSS fuses—users of your equipment receive maximum protection against damage due to electrical faults. And just as important, users are safeguarded against irritating, useless shutdowns caused by faulty fuses blowing needlessly.

A component part that operates as intended helps to maintain the reputation of your equipment for quality and service. That's why it pays to rely on dependable BUSS fuses.

If you should have a special problem in electrical protection . . . the world's largest fuse research laboratory and its staff of engineers are at your service—backed by over half a century of experience. Whenever possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be easily serviced.

For more information on BUSS and FUSETRON Small Dimension Fuses and Fuseholders . . . Write for bulletin SFB.

BUSS: The complete line of fuses and fuse mountings of unquestioned high quality.

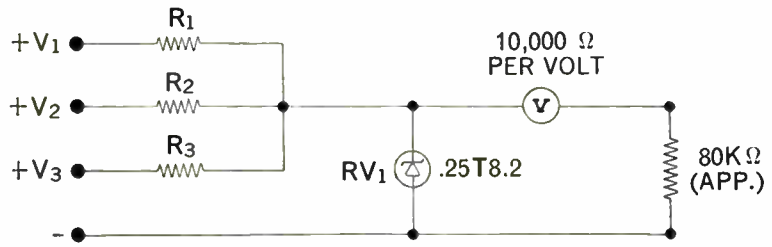
FUSETRON BUSS McGRAW EDISON

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

862

TARZIAN DESIGN IDEAS

Regulator Diodes–useful devices in electronic circuits

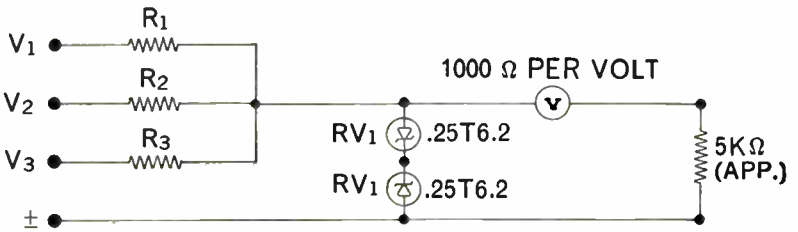


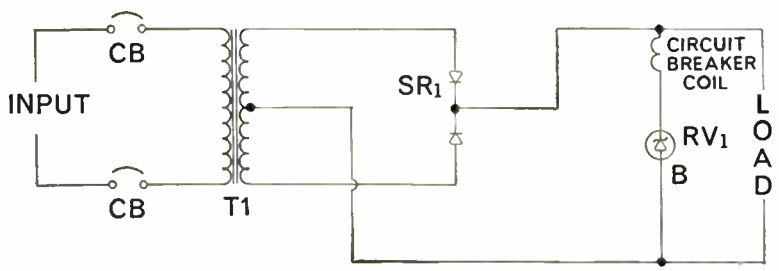
PROTECTION OF DC METER MOVEMENTS

R_1, R_2, and R_3-Meter Multipliers.
RV_1-Sarkes Tarzian Type .25T8.2 Regulator.
V = 100 Microampere Meter Movement.

PROTECTION OF AC METER MOVEMENTS

R_1, R_2, and R_3-Meter Multipliers.
RV_1-Sarkes Tarzian Type .25T6.2 Regulators.
V = 1 Milliampere Meter Movement.



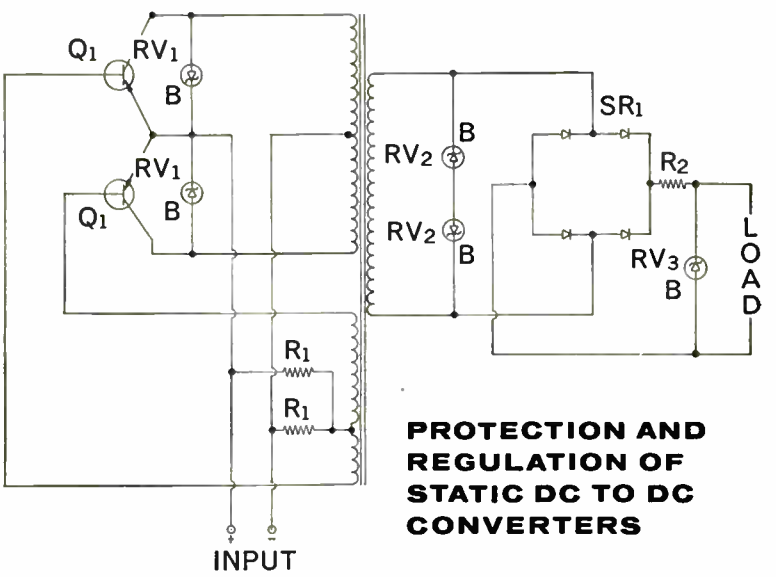


OVERVOLTAGE PROTECTION FOR SENSITIVE LOADS

RV_1-Selected to Avalanche at Critical Voltage and Cause Circuit Breaker to Open.

■ Not too long ago, the regulator diode (Zener) was considered a "luxurious" component, to be used only in the most sophisticated circuit. Progress in processing techniques and predictable voltage yields has made almost any application economically practical. The small size, inherent ruggedness, and physical simplicity of these devices—and their clipping, limiting, and protecting functions—can now be put to work widely.

The four applications shown here, while typical, can only suggest the usefulness of the silicon voltage regulator. We hope they will also suggest some useful answers to your problems, or new ways to improve reliability and performance. Our new catalog, 61-VR-11, contains data on five Tarzian series of silicon voltage regulators, plus design and test information. We will include prices. (You may be pleasantly surprised!) Prompt engineering service is also available.



PROTECTION AND REGULATION OF STATIC DC TO DC CONVERTERS

RV_1-Transistor Protectors.
RV_2-Transient Voltage Suppressors.
RV_3-Voltage Regulator-Transient Suppressors.

From Raytheon / Rheem:

1N3730/RD750 subminiature power diodes feature high conductance—1 Amp @ 1 volt—at nanosecond switching speeds

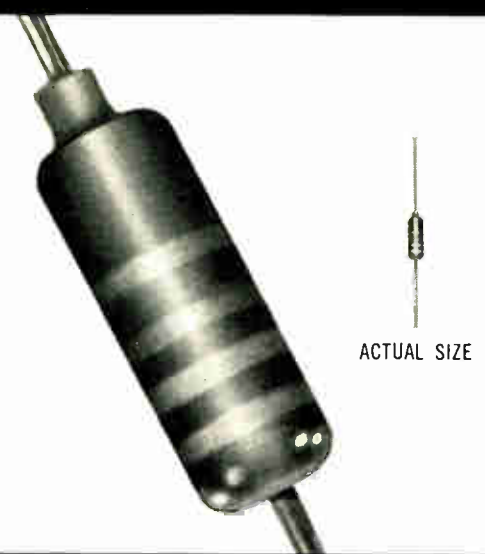
High-speed, high-current core driving This Raytheon/Rheem .107"-diameter silicon diode combines high power dissipation plus ultra-high conductance — typically 1 Amp @ 1 volt. Result: cooler junctions and more reliable operation. Switching speed is 15 nanoseconds max. at 10 mA ($V_R = -6V_t$, $R_L = 75$ ohms); power dissipation rating is 750 mW — three times that of conventional diodes. The high current capabilities of the 1N3730 provide substantial operating stability for greater reliability.

Miniaturized power supplies The 1N3730/RD750 marks a big step forward for low frequency power supply design. Extremely fast turn-on time — V_{fr} (peak) is typically 1.0 volt at $I_F = 750$ mA — prevents impulse distortion and undesirable voltage feedback. Superior turn-off results from a low stored charge (typically less than 20 picocoulombs per mA).

Computer switching This subminiature diode is ideal for a large number of computer applications because of its wide switching current range — 1.0 mA to 5 Amps. Actual specification at several current levels is your assurance of ultra-fast reverse recovery over a wide range. Direct correlation to stored charge is also provided.

For complete details, please call or write the Raytheon Field Office nearest you, or write Raytheon Semiconductor Division, 900 Chelmsford Street, Lowell, Massachusetts.

RAYTHEON/RHEEM 1N3730/RD750

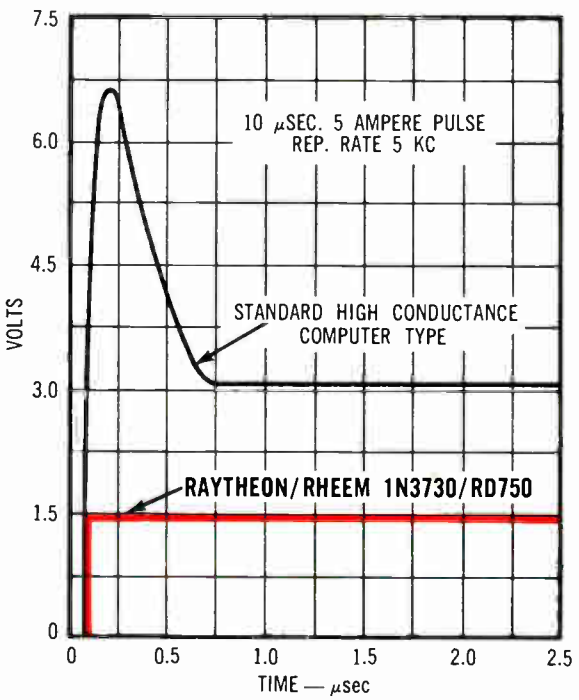


KEY PARAMETERS

- **Switching Speed**..... 15 nanosecond max.
- **Forward Conductance**.. 1 Amp @ 1 volt typical
- **Power Dissipation**..... 750 mW max. @ 25°C.

FAST TURN-ON TIME

FIVE AMPERE PULSE SCOPE TEST — COMPARING TURN-ON TIME OF 1N3730/RD750 WITH STANDARD COMPUTER DIODE

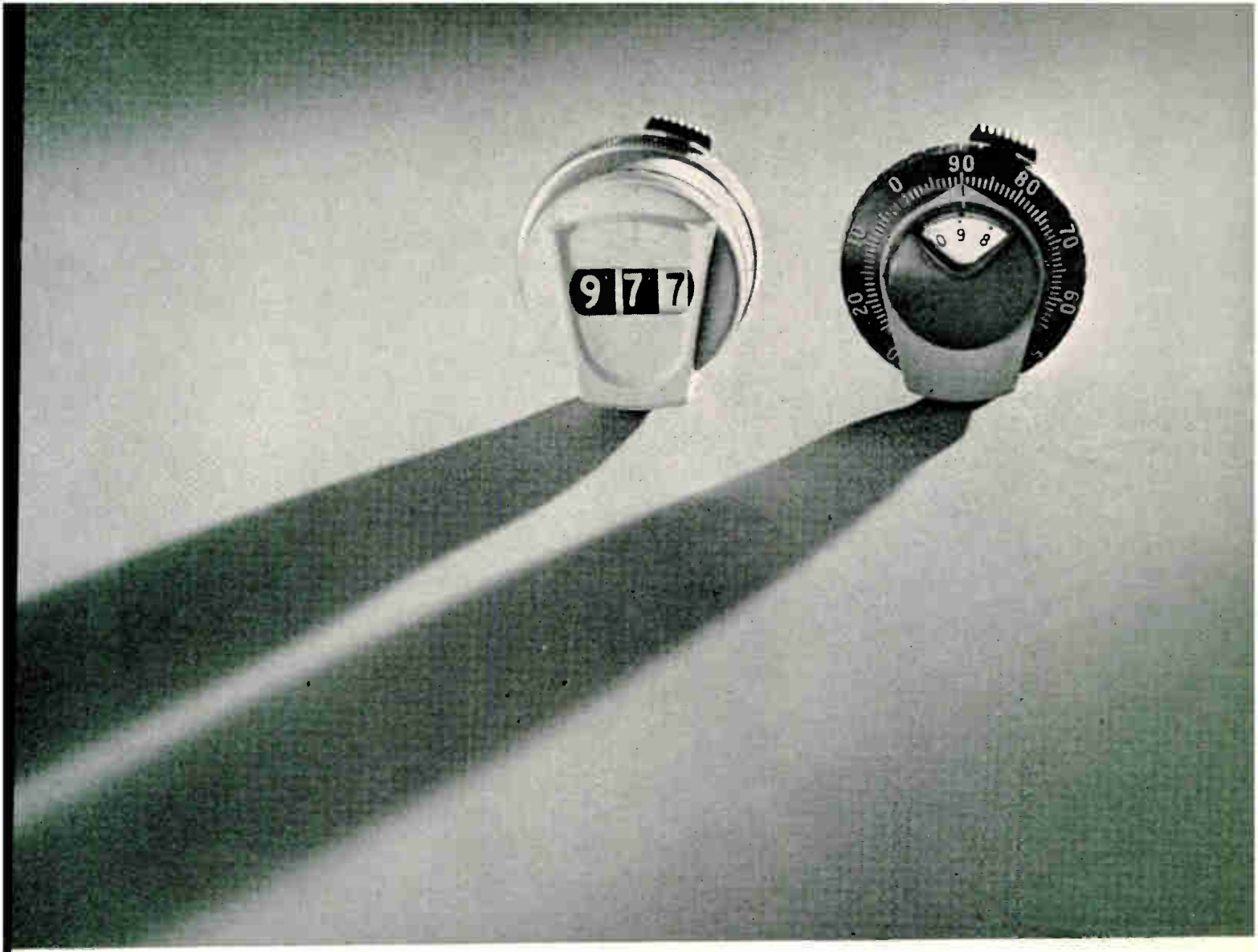


SEMICONDUCTOR DIVISION

LOWELL, MASSACHUSETTS

RAYTHEON

Circle 10 on Inquiry Card.



How do you prefer your Microdial®: Digital or Concentric Scale?

The Borg Microdial line (broadest in the industry) offers both types—two digital series, and three concentric scale series. Whichever type you like for potentiometer control, remember:

1. Each Borg Microdial features large numerals that are well contrasted to their backgrounds for squint-free readability. 2. Each can be equipped with positive braking to prevent accidental setting changes. 3. Indexing accuracy is one part in a thousand, suitable to a potentiometer of .1% linearity, thus enabling you to get all the precision you pay for in a precision potentiometer. 4. Rugged design withstands rough handling and "panic" responses or setting changes. 5. Customization of counting wheels and gearing can give you practically any readout configuration you might require.

Most Microdial models come in a variety of color combinations that contribute to appearance and permit coding for fast identification in panel groupings.

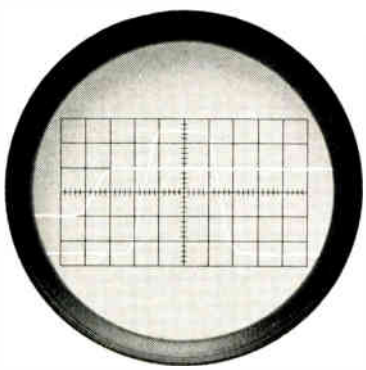
The Borg Microdial line is competitive too, as you can verify by contacting your nearby Borg technical representative or omnipresent Amphenol-Borg Industrial Distributor. Or, you can address specific inquiries to R. K. Johnson, Sales Manager:

Circle 9 on Inquiry Card

BORG

BORG EQUIPMENT DIVISION
Amphenol-Borg Electronics Corporation,
Janesville, Wisconsin.

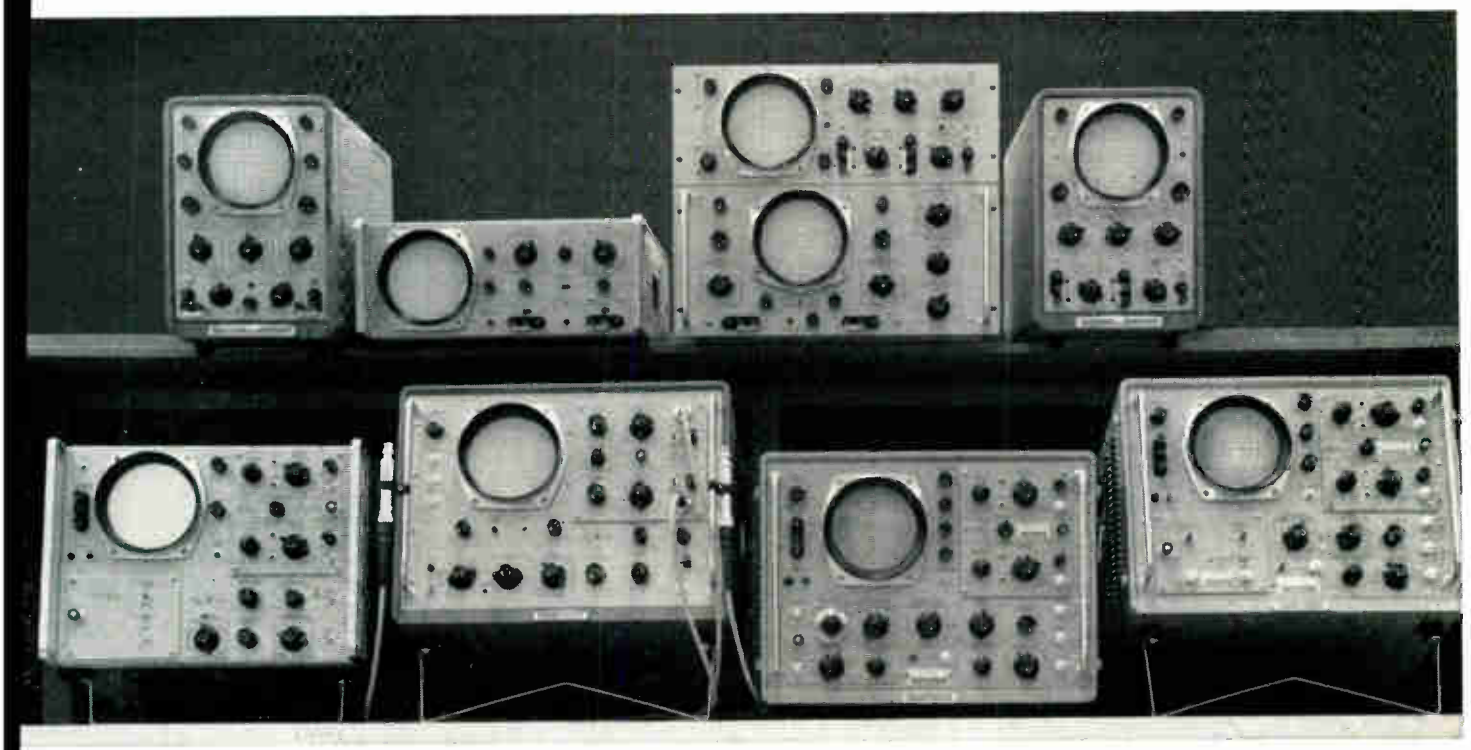
TOTAL COVERAGE in quality hp SCOPES



Easy, fast, accurate measurements

DC to 1000 MC

OSCILLOSCOPE	Description	Features
hp 185B	High-speed sampling-type scope, dc to 1,000 MC, conventional convenience over entire range (3 db point beyond 800 MC). Dual trace presentation with hp 187B plug-in. hp 186A Switching Time Tester available.	High sensitivity, wide dynamic range, high impedance signal probes. Versatile signaling up to 1,000 MC. Rise time less than 0.5 nanosecond. X-Y recorder output; time, amplitude calibrators. Rack mount available.
hp 175A	Dual trace 50 MC universal scope. Horizontal and vertical plug-ins for dual trace to 40 MC; high gain, single channel viewing, sweep delay, display scanning for X-Y output, time markers. Modular packaging for bench or rack mount.	12 Kv post-accelerator CRT with 6 x 10 cm display with internal graticule, no front panel astigmatism control; beam finder; simplified circuitry, no distributed amplifiers.
hp 160B, 170A	Militarized scopes, hp 160B, dc to 15 MC; hp 170A, dc to 30 MC. Plug-ins: dual trace, fast rise, high gain vertical amplifiers; marker generator, display scanner, sweep delay generator horizontal plug-ins.	Designed to withstand shock, vibration, humidity, temperature variations; beam finder; meet environmental requirements of MIL-E-16400. Rack mount available.
hp 120B	General purpose 450 KC scope. Human engineered front panel, simplified circuitry; no-parallax no-glare CRT; modular packaging for bench or rack mount.	Beam finder, automatic triggering, amplifier calibrator.
hp 122A, AR	Dual trace 200 KC scopes. Twin vertical amplifiers for either dual or single trace viewing. Bench or rack models.	Alternate, chopped presentation; differential input; automatic sync; x 5 sweep expansion.
hp 130B, BR	General purpose 300 KC scopes. 1 mv sensitivity. Similar vertical, horizontal amplifiers. Bench or rack models.	Minimum controls, easy operation, balanced inputs, high sensitivity.



130B 120B 122AR 130BR 122A
175A 185B 170A 160B

There's a dependable, accurate Hewlett-Packard oscilloscope for your every measuring task from dc to 1,000 MC. In addition to conservative design and rugged construction, hp scopes offer such error-free operating features as human engineered front panels, beam finder and automatic preset triggering. hp scopes are easy to use and easy to maintain.

hp CRTs eliminate scope parallax error!

Hewlett-Packard developed cathode ray tubes, standard on hp 175A, 185B, and 120B Oscilloscopes and optional for other hp scopes, use an interal graticule to eliminate parallax error! The graticule is *inside* the CRT so that trace and graticule are in exactly the same plane. These CRTs also have the exclusive hp no-glare, no-reflection faces. Select the scope for your job and call or write today for complete information.

HEWLETT PACKARD COMPANY

1501 Page Mill Road, Palo Alto, California,
Area Code 415, DA 6-7000

Sales and service representatives in all principal areas; Europe, Hewlett-Packard S.A., 54-54bis Route des Acacias, Geneva; Canada, Hewlett-Packard (Canada) Ltd., 8270 Mayrand Street, Montreal 7900

*Data subject to change without notice. Prices f.o.b. factory. *Prices do not incude plug-ins.*

Vertical Sensitivity	Horizontal Sweep	Price, basic oscilloscope
10 to 200 mv/cm, vernier to 4 mv/cm, with dual trace amplifier.	0.1 nsec/cm calibrated (0.04 nsec with vernier) to 10 μsec/cm.	$2,300.00*
5 mv/cm with high gain amplifier plug-in; 0.05 v/cm to 20 v/cm (50 v/cm with vernier) with dual trace amplifier.	0.1 μsec/cm to 5 sec/cm, vernier to 12.5 sec/cm. x 10 magnifier increases max. sweep speed to 10 nsec/cm.	$1,325.00*
5 mv/cm with high gain amplifier. 0.02 v/cm to 50 v/cm with dual trace amplifier; 0.05 v/cm to 50 v/cm with fast rise preamplifier.	0.02 μsec/cm with expander to 15 sec/cm with vernier.	hp 160B, $1,850.00* hp 170A, $2,150.00*
10 mv/cm to 100 v/cm	1 μsec/cm to 200 msec/cm, vernier to 0.5 sec/cm.	$475.00
10 mv/cm to 100 v/cm	1 μsec/cm with expander to 0.5 sec/cm with vernier.	$675.00, cabinet (hp 122A) or rack mount (hp 122AR)
1 mv/cm to 125 v/cm	0.2 μsec/cm with expander to 12.5 sec/cm with vernier.	$650.00, cabinet (hp 130B) or rack mount (hp 130BR)

SAC Orders B-47 Communication Systems

Award of a $2,009,500 Air Force contract to provide communication systems for B-47 aircraft as part of the Strategic Air Command's Airborne Command Post Program, has been announced by Electronic Communications, Inc., St. Petersburg, Fla.

SAC maintains an Airborne Command Post aloft around the clock, providing assurance of a command and control communication system which would survive any nuclear attack upon the U. S. The B-47's will serve as radio relay aircraft operating in conjunction with SAC KC-135 airborne command planes. When the program is fully operational the communications range of the airborne command post plane will be extended by the B-47 relay aircraft.

Firm Betters Objective

The Minuteman reliability objective of a failure rate of .001% per 1,000 hours for solid tantalum capacitors has been bettered, claims Sprague Electric Co.

This achievement results from more than two years of effort on the part of the firm to improve the reliability of solid tantalum capacitors. Sprague is working under a $1.26 million contract with Autonetics Div. of North American Aviation.

Sprague has reportedly achieved a figure of .0004 or 1 failure in 5,500 units on test for 1,000 hrs.

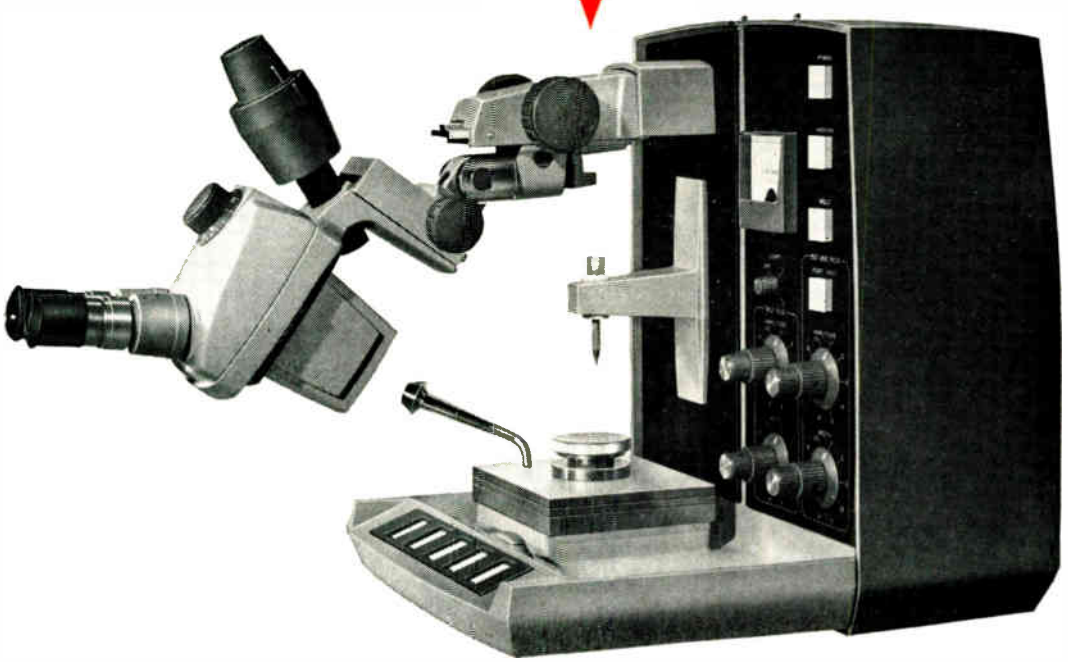
Navy Releases Component Failure Study

Better methods for reporting early component failures are recommended in a study recently made for the Navy's Bureau of Weapons and now available through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Ask for PB 181 040.

Entitled, "Study of Initial Failures of Precision Instrument Components," the 167-page report suggests a standard form for outlining the "when, where and how" of early component failures. Price is $3.

The study states, "Failure information presently generated is so inconsistent and misleading as to be practically worthless as an impetus for corrective action." The investigators, Paratron Corp., recommend standardization of all terms and forms used in reporting component failures.

revolutionary new single point resistance MICROWELDER

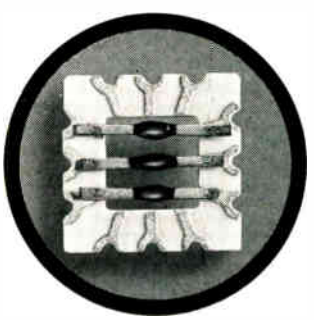


WELDS ½-MIL WIRE ON 3-MIL CENTERS

■ Metal-to-glass bonds ■ Metal-to-ceramic bonds ■ Metal-to-semiconductor substrates ■ Bonds to angstrom-thick thin-films ■ Portable—110-115 V, ac, 60-cycle operation

Provides reliable bonds...from printed circuitry to molecular electronic functional blocks.

For further information write Aerojet-General® Corporation Astrionics Division, Dept. 505, Azusa, California



WELDED WINDOW-FRAME MICROELECTRONICS

See the MICROWELDER at Wescon Booth No. 3817, 3818

AEROJET GENERAL TIRE GENERAL

ASTRIONICS DIVISION / AZUSA, CALIFORNIA

Garrett Will Build 'Moon Lab'

The largest "Moon Lab" of its kind in the world will be built by the Garrett Corp.

An initial allocation of $3 million has been made for the 87,000 sq. ft. research facility, including a laboratory capable of simulating a trip to the moon. Also included is a program to up-grade machining, welding and processing capabilities in the company's Los Angeles and Phoenix plants.

The new space research facility, scheduled for completion in early 1963, will be built on a 70-acre site in Torrance, Calif., near another Garrett electrical and electronic plant.

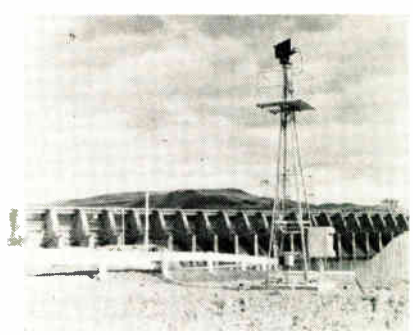
This Moon Lab will include equipment necessary to simulate the environment expected during a trip to the moon—17 space chambers, 2 vibration rooms, 2 hot and cold chambers, humidity and fungus chambers, 2 clean rooms, a data acquisition center and test benches.

Data System To Pay Taxes

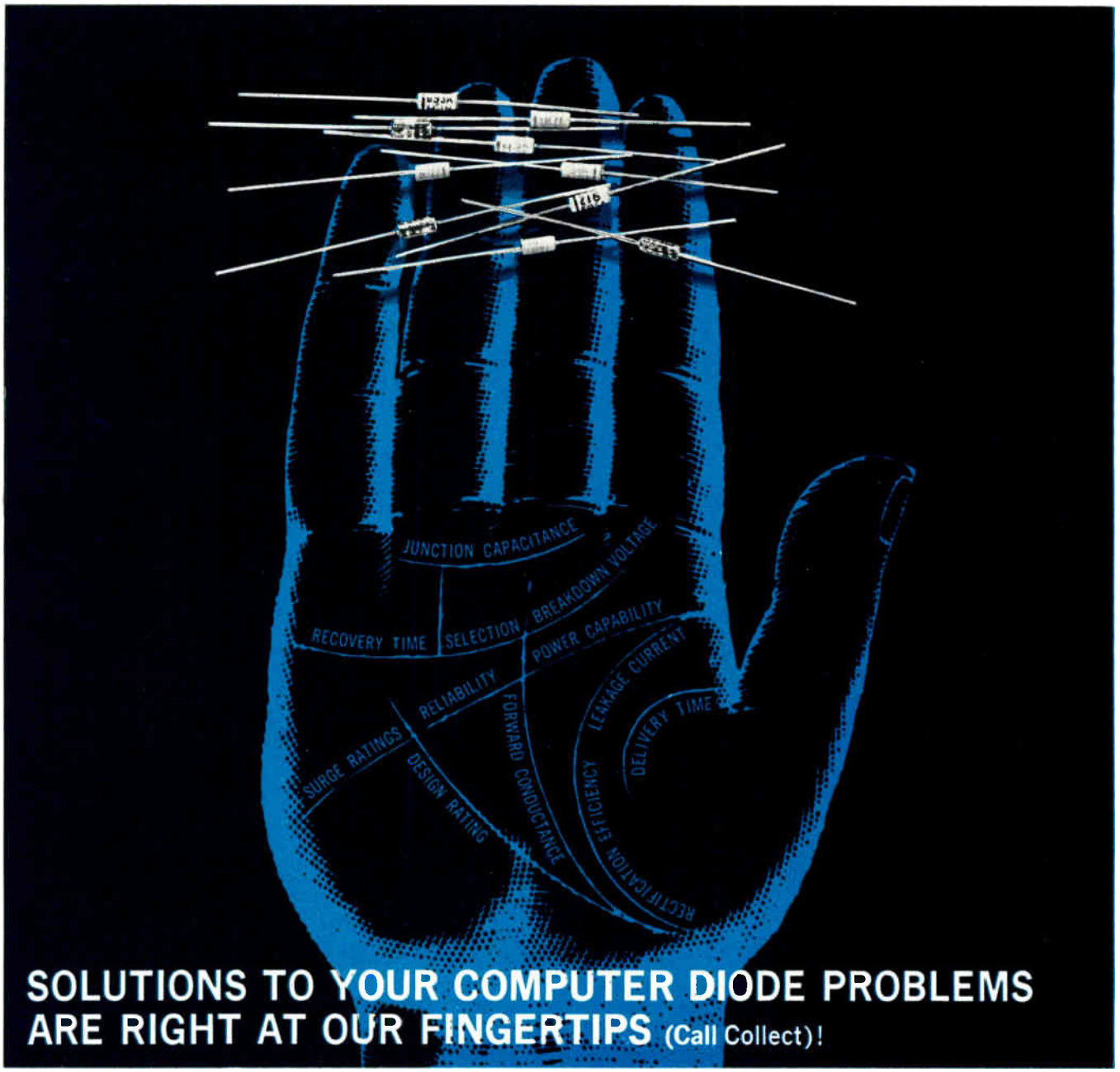
A "jack of many trades" data processing system is being called upon to mastermind payment of varied tax obligations involving 999 separate tax levies faced by a manufacturer throughout a 50-state marketing area.

Julius Klein, President of Caloric Appliance Corp., said an RCA 301 electronic data processing system being installed at Caloric's Topton, Pa., plant on lease "will be programed to handle all our local tax problems, and is expected to reduce our tax accounting costs substantially."

TV SENTRY



This camera is part of a 4-camera closed circuit TV system at Dalles Dam in Oregon. System "looks out" for log jams, ice floes, and other hazards in the reservoir. Manufactured by the Dage Div. of Thompson Ramo Wooldridge Inc., for the U. S. Army Corps of Engineers, the entire surveillance and security TV system operates round-the-clock in all weather conditions.



SOLUTIONS TO YOUR COMPUTER DIODE PROBLEMS ARE RIGHT AT OUR FINGERTIPS (Call Collect)!

Whatever your requirements, talk to us first. Check these parameter spectrums for an indication of the breadth of our diode capabilities, and for representative parameters in each diode group.

REVERSE RECOVERY TIME (NANOSECONDS)*

	< 0.5	0.6	0.7	0.8	0.9	1	2	3	4	5	6	7	8	9	10	15	20	50	100
Silicon Bonded	HD5001,03,04																		
Silicon Planar Passivated							1N3064,67 1N914,16											1N3068	
Silicon Alloy																	HD4112,13,14		1N643
Germanium Point Contact			HPS1670,71,72				HD1062,63,64					HD1310,20A,30							
Germanium Gold Bonded									HD1871		HD1841			HD1811		HD1705,06,07			

*Sampling Scope—10mA/ 6V Recovery to 3mA.

PEAK INVERSE VOLTAGE (VOLTS)

	10	20	30	40	50	100	150	200	250
Silicon Bonded		HD5004 HD5001,03							
Silicon Planar Passivated			1N3067,68			1N914,16,1N3064			
Silicon Alloy					HD4114	HD4113	HD4112	1N643	
Germanium Point Contact		HPS1670,71,72			HD1064	HD1063 HD1062	HD1330	HD1320A	HD1310
Germanium Gold Bonded		HD1871	HD1841 HD1811		HD1707	HD1706 HD1705			

NOTE EIA numbers pend ng on all house types listed above

For complete details, call your nearest Hughes representative; or write or call collect: Hughes Semiconductor Division, Marketing Department, Newport Beach, California. Phone: Liberty 8-0671, Ext. 323.

RELIABILITY PLUS

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
SEMICONDUCTOR DIVISION

DIODES • TRANSISTORS • RECTIFIERS • PACKAGED ASSEMBLIES • CRYSTAL FILTERS

HOW MANY READOUTS DO YOU SEE HERE?*

2 LIGHTED BULBS One each for digit and polarity

2 LIGHTED BULBS One for each word

1 LIGHTED BULB

3 LIGHTED BULBS One for each word

1 LIGHTED BULB

3 LIGHTED BULBS One for each digit and color

ACTUAL SIZE SERIES 10000 READOUT SCREEN

Readouts that do more

DISPLAY NUMBERS, WORDS, COLORS, AND SYMBOLS

Here is an extremely versatile readout employing all or any one of these features... plus a clear distinct one inch character with high even brightness and wide viewing angle. Only inexpensive lamps have to be replaced with I.E.E. readouts. Ideal for all applications where visual display is required. Available in individual units or assemblies. Unit price is $18.00. Larger and smaller models also available. For complete specifications contact our nearest representative or write to Dept. PE.

***Just one IEE Readout containing 12 displays. How many of these possibilities fit your application?**

INDUSTRIAL ELECTRONIC ENGINEERS, INC.

Representatives in Principal Cities

5528 Vineland Avenue, North Hollywood, California

Circle 50 on Inquiry Card ➔

BOURNS KNOBPOT— NOTHING BEHIND THE PANEL BUT THE SOLDER HOOKS AND THE BUSHING!

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.

Resistances: 1000Ω to 100K std. (to 250K spl.)
Dial Accuracy (Including 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)

ACTUAL SIZE

NOW YOU CAN MULTIPLY THE USEFULNESS OF KNOBPOT

TAKE YOUR CHOICE OF DIAL-FACE OR PLAIN-FACE STYLE

This is the standard model Knobpot—complete with dial for visual read-out of settings

If you don't need the read-out dial, here's the same basic 10-turn precision potentiometer at a much reduced price.

WITH ANY OF THESE ACCESSORIES OR ANY COMBINATION OF THEM

Accessories meet color requirements of MS-91528B and MIL-STD-242 (ships)

COLORED SNAP-RINGS

To color-code control panels or impart higher style to equipment design.

COLORED MIL-SPEC SLIP-OVER KNOBS

For function, for style. Standard 1" MIL-spec diameter.

STAINLESS STEEL SKIRTS

For a finishing touch of high-polish glamour.

LOCKING DEVICE (BRAKE)

To prevent accidental jarring of settings. Easy to install—simply snaps into place between the potentiometer and the panel.

BOURNS

BOURNS INC. TRIMPOT® DIVISION
1200 COLUMBIA AVE. RIVERSIDE CALIF.
684 1700 TWX RZ9222 CABLE BOURNSINC

WRITE FOR FULL INFORMATION ON KNOBPOT AND KNOBPOT ACCESSORIES

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

B&A® assures same or next day delivery of highest purity "Electronic-Grade" chemicals

Specify B&A chemicals today . . . *use* them today or tomorrow! Baker and Adamson delivers "Electronic-Grade" chemicals the same or next day—no matter which major electronics center your plant is in. B&A's coast-to-coast facilities make this speedy service possible.

"Electronic-Grade" chemicals are produced on the West Coast at El Segundo, Calif.; in the Midwest at Chicago; on the East Coast at Marcus Hook, Pa. Twenty-four B&A stock points strategically located across the country provide local service.

Fast, dependable delivery is only a part of B&A's policy. *Highest product purity* is another! B&A holds down impurities in its "Electronic-Grade" chemicals to the *lowest levels ever attained* . . . and insures this high purity through rigid chemical and instrument analysis.

When specifying chemicals for semiconductor production—wherever you are—get the finest, fastest . . . B&A "Electronic-Grade" chemicals.

For our brochure containing complete product lists and specifications—please write us on your letterhead.

See us at Booth 3752, WESCON, August 21-24, Memorial Sports Arena, Los Angeles

BAKER & ADAMSON®
"Electronic-Grade"
Chemicals

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GENERAL CHEMICAL DIVISION
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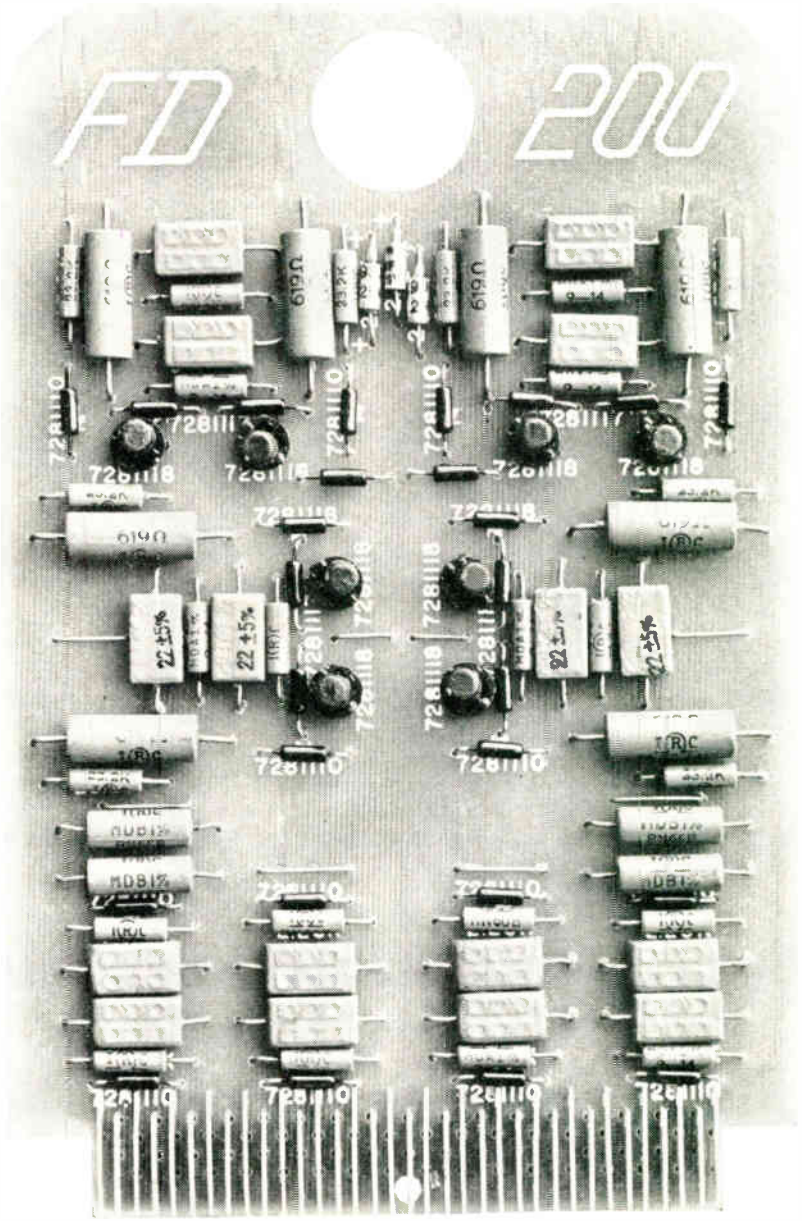
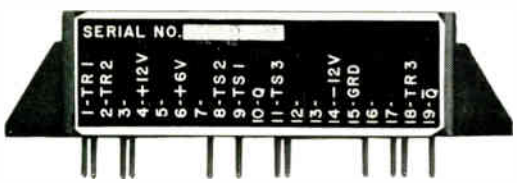
Circle 19 on Inquiry Card

←Circle 50 on Inquiry Card

both 10mc





ONE FOR THE BIRD

Tested, proved, ready for work . . . Delco's new 10 mc Silicon Digital Modules are available in either building block or plug-in card. Both circuits are *exactly* the same electrically. Either way, these modules meet or exceed all MIL-E-5272D (ASG) environmental requirements. In the blockhouse, the plug-in card package offers extreme accuracy and reliability with a gate-switch speed of 40 nanoseconds. The building block package and the card offer the same high speed at temperatures of −55°C to +100°C. Ideally suited to airborne guidance and control, the building block package is environmentally

ONE FOR THE BLOCKHOUSE

proved to: *Shock*, 1,000G's in all planes; *Vibration*, 15G's at 10 to 2,000 cps.; *Humidity*, 95% at max. temp.; *Storage and Sterilization Temp.*, −65°C to +125°C; *Acceleration*, 20G's. Both building block and plug-in card modules are designed for systems using from one module to 100,000, and the module's rated performance considers the problems of interconnection. Delco Radio can offer both 10 mc module packages off-the-shelf or can supply circuits to meet your specific needs. Write Delco Radio Military Sales Department, Kokomo, Indiana.

DELCO RADIO
DEPENDABILITY

Division of General Motors • Kokomo, Indiana

Now! The AMPin-cert* DUO-TYNE* Leaf Connector . . . so adaptable it offers virtually unlimited application possibilities. Individually housed contacts snap-mount into aluminum plates which can be designed to most any size or configuration imaginable. Makes no difference whether you need 10, 20, 40, 100 . . . 1,000 or more positions in modular construction connectors. Any way you adapt it, the AMPin-cert DUO-TYNE Leaf Connector will be right at home. To make doubly sure that it's right for you, the AMPin-cert DUO-TYNE Leaf Connector uses special A-MP* crimp-type, snap-in contacts. These contacts, originally designed to meet the stringent application requirements in atomic submarines, provide unmatched electrical qualities. The unique shape of the female contact creates pressure-spring mating with the flat male tab (.031 x .082) . . . provides enlarged redundant areas of contact . . . and insures greatly increased wiping action for maximum conductivity. And these are but a few of the advantages. Check these additional AMPin-cert DUO-TYNE Leaf Connector features:

● Precision-engineered contacts applied by A-MP* automatic crimping machines on A-MP* hand tools guarantee the most reliable connections possible with the lowest applied costs in the industry. ● Rugged, shock resistant nylon housings provide high dielectric strength. ● Insulation support crimp eliminates small wire handling problems. ● Contacts are duplex-plated. Gold over nickel on a phosphor bronze base. ● Contacts hand-inserted, easily removed and reinserted. See how the AMPin-cert DUO-TYNE Leaf Connector can be at home in your design plans. Send for more information.

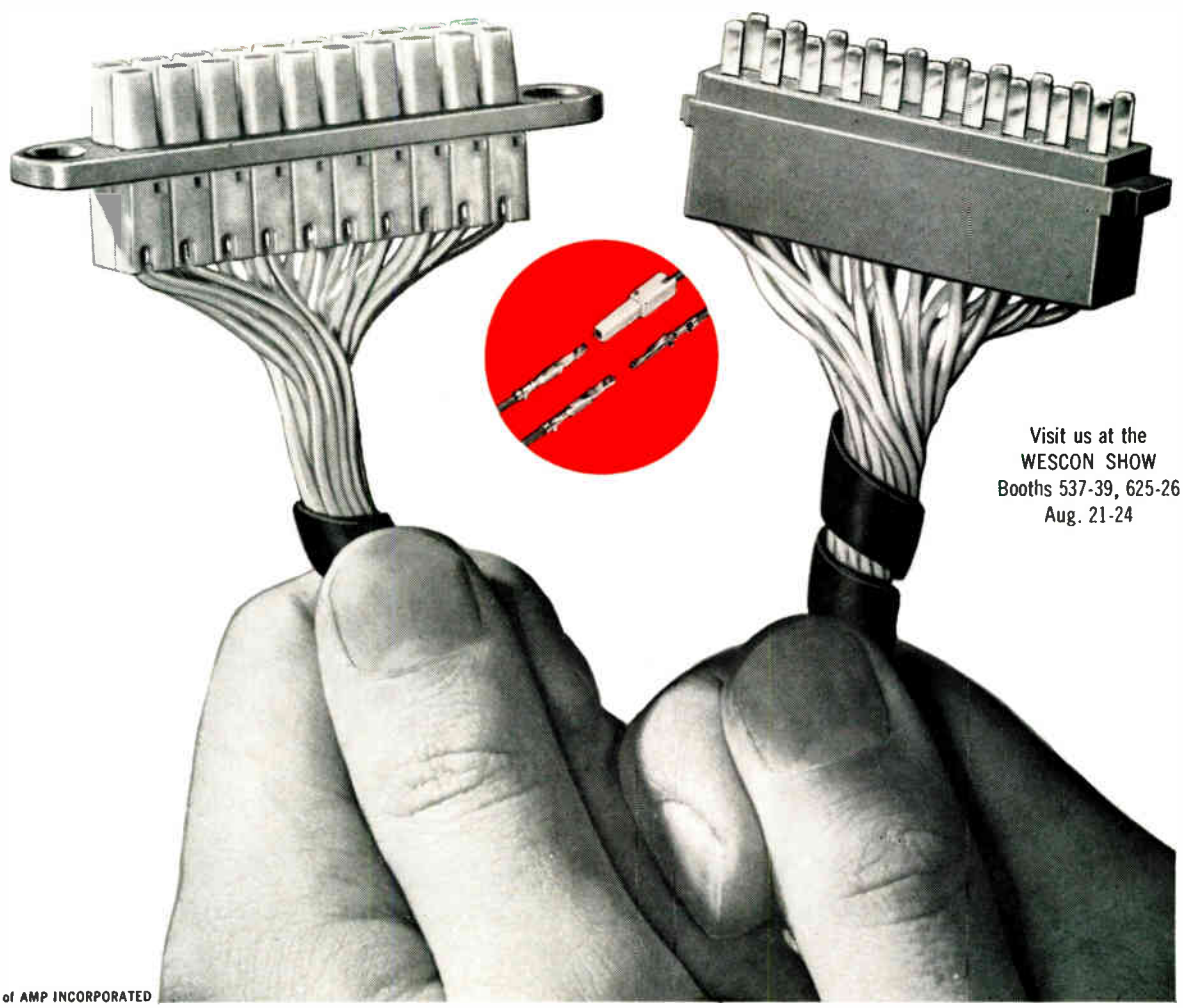
AMP

INCORPORATED

Harrisburg, Pennsylvania

AMP products and engineering assistance are available through subsidiary companies in Australia • Canada • England France • Holland • Italy • Japan • Mexico • West Germany

up for adaption



Visit us at the
WESCON SHOW
Booths 537-39, 625-26
Aug. 21-24

*Trademark of AMP INCORPORATED

Vital Instruments For Dyna-Soar Ordered

Cockpit instruments for the Dyna-Soar Manned Space Glider will be designed, developed and produced by Kollsman Instrument Corp., Elmhurst, N. Y. The instruments which will display the Space Glider's angle of flight and rate of climb, were ordered by The Boeing Co., System Contractor for the program.

Referred to as Vertical Scale Indicators because of their shape, the instruments present information by means of a pointer moving along a straight scale, making the instrument face easier for the space pilot to read than the usual radial type. Dyna-Soar is an Air Force program to boost a manned glider into orbit and bring it back to earth under control of its own pilot. On its return from space, the glider will be flown through the atmosphere like an airplane and will be capable of piloted landings at conventional airfields.

Florida Underwater Research Station Opened

A deep water acoustic-video research station is now functioning under a Navy contract in the Florida Straits. Scientists from the University of Miami's Marine Science Institute operate it.

The station consists of hydrophones installed on the ocean floor and is to include an underwater TV camera. It is cable-linked to the Lerner Marine Laboratory, in the Bahamas, which is connected with the American Museum of Natural History.

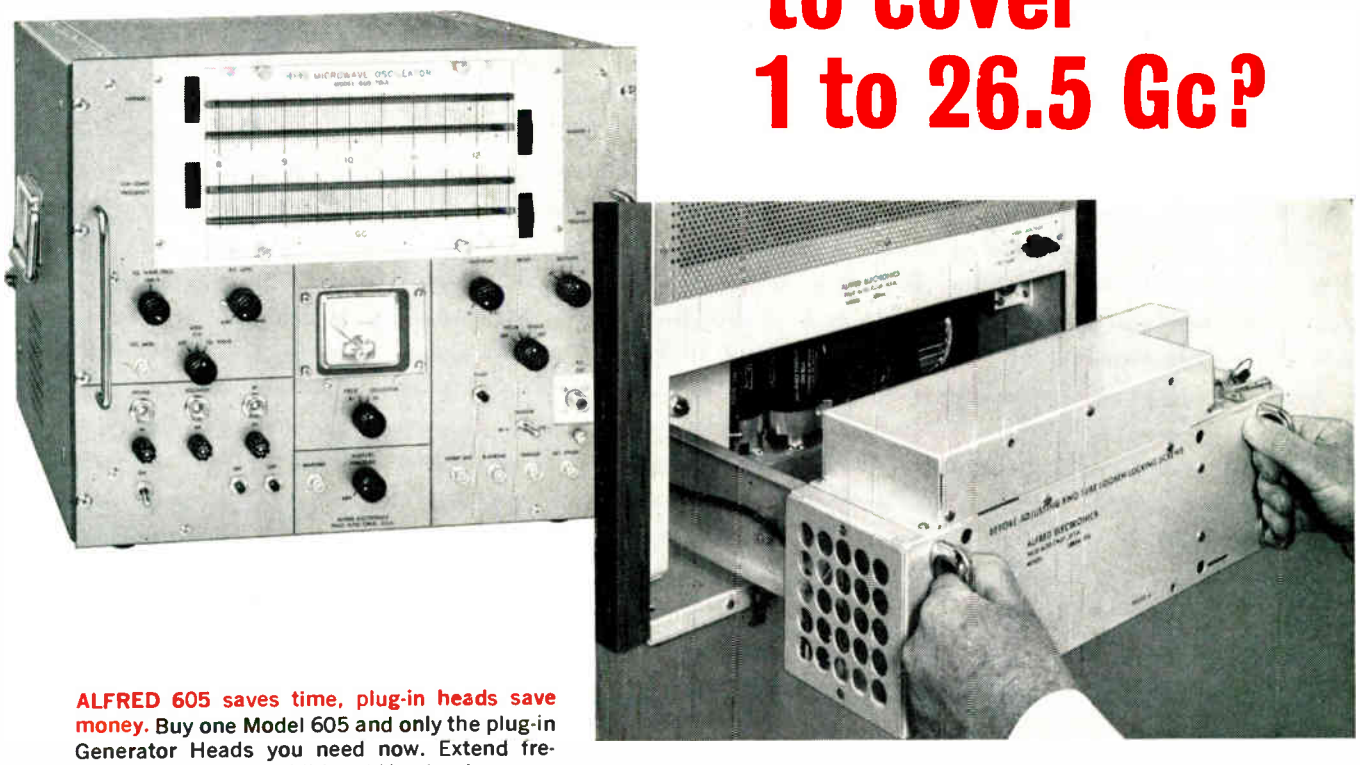
Ryan Equipment Ordered By Australia and Japan

Office of the Australian Consulate General in New York City and the Nissho Agency in Los Angeles have placed orders totaling more than $320,000 with Ryan Electronics, San Diego, Calif.

The Australian order is for AN/APN-122(V) radar navigation sets, to be installed in Australia's P2V-7 aircraft.

The Japanese order is for use by the Japanese Maritime Self Defense Agency and is for AN/APN-97A sets, test equipment and special support equipment. The AN/APN-97A is a self-contained system employing pure CW Doppler radar to automatically and continuously detect and display ground speed and drift angle.

WHY BUY SIX SWEEPERS to cover 1 to 26.5 Gc?



Plug-in Generator Head slides simply and quickly into Alfred's Model 605 General Frequency Oscillator.

ALFRED 605 saves time, plug-in heads save money. Buy one Model 605 and only the plug-in Generator Heads you need now. Extend frequency range with additional Heads when your requirements change. The 605 with six plug-ins provides electronically swept or single frequency coverage from 1 to 26.5 Gc. Sweep rate adjustable from 100 cps to 0.01 cps permits either oscilloscope or recorder display of broadband microwave component characteristics.

Your Model 605 is never obsolete; greater coverage is possible with new Heads as they become available. Special frequency requirements are covered with intermediate range Heads (some are listed below).

Heads Easily Installed—Heads are pre-calibrated—no adjustment needed—and can be changed in 3 minutes. Any Head can be used with any Model 605.

Replaces Signal Generators—As single frequency signal sources ALFRED Microwave Oscillators are as stable as mechanically tuned signal generators.

Field Proven Performance—Over 2 years in production and over 200 units in service.

SPECIFICATIONS

SWEEP WIDTH Continuously adjustable from 0 to any part of the entire frequency range with direct calibrated dial.

SELECTOR Recurrent Sweep, Single Sweep, CW, and External.

CONTROL Single Sweep triggered by panel button, external positive going 20 v signal or internal line frequency signal.

TIME 100 to 0.01 second.

EXTERNAL SWEEP 200 v gives full sweep. DC to approx. 10 Kc response.

FREQUENCY MARKERS Two markers continuously adjustable over entire frequency range.

INTERNAL AM Square wave. 800 to 1200 cps.

EXTERNAL AM 25 v for 100% control. DC to 1 Mc response.

PRICE Model 605: $1,750 fob factory.

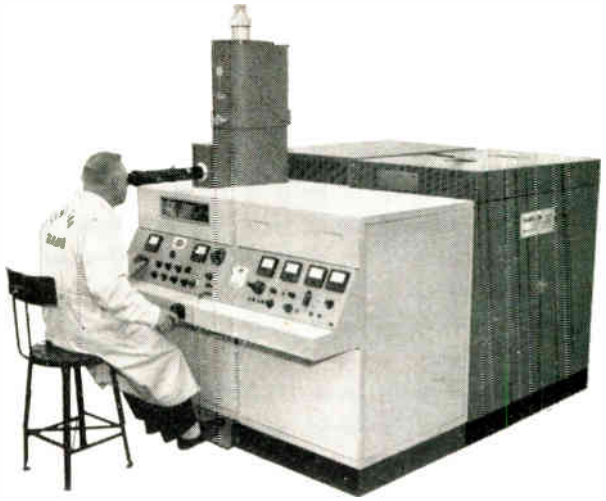
SEE US AT WESCON — BOOTH 609

ALFRED ELECTRONICS

3176 Porter Drive • Palo Alto, California • Phone: DAvenport 6-6496

GENERATOR HEADS FOR MODEL 605	A Generator Head consists of voltage tuned backward wave oscillator and focusing magnet arranged for convenient insertion into Model 605. When installed the Heads will perform to following specifications:										
Generator Head Model Number	GA102	GA103	GA204	GA408	GB6012	GB7013	GB7013A	GB10015	GB12018	GC15022	GC18026
Frequency Range Gc	1 to 2	1.4 to 2.5	2 to 4	4 to 8	6.5 to 11.5	8 to 12.4	8.2 to 12.4	10 to 15.5	12.4 to 18	15 to 22	18 to 26.5
Power Output—minimum mw	10	10	10	10	10	10	10	10	10	5	3
Residual FM percent peak	0.003	0.003	0.0025	0.002	0.002	0.0015	0.0015	0.001	0.001	0.001	0.001
Drift % of max. freq/hr.	±0.025	±0.02	±0.02	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01
Price of Generator Heads	$1690	$1790	$1690	$1590	$1590	$1590	$1650	$1940	$1990	$2650	$2950

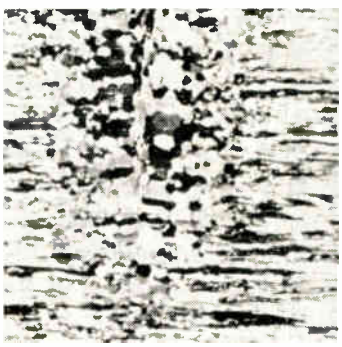
SEE "impossible" welds in the making by electron beam...



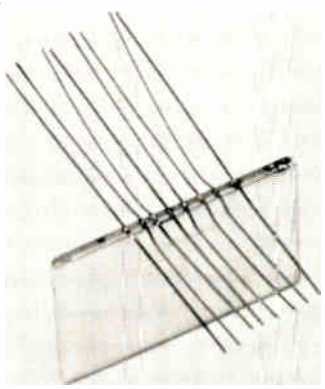
EXCLUSIVE OPTICAL VIEWING SYSTEM permits the operator to sight down the center line of the electron beam column and see a magnified view of the exact position of the beam on the work piece.

Welds that were once "impossible," like those shown, are now everyday occurrences—wherever Hamilton-Zeiss high energy-density electron beam welding machines are at work. These Hamilton Standard machines provide flexibility, repeatability, reliability. You can solve fabrication problems involving refractory materials, unequal thicknesses, deep penetrations, and hard-to-reach locations, with an ultraprecise electron beam focused through an exclusive magnetic optical system.

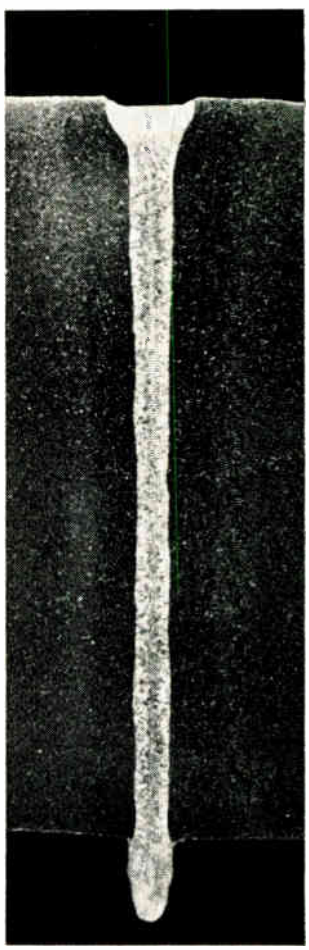
Hamilton-Zeiss electron beam machines produce welds in a vacuum, thereby eliminating contamination. Additional advantages include close control of dimensions and penetration, and low thermal distortion. Supporting metallurgical reports are available for your inspection. For complete information about Hamilton-Zeiss Electron Beam Welders, write or wire: Sales Manager, Electron Beam Machines, Hamilton Standard Division of United Aircraft Corporation, Windsor Locks, Connecticut.



Weld on 0.1" tungsten shows no contamination, minimal grain growth. Reasons: welding time is extremely short, heat is localized, impurities are vaporized, no filler is used.



Copper ribbon wires (0.002" x 0.01") welded to edge of nickel-plated ceramic substrate. Snows wide range of thicknesses and materials which can be joined on the same machine.



High energy density permits deep weld through 1" stainless steel with over 20:1 depth-to-width ratio. Weld is as strong as base material.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

DYNAMICALLY TESTED!!!!!

NEW FROM BENDIX

42 RECTIFIERS 3-6-12 AMP SERIES

New Bendix® silicon rectifiers offer lower current leakage for greater circuit stability—as low as 10 microamps at 600 volts. They're 'Dynamically Tested', an exclusive Bendix quality control process that individually tests each unit to assure uniform reliability. The result: dependable, versatile units that offer a wide range of voltage capabilities (50 to 600 volts PRV). Designs conform to JEDEC DO-4 outlines—with welded case and glass-to-metal hermetic seal between case and anode lead. Ideally suited for applications including magnetic amplifiers, DC blocking units, and power rectification. Write Bendix Semiconductor Division for information.

MAXIMUM RATINGS

Type Number	Forward Current	Peak Reverse Voltage	Reverse Current at PRV		Forward Drop at 25°C
	Adc	Vdc	@ 150°C	@ 25°C	Vdc
1N1124-1N1128	3 @ 50°C	200-600	—	10 μAdc	1.1 @ 6 Adc
1N1199-1N1206	12 @ 150°C	50-600	10.0 mAdc	—	1.25 @ 12 Adc
1N1341-1N1348	6 @ 150°C	50-600	10.0	—	1.15 @ 6 Adc
1N1581-1N1587	3 @ 150°C	50-600	0.5	—	1.5 @ 6 Adc
1N1612-1N1616	5 @ 150°C	50-600	1.0	—	1.5 @ 10 Adc
1N2491-1N2497	6 @ 150°C	50-600	2.0	—	1.1 @ 6 Adc
B-443-B-449	12 @ 150°C	50-600	2.0	—	1.2 @ 12 Adc

Bendix Semiconductor Division

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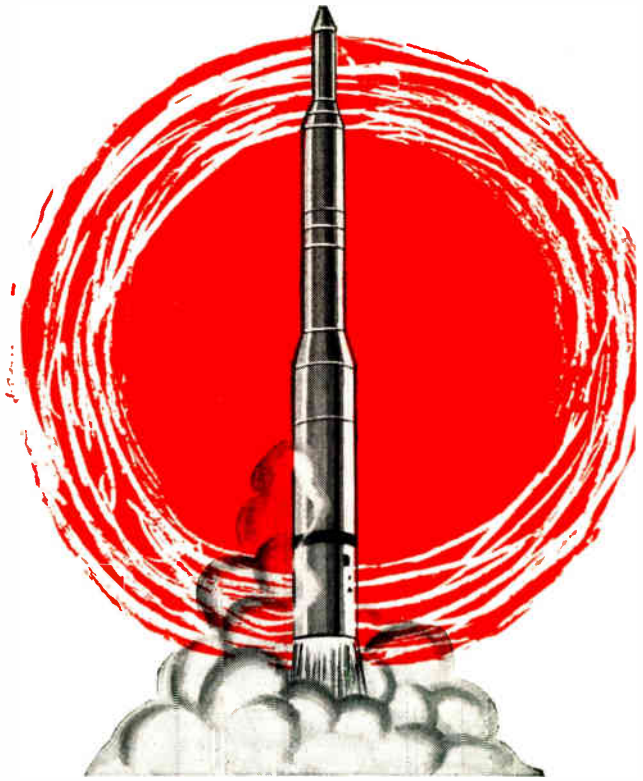
SELECTED BY RCA FOR A HIGH RELIABILITY * PROJECT



Here is MEASURED RELIABILITY!

Ten thousand El-Menco high reliability dipped mica capacitors were put on life test at 85°C with 225% of the rated DC voltage applied in accordance with an RCA high reliability specification.

*After 22,000,000 actual test unit-hours no** failures of any type occurred*

The accumulated 22 x 10^6 test unit-hours without any failures can be used to calculate many different failure rates depending upon the confidence level desired. However, we shall explore the meaning of the results at a 90% confidence level.

Assuming no acceleration factor for either temperature or voltage, we have verified a failure rate of approximately .01% per 1000 hours. (Actually, there is a temperature effect and it has been found that, with the DC voltage stress remaining constant, the life decreases approximately 50% for every 10°C rise in temperature. There is also a voltage effect such that, with the temperature stress remaining constant, the life is inversely proportional to the 8th power of the applied DC voltage.)

Assuming no temperature acceleration factor and assuming the voltage acceleration exponent is such as to yield an acceleration factor as low as 100, we have nevertheless verified a failure rate of approximately .0001% per 1000 hours.

Assuming no temperature acceleration factor and assuming the voltage acceleration factor is on the order of 250 (test results are available to confirm this) we have accumulated sufficient unit-hours to verify a failure rate of less than .00005% per 1000 hours!

Note that all the above failure rates are calculated at a 90% confidence level!

* *The El-Menco high reliability dipped mica capacitors are being supplied to the Radio Corporation of America for a high reliability military ground electronics project.*

** A failure was defined as follows:

1. A short or open circuited capacitor occurring during life test.
2. A part whose capacitance changed more than ±2% and whose capacitance did not fall within the original tolerance of ±5%.
3. A part whose final dissipation factor exceeded .002.
4. A part whose final insulation resistance measured less than 100,000 megohms.

Write for a copy of our "Reliability Study of Silvered Mica Capacitors".

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC, CONNECTICUT

MANUFACTURERS OF El-Menco Capacitors

Dipped Mica • Molded Mica • Silvered Mica Films • Mica Trimmers & Padders
Mylar-Paper Dipped • Paper Dipped • Mylar Dipped • Tubular Paper

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Exclusive Supplier to Jobbers and Distributors in the U. S. and Canada

West Coast Manufacturers Contact:
COLLINS & HYDE CO., 535 Middlefield Road, Palo Alto, California
1250 E. Artesia Avenue, Long Beach, California

Tele-Tips

SCIENTISTS at Stanford Research Institute have developed a new electrostatic printing process that reportedly may cut printing equipment costs and weight in half. With engineering improvements, both sides of paper can be printed simultaneously. Key component in new pressureless printing is 200-mesh stainless steel wire screen. Research is needed to develop full range of dry printing inks and rapid fixing method.

SPACE SATELLITES will be used by the U. S. Coast & Geodetic Survey to measure the true distances across the U. S. The program, which will begin early in 1963, is expected to measure the true distance from coast to coast within an error of less than 10 meters. The new method of triangulation will use optical tracking of Echo-type satellites from 3 or more mobile camera tracking stations located on base lines several hundred miles long and accurate to within 1 ppm.

PERSONAL RADIATION MONITOR developed by the AEC is shaped like a fountain pen, and lights up and "chirps" when the wearer is exposed to radiation. It differs from previous devices in that it actually reads the radiation level while it is being received. It contains a miniature halogen filled Geiger counter. The 500 v. to operate the counter is provided by a transistor blocking oscillator, transformer and semiconductor diode voltage quadrupler.

INTERMITTENT INTERFERENCE was reported by coast and harbor radio stations in the New York area on the marine international calling and distress frequency. It appeared infrequently and lasted but a few minutes. Finally FCC engineers found that it occurred whenever a particular bridge over the Passaic River between Newark and South Kearny was opened. The bridge carries an electrified railroad line. Repairs to the 12,000 volt disconnect switch eliminated the trouble.

"ASTROSCIENTISTS" to accompany astronauts on space missions should be developed for space science exploration, suggests Malcolm D. Ross, of General Motors Defense Research Labs. He proposes that three universities in this country establish professorships in astroscience to head up a graduate program of learning aimed at developing men with the proper scientific background and motivation for space missions.

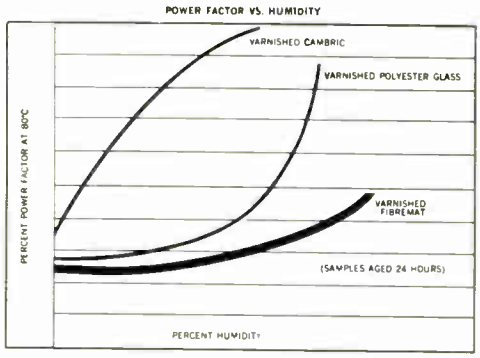
TOP TEN SCIENCE ADVANCES picked by Science Service are: (1) manned orbital and suborbital flights by USSR and U. S., and successful launching of Saturn rocket, (2) discovery of element 103, (3) plans to license measles vaccines from both live and killed viruses, (4) advances in cancer treatment, (5) brain radiosurgery without opening the skull, (6) cultivation of hepatitis in laboratory, (7) method of re-lighting solid-rocket fuels, (8) process to remove 98% of strontium-90 from milk, (9) inexpensive freezing method of converting salt water to fresh water by using butane gas as refrigerant, (10) man-like creature, Zinjanthropus, dated atomically as about 1,750,000 years old.

"ENGINEERING OR SCIENCE" is a distinction that seems to be haunting all of the engineering circles. In the recent issue of the *Journal of Metals*, C. L. McCabe of Carnegie Tech writes, "The contributions of engineers to the final solution of the technological problems involved have not been brought to the attention of the public and have not been in the early critical phases of development." "Important implications," he continues, "result because the public press now gives science so much of the credit that many young men choose scientific careers — physics, mathematics, or chemistry—who are temperamentally or intellectually better suited to a career in engineering than to one in science."

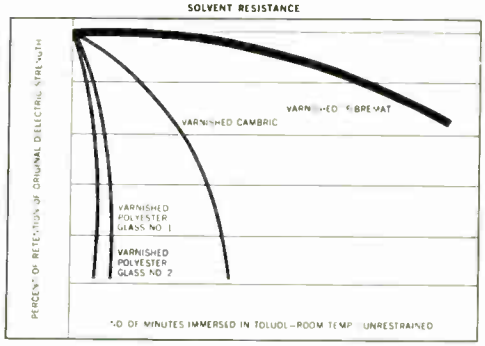
FOUR COMPARISON TESTS SHOW WHY YOU GET GREATER DEPENDABILITY WITH

NEW Fibremat® BRAND ELECTRICAL INSULATIONS

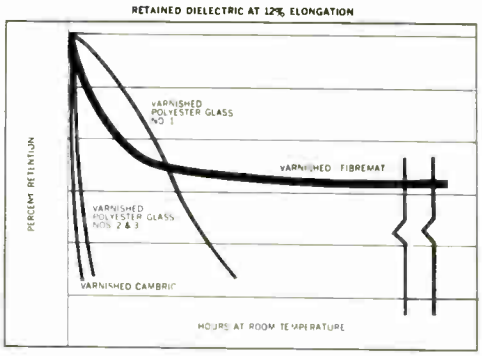
MOISTURE ABSORPTION – UNCOATED FABRICS – There's no pre-baking to drive out moisture when you use "Fibremat." The non-hygroscopic base fabric resists moisture. When exposed to 96 percent relative-humidity for 45 hours bias-cut cambric showed a moisture absorption of 25 percent, polyester-glass showed a moisture absorption of 2 percent, while "Fibremat" showed a moisture absorption of less than .7 of one percent. Proof of the superior moisture-resistance of "Fibremat" Insulation.



MOISTURE ABSORPTION–COATED INSULATIONS – In moist or humid environments "Fibremat" outperforms varnished cambric or polyester-glass materials. Continuous filaments in woven fabrics wick up moisture and offer a direct path for moisture to follow. The non-woven construction of "Fibremat" prevents wicking and moisture absorption. The power factor of varnished "Fibremat" remains relatively stable while the power factor of the other insulations zoom upward under increased humidity conditions.



SOLVENT RESISTANCE – COATED INSULATIONS – "Fibremat" offers outstanding resistance to solvents used in dipping or impregnating operations. Conventional woven insulations leave relatively large unsupported areas of varnish film between the filaments. This unsupported film, when exposed to solvent, tends to swell and flake away from the base fabric and cause electrical failure. The uniform dispersion of fibers in "Fibremat" however, provides equal support for all areas of the varnish film and prevents this solvent-caused breakdown.



RETAINED DIELECTRIC AT 12% ELONGATION–COATED INSULATIONS—At 12% elongation varnished "Fibremat" retains a significantly greater percentage of its original electric strength than either varnished cambric or varnished polyester-glass materials. Woven insulation, when stretched, creates points of stress where filaments cross each other. Elongation produces a scissor-like action that weakens the structure, tends to tear the varnish film and rupture the insulation coating. Non-woven "Fibremat" has built-in stretch, doesn't "scissor", supports the entire film.

Irvington Division

3M MINNESOTA MINING & MANUFACTURING CO.

"FIBREMAT" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 1, MINN.

"Fibremat" is no ordinary insulation. It's formed from a non-woven web of polyester fibers without the use of adhesives or any other bonding agent. This unique non-woven construction gives "Fibremat" flexibility to conform snugly to irregular shapes without gapping or voiding. Helps it retain electric strength under elongation so fewer layers are needed to attain the same electrical performance achieved with many layers of ordinary insulating materials. Use "Fibremat" for wrapping form wound coils, layer and phase insulation, slot liners, and high voltage cable. For more information, write: 3M Company, Irvington Division, St. Paul 6, Minn., or phone and ask for "Fibremat" at your nearest branch office listed below.

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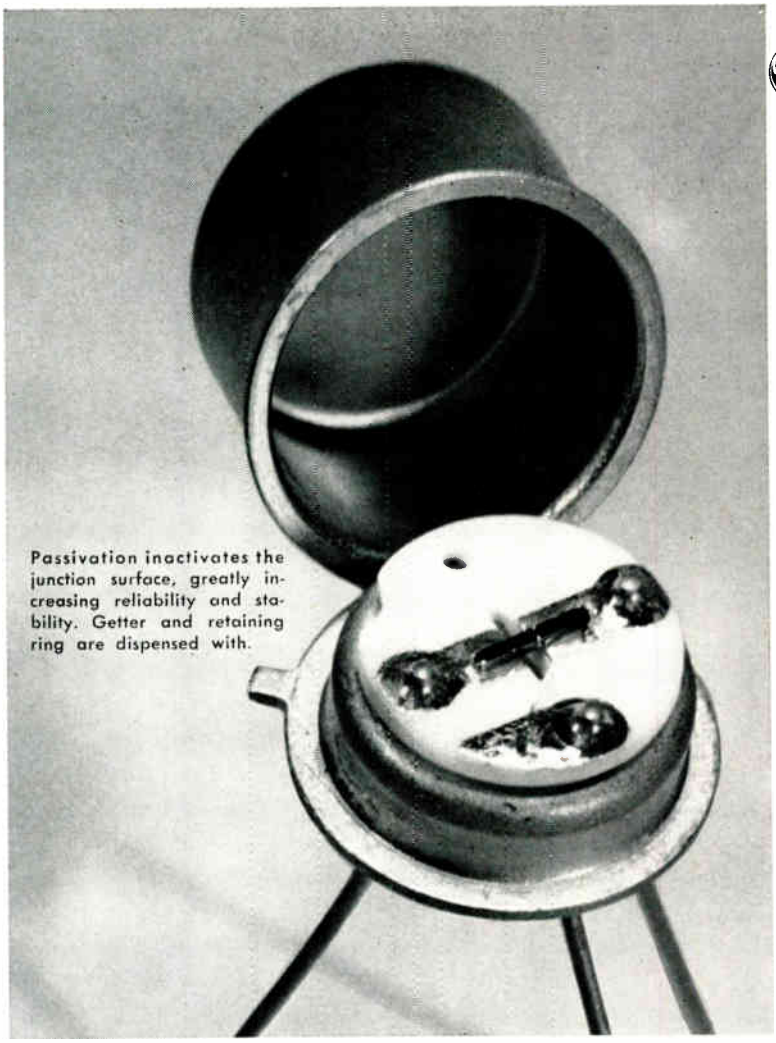

Passivation inactivates the junction surface, greatly increasing reliability and stability. Getter and retaining ring are dispensed with.

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General Electric's new passivated 2N332A thru 2N338A transistors exceed in reliability even the heretofore unsurpassed G-E 2N332 series, an industry standard. General Electric developed its new process for the MINUTEMAN RELIABILITY Program. The surface passivation technique inactivates the junction surface and dispenses with the need for getter and retaining ring.

4700 units now on MINUTEMAN life test at G.E. have operated for 1000 hours without a single failure. These units have already operated for 6,650,000 transistor hours @ 280 mw., and are still on test. This new passivated series may well comprise the most reliable silicon grown-junction triodes available today . . . and they are in stock now at all General Electric Semiconductor distributors. Every "A" and MIL version of the 2N332A-338A series you purchase from now on will be this new, high-reliability passivated transistor type. *And at the same price as before.*

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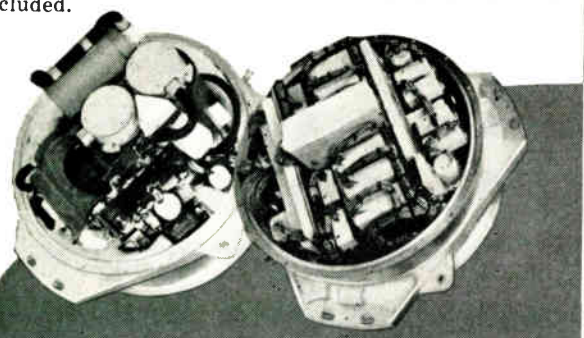
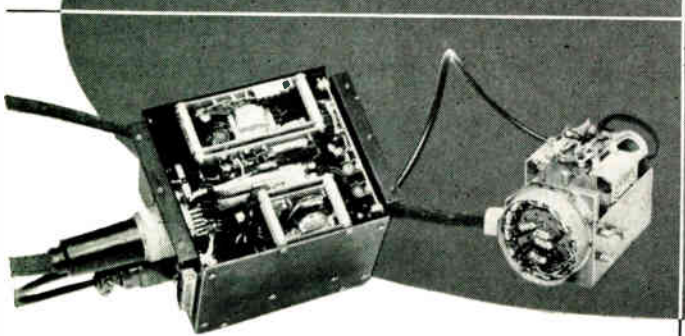
THREE AXIS SATELLITE INERTIAL REFERENCE PACKAGE: Three single axis floated gyros and two accelerometers are employed. The gyro and accelerometer loops employ seven voltage amplifiers and five power amplifiers. All amplifiers are individually encapsulated, transistorized units. A current regulator amplifier and heater relay amplifier are also included.



