

ELECTRONIC INDUSTRIES



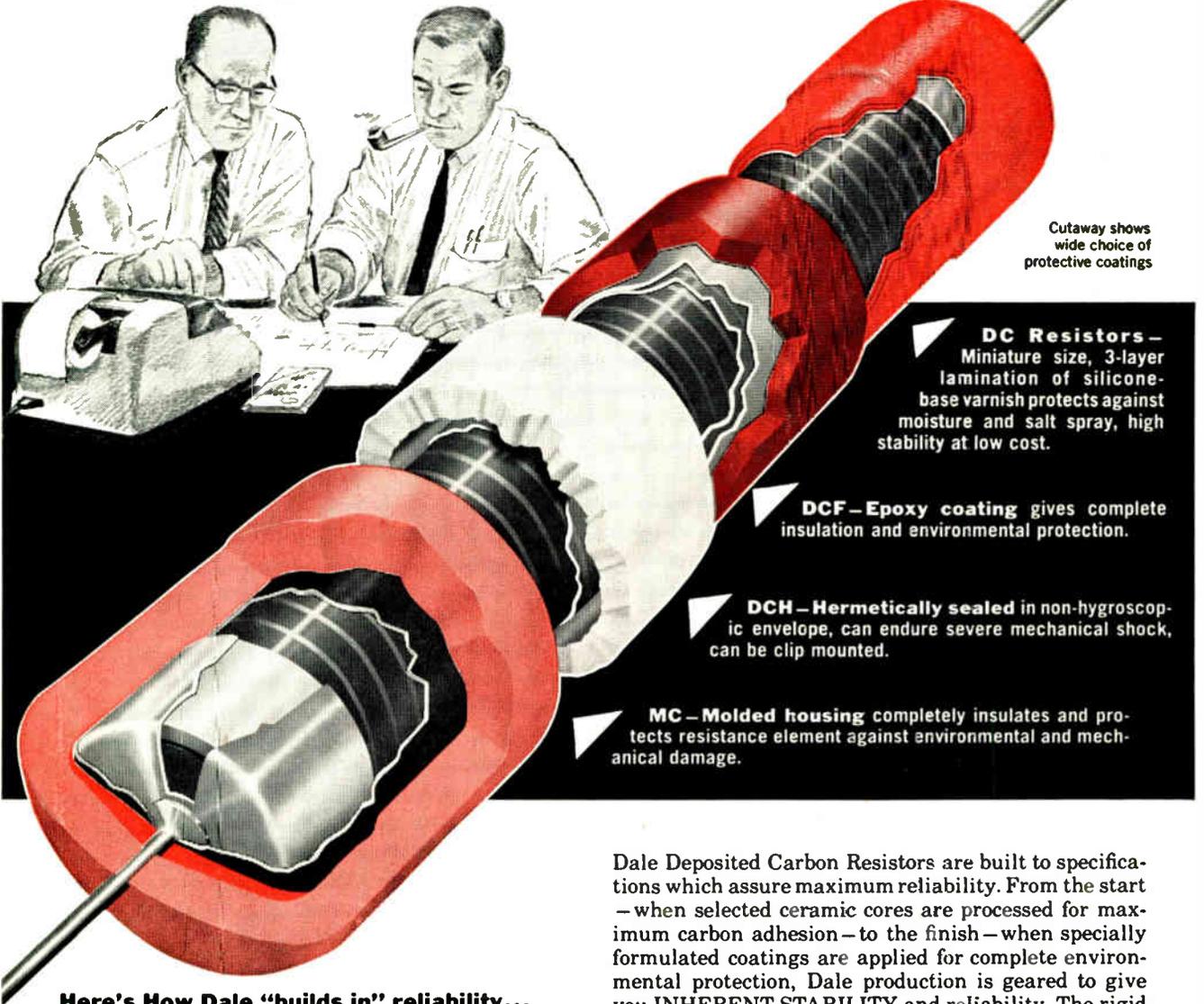
AUGUST 1963

12th annual western issue

featuring WESCON 1963

DALE RELIABILITY...

is assured in your circuit with
Deposited Carbon Resistors



Cutaway shows wide choice of protective coatings

DC Resistors— Miniature size, 3-layer lamination of silicone-base varnish protects against moisture and salt spray, high stability at low cost.

DCF—Epoxy coating gives complete insulation and environmental protection.

DCH—Hermetically sealed in non-hygroscopic envelope, can endure severe mechanical shock, can be clip mounted.

MC—Molded housing completely insulates and protects resistance element against environmental and mechanical damage.

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- 1. SPECIALLY-SELECTED CERAMIC CORES** are heat treated to remove all surface impurities, then abrasive treated to assure maximum carbon adhesion. Untouched by human hands.
- 2. FIRM, HARD CARBON DEPOSIT** is assured through the use of highest purity commercial gases. Adheres tightly to core with no loose particles.
- 3. ULTRA-PRECISE AUTOMATIC SPIRALLING** is continually micro-inspected according to rigid Dale specification which insures accurate resistance values.
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Dale Deposited Carbon Resistors are built to specifications which assure maximum reliability. From the start —when selected ceramic cores are processed for maximum carbon adhesion—to the finish—when specially formulated coatings are applied for complete environmental protection, Dale production is geared to give you **INHERENT STABILITY** and reliability. The rigid quality control procedures and materials procurement standards used in the production of all Dale resistors have reached new levels of achievement as a result of Dale participation in the **MINUTEMAN** High Reliability Component Development Program. EIA Color Banding and Reel Packaging is available for all Dale Deposited Carbon Resistors.

SPECIFICATIONS

- Meet requirements of MIL-R-10509D, Char. B. DC meets Char. X
- Seven physical sizes rated at $\frac{1}{10}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 5 watts • Resistance range from 1 ohm to 200 megohms • Standard tolerance 1%
- Temperature Coefficient 500 P.P.M. • Operating Temperature Range -55° to 120° C (DC); -55° to 150° C (DCF, DCH, MC)

Write for Dale Resistor Catalog A

DALE

DALE ELECTRONICS, INC.

1304 28th Avenue, Columbus, Nebraska

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Circle 98 on Inquiry Card

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VSMF
THE MICROFILM CATALOG FILE

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

ELECTRONIC INDUSTRIES

OUR 'NEW LOOK' CONTINUES . . .

LAST YEAR AT THIS TIME we announced a "New Look" for ELECTRONIC INDUSTRIES. Changes were planned in several areas, all designed to help you keep pace with our dynamic industry.

Here are some of the improvements:

August 1962—Initiated our new series of "photogram" design covers. (This year's August cover is unique—a spectrogram of the word WESCON.)

September 1962—Launched our new format, using new layouts and type faces.

February 1963—Rearranged our feature section to present general-interest articles in the front of the magazine.

March 1963—Expanded the "What's New" department from 2 to 4 pages each month.

April 1963—Doubled the size of the "Snapshots" and the "Radarscope" features, from 2 to 4 pages.

June 1963—Published our first "State of the Art" issue, in which scientific and industry leaders described current technical developments and future trends.

July 1963—Redesigned our "Contents" and "Highlights of the Issue" pages for improved readability.

In this, our 12th annual Western issue, we have incorporated something new. It is your WESCON Show Planner booklet which appears after Page 100. This will be most useful to engineers attending the show. All WESCON activities, exhibitors and products appear between Pages 16 and 100.

Of significant interest in this issue is the guest editorial (Page 19), written especially for us by Mr. Emmet Cameron, President of the Western Electronic Manufacturers Association. Mr. Cameron discusses frankly the concern of electronic management over a lack of communications with the Department of Defense.

As you can see, we have indeed been on the move in the past year. Our objective is to report and analyze every new industry development before it is available from any other source. Our goal is to make ELECTRONIC INDUSTRIES the most interesting and useful magazine for you.

PS: We hope you will visit us at WESCON. Our booth number is 2612.

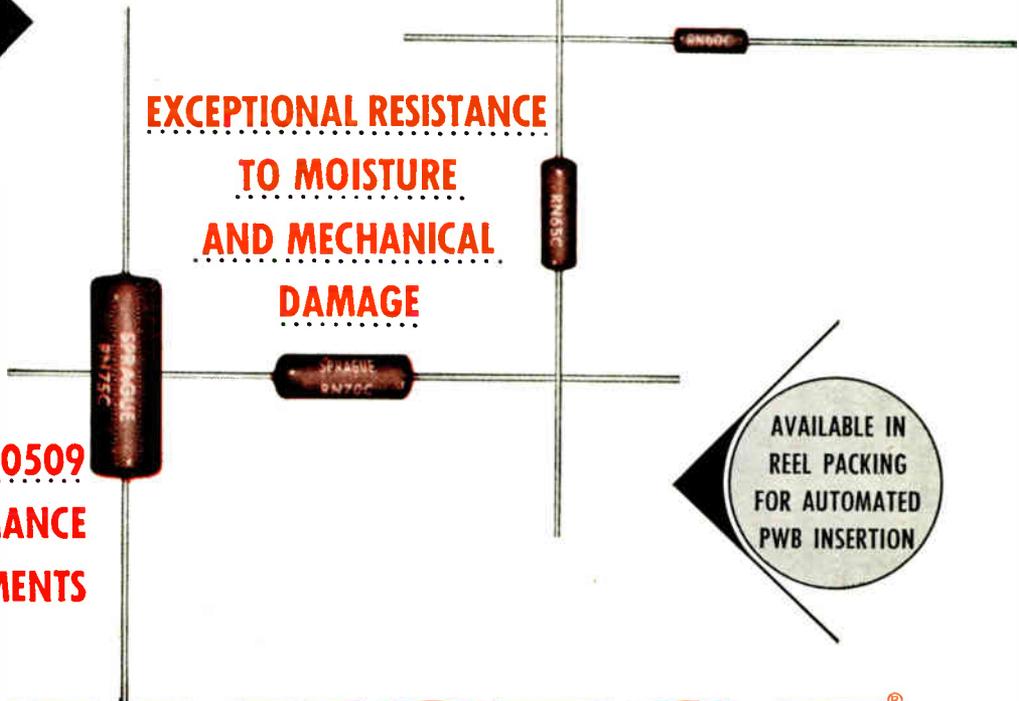
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Filmistor Metal Film Resistors, in 1/8, 1/4, 1/2 and 1 watt ratings, surpass stringent performance requirements of MIL-R-10509D, Characteristics C and E. Write for Engineering Bulletin No. 7025A to: Technical Literature Service, Sprague Electric Co., 233 Marshall Street, North Adams, Mass.

For application engineering assistance write:
Resistor Division, Sprague Electric Co., Nashua, New Hampshire.
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Get the Full Story of WESCON Booth 1818-22

ELECTRONIC INDUSTRIES

August 1963
Vol. 22, No. 8

COVER: Bell Telephone Labs has developed a unique method of making graphic "voiceprints" of a person's speech. The unusual design on this month's cover is the spoken word "WESCON." Interestingly, the Bell Lab researchers find that a person's "voiceprint" is just as distinctive as his fingerprints.

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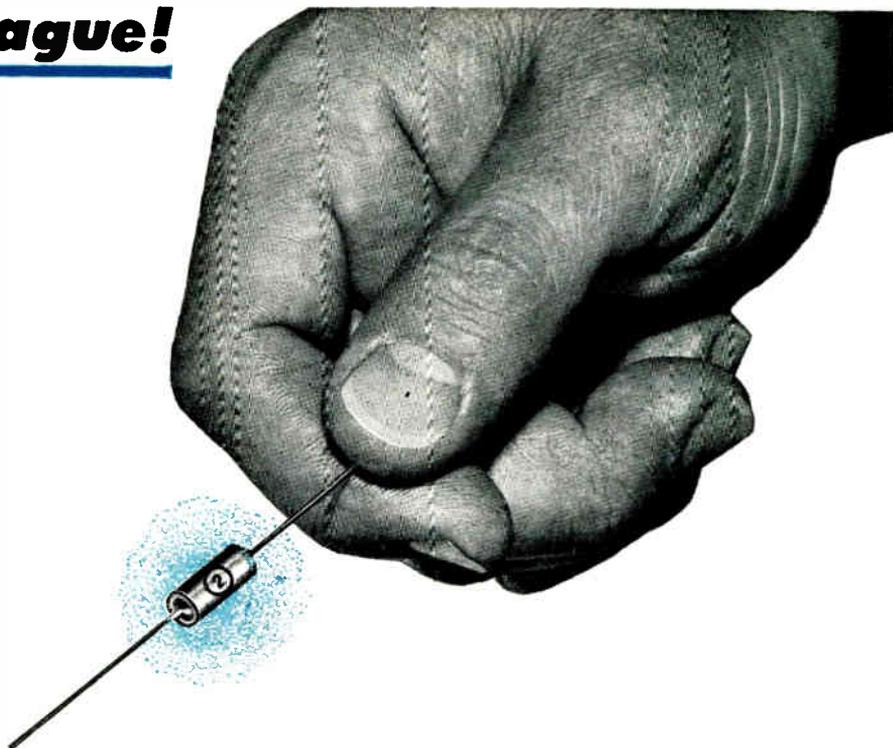
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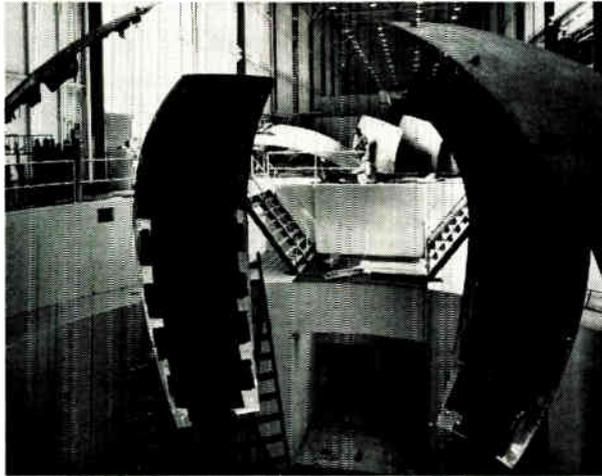
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ELECTRONIC INDUSTRIES • August 1963

ARTICLE HIGHLIGHTS

of this issue



WESCON 1963: 17

The largest annual event of its kind in the west is expected to draw about 35,000 people this year. Our package gives a rundown on the highlights of the WESCON show.

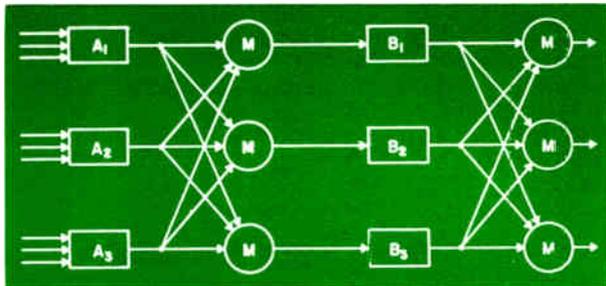
Western Electronics Clings to Success 90

Western electronics started long after midwest and east firms were well fixed. West coast industry got a beachhead with World War II aircraft. The rise in U.S. R&D snowballed western electronics. The west currently holds a quarter of the market, and is fighting to keep it.

Choosing a Voltage Reference

129

The unsaturated standard cell and Zener references are used in precision equipment. A continuing program of component improvement closely evaluated both types for two years. The results of this are presented in a comparison with guidelines for choosing the reference of a specific application.



High-Reliability Computers Using Duplex Redundancy

116

A recent trend has been toward duplicating computer subsystems or logic elements. This article is mainly concerned with element or section redundancy in a digital computer. It describes an approach using duplex elements which has better reliability than triplicated majority-vote logic redundancy, while using fewer parts.

Selecting an AC Power Source

192

When selecting an ac converter or power source the main items to be considered are use or load parameters, input parameters, output parameters, mechanical configuration and cost. All of these important items plus many more are covered in this article.



Helping Employees Pays Off

206

The Golden Rule has varied applications. Autonetics put its employee progress interview program into action a few years ago. Management has discovered that helping an employee to find his way and seek his level pays off—for both the employee and the company.



"made-to-measure precision"

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be casual
with a
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WHAT HAPPENS TO MATERIALS WHEN THEY COME IN CONTACT WITH FC-75 COOLANT?

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SEE OUR EXHIBIT, BOOTH 4122, WESCON SHOW, COW PALACE, SAN FRANCISCO, AUG. 20-23.

Protection against thermal or electrical overload is greatly increased. FC-75 stays stable, no matter what materials it's in contact with; won't sludge or gum.

But in one way FC-75 and its companion liquid FC-43 do "affect" material. They permit extensive miniaturization by removing up to 40 times more heat through boiling than oil type coolants. Some transformers, for example, have been trimmed 4 to 1 in volume, 2 to 1 in weight!

For details on non-explosive, non-flammable, odorless FC-75 and FC-43, write Chemical Division, Dept. KCQ-83, 3M Company, St. Paul 19, Minn.

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RADARSCOPE

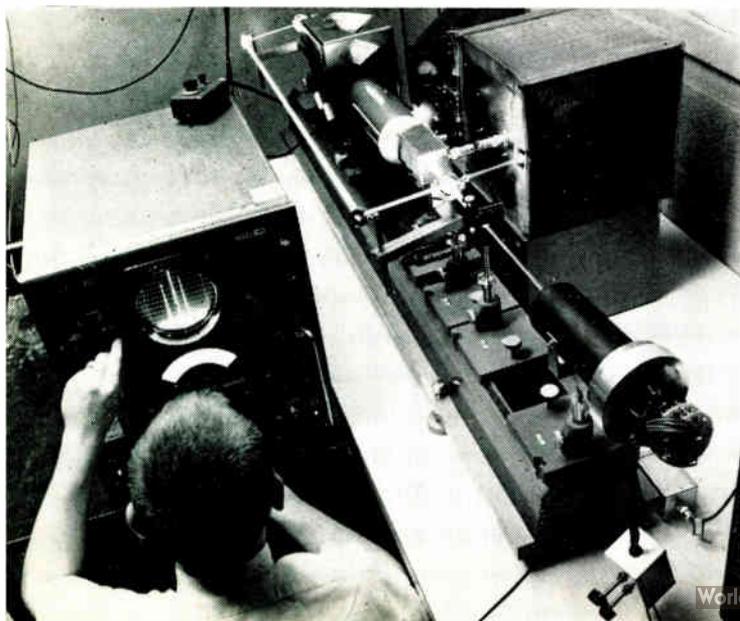
Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

DEVELOPMENT ENGINEERING was suggested as a tool to bridge "the tremendous gap between supply and demand for engineer talent in less developed countries." Frederick G. Draper, from the State Department's Agency for International Development, said that the U. S. is used to specialization because of the advanced state of our technological development and our institutional environment, which has no parallel in our overseas programs. Special skills can be imported for specific needs. But, the greatest premium in our programs may actually be on versatility during the present acute shortage of skilled manpower.

ELECTRONICALLY CONTROLLED COSTS in American industry can be reality, according to RCA-EDP Specialist E. M. McPherson. He reports that no single inventory item, no product, is a difficult control problem. Problems today are no more difficult than those of yesterday—there is only less time left to solve them. No one is interested in a report on the progress of 98,000 space rocket parts if they are being produced on schedule. However, any manager is interested in a review of the 5 to 10% exception list of delayed or off-schedule parts. The chore of review can be left to the computer.

GREATER BEAM CAPACITY

Westinghouse has found a method to increase a laser beam's data-carrying capacity. Gas laser emits beams from both ends, one passing through optical phase modulator. Modulated light is mixed with unmodulated beam, mirror-reflected, from the end opposite the modulator; side-band frequencies are generated.



MAKERS OF LOUDSPEAKERS face economic stagnation unless they score a technological breakthrough, the industry was warned at a meeting of the EIA Loudspeaker and Loudspeaker Parts Section, represented by most of the nation's 51 loudspeaker firms. The industry has relied on economic and technical progress in other parts of the electronics industry; there have been no significant contributions to speaker technology in several decades, according to Section Chairman Marvin L. Bruckner, sales manager of Oxford Electric Corp. He attributed lack of R&D to "natural inertia" and manufacturers' emphasis on keeping up with competitors by duplication, or to their attempt to maintain status.

TIGHTER CURBS ON GRANTS to scientists have been placed by U. S. Health officials while educators charge "policing." National Institute of Health yearly hands out \$500 million to 1200 colleges, medical schools and research institutions. Congress yelling for closer accounting, has caused NIH to make changes: Scientists under grants must now account for time and effort to verify salary needs. Use of funds to support teaching is now restricted. Accounting by schools must be more extensive and stricter to prove need for new equipment bought with U. S. money. Scientist can no longer alter scope of research even in a blind alley—new action and money are required. Foreign travel is approved only if adjunct to research work. University officials and some Government men insist the new measures are senseless and "asinine."

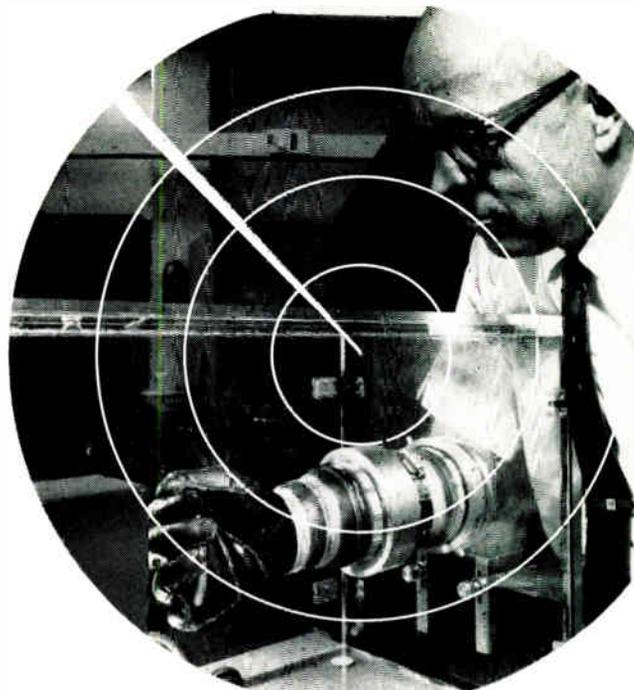
DESTRUCTIVE LASER EFFECT on malignant tumors and occlusive lesions of the arterial system is the basis of research now underway as confirmed by Raytheon Co. and the surgical research staff of Pratt Clinic-New England Center Hospital, Tufts-New England Medical Center. Intensive experiments have been conducted using hamsters and human biopsy and autopsy specimens. Under close study is the immediate and long-term effectiveness of laser energy from 1/2 to 360 joules on malignant tumors, cardiovascular lesions, skin and viscera. Laser has maximal effect on some malignant tissue and minimal effect on normal tissue. Goal is to find out whether the phenomenon has a therapeutic application for humans.

GLOBAL COMMUNICATIONS remained a bouncing ball as RCA's chairman David Sarnoff urged congressional action on a unified national communications policy. ITT president Harold S. Geneen had attacked proposals to merge all international voice and record communications facilities under control of the Communications Satellite Corp. as "counter to U.S. historical opposition to monopoly in any field." Gen. Sarnoff reaffirmed his support of the global satellite communications system and said that the ITT proposal to separate voice and record services in communications "would turn back the clock of progress and would be a disservice to the public."

MORE THAN 1,000 ETV CHANNELS will be needed within the next decade according to a survey of U.S. educators. Up to June 1 of this year, FCC had reserved 332 channels for education, but only 80 ETV stations were in operation. As a result of the Educational Television Facilities Act becoming law in May, 1962, Congress had authorized \$32 million to be allocated during the five years ending July 1, 1968, for matching grants in support of approved ETV projects. The program really got underway when \$1.5 million became available on May 17, 1963. Congress will be asked yearly to appropriate additional funds for the program as more regions apply for grants.

ONE-POUND PORTABLE LASER

An experimental laser tested by Raytheon can send 10 voice messages for more than a mile over an infrared beam, generated by a one-pound gas laser. The 3.5 micron device shows promise for use in space exploration, on a battlefield or aircraft carrier and for "secured" communications.



HOW DOES IT FEEL IN SPACE?

While working on controls and display systems for NASA Apollo Moonship command module, Honeywell's engineers can reach into "space" through a pressure-suit glove in vacuum chamber, as engineer Don Miller does. Getting the feel of a pressurized space suit enables engineers to design gear for astronauts.

GALLIUM ARSENIDE JUNCTION LASER

operating continually at more than one watt output was described by two G. E. physicists at a recent IEE conference. The output of the laser is a ten-fold improvement over ordinary ruby and gas lasers, according to the designers. It operates at 20 to 30% efficiency, requiring only 5 to 6 watts in to produce one watt-plus output. The laser junction showed maximum performance at 20° K, but also has excellent performance at higher temps. A unique heat-transfer design allows current at the rate of 4,000 amp. per sq. cm. to pass through the junction. Cross section of the junction is about 1/1000 sq. cm. Coherent light emitted is near infrared (8400 Å).

WELDING ELECTRONIC WIRES thinner than a human hair to surfaces only a few thousandths of an inch thick is no problem now to Boeing engineers. They spent nearly a year developing a new machine that has proved its ability to overcome most joining problems met in microelectronics. Easily used, the device reduces the need for skilled welding technicians and cuts joining time by 80%. Using a precise weld pulse, the machine controls duration accurately from 1/1000 to 1/16 second. Electrode pressure is varied from less than an ounce to 24 pounds.

(More RADARSCOPE on Page 10)

RADARSCOPE

EIA PRESIDENT WARNS the nation's electronics firms that "fragmentation" poses their greatest threat. Charles F. Horne, EIA head and president of General Dynamics, Pomonca, Calif., called for unity in purpose and goals beneficial to all electronics manufacturers. "Unless we find a mutually acceptable modus operandi for unifying electronic industries and working together we may disintegrate into a heterogeneous assembly of manufacturing groups whose identities are absorbed in our many customer industries," he said. "Government and national prestige rest heavily on the ability of electronic industries to maintain our world leadership in research and development."

VARIABLE FREQUENCY IN LIGHT, by changing the frequency of a laser light beam, is now possible, according to Dr. Robert Terhune, of Ford Motor Co. By passing light through liquid nitrogen, the "Raman Effect," light of other frequencies can be extracted in a "four photon process." As the beam passes through nitrogen, a red spot appears surrounded by brilliant colored rings, color depending on ring diameter. Photon pairs are annihilated as they enter the nitrogen and are replaced by others of different frequencies, equally above and below laser frequency, by some multiple of liquid nitrogen's molecular vibration. The colored rings show that highly sensitive light amplifiers, using laser radiation similar to radar parametric amplifiers, are feasible. Intense laser beams with frequencies from far infra-red to near ultraviolet are possible.

LASER BEAM MESSAGES could lift radio "blackout" that isolates Mercury astronauts re-entering the atmosphere, according to a Douglas Missile & Space Systems Division Physicist. The physicist, Richard C. Sykes, said that an ion sheath called plasma surrounds the re-entering vehicle and acts as a barrier to r-f signals. Laser beams will penetrate this, says Sykes. Mercury pilots have experienced radio "blackout" as long as 4½ minutes. Douglas simulated the sheath in a hypervelocity wind tunnel. Fixed models were given shock waves at 40 times speed of sound. Slivers of coherent light were beamed through the plasma around the models with a ruby laser.

RCA'S RADICAL COMPUTER MEMORY is a thin-film superconductive array that stores 16,384 bits in an area smaller than a playing card, and only 120 millionths of an inch thick. It combines higher speed, large capacity and compactness in single all-electronic unit. The experimental unit is a glass plate two inches square. Between three silicon oxide layers (insulators) are two conducting grids, each of 128 hair-thin lead strips, deposited at right angles in a fine screen pattern. Below this is the thin-film storage area; its capacity is the 16,384 intersections formed by the grids.

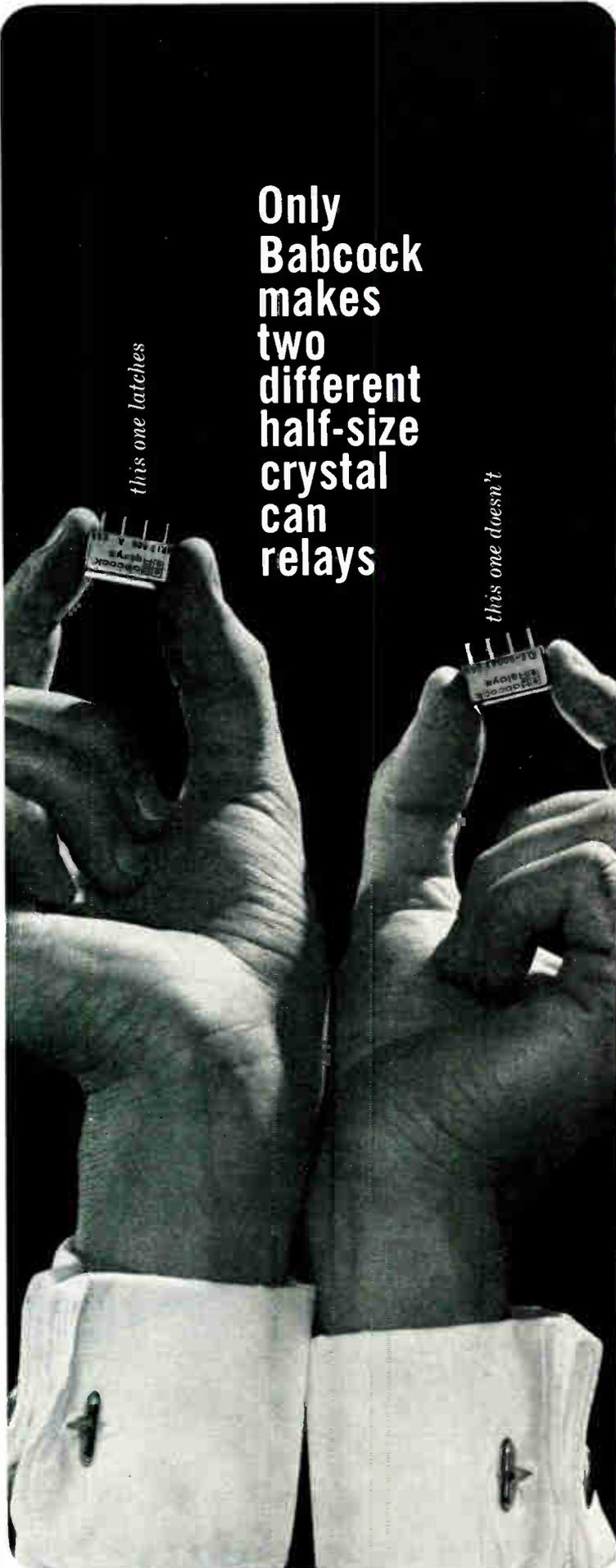
LASER GYROSCOPE RESEARCH, for a space guidance device, will be continued by Sperry Rand scientists under a USAF contract for \$100,386. Sperry first demonstrated the practicality of a laser gyro by whirling counter-rotating beams of light around a meter-square ring on a movable platform. Rotation of the platform lengthened the path of one beam while shortening the other. This caused a frequency difference between the two beams proportional to the rate of rotation.

(More RADARSCOPE on Page 13)

PHONE CALL TO THE MOON

Louis Focht, Philco scientist, checks small speech sounds on incremental speech analyzer in studies to send human voice on single signal or tone, rather than as complex signal. He says that one day, with low power and narrow bandwidth, we may send phone calls to the moon, to space craft, even beyond Pluto.





Only Babcock makes two different half-size crystal can relays

this one latches

this one doesn't

Designed for low profile mounting, Babcock's new half-size crystal can relays are available for latching (BR-17) and non latching (BR-16) application. Both types feature exceptionally high sensitivity and durability. Remarkably efficient coil operation requires only 175 mw pull-in power to switch any load from dry circuit to 2 amps. Predicted failure rate on the BR-16 and BR-17 is less than 0.1% in 10,000 operations with a 90% confidence factor.

These exclusive Babcock high reliability features are the reasons why:



High-flux armature action. Balanced armature is located inside coil along path of maximum flux concentration. High density of magnetic force lines in core allows armature movement with minimum field excitation.



Heat sink / magnetic flux conductor. Coil cover of high permeability alloy lowers heat generation through improved magnetic circuit efficiency, while functioning in dual capacity as heat conductor-radiator.



Activated Vycor getter. Exclusive to Babcock, this porous glass getter prevents contact contamination by adsorbing outgassed organic substances, following production degassing at 200° C under less than 5 microns vacuum.



Welded-header construction. Automatic sewing process gives stronger header-case bond and prevents solder flux contamination. Leakage rate is less than 10⁻⁶ c.c. per sec. by mass spectrometer.



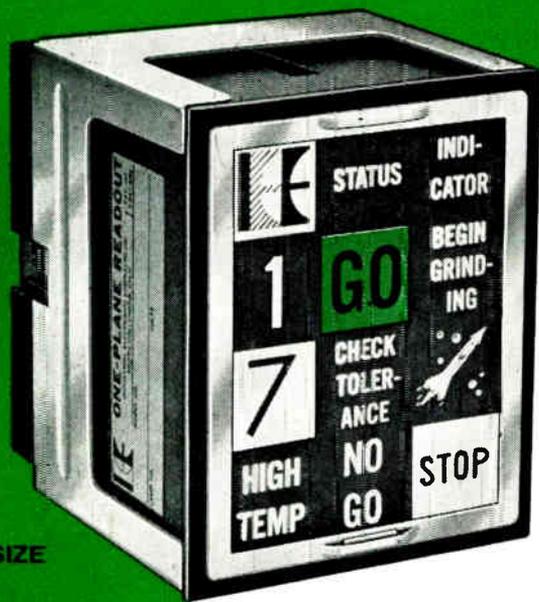
Self-wiping, gold-plated contacts. Contacts of AgMgNi alloy with specially designed configuration assure miss-free performance under load and minimize low level contact resistance.

The BR-16 is available in SPDT and DPDT versions, the BR-17 as DPDT only. Various mounting arrangements and either plug-in or solder hook terminals can be supplied as standard. Send for complete details.

BABCOCK RELAYS

A DIVISION OF BABCOCK ELECTRONICS CORPORATION
3501 HARBOR BLVD., COSTA MESA, CALIF. • 546-2711

Booth 316 WESCON



ACTUAL SIZE

**IEE low cost
Status Indicators
give you up to
12 message displays
in 3 square inches**

...simultaneously!

SPECIFICATIONS

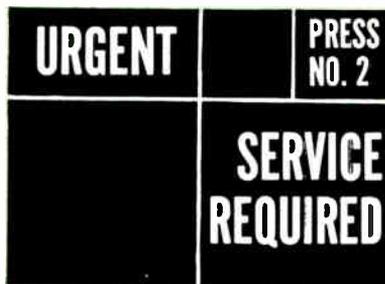
Message Areas: Up to 12 per unit; each $\frac{7}{16}$ " sq. • **Message Displays:** Numbers, letters, words, symbols, colors • **Input:** Straight decimal system • **Lamps:** Any T3- $\frac{1}{4}$ " bayonet base lamp • **Voltage:** 6 to 28 volts • **Ambient Temp.:** 140° F maximum with all 12 lamps lit • **Unit Price:** \$12.50 in 1-9 quantities; engraved screens slightly higher.

You get up to 12 message displays individually, in combination, or all simultaneously...at costs as low as 80 cents per indication...with the IEE Status Indicator.

Each of the 12 message positions is back lighted by an individual lamp—easily replaceable from the front.

All messages are displayed on a single-plane viewing screen.

Messages can be engraved on the viewing screen, placed on film, or by use of both methods, you can obtain combination effects.



Larger message displays can be obtained by combining message areas and lighting message with more than one lamp. This unit shows dividing lines engraved on screen, messages on film. Unit can be mounted vertically or horizontally.

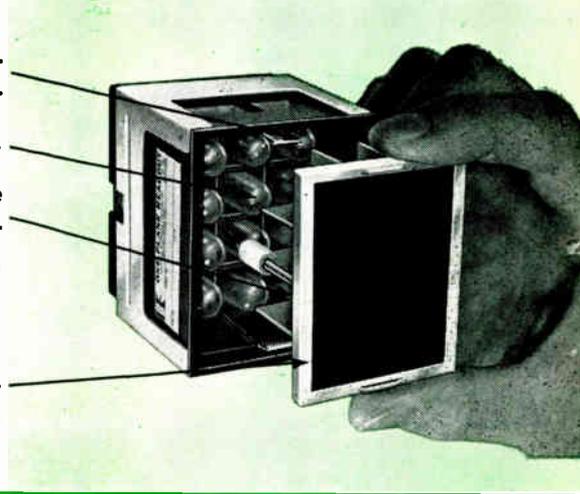
Quick, easy lamp replacement from front of unit.

Redundant lamping available.

Message film behind screen can be replaced easily for field changes.

Messages can be typed or lettered on mylar film or parchment for development jobs.

No mounting screws on face of unit. Two screws inside Status Indicator draw unit tight against front of panel.



Write today for Status Indicator message designer sheet and complete specifications.

INDUSTRIAL ELECTRONIC ENGINEERS, INC.

5528 Vineland Avenue • North Hollywood, California • Phone: (213) 877-1144 • TWX: (213) 769-1636

Circle 6 on Inquiry Card

ENGINEERING SALARIES for 1962 had a median increase of 8% over 1960 according to the latest "Professional Engineers Income & Salary Survey" of the National Society of Professional Engineers. The median annual income for the 26,617 engineers included in the Survey was to be \$11,460, as compared with a median of \$10,660 in 1960, and \$10,000 in 1958. The survey presents a statistical summary of engineer earnings from 1952 to 1962. East coast engineers continued to lead all others in general income. Engineers in the plains areas reported median earnings of \$2,250 below those in the east.

TV SET MANUFACTURERS are revving up changeover to full production of all-channel TV sets, although they still have about eight months to comply with the new law that all TV units receive all 82 channels. According to Morris Sobin, president of Olympic Radio & Television Division of Lear-Siegler, 20% of black and white sets produced in 1963 will be all-channel. But, many who buy sets may never use their UHF tuner. Mr. Sobin suggested the U.S. might kill the 10% excise tax on sets, bringing prices down. Then buyers won't feel cheated if they can't use their UHF tuner.

LASER QUALITY CRYSTALS of Lanthanum trifluoride have been produced by Philco scientists. The crystals, grown in active ambient gases with new techniques, measure one inch long by a quarter inch wide. Measurements of threshold levels indicate that a crystal grown with 1% by weight of neodymium had a threshold level of 175 joules, while a second crystal half as long but with a neodymium of 5% showed laser action at 135 joules. An FT 524 discharge lamp was used. Philco scientists say crystals should afford laser systems with minimum weight, space and power, especially in mobile ground and space equipment.

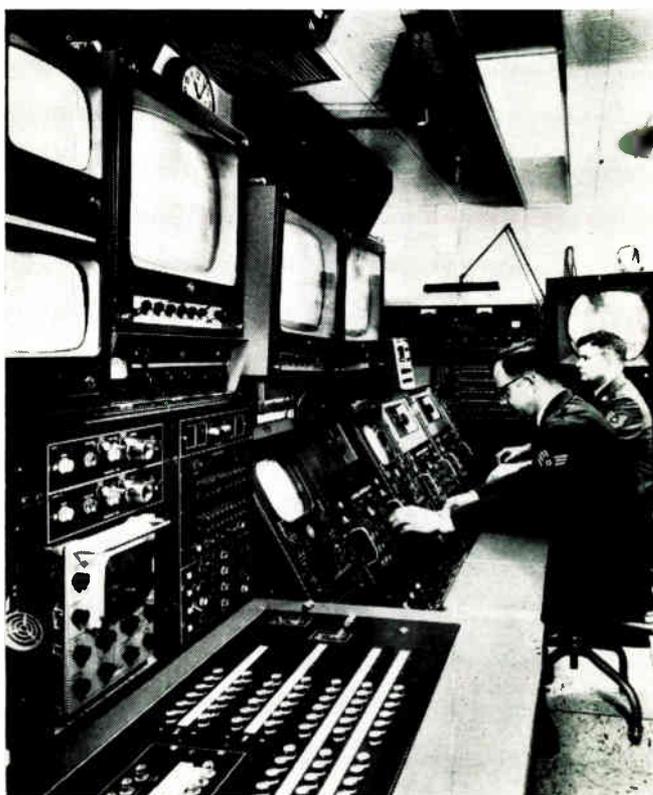
ELECTRICAL POWER SYSTEM for space rockets has been invented by an engineer at the NASA-Marshall Space Flight Center. The engineer, Robert J. Schwinghamer, said solar cells on the rocket's exterior would gather sun's energy and store it in capacitors. The capacitors would

serve as an integral part of the rocket exterior and of the bulkhead structures. The stored energy could be switched rapidly to energize rocket components such as lasers, radar and electric engines. It would also provide magnetic field pulse-power for tools to be used in building space structures, including assembly, maintenance and repair.

ELECTRONIC PRODUCT EXPORTS in 1962 hit \$747 million, a jump of 22% over the \$613 million a year ago, reports Commerce Department. Electronic detection and navigation equipment jumped from \$70 million to \$163 million. Exports of computers and parts in 1962 topped \$136 million; principal markets were the European Economic Community, Japan, the United Kingdom and Canada. Test equipment shipments increased from \$23.5 million to \$26.2 million. Television CRT's dropped from \$21.3 million in 1961 to \$16.2 million in 1962.

AIR FORCE TV GOES TO COLOR

Control center at Andrews Air Force Base, Md., one of three Systems Command bases using color TV for management communications, contains equipment comparable to commercial TV stations. The closed circuit systems, by RCA, includes complete studio facilities to record briefings and reports on TV tape.

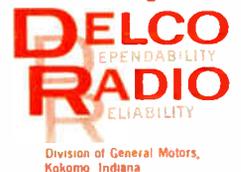


NEW



No.	V _{ceX} I _{cex} =5ma	V _{ce} Sustaining	h _{FE}		V _{ce} Sat.		V _{be} Sat.	
			I _c =5A	I _c =10A	I _c =5A	I _c =10A	I _c =5A	I _c =10A
2N2580	400	325v	10 min. 40 max.		0.7v		1.5v	
2N2581	400	325v	25 min. 65 max.	10 min.		1.0v		1.7v
2N2582	500	325v	10 min. 40 max.		0.7v		1.5v	
2N2583	500	325v	25 min. 65 max.	10 min.		1.0v		1.7v

New from Delco Radio! Silicon power transistors with V_{ceo}, V_{cb0} and V_{ces} of 400 and 500 volts in two gain ranges. This new line of high power transistors permits never-before-possible simplification of design in a wide area of applications. Available at all Delco Radio distributors or through our sales offices. Right now.



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SEE OUR DISPLAY AT WESCON—BOOTHS 3814 AND 3815.

COMING EVENTS

AUGUST

- Aug. 11-15: Heat Transfer Conf. & Exh., ASME, AIChE; Somerset Hotel, Boston, Mass.
- Aug. 11-17: Annual Ind. Res. Conf., Columbia Univ.; Arden Hs., Harriman, N. Y.
- Aug. 12-14: AIAA Guidance & Control Conf.; Mass. Inst. of Tech., Cambridge, Mass.
- Aug. 14-16: Symp. on Electronic Circuit Packaging, Univ. of Colo., Boulder, Colo.
- Aug. 19-21: Cryogenic Eng'g. Cong.; Univ. of Colo., Boulder, Colo.
- Aug. 26-28: Conf. on Simulation for Aerospace Flight, AIAA; Deshler-Hilton Hotel, Columbus, Ohio.
- Aug. 26-28: Conf. on Physics of Entry into Planetary Atmospheres, AIAA; Mass. Inst. of Tech., Cambridge, Mass.
- Aug. 26-28: 46th Summer Mtg., MAA; Univ. of Colo., Boulder, Colo.
- Aug. 26-29: Pacific IEEE Gen'l. Mtg.; Davenport Hotel, Spokane, Wash.

'63 Highlights

- WESCON, Western Electronic Show and Conf., Aug. 20-23, IEEE, WEMA; Cow Palace, San Francisco, Calif.
- NEC, National Electronics Conf., Oct. 28-30, IEEE, McCormick Place, Chicago, Ill.
- NEREM, Northeast Research and Eng. Mtg., Nov. 4-6, IEEE; Boston, Mass.

- Aug. 26-30: 68th Summer Mtg., AMS; Boulder, Colo.
- Aug. 26-30: Annual Summer Mtg., Soc. for Ind. & Applied Mathematics; Univ. of Colo., Boulder, Colo.
- Aug. 26-31: Annual Mtg., Electron Microscope Soc. of America; Denver-Hilton Hotel, Denver, Colo.
- Aug. 27-30: 18th ACM Nat'l. Mtg. & Exh.; Denver-Hilton Hotel, Denver, Colo.

SEPTEMBER

- Sept. 8-13: AChs Fall Mtg.; New York, N. Y.
- Sept. 9-11: 7th Nat'l. Conv. on Military Electronics (MIL-E-CON 7), IEEE (PTG-MIL); Shoreham Hotel, Washington, D. C.
- Sept. 9-12: 18th Annual Instrument-Automation Conf. & Exh., ISA; McCormick Place, Chicago, Ill.
- Sept. 10-12: Fall EIA Conf.; Biltmore Hotel, New York, N. Y.
- Sept. 10-13: Ceramic-Metal Systems Fall Mtg., ACS; French Lick Hotel, French Lick, Ind.
- Sept. 11-13: SME Annual Fall Mtg. & Rocky Mountain Minerals Conf., AIME; Salt Lake City, Utah.
- Sept. 12-13: 11th Annual Joint Eng'g. Mgmt. Conf., IEEE, ASME, AIIE, ASCE, others; Biltmore Hotel, Los Angeles, Calif.

(Continued on page 187)

A tape recorder?



Not A tape recorder. SIX tape recorders! Stacked inside a KRS DATA-Stack™ Portable Instrumentation Recorder, six magnetic tape cartridges perform the functions of six tape recorders, giving you 12 full channels of data-logging capacity. The cartridge-stack is fitted into a single 1½-foot cube.

Loads like a toaster?



Slide six continuous-loop, reversible STACTape™ Cartridges into a DATA-Stack Recorder. Ease them down guide rails with fingertip pressure. You've just loaded six tape recorders in less than 20 seconds. And you never need to handle factory-loaded tapes during operation or storage.

Reproduce? While recording?



Nothing to it, when your recorder is Stact. While recording data on one or more tapes, you can reproduce them simultaneously on the remainder with automatic synchronous start-stop operation of the six cartridge stack.

Who puts S. A.* into Data Recording?



Only KRS offers *Stack-Able design. Based on units thoroughly tested in broadcast and professional applications, DATA-Stack recorders are all-solid-state, use only two moving parts, and require virtually no maintenance to keep in top operating trim.

Write for Instrumentation Division Bulletin DR-1 giving the vital statistics.



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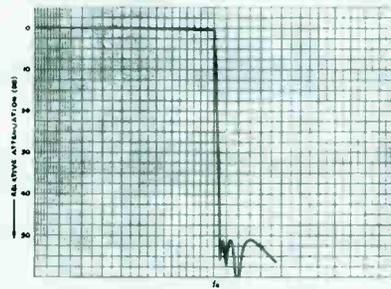
™ Trademarks of KRS Electronics

You Specify Them...

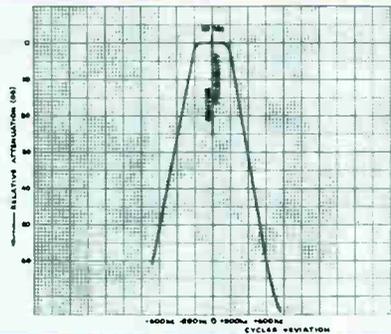
ESC

DESIGNS AND BUILDS THEM

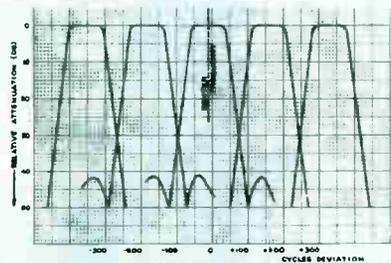
FILTERS



TYPICAL LOW PASS FILTER



TYPICAL BAND PASS FILTER
CENTER FREQUENCY 10Mc



TYPICAL TONE CHANNELS
170 cps SPACING

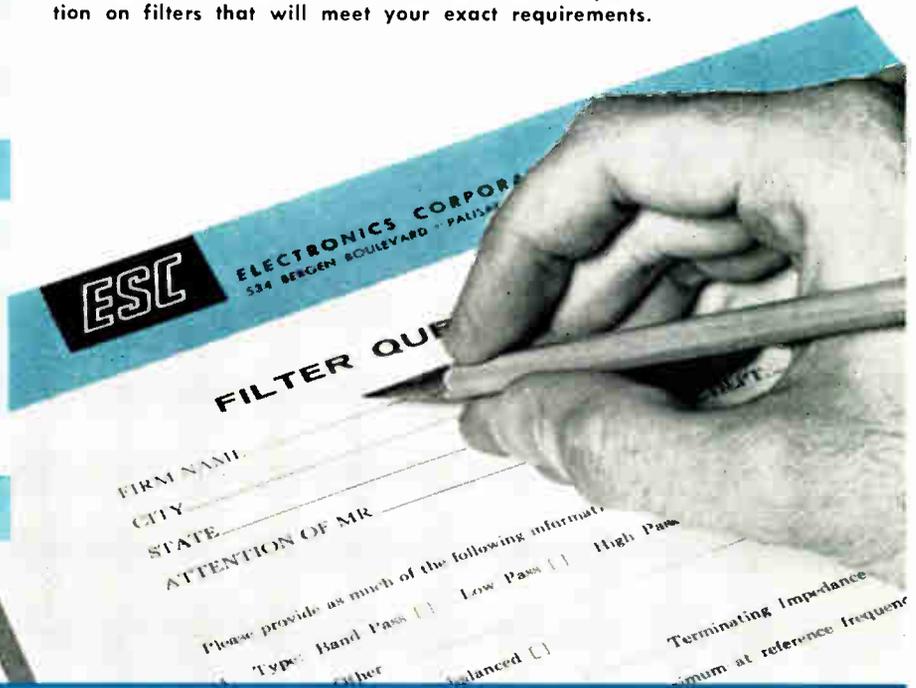
When you are looking for high quality, choose ESC filters. Every unit is built to **your** specifications.

From initial filter design, through applications engineering, to final production of a unit that will meet your exact needs, the established ESC reputation for quality is your assurance of maximum performance and reliability.

Many of your requirements can be met by one of the special units that ESC has designed and produced for specific uses. Or, we will design, modify and produce filters to your exact specifications.

ESC filters are designed to meet all the requirements of MIL SPEC. F 18327.

Write today for your copy of the ESC filter questionnaire. We will analyze your requirements and furnish a quotation on filters that will meet your exact requirements.



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ELECTRONIC INDUSTRIES

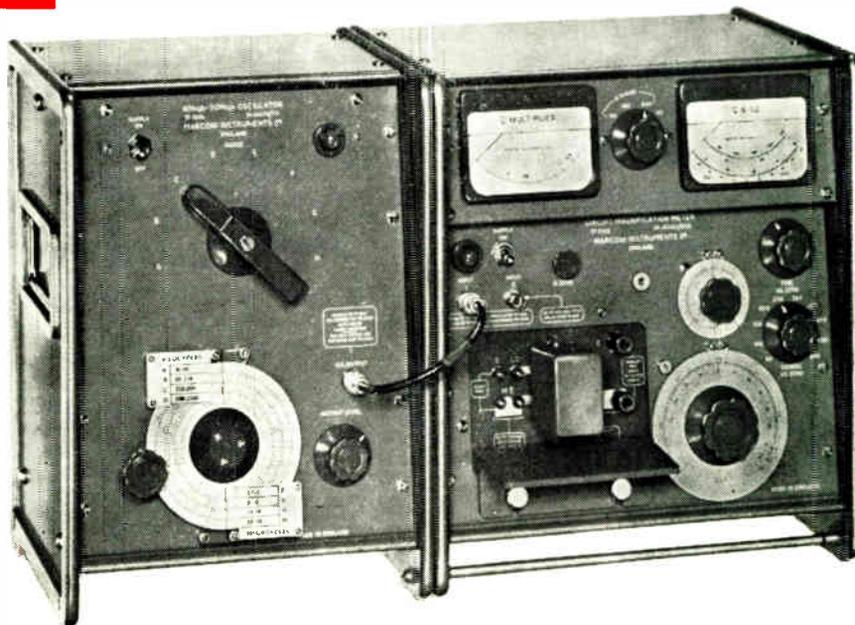
WESCON 1963

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WIDEST FREQUENCY RANGE EVER

WESCON BOOTHS #4728-29

1245 Q METER



Marconi Instruments' Q Meter, 1245, has the widest range ever (1Kc to 300Mc) — it replaces two instruments. New design of injection impedance gives increased accuracy and reduces need for corrections. Appreciate this accuracy, versatility and economy with your own in plant demonstration NOW.

Product Highlights

FROM MARCONI INSTRUMENTS FAMILY OF TELECOMMUNICATIONS MEASUREMENT EQUIPMENT

MODEL NO.	DESCRIPTION	RANGE	CHECK READER SERVICE CARD
144H	AM Signal Generator	10Kc-72Mc	34
791D	*FM Deviation Meter	4Mc-1024Mc	35
995A/2M	FM/AM Signal Generator	1.5Mc-220Mc	36
1066B	*FM Signal Generator	10Mc-470Mc	37
1245	Q Meter	1Kc-300Mc	38
1249B	Noise Loading Test Set	Up to 960 channels (1200 channels to special order)	39
1313	1/4% Universal Bridge	7 decade ranges LCR	40
1370	R.C. Oscillator	10cps-10Mc	41

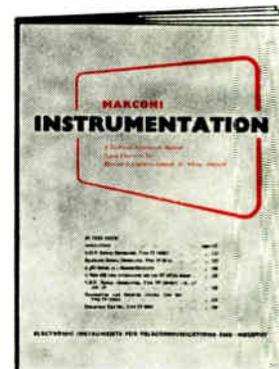
* Telemetering Version Available.

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Marconi Instrumentation

A technical information bulletin issued quarterly.

Check 42 Reader Service Card



MARCONI INSTRUMENTS

DIVISION OF ENGLISH ELECTRIC CORPORATION
111 CEDAR LANE • ENGLEWOOD, NEW JERSEY

OVER-REGULATION: A GENUINE PROBLEM

(A Guest Editorial)

AS WESCON TIME ARRIVES this year, the western industry finds itself in an uneasy and unsettled mood. Western electronics is busy, and its capacity for innovation and its facilities for production is greater than ever before. Yet a growing awareness of heavy dependence on the enormous monopsony which is the Department of Defense has brought unprecedented nervousness to the usually cheerful west.

The entire industry is affected by recent changes in DOD buying policies, and not only the west. But these changes seem to affect most heavily the R&D-oriented western segment of the industry. Many of the changes are designed to hamper and circumscribe the company in a sole-source position, with a product that cannot at the moment be obtained elsewhere. The purpose, of course, is to prevent the sole-source company from taking unfair advantage of its position. The effect is to make it disadvantageous to be a leader, since it is obviously impossible to lead without being, from time to time, out in front with products not available elsewhere because competition has not had time to copy.

Not all western companies are involved, of course. The changes in regulations introduced last winter affect very little the great system manufacturers, and the many small specialist concerns in the west are not bothered much, except by new and cumbersome bidding procedures. But many western outfits have prided themselves in leading the world for years in the development and production of sophisticated subsystems, instruments and components. These people are now looking hard for non-military markets. And they wonder whether the country will really gain by procedures which protect the DOD from paying excessive prices, at the cost of stifling the inventive advancement which has been the hallmark of the industry, and on which our relative military position depends so heavily.

Western Electronic Manufacturers Association (WEMA), as spokesman for western electronics, submitted a formal statement to the DOD last spring. This statement, which included recommendations, expressed the serious concern of many western companies. It pointed out the high probability of a slow-down in technological advance, because the cumbersome controls prevented plowing back profits made

on advanced products into development of still better devices. It also criticized the ambiguities in the ASPR changes which were causing costly overuse of the cost-analysis technique, the dangers inherent in forcing exchange of cost information between competitors, and the unfairness of preventing companies which had entered into "cost-sharing" contracts from recovering their investment.

Some of the minor matters are corrected by recent amplifications and interpretations issued by DOD. But the DOD policymakers, unquestionably intelligent and dedicated men, appear to remain unconvinced by the key concern of the industry—that the rigid pricing controls will cut off the water from the fertile and productive fields of electronic innovation, and that this will inevitably hurt our national military position.

Industry representatives return from their frequent visits to the Pentagon disheartened and discouraged by this failure in communication. Many of them feel that the DOD people consider the industry complaints as simply crybaby stuff—the weeping and wailing of people who are being hurt in the pocket-book. They know that this is not so and that time will prove that it is not so. But can we afford the time?

So electronics management men arrive at WESCON this year with a new kind of problem and a new and unpleasant nervousness on top of their load of responsibilities. We deplore the unnecessary and obstructive over-regulation which has created this additional burden. But we believe that the industry has the brains and the spirit, the vigor and the resilience to overcome this problem as it has so many others.



By **EMMET G. CAMERON**

Varian Associates;
President, Western Electronic
Manufacturers Association

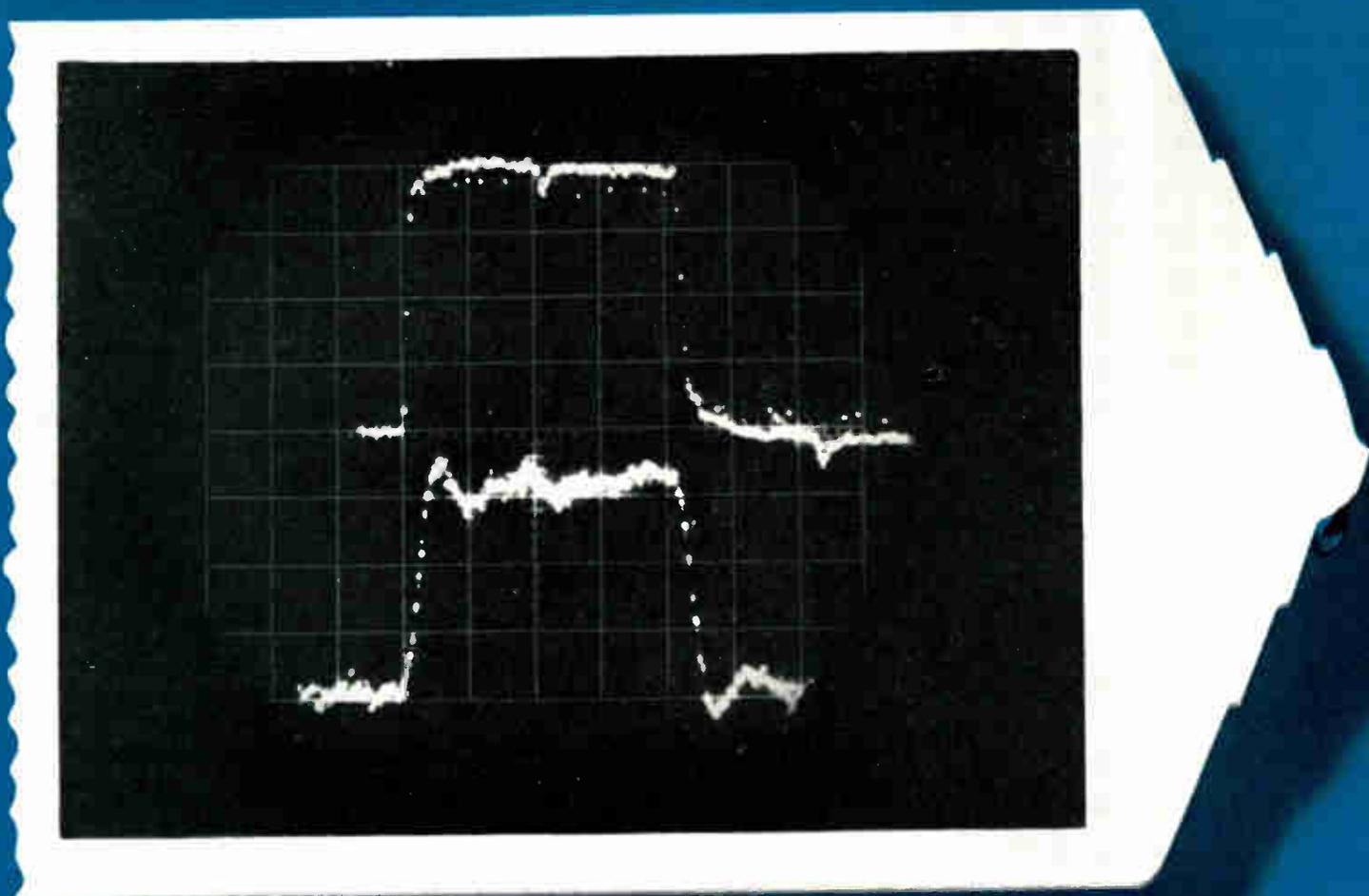
Unusually sharp, clean pulses come from the Sylvania SYS-3014/3055*, a new microwave diode switch with 5-nanosecond speed, specifically designed for the Bendix APN-141 radar altimeter system. Because of this speed, it is now possible to measure lower altitudes with greater accuracy than ever before.

Design of the SYS-3014/3055 Diode Switch eliminates undesirable mixing of the trigger pulse with the r-f signal and minimizes any static noise contribution of the switch. Switching time is determined only by the characteristics of the driver. And the high isolation figure (36 db minimum) makes the unit useful for receiver protection as well as for pulse modulation.

*Patent applied for

Sylvania...first with a 5-nsec 4300 Mc

R-f pulse closely duplicates drive pulse



Actual scope photo of r-f pulse (top) and drive pulse. Horizontal scale - 3 nsec/cm

Diode Switch SYS-3014/3055

Switching time:	5 nanoseconds
Frequency:	4250 to 4350 Mc
Minimum isolation:	36 db
Maximum insertion loss:	1 db
Maximum peak power:	36 watts
Max. CW or average power:	1 watt
Length:	3½ inches
Weight:	6 ounces
Temperature range:	-30°C to +85°C

In addition to the SYS-3014/3055, a variety of other microwave diode switches is available from Sylvania. Typical examples are:

Type	Frequency
SYS-3016	1700-1800 Mc
SYS-3186	1500-2000 Mc
SYS-3145	13325 ±30 Mc
SYS-3113	5925-6425 Mc

diode switch



New full-octave circulator...compact, fully shielded



Sylvania meets the need for wideband circulators with a new miniature unit featuring a frequency range of 2 to 4 Gc—the only full-octave completely shielded circulator available today. The SYF-3248 is readily available in sample quantities. Summarized specifications appear below.

SYF-3248 is the newest in a broad line of Sylvania shielded 3-port circulators covering frequencies from below 1 Gc to more than 35 Gc. All offer high stability over a temperature range of -30°C to +70°C, and all have low VSWR and excellent ratios of isolation to insertion loss.

Type	Frequency (Gc)	Min. Isolation (db)	Max. Insertion Loss (db)	VSWR	Length (inches)
SYF-3248	2-4	20	0.4	1.3	2
SYF-3030	0.9-1.0	15	0.5	1.3	2
SYF-3207	3-4	20	0.5	1.3	1½
SYF-3231	4-5	20	0.4	1.3	1½
SYF-3233	4-6	20	0.4	1.3	1½
SYF-3232	5-6	20	0.4	1.3	1½

As a leading producer of solid-state devices, Sylvania is in an excellent position to satisfy your particular microwave design requirements. Contact your Sylvania Sales Engineer, or write to Sylvania Electric Products Inc., Mountain View, Calif.

MICROWAVE DEVICE DIVISION

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NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS
MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

AT WESCON: BOOTHS 2901-06 AND 2917-22

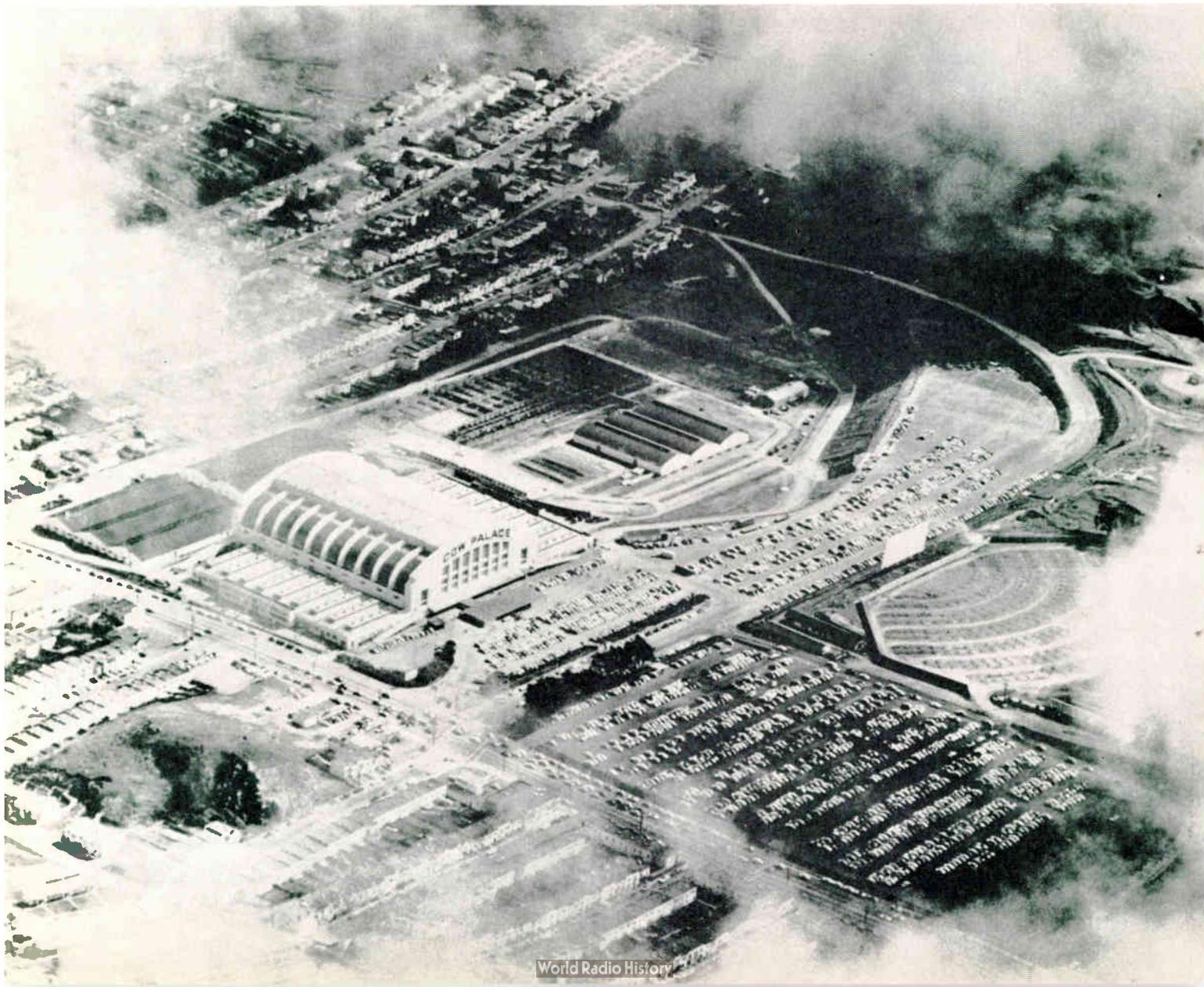
WESCON: THE OUTLOOK FOR 1963

The largest annual event of its kind in the West is expected to draw about 35,000 people this year. Here's a rundown on the highlights of the show.

MORE THAN 800 EXHIBITORS, displaying their wares in 1,210 booths, will be on hand for the 1963 WESCON Show at San Francisco's Cow Palace Aug. 20-23. Some 35,000 engineers are expected to attend.

Every available booth has been booked, and the exhibits, if lined up, would stretch more than two miles.

WESCON will use nearly a third of a million square feet of floor space for its show, including one



adjoining hall where meetings will take place in four rooms seating 500 and a fifth seating 800. Because of the huge expected turnout, a new entrance has been added this year.

This year's theme is "Frontiers in Electronics," an appropriate phrase for a booming area. The West now accounts for a fourth of all electronic sales and employment in the U.S., with 1190 electronic firms employing more than 260,000 people and with factory sales of about \$3.9 billion a year. Five years ago there were but 920 firms employing 164,000 people with factory sales of \$2.2 billion.

The San Francisco Bay Area ranks second behind Los Angeles as the top electronics center in the West. In five years the area gained 46 companies, 15,000 employment and \$315 million in sales.

Here are highlights of the show:

Technical Sessions

A record 300-plus papers have been submitted for consideration along with 20 invited papers to make up the 18 regular morning sessions. Four special afternoon sessions are scheduled. Session subjects include antenna arrays, network theory, control systems and theory, reliability, pattern recognition, semiconductor devices, semiconductor microelectronics, adaptive learning machines, high power modulators and engineering management.

Field Trips

Eleven technical tours have been set, closely identified with the main subjects of the technical program. Among the firms and organizations to be visited are the Electronics Research Laboratory at the University of California; Spectra Physics; Sylvania; Westinghouse; Systron-Donner; NASA Aeronautical Research Laboratories at Moffett Field; station KPEN in San Francisco; United Technology Corp., Jennings Radio Manufacturing Corp., Microwave Electronics Corp., and the Stanford Linear Accelerator Center.

Future Engineers

This will be the seventh consecutive year for a Future Engineers Show and Symposium Competition, a popular WESCON program begun with the 1957 show. The show is open to the public. More than 30 displays are to be prominently located at the new east entrance to the Cow Palace. IEEE sections sponsor the participants, choosing them from local science fairs or by direct acquaintance with school programs and arranging their transportation. Scholarship-fund prizes will be awarded for the best displays in the show and in a student paper competition held separately. *(Continued on page 24)*



Exhibition booths: They'll total more than 1200 this year.

NIGHT LIFE

BIMBO'S 365 THEATRE RESTAURANT — 1025 Columbus Avenue. GR 4-0365. 6 PM to 2 AM, closed Sunday. Dinners, dancing, floor show. D, CB.

BOCCE BALL—638 Broadway. YU 2-8597. 8:30 PM to 1:30 AM. Entertainment.

BUSTLES AND BEAUS—247 Powell Street. YU 2-7330. 4 PM to 2 AM, except Saturday, noon to 2 AM.

DOMINO PENTHOUSE — 25 Trinity Place. EX 2-5579. 8:30 PM to 2 AM, closed Sunday. Dancing, entertainment. D, CB.

FINOCCHIO CLUB—506 Broadway. DO 2-9913. 8 PM to 2 AM daily; closed Monday. November thru May. Floor show.

GOMAN'S GAY 90'S—345 Broadway. SU 1-1899. 6 PM to 2 AM, closed Sunday. Dinners, dancing, floor show. D, CB.

hungry i—599 Jackson Street. EX 7-0929. 5:30 PM to 2 AM, closed Sunday. Dinners, entertainment. D, CB.

MOULIN ROUGE—412 Broadway. EX 7-6488. 6 PM to 2 AM. Floor show.

NEW FACK'S—2215 Powell Street. YU 2-2455. 7 PM to 2 AM Tuesday thru Sunday. 7 PM to 3 AM Friday & Saturday, closed Monday. Dinners, dancing, entertainment. D.

PURPLE ONION — 140 Columbus Avenue. SU 1-0835. 8 PM to 2 AM, closed Monday. Entertainment.

RED GARTER—670 Broadway. YU 2-7483. 8 PM to 2 AM. Beer, wine and champagne; entertainment.

A. SABELLA'S CAPRI ROOM—2766 Taylor Street. GR 4-8770. Dinners from 4 PM, dancing from 9 PM, nightly except Sunday.

SINALOA MEXICAN CANTINA & RESTAURANT — 1416 Powell Street. SU 1-9624. 6 PM to 3 AM. Dancing, dinners, floor show. D, CB.

STATION J—569 Commercial Street. YU 1-4847. 5 PM to 2 AM, closed Sunday. Dinners, dancing.

SUGAR HILL—430 Broadway. SU 1-3872. 9 PM to 2 AM. Closed Sunday. Entertainment.

VARNI'S ROARING TWENTIES—807 Montgomery Street. YU 2-1350. 5 PM to 2 AM, closed Sunday. Entertainment.

D-Diner's Club; CB-Hilton Carte Blanche



All-industry cocktail party: It's scheduled for August 20.

WESCON PREVIEW (Continued)

HOTELS—DINING & DANCING

NAME	ADDRESS	CREDIT*
Claremont	Ashby Ave., Berkely	
Fairmont	California & Mason Sts.	
Hilton Inn	International Airport	CB
Hyatt House	1333 Old Bayshore Highway, Burlingame	
Jack Tar	Van Ness Ave. & Geary St.	AE, D
Mark Hopkins	California & Mason Sts.	AE
Sheraton Palace	Market & New Montgomery Sts.	D
Sir Francis Drake	Sutter & Powell Sts.	AE
Thunderbird	101 Bayshore Blvd., Millbrae	AE

*AE—American Express; D—Diner's Club; CB—Hilton Carte Blanche

Industrial Design

WESCON's Industrial Design exhibit will be on public display at the San Francisco Museum of Art at Civic Center for a month preceding the show. Twenty entries chosen for Awards of Merit will be installed in a main gallery for public viewing July 20

(Continued on page 26)

SELECTED RESTAURANTS IN SAN FRANCISCO

(See Key for explanation of symbols)

CUISINE	RESTAURANT	ADDRESS	PRICES	CREDIT	CUISINE	RESTAURANT	ADDRESS	PRICES	CREDIT
CN	Alexis	1101 California St.	V	D	IT	New Joe's	540 Broadway	M	
SF	Alioto's Seafood Grotto	8 Fisherman's Wharf	M-E	D	FR	Normandie International	1326 Powell St.	E	D, CB
IT	Alfred's	886 Broadway	M-E		AR	Omar Khayyam's	Powell & O'Farrell Sts.	M-E	D, CB
FR	Alouette	1121 Polk St.	M-E	D, CB	IT	Oreste's	118 Jones St.	E-V	D
CN	Amelio's	1630 Powell St.	E	D	IT	Original Joe's	144 Taylor St.	M	
CN	Bardelli's	243 O'Farrell St.	M-E	D, CB	CN	Owl 'N' Turtle	615 Washington St.	E	D, CB
SF	Bernstein's	123 Powell St.	M	D, CB	GR	Palm Garden Grill	975 Market St.	I	
AM	Breen's	Third St. near Market	M		IT	Panelli's	453 Pine St.	E	
CN	Blue Fox	659 Merchant St.	E-V	D, CB	IT	Paoli's	345 Montgomery St.	E	D, CB
SF	Castagnola's	Fisherman's Wharf	M		FR	Place Pigalle	3721 Buchanan St.	E	D, CB
CH	Cathay House	718 California St.	M		IT	Polo's	34 Mason St.	M	
JP	Che-Che	1020 Kearny St.	M		CN	Rod Knight	624 Sacramento St.	E	D, CB
AM	Cliff House	1090 Pt. Lobos	M	D	FR	Ritz Old Poodle Dog	65 Post St.	E	D, CB
CN	David's	474 Geary St.	M		SF	A. Sabella Fish Grotto	Fisherman's Wharf	M	D
IT	Del Vecchio's	391 Broadway	E	D, CB	SF	Sabella & La Torre	3 Fisherman's Wharf	I	
SF	DiMaggio's	Fisherman's Wharf	M-E	D, CB	GR	Schroeder's Cafe	240 Front St.	M	
CN	Doro's	714 Montgomery St.	E	D	GR	The Shadows	1349 Montgomery St.	E	
AM	El Matador	492 Broadway	M	D	CH	Shanghai Low	532 Grant Ave.	I	D, CB
CN	Engler's	20 Tenth St.	M	D	PO	Skipper Kent's	1040 Columbus Ave.	E	D, CB
CN	Ernie's	847 Montgomery St.	V	D	AM	Spinacker	Sausalito	M	
SF	Exposition Fish Grotto	1 Fisherman's Wharf	M		EI	The Taj	825 Washington St.	M	D, CB
IT	Fior D'Italia	621 Union St.	M-E		CH	Tao Tao	675 Jackson St.	M	
SF	Fisherman's Grotto	9 Fisherman's Wharf	M		SF	Tarantino's	Fisherman's Wharf	M	
FR	Fleur De Lys	777 Sutter St.	V	D	PO	Tiki Bob's	Post & Taylor Sts.	M-E	D
CH	Four Seas	731 Grant Ave.	M	D, CB	JP	Tokyo (Tokyo Sukiyaki)	225 Jefferson St.	M-E	D, CB
SF	Franciscan	Fisherman's Wharf	M	AE	LT	The Tortola	1237 Polk St.	M	
SF	Golden Rule Cafe	763 Market St.	I		PO	Trader Vic's	20 Cosmo Pl.	V	CB
AM	Grison's	Van Ness & Pacific	E	D	IT	Vanessi's	498 Broadway	M-E	D, CB
CN	Henry's Fashion Restaurant	22 Davis St.	M-E	D, CB	IT	Veneto	389 Bay St.	M-E	D
AM	House of Prime Rib	1906 Van Ness Ave	E		JP	Yamato Sukiyaki House	717 California St.	M	D, CB
CH	Imperial Palace	919 Grant Ave.	M-E	D					
EI	India House	629 Washington St.	E	D, CB					
FR	Jack's Restaurant	615 Sacramento St.	E						
CN	Julius Castle	302 Greenwich St.	E-V	D					
CH	Kan's	708 Grant Ave.	M-E	D					
CN	Koe's Auberge	1206 Stockton St.	M						
FR	La Bourgogne	320 Mason St.	V	D, CB					
CN	La Strada	443 Broadway	E	D					
AM	La Boeuf	545 Washington St.	E-V	D, CB					
AM	Leopard Cafe	140 Front St.	E	D, CB					
CN	Le Poulet	535 Washington St.	M	D, CB					
AM	Lew Lehr's	3345 Siner St.	E	D, CB					
FR	Le Triomp	242 O'Farrell St.	E						
CH	Nam Yuen	740 Washington St.	M						
JP	Nikko	Van Ness Ave. & Pine St.	M	D, CB					

PRICES	CUISINE	CREDIT
I=Inexpensive (\$2.50 & under)	AM=American	AE=American Express
M=Moderate (\$2.75-\$4.)	AR=Armenian	DC=Diners' Club
E=Expensive (\$4.25-\$6.)	CH=Chinese	CB=Hilton Carte Blanche
V=Very Expensive (\$6. & over)	CN=Continental	
(Based on prices for average dinner - not entree only - and not most or least expensive items on menu.)	EI=East Indian	
	FR=French	
	GR=German	
	IT=Italian	
	JP=Japanese	
	LT=Latin American	
	PO=Polynesian	
	SF=Sea Food	

New Precision Ceramics!

A virtually new technology has been developed to increase the strength, precision and adaptability of ceramics, giving them almost unlimited possibilities.

Newly developed precision ceramics offer dimensional tolerances to 6-millionths of an inch, surface finishes to 2 RMS micro-inch, and electrical properties including high dielectric strength and high piezoelectric constants. These results have been achieved through a continuing program of materials research.

For the past nine years Honeywell has probed into the densities, purities and electrical and mechanical properties of ceramic materials. As a result, exclusive, superior piezoelectric and structural materials have been developed and proved. For example, Honeywell's **Type K-12** piezoelectric material can be stressed to higher levels without depoling than other ceramic materials, thus giving it advantages for high voltage generators.

PIEZOELECTRICS FILLING

IMPORTANT JOBS. Honeywell's **Type C-16** combines a high piezoelectric "g" constant and a high dielectric constant. Because it is very stable and has a low aging rate, it is especially suited for acoustic sensing devices such as hydrophones.

Type S-4 generates high voltages under stress and is ideal for impact fuzing devices. **Type 101**, a modified barium titanate, is used in large quantities in sonar and hydrophone drive elements to produce an ultra-low frequency. It is especially desirable where low price and reliability are of prime importance.

Exclusive techniques for hot pressing lead zirconate/titanate have resulted in ceramics with a theoretical density of 99.5%—a density up to 3.5 percentage points higher than conventional, atmosphere-fired materials. Such superior properties produce a dielectric strength of 250 volts/mil, or more than a 100% increase over other ferroelectric ceramics.



PRECISION SHAPED

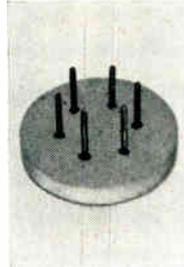
HIGH-TOLERANCE STRUCTURAL CERAMICS.

Honeywell's research has resulted in aluminum oxide ceramics that can be machined to 6-millionths of an inch. Used in gyro spin motors, these materials sharply reduce drift. Use of these materials also results in a theoretical life span that approaches infinity.

A magnesium oxide ceramic material has been developed that is 99.9% pure, is 98% of theoretical density, and has a melting point of 5,075°F. With these properties it has the highest known quality for electrical insulators, or for thermal conductors used in environments where dusting and spalling cannot be tolerated.



HIGH DENSITY



SEALING

SEALS AND METALLIZING. Both metallizing and ceramic-to-metal sealing techniques have been developed to seal high-expansion steatite ceramics to stainless steels, and to seal alumina ceramics to titanium, tantalum and molybdenum. Active metal soldering techniques for ceramic-to-metal sealing result in devices that withstand thermal cycling from -140°F to 750°F. Metallized ceramic surfaces are bonded so firmly with electrodes of gold, nickel, stainless steel, silver, or copper that separation of the metal and ceramic is impossible without destroying the ceramic base.

WRITE FOR TECHNICAL BROCHURE.

These are only a few of the many ceramic materials and techniques that are available to you now. Suggestions on how precision ceramics may be used to advance the state-of-the-art of your systems are listed below.

We will be happy to discuss precision ceramics with you. Write for our technical brochure, or if you have a specific use in mind, send us details and we will analyze them to determine how precision ceramics may be applied to improve your system. Write Honeywell, Dept. 671-D, 2600 Ridgway Road, Minneapolis 40, Minnesota.



FREE BROCHURE

HONEYWELL PRECISION CERAMICS OFFER MANY ADVANTAGES FOR:

PIEZOELECTRICS

- | | |
|---------------------------------------|--------------------------|
| Ignition Systems | Sonar Listening Elements |
| Voltage Sources | Strain Gages |
| Ultrasonic Cleaners, Welders, Cutters | Depth Gages |
| Accelerometers | Pressure Sensors |
| Sound Detectors | Liquid Level Gages |
| Sound Emitters | Surface Gages |
| Sonar Drive Elements | Switches |
| | Fuzing Elements |

STRUCTURAL CERAMICS

- | | |
|--|---|
| High Temperature Heat Exchange Media | Precision Shaped Structural Members, such as Gimbals, Housings, Bearings, Seal Rings, Cylinders, Dies |
| Electronic Micro Module Substrates | |
| Precision Shaped Electrical Insulators | Precision Orifices and Valve Components |
| Radomes | Precision Gages |
| Antenna Housings | |

CERAMIC TO METAL SEALS

- | | |
|------------------------------------|---|
| Specialized Vacuum Tube Bases | Electrical Connectors, Terminals, Headers |
| Metal to Ceramic Structural Joints | Precision Coatings |
| Electrical Circuit Boards | Aerospace Vehicle Window Seals |

Honeywell

Why
MAPICO
iron oxides
 for ferrites, above all others?

Because...

Mapico pure synthetic iron oxides are unmatched for uniformity... they are subjected to the most precise production controls.

Because...

There's range... a Mapico iron oxide raw material is available for every end use area from deflection yokes to temperature compensated cores to hard ferrites.

Because...

Mapico iron oxides are made in three typically different particle shapes... each available in several ranges of particle size.

Because...

Selection of the right Mapico iron oxide gives controlled electronic characteristics and shrinkage.

MAPICO

offers a useful, up-to-date chart on these many oxides with detailed data on particle shapes and other properties.

WRITE FOR IT TODAY!



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 Position.....
 Firm.....
 Address.....
 City.....Zone.....State.....



WESCON PREVIEW (Continued)

to Aug. 20. Entries will be accompanied by 200-word descriptions of "visual clarity of function, ease and safety of operation, and appropriateness of appearance." A final judging during the museum showing will determine the five main awards to be made at the annual banquet.

Pre-Show Conference

On Monday, Aug. 19, the annual conference will be held for distributors, manufacturers and representatives. The site is the International Room of the Jack Tar Hotel. The eighth annual conference will begin with breakfast and a morning session at 8:40, and include a second session after lunch. Each session will have ten 20-minute conference periods. A cocktail hour and dinner will be followed by entertainment.

Cocktail Party

The cocktail period will have a circus theme. It is scheduled for the Grand Ballroom of the Fairmont Hotel. Featured will be performing clowns, a caliope, a uniformed circus band and some surprise acts.

Banquet

The annual banquet is scheduled for Thursday, Aug. 22, also in the Grand Ballroom of the Fairmont. Dr. Lee A DuBridge, president of California Institute of Technology, is the featured speaker. The program includes the annual recognition award of the Sixth Region of IEEE to a member for his outstanding professional contribution, and the awards in the Industrial Design Competition. Music and dancing continues throughout the evening in this formal event.

(Continued on page 31)

ENTERTAINMENT IN SAN FRANCISCO

SPORTS

Baseball: San Francisco Giants vs. Milwaukee Braves, Aug. 20 (night), 21, 22; Giants vs. Cincinnati Reds, Aug. 23 (night). Day games 1 p.m., night games 8:15, at Candlestick Park.

THEATER

Musical: Zenda, starring Alfred Drake, nightly at Curran Theatre, 445 Geary St.
Drama: A Man for All Seasons, outlining high points in the career of Sir Thomas More, nightly at Geary Theatre, 415 Geary St.

SPECIAL ATTRACTIONS

Ice Show: Ice Follies of 1963, at Winterland, Post & Steiner Sts.

FEATURED ENTERTAINERS

Name Attractions: Venetian Room, Fairmont Hotel, California & Mason Sts.
 hungry i, 599 Jackson St.
 New Fack's, 2215 Powell St.
 The Black Hawk, 200 Hyde St.



Thin coat tapes...*like having a quarter reel bonus in recording time!*

25% more tape to the reel! That explains how "SCOTCH" BRAND Thin Coat Heavy Duty Instrumentation Tapes extend recording time, conserve data storage space, permit more compact equipment for high frequency recording.

An .18-mil oxide coating (60% thinner than standard) reduces tape thickness, while polyester backings of normal thickness assure no loss in strength or change in physical properties. And the thinner coating of high potency oxides provides closer head-to-tape conformity and improved high frequency resolution in the bargain.

Heavy duty oxide-binder formulation shrugs off heat as high as 225°F, minimizes rub-off to assure 15 times the life of ordinary tapes. Conductivity is 1000 times that of



ordinary coatings, drains off dust-attracting static. Silicone lubrication protects against head wear, extends tape life. Choice of 7 thin coat heavy duty tapes meets all high frequency and short wavelength requirements.

TECHNICAL TALK Bulletin No. 1 provides helpful information on handling and storing instrumentation tapes. It discusses splicing, ways of minimizing dropout errors, precautions in handling and storing, and how to avoid tape distortion, accidental erasure, etc. Free. Write 3M Magnetic Products Division, Dept. MBR-83, St. Paul 19, Minn.

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF MINNESOTA MINING & MANUFACTURING CO., ST. PAUL 19, MINNESOTA. EXPORT: 99 PARK AVENUE, NEW YORK. CANADA- LONDON, ONTARIO ©1963, 3M CO.

Magnetic Products Division **3M** COMPANY



Reports are coming in: Sylvania Strap Frame Grid Subminiature Tubes are proving themselves as they are designed into radar, communications equipment, telemetry and other systems. "Greater performance per dollar"—"Higher Class C efficiency than any tube they have seen," are typical field reports from our men. Ready availability and competitive prices, stemming from long experience and mass-production facilities, are other Sylvania advantages.

Sylvania made the first Strap Frame Grid Sub-

miniature, and the line has now expanded to 10—including two 26.5-volt types. Each one, when compared to its nearest conventional counterpart, shows a marked improvement in gain and operating efficiency of both the plate and heater. In addition, subminiature construction offers new ruggedness, stability and radiation immunity—adding up to high reliability. And you're not limited to triodes. Double triodes and pentodes in the Sylvania line can often do the job of two competitive tubes, thus saving space and cost.

Proved in use: Sylvania Strap Frame are practical route to top performance



CIRCUIT DESIGN HELP. New booklet on Strap Frame Grid Subminiature Tubes, complete with individual data sheets, circuits.



GRID RIGIDITY—KEY TO PERFORMANCE

Conventional grids, with wire wrapped around two vertical "backbones," depend on the windings for sturdiness. If the wire diameter is made small to achieve close cathode-to-grid spacing, the grid becomes extremely delicate and distances may change.

By introducing metal straps between the two backbones, a stretcher is formed whose rigidity depends on the frame and not the winding. Hence the wire can be smaller and closer to the cathode. This precise dimensional control significantly improves Gm, Gm-to-Ib ratio, gain, bandwidth and noise figure. And stability is excellent, even under varying voltages and environmental conditions.

Frame Grid performance is also available in economical miniature tubes for industrial and commercial applications.

Subminiatures and reliability

SUMMARY OF TYPES

SINGLE TRIODES

Type 8070 — 11,000 Gm, 58 Mu. Grounded cathode IF preamp, RF amp and mixer, operable into UHF; low heater power.

Type 8071 — 12,000 Gm, 56 Mu. Grounded grid RF amplifier; operable into UHF; low heater power.

Type 8185 — 19,000 Gm, 42 Mu. RF grounded grid power output amplifier. PO = 3.9 watts at 235 Mc.

Type 8186 — Same as 8185 except for 26.5-V heater.

DOUBLE TRIODES

Type 7692 — 10,500 Gm, 22 Mu. Low heater power; RF & IF cascode preamp, mixer, operable into UHF.

Type 7693 — 13,000 Gm, 40 Mu. Low B+; BTO, multivibrator, trigger, cascode RF & IF amp, mixer; operable into UHF.

PENTODES

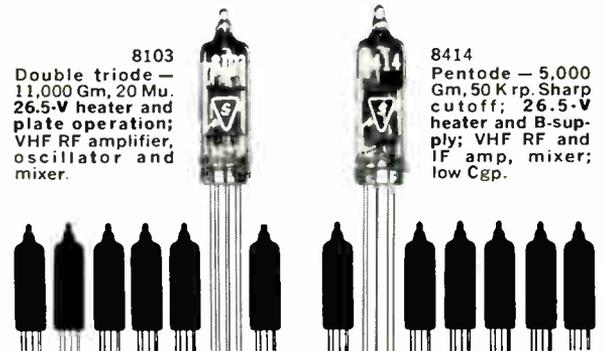
Type 8210 — 8,500 Gm, 250 K rp. Sharp cutoff; VHF RF and IF amp, mixer; low Cgp.

Type 8211 — 15,000 Gm, 65 K rp. High gain video amplifier; low heater power.

EXCLUSIVE:

Strap Frame Subminiatures for 26.5-V operation of all elements

Only Sylvania combines the advantages of Strap Frame Grid and subminiature construction in tubes for mobile applications—able to use 26.5-volt supply without transformers or the problems of series strings. These two new Strap Frame Grid types are:



The full line of Sylvania 26.5-volt Gold Brand Subminiature Tubes includes 7 types for 26.5-volt heater operation as well as 7 additional types for 26.5-volt operation of all elements. By eliminating unnecessary system components and circuits, they enhance reliability and facilitate circuit design—they are ideal for use in hybrid circuits with transistors. In addition, these compact tubes have the ruggedness and tested-in reliability to meet the severe requirements of mobile service.

For more information write to Electronic Tube Division, Sylvania Electric Products Inc., Box 87, Buffalo, N. Y.

AT WESCON: BOOTHS 2901-06 AND 2917-22

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS



NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS
MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

Circle 13 on Inquiry Card

New compact storage tube for airborne applications

Hughes has developed a 5" diameter direct view storage tube with an overall length of 8" (tube envelope length — 4"). The Hughes H-1076AP20 TONOTRON* tube overcomes the severe size limitations inherent in airborne equipment. Designed with weather radar and terrain avoidance radar in mind, the H-1076AP20 has both original design and retrofit applications. It is now feasible to realize the advantages of high light output direct view halftone storage tubes where before only standard cathode ray tubes could be used.

While much smaller in size, the average performance characteristics of the Hughes compact TONOTRON* tube are equal to or better than many larger 5" diameter storage tubes:

H-1076AP20 5" TONOTRON* direct view halftone storage tube with electrostatic focus and magnetic deflection. 4" minimum useful screen diameter. On-axis construction.

STORED RESOLUTION 50 lines/in (shrinking raster) for 5 μ a beam current and 80% of equilibrium brightness.

BRIGHTNESS 2000 ft. L equilibrium brightness at 10,000 volts.

WRITING SPEED 60,000 in/sec for 5 μ a beam currents, from 0% to 80% of equilibrium brightness.

ERASE TIME 200 milliseconds (length of single pulse to reduce brightness from 100% to 20%).

VIEWING TIME** 30 secs.—0% to 20% of equilibrium brightness.

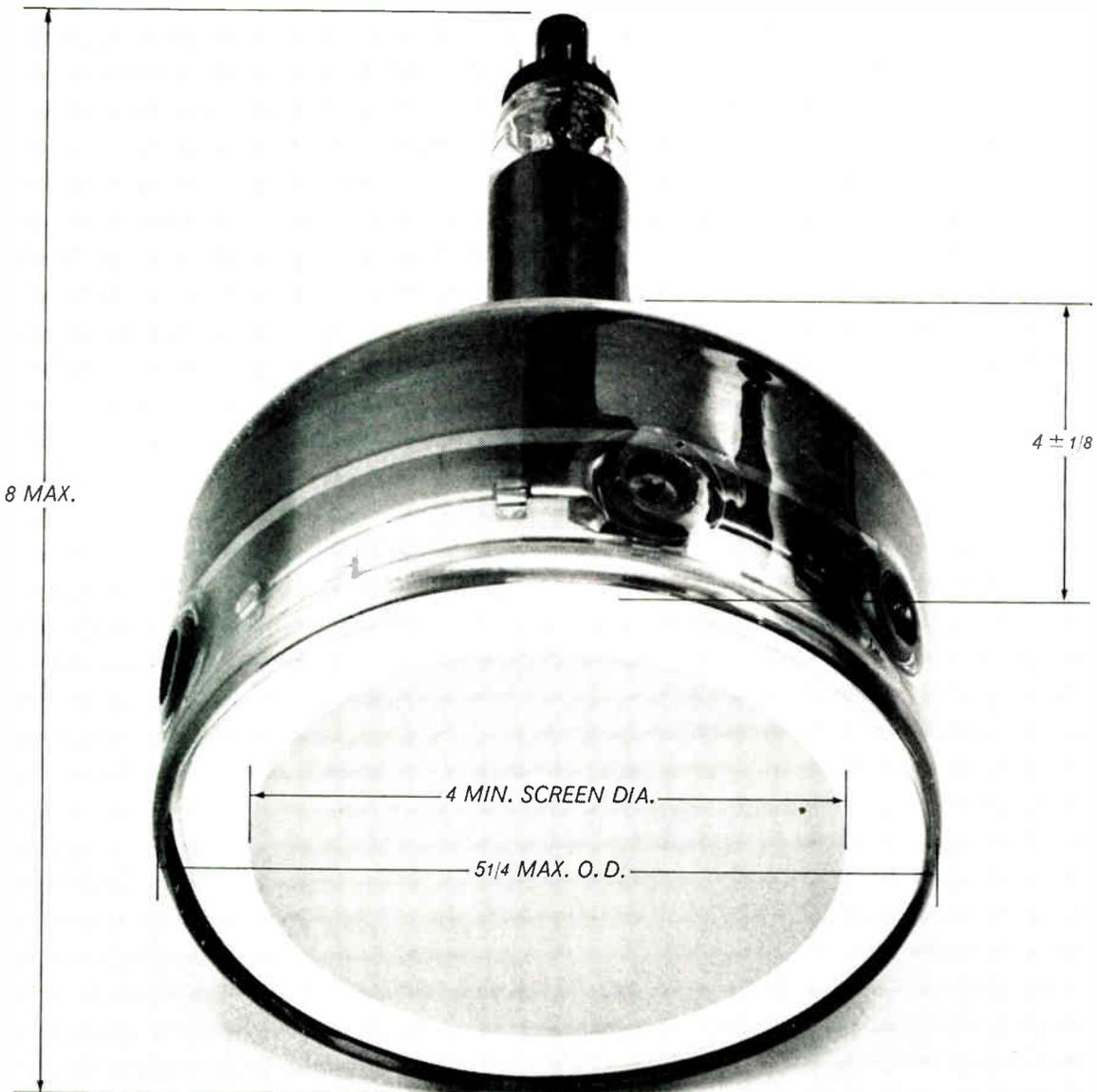
For additional information and answers for your specific display problems, call, wire or write today: Hughes Storage Tubes, 2020 Short Street, Oceanside, California— Area Code 714, 722-2101, Ext. 273 or 280. Hughes Storage Tubes, 1 Bala Ave., Bala Cynwyd, Pennsylvania, Area Code 215, MO. 4-3950. For export, write Hughes International, Culver City, California.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIV.

*Trademark Hughes Aircraft Company **By means of pulsing techniques, unneeded light output can be traded for extended viewing time.



WESCON PREVIEW (Concluded)

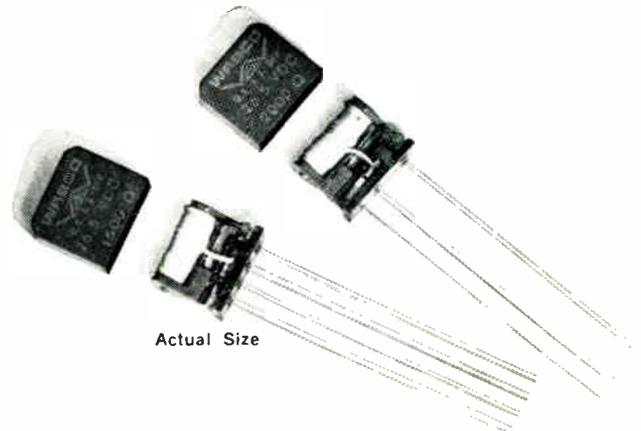
Ladies' Program

International overtones will flavor the social program for ladies. There will be two main activities. On Wednesday, Aug. 21, a cruise boat will cross San Francisco Bay to the Tiburon waterfront, which features upperclass Bohemia in the form of handsome homes, specialty shops, art galleries and unusual cafes. The Quay Gallery will have a special sidewalk art show and luncheon tables will be set at Tiburon Tommy's and The Dock. At Thursday noon a large luncheon is scheduled in the Garden Court of the Sheraton-Palace Hotel, as the setting for an Oriental fashion show. Miss Mai Tai Sing will be the commentator for modeled contemporary fashions created in Hong Kong and a collection of traditional Chinese wedding costumes. The "Lion's Dance" and butterfly harp music are planned. A hospitality suite at the Fairmont will be headquarters for the women's events.

Show Committees

WESCON is run by 14 standing committees involving nearly 350 volunteers, including area representatives helping with the pre-show conference. The governing body is an eight-man board of directors, with four host-area men comprising an executive committee. The 1963 committee is headed by Calvin K. Townsend of Jennings Radio Manufacturing Corp., San Jose, and includes Dr. John V. N. Granger of Granger Associates, Palo Alto; John A. Chartz, Dalmo Victor Co., Belmont; and Dr. Edward W. Herold, Varian Associates, Palo Alto. Dr. Herold has been elected an interim member of the board succeeding Meyer Leifer.

WESCON committee members for 1963 are (seated, from left): Calvin K. Townsend, the show's Chairman of the Board; Dr. John W. Granger, the Chairman of the Executive Committee; and Edward W. Herold, the Convention Director. Standing: John A. Chartz, the Show Director, and Don Larson, WESCON Manager.



NEW 1/6-SIZE CRYSTAL CASE RELAYS MODELS 900 (SPDT) and 901 (DPDT)

Meets requirements of MIL-R-5757D
Self-mounting to printed circuit boards

0.1" grid spaced terminals

Balanced rotary type armature

Positive contact wiping action

High-temp. coil wire rated +220°C

Large coil provides greater coil power

All welded rigid frame construction

Corrosion resistant throughout

Size: .500"L x .230"W x .430"H

Weight: 0.15 ounce

Coil rating: 6, 12, 26.5, 48, 76 VDC (others available)

Contact arrangement: Form C

Contact rated load: low level dry circuit to
1.0 amp resistive at 26.5 VDC

Contact life: 100,000 operations at rated load

Terminals: 1 1/2" or 1/2" leads, or solder hook

Vibration: 0.1" D.A. or 20G peak, 10 to 2000 c.p.s.

Shock: 50G for 11 milliseconds

Temperature: -65°C to 125°C

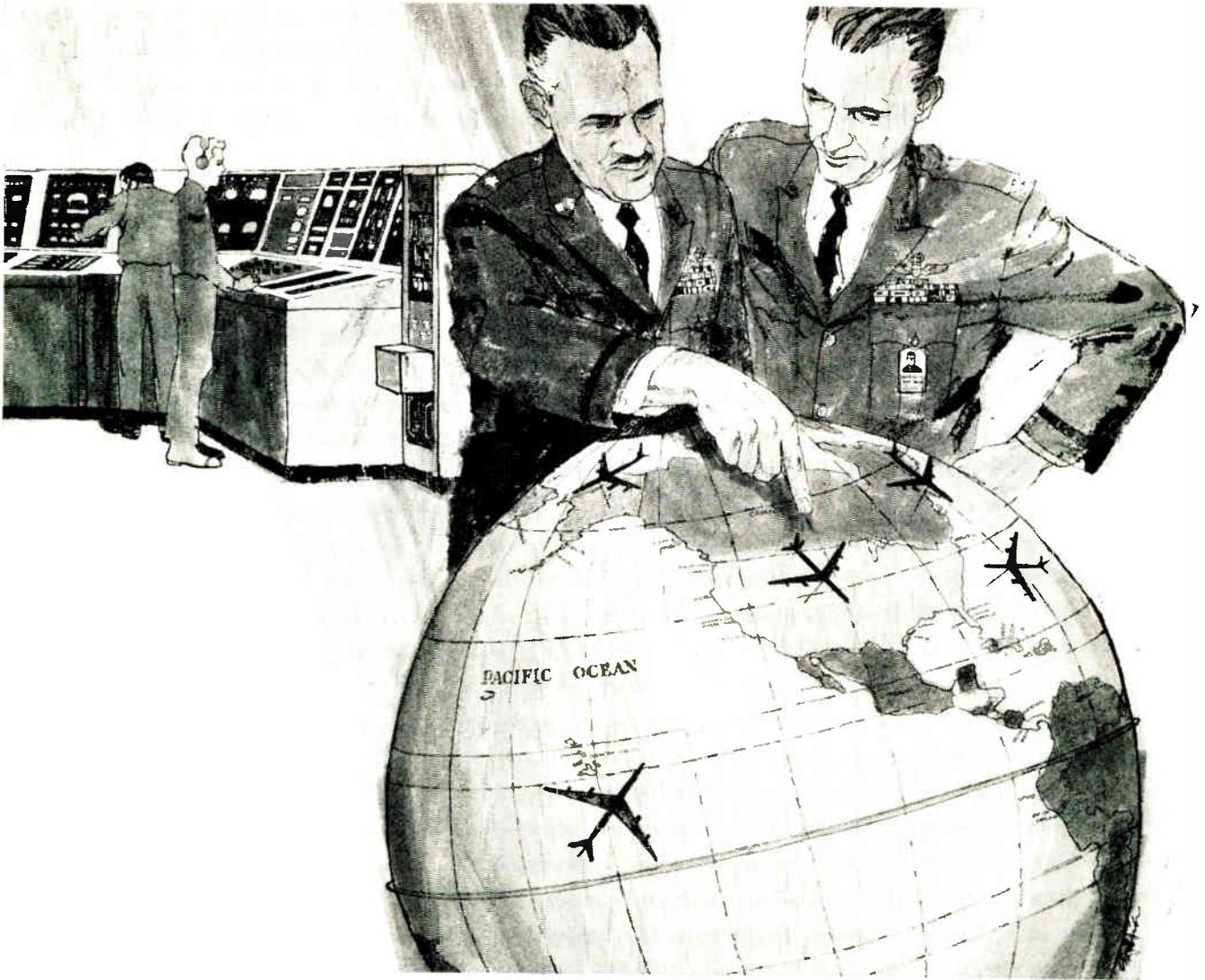
Produced with meticulous care under white room
conditions and rigid quality control procedures

These relays are reliable! They are constructed of precision made parts to exacting tolerances for uniformity of production, and provide consistent, dependable performance. Available from stock. For technical information call Aerospace Products, or write for Bulletins 1076 (Model 900) and 1077 (Model 901). Telephone: 242-5000, Area Code 412. TWX 412-642-4097, TELEX 086748.

