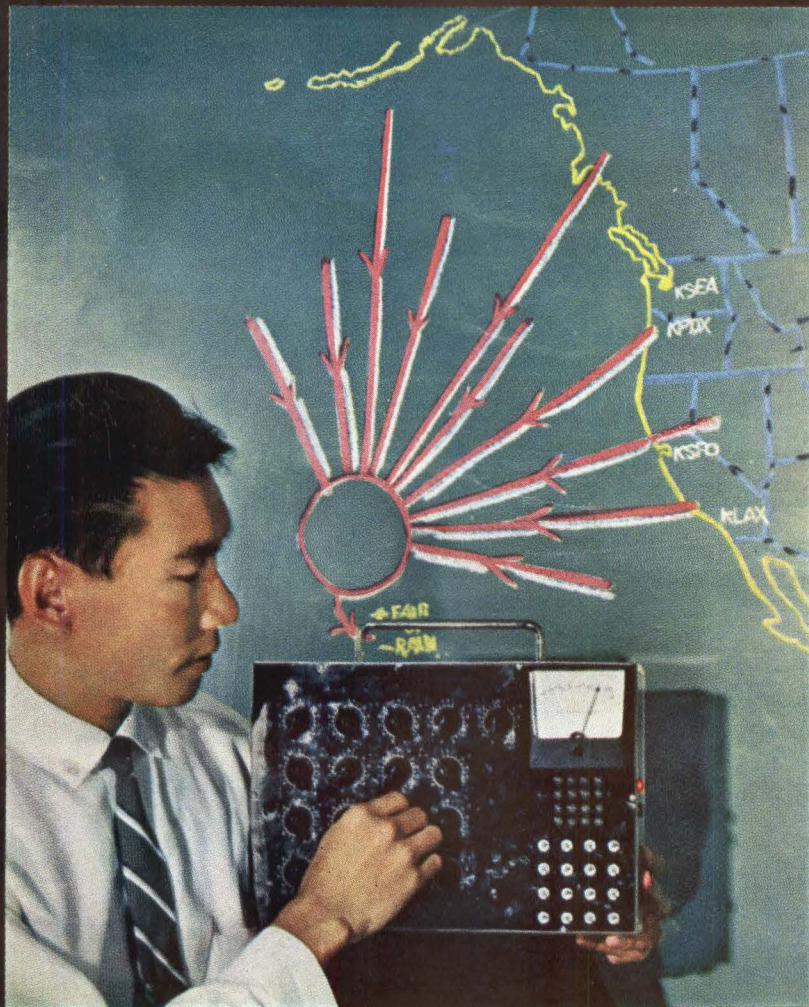
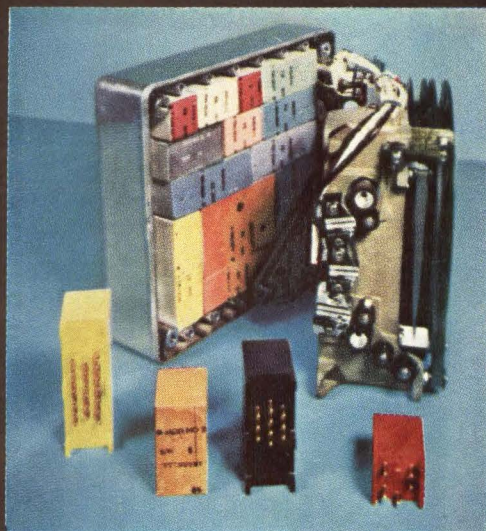


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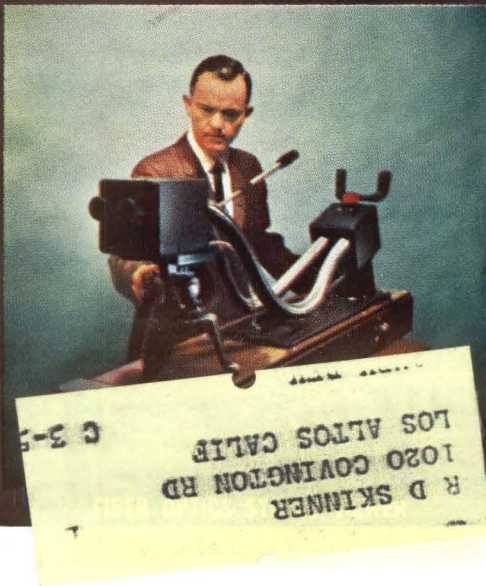
CONFERENCE HIGHLIGHTS:

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FRONTIERS IN ELECTRONICS

- NEW CONCEPTS
- NEW DEVICES
- NEW SYSTEMS

WESCON'S NEW LOOK

WEST COAST BUSINESS



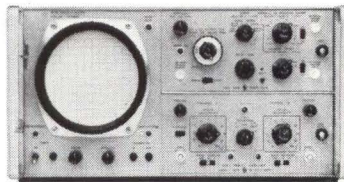
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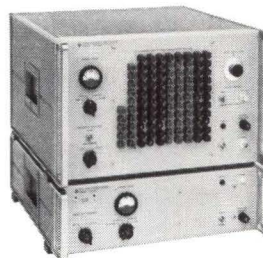
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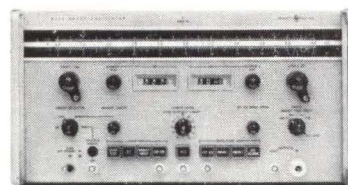
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WESCON
63!

- **WESCON SNAPSHOTS.** Reading clockwise: Adaline weather forecaster from Stanford shows adaptive circuits can equal or better human performance (p 49); satellite tape recorder by Leach is hardened to resist ionizing radiation (p 70); acceleration transducer by Giannini is also hardened against radiation (p 78); *binocular viewing device developed for the Army by Northrop uses two four-foot-long fiber optics bundles, each of which is one inch in diameter and contains several million glass fibers* COVER
- COMMUNICATIONS SATELLITE Corporation Tackles Its Problems.** Probably \$600 million will be spent before a commercial system will be in operation. *System target date: 1967* 18
- **WESTERN SALES Show More Zing.** Latest estimates point to a \$4-billion year. *Four states are vying for the proposed U.S. Space Recovery Center* 24
- **INVITED SESSIONS Dig Into Future Techniques.** WESCON speakers will explore bionics, lasers, satellites, space. *One scheme for interplanetary contact: binary pictures* 26
- **COMPANY SEMINARS.** WESCON officials are concerned by competition from privately-sponsored technical sessions. *Solution may be to allot them part of the conference's time* 29
- SAMOS CATCHERS Score High.** Air Force catches 88 percent of capsules ejected from orbiting satellites. *This is how reconnaissance film gets back to earth* 30
- IEEE'S NOMINEE—His Views.** Clarence H. Linder, slated for the 1964 IEEE presidency, tells ELECTRONICS what he thinks the issues are. *He sees a critical 4 or 5 years before the merger settles down* 38
- FOUR-IN-ONE System Tests Plastics Structures.** Epoxy-glass rocket-motor chambers are automatically tested. *Combined are microwave, eddy-current, corona and beta-ray techniques* 38
- **WESCON: The Technical Highlights.** Advances to be described will include microelectronics for the Minuteman missile, subnanosecond switching with gallium-arsenide diodes, tunnel-diode charge-transformation logic, metal-oxide semiconductor field-effect transistors, metal-oxide silicon diodes and use of a gas laser and diffraction grating to simulate large antennas. *New adaptive circuit applications forecast the weather, recognize speech and diagnose heart disease.* 49
By H. C. Hood
- NEW DEFLECTION CIRCUIT Uses SCR, Saves Power.** High-power horizontal sweep circuit for a cathode-ray tube uses a silicon controlled rectifier as the switching element. *It overcomes limited sweep ability of transistors and large power consumption of electron tubes.* 56
By T. Tarui, Tokyo Shibaura Electric

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WESCON 63!

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By W. W. Anderson, U. S. Naval Engineering Experiment Station 58

R-F OSCILLATOR HAS IMPROVED STABILITY. Modified Lampkin oscillator has its copper-shielded tuned circuit enclosed in a mahogany box to protect against short-term ambient temperature changes. *But the real secret is that the tube circuits are excited through a very high impedance while power is fed back to its resonator at a point of very low impedance.*
By E. Robberson, Consultant 62

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Is Peace Breaking Out?

JUST IN CASE your hometown newspaper did not publish the atomic test treaty provisions in full, read what the United States, British and Russian representatives state in the preamble:

“Proclaiming as their principal aim the speediest possible achievement of an agreement on general and complete disarmament under strict international control in accordance with the objectives of the United Nations, which would put an end to the armaments race and eliminate the incentive to the production and testing of all kinds of weapons, including nuclear weapons, . . .”

As our news report on p 18 last week said, the treaty is as yet only symbolic of possible disarmament moves. So far, it is of immediate business concern to just a particular segment of the electronics industry—it will directly affect companies supplying instrumentation and services to the atomic test program. An overall cut-back in defense systems—which would affect the entire electronics industry—is not planned, officials say.

But the electronics industry must recognize that if the mood of the treaty prevails through future disarmament negotiations a moratorium on the arms race and an eventual beginning of disarmament is a distinct possibility.

We must be alert to this possibility. Whatever our individual personal opinions of the treaty—hopeful sign or sucker play—we as an industry should be watchful.

The question “What if peace breaks out?” is one that the electronics industry has largely ignored throughout the cold war. But we cannot afford to ignore it indefinitely. As urged—though for different reasons—in this column on June 28, the electronics industry and its sister industries must make a determined effort to become less dependent on military procurement by more actively developing civilian products and seeking new civilian markets.

Historically, munitions industries have been subjected to the feast or famine of war and peace cycles. If peace does break out, let us not regret it. There could be no sadder commentary on the

electronics industry than that it was unprepared for peace.

PRIVATE CONFERENCES. One of our WESCON stories this week (p 29) points out that future meetings may formally recognize private company seminars and allot time for them. The reasons: to avoid conflicts and competition with regular sessions, and to serve an apparent need.

Some companies do not approve of competing with conferences they support. Others consider simultaneous company seminars appropriate and a fair number of conference goers want to attend such seminars to satisfy immediate and practical information needs. So company seminars do exist and do compete with conference sessions for an audience.

Is this bad? It is if you are the volunteer who has worked hard and long to develop a conference program, or if you are an author speaking to a half-empty auditorium. It is bad if you are Joe Smith, the conference goer, who wants to but cannot be in two places at the same time. It is not bad if you are a marketing manager with something important to say to an important group already on the ground.

In their study concerning the feasibility of providing time for company seminars conference planners will, we hope, take the long view: the primary reason for a conference is to inform the conference goers. If a substantial portion of conference goers want to attend company seminars as well as conference sessions why not make it easier for them to attend both?

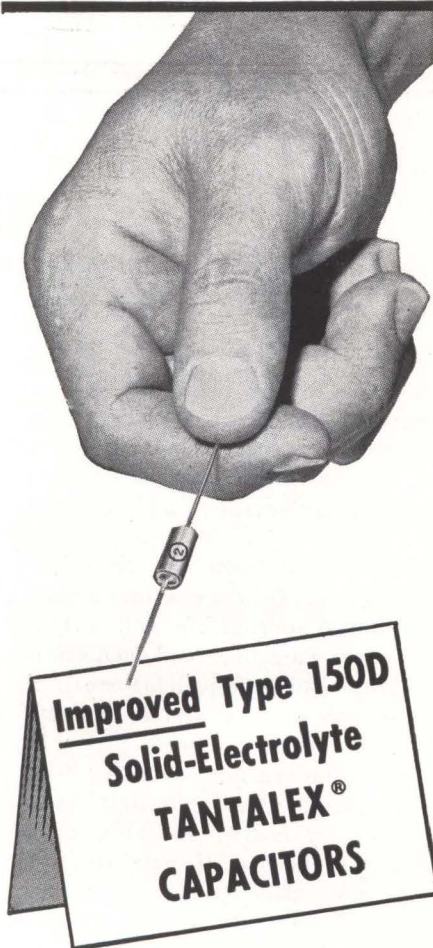
Coming In Our August 16 Issue

MICROWAVE'S LATEST. A new tube under development will be shown for the first time next week. It applies advanced magnetic and energy-conversion techniques to convert microwave energy into millimeter wavelengths.

Other feature articles next week will describe:

- Infrared system for detecting intruders
- Schmitt trigger to drive low-impedance loads
- Talking computer. Inquiries are answered by a digital-to-voice translator.

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COMMENT

Metric System III

Finn Poulsen's suggestion of a method of introducing the metric system into ELECTRONICS (p 4, June 7) is but one of the many "cries in the wilderness" published in our leading electronics journals.

However, few of these letters propose a date for Poulsen's Phase II, when the metric measurement would be given first. I hereby propose that we celebrate the centennial of the legalization of the metric system by the U.S. government by beginning to use it. The Act of Congress legalizing the metric system was dated 28 July 1866, so that we have over three years for Poulsen's Phase I. (See *NBS Technical News Bulletin*, Vol. 42, March 1958, pp 41-45. Also, "Weights and Measures Administration," NBS Handbook 82, 22 June 1962.)

By 1966, even the stodgy old U.S. Army will be using the meter to express all linear measurements for survey, fire direction, and fire coordination equipments used outside the continental U.S. (See Army Regulations No. 525-8 and No. 700-75.) Many U. S. industries other than electronics will also have converted by then.

Traditionally, engineers have not minded being a decade or two behind the scientists. However, I suspect that our children will be ashamed to be over a century behind our congressmen, and even behind our generals.

Since almost all of your readers use the metric system in school, I believe that the principal source of inertia has been our conception of miles as the distance to the grocery store, and pounds as the way one buys meat. To placate the "old dogs" who "can't learn to think in the metric system," I propose the following table of "old dog's equivalents":

U.S.A.	Ancient
1 meter.....	1 yard
1 km.....	1/2 mile
1 cm.....	1/2 inch
5 g.....	Weight of a nickel
1 kg.....	2 lb
1 liter....	Economy-size quart

LEE E. DAVIS

Portola Valley, California

Thermal Resistance

In defense of the critical views expressed by Canadian correspondent Soanes regarding thermal resistance (p 4, June 14), may I quote from EIA-JEDEC Publication No. 19, "Measurement of Thermal Resistance," Nov., 1960?

"The parameter most frequently used for thermal resistance measurements is I_{obs} or the saturation current of a reverse-biased junction. This temperature-sensitive parameter is adequate, but not completely reliable, for germanium, and is completely unreliable for use as a temperature-sensitive parameter for silicon."

"The voltage drop across a forward-biased junction is a temperature sensitive parameter which is equally reliable for both silicon and germanium devices. The variation of this drop with temperature can be determined both analytically and experimentally."

R. C. GRAY

Space Technology Laboratories, Inc.
Redondo Beach, California

Seismometer

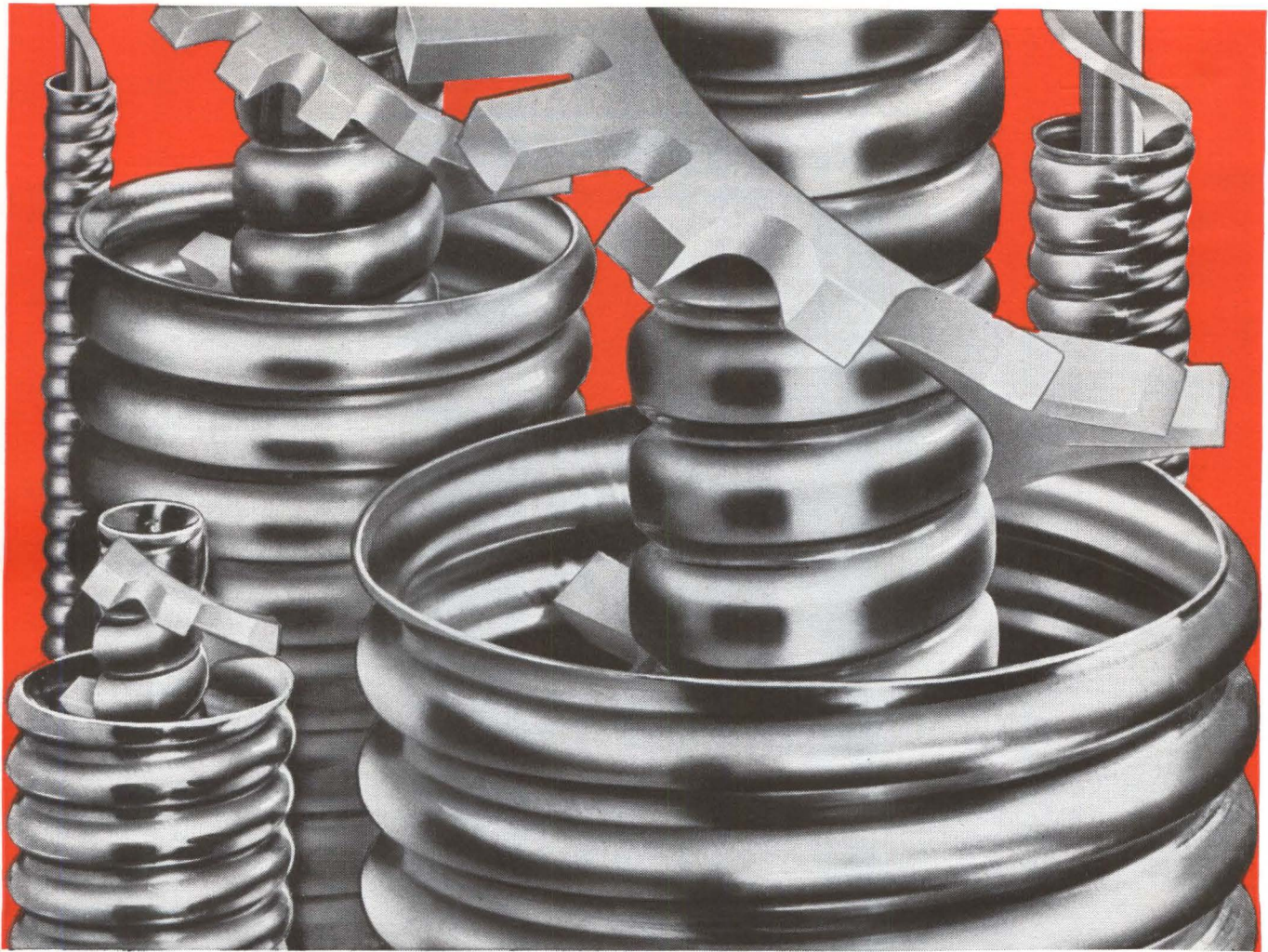
Your June 21 *New Products* column (p 101) says, "Ultra-sensitive seismometer detects 10^{-7} mm of motion, accelerations of 10^{-8} g, change of tilt to better than 0.1 second of arc, change of azimuth better than 0.2 second of arc, temperature variation of 0.1 F and magnetic field strength and ripple of 0.1 gauss."

Although Geotechnical appreciates your making a super-sensor out of our seismometer, it makes the engineers who designed the tilt, azimuth, magnetic and temperature transducers very jealous. They insist that a device with such acceleration and motion-detection capabilities needs no fringe benefits, and demand separate recognition of their instruments.

J. D. HAMEL

Geotechnical Corporation
Garland, Texas

Mixed specs. The pictured seismometer measures motion and acceleration only. Different instrumentation is required for measuring tilt, change of azimuth, magnetic field strength and temperature.



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Step 4 Assemble inner connector to the center conductor.

Step 5 Assemble flare ring, O ring, anchor insulator. Thread outer body onto clamping body.

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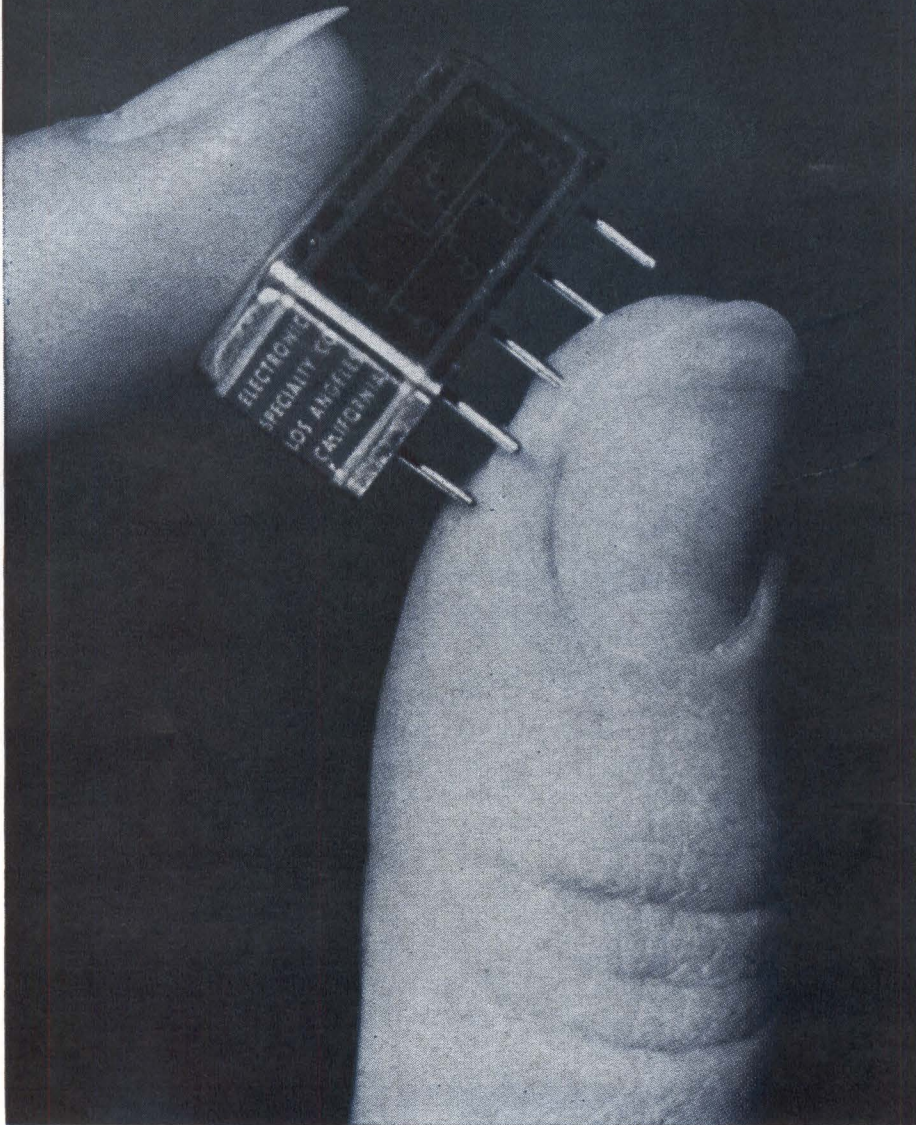
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Product of the Month: MAGNETIC LATCH



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SPACE CONDITIONING:

electronically programmed environmental controls and systems for industrial, commercial, and military applications.

SYSTEMS:

Systems Laboratories conduct research, development and study programs in reconnaissance, electronic countermeasures, interferometer phased array systems, and total energy packages; integrating divisional components, sub-systems, and specialized technical skills.

For information concerning the corporate systems capability, product line, or research and development programs, write to the Director of Marketing, address below.



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Experts Disagree on Nuclear Test Ban

SAN FRANCISCO—The only way to detect testing of nuclear weapons in space is to develop monitor satellites, Edward Teller said in an interview here last week. Before the Senate ratifies the nuclear blast treaty, it must be learned whether such systems can be developed, he warned.

He also said small atomic shots in the atmosphere are hard to detect and it is possible to conduct secret tests of weapons up to several megatons. These data could be applied to detonations in space that would block oncoming missiles, he said.

WASHINGTON—There is so little question about enforcement of the nuclear test ban treaty it's hard to see how any objection can be raised on technical grounds, the Federation of American Scientists said here last week. "There is almost no chance that a nation could perform a series of militarily important nuclear test explosions without being detected," FAS said.

Existing equipment for probing the ionosphere will detect, by the signature in the very low frequency range, any high altitude test. Extremely minute quantities of radioactive debris from a surface or near-surface test can be detected, dated, evaluated and identified.

Ground-based equipment can detect megaton tests a million kilometers in space. Larger tests can be detected further out. If satellite detection systems are deployed, detection beyond the sun and behind the moon, by delayed gamma radiation, is also feasible.

Microwave Device Detects Plastic, Metal Mines

FORT BELVOIR, VA.—A microwave device capable of locating nonmetallic as well as metallic mines has been developed by the U.S. Army Engineer Research and Development

Laboratories here. Details are classified but basically, a spokesman said, the device distinguishes differences in reflectivity between the mine and surrounding soil.

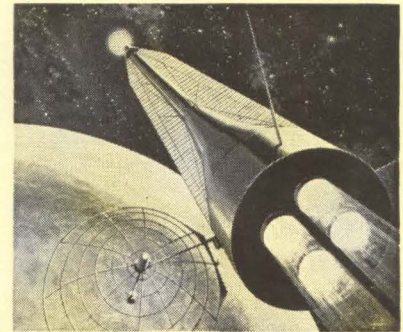
Stones and other objects in the ground can be differentiated from mines "by the particular design of the antenna and the manner in which the output is presented in the binaural headset," the spokesman said. Models now being troop-tested at Fort Knox and Fort Benning were made by Dalmo Victor Co. under a \$110,000 contract.

Computer Command Post Received by Army

COMPUTER-ORIENTED electronic command post, designed to provide field commanders with all information necessary for battlefield decisions, has been delivered to the Army by Philco (p 32, April 12). Operations Central AN/MSQ-19 takes data-link, telephone, radio, and courier-supplied data and displays it in seconds on back-lighted screens in command headquarters.

Acceptance tests are scheduled to last two to three months. Major suppliers and subcontractors are:

Spur to Mars



POWER for electronics systems and ion engines aboard Mars-mapping vehicle could be supplied by Spur (Space Power Unit Reactor), a 350-Kw nuclear-powered turbine, says Garrett AiResearch of Phoenix, which is putting the system through development tests

Sylvania, Mobidic computer and mass memory; Goodyear, inflatable rubber shelters; and General Dynamics, telephone system links.

Data System Will Ease Air Controller's Load

NEW SYSTEM being developed by Burroughs under a \$2.1-million FAA contract will process radar

Danger—Reflected Laser Beams

BOSTON—Scientists and engineers who would never think of looking directly at a laser beam are often careless around diffusely reflected beams, a biophysicist warned at the second Boston Laser Conference here last week. Gerald Grosf, of TRG Inc., said these beams have a dangerous energy density at virtually any angle. He recommended the wearing of safety glasses (p. 27, Jan. 26, 1962).

A speaker from the floor said there are no documented cases of retinal burns to laser experimenters, but only because companies and institutions where the injuries occurred have kept the information to themselves. He said researchers in the field know of at least five cases of damage to human retinas and one case of skin damage. Of the five retinal burns, three of the patients recovered completely, the damage is transient in the fourth case and permanent injury was inflicted in the fifth case

WESCON AWARD WINNER

Donald K. Weaver, professor of electrical engineering at Montana State College, has been voted the 1963 Electronic Achievement Award by the Sixth Region IEEE. Weaver, 39 years old, established a graduate program in electrical engineering at Montana State, helped finance it by securing R&D contracts, then helped set up a company to hire local EE graduates. The award will be presented at Wescon's annual all-industry banquet

**WESCON
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and beacon data to automate some of the functions of the air traffic controller. The system will filter data at the radar site and transmit the information to the control center over telephone lines, instead of using a microwave transmitter and repeater links.

Although the inputs to the processor will still be monitored at the radar site, Burroughs says the system will free the controller from many of his sorting tasks and permit him to concentrate on controlling air traffic.

Cradle Would Land Crippled Aircraft

WOODBURN, OREGON—A radio-controlled, rocket-powered cradle that would enable aircraft with crippled landing gear to touch down safely, has been proposed here by Joseph Uphoff, retired inventor, and Arch F. Bruschi, president of the Pacific Coast Institute of Technology. An airport's control tower would steer the cradle and direct planes onto it. Doppler radar would ascertain the difference between aircraft and cradle speeds. Cradle cost is estimated at \$250,000.

Ground Position System Uses Magnetic Logic

LONDON—Airborne ground position indicator system developed by Ples-

sey Ltd. uses multiaperture ferrite cores for its logic operations. The indicator system is fed speed and flight-track data from doppler navigation equipment, and also heading information from a sine-cosine digitizer fitted to the aircraft compass.

Each pulse in the doppler information trains represents a fixed-distance quantum. As each pulse occurs the heading sine-cosine values are extracted and summed by a computer. The processed information feeds a counter-type digital display showing distance travelled in north-south and east-west directions. The processing system includes corrections for the doppler frequency change occurring between land and sea flights.

All-Planar Construction Increases SCR Sensitivity

SILICON controlled rectifiers made by planar instead of conventional diffused construction techniques are to be introduced at WESCON by Texas Instruments Incorporated. The company says the use of planar techniques improves sensitivity, gain, output, and heat and radiation resistance. Characteristics include forward-current ratings of 350 ma at 55 C, surge currents up to 6 amp at 150 C and typical speeds (t_{on}) of 0.3 μ sec. Applications such as high-speed ring counters, and Nixie and electroluminescent display drivers are anticipated.

Flexible Superconductor Goes Into Production

NATIONAL RESEARCH CORP. reports this week it is now in commercial production of flexible superconducting ribbon made by putting a thin layer of Nb_3Sn on a niobium ribbon (p 19, March 1); Nb_3Sn is normally brittle. The company says the new material, called Niostan (niobium stannide), can be used to build 100-kilogauss magnets. In an applied field of 100 kilogauss, the film will carry 200,000 amp per square cm, the company says, and maximum field is about 250 kilogauss.

In Brief . . .

D. BRAINERD HOLMES, outgoing head of NASA's manned space flight program (p 22, June 21), will join Raytheon Oct. 1 as a senior vice president. Industry observers said the move underscores Raytheon's attempts in the last 18 months to obtain a larger share of the nation's space work.

SYNCOM II will be in its appointed position sometime today or tomorrow thanks to a maneuver that killed three birds with one stone. Pulses sent to the satellite brought temperature up to normal (p 8, Aug. 2), reoriented the antenna and speeded up westward drift.

TWO MORE Japanese companies have ratified the agreement on minimum prices for tv sets for export to the U. S. (p 7, Aug. 2). This brings the total to 19, and EIA-J expects two more firms to join.

FRENCH government has bought an APT ground station (p 20, July 26) from Fairchild Stratos. It will be installed at Lannion, Brittany, in time for use with the Tiros VII satellite this fall.

SINGER is acquiring the assets of Empire Devices.

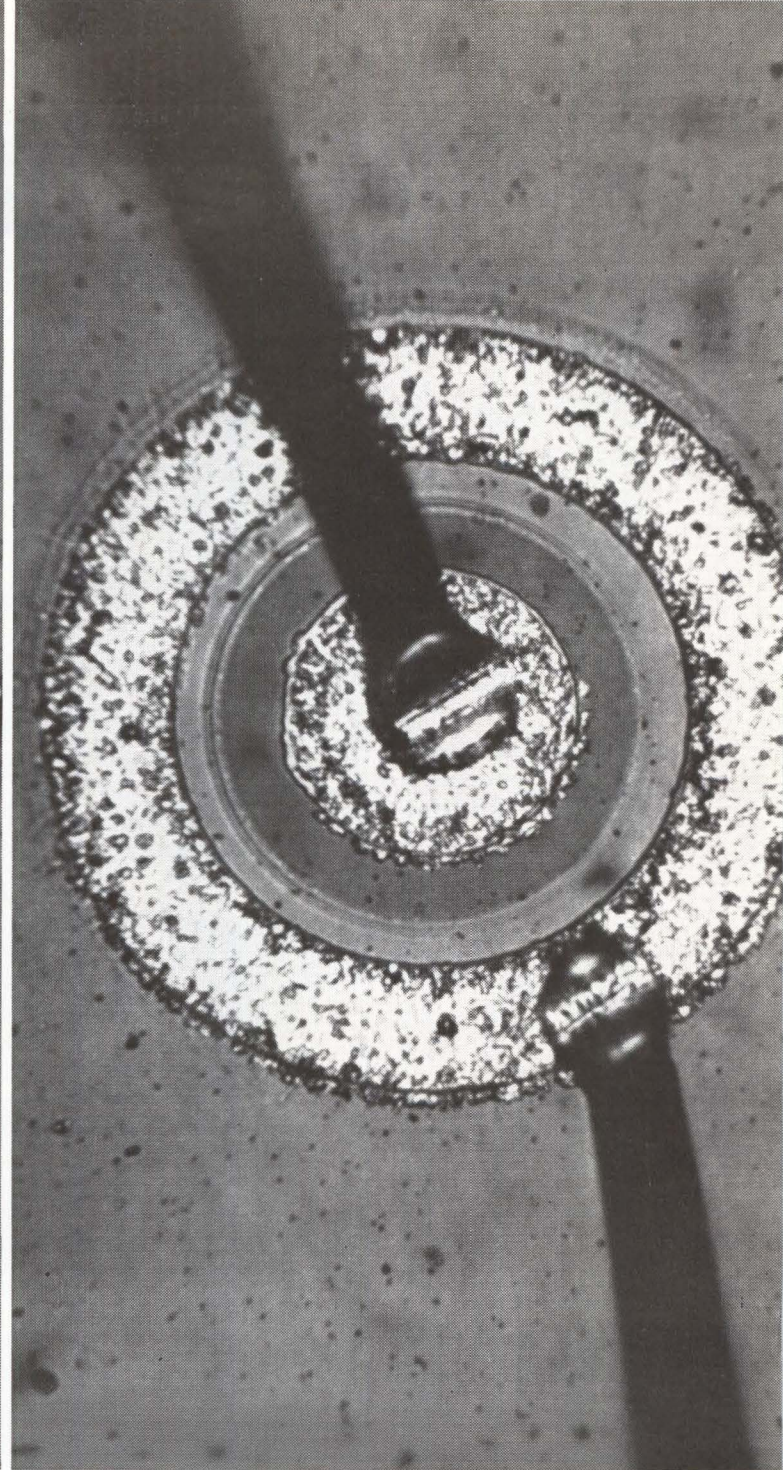
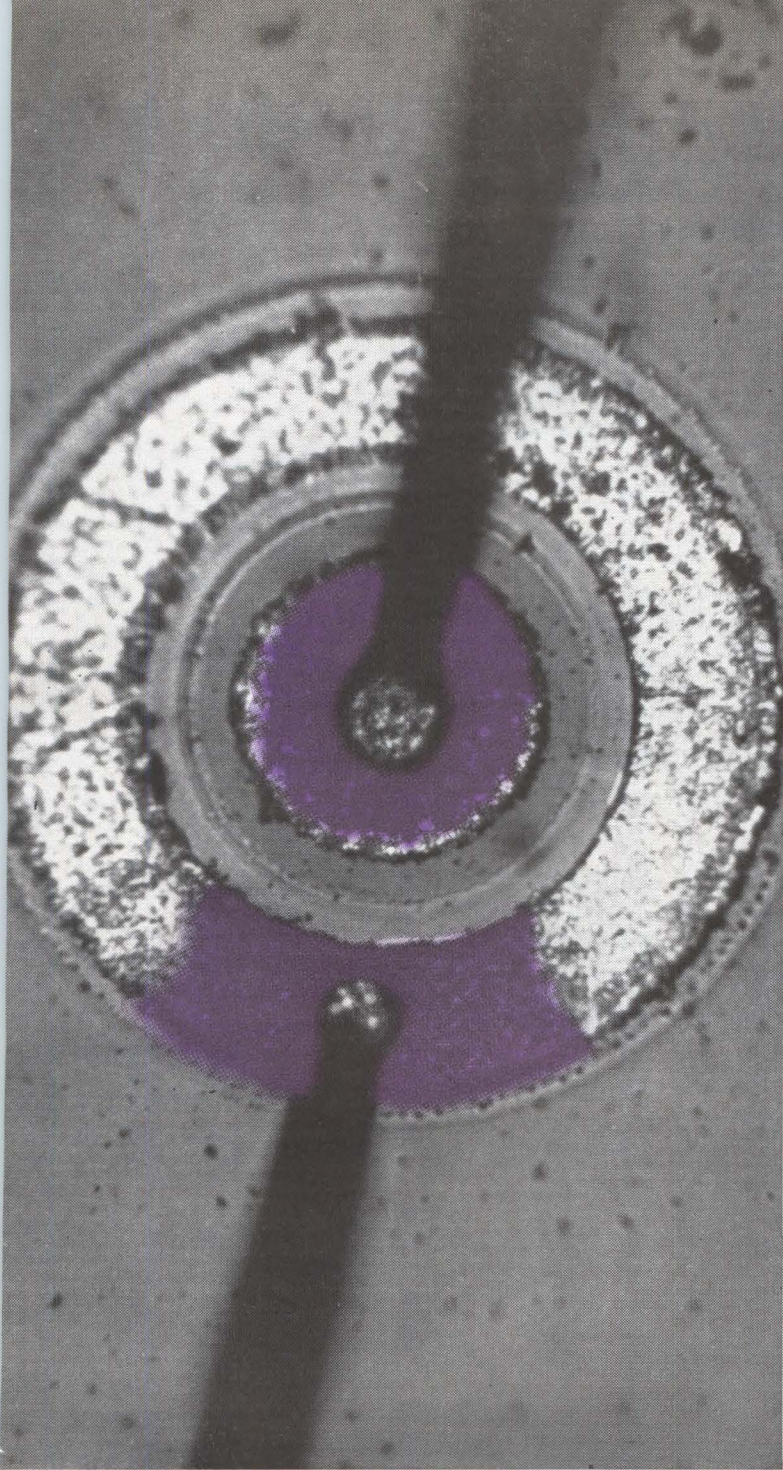
GENERAL DYNAMICS sold an airborne display console to the Navy for use in designing a system for sub-killer aircraft.

GULTON Industries has acquired Servonic Instruments.

SUBSCRIPTIONS to pay tv in the Hartford area have increased sharply over the past two months. According to RKO General and Zenith, more than 3,000 homes now carry the service.

AEROSPACE Industries Association's report on the Defense Department-industry program for technical manual cost reduction states that savings of "millions of dollars per year" have been achieved.

PILOT RADIO CORP., which suspended tv production in 1952, will produce color tv receivers this fall.



How Sylvania checked "purple plague" and boosted reliability

What you see above represents a victory over an insidious cause of semiconductor device failure—a problem faced by the whole industry—the "purple plague."

On the left, the blotches are a gold-aluminum-silicon alloy formed by reaction between the gold wires and aluminum base areas of the chip. Accelerated by high temperatures, this reaction increases se-

ries resistance and weakens the leads—bad news when reliability is essential.

Sylvania engineers departed from standard industry practice and developed a technique of bonding aluminum wires to aluminum, illustrated at the right. After long testing at worse-than-actual conditions, the clean Sylvania junctions confirm: no chemical reaction, no purple plague at

the chip—a big step forward that means greater system reliability.

All Sylvania epitaxial planar devices now benefit from this victory. The broad, integrated capabilities that made it possible are being applied constantly to the improvement of Sylvania semiconductors.

Semiconductor Division, Sylvania Electric Products Inc., Woburn, Massachusetts.

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The solid state 5245L Counter and its plug-in units let you custom-design the instrument to your specific measuring need by adding plug-ins when, but not until you need them. As your requirements change, you can easily and economically change the 5245L to meet them.

The 5245L measures frequency, period, multiple period average, ratio and multiples of ratio. The basic counter, without plug-ins, offers a maximum counting rate of 50 mc with 8-digit resolution. With just one plug-in you can measure from 50 to 512 mc.

Other plug-ins include a video amplifier which increases the 5245L sensitivity to 1 mv rms and a time interval unit which enables the counter to measure time interval from 1 μ sec to 10^8 sec. More plug-ins, including one to extend the capability to 2500 mc, are in final development. All retain the basic accuracy of the counter.

SPECIFICATIONS

FREQUENCY MEASUREMENTS

Range: 0 to 50 mc
Gate time: 1 μ sec to 10 sec in decade steps
Accuracy: ± 1 count \pm time base accuracy
Reads in: kc or mc, with positioned decimal

SCALING

Range: 0 to 50 mc
Factor: by decades up to 10^9

PERIOD AVERAGE MEASUREMENTS

Range: single period, 0 to 1 mc; multiple period, 0 to 300 kc
Periods averaged: 1 period to 10^5 periods in decade steps
Accuracy: ± 1 count \pm time base accuracy \pm trigger error
Frequency counted: single period, 10^7 to 1 cps in decade steps; multiple period, 10^7 to $\frac{1}{10}$ the number of periods averaged, cps in decade steps
Reads in: sec, msec, μ sec with positioned decimal

RADIO MEASUREMENTS

Displays: (f_1/f_2) times period multiplier
Range: f_1 , 0 to 50 mc; f_2 , 0 to 1 mc in single period, 0 to 300 kc in multiple period; periods averaged 1 to 10^5 in decade steps
Accuracy: ± 1 count of $f_1 \pm$ trigger error of f_2

TIME BASE

Frequency (internal): 1 mc
Stability: aging rate: less than ± 3 parts in 10^6 per day; as a function of temperature, less than ± 2 parts in $10^{10}/^\circ\text{C}$, -20°C to $+55^\circ\text{C}$; as a function of line voltage, less than ± 5 parts in 10^{10} for $\pm 10\%$ change in line voltage
short term: less than ± 5 parts in 10^{10} p-p with measurement averaging time of 1 sec under constant environmental and line voltage conditions

With still more plug-ins on the way, the 5245L will never lose its usefulness . . . in fact will become more useful as your measuring task becomes more demanding and you add plug-ins to the one basic counter.

Beyond this built-in flexibility, the 5245L offers these unparalleled advantages . . . yours to match against any comparable instrument:

- Direct counting to 50 mc
- Time base stability better than 3 parts in 10^6 /day
- Display storage for continuous readout
- Sample rate, independent of gate time, adjustable 0.2 to 5 sec
- Readout in close-spaced rectangular Nixie tubes
- Four-line BCD output for systems, recorder use
- Remote programming capability
- Plug-in circuit construction for easy maintenance
- Compact, stackable cabinet only 5 $\frac{1}{4}$ " high

The specifications tell the story briefly. Check them out for a partial indication of the superior performance offered by the 5245L. Then call your Hewlett-Packard field sales office for a demonstration on your bench.

Start using the 5245L today . . . and you'll be using it for a long time to come.