TWO CHANNEL ANTENNA STABILIZATION SYSTEM: Each loop comprises a Reeves HIG-4 gyro and a voltage amplifier and power amplifier. Proportional temperature control amplifiers regulate temperature to ±0.5 degrees for each gyro.



SINGLE CHANNEL SATELLITE STABILIZATION SYSTEM: This high precision system utilizes a Reeves D30S gyro, with trimmed drift rate of 0.1°/hr. The gyro loop incorporates a voltage amplifier, a demodulator and a d.c. power amplifier for driving the gyro d.c. torque motor. Temperature regulation is effected by means of a proportional temperature control amplifier.

MODULAR AMPLIFIER COMPONENTS: Transistorized, fully encapsulated units which can be readily incorporated into any system for providing voltage and power amplification; demodulation where required, and high precision temperature control.

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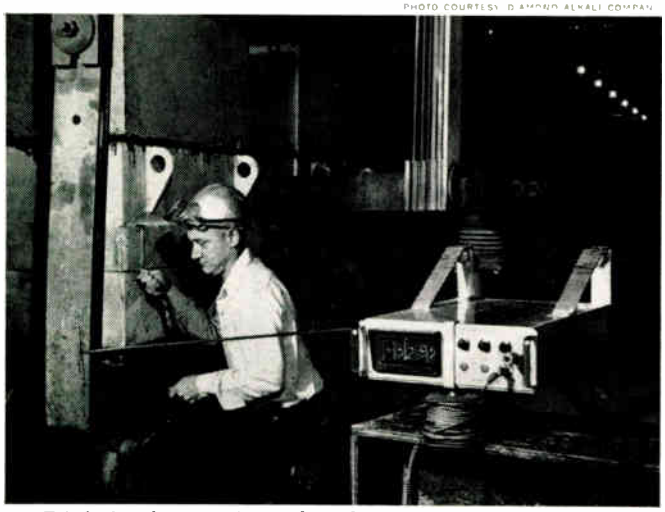
Del Mar, California
and
HENRY W. LAUB
Project Engineer, Cell Development
Diamond Alkali Company
Deer Park, Texas

Digital Measuring Technique Yields up to $8,000 Annual Saving

Wide application seen for highly accurate method to detect small changes in voltage and voltage drop – Diamond Alkali uses it to optimize efficiency of production project.

PHOTO COURTESY DIAMOND ALKALI COMPANY



Digital voltmeter is used to detect small voltage drops.

A simple, digital measuring technique that can result in significant savings in AC or DC power helped solve a production problem for Diamond Alkali Company.

The problem centered around the question:
"How do you measure very small changes in voltage quickly and accurately?"

The method used by Diamond Alkali to solve the problem is applicable wherever large amounts of AC or DC power are used. By detecting small voltage drops in electrical distribution systems, the technique can provide power savings in such applications as electrolytic processing, electrical power generation, and in the nuclear sciences. More broadly, it can serve as a general design tool by accurately and automatically measuring a wide range of voltages.

In the specific case of Diamond Alkali, personnel at the diaphragm plant in Deer Park, Texas, had believed that optimum placement of internal cell components would provide more efficient use of power in producing chlorine from sodium chloride brines by electrolysis. Also, voltage drops in bus bar connections had to be minimized to reduce power loss. In fact, a voltage drop of 0.01 volt at 30,000 amps would result in a loss of $8,000 a year. But because the voltage changes involved were only several hundredths of a per cent, it was difficult to recognize them with existing equipment.

The answer was a bit of ingenuity and an automatic digital voltmeter made by Non-Linear Systems, Inc., originator and world's leading manufacturer of DVMs. By allowing one or two men to make the measurements and observe instantly and accurately changes as small as one millivolt in 5 volts, the NLS 4-digit voltmeter (now $1,460) aided in producing power savings of up to $8,000 annually in this one area. Of significance was the fact that personnel making measurements could observe the digital readings from as far as 30 feet away. A long cable permits the operator to place the input probes anywhere along the long line of chlorine cells.

This means that the operator need only connect the digital voltmeter input probes and immediately note any changes displayed by the large digital readout of the DVM.

For information on how digital voltmeters and other digital measuring instruments and systems might be of assistance to you, please contact one of the 19 NLS factory offices or write Non-Linear Systems, Inc., Del Mar, California.

NLS non-linear systems, inc.

Smaller diameter for complex hook-ups with Beldfoil* shielded cables

Beldfoil* Shielding

Conventional Shielding

Where shielding is required you can reduce the size and weight of your cable with Beldfoil shielding. This new development can greatly reduce the diameter of multi-conductor cables.

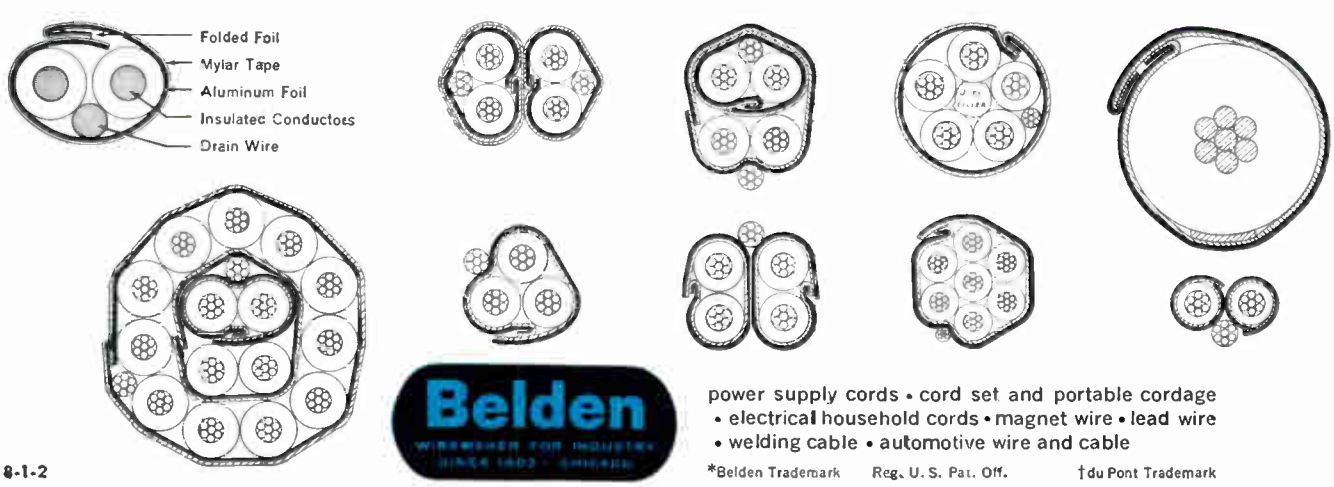
Multi-cable hook-ups can also be confined to less area. In many applications Beldfoil shielded cables can replace combined and complex hook-ups of twisted pairs and individual conductors laced together.

Beldfoil is a lamination of aluminum foil with Mylar† which provides a high dielectric strength insulation that is small in diameter, light in weight and low in cost. Its superior characteristics give 100% isolation between shields and adjacent pairs.

For audio and radio frequency applications, it eliminates cross-talk and is ideal for stationary or limited flexing.

The cable cross sections shown below (outer jacket not shown) are just a few of the many intricate and diverse ways Beldfoil has been used to solve a specific shielding problem for a customer.

If you have a space or design problem on shielded cables Belden engineering can help you.



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8-1-2

Philco Test Center Opened to Industry

Philco's $1 million Environmental Test Center in Philadelphia, one of the largest and most diversified of its kind, has been opened to industry and government agencies wanting to test equipment in simulated environments.

The 30,000 square-foot test center is capable of simulating extreme environments of temperature, altitude, humidity, outer space vacuum, salt spray, immersion, rain, vibration and shock for equipments, components and packages.

The Center recently added a 26½ ton shaker system, one of the largest in the country.

The unit consists of a 6,000-lb. exciter, a 3,000-lb. granite block and a 44,000-lb. mass. The mass, a concrete block 12 ft. long, 7½ ft. wide and 6 ft. high, rests on special isolating blocks or Isomodes. The exciter and granite block rest on the mass.

The exciter creates up to 100 G's of force. It can be tilted sideways and used with the granite block to produce horizontal vibrations. This system's transmission of force has been rated as 98% efficient, half again as efficient as other types.

Other conditions which can be created include shock, acceleration, hydrostatic pressure, vacuum-steam pressure and radio interference. Multiple installations permit simultaneous testings.

CONTINUOUS WAVE LASER

Continuous wave helium-neon gas phase laser being checked above is first such device commercially available. It produces highly directional, coherent beam of near-infrared light. Plasma tube is fused silica construction, and the radio frequency excitation unit is integrally mounted in tube center. New laser, developed by Perkin-Elmer Corp. and Spectra-Physics, Inc., will be marketed by latter.

NOW! **RECTANGULAR CERAMIC CRT** **ILLUMINATED INTERNAL GRATICULE** **NEW DUAL-TRACE AND NEW DELAYED SWEEP PLUG-INS**

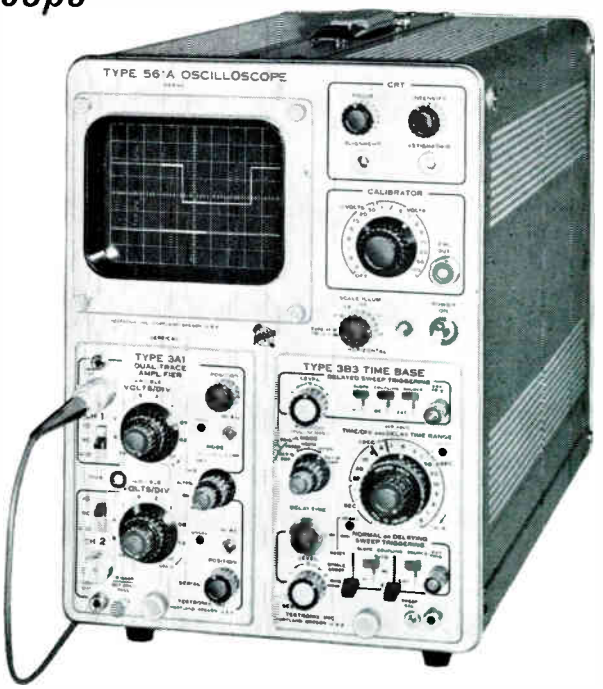
with the Tektronix Type 561A Oscilloscope

The Type 561A employs a unique 5-inch rectangular "ceramic envelope" cathode-ray tube with the following features:

1. Illuminated "no parallax" internal graticule on a high-quality parallel-ground plate-glass face.
2. Controllable graticule lighting, permitting trace photography with the same convenience as provided by external graticules.

Other features of this compact new oscilloscope include: Improved regulated power supplies • Regulated dc heater supply • Z-axis input • 3.5-KV accelerating potential • Amplitude calibrator with 18 steps from 0.2 mv to 100 v • Operation from 105 v to 125 v or 210 v to 250 v, 50 to 400 cps.

A wide range of performance characteristics is provided by available plug-in units—from the simple single-channel 2A60 to the dual-channel 0.4 nsec-risetime 3S76. For example, the two latest additions to this ever-growing family of plug-ins, the 3A1 and 3B3, provide high-sensitivity wide-band dual-trace operation combined with calibrated sweep delay.



Type 3A1 Dual-Trace Amplifier Unit

Passband—dc to 10 Mc at 3-db down.

Displays—single trace, dual trace, or algebraic addition. 6-cm linear scan.

Sensitivity—10 mv/cm to 10 v/cm in 10 calibrated steps, 1-2-5 sequence. Variable sensitivity between steps.

No Signal delay.

Type 3B3 Time-Base Unit

Normal and Delayed Sweeps—0.5 μsec/cm to 1 sec/cm in 20 calibrated steps, 1-2-5 sequence. Variable adjustment between steps. 5X Magnifier extends calibrated range to 0.1 μsec/cm.

Precision Delay Interval—0.5 microseconds to 10 seconds.

Triggering—Flexible Tektronix triggering, plus single-sweep operation for normal sweep. Triggered operation to above 10 Mc.

Type 3B1 Same as 3B3 except has uncalibrated delay and does not have single sweep feature.

TYPE 561A OSCILLOSCOPE (without plug-ins) . $470
TYPE 3A1 DUAL-TRACE AMPLIFIER UNIT . . . $410
TYPE 3B1 TIME-BASE UNIT $475
TYPE 3B3 TIME-BASE UNIT $525

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

For more information on a Type 561A Oscilloscope and plug-in combinations, please call your Tektronix Field Engineer.

OTHER 2-SERIES AND 3-SERIES PLUG-INS AVAILABLE

AMPLIFIER UNITS TYPE	PASSBAND (3-db down)	SENSITIVITY	PRICE
2A60	dc—1 Mc.	50 mv/cm—50 v/cm 4 decade steps with variable control.	$105
2A63—Differential (50:1 rejection ratio)	dc—300 kc.	1 mv/cm—20 v/cm 1-2-5 sequence with variable control.	$130
3A72—Dual Trace (Identical Channels)	dc—650 kc. (each channel).	10 mv/cm—20 v/cm, 1-2-5 sequence, with variable control.	$250
3A74—Four Trace	dc—2 Mc (each channel).	20 mv/cm—10 v/cm, 1-2-5 sequence, with variable control.	$550
3A75—Wide Band	dc—4 Mc.	50 mv/cm—20 v/cm, 1-2-5 sequence, with variable control.	$175
3S76—Dual Trace Sampling (for use with 3T77)	equivalent dc-to-875 Mc. (0.4-nsec risetime)	2 mv/cm—200 mv/cm, 1-2-5 sequence, with variable control.	$1100

TIME-BASE UNITS TYPE	SWEEP FEATURES	TRIGGERING	PRICE
2B67	1 μsec/cm to 5 sec/cm, 1-2-5 sequence, variable between rates. 5X Magnifier. Single Sweep.	Internal, External, Line; Amplitude-Level Selection; AC or DC-Coupling; Automatic or Free-Run; ± Slope.	$175
3T77 Sampling Sweep (for use with 3S76)	Equivalent to 0.2 nsec/cm to 10 μsec/cm, 1-2-5 sequence, variable between rates. 10X Magnifier.	Internal or External, ± Slope.	$650

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

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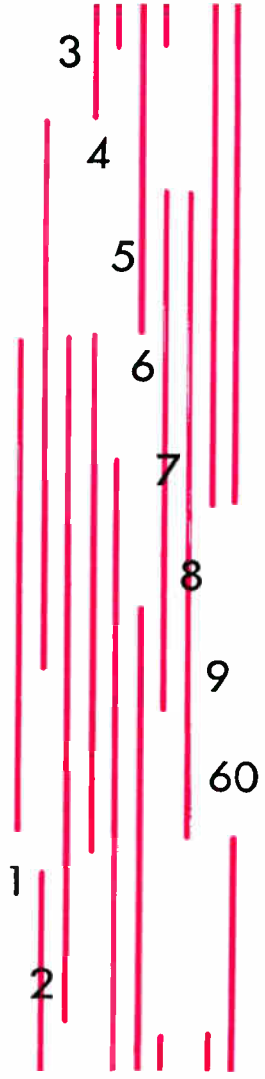
SEE THIS TEKTRONIX OSCILLOSCOPE AT WESCON—BOOTHS 751-752-753-754.

verify events permanently in milliseconds



Brush Operations Monitors' response to signals is virtually instantaneous—less than 4 milliseconds. Multiple high-speed events are clearly defined from start to stop, on a common time base—and at rates up to 500 per second. Portable 30 channel or rack-mounting 100 channel models record sharp reproducible traces with fixed-stylus electric writing that provides the utmost in reliability. "Built-in" transistor switching to eliminate relays is optional. No direct writing recording system can match the capabilities of Brush Operations Monitors for industrial and military analysis and control. Write for complete specifications and application data.

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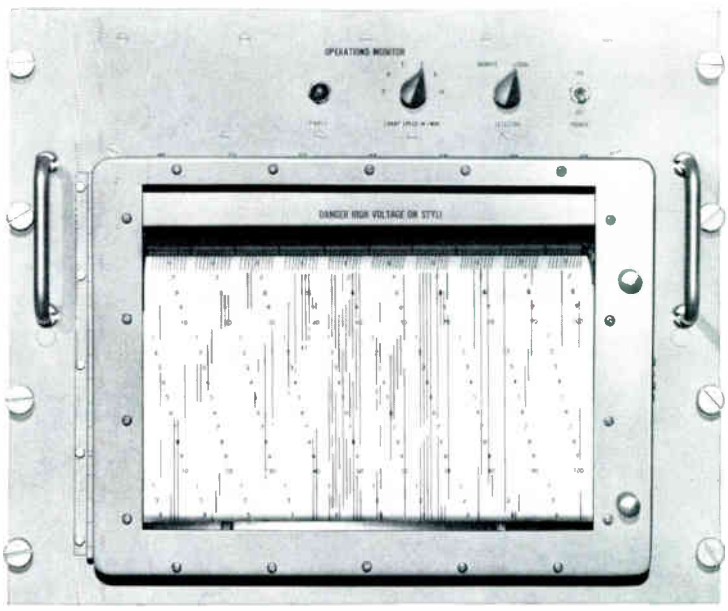


Next month

ELECTRONIC INDUSTRIES

ANALYZING DATA BY LEAST SQUARES

Least squares is a very useful statistical method of analyzing data having a common factor. In describing the characteristics of gyros, potentiometers, and displacement transducers, it can determine the most probable true value of a common factor with a maximum of accuracy.

HIGH INPUT IMPEDANCE METHODS FOR TRANSISTOR CIRCUITS

The low input impedance of transistor stages may be detrimental when used with high impedance sources. More and more it becomes necessary to know how to increase the input of these stages. This article shows three successful ways of doing just that.

GRAVITATION . . . FOR THE ELECTRONIC ENGINEER

Satellites and ultraprecise measuring instruments have renewed interest in gravitational experiments—for better understanding . . . for possible control. Here's how to develop an intuitive picture of what is being done . . . without having to learn Einstein's General Relativity.

REGISTERING THIN-FILM MEMORY MASKS

Present methods are inadequate to produce masks containing hundreds of fine lines 8 or 10 inches long which may be required to register with thousands of magnetic bits within a tolerance of a few ten-thousandths of an inch. Here are 4 approaches to produce masks to these registration tolerances.

SHORTAGE OF ENGINEERS

For a decade, in both technical and lay publications, numerous articles have appeared discussing this "shortage." Here's a new slant on the subject.

Plus all other regular departments

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, EI Totals, Snapshots of the Electronic Industries, EI International, News, Briefs, Tele-Tips, Books, Representatives News, International Electronic Sources, Personals, etc.

Watch for these coming issues:

***NOVEMBER**
Annual Microwave Issue

***JANUARY**
Statistical and Annual Industry Review

***MARCH**
Annual IRE Issue

By DR. JACK De MENT
De Ment Laboratories
1717 Northeast 19th Avenue
Portland 12, Oregon

This article is a primer.
It presents a first, unclassified, technical treatment.
Ranging from electronics to bio-medics,
it gives a totally new and unified concept
of weapons, and countermeasures,
with potential that pales the imagination.

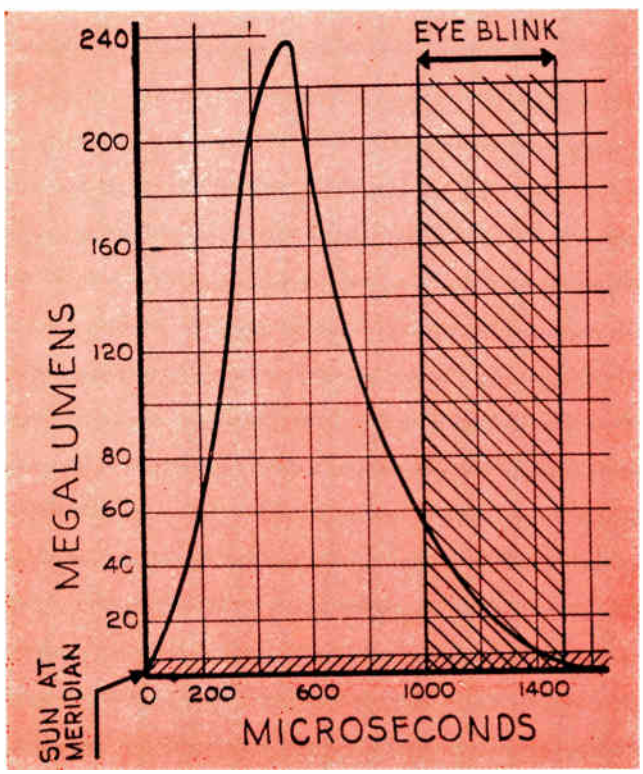
Directed Energy Weapons

DIRECTED Energy Weapons (DEW) feature directional release of non-particulate energy — strong enough for warfare.

The primary DEW class is electromagnetic, i.e., radiant energy traveling unidirectionally at the velocity of light. Other classes include ultrasonic, blast, and special forms of mechanical energy. Here we examine a DEW model and a living target *model*, the maser and eye, respectively. Countermeasures are also explored.

DEW is a very broad unifying concept. It includes parameters—new, old and re-defined—extending into and integrating many scientific and technological areas.

Fig. 1: Typical xenon flash curve. Shown is relationship between light output and sun, with blink time of the eye.



DEW now appear to be more technically feasible and accessible than Directed Matter Weapons (DMW). One reason—a greater working fund of theory and technology relating to electromagnetic energy, and a less matured state-of-the-art for intense, particulate matter beams.

When electromagnetic energy can be beamed at ultra-high fluxes, it offers an approach to a DEW. Its spectrum covers about 60 octaves, of which only one is visible. Theoretically, many octaves can be used as DEW. These range from the gamma and X-ray regions into certain r-f energies, notably microwaves.

At exceedingly high intensities these radiations have the common quality of being abiotic or photochemically and/or photophysically active. When abiotic, a living target is involved; photochemical or photophysical, a non-living target.

Basic Kinds

There are three basic kinds of DEW:
(a) Anti-personnel (tissue traumatic);
(b) Anti-personnel (psychologically traumatic);
(c) Anti-material.

The distinction between the first two may be somewhat arbitrary for the human target. Because, there is generally mental pain when there is physical pain. Sometimes, type (a) DEW is not noticed right away. The purely psychological variety involves no overt lesion. Rather, the emotional, mental and behavioral responses evoked sustain a warfare aim; and, self-propagating "psychological noise" is induced in the target.

It is very clear that psychological DEW reinforce CEBAR (chemical, biological, atomic, radiological) weapons and vice versa. Examples of susceptible targets: green troops, primitive and underdeveloped peoples and, generally, jittery peoples, e.g., those evac-

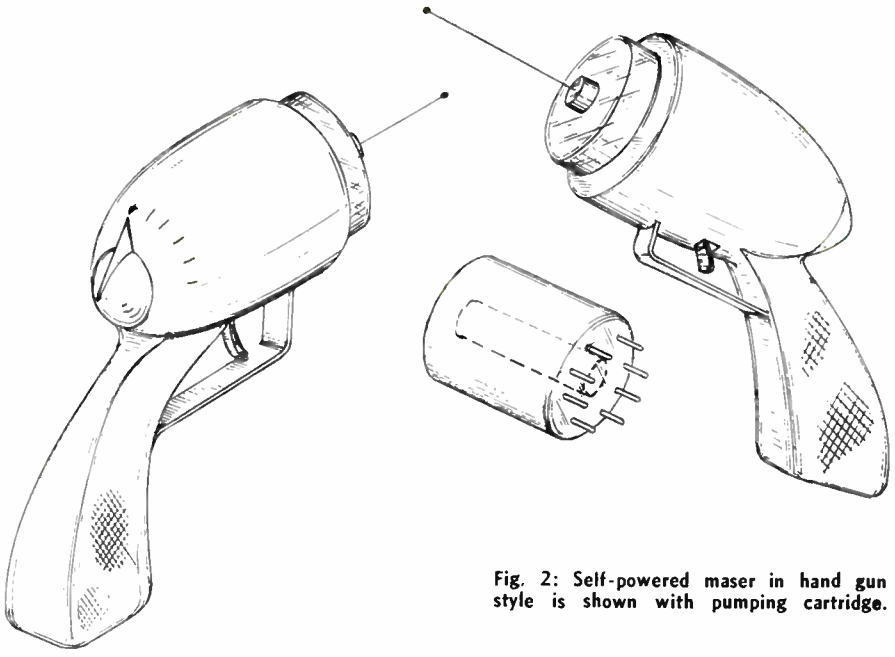


Fig. 2: Self-powered maser in hand gun style is shown with pumping cartridge.

uating or coming out of shelters after unexpected or long confinement.

An electromagnetic energy source becomes directed once it is provided with a collimator, a reflector or a lens; or, when the design of that source is such that it emits a radiant energy beam. Generally, DEW effectiveness increases with sophistication—assuming a projection from the state-of-the-art and precluding a highly unusual breakthrough. Thus, the efficacy is lowest for a source that is merely collimated without light-gathering elements, higher when systems such as the maser become available.

Effects

DEW effects are classed as: (a) prompt and (b) delayed. The former is generally that of choice; particularly, for a living target. Delayed DEW effects may, or may not, be desirable, depending upon the warfare problem. With a delayed, but reversible, effect, a fatalistic indifference induced in a target people may be of value. With a delayed, but irreversible, effect, the result could backlash as a suicidal retaliatory effort.

The DEW is highly unusual—it is silent! A living target may be completely unaware that it has been attacked unless the effect is quite prompt; or, unless the attack is signaled by definitive sensation, e.g., intense burning.

A target equipped with DEW energy sensing gear is naturally another matter. To function ideally, the sensing field of the gear should be able to (a) completely envelope the individual target, (b) be able to sense throughout a large portion of the spectrum, and (c) warn in time to allow evasive or protective action by the target. Obviously the latter is not possible with any type of DEW pulse of less than the 100-200 msec reflex time of a living target.

For a DEW to incapacitate a target, is must be *coupled* with that target for a period adequate for optimal effect. This ranges from nanosecond (10^{-9} second) intervals on up in time for extended dose periods. The coupling efficiency depends upon: (a) the transmission qualities of the intervening medium, if any, and (b) the specific and special absorption qualities of the target.

The lethality-criticality effect is not always a simple derivative of target absorptivity and threshold energy. Each case must be considered on its own.

For a non-living target, many disruptive effects can be caused or postulated. A large and important class is photophysical, introducing "noise" into the inanimate target. Another is based upon deleterious photochemi-

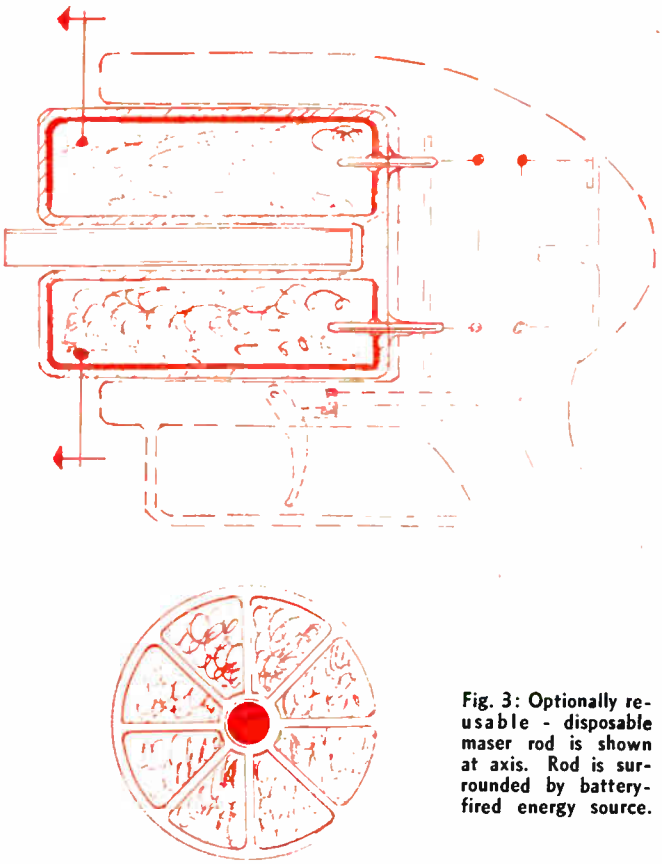


Fig. 3: Optionally re-usable - disposable maser rod is shown at axis. Rod is surrounded by battery-fired energy source.

Directed Energy
(Continued)

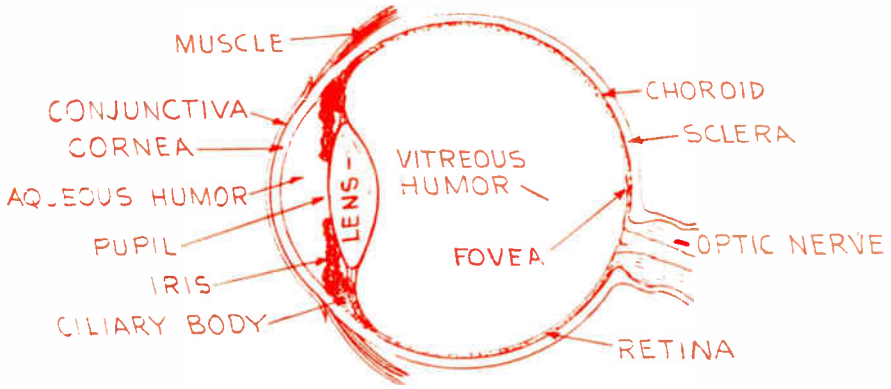


Fig. 5: Schematic view of the human eye.

cal changes induced in the target. Certain electronic countermeasures and electromagnetic warfare techniques extant compare with type (c) DEW.

Coupling

A DEW may be coupled to target by: (a) probability coupling, (b) sense-and-lock, and (c) search-and-lock. In the first, the target environ is scanned by one or more DEW beams, with Monte Carlo or like rules deciding when in time and space the DEW couples with target or, conversely, with a non-scanning DEW beam whether the target moves into the energy field. The value of probability coupling lies in special kill and countermeasure problems where, in effect, an electromagnetic shield is necessary.

Sense-and-lock coupling relies upon an active target —one that emits radiation. Search-and-lock depends upon a sensing beam reflection.

The very basis of any DEW is a transducer and a feed energy source. The transducer might be a special explosive device fed by chemical energy; the transducer, fission or fusion apparatus powered by nuclear reaction.

A DEW beam may be (a) continuous or (b) modulated. Technically, more problems arise in the production of continuous ultra-high energy beams than for pulsed beams, at least for luminous and near-luminous frequencies. Loss of DEW energy into non-target channels would appear to be less for the modulated beam. Thus, a super-intensity light output is achieved more readily by concentrating the energy into an ultra-brief period of time. The result is a *light projectile*, the dimensions of which are "caliber," decided by the duration of the pulse, and "analog velocity" (as compared to a solid projectile), determined by the integrated pulse energy.

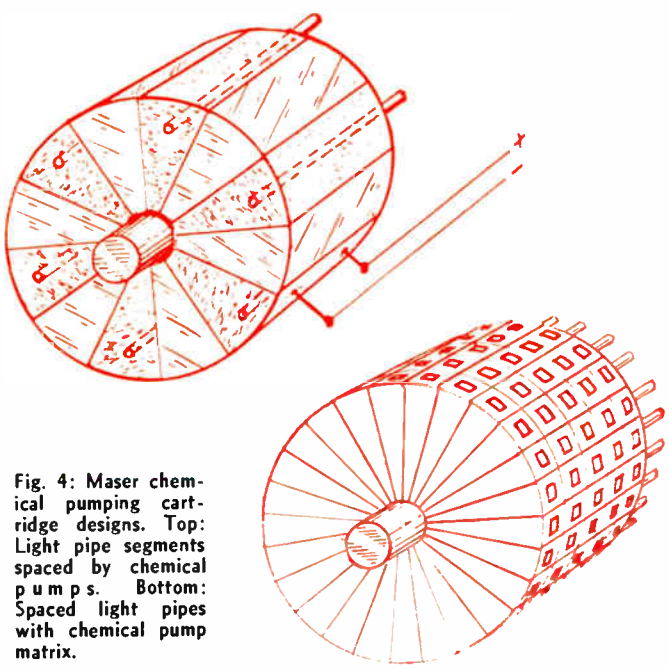


Fig. 4: Maser chemical pumping cartridge designs. Top: Light pipe segments spaced by chemical pumps. Bottom: Spaced light pipes with chemical pump matrix.

An electronic flash tube is a good example. This is usually done by discharging a capacitor through a very low resistance gas column.[11] With a capacitor charged at 1 kilojoule (1000 watt-seconds), driving the tube for 1 msec, this represents an average power of 1 megawatt and a peak intensity of several megawatts. Even a low joule input can be made to reach power outputs rated in multimegawatts by compressing the energy into microseconds of time. With suitable circuitry low power batteries can be used to attain light pulse intensities at these very great magnitudes.*

A photoflash bulb is a model of a very rudimentary DEW once it is provided with a parabolic reflector. It is interesting to compare the light fluxes of modern high-intensity light sources—from the standpoint of retinal burn potential—with the sun as a base. For the earth's surface at meridian, the sun's intensity is about 520,000 lumens/cm^2; near the horizon it is 1885 lumens.[7] Large flashbulbs using aluminum, zirconium or zirconium hydride emit 6 megalumens at the peak of their brief emission; or, 110,000 lumen-seconds of energy. These flashbulbs put out energy averaging over their flash duration the equivalent of 0.2 megawatt fed into an electric lamp. Normal size electronic flash tubes release 10 to 50 megalumens at peak, and a large flash tube emits more than 500,000 lumen-seconds.[11] See Fig. 1.

The Maser as a DEW Model

The maser may be a DEW *model.*

A self-powered maser (or "SP-maser)[3] is simply a maser rod surrounded by a chemical source of pumping light, such as a modified photoflash bulb. The bulb pumps at high energies, having an equivalent electric lamp wattage of several hundred kilowatts. While this is a one-shot affair, this apparent disadvantage is partially offset by the fact that many SP-masers can

* By comparison, an elaborate and advanced radar station may be continuously powered at 50 megawatts, the energy requiring a radio-frequency shielding fence 65 ft. high around the installation to prevent injury to personnel.

be used at one time freely in the atmosphere or in outer space. See Figs. 2, 3, and 4.

At the Spring 1962 meeting (March 14-17) of the Optical Society of America papers considered the use of the sun as a source for optical pumping, *high energy experiments*, and the use of exploding wires. Sun-pumped masers are extremely attractive for outer space applications. One design (by the writer) depends upon tapered fiber optics to gather sun light and feed it into the maser rod, the device looking like an oblate spheroid with the maser rod at its axis. Sun-pumped masers, having gaseous or low-density organic cores, could be made in comparatively huge sizes.

Conversely, it is important to emphasize the feasibility of maser systems with 1-shot rods, i.e., systems which would be "reloaded" with maser "cartridges" after being used one or several times. This should be feasible for short-lived maser materials, e.g., organics, plastics, liquids and liquids frozen into rigid glasses at outer space temperatures.

The Eye as Dew Target Model

The eye is susceptible to injury by radiation which it is designed to perceive, as well as by extra-visual radiation.

Although no threshold radiation dose for eye damage has been determined, ionizing radiations produce highly deleterious ocular effects.[9] A single large dose of radiation is more harmful than is an equivalent amount of small doses of radiation.

Eye injury is divided into *reversible* and *irreversible* trauma. Reversible eye trauma is exemplified by flash blindness and by conjunctivitis and similar globe dyscrasias.

Retinal burn is usually an irreversible and silent internal eye injury. Absorptivities of the cornea, aqueous humor, lens, and vitreous humor for red and infrared are the same as a like thickness of water (2.28 cm.), the average distance from cornea to retina. Radiation longer than 1.4 μ does not penetrate to the retina, although for red about 94% of the light gets through to it.

Our present knowledge of what the eye or its components pass or absorb is largely based on conventional light sources. Once the ultra-high domain of the maser is entered even very small transmissivities assume very substantial importance.

Most of the absorption by the eye takes place in its outer portion, Fig. 5, the cornea absorbing a large proportion of the energy not active in producing a sensation of light. The iris obstructs heat radiation of all wave-lengths, absorbing the same percentage radiation as that which reaches the anterior surface of the lens, about 75%, between 1.3 μ and the visible. The lens absorbs only about 12% of the energy incident upon the pupil. Four times the amount of energy is absorbed per unit area by the iris as by the lens and much more per unit volume. Moreover, the lens by virtue of its fluorescence is a natural absorber of ultraviolet, cutting off at 326 mμ and fluorescing a blue color. The cornea, and the vitreous and aqueous humors, all cut off at or within the abiotic portion of the ultraviolet.[9]

Retinal Burn

Retinal burns range from total and absolute blindness to simple impairment of vision.*

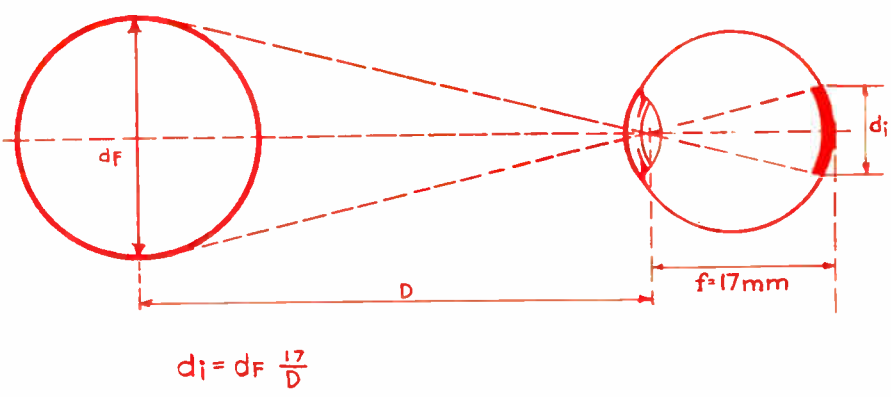
Intense irradiation of the retina results in more than localized eye change.[13]

The eye is physically structured so as to allow a greenhouse effect.[3] This undoubtedly occurs in a badly damaged eye, particularly with iridopathies (iris diaphragm disorders), and a malfunctioning supporting organism. But in the healthy eye the heat regulatory mechanism offsets a greenhouse effect below a presently unknown threshold value. The threshold point provokes extremely interesting questions.

As a sensor the eye is unusual. It carries a compensating mechanism which voids in a traumatic-susceptibility sense an otherwise operant inverse square law. Luminous and near-luminous radiation normally fall off in intensity inversely with the distance. In terms of retinal end-effect this is not so. The iris and the lens are an optical system designed to reproduce a faithful image of the luminous object on the retina. As the distance from a nuclear fireball increases, the radiant energy incident on the cornea decreases as the square of the distance; but, the fireball image diameter on the retina also decreases in exactly the same proportion.[8]

In Fig. 6, the large circle shows the fireball. In reality, it would be much further out, and have a very small angle coming into the eye through the lens and back to the retina. The two angles, at the fireball and at the eye, are equal. Neglecting attenuation by the atmosphere, the result is constant thermal exposure of the retina. It is possible, therefore, to produce burns on the retina out to distances that greatly exceed any of the other prompt effects of a non-DEW weapon, except a nuclear explosion. High-altitude, high-yield nuclear bursts on a clear day with no cloud cover may produce retinal damage at distances of 700 miles.[16].

It is when the eye is partially or fully dark-adapted that maximal retinal damage can occur. The more highly dilated pupil of a person during nighttime or immediately after entering an open space from a lesser-lighted one is, in terms of



* De Ment, J., Eye Damage and Modern High-Intensity Light Sources, *Ore. Opt.* 24:7-8 (1962).

Fig. 6: Retinal burn schematic D = distance between eye lens and nuclear fireball center; f = 17mm = the distance from lens to retina; d_f = dia. of fireball; d_i = dia. of retina image.

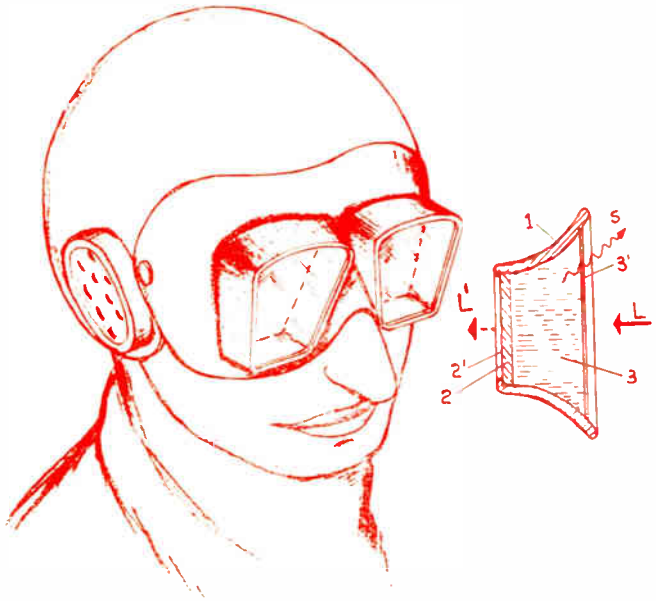


Fig. 7: Shown is eye armor design. The lens passes only enough light for working vision by means of a filter.

Directed Energy *(Concluded)*

vulnerability, an important parameter in assessing the eye as a target model.

DEW Countermeasures

As an anti-material weapon, DEW is a countermeasure itself.

Note that this includes a DEW beam "fence" as well as DEW-armed satellites or missiles designed for the antimissile problem. With DEW-armed satellites a "destruct swath" of desired geometry and size would be cut by the satellite trajectory.

Aside from destroying a DEW at its source, preventing its use, or jamming it during use, there are. broadly, two countermeasures: (a) prevent coupling with target, i.e., intercept and attenuate the DEW beam before it strikes, and (b) provide the target with anti-DEW prophylaxis internally and/or externally (before exposure) and/or treat the non-fatally wounded target (after exposure). It is evident that prevention of coupling is the more desirable of the two.

Absorption by anti-DEW screens or shields is generally the reason in preventing coupling. For penetrating gamma ray and X-ray beams, high density solids are necessary. Beams of these energies, however, might be sufficiently attenuated during long passages through the atmosphere by certain heavy metal screening smokes. This would be more effective for DEW beams involving luminous and near-luminous wavelengths, as well as microwave and ultrasonic beams.

The presence of water in the atmosphere, enough to provide a cloudy overcast, reduces solar radiation by 60% or more. By the same token, a titanium dioxide screening smoke should be highly effective. Of greater efficacy would be members of a large class of metal haloid smokes. This class includes gas-dispersoids made by pyrotechnic deflagration, containing some 65 different elements with at least 600 varieties possible. Smokes can be formed from such high density metals as lead, tungsten and uranium.[4]

A class of gas-dispersoids of interest as a countermeasure is based upon the ablation principle. The screen is of sublimone particles. Dispersed in the atmosphere as smoke, the particles absorb infrared, ultraviolet and visible photons, the absorbed energy being dissipated as heat of sublimation, i.e., the sublimone changes directly to vapor. Once in the vapor state, cooling may take place with condensation back to solid sublimone particles, thus continuously cycling as solid—vapor—solid—vapor. . . . Smoke-forming pyrotechnic compositions carrying sublimable dyestuffs are examples now-known but not presently viewed in terms of this quality.

Eye Armor

An eye armor based upon the ablation principle is made of a sublimone lens,[3] Fig. 7. This lens passes only enough visible light for working vision by means of tint filter, interference filter or Christiansen filter (which is temperature-dependent). Ultra-high luminous and thermal fluxes are intercepted and absorbed by the sublimone lens. The absorbed energy is dissipated as heat of sublimation, the ablation principle. The time-constant of the sublimone is theoretically of the order of a nanosecond, but in application this would be reduced by several orders of ten. The ablation armor can be of geometric configuration that corresponds to a given flash curve.

The dark, anti-flash, filter-goggle shortens by about 30% the normally long period of incapacitation of individuals unprotected from nuclear flash; this figure presumably holds for the pre-100 megaton era.[8] While the dark goggle does have a place, its obvious and severe limitation is that it does not permit a working vision, and thus would be totally useless against a DEW having the eye among its targets.

References

1. Abbott Laboratories, Burns, "What's New," No. 224, pp. 2-7 (June-July) 1961.

2. Buchanan, A. R. et al, "Biomedical Effects of Exposure to Electromagnetic Radiation. Pt. I—Ultraviolet," A.R.D.C., USAF, Wright-Patterson AFB, Ohio, May 1960 [WADD Tech. Rept. 60-376]; "Pt. II—Biomedical Effects on the Eye from Exposure to Microwaves and Ionizing Radiations." Ibid., June 1961 [ASD Tech. Rept. 61-195].

3. De Ment, J., Unpublished Studies, 1961.

4. De Ment, J., "Composition for Smoke Production," U.S. Patent 2,995,526 (8 Aug. 1961); "New Sublimation Nomenclature," *Chem. Eng.*, p. 7 (13 Nov. 1961).

5. De Ment, J., "Radioprotectant Drugs," *The Military Engineer*, 54:40 (Jan.-Feb.) 1962.

6. *Electronic Industries*, p. 93 (Nov.) 1961.

7. Illuminating Engineering Society, *I.E.S. Handbook*, New York, Illuminating Engineering Society, 1947.

8. Joint Committee on Atomic Energy, "Hearings Before Special Subcommittee on Radiation: Biological and Environmental Effects of Nuclear War," Pt. I, pp. 230-250, 297-298 (22-26 June 1959).

9. Laurens, H., "The Physiological Effects of Radiant Energy," New York, Chemical Catalog Co., 1933, chap. 5.

10. Oregon Optometric Assn., data furnished writer 30 Jan. 1961.

11. Purves, E., ed., *The Focal Encyclopedia of Photography*, New York, Macmillan, 1960, pp. 469-477, 668-672.

12. Raleigh, H., "Masers—A Literature Search," U. S. Atomic Energy Commission, Washington, D. C., 1961, 50 pp.; *Proc. N.S.I.A.-I.R.D. Conf. Molecular Electronics*, Washington, D. C., Nov. 1958.

13. Reed, C. I., *Amer. J. Physiol.*, 65:477 (1923).

14. Schawlow, A. L., *Bell Tel. Record*, pp. 1-7, Nov. 1960; *Bell Tel. News*, 7 pp. (5 Oct. 1960); Schawlow, A. L. and Townes, C. H., "Masers and Maser Communications System," U.S. Patent 2,929,922 (22 Mar. 1960); Weber, "Comprehensive Maser Summary," *Rev. Mod. Phys.*, 31:681-710 (July) 1959.

15. U. S. Air Force, "Feasibility Study and Design of a Self-Attenuating Light Valve," Polacoat, Inc. for W.A.D.D., USAF (Feb.) 1961, 26 pp.

16. U. S. Atomic Energy Commission, Release No. D-279, pp. 4-5 (31 Oct. 1961).

A method for analog simulation of discontinuous nonlinear functions, as in practical systems, is presented. It uses high gain, nonlinear feedback methods to achieve precision simulation with a minimum of components.

Simulating Discontinuous Nonlinear Functions

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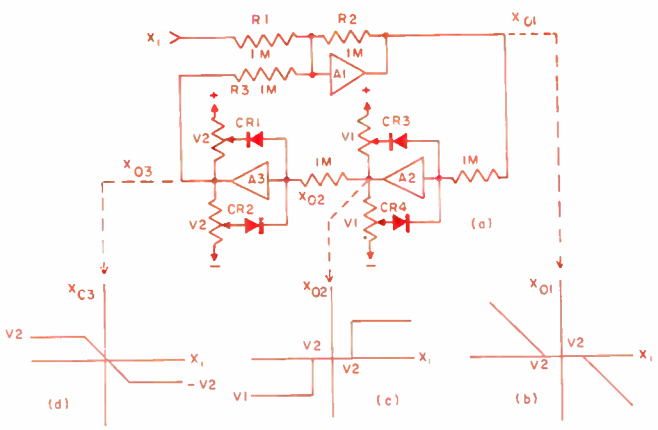
Fig. 1a: Basic high gain feedback circuit is shown. b: Output of amplifier A_1 provides Dead Space simulation. c: Output of A_2 simulates the operation of a Relay or On-Off circuit. d: Output of A_3 is a Limiter.



A BASIC circuit using the high gain negative feedback method for nonlinear simulation is shown in Fig. 1a. Operational amplifier A_1 has unity gain from X_i to X_{01} (since $R_1 = R_2$); the feedback path is from X_{01} through A_2 and A_3 in series back through R_3 to A_1. The circuit has two distinct modes of operation: (1) when the input signal at X_i is less than the bias voltage V_2, and (2) when X_i is greater than V_2.

In (1), when X_i is less than V_2, feedback amplifiers A_2 and A_3 are operating at full gain, so that the feedback gain is extremely high (at least 10^8). Since the feedback is negative, the voltage at X_{01} remains essentially at zero, as does the voltage at X_{02}. The output of A_3 (X_{03}) is the negative of X_i so that the net input to A_1 is zero.

This condition of operation, known as the dead space, holds as long as the input X_i lies in the region $-V_2 < X_i < +V_2$.

In (2), as X_i increases to a value greater than V_2, the output of amplifier A_3 is clamped by the limiter action of CR_1 and CR_2 to a value equal to V_2. Net input to A_1 is no longer zero, but is equal to $(X_i - V_2)$. Output of A_1 (Fig. 1b) is $-(X_i - V_2)$ and the output of A_2 (Fig. 1c) jumps to a value equal to V_1. Since the gains of both A_2 and A_3 are reduced to zero, the feedback loop is no longer effective and A_1 acts as a straight gain-of-one amplifier with a bias voltage V_2 subtracted from the input. If the input voltage X_i decreases below the value of V_2, the net input to A_1 becomes negative, the output X_{01} reverses, amplifiers A_2 and A_3 switch out of their clamped mode of operation, and the large negative feedback is restored.

The output of A_1 provides Dead Space simulation; the output of A_2 simulates the operation of a Relay or On-Off circuit; and the output of A_3 is a Limiter.

Simulating Hysteresis

Addition of positive feedback, as shown in Fig. 2, introduces into the circuit hysteresis, permitting the simulation of such functions as the Polarized Double-Throw Relay with hysteresis.

This network functions in the following manner: as the input X_i increases positively approaching the voltage V_2, the output X_{02} is held at zero, as previously explained. When X_i exceeds the dead space voltage V_2, the feedback loop loses control and X_{02} is limited to the voltage V_1. Positive feedback, through the potentiometer P, reduces the bias on amplifier A_1 from V_2 to $(V_2 - \beta V_1)$. Therefore, if the input signal is reduced, the negative feedback loop does not regain control until the input reaches this new bias. Thus both dead space and hysteresis have been simulated; the amount of hysteresis is controlled by the positive feedback factor β, as shown in Fig. 2c, d, and e. Note that the hysteresis can exceed the dead space V_2 with no loss of control.

Simulating Backlash & Quantizing

Integral feedback may be added to the polarized relay network of Fig. 2 as shown in Fig. 3a. This circuit may be used to simulate the action of Backlash, Quantizing, and the Free Running Multivibrator; the type of simulation obtained is determined by the positive feedback factor β.

Action of the circuit is as follows: As X_i exceeds the

Nonlinear Functions *(Concluded)*

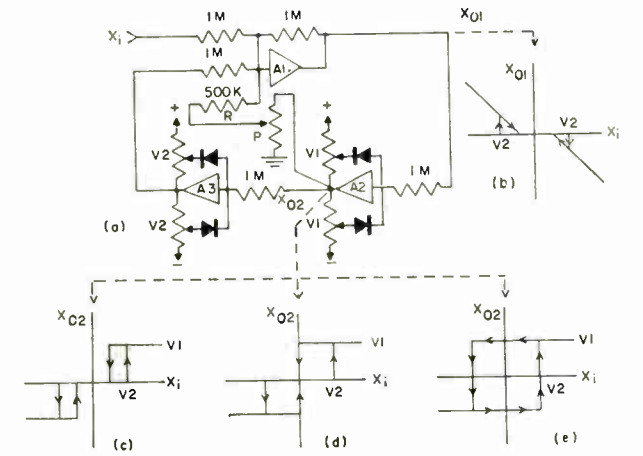


Fig. 2a: Addition of positive feedback to basic circuit. b: Output of A_1 ($\beta V_1 = 0.5V_2$). c: $\beta V_1 = 0.5V_2$. d: $\beta V_1 = V_2$. e: $\beta V_1 = 2V_2$. β is the positive feedback factor and is determined by the setting of potentiometer P and resistor R.

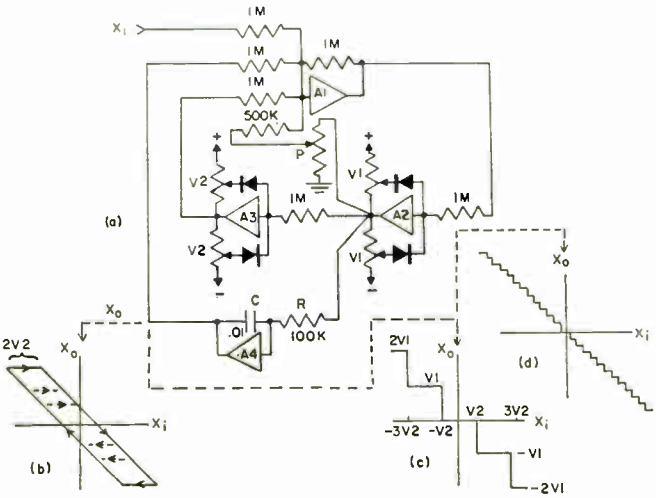
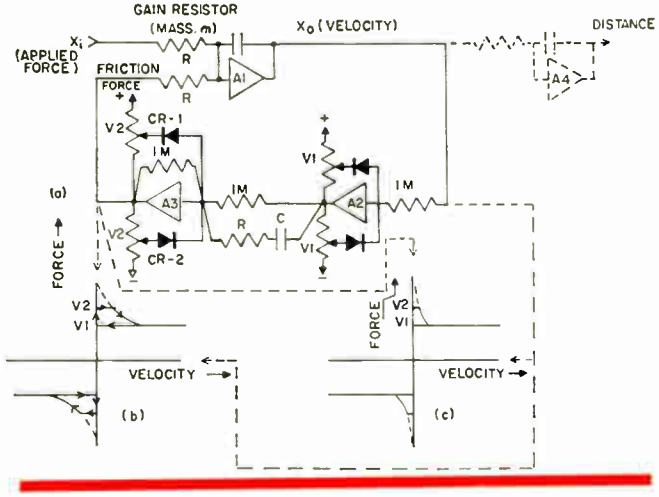


Fig. 3a: Addition of integral feedback. b: Backlash simulation. c: Quantizing simulation. d: Granularity simulation (small quantizing steps).

Fig. 4a: Use of derivative feedback. b: RC=0.01 sec. c: RC=0.001 sec.



dead space voltage V_2, a step of magnitude V_1 appears at the output A_2 as explained before. A fast acting integrator, A_4, integrates this voltage and applies additional negative feedback to the input of A_1. The action continues until the ouput of A_2 is forced back to zero, at which time the circuit returns to the dead space condition.

If no positive feedback is used ($\beta V_1 = 0$), the Backlash transfer function shown in Fig. 3b is obtained. With unity positive feedback and with $V_1 = 2V_2$, so that the positive feedback voltage is equal to $2V_2$, the Quantization action of Fig. 3c results. If V_1 and V_2 are made very small, so that a large number of quantizing steps are obtained, the action of Granularity (e.g., granular potentiometer) is simulated (Fig. 3d).

When the circuit is adjusted to give Quantization stimulation, the output of amplifier A_2 is a series of pulses which may be used to measure slope: polarity of the pulses indicates the direction of the slope of the input (i.e., positive pulses indicate a positive slope), and the frequency of the pulses accurately indicates the steepness of the slope. If small quantizing steps are used, so that the sensitivity is high, the circuit will give excellent results even for inputs which have a very slow rate of change.

For positive feedback greater than $2V_2$, the circuit becomes a Free Running Multivibrator with the period precisely controlled by the integrator time constant RC and by the amount of positive feedback.

Use of Derivative Feedback

An example of the use of derivative feedback added to the basic method is the static and coulomb friction simulation shown in Fig. 4a. For this simulation the amplifier A_1 is replaced with an integrator. If the applied force (X_i) is greater than the friction force subtracted by the feedback loop, there exists a net force which acts on the body of mass "m" and accelerates the body. This acceleration is integrated with respect to time by A_1 and velocity appears at X_o.

The limit voltage on A_2 (V_1) represents the magnitude of the coulomb friction and the limit voltage on A_3 (V_2) represents static friction. It is seen that X_o (velocity) will remain at zero, by the same reasoning given in the basic method, until X_i (force) exceeds the voltage V_2 (static friction). Once this has occurred, the feedback loop loses control and the ouput of A_2 jumps to V_1. Differentiation action of R-C in the input circuit of A_3 would cause the output of A_3 to jump except that it is clamped at V_2 (static friction) by the action of CR_1 and CR_2. As the capacitor C charges, the gain of A_3 reduces to unity and the output of A_3 becomes that of A_2 (coulomb friction).

If the applied force (X_i) is now decreased to a value equal to V_1 (coulomb friction) the velocity (X_o) will become constant. If the force is further reduced to a value below the coulomb friction, the net input to A_1 reverses and the velocity decreases until it becomes zero. At this time the feedback loop regains control and the static friction can once again appear.

Addition of another integrator, A_4, integrates velocity to give distance.

Summary

It has been shown that the high gain feedback

method can be used to simulate a variety of discontinuous nonlinear functions. No attempt has been made to illustrate all of the functions which may be simulated. The simpler nonlinearities, such as limiters, absolute value circuits, and flip-flop comparators may all be simulated using this method. However, since the basic circuit uses three amplifiers (the high gain feedback loop requires two amplifiers to obtain negative feedback), the simpler nonlinearities may be simulated with fewer components using other methods.

As the complexity of the nonlinear function increases, the use of the high gain feedback method for simulation results in the use of a smaller number of components than is required when using more conventional "series building block" methods.

A great variety of wave forms may be generated using different combinations of positive, negative, integral, and derivative feedbacks. The more common simulations have been outlined and should suffice for the majority of control system simulations. In most cases, more complex discontinuous nonlinear functions may be simulated with an extension of the principles shown.

The same basic circuit is used for all simulations using the high gain feedback method. This makes it a straightforward and relatively inexpensive task to build a Nonlinear Function Generator consisting of four operational amplifiers packaged into a unit. The unit would have a front panel selector switch which would make the proper connections to obtain all of the simulations outlined in this paper. Such a unit might well be a valuable addition to any analog computer installation engaged in control system analysis.

Addendum

Circuits illustrated in this paper were breadboarded and tested at the Hughes Aircraft Co., Tucson, Ariz., using a twelve amplifier manifold designed by the authors. George A. Philbrick K-2 series plug-in operational amplifiers were used throughout.

It was necessary to use 100 pf capacitors across the input resistors of A_2 and A_3 for equalization to prevent oscillations.

Dual Visibility

A DRAFTING reproduction method makes both sides of an etched circuit board visible simultaneously. It was developed by engineers of the Hughes Aircraft Co., Culver City, Calif. communications division.

The "dual visibility" is achieved photographically by printing a bold outline of the front, or component side, of the circuit board, over a faded outline representing the back, or solder side.

Thus the complete circuit, with the location of all the components in relation to the solder points, is clearly visible at a glance. The method virtually eliminates chance of error in circuit layout and has reduced design drawing costs by 50%.

The quality of microfilmed copies of the drawings meet the strictest requirements of military specifications. Sensitized drawing film is used to make the photographic drawing, Reade said. Here's how its done:

First a master drawing of 4:1 scale is made of only the etched side of the board. This is photographically reduced to make negatives of machine and assembly drawings.

Two negatives of the master are made, both reduced to 2:1 to fit on D-size sensitized drawing film.

The dual visibility is achieved by projecting the etched circuit on the sensitized film and fading it out by use of a screen. Then the components are inked in by the draftsman or engineer, and the boldness of the component outline over the faded circuit presents a distinctive drawing, providing marked contrast between the two sides.

Solder pads, marked with a dot in the center, identify drill holes in the machine drawing. Assembly information is noted in the margins of the master drawings, thus providing a permanent guide to each circuit board.

The same technique can be used to show circuits on a double-sided etched board. The circuit on the near side is shown very bold and the reverse side is "faded out."

The differences in line density readily distinguish the component, circuit-near-side, and circuit-far-side in the double-sided etched board.

Hughes engineer A. P. Johnson demonstrates ease of tracing circuit when compared with master drawing.

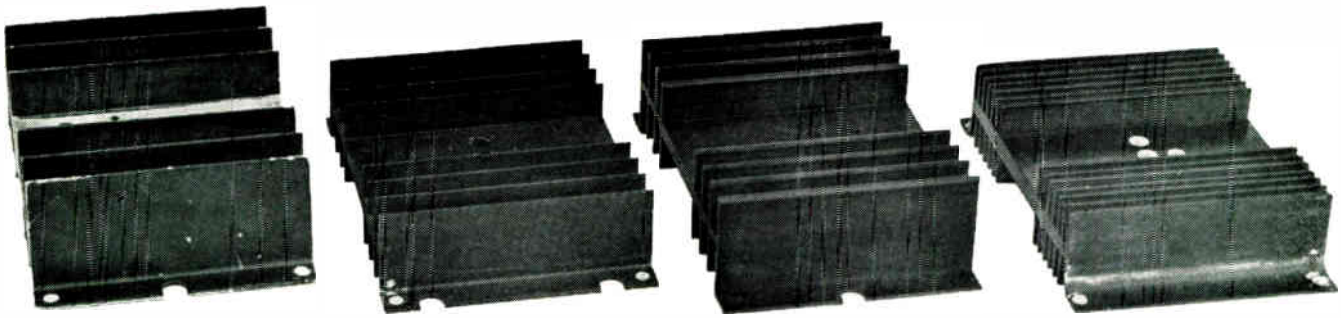


Fig. 1: Shown are some of the heat sinks used to determine the optimum configuration for the best heat dissipation.

Getting the Most From a

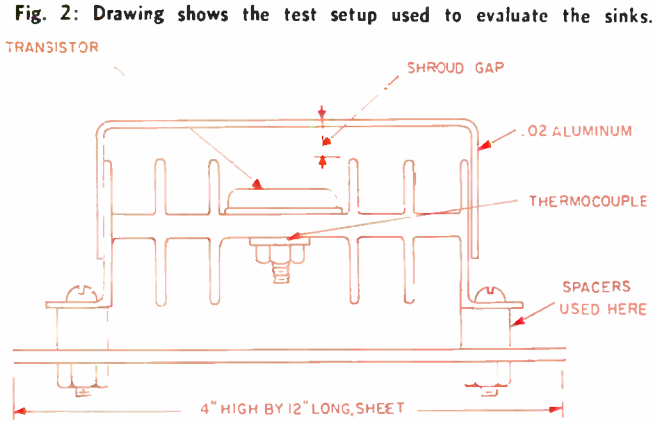
Careful thought to location, fin spacing and shroud placement will increase the heat transfer efficiency of a power transistor heat sink. The findings described here should improve any heat sink installation.

THE effectiveness of extruded heat sinks designed for high power transistors, such as the TO-3 and TO-36 types, can be much improved (and also degraded) by the method of mounting.

Heat sinks are generally rated by the manufacturer when suspended in free air. In a practical application, however, the sink must be mounted in a chassis where other components and structure can affect the air flow to and from the sink, as well as conduction of heat from the feet of the sink. These factors are very important in predicting sink performance. They can change the free air rating as much as 27%!

Although very complex, consideration of the factors which affect the heat transfer will show the important ones. The effect of radiation at the temperature differentials normally used is small. For a difference of 50°C and with 100% emissivity of both surfaces, radiation accounts for about 0.015 watts/sq. in.[1]. The basic equations for convective heat transfer involve many factors, most of which have small effect.

Fig. 2: Drawing shows the test setup used to evaluate the sinks.

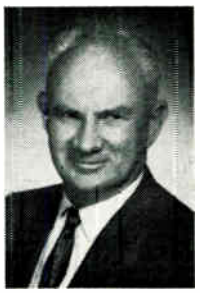


A survey of available data [1, 2, 3] indicates, without detail analysis, where improvements in the convective transfer may be expected, and what structures would degrade it. These data show that a parallel plate, more than 20 mm away from the heat transfer surface, does not affect convective transfer. In fact, the optimum distance for maximum velocity of air flow past a smooth vertical plate is between 2 and 4 mm. Beyond 10 mm, the velocity is practically negligible. Also the temperature rise in the air flowing past the plate is negligible beyond 10 mm. This would indicate that a shroud between 10 and 20 mm away would not adversely affect the heat transfer coefficient. Such a shroud, if formed into a chimney, might help create a draft which would increase the air flow past the surface. Extension of the shroud above the surface of the heat sink should increase the draft effect. A limit would be reached, however, when the additional friction loss would exceed the draft gain.

To verify these conclusions, 4 heat sinks, from different manufacturers, were tested with several combinations of mountings and shrouds. (See Fig. 1.) The sinks all were basically the same in overall dimensions, but differed widely in the number and spacing of fins. Refer to Table 1.

The Test Standard

Most of the tests were run at a constant 20 watts input to a 2N441 transistor mounted in the center of the sink. The stud temperature of the transistor



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Heat Sink

was measured with a thermocouple imbedded in a copper washer under the retaining nut. The tests were run with the axis of the extrusion vertical, in still air at 75°F and 100 ft altitude. Except for free air tests, the sinks were mounted as shown in Fig. 2, with the plate material, spacers, and shrouds combined as shown in Table 2. The actual temperature rise (°F) for the combinations is also shown in this table. Some other combinations were tried, but where the resultant change was less than 1°, the version is omitted.

The tests substantiate the worth of the "chimney effect," and also the importance of the mounting on the heat transfer capabilities of the sink. Time did not permit a detailed analysis of each variation. The effort had to be concentrated on developing a mounting which would improve the sink performance. The heat transfer was improved from 16 to 32%, depending on the sink design itself.

Effect of Fin Spacing

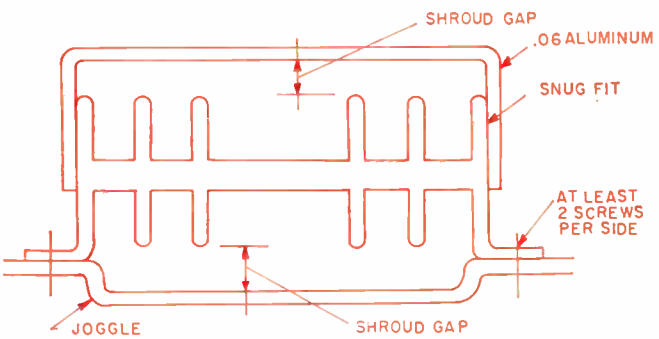
The effect of fin spacing is quite important. Unit D, with very narrow fin spacing, showed a slight advantage over the others in free air, but it was much less sensitive to environment, so its performance could not be upgraded as much as the others. In some cases this insensitivity to environment can be an advantage, and this sink probably will perform well where forced convection is used.

The unit A, with the widest spaced fins, showed the best improvement, probably due to the favorable ratio of friction coefficient inherent in a high duct area to surface perimeter. Because of the small forces available to induce air flow, the flow friction losses are important. It is possible that further tests would show a more optimum value for such factors as the shroud spacing, metal thicknesses, and length of duct for each sink style. Possibly the performance of types B and C could be made equal to, or exceeding that of A, but there is no indication that type D could be brought up to a comparable level.

Obviously, direct mounting of the sinks to thermally conductive plates improved the performance because of heat flow through the mounting feet. Not so obvious, however, is the fact that when the mounting plate is against the fins, the restriction of air flow on this side of the sink degrades the convective transfer. When the sinks were spaced out from the plate with an aluminum bar the full length of the sink, all gained in performance. Metal spacers of small area or plastic low-conductivity spacers degraded performance, both by decreasing conductivity and by destroying the chimney draft effect by side leakage of air. The best mounting will probably be a form shown in Fig. 3, where the mounting is joggled to form the air passage, and only a single joint restricts heat flow under the mounting feet. The optimum air passage width is difficult to define. It is dependent on the sink design itself, on the temperature rise, and on air density. The optimum appears to be fairly broad, with a range between ¼ and ⅜ inch producing about the same results on types A, B, and C.

The same considerations apply to the position of the shroud used on the other side. Added gain can be made by using a heavier gage material than the 0.02 inch stock used in the tests, by using a closely fitted joint between the sink and shroud, and where temperature differences are larger, a black high-emissivity coating will increase heat transfer. Where top performance is needed, all these little items can be used to accumulate a large gain in heat transfer. The problem of altitude needs investigation. The heat transfer rate suffers at altitude because of the lowered density of air, and must be seriously considered even for equipment used in the 5000 to 10,000 ft range. There is a lack of data, and the mathematical correction for this type of unit is not very satisfactory. The effect of altitude on conventional chimneys has been found[4], and the data can be summarized as follows:

Fig. 3: This shows the recommended heat sink installation.



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Heat Sink

(Continued)

Table 1

Summary of Heat Sink Characteristics

Parameter	Sink A	Sink B	Sink C	Sink D	
A. Fins per side	6	8	8	14	
B. Spacing between Fins	0.62	0.38	0.38	0.18	inches
C. Fin height	0.60	0.43	0.50	0.38	inches
D. Fin thickness	0.075/0.040	0.050/0.020	0.10	0.050	inches
E. Fin shape	tapered	tapered	rect.	rect.	
F. Fin surface	smooth	smooth	serrated	serrated	
G. Thermal resistance as listed in mfgr's catalog	2.1	2.3	1.28	1.1	°C/watt
H. Measured thermal resistance	2.2	2.2	2.1	2.1	°C/watt
I. Thermal resistance for best combination of factors	1.6	1.7	1.6	2.0	°C/watt
J. Improvement	27%	23%	24%	5%	
K. Heat transfer coefficient*	0.0044	0.0038	0.0035	0.0029	Watts/°F/sq in.

* Mc Adams[1] value for vertical, smooth, flat plate is 0.0024 watts/°F/sq in.

Relative increase of stack height and diameter to produce draft equivalent to that of sea level for same temperature difference.

Altitude	*Stack Height*	*Stack Diameter*
S.L.	1.00	1.00
5000	1.36	1.06
10000	2.14	1.17

Table 2

Temperature Rise Test Results

Configuration of Test	Temperature Rise (°F) With 20 Watts Input Sink A	Sink B	Sink C	Sink D
Free air	79	78	75	76
Mounted Flat on 0.04 in. steel plate	73	75	72	77
Same but with shroud having ¼ in. gap	68	76	69	73
Same but spaced from plant with ⅜ in. bars	70	70	65	72
Same but with ⅜ in. bars and shroud	62	64	63	70
Same but with 4 in. stack on top	—	54	—	—
Mounted flat on 0.09 in. aluminum plate	64	72	62	76
Same but with shroud having ¼ in. gap	60	67	56	—
Same but spaced from plant with ⅜ in. bars	61	65	62	—
Same but with ⅜ in. bars and shroud	58	61	56	71
Horizontal plate ⅝ in. below	70	72	—	78
Mounted on 0.09 in phenolic sheet	—	82	—	—
Mounted flat on 0.04 in. steel plate	—	81	—	—
Same but with shroud having no gap	—	77	—	—
Spaced from steel plate on ¼ in. standoffs	—	75	—	—
Mounted on 0.09 in. aluminum plate with 0.008 in. Mylar between plate and ⅜ in. bars	—	68	—	—
Same except only 0.004 in. Mylar	—	65	—	—

The restricted passages between fins and any turns or restrictions in the air passage have a more pronounced effect at altitude.

Any restriction of the free flow of air into and out of the sink will degrade the performance. A flat horizontal plate ⅝ inch below the bottom of the sink will increase the temperature rise by 6° to 9°. A 3 or 4 inch high stack above the sink on the other hand, can decrease the temperature drop by 8° to 10°. A 0.004 inch film of Mylar® under the feet of the sink can change the temperature 4°; a 0.008 inch film can change it 7° or so. Such values are much better than when the sinks are mounted on plastic standoffs or collars, so the former is a better method of insulating the sink from the mounting panel. Mica or a similar high heat conductivity insulator can be used to advantage here.

Fig. 3 shows a heat sink mounting designed in accordance with our tests and analysis. With one sink a gain of better than 30% is attained.

Locating the Heat Sink

When space is available, a greater gain results from the use of a stack, such as is shown in the vertical section of Fig. 4d. Given a choice of sink location, it is best placed at the bottom of a chassis so a duct configuration like Fig. 4d or 4e can be used. If the sink must be placed at the top of the unit, use a shroud as shown in Fig. 4c, or if there is high internal heat generated in the box, consider Fig. 4f. Avoid configurations like 4a and 4g if high wattages are to be dissipated—they will not do the job. A narrowly spaced fin style of sink like unit D, placed outside the box as in Fig. 4h, and spaced out about ¼ inch will do a better job.

When design 4b is to be used, the bottom opening can be about the same size as the sink overall projected area, but the top opening must be at least 20% longer and 35% wider than the sink to assure adequate air flow. Where a curved duct is needed as in 4e and 4f, the opening should be about 120% of the

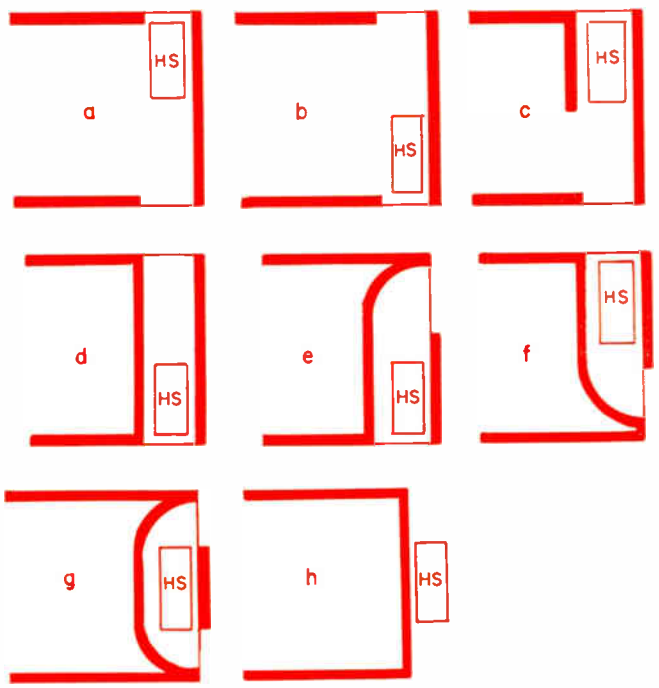
sink area. When the mounting in 4h is used, the sink must be spaced off of the mounting surface to be fully effective. This is particularly important if the mounting surface is thin gage metal or an insulating material. With widely spaced fins, a shroud will also help.

Screens should not be used over vent openings if at all possible. When required by RFI shielding or other reasons, use a material with as high a percentage of opening as possible, and increase the vent size to compensate for the restriction.

The tests brought out a discrepancy between the manufacturer's published data and the test results in free air for two of the sinks. The discrepancy is well beyond the normal instrument error. Since the tests on all units were conducted under the same conditions, the presumption is that there is an error in the published data, or the tests were run under much different conditions by the manufacturer. As shown in Table 2, all units had about the same thermal resistance in free air, about 2°C/watt. In two cases the manufacturer's data agreed with the value actually measured in the tests, but in the other cases, the manufacturers gave values of 1.6 and 1.1°C/watt.

Before published values for the thermal resistance are used, they apparently need to be checked by actual tests, or should be certified by an independent laboratory, and the method, procedure and mounting of the heat sink for the test explained in detail. There is a need for a standardized procedure so the data can be relied upon for design. As far as the 4 sinks used in these tests are concerned, the use of the published data in two cases for design will be in error—in one case by almost 100% for free air. When the sink is placed in a restricted area, and hemmed in by other components, all the data may be invalid—so be careful!

Fig. 4: Shown below are several methods of mounting transistor heat sinks. Obviously, some are much better than others.



With respect to the heat sink design itself, there is room for improvement when only natural convection is to be used. Multiplying the fins within a given volume will increase the area available for heat transfer to be sure, but as line K of Table 1 shows, the convection transfer coefficient itself decreases more rapidly, so the overall efficiency is less. The answer is not to engage in a "Horsepower" race to increase the area.

Fin shape has an effect on the performance as brought out by Kraus[6], but the effect is small. This is so because the generally low surface-to-air convection factors do not produce appreciable temperature through the fin length. However, some of the ineffectiveness of Unit B is due to the very thin fins. On the other hand, the data of Schmidt[1, 3] show the overriding importance of adequate air flow space between the fins—performance drops when the space is narrow enough to affect the velocity or temperature gradient. Examination of the important area/wetted perimeter ratio effect on the friction losses in the duct[1] will lead to the same conclusions. The optimum fin size and spacing for natural and forced convection conflict, so a unit designed for both will not be optimum for either. It should be possible to gain better performance if the sink is designed only for natural convection. Unit A is better in this respect than the others.

Sufficient data were not available to find the effectiveness of the serrations of units C and D. The effect of serration area is certainly obvious in the catalogs, but consideration of Schmidt's data make the heat transfer effect questionable.

Conduction Through the Feet

The second improvement is better provision for heat transfer by conduction through the feet. Sinks A and C, with heavier walled feet show greater improvement when mounted on conductive plates. In fact, roughly half the gain came in this manner. Some of this gain has to be sacrificed when the sink must be electrically insulated from the mounting. However, this can be minimized by using thin, high heat conductivity insulation such as mica or silicone impregnated glass cloth. Conductive heat flow could be aided by proper location and proportioning of the feet.

By using the principles of mounting design outlined, it is possible to obtain better performance from available high power heat sinks when using natural convection alone. Greater gains are possible by an intelligent re-design of the sink itself, using the available data on convective heat transfer. Such an attack is more in keeping with creative engineering than such methods as grease under the joints and black paint. These may be in keeping with laboratory experiments, but are hardly suitable for reliable production units.

References

1. Mc Adams, "Heat Transfer," *McGraw Hill.*
2. Griffiths, E. and A. M. Davis (Special report), HM Stationary Office, London, 1922.
3. Schmidt, E., *Zages Kalte Ind.* 35,213 (1928).
4. "Mark's Mechanical Eng. Handbook," *McGraw Hill.*
5. Kraus, Allen D., *Electro-Technology*, Feb., March, April, May, June, 1961.

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These antennas were designed for operation in the 8.2 to 12.4 gc frequency range. They are simple in design and can be produced in quantity by using low cost aluminum casting processes.

Design & Performance Data For . . .

X-Band Aircraft Antennas

DESIGN and performance data are given for a set of X-Band antennas suitable for airborne use in the 8.2 GC to 12.4 GC frequency range. The antennas described are a linear vertical polarized horn, a linear horizontal polarized slot radiator, and right- and left-circular polarized horns.

The antennas are simple in design. They are useful in airborne applications for the transmission or reception of r-f energy of either linear or circular polarizations. These units can be used as antenna and detector assemblies for crystal-video systems with the use of suitable waveguide-to-coaxial crystal mounts.

Performance data is presented in the form of VSWR, radiation patterns, axial ratio, and gain measurements.

General Design

Construction Details—Photographs in Figs. 1, 2 and 3 and the three view drawings of Figs. 4, 5 and 6 reflect the general construction details. The antennas shown were fabricated of brass for ease of laboratory modification and adjustment during the development program. The simplicity of these designs, however, will permit the use of low cost aluminum casting processes for their fabrication.