See these relays at Booth 3301-3302 WESCON '63 Aug. 20, 21, 22, 23



UNION SWITCH & SIGNAL DIVISION
PITTSBURGH 18, PA./Westinghouse Air Brake Company



***... extended
protection ...***

Vital communications links and command positions, free from long range attack, are a part of our deterrent power made necessary to provide a world free of uncontrolled aggression.

Operational today is a network of flying command posts and communications relays which play a vital part in America's deterrent capability. An important part of this airborne system is the AN/ARC-89(V) UHF Multiplex Links installed aboard modified B-47E aircraft of the Strategic Air Command by Temco Aerosystems Division of Ling-Temco-Vought.

Temco Aerosystems evolved a prototype configuration, installed two in modified aircraft and performed contractor flight test in just 65 calendar days after receipt of the contract and aircraft. This record was made possible through the use of Temco-developed quick-reaction techniques.

This RB-47L project is part of the pioneer efforts in the field of Electromagnetic Reconnaissance, Missile Range Support, Airborne Command Communications and Control being done by Temco Aerosystems, P. O. Box 1056, Greenville, Texas.

LTV LEADERSHIP THROUGH VERSATILITY

INCOME TAX TIPS

(Compiled from Internal Revenue Service's Document 5049 (1-63).
"Rules for Deducting Travel, Entertainment and Gift Expenses.")

TRAVEL: If you travel for more than a week on a trip, and spend 25% or more of that time for personal pursuits, you may claim only the business percentage of expenses. (Convention travel is normally considered tax-exempt.) **YOU MUST PROVE:**

1. The dates of your departure and return home.
2. The number of days spent on business away from home.
3. Your destination and your reason for travel.
4. Your cost of transportation.
5. Your cost of lodging.

YOU MAY AGGREGATE:

1. Your cost of meals, gasoline and oil, taxi fares, etc., "if they are set forth in reasonable categories."

ENTERTAINMENT: It must be "directly related" to the conduct of your business. This includes entertainment, amusement and recreation "directly before or after a substantial and bona fide business discussion," including business meetings at conventions of professional and business associations. **YOU MUST PROVE:**

1. The amount of each separate expenditure.
2. The date the entertainment took place.
3. The name, address and type of entertainment.
4. Your reason for entertaining.
5. Your business relationship with the person entertained.

YOU MAY AGGREGATE:

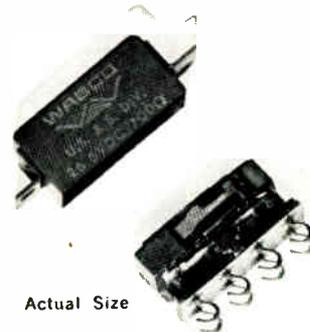
1. Incidental items such as taxi fares and telephone calls, on a daily basis.

CAUTION: "No deduction will be allowed for lavish or extravagant expenses."

CONVENTION EXPENSES: "You may deduct travel expenses which you incurred in attending a convention if you can show that your attendance benefits or advances the interest of your own employment or other trade or business, as distinguished from the business or employment of another. The mere fact that you were appointed or elected as a delegate does not, in itself, entitle you to or deprive you of, the deduction.

"You may not deduct those expenses which were paid by others, and any expenses you paid must be reduced by amounts received from others in the form of reimbursements or allowances.

"Incidental personal expenses, such as those incurred for entertaining, sightseeing, social visiting, etc., are not deductible."



NEW 1/2-SIZE CRYSTAL CASE RELAY MODEL 902 (DPDT)

Meets requirements of MIL-R-5757D

Rigid frame construction

Positive contact wiping action

High-temp. coil wire rated +220°C

Size: .80"L x .40"H x .40"W

Weight: 0.3 ounce

Contact arrangement: Form C

Coil rating: 6, 12, 26.5, 48 VDC (others available)

Contact rated load: low level dry circuit to 2 amps
resistive to 26.5 VDC

Contact life: 100,000 operations at rated loads

Vibration: 0.1" D.A. or 20G peak, 10 to 2000 cps

Temperature: -65°C to 125°C

Shock: 50G for 11 milliseconds

Dielectric strength: 1000 volts RMS except 500 volts RMS
from coil to case and across open contacts

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WESCON FEATURES HEAVY TECHNICAL PROGRAM

More than 90 papers will be presented to the 35,000 engineers attending the Show and Convention. Among the highlights will be sessions on "Active Communications Satellites," "Information Processing in Living Systems," and a particularly comprehensive session on "Recent Advances in Lasers."

THE TECHNICAL PROGRAM FOR THE 1963 WESCON will have a rich fare of papers for the morning and afternoon sessions to be held daily at the Cow Palace. More than 300 papers were submitted for consideration along with 20 invited papers to make up the regular morning sessions, presenting the reviewers and session organizers one of the most exacting tasks in Wescon convention history.

Exploration in Space

A session on "Active Communications Satellites" will review devices presently performing and those anticipated to be lofted in the near future. Dr. H. Richard Johnson of Watkins-Johnson Co., Palo Alto, the organizer, has submitted the following subjects and speakers:

"Telstar," by Irwin Welber of Bell Telephone Laboratories, Murray Hill, N. J.; "Relay," by Warren Schreiner of Radio Corporation of America, Hightstown, N. J.; "Syncom," by Dr. Harold A. Rosen of Hughes Aircraft Co., Culver City, Calif.; "ComSat," by Wilbur L. Pritchard of Aerospace Corp., El Segundo, Calif.; and "Commercial Communication Satellites," by Beardsley Graham, president of Spindletop Research, Lexington, Ky.

"Life on Other Planets"—speculations based on electronic, physical and biological investigations to the moment—has been organized by Dr. Elliott Levinthal of the Exo-Biology Laboratories, Department of Genetics, Stanford University. Dr. Joshua Lederberg of Stanford's Department of Genetics will treat on the biological background (the origin of life) and biological interest in the question. R. W. Bussard of Space Technology Laboratories will deal with travel beyond our planetary system but within our galaxy.

Dr. Bernard M. Oliver of Hewlett-Packard Co. will discuss the probabilities for communication with

intelligent life on other planets. Finally, Dr. Levinthal will describe approaches to detecting life within our planetary system.

Bioengineering, Lasers

Dr. James C. Bliss of Stanford Research Institute has reported confirmation of three of four speakers for a session on "Information Processing in Living Systems." Scheduled thus far are: Prof. Donald Kennedy of Stanford University, "Neural Processing"; Prof. G. D. McCann of California Institute of Technology, "Sensory Perception—Focal Point of Interdisciplinary Research by Biologists and Engineers"; and Dr. Kenneth Brown of the University of California Medical School, "Rod and Cone Receptor Potentials from Monkey Retinas."

Another round on lasers, this one dated to the opening of Wescon, has been organized by Dr. A. E. Siegman of Stanford University. Appearances have been scheduled for Dr. Glen Wade of Raytheon, Burlington, Mass., on "Laser Fundamentals"; Dr. George Dacey of Sandia Corp., Albuquerque, N. M., assessing the effort going into laser development and the relative slow pay-off; Dr. R. C. Fletcher of Bell Telephone Laboratories, Murray Hill, N. J.; on "New Communications Applications of Lasers"; and Dr. Warren Macek of Sperry Gyroscope Co., Great Neck, N. Y., speaking on "Laser Rotation Rate Sensor."

Highlights

One of the features of the Session on "Component Reliability" will be a paper, "A Program of Quality Assurance for Welded Electronic Circuitry," by F. H. Lalley, of the Boeing Co., Seattle, Wash. Welding offers many advantages as a method of connection but there are a greater number of variables than the more commonly employed soldering techniques. This
(Continued on page 38)

TECHNICAL PROGRAM

Special Sessions

SESSION A: August 20, 2:00 to 4:30 PM.

Extraterrestrial Life, Detection, Communication and Exploration

Session Chairman: Elliott Levinthal, Stanford Medical Center, Palo Alto, Calif.

A/1 ORIGINS AND DIRECTIONS OF LIFE, by Joshua Lederberg, Genetics Dept., Stanford Medical Center, Palo Alto, Calif.

A/2 THE DETECTION OF LIFE WITHIN OUR PLANETARY SYSTEM, by Elliott Levinthal, Stanford Medical Center, Palo Alto, Calif.

A/3 THE POSSIBILITIES OF INTERSTELLAR COMMUNICATION, by Bernard Oliver, Vice President, Research and Development, Hewlett-Packard Company, Palo Alto, Calif.

A/4 THE POSSIBILITIES OF INTERSTELLAR FLIGHT, by R. W. Bussard, Senior Staff Engineer, Space Technology Laboratories, Redondo Beach, Calif.

SESSION B: August 21, 2:00 to 4:30 PM.

Information Processing in Living Systems

Session Chairman: James Bliss, Stanford Research Institute, Menlo Park, Calif.

B/1 UNIT PROPERTIES IN NERVOUS INTEGRATIONS, by Donald Kennedy, Dept. of Biological Sciences, Stanford University, Stanford, Calif.

B/2 ROD AND CONE RECEPTOR POTENTIALS FROM MONKEY RETINAS, by Kenneth T. Brown, Dept. of Physiology, School of Medicine, University of Calif. Medical Center, San Francisco, Calif.

B/3 METHODS USED BY A SIMPLE EYE TO IMPROVE ITS SPATIAL AND TEMPORAL RESOLVING POWER, by Charles E. Stevens, Dept. of Physiology and Biophysics, University of Washington, Medical School, Seattle, Washington

B/4 TACTILE PERCEPTION WITH ELECTRIC STIMULI, by Robert H. Gibson, Dept. of Psychology, Carnegie Institute of Technology, Pittsburgh, Pa.

B/5 SENSORY PERCEPTION—FOCAL POINT OF INTERDISCIPLINARY RESEARCH BY BIOLOGISTS AND ENGINEERS, by G. D. McCann, Director, Computing Center, California Institute of Technology, Pasadena, Calif.

SESSION C: August 22, 2:00 to 4:30 PM.

Recent Advances in Lasers

Session Chairman: Anthony Siegman, Stanford University, Stanford, Calif.

C/1 RECENT ADVANCES IN LASER DEVICES, by Glen Wade, Raytheon Company, Burlington, Mass.

C/2 WHAT, IF ANYTHING, ARE LASERS GOOD FOR? by George Dacey, Sandia Corporation, Albuquerque, New Mexico

C/3 COMMUNICATIONS APPLICATIONS OF LASERS, by R. C. Fletcher, Bell Telephone Laboratories, Murray Hill, New Jersey

C/4 THE LASER ROTATION RATE SENSOR, by Warren Macek, Sperry Gyroscope Company, Great Neck, Long Island

SESSION D: August 23, 2:00 to 4:30 PM.

Active Communication Satellites

Session Chairman: H. Richard Johnson, Watkins-Johnson Company, Palo Alto, Calif.

D/1 TELSTAR, by Irwin Welber, Bell Telephone Laboratories, Murray Hill, New Jersey

D/2 RELAY, by Warren Schroiner, Radio Corp. of America, Hightstown, New Jersey

D/3 SYCOM, by Harold A. Rosen, Hughes Aircraft Co., Culver City, Calif.

D/4 COMSAT, by Wilbur L. Pritchard, Aerospace Corp., El Segundo, Calif.

D/5 COMMERCIAL COMMUNICATIONS SATELLITES, by Beardsley Graham, Spindletop Research, Inc., Lexington, Kentucky

Tuesday, August 20

SESSION 1: PATTERN RECOGNITION

10:00 am — 12:30 pm

Session Chairman: Philip E. Merritt, Stanford Research Institute, Menlo Park, Calif.

1/1 THE ELECTRONIC INSTRUMENTATION OF PHOTOGRAMMETRIC SYSTEMS, by P. M. Salomon, Librascope Division, Information Systems Group, General Precision, Inc., Glendale, Calif.

1/2 THE USE OF THRESHOLD LOGIC IN PATTERN RECOGNITION, by S. B. Akers, Jr. and Barry H. Rutter, Electronics Laboratory, General Electric Company, Syracuse, N.Y.

1/3 ADAPTIVE PATTERN RECOGNITION, by A. B. Bishop, North American Aviation, Inc., Columbus, Ohio

1/4 AN ITERATIVE DESIGN TECHNIQUE FOR PATTERN CLASSIFICATION LOGIC, by J. A. Daly, R. D. Joseph and D. M. Ramsey, Astro Power, Inc., Newport Beach, Calif.

1/5 A PATTERN RECOGNITION METHOD BASED ON THE LINEAR SEPARABILITY OF THE SIGNAL SPACE, by Gabriel E. Lowitz, Data Systems Division, Litton Systems, Inc., Canoga Park, Calif.

SESSION 2: FEEDBACK SYSTEMS

10:00 am — 12:30 pm

Session Chairman: George N. Ornstein, North American Aviation, Inc., Columbus, Ohio

2/1 INTERACTING DEMAND IN MULTIVARIABLE CONTROL SYSTEMS, by Lou Bircia, Case Institute of Technology, Cleveland, Ohio

2/2 ENHANCED RESOLUTION IN A POTENTIAL PLANE ANALOG THROUGH A VARIABLE CHANGE OR AN ORIGIN TRANSLATION, by Otto J. M. Smith, University of California, Berkeley, Calif. and Edward Swenson, Electro Scientific Industries, Inc., Portland, Ore.

2/3 ON-LINE IDENTIFIER FOR SYSTEM EQUATION IN THE PRESENCE OF NOISE, by Richard Rucker, 1708 Euclid No. 7, Berkeley, Calif.

SESSION 3: COMPONENT RELIABILITY

10:00 am — 12:30 pm

Session Chairman: Bruce Clark, Stanford Research Institute, Menlo Park, Calif.

3/1 TEMPERATURE SENSITIVE FLUORESCENT PAINTS, A GRAPHIC DISPLAY OF TEMPERATURE DISTRIBUTION, by H. D. Frazier, Research and Development, Pacific Semiconductors, Inc., Lawndale, Calif.

3/2 CONNECTOR RELIABILITY BASED ON ACTUAL FIELD MEASUREMENTS, by James E. Atkinson and Hugh C. Edfors, Amphelborg Electronics Corporation, Chicago, Ill.

3/3 USE OF CONDUCTIVE EPOXIES FOR ELECTRICAL INTERCONNECTIONS, by J. M. Okada, Douglas Aircraft Co., Santa Monica, Calif.

3/4 A PROGRAM OF QUALITY ASSURANCE FOR WELDED ELECTRONIC CIRCUITRY, by F. A. Lally, Aero-Space Division, The Boeing Company, Seattle, Wash.

SESSION 4: MICROWAVE COMPONENTS

10:00 am — 12:30 pm

Session Chairman: Richard C. Honey, Stanford Research Institute, Menlo Park, Calif.

4/1 THE GROOVE GUIDE, A LOW-LOSS WAVEGUIDE FOR MILLIMETER WAVES, by F. J. Tischer, Research Institute, University of Alabama, Huntsville, Alabama

4/2 BROADBAND STRIP-TRANSMISSION LINE Y-JUNCTION CIRCULATORS, by J. W. Simon, Sperry Microwave Electronics Company, Clearwater, Fla.

4/3 A SINGLE JUNCTION 4-PORT COAXIAL CIRCULATOR, by D. H. Landry, Sperry Microwave Electronics Company, Clearwater, Fla.

4/4 FIELD OPERATIONAL TRAVELING-WAVE MASER AMPLIFIERS, by J. R. Yacger, L. D. Buchmiller, W. P. Jones, and W. A. Peterson, Microwave Electronics Corporation, Palo Alto, Calif.

4/5 YAGI TRANSMISSION LINES, by Donald K. Reynolds, Robert F. Tighe, and Thomas L. Blakney, Dept. of Electrical Engrg. University of Washington, Seattle, Wash.

SESSION 5: SWITCHING CIRCUITS

10:00 am — 12:30 pm

Session Chairman: Robert M. Shultz, Fairchild Semiconductor Corp., Mountain View, Calif.

5/1 EXPLOITATION OF INITIAL CONDITIONS TO ACHIEVE FLUX GAIN IN BALANCED MAGNETIC CIRCUITS, by E. E. Newhall and J. R. Perucca, Bell Telephone Labs., Inc., Murray Hill, N.J.

5/2 NOVEL NANOSECOND CIRCUITS USING STORAGE DIODES AS CHARGE TRANSFORMERS AND TUNNEL DIODES AS CHARGE AMPLIFIERS, by Brian E. Sear, Electronic Systems and Products Division, Martin Company, Baltimore, Md.

5/3 A PRECISION SAMPLE AND HOLD CIRCUIT WITH SUB-NANOSECOND SWITCHING, by J. R. Gray and S. C. Kitsopoulos, Bell Telephone Labs., Inc., Murray Hill, N.J.

5/4 APPLICATION OF NANOSECOND LOGIC CIRCUITS, by J. S. Jamison, T. E. Gilligan, and J. Bacon, Burroughs Corporation, Great Valley Labs., Paoli, Pa.

TECHNICAL TOURS

1. University of California Electronic Research Lab, 1 to 5 pm
2. Kaiser Aircraft and Electronics, 1 to 5 pm
3. Westinghouse/Sunnyvale, 1 to 5 pm

Wednesday, August 21

SESSION 6: TRAINABLE SYSTEMS—REALIZATION & SIMULATION

10:00 am — 4:30 pm

Session Chairman: James B. Angell, Stanford University, Stanford, Calif.

6/1 A LARGE SELF-CONTAINED LEARNING MACHINE, by A. E. Brain, G. E. Forsen, D. J. Hall, and C. A. Rosen, Stanford Research Institute, Menlo Park, Calif.

6/2 DESIGN OF A MAGNETIC VARIABLE-GAIN COMPONENT FOR ADAPTIVE NETWORKS, by H. S. Crafts, Stanford Research Institute, Menlo Park, Calif.

6/3 INFLUENCE OF COMPONENT IMPERFECTION ON PERFORMANCE OF TRAINABLE SYSTEMS, by P. R. Low, I.B.M. and Stanford University, Stanford, Calif.

6/4 SIMULATION OF ADAPTIVE LINEAR DECISION FUNCTIONS USING THE IBM 7090 COMPUTER, by J. S. Griffin, Jr., J. H. King, Jr., and C. J. Tunis, I.B.M. Corp., Endicott, N.Y.

SESSION 7: MODULATION THEORY AND TECHNIQUES

10:00 am — 12:30 pm

Session Chairman: Malcolm McWhorter, Vidlar Corporation, Mountain View, Calif.

7/1 A TWO-STATE MODULATION SYSTEM, by Amar C. Bose, Dept. of Electrical Engrg.

TECHNICAL PAPERS PROGRAM

and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Mass.

7/2 A NEW FM MULTIPLEX SYSTEM FOR PRECISION DATA RECORDING, by Dalton Martin, Vidar Corporation, Mountain View, Calif.

7/3 MAGNETIC FEEDBACK MODULATOR IMPROVES ACCURACY IN FM RECORDING, by R. Lee Price, Mincom Division, Minnesota Mining & Mfg. Co., Los Angeles, Calif.

7/4 FM SIGNALS TAILORED TO SPECIFIC SONAR AND RADAR REQUIREMENTS, by Richard O. Rowlands, Ordnance Research Laboratory, Pennsylvania State University, University Park, Pa.

SESSION 8: SEMICONDUCTOR MICROELECTRONICS

10:00 am - 12:30 pm

Session Chairman: R. Alberts, Wright Air Development Center, Dayton, Ohio

8/1 TELEMETHY ENCODER, by T. Galindo and Gerald Luecke, Components Division, Texas Instruments, Dallas, Tex.

8/2 MICROELECTRONICS AND MINUTEMAN, by Richard Platzek, Autonetics Division of North American Aviation, Inc., Anaheim, Calif.

8/3 INTEGRATED CIRCUIT PACKAGING AND INTERCONNECTIONS, by W. H. Ayer and T. E. Kirchner, Sippican Corp., Santa Ana, Calif.

SESSION 9: PLASMAS

10:00 am - 12:30 pm

Session Chairman: Gordon Kino, Microwave Laboratory, Stanford University, Stanford, Calif.

9/1 HARMONIC GENERATION IN PLASMAS, by C. B. Swan, Bell Telephone Labs., Inc., Murray Hill, N. J.

9/2 HARMONIC GENERATION AND PARAMETRIC OSCILLATIONS IN A PLASMA DISCHARGE, by J. H. Krenz and G. S. Kino, Microwave Laboratory, Stanford Uni., Stanford, Calif.

9/3 MODULATED PLASMA ELECTRON BEAM, by L. W. Stauffer, General Electric Company, Schenectady, N. Y.

9/4 PHYSICS OF ION EXTRACTION FROM PLASMAS, by W. Eckhart, Hughes Research Laboratories, Malibu, Calif.

SESSION 10: MANAGEMENT

10:00 am - 12:00 pm

Session Chairman: Stanley F. Kaisel, Microwave Electronics Corp., Palo Alto, Calif.

Titles and Authors to be Announced

TECHNICAL TOURS

4. Microwave Electronics Corp., 1 to 5 pm

5. Systron-Donner Co., 1 to 5 pm

6. Ames Laboratory, NASA, 1 to 5 pm

Thursday, August 22

TECHNICAL TOUR

7. Stanford Linear Accelerator, 9 to 12:30 pm

SESSION 11: TRAINABLE SYSTEMS—THEORY & APPLICATIONS

10:00 am - 12:30 pm

Session Chairman: Nils Nilsson, Stanford Research Institute, Menlo Park, Calif.

11/1 THE ARTIFICIAL INTELLIGENTSIA—A CRITIQUE OF VARIOUS CAMPS IN ARTIFICIAL INTELLIGENCE, by Louis Fein, Applied Physics Lab., Stanford Research Institute, Menlo Park, Calif.

11/2 SIMULATION STUDIES OF FOUR-LAYER AND CROSS-COUPLED PERCEPTRONS, by Frank Rosenblatt, Cognitive Systems Research Program, Hollister Hall, Cornell University,

Ithaca, N. Y.

11/3 AN ADAPTIVE PREDICTION TECHNIQUE AND ITS APPLICATION TO WEATHER FORECASTING, by Richard O. Duda and Jack W. Machanik, Stanford Research Institute, Menlo Park, Calif.

11/4 SOME APPLICATIONS FOR ADAPTIVE DATA PROCESSING SYSTEMS, by Bernard Widrow, Lee Talbert, Gabriel Groner, Fred Smith, Michael Hu, and Donald Specht, Stanford University, Stanford, Calif.

SESSION 12: CONTROL THEORY

10:00 am - 12:30 pm

Session Chairman: James Eaton, Dept. of Electrical Engrg., University of California, Berkeley, Calif.

12/1 A CONTROLLABILITY CRITERION FOR A CLASS OF LINEAR SYSTEMS, by A. R. Stubbord, Dept. of Electrical Engrg. University of California, Los Angeles, Calif.

12/2 USE OF A COORDINATE TRANSFORMATION IN THE INCREMENTAL PHASE PLANE, by David P. Lindorff, Dept. of Electrical Engrg., University of Connecticut, Storrs, Conn.

12/3 SYMBOLIC REPRESENTATION OF COORDINATE TRANSFORMATIONS, by R. L. Pio, Hughes Aircraft Co., Culver City, Calif.

12/4 A METHOD FOR COMPUTING TIME OPTIMAL CONTROL, by Harold Knudsen, Lincoln Laboratories, M.I.T., Lexington, Mass.

12/5 A SURVEY OF MINIMUM FUEL SYSTEMS, by Michael Athans, Lincoln Laboratories, M.I.T., Lexington, Mass.

SESSION 13: INTEGRATED CIRCUITS

10:00 am - 12:30 pm

Session Chairman: R. S. Pepper, University of California, Berkeley, Calif.

13/1 AN APPROACH TO LOW-COST, HIGH-PERFORMANCE MICROELECTRONICS, by E. M. Davis, W. E. Harding, and R. S. Schwartz, Components Division, I.B.M. Corporation, Poughkeepsie, N. Y.

13/2 METAL-OXIDE-SEMICONDUCTOR FIELD EFFECT TRANSISTORS AND MICROCIRCUITRY, by E. M. Wanlass, Research & Development Lab., Fairchild Semiconductor, Palo Alto, Calif.

13/3 ELECTRON BEAM MANUFACTURING TECHNIQUES FOR INTEGRAL DEVICE INTERCONNECTIONS, by D. J. Garibotti, Electronics Department, Hamilton Standard Division, Broad Brook, Conn. and E. H. Miller, Manufacturing Technology Laboratory, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio

13/4 INTEGRATED COMPLEMENTARY TRANSISTOR LOGIC GATES, by Robert Seeds, Application and Engrg. Department, Fairchild Semiconductor Palo Alto, Calif.

SESSION 14: LASER TECHNIQUES

10:00 am - 12:30 pm

Session Chairman: William Culshaw, Lockheed Missiles & Space Company, Palo Alto, Calif.

14/1 POLARIZATION MODULATION AND DEMODULATION OF LIGHT, by W. Niblack and E. H. Wolf, Sylvania Electronic Systems, Division of Sylvania Electric Products, Inc., Williamsville, N. Y.

14/2 DIFFRACTION LIMITED, SINGLE MODE GLASS LASER, by J. W. Kantorski and C. G. Young, American Optical Company, Southbridge, Mass.

14/3 THE POTENTIAL OF TECHNIQUES USING COHERENT LIGHT DIFFRACTION, by W. H. Huntley, Jr., Stanford Electronics Laboratories, Stanford, Calif.

14/4 A 2 MM (NON)-CONFOCAL RESONATOR FOR USE AS A WAVEMETER OR FILTER ELE-

MENT, by George Oltman, Space Technology Labs., Inc., Redondo Beach, Calif.

SESSION 15: FUTURE ENGINEERS SYMPOSIUM

10:00 am - 12:30 pm

Papers to be Selected

SESSION 16: DATA CODING & SWITCHING THEORY

10:00 am - 12:30 pm

Session Chairman: Bernard Elspas, Stanford Research Institute, Menlo Park, Calif.

16/1 PERFORMANCE OF ORTHOGONAL AND BI-ORTHOGONAL CODES UTILIZING SUB-OPTIMUM DETECTION TECHNIQUES, by R. Marquedant and H. Hodara, Research and Development Division, The Hallicrafters Co., Chicago, Ill.

16/2 A DECOMPOSITION RESULTING IN LINEARLY-SEPARABLE FUNCTIONS OF TRANSFORMED INPUT VARIABLES, by James Arlin Cooper, Stanford University, Palo Alto, Calif.

16/3 PERFORMANCE OF HAMMING CODES, by R. G. Marquart and J. C. Hancock, Communications Science Laboratory, School of Electrical Engrg., Purdue University, Lafayette, Indiana

16/4 ON BINARY DATA TRANSMISSION ERROR RATES DUE TO COMBINATIONS OF GAUSSIAN AND IMPULSE NOISE, by Leonard R. Halsted, Institute of Science and Technology, University of Michigan, Ann Arbor, Mich.

TECHNICAL TOURS

8. Jennings Radio Manufacturing Co., 1 to 5 pm

9. United Technology Corp., 1 to 5 pm

10. Spectra-Physics/Sylvania, 1 to 5 pm

Friday, August 23

TECHNICAL TOUR

11. Station KPEN Transmitter Site, 9:30 to 12:30 pm

SESSION 17: NON-LINEAR CIRCUITS AND SYSTEMS

10:00 am - 12:30 pm

Session Chairman: R. W. Newcomb, Stanford University, Stanford, Calif.

17/1 THE FREQUENCY RESPONSE OF A BISTABLE OSCILLATING CONTROL SYSTEM, by W. C. Foster, Douglas Aircraft Company, Inc., Santa Monica, Calif.

17/2 FUNCTIONAL TECHNIQUES FOR THE ANALYSIS OF THE NONLINEAR BEHAVIOR OF PHASE-LOCKED LOOPS, by Harry L. Van Trees, Dept. of Electrical Engrg., Massachusetts Institute of Technology, Cambridge, Mass.

17/3 FREQUENCY TRANSIENTS IN SYNCHRONIZED OSCILLATORS, T. N. White and W. B. Jones, School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Ga.

17/4 NONLINEAR SYSTEMS ANALYSIS AND SYNTHESIS, Ming-Lei Liou, Department of Electrical Engineering, Stanford University, Stanford, Calif.

SESSION 18: SOLID-STATE ELECTRONICS

10:00 am - 12:30 pm

Session Chairman: John J. Linvill, Stanford University, Stanford, Calif.

18/1 ELECTROLUMINESCENT INSTRUMENT DISPLAYS, by W. Brooks, Electronic Sciences Laboratory, Lockheed Missiles and Space Company, Palo Alto, Calif.

(Continued on page 203)



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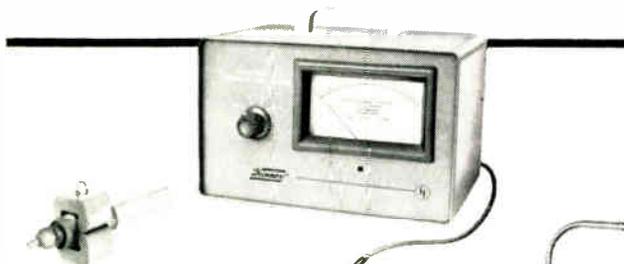
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TECHNICAL PROGRAM (Concluded)

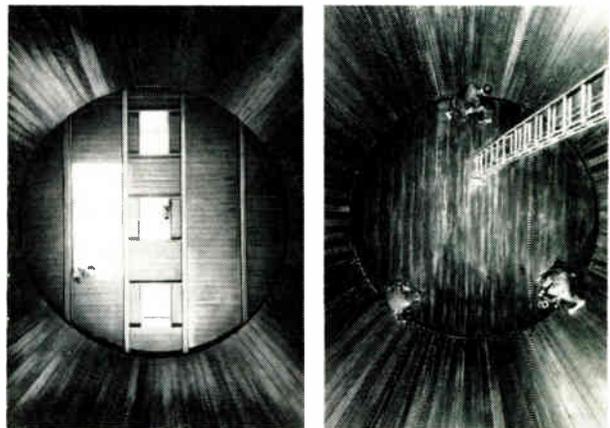
paper describes how control can be exercised over (1) Process and Equipment (2) Material, (3) Environmental Conditions, and (4) Human Factors, combined with the most effective and up to date inspection and test techniques.

In the session on "Switching Circuits," three engineers from Burroughs Corp., J. Bacon, T. Gilligan and J. Jamison will present a paper, "An Application of Nanosecond Logic Circuits." The circuit configurations discussed were chosen to combine multiple logic operations into functional blocks wherever possible. This approach lightened the burden on the interconnecting networks. The components in the current were to be used in their most favorable high-frequency operating regions, and were not to be subjected to excessive range or tolerance requirements.

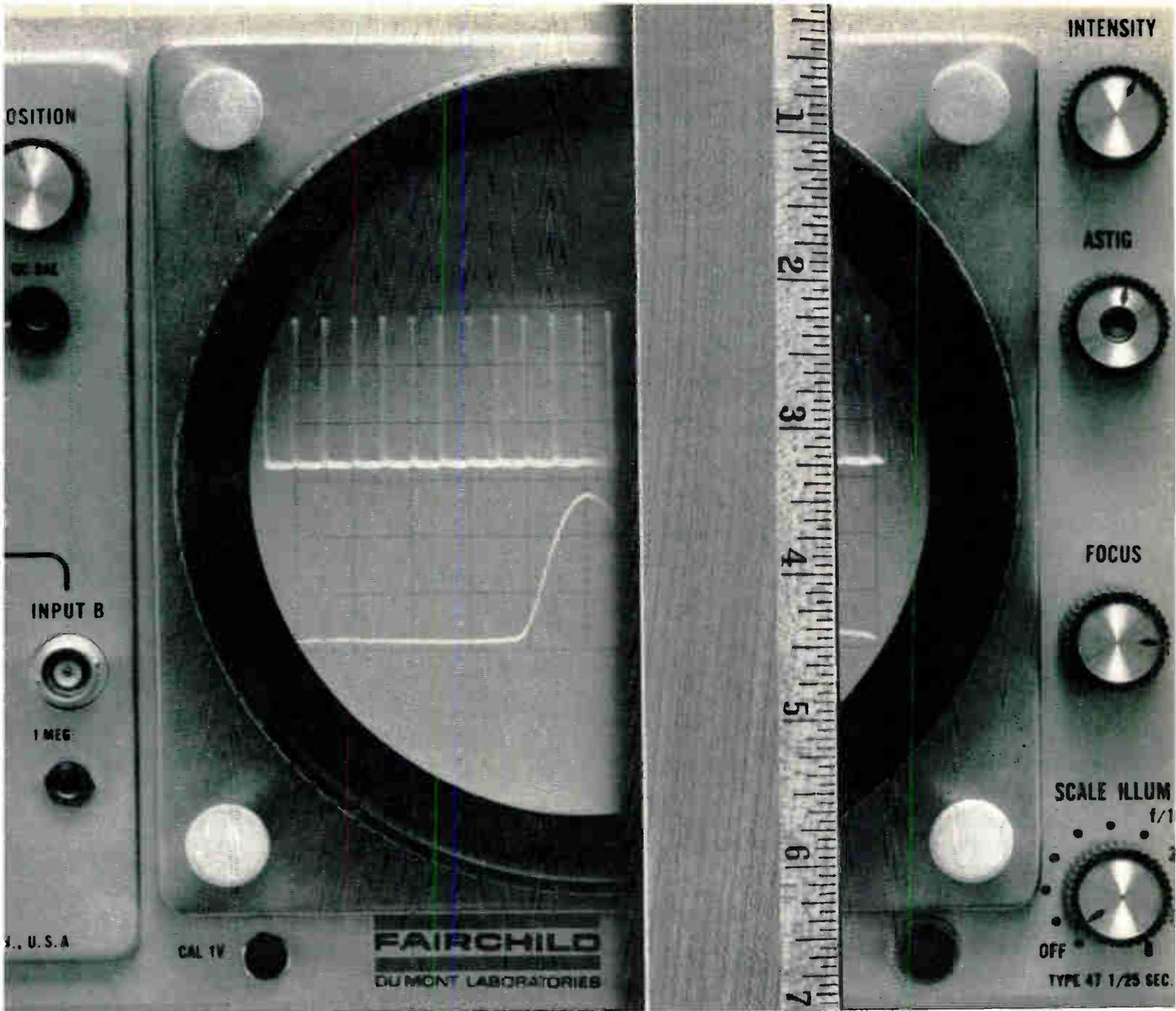
The paper, "The Groove Guide, A Low-Loss Waveguide for Millimeter Waves," by F. J. Fischer, will be one of the features of the Microwave Components session." Groove guide is a new waveguide for the low-loss transmission of millimeter waves. The guide consists of two parallel conducting walls with grooves in the central region of the guide cross-section. When the guide is excited in the TE-wave mode it has properties similar to those of the H-Guide.

One of the more troublesome areas of the microelectronics art—packaging and interconnection—will be discussed in the paper, "Integrated Circuit Packaging and Interconnection," by W. Ayer and T. Kirchner. They will describe a number of different approaches in packaging that they investigated and the advantages and drawbacks of each.

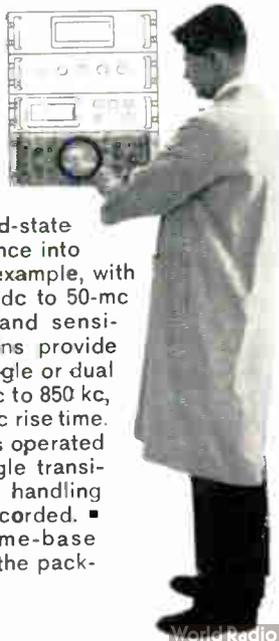
ACOUSTICAL TANK



Photos show inside of 41,000 gal. tank at Sparton Electronics' new underwater acoustic laboratory, Jackson, Mich. Tank, 18 ft. in dia. by 20 ft. deep, has special foundation and vibration dampeners to reject external noise, temp. control between 20 and 25° C. Firm uses tank to study electro-acoustical devices.



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- For instance, there is an oblique cutter, specially designed for printed circuits . . . it cuts and crimps the end to hold wire in place for soldering. (D 052-C).
- For instance, there is a needle nose plier with the tip bent to facilitate reaching into confined spaces. D 338-5½ C.

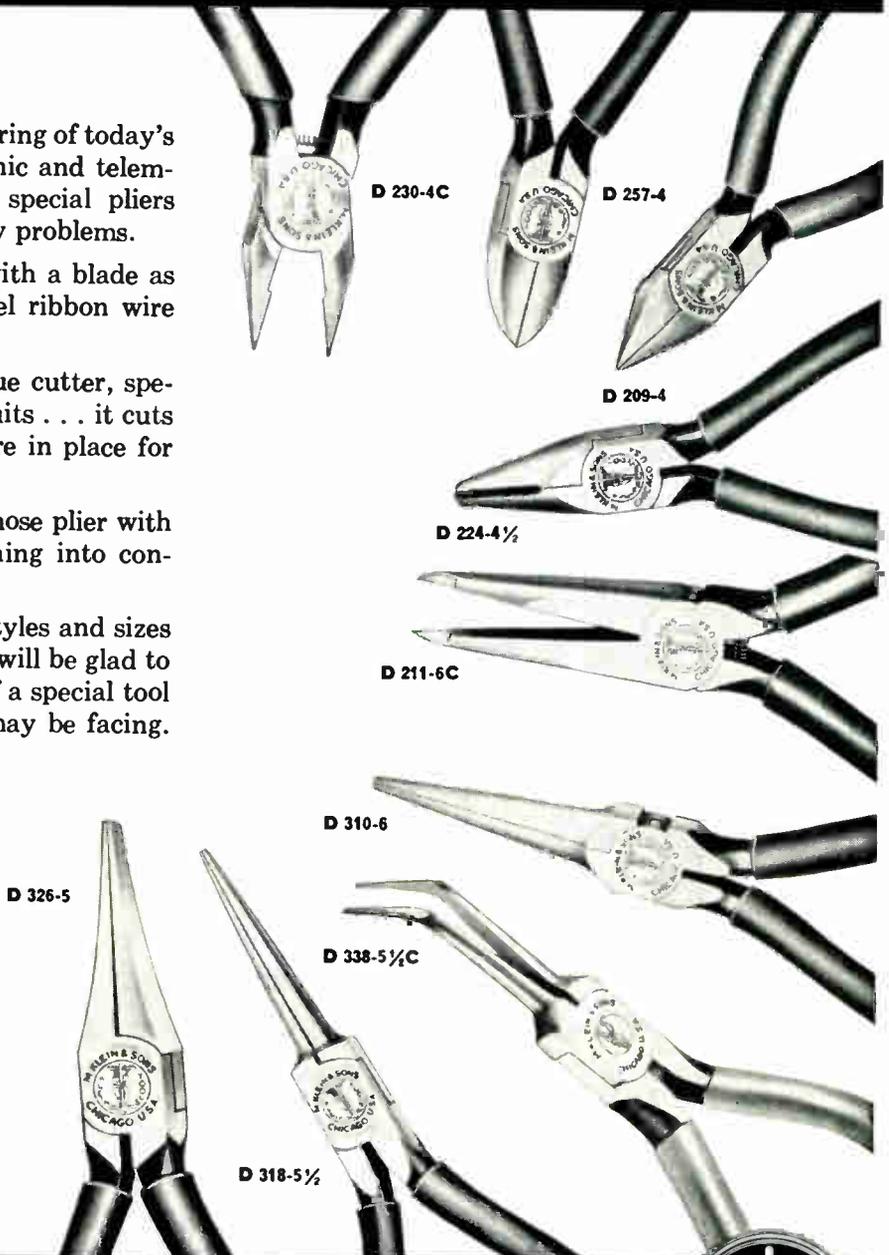
In all, there are over 100 different styles and sizes of pliers available from stock. Klein will be glad to discuss with you the development of a special tool to solve a particular problem you may be facing.

ASK YOUR SUPPLIER

**SEE US AT THE WESCON SHOW
BOOTH 1318**



The Klein Plier Catalog illustrating and describing the complete Klein line of pliers is available on request.



Mathias KLEIN & Sons
 Established 1857 **KLEIN** Chicago II U.S.A.
 INCORPORATED
 7200 McCORMICK ROAD, CHICAGO 45 ILL

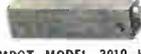


Bourns offers you 14 proven, off-the-shelf answers to MIL-STD-202A, Method 106 (cycling)—the most stringent humidity spec in the book. More than just "moisture-resistant" or "humidity-defying," these units are humidity-proof. No coatings or potting compounds are required.

The reliability of Bourns potentiometers is a matter of record in virtually every U.S. space and defense program. Don't MIL-SPECulate—SPECify Bourns!

UNITS READY FOR IMMEDIATE DELIVERY FROM FACTORY OR DISTRIBUTOR STOCK. WRITE FOR DETAILS!

BOURNS® Potentiometers

 TRIMPOT® MODEL 3000 Micro-miniature, high-temperature, wirewound; 50Ω to 20K; 0.5W at 70°C.; Max. oper. temp. 175°C.	 TRIMPOT MODEL 3051 High-temperature, RESISTON carbon element; 20K to 1 Meg.; 0.25W at 50°C.; Max. oper. temp. 150°C.	 BOURNS MODEL 3281 Square, micro-miniature RESISTON carbon element; 20K to 1 Meg.; 0.25W at 50°C.; Max. oper. temp. 150°C.
 TRIMPOT MODEL 3001 High-temperature, RESISTON carbon element; 20K to 1 Meg.; 0.20W at 70°C.; Max. oper. temp. 150°C.	 BOURNS® MODEL 3250 Square, high-temperature, wirewound; 100Ω to 50K; 1.0W at 70°C.; Max. oper. temp. 175°C.	 BOURNS MODEL 3300 Single-turn, wirewound, micro-miniature; 50Ω to 20K; 0.5W at 70°C.; Max. oper. temp. 175°C.
 TRIMPOT MODEL 3010 High-temperature, wirewound; 10Ω to 100K; 1.0W at 70°C.; Max. oper. temp. 175°C.	 BOURNS MODEL 3251 Square, high-temperature, RESISTON carbon element; 20K to 1 Meg.; 0.50W at 50°C.; Max. oper. temp. 150°C.	 BOURNS MODEL 3301 Single-turn, RESISTON carbon element, micro-miniature; 10K to 1 Meg.; 0.25W at 70°C.; Max. oper. temp. 150°C.
 TRIMPOT MODEL 3011 High-temperature, RESISTON carbon element; 20K to 1 Meg.; 0.25W at 50°C.; Max. oper. temp. 150°C.	 BOURNS MODEL 3280 Square, micro-miniature, wirewound; 100Ω to 50K; 1.0W at 70°C.; Max. oper. temp. 175°C.	 TRIMPOT MODEL 220 Sub-miniature, high-temperature, wirewound; 100Ω to 30K; 1.0W at 70°C.; Max. oper. temp. 175°C.
 TRIMPOT MODEL 224 High-temperature, wirewound; 10Ω to 100K; 1.0W at 70°C.; Max. oper. temp. 175°C.	ALL UNITS SHOWN 1/2 ACTUAL SIZE	

Your Widest Choice of Answers to Problems in

HUMIDITY



BOURNS

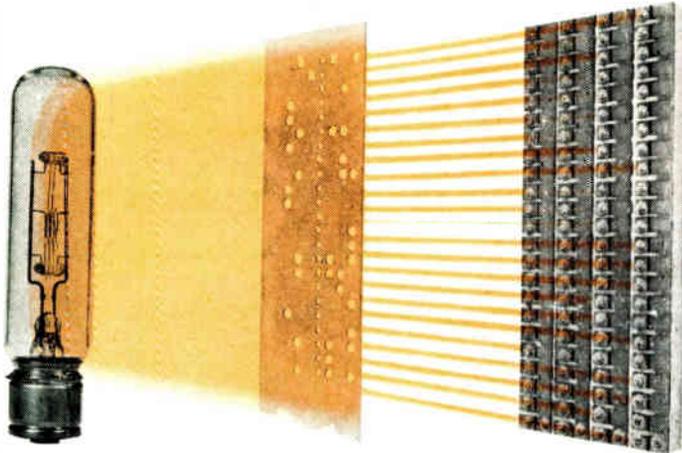
BOURNS, INC., TRIMPOT DIVISION
1200 COLUMBIA AVE., RIVERSIDE, CALIF.
PHONE 884-1700 TWX: 714-682-9582
C. E. BOURNS, INC.

MANUFACTURER: TRIMPOT® & PRECISION POTENTIOMETERS, RELAYS; TRANSDUCERS FOR PRESSURE, POSITION, ACCELERATION. PLANTS: RIVERSIDE, CALIFORNIA; AMES, IOWA; TORONTO, CANADA
See Bourns products in Booths 3109, 10, 11 at WESCON



TIPS (Technical Information and Product Service)

7 NEW G-E DEVELOPMENTS



3 new G-E photoconductive devices offer a host of new uses



Photoconductive Arrays: Newly developed photoconductor arrays (illustrated) offer many promising applications, especially for data processing, industrial automation, telephony, photocopying, proportional control devices, and alarm systems of all sorts.

The cadmium sulfide or cadmium selenide cells in the arrays can provide a wide range of electrical characteristics to meet specific needs: *spectral response* 5,500-7,300 angstroms; *light resistance* 100-125 K ohms (@ 1-5 ft-c; *dark resistance* 15-100 megohms; *power dissipation* 50-400 mw.

Tightly compact 20-, 40-, 90-cell and even more complex G-E photoconductor arrays are now under development. Pinpoint photosensitive areas can be tailored to almost any design configuration.

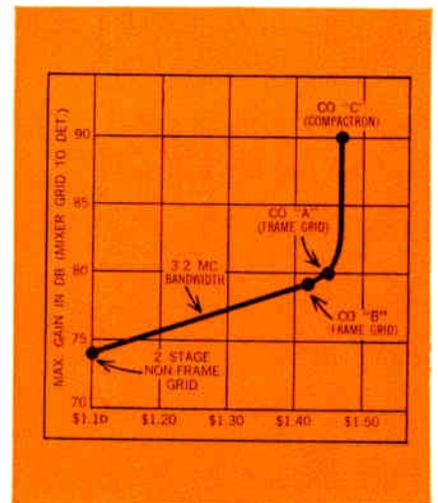
Photosensitive "Siamese twins." Double-cell G-E photoconductors, in two sizes, also are now available. Each highly sensitive, hermetically sealed unit has three flexible leads, one interconnecting both photosensitive areas. Electrical characteristics can be varied considerably to meet special needs.

New PC-L devices make noiseless controls and rugged low-level switches. G.E.'s new PC-L (photoconductor-lamp combination devices) are light-tight packages which enclose a photoconductive cell and a variable illumination source. Photoconduction is controlled by varying the voltage to the light source. Circuit isolation, noiseless potentiometry, and reliable low-level switching are just a few of the new product possibilities that G-E PC-L devices open up. Here are typical characteristics:

Developmental Types:	Y 1079	Y 1128	Y 1138	Y 1248
Lamp rating	5v 60ma	5v 60ma	5v 60ma	28v 40ma
Max. photoconductor voltage	60v	30v	60v	60v
Power dissipation	150 mw	75 mw	250 mw	100 mw
Photoconductor resistance (ohms) for various lamp input voltages	45 @ 4v 3K @ 1v	150 @ 4v 17K @ 1v	45 @ 4v 3K @ 1v	50 @ 20v 1700 @ 6v

Free booklet gives application data and specifications on the complete line of "standard" G-E photocells—get yours today!

Circle 60 on Inquiry Card



Compactron IF amplifier gives 15% higher gain than comparably priced frame-grid types



IF amplifier cost-and-performance figures were determined for TV sets of three manufacturers:

Two manufacturers, Co. "A" and Co. "B," used the popular 6EH7 and 6EJ7 frame grid tubes plus a frame grid mixer. The third, Co. "C," used a 3-stage IF amplifier consisting of a 6AR11 compactron plus a non-frame grid 6JN8 pentode and a less expensive non-frame grid mixer.

The results showed that all three amplifiers fell in the cost range of \$1.40-\$1.49.* However, the compactron version gave 90 db maximum gain as compared to only 78 db for the frame grid types. In all cases, gain was measured from mixer grid to detector; bandwidth was 3.2 mc.

To increase gain, Co. "A" and Co. "B" have chosen to allow IF "pole shifting" to occur so that at maximum gain (fringe area signal) the bandwidth reduces to about 1.5 mc. This yields about 6 db more gain—still 6 db less than the compactron version.

*Includes price of IF tubes, plus component and socket cost differences and tuner cost difference for frame grid mixer required by Co. "A" and Co. "B."

Circle 61 on Inquiry Card

ELECTRONIC INDUSTRIES • August 1963

FEATURE THE "ACCENT ON VALUE"



More G-E compactrons in tomorrow's radio, TV, hi-fi, and industrial equipment

Accent on Value Over 40 of today's major equipment manufacturers have joined the move to compactrons. Many of the 65 compactron types now available have been designed into equipment such as: portable and console TV sets, electronic organs, telemetering units, sweep generators, mobile and fixed communication equipment, stereo tuners, multiplex adapters, microwave amplifiers, halogen leak detectors, and precision power sources.

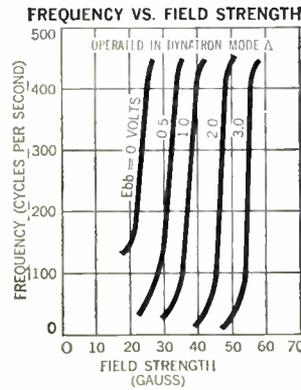
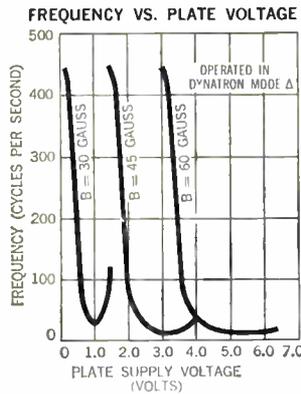
Major reasons for this mushrooming growth of G-E compactrons are: (1) performance, (2) lower costs. Compactrons overcome the limitations of tubes and transistors and deliver more watts per cubic inch than any other component. They have a lower initial cost per function and offer savings in labor and materials.

By combining several functions into one low-profile envelope requiring fewer pins, stems, sockets, welds, and handling, compactrons provide increased reliability and more compact circuitry, when compared to present-day components.

They cost less than tubes or transistors and use up to 35% less power to perform the same function. Compactrons reduce hardware, wiring, and soldering connections and lower assembly time. Heat dissipation is up to 35% better than with conventional tubes, increasing life and reliability. Multifunction design provides more compact circuits, allowing use of a smaller chassis and cabinet with resultant savings in materials.

Circle 62 on Inquiry Card

ELECTRONIC INDUSTRIES • August 1963

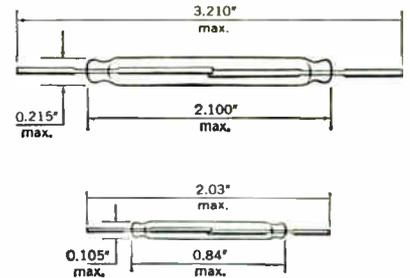


New areas of design opened up by highly sensitive subminiature magnetron

Accent on Value Two curves, illustrated above, emphasize the Z-2935's ability to produce large changes in frequency with slight changes in plate voltage and magnetic field strength. Typical sensitivities: for voltage, 1CPS/mv, or for magnetic field strength, 100 CPS/gauss. Specifications of the Z-2935 are:

Heater Voltage, AC or DC+	6.3±0.3 Volts
Heater Current	0.15 Amperes
Plate Voltage	25 Volts
Internal Shield Voltage	
Positive	5 Volts
Negative	5 Volts
Cathode Current	6.0 Milliampere
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	25 Volts
Heater Negative with Respect to Cathode	25 Volts

Circle 63 on Inquiry Card



Versatile G-E reed switches outlive, outspeed, outswitch any other mechanical switching device

Accent on Value G-E dry reed switches are designed to work perfectly, with milliwatt sensitivity, up to 100 million cycles or more. They're small, simple, rugged, and fast acting. All types are magnetically actuated. Contacts are pure gold, silver, or rhodium.

Dry reed switches appeal especially to the designer who can't let well enough alone. Appliances, alarm systems, telephony and data processing gear, and virtually all other electro-mechanical equipment can be improved with economical dry reed switches.

Some typical performance characteristics:

SWITCH TYPE:	ZDR15	ZDR50	Y1027	Y1135
Life expectancy (at half load)	100 million operations	100 million operations	15 million operations	100 million operations
Ampere turns Pull-in	90 ± 15	90 ± 15	43 ± 7	90 ± 15
Release	35 ± 10	40 ± 10	25 ± 6	65 ± 10
Max. contact rating (DC resistive)	15 watts 250 volts 1 amp	50 watts 250 volts 3 amps	4 watts 250 volts 250 mA	15 watts 250 volts 1 amp
Max. contact resistance	50 milli-ohms	150 milli-ohms	150 milli-ohms	50 milli-ohms
Length (excluding leads)	2.10"	2.10"	0.84"	2.10"

Progress Is Our Most Important Product

GENERAL ELECTRIC

For more information: Write G-E Receiving Tube Dept., Technical Information and Product Service (TIPS), Room 7013-B, Owensboro, Ky. Please specify product(s).

Circle 64 on Inquiry Card

Now Motorola Has BOTH . . .

SILICON

PNP & NPN

STAR* TRANSISTORS



(TO-5)
2N2904
2N2905

(TO-18)
2N2906
2N2907



(TO-5)
2N2218
2N2219

(TO-18)
2N2221
2N2222

IMMEDIATELY AVAILABLE from your Motorola District Representative or Motorola Semiconductor Distributor. Priced even lower than non-passivated PNP devices designed for similar applications, the new high-voltage PNP silicon epitaxial passivated STAR transistors are made by the revolutionary annular process, and are the newest additions to Motorola's growing line of BAND-GUARD* types.

PNP		CHARACTERISTICS	NPN	
Min.	Max.		Min.	Max.
60V	—	BV_{CBO}	60V	—
40V	—	BV_{CEO}	30V	—
5V	—	BV_{EBO}	5V	—
—	20nA	$I_{CBO} @ 50V$	—	10nA
—	0.4	$V_{CE(sat)} I_C = 150$	—	0.4
—	1.3	$V_{BE(sat)} I_B = 15$	—	1.3
20	—	$h_{FE} @ 0.1 \text{ mA}$	20	—
35	—	2N2904, 2N2906, 2N2907, 2N2905, 2N2907	2N2218, 2N2221, 2N2219, 2N2222	35
25	—	$h_{FE} @ 1 \text{ mA}$	25	—
50	—	2N2904, 2N2906, 2N2907, 2N2905, 2N2907	2N2218, 2N2221, 2N2219, 2N2222	50
35	—	$h_{FE} @ 10 \text{ mA}$	35	—
75	—	2N2904, 2N2906, 2N2907, 2N2905, 2N2907	2N2218, 2N2221, 2N2219, 2N2222	75
40	120	$h_{FE} @ 150 \text{ mA}$	40	120
100	300	2N2904, 2N2906, 2N2907, 2N2905, 2N2907	2N2218, 2N2221, 2N2219, 2N2222	100
20	—	$h_{FE} @ 500 \text{ mA}$	20	—
30	—	2N2904, 2N2906, 2N2907, 2N2905, 2N2907	2N2218, 2N2221, 2N2219, 2N2222	30
—	8 pf	C_{cb}	—	8 pf
—	30 pf	C_{cb}	—	20 pf
200 mc	—	f_T	250 mc	—

*Trademark of Motorola Inc.



"new leader in Total Silicon Technology"

MOTOROLA Semiconductor Products Inc.

BOX 955 • PHOENIX 1, ARIZONA

A SUBSIDIARY OF MOTOROLA INC. 73-048

Here's a list of exhibitors and booth numbers,
with a known listing
of hotels and special events
planned by visiting firms.

WESCON EXHIBITORS & VISITING COMPANIES

COMPANY	HOTEL/BOOTH
ABSCO INDUSTRIES	705
AD-YU ELECTRONICS, INC.	4233
AMP, INC.	3112-3113-3114-3115
ABLESTIK ADHESIVE CO.	1007
ACCURATE INSTRUMENT CO.	4322
ACE ELECTRONICS ASSOCIATES, INC.	3309-3310
ACE ENGINEERING & MACHINE CO., INC.	1311
ACOUSTICA ASSOCIATES, INC.	602
AEROJET-GENERAL CORP.	1117
AEROVOX CORP.	211
AFFILIATED MANUFACTURERS, INC.	1209
AIRBORNE INSTRUMENTS LABORATORY	1618
AIRPAX ELECTRONICS INC.	2301; International Inn
ALADDIN ELECTRONICS	3411; Fairmont
ALBEROX CORP.	4114; Holiday Lodge
ALFORD MANUFACTURING CO.	3819-3820
ALFRED ELECTRONICS	2117
ALLEN-BRADLEY CO.	3119-3120-3121-3122
ALLIED CHEMICAL CORP.	1404-1405-1406
ALLISON LABORATORIES, INC.	4524
ALLOYS UNLIMITED, INC.	1113
AMCO ENGINEERING CO.	801
AMELCO SEMICONDUCTOR	4118
AMERICAN ELECTRICAL HEATER CO.	1319
AMERICAN ELECTRONIC LABORATORIES, INC.	4316
AMERICAN OPTICAL CO.	4525-4526
AMPEREX ELECTRONIC CORP.	3701-3702
AMPEX CORP.	4512-4513-4514-4515-4516; Hyatt House, Burlingame*
AMPHENOL-BORG ELECTRONICS CORP.	3012-3013-3014-3015-3016-3017-3018-3019
ANADIX INSTRUMENTS, INC.	4138
ANCHOR PLATING & TINNING CO., INC.	1315
ANDREW CORP.	1713-1714
ANETSBERGER BROTHERS, INC.	708
ANGSTROMH PRECISION, INC.	4404
ANTENNA & RADOME RESEARCH ASSOCIATES	4117
ANTLAB, INC.	4527
APM-HEXSEAL CORP.	4221
APPLIED DEVELOPMENT CORP.	4711
APPLIED PHYSICS CORP.	4536
THE ARNOLD ENGINEERING CO.	1727-1728-1729
ARTOS ENGINEERING CO.	918-919
ASSEMBLY PRODUCTS, INC.	3501-3502
ASSOCIATED AMERICAN WINDING MACHINERY, INC.	4109-4110
ASTRO-SCIENCE CORP.	4613
ASTRODATA, INC.	4733-4734
ATOHM ELECTRONICS	3821-3822
AUGAT, INC.	112; Caravan Lodge
AUTOMATIC ELECTRIC SALES CORP.	2203-2204

COMPANY	HOTEL/BOOTH
AUTOMATIC METAL PRODUCTS CORP.	217
AUTOMATION DEVELOPMENT CORP.	2023
AVCO CORP.	116-117-118-119
AVNET CORP.	109-110-111; Jack Tar
BABCOCK RELAYS DIV. BABCOCK ELECTRONICS CORP.	316
BAIRD-ATOMIC, INC.	4427-4428
BALDWIN-LIMA-HAMILTON	4726-4727
BALL BROTHERS RESEARCH CORP.	4405
BALLANTINE LABORATORIES, INC.	2504
BARBER-COLMAN CO.	113-114
BARNES ENGINEERING CO.	4633-4634
BAUSCH & LOMB INC.	4315
THE BEAD CHAIN MANUFACTURING CO.	4105
BEATTIE-COLEMAN, INC.	1503
BECKMAN INSTRUMENTS, INC.	1606-1607-3104-3105-3106-3107-3108; Jack Tar
BEHLMAN-INVAR ELECTRONICS CORP.	416-417
BELDEN MANUFACTURING CO.	703-704
F. W. BELL, INC.	4017
BELOCK INSTRUMENT CORP.	4201; Sheraton-Palace
THE BENDIX CORP.	306-307-308-309-310-311-312-313-314-315
BIRD ELECTRONIC CORP.	1919-1920
THE BIRTCHEER CORP.	1808
BLILEY ELECTRIC CO.	1921
BLUE M ENGINEERING CO.	802-803
BOESCH MANUFACTURING DIV.	601
BOONTON ELECTRONICS CORP.	2408-2409
BOONTON RADIO CO.	2015-2016
BOURNS, INC.	3109-3110-3111
BOWMAR INSTRUMENT CORP.	1922-1923-1924-1925
BRACAMONTE & CO.	817
BRADLEY SEMICONDUCTOR CORP.	4611
W. H. BRADLEY CO.	812-813
BRANSON CORP.	4318
THE BRISTOL CO.	3409-3410
BUCKBEE MEARS CO.	1408
BURGESS BATTERY CO.	2321
BURNDY CORP.	4424-4425-4426
BURR-BROWN RESEARCH CORP.	3811
BURROUGHS CORP.	3619-3620
BURTON MANUFACTURING CO.	4706
BUSSMAN MANUFACTURING DIV. MCGRAW-EDISON CO.	1803
CBS LABORATORIES	3517-3518
CELCO PACIFIC DIV.	4108
C & K COMPONENTS, INC.	4510
CALCOR SPACE FACILITY, INC.	1215
CALIBRATION STANDARDS CORP.	4116
CALIFORNIA INSTRUMENTS CORP.	4231
CALIFORNIA TECHNICAL INDUSTRIES	1809-1810

COMPANY	HOTEL/BOOTH
CAMBLOCK DIV. OF WALTHAM PRECISION INSTRUMENT CO., INC.	814
CAMBRIDGE SCIENTIFIC INDUSTRIES, INC.	4643
CAMBRIDGE THERMIONIC CORP.	1619
CAMLOC FASTENER CORP.	1313
CANNON ELECTRIC CO.	2307-2308-2309
CAPITOL RADIO ENGINEERING INSTITUTE (CREI)	2623
CARPENTER MANUFACTURING CO., INC.	1218
CENTRAL VACUUM CORP.	716
CENTRE CIRCUITS, INC.	1214
CERAMASEAL, INC.	4539
CHICAGO DYNAMIC INDUSTRIES, INC.	3603
CHICAGO TELEPHONE OF CALIFORNIA, INC.	4321
CHRISTIE ELECTRIC CORP.	3422
CIMRON CORP.	4413
CINCH MANUFACTURING CO.	1301-1302-1303-1304
CINCH-MONADNOCK DIV., UNITED CAR-FASTENER	Hillsdale Inn, San Mateo
CIRCUIT DEVELOPMENT CO.	4444
CLARE CERAMICS, INC.	4309
C. P. CLARE & CO.	3604-3605
CLEVITE CORP.	2708-2709-2710-2711
CLEVITE TRANSISTOR	St. Francis Hotel
COHU ELECTRONICS, INC.	1926-1927
COIL WINDING EQUIPMENT CO.	901-902
COLEMAN ELECTRONIC SYSTEMS	4523
COMPO SHOE MACHINERY CO.	4012-4013
COLLINS RADIO CO.	209-210
COMPUTER CONTROL CO.	2524-2525-2526
COMPUTER MEASUREMENTS CO.	2115-2116
CONDUCTRON CORP.	4022
CONRAD, INC.	1310
CONSOLIDATED AVIONICS CORP.	4615
CONSOLIDATED ELECTRODYNAMICS CORP.	4019-4020-4021
CONSOLIDATED PRODUCTS CORP.	1107
CONSOLIDATED REACTIVE METALS, INC.	1216
CONTINENTAL CONNECTOR CORP.	503
CONTINENTAL DEVICE CORP.	Sheraton Palace*
CONTROLS CO. OF AMERICA	1308-1309
COOL-FIN ELECTRONICS CORP.	4638
COORS PORCELAIN CO.	3403-3404; Clift Hotel
CORBIN-FARNSWORTH, INC.	4103
CORNELL-DUBILIER ELECTRONICS DIV. OF FEDERAL PACIFIC ELECTRIC CO.	3514-3515-3516
CORNING GLASS WORKS	1912-1913-1914

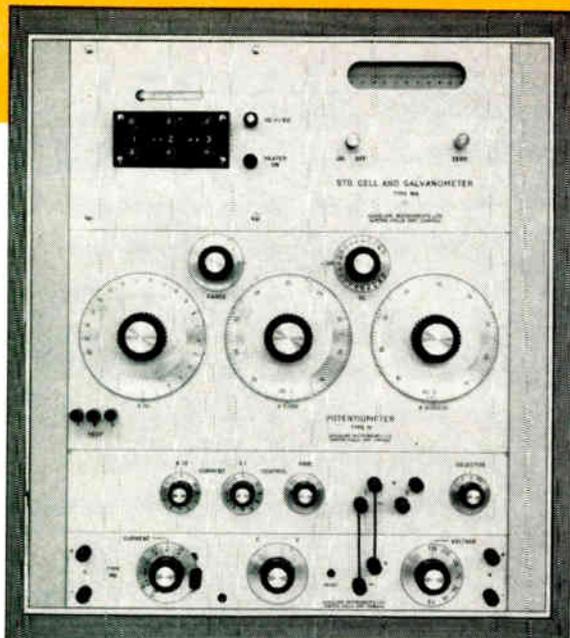
(Continued on page 47)

*Hospitality suite, exhibit, demonstration, seminar or technical tour. Contact company at hotel for exact information.

MODULARIZED *

CALIBRATION STANDARDS

* **NEW AT WESCON**



TYPE M



LTC-2

DC CURRENT/VOLTAGE STANDARD

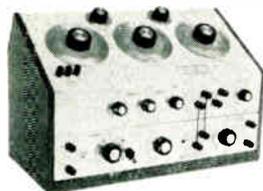
COMMANDER TYPE M — NEW HIGH ACCURACY DC POTENTIOMETER SYSTEM modularized for standard 19" rack mounting. Each module may be used independently. When employed together as a system, interconnection facilities are provided to speed up operation and reduce dependence on user technique. It consists of the following instrumentation:

■ **5 FIGURE, 3 DIAL, SHIELDED POTENTIOMETER** having measuring ranges of $-10 \mu\text{v}$ to 2 v in steps of $10 \mu\text{v}$ and $-1 \mu\text{v}$ to 0.2 v in steps of $1 \mu\text{v}$. All positions on the switches are individually calibrated points and there is no slidewire in the circuit. Accuracy is $\pm (0.003\%$ of reading $+1 \mu\text{v}$) on X1 range and $\pm (0.003\%$ of reading $+5 \mu\text{v}$) on X.1 range. Thermals are less than $0.5 \mu\text{v}$.

■ **CURRENT VOLTAGE RANGE EXTENSION UNIT** made up of seven 0.01% accurate, 4 terminal, standard resistors (0.01Ω to 10,000 Ω) enabling measurements from 0-10 amps and an overload protected 0.01% accurate volt ratio box enabling measurements from 0-750 v.

■ **± 10 PPM VOLTAGE REFERENCE**; 3 portable saturated cells installed in a small constant temperature enclosure.

■ **HIGH SENSITIVITY OIL DAMPED GALVANOMETER** with a double light spot.



Type M consisting of the potentiometer and range extension modules is available as a bench mounted system with 30° sloping top panel.

AC/DC CALIBRATION CONSOLE

MODEL LTC-2 — NEW AC/DC CURRENT/VOLTAGE CALIBRATION STANDARD featuring high speed operation up to 25 kc and digital readout. Designed for 19" rack or bench mounting, the console covers a range of 1 mv to 1000 v and $1 \mu\text{a}$ to 10 amps. Readout is in "% error" or actual values, 6 digits in steps of 1 mv on voltage and 5 digits in steps of $100 \mu\text{a}$ on current, except on currents below $100 \mu\text{a}$, 6 digits with $1 \mu\text{a}$ resolution. Accuracy is better than $\pm 0.035\%$.

To reduce calibration time a thermocouple reference circuit with better than 0.01% stability per hour has been designed. This permits direct AC readings without frequent AC-DC transfers.

The galvanometer is oil damped and relatively free from the effects of vibration. It has a clearly defined light spot and front panel zero control over the entire scale.

The console is completely shielded and when ordered case mounted is installed in a durable formica case. Compact — versatile — rugged, a Calibration Standard in both appearance and function.

MODEL RFS IS A NEW RF TRANSFER STANDARD enabling measurements from .5 ma to 100 amps and $1 \mu\text{v}$ to 300 v at frequencies up to 1000 mc and "state of the art" accuracies. Its availability in modular form makes it compatible for rack mounting in a single console with the AC/DC standards described above.

All Sensitive Research indicating instruments can be obtained as edgewise panel instruments with the same rigid performance specifications as their portable counterparts.

* **NEW AT WESCON — BOOTHS 2415/2416/2417**

Sensitive Research INSTRUMENTS

SINGER METRICS DIVISION, THE SINGER COMPANY
915 PEMBROKE STREET, TELEPHONE (203) 366-3201, BRIDGEPORT, CONNECTICUT — 06608



50-6

P.A. TRADEMARK OF THE SINGER COMPANY

EXHIBITORS (Continued)

COMPANY	HOTEL/BOOTH
COSTELLO & CO.	4632
C. E. COX CO.	4209
CRAIG CORP.	103
CRUCIBLE STEEL CO. OF AMERICA	1422-1423
CRYSTALONICS, INC.	4714
CUBIC CORP.	2529-2530
CURTISS-WRIGHT CORP.	2101-2102
DAGE ELECTRIC CO., INC.	320-321
DALE ELECTRONICS, INC.	2107-2108
DANA LABORATORIES	4804
DATA TECHNOLOGY CORP.	4806*
DATAPULSE, INC.	2407
DAVEN DIV. OF GENERAL MILLS, INC.	1722-1723
DAYSTROM, INC.	3607-3608-3609-3610-3611 and 3712-3713-3714-3715-3716
DEARBORN ELECTRONIC LABORATORIES, INC.	4314; Huntington Hotel
THE DECKER CORP.	4630-4631
DELCO RADIO DIV. GENERAL MOTORS CORP.	3814-3815
DELTA SEMICONDUCTORS, INC.	4535
DeMORNAY-BONARDI CORP.	2511-2512
DEMPA SHINBUN, INC.	4415-4416-4417-4418-4419 and 4639-4640
DEVICE SEALS, INC.	4134
DE VRY TECHNICAL INSTITUTE	2607
DEWCO SALES, INC.	207
DIALIGHT CORP.	4528-4529
DI/AN CONTROLS, INC.	4206-4207
DICKSON ELECTRONICS CORP.	4540
DIGINAMICS	2405
DIGITAL EQUIPMENT CORP.	4641-4642
DIX ENGINEERING CO.	815
THE DOALL CO.	1327-1328
DODGE FIBERS CORP.	1217
DORMEYER INDUSTRIES	4808
DOW CORNING CORP.	1014-1015
DRESSEN-BARNES ELECTRONICS CORP.	2120-2121
WILBUR B. DRIVER CO.	622
DRIVER-HARRIS CO.	1411
E. I. DuPONT de NEMOURS & CO., INC.	910-911-912-913
DURA-BOND BEARING CO.	615
DURANT MANUFACTURING CO.	4304
DYMEC, A DIV. OF HEWLETT-PACKARD CO.	2722-2723
DYMO INDUSTRIES, INC.	1018
DYNALECTRON CORP., STEPPER MOTORS DIV.	4621
DYNAMIC GEAR COMPANY, INC.	3116
DYNASCAN CORP.	4433
E-H RESEARCH LABORATORIES, INC.	4319-4320
ESC ELECTRONICS CORP.	2503
ETC INC.	4704-4705
EASTERN INDUSTRIES	3615-3616
EDGERTON, GERMESHAUSEN & GRIER, INC.	4718-4719
JACKSON EDWARDS CO.	3405
EITEL-McCULLOUGH, INC.	2310-2311-2312
ELASTIC STOP NUT CORP. OF AMERICA	2714-2715-2716
ELCO CORP.	2124-2125
ELECTRA MANUFACTURING CO.	2118-2119
ELECTRALAB ELECTRONICS CORP.	4530
ELECTRIC MOTOR ENGINEERING, INC.	4608

COMPANY	HOTEL/BOOTH
THE ELECTRIC STORAGE BATTERY CO.	4244
Missile Battery Division	
ELECTRICAL INDUSTRIES	3020
Div. of Philips Electronics & Pharmaceutical Industries Corp.	
ELECTRO DEVICES, INC.	916
ELECTRO ENGINEERING WORKS	1806
ELECTRO INSTRUMENTS, INC.	2109-2110
ELECTRO-MECHANICAL INSTRUMENT CO.	4403
THE ELECTRO MOTIVE MFG. CO., INC.	4543
ELECTRO SCIENTIFIC INDUSTRIES, INC.	2317-2318 2319-2320; International Inn, South San Francisco
ELECTRO SWITCH CORP.	4517
ELECTROCHIMICA CORP.	4501
ELECTRONIC ASSOCIATES, INC.	2213 and 2302-2303
ELECTRONIC ENCLOSURES, INC.	1012-1013 1110-1111
ELECTRONIC ENGINEERING CO. OF CALIFORNIA	519-520 521-522
ELECTRONIC INSTRUMENT CO., INC. (EICO)	4308
C/o Erlanger Sales Company	
ELECTRONIC MEASUREMENTS CO., INC.	4228-4229
ELECTRONIC RESEARCH ASSOCIATES, INC.	201
ELECTRONIC SALES-MARKETING ASSOCIATION	Jack Tar*
ELECTROPLEX, INC.	4814
ELGIN NATIONAL WATCH CO.	2210
ELECTROVERT, INC.	4009
ELGEET OPTICAL CO., INC.	4241
EMERSON & CUMING, INC.	2808-2809
EMPIRE DEVICES, INC.	4623-4624-4625
ENGELHARD INDUSTRIES, INC.	3617-3618 2701-2702
EPSCO, INC.	
EQUIPTO ELECTRONICS CORP.	1003-1004
ESTERLINE ANGUS INSTRUMENT CO., INC.	4438-4439
EUBANKS ENGINEERING CO.	605
EXACT ELECTRONICS, INC.	4203
EXIDE INDUSTRIAL MARKETING DIV.	4243
The Electric Storage Battery Co.	
FAIRCHILD CAMERA & INSTRUMENT CORP., Fairchild Semiconductor	3412-3413-3414 3415-3416-3417 3418-3419-3420 3421
FANSTEEL METALLURGICAL CORP.	2912-2913-2914
FENWAL ELECTRONICS, INC.	3818
FERRANTI ELECTRIC INC.	2515-2516
FERROXCUBE CORP. OF AMERICA	4506-4507
FILMOHM CORP.	4323
FILTORS, INC.	3406-3407-3408
THE FILTRON CO., INC.	1613
FLITE ELECTRONIC WIRE & COMPONENTS, INC.	706
FLOATS, INC.	4127
FLOTRON INDUSTRIES, INC.	717-718
JOHN FLUKE MFG. CO., INC.	3220-3221; Jack Tar
FORK STANDARDS, INC.	4113
FRANKLIN ELECTRONICS, INC.	3817
OTTO FREI	4011
FURANE PLASTICS, INC.	1022
FUTURECRAFT CORP.	4802

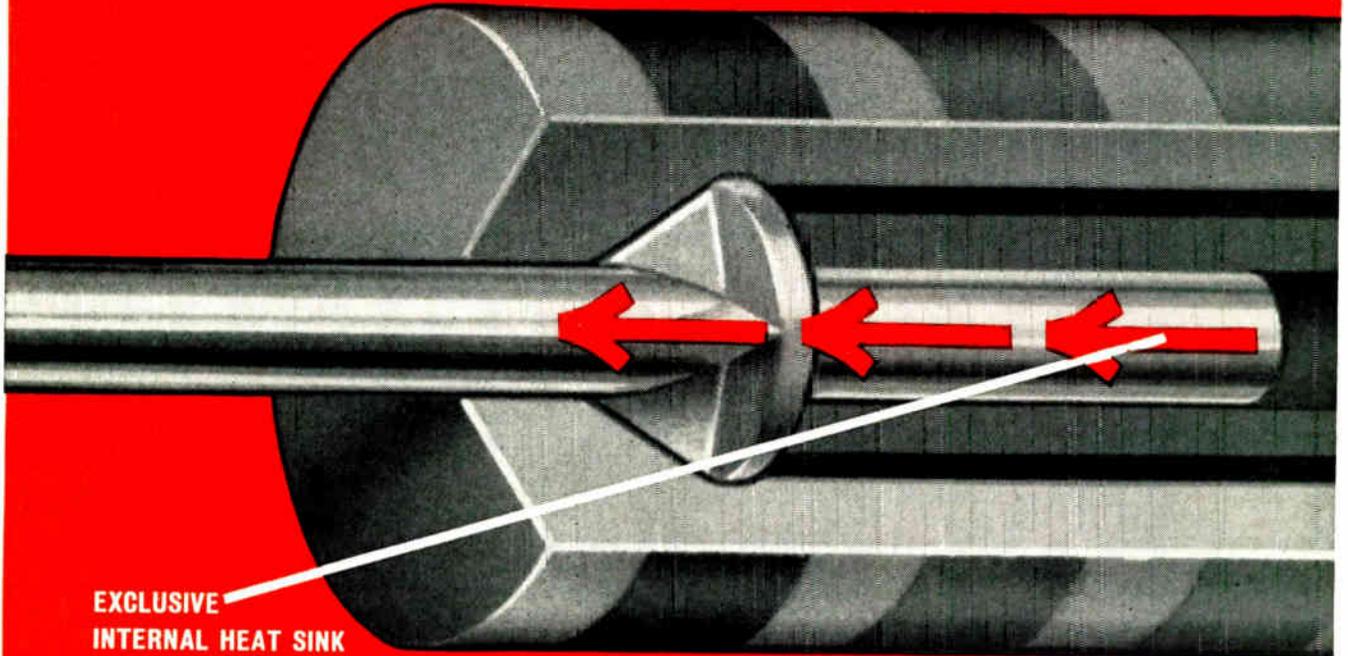
COMPANY	HOTEL/BOOTH
G-L ELECTRONICS CO., INC.	3816
THE GAMEWELL CO.	4140-4141; International Inn
GARLOCK ELECTRONIC PRODUCTS	4238
THE GARRETT CORP.	4617-4618
W. K. GEIST CO.	3812-3813
GENERAL COMMUNICATION CO.	4645
GENERAL CONTROLS CO.	4432
GENERAL ELECTRIC CO.	2801-2802-2803-2804-2805-2806-2807 and 2816-2817-2818-2819
GENERAL EQUIPMENT & MFG. CO.	2820-2821-2822 4301
GENERAL INSTRUMENT CO.	Fairmont
GENERAL MAGNETIC CORP.	4741
GENERAL PRECISION, INC.	3004-3005-3006-3007 3008-3009-3010-3011
GENERAL RF FITTINGS, INC.	4644
GENERAL RADIO CO.	2215-2216-2217-2218
GENERAL RADIOTELEPHONE CO.	4545
GENERAL RESISTANCE, INC.	4314
GENERAL TIME CORP.	3613-3614
GENISCO INC.	2601-2602-2603
GENISTRON INC.	Villa Chartier*
GERTSCH PRODUCTS, INC.	1620-1621-1622-1623
GLOBE INDUSTRIES, INC.	501-502
GOE ENGINEERING CO.	619
THE B. F. GOODRICH SPONGE PRODUCTS	4601
B. F. GOODRICH RIVNUT DIV.	818
W. L. GORE & ASSOCIATES, INC.	611
GORMAN MACHINE CORP.	1201
GOULD-NATIONAL BATTERIES, INC.	4215-4216
GRANGER ASSOCIATES	2704-2705
GRANT PULLEY & HARDWARE CORP.	607
GRAPHIC CONTROLS CORP.	4712
Technical Recording Chart Div.	
GRAYHILL, INC.	3711
GREMAR MANUFACTURING CO., INC.	1506
GUARDIAN ELECTRIC MANUFACTURING CO.	122-123
GUDEBROD BROS. SILK CO., INC.	921
GULTON INDUSTRIES	4402
W. & L. E. GURLEY	2706
HI-G, INC.	2501-2502
HAFSTROM-THOMPSON, INC.	4302
HALLIBURTON ENTERPRISES, INC.	612-613
Manufacturing Division	
HAMILTON WATCH CO.	4006
Precision Metals Division	
HARDWICK, HINDLE, INC.	4210
HARRISON LABORATORIES	2720-2721
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THE HARTWELL CORP.	614
HASTINGS-RAYDIST, INC.	202
THE A. W. HAYDON CO.	2813-2814
C. I. HAYES, INC.	4007
HEINEMANN ELECTRIC CO.	3801-3802
HELLER INDUSTRIES, INC.	606
HERMETIC SEAL CORP.	1705-1706
CARL HERRMANN ASSOCIATES	3021-3022
HEWLETT-PACKARD CO.	2006-2007-2008 2009-2010-2011
HEXACON ELECTRIC CO.	711
THE HICKOK ELECTRICAL INSTRUMENT CO.	3216-3217
J. T. HILL CO.	2509-2510
HIRSCHMANN CORP.	1325

(Continued on page 48)

*Hospitality suite, exhibit, demonstration, seminar or technical tour. Contact company at hotel for exact information.

In **FIXED COMPOSITION RESISTORS**

if it's news, expect it first from IRC



**EXCLUSIVE
INTERNAL HEAT SINK**

IRC Fixed Composition Resistors **RUN COOLER**

HERE'S WHY . . . IRC's resistance element is a film of carbon composition thermally bonded to a glass body. Exclusive talon leads extend far into the body and act as heat sinks to conduct heat away from the "hot spot" and out of the resistor.

60% of the heat generated in an IRC resistor is removed by this metallic conduction. 35% is carried off by convection, and 5% by radiation.

Other Fixed Composition Resistors use a solid carbon slug element. Without metallic conduction from the center of the resistor, their typical operating temperatures range from 6 to 14% higher than IRC's.

For better load life and long term stability, specify IRC MIL-R-11 resistors. Write for GBT Bulletin. International Resistance Co., Philadelphia 8, Pa.

PERFORMANCE ADVANTAGES

IRC Type GBT's also provide

- Stronger termination
- Weldable leads
- Outstanding load life
- Greater moisture protection
- Better resistance-temperature characteristics
- Superior high frequency characteristics
- Ranges to 100,000 megohms



EXHIBITORS (Continued)

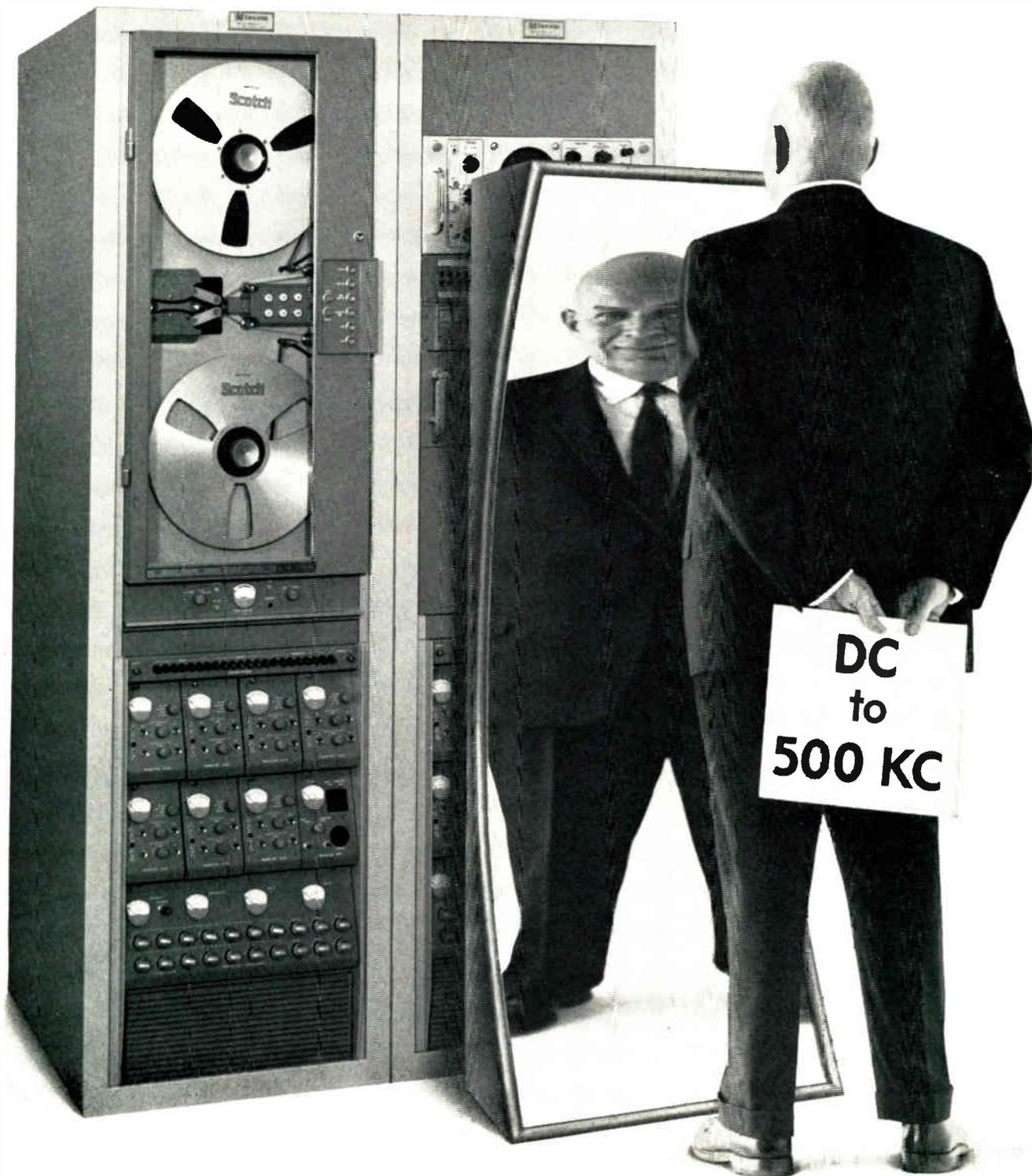
COMPANY	HOTEL/BOOTH
HOFFMAN ELECTRONICS CORP.	1906-1907-1908
KENNETH C. HOLLOWAY, INC.	4010
HOLLYWOOD PLASTICS, INC.	4001
HONEYWELL	3504-3505-3506-3507-3508-3509-3510-3511
HONEYWELL DENVER DIV.	Stewart Hotel
HOPKINS ENGINEERING CO.	3503
HORIZON HOUSE, INC.	2606
HOUSTON INSTRUMENT CORP.	4434
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HUGGINS LABORATORIES, INC.	1724-1725-1726
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Vacuum Tube Products Division	
HUGHES AIRCRAFT CO.	1204; Sir Francis Drake*
Videasonic Systems Division	
HUGHES COMPONENTS GROUP	1413-1414-1415-1416
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HULL CORP.	1203
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HURLETRON INC.	2527-2528
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IDEAL PRECISION METER CO., INC.	208
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INDUSTRIAL INSTRUMENTS, INC.	4609
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INFRARED INDUSTRIES, INC.	4518
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INTERCONTINENTAL INSTRUMENTS, INC.	4503
INTERNATIONAL EASTERN CO.	1011
INTERNATIONAL ELECTRONIC RESEARCH CORP.	1501-1502
INTERNATIONAL INSTRUMENTS, INC.	4306
INTERNATIONAL RECTIFIER CORP.	2304-2305-2306
INTERNATIONAL RESEARCH & DEVELOPMENT CORP.	4801
INTERNATIONAL RESISTANCE CO.	1813-1814-1815-1816-1817
INTERNATIONAL TELEPHONE & TELEGRAPH CORP.	407-408-409-410-411
J-B-T INSTRUMENTS, INC.	2514
JFD ELECTRONICS CORP.	3212-3213
St. Francis	
JENNINGS RADIO MANUFACTURING CORP.	1901-1902-1903
THE JERROLD CORP.	3705-3706-3707-3708-3709-3710
JONATHAN MANUFACTURING CO.	1002
KAISER ALUMINUM & CHEMICAL CORP.	1420-1421

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KAY ELECTRIC CO.	3117-3118
KAYNAR MFG. CO., INC.	715
KEINATH INSTRUMENT CO.	4803
KEITHLEY INSTRUMENTS, INC.	2103-2104
KENT MANUFACTURING CORP.	4445
KEPCO, INC.	3001-3002
KESTER SOLDER CO.	709
KEWAUNEE SCIENTIFIC EQUIPMENT	1020
KEY RESISTOR CORP.	2815
KING ENGINEERING CO.	121 and 1407
Fairmont Hotel*	
KINGS ELECTRONICS CO., INC.	4817
KINGSLEY MACHINE CO.	920
MATHIAS KLEIN & SONS, INC.	1318
KLEINSCHMIDT, DIV. OF SCM CORP.	4211-4212
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KROHN-HITE CORP.	4616
KULICKE & SOFFA MFG. CO.	1219-1220
KURMAN ELECTRIC CO.	4622
K. O. LEE CO.	4245
LEL, INC.	4708
LABORATORY FOR ELECTRONICS	2412
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LAMINATED SHIM CO., INC.	1106
LANDIS & GYR, INC.	4014; Jack Tar
LARSON INSTRUMENT CO.	4312
LAVOIE LABORATORIES, INC.	2707
LEACH CORP.	1909-1910-1911
LEEDS & NORTHRUP CO.	4107
LENKURT ELECTRIC CO., INC.	1804-1805
LERNER ELECTRONICS	Mark Hopkins*
G. B. LEWIS CO.	1115-1116
LEYMAN CORP.	4542
Magnetics Division	
LICON DIVISION	3612
Illinois Tool Works, Inc.	
LINDBERG ENGINEERING CO.	904
LING-TEMCO-BOUGHT, INC.	422
LITTELFUSE, INC.	401
LITTON INDUSTRIES, INC.	3205-3206-3207-3208-3209-3210, 3312-3313-3314-3315-3316-3317;
Fairmont	
LITRELL WESTERN SALES, INC.	1205
LOCKHEED AIRCRAFT CORP.	4120-4121-4122
LORAL ELECTRONICS CORP.	3804-3805-3806-3807-3808; Thunderbird
LORD MANUFACTURING CO.	403-404
LUMATRON ELECTRONICS, INC.	4409
MAC PANEL CO.	4637
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MM ELECTRONIC ENCLOSURES, INC.	819
MACDONALD & CO.	618
MAGNECRAFT ELECTRIC CO.	504
MAGNETIC METALS CO.	4715
MAGNETIC SHIELD DIV.	1314
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MALCO MANUFACTURING CO.	4008
P. R. MALLORY & CO., INC.	1715-1716-1717
MARCO INDUSTRIES CO.	4442
MARCONI INSTRUMENTS	4728-4729
MARKEM MACHINE CO.	4101
MARSHALL INDUSTRIES	1603-1604-1605

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MEASUREMENTS, A McGraw-Edison Div.	2911
MELABS	4225
ADOLF MELLER CO.	1021
MELPAR, INC.	4230
Special Products Div.	
MEPCO, INC.	203-204
METALPHOTO CORP.	1008
METCOM, INC.	4324
METEX ELECTRONICS CORP.	617
METHODE ELECTRONICS, INC.	4717
METRONIX	4614
MICRO DYNAMICS CORP.	4003
MICRO-RADIONICS, INC.	4129-4130
MICRO STATE ELECTRONICS CORP.	4146
MICRO SYSTEMS, INC.	4532
MICRO TECH MANUFACTURING CO.	4004
MICRODOT, INC.	2322-2323-2324
MICROLAB	4713
MICRONIA AMPLIFIER CORP.	4401
MICROTRAN COMPANY, INC.	2910
MICROWAVE ASSOCIATES, INC.	512-513
MICROWAVE DEVELOPMENT LABORATORIES, INC.	3803
MICROWAVE ELECTRONICS CORP.	4731; Fairmont*
MIDWESTERN INSTRUMENTS	Del Webb's Towne House*
JAMES MILLEN MFG. CO., INC.	402
J. W. MILLER CO.	2003
MILLER-STEPHENSON CHEMICAL CO.	1120
MILLIPORE FILTER CORP.	4102
MILLIVAC INSTRUMENTS, INC.	120
MINCOM DIV.	1611-1612
Minnesota Mining & Manufacturing Co.	
C. H. MITCHELL CO.	1305
MITRONICS, INC.	4738
MOBIL-TRONICS CO., INC.	1206
MONITOR PRODUCTS CO., INC.	1610
F. L. MOSELEY CO.	2013-2014
MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.	4223-4224
MOTOROLA SEMICONDUCTOR PRODUCTS, INC.	106-107-108
MOXON ELECTRONICS	2113-2114
MUCON CORP.	4239
MYCALEX CORP. OF AMERICA	1409-1410
MYSTIK TAPE, INC.	608
McCOY ELECTRONICS CO.	2513
McKEE AUTOMATION CORP.	4436
McLEAN ENGINEERING LABORATORIES	420
NJE CORP.	4412
NRC EQUIPMENT CORP.	4521-4522
NANOSECOND SYSTEMS, INC.	4707
NARDA MICROWAVE CORP.	2401-2402
NATIONAL BERYLLIA CORP.	807
NATIONAL CONNECTOR CORP.	4443
NATIONAL RADIO CO., INC.	2207-2208-2209
NATIONAL SEMICONDUCTOR CORP.	4440-4441
NATIONAL VULCANIZED FIBRE CO.	713-714
NAVIGATION COMPUTER CORP.	4307
NEFF INSTRUMENT CORP.	4410
NEW DEPARTURE DIV. of General Motors Corp.	1118
NEW HERMES ENGRAVING MACHINE CORP.	1320
THE J. M. NEY CO.	2214
NIPPON ELECTRIC CO., LTD.	4716
NON-LINEAR SYSTEMS, INC.	2313-2314-2315-2316

(Continued on page 53)

*Hospitality suite, exhibit, demonstration, seminar or technical tour. Contact company at hotel for exact information.



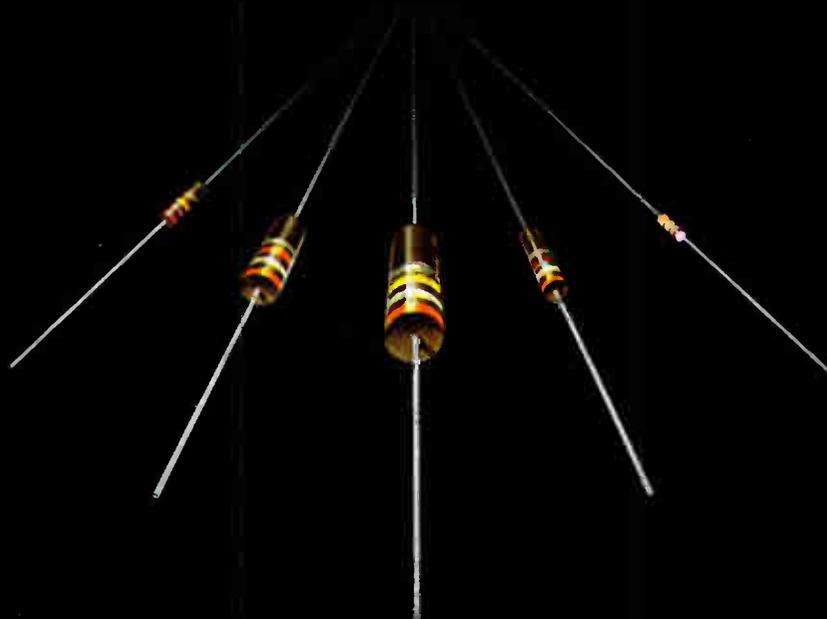
WIDEBAND FM recording, using 1.5-megacycle analog techniques to attain an improved frequency response of DC-500 kc, is Mincom's latest telemetry development. Heart of the new system is the standard Mincom 1.5-mc CM-114 Recorder/Reproducer. The extended FM responses enable telemetry facilities to record simultaneously the most complex narrow-band and wideband signals in PCM, PCM/FM, PDM, and FM/FM modulation. More advantages: Extended low frequency response, excellent linearity, seven or fourteen recording tracks, versatility without modification, greater dynamic range, dropout reduction virtually to zero. Write today for details and complete specifications.

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COMPANY

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OVER TEN BILLION A-B HOT MOLDED RESISTORS

and not even one catastrophic failure



ALLEN-BRADLEY HOT MOLDED FIXED RESISTORS.
SHOWN ACTUAL SIZE. ARE AVAILABLE IN ALL STANDARD EIA
AND MIL-R-11 RESISTANCE VALUES AND TOLERANCES

■ Such an outstanding record of resistor performance—accumulated over some twenty-five years—clearly demonstrates the all around reliability of Allen-Bradley hot molded resistors. It is more conclusive proof of the total reliability of the A-B resistors than could be produced by any massive testing program. The unique Allen-Bradley hot molding process results in such uniformity from resistor to resistor—year after year—that long term performance can be accurately predicted.

Because the many years of use in the most critical applications have established the reputation of Allen-Bradley hot molded resistors for their stable characteristics and

conservative ratings, they are generally “required” in today’s critical military and industrial electronic circuitry.

Let your own circuitry benefit from the reliability that’s based on more than ten billion field proven resistors—without a single failure. For detailed specifications on Allen-Bradley’s resistors, please send for Technical Bulletin 5050. You also should have Publication 6024, which briefly describes the full line of Allen-Bradley quality electronic components. Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis.

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

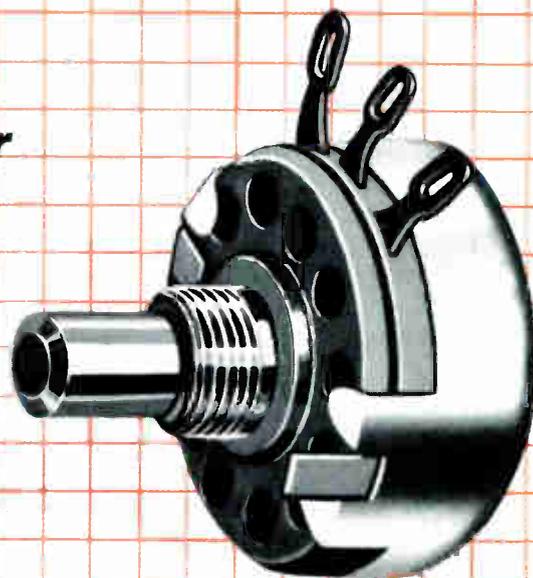


ALLEN-BRADLEY

QUALITY ELECTRONIC COMPONENTS

World Radio History

***Allen-Bradley's Type J is the
only hot molded Potentiometer
with a 25-year record of
unfailing service***

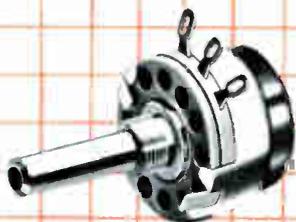


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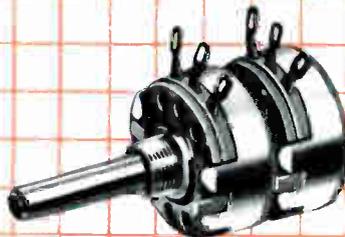
Type J controls are rated 2.25 watts at 70°C and are available in special as well as standard tapers . . . and in standard total resistance values up to 5 megohms. Higher resistance values and various mechanical variations can also be furnished to fit your special requirements.



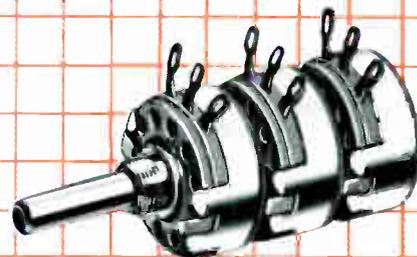
Type J
(encapsulated)



Type JS



Type JJ



Type JJJ

■ Over "25 years" much can go wrong — but no A-B hot molded potentiometer has failed in service to date. And, the A-B potentiometers of today are superior to those built 25 years ago, because continuing improvements have been made over the years to make sure the Type J has no equal for performance.

Today, the Type J hot molded potentiometers can claim: Longest life, yet high wattage rating in a compact structure; stability under the most demanding conditions; extremely low noise level; smooth, stepless control.

And here are the reasons: Type J solid resistance element made by A-B's exclusive hot molding process; and

A-B's production control of resistance-rotation characteristics. These reasons account for the fact that the Type J potentiometer provides consistently uniform characteristics . . . that the Type J assures complete freedom from catastrophic failures . . . that the Type J eliminates the incremental steps of wire-wound units, and provides the freedom from inductance which insures excellent high frequency response.

For full details on Type J potentiometers, write for Publication 5200, please: Allen-Bradley Co., 222 West Greenfield Ave., Milwaukee 4, Wisconsin. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario.