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Registration: 8 digits in-line with Nixie tubes
Sample rate: 0.2 sec to 5 sec, independent of gate time
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Output: 4-line BCD
Remote operation: all functions programmable from front panel controls except "sample rate" and sensitivity, may be programmed remotely
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Price: \$3250

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extends range of 5245L to 512 mc, \$500
hp 5261A Video Amplifier:
increases sensitivity of 5245L to 1 mv rms, 10 cps to 50 mc, \$325
hp 5262A Time Interval Unit:
converts 5245L to time interval counter with a resolution of 0.1 μ sec, \$300

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

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8923

WASHINGTON THIS WEEK

FCC TOUGHENS RATE POLICY, UTILITIES R&D MAY BE SLOWED

SHARP CHANGE in Federal Communications Commission policies bears watching because it can affect communications carriers R&D efforts. Their revenues may be reduced by firmer rate-making policies.

Newton N. Minow, former FCC chairman, felt that with technology evolving so rapidly the carriers require generous earnings to attract the capital to keep pace. But Minow's successor, E. William Henry, is changing things. Last week, he and three other commissioners gave an accounting ruling that may be the first step toward shifting to utility customers, rather than the companies, the tax credit that Congress voted last year to stimulate investment in equipment. Congress, however, may pass a new bill effectively reversing the ruling.

Earlier, Henry and two other Kennedy appointees tried to force AT&T to drop its developmental rate for Wide Area Data Service while a new rate structure was designed. FCC had already rejected the rates, and Henry, Lee Loevinger and Kenneth A. Cox didn't want them charged AT&T customers while new rates were being fixed.

ANTIMISSILE PROSPECTS CALLED DIM

PRESIDENT KENNEDY has undercut efforts to establish operational antimissile-missile batteries. "Developing a defense against a missile is beyond us and beyond the Soviets technically," he said last Thursday. This seems to relegate Nike Zeus and newer Nike X development (ELECTRONICS, p 24, March 8) to R&D status almost indefinitely. Zeus R&D has already cost \$1.5 billion; this year's expected funding is \$89 million. The new Nike X effort is funded at the \$250-million level. Nike X is rated higher than Zeus. Its better discrimination radar techniques and faster, shorter-range missiles hopefully can separate warheads from decoys and destroy the warheads in time. Nothing in the new nuclear test ban, the President said, will interfere with this effort.

CONGRESS SET TO BATTLE ON NASA FUNDS

HOUSE APPROPRIATIONS Committee is preparing to support its colleagues on the House Space Committee in the coming battle with the Senate on NASA appropriations. There is a chance the purse-controlling group may act this year—as it did last year—even before an official NASA authorization bill reaches it. Two issues are knotty: the House passed an authorization cutting 8 percent from NASA projects while the Senate Space Committee sent to the floor a 1-percent cut; and the House tied strings to its \$3.9-million authorization for the Boston electronics center while the Senate group, under pressure from the White House, reversed earlier action and approved the project. Differences on money can be cut down the middle; differences of "principle" like the politics-tied electronics center—sought by Sen. Ted Kennedy (D.-Mass.)—may prove knottier. House Appropriations Committee will probably have the last word.

ANOTHER SQUEEZE ON R&D MONEY

CONGRESS is beginning to look more critically at the government's sprawling \$14-billion R&D effort. Powerful members of the Rules Committee of the House of Representatives—both Democrats and Republicans—now favor a top-to-bottom investigation, aimed at cutting waste and duplication. This would cut across all the departments engaged in R&D.

EXCLUSIVE...

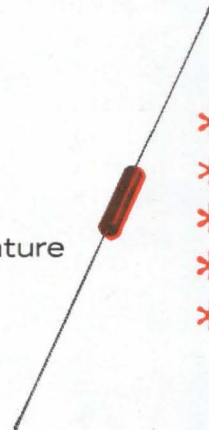
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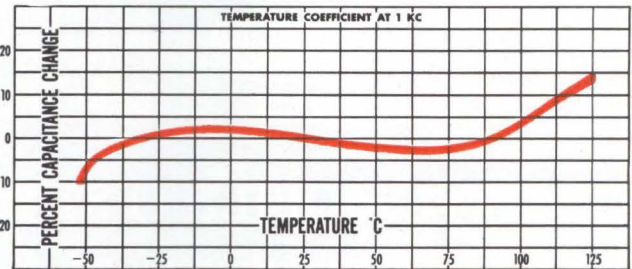
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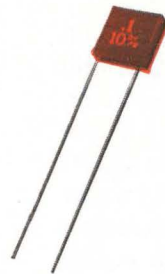
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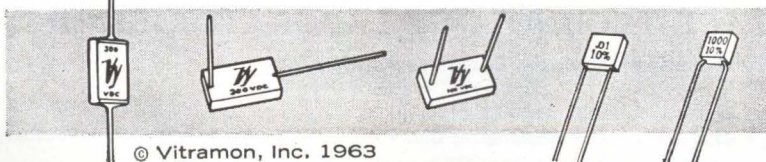
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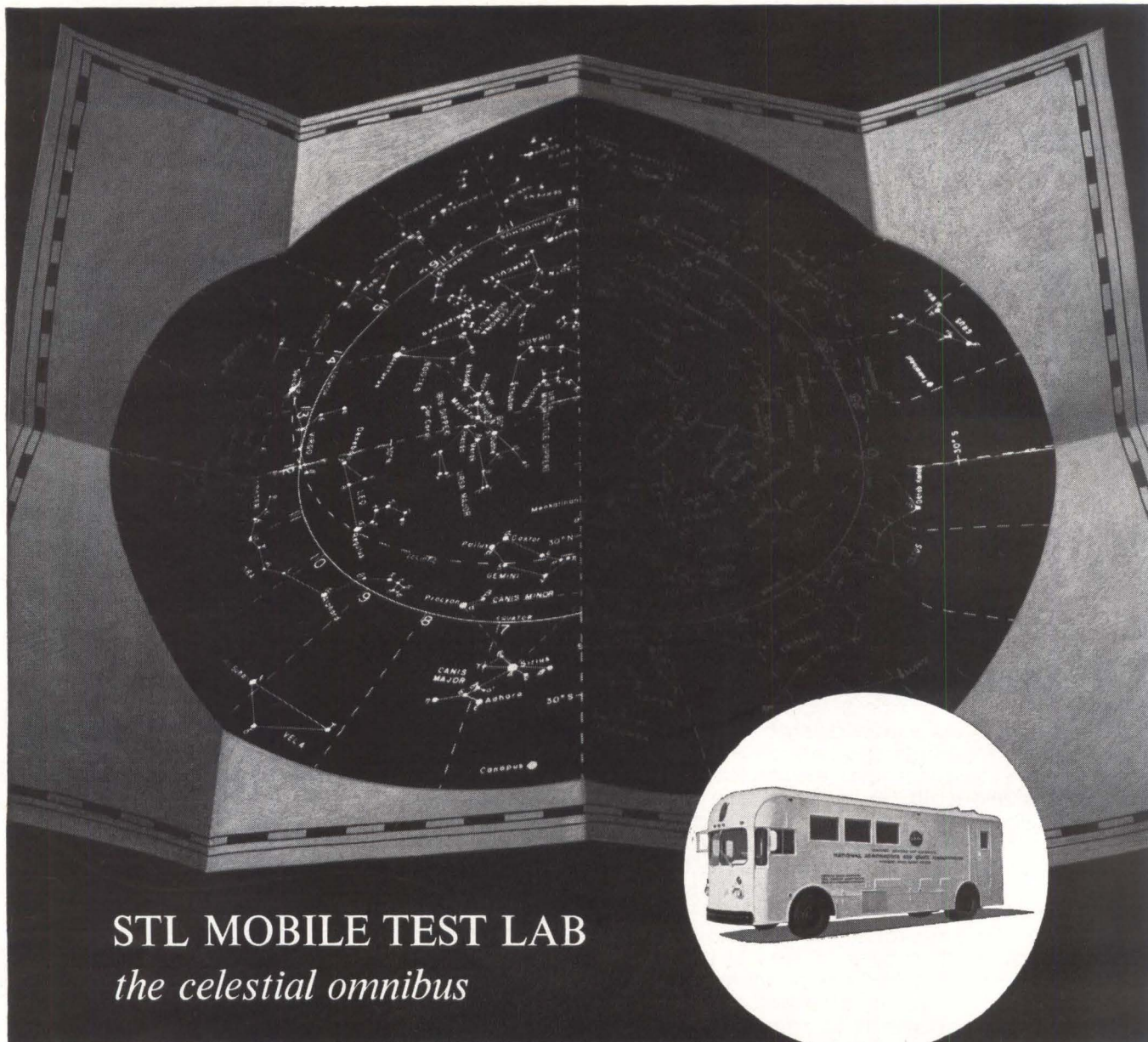


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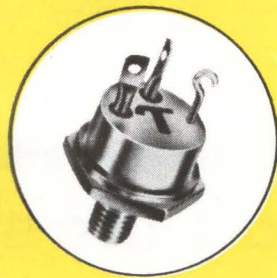


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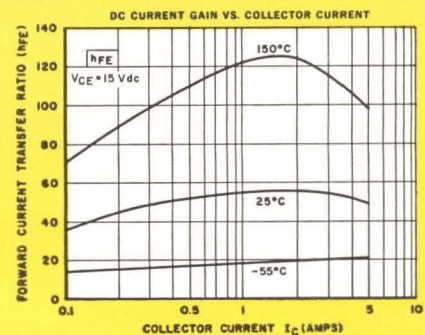
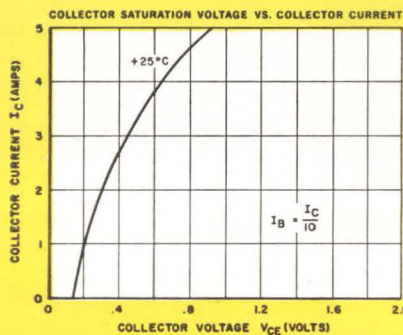
2N1722

and

2N1724

power transistors

Type	DC Current Gain @ $I_C=2$ Amps (β)	Typical Collector Saturation Voltage @ $I_C=2$ Amps (Volts)	Minimum Sustaining Voltage @ $I_C=200$ mA (Volts)	Typical Cut-Off Frequency @ $I_C=100$ mA (Mc)	Power Dissipation Rating @ 100°C Case (Watts)
2N1722 } 2N1724 }	20-90	0.3	80	20	50

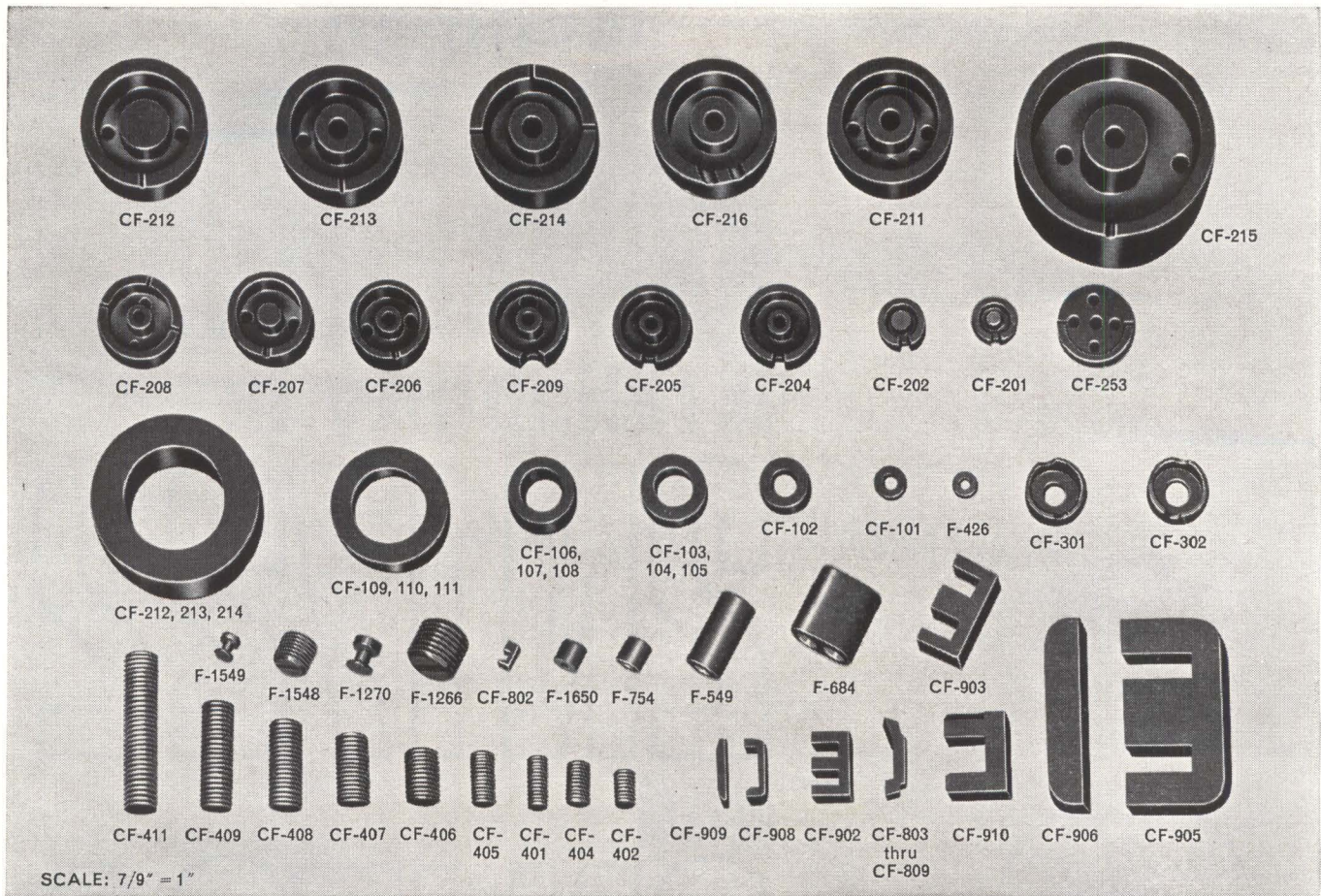


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IF Transformers	Moderate Q, high μ , magnetic stability, adjustable	465 kcs 40 mcs other	"Q-1" "Q-2" Materials for filter inductors apply	Cup cores, threaded cores, toroids
Antennae Cores	Moderate Q, high μ , magnetic stability	5-10 mcs 10-60 mcs	"Q-1" "Q-2"	Rods, flat strips
Wide Band Transformers	High μ , moderately low loss	1 kc-400 kcs 1 kc-1 mc 200 kcs-30 mcs 10 mcs-100 mcs 50 mcs-225 mcs	"Q-3", "T-1" "H" "Q-1" "Q-2" "Q-3"	Cup cores, toroids, C-cores, E-cores
Adjustable Inductors	High μ , moderately low loss	Same as Wide Band Transformers	Same as Wide Band Transformers	Rods, threaded cores, tunable cup cores
Tuners	High μ , moderate to high Q, magnetic stability, as much as 10-to-1 adjustability with mechanical or biasing methods.	Up to 100 mcs	For high Q selective circuits, materials under filter inductors apply. For others, materials under wide band transformers apply.	Threaded cores or rods for mechanical tuning, Toroids, C-cores, E-cores for biasing methods.
Pulse Transformers	High μ , low loss, high saturation	Pulse	Materials under wide band transformers apply	Cup cores, toroids, C-cores, E-cores
Recording Heads	High μ , low loss, high saturation, resistance to wear	Audio, pulse	"H" "Q-3", "T-1"	

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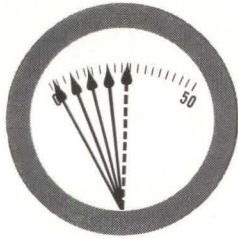
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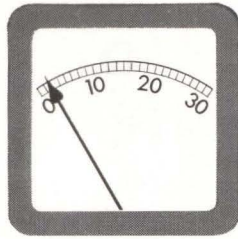
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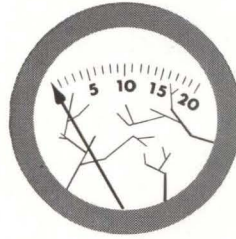
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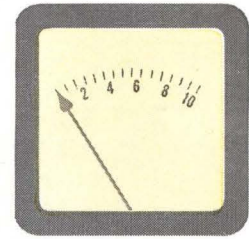
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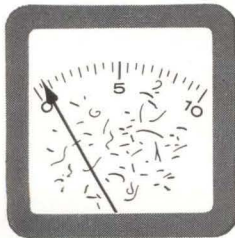
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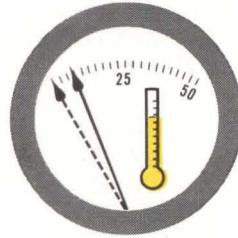
CRAZED CASES



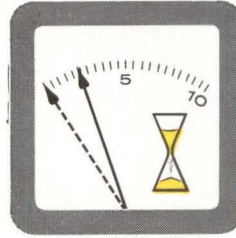
YELLOWING CASES



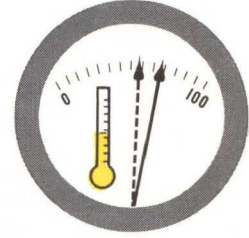
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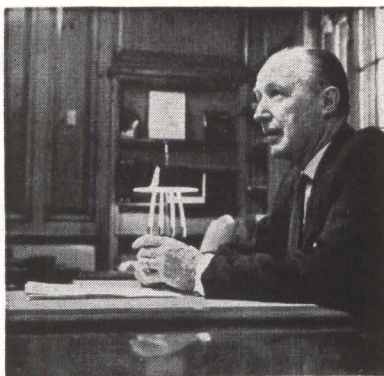
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HEADQUARTERS for the *Communications Satellite Corporation* is called by those working in it "the house of questions"

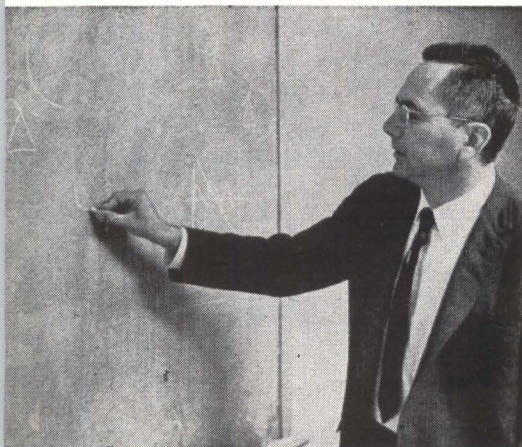


L. D. WELCH, *corporation chairman*



J. V. CHARYK, *president*

S. METZGER, *R&D manager*



ComSat Tackles Problems—

Operating a commercial satellite system by 1967 is a \$600-million job

By **SETH PAYNE**
McGraw-Hill World News

WASHINGTON — The tranquil setting of the 26-acre estate, Tregaron, belies the bustle that permeates the improvised headquarters of the new Communications Satellite Corporation—or the controversy around it. ComSat officers are trying hard to whip into shape a billion-dollar corporation with a target date of 1967 for an operating satellite system. But they face mountainous problems aggravated by governmental criticism.

The stately mansion, once the home of the late Joseph E. Davies, is now being dubbed the "house of questions." "Right now it is nothing but an endless string of questions," says one official, "But before long we've got to hammer out the answers."

- What kind of satellite system?
- How much will it cost?
- What kind of international agreements are to be made?
- How do new countries enter the system?

These and a dozen or more such questions face the new corporation. Solution to almost any question is so interrelated to the others that all must be dealt with almost simultaneously.

As if this was not complicated enough, the corporation by its quasi-government status must please just about everyone. The administration wants a show piece for democracy with early service to underdeveloped countries; Congress wants wide public ownership without domination by any single company; the Federal communications Commission will regulate rates and contracting. FCC is already pressing for a stock issue (*ELECTRONICS*, p 12, Aug. 2).

Underlying all this is the corporation's obligation to come up with a profitable system.

To insure against slip-ups, the

White House recently set up an *ad hoc* committee, headed by Deputy Attorney General Nicholas de B. Katzenbach, to coordinate related government agency actions. Some reports say the committee also keeps a close eye on corporate progress for the White House. Other agency members include the FCC, State Department and NASA.

ORGANIZATION — Four months ago, Leo D. Welch, former chairman of Standard Oil of New Jersey, and Joseph V. Charyk, former Air Force Under Secretary, became ComSat's chairman and president. Now there is a 27-man staff, a 100-man staff is expected in a year, and officials won't guess at future size. Some key men are Sidney Metzger, manager for components development and systems research. At RCA, he was responsible for radio communication engineering and equipment for Projects Score, Tiros and Relay. S. H. Reiger, manager for systems analysis, headed Rand Corp. studies on satellite system economics.

Financial coordination is handled by Lewis C. Meyer, a former top financial analyst for the Air Force. Temporary consultants are J. P. Ruina, former director of the Pentagon's Advanced Research Projects Agency, and Milton U. Clauser, vice president of Space Technology Laboratories. General counsel is Allen E. Throop, formerly with the New York law firm of Shearman & Sterling.

WHAT KIND OF SYSTEM?— Determining the kind of satellite system to install is the key to many other decisions; for example, how much stock to sell. Agreements with foreign countries are also needed to apportion costs. The corporation has several choices of systems:

- Orbiting 30 or so satellites at altitudes of around 3,000 miles. This is virtually ruled out—too many satellites are needed

- Using 15 to 20 satellites in medium-altitude orbits around 6,000 miles high. This is the probable choice, at least at the outset

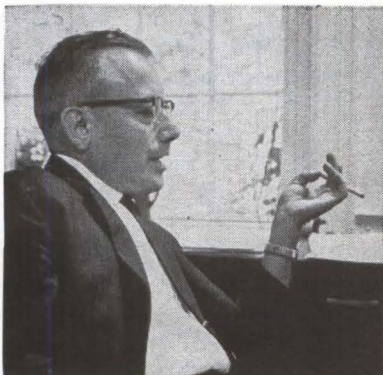
- Or using 3 satellites in 22,300-mile-high synchronous orbits. This

Technical and Fiscal

has a low priority. There is little experience with this type of satellite. To date, there is a built-in time delay and echo in communicating with satellites at the distance. If perfected, these may be used.

TECHNICAL PROBLEMS—While the corporation seems likely to adopt the medium-altitude system, there are still many technical matters to be solved. Metzger divides the problem into four parts: ground stations, communications equipment carried in the satellite, the overall satellite, and the launch booster.

Ground stations are not too difficult a problem. At least three are



L. C. MEYER, *financial chief*

planned for the U. S.—AT&T's station at Andover, Me.; another in the southeast, probably in Florida; a third on the West coast, probably near Seattle. FCC will determine whether the ground stations are owned by communications carriers or the corporation. Overseas, most major countries are expected to have their own station, with regional stations for smaller countries.

Launch booster will probably be the Atlas-Agena. A multiple-launch technique being developed by Air Force will put about a half-dozen satellites into orbit by a single booster.

The spacecraft and its communications require the most work. A key factor is the ability of multiple ground stations to communicate simultaneously. Telstar and Relay can only accommodate two ground stations at once; for example, the

U.S. can talk with France or England, but not both.

Industry has already been put to work developing a multiple-access system, but it is a knotty problem. Each new station in the system would reduce the number of channels available to each station throughout the entire system.

The problem must be settled before foreign negotiations can go ahead or costs of the system predicted. Other problems, such as orientation and improving power efficiencies must be solved before satellite life and costs are known.

Despite these formidable problems, the corporation has set a tight schedule. By the end of the year it wants to evaluate the proposed solutions and start research contracts. It wants to freeze on a satellite system design by next summer, have a prototype in orbit by the summer of 1965, and be in full operation by 1967.

THE COSTS—While it is still too early to set actual costs the best thinking of the corporation runs like this: assuming a medium-altitude system with a 600-voice-channel capacity is adopted, it will cost close to \$600 million to get the system into service.

Monthly costs would be around \$1 million to \$3 million in the early phases, \$5 million to \$15 million in the hardware stage, \$10 million to \$20 million in the flight test phase. Spread over a four-year development period, estimates Lewis Meyer, costs could average out to \$10 million to \$20 million per month.

To finance the program, the corporation is borrowing on a \$5-million line of credit from 10 banks. It is expected to issue stock next spring, possibly earlier—as soon as times and costs for solutions to technical problems are predictable.

Initial exploratory talks were held this year with Canada, England, Germany, France and Italy. New rounds of talks will be started as soon as a solution to the multiple access problem seems possible. Best guess is that these talks can be started by late fall. Basic principles for negotiating with foreign countries are being worked out now.



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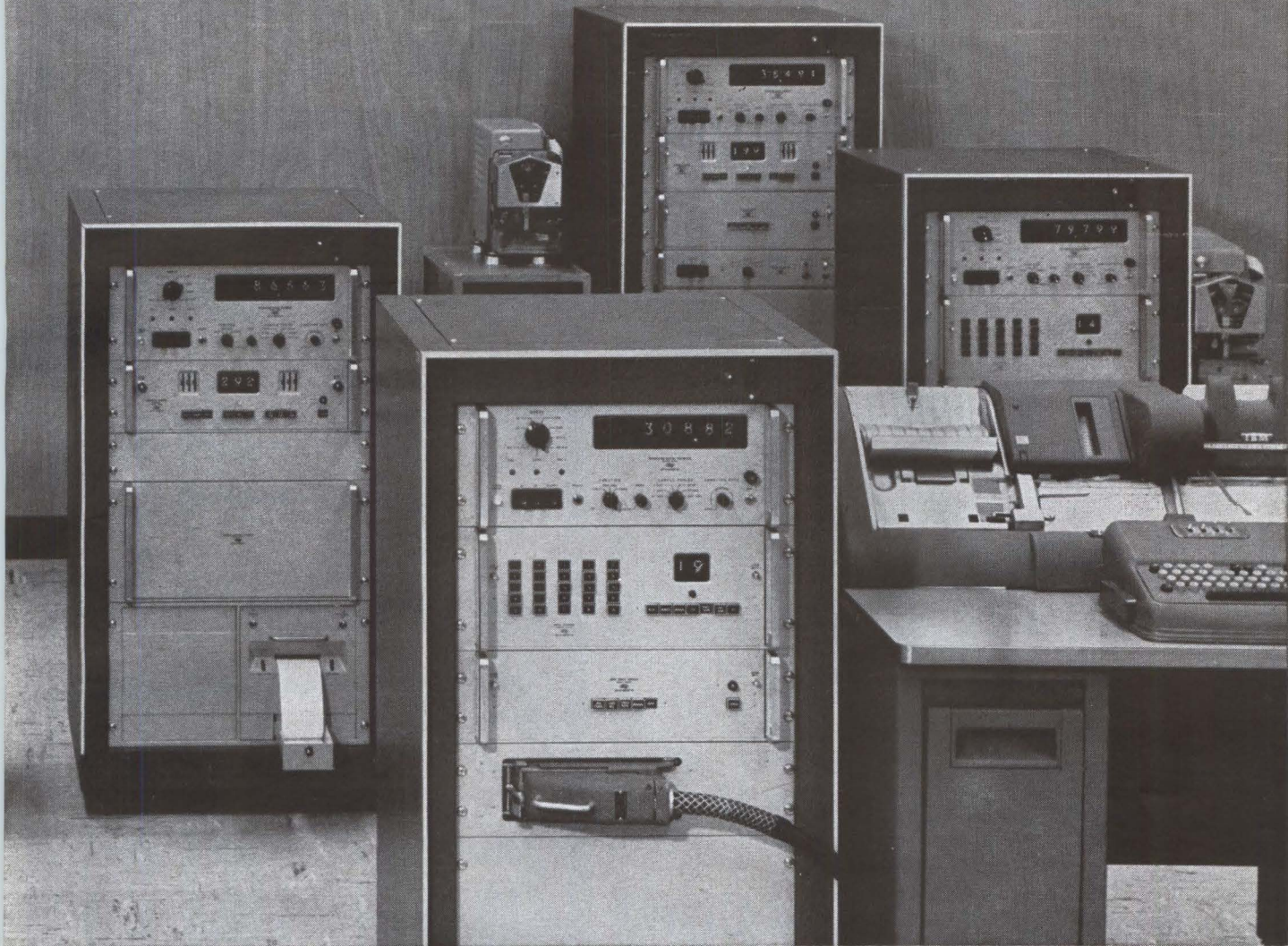
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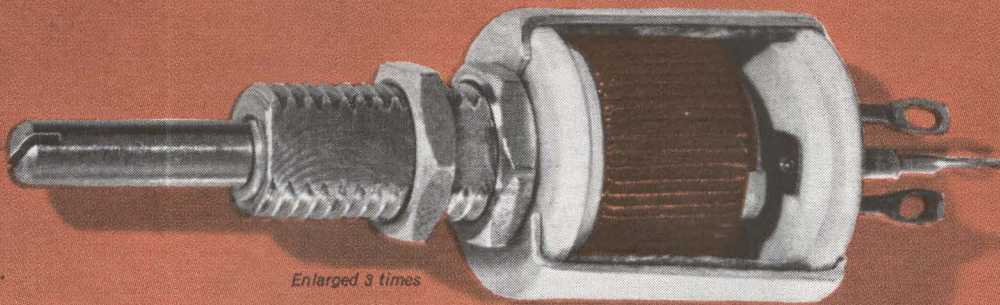


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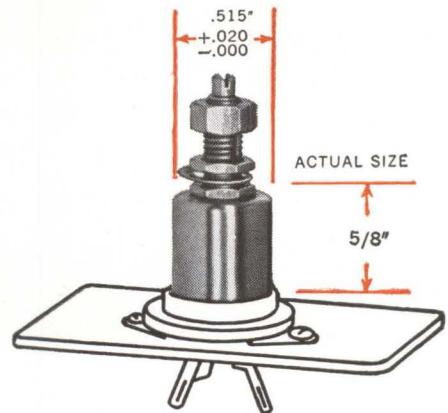
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WESTERN SALES SHOW MORE ZING

*A \$4-billion year—and
a new space center—
are Western targets*

By **HAROLD C. HOOD**
Pacific Coast Editor (Los Angeles)

SAN FRANCISCO—First returns from a pre-WESCON business survey of member companies by the Western Electronics Manufacturers Association (WEMA) indicate a somewhat cheerier economic atmosphere for the upcoming convention than the slightly-better-than-gloomy one that pervaded last summer's meeting in Los Angeles.

Based on dollar volume of order billings, the survey shows that this year's third quarter should be considerably better than the second, and should show an appreciable gain over the third quarter of 1962.

WEMA reports that its smaller companies, with annual sales under \$1 million, are leading the apparent rise. Taking into account that several of the responding companies in this category were formed during the past year, and consequently somewhat distorted the true growth-in-sales picture, WEMA spokesmen feel this is an indicator of an across-the-board increase in sales.

SALES UP—They are optimistically looking for a probable hurdling of the \$4-billion mark this year by the 13 western states.


Seventy-two percent of all companies returning the questionnaire predict a brighter third than last year's, and 74 percent look for an

increase over the quarter just past. Corresponding percentages for the smaller companies are 86 percent and 63 percent.

Earlier statistics compiled by WEMA had set the 1963 sales figure at \$3,885 million, or slightly more than one-quarter of the country's total electronics output. This represented an increase of 8 percent over 1962 sales, and an attendant increase in employment placed the number on the industry's western payroll at slightly over 260,000, a rise of 15,000 since 1962.

A geographical breakdown reveals that Arizona presently leads the other electronics centers in growth rate, with projected 1963 sales of \$240 million, or 26 percent above last year's figure. Second in the growth race is the Greater Los Angeles area with an 8.5-percent increase over 1962 and accounting for 59 percent of all sales in the West. The Pacific Northwest follows with a 6-percent gain over last year's \$165 million. Next comes the San Francisco Bay area with a 5.3-percent increase, boosting its output to slightly over \$800 million. San Diego, hard hit by defense contract cancellations, anticipates little increase over the 1962 figure of \$185 million.

PROFITS DOWN — Depending heavily upon aerospace dollars, the West has reflected the general belt-tightening process in evidence across the nation among companies involved in defense and space exploration. A recent Arthur D. Little report, based on the balance sheets of 51 aerospace firms, points out that net profit in 1961 for these companies amounted to 2.1 percent of sales contrasted with 4.8 percent



WEST'S STILL-CLIMBING sales are heavily dependent on aerospace contracts. This is a rocket test at the United Technology Center of United Aircraft, scene of one WESCON field trip

for all industry. This represents a formidable decline from the 1956 figure of 3.7 percent. Over the same period of time the Arthur D. Little researchers discovered that sales had increased 26.7 percent, while net profit had dropped 25.9 percent.

While the number of electronics companies in the West was up 50 to a total of 1,190, several fell by the wayside. Number of bankruptcies was roughly one-fifth the national total of 92 just reported by Dun & Bradstreet. Political pressure for relocation of defense-oriented industry away from California is blamed for some.

SPACE CENTER SOUGHT—California industry, notable for its willingness to wage battle for its interests, is starting to apply some pressure of its own on another issue certain to affect western electronics. The question to be settled is whether the much-publicized U. S. Space Recovery Center will be located at California's Edwards Air Force Base or at other proposed sites in New Mexico, Texas, or Florida.

NASA, operating under a certain amount of political influence, reportedly favors Corpus Christi, Texas. The Air Force is believed to have made up its mind that Edwards is the logical choice for a base of operations for its controversial Dyna Soar, and for future programs.

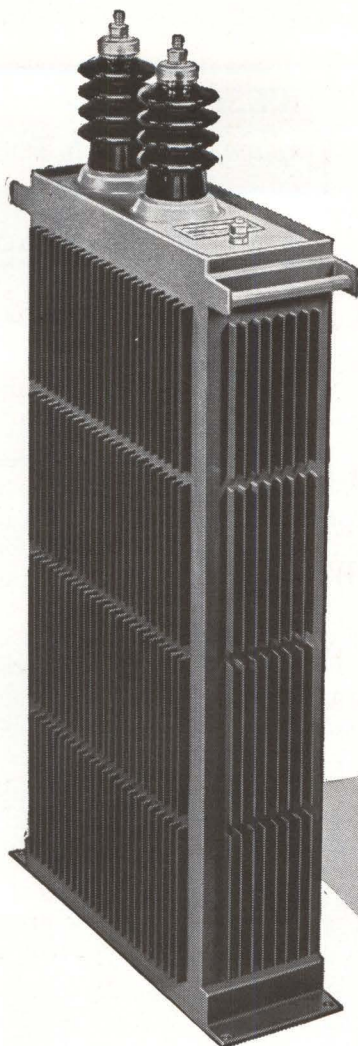
This week, Harold W. Wright, general manager of the Los Angeles Chamber of Commerce, commenting on the findings of a chamber study, declared that final settlement on Edwards will save taxpayers an estimated half-billion dollars. This figure, he says, covers only the initial outlay and does not take into consideration the \$15 million in operating costs which would be saved each year.

Besides urging the California site as the most economical and efficient site for the recovery of manned space vehicles, the report hints at business ramifications for California industry.

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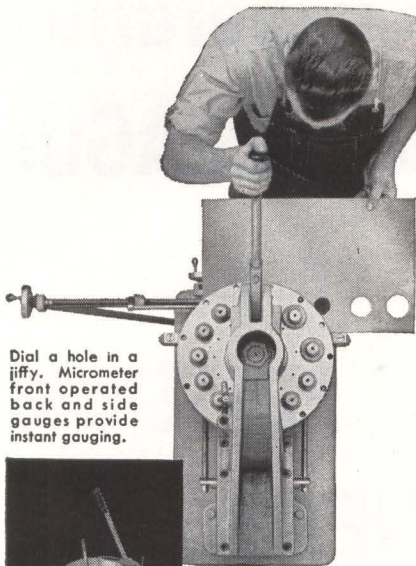
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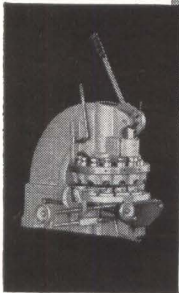
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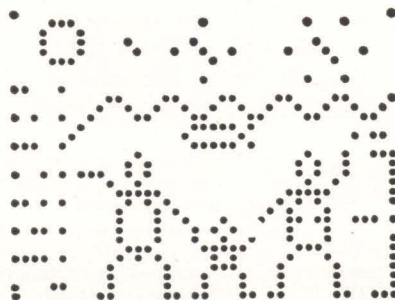
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SAN FRANCISCO—Four topics of particularly wide interest have been selected for WESCON's afternoon invited-papers sessions, designed to present the latest information on advanced—or future—engineering fields. Session topics are:

- Extraterrestrial Life, Detection, Communication and Exploration, on Tuesday, August 20
- Information Processing in Living Systems, on Wednesday—a topic new to WESCON and heavily oriented to the biologist and psychologist working in electronic areas
- Recent Advances in Lasers, on Thursday
- Active Communications Satellites, on Friday, presenting reports on Telstar, Relay, Syncom and discussions of military and commercial communications satellite systems.

WHO GOES THERE?—One opening day speaker, Bernard Oliver, of Hewlett-Packard, says that if there is technologically advanced life on another planet, man can try to communicate by searching for extraterrestrial messages, or by attempting to transmit messages to the planet. One of Oliver's theories



SIMPLE PICTURES like this, suggests Bernard Oliver, could be transmitted from other planets as binary pulse patterns

is that a race able to intercept interstellar messages must possess eyesight and might respond to a crude picture comprised of an array of binary 1's and 0's imparting basic information about our civilization.

Elliot Levinthal, session chairman, in discussing the detection of life within our planetary system, will describe the Multivator, being developed at Stanford Medical Center for experiments on the surface of Mars. The 15-chamber device uses a multiplier phototube as the output transducer for most of its biochemical experiments.

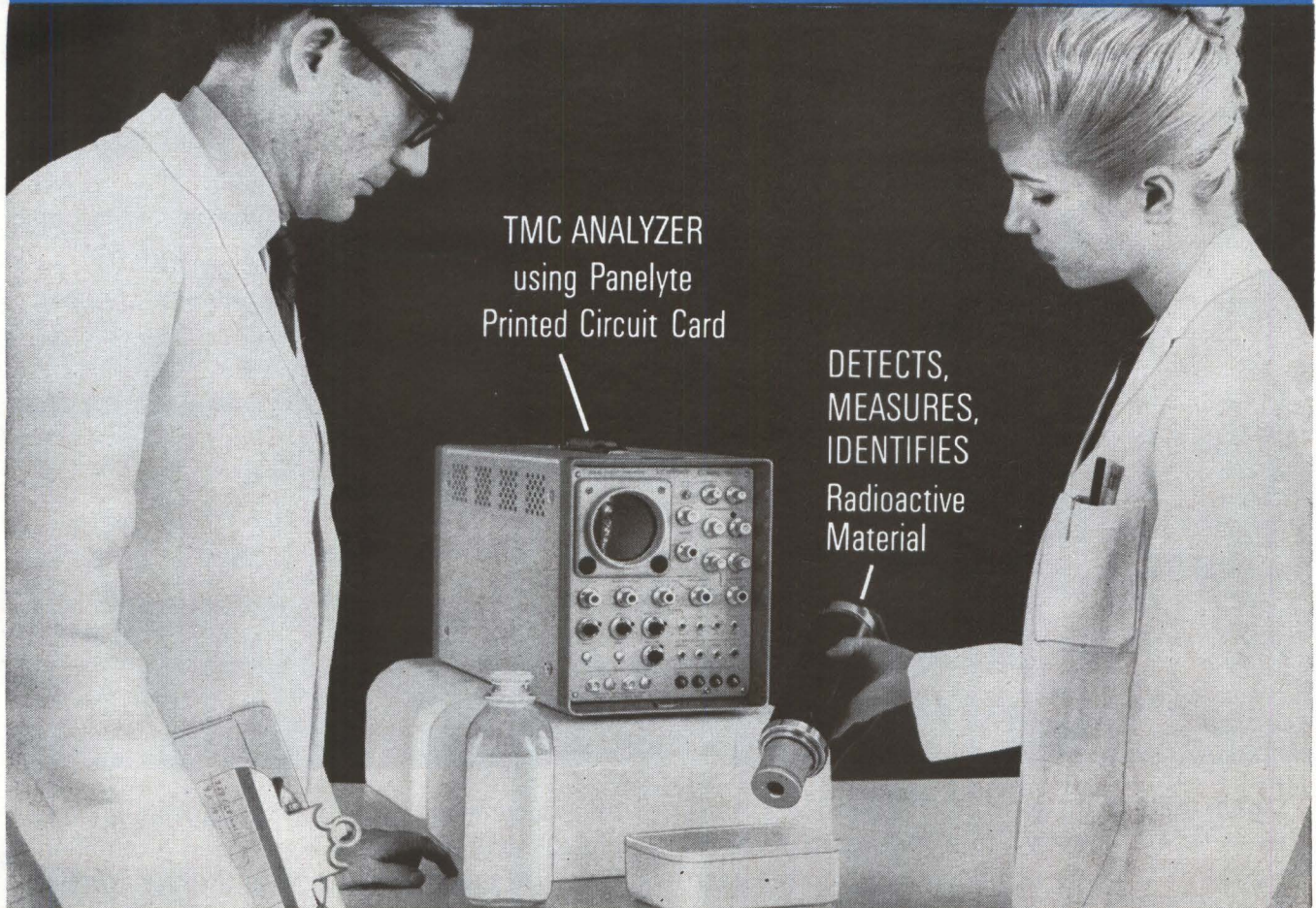
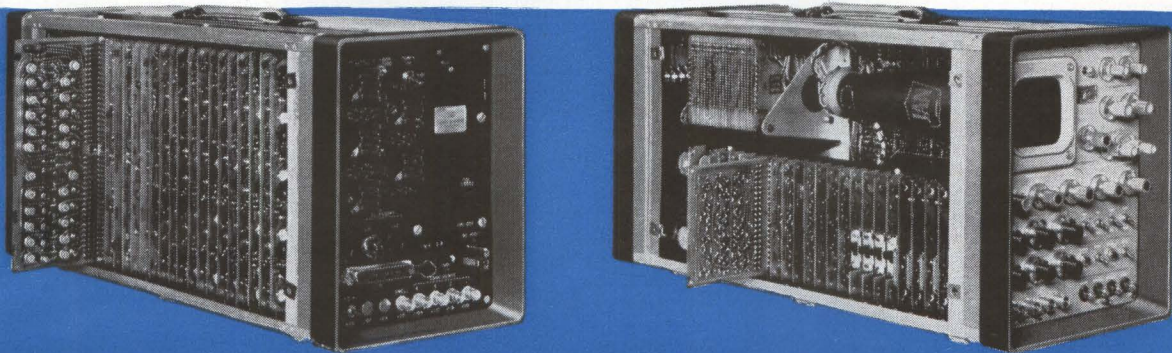
The problem of attaining relativistic velocity, so that interstellar trips may be completed within the lifetimes of the initial crew, crops up in another paper, by R. W. Bus-sard, of Space Technology Laboratories. He proposes an interstellar ram-jet, fueled by hydrogen atoms existing in space and operating on thermonuclear fusion principles, as a possible solution.