The antenna feeds are sections of standard X-Band waveguide for which the inside width and height dimensions are 0.900 in. and 0.400 in. respectively. Choke flange connectors are used for a good degree of coupling flexibility on installation of the units in system waveguide assemblies. These flanges intro-

Fig. 1: Photograph of X-band vertical polarized antenna.

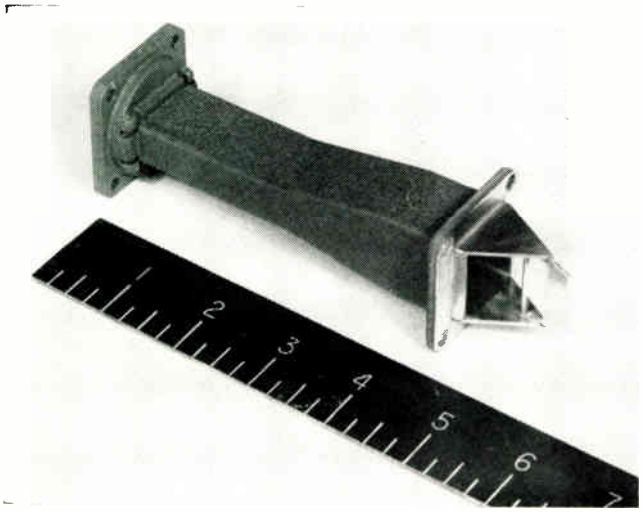
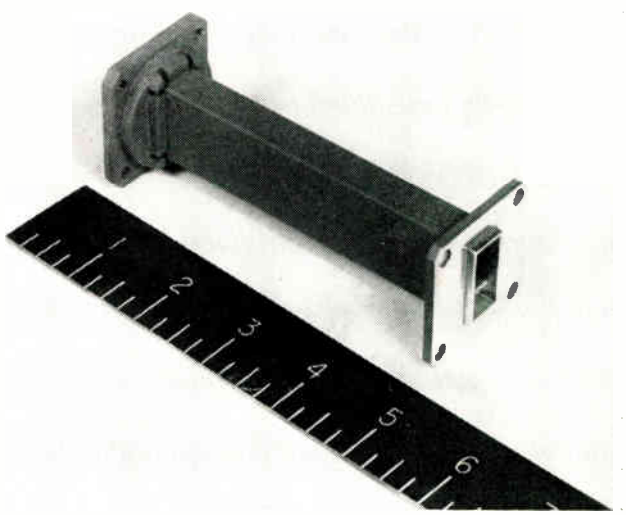


Fig. 2: Photograph of X-band horizontal polarized antenna.



R. L. Thomas

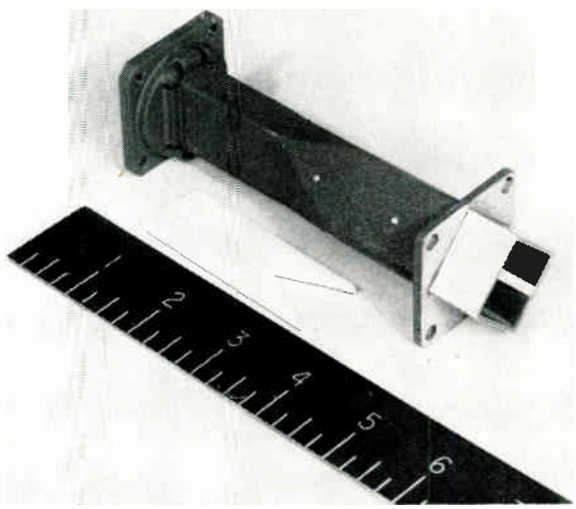
M. F. Gunderson

duce only very small reflection and loss in the system transmission line.

Vertical Polarized Antenna—This antenna is a waveguide horn type radiator designed for broad pattern coverage in the azimuthal plane (H-plane). The broad H-plane patterns are obtained because of the geometrical shaping of the physical aperture of the antenna. This technique has been used by other workers[1,2] in the field and is very useful in applications where broad pattern coverage is needed.

The V-shaped antenna aperture and vertical septum broaden the radiation pattern in the H-plane, with little or no effect on the patterns in the E-plane. The reflection caused by the vertical septum, however, was sufficient to necessitate the use of internal "matching." Inductive post tuning was used to provide the needed

Fig. 3: Photograph of X-band circular polarized antenna.



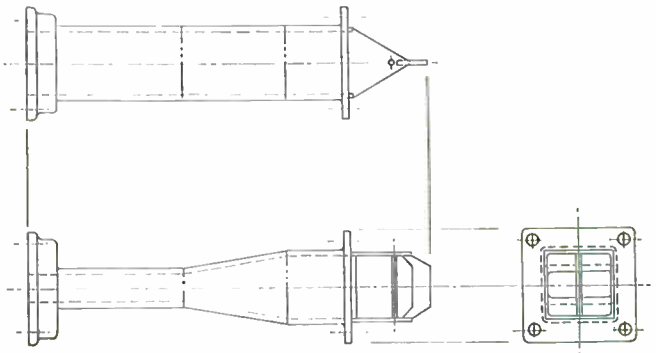


Fig. 4: Drawing of X-band vertical polarized antenna.

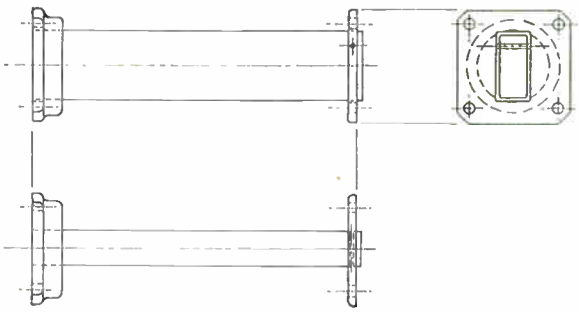


Fig. 5: Drawing of X-band horizontal polarized antenna.

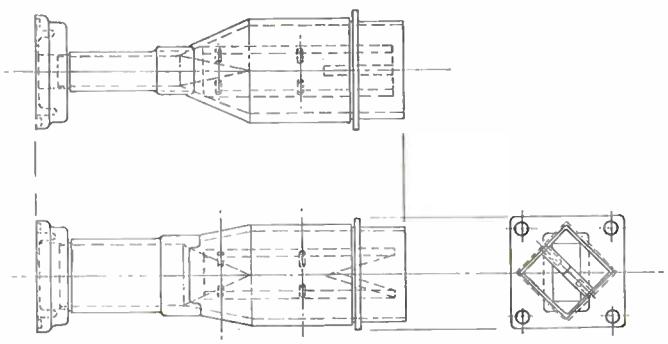
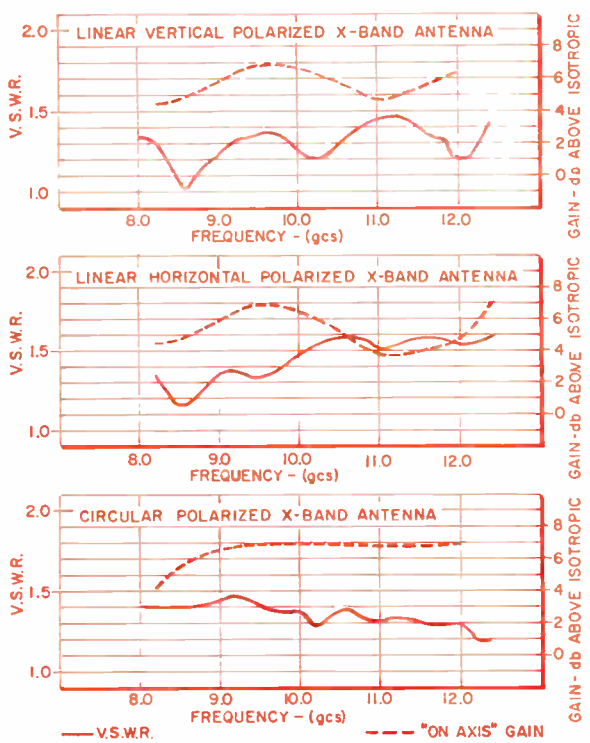


Fig. 6: Drawing of X-band circular polarized antenna.

Fig. 7: "On axis" gain and VSWR measurements of antennas.



match. A one-sixteenth diameter metallic rod, positioned within the aperture, Fig. 4, reduced the VSWR of the antenna to less than 1.5:1 across the operating frequency band. The post position was found experimentally in a slotted line test set-up.

Horizontal Polarized Antenna—A short section of standard X-Band waveguide, terminated in a ground plane, provided a very simple broadband slot radiator for the linear horizontal polarized antenna. The maximum VSWR that may be expected for a radiator of this type,[3] considering the width-to-height ratio of the waveguide, would be about 2:1. For many applications, this maximum value would be acceptable. However, for our specific applications, it was desired to limit the VSWR to less than 1.6:1 over the waveguide bandwidth. Internal "matching" of this unit, as described for the vertical polarized element, provided the necessary tuning to meet the VSWR requirements.

The ripples found in the radiation patterns (Figs. 10 and 11) are those to be expected in the plane of polarization of a slot radiator terminated in a finite ground plane.

Circular Polarized Antenna—This antenna is a horn type with a square aperture. The basic construction permits the unit to be configured for either right or left-circular polarization.[4] This is dependent only on the physical orientation of the dielectric phasing section within the square guide section.

The basic conditions needed for an antenna to produce circular polarization are:[5]

(a) Radiation of two simultaneous fields of equal intensity.

(b) The E vectors of the fields must be in space quadrature.

(c) The E vectors of the fields must also be in time quadrature.

The conditions noted in (a) and (b) above are fulfilled in this design by the physical geometry of the antenna. The waveguide feed section propagates the dominant $TE_{1,0}$ mode. This feed section is clocked at 45°, with respect to the square guide section, so that the resultant wave entering the square section is resolved into two orthogonal modes—$TE_{1,0}$ and $TE_{0,1}$.

Condition (c) was obtained by using a teflon dielectric sheet located in the square guide section. The dielectric sheet alters the velocity of propagation of one mode without much effect on the other mode. In this case, the mode whose E lines are parallel to the dielectric sheet is retarded in phase with respect to the mode whose E lines are normal to the dielectric sheet. The important parameters in the design of a phasing section of this type, to produce the desired phase quadrature between the two modes, are the dielectric constant (ε) of the material and the ratio of the thickness of the material to the inside dimension of the waveguide. Design data[6] is available for finding the desired phase shift per centimeter of length of the dielectric sheet. The length may then be adjusted for the phase quadrature relationship.

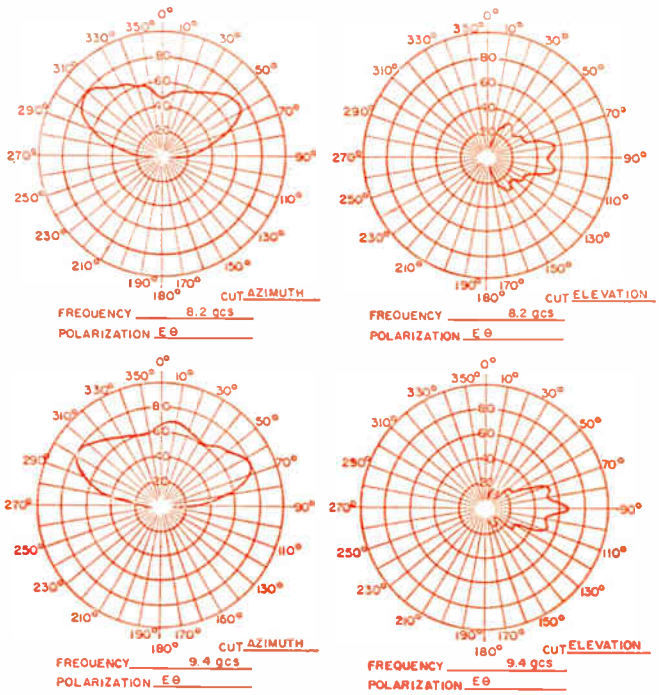


Fig. 8: Radiation pattern data for linear vertical antenna.

The dimensions of the phasing section, in this application, needed slight adjustment in the lab. for best performance. The measured axial ratios of the antenna, with the phasing section, is less than 2.0 db both "on-axis" and for angles of ± 30° in the E and H planes over the full waveguide bandwidth. Dimensions of the phasing section are as shown:

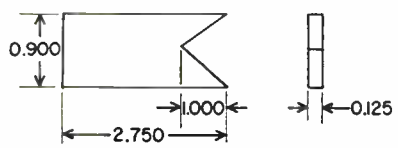
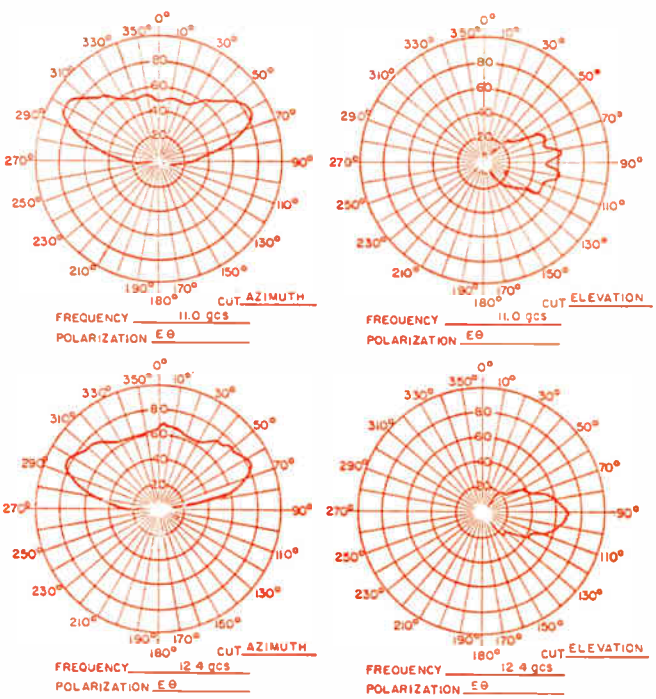


Fig. 9: Radiation pattern data for linear vertical antenna.



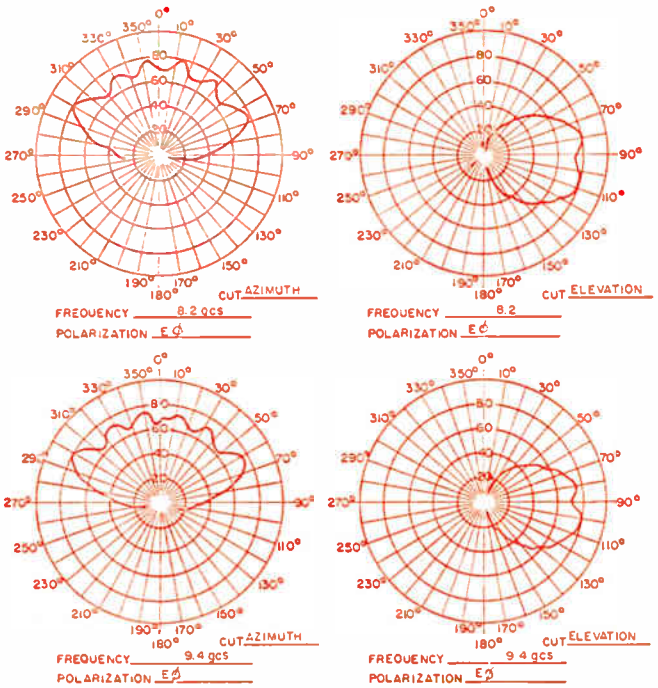


Fig. 10: Radiation pattern data for linear horizontal antenna.

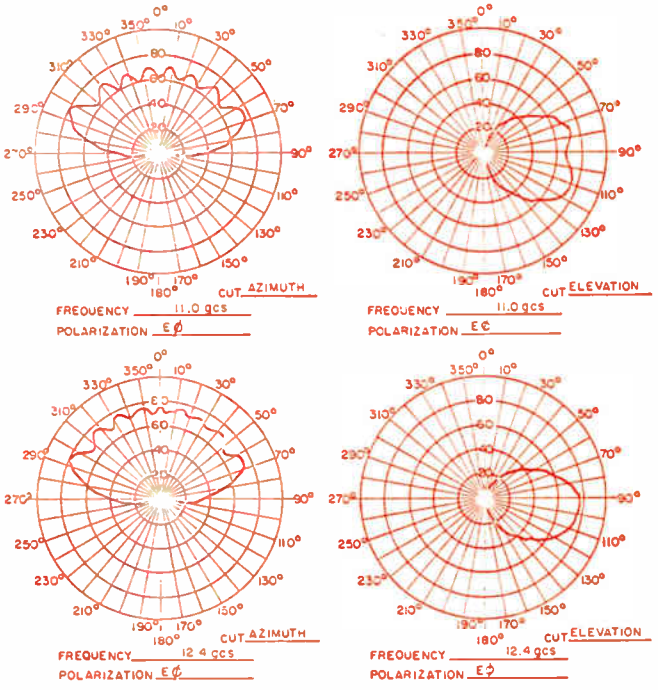


Fig. 11: Radiation pattern data for linear horizontal antenna.

One end of the phasing section is tapered in the form of a V-notch to reduce reflections. Notching of the other end would, no doubt, further reduce the reflections. This was not necessary as the measured VSWR of the antenna, with the phasing section, was less than 1.5:1 over the bandwidth. Small teflon rods, extending through the upper and lower walls of the waveguide, are used to pin the phasing section in position. Other methods, such as slight grooving of the inner waveguide walls, may also be used.

The antenna shown in Fig. 6 is configured for left-circular polarization. Right-circular polarization may be obtained by physically rotating the phasing section by 90° within the square guide section.

Performance Data

Test Conditions—All antenna measurements were conducted in an r-f anechoic chamber that was free of reflections and spurious responses. Each antenna was mounted in the center of an 8 in. circular metallic disk ground plane. Gain, axial ratios and radiation pattern measurements were performed at a transmitting test distance within the Fraunhofer Region (Far Field).

VSWR and Antenna—Curves in Fig. 7 show the measured VSWR and "on-axis" gain of each of the antennas. The VSWR of all units is less than 1.6:1 over the frequency band, with gains varying from about 4 db to 7 db above an isotropic radiator. The

Fig. 12: Radiation pattern data for circular polarization.

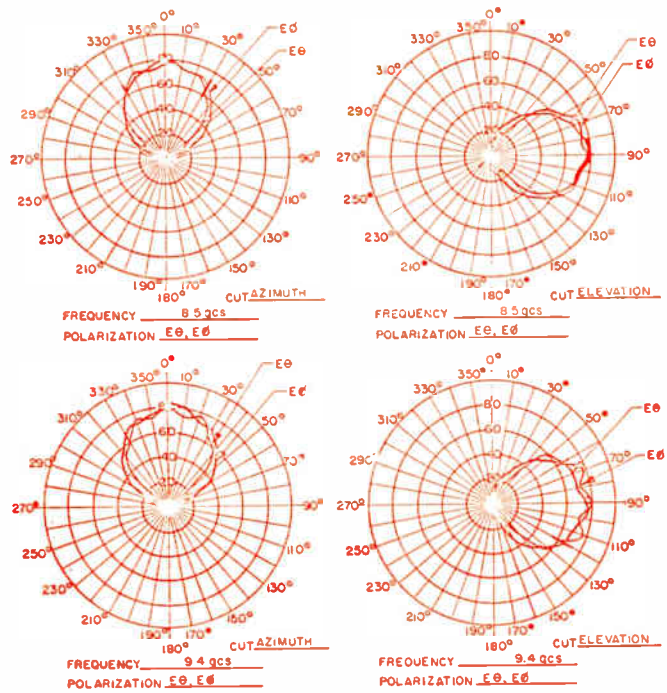
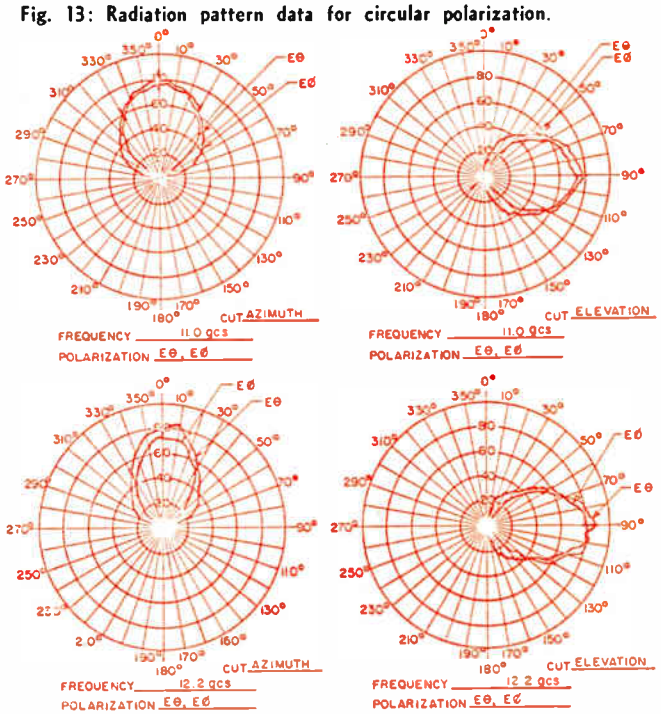


Fig. 13: Radiation pattern data for circular polarization.



X-Band Antennas *(Concluded)*

gain values are compatible with the radiation pattern coverages obtained.

Radiation Patterns—Figs. 8 through 13 are the principal E- and H-plane radiation patterns. The patterns are voltage plots and the half-power beamwidths may be found upon inspection.

Axial Radios—The axial ratios of the circular polarized unit are less than 2 db over the waveguide bandwidth—both "on-axis" and for elevation and azimuth angles of ± 30°. The maximum-minimum cuts (shown in the radiation patterns) were performed by rotating a linear polarized transmitting horn through 360° and recording the response. The phasing section has been optimized for use over the 8.2 to 12.4 GC bandwidth. Later tests, not reported here, indicate that the circular antenna performs well down to about 7.5 GC. For operation over a narrow bandwidth, the dimensions of the phasor may be adjusted to provide lower axial ratios.

Environmental Tests—These antennas have been subjected to, and passed environmental tests in accordance with Military Specification MIL-T-5422D-(ASG). These tests consisted of temperature, altitude, vibration, shock, humidity and salt spray.

The use of standard waveguide flanges permits the units to be readily converted to antenna and detector assemblies, with the use of a suitable waveguide-to-coaxial crystal mount, for usage in crystal-video receiver applications. Estimated tangential sensitivities of such assemblies (based on a video amplifier bandpass of dc—4 MC and using MA408B or 1N358A video diodes) would be on the order of −45 to −50 dbmw/cm².

Acknowledgements

Appreciation is expressed to Mr. Ernst L. Bock, consulting radio physicist, for technical consultation during the antenna development and testing programs.

The authors also wish to acknowledge the support of Mr. Richard L. Curtis in the mechanical considerations involved and to Mr. Arthur L. Weber who conducted the environmental test program.

References

1. R. E. Beam, M. M. Astrahan, and H. E. Mathis: "Open-ended Waveguide Radiators," *Proc. Natl. Electronics Conf.*, Vol. 4, pp. 472-486, November, 1948. Experimental radiation patterns of waveguide with shaped ends.

2. R. E. Metter, "X-Band Horn Antenna," *Electronics*, p. 50, March 4, 1960.

3. Radio Research Laboratory Staff, "Very High Frequency Techniques," Vol. I, p. 181. New York and London, *McGraw-Hill Book Co., Inc.*, 1947. Curves of VSWR characteristics of waveguide terminated in ground screen.

4. ibid, p. 153.

5. The terms "right-circular and left-circular polarization" used in this paper are as defined in "IRE Standards on Radio Wave Propagation (definition of terms)," p. 2, 1942, *Supplement to Proceedings IRE*, No. 7, Part III.

6. Theodore Moreno, "Microwave Transmission Design Data," New York, New York, *Dover Publications, Inc.*, pp. 192-4, 1948. Curves relating the properties of a waveguide partially filled with a dielectric.

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What's New

Numeral Reader

AN experimental machine recognizes numbers in different handwritings and can enter them directly into a computer system.

The numeral reader is being evaluated jointly at Tufts University by the Advanced Systems Development Division of IBM and the university's Institute for Psychological Research. Evaluation is still underway, and IBM has no plans to market it commercially.

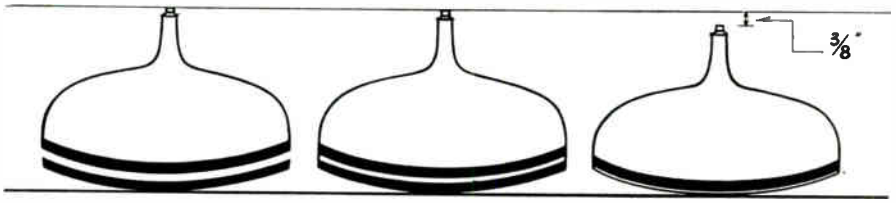
Purpose of the experiments is to see how well the reader performs when people have been trained to write "correctly," and how much tolerance for variations in character shapes should be provided in the next version of logic for the machine. The logic of the experimental reader was developed on the basis of a sample of 3,000 numbers handwritten by a group of 30 people with no constraints placed on their style.

IBM's experimental numeral reader recognizes numbers that are handwritten in a varieity of styles, sizes and positions.

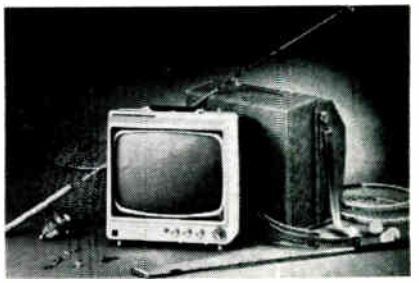
At the present level of logic development, 98.5% of the numerals have been read correctly. Of the numerals written by 90% of the subjects, the reader correctly identified 99%, rejecting 1% as "unreadable" and mistaking .07% for the wrong numerals.

Operation begins with insertion of an ordinary IBM card bearing 25 handwritten numerals. The card is scanned optically. When a numeral is identified, this is recorded by means of punched holes in another IBM card which can be processed by conventional computers or accounting machines. During a demonstration, an oscilloscope displayed the number shapes represented by analog voltages.

The design departs from previous methods. Whereas they scanned optically with one fixed "routine," this scanner explores the contours of a character with a moving beam of light. As the scanning beam moves over its path, following the contours of the numbers, analog voltages corresponding to the shape of the characters are generated and analyzed, using a combination of analog and digital techniques. Special cir-



Plastic Shields Picture Tubes



New G.E. portable TV is much lighter than previous models. Part of this lightness was achieved by using the new Lamilite shield.

. . . . from General Electric

AN entirely new method of providing a safety shield across the viewing surface of a television picture tube permits reductions in weight and size, and improved viewing quality—all without reducing the screen size.

The new type shielding developed by G.E.'s Cathode Ray Tube Dept., Syracuse, N. Y., is trademarked "LAMILITE." It consists of a thin coating of tough plastic, similar to the safety coating used on photo flash bulbs.

While providing as great or more safety than current shielding methods, the shield reduces reflection. Heretofore, portable TV receivers used either a separate panel of safety glass, a heavy plastic shield, or an extra glass face plate bonded on the front of the picture tube. All these methods require that light pass through several layers and thicknesses, causing quality-damaging reflections and refractions.

In the new method the outside shield surface adds only a thin (35 mils) tough skin in direct contact with the face plate of the picture tube. This reduces both the number and angles of refractions and reflections occurring as light passes from the inner phosphor surface to the eye of the TV viewer.

Use of the new plastic shield can reduce the weight of typical 19-inch television picture tube installation as much as four pounds, which should be a considerable advantage in table and portable models. This makes worth while another four or five pounds of weight reduction by use of lighter material for the cabinet and for the metal chassis that holds the electronic components.

In addition, use of the "LAMILITE" picture tube could reduce the overall depth of a television set by a full inch or more—as compared with a typical 19-inch set using the twin-panel bonded picture tube or a separate pane of safety glass of thick plastic shield.

. . . from Kimble Glass

A NEW process, called Kimcode, will enable the TV industry to make picture tubes lighter, shorter and more economical. Kimble Glass Company, subsidiary of Owens-Illinois, is the developer.

The new process—called Kimcode for "Kimble method for controlled devacuation"—eliminates the presently used safety shield on TV picture tubes. Today's shield is either a separate piece of glass placed in front of the tube or a newer, more costly method of laminating the shield directly to the tube face.

The Kimble process reduces the weight of components needed for shielding a 23-inch tube from 11¾ pounds for a laminated tube to 2 pounds for the Kimcode method.

The Kimcode process has three major elements—two metal bands and a fiberglas fabric skirt. The net result of these elements is to arrange the stresses to provide for a mild and safe devacuation of the tube should it be cracked or broken.

cuits detect the presence of important shape features of the handwritten numbers. The technique is flexible enough to allow recognition regardless of wide variations in size, registration, orientation, or shape of the numbers, so long as they are written in the 2x3-inch space of an IBM card.

Program for Subscription Fulfillment

EXECUTIVES of 14 leading publishing companies have viewed a high-speed EDP system solving one of their industry's knottiest problems.

The problem: keeping subscriber lists up to date against thousands of individual changes received daily. The solution: a computer method developed by the publishers and IBM in a joint study which lasted 19 months.

The procedure will be made available to both the publishing and the computer manufacturing industries. It can be adapted to the needs of any magazine or subscription procurement source.

The project represents the first time magazine publishers have joined together to improve procedures for subscription fulfillment. Now, EDP methods have been approved by a major segment of the publishing industry as the most effective means of handling the common problem of maintaining accurate subscriber files.

The new procedure can be adapted to a specific publisher's needs without his being penalized by the needs of others.

The program provides other advantages. Foremost among these is a considerable reduction in the cost of installing a computer. The new system, with special and standard "library" programs, can cut these

(*Continued on page* 199)

One method of detecting nuclear blasts is by using a thermal detection system. The simulator described here can be used to test nuclear bomb alarm systems. It can simulate nuclear yields extending into the megaton range.

It Simulates Burst Irradiance . . .

A Nuclear Burst Alarm Tester

By D. J. BAKER, F. R. BROWN, and C. L. WYATT

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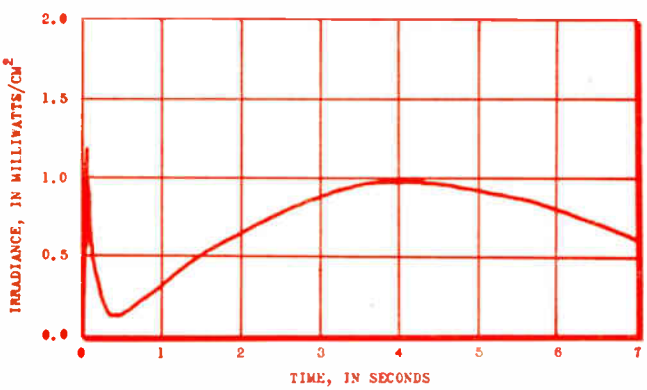
TO test nuclear bomb alarm systems,[1] and for operational checks on various thermal instrumentation systems, a nuclear pulse simulator was developed.[2] The simulation device for nuclear yields extending into the megaton range is described here.

The simulator is designed to produce the characteristic shape of the thermal pulse from a nuclear detonation (Fig. 1). The rate of emission of thermal energy following detonation rises very rapidly to a first maximum, and then decreases to a minimum. Subsequently, however, the radiant power rises to a second maximum, after which it decays gradually to zero.

Fig. 1: Pulse of radiant flux which simulates that resulting from a 16 megaton nuclear detonation.



The minimum which occurs in the thermal pulse is caused by the atmosphere surrounding the detonation. A spherical shell of shock-heated, ionized air forms around the hot central core of the fireball, shielding it from observation. This shielding occurs because the ionized gases strongly absorb thermal radiation as long as their temperature is above about 2300°K.[3] As the ionized shock front expands and cools, the hot interior is gradually unmasked, creating the second maximum in the pulse of radiant flux. The thermal emission falls off continuously with the subsequent cooling of the fireball.

For a given atmosphere, the times to the minimum and the second maximum are functions of the yield of the nuclear device. The latter can be approximated from $t_{2max} = W^{1/2}$, where t_{2max} is the time to second maximum in seconds and W is the yield expressed in megatons.

The simulator was designed to produce a peak irradiance in excess of 1 mw/cm² in a spectral range roughly corresponding to that of an actual burst. It was required to produce the first maximum with a rise time of microseconds and a pulse width of milliseconds. The time of second maximum was required to be variable out to 4.5 seconds, corresponding to yields up to 20 megatons.

We used an electrical gas discharge tube to achieve the very short rise time. Standard Westinghouse 4-watt fluorescent lamps were successfully used as discharge tubes. The difficulty of sustaining the gas discharge for the required duration was resolved by

using three of the lamps each with its rise time, duration, and intensity such that the total additive flux gave the required shape for the first maximum.

The operation of the simulator is described with the aid of Fig. 2. When the trigger switch is initiated, each discharge capacitor is placed across its discharge tube and the series of 3 four-layer diodes. Simultaneously, the four-layer diodes are triggered causing them to break down and apply the capacitor voltages to the discharge tubes, creating the desired light flash. The desired shape and intensity of the flux from each lamp was achieved by choosing appropriate time constants for each discharge circuit. It was necessary to use the same value of series resistance on all 3 lamps to avoid a staircase front edge on the pulse.

The generation of the second maximum for the simulated nuclear thermal radiation pulse is also explained by reference to Fig. 2. The pulse shape is generated by the 6J5 stage. The grid capacitor of this stage is negatively charged by the rectified voltage from the heater winding of the power transformer. At time zero a manual triggering switch removes the charging voltage. As the capacitor discharges the grid potential becomes less negative, thus increasing the plate current and decreasing the plate voltage. The discharge time constant determines the rise time of the pulse. The fall time of the pulse is determined by the time constant of the coupling circuit to the following stage. The rise and fall time can be varied with the potentiometers in the discharging circuits to correspond to various yields. The polarity is chosen to facilitate the driving of the output stage.

The second maximum waveform thus produced is used to control a saturable reactor. This is essentially a magnetic amplifier. The small power transformer T2 is saturated by the plate current of the 6L6GB which is connected to the high voltage winding. A Westinghouse 75-watt flood lamp connected in the primary closely follows the voltage waveform, thus producing the desired thermal waveshape for the second maximum.

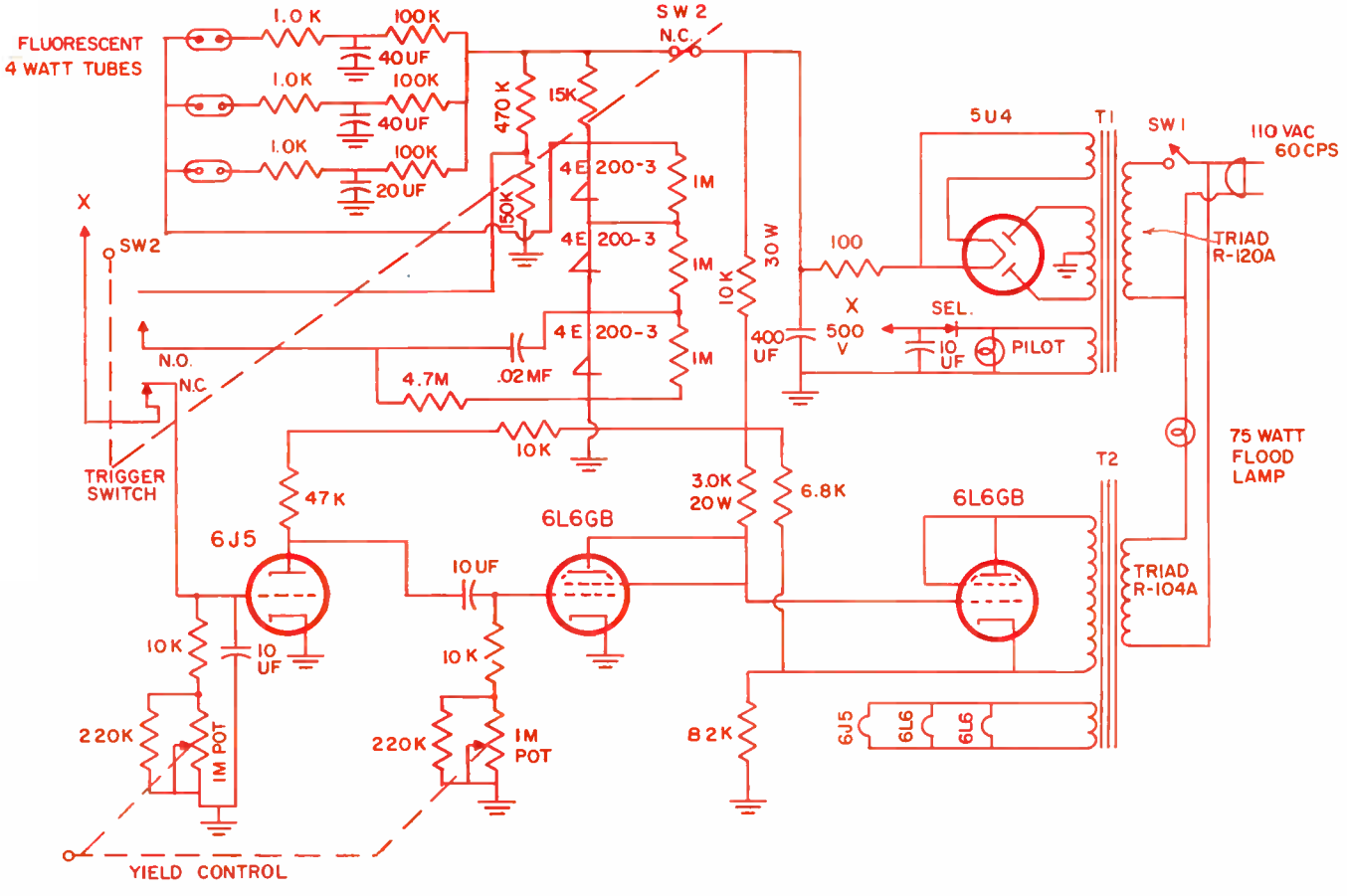
The manual initiation switch operates the two portions of the simulator circuit simultaneously. The total thermal output of the unit effectively simulates the wave shapes of thermal pulses from megaton nuclear detonations at the required irradiance levels.

This research was supported in part by the Air Force Cambridge Research Laboratories, and the conceptual contributions of Messrs. H. P. Gauvin and C. L. Dieter are acknowledged.

References

1. J. C. Champeny, T. E. Petriken, and S. Siciliano, "Nuclear Bomb Alarm Systems," *Electronics* 32, Vol. 19, p. 53: 8 May 1959.
2. D. J. Baker, D. E. Thomas, "Nuclear Thermal Pulse Simulator," *Electronics* 32, Vol. 44, p. 66; 30 October 1959.
3. U. S. Atomic Energy Commission, "The Effects of Nuclear Weapons," Washington, D. C.; June 1957.

Fig. 2: Schematic diagram of the nuclear simulator. It is used to test nuclear alarm systems. Parts values are given for construction.



By JOHN S. FERGUSON

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Finding Circuit Parameters By . . .

Drawing Ladder Network Flowgraphs

The flowgraph of a ladder network can be drawn with a set of simple rules given here. This method eliminates loop and node equations. The most often needed circuit design parameters such as input or output impedance, voltage or current gain can be found quickly and simply.

FLOWGRAPH use in circuit analysis consists of two steps. First a flowgraph is drawn from an equivalent circuit. Secondly the flowgraph is reduced to a single transmittance which is the parameter for which the circuit is being solved. The second step is done by methods of reduction, or by the topological formula due to Mason.[1,2]

The first step, drawing the flowgraph, is done by writing the branch and node equations of the equivalent circuit. The nodes are drawn and labeled, and the branch equations—as transmittances—are fitted in between the nodes to form the flowgraph. This requires a good deal of experience before flowgraphs can be drawn rapidly, with confidence.

The method of drawing flowgraphs shown here is simple and rapid. The flowgraph of a ladder network can be drawn by following a set of simple rules, without writing any loop or node equations. It will "look like" the circuit it represents. If the graph is superimposed on the circuit, each transmittance will line up with its associated circuit element.

The procedure is restricted to ladder type networks of the type in Fig. 1, where one side of the circuit is grounded.

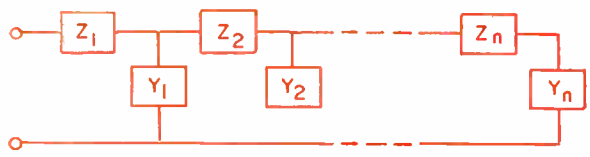


Fig. 1

1. "Feedback Theory—Some Properties of Signal Flow Graphs," S. J. Mason, *Proceedings of the IRE*, September 1953.
2. "Feedback Theory—Further Properties of Signal Flow Graphs," S. J. Mason, *Proceedings of the IRE*, July 1956.

Begin by considering the circuit of Fig. 1 with all its Y's and Z's equal to zero—or as just two conductors. The flowgraph of the two conductors is drawn as two parallel paths, one for voltage signal flow and the other for current signal flow. The elements are then added to the circuit, one at a time. As each is added, its transmittance is drawn into the flowgraph. When all of the transmittances have been included, the flowgraph is altered to provide entry and exit for the signal flow of the required circuit parameter.

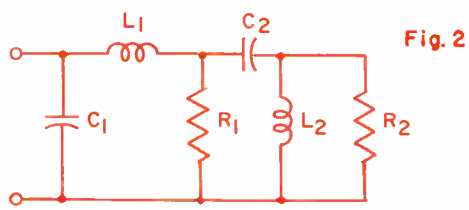


Fig. 2

As an example, look at Fig. 2. The flowgraph is begun by assuming the series elements L_1 and C_2 to be very small impedances, and the parallel elements C_1, R_1, L_2 and R_2 to be very small admittances. With these approximations, the circuit simplifies to two parallel conductors, Fig. 3a whose flowgraph is as in Fig. 3b.

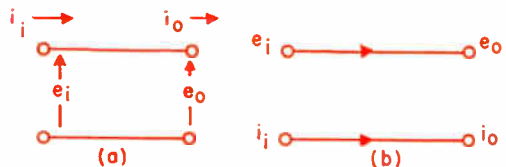


Fig. 3

Proceeding from the left in Fig. 2, the first element is a capacitor, C_1, in parallel. The effect the capacitor has on the circuit determines how its transmittance should effect the flowgraph. Since the capacitor is in parallel, part of the input current will flow through it, $i_c = e_c C_1 s$. The voltage between the conductors will be the same to the right as to the left, of C_1. The transmittance should then subtract from the current signal flow, but do nothing to the voltage signal flow. The circuit and flowgraph are now as in Figs. 4a and b.

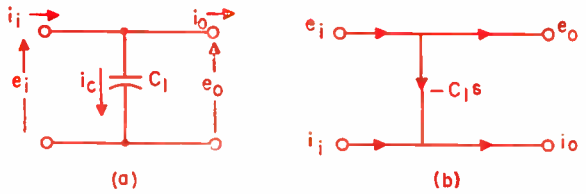
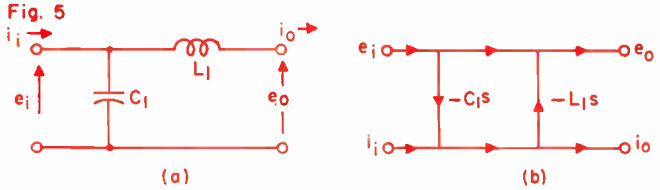


Fig. 4

Continuing to the right in Fig. 2, the next element is the series inductor L_1. Since the current in the circuit is the same on both sides of the inductor, there is no change in the current signal flow at this point. The voltage drop $e_L = i_L L_1 s$ is represented by a subtractive transmittance $-L_1 s$, directed toward the voltage signal flow path. The circuit and flowgraph at this point are shown in Figs. 5a and 5b.

Fig. 5



The remainder of the flowgraph is drawn with the rest of the elements in order, one at a time. The transmittances of parallel components are drawn as subtractive admittances, directed toward the current flow. The transmittances of series components are represented by impedances subtracting from the voltage signal flow path. The flowgraph will now be as in Fig. 6a.

The circuit drawn this way gives an insight into the effect the components have on the circuit, and an idea of how a flowgraph works. As both the voltage and current signal flow paths are directed from the input to the output, each component reduces either the voltage signal or the current signal. This is what is intuitively known about non-resonant circuits with passive components. In measuring currents and voltages, there is a continual decrease in them when moving from the input to the ouput of a circuit.

Although the flowgraph in Fig. 6 gives the correct feeling of what is happening, its use in analysis is limited. The signal flow paths of both current and voltage were drawn from the input to the output. Consider the direction of signal flow to be independent of the circuit's input-output direction. Either or both of the current or voltage signal paths of Fig. 6a may be reversed without violating the flowgraph's logic. Since the nodes have been conveniently split, it is only necessary to change the signs of the transmittances

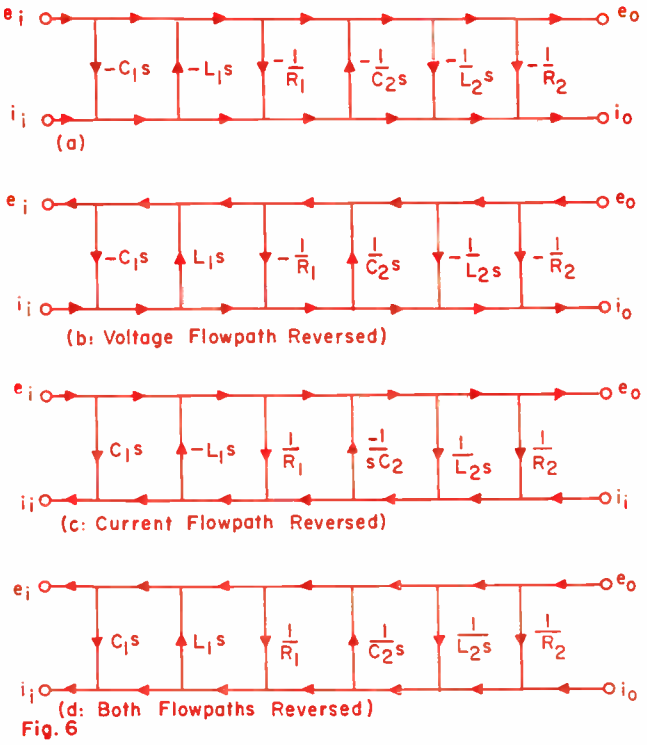


Fig. 6

pointing into the reversed paths. Fig. 2 may be just as well shown by Figs. 6b, c or d.

The direction of a voltage or current signal flow path corresponds to the direction one is "walking through" a circuit. It has nothing to do with the input-output direction, the direction of current flow, nor the direction of voltage drops in the circuit. The reason for the transmittance sign change in Figs. 6b, c and d may be seen from Fig. 2. Reversing the signal flow paths means one is examining, or "walking through," from the output to the input. In passing a series component, the voltage to ground, measured to the right of it is less than the voltage measured to the left of it. The additive transmittance accounts for this.

In analyzing circuits, the most often needed parameters are:

Input impedance	$Z_i = e_i / i_i$
Output impedance	$Z_o = e_o / i_o$
Voltage gain	$A_v = e_o / e_i$
Current gain	$A_i = i_o / i_i$

To calculate these, the proper direction of voltage and current flow paths must be chosen from Figs. 6a, b, c or d.

In the examples to follow, 3 element circuits are used to simplify writing the equations. The methods shown may be applied for any number of components.

Input Impedance

Consider the circuit of Fig. 7a.

Flowgraphs *(Continued)*

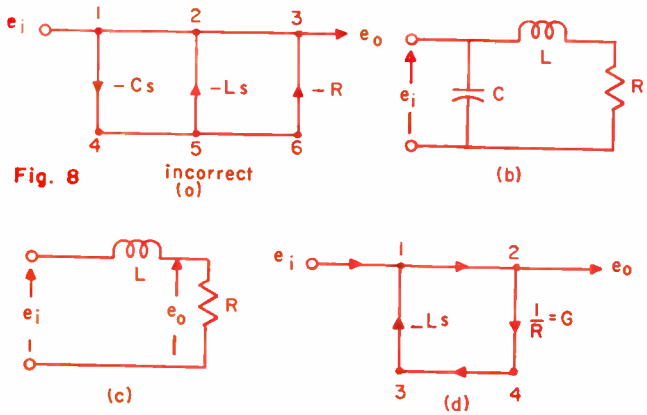


Fig. 8

Since $Z_i = e_i/i_i$, the flowgraph must be entered at i_i and left at e_i. This requires the current and voltage paths directed as in Fig. 7b.

This graph is illogical, since at node 1 there is no transmittance entering, and at node 2 none leaving. Fig. 7a was drawn considering the terminating resistor to be a parallel conductance, subtracting from the current flow. When considering input impedance, the circuit could be drawn as in Fig. 7c, with a flowgraph as shown in Fig. 7d.

The solution of 7d may be found easily from Mason's topological formula, $T = \frac{\Sigma\, p_k\, \Delta K}{\Delta}$ which for the simple circuits of these examples may be reduced to $T = \frac{\Sigma \text{ paths}}{1 - \Sigma \text{ loops}}$. The paths are (1,2,5,6) and (1,2,3,4,5,6), $Ls + R$. The loops are (1,2,3,4,5,6,1) and and (1,2,5,6,1), $-LCs^2$ $-RCs$. Then

$$Z_i = \frac{Ls + R}{LCs^2 + RCs + 1}$$

Voltage Gain

If the same procedure were to be followed, the flowgraph for voltage gain would be drawn as in Fig. 8a, with paths of (1,2,3), (1,4,5,2,3) and (1,4,5,6,3).

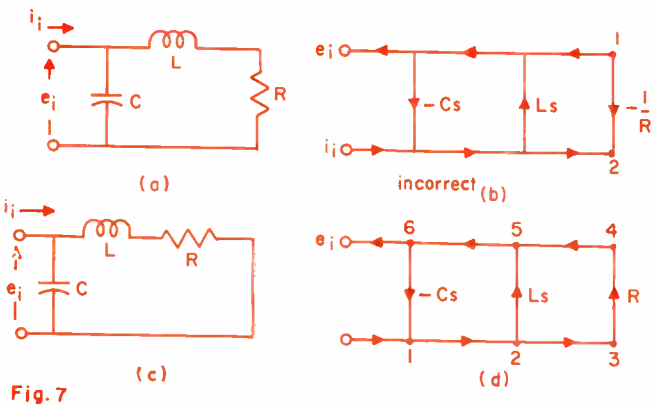


Fig. 7

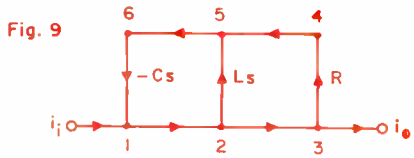
There are no loops in Fig. 8a. Then $A_v = LCs^2 + RCs + 1$. Checking the voltage gain by impedance division gives $A_v = R/(Ls + R)$. The comparison between the two expressions is not striking. The difficulty here is the shunt capacitor. The voltage gain of the circuit of Fig. 8b is the same as the voltage gain of 8c. The capacitor is a redundant element. It must be removed from the circuit when drawing the flowgraph for voltage gain. The flowgraph for Fig. 8c, shown in Fig. 8d, has a single path (1,2), +1 and a single loop (1,2,4,3,1) $-GLs$. It solution is

$$A_v = \frac{1}{1 + GLs} = \frac{R}{Ls + R}.$$

which is the same as found by impedance division.

Current Gain

For current gain, the flowgraph is the same for input impedance except for the exit at i_o instead of e_i.



The graph of Fig. 9 has a single path (1,2,3), +1. Its loops are the same as for the flowgraph of input impedance, Fig. 7d. Current gain,

$$A_I = \frac{1}{LCs^2 + RCs + 1}.$$

If the circuit were changed to Fig. 10a, the flowgraph might mistakenly be

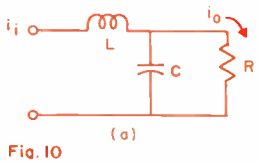
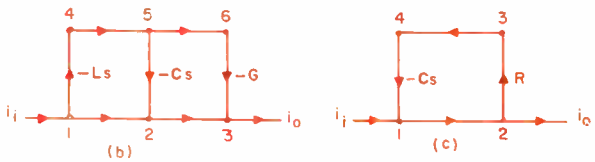


Fig. 10

drawn as in Fig. 10b



The paths for Fig. 10b are (1,2,3), (1,4,5,2,3) and (1,4,5,6,3). There are no loops, and

$$A_I = 1 + LCs^2 + LGs.$$

Current division in Fig. 10a correctly gives,

$$A_I = \frac{G}{Cs + G}.$$

The same trouble is found here as in the example for voltage gain. So far as current gain is considered, leading series elements are redundant. The current gain is the same with or without the series coil. The correct flowgraph for the current gain of Fig. 10a is shown in Fig. 10c, with the voltage path reversed. The single path (1,2), +1, and the loop (1,2,3,4,1), $-sRC$ gives $A_I = \frac{1}{RCs + 1} = \frac{G}{Cs + G}$ as before.

Output Impedance

The circuit for output impedance has its load resistor removed and a Thevenin equivalent generator resistance put across the input. This is shown in Fig. 11a.

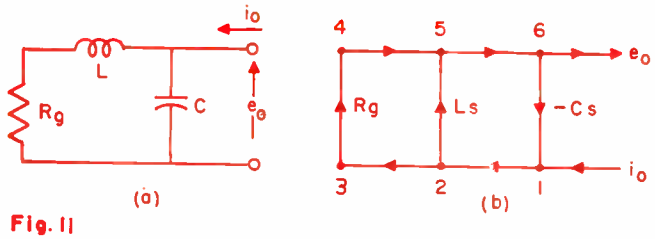


Fig. 11

The flowgraph of Fig. 11b has paths of (1,2,5,6), (1,2,3,4,5,6) and loops of (1,2,5,6,2) and (1,2,3,4,5,6,1). The output impedance is

$$Z_o = \frac{Ls + R_g}{LCs^2 + R_g Cs + 1}.$$

Note the path reversal of voltage signal flow. Since the flowgraph was drawn by looking in at the output, it is the voltage signal flow that has been reversed. This can be seen by turning the circuit end for end and considering it an input impedance.

The main points of the 4 previous examples are summarized in the following set of rules:

1. Draw the voltage and current signal flow paths in parallel, horizontally.
2. Draw the transmittances vertically in the same order as they appear in the equivalent circuit.
3. Draw parallel circuit elements as admittances directed toward the current flow path. Draw series elements as impedances directed toward the voltage signal flow path.
4. For input impedance:
   a. Draw the current flow path forward and the voltage flow path reversed.
   b. Make impedance transmittances positive, admittance transmittances negative.
   c. Consider the terminating element to be in series.
5. For voltage gain:
   a. Draw the voltage path forward and the current path reversed.
   b. Remove leading parallel elements from the circuit.
   c. Draw impedance transmittances negative, admittance transmittances positive.
6. For current gain:
   a. Draw the current flow path forward, the voltage path reversed.
   b. Remove leading series elements.
   c. Make impedance transmittances negative, admittance transmittances positive.
7. For output impedance:
   a. Draw the current signal flow reversed (output to input) and voltage signal flow forward (input to output).
   b. Terminate the input with the generator's series impedance.
   c. Label the impedance transmittances positive, the admittances negative.

These rules are illustrated in Figs, 12a, b, c, d. Circuit parameters such as Y_o, Y_i, Z_{12} may be found by altering one of the circuits found by the above rules. The voltage or current in some point in the circuit may be found by finding a suitable node from which to exit. Elements other than R, L and C may be drawn into a flowgraph by considering the element's equivalent circuit and applying the rules for the circuit parameters required. Using the hybrid parameters of a transistor, the equivalent circuit shown in Fig. 13a has a flowgraph represented by Fig. 13b.

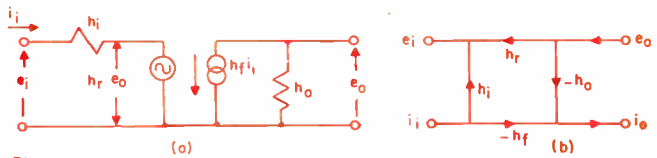


Fig. 13

The minus sign for h_f in the flowgraph is due to the convention of drawing the equivalent circuit's output current inward. This minus sign is obvious in the common emitter configuration.

For a basic transistor amplifier terminated in a resistance, Fig. 14a, the input impedance is, by Fig. 14b,

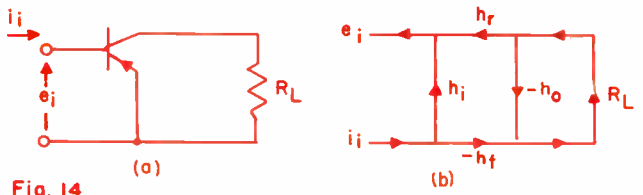


Fig. 14

$$Z_i = h_i - \frac{h_f h_r R_L}{1 + h_o R_L}.$$

The current gain from Fig. 15a, b,

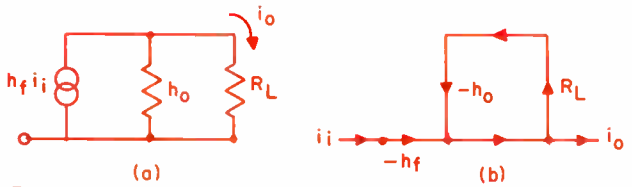


Fig. 15

$$A_I = \frac{-h_f}{1 + h_o R_L}$$

Remembering the rule for removing leading series elements for current gain flowgraphs, the flowgraph requires neither h_r nor h_i.

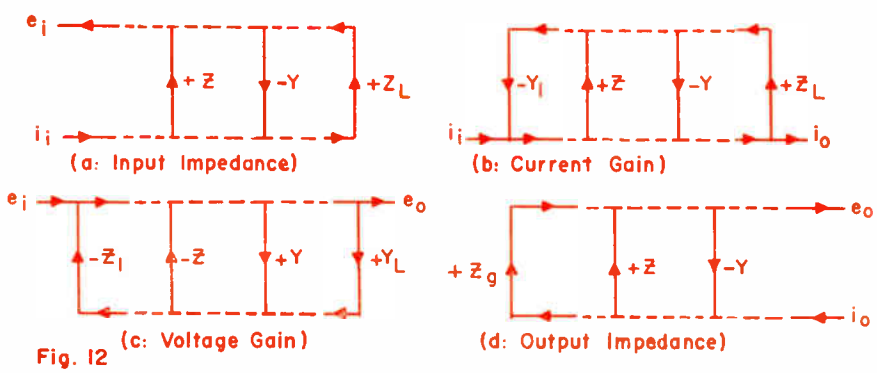


Fig. 12

Flowgraphs *(Concluded)*

Voltage gain is found by reversing the voltage and current flow paths of Fig. 14b, recalling that the reciprocals for h_f and h_r are used when paths are reversed

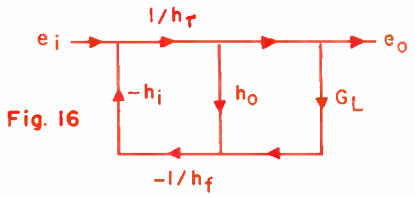


Fig. 16

$$A_v = \frac{1/h_r}{\frac{-h_i}{h_r h_f}(h_o + G_L) + 1} = \frac{-h_f}{h_i(h_o + G_L) - h_r h_f}$$

The flowgraph for output impedance Fig. 17a, b requires a generator impedance R_g.

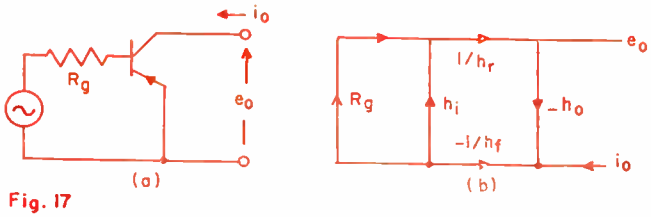


Fig. 17

$$Z_o = \frac{-\frac{1}{h_f h_r}(h_i + R_g)}{1 - \frac{h_o}{h_f h_r}(h_i + R_g)} = \frac{h_i + R_g}{h_o(h_i + R_g) - h_f h_r}$$

A further advantage of this method lies in finding the multiple loops and paths of longer ladder networks.

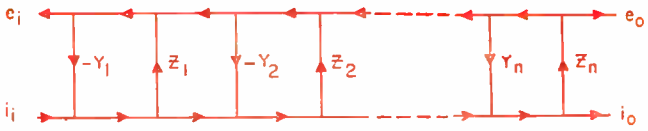


Fig. 18

Fig. 18 shows the flowgraph of an N section ladder network, with input and exits suitable for finding current gain, the transfer function $Z_{12} = e_o/i_i$ and input impedance. There is only one path for current gain and one for Z_{12}, neither of which has any non-touching loops. The paths for input impedance consists in the sum of all the upward directed transmittances, times the non-touching loops. Non-touching loops may only be to the right of a path. The loops of all 3 parameters will be the same in this flowgraph. Since the current and the voltage flow paths are oppositely directed, all the loops must be counterclockwise.

Similar simplifications can be seen in finding the circuit parameters of voltage gain and output impedance.

Conclusions

The method presented here enables one, with a little practice, to rapidly draw flowgraphs of ladder networks of any length. The pitfall of drawing in redundant transmittances for voltage and current gain has been explored. The completed flowgraph is well suited to finding the loops and paths of Mason's topological formula because of the restrictions on where the loops and paths may be. As the components of the equivalent circuit are in the same order as the transmittances of the flowgraph, it is difficult to omit any of the transmittances in drawing the flowgraph.

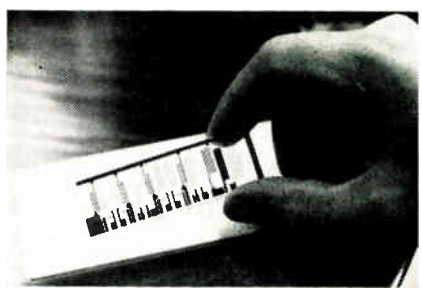
Flowgraphs drawn by any set of rules have all the advantages and drawbacks of any standardization. They are not always the most simple, nor the most elegant flowgraphs that can be drawn. However, the speed with which they can be drawn is compensation for lack of simplicity.

Nitrogen Improves Tantalum-Sputtered Resistors

BY sputtering tantalum films in a partial nitrogen atmosphere, improved thin-film resistors have been obtained. The tantalum-nitride method provides resistors with a stability and reliability formerly available only in the larger and more expensive hermetically-sealed devices.

Engineers from Bell Telephone Laboratories recently described the method at the Electronics Components Conference in Washington, D. C.

In "sputtering," ionized gas molecules bombard a cathode of a refractory metal such as tantalum, dislodging its atoms which then redeposit on nearby surfaces. Very precise miniature resistors can be produced on glass or ceramic bases by this method when used with a photolithographic etching process. This process leads to resistors as narrow as 2 mil, as close as 2 mil apart, producing high resistance in a small area.


Shown is a glass substrate containing resistors produced by sputtering.

Heretofore, tantalum devices have been sputtered in an atmosphere of inert gas such as argon. Traces of certain impurities, like oxygen and water vapor, usually appear in these tantalum films, resulting in resistors with relatively wide variances in resistivity and temperature coefficient.

Small amounts of nitrogen (1 to 10% by pressure) added to the argon tend to override the accidental impurities, resulting in resistors with much narrower spreads in resistivity and temperature coefficient. In addition to being more stable over wide temperature ranges than their predecessors, tantalum-nitrode re-

(*Continued on page* 199)

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Chart of Hall Generator Applications

Hall generators are now being widely used in industry, in both measuring devices and various modulation applications. A list is presented here, together with a bibliography of significant articles on the subject.

Hall Generator Bibliography

Hall Generators—General

"Using the Hall Generator; a New Control and Instrumentation Component," J. W. Motto, Jr., *Automatic Control;* Part 1 (June 1961), Part 2 (July 1961).

"Hall Effect Stroboscope and Noise Discriminator," H. H. Wieder, *The Review of Scientific Instruments;* Jan. 1962; pp. 64-70.

"Rotating Sample Method for Measuring the Hall Mobility," F. M. Ryan, *The Review of Scientific Instruments;* Jan. 1962; pp. 76-79.

"Hall Effect Generators: How They Work and How They're Used," Dr. Warren E. Bulman, *Electronic Design;* March 4, 1959; pp. 28-31.

"Galvanomagnetic Efforts and Their Application," C. Hilsum, B.Sc., Ph.D., *British Journal of Applied Physics;* March 1961; pp. 85-91.

"Solid State Devices," I. J. Richmond, *Research;* vol. 12, 1959; pp. 374-380.

"Hall Effect Devices: Steadily Growing Applications," James R. McDermott, *Space/Aeronautics;* May 1961; vol. 35 #5; pp. 145-168.

"Hall's Effect and its Application in Measurement Techniques," A. M. Ilyukovich, *Measurement Techniques;* February 1961; #7; pp. 623-626.

"After 80 Years the Hall Effect is Being Put to Work," I. R. Lawson, Jr., *Canadian Electronics Engineering;* November 1957.

"Second Generation Hall Generators," Kermit Heid, *Military Systems Design;* March-April 1962; pp. 4-7.

"Indium Antimonide as a Fluxmeter Material," E. W. Saker; F. A. Cunnell; T. J. Edmond, *British Journal of Applied Physics;* vol. 6, 1955; pp. 217-220.

"A Method of Measuring Specific Resistivity and Hall Effect of Discs of Arbitrary Shape," L. J. van der Pauw, *Philip's Research Reports;* vol. 13, #1; Feb. 1958; pp. 1-9. Reprint 334.

"Properties and Applications of Indium Antimonide," R. E. J. King; B. E. Bartlett, *Philip's Technical Review;* vol. 22, #7; April 5, 1961; pp. 217-225.

"Improved Method for Measuring Hall Coefficients," I. Isenberg; B. R. Russell; R. F. Greene, *The Review of Scientific Instruments;* Oct. 1948; pp. 685-688.

"The Hall Effect and its Uses," T. R. Lawson, Jr., Reprinted from *Westinghouse Engineer;* May 1957; Reprint 5435.

"On the Accuracy of Hall Elements," L. S. Vasil'chenko; L. V. Sentyurina; B. S. Sotskov, *Automation and Remote Control;* July 1959; pp. 913-920.

"Hall Effect Transducer," (from "Electric Displacement Transducer Applying Hall Effect"), Isamu Ohno, *Control Engineering;* December 1960; vol. 7 #12.

"Thin Film Hall Generator," Kermit Heid, *Electronic Equipment Engineering;* November 1961; pp. 20, 22, 23.

"Multiple-Element Hall Effect Sensor," M. Epstein; H. M. Sachs; L. J. Greenstein, *Proceedings of the IRE;* November 1959.

"Use of Hall Measurements in Evaluating Polycrystalline Silicon," P. J. Olshefski; D. J. Shombert; I. R. Weingarten, *Journal of the Electromechanical Society;* April 1961; pp. 362-365.

"Hall Effect Devices," Ronald K. Jurgen, *Electronics;* January 16, 1959; page 63.

"Hall Effect Devices," W. J. Grubbs, *Bell System Technical Journal;* vol. 38; 1959; pp. 853-876.

"Note on the Hall Potential Across an Inhomogeneous Conductor," J. Volger, *Physical Review;* vol. 79 second series; July-Sept. 1950; pp. 1023-1024.

Hall Generators—Synchros and Resolvers

"Progress Report on Hall Effect Devices," Sigmund Harac, *Missiles and Rockets;* Sept. 18, 1961; pp. 44 & 45.

"Brushless and Windingless Components," Z. R. S. Ratajski, *Military Systems Design;* Nov.-Dec. 1961; pp. 4-10.

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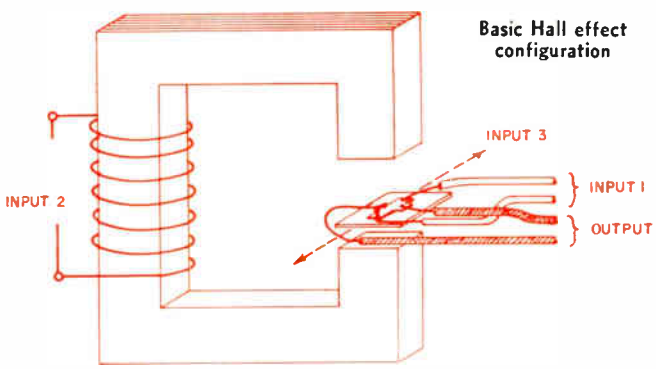

Chart of Hall Generator Applications

DEVICE		CONTROL CURRENT INPUT 1	MAGNETIC FIELD INPUT 2	MECH. DISPLACEMENT INPUT 3	HALL VOLTAGE OUTPUT REPRESENTS	ADVANTAGES	DISADVANTAGES
Multiplier		Variable current or voltage	Variable magnetic flux achieved by varying current or voltage through winding.	None	1 · 2	Very high frequency response for Input 1 Passive multiplier High dynamic range	Frequency response of Input 2 limited by magnetic structure
Wattmeter		Load voltage AC or DC	Load current AC or DC	None	Real power or volt-amps	Power and frequency range high Well adapted to transient or very low power measurements	Same as above
Varmeter		Load current AC	Load voltage AC	None	Imaginary power	Same as above	Same as above
Clip-on Ammeter		Fixed AC or DC current	Magnetic field of current in circuit wire (AC or DC)	None	Current	Measurements very low currents	—
Modulator	a.	Variable DC	Constant amplitude, constant frequency excitation of magnetic winding	None	Signal modulated carrier (carrier suppressed modulation)	Low to high frequency carriers Wide band signal Non-wearing	Difficult to obtain sufficient magnetic flux as frequency increases
	b.	Constant amplitude, constant frequency excitation of element	Variable DC	None	Same as above	Low to very high frequency carriers Non-wearing	Signal bandwidth limited
	c.	Variable DC	Permanent magnet	Synchronously driven rotary or reciprocating linear	Same as above	Good signal bandwidth	Limited to low carrier frequencies
Resolver or other Rotary Position Transducer		Constant amplitude AC or DC	Permanent magnet	Rotary	f (θ) where θ is the angle between the flux (B) and the control current (1)	Brushless, DC and AC rotary transducer No phase differences between input and output	Relatively small output without amplification
Linear Displacement Transducer		Same as above	Same as above	Rectilinear	f (X) where X is the displacement of the magnetic structure with respect to the element	Brushless, DC and AC rectilinear transducer No phase differences between input and output	Same as above
Microwave Power		Electric field	Magnetic field	None	Watts	Direct, one transducer measurement No thermal lag	Seebeck effect disturbance
Magnetic tape or Drum Reader		Constant amplitude AC or DC	Magnetic field from information stored on tape	Rectilinear or rotary	Signal	Amplitude of output is independent of speed of tape or drum and is directly proportional to intensity of stored field	—
Gyrator		Signal (1) or Output (−k1)	Fixed field	None	Output (k1) Signal (1)	Non-reciprocal performance when output and input 1 are interchanged	—
Isolator		Signal (1) or Output (0)	Permanent magnet	None	Output (k1) or Signal (1)	Non-reciprocal performance	—
Frequency multiplexing		ω_1	ω_2	None	1 · 2 at $(\omega_1 - \omega_2)$ and $(\omega_1 + \omega_2)$	Amplitude modulation solely	Small output

DEVICE	CONTROL CURRENT INPUT 1	MAGNETIC FIELD INPUT 2	MECH. DISPLACEMENT INPUT 3	HALL VOLTAGE OUTPUT REPRESENTS	ADVANTAGES	DISADVANTAGES
Gaussmeter	Fixed AC or DC	Signal measured	As required	Flux density	Great sensitivity Small probe size Large dynamic range	—
Variable Attenuator a. b.	Signal Signal	Variable control current Fixed control current	None Mechanically variable flux density	Attenuated signal	Mechanically or Electrically controlled Very high frequency (non-frequency resistance) Pure resistance	Substantial Insertion loss
Single side band Modulator	ω_1	ω_2	None	1 · 2 at $(\omega_1 + \omega_2)$ or $(\omega_1 - \omega_2)$	Relatively simple	Needs frequency compensation for magnetic circuit
Field Direction (Compass)	Fixed AC or DC	Signal measured	As required	Direction of flux vector	Sensitive and precise	—
Low frequency Electro-magnetic Radiation Detector	Fixed AC or DC	Signal measured	None	Signal	Independent rate of change of signal	—
Wave Analyzer	Signal to be analyzed	Sweep signal generator	None	Proportional DC at each harmonic	Simplicity	Frequency compensation of magnetic structure required.

Hall Generator Bibliography—Continued

"New Synchros and Resolvers," *Electromechanical Design;* June 1960; pp. 16, 20-22.

"Hall Effect Generators for Solid State Synchros and Resolvers," Sigmund Harac; Oscar Tischler, *Electromechanical Design;* January 1961; pp. 14, 15, 19, 20.

"Designing Solid-State Synchros with Hall Effect Components," Z. R. S. Ratajski, *Electronics;* September 8, 1961; pp. 59-63.

"A Hall Effect DC Resolver," Louis E. Fay, III, *Control Engineering;* December 1959; pp. 131.

Hall Generators—Wattmeters

"Applications of the Hall Effect—Watt Measurement with a Hall Multiplier," *Electromechanical Design;* January 1960; pp. 14-16.

"The Hall Effect and its Application to Power Measurement at 10 Gc/s," Prof. H. E. M. Barlow; S. Kataoka, *Institution of Electrical Engineers Proceedings;* vol. 105 B, 1958; pp. 53-60. (Paper #2450R, Jan. '58.)

"Power Measurement at 4 Gc/s by the Application of the Hall Effect in a Semiconductor," L. M. Stephenson; Prof. H. E. M. Barlow, *Institution of Electrical Engineers Proceedings;* January 1959; pp 27-30. (Paper #2748R.)

"The Application of the Hall Effect in a Semiconductor to the Measurement of Power in an Electromagnetic Field," Prof. H. E. M. Barlow, *Institution of Electrical Engineers Proceedings;* vol. 102 B, 1955; pp. 179-185. (Paper #1654M, June 1954.)

"The Design of Semiconductor Wattmeters for Power-Frequency and Audio-Frequency Applications," Prof. H. E. M. Barlow, *Institution of Electrical Engineers Proceedings;* vol. 102 B, 1955; pp. 186-191. (Paper #1778, Nov. 1954.)

"Hall Effect Wattmeters," D. P. Kanellakos; R. P. Schuck; A. C. Todd, *IRE Transactions on Audio;* vol. AU-9, #1; Jan-Feb; pp. 5-9.

"Telemetering Apparent Power with a Hall Effect Transducer," D. Frenkel; V. Stoika, *Measurement Techniques;* #12, 1960; pp. 1039-1041.

"Milliwattmeter with Hall Effect Pickup," V. K. Subashiev; N. P. Druzyak, *Instruments and Experimental Techniques;* December 1961; page 333.

"'Halltron' and Meter Relay Indicate and Control Power," *Electrical Design News;* February 1961.

"Better Watt Transducer Design uses Indium Arsenide Semiconductor," Theodore Barabutes, *Materials in Design Engineering;* May, 1960; pp. 146 & 147.

Hall Generators—Multipliers

"An Electrical Multiplier Utilizing the Hall Effect in Indium Arsenide," R. P. Chasmar; E. Cohen, *Electronic Engineering;* November 1958; pp. 661-664.

"Multiplication by Semiconductors," C. Hilsum, *Electronic Engineering;* November 1958; pp. 664-666.

"Analog Multiplier Based on the Hall Effect," Lars Lofgren, *Journal of Applied Physics;* February 1958; pp. 158-166.

"Properties of Hall Effect Multipliers," Stephen P. Denker, *Semiconductor Products;* June 1961; pp. 32-34.

"The Hall Effect Analog Multiplier," G. Kovatch; W. E. Meserve, *IRE Transactions on Electronic Computers;* September 1961; pp. 512-515.

"A Hall Effect Analog Multiplier," H. Fuchs; D. G. Flockhart, *Electronic Engineering;* November 1960; pp. 696-699.

"The Design and Performance of a Hall Effect Multiplier," R. P. Chasmar; E. Cohen; D. P. Holmes, *Institution of Electrical Engineers Proceedings;* 106 B, 1959; pp. 702-705.

"The Sources of Error in Hall Effect Multipliers," A. R. Billings; D. J. Lloyd, *Institution of Electrical Engineers Proceedings;* 106 B, 1959; pp. 706-713.

"Discussion on Applications: Industrial and Instrumentation," *Institution of Electrical Engineers Proceedings;* 106 B, 1959; pp. 746-747.

"Feedback Amplification Improves Hall Effect Multipliers," R. A. Greiner, *Electronics;* August 25, 1961; pp. 52-55.

"Hall Effect Multipliers," William A. Scanga; Albert R. Hilbinger; Carroll M. Barrack, *Electronics;* July 15, 1960; pp. 64-67.

"Hall Effect Multipliers for Analog Computers," Abstracted from an article by J. Oxenius, *Electronic Design;* September 3, 1958.

(*Continued on page* 201)

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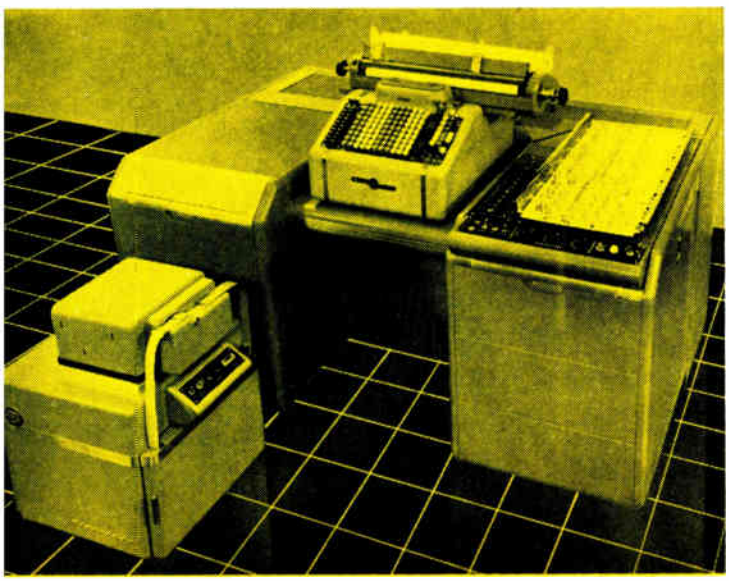
Since the outset of computer technology, methods proposed for the storage of data have greatly outnumbered those for the processing of logic. Here briefly, is a rundown and functional comparison of most of the storage methods which have been used or seriously proposed.

Comparing Storage Methods

STORAGE includes all media which retains data indefinitely; and, which can be read from, written into, or both, by automatic systems. Thus, output printers represent write-only storage. Excluded are electronic displays, indicator lamps, communications links, and data converters. These can be thought of as transient write-only or read-only storage devices.

Fig. 1. Burroughs E101 Computer illustrates combined use of switches, plugboards, punched paper tape, and magnetic drum (not visible) storage methods.



A storage medium can have one or more of three basic goals—the abilities to be written into, to be read from, and to permit electronic alteration of data. Research has concentrated on methods which provide all three.

The second distinction to be made is that of random or sequential access. That is, whether each bit of stored data is accessible within the same time duration as any other bit; or, is accessible only within a broadly variable duration determined by the bit position in a fixed sequence at interrogation time. This distinction is occasionally referred to as that of fixed access time or variable access time.

The third concern is for the status of storage when operating power is removed for any reason. In volatile storage, data is destroyed; in nonvolatile storage, data is retained intact. The terms static and dynamic, as applied to this distinction, encounter an ambiguity resulting from the additional use of "dynamic" to imply motion, as a drum or tape. There is another argument, also to be avoided, that some volatile methods provide static storage.