EXHIBITORS (Continued)

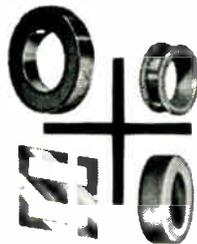
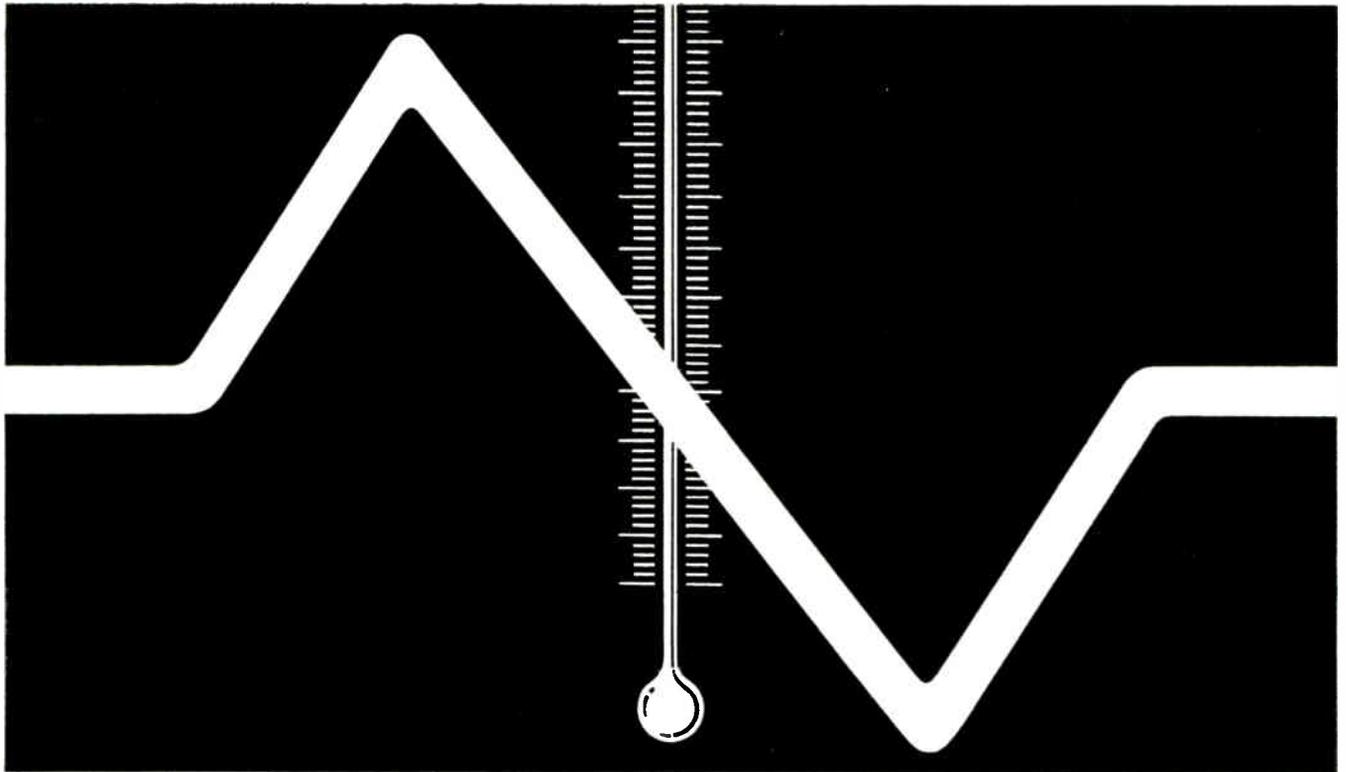
COMPANY	HOTEL/BOOTH
NORTH ATLANTIC INDUSTRIES	
INC.	4217-4218; Del Webb's Towne House
NORTHEASTERN ENGINEERING,	
INC.	4602-4603
NORTH ELECTRIC CO. 1707-1708-1709	
NORTHWEST SALES AND	
ENGINEERING SERVICE CO. 4414	
PAUL NURCHES CO.	4015
NYLOK WESTERN	820-821
Division of The Nylok Corporation	
OHMITE MANUFACTURING CO.	
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OMARK INDUSTRIES, INC.	1108
OMNITRONICS, INC.	4805
OMNI SPECTRA, INC.	4235
OPTICAL COATING LABORATORY,	
INC.	822
OPTIMATION, INC.	4112
OPTO-ELECTRONIC DEVICES,	
INC.	4236
JOHN OSTER MANUFACTURING	
CO.	3519-3520
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PEK LABS, INC. 3704	
PRD ELECTRONICS, INC. 1904-1905	
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PACIFIC SCIENTIFIC CO. 305A-2519	
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TELEGRAPH CO. 4812-4813	
PALO ALTO ENGINEERING	
CO.	2004-2005
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Div.	1112
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GEORGE A. PHILBRICK	
RESEARCHES, INC. 4739	
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	4724-4725; Richelieu
PIC DESIGN CORP.	507
PICO CRIMPING TOOLS CO.	4002
PIDDINGTON & ASSOCIATES	
LIMITED	909
PLASTIC CAPACITORS INC.	2909
POLARAD ELECTRONCS CORP.	
	2105-2106; Fairmont
POMONA ELECTRONICS CO.,	
INC.	4016
POTTER & BRUMFIELD 2001-2002	
POTTER INSTRUMENT COMPANY,	
INC.	4124-4125-4126;
	Dinah's Motel, Palo Alto
POWER DESIGNS, INC. 4018; Clift Hotel	
PRECISION INSTRUMENT CO. 205-206	
PRECISION LABORATORY	
PRODUCTS	4005
PRECISION SCIENTIFIC CO.	808-809
PRICE ELECTRIC CORP.	2812
PROBESCOPE CO., INC.	4604
PRODELIN, INC.	4422-4423
PULSE ENGINEERING, INC.	4411
Velonix Div.	
THE PYLE-NATIONAL CO. 4709-4710	
PYROFILM RESISTOR CO., INC. 4429	

COMPANY	HOTEL/BOOTH
QUALITRON CORP. 2325	
QUAN-TECH LABORATORIES,	
INC. 2712-2713	
RS ELECTRONICS CORP. 2520	
RADIATION INC. 2719	
RADIATION MATERIALS, INC. 707	
RADIATION AT STANFORD 2717-2718	
RADIO CORP. OF AMERICA	
	3201-3202-3203-3204 and
	3318-3319-3320-3321
RADIO FREQUENCY LABORATORIES,	
INC.	3214-3215
RANTEC CORP.	2604-2605
RAYCHEM CORP.	212-213
RAYTHEON CO. 3601-3602-3603-3718-	
	3719-3720-3721-3722
RAYTHEON CO. 1210-1211	
Production Equipment Div.	
RAYTHEON SEMICONDUCTOR	
	Sheraton-Palace
REDCOR CORP. 4541	
REEVES INSTRUMENT	
CORP.	301-302-303
REEVES SOUNDRAFT CORP.	1505
REMANCO, INC.	4816
RENWELL INDUSTRIES,	
INC.	1522-1523
RHEEM ELECTRONICS	
CORP.	3401-3402
RIMAK ELECTRONICS, INC.	1322
ROBINSON TECHNICAL PRODUCTS,	
INC.	4742-4743
Kupfrian Manufacturing Div.	
ROCKBESTOS WIRE & CABLE	
CO.	1009
Div. of Cerro Corporation	
ROHDE & SCHWARZ SALES CO.	
(USA), INC.	3809-3810
ROSEMOUNT ENGINEERING CO. 4810	
THE MILTON ROSS CO. 4213	
ROTRON MANUFACTURING	
CO., INC.	4420-4421
THE ROWAN CONTROLLER	
CO.	4317 and 4123
RUTHERFORD ELECTRONICS	
CO.	2111-2112
STL PRODUCTS 4537-4538	
Div. of Space Technology Labs., Inc.	
STACO, INC. 4430	
LES SACHS ASSOCIATES 616	
SAGE LABORATORIES, INC. 4219	
SANBORN CO. 2017-2018-2019-2020	
SANDERS ASSOCIATES, INC. 505-506	
SAN FERNANDO ELECTRIC	
MANUFACTURING CO. 2021-2022	
SANGAMO ELECTRIC CO.	
	1701-1702-1703 and 2205
SARKES TARZIAN, INC. 1524-1525	
SCHWARZER CORP. 4104	
SCHWARZSCHILD ASSOCIATES 4303	
SCIENTIFIC-ATLANTA, INC.	
	2507-2508; Broadway Manor
SEAELECTRO CORP. 2907-2908	
SECURITY DEVICES	
LABORATORY 4437	
Electronics Div.	
SELECTIONS LIMITED 1221	
SERVO DEVELOPMENT CORP. 4406	
SERVONIC INSTRUMENTS, INC. 4508	
SHALLCROSS MANUFACTURING	
CO.	4139
SHEPARD-WINTERS CO., INC. 4619	
SHEROLD CRYSTALS, INC. 4620	
SHIELDING 4023-4024	
Div. of Shieldtron, Inc.	
H. M. SHOEMAKER &	
ASSOCIATES 319	
SIERRA ELECTRONIC 2201-2202;	
	Jack Tar
Div. of Philco Corp.	
SIGMA INSTRUMENTS,	
INC.	3621-3622
SILICON TRANSISTOR CORP. 4128	
SIMPLEX WIRE & CABLE CO. 1419	

COMPANY	HOTEL/BOOTH
SIMPSON ELECTRIC	
CO.	1801-1802; Fairmont*
Div. of American Gage & Machine Co.	
SINGER METRICS DIV. 2415-2416-	
	2417-2418-2419-2420
The Singer Manufacturing Co.	
THE SIPPICAN CORP. 805	
SKYDYNE, INC. 905-906	
SLIDING MECHANISMS, INC. 719	
HERMAN H. SMITH, INC. 2123	
SOLA ELECTRIC CO. 3101-3102-3103	
SOLID STATE PRODUCTS,	
INC.	4519-4520
SONY CORP. OF AMERICA 4119	
SORENSEN 2410-2411	
A Unit of Raytheon Co.	
SOUTHCO DIVISION, SOUTH	
CHESTER CORP.	903
SOUTHERN ELECTRONICS CORP. 1517	
SPACEONICS INC./PORTABLE	
ELECTRIC TOOLS, INC.	4144
SPAULDING FIBRE CO.	1019
SPECIFIC PRODUCTS	1718
SPECTRA-PHYSICS, INC.	2404
SPECTRA-STRIP WIRE & CABLE	
CORP.	806
SPECTROL ELECTRONICS	
CORP.	3512-3513
SPECTRUM INSTRUMENTS,	
INC.	4135
SPERRY MICROWAVE ELECTRONICS	
CO.	218-219-220-221
Div. of Sperry Rand Corp.	
SPRAGUE ELECTRIC CO. 1818-1819-	
	1820-1821-1822
SPRAGUE ELECTRIC CO. 4214	
Dynacor/Sky-Borne	
STANCOR ELECTRONICS, INC. 1811	
STERLING INSTRUMENT 2703	
Div. of Designatronics, Inc.	
STEVENS-ARNOLD, INC. 514-515	
STEWART ENGINEERING CO. 4504	
STEWART STAMPING CO. 1001	
STONE & SMITH, INC. 810-811	
STRUTHERS-DUNN, INC. 4202	
SUN ELECTRIC CORP. 4544	
THE SUPERIOR ELECTRIC CO.	
	1518-1519-1520-1521
SWITCHCRAFT, INC. 1508	
SYLVANIA ELECTRIC PRODUCTS,	
INC.	2901-2902-2903-
	2904-2905-2906 and
	2917-2918-2919
	2920-2921-2922
SYNTHANE CORP. 1412	
SYSTRON-DONNER	
CORP.	2521-2522-2523*
TRG, INC. 4142-4143	
TRW ELECTRONICS 412-413-414-	
	415-508-509-510-511
TALLY REGISTER CORP. 4730	
TAMAR ELECTRONICS,	
INC.	1401-1402-1403
TECH-SER, INC. 2211-2212	
TECHNIBILT CORP. 1326	
TECHNICAL DEVICES CO. 701-702	
TECHNICAL WIRE PRODUCTS,	
INC.	1202
TECHNI-RITE ELECTRONICS,	
INC.	4133
TEKTRONIX, INC. 1915-1916-1917	
	1918; Del Webb's Towne House
TELETYPE CORP. 4131-4132	
TELEX, INC. 2505-2506	
TELONIC ENGINEERING CORP. 4605	
TELONIC INDUSTRIES, INC. 418-419	
TENSOLITE INSULATED WIRE,	
PACIFIC DIV.	*
TERADYNE, INC. 4305	
TEST EQUIPMENT CORP. 4115	
TEXAS INSTRUMENTS	
INCORPORATED	3303-3304-3305-
	3306-3307-3308;
	St. Francis*

(Continued on page 164)

*Hospitality suite, exhibit, demonstration, seminar or technical tour. Contact company at hotel for exact information.



Compensating for temperature extremes? Get more from magnetics

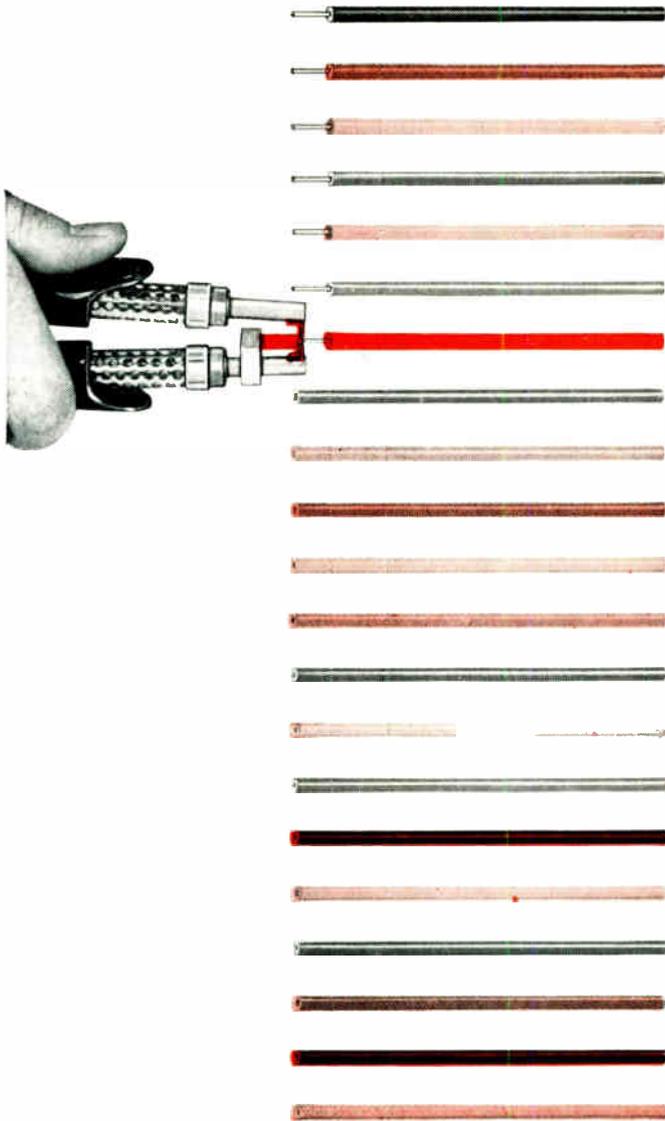
THE CORE: Tape wound cores of Supermendur in GVB or anodized aluminum boxes perform well at temperatures as high as 200°C, and are ideal for many military applications. A good choice for lower frequency filters when *temperature extremes* are encountered may be an inductance stabilized 160 mu moly-permalloy core. When using linear permalloy powder cores with polystyrene capacitors for audio filter networks, you'll find that *temperature fluctuations* have little effect on frequency stability, even when those fluctuations range from -55°C to +85°C. Finding exactly the right core for the application has been known to take development time, many guesses and some costly over-engineering. Best way to solve the problem is to give it to the *man from Magnetics Inc.* next time he's nearby. He likes to help solve brain-teasers that make use of his specialized experience.

THE MORE: Though Magnesil® tape cores have a temperature range as high as Supermendur, the latter has a higher flux density. As a result, Supermendur makes possible size and weight reduction. When using linear permalloy cores with polystyrene capacitors instead of temperature stabilized moly-permalloy and silvered mica capacitors for filters, you can reduce costs as much as 50%—proof that searching for the right components for your specific application can mean real economy and better performance. We can help, since we produce and stock hundreds of laminations, flake, powder, bobbin and tape wound cores. Thus, we can provide the technical data and service often needed in design and selection. If you have a sticky problem now and can't wait to talk to the *man from Magnetics Inc.*, write details on your letterhead to Magnetics Inc., Dept. EI-8 Butler, Pa.

TOTAL ASSISTANCE, SERVICE, SELECTION/GET THE MORE FROM MAGNETICS



NOW
ANYONE CAN
STRIP WIRE
ALL DAY
WITHOUT
NICKING!



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.

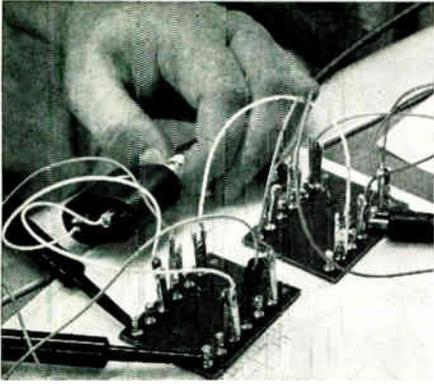
Sold Through America's Leading Distributors. IN CANADA: IDI ELECTRIC (CANADA) LTD., AJAX, ONTARIO

TRY IT IN YOUR SHOP!

IDEAL INDUSTRIES, Inc.
 5127-H Becker Pl., Sycamore, Illinois

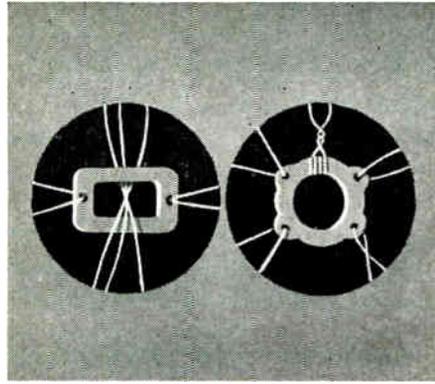
- Please arrange a trial for me
- Send data only

Name _____
 Company _____
 Address _____
 City _____ Zone _____ State _____



Despite the tremendous speed and ravenous appetite of today's most advanced computers, scientists at Lockheed Missiles & Space Company's Computer Research Laboratories feel that there is room for a great deal of improvement. They have dedicated themselves to the discovery and development of ways to increase the speed and reliability of computers while simplifying their operation.

Though today's computer circuits are capable of operating at speeds measured in tens of nanoseconds, the useful computation rate is far slower. One of the roadblocks hindering speed is the need for the computer to wait for the carryovers from one column of figures to catch up with the main calculation. A possible an-



swer to this problem is modular arithmetic, which avoids carryover. Based on the ancient Chinese Remainder Theorem, this concept is being re-examined at Lockheed for potential computer applications.

Lockheed's Computer Research Laboratories are studying a very broad group of related computer research areas, and the company can boast that an unusual number of its specialists are at the very forefront of their specific fields.

Among the major areas of research being undertaken at this time are basic physical phenomena, such as phonons; quantum mechanics; switching theory; residue arithmetic (number system research); threshold logic and pattern recognition and logic design techniques.

LOOK AT LOCKHEED... AS A CAREER

Consider Lockheed's leadership in space technology. Evaluate its accomplishments —such as the Polaris missile, the Agena vehicle's superb record of space missions. Examine its outstanding advantages —location, advancement policies, creative climate, opportunity for recognition.

Then write for a brochure that gives you a more complete Look at Lockheed. Address: Research & Development Staff, Dept. M-48B, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

SCIENTISTS & ENGINEERS: In addition to positions relating to computer research, such as logical design specialists and mathematicians, other important openings exist for specialists in: Trajectory analysis • Inertial guidance • Electromagnetics • Orbit thermodynamics • Gas dynamics • Chemical & nuclear propulsion • Systems engineering • Electronic engineering • Communications & optics research

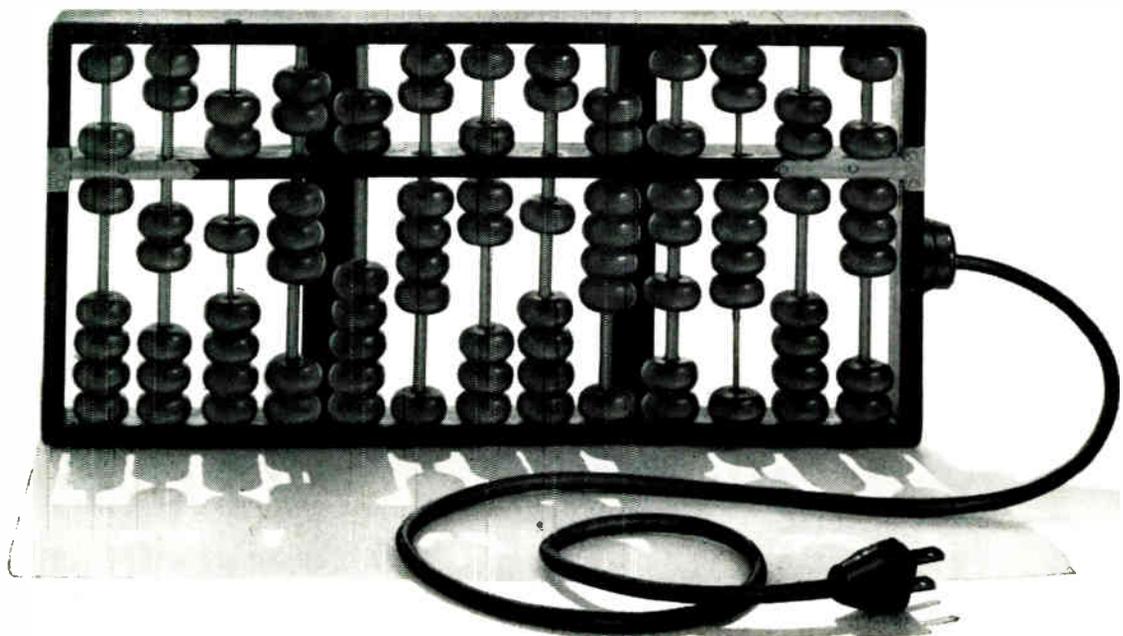
LOCKHEED **MISSILES & SPACE COMPANY**

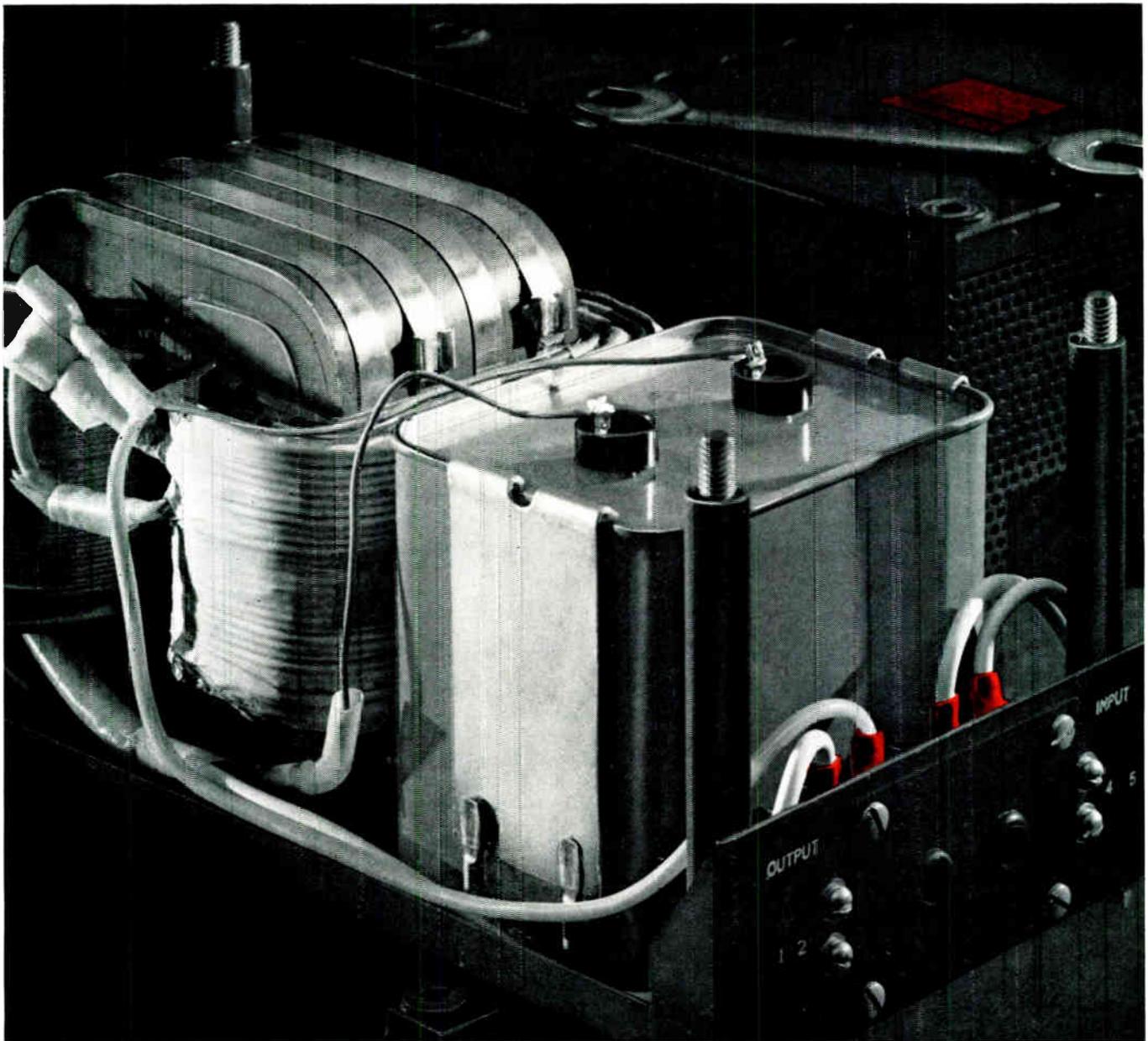
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Sunnyvale, Palo Alto, Van Nuys, Santa Cruz, Santa Maria, California • Cape Canaveral, Florida • Huntsville, Alabama • Hawaii

LOOK AT LOCKHEED IN DIGITAL TECHNIQUES:

Basic research toward simpler, faster, more reliable computers





See the wrench?

The wrench is on the black box. It is an ordinary wrench.

The black box is an ordinary box. Commonplace. *Everybody* has one. That's why we used the wrench. We took the black box off.

Now you can see our new constant voltage transformer. See. It is small (13½" x 5⅞" x 6"). It is sturdy (Note construction). It is efficient (± 1% line regulation). It is reliable (we never put the trademark CAPITRON on anything that isn't).

You can't buy a better constant voltage transformer anywhere. It's so good, you'll probably never have to take it out of the black box. That's why you won't get a wrench when you order but you *will* get:

- all solid state components (no moving parts)
- input voltage—95—135 VAC

*Trademark of AMP INCORPORATED

- outpower —1450 VA
- Current limiting to 20 amps under short circuit conditions
- output current—12 amps
- line regulation—± 1%/load regulation—± 2%
- input frequency—60 CPS
- output voltage—120 VAC

We'll take the wraps off additional information, test data and other pertinent facts when you send for full details on the CAPITRON* Constant Voltage Transformer. Send today!

AMP | **CAPITRON**
INCORPORATED | **DIVISION**
 155 PARK STREET, ELIZABETHTOWN, PA.

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

VISIT US AT THE WESCON SHOW AUG. 20-23 BOOTHS 3112-15

NEW PRODUCTS

...for the Electronic Industries

ANALYZER MODULES

The unit is used for sonic and ultrasonic analysis.



Three plug-in interchangeable modules covering the 20cps to 25Mc range are for use with the portable TA-2 Universal Panoramic spectrum analyzer. Any ac line from 95 to 1000cps will recharge the unit's nickel cadmium batteries. Singer Metrics, 915 Pembroke St., Bridgeport, Conn. BOOTH 2415.

Circle 236 on Inquiry Card

GENERATOR/READER

Output jacks supply time codes for re-recording or dubbing.

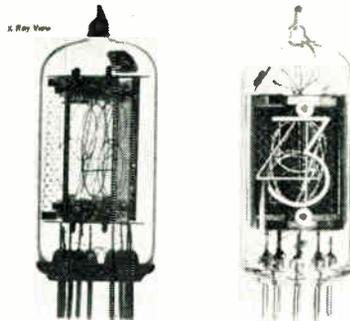


The EECO 858 combination time-code generator/reader serves as a data-handling facility where analog data must be recorded and referenced for quick playback. A single unit generates a reference code signal and then displays it for search purposes during playback of a magnetic tape. The reproduced section transforms nearly any instrumentation-type analog tape transport into a simple search system. It searches at any playback speed from 1/16 to 170x record speed. Electronic Engineering Co., 1601 E. Chestnut Ave., Santa Ana, Calif. BOOTH 519.

Circle 239 on Inquiry Card

BIQUINARY TUBE

Reduces driver-circuit transistors from 10 to 7.



Indicator tube type ZM1032 is for read-out uses in digital voltmeters, cash registers, calculating machines, counters, and computers. It has 2 separated anodes and is divided internally into 2 vertical compartments by a shield electrode. The rear compartment contains 1 anode and the figures 0-2-4-6-8; the front contains the other anode and the figures 1-3-5-7-9. The figures are connected electrically in pairs: 0 to 1, 2 to 3, 4 to 5, 6 to 7 and 8 to 9. Amperex Electronic Corp., Semiconductor & Receiving Tube Div., 230 Duffy Ave., Hicksville, L. I., N. Y. BOOTH 3701.

Circle 237 on Inquiry Card

THYRATRONS

These hydrogen-filled tubes cover ranges from 6 to 45 kv.



Thyratrons and diodes are included in this expanded line of hydrogen-filled ceramic tubes. Thyratrons cover a voltage range from 6 to 45kv with peak current ranges up to 2400a. Diodes cover the range up to 33kv with peak currents up to 5000a. Applications: radar pulse modulators, clippers, crowbars, and high-voltage rectifiers. Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N. J. BOOTH 1601.

Circle 240 on Inquiry Card

PERMANENT-MAGNET TWT

Excluding connectors, unit is 11.5 in. long x 4.5 in. dia.

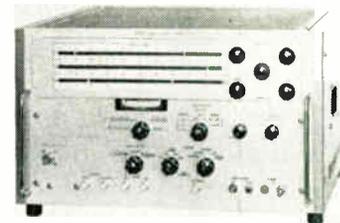


The WJ-269 is completely self-contained, requires only an ac line-voltage input, and is adjustment free. The compact L-band amplifier with its integral power supply weighs less than 17 lbs. Max. noise is 5.5 db from 2.0 to 4.0Gc. Small signal gain is 25 db (min.); saturated power output is nominally -5-dbm. Watkins-Johnson Co., 3333 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif. BOOTH 4505.

Circle 238 on Inquiry Card

SIGNAL GENERATOR

Available in 1-2, 2-4, 4-8, 8-12.4 and 12.4-18Gc ranges.



Series 630A provides a power output of 10dbm leveled to better than $\pm 1/2$ db at rated output over each range. Freq. is continuously adjustable, and balanced bolometers assure constant power output over wide temp. range. Specs.: r-f power is at least 10.0mw; residual FM less than 0.001% of peak of highest freq.; drift is $\pm 0.01\%$ /hr.; symmetrical sweep is 0 to $\pm 5\%$ of range about any center freq.; sweep timing is 100 to 0.01 sec. Alfred Electronics, 3176 Porter Dr., Palo Alto, Calif. BOOTH 2117.

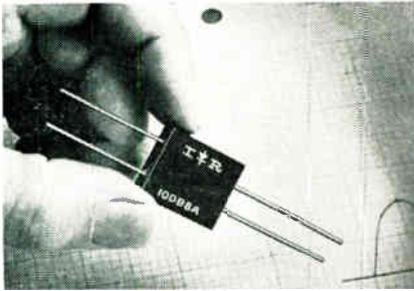
Circle 241 on Inquiry Card

NEW PRODUCTS

...for the Electronic Industries

BRIDGE RECTIFIERS

Replaces bulky tube rectifier bridge circuitry for miniaturization purposes.

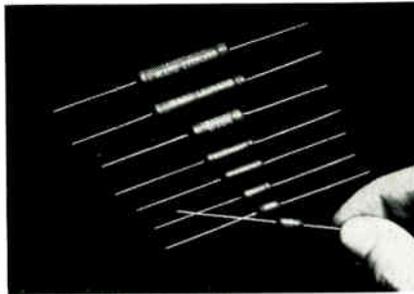


The 10DB Series single-phase full-wave bridges perform the function of 4 individual silicon rectifiers, and measure 0.830 x 0.530 x 0.215 in. Rated up to 1.8a. dc over a PRV range of 200 to 1000v., these units operate to 140°C. International Rectifier Corp., 233 Kansas St., El Segundo, Calif. BOOTH 2304.

Circle 242 on Inquiry Card

SILICONE RESISTORS

They exceed Mil-R-26C, char. G or V and are available in ranges to 170KΩ.

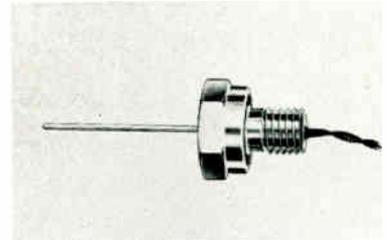


The S-Coat miniature silicone precision resistors come in 8 sizes ranging from 1 to 12.5w. Accuracy is $\pm 1\%$ (min.). Features: low drift, no noise, high momentary overload capacity, resistance to vibration and zero voltage coefficient. Ward Leonard Electric Co., Mt. Vernon, N. Y. BOOTH 3521.

Circle 243 on Inquiry Card

THERMISTOR PROBE

Moving in water at 20 ft./sec., time constant is 0.4 sec.

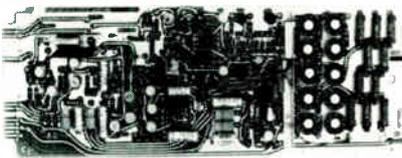


These thermistor-probe assemblies are designed for oceanographic temp. measurement. Capable of withstanding fluid pressures of greater than 15,000psi, they also exhibit a fast response time. Units can be supplied to a standard temp.-resistance curve, permitting complete interchangeability where required. Fenwal Electronics, Inc., 63 Fountain St., Framingham, Mass. BOOTH 3818.

Circle 244 on Inquiry Card

AMPLIFIER

Current offset drift is 1.5×10^{-11} a./day; freq. response, dc to 100kc.



Model 117 is a solid-state, chopper-stabilized, operational 100v. amplifier in modular form for use in analog computer and data-reduction systems. Featuring fast settling time, low offset and low noise, its plug-in units use field-effect transistors in the input stages of the wideband dc amplifier. Voltage offset drift is $20\mu\text{v}/\text{day}$. Transient response time permits settling to 0.1% of final value within $50\mu\text{sec.}$ after a full scale $\pm 100\text{v.}$ step. Features: open-loop gain is greater than 100 million; input resistance is greater than 3 megohms. Astrodata Inc., 240 E. Palais Rd., Anaheim, Calif. BOOTH 4733.

Circle 245 on Inquiry Card

THERMAL SHOCK CHAMBER

Features include off-on control of fans, heaters and cooling systems.



This compact environmental chamber performs the thermal shock portions of Mil-202B, Methods 102A and 107A. It performs between -100°F to $+300^\circ\text{F}$ range. The unit can also be supplied for operating in a range of -300°F to $+1000^\circ\text{F}$. Operation is completely automatic with cycling timers for each test phase. Interior of the chamber is 16-gauge stainless steel with 16-gauge galvanized exterior. Conrad, Inc., Holland, Mich. BOOTH 1310.

Circle 246 on Inquiry Card

TRAINING AIDS

Reduces the time needed to train assemblers; produces gains in production.



Videosonic™ systems cut training time and increase efficiency of assemblies. The systems use colored slides and tape-recorded instructions which allow individual instruction to each person. Thus, the retention of instructions is higher than by conventional training methods. Hughes Aircraft Co., P.O. Box 3310, Fullerton, Calif. BOOTH 1204.

Circle 247 on Inquiry Card

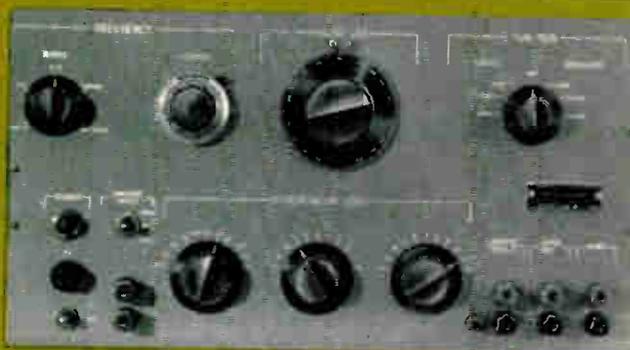
NEW FROM TEMCO ELECTRONICS TWO SOLID STATE SERVO ANALYZERS



NEW
301 PORTABLE All solid state circuitry • Small (11 x 5 x 9 inches) • Light weight (less than 20 lbs.) • Self contained indicator for phase and response measurement • In-line numerical readout—no parallax • Power source from 50 to 400 cps 115V



NEW
501 AUTOMATIC Automatic in-line presentation of phase and gain response • High speed operation for production line testing • All solid state circuitry — modular construction • Self check capability • Analog outputs for response plot



201 STANDARD Industry standard — proven operation for 3 years • All electronic — no mechanical parts • Wide frequency range • Modulated or direct sine, step, ramp driving functions

COMPARATIVE SPECIFICATIONS	Frequency Range	Model 201	Model 301	Model 501
	Frequency Accuracy	Carrier Range	.005-1kc	.005-1200 cps
Measurement Accuracy:		2%	1%	0.1%
Phase		50cps-10kc	400cps-10kc	400cps-10kc
Amplitude		2°	2°	1°
		—	0.2db	1% or 0.2db

To meet your specific servo test requirements for field, laboratory, and production line, Temco Electronics now offers the Model 301 Portable and Model 501 Automatic in addition to the widely used Model 201 Standard Servo Analyzer. These precision instruments are available off-the-shelf to give you accurate, repeatable tests of servo response characteristics.

Simple to operate and easy to maintain, these competitively priced servo analyzers are an outgrowth of Temco's years of experience in servo testing in Ground Support Systems, and they meet the stringent requirements of space and launch vehicles, weapons systems and automatic controls.

All models are available in rack or cabinet mounts. Write for descriptive literature today.

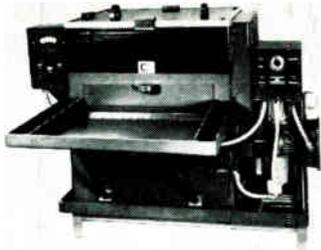
LTV TEMCO ELECTRONICS
A DIVISION OF LING-TEMCO-VOUGHT, INC.
P.O. BOX 6118 / DALLAS 22, TEXAS

SEE ALL THREE TEMCO SERVO ANALYZERS AT WESCON EXHIBIT 422.

NEW PRODUCTS

SPRAY ETCHER

Temperature of the etchant is regulated to $\pm 2^\circ\text{F}$ by an indicating thermostat.

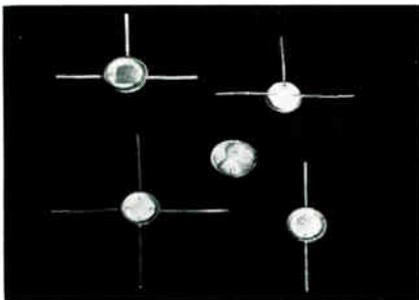


Chemcut Model 800 spray etcher allows: chemical machining of metal parts; chemical engraving of nameplates, instrument panels, etc.; etching of printed-circuit boards with lines and spaces as fine as 0.002 in. on 1 oz. copper. Spray etching is uniform over the 19 x 21-in. workholding rack area. A titanium cooling-coil system allows exothermic etchants to be used. Chemcut Div. of Centre Circuits, Inc., P.O. Box 165, State College, Pa. BOOTH 1214.

Circle 296 on Inquiry Card

TRANSISTOR PACKAGE

Line includes packages of $\frac{5}{8}$ in. and $\frac{3}{4}$ in. dia. for devices in 12 and 20a. range.

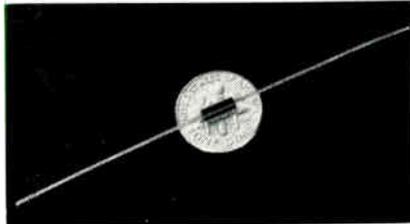


This development in semiconductor packaging eliminates glass-to-metal seals and increases heat dissipation to permit more power capacity in a smaller envelope. The package is based on a disc of Berlox beryllium-oxide ceramic which has a thermal conductivity greater than aluminum. National Beryllia Corp., Haskell, N. J. BOOTH 807.

Circle 299 on Inquiry Card

FILM RESISTOR

Resistance range is from 10 Ω to 400K Ω ; it meets RN-55D of Mil-R-10509D.

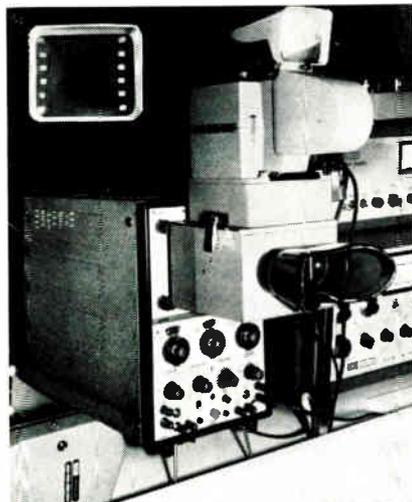


The MC-1/10 is a subminiature carbon film resistor with a molded covering. It has a power rating of $\frac{1}{8}$ w. at 70°C amb., derating to 0 at 165°C. Physical size is 0.093 in. dia., 0.250 in. long. Dale Electronics, Inc., P.O. Box 488, Columbus, Nebr. BOOTH 2107.

Circle 297 on Inquiry Card

PROCESSOR-VIEWER

Waveforms are photographed, developed and reviewed in 70 sec.



With an Analab 3800C Rapromatir[®] Film Processor-Viewer you see the fully developed and fixed film in 70 sec. or less. The Type 3800C works with the basic Analab 35mm scope camera which features non-parallax viewing periscope, electrical shutter camera system, a data chamber with 24 hr. clock, 4-digit counter, and handwritten data-card holder. The entire 70 sec. shoot-to-view process takes place in a thermostatically-controlled chamber. Analab Instrument Corp., 30 Canfield Rd., Cedar Grove, N. J. BOOTH 3707.

Circle 300 on Inquiry Card

VOM

Switching circuit that guards against burnouts.

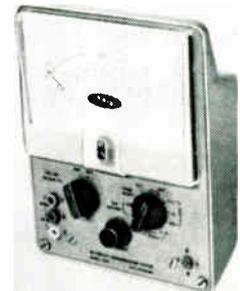


Model 630-PLK has a sensitivity of 20K Ω /vdc and 5K Ω /vac. It features $\pm 3\%$ accuracy on dc and $\pm 4\%$ on ac. Stray magnetic fields are eliminated by a self-shielding bar-ring movement. It is usable with freqs. through 500kc. The Triplet Electrical Instrument Co., Bluffton, Ohio. BOOTH 3311.

Circle 298 on Inquiry Card

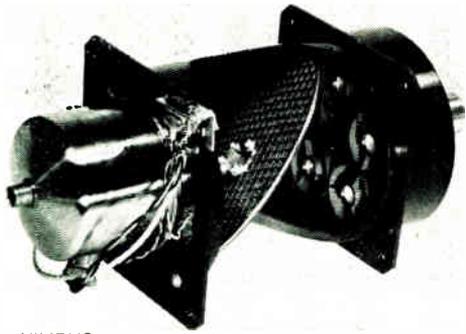
TRANSISTOR TESTER

Measures for Beta, in or out of circuit, over a range of 1-1000.



The Model 245 Tester measures both low- and high-power transistors, either in or out of circuit, for 1000-cycle Beta (h_{fe}), within a range of 1 to 1000. Betas between 1 and 100 may be measured in-circuit with as low as 50 Ω of loading between the emitter and base with an accuracy of $\pm 10\%$. Transistor shorts and opens are immediately detected. American Electronic Laboratories, Inc., Richardson Rd., Colmar, Pa. BOOTH 4316.

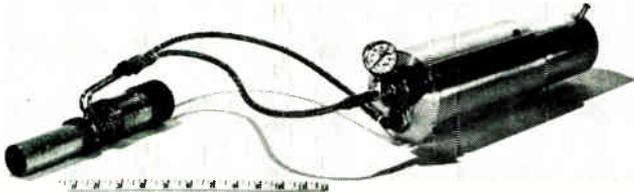
Circle 301 on Inquiry Card



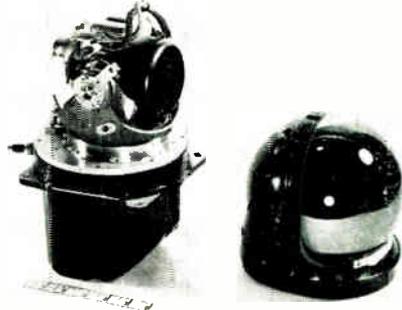
Radiometer for NIMBUS weather satellite



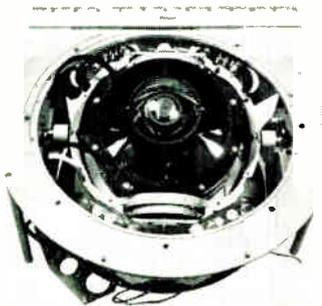
Interceptor IR installation



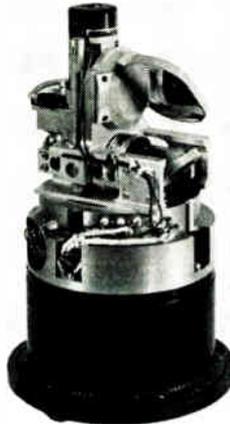
12°K closed-cycle cryostat



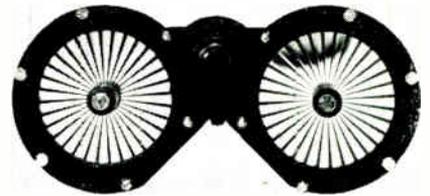
90C IR search/track set



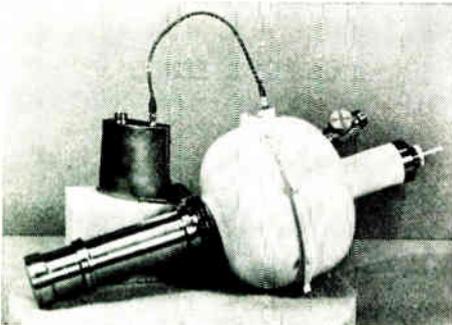
IR multi-channel tracking radiometer



Star tracker for SURVEYOR spacecraft



Modulated IR source



Liquid-helium-cooled IR detector



IR anti-tank missile controller

Expanding Infrared Programs

create new career assignments

Rapid growth of HUGHES Infrared activities in the Aerospace Divisions and the Santa Barbara Research Center has created many responsible positions for qualified engineers and scientists in all phases of IR systems development from conception through production engineering.

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engineering, precision electro-mechanisms, electronic circuit design, servo systems...and many other areas.

Current HUGHES IR contracts include advanced systems for space exploration, weather reconnaissance, anti-ballistic missile defense, anti-submarine warfare, interceptor weapon guidance & fire control, bomber defense and tactical weapon control.

Professional experience, an accredited degree and U.S. Citizenship required.

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El-Menco

*MYLAR-PAPER DIPPED CAPACITORS

TYPE
MPD

ASSURE A LOW FAILURE RATE OF
Only 1 Failure in 7,168,000 Unit-Hours for 0.1 MFD Capacitors*

14,336,000

Setting A New High Standard Of Performance!

Life tests have proved that El-Menco Mylar-Paper Dipped Capacitors — tested at 105°C with rated voltage applied — have yielded a failure rate of only 1 per 1,433,600 unit-hours for 1.0 MFD. Since the number of unit-hours of these capacitors is inversely proportional to the capacitance, 0.1 MFD El-Menco Mylar-Paper Dipped Capacitors will yield ONLY 1 FAILURE IN 14,336,000 UNIT-HOURS.

CAPACITANCE AND VOLTAGE CHART

• Five case sizes in working voltages and ranges:

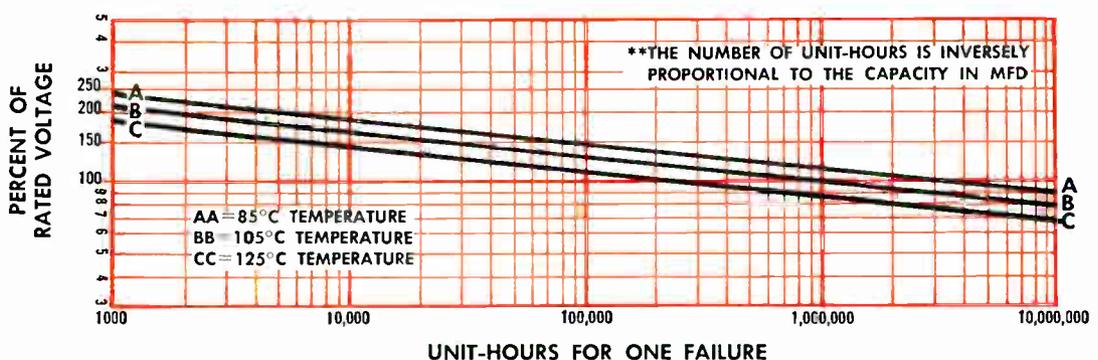
200 WVDC —	.018 to .5 MFD
400 WVDC —	.0082 to .33 MFD
600 WVDC —	.0018 to .25 MFD
1000 WVDC —	.001 to .1 MFD
1600 WVDC —	.001 to .05 MFD

SPECIFICATIONS

- **TOLERANCES:** 10% and 20%. Closer tolerances available on request.
- **INSULATION:** Durez phenolic, epoxy vacuum impregnated.
- **LEADS:** No. 20 B & S (.032") annealed copper clad steel wire crimped leads for printed circuit application.
- **DIELECTRIC STRENGTH:** 2 or 2½ times rated voltage, depending upon working voltage.
- **INSULATION RESISTANCE AT 25°C:** For .05MFD or less, 100,000 megohms minimum. Greater than .05MFD, 5000 megohm-microfarads.
- **INSULATION RESISTANCE AT 105°C:** For .05MFD or less, 1400 megohms minimum. Greater than .05MFD, 70 megohm-microfarads.
- **POWER FACTOR AT 25°C:** 1.0% maximum at 1 KC

These capacitors will exceed all the electrical requirements of E. I. A. specification RS-164 and Military specifications MIL-C-91B and MIL-C-25C.
Write for Technical Brochure

MINIMUM LIFE EXPECTANCY FOR **1.0 MFD *MYLAR-PAPER DIPPED CAPACITORS AS A FUNCTION OF VOLTAGE & TEMPERATURE



*Registered Trade Mark of DuPont Co.

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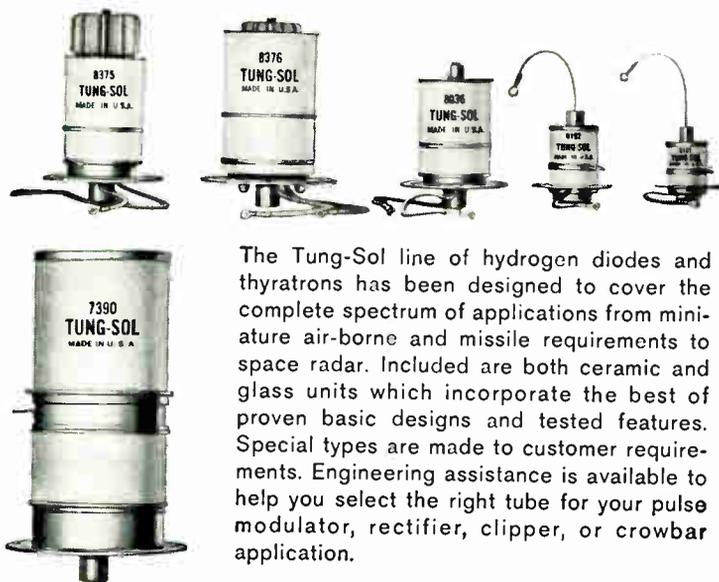
West Coast Representatives: LORCH
COLLINS & HYDE CO., 525 Middlefield Road,
Palo Alto, California
3380 Wilbur Boulevard, Los Angeles, California

MANUFACTURERS OF
El-Menco
Capacitors

TUNG-SOL TOOLS FOR EQUIPMENT DESIGNERS

CENTER LINE
QUALITY

HYDROGEN TUBES



The Tung-Sol line of hydrogen diodes and thyratrons has been designed to cover the complete spectrum of applications from miniature air-borne and missile requirements to space radar. Included are both ceramic and glass units which incorporate the best of proven basic designs and tested features. Special types are made to customer requirements. Engineering assistance is available to help you select the right tube for your pulse modulator, rectifier, clipper, or crowbar application.

Circle 30 on Inquiry Card

SUBMINIATURE INDICATOR TUBE

The Tung-Sol 6977 is a filamentary, high-vacuum subminiature indicator with a fluorescent anode. It operates on AC or DC current—direct or parallel supply—and is designed for mounting flat on printed circuit boards behind display panels. Power drain is exceptionally low.



Electrical, environmental and life test procedures insure reliable performance despite shock, vibration or critical life requirements.

A single 6977 uses less than 1/4 square inch of panel display space.

Circle 31 on Inquiry Card

SILICON RECTIFIERS TO 250 AMPERES

Tung-Sol silicon power rectifiers range from 1 to 250 amps in all standard configurations.

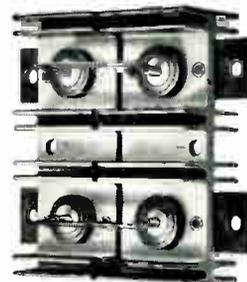
Exclusive design features combine with Tung-Sol's historically rigid quality control to assure designers unmatched operating reliability. Wide interchangeability permits specification of these outstanding components for most commercial and military applications.

Controlled avalanche reverse power rated rectifiers for 25 amp service are available in the economical pressure fit style. Exceptional performance ratings make these units an attractive consideration for a wide range of applications.



Circle 32 on Inquiry Card

SPECIAL STACK ASSEMBLIES



For applications requiring 3 amps to 75 amps, Tung-Sol production techniques can deliver economical, production-ready rectifier assemblies employing pressure fit rectifiers. Stacks employing other configurations and ratings can also be supplied.

Availability of rectifiers in both polarities makes it possible to mount more than one rectifier on a single heat sink. The result is assemblies that are lighter in weight for any given power capacity. They lend themselves to compact designs. The shortest dimension can be mounted in any of these planes.

Circle 33 on Inquiry Card

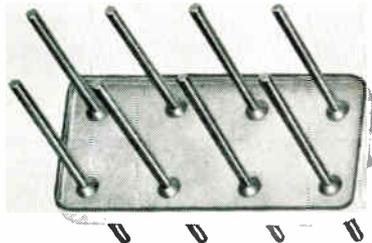
For more information about Tung-Sol components contact: Tung-Sol Electric Inc., Newark 4, N. J. TWX:201-621-7977
Complete technical assistance is available at the following sales offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Melrose Park, Ill.; Newark, N. J.; Seattle, Wash. In Canada: Abbey Electronics, Toronto, Ont.; Canadian Electronics Ltd., Edmonton, Alta.

 **TUNG-SOL**

NEW PRODUCTS

RELAY HEADER

Features high thermal-shock resistance and vacuum tightness.



Ceramic-to-metal microminiature relay header has 0.200 in. grid spacing for full-size or half-size crystal can relay. High-alumina body copper is brazed to terminals and outer metal mounting member. Header is designed for heliarc welding to crystal can. Clare Ceramics Inc., 15 W. Main St., Cary, Ill. BOOTH 4309.

Circle 323 on Inquiry Card

MINIATURE RHEOSTAT

Terminals fit standard transistor socket; range is 1 to 5KΩ(±10%).

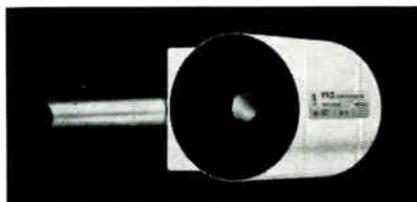


Model C has a rating of 7½w., weighs 0.265 oz., has 0.515 in. dia., and is 9/16 in. long. This ceramic and metal wire-wound rheostat operates at a hot spot temp. of 340°C. Ohmite Mfg. Co. 3601 Howard St., Skokie, Ill. BOOTH 1928.

Circle 324 on Inquiry Card

LASER BOLOMETER

The spectral response is 1000 to 40,000Å; reading time is 10 sec.

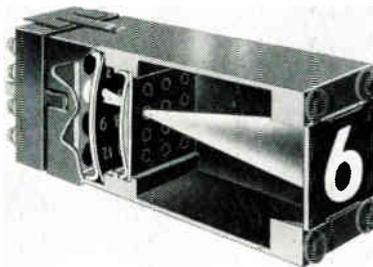


The PRD 6621 consists of a thin-film structure upon which a black-body absorptive coating has been applied. When the CW laser beam strikes the blackened surface, the optical power absorbed causes a temp. change. PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N. Y. BOOTH 1904.

Circle 325 on Inquiry Card

INDICATOR

New lens increases lamp intensity with less voltage.

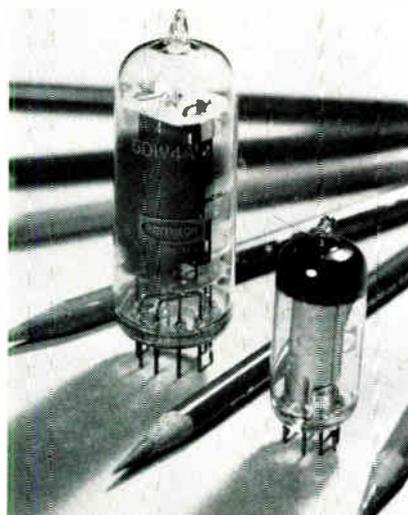


Series 120 and 220 uses a new lens to double the brightness of readouts and cue indicator switches. This lens increases the brilliance of 6v. unit, type 328, to 50 ft.-lamberts. Normal lifetime is 500 hrs. Reducing operating voltage to 5v. extends lamp life to 5000 hrs. Up to 50,000 hrs. at 17 ft.-lamberts (using the lens) can be obtained by operating the 6v. type 349 lamp at 5v. Industrial Electronic Engineers, Inc., 5528 Vineland Ave., N. Hollywood, Calif. BOOTH 4531.

Circle 326 on Inquiry Card

COLOR TUBES

Tubes improve reliability in color television receivers.



The 9-pin diode 6DW4A is a horizontal freq. damper with greatly extended ratings over the earlier 6DW4. A filamentary diode, the 1AU2 is an improved replacement for the 1V2. Raytheon Co., 225 Crescent St., Waltham, Mass. BOOTH 3718.

Circle 327 on Inquiry Card

SUBMINIATURE CHOPPER

RMS noise level less than 0.8µv when chopping into a 10K load at 400cps.

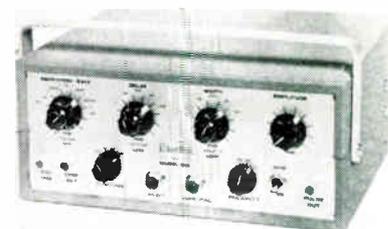


Series F subminiature chopper occupies 0.1 cu. in. and coil requires 160mw when operated at 6.3v., 400cps, and within environmental ratings of: temp., -65° to +125°C; shock, 30Gs; vibration, 0.25 in. D.A. or 20Gs, 5-2000cps. Bristol Co., Waterbury 20, Conn. BOOTH 3409.

Circle 328 on Inquiry Card

PULSE GENERATOR

The pulse delay and width are variable up to 10 nanoseconds.

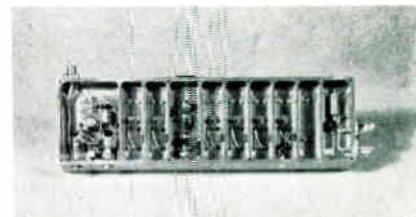


The battery-operated Model B-14 portable pulse generator has repetition rates from 20cps to 2Mc. The output is 8v. into 50Ω with a maximum rise and fall time of 10nsec. Rutherford Electronics Co., P.O. Box 472, Culver City, Calif. BOOTH 2111.

Circle 329 on Inquiry Card

HYBRID AMPLIFIER

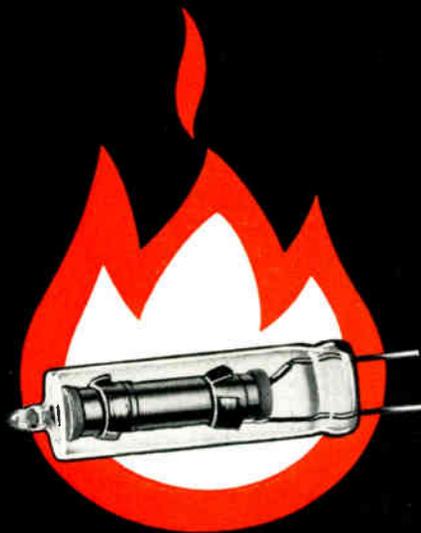
Interstage compartments are machined from solid aluminum.



The 11M-1 series features 105db gain and a good noise figure. Temp. range is -55°C to +100°C. Attenuation is achieved by a solid-state circuit which provides 40db range, while center freq. and bandwidth remain unchanged. Lel Inc., 75 Akron St., Copiague, N. Y. BOOTH 4708.

Circle 330 on Inquiry Card

not shot when hot



Engineer a neat defeat for heat. Victoreen GV3 series Corotron voltage regulators are available for operation in environments to 200°C. Ruggedized versions for shocks to 2000G, vibration 10-2000 cps at 10G. Yes, Corotrons beat the heat—high cost, too.

VICTOREEN

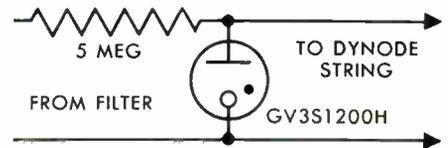


THE VICTOREEN INSTRUMENT COMPANY
5806 HOUGH AVENUE • CLEVELAND 3, OHIO, U.S.A.

Victoreen European Office: P. O. Box 654, The Hague

HIGH TEMPERATURE, HIGH VOLTAGE

reference and regulator tubes of the corona discharge type — originally developed for oil well logging in depths where temperatures rise to a sizzling 200°C — are now in widespread use in jets, in the upper atmosphere, in outer space satellites.



Regulator for Power Supply for
Photomultiplier Tube.

At one time well logging was limited to depths where temperatures no higher than 85°C were encountered because of limitations on regulators and other components. To permit logging deeper holes Victoreen developed the 150°C Corotron regulator, later pushed this to 200°C with voltage stabilities better than 1% over the range of -65° to 200°C, or .005%/°C. This gave high accuracy logging of 3-mile-deep wells with photomultipliers and geiger tubes due to excellent regulation of high voltage supplies. In addition to solving temperature problems, Victoreen Corotrons were required to withstand shocks and vibration encountered at these depths. The military found these same capabilities mandatory in lunar probes and high altitude jet operation.

Contrary to the usual sequence — where components developed for the military find commercial applications—Victoreen Corotrons developed for commercial uses now are found to be ideal for many military uses.

Perhaps one of our commercial designs will fit your military requirement, or vice versa. We are continuing to push back the barriers in the areas of high temperature, high resistance and high voltage regulation. Contact our

Applications Engineering Department
THE VICTOREEN INSTRUMENT COMPANY
5806 Hough Ave., Cleveland 3, Ohio, U.S.A.

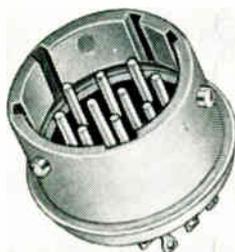
A 9710A

At WESCON . . .

NEW PRODUCTS

SEALED CONNECTOR

Available in many shell sizes and in standard shell and contact finishes.



These multi-pin connectors are in the Mil-C-26482 (Class H), Mil-C-5015, and Mil-C-25955 series. They are rated at 5a. with peak voltages at 1000v. All connectors are hermetically sealed and have a leak rate of less than 10^{-8} cc of helium as measured at a pressure of one atmosphere. Dage Electric Co., Hurricane Rd., Franklin, Ind. BOOTH 320.

Circle 260 on Inquiry Card

HIGH-CURRENT RELAY

Low arc erosion allows a life of over 100,000 operations.

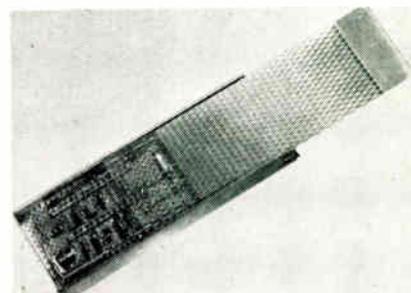


Type RA24A 3-phase vacuum relay operates up to 120 amps each phase and at 115vac (400 cycles). The contacts need only be separated only a few thousandths of an inch to achieve 1000 megohms. Peak test-voltage rating is 2kv. Jennings Radio Mfg. Corp., P. O. Box 1278, San Jose, Calif. BOOTH 1901.

Circle 261 on Inquiry Card

H-F BREADBOARD

Eliminates the need for insulated terminals and metal chassis.

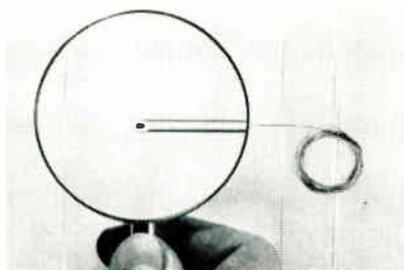


This h-f breadboarding kit consists of r-f tight, shielded aluminum case with 2 slide-out sides. The copper-clad Vectorboard serves as the ground plane and the terminals can be readily insulated or grounded. Vector Electronic Co., Inc., 1100 Flower St., Glendale 1, Calif. BOOTH 2012.

Circle 262 on Inquiry Card

FILLED SOLDER

Simplifies soldering of miniaturized components.

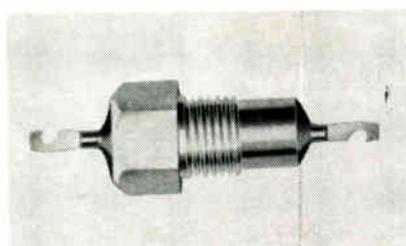


Kester "44" resin flux filled solder has a dia. of 0.005 in. The solder is available in a range of alloys and core sizes to meet specific requirements, and provides precision control of both solder volume and flux volume. Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill. BOOTH 709.

Circle 263 on Inquiry Card

FILTERS

Filtering is greater due to the elimination of precorona discharge.



These low-pass filter components have a freq. range from 100mc to 10gc and attenuations of 50db or more. These components substantially eliminate spurious radiation from unshielded external wiring. Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis. BOOTH 3119.

Circle 264 on Inquiry Card

BREADBOARD

There is no need for soldering components for breadboarding.



On the Mark V, circuit diagrams can either be drawn or placed on the schematic-transferal board and seen from the work surface above. The breadboard measures 14 x 17 in.; weight $4\frac{3}{4}$ lbs. Phillips Control Co., 59 W. Washington, Joliet, Ill. BOOTH 3703.

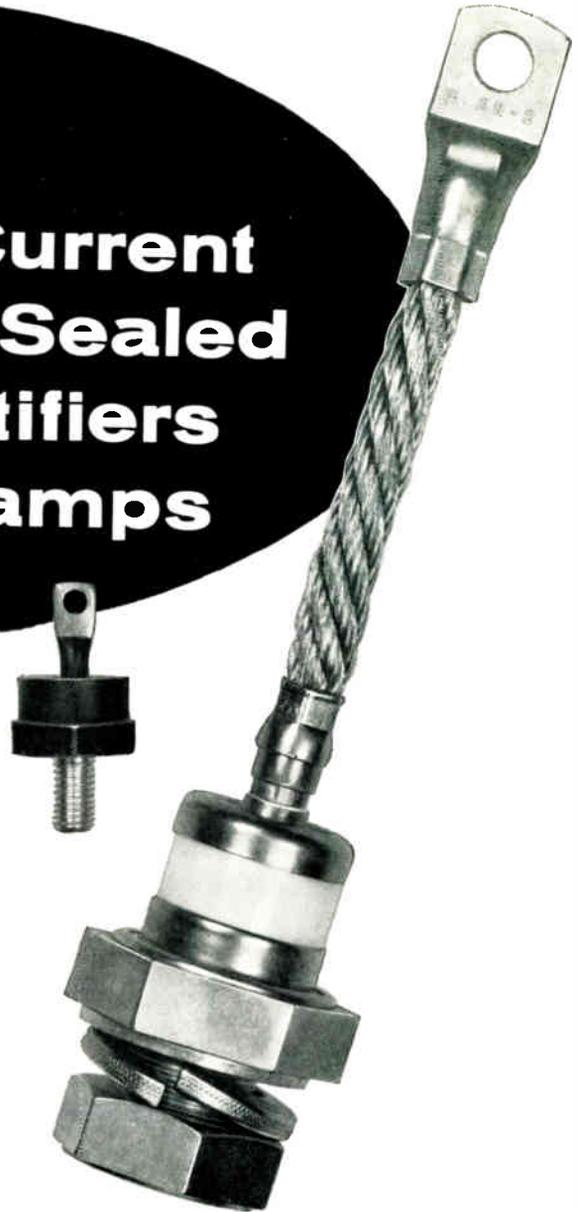
Circle 265 on Inquiry Card



8

Tarzian Hi-Current Hermetically Sealed Silicon Rectifiers 25 to 250 amps

- ★ Hermetically sealed
- ★ Hard solder at every junction interface
- ★ Oversized junctions hold maximum forward voltage drop to a low 1.2 volts in all units
- ★ Processed in reducing atmosphere for maximum bonding and stability
- ★ Extremely low dislocation density silicon (plus flat junctions) to eliminate points of high voltage or current concentration
- ★ Choice of positive (cathode to stud) or negative (anode to stud) polarity



ELECTRICAL CHARACTERISTICS—(60 CPS, Resistive or Inductive Load; Maximum Operating Temperature 190°C.)

Tarzian Type	Amps D.C.	Max. Peak 1-Cycle Surge (Amps)	Dash No.	Maximum PIV	RMS* Volts	Notes
ST3-10,20,30,40,50,60	25	400	—10	100	70	160 and 250-amp units are available with either 1/2-inch or 3/4-inch studs. Add N for negative, P for positive base polarity when designating type number Derate DC current by 20% for capacitive, battery, or motor load when connected for single-phase operation
ST4-10,20,30,40,50,60	35	500	—20	200	140	
ST5-10,20,30,40,50,60	50	750	—30	300	210	
ST6-10,20,30,40,50,60	100	1600	—40	400	280	
ST7-10,20,30,40,50,60	160	3000	—50	500	350	
ST8-10,20,30,40,50,60	250	5000	—60	600	420	
ST9-10,20,30,40,50,60	250	5000				
ST10-10,20,30,40,50,60	160	3000				

* Derate 50% for single-phase half-wave with capacitive, battery, or motor load

Get complete information on each unit—engineering bulletins cover specifications, typical characteristics, application and circuit data. Tarzian application engineering aid is also at your service. Write now!

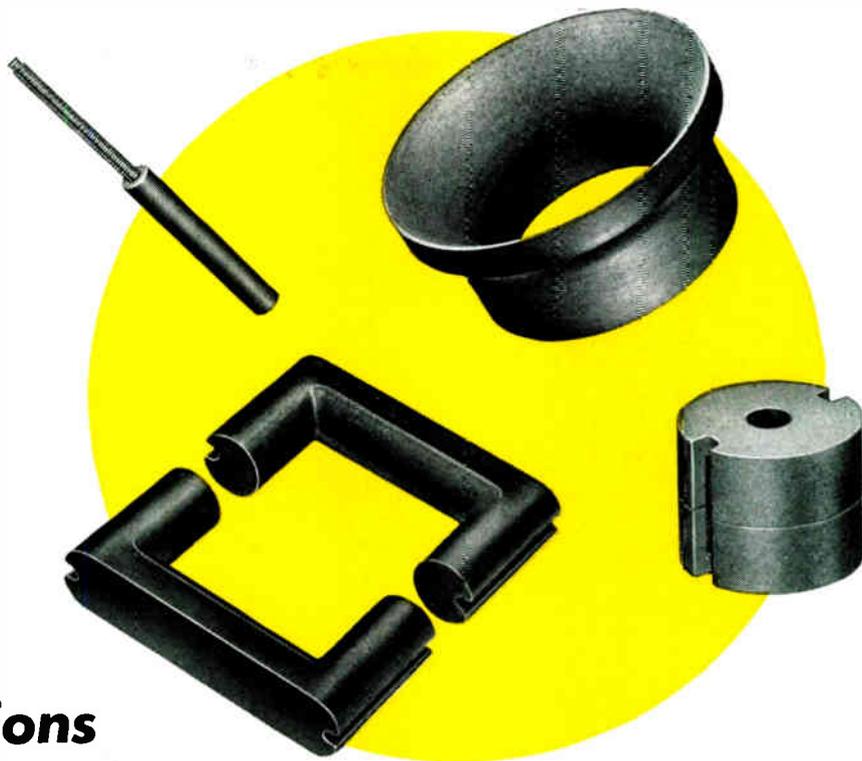


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Stackpole CERAMAG[®] ferrite cores have been the standard of the industry since their introduction in 1946. Flyback transformers, deflection yokes, R-F and I-F transformers, magnetic amplifiers, filters of all types . . . these are some of the known areas where CERAMAG cores have licked design and production problems.

Right now, Stackpole research is adding to one of the industry's most impressive variety of ferrite grades . . . perfecting new types and uses for CERAMAG ferrite cores . . . looking for those areas where they can help you make your product better or easier to produce.

Maybe you have pending applications where CERAMAG ferrite cores can offer distinct advantages over other materials or methods . . . or maybe you are searching for fast, on-time deliveries of ferrite cores for present applications with each core as accurate physically and electrically as the lab sample.

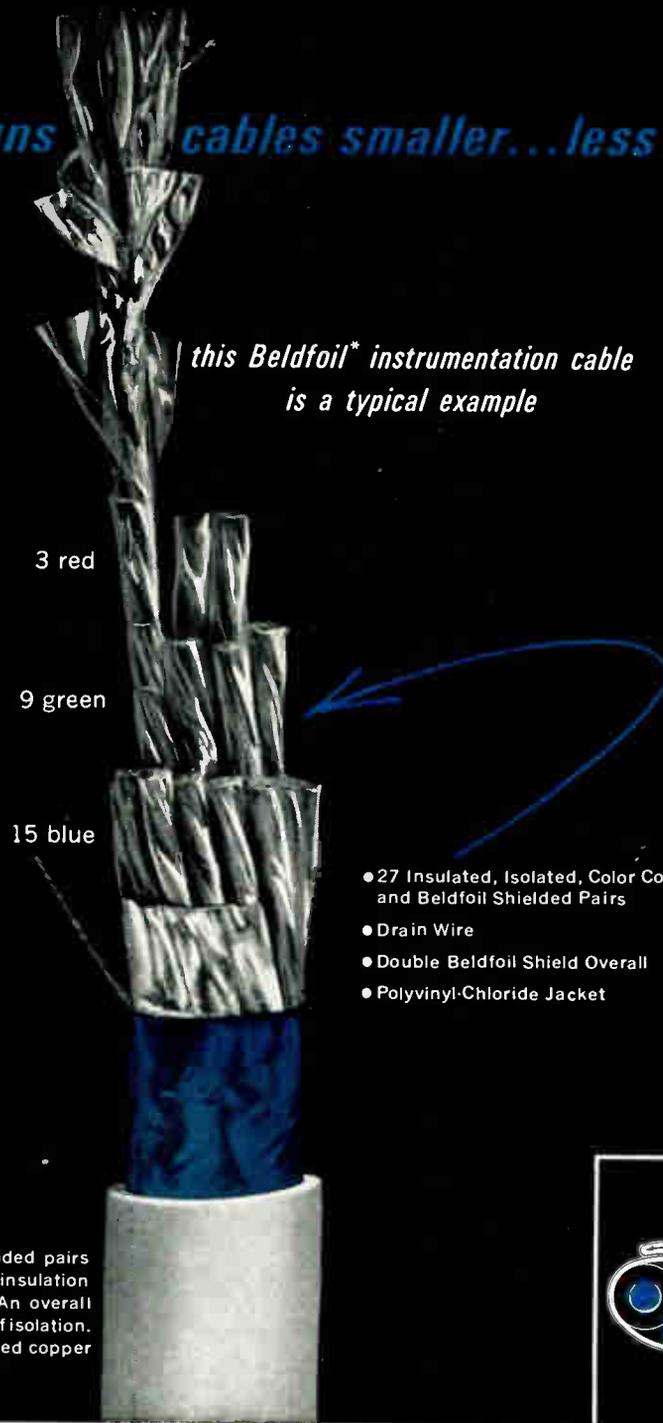
In either case, you should see Stackpole.

STACKPOLE

CARBON COMPANY, *Electronic Components Division*
St. Marys, Pennsylvania

Complex? No!

BELDEN designs cables smaller...less complicated



this Beldfoil instrumentation cable is a typical example*

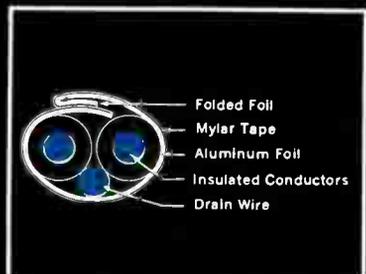
3 red

9 green

15 blue

- 27 Insulated, Isolated, Color Coded, and Beldfoil Shielded Pairs
- Drain Wire
- Double Beldfoil Shield Overall
- Polyvinyl-Chloride Jacket

Individually insulated and color coded pairs are protected by a Mylar** tape insulation under a wrapped Beldfoil shield. An overall Mylar tape adds the final measure of isolation. Each pair has its own stranded tinned copper drain wire for shield grounding.



Belden engineers have designed thousands of Beldfoil shielded cables similar to this one.. special instrumentation, strain gauge, and control cables. They can and will design a smaller cable to reduce the size of your product.. a less complicated cable that will do the same job better.. or perhaps a single cable to do the job of two or more different cables. Many well-known manufacturers of specialized electronic products depend on Belden for special cable design. If a smaller, less complicated cable will improve your product.. call on Belden.

*BELDFOIL shielding is a lamination of aluminum foil with Mylar which provides a high dielectric strength insulation that is lighter in weight, requires less space, and is usually lower in cost. For multiple-paired cables with each pair separately shielded, the Mylar is applied outside with an inward folded edge. This gives 100% isolation between shields and adjacent pairs.

Write Belden Manufacturing Company, 415 South Kilpatrick Avenue, Chicago 80, for data sheet on Beldfoil shielding.



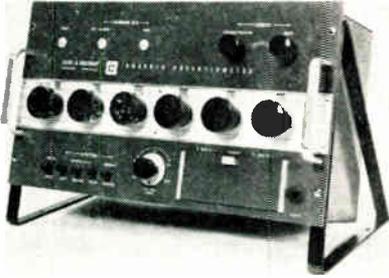
*Belden Trademark Reg. U.S. Pat. Off. **du Pont Trademark

8-6-2

NEW PRODUCTS

GUARDED POTENTIOMETER

Error limit is 0.001% on high range and 0.003% on low range.

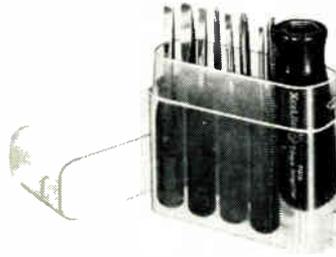


The #7556-1, 6-dial guarded potentiometer can be used for emf measurements up to 1500v. with a suitable volt box; for standard cell checking and calibration; for measuring resistances by the IR-drop comparison; and for calibrating other precision potentiometers. Leeds & Northrup Co., 4901 Stenton Ave., Phila. 44, Pa. BOOTH 4107.

Circle 266 on Inquiry Card

SCREWDRIVER SET

Available in sizes 3/32, 1/8, 5/32, 3/16, and 1/4 in.

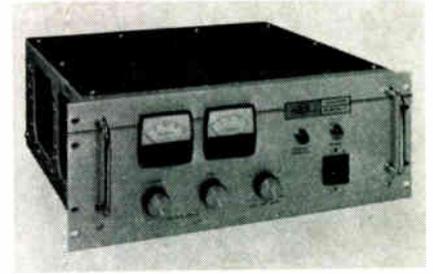


The PS88 compact convertible screwdriver set contains eight 3 1/2 in. screwdrivers and a torque amplifier handle. The amplifier handle slips over the top of the midget screwdriver handles to increase their length and driving power. Screwdrivers include 3 Phillips (#0, 1, 2) and 5 slot tips. Xcelite Inc., Orchard Park, N. Y. BOOTH 922.

Circle 267 on Inquiry Card

DC POWER SUPPLY

Delivers 1.5 to 16.5 amps regulated to ±30 milliampercs.

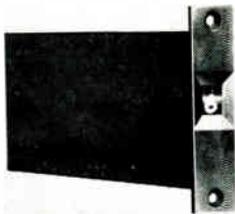


The DCR150-15 is a low-cost, small-size 2250w. regulated dc power supply. It accepts inputs centered at 208 or 230v. Output can be varied from 0 to 150v. It can be regulated to ±0.1% +15mv for 0 to 15a. load variation and ±10% input line variation. Sorensen, a unit of Raytheon Co., Richards Ave., So. Norwalk, Conn. BOOTH 2410.

Circle 268 on Inquiry Card

DECADE COUNTER

Has a count freq. of 40 pulses/sec. and a pulse voltage of 24vdc.

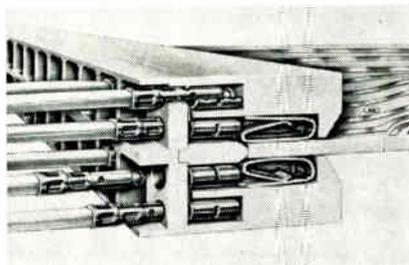


The Unipulser is a high-speed, single-decade counter with visual and electric readout. Features: accumulated data is always retained, even if power fails; unit life is not subject to hours of usage; printed circuits permit high electrical loads; counting, controlling, and readout is internally performed and no additional modules are required. Durant Mfg. Co., Milwaukee 1, Wis. BOOTH 4304.

Circle 269 on Inquiry Card

CONNECTORS

The pins can be crimped over 20, 22 or 24 gauge wire.

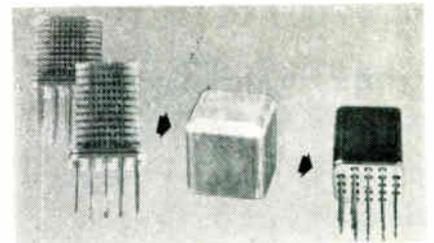


The TWIN-CON connectors combine the reliability of permanently assembled bifurcated contacts with the convenience and versatility of a crimp-on, snap-in connector. They meet Mil-C-21097 and are used with double-sided 0.062 in. printed-circuit boards. Cinch Mfg. Co., 1026 S. Homan Ave., Chicago 24, Ill. BOOTH 1301.

Circle 270 on Inquiry Card

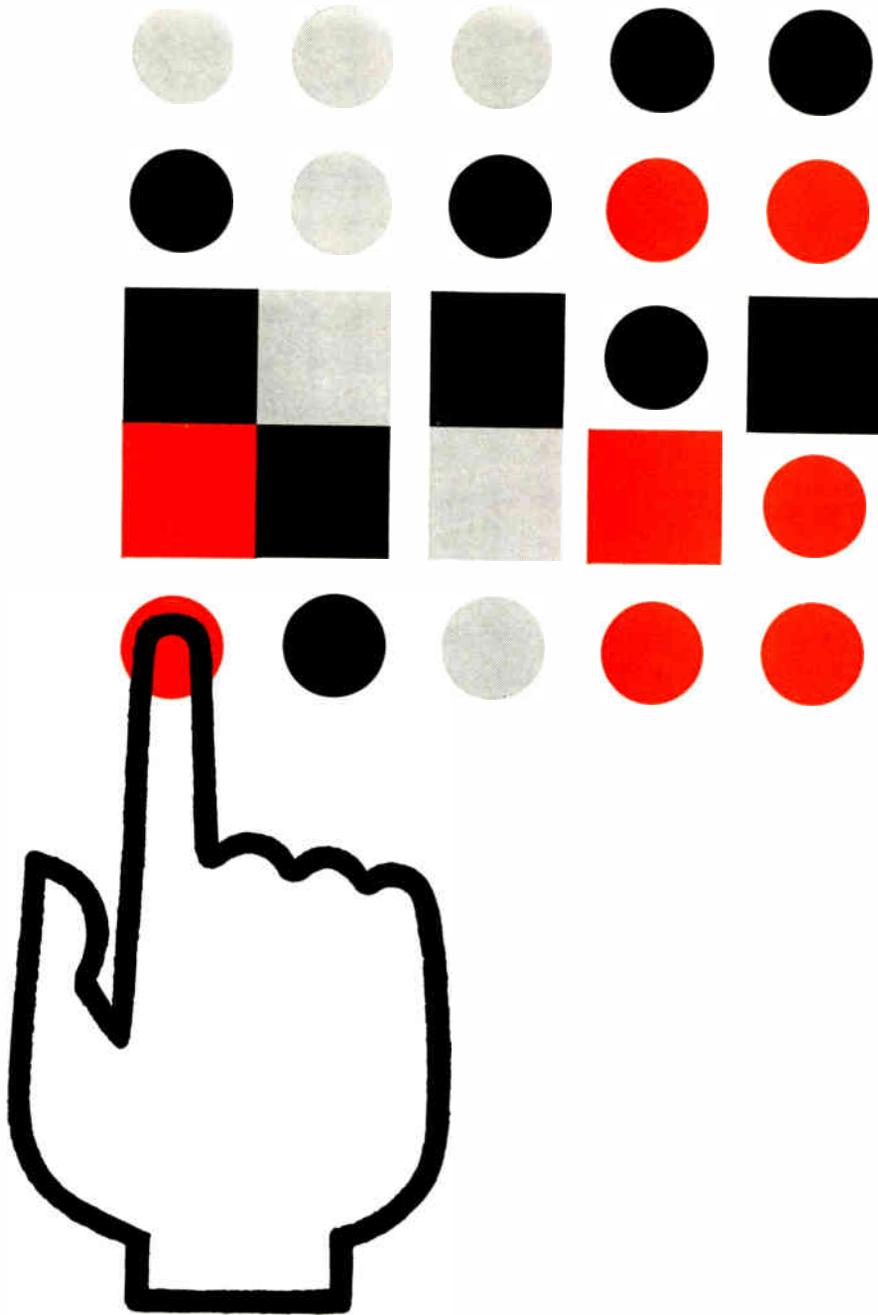
PACKAGING SYSTEMS

System can withstand extreme environments.

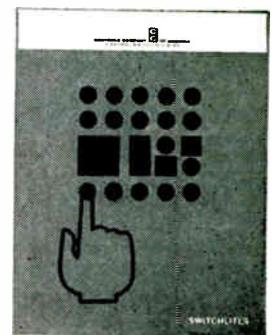


The microminiature, hermetically-sealed enhanced micro-module are electron-beam welded, interconnection packaging systems. The structure allows interconnection and hermetic sealing of integrated, hybrid semiconductor, and thin-film circuits on standard micro-circuit wafers. Hamilton Standard, Windsor Locks, Conn. BOOTH 2404.

Circle 271 on Inquiry Card



QUICK-REACTION SWITCHLITES— You design a lighted switch into your circuit to: (1) get operator's attention (a status signal); (2) direct action (push where you see the signal); and (3) perform a circuit function (operating characteristics of the switch). We offer advanced-thinking designers a fully-stocked line of switchlites in a complete variety of sizes, shapes, mounting styles and circuitry. Select from a line of one, two, three or four-lamp models. And as a bonus, every switchlite (and matching indicator light) is easily re-lamped from the front. Write for our new free *Switchlite Catalog #220*.



CONTROLS COMPANY  **OF AMERICA**
 CONTROL SWITCH DIVISION
 1420 Delmar Drive, Folcroft, Pennsylvania

NEW PRODUCTS

WAVE APPLICATOR

Ultrasonic action enables cleaning and fluxing in one operation.



The USWA is an ultrasonically energized wave applicator which allows a straight-line ultrasonic process. The elevated standing wave is 12 in. wide x 12 in. long and is raised $\frac{3}{4}$ in. above the tank surface. The unit may be used for pickling, bleaching, washing, burnishing and tanning processes. Electrovert Inc., 240 Madison Ave., New York 16, N. Y. BOOTH 4009.

Circle 272 on Inquiry Card

ATTENUATOR

Each of the turret units consists of a precision machined rotor.

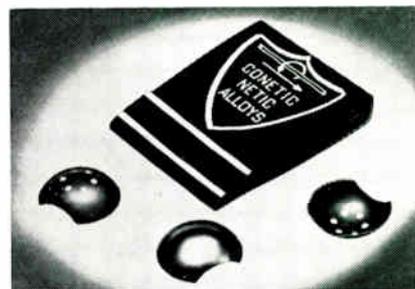


Model TAD-50A is a turret-type decade attenuator designed for r-f signals in the dc to 1000mc range. It contains 3 separate turret attenuators covering 10db in 10 steps, 50db in 5 steps, and 50db in 1 step. Max. error at 900mc is 0.5db for the 1 db-step turret; 0.5db $\pm 5\%$ for 10 db-step turret, and 3db for the 50 db-step unit. Insertion loss is less than 0.5db and is down below 0.2db at 30mc. Telonic Industries, Inc., 60 N. 1st Ave., Beech Grove, Ind. BOOTH 418.

Circle 273 on Inquiry Card

MAGNETIC SHIELDS

Designed for small-space gyro and other retrofit uses.



Netic and Co-Netic are space-saving sectional miniature precision magnetic shields for gyro and other retrofit uses. Shields conform to the space outline. Leadouts can be pierced if desired. They are insensitive to shock; have min. retentivity and require no periodic annealing. Units are approx. $\frac{3}{4}$ in. across the flats and are radially contoured. Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill. BOOTH 4210.

Circle 274 on Inquiry Card

DOPPLER NAVIGATION

Operates in any weather and over any type of terrain.

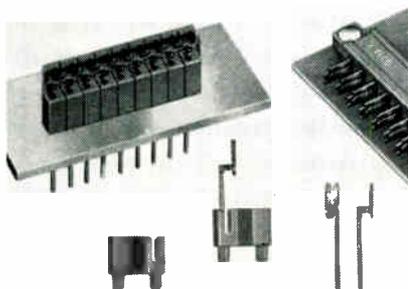


The GPL navigator features a light, small antenna for use in high-performance aircraft. Weighing 9 lbs., the radar antenna is small enough to make Doppler radar navigation practical for even the smallest aircraft. The entire AN/APN-153 Doppler navigation radar weighs 48.5 lbs. General Precision, Inc., Tarrytown, N. Y. BOOTH 3008.

Circle 275 on Inquiry Card

CONNECTOR

Speed and efficiency of programmed wiring increases versatility.



The Series 5501 Variplate™ connector allows any number of individual connectors—each with its own complement of contacts—to be constructed on the same distinguishably patterned base plate. Series 5501 mates with Series 7000 module cards, including the new 7021-7022 miniature double-tier card plugs. Elco Corp., Willow Grove, Pa. BOOTH 2124.

Circle 276 on Inquiry Card

SILICON POWER SUPPLY

Silicon transistors produce a transient response of less than 10µsec.



This regulated dc power supply is built with silicon transistors and has a 75°C amb. temp. range. Models are available with output voltages from 6 to 31vdc and current capacities from 600ma to 1.5a. Input range is from 105-125vdc, 47 to 440cps. Consolidated Avionics Corp., 800 Shames Dr., Westbury, L. I., N. Y. BOOTH 4615.

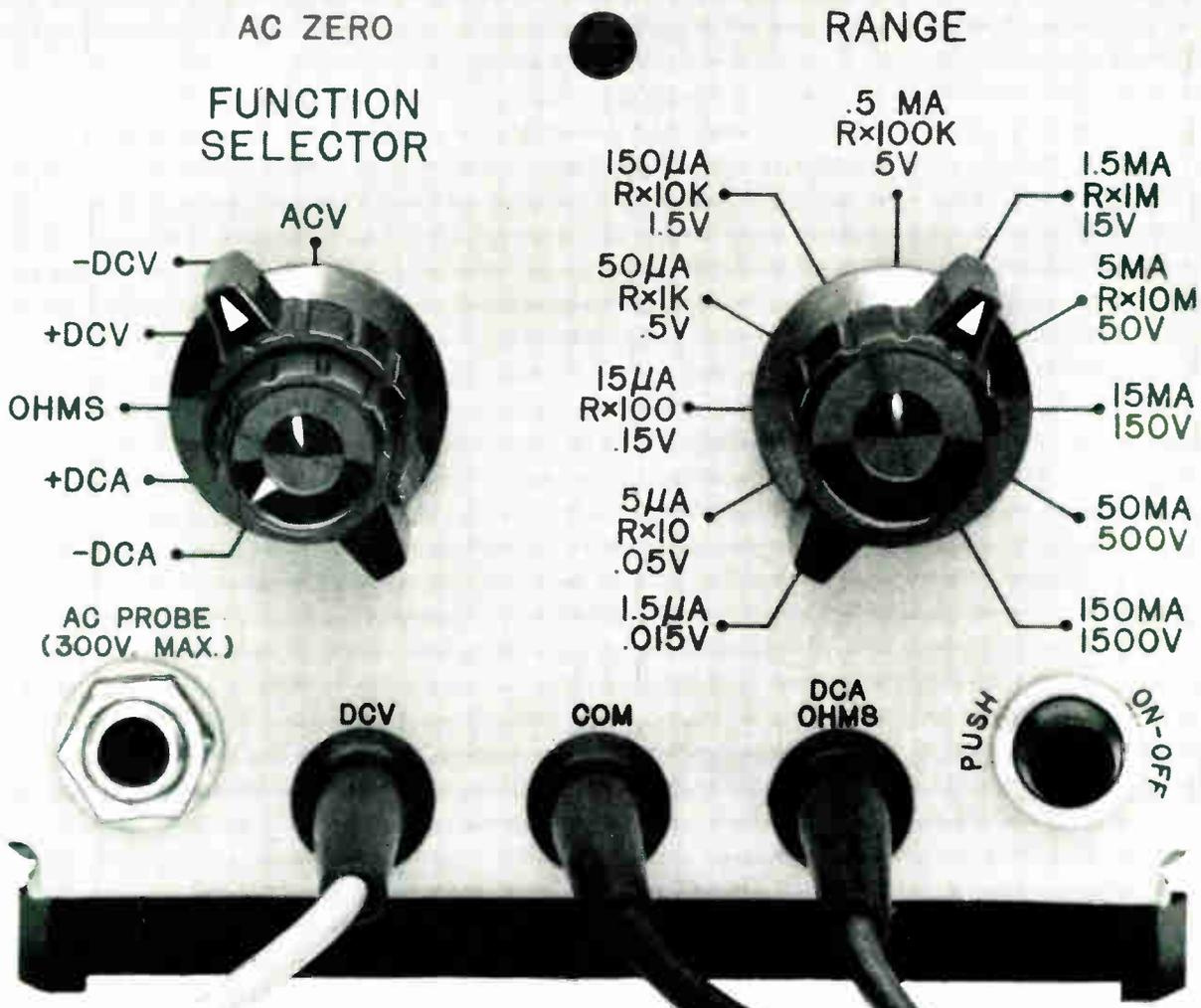
Circle 277 on Inquiry Card

1 DC VOLTS 2 DC CURRENT 3 AC VOLTS 4 OHMS

ELECTRONIC
VOLTMETER

HEWLETT  PACKARD

MODEL 410C



1. dc voltage — 1.5 mv to 1500 v — no zero set
2. dc current — 0.15 nanoamps to 150 ma — no zero set
3. ac voltage — 50 mv to 300 v — to 700 mc
4. resistance — 0.2 ohm to 500 megohms — no zero or ∞ set

MULTIMETER CONVENIENCE — with LABORATORY PRECISION!

hp introduces the 410C Electronic Voltmeter—a compact, wide-range instrument that makes all the measurements of a pocket-size meter with laboratory accuracy!

No single instrument has ever offered the accuracy available to cover this wide range of measurements: dc voltages from 15 mv to 1500 v full scale, direct current from 1.5 μ a to 150 ma full scale, resistance from 10 ohms to 10 megohms center scale and, with an optional plug-in probe, ac voltages at 20 cps to 700 mc from 0.5 v to 300 v full scale. Special current ranges, ± 1.5 , ± 5 and ± 15 nanoamps may be measured on the 15, 50, and 150 mv ranges using the voltmeter probe; 5% accuracy and 10 megohm input resistance. The compact design and light weight of the 410C make it an ideal multimeter for laboratory, production line and service department.

A neon oscillator and unique photoconductor chopper amplifier combine with the best advantages of vacuum tube and solid state design to provide such features as:

- no zero adjustment for dc voltage, current and resistance ranges
- 100 megohms dc voltmeter input impedance
- low resistance recorder output of less than 3 ohms
- dc voltage accuracy of $\pm 2\%$ of full scale, current accuracy of $\pm 3\%$ of full scale

Further, the high sensitivity, low drift and low noise of the neon oscillator photochopper amplifier make the instrument ideal as a preamplifier for data logging on analog recorders.

Add to this the optional hp 11036A AC Probe, and the 410C measures ac voltages with 3% accuracy. AC probe responds to positive peak voltage with meter reading in rms.

DC voltage measurements may be made up to 400 v above ground, thus eliminating ground-loop problems, and built-in self protective devices permit recovery in less than three seconds from overloads at up to 100 times full scale!

The individually calibrated taut band meter incorporates a 5:15 scale which permits most measurements to be made on the upper two-thirds of the meter scales.

Call your Hewlett-Packard representative now for convincing demonstration of the 410C on your bench.

HEWLETT PACKARD COMPANY



8521

1501 Page Mill Rd., Palo Alto, Calif., (415) 326-7000. Sales and service representatives in principal areas. Europe, Hewlett-Packard S.A., 54 Route des Acacias, Geneva, Switzerland; Canada, Hewlett-Packard (Canada) Ltd., 8270 Mayrand St., Montreal, Que.



SPECIFICATIONS

DC VOLTMETER

Voltage Ranges: ± 15 mv to ± 1500 v full scale
Accuracy: $\pm 2\%$ of full scale, any range
Input Resistance: 100 megohms $\pm 1\%$ on 500 mv range and above; 10 megohms $\pm 3\%$ on 15 mv, 50 mv and 150 mv ranges

DC AMMETER

Current Ranges: ± 1.5 μ a to ± 150 ma full scale
Accuracy: $\pm 3\%$ of full scale, any range

OHMMETER

Resistance Range: resistance from 10 ohms to 10 megohms, center scale
Accuracy: $\pm 5\%$ of reading at mid-scale

AMPLIFIER

Voltage Gain: 100 maximum
Output: proportional to meter indication; 1.5 v dc at full scale; maximum current 1 ma

AC Rejection: 3 db at $\frac{1}{2}$ cps; approx. 66 db at 50 cps and higher frequencies for signals less than 1600 v peak or 30 times full scale, whichever is smaller

Output Impedance: less than 3 ohms at dc

Noise: less than 0.5% of full scale on any range (p-p)

DC Drift: less than 0.5% of full scale/year at constant temperature; less than 0.02% of full scale/ $^{\circ}$ C

Overload Recovery: recovers from 100:1 overload in less than 3 sec

AC VOLTMETER

hp 11036A AC Probe Required

Ranges: 0.5 v to 300 v full scale, 7 ranges
Accuracy: $\pm 3\%$ of full scale at 400 cps for sinusoidal voltages from 0.5 to 300 v rms; the ac probe responds to the positive read-above-average value of the applied signal.

Frequency Response: $-3\% \pm 2\%$ at 100 mc; $\pm 10\%$ from 20 cps to 700 mc (400 cps reference); indications to 3000 mc

Frequency Range: 20 cps to 700 mc

Input Impedance: Input capacity 1.5 pf, input resistance greater than 10 megohms at low frequencies; at high frequencies impedance drops because of dielectric loss

Meter: peak-above-average responding, calibrated in rms volts for sine wave input

GENERAL

Maximum Input: dc—100 v on 15, 50 and 150 mv ranges; 500 v on 0.5 to 15 v ranges; 1600 v on higher ranges; 100 times full scale or 1600 v, whichever is less ac—100 times full scale or 450 v peak, whichever is less

Power: 115 or 230 v $\pm 10\%$, 50 to 1000 cps, 13 watts (20 watts with 11036A Probe)

Dimensions: 6-17/32" high, 5 1/8" wide, 11" deep behind panel

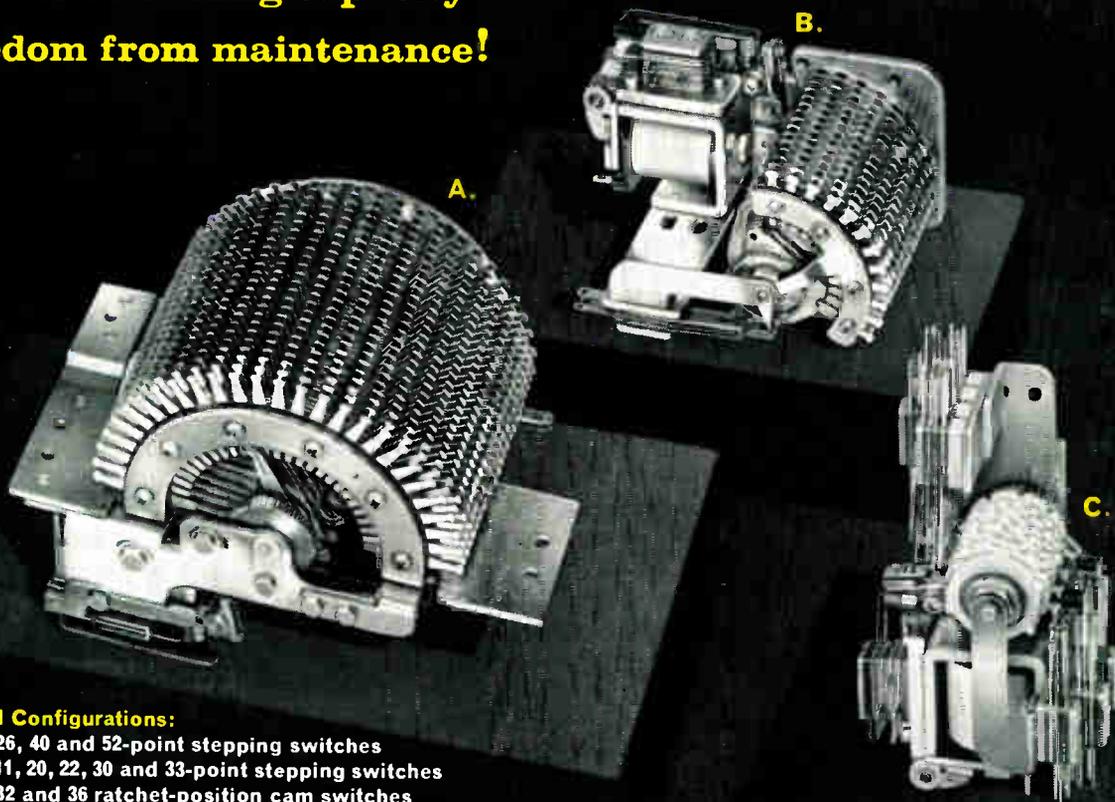
Price: hp 410C, \$300

Option 01: hp 11036A Probe calibrated with instrument, add \$50 to price of 410C; hp 11036A Probe when sold separately, \$60

Data subject to change without notice. Prices f.o.b. factory.