LASERS—In the laser session, George Dacey, of Sandia Corp., will contrast the assimilation within the industry of semiconductor and laser developments. Because of vacuum tubes, he says, the transistor found a built-in market. But lasers have opened a whole new frequency range and the production of usable hardware is bound to take more time.

Too much effort, he feels, goes into attaining dramatic rather than immediately possible achievements. As examples of practical hardware, he cites a new laser interferometer displacement measuring device developed by Sandia, and Sperry's laser gyro (ELECTRONICS, p 82, June 28), to be described by Warren Macek.

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WESCON 63!



SIZE OF AUDIENCE drawn, to Texas Instruments Incorporated seminar, in Boston, indicates appeal company seminars can have

AT WESCON: Watchful Eye on Company Seminars

Officials, concerned by rump-session competition, may program them in 1964

SAN FRANCISCO — When the doors open on WESCON August 20, convention authorities plan to keep a watchful eye on one of the mavericks sired by this largest of Western trade shows. The company-sponsored technical seminar, believed by some participating firms to be a necessary supplement to their efforts in the exhibit booth and technical sessions, could get out of hand.

WESCON concern is borne of the possible dilution of interest in and attendance at its own technical sessions, and is catalyzed by the apparent rise in enthusiasm and acceptance of various seminars being held around town.

"If you're aiming at a specific, tight audience," remarked one WESCON official, "this is an ideal vehicle for reaching them." Companies know this and some plan to capitalize on the anticipated



UNITED NATIONS air is imparted to another recent TI seminar in, Zurich, by earphones for French, German and English translations

35,000 attendees by corraling various groups to harken to their own latest corporate developments.

While no WESCON official will admit the outside sessions pose a "threat" to the convention's success, all of those approached by ELECTRONICS were aware of "a potential trouble area," and one reports that there have been discussions about allocating noncompeting time at future conventions.

WESCON manager Don Larson indicates that there had been some concern, after the heavy participation in outside seminars at the March IEEE Show in New York, that this apparent trend might pick up momentum and be evidenced in force at San Francisco this year. "But judging from conference room reservations at the hotels, and from the dearth of seminar notices that have come to our attention this is not going to materialize," he says. "The seminars we've observed in the past constitute acceptable sales and educational efforts on the parts of their sponsors, and in the frequency we anticipate, are not a bad thing."

One WESCON board member observes that recent increased interest in outside seminars, both in New York and the West, might be a rubbing off of the more product-oriented format of AIEE enclaves. "And this might be good. A slight shift from the lily-white science stand that some people have doggedly held to, won't hurt anyone."

A VOTE FOR—Texas Instruments is one firm that believes strongly in presenting their own forums at industry conventions. "There's so much being done and

so much emphasis on new products," said a highly placed spokesman, "I think many people, TI included, forget that we have a basic communications job aimed at the engineer who's working with day-to-day products. The primary purpose of our seminars is to present something useful, even though the end result, hopefully, is sales."

TI is having three seminars at WESCON, on design and manufacturing using semiconductor networks, on solid-state, low-level, low-noise amplification, and on advanced semiconductor devices and technology. "Frankly, these seminars will conflict somewhat with WESCON attendance," the TI man said.

It is this type of conflict that prompted one WESCON spokesman to suggest that WESCON look at the possibilities of integrating this kind of seminar into the program in the future.

"In other words," he said, "to take some part of the program and let people bid for it on the basis of the technical merit of what they want to do. You don't block these people out and you don't let them run away with the show." He denies this proposal smacks of an "if you can't beat 'em, join 'em" solution.

A VOTE AGAINST—On the other side of the coin, Beckman Instruments will not hold technical sessions outside of WESCON's programmed papers. A company spokesman quotes Karl E. Heller, marketing manager of Beckman's Helipot Division, as saying they will not do anything to dilute interest in, or to compete with, WESCON. Heller said they would rather cooperate with WESCON as much as possible

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by taking part in their technical sessions and not do anything that would detract from the show's efforts. Three of Beckman's divisions will maintain exhibits at the show.

At the IEEE show in New York last March, several companies conducted their own technical gatherings outside the program. Among them were Alpha Metals, Texas Instruments, Amelco, P. R. Mallory, Motorola Semiconductors and Litton Industries. A spokesman for Litton notes that all of the outside seminars were "too much distraction from the main show, and IEEE was rather unhappy. Litton has never held any outside seminars in conjunction with WESCON." He added that they will not do so this year either.

CATCHING ON—A critical evaluation of technical programs, including WESCON was offered by a WESCON official. "There's too much stress, on the number of papers, the number of sessions, and not enough on the caliber and quality of these sessions," he said.

"WESCON has examined this and investigated and has tried to do as much as it could along this line, being at a disadvantage in some respects, because of the commercial aspects, the exhibits and technical aspects from the program angle. When compared with a sound technical seminar, WESCON is at a disadvantage from a pure high-level technical standpoint."

"I think the company seminars are catching on," he continued, "as a reflection upon the lack of completeness and high quality of the format of the existing technical programs. The manufacturer, when he conducts his own seminar, deals with the state-of-the-art, the advancements. The seminar is bound to be slanted to what the company is dealing with, but by attending several of these outside seminars a very complete picture of the industry will emerge. Any one seminar will not be of much value in itself." He indicated that widespread attendance of these seminars does not indicate a dissatisfaction with the WESCON technical format.

PRACTICE capsule is captured by members of 6593rd Test Squadron

Samos Catchers Score High



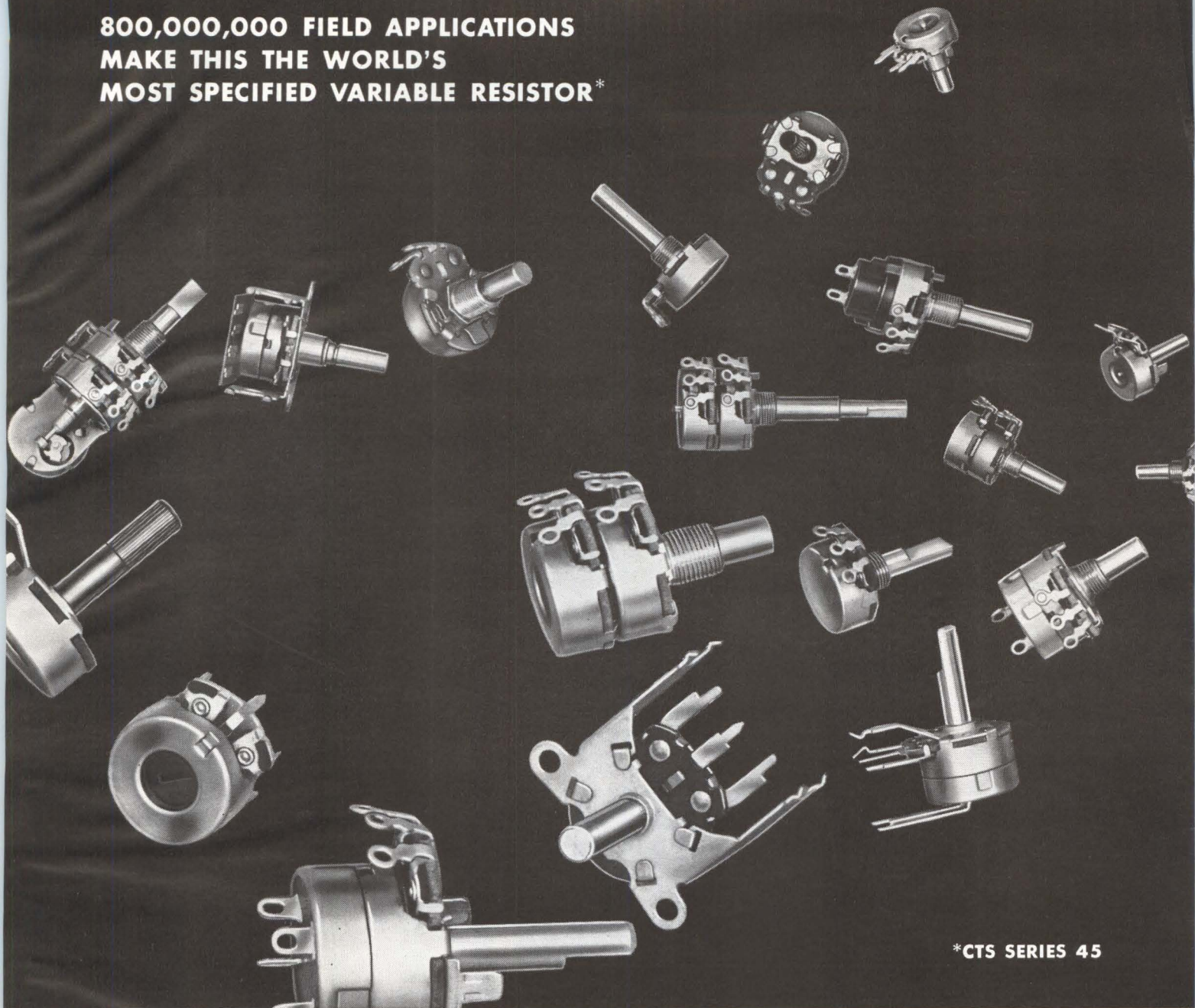
ANDREWS AFB, MD. — Last week, Air Force Systems Command described in unprecedented detail progress in recovering capsules ejected from satellites in orbit.

Although still not mentioned by name, one satellite from which data must be physically retrieved is Samos—the polar-orbiting reconnaissance satellite that takes photographs on film and ejects the

exposed film in a recovery capsule.

On reaching a certain altitude a parachute opens and the capsule transmits a radio-homing signal. JC-130B Hercules planes, based in Hawaii, that have been circling and waiting in the general vicinity, pick up the radio signal on their direction finder, spot the descending parachute visually and snatch it from its fall. (For details on homing system see ELEC-

800,000,000 FIELD APPLICATIONS
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MOST SPECIFIED VARIABLE RESISTOR*



*CTS SERIES 45



PRODUCT RELIABILITY

has been proved in over 800,000,000 applications in all kinds of environments. Year after year Series 45 variable resistors have led the industry to new standards of excellence. Over 300,000,000 are in active service today.



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is demonstrated by countless variations of Series 45 and other controls in today's rapidly changing commercial and industrial requirements. Tomorrow's requirements are even now being met by CTS' dynamic R/D & Engineering programs.

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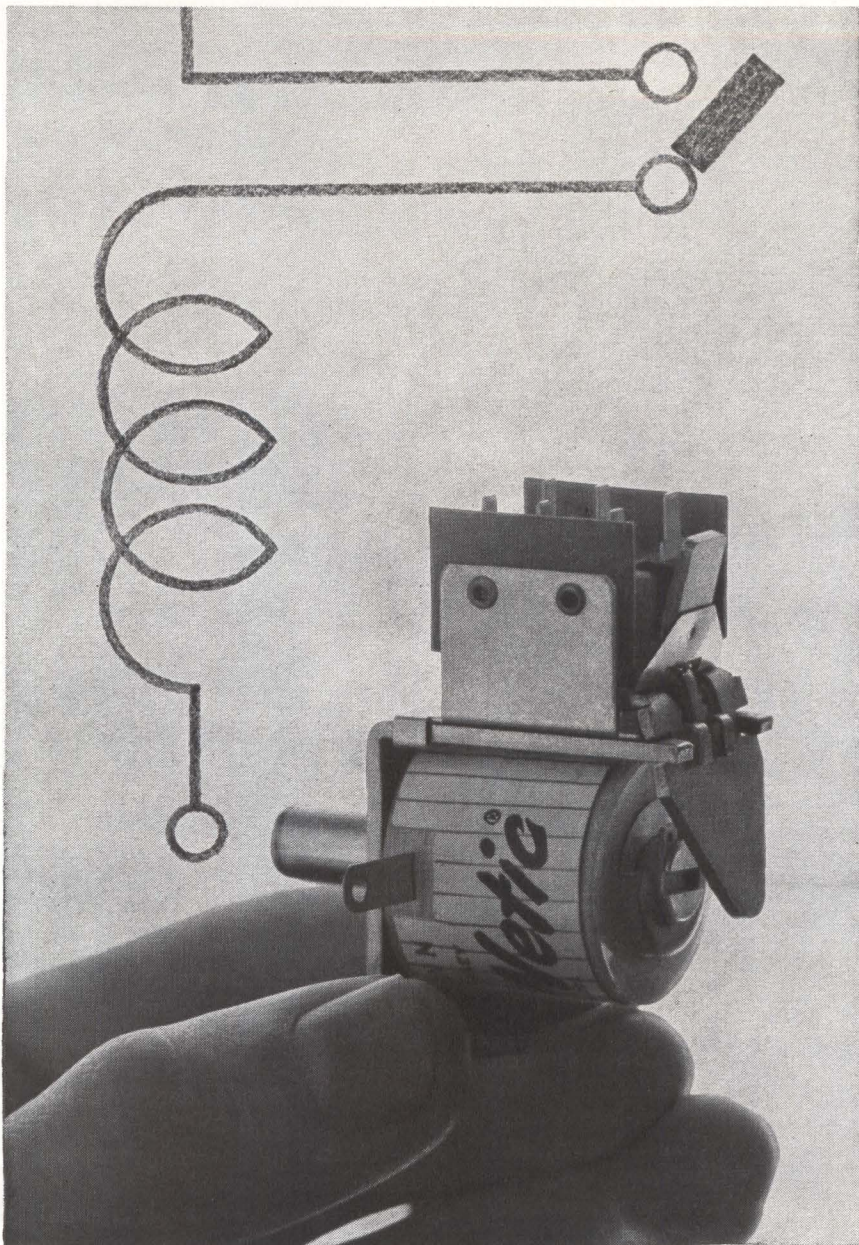
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CTS of Paducah, Inc., Paducah, Kentucky
Chicago Telephone of California, Inc.,
South Pasadena, Calif.
CTS of Canada, Ltd., Streetsville, Ontario.



WHY USE TWO IF ONE WILL DO?

The Heinemann Type B Time-Delay Relay can double as its own load relay. It's got a continuous-duty coil. Once actuated, it can remain locked-in indefinitely. This, combined with DPDT snap-action switching at up to 5 amps, can obviate the need for a separate slave relay in many applications.

Yours might be one of them. Here's a quick rundown of the Type B's specs:

Standard Timings: 1/4, 1/2, 1, 2, 3, 4, 5, 8, 10, 15, 20, 30, 45, 60, 90, 120 seconds.

Contact Capacity: 5 amperes at 125V or 250V AC; 5 amperes at 30V DC, resistive; 3 amperes at 30V DC, inductive.

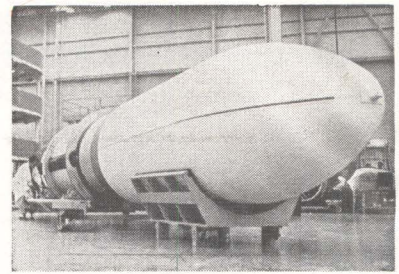
Coil Voltages: 60 cycles AC: 6, 12, 24, 48, 110, 115, 120, 208, 220, 230, 240 volts; DC: 4, 6, 12, 24, 28, 48, 64, 110, 120 volts. (Others available.)

For more detailed specifications on the Type B (and on all the other time-delay relays in the Heinemann line), write for Bulletin 5005.



HEINEMANN
ELECTRIC COMPANY
2600 Brunswick Pike, Trenton 2, N. J.

SA 2578



BASIC satellite vehicle for Samos program is Lockheed's Agena

TRONICS, p 42, March 3, 1961.)

Last year, recovery was achieved over 75 percent of the time, AFSC said. During a more recent series, the batting average has advanced to 88 percent.

The Samos satellite—like Midas—consists of a Thor booster and an Agena vehicle that serves as the second stage as well as the satellite itself.

Czechs Claim Best

Power-Switching Transistor

VIENNA — Czechoslovakia's State Research Institute for High Frequency Engineering claims it has developed a silicon switching transistor with parameters better than units produced in the U. S.

The transistor—called a tetrastor—attains a maximum thermal voltage of 250 v between emitter and collector, according to an article in *Rude Pravo*, a Prague newspaper. Switching time is reported as 1 microsecond, usable frequency to 2 Kc, steady current 10 amp, pulse current up to 100 amp, and current-amplification factor 200.

Its high amplification makes pre-amplifiers unnecessary, while its resistance to overloads eliminates need for protective equipment, the article said. Applications are expected in machine-tool control, auto governors and neon-light converters.

Rude Pravo also reported that the Solid-State Physics Institute has completed Czechoslovakia's first gallium-arsenide diode laser, nine months after their development in the U. S. (*ELECTRONICS*, p 24, Nov. 16, 1962). Injection-current pulses several milliseconds long were applied while the diode was cooled by liquid nitrogen. The diode was described as a prism 0.2 × 0.2 × 0.6 mm in size.

TIME DELAY

SANGAMO 480 SERIES DUAL-CAPSTAN RECORDER/REPRODUCER

RECORD HERE

(or reproduce) with automatic switching of 4 speeds of FM or Direct electronics . . . 7 to 28 channels of data.

DELAY HERE

in buffer storage bin with capacity of 125 feet, providing fixed or continuously variable delay up to 12 minutes . . . recording simultaneously at both head stations, then reproducing, you can achieve delays as short as *zero* seconds—even *negative* time delays.

REPRODUCE HERE

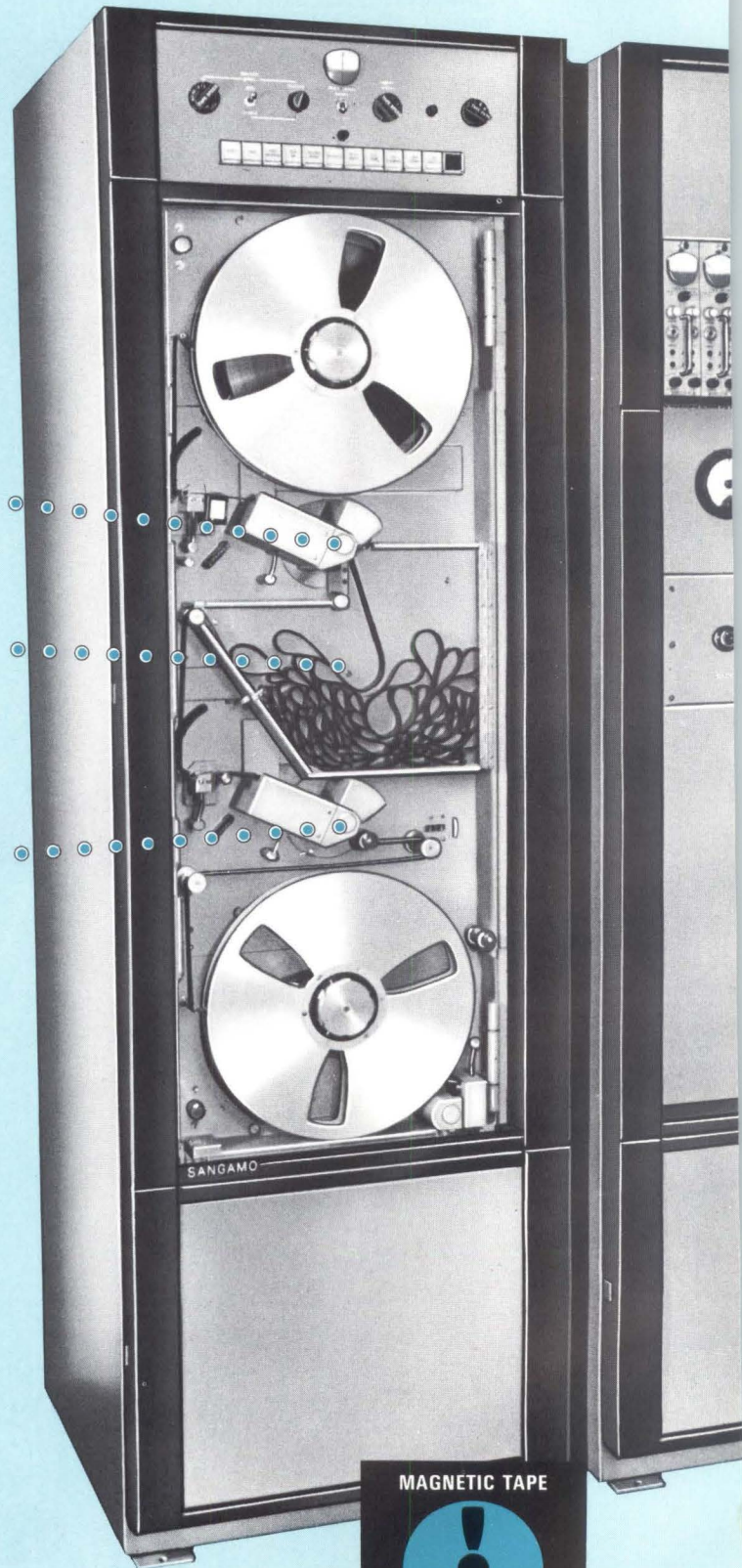
(or record) with time-delay accuracies varying from .0004% to a maximum of ± 25 microseconds . . . record or reproduce at first head station, with simultaneous delayed reproduce or record at second station . . . speed ratio between capstans may vary as much as 16:1 for time-base expansion or contraction while continuing to record.

FIXED OR VARIABLE TIME DELAY

The Sangamo 480 Series Recorder/Reproducer offers a totally new kind of application flexibility and reliability to the instrumentation field. The Model 480 is essentially two independent magnetic tape recorder/reproducers with a time-delay tape storage bin between the two capstans. Fixed or variable time delays can be achieved in either reel-to-reel or continuous loop applications.

Loop storage bin permits up to 250-foot loop for monitoring of infrequent data. Loop bin provides time delay between second capstan and first, in addition to providing any necessary delay to allow readout equipment to reach operating speed. Tape is continuously erased prior to passing the first head station.

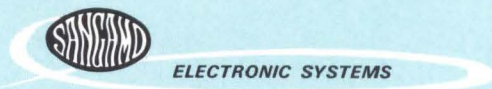
Some operating features are shown above, but there's much more to tell. Write, wire, or phone us for the complete story.



MAGNETIC TAPE



INSTRUMENTATION



SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

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MORE THAN 100 KLEIN PLIERS

SPECIALLY DESIGNED FOR THE ELECTRONIC FIELD

Special skills are important in the wiring of today's sophisticated assemblies for electronic and telemetry systems. Klein has developed special pliers to assist in solving difficult assembly problems.

- For instance, there is a plier with a blade as hard as a file for cutting nickel ribbon wire (No. D230-4C).
- 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.

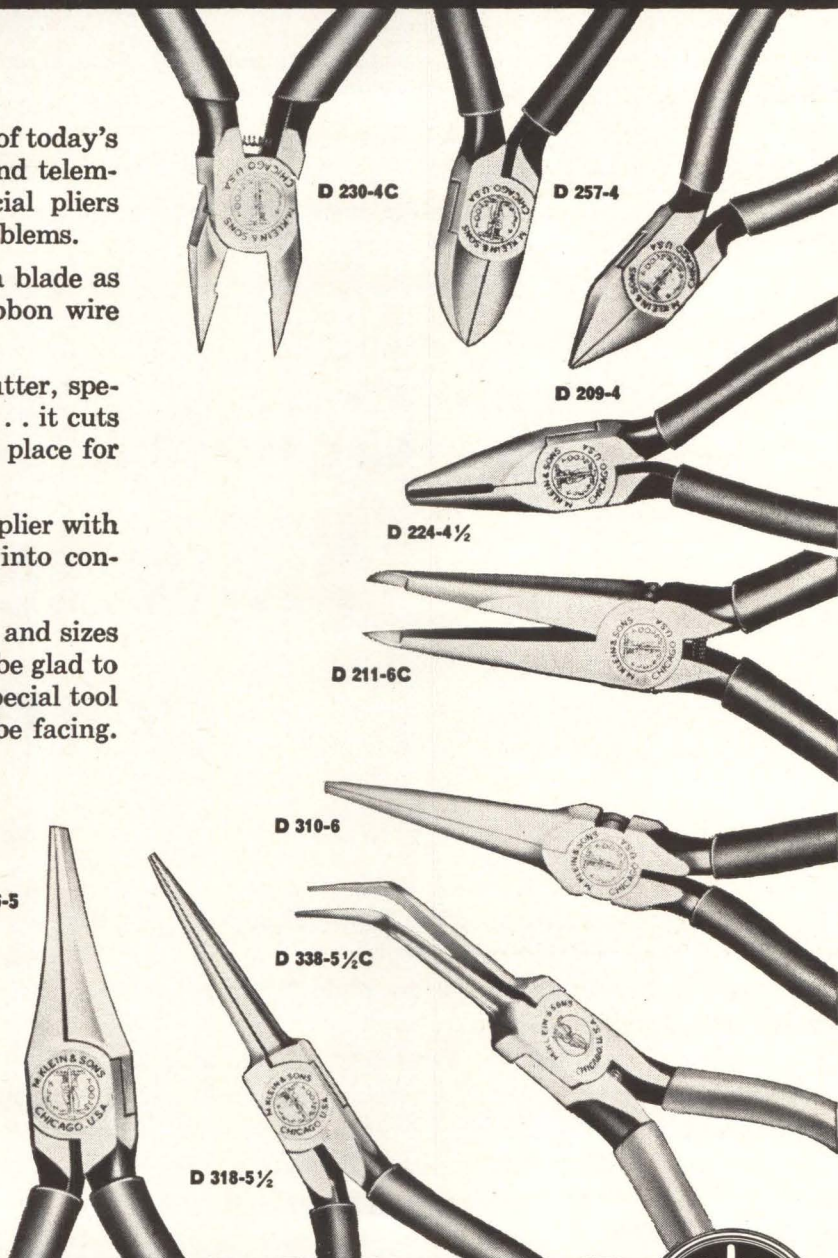
In all, there are over 100 different styles and sizes of pliers available from stock. Klein will be glad to discuss with you the development of a special tool to solve a particular problem you may be facing.

ASK YOUR SUPPLIER

See us at The WESCON Show
Booth 1318



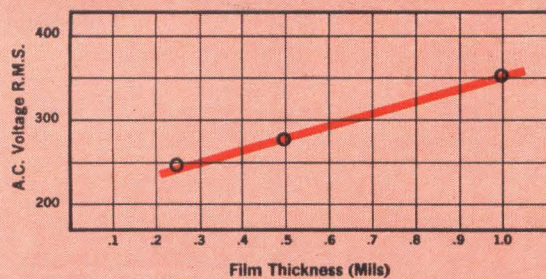
The Klein Plier Catalog illustrating and describing the complete Klein line of pliers is available on request.



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A.C. Corona Level Unimpregnated Wound Capacitors "Mylar" Polyester Film



AC CORONA LEVEL

Corona levels for various gauges of "Mylar"* in capacitors were determined in life tests and are shown above. AC corona level is defined as the r.m.s. voltage below which corona does not exist.

Unimpregnated Single Layer 25 Gauge Capacitors of "Mylar"

D.C. Bias (Volts)	0	100	300
A.C. Volts R.M.S. necessary to produce corona at 25°C	290	290	290
at 125°C	285	285	280

Unimpregnated Single Layer 50 Gauge Capacitors of "Mylar"

D.C. Bias (Volts)	0	200	400
A.C. Volts R.M.S. necessary to produce corona at 25°C	345	350	350
at 125°C	315	320	310

AC/DC CORONA LEVEL

Corona is a function of AC voltage only. Table shows full AC voltage must be applied before corona can exist, whatever the DC bias may be.

AC/DC Capacitor study... New tests show compatible in

Now designers can apply the high reliability and low cost of capacitors of "Mylar" to AC and AC/DC circuits. Capacitors with "Mylar"* polyester film as the dielectric are completely compatible in these circuits in home entertainment equipment and similar circuits in other equipment. Data proving compatibility was developed in Du Pont's test at the Film Department Sales-Service Laboratory and at Inland Testing Laboratory.

Briefly, the tests showed that for a capacitor with a dielectric of dry "Mylar" it does not matter whether the voltage is DC, or AC, or combinations

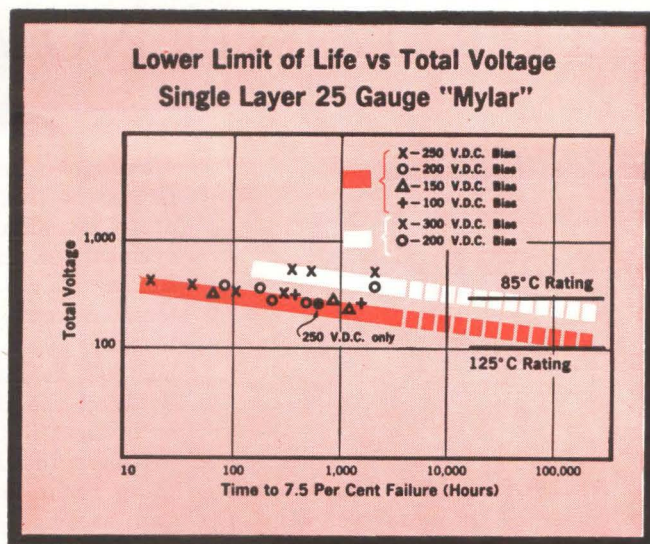
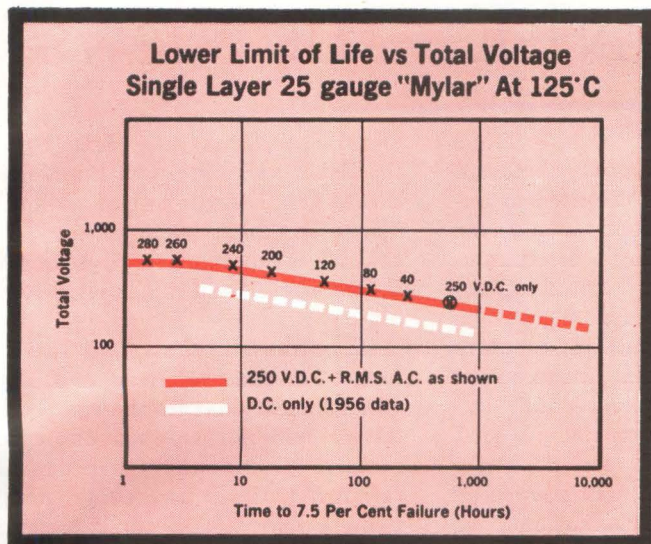
of these voltages. There are only two limitations: (1) the AC voltage or AC component in an AC/DC situation should not exceed the corona level, and (2) the total of the DC voltage plus the r.m.s. AC should not exceed the rated DC working voltage.

Now that it's assured that these capacitors are completely functional in such circuits, designers can utilize the other advantages of "Mylar"—over-all reliability, high IR, small size, moisture resistance, capacitance stability. Remember, too—capacitors of "Mylar" cost about the same as paper.

*Du Pont's registered trademark for its polyester film.

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AC/DC LIFE

Below AC corona level, life is a function of total voltage. AC/DC total voltage life performance is identical to DC life performance.

Regardless of AC/DC combinations, the basic voltage-life law is maintained, and the law applies to various operating temperatures as shown.

capacitors of **MYLAR**[®] AC/DC circuits

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... THROUGH CHEMISTRY

only **DU PONT** makes

MYLAR[®]
POLYESTER FILM

THE LONE NOMINEE—His Views

*Here's the thinking
of the apparent shoo-in
for the IEEE presidency*

By DAN SMITH
Assistant Editor

CLARENCE H. LINDER, who will probably be the next president of the IEEE, hasn't yet crystallized his thinking about the job. "But very broadly the basic problem still is the consummation of the merger," he told *ELECTRONICS* during an interview at his home in Schenectady, N. Y.

"There are a great number of problems that haven't been thought through yet and solved—some haven't even been formulated," he said. "These first four or five years are going to be critical." Linder, a past president of the AIEE, was active in the merger of the AIEE and IRE, which brought the IEEE into being at the beginning of this year.

He feels the IEEE must not be an "ordinary combination" of the AIEE and IRE but "something new." "We must take a new look at problems and come up with new answers," he said. A tall, lean white-haired man, he talked softly but earnestly in his ground-floor den, darkened in an unsuccessful attempt to keep out the late July heat.

Perhaps the biggest challenge facing the IEEE is the need to improve communications among the various engineering disciplines, Linder said. "An engineer interested in a certain field must go to far too many meetings before he feels he has come into contact with all the competence that can be brought to bear on the subject."

Unless the IEEE can do something about this, it will have been "an exercise in frustration", he added.

MORE MERGERS—He feels there will be more mergers of engineering societies in the near future. However, he can see none in the offing for the IEEE. But the IEEE should not hesitate, he said, to recognize new "focal points" for technology and science. Where other professional societies are concerned, it should take the initiative in setting up cooperating committees. "We're in the communications business," he said. Where only its own members are involved, it should not be backward in making allowance for new interests.

He recalled that the IRE had started as a splinter group of the AIEE but "if the IEEE moves creatively and vigorously there will be no need for splintering now."

FINANCES—Moving on to another area, Linder said he hasn't seen the figures yet but is certain

the IEEE will end up with a deficit this year. "I haven't seen the estimates for next year either," he said, "but the financial problems of the merger won't disappear overnight."

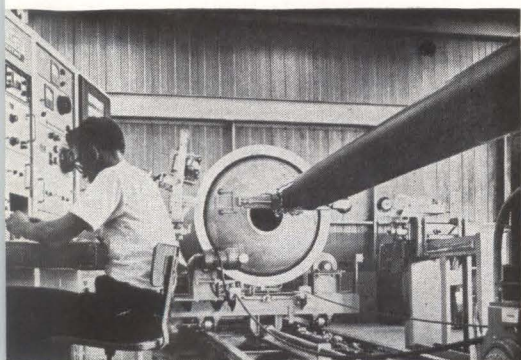
He stressed that the IEEE's long-term finances was one item among many that the merger committee had not mapped out completely. "Our finances will depend on our policies regarding many things. Our needs can't be estimated until detailed objectives are worked out."

Asked if an increase in dues is likely, he said:

"I just don't know how to predict this today."

THE ELECTION—Linder is the only nominee for president chosen by the IEEE's nominating committee. Nominations can also be made by petition until August 15 but there have been none so far and an IEEE official said he would be surprised if there are any. If there aren't, Linder for all practical purposes will be president-designate for 1964, although he cannot be named officially until after the election. Ballots will be mailed out at the end of the month and the results will be made known October 30.

PERSONAL—Linder retired as vice president for engineering at General Electric early this year but is finding it hard to take it easy. "I'm terribly busy," he said.



BOOM AT RIGHT carries microwave passive reflector and inner corona test wheel into chamber

Four-in-One System Tests Plastic

CHICAGO—Four nondestructive test techniques are combined by Magnaflux Corp. in a new system for testing nonmetallic structures. The first CEBM (Corona-Eddy current-Beta ray-Microwave) system was scheduled for delivery last week to Aerojet-General. It will be used to test automatically the soundness, resin-to-glass ratios

and wall thickness of Polaris A-3 motor chambers.

Aerojet-General has been testing the chambers with a six-man crew, taking five to six hours and using a 25-Mev betatron. The new system is expected to take a two-man crew less than eight hours.

TEST PROCEDURE—While the



CANDIDATE, C. H. Linder

"The only thing is, I'm not on a payroll—but there are just so many interesting and challenging things to be involved in." A list of the committees he belongs to would fill the page. Among other things, he is chairman of the National Academy of Sciences' Commission on Science and Technology—the Railroad Industry; a member of the National Commission for Cooperative Education, and a member of the executive committee of the Thomas Alva Edison Trustees.

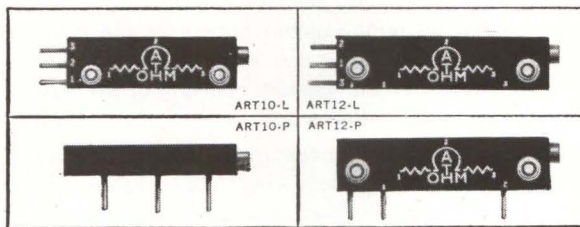
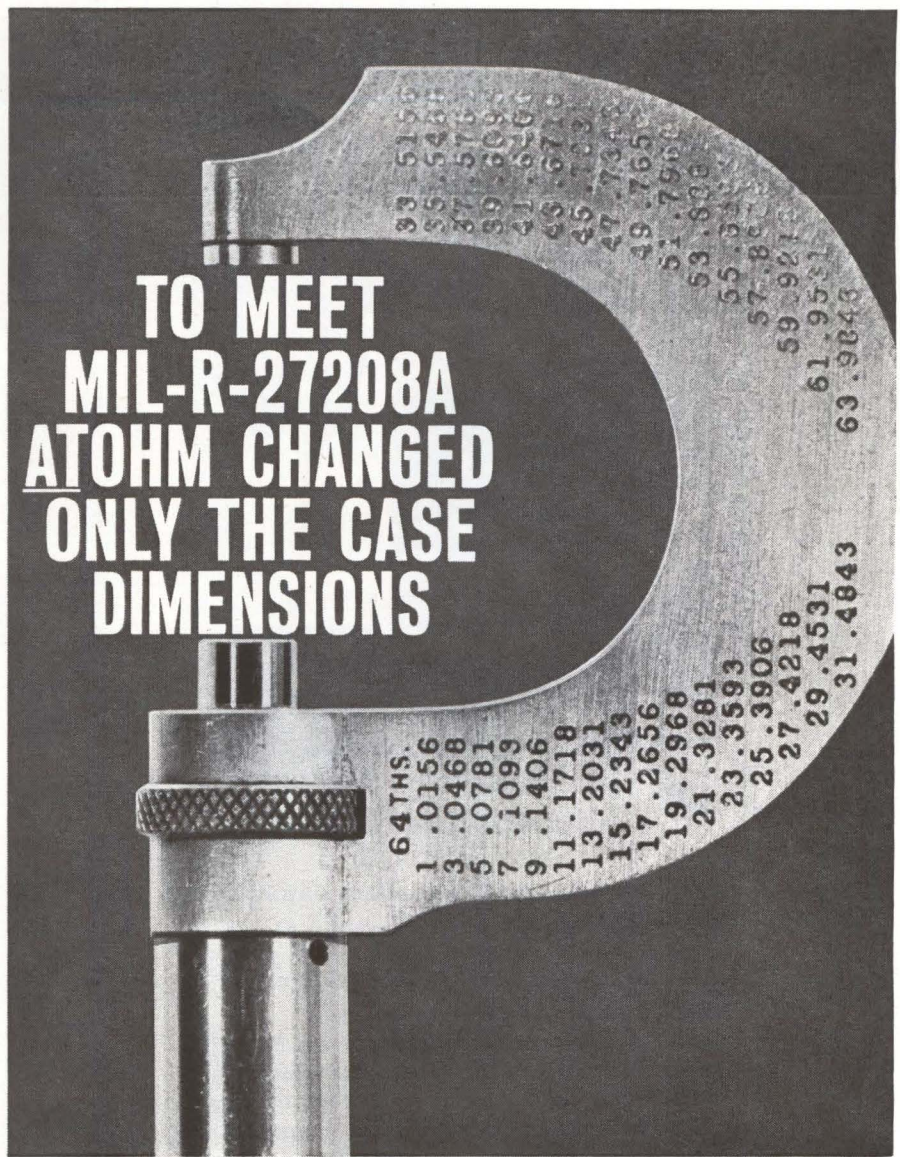
An alumnus of the University of Texas, where he received both the bachelor's and master's degrees in electrical engineering, he went to work for General Electric in 1924. In the course of his career, he managed both engineering and manufacturing operations for a variety of products, ranging from heavy apparatus to consumer goods. In 1951 he became general manager of the company's activities in the large appliance field. He was elected vice president in 1953.

Structures

motor chamber is advanced and rotated on a carriage, the chamber—made up of about 1 million miles of glass-epoxy filament—is inspected as follows:

- Microwave subsystem detects voids, delaminations or bubbles that could cause structural failure—by measuring effective dielectric constant. A Varian back-

TO MEET MIL-R-27208A ATOHM CHANGED ONLY THE CASE DIMENSIONS



New Atohm ART Styles have the same mechanical and electrical design proved ultra-reliable for over five years.