The final consideration, whether data is destructively read (and must be replaced following each read) or nondestructively read, is of more relative importance. If other factors are held equal, nondestructive reading increases both operating rates and data protection. Some destructively read methods are nevertheless superior in all significant aspects to some that are nondestructively read.

In general, system storage is oriented in hierarchies,

* A trademark of Burroughs Corp.

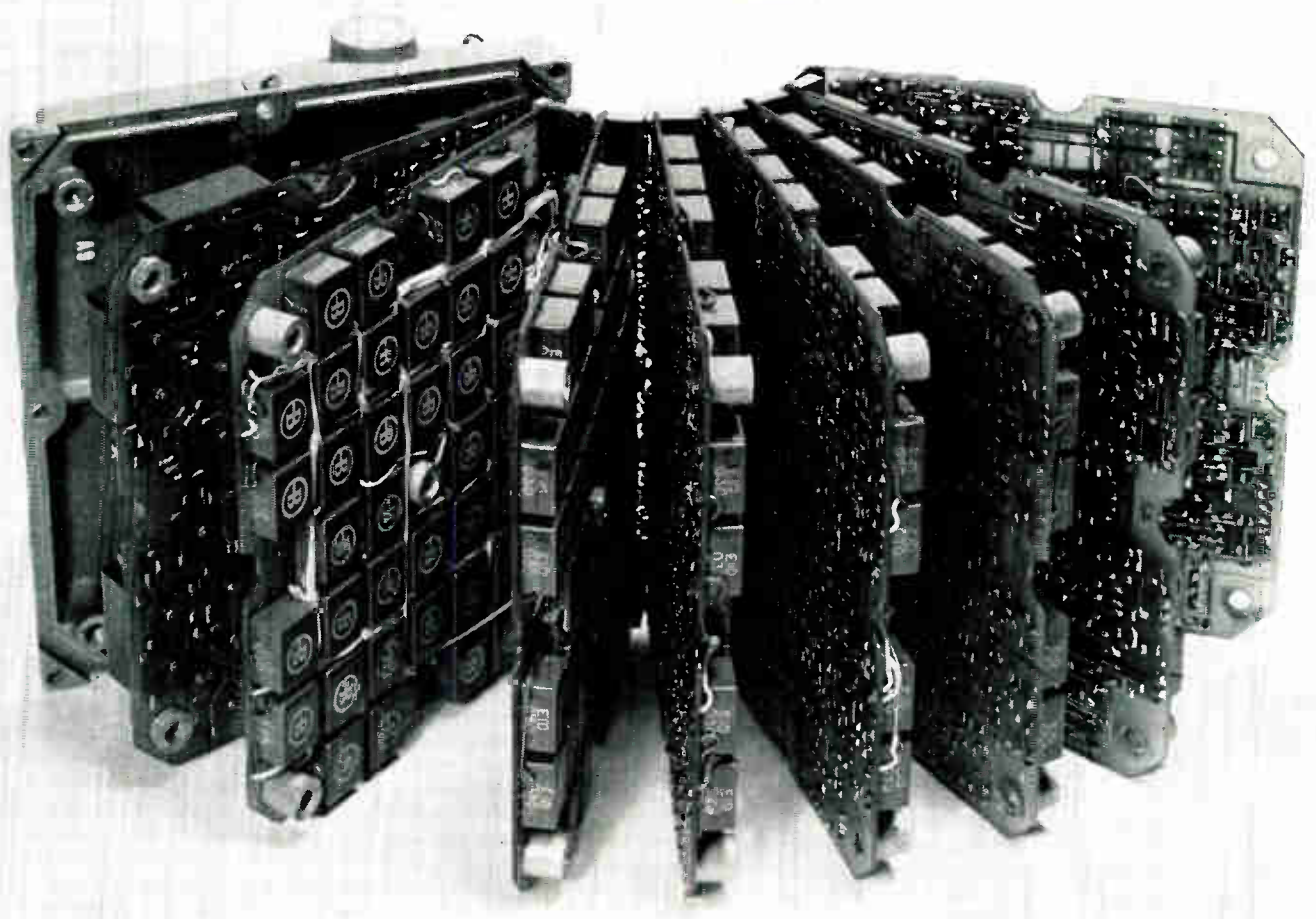


Fig. 2. Control system is packaged for extreme environmental conditions (230°F temperature variation, 6000 Gs shock, free-fall water entry from 20,000 feet). It employs metallic-tape cores for all logic, shifting, and temporary storage functions.

one level feeding to the next. Top of the hierarchy is the zero-access-time register, generally an integral portion of machine logic, and of minimal (one-word) capacity. Succeeding levels are characterized by lower access rates, higher capacities, lower costs per bit stored, and a general elimination of genuine random-access capability. Main storage, typically a random-access ferrite-core memory or a magnetic drum, is usually the second level. Bulk storage, typically magnetic drums, discs, or tapes, is the third level. Base of the hierarchy might be punched cards, paper or magnetic tapes, as well as input switches and keyboards. Storage techniques can generally be equated to some level of this hierarchy.

Among the many other variables to be considered are bit density, complexity and component count, operating and standby power requirements, signal properties, tolerances (to drive transients, temperature, shock and vibration, and electromagnetic and nuclear radiation), degree of data protection, data format modification capability (such as serial-to-parallel) and modular expansibility.

Most important and most elusive, are cost and development status. Generalities are inadequate here. Costs range from perhaps $0.0000002 per bit to well beyond $10 per bit, and comparisons of development status, at least on a class basis, are apt to be unrealistic.

Various storage types are indicated in tables 1 through 5.

Zero-access-time Registers

Zero-access-time registers, for temporary storage and buffering, as well as logic, were implemented in early high-speed computers with vacuum-tubes and, in most modern computers, by transistors. Most recently, tunnel diodes and magnetic thin films have been successfully applied to the function. Registers, working closely with computer logic (and not generally looked upon as storage), typically store one word of data. At one bit per tube, vacuum-tube registers are expensive; the cost is also great in both bulk and power requirements. By modern standards, the method is unreliable and sensitive to environment. Transistors are inherently vulnerable to radiation, and require continuous application of power for retention of data. As these inadequacies are not important in most applications, transistor registers can be expected to dominate all other methods in the higher speed ranges for some time to come. Tunnel diodes may replace transistors for this function for large bit capacities and under certain environmental conditions. Slower but less expensive thin films are already being substituted for transistors in low-megacycle registers.

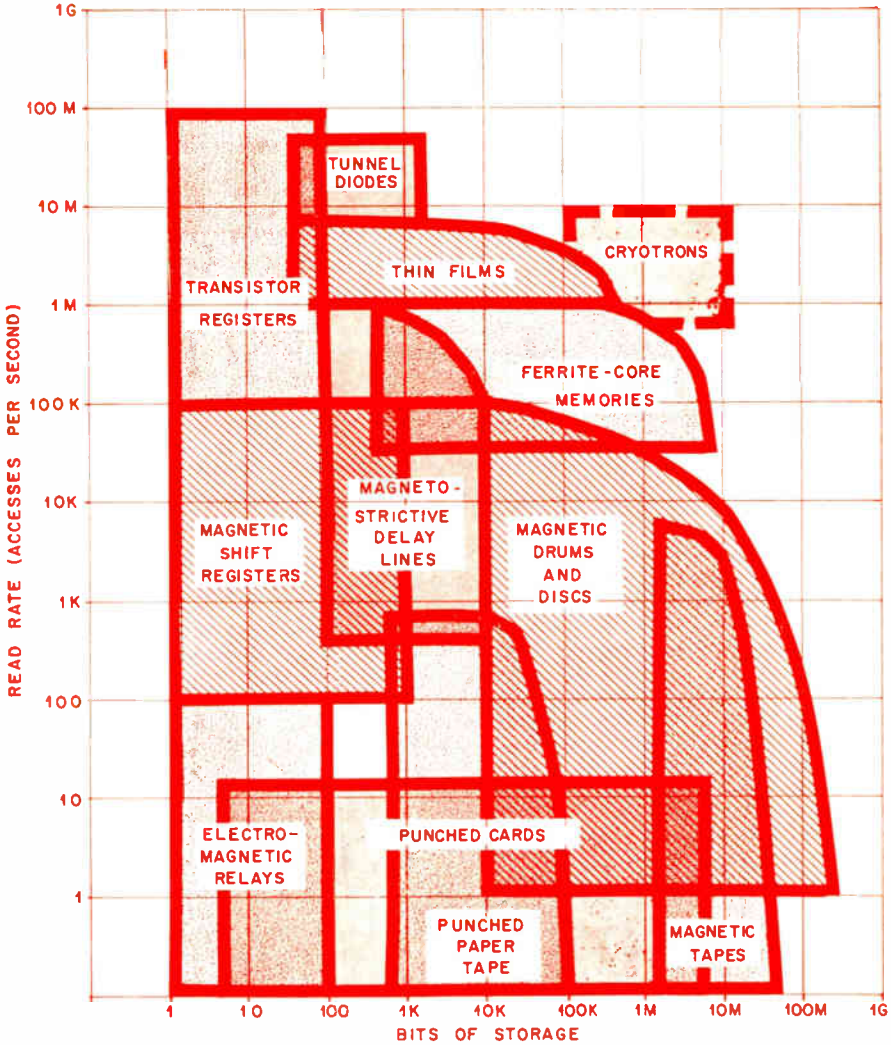
Electromagnetic Relays

Conventional electromagntic relays have been employed for temporary, alterable, low-cost storage of small quantities of data since the outset of computer development. Many early systems, such as the Bell Laboratories series of computers employed extensive arrays of relays for low-speed buffer storage. In modern systems, speed and reliability limitations are prohibitive for all but a minimum of very specialized conditions.

Storage Methods

(Continued)

Fig. 3. Speeds of representative storage types are indicated in accesses/sec. Each access may be to a bit, a character, or a complete word, depending upon storage format. Both serial and random read rates are considered for the inherently sequential-access storage media (tapes, drums, and discs.) Capacity is measured in bits (per reel, for tapes). No reference is determined for punched cards. Speed/capacity ranges are approximate; expansion of many ranges is possible, but uneconomical. The ranges are thus intended to describe not what can be done, but rather the methods most reasonably suited to various speed and capacity requirements.



Electrostatic Storage Tubes

Many early digital computing systems, such as EDSAC and ORDVAC, used electrostatic storage tubes for high-speed, random-access, electrically alterable, main storage. Although several of the systems employing these tubes are still in use, the method is essentially a thing of the past.

Binary data are stored as electrostatic charges on the inner face of an addressable cathode-ray tube. Ditigal-to-analog conversion, involving fairly complex circuitry, is necessary to address storage. The *Williams tube* is typical. The *barrier grid* storage tube, less common but generally similar, employs a grid for the storage surface. Storage tubes are expensive, require constant regeneration of stored data, and offer relatively low storage density. They are otherwise quite effective.

Metallic-tape Core Registers and Memories

Toroidal magnetic cores employing a thin strip of ferromagnetic metal, such as molybdenum permalloy, wrapped about a magnetically inert bobbin, have been available for all forms of digital circuit functions since the early 1950's. The metallic-tape core actually preceded the ferrite core, even in memory use. Although bulkier and more expensive, it provides higher signals for given input power and greater immunity to temperature variation. For these reasons, the ferrite core has trailed in application to logic functions, and has been considered for logic more often in sophisticated multiaperture variations than in the standard toroidal form.

Data are moved from core to core in metallic-tape core circuits by clocked pulses, and are stored statically between pulses. Diodes, operating well within tolerances to ensure reliability, are included at each stage to ensure oneway data transfer. Several families of these circuits, differing in methods of fabrication, interconnection, and control, have evolved. *Diodeless-core* circuits have been hampered by close tolerances. Core-diode versions (parallel, delay parallel, and serial magnetic pulse amplifiers) are more commonly used. Most employ n + 1 cores per n bits with a two-phase clock, although one includes a capacitive delay per stage to permit one-core-per-bit single-phase operation. All are characterized by low operating speeds, extreme ruggedness, relative immunity to temperature variation and nuclear radiation, broad logical flexibility, minimum operating power and zero standby power, and long life. The *magnetic shift register* has been employed in a great variety of schemes, including small-quantity temporary storage and buffering and recirculating delay lines. In certain applications, complete core-diode systems have been successfully designed to withstand shocks up to 20,000 g's, rotational velocities of 15,000 rpm, temperature extremes of 265° F., and free-fall water entry from as high as 30,000 ft.

Coincident-current Ferrite-core Memories

Ferrite-core memories are the oldest and still most widely employed technique for electrically alterable, random-access, main data storage. These memories, employing toroidal ferrite bistable cores in three-dimensional matrix stacks, one core per bit of stored

data, are by now thoroughly analyzed. They are marketed in a variety of capacities, speed ranges, packaging configurations, and environmental tolerance specifications. Their dominance of the main store function, where extremely high speeds are not required, is certain to continue for some time. Neither packing density nor capacity of magnetic thin film memories have been shown to be potentially superior to that of ferrite cores, and cryotrons appear to be competitive (in several more years) only in very large capacities. Individual ferrite-core stacks store typically 32,000 words, while complete memories with capacities beyond one million bits have been constructed.

Read is destructive, so that the logic for initial write must also be used for data restoration following each read cycle. Despite this inherent delay, read/write cycle times of 2 to 16 μsec are common. Numerous schemes for nondestructive read of standard ferrite memory cores have been proposed through the years. Virtually none of them has shown sufficient practicality and reliability to justify the increased speed and data protection thereby obtained. In the older coincident-current version, a word is read (or written) by the coincidence of two or more currents at the intersections of the matrix storing the addressed word. Cores are made to distinguish, by virtue of the switching threshold or knee of the B-H hysteresis loop, between partial drive current (unselected cores in selected row and column) and full drive current (cores at the line of intersections—the addressed location). This threshold makes practical ferrite-core memories possible, but the cumulative noise from the many partially selected cores may approach the magnitude of the data signal, and represents the major concern in ferrite-core memory design. The coincident-current version requires fewer selection-circuit components than the linear-select version, particularly in large arrays ($> 10^4$ words), but at the expense of greater noise levels (because partial currents are applied to unselected cores) and stricter design tolerances.

Linear-select Ferrite-core Memories

In the linear-select, or word-organized, ferrite-core memory, each word is read by a single drive current pulse which affects only the addressed word. (Some coincidence of currents is required during write, but much less than is required in the coincident-current memory.) Speeds are generally greater, and tolerances to noise, temperature, shock, and other environmental effects higher than those of the coincident-current memory, but at the expense of an increase in addressing circuitry, particularly for very large capacities. In a 64 x 64 matrix (4096 words), 4096 selection elements, typically diodes, are required in the linear-select method. Only 128 are required in the coincident-current version. However, the greater degree of data protection often prompts the use of the linear-select version in critical military applications.

Ferrite-plate Memories

The *Multiaperature ferrite-plate memory* is logically and electrically equivalent to the linear-select ferrite-core memory, although two cores are generally used for storage of one bit. The extra core is used so that,

Table One

Write/Read, Electronically Alterable, Random Access

VOLATILE STORAGE

DESTRUCTIVE READ
- Electrostatic storage tubes
  - (Williams tubes and barrier grid storage tubes)
- Transistor-magnetic core registers
- Tunnel-diode registers
- Tunnel-diode memories
- Cryosar memories
- Ferroelectric memories (nonvolatile in principle)

NONDESTRUCTIVE READ
- Electromagnetic relays
- Vacuum-tube registers
- Transistor registers
- Parametron registers
- Parametron phase-script memories
- Tunnel-diode registers
- Tunnel-diode memories

NONVOLATILE STORAGE

DESTRUCTIVE READ
- Metallic-tape core registers
  - (Core-diode and diodeless core circuits)
- Metallic-tape core-diode memories
- Coincident-current ferrite-core memories
- Linear-select (word-organized) ferrite-core memories
- Ferrite-plate (linear-select) memories
- Twistor memories
- Magnetic thin film registers
- Magnetic thin film memories
- Persistor and persistatron memories

NONDESTRUCTIVE READ
- Charged magnetic cards
- Multiaperture-core registers
- Multiaperture-core memories
- Biaxial multiaperture-core memories
- Fluxlok memories
- Cryotron memories
- Magnetic thin film registers
  - (under development)
- Magnetic thin film memories
  - (under development)

Table Two

WRITE/READ, ELECTRONICALLY ALTERABLE, SEQUENTIAL ACCESS

VOLATILE STORAGE, TRAVELING DATA, NONDESTRUCTIVE READ
(by virtue of recirculating logic)
- Electromagnetic transmission delay lines
- Mercury sonic delay lines
- Quartz and glass sonic delay lines
- Magnetostrictive sonic delay lines

NONVOLATILE STORAGE, TRAVELLING DATA, DESTRUCTIVE READ
- Metallic-tape core (core-diode and diodeless-core) delay lines

NONVOLATILE STORAGE, TRAVELLING SURFACE, NONDESTRUCTIVE READ
- Magnetic wires
- Magnetic tapes
- Magnetic drums
- Magnetic discs and disc files
- Bernoulli discs

Table Three

WRITE/READ, ALTERABLE ONLY WITH DIFFICULTY

(All sequential access, nonvolatile storage, and nondestructive read)

BINARY REPRESENTATION ONLY
- Punched cords
- Punched paper tape

- Printed magnetic cards
- Fluorescent spot scanning

BINARY OR ALPHANUMERIC REPRESENTATION
- Magnetic ink character recognition (MICR)
- Optical character recognition (contemporary)

Table Four

READ ONLY (REWRITE BY OPERATOR OR BY FABRICATION)

(ALL RANDOM ACCESS, NONVOLATILE STORAGE, AND NONDESTRUCTIVE READ)
- Wired-core matrix memories
- Bar magnet twistor memories
- Ferrite rad memories
- Switches, plugboards and keyboards
- Optical character recognition (anticipated, reading from variety of copy)

Table Five

WRITE ONLY (READ BY OPERATOR OR OTHER SYSTEMS)

NONVOLATILE STORAGE
- Hard-copy impact printers
- Non-impact (electrostatic and electrochemical) printers

VOLATILE STORAGE
- (Output to communications links)
- (Output to electronic data displays)
- (Output to indicator lamps)

Fig. 4. Lt. A. Clum operates U.S. Army teleprinter. The general-purpose message printer can type at 3,000 words/min.

Storage Methods *(Continued)*

by inducing positive and negative voltage signals for ONEs and ZEROs respectively, rather than signal for a ONE and silence for a ZERO, very high signal-to-noise ratios can be obtained. Each plane in the memory stack is a single ferrite plate coated from hole to hole in series by a deposited metal sense and information conductor. Wire drive conductors pass through holes from plate to plate. Method has been used infrequently since 1957 as a means of simplifying memory fabrication, particularly in very compact arrays.

Twistors

The *twistor* memory device employs a helical wrapping or plating of ferromagnetic material about conducting wires such that the wire serves as sense and information conductor. The portions of the helix beneath transversely laid solenoids are one-bit storage elements. Early designs employed solid, torsionally stressed, ferromagnetic wire, but tolerance problems and fabrication difficulty led to abandonment in favor of the wrapped "barber-pole" twistor. Memory arrays are equivalent to ferrite-core coincident-current or linear-select arrays.

Twistors were first announced in 1957, and were immediately felt to justify extensive investigation toward possible replacement of the ferrite-core memory. Until as recently as last year, widespread use was still anticipated. The method offers relatively high speeds and low fabrication costs, but adequate control of material characteristics during fabrication has never been obtained. Twistors have been used in a number of special applications, such as in certain read-only memories, but it appears that further interest, at least for random-access memory applications, must await advances in materials development.

Thin Magnetic Films

Thin magnetic films will soon become the basic storage medium for high-speed, high-density, electrically alterable, random-access registers and main memory applications. Very thin films (as little as 500 Angstroms thick) of ferromagnetic material are made by vacuum deposition or electroplating methods on thin, typically glass substrates. Small arrays with read/write cycle rates as high as 5MC are presently in use, and practical low-cost, fully deposited, large arrays await only further refinements of fabrication methods. Adequate control of fabrication parameters, particularly in large bit plane capacities, has been the principal obstacle to earlier realization of the method.

Film elements are switched between binary states by domain rotation (wherein entire magnetic domains switch magnetization simultaneously), as opposed to the domain wall motion mechanism of magnetic cores (wherein domains reverse magnetization more gradually, as a result of wall motion). Driving and sensing circuitry and all interlayer insulation can be made by additional depositions; memory geometry is thus very simple. Electromagnetic shielding is generally necessary, but seldom becomes a design problem. Most examples are destructively read, but several methods for nondestructive read are being studied.

Multiaperture Cores

Various schemes for *multiaperture ferrite cores* have been studied since the early 1950's, primarily as a means of developing all-magnetic logic circuits. Small ferrite discs pierced by one major aperture and as many as eight minor apertures are used to perform

Fig. 5. Magnetic drum, developed by Ex-Cell-O Corp. (Bryant Computer Div.), stores over 12,000 words, rotates at 12,000 rpm. It is used in a high-density military airborne computer.

all logic and shifting functions. These include many sophistications possible elsewhere only at the expense of increased component count. Flux is shifted in any of several paths depending upon the number of minor apertures and the manner of applying drive currents. This permits, among other faculties, nondestructive read. Several configurations, particularly those with single minor apertures, have been employed for specialized nondestructive-read storage applications, but close tolerances and expensive wiring patterns have prevented broad use.

Biaxial Multiaperture Cores

Biaxial multiaperture ferrite cores, wherein two apertures are oriented at right angles to each other in a single piece of ferrite, have been used recently for electrically alterable, nondestructive-read, random-access storage. The cores are inexpensive, and can be packed with greater density than toroidal cores. Systems of reasonable size appear to be awaiting only design refinements.

Fluxlok Memory

The *Fluxlok* Memory* is an electrically alterable, nondestructive-read storage method using standard ferrite memory cores. Drive conductors are orthogonally oriented across core faces to permit nondestructive sensing. Read rates are comparable to those of standard ferrite-core memories, while write is achieved by a barrage of perhaps 20 pulses, and is relatively slow. Method is suited to, and is in use for, critical military applications requiring absolute protection of program and contents data and occasional off-line program rewrite.

Cryogenic Memories

Electrical resistance in certain materials drops to zero below characteristic critical temperatures near 0° K. The materials are said to be superconducting below these temperatures. By appropriately inducing and suppressing supercurrents in elements of these materials, by means of applied fields, magnetic flux may be trapped locally, and binary storage devices thereby devised. This is the *cryotron*, a superconductor. Other cryogenic memory elements, less broadly studied at present (and less likely to achieve major status), are the *cryosar* (a semiconductor, and the *persistor* and *persistatron* (superconducting inductors). Cryotrons, under intensive investigation, are expected to become the prime approach to very-large-capacity, high-speed, random-access, main or primary bulk storage of binary data. Low-cost, very-high-density fabrication in arrays as great as 10^9 bits appears to be possible. Previously expensive helium liquefier refrigeration units are ceasing to be a problem, beyond posing a lower limit to cost-competitive capacities. A high signal-to-noise ratio, and an ability to perform certain logic tasks as well as storage, have led to several attempts to build large associative memories. These offer a highly desirable, fundamentally different, but previously unfeasible method of content addressing, as opposed to conventional coded location addressing, permitting for the first time the question, "Are you storing such and such at present?" Several laboratory models are now in operation, but large-scale use is probably several years away.

Transistor-Magnetic Core Circuits

The hybrid transistor-magnetic core circuit, primarily a logic circuit, combines a transistor and a magnetic core in regenerative fashion. The device has the ability to produce high-energy rectangular voltage pulses when triggered by low-energy voltage pulses. Several varieties of this circuit (most are two-element-per-bit arrays, although one employs a capacitive delay per stage to permit one-element-per-bit operation) have been, and are, used for various specialized shifting and storage functions, such as recirculating delay lines.

Tunnel-diode Memories

Tunnel diodes give promise of providing the basic storage element, and driving circuitry, for practical memories of perhaps 1000 words operating at frequencies of from 10 to 65 MC. Tunnel diodes appear to be uniquely suited, among methods presently contemplated, for this speed/capacity range. The capacity is too great for transistors and too small for cryotrons, on a competitive cost basis, and the speed is probably beyond the limits of thin films. Although only recently discovered, tunnel diodes have already been well analyzed, and intensively investigated for a variety of applications.

In the forward direction, the voltage-current characteristic exhibits a rise to a peak, a drop corresponding to negative resistance, and a subsequent rise. When wired in series with a resistance and a power source, two stable potentials are available, one below the peak, the other above the valley. Switching between potentials is as short as 1 nsec. With certain biasing schemes, memories of conventional linear-select (word-organized) configurations are quite possible. During reading, switching occurs or does not occur (and is sensed or not) in response to a drive current. Read is destructive or nondestructive, depending upon circuit design. Both approaches have been reported. Storage density is high—about five storage elements/cm. appears to be reasonable. Storage is volatile and power requirements are high, but all of the problems presently faced appear to be solvable. Speeds obtainable more than justify continued study.

Parametron Phase-script Storage

Parametrons, a unique class of digital circuits have, since 1959, been investigated in this country as a means of providing all-magnetic logic for operation in environments too rigorous for semiconductor devices. Several studies have already demonstrated practical feasibility, particularly where high-speed magnetic thin films are used for the variably inductive portion of the L-C parametron circuit.

Data is transferred by three-phase clock and majority logic from element to element as a relative phase angle of subharmonic parametric oscillation, rather than as a relative level of a current or voltage pulse. Memories for parametron systems ideally employ phase-script dynamic storage, perhaps in conjunction with conventional nonvolatile storage. Several methods for phase-script storage are under development. Parametrons are also being studied as storage for conventional systems.

Fig. 6. Wired-core matrix memory (cores are encased behind layout panels) used for program and constants data in the Atlas Ground Guidance Computer.

Storage Methods

(Continued)

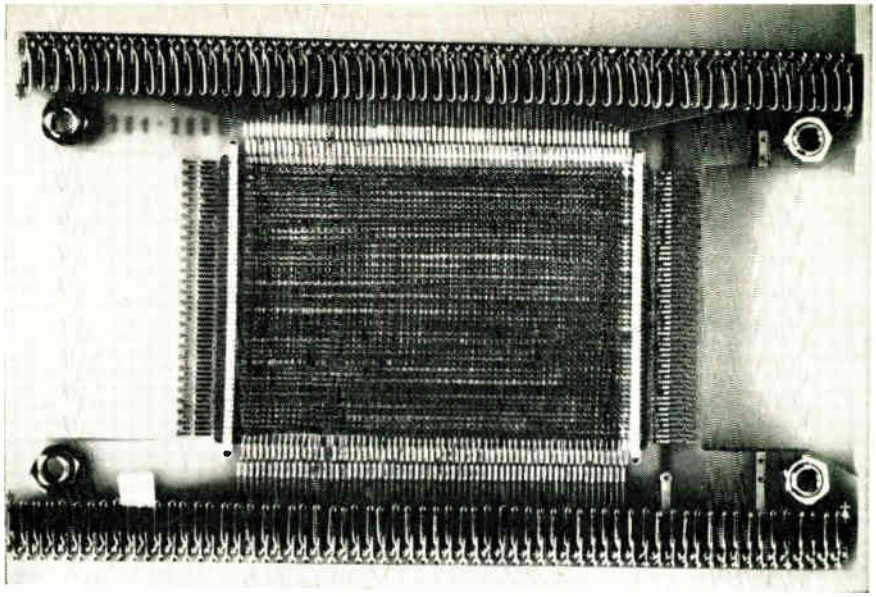


Fig. 7. Bit plane from linear-select (word-organized) memory module of a large-scale military-oriented computing system. Each of 64 bit planes in this memory contains 64 complete 51-bit words.

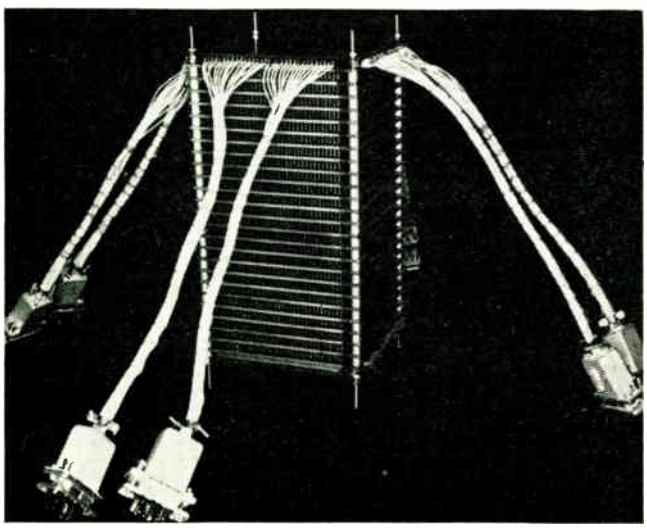
Ferroelectric Memories

Ferroelectric condensers have been studied for possible suitability to the storage function—without encouraging results. Internal polarization effects in ferroelectric materials such as barium titanate produce a D-E hysteresis loop (electric induction D and applied electric field E) quite similar to the B-H loop of square-loop magnetic materials. When a varying electric field is applied, no current flows when the condenser is driven from remanence into saturation; but, a large brief signal is available when the condenser is reversed to the opposite remanent state. It appears that the linear-select (word-organized) drive configuration must be used. Laboratory models have shown insufficient speed, excessive power levels, no absolute threshold for noise, and numerous problems of tolerances, fabrication, and signal consistency.

Electromagnetic Transmission Delay Lines

Transmission lines can be used to carry pulse trains of digital data, as *electromagnetic delay lines*. Data is constantly recirculated from output to input around a closed path. Access is necessarily serial, and access to data in the worst-case position is delayed in proportion to the amount of data stored. Unless lines of enormous length are employed, delay time per storage cycle is very brief, and little data can be stored. On the other hand, large capacities are frustrating, since bandwidth decreases with increased length. The method is expensive, and has found only sporadic use for years, but with rapidly increasing computer clock rates, may yet be occasionally suitable.

Fig. 8. The 4096-word coincident-current ferrite-core memory module in the Burroughs B5000 computing system uses this memory stack.



Mercury Sonic Delay Lines

Several early computers, such as Univac I, employed columns of mercury as delay mediums, with quartz piezoelectric crystals to convert electrical energy into sound energy, and vice versa. In a *mercury delay line*, data travels as sonic pulses, providing a greater delay time through a given length of delay medium and, generally, a more suitable match to computer rates than is presented by electromagnetic delay lines. The method is expensive and cumbersome compared with the modern magnetostrictive sonic delay line. Quartz and glass have been studied recently as delay media in nonmagnetostrictive sonic delay lines of improved characteristics.

Magnetostrictive Sonic Delay Lines

Certain metals such as nickel, when subjected to a magnetic field, exhibit a change in physical dimension, a property known as magnetostriction. This property has been exploited to pass sonic pulses through a storage wire in the form of travelling deformations in the wire; to provide small, inexpensive, sequential-access, delay-line storage for computers with clock rates from 500 KC to 2 MC. *Magnetostrictive sonic delay lines* with serial read rates as high as 10 MC and capacities of 10,000 bits are offered. A transducer converts electrical inputs into sonic pulses in the wire, and a similar transducer at the other end of the wire reconverts the sonic signals into electrical pulses. (Sonic pulses are actually dissipated in an acoustical termination beyond the output transducer.)

As with other methods of delay line storage, a certain amount of logic circuitry is required to synchronize the data flow with the system clock between data cycles, to permit parallel read and recirculate, and erase and replace. Furthermore, the logic can serve a large array of delay lines in parallel, to correspond to parallel-track magnetic tapes. Delay times

within the delay line must be held to within close tolerances, but the logic can be used to correct variations in signal amplitude and timing due to environmental factors.

Magnetic Wires

Prior to development of magnetic tapes, *magnetic wires* were used in early systems, such as EDVAC, for bulk serial storage of data, a method used more than fifty years ago in rather crude form for storage of telephone and telegraph signals. Characters and words were stored a bit at a time, serially, with the wire travelling at perhaps 200 in./sec., resulting in low read rates. Chronic breakage problems could not be overcome, and braking to a designated address was inadequate. Either condition could occasionally result in an indescribable tangle. The method has given way to the parallel-track magnetic tape.

Magnetic Tapes

From the outset of computer development magnetic tape transports have dominated the bulk secondary storage function, particularly where information is to be used in a sequential fashion. Cost per bit is very low. Data is stored in any of several binary magnetization formats on a plastic tape continuously coated with a ferromagnetic material (Earlier tapes were of solid metal). Read/write heads are generally ganged in parallel tracks across the width of the tape to permit parallel read and write of binary-coded alphanumeric characters. Read is nondestructive, and data is easily erased and replaced. High write or readout speeds are possible in the serial mode; but, although data at any location can be addressed at any time, access to the worst-case position may require as much as several minutes. An important advantage of the magnetic tape unit over other bulk storage methods is the ease with which individual tapes can be replaced and stored. Furthermore, random access time can be somewhat reduced, and capacity per read/write head increased by employing a number of selectable tape reels per tape unit.

Magnetic Drums

Vast amounts of data—perhaps 108 bits—are, with present methods, most efficiently and economically stored on *magnetic drums* or *discs*. The two media are closely related, and steam directly from inventions more than sixty years old. A high-precision drum, coated or electroplated with a ferromagnetic material such as cobalt-nickel alloy or ferric oxide, rotates continuously at perhaps 3,000 to 12,000 rpm. Data is stored nonvolatilely as magnetized spots on the drum surface, and is nondestructively read. Read/write heads are arranged in parallel or helically along the length of the drum, each head associated with one track of stored data. The application typically determines the drum characteristics. For example, it may be desirable in airborne applications to interlace programs at alternate positions on tracks and provide two or more sets of heads, in order to increase access speed and storage density.

Random access is more rapid than with magnetic tapes, but interchange of data can only be achieved by erasing and replacing. Objections to electromechanisms on grounds of reliability do not seem to be justified in this case, even in high-shock environments; a number of drum designs have been successfully employed in mobile and airborne military systems. Principal advantage of drums over discs is that parallel readout of a word is achieved quite simply; all points on the drum surface move at the same speed. Since each successive track on a disc is farther from the axis of rotation and moving at a greater speed, synchronizing the separate bits of parallel readouts calls for fairly sophisticated logic. For the same reason, efficient use of the available surface area is more difficult and costly with discs than with drums.

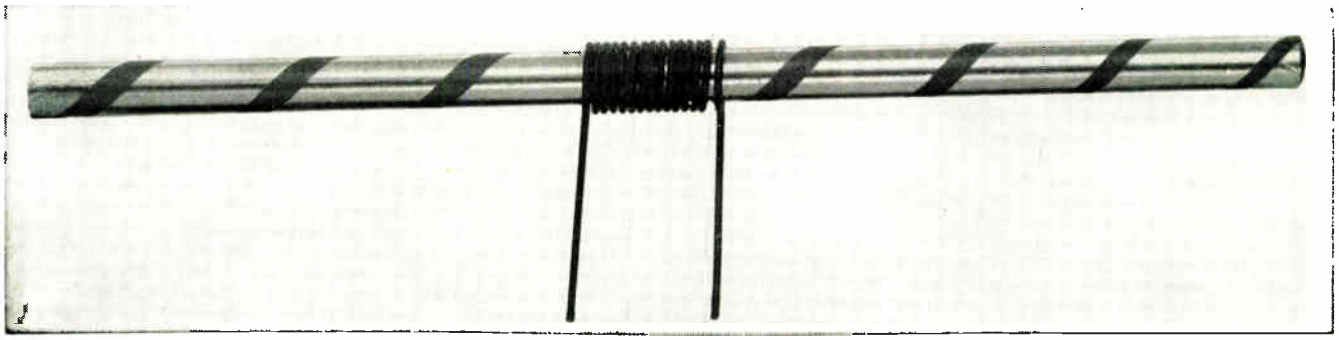


Fig. 9. Demonstration element of helically wrapped metallic-tape twistor storage method, enlarged. Incomplete systems, multiple drive solenoids are used, each enclosing many such twistor wires; area of helical wrapping beneath solenoid represents one storage cell.

Magnetic Discs & Disc Files

Magnetic discs store data on one or both faces of a set of plated discs rotating on a common shaft, rather than on the single cylindrical surface of a drum. A number of discs are generally combined with common read/write heads and logic in a *disc file* unit. The method affords greater storage density than the drum, and more rapid random access to data. This is possible since the unusuable inner bulk of a drum is no longer present, and read/write heads can be concentrated in various patterns between discs.

In one form of disc file, individual discs are automatically lifted into read/write/rotate position, thereby permitting a reduction in number of read/write heads, simple replacement of discs, and permanent storage of enormous quantities of data. Tolerances on this technique are closer, and storage capacity per disc is lower. Another low cost variation involves a single traveling head writing and reading

Storage Methods

(Continued)

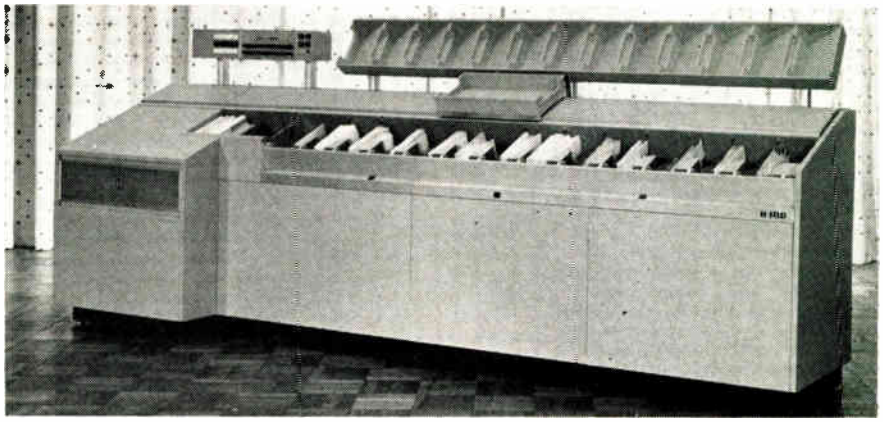


Fig. 10. MICR (Magnetic Ink Character Recognition) check sorter/reader. MICR has been in use for about two years, principally for specialized banking functions.

bits, as well as characters, in series (with consequent long access times and lower costs). The major problem in disc memory development has been to assure a constant gap between head and disc surface. Air-sled floating-head methods, permitting more precise positioning than rigid mountings despite looser tolerances, appear to be an adequate solution. Several large disc memory units are presently marketed, some with capacities exceeding 500 million bits. The method appears to offer the best means of bulk storage for large systems presently planned or under development.

Bernoulli Discs

The Bernoulli separation effect (pressure exerted by the flow of air through an orifice increases as the orifice becomes smaller) has recently been applied to the development of fixed heads and flexible discs in the Bernoulli disc memory. Discs are limp at rest, becoming flattened by centrifugal force when in motion. Air (or gas, in some environments) is forced between the disc and a backplate in which read/write heads are embedded. Material tolerances are greatly reduced, while head positioning accuracy is increased. Potential variations in read/write head gaps are automatically compensated by the pressure of the gas cushion, and actual contact of head with surface—a catastrophe in conventional drums and discs—is impossible. Bernoulli discs, presently marketed in a wide range of speeds and capacities (up to 500 KC serial read and 500,000 bits) are more suited than conventional discs to bulk storage in harsh, mobile environments, but appear to be more limited in disc diameter, and, hence, capacity.

Punched Cards

Card punches and *readers* are the oldest, most elementary, and still most inexpensive form of storage suitable to direct processing of data. Small holes representing data coded in any of a variety of systems, are punched in cards of constant dimensions and read by shuffling card stacks (at about 12.5 cads/sec.) through simple electrical contacts, or capacitive or optical sensing circuits. An advantage of the method is that explanatory markings can be printed upon the storage surface, rendering data intelligible to users as well as machines. Cards may be punched by keyboard inputs or by computer output, and may even be edge-punched by hand and sorted simply by passing a "knitting-needle" rod through a selected data position of all cards, with selected (or unselected) cards then falling from the deck. Even this latter method is an improvement in sorting efficiency over any visual scanning of lists of data. Because of their simplicity and convenience, punched cards have been the most universally employed form of data storage in low-speed, low-cost, automatic processing applications, particularly where data is repetitive within fixed sets of categories. In more complex, large-scale computer systems, punched cards (with more recent competition from punched paper tape) are still a principal means of achieving initial input.

Punched Paper Tape

Reels of *paper tape* may be mechanically perforated incoded patterns and sequences as a direct analogue of magnetic tape storage. Input may be from computer output or from a manual keyboard. Output is sensed in the same manner as punched cards. *Reader* and *perforator* may be used separately, or as a combined unit. Tapes store typically 10 character/in., and read 100 in./sec. in reels up to 700 ft. long. For many applications, particularly those wherein data is usable in a wholly serial configuration at perhaps 10 KC, paper tapes have no real competition. In one device, a keyboard output may be dispatched in parallel to a hard-copy printer, a communication link, and a paper tape perforator, and the input to the perforator or the printer may also be from the communications link or a computer output line. As with punched cards, the principal disadvantages of the method—low speeds and the inability to erase and replace—are offset by economy and capacity. In both methods, errors may be corrected by patching and repunching, but only in a cumbersome manner and with diminished reliability.

Printed Magnetic Cards

Replacing the holes in punched cards with printed dots of magnetic material results in an analogous storage device of greater speed and far greater storage density (up to 1000 decimal digits on a 1 x 3 in. card). Dots are sensed by moving cards past a reading head. Random access to any one of 120,000 cards can be obtained in no more than 5 secs; 300,000 cards permit storing a billion bits in 2.5 cubic ft.

Charged Magnetic Cards

A variation of the magnetic card employs electronic magnetization of a ferromagnetic coating in a pattern of charges, in the manner of magnetic tapes and

drums, permitting electrical alteration of stored data.

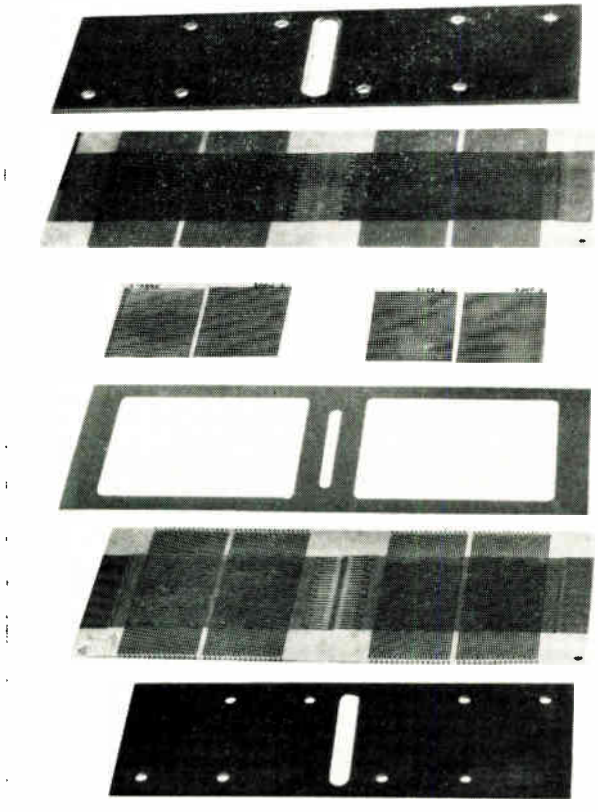
Fluorescent Spot Scanning

A method which at one time showed considerable promise for automatic reading of printed documents was that of fluorescent spot scanning. Coded patterns of spots of fluorescent ink were printed, typically on bank checks, and read by light-sensitive (ultraviolet) scanners. The method was functionally equivalent to magnetic ink character recognition except that development had not yet extended to reading of fully-formed alphanumeric characters. Essentially no work continues, and the future of the method appears doubtful.

Magnetic Ink Character Recognition

The first reliable method of providing printed alphanumeric data storage in a form directly readable by both data systems and users is the method of *magnetic ink character recognition* (MICR), now in use for about two years, principally for specialized banking functions. A standard character font, designed for maximum machine discrimination among characters, is used to print data in a standard magnetic ink in closely controlled positions upon checks of fixed dimensions and paper content. Checks can then be read rapidly and accurately by a simple scanning matrix. In such a rigorous format, the method is quite effective. More ambitious schemes are uncommon, but, for certain applications, the method will probably continue to be competitive, even when advanced methods of optical character recognition begin to demonstrate suitable capability.

Fig. 11. Vacuum-deposited magnetic thin films and drive and sense conductors for thin film registers and temporary storage. They are used for clock-rate (3 MC) operation in computer module of a large-scale military modular processor.



Optical Character Recognition

A major goal of the data-processing industry is a flexible, reliable, high-speed method of *optical character recognition*. This is a means of directly reading and recognizing a variety of data in a variety of type fonts (or even in hand lettering) in a variety of inks on a variety of form sizes and materials, with speed and reliability. Any document will then become an input of stored data.

Existing equipments read standard alphabets from standard forms especially prepared by companion equipments. Each character is divided optically into a matrix of black and white blocks. This matrix is then compared with stored rules for recognition, and a recognition decision is made, or the character is rejected. Many characters readily intelligible to the human are rejected as noise by the optical scanner in these systems. Means are provided to recognize and reject, for operator evaluation and action, any data sample of doubtful clarity. Document rejections may run from 5 to as much as 20%. Such poor error rates are more than justified in many applications by the savings in manpower afforded by successful direct processing of 80 to 95% of the input received. For the more general case, however, a substantial improvement must be made in the theory and practice of pattern recognition before widespread use becomes feasible.

Wired-core Matrix Memories

Magnetic cores, typically linear pulse transformers, are often used to provide permanent wired-in ("read-only") storage of program subroutines and constants data. Each core in a *wired-core matrix memory* stores one bit of all words, or all bits of one word. In either case, conductors (drive or sense lines, respectively) pass through cores where ONEs are to be stored, but bypass cores where ZEROs are to be stored. Outputs from ZERO locations are therefore impossible. Data cannot be electrically altered, but neither can it be permanently affected by transients, noise, power failures, or read/write circuit failures.

No better method exists for protection of critical, unchanging data, a requirement typical of many military and industrial control applications. Read rates are high since cores need only be sensed, not switched and rewritten, and output signals can be made higher and drive power lower than is possible with other storage methods. Memory stacks may be constructed in easily replaceable modules to permit simple manual interchange of storage blocks. This scheme is employed in a wired-core memory storing program and constants data for the Atlas Ground Guidance Computer, an ultra-high-reliability system developed by Burroughs Corp.

Bar Magnet Twistor Memories

Twistors may be used in conjunction with permanent bar magnets to provide an excellent read-only memory. Cards of bar magnets, arranged in patterns determined by the data to be stored, are superimposed upon more or less conventional twistor arrays. During read, the magnets paralyze those twistor elements where ZEROs are to be read out, and permit flux changes and induced voltages from twistors where ONEs are to be read. Cards are easily and cheaply

Storage Methods *(Concluded)*

fabricated, and readily interchanged. Since the twistors themselves store no information, storage is nonvolatile, read is nondestructive, and driving logic is quite simple.

Ferrite Rod Memory

A high-speed, wired-in, read-only memory for storage of computer subroutine commands has been developed which uses solid ferrite rods passed appropriately through a large piece of metal mesh similar to a window screen. Data is determined by the path of the rods through the mesh, in a manner functionally similar to storage representation in the wired-core matrix memory. Fabrication is relatively inexpensive, capacities very high, and access times as low as 0.2 usec.

Switches, Plugboards & Keyboards

Manual switches, plugboards, and keyboards, not generally looked upon as storage, are employed in almost all computing systems, but more extensively in real-time control applications, for updated storage of certain variables. For example banks of switches, a plugboard, or a keyboard may be used to enter prelaunch constants into a missile guidance computer prior to launch. Plugboards are often used in small, low-cost computers. Where a small number of simple variables are to be held constant for increments of time, or altered infrequently in real time, all three storage methods are straightforward and quite adequate. Reliability is high, read access rates are high, and costs are low. Operator-effected alteration of data is rapid and incomparably simple. Furthermore, all data stored is clearly visible.

Hard-copy Impact Printers

Computer output printers constitute, in effect, write-only storage. Conventional *hard-copy impact printers* may be classified on the basis of three distinctions: serial or ganged output, flying-head or traveling-carriage type positioning, and fully-formed or wire matrix character production. Serial printers, including teletypes and electric typewriters, are less expensive than ganged printers (several characters printed in parallel), but slower (on the order of 10 to 100 characters/sec. as compared with some multiple of these figures). Flying-head printers employ a moving "box" of type and a fixed carriage. Although less expensive, the traveling-carriage type requires excessive movement of documents with consequent limitations on speeds and document format. Wire matrix character printing differs from the conventional fully-formed character method in that selected wires in a two-dimensional matrix are moved forward to form a character.

Fig. 12. Operator holds insurance premium notices, one of many types of business records that IBM 1418 optical character reader reads at speeds up to 480 characters/sec. and 400 documents/min. Reader automatically converts numerical printed data to computer language.

The method suffers somewhat in character quality, but permits speeds possibly 50% higher, since a small flying-head wire matrix with flexible-tube (frequently hydraulic) feed is all that is required. Write-only printers will be an integral part of most computing and data processing systems for several more years, augmented eventually by some form of optical character recognition write/read systems.

Non-Impact Printers

Methods for eliminating both paper/printhead impact and lateral movement of printheads have been sought for several years as a means of increasing printout speed to a limitation imposed only by the rate at which paper can be pulled from a roll. By ganging non-impact printheads across the width of the paper surface, and selecting characters electronically, enormous output speeds are possible.

Electrostatic non-impact printers have been developed and marketed since the mid-50's, delivering rates as high as 1000 characters/sec. Ordinary paper, dusted evenly with a powered magnetic ink, passes in a continuous roll through the printer, with no lateral motion. A column of addressable electrostatic charge-generating pins (typically seven) produces a character upon the paper by moving from left to right in, typically, five successive positions, firing charges from appropriate pins at each position. Ink collects at each charge. Ink not held by electrostatic charges is removed by a flow of air, and the remaining ink is permanently fixed upon the paper surface by a brief application of heat or pressure. At greater expense, a matrix of pins can be used to print a complete character, and matrices can be ganged across the page to eliminate all lateral motion. In an interesting variation of the method, useful for transmittals of classified military data, paper is charged without ink during printout, and fixed permanently by the receiving agency.

The method has been hampered by a poor tolerance to environment. In carefully controlled air, highly reliable operation can be achieved, but ionization of various substances suspended in impure air, such as salt or dust, may cause occasional breakdown of the electrostatic charge. Investigations continue toward solution of the problem.

Electrochemical printers are less troublesome but generally quite slow; characters are etched upon photosensitive paper by electrical or photo-optic action (in either pin configurations or fully formed characters).

Acknowledgement

The author wishes to thank Glenn A. Oliver and George H. Barnes of Burroughs Corp., Burroughs Laboratories, for their many helpful suggestions.

Los Angeles Memorial Sports Arena, scene of the 1962 WESCON, August 21 through 24.

Previewing 1962 WESCON

WESCON 1962 features a theme, "Frontiers in Electronics," and this has resulted in sweeping changes to the technical program. These changes, plus an expected greater attendance and all the usual features, promise to make this year's WESCON the best ever.

GREATER attendance and more exhibitors than ever are expected at the huge 1962 WESCON Show, which will take place August 21st through the 24th at the Los Angeles Memorial Sports Arena and Statler-Hilton Hotel, Los Angeles, Calif.

The theme of the 1962 WESCON, "Frontiers in Electronics," has resulted in its Technical Papers Program being greatly modified. This is the first time the show has had a theme. Exhibits and special events will also fit the theme.

This year's show is expected to have over 35,000 attending, and 850 exhibitors in 1,230 display booths. The size of the exhibit requires that a 96,000 sq. ft. tent annex be erected outside the Sports Arena building. The Western Electronic Manufacturers Association and Institute of Radio Engineers are once again sponsors of the show.

Technical Sessions

To concentrate attention on the significant advances toward "Frontiers in Electronics," the regular technical sessions have been reduced in number to 21. All will be in the morning at the Statler-Hilton Hotel. This is about half the number of sessions in past years.

Highlighted will be five special afternoon sessions, all on timely topics of broad interest. All speakers for these sessions will be noted authorities in their fields. These sessions will also be at the Statler-Hilton.

Special Sessions

Topics for the five sessions are: "Biological Aspects of Communications" (Tuesday); "Weather Satellites and Data Processing" and "Research in Nuclear Test Detection" (Wednesday); "Advanced Power Propulsion Systems" (Thursday); and "Lunar Exploration" (Friday).

Speakers for the first three special sessions will be: Prof. W. A. Rosenblith, Massachusetts Institute of Technology; David Johnson, Deputy Director, Meteorological Satellite Activities, U. S. Weather Bureau; and Dr. George F. Bing, Assistant for Nuclear Test Detection, Advanced Research Projects Agency.

The last two will each be a series of four lectures. Dr. A. M. Zarem, Electro-Optical Systems, Inc., will moderate the presentations making up Thursday's program. Robert Goddard, Jet Propulsion Lab, will act as Program Director for Friday's reports.

The regular sessions will all last from 9 to 11:30 a.m., except the last. This one, "State of the Art—

WESCON *(Continued)*

Integrated Circuits," has not had a time fixed. The times of the afternoon sessions will vary.

"Hoax Paper"

A special panel discussion lately added will feature two collaborators who submitted a "hoax paper," which was selected by WESCON officials for presentation. The authors, W. D. Rowe and C. D. Simmons, submitted the summary to dramatize their conviction that methods of selecting papers for technical conferences are inefficient.

Rowe, Manager, Digital Systems Department, Sylvania Electric, Needham, Mass., and Simmons, Lansdale, Pa., Tube Division of Philco, will be joined by Dr. J. V. N. Granger, Convention Director, and Dr. Bernard M. Oliver in the discussion.

The title of their paper was "Linotron—A Practical Device for Majority Logic," The discussion is entitled, "Can a Foolproof Method be Devised for Selecting Valid, High-Quality Technical Papers for Major Technical Conventions."

Other activities at this year's WESCON include the WESCON Banquet, the Future Engineers Program, the All-Industry Cocktail Party, and "Time Out for Fun," an event for ladies attending.

WESCON Banquet

The WESCON Banquet will be held Thursday evening, August 23, in the Biltmore Bowl of the Biltmore Hotel. Principal speaker will be Elmer W. Engstrom, President of the Radio Corporation of America. Dr. Zarem will be toastmaster. Jerry Gray and his band will provide the music.

Future Engineers Program

This year about 40 young engineers, representing schools in a dozen states, will participate in the Future Engineers Program. The program includes an exhibit of experiments, a technical seminar, awards luncheon and technical field trips. Students compete for $2,800 in scholarships, including the Lee DeForest and Frederick E. Terman awards. The students and their instructors are guests of the show.

Industrial Design Program

More than 200 entries have been accepted in the Fourth Annual Industrial Design Award Competition. The Pacesetter Award will be given the product evidencing the most original design effort. Richard Neutra, world-famous architect, will present the award at a seminar on "Industrial Design and World Trade." Instruments, systems, components, test equipment and other electronic products will be judged on the basis of design for ultimate usefulness and basic appeal.

Cocktail Party

WESCON delegates and their wives traditionally point to the All-Industry Cocktail Party as a social "must." This year's party will be held, as usual, on WESCON's opening day, Tuesday, August 21. It will take place at the world-famed Palladium in Hollywood, from 6 to 8 p.m.

Ladies Program

The Women's Program, "Time Out for Fun," will include a flower-arranging show, a Los Angeles Tour, a fashion show and a visit to Disneyland. Headquarters for the women's activities will be in the Hospitality Room of the Statler-Hilton.

Field Trips

Field Trips for this year's show will include the following:

Tuesday afternoon, August 21—Guidance and Control Systems Division, Litton Systems, Inc., Woodland Hills, to view the production and development facilities for inertial navigation systems.

Wednesday morning, August 22—Rocketdyne Division, North American Aviation, Inc., Canoga Park, to view the rocket engine testing facility in the Santa Susana Mountains. Actual test firings are planned.

Wednesday afternoon, August 22 — ElectroData Division, Burroughs and Consolidated Electrodynamics Corporation, to show special techniques in manufacturing the new B200 and B5000 computing systems; also Bell and Howell Research Center, to view Consolidated Electrodynamics data-recorder and analytical and control divisions.

Wednesday, August 22, all day—All-day cruise from Los Angeles Harbor on a U. S. Navy LCG Class Missile Cruiser. Participants will be given a briefing and demonstration of unclassified electronics communications and control systems on a modern Navy ship.

Thursday morning, August 23—Jet Propulsion Laboratory. The tour will encompass environmental testing facilities, the space simulator and spacecraft assembly facilities. Project engineers will explain JPL's responsibility for designing and supervising construction of spacecraft systems.

Thursday afternoon, August 23—Hughes Semiconductor Division, Newport Beach, to view semiconductor production, from preparation of crystals to the final assembly of diodes, transistors and rectifiers. The latest versions of these products will be shown.

Friday morning, August 24—NBC Color Studios, Burbank, to see latest engineering developments and electronic equipment for network colorcasts. T. W. Sarnoff, Vice President for West Coast Operations, will welcome the tour. A live camera demonstration is scheduled.

Show Committees

Chairman of the 1962 WESCON Board is Albert J. Morris, who also headed the board last year. The other top executives are also repeaters from the group which put on last year's successful San Francisco show.

These executives include O. H. Brown, Chairman, Executive Committee; Calvin C. Townsend, Show Director; Granger, Convention Director; and Don Larson, WESCON Manager.

The 14 working committees which helped make up WESCON were made of about 300 industry volunteers. Each committee was given full responsibility for its event or show surface. Hard work over a period of five months helped make the 1962 WESCON possible.

Special Invited Sessions

SESSION A: August 21, 2:00 to 4:30 PM.
Pacific Ballroom, Statler-Hilton Hotel

BIOLOGICAL ASPECTS OF COMMUNICATIONS, by Prof. W. A. Rosenblith, Massachusetts Institute of Technology

BIOLOGICAL INFORMATION TRANSFER ON THE MOLECULAR LEVEL, by Prof. Alexander Rich, Massachusetts Institute of Technology

Electronic engineers and research personnel have a great deal to learn about the selective processes by which nature has arrived at the solution of electronic problems. These papers will discuss two aspects of the field of biology now attracting the interest of electronic research personnel.

SESSION B: August 22, 1:30 to 3:00 PM.
Pacific Ballroom, Statler-Hilton Hotel

WEATHER SATELLITES AND DATA PROCESSING, by David Johnson, Deputy Director, Meteorlogical Satellite Activities, U. S. Weather Bureau, Washington, D.C.

TIROS now provides meteorological information on a world-wide basis enabling maps unprecedentedly current. NIMBUS will enlarge these capabilities. Although simple to state, these activities are complex in character.

SESSION C: August 22, 3:15 to 4:45 PM.
Pacific Ballroom, Statler-Hilton Hotel

RESEARCH IN NUCLEAR TEST DETECTION, by Dr. George F. Bing, Assistant Director for Nuclear Test Detection, Advanced Research Projects Agency, Washington, D.C.

The international interest in this subject makes timely this discussion by the United States authority in the subject.

SESSION D: August 23, 2:00 to 4:30 PM.
Pacific Ballroom, Statler-Hilton Hotel
Advanced Propulsion — State of the Art Review on Devices
Moderator: Dr. A. M. Zarem, Electro-Optical Systems, Inc.

D/1 AN ANALYSIS OF POSSIBLE SPACE MISSIONS IN THE INTERVAL FROM 1963 TO 1978 DESCRIBING THE CONSEQUENT NEEDS FOR ADVANCED PROPULSION AND POWER SYSTEMS, by Dr. John Evaard, Deputy Associate Director, Lewis Research Center, NASA, Cleveland

D/2 A TUTORIAL PRESENTATION ON ELECTROMAGNETIC THRUST TECHNIQUES AND A REVIEW OF STATE OF THE ART ELECTRO-MAGNETIC THRUST DEVICES, by Dr. Jack Kerrebrock, M.I.T.

D/3 A TUTORIAL PRESENTATION OF ELECTROSTATIC THRUST TECHNIQUES AND A REVIW OF THE STATE OF THE ART FOR ELECTRO-STATIC THRUST DEVICES, by Dr. A. T. Forrester of Electro-Optical Systems, Inc.

D/4 A TUTORIAL PRESENTATION ON NUCLEAR PROPULSIVE TECHNIQUES AND A REVIEW OF THE STATE OF THE ART INCLUDING PROBLEM AREAS RELATING TO POWER INTEGRATION, by Dr. R. Bussard, Los Alamos Scientific Labs, New Mex.

SESSION E: August 24, 2:00 to 4:30 PM.
Pacific Ballroom, Statler-Hilton Hotel
Lunar Exploration
Program Chairman: Robert J. Gunkel, Douglas Aircraft Company, Missile and Space Systems Division, Santa Monica, California

E/1 PROGRESS REPORT ON RANGER, by James B. Burke, Ranger Project Manager, JPL, and Melvin R. Mesnard, JPL

E/2 PROGRESS REPORT ON SURVEYOR, by Walker E. Giberson, Surveyor Project Manager, JPL

E/3 PROGRESS REPORT ON SATURN, by Dr. Oswald H. Lange, George C. Marshall Space Flight Center, NASA, Huntsville

E/4 PROGRESS REPORT ON APOLLO, by Charles W. Frick, Manned Spacecraft Center, NASA, Houston, Texas

Tuesday, August 21

SESSION 1: CIRCUIT THEORY
9:00 am — 11:30 am

1/1 DISTRIBUTED PARAMETER CIRCUIT DESIGN TECHNIQUES by P. S. Castro, A. J. Nichols, and H. R. Kaiser, Lockheed Missiles & Space Co.
1/2 TRANSFER FUNCTION SYNTHESIS EMPLOYING ONE TUNNEL DIODE AND A PASSIVE RC LADDER NETWORK by G. Herskowitz and M. S. Ghausi, New York University
1/3 MINIMUM PERIOD OF OSCILLATION OF TUNNEL-DIODE OSCILLATORS by R. S. Pepper, University of California, Berkeley
1/4 HIGH POWER PARAMETRIC UPPER SIDEBAND UPCONVERTERS by H. Y. Miyahira, Space Technology Lab, Redondo Beach

Sponsored by: Professional Group on Circuit Theory
Session Chairman and Organizer: R. C. Booton, Space Technology Lab, Redondo Beach

SESSION 2: COMPUTER MEMORIES
9:00 am — 11:30 am

2/1 A PRACTICAL NON-DESTRUCTIVE RANDOM ACCESS TUNNEL DIODE MEMORY by James Y. Payton, Litton Systems, Woodland Hills, California
2/2 THE DESIGN OF A 4096 WORD ONE MICROSECOND MAGNETIC FILM STORE by J. B. James, B. J. Steptoe, and A. S. Kaposi, I-C-T (International Computers & Tabulators (Engrg.) Ltd., Stevenage, Hertfordshire, England
2/3 Inductive Coupled Read-Only Memory by J. G. Wamsley, IBM Corporation, Poughkeepsie, New York

Sponsored by: Professional Group on Electronic Computers
Session Organizer: Paul M. Davies, Abacus, Inc. Santa Monica, California
Session Chairman: To be appointed

SESSION 3: INSTRUMENTATION
9:00 am — 11:30 am

3/1 SPECTRUM ANALYSIS TECHNIQUES by Alexander Basil, Cutler Hammer Melville, L. I., New York
3/2 A HALL EFFECT INCREMENTAL ANGLE ENCODER by Earl R. Strandt, General Motors Corporation, Milwaukee
3/3 PROPERTIES AND APPLICATIONS OF A SENSITIVE MAGNETIC TRANSDUCER by A. P. Schmid and W. Rindner, Raytheon Company, Waltham, Mass.
3/4 CODING FOR LEAST RMS ERROR IN BINARY PCM CHANNELS by Jozsef Bodo, Ampex Corporation, Redwood City, California
3/5 A NEW P-N JUNCTION STRAIN TRANSDUCER by W. Rindner and R. Nelson, Raytheon Company, Waltham, Mass.

Sponsored by: Professional Group on Instrumentation
Session Chairman and Organizer: Edwin N. Kaufman, Litton Systems, Woodland Hills, California

SESSION 4: SPACE ELECTRONICS AND TELEMETRY
9:00 am — 11:30 am

4/1 IONOSPHERE PLASMA FREQUENCY PROBE by Obed C. Haycock and Kay D. Baker, University of Utah, Salt Lake City
4/2 AN INTEGRATED SATELLITE TRACKING AND COMMUNICATION SYSTEM by Leonard Farkas, Radio Corporation of America, Moorestown, New Jersey
4/3 ANTENNA BEAM ELEVATION ANGLE FOR CONTROL OF TROPOSPHERIC INTERFERENCE BETWEEN SPACE/EARTH AND TERRESTRIAL STATIONS by S. G. Lutz, Hughes Research Lab, Malibu, California, and W. J. Hartmen, U. S. Bureau of Standards, Boulder, Colorado
4/4 CONSIDERATIONS ON COMMUNICATION WITH INTELLIGENT LIFE IN OUTER SPACE by Morris Handelsman, Radio Corporation of America, Princeton, New Jersey

Sponsored by: Professional Group on Space Electronics and Telemetry
Session Organizer and Chairman: Warren S. Pope, North American Aviation, Downey, Calif.

SESSION 5: COMPONENT PARTS
9:00 am — 11:30 am

5/1 OPTIMIZED DESIGN OF TRANSFORMERS FOR APPLICATION IN SILICON CONTROLLED RECTIFIER EXTINCTON AND IGNITION CIRCUITS by Ronald J. Hruby, Nortronics, Anaheim, California
5/2 POWER TRANISTOR RELIABILITY by A. Ralph Greenburg, Motorola Inc., Phoenix
5/3 OPTIMUM DESIGN OF MEDIUM POWER TRANSISTOR HEAT SINKS by Dr. Herbert Tramposch, IBM Corporation, Poughkeepsie, New York
5/4 CAUSE AND CORRECTION OF PHASE DISTORTION IN PULSE EXCITED LONG ULTRASONIC DELAY LINES by P. S. Fuss and R. M. Lauver, Bell Telephone Company, Whippany, New Jersey

Sponsored by: Professional Group on Component Parts
Session Chairman and Organizer: Jack E. Fort, National Cash Register Company, Hawthorne, California

Wednesday, August 22

SESSION 6: PATTERN RECOGNITION
9:00 am — 11:30 am

6/1 AN OPTICAL DECISION by R. D. Joseph, P. M. Kelly and S. S. Viglione, Astropower, Inc., Costa Mesa, California
6/2 A RECOGNITION LOGIC DESIGNED FOR HAND PRINTED CHARACTERS by Seymour Spilerman, IBM Corporation, New York
6/3 THE APPLICATION OF INTEGRAL GEOMETRY TO MACHINE RECOGNITION OF VISUAL PATTERNS by Geoffrey H. Ball, ITT Federal Laboratories, Palo Alto
6/4 A MACHINE FOR PERFORMING VISUAL RECOGNITION BY USE OF ANTENNA-PROPAGATION CONCEPTS by Harry Blum, Cambridge Research Lab, U. S. Air Force, Bedford, Mass.

Sponsored by: Professional Group on Information Theory
Session Organizer: R. E. Kalaba, Rand Corporation, Santa Monica

SESSION 7: MICROWAVE THEORY AND TECHNIQUES
9:00 am — 11:30 am

7/1 MICROWAVE PHASE MEASUREMENT OF DISPERSED PULSE TRANSMITTER SYSTEMS by R. F. Koontz, Radio Corporation of America, Moorestown, New Jersey
7/2 4 Gc PARAMETRIC AMPLIFIER FOR SATELLITE COMMUNICATION GROUND STATION RECEIVER by M. Uenohara, M. Chruney, K. M. Eisele, D. C. Hanson, and A.L. Stillwell, Bell Telephone Lab, Murray Hill, New Jersey
7/3 ADVANCES IN FERRITE ROTATING-FIELD PHASER DESIGN by Jerald A. Weiss, Hyletronics Corporation, Burlington, Mass.
7/4 PRACTICAL PROBLEMS IN THE DESIGN OF TUNNEL DIODE AMPLIFIERS by John C. Hoover, Sperry Microwave Electronics Company, Clearwater, Florida

Sponsored by: Professional Group on Microwave Theory and Techniques
Session Chairman: A. Clavin.
Session Organizer: Warren C. Perry, Bendix Pacific, North Hollywood, California

SESSION 8: COMPUTER MECHANIZATION
9:00 am — 11:30 am

8/1 THEORETICAL & EXPERIMENTAL EVALUATION OF RZ AND NRZ RECORDING CHARACTERISTICS by Irving Stein and M. F. Barkouki, Ampex Corporation, Redwood City, California
8/2 A UNIFIED APPROACH TO THE DESGN OF SOLID-STATE INTEGRATED LOGIC ELEMENTS by R. H. Beeson and O. R. Baker, Signetics Corporation, Sunnyvale, California
8/3 EXPERIMENTAL 100-mc TUNNEL-DIODE DDA by E. R. Beck and G. A. Brumm, Bendix Corporation, Southfield, Michigan

Sponsored by: Professional Group on Electronic Computers
Session Organizer: Paul M. Davies, Abacus, Inc. Santa Monica, California
Session Chairman: To be appointed

Technical Papers Program

SESSION 9: AERONAUTICAL AND NAVIGATIONAL ELECTRONICS

9:00 am — 11:30 am

9/1 AN ACCURACY STUDY OF A DOPPLER NAVIGATION SYSTEM ASSUMING TIME-STATIONARY RANDOM INPUT ERRORS by C. James Styers, Collins Radio Company, Cedar Rapids, Iowa
9/2 MARK TWAIN BEACONRY FOR LUNAR ORBITING AND LANDING by William E. Muntz, General Electric Company, Utica, New York
9/3 HIGH ALTITUDE RADIO ALTIMETER SIMULATION STUDY by A. R. Edison, R. K. Moore, B. D. Warner, and W. W. Koepsel, University of New Mexico, Albuquerque
9/4 TWO METHODS OF GYROLESS NAVIGATION by Eugene Ohlberg, Nortronics, Palos Verdes Estates, California

Sponsored by: Professional Group on Aeronautical and Navigational Electronics
Session Chairman and Organizer: Stephen Z. Szirmay, Jet Propulsion Lab, Pasadena, Calif.

SESSION 10: PRODUCT ENGINEERING AND PRODUCTION

9:00 am — 11:30 am

10/1 A NEW APPROACH TO MINIATURE MAGNETIC TAPE TRANSPORT DESIGN by R. S. Anderson, Weber Aircraft Corporation, Burbank
10/2 WELDABLE PRINTED CIRCUITS by Dimitry Grabbe, Geo. Messner and James Saffery, Photocircuits Corporation, Glen Cove, New York
10/3 A LOGICALLY CONSISTENT SYSTEM OF COMPONENTS AND TECHNIQUES FOR TRANSISTORIZED RADIO SETS by Ir J. Rodrigues de Miranda, Philips, Eindoven-Nederland

Sponsored by: Professional Group on Product Engineering and Production
Session Chairman and Organizer: George R. Beck, Space Technology Lab, Redondo Beach, California

Thursday, August 23

SESSION 11: COMPUTER THEORY

9:00 am — 11:30 am

11/1 THE STANDARDIZATION OF PERIPHERAL INTERFACES by Marvin Jacoby, Remington Rand Univac, Blue Bell, Pennsylvania
11/2 A REAL TIME FUNCTION ANALYZER-SYNTHESIZER USING ORTHOGONAL POLYNOMIALS by Arthur H. Ballard, Bernard Electronics Company, Washington D.C.
11/3 INEXPENSIVE CONTROL VIA MODAL COMPUTERS by Floyd George Steele, Modal Systems, Inc., La Jolla, California

Sponsored by: Professional Group on Electronic Computers
Session Organizer: Paul M. Davies, Abacus, Inc., Santa Monica, California
Session Chairman: To be appointed

SESSION 12: ANTENNA AND PROPAGATION

9:00 am — 11:30 am

12/1 RANGE LUNAR CAPSULE ANTENNA by W. G. Scott, Ford Motor Co., Newport Beach
12/2 A SELF-FOCUSING ANTENNA by M. Breese and P. Sferrazza, Sperry Gyroscope Company, Great Neck, New York
12/3 THE 'DOUBLE HELIX' AND ITS VARIANTS: A NEW CLASS OF TUNABLE ENDFIRE ANTENNAS by H. W. Ehrenspeck Cambridge Research Lab, United States Air Force, Bedford, Mass.
12/4 ANTENNA BEAM SHIFTING BY DUAL MODES by Takashi Kitsuregawa and Seibei Tachikawa, Mitsuhishi Electric Mfg. Company, Amagasaki, Hyogo Prefecture, Japan

Sponsored by: Professional Group on Antennas and Propagation
Session Organizer: L. L. Bailin, Hughes Aircraft Co., Culver City, California
Session Chairman: Kenneth C. Kelly, Hughes Aircraft, Culver City, California

SESSION 13: SOLID STATE DEVICES

9:00 am — 11:30 am

13/1 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF SILICON SEMI-CONDUCTORS FOR GOLD AND ANTIMONY by J. D. Buchanan, Diane M. Fleishman, V. P. Buinn and R. R. Ruch, General Dynamics, San Diego, California
13/2 SURFACE STABLIZED HIGH VOLTAGE DIODES by T. C. Hall, Micro Semiconductor Corporation, Culver City, California
13/3 PLANAR EPITAXIAL PNPN SWITCH WITH GATE TURN-OFF GAIN by Thomas A. Longo, Marvin Miller, Albert E. Derek and Joseph D. Eknaian, Sylvania Electric Products, Woburn, Mass.
13/4 LINOTRON — A PRACTICAL DEVICE FOR A MAJORITY LOGIC by W. D. Rowe, Sylvania Electronic Systems, Needham, Mass. and C. D. Simmons, Philco Corporation, Lansdale, Pa.

Sponsored by: Professional Group on Electron Devices
Session Organizer: John E. Nevins, Jr., Hughes Research Laboratory, Malibu, California
Session Chairman: Jan Black, El Monte, Calif.

SESSION 14: COMMUNICATION SYSTEMS

9:00 am — 11:30 am

14/1 THE DESIGN AND CAPABILITIES OF FEEDBACK FM RECEIVERS by R. M. Gagliardi, Hughes Aircraft, Culver City, California
14/2 CHIRP SIGNALS FOR COMMUNICATIONS by Marion R. Winkler, Radio Corporation of America, Tucson, Arizona
14/3 REAL CHANNEL ASPECTS OF AN ERROR-FREE DATA TRANSMISSION SYSTEM FOR TOLL-GRADE TELEPHONE CIRCUIT by W. G. Schmidt, Massachusetts Institute of Technology
14/4 THE APPLICATION OF CORRELATION TECHNIQUES TO METEOR BURST COMMUNICATIONS by John D. Belenski, The Boeing Company, Seattle

Sponsored by: Professional Group on Communication Systems
Session Chairman and Organizer: Lawrence R. Norwood, Aerospace Corporation, El Segundo, California

SESSION 15: RELIABILITY AND QUALITY CONTROL

9:00 am — 11:30 am

15/1 FAILURE THERBLIG FAILURE RATES by D. R. Earles and M. F. Eddins AVCO Corporation, Wilmington, Mass.
15/2 OPTIMIZING RELIABILITY by John C. Kemp, General Electric Company, Ithaca, New York
15/3 HIGH POWER LIFE TESTING OF TRANSISTORS by K. W. Doversberger, Delco Radio Division, General Motors, Kokomo, Indiana
15/4 THE RELIABILITY OF SYSTEMS UNDER RANDOM DEMANDS by Kenneth M. Hall and Kenneth M. Zenkere, Sylvania Electronic Products, Mountain View, California

Sponsored by: Professional Group on Reliability and Quality Control
Session Organizer: Donald P. Boe, Space-General, El Monte, California
Session Chairman: To be named

Friday, August 24

SESSION 16: GENERAL TOPICS IN INFORMATION THEORY

9:00 am — 11:30 am

16/1 ADAPTIVE INFORMATION PROCESSING by S. S. L. Chang, New York University
16/2 MAXIMAL PATHS ON THE N-CUBE AND GENERATION OF CODES by Ivan T. Frisch and Wan H. Kim, Columbia, University
16/3 A COMPARATIVE EVALUATION OF SEQUENTIAL DECODING ALGORITHMS by D. M. Jones, W. R. Wadden, and J. J. Bussgang, Radio Corporation of America, Burlington, Mass.
16/4 A RECONSIDERATION OF CERTAIN TOPICS IN NYQUIST'S TELEGRAPH TRANSMISSION THEORY by R. A. Gibby, Bell Telephone Lab, Murray Hill, New Jersey

Sponsored by: Professional Group on Information Theory
Session Chairman and Organizer: R. E. Kalaba Rand Corporation, Santa Monica, California

SESSION 17: ELECTRON DEVICES II

9:00 am — 11:30 am

17/1 RECENT DEVELOPMENTS IN FIELD EMISSION by W. P. Dyke, F. M. Charbonnier and F. J. Grundhauser, Field Emission Corporation, Mc-Minnville, Oregon
17/2 DESIGN METHOD FOR HIGH-CONVERGENCE, HIGH-PERVEANCE SOLID BEAM GUNS by R. D. Frost, O. T. Purl and H. R. Johnson, Watkins-Johnson Company, Palo Alto, California
17/3 AD-C PUMPED COUPLED MODE PARAMETRIC AMPLIFIER WITH DEPRESSED COLLECTOR by James E. Dalley and C. C. Johnson, University of Utah
17/4 RECENT ADVANCES IN NON-REENTRANT, CROSSED-FIELD, FORWARD-WAVE AMPLIFIERS by J. F. Hull, G. E. Pokorny, and C. P. Kooyers, Litton Industries, San Carlos, California

Sponsored by: Professional Group on Electron Devices
Session Chairman and Organizer: John E. Nevins, Jr., Hughes Research Lab, Malibu, Calif.

SESSION 18: AUTOMATIC CONTROL

9:00 am — 11:30 am

18/1 STATE TRANSITION FLOW GRAPHS OF CONTINUOUS AND SAMPLED DYNAMIC SYSTEMS by Benjamin C. Kuo, University of Illinois
18/2 STABILITY OF SAMPLED-DATA CONTROL SYSTEMS, A SIMPLE CRITERION by P. W. Becker, General Electric Company, Syracuse, New York
18/3 HIGH-FREQUENCY SIGNAL INJECTION: A MEANS OF CHANGING THE TRANSFER CHARACTERISTICS OF NONLINEAR ELEMENTS by Olle I. Elgerd, University of Florida
18/4 ON THE OPTIMUM DESIGN OF PREDICTOR CONTROL SYSTEMS by Sheldon Horing, Polytechnic Institute of Brooklyn

Sponsored by: Professional Group on Automatic Control
Session Chairman and Organizer: Walter K. Waymeyer, Douglas Aircraft Company

SESSION 19: MILITARY ELECTRONICS

9:00 am — 11:30 am

19/1 OPTIMAL BANG-BANG GUIDANCE SYSTEM by G. L. Harmon, K. E. Kent, and W. O. Purcell, Martin Marietta Corporation, Orlando, Fla.
19/2 PERFORMANCE OF DIGITAL COMMUNICATION SYSTEMS IN AN ARBITRARY FADING RATE AND JAMMING ENVIRONMENTS by A. B. Glenn and G. Lieberman, Radio Corporation of America, Camden, New Jersey
19/3 ELECTROMAGNETIC SUSCEPTIBILITY TESTING TECHNIQUES FOR AIRBORNE EQUIPMENT by C. B. Pearlston, Jr., Nortronics, Hawthorne
19/4 LONG-RANGE CW RADAR by B. E. Potter, Sperry Gyroscope Company, Great Neck, L. I. New York

Sponsored by: Professional Group on Military Electronics
Session Chairman and Organizer: Paul F. Glaser, Space Technology Lab, Redondo Beach, Calif.