CLARE stepping & cam SWITCHES

provide longer service life •
greater switching capacity •
freedom from maintenance!



Typical Configurations:

- A. 20, 26, 40 and 52-point stepping switches
- B. 10, 11, 20, 22, 30 and 33-point stepping switches
- C. 30, 32 and 36 ratchet-position cam switches

CLARE Stepping and Cam Switches provide millions of steps with minimum maintenance. They are capable of handling extremely complex switching, counting, totalizing, selecting and sequencing operations. Special wiper configurations, shorting together all but one point in a level or leaving alternate points unshorted, are available.

Mechanical life of Clare Spring-Driven Stepping Switches ranges from 50,000,000 operations for switches with from 13 to 16 levels to 280,000,000 operations for from 1 to 4 levels. Cam switches range from 10,000,000 operations for switches with eight cams to 30,000,000 operations for two-cam switches.

Increased capacity of Clare stepping switches stems from a design which permits not only more levels per switch...but more levels in less space. For instance, the Clare Type 26 switch can provide twelve 52-point levels within a height of 4-11/16 in. This is but 11/16 in. higher than a comparable 52-point switch of eight levels. This compactness often allows more simplified circuitry when a single Clare switch can do the job which otherwise might require a multiple switch assembly.

For Complete Information on Clare Stepping and Cam Switches • Send for Clare Application Manual 202A

Electrical and Mechanical Characteristics of Spring Driven Stepping Switches and Cam Switches

Type	Points per Level	Levels (max)	Total Points (max)	Operating Speeds		Nominal voltages and Coil resistances
				Self-Interrupt	Remote impulse	
210	10, 20 or 30	12	120	60 steps per second at nominal voltage; 25°C	30 steps per second at nominal voltage with 66% "on" time; 25°C	6, 12, 24, 48, 60 and 110 vdc 1.5-600 ohms
211	11, 22 or 33	12	132			
20	20 or 40	16	480			
26	26 or 52	16	624			
200	Up to 8 cams with up to 6 contact springs per cam and 30, 32 or 36 steps per revolution					

ENCLOSURES: Hermetically-sealed enclosures or dust covers, with solder terminals or plug connectors, are available for all Clare Spring-Driven Stepping and Cam Switches.

Address: Group 8D6, C. P. Clare & Co., 3101 Pratt Boulevard, Chicago 45, Illinois. Cable Address: CLARELAY. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ontario. In Europe: C. P. Clare, Ltd., 70 Dudden Hill Lane, London NW 10, England.



Relays and related control components

NEW PRODUCTS

DIFFERENTIAL VOLTMETER

Divider terminal linearity is 2 to 20 ppm.

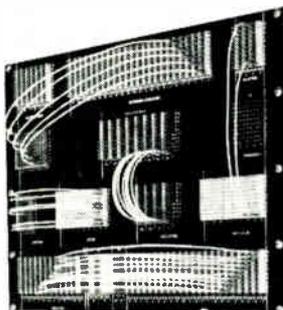


Model 823A has dc voltage measurements of $\pm 0.01\%$ accuracy and $\pm 0.1\%$ ac accuracy (infinite at null) over 0 to 500v ranges. It features in-line readout with lighted decimal, dc polarity switch, recorder output, and no zero controls. John Fluke Mfg. Co., Inc., P. O. Box 7428, Seattle 33, Wash. BOOTH 3220.

Circle 278 on Inquiry Card

PATCHBOARDS

Can be supplied in single units to fit standard rack widths.



The Wasp patchboard assembly uses point-to-point patch cords for quick program changes, or pre-programmed patch-plug modules for semi-permanent installation. If a more positive system is required, grid marking or positions may be imprinted by silk screening. It can be made as a complete 24 x 24 in. unit panel. Malco Mfg. Co., 4025 W. Lake St., Chicago 24, Ill. BOOTH 4008.

Circle 279 on Inquiry Card

TELEMETERING FILTERS

Insertion loss at center freq. is less than 3db.

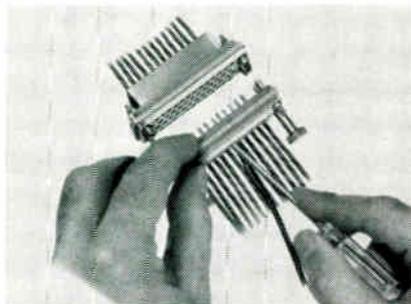


FL-384 through FL-388 subminiature telemetering filters have source and load impedance of $47K\Omega$. The units are designed for IRIG channels, A, B, C, D, E, with center freqs. from 22kc to 70kc. Attenuation in pass band ($F_0 \pm 15\%$) is less than 1db. At freqs. below $0.15 \times F_0$, the attenuation is over 20db. At freqs. above $2 \times F_0$, the attenuation is over 30db. Triad Distributor Div., Litton Industries, 305 N. Briant St., Huntington, Ind. BOOTH 3316.

Circle 280 on Inquiry Card

PLUG AND SOCKET UNITS

Contacts are separate from connector body and wired independently.



Series 25 miniature rectangular plug and socket connectors and solderless crimp-termination removable contacts conform to Mil-C-22857. The contacts feature an extra-wide, 3-tine tension-spring clutch. Connectors are available in 14, 20, 26, 34, 50, 75 and 104-contact sizes with removable contacts for #14 to 24 AWG wire sizes. Continental Connector Corp., 34-63 56th St., Woodside 77, N. Y. BOOTH 503.

Circle 281 on Inquiry Card

ACCELEROMETER

Dynamic operating range is 100g and above.

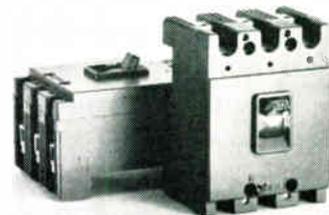


Model 5310 is a servo accelerometer which uses a gravity-sensing system instead of the conventional pivot and jewel suspension system. Designated Flexure Accelerometer, it withstands shock and vibrations up to 500g at 8msec. Systron-Donner Corp., Concord, Calif. BOOTH 2521.

Circle 282 on Inquiry Card

CIRCUIT BREAKER

There are 11 standard current ratings from 10 to 100a.



Series EH is a 480v., 100a. hydraulic-magnetic circuit breaker. It permits a trip range high enough to allow starting inrushes as high as 2000% without tripping, and low enough to interrupt short-circuits instantaneously. The 3 trip ranges are 700-1000%, 1000-1400%, and 1400-2000% of rated load. Heinemann Electric Co., 250 Magnetic Dr., Trenton 2, N. J. BOOTH 3801.

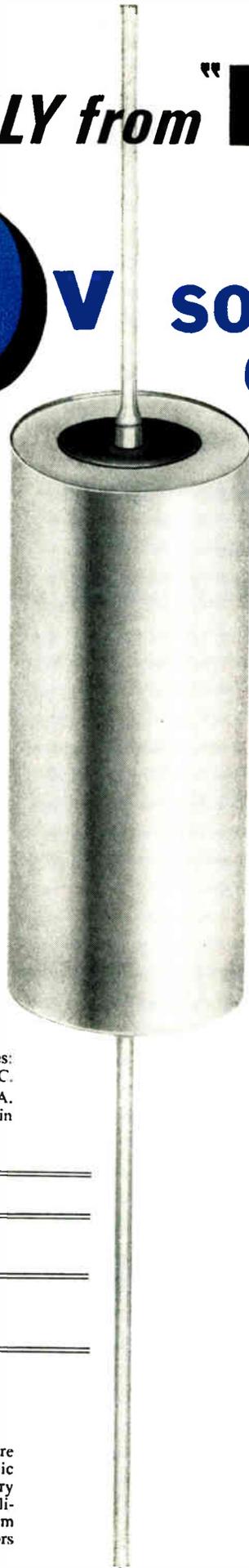
Circle 283 on Inquiry Card

Available *ONLY* from "KEMET"

100v

75
60
50
35
20

J-SERIES
(POLAR TYPE)
SOLID TANTALUM CAPACITORS



0.1 to 2.7 Microfarads

Temperature Range:
100v at 85°C. • 67v at 125°C.

KEMET was first to bring you high-voltage solid tantalums—50, 60, and 75 volts—three big contributions in 2½ years!

Now KEMET pioneers with true *quantity* production of 100-volt units—in hermetically sealed A and B case sizes conforming to Style CS12 and Style CS13 in MIL-C-26655A.

These new 100-volt capacitors show the same resistance to shock and vibration, the same stability of electrical parameters with temperature change, and the same low levels of leakage current as the lower-voltage J-Series units. Also, the maximum dissipation factor has been reduced to 3%—the lowest ever—or one-half the usual J-Series m.d.f.

Today's total J-Series provides microfarad values from .0047 to 330; working voltages of 6, 10, 15, 20, 35, 50, 60, 75, and 100 volts—offering standard E.I.A. values with ±5, 10, and 20% tolerances.

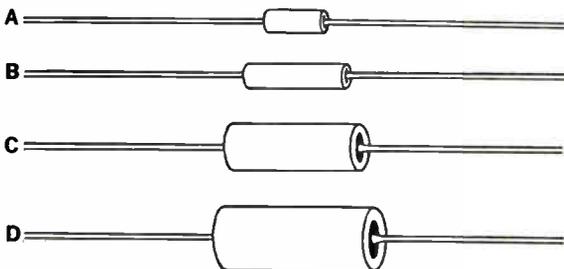
KEMET is your assurance of maximum reliability, since KEMET controls the characteristics of tantalum powder from mine to finished product! For technical data on any member of the J-Series, write to:

**"THE SPECIALIST IN
SOLID TANTALUM CAPACITORS"**

Kemet Department, Linde Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio. Telephone: 216-221-0600.

J-Series • Actual Size

Microfarads: Temperatures:
.0047 to 330 -80 to +125°C.
4 cases conform to MIL-C-26655A.
100v units presently available only in military cases A and B.



**LINDE/KEMET PRODUCTS
for Electronics/Aerospace**

LINDE Laser/Maser Crystals • Sapphire
• Rare Gases/Mixtures • Cryogenic
Materials • Single Crystal Refractory
Metals • Semiconductor Silicon • Silicon
Monoxide • KEMET Barium
Getters and Solid Tantalum Capacitors
(Request Technical Data)

KEMET DEPARTMENT

**LINDE
COMPANY**

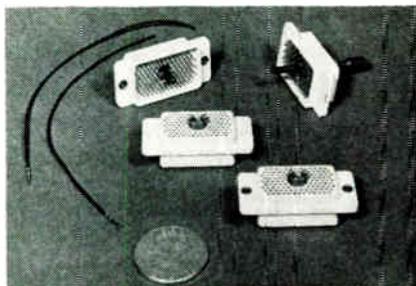


*Kemet, **Linde, and ***Union Carbide* are registered trade marks of Union Carbide Corporation.

NEW PRODUCTS

MINIATURE CONNECTOR

They are available in 14 to 244 contact configurations.

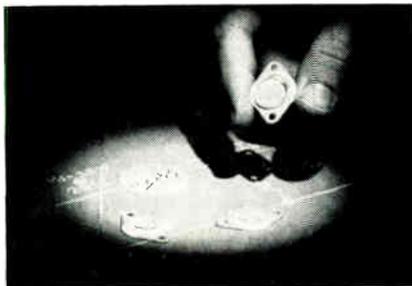


These subminiature connectors have solderless crimp-removable type 22-gauge pin and socket contacts which withstand 25 lb. axial load. The contact rating is 30a. at 280vac and 200vdc. Density is 110 psi. Hughes Aircraft Co., Florence Ave. & Teale St., Culver City, Calif. BOOTH 4240.

Circle 284 on Inquiry Card

LIGHT-DEPENDENT RESISTOR

Current-handling capacity is 0.5 amp.; power dissipation is 25w.



The LDR-25 light-dependent resistor with high power-handling capabilities is now commercially available. In some uses it eliminates the need for high-current-carrying relays. It operates from 110vac and is rated at 200vdc or peak ac. Deleo Radio Div., General Motors Corp., Kokomo, Ind. BOOTH 3814.

Circle 285 on Inquiry Card

MULTI-SWEEP OSCILLATOR

Provides continuous sweep width over its 1100mc range.



The Multi-Sweep 121-A covers the range from 0.5 to 1100mc in all-electronics freq. sweeps up to 300mc wide. It provides a single continuous sweep from 0.5 to 300mc variable center freq. Kay Electric Co., Maple Ave., Pine Brook, N. J. BOOTH 3117.

Circle 286 on Inquiry Card

MACHINE TOOL

Removable worktables may be replaced within 0.0002 in. accuracy.

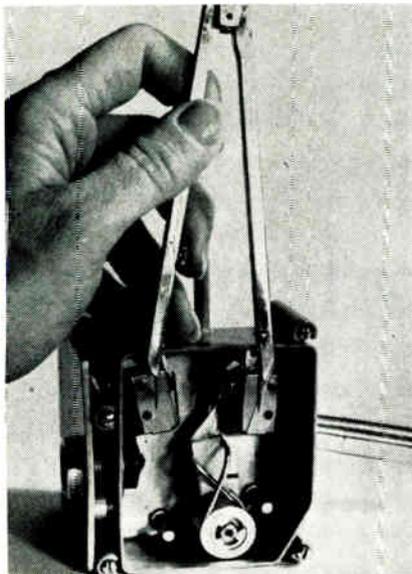


Ultramill is a laboratory tool used for development work in semiconductors and microelectronics. This micro-manipulated machine tool permits direct working from 8½ x 11 in. drawings. Movements traced by a plastic chessman on the drawing are reduced mechanically and transmitted to 2 interchangeable tool housings. The Ultramill machines its own tools. Micro Dynamics Corp., 34118 Pacific Coast Hwy., Dana Point, Calif. BOOTH 4003.

Circle 287 on Inquiry Card

HERMETIC SWITCHES

Life using ratings of 0.3 to 0.4a. dc at 28v. inductive above 100,000 cycles.

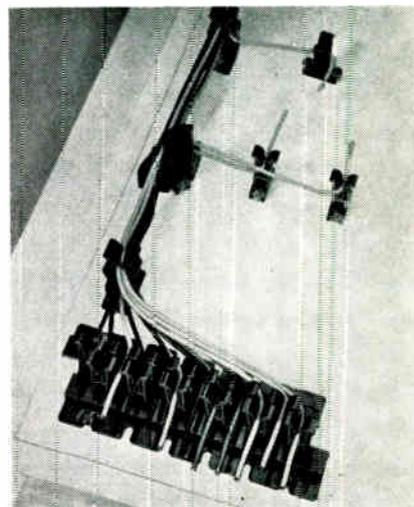


Enclosed within Model H10-1000 hermetic housing are 2 hermetically-sealed SPDT H16-200 Model basic switches. If the housing is damaged, the unit functions properly as long as both H16-200 switches are not damaged and remain sealed. Controls Co. of America, 1420 Delmar Dr., Folcroft, Pa. BOOTH 1308.

Circle 288 on Inquiry Card

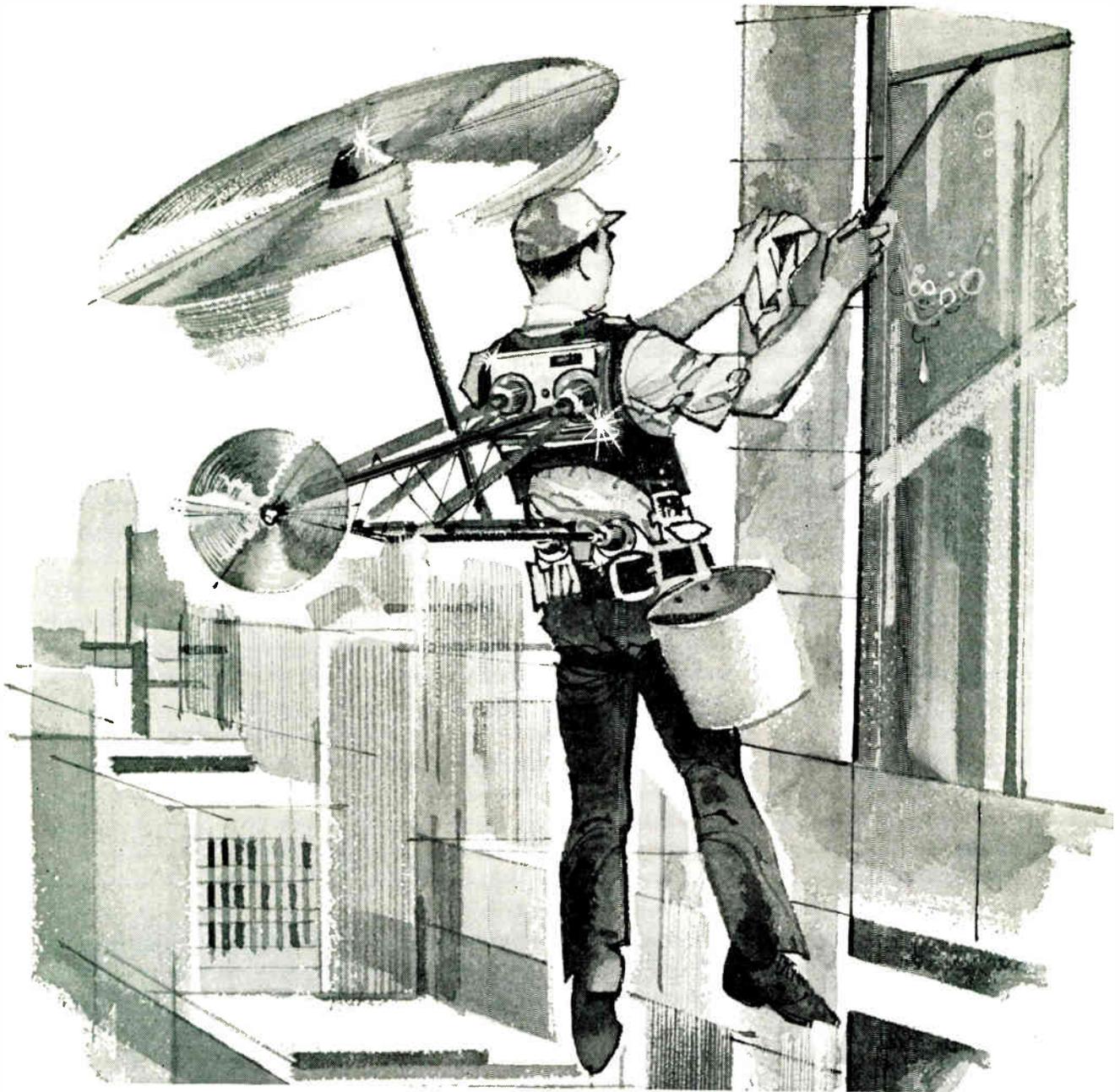
HARNESSING SYSTEM

Provides a fast and economical method of harness building.



A time-saving method for preforming cable harnessing is accomplished by a few components: harness assembly clips, end clips, junction posts, and end clip brackets. All wires are held in place right through banding, lacing or tying. The harness is then peeled off the board and is ready for installation. Weckesser Co., Inc., 5701 Northwest Hwy., Chicago 46, Ill. BOOTH 712.

Circle 289 on Inquiry Card



What won't you think of next?

A winged window washer? We may never see one. Where, in the elite corps of fearless window washers, are we going to find enough pilots.

Our point is this—your present design problem may seem impractical, just as the drill, shaver, mixer and other cordless products did a few years ago. But Gould-National research engineers developed a package of concentrated power using NICAD® Hermetically Sealed Rechargeable Cells that helped to make these products a reality.

Have a design problem that could be solved with Nicad portable power? Write us. We may be able to help you solve your problem.



NICAD BATTERY DIVISION

GOULD-NATIONAL BATTERIES, INC. / St. Paul 1, Minnesota



Now three
semi-flexible
epoxy resin
systems
for use at
temperatures
up to

155° C

Presenting the new "Scotchcast" Brand Resin No. 280 family. No. 280 (unfilled, very low viscosity), No. 281 (filled, low viscosity), and No. 282 (thixotropic, medium viscosity) are a major breakthrough in electrical insulating resin systems. They combine semi-flexibility, exceptional moisture resistance and excellent Class F temperature characteristics.

These resin systems can eliminate major packaging and insulating bottlenecks. No worry about thermal shock cracking, or stresses on delicate components, thanks to their built-in flexibility. And look at these high temperature properties:

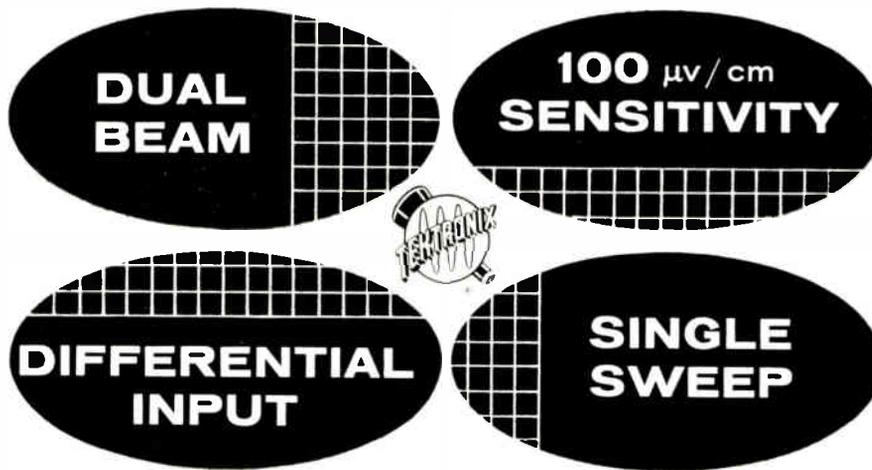
One week heat aging at 155°C.—weight loss only 0.38%. One week immersion in water—weight gain only 0.25%. Dielectric constant and dissipation factor at 1000 cycles—practically flat through entire range of 23 to 155°C.

Try these resin systems for your MIL-T27 transformers or for impregnation or encapsulation of strain-sensitive electronic and electrical components. For complete facts see your 3M "IQ" Man* or write: 3M Co., Bldg. 220-5W, St. Paul 19, Minn.

*"IQ" means Insulation Qualified. Your 3M Man is trained and qualified to help you with your electrical insulating problems.

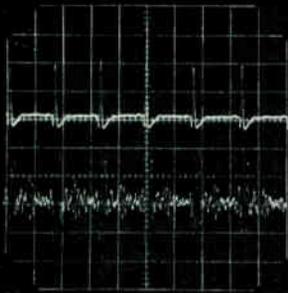


3M MINNESOTA MINING & MANUFACTURING CO.
"SCOTCHCAST" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 19, MINN.



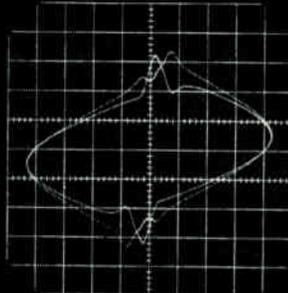
to simplify waveform-comparison applications . . . Type 502A

- . . . To measure stimulus and reaction on the same time base.
- . . . To measure transducer outputs, such as pressure vs. volume.
- . . . To measure phase angles and frequency differences.
- . . . To measure plots of X-Y curve-tracing presentations.
- . . . To measure other characteristics of low-level displays.



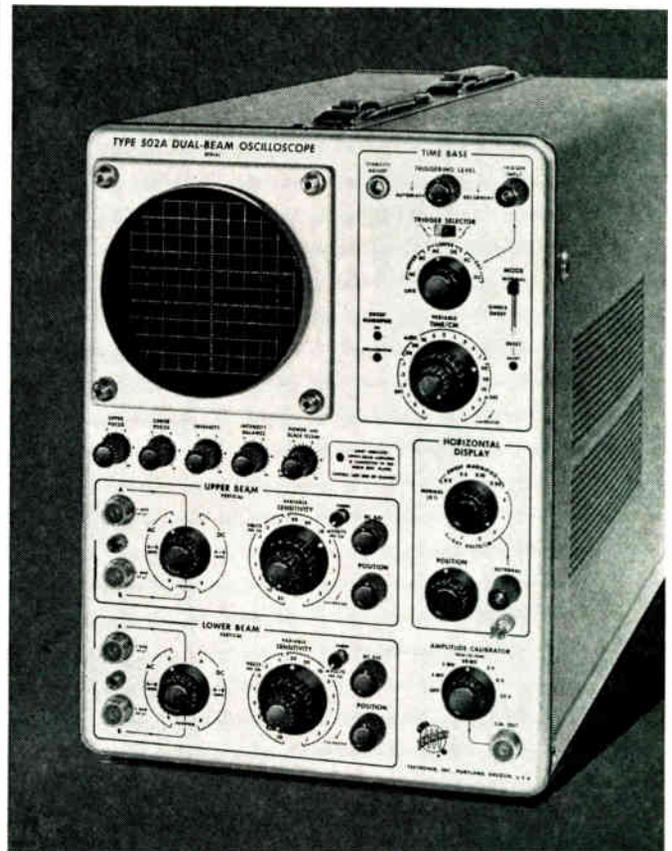
BIO-MEDICAL APPLICATION

Typical dual-beam display shows presentation of ECG (upper beam) vs. heart sounds (lower beam) of patient.



QUALITY-CONTROL APPLICATION

Typical dual-beam X-Y display shows comparison of E/I loops of two transformers in a production run.



FEATURES

- 2 identical vertical amplifiers
- 17 calibrated steps of sensitivity
- 21 calibrated sweep rates
- 4 steps of sweep magnification
- Continuously adjustable sweep and sensitivity controls
- Push-button beam finders
- Intensity-balance control

FOR A DEMONSTRATION, PLEASE CALL YOUR TEKTRONIX FIELD ENGINEER

MAIN PERFORMANCE CHARACTERISTICS

- Passbands from dc-to-50 kc, minimum, to dc-to-1 Mc maximum
- Calibrated Vertical Sensitivity in 17 steps from 100 $\mu\text{v/cm}$ to 20 v/cm , both amplifiers
- Calibrated Sweep Range in 21 rates from 1 $\mu\text{sec/cm}$ to 5 sec/cm
- Variable, Uncalibrated, Sensitivity and Sweep Range Controls
- 2X, 5X, 10X, or 20X Sweep Magnification
- Flexible Trigger Facilities
- Amplitude Calibrator
- Electronically-Regulated Power Supplies

Type 502A Oscilloscope \$1050
 U. S. Sales Price f.o.b. Beaverton, Oregon

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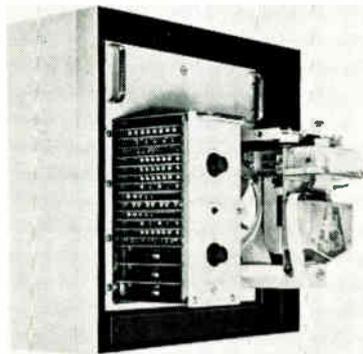
Tektronix Canada Ltd: Montreal, Quebec • Toronto (Willowdale) Ontario • Tektronix Ltd., Guernsey, Channel Islands

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NEW PRODUCTS

SERIAL CONVERTER

Data is recorded continuously at 110 characters/sec.



Model 265 solid-state, high-speed serial converter converts parallel digital data to serial form in data-logging applications using tape punches or magnetic-tape recorders. A built-in memory allows it to acquire new information while feeding previously gathered information to the tape punch or recorder. Non-Linear Systems, Inc., Del Mar, Calif. BOOTH 2313.

Circle 290 on Inquiry Card

COUNTERS AND TIMERS

With 100mc plug-in, measures time intervals with a resolution of 10nsec.



The 6100 Series of solid-state counters and timers feature plug-in flexibility and are completely solid-state with in-line, in-plane electroluminescent digital display. Featuring both 25Mc and 2.5Mc instruments, models are available as EPUT® meters and timers. Range and functions may be extended through a series of plug-in accessory units. The 25Mc models can be extended to 100Mc, and through heterodyning to 1Gc. All instruments may be used with a voltage-to-freq. converter plug-in, which gives voltage readings directly on a digital display. Beckman Instrument Inc., Berkeley Div., 2200 Wright Ave., Richmond, Calif. BOOTH 3104.

Circle 293 on Inquiry Card

TUNING FORK OSCILLATOR

Waveform is essentially square with a rise time of less than 10µsec.

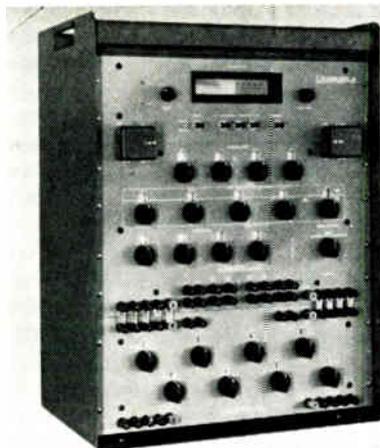


The Tf-O is a compact tuning-fork oscillator which fits a standard RETMA socket. The hermetically-sealed unit has an all transistorized silicon, self-contained circuit and is internally regulated and temp. compensated. Freq. range: 400 to 8600cps; accuracy is $\pm 0.005\%$ (room amb.); stability is $\pm 0.075\%$ from -20°C to $+75^{\circ}\text{C}$; voltage coefficient is $\pm 0.005\%$ for 10% supply-voltage variation. Time and Frequency, 127 S. Batavia Ave., Batavia, Ill. BOOTH 2403.

Circle 291 on Inquiry Card

RESISTANCE COMPARISON

Resolution is 1/10ppm; eliminates lead and contact resistance.



Model 121 direct-reading, double-ratio resistance comparison system is a matched assembly of a resistance bridge, special generator-detector and a lead corrector. It has a comparison accuracy of approx. 1 ppm over a range of ± 6000 ppm. Electro Scientific Industries Inc., 7524 S.W. Macadam Ave., Portland 19, Ore. BOOTH 2317.

Circle 294 on Inquiry Card

DIGITAL PHASE METER

Input signal ratio varies from 1 to over 100 with no effect on accuracy.



Type 524A measures the phase angle between 2 alternating voltages, and shows the findings in a 4-digit readout. It provides an analog output for plotting characteristic curve on recorders. An optional digital voltmeter provides a digital output for operating tape punches, printers, and typewriters. Features: No freq. adjustment from 20cps to 40kc; no instability between 0° and 360° ; accuracy of $\pm 0.1^{\circ}$. Ad-Yu Electronics, Inc., 249-259 Terhune Ave., Passaic, N. J. BOOTH 4233.

Circle 292 on Inquiry Card

PORTABLE RECORDER

Pushbutton selected chart speeds of 1, 5, 20 and 100mm/sec. are provided.



Tracemaster® single-channel portable direct-writing recorder, model 29105, has a timer-event marker to correlate time of data with related events. The marker may be used as a timer or remote timer. The unit has a response from dc to 90cps; is essentially flat at 30mm (P to P amplitude), 3db down at 125cps. Rise time is approx. 5msec. American Optical, Instrument Div., Buffalo 15, N. Y. BOOTH 4525.

Circle 295 on Inquiry Card



Electronic technology that works...

CERAMIC FILM CAPACITORS SAVE SPACE ABOARD IMPROVED MINUTEMAN

An exciting breakthrough in technical ceramics . . . a ceramic film so thin that you can read through it . . . is being used now in space-saving, miniaturized Erie film capacitors on the Air Force's new, improved Minuteman missile.

Replacing bulkier capacitors, these new high performance, high volumetric efficiency parts save valuable space and withstand flight environmental conditions in the circuitry of this vital missile.

These smaller, better, shockproof, Erie ceramic film capacitors are another example of the new advanced research and production technologies now at work at Erie . . . where reliability goals are assured.

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Circle 56 on Inquiry Card

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Waste not (today) **Want not** (tomorrow)

You'll never again need to waste a penny on features you don't need in the microwave signal generator you buy today. Better still, tomorrow, when you need more range, or extended modulation capabilities, you won't have a moment's regret—just add another inexpensive module, stack (or rack) it with the first, and you're all set!



PRODUCTION TESTING? Choose an X-band or C-band source. . . add the compatible doubler later, for Ku or Ks band.



ANTENNA RANGING? Why buy fancy modulation? The signal generator you need is available without that expense . . . add the universal modulator next year, when you move into the lab!



OUTFITTING A LABORATORY? One universal modulator, racked up with the generators, sources, or doublers you choose, will cut thousands of dollars off your equipment budget, at no loss in measurement capability.

You can build up literally dozens of versatile packages with the seven modules shown here. Soon you will be able to add L and S band modules . . . now in prototype production!

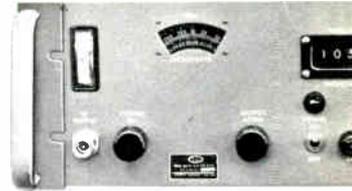
Want the complete Polarad Signal-Generator story? Turn the page!



MODULAR SIGNAL GENERATOR 1107
Freq. Range:
3.8 GC-8.2 GC



MODULAR SIGNAL GENERATOR 1108
Freq. Range:
6.95 GC-11.0 GC



MODULAR COMMON MODULATOR 1001
Modulation and Sync Signals



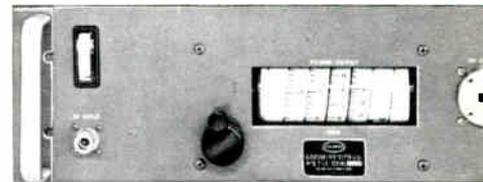
MODULAR SIGNAL SOURCE 1207
Freq. Range:
3.8 GC-8.2 GC



MODULAR SIGNAL SOURCE 1208
Freq. Range:
6.95 GC-11.0 GC



MODULAR FREQUENCY DOUBLER 1509
Freq. Range:
10.0 GC-15.5 GC out



MODULAR FREQUENCY DOUBLER 1510
Freq. Range:
15.0 GC-21.0 GC out



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Choose from the industry's largest line of precision microwave signal generators & sources manufactured to the industry's highest standards of quality by the men who have made



World Leader in Microwave Instrumentation.

	MODEL-DESCRIPTION	FREQUENCY-GC	CALIBRATED POWER OUTPUT	INTERNAL MODULATION	NOTES
MODULAR	1107 Signal Generator	3.80-8.2	+3 dbm to -127 dbm (+10 dbm uncalibrated)	Square wave: 800-1200 cps	Completely modular design for stacking or rack-mounting. Single-band continuous UNIDIAL® tuning. ±0.5% accurate digital frequency indicators. Ultra-stable design; very low incidental AM and FM. Auxiliary RF output for phase lock capability and frequency monitoring. Panel height 5¼".
	1108 Signal Generator	6.95-11.0		800-1200 cps	
	1207 Source	3.80-8.2	50 mw min	FM deviation: 0 to ±5.0 mc	
	1208 Source	6.95-11.0	25 mw min	FM rate: 1 cps to 1 mc	
	1509 Doubler	10.0-15.5 out	0 dbm to -100 dbm; max. input 250 mw; conversion loss less than 18 db	External pulse: 40 cps to 1 mc	
	1510 Doubler	15.0-21.0 out		Pulse width: 0.2 to 2,500 μsec	
	1001 Modulator	Modulation and Sync Signals	Sufficient level to modulate all generators and sources	External FM rate: 100 cps to 0.5 mc	
TYPICAL MODULAR COMBINATIONS	1709	3.80-8.20/10.0-15.0	See 1207/1509	Pulse & Sawtooth FM: 10-10,000 cps	Modulates all above instruments. Panel height 5¼".
	1710	6.95-11.0/15.0-21.0	See 1208/1510	Pulse width: 0.2-10 μsec	
	1809	3.80-8.20/10.0-15.0	See 1207/1509	Sync delay: 0 and 2-2,000 μsec	
	1810	6.95-11.0/15.0-21.0	See 1208/1510		
	1607	3.8-8.20	See 1107		
	1608	6.95-11.0	See 1108		
	INTEGRAL	PMR-Signal Generator	0.5-1.0	-3 dbm (0.5 mw) to -127 dbm calibrated to ±2 db	
MSG 1R/2R/2PA Signal Generator		0.95 to 4.6 (2 plug-ins) MSG-2PA High Power Tuning Unit (10 mw cal. output)	0 dbm (1 mw) to -127 dbm calibrated to ±2 db	AM: Pulse and square wave; 10-10,000 pps	
PMX-Signal Generator		4.45-11.0 (2 plug-ins)		Pulse width: 0.2-10 μsec	
MSG 34 Ultra-Broadband Signal Generator		4.2 to 11.0 (single tuner; digital indicator)	0 dbm (1 mw) to -127 dbm calibrated to ±2 db	Pulse delay: 2-2,000 μsec	
UNIVERSAL INTEGRAL	KSS Source	1.05 to 11.0 (4 plug-ins)	14-400 mw, depending on frequency; uncalibrated	Square wave: 10-10,000 pps	115 V AC and 12 V DC battery operation.
	EHF Generator	18.0 to 39.7 (7 plug-ins)	-10 dbm to -90 dbm calibrated to ±2 db	External: pulse, square wave, FM Sawtooth or sine wave	
	EHF Source	18.0 to 50.0 (9 plug-ins)	3 to 10 mw, depending on frequency; uncalibrated	Square wave: 1,000 cps	
	IC-120 A/B Impulse Generator	1 mc-10.0 GC continuous; flat within ±0.5 db	60-70 db above 1 μv/mc	External: pulse, FM	
				PRR: 1,000 cps	
			Pulse width: 0.02 nanoseconds	Pulse train width: 0.06 nanoseconds	

If you do not find exactly what you need in this chart, call in your Polarad field engineer. (See the Yellow Pages for his listing.) He is a microwave expert. If you prefer, communicate directly . . . by calling EXeter 2-4500 (Area Code 212) . . . for prompt, informed assistance.

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MICROWAVE SIGNAL GENERATORS & SIGNAL SOURCES

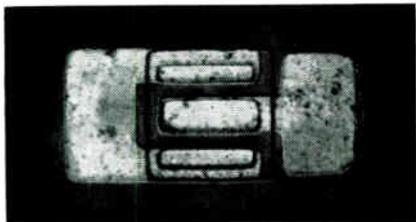
JUST OFF THE PRESS!

Free 40 page Engineering Bulletin includes a complete review of the design principles and application techniques of microwave signal generators, as well as complete specifications on the entire Polarad line. Write for yours today!

NEW PRODUCTS

MICROPOWER TRANSISTOR

The gain bandwidth is greater than 1ca. Beta is 70 at 8ma.

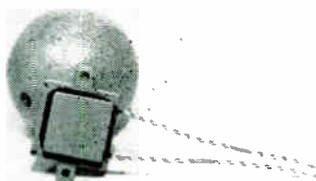


The 2N2784 silicon epitaxial planar switch is a small, high-freq. unit with a typical total switching time of 12 nsec. in a saturated circuitry. It has optimum efficiency at the μ w and mw range. Sylvania Electric Products, Inc., 100 Sylvan Rd., Woburn, Mass. BOOTH 2901.

Circle 347 on Inquiry Card

THERMOELECTRIC COOLER

Maximum heat pumping capacity is 6.8w/hr. (21.4 btus/hr.).

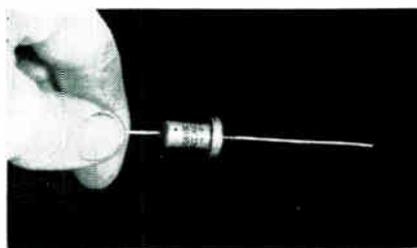


Model 3950 is a 7.5dc amp, 1.5vdc thermoelectric cooler. It may be used separately for low heat-load cooling, or multiple arrays connected in series may be used for higher heat-load conditions. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. BOOTH 1619.

Circle 348 on Inquiry Card

125V WET CAPACITORS

Offers high capacitance rating for this voltage.

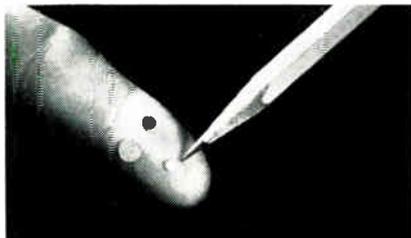


The type PP tantalum capacitor offers a capacitance rating of 39 mfd at 125-vdc. This addition to the PP series line will be available in the T3 case size. Fansteel Metallurgical Corp. No. Chicago, Ill. BOOTH 2912.

Circle 349 on Inquiry Card

THERMISTORS

Values from 50 Ω to 10 megohms with temp. coef. of -3.9% °C to -6.8% °C.

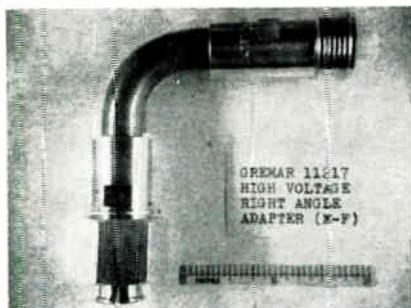


The Glennite microminiature D series is used for temp. compensation and thermometry. They come in 4 sizes: dia. of 0.100, 0.150, 0.200 and 0.250 in., with a standard thickness of 0.031 in. Operating temp. range is -55° C to $+150^{\circ}$ C. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J. BOOTH 4402.

Circle 350 on Inquiry Card

RIGHT-ANGLE ADAPTER

Two or more distribution sources may be used to increase output.

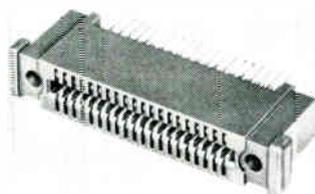


The 11217 right-angle 30kv adapter permits tapping existing cable runs to eliminate extra cables from remote power source. Greomar Mfg. Co., 7 North Ave., Wakefield, Mass. BOOTH 1506.

Circle 351 on Inquiry Card

CONNECTOR

Accordion-style contact spring is made of beryllium copper wire.

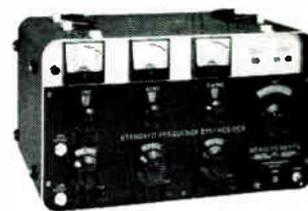


This 0.050 in. space printed-circuit card receptacle connector accommodates 0.054-0.070 in. thick cards with 20 contacts on each side of a double-sided board. Termination is either solder or weld, or dip soldered to another board 1/16 - 1/8 in. thick. Burndy Corp., Omaton Div., Norwalk, Conn. BOOTH 4424.

Circle 352 on Inquiry Card

FREQUENCY SYNTHESIZER

Unit is completely self-checking and self-calibrating.



Model M-502 produces any freq. within its basic range of 10Mc/s to 20Mc/s (± 50 cycles). External freq. multipliers or dividers extend to frequencies as high or low as desired. Stability and resetability is better than ± 10 eps at all freqs. Measurements, a McGraw-Edison Div., Bounton, N. J. BOOTH 2911.

Circle 353 on Inquiry Card

METAL-FILM RESISTORS

The helium atmosphere increases stability by eliminating possible contamination.



Series FH are available in 1/8, 1/4, and 1/2w. ratings. These hermetically-sealed units are helium filled, making possible spectrometer test procedures at leakage rates of 1×10^{-11} cc/sec. of helium. The components meet applicable Mil spec. Mepeco, Inc., 37 Abbebt Ave., Morristown, N. J. BOOTH 203.

Circle 354 on Inquiry Card

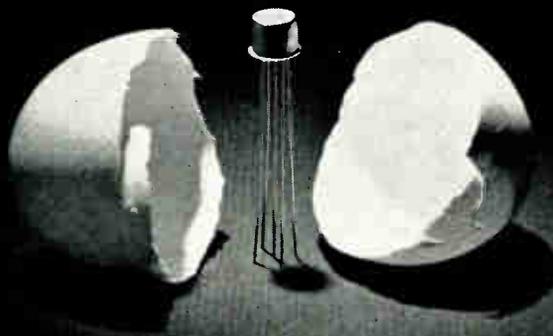
JACK PANELS

Panels feature one designation strip for identification.



Jack panels Series 1400 and 1500 are molded of solid phenolic and reinforced with steel. Botl. fit 19 in. relay rack and are ideal for telephone, broadcast and communication uses. Series 1400 and 1500 support 26 jacks in a single row. Series 1400 is available with long frame telephone jacks mounted on the panel; 1500 has military phone jacks. Switchcraft, Inc., 5555 N. Elston Ave., Chicago 50, Ill. BOOTH 1508.

Circle 355 on Inquiry Card



RELAY breakthrough !

The smallest SPDT Relay available for immediate delivery.

TO-5 transistor case size.

DC coil voltages: 1.5 to 32 volts.

Operate power: 100 milliwatts at pull-in.

Operate time: 1.5 milliseconds max.

Dissipation: 0.3 watts at rated voltage.

All-welded construction.

1,000,000 operations at 125° C at 0.5 amp.

100,000 operations at 1 amp.

10,000,000 operations at low level.

Continuous duty.

Dry circuit to 1 amp.

Vibration: 30 G's to 3,000 cps.

Shock: 80 G's, 11 milliseconds.

Meets requirements of MIL-R-5757D.

PATENT APPLIED FOR.

Contact: Your local Teledyne Precision Representative or Teledyne Precision, Inc., a subsidiary of Teledyne, Inc., 3155 El Segundo Boulevard, Hawthorne, California. 679-1186.

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Every silicon diode you buy from Syntron has avalanche characteristics. Syntron, the first semiconductor manufacturer to offer a complete line of avalanche diodes on this basis.

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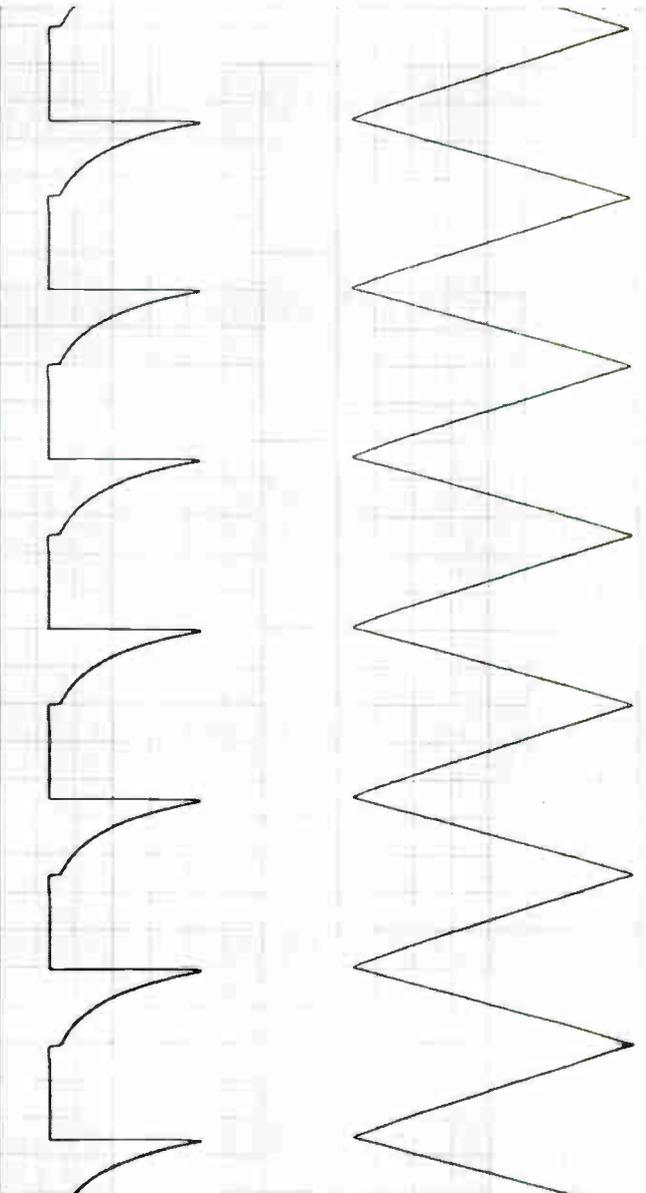
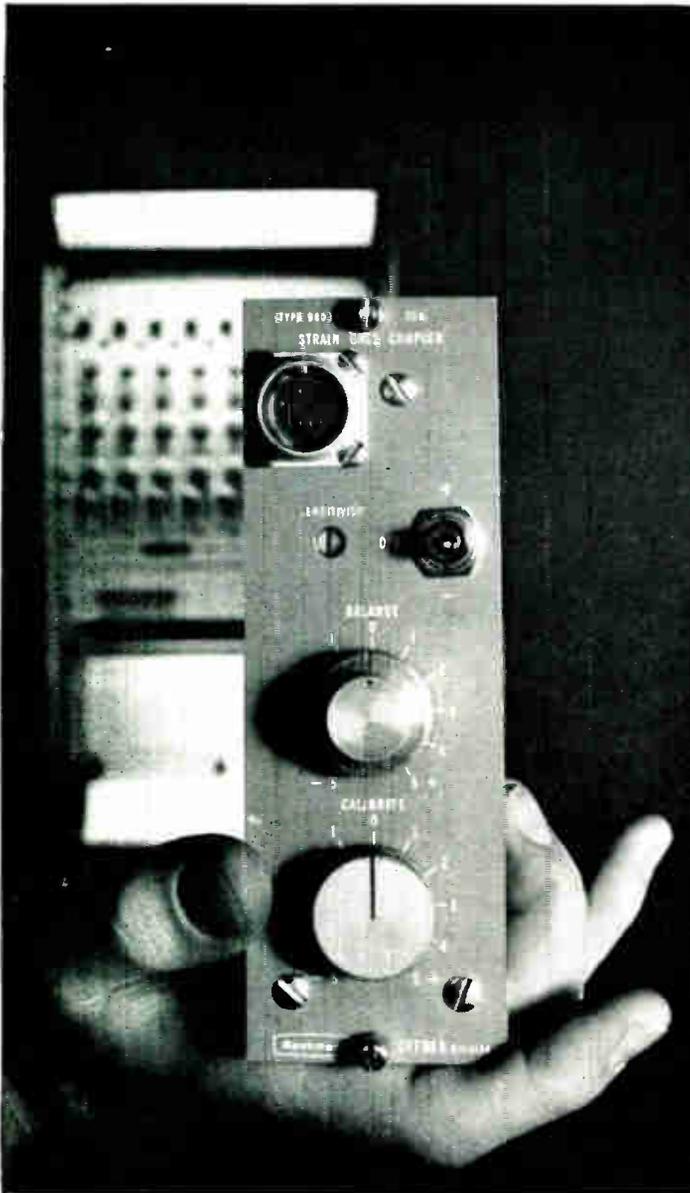
63R103

SYNTRON

SYNTRON COMPANY

SEMICONDUCTOR DEPT. 63R103

263 Lexington Avenue • Homer City, Pa.



LOW-COST PLUG-IN INPUT COUPLERS ALLOW THE TYPE S RECORDER TO ACCOMMODATE A WIDE RANGE OF INPUT SIGNALS. 23 STANDARD COUPLERS ARE AVAILABLE.

OFFNER TYPE S OYNOGRAPH[®] IS SERVO CONTROLLED AT THE PEN POINT TO ASSURE LOCKED-IN ACCURACY.

Offner adaptability in ink rectilinear recordings

Only OFFNER offers the advantages of ink rectilinear recording with the flexibility of fast input coupler exchange. Servo loop at the stylus point forces locked-in accuracy. The OFFNER input couplers change the function of the amplifier system and provide all necessary bridge balancing, calibration and "computing" facilities...thus obviating the need for expensive special-purpose amplifiers.

Specifications:

Number of Channels	1-8 standard; to 24 special
Sensitivity	With preamp 1 μ v/mm to 5v/mm Without preamp 1m v/mm to 5v/mm
Frequency Response	DC to 150 cps
Phase Delay	2.5 ms \pm 0.05 ms, 0-120 cps
Linearity	0.1% (full scale) for DC; or AC within maximum amplitude envelope
Drift	(shorted input) With preamp 1 μ v/hr at max. gain Without preamp <0.05mm/hr
Recording Amplitude	Full chart channel width from DC-40 cps with progressive reduction to 5mm at 150 cps

Input Impedance	With preamp 2 megohms without preamp 1 megohm
Warm-up Time	Instantaneous
Nominal Cost, Channel	With preamp \$1,250 Without preamp \$850

Booths 3107-3108, WESCON Show, San Francisco

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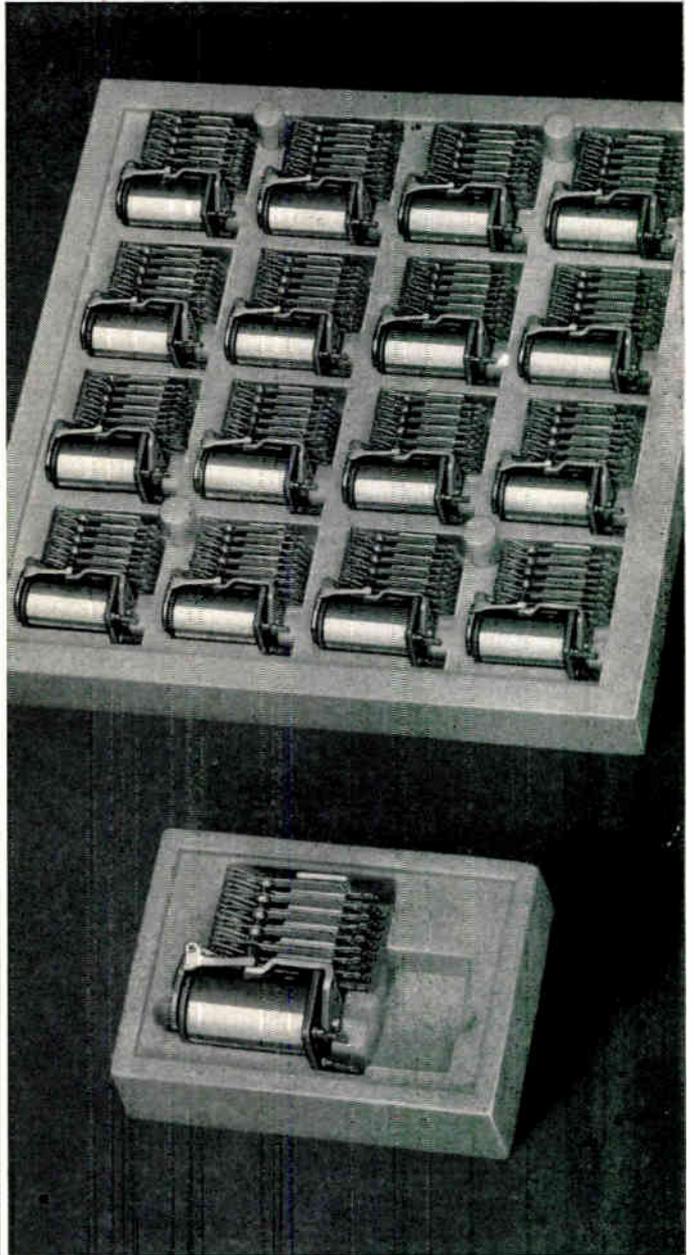
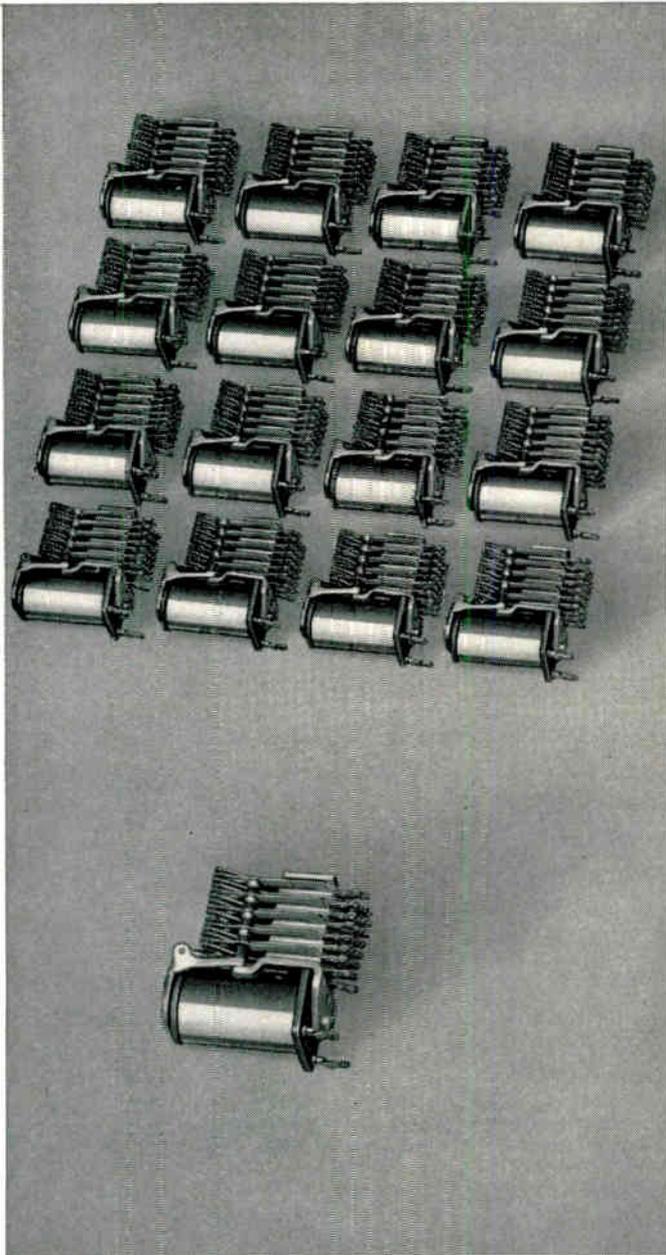
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The possibility of relay damage in packing, in transit or in removal is virtually eliminated. And you get added protection right up to the moment of mounting, because the safety containers can be fed directly from your stock to your

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AE's Class E Relays offer by far the broadest capabilities of any comparable relay on the market, compacted into a minimum of space and weight. And each of the numerous standard variations features the long life and stability of adjustment for which Automatic Electric relays are noted.

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Western electronics started long after midwest and east firms were well fixed. West coast firms made a beachhead with World War II aircraft. The rise in U.S. R&D snowballed western electronics. The west currently holds a quarter of the market, and is fighting to keep it.

WESTERN ELECTRONICS CLINGS TO SUCCESS

TWO MAJOR ECONOMIC AND INDUSTRIAL BATTLES have been shaping up in the ever-growing sea of competition for the U. S. electronic dollar. Western states, including the cosmopolitan Pacific coast, have hoisted colors and are out to capture contracts, plants, markets, talent and other booty, while other regions—notably the east—yell “Piracy! Foul!”

As western electronic firms compete nationally, chiefly with midwest and eastern firms, an internal battle of growth also rages among the western states and regions themselves.

The reasons behind these tugs-of-war can be explained much more easily than they may be resolved. Statistically, Government defense and aerospace, plus civilian agency business, represent between 70% and 80% of annual electronic sales, and the western industries' share of this titanic market is about 25%—one-fourth of every Government dollar spent on electronics. In addition, California gets about one-fourth of the prime defense-aerospace contracts in dollars, and also drags in more than 40% of Federal R&D funds.

Metropolitan Los Angeles accounts for 59% of

California's Gov. Edmund G. (Pat) Brown in Dyna-Soar Flight Simulator, Edwards Air Force Base, part of western complex. He opposes turning defense contracts into political prizes.



total electronics operations in the west. But the electronics growth around L.A. did not happen overnight. In 1940, Los Angeles firms produced about 1% of all U. S. electronics products. By 1949 this figure was 7%, and 21% in 1961. Currently, about 25% of U. S. electronics products are made in and around L. A.

West Includes 13 States

Originally, the active western electronic region included only Washington, Oregon and California—in effect, the Pacific coast. Now the active area engulfs Idaho, Montana, Wyoming, Utah, Nevada, Colorado, New Mexico, Arizona, Alaska and Hawaii, 13 states competing for the U. S. electronic dollar.

For a record of \$3,885,000,000 in 1963 sales by electronics firms in the west, here is an area distribution according to the Western Electronics Manufacturers Association:

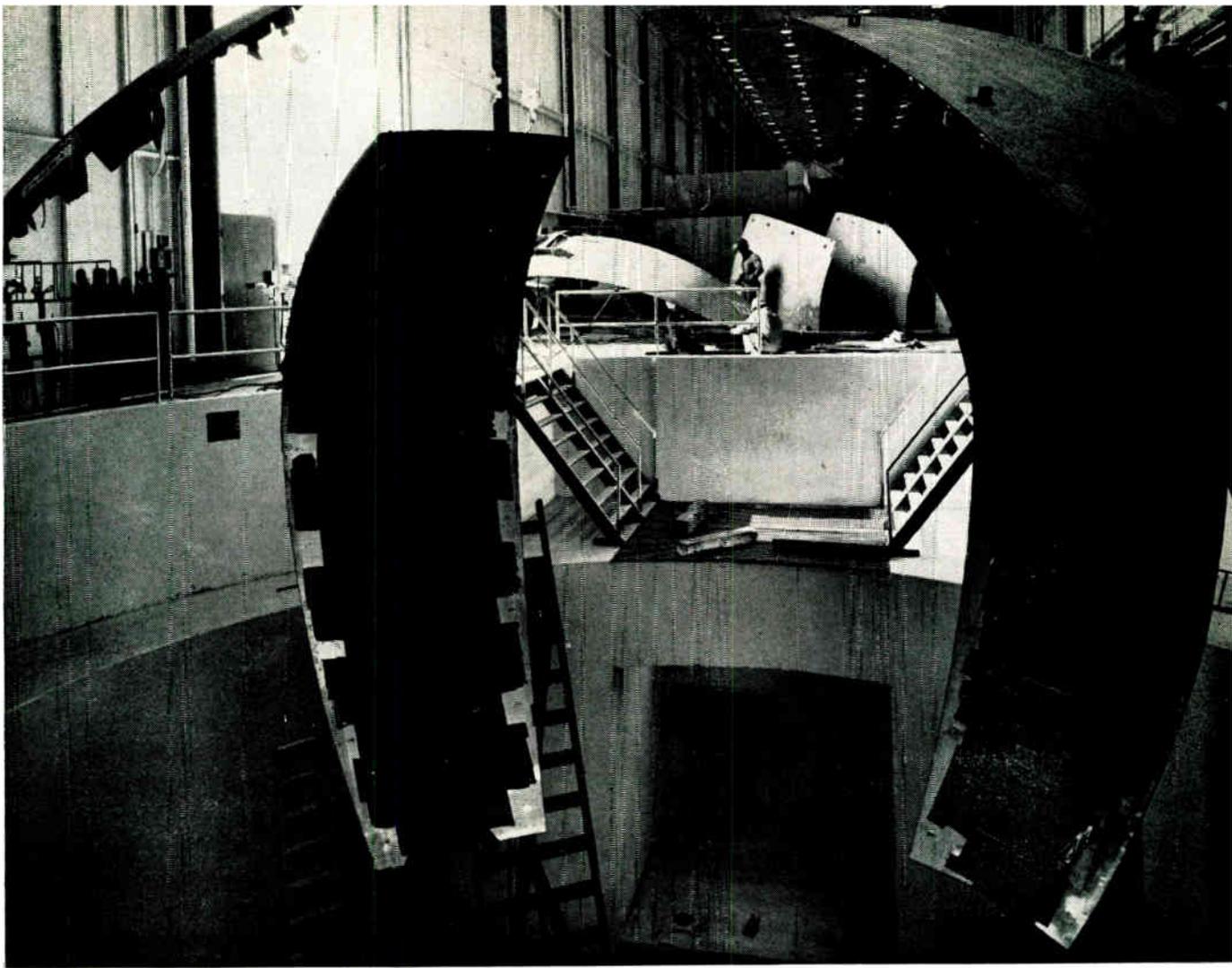
AREA	TOTAL SALES (1963 estimates)	% of TOTAL
Los Angeles	\$2,300,000,000	59.2
San Francisco	800,000,000	20.6
Arizona	240,000,000	6.1
San Diego	185,000,000	4.8
Northwest Pacific	175,000,000	4.5
Balance of West	185,000,000	4.8
	\$3,885,000,000	100.0%

According to a WEMA survey, Arizona is the fastest moving western state with 1963 electronics sales put at \$240 million, up from 1962's \$190 million; a rise of more than 26% in productivity. Greater L.A. grew in productivity by only 8.5%, as its 1963 factory billings hit around \$2.3 billion.

Historically, the electronics industry was born in the midwest, which is beginning to make headway in outgrowing its original radio-TV and loudspeaker business. The long-depressed south has been coming up slowly from out of nowhere into big U. S.

By **SIDNEY FELDMAN**

Contributing Editor
ELECTRONIC INDUSTRIES



Large space chamber, now completed, in the spacecraft manufacturing building of Space Technology Laboratories, Inc.,

a subsidiary of Thompson Ramo Woolridge, Inc., at Redondo Beach, Calif. STL and parent figure heavily in western R&D.

funding in aerospace activity. The east, coming to grips with the west for defense and aerospace dollars, long has been regarded as the great oppressor of the west.

Easterrers Became Westerners

Strangely, it was easterners who wagoned west, brushing aside Indians, buffalo and trees, pulling gold out of ground and pocket alike. Since the end of the Civil War, the ex-eastern westerners had dreamed of industrialization and having a part in the great industrial revolution. They cursed the "greedy, exploiting east."

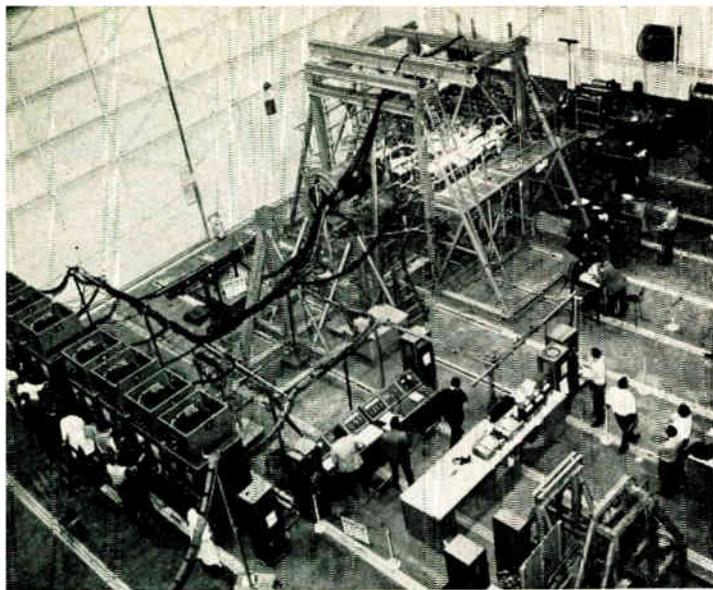
The western states bided time, developing their own industries, as such, livestock, forestry, oil, mining, real estate, movies, climate, tourism and cheap water power. It was really World War II that industrialized the west, enabling hundreds of thousands of since-1900 migrants and dust-storm itinerants to find various levels of work pounding out planes, ships and some early embryo electronics.

When Hitler crossed the Polish frontier, the west coast had a few firms making radios, components,

specialties and some high-power, special-purpose electron tubes. By 1942, the war had boomed the Flying Fortress and Victory Ship business, which both nurtured yet overshadowed the teething electronics industries. By V-J Day, the west could boast of well-established signposts of industrial progress such as smog, labor troubles, water shortage and overnight diversification.

Aircraft Development Key

The key to long-range electronics development in the west lay with big airplane makers, versed in radio, navigation, instruments, and controls, and ring-wise in sparring with Government people in far-off D.C. Boeing, kingpin of Seattle industry, created fine Fords and Superfords but slid on its tail when it coped with vehicles, refrigerators and kitchen cabinets. Through the peace transition the plane makers managed, producing Stratocruisers, Constellations, DC's—and military jets where they felt more at home. There came a gradual transition into electronics during the mid-1950's, and then Sputnik jolted everyone into aerospace and defense electronics.



Structural test laboratory of Boeing Airplane Co., Seattle, third in top ten contractors in U.S. defense-aerospace R&D.

WESTERN ELECTRONICS (Continued)

manage to hold its own big share, while the rest of the nation is given a chance to grow ahead.

Some west coast electronics spokesmen attribute part of the slow-down to an upswing in conventional weapons funded in the midwest. But more cogent were the words of NASA Administrator James E. Webb who warned Californians that other states and areas, which had based their industrial economy almost totally on mass consumer production, are awakening to the growth potential in scientific research and technological development. While Webb acknowledged L.A. as the "space capital of the U. S.," he predicted that California's space business will expand but its total percentage will decline.

California's head-start in aerospace research, technical facilities and capabilities are reflected in these statistics, showing NASA space research—in the top six states by prime contracts—in thousands of dollars:

STATE	FY 1961	FY 1962	FY 1963
California	\$274,993	\$459,289	\$830,704
Louisiana	88	46,578	359,102
Missouri	47,270	107,260	264,898
Alabama	67,290	138,110	234,028
Florida	58,641	94,857	174,799
New York	51,181	82,785	152,553

California Firms Sub-Contract

Observers point out that "California dollars" are prime-contract dollars re-allocated by California firms to sub-contractors in other states. While DOD has no breakdown of sub-contracting, a rule of thumb is that 50% of military contract work ultimately is sub-contracted. It is further assumed that a state like Pennsylvania may end up with more defense dollars than statistics show, while California may actually get less than indicated.

In 1962, California contractors were reported to have sub-contracted some \$1.6 billions of Federal funds in 49 states and the District of Columbia. But, a "Los Angeles Times" editorial pointed out that sub-contractors also sub-contract, and that "sub-sub-contracts might very well come home to California."

Despite climate and geological charms, and technological capabilities, the Golden West has a few tarnished spots. Certain eastern and midwest electronics companies may cash in on the west's brainwork by having placed their R&D "think" operations there, then producing outside the west, especially not in California where labor rates and business taxes run highest in the U. S.

Some California firms have read the handwriting on the wall in D. C., and have responded to the Government's move to channel more contracts into depressed areas. Example: Hoffman Electronics Corp., hit by hard times, established Hoffman Electronics of Minnesota, in Hibbing, Minn., depressed by slackened Mesabi iron range operations. Hoffman expects "to capture new business that we could not get as a California firm."

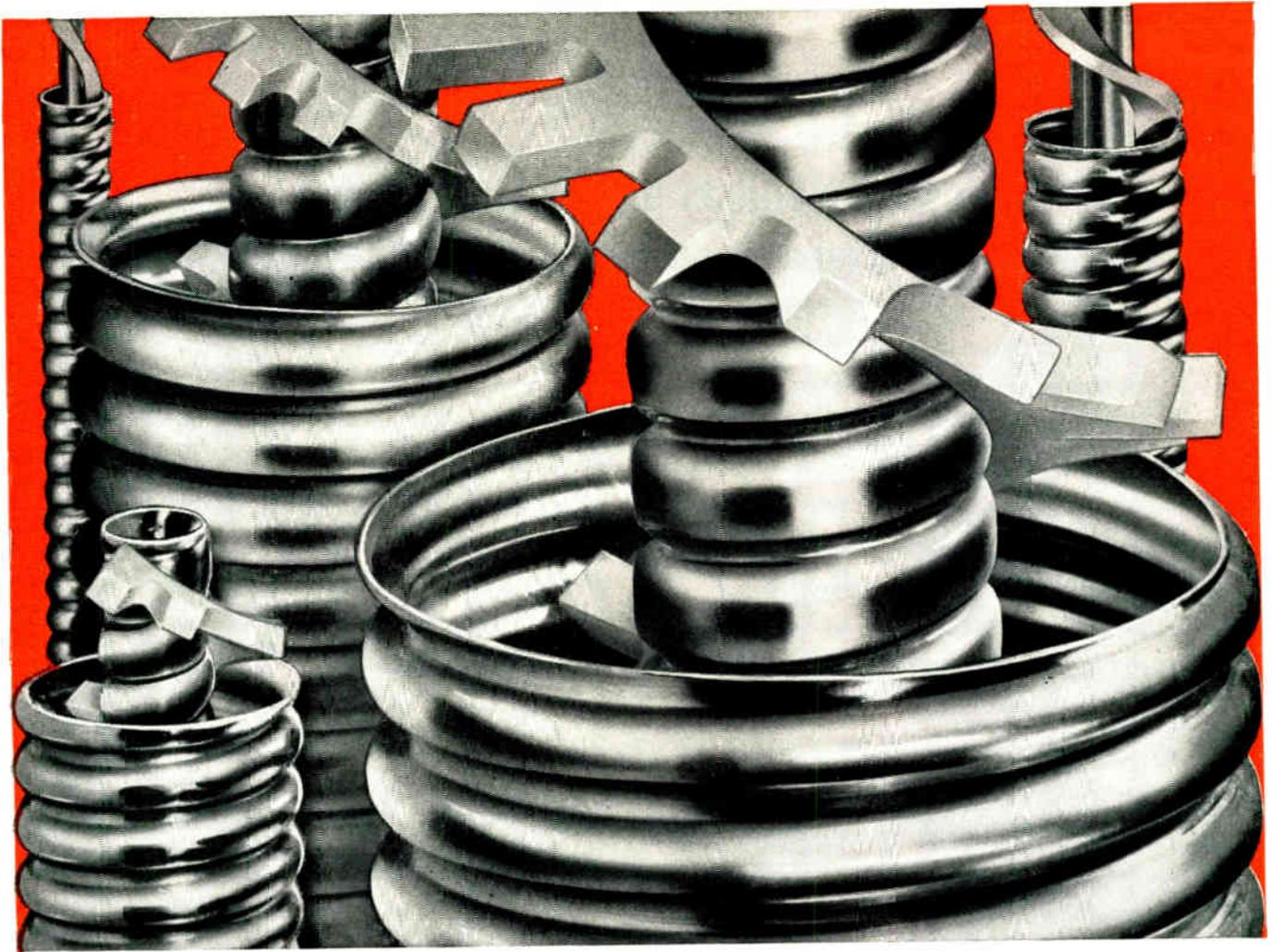
Lion's Share in Cancellations

Then, if a ban on atomic tests should be worked out with the Soviet bloc, followed by some form of arms control and disarmament, California and the rest of the west could easily end up holding a helluva lion's share in contract cancellations and cutbacks. Western firms, among others, are not unmindful of their deep and heavy investment in defense and aerospace work.

California's head start in aerospace and defense personnel, capabilities and contract money may be whittled down by degrees. One inroad is the NASA aerospace research center planned for the Boston area. Last year Minneapolis-Honeywell moved its entire electro-optical operations from L.A. to Boston.

California must pay a price for its growth and geography, while struggling to balance income and outgo to meet a whopping \$3 billion budget. The state paradoxically must welcome some 500,000 yearly newcomers, yet cope with aggravated problems—crime, schools, housing, zoning, welfare, mental health—and other headaches that beset big urban areas growing bigger.

All west coast firms must face problems affecting electronic industries everywhere: how deep to get into industrial electronics, how to finance and convert U. S. R&D into consumer hardware, how to compete with foreign firms, how to compete for engineer talent, how to cope with corporate competition on one hand, and greater pressures from DOD and NASA on the other. (Continued on page 185)



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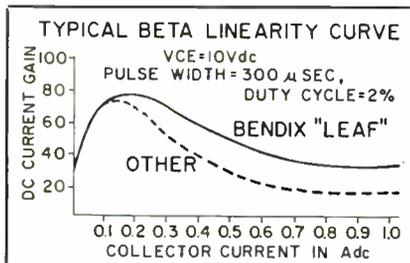
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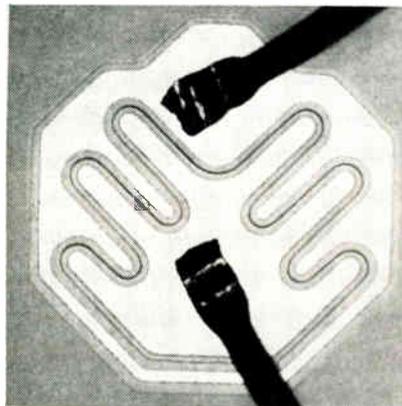
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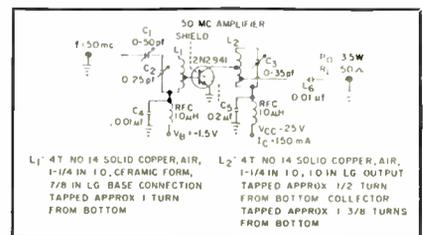
- $V_{CE(SAT)}$ very low, typically 0.2 volts with $I_C = 150mAdc$, $I_B = 15mAdc$,
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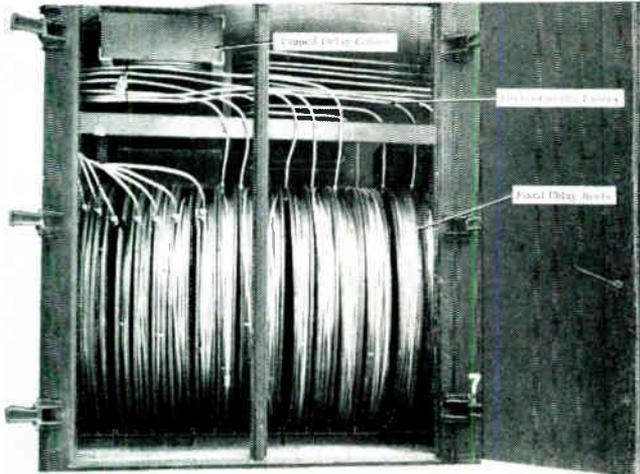


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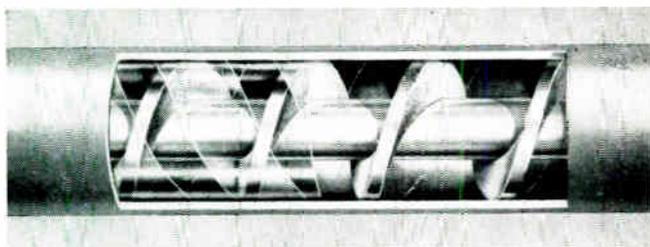
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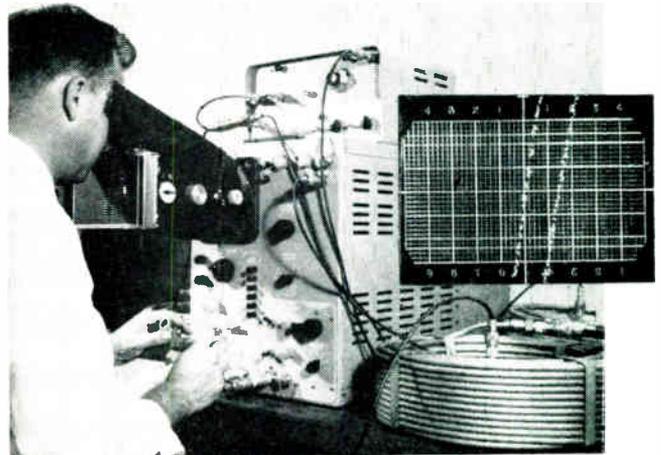
The Inertialess Steerable Communication Antenna developed by the U. S. Army Electronics Research and Development Laboratories and Avco Corporation's Electronics Division enhances high frequency communications by reducing effects of multipath and interference. Each of the 24 wooden poles support a dipole element linked to a control van with 56,000 feet of buried 70 ohm, 1/2" semi-flexible, air dielectric Foamflex coaxial cable. Foamflex was chosen for its low attenuation and good temperature characteristics. The second principal section of the ISCAN System is an electronic beam forming matrix. The 14 terminals of the matrix each produce a single, fixed-beam radiation pattern formed by use of tapped delay cables fabricated of 4,000 feet of 1/2" Foamflex cable. Another 18,000 feet of 1/2" Foamflex is used for fixed delay cables. Cable lengths from each dipole element to the combiner of the beam forming system were controlled to less than 7 electrical degrees for lengths that exceeded 5,000 feet.

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SIGNAL GENERATORS



7

GENERATORS

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MODEL NO.	FREQ. RANGE
7101	50 kc/s - 65 Mc/s
7201	10 - 420 Mc/s
7301	400 - 1200 Mc/s
7411	900 - 2200 Mc/s
7412	1.8 - 4.4 Gc/s
7413	3.8 - 7.6 Gc/s
7414	7.0 - 11.0 Gc/s

Units install in standard 19" rack; max. dimensions: 13½" h x 19¼" w x 20" d in easily portable cabinet.

NEW STANDARDS OF

Quality and versatility!

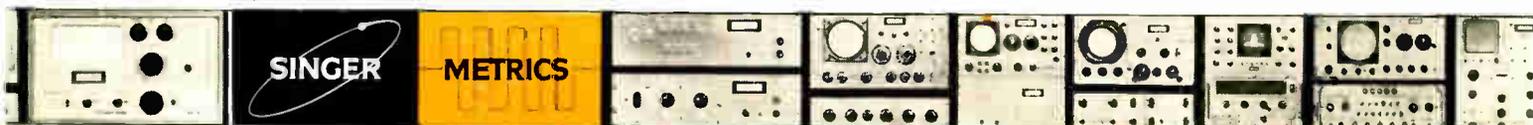
These seven functionally designed, precisely calibrated signal generators by Singer Metrics provide exceptional performance and reliability at low cost. In attractively styled compatible units, the Models 7101, 7201, 7301, 7411, 7412, 7413 and 7414 are ideal for bench top, rack mount, or stacking in R & D, production, and field applications.

Each generator provides better than $\pm 1\%$, generally $\pm 0.5\%$ frequency scale accuracy, with frequency stability to 0.004%/°C. Covering the 50 kc/s to 11.0 Gc/s range without a gap, they deliver stable, accurately calibrated outputs from 0.1 μv to as high as 3 volts (50 Ω). All have provisions for internal and external AM modulation. Some include internal and external FM, pulse, and square wave modulation.

They are especially engineered for superiority in handling and use as well as performance. A clean, compact design takes minimum bench space and simplifies handling. Units are lightweight and easy to handle. They are adaptable to standard 19" rack mounting. The well-spaced, functionally-grouped controls and recessed meters make operation easier, readings more accurate. Maintenance is simplified by straightforward mechanical construction, with no hidden components or adjustments. Expanded-dial tuning with negligible backlash plus fine control provide high readability and precise reset capability.

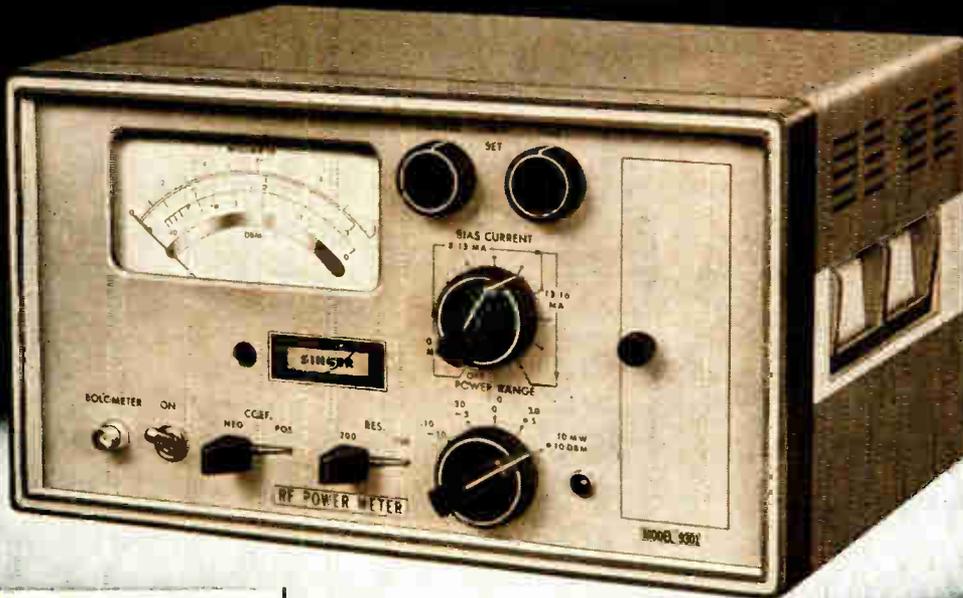
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TEST INSTRUMENTS



4

INDICATORS

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9101 BROADBAND VOLTMETER: 10 c/s - 4 Mc/s; 1 mv - 300 v (full scale), acc. $\pm 2\%$ 20 c/s - 1 Mc/s; serves as video amplifier, to 150 gain.

9201 BROADBAND VOLTMETER-OHMETER: Probe compartment. DC to 700 Mc/s. 0 - 300 v AC 6 ranges, 0 to ± 1000 v DC 7 ranges, 0 - 500 Megohms 7 ranges. Volt acc. $\pm 3\%$ full scale; res. acc. $\pm 5\%$ midscale.

9301 RF POWER METER: Reads directly 0.1 - 10 mw or - 10 to + 10 dbm (full scale). Frequency range limited only by bolometer used.

9401 STANDING WAVE RATIO INDICATOR: 0.1 μ v sensitivity (200 Ω), 0.03 μ v noise. Scales: 0 - 10, 0 - 2.5 (EXP) db; 1 - 4, 3.2 - 10, 1 - 1.33 (EXP) VSWR. Has 70 db range in 1 db steps plus smooth control. Adjustable bolometer bias 0.4 - 9.0 ma DC (connect any bolometer).

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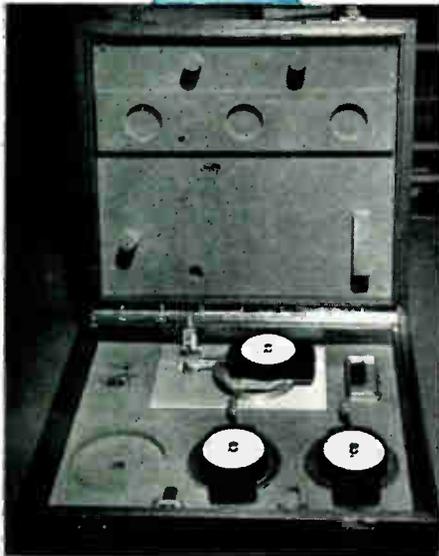


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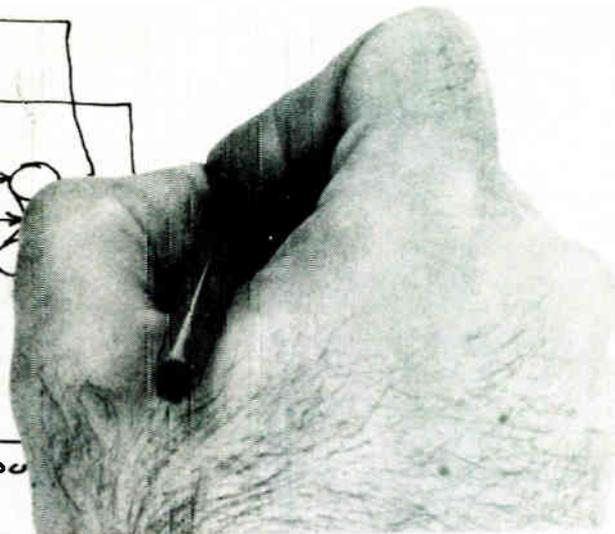
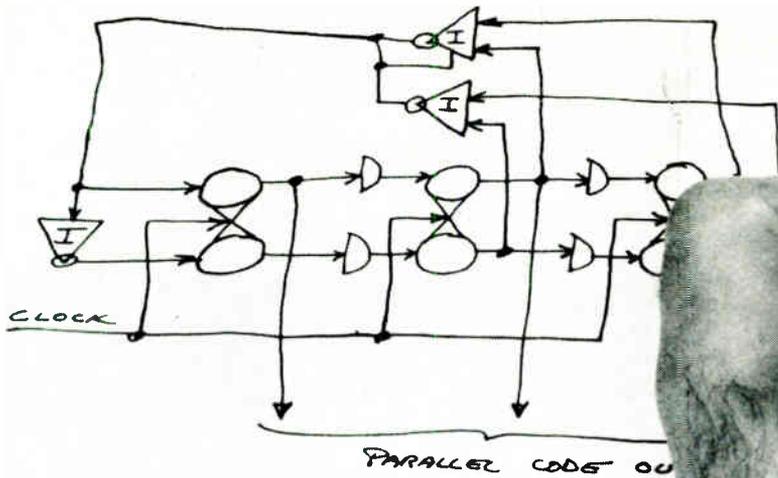


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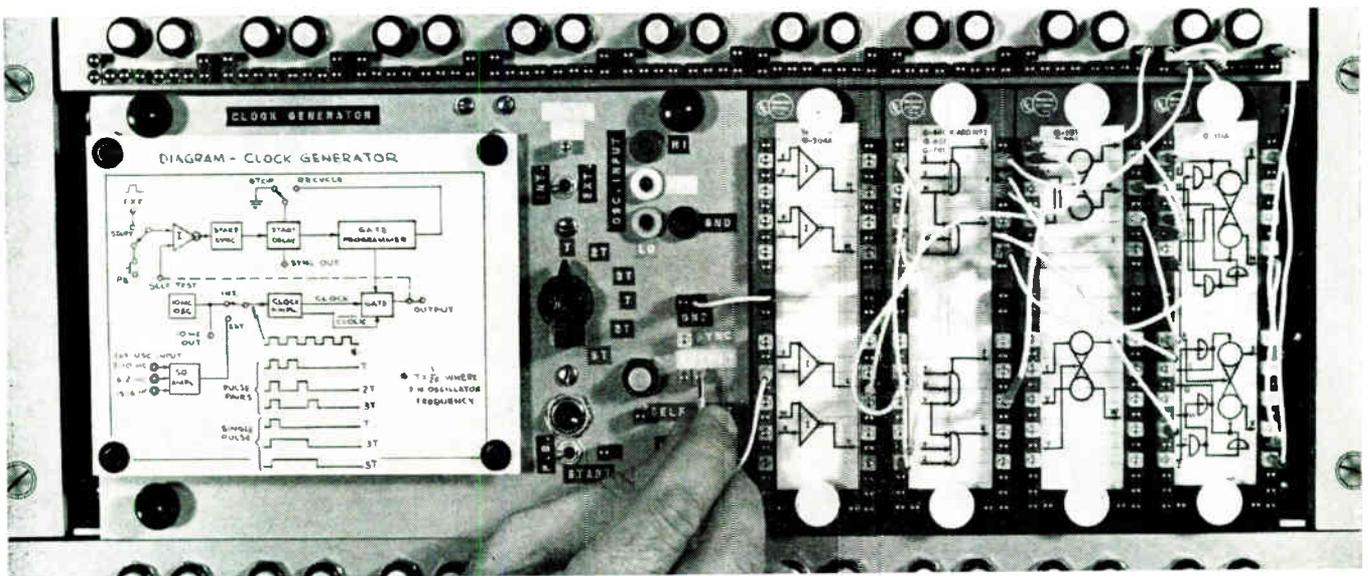
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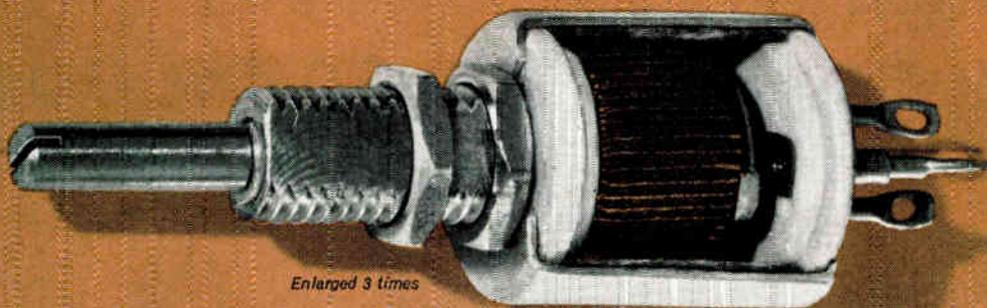


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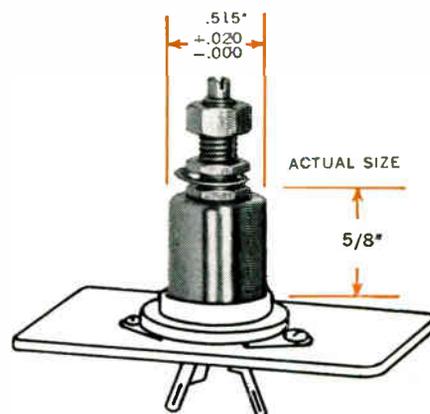
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CONGRESS MAY BRIDLE NASA—Congress is threatening to curtail NASA's free-wheeling authority to spend money as it wishes—without telling lawmakers where it goes. During recent Senate Space Committee hearings, Chairman Clinton P. Anderson (D., N. M.) and others said that unless NASA confides more in Congress, it may limit the agency's power to pursue projects without specific authority. NASA up to now has been given broad authority to cancel and begin projects as it wishes because the program has been so fast moving.

CONGRESS HITS NASA PLANS—NASA is under congressional fire because of continued space communications research. Congressmen say NASA should drop spending in this area since a special private corporation has been set up to handle space satellite communications. Space agency has budgeted \$55 million for communications work which will be made available to the private corporation.

OVERSEAS COMMUNICATIONS STIRS FIGHT—Two international communications giants are arguing over government comsat policies. ITT wants Congress to approve multi-company international communications organization for transmission of records to compete with Communications Satellite Corp. Proposal was prompted by RCA President David Sarnoff's statement that all international voice and record communications should be controlled by CSC. ITT President Harold S. Geneen charged such a move would mean "complete monopoly" in international communicating.

SBA SETS NEW RULES ON CONTRACTS—New rules on size of firms which can qualify for small business contracts are now in effect. Subcontractors and prime contractors must qualify for government jobs earmarked for small firms. New rules increase number of employees for many electronic manufacturers in SBA's Schedule "B" categories, from 500 to 750. Some will be allowed 1,000 workers without losing small business status. Code for non-manufacturers goes unchanged for time being, but \$2 million annual gross limit has been proposed instead of number of workers for non-producers. SBA admits this could be too low for many, however, says it could be raised in further rule amendments later this year. New rules, in effect since July 1, are described in free booklet, "Qualifying as a Small Business for Government Contracts and Subcontracts," available from all SBA field offices.

CONTRACTORS FACE NEW RULES—The Pentagon is trying to stop contractors from developing a privileged relationship with the military. New rules disqualify contractors from supplying items on which they have done preliminary R&D. Rules will prevent companies from becoming suppliers of items they recommended in an early stage, or the purchase of which they could control through a management function. Contractor may be exempt from the rules if he is the sole supplier of the item, has undertaken full responsibility for development or production, or if denial of the contract would be prejudicial to government interests.

PENTAGON-KREMLIN CIRCUIT OPENS—Direct teletype communication between the Pentagon and the Kremlin has been established. White House says the hot link is "a first step to help reduce the risk of war." Washington and Moscow have been linked by a direct, on-line, radio-TT circuit, with physical access to the two send-receive sets confined to heads of the two nations, their immediate advisers, and the necessary technicians. U. S. and Russia brushed aside requests from London and other world capitals for the 2-station net to be expanded into a select world network. Decision to locate the equipment in the Pentagon means that military technicians and brass, not civilians, will be reading the Kremlin's radio-TT transmissions shoulder to shoulder with the President.

ELECTRONIC BUGS SLOW PLANE—Fight between Defense Sec. McNamara and Congress centers on electronic problems encountered in developing the RF4C reconnaissance plane. House Appropriations Committee cut funds for project by \$25 million. Committee said the cut would not affect procurement of the fighter version of the plane, the F4C. Cut was made, Committee said, because McNamara is loath to proceed with reconnaissance version due to electronic "bugs."

NEW PLANES SOUGHT—Pentagon is developing new interest in manned aircraft. Opposition to manned planes appears to have been dropped by Defense Sec. Robert McNamara and staff. Though they still don't go for the RS70 long-range bomber, 2 other new plane concepts do interest them. One is the "Dromedary," a hump-backed plane which could fly a week and carry missiles and bombs. The other is a "low-level penetrator," armed with missiles. Despite the 6 years or more needed for their development, the Pentagon may okay these planes.



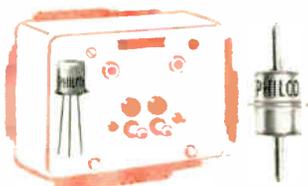
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MARKETING

Facts and Figures Round-Up

ARE TRADE SHOWS LOSING SALES PROMOTION VALUE?

Trade shows may be losing some of their sales promotion value, if two recent trade shows held in New York City can serve as examples.

It is a little known and unpublicized fact that, despite the expectations from the merger of IRE and AIEE, show attendance dropped from 74,734 at the IRE convention, in 1962, to 67,354 at the IEEE show in 1963.

The recent American Society of Mechanical Engineers Design Engineering Conference registration, predicted at about 3,000, was recorded at about 2,500—under the 1962 record of 2,700 attendance.

The real reasons for these attendance drops are uncertain. Suggested reasons might be: (1) uncertainty over U. S. tax write-offs of cost for more than one firm representative at each show; (2) decrease in number of wives attending, taxes again; (3) too many big trade shows; (4) trend to more business and more sales promotion being done at regional trade shows; and (5) reaction to too many conferences, seminars, meetings and conventions.

TV BUYERS ABROAD DIFFER 'AS IN U. S.'

Europe electronics market is "tough" but it offers increased sales opportunities, said EIA European Market Symposium panelists. They suggest thinking of Europe in terms of individual customs who differ as U. S. buyers differ. Cater to differences rather than to national stereotypes. There is growth potential in communications equipment for European governments. In government-owned broadcasting there will be added TV channels as public and industrial pressure for federal action builds up. Computers are growing fast in business and industrial uses.

ILLINOIS REP. PREDICTS RESEARCH EDP FUTURE

Marketing men for computer firms took heart from prophetic words of Rep. Roman C. Pucinski (D.-Ill.), as he told Congress that "before this decade is over, research data processing and information retrieval will be one of the biggest industries in the U. S. and the world."

He observed that proper data processing and retrieval could help overcome the "wasteful duplication of research estimated to be up to 50% of our current \$15 billion effort in R&D."

DEFENSE FIRMS FALTER; HIGHER COSTS FORESEEN

While electronics industry prospects are good in general, The Value Line Investment Survey says that profits of military-oriented firms have not responded with the vigor of the total national economy.

Out of ten companies depending heavily on the U. S. for bread and butter, only one showed significant gain in first quarter profits as against last year. The Survey points out that the ever-increasing military budget attracted large and small companies, ending in keener competition and lower profit margins.

The Pentagon's more cautious approach in awarding contracts hasn't helped the situation. U. S. goals are being better defined while contracts awarded are more specific. Fewer contracts contain built-in profits although the trend to incentive-type contracts could hold more efficient producers.

Some military service inventories

have been consolidated, resulting in over-supply of some electronic items such as microwave tubes. The future for military electronic companies holds permanent prospects of increasing costs and more competition.

LEAR JET TO MARKET ADVANCED STEREO RIG

Lear Jet Corp. disclosed plans for producing and selling an advanced stereo sound system for use in mobile, marine, and aircraft installations. The system, which used tape cartridges, will also be made for home use.

William P. Lear, president, said that consumer acceptance of similar products up to now indicates that an improved stereo tape player may become as common in a few years as radio is now. Lear's Industrial Division is developing the new line.

CENTRALIZED U. S. EDP SOUGHT IN HOUSE BILL

The U. S. Government, world's largest user of computers may centralize procurement of all Federal EDP hardware in the General Services Administration if a bill, offered by Rep. Jack Brooks (D.-Tex.), becomes law.

Congressman Brooks, chairman of the House Government Operations Subcommittee on Government Activities, estimates that centralized computer procurement may provide savings of more than \$100 million annually. He cited a recent report by the Government Accounting Office which estimated such savings accruing by purchase, rather than by lease of EDP units.

The Government spends more than \$3 billion yearly—mostly in rents—for the use of 1,170 computers. Monthly rentals range from below \$5000 for small units to more than \$30,000 for

large computers. In recent years, the U. S. has shown a mixed-trend in outright purchase of computers.

Hearings on the proposed Brooks bill may consider other activities in EDP by various branches of the Federal Government. The largest single user of computers and patron of computer R&D is the Department of Defense.

COMPUTER FIELD HEAVY, PROFITS MAY DECLINE

Future profits for business machine companies may not be as high as they have been, according to a recent survey. More than 25 firms are now making general purpose computers.

Because a large number of users lease their machines, rapid technological improvements can be both expensive and profit-defeating temporarily. Users naturally want machines incorporating new features. Discarded computers may still be leased or sold to less demanding users, but at a lower rental or price.

Despite handicaps the business machine and computer industry is not expected to fall apart. Further growth in earnings and dividends is predicted. Rising competition problems, the need for more research capital, and the lease of very expensive equipment may weed out the less efficient and less well-financed firms.

TV AND RADIO SALES FALL IN APRIL—UP FROM 1962

Monthly distributor sales and factory output of TV receivers dropped sharply in April but cumulative totals remained ahead for the same period last year, according to EIA Marketing Services. Radio sales and output also dropped.

April distributor sales of TV sets fell to 395,166 units from 601,797 the month before. Radio sales slid from 818,510 in March to 637,443 in April.

SNAPSHOTS... OF THE ELECTRONIC INDUSTRIES



ANECHOIC CHAMBER

Anechoic chamber at Sperry Gyroscope Co., Great Neck, N. Y. (r), will be used to test new ECM techniques. Over 2,500 urethane foam spikes absorb radar waves, just as the emptiness of space dissipates them. Engineer in the background places a test sphere on a polystyrene pedestal that is nearly invisible to radar.

BROADCASTING SYSTEM

Army technician checks modulation tubes of a 50 kw. transmitter. AM transmitter is part of a Helicopter - Transportable Broadcasting System (AN/TRQ-20) made for the army by the Gates Radio Co., of Quincy, Ill.



COMPUTING COMPLEX

Boeing Company personnel operate a section of the company's new analog computer facility in Seattle, Wash. The installation contains four major computers between which interconnections can be made to form a large computing complex. These computers will be used for engineering design and development studies.



"THIN FILMS"

Rugged thin films such as these Burroughs Corp. devices have helped make miniaturization of equipment possible. One of the newest of these elements is the thin film amplifier, essentially a voltage booster.