When MIL-R-27208A, the new specification covering wire-wound trimmer potentiometers, was recently released by the military, Atohm needed only to make minor changes in case dimensions to fully meet and, in many instances, exceed the requirements of the new specification. ■ The new Style ART potentiometers are basically identical to the precision Series 120 and 220 units which Atohm has produced for years. A continuing life test program was begun more than five years ago on these instruments. As of June 15, 1963, 558 units accumulated over 4.2 million working hours in test equipment without a single failure or out-of-spec condition. Because only case dimensions were changed in the new Style ART, they are actually third generation instruments—thoroughly tested and proven reliable in the field. ■ Why gamble with new designs when proven MIL spec units are available now? ■ Send for new four-page folder. Atohm Electronics, 7648 San Fernando Road, Sun Valley, California **ATOHM ELECTRONICS**





**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.

ward-wave oscillator radiates 250 mw at 12 to 18 Gc. Waveguide and horn focus the beam through wall of material to a passive reflector mounted on a boom inside the case. Voids or other flaws show up as changes in amplitude or phase of the reflected wave, which is processed through an electronic filter and recorded on a strip chart

- Meanwhile, the beta-ray backscatter tester, using strontium 90, measures skin density and thickness to 0.04 inch. Backscatter beta-ray variations are recorded on a strip chart and translated into specific glass-to-resin ratio data

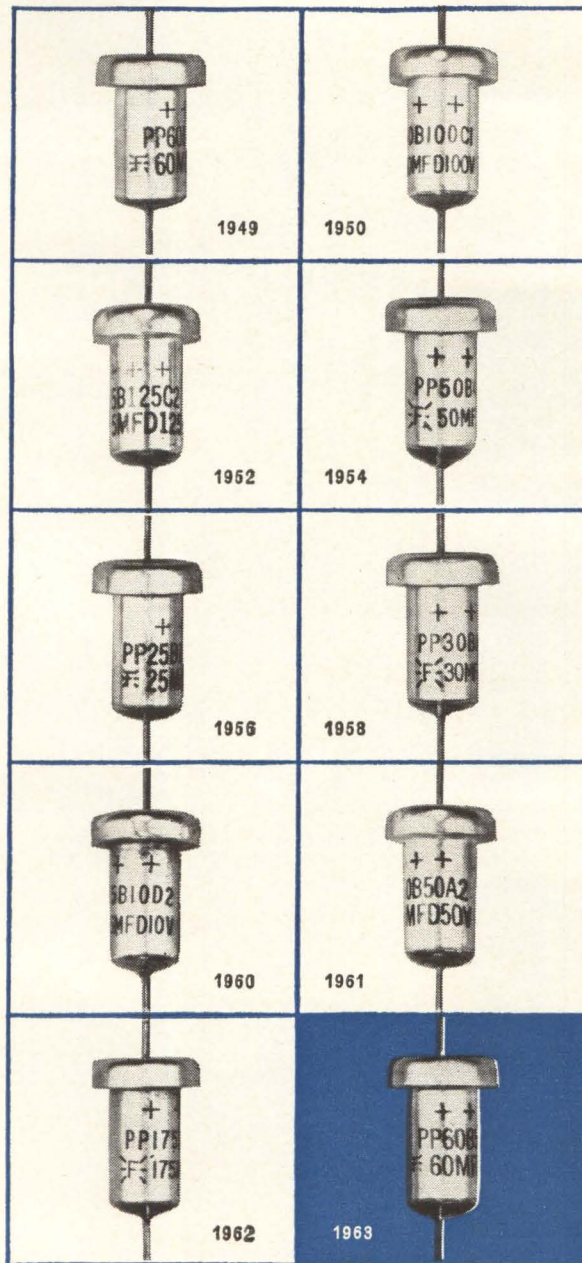
- Corona test mode detects voids and delaminations that the microwave test might miss. Oil-filled, 6-inch neoprene wheels are positioned inside and outside the case. They apply 60 Kv at 60 cycles to ionize any gas trapped in a bubble or void passing through the field. Pulses of corona current are recorded on a strip chart. Electronic circuits filter out background noise and amplify the signals

- Portable eddy current tester uses a ferrite core and reflector combination to measure impedance variations with distance between its elements—thus determining wall thickness of the inner rubber core on ends of the missile motor case. The eddy tester's probe reports insulation thickness directly on a drum dial. Defects actuate audible alarms, mark faulty spots with colored chalk and record their locations on facsimile paper for the other three test modes.

**Computer Control Center
 Planned for Satellites**

PROGRAM definition studies for a satellite communications control center will be made by RCA's Surface Communications division, under a new contract from the U.S. Army Satellite Communications Agency, Fort Monmouth, N. J. The computer system will schedule available communications links through the satellite system. Data flow from the center will enable terminals to aim receiving and transmitting antennas at an appropriate satellite within their field of view.

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.

COPY
CAT

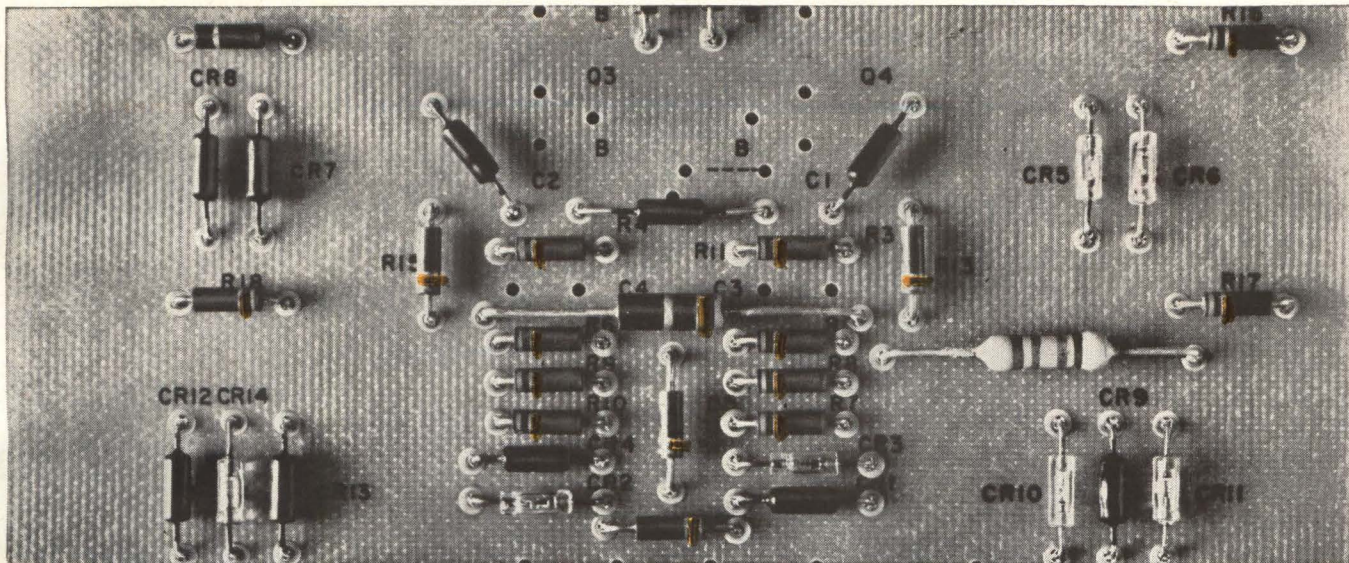


TAPE COPY STATION FOR ATLANTIC MISSILE RANGE

Six 1.5-mc Mincom CM-100 Recorder/Reproducers form the backbone of an extremely complex tape copy station recently delivered to the Atlantic Missile Range, through Defense Electronics, Inc., Rockville, Maryland. Set up at AMR last March, the station makes possible for the first time as many as five first-generation copies of prime data tapes in one operation. In addition to the six CM-100's, it also includes two 600-kc Mincom G-100's, two degaussers, and an advanced monitor alarm system policing forty-two 1.5-mc channels. The station is the result of Mincom's long experience with frequency responses of better than 1 mc—an outstanding reliability record since 1955.

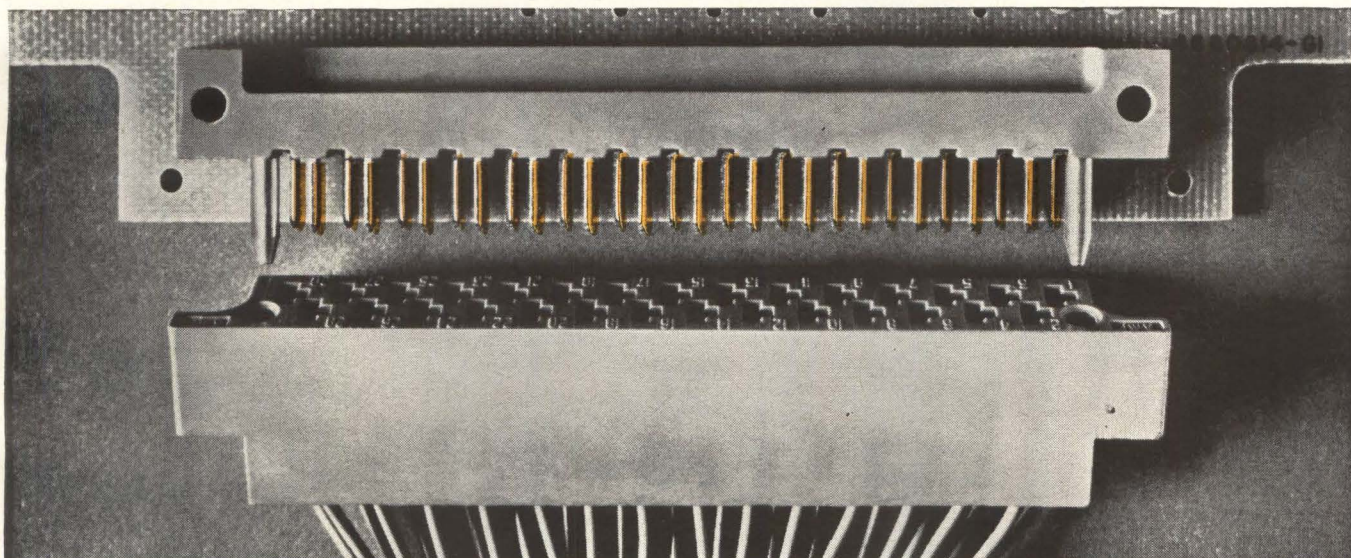
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Doesn't it deserve the best connector ?

You bet it does! And the best going is the AMP-BLADE® Connector you see above. Here's why:

Staked Down Construction. Each male tab is mechanically staked to the board. This rigid staking eliminates all board warpage problems. Joins male housing solidly to board. Assures intimate contact between board paths and male contacts.

Molded Male Tab Housing. Male tabs, encapsulated into the housing, assure correct alignment with receptacle contacts. This eliminates any possibility of mismatching, leading to plating wear, environmental problems and poor contact.

Large Areas of Contact. Receptacle contacts provide 3 "long" areas of contact with male tab. This eliminates "rocking" and plating wear. Special contact spring assures uniform contact pressures. Stabilizing boss controls receptacle float in housing.

Crimp, Snap-in Design. Receptacle contacts are terminated automatically at rates up to 4,000 per hour. Precision crimping with automatic machines assures

unvarying mechanical and electrical uniformity, lowest possible installed costs. Snap-in assembly means no unused contacts. You pay for only those contacts you need.

Gold Plating. .000030" gold over .000030" nickel contact plating is standard. Never an option or extra. Control by X-ray measurement assures uniformity in thickness and prevents metal creep and oxide buildup.

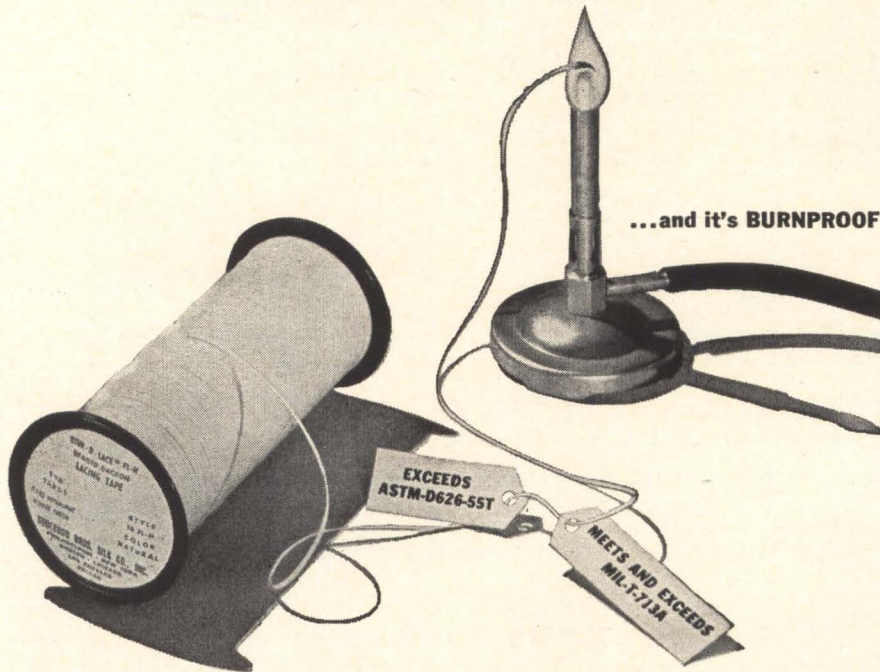
You can count on AMP-BLADE Connectors to deliver smooth, uninterrupted current flow in your most advanced solid state designs. But don't take our word for it. Find out for yourself. Our test reports tell the story in facts and figures that make interesting reading for any design engineer. Send today for your free copy.



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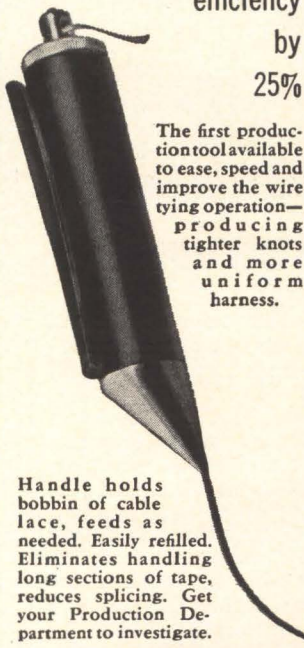
BURNPROOF LACING TAPE AT NO ADDITIONAL COST —FROM GUDEBROD



...and it's BURNPROOF

THE CABLE-LACER

increases worker
efficiency
by
25%



The first production tool available to ease, speed and improve the wire tying operation—producing tighter knots and more uniform harness.

Handle holds bobbin of cable lace, feeds as needed. Easily refilled. Eliminates handling long sections of tape, reduces splicing. Get your Production Department to investigate.

The specification of non-combustible materials in electronic equipment has, until now, required the use of special, higher priced lacings for harness tying. Through extensive work in their R&D Department, Gudebrod is producing two new burnproof lacing tapes—both available at no additional cost!

The first of their kind, these new tapes are made of Dacron* fibers and are flat braided for excellent handling and knotting qualities. In addition to meeting or exceeding all requirements for MIL-T-713A, the burnproofing exceeds ASTM-D626-55T.

Two types are being produced—Stur-D-Lace FIH, impregnated with a flame-proof fungistatic synthetic rubber finish, and Stur-D-Lace-R impregnated with a flameproof fungistatic vinyl finish. Both are essentially stable at -100° to 350°F. Neither will burn, but they will melt when a hot flame is applied. Each type is available in seven different strengths. Gudebrod Technical Product Bulletin #6 gives details.

The introduction of burnproof lacing tapes at standard prices represents another advancement in cable lacing practice by Gudebrod. The Gudebrod line of lacing tapes covers the entire range of wire harness tying requirements for both military and commercial equipment. Send for the Data Book on Gudebrod Tapes.

*"Dacron" is Du Pont trade name for its polyester fiber.

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FOUNDED IN 1870



Electronics Division
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MEETINGS AHEAD

SYMPOSIUM ON THE IONOSPHEREIC PROPAGATION OF VLF RADIO WAVES, The Central Radio Propagation Laboratory of the National Bureau of Standards at the Boulder Laboratories, Boulder, Colo. Aug. 12-25.

INTERNATIONAL ELECTRONICS CIRCUIT PACKAGING SYMPOSIUM, University of Colorado, Boulder, Colo., Aug. 14-16.

WESTERN ELECTRONICS SHOW AND CONFERENCE, WEMA, IEEE; Cow Palace San Francisco, Calif., August 20-23.

DATA PROCESSING NATIONAL CONFERENCE & EXHIBITION, Association for Computing Machinery; Denver Hilton Hotel, Denver, Colo., Aug. 27-30.

AUTOMATIC CONTROL INTERNATIONAL CONGRESS, International Federation of Automatic Control; Basle, Switzerland, Aug. 27-Sept. 4.

MILITARY ELECTRONICS NATIONAL CONFERENCE, IEEE-PTGMIL; Shoreham Hotel, Washington, D. C., Sept. 9-11.

ELECTRICAL INSULATION CONFERENCE, IEEE, NEMA; Conrad-Hilton Hotel, Chicago, Sept. 10-14.

JOINT ENGINEERING MANAGEMENT CONFERENCE, IEEE, ASME; Biltmore Hotel, Los Angeles, Sept. 12-13.

INTERNATIONAL ASSOCIATION FOR ANALOG COMPUTING, AICA; Brighton College of Technology, Lewes Rd., Brighton, England, Sept. 14-18.

INDUSTRIAL ELECTRONICS ANNUAL CONFERENCE, IEEE, ISA; Michigan State University, East Lansing, Mich., Sept. 18-19.

NATIONAL POWER CONFERENCE, IEEE, ASME; Netherland-Hilton Hotel, Cincinnati, Ohio, Sept. 22-25.

INTERNATIONAL TELEMETERING CONFERENCE, IEE, IEEE, ISA, ARS, IAS; London, England, Sept. 24-27.

PHYSICS OF FAILURE IN ELECTRONICS SYMPOSIUM, Armour Research Foundation and Rome Air Development Center, Illinois Institute of Technology, Chicago, Sept. 25-26.

ELECTROCHEMICAL SOCIETY FALL MEETING, ECS; New Yorker Hotel, New York, Sept. 29-Oct. 3.

SYMPOSIUM ON PHYSICS AND NONDESTRUCTIVE TESTING, Southwest Research Institute, San Antonio, Texas, Oct. 1-3.

INDUSTRIAL COOPERATION MEETING: ION SOURCES AND PULSED ACCELERATOR TECHNIQUES, Oak Ridge National Laboratory, Oak Ridge, Tennessee, Oct. 3.

INSTRUMENT SYMPOSIUM AND RESEARCH EQUIPMENT EXHIBIT, National Institutes of Health, Bethesda, Maryland, Oct. 7-10.

*The latchstring is out to the
Electronics Industry...*

COLORADO!

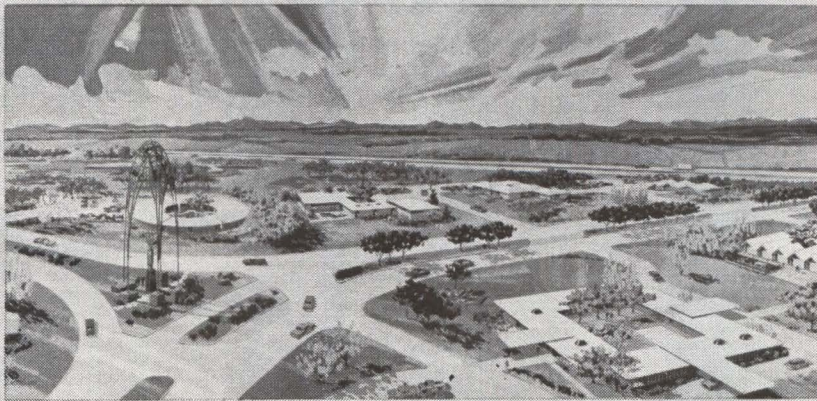
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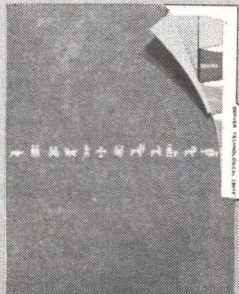
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CONCEPT

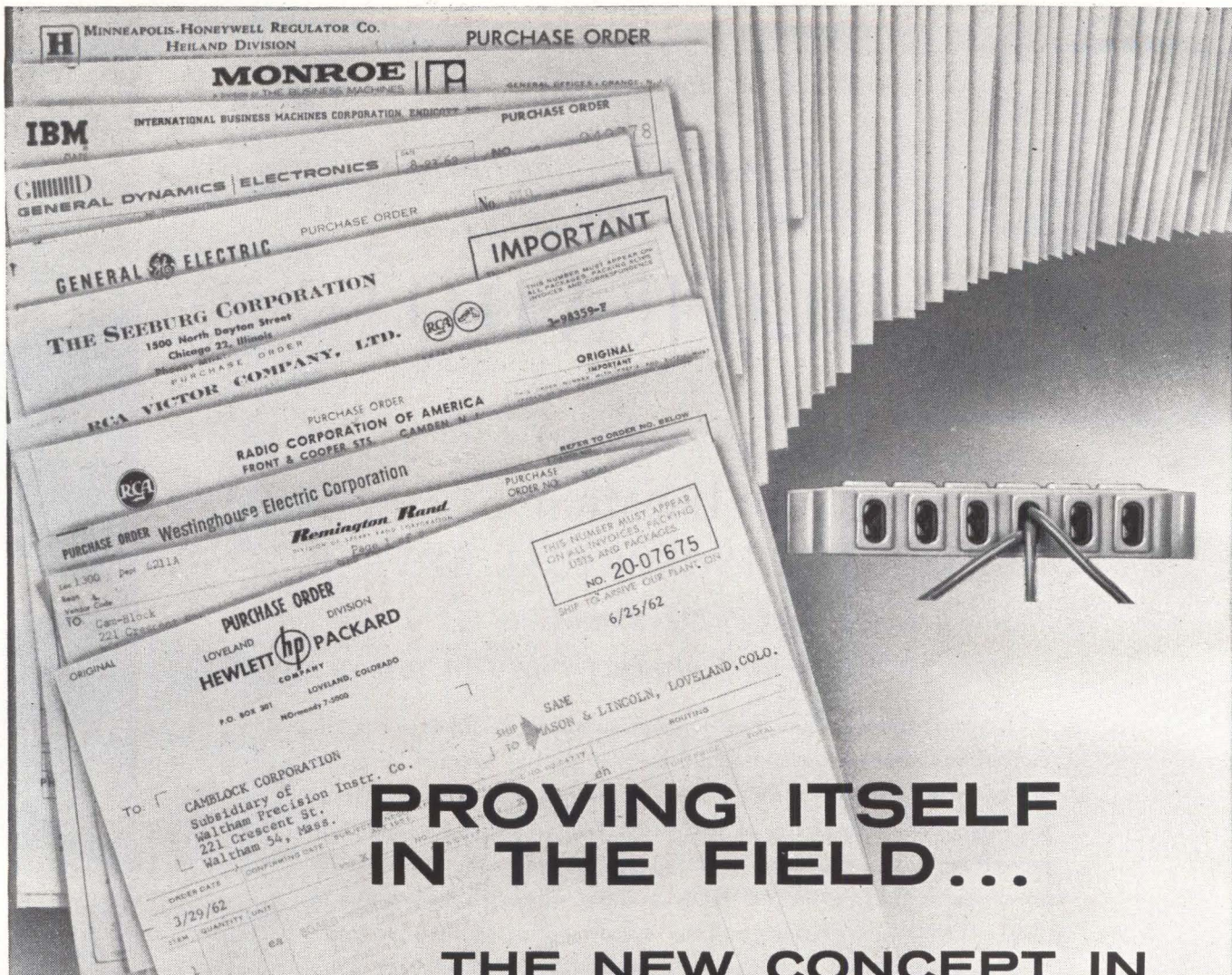
DESIGN

EXPANSION

PROTECTIVE
COVENANTS

SITE
FEATURES

SELECT
OCCUPANCY



PROVING ITSELF IN THE FIELD...

...THE NEW CONCEPT IN TERMINAL BLOCKS

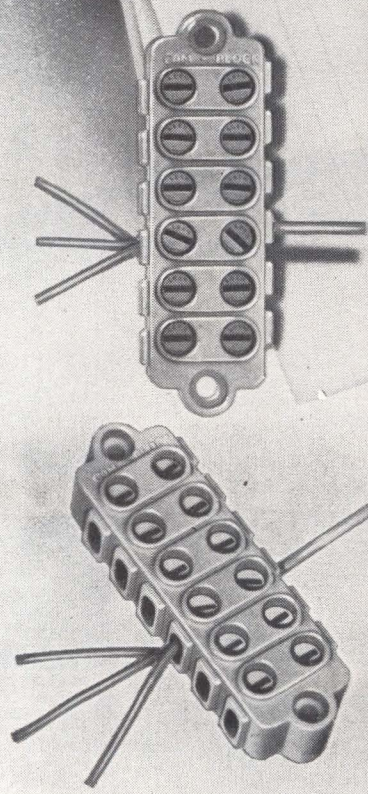
Our growing list of distinguished customers is an indication of the acceptance Camblocks are earning in the field. Because of their unique construction, Camblocks offer outstanding operating economy and performance. They eliminate the need for solder, lugs, self-locking fasteners or special tools. **Wiring labor costs are sharply reduced.** In-field service becomes simple and quick. There are no breakage and loose part problems. And connections are better.

Camblock's construction embodies a self-contained cylindrical cam. The wedging action of the cam, in conjunction with the busbar design, produces fast, positive locking with high vibration proof characteristics and extremely efficient conduction.

Unbreakable, solid bottom body design provides high dielectric strength and good protection against short circuiting and contamination. Terminal markings can be applied directly to the housing.

A single series Camblock will accept a wide range of wire sizes, accommodate multiple leads, has high current carrying capacity . . . it is the equivalent in performance to a range requiring three series of conventional terminal blocks.

Write for technical data sheets:
 Medium (CB-M) Series: Rated to 30 amps, #10 to #20 AWG wire, in 2 to 20 stations.
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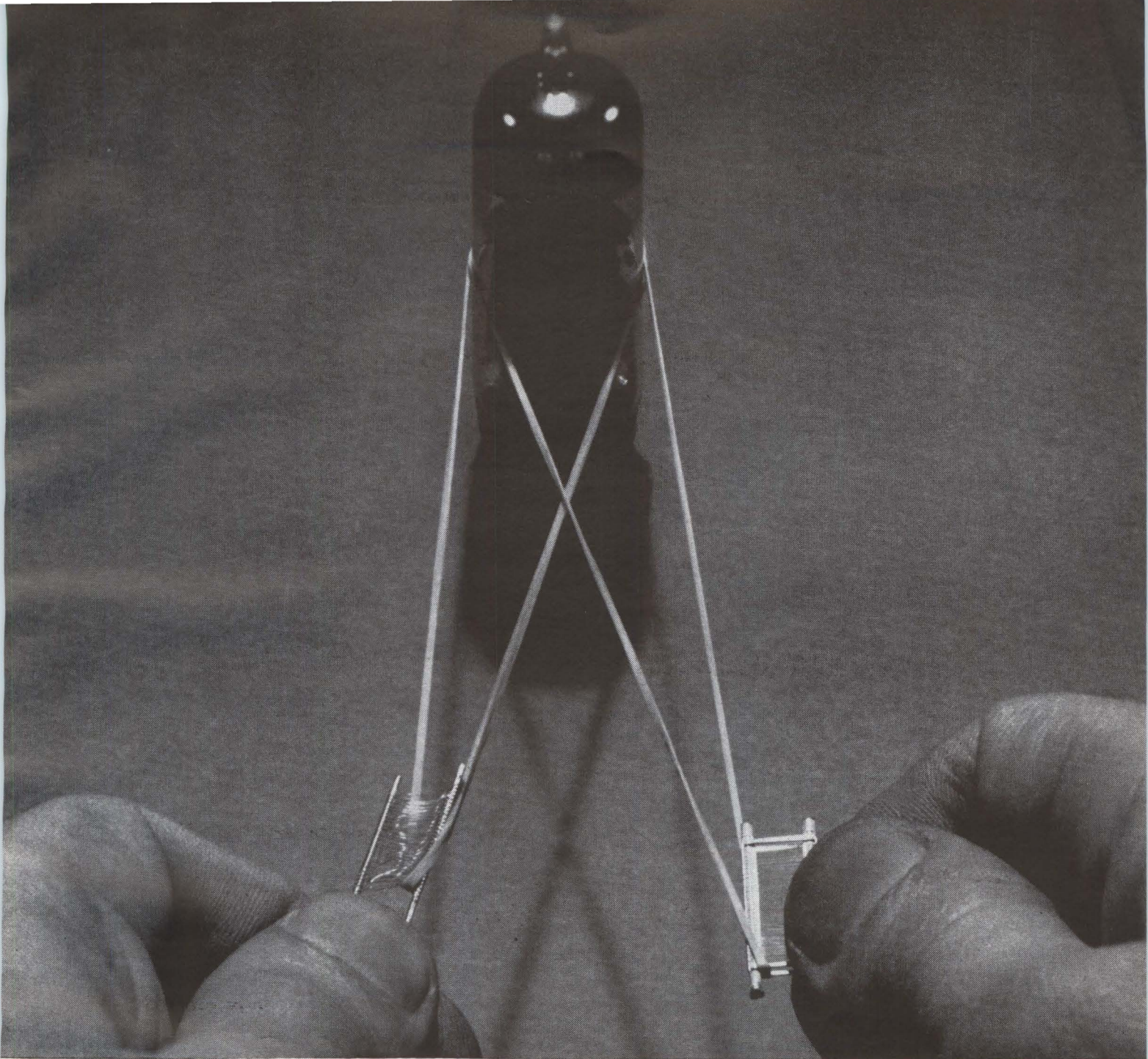
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 WALTHAM 54, MASSACHUSETTS

Tel: TWInbrook 3-4000 TWX: WALTH 1183-X

Patent No. 3,042,896



How the strength of Sylvania's Strap Frame Grid improves tube performance

Tube grids in service never get the exact rack torture shown here, but it illustrates a point.

The conventional grid, on the left, depends on its winding for rigidity (which automatically imposes a minimum size limit on the wire). With any rough treatment of the sort encountered in missiles and planes, distances can easily change between the winding and the cathode it surrounds.

By putting metal braces across the back-

bones, the Strap Frame Grid is formed, which is rigid with or without the winding. With no physical support requirement, the wire can be smaller (allowing more turns per inch) and placed a short, precise distance from the cathode—permanently. This closeness greatly improves transconductance, Gm-to-Ib ratio, gain, bandwidth and noise figure. And physical stability translates into electrical stability, even with jarring or environmental changes.

Sylvania was several years ahead of other U. S. tube manufacturers putting Strap Frame Grids in subminiature tubes. And industrial and commercial versions in miniature size have been star performers for even longer.

Another example of how Sylvania advances electronics by introducing—ahead of the field—better-performing, more reliable components. Electronic Tube Division, Sylvania Electric Products Inc., Box 87, Buffalo, New York.

SYLVANIA

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AT WESCON: BOOTHS
2901-06 AND 2917-22

Complex? No!
BELDEN designs cables smaller...less complicated

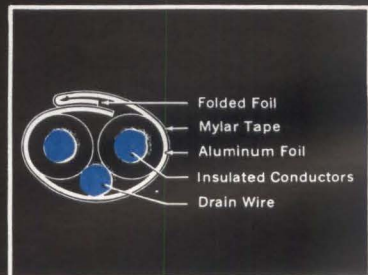


this Beldfoil instrumentation cable is a typical example*

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.



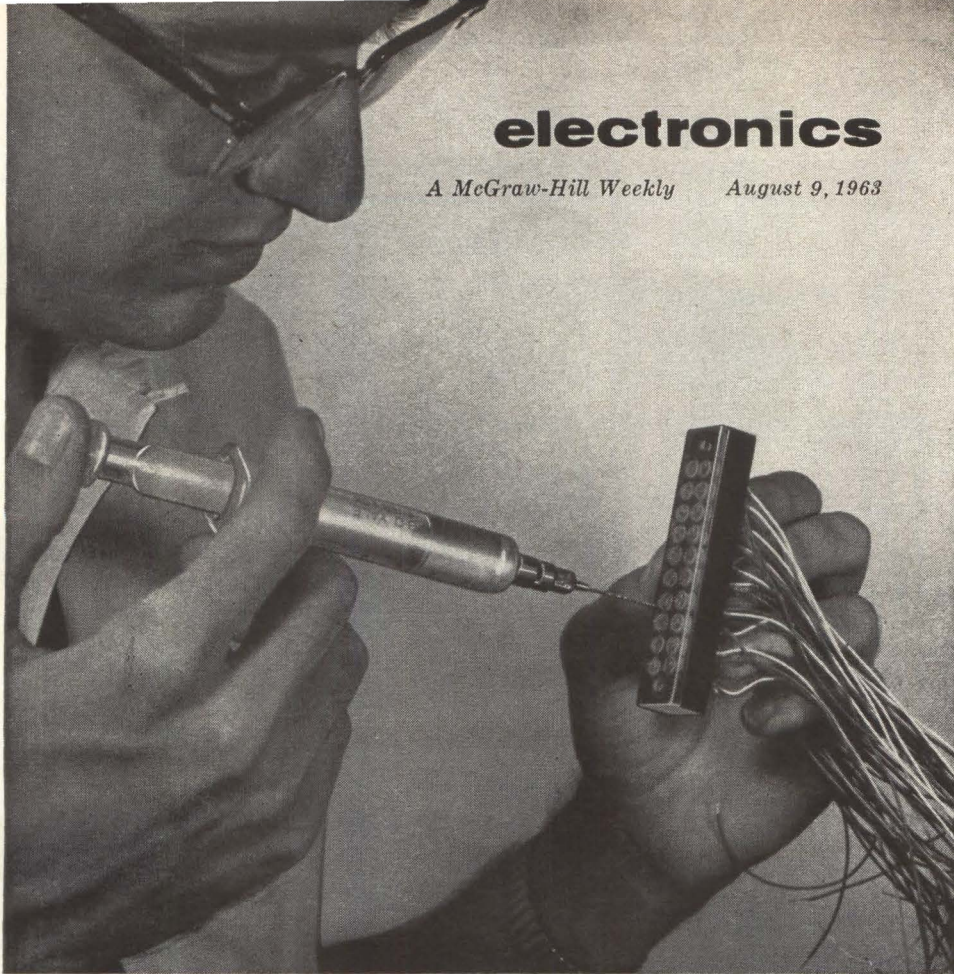
Belden engineers have designed thousands of Beldfoil shielded cables similar to this one...special instrumentation, strain gauge, and control cables. They can and will design a smaller cable to reduce the size of your product...a less complicated cable that will do the same job better...or perhaps a 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 44, for data sheet on Beldfoil shielding.

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





COPPER ELECTROLYTIC solution is injected into one of the electrochemical circuit elements employed in the neurons that make up an Adaline

WESCON 63! W E S C O N

The Technical Highlights

Forecasting weather with Adaline, new nanosecond switching circuits, system design with coherent light diffraction, and latest techniques in microelectronics and lasers are among the advances

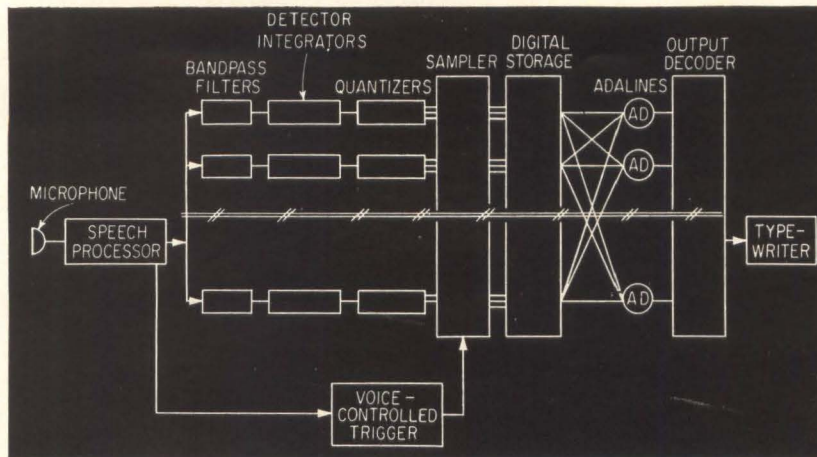
By HAROLD C. HOOD, Pacific Coast
Regional Editor, Los Angeles

IN THE SAN FRANCISCO Bay Area where WESCON is being staged Aug. 20-23, the months from January through April make up the "rainy season," and give weather forecasters the most trouble. Recently, a 100-input Adaline

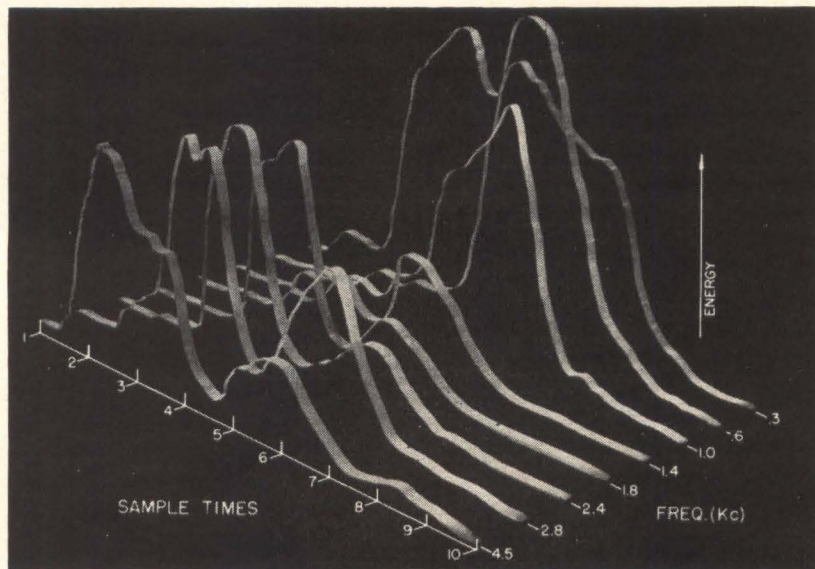
(Adaptive Linear Neuron) data-processing system was assigned the task of predicting "tomorrow's weather over an 18-day trial period." Data inserted consisted of samples of "today's" pressure patterns from 48 geographical divisions. On the 18th day results showed that Adaline had chalked up a score of 83 percent accuracy

against the official forecast's 67 percent.

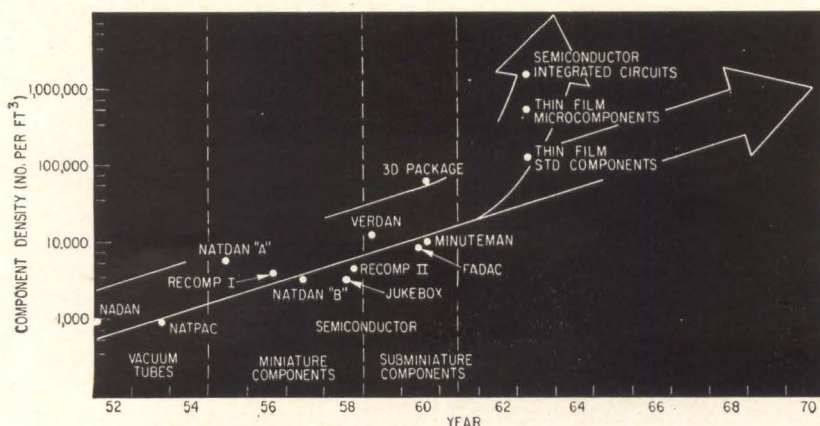
Details of this and other equally impressive applications of adaptive data-processing systems will be aired in one of four papers in the session on trainable systems. A total of 20 technical sessions and approximately 85 papers, covering the industry spectrum from



ADAPTIVE SPEECH recognition system can identify new word samples with 95 percent reliability—Fig. 1



SPECTRAL STRUCTURE of the spoken word "zero"—Fig. 2



COMPUTER PACKAGING trend for 1960 through 1970—Fig. 3

component reliability through microelectronics and new laser techniques to the latest theories on plasmas, will be presented in morning sessions during the four-day conference at the Cow Palace. A sampling of the highlights is presented here.

ADAPTIVE SYSTEMS — Linked with details of the weather prediction system mentioned above will be the description of a real-time adaptive speech recognition system, Fig. 1, that can correctly identify new samples in its 18-word vocabulary with better than 95 percent reliability after training on only 8 samples a word. This level drops somewhat when interrogation is made by new voices, but reliability still averages better than 85 percent.

Input to the pre-processor section is by voice microphone and goes through an audio amplifier and automatic level control to a bank of eight bandpass filters spaced throughout the audio spectrum at intervals of roughly 200 cps. Spectral power is quantized and sampled to form a 240-bit pattern for each spoken word. Variables which are quantized and presented to Adaline are frequency, energy and time. Outputs of each filter are rectified and integrated to produce waveforms similar to the "slices" shown in Fig. 2 for the word "zero."

Real-time sampling, initiated and terminated by a voice-controlled trigger, takes place at about 250 samples a second. Most of these are discarded, and normalized patterns are formed by taking 10 samples at evenly spaced time intervals throughout the utterance. The amplitude and time normalization techniques used are believed to reduce error rate for a wide variety of test situations by a factor of from 5 to 10.

A third application, potentially useful as a reliable diagnostic aid for heart disease, uses a Madaline (Multiple Adalines) for distinguishing abnormal from normals among EKG vector cardiograms. After training on 100 cases, the reliability was 81 percent when tested on 57 new cases not contained in the training set.

MINUTEMAN—Discussion of microelectronics and USAF's advanced Minuteman² is expected to attract considerable attention from systems management and design engineers contemplating implementation of integrated circuits technology into other programs. The author points out that decreased size, while perhaps the most obvious benefit derived from integrated circuits, is frequently dwarfed by advantages in increased reliability and lower power requirements. He also stresses the need for a complete reappraisal of long-accepted basic design concepts in order to fully exploit the potential of integrated circuits.

"Planning must extend to the loftiest reaches of preliminary engineering concepts," he warns. "Efforts to predetermine solutions at the component level can only result in badly compromised systems in terms of performance, reliability, cost, and operational support factors."

Studies conducted at Autonetics Division of North American Aviation indicate that packaging densities of one-half million equivalent parts per cubic foot are currently realizable using semiconductor integrated circuits, including memory, power supply, interconnecting wiring, and overall chassis envelope (see Fig. 3). The theoretical maximum is 10-30 million. Autonetics has not pressed for the ultimate in packing density on Minuteman; in the guidance and control computer fewer than one-half the maximum possible number of integrated circuit packages per square inch of board surface was called out.

The study discloses that discrete parts displaced by integrated circuits in typical digital equipment applications falls between 75 and 98 percent, depending upon input, output and power supply requirements. To achieve satisfactory functional operation over certain military equipment temperature ranges, some memory circuits require hybridizing of integrated circuit and discrete components. Displacement figure for the advanced Minuteman's computer is 93.6 percent. Memory electronics

are mechanized with 10 integrated circuit types, of which 4 are logic elements common to the arithmetic section.

While linear circuits account for but a small percentage of the total of Minuteman's integrated circuits, a significant number are being used in the Flight Control and Inertial Measurement Unit sections of the guidance and control system. In the former, 68 percent of the up-stage electronics is integrated, in the latter 45 percent or 73 percent if hybrid circuits are included.

The general purpose amplifier in frequent use throughout these two sections, points up the versatility possible with an integrated circuit linear amplifier. This high-gain, small-signal device uses active common-mode offset control and is easily adaptable to many applications requiring d-c and audio frequency amplification.