SESSION 20: ENGINEERING MANAGEMENT

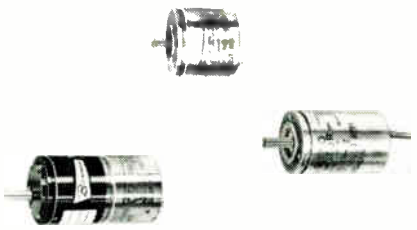
9:00 am — 11:30 am

20/1 COMMUNICATIONS FOR THE ENGINEERING MANAGER by John B. Bennett, Organizational Communication, Los Angeles, California
20/2 SOME ASPECTS OF THE POLICY FOR THE FORMULATION OF NAVAL ACTIVITY LONG RANGE PLANS (LRP), by Lyman E. Wood, U. S. Naval Missile Center, Point Mugu, California
20/3 A SIMPLIFIED WORK-LOAD EVALUATION AND COST CONTROL METHOD FOR REPORT PRODUCTION by Paul Alelyunas, Radio Corporation of America, Moorestown, New Jersey

Sponsored by: Professional Group on Engineering Management
Session Chairman and Organizer: Charles McPheeters, Pacific Missile Range, Point Mugu, California

SESSION 21: STATE OF THE ART— INTEGRATED CIRCUITS

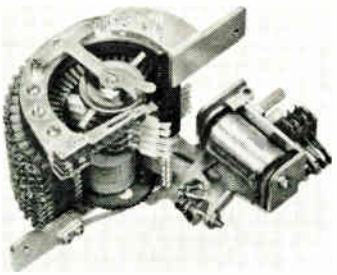
A panel discussion of the optimum technological trade-off between the multiple device subassembly and its intimately related system application. Six representatives of industry, three from large users doing prototype work, and three from the components/semiconductor industry, active in supplying integrated devices, will participate, and the discussion will cover the broad area of traditional vendor/use system practicability.



Size 8 Servo Motors

Type M80-000, are "high torque" motors giving 0.35 in. of torque at stall. A size 10 motor, M100-502, measures 0.781 in., exclusive of the shaft and terminals. Bowmar Instrument Corp., BOOTH 845.

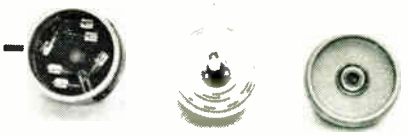
Circle 244 on Inquiry Card



Computer Relays

Three mercury-wetted-contact relays. V52, V53 and V54, with multiple capsules give 2-, 3-, and 4-pole contact assemblies. Switch 250va loads with a max. of 5a or 500v. Automatic Electric Co., BOOTH 2004.

Circle 247 on Inquiry Card



Digital Encoders

Custom-coded analog/digital shaft position units of brush-type design have capacities of 5-13 bits/disc for 30 to 8192 counts/rev. Guidance Controls Corp., Subs. Warner Electric Brake & Clutch Co., BOOTH 3113.

Circle 249 on Inquiry Card

Readout Device

Miniature readouts features front panel access. Operate on a projection principle with 12 miniature lamps lo-

cated at rear of the readout. Industrial Electronic Engineers, Inc., BOOTH 3449.

Circle 245 on Inquiry Card

See These Products At WESCON

Programmable Supply

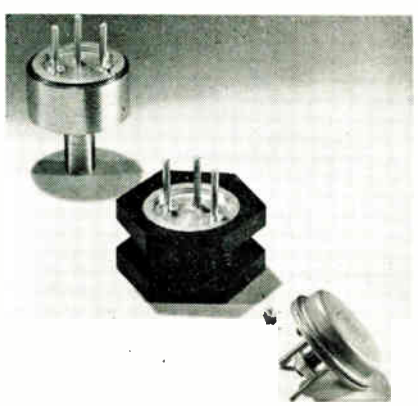
Wide range laboratory power supply Model TR60-2, measures 3½ x 8⅝ in., and gives a highly regulated,

continuously adjustable output of 0-60vdc at 0-2a. Electronic Research Associates, Inc., BOOTH 1019.

Circle 250 on Inquiry Card

Power Transistors

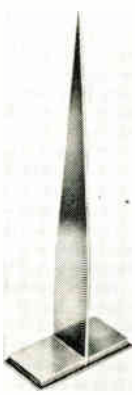
Series MHT 1800, 1900 and 2000 are pnp germanium units. At 65a I_C, h_{FE} is 20 min. $V_{CE(SAT)}$ is 0.45v max. $V_{BE(SAT)}$ is 2v max. Minneapolis-Honeywell Regulator Co., Semiconductor Div., BOOTH 2013.



Circle 246 on Inquiry Card

Waveguide Terminations

This series of low VSWR waveguide terminations is rugged and durable under severe shock and vibration environments. They are available in power ratings from ¼ to 3w. Filmohm Corp., BOOTH 3801.

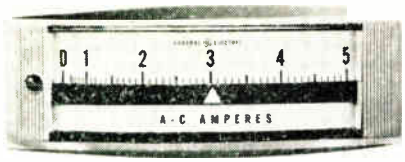


Circle 248 on Inquiry Card

Noise Analyzer

This transistorized, portable sonic proportional bandwidth unit, Model LPP-4, measures acoustic noise and vibration in the 4 to 20,000CPS frequency range. Panoramic Electronics, Inc., BOOTH 3354.

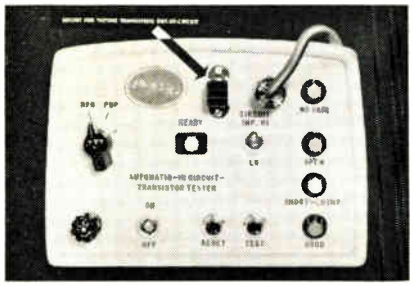
Circle 251 on Inquiry Card



Indicating Instruments

Type 180 horizontal and vertical indicating, self-shielded, slim-line ammeters and voltmeters designed with a full 4½ in. scale, in ac and dc models. Industrial Electronics Div., General Electric Co., BOOTH 107.

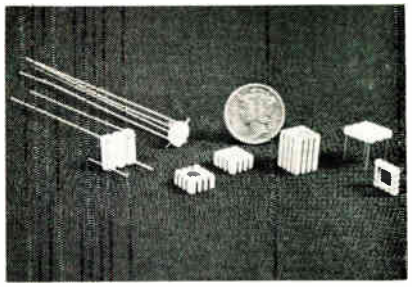
Circle 252 on Inquiry Card



Transistor Tester

Automatic lead finding, in-circuit tester checks power, switching, small signal, junction, alloy, and point contact transistors with GO-NO GO indications. American Electronic Laboratories, Inc., BOOTH 3044.

Circle 255 on Inquiry Card



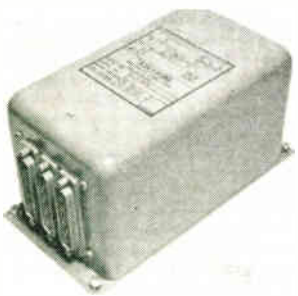
Substrate

Mykroy, when used for thin film deposition, provides substrates that are superior to aluminum oxide or glass in that they are readily machined and optically flat. Molecular Dielectrics, Inc., BOOTH 3313.

Circle 257 on Inquiry Card

Stepping Switch

This motorized Stepping Switch is capable of controlling 468 circuits. It is in a hermetically sealed housing



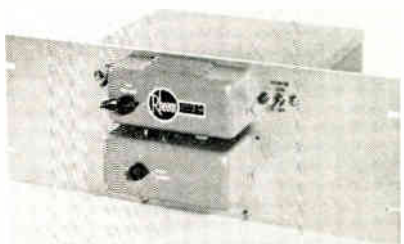
4 in. sq. and 7 in. long. Rated voltage is 26 to 30vdc. The A. W. Haydon Co., BOOTH 849.

Circle 253 on Inquiry Card

See These Products At WESCON

Punched Tape Readers

Photocell Punched Tape Readers, Models RR-21 and RR-101, are of the 20 and 100 inch per second types.

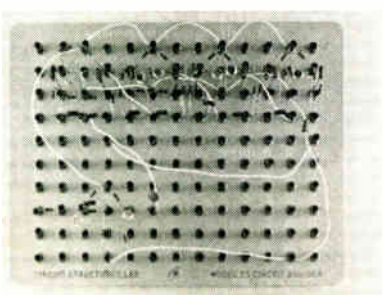


They feature transistor control and output circuits. Rheem Electronics Corp., BOOTH 544.

Circle 258 on Inquiry Card

Breadboard

The Circuit Builder allows components to be arranged approximately as they appear in a schematic for rapid evaluation. For use with tubes or semiconductors. Circuit Structures Lab., BOOTH 3141.



Circle 254 on Inquiry Card

Miniature Trimmer

This ½ in. round trimming potentiometer, Type CT-110 has standard resistance ranges from 10Ω to 50KΩ. Standard tolerance is ±5%. Power rating is 1.0w at 50°C. International Resistance Co., BOOTH 615.

Circle 256 on Inquiry Card

Diode-Noise Analyzer

Model 327 is for quantitative analysis of electrical noise generated in back-biased diodes, in some instances, forward-biased diodes, and particularly zener diodes. Quan-Tech Laboratories, Inc., BOOTH 304.

Circle 259 on Inquiry Card

Circle 75 on Inquiry Card ⟶

Cinch ELECTRONIC COMPONENTS

CONNECTORS, ENGINEERED FOR **SPECIFIC** RELIABILITY REQUIREMENTS.

TYKON EDGE CONNECTOR is what it's called.

TYKON is designed for double-sided .062" printed circuit boards.

TYKON is miniature in size. Contacts are spaced on .050" centers.

TYKON ribbon-type flexing action contacts guarantee a new plateau of reliability. (A flat surface yields more points of contact over an area than a round surface does on a line.)

TYKON is ideal for all high density connection jobs including: diodes on insulating substrates; memory planes (standard and thin film types); and almost any type of modular plug-in unit.

TYKON is furnished with conventional wiring tails. It can also be made available with tails for wire wrapping or dip soldering.

TYKON is available in various sizes with 6 to 25 contact positions.

For additional information on this connector, or any connector requirement, write us at our Chicago office or contact your local Cinch representative.

HERE IT IS!
A NEW PLATEAU OF RELIABILITY FOR HIGH DENSITY CONNECTORS

This is a 25 contact position **TYKON** and a regular cigarette **in actual size**

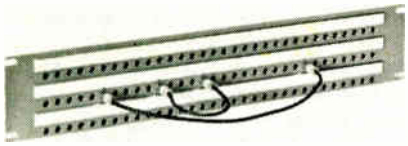
FEATURES:

- **CONTACT MATERIAL**—PHOSPHOR BRONZE, FLAT RIBBON
- **CONTACT FINISH**—COPPER FLASH PLUS .00003 GOLD PLATE PER MIL-G-45204 TYPE II
- **INSULATOR MATERIAL**—GLASS-FILLED ALKYD TYPE: MAI-30 PER MIL-M-14F

See the new TYKONS at the Wescon Show
Booths 2169-2172
(Also the new Ultrekon and Cosi-kon connectors.)

CINCH MANUFACTURING COMPANY
1026 South Homan Avenue, Chicago 24, Illinois
Plants located at Chicago, Illinois; Shelbyville, Indiana, City of Industry, California; St. Louis, Missouri.

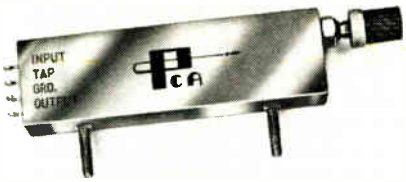
DOT **A DIVISION OF UNITED-CARR FASTENER CORPORATION, BOSTON, MASSACHUSETTS**



Coaxial Patching System

I-F and video patch panels for installation in standard 19 in. cabinets, are for 52 or 72Ω systems using RG-8 9/11/55/58/59/62 or miniature cables. Trompeter Electronics., BOOTH 3138.

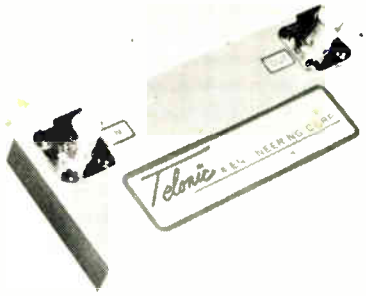
Circle 260 on Inquiry Card



Variable Delay Line

Features: range—0.05 to 1.0μsec. total delay; rise time—approximately 0.14μsec.; attenuation — less than 15%; and impedance — 500 to 1000Ω. PCA Electronics, Inc., BOOTH 536.

Circle 263 on Inquiry Card



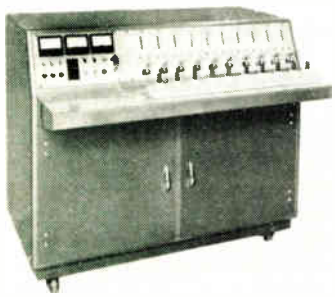
Interdigital Filter

Microwave Filter, Series TIF, has low insertion loss and uses field-coupled, quarter-wave resonators for sharp passband characteristics. Telonic Engineering Corp., BOOTH 3606.

Circle 265 on Inquiry Card

Dry Circuit Tester

The Miss Tester is a completely packaged, automatic contact resistance tester for dry circuit testing,



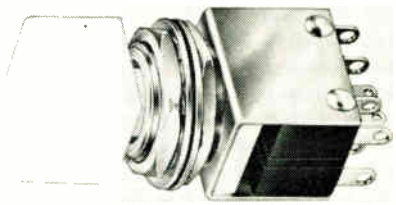
to high-reliability standards, of make/break contact devices. Hi-G, Inc., BOOTH 802.

Circle 261 on Inquiry Card

See These Products At WESCON

Pushbutton Switch

These lighted pushbutton switches, 01 Series, combine panel indicating and manual switching functions in a



single compact package. Four different types available. Licon Div., Illinois Tool Works Inc., BOOTH 705.

Circle 266 on Inquiry Card

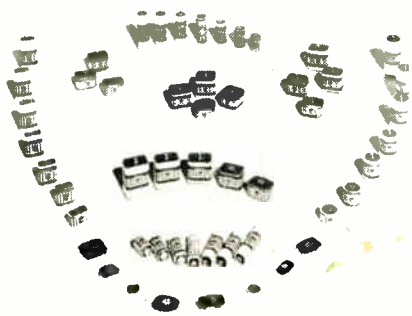
Octave-Band Analyzer

Type 1558-A Octave-Band Noise Analyzer measures sound-pressure level in 10 octave bands as well as overall level. Type 1588-A is fully transistorized and battery-operated. General Radio Co., BOOTH 643.

Circle 262 on Inquiry Card

Miniaturized Batteries

This line of 44 types of miniature batteries are for use with transistorized circuits. They come in 8 different power ratings, ranging from 3 to 13½v in 1½v increments. Burgess Battery Co., BOOTH 710.



Circle 264 on Inquiry Card

P.C. Receptacle

Micro-Edge® printed circuit or printed wiring receptacle, Series 64, Model 64-1, is a 25-contact unit with 0.025 in. centers. Amphenol Connector Div., Amphenol-Borg Electronics Corp., BOOTH 919.

Circle 267 on Inquiry Card

Circle 76 on Inquiry Card ⟶

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NEW FROM
SANGAMO

TOUGHER
TANTALUM
CAPACITORS

TANTALUM
CAPACITORS

These solid electrolyte capacitors, Sangamo Type 595, represent a distinct achievement in tantalum capacitors. They utilize Sangamo's exclusive "Innerseal" construction with the terminals mechanically secured to the tubular container and precisely positioned without regard to the capacitor element. The seal is produced with a minimum of solder and flux, and with minimum thermal and mechanical stress on the glass insulator. There is absolutely no reliance on solder for mechanical strength. That's why these *tougher* units give peak performance under the most drastic shock and vibration conditions.

Sangamo tantalum capacitors comply with all the electrical and mechanical requirements of Mil-C-26655A.

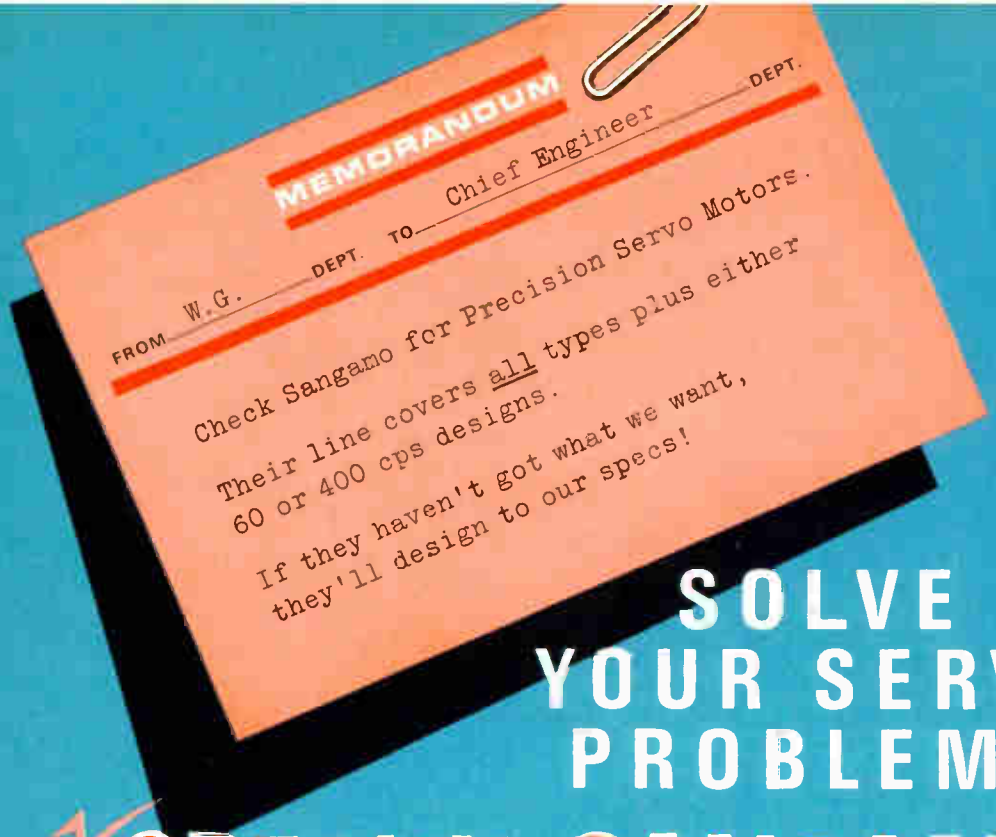
Basically, these tantalum capacitors provide the highest capacitance per-cubic-inch in an extremely small and strong, hermetically sealed package.

Sangamo Type 595 capacitors are designed for filter, by-pass, coupling, blocking, and low voltage applications in telemetering devices, airborne systems, computers, missiles, and transistor circuits. They have low dissipation factor, low dc leakage, and excellent shelf life. They are available in capacitance values of 0.22 to 330 mfd, and in voltages from 6 to 35 WVDC. They're suitable for operation at full-rated voltages over a temperature range of —80°C to +65°C and, when properly derated, will operate up to +125°C. Complete information is yours for the asking.

SANGAMO
ELECTRONIC COMPONENTS

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

EC62-1



SOLVE YOUR SERVO PROBLEMS

SPECIFY SANGAMO

For special precision servo motors to meet your most exacting requirements—order from Sangamo. Sizes range from 5 to 25 with most designs available in either 60 or 400 cps.

For more than 20 years Sangamo has been manufacturing quality AC servo motors induction generators, drag cup motors, synchros, PM generators, synchronous motors, and motor generators. Most of these types are available from stock and we are prepared to modify our designs to your system where necessary. If this is not possible, our engineers will design to meet your specifications.

You can solve your servo motor problems by discussing your requirements with a Sangamo Precision Motor Sales Engineer. Please write for further information on Sangamo's complete line.

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GEARED MOTOR GENERATORS

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DRAG CUP MOTORS

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PM61-2

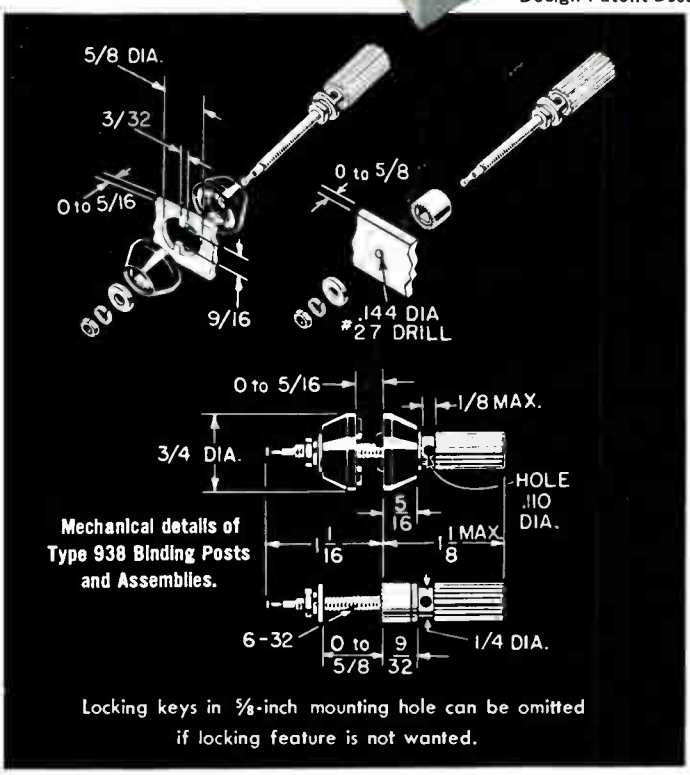
For Engineers Seeking the Best Connection

Design Patent D161,030

4,000 volts | peak
30 amperes |

10,000 volts peak breakdown

Dissipation Factor = 0.0005 at 1000 cps



Mechanical details of Type 938 Binding Posts and Assemblies.

Locking keys in ⅝-inch mounting hole can be omitted if locking feature is not wanted.

Type	Description	QUANTITY PRICES 10-99	100-999	1000-1999	2000 up
938-P	Metal top binding post with metal spacer	.50	.36	.34	.32
938-WB	Black top, black insulator	.70	.47	.44	.40
938-WR	Red top, red insulator	.70	.47	.44	.40
938-L	Captive shorting link	.10	.09	.09	.09

- ★ Banana plug fits into body of post, NOT just the top
- ★ Chamfered tops insure proper seating of banana plugs
- ★ All tops captive to prevent loss
- ★ No awkward lugs — you solder directly to turret on mounting stud
- ★ Grounding post has spacer for proper height — knurl on bottom of spacer bites into panel for good contact and prevents rotation
- ★ Will accommodate telephone cord tips, spade terminals, slender alligator clips, etc. — contoured cross-hole grips without shearing any wire from A.W.G. No. 40 to No. 10
- ★ Interlocking, anti-rotation keyed bases for any panel thickness to 5/16". If keying is not desired, ⅜" hole in panel frees key.
- ★ Polystyrene insulating bushings, hollowed to minimize solid dielectric
- ★ Low dielectric constant and dissipation factor
- ★ High leakage resistance
- ★ Minimum moisture effects

A sample G-R Binding Post available on request.

GENERAL RADIO COMPANY

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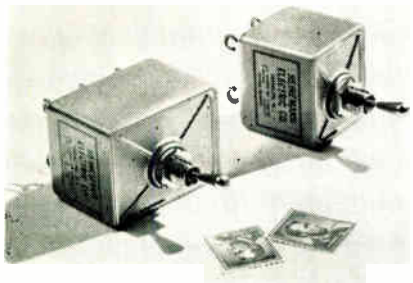
← Circle 152 on Inquiry Card

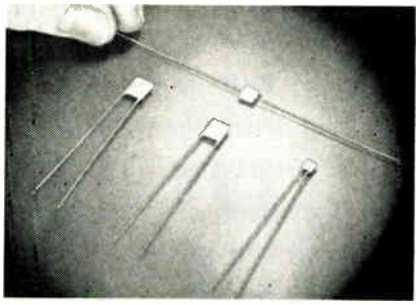
Circle 77 on Inquiry Card



Circuit Breakers

Series SM, 2- and 3-pole subminiature breakers available in current ratings from 0.050 to 15a. Voltage ratings: 120vac, 60CPS; 120vac, 400-CPS; and 50vdc. Heinemann Electric Co., BOOTH 449.

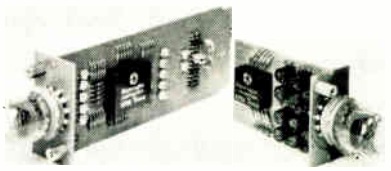
Circle 268 on Inquiry Card



Subminiature Capacitors

Slim-rectangular design for max. circuit component density, available in broad range of capacities and temp. coefficients. Rated 50vdcw at 85°C and derated 50% at 125°C. Hi-Q Div., Aerovox Corp., BOOTH 2032.

Circle 271 on Inquiry Card



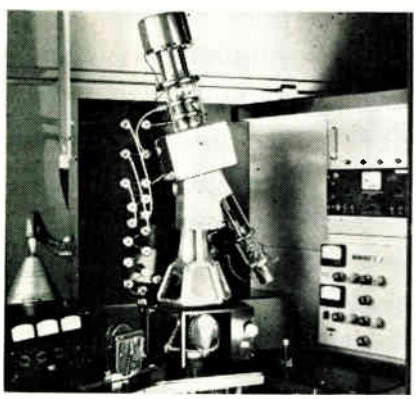
Decade Counter

The BIP-8001 is a decimal decade counter with 100KC freq. capability. The BTR-58A is a BCD to a decimal decoder accepting 8-4-2-1 binary information. Burroughs Corp., Electronic Components Div., BOOTH 1017.

Circle 273 on Inquiry Card

Electron Microscope

Electron Mirror Microscope displays dynamic behavior—moving electric charge patterns, magnetic do-



mains set in motion by mechanical strain or applied fields. General Mills Electronics Group, BOOTH 3050.

Circle 269 on Inquiry Card

See These Products At WESCON

Hard Anodizing Unit

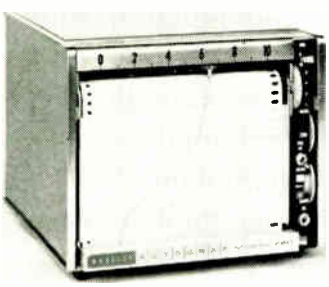
This low-cost hard-anodizing unit with fully-automatic constant current control can be used for all types of

anodizing including straight chromic, sulfuric, and oxalic acids. Selectrons, Ltd., BOOTH 3939.

Circle 274 on Inquiry Card

Strip Chart Recorder

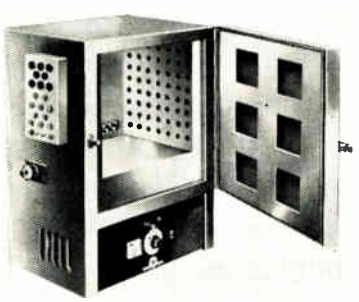
The Moseley Model 681 features: customer selected single span, dual chart speed; one-half sec. max. balance time; 0.2% full scale accuracy; and all solid state circuitry. F. L. Moseley Co., BOOTH 552.



Circle 270 on Inquiry Card

Saturable Reactor Oven

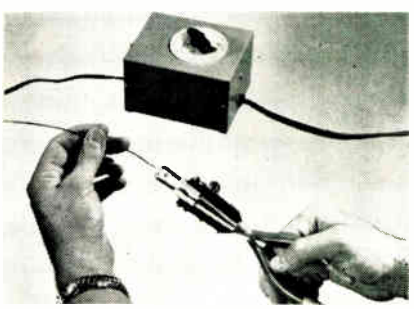
Designed for the semiconductor industry, for the Thermal-Resistance Break-Down testing of semiconductor diodes, rectifiers, and capacitors at 60°, 85°, and 125°C. Blue M. Electric Co., BOOTH 3547.



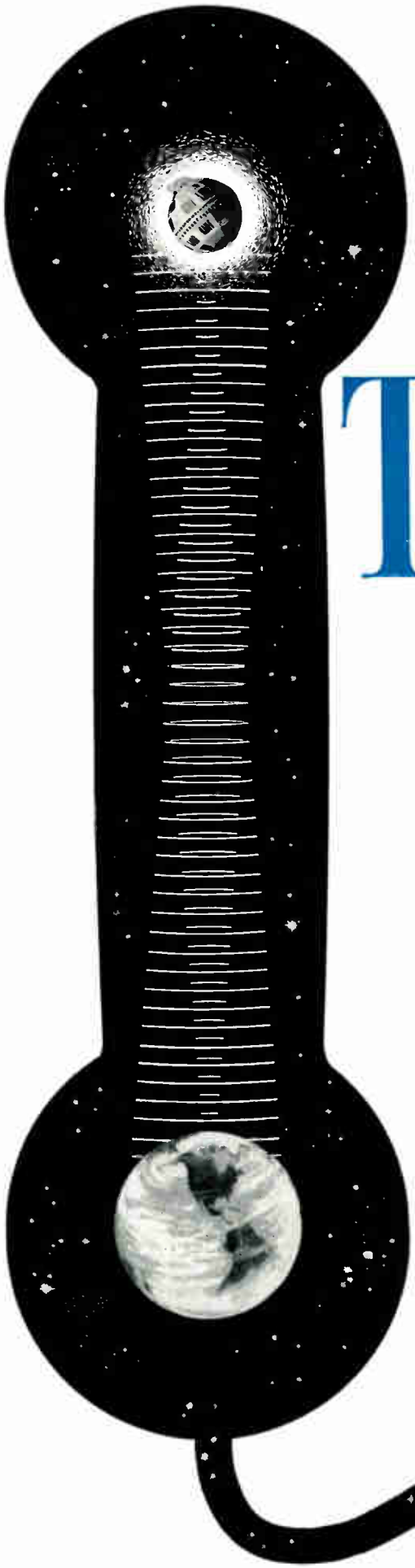
Circle 272 on Inquiry Card

Thermal Wire Stripper

Plier Style Thermal Wire Stripper has rheostat heat control for stripping insulations from low heat vinyl to high heat teflon from wires 40 to 12AWG. R. N. Hunter Sales Co., Inc., BOOTH 3542.



Circle 275 on Inquiry Card



NEW MILESTONE

in world-wide telephony and TV

TELSTAR

ORBITING THE EARTH every 160 minutes at altitudes from 500 to 3,000 nautical miles is Bell Telephone Laboratories' NASA-launched *Telstar* . . . a major experimental step toward commercial communications via outer space.

Proudly sharing the *Telstar* payload are "Kemet" solid tantalum capacitors . . . selected by Bell Laboratories to play an important part in an experiment pointing toward more high quality voice channels and, ultimately, global television channels. Kemet engineers met the challenge of developing special *pedigreed* capacitors to match *Telstar's* rigid specifications.

Every step of the way—from tantalum ore to finished capacitors—production, testing, and inspection stages were meticulously controlled within Union Carbide. The end result was solid tantalum capacitors representing the highest performance under the present state of the art.

Kemet's contribution to *Telstar's* sophisticated circuitry exemplifies the craftsmanship that has enabled it to become—in a brief space of time—"The Specialist in Solid Tantalum Capacitors." Kemet Department, Linde Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio.

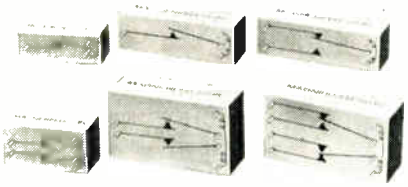
KEMET DEPARTMENT
LINDE COMPANY

UNION CARBIDE

"Kemet," "Linde," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

Circle 78 on Inquiry Card

See These Products At WESCON



Dry Reed Relays

Fast, low level and low load switching, combined with compact, quick and secure printed circuit mounting, is featured in Magnereed Encapsulated Relay assemblies. Magnecraft Electric Co., BOOTH 723.

Circle 308 on Inquiry Card

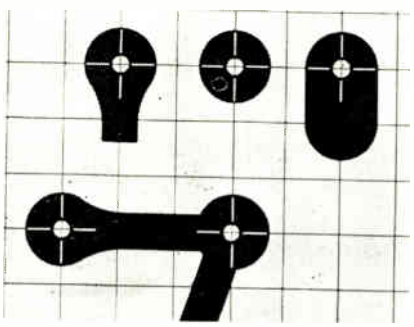
Microwave Oscillator

Type 2979C is a C-band plate-pulsed unit, with a power output of 400w min. at 5.4-5.9GC. It is 1 in. in dia. by 4 in. overall length, less output connector and weighs 8 oz. Trak Microwave Corp., BOOTH 648.

Circle 311 on Inquiry Card

Self-Registering Shapes

These pressure-sensitive, self-registering fillets and terminal circles for printed circuit master layout are die-

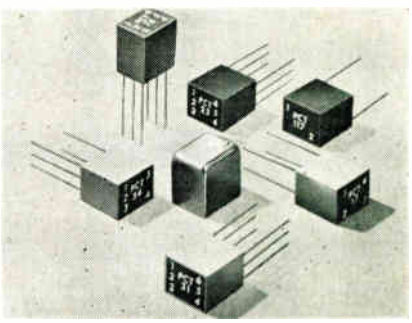


cut to ±0.005 in. with a small aperture in the exact center. W. H. Brady Co., BOOTH 3709.

Circle 309 on Inquiry Card

Transistor Transformers

Miniature series, called Polychromatrans, measure 0.410 x 0.310 x 0.465 in. and include output, isola-



tion, choke and interstage types. For printed circuits. Stancore Electronics, Inc., BOOTH 414.

Circle 312 on Inquiry Card

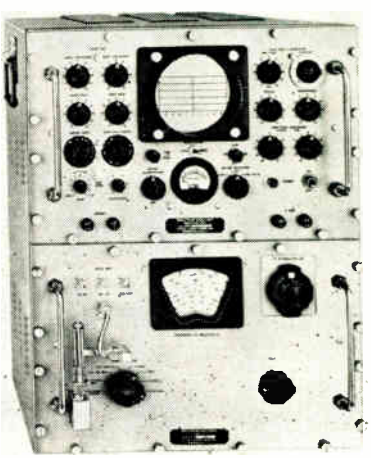
Salinometer

Model RS-5 Electrodeless Induction Unit measures salinity, temp., and conductivity to 300 ft. by lowering electrodeless cell to desired depth and reading instrument. Industrial Instruments, Inc., BOOTH 3648.

Circle 310 on Inquiry Card

Spectrum Analyzer

Model 18MY, allows a full display of pulses as narrow as 0.1μsec and a clear display down to 0.05μsec. This microwave spectrum analyzer provides a 100MC display. Lavoie Laboratories, Inc., BOOTH 451.



Circle 313 on Inquiry Card

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.

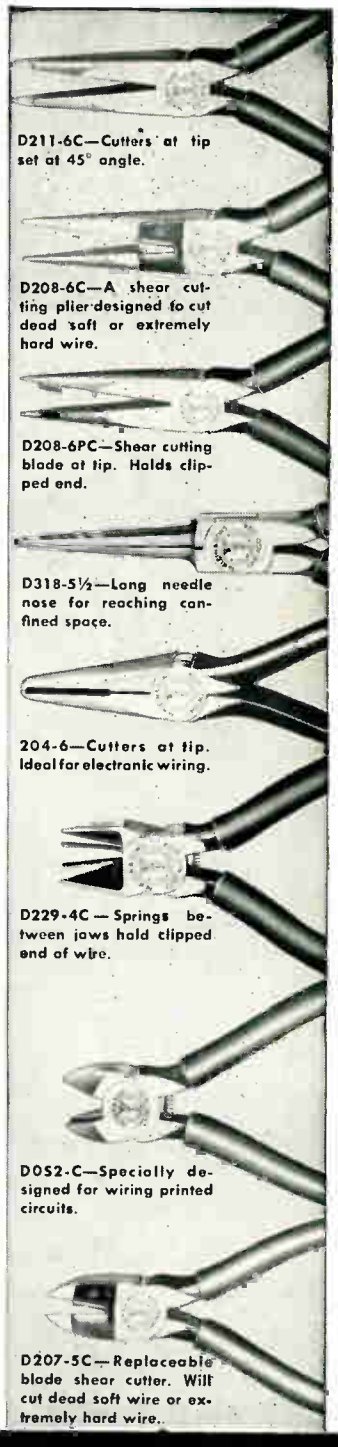
Klein has kept pace with the development of the electrical field, meeting each new challenge with tools specially designed to do the wiring job better . . . more economically.

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 US AT THE WESCON SHOW, BOOTH 3519

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.

Mathias Established 1857 **KLEIN** & Sons Chicago, Ill., U.S.A.

INCORPORATED

7200 McCORMICK ROAD, CHICAGO 45, ILL

Mathias Klein & Sons, Inc. 7200 McCormick Road, Chicago 45, Ill.
Please send me the Klein Plier Catalog and information.

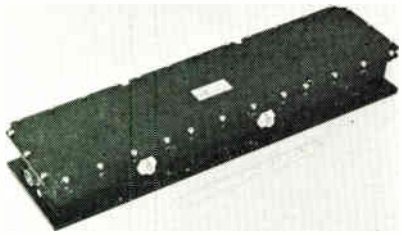
Name_____

Title_____

Company_____

Address_____

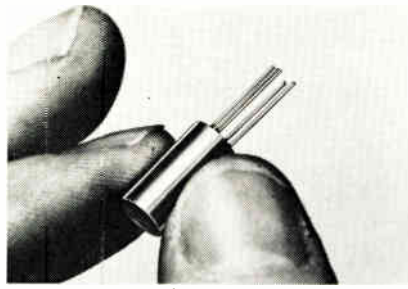
City_____ State_____



Satellite Amplifier

The WJ-115 is a high efficiency, high-reliability space communications amplifier package for the 2.0-2.4GC band. It delivers a nominal output power of 12w. Watkins-Johnson Co., BOOTH 2141.

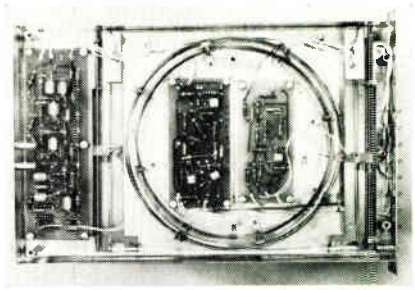
Circle 284 on Inquiry Card



Micro-Miniature Relay

Model MR2A micro-miniature relay, a hermetically sealed unit, is ¼ x ½ in. and weighs 0.075 oz. Operating and release time is less than 2.5msec. Miniature Electronic Components Corp., BOOTH 3826.

Circle 287 on Inquiry Card



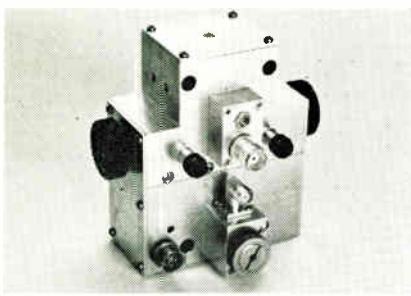
Long Delay Line Timer

Model ML100 (50 cu. in.) is capable of producing very long delays for triggering, timing signals, range markers, and control signals. Control Electronics Div., Paradynamics, Inc., BOOTH 648.

Circle 289 on Inquiry Card

S-Band Cavity Amplifier

This miniature cavity amplifier, Model P-30A, has an output of 20w. It measures 4 x 3⅛ x 2¼ in. and



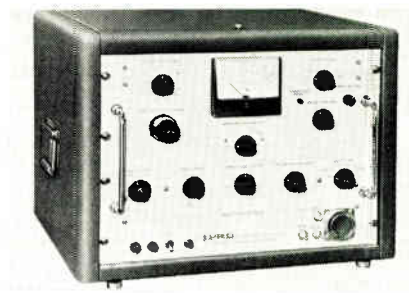
weighs only 21 oz. Model P-30A covers from 2075 to 2325MC. Resdel Engineering Corp., BOOTH 3208.

Circle 285 on Inquiry Card

See These Products At WESCON

Klystron Power Supply

The Model 815 features: 4 separate supplies—beam, reflector, grid, and heater; and unitized assembly—beam,

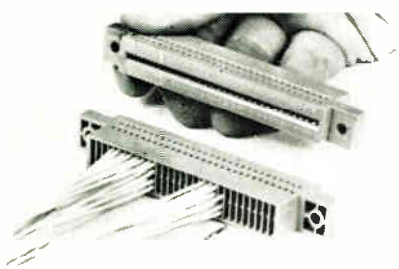


reflector and grid, modulator are separate plug-in packages. PRD Electronics, Inc., BOOTH 2103.

Circle 290 on Inquiry Card

PC Connector

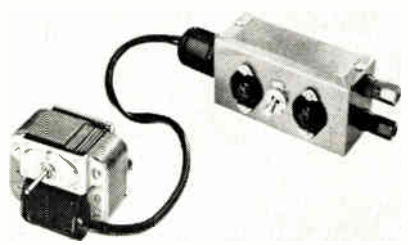
This series of 0.100 in. spaced EDGE-ON® printed circuit HYFEN® connectors have crimp-type removable terminals. They are offered in 15, 22, 30, 43 positions. Burndy Corp., Omaton Div., BOOTH 942.



Circle 286 on Inquiry Card

Brushless DC Motor

The type YAD brushless dc motor is designed for cooling fans and similar applications. A simple transistor oscillator circuit converts dc to ac to drive the motor. Barber-Colman Co., BOOTH 228.



Circle 288 on Inquiry Card

Snap Switch

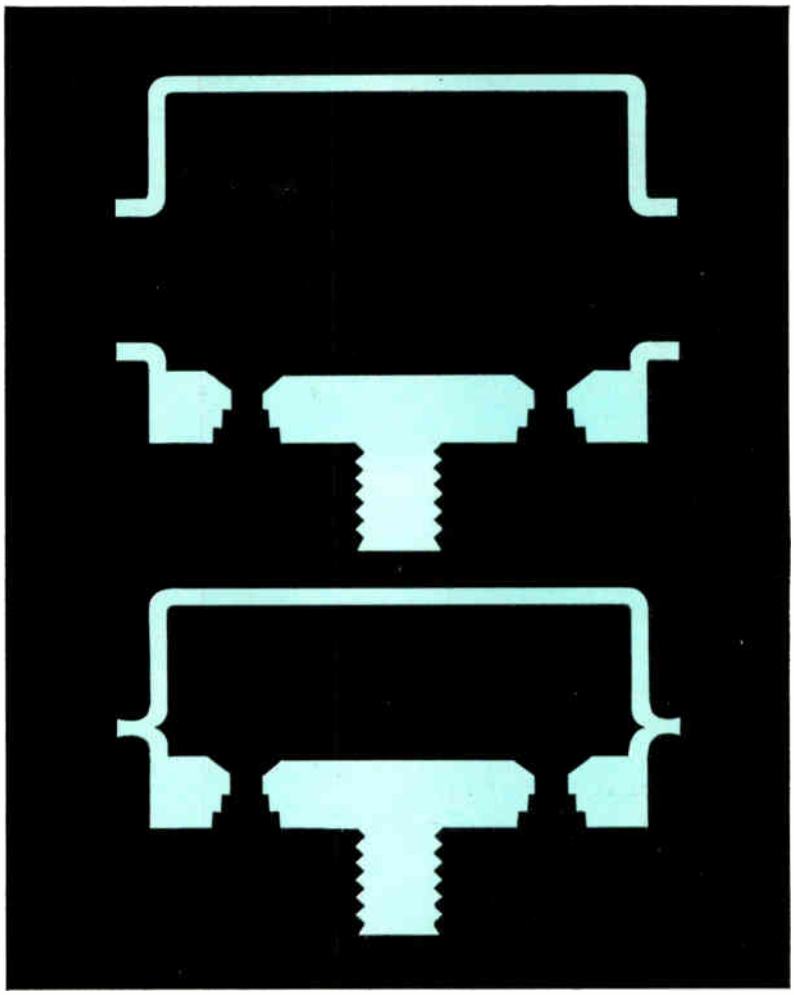
CEMCO subminiature snap switch, Model MAC, features: operating force of 1 oz. max.; measures 0.175 in. wide; is rated at 5a, 250vac; operates in −65° to +350°F. Columbus Electric Mfg. Co., BOOTH 3111.

Circle 291 on Inquiry Card

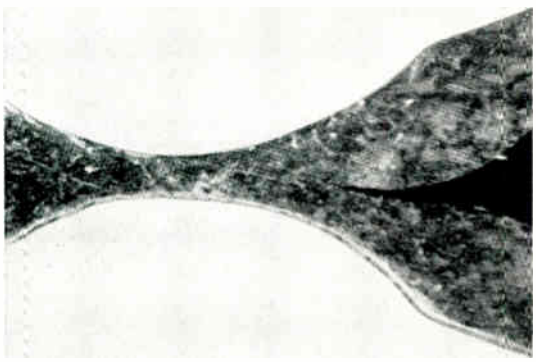
TUNG-SOL COLD WELDS OFHC* CASES

TO PRODUCE POWER TRANSISTORS THAT DELIVER FULL POWER

*Oxygen Free, High Conductivity



To be Cold-Welded, the flanges of the transistor can must be free of contaminants. The two surfaces are united under evenly distributed high pressure, causing copper molecules to flow together, producing an unbreakable, hermetic seal. Photomicrograph (45X) reveals absence of seam or interface. In addition to photomicrographs, Tung-Sol non-destructively tests weld quality with 100-psi water bomb immersion, mass spectrometer and radioactive tracer tests.



Cold-Welded germanium power transistors originated with Tung-Sol. The Cold-Weld process provides Tung-Sol transistors (in all case styles) with several significant advantages over transistors sealed by other techniques:

A seamless molecular bond between can and header improves thermal properties. Hot spots are eliminated, preventing reduction in power output or degradation of the semiconductor. The oxygen-free, high-conductivity copper provides superior heat conduction and is compatible with other device parts.

Cold-Welding prevents heat-caused damage during production, contributing to longer life and optimum performance. There are no "splash"-produced fragments, which, if undetected during factory tests, could short the transistor in operation.

Temperature fluctuations due to environmental changes, or on-off operations, cannot cause "breathing". The seam-free molecular bond excludes moisture and cannot be torn apart by mechanical stress.

Cold-Welding typifies the advanced design and production techniques employed by Tung-Sol in the manufacture of power transistors. Characteristics such as thermal resistance (K factor) are based upon the most meaningful combination of environmental and electrical tests. Design center ratings are given for junction temperatures of 110°C, 10 degrees above usual requirements. Saturation voltages are lower and breakdown voltages higher than in ordinary transistors. Mounting surfaces are flat-ground to provide full contact with heat sinks.

These features are present in all Tung-Sol 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

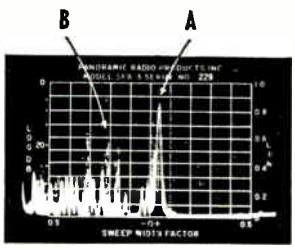
1kc to 25mc
FREQUENCY RANGE

up to 3mc
SWEEP WIDTH

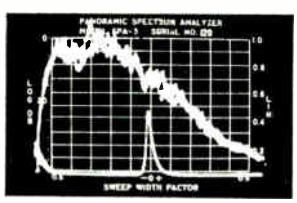
2μv
USABLE SENSITIVITY

MORE CAPABILITIES for MORE APPLICATIONS

PANORAMIC MODEL SPA-3/25 SPECTRUM ANALYZER



Analysis of multiplexed voice communications circuit pinpoints high channel level (A) due to "singing" or oscillations. Adjacent channels at 4 kc intervals, some voice modulated, are also seen. Voice peaks (B) show up clearly. 40 db log scale.



Noise spectrum analysis using internal video smoothing filter displays average noise level versus frequency in easily appreciated form. Internal marker pip at center of screen.

HIGHLIGHT SPECIFICATIONS

Frequency Range 1 kc—25 mc (usable to 200 cps) (SPA-3 to 15 mc)

Sweep Width Adjustable, calibrated from 0 to 3 mc

Center Frequency Adjustable, calibrated from 0 to 23.5 mc.

Markers Crystal controlled, 500 kc and harmonics to 25 mc.

Resolution I-F bandwidth adjustable, 200 cps thru 20 kc

Sweep Rate 1 to 60 sweep/sec. continuously adjustable. Sweep operated synchronized to power line, or non-synchronized.

Amplitude Scales Linear, 40 db Log and Power

Sensitivity 20 μv to 2 v full scale. Min. discernible level = 2 μv

Attenuator 100 db calibrated

Response Flatness ±15% or ±1.5 db up to 23.5 mc

Input Impedence 72 ohms. (50 ohms optional. High impedence probe PRB-1, optional)

dependable CERTIFIED SPECIFICATIONS for accurate data

Wide frequency coverage to 25 mc, scanning width to 3 mc and sensitivity to 2μv plus many other exceptional performance characteristics enable the SPA-3/25 to provide accurate graphic measurement of virtually all types of signals; CW, AM, FM, pulsed, and noise. Its versatility and convenience for a multitude of applications have resulted in widespread acceptance.

The calibrated sweep width and center frequency controls are readily adjusted to select broadband scans or high resolution "zoomed in" analyses. Resolution capability is 200 cps. Crystal controlled markers check the frequency calibrations. The high persistence 5" CRT readout includes 3 selectable calibrated level scales; linear, 40 db log, and power. An adjustable smoothing filter facilitates single line noise density plotting. *(See screen photo at lower left)* Scanning rate is adjustable from 1 to 60 cps.

For applications requiring measurement only up to 15 mc, specify Model SPA-3. It includes all the outstanding features of the Model SPA-3/25. A companion Sweep Frequency Generator, Model G-6 is used with the SPA-3/25 or SPA-3 for single line response plotting to 15 mc. With the G-6, testing and alignment of filters, I-F's, and other networks are performed in a fraction of the time required for manual tuning methods.

Comprehensive technical bulletins are available on SPA-3/25, SPA-3, G-6, and other Panoramic instruments used from 0.5 cps to 44 kmc.

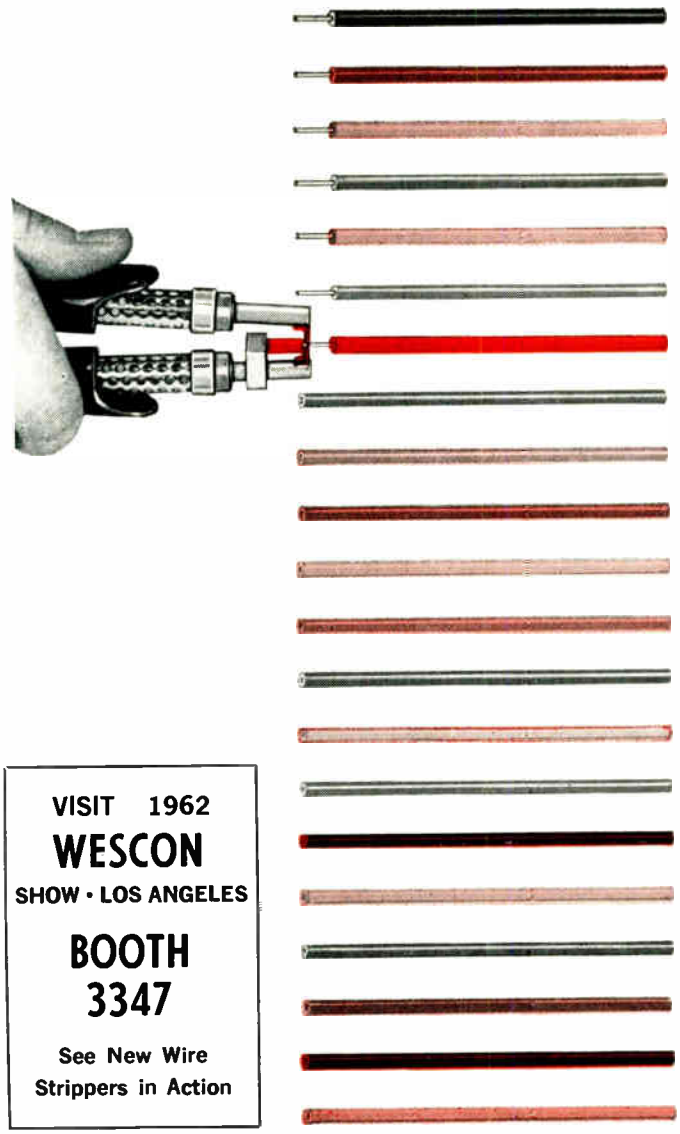
Panoramic electronics, inc.

Panoramic Electronics, Inc. • 540 South Fulton Avenue, Mount Vernon, N. Y. Phone: (914) OWens 9-4600
TWX: MT-V-N.Y.—5229 • Cables: Panoramic, Mount Vernon, New York.

Circle 82 on Inquiry Card

Be sure to see us at WESCON: Booth #3354-5.

NOW ANYONE CAN STRIP WIRE ALL DAY WITHOUT NICKING!



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BOOTH 3347
See New Wire Strippers in Action

New **IDEAL**

THERMO-STRIP™
WIRE STRIPPER
FOR PLASTIC INSULATION

The Precision Stripper That Can't Harm Wire

Make precision stripping **routine** — for missile components, aircraft, computers, instruments — any equipment where wire damage can't be tolerated. New Ideal Thermo-Strip melts through insulation — no cutting, no tearing — prevents all nicking and breaking. Won't disturb strands of even finest wire. Works on all thermo-plastic insulation, including Teflon. Infinitely variable heat control prolongs element life, cuts fumes, lets you pick the exact temperature for the job. Can operate continuously — with no warm-up wait. Safe, fast, easy to use — Thermo-Strip is a precision wire stripper, **not** a converted soldering gun.

JUST PLUG IT IN . . .
Comes complete with 50-watt transformer and your choice of tools:

Pincer — for high-speed production stripping. Just grip wire, and pull off insulation slug with heating elements.

Single Element — for probing into miniature or crowded assemblies. Just put wire end in electrode V-notch.

Selection of elements.

Sold Through America's Leading Distributors. IN CANADA: IRVING SMITH, Ltd., Montreal

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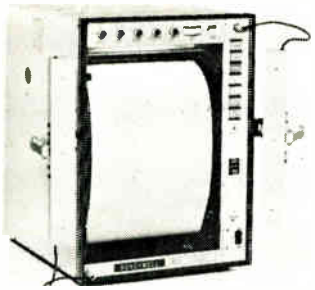
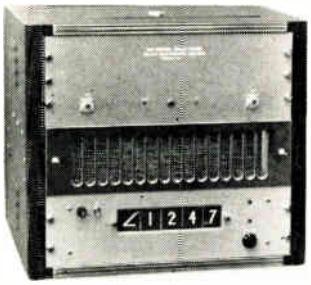


Oscillograph

The 1612 Visicorder is a 36 channel direct-writing unit with 15 forward speeds (0.01 to 160ips) and 10 reverse speeds, pushbutton selected. Minneapolis-Honeywell, Heiland Div., BOOTH 2015.

Circle 292 on Inquiry Card



Digital Phase Meter

The Type 524 Digital Phase Meter features: phase angle in degrees directly represented in four digits; and no freq. adjustment over a wide range, from 50CPS to 40KC. Ad-Yu Electronics Lab., Inc., BOOTH 3350.

Circle 295 on Inquiry Card

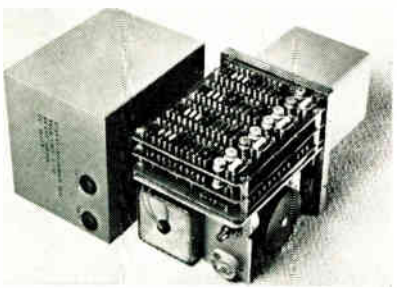
Power Supplies

These high-resolution, decade controlled supplies have 0.01% regulation and stability. Model DR 11's range is 0 to 11.110v at 0 to 1.0a; the Model DR400's is 0 to 411.110v at 0 to 0.5a. Kepco Inc., BOOTH 114.

Circle 297 on Inquiry Card

Frequency Standard

S1115, a 60CPS freq. standard, one of a line of subaudio and audio crystal-controlled freq. standards, has



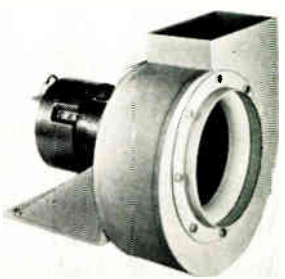
freq. stabilities to 1 part in 10^7. Reeves-Hoffman Div., Dynamics Corp. of America, BOOTH 906.

Circle 293 on Inquiry Card

See These Products At WESCON

Cooling Unit

Direct drive general purpose centrifugal air unit, 89KC8, has a life, from sea level to 35,000 ft., in an

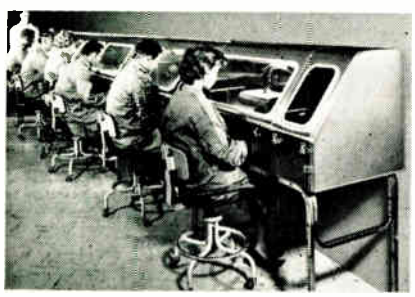


amb. temp. of −65° to +160°F, of a min. of 1000 hrs. American-Standard, Industrial Div., BOOTH 3150.

Circle 298 on Inquiry Card

Environmental Cabinets

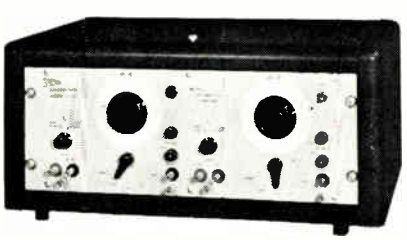
This government-approved line of modularly connected Primaire climate control cabinets provides dust, temp. and humidity control in a start-to-finish assembly line setup. Dexon, Inc., BOOTH 3533.



Circle 294 on Inquiry Card

Filter

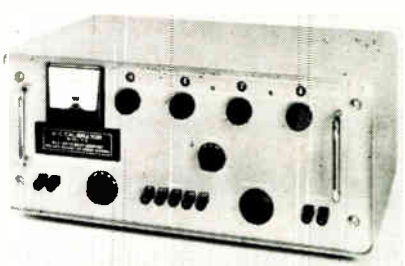
Type LH-42 Analog Filter has seventh-order Butterworth response as either highpass or lowpass device and wide, continuously tunable cutoff range at 42 db/octave slope. Spectrum Instruments, Inc., BOOTH 3206.



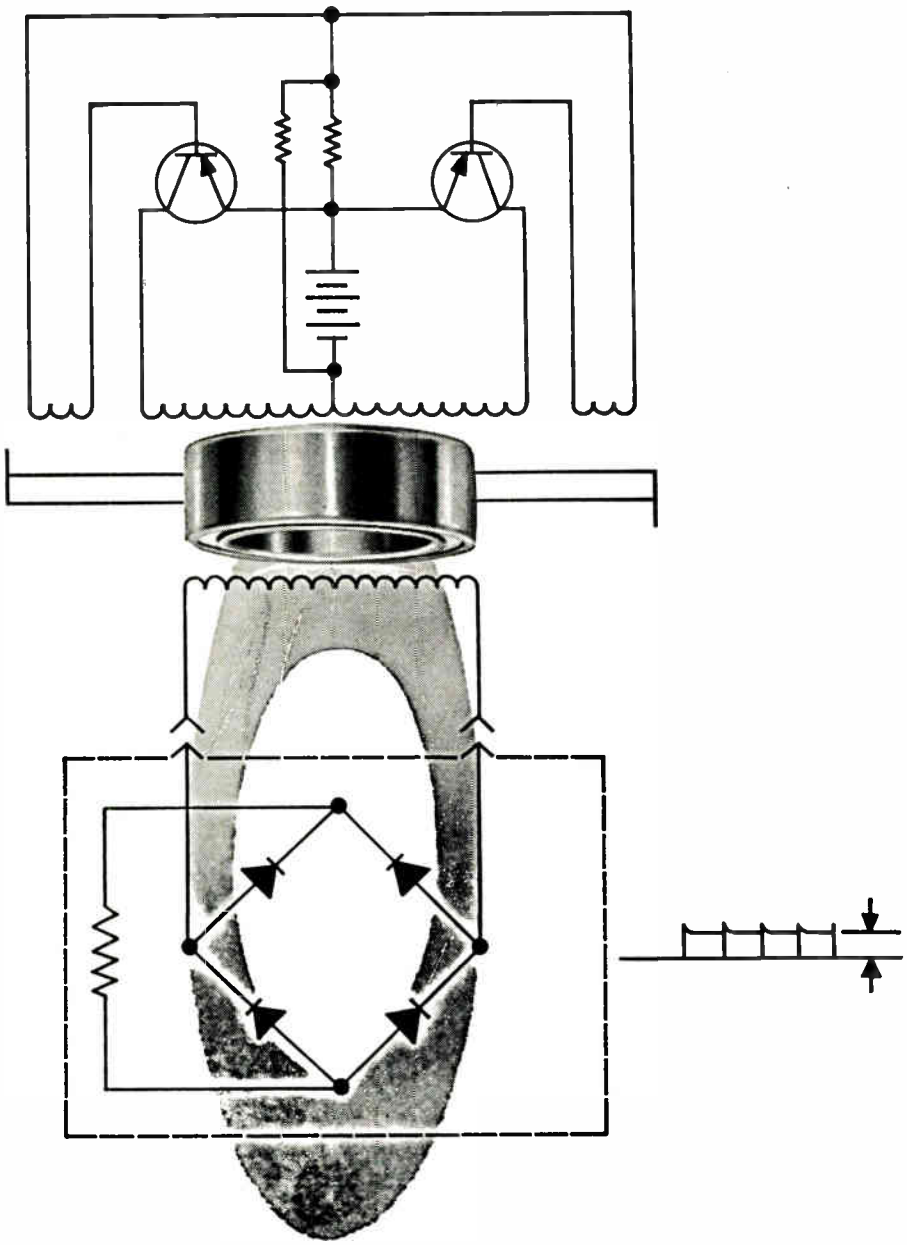
Circle 296 on Inquiry Card

AC Calibrator

Model P-4 AC Calibrator features: 0 to 1511v RMS in 0.1v increments; 0 to 151.1v RMS in 0.01v increments; and transformer accuracy 0.05% at 50 to 500CPS. Wilk Instruments, Div. of Quality Electric Co., BOOTH 3832.



Circle 299 on Inquiry Card



How to design a static converter/inverter

Basically a magnetic coupled multivibrator, the square wave output of this static converter/inverter can be delivered as a-c directly to a load. Or, it can be rectified (full wave) to supply d-c voltages higher or lower than battery supply voltage. Ideal for highly portable equipment, the circuit has all the advantages of solid state devices. And, because transistors are the switches, replacing mechanical vibrators, potential maintenance problems are eliminated.

A Magnetics Inc. tape wound core is the *key* to perfect switching operation. The rapid change in core impedance in going from the unsaturated to saturated state forces the transistor switching. Thus, *a properly selected core* and the number of turns of wire on it become important, since this determines the operating frequency of the inverter.

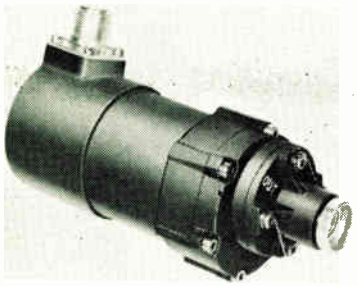
Core material is important, too. For example, Magnetics Inc. Orthonol,® is ideal for most power applications where a given voltage and frequency are required. Where the design calls for a high voltage at low power levels, such as a d-c supply for photo tubes, Geiger tubes, or where high efficiencies are required under light loads, Magnetics Inc. Permalloy 80 should be selected.

Since power requirements, wire size, and frequency influence core size, Magnetics Inc. has a complete range of sizes and alloys available for complete design freedom.

To help you choose the core you need . . . and for more details on this circuit, write for bulletin "Designing d-c to d-c Converters" to Magnetics Inc., Butler, Pa.

MAGNETICS inc. ®

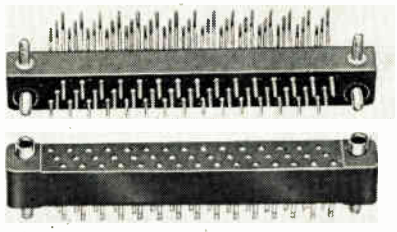
Circle 84 on Inquiry Card



Hydraulic Pump

This seal-less airborne pump and motor package features lightness, dependability and compactness. No convection cooling is required. Eastern Industries Div., Laboratory For Electronics, Inc., BOOTH 436.

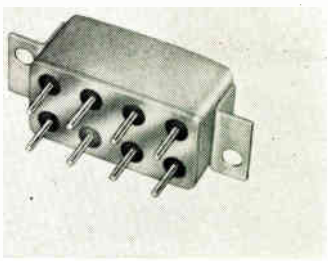
Circle 300 on Inquiry Card



PC Connector

Sub-miniature right angle plug and socket connector, Series 600-1-45, designed for printed circuit board uses. The 2⅞ in. long unit holds 45 contacts. Continental Connector Corp., BOOTH 3609.

Circle 303 on Inquiry Card



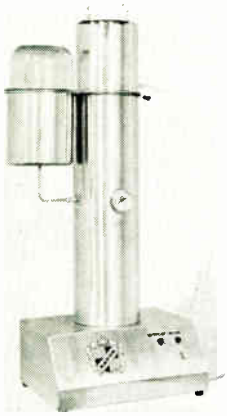
Crystal Case Relay

This 2PDT General Purpose Half-Size Crystal Case Relay is for use in high environmental applications and printed circuits. It weighs 0.3 oz. max. Union Switch & Signal Div. of WABCO, BOOTH 2163.

Circle 305 on Inquiry Card

Solvent Stills

Micro-Line Solvent Stills reduce cleaning costs by reclamation of dirty solvent for reuse whenever a high



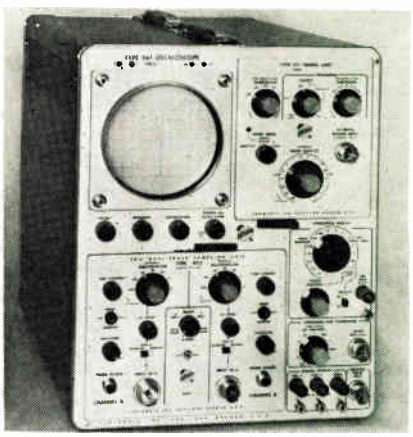
quality pure distillate is required. Baron Industries, BOOTH 3346.

Circle 301 on Inquiry Card

See These Products At WESCON

Sampling Scope Plug-in

Vertical amplifier plug-in, 4S2 Dual Trace Sampling Unit, for type 661 O-Scope, permits display of sinusoidal

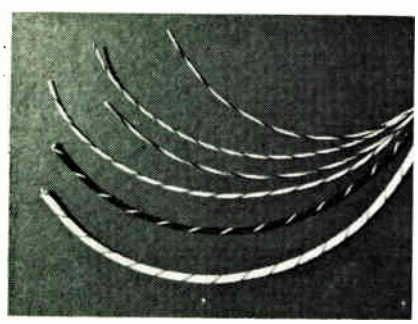


signals to 3.5GC and repetitive pulses with risetimes to 100 psec. Tektronix, Inc., BOOTH 751.

Circle 306 on Inquiry Card

Markable Wire

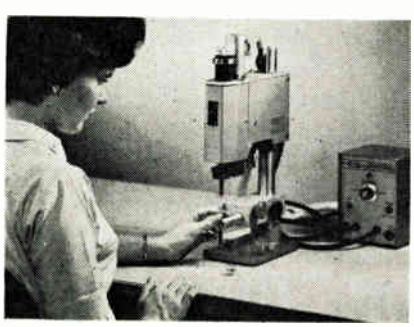
This Teflon wire meets Mil-W-16878D. Ordinary solvent type inks will adhere to the wire. Wire and inks meet Mil-STD-104, allowing stocking of only white wire. W. L. Gore & Associates, Inc., BOOTH 3707.



Circle 302 on Inquiry Card

Welding Heads

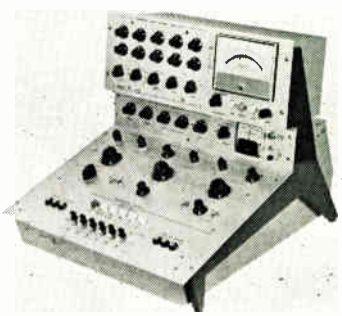
Press-type resistance units, Model Q and pneumatically-operated QB, have welding forces to 60 lbs. for hermetic sealing of transistor packages. Raytheon Co., Commercial Apparatus and Systems Div., BOOTH 3928.



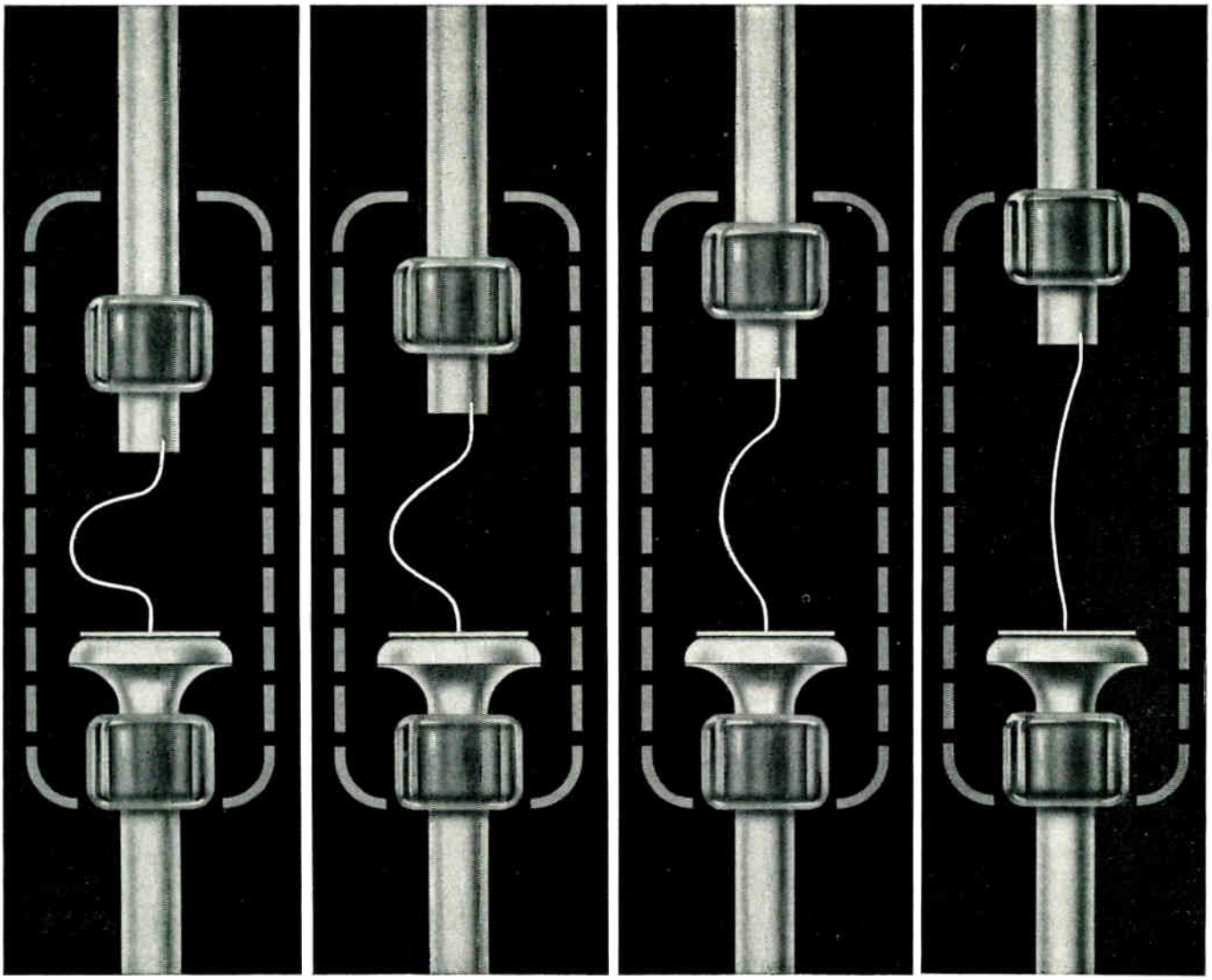
Circle 304 on Inquiry Card

Transistor/Diode Tester

Wide range dc tester with 1% meter accuracy measures breakdown voltages up to 1000, current gains from 5 to 50,000, and leakages down to 1na full scale. Test Equipment Corp., BOOTH 3149.



Circle 307 on Inquiry Card



Why pulling the whisker means more uniform, more reliable gold bonded diodes

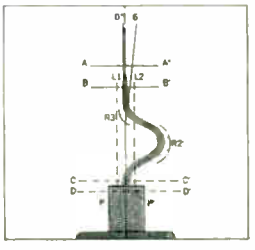
Sylvania builds extra reliability into gold bonded diodes by pulling the gold whisker from its original "C" shape immediately after bonding. This whisker-retraction, exclusive with Sylvania, serves two purposes. Reshaping the whisker into an upright bow increases tolerance to mechanical shock and vibration. At the same time, the retraction process tests the strength of the junction.

Why start with the long, C-shaped whisker?

The straight, short whiskers of competitive diodes require less gold wire but tend to be overly rigid. During bonding, this rigidity often causes whisker points to slip, causing imperfect junctions and "on-the-move" welding that may or may not hold. Sylvania solves this problem by using a longer C-shaped whisker that acts as a temporary spring during point contact. The tip stays put—creating a perfect junction and a permanent bond. Result: better uniformity and greater reliability.

These and other common sense improvements are products of Sylvania's modern, automated plant in Hillsboro, N. H., where diode reliability is built in—not sorted out.

If you want proof, order from the full range of Sylvania gold bonded diodes available through your Sylvania Sales Engineer or Franchised Semiconductor Distributor. For technical data write: Semiconductor Division, Sylvania Electric Products Inc., Dept. 198, Woburn, Massachusetts.



Shadowgraph inspection of whisker shape is typical of careful controls and checks in Sylvania diode manufacture.

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Booths 3157-3159

Circle 85 on Inquiry Card

Latest Western Literature for Engineers

Microwave Chart

Tech. data is available which includes a Microwave Amplifier Selection Chart covering general purpose; medium power; high power; and low and medium noise amplifiers. This 15-page tech. catalog also contains information on microwave oscillators; signal generators; levelers; and power supplies (TWT & High voltage). Alfred Electronics, 3176 Porter Dr., Stanford Industrial Pk., Palo Alto, Calif.

Circle 160 on Inquiry Card

Digital Circuit Modules

This economical series of transistor digital circuits on etched cards can be used in either synchronous or non-synchronous systems. This catalog G42A, 17 pages, 2 colors, contains information on 10 Mpps elements of the Series G-family. The G-100 units are active circuits; G-400 units are logic circuits. Information included covers electrical and mechanical features, systems design data, recommended power supply connections, definition of terms, and data on a triple logic amplifier, quadruple logic inverter, clock driver and 2 Universal logic units. Engineered Electronics Co., 1441 E. Chestnut Ave., Santa Ana, Calif.

Circle 161 on Inquiry Card

Components Marker

Information is available on "Component Serialization" a sub-miniature marker for identification of small size components. The markers can be applied to diodes, transistors, relays, resistors and other miniaturized components. Westline Products, P.O. Box 2980 Terminal Annex, Los Angeles 54, Calif.

Circle 162 on Inquiry Card

Diode Test Fixture

Information is available on the Model CD-101 Diode Test Fixture which has flexible stainless steel springs that firmly grip straight diode leads and does away with the major cause of bent leads. The fixture contains 4 springs giving separate read out contacts to eliminate errors caused by contact voltage drop. Indamer Electronics, Inc., 1038 W. Evelyn Ave., Sunnyvale, Calif.

Circle 163 on Inquiry Card

Computer Diodes

Tech. data is available on Gallium Arsenide Ultra Fast Computer Diodes in subminiature glass package. Information is also included on 125mw low power silicon rectifiers, 150mw double anode zener diodes, 250mw zener diodes in subminiature glass packages, temp. compensated reference elements, high voltage silicon cartridge rectifiers, and 750mw zener diodes with low noise and high performance characteristics. Western Semiconductors, Inc., 605 G Alton St., Santa Ana, Calif.

Circle 164 on Inquiry Card

Hall Effect Bibliography

This 10-page bibliography available from the Helipot Div. of Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif., contains conveniently listed reference material on Hall effect devices. The bibliography gives complete titles, authors, publication and page numbers of all Hall effect articles appearing in the trade press during the last several years.

Circle 165 on Inquiry Card

Transistor Cooling

This 48-page engineering test report gives junction, case dissipator and ambient temperatures at various levels of power dissipation. Text and over 40 tables and graphs provide useful design and application data. Information covers both glass and metal header TO-5 transistors, which were tested in each of 10 new low power heat dissipators in natural and forced convection conditions. IERC Div., International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, Calif.

Circle 166 on Inquiry Card

Chopper Transistor

Bulletin DL-S, 622467, contains comprehensive data on Type 2N2432 NPN Diffused Epitaxial Planar Silicon Transistor. The 2N2432 is for low-level, high-speed chopper applications in inverted connection. Photographs, specifications, and characteristic charts are included. Texas Instruments Incorporated, Transistor Products Div., P.O. Box 5012, Dallas 22, Tex.

Circle 167 on Inquiry Card

Power Resistor

Information is available on the Series T Resistors which range from 0.05Ω through 275KΩ, tolerances to ±0.05% and wattage ratings from ½ through 10w, with operating temps. to 350°C. Omtronics Mfg., Inc., P.O. Box 1419, Peony Park Station, Omaha 14, Nebr.

Circle 168 on Inquiry Card

Refractory Metals

Oregon Metallurgical Corp., P.O. Box 484, Albany, Ore., is offering an illustrated brochure on their capabilities in precise melting, casting and testing of all reactive and refractory metals.

Circle 169 on Inquiry Card

Semiconductor Tester

Tech. data is available on the Model 1, Automatic Transistor and Diode Tester. The unit measures leakage to Ina full scale and tests with up to 10a collector current, performs 19 dc tests, sequences through 5, and categorizes semiconductors in 3 ranges/test. Output meter accuracy is ±1% full scale. Test Equipment Corp., P.O. Box 13185, Houston 19, Tex.

Circle 170 on Inquiry Card

Phosphor Data Chart

An 18 x 22 in. wall chart on the "Typical Absolute Spectral Response Characteristics of Aluminized Phosphor Screens" is available from the Industrial Laboratories Div., International Telephone and Telegraph Corp., Ft. Wayne, Ind. The chart shows wavelength vs. spectral efficiency for the most common phosphors and also lists in tabular form such data as chemical composition, color, persistence, peak wavelength, luminous efficiency, and quantum yield. The chart is printed in 14 different colors for clarity.

Circle 171 on Inquiry Card

Rotary Welding Tool

Tech. data is available on the Rollectrode Model MT-809 which was developed for the installation of the Microdot® Weldable Strain Gages. MT-809 is a hand-operated, motor-driven rotary welding tool making installation of weldable gages a simple, fast, and accurate operation. Microdot Inc., 220 Pasadena Ave., So. Pasadena, Calif.

Circle 172 on Inquiry Card

Ultrasonic Equipment

Ultrasonic equipment for cleaning, machining, homogenizing, welding and soldering and automatic systems for cleaning, rinsing, drying and filtering, are described in tech. data available from Xonics Corp., 5975 Fairmount Extension, San Diego 20, Calif.