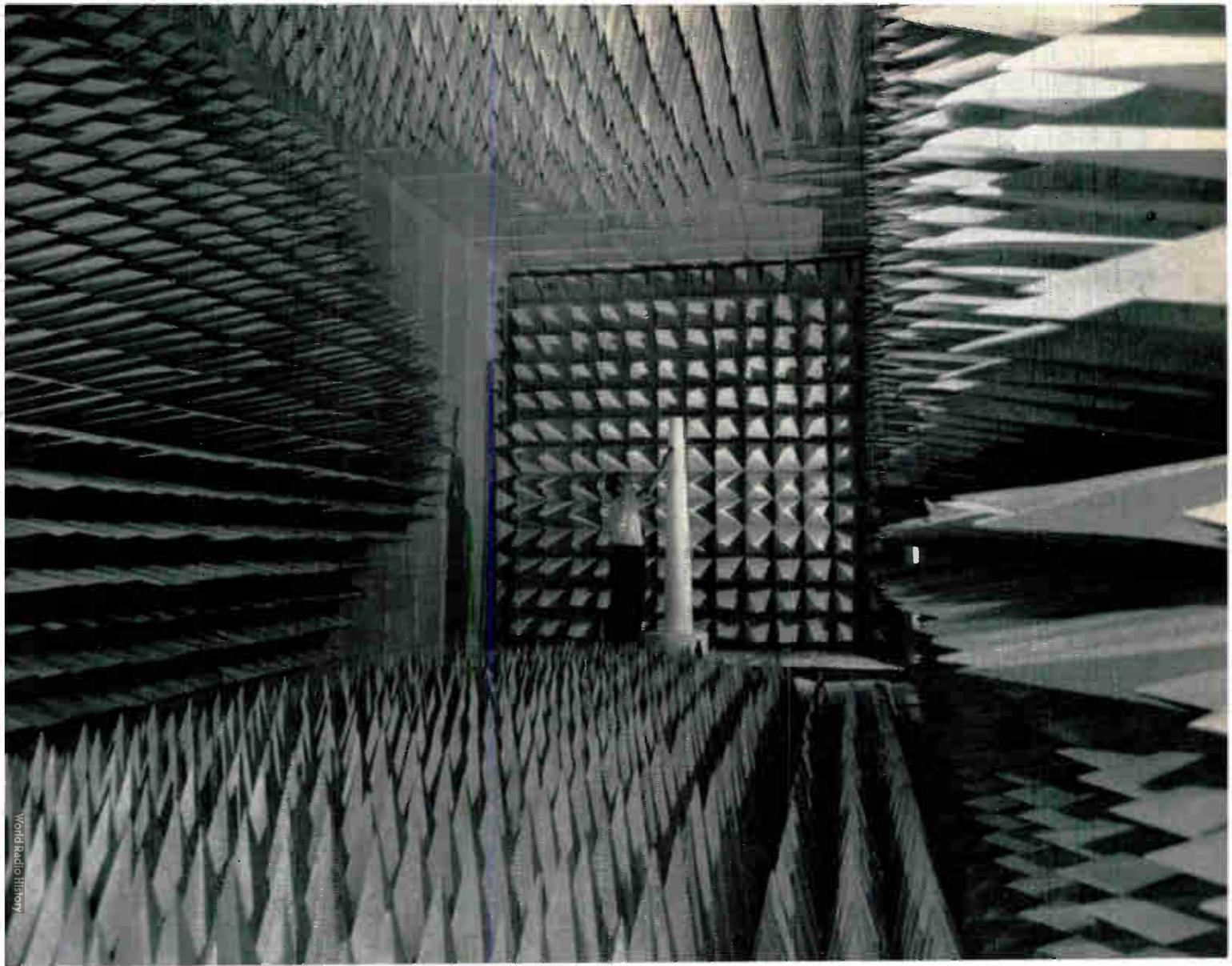


RIGID-FOAM

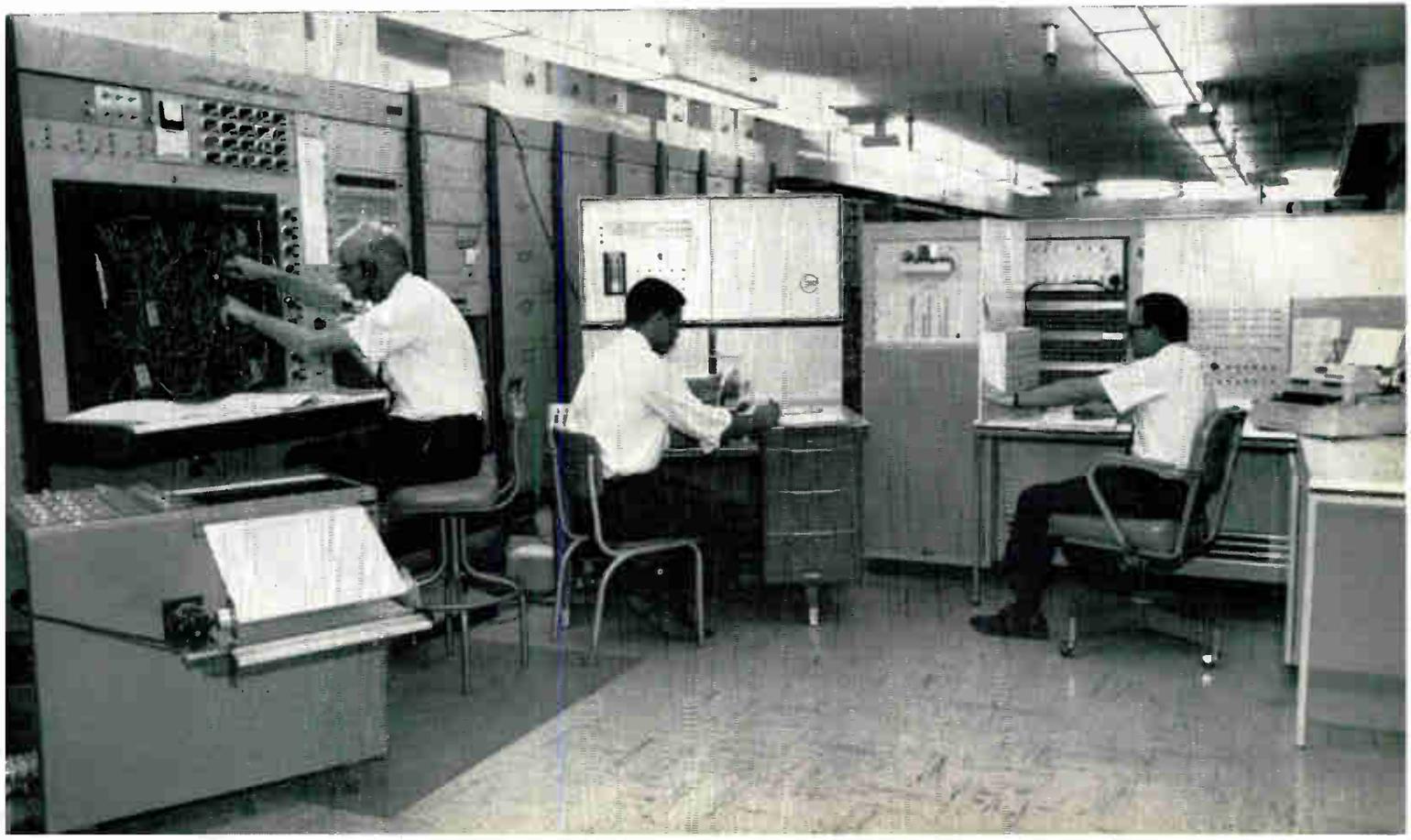
Boys gaze at huge antenna which could be used for satellite communications. Designed by Sylvania Electronic Systems, the antenna is encapsulated in tough styrofoam, a porous plastic that provides rigidity and portability.

HYBRID

North American Aviation engineers (r), work with new hybrid computer system at Co.'s lab in Columbus. System combines precise accuracy of a digital computer and instantaneous speed of an analog computer.



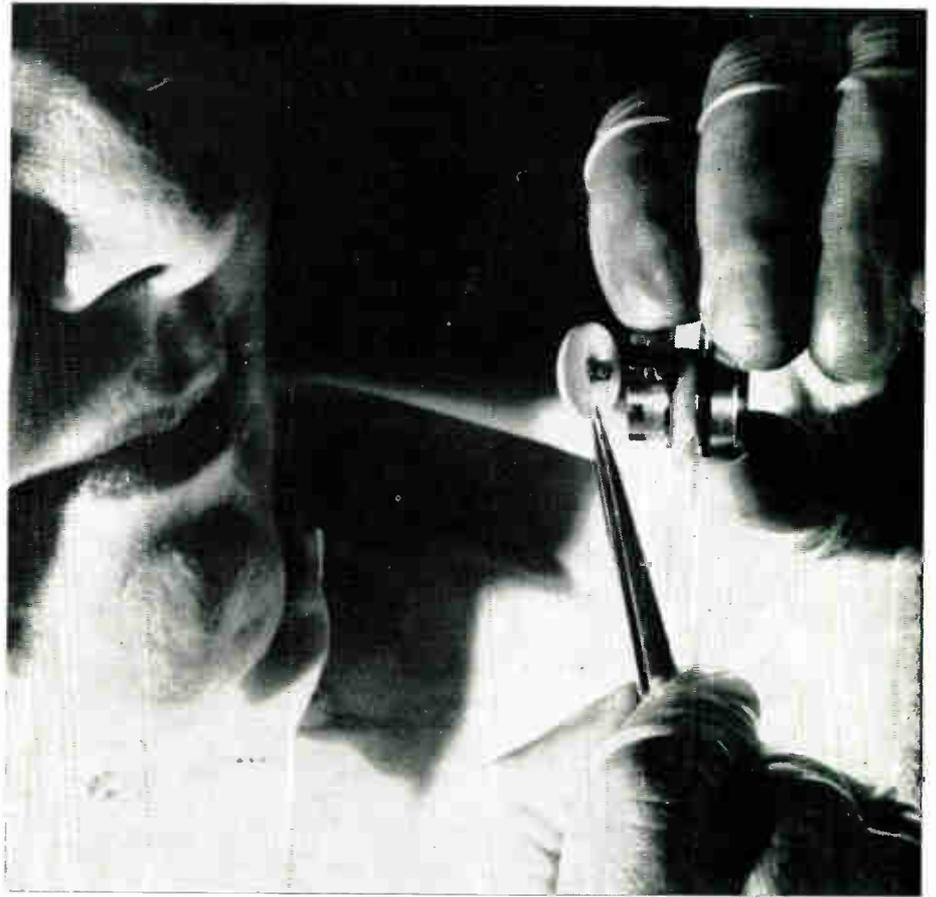
World Radio History



SNAPSHOTS . . . OF THE ELECTRONIC INDUSTRIES

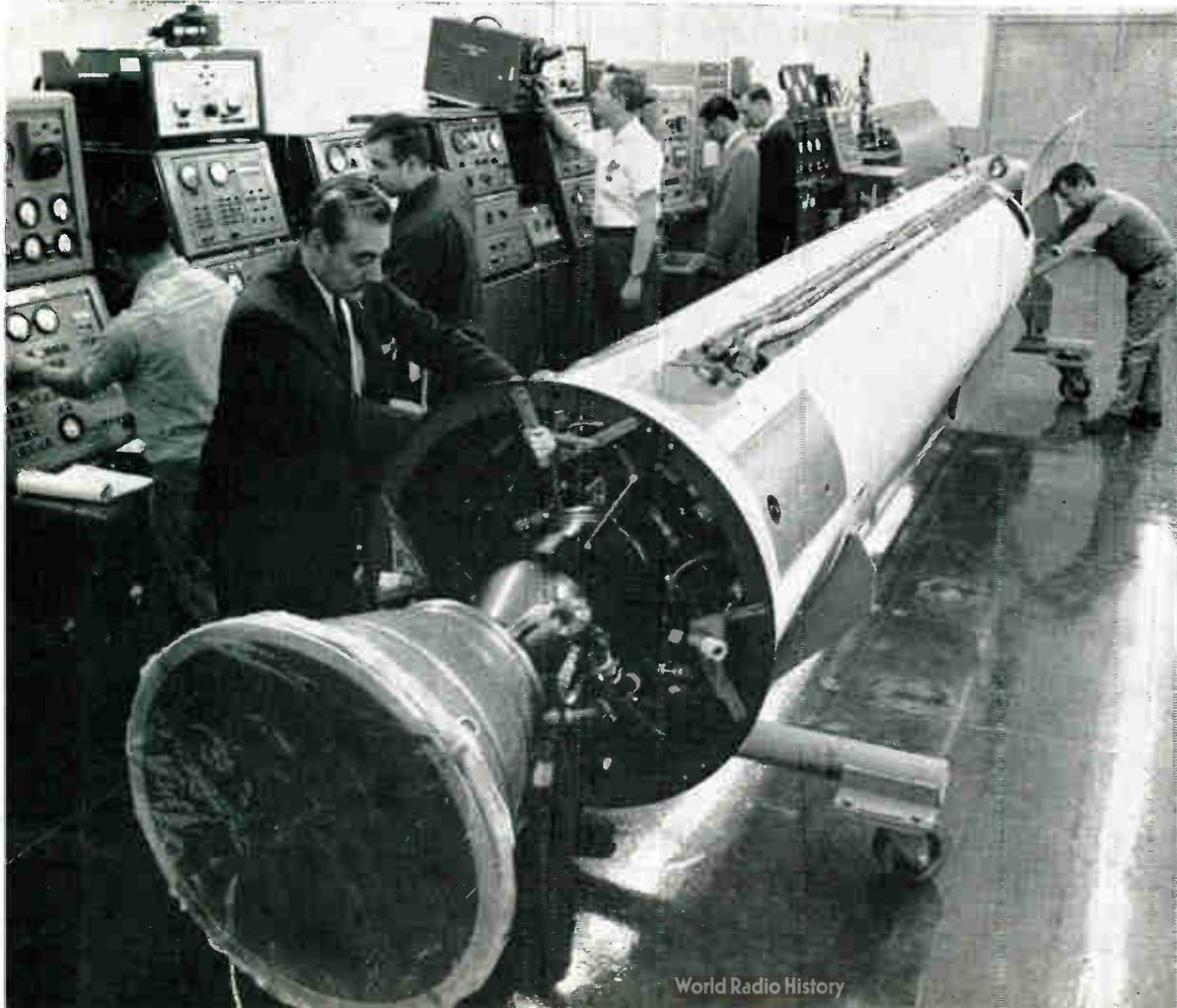
ASSEMBLY

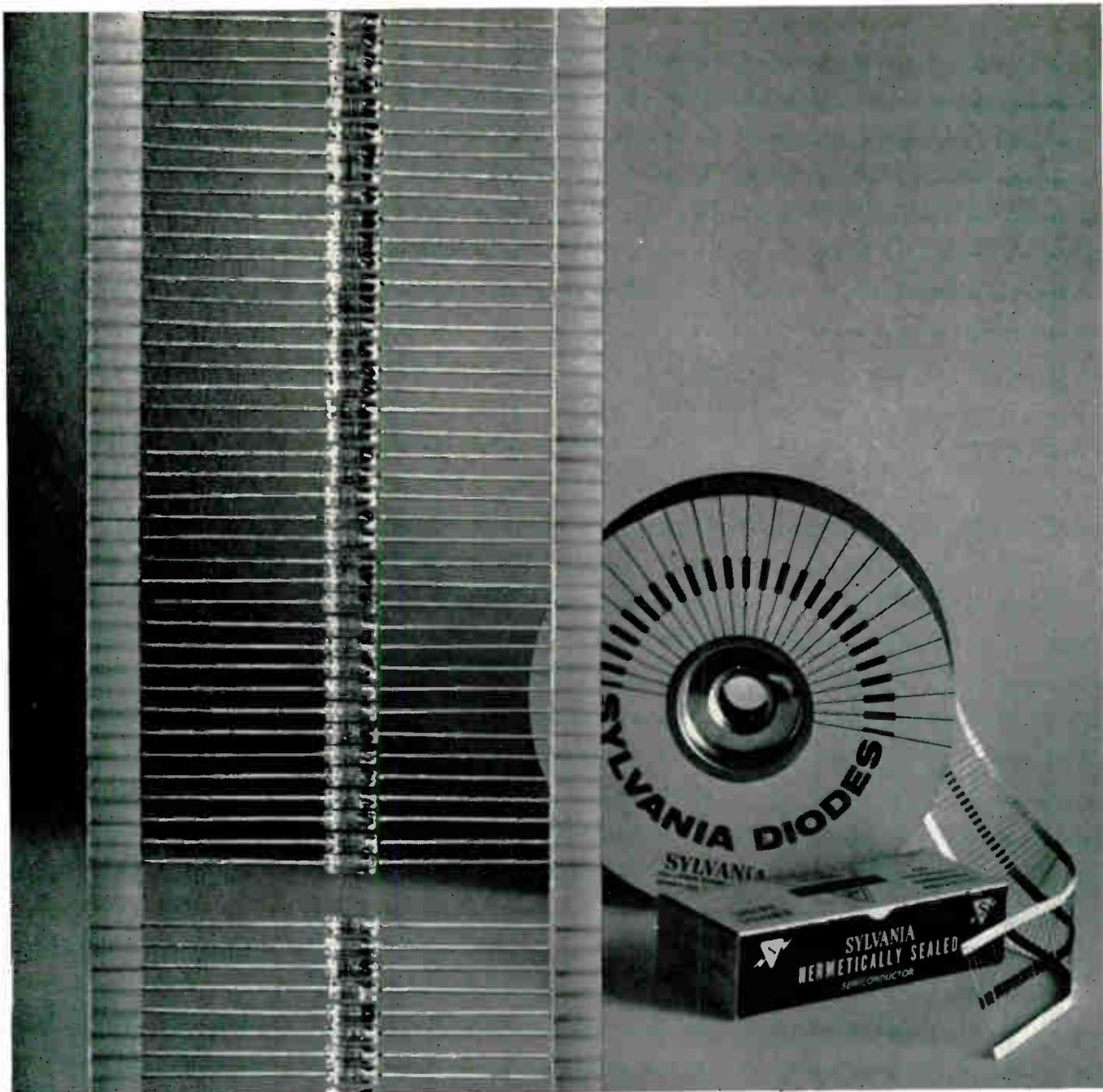
Assembler adds a filament assembly to a voltage tunable magnetron in one of the nearly 300 operations needed for each tube's assembly at General Electric's Power Tube Dept. plant in Schenectady, N. Y.



PHYSICAL EXAMINATION

Physical examination for second stage of NASA-Douglas Delta space vehicle is done in "clinic" at the Douglas Missile & Space Systems Div., Santa Monica, Calif. Before subjection to the rigors of space flight, the Delta must pass many exacting tests.





This "diode gap" saved our customer money

Along with controlled manufacture, another benefit of the high degree of automation at Sylvania's diode plant is the packaging flexibility we can offer.

For example, the unusual packaging shown above came about when one customer asked us to deliver his diodes taped in tight groups of 50, with a gap between groups. This made it easy to

pick up 50 at a time for insertion into lead-bending machines, with a considerable saving in girl-hours. Another customer asked for leads already bent at the ends, with the diodes inserted into blocks of foam plastic. We were able to oblige in both cases.

Neither of these "specials" caused any great problem or expense, thanks

to the versatility of Sylvania's automated packaging equipment. It can be programmed to meet your needs, whether the requirement is reels, boxes, or some other form of packaging. One more reason to consider Sylvania for your diode requirements, germanium or silicon.

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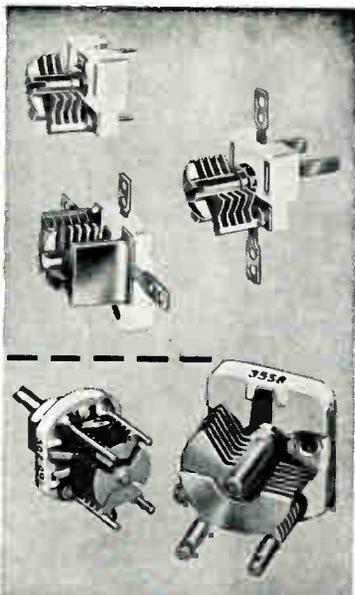
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"M" AND "S" MINIATURES

Slightly larger than the "U" and "UB" Types, still excellent for use in compact equipment. Soldered plate construction, heavily anchored stator supports. DC-200 treated steatite insulators. Plates are nickel-plated brass. Available in Single Section, Butterfly and Differential types with straight, locking and screwdriver shafts. "S" also available in Dual type.

TYPE "M"—Requires only $\frac{5}{8}$ " x $\frac{3}{4}$ " panel area. Peak voltage rating: 1250 volts on .017" spaced units; 850 volts on 160-130, spaced .013"; mounting bushing, $\frac{1}{4}$ "-32.

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SUB MINIATURE "U" AND "UB" TYPES

These tiny, sub-miniatures require less than 0.2 or 0.3 square inch mounting area, depending on type. Unique, precision machined design from one piece of solid brass delivers outstanding reliability, with exceptionally uniform delta C and voltage characteristics.

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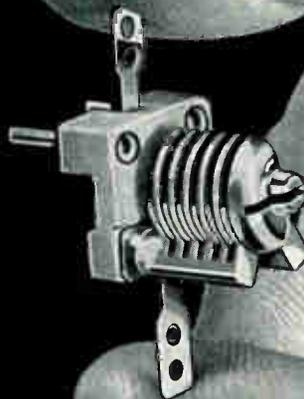
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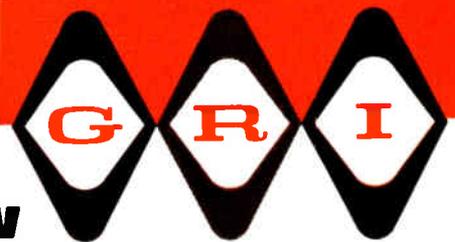
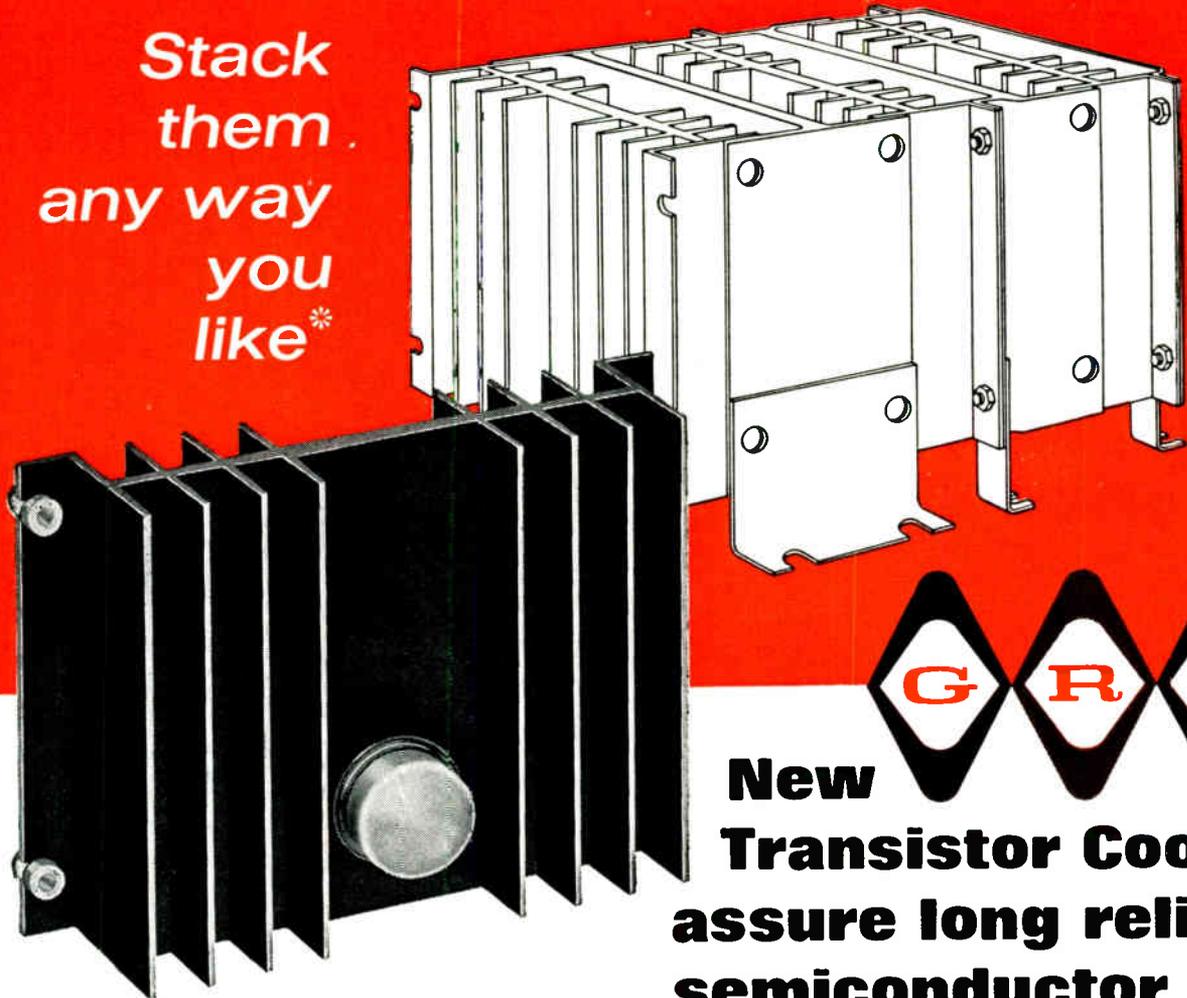
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Transistor Coolers
assure long reliable
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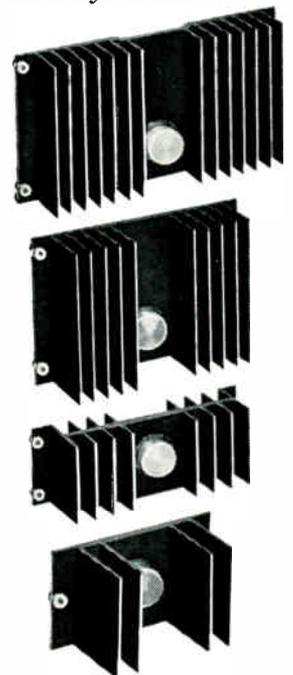
The present GRI line contains 5 finned heat dissipators, available in several different models. For each of these models, careful engineering has established the optimum surface area, number of fins, fin size, fin spacing and fin configuration. As a result you are assured of maximum heat transfer per ounce of dissipator weight and square inch of surface area.

Part 2--Solving Insulation Problems

For the first time, GRI makes it possible to mount heat dissipators directly to the chassis without efficiency-robbing insulation. This problem has been solved by fabricating a special insulating material (Be.O.) with good heat transfer efficiency and high dielectric strength directly into the transistor mounting area. This integral insulation (patent applied for) eliminates two major barriers to thermal conductivity: (1) Need for using a mica or other wafer-type insulator; (2) Need for insulating heat dissipator from chassis if wafer insulation is not used. Additional efficiency is gained by surface grinding the insert material to perfect flatness. This allows the intimate interface contact necessary for maximum lowering of junction temperatures.

***Part 3--Shrouds and Stacking System** Patent Applied For

By using the "chimney effect" (i.e. a shroud specially designed to direct maximum air flow past the dissipating fins) it is possible to *improve heat transfer efficiency by more than 25 per cent with natural convection conditions*. And, GRI is the first to let you take advantage of this proven efficiency booster. A complete line of shrouds and mounting brackets is available for GRI transistor coolers. GRI shrouds and mounting brackets give you extra flexibility by allowing any number of coolers to be "stacked" (see illustration).



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A recent trend has been toward duplicating computer sub-systems or logic elements. This article is mainly concerned with element or section redundancy in a digital computer. It describes an approach using duplex elements which has better reliability than triplicated majority-vote logic redundancy, while using fewer parts.

HIGH-RELIABILITY COMPUTERS USING DUPLEX REDUNDANCY

THE FIRST USE OF DUAL EQUIPMENT to improve reliability in a large scale computer was in the AN/F-5Q-7 or SAGE Computer designed in 1952-53.

The idea there was to build 2 independent computers and switch between them whenever an error occurred. It turned out that the switching process, using relays, although successful, was difficult.

Use of 2 or more complete computers is called system redundancy. It has been most useful where more refined reliability methods are not desired for various reasons.

A recent trend has been toward duplicating (or multiplexing) computer subsystems or logic elements. A typical example would be triplicated components feeding a majority vote element. Quadded logic is another approach. This type is called logic or section redundancy. An even finer subdivision of the computer results in component redundancy, such as using 4 resistors or diodes in series parallel. All of these types could be combined, but the cost would be about 100 times that of a non-redundant computer.

* * *

Reliability of a small computer is compared in 3 ways: no redundancy, duplex redundancy, and triple majority-vote redundancy. The duplex approach offers typical improvements of 5 to 10 in MTBF over the non-redundant approach. It also offers an improvement of about 50% in MTBF, with 20% fewer components than the triple redundancy majority-vote system.

The Duplex Redundancy Technique

Main disadvantage of this method is the need for an immediate, short diagnostic program in the event of a failure. The immediacy need depends on how serious the error is and how urgent the real-time calculations are.

The redundancy system as described here uses duplicated logic sections operating in parallel. It has

an error detector at the output of each section to detect any non-coincidence outputs from the logic units and to start a diagnostic routine. This routine may last from a few μ sec. to a few msec. depending on the diagnostic process chosen in the design.

Main characteristics of the duplex logic redundancy system are that 1) it is primarily applicable to digital computers, 2) it is applicable either to repairable or non-repairable computers (manned or unmanned), 3) dual active hardware is provided in parallel at the logic level. Faulty sections are automatically switched out, 4) it is designed to minimize effects of random component degradation or failure, 5) it is designed to provide long MTBF and to minimize repair time, 6) it detects, localizes, and isolates all failures automatically, with external signal showing where error occurred, 7) it has better MTBF than triple majority logic with fewer components. Disadvantage: Needs time for diagnosis and switching.

The proposed duplex scheme is shown in Fig 8. Boxes A_1 and A_2 are the basic logic elements. They have the same output, i.e., A_1 and $A_2 = 1$ or 0 simultaneously except for a failure.

If either logic box fails, the error detector starts a diagnostic process to find the faulty unit (A_1 or A_2). The routine consists of sending a pulse to the "stop A" box which inhibits the A_1 output but not the A_2 output. The output from A_2 is then tested to see if it is correct. If it is, then A_1 is faulty and is left off.



By R. W. LOWRIE

Project Engineer
Minneapolis-Honeywell Regulator Co.
St. Petersburg, Fla.

If A₂ is bad, then it is turned off and A₁ checked. If both are OK, the error detector is faulty or an intermittent error occurred. Both should be checked at each error detection to find intermittents or a faulty error detector. If both A₁ and A₂ in any one section are bad, then the system is out of business until repairs are made. Complexity of the error detector, diagnostic logic, etc., should be about ½ (or less) that of logic box A.

Since the output OR's give a "1" output when either input is a "1," a failure causing one line to permanently go to ground will not affect the output of the section even if the error detector fails.

A failure need not always cause an error. That is, a component may have failed, but the output still may be temporarily correct. An example of this is when the "0" logic state corresponds to 0 v., and an intermittent failure clamps the output line to ground. Errors exist in this case only when the output logic level is supposed to be a "1". Since the error detector senses "errors" and not "failures," it is possible for some intermittent failures to go undetected. This is generally true in all circuitry and any redundancy system.

The error detector is simply a non-coincidence detector. The computer diagnostic program can be replaced with separate diagnostic logic if desired. However, even if the computer program is used, the computer need not be operative and go through the diagnostic program to isolate the faulty unit.

A variation on the system consisting of 2 computer-controlled AND's can be added, Fig. 10. This provides the capability of isolating the 2 channels, providing 2 separate computers if no faulty logic sections are present. These AND's are not needed for initial test and checkout; that can be done in the usual manner, since the error detector will indicate any errors which occur.

Advantages & Disadvantages

Advantages of the duplex logic redundancy system are:

1. Basic logic circuitry component count is doubled, not tripled.
2. All errors are detected and, through the program, the faulty unit disabled, "correcting" the error. Faulty units can be repaired without interrupting the computer. Both A₁ and A₂ could err at the same time, giving no error detection. This possibility is also inherent in majority logic and is generally considered too improbable to design around; such errors would be detected only by independent programming checks. *(Continued on following page)*

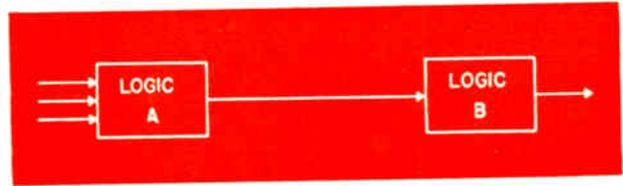


Fig. 1: Conventional non-redundant logic. Much of a computer can be considered to be made up of such elements. This arrangement will be used in subsequent figures for comparison.

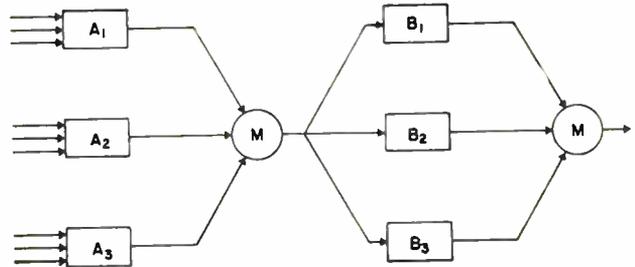


Fig. 2: Conventional majority-vote logic system with one voting element per stage. Outputs of A₁, A₂ and A₃ are identical.

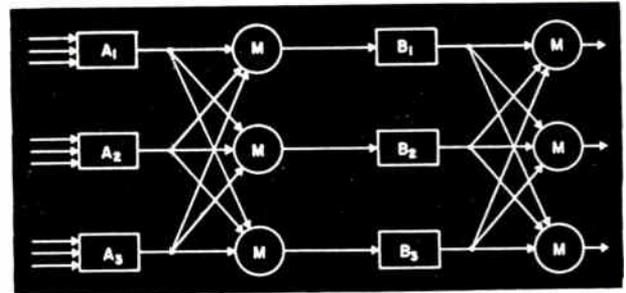


Fig. 3: Majority-vote logic with triplicated voting elements. Component count will vary from 3 1/6 to 3 1/2 times that of a non-redundant computer. Improvement in reliability will generally be better than a factor of 3, however, depending on the number of sections the computer is divided into, reliability of the voting element, mission time and the element MTBF.

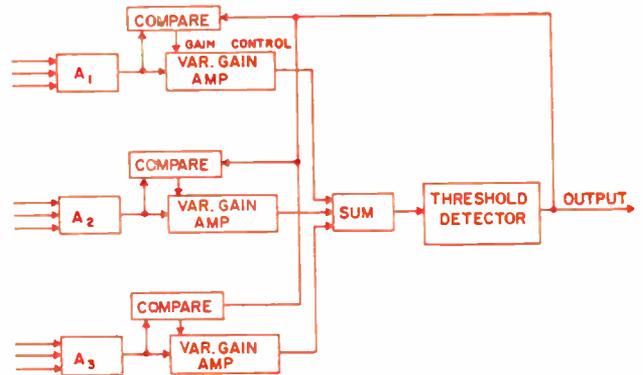


Fig. 4: One form of adaptive majority-vote logic for one stage of logic. Here, gain of an amplifier is decreased whenever an error occurs and increases slowly as correct outputs occur.

Reliability Comparison of 3 Systems			
System	Relative Number of Components	MTBF (hours)	Mean Life at Prob. of Success = .95
No redundancy	1.0	3000	155 hrs
Majority vote redundancy (30 sections)	3.1	10,500	2200 hrs
Duplex logic redundancy (30 sections)	2.5	15,000	3200 hrs

DUPLEX REDUNDANCY (Continued)

3. Failure of 2 logic units is needed to disable the system, the same as in triplicated majority voted logic.
4. The error detector is not in series with the data, hence if it fails, no harm is done. Such a failure can be identified by a periodic automatic test program.
5. For initial tests, debugging, etc., either set of logic, A_1 or A_2 , can be de-activated to enable a complete independent computer test of all logic, although this is not necessary in general, for debugging. Also, by disconnecting "OR" cross-branches through the optional "AND" circuits, 2 separate and independent computers may be obtained.
6. For extra reliability, 3 sets of logic could be used together with 2 error detectors. This would correct single failures and detect dual failures.
7. Maintenance problems are simplified since the faulty unit is identified automatically. Identification of faults is also important to enable rapid replacement of units which may have a degrading influence on other units. Further, failure indication may provide information as to the remaining life of the computer. A serious disadvantage with majority-vote logic is the lack of a failure indication. This should be provided even though complexity is increased slightly.

Disadvantages are:

1. Computer program (or a separate diagnostic unit) has the burden of isolating the failed unit within the section. This may require 10 μ s to 10 ms of program time.
2. Diagnostic check requires at least a small part

of the diagnostic equipment to be operative. If the diagnostic program cannot be initiated, this part of the diagnostic equipment must be replaced.

3. The system will not automatically correct intermittent errors, but will detect them.
4. The system may not detect 2 simultaneous failures within one section.
5. If one output line should fail to the "1" level, the output would be in error requiring either replacement of the defective module or isolation of the fault by using the cross coupling "AND" logic if they are installed. This is one of the few situations where a single failure will cause section malfunction (assuming no "AND's" are included). This error will be detected, but cannot be corrected automatically. For this reason, care must be taken in design to minimize the chances of such an error occurring.
6. Neither of the 2 logic units is on standby. This results in a slight decrease in component life due to electrical and thermal stresses. With stress levels on components not over 25% of rating, life of the components in operation vs. being on the shelf is estimated to be reduced by 20%. This is significant, but does not override the advantages obtained by dual active logic units.

In many uses it appears that this sort of duplex redundancy would be advantageous, being in principle somewhat more reliable while using $\frac{1}{3}$ fewer components. It appears to be quite adaptable to cryotron logic.

The above error detection scheme can be extended to triplicated units, with similar advantages and disadvantages over majority-vote logic.

Illustrative Example

To measure the value of the duplex logic concept, a M-H core memory computer was used as a basis for analysis. This computer is non-redundant and has 16,000 components not including the cores, with a calculated MTBF of about 3,000 hrs.

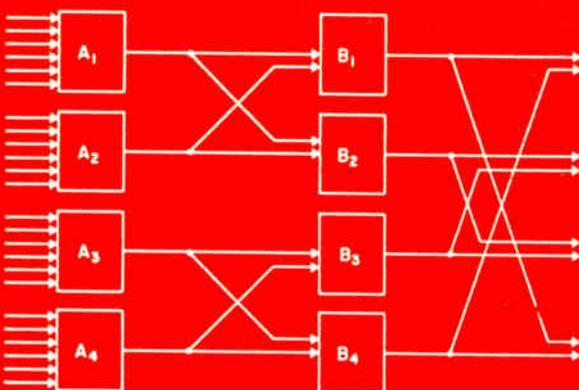
Reliability of this computer using (1) no redundancy, (2) triplex majority vote logic redundancy, and (3) duplex error detection redundancy is compared. Also, realistic assumptions are made as to reliability of the majority voting elements and the error detection equipment.

Reliability of a non-redundant computer is given by:

$$R = e^{-\frac{t}{3000}} \quad (1)$$

where R equals the probability of success. This curve

Fig. 5: Quadded logic. Quadruple logic elements are required.



is plotted in Fig. 11 with the assumption that MTBF of the non-redundant computer is 3,000 hrs.

Triplex redundancy majority vote computer reliability is given by:

$$R_1 = \left[4e^{-\frac{3t}{3000n}} e^{-\frac{3t}{30000n}} + 3e^{-\frac{2t}{3000n}} e^{-\frac{2t}{30000n}} \left(3 - 2e^{-\frac{t}{30000n}} - 2e^{-\frac{t}{30000n}} \right) \right]^n \quad (2)$$

The computer is assumed to be subdivided into n equal sections, and t is the mission time. The 30,000 n in some of the exponents represents an assumption as to the reliability of the voting elements.

It is assumed that the MTBF of each section of the computer can be approximated by:

This equation has also been plotted in Fig. 11 for $n = 10, 30,$ and 100 . It will be noted that computer MTBF has increased from 3,000 to about 25,000 hrs (29 mon.), for $n = 100$. This is a big increase (50%) over the majority logic system and is attained with about 20% fewer components.

In plotting Eqs. 2 and 4, MTBF's of the majority voting elements were assumed to be $10 \times$ that of the section. MTBF's of the error detection elements were assumed to be $2 \times$ that of the section. Other calculations were made assuming both the voting element and error detection equipment to have other MTBF's, as described below.

For the *majority logic case*, assuming the computer is divided into 100 parts, MTBF is 16,200,

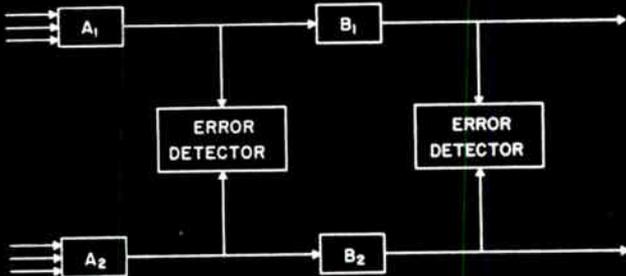


Fig. 6: Duplex logic with error detection. No provision is shown for finding which unit A1 or A2 (or B1 or B2) is faulty. No provision is shown for isolating the faulty unit.

$$\text{Section MTBF} = 3,000 n \quad (3)$$

This implies that for $n = 1$ (computer is not divided at all) it will have an MTBF of 3,000 hrs. If the computer is subdivided into 100 sections, then MTBF of each section should be 300,000 hrs. This assumption is somewhat artificial because an MTBF of 300,000 hrs is equal to 34 yrs. Obviously, many components will not last 34 yrs. However, if they last 20,000 hrs with a low probability of failure, this is all that is needed. The voting element has about 1/10 the components of a section, so its MTBF was assumed to be 30,000 n .

Eq. 2 was programmed for a computer and a plot of it is given in Fig. 11. In this plot $n = 10, 30,$ and 100 .

It can be noted that by going to triple redundancy computer MTBF has increased from 3,000 to 18,000 hrs (4 to 20 mon.), for $n = 100$.

The equation describing reliability of the duplex redundancy scheme with error detection is given by:

$$R_2 = \left[e^{-\frac{t}{3000n}} + e^{-\frac{t}{3000n}} e^{-\frac{t}{6000n}} - e^{-\frac{2t}{3000n}} e^{-\frac{t}{6000n}} \right]^n \quad (4)$$

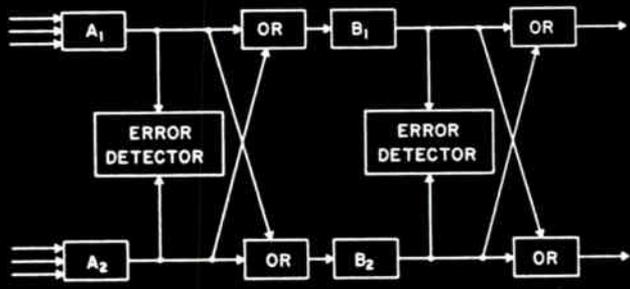


Fig. 7: Duplex logic with error detection. Cross coupling is added at each section so that after a faulty unit is isolated information will flow back into both top and bottom lines.

17,670, and 18,180 hrs respectively, for the 3 cases where the voting element has MTBF's of 6,000, 12,000, and 30,000 n hrs. n is the number of sections in the computer, in this case 100. Basic computer section MTBF is, in all cases, 3,000 n , so that the voting element reliability numbers above represent MTBF's 2, 4, and $10 \times$ that of the computer section.

Corresponding numbers for $n = 10$ are 5,550, 6,125, and 6,345 hrs MTBF for the voting element MTBF's of 6,000, 12,000 and 30,000 n respectively.

For the *duplex redundancy case*, for $n = 100$,

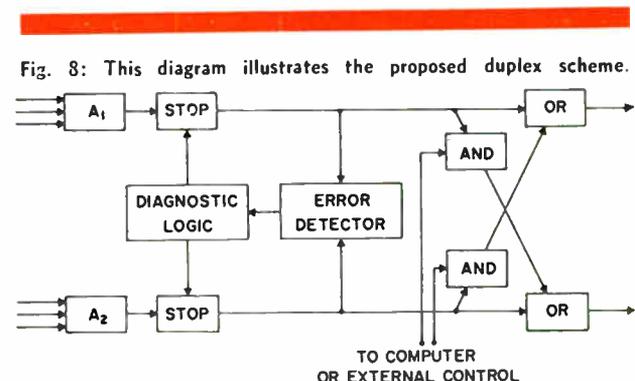


Fig. 8: This diagram illustrates the proposed duplex scheme.

DUPLEX REDUNDANCY (Continued)

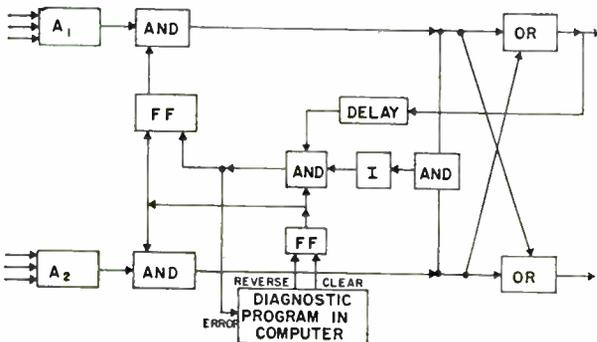
MTBF numbers are 25,940, 28,400, and 30,250. For $n = 10$, the numbers are 9,135, 9,985, and 10,630.

Increasing MTBF's of the voting element or the error detector has little effect on the computer MTBF. Also, duplex redundancy gives 50% longer MTBF with 20% fewer components compared to majority vote logic. Some of this data is summarized in the chart shown in Fig. 12.

It can be seen from the chart that a big improvement in computer MTBF can be obtained using redundancy methods.

Diagnosis Problems

The major problem in the duplex logic scheme is finding a method by which the error can be diagnosed to one of the 2 suspected logic boxes within a section. There are several possibilities, all involving a short interruption of the regular program. This interruption may last from a few μ sec up to a few msec, depending upon the type of diagnostic system used.



The system used will depend upon the type of computer. For example, a computer with no real-time inputs can use a routine in which an error (coming from the error detection box) will interrupt the program and cause it to branch into a separate diagnostic program. This program exercises the faulty section and determines which unit is causing trouble. Once the defective unit is isolated, the computer program reverts to the main program, picking up the computations at some convenient point. It may be necessary to store, after detecting an error and before going into the diagnosis, the contents of some of the principal registers in the computer. On the other hand, it may be possible by judicious programming and some forethought of a possible failure, to avoid having to store the contents of registers before diagnosis.

The question arises as to what happens if failure

prevents the necessary storage or the diagnostic routine from operating. This is actually a favorable situation. What happens is this: as soon as an error is detected, one of the logic boxes in that section (either half) is automatically disconnected. If the process of storage of register data, the diagnostic instructions, and all other incidental operations operate correctly, and if no error is found, then the defective part of the section was fortuitously disconnected in the first place (except for an intermittent or error detector malfunction, checked for separately).

If, on the other hand, an error is detected or if anything fails to operate correctly, the defective part of the section was probably not isolated. All that is necessary then is to isolate the defective half of the section and test the other half. One pulse to a flip-flop will switch the one side out and the other side in. If improper operation results with both halves of the section, then we can suspect either a programming error or the possibility that 2 errors have occurred simultaneously. If the latter happens, it is probably a symptom of massive degradation of the

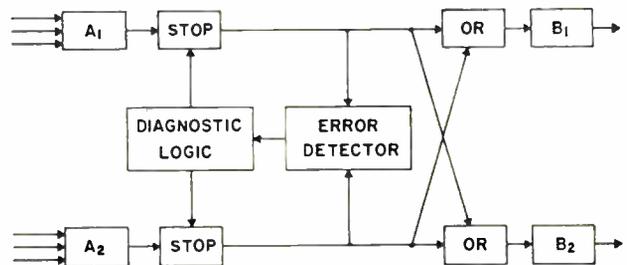


Fig. 9: Diagram at left shows duplex logic with error detection and correction details. Fig. 10: Above diagram shows duplex logic including "ands" to provide two separate computers.

computer capability, such as might be caused by the external environment. In such a case, the best that can be hoped for is that the trouble will go away by itself, leaving the computer undamaged and with no more than one error to diagnose (more than one simultaneous error can be diagnosed if these errors are in sufficiently isolated parts of the computer).

If an error is detected and the diagnostic routine shows no malfunction in either half of the section, then either of 2 things may be wrong—the error detection circuit itself is faulty (this is obvious if the error indication persists) or an intermittent

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error has occurred. In the latter case, it would be wise to mark in the computer memory the location of the intermittent section. In this way if intermittents occur in the same unit often, they can be diagnosed in the regular manner by the computer, or a maintenance man can replace both units.

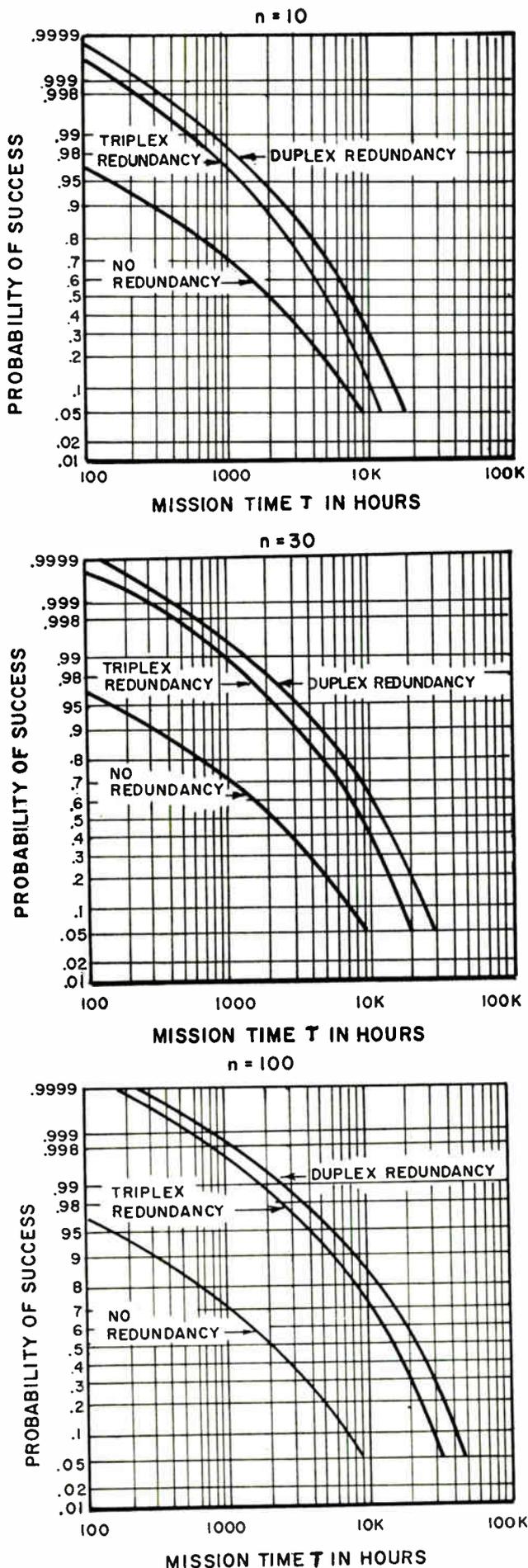
For computers having a program which is highly iterative, the same procedure can be followed if the real-time inputs which occur during the diagnostic interval can be either ignored or otherwise provided for.

In the most difficult case (a real-time computer handling inputs at a rate near its capacity) there are several alternatives:

1. A diagnostic control unit can be provided external to the main operating equipment of the computer. In this concept, when an error is detected in the computer, an interrupt signal is given which stops the computer clock. When the diagnostic equipment is activated, it generates artificial inputs to the defective section and isolates the faulty unit in μ secs. The computer clock is then turned back on and normal operation is resumed. This operation can be made so fast that there need be no loss of real time input data. In some special circumstances, it may be desirable to provide extra input buffering capacity to provide for incoming data during the diagnostic interval. If the computer is not a synchronous computer, instead of stopping the clock we would introduce a signal to stop the program counter.
2. If it is not desired to provide separate diagnostic equipment, then it is necessary to either provide much buffering for the inputs or ignore them during the diagnostic interval. It may be possible to reserve a small part of the computer to handle the input data during diagnosis by direct transfer of it to the memory. This special buffering equipment could be isolated from the rest of the computer so that the diagnostic routine would not interfere with it. Alternately, it could be constructed with a higher degree of redundancy and reliability.
3. One item to consider during an interruption is the status of the active and critical memory registers. To avoid losing essential information,

(Continued on page 128)

Fig. 11: Reliability vs time for 3 systems is plotted (right). The redundant computers are each considered to be subdivided into n equal and independent sections. The MTBF of the majority-vote circuit is assumed to be five times that of the error detector circuit used in the duplex redundancy system.



SAMPLING SCOPE (Continued)

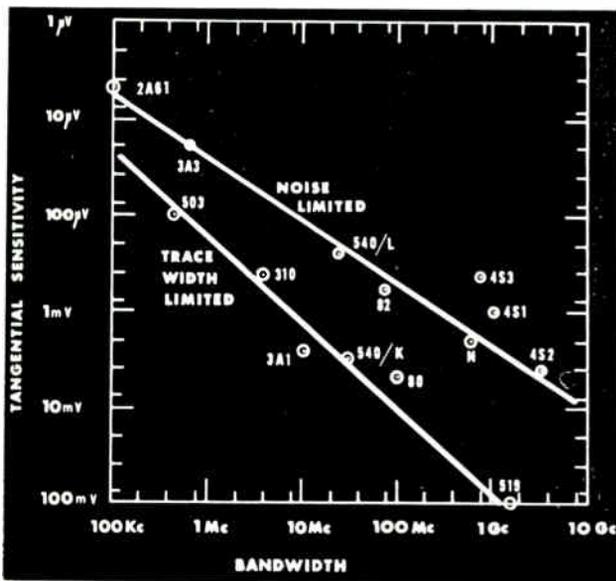


Fig. 1: Graph shows "tangential" sensitivity for some instruments, limited by two causes. The term is borrowed from radar.

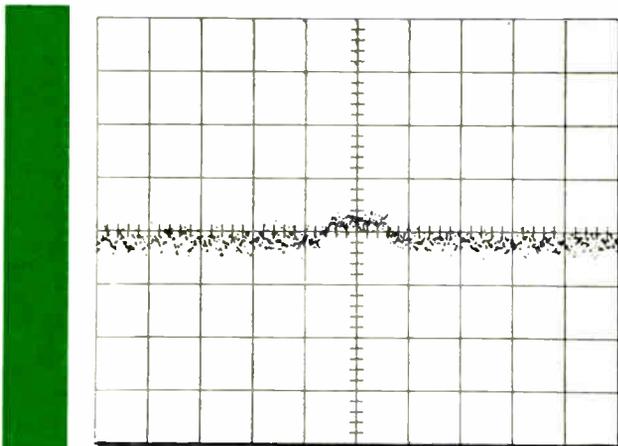
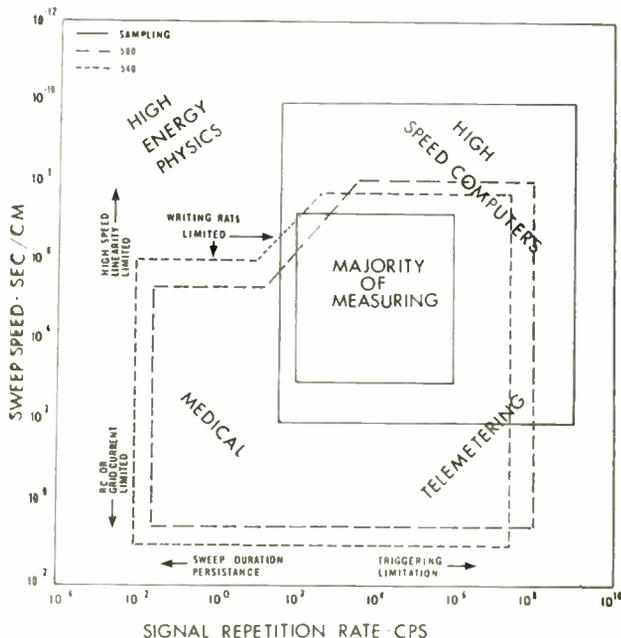


Fig. 2 (above): Sampling technique of "smoothing out" random noise without loss in bandwidth is seen in a typical display for 0.8mv/2.5nsec pulse triggering sampling and timing units.

Fig. 3 (below): Use domain areas indicate a very wide range of horizontal sweep speed for the sampling type oscilloscope.



other restriction—the gain bandwidth product of the available amplifying devices and the CRT deflection structure.

Relatively slow conventional oscilloscopes are confined to about $100 \mu\text{v}/\text{cm}$ sensitivity. Added sensitivity would not improve the utility of the scope because the equivalent input drift of existing amplifying devices is a few $\text{mv}/\text{hr.}$,⁶ and in a dc coupled mode the trace tends to wander up and down the screen in an annoying way when the sensitivity is greater than the $100 \mu\text{v}/\text{cm}$ order.

The faster scopes are limited in sensitivity for a given bandwidth by the active devices and CRT's on hand. As mentioned before, the available devices of a given gain-bandwidth product, and the capacity of the CRT, limit the amount of gain; also the deflection factor determines overall sensitivity. Conventional oscilloscopes feature $10 \text{ mv}/\text{cm}$ and about 80 mc . The sampling scope's characteristics are $2 \text{ mv}/\text{cm}$ and 1000 mc without smoothing; noise is about $\frac{1}{2} \text{ mv}$. The drift number for the sampling scope is about the same as for conventional types and is of the order of a few $\text{mv}/\text{hr.}$

Horizontal Sweep Speed

One of the outstanding attributes of the modern oscilloscope is its extremely wide range horizontal sweep speed.⁷ The drawback in the slow-sweep speed direction is one of input leakage in the amplifier and the quality of the capacitors used to generate the sweeps. This, however, is not serious, since sweeps as slow as many $\text{sec.}/\text{cm.}$ in conventional models. The speeds are slow enough to permit use of chart recorders.

The oscilloscope has one basic advantage over the oscillograph at extremely slow sweep speeds; one can observe CW carriers or pulse train envelopes which are too fast for galvanometers or servo writers to follow.

The sweep generators can generate 0.1% linearity sweeps without great difficulty when the Miller or boot-strap type sweep generators are used. It is the starting transient of the generator and the deflection amplifier, as well as the linearity of the very wide swing amplifier, which mainly gives a problem. Sweep speeds of conventional scopes are limited to about $10 \text{ nsec}/\text{cm}$, except for a no-amplifier special purpose indicator which has a speed of $1 \text{ nsec}/\text{cm}$. Fig. 3 summarizes some of the uses.

The sampling scope has a much easier time with fast sweep speeds since its sweep need only be large

enough to avoid drift problems in its comparator pick-off circuits. Thus, instead of hundreds of volts to deflect the CRT, the sampling instruments need only tens of volts. In addition, since magnification can be obtained by means of rather slow-speed circuits, sweep or time expansion is somewhat a simple matter.

Sweep speeds of tens of psec./cm. are possible; this greatly exceeds the need at the moment. Slow sweeps on a sampling oscilloscope are readily obtained by operating the sampler in a real time mode. In this mode, the horizontal sweep is in real time, instead of being reconstructed.

The sampling time interval is obtained from a constant speed clock, rather than by slewing on a fast ramp. Thus, it has become possible to use sampling on sweeps as slow as conventional scopes. E.g., one can not only observe bursts of parasitic oscillations of hundreds of μC in a feedback power supply, but can measure the time relation with respect to the power line or ripple phase. This is not possible with most conventional scopes.

Triggering

A basic use of the oscilloscope is to observe voltage as a function of time on a linear time base. For proper results the signal must appear with reasonable steadiness within the selected time window. In early days, the time base was a free-running type synchronized to the signal by taking a portion of the signal and introducing it into the sweep circuit to influence its rate. There was one drawback in this system: "to sync" the sweep, its speed had to be set to make the sweep period slightly longer than the normal signal interval, so that the signal could revert the sweep slightly before it would normally occur.

Modern scopes are normally operated on a triggered mode⁸ rather than a sync mode. In the triggered mode the sweep circuit runs for a given length of time. Its sensitivity to triggers is curbed until a cycle has been completed and another trigger occurs. An advantage of this approach, notwithstanding the problem of sweep length varying with signal period, is that the sweep period can be adjusted to a much shorter time than the signal period.

Current models of oscilloscopes have the sync mode available usually as an aid in displaying signals whose repetition rate far exceeds the instrument's maximum rate. For example, a conventional high-speed scope may have a sweep circuit able to operate at a rate of several $\mu\text{C}/\text{sec}$. By free-running the sweep-gating multivibrator, the sweep circuit can synchronize to several tens of μC 's with greater sensitivity than it could trigger.

Today, most scopes use a tunnel diode in the trigger-recognizing system, and synchronizing count-down to a few hundred μC is common. Sampling scopes have synchronizing capabilities to several μC .

Oscilloscopes intended primarily to observe pulses are usually equipped with internal delay lines so that the trigger pick-off system can precede the delay line. Thus the sweep can be started early to allow the leading edge of the pulse to appear at the deflection plates well after a linear start of the sweep.

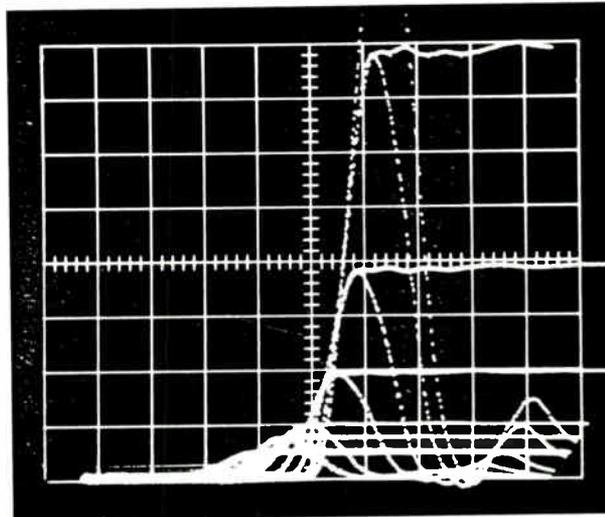
Trigger amplifiers, like vertical amplifiers, should have a good transient response for sensible triggering. Clearly one could obtain triggering on rather narrow pulses in a somewhat slow trigger amplifier by having a great deal of slow-speed gain. But then one would find that the time position of varying-height narrowing pulses would change very much. Tendency of fast signals to move as a function of amplitude is called slewing. See Fig. 4.

In sampling scopes, especially, one should have fast trigger amplifiers to minimize time jitter. (See Fig. 5).

It is interesting to note that with all the advantages of the triggering mode, compared to the sync mode, many modern scopes include automatic⁹ operation in the trigger function. This automatic function programs the scope's sensitivity to small triggers, making it unnecessary to adjust manually.

The trigger sensitivity of conventional scopes is a few trace widths on internal triggering with rather slow signals. Since the trigger channel is generally slower than the oscilloscope, a cm. or so of deflection may be required for synchronizing at high speed. In the case of sampling scopes, where the trigger

Fig. 4: Slewing results shown are explained in text. From off-screen amplitude down to about 100mv. nearly $\frac{1}{2}$ nsec. slewing occurs. At 75 mv. the impulse begins to slew more than the step.



SAMPLING SCOPE (Continued)

take-off occurs ahead of the sampling bridge, the internal sensitivity is generally several tens of mv. External triggering of conventional scopes is usually a few hundred mv. and for sampling oscilloscopes several mv.

Special Display Modes

The low-input signal energy needs and fast response of modern scopes have prompted a variety of novel uses.¹⁰ An example is the multiple trace where more than one signal can be shown by time-sharing. For high-repetition-rate signals time-sharing can be done by alternately displaying one trace, and then at a different vertical position the second trace.

Time-sharing by switching at a rapid rate offers an unique advantage; single transients can be displayed in their proper time relationship. Conventional scopes provide a switching rate of 100 kc to 1 mc. Thus, for speeds faster than 100 μ sec/cm to 10 μ sec/cm, the alternate trace time-sharing method must be used to avoid problems of resolution due to switching between traces. If the single transient ability is needed, one must resort to the use of a multiple-beam scope as opposed to multiple trace.

Besides displays involving vertical deflection proportion to input voltage and horizontal deflection proportion all the time, there are other modes of interest, such as the X-Y mode or Lissajous pattern. See Fig. 6. Here, the horizontal and vertical inputs should be essentially identical for both channels. In the better types of oscilloscopes, the X-Y type displays have relative phase shifts of only a few degrees upward to the 3 db limit frequency.

The delaying sweep is another important type of display often used. The technology of generating a linear sweep for the horizontal deflection of the oscilloscope naturally leads to the use of similar generators to generate delay intervals. This feature allows one to examine a pulse train in detail.

The sampling scope has the necessary speed and overload ability to allow rather extraordinary performance as a "reflectometer." With a 1000:1 dynamic range and 0.1 nsec risetime, 0.1% reflections can be observed and centimeter distances distinguished. See Fig. 7.

Besides the relatively common-place uses, there is a trend to combine the oscilloscope with counters or other devices to perform readout functions. Here we have the so-called automatic scopes which, according to a pre-selected program, can adjust their sensitivity

and sweep speed to display a certain number of cycles and a certain number of centimeters of signal. Generally, there is a readout device which shows the sensitivity settings that were automatically selected.

Also, we have the readout scope which can be programmed to a certain sensitivity and sweep speed. It is thus possible to take measurements on the signal, and produce in the form of a printed signal or indicator lights, a time interval or amplitude that was programmed to be read. Sampling oscilloscopes lend themselves to time readout nicely, digitizing time by nature of the sampling process. In addition, amplitude measurements are made easy by the availability of the relatively slow equivalent time signal.¹²

Plug-in units, featured in many modern oscilloscopes, have contributed greatly to display versatility, with reasonable economy.

Writing Rate and Persistence

The CRT used to obtain the display is available with a wide range of phosphors¹³ varying widely, even within a given type; for example, P31. There

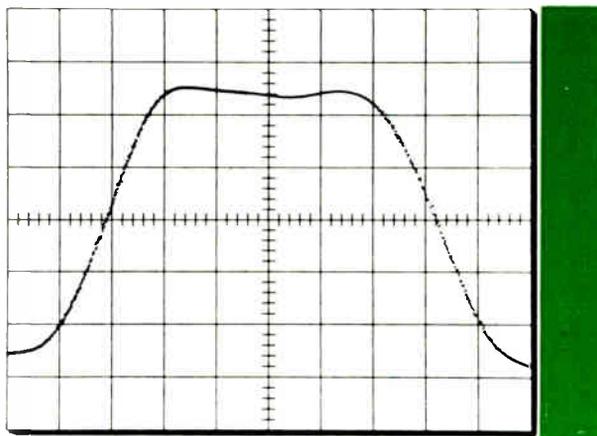


Fig. 5: Depicted here is a small time jitter that occurs during internal triggering of sampling. Pulse is 1v.-1.2nsec.

are many phosphors, at least 35 having been registered with JEDEC.

Of interest is the possibility of virtually infinite persistence, the basis for the storage tube. There are several storage tubes available. The most popular, at present, stores directly on the phosphor, either electrostatically or as a result of producing color centers due to electron beam bombardment. The color center type, P10, produces a purple color trace which is erased thermally. Its writing rate is generally slower than 40 μ sec/cm and erasure takes the better part of a minute.

Electrostatic storing types come in two versions. One is the mesh type. It has a relatively high writing rate for storage types of $\frac{1}{2}$ μ sec/cm. The non-mesh

version, which stores on a R1 like phosphor, has a writing rate in the range of 10 $\mu\text{sec}/\text{cm}$ to 40 $\mu\text{sec}/\text{cm}$.

Display Size

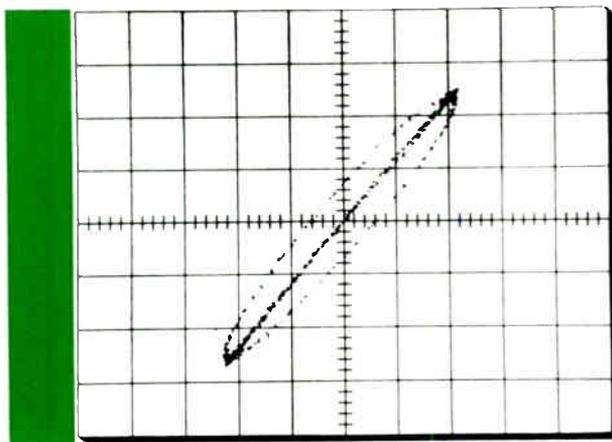
The proper display size is a subject which has often been treated emotionally, rather than scientifically. In the early days, a 3-inch screen was considered a large one and the optimum standard. Today, the 5-inch screen is by far the most common size. One might conjecture that tomorrow 7 inches will be the vogue. The tube diameter is not the only factor to be considered in display size, rather the useful display area and the spot size.

System Interaction

The acceptance of the oscilloscope as a measuring device is due to the relatively light loading of the system being measured. Typical probe input impedances are statically in the order of 10 meg Ω and 10 pf.¹⁵ For relatively slow speed systems this loading was often so light that it was ignored. As systems became faster, loading could no longer be ignored. The reason for this is fairly simple—the scope was asking for the same amount of data in a shorter time. Since information is energy, the shorter time requirement meant that peak power needed by the scopes went up as the speed of the system. The loading of a typical capacitor-divider type probe, at several tens of mc's is in the region of several hundred ohms, and is not a trivial one. The input loading effect has received a good deal of attention. Probes which appear as more than 1 K Ω at 1000 mc are available, but their static input impedance is also low.

In addition to passive-input loading, one must be aware that the oscilloscope may be an active device, insofar as the circuit is concerned. In vertical inputs

Fig. 6: Lissajous display with a 2 GC sine wave driving inputs to a dual-trace sampling scope set up for x-y operation. The ellipse results from insertion of 8mm air line to one input giving about 20° phase shift. Resolution below 1° is possible.



at very high speeds, the input cathode followers may become negative-resistance devices, and low-impedance systems might actually oscillate, if the system was not properly damped, or if an appropriate probe was not used. In sampling scopes, the gating pulse which actuates the sampling head may be out of balance and cause an output pulse to perturb the circuit under measurement. The size of this kick-out pulse may be anywhere from 1 v., with unbalanced, to tens of mv's, in the case of balanced sampling heads. The saving factor is that the sampling

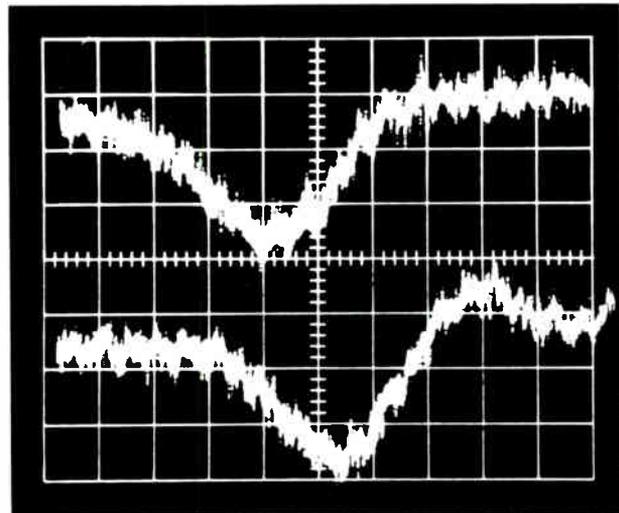


Fig. 7: Double exposure plot of reflectometer resolution. Shown are 0.02pf discontinuities in sequence at points 1 cm. apart on a 50 Ω air line. Sampling is at 50 psec/cm and 1 mv/cm.

pulse is usually quite brief in time duration, and many times the circuit is not perturbed, because of the small amount of energy involved in a sampling pulse.

With a trigger input to the scope, particularly in high-speed instruments, there can be capacitive or conductively-coupled output signals due to the trigger recognizing element within the scope. The trend is to isolate these kickout pulses, but the desire to retain wide-band triggering capabilities makes this difficult.

Signals of a few mv may be expected from typical trigger input. Some designs, upon actuation of trigger selection switches, may switch coupling capacitors into the system and the external circuit thus must supply the charging (or discharging) current. In the case of sensitive circuits, this may make a false actuation signal, or worse yet, a destructive signal in the case of fragile semiconductors.

RFI

Radio frequency interference has also been found to be a source of trouble for scopes. The normal out-

SAMPLING SCOPE (Concluded)

puts, such as the sweep gate and the sweep output, on the front panel of many scopes, may be an offender if uncapped. Also the silicon rectifier diodes used in power supplies frequently cause considerable RFI via the line cord. Most oscilloscopes can withstand only the normal electrical environment found in research labs. Very strong magnetic fields, or strong r-f signals can overcome the normal shielding built into the scope.

Continuing Accent on Tubes

At present most scopes use a tube in the input stage and frequently as deflection amplifiers, sweep generators. In addition, in sampling scopes, the tube is generally used in the long-term memory. Eventually, insulated-gate field-effect devices will replace the input, sweep generator and memory tubes. It will be some time before semiconductors are used as a high-voltage rectifier or to replace the cathode-ray tube; both the CRT and the HV rectifier are reliable; replacing them now with semiconductor devices would be extravagant.

Integrated circuits represent another area of questionable value in scopes today. If someday we have a semiconductor display device, using, e. g., 200,000 display elements, then perhaps the large number of

iterative circuits needed to control the display elements will justify integrated circuit assemblies.

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DUPLEX REDUNDANCY (Concluded)

Continued from page 121

it may be necessary to store the contents of important registers every several hundred instructions and doubly store input data occurring during this instruction interval. In this way, if an error occurs, after it is corrected, the main program reverts back to the point where the contents of the registers were stored, and together with the input data which occurred during that instruction interval, regenerates the situation.

It is seen that, although the duplex redundancy scheme offers much improvement in computer reliability at comparatively low cost, it is desirable that the error detection system be designed into the computer from the earliest stages. In this sense, a degree of sophistication in the use of the concept is necessary and must be considered along with the program

interrupt as a basic disadvantage of the system. However, the advantages may outweigh these disadvantages in many uses.

Acknowledgements

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The unsaturated standard cell and Zener references are used in precision equipment. A continuing program of component improvement closely evaluated both types for two years. The results of this investigation are presented in a comparison with guidelines for choosing the reference for a specific application.

MUCH HAS BEEN WRITTEN AND SAID in recent months about the superiority of the Zener diode over the unsaturated standard cell as a voltage reference. Very little has been heard from the standard cell industry. It is appropriate now to review both references objectively in an attempt to evaluate their relative merits. The use of standard cell and Zener references in equipment, and having both types in a two-year program of component improvement under close study, is summarized here.

It is first necessary to clearly define the function of a voltage reference in a precision instrument. From this the necessary characteristics can be developed and then the devices themselves examined to learn how well they meet these requirements. Finally they will be considered from a value analysis standpoint.

* * *

The function of a voltage reference in a precision instrument is to relate the calibration of the instrument to basic electrical units maintained by the National Bureau of Standards, Washington, D. C. The basic unit in the case of voltage is the absolute volt.¹ Its practical embodiment is found in the normal or saturated cadmium standard cell, banks of which are at NBS under carefully controlled laboratory conditions. By intercomparison methods it is known that the stability of these cells is better than 1 ppm (part per million) per year and that a typical bank holds its accuracy in terms of the absolute volt by about the same figure.

Some definitions are in order at this point:

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President

and **ROBERT W. HAMMOND**

Head,
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CHOOSING A VOLTAGE REFERENCE

Accuracy — The deviation of measured value from true value.

Precision—The repeatability of a measurement.

Stability—The constancy of a quantity with respect to time and external influences.

Temperature Coefficient of Voltage—The ratio of the change in voltage of a source due to a change in temperature of 1°C, to its voltage at some reference temperature, usually 25°C.

Temperature Hysteresis of EMF—The measure of EMF excursion of a voltage reference before settling to its stable value following a rapid temperature change.

Calibration

Our voltage reference must relate the calibration of the instrument to absolute units maintained by NBS. While this suggests that the reference must be accurate, in most cases this is not so. Usually the accuracy of an instrument's voltage reference need not be high or, for that matter, even known. However, the stability of the reference must be high. And it is mandatory that the instrument maker's calibration equipment be both accurate and stable.

This is illustrated with a typical Fluke dc differential voltmeter. This device measures voltage to an accuracy of better than 0.01% by comparing the unknown voltage with a known portion of an extremely accurate, stable 500 v. developed by a highly regulated electronic power supply. A self-contained 1-0-1 mv null detector is used to adjust the 500 v. to an accuracy of $\pm 0.0003\%$ by comparing a sample of it



Authors:

John M. Fluke, left,
and Robert W. Hammond.

1. A detailed discussion of the basic electrical units and the transition from International to Absolute units on Jan. 1, 1948, appears in NBS Circular 475 entitled "Establishment and Maintenance of the Electrical Units" by F. B. Silsbee.

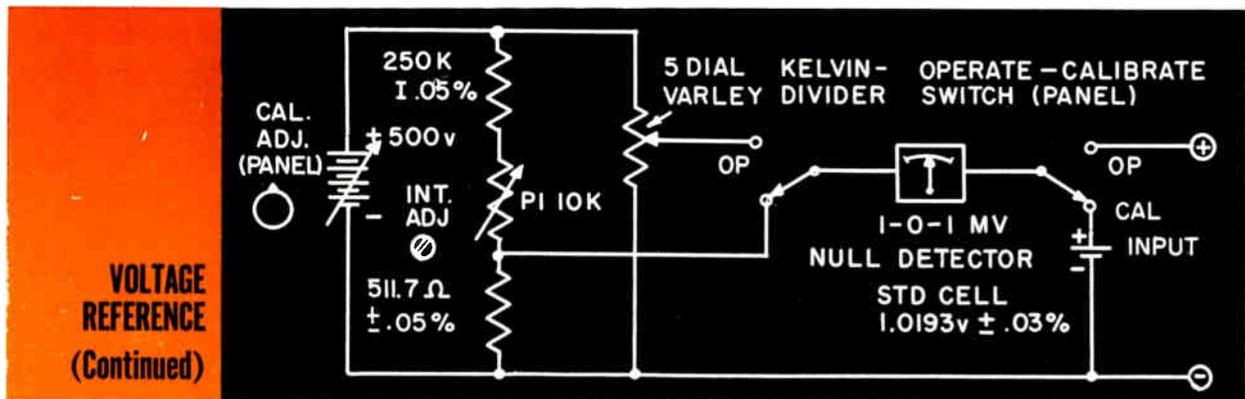


Fig. 1: Accuracy and stability of a Fluke DC differential voltmeter depends on its internal reference seen.

with an internal reference voltage (standard cell or Zener). This is done by occasionally throwing a front panel Operate-Calibrate knob to CAL position and adjusting the front panel CAL ADJ knob for meter null (See Fig. 1).

You will note that the accuracy of the standard cell (certainly of true value as guaranteed by manufacturer) is only $\pm 0.3\%$, yet we achieve a calibration accuracy of $\pm 0.003\%$.

The factory calibration procedure for this consists of connecting a special potentiometer accurate to 0.001% (referenced against a saturated standard cell whose EMF is known to $\pm 0.0002\%$) to the instrument's 500 v. reference supply and adjusting the panel CAL ADJ knob until the potentiometer indicates 500.000 ± 0.005 v.

Next the OP-CAL switch on panel is thrown to CAL position and an internal screw drive adjust control, PI, adjusted until the null detector comes to zero. With this simple operation we wash out all the "inaccuracies" of divider and reference element; then the accuracy of the 500 v. depends solely on the stability of divider resistors and reference element. The divider resistors are stable to better than ± 2 ppm per 1000 hrs. and the standard cell to better than -4 ppm.

It should be pointed out that the best stability figure to which any known diode manufacturer will certify his Zener reference element is ± 20 ppm per 1000 hrs. Since unsaturated cells always age downward, their stability figure is negative only, while the Zener reference voltage fluctuation is completely random, so is effectively 40 ppm compared to the cell 4 ppm.

Requirements of a Reference

The requirements of a voltage reference are listed in Table 1 in about the order of their importance to precision commercial laboratory equipment. This order might be quite different for military equip-

ment. Here the uses are so diverse that such a listing is almost impossible. For example, the ability to withstand shock and vibration might head the list for a reference used in a missile guidance system, whereas operation and storage at extreme temperatures would probably be near the top for DEAW line equipment references.

This brings up an important point: voltage references, like most other components, should be selected and on the basis of the use. The question is not "which is the better component, a Zener reference or an unsaturated cell?" Rather it is, "which one best serves the application?"

Table 1 also shows typical characteristics for unsaturated standard cells and certified Zener references from two highly reputable semi-conductor manufacturers. The last column lists performance characteristics of a good quality uncertified Zener reference.

Discussion

A brief discussion of these requirements and how well the two types of references meet them, follows.

1. **Stability:** The unsaturated standard cell is at least four times better than the best commercially available Zener at the present time. Also, the significance of the bilateral stability tolerance on E_z cannot be disregarded. Since the absolute value of reference voltage is seldom measured in calibration procedures (discussed above) and the time variation of E_z is completely random, there is no way of knowing at any particular point in time just where in the 40 ppm stability band the reference E_z happens to be. If it happens to be at the negative extreme (-20 ppm) at the time of factory calibration, subsequent drift to the positive extreme ($+20$ ppm) will result in instrument error of $+40$ ppm.

Precise determination of absolute E_z and compensation for deviation from nominal greatly complicate the calibration procedure and make field recalibration

a near impossibility. The unsaturated cell on the other hand has a known rate of EMF decay which, at normal room temperatures, runs 20 to 40 ppm per year (8800 hrs). Taking 3 months (2200 hours) as the average recalibration cycle period, the maximum degradation of instrument accuracy caused by cell voltage drift will be 10 ppm compared to 40 ppm for the Zener diode.

2. Low Temperature Coefficient of Voltage:

It is important that an instrument voltage reference have a very low TC of voltage. Temperature compensation of Zener references is usually made by combining avalanche diodes (or dice) having an inherent positive TC with forward biased "Stabistor" diodes (or dice) having an inherent negative TC so that the TC of one compensates the other.

TC is a rather complex subject requiring clear definition of the reference temperature and the operating limits. For example, Zener TC's are often specified over a very wide temperature range, say -55°C to $+100^{\circ}\text{C}$. This would appear to be a distinct advantage, but this is not always true.

Over this range the sign of the TC may actually change from negative to positive with the slope quite steep at the extremes, even though the average TC may be fairly low. This makes temperature compensation by usual means (thermistors, high TC

Table 1

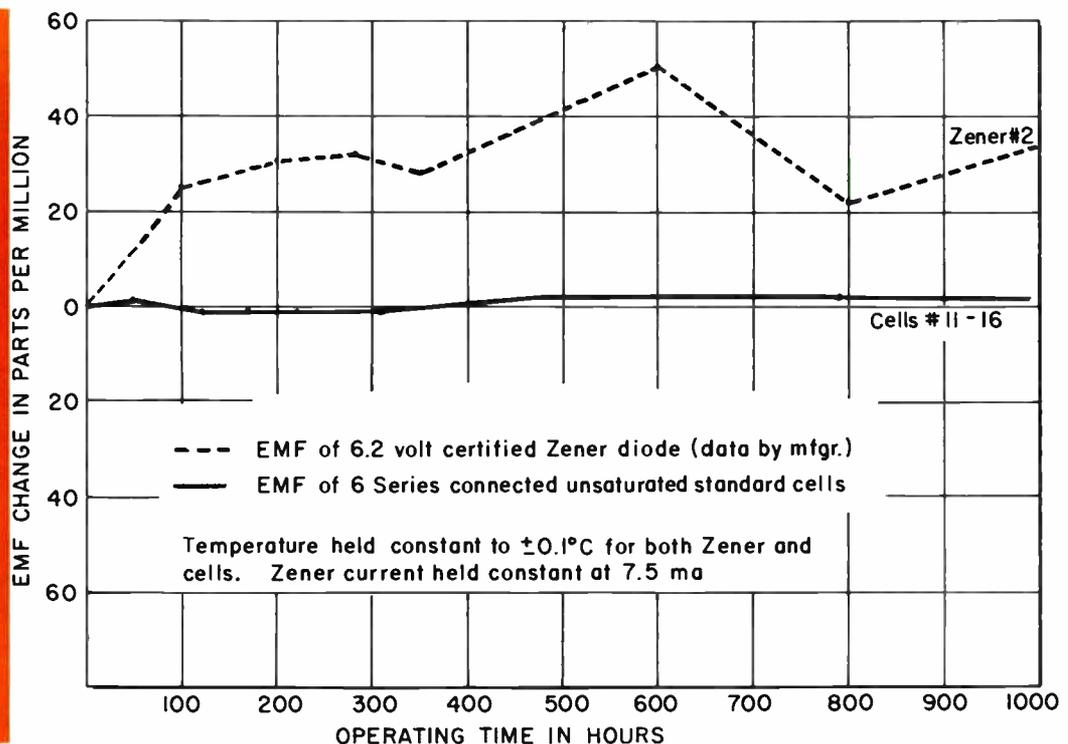
Voltage Reference Requirement	Unsat. Cell	Cert. Zener #1	Cert. Zener #2	Uncert. Zener
1. High Stability—1000 hrs.	-4 ppm	± 20 ppm	± 25 ppm	None
2. Low TC of Voltage	± 3 ppm/ $^{\circ}\text{C}$	± 10 ppm/ $^{\circ}\text{C}$	± 10 ppm/ $^{\circ}\text{C}$	± 7 ppm/ $^{\circ}\text{C}$
3. Freedom from Hysteresis	20 ppm	Not specified—probably 10 ppm		
4. Narrow Voltage Range	$\pm .03\%$	$\pm 5.0\%$	$\pm 2.4\%$	$\pm 1.6\%$
5. Long Service Life	5-10 yrs.	Unknown	Unknown	Unknown
6. Low Initial Cost (100 quan.)	\$7.00	\$70.00	\$50.00	\$15.00
7. Min. auxiliary components	None	.01% const. current supply, oven		
8. Operation at extreme temp.	0 to 50°C	-65°C to $+150^{\circ}\text{C}$		
9. Storage at extreme temp.	-15 to 60°C	-65°C to $+150^{\circ}\text{C}$		
10. Withstand shock & vibration	Mil-Std-202A	Not specified—probably very good		
11. Ability to furnish current	1 ua	Limited by allowable ΔE_z (f of r_z)		
— Minimum Maintenance	None	Check constant current source		

wire-wound resistors, etc.) very difficult. Often the best solution is the use of a crystal oven. These can be expensive and present their own problems such as temperature set point drift. Also, they require power and take up space.

The unsaturated standard cell, on the other hand, inherently has a much lower TC of EMF running from ± 1 to ± 3 ppm/ $^{\circ}\text{C}$. (A recent check of 5 miniature cells over the range of 10°C to 40°C showed a spread of average TC of 0.5 ppm/ $^{\circ}\text{C}$ to 1.4 ppm/ $^{\circ}\text{C}$.) The TC of an unsaturated standard cell is controlled by the chemistry and geometry of the ingredients.

3. Freedom from Hysteresis: This characteristic, defined earlier, is negligible for Zener reference elements of small thermal mass over reasonable temperature changes. Very little in the way of quantitative data on this phenomenon is usually provided in the specs for these devices. Actual tests

Fig. 2: This is a curve prepared to illustrate the relative long term stability of two reference devices.



VOLTAGE REFERENCE (Concluded)

on 400 mw glass package units, however, show that EMF stabilizes to within 10 ppm of final value within 10 minutes following a 25° C change.

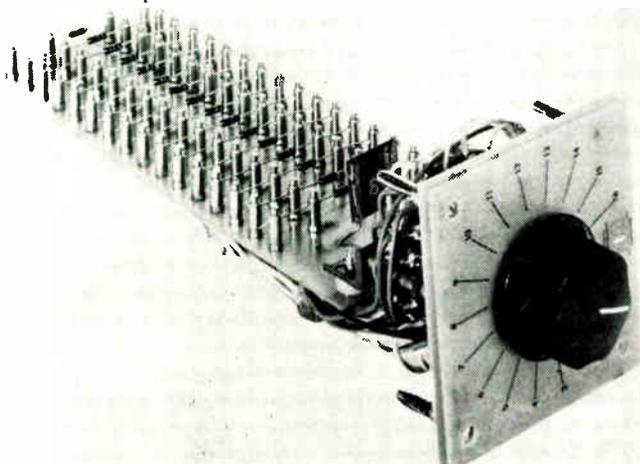
The unsaturated cell generally shows an excursion of 0.01 to 0.02% and requires about 40 minutes to stabilize within 20 ppm of final value following a 25°C change, when packaged as described in the previous paragraph. The newer miniature cells use a porous polyethylene plug in place of cork. This and other refinements have minimized hysteresis even at ages up to 5 years. Most data given is for uncased, unlagged cells—here the EMF excursion is much larger after rapid temperature change. With proper thermal lagging and heat sinking, this effect is greatly reduced.

4. Narrow Voltage Range: This is desirable, since it simplifies the voltage divider used to sample the voltage being controlled.

If the reference voltage tolerance is broad, several rheostats or potentiometers must be cascaded to provide the necessary resolution for precise factory calibration. The alternative is to use a family of fixed precision resistors and a single vernier rheostat to cover the normal variation in any shipment of references. The former approach requires precision low TC pots and introduces additional sliding contacts into the circuit. The latter complicates the replacement problem since a factory selected resistor must be shipped with each replacement reference element.

The unsaturated cell, due to its chemistry and close control of the manufacturing process, shows a very small range of EMF variation cell to cell, typically

Section from bulk-ager showing 16 zener diodes mounted in spring-loaded terminals. Capacity of bulk-ager is 192 diodes, with coarse and fine controls for setting I_z to test value.



$\pm 0.03\%$. The Zener reference, consisting of 2 or more separate dice, each selected for several parameters, only one being voltage, shows a much broader spread, typically ± 2 to 5%. Although manufacturer's selection can be used to narrow the spread, the cost of units so selected is increased accordingly.

5. Long Service Life: Because of the relative newness of the high stability Zener reference, stability data extending over several years are practically nonexistent. However, barring catastrophic failure such as broken welds or loss of hermetic seal, it appears likely that service life might prove indefinite. It is a well documented fact that Zeners tend to become more stable with time and use, particularly use. Upon turning off for a few days and then reenergizing, an "ON-OFF shift" is often noted, where the E_z tends to return to an earlier (and usually higher) value.

The unsaturated standard cell has a well established useful service life of from 5 to 10 years, generally outliving most other circuit components. Replacement cost is only a fraction of certified Zener cost and presents no problems of resistor matching or complicated recalibration procedure.

Over the past several years we have shipped more than 20,000 instruments of various types using unsaturated standard cells as the reference element. Fewer than 150 replacement cells have been shipped.

6. Low Initial Cost: At the present time certified Zener references cost 5 to 20 times as much as standard cells. Off the shelf, uncertified Zeners cost 2 to 3 times as much, but must be aged and checked for stability before use.

Various methods may be employed to accelerate the aging and increase the yield—these include power aging, hot and cold temperature cycling, passive storage at elevated temperatures, high current pulsing and other schemes. After each process phase, various parameters are checked to detect defective and marginal units. Also the E_z is measured under rigidly controlled operating current and ambient temperature conditions as the final measure of stability.

The unsaturated standard cell costs under \$7 and comes complete with manufacturer's certificate giving EMF accurate to $\pm 0.03\%$ and requires absolutely no processing, aging or other special stabilizing operations.

7. Minimum Auxiliary Equipment: The unsaturated standard cell is a true voltage source while the Zener reference is a passive voltage regulator. The cell requires no auxiliary equipment other than some sort of holder.

The Zener requires a constant current source to

drive it, usually a 5 to 10 ma. supply regulated to 0.01% or so, to minimize the effect of its 15 to 30 Ω internal resistance. This current supply must be stable with time and line voltage fluctuations so it must employ either the reference being driven as its reference, or where circuitry won't permit this, one nearly as good. This often results in a chain of pre-regulator circuits ahead of the reference.

Unfortunately, the slope of the voltage-temperature curve for Zener references is not only non-linear but often changes sign, thus making compensation over a wide temperature range virtually impossible.

The standard cell requires no auxiliary equipment, thus increasing reliability.

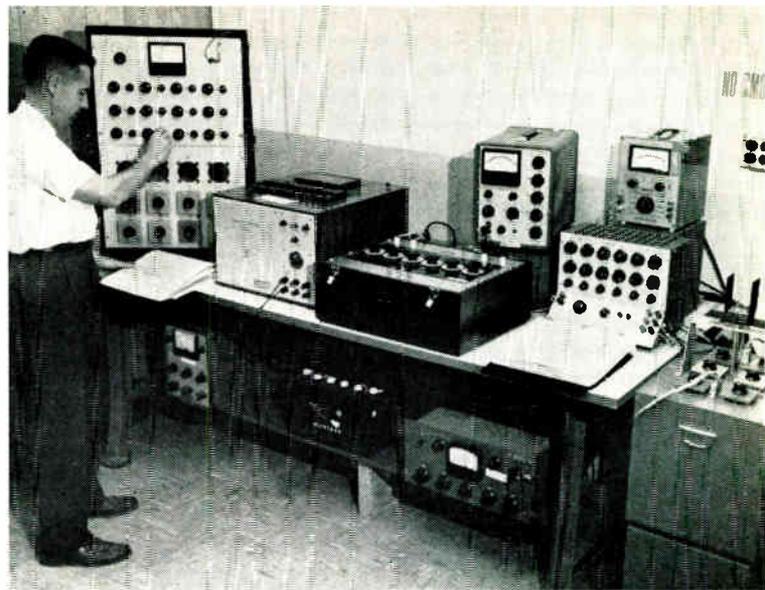
8. Operation at Extreme Temperatures: Over the range of 0° to 50°C the unsaturated standard cell provides a highly satisfactory reference for the usual precision instrument. At 60°C the amalgam melts and at -17°C the electrolyte freezes, both conditions rendering the cell inoperative. While these are conditions never encountered in ordinary laboratory or industrial work they are not unusual in certain military applications. Obviously the Zener reference is the logical choice for the latter equipment. If high accuracy is important at extreme temperatures, operation in an oven is essential; if accuracy degradation can be tolerated, it is not.

9. Storage at Extreme Temperatures: If equipment must be stored for prolonged periods at temperatures above 60°C, some shortening of standard cell life may occur since aging rate increases with temperature. Recovery time tends to increase for storage below -10°C although no permanent damage will result. Below -40°C there is danger of glass breakage on thawing. Where such extreme storage conditions occur, again the Zener reference is ideal.

10. Ability to Withstand Shock and Vibration: Probably no other device has received so much soft handling over the years as the unsaturated standard cell. With the simplest sort of shock mounting (2 squares of foam rubber) it may be dropped on the floor or thrown against a wall with no damage. After violent shaking, upending or pounding on all surfaces, it will return to within 0.002% of its original value almost instantly. We have seen many instruments damaged beyond repair where the standard cell was found to be still in perfect condition.

Some of the misunderstanding associated with these devices probably stems from confusing them with the normal or saturated standard cell which is quite a different device.

In certain installations, notably aboard submarines, the presence of devices containing mercury is ruled



Some of the lab equipment used to accelerate the aging and increase the yield of zener diodes. Methods include power aging, hot-cold temperature cycling, and high current pulsing.

out due to breakage hazard and the possibility of subsequent serious toxic effects. To minimize this danger an encapsulation technique was developed by the Mare Island Naval Shipyard (refer to their Production Department Process Data sheet Number 401.1).

Where actual operation under severe vibration and shock is needed, the Zener reference may be more proper since its dynamic output is little affected by such disturbances. The rest of the instrument, of course, must be equally rugged.

11. Ability to Furnish Current—For use requiring a steady current drain on the reference element any larger than a μ a, the standard cell is not satisfactory. On the other hand, temporary current drain or even a short circuit of a sec. or two duration will not permanently damage the cell. In most places, however, the cell is used in a null seeking circuit where current drain (or charge) is close to zero. Where current must be furnished by the reference on a steady basis, the Zener diode is the only choice.

Conclusion

It can be seen from the foregoing discussion that both the unsaturated standard cell and the reference Zener diode have advantageous traits and either may be the best choice depending upon the use. Generally, current handling by the Zener is better suited to low impedance solid state circuits where constant drain is required.

However, in high-impedance, null-seeking circuits, the unsaturated standard cell is definitely superior from the standpoint of stability and cost, and is more than an equal match in terms of ruggedness and reliability than is generally appreciated. All of these factors must be considered by the designer.

DIODE RESISTANCE TO NUCLEAR RADIATION

Previous research had shown that in irradiations, some unenergized but exposed transistors showed less damage than ones which were intermittently energized during the same nuclear exposure. This led to a study of the effect of energization on the simpler semiconductors, i.e., the 2-port diode, which is presented here.

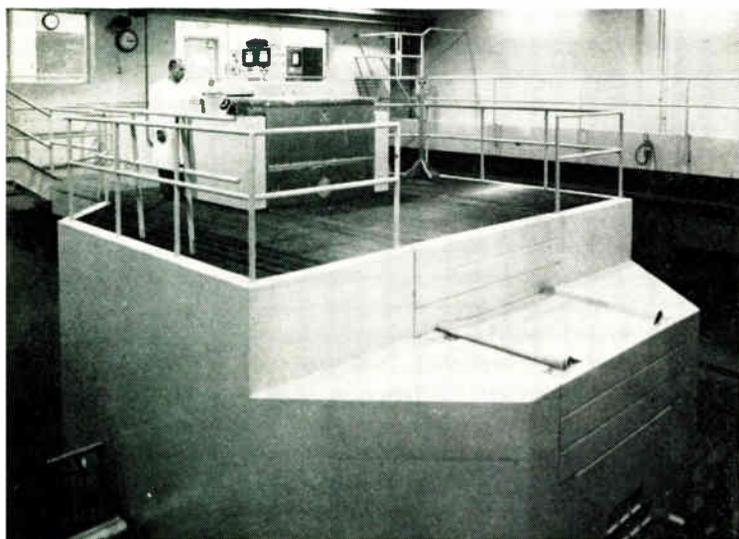


Fig. 1: Used in the test program on diodes is this 10 Kilowatt Argonaut Nuclear Reactor located at UCLA Dept. of Engineering.

KNOWLEDGE OF THE EFFECTS OF NUCLEAR RADIATION on electronic components is very important to us: the Van Allen belt and man-made radiation in space has knocked-out some of our orbiting space electronics; electronic equipment and systems must operate close to nuclear reactors generating power and propelling vessels; in the event of a nuclear war it is vital that equipment not destroyed by heat or shock waves continue to function.

To overcome the effects of radiation we must know what this radiation does to components. This means that we must subject parts to a strong field and then see what happens.

* * *

Many reports and publications have presented the front-back conductance performance of diodes in nuclear environments. The dynamic or static readings of forward conduction and reverse leakage cur-

rents were charted as irradiation progressed, to secure damage parameters as a function of exposure.

Most, if not all, of these tests were with the semiconductor energized only for a few minutes each time data was taken. This procedure has also been used widely in transistor investigations.

Some special types of diodes (gallium-arsenide) showed migration of material and degradation of performance which was much higher when life tested (energized) than with storage. The question arose, if such an effect might be possible with diodes or transistors which, while not normally showing this characteristic, might react somewhat similarly in a neutron environment then produce atomic displacements within the semiconductor. Also, prior research had indicated that in irradiation, some unenergized but exposed transistors exhibited less damage than their counterparts which were energized at intervals during the same nuclear exposure.

Samples Chosen

To simplify the study of the effect of energization on semiconductors, it was decided to use the simpler of the semiconductors, i.e. the two port diode. The experiment used a small sample size, but one which nevertheless was adequate to lend just validity and confidence factor in the results.

Fifteen diodes were used. Five of the diodes had

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constant forward current applied, and 5 had continuous reverse voltage applied. The remaining 5 diodes were not energized until the integrated exposure had reached $\sim 10^{15}$ nv_0t . In the reactor used, this exposure is closely equal to the thermal flux (nv_0t) but the reporting in either figure is for a measurement of exposure, not as a damage criterion.

Thermal flux is responsible chiefly for transmutations and induced radioactivity, whereas flux above some energy point (~ 250 eV for silicon) is deemed effective for atomic displacements. This article is not concerned with this facet of radiation effects, hence this area will not be discussed in detail.

The empirical test results noted will probably vary with irradiation in reactors with other spectral distributions of energy, and with the make-up of the specimen's electrode material and the nature and extent of semiconductor doping.

The engineering nuclear reactor laboratory of the University of California, Los Angeles, was used in the test program. This facility is shown in Fig. 1.

The samples chosen for test were Pacific Semiconductors microdiode type PD-105. These microdiodes proved quite nuclear resistant in other test programs. Also, their stability in energized life tests, without the nuclear environment, showed that the test data accrued would indicate the results of irradiation rather than a combination of parameters.

Test Circuit

Fig. 2 is the test circuit schematic. The diodes with continuous forward current were each monitored and held at one ma. via use of 50 K Ω rheo-

stats in series with a 30 vdc supply. The voltage drop across the diode was measured and plotted vs. nuclear exposure as seen in Fig. 3. This figure also shows results with diodes which were measured at intervals after $\sim 10^{15}$ nv_0t .

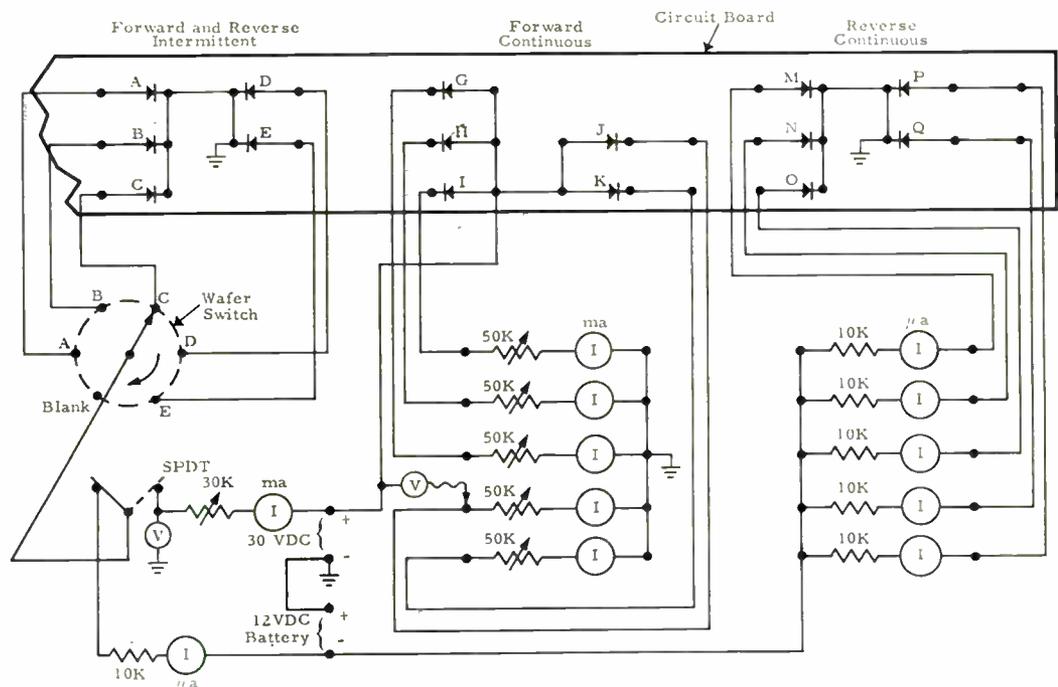
To simplify the average of each lot of 5 diodes is plotted. Averaging the data for diode forward performance is quite proper for all exposures, but for reverse performance is deemed truly representative only above $\sim 4 \times 10^{15}$ nv_0t . Below this value an average is not necessarily descriptive, wherein reverse resistance varies from infinite to ~ 12 megohms.