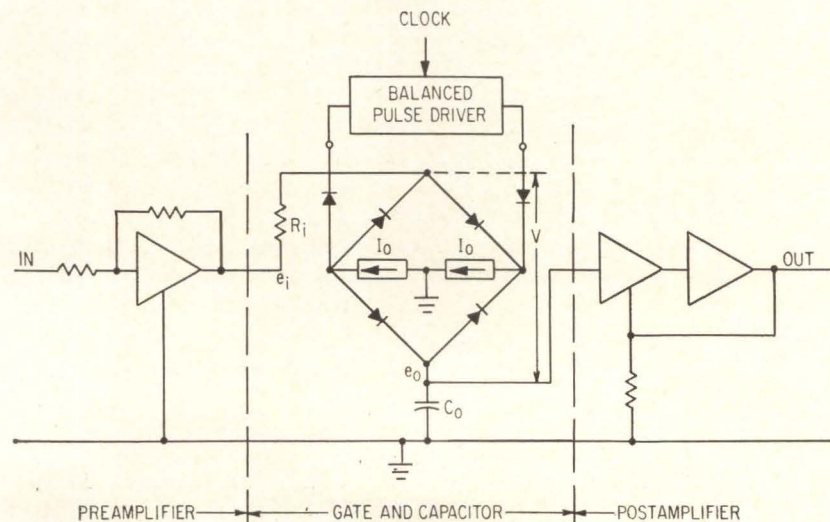
Autonetics feels that since Minuteman integrated circuits are fabricated in exactly the same manner as silicon planar passivated transistors, much of the extensive data acquired from the Minuteman high-reliability component program can be adapted for reliability predictions. The technique of "step-stress" testing has been widely used to assure the absence of new failure modes.

To date, more than 10^7 device hours have been chalked up in ele-

vated temperature tests by companies involved in the Advanced Minuteman program, and no new failure modes have been identified. Operational failure rates of 0.002 to 0.001 percent per 1,000 hours have been extrapolated from achieved failure rates of 0.01 to 0.5 percent per 1,000 hours at elevated temperatures, and it is felt that eventually these may be improved by factors of from 2 to 10. (The contention that integrated circuits will have failure rates closely approximating those of individual discrete transistors has been fairly well substantiated.) Minuteman design philosophy dictates that the basic throw-away package is an integrated circuit.

In the areas of yield and cost, studies indicate that semiconductor network yields will be 25 to 80 percent that of the transistor being used when manufactured as a discrete device. These figures imply that average circuits having two or more transistors will cost no more than the discrete transistors used to make them.

SUBNSEC SWITCHING—A precision bilateral Lewis gate employing gallium arsenide diodes, Fig. 4, provides the nucleus of a recently designed precision sample and hold circuit having a switching time of less than one nano-second and capable of maintaining the held waveform flat to



PRECISION SAMPLE AND HOLD circuit is built around bilateral Lewis gate using gallium arsenide diodes—Fig. 4

within one part in 5,000 or one-tenth of a quantizing step.³

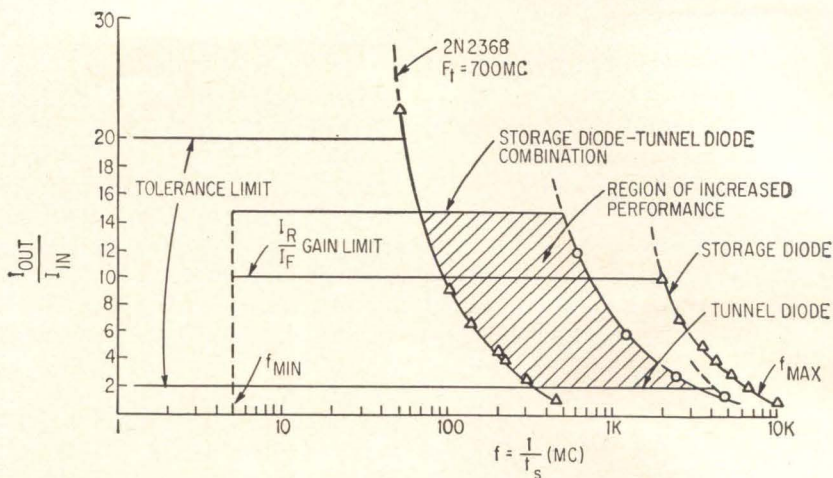
The circuit forms the link between a band-limited signal source and an analog-to-digital converter in a high-speed 9-digit pcm system, designed to handle either one NTSC color television signal or 1,200 frequency division multiplexed telephone channels.

The gate diodes are characterized by subnanosecond recovery time, capacitance less than 1 pf, and large forward conductance. The diode bridge is driven from a d-c coupled preamplifier with very low impedance and the gate is switched at 12 Mc by a fast driver circuit. Charging interval is about 20 nanoseconds of the sampling period, and holding is maintained over the remaining 60-nanosecond interval. Test results on the system have confirmed expected performance including a s/n ratio of a few db better than theoretical rms signal-to-quantizing noise ratio for an ideal 9-digit pcm system.

Because of stringent speed and accuracy requirements, physical embodiment of the circuit is critical. Wherever possible, miniature components are used, and all lead lengths have been minimized by triplate construction for the amplifiers. The upper printed circuit plate contains all signal paths, and all components and devices are sandwiched between it and the power supply printed circuit plate.

TDCT LOGIC—The evolution of high-speed computing circuitry recently led to the compromise measure of combining the tunnel diode, which could operate with stringent tolerance requirements, and a complementary device giving interstage current gain.⁴ The most obvious answer to the latter requirement was the transistor, but it was soon discovered that by combining the tunnel diode and transistor the circuit operating bandwidth was reduced to that of the transistor.

A new approach that can tolerate a tradeoff between speed and current gain without the need for a power amplifying device is the combining of storage diodes as charge transformers and tunnel



GAIN-BANDWIDTH tolerance comparison of high-speed logic devices—*Fig. 5*

diodes as charge amplifiers. Since the frequency limit of most present logical devices is charge-controlled, and since the combination of these two devices can achieve charge transformation, the approach appears promising. Considerable gain-bandwidth advantage can be exploited in nanosecond circuits by using the new combination (see Fig. 5).

General-purpose high-performance AND, OR and NOR circuits, and a simple charge transformer recirculating register have been developed, and provide evidence that practical nanosecond high-gain circuitry is now possible with considerable system flexibility for the logic designer.

INTEGRATED CIRCUITS—Fabrication of the metal-oxide-semiconductor field-effect transistor (MOST) and its use in digital systems will be described during WESCON'S session on integrated circuits.⁵ The author points out that densities of over 10,000 active devices per square inch are currently possible.

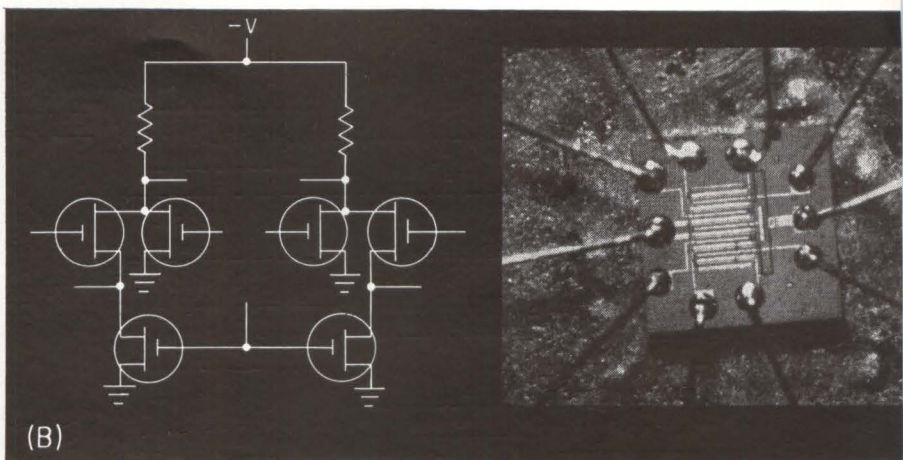
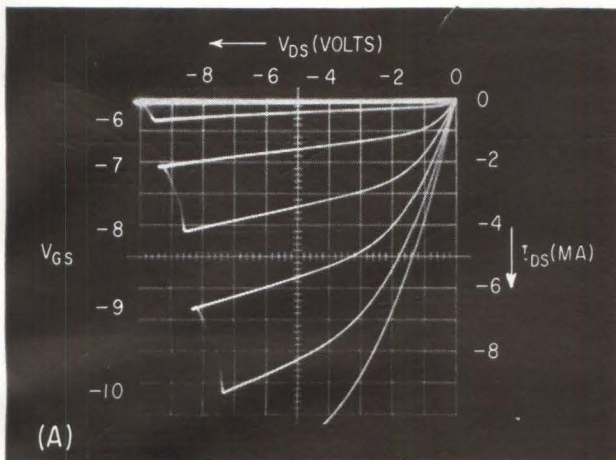
Simple in structure, the device is fabricated from single crystal *n*-type silicon by planar diffusion. Adjacent *p*-type islands are diffused into the *n*-doped wafer, and a thin SiO₂ layer grown over the separating area. After contact holes are etched through the SiO₂, metal gate, drain and source electrodes are vacuum deposited. Gate input impedances exceeding 10¹⁵

ohms and input capacitances of about 2 pf enable large fanouts.

Figure 6A illustrates the transfer characteristics of the MOST that can be exploited for integrated digital systems. Drain current is plotted against drain-source voltage with gate voltage a parameter and it is significant that no drain current is flowing at zero gate voltage. However, considerable current flows by biasing the gate with the same polarity as the drain. Rarely found in other active devices, this enhancement mode of operation makes it possible to couple between units without the need of level shifting resistors.

For logic applications, large arrays reportedly can be diffused with their load resistors and without isolation problems almost as simply as fabricating one device. The silicon wafer can be at a common ground potential and acts as a natural shield between active regions.

Also, since MOSTs are voltage-controlled devices with no fixed voltage offset between the source and drain when conducting, series-parallel logic combinations can easily be implemented. In series applications, several gate electrodes span an array of diffused *p* islands with contact being made only at the source of the first device, the drain of the last, and the diffused load resistor for the supply voltage. In the parallel case, the desired number of gate electrodes extend over the region be-



MOST starts conducting when gate voltage is below $-5v$ (A). Circuit in (B) performs several logic functions, is 0.03×0.03 inch—Fig. 6

tween the two elongated p regions.

Versatility of MOST circuitry is demonstrated by the circuit shown in Fig. 6B which, by appropriate connection of its internal leads, will perform the logical functions of half-adder, shift register stage, flip-flop, NOR-NAND gate, and many others.

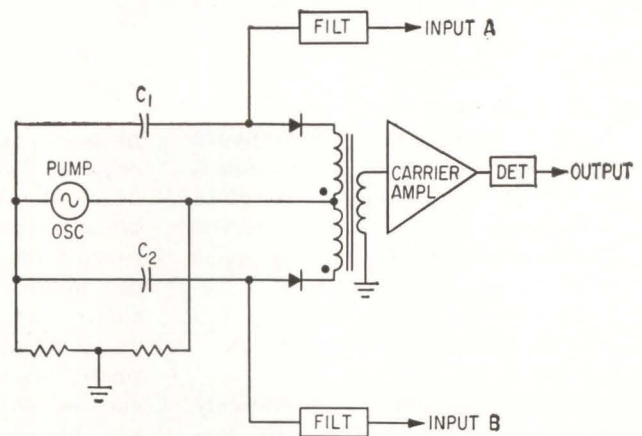
M-O-S DIODES—Performance of high input impedance reactance amplifiers and systems requiring reduced $1/f$ noise in low-level amplifiers reportedly can be enhanced by the use of newly developed metal-oxide-silicon diodes.⁶ Silicon dioxide serves as a dielectric barrier between the silicon and a metal, permitting exceptionally high capacitance versus voltage ratios and low leakage characteristics.

Units have been constructed which exhibit conduction currents below 10^{-16} amp at one volt in either polarity. By optimizing diode materials and dimensions, a device may be made which exhibits capacitance changes as high as 1,200 pf per volt when passing through zero voltage.

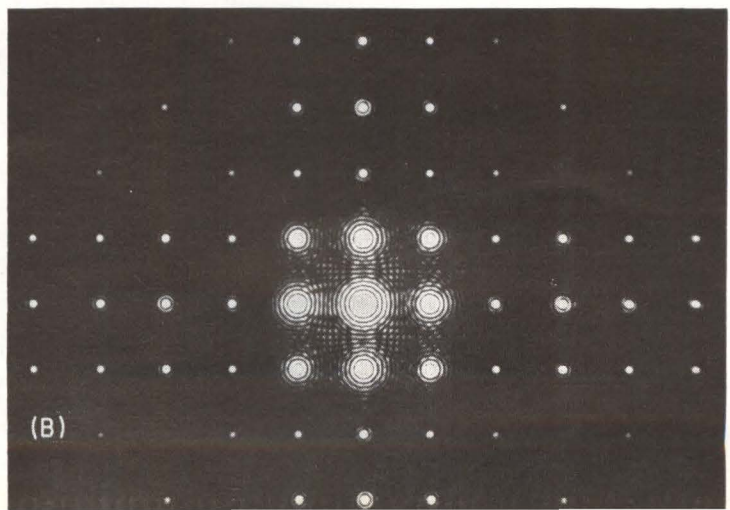
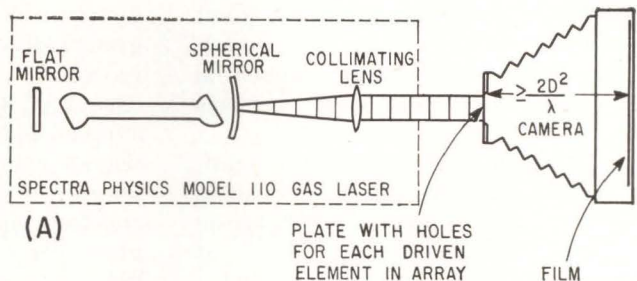
A solid-state electrometer has been selected as an example of devices for which the unique characteristics of the M-O-S diode may be exploited. The basic electrometer balanced ratio transformer bridge circuit is shown in Fig. 7.

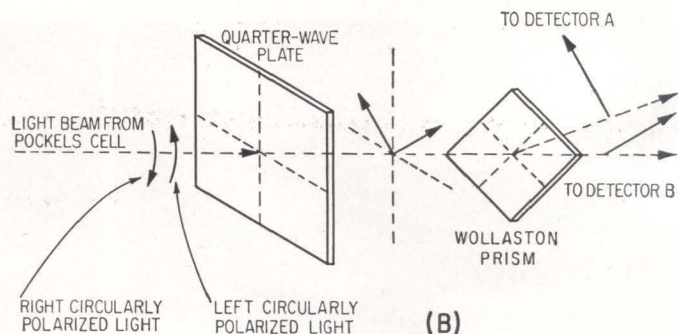
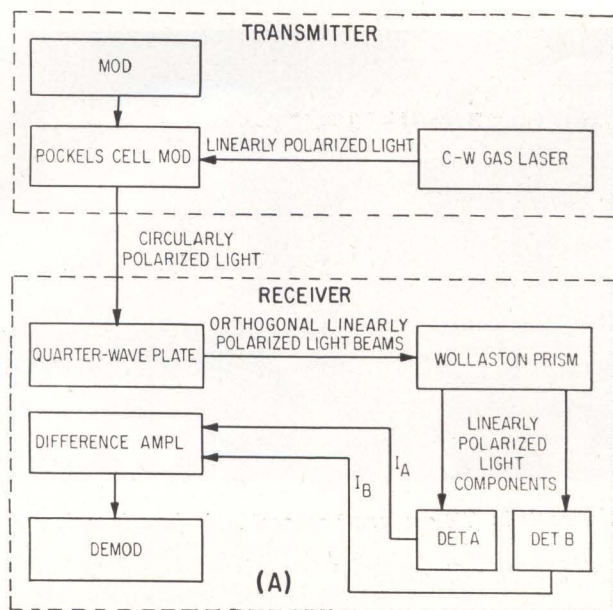
Performance of the circuit includes input impedance above 10^{17} ohms in shunt with 150 pf, fre-

BASIC CIRCUIT for solid-state electrometer using metal-oxide-semiconductor diodes—Fig. 7



TYPICAL ARRANGEMENT for simulating large antenna patterns (A) produces two-dimensional far-field pattern (B)—Fig. 8





POLARIZATION modulation-demodulation transmission system (A) uses detection process shown in (B)—Fig. 9

quency response from d-c to above 5 Kc when driven by a low impedance source, baseline stability of 15 microvolts per deg C, no observed $1/f$ noise down to 0.001 cps, noise level below 10 microvolts with reactive input filters shorted, and overall voltage gain above 50 db.

COHERENT LIGHT — Entirely new approaches to electronic systems design are predicted by using coherent light diffraction effects.⁷ Constructing scale models of giant antenna arrays and instantaneously measuring radar-target tangential velocity are two typical problems that may be solved.

Recently a novel method was proposed for adapting the classic "slits and pinholes" diffraction demonstration to scaling models of antenna arrays. By substituting a hole in a conducting plate for each driven element in the array and illuminating the back side of the plate with radiation of the appropriately scaled microwave frequency, a pattern similar to that produced from active radiating elements was generated on the front side of the plate. The advantages of such a method over the practice of actually assembling the array with waveguide or coaxial feedlines connected to each element are obvious.

An extension of this technique, using a helium-neon c-w laser, is

proposed. Operated in the visible region (6328 angstroms) the laser beam furnishes a stable source of plane waves over a large cross-section of roughly 1,580 wavelengths per millimeter. Circular polarization reportedly may be obtained by using $\frac{1}{4}$ -angstrom plates, and phase or amplitude distributions can be controlled by wedges or variable density filters.

Operator of the setup shown in Fig. 8A can see the actual pattern distribution on the camera's ground glass or it can be directly recorded on photographic film. (See Fig. 8B.) More conventional antenna plots may be obtained by scanning the negative with a densitometer. Surprisingly small back-and-forth movements of the ground glass cause quite abrupt transitions between Fresnel and Fraunhofer regions. It is reported that by using the above technique antennas of hundreds or even thousands of wavelengths in diameter may be scaled on a measurement range the size of a large laboratory workbench.

The latter half of the paper describes experiments conceived to substantiate B. M. Oliver's hypothesis that coherent light reflected by a diffusing surface produces a complex, random, but *stationary* diffraction pattern, and also to prove that severe amplitude fluctuations at the detector in optical radars will

be caused by relatively small translation of the diffusing surface (or target) because of the new relationship demonstrated between typical size of target surface irregularities and wavelength.

Feasibility of using this phenomenon for direct measurement of tangential target velocity, and hence to provide a rapid tracking capability, is pointed out, and it is believed that the monumental problems associated with acquisition and tracking by proposed optical electronic systems will be simplified. Using an array of detectors with proper correlative interconnection, the sweeping motion of the random field pattern would be a direct function of the tangential velocity vector of the target in the beam, and angular tracking information on a nearly instantaneous basis should be obtainable. Since it is possible to modulate the beam to obtain range and radial velocity data, continuous tracking in three dimensions could be accomplished.

LASER MODULATION — Polarization modulation may have some distinct advantages over the other modulation schemes for laser communications.⁸ Initial investigations indicate that, unlike intensity modulation systems, all components of the polarization vector are detected and the 50 percent loss

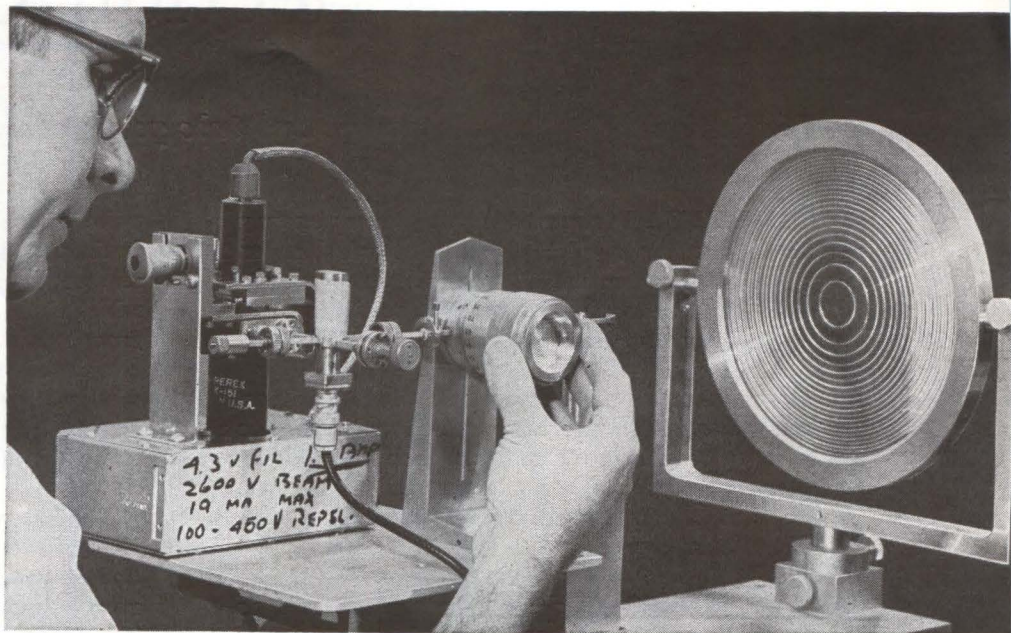
attendant with the former is not present. The full power of the transmitter is, therefore, effective at all times and the range over which information may be transmitted is substantially greater. In addition, interference due to linearly-polarized background light is negligible, and the transmitter and receiver comprising the system need only be aligned axially to initiate transmission.

Basic parts of an experimental polarization modulation system are shown in Fig. 9A. A He-Ne c-w laser and a Pockels cell modulator make up the transmitter. Output light is linearly polarized by means of Brewster-angle end windows and is passed through the Pockels cell along the Z-axis of the crystal and at 45 degrees to the cell's electro-optic axis.

Modulation is achieved by continuously varying the voltage across the Pockels cell along the Z-axis, alternately converting the incident linearly polarized light to right- and left-circularly polarized components.

At the receiver, the polarization of the incident light is changed to linearly polarized beams by a quarter-wave plate. Figure 9B shows that the emergent beams are at 90 deg to each other. Spatial separation of the two linearly polarized components is accomplished by a Wollaston prism, and they are detected as variations in intensity of photocell current.

CONFOCAL RESONATOR—The recently developed 2-mm confocal resonator shown in Fig. 10 is reported to have a sharper resonance dip than commercially available wavemeters and to be useful in extending microwave concepts into the millimeter (and smaller) wavelength region.⁹ In the experimental receiving system pictured, a parallel beam of modulated 140-Gc energy enters from the right and is received by a Fresnel zone plate lens which focuses it to the waveguide receiving horn. Energy is transmitted from this horn through the waveguide past the wavemeter (the cylindrical object bearing calibration marks) to a harmonic mixer fed from a 4-mm klystron. The detected 60-Mc output signal



CONFOCAL RESONATOR wavemeter is installed in experimental receiving system. The resonator consists of two spherical mirrors with electromagnetic energy propagating between them. An infinite number of distinct field distributions can exist between the mirrors—Fig. 10

is then supplied to an i-f strip.

The device, which can be operated nonconfocally, can be calibrated to an accuracy of about 0.2 percent directly from the physical dimensions. Indications point to its practical use as a filter element in narrowband filters as its passbands are narrow but sharp. Other reported advantages include ease of construction and of suppressing higher order modes.

VLF ARRAY—Recent requirements for long-range communications and other long-range electromagnetic systems have brought about a resurgence of interest in very low radio frequencies.¹⁰ The disadvantages of high natural noise environment and difficulty of radiating power inherent in vlf systems make it imperative that receiving antennas used have high directivity.

The principle of superdirectivity can be effectively applied in reducing the size of antenna structures necessary for the desired high directivity at vlf, where wavelengths are measured in miles. The usual detrimental characteristics associated with superdirectivity fortunately are minute in superdirective vlf receiving arrays.

The three-loop array is shown to

have greater directivity than the more familiar two-loop array. Beamwidth is narrowest, front-to-back voltage and power ratios are greatest, and position of the back lobes and nulls are most invariant when closely spaced loops are used. Null positions, which are a function of only the inserted delay and the free space delay between loops, are located so that unwanted signals may be excluded.

This array is particularly useful for receiving sferics because of its broad bandwidth.

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New Deflection Circuit Uses

Limitations of transistor sweeps and tube power consumption overcome in new design

A HIGH-POWER horizontal sweep circuit, newly devised and using a silicon controlled rectifier as a switch element, makes it possible to overcome both the limited sweep ability of transistors and the large power consumption of an electron-tube circuit.

The scanning power achieved is large with an LI^2 product as high as 40 mha², which surpasses the sweep power requirement of large-face color kinescopes. A driver stage is no longer needed because of the high trigger sensitivity of the silicon controlled rectifier (scr).

HOW IT WORKS—The fundamental circuit is shown in Fig. 1A. The scr is fired by a trigger

pulse at the beginning of the retrace time for every horizontal scan and sends to the deflection yoke L_y the energy stored across the retrace capacitor C , which has been charged during the sweep period just before. When this energy transfer has been completed at the end of the retrace cycle, the damper diode turns on and the energy just transferred begins to return to the power supply source, resulting in a linearly varying sweep current through the yoke.

The scr current decreases suddenly to zero when the yoke current is switched to the damper diode and is completely extinguished by the reverse current supplied from the circuit residual inductance L_x . In principle, this inductance must be inserted into the circuit as shown in Fig. 1A, but in actual circuits, the flyback transformer offers enough leakage inductance for this purpose.

The sweep circuits so far considered can not be driven by the scr, because these circuits necessitate intentional switch-off from the high current state. In the new circuit, however, the retrace capacitor is charged through the choke coil resonantly or linearly and hence no current switching is required.

Consider the behavior of this circuit in more detail. The retrace capacitor C may reach a voltage of about $2E_1$ at the end of the sweep period, where E_1 is the supply voltage. Then the stored energy of $C(2E_1)^2/2$ joule is driven into the yoke coil in a retrace time of about $\pi\sqrt{L_y C}/2n$, or in a quarter cycle of the ringing frequency, where n is the transformer step-up ratio. This energy transfer establishes a peak yoke sweep current of approximately

$$I_{vp} = \sqrt{\frac{C}{L_y}} (2E_1)$$

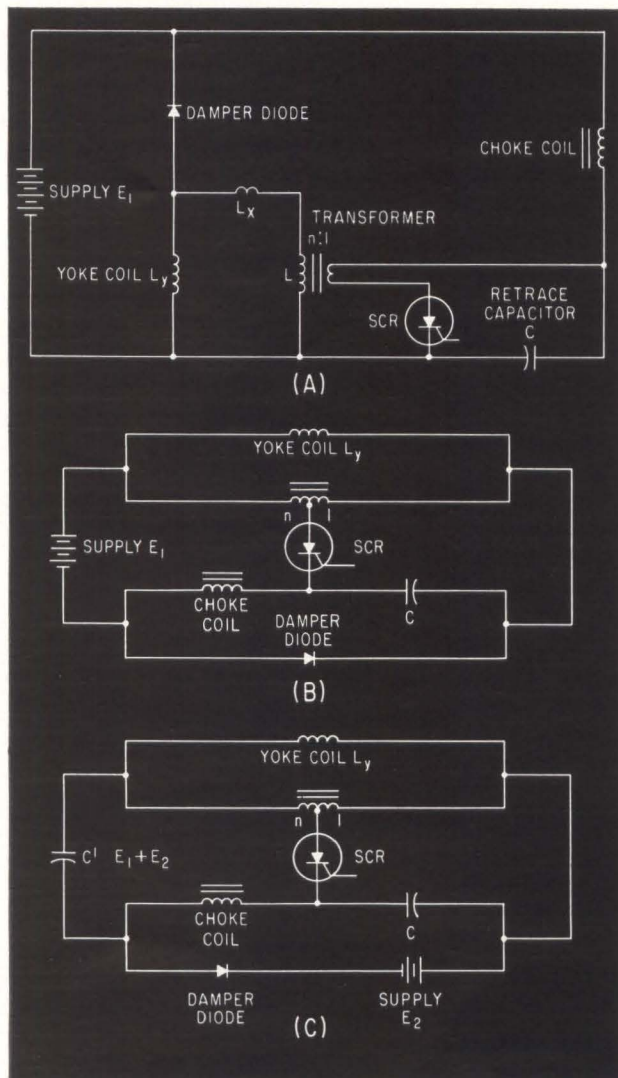
When the damper diode turns on, the linear sweep current with a slope E_1/L_y begins to flow. The next start of the retrace time must coincide with this sweep end and hence the relations

$$\sqrt{\frac{C}{L_y}} (2E_1)/t_{sw} \cong E_1/L_y$$

from which are obtained

$$C \cong t_{sw}^2/4 L_y \text{ and } n \cong \frac{\pi}{4} \left(\frac{t_{sw}}{t_{ret}} \right)$$

PRACTICAL CIRCUITS—The circuit of Fig. 1A may be rearranged to the circuit of Fig. 1B and 1C using autotransformers. In Fig. 1C the sweep voltage, $2(E_1 + E_2)$, automatically develops across C' , an electrolytic capacitor. In the circuits of Fig. 1B and 1C choke coil inductance is to be so chosen that the retrace capacitor gets its energy by linear charging, that is choke coil inductance should be large compared with the case of resonant charging



FUNDAMENTAL circuit using scr (A), actual sweep circuit using an autotransformer (B), and low supply voltage variation (C)—Fig. 1

SCR, Saves Power

By TADA AKI TARUI

Electronics Department
Central Research Laboratory
Tokyo Shibaura Electric Co., Ltd.
Kawasaki, Japan

for which the relationship is $(L_z \gg t_{sw}^2/C)$.

High voltage for the cathode-ray tube may be taken from a secondary winding either on the transformer or on the choke coil.

EXPERIMENTS—All developments were carried out using the circuits given in Fig. 1B and 1C.

Rectifier types 2SF62 and 2SF69 were used, corresponding to General Electric's C35 and C36 series, respectively. It seems likely that the C40 type scr would also be well suited to horizontal sweep applications. High-power operation of the high-E type circuit giving an LI^2 output of about 41 mha^2 is shown in the oscillogram, Fig. 2A. In Fig. 2B is the 32 mha^2 deflection case for the low-E type of circuit. The power supplies are 64 volts and 13.6 volts respectively. The yoke inductance is 200 μh in both cases. Ultimate circuit performance has not yet been determined but an efficient heat sink is required for the highest power operation.

CIRCUIT CONSTANTS—Considering the partial energy return back to the retrace capacitor C owing to series inductance L_z , more accurate expressions can be obtained for circuit component values. For example, in the high-E type circuit, the approximate values of C and n in actual circuits become

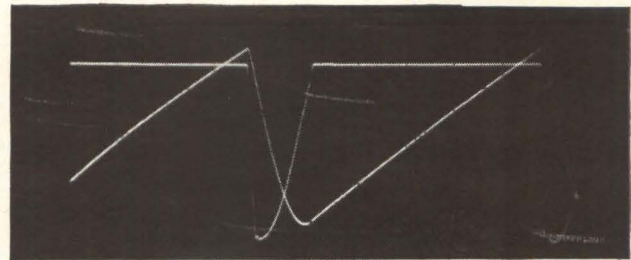
$$\sqrt{\frac{C}{C_{id}}} \sim \sqrt{\frac{1+b}{b}} \left(\sqrt{1+a \frac{1+b}{b}} - \sqrt{a \frac{1+b}{b}} \right) \sqrt{\eta} \quad (1)$$

$$\frac{n}{n_{id}} \sim \sqrt{1+a \frac{1+b}{b}} \left(\sqrt{1+a \frac{1+b}{b}} - \sqrt{a \frac{1+b}{b}} \right) \sqrt{\eta} \quad (2)$$

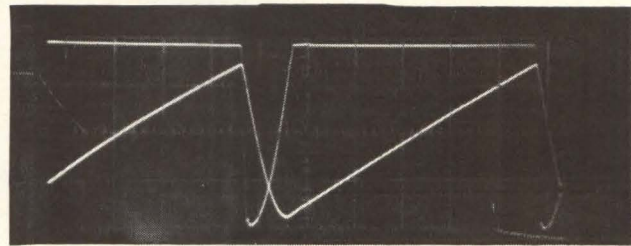
where, $C_{id} = t_{sw}^2/4L_y$ and $n_{id} = \pi t_{sw}/4t_{RETR}$ as obtained elsewhere, and $a = L_z/L_y$, $b = L/L_y$. (Fig. 1A). The symbol η means power transfer ratio, the ratio between the actual power transferred from C and the required total reactive power, which is smaller than unity, because of the charge storage effect of the damper diode. In actual circuits, a is about 0.1, b is 5 to 10, and $\sqrt{\eta}$ is about 0.9, so C/C_{id} becomes about 0.5 and n/n_{id} about 0.7, hence $n \sim 3$. For the low-E type circuit \sqrt{C} and n are further de-

SWITCHING POWER TO 100 KVA

Using the silicon controlled rectifier as a switching element, a new solid state circuit for magnetic horizontal deflection has been devised for large crt's. Compared with electron tube circuits, much less power is dissipated. The restricted deflection available from present conventional power transistor circuits is likewise overcome. Trigger sensitivity is high



(A)



(B)

WAVEFORM of yoke sweep in high-E type circuit with $L_y = 200 \mu h$, $C = 1.27 \mu f$ and $n = 2.5$ (A), low-E circuit with $C = 0.96 \mu f$ and other circuit constants as above (B). Vertical axis is 100 v and 4 amp per cm and horizontal is 10 μsec per cm—Fig. 2

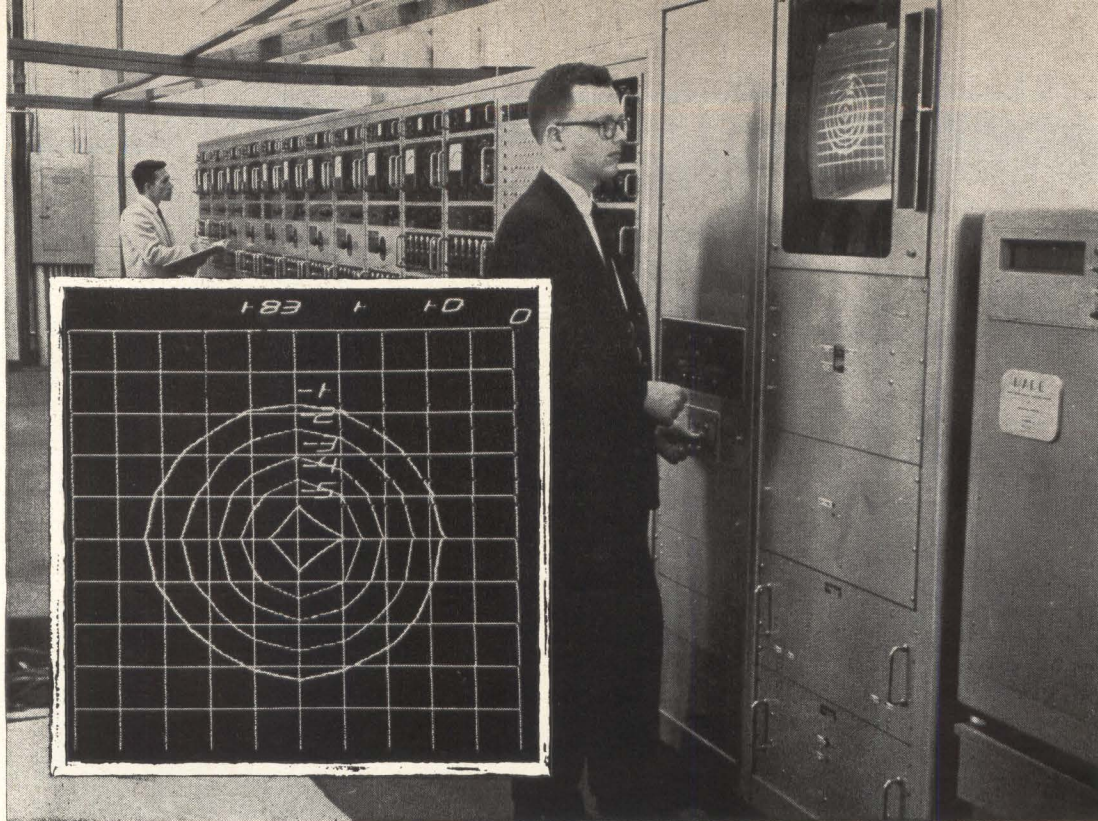
creased by the factor.

$$1 / \left(1 + \frac{E_1}{E_2} \right)$$

YOKE INDUCTANCE—For a 200 microhenry deflection yoke, 40 percent of supplied power is dissipated in the scr and damper diode. For optimum, minimum loss, design the yoke inductance should be the highest possible value, because the circuit loss can be reduced by decreasing the forward loss of scr and damper diode.

If an scr of 400-volt maximum rating is used, optimum inductance may become about 1.7 millihenries and the supply voltage ranges from 105 to 115 volts for 18 to 20 mha^2 deflection. In this case the semiconductor loss may be greatly lessened, say about 8 watts, and further examination of various circuit components may reduce the total power loss to 20 watts or less. Preliminary experiments using a 960 microhenry yoke has substantiated this figure. So the overall horizontal deflection and high voltage system will dissipate about 24 watts or less.

COMPARISON—The scr sweep circuit features high power swing capability yet requires small triggering power. Its circuit loss is large compared with the transistor circuit but much less than the conventional electron-tube circuit. Considering typical overall horizontal and high voltage supply system d-c power demands, a transistor circuit takes 16 watts, the scr circuit, 22 watts and an electron-tube circuit, 60 watts for 18 to 20 mha^2 deflection.



AUTOCON SYSTEM showing portions of the accompanying magnetic measurement system, with author in foreground; typical contour plot (inset) taken from the 11-by-11 matrix for a vertical dipole located 10 feet above the matrix plane—*Fig. 1*

LATEST ANTISUBMARINE AID **Magnetic**

Hybrid analog-digital apparatus receives analog point data from a single input and generates a complete contour response surface

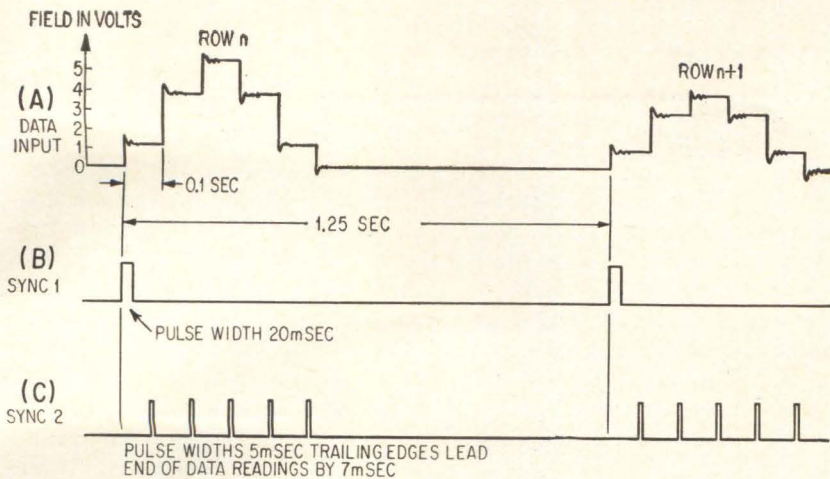
By **WILLIAM W. ANDERSON**,
U. S. Naval
Engineering Experiment Station,
Annapolis, Maryland

HOW NAVY MAY USE AUTOCON

1. To study shipboard magnetic fields (including stray, permanent and induced fields), locate their sources and reduce them.
2. To evaluate, locate and reduce sources of submarine acoustic noise.
3. Hull pressure distribution and advanced design studies.
4. Electromagnetic propagation study and analysis.
5. Analog computer simulation, network analysis, and node distribution.

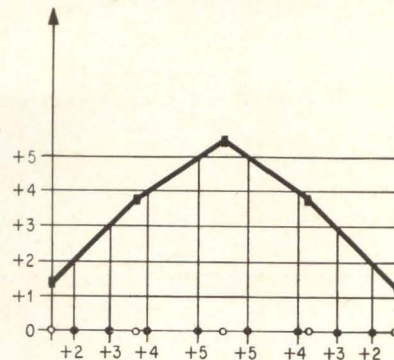
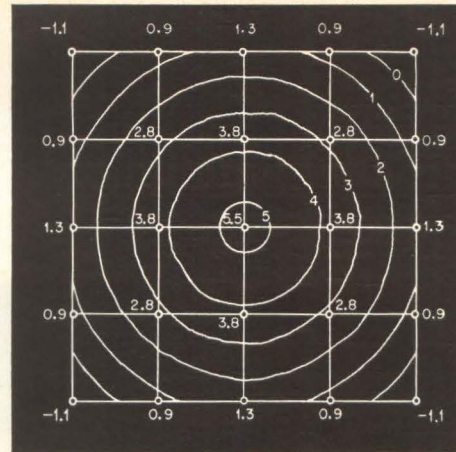
Other possible uses are in tactical search, classification and location. Sonar input could create a continuous crt display of a moving submarine, as a contour rather than a single blip. Autocon may also find a use in displays for guidance, navigation and alarm systems by presenting three-dimensional information as grid lines and outstanding terrain features

THE CONTOUR RESPONSE surface has long been an important means of data presentation. To meet the need of immediate data display in the specialized form of the contour plot, a new hybrid analog-digital system of automatic contour display called Autocon has been developed. This system receives sequential single-point analog data from a plane of measurement points, and through a series of scanning, analog storage, and interpolation operations, simultaneously converts this data into an interpolated surface over the entire measurement plane. As this surface is generated, a voltage comparison generates a series of pulses that represent the positions of the contour lines on the measurement plane. These pulses form the z axis for a high-resolution cathode ray tube and, along with simultane-



▲ INPUT WAVEFORMS of the third (row n) and fourth (row $n+1$) rows of data for the sample matrix given in Fig. 3 (top)—Fig. 2

► CONTOUR CONSTRUCTION techniques, showing a sample matrix of data with contour lines superimposed (top, A) and profile determination of contour-line intersections (bottom, B)—Fig. 3



Contour Display System

ously generated x and y axis signals, create a pattern of moving dots and dashes on the crt face to form a complete contour plot.

A photograph of the complete system, showing part of the magnetic-field measurement system, is shown in Fig. 1. The inset illustrates a typical contour display for an 11-by-11 matrix of data taken directly from the permanent film record. Included in this final display are the contour lines themselves, horizontal and vertical scale lines whose intersections represent the data matrix from which the contour was obtained, and electronically generated characters that identify each contour level, the experiment run number, and the sensitivities at which the data was taken.

INPUT—The inputs to the Autocon system come directly from the magnetic-field measurement system. This system is able to gather vertical component d-c magnetic field data from three matrix data planes whose data point sizes are 11

by 11, 7 by 7, and 5 by 5. Magnetic field investigations are carried out on only one of these planes at a time, the particular one being selected to meet experiment requirements. While the Autocon system generates contour plots from all three data matrices, examples given here will be frequently in terms of the 5-by-5 matrix for simplicity.