Circle 173 on Inquiry Card

Commutators

Deltaswitch High Speed Mercury Jet Commutators are for multiplexing up to 100 signals, for data sampling, telemetry, and pulse generation, for use in reactors, wind tunnels, power plants, and laboratories. Advantages of the mercury jet over the conventional wiper arm are that it doesn't bounce, wear, warp, fatigue, or pit. Advanced Technology Laboratories, Div. of American-Standard, 360 Whisman Rd., Mountain View, Calif.

Circle 174 on Inquiry Card

Welding Machine

Tech. data is available on the Hydro-Water Welder which weighs 30 lbs., measures 9¼ x 10¼ x 6 in. and produces a 6000°F usable torch flame by burning the component elements of water at the rate of ½ oz./hr. Henes Mfg. Co., 4301 E. Madison St., Phoenix, Ariz.

Circle 175 on Inquiry Card

Digital Voltmeter

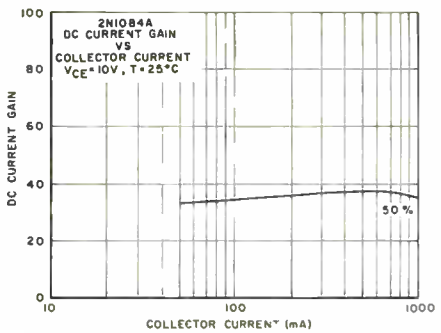
Information is available on the Model 10, a 5 digit unit for 5000 readings/sec. at 0.01% accuracy. Non Linear Systems Inc., Del Mar, Calif.

Circle 176 on Inquiry Card

Circle 86 on Inquiry Card →

PNP POWER IN A TO-5 SILICON TRANSISTOR

1952 10 1962 YEARS LEADERSHIP IN SEMICONDUCTORS



A new high in power... a new low in RCS

Broad new areas of circuit design have been opened with the perfection of Transitron's TO-5 2N1084 PNP silicon transistor. Developed in association with the U. S. Army Signal Corps, the new device brings greater simplicity and improved reliability and performance to both industrial and military circuitry. It features: operation at current ratings up to 1 amp, a low saturation resistance of under 3 ohms and cut-off frequencies as high as 30 Mc. A silicon transistor produced by gaseous diffusion techniques, the 2N1084 is available in prototype quantities with compatible heat sink mountings. For complete details write to Transitron, Wakefield, Mass., for Bulletin TE-1354-1084A.

Type	Collector to Base Breakdown Voltage (Volts)	Typical Saturation Voltage (Volts @ 500mA)	Typical Gain Bandwidth Product (Mc)	DC Current Gain @ Ic=500mA Min.	Max.
2N1084	60	1.6	30	10	40
2N1084A	60	1.35	30	20	60

OTHER MEMBERS OF TRANSITRON'S BROADENING FAMILY OF PNP SILICON TRANSISTORS include the popular 2N1131 with a 20-45 beta range and 2N1132 with a 30-90 beta range. Both are designed for 1 to 200 mils operation and come in a TO-5 package. They are also available in TO-18 packaging as the 2N721 and 2N722, and in micro and nano packaging as the TMT1131-32 and TNT1131-32. All are produced by gaseous diffusion techniques. All are available in quantity through your Transitron Distributor.

MEET US AT WESCON, BOOTHS 2176-77

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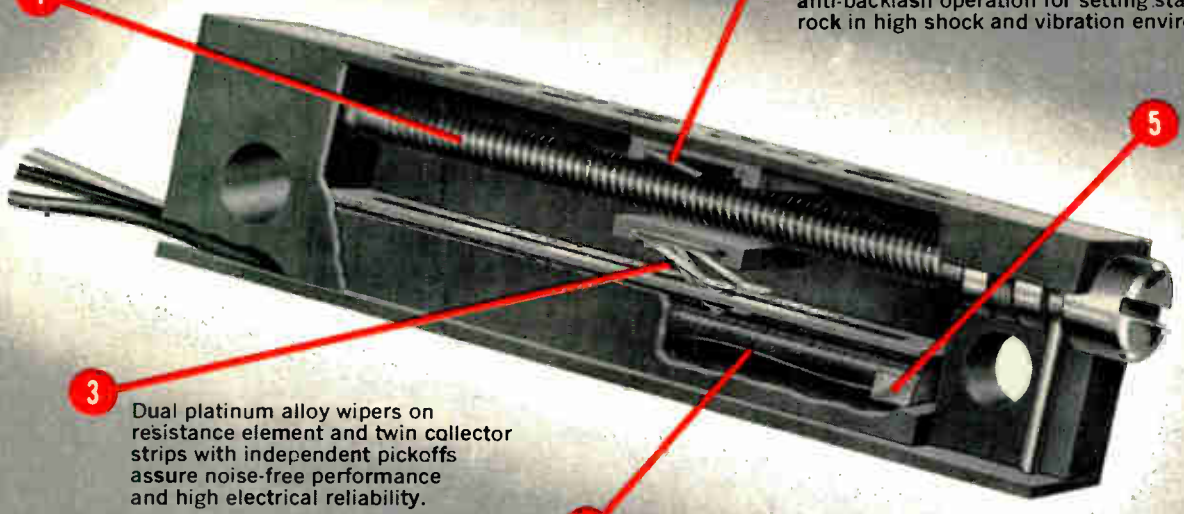

1. One-piece stainless steel shaft (electrically isolated) provides mechanical strength for maximum reliability.
2. Unique spring loaded slider block design insures anti-backlash operation for setting stability, eliminating rock in high shock and vibration environments.
3. Dual platinum alloy wipers on resistance element and twin collector strips with independent pickoffs assure noise-free performance and high electrical reliability.
4. ⅓ greater element length permits use of larger diameter resistance wire for greater reliability and longer operational life.
5. Silicone insulated copper mandrel provides uniform heat dissipation, eliminates hot spots and burn-outs.

In 3 Basic Models and 11 Terminal Types

SPECIFICATIONS		Model 40	Model 42	Model 44
ELECTRICAL Standard Resistance Range		50 Ω to 50 K	50 Ω to 100 K	
Power Rating		1 watt at 70° C		
Operating Temperature Range		−55° C to +175° C		
MECHANICAL Number of Turns		15	25	
Case Dimensions	Width	0.180	0.190	0.280
	Height	0.315	0.315	0.315
	Length	1.000	1.250	1.250
Weight		2.5 grams	4.5 grams	
Price for 100 pieces in popular resistances		$6.33	$5.14*	

*Lower priced unsealed versions of the Model 44 with lower temperature range are also available.

Improved design of Spectrol rectangular trimming potentiometers gives you higher maximum standard resistance values. Model 40 to 50 K . . . Models 42 and 44 to 100 K.

More economical use of space allows greater usable resistance element length (0.645" in Models 42 and 44) and larger diameter resistance wire to provide longer life, better heat dissipation and greater reliability.

Spectrol rectangular trimmers are tested to assure compliance with the requirements of the new ASESA specification MIL-R-27208A including moisture resistance and immersion.

All rectangular trimmers available in three basic terminal types: Insulated Teflon Leads, Printed Circuit Pins, Solder Hooks.

Call your nearest Spectrol distributor for immediate off-the-shelf delivery at factory prices, or write for complete specifications.

Spectrol also manufactures a complete line of square and round trimmers, miniature and precision potentiometers and turns-counting dials.

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Centralab feed-thru capacitors range from 100 V to 25,000 V, high K or temperature compensating types. In addition to the standard types, Centralab has developed many unique designs for unusual applications.

These feed-thrus do real double duty, because they can perform mechanical functions along with their electrical functions. A feed-thru can serve as a bracket for separating a terminal board from the chassis—or other circuit components can be mounted directly on the capacitor.

CERAMIC FEED-THRUS BEAT PAPER AND VACUUM UNITS FOR SPACE, COST, AND RELIABILITY

Centralab ceramic feed-thrus are smaller than equivalent paper or vacuum units. They never "go soft" like vacuum units, which cost twice as much—and they offer 10 times the reliability of paper capacitors.

A new catalog has just been prepared giving full information about Centralab feed-thru capacitors. Write for your free copy to . . .

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In Canada, write Centralab Canada Ltd.
P. O. Box 400, Ajax, Ontario

CIRCLE 103 ON READER SERVICE CARD

Latest Western Literature for Engineers

Automatic Oscilloscopes

Tech. data is available on the Series 5000 Automatic Oscilloscopes which provide waveform automatically positioned on scope regardless of amplitude, frequency or dc offset without adjusting manual controls and vertical sensitivity. Horizontal sweep speed, vertical sensitivity and dc offset are automatically displayed in easy-to-read digital form. California Instruments Corp., 3511 Midway Dr., San Diego, Calif.

Circle 177 on Inquiry Card

Decade Counter

Model DC-100 Plug-in Decade Counter Module, measuring 1¾ x 1¼ x 6½ in., is described in tech. data available from Anadex Instruments Inc., 7617 Hayvenhurst Ave., Van Nuys, Calif. Specs. included a counting rate of 0 to 100KC and an input signal of 25 to 40v rectangular pulse, 4μsec. minimum duration.

Circle 178 on Inquiry Card

Pressure Transducer

This bulletin describes the features of the Type 4-312 Strain Gage Pressure Transducer. Pressure range is from 10 to 160psi for absolute, gage, and unidirectional differential models, and ±5 to ±50psi for bidirectional differential models. Bulletin 4312 is available from Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 179 on Inquiry Card

Ultrasonic Equipment

This fully-illustrated brochure gives applications, specs. and prices on a low-cost line of modular ultrasonic cleaning equipment. Information covers transistorized, automatically tuned generators and ultrasonic tanks. Delta Sonics, Inc., 12918 Cerise Ave., Hawthorne, Calif.

Circle 180 on Inquiry Card

Microwave Capabilities

TEMEC, Inc., 7833 Haskell Ave., Van Nuys, Calif., is offering 16-page, 2-color facility brochure covering antenna pedestals, missile and satellite tracking systems, and telemetry and microwave systems. Information is included on the firm's history, products, and facilities. Photographs are also included.

Circle 181 on Inquiry Card

Recorder/Reproducer

Capabilities of the PR-3300 Magnetic Tape Recorder/Reproducer are described in a 4-page bulletin available from Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. The PR-3300 is a portable, solid state recorder combining precision performance with low cost. Freq. response is 100CPS to 100KC on direct and 0 to 10KC on FM.

Circle 182 on Inquiry Card

Wire Markers

Information is available on self-laminating E-Z-Code wire markers which offer high resistance to all conventional oils, greases, chemicals, fluids and other foreign matter. Westline Products Div., Western Lithograph Co., 600 E. 2nd St., Los Angeles 54, Calif.

Circle 183 on Inquiry Card

Soldering Irons

This 8-page catalog describes the Imperial soldering iron. Fully-illustrated, the 4-color catalog contains applications, specs. and user net prices on Ungar's complete line of interchangeable Imperial components including Perma-Cool handles, standard or grounded cord sets, 25-30-40w long-life heat cartridges and 42 Mini-Tip thread-on soldering tips. Ungar Electric Tools, Electronic Div. of Eldon Industries, Inc., 1475 E. El Segundo Blvd., Hawthorne, Calif.

Circle 184 on Inquiry Card

Crossbar Switch

Tech. data on the McKee Crossbar Switch is available from McKee Automation Co., 13421 Wyandotte St., No. Hollywood, Calif. Part I is an explanation of the principle of the 400 position multiselector crossbar switch (normally open contacts), and the 400 position continuity Hi-pot unit (normally closed contacts). Part II contains diagrams and explanation of the open contact switch in combination with the Hi-pot unit.

Circle 185 on Inquiry Card

Drill Bushings Glide

The Ace Standard and Thin-Wall Standard Drill Bushings slide guide contains full data for ASA standard and thin-wall standard drill bushings. This color-coded slide chart contains data for press fit and head press fit bushings, slip and fixed renewables and liners and head liners. Ace Drill Bushing Co., Inc., 5408 Fountain Ave., Los Angeles 29, Calif.

Circle 186 on Inquiry Card

Bright Dip

Information is available on a room temperature bright dip for processing Kovar alloy. Bright Dip CX-215 reduces heat requirements, gives longer life to tank linings, reduces gassing and improves lift of bath. Cox Laboratories, 2275 Vantage St., Dallas 7, Tex.

Circle 187 on Inquiry Card

R-F Filters

Tech. data is available on the TBP Series Miniature Band Pass R-F Filters. Features include 125-2000MC coverage; low VSWR; low insertion loss and ruggedized coaxial configuration. Telonic Engineering Corp., Laguna Beach, Calif.

Circle 188 on Inquiry Card

Transistors/Diodes

Fairchild Semiconductor, 545 Whisman Rd., Mountain View, Calif., is offering an 8-page brochure describing their transistor/diode special semiconductor product capability. Forty transistor/diode multiple devices are shown.

Circle 189 on Inquiry Card

Metalforming Machine

Information is available on the Magneform[T.M.] which is an electromagnetic metal-forming machine. It swages, expands, compresses, coins, shears, and assembles light to medium gauge conductive metals without mechanical contact with the work. General Atomic Div., General Dynamics Corp., P.O. Box 608, San Diego 12, Calif.

Circle 190 on Inquiry Card

Ultrasonic Cleaning

Information is available on the Baron Micro-Line Solvent Stills which reduce cleaning costs by reclamation of dirty solvent for re-use whenever a high quality pure distillate is required. Baron Industries, 241 W. Avenue 26, Los Angeles 31, Calif.

Circle 191 on Inquiry Card

Strip Chart Recorders

Tech. data is available on the Model 680 Series, Strip Chart Recorders, which include the Model 680 (10 ranges, 8 chart speeds, and continuous electronic reference); Model 681 is a single range, single chart speed version of the 680; Model 682 (same as Model 681 except that it is designed for thermocouple input); and the Model 683 (same as Model 681 except the input is designed for current measurement). F. L. Moseley Co., 409 N. Fair Oaks Ave., Pasadena, Calif.

Circle 192 on Inquiry Card

Current Regulators

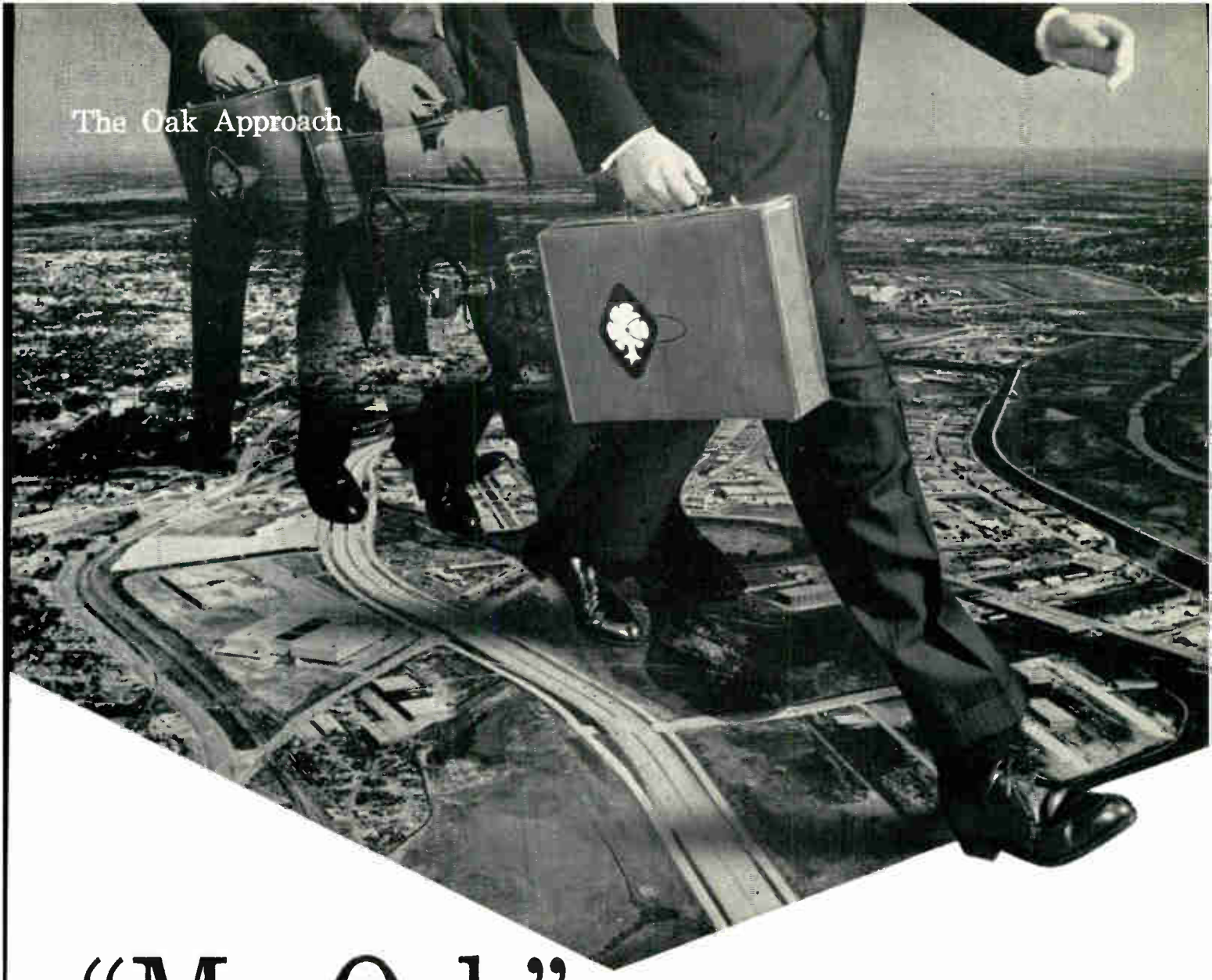
Tech. Bulletin T-413 on Currector Current Regulators, CP7 Miniature Germanium Series, describes solid-state, 2-terminal devices that limit current in a manner similar to the voltage limiting action of the Zener diode. Outline drawings, photographs, and characteristics charts are included. CircuitDyne Corp., Laguna Beach, Calif.

Circle 193 on Inquiry Card

Microwave Capabilities

Applied Technology Inc., 930 Industrial Ave., Palo Alto, Calif., is offering a brochure on their capabilities in the areas of electronic warfare, microwave telemetry, and space surveillance communications and control. Included are photographs and specifications on countermeasures systems, telemetry system components, and VHF and UHF system elements and accessories.

Circle 194 on Inquiry Card



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Circle 88 on Inquiry Card

New Tech Data for Engineers

Flat Cable Design

This 24-page booklet entitled, "Flat Cable Design Guide" provides information on materials used in fabricating flat cable and practical design recommendations on selection of specific cable parameters to suit a particular application. Included are photographs, characteristic charts, and comprehensive application data on Polystrip® and Lamoflex® flexible, flat cable. International Resistance Co., Plastic Products Div., 401 N. Broad St., Philadelphia 8, Pa.

Circle 195 on Inquiry Card

Delay Lines

Paradynamics, Inc., Control Electronics Div., 10 Stepar Place, Huntington Sta., N. Y., is offering their 1962 Catalog on delay lines. This 32-page catalog contains 17 pages on magnetostrictive units and 15 pages on electromagnetic delay lines. Also included is special information to help in determining the type of delay lines needed, operational theory, measurement data, recommended design procedure and methods of installation.

Circle 196 on Inquiry Card

Shaded-Pole Motors

Tech. data is available on Type YAD Brushless DC Motor which is an inexpensive dc fan motor designed for cooling applications. The Type YAD has no brushes to wear out and no arcing contacts to cause conducted electrical interference. Barber-Colman Co., Motors and Components Div., Rockford, Ill.

Circle 197 on Inquiry Card

Coil Winding Machines

Catalog No. 62HD, 16 pages, 2 colors, illustrates and describes 17 heavy duty transformer and field coil winding machines and 4 heavy duty tensions. Information includes types of windings, wire sizes, max. loading distance for multiple winding, tensions, counters, brakes, tailstocks, and other important features. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 46, Ill.

Circle 198 on Inquiry Card

Microwave Sources

"Microwave Energy Sources," 28 pages, includes information on a complete line of: microwave oscillators covering all bands from 400 to 6200 MC, for CW, grid or plate pulse service; harmonic generators with a wide tuning range to 1 octave for radio spectroscopy and solid state up through X-band for local oscillators and parametric pumps; and small signal, low noise and high power pulse amplifiers for use in radar receivers and transmitters. Included are outline drawings, photographs, and specifications. Trak Microwave Corp., 5006 N. Coolidge Ave., Tampa 3, Fla.

Circle 199 on Inquiry Card

Indicator Tube Catalog

This 28-page NIXIE® Indicator Tube Catalog has complete information on all NIXIE tube types. Catalog contains more than 60 photographs, diagrams, and schematics, plus selection charts for standard and special character units. Technical memorandum in the catalog discusses circuit design criteria, ionization and operating voltages, and methods of selecting circuit parameters. Burroughs Corp., Electronic Components Div., P. O. Box 1226, Plainfield, N. J.

Circle 200 on Inquiry Card

Microwave Absorbers

Information is available on Type VHP (very high performance) absorber, which is designed for broadband anechoic chambers, featuring high performance and low cost. In its thicker versions this material is said to provide 15 to 20db greater absorption (both at normal and wide angles of incidence) than has been previously available. B. F. Goodrich Co., Sponge Products Div., Shelton, Conn.

Circle 201 on Inquiry Card

Cable Ties

Information is available on Gude-Ties which are made of soft nylon braid and microcrystaline wax and comply with the requirements of Mil-T-713A, including fungus proofing. Three standard sizes are available in 8, 10, and 18 in. lengths and other lengths are available on order. Gudebrod Bros. Silk Co., Inc., Electronics Div., 225 W. 34th St., New York 1, N. Y.

Circle 202 on Inquiry Card

Choppers

Information is available on "No Noise Choppers." These units (the 228 for 60CPS and 428 for 400CPS), measure 0.525 x 0.750 x 0.350 in. Cambridge Scientific Industries, Inc., 18 Popler St., Cambridge, Md.

Circle 203 on Inquiry Card

Meter Protector

Tech data is available on the Model 201 Meter Protector. This device is for the protection of sensitive meter movements and will protect any D'Arsonval meter movement whose full scale terminal voltage is greater than 100mv. Protection is instantaneous and automatically recovers when the overload is removed. Dynatron Laboratories, Inc., 553-E Dawson Drive, Camarillo, Calif.

Circle 204 on Inquiry Card

Shielding

Data Sheet 159, available from Magnetic Shield Div., Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill., illustrates and describes a Netic Co-Netic magnetic shield for close fit and retrofit display tube applications.

Circle 205 on Inquiry Card

Ceramic Capacitors

Catalog M-1 contains comprehensive information on Subminiature Ceramic Capacitors covering thinline temperature-compensating; thinline general purpose; narrow-caps (which fit 1/10 in. modular spacing); Mucaps (150°C operation, molded case); UHF standoff; UHF ribbon lead; and transistor-circuit capacitors. Included are characteristic charts, spec. outline drawings and photographs. Mucon Corp., 9 St. Francis St., Newark 5, N. J.

Circle 206 on Inquiry Card

Relays

Engineering Catalog No. 62, 44-pages, available from Comar Electric Co., 3349 Addison St., Chicago 18, Ill., contains information on relays, solenoids, switches, and coils. Some of the units covered include: general-purpose ac relays including bank assembly, compacts, interlocks, and impulse latching types; and general-purpose dc relays—compact, interlock, light duty, switching, stepping switch, miniature, plug-in and circuit types; telephone-type relays—subminiature, sensitive, fast acting and rotary types; and solenoids—laminated, solid frame, and miniature types. Included are photographs, outline drawings, and specs.

Circle 207 on Inquiry Card

Alphanumeric Display

Information is available on the Videograph Model 985 Digital-to-Television Alphanumeric Display. Model 985 is a device for converting digital data into a tabular display of alphanumeric characters on one or more TV monitors. It permits display on conventional TV's without modification. A. B. Dick Co., 5700 W. Touhy Ave., Chicago 48, Ill.

Circle 208 on Inquiry Card

DC Reference Elements

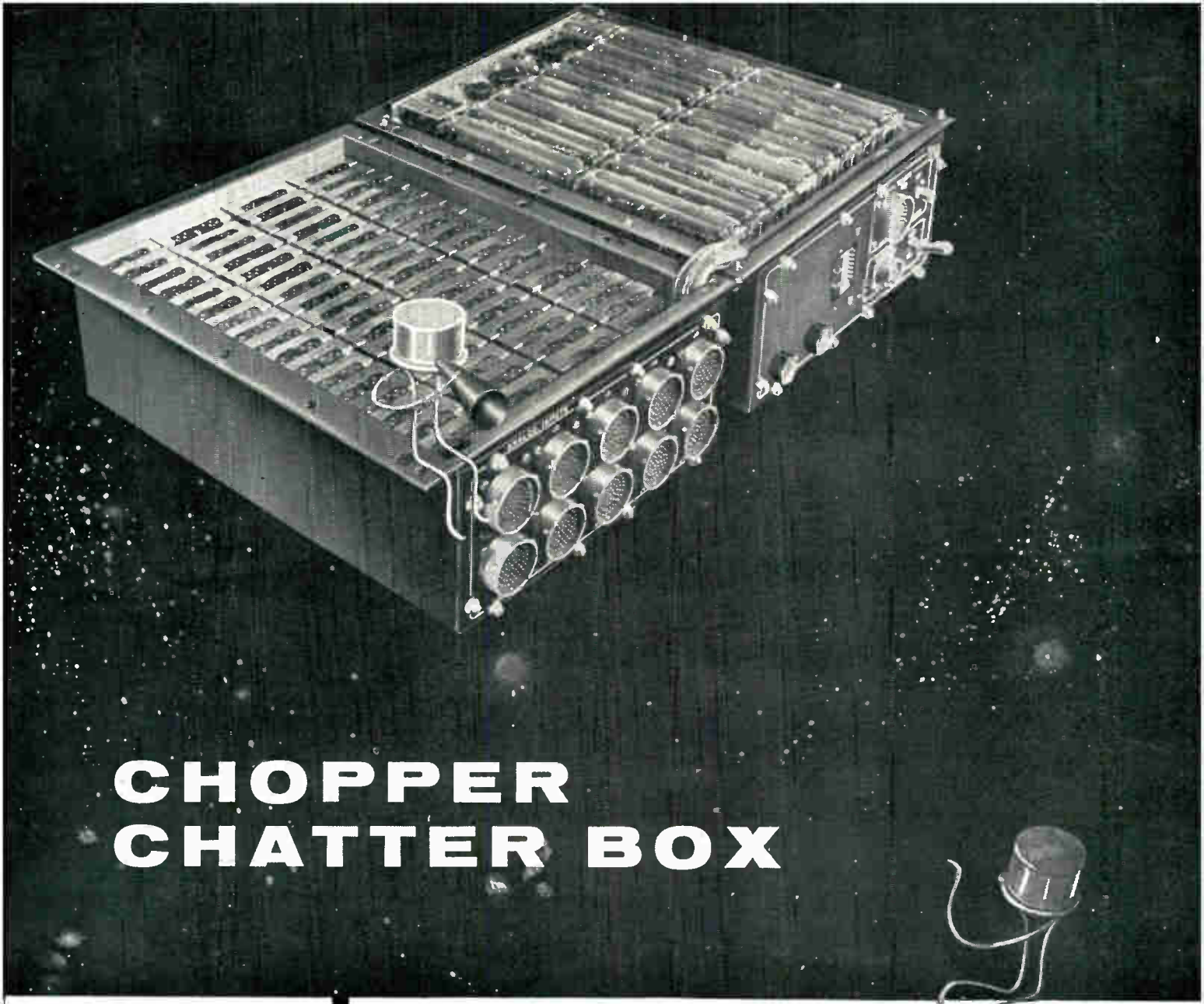
Complete engineering data for 2 new series of 10.5 and 8.4v miniature zener dc reference elements is available from Henry Engineering Co., 3625 W. Pacific Ave., Burbank, Calif. Information includes electrical and environmental specs., ambient temp. curves, temp. coefficients and a dimensional drawing.

Circle 209 on Inquiry Card

Digital Instruments

Product Digest, Spring 1962, 14 pages, 2 colors, on digital instruments for measurement, counting and control is available from Beckman® Instruments, Inc., Berkeley Div., Richmond, Calif. Units covered include solid-state printer; solid-state frequency and time measuring instruments; electron tube frequency and time measuring instruments; high frequency measuring systems to 21GC; and information on transducers.

Circle 210 on Inquiry Card



CHOPPER CHATTER BOX

America's First Operational
LOW LEVEL PCM TELEMETRY SYSTEM DESIGNED BY EPSCO FOR TITAN II USES SPERRY MATCHED CHOPPERS

The Epsco Pulse Code Modulation system made telemetry history on the U.S. Air Force's Titan II 5,000 mile test. It is the center of the fact gathering complex and transmits 196 channels of vital information to ground stations.

A unique feature of the Epsco system is a technique which appreciably reduces the size and the number of components while actually increasing reliability — and it's only the size of a shoe box.

Almost all the semiconductors in this miniaturized system are Sperry Matched Chopper transistors. For detailed information on Sperry Choppers, write for Technical Application Bulletins 2107 and 2109. For Epsco PCM Specifications write for brochure PC 5196LL.

SPERRY

SEMICONDUCTOR

DIVISION OF
SPERRY RAND CORPORATION
NORWALK, CONNECTICUT

Circle 89 on Inquiry Card

SEMICONDUCTOR INTEGRATED NETWORKS (SEMI-NETS*).
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

WESCON New Products

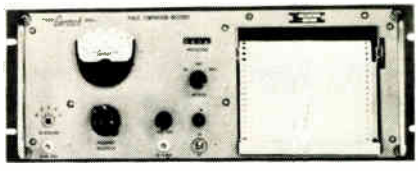
Frequency Discriminator

This FM/FM bandswitching telemetering discriminator, Model 43-7959, demodulates freq. modulated carriers in the 300 to 100,000CPS range to IRIG specs. Seminol Div., AIRPAX ELECTRONICS Inc., BOOTH 601.

Circle 314 on Inquiry Card

Standards Receiver

Model PCR-1, Phase Comparison Receiver, all solid-state, is for accurate freq. comparisons against carri-

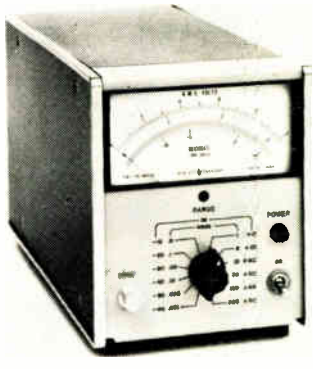


er-stabilized LF and VLF transmissions. Gertsch Products, Inc., BOOTH 952.

Circle 315 on Inquiry Card

RMS Voltmeter

Model 3400A RMS Voltmeter is for accurate measurements of a broad range of sinusoidal or non-sinusoidal waveforms at frequencies from 10CPS to 8MC. Hewlett-Packard Co., BOOTH 508.



Circle 316 on Inquiry Card

New Tech Data for Engineers

Connectors

This 12-page, 2-color catalog covers an expanded group of right angle plug and socket connectors for printed circuit applications. Units are available in a variety of configurations and contact sizes from 4 to 38. All dip solder to a printed circuit board at right angle to the plug and receptacle contacts. Complete specs., outline drawings and illustrations are included in the catalog, Form REVRTA 362. Continental Connector Corp., 34-63 56th St., Woodside 77, N. Y.

Circle 211 on Inquiry Card

Control Knobs/Handles

This 21-page catalog lists the wide selection of control knobs and handles available from Rogan Brothers, Inc., 8025 N. Monticello Ave., Skokie, Ill. Along with photographs, dimensional drawings and individual descriptions, a section is devoted to the wide variety of markings possible.

Circle 212 on Inquiry Card

Voltage Comparator

Tech. data is available on the VC 670, which is a transistorized monitor which continuously compares a random signal with an external reference voltage and provides a fail-safe alarm (contact opening) when the signal value exceeds the external reference limit. Verco Inc., 1430 130th N.E., Bellevue, Wash.

Circle 213 on Inquiry Card

Circuit Breakers

Bulletin No. 3502, describing the Series SM Sub-Miniature Circuit Breakers, is available from Heinemann Electric Co., Trenton 2, N. J. The SM series units feature lightweight, compact design; large circuit breaker stability; hermetically-sealed case and are built to operate under severe environmental conditions.

Circle 214 on Inquiry Card

Microwave Power Meter

PRD 650-C, Microwave Power Meter features direct readings in db or mw from 0.1 to 100mw full scale in 7 ranges, measures average power value of pulse or CW signals instantaneously, and has a ±3% accuracy for 0.1 to 100mw full scale without external attenuators. PRD Electronics, 202 Tillary St., Brooklyn 1, N. Y.

Circle 215 on Inquiry Card

Precision Potentiometers

Complete catalog of all Clarostat industrial electronic components including precision potentiometers, upgraded industrial potentiometers, precision deposited carbon resistors, vitreous enameled resistors, and Military-type resistance devices is available from Clarostat Mfg. Co., Inc., Dover, N. H. This 19-page, 3-color brochure includes characteristic curves, specifications, outline drawings, and photographs.

Circle 216 on Inquiry Card

Switches

Military type switches are described in a 28-page catalog available from Cutler-Hammer Inc., 436 N. 12th St., Milwaukee 1, Wisc. Catalog LJ-137 lists the standard design features, mounting methods, terminal types, ratings, and electrical and mechanical details for flush and 1 hole mounting, microphone, miniature, positive action, pushbutton, rotary, and slide button switches. Also included are selection tables and military specs. to simplify the choice of devices for particular applications.

Circle 217 on Inquiry Card

Recording Instruments

This 20-page, 2-colored catalog contains information on a complete line of graphic recording instruments. It lists instrument types and applications, case styles, chart drives, and measuring elements. Esterline Angus Instrument Co., Inc., P.O. Box 596, Indianapolis 6, Ind.

Circle 218 on Inquiry Card

Connectors

"Tiny Tim"® connectors for microminiature rack and panel applications are described in an 8-page, 2-color brochure available from Amphenol Connector Div., Amphenol-Borg Electronics Corp., 1830 So. 54th Ave., Chicago 50, Ill.

Circle 219 on Inquiry Card

Analog Filters

Tech. information is available on the Series LH-24 Analog Filters which are a family of precision, active network devices applicable to a wide variety of freq. selective operations from dc through the sub-audio, audio, ultrasonic and medium video regions of the frequency spectrum. Spectrum Instruments, Inc., Box 61, Steinway Sta., Long Island City 3, N. Y.

Circle 220 on Inquiry Card

Connectors

Catalog No. 362 contains information on removable contact connectors, hermetically sealed connectors and terminals; and miniature rectangular, external miniature rectangular, miniature round, subminiature, printed circuit, quick disconnect, and heavy duty type connectors. This 23-page, 2-color catalog is available from Winchester Electronics, Inc., 19 Willard Rd., Norwalk, Conn.

Circle 221 on Inquiry Card

O-scope Plug-in

Information is available on the Type 701 Sampling and Sweep Plug-in for all Analab oscilloscope main frames. The Type 701 provides dual channel operation and a complete trigger and sweep circuit in a single plug-in unit. Analab Instrument Corp., 30 Canfield Rd., Cedar Grove, Essex County, N. J.

Circle 222 on Inquiry Card

QC Instruments

Catalog supplement No. 1-09 illustrates and describes, in condensed form, the recent advances in uses of optical, electronic, and mechanical instruments for industrial inspection and quality control. Included in the supplement are autocollimators, levels, surface measuring instruments, microscopes, improved accessories, and latest spectrographic, interferometric and X-ray instrumentation. Engis Equipment Co., Div. of Engineering and Scientific Instrumentation, 431 S. Dearborn St., Chicago 5, Ill.

Circle 223 on Inquiry Card

Drive Systems

A comprehensive 32-page report on "Harmonic Drive Operational Systems, Advanced Developments, and Technical Capabilities" is offered by the Harmonic Drive Div., United Shoe Machinery Corp., Beverly, Mass. Information covers 20 mechanical systems using the basic Harmonic Drive concept which features high output torque in a given physical volume and weight; high reduction ratio in small volume; angular positional accuracy and rate constancy; and efficiency as either a speed reducer or speed increaser.

Circle 224 on Inquiry Card

AC Power Supplies

Single phase, two phase, and three phase Powertrons AC Power Supplies are described in tech. data available from Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y. Total power output for 1ϕ units ranges from 3va to 3000va; for 2ϕ units from 6va to 6000va; for 3ϕ units from 9va to 9000va.

Circle 225 on Inquiry Card

Measuring Instruments

Yokogawa Electric Works, Inc., 40 Worth St., New York 13, N. Y., is offering information on their line of laboratory standards; dc ammeters and voltmeters; ac ammeters, voltmeters and wattmeters of the electrodynamometer type; multi-range portable standards; miniature precision ammeters and voltmeters; high freq. thermocouple milliammeters and voltmeters; portable insulation testers; and portable single phase watt meters.

Circle 226 on Inquiry Card

Protective Film

Aclar films are made from fluorohalocarbon resins and contain no plasticizers, fillers or other additives. Aclar can be printed, vacuum formed, extrusion coated, metalized, also laminated to other films, paper, cloth, metals, etc. Some uses include printed cable assemblies and in packaging for moisture sensitive products. General Chemical Div., Allied Chemical Corp., 40 Rector St., New York 6, N. Y.

Circle 227 on Inquiry Card

New Tech Data for Engineers

Marking Machines

Information is available on High Speed Printing Machines for electronic components. Included is the Model RG-3 for printing cylindrical components having a single wire lead from each end of the body; Model RB-3 for components having a short cylindrical body and several leads from one end; and Model RG-1 for printing flat or nearly flat components with or without leads. International Eastern Co., 801 Sixth Ave.. New York 1, N. Y.

Circle 228 on Inquiry Card

R-F Connectors

Crimp-type connectors are described in a "Source Book for Relia-Bilt R.F. Connectors" available from Tru-Connector Corp., 245 Lynnfield St.. Peabody, Mass. The Tru-Connector Crimp Series is suited for mass production of cable assemblies. Information is included on Crimp Series designed for BNC, N, QDS, TNC, MHV, C, HN, and LC.

Circle 229 on Inquiry Card

Metals Booklet

A supplement to J. Bishop & Co.'s regular product catalog, this booklet contains articles of interest written by Bishop's technical people over the past few years. Included are articles on platinum products, Bishop's ability to fabricate the refractory and reactive metals, as well as articles on clads and composites. J. Bishop & Co., Platinum Works, Malvern, Pa.

Circle 230 on Inquiry Card

Socket Screw Catalog

"Socket Screw Catalog and Engineering Standards," 52-pages, revised edition, contains data on standard (stock) sizes, nominal thread length, dimensions and specifications for all socket screw types, including those stocked in stainless. Hex keys are also tabled, along with dowel pins. Performance data is also included on P-K's W-Point™ socket set screws, and socket screws with Long-Lok inserts for vibration resistant applications. Parker-Kalon, Clifton, N. J.

Circle 231 on Inquiry Card

Microwave Capabilities

"O/H Microwave Capabilities," 30 pages, 2 colors, contains information on ITT's Federal Laboratories capabilities in the microwave field. Information is included on advanced O/H (over-the-horizon) equipment designed for worldwide service; principle ITT O/H communications systems — program management, installation, operation; related ITT experience—microwave, aerospace, telephone; and facilities—pilot plants and manufacturing. ITT Federal Laboratories, 500 Washington Ave., Nutley 10, N. J.

Circle 232 on Inquiry Card

Memory Systems

Bulletin MS-1 "Applications Guide to Magnetic Core - Memory Systems" is available from Indiana General Corp., Electronics Div., Keasbey, N. J. Information is included on 3 basic access modes of coincident current memory systems: random access; sequential non - interlaced; sequential interlaced.

Circle 233 on Inquiry Card

Static Inverters

Tech. data is available on 8 different types of static inverters ranging from 1.5 to 400kva. The units are for converting dc emergency stand-by power into ac power and for frequency conversion. General Electric Co., Low Voltage Switchgear Dept., 6901 Elmwood Ave., Philadelphia 42, Pa.

Circle 234 on Inquiry Card

Harmonic Generators

A short form Harmonic Generator Catalog, 4 pages, 2 colors, describing 63 doublers, triplers, quadruplers, and multiple-stage units is available from Microwave Associates, Inc., Burlington, Mass. Catalog SF-7001 contains information on precise frequency multiplication without dc bias which is provided by the single and multiple-stage varactor units.

Circle 235 on Inquiry Card

Metal Capabilities

The Metal Strip Capabilities of the Industrial Metals Div., American Silver Co., Inc., 36-09 Print St., Flushing 54, N. Y., is described in a general brochure. Information is included on high precision tolerances; thin and ultra thin gauges; surface qualities; large or small quantities; mill limits and delivery.

Circle 236 on Inquiry Card

Angle Rate Measurement

Tech data is available on MIDARM, a general purpose, wide angle, electro-optical, angle and angular rate measuring and rate control system. Performance specs include 0.0002°/hr rate accuracy in less than 1 min. of time; 0.02 arc-sec. angular repeatibility; and 0.05 arc-sec. angular accuracy. Razdow Laboratories, Inc., 77 12th Ave., Newark 3, N. J.

Circle 237 on Inquiry Card

DC Power Supplies

Information is available on Kepco's ABC Series, low cost, voltage and current regulated, dc power supplies. Fully transistorized, these units are adaptable for laboratory or system use and feature 0.05% line/load regulation and stability and 0.5mv RMS ripple. Kepco Inc., 131-38 Sanford Ave., Flushing 52, N. Y.

Circle 238 on Inquiry Card

Feedthru Assembly

Information is available on an alumina-to-metal electrical feedthru assembly for high-vacuum equipment. The units remain high-vacuum-tight at either cryogenic temps. or following bake-out temps. to 500°C. Feedthrus available for voltages to 100kv (dc) or currents to 2000a. Ceramaseal, Inc., New Lebanon Center, N. Y.

Circle 239 on Inquiry Card

Computer Display System

Computer Products, Inc., 21 Broad St., Manasquan, N. J., is offering a 4-page catalog on their Model 1000 Display System for use with all repetitive analog computers. Up to 10 inputs may be viewed as functions of time and voltage coordinate lines are provided at 10v intervals when using a 100v reference system (1v when using a 10v reference system).

Circle 240 on Inquiry Card

Optical Capabilities

Precision Photomechanical Corp., 170 S. Van Brunt St., Englewood, N. J., is offering information on their capabilities in the area of producing finished optical materials and control devices. Areas covered by PPM include scanning devices, divided circles, complex wave forms, digital computer coding discs, and sine wave frequency standards.

Circle 241 on Inquiry Card

Pulse Generator

Tech data is available on LA-595 Modular Pulse Generator which uses 3 groups of plug-in modules which determine rate repetition, width and delay and output characteristics. The unit features dual channel outputs, separate or parallel with independent amplitude, width and delay controls for each channel. Lavoie Laboratories, Morganville, N. J.

Circle 242 on Inquiry Card

Electroplating

This "Guide to Fluoborate Plating" shows how to produce heavy deposits quickly with high coverage from easily-controlled (95-100% efficient) acidic baths. Copper, lead, tin, lead-tin, zinc, iron and nickel fluoborate plating baths, each with its particular advantages, are described in this 26-page manual available from The Meaker Co., Nutley 10, N. J.

Circle 243 on Inquiry Card

Capacitor Testing

Accelerated life tests and how they correlate with capacitor life is discussed in Technical Paper N. 62-4 entitled "Accelerated Tests and Predicted Capacitor Life" available upon letterhead request from Sprague Electric Co., Marshall St., North Adams, Mass.

THIS

BRINGS YOU THIS

The Delco Radio 251M-1 Minuteman transistor. Equivalent characteristics are also available for high reliability applications in our 2N1358A version.

110

ELECTRONIC NEWS, MONDAY, MARCH 26, 1962

99.997% Reliability Achieved For Minuteman Transistors

KOKOMO, Ind.—The Delco Radio division has succeeded in manufacturing power transistors for the Minuteman missile with 99.997 per cent reliability, based on tests with an assumed acceleration factor of 50. The firm is said to be the first power transistor producer to meet such requirements, according to Delco officials.

This extreme reliability was achieved in a research and development contract with Autonetics, a division of North American Aviation, Inc., associate prime contractor responsible for the inertial guidance and flight control systems for the Minuteman, developed by the Ballistic Systems division of the Air Force Systems Command.

The transistor involved is the Autonetics 251M-1. It is covered by specifications similar to those of the Delco 2N1358. More than 50,000,000 hours were accumulated testing it.

The reliability program at Delco Radio was an effort to accelerate the rate of transistor development to provide power transistors with a failure rate of 0.003 per cent/1000 hours or lower at 60 per cent confidence level.

Part of the program consisted of obtaining histories on specific lots of power transistors. The histories included absolute documentation of all environments, processes, and parts which in any way affect production of the transistors. The lot size was chosen to be the output of transistors from a single germanium crystal.

DOWNEY, Calif.—Autonetics division of North American Aviation, Inc., associate Minuteman contractor responsible for inertial guidance, flight control and aero-space ground equipment, confirmed that Delco Radio power transistors had met Minuteman reliability requirements.

A spokesman said Delco's 251M transistor, for use in Minuteman's guidance and flight control, had achieved the failure requirement of .003 per cent per 1,000 hours.

251M-1
Germanium Transistor

TYPE	Vcbo @ Icb=4 ma	Vceo @ Iceo= 1 Amp Sweep	H_{fe} @ Ic=5A Min.	Max.	Vce (sat) Ib=2A Ic=12A	Thermal Resistance Junction to Case	Junction Temp. (Max.)
251M-1	80V min.	60V min.	25	50	0.7V	0.8° C/w max.	95° C

Write for additional information on the Delco Radio Power Transistor Reliability Story

DELCO RADIO

Sales Offices

Union, New Jersey
324 Chestnut Street
MUrdock 7-3770
AREA CODE 201

Detroit, Michigan
57 Harper Avenue
TRinity 3-6560
AREA CODE 313

Santa Monica, California
726 Santa Monica Blvd.
UPton 0-8807
AREA CODE 213

Syracuse, New York
1054 James Street
GRanite 2-2668
AREA CODE 315

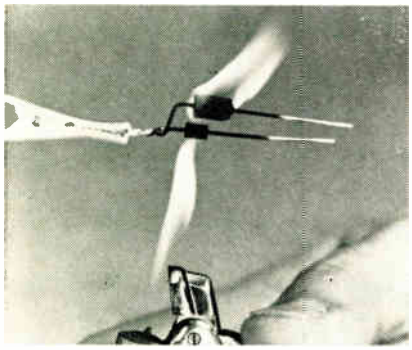
Chicago, Illinois
5151 N. Harlem Ave.
775-5411
AREA CODE 312

General Sales Office: 700 E. Firmin, Kokomo, Ind., Gladstone 2-8211—Ext. 500 • AREA CODE 317 • Division of General Motors, Kokomo, Indiana

New Products . . . for the Electronic Industries

ZENER DIODE

Flame-proof; electrical characteristics return to normal after fire.

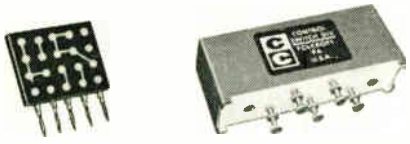


This zener diode series has an inorganic-glass layer grown thermally as an integral part of the junction surface. Tradenamed "Surmetic," they have been constructed to conservatively dissipate ¾ w. Available with nominal voltages of 11 to 51v. Silicone polymer package with high temp. thermal and dielectric characteristics makes possible max. storage and operation junction temp. of 175°C. This material is flame-proof and under a new high-pressure molding process results in void-free encapsulation. Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix 8, Ariz.

Circle 320 on Inquiry Card

CIRCUIT BREAKER

This solid state circuit breaker operates in 10μsec.

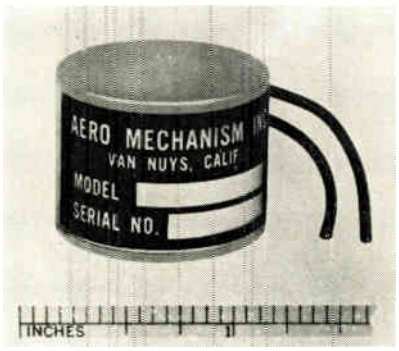


It is offered in both of the configurations pictured above — a plug-in high density component assembly, and a mount-in wire-in model. Both styles are available with ratings from 6 to 28v and 1 to 250ma. The circuit-breaker is reset by a remote momentary contact normally-open switch. Status is indicated by a remote lamp. The circuit-breaker is a 4-terminal device drawing a current equal to approx. 1% of the load current from the dc power source at all times. Control Switch Div., Controls Co. of America, 1420 Delmar Dr., Folcroft, Pa.

Circle 321 on Inquiry Card

ALTITUDE SWITCH

For high altitude radar voltage and missile command signal control.

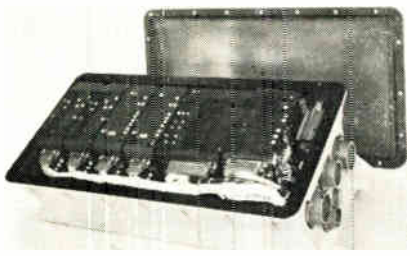


The Model 9026 actuates on an increase in altitude from 15,000 to 18,000 ft. and deactivates on decreasing altitude from 15,000 to 12,000 ft. It is a SPDT switch, rated at 2a resistive with contacts in either NO or NC position. Temp. range under continuous operation is from —54° to 125°C, per Mil-Std. 202B, Method 102A. Meets or exceeds Mil-Std. 202B for resistance to humidity, salt spray, sand and dust. Aero Mechanism, Inc., 7750 Burnet Ave., Van Nuys, Calif.

Circle 322 on Inquiry Card

DC-DC CONVERTER

This 1/2KW dc to dc unit is for missile and space craft use.

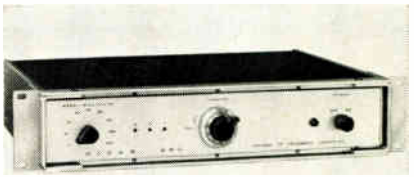


Capable of converting 28v battery power into regulator dc output over a temp. range from —32° to +115°C, it combines 65% efficiency with unlimited short circuit protection. It is self-contained in an 18 x 7 x 9 in. leak-tight cast aluminum housing weighing a total of 44 lbs. Specs. include multiple output voltages: ±150v, ±0.3%; ±65v, ±1.0%; 36v, ±0.5%; and 6.6v, ±5%; and with low pass, filtered (50dc) ripple voltages of 10, 25, 5 and 100 mv, respectively. Sperry Electro Devices Laboratory, 55 Denton Ave., So., New Hyde Park, N. Y.

Circle 323 on Inquiry Card

SIGNAL CONVERTER

Low level unit digitizes or integrates millivolt signals.

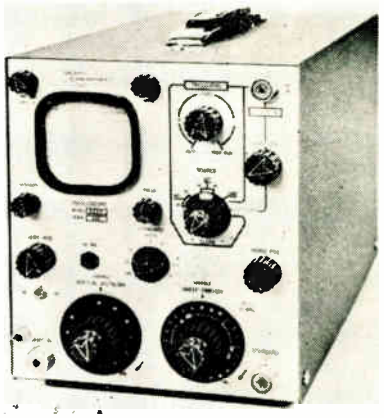


Featuring 5mv sensitivity and 0.03% linearity, Series 260 low level, floating input converters operate without preamplification from all direct analog transducers — thermocouples, load cells, and other strain gage devices. Because input voltages are converted to proportional freq., any freq. counter can be used for digital display of input voltage magnitude. Precise integration of transducer output possible by using counter as a totalizer. Overall conversion accuracy is 0.1%. Vidar Corp., 2296 Mora Dr., Mountain View, Calif.

Circle 324 on Inquiry Card

OSCILLOSCOPE

This 16 lb. transistorized unit has a dc to 15MC vertical bandwidth.



It has a dynamic range of vertical sensitivities from 10mv/div. to 50v/div. The stable vertical amplifier can be ac or dc coupled at all sensitivities. A precision sweep having a range of 1.2 sec./div. to 0.02 μsec./div. is another feature of the Model 3015. Designed for field or production testing it measures 7 x 8 x 14 in. It has regulated power supplies and will operate on power line freqs. of 60 to 400CPS. Unit dissipates approx. 15w of power under normal line conditions. Galaxy Laboratories, Inc., 3606 Midway Dr., San Diego 10, Calif.

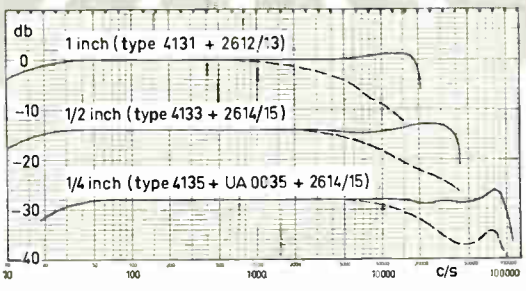
Circle 325 on Inquiry Card

NEW SERIES 4131/6

PRECISION CONDENSER MICROPHONES

- **Universally Practical for all Sound Measurements**
- **High Calibration Stability**
- **Broad Range**
- **Immune to Rugged Environments**

● Now, whatever your sound measurement requirements, B & K INSTRUMENTS can provide the precision condenser microphone . . . with absolute calibration for broad measurement range (10 to 100,000 c/s over 15 to 180 db levels) . . . and with a very extensive measurement versatility through a wide selection of accessories. ● Highly dependable, these ¼, ½ and 1-inch precision microphones withstand prolonged rugged environments without failure. Their long-term stability, physical ruggedness and ease of calibration combine to provide the acoustical engineer with the most practical precision condenser microphones ever available. B & K microphone systems offer the most economical path to reliable acoustic data acquisition . . . Write for 4131/6 technical brochure today!

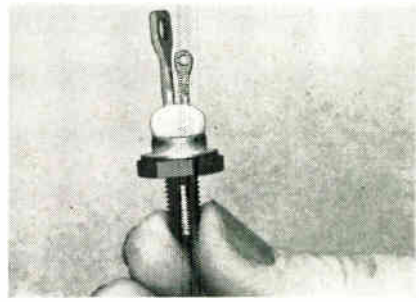


Typical frequency response of the B & K free-field calibrated Microphones. The curves in full are the free-field response for normal (0°) incidence with protecting grid in the case of 1-inch and ½-inch Microphones and without protecting grid for ¼-inch Microphones. The dotted line in each case represents the over-damped pressure response. NOTE: The sensitivity of the Microphones is referred to 5 mV/ μbar = —46 db, re. 1 V/ μbar.

B & K INSTRUMENTS, INC.
Please send me . . .
☐ Technical Brochure on Microphone Systems
(A-117)

B & K INSTRUMENTS, INC.
Bruel & Kjaer Precision Instruments
3004 West 106th Street • Cleveland 11 Ohio • CLearwater 1-8430
Specialists in Sound, Vibration & Data Analysis Instrumentation

WESCON New Products



Power SCR

For power control and switching uses, Type 10CR is available with ratings of 4.7, 10, and 16a. Have a low forward voltage drop when switching rapidly. Fansteel Metallurgical Corp., BOOTH 2074.

Circle 317 on Inquiry Card

Current Regulators

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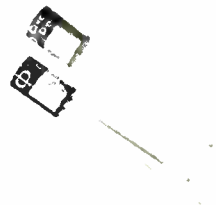

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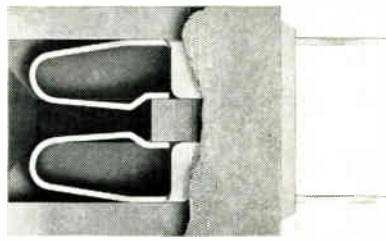

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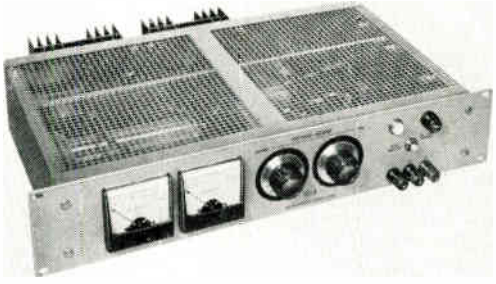

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International Electronic Sources

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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 Uber tragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electro-akustik
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 i Telemakhanika
Radio. Radio
Radiotek. Radioteknika i Elektranika
Rad i Elek. Radioteknika i Elecktranika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

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ANTENNAS, PROPAGATION

Transmitter Combining Unit for Low-Power Systems, A. B. Shone. "El. Tech." May 1962. 9 pp. Equipment is described for combining two or more transmitters into one aerial system using a compact form of the Maxwell bridge. In all forms of the network the loss introduced by the reactive arms is a function of the Q of the resonators which is, in general, a function of their physical size. (England.)

Losses in a Balanced Antenna Duplexer During Reception with Mismatched Oscillator, Antenna and Receiver, B. E. Rubinstein. "Radiotek" 17, No. 5, 1962. 6 pp. The dependence of the losses in a balanced antenna duplexer on the SWVR of the discharges, oscillator, antenna and receiver, and the separation between them is investigated. It is shown that a poor choice of separation may lead to a considerable increase in the losses of the duplexer. (U.S.S.R.)

Directivity Patterns of Linear Radiators, N. A. Semyonoff. "Radiotek" 17, No. 5, 1962. 8 pp. Differences between directivity patterns of linear systems in continuous and discrete radiators are analyzed. (U.S.S.R.)

CIRCUITS

Discrete Automatic Optimizer. I, T. S. Paulauskas. "Avto. i Tel." Vol. 23, #5. 10 pp. A circuit of a discrete automatic optimizer is suggested. Paper includes description and results of the testing of a program controlled semiconductor matrix distributor which is a control part of a semiconductor element discrete automatic optimizer. (U.S.S.R.)

A Possibility of Producing Almost Ideal All-pass Networks by Additions to Lossy Bridged-T Sections, P. Birgels. "Nach. Z." May 1962. 8 pp. A circuit is given for purposes of equalizing amplitude disturbances due to losses in bridged-T sections and this circuit supplements the lossy circuit to a pure allpass network. (Germany.)

About Canonical Method of Synthesis of Contact Circuits, A. Sh. Blokh. "Avto. i Tel." April 1962. 6 pp. A canonical method for the synthesis of contact circuits in the case of intermediate integer parameters is described. (U.S.S.R.)

Stabilized Power Supply with Automatic Overload Protection, E. Dell'Oro and K. P. Nambiar. "El. et Auto." March-April 1962. 2 pp. A new overload protection circuit, based on a controlled rectifier, is incorporated in this stabilized power supply designed to deliver 2a under 30v. (France.)

Pulse Bridge Circuit Analysis, E. F. Udin. "Avto. i Tel." Mar. 1962. 6 pp. A pulse supply bridge circuit with a pulse indicator is considered. It is shown that the maximum sensitivity of the pulse bridge circuit prevails the maximum sensitivity of dc bridges or ac ones. (U.S.S.R.)

Highly Accurate Stabilization of Electron Emission in an Omegatron Gauge Head, G. Krause. "Vak. Tech." Mar. 1962. 2 pp. A closed loop feedback control circuit which keeps constant the electron current to the collector of an omegatron type mass spectrometer within 0.3% is described. (Germany.)

The Non-Linear Element, I. T. Band. "Brit. C.&E." May 1962. 4 pp. In circuit design work there is frequently a need for constant current and constant voltage sources. Constant currents of all magnitudes can be approximated without difficulty, but there is a real need, particularly in the transistor field for a device having a low voltage drop (<2.7v) and a low slope impedance. The non-linear element has been developed to meet this need. (England.)

Pulse Generators, R. Duchamp. "El. et Auto." Jan. 1962. 4 pp. The basic circuits of the multivibrator and the blocking oscillator are found in most pulse generators, whether they are astable, monostable, or bistable. The fundamental circuits are presented and their operation analyzed. Numerous proven practical designs are then given. They are suited to various uses and illustrate through examples the application of the basic principles. (France.)

Decoupling Bridge Circuits for Parallel Operation of Transmitters in the Medium and Long Wave Bands, W. Buschbeck. "Nach. Z." May 1962. 9 pp. When additions are made up to the phase constant 0 or $\pi/2$ of the Bartlett bridge (which represent a $\lambda/8$ section) wideband variants can be obtained. In this manner, a relatively simple bridge comprising only three $\lambda/8$ sections and having good wideband properties can be produced. (Germany.)

Review of the Circuits of Flip-Flop Stages With Complementary Transistors, F. Schreiber. "Freq." April 1962. 5 pp. Numerous flip-flop stages with two complementary transistors that have become known can be derived from three simple fundamental circuits which satisfy a rule of symmetry as well as two rules for sustaining the static operating conditions. (Germany.)

COMMUNICATIONS

A Caribbean V.H.F. Scheme, J. W. Burgett. "Brit. C.&E." April 1962. 5 pp. Between Trinidad and Puerto Rico, over 620 miles apart, lies a chain of islands, the Windwards, Grenadines, Leewards and Virgin Isles. These islands, although belonging to different countries, are linked by a common need for communication to meet the expansion of tourism and commerce. A VHF multi-channel system was decided on in 1956, and came into operation in June, 1960. (England.)

International ELECTRONIC SOURCES

A Telemetering Electromyograph with a Single Frequency-Modulated Channel, C. K. Battye. "Elec. Eng." June 1962. 2 pp. Apparatus is described for telemetering electromyograph signals by means of a single channel frequency modulated radio link. (England.)

New Stable Microwave Generator Improves Performance of TD2 Radio, George H. Bennett. "Can. Elec. Eng." April 1962. 2 pp. A very stable oscillator works through carefully chosen components in multiplier stages to give an output of 23.5dbm between 3780 and 4100MC. (Canada.)

Optimum Parameters of Multi-Channel Telemetering FM-FM Systems with Fluctuation Noises, I. Chugin. "Avto. i Tel." Vol. 23, #5. 14 pp. Noise stability of a multi-channel FM-FM system regarding the unstability of carrier and sub-carrier frequencies with an arbitrary noise level at the receiver input is analyzed. Optimum parameters of the system are found. (U.S.S.R.)

Research on Radio Relay Systems Having a Very High Transmission Capacity (2700 Telephone Channels or the Equivalent), F. Carassa. "Alta Freq." Feb. 1962. 14 pp. Experiments and the results of a research program carried out to investigate the possibility of realizing radio relay systems having a transmission of capacity of 2700 telephone channels per radio carrier, are described. (Italy in English.)

The General Development of the Posts and Telegraphs Radio Services from 1944 to 1961, G. Montmaneix. "Onde." Feb. 1962. 6 pp. Largest part of this account is concerned with the fixed services and more particularly with the field of long distance communication where the short wavelengths used bring ionospheric propagation into operation. The writer explains the general arrangement of the network, including transmitters, reception and organization and provides some account of the characteristics and the development of the equipment used. (France.)

Noise Stability of Pulse Signal Receiver with Superfluous Bandwidth of Input Filter, F. A. Shastova. "Avto. i Tel." April 1962. 8 pp. Approximate formulae for calculation of probability of suppressing and forming a false pulse in the receiver with the linear detector when the input filter band is many times wider than the output filter band, are found. Power loss due to the superfluous bandwidth of the input filter is determined. (U.S.S.R.)

Noiseproof Features of Single and Double Sideband Communication Systems, I. A. Tzykin. "Radiotek" 17, No. 4, 1962. 10 pp. Signal to noise ratios are compared for the reception of single sideband and double sideband suppressed carrier signals. The rms values of the error in the reproduction of the useful signals at the outputs of both systems are found in order to determine the influence of the interference signals on the reception. (U.S.S.R.)

COMPONENTS

Piezoelectric Crystals in Low-Pass, High-Pass and Band-Pass Ladder Filters, J. E. Colin. "Cab. & Trans." April 1962. 9 pp. Purpose of this paper is to describe two alternative methods of introducing piezoelectric crystals, such as quartz crystals, in an already calculated ladder filter structure. These original methods, applicable to low and high-pass filters (with possible extension to bandpass filters) make use of four-terminal network transformations. (France.)

Photoelectric Relay Design, F. Bobot. "El. et Auto." Jan. 1962. 2 pp. The design of sensitive photoelectric relays is greatly facilitated by the use of photovoltaic cells. Such a cell can be followed by simple 2 or 3 transistor amplifiers and control the operation of a standard relay for illumination levels as low as a few lux. (France.)

Piezoelectric Resonators, M. de Hautsegur. "El. et Auto." March-April 1962. 6 pp. A new component for use in i-f circuitry is described. Fabricated of a new piezoelectrical ceramic of improved stability, the component takes the form of small radially resonant disks. (France.)

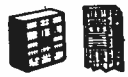
Influence of Electronic Component Progress on the Layout of 12-channel Carrier-Current Telephone Equipment, A. Fromageot. "Cab. & Trans." April 1962. 15 pp. Purpose of this paper is to show how recent progress in the design, manufacturing and assembling of electronic components and circuits allows the technical requirements resulting from the present trends in telephone systems to be more easily fulfilled in 12-channel carrier-current terminal equipment. (France.)

Ceramic Filters, M. de Heutsegur. "El. et Auto." May 1962. 3 pp. A new component for use in i-f circuitry is described. Fabricated of a new piezoelectrical ceramic of improved stability, the component takes the form of small radially resonant disks. (France.)

Subminiature Relay Application and Design, R. T. West. "Brit. C.&E." June 1962. 6 pp. Within the last few years and especially since the introduction of electronic switching devices, the design of relays has been radically reviewed. The result was first the miniature and then the subminiature relay, which is small, reliable, robust and extremely sensitive. (England.)

Investigations Relating to Life and Reliability of Carbon Film Resistors, H. Forster. "Nach. Z." May 1962. 3 pp. Carbon film resistors cannot be graded with respect to early, normal and "wear and tear" failures. With a sensible definition of the failure criteria the life is obviously unlimited. (Germany.)

Investigation of Contacts on Shock Vibrated Relays, M. Eickmeyer. "Nach. Z." May 1962. 4 pp. Ordinary relays have been subjected to shocklike accelerations. The acceleration producing failures, i.e., the acceleration at which contact trouble was perceptible, has been determined. (Germany.)



COMPUTERS

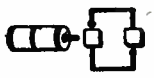
Ring Counter for Binary to Decimal Conversion, "El. et Auto." Jan. 1962. 4 pp. Design procedure of a transwitch ring counter for binary to decimal conversion is investigated. It is found that the device is well suited for this kind of application and taking into consideration the turn on and turn off periods of the existing devices, reliable operation up to 100kc may be readily obtained. (France.)

Magnetostrictive Delay Lines, A. P. C. Thiele. "Brit. C.&E." May 1962. 5 pp. Magnetostrictive delay lines are finding increasing application where cheap delay lines, generally of delay greater than 10 μsec are required. Lines described all operate in the longitudinal mode where delay adjustment is simple, and any number of output transducers can easily be provided with no increase in insertion loss. Main applications at present are storage, coding and decoding of pulses and measurement of time delay. (England.)

Preventive Maintenance of Large Analog Computers, J. Morrison. "Brit. C.&E." June 1962. 4 pp. Article describes a maintenance procedure which is being successfully used to reveal faults and anticipate performance degradation in a large analog computer installation with a view to keeping machine operating time, operator morale and confidence in results at a maximum. (England.)

A 100 KC "Transwitch" Ring Counter for Binary to Decimal Conversion, E. Dell'Oro & K. P. P. Nambiar. "Elec. Eng." June 1962. 4 pp. Article deals with the design of a ring counter for binary decimal conversion. Reliable operation up to 100KC is shown to be readily possible. (England.)

Application of Computers in Determination of Transient Processes in Systems With Unit Described by Telegraph Equations, I. S. Ratner. "Avto. i Tel." April 1962. 8 pp. An approximate determination of processes by means of the known types of computers is proposed for systems which, besides lumped parameter units, also have a unit described by telegraph equations. (U.S.S.R.)



CONTROLS

Estimation of Quality Factors of Processes in Closed-Loop Sampled-Data Automatic Control Systems, B. B. Benjaminov. "Avto. i Tel." Vol. 23, #5. 9 pp. A recurrent correlation for transient process ordinates is deduced. Estimations for a control time as well as for a system overshoot are found. (U.S.S.R.)

About Calculation of Information Loss in Centralized Control Systems, M. I. Lanin. "Avto. i Tel." Mar. 1962. 10 pp. Application of the methods of the theory of queues to the analysis of the systems of the centralized control of industrial processes is considered. When the sporadic transmission of the information takes place, one of the quality factors of the operation of the complex and block telemechanic devices is the percentage of the lost information or the probability of the structural loss of the information. The method is suggested for finding this factor for systems with one receiver or with several general receiving devices at the central station and with the single delay of information in the memory devices. (U.S.S.R.)

Self-Adjusting Program as Means to Get Required Reaction at Output of Dynamic Linear Control Object, I. I. Perelman. "Avto. i Tel." Mar. 1962. 9 pp. A system of control according to the self-adjusting program which is learned during successive training to reproduce the dynamic linear object output reaction which at the set discrete moments coincides to an arbitrary selected time function, is described. The described control process is realized without using the information about the transfer function of the control object. (U.S.S.R.)

Transfer Function of Servosystem with Two-Phase Asynchronous Motor, N. P. Vlasov. "Avto. i Tel." April 1962. 6 pp. A servosystem with a two-phase asynchronous motor is considered. Its transfer function is found under quite general conditions. (U.S.S.R.)

Synthesis of Automatic Control Systems with Random Disturbances. II, N. I. Sokolov. "Avto i Tel." Mar. 1962. 11 pp. A method for the determination of the desired transfer function of the servosystem under the condition of answering the permissible mean-square error when the metering element of the system is acted by the random stationary noise, is described. (U.S.S.R.)

(Continued on page 172)

Sources

On Prophylactic Actions in Automatic Devices with Controlled Parameter, G. V. Druzhinin. "Avto. i Tel." Vol. 23, #5. 13 pp. A problem of determining periods of prophylactic actions according to the experimental data about the discontrol of automation devices during their exploitation is considered. (U.S.S.R.)

Extrapolating Device Effect on Characteristics of Linear Digital Antomatic Control Systems, D. A. Fedorov. "Avto. i Tel." Vol. 23, #5. 8 pp. Linear digital automatic systems with extrapolating devices are considered. Systems under consideration are described using the terminology of the classic Laplace transformation. (U.S.S.R.)

Harmonic Linearization of Nonlinear Aperiodic Networks of Automatic Systems, E. D. Garber. "Avto. i Tel." April 1962. 4 pp. Harmonic linearization of some nonlinear aperiodic networks of the automatic control systems is realized. (U.S.S.R.)

Optimum Transfer Number of Reductor in High-Speed Servosystems, G. A. Nadzhaphova. "Avto. i Tel." Mar. 1962. 7 pp. Technique of selecting the optimum transfer number of the reductor in high-speed servosystems possessing electrical dc servomechanics with independent excitement in which values of a moving moment and of an operating mechanism speed are restricted, is given. (U.S.S.R.)

Dynamic Properties and Adjustment of Discrete Regulator Systems, E. K. Kroog. "Avto. i Tel." April 1962. 16 pp. Systems with control objects, which dynamic properties are described by the first-order equations, with time-delay and discrete regulators of different types are considered. Stability of the systems is analyzed, systems with corresponding discrete regulators are compared to the systems with continuous regulators. Recommendations concerning the choice of discrete regulator adjustment parameters are proposed. (U.S.S.R.)

Concerning Stability of Unsteady Motions of Nonlinear Automatic Control Systems, A. K. Bedelbaev. "Avto. i Tel." April 1962. 3 pp. A problem of determining the boundaries of the stability zone of the unsteady motion of the nonlinear automatic control system is considered. (U.S.S.R.)

Mapping of Motion of Digital Servosystem on Multi-Plane Phase Surface, V. P. Strakhov. "Avto i Tel." April 1962. 14 pp. Possibility of analysis of digital servosystems by means of mapping of their dynamics on the multiplane phase surface is shown. Behavior of such systems with various typical non-linearities is considered. Some correlations for parameters characterizing the quality of the transient process are proposed. (U.S.S.R.)

GENERAL

Reduction of the Number of Elements in Ladder Filters by Use of Auto-Transformers, J. Gaillard. "Cab. & Trans." April 1962. 9 pp. A process is proposed allowing reduction of the number of elements of an already calculated adder filter by insertion of auto-transformers. Various examples are given of problems, which could not be handled by the usual methods. (France.)

New Stereophonic System for Theatres Links Sound with Stage Action, George T. Quigley, "Can. Elec. Eng." April 1962. 3 pp. A new, live pick-up stereo system, specifically designed for an open-air theatre, brings sight and sound into line with one another in a unique way. (Canada.)

Sources

Automatic Telephone Exchange Mechanisms Operating and Adjustment Characteristics, D. H. Whalley. "ATE Jour." Jan. 1962. 16 pp. Mechanisms in general use in telephone exchanges are described and the relationship between the various functions which they perform are illustrated graphically. Typical empirical results are tabled and an explanation is given of how to use this information. (England)

Loss and Delay in Telephone Call Queueing Systems, J. R. W. Smith and J. L. Smith. "ATE Jour." Jan. 1962. 13 pp. Call queueing systems and information required regarding traffic distribution are briefly discussed and a review is made of existing call queueing data. (England)

A Dictionary of "Trons," J. H. Jupe. "Brit. C.&E." March 1962. 8 pp. This article represents a survey carried out over a year by Mr. Jupe, of the Hirst Research Centre, and includes some 580 words with the termination "tron." (England)

Investigation of Speech with the Sound Pitch Recorder. W. Kallenbach. "Freq." Feb. 1962. 6 pp. The sound pitch recorder developed by Grutzmacher and Lottermoser in 1937 allows the instantaneous recording of the melody curve of speech and vocal recitals. By the introduction of brightness modulation, it has become possible to distinguish vowels from each other and to establish a boundary line separating them from voiced consonants. (Germany)

Electromechanical Filters, A. Smolinski. "Roz. Elek." Vol. 7, #4. 43 pp. An introductory classification of electromechanical filters, dividing them into the filters of electric filtration and those of mechanical ones has been made. (Poland)

Statistical Reliability Evaluation of "Aging" Devices. V. I. Siforov and G. B. Linkovsky. "Radiotek" 17, No. 1, 1962. 6 pp. Statistical reliability evaluation of "aging" devices is analyzed on the basis of approximating failure probability by a polynomial of high degree. A system of equations of relatively evaluated probability of failure parameters is derived which is solved by using numerical methods. A method to determine the confidence level for the evaluated failure probability and reliability of the device is given. (U.S.S.R.)

Automatic Optimization of Space Distribution. IV, L. N. Fitzner. "Avto. i Tel." Vol. 23, #2. 10 pp. Synthesis technique for the space distribution system considered in (1) is suggested. Sufficient conditions for the optimized functions to have an extremum are determined as well as the minimum number of the deflection indicators enough for the forming of the functions. (U.S.S.R.)

Concerning Analytical Calculation of Hysteresis Clutches, T. M. Vorobjeva. "Avto. i Tel." Vol. 23, #5. 3 pp. An analytical calculation of hysteresis clutches is proposed which permits easy determination of a torque by the known electromagnetic and construction parameters of the clutch. (U.S.S.R.)

Concerning Determination of Optimum Adjustment of Pid-Regulators, V. V. Volgin. "Avto. i Tel." Vol. 23, #5. 11 pp. Optimum ratio of the prediction time to the time of a stabilizator without droop in a PID-regulation which depends on the dynamic characteristics of the control object and on the point of the disturbance application is considered. (U.S.S.R.)

Synthesis of the Division Operation by Linear Charging of a Capacitor, L. Y. Ilnitzky. "Radiotek" 17, No. 4, 1962. 5 pp. A new method for producing the division operation using an open-loop circuit is described. Method is based on producing a saw-tooth wave whose rate of change of the voltage level and whose frequency are directly proportional to controlling voltages. (U.S.S.R.)

(Continued on page 174)

Sources

Automatic Telemetry Equipment Aids Avalanche Prediction, G. Neal. "Can. Elec. Eng." April 1962. 4 pp. Automatic telemetry equipment is modulated with discreet audio frequencies to transmit data on direction and velocity of wind, temperature and precipitation. Information is used for snow avalanche prediction along highway at Glacier, B. C. (Canada.)

Interferometers for Radio Astronomy, R. C. Glass. "Brit. C.&E." April 1962. 6 pp. Serious resolution limitations of the simple pencil-beam radio telescope have led to extensive development of interferometers for the study of extra-terrestrial radio sources. Principles of operation and characteristics of these instruments from the early two-element devices to the complex multi-antenna systems of the present day are described. (England.)

Adaptive Systems with Dynamic Characteristic Adjustment, R. S. Rutman. "Avto. i Tel." Vol. 23, #5. 24 pp. Periodicals, books and conference materials on adaptive systems with dynamic characteristic adjustment, or plant adaptive systems, are surveyed. Main design principles are stressed for the mentioned types of systems and the methods for their realization are determined. (U.S.S.R.)

Production of Vacuum by Condensation on Low Temperature Surfaces, I. Cryogenic Pumps, G. Klipping & W. Mascher. "El. Tech." June 1962. 5 pp. Facilities for making available the required cooling media on a commercial scale are surveyed. This leads to the basic conceptions which guide the design and operation of cryogenic pumps. (Germany.)

Variable Pass-Band RC Filter with a Single Control, Abdallah A. Mahmoud. "El. Tech." April 1962. 6 pp. A circuit is described which has bandpass characteristics and in which the pass-band is controlled by a single control. (England.)

Transistorized Amplifiers, M. Ulrich. "El. et Auto." May 1962. 3 pp. Paper describes a high output dc coupled amplifier, a negative feedback video amplifier, a diode-coupled preamplifier, and a high input impedance preamplifier. (France.)

A Stabilized Constant Current Power Unit. D. E. Walker. "Elec. Eng." June 1962. 4 pp. Theory of operation and detailed design are described for a power unit providing regulation and stability of current to better than 0.1%. (England.)

INDUSTRIAL ELECTRONICS

The Gettering of Chemically Active Gases in a Mercury Arc Discharge and its Significance for Steel Tank Converters, M. J. Schonhuber. "Vak. Tech." February 1962. 8 pp. Conclusions deduced from these investigations are of beneficial importance for production methods and degassing procedures for steel tank mercury arc rectifiers and for the evaluation of the useful life of pumpless discharge vessels. (Germany)

Palladium Plating, J. J. Miles. "ATE Jour." Jan. 1962. 3 pp. Article describes a recently developed palladium plating process that is unique and enables satisfactory deposits to be made. Applications of this new process are described and illustrated. (England)

Industrial Applications of Radioisotopes. F. Juster. "El. et Auto." Feb. 1962. 4 pp. Paper describes a thermal neutron level indicator, an automatic level stabilizer, and a rugged radioactivity recorder designed for the petrol industry. (France)

Sources

Single-Sideband Generation, W. Saraga. "El. Tech." May 1962. 4 pp. A modification of the outphasing method is described in which instead of two separate modulators only one single "symmetrical" multiplier is used and in which ideally the unwanted sideband is never generated—as distinct from suppression after generation in the conventional outphasing method. (England.)

Background to "Telstar." "Brit. C.&E." May 1962. 3 pp. Article outlines some of the design and development features of the system. (England.)