Tests Run

The 5 diodes with reverse voltage applied constantly had a limiting resistor of 10K Ω and a microammeter inserted into each diode circuit. The reverse voltage was held constant at 12 vdc. The reverse resistance was calculated and plotted for various exposures, as shown in Fig. 4, along with the average of the diodes measured at intervals.

The finding of diode reverse impedance required the measurement of low current, in the μa range. Ionizing radiation no doubt created some shunt current paths across the diode(s). This parameter would of course affect both measurement of the intermittently and continuously energized diodes to the same extent, if each had equal reverse resistances. Inasmuch as reverse impedances of 120 meg Ω to infinity (>1000 meg Ω) were measured during irradiation, it appears the ionizing dose rate was not enough to affect the validity of the reverse current measurements, particularly below 50 meg Ω as shown.

Fig. 2: This is the schematic of the test circuit used for study of diode reaction to nuclear exposure.



R. C. Eckerman



NUCLEAR EFFECTS (Continued)

The intermittently measured diodes used a single voltmeter and microammeter which were switched to the test sample. The test specimens were energized just long enough to take the required readings.

The specimens were held between 105° to 120°F for the time of the test. Their nearness to the core of the reactor, and the test board placement and geometry indicate that all test samples got close to the

same exposure. Dosimetry mapping was, however, not on hand to verify this conclusion.

Data and Analysis

The forward and reverse traits of the PD-105 with nuclear exposure in General Dynamics ground test reactor (GTR) are shown in Fig. 5. During this test the diode(s) were intermittently energized. The exposures noted are for neutrons measured above 2.9 Mev. The 10^{16} nv_{0t} (nv_{0t}) exposure noted in Figs. 3 and 4 is closely equal to 5×10^{15} nv_{0t}, $E_n > 2.9$ Mev, but direct comparison of graphs 3 and 4 to 5 is not necessarily representative of anything because of the differing spectral characteristics between the two reactors. Test results show that the energization of silicon diodes, while subject to a nuclear exposure, increases to a marked degree, degradation of performance when compared with on and off-operated diodes.

Findings

Although the graphs describe the static characteristics of the diodes, this data is not enough per se to fully evaluate nuclear induced damage and the post-irradiation usefulness of the diodes. Three significant traits in diode performance are 1. forward conductance, 2. reverse resistance, and 3. break-away point for forward conduction. The first two of these items
(Continued on page 138)

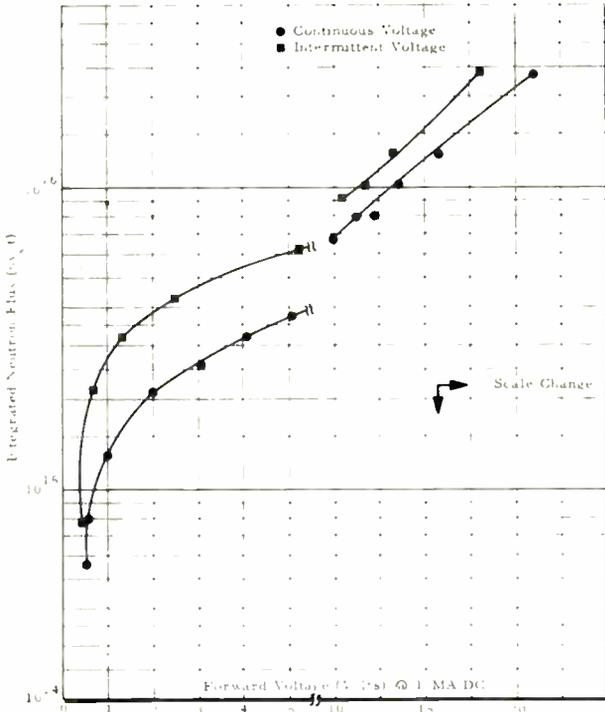


Fig. 3: Results are these plotted curves of diode(s) forward characteristics with and without energization during nuclear exposure.

Fig. 4: The reverse leakage resistance of diode(s) is shown as the function of energization and nuclear irradiation received.

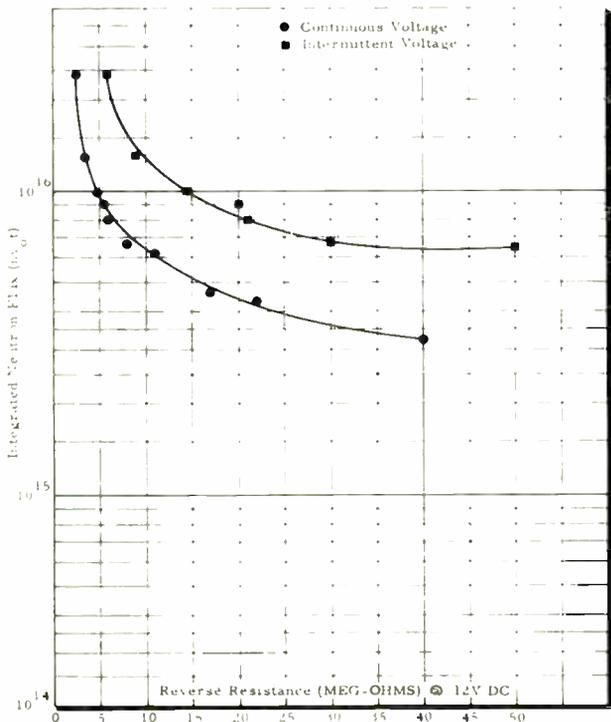
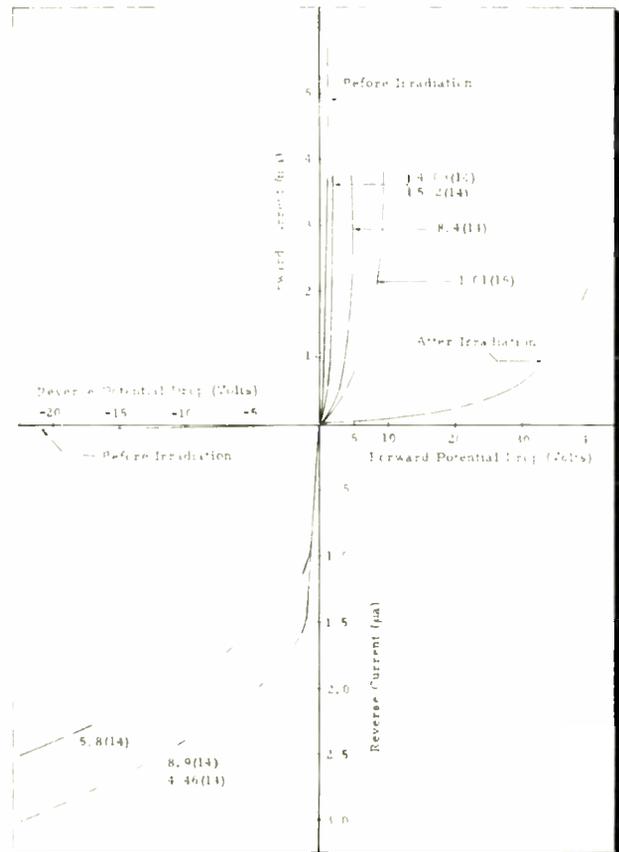


Fig. 5: Typical forward and reverse voltage vs. current curves for microdiode type PD-105 with neutron energy greater than 2.9 Mev.





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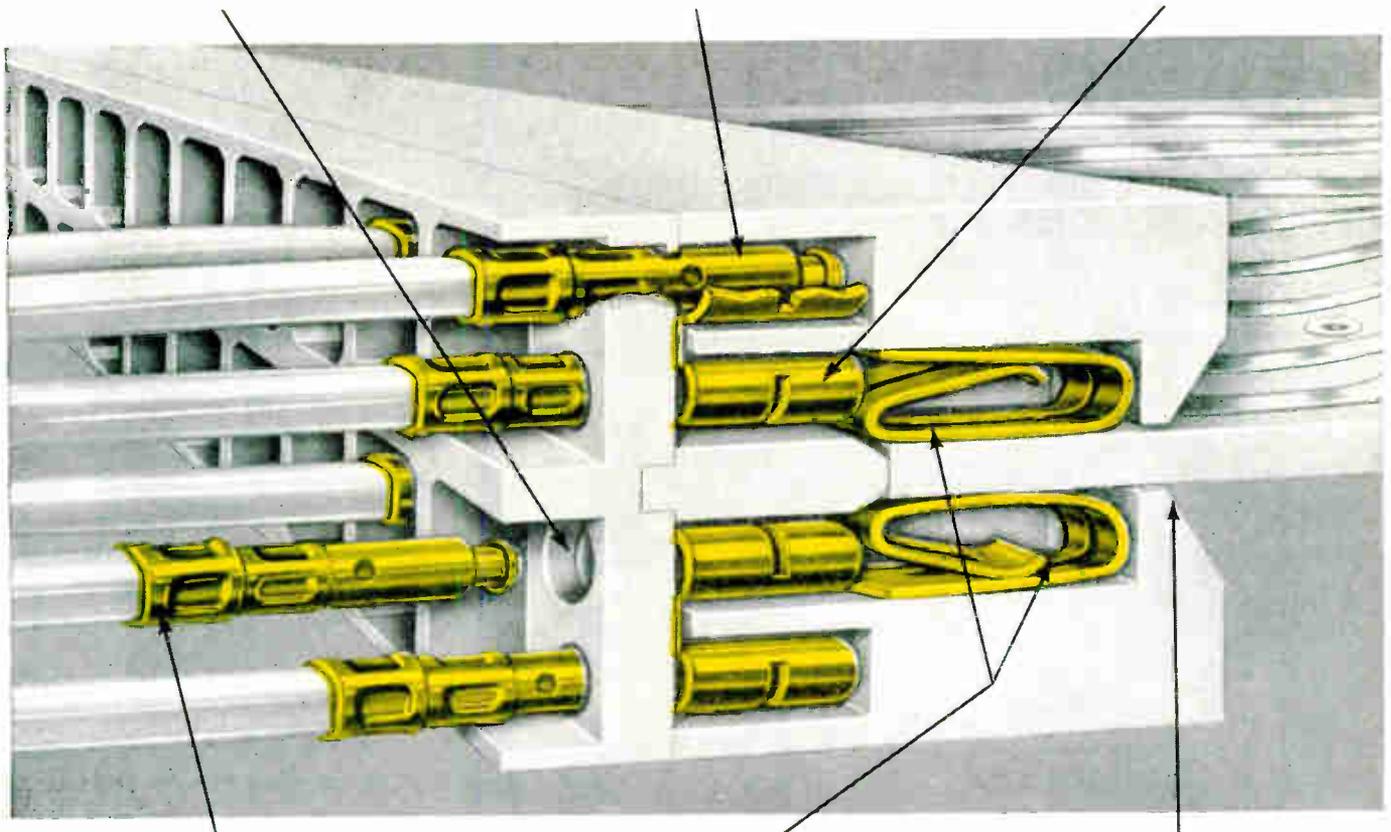
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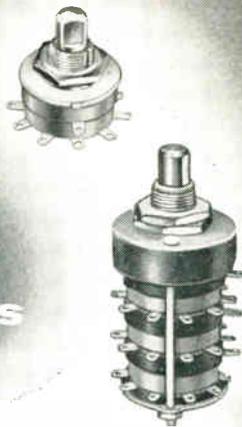
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Grayhill offers a full line of Rotary Tap Switches, Push Button Switches, Test Clips, Binding Posts, and other miniature electrical and electronic components.

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INC.

Phone: Fleetwood 4-1040
543 Hillgrove Avenue,
LaGrange, Illinois

"PIONEERS IN MINIATURIZATION"
Circle 80 on Inquiry Card

are commonly referred to as the "front-to-back" ratio. This ratio (and its drop with irradiation) may be calculated for static values, i.e. R_f/R_r at specified V_f and V_r . This method of notation for front-to-back ratio, although commonly used, does not delineate the ratio of front-to-back dynamic resistance and can lead to error in diode evaluation, mainly where the forward breakaway points are not similar. The ratio of resistance slopes more accurately defines the true rectification efficiency of a diode. The dR_f/dR_r ratio (dynamic or ac) is found by using dE_f/dI_f (past the breakaway point) to find forward dynamic resistance, and dE_r/dI_r for reverse.

The ratio of the pre to post irradiation front-to-back ratios supplies a handy damage constant which reveals the nuclear resistance of a diode, but not needfully circuit aptness. This is a function of 3 parameters. The diode with the highest dynamic front-to-back ratio could stand a higher degradation than a diode with a poorer ratio. Secondly, any change in the forward breakaway point may be crucial, or reverse characteristics alone may be critical, as for blocking diode usage. In addition, 2 diodes may possess the same front-to-back ratio, but the reverse resistances and forward conductances between the two might be a magnitude apart, thus also affecting circuit use.

PUT... The Touch of
Brilliance in your
Panel Design with...



HIGHEST QUALITY • PERFORMANCE • RELIABILITY AND LONGER LIFE

SMALLEST INCANDESCENT LAMP HOLDERS AND INDICATOR LIGHTS FOR T-1 AND T-1 3/4 BASED BULBS

Color-Lites are precision engineered to offer uniform light distribution and optimum light dispersion and direction.

Outstanding features include:

- Wide variety of lens styles and colors
- Insulated and Non-insulated models
- Single or Two Terminal models

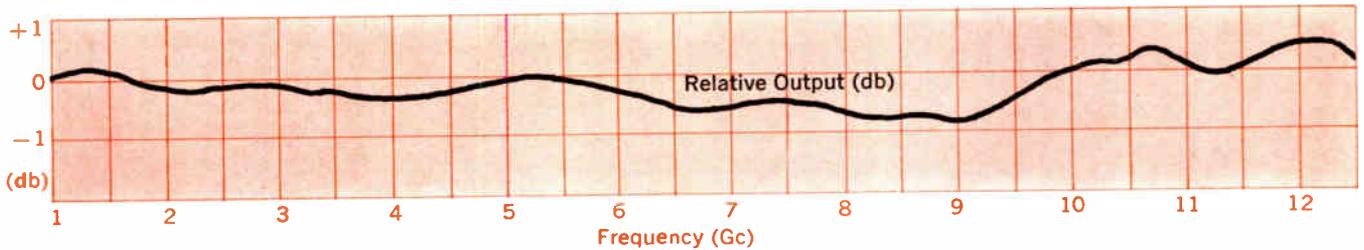


For complete specifications,
write to Dept. EI863.

Manufactured By
THE SLOAN COMPANY
7704 San Fernando Rd. ■ P. O. Box 367
Sun Valley, California ■ TRiangle 7-1123

Circle 165 on Inquiry Card
ELECTRONIC INDUSTRIES • August 1963

The Flattest RF Crystal Detectors Yet!



TYPICAL RESPONSE CHARACTERISTICS



Only ALFRED can give you a broadband crystal detector with a frequency response of less than ± 1 db over the entire range from 1 to 11 Gc.

And only ALFRED has matched crystal detectors which have a flat frequency match of $\pm 1/4$ db and square-law response of $\pm 1/4$ db.



Here's how these painstakingly engineered and constructed crystal detectors provide a new standard of precision for:

Broadband Transfer Function Display RF component characteristics which vary with frequency may now be accurately displayed on an oscilloscope with the ALFRED Crystal Detector Model D 120.

Accurate Feedback Leveling A flat response ALFRED Crystal Detector may be used for automatic gain or power control. RF power is sampled with a directional coupler and detected with the ALFRED Crystal Detector. The detected signal is amplified and compared to a reference voltage. The resulting error signal is applied to the control electrode of the microwave tube or

the control winding of a ferrite device in the RF circuit. In the past, marginal crystal frequency response limited overall control.

Reflection Coefficient Measurements In reflection coefficient measurements using reflectometers, directional couplers and crystal detectors are used to sample the incident and reflected power. The well matched frequency and square-law response of the ALFRED Matched Detectors makes possible measurements having substantially greater accuracy than has been previously possible.

SPECIFICATIONS

	Broadband Detectors		Matched Detectors	
	D 120	D 121	D 122	D 123
FREQUENCY RANGE	1 to 11 Gc (operates to 12.5 Gc)	1 to 4 Gc	4 to 8 Gc	7 to 11 Gc
FREQUENCY RESPONSE	± 1 db	Pairs matched to $\pm 1/4$ db from -4 to -40 dbm (D123 $\pm 1/2$ db)		
SENSITIVITY	150 mv/mw, no load	Greater than 100 mv/mw at rated video load (5 K Ω typical)		
SQUARE LAW	± 1 db from -4 to -40 dbm	Pairs matched to $\pm 1/4$ db from -4 to -40 dbm		
VSWR	2.2:1 max.	2.2:1 maximum		
PRICE	\$90 per unit	\$150	\$200	\$250

GET COMPLETE DETAILS—ALFRED's policy is to publish complete specifications and guarantee them as stated. For complete information on ALFRED flat response crystal detectors, please contact your ALFRED engineering representative or write to:

ALFRED ELECTRONICS

3176 Porter Drive • Palo Alto, California
Phone: (415) 326-6496

BLOCKS for BUSS FUSES

Standard type — 1 to 12 pole.

BUSS Write for BUSS Bulletin SFB.

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

BUSS FUSEHOLDERS

● LAMP INDICATING SERIES HG

Made To
Military
Specifications

Provides quick, positive, visual identification of faulted circuit. Transparent knob permits indicating light to be readily seen.

Fuses are held in clips on a fuse carrier. Fuse carrier slides into holder and is locked in place with bayonet type knob.

Holder designed for panels up to 3/8 inch thick.

Holder is inserted in panel from rear. Mounting screws can be conveniently tightened from front of panel.

BUSS Write for BUSS Bulletin SFB.

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

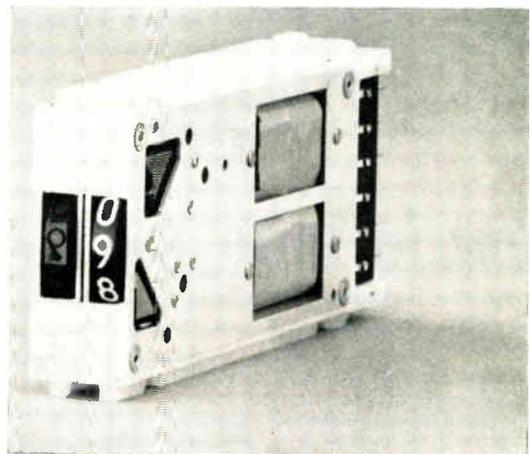
BUSS : the complete line of fuses .

COUNT MODULES READOUT & PRINT

THE CM SERIES INTRODUCES A NEW CONCEPT of electromagnetic counting and display. This one module is the root of a whole family of impulse counters for printing, readout, counting and predetermination.

Each 0.281 in. wide module is a single-digit electromagnetic counter with electrical reset. It slides in on rails to plug-in sockets. The module may be had with 10-, 11-, or 12-position wheels, and with numbers or arbitrary symbols as desired.

With the 10- or 12-position wheel, a contact closure may be obtained for serial counting, in which case the transfer between digits is electrical instead of mechanical. Further, each digit is its own electrical reset by means of a 120 cycle line. The operating speed with 2½w. consumption/count module is in excess of 100/sec. Higher speeds are obtainable by special pulsing techniques. Life is estimated to exceed 200 million steps per module. When life is stated at this total, it should be understood that since the first digit accumulates 10 times the wear at 10 times the speed of the second, and since this is a plug-in device, it is simple to change the first digit and insert a new one without having to throw away the whole counter



In serial counting, a contact closure allows transfer between digits to be electrical instead of mechanical.

for wear. With backward numbered wheels for serial counting, these become predetermining counters in which the count is set electrically and remotely and in parallel to each digit. The assembly counts serially back to zero and gives a contact closure. This is a non-repeating predetermination.

For display purposes, with digits 3/16 in. high, information may be entered in parallel through these 10-, 11-, or 12-position wheels. Presin Co., 226 Cherry St., Bridgeport, Conn.

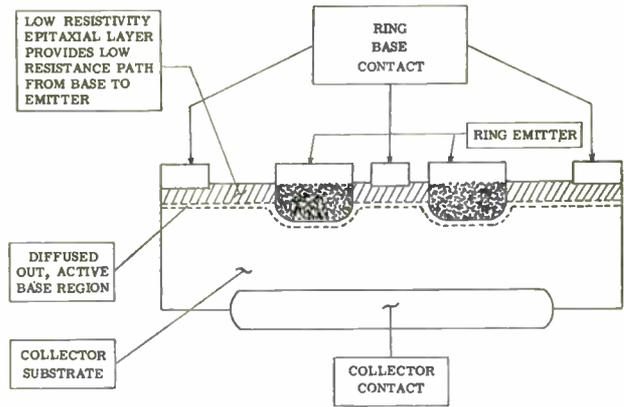
NEW TRANSISTOR MANUFACTURING PROCESS

DEVELOPMENT OF A NEW MANUFACTURING PROCESS for germanium power transistors, which yields highly-efficient power switching devices, has been announced by the Motorola Semiconductor Products Div., Phoenix, Ariz.

The process deposits an epitaxial layer in the base region which provides a low resistance path between the base and emitter.

The epitaxial base process reduces base resistance at least 50%. This in turn reduces the switching time constant. Moreover, the low base resistance improves transconductance by a factor of 2 and also contributes to a much lower collector-emitter saturation voltage and lower base-emitter saturation voltage. These improvements in device characteristics yield power switching transistors which are particularly applicable to flyback circuits in transistorized TV circuits and similar high-speed pulse uses.

Using the new epitaxial-base process, Motorola is now manufacturing 3 pnp germanium power transistors for high-speed, high-voltage switching uses.



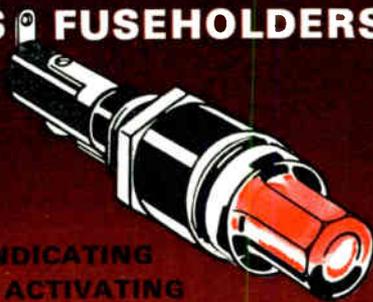
These new devices, types 2N2832, 2N2833 and 2N2834, have a specified fall time of 0.7 μ sec at 8 a. of collector current in TV flyback circuits and will operate at 83% efficiency in 15 kc power inverter circuits.

Other characteristics are:

Type	BV_{CEO}	h_{FE}	$V_{CE(SAT)}$	$V_{BE(SAT)}$
2N2832	80	50 @ 1a.	0.3v. max @ 10a.	0.75v. @ 10a.
2N2833	120	50 @ 1a.	0.3v. max @ 10a.	0.75v. @ 10a.
2N2834	140	50 @ 1a.	0.3v. max @ 10a.	0.75v. @ 10a.

..... of unquestioned high quality

BUSS FUSEHOLDERS



- LAMP INDICATING
- SIGNAL ACTIVATING
- SERIES HKA

For $\frac{1}{4}$ x $\frac{1}{4}$ inch BUSS GLD Fuses, $\frac{1}{4}$ to 5 amps.

Where a visible or audible signal or both is desired to indicate trouble on a circuit, the BUSS HKA fuseholder with BUSS GLD fuses presents a practical answer.

When fuse opens, an indicating pin completes a circuit that lights knob indicating lamp and makes electrical contact on external signal circuit. The external signal can be an audible alarm, or another lamp mounted at a distance, or it can operate a relay.

BUSS

Write for BUSS
Bulletin SFB.

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

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THE NEWEST DEVELOPMENTS IN ELECTRICAL PROTECTION

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WESCON SHOW

BOOTH 1803

If you can't make the show, but have a problem in electrical protection, our staff of fuse engineers is at your service to help you solve it. In any event, be sure to get latest information BEFORE final design is crystallized.

BUSS

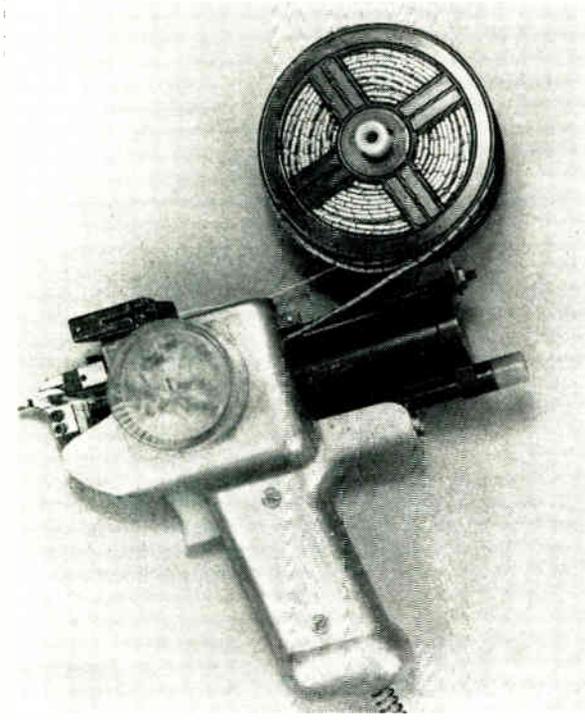
Just call
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SOLDERLESS WIRING TECHNIQUE

A NEW DEVELOPMENT IN SOLDERLESS TERMINATION announced by AMP, Inc., Harrisburg, Pa., permits high speed application of stranded, printed, enamel and tinsel wire as well as solid wire commonly used in wrap-type applications.



The new method, called Termi-Point®, uses strip-type terminals to make multiple post-connections to posts of various sizes. These posts need not have the sharp corners, common when using the wrap-type method.

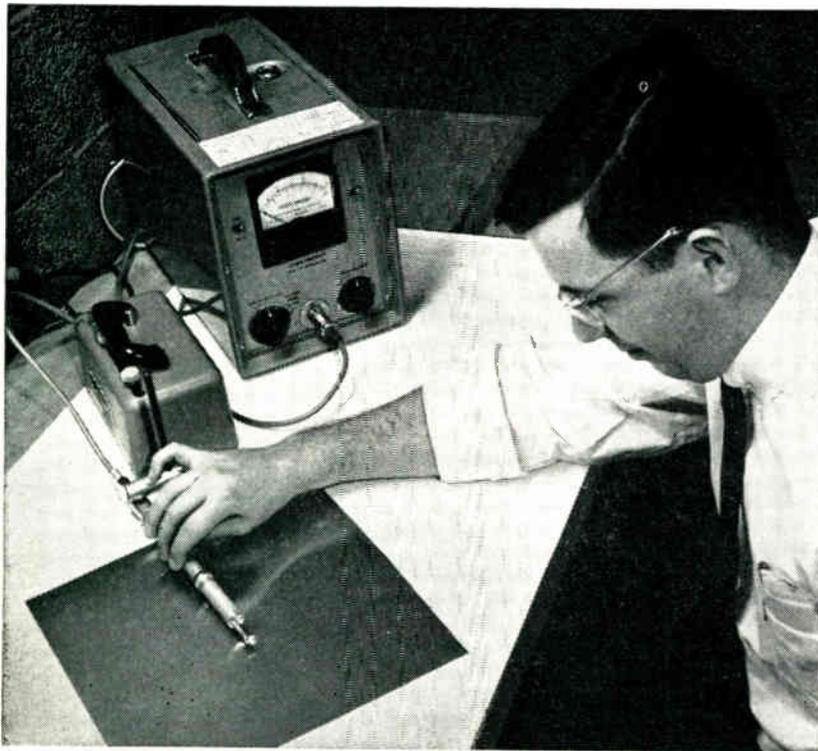
Connection in the new method is made by affixing a wire and terminal to the post. The terminal holds the wire, under high pressure, against the surface of the post. Strong retention values and electrical conductivity are maintained through this high pressure.

This type of connection is gas tight, has good wiping action and a large portion of the terminated wire makes contact.

Termi-Point offers a number of advantages, among which are increased density and complete ease of serviceability. The high density factor is made possible through use of the thin, metal terminals and a special small-nosed pneumatic tool. Serviceability is accomplished with a basic hand extraction tool. This tool permits removal of any one of the connections without disturbing, electrically, other terminations on the same or adjacent posts. The connection can be

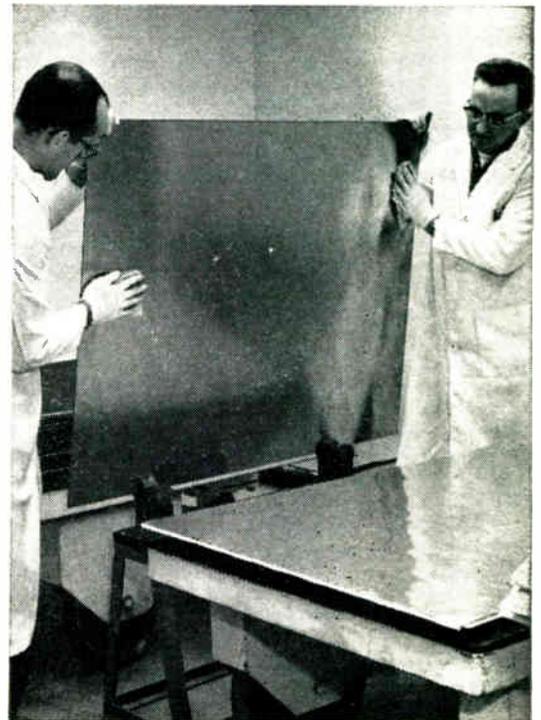
Light-weight hand applicator is used to make the connection. Wire is loaded into funnel loading device and when the operator trips the trigger, the tool simultaneously strips the conductor and affixes terminal and wire onto the post with a wipe-clean action. Reel-fed tool has an integral wire cutting device. Insulation waste is deposited into attached receptacle. A wide range of wire sizes can be handled by the tool.

How Taylor copper-clad quality control



One of the many instruments used by Taylor to check product quality is the Profilometer. Here a quality-control specialist is inspecting surface finish on a composite sheet.

You get clean copper-clad material. The copper-clad laminated plastic, used in making etched printed circuits, is prepared for pressing in Taylor's dustfree "white rooms."

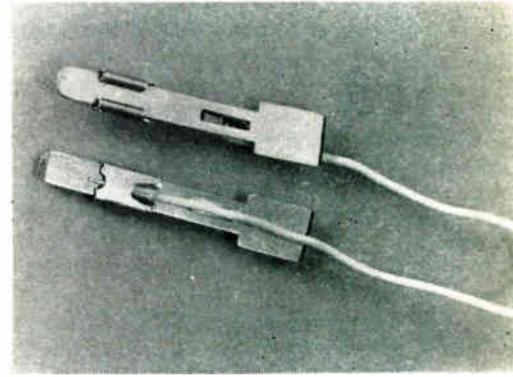


made again simply by using the same wire and a new terminal. The connection can be tested for both electrical and mechanical properties through use of a nondestructive terminal-checking tool.

In case of high production needs, the method uses an electro-mechanical application machine. This machine is guided by programmed instructions and automatically makes connections point-to-point horizontally, vertically and obliquely.

The new terminal, tool and the Point-To-Point Wiring Technique have withstood rugged tests.

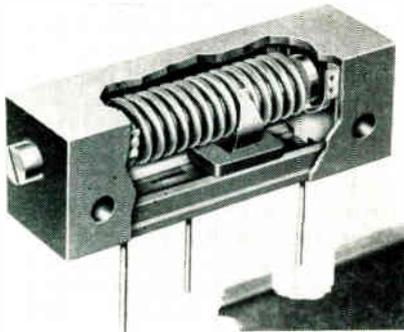
Completed Terminal connection shows (top) spring retention design of terminal and (bottom) strain-relief feature for insulation/conductor support.



®Trademark of AMP Inc.

POT HAS LOW BACKLASH

Cutaway view shows rotating winding and the wiper which follows the spiral turns.



THE SERIES 76 PADOHM potentiometer is said to have a resolution which is eight to ten times greater than existing models in the same range.

The improved resolution, stability, and setability of this rectangular-type component are accomplished by increasing the effective length of the resistance element fourteen times, and decreasing the tedious rotations by approximately one-half. The potentiometer features a rotating winding and a wiper which follows the

spiral turns. No lead screw is used. In operation, the wiper travels along the spiral turns of the rotating winding, thus giving a uniform and gradual resistance change. This allows very fine tuning over the entire resistance range.

The control is available in total resistance range from 100Ω to 20KΩ and operates between -55°C to +150°C. Total resistance is ±5% of rated resistance with a resetability of better than 1%. Clarostat Mfg. Co., Dover, N. H.

provides high reliability in etched circuits



Every precaution is taken to protect the surface. Before leaving the "white rooms" for the laminating presses, copper-clad loads are covered with plastic film to prevent dust or other foreign matter from contaminating the surfaces of the material.

Taylor copper-clad laminates are custom-engineered to provide assured performance by combining thermosetting resins, reinforcing materials, and copper foil in carefully formulated combinations.

Composite sheets are made in atmosphere-controlled layup rooms under strict quality control (MIL-Q-9858 qualified). All have low moisture absorption, excellent chemical re-

sistance, and high mechanical strength, combined with good dielectric strength, high surface resistivity and insulation resistance.

The standard glass epoxy grades shown in the table meet most of the critical requirements of today. If you are working on requirements for tomorrow, let Taylor assist you by developing a copper-clad material engineered to your planned application. Bulletin 8-1B gives technical information about our standard grades. Write for your copy today.

TAYLOR COPPER-CLAD GLASS EPOXY LAMINATES

TAYLOR GRADE	NEMA GRADE	MILITARY SPECIFICATIONS	PRINCIPAL CHARACTERISTICS
Fireban 1011-E	G-10, G-11, FR-4, FR-5	MIL-P-13949 Types GE, GB, GF, GH	Combines all desirable properties of G-10 (GEE) and G-11 (GEB), plus flame retardance in one grade.
Fireban 600-E	G-10, FR-4	MIL-P-13949 Types GE, GF	Self-extinguishing. Excellent electrical properties under high humidity conditions. Extremely high flexural, impact and bond strength.
GEC-500-E	G-10	MIL-P-13949 Type GE	Extremely high flexural, impact and bond strength. Low moisture absorption. High insulation resistance.

Taylor corporation
ENGINEERED PLASTICS

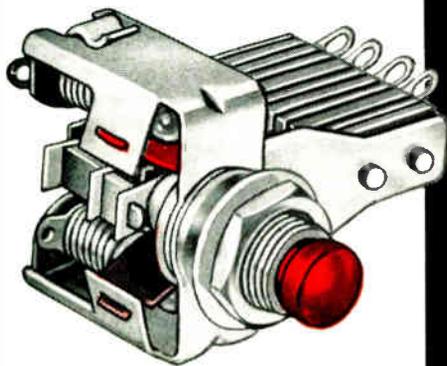
FORMERLY TAYLOR FIBRE CO.

VALLEY FORGE 53, PA.

WEST COAST PLANT: LA VERNE, CALIF.

SWITCHCRAFT LIGHTED SWITCHES

A NEW SWITCH IN LIGHTING!



-  Use with
-  Any Circuitry
-  to Color Code
-  Any Function

SWITCHCRAFT "NF-LITE" PUSHBUTTON SWITCHES

THE NEW APPROACH TO LIGHTED PUSH-BUTTON SWITCHES
 . . . Switchcraft's push-button design experience, proven in the reliable "NF-Switch" Series, has been extended to illuminated push-button switches covering a wide range of control panel and "Press-to-Test" applications.

The dual-lamp "NF-Lite Switch" Series 4200, is a flat-frame, illuminated, momentary-action push-button switch. Investigate these "NF-Lite" Switch advantages:

- Lower switch cost
- Wider range of multiple and complete switching circuits
- Greater reliability
- Two lamp voltages, 6V and 28V
- Five colors, Red, Amber, Green, Yellow, White
- Colors can be changed at any time in the field
- Lamp circuits independent of switching circuits
- Two lamps provide a margin of safety against lamp failure
- Two color indication
- Fast, single hole mounting in panels up to 1/4" thick.

There are several other types to choose from. The "NF-Lite" Switch Series 4100 has all the advantages of the dual-lamp Series 4200, except utilizes only one lamp. The "Littel-Lite" Switch Series 210, momentary action, single-lamp switch.



"Littel-Lite Switch"
Momentary Action Single Lamp
Series 210



"NF-Lite Switch"
Momentary Action Single Lamp
Series 4100

These switches are available at your local authorized Switchcraft industrial distributor for immediate delivery at factory prices.

Contact him or send for Catalog 125.
See it at WESCON Booth 1508



5599 N. Elston Ave. Chicago 30, Ill.

Canadian Representative: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto, Ont., Can.

Circle 89 on Inquiry Card

NUCLEAR PARTICLE DETECTOR



No appreciable increase in noise level even when bias voltage is increased to 400v.

(Continued from page 134)

tially independent of the particle energy and the type of the particle. A thin dead layer at the surface limits the linearity for particles that do not penetrate above 30 microns. However, 5 mev alpha particles can be counted. For beta particles linearity is within $\pm 1\%$. Bradley Semiconductor Corporation, 275 Wilton Street, New Haven 11, Conn.



Measures resistance to 10,000,000 megohms

ONLY \$250
fob Chicago

versatile • accurate • reliable

advanced features

dual test voltage... 500 vdc and 50 vdc
 24" total scale length... 1 to 10,000,000 megohms in 6 decades

measures resistance on printed circuits, transistor and miniaturized circuit components, cables, motors, etc.

measures leakage resistance of capacitors

measures grounded and ungrounded sections of three-terminal resistors

2-35.7

- constant test voltage over full range
- no overload damage
- positive line voltage control
- maximum guarding flexibility
- latest tube-miniaturization techniques

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write for Bulletin 2-1.4



Associated Research, Inc.
 Manufacturers of Electrical Testing Instruments since 1936
 3787 W. Belmont Avenue, Chicago 18, Illinois

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 ELECTRONIC INDUSTRIES • August 1963

Without this
beryllium oxide
heat sink...

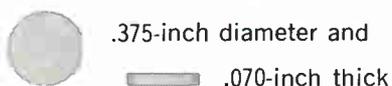


...this new dimmer control
would cost twice as much, be larger,
and wouldn't work as well

Best way to reduce the size and cost of an autotransformer is to eliminate it.

A new electronic light dimmer control, produced by Hunt Electronics of Dallas, uses a silicon symmetrical switch to control the power inflow of the conventional autotransformer.

Hunt mounts their silicon symmetrical switches to the control chassis through a



heat sink made of Brush Beryllium Oxide.

They use beryllium oxide because it is the *only* material which insulates electrically while it conducts and dissipates heat, so well, in so small a space. At 100°C.,

mean operating temperature of many electronic components and systems, the thermal conductivity of beryllia ceramics is 105-115 Btu/hr./ft.²/°F/ft. compared to 6-13 for alumina.

If you need a component which will *stop electric current* like a ceramic, but *let heat come through* like a metal, discover beryllium oxide. We make it in virtually unlimited sizes and configurations. Beryllia can be metalized and precision ground.

Write to us for technical service and information on BERYLLIUM OXIDE CERAMICS; BERYLLIUM COPPER ALLOYS (combining high strength with excellent electrical conductivity) in rod, bar, plate, wire and strip; and BERYLLIUM METAL (lighter than aluminum and about a quarter the density of steel) in block, sheet, extrusions, forgings and wire.



THE BRUSH BERYLLIUM COMPANY

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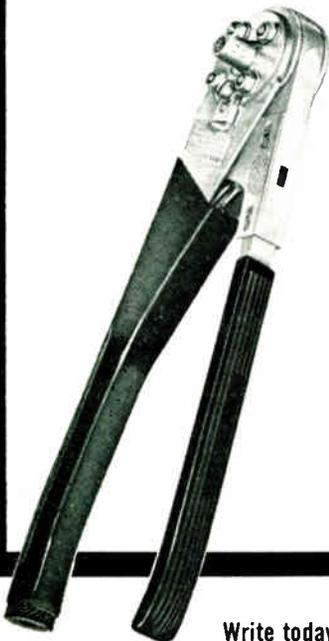
World Radio History

3 FOR THE SHOW

See them in action at Wescon Booths #2715 and 2716 — cycle-controlled crimping tools from Buchanan, your one source for the solution to all crimping problems!

CYCLE-CONTROLLED HAND TOOL

Designed for low volume production and maintenance, this one tool and inexpensive positioners can crimp almost any proprietary or Mil-Spec contract — #12 through #20 — for wire sizes #12 through #30. By selecting the positioner, you program the tool to provide crimp depth, crimp location and point of ratchet release. There are no operator adjustments. Meets all requirements of MIL-T-22520A, Class 1.



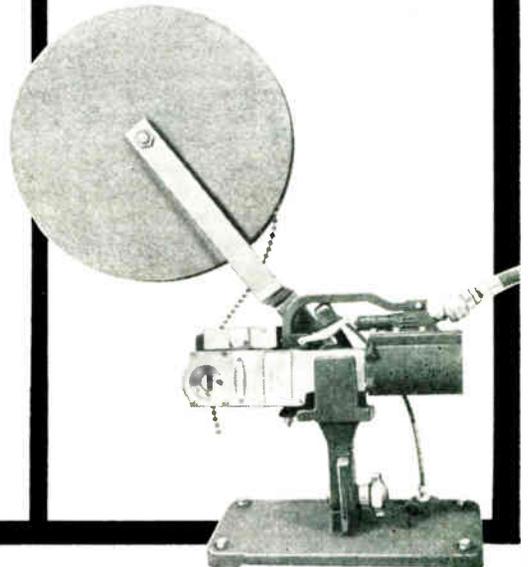
CYCLE-CONTROLLED MANUAL FEED TOOL Portable or Bench Mounted

This pneumatic tool (and associated types), designed for medium volume production, crimps almost any proprietary or Mil-Spec contact in wire sizes #12 through #30. There are no operator adjustments. Crimp depth can be adjusted by qualified personnel for specific job. Tool weighs less than 5 pounds. Replaceable, inexpensive contact locator properly positions contacts for crimping and can be drilled to accommodate specific contact sizes and types. Indenter configuration conforms to MS-3191 geometry. Speed limited only by operator's ability to insert contacts and wires. Bench mounted tool available with foot pedal, permits free use of both hands for crimping operation. Meets performance requirements of MIL-T-22520A.



CYCLE-CONTROLLED AUTOMATIC FEED TOOL Portable or Bench Mounted

For high volume production, this tool automatically feeds contacts from disposable carrier which can be modified for almost any pin and socket contact through #20 (also protects contacts from mechanical damage). Meets performance specs of MIL-T-22520A. In bench mounted unit, carrier reel holds up to 2,000 contacts. Crimp depth is automatically controlled by interchangeable snap-in blocks; accommodates foot valve control. For portable application, carrier in self-positioning "see-thru" magazine holds up to 102 contacts; magazine automatically selects proper crimp depth. Speed limited only by operator's ability to insert wires. No operator adjustments.



Write today for catalog and the new manual on crimping pin and socket connectors!

See these tools in operation at
WESCON,
Booths #2715 — 2716

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ELECTRICAL PRODUCTS CORPORATION

a subsidiary of Elastic Stop Nut Corporation of America
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AUGUST, 1963

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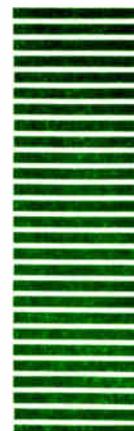
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Postcard valid 8 weeks only. After that use own letterhead describing item wanted.
Please send me further information on the items I have circled above.

EI-09

AUGUST, 1963



Assembly

(less than 30 seconds)



Performance

(up to 10Gc.)



Cost

(save up to \$1.20)

These are FXR's revolutionary new Amphenol/IPC "quick-crimp" BNC coaxial connectors.

Assembly: Simplicity itself. No hypercritical tolerances, no tiny washers or inserts. Just three pieces that even a butterfingers can assemble in 15 to 30 seconds. And of course no braid comb-out or anything like that.

Cost: Less, much less. (\$.60 each in quantities of 250.) That's 60 cents to \$1.20 less than other crimp-type connectors. And it's seven cents less than its UG 260 B/U counterpart. Plus the much-reduced assembly labor costs of quick-crimps over UGs.

Performance: Positive electrical and mechanical uniformity. Increased cable retention. 500 volts rating. VSWR is uniformly excellent to 10 Gc. Connectors are impedance matched to all 50 ohm RG cables normally associated with the BNC Series, but may also be used with 75 and 95 ohm RG cables when VSWR is not critical.

Test them yourself. Order a few (or a lot—we're in mass-production now) from FXR or your local Amphenol-Borg distributor. FXR, 33 East Franklin St., Danbury, Conn.

FXRTM THE RF PRODUCTS AND MICROWAVE DIVISION
OF AMPHENOL-BORG ELECTRONICS CORPORATION

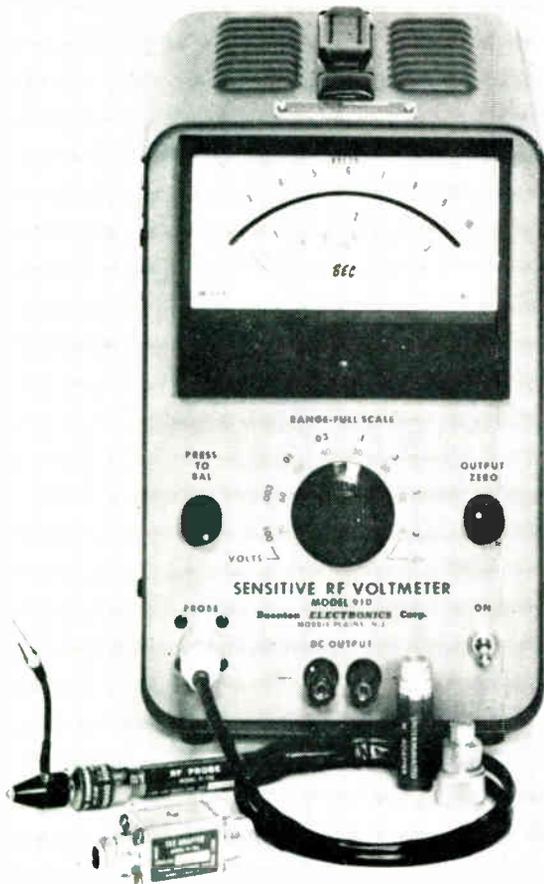
In RF VOLTAGE MEASUREMENTS

Voltmeters from Boonton Electronics give you

- Accuracy up to 3%
- Voltage readings: 300 μ v to 300 v
- Frequency range: 10 Kc to 1200 Mc
- VSWR better than 1.2 up to 1200 Mc
- True RMS response up to 3 v
- Temperature stability inherent in probe design

See condensed specification chart below. For complete data contact Boonton Electronics Corporation or our local representative.

VOLTMETER MODEL NO.	VOLTAGE RANGE	FREQUENCY RANGE	ACCURACY	INCLUDED ACCESSORIES	PRICE
91D	300 μ v to 300 v	10 Kc to 1200 Mc	50 Kc - 50 Mc \pm 3% 25 Kc - 200 Mc \pm 5% 10 Kc - 1200 Mc \pm 10%	RF Probe "TEE" Adapter 50 Ω termination Voltage Divider "N" Adapter	\$750
91CA	300 μ v to 3 v	10 Kc to 600 Mc	25 Kc - 200 Mc \pm 5% 10 Kc - 600 Mc \pm 10%	RF Probe 50 Ω Adapter	\$550
91C	1 mv to 3 v	10 Kc to 600 Mc	25 Kc - 200 Mc \pm 5% 10 Kc - 600 Mc \pm 10%	RF Probe 50 Ω Adapter	\$450



BOONTON ELECTRONICS CORPORATION

RF VOLTMETERS • CAPACITANCE BRIDGES • INDUCTANCE BRIDGES
RF ADMITTANCE BRIDGES • DC METERS • RF DISTORTION METERS
MORRIS PLAINS, N. J.

Thermocouple Alloys

Information on tungsten-rhenium thermocouple alloys used to measure temps. in the 3000°F—5000°F range is contained in a new brochure offered by Hoskins Mfg. Co., 4445 Lawton Ave., Detroit 8, Mich. Featured are physical, thermoelectric and mechanical properties as well as recently revised temp.-millivolt equipment tables.

Circle 180 on Inquiry Card

Lumped Delay Line

Information is available on a heavy-duty lumped delay line which features a 3000v. pulse level at a characteristic impedance of 20K Ω and a delay time of 6 μ sec. Modular construction: 1 $\frac{1}{4}$ x 1 $\frac{1}{2}$ in. rectangular tube 9 in. long. Any time delay can be made for any comparable length up to 500 μ sec. Vidcor Components Div., Video Color Corp., Inglewood, Calif.

Circle 181 on Inquiry Card

Transistor-Controlled Supplies

Bulletin No. MRST 1-600 shows detailed specs. on the MRST line of 50 to 600 amp. transistor-controlled dc power supplies. Information includes detailed specs., description of special features, dimensional and price information. Perkin Electronics Corp., 345 Kansas St., El Segundo, Calif.

Circle 182 on Inquiry Card

DC Supply

The DCR150-15 is a 2250w. regulated dc power supply. Using silicon-controlled rectifiers, the 7 in. high unit accepts inputs centered at 208 or 230v. Output can be varied from 0 to 150v. for 0 to 15a. load variation. Additional information available from Sorensen, a unit of Raytheon Co., Richards Ave., S. Norwalk, Conn.

Circle 183 on Inquiry Card

Recording Paper

Brochure 2951A describes chart paper engineered for all types of direct writing recorders. A pocket in the brochure contains specimens of chart paper with traces produced by ink, electric, pressure-thermal, and forced-fluid direct-writing techniques. Engineering specs. for chart paper are tabulated. Brush Instruments div. of Clevite Corp., 37th & Perkins, Cleveland 14, Ohio.

Circle 184 on Inquiry Card

Subminiature Products

This periodical illustrates and describes a number of new electronic parts, with emphasis on subminiature and printed circuit items. Computer components described include the new Cambion[®] molded plug-in line of 12-pin 100kc digital modules, and a versatile 10-stage scaler. Also listed are improved parts and hardware for conventional circuits. Cambridge Thermionic Corp., Cambridge, Mass.

Circle 185 on Inquiry Card

NEW TECH DATA

Components Catalog

Catalog 63, 72 pages, offers latest information on integrated mixer-preamps, strip-type components (including filters, dividers, mixers and modulators), laboratory receivers, i-f and r-f amplifiers, and other special-purpose receiving equipment. Photos, dimension drawings, curves, tables, electrical and mechanical characteristics are given. Lel, Inc., 75 Akron St., Copiague, N. Y.

Circle 186 on Inquiry Card

Light and Push Switch

Bulletin GEA 7379 describes CR103 Type G transistorized neon indicating light and push switch and operator. Type G1 indicating light operates on 3v. and responds to 1.5mw signal. Type G2 push switch and Type G4 operator are for computer test and indicating circuits. Included are ordering information, photos, engineering data, and outline drawings. General Electric Co., Schenectady 5, N. Y.

Circle 187 on Inquiry Card

Pulse Switches

Bulletin 10 describes a new line of rotary pulse switches that convert shaft rotation to a pulse rate for directly actuating counters, printers, and stepping motors. Designed to operate on ac or dc power, they are available with 2 types of contacts—the mercury-wetted type and the dry reed type. Disc Instruments, Inc., 3014-B So. Halladay St., Santa Ana, Calif.

Circle 188 on Inquiry Card

Power Transistors

Engineering data is available on a new series of germanium pnp alloy power transistors. The 2N1038-2N1045 series give good thermal dissipation capacity; are reliable in vibration and shock applications; and have open base voltages (emitter-to-collector) to -60vdc. Used in audio amplifiers, pulse amplifiers, relay drivers and switching functions. Bendix Semiconductor Div., The Bendix Corp., Holmdel, N. J.

Circle 189 on Inquiry Card

Transient Timer

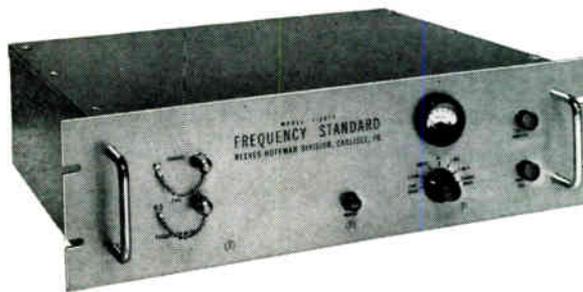
Bulletin R3c describes Model OT-4 transient timer, which reduces bandwidth requirements from hundreds of cycles to only a few cycles by coding timing information prior to transmission. It is possible to transmit the time a transient or on-off function occurs to within ± 0.5 -msec. of occurrence. Gulton Industries, Inc., Technical Publications Dept., 212 Durham Ave., Metuchen, N. J.

Circle 190 on Inquiry Card

Tube Sockets

Data Sheet 23A contains illustrations, 14 dimensional drawings and technical data on a complete line of versatile firm-fit compactron tube sockets. Connector Corp., 6025 No. Keystone Ave., Chicago 46, Ill.

Circle 191 on Inquiry Card



2.5 mc Frequency Standard offers stability of $2 \times 10^{-11} \left(\frac{\Delta F}{F} \right)$ per day

Model S2075, utilizing an AT-cut 5th overtone crystal of our own manufacture, provides an ultra-stable, in-house standard. Phase stability is 7×10^{-3} degrees peak to peak during a 20 millisecond period. Output frequencies are 100 kc, 1 mc and 5 mc simultaneously. Unit features double proportional control oven, is transistorized throughout, and is constructed on a 5 1/4-inch rack panel.

**New Reeves-Hoffman Ultra-Precise
FREQUENCY STANDARDS
on display at WESCON**

1 mc Frequency Standard offers stability of $1 \times 10^{-9} \left(\frac{\Delta F}{F} \right)$ per day

Model S2284-1 is an ultra-precise frequency standard in a case measuring only 2 x 2 x 4.75 inches. It uses a crystal of our own manufacture, proportional control oven, transistorized circuitry. Frequency trim range is sufficient for five years.



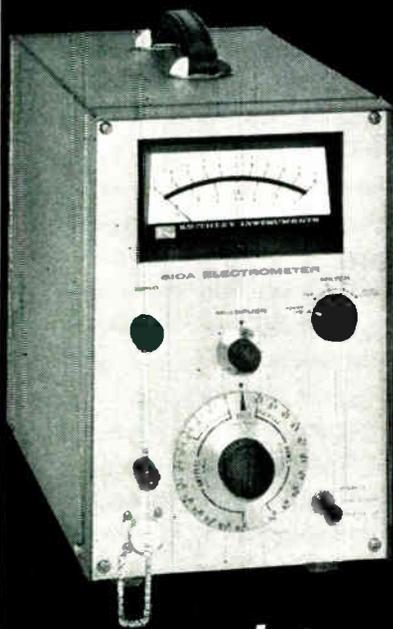
Reeves-Hoffman manufactures a complete line of frequency standards and sources, filters, ovens and crystal units. These can be designed, manufactured and packaged to your specifications. See us at . . .

BOOTHS 301-302-303 at WESCON SHOW

**REEVES-
HOFFMAN**

CARLISLE, PENNSYLVANIA
DIVISION OF DYNAMICS CORPORATION OF AMERICA

in this neat package . . .



a complete dc laboratory

The Keithley 610A Electrometer has 64 dc ranges . . . all you need to investigate in-circuit measurements with no loading, semi-conductor parameters, capacitor characteristics, photo-electric devices, piezo-electrics, properties of insulators and outputs of ion chambers. The 610A is line-operated and comes in bench or rack models. Brief specifications:

- 9 voltage ranges from 0.01 to 100 volts fs with 2% accuracy on all ranges
- input impedance selectable in decade steps from 1 ohm to 10^{14} ohms
- 28 current ranges from 3 amperes to 10^{-12} ampere fs
- 27 resistance ranges from 10 to 10^{14} ohms fs with provision for guarding
- constant current source from 1 milli-ampere to 10^{-12} ampere in decade steps
- gains to 1000 as a preamplifier, dc to 500 cps bandwidth, 10 volt and 1 milliampere outputs
- price \$565

Other ELECTROMETERS

Model 620,	31 ranges, bat.-operated,	\$280
Model 621,	37 ranges, line-operated,	\$390
Model 600A,	54 ranges, bat.-operated,	\$395
Model 603,	50 kc bandwidth amplifier,	\$750

Send for latest catalog



KEITHLEY INSTRUMENTS

12415 Euclid Avenue • Cleveland 6, Ohio

Circle 95 on Inquiry Card

NEW TECH DATA

Tantalum Capacitors

Data is available on solid electrolyte tantalum capacitors in 75 and 100v. ratings. They feature stable electrical characteristics, hermetically - sealed tin-plated metal case, and nickel lead wires tinned to facilitate soldering. Operating temp. is -80°C to $+125^{\circ}\text{C}$. Available in ranges from 0.47mfd to 3.3mfd for 75v., and the 100v. "solids" are available from 0.47mfd to 2.7mfd. P. R. Mallory & Co., Indianapolis 6, Ind.

Circle 192 on Inquiry Card

Cable Harnesses

Wire and cable harnessing and tying components are the subject of this booklet. This comprehensive booklet gives dimensional data on all items, including the recommended cable form sizes. Electrovert Inc., 240 Madison Ave., New York 16, N. Y.

Circle 193 on Inquiry Card

Ceramic Capacitor

This tech. data sheet covers specs. of the MC-70 ceramic capacitor. It includes capacity ranges from 10pf to 20,000pf, in addition to minimum capacity tolerance, power factor, and physical dimensions. Hi-Q Div., Aerovox Corp., Olean, N. Y.

Circle 194 on Inquiry Card

NEW DIGITAL CLOCK . . . in Stainless Steel



#920 VANGUARD TYMETER® CLOCK

12-HOUR READ OUT . . . 22.50
24-HOUR READ OUT . . . 24.50

Engineered and designed for the synchronization of your operations. Brushed satin stainless steel case with walnut wood ends. Large, easy-to-read 5/8" Colarama numerals give you "time at a glance". Self starting electric. 110-120V, 60 cy. AC. $7\frac{3}{4}'' \times 3\frac{3}{4}'' \times 3\frac{3}{8}''$. UL approved motor and cord. One Year Guarantee. Plus applicable tax.

ORDERS PROMPTLY FILLED

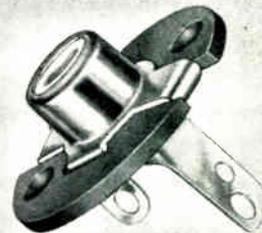
**TYMETER ELECTRONICS
PENWOOD NUMECHRON CO.
7249 FRANKSTOWN AVE. PITTSBURGH 8, PA.**

Circle 96 on Inquiry Card

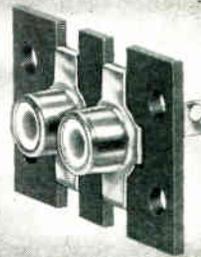
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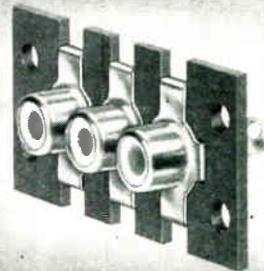
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RECEPTACLES



Lowest Cost...



Quick Delivery...

Send specs. or drawing for quote and samples. Request Bulletin 616.



MANDEX MANUFACTURING COMPANY, INC.
Specialists In Electronic Parts

2618 West 48th St., Chicago 32, Illinois

Circle 97 on Inquiry Card

NEW TECH DATA

Solid Tantalum Capacitors

Form 2743, "IEI Solid Tantalum Dry Slug Electrolytic Capacitors," gives comprehensive application data, construction and performance characteristics on capacitors conforming to Mil-C-26655/2. They are intended for bypass and other uses where the ac component is small compared to the dc rated voltage. The IEI Series CS 12-13 tantalum dry slugs operate at temps. from -55°C to $+125^{\circ}\text{C}$. Voltages range from 6 to 35, and capacitances extend from 1 to $330\mu\text{f}$. Standard Pressed Steel Co., Box 899, Jenkintown, Pa.

Circle 195 on Inquiry Card

Mica Capacitors

Bulletin 2321 describes a complete line of fixed-terminal, molded-mica capacitors. Engineering information, tables, and graphs supplement descriptive material. Types A and II and the Mil-C-5 Types CM45, CM50, CM55, and CM60 are described and listed. Sangamo Electric Co., Springfield, Ill.

Circle 196 on Inquiry Card

Nanosecond Circuit Chart

A new nanosecond data chart listing 12 tables of parameters useful in the design and application of nanosecond circuits is available from Lumatron Electronics, div. of General Applied Science Laboratories, Inc., 116 County Courthouse Rd., New Hyde Park, N. Y. In addition, the charts include condensed data on nanosecond instruments.

Circle 197 on Inquiry Card

Electrical Tape Chart

A data and property chart with samples of more than 30 Scotch brand electrical tapes attached is a comparative guide for tape-selection purposes. Electrical Products Div., Dept. W3-325, 3M Co., 2501 Hudson Rd., St. Paul 19, Minn.

Circle 198 on Inquiry Card

Shaft Angle Digitizer

Tech. spec. sheet TP-1000 describes Model AER 1001 Precision Angle Digitizer which senses angles to 1 part in 3.5 million, and converts the information to a digital form suitable for numerical indication, digital computers, and data recording systems. Digital information and visual readout of angular position is provided to 0.0001 resolution, with sampling rate from 0 to 1Kc/sec. J. W. Fecker Div., American Optical Co., 4709 Baum Blvd., Pittsburgh 13, Pa.

Circle 199 on Inquiry Card

Diodes

Literature describing its line of whiskerless MicroSan diodes which enable the user to miniaturize existing circuitry with the "swiss cheese" concept is available from Western Semiconductors, Inc., 2200 So. Fairview St., Santa Ana, Calif.

Circle 200 on Inquiry Card

NOW GAS WELD WITH DISTILLED WATER



- Dial the flame size you want
- Fuses wires from .0003" diameter up to 1/10"
- Anneals small spot weld joints
- Flame polishes glass and acrylic
- Silver solders and brazes to precision
- Welds small exotic metal parts
- Eliminates valves, tanks and cylinders
- No gas storage needed, it generates its own gas
- Gives you any temp. up to 6000°F .
- Plugs into any 110-120 Volt A.C. outlet
- Costs only a few cents a day to use

HEAVIER DUTY, LARGE CAPACITY MODEL "M" ALSO AVAILABLE FOR WELDING SHEET METAL UP TO 16 GAGE AND FUSING BARS AND RODS UP TO 1/4" DIAMETER.

Write, wire or phone for literature on new Model "V"

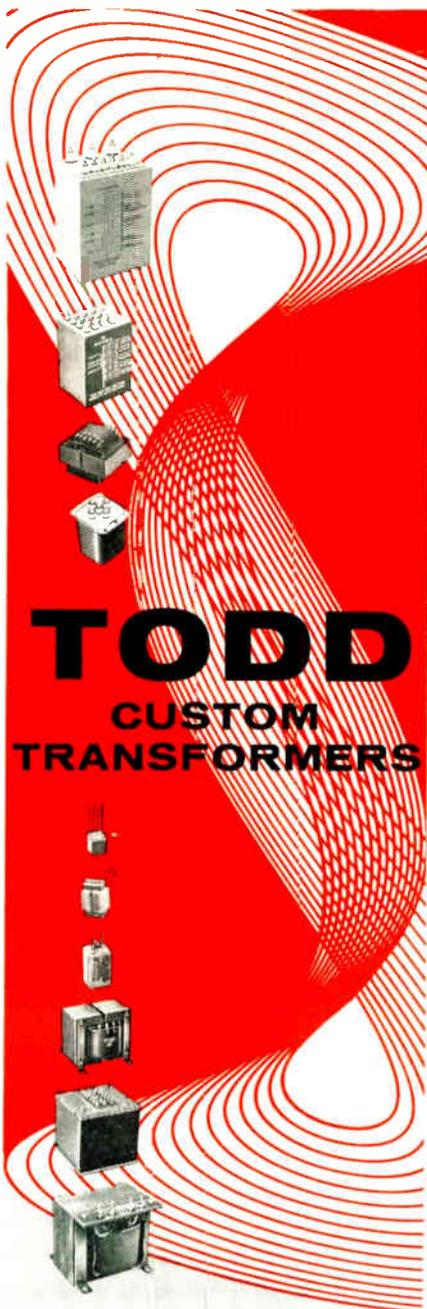
Electronics Division

* **HENES MANUFACTURING COMPANY**

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TODD CUSTOM TRANSFORMERS

When the ultimate in quality and reliability is required...when you can't tolerate downtime...when transformer consistency is critical...then it's high time to specify TODD ELECTRIC transformers. Here are only a few reasons why they provide performance beyond the expected.

- Rigid component quality control
- Electronically controlled winding
- Automated assembly
- Automatic electrical test procedures at all stages
- Accurate production scheduling assures delivery you can count on.



TODD ELECTRIC Co., Inc.
20 Harrison Avenue • Yonkers, N. Y.
914 YO 3-8850

Circle 101 on Inquiry Card

NEW TECH DATA

Plastics Brochure

The properties and uses of Plaskon Halon TFE are described and illustrated in this brochure. Material is unaffected by temps. from -450°F to $+500^{\circ}\text{F}$; it has a low friction coefficient; it is inert to most chemicals; and has total electrical insulation properties over a wide freq. and temp. spectrum under wet and corrosive conditions. Plastics Div., Allied Chemical Corp., Box 365, Morristown, N. J.

Circle 201 on Inquiry Card

Foil Tantalum Capacitors

Bulletin GEA-7614 explains the development of a hermetic seal that eliminates out-gassing in foil tantalum electrolytic capacitors. Information includes a cutaway picture of the hermetic seal. General Electric Co., Schenectady 5, N. Y.

Circle 202 on Inquiry Card

Strain Gage

Brochure SG-1B describes Microdot's weldable strain gage. Described in full are the construction and applications of weldable gages, including sealed integral-lead types and types suitable for welding to aluminum. In addition to performance curves and dimensional drawings, complete specs are listed. Microdot Inc., 220 Pasadena Ave., So. Pasadena, Calif.

Circle 203 on Inquiry Card

- SCAN CONVERSION
- FLICKERLESS DISPLAY STORE
- VIDEO STORAGE

RECORDING STORAGE TUBE SYSTEMS

Single-gun, dual-gun, multi-tube systems to convert scan for radar, sonar, television, and to perform analog processing, data analysis, contract or expand time scale, auto correlation.

- SLOWED TELEVISION TRANSMISSION

by telephone line or other narrow-band systems.

- IMAGE ENGINEERING

OPTICAL CHART READERS, FLYING SPOT SCANNERS, LOW-LIGHT-LEVEL CAMERAS, and IMAGE RECTIFICATION. Automatic inspection and recognition of size, shape, color, and texture.



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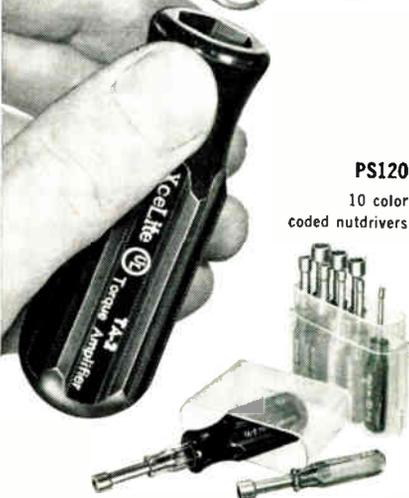
now there are 3 time & tool-saving double duty sets

New PS88 all-screwdriver set rounds out Xcelite's popular, compact convertible tool set line. Handy midgets do double duty when slipped into remarkable hollow "piggyback" torque amplifier handle which provides the grip, reach and power of standard drivers. Each set in a slim, trim, see-thru plastic pocket case, also usable as bench stand.



PS88

5 slot tip,
3 Phillips screwdrivers



PS120
10 color
coded nutdrivers



PS7

2 slot tip,
2 Phillips screwdrivers,
2 nutdrivers

WRITE FOR CATALOG SHEET N563



XCELITE, INC., 28 Bank St., Orchard Park, N. Y., U.S.A.
Canada: Charles W. Pointon, Ltd., Toronto, Ont.
Circle 103 on Inquiry Card

NEW TECH DATA

Alloy Evaluation Catalog

This 20-page catalog contains tech. data on base metal nickel-chrome and iron-chrome-aluminum alloys plus refractory metal alloys for use as heating element material for electric furnaces. A section entitled, "How to Diagnose Premature Heating Element Failures" contains photos showing 4 major causes of premature failure. Hoskins Mfg. Co., 4445 Lawton, Detroit 8, Mich.

Circle 204 on Inquiry Card

Wire Marker

Data sheet No. 600 describes a pressure-sensitive marker which has subsurface printing under a single thickness of Mylar®. The legend and background color of the Brady B-600 Perma-Shield™ wire marker is deposited on the underside of Mylar. The printing is permanently protected against smearing, smudging and abrasion. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 9, Wis.

Circle 205 on Inquiry Card

Chemical Stripper

Data sheet ELEC 900 describes chemical stripper Lea Coldstrip No. 900, which offers a fast, clean method of stripping wire ends. This stripper breaks the bond between the metal and the coating. It does not attack the base wire. The Lea Mfg. Co., 20 Cherry Ave., Waterbury 20, Conn.

Circle 206 on Inquiry Card

Silicone Lubricants

A 32-page booklet, Tech. Data Book S-10, contains performance information for application and test conditions for silicone lubricants, including temps. up to 700°F. Information includes more than 60 photos, graphs, and tables. General Electric Co., Silicone Products Dept., Waterford, N. Y.

Circle 207 on Inquiry Card

Nonmetallic Etching Solution

Metex Etchant M-U eliminates disposal problems normally associated with most printed-circuit etching solutions. It does not attack tin plate, nickel plate, silver, solder, tin-nickel, gold, rhodium or most organic resists. It is not acidic. MacDermid Inc., Waterbury 20, Conn.

Circle 208 on Inquiry Card

A-D Calibrator

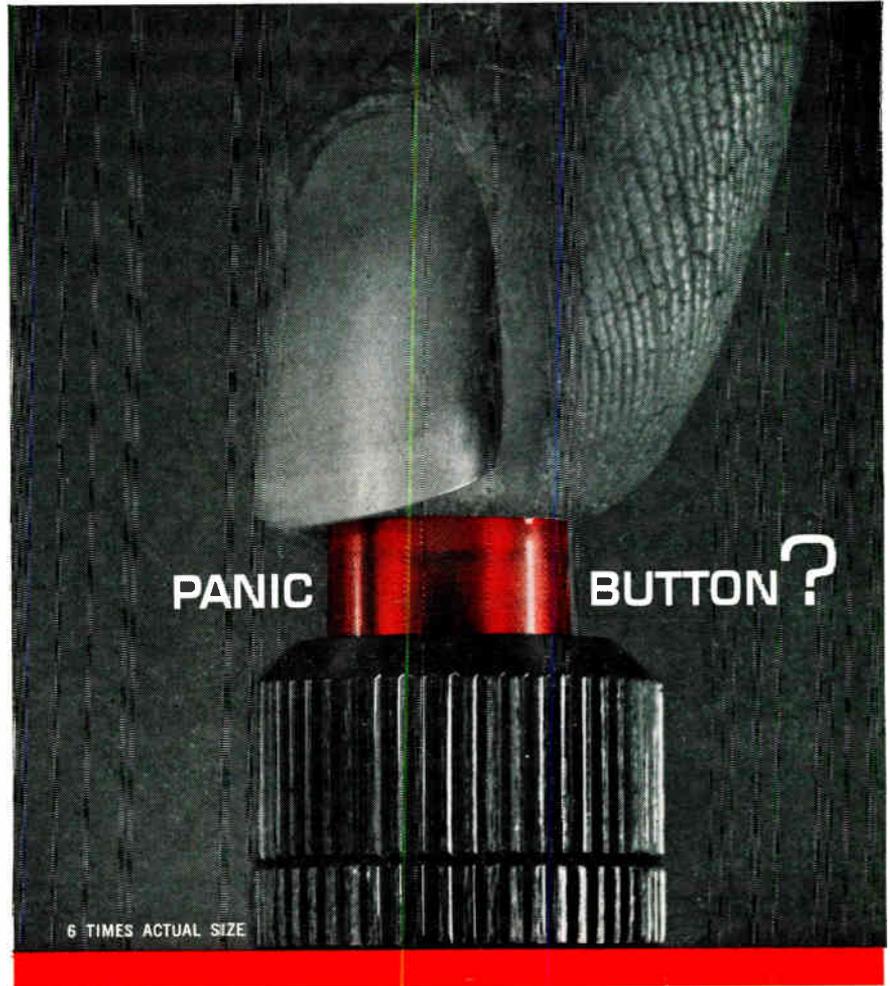
Data sheet 9 describes Model 6206 DAC calibrator, which powers, displays, and calibrates up to 50 digital-to-analog converters. Specs. and photos are provided. Telemetry, Inc., 12927 So. Budlong Ave., Gardena, Calif.

Circle 209 on Inquiry Card

Thin-Film Flip-Flop

Spec. Sheet on Model 1010FF micro-miniature thin-film flip-flop provides specs. and diagrams. Size is 0.8 x 0.8 x 0.12 in. (encapsulated) with flat ribbon nickel-silver, weldable leads. Halax, Inc., 139 Maryland St., El Segundo, Calif.

Circle 210 on Inquiry Card



Could be! This new Marco Press-Lite Switch can be used for *all kinds* of airborne, ground support and commercial applications, even in major emergencies. Naturally, Press-Lite Switches have all the qualities that a designer or engineer seeks in panel configuration — they fit everywhere. And there's one important item that these Marcoswitches lack — *size*. They are small in diameter for their rating and you get just what you need — more per panel. Also, each switch forms a good-looking compact package — an extra for the aesthete.

■ Designed to provide a minimum of 25,000 cycles of operation at rated load, these switches are available in momentary contact and alternate action styles in 2 and 15 amp, SPDT models, each model featuring "velvet pressure" pushbutton action. And the efficient light circuit performs entirely separate from the switch circuit. Relamping is simple — the lamp can be replaced from the front of the panel, making switch removal unnecessary. Several cap colors are available — white, red, green and yellow — in various shapes and sizes.

■ Whether standard or custom-engineered assemblies, Marco can meet your specifications. Write today for technical information.



SW 616
alternate
action
SW 618
momentary
contact
2 amp at
125 volts AC,
75% power factor
3/8" outside dia.
Lamp Size - T 1 1/4"



SW 617
alternate
action
SW 619
momentary
contact
15 amp at
125 volts AC,
75% power factor
7-1/2 amp at
250 volts AC,
75% power factor
3/4" outside dia.
Lamp size - T 1 1/4"

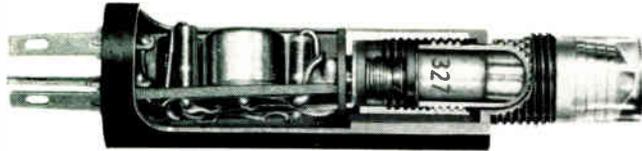
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2 μ SEC PULSE

TML-8 & 9
Series

TML-7 Series



TURNS ON INCANDESCENT INDICATOR

One time pulses as small as two-microseconds and two volts turn ON TML Series MEMO-LITE[®] Indicators... the bright, incandescent indicator remains ON when the signal is removed. Interruption of supply extinguishes the replaceable lamp.

MEMO-LITE Indicator's highly reliable solid state memory and lamp control circuitry are commonly used for error indication and alarm actuation. They can also function as a logic element in computers, industrial control, guidance and other solid state systems. Completely self-contained design eliminates the need for separate latching devices and only signal and lamp supply voltages are required.

TML-7 Series offers indicator only; TML-8 Series combines indicator and integral dual purpose switch that tests lamp when lamp is OFF and resets (turns OFF) the lamp when it is ON. TML-9 Series combines indicator and isolated SPST normally open or closed switch rated at 100ma at 120 VAC, non-inductive.

See your TEC-REP for complete information

- Supply voltages; -6, -10, -14, -18, -28VDC.
- 10 cataloged models—others available to meet unusual signal or supply conditions.
- TML-7 Series, size: 9/16" dia. x 2 1/16" long backpanel.
Price as low as: \$8.70 each in 100-499 quantities.
- TML-8 Series, size: 9/16" dia. x 2 1/4" long backpanel.
Price as low as: \$9.50 each in 100-499 quantities.
- TML-9 Series, size: 9/16" dia. x 2 1/4" long backpanel.
Price as low as: \$9.95 each in 100-499 quantities.
- Signal input impedance: 1,000 ohms, minimum.
- 13 lens colors, four terminal types available.



Originator of
Transistorized
Indicating Devices

Transistor Electronics Corporation

Box 6191

Minneapolis 24, Minnesota

Phone (612) 941-1100

3ma CONTROLS
INCANDESCENT
INDICATOR



TIL Series controls replaceable incandescent lamp with small current signal, TIB Series adds isolated SPST switch.

3VOC SUPPLY
LIGHTS NEON
INDICATOR



LVN Series amplifies low voltage supply to fire neon. Can also be controlled by small signals.

2 VOLTS
CONTROL NEON
INDICATOR



MTL Series controls neon lamp with small voltage signal. TBL Series combines same functions with isolated SPST switch.

2 VOLT BINARY CODED
INPUT SIGNAL CONTROLS
DIGITAL READOUT



TNR Series display controlled by low level decimal or binary signals. Memory optional. Mounts on 1" centers.

TEC-LITE Transistorized Indicators are protected by one or more of the following patents: U.S. Pat. Nos. 2,985,874; 3,041,499. French Pat. No. 1,291,911. Italian Pat. No. 647,414. Belgian Pat. No. 604,246.

NEW TECH DATA

Instrument Catalog

Digital instruments for laboratory and industrial use are described in a 16 page, 2-color catalog. Descriptions of 4- and 5-digit digital multimeters, scanners, buffers and differential voltmeters include illustrations and specs. Houston Instrument Corp., 4950 Terminal Ave., Bellaire 101, Tex.

Circle 211 on Inquiry Card

Electromagnet

Model 6-100 6 in. laboratory electromagnet features fixed-pole pieces which afford max. field homogeneity. The electromagnet, which is rigidly mounted at 45°, may be rotated completely around its vertical axis, and may be set at any angle about its vertical axis to within 0.1° and firmly locked. Information available from Spectromagnetic Industries, P. O. Box 3306, Hayward, Calif.

Circle 212 on Inquiry Card

Relay Catalog

Relay catalog No. 63-3 presents comprehensive specs. and consolidates them together with dimensional illustrations. It facilitates relay selection and ordering by providing more useful data. All of the approx. 200 relay models are stock items. Kurman Electric Co., div. of Kurman Instruments Corp., 191 Newel St., Bklyn 22, N. Y.

Circle 213 on Inquiry Card

Metal Bellows

"Design and Application," presents design and application data on welded diaphragm metal bellows. Sections cover basic diaphragm contours, application illustrations, definitions of terms, explanation and use of design curves and bellows materials, and volume compensator design data and uses. Metal Bellows Corp., 3092 Providence Hwy., Sharon, Mass.

Circle 214 on Inquiry Card

Optics and Infrared

A brochure describes engineering, manufacturing, infrared and quality assurance capabilities in high-precision optics and optical systems. They maintain complete in-plant manufacturing production, high-vacuum coating and quality control testing. Test facilities, test-plate library, and manufacturing facilities are described. Larr Optics and Electronics Co., 4901 Ward Rd., Wheatridge, Colo.

Circle 215 on Inquiry Card

Thermally-Actuated Devices

A new brochure describes the principle of operation and performance characteristics of a complete line of thermally-actuated devices. These devices are all powered by a new thermal actuator which is a sealed chemical unit that exerts output force as its temp. changes. No external power is required. Pyrodyne, Inc., 11876 Wilshire Blvd., Los Angeles 25, Calif.

Circle 216 on Inquiry Card

NEW TECH DATA

Inductive Components Catalogs

Two 1963-1964 catalogs of iron-core components are available. Volume I features 52 pages of transformers, inductors and magamps. Volume II features 24 pages of electric wave filters, high-Q coils and inductors. A wide range of special custom-built components are illustrated. United Transformer Corp., 150 Varick St., New York 13, N. Y.

Circle 217 on Inquiry Card

Reed Relays

A set of 4 data sheets illustrating and describing various types of reed relays has been released by Douglas Randall Inc., 6 Pawcatuck Ave., Westerly, R. I. Characteristics include 1 to 2 msec. operating time, sensitivity of 10mw, and ratings of 12, 15, and 50va.

Circle 218 on Inquiry Card

Servoamplifiers

Data Sheet 63542 describes 3 new models of transistorized servoamplifiers. It contains drawings, schematics, and specs. on Models 951, 952, and 953. These units are standard amplifiers designed for 33-40v., 60-cycle and 400-cycle servomotors in sizes 5, 8, and 11. Helipot Technical Information Service, 2500 Harbor Blvd., Fullerton, Calif.

Circle 219 on Inquiry Card

Multi-Trace CRT

SC-3561 is an electrostatically focused and deflected tube for displaying 3 independently controlled traces. It features mono-accelerator design for max. pattern linearity and deflection factor uniformity. An independent astigmatism electrode connection is provided so that max. resolution can be attained by using dynamic control of both focus and astigmatism voltages. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

Circle 220 on Inquiry Card

Transmission System

Transmission system, B770, is described in a bulletin from Lynch Communication Systems Inc., 695 Bryant St., San Francisco 7, Calif. This transistorized, freq.-shift, narrow-band carrier communication system transmits digital data, control, and teletype information at rates up to 300 bits/sec. The 109 freq. allocations provide 89 simultaneous data channels from 420 to 30,500 cycles.

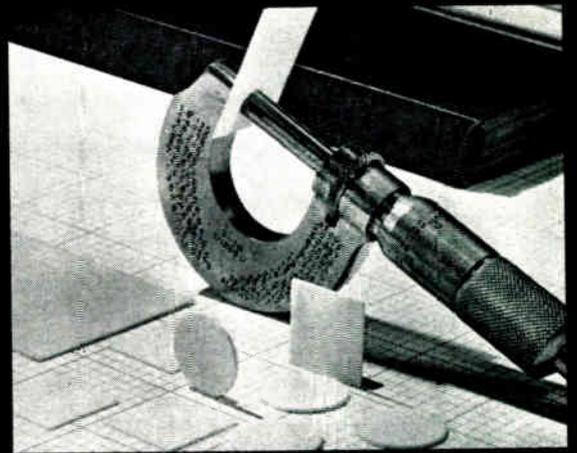
Circle 221 on Inquiry Card

Solid-State Relay

Model SSR-1285-5050 solid-state relay is a silicon transistorized static switching relay with no moving parts. It is capable of over 1 trillion operations; actuation time is 2µsec. and dropout time is 5µsec. Actuation freq. can be as high as 50kc. The contacts are rated at 50v., 50ma. Solid State Electronics Corp., 15321 Rayen St., Sepulveda, Calif.

Circle 222 on Inquiry Card

**NOW
FROM
SAXONBURG**



ALUMINA CIRCUIT PLATES

Made from high-purity 96% alumina, these lightweight plates are used primarily as printed circuit bases for assembly into electronic components. The plates provide high physical strength and resistance to softening as well as good electrical properties.

SIZES: Up to 3" square

THICKNESSES: Down to .008" with tolerances to ±.0005"

FLATNESS: Polished or lapped faces made parallel within .0005"

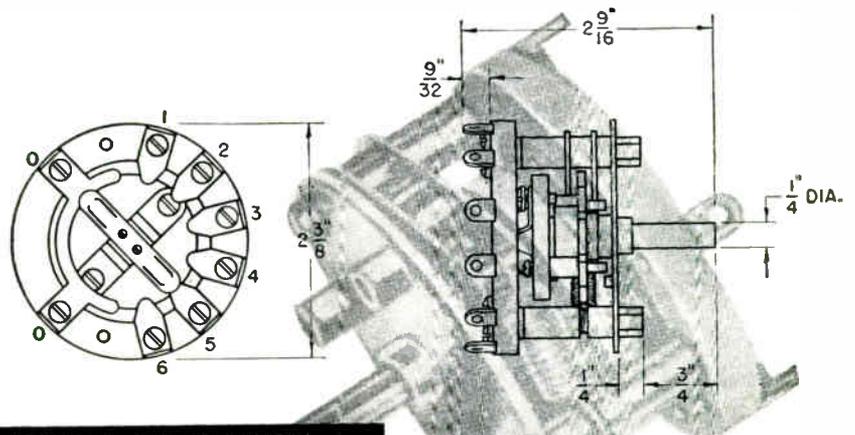
Write for additional information and samples.

Saxonburg
CERAMICS, INC.

8003rd Ave. • SAXONBURG, PA.
Quality Ceramics for Industry Since 1924

Circle 106 on Inquiry Card

SWITCH TO THE BEST



MODEL 65 SWITCH

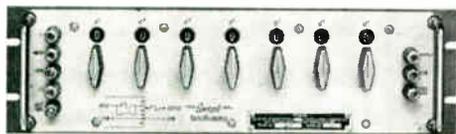
- Available as single section only
- 4500 volt peak flashover at 60 cps
- 25 ampere current carrying capacity
- Current carrying members heavily silver plated
- Low loss silicone impregnated steatite stator and rotor
- Nylon detent wheel
- Sleeve bearing



RADIO SWITCH CORPORATION

MARLBORO, NEW JERSEY
Tel. 462-6100 (Area Code 201)

NOW... GERTSCH HIGH-ACCURACY, INDUCTIVE VOLTAGE DIVIDERS —AT LOW COST



Model 1011R AC Ratio Standard with terminal linearity better than .0001% (1ppm)

\$550.00

including point-by-point data*



Model RT-60 general-purpose Ratio-Tran®, accurate to 0.001%

\$275.00

including half-rack mounting brackets

You get more than low price tags with these instruments — you get typical Gertsch quality and performance.

Model 1011R — a precision AC ratio standard providing minimum ratios as low as $-.0111111$, accurate to 0.0001%. Instrument features transient suppression, and 7-place resolution. Gertsch 1011R is ideal for standards and calibration laboratories requiring maximum accuracy.

Write for Bulletin 1000 Series.

Model RT-60. This voltage divider features high input impedance, low effective series impedance, and very low phase shift. Unit has 5 decades of transformer switching — excellent for checking servos and resolvers . . . for voltmeter calibration, computer testing, and transformer turns ratio measurements. Size: 7" x 7½" x 3½" high — designed for bench, or half-rack mounting.

Write for Bulletin RT-60 Series.

*Point-by-point data is provided in terms of a Gertsch standard traceable to the National Bureau of Standards.

Gertsch

GERTSCH PRODUCTS, Inc.

3211 South La Cienega Boulevard, Los Angeles 16, California/UPton 0-2761 - VERmont 9-2201

See us at WESCON, Booths 1621-23

NEW TECH DATA

Semiconductor Catalog

This 16-page brochure contains information on electrical characteristics, performance and dimensions of over 1500 silicon rectifiers, controlled rectifiers and voltage regulators, including Mil types. North American Electronics, Inc., 71 Linden St., West Lynn, Mass.

Circle 223 on Inquiry Card

Signal-Conditioning Systems

Miniature signal-conditioning systems modules are described in Bulletin PD4453. The miniature modules are for low level sensors and other transducers used in aerospace miniaturized telemetry and data-processing uses. Included are circuit block diagrams for telemetry systems, photos of various units, systems and packaged modules, circuit diagrams, response and stability curves, and complete specs. for the Model 750 packaged system. Electronics Div., Baldwin - Lima - Hamilton Corp., 42 Fourth Ave., Waltham 54, Mass.

Circle 224 on Inquiry Card

Power Supply Wall Chart

This wall chart lists useful data for the design of dc power supplies. Complete specs. are included for many modular dc power supplies. Dressen-Barnes Electronics Corp., 250 N. Vinedo Ave., Pasadena, Calif.

Circle 225 on Inquiry Card

Computer Products

A complete line of computer products is listed in this 2-color publication. Included are cores, arrays, stacks, tape transports, read-write electronics and tape. Applications, features, advantages and specs. are listed. Ampex Corp., Mail Stop 24-1, 934 Charter St., Redwood City, Calif.

Circle 226 on Inquiry Card

Fault Analyzer

The 371A consists basically of a high-sensitivity oscilloscope with linear variable-sweep generator, an output pulse generator, and a marker generator. Operating on radar principles, it sends either 1 or 8µsec. pulses down the line under test. Faults or changes in characteristic line impedance reflect pulses back to the instrument for display on the CRT. Additional information from Sierra Electronics Div., 3885 Bohannon Dr., Menlo Park, Calif.

Circle 227 on Inquiry Card

Thin-Film Potentiometers

MystR™ is a thin-film resistance element used in high-reliability, infinite resolution potentiometers. It is a stable, chemically-formed material having good life characteristics (over 250,000 cycles) with virtually no degradation in its low initial noise values or total resistance. They exceed Mil-22097B and Mil-R-19A characteristics. Waters Mfg. Inc., Wayland, Mass.

Circle 228 on Inquiry Card

Response Indicator

Data is available on Model C2A1 stand-ard response indicator which is a general-purpose instrument for automatically measuring signal-pulse noise-to-noise ratio of pulse radar system receivers. The input pulse width range is 0.25 to 10 msec.; pulse repetition rate range is 100 to 20,000pps; input noise range is 0.1 - 0.5v. RMS; and the input pulse range is 0.05 to 5v. peak. Sperry Microwave Electronics Co., P. O. Box 1828, Clearwater, Fla.

Circle 229 on Inquiry Card

Card and Tape Reader Cells

IISRA 9-12 use glass-encapsulated solar cells mounted in compact plastic units to sense the presence or absence of light through paper tape or cards. Their primary use is in the read stations of digital units. Hoffman Electronics Corp., 3761 So. Hill St., Los Angeles, Calif.

Circle 230 on Inquiry Card

Patch Generator

Data is available in the Datatrol Patch Generator which enables the 1401 programmer to easily make patch corrections to an assembled program deck. The DPG uses the 1401 to make its own patch cards. Datatrol Corp., 8115 Fenton St., Silver Spring, Md.

Circle 231 on Inquiry Card

Laboratory Oscillator

Bulletin 101 describes the Model RCD-4 standards laboratory oscillator which is a sine wave source in the freq. range of 0.1 to 100,000cps. Virtually immeasurable low distortion and high amplitude stability make this unit good for use as a laboratory standard. Optimization, Inc., 7243 Atoll Ave., N. Hollywood, Calif.

Circle 232 on Inquiry Card

VHF-UHF Tubular Filters

Six bulletins are available on low-pass and band-pass filters which are used in freq. range from 10mc to 1gc. Power capacities are 2, 20, and 200w. I-TEL, Inc., P. O. Box 641, Rockville, Md.

Circle 233 on Inquiry Card

Grommets

The 295202 Series conforms to NAS 557. The grommets are available for use in round holes and in various formed shapes for use in irregularly shaped holes. Catalog available from Cinch-Monadnock, Div. of United-Carr Fastener Corp., 1977 Marina Blvd., San Leandro, Calif.

Circle 234 on Inquiry Card

Prepunched Terminal Boards

For prototype or product use, these standardized prepunched boards are available in 6 popular patterns and a variety of materials that meet government specs. A wide selection of mounting hardware is available. Keystone Electronics Corp., 49 Bleeker St., New York 12, N. Y.

Circle 235 on Inquiry Card

this is STATE OF THE ART RESISTANCE MEASUREMENT

Direct Reading Accuracy 0.01% 1 ppm Resistance Comparison

Guarded DC Generator—Double-chassis guarding eliminates errors due to leakage paths or stray ac pickup. Output impedance can be selected to match loads from 1 ohm to 100 kilohms. Variable output power limited to 1 watt into a matched load. Polarity can be reversed to check for residual thermal voltages and increase deflection on critical nulls.

Large Visual Readout—Controls can be varied to use meter as null indicator or calibrated to read directly in resistance difference or percent deviation.

Range Multiplier—Permits unknown resistance to be compared to standard in ratios of 1:100, 1:10, 1:1, 10:1 or 100:1. Accuracy of $\pm 0.001\%$ or better on 1:1 range.

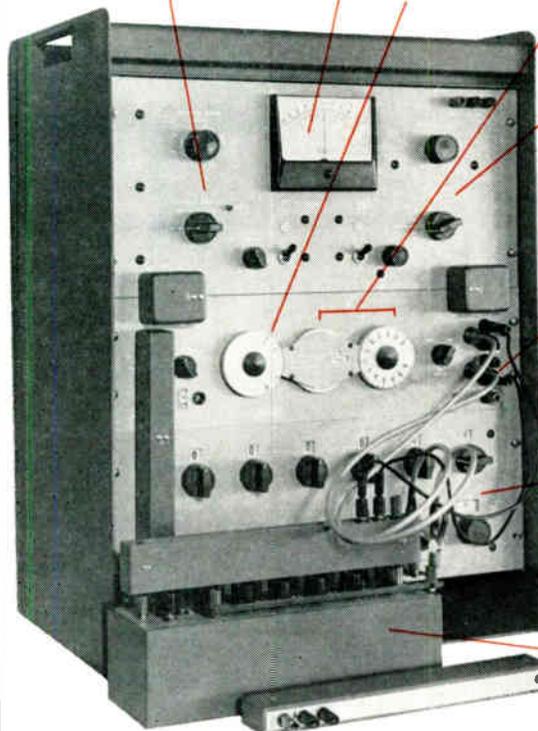
Percent Deviation—Unique guarded double Kelvin Bridge circuit permits unknown to be measured as a percent deviation from nominal or standard value. Range from 1 part per million to 0.6%. Useful in high accuracy or high-speed testing.

Electronic DC Microvoltmeter—Modulator-type dc amplifier provides sensitivity better than 1 microvolt. High rejection of ac pickup. Can be used separately as linear voltmeter up to 1000 volts. Special circuit protects against transient overloads when applying power to bridge. Zeroing detector automatically compensates for thermal voltages.

4-Terminal Connections—All connections to unknown made by 4 terminal technique to minimize effect of leads and junction resistance. Choice of "quick connection" shielded Kelvin Klips or four separate leads.

Resistance Standard—Nine-dial, 4-terminal decade resistance standard. Any resistance value between 10 milliohms and 1.2 megohms can be obtained by simply switching in the various decades. Accuracy of $\pm 0.005\% + 0.002$ ohm. Special circuit arrangement allows continuous changes in 100 microhm divisions.

SR 1010 Resistance Transfer Standard—Special transfer standards and connection hardware for making resistance transfers from an NBS certified one ohm standard to other resistance values.



Illustrated, Model 242 with optional SR 1010 Resistance Transfer Standard and attaching accessories.

MODEL 242 RESISTANCE MEASURING SYSTEM

High accuracy, matched instrumentation for standards labs or for production. Direct reading accuracy $\pm (0.006\% + 0.002$ ohms) from 10 milliohm to 1.2 megohms; $\pm (0.01\% + \text{multiplier} \times 0.002$ ohms) to range extremes of 100 microhms to 120 megohms. Comparison accuracy ± 1 part per million over most of the operating range. Complete system—Model 240 Kelvin Ratio Bridge; Model 800 Generator-Detector; Model RS 925 Decade Resistance Standard; specially designed Kelvin Klip lead assembly for making rapid 4-terminal connections—\$3,400.00 f.o.b. Portland, Oregon.

Model SR 1010 Resistance Transfer Standards—Twelve nominally equal precision resistors in a shielded enclosure. Initial accuracy $\pm 0.002\%$. Stability, better than $\pm 0.005\%$ per year. With appropriate accessories can be used to make resistance transfers with less than ± 2 ppm error. Available in resistance values of 1, 10, 100, 1k, 10k or 100k ohms per resistor. Each box—\$250.00 f.o.b. Portland, Oregon.

For additional information, request Catalog Sheet C-27, "Design Ideas," Vol. 1, Nos. 1, 2 and 3, Engineering Bulletin No. 30, "Traceability of Resistance Measurements."



See it in operation with automatic data recorder
WESCON — BOOTHS 2317-2320

The Model 242 adapted to record measurements
as typed numbers or on punched tape.

Electro Scientific Industries

13900 N. W. SCIENCE PARK DRIVE • PORTLAND, OREGON 97229

WESCON EXHIBITORS

(Continued from Page 53)

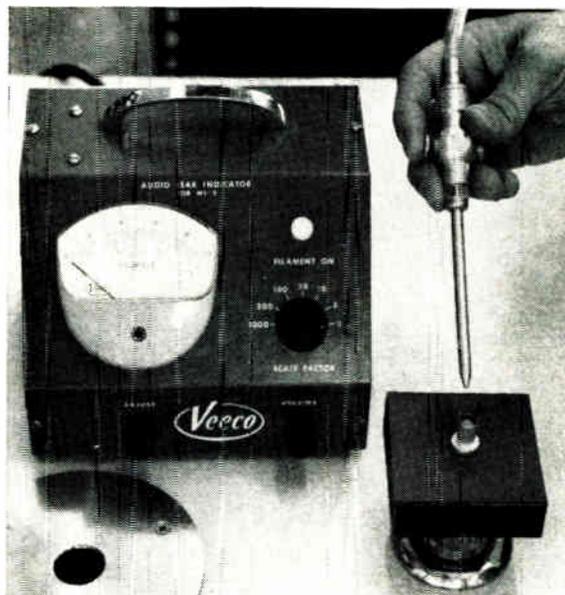
COMPANY	HOTEL/BOOTH
THERMADOR	1704
Div. Norris Thermador Corp.	
THIOLKOL CHEMICAL CORP.	1212-1213
Panelyte Industrial Div.	
THOMAS ELECTRONICS, INC.	4509
THE THOMAS & BETTS CO.	
INC.	609-610
THOMAS & SKINNER, INC.	1504
THE THORSON CO.	4220
TIME AND FREQUENCY	2403
THE TORRINGTON	
MANUFACTURING CO.	4811
TOWSON LABORATORIES, INC.	4446
TRAK ELECTRONICS	Thunderbird*
TRAK MICROWAVE	1616-1617
TRANSISTOR SPECIALTIES	
INC.	2413
TRANS-SONICS, INC.	4737
TRANSITRON ELECTRONIC	
CORP.	3218-3219; Thunderbird
TRIMM, INC.	4145
TRIO LABORATORIES, INC.	104-105
TRIPLETT ELECTRICAL	
INSTRUMENT CO.	3311
TRU-CONNECTOR CORP.	4534
TRU-OHM PRODUCTS DIV.	1507
Model Engineering & Mfg., Inc.	
TRYGON ELECTRONICS, INC.	4732
TUNG-SOL ELECTRIC	1601-1602
TUR-BO JET PRODUCTS CO.,	
INC.	3003
TYMAC TRACER DIV.	1207
Tydeman Machine Works	
UGC INSTRUMENTS	4502
A Div. of United Gas Corp.	
U. S. COMPONENTS, INC.	4111
U. S. NAVAL ORDNANCE TEST	
STATION	304-305
U. S. NAVY ELECTRONICS	
LABORATORY	317
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ULTRONIX, INC.	405-406
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UNIFORM TUBES, INC.	1208
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CORP.	4701-4702-4703
UNION SWITCH & SIGNAL	3301-3302
Westinghouse Air Brake Co.	
UNITED AIRCRAFT CORP.	4204-4205
UNITED SHOE MACHINERY	
CORP.	1005-1006
UNITED STATES DYNAMICS	1105
UNITED SYSTEMS CORP.	4612
UNITED TRANSFORMER CORP.	2122
UNITEK CORP. WELDMATIC	
DIV.	603-604
UNITRODE TRANSISTOR	
PRODUCTS, INC.	4237
UNIVERSAL ELECTRONICS CO.	318
UNIVERSAL INSTRUMENTS	
CORP.	1121-1122
UNIVERSAL MANUFACTURING	
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Div. of Kelsey-Hayes Co.	
VACO PRODUCTS CO.	907
VACUUM-ELECTRONICS	
CORP.	4606-4607;
Sheraton-Palace	
VALOR ASSOCIATES	4809
VALPEY CRYSTAL CORP.,	
OPTICAL DIV.	4740
C/o Frequency Control Div.	
VARIAN ASSOCIATES	1509-1510-1511
	1512-1513-1514
	1515-1516; Jack Tar
VARO, INC.	4226-4227
VECTOR ELECTRONIC CO.,	
INC.	2012

(Continued on Page 166)

*Hospitality suite, exhibit, demonstration, seminar or technical tour. Contact company at hotel for exact information.

ReCap

The latest
technical information on Fansteel
Rectifiers, Capacitors, and Semiconductors



Tests show Fansteel tantalum capacitors ideal for low pressure applications

Leak rate less than 2.8×10^{-10} cc/sec.

Fansteel shoulder type capacitors were recently tested at Fansteel laboratories for seal leak rate with a helium mass spectograph. Results indicate that these Fansteel capacitors are equivalent in hermetic seal characteristics to glass-to-metal seal encapsulation.

Before testing, randomly selected Fansteel capacitors were prepared by removing the bottom of the case, washing out the electrolyte and drying. The capacitor was then placed over the vacuum aperture of the leak rate tester, creating in effect a positive internal pressure.

While under vacuum, a stream of helium was directed into the opening at the bottom end of the capacitor. Any seal leakage would allow helium to penetrate into the vacuum, causing the mass spectrometer to respond.

The instrument indicated no leakage on the capacitors. In fact, it registered no indication of leakage on the lowest scale multiplier where each scale division of the meter is equivalent to 2.8×10^{-10} cc/second.

These tests show that Fansteel capacitors keep electrolyte in and impurities out, assuring you of highest reliability in performance. See your Fansteel representative for complete details, or write Fansteel direct.