The primary input to the Autocon system is a series of d-c voltages proportional to the magnetic field sensed at the matrix measurement points (Fig. 2A). These voltages are in the sequence obtained by scanning the matrix row-by-row, starting with the first row and reading the data points for each individual row from left to right. In addition, the Autocon system receives two synchronizing inputs from the measurement system. The first of these (Fig. 2B) consists of a single pulse at the beginning of each new matrix row. The second synchronizing input (Fig. 2C) consists of a single pulse for each reading whose trailing edge occurs at the valid part of the reading.

THEORY—An understanding of the basic theory of operation of the Autocon system is easily obtained by considering one particular method of manual contour construction. Figure 3A shows a sample matrix of data with the contour lines superimposed upon it. These contour lines are usually obtained by a process of linear interpolation between data points to determine the intersections of the contour lines with the rows and columns of the measurement matrix. The contour lines are then "faired in" between these points of intersection.

One method of linearly interpolating between each reading is to graphically construct a "profile" of the readings in a particular row or column. Figure 3B shows such a profile of the center row of the example matrix.

The Autocon system uses a variation of this plotting method. Contour-line intersections are determined for the rows only of the matrices. However, to determine column intersections and to provide greater resolution, a number of

"interpolated" rows are linearly constructed at selected locations between the actual rows of the matrix. This process can be expressed as a general formula: $(1 - k) A_{n-1} + kA_n$, $(1 - k) B_{n-1} + kB_n$, \dots , $(1 - k) E_{n-1} + kE_n$, where A_n , B_n , C_n , D_n and E_n represent the data points of the most recent row, n , and A_{n-1} , B_{n-1} , C_{n-1} , D_{n-1} , and E_{n-1} represent the data points of the earlier row, $n-1$. Quantity k is an "interpolation factor" and is defined as the ratio of the distance of the interpolated row from row $n-1$ divided by the total distance between row $n-1$ and row n . The number of interpolated rows can, of course, be any amount. The Autocon system itself forms 32 such interpolations between each pair of rows for the 11-by-11 matrix and 64 interpolations for the 7-by-7 and 5-by-5 matrices.

Thus, for each of these interpolated rows, a profile is constructed and the intersections of the contour lines with the axis of the interpolated row are determined as before. Therefore, two types of interpolation are required. The first is "row-to-row interpolation." The second is required to obtain the straight-line segment profiles of a particular interpolated row and is called "column-to-column interpolation."

The final process of determining the points of intersection of the contour lines with the axis of the interpolated row is termed "discrimination."

SYSTEM—A block diagram of the Autocon system is shown in Fig. 4. The three identical row storage units provide the analog storage necessary to accomplish row-to-row interpolation between two rows of data while a third is being read in. The basic system logic is as follows: An input commutator selects a particular row storage unit for data read-in. A commutator at the row storage unit outputs selects the other two units containing stored analog data from the previous two rows. Inasmuch as the system must generate 32 or 64 interpolated rows during one row read-in, the row storage read-out occurs at a rate 100 times faster than the read-in. The fast read-outs of the two storage units are then fed to the other system components which perform the function their design

implies. At the end of a row read-in, the row interpolation process between the previous two rows is also completed.

The entire process then repeats itself between the new row pair consisting of the most recently read-in row and the one that immediately preceded. Data read-in now takes place with the storage unit that previously held the contents of the oldest of the three rows. This procedure continues until each row of the matrix has been read in, read out, interpolated, discriminated and presented on the final display.

The principal component of the system that permits this approach to be taken is the row storage unit. The simplified diagram of Fig. 5 shows the three basic parts of the unit: the storage capacitors, the switching circuits, and the access logic. During read-in, the input to the unit is connected through the input commutator to the magnetic field measurement system. The scan pulse input to the four-stage binary counter is the same as the waveform shown in Fig. 2C with an extra pulse added at the beginning. At the start of read-in, the unit is in the reset position. The added first scan pulse takes the unit out of reset and activates the first NOR gate, resulting in -10 volts at the NOR gate output. This -10 volt signal in turn activates the associated diode switching circuit, grounding the capacitor in storage position 1. This causes the capacitor to charge up to the value of the first reading of the data input.

This process continues with successive scan pulses until the last scan pulse occurs, which returns the unit to the reset position. Except for the NOR gate inputs, circuits for all storage positions and the reset position is identical to that shown for storage position 2 in Fig. 5.

READ-OUT—During data read-out, the input to the row storage unit is left open by the input commutator. Internal logic of the system provides scan pulses to the binary counter which occur every millisecond, as contrasted with the 0.1-second duration per reading during read-in. This permits a number of identical fast scan read-outs to be generated during the time required for one read in.

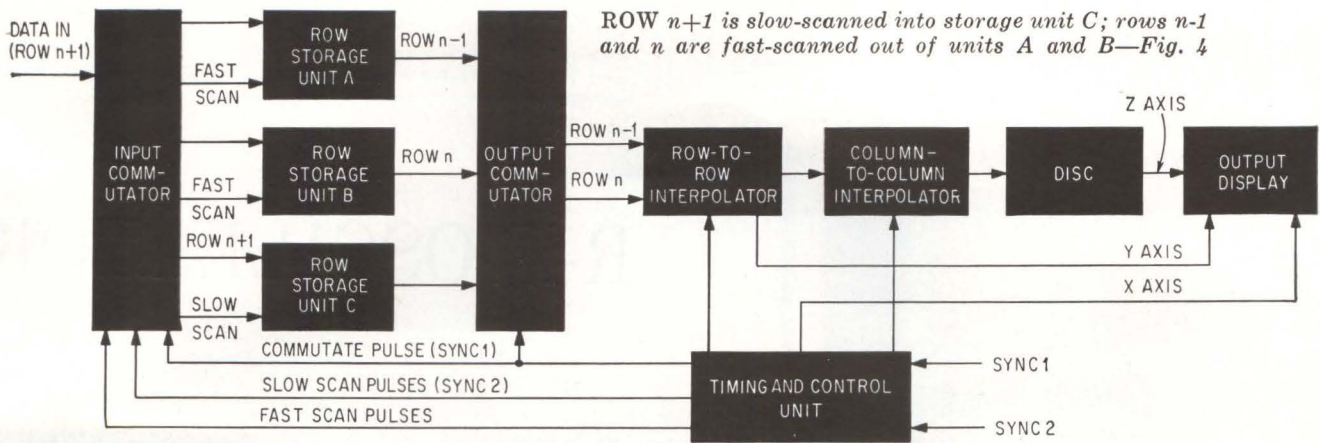
The read-out switching action is identical with the read-in. The output waveform, therefore, is the same as the input waveform (without noise) shown in Fig. 2A except that it occurs 100 times faster than the input.

The row-to-row interpolator consists of a six-stage binary counter, each stage of which switches in and out various portions of a passive resistance network. The binary counter receives a fast-scan count pulse at the end of each completed fast scan. During a 10-msec waiting period between fast scans, the appropriate relays switch to the next configuration dictated by the counter. This process continues for a total of 64 fast-scan read-outs from the two row-storage units. The unit performs exactly the function described by the general row-to-row interpolation formula mentioned previously, the interpolation factor, k , being changed in increments of $\frac{1}{64}$ for each fast scan. The passive network, however, causes the output to be attenuated by a factor of $\frac{1}{3}$.

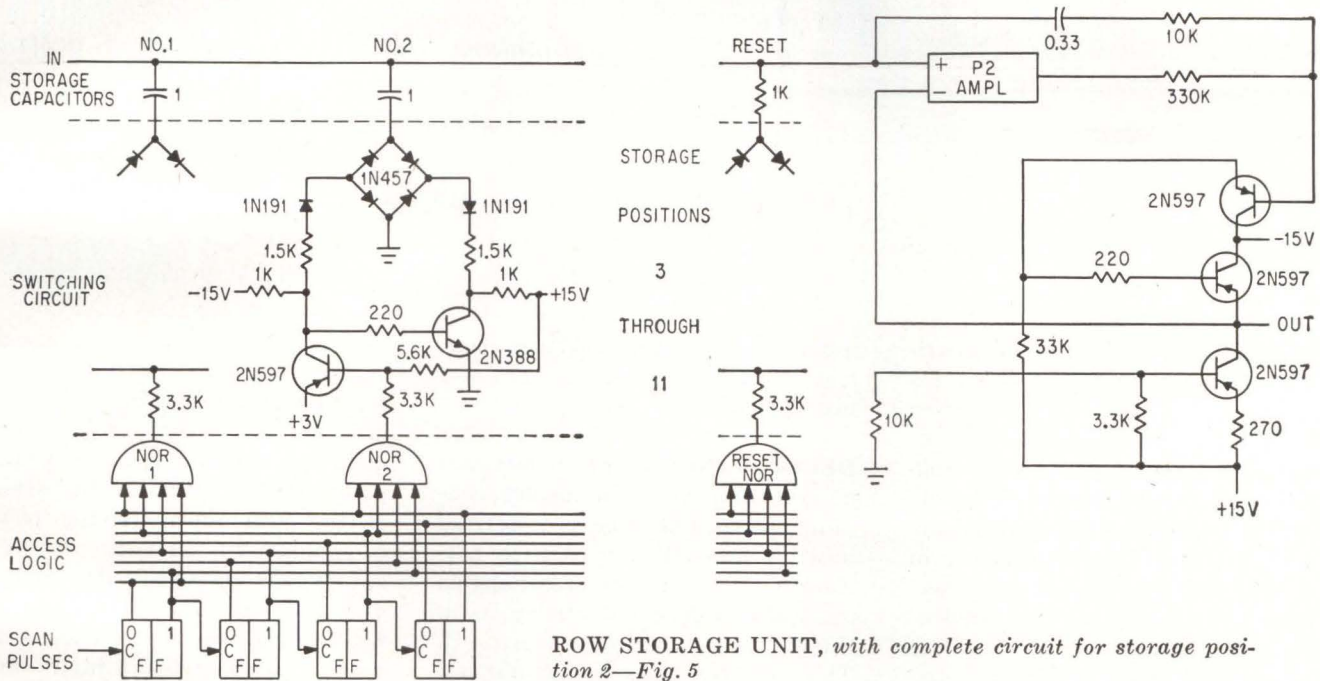
The 1.25 seconds required to read in a single row of data (Fig. 2A) limit the number of interpolations which can be carried out. Consequently, 64 interpolations for the 11-by-11 data matrix which requires 21 msec for each fast scan (11 readings at 1 msec per reading plus 10 msec wait time) cannot be achieved. In this case, the first stage of the counter is disabled, resulting in a 5-stage unit which performs only 32 row-to-row interpolations.

Similar circuits provide an analog voltage of the position of a given interpolated row between two data rows. In this case, two constant voltages are fed into a second resistive circuit. The output then becomes the desired voltage analog. Four additional stages are added to provide a voltage that can traverse the entire data matrix. As is indicated, this signal is used as a "y axis" to vertically position a crt trace.

The column-to-column interpolator makes use of the fact that the time spacing between readings is always constant at 1 msec per reading. The process of generating straight line segment profiles from data of this form can be described
$$\int (V_{i+1} - V_i) dt = (V_{i+1} - V_i)t + V_i$$



ROW $n+1$ is slow-scanned into storage unit C; rows $n-1$ and n are fast-scanned out of units A and B—Fig. 4



ROW STORAGE UNIT, with complete circuit for storage position 2—Fig. 5

where V_i equals the i th reading and V_{i+1} equals the i th plus one reading; that is, the reading which immediately follows.

Thus, the interpolator consists of a conventional analog integrator which is fed by a "difference generator" that performs the $V_{i+1} - V_i$ function.

The output of the column-to-column interpolator consists of a series of ramp-like profiles similar to that shown in Fig. 3B and is fed to eleven discriminator circuits in parallel. The voltage of the system at this point is ± 5 v full scale, corresponding to a full-scale reading on the magnetometers of ± 100 meter divisions. Contours were desired at 20-percent increments of full scale; hence the discriminators are individually set in one-volt increments from -5 to $+5$ volts, for a total of eleven reference voltages,

one for each discriminator.

The discriminator circuit is a voltage comparator that performs the function

$$V_{out} = \begin{cases} \text{a constant, for } V_k - \epsilon \leq V_{in} \leq V_k + \epsilon \\ 0, \text{ for all other } V_{in} \end{cases}$$

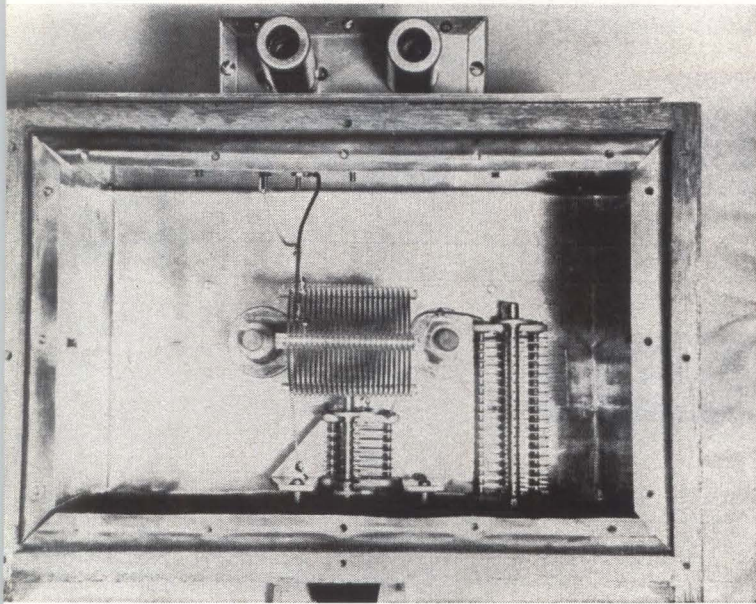
where V_k is the reference voltage and 2ϵ the small interval around V_k within which the discriminator operates.

OUTPUT—The eleven discriminator outputs are then combined into a single output of pulses which represent the intersections of the contour lines with the axis of the interpolated row (Fig. 3B). This output forms the major portion of the z axis for the output display. The operation of the discriminator circuit is such that pulse width varies with the slope of the input ramp voltage.

In addition, the output display receives an x-axis trigger that generates a linear sweep proportional to the fast-scan time base to horizontally position the crt trace.

The net result, as seen on the face of the crt, is a series of dashes moving in and out along a horizontal line that travels down the vertical axis of the crt. When viewed as a complete picture of all data rows, the lines drawn on the crt face by the moving dashes are the contour lines of the data matrix being read in. Pastoriza Electronics, Boston, worked on the analog portions of the Autocon circuit and R.M.S. Associates, of Mamaroneck, N. Y., provided the output display.

The opinions given here are those of the author, and are not to be construed as official views of the U. S. Navy.



COPPER shield enclosed in a mahogany box protects the tuned circuit from short-term ambient temperature changes and improves stability

R-F OSCILLATOR

Variable frequency oscillator stability is parameters. Here is a method of getting in conventional circuits

FREQUENCY stability of variable-frequency r-f vacuum-tube oscillators is easiest to maintain when the frequency of oscillation depends primarily upon a stable high-quality resonator. Requirements for obtaining resonator (*LC* circuit) stability, through the maintenance of high *Q* and mechanical and electrical dimensions, are well known; greatest difficulty lies in reducing undesirable effects from the electronic (or "driver" and output) portion of the oscillator due to variable phase shift, harmonic generation, thermal and capacitance changes, variable resonator loading and supply-voltage changes, etc.

Clapp, Lampkin, Franklin, and others, have achieved high frequency stability by isolating the resonator from the driver or load; still others have chosen various methods of compensation for changes external to the resonator or have evolved combinations of these approaches.

These oscillators have disadvantages in complexity, requirements for special components, critical adjustments, or limited tuning range. A slightly different approach, leaning heavily upon existing circuits in principal, permits construction of a relatively simple oscillator that is nearly independent of parameters external to the resonator. The circuit lends itself well to both trans-

mitter and receiver frequency control, and to various generators and instruments.

DECOUPLING—Common methods of resonator isolation involve coupling the vacuum tube as loosely as possible through a capacitive network, as in the Clapp circuit shown in schematic A or inductively, as in the Lampkin circuit of schematic B. This oscillator uses Lampkin's system of tapping tube circuits across a portion of the coil, but to further reduce resonator loading and the influence of external capacitances, it excites tube circuits from the resonator through a high impedance and feeds power back at a point of low impedance. The circuit in schematic C is an economical, workable, high-stability oscillator.

The circuit consists of a pair of cathode-followers in cascade, the

first being driven by the voltage appearing across a small portion of the resonator coil (which may be as little as 10 percent of the total) and the second, by the voltage across the r-f choke in the cathode of the first tube. Driving power is supplied to the resonator without phase shift by the cathode of the second tube. Both tubes are biased by R_1 and R_2 for class A operation. A tube with a high amplification factor will oscillate with least coupling to the coil. A dual triode, such as the 12AT7, performs.

The largest external capacitance shunted across any part of the frequency-determining *LC* circuit is the heater to cathode capacitance of the driver tube. The simplest method of minimizing this variable is to feed the heater current through a small bifilar r-f choke as shown in diagram C. The choke

R-F ISOLATIONIST

Oscillator stability is important in modern electronics equipment. Where price is no object, many sophisticated schemes permit the design of variable oscillators with crystal dependability.

In this article, the author shows how to get high vfo stability by isolating conventional circuits from external effects and controlling factors such as heater to cathode capacitance

Has Improved Stability

usually influenced by a number of circuit and external greater stability by carefully controlling design factors

By ELBERT ROBBERSON, Marine Electronics Consultant, Setauket, New York

should have a value that places the heater and cathode at the same r-f voltage above ground. When this is the case, changes in heater to cathode capacitance due to heater-current fluctuations have minor effect upon frequency.

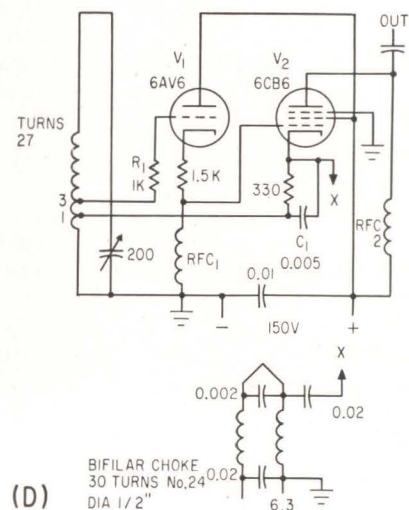
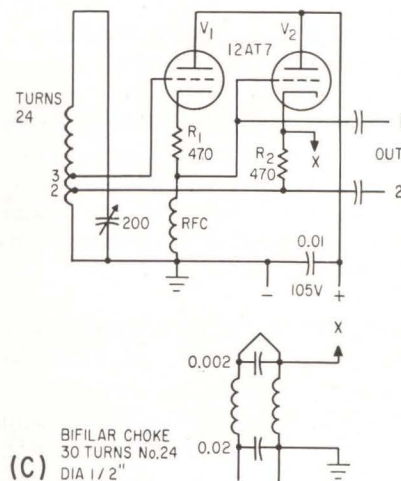
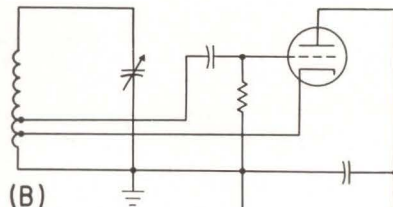
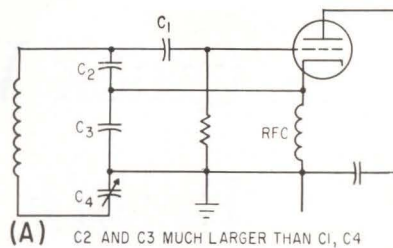
CIRCUIT—Output may be taken from points 1 or 2 without appreciable difference in operation. However, improved isolation of the output load from the oscillator is obtained by the circuit shown in circuit D.

This circuit is used as the variable r-f oscillator in a dual-conversion receiver, covering the range of 3.000 to 3.550 Mc. Output is uniform over this band and, with no temperature compensation or thermal shielding, stability is sufficient for adequate single-sideband reception after a 30-second warmup. In 15-minutes, the drift drops to less than one-cycle per minute; after 30-minutes of operation, frequency remains as constant as room temperature. Under reasonable room temperature and line-voltage conditions, drift is about one part-per-million over long periods of time.

The inductor in this particular oscillator consists of 27 turns of a 2 × 2-inch coil that is enclosed with bandset and tuning capacitors in a 6-inch-square aluminum box as shown in the photo. Additions to

the basic oscillator are minimal; one is grid resistor R_1 , that eliminates any tendency toward instability due to oscillation at both the frequency of the entire LC resonator and in a vhf mode corresponding to the number of coil turns at which the tube is tapped. The choice of grid resistor also permits fine adjustment of the amount of drive to the isolation tube when taps on the coil cannot easily be adjusted to fractional turns. The cathode-resistor bypass capacitor C_1 permits the cathode tap of V_2 to be more closely connected to the ground end of the coil. The plate r-f choke and coupling capacitor on V_2 provides electron-coupled output. Although voltage regulation was not found essential with the line-voltage fluctuations normal to the location where this oscillator is used, B voltage is regulated to allow for occasional extreme changes when machinery in the building is started. Tubes and associated parts are installed in a 2 × 2 × 5 inch aluminum box separated from the coil shield-box by small spacers to minimize heat conduction.

In other applications of the oscillator, greater freedom from ambient and adjacent-equipment temperature changes has been obtained by enclosing the coil-shield in foamed-plastic or porous wood insulation.



POPULAR variable-frequency oscillators include the Clapp circuit (A), and the Lampkin circuit (B). Author's oscillator is a modified Lampkin operating between 3.5 and 4 Mc (C). Refined version has highest stability (D)

In our issue of June 26, p 47, the author discussed the various ways to measure transistor beta (h_{FE}). Here he rounds off the job with a simple nomograph to convert to the desired quantities

Quick Way to Find Beta(h_{FE}), Alpha(h_{FB}), and h_{FC}

By RONALD M. MANN

Texas Instruments Inc.,
Dallas, Texas

AFTER BASE and collector currents have been obtained from test equipment, the accompanying nomograph quickly converts the measurements to beta, alpha and h_{FC} .

A straight line passing through base current and collector current gives transistor beta on the scale at right. The next two columns give alpha and the common collector or h_{FC} value.

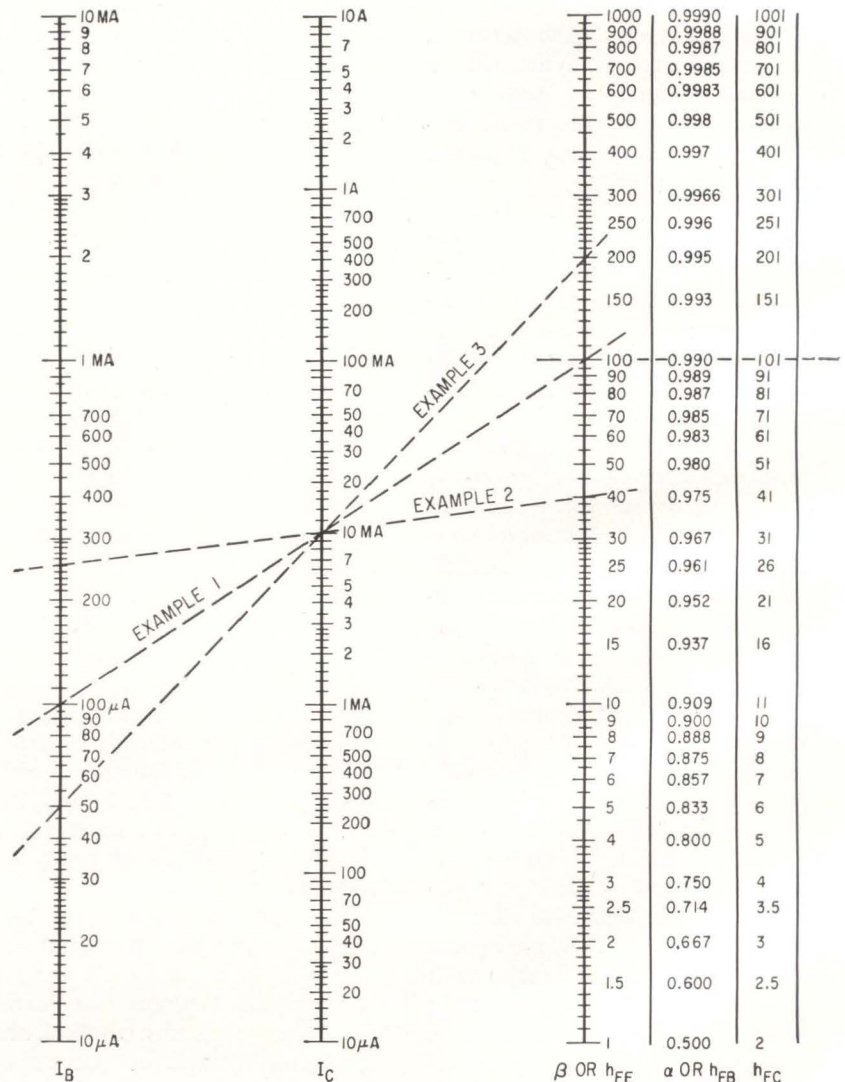
BETA CALCULATION — To measure beta for any transistor, set V_{CE} and I_C for conditions specified. For a 2N1305, for example, I_C can be set at 10 ma and held constant and base current (I_B) measured. If 100 microamp is obtained for I_B —a typical reading—a line from 100 μ a on the I_B scale through 10 ma on the I_C scale will intersect the beta scale at 100, alpha at 0.990, and h_{FC} at 101.

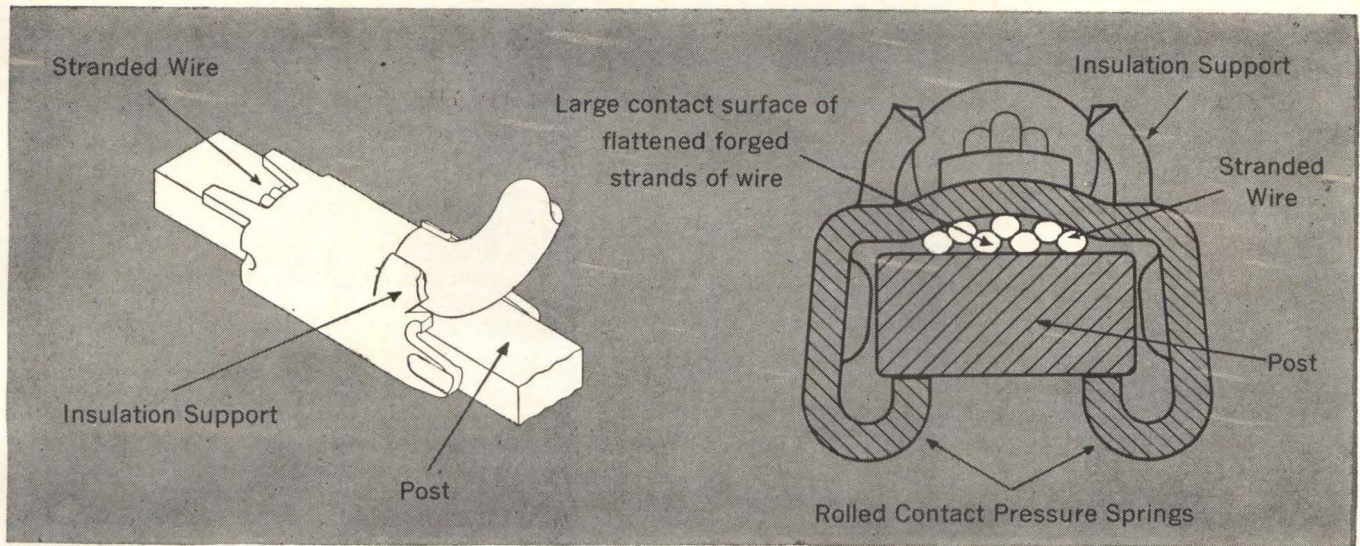
CIRCUIT DESIGN—One of the first steps in designing an amplifier stage is to choose the transistor and a desired collector current. If a 2N1305 were chosen and a collector current of 10 ma were dictated by circuit requirements, then, to obtain a worst-case condition of base current required, the minimum data sheet value for beta is selected. The minimum beta for a 2N1305 is 40 at 10 ma collector current. A line from 40 on the beta scale through the 10 ma point on the I_C scale gives an I_B of 250 microamp; this is the maximum

current needed to turn the transistor ON to 10 ma collector current.

Assume a switching application for the 2N1305 and determine if the combination of maximum leakage current and highest possible beta would turn the transistor ON.

Let the desired I_C be 10 ma. From the data sheet, maximum beta at 10 ma is 200. A line through the two values gives an I_B of 50 microamp, which is many times the maximum leakage current of the device. Leakage current therefore, would not be a problem.





See what's happened to stranded wire

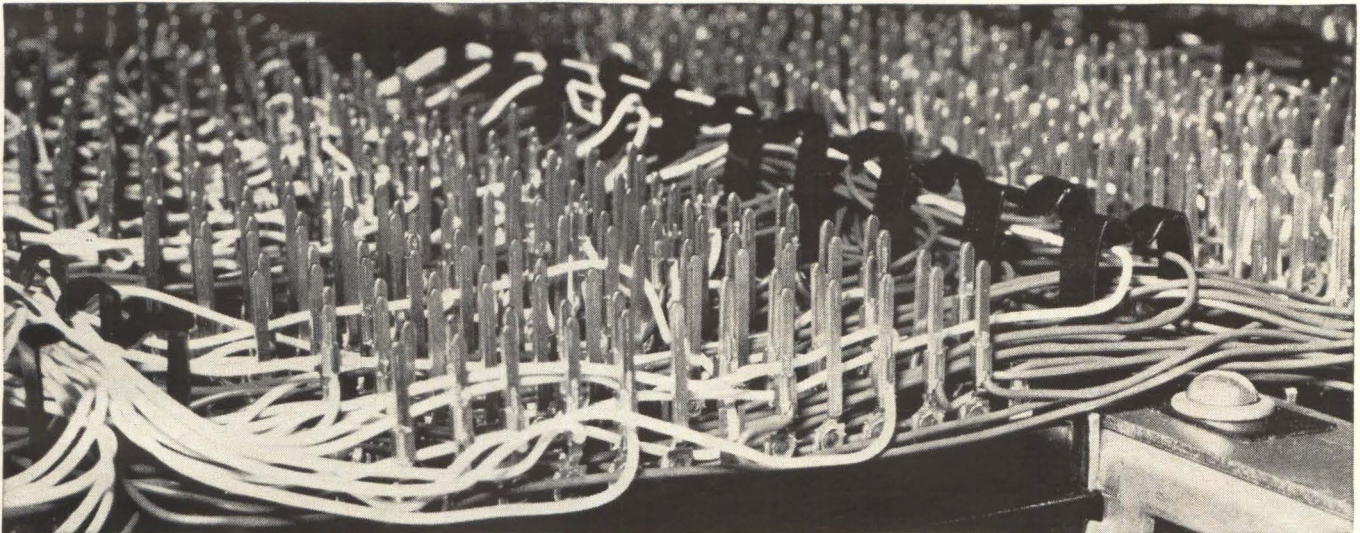


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position on the post without electrically disturbing others—and leaves the conductor ready to be used again, if necessary.

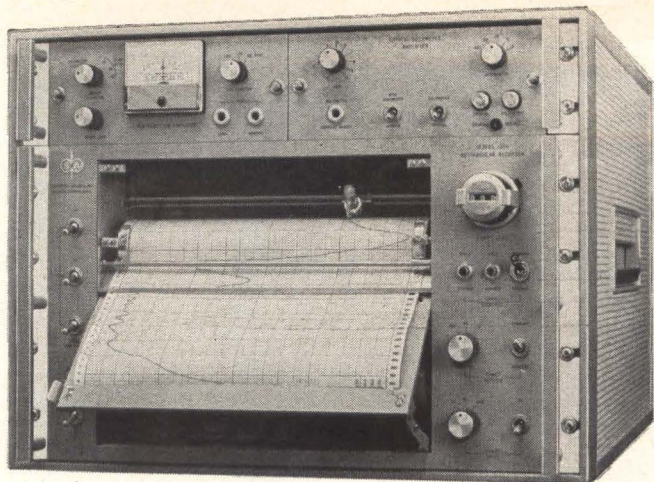
There's more . . . a lot more to tell about this new technique and how you can benefit in your point-to-point wiring program. Find out how you can achieve greater density, even modular design; gain higher production levels at lower applied costs; eliminate stocking various pre-cut wire lengths; and service with an ease unknown in other point-to-point wiring techniques. It's all in our booklet, TERMI-POINT Tools and Terminals For A New Point-To-Point Wiring Technique. Send for your copy today.

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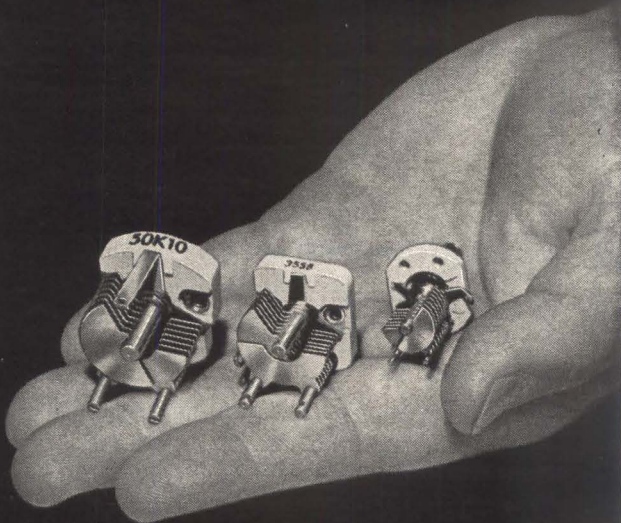
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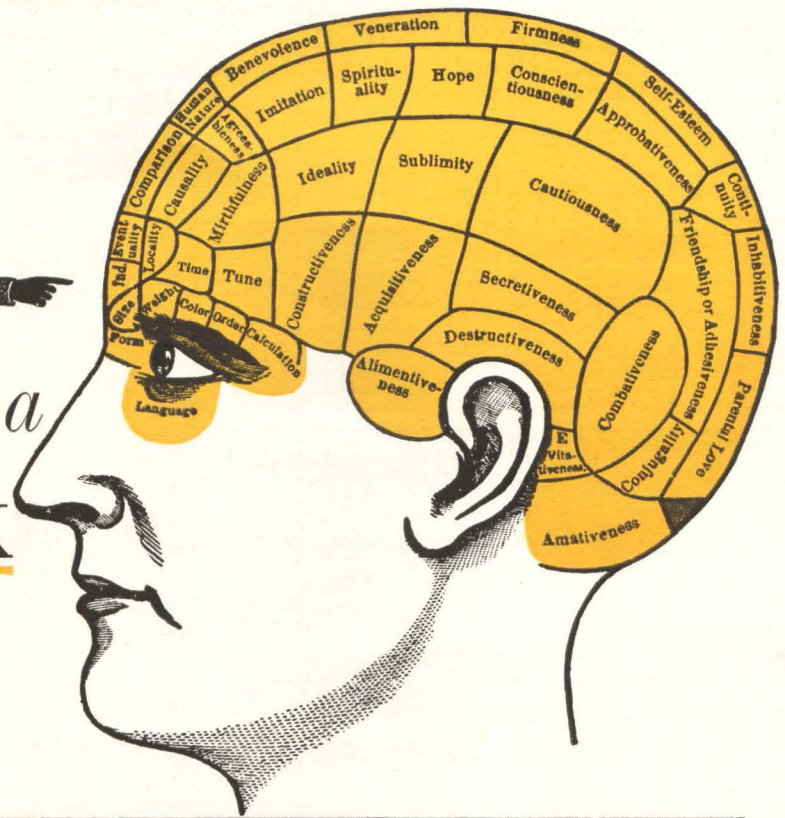


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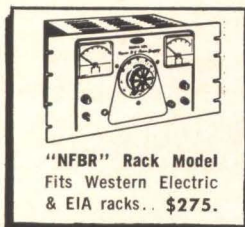
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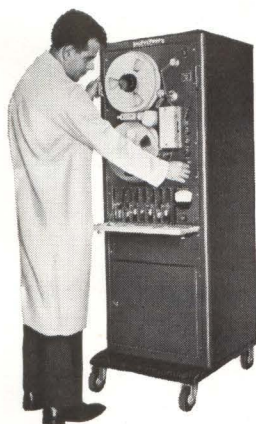
Today you may be working in microwaves. But on what project will you be working tomorrow? You *could* have read **electronics** this past year and kept abreast of, say, microwave technology. *There were 96 individual microwave articles between July, 1961 and June, 1962!*

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Basic system features include quickly interchanged, readily accessible printed circuit plug-in modules . . . flutter compensation by using one channel to compensate all others . . . alignment of all FM channels with built-in meter and selector switch, eliminating need for electronic counters . . . automatic squelch circuit . . . entire system in only 31" of rack panel space . . . packaging in either mobile console shown or portable cases for tape transport and electronics.

System price of \$7200 includes 7-channel tape transport, transfer chassis, playback preamplifiers, power supply and 7 channels of FM Record/Reproduce electronics, housed in metal mobile cabinet. All prices F.O.B. Waltham, Mass., and subject to change without notice.

Get the complete specifications on this new Tape System — as well as 3 new types of Sanborn Data Amplifiers, 17" Multi-Trace Scope and other related instrumentation — from your local Sanborn Industrial Sales-Engineering Representative. Ask him for your copy of the complete Industrial Catalog.

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Developing Radiation-Proof Space Equipment

Tape recorder for deep space missions is not affected by neutron beams

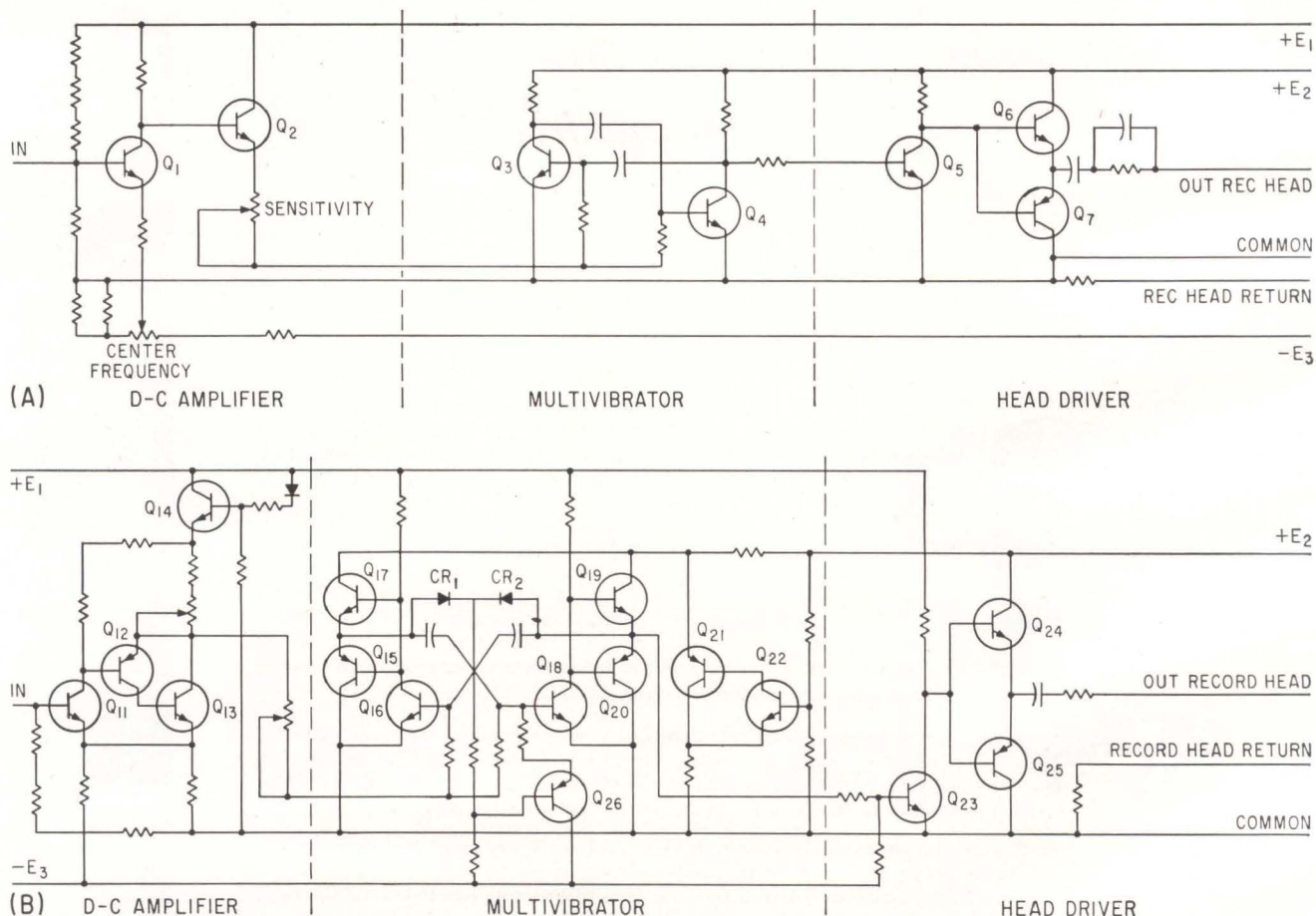
RADIATION PROOF systems and subsystems have lagged in development behind the considerable amount of research conducted into the effects of nuclear radiation on individual components and materials. Several novel considerations arise in developing a radiation-hardened piece of equipment:

Individual component parameter variations must be considered. Specifically in the case of transistors, this means that the H_{FE} parameter may change, under radiation, from say 200 to 5; the circuit must withstand such variation. The interaction of components within a circuit must be taken into account, as well as the interaction of circuits within a system.

Circuit design approaches are needed that minimize system level radiation effects, and yet do not

severely penalize system size, weight and power consumption.