MATERIALS

Design, Material and Performance of Plugs and Sockets for Electronic Switching Applications, R. W. Beattie, et al. "ATE Jour." Jan. 1962. 16 pp. Extensive research into the study of materials has led to the formation of a test specification which has the objective of determining plug and socket reliability for an anticipated usage of 30 years. This specification is given in an Appendix. Two designs satisfying this specification are outlined. (England)

Metallurgy and Electronics, A. Danzin and N. Thien-Chi. "Onde." Jan. 1962. 16 pp. Article examines the various items which electronics has brought to metallurgy in various ways: telecommunication, television, computers, process control, measurement, high frequency energy and scientific instruments. These electronic functions are only possible by the use of special metals whose degree of purity and the nature of whose manufacture are owed in a great part to the metallurgy of special metals. There is a corresponding review of the problems posed in this way to metallurgy by electronics. The summary underlines the importance of cooperation between metallurgists and electronic specialists. (France)

MEASURE & TESTING

Thermal Measurements on a Power Germanium PNP-Junction Transistor, P. Thureau and J. Benois. "Onde." Jan. 1962. 3 pp. Recent advances in the field of temperature measurement by photoluminescence make it possible to envisage thermal measurements at the active points in transistors. An example is given concerning the study of temperature distribution on a working power transistor including an examination of its heat dissipation and, particularly, the evaluation of thermal resistances of the collector-mounting base and mounting base-heat sink. (France)

Radio-Frequency-Proofed Installations for Audio-Frequency Circuits, Hans Schiesser. "Rundfunk." Feb. 1962. 5 pp. Author describes a series of measurements for this purpose and shows the results of measurements on typical forms of cable construction. (Germany)

Gas Desorption from Glass, S. Garbe and K. Christians. "Vak. Tech." Feb. 1962. 8 pp. A method is described which allows the continuous measurement of the amount of gas, which is desorbed when glass is heated. (Germany)

(*Continued on page 176*)

Sources

Design of a Multi-Cascaded Frequency Multiplier. M. E. Zhabotinsky and Y. L. Sverdloff. "Radiotek" 17, No. 2, 1962. 11 pp. A design method and experimental results in the analysis of multi-cascaded frequency multipliers are given. Multipliers consist of multiplying cells of a new type which provide for a very low content of side frequencies in the spectrum of the output signal. (U.S.S.R.)

SEMICONDUCTORS

Strobe Generation and Distribution Using Junction Transistors, I. G. Morris. "ATE Jour." Oct. 1961. 27 pp. Electronic exchanges using logic circuitry depend to a large extent for data processing operations upon pulses of accurate and consistent shape and of precise timing. Development of a pulse generation system for a prototype electronic exchange is discussed, followed by descriptions of the subsequent developments. Author deals successively with detection of pulses from the magnetic drum track by the read amplifier, phase shifting, phase splitting, squaring, preamplification, final amplification and distribution. Strobe monitoring and strobe width control is then discussed. (England)

Tunnel Diodes as Oscillators, E. Klein. "Nach. Z." March 1962. 9 pp. Tunnel diode characteristics have a portion with a negative slope which makes possible the generation of oscillations. Effects on the onset of oscillation by varying the elements of a tuned circuit consisting of a tunnel diode and a parallel tuned circuit and the conditions under which harmonic oscillations occur have been investigated. (Germany)

Current Steering Technique in Transistor Switching Systems, C. S. den Brinker. "ATE Jour." Oct. 1961. 12 pp. In certain systems the current steering technique effects the highest digit switching rates. Article discusses first the principles of current steering and then the gate and bistable circuits, proceeding to the analysis of a chain. The basic circuit "brick" is dealt with, the two-transistor circuit being the worst in terms of speed. (England)

Experimental Investigation of Switching Operation of Two-Terminal Type p-n-p-n Semiconductor Devices With Negative Resistance, M. A. Berg and S. A. Garainoff. "Radiotek" 17, No. 1, 1962. 8 pp. Switching operation of two-terminal type p-n-p-n semi-conductor devices with negative resistance have been experimentally investigated. It is shown that switching time depends on the switching operation. A delay precedes the switching from the "closed" state to the "open" state. Duration of the delay depends on the switching operation and can be varied within wide limits. (U.S.S.R.)

Applications of Transistors as Power Rectifiers, H. Marmurek. "El. et Auto." Feb. 1962. 4 pp. The collector junction of a power transistor can be used as a rectifying diode. Paper studies classical rectifier circuits: half-wave, full-wave, and bridge, as well as variants for high voltages or currents. (France)

Microminiaturization, J. C. Asscher. "El. et Auto." Feb. 1962. 3 pp. Paper reviews the various methods having successfully met the challenge of industry. It describes multiple structure transistors and their logic applications. (France)

Transistor Base Resistance Determination and Behavior, L. van Biljon. "El. Tech." March 1962. 8 pp. Measurement of transistor base resistance, both for the normal and for the inverse transistor is investigated. (England)

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This relatively low cost permanent magnet dc motor has a flat shape and is ¾ in. thick. Windings from 6 to 90vdc are available, and no-load speeds are in the 12,000 to 15,000RPM range. Unit is designed to meet the environmental conditions specified in DO-60-A, for commercial aviation equipment. Unit measures 1½ x 1½ x 0.75 in. overall and weighs 3 oz. Gear reducers available on special order. Metal housing has integral mounting flange with 2 holes. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

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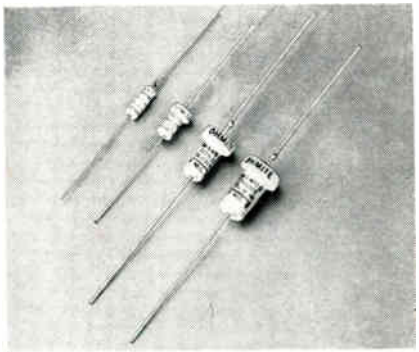

The "high-capacitance" series of values of hat-shape, tantalum slug, wet-electrolytic capacitors use a specially constructed slug anode. This makes possible units with over twice the max. capacitance of others with the same case size and voltage rating. The new high-capacitance listings include 85°C and 125°C ratings, and follow the recommended values of Mil-C-3965B for wet slug units in case sizes T1, T2, and T3. These same values are provided in commercial types also. Ohmite Mfg. Co., 3638 Howard St., Skokie, Ill.

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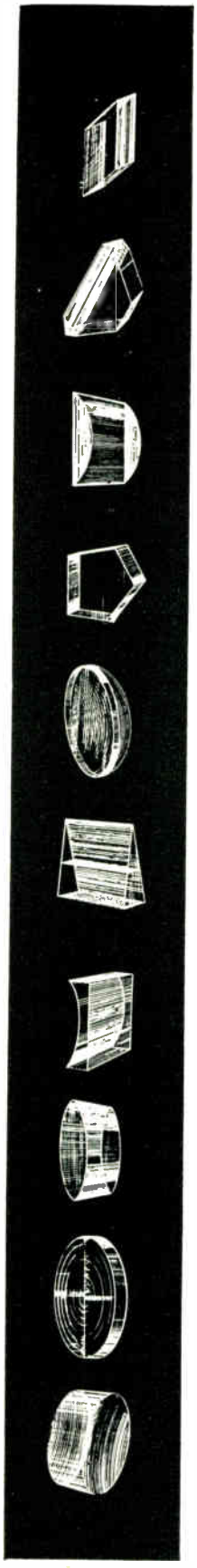

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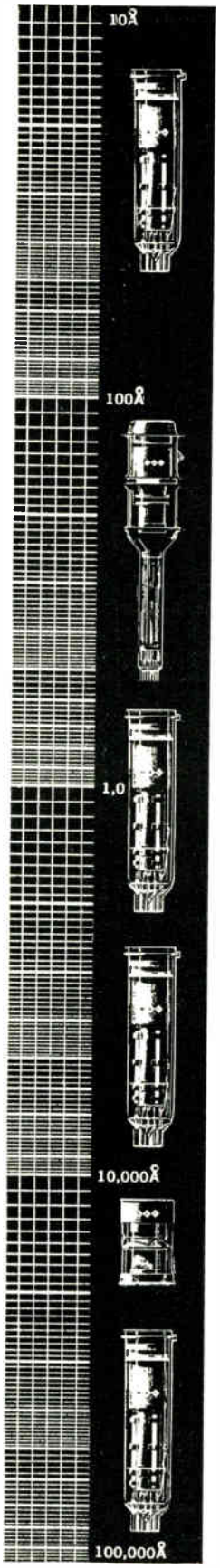

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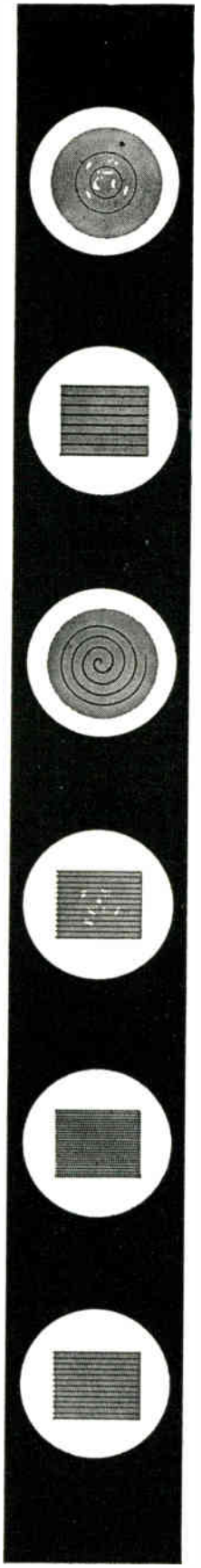

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The System Engineering Section of ELECTRON IC INDUSTRIES • AUGUST 1962

SYSTEMS—WISE . . .

RADIO CONTROLLED SIGNS IMPROVE TURNPIKE SAFETY

A radio sign control system, encompassing the 131 mile long New Jersey Turnpike, is alerting motorists to vital road conditions. From a main console in New Brunswick, N. J., the Turnpike Dispatcher controls 64 roadside signs which warn of 5 road conditions — Drive Slowly Ahead, Ice, Fog, Snow and Accident. The signs can be activated within 5 seconds after receipt of a dangerous road condition warning from state troopers. The system was built and installed by Motorola, Inc., Fairview, N. J.

▸ An airborne flight recorder, capable of being ejected from the aircraft, for recovery either on land or sea, has been announced by Lockheed Aircraft Service Co., Div of Lockheed Aircraft Corp., Ontario International Airport, Ontario, Calif. The recorder tapes cockpit voice communications and up to 90 parameters of flight operation data. It is equiped with flotation gear, marker dye, and a radio beacon.

▸ The Air Weather Service of the USAF has ordered an ITT 7300 Automatic Data Exchange System for use with the service's new global weather alarm system. Able to handle over 3 million bits of data per second, the ADX System will be part of "Met-Watch," the USAF's early warning, world-wide weather system. The ITT 7300 ADX System was designed and built by the Information Systems Div. of International Telephone and Telegraph Corp., New York, N. Y.

▸ The Dept. of Defense has told the FCC that one of the basic defense requirements for CONELRAD no longer exists. The DOD reevaluated the requirement and found it no longer essential to minimize the use of radiation on non-Government transmitters as navigational aids to an enemy.

▸ A contract, for a nearly 1,000 mile long transistorized microwave relay radio system, has been awarded to Motorola, Inc., Chicago, Ill., by the Atlantic Pipe Line Co., Philadelphia, Pa. The system will be used for communications and remote control of pumping operations, and will operate from 48v batteries.

▸ TIROS V uses the earth's magnetic field to orient itself for a better view of weather it observes. Magnetic fields set up in the satellite's attitude control coil interact with the earth's magnetic field. The amount and direction of the current in the attitude coil is programmed from the ground. Axis position of TIROS V can be changed as much as 25° in one day with this method of orientation. Radio Corp. of America's Astro-Electronics Div., Princeton, N. J. designed and built TIROS V.

▸ The National Association of Manufacturers' Committee on Manufacturers Radio Use (CMRU) had filed a petition with the FCC asking for 30 frequencies to be set aside in the 72 to 76MC band for use by low, or "flea" power short range personal radios. This move was prompted by NAM's safety drive, to spread the use of radio in saving industrial workers from accidents. The frequencies would be divided—15 on the upper side and 15 on the lower side of this astronomy band.

▸ First Nimbus, an advanced weather observation satellite, command system ground station has been delivered to Goddard Space Flight Center by California Computer Products, Inc., Downey, Calif. Designed for mobile or fixed deployment, the station has manual and automatic command capabilities and self-checking equipment.

BEAUTY AND THE . . . COMPUTER

While hubby the engineer uses computers to aid in design, his spouse is now using computers to tell her what shade lipstick to wear. Yardley of London has introduced a beauty analysis computer program called "Beauty Brain." A Univac Solid-State computer, in the Univac Service Center in New York City, using the program, digests 51 personal facts, taken from a questionnaire, (such as skin tone and complexion type, environment, social background, health and grooming habits, and personality) and recommends specific beauty treatments and cosmetics. Successful trial runs have been held in Birmingham, Ala., New Orleans, La., and Grand Rapids, Mich. Plans call for expansion to 10 more cities this year; nation-wide service in '63.

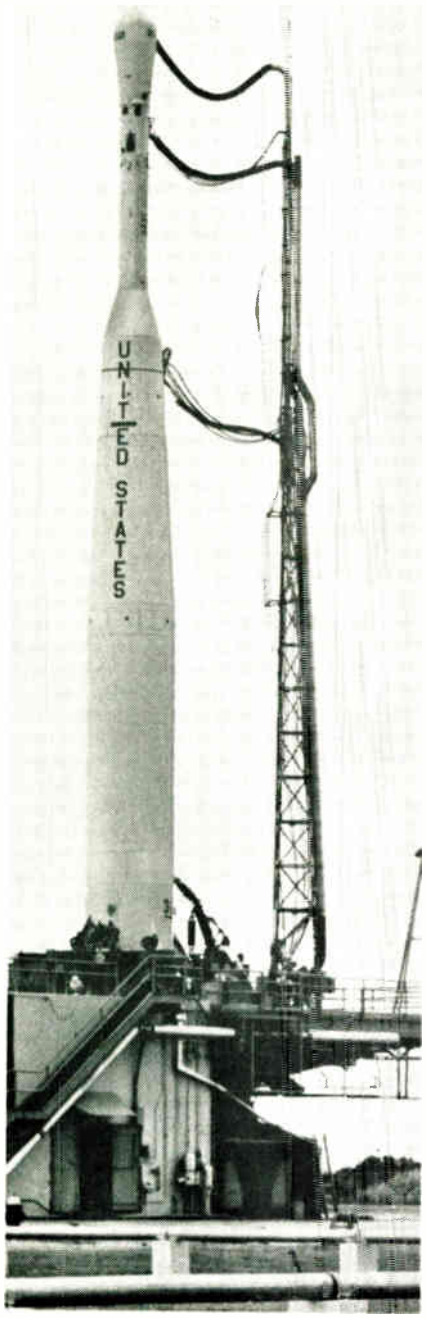
CLOSE-UP OF OUR "SWITCHBOARD IN SPACE"

Experimental active repeater communications satellite, designed and built by the Bell Telephone Laboratories of American Telephone and Telegraph Co. Measures 34½ in. in diameter and weighs 170 lbs. Its broadband communications channel is capable of 600 1-way voice channels or 1 TV channel, or the equivalent in data, teletype, or facsimile. There are 2 broadband antennae around the center; the upper for receiving on 6390MC, the lower for transmitting on 4170MC. The helical antenna on top is for receiving and transmitting of telemetry and command signals between the frequencies of 120 to 136MC.

POINTING ACCURACY IS 0.02°

Measuring 177 ft. long and 94 ft. high, this 380 ton horn antenna has an opening area of 3,600 sq. ft. Reason for the odd structure of the horn opening is to screen the sensitive maser amplifier from the radiation emitted by trees, the earth, and even the people themselves. The opening scoops up between a billionth and 1/10 of a billionth of a watt of the 2¼ watts Telstar transmits. At the apex of the horn (far left) is the "cab", which houses the maser (it has a man-made ruby crystal cooled by liquid helium to a −456°F) amplifier and the FM feedback circuitry. The feedback circuit acts as a very rapid, automatic, tuning device, tuning a narrow-band receiver to the exact frequency being transmitted; although the signal varies over a band 25MC wide. Also included in the "cab" is the "TH" transmitter and a water-cooled 4 ft., 3 in. long TWT. Power output on the 25MC bandwidth is about 2kw. The housing in the middle (at bottom) contains the antenna-control and power-amplification equipment and a NASA transmitter for Project Relay, scheduled later this year. The McKiernan-Terry Corp., in cooperation with Bell Telephone Laboratories, designed and built the horn antenna.

TELSTAR

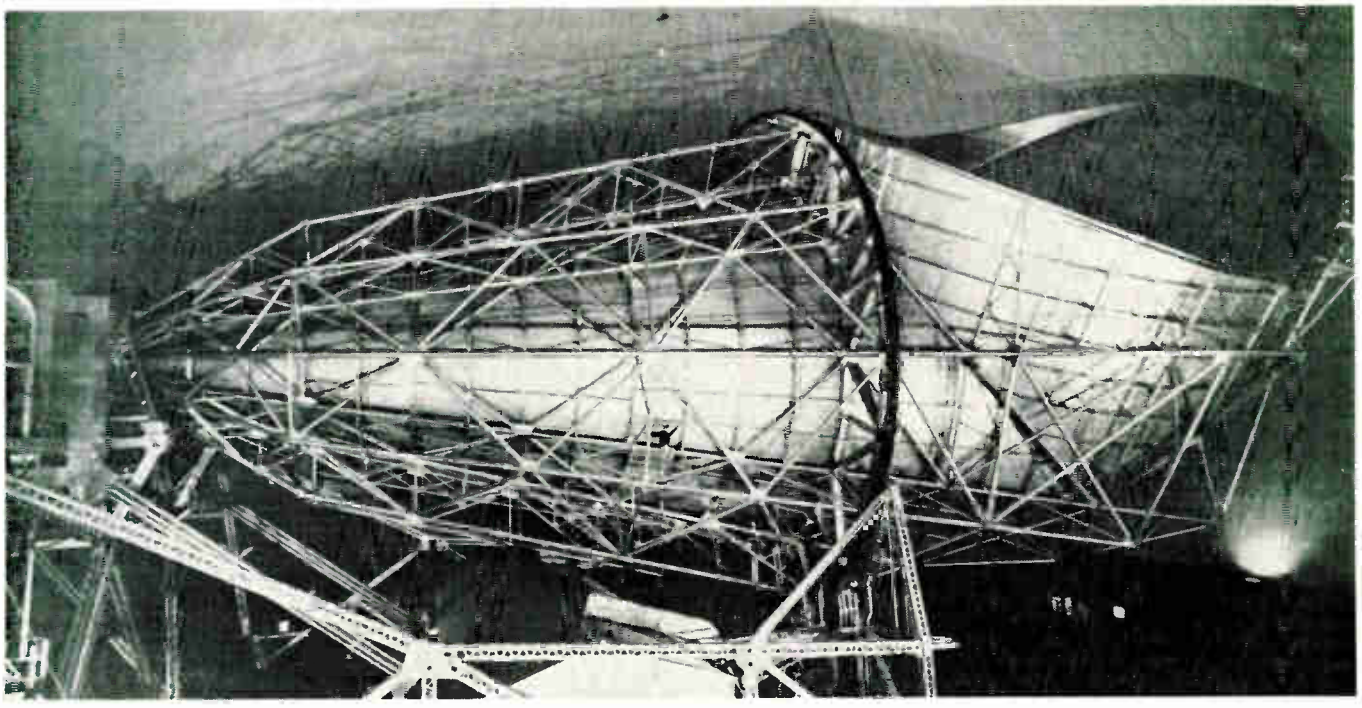


DELTA LAUNCH VEHICLE ON THE PAD

Under a cooperative agreement, NASA launched the satellite. AT&T reimbursed the space agency some $3 million for the Delta and launch services. Built by Douglas Aircraft Co., this vehicle has been used to orbit such satellites as Echo I, Explorer X, the Orbiting Solar Observatory, Ariel (US-Brit.) and TIROS V.

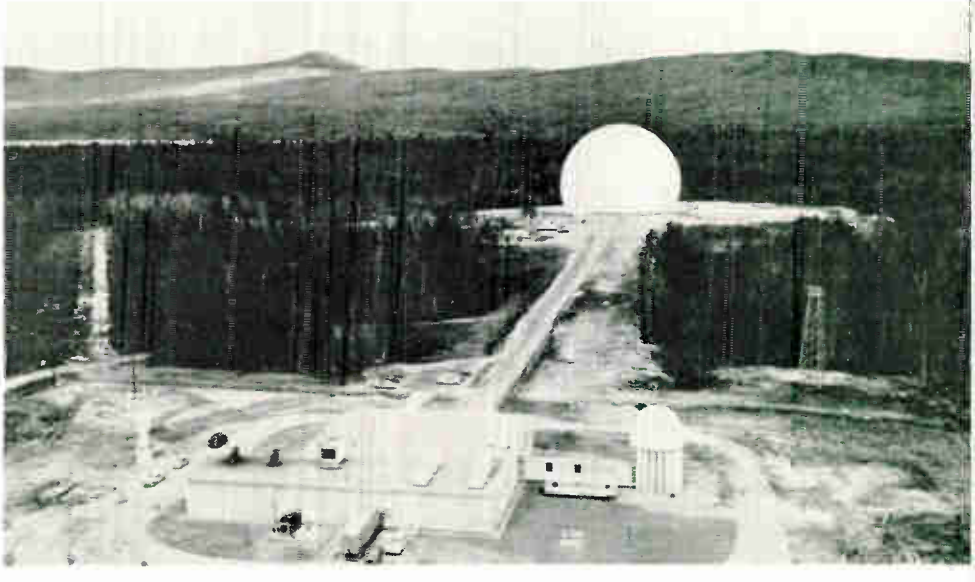
CONTROL ROOM—ANDOVER, MAINE

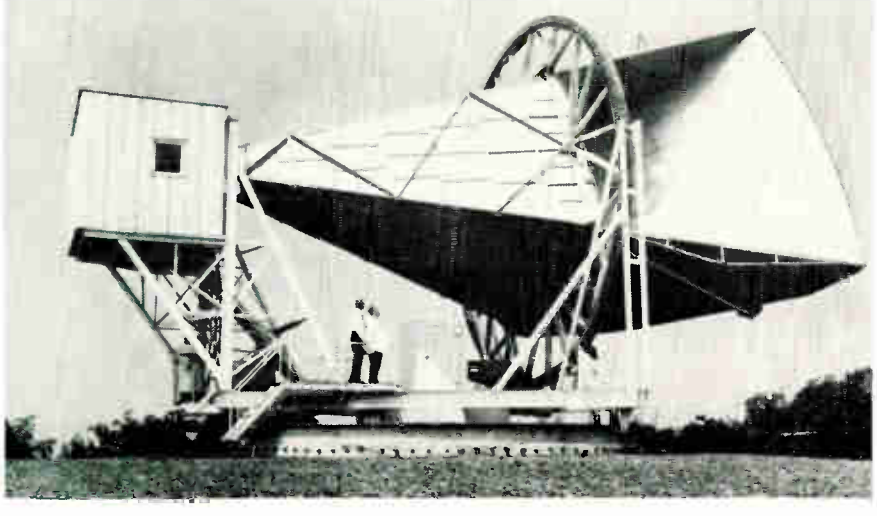
Consoles in the foreground are used for satellite tracking operations. Monitors on the right and those attached to the ceiling are for evaluating signal levels during transmit and receive tests. Man to the extreme left is at the precision tracking console. Other facilities involved in these first trans-oceanic, wide-band communications by satellite include: Britain's station at Goonhilly; NASA's Goddard Space Flight Center, Greenbelt, Md., and the Worldwide Tracking Network; and France's station at Pleumeur Bodou, Brittany Peninsula. The latter is identical to the station at Andover.



SPACE HILL, U. S. A.

The control building in the foreground houses the control, computing and the tracking equipment that operates the horn antenna. Dome covering the Andover antenna measures 210 ft. in diameter, 161 ft. high, and weighs some 20 tons. The quad-helix antenna at left receives the satellite's 136MC beacon and telemetry information, and also transmits commands on 120MC. The smaller dome at right houses the precision tracking antenna, which tracks Telstar on the 4080MC precision tracking signal. The horn antenna was calibrated by focussing it on radic energy emitted by non-visible stars and comparing dial readings of the horn's position with the known position of the stars. The precision tracker was calibrated by aiming it on the center of the sun, which emits large amount of radio energy.



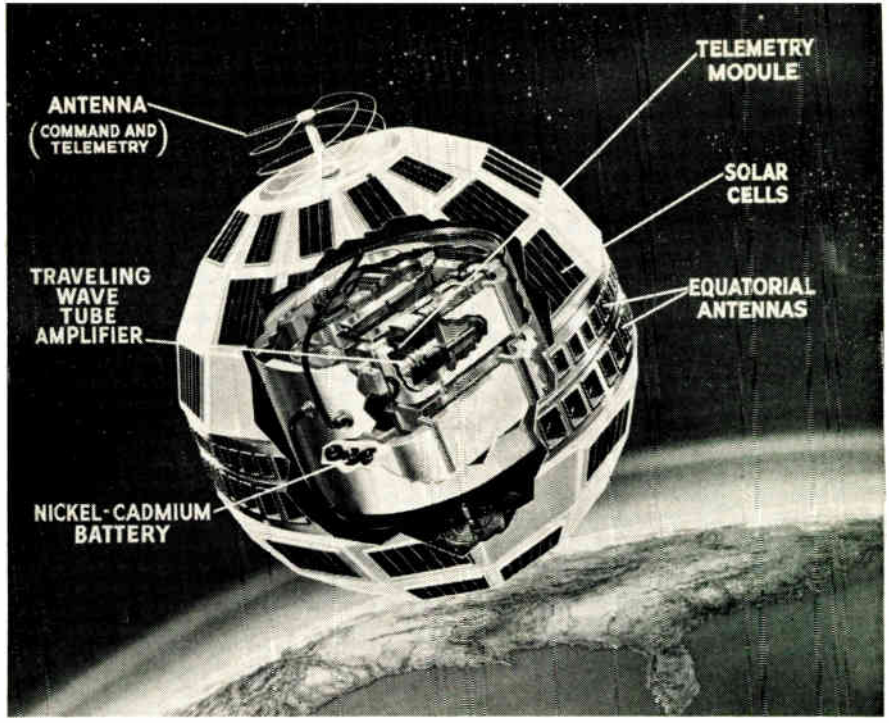


FIRST TERMINAL TO SPACE

Famous for its part in the Echo I experiments, this station on Crawford Hill in Holmdel, N. J., has been modified, by adding a second maser amplifier, to receive the broadband signals from Telstar. Optical tracking equipment was also installed, to detect flashes of sunlight reflected by the 3 mirrors which Telstar carries. Pinpointing the flashes gives one measure of the angle of the satellite's axis in space. This station does not transmit, because the test frequencies are in the "common carrier band" allotted to microwave relay in New Jersey.

(Continued on next page)

TELSTAR *(Concluded)*



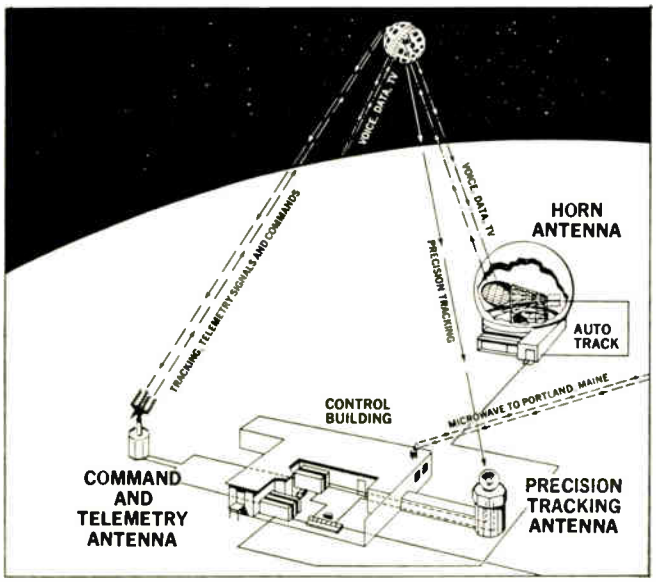
SOLID-STATE SATELLITE

Solar cells, 3,600 of them, are mounted on 60 of Telstar's facets. Mirrors are on another 3 facets. The equatorial antennae transmit and receive with nearly equal efficiency in all directions, except in the direction of the satellite's "poles". Telstar contains 1 electron tube, a TWT, and 1,064 transistors and 1,464 diodes. Power is supplied by 19 rechargeable nickel-cadmium cells. The electronic equipment is sealed in a 20 in. aluminum canister, suspended inside the satellite framework by nylon cord lacings, to absorb shock and high frequency vibration.

WHILE the trans-oceanic television transmissions are the most spectacular of the tests Telstar performs, the most important goal of our first "space switchboard" should not be over-looked. The addition of a large number of channels for overseas communications. It is estimated, that by 1965 communication needs will demand some 1,200 circuits, as compared with the 600 now available. By 1970 needs dictate 3,000 be in existence. In 1980, predictions call for 10,000 telephone circuits alone! We have not even mentioned circuits for computer data, industrial pictorial data, teletype, facsimile and of course international TV.

SATELLITE-GROUND STATION COMMUNICATIONS

Telstar receives a 6390MC signal, mixes it with the output of a quartz crystal-controlled beat oscillator giving an I-F of 90MC. The I-F is amplified about 1 million times by 14 germanium (diffused base) transistors. I-F is then mixed with another crystal-controlled oscillator frequency giving 4170MC, which is amplified by the 1 ft. long, pencil-thin glass TWT about 10,000 times, and then re-transmitted. The TWT also amplifies the 4080MC precision tracking beacon, which is sent out at about 0.02 watts. Coarse beacon is 136MC.



The other goal of major importance is the development of useful, long-lived communication satellites. Telstar is our realistic laboratory. A large part of it is devoted to the measurement of some 115 environmental conditions and circuit and device performances; and getting this data back to the scientists.

Included in Telstar is a radiation experiment to probe the inner part of the Van Allen belt. Particles in the belt can be damaging to communication devices to an extent which varies markedly with the particle energy. The experiment has two purposes: to measure radiation in space; and find out the actual radiation damage to semiconductor devices.

Four special silicon diodes, made by Bell Laboratories, are being used for the measurements. The electrical response of these diodes is in direct proportion to the amount of energy a particle loses in striking or passing through them. Located on the skin of the satellite, 3 count and measure proton energy; the other counts and measures electron energy. Shielded by different amounts, they measure from ¼ to 1, 2 to 25, above 25, and above 40 Mev.

The second purpose—actual damage—uses 3 solar cells and 6 silicon transistors. The 3 solar cells are monitored for decrease in short-circuit current output over a period of time; each is shielded a different amount. The 6 "wide base" transistors are very sensitive to radiation damage. Their outputs will be monitored over a period of time with that of a seventh similar transistor, which has been pre-radiated.

Six pre-radiated solar cells are attached to the satellite skin. They are used as light detectors. By comparing the amount of light on each at any instant, the side of the satellite nearest the sun can be determined. These amounts are telemetered back, computer analyzed, and determine the angle between the satellite's spin axis and the sun.

Together with the telemetered data on actual operating circuits and devices, a comprehensive amount of vitally needed information will be gathered, and distributed to the scientific world. For progress—for increased communication between the peoples of earth —these goals are of paramount importance.

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Look to Force for the design and manufacture of numbering and encoding equipment in the very latest optical or magnetic printing systems. Rely on Force, a leader in the engraving and marking machine field for over 85 years for precision units.

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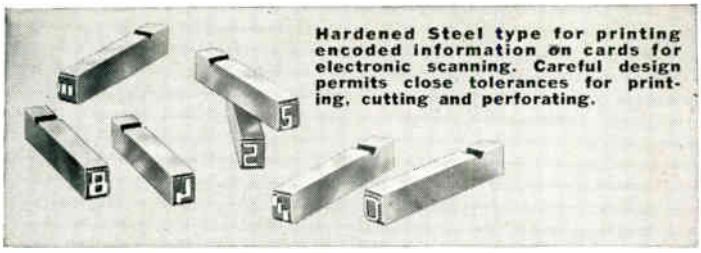

Hardened Steel type for printing encoded information on cards for electronic scanning. Careful design permits close tolerances for printing, cutting and perforating.

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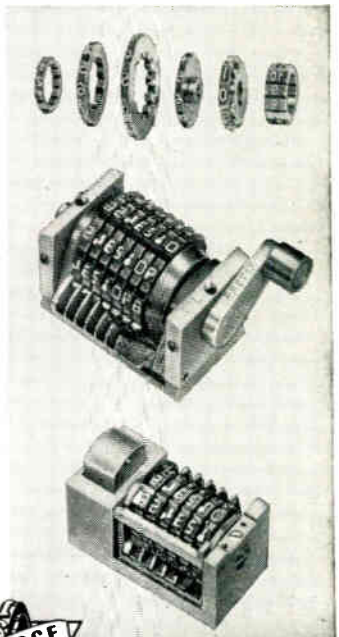

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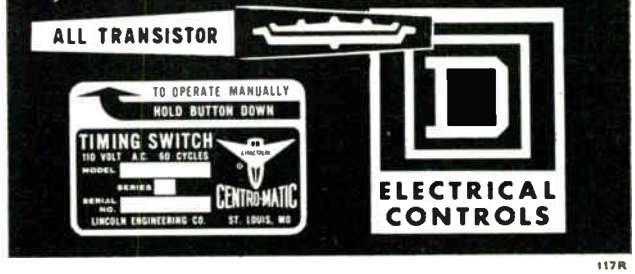

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QUIK-PLATES — Colorful Anodized Aluminum Nameplates with permanently etched printing.

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CUES for Broadcasters

A Gates "Yard" Console Modification

STANLEY R. SWANSON, Program Manager
WCMF, Rochester 4, N. Y.

The Program-Audition switches on the Gates "Yard" console momentarily short the Audition line to ground when the switches are operated between the "Audition" and "Off" (center) positions. Since we use the Audition line for tape recording, this results in a short dead spot on the tape if, for instance, a mike is switched to Audition while a disc recording is being taped.

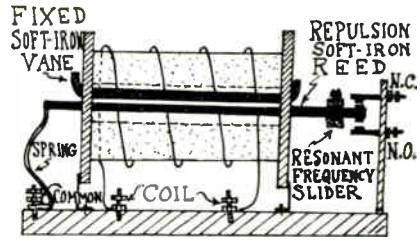
This effect can be eliminated by a small change in the wiring of switches S7 thru S14 on the console. First locate the 560 ohm resistor between the C terminal on the mixer and pin 3 on the top side (Audition circuit) of the switch. Remove the jumper between pins 3 and 4 and add a new 560 ohm resistor from pin 4 to the C terminal on the mixer. Repeat this procedure for each switch.

This change may apply to other Gates consoles as well as to the "Yard."

Adjustable Frequency Relay

SIEGFRIED S. MEYERS, Ph.D
Brooklyn Technical H. S., N. Y.

The need for a resonant reed relay of adjustable frequency is met by employing the iron-vane repulsion principle, together with an adjustable slider attached to a moveable soft-iron reed. The pair of soft-iron elements provides core-permeability for ac operation.



Adjustable slider is shifted in a slotted hole to vary frequency of relay.

By adjusting the slider away from the vibrating end of the moveable soft-iron reed, response to higher frequencies is obtained; by moving the slider toward the vibrating end, the relay responds to lower frequencies. Operation depends upon the principle that a pair of similar magnetic poles is briefly established at each end of the pair of soft-iron elements, when current flows through the coil. This results in repulsion of the free end of the soft-iron reed. When the ac cycle reverses through the coil, the magnetic polarity at both ends of the coil is reversed. Hence, by induction, the ends of the adjacent iron vanes acquire similar poles at their respective ends. This results in a vibratory motion of the reed, with maximum amplitude occuring when the coil's driving frequency approaches the natural period of mechanical vibration of the moveable soft-iron reed.

WASHINGTON News Letter

GOVT. R & D POLICY CHANGES—The administration has formulated a series of policy goals aimed at cutting waste from the huge federal R & D program. They were outlined recently by Budget Director David E. Bell to the House Military Operations Subcommittee. The objectives, developed from a Bureau of the Budget study requested by the President, are intended to straighten out both government direct R & D operations and government contracting procedures. Direct operations will be buoyed by assigning more challenging jobs to federal R & D agencies and by increasing benefits available to their scientific and engineering personnel. Contracting procedures will be streamlined by increasing the use of incentive and fixed-price contracts, improving contract specification methods, and increasing federal control over salaries and benefits paid by non-competitive contractors. Other measures include bettering information-exchange techniques and standardizing procurement policies among government agencies.

IMPORTANCE OF GOVT. R & D SPENDING—Bell pointed out to the committee that the federal government spends about 65% of all dollars spent for R & D in this country ($12.4 billion estimated for fiscal 1963). He said the total will be even higher in the future "because R & D is fundamental to national defense, space exploration, public health and other public purposes." The Director said the study's fundamental conclusion was that the present degree of cooperation between business and government should be retained. (About 80% of all federal R & D funds are now spent through private institutions and enterprises.) He said the main question then is how to use the nation's R & D resources and facilities, both public and private, to best advantage.

LUNAR COMMUNICATIONS—The NBS has been studying the problem of point-to-point communications on the moon in experiments at its Central Radio Propagation Lab at Boulder, Colo. The study is directed by L. E. Vogler. Data obtained so far have been used to determine power required for various transmission distances and band widths. The study has predicted that a 16 w. input to a ground-level wave antenna could maintain reliable low-grade radio-telephone communications over a 100 km lunar distance.

NSF RESEARCH GRANTS—The National Science Foundation has awarded 42 grants totaling $587,455 to aid institutions in developing science, engineering and mathematics teaching equipment. Colleges, universities, and research institutes in 22 states and the District of Columbia received the grants. The scientists and engineers who will work on the projects are specified. Grantees will provide information on equipment they devise, through reports, articles in professional journals and presentations at professional meetings. They are to allow commercial suppliers to negotiate for possible production and marketing. The awards bring the number of grants to 150 made since the Science Teaching Development Program was begun in 1959.

SPACE PROGRAM IMPACT—Light was shed on the total impact of America's space program on the economy by Chairman George P. Miller of the House Committee on Science and Astronautics. Miller said the Department of Defense and NASA programs have produced a burgeoning industry now numbering 5,000 firms and organizations. He said the national space program has produced an impressive number of products for other uses. He cited the high-speed, lightweight computer, electronic guidance and control systems for civil and military aviation, and the laser or maser with wide communications possibilities.

BIOCHEMICAL DEMONSTRATION — The recent Armed Forces Communications & Electronics Association convention was uniquely opened by a micro-activated electronic generator having a biochemical fuel cell. It was developed by the General Scientific Corp. The power plant provided the energy for operating the PA system—both transmitters and receivers. The cell has far-reaching potential applications, including communications in underdeveloped countries, mineral and isotope recovery and solar energy conversion.

CATV PICTURE—Community TV antenna operators plan to furnish the Justice Department with evidence for possible antitrust action of telephone companies' restricting cable pole line rights. At the recent national CATV convention in Washington, House Interstate Commerce Committee member Harris (D., Ark.) said CATV systems should have common carrier and microwave facilities without restrictions. Interest in CATV was shown by the attendance of Vice President Lyndon Johnson, several key Senators and President Kennedy's radio-TV advisor, J. Leonard Reinsch. Leaders in the CATV field estimate that there will be 1,630 CATV systems serving 1,520,408 subscribers, or 5,321,918 people, in five years—and nearly double that in ten.

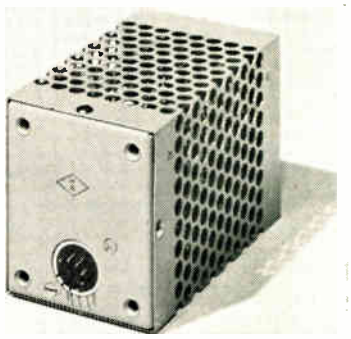
National Press Building
Washington 4

ROLAND C. DAVIES

New Products

SERVO AMPLIFIER

Transistorized, 10w, plug-in unit is for marine or industrial uses.



It is designed to drive a frame 18 ten watt servo motor like the Navy's Mark 16 Mod 3. It features adjustable gain and its own source of anti-stickoff voltage for use with dual speed synchros. It also supplies a reduced reference voltage for the fixed field of the servo motor. For operation in single or double speed synchro systems, it works directly from 115v, 400 CPS. Standard model operates at temps. up to 85°C. Optional models may be hermetically sealed or operated in temps. to 125°C. Henschel Corp., Amesbury, Mass.

Circle 328 on Inquiry Card

PHOTOELECTRIC CONTROL

Can exceed 1500 counts/minute; handle up to 5a.

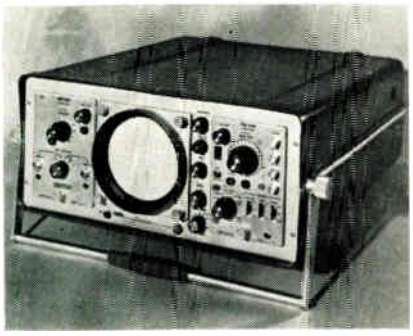
This line of transistorized photoelectric control units combines high reliability, low cost, and is designed for use in applications involving counting and sorting functions, as well as control equipment. The units can be used in light-to-dark or dark-to-light operations. Models 155 and 205 each contain a power control relay, amplifier and power supply in one aluminum housing 3 x 5 x 7 inches and they weigh 1½ and 2½ pounds, respectively, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va.

Circle 329 on Inquiry Card

New Products

PORTABLE OSCILLOSCOPE

Features 5mv/cm sensitivity with a bandwidth of 25MC; weighs 35 lbs.

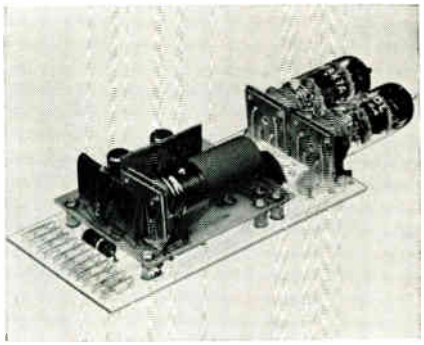


PortaScope, Type 765, is encased in an unbreakable fiberglas case. This solid-state instrument's main frame includes the power supply, calibrator, and daylight view bright display CRT. Three plug-in units are available—a time base unit; a single channel, wide-band unit; and a dual trace unit. The PortaScope may be used for computer maintenance, flight and pre-flight testing, or anywhere a highly accurate, high freq. oscilloscope is needed. The PortaScope is tested to military specs. Allen B. DuMont Laboratories, 750 Bloomfield Ave., Clifton, N. J.

Circle 330 on Inquiry Card

DC AMPLIFIER

This chopper stabilized operational unit has 2-deck construction.



This dc amplifier on a printed circuit card is for analog computer systems, original equipment and control systems. The Model 1700 Nuvamp's base deck is a self-contained low drift, high gain unstabilized dc amplifier giving 5ma at ±100vdc and 1ma at ±150vdc. Nominal open-loop gain is 30,000 with bandwidth in excess of 300KC. The upper deck is an independent, self-contained stabilizing amplifier with a mechanical chopper and 2 nuvistors. The combination offers open loop dc gain over 30 million and a noise level of 200μv RMS. Embree Electronics Corp., 993 Farmington Ave., W. Hartford, Conn.

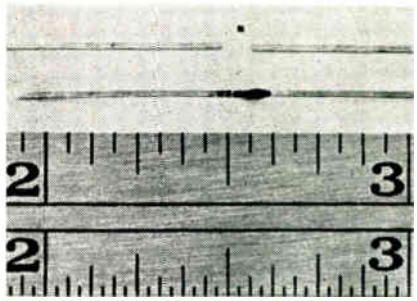
Circle 331 on Inquiry Card

Circle 111 on Inquiry Card

New Products

SILICON DIODES

Designed to replace high voltage regulator tubes.



These single junction devices have sharp breakdown and low noise characteristics. Primarily used as decoupling elements or other high voltage, low current regulation applications in high voltage power supplies. Units are operable from —65° to 150°C. The 400 to 1500v devices come in 2 sizes: microsize 0.06 dia. x 1 in. length (body) with 0.018 x 0.003 in. gold plated ribbon leads; or subminiature size, 0.1 dia. x 0.3 in. length body with 0.020 in. dia. round leads. Micro/Semiconductor Corp., 11250 Playa Court, Culver City, Calif.

Circle 332 on Inquiry Card

SIGNAL ANALYZER

Model 41 Signal Analyzer is designed for use from 1CPS to 30KC.

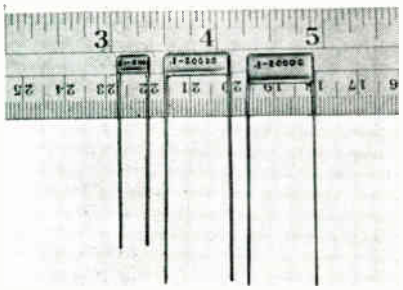
Features solid-state, plug-in modular circuits and simplicity of operation for detection of nuisance sound levels. It has 5 panel selected inputs, scalable to all types of transducers; a peak hold for impact signal response and retention of max. vibration amplitude data; and a tunable broad range wave filter (2.8CPS to 10KC). Line powered or portable battery operated, including stroboscope. Accuracy is 2% of calibrated ranges; 0.5% of deviation values in "deviation" mode. RayData Corp., 1078 E. Granville Rd., Columbus 24, Ohio.

Circle 333 on Inquiry Card

New Products

EPOXY SEALED CAPACITORS

Type AQ is designed for military and commercial applications.

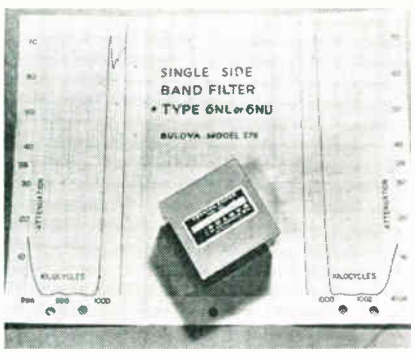


Features include: sparking and particle migration have been virtually eliminated; protective housing of epoxy permits applications of multiple finish coating; housing is relatively flexible, heat-resistant, and adheres to the transfer bond at the point of lead entry. Available in tubular style and flat oval shape with either radial or axial tinned copper wire leads, in a variety of ratings: 200 to 600v; 0.01 to 10.0μf. Plastic Capacitors, Inc., 2620 N. Clybourn Ave., Chicago, Ill.

Circle 334 on Inquiry Card

SSB FILTER

Designed for either military or commercial applications.



This quartz crystal filter for single side band communications has a carrier freq. of 1MC. The pass band is from —3250 to —250CPS or 250 to 3250CPS for lower or upper passbands, respectively. The filters are designated as Models 279L or 279U. Max. ripple is 1.5db. Min. loss in the other band is 60db and at the carrier it is 30db. Insertion loss is 3db. Impedance at input and output is 18K. Outside dimensions of the can are 1 7/16 x 2 19/64 x 3 2/32 in. Bulova Watch Co., Inc., Electronics Div., 40-10 61st St., Woodside 77, N.Y.

Circle 335 on Inquiry Card

New Products

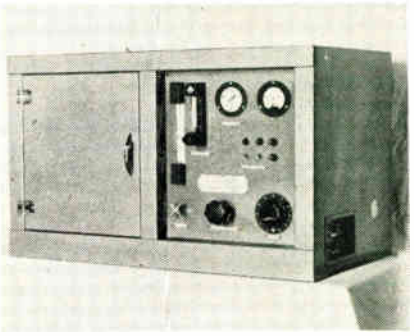
DIGITAL READOUT

Compact readout provides bright 0 to 9 neon numerals on 1 in. centers.

TNR Series transistor-driven readout, measures 1 x 1¾ in. x 3 in. External drive circuits or relays are eliminated by the self-contained NIXIE® driver. Internal circuits controlled by input signals of 4v to select numeral. High voltage, 180vdc at 2 to 3ma to fire numeral elements, is confined to unit and console. Only low level control signals required from logic circuits. TEC-LITE Div., Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26, Minn.
Circle 336 on Inquiry Card

OZONATOR

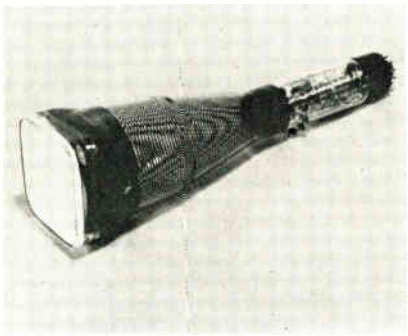
High ozone output for use in transistor oxidation processes.



OREC O3C Series Ozonators produce ozone up to 36 grams/hr. and may be used for both laboratory and production process applications. Ozone output is panel regulated and units incorporate integral ozone monitoring equipment. Ozone concentrations as high as 70mv/liter can be delivered using oxygen as parent gas. Power requirements: Model O3C6, 650w; Model O3C12, 1300w. Ozone Research and Equipment Corp., 3840 N. 40th Ave., Phoenix, Ariz.
Circle 338 on Inquiry Card

CATHODE RAY TUBES

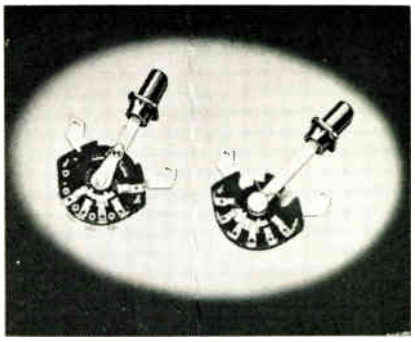
Have spiral acceleration; for use with transistor deflection circuits.



These 2 high sensitivity CRT's, are designated SC-3377 and SC-3511, and feature high deflection sensitivity and a 3½ inch square face for optimum use of display space. Overall tube length is only 13¾ in. Typical operating conditions are: A3 voltage—3kc; A2 voltage—1kv; A1 voltage for focus—0-300v; Eco is −30 to −50v; Line width @ Ib3=10μa—0.45mm max; and deflection factors—ID2 is 27 to 33v/in. and 3D4 is 23 to 29v/in. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.
Circle 337 on Inquiry Card

LEVER SWITCHES

Available with 2, 3, and 4-position indexing, with spring return.

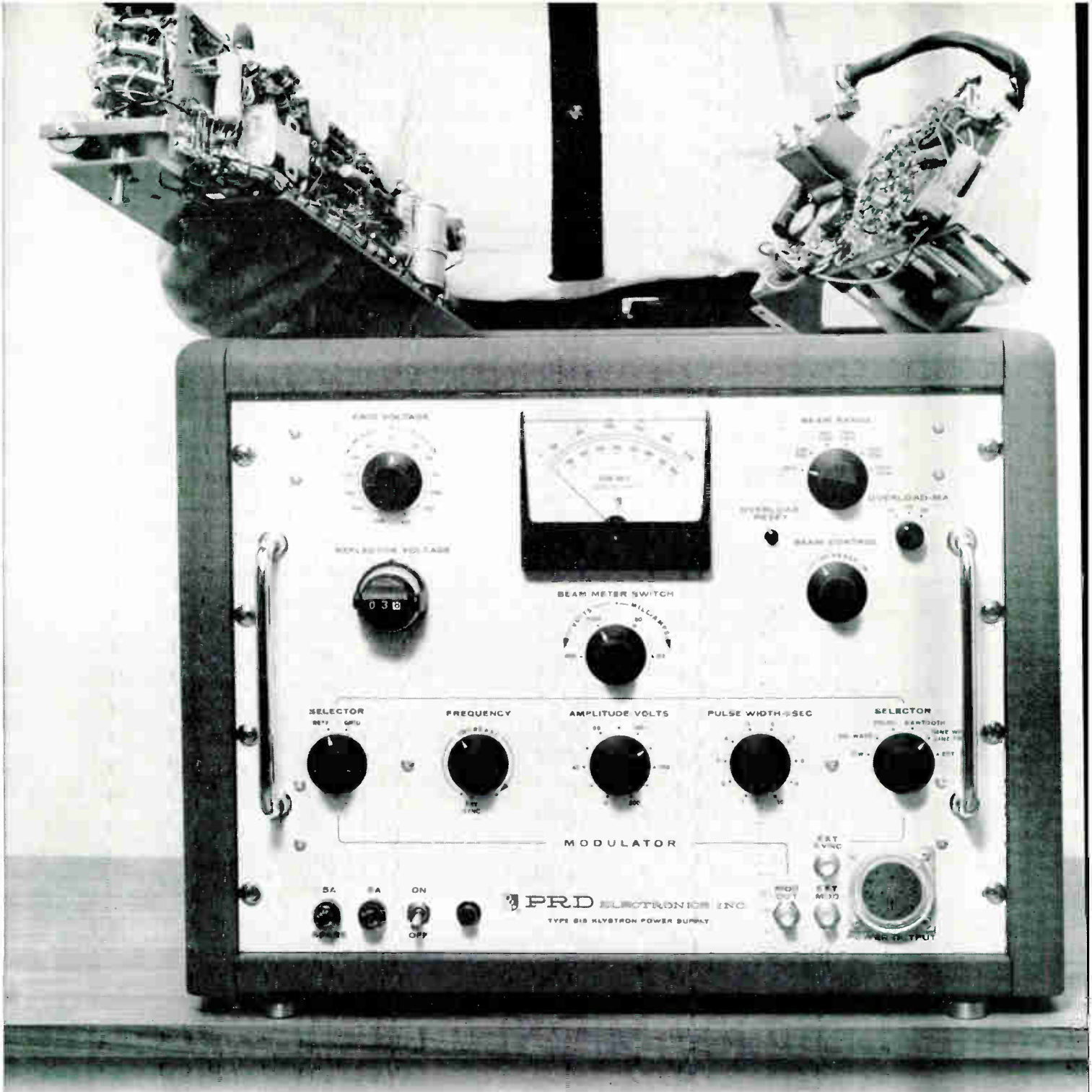


The PA-700 series is available as single units or ganged assemblies with end brackets for mounting. Rated at 1.5a at 28vdc, 230ma at 115-vac, with a current carrying capacity of 9a. Clips and rotor contacts are silver plated brass and clips will accommodate up to No. 18 wire. Silver alloy clips are available. Insulation is laminated phenolic with voltage breakdown between critical parts of 1000v RMS. Centralab. The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.
Circle 339 on Inquiry Card

Moving air is easy . . . controlling it takes an expert

This happy fella has blown smoke rings for millions of people who accept it as part of the excitement of Times Square. The imaginative engineering that went into his creation isn't given a second thought. That's the way it is with a skillful design. It is efficient, practical and taken for granted. That's the way we find it in our business of designing and building all types of air moving units. We consider it high praise when we are told we have created a simple design. Write for Brochure 102 to the Torrington Manufacturing Company, Torrington, Conn.

TORRINGTON



Immediate Delivery!

NEW 200 TO 2200 VOLT PRD KLYSTRON POWER SUPPLY FEATURES RUGGED MODULAR CONSTRUCTION

The versatile new PRD 815 Klystron Power Supply has four separate supplies for beam, reflector, grid, and heater. Further, it features unusually rugged construction, in which each supply is a separate plug-in module, easily accessible. A floating modulator system allows switching from CW to square wave or pulse without altering the output frequency. Beam supply ranges from 200 to 2200 volts, reflector (with digital readout) from 0 to 1000 volts, thus a wide range of tubes (including TWT's) can be accepted. Sawtooth, sine, square wave and pulse, plus external modulation, are built in. 19″ width fits standard rack. Price $1195. Send for data!

PRD Electronics, Inc.,
202 Tillary Street, Brooklyn 1, New York

A subsidiary of
Harris-Intertype Corporation

HARRIS INTERTYPE CORPORATION

PRD Electronics, Inc.

Brooklyn, New York · Los Angeles and Redwood City, Calif. · Haddonfield, N. J.

Circle 41 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.

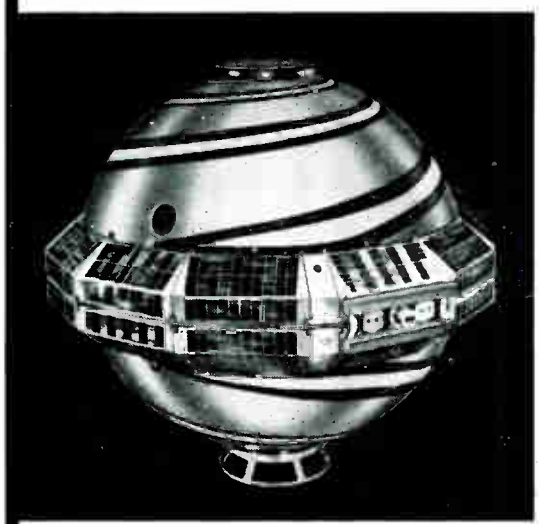
JFD LC tuners as well as trimmers were called for in both the B-system and C-system power amplifiers of the transmitter circuits and in the Transit diplexing antenna system to provide highest possible operating stability.

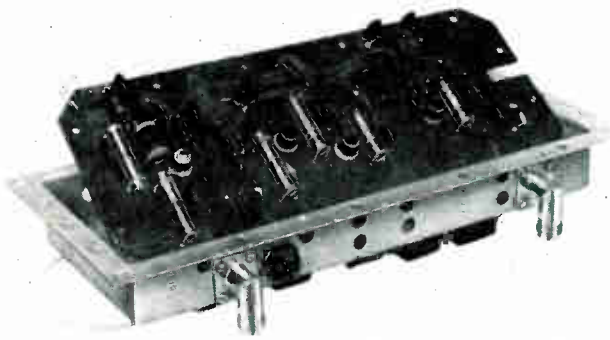
This is another example of how JFD precision electronic components satisfy space-challenging demands of tuning accuracy and stability under severe shock and vibration. Fewer parts, precise tolerances, patented telescoping anti-backlash adjustment are a few of the reasons why more engineers specify JFD

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	JFD MIDWESTERN	JFD NORTHEASTERN	JFD CANADA
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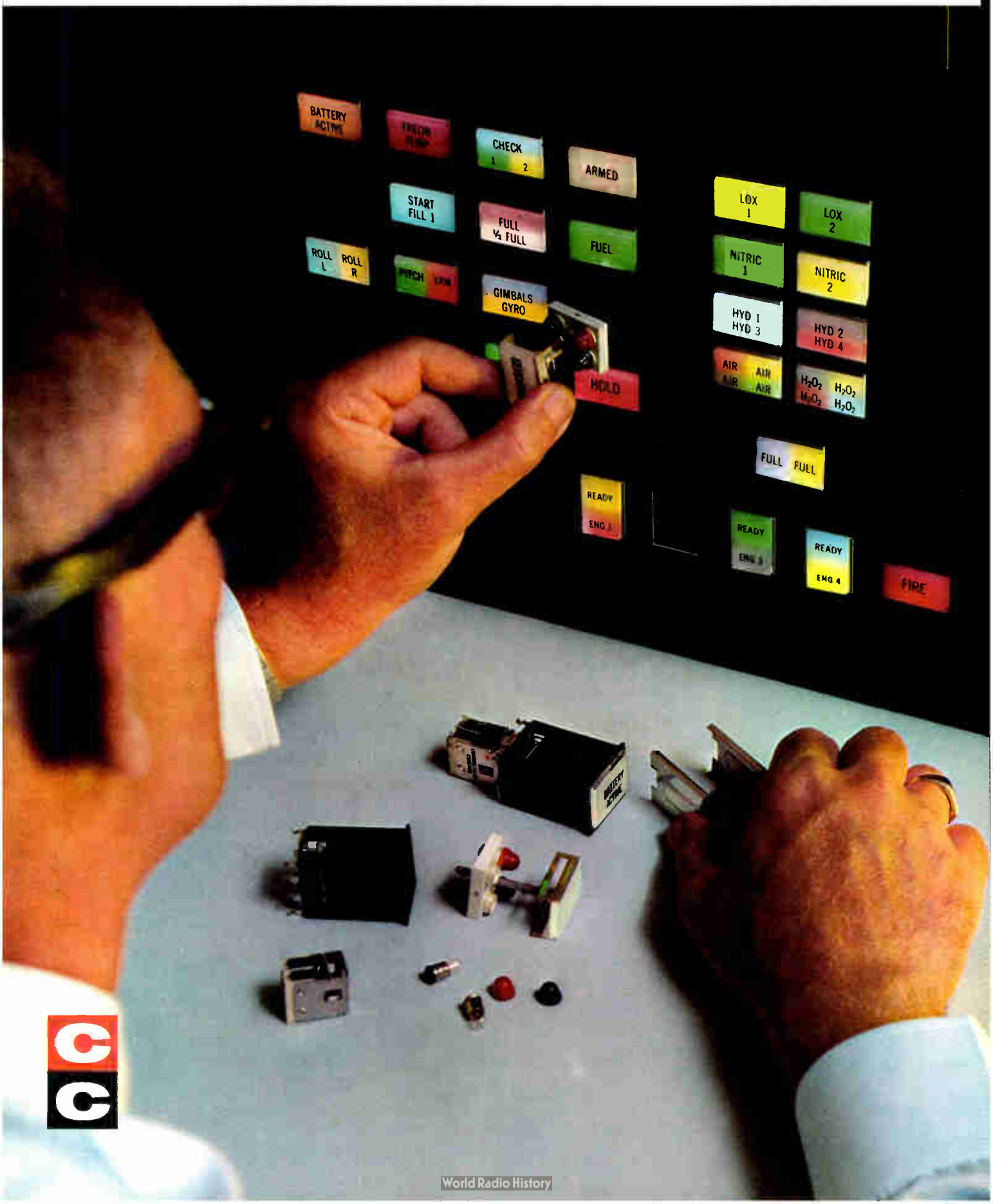
VARIABLE TRIMMER PISTON CAPACITORS • FIXED METALIZED INDUCTORS • LC TUNERS • DIPLEXERS
FIXED AND VARIABLE. DISTRIBUTED AND LUMPED CONSTANT DELAY LINES • PULSE FORMING NETWORKS

SEE JFD BOOTHS 708-709 AT WESCON 1962

THIS NEW SWITCHLITE IS IDIOT—



Subscription Fulfillment

(*Continued from page* 109)

costs considerably for publishers of consumer magazines.

Still other management advantages are possible. Promotion people can designate various categories of subscribers they wish selected from the main file for promotional, statistical or other purposes.

The computer can be directed to select and count, but not delete from the files, all subscriptions which will expire in October, 1962, whose original orders came through a department store, were charge orders and have not had a recent address change. Other combinations of variables can also be specified. The results are printed out for easy use.

Resistors

(*Continued from page* 116)

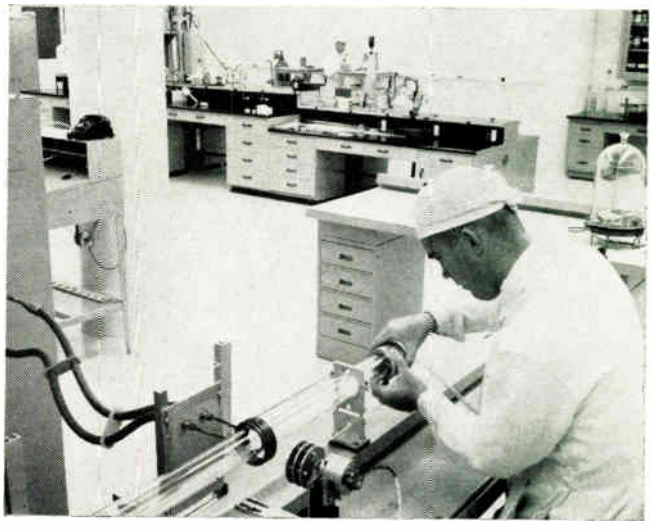
sistors are more stable over a long period of time. Ordinary sputtered-tantalum resistors, when subjected to a load test for a thousand hours, show changes in resistance of 1% or more. Tantalum-nitride resistors of the same design, tested under similar conditions, vary less than 0.1%.

Like ordinary sputtered-tantalum resistors, the tantalum-nitride devices can be protected with an oxide film, and indeed, it is the "anodizing" of a layer of tantalum-oxide that permits the close tolerances to which sputtered devices can be "trimmed." The anodizing technique produces resistors within 0.1% of their nominal resistance.

Because of their minuteness, the way they are constructed, and their reliability, tantalum-nitride resistors will be particularly suitable for use in integrated circuits. Typical applications would be in logic modules in certain types of switching systems, or in certain types of transmission networks.

INFRARED LABORATORY

Ultra-clean infrared laboratory in the Martin Marietta Electronic Systems and Products div. at Baltimore develops doped germanium crystals for use as infrared sensors to detect missiles, aircraft, and space vehicles—and even to track the wake of a submerged submarine. These devices detect the heat emitted by moving objects in the environment in the form of infrared radiation.



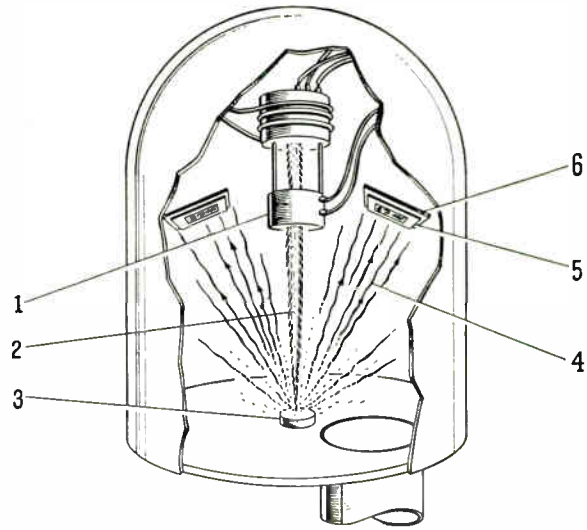
Vapor-Forming Circuits

SEMICONDUCTOR devices now form directly on a ceramic microcircuit wafer, smaller than a postage stamp, from a vapor.

The breakthrough by Sylvania Electric Products, Inc., Waltham, Mass., makes possible vapor-formation of thin-film silicon semiconductor devices on the wafer without the need for crystal growing, cutting, or polishing. A number of silicon diodes and transistors have been formed in this fashion. They are being evaluated as part of a continuing research effort in this area.

The ultimate objective is to form thin-film diodes and transistors directly—without added process steps—on the ceramic wafer as other thin-film circuit elements are being formed. This will lead to truly integrated molecular thin-film circuits, formed in one place, at one time.

The present thin-film microcircuit is formed on a high-strength ceramic wafer smaller than a postage stamp and one-hundredth of an inch thick by vaporizing materials with intense heat in a high-vacuum chamber. The resultant vapor passes through fine openings—as narrow as two thousandths of an inch—in a thin metal mask to form a deposit of a thin film of material on the wafer in the precise circuit pattern.



A 20,000 volt electron beam gun (1) directs electrons (2) at a material (3) causing it to evaporate. The resultant vapor (4) passes through a mask to form a film on ceramic (6).

The function of a conventional computer printed circuit board 6 inches long and 1½ inches wide, for example, can be carried out by a three-wafer microcircuit package ⅜ in. high and less than ½ in. square, or by one wafer 1 inch square by 1/10 inch thick.

The laboratory achievements in Waltham will make possible the simultaneous formation of several circuits on the postage-stamp-size wafer with no added cost, where previously only the passive components of one circuit could be formed by vapor deposition. They will bring more circuitry in less space with fewer production processes and costs.

Hall Generator Bibliography

(*Continued from page* 119)

"True Electrical Multiplier," *Electronic Equipment Engineering;* February 1960; page 39.

"A Hall Effect Multiplier for use at Radio Frequencies," E. Cohen, *Electronic Engineering;* September 1960; pp. 558-559.

Hall Generators—Magnetic Probes

"Synchronous Cancellation and Detection Step Up Resolution of Gaussmeter," *Electronic Design News;* March, 1962.

"Hall Generator Fluxmeter," *Electronic Design;* May 11, 1960; pp. 64-65.

"A Magnetic Field Strength Meter Employing the Hall Effect in Germanium," G. L. Pearson, *The Review of Scientific Instruments;* vol. 19, #4, April 1948; pp. 263-265.

"Temperature-Regulated Bismuth Resistor for Magnetic-Field Measurements," C. G. Dols, et al, *The Review of Scientific Instruments;* vol. 29, #5, May 1958.

Hall Generators—Magnetoresistance

"Application of the Magnetoresistance Effect to Analog Multiplication," J. M. Hunt, *Proceedings of the National Electronics Conference;* vol. 16, 1960; pp. 619-628.

"Magnetoresistance—New Tool for Electrical Control Circuits," R. K. Willardson; A. C. Beer, *Electrical Manufacturing;* January 1956; pp. 79-84.

Hall Generators—Miscellaneous

"Using Hall Generators as Contactless Commutators," T. J. Marcus, *Electronics;* February 9, 1962; pp. 43-45.

"Measurement of Direct and Alternating Current by means of the Hall Effect," M. E. Mazurov; I. N. Prudnikov, *Measurement Techniques;* #7, February 1961; pp. 613-614.

"The Hall Effect Compass," I. M. Ross; E. W. Saker; N. A. C. Thompson, *Journal of Scientific Instruments;* vol. 34, December 1957; pp. 479-484.

"Mechanical Measurement—Use of Hall Effect," Maciej Nalecz, *Electronic Technology;* January 1961; pp. 15-17.

"Intermodulation Distortion Meter Employing the Hall Effect," A. C. Todd; J. N. Van Scoyoc; R. P. Schuck, *IRE Transactions on Audio;* March-April 1961; pp. 44-48.

"Fourier Analyzer Uses the Hall Effect," James D. Williams; Stephen P. Denker, *Electronic Industries;* September 1961; pp. 108-110.

"An Experimental Impedance Relay Using the Hall Effect in a Semiconductor," Prof. H. E. M. Barlow; J. C. Beal, *The Institution of Electrical Engineers;* February 1960; pp. 48-50; (Paper #3136M).

"Magnetic-Field Pickup for Low-Frequency Radio Interference Measuring Sets," M. Epstein; R. B. Schulz, *IRE Transactions on Electron Devices;* January 1961; pp. 70-77.

"Microwave Isolator Combines Hall Effect and Tunnel Diodes," C. H. Hubbard; L. A. LoSasso; E. Rousso, *Electronics;* June 16, 1961; pp. 56-57.

"Hall Effect Modulators & Gyrators Employing Magnetic Field Independent Orientations in Germanium," W. P. Mason, et al, *Journal of Applied Physics;* vol. 24, #2, Feb. 1953; pp. 166-175.

"Solution of the Field Problem of the Germanium Gyrator," R. F. Wick, *Journal of Applied Physics;* vol. 25, #6, June 1954; pp. 741-756.

Hall Generators—Reports

"Indium Antimonide for Semiconductor-Device Feasibility Studies," F. J. Reid, et al, *WADD Technical Report 60-387;* April 1960.

"Measurement of Hall Voltages at Microwave Frequencies," Anthony D. Rugari, *RADC-TN-60-164;* September 1960.

"Some Applications of Hall Generators," E. Laisk, *Australian IRE Radio and Electronics Convention;* March 20-25, 1961; 13 pages.

"A Hall Effect Function Generator Using Thin Semiconductor Films," A. R. Billings, *Australian IRE Radio and Electronics Convention;* March 20-25, 1961.

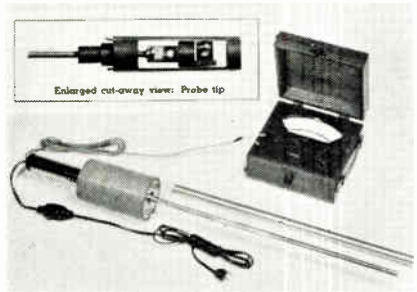
"Indium Antimonide for Semiconductor-Device Feasibility Studies," F. J. Reid, et al, Scientific Report #6 to WADD; April 20, 1961, *AD 255 986; ASTIA.*

"Final Report on Application of the Hall Effect to Basic Measurements," N. P. Milligan; R. W. Crawford, *AD 255 070; C2; ASTIA;* January 16, 1961.

New Products

GAUSSMETER

For measuring magnetic fields in three dimensions.

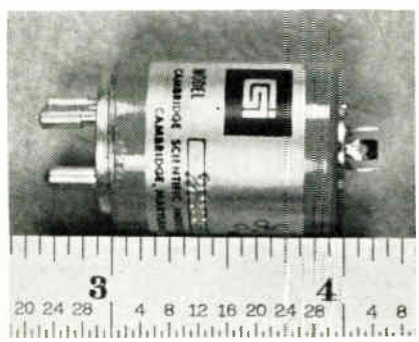


Along with the rotating coil for transverse fields, this gaussmeter has a second coil for measuring the field along the axis. For convenient and highly accurate measurements of the magnetic fields of solenoids, focussing coils and magnets for ion or electron beams. The Rawson-Lush Type 729 gaussmeter specs are: Dia. of probe, 7/16 in.; dia. of rotating coils, approx. 3/16 in.; ranges 0.4/1.2/4/12/-40/120 kilogausses, full scale. Rawson Electrical Instrument Co., 116 Potter St., Cambridge 42, Mass.

Circle 340 on Inquiry Card

LOW NOISE CHOPPER

Chopping into a 1meg load, noise level is less than 1μ v RMS.

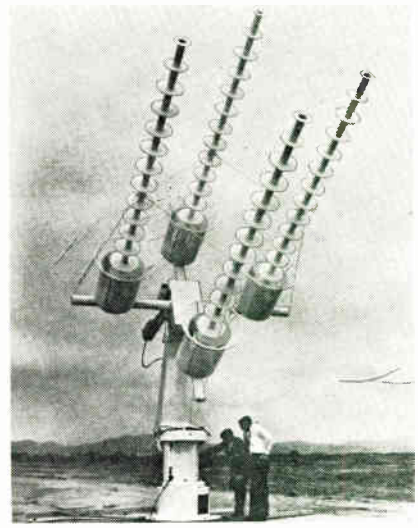


Designated Model 228, for 60 CPS operation, this chopper features complete electrostatic shielding, by completely isolating the drive coil from the hermetically sealed contacts. Combined with complete magnetic shielding and low thermal construction, the new series maintains an extremely low noise level. In addition to the conventional 7 pin "plug-in" version, the chopper is also available in 4 pin mounts with center tap coil connections. Cambridge Scientific Industries, Inc., 18 Poplar St., Cambridge, Md.

Circle 341 on Inquiry Card

ANTENNA

This transmitting-receiving antenna has a bandwidth of 1.275:1.

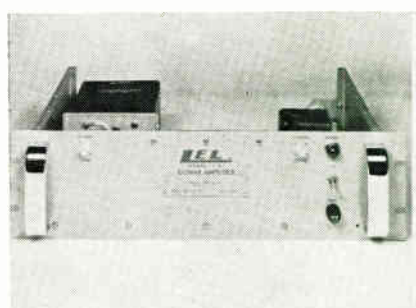


Features low side lobe levels, high gain and polarization diversity either manually or remotely selectable. Meeting all applicable specs. for military ground communication equipment, this highly directional antenna consists of 4 corrugated cylinder surface wave antenna elements arranged in a diamond configuration. Typical specs: freq. range—225-260MC; gain 25db nominal; beamwidth—10° nominal; side lobes—25db down nominal; and operating temp.— a —28°C to +65°C. TEMEC, Inc., 7833 Haskell Ave., Van Nuys, Calif.

Circle 342 on Inquiry Card

OCTAVE AMPLIFIER

These low noise, broadband r-f units cover from 40 to 640 MC.



The Model OMP-5-160 has a gain of 30db minimum, ±0.5db ripple and a linear output of greater than 1v over the range of 160 to 320MC. It is available as a self-contained rack-mounted unit as shown or as an amplifier only, Model OMX-5-160 (Average noise figure is 6db). The rack mounted units employ a solid state regulated power supply. LEL, Inc., 75 Akron St., Copiague, N. Y.

Circle 343 on Inquiry Card

Books

Inertial Guidance

Edited by G. R. Pitman, Jr. Published 1962 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 481 pages. Price $18.50.

Progress in the design and development of inertial guidance systems depends on the cooperation of specialists in several fields of science and technology. In this book, leading experts in each of these fields combine their talents and knowledge to create a comprehensive discussion of inertial guidance and navigation, including inertial instruments. The various subjects discussed were selected in such a way that the book as a whole provides balanced and systematic coverage of the entire field.

Fundamentals of Semiconductor and Tube Electronics

By H. Alex Romanowitz. Published 1962 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 620 pages. Price $8.25.

Book embraces both tube and semiconductor theory and practice. It offers a comprehensive introduction to electronics which requires only a knowledge of elementary algebra and simple trigonometry.

Book begins with a review of basic (non-electronic) circuit theory and an introduction to the use of the multimeter, the vacuum-tube voltmeter, and the oscilloscope—and goes on to cover virtually every topic necessary to a basic understanding of electronics.

Semiconductor Device Physics

By Allen Nussbaum. Published 1962 by Prentice-Hall, Inc., Englewood Cliffs, N.J. 340 pages. Price $11.00.

Book is a unified presentation of all aspects of physics necessary to understand semiconductor devices. It requires only a minimum background in physics and calculus and serves as an ideal self-study guide for engineers who have only a modest or varying background knowledge of the connection between fundamental concepts of quantum theory, statistical mechanics, energy band theory, thermodynamics, electromagnetism, and the properties of semiconductors.

Switching Circuits for Engineers

By Mitchell P. Marcus. Published 1962 by Prentice-Hall, Inc., Englewood Cliffs, N.J. 296 pages. Price $12.00.

A clear, concise treatment of the design and simplification of combinational and sequential switching circuits—presented so that the theory can be applied. It was written for the logical design engineer, for self-study and as a reference, and as a basic text for courses in switching circuits in schools and colleges as well as in company training or educational programs.

Electroplating Engineering Handbook, 2nd Edition

Edited by A. K. Graham. Published 1962 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 774 pages. Price $18.50.

Expressly designed to answer every imaginable electroplating problem, this revised second edition of an authoritative data book contains a wealth of completely up-to-date working information in an easy-to-use form. Forty-five authorities cover every conceivable aspect of engineering fundamentals and general processing data applicable to the electroplating and metal finishing industries.

Repairing Home Audio Systems

By E. Eugene Eckland. Published 1962 by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 311 pages. Price $6.95.

Book provides the reader with all the information he needs to repair home audio, whether the system is a simple portable phonograph or an elaborate multichassis, multispeaker custom installation. It explains the essential facts required to analyze troubles, isolate defects, and repair faults in high-fidelity systems, turntables, record changers, portable phonographs, magnetic tape recorders, AM and FM tuners, preamplifiers, audio amplifiers and speakers.

Electronic Drafting

By George Shiers. Published 1962 by Prentice-Hall, Inc., Englewood Cliffs, N.J. 556 pages. Price $11.70.

Book introduces the various drafting techniques and types of drawing used in the design and construction of electronic equipment. A close relationship is maintained between graphical methods, basic electronic principles, and construction practices. Descriptions of component parts, drafting processes, and typical applications serve to acquaint the reader with the wide scope of commercial and military electronics.

Bibliography of the Ionosphere

By Laurence A. Manning. Published 1962 by Stanford University Press, Stanford, Calif. 613 pages. Price $15.00.

Significant research relating to radio studies of the ionosphere did not begin to be published until 1925, when the first direct measurements of the ionosphere were accomplished. The great majority of the papers published from 1925 through 1960 are listed here and annotated for easy reference. The bibliography will prove useful both to scientists dealing with research in ionospheric radio or upper atmospheric physics, and to persons concerned with design of communications, radar, and telemetering systems.

Programming for Digital Computers

By J. F. Davidson. Published 1962 by Gordon and Breach, Science Publishers, Inc., 150 Fifth Ave., New York 11, N. Y. 175 pages. Price $6.00.

Book is an introduction to the writing of programs for digital computers. Problems encountered are first described in general terms, and then considered in detail in relation to an imaginary computer which illustrates many of the features found on real machines.