FANSTEEL

METALLURGICAL CORPORATION

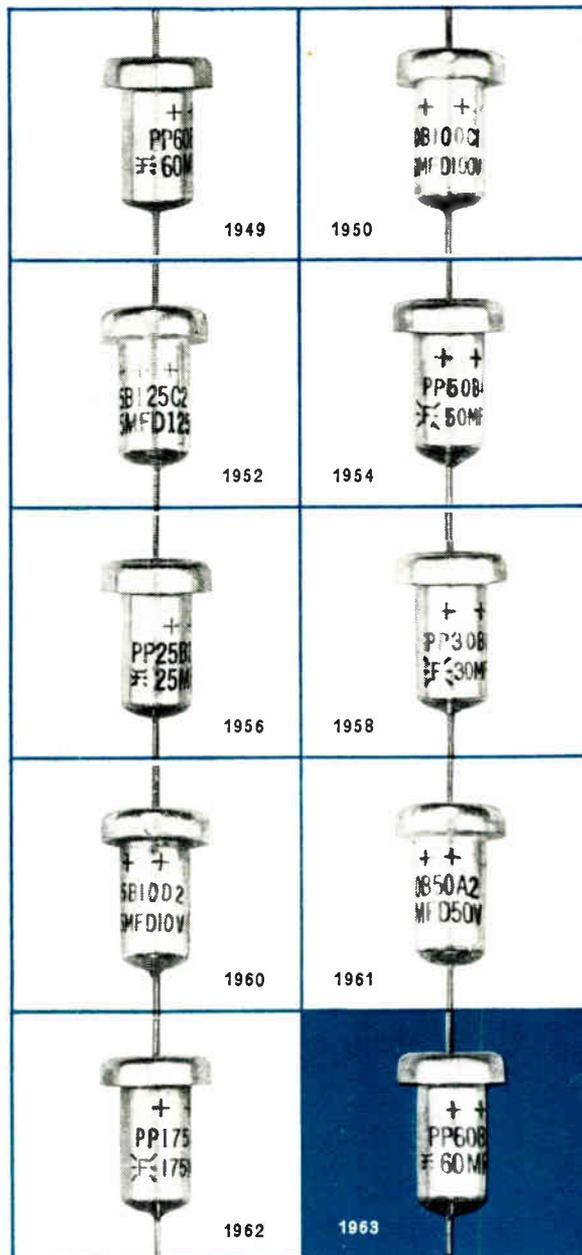
RECTIFIER-CAPACITOR DIVISION

North Chicago, Illinois.

Circle 110 on Inquiry Card

ELECTRONIC INDUSTRIES • August 1963

Can you spot the difference in our '63 model?



Fansteel has been making modern tantalum capacitors since 1949. (Actually, we marketed our first tantalum capacitors in 1925, but they were bulky things in glass jars). Demand has grown. So has Fansteel.

1963 is a landmark, though, because we now have our completely new test facility in operation. Tantalum capacitor testing procedures can now be tightened up to a degree that previously was not practical for high volume runs.

Test ovens are bigger and better. Modern data processing equipment

makes calculations in fractions of a second. These and other factors have more than tripled Fansteel's capacity for high reliability testing. Thus you can be assured of reliability for your products that was heretofore impossible.

As originators of the tantalum capacitor, we're rather proud of this new achievement. We're also proud of the growth of the Fansteel line. For example, the style shown above comes in five varieties: Type PP, HP, CL, Gold-Cap, and Blu-Cap. You'll find a few star performers on the opposite page.

FANSTEEL

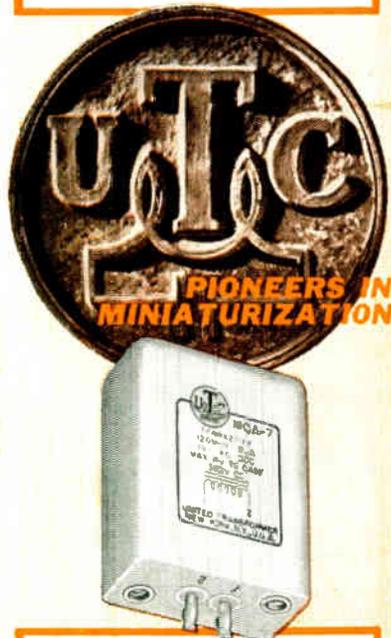
METALLURGICAL CORPORATION

RECTIFIER-CAPACITOR DIVISION

North Chicago, Illinois.

TOROIDAL INDUCTORS

M INIMUM SIZE
MAXIMUM Q
MAXIMUM STABILITY



**IMMEDIATE DELIVERY
From Stock**

MQ SERIES are hermetically sealed to MIL-T-27A Specifications . . . laboratory adjusted to 1% tolerance—O DC. Uncased and molded toroids available on production orders. The stability is unequalled. Inductance is virtually independent of frequency, temperature and vibration. Hum pickup is extremely low due to the toroidal winding structure, with windings uniformly spread over the core. The case is of high permeability, affording additional shielding such that close spacing of units can be effected, the coupling attenuation being approximately 80 db.

TQA SERIES are centertapped for oscillator applications, etc. They employ an extremely stabilized structure for wide temperature range.

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TRANSFORMER
CORPORATION**

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

PACIFIC MFG. DIVISION
3630 Eastham Drive, Culver City, Calif.
EXPORT DIVISION

WRITE FOR LATEST CATALOG

Circle 112 on Inquiry Card

EXHIBITORS (Concluded)

COMPANY	HOTEL/BOOTH
VEEDER-ROOT, INC.	1306
VICTOR COMPTOMETER CORP.	1307
Business Machines Div.	
VIKING INDUSTRIES, INC.	1614-1615
VISHAY INSTRUMENTS, INC.	4242
VITRAMON, INC.	1608-1609
VOGUE INSTRUMENT CORP.	4610
WABER ELECTRONICS, INC.	4807
WAKEFIELD ENGINEERING, INC.	1114
WALEX STRIPPIT CO.	914-915
A Unit of Houdaille Industries, Inc.	
THE WALKIRT CO.	1812
ERIC B. WARD ASSOCIATES	4610
WARD LEONARD ELECTRIC CO.	3521-3522
WARNER ELECTRIC BRAKE & CLUTCH CO.	4136
WATKINS-JOHNSON CO.	4505
WAUGH ENGINEERING DIV.	4208
The Foxboro Co.	
WECKESSER COMPANY, INC.	712
WEIGHTMAN & ASSOCIATES	516
THE WELCH SCIENTIFIC CO.	1109
WELLER ELECTRIC CORP.	917
WESTERN GOLD & PLATINUM CO.	621
WESTERN SEMICONDUCTORS, INC.	4232
WESTINGHOUSE ELECTRIC CORP.	4626-4627-4628 4629 and 4720 4721-4722-4723
WESTLINE E Z CODE Div. of Western Lithograph Co.	1321
S. W. WHITE DENTAL MFG. CO.	1103-1104
Industrial Div.	
JOHN WILEY & SONS, INC.	2608
THE WILKINSON CO.	816
WILTRON CO.	2414
WINCHESTER ELECTRONICS, INC.	3211
WRIGHT ENGINEERING CO., INC.	1616-1617
WYCO METAL PRODUCTS	2915-2916
Stantron Div.	
WYLE LABORATORIES	4407-4408
XCELITE INCORPORATED	922
YELLOW SPRINGS INSTRUMENT CO., INC.	4137
YOKOGAWA ELECTRIC WORKS, INC.	4533
YOLATRON, INC.	4106
ZERO MANUFACTURING CO.	720-721-722
THE ZIPPERTUBING CO.	1324

KEY TO TACC



John J. Connolly, VP and Gen. Mgr. of Lit-ton Data Systems Div., presents Maj. C. P. Buschmann, USMC, with keys to first Tactical Air Control Ctr. delivered to the Marines.



- **DM Series** — push-pull, meets Mil-C-26482
- **DS Series** — push-pull, insertable, removable, crimp contacts
- **DTK Series** — bayonet lock, meets or exceeds applicable requirements of Mil-C-0026482C
- **DRS Series** — rectangular rack and panel, advanced application performance
- **DC Series** — push-pull, environmental, crimp-type RF connector
- **DM and DH Hermetics** — leak proof glass to metal seals
- **MDR Series** — rigid insert connector with snap-in crimp contacts

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2523 Farrington St., Dallas 7, Texas
214 Melrose 1-0270 TWX: 214-631-5910

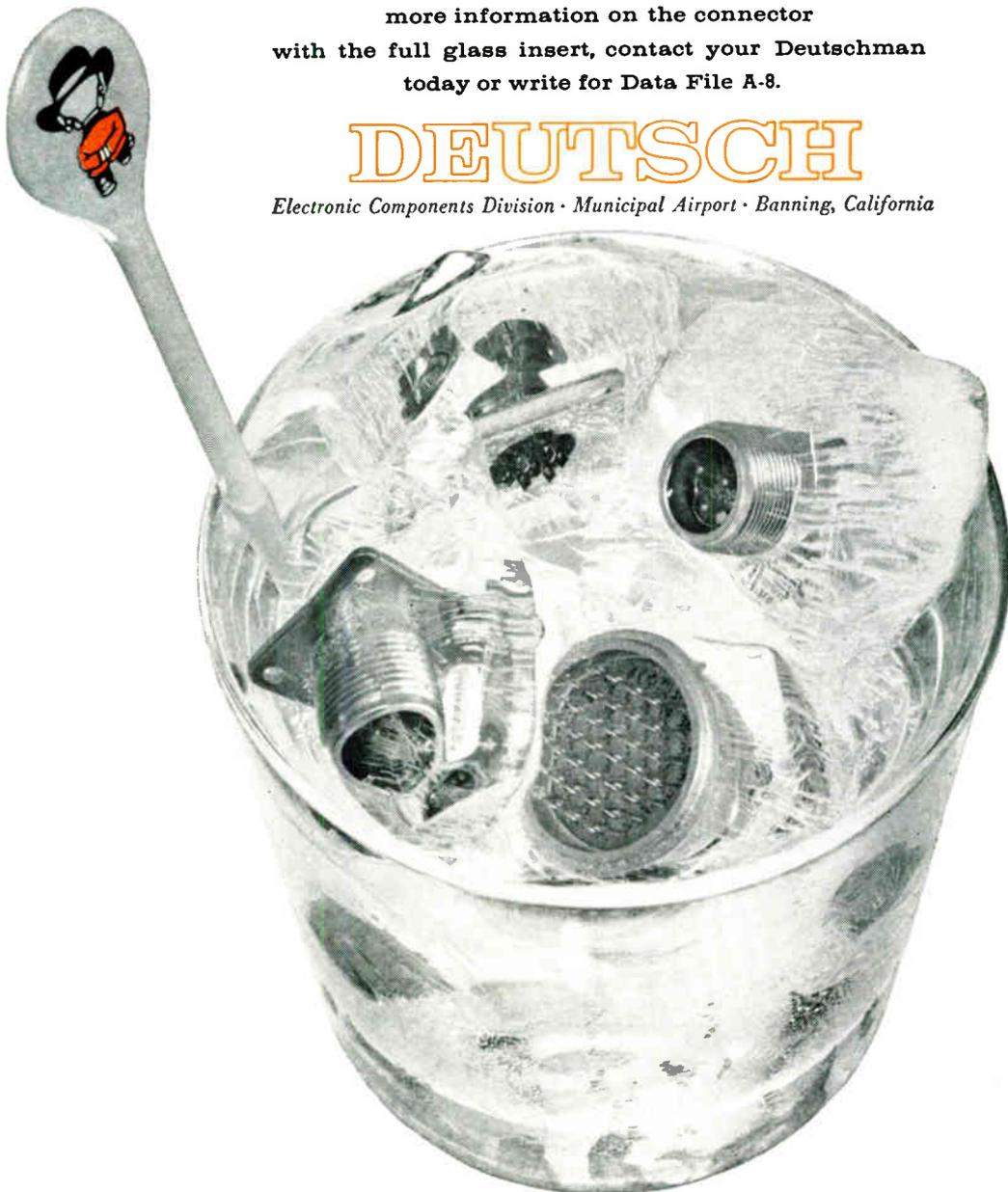
Circle 113 on Inquiry Card

A Toast to Environmental Testing

The Deutsch hermetic receptacle has withstood every kind of trial and tribulation we could think of, and will soon be toasted from Cape Canaveral to Edwards as the only connector giving true hermetic sealing against extreme environmental conditions. The secret of this leak-proof performance is the unique compression glass insert molded into the connector shell as one solid piece with contacts fused right in. And we can guarantee sealed reliability because Deutsch handles every step of production under quality control procedures that have set new standards in the industry. For more information on the connector with the full glass insert, contact your Deutschman today or write for Data File A-8.

DEUTSCH

Electronic Components Division • Municipal Airport • Banning, California



ULTRA STABLE NANO SECOND DELAYS IN A MINIATURE PACKAGE — WILL SOLVE YOUR HIGH-SPEED PULSE CIRCUITRY DESIGN PROBLEMS

NEW JFD

PICOLINE[®]



A MAJOR BREAKTHROUGH IN THE DELAY LINE ART

Newly developed JFD Picolines are extremely constant delay lines. They offer less than one nanosecond rise time in a range of delays from 1 to 10 nanoseconds, in one nanosecond increments. Picolines are more stable than cable under extreme environments and have higher resistance to shock and vibration.

Each one inch section of the JFD Picoline replaces one foot of cable—a welcomed advantage for miniaturized equipment. Unique Picoline metalized glass construction encapsulated in one monolithic housing, offers exceptional strength and durability not inherent in cable.

The 3 db down bandwidth exceeds 300 mc. The Picoline T.C. of delay is approximately 20 ppm/°C over a temperature range of -55 to +125 C. Longer delays are possible through cascading Picolines, or taps can be added at any point along the lines, with only a very slight increase in the resulting rise time. Special Picolines are available in a variety of case styles with delays of up to 10 nanoseconds, by 1/4 nanosecond increase steps.

Picolines will also reduce costs of ultrasonic glass delay lines when used as a tapped variable trimmer element at the termination of an ultrasonic line, as well as provide tighter tolerances.

Write today for our new Picoline Bulletin DLN-63, giving complete characteristics.

SOME OF MANY POSSIBLE USES:

Frequency counters with increased measurement accuracy — Faster oscilloscopes — Time-base measuring devices — Digital UHF flip-flops — Reduce physical size and display linear base characteristics — Faster switching at higher frequencies — Circuits employing avalanche transistors or tunnel diodes; the less than 1 nanosecond rise time complements fast switching transistor characteristics for computers —



Components Division

JFD ELECTRONICS CORPORATION, 15th Ave. at 62nd St., Brooklyn 19, N. Y. • DEWey 1-1000

JFD NORTHEASTERN, Ruth Drive, P.O. Box 228, Marlboro, Mass. • HUNtley 5-7311

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JFD MIDWESTERN, 6330 Hermione St., Chicago 46, Illinois • 775-5424,5425

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STANDARD TELEPHONE & CABLES LTD., Components Group, Capacitor Sales Dept., Footscray, Sidcup, Kent, England

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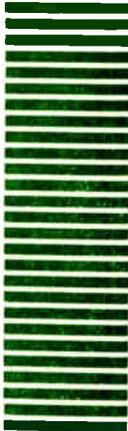


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NEW PRODUCTS

SEALED VACUUM ACTUATOR

Unit measures 3 in. x 2 in. dia. and generates 10 to 40 in.-lb. torque.

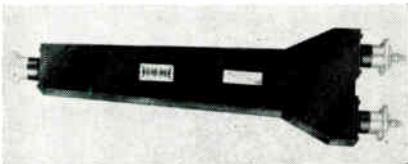


The Model 32-310 is a versatile hermetically-sealed actuator for high-vacuum instrumentation use and feed-through motion transmission. This rotary-to-rotary drive may be manually actuated or motorized. Reduction ratio is 72:1, and servomotors ranging from size 11 to size 18 can be coupled to the input shaft. High-speed input components can be removed to allow bakeout to 400°C. Actuator weight, less motor, is approx. 2 lbs. Harmonic Drive Div., United Shoe Machinery Corp., Beverly, Mass.

Circle 338 on Inquiry Card

COAXIAL POWER DIVIDER

Insertion loss, below 0.2db; power division, within 0.1db; input impedance, 46. 3Ω.

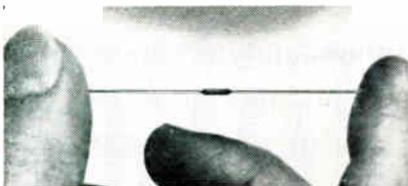


This broadband high-powered coaxial power divider operates from 350-2350mc. Designated Model C-991-185-001 it has been developed using 7/8 in. coaxial connectors. Internally, it is a low-loss rigid strip-line power divider with vswr indicated at 1.15 max. from 450mc to 2350 and 1.3 max. at 350mc. Micro-Radionics, Inc., 14844 Oxnard St., Van Nuys, Calif.

Circle 339 on Inquiry Card

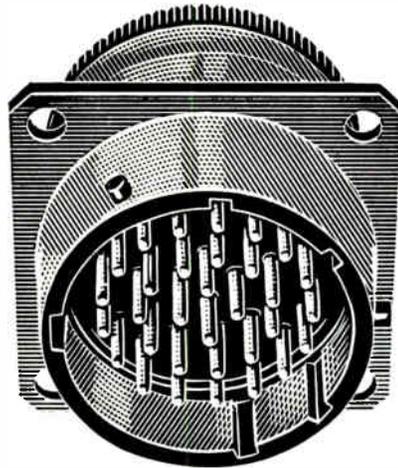
CERAMIC CAPACITORS

These subminiature capacitors have capacitance values as large as 0.01μf.

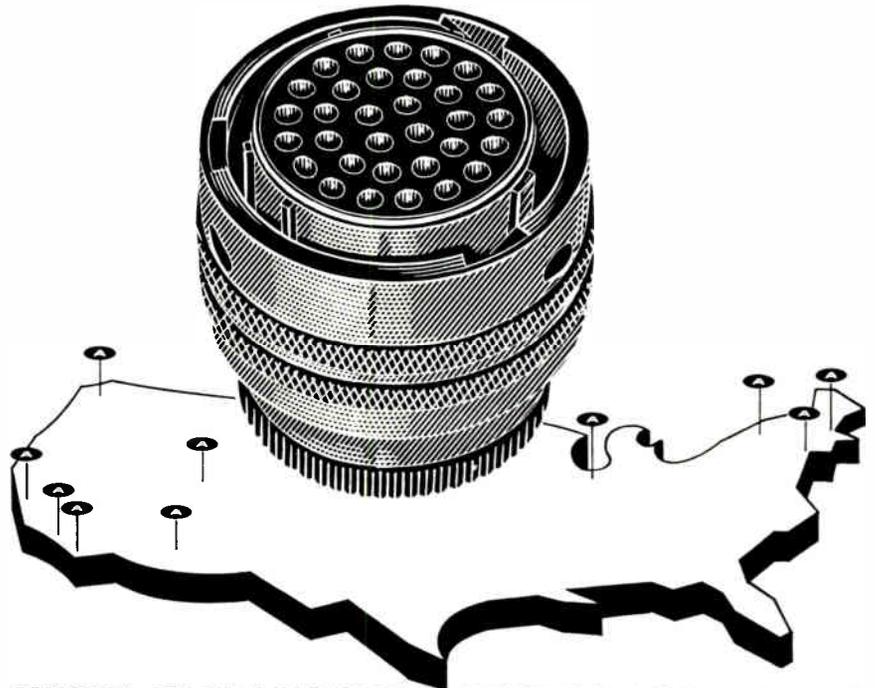


The Narrow-Caps subminiature ceramic capacitors have temp. stability of ±10% between -55°C and +125°C. Capacitance values from 5pf through 750pf are 0.095 in. wide max. x 1/4 in. long max. x 0.095 in. thick max. Larger capacitance values are available. Mucon Corp., Dept. 2, 9 St. Francis St., Newark, N. J.

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Shown here: 32 contacts in 1.375" diameter; contact density available up to 61 contacts.



AVNET PROTOSEMBLES BENDIX CONNECTORS

Your prototype assembly requirements of Bendix Connectors can be met by Avnet. To supplement Bendix Scintilla, your local Avnet Headquarters offers quick and flexible service on Bendix Pygmy types PT and SP and other special types, Pygmy crimp types PTCE and PTSE (shown above), MS, MS-E, MS-R, QWDL, SR rack and panel. For your next emergency or prototype need of Bendix Scintilla Connectors, take advantage of Avnet's on-time delivery. There are Ten Local Avnet Headquarters.

SAN DIEGO, CALIF., 714-279-1550; LOS ANGELES, CALIF., 213-UP 0-6141; SUNNYVALE, CALIF., 408-RE 6-0300; BELLEVUE, WASH., 206-GL 4-4911; PHOENIX, ARIZ., 602-273-1261; SALT LAKE CITY, UTAH, 801-486-7566; CHICAGO, ILL., 312-GL 5-8160; SYRACUSE, N. Y., 315-454-3238; WESTBURY, L. I., N. Y., 516-ED 3-5800; BURLINGTON, MASS., 617-BR 2-3060

AVNET

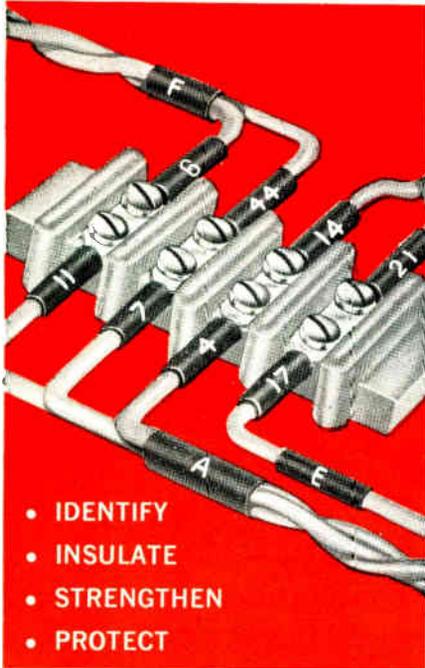
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NEW 4-WAY WIRE MARKERS



- IDENTIFY
- INSULATE
- STRENGTHEN
- PROTECT

ALPHLEX® **SHRINKABLE** FIT^{T.M.} - Markers!

FIT-Markers are pre-printed lengths of abrasion-resistant, irradiated polyolefin tubing designed as a simple, convenient method for permanently identifying multi-wire or cable circuits.

Supplied in expanded form, the markers may be applied over terminations or connectors and shrunk down to form a tight, moisture-resistant, permanent bond even over irregular shapes. The shrinkage process guarantees a tight, slip-proof marker, without the use of insulation-damaging adhesives.

When a temperature of approximately 275°F (125°C) is applied with the Alpha Heat Gun, or other heat sources, the markers immediately return to the predetermined size (approximately 50% smaller).

FIT-Markers are available pre-printed in numbers or letters, in white type on black tubing, and are available at your local electronics distributor. Write for your FREE Alphlex Catalog AT-63 describing the industry's most complete line of tubing products.



ALPHA WIRE CORPORATION

Subsidiary of LORAL Electronics Corporation
200 Varick Street, New York 14, N.Y.

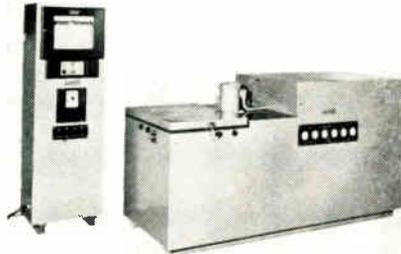
PACIFIC DIVISION:
11844 Mississippi Ave., Los Angeles 25, Calif.

Circle 117 on Inquiry Card

NEW PRODUCTS

FLUID TEST CHAMBER

Adjustable temp. to -175°F ;
accuracy better than 1/10 of 1°.



Model WT-2.4-175 is an open-bath convection fluid test chamber for dehydration uses. A heating cycle raises the temp. 5°/min. from the extreme low to ambient. Low and amb. temp. ranges are equipped with separate low and high temp. thermocouple actuated safety controls. Webber Mfg. Co., Inc., P. O. Box 217, Indianapolis 6, Ind.

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GEORGE HARRIS
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Northern New Jersey

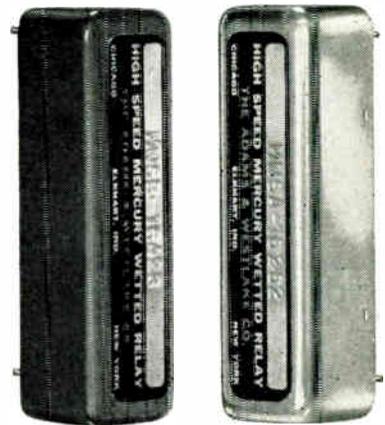
4808 Bergenline Avenue
Union City, New Jersey
UNION 4-9577

NY: OXford 5-3727
TWX: 201-868-0106

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Liverpool, N. Y.
(315) OL-7911

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NEW HIGH DENSITY RELAYS DELIVER 200 OPNS. PER SECOND



These contact form C relays follow signals up to 200 operations per second without variation in timing. Are available in single-side-stable, bi-stable and chopper forms. Adlake MWSA 16000 relays like the one on the left are the only ones you'll find anywhere molded in epoxy. Though less expensive, they stay cooler. Contain no wax to overheat and run. Parts are rigidly secured—no movement to cause circuit noise. Epoxy is proof against all caustics and solvents except acetic acid. The metal encased version on the right can be grounded to assure magnetic shielding. Use it where magnetic interference is a special problem. For more information, call Adlake. And remember, *Adlake makes more kinds of mercury relays than anybody.*



The Adams & Westlake Company
Dept. 8808 Elkhart, Indiana
Phone Area 219, CONgress 4-1141
Circle 119 on Inquiry Card

NEW PRODUCTS

PUSHBUTTON SWITCH

For manual pulsing of digital circuits.

VG20 pushbutton switch consists of



standard model switch with actuator added. Features no bounce, no noise, and low-level switching characteristics. Available with standard red, yellow, green, black and white pushbuttons. Vitramon, Inc., P. O. Box 544, Bridgeport 1, Conn.

Circle 341 on Inquiry Card

INSULATION

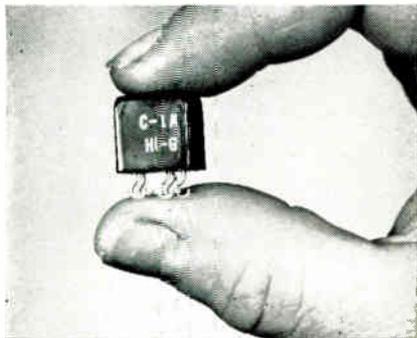
Tensile strength is 3000psi, and the dielectric strength is 1000v./mil.

Thermofit CR Thin Wall is a clear, thin-wall, semi-rigid, radiation cross-linked, modified polyolefin tubing. It is available in 8 standard sizes from 0.200 in. to 2.000 in. expanded, with a wall thickness of 0.010 in. Standard length is 4 ft. A brief exposure to heat in excess of 275°F will cause the tubing to shrink as much as 50% and tightly encapsulate the components over which it may be placed. Rayclal Tubes Inc., Redwood City, Calif.

Circle 342 on Inquiry Card

DICE CUBE RELAY

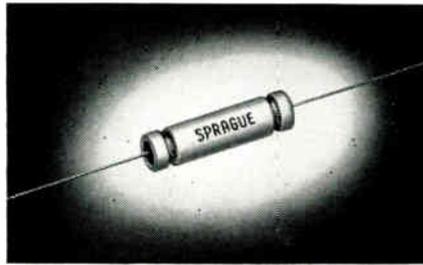
Offered in 3 coil voltage ranges: 6, 12, and 26.5vdc. Temp. -65°C to +125°C.



The Dice Cube microminiature relay meets Mil-R-5757 and measures 0.500 x 0.500 x 0.500 in. Dice Cube is a 1pdt, dc relay with a contact rating of 1a. resistive at 32vdc. Hi-G Inc., Bradley Field, Windsor Locks, Conn.

Circle 343 on Inquiry Card

New High-gain Etched-foil Tantalex® Capacitors Have Twice the Capacitance of Older Designs



HIGH CAPACITANCE Tubular Tantalex Capacitors with almost double the capacitance of standard etched-foil tantalum capacitors have been developed by the Sprague Electric Company to meet the needs of design engineers.

A new etching technique, the result of an intensive research program, gives considerably higher effective surface area to the capacitor electrodes *without sacrifice in reliability or in any of the electrical parameters* by which foil tantalum capacitors are usually judged.

Unlike other "high capacitance" foil tantalums, Sprague Tantalex Capacitors continue to maintain their rigid standards for shelf and service life under severe environmental conditions. Certain performance characteristics have actually been tightened. For example, allowable leakage current has now been halved, making the use of these capacitors possible in many new applications.

Etched-foil Tantalex Capacitors are available in two operating temperature ranges—polarized Type 112D and non-polarized Type 113D for -55 C to +85 C operation, as well as polarized Type 122D and non-polarized Type 123D for -55 C to +125 C operation.

The foil-type Tantalex Capacitor Line also includes conventional low-gain etched-foil and plain-foil capacitors in both polarized and non-polarized construction, providing a foil tantalum capacitor for every application.

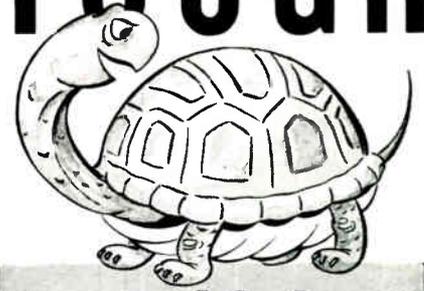
For complete technical data on 85 C capacitors, request Engineering Bulletin 3601B. For the full story on capacitors for 125 C operation, write for Engineering Bulletin 3602B. Address Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

45C-108-63

Get the Full Story at WESCON Booth 1818-22

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TOUGH



... AS A TURTLE'S BACK



ARMAG*-PROTECTED DYNACOR® BOBBIN CORES

AT NO EXTRA COST!

Tough-as-tortoise-shell Armag armor is an exclusive Sprague development. It is a thin, non-metallic laminated jacket for bobbin cores that replaces the defects of nylon materials and polyester tape *with very definite advantages*—and, you pay no premium for Armag extra protection.

Tough Armag is suitable for use with normal encapsulation techniques on both ceramic and stainless steel bobbins. It withstands 180°C without deterioration—is completely compatible with poured potted compounds—has no abrasive effect on copper wire during winding—fabricates easily to close-tolerance dimensions—inner layer is compressible to assure tight fit on bobbin—does not shrink, age or discolor.

For complete data covering the wide range of Dynacor standard and custom Bobbin Cores, write for Engineering Bulletins to Technical Literature Service, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

TRADEMARK

SPRAGUE®
THE MARK OF RELIABILITY

4S-512-R1

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**FREQUENCY
STANDARD
PERFORMANCE**
in
**Packaged
Oscillator
Size**



For additional technical data, WRITE:



**THE
JAMES
KNIGHTS
COMPANY**

SANDWICH, ILLINOIS

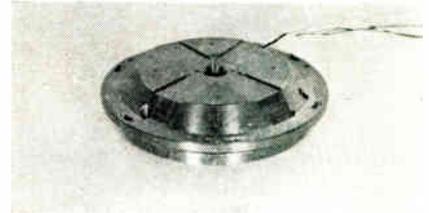
JKTS-1000: A completely packaged oscillator-oven unit. Performance equal-to or better than many laboratory frequency standards designed for system and equipment use. SPECIFICATIONS: large diameter, 1 mc, glass-enclosed crystal, together with oscillator-buffer circuitry, voltage regulation and temperature control completely housed in a double proportionally-controlled oven. External and remote trimming. Stability and calibration 1×10^{-9} per day at time of shipment.

Circle 122 on Inquiry Card

NEW PRODUCTS

PANCAKE RESOLVER

Two-speed pancake resolver provides 16- and 1-speed outputs.



Model 48DRU816 has an accuracy of better than 10 sec. for the 16-speed output and 3 min. for the 1-speed. Phase shifts are 14° and 2.4° respectively. The assembly consists of 2 independent 4-wire resolvers, which are wound on common rotors and stators. The 2 sets of windings are electrically independent, and there is no cross-coupling. Standard input voltage is 28v. at 800 cycles; primary power requirement is 0.030w. for single-speed windings and 1.0w. for 16-speed. Unit can be supplied at other freqs. and input voltages. Components Marketing Div., Reeves Instrument Corp., Garden City, N. Y.

Circle 309 on Inquiry Card

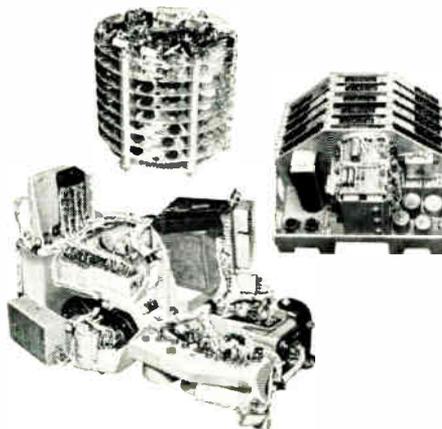
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- designed
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**MISSILE
FLIGHT
CONTROL
SYSTEMS in quantity**

For information about how you can apply this capability to your electronic system and equipment requirements, write:

ELECTRONICS



Featuring high reliability in actual service usage.

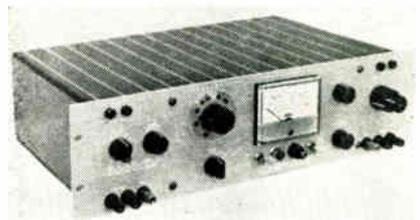
THAT'S CAPABILITY

W. W. Toole
Manager of Sales, Dept. 946
McDonnell EED
Box 516, St. Louis 66, Missouri

Circle 123 on Inquiry Card

GENERATOR-DETECTOR

Generator provides a variable freq. from 20cps to 20kc in 3 ranges. Max-power 1w.



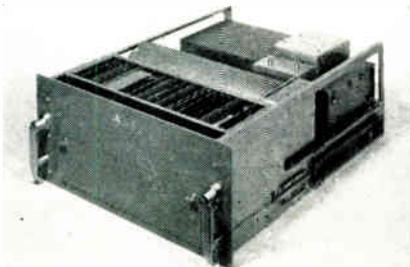
Model 861A generator-detector is an a-f generator and a sensitive, low-noise detector ganged together as a versatile signal source and null indicator for use in precision measurement work. Generator output can be varied from 0 to 200v., with 4 levels of impedance available for optimum load matching and measurement sensitivity. Sync output terminals give a signal for oscilloscope or phase-sensitive voltmeter reference and freq. measurement. Null meter shows full scale with less than $1\mu\text{v.}$ input to the detector. Electro Scientific Industries, 7524 S.W. Macadam Ave., Portland 19, Ore.

Circle 310 on Inquiry Card

NEW PRODUCTS

SCAN CONVERTER

Nondestructive readout permits storage for several minutes.



The scan converter of Model 212 Electrostore® recording storage-tube system has a single-gun recording storage tube that performs instantaneous recording and readout of video signals. The wideband deflection system makes it suitable for high-speed deflection patterns. The 30Mc bandwidth of the input and output video circuitry permits wide-range, high-resolution storage and retrieval. Image Instruments, Inc., 2300 Washington St., Newton 62, Mass.

Circle 344 on Inquiry Card

PREAMPLIFIER

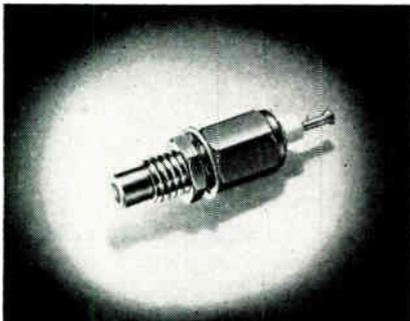
15cps to 200kc bandwidth with noise -118dbm. Extended freq. response to 2.5m

The Model WB50 solid-state, miniature instrumentation preamplifier has 53db gain and 600Ω input and output. Dimensions are 5/8 x 5/8 x 1/4 in. Special Instrumentation Service Inc., 19530 So. Normandie Ave., Torrance, Calif.

Circle 345 on Inquiry Card

LOW-PASS FILTER

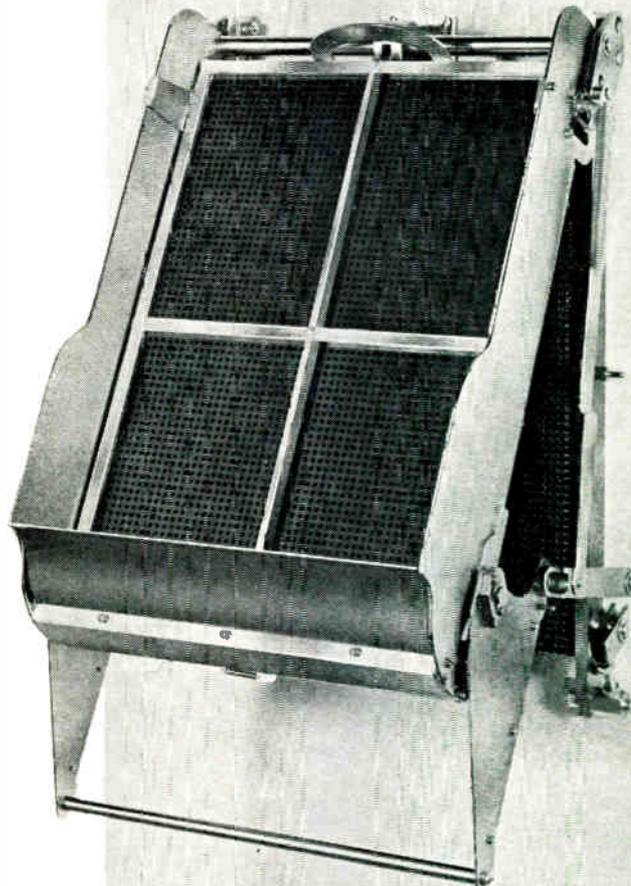
Prevents spurious radiation and has a min. atten. of 45db from 200Mc to 2Gc.



The 5367 subminiature r-f connector has a low-pass filter installed in one end of the connector body. The connector body is of hex design with 0.0001 gold plating. Captivated contacts insure proper engagement of mating parts. Seaelectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

Circle 346 on Inquiry Card

NOW THERE ARE **10** SIZES OF PROGRAMMING SYSTEMS



**A PLUGBOARD PROGRAMMING SYSTEM
ENGINEERED TO FIT STANDARD RACKS!**

MODEL 909 WITH 3264 POSITIONS

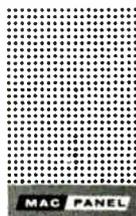
MAC Panel Plugboard Programming Systems are designed to meet all your requirements for dependable program control of electronic equipment. Available in sizes ranging from 200 to 5120 positions, systems include receivers, lightweight phenolic or diallyl phthalate plugboards and a complete set of manual and fixed plugwires.

Check the complete line . . . write for catalog, price list and set of receiver mounting dimension sheets.

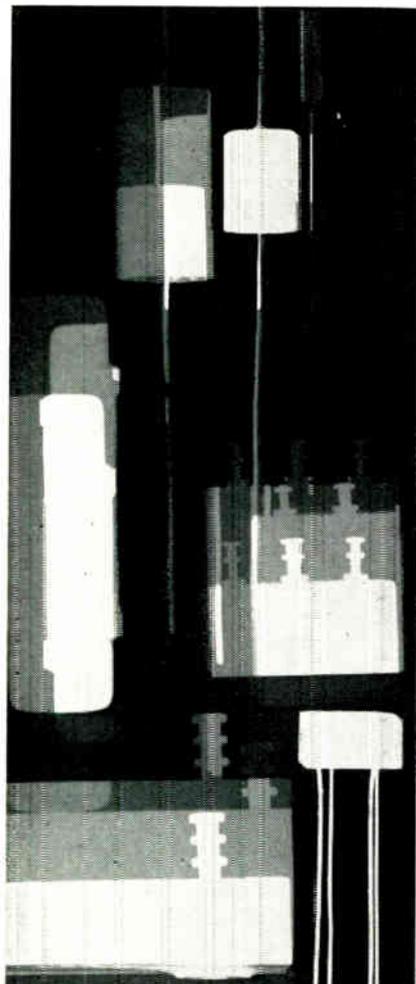
MAC PANEL CO./O.E.M. DIVISION

Division of Adams-Millis Corporation

High Point, North Carolina



MAC PANEL



if your application requires
CUSTOM RECTIFIERS
 call **DICKSON**

Dickson supplies special rectifier cells and rectifier assemblies for many exacting applications where "standard" types have proved inadequate. Typical ratings include:

1. 1 kv to 36 kv PIV / leg
2. 10 mA through 1.5 Amps average rectified current (I_{avg})
3. High surge capabilities
4. I_r less than 2 μ A at 25°C and at rated PIV
5. Operating temperatures up to 150°C
6. Meets or exceeds environmental requirements of MIL-S-19500

Send us your specific electrical requirements, package preference, mounting and lead requirements, size limitations, and other pertinent details. We will submit our recommendations and quantity prices. Phone, wire, or writer: Mr. Russ Grabb, Dickson Electronics, P.O. Box 1387, Scottsdale, Arizona. Phone WH 6-3357



SEE US AT WESCON
 BOOTH 4540

DICKSON
 ELECTRONICS CORPORATION

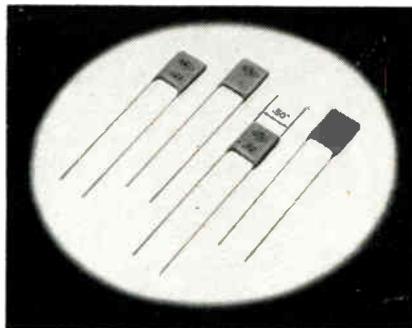
218 Wells Fargo Avenue, Scottsdale, Ariz.

Circle 125 on Inquiry Card

NEW PRODUCTS

CERAMIC CAPACITORS

Working voltage is 150v. at temp. ranges of -55°C to +85°C.

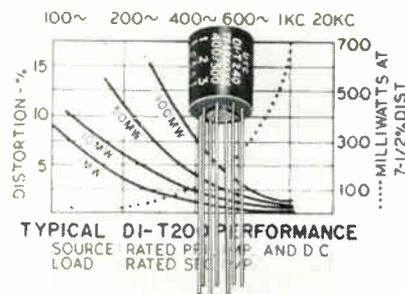


Type DA-790 measures 0.5 in. sq. with thickness ranging from 0.150 to 0.300 in. They combine metal electrodes with laminated layers of thin-film ceramic. Capacitance values are from 0.022 to 0.47 μ f. Dielectric strength is 450v. for 1 sec. min., and insulation resistance is 150 megohm- μ f minimum at +25°C. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Circle 313 on Inquiry Card

ULTRAMINIATURE COMPONENTS

Transformer power level is 50 to 100mw.; inductors dc resistance is 6 to 2300 Ω .



The DI-T200 series of ultraminiature transformers and inductors are metal-encased, hermetically-sealed units, which meet Mil-T-27B and Mil Type TF4RX-YY. Terminals allow plug-in printed circuit mounting. Electrical ranges of the transformers: Pri. impedance is 20 Ω to 30K Ω and sec. impedance is 8 Ω to 12K Ω . Ranges of inductors are from: 0.02hys at 20ma dc to 4.5hys at 2ma dc. Size is 5/16 in. dia. x 3/8 in. high; weight 1/15 oz. United Transformer Corp., 150 Varick St., New York 13, N. Y.

Circle 314 on Inquiry Card

AUGAT

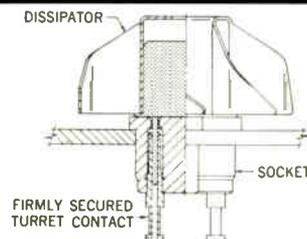
HEAT DISSIPATOR SOCKET ASSEMBLIES

A COMPLETE MOUNTING PACKAGE



Augat makes it possible to buy socket assemblies with mating heat dissipators and Teflon[®] sockets from one dependable source.

HERE'S WHAT YOU GET ...



OR SEPARATE UNITS AS YOU NEED THEM!



Series 9017, 9018 Heat Dissipators

Series 8058 Sockets for T0-5 (3 pin) or T0-12 (4 pin) Transistors



Series 8060 Sockets for T0-18 (3 pin) Transistors

Sockets are manufactured for "Push-Fit" metal chassis or printed circuit dip solder mounting. "Push-Fit" Sockets are also available for T-3 sub-miniature tubes.

WRITE FOR THE COMPLETE STORY

Data Sheet No. 263 describes this mounting package in detail. Write for a copy today.

AUGAT INC.
 Booth 112, WESCON

[†]DuPont trademark

Circle 126 on Inquiry Card

ELECTRONIC INDUSTRIES • August 1963

NEW PRODUCTS

CAPACITANCE BRIDGE

Measures continuously from 5 to 500Kc; insensitive to stray capacitance.

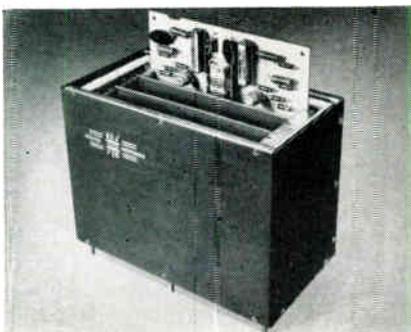


The Model 75C is a 3-terminal direct-capacitance bridge. The Wien bridge oscillator, multi-stage tuned detector, and power supply are self-contained. No accessories are needed for normal use. Built-in provision is made for applying dc bias to the specimen under test. The bridge permits investigation of freq. influence on the test. The signal level across the test is continuously variable from a max. of about 3v. to a min. of less than 10mv. Boonton Electronics Corp., Morris Plains, N. J.

Circle 315 on Inquiry Card

PRINTED-WIRING BOARD OVEN

Capacity of three 4 x 5.4 x 1/16 in. boards; overall dimensions of 4 1/2 x 5 1/4 x 7 in.



In component oven V1318 standard female printed-wiring board connectors are installed in the base of the oven to receive the boards. Stability over the amb. range is $\pm 0.5^{\circ}\text{C}$. The amb. range is from 15°C to 30°C , and operating temp. is 75°C ($\pm 2^{\circ}$). Power requirements vary, depending upon the amb. temp. range, but the preferable operation is 115vac, 50w. Reeves-Hoffman Div. of Dynamics Corp. of America, Cherry & North Sts., Carlisle, Pa.

Circle 316 on Inquiry Card

NEW, RECTANGULAR KELVIN Wire-Wound RESISTORS

for reliability
in printed circuit
high-density packaging



RECTANGULAR RESISTORS SAVE MORE SPACE !!

Rectangular and flat in configuration, the new Kelvin Series "P" precision wire-wound resistors offer a circuit designer the ideal solution for high density packaging.

The new, flat configuration permits "stacking" one on top of another or laying resistors side-by-side for minimum space requirements, especially in printed circuit applications. All units are wound with a single length of wire (no splices permitted) using Kelvin developed "relaxed" winding techniques. This method, by allowing a winding tension of only 1 1/2 to 3 grams, minimizes resistance drift with age and "opens" or "shorts" resulting from over-stressed wire. Units are further stabilized by artificial aging and temperature cycling prior to final inspection. Vacuum encapsulation eliminates voids.

GENERAL SPECIFICATIONS

*WATTAGE RATINGS: based upon maximum ambient temperature of 125°C , derated 5%/ $^{\circ}\text{C}$ above 125°C .

WINDINGS: card type

TEMPERATURE COEFFICIENT: ± 20 ppm/ $^{\circ}\text{C}$; (as low as ± 2 ppm/ $^{\circ}\text{C}$ — limited temperature range). Resistance wire having low thermal E.M.F. to copper is used exclusively.

TEMPERATURE RANGE: -65°C to $+125^{\circ}\text{C}$.

STANDARD TOLERANCES: 1%, 0.5%, 0.1%, .05%, .025%, .02%, .01%.

CONNECTIONS: welded.

ENCAPSULATING MATERIAL: high temp. epoxide resin.

KELVIN TYPE	COMMERCIAL WATTAGE*	MAXIMUM OHMS	MINIMUM OHMS	SIZE	MAXIMUM VOLTS	LEAD SPACING	LEAD DIA.
446-P	.200	2 Meg.	1	1/8" x 1/4" x 1/2"	100	.250	#20
447-P	.125	1 Meg.	1	1/8" x 1/4" x 1/4"	100	.125	#20

Our experienced engineers will answer your high-density packaging application inquiries promptly.

Send specifications or requirements to:

Representatives in principal cities



KELVIN ELECTRIC COMPANY

5907 Noble Ave., Van Nuys, Calif., TRiangle 3-3430
New York: Yonkers, 916 McLean Ave., BEverly 7-2500

now from DAGE

Hermetically Sealed MULTI-PIN CONNECTORS

- MIL C 26482 Class H
- MIL C 5015
- MIL C 25955

Newest addition to line of famous DAGE connectors! Hermetically sealed Multi-pin Connectors meet or exceed all applicable MIL specs. Shell sizes and finishes for most popular needs; custom engineering and finishes available. Get full details and performance data.

Write for New Catalog T-503



at WESCON BOOTHS
320-321

DAGE ELECTRIC CO., Inc.
HURRICANE ROAD • FRANKLIN, INDIANA
PHONE AREA CODE 317/787-5305

Circle 128 on Inquiry Card

8 Poles in a Display Switch? 500,000 Operations?



A WESCON Design
Award Selection

Now you get both of these exclusive features in the new Telex Pushbutton Display Switch. Standard 8-pole, single-throw, normally open contacts provide more control circuits with less panel space. Extremely long life—500,000 operations at 1 amp 30 VDC—assured by patented wire bridge design. Heat-resistant materials used in construction make possible continuous 4-bulb operation.

See the Series TM Pushbutton Display Switch at the Telex Wescon booth No. 2505-2506, or write for illustrated data sheet.

TELEX/Acoustic Products

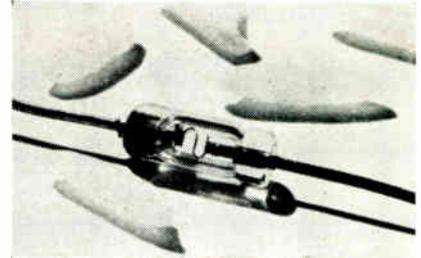
3054 Excelsior Blvd. • Minneapolis 16, Minn.

Circle 129 on Inquiry Card

NEW PRODUCTS

GaAs LIGHT SOURCE

Max. average current is 180ma; pulsing with 12a. gives 5×10^{-3} w./steradian.

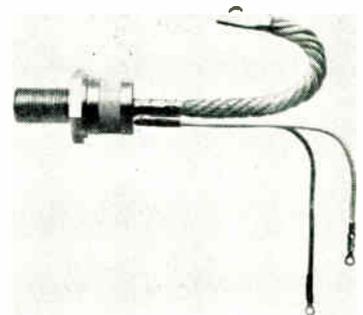


Model 437 gallium arsenide emitting diode is packaged in standard subminiature glass diode configuration. The unit emits in a doughnut pattern, allowing 360° collection and concentration of energy. Peak wavelength is 0.94 microns, with a 0.04 micron bandwidth. Three classes of the Model 437 are available according to minimum radiant power output of: 1.0×10^{-5} , 3.5×10^{-5} , and 7×10^{-5} w./steradian when operated at a current of 180ma. Cooling to 77°K increases the output and efficiency approx. 30 times. Infrared Industries, Inc., P. O. Box 989, Santa Barbara, Calif.

Circle 317 on Inquiry Card

250 AMP SCR

The 1-cycle surge rating is 5000a. peak. RMS forward current is 400a.



This 3-terminal, 4-layer pnpn 250a. unit has a forward blocking voltage and peak reverse voltage to 700v. The type 221 is used for fast switching high-power inverters. Other uses include motor control, plating supplies, and ignitron replacement. Features: internal construction that eliminates thermal fatigue problems; low thermal impedance; glazed ceramic headers; and hermetically weld-sealed cases. Westinghouse Semiconductor Div., Youngwood, Pa.

Circle 318 on Inquiry Card

NEW PRODUCTS

PEDESTAL CONTROL

Slew velocity, 20°/sec.; each axis has 13-bit encoders.

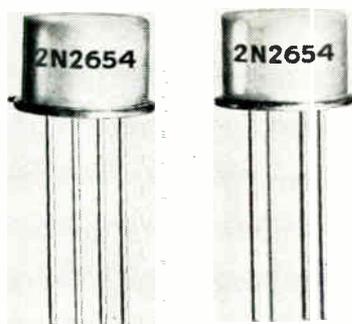


Model 170 antenna pedestal control system is used with ground-based telemetry where the receiving antenna is an end-fire corrugated cylinder surface wave-element array. Control system includes a servo bandwidth adjustment which allows the system to be optimized for any tracking condition. Modifications of existing design are available for mounting parabolic reflectors and multi-element arrays. TEMEC, Inc., 7833 Haskell Ave., Van Nuys, Calif.

Circle 319 on Inquiry Card

HIGH GAIN TRANSISTOR

Typical power gain at 100mc is 18.8 db. Cut-off freq. is 250mc.



The 2N2654 is a germanium PADT transistor for use in vhf high-gain circuits. It has feedback capacitance of 0.5pf; an output conductance of 3.5 μ mhos at 10.7mc eliminates variations in-stage gain and bandwidth between individual transistors, thus permitting optimum gain. Amperex Electronic Corp., Semiconductor and Receiving Tube Div., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 320 on Inquiry Card

RUSSIA MARKETING COMPUTERS TO WEST

The Soviets reportedly ran a full-page ad in a Dutch magazine offering Russian-built Ural-2 computers for sale in Western Europe.

A full page, 4-color ad described a computer line, including the Ural-2 Universal Computer, the MN-7 Analog Computer, various perforators, verifiers, tabulators, and summary punches.

The Ural-2, a vacuum-tube computer, has been used by the Soviets to compete with the west in underdeveloped areas such as Ghana. This is the

first time the Soviets have indicated they may mount a major marketing effort.

Since the machine has been in use in the Soviet Union, China, and such satellites as Czechoslovakia and Rumania since 1959, it may be that prestige, rather than actual help of mass sales, is the principal motive for the advertising.

Since the Ural-2 does not have any advanced features of the newer solid-state computers being made in the U.S.S.R., it may even be an effort to dump over-runs or old inventory.

When the need is critical . . .

ALITE[®] MISSILE NOSE CONES



with

MAXIMUM PERFORMANCE CHARACTERISTICS

As requirements become more demanding, high alumina ceramic—with its ability to withstand temperatures in excess of 3000°F — is being used more frequently for missile nose cones.

Increasingly, missile manufacturers are turning to Alite for their alumina nose cones for two principal reasons:

- Alite's capability for the electromagnetic and mechanical design of a nose cone with maximum transmission efficiency and structural reliability.
- Alite's capability for the production of nose cones which are uniformly accurate—physically and electrically—in production lots. Here, not only close dimensional tolerances but also absolute uniformity of high purity ceramic formulations from batch to batch is essential.

Produced under rigid Quality Control procedures, you can rely on Alite high alumina ceramic nose cones' low loss tangent . . . zero water absorption . . . dimensional and chemical stability . . . and high temperature resistance.

★ ★ ★

Let us review your specific requirements — without obligation: send us prints and other pertinent data. Or, write for free bulletins giving complete information about Alite.

ALITE

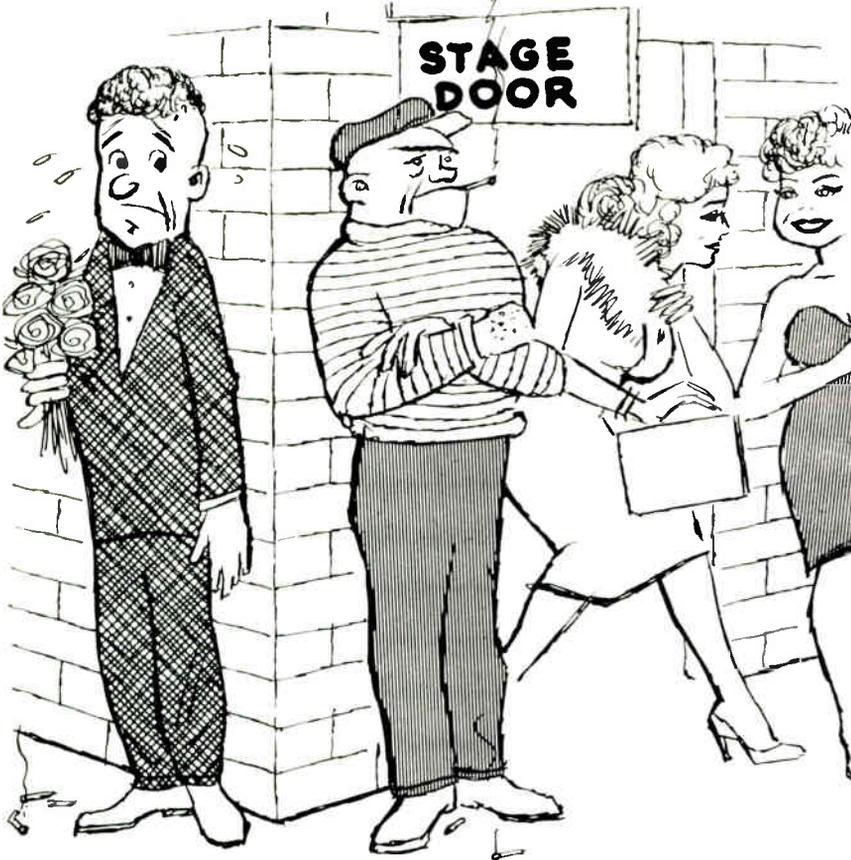
DIVISION

U. S. STONEWARE

BOX 119

ORRVILLE, OHIO

GOT A CONTACT PROBLEM?



PROBLEM: To select a contact material for an oil-immersed contactor.

An oil-immersed contactor has the advantage of protecting the contacts from air, thereby minimizing their oxidation. It has the disadvantage of confining the arc which forms when the contacts separate, thus subjecting the contact surfaces to the erosive effects of a confined arc. The contact material for an oil-immersed contactor must have adequate conductivity for low temperature rise, must avoid welding, and must provide adequate life under the severe arcing conditions.

Copper, which would be unsuitable for an air-contactor because of excessive oxidation, could be considered for an oil-immersed contactor because it would be protected from the air. However, the erosive effects of the confined arc would wear out the copper contacts rapidly.

For the same reason, silver contacts, satisfactory for a small air contactor, would wear out rapidly in an oil-immersed contactor of the same rating.

ANSWER: GIBSILLOY UW-8, copper-tungsten. GIBSILLOY UW-8 is a powdered metal product of copper and tungsten having the right combination of high conductivity and arc erosion resisting characteristics for the typical oil-immersed contactor. Comparisons have shown the life of GIBSILLOY UW-8 contacts to be 6 or 8 times as long as copper contacts.

OTHER APPLICATIONS: Because of their desirable characteristics, GIBSILLOY UW-8 (and other GIBSILLOY copper-tungsten materials) have found application in oil circuit breakers, gas enclosed circuit breakers, and arcing tips for oil or air circuit breakers.

Write for Catalog C-604 and Bulletin TB-506



Photo Courtesy General Electric Co.

GIBSON ELECTRIC COMPANY
A subsidiary of TALON, INC.

BOX 598 DELMONT (PITTSBURGH DISTRICT), PA.

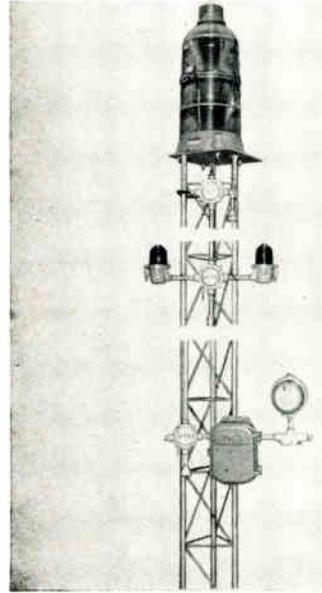
Representatives in Principal Cities of the United States and Canada

Gibsilloy
ELECTRICAL CONTACTS
Since 1923

NEW PRODUCTS

TOWER LIGHTING EQUIPMENT

Meets FAA & FCC specifications for low-flying aircraft warning system.



The Rohm B-1 300 MM Code Beacon is for use on TV, microwave and transmission line towers, water tanks, bridges and other loft structures. They are available in either single or double models. Beacon flasher units and junction boxes are available. Rohm Mfg. Co., P. O. Box 2000, Peoria, Ill.

Circle 321 on Inquiry Card

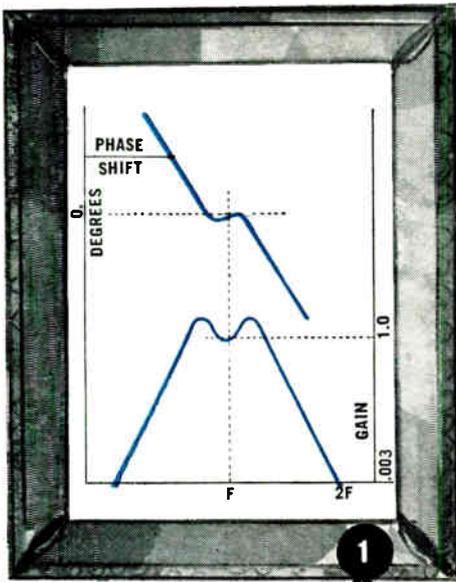
PULSE GENERATOR

Rise time of 400 psec; freq. variable 40 to 300cps; negligible overshoot.

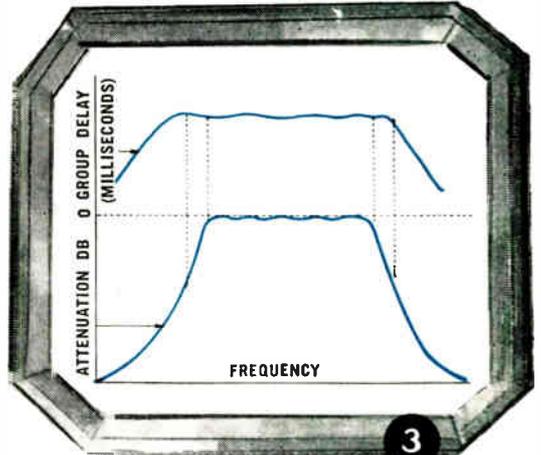


Model 126 uses transistorized circuits and a high-speed coaxially-mounted mercury switch to produce its fast rise times. The fast pulses of calibrated amplitudes make it useful in checking transient response of wide-band systems, fast solid-state switching circuits, computer devices, and nuclear applications. E-H Research Laboratories, Inc., 163 Adeline St., Oakland 20, Calif.

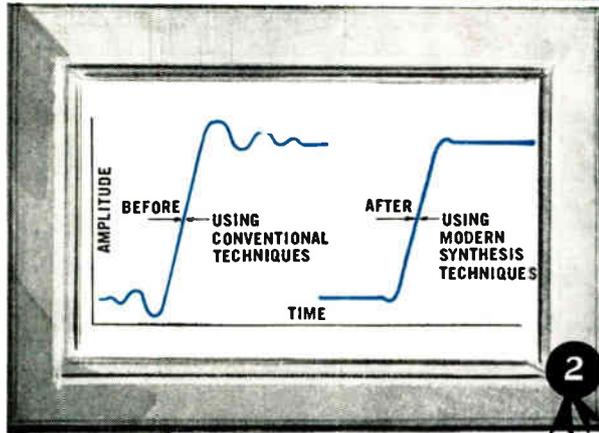
Circle 322 on Inquiry Card



1



3



2

Burnell advances the state of the art with three new filter families

If you are concerned with new systems development, and would like to take advantage of advanced technology and the kind of sophistication that will improve transient response and eliminate obsolete circuitry . . . then here are three new filter families, that have advanced the state of the art, which you can immediately incorporate in your network designs — exclusive from Burnell. Call or write today for literature and technical assistance.

Burnell offers the most complete line of communications network components available to the electronics industry, with a versatility of experience unmatched in the production of filters, delay lines and toroids for interpretation of *complex signals*. Burnell will custom design filter networks to your specifications which may include special delay, attenuation, and transient response, involving precisely specified rise time, overshoot and ringing.

1 ZERO PHASE FILTERS

OP SERIES	OP400 L	OP400 M	OP400 H
Pass Band (3 DB)	±20 cps	±20 cps	±20 cps
Harmonic attenuation 2nd harmonic and all higher frequencies			50 DB
Harmonic attenuation (2nd)	>15 DB	>25 DB	
Harmonic attenuation (3rd)	>40 DB	>60 DB	
Max. phase ±20 cps	±1°	±1°	±1°
Max. phase ±30 cps			±5°
Phase shift at Center Frequency	0° ± ½°	0° ± ½°	0° ± ½°
Gain =	UNITY	UNITY	UNITY

60 cps equivalent filters are also available having a pass band of ±5% with phase of ±1°.

For the Servo Engineer . . .

By specifying Burnell's new line of Zero Phase Shift networks, it is possible to recover, without phase shift, the fundamental frequency from any periodic wave form without using complex squaring circuitry. This advancement in the state of the art is accomplished by combining zero phase shift in the vicinity of the center frequency — with high attenuation in the stop bands.

2 LOW PASS FILTERS WITHOUT DISTORTION

This family of filters is designed with modern synthesis techniques to have specified transient characteristics such as fast rise time, low overshoot and ringing.

60/3 DB Shape Factor	Ringing (over/undershoot)
2:1	< 5%
3:1	< 2%
4:1	< 1%

This is part of a family of constant delay band pass filters of unusual characteristics, for example:

- 1—Group delay is constant well into the stop band!
- 2—Matched delay—as an example of delay matched band pass filters, we have produced a set of four filters having the same band widths of 500 cycles at 1½ DB with center frequencies ranging from 680 cycles to 2720 cycles; having a 20 DB band width of 710 cycles with group delay constancy of ±3½% over the pass band and between channels.
- 3—Constant delay band pass filter.

Frequency	Attenuation
5210 cps to 8336 cps	< .5 DB
1,000 cycles & below	> 20 DB
10,000 cycles & higher	> 20 DB

Delay: Group delay constant ±1% from 3,500 cps to 9,900 cps.

Copyrighted 1963

Burnell & Co., Inc.

PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

EXECUTIVE OFFICE AND PLANT
DEPT. EI-38
PELHAM, NEW YORK
PELHAM 8-5000
TELETYPE PELHAM 3633



MFD. IN CANADA BY EDO (CANADA) LTD. CORNWALL, ONT. WELLINGTON 2-6774 ALSO MFD. AT PACIFIC DIV.

SUBSIDIARIES: G-K electronics Inc., Pelham, New York • GLP electronics, Inc., Bristol, Conn.

WHAT GASEOUS DIELECTRIC HAS...

- high heat transfer
- high dielectric strength, power to microwave frequencies
- no dipole moment
- unusual sonic properties
- remarkable inertness
- high molecular weight
- low condensation temperature
- high compressibility
- virtually unlimited life
- colorlessness
- odorlessness
- non-toxicity
- detectability
- ready availability from two producing locations

SF₆ offers all of the above. This dielectric gas has found successful application in heavy electrical units, miniaturized electronic devices and X-ray equipment. If the unusual properties of sulfur hexafluoride suggest other potential applications to you, mail the coupon for our 22-page technical bulletin.

E1-83

Baker & Adamson® Fine Chemicals
GENERAL CHEMICAL DIVISION
P. O. Box 353, Morristown, N. J.



Please send your technical bulletin on SF₆.

Name _____

Title _____

Firm _____

Address _____

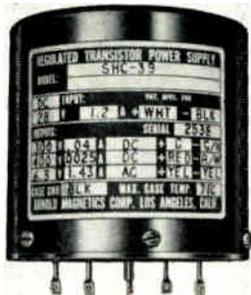
City _____ Zone _____ State _____

Circle 133 on Inquiry Card

NEW PRODUCTS

DC to DC POWER SUPPLIES

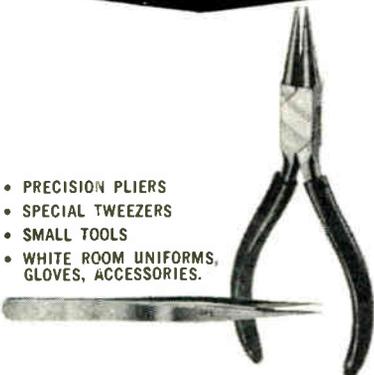
Multiple outputs from 6.3 to 3000vdc at 60w; ripple maintained at 0.3% RMS.



SH series feature input voltages from 12-32vdc (± 2). Any 3 output voltages may be selected at any combination of amperages up to 60w. They meet the requirements of Mil-E-52721D. Units are encapsulated in thermal-conducting epoxy, permitting relatively transient-free operation from -54°C to $+71^{\circ}\text{C}$. Within this range, line and load regulation are maintained to $\pm 0.5\%$. Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 302 on Inquiry Card

MICRO-MINIATURE TOOLS



- PRECISION PLIERS
- SPECIAL TWEEZERS
- SMALL TOOLS
- WHITE ROOM UNIFORMS, GLOVES, ACCESSORIES.

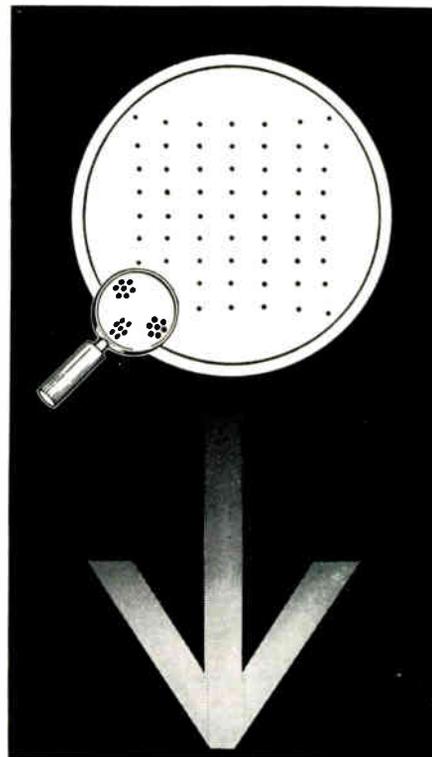
Techni-Tool, with an awareness of your production problems, now offers for your inspection a comprehensive catalog of micro-miniature and electronic assembly tools. Comprised of over a hundred stock items, this catalog can be an important time- and money-saver to the production manager.

Write for your Techni-Tool catalog today.

TECHNI-TOOL, INCORPORATED

1216 ARCH STREET, PHILA. 7, PA.
Area Code: 215 — LO 8-4457

Circle 134 on Inquiry Card



WHY

MAJOR C. R. TUBE MFGRS. RECOMMEND SYNTRONIC YOKES

Exceptional manufacturing uniformity. Achieved by unique pepperpot tube testing—the most comprehensive method known for precise measurement for spot uniformity . . . to attain extremely accurate focusing. For technical details, request ELECTRONIC INDUSTRIES reprint #6-57 from Syntronic Instruments, Inc.

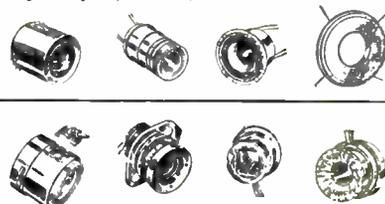
Call your nearest SYNTRONIC REP today

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Wash.-Balt. Area:	277-1023
Indianapolis:	846-0359
Los Angeles:	283-1201

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INSTRUMENTS, INC.

100 Industrial Road, Addison, Illinois
Phone: Kingswood 3-6444

The Industry's broadest yoke line . . . already tooled for quantity production. Or, yokes can be custom designed to your precise requirement.



Circle 135 on Inquiry Card

LETTERS

"We Do Not Make ..."

In the June 1963 Directory issue, the Patwin Electronics Div. of Patent Button Co, Waterbury, Conn. was mistakenly identified as manufacturing "capacitor leakage indicators." The firm actually manufactures "data display indicators."

Patwin Electronics also manufactures: binary converters, card-type converters, code converters, decoders, logic circuits, matrixes, and readout devices.

"Antennas Have Built-In Circuits"

Editor, ELECTRONIC INDUSTRIES:

We have located several errors in our paper, "Antennas Have Built-in Circuits," Electronic Industries, May 1963, most of which were incorrect in our manuscript, and for which we are very regretful. I hope you will be able to print the appropriate corrections listed below:

1) In Figure 5b, G_v represents voltage gain, not power gain.

2) Equation 3 should read

$$P_{out} = \frac{E_o^2}{Z_o} \left[\sum_{i=1}^N G_v^i \right]^2$$

3) Equation 5 should read

$$G = \frac{P_{out}}{P_{in}} = \frac{1}{N} \left[\sum_{i=1}^N G_v^i \right]^2$$

4) T_u and T_A were interchanged in both Equations 6 and 7.

John R. Copeland
Research Associate

The Ohio State University
Antenna Laboratory
Department of Electrical Engineering
1320 Kinnear Road
Columbus 12, Ohio

"Unionism or Professionalism"

Editor, ELECTRONIC INDUSTRIES:

Your April editorial, "Unionism or Professionalism," is so very well pointed. We sure need to point up and stress these points having to do with the image of engineers with both engineers and the public. We need more such pertinent information.

(Continued on following page)

OVER 100

DIFFERENT TYPES NOW IN PRODUCTION



JENNINGS CERAMIC VACUUM CAPACITORS

... have been accorded an enthusiastic vote of approval from users for their superior performance in the field. Now we've added many new styles to accommodate the demand for these capacitors in an even wider variety of size, capacitance, voltage and current levels.

Ceramic vacuum capacitors combine the inherent advantages of vacuum with a high strength ceramic envelope to form the most advanced high voltage capacitor ever devised. The low loss ceramic allows operation in excess of 400 megacycles. It also provides better vibration characteristics, greater shock resistance, higher current ratings, and smaller size. A few of the many ceramic vacuum capacitors available from Jennings are illustrated below.

<p>Type CVFA-450</p> <p>Capacity Range 25-450 PF Voltage Rating 40 kv pk RF Current Rating 100 amps rms Length 9 3/8 inches Width 5 1/2 inches</p> 	<p>Type CVA-7</p> <p>Capacity Range 3.5-7 PF Voltage Rating 35 kv pk RF Current Rating 60 amps rms Length 4 1/8 inches Width 3 1/8 inches</p> 
<p>Type CFHA-1000</p> <p>Capacity 1000 PF Voltage Rating 50 kv pk RF Current Rating 200 amps rms Length 6 1/2 inches Width 7 inches</p> 	<p>Type CVHA-650</p> <p>Capacity Range 30-650 PF Voltage Rating 55 kv pk RF Current Rating 150 amps rms Length 10 3/4 inches Width 7 inches</p> 

Our radio frequency laboratory with 12 functioning transmitters ranging from 17 kc to 600 mc and up to 100 kw cw power is at your service to test our products under your particular circuit conditions.

Write for more detailed information regarding these capacitors.

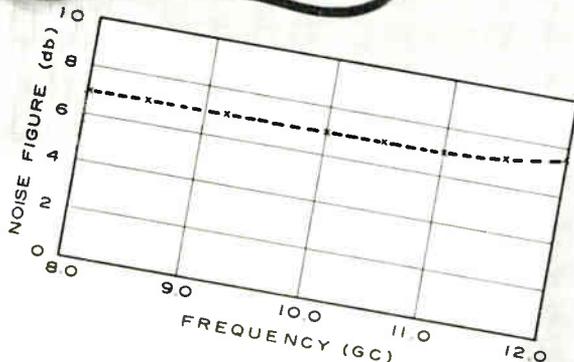
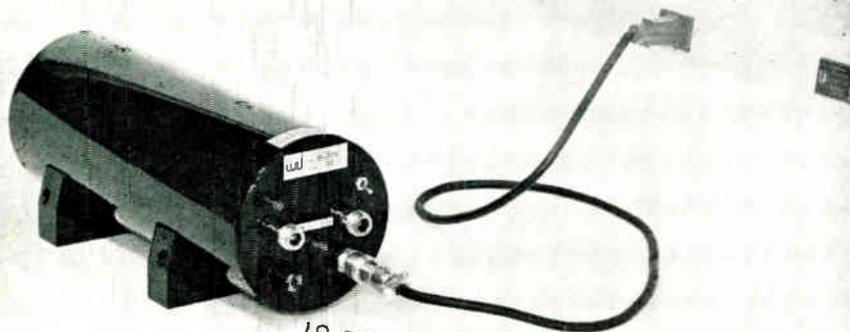
RELIABILITY MEANS VACUUM / VACUUM MEANS

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Specifications for the WJ-276

PERFORMANCE	TYPICAL
Range	8-12 Gc
Noise Figure, Terminal	7 db
Gain, Small Signal	28 db
Saturation Power	1 mw
Power Input	18 w, 115 vac
Environmental	MIL-E-5400, Class 2

Information in more detail available from representative in your area, or from Applications Engineering

WATKINS-JOHNSON COMPANY

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STANFORD INDUSTRIAL PARK
PALO ALTO, CALIFORNIA

LETTERS

(Continued from preceding page)

How about an editorial on what you would tell high school students at a Careers Day seminar to interest them more in engineering and improve their image of the profession.

I understand that the "Professional Engineers Conference Board for Industry" has made a survey on why students shun engineering. I think this is an important study, and that we must soon find some answer for this problem. At a recent Electronic Industry committee study, we were told by two Institute representatives that the applicants to 2-year junior college level technicians course is going the way of freshman college engineering entrants for the last 6 years or so—down! This is not good for the Electronics Industry in these times!

In the above connection, I am attaching a copy of Edelman-Elliott-Morris series of letters. Being an elementary school board member for 5 terms and talking to high school Careers Day groups for about 15 years, as well as being in industry, may have clouded my thinking, but, as you might guess from my above Electronics News letter, I feel much of the attention on this problem of engineering recruitment has not been, or is being, directed at the most effective spot the junior high "upper elementary" in school areas. Perhaps we need to point out the narrowing line between the results of the engineer and scientist: but that reporters and the press accentuate the word "scientist."

We have corresponded several times in the past on the air/satellite-based ETV directed broadcasting principle as compared to the ground-based system. My contention is that this 10/14 million dollar experiment now reorganized into an expected expanding 5-year 20/30 million dollar operation, on our school boards' public tax dollars, is about the most inefficient frequency space utilization a communications engineer could devise, and about the worst thing that could happen to we school people and educational TV, on a country-wide application basis. Already, before they have attained 1/3 of their channel/lesson promises, and

(Continued on page 186)

WESTERN ELECTRONICS (Concluded)

West Winks at Future

But, optimistic westerners don't wince at the future—they wink at it. They take consolation from the sheer weight of nearly \$4 billion worth of electronics goods and services they will have created this year. Since pessimists have been proven wrong in the past, optimists abound. There are projections of national electronics sales swirling to \$17 billion by 1965, \$24 billion by 1970, and \$35 billion by 1975.

Projections for electronics business in the L.A. area, by Robert R. Dockson, Dean of the Graduate School of Business Administration, University of Southern California, suggest a range:

(1) Higher projection for Los Angeles area sales of electronics is from \$4.5 billion to \$4.9 billion by 1975, assuming that area sales grow along with the national sales rate.

(2) Lower projection of \$3.6 billion by 1975, assumes that the area's share of the nation's electronics sales will decline gradually.

Dean Dockson suggests that there "is no logical reason to reduce the Los Angeles area's share of Government contracts."

L. A. Hard at Work

The Los Angeles business community is working hard to keep ahead in the electronics field. Purchasing agents in L.A. are being asked, "What are you buying from suppliers located out of southern California?" Answer: "709 million out-of-area purchases to identify potential business for new or existing firms."

A consensus from a meeting of the Los Angeles Chamber of Commerce indicated that southern California electronics firms "can compete successfully in the European Economic Community provided they continue their current technological lead." The chamber is sponsoring a 10-year action program called "Destination '70" to attack critical community problems where electronics may play vital roles. Also, the Chamber will sponsor an industrial fair in connection with a technological congress in March, 1964, to signal arrival at "industrial maturity." The New York World's Fair opens in 1964, runs through 1965.

Los Angeles and the rest of southern California—and the west in general—strongly back the vital electronics industries in their areas. The rest of the country will keep on trying to catch the eye and ear of Congress.

CARBON FILM

MOLDED STYLE: The Electra DCM Series offers the extra protection of a durable molded jacket of thermosetting alkyd resin and capped lead construction. Stocked in sizes from 1/10 to 2 watts and resistances from 10-ohms to 10 meg.

CONFORMAL COATED: Both CF and DC series coated with high impact Impervium "N". Available in sizes from

1/10 to 2 watts and values from 10 ohms to 10 meg. Copper leads are standard. Dumet, Grade A nickel, and gold-plated leads are available on all styles of Electra resistors.

HERMETICALLY SEALED STYLE: Available in 1/4 to 2 watt sizes, the HC Series is indicated for extreme moisture resistance. Meets or exceeds MIL-R-10509 D.

METAL FILM

MOLDED STYLE: Standard of the industry in sophisticated applications. Weldable leads; Dumet, nickel & gold-plated. Thermosetting alkyd resin jacket. 1/10 to 2 watts, 25-ohms to 10 Meg. Electra Series MF.

CONFORMAL COATED: High performance in small light package. Coated light blue in Impervium "X" identifies Electra Series MFC. Cap terminals—complete selection of leads. 1/4 to 2 watts, 25 ohms to 10 meg.

HIGH RELIABILITY

SERIES HRM: Designed and produced to meet the most exacting reliability requirements. HRM 1/4 is designed toward a failure rate of .0004 ER*, meets the dimensional requirements of RNR57 as specified in MIL-R-55182. 30.1 ohms to 301 K.

SERIES CHM: Companion to HRM 1/8, the CHM 1/8 is highly miniaturized. Eminently suitable for use in cordwood packaging or other high density applications. 20 Ohms to 301 K.

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Built into every Electra Resistor is a reliability unmatched throughout the industry. This is a large claim, but we back it up with proof. Type for type, resistor for resistor, Electra can and does prove their reliability in *continuing* power-temperature testing.

Since the start of the test, undergoing 2½-times their rated wattage load, sufficient data has been accumulated to establish a reliability figure of better than .000139 ER* on standard Electra Carbon Film resistors—that is Electra Reliability!

*ER=per cent per one thousand hours.

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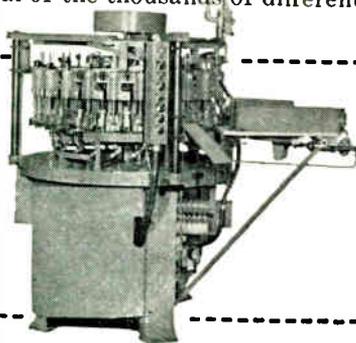
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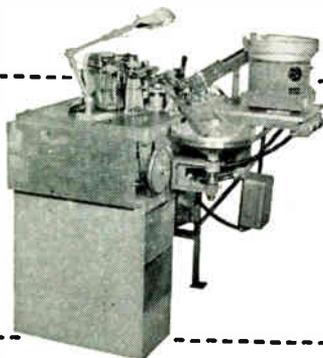
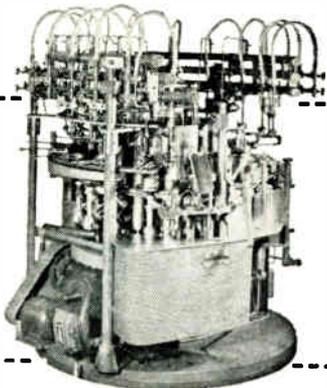
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LETTERS

(Continued from page 184)

during their first full formal year of air based, the MPATI (Midwest Project on Airborne Television Instruction) operators have saturated the allocation UHF band channel space in our area. Even before they have completed their promised channels to 1 district (the Chicago City system) hundreds of our surrounding school districts are prevented from repeated potential use of these ETV channels for our own local use and needs.

In this connection I am attaching a copy of a "Memo to Tri County ETV Council-TAE040963LM1," and to some fellow board members (our area includes half the pupils in the state).

This is important because I think this air based direct broadcasting principle, with multi-million-dollar support is about the worst possible example of communications frequency space utilization that could be devised; and because they petitioned the FCC last January for a regularization of the service and a complete reallocation of UHF broadcast frequency spectrum space to allow expansion of air based ETV from the present 2 experimental channels to 6 regular service channels. Because this is a technical problem, and the air based ETV proponents are not telling the non technical educators the complete story, school people do not realize the future implications. As a result, some school people are hounding the FCC to allow the petition, and no negative comments were filed. These school people do not yet realize that in such requests they are restricting fellow school people from independent ground based use of the same frequencies. Because of this inefficiency MPATI's expansion of coverage with TV translators the usurpation of our schools' applications comes quicker. This translator application is even more inefficient when combined with the air based principle. We understand Detroit and some other places are already into channel saturation and their surrounding schools also prevented from potential local ETV use of the same frequencies for local and more applicable educational content and programming.

Lloyd P. Morris
2947 North 78th Court
Elmwood Park 35, Illinois

COMING EVENTS

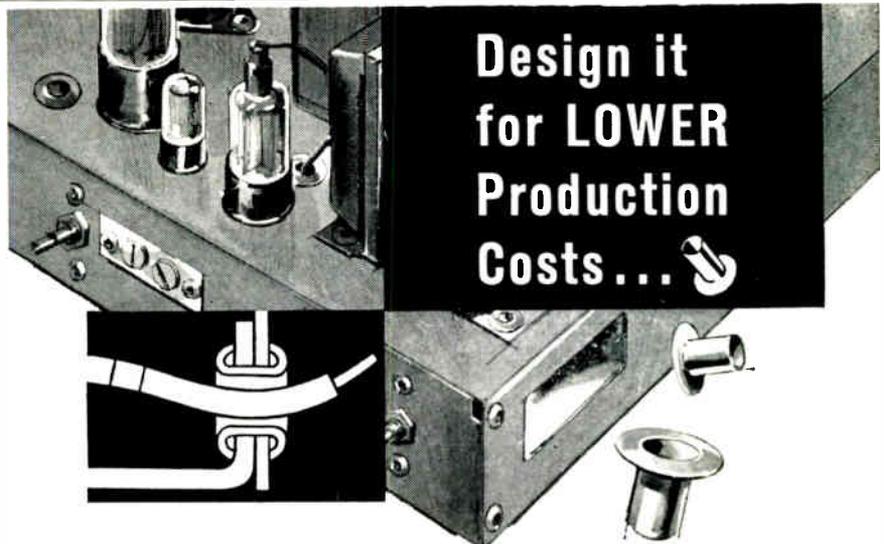
- Sept. 15-19: **Electrical Insulation Conf.**, IEEE, NEMA; Conrad-Hilton Hotel, Chicago, Ill.
- Sept. 16-18: **Nat'l. Conf. on Antisubmarine Warfare**, AIAA, ONR; San Diego, Calif.
- Sept. 16-20: **13th Int'l. Mgmt. Cong.**, Int'l. Committee for Scientific Mgmt.; Waldorf-Astoria, New York Hilton Hotels, New York, N. Y.
- Sept. 18-19: **12th Annual Ind. Electronics Symp.**, IEEE, ISA; Kellogg Ctr., Mich. St. Univ., E. Lansing, Mich.
- Sept. 22-25: **Nat'l. Power Conf.**, IEEE, ASME; Netherland-Hilton Hotel, Cincinnati, Ohio.
- Sept. 23-24: **Int'l. Conf.**, AIEE; New York, N. Y.
- Sept. 23-24: **Reg. Tech. Conf.**, SPE; Holy Cross College, Worcester, Mass.
- Sept. 25-26: **2nd Annual Symp. on Physics of Failure in Electronics**, Rome Air Development Ctr., IIT Res. Inst.; Ill. Inst. of Tech., Chicago, Ill.
- Sept. 25-28: **Materials & Eqpt. and White Wares Divs. Fall Mtg.**, ACS; Bedford Springs Hotel, Bedford, Pa.
- Sept. 29-Oct. 2: **51st Nat'l. Mtg.**, Amer. Inst. Chem. Engrs.; Hotel America, San Juan, Puerto Rico.
- Sept. 29-Oct. 3: **Fall Mtg.**, Electrochemical Soc.; Hotel New Yorker, New York, N. Y.
- Sept. 30-Oct. 3: **Nat'l. Fall Mtg.**, AWS; Hotel Statler-Hilton, Boston, Mass.

OCTOBER

- Oct. 1-2: **Engineering Problems of Manned Interplanetary Exploration Mtg.**, AIAA; Cabana Motor Hotel, Palo Alto, Calif.
- Oct. 1-2: **SPE Reg. Tech. Conf. on Reinforced Plastics & Chemical-Electronics Symp.**; Cleveland - Sheraton Hotel, Cleveland, Ohio.
- Oct. 1-3: **8th Nat'l. Symp. on Space Electronics**, IEEE (PTG-SET); Fontainebleu Hotel, Miami Beach, Fla.
- Oct. 1-3: **North Central Reg. Conf.**, NACE; Hotel President, Kansas City, Mo.
- Oct. 2-4: **Western Reg. Conf.**, NACE; Disneyland Hotel, Anaheim, Calif.
- Oct. 2-4: **Electronics Div. Fall Mtg.**, ACS; Riverside Hotel, Gatlinburg, Tenn.
- Oct. 3-5: **Refractories Div. Fall Mtg.**, ACS; Bedford Springs Hotel, Bedford, Pa.
- Oct. 4-6: **Amer. Radio Relay League Nat'l. Conv.**; Cleveland, Ohio.
- Oct. 6-8: **Basic Sci. Div. Fall Mtg.**, ACS; Nat'l. Bureau of Standards, Washington, D. C.
- Oct. 7-9: **9th Nat'l. Communications Symp.**, IEEE (PTG-CS); Utica, N. Y.
- Oct. 7-10: **13th Annual Instrument Symp. & Res. Eqpt. Exh.**, Nat'l. Institutes of Health; Bethesda, Md.
- Oct. 9-10: **1963 ERA/ISA Electronics & Instrumentation Exp.**; Seattle Ctr. Display Hall, Seattle, Wash.
- Oct. 9-11: **21st Annual Aerospace Electrical/Electronics Conf.**, Aerospace

- Electrical Soc.; Pan Pacific Audit., Los Angeles, Calif.
- Oct. 9-12: **Glass Div. Fall Mtg.**, ACS; Bedford Springs Hotel, Bedford, Pa.
- Oct. 13-18: **Semi-Annual Conv.**, SMPTE; Somerset Hotel, Boston, Mass.
- Oct. 14-16: **Materials Handling Conf.**, IEEE, ASME; Chamberlain Hotel, Monroe, Va.
- Oct. 14-17: **South Central Reg. Conf.**, NACE; Oklahoma City, Okla.
- Oct. 14-18: **Annual Fall Conv.**, Audio Eng'g. Soc.; Barbizon-Plaza Hotel, New York, N. Y.
- Oct. 14-18: **Nat'l. Mtg.**, Soc. for Applied Spectroscopy; El Cortez Hotel, San Diego, Calif.
- Oct. 15-17: **9th Tri-Service Conf.** on

- Electromagnetic Capability**, IIT Res. Inst., U. S. Army, Navy and Air Force, IEEE (PTG-RFI); Ill. Inst. of Tech., Chicago, Ill.
- Oct. 15-23: **Anglo-American Conf.**, AIAA, Canadian Aeronautics & Space Inst., Royal Aeronautical Soc.; New Ocean House, Swampscott, Mass.
- Oct. 16-18: **Nat'l. Symp. on Vacuum Technology**, Amer. Vacuum Soc.; Statler-Hilton Hotel, Boston, Mass.
- Oct. 17-18: **Regional Mtg.**, AIEE; Dallas-Ft. Worth, Tex.
- Oct. 20-23: **Joint Solid Fuels Conf.**, AIME; Chase Park Plaza, St. Louis, Mo.
- Oct. 21-23: **East Coast Conf. on Aero-**
(Continued on page 188)



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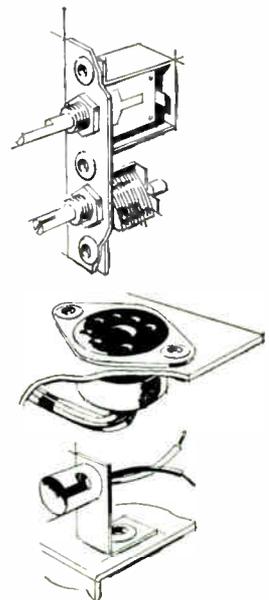
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COMING EVENTS

(Continued from page 187)

- space & Navigational Electronics, IEEE (PTG-ANE); Emerson Hotel, Baltimore, Md.
- Oct. 21-25: ASM Metals/Materials Exp. & Cong., ASM; Statler-Hilton Hotel, Cleveland Public Hall, Cleveland, Ohio.
- Oct. 22-24: Northeast Reg. Conf., NACE; Niagara Falls, N. Y.
- Oct. 23-25: 16th Pacific Coast Reg. Mtg., ACS; Ambassador Hotel, Los Angeles, Calif.
- Oct. 28-30: "Plastics Packaging and Custom Molding," Conf. & Eng'g. Exh., SPE; Sheraton-Dallas Hotel, Dallas, Tex.
- Oct. 29-31: 10th Annual Mtg. PTG-NS, IEEE (PTG-NS); El Cortez Hotel, San Diego, Calif.
- Oct. 31-Nov. 1: 1963 Electron Devices Mtg., IEEE (PTG-ED); Sheraton-Park Hotel, Washington, D. C.

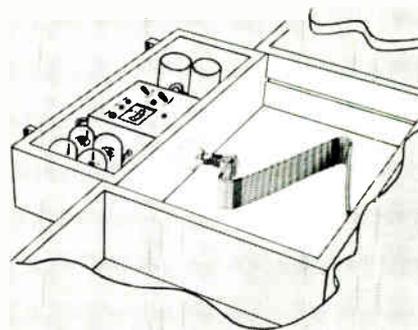
NOVEMBER

- Nov. 4-6: Design & Propulsion for Future Aerospace Vehicles Conf., AIAA; Biltmore Hotel, Dayton, Ohio.
- Nov. 6-8: Southeast Reg. Conf., NACE; Key Biscayne Hotel, Miami, Fla.
- Nov. 11-13: Radio Fall Mtg., IEEE, EIA; Hotel Manger, Rochester, N. Y.
- Nov. 12-14: Fall Joint Computer Conf., AFIPS (IEEE, ACM, Simulation Councils, Inc.); Conv. Ctr., Las Vegas, Nev.
- Nov. 12-14: Manuf. Automation Show & 7th Conf. on Manuf. Automation, Manuf. Eng. Council, Purdue Univ.; Cobo Hall, Detroit, Mich.
- Nov. 12-15: 9th Annual Conf. on Magnetism & Magnetic Materials, IEEE (PTG-MTT), AIP; Chalfonte - Haddon Hall, Atlantic City, N. J.
- Nov. 17-21: Joint Mtg. and Atom Fair Exh., ANS, AIF; New York Hilton, Americana Hotels, New York, N. Y.
- Nov. 17-22: Winter Annual Mtg., ASME; Bellevue-Stratford Hotel, Philadelphia, Pa.
- Nov. 18-20: 16th Annual Conf. & Exh. on Eng'g. in Medicine & Biology, IEEE, ISA; Lord Baltimore Hotel, Baltimore, Md.
- Nov. 18-22: 10th Nat'l. Plastics Exp. & Nat'l. Plastics Conf., SPI; Sheraton-Chicago Hotel, McCormick Place, Chicago, Ill.

DECEMBER

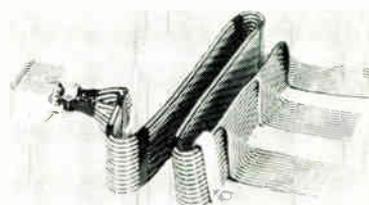
- Dec. 1-5: 56th Annual Mtg., AIChE; Rice Hotel, Houston, Tex.
- Dec. 3-5: Winter Conf., EIA; Statler-Hilton Hotel, Los Angeles, Calif.
- Dec. 4-6: AIAA/Air Force Testing of Manned Flight Systems; Edwards AFB, Calif.
- Dec. 4-6: Ultrasonics Eng'g. Symp., IEEE (PTG-UE); Marriot Motor Hotel, Washington, D. C.
- Dec. 5-6: 14th Nat'l Conf. on Vehicular Communications, IEEE (PTG - VC); Adolphus Hotel, Dallas, Tex.

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COMING EVENTS

"CALL FOR PAPERS"

1964 *Electronic Components Conf.*, May 5-7, 1964, Marriot Twin Bridges Motor Hotel, Washington 1, D. C. Papers are being sought in the following areas: capacitors, resistors, wiring and cabling, interconnections, connectors, reliability, thin-film devices, and materials. Three copies of a 500-word abstract should be sent by *Nov. 1, 1963*, to: Dr. John J. Bohrer, Technical Program Chairman, International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

ENGINEERING EDUCATION

Short courses of interest to engineers Hybrid Computation

A 1-week course on the concepts and uses of hybrid computation will be conducted by *Electronic Associates, Inc.*, at its Princeton, N. J., Computation Center on *Aug. 26-30, 1963*. Course is for the scientist, computer programmer or engineer who wants a working knowledge of hybrid computation and its uses in system analysis, design and simulation. Modern general-purpose digital and analog computers will be reviewed both as to basic characteristics and general programming. Hybrid systems will be discussed and an operational hybrid computer system will be demonstrated. Registrants should have a bachelor's degree or higher in engineering, physics or mathematics. Tuition will be \$175 per student, payable in advance to *Electronic Associates, Inc.*, Box 582, Princeton, N. J.

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To instruct systems men in automating computer inputs, *Friden, Inc.*, is offering a free 1-week training course. It is for persons who know the data input of their own computer program and who must achieve the proper configuration of peripheral equipment. Instruction covers code-by-code programming of a basic source document through by-product tape and tape-to-card conversion. Stress is placed on the creation of an accurate and economical data flow in paper tape or tabulating card form to the computing center. Course will be given *Aug. 5-9, Oct. 21-25, and Dec. 2-6*. Applicants contact: *Friden, Inc.*, Dept. 946, 97 Humboldt St., Rochester, N. Y.

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Dekoron Computer Twist-Ex is also available in cables (lower left) of from 4 to 36 pairs per cable in up to 1000 ft. lengths. Wire insulation and cable jackets are color coded to ISA standards. Engineered to highest standards, Dekoron computer wire products assure cleaner signals and lower installed costs. Samuel Moore & Co., Mantua, Ohio.

TYPE CM

SAMUEL MOORE

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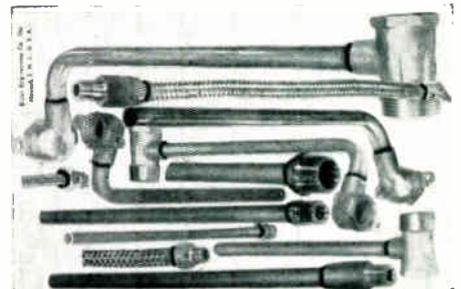
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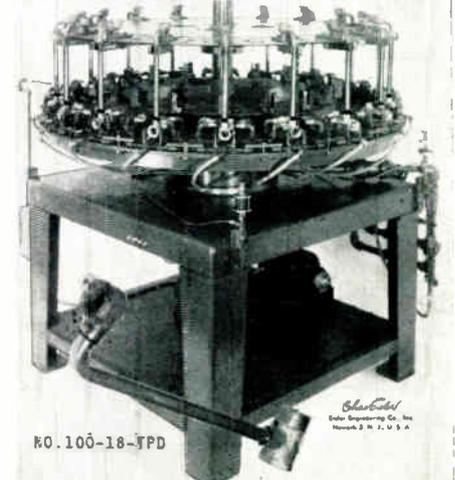
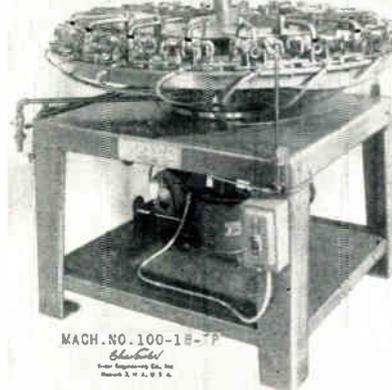
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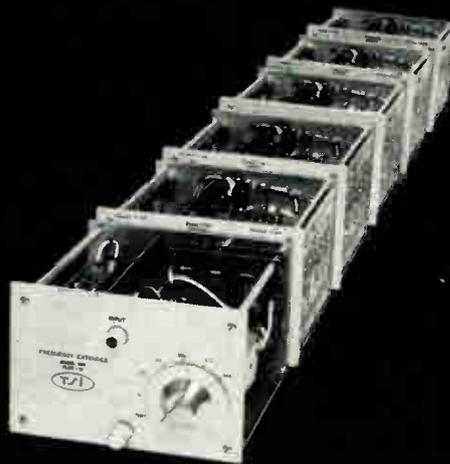
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5 other plug-ins available

Match a TSI Counter To Your Needs—Select From 6 Standard Plug-Ins

TSI's MODULAR COUNTERS FACILITATE: • Precise Frequency measurement from DC to 500 MC • Frequency Ratio measurements from 0-20 MC, measured over 1 to 10^5 periods for greater resolution • Time Interval measurements from 0.1 micro sec. to 10 sec. • Periods averaged over 1 to 10^5 periods.

The eight digit, direct reading Nixie® display provides storage or count-display operation. Decimal point is automatically positioned and units as KC or MC are Nixie indicated.

Sensitivity is 100 MV for AC or DC signals, with stability better than ± 2 parts in 10^8 per week. Packaged in an engineered enclosure, the TSI 500 or 500L counter with plug-in weighs less than 45 pounds.

*Factory conversion to 100 MC capability available for \$480

Plug-in	"A" input DC-20MC	"B" input DC-20MC	"C" input 1MC- 100 MC	"D" input 1 MC- 500 MC	Function †	used with Model 500	used with Model 500L	price
510	x	x	x		F, FR, P, TI, E	x		420
511	x		x		F, P, E	x		310
512			x		F	x		200
515	x	x			F, FR, P, TI, E	x	x	280
516	x				F, P, E	x	x	170
520				x	F	x		680

†F=Frequency • FR=Frequency Ratio • P=Period and Multiple period average • TI=Time Interval • E=Total Events

WRITE FOR COMPLETE SPECIFICATIONS



TRANSISTOR SPECIALTIES, INCORPORATED

TERMINAL DRIVE, PLAINVIEW, L. I., N.Y. PHONE 516 WELLS 5-8700

NEWS NOSES THROUGH OUTER SPACE

News stories were transmitted for the first time between two continents for automatic typesetting, passing through an RCA computer en route and spanning the Atlantic by Relay Communications satellite. Place was American Newspaper Publishers Association meet in Chicago. Relay replica is in foreground.



In expanding video tape facilities, WNDT, Channel 13 in Metropolitan New York, will be the first educational TV station to use a new TV tape recorder. Made by RCA, the new TR-22 solid state recorders have improved performance and reliability, plus reduction in size, weight and power use. The expanded tape facilities will enable the station to present more taped programs for the National Educational Television and Radio Center, the U.S.I.A. and other users of educational programming.

Some 30,000 marine radiotelephones now in use do not qualify for FCC license renewals, according to J. Leonard Lovett, manager of Raytheon's Marine Product Operations. The FCC denies licenses to ship-to-shore radios not "type accepted." Manufacturers have been complying with the "type acceptance" requirements for some time, Lovett said, but some older sets and most foreign sets are affected. Most 2 mc radiotelephones are not eligible for license unless they have been "type accepted."

FCC has adopted a schedule of fees for the filing of applications in most of its licensing activities, to be effective January 1, 1964. Part I of the Commission's rules of practice and procedure is amended to include the prescribed fees, which range from a minimum of \$2 for amateur license modifications, to \$100 for TV station applications. The only exemption in broadcast fees from the original proposal is to eliminate noncommercial educational applications by tax exempt organizations.