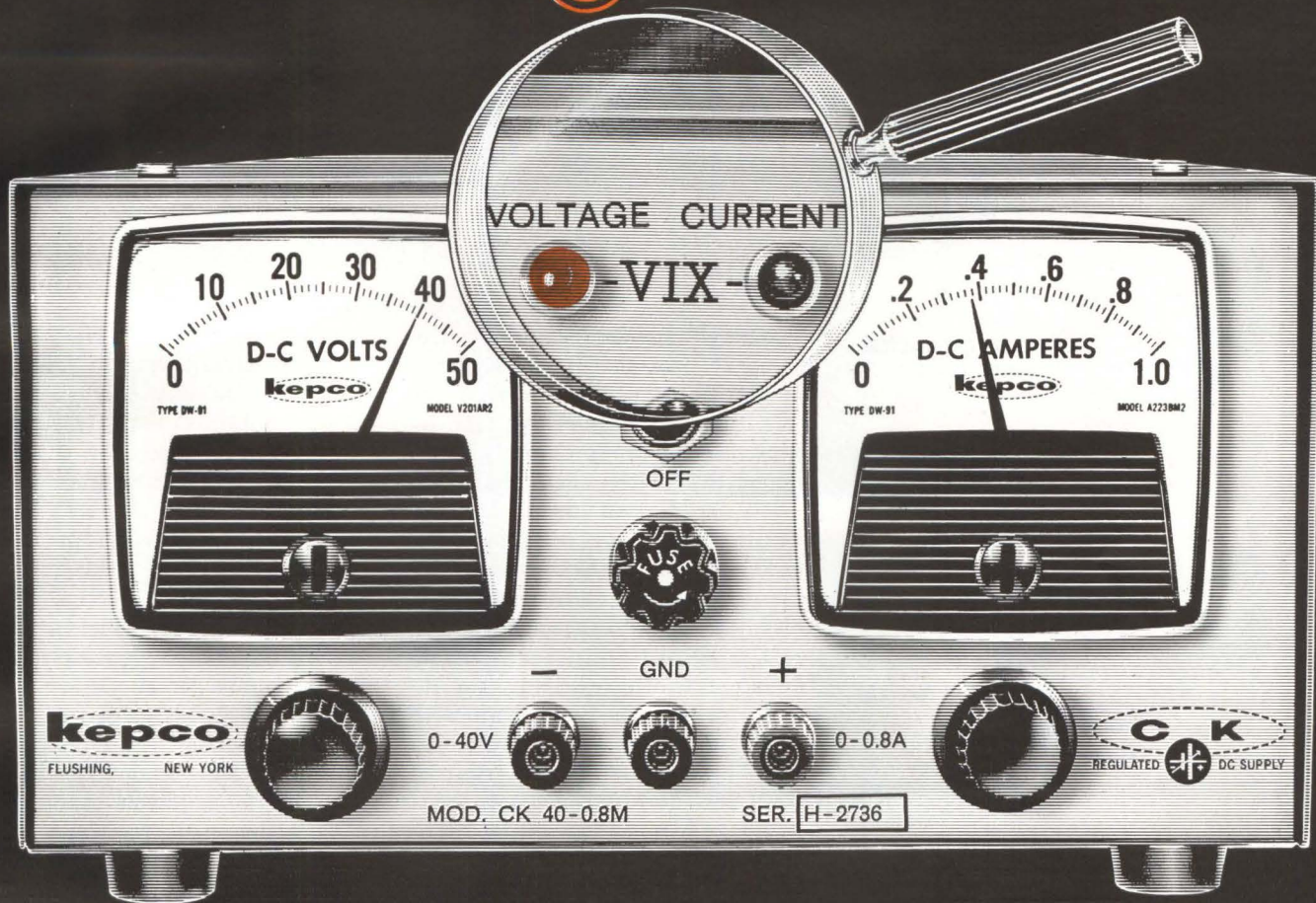
TAPE RECORDER—A radiation-hardened satellite tape recorder, has been developed by the Controls Division of Leach Corporation. It is capable of recording up to 220 minutes of d-c to 128-cps square-wave data on two channels, at 3.75 ips, readout at 48.75 ips. The radiation resistance goals were 10^{13} neutrons/cm²/year, or 10^8 carbon rads/year, or twenty times the



COMPARISON between standard satellite data tape recorder head drive circuit, (A), and its radiation-hardened counterpart for interplanetary use, (B), shows radiation-hardened circuit uses more transistors, but operates in spite of component parameter deterioration

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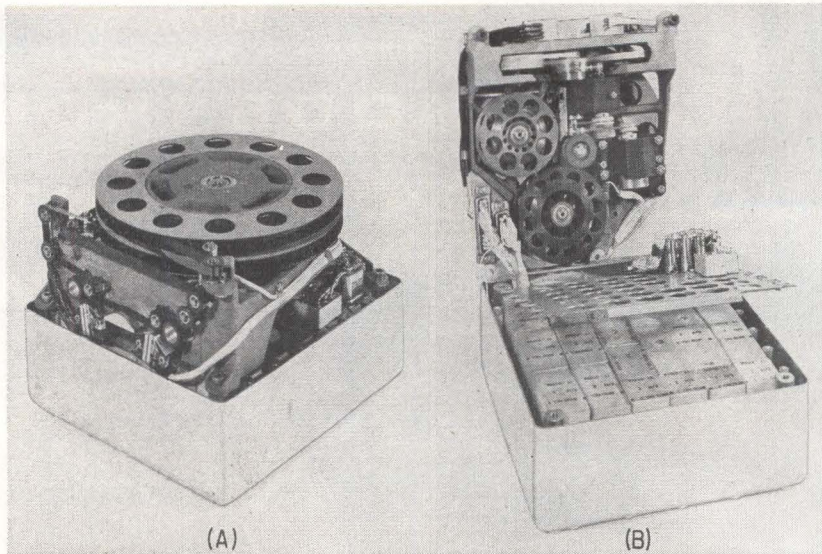
MODEL	OUTPUT	ACCURACY (% full scale)
SBI-7000	single pointer dial	$\pm 0.2\%$ to $\pm 0.5\%$
	linear dial, single pointer	$\pm 0.2\%$ to $\pm 0.5\%$ f.s. numerator
SBI-7070	dual pointer; coarse and 10:1 vernier	$\pm 0.1\%$
SBI-8000	single or dual pointer, counter-pointer	$\pm 0.1\%$ to $\pm 0.5\%$
SBI-7080	counter or counter-pointer	$\pm 0.1\%$ to $\pm 0.5\%$
SBI-7090	digital encoder	$\pm 0.1\%$
SBI-8010	1/8" dia. shaft	$\pm 0.1\%$ to $\pm 0.5\%$ with 15 oz. in. load
SBI-8020	0-999 decimal counter	$\pm 0.05\%$ to $\pm 0.1\%$
SBI-8050	pointer and subdial vernier	$\pm 0.05\%$ to $\pm 0.1\%$

Specifications are for typical production models.

For complete data request SFC-1



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HERMETICALLY sealed continuous tape recorder developed by Leach for deep space probe use is shown without cover, left; view at right shows underside of tape mechanism and modular electronic circuit section

anticipated space dosage requirements. It became evident early in the development program that the design goal could not be met by simply replacing previously used components with ones that had passed irradiation tests. Instead, circuits had to be designed that would operate in the face of component parameter variations caused by radiation; d-c beta variations as great as 20 to 1 are not uncommon. The pulse width regulator, for instance, was designed to operate with output transistors having a d-c beta of 4. Because the system required both a 28-v d-c/d-c converter and a 5-volt signal input capability, high-voltage power transistors were required; these have to have large base widths significantly limiting their radiation resistance.

RADIATION TESTING—The system was successfully radiation-tested first in breadboard form, then as a completed assembly, indicating that those circuits that had been completely tested with components having maximum variations expected after irradiation had no difficulty in meeting the radiation requirements.

CIRCUIT DESIGN—An example of radiation-proof circuit design is the 40-percent f-m record amplifier used in the recorder, compared here to a similar Leach satellite tape recorder circuit that was not radiation-hardened. Both circuits perform with p-a-m input data, have

similar center frequencies and drive similar record heads; their differences are due only to the nuclear radiation requirement. Both circuits can be broken into three main parts: d-c amplifier, multivibrator and head driver. The two circuits are compared in the diagram.

D-C AMPLIFIER—The d-c amplifier in the non-hardened circuit has a d-c input resistance above 100 kilohms if Q_1 has an H_{FE} of at least 130. As seen by the multivibrator, this stage has voltage gain of about two. In the radiation-hardened circuit, a d-c input resistance of 250 kilohms minimum is provided with a minimum H_{FE} of 5 to 10. Transistor Q_{14} compensates the V_{BE} change in Q_{11} over temperature and also increases voltage gain as H_{FE} decreases.

MULTIVIBRATOR—The multivibrator stage of the non-radiation-hardened system operates well as long as the H_{FE} of Q_4 and Q_3 remains over 140, and operates on a low enough voltage that V_{BE} of the transistors is not approached. For H_{FE} lower than 140, frequency becomes erratic, since the transistors no longer remain saturated. This happens when the highest input voltage is applied to the d-c amplifier, since this condition produces minimum voltage output.

The radiation-hardened circuit operates with H_{FE} variations from 5 to 200; extra transistors Q_{15} and

Q_{20} provide another H_{FE} term to reduce the required base current in the on-condition to Q_{16} and Q_{18} by the H_{FE} of the transistors. Rapid charging of the time-constant capacitors is accomplished by Q_{17} and Q_{19} ; these transistors also reduce the collector current switched by the complementary pair on each side of the multivibrator. Reliable starting is provided by Q_{20} in an OR circuit using diodes CR_1 and CR_2 . Switching transistors Q_{21} and Q_{22} compensate for temperature and the drop in H_{FE} due to radiation.

HEAD DRIVER—This stage is quite similar in both circuits, using two transistors in a complementary switch, and one transistor to isolate the multivibrator and provide gain for the complementary circuit.

The radiation-hardened circuit operates within one percent of bandwidth over a temperature range of -40 to $+85$ deg C, as H_{FE} drops from 200 to 5. Even with 16 transistors instead of 7, it consumes less total power than the non-hardened circuit. Even with random placement of individual transistors with an H_{FE} of 10, while other transistors had H_{FE} 's of 170 or more, the circuit operated within two percent of bandwidth. In practice all components may be expected to deteriorate roughly at the same rate.

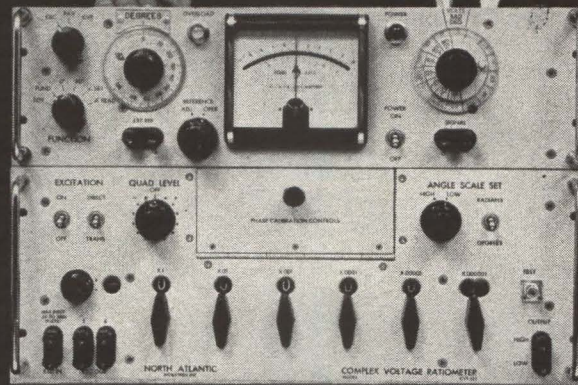
Nuclear Power Supply Unit Has No Moving Parts

THERMIONIC AUXILIARY reactor to develop electric power directly from atomic fuel without intermediate moving parts is subject of a \$65,000 research contract awarded to General Electric by Air Force Systems Command's Air Force Weapons Laboratory.

The unit will use a simple reactor made up of a number of doughnut shaped rings, divided into segments, containing small amounts of atomic fuel and thermionic converters. Power output will be adjustable by adding or subtracting rings, will be in 1,000 to 100,000-watt range, with specific weight of about 15 pounds per kilowatt in the larger sizes. Unit should operate continuously for 20,000 hours, or more than 800 days.

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Director of Marketing, North Atlantic Industries

how to measure ac ratios regardless of quadrature

North Atlantic's **Complex Voltage Ratiometer** is a completely integrated test set for measuring grounded 3 terminal networks. By providing self-calibrated quadrature injection, the Model CVR-551 permits calibrated meter readings of phase angle up to 30° or 300 milliradians full scale, and, in addition, provides direct readings of in-phase and quadrature voltages. As an added feature, the integral Phase Angle Voltmeter* and AC Ratio Box can be used independently. Abridged specifications follow:

In-Phase Ratio Range, R_I000000 to ± 1.111110 with full accuracy
Phase Angle Range, α	± 1.0 to ± 300 milliradians ± 0.1 to $\pm 30^\circ$ (in 6 calibrated ranges)
Frequency	Any specified frequency, 50 cps to 3KC
Input Ratio Error, R_I	$\pm (.001 + \frac{.0001}{R_I} + \delta \tan \alpha)$ % of reading
Phase Angle Error, α	$\pm .0003$ radians or $\pm .017^\circ$ (low ranges) $\pm 3\%$ full scale (high ranges)
Phase Angle Voltmeter* (independently used)	$\pm 2\%$ full scale 1 millivolt to 300 volts (in 12 calibrated ranges)
A.C. Ratio Box (independently used)	1 ppm terminal linearity .35f (300 volts max)

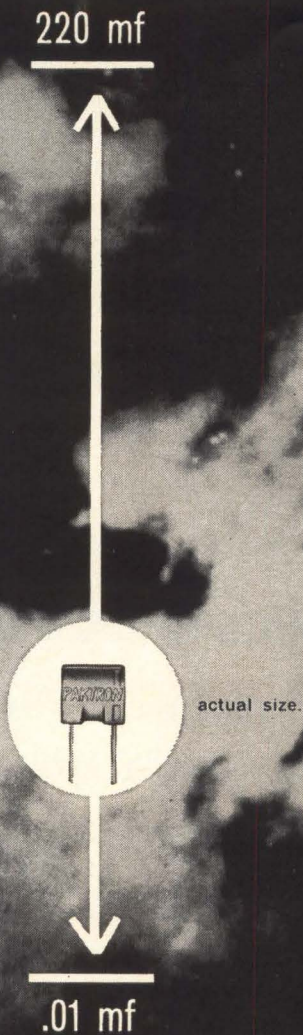
North Atlantic's CVR* line includes 2 and 3 frequency models. All models available with optional 10 ppm Ratio Box control of quadrature injection.

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FOOT IN DIAMETER and three feet long, "atomic heat engine" will convert a small reactor's atomic heat directly to electricity, operating in a manner analogous to thermionic diodes. The power converter shown here is a half-size mockup

decay, is converted into electricity in the device by boiling off or evaporating electrons from tungsten emitting plates, resembling vacuum thermionic diode operation. The electrons jump across a gap to produce an electric current. The gap between the emitting and collecting points is filled with cesium gas which neutralizes and removes the space charge barrier, and also improves cathode and anode efficiency.

Intended for use in spacecraft, the power unit operates at temperatures comparable to those in vacuum tubes; excess heat is to be radiated into space through the outer surface. The system eliminates cooling fluids and radiators.

Doppler Measures Helicopter Speeds

LONDON—A new c-w doppler system designed by Marconi for helicopter applications provides measurements of position and negative, horizontal and vertical velocities essential for hover control to an accuracy of better than one percent.

Simultaneously, the system measures ground speed, drift angle and aircraft height. Due to the high rate of change of velocity in helicopter maneuvers, a fixed planar antenna array incorporating separate transmit and receive waveguide systems is used in place of the normal moving antenna.

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PNP & NPN

STAR* TRANSISTORS



(TO-5)
2N2904
2N2905

(TO-18)
2N2906
2N2907



(TO-5)
2N2218
2N2219

(TO-18)
2N2221
2N2222

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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	—	$h_{FE} @ 0.1 mA$ 2N2904, 2N2906 2N2218, 2N2221 2N2905, 2N2907 2N2219, 2N2222	20	—
35	—	$h_{FE} @ 1 mA$ 2N2904, 2N2906 2N2218, 2N2221 2N2905, 2N2907 2N2219, 2N2222	35	—
25	—	$h_{FE} @ 10 mA$ 2N2904, 2N2906 2N2218, 2N2221 2N2905, 2N2907 2N2219, 2N2222	25	—
50	—	$h_{FE} @ 150 mA$ 2N2904, 2N2906 2N2218, 2N2221 2N2905, 2N2907 2N2219, 2N2222	50	—
35	—	$h_{FE} @ 500 mA$ 2N2904, 2N2906 2N2218, 2N2221 2N2905, 2N2907 2N2219, 2N2222	35	—
75	—	C_{cb}	75	—
40	120	C_{ib}	40	120
100	300	f_T	100	300
20	—		20	—
30	—		30	—
—	8 pf		—	8 pf
—	30 pf		—	20 pf
200 mc	—		250 mc	—

*Trademark of Motorola Inc.

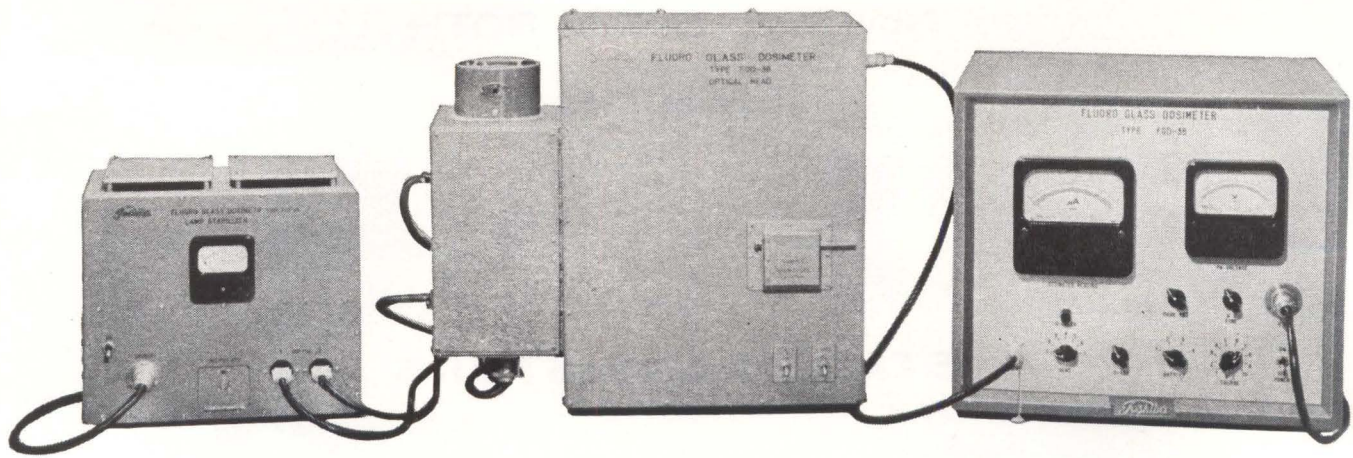


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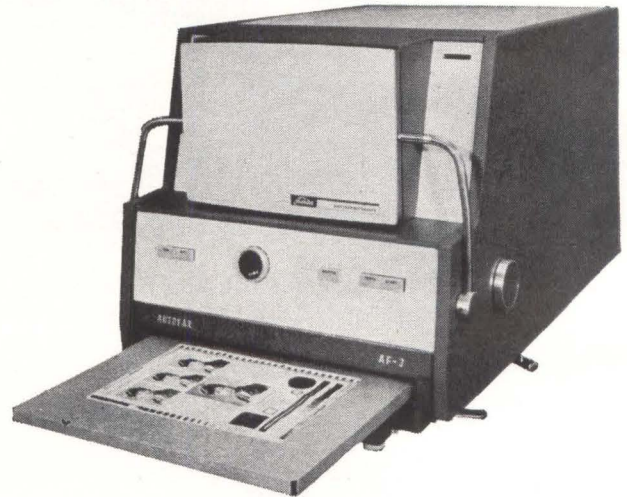


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MICRO MODULE CRYSTALS (GLASS)

SHOWN ACTUAL SIZE

This vacuum sealed, hard glass crystal unit was developed and designed for use with the RCA micromodule wafer shown above. Available in frequencies ranging from 10 mc to 200 mc, the type MM crystal provides electronic miniaturization programs with a reliable evacuated crystal enclosure of excellent stability.



M-1 (HC-6/U)

METAL ENCASED STANDARD SIZE AND MINIATURE CRYSTAL UNITS

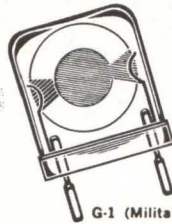
SHOWN ACTUAL SIZE

The crystals that made the name of McCoy a synonym for quality. Metal encased, HC-6/U size is available in frequencies from 500.0 kc to 200.00 mc.



M-21 (HC-25/U)
M-20 (HC-18/U)

Fills the need for miniature crystals in frequencies from 2.5 mc to 200.0 mc. Meets specs MIL-C-3098C and ARINC No. 401.

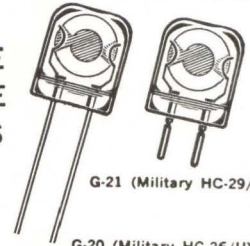


G-1 (Military HC-27/U)

ALL GLASS STANDARD SIZE AND MINIATURE CRYSTAL UNITS

SHOWN ACTUAL SIZE

This vacuum sealed, hard glass crystal unit possesses all of the quality features for which the McCoy M-1 is so famous. It has long term frequency stability five times better than the conventional metal types. Available in frequencies from 1000 kc to 200 mc.



G-21 (Military HC-29/U)
G-20 (Military HC-26/U)

This vacuum sealed, hard glass crystal unit meets the new CR-73/U and CR-74/U specifications. It has long term frequency stability five times better than the conventional metal type. Available in frequencies from 5000 kc to 200 mc.

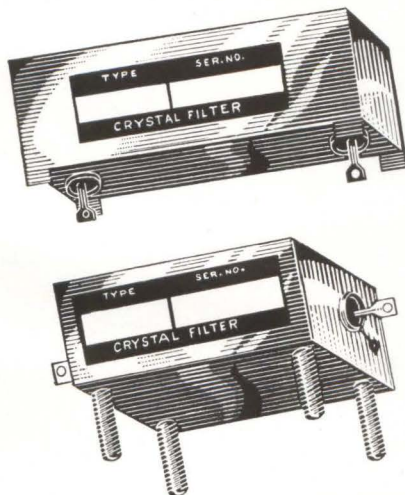
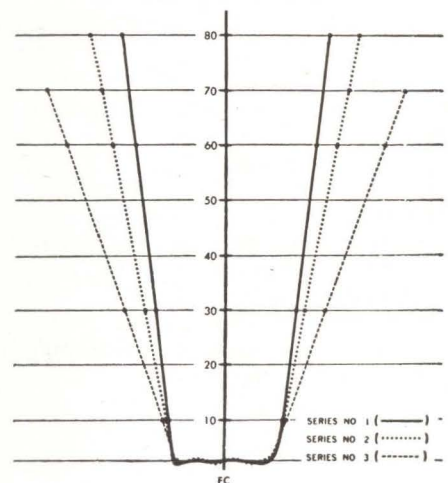
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The following chart shows bandwidths available in specific frequency ranges (expressed as % of center frequency).

Frequency	B.W.
1 mc to 30 mc	.01% to 4.0%
30 mc to 75 mc	.001% to .04%
up to 125 mc	up to .01%

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Probes Can Take Nuclear Blasts

Nuclear rocket programs call for new series of hardened instruments

SOME SUCCESSFUL tests have been recorded for radiation-resistant transducers that are planned to take as high as 10^{22} fast neutrons per cm^2 at energy levels well in excess of 1 Mev, according to spokesmen of Giannini Controls Corp. These units are still under development.

Giannini will unwrap their radiation-resistant instrumentation at special showing during WESCON week August 20 to 23.

Present impetus for radiation-resistant probes is result of nuclear rocket programs. Table gives details of some of the latest transducers that the Navy has tested for nuclear environments. Several transducer firms are involved.

Giannini is now supplying pressure and acceleration transducers to Aerojet for the Nerva program (nuclear engine for rocket vehicle

application). Nerva should show step-up activity this year, and Rift (reactor in flight tests) earlier next year. These and other proposed nuclear vehicles will require temperature, pressure, acceleration and velocity transducers.

Giannini began developing radiation-resistant components about three years ago. Company will soon market a limited selection of high and low pressure transducers, accelerometers, temperature probes and an accelerating switch. These components meet present

STATUS OF TRANSDUCERS TESTED IN RADIATION ENVIRONMENT

Component	Neutron Dose fast neutrons/ cm^2	Gamma Dose photons/ cm^2 or erg/gm	Temperature		Status ^a
			C	F	
Accelerometer, a-c output; air damped	3.6×10^{16} E = 1 Mev	1×10^{18} photons/ cm^2 (Cobalt 60) E = average 1 Mev 4.5×10^{10} ergs/gm E = ave. 1 Mev	-54 C to 300 C	-65 F to 572 F	Successfully tested at approximate design levels
Accelerometer, potentiometer output gas damped; pendulous type, high natural frequency	7×10^{16} E > 1 Mev	1.8×10^{17} photons/ cm^2 E = ave. 1 Mev 8.1×10^9 erg/gm E = ave. 1 Mev	-18 C to 149 C	8 F to 300 F	Test in progress
Integrating switch transducer integrates acceleration over a given detection range	10^{17} E > 1 Mev	2.22×10^{18} photons/ cm^2 E = ave. 1 M 10^{11} ergs/gm ave. E = 1 Mev	24 C	75 F	Successfully tested at approximate design levels
Pressure transducer Bourdon tube potentiometric type; range 0-100 psi min to 0-1,000 psi max; suitable for absolute, differential or gage	5×10^{15} E > 1 Mev	8.89×10^{17} photons/ cm^2 E = ave. 1 Mev 4×10^{10} ergs/gm E = ave. 1 Mev	25 C	78 F	Successfully tested at approximate design levels
Pressure transducer, capsule pressure element, potentiometric; range, 0-15 min to 0-150 max, suitable for absolute, differential or gage	5×10^{15} E > 1 Mev	8.89×10^{17} photons/ cm^2 E = ave. 1 Mev 4×10^{10} ergs/gm E = ave. 1 Mev	25 C to 300 C	78 F to 572 F	Test unsuccessful. Cause not determined but thought to have been in external wiring; failure not credited to instrument
Pressure transducer Bourdon tube potentiometric; range, 0-300 psia min to 0-10,000 psia max	10^{17} E > 1 Mev	2.22×10^{18} photons/ cm^2 E = ave. 1 Mev 10^{11} ergs/gm E = ave. 1 Mev	300 C	572 F	Test in progress

^a—tests conducted at Naval Aviation Reactor Facility, Ft. Worth

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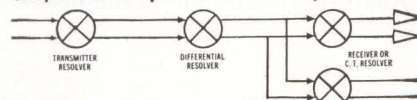
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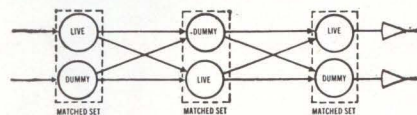
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Simple Follow-Up Chains—No Compensation



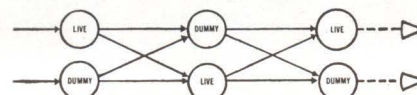
The above chain uses simple production tolerances on the components and represents a four wire data transmission system used in servo work. Variations of the above system can utilize several receivers if necessary by proper impedance matching.

Simple Amplifierless Chains With Matched Sets of Live and Dummy Resolvers



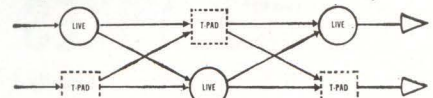
The above concept can be supplied as matched sets of live and dummy resolvers either as independent components or built into a single integral case. Matched sets can be constructed that will be all the same for a system or matched sets for different impedance levels (e. g. matched set #1, set #2, set #3, etc.). No compensation resistor, thermistor or capacitor is used in the above concept.

Intermediate Chains With Interchangeable Components—Some Compensation



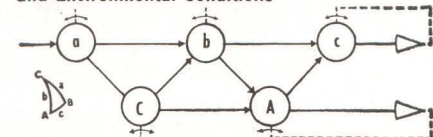
In the system above only one electrical type is utilized for both dummy and live resolver. All live resolvers are interchangeable with any other live resolver and any dummy resolver is interchangeable with any other dummy resolver. Units are compensated for constancy of transformation ratio and phase shift over temperature as well as unit to unit. No capacitors are used in the above system to reduce phase shifts.

Completely Compensated Interchangeable Amplifierless Chains With Thermal Stability



The illustrated system employs the use of completely compensated resolvers. These units are compensated for T.R. and phase shift over temperature with a characteristic impedance concept. T-Pads are shown which are utilized with this system but dummy type transformer units completely compensated will yield better system accuracy and symmetry. The above system is frequency sensitive due to the use of timing capacitors.

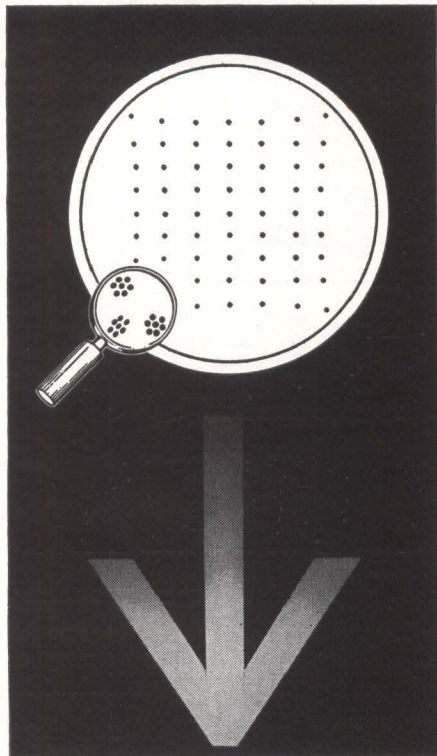
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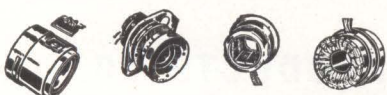
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requirements for nuclear environments, spokesmen say.

HARDWARE—Military specifications for nuclear environment instrumentation usually call for hardware that can take fast neutron intensities of 10^{15-17} per sq cm at energy levels greater than 1 Mev, and gamma radiation of 10^{17-18} photons per sq cm at average intensity of 1 Mev, according to Joseph Smith, chief engineer at Giannini's Transducer Division, Duarte, California.

Some materials used by company in its radiation-resistant components include stainless 303, 347, 410, aluminum, ceramics, polystyrene, lava, and boron-free glass.

When turned out in production quantities, radiation-resistant components should cost approximately 10 percent more than comparable non-radiation hardened components. But significant production is at least several years away, Giannini says.

Chief market for radiation-resistant instrumentation appears to be for nuclear space programs. Healthy production of components

for these systems will have to wait until nuclear rockets reach hardware stage.

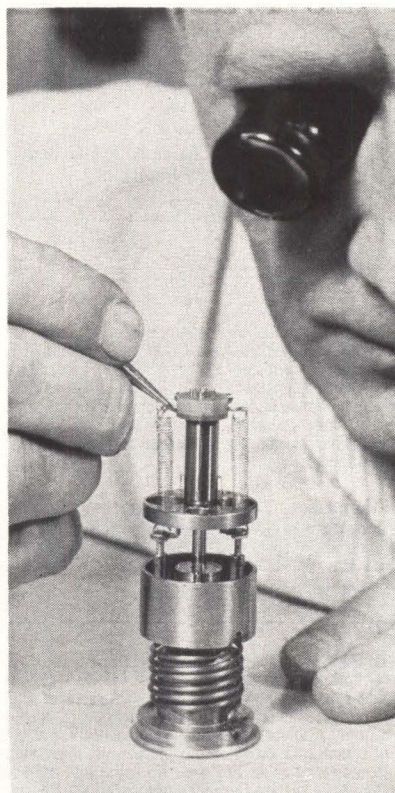
Smith cited problems involved in making probes for nuclear systems. He analyzed two comparable transducers: one radiation hardened, the second not radiation resistant. Design and function of the two units were the same. Modifications in materials were necessary. Although in some components it is sometimes necessary to alter the functional design. Smith says the bulk of alpha and beta particles is usually filtered out by instrument casing.

One of Giannini's radiation-hardened absolute pressure transducers uses a Bourdon tube element. The non-radiation hardened equivalent would fail within 3 to 4 hours in a nuclear environment. For nuclear systems, the silicon oil damping fluid was eliminated. Under radiation this would become butter-like in consistency. The Teflon insulation on the hook up wire was replaced with boron-free glass braid. Teflon would break down under bombardment. Only boron-free glass is used throughout. Boron contamination makes glass brittle and could crack, losing vacuum. All plastics in coil form are replaced by ceramic. The pot is space wound, enamel insulation is kept from breaking and causing short.

PARAMETERS — These material modifications change the transducer's parameters. Resistance to vibration is reduced from 75 g's at 2,000 cycles, to 20 g's at 2,000 cycles. Resolution of the transducer changes from 0.25 percent to 0.40 percent, and hysteresis changes from 0.50 percent to 0.80 percent. Other parameters remain the same.

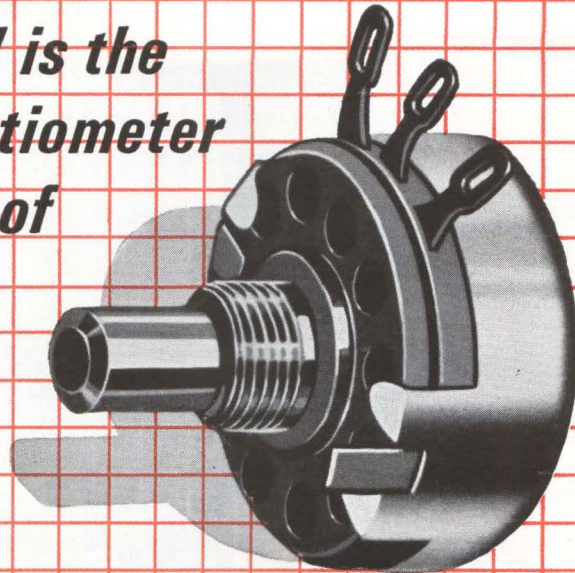
The materials know-how involves detailed knowledge of the response of specific quantities of selected materials to varying radiation levels and exposure time. Extensive reactor test time is necessary to establish untoward effects.

Materials with high cross-sections of reaction are of little value, including such metals as manganese and magnesium alloys. The use of elements with high atomic numbers, such as gold, silver and



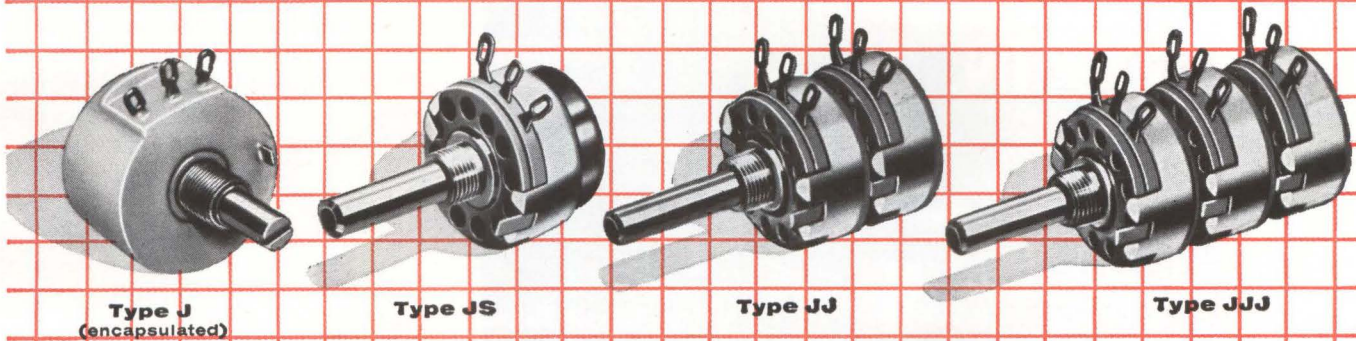
AXIAL accelerometer is assembled prior to test at radiation levels of 1.5×10^{16} fast neutrons/cm² (Giannini)

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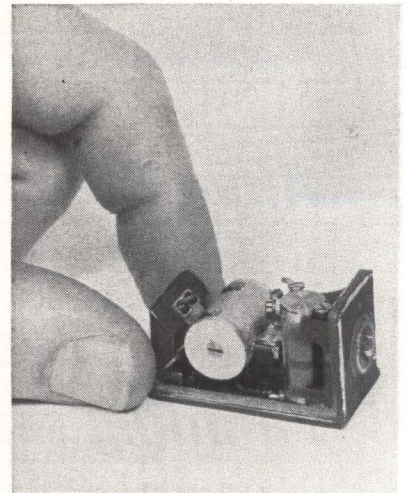


3.4

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RADIATION-hardened, gas-damped, pendulous accelerometer is now being evaluated for nuclear rocket (Giannini)

platinum, is held to a minimum.

Some materials can take neutron and electron dosages, but may be quite susceptible to gamma radiation. Reactions are not always straightforward. Under radiation, some metals become stronger, and their elastic limits are increased. Or their tensile and compressional limits may be changed. Furthermore, though the functional properties of a material may not be affected by radiation dosage, it may acquire a high degree of radioactivity, making repair or replacement difficult or impossible.

Of those components which are used in radiation-resistant design, transistors and diodes remain the biggest headache, Smith says. Much development work is still to be done to increase reliability of these components.

Giannini doesn't see a sizable market for radiation-resistant instrumentation in stationary nuclear power plants. Here weight penalties from use of thermal and radiation shielding are not at all critical.

Boron Nitride Meets Space-Age Needs

STRIP of boron nitride deflects 10,000 volts, see photo. Micron-thin deposits can adhere to metal substrate without loss of useful properties. Dielectric constant is 4.4. Loss factors are low. According to

LIKE HAPPY ENDINGS?

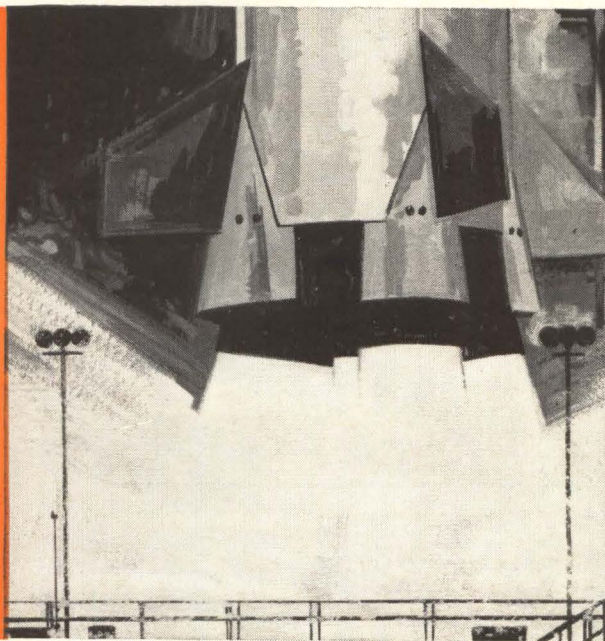
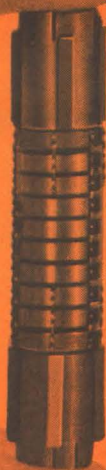
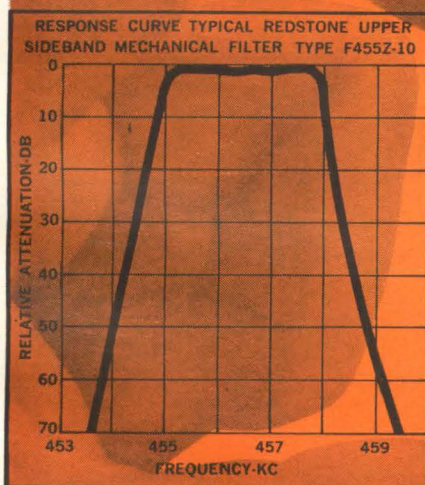
Here's one from the Saturn program about a new telemetry technique — and a Collins Mechanical Filter.

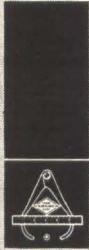
The Saturn missile brought up a tough telemetry question: How to provide adequate transmission capacity for wideband data such as vibration measurements. □ Bandwidth capacity of available telemetry systems was too low. A new kind of transmission, using single sideband modulation of an AM subcarrier and providing 10 times the equivalent bandwidth, had been proposed. □ Filters were key factors in the system's operation. In addition to the extreme selectivity demanded of the bandpass filters, they had to be tough enough to operate under 20 G's vibration from 50 cps to 200 cps without modulation and spurious signals. They had to withstand a 100 G shock. And they would have to reduce insertion loss and passband ripple to new minimums. □ Because of these rigorous requirements, the logical answer was a Collins Mechanical Filter, but with significant state-of-the-art improvements. For the transducer, Collins developed a new ferrite material, increasing the mechanical strength of the filter and reducing insertion loss. Another benefit of the ferrite transducer was a 3 db to 1 db drop in passband ripple. □ Specs for frequency stability of the filters under radical temperature changes sounded impossible at first. But with new heat treatment techniques for the nickel-alloy discs that are the filter's resonant elements drift was held to within 1 ppm/C° temperature change. □ This Collins Mechanical Filter, packaged in less than 1/3 cubic inch, was a key to development of this new SS-FM telemetry technique at NASA's George Marshall Space Flight Center. The new technique has been invaluable in transmitting the avalanche of vibration data and other wideband information through two successful Saturn launchings. □ More than 100 standard mechanical filters for the 60 kc to 600 kc range are in the Collins catalog today, and if one of these won't do, the industry's *only* mechanical filter design staff is ready to help you with special designs. Call Collins today or write for Data File 202. □ COLLINS RADIO COMPANY • Components Division,

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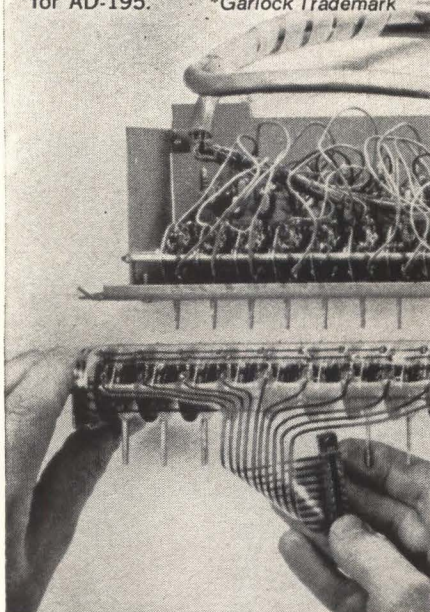




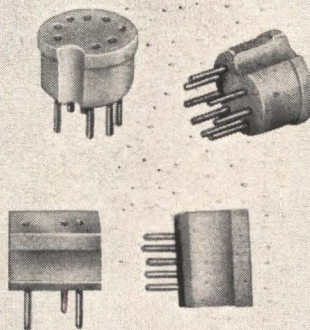
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Pressure Transducers Picked for Gemini

A NEW LANDING system, employing a Rogallo-type paraglider, is planned for the Gemini spacecraft. Inflation of the paraglider will be controlled by Fairchild TP-175 transducers. Important airspeed computation during the 25 to 75 knot glide descent will be provided by a Fairchild TP-350 airspeed transducer. Unit has pressure range of 0 to 0.236 psi.