Programming techniques are discussed up to the point of showing why Autocoding is desirable, and indicating how it can be done. Possible variations between different machines, as they affect the programmer, are considered, and finally the use of such items as magnetic tape, line printers, card readers and punches is explained.

Report Writers' Handbook

By Charles E. Van Hagan. Published 1961 by Prentice-Hall, Inc., Englewood Cliffs, N. J. 276 pages. Price $6.75.

This handbook has been prepared for the scientists, engineers, economists and administrators whose work involves the writing of reports. It is a practical, usable guide to the current procedures and techniques that have proven objectively effective in technical fields.

All phases of report preparation are analyzed and discussed: the preliminary planning and organization, the actual writing, and the use of appropriate supporting material, with special attention focused on the selection and preparation of illustrations and tables.

BOOKS RECEIVED

Analogue Computation

By R. W. Williams. Published by Academic Press Inc., Publishers, 111 Fifth Ave., New York 3, N.Y. 271 pages. Price $9.50.

Microminiaturization

Proceedings of the AGARD Conference, Oslo, July 24-6, 1961. Edited by G. W. A. Dummer. Published 1962 by Pergamon Press Ltd., Headington Hill Hall, Oxford, England. 355 pages. Price $15.00.

Proposal and Inquiry Writing

By Siegfried Mandel & David L. Caldwell. Published 1962 by The Macmillan Co., 60 Fifth Ave., New York 11, N.Y. 246 pages. Price $7.50.

Handbook of Electronic Tables & Formulas, 2nd Edition

Compiled and Edited by D. Herrington and S. Meacham. Published 1962 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 192 pages. Price $3.95.

ABC's of Missile Guidance

By Ray Schapiro. Published 1962 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind., Paperback, 96 pages. Price $1.95.

Troubleshooting with the Oscilloscope

By R. G. Middleton. Published 1962 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 128 pages. Price $2.50.

Airborne VHF Communications Transceiver System, AIRNC Characteristic No. 546

Published 1961 by ARINC, 1700 K St., N.W., Washington 6, D.C. 88 pages.

Airborne VHF Navigation Receiver, ARINC Characteristic No. 547

Published 1961 by ARINC, 1700 K St., N.W., Washington 6, D.C. 84 pages.

ABC's of Electronic Organs

By N. H. Crowhurst. Published 1962 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 96 pages. Price $1.95.

Bench Servicing Made Easy

By R. G. Middleton. Published 1962 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 160 pages. Price $2.95.

A Course of Mathematics for Engineers and Scientists, Volumes 1 & 2

By C. Plumpton and B. H. Chirgwin. Published 1962 by Pergamon Press, Inc., 122 East 55th St., New York 22, N.Y. Vol. 1—334 pages, $4.00. Vol. 2—380 pages, $5.00.

The Plasma Dispersion Function, The Hilbert Transform of the Gaussian

By Burton D. Fried & Samuel D. Conte. Published 1961 by Academic Press Inc., 111 Fifth Ave., New York 3, N.Y. 419 pages. Price $12.00.

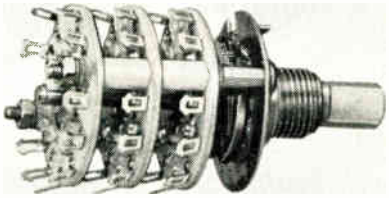
Tool Steels, 3rd Edition

By G. A. Roberts, J. C. Hamaker, Jr., and A. R. Johnson. Published 1962 by the American Society for Metals, Metal Park, Ohio. 780 pages. Price $12.50.

New Products

ROTARY SWITCH

Subminiature, low power unit for use where size is important.

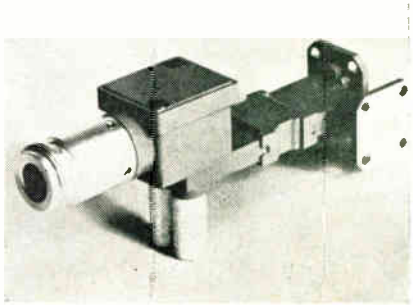


The 1 in. "Acorn" Rotary Switch has a dia. of just 1 in. (1 3/32 in. over 45° bend terminals). It can provide 12 positions, with each position being mechanically indexed by OAK precision dual-ball spring operated mechanism. Available in a variety of configurations. Stops can be fixed at any specified total number of positions. Performance tolerances include a temp. range of standard commercial −25° to +85°C. and military −65° to +125°C. Oak Manufacturing Co., Crystal Lake, Ill.

Circle 344 on Inquiry Card

SIDEWALL BALANCED MIXER

This WR 28 hybrid mixer has a 2.9GC i-f output.



The Sidewall Balanced Mixer has an i-f output of 2.9GC with input frequencies of 34.0—36.0GC. The i-f output uses a type "N" connector and has a VSWR of 1.20. This compact unit measures less than 4.00 in length and uses 1N53 crystals. Electrical specifications include: VSWR=1.30 max. and isolation=12 db min. Microwave Development Laboratories, Inc., 15 Strathmore Rd., Natick Industrial Centre, Natick, Mass.

Circle 346 on Inquiry Card

ION GAUGE CONTROL

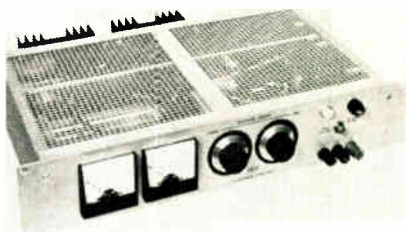
Pressures of 10^{-4} to 10^{-9}mm Hg read directly from logarithmic scale.

Pressures between 10^{-4} and 2 x 10^{-11}mm Hg can be read from linear scales. The grid supply produces a stabilized current output which can be varied between 50μa and 10ma for use with most ionization gauges. Recorder output terminals, electron bombardment degassing of both grid and collector, filament protection circuit and external relay circuit are some of the additional features. Vacuum Products Div., Varian Associates, 611 Hansen Way, Palo Alto, Calif.

Circle 345 on Inquiry Card

DC POWER SUPPLY

Input: 105-125v, 57-440CPS, 1φ; Output: 0-60vdc, 0-10a adjustable.



The entire QSA line is available as distributor off-the-shelf items. Static-line regulation is ± 0.05% or 5mv, whichever is greater. Static-load regulation is 0.05% or 5mv, whichever is greater. Response time is less than 50μsec for 10% line change at any load. Less than 50μsec for ½ max. load at any time. QSA supplies measure 3½ x 19 in. panel for relay rack panel; extends 13 in. behind panel. Long term stability is less than 0.1% in 8 hours. Ripple and noise are less than 1mv RMS. Operating temp. is 0° to 40° C. Sola Electric Co., Elk Grove Village, Ill

Circle 347 on Inquiry Card

Systems and Circuits

TESTING has been and still is a growing problem for manufacturers. Quite often building a component or a black box is not as difficult as testing the item to prove it is reliable or that it will function exactly as intended. Sometimes the testing facility requires more space than the actual manufacturing setup. Most of today's testing is so complex that automated test equipment is the only answer.

CAPACITOR SALES are expected to reach $500 million within the next five years. Tantalum types have made the greatest jump in sales. Sales of tantalum capacitors passed aluminum electrolytics by $10 million last year. The biggest purchaser of tantalums is the military, with industrial applications developing rapidly.

NEW COMPUTER MEMORY MATERIAL is manufactured chemically instead of by electrolysis. The material is available in engineering samples and can be manufactured in large sheets. Precision Plating, Inc., Minneapolis, claims that the material has up to five times the storage capabilities of normal materials used in disc and drum storages. The material also shows promise for delay line applications.

DESIGN OF A DIGITAL COMPUTER using modular arithmetic techniques is the aim of research now being conducted at Westinghouse Electric Corporation's Defense Center. The research is also aimed at applying these techniques to computation problems.

Some of the problems under study include division, overflow, conversion of binary or decimal from or to modular notation, magnitude comparison, and the development of suitable residue class computational algorithms.

Research at Westinghouse is being conducted under contract to the Electronic Technology Lab, Aeronautical Systems Div. of the USAF.

COMPACTING FERRITES was a major consideration in designing a new series of die-set presses. To meet the increasing demand for extremely high dimensional accuracy in these components, F. J. Stokes Corp., Phila., took a unique approach. It consists of having the dimensional accuracy supplied by the die-set tooling; the press proper merely supports and actuates and guides this tooling. As a result, tooling with a clearance between the punch and die as fine as 0.0001 inch can be successfully used. Moreover, the die-set construction makes rapid set-up and adjustment of this tooling a simple matter, independent of the press motions. The series of presses have a capacity from ½ ton to 20 ton.

WOMEN'S FASHIONS COMPUTER PREDICTED. Univac Div. of Sperry Rand Corp., New York, N. Y., came up with this news. Fashions for women's wear have been forecast for years ahead. Based upon measurements during the past 25 years, a computer projected trends for the future and a noted dress designer produced a collection that will be worn in 1987.

Predictions: the Empire silhouette; skirts longer for day, shorter for evening; high-rising neckline by day, a plunging, below-the-navel neckline by night.

TV SYSTEM IN THE 2GC BAND to be used for educational television was recently demonstrated. The Plainedge School Dist. in Plainedge, N. Y., was used as the test bed. Programs were telecast from the high school to 7 other schools. At the schools a converter, similar to a UHF type, converted the 2GC signal to VHF and then fed the program into the school's internal distribution system. The program was then viewed on standard TV receivers. The demonstration was held to support proposed FCC rules opening the 2GC band to educational TV.

QUALITY CONTROL has always been closely affiliated with statistical analysis. Now, a computer-based system picks up quality control information from a final assembly line and analyzes the data so that management can take faster action to control trouble spots. IBM is using the system in its Lexington, Ky., typewriter plant. At various checkpoints, inspectors take control cards, prepunched with model and serial number, and enter information by code of any defects or errors noted. The number and department of the operator on the line is also entered. This information goes direct into the data processing system which stores the data on magnetic disks. When any defect on the line reaches a predetermined level of occurrence, the computer immediately prints out a report identifying the source of the trouble. The information is also relayed to the plant data processing department, which produces daily reports for management analyzing error trends during the preceding five days.

AIRBORNE FOG SIMULATOR will aid the FAA. The simulator will help to provide more accurate experimental data on increasing the effectiveness of runway lighting, approach lighting, runway configuration and pilot performance under adverse conditions. Developed by Link Div., General Precision, Inc., the equipment was installed in an FAA C-54 for flight tests.

Heart of the device is a variable density film strip which is mounted between the pilot and the windshield. Computers convert altimeter readings into fog-film position adjustments to adjust for the apparent decrease in visibility with altitude.

ALL-CHANNEL TV RECEIVER bill, H.R. 8031 has been approved by congress. Now that the president signed the bill the FCC will have the power to force set manufacturers to incorporate UHF reception capabilities in TV sets. See our editorial "Do Two Wrongs Make a Right?" which appeared in the May issue for a complete explanation.

News of Mfrs' Representatives

Microlab, Livingston, N. J., announces the appointment of the following representatives to market its microwave components: **W. E. Fry Co.**, Shawnee, Mich., to cover Kansas; and **Edward A. Ossman & Associates**, Rochester, N. Y., covering Central N. Y.

Sangamo Electric Co., Springfield, Ill., announces the following representative appointments for its line of servo and synchronous motors, PM generators and frequency converters: **L. A. Nott Co.**, San Francisco, Calif., to cover Northern California and Nevada; **El-Kap Sales Co.**, Los Angeles, Calif., covering Southern California, Arizona and New Mexico; **Datronics, Inc.**, Ft. Worth, Tex., to cover Texas, Oklahoma, Arkansas and Louisiana; **E. A. C. Associates**, New York, N. Y., for metropolitan New York; and **Grant Shaffer Co.**, Detroit, Mich., covering Michigan.

W. M. Hague Co., Inc., Lexington, Mass., has been appointed New England representative for Dytronics Co., Inc., Columbus, Ohio.

Tri-Tel Associates, Willowdale, Ont., has been appointed representative by Cadre Industries Corp., to cover all of Canada.

Compar Corp., San Francisco, Calif., is now national special components representative for Philco's Lansdale, Pa., Div. Compar will market Philco's lines of microwave, infrared and photosensor solid-state components and related devices.

Wolcott Associates, Winter Park, Fla., has been appointed Southeastern U. S. representative by Harmon-Kardon, Inc., Plainview, N. Y., manufacturer of digital logic modules for data reduction systems.

The Branum Co., Dallas, Tex., will cover Texas and Oklahoma as factory representative of the California Chassis Co., Lynwood, Calif.

IBL Engineering & Sales, Inc., Dallas, Tex., has been appointed representative by Industrial Instruments, Inc., Cedar Grove, N. J., for their line of test and measuring equipment in Texas, Arkansas, Oklahoma and Louisiana. **Process Equipment Co., Inc.**, Denver, Colo., will represent Industrial Instruments in Colorado, Wyoming, Montana, Utah and Southern Idaho.

Mel Foster Co., Minneapolis, Minn., has been appointed Upper Midwest representative by Sola Electric Co., Elk Grove Village, Ill., manufacturer of mercury and fluorescent ballasts, power and voltage regulating equipment.

Lightner Associates, Inc., Chicago, Ill., has been named Midwest representative by Polyphase Instrument Co., Bridgeport, Pa., manufacturers of specialty and pulse transformers, filters, magnetic amplifiers and delay lines.

The John G. Twist Co., Chicago, Ill., has been named representative by the Semiconductor Dept., ITT Components Div., Clifton, N. J. The Chicago firm will cover Illinois, Wisconsin and the Michigan peninsula.

Scientific-Atlantic, Inc., Atlanta, Ga., announces the appointment of the following representative firms: **Engineering Associates**, Washington, D.C., and Baltimore, Md., to cover Northern Virgina, Washington, D.C., Maryland, and Southern New Jersey; **CDB Enterprises, Inc.**, Hicksville, N.Y., to cover Northern New Jersey (including Camden), Eastern New York, New York City, Long Island, and Eastern Pennsylvania; and **Cozzens & Dudahy**, Chicago, Ill., to cover Indiana, Illinois, Wisconsin, Iowa and Minnesota.

Arizona Plastics, Inc., Phoenix, Ariz., has been named representative for that state by General Electric Co. for its complete line of Textolite decorative products.

Electronics Div., Graybar Electric Co., Los Angeles, Calif., has been appointed Southern California representative by Gremar Manufacturing Co., Inc., Wakefield, Mass.

Semiconductor Div., Bendix Corp., announces the following representative appointments: **Lawrence Electronic Co.**, Dallas Tex.; and **Denver Electronics Supply Co.**, Denver, Colo.

B. F. Goodrich Co., Shelton, Conn., announces the appointment of the **Kenneth W. Meyers Co.**, Chicago, Ill., as representative to cover Illinois, Indiana, Wisconsin, Minnesota, Iowa, North and South Dakota; and **J. T. Hill Co.**, San Gabriel, Calif., to cover Southern California and Nevada.

Raytheon Co.'s Sorenson Unit has named the following representatives to handle its line of controlled power equipment: **Barnhill Associates**, Denver, Colo., and Salt Lake City, Utah, to cover the West-Central U. S., including Colorado, Utah, Wyoming, North and West-Central Nebraska, Central Montana, El Paso, Texas, and New Mexico; **Electronic Marketing Associates**, Wheaton, Md., covering the Chesapeake Bay states; and **Megatronix Ltd.**, Toronto, Ontario, covering Eastern Canada.

Pioneer Electric Supply Co., Cleveland, O., has been appointed representative by Rotron Manufacturing Co., Inc., Woodstock, N.Y.

National Electronic Sales Associates, Hicksville, N. Y., has been appointed Southern New York-Long Island representative by Microtran Co., Valley Stream, N. Y., manufacturers of precision miniature transformers.

Tools for Electronics, Waltham, Mass., has been appointed New England representative for Spectra Strip Wire & Cable Co., Garden Grove, Calif.

Calibration Standards Corp., Alhambra, Calif., announces the appointment of the following representatives and their territories: **W. A. Brown & Associates**, Southeastern United States; **Brooks, Feeger Association**, Arizona, Colorado, Eastern Idaho, Eastern Montana, Nevada, New Mexico, Western Texas, Utah and Wyoming; **Mitchell Spears Co.**, Arkansas, Louisiana, Oklahoma, Eastern and Southern Texas; **Smith-Dietrich Sales Co.**, California; **George Gostenhofer & Associates**, New England; **Stanley Enterprises**, Western Idaho, Western Montana, Oregon and Washington; **Loren F. Green & Associates**, Illinois, Indiana, Eastern Iowa, Southeastern Minnesota and Wisconsin; **Electro Sales Associates**, Michigan, Ohio and Western Pennsylvania; **Louis A. Garten & Associates**, New Jersey, Southern New York, Long Island and Eastern Pennsylvania; **KLM Associates**, Up-state New York.

Moler-Billis Associates, Haddonfield, N. J., has been appointed representative by Waveline, Inc., Caldwell, N. J., to cover Maryland, Delaware, Southern New Jersey and Eastern Pennsylvania.

Electronautics Corp., Maynard, Mass., has appointed **Tri Tek, Inc.**, Lexington, Mass., as its new England representative.

Magnetic Shield Div., Perfection Mica Co., Chicago, Ill., announces the appointment of **J. E. Hall Co.**, Salt Lake City, Utah, as representative to cover Utah; **ECRA, Inc.**, Greensboro, N. C., to cover North and South Carolina; and **Nuclear Enterprises, Ltd.**, of Winnipeg, to cover the Canadian provinces of Manitoba, Saskatchewan and Alberta.

Kemp Engineering Co., Dallas, Tex., has been appointed representative by Spectran Electronics Corp., Maynard, Mass., to cover Texas, Oklahoma, Louisiana, Missouri, Kansas, Alabama, Tennessee, Georgia, Mississippi and Southern and Central Illinois.

Leonard D. Allen, Inc., Syracuse, N. Y., has been appointed New York representative, excluding the metropolitan area, by Ortho Industries, Inc., Paterson, N. J., manufacturers of filters, transformers, rectifiers and power supply equipment.

Industry News

H. E. J. Finke—named Director of International Planning, Raytheon Co.

General Precision, Inc., Tarrytown, N. Y., announces the following executive appointments: **Fred D. Herbert, Jr.**—named President, Aerospace Group, a newly formed organization; **R. N. Brown**—named Executive Vice President and General Manager, Aerospace Group; and **Robert J. Maroni**—elected Assistant Vice President, Defense Marketing.

A. C. Andrews—elected Vice President, The Potter Co., Skokie, Ill.

Cornell-Dubilier Electronics, Newark, N. J.. announces the following appointments: **Joseph F. Ferrante**—named Vice President; and **John H. Feder, Jr.**—appointed General Sales Manager.

Alfred A. Goldberg—appointed Vice President, Sales, Power Designs, Inc., Westbury, N. Y.

F. D. Herbert, Jr.

J. V. McGuire

A. A. Goldberg

Edward C. Hewitt

John V. McGuire — named Senior Vice President and General Manager, Sola Electric Co., Elk Grove Village, Ill.

Radio Corp. of America announces the following major appointments: **Arthur L. Malcarney**—named Group Executive Vice President; **Theodore A. Smith** — named Executive Vice President, Corporate Planning; **Walter G. Bain**—named Vice President, Defense Electronic Products; **Kenneth L. Klippel** — appointed Marketing Manager, Aerospace Communications and Controls Div., Defense Electronic Products; and **Dr. Alfred N. Goldsmith**—appointed Honorary Vice President.

Thomas Allinson — elected Vice President and Executive Assistant to President, Curtiss-Wright Corp., Wood-Ridge, N. J.

James M. Crawford — appointed General Manager, Motion, Inc., newly formed subsidiary of Tung-Sol Electric Co., Inc., Newark, N. J.

Terry F. Newkirk—appointed Manager of the newly formed Ceramics Div., Transitron Electronic Corp., Wakefield, Mass.

Fansteel Metallurgical Corp., North Chicago, Ill., announces the following have been elected Vice Presidents: **Ralph W. Rawson**—named Vice President and General Manager, Chemical and Metallurgical Div.; and **George T. Brennan**—elected Vice President, Operations.

Edward C. Hewitt—appointed Vice President and General Sales Manager, Thomas & Betts Co., Inc., Elizabeth, N. J.

The Bendix Corp., Detroit, Mich., announces the following appointments: **Dr. Winston E. Kock**—named Vice President, Research; **Robert J. Krause**—appointed Marketing and Planning Director, Bendix—Pacific Div., North Hollywood, Calif.; and **John C. Youmans**—named Assistant General Sales Manager, Scintilla Div., Sidney, N. Y.

D. L. Sweeney—appointed Marketing Manager, recently formed Industrial Micarta Div., Westinghouse Electric Corp., Pittsburgh, Pa.

Automatic Electric Sales Corp., Northlake, Ill., announces election of the following as Vice Presidents: **William S. Gage**, Communications Products; **Carl W. Schwob**, Supply Sales; **Harrison C. Smith**, Communications Products, also made divisional Field Sales Manager; **Thomas E. Smith**, Industrial Products; and **Keith A. Regel**, Marketing Services.

Walter Bencher — appointed Industrial Sales Manager, Microtran Co., Inc., Valley Stream, N. Y.

Motorola Semiconductor Products, Inc.. Phoenix, Ariz., announces the following appointments—**Christian J. Goodman, Jr.**—named Vice President and Sales Manager; and **William S. Hiatt, Jr.**—appointed Southeastern U. S. District Sales Manager.

Edward Crook — appointed New England and Eastern Canadian District Sales Manager, Mathias Klein & Sons, Inc., Chicago, Ill.

Paul E. Ritt, Jr.—named Vice President, Research, Melpar, Inc., Falls Church, Va.

A. P. Stuhrman—appointed Vice President, Trimpot Div., Bourns, Inc., Riverside, Calif.

Chester A. Sankey—named Railway Marketing Supervisor, Stackpole Carbon Co., St. Mary's, Pa.

Dr. John L. Sprague—elected a Senior Vice President, Sprague Electric Co., North Adams, Mass.

Dr. J. L. Sprague

Dr. L. G. Cole

Dr. Leland G. Cole—named Vice President, Research and Engineering, Telecomputing Corp., Los Angeles, Calif.

Irving Koss — appointed General Manager, E. F. Johnson Co., Waseca, Minn.

Robert C. Chilton—appointed General Manager, Computer Diode Corp., Lodi, N. J.

Microlab, Livingston, N. J., announces the following appointments: **Robert T. Vance**—named Administrator of newly formed Contracts Dept.; **John E. Wallace**—appointed Manager, Finance Dept.; and **Richard F. Powell**—named Personnel Manager.

General Dynamics/Electronics, San Diego, Calif., announces the following appointments: **James H. Thompson**—named Operations Manager; **Ira D. Sykes, Jr.**—appointed Assistant to General Manager; and **Frederick L. Hodgins**—named Customer Requirements Manager.

James H. Schaefer—appointed Vice President and General Manager, Viking Industries, Inc., Canoga Park, Calif.

James C. Perry—named Assistant Manager, Videosonic Systems Div., Hughes Aircraft Co. Ground Systems Group, Fullerton, Calif.

Burton H. Townsend — appointed Sales Manager, Caswell Electronics Corp., San Jose, Calif.

Personals

Dr. Robert Spencer—appointed Research Manager, MINCOM Div., Minnesota Mining & Mfg. Co., Los Angeles, Calif.

Scientific Data Systems, Inc., Santa Monica, Calif., announces the following appointments: **Emil R. Borgers**—named Programming Manager; and **Frank Woolam**—appointed Design Engineer for amplifiers and analog devices.


E. R. Borgers


Dr. F. M. Fowkes

Dr. Frederick M. Fowkes—named Director of Research, Sprague Electric Co., North Adams, Mass.

Polarad Electronics Corp., Long Island City, N. Y., announces the following appointments: **Robert Friedman**—named Applications and Service Engineering Manager; and **Herbert Seymour**—appointed Domestic Sales Administration Manager.

Scintilla Div., The Bendix Corp., Sidney, N. Y., announces the following appointments: **David C. Baker**—named Assistant Chief Engineer, Electronic Products; **Robert D. Bennett**—named Senior District Application Engineer, Dayton, Ohio, area; and **A. Patrick Moran**—appointed New Products Manager.

Westinghouse Electric Corp. announces the following appointments to its newly formed Superconducting Materials Dept., Materials Mfg. Div., Blairsville, Pa.: **Dr. Malcolm J. Fraser**—Director; **Raymond E. Wien**—Manufacturing Superintendent; **William J. Reichenecker**—Engineering Manager; and **Thomas J. Holleran**—Marketing Product Specialist; also, **C. J. Moll**—appointed Manager, Environmental Contract Dept., Construction Group, Pittsburgh, Pa.

Arthur E. Mahack—appointed Director of International Operations, Motorola Semiconductor Products, Inc., Phoenix, Ariz.

Oskar L. Eichna, Jr.—named Systems Analysis Engineer, Weapons Systems Div., PRD Electronics, Inc., Hicksville, N. Y.

Richard Dahlem—appointed to newly formed Application Engineering Dept., Semiconductor Specialists, Inc., Chicago, Ill.

General Precision, Inc., Tarrytown, N. Y., announces the following appointments: **Dr. Coleman duP. Donaldson**—named Chairman, Scientific Advisory Group; and **Dr. Raymond L. Garman**—named Vice Chairman of the same group.

Frank C. Elias—named Manufacturing Manager, Sola Electric Co., Elk Grove Village, Ill.


F. C. Elias


J. Carmichael

Hughes Aircraft Co. announces the following appointments: **Charles M. Horsley**—appointed Head of Production Control, Semiconductor Div., Newport Beach, Calif.; **John W. Scholz**—named Head of Production, Transistor Product Line, Semi-Conductor Div.; and **James Carmichael**—appointed Manager, Vacuum Equipment Product Line, Vacuum Tube Product Div., Oceanside, Calif.

J. C. Rodriguez—appointed Broadcast Sales Engineer, Stainless, Inc., North Wales, Pa.

Ira M. Rosenthal—appointed Chief Industrial Engineer, Oak Mfg. Co., Crystal Lake, Ill.

Donald N. Davis—appointed Field Sales Engineer, Arco Electronics, Inc., Great Neck, N. Y.

Dr. Julien Keilson—appointed Senior Scientist, Sylvania Electric Products, Inc., Waltham, Mass.

Dr. David A. Kahn—named Systems Associate, Melpar, Inc., Falls Church, Va.

Dr. Aram K. Hampikian—appointed Technical Director, Sperry Semiconductor Div., Sperry Rand Corp., Norwalk, Conn.

Dr. Karl B. Niclas and John E. Schulz—appointed Senior Engineers, Traveling-Wave Tube Production Section, General Electric Co.'s Power Tube Dept., Schenectady, N. Y.

Dr. Landis S. Gephart—named Director of Products Assurance for Space Systems, Lockheed Missiles & Space Co., Sunnyvale, Calif.

GOVERNMENT ELECTRONIC CONTRACT AWARDS

(CONTINUED FROM PAGE 21)

Oscilloscope	36,315
Power supplies	1,232,402
Radar	2,416,011
Radiac set	216,860
Radio set	7,214,980
Radiosonde set	278,716
Receivers	913,629
Recorder/Reproducer	1,204,332
Recorders	1,113,291
Recording systems	1,764,233
Relay armature	299,124
Relays	93,482
Reproducers	30,302
Resistors	462,231
Semiconductors	1,018,715
Signal generators	559,810
Spectrophotometer	31,501
Switches	27,569
Switching system	263,958
Synchro equipment	503,926
Tape, recording	800,599
Telegraph equipment	168,945
Telephone equipment	1,248,106
Test equipment	2,891,412
Test sets	1,567,497
Time signal generation system	515,393
Transceivers	3,589,754
Transducers	179,568
Transformers	87,810
Transmitters	529,498
Transponders	359,101
Tube, electron	4,958,708
Tube, magnetron	1,954,838
Tube, traveling wave	1,720,650
TV equipment	360,699
Wire & cable	538,334
X-Ray equipment	307,250

Vehicle Monitoring Contract Awarded

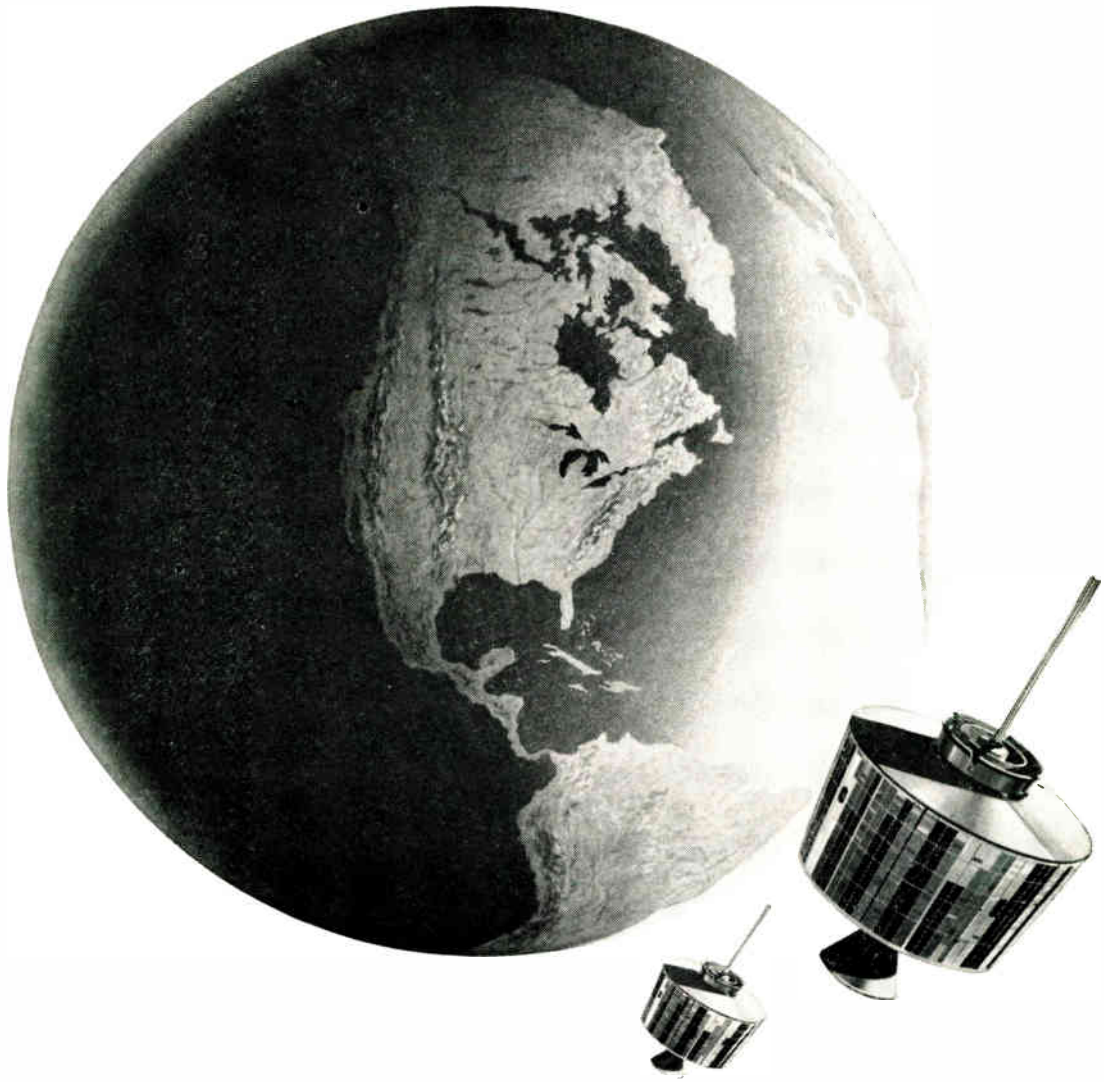
A contract to develop and implement a portion of the shipboard instrumentation systems for monitoring the flights of vehicles launched from Cape Canaveral has been awarded ITT Federal Laboratories, Nutley, N. J.

The contract is from Sperry Rand Corp. It is aimed at increasing the flexibility of Atlantic Missile Range facilities. Program calls for the development of a portion of the instrumentation systems and related equipment to be installed aboard two ships being specially outfitted for service at distant AMR target areas.

ITT responsibilities will include the ship's telemetry, communications, data recording, timing, meteorological and electronic recovery systems.

Joins U. S. Industries

Dr. John J. Theobold, who is retiring as Superintendent of Schools, New York City, will become a Vice President of U. S. Industries, Inc. The firm, located in New York City, pioneered the field of programmed instruction and teaching machines.



circuit designers... is your appointment in space with Hughes?

Today at Hughes you will find one of the country's most active space-electronics organizations. Important new and continuing projects, including SURVEYOR, SYNCOM, Missile Defense and POLARIS guidance systems are growing at unprecedented rates.

This vigor promises the qualified engineer or scientist more and bigger opportunities for both professional and personal growth.

Many immediate openings exist. The engineers selected for these positions will be assigned to the following design tasks: the development of high power airborne radar transmitters, the design of which involves use of the most advanced components; the design of low noise radar receivers using parametric amplifiers; solid state masers and other advanced microwave components; radar data processing circuit design, including range and speed trackers, crystal filter circuitry and a variety of display circuits; high efficiency power supplies for airborne and space electronic systems; telemetering and command circuits for space vehicles, timing, control and display circuits for the Hughes COLIDAR* (Coherent Light Detection and Ranging).

If you are interested and believe that you can contribute, make your appointment today.

Please airmail your resume to:
Mr. Robert A. Martin
Head of Employment
Hughes Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 20, California
We promise you a reply within one week.

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HUGHES AIRCRAFT COMPANY
AEROSPACE DIVISIONS
An equal opportunity employer.

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

Management Research Summary Available

A study by the Small Business Administration shows that many businessmen believe recruitment of management personnel should be continuous and involve five fundamental approaches.

First. Systematic recruitment of potential managers. 2. Preliminary screening of candidates on the basis of past records and preliminary interviews. 3. Further probing of their abilities through tests and references. 4. A series of intensive interviews, and 5. Final selection based on all the data plus the personal judgment of the executive making the decision.

The summary cites, as one of the most intensive studies of the characteristics necessary for successful management, the Round Table on Executive Potential and Performance. This conference was conducted by the Columbia Univ. Graduate School of Business. Conclusion of the conference was that the personal characteristics essential to a good manager are a strong drive and ambition, physical and emotional stamina, willingness to make personal sacrifices, and willingness to take risks.

The 4-page summary is based on a study made by the College of Business Administration of Louisiana State Univ. under the SBA research grant program. It can be obtained at no charge from any of the 59 SBA offices. Copies of the full report, "Providing Management Talent for Small Business," may be purchased for $2.50 from the Div. of Business Research of LSU at Baton Rouge, La.

N. J. Research Center

A $50,000,000 industrial scientific research center consisting of an R & D area and adjoining housing development is being built about three miles north of Princeton, N. J., on U. S. Route 1.

AIR FORCE AWARD

Dr. Leonard S. Sheingold, Vice President, Research, Sylvania Electronic Systems, is shown (l.) receiving exceptional civilian service citation from Gen. Curtis E. LeMay, AF Chief of Staff. Dr. Sheingold returned to Sylvania following 12-month leave to serve as Air Force's Chief Scientist.

Demand for Scientists, Engineers Increases 50%

Demand for scientists and engineers rose nearly 50% this January through April over the same four months last year, reports Deutsch & Shea, New York advertising firm. The firm based its survey on the amount of "help wanted" ads engineering firms placed in newspapers and technical journals.

'Workship' Aids Studies At Calif. Tech College

A unique program called "workship" has been adapted at California State Polytechnic College, San Luis Obispo.

In the program cash grants secured from industry of up to $500 are used to employ students for equipment maintenance and setting up experimental lab projects at the school.

School officials say the program results in three positive benefits:

The students earn while they learn. The college benefits by improved facilities, longer life of equipment and some relief from rising operational costs. Industry benefits most of all, by obtaining college graduates who have some work experience to go along with their degrees.

College Classroom Need Overrated—C. of C. Head

A shortage of college and university facilities "exists only in the minds of those who wish to see the federal government take over the responsibility for financing and managing higher education," Ladd Plumley, U. S. Chamber of Commerce President, recently declared in Washington.

Plumley issued a statement to correct what he termed the "distorted picture of higher education" which has been presented to Congress in support of H. R. 8900, a bill to appropriate federal funds for construction of college classrooms and laboratories.

He continued, "Many recent studies have indicated that classrooms and laboratories—academic facilities—on our campuses are not only adequate, but sufficient for immediate enrollment increases of 300,000 to 400,000 students.

"Much of the illusion created of a facilities shortage," he said, "stems from the fact that more than 50% of college enrollment applications are directed, often in duplicate, to the so-called prestige institutions comprising only 10% of the nation's accredited colleges and universities."

Electronics Now Top L. I. Industry

The electronics industry is now Long Island's biggest employer. Electronics manufacturers in Nassau and Suffolk Counties now employ 50,000 persons, or 30% of the working force, according to a report of the Franklin National Bank. The aircraft industry, until this year first, is now second.

Of 123 plants built on Long Island last year, 34 were electronic.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient resume form, page 218.

ELECTRONIC INDUSTRIES *Professional Profile*

The ELECTRONIC INDUSTRIES Job Resume Form for Electronic Engineers

Name _____ Tel. No. _____

Street Address _____ Zone _____

City _____ State _____

☐ Single ☐ Married ☐ Citizen ☐ Non-Citizen Date of Birth _____

Will Relocate ☐ Yes ☐ No. If Yes ☐ Another City ☐ Another State

Salary Desired to Change Jobs in present area _____

Salary Desired to Change Jobs and relocate in another area _____

Professional Memberships _____

College or University	Major	Degree	Dates

RECENT WORK EXPERIENCE

Company	Div. or Dept.	Title	Dates

SIGNIFICANT EXPERIENCE AND OBJECTIVES

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.

Mail to: ELECTRONIC INDUSTRIES—Professional Profile—56th & Chestnut Sts.—Philadelphia 39, Pa.
This resume is confidential. A copy will be sent only to those Companies whose number you circle below.

800 801 802 803 804 805 806 807 808 809 810

By J. R. Moore*
President, Autonetics Division
and Vice President
North American Aviation, Inc.
Downey, Cal.

Electronic Trends in Southern California

THE electronic industries of southern California enter 1962 with a new maturity, born out of the recognition of past mistakes in forecasting development times, costs, and markets. This maturity provides the kind of realism which makes it possible to discuss with confidence trends and changes which will be evident in 1962—but which are more accurately associated with the whole decade of the 1960's. It is these trends and changes with which we shall be concerned.

What Constitutes the Electronic Industries

I have spoken of the "electronic industries" as though we all had a common understanding of the meaning of the term. Because this is probably not the case, it will be desirable at this point to discuss what this industry includes. At one time, the semantics gave no problem because the primary manifestations of the industry were radio and television receivers and transmitters and radar equipment—all having in common a critical dependence on thermionic vacuum tubes. During the 1950's, however, many vacuum tubes were replaced by semiconductor transistors and diodes, and the bulk of the engineering and manufacturing activities began to evolve as end products, various types of sophisticated military and industrial automatic control devices, electronic digital computers, automatic navigation equipment, and automatic pre-operational checkout systems. The term "electronics industry" was then broadened to include not only the end items, but also all of the instruments such as gyroscopes, accelerometers, tape punches, tape readers, detectors and display devices, along with electronic components such as tubes, transistors and diodes. With these changes, the whole character of the industry also underwent a transformation, so that now there has emerged a major facet of the business in which the largest efforts in manpower and money are associated with engineering, manufacturing, and field servicing of relatively smaller numbers of more and more complicated aggregations of interacting elements. This is the *electronic systems activity* which forms the heart of so many of our military, space, and industrial automation programs.

Several examples of major electronic systems include:

A. Radio and television networks.
B. Aircraft automatic controls for flight, navigation, communication, and engine operation.
C. Ground-based aircraft traffic controls, such as ground-controlled approach systems (GCA) and instrument landing systems (ILS).
D. Missile guidance, flight control, and automatic countdown systems.
E. Spacecraft navigation, control, communications, calibration, and malfunction detection systems.
F. Navigation and control equipment for ships and submarines.
G. Electronic data-processing systems for management monitoring and control of factory labor costs, inventory requirements, material purchasing and handling, accounting activities, and various business indices.
H. Automatic controls for machine tools, chemical processes, power plants, and pre-operational inspection and calibration of manufactured items.

The trend of a major part of

The West Coast Electronic Manufacturers Association reports that over the past five years, the number of graduate professional engineers in the western industry increased almost exactly 100%—from 17,000 to 34,000. In the same period, average investment in research and development among western companies has grown to 8½% per year.

* From the paper presented to the 1962 Business Outlook Conference Los Angeles Chamber of Commerce.

the electronic industries toward increasingly complicated end products is having far-reaching consequences on all facets of the business. Thus:

A. An increasingly larger fraction of total product cost is devoted to development and design engineering. This is necessary because of the increased numbers of interactions among individual elements required by today's large systems; because the total number of systems produced is relatively small, so that operational experience cannot be relied upon to uncover design deficiencies; and, because the whole expanse of science is moving forward so rapidly that engineering changes are frequent, even in equipment which has been delivered.

B. Electronics is becoming more and more the means for interconnecting and controlling systems involving several business and scientific disciplines. Major electronic organizations must, therefore, include on their engineering, field service, sales, and management rosters individuals with increasingly broad scientific and business backgrounds — backgrounds in aerodynamics, propulsion, nuclear physics, chemistry, metallurgy, manufacturing methods and processes, operations analysis, and business systems.

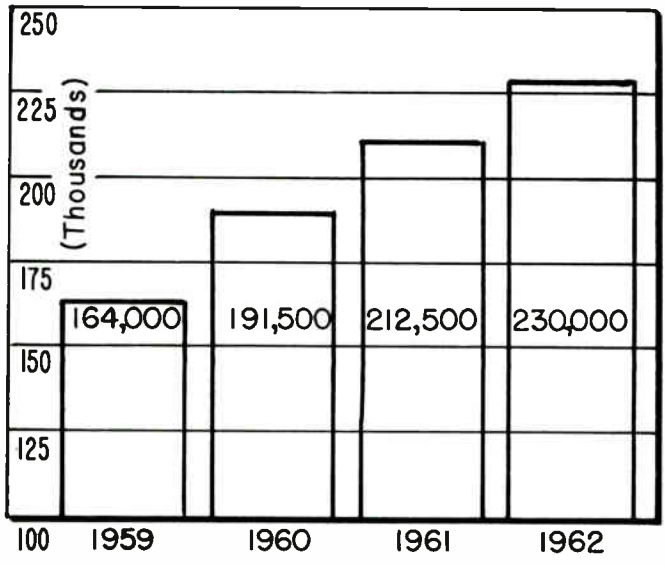
C. Similarly, the industries which depend upon electronics to provide the brains, senses, reflexes, and nerve ganglia which control and motivate their own products are finding it necessary to engage personnel with some knowledge of electronics to make certain of its effective application. Thus, the identification barrier between the electronic system industry and other systems industries is becoming increasingly diffuse and difficult to delineate.

D. A much greater emphasis on reliability has been required to achieve satisfactory field operation of the increasingly complicated systems. This emphasis on reliability begins with basic concepts—is carried as a primary design criterion through the engineering organizations — is a necessary specification for the procurement of parts — has become a way of life in the electronic industry's factories—is a major factor in field service organizations, techniques, and equipment. It has spawned a whole new facet of the electronic industry, whose output is equipment for torturing, testing, and evaluating a complex electronic system in search of its proverbial horseshoe nail.

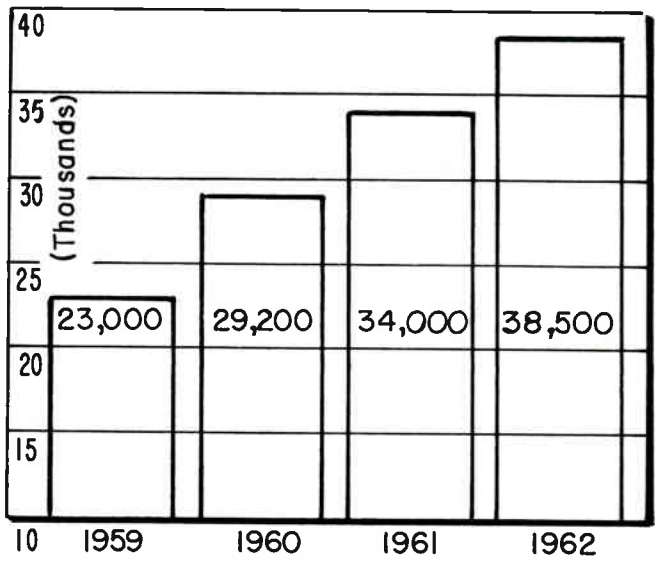
The combination of large numbers of interacting parts requires that the chances of failure of any of these parts, or the elements which interconnect them, be correspondingly reduced as the number of parts increases. For example: a spaceship containing 100,000 parts on a three-day trip to the moon could have a chance of failure of one part in a hundred if each one of its 100,000 parts would have an average failure-free existence of thirty million days. Furthermore, the electronic systems industry is developing against a requirement that complicated assemblies of elements work reliably the first time they are put into the field. This emphasizes the requirement for accurate simulation of field conditions in the engineering laboratories and factories, together with an all-out effort in engineering and manufacturing to anticipate possible causes of failure and eliminate them from the design and the production process.

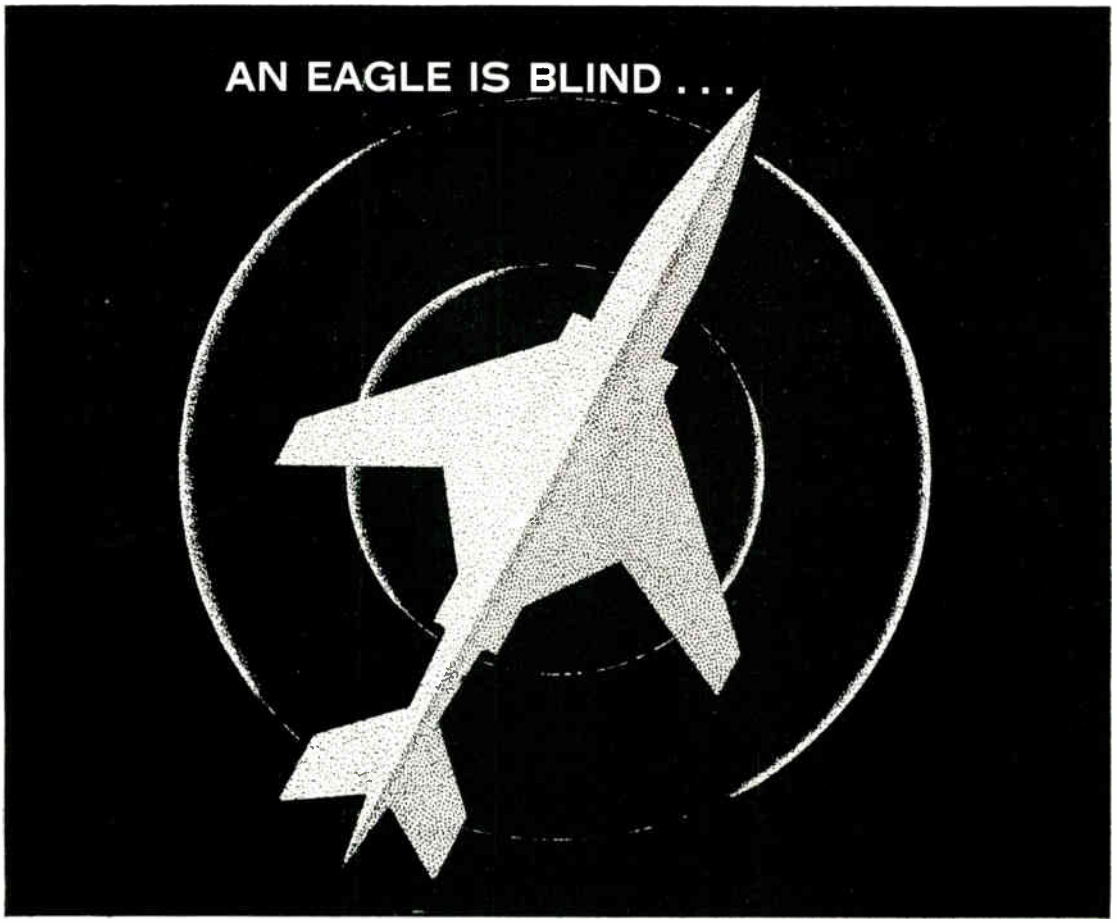
E. The increased complexity of electronic systems, their interaction with the products of other industries, the small number of elements in any production run, and the re-

Electronics employment in the West has climbed steadily



No. of graduate engineers employed by Western electronic firms





. . . Compared to the pinpoint infrared accuracy of today's weapons.

Boeing engineers at the Military Aircraft Systems Division are making rapid advances in this important technology. They are working vigorously in the field of infrared countermeasures. And they are developing advanced infrared surveillance systems to improve the military's "seeing" capability. To assist them and to speed their progress, they are provided with the finest laboratory and test facilities available — including mobile and fixed installations.

Other electronic engineers are progressing in the areas of acoustics, antennas, and radar. Their backup facilities are among the best. Positions are open at both the Wichita and Seattle Branches of this division.

Career positions are also open in the following technologies:

- ☐ Propulsion
- ☐ Structural Dynamics
- ☐ Aerodynamics
- ☐ Stress
- ☐ Automatic Controls
- ☐ Mechanical Controls
- ☐ Systems Design
- ☐ Operations Analysis

The Military Aircraft Systems Division is presently working on long-range weapon system programs. Opportunities for professional growth at both the Wichita and Seattle Branches are excellent.

If you have a Bachelor of Science or Advanced degree and are experienced in any of the above technologies, send your resume in confidence to Mr. Melvin Vobach, Dept. OE8, Military Aircraft Systems Division, The Boeing Company, Wichita 1, Kansas.

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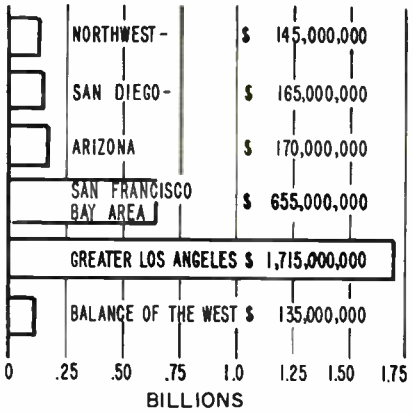
quirement for large numbers of changes, has greatly increased the problems of estimating engineering and manufacturing costs and completion times. This has led to a concentrated exploration of new cost accumulation and control techniques with particular emphasis upon efficient and accurate communication among various elements of the engineering, manufacturing, material, quality control, and field support elements of electronic organizations. It has also insured that a continuously increasing percentage of total expenditures in the electronic industries is for programs where the risk is shared by the customer and an electronic supplier via the medium of cost-plus-fixed-fee or cost-plus-incentive-fee contracts. Such a situation has served to reduce the percentage profit on sales in some cases while, at the same time, reducing the number of financial reports involving red ink.

F. Management problems and requirements associated with the increasingly complex equipment and organizations of the maturing electronic industry must command as much application of ingenuity as the development, design, and manufacture of the electronic products. There must be as much emphasis on developing improved management techniques for producing complex equipments (by organizations having a large percentage of technicians under conditions where program costs are difficult to estimate, and interfaces with other industries are numerous and complex) as there is upon the development of scientific capabilities for handling the complexities of the equipments themselves. This has led to the evaluation of a new activity, sponsored mainly by the requirements of Defense Department systems but increasingly applicable in the electronic industry, called "program management." As a result, the management matrix of the modern electronic systems organization includes the management of people, the management of programs, and the management of specialties. We can expect the future to bring developments in the management of complex systems and the organizations that produce them slightly less dramatic but every bit as necessary as the accomplishments of the expanding universe of science.

1961 electronic sales by areas



All of the foregoing consequences represent trends which will continue and should have a profound effect upon the character of the electronic industry. Thus, we find it maturing with a major part of its activity rooted in complexity and becoming less and less distinguishable from the other systems industries of our age.

Following the discussion of changing characteristics of the electronic industry, it now becomes possible to identify some other trends for 1962 and for the 1960 decade.

General Business Trends

My crystal ball corroborates the numerous economic forecasts which have preceded me—at least for the year ahead. We can look for an *evolutionary*, rather than a *revolutionary*, extrapolation of the situations which emerged during the last half of 1961. These include:

A. A continued increase in sales and employment by the electronic industry, with greatest emphasis on military and space electronics, but with industrial electronics also moving ahead on a solid base.

B. A continued maturing of the industry in terms of elevating problems of management, manufacturing, field service and finance into equivalence with technical competence as ingredients of the success equation—a necessary condition for survival!

C. Increased emphasis on efficiency and cost avoidance as a necessary condition for sales, profits, and success against an intensification of competition.

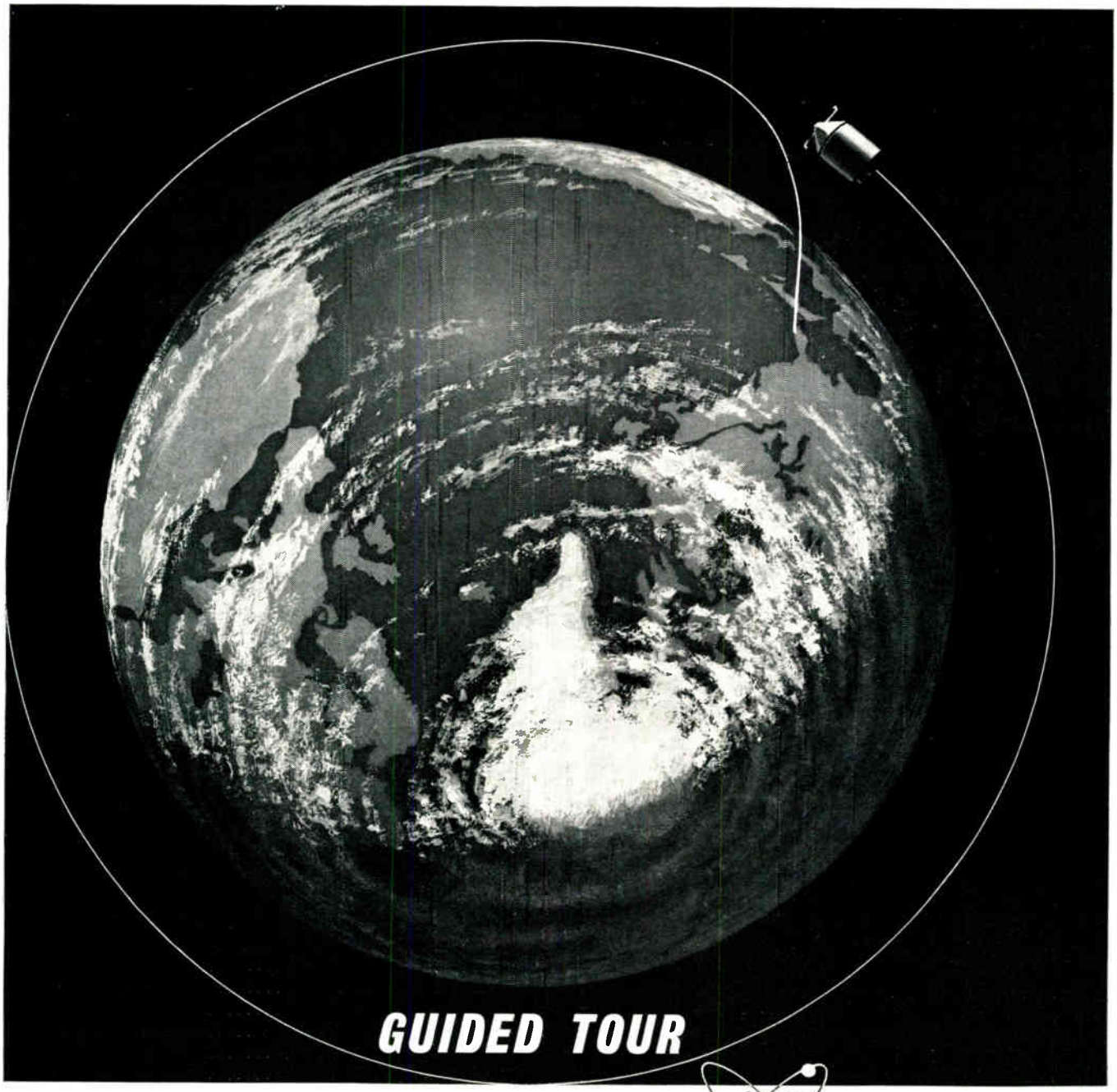
D. Increased employment of corporate funds for research and new product development.

E. A further increase in the percentage of capital expenditures used for machinery, test equipment, and data processing as contrasted with brick and mortar.

F. A continuation of the recent increase in wariness by investors, who have seen that the term "electronics" has no magical powers and can lead to financial difficulties unless the activities which it describes are leavened with sound business judgment and good management.

Beyond 1962, the crystal ball grows more opaque. The timing and effect of an impending technical revolution cannot be accurately predicted at this time. The extent and geographical allocation of major new defense and space programs is difficult to forecast. The definition of the electronic systems industry itself becomes uncertain as it mingles more and more with the aerospace, atomic energy, and manufacturing equipment industries.

Some factors can be discerned which represent the only solid basis for business prediction. Southern California has built up a reservoir of technical and management talent which should assure its success in any competition involving equipment with such high technical content and management complexity as electronic systems. Furthermore, the same factors of opportunity and unexcelled living conditions should



BY AC

AC Spark Plug, The Electronics Division of General Motors, has accepted an exciting new challenge: the development and production of a navigational-guidance system for the first phase in NASA's APOLLO project of manned flight to the moon. This new assignment is another significant step in the progress that is being made at AC . . . progress achieved through the knowledge of AC's highly skilled, highly respected staff of creative engineers.

We suggest that you inquire about the advantages of being associated with our new assignment or other projects now underway at AC. If you have experience in any of the following specialties and have a B.S., M.S., or Ph. D. in Electrical Engineering, Mechanical Engineering, Physics, or Mathematics, send your resumé to G. F. Raasch, Dir. of Scientific and Professional Employment, AC Spark Plug Div., Dept. 5753K, Milwaukee 1, Wis.

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LOS ANGELES RESEARCH AND DEVELOPMENT LABORATORY (Airborne Digital Computers & Advanced Inertial Guidance Systems) ■ Development Engineers ■ R & D Engineers ■ Circuit Design Engineers ■ Systems Engineer

BOSTON RESEARCH AND DEVELOPMENT LABORATORY (Advanced Inertial Guidance Systems & Components for Future Aircraft, Ballistic Missiles & Space Vehicles) ■ Systems Engineers & Mathematicians ■ Electronic Circuit Engineers ■ Physicists ■ Instrument Engineers ■ Electromagnetic Engineers ■ Radar Systems Engineers

AC SPARK PLUG ⚛ THE ELECTRONICS DIVISION OF GENERAL MOTORS

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AChiever Inertial Guidance for the TITAN II, THOR, and MACE/Bombing Navigation Systems Integrator for the B-52(C&D)/POLARIS Gyros and Accelerometers/ALRI

insure a continuation of this advantage. Correspondingly, southern California has in being some of the major electronic facilities in the country, with hard-hitting teams to operate them. This, too, should auger well for electronics in southern California during the decade.

On the negative side of the ledger, it should be pointed out that California labor rates and business taxes are not among the lowest in the country. Furthermore, many eastern and midwestern organizations have selected California only as the site of their "brain" factories. Thus, we are familiar with research, advanced development, and operational study organizations, representing businesses whose production facilities are located in other parts of the country. By establishing these "brain factories," major industrial organizations have attempted to take advantage of the superior creative atmosphere in southern California, combined with existing plant and facility investments and lower manufacturing costs to be found elsewhere.

Technical Trends

The 1950's saw the rapid growth and beginning of maturity of the electronic industry. Perhaps the most important single catalyst for the industry during the 1950's was the introduction of semiconductor devices typified by the transistor. With the transistor, it became possible to contemplate practical versions of high-speed computers, complex control amplifiers, and communications equipment. This was not only because of the substantial reduction in size which could be accomplished by using transistors, but, more importantly, because of the greatly increased reliability of the transistors. This reliability has been a necessary condition to the design of all of the complicated equipments which are becoming part of our industrial, defense, and space establishments. Wiring and hand-soldering were replaced by printed circuits, machine soldering, and welding. Means were found to strike the proper balance between the reliability of the transistor or diode and the manufacturing processes for interconnecting them and communicating with them.

However, a long look into the crystal ball for the decade of the 1960's reveals the beginning of a technological revolution which should far transcend, by comparison, the substitution of the transistor for the vacuum tube. This revolution involves a number of technical developments normally gathered together under the title of "microminiaturization." With microminiaturization, it is possible to produce whole circuits without their being touched by human hands in the processing. Fingers are far too clumsy for control elements capable of doing many of the functions of a transistor but with dimensions measured in thousandths of an inch. Close control of manufacturing processes by electronics, and the replacement in some cases of deft fingers by infinitely more deft electron beams, make it possible to build devices in which ten million interconnecting operating parts are packed into a single cubic foot. This represents a reduction in volume, over the best that we can do using conventional transistors and diodes, by a factor of one hundred. As another example, the Bureau of Standards has reproduced six 8½" by 11" pages of normal size print on the cross-section of a human hair; In Autonetics laboratories, we have reproduced the Lord's Prayer, not on the *head* of a pin, but on its *point*.

The implications of these advances which are now beginning to emerge from the laboratory reach into all walks of life. One obvious class of consequences is based upon the exploitation of advantages to be gained by reductions in size and weight — complex equipments can be designed for aircraft, missiles, and space vehicles which, without microminiaturization, would be too heavy to justify them. Sensitive electronic computers and controls can be shielded from the effects of radiation in space which could be harmful to conventional transistors. Tiny electronic transmitters can be implanted along with suitable detectors, in humans and animals to provide a dynamic record of the measurement of vital functions with negligible discomfort to the individuals. Information broadcast by these transmitters will be

WEMA PAST PRESIDENTS

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S. H. Bellue
Paul F. Byrne
John A. Chartz
Donald C. Duncan
W. Noel Eldred
James L. Fouch
E. P. Gertsch
Phillip L. Gundy
H. Leslie Hoffman
L. W. Howard
Norman H. Moore
H. Myrl Stearns
Calvin K. Townsend
Leon B. Ungar
W. W. Wahlgren
Thomas P. Walker

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	Los Angeles	*San Francisco*
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1944	H. Leslie Hoffman	Jack Kaufman
1945	Howard D. Thomas, Jr.	Clayton F. Bane
1946	L. W. Howard	R. C. Shermund
1947	L. W. Howard	W. W. Wahlgren
1948	James L. Fouch	William Hewlett
1949	Robert Newcomb	W. Noel Eldred
1950	H. P. Balderson	O. H. Brown
1951	Fred W. Falck	Paul F. Byrne
1952	Leon B. Ungar	Noel Porter
1953	E. F. Grigsby	Norman H. Moore
1954	E. P. Gertsch	J. J. Halloran
1955	Gramer Yarbrough	H. Myrl Stearns
1956	Thomas P. Walker	Winfield G. Wagener
1957	Hugh P. Moore	Calvin K. Townsend
1958	Donald C. Duncan	St. George Lafitte
1959	Richard B. Leng	John A. Chartz
1960	S. H. Bellue	Phillip L. Gundy
1961	A. N. Curtiss	Phillip L. Gundy
1962	William J. Miller	Walter G. Scott

	San Diego	*Northwest*
1956	Clayton G. Jack	
1957	Richard T. Silberman	
1958	Donald E. Root	
1959	William S. Ivans, Jr.	Lawrence R. Rockwood
1960	Edward T. Clare	M. Ray Dilling
1961	Kenneth C. Stone	William B. Webber
1962	William G. Alexander	Orval D. Berry

	Arizona
1962	Rudy W. Liska

received remotely and analyzed to give medical science a far deeper insight into vital processes, disease, and life itself.

Even more important than the advantages to be gained by dramatic reductions in size, will be the effects of microminiaturization on reliability. It would be impossible to contemplate increasing the number of elements in a given volume by a factor of 100 without a corresponding improvement in the reliability of each element. Fortunately however, the expected factor of increase in reliability is even greater than that of the reduction in size. This arises from the elimination of processes which can be improperly performed leading to malfunctions—and the possibility of taking advantage of redundancy of elements in which the chance of failure of a single element may be small, but the chance of a simultaneous failure of two or more elements is almost completely negligible.

With such increases in reliability, it becomes feasible to design control systems which are more reliable than human beings and which, similar to human beings, detect their own failures and make suitable corrections for them. With such reliability, the electronic industry will be able to offer the aircraft industry completely automatic pilots which can handle the aircraft from "power on" to "power off," calibrate its instruments, provide its pre-operational readiness check, and control it through a density of air traffic many times that now handled by our airways and terminals.

In a similar manner, complete factories can be entrusted to on-line electronic controls, where previously the reliability of such controls and the serious consequences of their failure required that they operate mostly off-line.

Complex data processing equipment, already an important factor in our laboratories and businesses, can be called upon to perform many more tasks which are now considered uneconomical. Many other consequences of microminiaturization are suggested by these few examples.

However, with such possibilities on the microminiaturization hori-

(*Continued on page* 226)

Electronic Trends

zon, it is well to be warned against the rainbow chasing which characterized so much of the electronic industry in the 1950's. First of all, what I have spoken of exists in many of the laboratories of the electronic industrial and scientific institutions throughout the country. However, it is also a fact that, despite the fanfare which has accompanied words such as "molelectronics" over the past two years, we do not see this equipment in major production programs at this time. This is a result of the following factors:

A. The manufacturing processes are just being developed.

B. Negligible field experience exists with the equipment produced by such processes.

C. Although massive aggregations of microminiature elements are theoretically possible, such interconnected complexes have not yet been demonstrated in the field.

D. The primary advantage of microminiaturization is in the processing of very low-power signals. These signals must be obtained from mechanical devices such as pressure meters, thermometers, voltmeters, gyroscopes, mass spectrometers, and many other so-called "end organs." The reduction in size of these devices has not kept pace with the advances in the electronic circuitry. These devices represent the inputs to the microminiature circuits. The output of the microminiature circuits almost always involves power—power to run motors—actuate displayers—or control loudspeakers. The field of microminiaturization has not yet encompassed amplification involving power, either electronic or mechanical. As a result, the application of microminiaturization must be carefully evaluated in parallel with advances in end organs and power elements. There are many applications where it would not be economical to have an amplifier as small as the head

Electronic Trends *(Continued)*

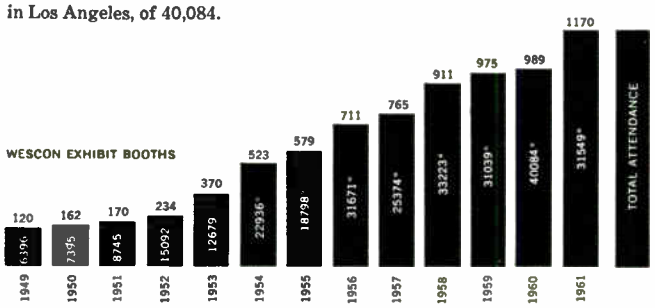
of a pin to control cubic feet of power generation equipment.

It is difficult to predict accurately the time when microminiaturization will become a major factor in the electronic industry, measured in terms of a major percentage of the industry's sales dollar. It seems almost certain that this cannot occur until near the end of the decade.

In the meantime, designs based on the refinement of existing techniques will bring a new era of reliability and performance to electronic systems, short

PROGRESS REPORT

The steady growth of WESCON has been in both number of visitors and number of exhibitors. A ten-fold increase in number of booths has taken place since 1949. Number of visitors in 1962 should surpass the 1960 attendance in Los Angeles, of 40,084.



Electronic Trends

(*Continued from page* 227)

of the full-fledged introduction of microminiaturization. Electronic data processing in all of its forms will continue to expand in the factory, the office, and the laboratory.

The need for men with capabilities in several fields—already too great to satisfy from our existing stockpile—will continue to increase. More scientists will have to learn how to communicate efficiently and how to evaluate the effect of non-scientific factors on technical decisions—how to recognize the relative importance of all types of problems viewed against the objectives of the organization as a whole.

By the same token, managers will have to become conversant with technical factors—to avoid the mistakes of the rainbow chasers of the 1950's. Even in the factory, the technical competence of the employees will have to be steadily upgraded.

All of this poses a challenge to our industry and our educational system — which more than ever must work hand in hand to solve the human problems of this new age of complexity which we are laboring so rapidly to create.

In summary, then, we can view the electronic industry as one of southern California's greatest assets — now and in the future. Although becoming less and less separable from the aerospace and manufacturing equipment industries, the electronic industry will almost certainly continue to be the southland's largest industrial employer—at least until it successfully collaborates with the aerospace industry to achieve the dream of an aeroplane in every garage — not likely during the decade of the 1960's.

The increasing percentage of total product cost which lies in research, development, engineering, and field service has far-reaching consequences for management, employee, and our educational institutions. Industries which once were geared to one engineer for every ten production workers are now finding this ratio more like 1-to-2. This trend, with increased emphasis on aerospace programs and the approaching advent of microminiaturization is definitely continuing.

ELECTRONIC INDUSTRIES Advertisers—August 1962

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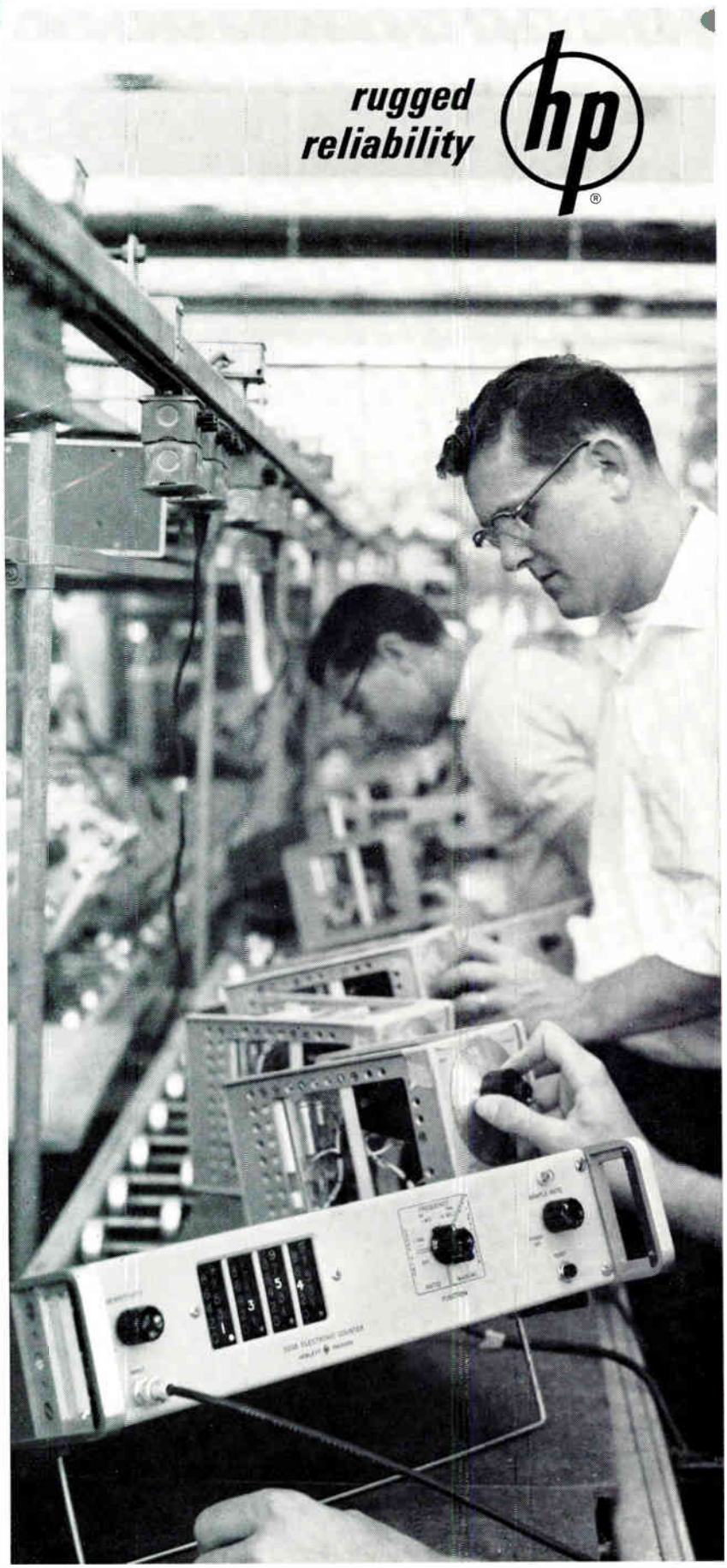
EQUIPMENT, MATERIALS, PARTS & COMPONENTS

New Journal Published

The first issue of the RAE Journal was published in June. The quarterly magazine is published by the RAE Society, a national group of hobbyists interested in assembling kits for radio, audio and electronic equipment.

The organ will be available only to members, who pay dues of $1 per year.

A 300 KC Solid State Counter for $750



Measure frequency and ratio directly; measure speed, rpm, pressure, temperature, acceleration or any phenomena that can be converted with transducers to ac or pulses.

The same design, circuitry and construction features of all new transistorized hp counters are incorporated in this low-priced, general-purpose counter. Time base is derived from the power line, providing 0.1% accuracy—fully adequate for many frequency measurements. The counters have a maximum counting rate of 300 KC. 0.1 v sensitivity permits low-level measurements.

Model 5211A has gate times of 0.1 and 1 second. Model 5211B has an additional gate time of 10 seconds. Otherwise, the instruments are identical. A storage feature, which can be disabled by a rear-panel switch, provides a continuous display, each reading held on the 4-digit neon columnar readout until the count itself changes. The counters provide a 1-2-2-4 BCD code output for systems use or recording devices. Manual gate allows the 5211 counters to be controlled by the front panel, or be operated remotely by contact closure or suitable pulses.

Solid state design and construction provide low power consumption, low heat dissipation, operation over a wide temperature range. The counters are housed in the new hp modular cabinet for bench and rack mount. Plug-in circuit modules and ready accessibility simplify maintenance. Both models weigh but 10 lbs. and can easily be carried in one hand. Conservative design features, such as the use of decade dividers in the gate generating circuits, provide operational stability and eliminate calibration problems.

Specifications

Maximum counting rate: 300 KC
Display: 4 digits, neon column
Input sensitivity: 0.1 v rms sine wave
Temperature range: —20 to 50°C
Time base: 50 or 60 cps power line
Manual gate: Controlled by front panel function switch, by external contact closure, or by 3 volt peak positive pulses at least 10 μsec wide at half amplitude point.
Frequency measurement: 2 cps to 300 KC; accuracy ± 1 count, ± time base accuracy
Ratio measurement: Reads: (f_1/f_2)
Range: f_1: 2 cps to 300 KC (0.1 v rms)
f_2: 100 cps to 300 KC (1 v rms into 1000 ohms)
Accuracy: ± 1 count of f_1, ± trigger error of f_2
Dimensions: 16¾" wide x 3½" high x 11½" deep, 10 lbs.
Price: hp 5211A, $750.00; hp 5211B, $825.

Data subject to change without notice. Prices f.o.b. factory.

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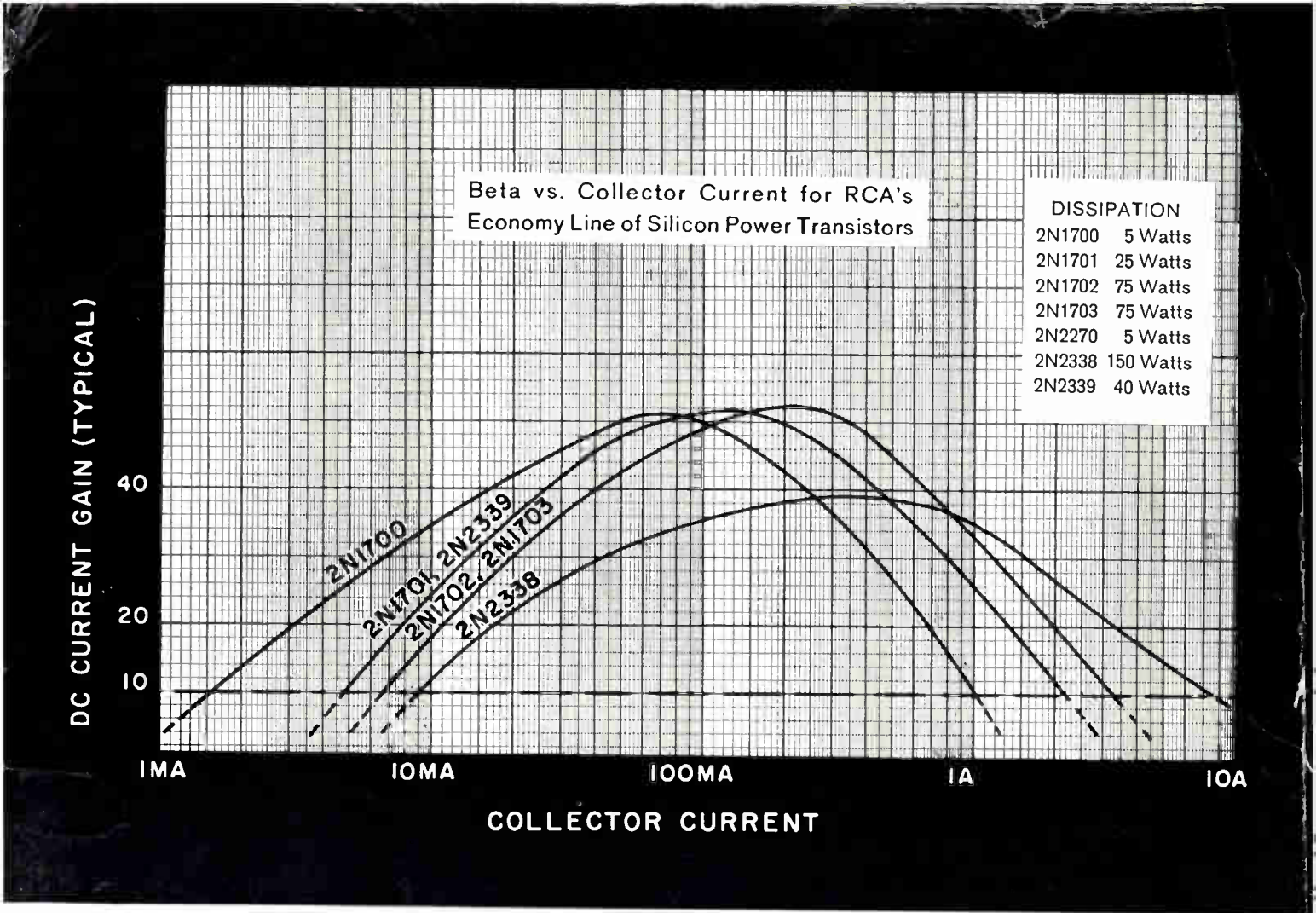

RCA EXPANDS ECONOMY SILICON LINE FOR LOW COST DESIGN FLEXIBILITY UP TO 150 WATTS

Now, RCA adds 3 new types, 2N2338, 2N2339, 2N2270 to its line-up of low-cost silicon transistors at prices starting as low as comparable Germanium Power Types.

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- Top performance at high temperatures... up to 200°C
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Triple-Diffused Planar

New 150-watt
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