← Circle 145 on Inquiry Card

ELECTRONIC SYSTEMS

Construction will begin soon on a microwave radio system to link the Bureau of Reclamation's power generation and transmission facilities in the five-state Colorado River Storage Project, the Department of Interior has disclosed. Utah, Wyoming, Colorado, Arizona and New Mexico will be served by the federally operated, multi-channel microwave system to be built by Stromberg-Carlson, division of General Dynamics. The contract is for \$2,278,364.

Sen. Gordon Allot (R.-Colo.) called for one "protected" frequency, out of 69 UHF TV channels, for radio astronomical research. He said that scientists in space observations had hoped that the FCC would provide a protected channel, but that the proposed rule-making now before the FCC could open Channel 37, wanted by scientists, to limited commercial operations.

New CBS Broadcast Center in New York City, set for the air early 1964, will include two Thompson Ramo Woolridge, Inc., Type-330 control computers to aid in all routine, preplanned program switching operations. Three distinct on-line functions to be performed by the computer system are on-air continuity switching, facilities assignment switching, and studio lighting preset storage and retrieval.

William J. Weisz, product vice president of Motorola's Communications Division, in a special letter, asked President Kennedy to consider a non-broadcaster for the next FCC appointment. Weisz, as chairman of the EIA's Land Mobile Communications Section, said that the public is vitally affected by FCC actions and will benefit only by appointment of a commissioner whose interest and experience cover the entire radio spectrum administered by the Commission. He pointed out that a broadcaster's experience is usually limited to broadcasting, and seldom includes experience in any of the broader fields of radio.

MINUTEMAN SECURITY SYSTEMS

Sylvania Electronic Systems continues research and development on electronic security systems to help guard U.S. Air Force Minuteman ICBM sites. Above, engineers check part of the security system equipment before being sent to the Minuteman site. Contract for \$3.2 million calls for 9 systems to be distributed to Minuteman bases.



When selecting an ac converter or power source the main items to be considered are use or load parameters, input parameters, output parameters, mechanical configuration and cost. All of these important items plus many more are covered in this article.

FOR SYSTEMS...

SELECTING AN AC POWER SOURCE

THE SELECTION OF AN AC POWER SOURCE presents a variety of problems unheard of a few years ago. Some 100 parameters should be considered in their selection.

A significant change has been in the gradual replacement of rotating devices by static inverters such as SCR's and solid state switches, or by vacuum tube oscillator-amplifiers. Most inverter or dc-to-ac applications in the missile and mobile fields have gone to transistor and SCR packages. Here small size, light weight, and high efficiencies are of prime importance, whereas cost may be of less consequence. In laboratory and production, check-out size and weight considerations are less important. Vacuum tube converters are being used here not only because of their lower cost, but more important, because of their extreme voltage and frequency stability coupled with their ultra-low distortion and ease of maintenance. Selection of this latter group of ac power sources, because of their more exotic nature, is the purpose of this discussion.

* * *

Main items to consider in the selection of an ac converter or power source are use or load parameters, input parameters, output parameters, mechanical configuration and cost.

Since cost is a personal thing and varies with the required specifications, we will only remind you that you usually get what you pay for, no more. One cannot expect to get the precision and stability from a \$180.00 oscillator coupled to a \$200.00 amplifier that could be obtained from a precision power supply designed for this particular use, and costing maybe 2 to 3 times as much. Neither should one buy the latter if only the former is needed; that is why use or load parameters should be considered first.

For the most part, precision ac sources are specified and purchased to most nearly approximate an ideal power source. This is done to remove as many variables as possible from the testing and evaluation

of electronic components. A perfect ac power supply has as yet to be designed; but, there are certain load parameters the maker should know to aid him in designing as close as possible for the desired use. Following are some items that should be known about the load. Most of them are self explanatory, though a few need some comment.

Load Parameters

What is the load? What is its description, va rating, power factor, equivalent circuit and impedance?

Why is a precision type supply necessary? What type of tests have to be made, over what periods of time, through what temperature range?

Special considerations are multiple loads, multiple taps, starting currents, induced transients and varying PF loads.

Type of Service—continuous duty or intermittent (length of warm-up).

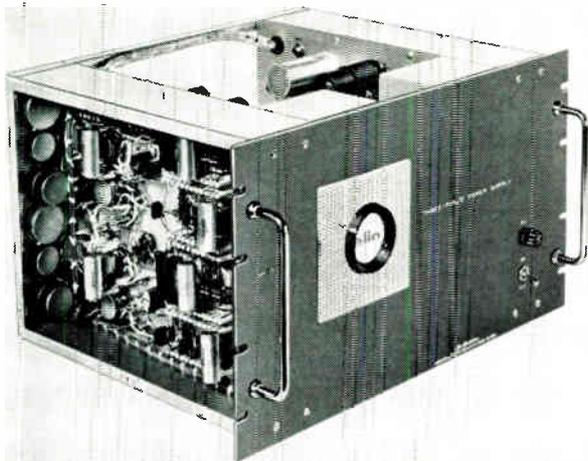
Associated equipment considerations are resistance of cabling, capacitance of cabling, types of metering and switching (resistance and transients).

The maker should always be given as complete a description of the electrical characteristics of the load, including equivalent circuit, as possible. If a maker has been in the business long, he will have come across all kinds of loads and will be better able to judge how his supply will react to your load. Also, with an equivalent circuit, he can duplicate your load in final testing and calibration of the supply, and thus assure a better supply for a specific use.

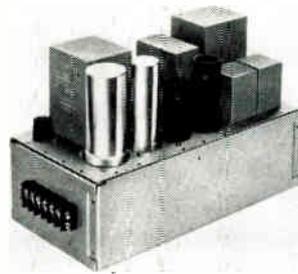
Transients induced back into the supply by such loads as magnetic amps or automatic programming

By **O. G. LEICHLITER**

Elin Division
International Electronic Research Corp.
135 West Magnolia Boulevard
Burbank, Calif.

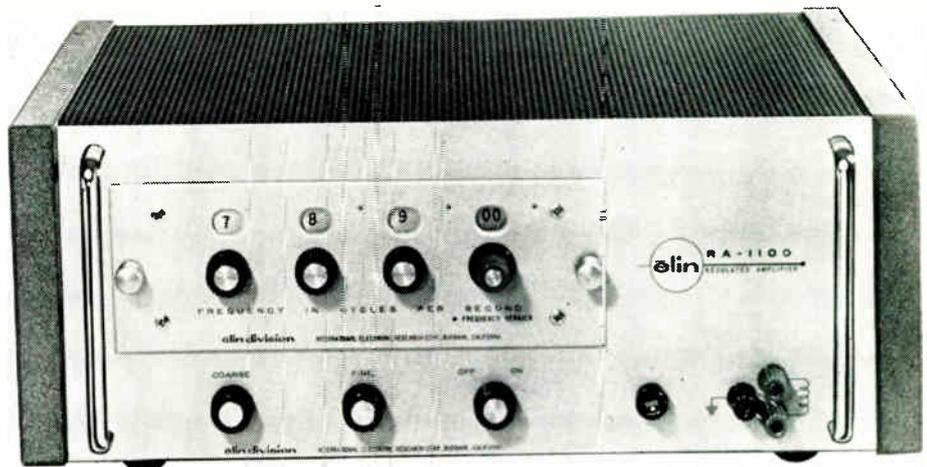


Front view of the MK-150 3 phase, 50 w. power supply. This supply consists of three 15 w. oscillators with an integral oscillator driver mounted on a 10½ in. rack panel. Delta and wye connections are located at rear panel of the unit.



This 2 watt power oscillator has a maximum total harmonic distortion of 0.1%, a frequency stability of 0.1% and amplitude regulation of 0.2%, under all conditions of line and load.

DK1-102A 2w. power oscillator is designed for shock-mounted installation in aircraft and missiles as a power supply for control equipment, gyros, synchros and servos, etc. It is also readily used in electronic ground support systems.



RA-1100 precision ac power source provides regulation against varying line and load, 100 va power output, 45 to 5,000 CPS frequency range audio decade oscillator, fixed frequency oscillators, frequency standards, phase shifters and custom modules.

Programmable I-f oscillator (AM216-4R) will supply any one of four preset output frequencies in the range 20 to 400 cps. Output selection may be made remotely by use of one of four 28v. dc relays or manually by a switch. Supply will furnish 26v. unbalanced output at 52 ma. within above range.



AC POWER SOURCE (Continued)

can completely kill a solid state supply not designed to handle them. It can also seriously affect vacuum tube supplies. Many of these supplies with large amounts of feedback around them can be driven to instability by induced transients entering the feedback loop.

Lastly there is the matter of associated equipment such as cables, meters, switches, etc. These are important as frequencies and voltages increase. I have observed ratio-transformers inserted between small lab supplies and instruments to be calibrated. Most of these supplies are small 2 or 6 w. units, since no "power" is usually drawn by high impedance loads. At 100 v. and 400 cycles, one such ratio-transformer was driven satisfactorily by a small supply, but at 300 v. and 10 kc, the ratio-transformer represented a 16 va load. Small calibration units have been seen racked up in consoles where the associated cabling, due to capacitive loading at 500 v. and 10 kc, was equivalent to 8va.

Switches, too, can present a problem to a precision (0.1%) regulated supply. Let's say we are going to program 1 v. from a 2va supply. This would be 2 a. and at 0.1% voltage regulation, we could stand only 0.001 v. drop. Thus our contact resistance, excluding any associated wiring, would be only 0.0005 ohms, far less than any presently available programmable switch.

Next comes input parameters. This includes not only line input, but also sync. and signal inputs, for many users of ac power require these sources to be synchronized to a frequency standard already in their plant. Also, where high-power, regulated amplifiers are used, precision drive-signals are required. This means that many times we can have up to 3 inputs, about whose 12 to 15 parameters we must gain as much knowledge as possible.

Input Parameters

Input parameter data is needed for line, sync., and signal input. Under these we have voltage, frequency, distortion, power and phase. Under voltage we have potential (Line to line or line to neutral should be specified where applicable), long term regulation and short term transients. For frequency we must know how derived and stability (short term jitter and long term drift). In the distortion category we must know the harmonic to at least the 5th order, the phase and the trash on the line. Power information should include wattage available from the source, source impedance, wattage needed by supply and input im-

pedance. Phase data should include the number and type of hook-up.

Here again, most of the items are self explanatory, but a word of caution about a few of them.

Synchronizing a power source can be easy. But, we must know the type of sync. signal available, impedance of the source, and more important, the type of sync. desired. By this is meant, do we want the power source synchronized in frequency to some more precise standard or do we want it phase-locked to another source and if so, at what angle? As a third alternative, we might want the power source to follow, in frequency and phase, some varying frequency source. This latter problem, while it might look simple, is really quite complex and costly to do in a precision supply. This is because it entails, among other things, a compression amplifier. Then too, various methods of sync. require various levels of power. This is why the impedance and power of the sync. source must be known so that impedance and power matches can be supplied if the correct ones are not available.

Probably one of the most important factors to know concerning any input, (sync., signal or line) to an ac power source is its "figure of Merit" for that particular parameter. As an example, if the output voltage varies $\pm 0.1\%$ for $\pm 10\%$ line variation, the "figure of Merit" for output voltage vs. line is 100. If the output distortion increased 0.1% for a 5% sync. signal distortion, then this parameter's "figure of Merit" is 50. Some figures of merit may be so high as to be neglected, such as output frequency versus line frequency in certain unit oscillators. On the other hand it could be unity in such cases as output frequency vs. input signal frequency in a regulated amplifier. These "figures of Merit" vary from circuit to circuit and in different uses, so it is always better to find out from the maker what his particular figure of merit is for any given parameter.

Next let's consider output parameters. Following are some items, most of which we should know before attempting to settle on one particular supply.

Output Parameters

Output parameter data is needed for unit regulated oscillator, oscillator amplifier combination and regulated amplifier. Each of these categories should include:

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by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

Voltage information—balanced or unbalanced, number of taps (tap accuracy), potentials (specify line to line or line to neutral where applicable), regulation (varying line), varying load, stability (short or long term) and setability (resolution).

Frequency information—type of frequency determining network, accuracy and stability (with varying line, load and temperature and long term).

Distortion information—total harmonic (no load, full load), harmonic content, hum, noise, jitter and phase.

Power information—VA and PF ratings.

Phase information—number, type of hook-up (delta, wye, star, etc.), and stability in degrees (varying load, line and frequency, and short and long term).

The one exception is that for the regulated amplifier, band width should be substituted for frequency.

One item that will probably bring up more questions and entail more explanations than any other is voltage stability.

While few makers of ac supplies will specify voltage stability, they will specify frequency stability, voltage regulations, and even setability, but since there is no ac voltage standard to reference their output against, most manufacturers in this field will omit that spec or limit it to a short term (i.e., 30 sec. to 30 min.)

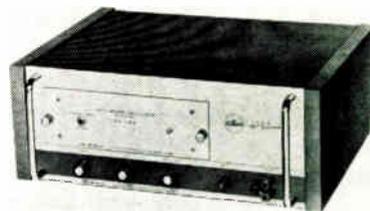
There are, however, a few who do specify ac voltage stability over periods up to 30 days. They do this by designing a stable ac to dc converter, then referencing against a dc standard and use this error signal to correct the output of their supply. These supplies cost between 3 and 5 thousand dollars, as compared to 5 to 8 hundred dollars for comparable supplies without reference and comparator circuits.

As a result, most ac supplies simply use large amounts of feedback to help with short term stability and depend on periodic monitoring for long term voltage control.

Other than this one item, there should be little trouble in arriving at the other output specs. It should always be borne in mind, however, that the tighter specs one places on a unit, the greater the cost. Too many times today, system engineers overspecify rather than take the time to figure exact specs. This can result in sharp increases in price. As an example, if a single phase, 400 cycle, 100va supply was ordered with 0.5% regulation, it would cost about \$500.00. At 0.1% regulation, the price would go to \$900.00 and at 0.01% regulation, the

price would be up to about \$3,500.00. Delivery time also can increase from a week to 10 days for the 0.5% unit to 30 to 45 days for the 0.1% unit, clear up to 4 to 5 months for the 0.01% unit. Before assigning output specs, therefore, all output parameters and what is actually needed should be carefully considered.

Mechanical parameters of an ac supply are usually determined by the maker unless a completely custom-built supply is ordered. Even so, there are many small items that can be changed, at nominal cost, which could greatly improve its use in a given installation. Placement of operating and non-operating controls is one of these items. It might be advantageous to have the voltage control or even regulation on the front panel. In other instances, where unauthorized people might move them, all controls could be mounted inside the unit. Placement or types of connectors might be changed to suit a given installation. Following are some such items.



General purpose ac power amplifier has 160 va power output and 45 CPS to 10 KC frequency range.

Mechanical Parameters

Mechanical parameters which should be known are: (1) Cabinet model, size, weight and color. (2) Rack model, size, weight and color. (3) Connectors needed for input, output, sync., signal and relay. (4) Remote or relay control voltage and whether it is internally or externally supplied. (5) Reason for oven stability required (frequency/voltage) and ambient temperature. (6) Which military specs are applicable. (7) Placement of voltage, regulation, phasing, bias, balance and fuse controls.

Cost

Changing any of these will usually entail some extra cost and changing many of them can run the basic cost of the ac supply quite high. Also, in the matter of remote control or programming, certain parts of the circuit such as input parameters are fairly easy to control. Other parts, such as programmable output voltages, can seriously affect the performance of the supply under certain operating conditions. This is why it is always best to gain as much knowledge as possible about the use to which a given supply will be put, and the loads connected to it.

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RELATIVE MASS/WEIGHT COMPARISON

Heat Dissipator Type	Displacement	Size	Weight
IERC Finger design	9 cu in	3" x 3" x 1"	1.5 oz
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EDITOR'S MAIL BOX

LOOK-OUT ASSIST DEVICES for ships are being studied by Sperry-Piedmont Co., Charlottesville, Va., for the Commerce Department's Maritime Administration, to improve Merchant Marine service, safety and economics. Radar has proved itself in collision studies but it has trouble spots, technical and human. Current device requirements are: detection of other objects with high certainty at a range of five to 20 miles without help from the other objects; detection of objects moving toward ship and indication of bearing within 10 to 15 degrees; suitability for use on a cargo ship of about 10,000 deadweight tons, and minimum servicing.

THE AVERAGE WOMAN ENGINEER is between 36 and 37 years old. She is equally likely to be married or single, is employed industrially, and earns about \$10,000 a year. If she is married, she has three children. She has a bachelor's degree in engineering or one of the physical sciences, and has a graduate degree or has taken specialized training at graduate level. Although a technical society member, she is not likely a licensed professional engineer. So reports the Society of Women Engineers in a recent pamphlet.

NEW OPTICAL MATERIAL by American Optical Company, based on "reversible photochromatic materials," may bring new wonders. The material changes properties in response to light, almost chameleon-like. It responds to blue or ultraviolet light of certain wave lengths and reverts to transparency when light stimulus is removed. Darkening action takes less than 40 μ sec; reverse process is slower. Material might lead to sunglasses equally useful in shade, welding goggles that darken automatically, atomic flash protection and windows for spacecraft that travel rapidly from complete darkness to bright sunlight.

FOX HUNTING BY RADIO is the newest thing in Virginia's Blue Ridge Mountains. Rappahannock Hunt Club members use walkie-talkies in place of the usual shouts too often lost to the wind among mountain tops. They report some success, though occasionally pick up a Mexican radio station or radio truck dispatchers. So far the Rappahannock Club is the only group to try the walkie-talkie idea. Yoicks!

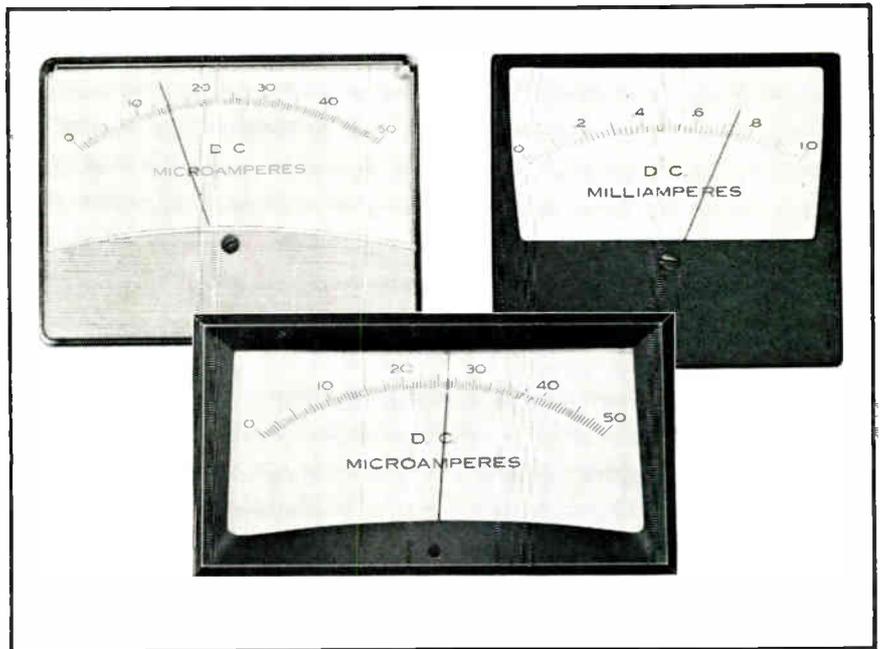
SIGHTS AND SOUNDS are no problem at all for an electronics dealer in Columbus, Ohio, whose auto is a moving ad. It's equipped with: AM and FM receivers, a TV set, police and highway patrol radios, CB units, power supplies for PA systems, and rear-view mirror, windows, seats and trunk latch, all electronically operated.

'WHISTLERS' AND 'IONOSPHERICS' may become better known to Dartmouth engineers when they put their listening station in "polar orbit" in 1964 aboard a NASA satellite. Dartmouth hopes to record the natural RF signals. "Whistlers" are AF waves from lightning-stroke radiation that have penetrated the ionosphere. "Ionospherics" are of unknown origin. Several ionospherics have been recorded; they have descriptive names such as "sliders" (falling whistle tones), "surf," "hisses" and "hooks" (falling tones with an abrupt end rise).

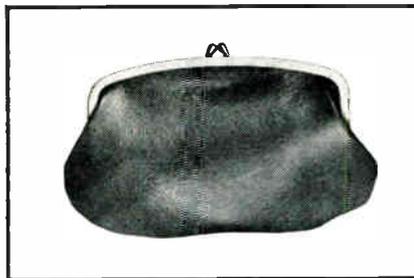
HUMAN BRAIN WAVES were transmitted from Bristol, England, to Minneapolis for diagnosis by a Computer of Average Transients (CAT). The brain waves, very low frequency, were put on a 1.75 kc carrier to a British TV station. The signals were transmitted by NASA's RELAY to ITT station at Nutley, N. J. Brain waves went over land directly into CAT at Minneapolis. Within seconds CAT, small and sophisticated, presented accurate data for diagnosis, which was returned to England by RELAY.

COLOR BLINDNESS, even in marginal cases, is an increasingly important factor in electronic manufacturing. The U. S. Gauge Division of AME-TEK, Inc., expanding some of its highly critical color-coded assembly work on a missile component, gave job applicants a physical examination with emphasis on the color factor. The firm found that a surprising 20% of otherwise fully qualified persons could not pass stringent color distinction tests.

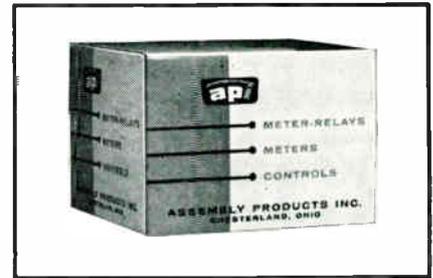
FOOD FALL-OUT has given our astronauts a bit of trouble as they orbited the Earth. Gordon Cooper complained of drinking water globules floating around his cabin. Scott Carpenter had similar trouble with cookie crumbs. So the Life Support Systems Division of Aerojet-General Corp. has come up with a hand-operated lightweight plastic gadget that neatly vacuums up the vagrant vittles. It is economical to make and requires no power except for a hand squeeze.



API announces: a new line of taut-band panel meters



lower prices



fast delivery schedule

API's new Stylist/Panelist series will completely change your meter ordering procedure. Now taut-band suspension is standard in fully half the ranges, costs just \$5 more for most others. Now you can add to your equipment the good looks of the panel-saving Stylist models (center, above) for only slightly more than the clear-plastic Panelist (at left).

Not only that, but you get self-shielding movements in almost every range, and the most popular ranges are in stock, ready for shipment in three days. The cost: an average of 20% less than previous API taut-band meter prices.

How did API do it? First we developed a new version of an internal-magnet, self-shielding movement that needs no recalibration when the meter is changed between magnetic and

nonmagnetic panels. Besides providing greater control of linearity, it's less expensive to build. Also, it takes full advantage of the rugged and sensitive taut-band suspension.

And we designed a new meter case that's convertible from the surface-mounting Panelist to the recessed-mounting Stylist merely by adding a bezel, held in place by two screws. We make these styles in eight sizes from 2¼" to 6"; in addition, there's one model in a black-phenolic case, in the popular 4½" size (shown above, right).

Stylist/Panelist meters are also available as pyrometers with built-in cold-junction compensation. Our new Bulletin 34 will give you complete details and prices; a copy is yours for the asking.



ASSEMBLY PRODUCTS, INC.

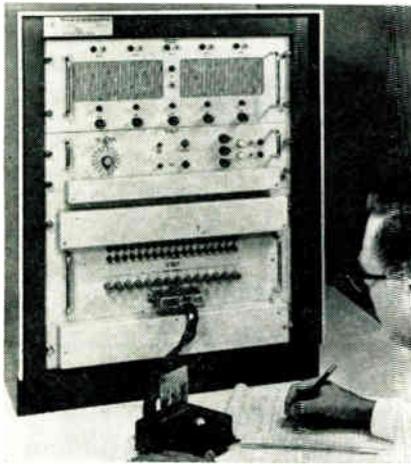
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5A2794

INTEGRATED CIRCUIT TESTER

THE TESTING OF INTEGRATED CIRCUITS has been simplified with the Model 659A. The tester claims high test capacity, programming simplicity and small size. The integrated circuits can be tested rapidly by unskilled personnel.

Programming is accomplished by precision resistors mounted on a plug-in board. This simplifies and speeds the testing of units.



In one second the 19 x 28 x 20 in. unit can perform 36 tests on devices with up to 14 terminals. Plug-in circuit boards for bias, limits, timing, and sorting add to programming simplicity. Programming is accomplished by precision resistors on a plug-in board. Sensing leads from power supplies to the bias program

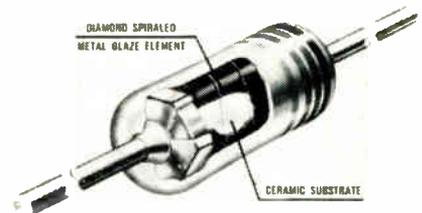
board where main power loads are located maintain voltage levels. Go/no-go decisions are made by a comparator which has a voltage resolution of 2mv and a current resolution of 100 picoamps. Texas Instruments Incorporated, P.O. Box 66027, Houston 6, Tex. BOOTH 3303.

METAL GLAZE RESISTORS

METAL GLAZE, the thick film of metallic alloys, has been incorporated into a new series of resistors. The L-series uses this reliable and stable material to offer a degree of precision which exceeds the requirements of Mil-R-22684. Temperature coefficient averages 160 ppm/°C.

The metal glaze material, which is practically impervious to environmental stress, is protected by a formulation of modified silicon.

Units are available in 2 sizes: L07



Sealed unit available to 470K ohms.

is rated at 1/4w. at 70°C and has a range from 51Ω to 150KΩ; L20 is rated at 1/2w. at 70°C and has a range from 51Ω to 470KΩ. Tolerances are ±2 and 5%. International Resistance Co., 401 N. Broad St., Phila., Pa. BOOTH 1813.

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MODEL 1100 SERIES

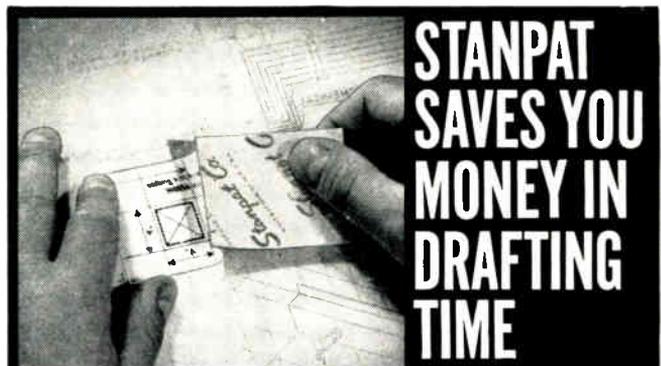
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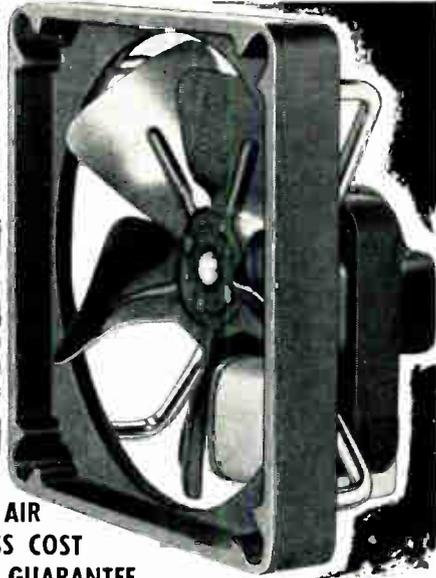
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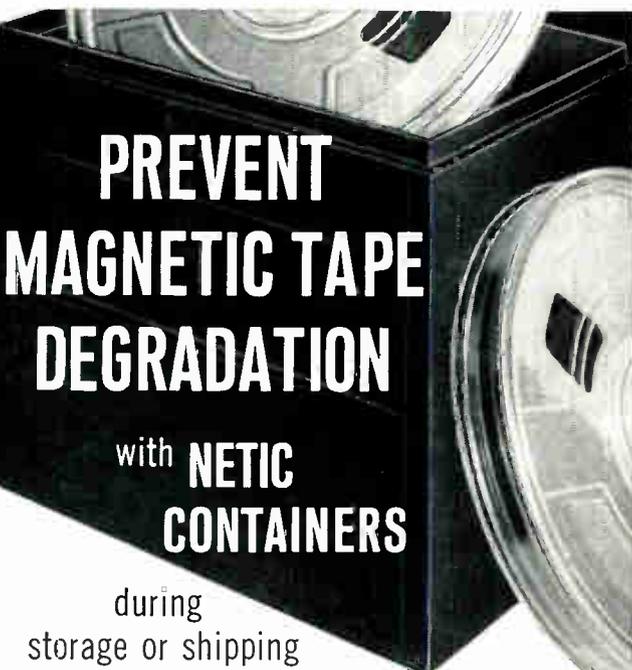
Divisions: Electric Motor Corp., Cyclohm Motor Corp., Racine Electric Products,
Lloyd Scruggs Co., Micro Gear Inc.,

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MAGNETIC SHIELD DIVISION

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Circle 150 on Inquiry Card

ELECTRONIC INDUSTRIES • August 1963

NEW
fully transistorized



**Motorola
1010
Frequency
Standard**

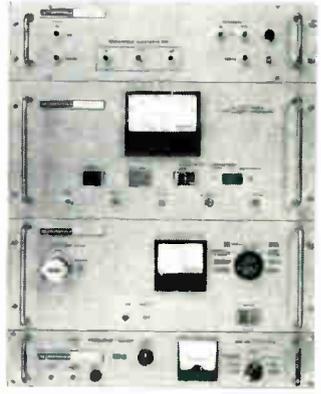
- **Output Frequencies** 1 mc and 100 kc at 1 volt RMS. Spectrally pure 5 mc output optional.
- **Stability** Time: 24 hours, less than 5×10^{-10} . Temperature: $25^{\circ}\text{C} \pm 25^{\circ}\text{C}$ less than 5×10^{-10} .
- **Circuitry** Double Proportional Control Oven, Zener regulation, Mega life transistors.
- **Input Voltage** 117 or 230 VAC, 50-400 cps, 26 VDC external and internal battery.
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- **Size** $3\frac{1}{2}$ " high, $14\frac{3}{4}$ " deep, 19" wide

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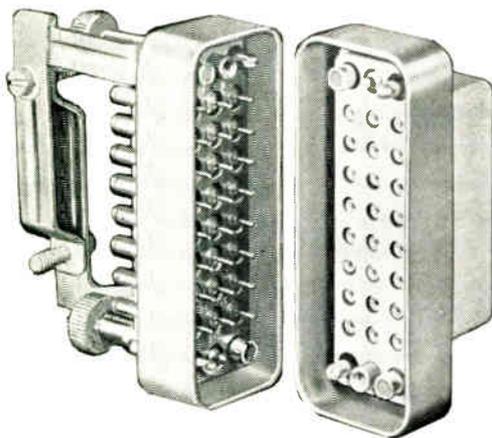
Motorola Communications & Electronics, Inc.
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For Multi-Contact Connectors
That Meet or Exceed Mil-C-22857 Requirements—

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The advantages of exclusive CURTAC design . . . the tremendous savings and convenience of removable crimp type contacts — you get both with our new Series 60 contacts!

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EXCLUSIVE

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DESIGN GIVES YOU THESE ADVANTAGES:

- Patented closed entry construction.
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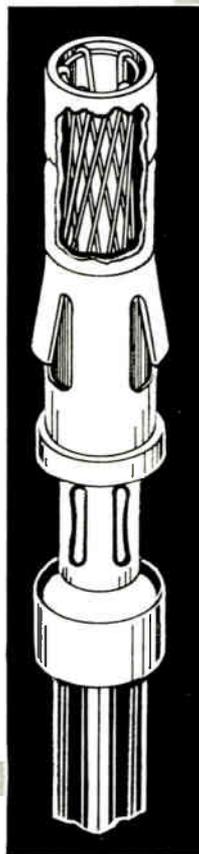
Send us your requirements. Our engineers will design and produce CURTAC Connectors to your specifications. Or, write for literature on standard connector models, available for 14 to 104 removable contacts.



ELECTRONIC FITTINGS CORPORATION

29 SUGAR HOLLOW ROAD, DANBURY CONNECTICUT

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CURTISS-WRIGHT CORPORATION



G. E. OPENS \$15-MILLION REFRACTORY METALS PLANT

The General Electric Co. has opened a \$15-million refractory metals plant near Cleveland. It is considered to be the largest and most highly integrated production facility of its kind.

Located on an 11-acre tract in Euclid, Ohio, the plant is already producing molybdenum and tungsten sheets. Tantalum and columbium processing will follow in coming months.



Molybdenum strips, basket-woven to form these cylindrical heat shields create an interesting pattern and form an effective thermal barrier for high-temp. furnace. Molybdenum and other refractory metals for electronic uses are being produced at new General Electric plant near Cleveland.

NEW MATERIAL EXTENDS INJECTION LASER RANGE

The recent successful operation by IBM scientists of an indium phosphide laser has extended the range of injection lasers. Its wavelength is 9,030 Ang., compared with 8,400 Ang. for gallium arsenide and 7,000 Ang. for a gallium arsenide-gallium phosphide combination also recently reported.

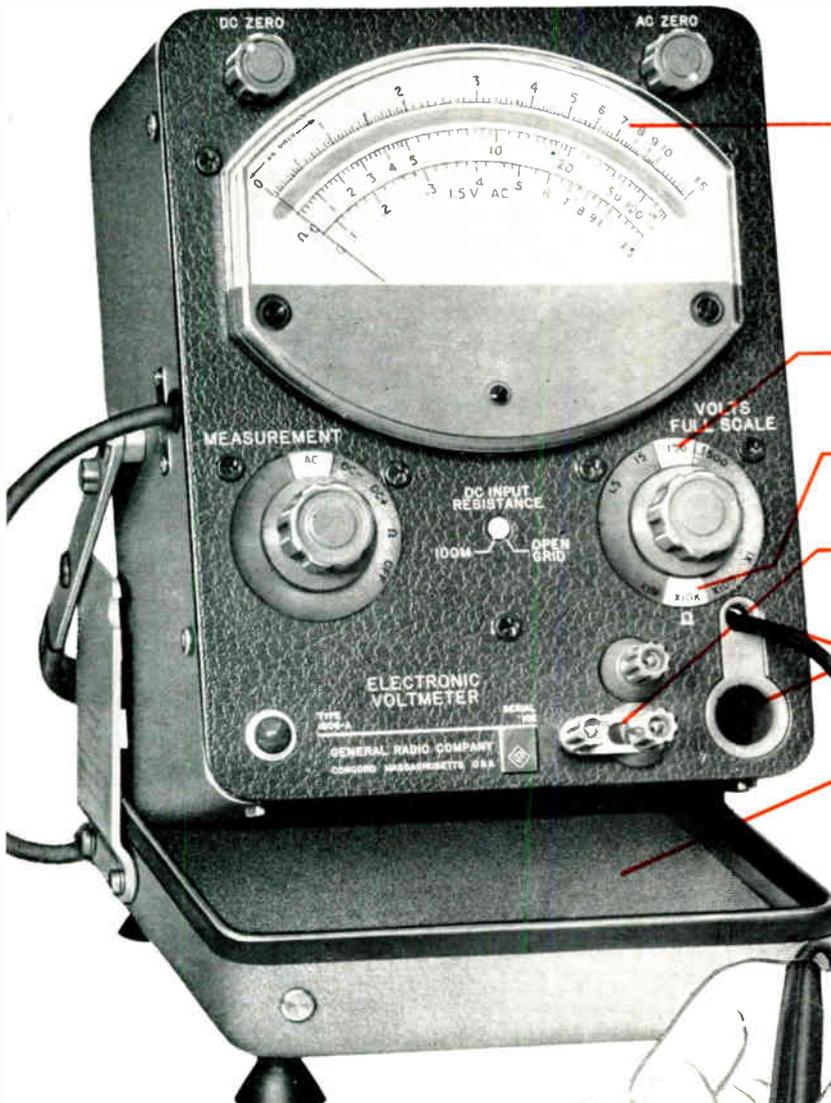
Experimental operation of the new laser strengthens the belief that still other semiconductor compounds can be used to make injection lasers. Use of these materials is expected to further the potential of injection lasers by further broadening their frequency range.

Laser action with short coherent light pulses was obtained by putting current of about 6,000 a./cm.² through the diode at 77°K. At much lower temps., the laser operated continuously. Threshold current was reduced by 80% at 4.2°K.

INTEGRATED CIRCUITS

The Data Systems Div., Litton Industries, Canoga Park, Calif., has ordered \$900,000 worth of integrated circuits from Texas Instruments Incorporated, Dallas, Tex. They are for installation in AN/ASA-27 computer-indicator systems.

New DC to 1500 Mc Voltmeter



Voltage Accuracy: $\pm 2\%$ of reading above one-tenth of full scale. 0.005v minimum dc reading

Only one scale for all voltage measurements. Prevents reading wrong scale. Expanded scale for measurements below 1.5 v ac.

Measures up to 1500 volts directly, ac or dc; no external multipliers required.

Wide-range ohmmeter — 0.2 ohm to 1000 megohms in four ranges.

Input Impedance: AC, 25 megohms, DC, 100 megohms or "open grid" (on all but 1500v range). Grid current is less than 10^{-10} ampere.

Built-in storage socket and reel for probe and its cable.

Handy storage compartment for accessories.

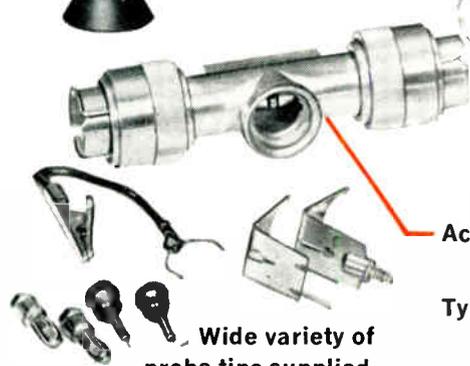
Calibration Stability is Excellent. The heart of the Voltmeter is a stable tube-and-transistor amplifier. There is so much feedback that changes in tube transconductance or transistor current gain have practically no effect.

Wide Frequency Range — within ± 3 db up to 1500 Mc; resonant frequency of probe is above 3000 Mc.

Input Impedance: 25 megohms in parallel with 2 pf.

Accessory Tee Connector available for uhf measurements in coaxial systems (Type 1806-P1, \$35.00).

Type 1806-A Electronic Voltmeter . . . in convenient flip-tilt case for portability, doubles as an adjustable stand — also available in rack model. Price either model \$490 (in U.S.A.)



Wide variety of probe tips supplied.

SEE this

NEW instrument at WESCON along with a *Waveform Analyzer* and *Digital Frequency Meter*

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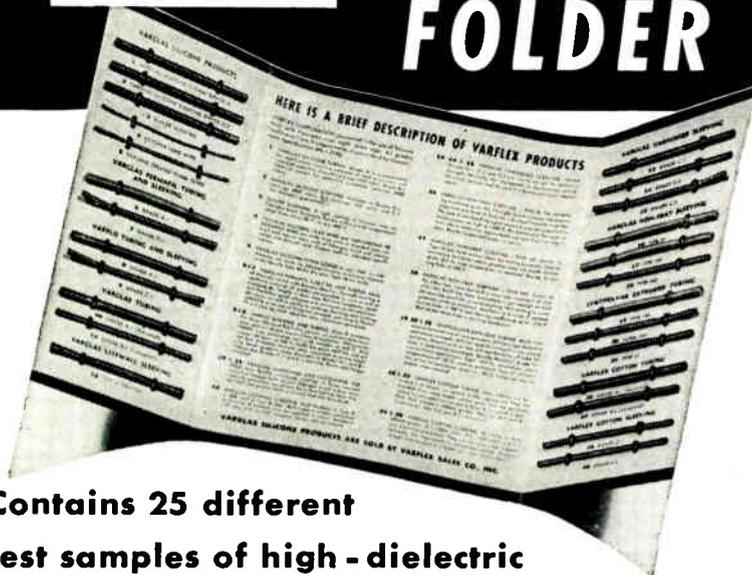
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Circle 153 on Inquiry Card

World Radio History

Send for this **FREE SAMPLE FOLDER**



Contains 25 different
test samples of high-dielectric
INSULATING TUBING and SLEEVING

Includes samples and descriptions of . . .

VARGLAS SILICONE—Class H tubing, sleeving, lead wire, tying cord. Withstands temperature from -85°F to 500°F .

PERMAFIL-IMPREGNATED VARGLAS TUBING—Fiberglas impregnated with General Electric Permafil.

VARGLAS SLEEVING AND TUBING—synthetic-treated, varnished, lacquered, saturated and others.

VARGLAS NON-FRAY SLEEVING—three types available. Withstands temperatures up to 1200°F .

VARFLO TUBING AND SLEEVING—full range of colors, sizes and grades. Vinyl coated Fiberglas.

VARFLEX COTTON TUBING AND SLEEVING—varnish or lacquer impregnated—all NEMA grades.

SYNTHOLVAR EXTRUDED TUBING—listed by UL for use at 105°C . Various formulations to meet unusual requirements.



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Please send me free folder containing samples of your electrical tubing and sleeving.

I am particularly interested in insulation for

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ANALOG/DIGITAL COMPUTER DEVELOPED BY 2 COMPANIES

A complete scientific computer system combining general-purpose analog and digital computers has been developed jointly by Electronic Associates, Inc., Long Branch, N. J., and Computer Controls Co., Framingham, Mass. The HYDAC 2400 (hybrid digital/analog computer) also includes a digital operating system.

The CCC digital computer used provides the arithmetic and data storage and retrieval not available in earlier EAI hybrids. The \$500,000 system also provides for independent use of either computer.

In another computer development, IBM has lowered the operating cycle of its 7094 from 2 to 1.4 μsec . New memory core and instruction processing units make this increase possible.

In the 7094 II, an interleaved addressing feature in the 32,768-word core storage unit provides, in effect, 2 separate memory banks, each with a 16,384-word capacity. The instruction processing unit can thus retrieve 2 instructions from storage at once, or retrieve 1 while processing another.

The 7094 II has demonstrated internal processing speeds up to 1.94 times faster than the 7094 in executing a typical mix of scientific instructions.

BLIND OPERATOR'S SWITCHBOARD DEVELOPED

A telephone switchboard which can be manned by blind operators has been developed by a British I.T.T. affiliate, Standard Telephones & Cables, Ltd.

The switchboard is cordless. The operator would normally be signaled by lamp indicators. (These are retained in the new design since relief operators may have sight.)

The blind operator is signaled by vibrating plungers which he feels with his fingertips. Knowledge of Braille is not needed. Switchboard can be operated after a few hours' training.

3 ENGINEERING GROUPS PLAN MERGER

Three national engineering societies are proceeding with merger plans following preliminary approval by their governing bodies.

The groups are the Society of Motion Picture and Television Engineers (SMPTE), the Society of Photographic Scientists and Engineers (SPSE), and the Society of Photographic Instrumentation Engineers (SPIE).

FLYING TEST PATTERN



This RB-57D will have its picture taken by remote-control 100,000 ft. above New Mexico desert. Purpose is to test effect of air turbulence on aerial photos. Ground radar ranging unit will track aircraft and balloon holding camera, electronically trigger the camera shutter and film-advance at proper times. Honeywell is conducting tests under \$2.25 million AF Systems Command contract.

WESCON Sessions

(Continued from page 36)

18/2 DESIGNING TRANSISTORS FOR OPTIMUM HIGH FREQUENCY OPERATION, by J. Gerard F. Bouchard, Sprague Electric Company, Concord, N.H.

18/3 UNIVERSAL MODEL FOR SEMICONDUCTOR DIODE SWITCHING CHARACTERIZATION, by H. John Kuno, The National Cash Register Company, Hawthorne, Calif.

18/4 SOLID STATE ELECTROMETER USING BARRIER VARICAP DIODES, by Thomas B. Hutchins, Tektronix, Inc., Beaverton, Ore.

SESSION 19: ANTENNA ARRAYS

10:00 am - 12:30 pm

Session Chairman: John Damonte, Dalmo Victor Co., Belmont, Calif.

19/1 VLF SUPERDIRECTIVE ARRAY, by E. W. Seeley, U.S. Naval Ordnance Laboratory, Corona, Calif.

19/2 NON-UNIFORM TWO DIMENSIONAL SCANNING ARRAYS, by Robert F. Tighe, Dept. of Electrical Engrg., University of Washington, Seattle, Wash.

19/3 FORESHORTENED LOG PERIODIC DIPOLE ARRAY, by Claes T. Elfving, Sylvania Electronic Systems-West, Electronic Defense Laboratories, Mountain View, Calif.

19/4 APPLICATIONS OF PERTURBATION TECHNIQUE TO SIDELobe REDUCTION OF AMPLITUDE TAPERED ANTENNA ARRAYS AND SURFACE WAVE STRUCTURES, by Dominick J. Cormignani, Grumman Aircraft Engrg. Corp., Bethpage, Long Island, N.Y.

19/5 A SYNTHESIS TECHNIQUE FOR LINEAR ARRAYS WITH WIDE-BAND ELEMENTS, by F. I. Tseng and David K. Cheng, Electrical Engrg. Dept., Syracuse University, Syracuse, N.Y.

SESSION 20: HIGH POWER MODULATORS

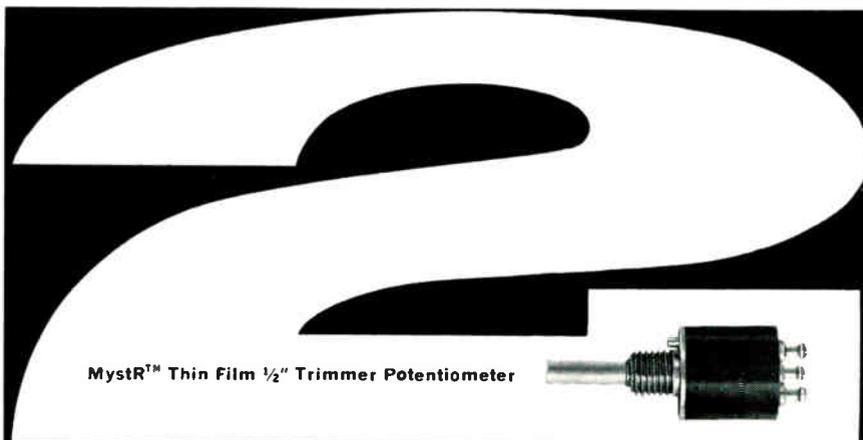
10:00 am - 12:30 pm

Session Chairman: Eli Goldfarb, Radiation at Stanford, Palo Alto, Calif.

20/1 SPARK CHAMBER PULSE MODULATORS, by Quentin A. Kerns, Lawrence Radiation Laboratory, Berkeley, Calif.

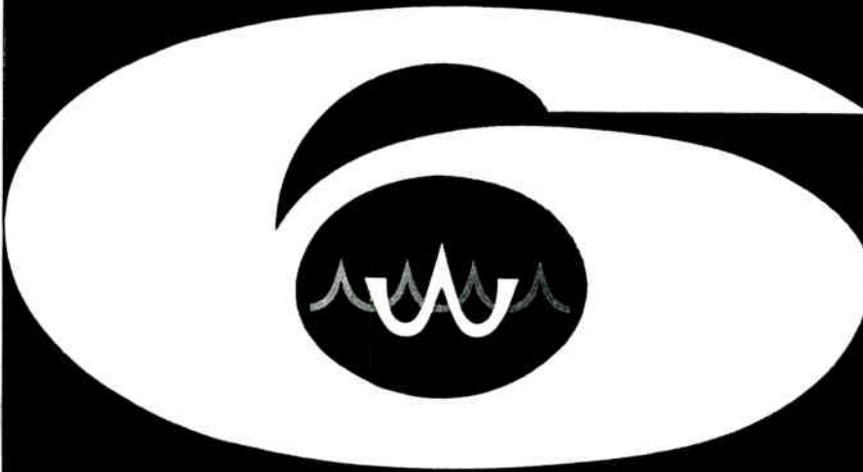
20/2 COMMAND RESONANCE CHARGING SYSTEM FOR THE ASTRON ACCELERATOR, by K. A. Saunders and R. L. Sewell, Lawrence Radiation Laboratory, Livermore, Calif.

20/3 180 MW SPARK-GAP LINE MODULATOR, by George Hanna, Continental Electronics Manufacturing Co., Dallas, Texas



MYSTR™ Thin Film 1/2" Trimmer Potentiometer

SECOND IN A SERIES OF SIX



NEW WATERS POTENTIOMETERS

Introducing the MYSTR™ thin film 1/2" trimmer potentiometer. MYSTR 1/2 has wire-wound quality with the advantages of a continuous film resistance • Infinite Resolution • High Resistance Values • Extreme Reliability and Long Rotational Life • High Frequency Operation (Low Inductance).

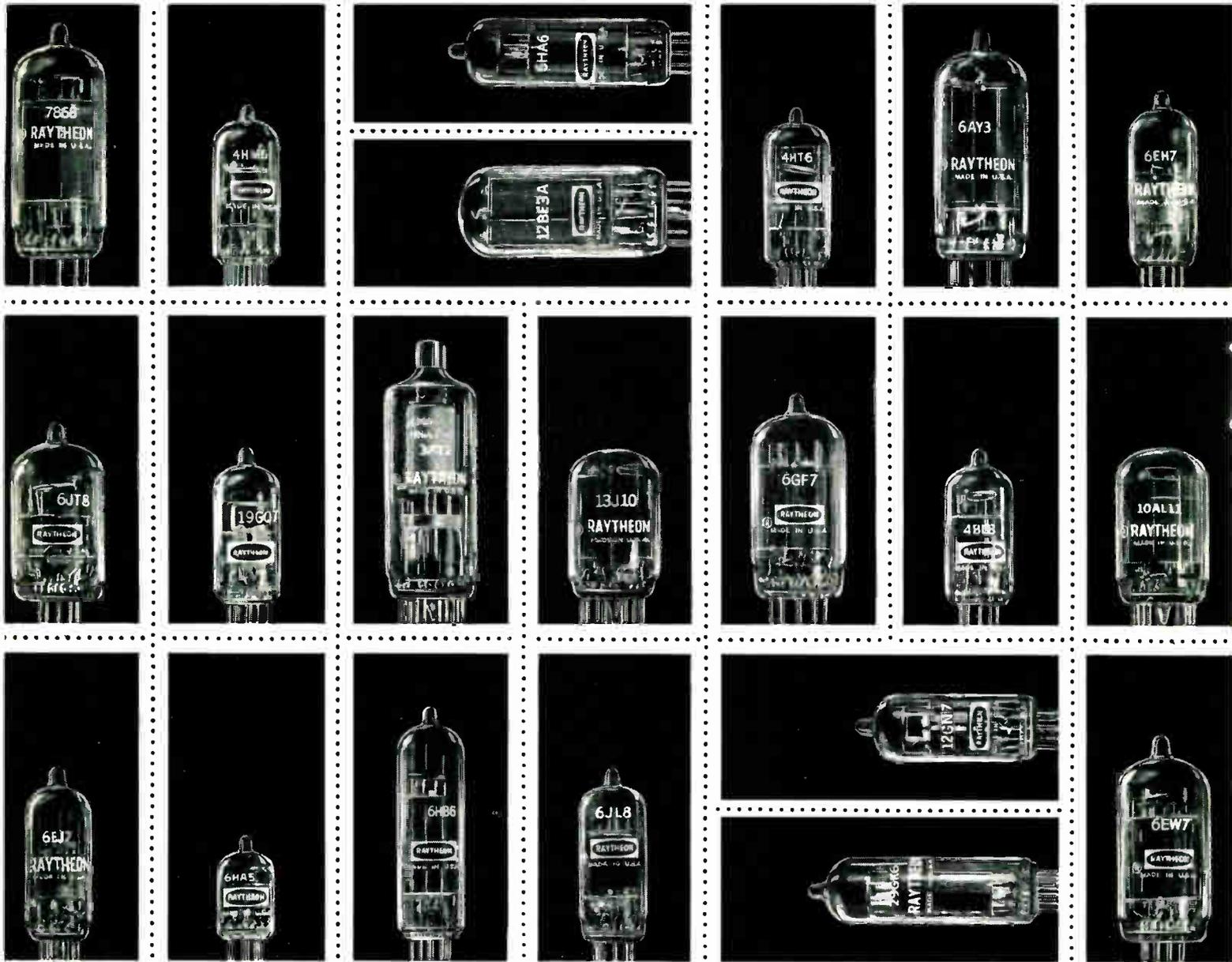
MYSTR trimmer potentiometers have excellent life characteristics (over 250,000 cycles) with no degradation in the low contact resistance and no change in the total resistance. Power dissipation rating is 1 watt at 85°C. The temperature coef. is unusually low for a film unit — less than 300 ppm. In many applications, MYSTR Trimmer Potentiometers can outperform wire-wound pots.

MYSTR 1/2 SPECIFICATIONS

Case Size.....	1/2" diameter X 1/2" length
Resistance Range.....	1KΩ to 1 megohm
Resistance Tolerance.....	±5% up to 1/2 megohm, ±10% to 1 megohm
Temperature Range.....	-65°C to +125°C
Power Rating.....	1 watt @ 85°C, derated to zero at 125°C
Contact Resistance Variation.....	±2% of total resistance
Resolution.....	Infinite
Temperature Coefficient.....	Less than 300 ppm

Write today for further information to: Mr. William Martz, Sales Manager

WATERS MANUFACTURING, INC., WAYLAND, MASSACHUSETTS (617) ELmwood 8-2777
Precision Potentiometers — Potentiometer Hardware — "Torque Watch Gauges" — Torque Calibrators — Amateur Radio Equipment



See one you need?

Here are the latest additions to Raytheon's collection of new tube types featuring advanced packaging and construction techniques. They are products of Raytheon's vigorous and continuing program to provide entertainment tubes designed to lower manufacturing costs and increase equipment performance. And, there are more

types to come. For technical data on recent additions to Raytheon's growing lines of entertainment receiving tubes, please write: Raytheon Company, Industrial Components Division, 55 Chapel St., Newton 58, Massachusetts.



Circle 156 on Inquiry Card



PROFESSIONAL OPPORTUNITIES

Design Engineers
Development Engineers
Administrative Engineers
Engineering Writers
Physicists
Mathematicians
Electronic Instructors
Field Engineers
Production Engineers

Reporting late developments affecting the employment picture in the Electronic Industries

EDUCATORS TO INVESTIGATE U.S. ENGINEER CURRICULA

What kind of education will prepare engineers to meet society's needs in the next 50 years? Dr. George A. Hawkins, dean of engineering and mathematical sciences at Purdue, will direct a three-year national study of undergraduate education for engineers to find out.

At the same time, graduate curricula will be investigated by Dr. Joseph M. Pettit, dean of engineering, Stanford. Both studies will examine engineering school curricula throughout the U. S., and also the entire range of U. S. engineers' responsibility in government and industry here and abroad.

The studies, supported by National Science Foundation grants, are being undertaken in view of the range of sciences now required in engineering, and especially the decreasing gap between discoveries and practical application. (For photography the gap was 112 years; for the transistor, only 3 years.)

Dr. Hawkins said that today we are teaching engineers who will have even newer and more complex systems thrown at them before they know it.

PLACEMENT SURVEY FINDS OUTLOOK UP FOR '63 GRADS

A survey of college placement directors in Middle Atlantic region indicates that the employment outlook will be better than last year. The Department of Labor's Bureau of Labor Statistics reports that, in addition to improvement in job opportunities, somewhat higher beginning salaries may be expected.

The fields of science, engineering, accounting and teaching dominate employer job lists. Placement directors all reported competition and higher starting salaries for graduates in the upper half of the class.

A substantial number of junior college and technical institute graduates are expected to continue on to higher education.

CLASSROOM COMPUTER



Robert D. LaRue, engineering professor at Colorado State U., shows use of general purpose analog computer and XY variplotter made by Electronics Associates, Inc. They are used in solving engineering problems. The devices will be used to illustrate the basic principles of flow and circuit diagramming, scaling and data presentation.

STUDY REVEALS ALARMING ENGINEER OBSOLESCENCE

A recent Careers Incorporated study indicates an alarming number of obsolete engineers and scientists in the U. S.

Surveys of registrants in four metropolitan areas, revealed that 54% of degree-holding registrants failed to receive a single interview bid from major defense contractors represented.

In the survey, William A. Douglass, Careers President, said "There seems to be considerable substance to the theory that our so-called technical manpower shortage is really just as much a question of proper use of our engineers and scientists as it is a question of a purely numerical shortage."

Engineering field analysis revealed that civil engineers were least in demand, with 91% receiving no bids. In contrast, 27% of data-processing men received bids from five or more employers, as did 18% of physicists and 23% in electronics.

Another finding of the study was that 17% of degree registrants were unemployed at the time they were registered for jobs. It had been generally assumed that practically all engineers were employed.

ENGINEERS MISUNDERSTOOD, NASA'S DRYDEN ASSERTS

Scientists too often get credit for work done by engineers, according to Dr. Hugh L. Dryden, Deputy Administrator of NASA.

Before the state convention of the New Jersey Society of Engineers, Dr. Dryden said, "There are few groups in our nation whose work is so much taken for granted and so little understood by the public.

"Engineers are only too rarely associated in the press with the great accomplishments of recent times.

"The complex jobs required by the nation's space program draw up almost every branch of science and engineering.

"Engineers still have an immense task of public education. We must bring before the public great engineers of our day as persons identified with their creative works and the contributions of these works to human welfare."

ILLINOIS TECH. TO OFFER SCIENCE WRITING COURSE

Undergraduate and graduate courses in science writing and science information—the first program of its kind—will begin this fall as an experimental program at Illinois Institute of Technology.

Dr. Henry Knepler, chairman of IIT's language, literature and philosophy department, said that the programs are designed to help solve the growing communications needs of business, industry, and scientific research organizations.

He pointed out that little has been done in the U. S. to combine communications skills with the sciences, engineering and medicine.

FOR MORE INFORMATION . . . on opportunities described in this section fill out the convenient resume form, page 208.

This Firm Finds that...

“HELPING EMPLOYEES PAYS OFF”

The Golden Rule has varied applications. Autonetics put its employee progress interview program into action a few years ago. Management has discovered that helping an employee to find his way and seek his level pays off —for both the employee and the company.

AFTER A YEAR OF RESEARCH, Autonetics' Progress Interview Program was at least a partial and somewhat significant answer to the man challenge when it was put into effect some five years ago.

Now, though modified a bit, its basic concepts still apply: (1.) Let the employee know where and how he stands, and (2.) Progress interviews must be apart from merit reviews. Here is a possible answer

Dr. Mario F. Conforti, Autonetics training chief, lectures engineering supervisors in progress interview training class.





In interview planning sessions, the group is paired off into "supervisor-employee" teams for practice and group discussion.

to an expanding organization that presents many opportunities for its employees.

Autonetics, young and vigorous as the largest division of North American Aviation, Inc., and in average executive age, is thoroughly experienced in advanced technologies that have helped to make the space age. Today it is one of the ten largest electronics organizations in the U. S., now employing more than 33,000 people. In 1946 it was a firm of about 5000 employees.

Abreast of North American's philosophy of promoting internally, this rapid expansion created opportunities for employees, challenges for management, and a need for providing education and training for all employees.

Supervision Training Centralized

Education and training in executive management and supervision at Autonetics are centralized under Central Education and Training. The Progress In-

terview Program comes within the scope of this department, and is aimed at improving job performance through scheduled employee progress interviews. An interview includes appraisal of job performance and plans for each employee to improve performance and prepare for advancement. Through interviews, the employee usually is better able to meet his goals and satisfy his job needs.

Progress interview training is conducted during a 10-hour session away from work to help Autonetics' supervisors improve methods used in employee development, and to instill in them the philosophy of good management. Initial training is mostly lecture-discussion with visual aids (see diagram). The second and larger part of the program concerns planning and conducting progress interviews.

Training begins with North American/Autonetics policy on employee development and advancement. Progress interview training underscores the employee's responsibility for doing the most about his own self-development, though there are areas where the supervisor must assume a share. The employee must be encouraged to talk freely and discuss his problems, his impressions, through rapport and empathy. To avoid just a "nice chat," however, the supervisor must plan his interview for a time best for the employee. *(Continued on page 209)*

By Dr. MARIO F. CONFORTI

Training Specialist
Autonetics
Div./North American Aviation, Inc.
Downey, Calif.

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

HELPING ITS EMPLOYEES (Continued)

Records, Observation Important

Supervisors use a worksheet to evaluate only the significant job factors. Accurate records and observation are important for adequate appraisal; the superior must be specific in dealing with the employee.

Appraisals must be job centered; areas discussed should include job duties, responsibilities, authority, relationships and accountability. The superior is responsible for correcting misunderstandings, and both superior and employee must "look at the same job," otherwise an appraisal cannot be justified.

Besides agreeing on job parameters, the superior must indicate performance standards. By way of definition, standards set minimal limits of satisfactory performance. Realistic standards, therefore, must be gauged by what can be expected of a fully-trained employee.

In our lecture-discussions an important subject is performance standards. When standards can't be predefined, an agreed-on procedure and adherence to all steps can be observed as "meeting standards." In engineer creativity, for instance, standards may simply be reports submitted plus evaluations of quality and timeliness of the reports.

In training, supervisors are encouraged to set written standards. Inaccurate standards will out when the next progress interview is planned or conducted.

Superior-Employee 'Get-Together'

If job parameters and standards are not known, the aim of the first interview should be a superior-employee "get-together." To lay ground work for the next interview, the meeting ought to cover how well the employee should do his job and how his performance will be measured.

Then, the superior should know whether certain areas need improving. He should include in his plan a course of action to help the employee on the job, and a tentative program to help him beyond the job. If a plan does not evolve, there has been no progress interview. Once there is mutual agreement on a plan of self-improvement, the superior must not divorce himself from the employee. To motivate the employee and show him sincerity, the superior should encourage a timetable, and then set a follow-up for action.

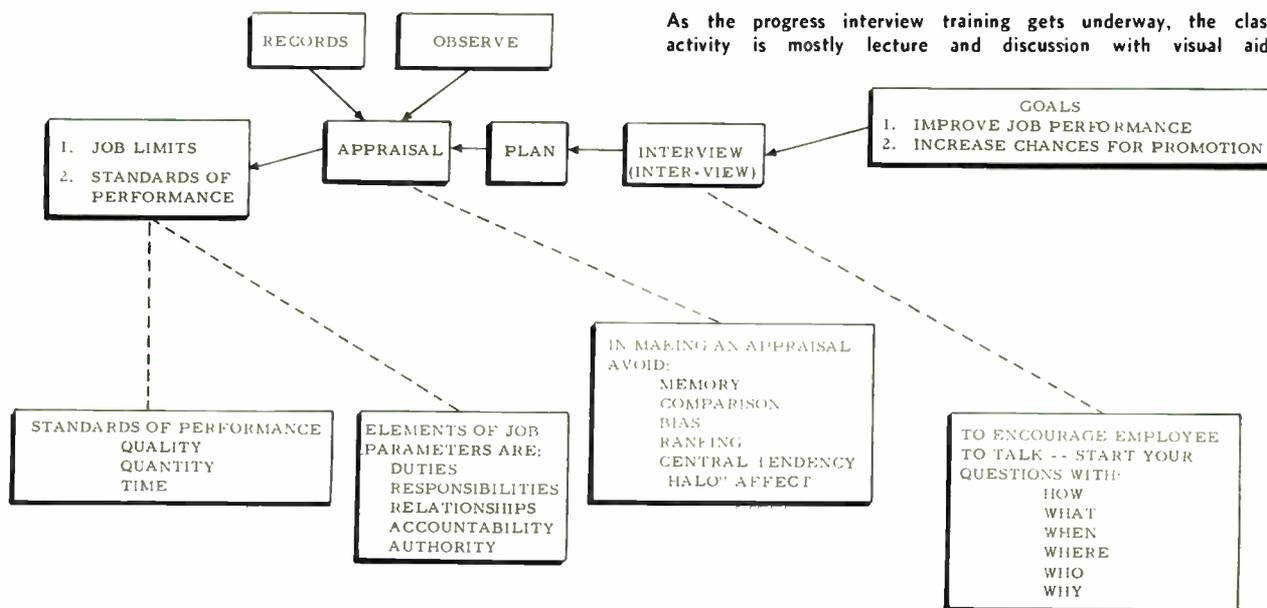
In closing the lecture, the instructor cites the importance of attitude, especially that of the superior. Supervisors must avoid the tendency to orient, sermonize, reprimand or ego-threaten the employee. The feeling must be positive and show desire to help the employee make his job more efficient and satisfying. The supervisor must discuss the employee's strengths and show appreciation for his past accomplishments. Past failures should be indicated briefly, and only to prevent future mistakes.

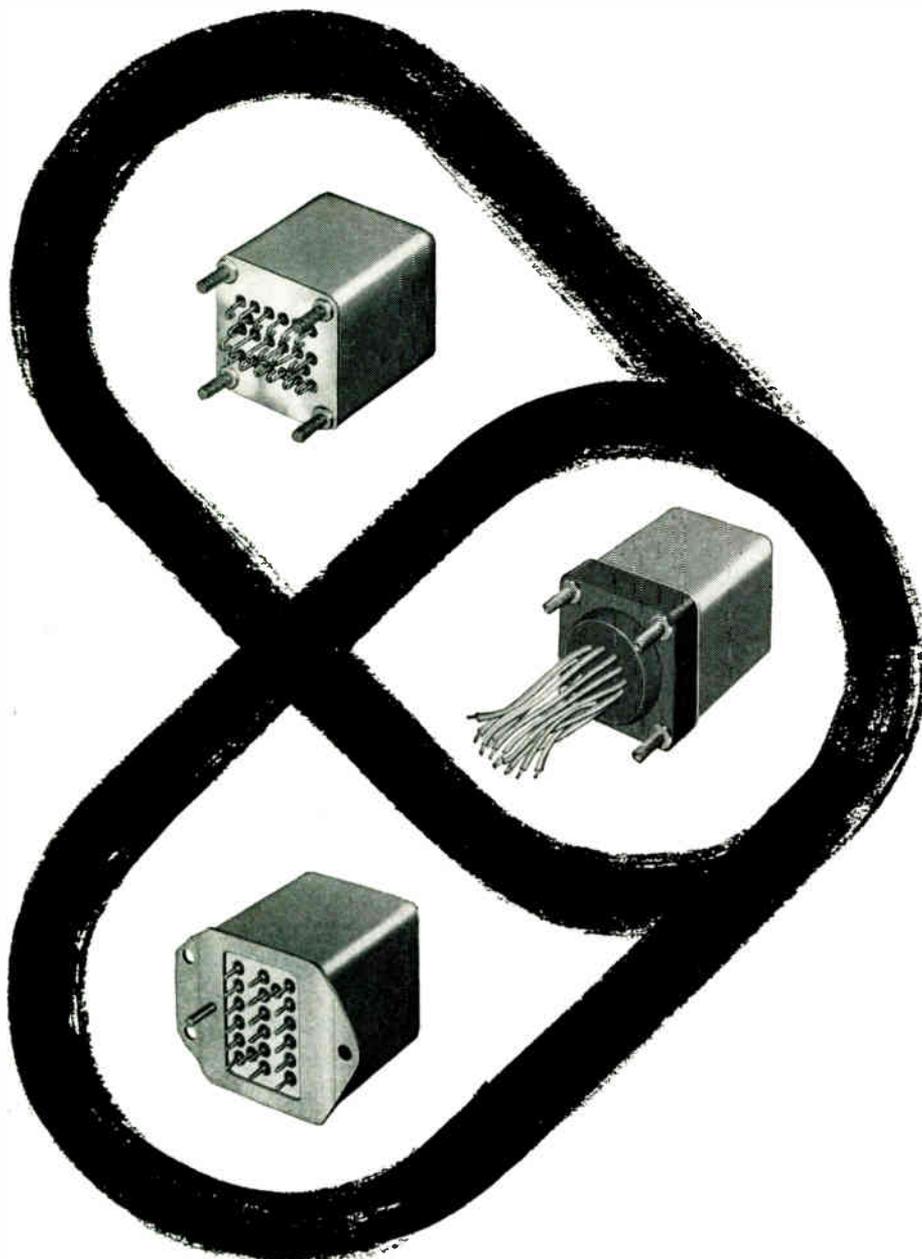
If the supervisor has done a good job in progress interviewing, he will learn how to better use his employee's job strengths and time, and the employee will be more motivated to self-development.

Practice Interview Training

The second half of the training program is devoted to planning and conducting practice interviews. The course is mostly lecture and discussion; individual discussion is encouraged. The instructor not only lectures but also becomes a conference leader to encourage group discussion. During the last half of each session, the class is paired into "supervisor-employee" teams for practice. Each pair conducts its interview before the class so that positive criticisms and suggestions may be offered.

(Continued on page 213)





HIGH-RELIABILITY RELAY DESIGN MEETS SEVERE REQUIREMENTS OF MISSILES AND JET AIRCRAFT

Style 801 Relays were designed for general purpose applications requiring heavy-duty power switching where the aim is for highest reliability rather than extreme miniaturization. Suggested applications include aircraft and communications equipment. They are small, compact 6-pole double-throw relays with 5-ampere contacts. The two-coil bipolar magnetic actuator is coupled with a balanced armature for maximum immunity to shock, vibration and acceleration. Withstands 50 G shock, 10 G vibration to 1500 cycles. Rated load: 5 amps resistive at 28 VDC. Contact arrangement: 6 PDT (6 Form C). Size of enclosure: 1.531" max. square \times 1.750" max. height.

Meets applicable portions of specifications MIL-R-5757 and MIL-R-6106, including minimum current.

For additional information, contact:

PRICE ELECTRIC CORPORATION

323 Church St. • Frederick, Md. • Phone: 301/663-5141 • TWX 301/553-0462

COMPUTER MATCHES NASA TECHNICAL DATA, READERS

An experimental computer system which automatically routes technical information to engineers or scientists who need it is being put into operation for NASA. The technique used, Selective Dissemination of Information, has been studied for many years by IBM's Advanced Systems Development Div., which is putting it in effect.

Each of 500 participants will list NASA index terms to describe his professional interests. This "profile" interest may average 40-50 words. It could contain 600. A typical one might contain such words as "lunar," "launch," "aerodynamics," "nuclear propulsion," "Apollo," and "inertial guidance."

These profiles will be stored on magnetic tape at Yorktown Hts., N. Y. Titles of reports and abstracts, along with NASA index terms, will also be sent there so a profile can be made for each report.

The computer program will compare the document profiles with those of the people. When they match, a notification card will go to the individual along with an abstract of the report.

If the participant wants a copy, he will request it by pushing out a pre-scored hole in the card.

SBA LISTS SMALL FIRMS SEEKING U. S. R&D WORK

The Small Business Administration has published a revised directory of nearly 2,800 small firms seeking Government R&D work. The 678-page list includes 875 firms not listed before. It does not indicate official endorsement by SBA of any concern's R&D abilities, or certify small business classification under SBA's size rule.

Small businesses received only 3.5% of the \$5.7 billion spent for military R&D in fiscal 1962. The 2,775 firms listed employ some 31,000 scientists and engineers, and 228,000 persons altogether.

NATIONAL ENGINEERING ACADEMY FORMED UNDER NAS

The National Academy of Engineering will soon be formed under the National Academy of Sciences. The new organization will advise the Government on engineering considerations related to national policy.

The NAE is being set up as a joint effort by committees of the NAS and the Engineers Joint Council, national federation of 29 engineering societies.

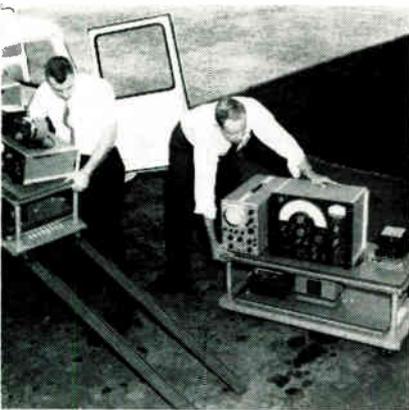
TEST EQUIPMENT MFR. PUTS SHOW ON THE ROAD

General Radio, West Concord, Mass., test equipment mfr., has found that its traveling exhibit saves time and money, and requires less planning than attendance at a big convention. Two of GR's station wagons put on 88 local exhibits in 1962, and another wagon has been added this year. Trips are as long as 6,000 miles. Attendance ranges from 30 to 300.

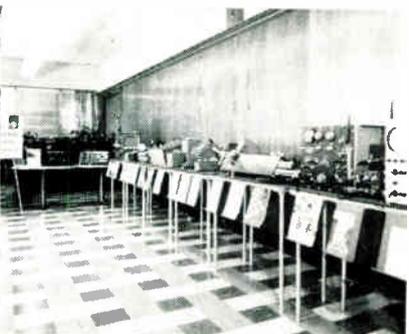
The company said its traveling exhibit has proved more valuable than participation in shows and conventions, partly because of the savings involved and partly because the show-on-the-road gets right to the point-of-interest. Although sometimes only 30 people attend, it said, "they are the right 30 people." Still another advantage is the exhibitors' ability to schedule performances almost on demand.



Full crew of 3 sales engineers can ride in the front seat of this show-bound wagon.



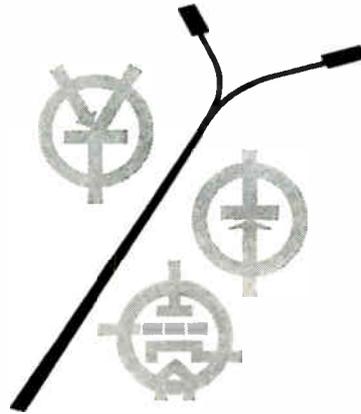
Unpacking is a snap with roll-out tables. Literature is stored behind driver's seat.



Complete exhibit is set up here in the cafeteria of the host company's plant.

ELECTRONIC INDUSTRIES • August 1963

Electronic Instrumentation Engineers / Physicists



The Stanford Linear Accelerator Center, located in the foothills of Stanford University's 9,000 acre campus, has a limited number of openings for very well-qualified engineers and physicists in the following areas of electronic instrumentation:

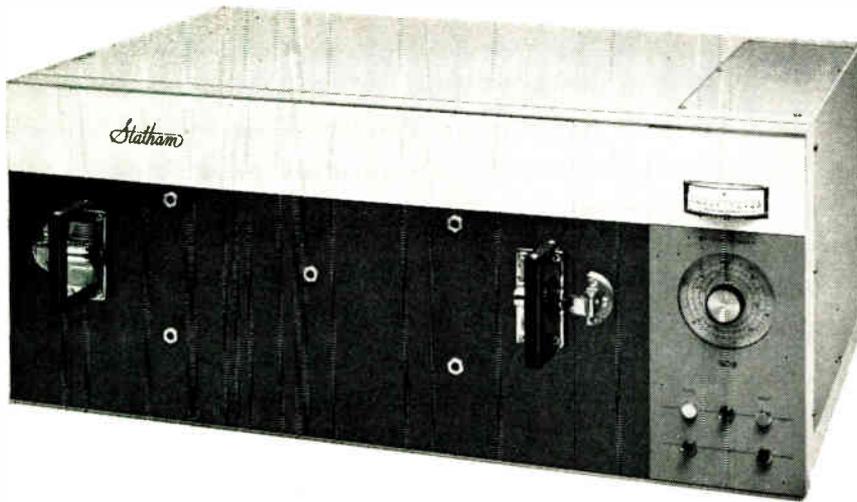
- Circuit design, analysis and synthesis. Broad experience in vacuum tube and solid state circuits from DC to the nanosecond region required.
- Digital logic circuits. Design of logic systems and circuits for the timing of accelerator components with a time definition of a few nanoseconds.
- Transducers and protective circuits. R & D of special devices to monitor the operation of diverse components of the accelerator. Integration of the circuits into the general protective concept of the machine.
- Nuclear instrumentation in support of the design of the high energy physics experimental area. Experience with electronic circuitry in high nuclear radiation environment is preferred.

Qualifications: Ph.D. or M.S. in E.E. or Physics with several years of relevant experience.

Please phone collect DAVenport 1-2300, Ext. 2826, for further information or address a résumé to: Mr. G. F. Renner, Professional Employment, Stanford Linear Accelerator Center, Stanford University, Stanford, California.

STANFORD / LINEAR ACCELERATOR CENTER
AN EQUAL OPPORTUNITY EMPLOYER

Circle Number 800 Professional Profile, page 208



PRECISION TEMPERATURE TEST CHAMBER 2.6 Cu. Ft. Capacity

The new Statham Model SD8 is a 2.6 cu. ft. bench-type chamber designed for precise temperature testing of electronic components from -100°F to $+525^{\circ}\text{F}$. It has a control accuracy of $\pm 1/4^{\circ}\text{F}$, and true proportional control of heater power by all solid-state circuitry. □ For high performance and convenience, liquid CO_2 is used for cooling. □ The design advances in the Model SD8 result in the elimination of the conventional heater power relay and cycling about control point. Heater life is extended by the smooth regulation of heater power from zero to 100 percent. Dual resistance temperature sensors eliminate stabilizing drift. Their fast response permits sensitive proportional gain control for tight temperature control. □ Automatic cyclic timers are available for use with the Statham SD8.

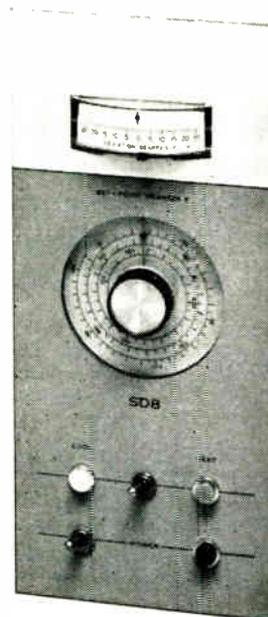
More Accurate,
Easier to Use
Temperature Selection
and Readout

Model SD8 features 24 lineal inches of calibrated set-point scale, with temperature readout by means of a deviation meter calibrated in one-degree increments. This expanded scale approach provides a level of accuracy and readability not attainable in conventional chambers.

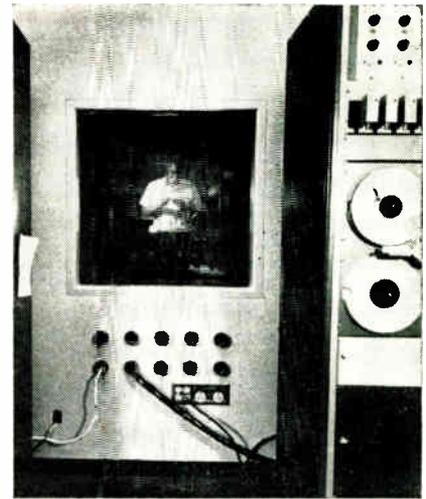
WRITE FOR SPECIFICATIONS



Statham Instruments, Inc.
12401 West Olympic Blvd.
Los Angeles 64



SUBJECT IN ISOLATION



Subject is seen through 1-way glass window in sound-proof isolation chamber at Barrow Neurological Inst., Phoenix, Ariz. Room is room within room with heavy metal inner and outer walls separated by acoustical filler. Built by Industrial Acoustics Co., New York, N. Y., room has noise reduction coef. of 0.95. Room is r-f and electrostatically shielded. Environment is exactly controlled.

PAPERS DESCRIBE NAVY MICROELECTRONICS PROGRAM

Papers describing the latest Navy R&D in microelectronics are contained in "Navy Microelectronics Program," available from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Order AD 401 862. Price: \$5.

Papers discuss the following: thin-film micronization; microwave semiconductor microelectronics; progress in thin-film components; a film electronics airborne computer; an FM phase-shift oscillator; insulated gate field-effect devices for microelectronics; microelectronic research for information processing, and readying industry for manufacture of microelectronic equipment.

The Navy has started a microelectronics program because of the necessity for small pieces of equipment to insert in aircraft and missile airframes and in cramped shipboard compartments. Light weight is also an important consideration.

POWDER PRESS ACTIVATED

An isostatic powder press operating at 75,000 lbs. per sq. in. has been placed in operation at the Towanda, Pa., plant of Sylvania Electric Products, Inc. It is expected to add significantly to Sylvania's capacity to produce refractory metals, important to missile and space applications.

HELPING ITS EMPLOYEES (Continued)

To encourage participation by group members, they are asked to note anything they believe significant, such as, "He asked that question well. I'd like to be able to handle it the same way," or "That remark makes me feel that he is reprimanding me."

The instructor leads the critique for the first two practice interviews allowing the "boss" to critique his own interview. The "employee" gives his reactions to the interview, then the group comments. With the third interview, and so on, a group member conducts the critique while the instructor observes.

The Progress Interview Workshops, part of the same program, assists Autonetics supervisors in reviewing interview techniques. Workshops offer a means for the supervisor to discuss in a group the problems that come up during interviews, and search for solutions through discussions of ideas and successes.

Basic Interview Problems

The course begins with a listing of some problem areas the group wishes to examine. Under guidance, rank order is determined to avoid "shot gunning," that is, hitting around wildly and never touching on the basic problem. For example, several problems that usually pop up are: (1) what do I say to the employee who is at the top of his classification, (2) how can I keep the employee from talking about more money, and (3) how do I talk to women?

Problem one generally boils down to the question of whether the top-of-his-classification employee is really outstanding in all phases of his job, and whether he knows and meets the qualifications for the next ladder rung. Almost invariably he needs more education. Groups agree that the supervisor must place the facts before the worker on his present job and future goals, and then it becomes the employee's responsibility.

An important point—the employee must take the initiative for job promotion. In return the supervisor indicates he will consider or recommend the employee for promotion to the level for which he is now qualified.

Money Is Always a Problem

As for problem two—the money problem—most supervisors will agree that money is important, but the progress interview is focused on job performance. During the workshops, the group learns to set the stage early by telling the employee that "we are here to discuss you and your job, and how to make it easier and more satisfying."

Plan the interview and ask specific questions to avoid talking money, but don't evade the subject if

the employee explores the area. Let it come, reply directly and briefly, defer the issue, and then get back on job performance. If he asks for more money, stress the job and how to improve performance. Let him know that the interview and how well he performs will influence merit review decisions. Unless a plan for improvement evolves, you've had merely a "nice chat."

If he insists on talking money, then the interview may have been ill-timed, some previous action is lacking, or the employee has a need to blow off steam before going into a progress interview. Reschedule the interview and spend the rest of the time on pay as it relates to better than average performance. Reduced tensions may induce objectivity.

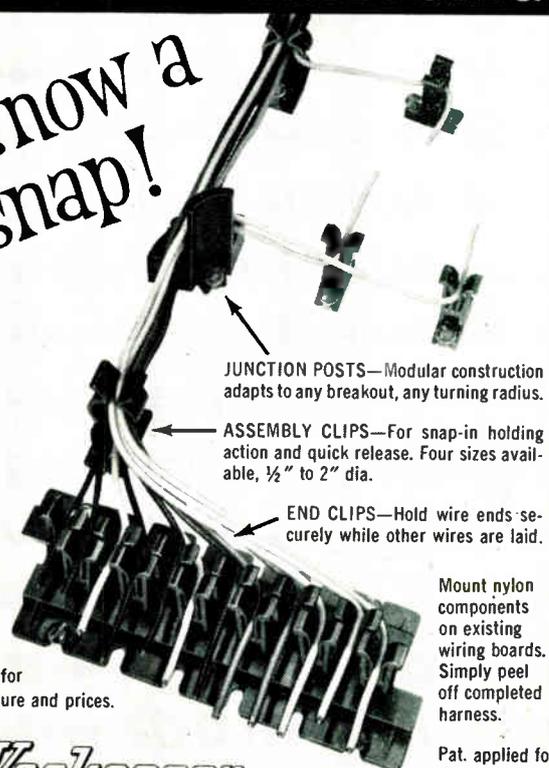
Here the instructor can point out that experience proves how impossible it is to discuss progress in a highly charged, highly emotional, highly defensive atmosphere. Discussions on money often lead to defensive reactions and prove highly unsatisfactory as a major consideration in progress interviews.

Even Firms Have Women Troubles

And now the women problem. This one can become as wild as Alice's tea party. Quite often interviews may cause women to become nervous and
(Continued on page 215)

CABLE HARNESSING

...now a
snap!



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Circle 161 on Inquiry Card

CANNON

engineering notes:

DESIGNING SUBMINIATURE RF PLUGS FOR SATELLITE CIRCUITRY

As the Space Program has expanded, there has been an increasing need for more sophisticated RF subminiature electronic circuitry to meet the exacting demands of satellites and spacecraft. This subminiaturized circuitry is used in many new design applications which require more ideally matched RF electrical connectors with very low VSWR and superior performance characteristics. To meet these needs we have developed the Cannon CX Series of subminiature RF Coaxial Plugs. This 50-ohm, matched-impedance series introduces a VSWR of less than 1.08:1 from dc up to 2000 mc, and does not exceed 1.25:1 up to 6000 mc.

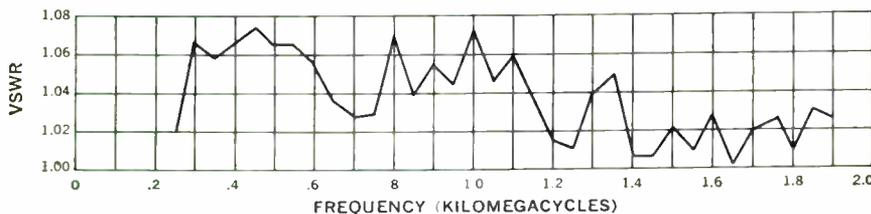
Because the total VSWR of a system is a function of several characteristics, with a high degree of probability of the phasing of many discontinuities, the individual electrical connector and its cable junction must be designed to exhibit extremely low reflections.

The high performance of Cannon CX Coaxial Plugs is made possible by incorporating Cannon Micropins[®] and Microsockets[®] as center contacts which are fully captivated. This design



MICROPIN AND CX COAXIAL PLUG
(ACTUAL SIZE)

eliminates the "slotted-contact" technique which exists in other configurations, and more closely approximates the ideal RF transmission concepts. Both the center contact and the outer-shielding braid ring are crimped securely to RG-188/U cable by means of the same hand tool, and with negligible physical distortion. Cable retention forces are the same as those required to break the cable shielding braid, which ranges from 23 - 30 pounds. A mated plug and jack weigh approximately .011 pounds. These connectors exceed the environmental and electrical performance requirement of MIL-C-22557 (SHIP) and thus are ideally suited for the exacting demands of satellites and spacecraft.



James H. Cannon
Vice President, Engineering

Imaginative Engineering For The Space Era.

**CANNON
PLUGS**

CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

45 ENGINEERS TALK SHOP IN SEMINAR-ON-A-TRAIN

A unique technical seminar, held aboard a New Haven RR train, had an attendance of 45 design engineers from a dozen Raytheon plants near Boston. They had 3-hour classes in the 170-mile trip to Connecticut, where they visited the company's Sorensen plant to see manufacturing processes.

Discussions on the return trip were aimed at specific problems.

The idea of the trip was "to cross-pollinate our engineering efforts in our Massachusetts plant with our power supply work being performed in South Norwalk," Raytheon said. A company spokesman said the whole idea of the seminar was "excellently received."



"Classroom on wheels" pulls into station as eager engineers prepare to step aboard.



Coffee break on 170-mile trip offers chance to exchange ideas, explore seminar topics.



Innards of equipment draws high interest at company's plant in Sorensen, Connecticut.

HELPING ITS EMPLOYEES (Concluded)

weep. Some will refuse to take part in progress interviews.

The class group will generally suggest orienting female personnel in advance, telling them about the Progress Interview Program, indicating purposes and goals. Start by interviewing those women who are most receptive to the idea. They will sell the program to others during rest periods, coffee breaks, riding home, or wherever they are able to talk privately.

Choose an interview time most favorable to the employee. For instance, after she has done something outstanding, or when the supervisor has something pleasant to tell her. Definitely avoid an interview on the heels of a reprimand, when she is under pressure.

A supervisor's personal discomfort owing to inexperience and fear from uncertainty may affect rapport. Here the instructor can summarize effectively that advance notice and orientation for women are important, that women can be dealt with basically the same as men, except that differences may lie in choice of words, voice inflection and manner. With practice and success, the discomfort should give way to confidence.

Some Problems Beyond Control

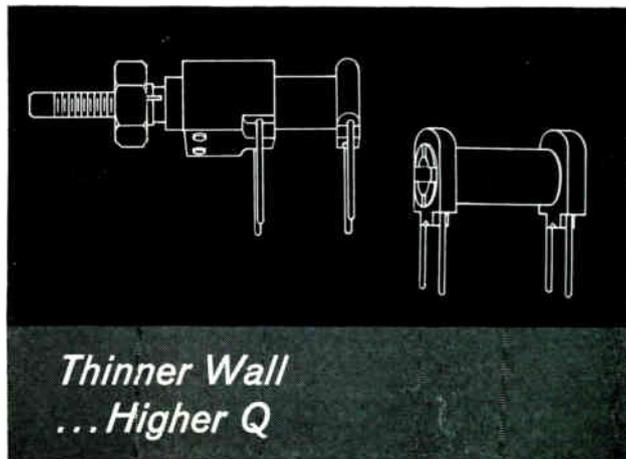
Where problems are beyond the supervisor's control, workshop discussions minimally assure him that he is functioning within the program's intent, and that he is fair in his employee relations. The conference leader's workshop function is to help clarify the problems, keep discussion on target, encourage group discussion, summarize issues, and contribute in the instruction.

At Autonetics, three hours affords a fruitful meeting, and effectiveness is usually highest when class groups number around 16 supervisors. No supervisor can attend workshop sessions unless he has taken progress interview training, and has conducted actual interviews for at least three months.

The workshop shows the supervisor that his problems are not unique, that all people can't be saved, and that he is, or is not, doing all within his power to meet his responsibility—to guide and to direct.

To enjoy Autonetic's successes with employees and to cope with opportunities presented to the deserving, the Progress Interview Program is explicit in company procedure. All employees, regardless of status, take part in regularly planned interviews.

Feedback from line supervision has proven beyond doubt that where departments implement the program, there has been growth, development, a more positive attitude, higher morale and greater productivity.



New CAMBION® tunable coil forms for printed circuit applications have a wall thickness of only .010", improving flux coupling and Q because the slug can be closer to the windings. The thin wall is made possible by a unique production technique — forms are molded of high-impact diallyl phthalate for close run-out (TIR) and concentricity control. Design highlights include live leads that double as studs for mounting on .250" x .500" PC grids and mounting lands that eliminate moisture traps.

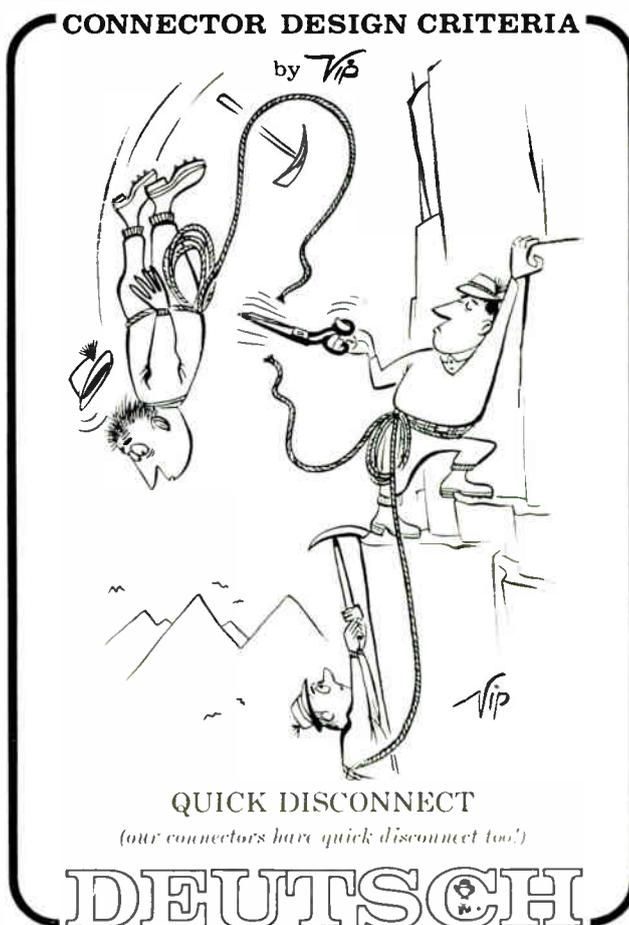
Severe environment version has a polypropylene liner that distends to receive slug threads, eliminating need for a screw stud, providing excellent shock and vibration resistance — positive torque to 2000 cycles at -55°C to +105°C.

For information or specific prints, write to Cambridge Thermionic Corporation, 330 Concord Avenue, Cambridge 38, Mass.

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DEUTSCH

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5" DC-4.5 MC Scope #460	89.95	129.95	DC-4.5 mc/flat	1 cps to 400 kc flat	25 mv/in	0.6V/in.



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DISTRIBUTOR-ORIENTED FIRMS MERGE TRADE UNITS

The Assoc. of Electronic Manufacturers, Inc., has been formed by merger of the Producers of Associated Components for Electronics and the Assoc. of Electronic Parts and Equipment Manufacturers, Inc. The new organization is composed of electronic manufacturers who sell through distributors, as were PACE and EP & EM.

PACE and EP & EM will continue operating as the Eastern and Central divisions of AEM; however, national programs will be combined and coordinated through AEM.

NAVY ACOUSTICS STUDY USES EXPLOSIVE CHARGE

An explosive charge is a better source of sound than electrical transducers presently used in certain studies of sound transmission under the sea. This fact was established in a recent underwater acoustics research project by scientists from the U. S. Naval Ordnance Laboratory in White Oak, Md. Purpose of the project was to learn more about how to predict the obscuring effect of back-scattering by the ocean floor on sonar signals.

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K-mag 800 is the first burn-out proof and shockproof precision DC voltmeter with $\pm 0.25\%$ accuracy on all ranges. Measurements are in nine ranges from 0-0.1 to 0-1000 volts, with overload insensitivity on all ranges. The instrument uses a special second-harmonic magnetic amplifier that has extreme linearity and gain stability, and no zero drift. High input impedance allows the K-mag 800 to be used without a transfer standard. Taut-band meter with mirror scale plate and 100 graduations assures fast, accurate reading without interpolation. Magnetic amplifier, taut-band meter, and solid state circuits make the K-mag 800 the most rugged DC voltmeter—and the most rugged is the most versatile. Request Bulletin 800 from Keinath Instrument Company, 1313 Chesapeake Avenue, Columbus 12, Ohio.

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ELECTRONIC INDUSTRIES • August 1963

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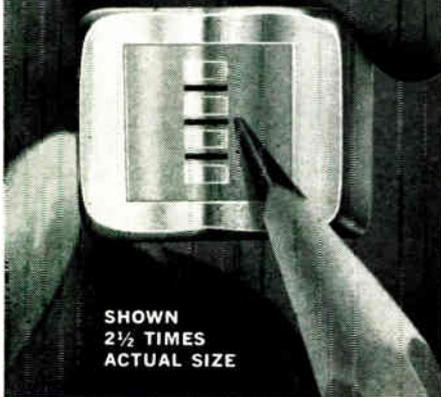
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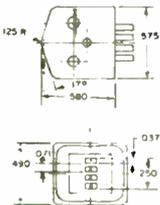
Multiple channels for less — with Nortronic's new, compact "BQQ" heads. Designed for digital, instrumentation, analog and audio recording or reproduction, "BQQ" heads are readily available in production quantities — will fit existing 4-track systems. Types include Record only and Record/Reproduce heads in no-mount, base-mount, rear-mount and side-mount styles.

TYPICAL APPLICATIONS — Used for instrumentation recording including carrier modulated types such as: AM, FM or Pulse; as straight Digital and Analog recording. Ideal for Audio Duplication, Background Music and 4-Channel "in-line" Stereo. In multiple staggered channel use, the "BQQ" accommodates 14 channels on 1" tape and 7 channels on 1/2" tape.

"BQQ" SERIES — Laminated core; flush or relieved metal face; hyperbolic contour; pin terminals. Impedances to 360 millihenrys. Wide range of gap lengths.

NEED MAGNETIC HEADS?

Cut specification time—check Nortronics first! Industry's widest line of "standards" plus specialized "know-how".



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AIRBORNE FAULT-FINDER MONITORS 250 INPUTS

A flying electronic trouble shooter which monitors up to 250 key parts of an airplane is being produced by Lockheed-Georgia Co., Marietta, Ga. SAC is installing it aboard B-47 and B-52 bombers.

Called MADREC (for "Malfunction Detection and Recording System"), it produces a strip chart recording which aircraft technicians can interpret to find in-flight operating conditions.

Pilot or navigator selects the system or systems to be checked and flips a switch. The three boxes, remote-control unit, multi-channel recorder and "Analog Factor Calibration Network Unit" go into action. "AFCAN" takes the signals from the monitored points and translates them, through the recorder, onto photo-sensitive tracing paper. It writes, not with stylus, but with fingers of light.

Aircraft ground technicians can see how equipment is working under in-flight conditions of pressure, vibration, altitude and attitude. This lets them pinpoint many troubles they cannot otherwise find. They can also forecast trouble and take action.

PRECISION

- Direct Reading in Degrees.
- Accuracy 0.05° or 1%.

PHASE SETTERS

Type 405 Series: 1 cps to 500 kc. Accuracy 0.25° relative, 1° absolute. No amplitude adjustment from 0.1v to 70v. Suitable for plotting phase curve.

Type 202: 20 cps to 500 mc. Accuracy 0.02° or 2%. 1° full scale sensitivity. Phase range 0-1, 0-2, 0-4, 0-12, 0-120, and 0-180 degrees.

Type 205A1-A2: 100 kc to 15 mc. Accuracy 0.05° or 1%. Sensitivity 0.04v.

Type 205B1-B2-B3: 15 mc to 1500 mc. Accuracy 0.05° or 1%. Sensitivity 10 millivolts or better with receiver.

AD-YU
ELECTRONICS LAB., INC.
249 TERHUNE AVE., PASSAIC, N. J.

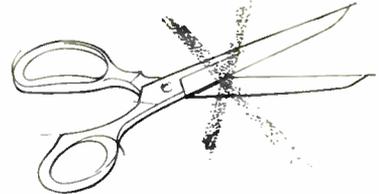
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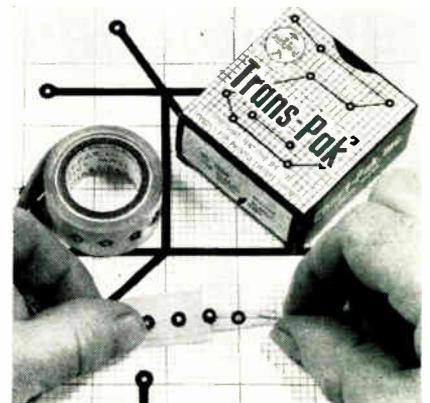
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ORIGINATOR OF THE TAPE METHOD OF DRAFTING

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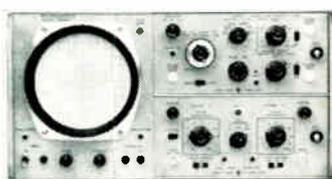
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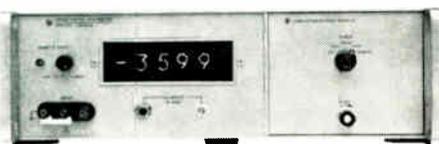
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All your measuring needs met with accuracy and reliability with top value instruments from Hewlett-Packard.



INTRODUCING 140A OSCILLOSCOPE for maximum measuring versatility with dual plug-in design. Offers parallax-free 10 x 10 cm

picture on 7.5 kv crt. Eight new vertical and horizontal plug-ins, more to come. \$575, without plug-ins.



INTRODUCING 3440A DIGITAL VOLTMETER with plug-in versatility. The

compact, solid state 3440A provides visual and electrical four-digit readout, offers 0.05% accuracy, 10.2 megohm input impedance. \$1160, without plug-ins.

SEE 200 WATT PULSES from the new 214A Pulse Generator. Big, clean 100 v pulses, positive or negative, into 50 ohms!

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3400A RMS VOLTMETER for measuring the level of noise with a crest factor as high as 80, measuring rms value of pulse train, true rms voltage!

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INTRODUCING NEW USEFULNESS for the hp 5245L Electronic Counter, with a plug-in extending the maximum counting rate to 2500 mc!

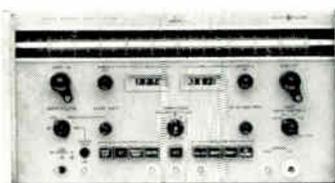
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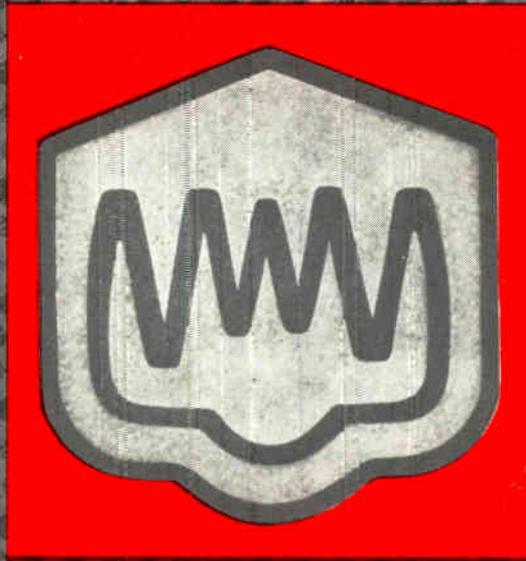


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New "Sharktooth" Geometry
of RCA 2N2476 and 2N2477.



The Revolutionary New RCA 2N2476 & 2N2477

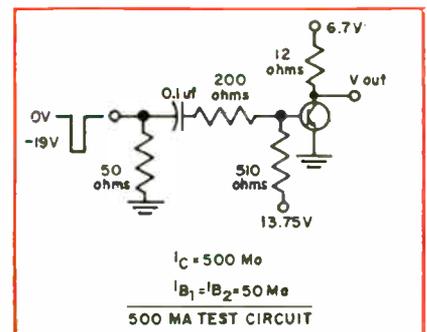
Switch 500 Milliampers in 50 Nanoseconds

Unique "SHARKSTOOTH" geometry of RCA's new Silicon NPN 2N2476 and 2N2477 provides new levels of performance as core or line drivers in high-speed memory circuits, and in other high-frequency, high-current applications.

The unique internal geometry of RCA's new 2N2476 and 2N2477 achieves a much larger emitter periphery AND a substantially reduced emitter area, providing high beta over a wide range of collector currents AND excellent switching speeds at high currents. For example, these new types have more than adequate speed and current capabilities for driving RCA's new Microferrite Memory Stacks. Check these outstanding performance features:

- Excellent high-current beta...20 typ. at $I_C = 1$ amp. for the 2N2476; 40 typ. for the 2N2477 (pulsed condition).
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- Low Collector Capacitance... 10pf max.
- Short Turn-On Time... 25nsec. max., $I_C = 150\text{ma}$, $I_B = I_{B2} = 15\text{ma}$.
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- Gain-Bandwidth Product... 250 Mc min.

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