A Fairchild TP-175 pressure transducer will monitor the Orbital Attitude and Maneuvering System. Pressurization of the Gemini radar will be monitored by a Fairchild TP-126 transducer. Orbital rendezvous will be attempted with an Agena B target vehicle.

High-Speed Oscilloscopes with General-Purpose Utility

TEKTRONIX TYPE 580A SERIES

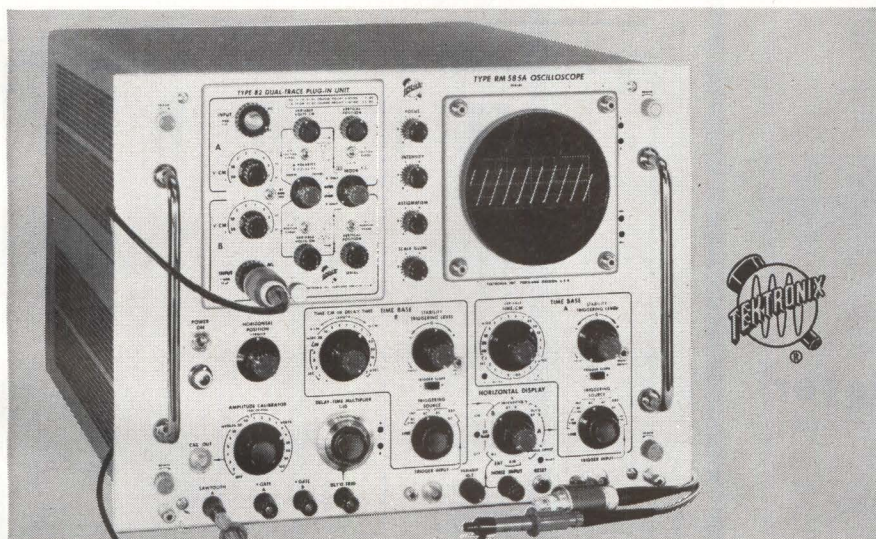
Used with a Type 82 dual-trace unit, a Type 580A-Series Oscilloscope offers new measurement convenience for high-sensitivity, wide-band, dual-trace applications.

Here are some of the features:

- **DUAL-TRACE OPERATION** with 4 operating modes and independent controls for each channel—for individual attenuation, positioning, inversion, and ac or dc coupling as desired.
- **PASSBAND** typically DC-TO-85 MC (3-db down) at 100 mv/cm (12-db down at 150 Mc), and typically DC-TO-80 MC (3-db down) at 10 mv/cm.
- **CALIBRATED SENSITIVITY** in 8 steps from 100 mv/cm to 20 v/cm, and in 10X Amplifier Mode, from 10 mv/cm to 2 v/cm, variable between steps.
- **INTERNAL AND EXTERNAL TRIGGERING** to 150 Mc.
- **SWEEP RANGE** from 10 nsec/cm to 2 sec/cm.
- **SINGLE-SWEEP PHOTOGRAPHY** at 10 nsec/cm.
- **BRIGHT, HIGH-RESOLUTION DISPLAY** with small spot size.
- **CONVENTIONAL PASSIVE PROBES** for convenience.

PLUS

- **COMPATIBILITY WITH 17 LETTER-SERIES PLUG-INS** to permit differential, multi-trace, sampling, other laboratory applications—when used with Type 81 adapter.



Supplied small size passive probes provide high input impedance characteristics. Probes increase input R to 10 megohms and decrease input C to approximately 7 pf.

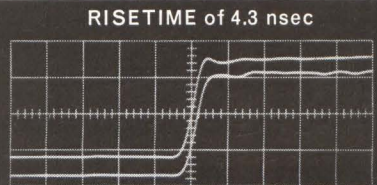
Risetime (of supplied probe, plug-in unit, oscilloscope) at over-all sensitivity of 0.1 v/cm is approximately 5¼ nsec.

Type RM585A Oscilloscope, illus. . . \$1825
Dimensions—14" high, 19" wide,
22¾" deep.
Weight—81 pounds, approx.

Type 585A Oscilloscope. . . \$1725
Dimensions—16½" high, 13½" wide,
23¾" deep.
Weight—74 pounds, approx.

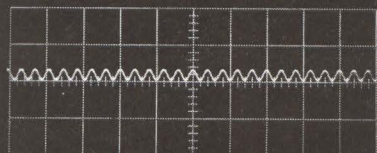
Types RM585A and 585A have 2 modes of calibrated sweep delay—either triggered or conventional—ranging from 1 µsec to 10 seconds.

Type 581A Oscilloscope. . . \$1425
No sweep-delay capabilities . . . but other features similar to Type 585A Oscilloscope.



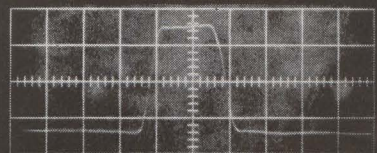
Dual-trace display of input and output pulses of a transistor amplifier at 10 nsec/cm—with lower trace delayed 1 nsec by amplifier under observation. Type 585A/82 combination can display time coincidence between input channels with no measurable difference at 10 nsec/cm.

HIGH-FREQUENCY SYNC to 250 Mc



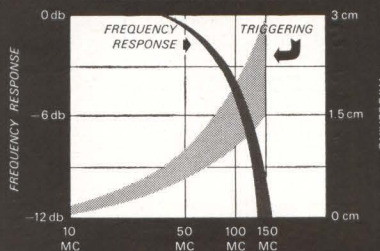
Display of a 250 Mc Sine Wave at 10 nsec/cm, using the H. F. Sync Mode. In this mode, the Type 585A/82 combination can display steady signals from 5 Mc to 250 Mc, with a fraction of a cm of displayed amplitude.

SINGLE SHOT at 10 nsec/cm



Display of a fast transient at 10 nsec/cm, using single-sweep operation and the Tektronix C-19 Camera. Single-sweep feature of the Type 585A/82 combination facilitates photographic recording of most one-shot phenomena.

TRIGGERING to 150 Mc



Typical frequency response and internal triggering characteristics of Type 585A/82 combination—showing minimum number of cm necessary for triggering.

PLUG-IN UNITS

Type 82 Dual-Trace Unit \$ 650
(includes 2 passive probes)

Type 86 Single-Trace Unit \$ 350
(includes 1 passive probe . . . has single channel operation.)

ADAPTER Enhances Versatility

The Type 81 Adapter allows insertion of 17 Tektronix letter-series plug-ins. Band-width (up to 30 Mc) and Sensitivity depend upon plug-in used.

Type 81 Plug-In Adapter \$ 135

Oscilloscope Prices without plug-in units.

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

Tektronix, Inc. / P. O. BOX 500 • BEAVERTON, OREGON / (Area Code 503) Mitchell 4-0161 • TWX: 503-291-6805 •
Telex: 036-691 • Cable: TEKTRONIX • OVERSEAS DISTRIBUTORS IN 27 COUNTRIES

Tektronix Field Offices are located in principal cities throughout the United States. Please consult your Telephone Directory.

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

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CIRCLE 85 ON READER SERVICE CARD

New Ceramic Component for New Electronics

Murata

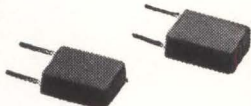
Ceramic Filter

Advanced 455KC
IF Filter



model CF
(actual size)

model BF
(actual size)

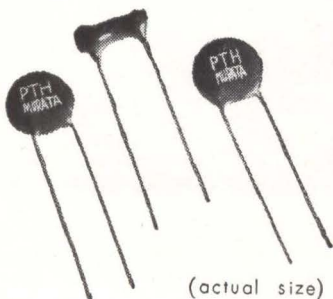


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Piezoelectric
Tuning Fork



(actual size)



(actual size)

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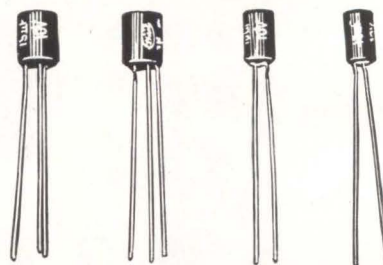
- Eliminates weld-joint failures
- Unaffected by salt-spray tests
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Nichicon research and experience assures remarkable strength and stability in all its capacitors. Nichicon produces a complete line of capacitors designed for every need.



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CABLE ADDRESS : CAPACITOR KYOTO

NOW AVAILABLE FROM STOCK!



FM-AM SIGNAL GENERATOR

TYPE 202-H

RADIO FREQUENCY CHARACTERISTICS

RF RANGE: 54-216 MC
 RF ACCURACY: $\pm 0.5\%$
 RF OUTPUT RANGE:
 0.1 μv to 0.2 volts*
 *Across external 50 ohm load at panel jack
 ACCURACY:
 $\pm 10\%$, 0.1 μv to 50 K μv
 $\pm 20\%$, 50 K μv to 0.2 volts
 AUTO LEVEL SET:
 Holds RF monitor meter to "red line" over band
 IMPEDANCE: 50 ohms
 VSWR: < 1.2

SPECIFICATIONS:

AMPLITUDE MODULATION CHARACTERISTICS

AM RANGE:
 Internal: 0-50%
 External: 0-100%
 AM ACCURACY:
 $\pm 10\%$ at 30% and 50% AM
 AM DISTORTION:
 $< 5\%$ at 30% $< 20\%$ at 100%
 $< 8\%$ at 50%
 AM FIDELITY:
 ± 1 db, 30 cps to 200 KC

FREQUENCY MODULATION CHARACTERISTICS

FM RANGE:
 Internal: 0-250 KC in 4 ranges
 External: 0-250 KC in 4 ranges
 FM ACCURACY: $\pm 5\%$ of full-scale*
 *For sine-wave
 FM DISTORTION:
 $< 0.5\%$ at 75 KC (100 MC and 400 cps modulation only)
 $< 1\%$ at 75 KC (54-216 MC)
 $< 10\%$ at 240 KC (54-216 MC)
 FM FIDELITY:
 ± 1 db, 5 cps to 200 KC
 SIGNAL-TO-NOISE RATIO:
 > 60 db below 10 KC

PULSE MODULATION CHARACTERISTICS

PM SOURCE: External
 PM RISE TIME: < 0.25 μsec
 PM DECAY TIME: < 0.8 μsec

MODULATING OSCILLATOR CHARACTERISTICS

OSC FREQUENCY:
 50 cps 7.5 KC 1000 cps 15 KC
 400 cps 10 KC 3000 cps 25 KC
 OSC ACCURACY: $\pm 5\%$
 OSC DISTORTION: $< 0.5\%$

PHYSICAL CHARACTERISTICS

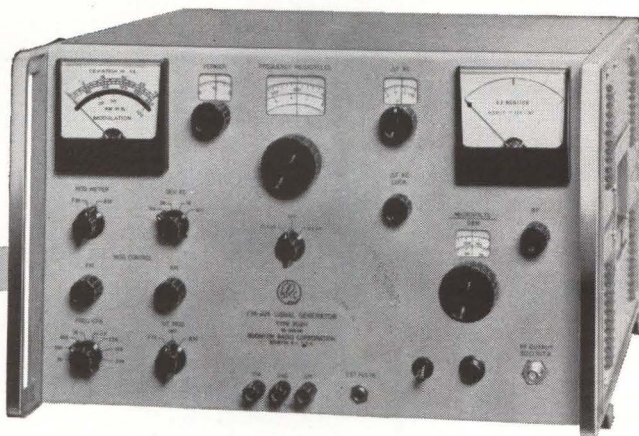
MOUNTING: Cabinet for bench use; readily adaptable for 19" rack
 FINISH: Gray engraved panel; green cabinet (other finishes available on special order)
 DIMENSIONS:
 Height: 10 $\frac{3}{4}$ " Width: 16 $\frac{3}{4}$ " Depth: 18 $\frac{3}{4}$ "

POWER REQUIREMENTS

202-H: 105-125/210-250 volts, 50-60 cps, 100 watts

PRICE — 202-H: \$1365.00

F.O.B. Rockaway, N. J.



The Type 202-H FM-AM Signal Generator covers the frequency range from 54 to 216 MC and is designed for the testing and calibration of FM receiving systems in the areas of broadcast FM, VHF-TV, mobile, and general communications. The generator consists of a three-stage RF unit, together with a modulating oscillator and power supply, all housed in a single cabinet which may be adapted for rack mounting.

The RF unit consists of a variable oscillator, a reactance tube modulator, a doubler, and an output stage. The modulator is specially designed for minimum distortion and operated in conjunction with the electronic vernier to provide incremental changes in RF output frequency as small as 1 KC. The RF output is fed through a precision, waveguide-below-cutoff variable attenuator; automatic RF level set is incorporated which maintains "red line" on the RF monitor meter over the entire band. The entire RF unit is shock-mounted for minimum microphonism.

An internal audio oscillator provides a choice of eight frequencies which may be used for either FM or AM modulation. A modulation meter indicates either FM deviation or % AM and is calibrated for sine-wave modulation.

A completely solid-state power supply furnishes all necessary operating voltages and may be switched for inputs of either 105-125 or 210-250 volts, 50-60 cps.

Model 202-J is also available for the 215-260 MC telemetering band.

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Micro-Packaging for Microelectronics

Two Wescon papers update high-density module fabrication

TWO APPROACHES to micro-miniature-circuit packaging are being presented at Wescon.

One technique, to be reported by W. H. Ayer and T. E. Kirchner, of Sippican Corp., uses welding to achieve assembly densities of 50 to 60 standard integrated circuits per cubic inch.

The other technique, to be described by E. M. Davis, W. E. Harding and R. S. Schwartz, of IBM's Component division, uses solder balls and a solder-immersion process to join active components to passive components on

a ceramic substrate, rather than compressive bonding.

WELDING—Ayer and Kirchner discuss several techniques for integrated circuit interconnections, including matrix film layers, photoetched circuit boards and chemically etched nickel-Mylar layers.

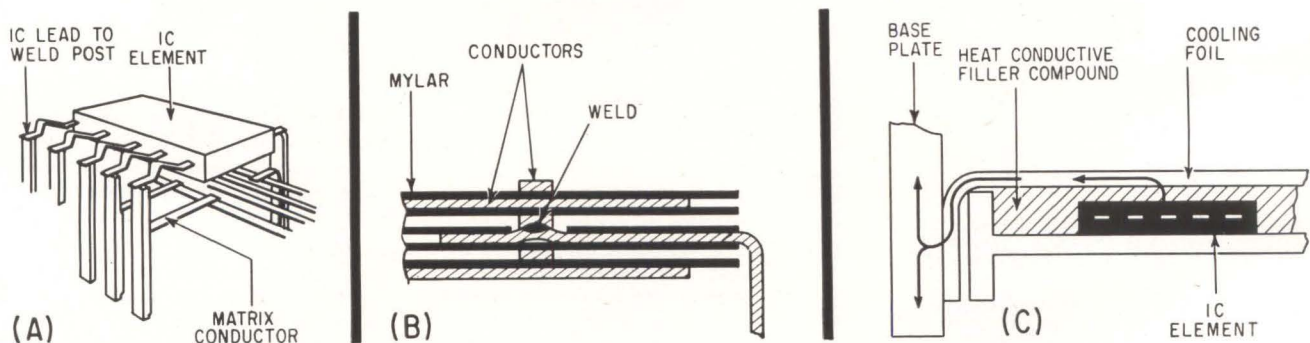
In the latter method, nickel sheet is etched to provide circuit paths and tabbed for interconnection to weld posts for any cross-through welds and for connections to terminal pins. This technique, they report, is readily adaptable to the high-density thermal-structural design approach employed by Sippican. A compressive-beam type of structure results.

The weld posts (Fig. 1) are

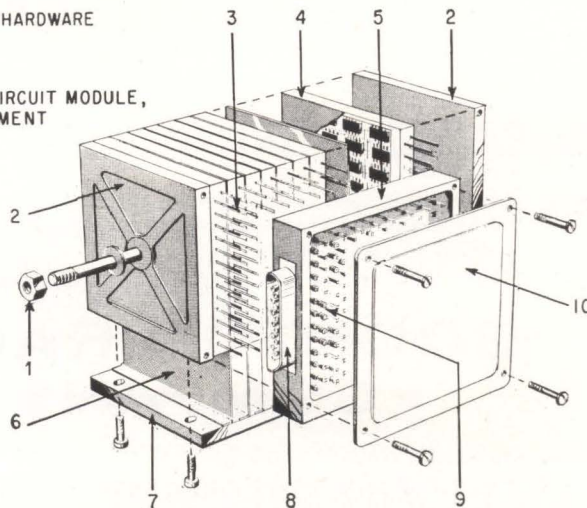
fabricated in a comb form, stamped from 10-mil hard nickel. After the etched nickel-Mylar layers are welded to the posts as shown the entire assembly is encapsulated with the post ends left exposed.

The weld-post concept, according to Ayer and Kirchner, lends itself to automation and provides an orderly and easily reproducible method for interconnecting integrated circuits and wiring layers. All the integrated circuits in an assembly can be located in one exterior plane for easy access and replacement.


The weld posts are positioned in an assembly fixture that also serves as the encapsulating mold. Interconnecting wiring layers, power planes and shielding layers are positioned over the posts. Welds are



1. TENSION BOLT AND HARDWARE
2. CLAMPING PLATE
3. TERMINAL PINS
4. CUTAWAY VIEW OF CIRCUIT MODULE, SHOWING ARRANGEMENT OF IC ELEMENTS
5. WIRING MODULE
6. COOLING FOILS
7. BASE PLATE
8. INPUT / OUTPUT CONNECTOR
9. WIRE WRAP
10. COVER PLATE



TYPICAL SYSTEM assembly by Sippican welding techniques to package 272 integrated circuits in 9.3 cu in. Specially located nickel weld posts are welded to matrix conductors (A) (B). Metallic foils permit heat conduction from the encapsulant (C)—Fig. 1



...a TV set
operating under water?

That's not water...that's FREON[®] fluorocarbon solvent

And we'll bet this is the cleanest electronic system at the Wescon show! Because it will play, while completely immersed, for the duration of the show.

This demonstration is possible because "Freon" is an excellent dielectric and a selective cleaning agent. There is no arcing, even in the TV set's high-voltage circuitry. "Freon" thoroughly removes dust, grease, lint and chips from components or entire assemblies—without harm to delicate parts, finishes, elastomers or insulation. "Freon" has a uniquely low surface tension that lets it penetrate minute openings. There it wets and displaces soils other solvents cannot.

And "Freon" is *safe* for production people because it's nonexplosive and virtually nontoxic. It leaves no residue and can easily be recovered for use over and over again for maximum economy.

So don't miss this one at Wescon! If you're not going to the show, write for complete technical information, and, if you wish, the services of a Du Pont technical man. Du Pont Company, 2420E-8 Nemours Building, Wilmington 98, Delaware.

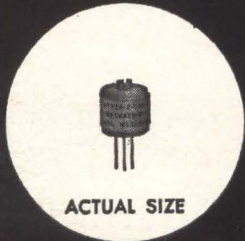
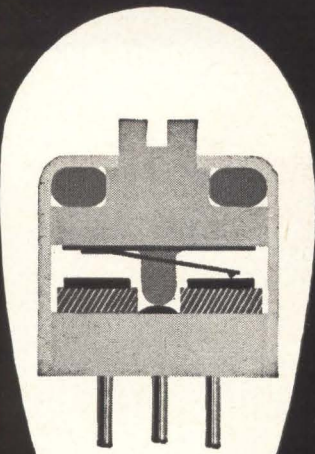
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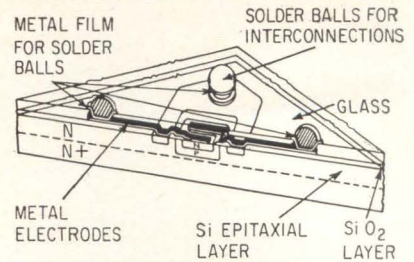
made to conductors in the layers and to wire-wrap terminal pins.

After this wiring subassembly is encapsulated with epoxy, integrated-circuit leads are welded to the upper ends of the posts. The area occupied by the integrated circuits is filled with thermally conductive compound to transfer heat to metal foils.

TYPICAL ASSEMBLY—One assembly using these techniques is shown in Fig. 1. It consists of eight encapsulated modules, electrically connected by wire-wrap terminals to a single wiring module that includes the system input/output connector.

The modules are assembled as a compressive beam by a single tension bolt and two clamping plates. The clamping plates have tapped inserts so the assembly can be mounted to a base plate. Metallic foils, brazed to the base plate, are inserted between the modules to conduct heat from the encapsulant. A cover plate protects the wire-wrapped connectors.

The assembly contains 272 integrated circuits and occupies a total volume of 9.3 cu in, and may



SEMICONDUCTOR CHIP sits on solder lands in IBM module. Flux holds chip in position before soldering. Chip is connected to module by its solder ball—Fig. 2

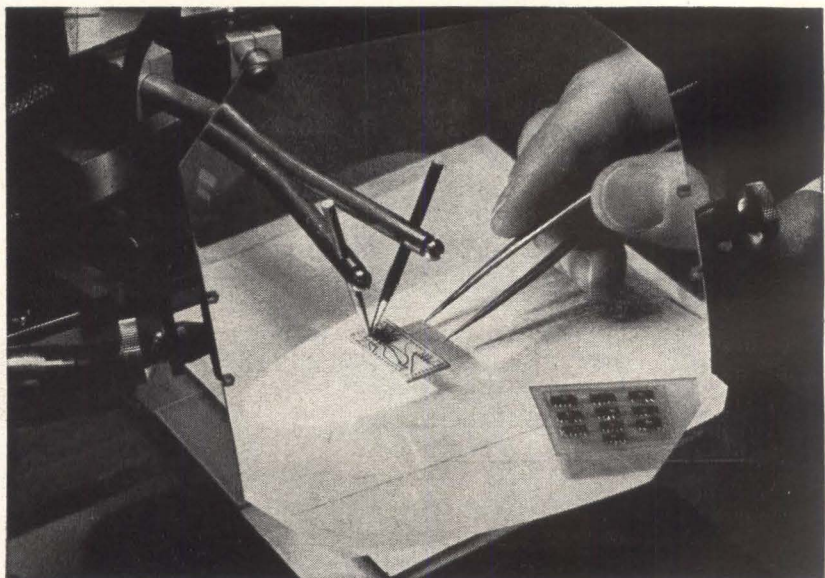
be reduced or enlarged.

Each of the 8 modules has 34 integrated circuits arranged in a 5×7 -element array with 5 rows of weld posts, 6 signal wiring matrices, 3 power and shielding planes, wire-wrap terminal pins and the encapsulating materials.

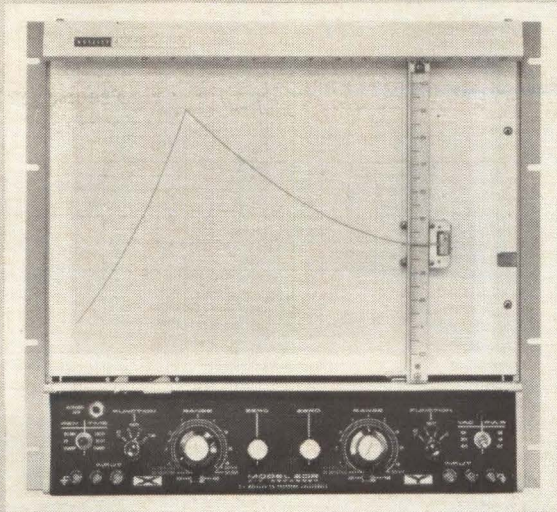
SOLDERING—Salient features of the IBM process are:

- Instead of thermal compression bonding, soldering is employed to join semiconductor elements and passive components on an alumina substrate
- Semiconductor devices are pro-

Pulse Welding Solves Problems



PRECISE REGULATION of weld pulse and electrode pressure ease operation of welding machine developed by Boeing Co. solves micro-miniature manufacturing problems. Constant electrode pressure from 1 oz. to 24 lbs, pulse durations of 1/1000 to 1/16 second and joining-time reduction of 80 percent contribute to accurate heat control



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AVAILABLE FEATURES—High input impedance • Wide range of chart sizes • Roll chart advance • Vacuum paper hold-down • Variable range control • Built-in time base • Zener reference supply; transistor amplifiers • Multi-pen models • Bench and rack mount models • Scaled in centimeters or inches • Symbol printers • Analog accessories.

Model	Price	Unique Characteristics
1	\$1190	8½" x 11", drum type
2D	\$2250	11" x 17", accepts ac and dc inputs
2D-2	\$1950	similar to 2D, except no ac input ranges
2D-2A	\$1950	high impedance, 2D-2
2D-2AM	\$1950	metric scaled 2D-2A
2D-2M	\$1950	metric scaled 2D-2
2D-3	\$2050	for computer use, similar to 2D-2, no time base
2D-3M	\$2050	metric scaled 2D-3
2D-4	\$1490	10 ranges, usefulness with simplicity
2D-4M	\$1490	metric scaled 2D-4
2DR	\$2250	rack mount 2D
2DR-2	\$1950	rack mount 2D-2
2DR-2A	\$1950	rack mount 2D-2A
2DR-2AM	\$1950	rack mount 2D-2AM
2DR-2M	\$1950	rack mount 2D-2M
2DR-3	\$2050	rack mount 2D-3
2DR-3M	\$2050	rack mount 2D-3M
2DR-4	\$1490	rack mount 2D-4
2DR-4M	\$1490	rack mount 2D-4M
2FR-A	\$3575	high impedance, two-pen, 11" x 17" x-y, recorder, rack mount

Model	Price	Unique Characteristics
6S	\$3150	10" x 10" rack mount, automatic chart advance
7	\$6500	30" x 30" x-y recorder
135	\$1650	compact, 8½" x 11" paper, occupies less than ½ cu. ft. 16 ranges plus variable, each axis
135A	\$1650	high impedance 135
135AM	\$1650	metric scaled 135A
135AMR	\$1650	rack mount 135AM
135AR	\$1650	rack mount 135A
135C	\$1190	10 ranges, usefulness with simplicity
135CM	\$1190	metric scaled 135C
135CMR	\$1190	rack mount 135CM
135CR	\$1190	rack mount 135C
135M	\$1650	metric scaled 135
135MR	\$1650	rack mount 135M
135R	\$1650	rack mount 135
136	\$2650	two-pen 135 (x-y, y)
136A	\$2800	high impedance 136
136AR	\$2800	rack mount 136A
136R	\$2650	rack mount 136

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

8525

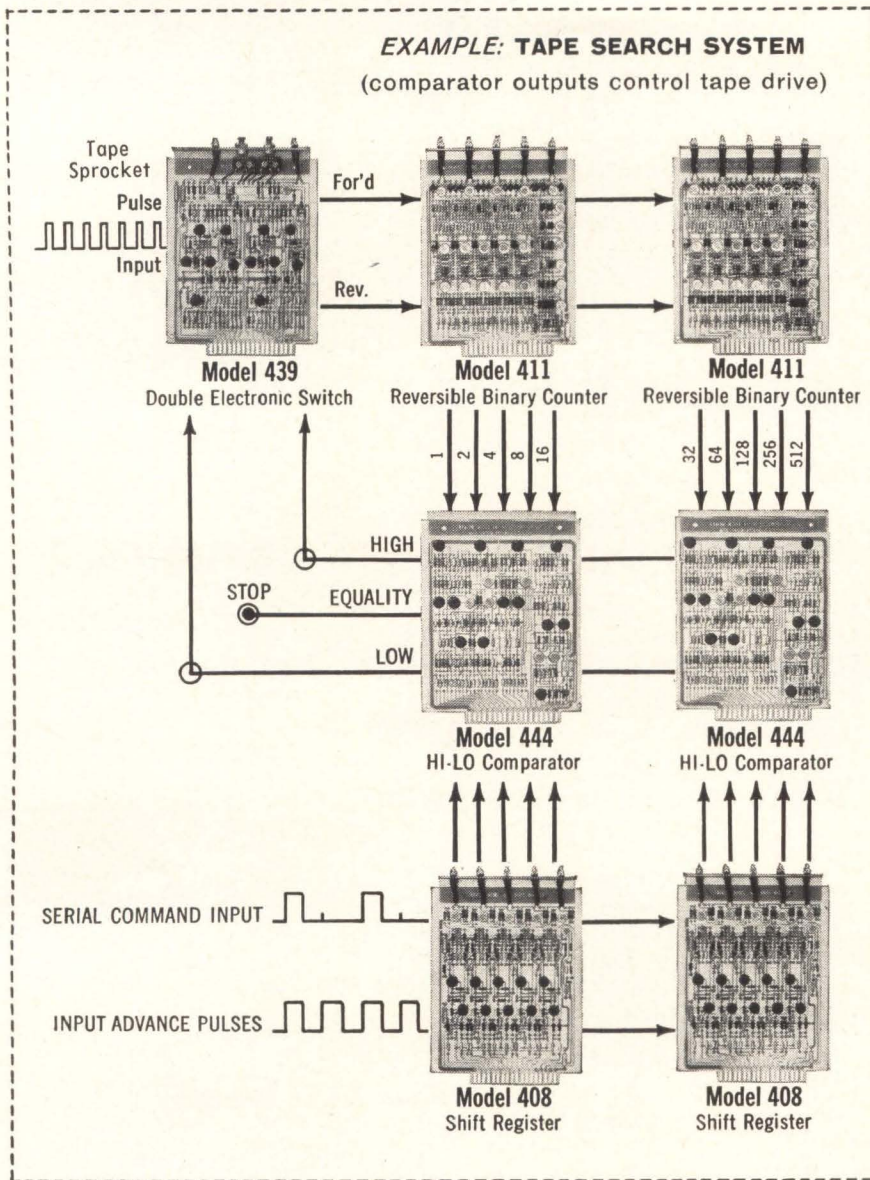
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YOU NEVER HAD IT SO SIMPLE:



Navcor System Function Modules are the closest thing to a system designer's master block diagram: They're easier to follow, greatly reduce design time, utilize far less wiring, and require but a fraction of the checkout time. In the example above, system flow lines correspond exactly to the actual wiring of the system back plane. The Navcor 400 Series includes 55 MIL Standard System Function Modules.

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tected by a glassing process, eliminating the need for hermetic sealing

- Graphic arts techniques are used to print resistors, capacitors and inductors

- Thermal difficulties are minimized by using low-thermal-resistance materials and high-tolerance components to reduce power requirements.

PASSIVE COMPONENTS—Passive components are formed on a ceramic substrate $0.445 \times 0.445 \times 0.060$ inches of 95 percent alumina. After cleaning, the interconnecting land pattern is printed with inks containing noble metals at 750 C to 800 C. Glazed resistors are printed, using palladium-silver with glass particles in an organic vehicle, and fired at 800 C. Twelve pins are inserted and mechanically locked.

The entire module is immersed in a solder bath to ensure good electrical connections between pins and lands and to provide solder for joining active elements. Abrasive trimming of screened resistors tailors them to tolerances of better than ± 1 percent.

Similar techniques are used to produce cross-overs, capacitors and inductors. A lower conductor is printed and fired. Next, a small square of high-temperature glass frit is screened over this conductor and fired, then a second conductor is screened over the glass. Through the use of small cross-over areas and thick glass the capacity is kept at less than one pf with voltage ratings of 300 volts. Capacitors are fabricated with this technique allowing capacitances of 75,000 pf/square inch and voltage ratings of 200 volts. With abrasive-trim tailoring, tolerances of 5 percent are obtained. Inductors are similarly formed by multiple printing of conductors and magnetic materials.

Semiconductor chip devices are joined to substrate solder lands simultaneously, after passive components have been tested. Fig. 2 shows a semiconductor chip sitting on the module solder lands before soldering. Flux is used to hold the chip in position. Heat is applied to melt the solder, which forms a fillet to the ball on the semiconductor chip.



**“I KNOW SOMETHING
YOU DON’T”**

What a completely carefree feeling! It comes from the confidence in Filtors' new DEMI-J LATCHING RELAY, a two-coil magnetic latching relay in a half-size crystal-case. It operates faster than standard relays without wasting power.

The relay design incorporates the magnetic motor structure that makes the standard DEMI-J RELAY the most efficient in the industry. A

3-millisecond pulse at rated coil voltage operates the relay and it will maintain either contact position, without consuming power, under all specified environmental conditions.

The DEMI-J LATCHING RELAY is all-welded, “Filtors’ Sealed” by an electron-beam in a near perfect vacuum —the ideal way to seal a relay.

Best of all—delivery in 60 days. Now *you* know!

SPECIFICATIONS

- AMBIENT TEMPERATURE RANGE... —65 degrees C to 125 degrees C
- DIELECTRIC STRENGTH.....1000 volts rms; 500 volts rms
between open contacts
and between coil and housing
- INSULATION RESISTANCE.....1000 megohms minimum
- CONTACT ARRANGEMENTS.....1 or 2 pole, double throw
- CONTACT RESISTANCE.....0.05 ohm initial, 0.10 ohm
after rated life
- CONTACT RATING......2 amperes resistive (4 amperes overload)
and dry circuit
- VIBRATION......30 g's from 5 to 3000 cps
- SHOCK......150 g's for 11 milliseconds
- LATCH TIME (MAXIMUM)......3 milliseconds
- RESET TIME (MAXIMUM)......3 milliseconds
- COIL RESISTANCE (BOTH COILS) ..1000 ohms = 10% (26-volt dc coil)



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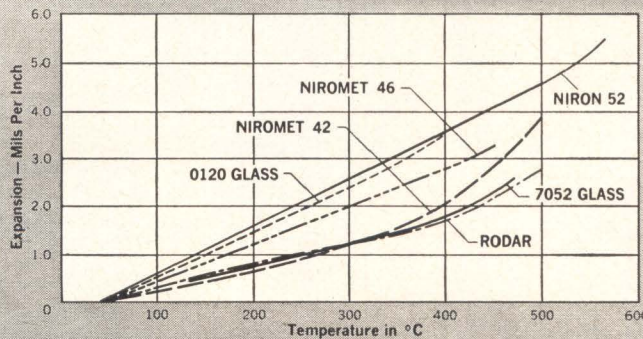


RODAR[®]
NIRON[®] 52
NIROMET[®] 46

Specified Industry-wide for

**PERMANENTLY-BONDED
VACUUM-TIGHT SEALS!**

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NOMINAL ANALYSIS: 29% Nickel, 17% Cobalt, 0.3% Manganese, Balance—Iron

Rodar matches the expansivity of thermal shock resistant glasses, such as Corning 7052 and 7040. Rodar produces a permanent vacuum-tight seal with simple oxidation procedure, and resists attack by mercury. Available in bar, rod, wire, and strip to customers' specifications.

Temperature Range	Average Thermal Expansion *cm/cm/°Cx10-7
30° To 200°C.	43.3 To 53.0
30 300	44.1 51.7
30 400	45.4 50.8
30 450	50.3 53.7
30 500	57.1 62.1

COEFFICIENT OF LINEAR EXPANSION

*As determined from cooling curves, after annealing in hydrogen for one hour at 900° C. and for 15 minutes at 1100° C.

NIRON[®] 52

NOMINAL ANALYSIS: 51% Nickel, Balance—Iron
For glass-to-metal seals with Corning #0120 glass.

NIROMET[®] 46

NOMINAL ANALYSIS: 46% Nickel, Balance—Iron
For vitreous enameled resistor terminal leads.

NIROMET[®] 42

NOMINAL ANALYSIS: 42% Nickel, Balance—Iron
For glass-to-metal seals with GE #1075 glass.

CERAMVAR

NOMINAL ANALYSIS: 27% Nickel, 25% Cobalt, Balance—Iron
For high alumina ceramic-to-metal seals.

Call or write for Sealing Alloy Bulletin

WILBUR B. DRIVER CO.
NEWARK 4, NEW JERSEY, U.S.A.

IN CANADA: Canadian Wilbur B. Driver Company, Ltd.
50 Ronson Drive, Rexdale (Toronto)

Precision Electrical, Electronic, Mechanical and Chemical Alloys for All Requirements

In addition to the silicon dioxide and glass layers, conformal coating of plastic is put on the module to mechanically protect the components and reduce corrosion.

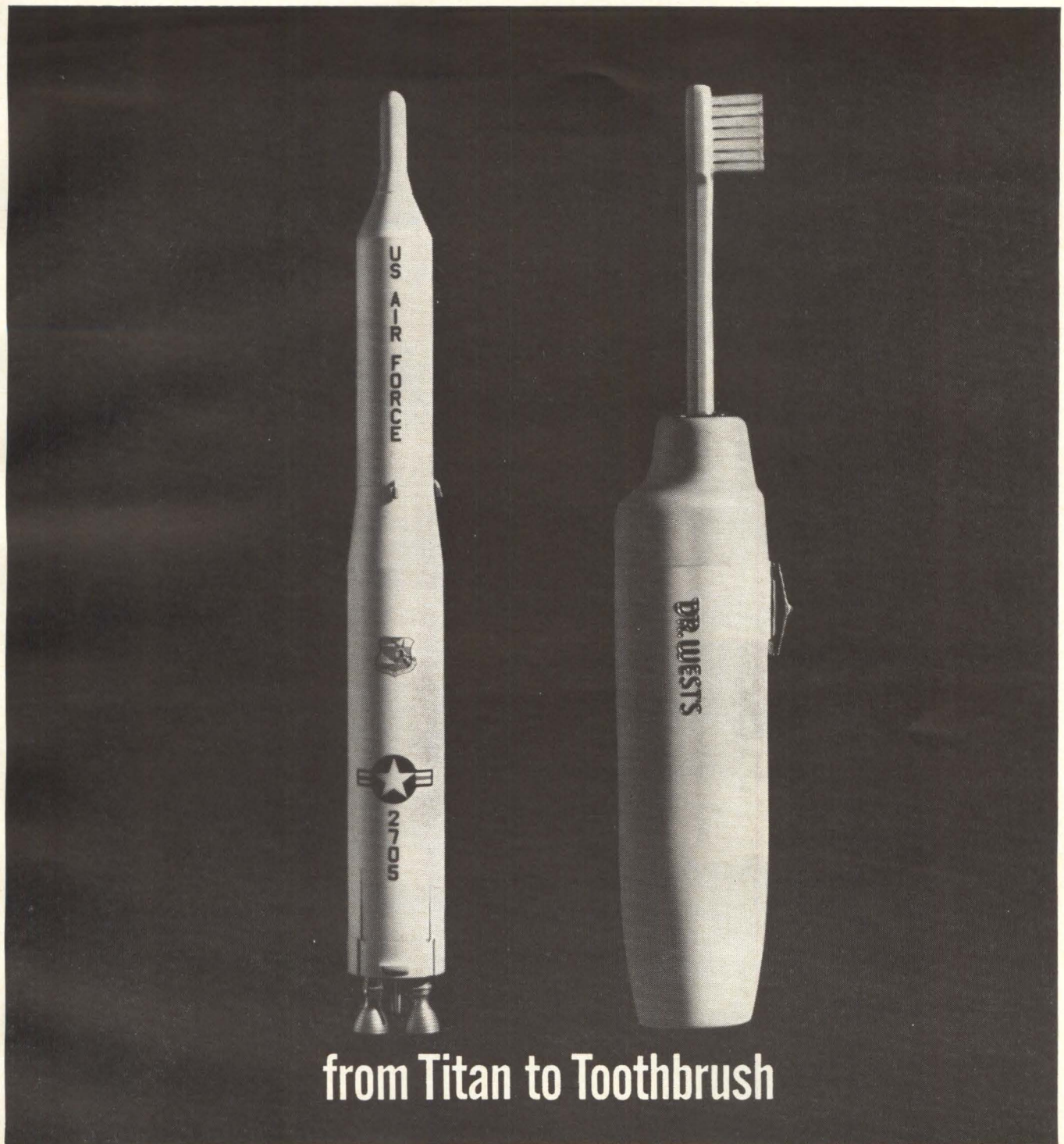
Indications are that this glass-over-oxide technique significantly reduces the degradation of transistor leakage and diode reverse currents in devices subjected to simultaneous reverse bias and ionizing radiation. It is believed that this reduction results from isolation, by the glass layer, of the junction from ions, generated in the surrounding gas, that collect on the surface to form an inversion layer.

Welding Permits Longer Longitudinal Lines

MAGNETOSTRICTIVE delay lines, using 0.005-inch nickel-iron wire for the transmission medium and a cobalt-iron alloy wire through the transducers, are being constructed for delays up to milliseconds using the longitudinal mode of supersonic transmission by GE's Hirst Research Centre, England. Resistance-welding is employed to join the two alloys causing virtually no change in their relevant characteristics and introducing minimum losses, says the company.

Welding is performed under a microscope fitted with a welding jig on the stage. Wires are cut with square ends in a specially designed tool before insertion in the jig. The operator sets them in correct axial alignments and the ends are then brought together. Physical contact initiates a resistance-welding pulse accurately controlled for current amplitude and time duration. A light spring pressure keeps the wire in compression to produce the desired slightly barrelled joint. Welding is performed in an ambient neutral atmosphere for argon or nitrogen to avoid contamination of the alloys.

Delay lines with a 1.3-millisecond delay time that can handle a digit rate of 1 Mc was developed at the research center using this technique. This delay line will be part the new time-division-multiplex electronic exchange to be installed for the G.P.O. at Goring-on-Thames, England.



from Titan to Toothbrush

Sonotone batteries spark portable power to action!

Mite or might—if it's portable, the chances are it relies on Sonotone rechargeable sintered-plate, nickel-cadmium cells and batteries. That goes for everything from space satellites and missiles to cordless razors and toothbrushes, and even to small, delicate medical instruments. The reason is this: Sonotone pioneered in the development of high-power/low-weight rechargeable batteries. With more years of experience in this field than any other American company, Sonotone has built up an unmatched record of reliability...and an unmatched reputation for cooperation with design engineers. What new product are

you working on? Let Sonotone help you solve your power problem. Write today for technical data, stating your application requirements...and we'll be happy to lend you a hand.

Sonotone Batteries MM-13 have been used in U.S. ICBM Titan I and Sonotone Batteries MM-14 have been used in the emergency ground support. Many electric toothbrushes use Sonotone Sealed Battery S-113. These are just three of more than 300 Sonotone rechargeable sintered-plate, **Sonotone Batteries** available to you. **portable power for progress**

Battery Division, Dept. B24-83, Sonotone Corporation, Elmsford, New York

Aircraft Batteries • Missile Batteries • Satellite Batteries • Power Supplies • Battery Chargers • Audio Products • Hearing Aids

Product Reliability Performance—To MIL-Q-9858 Requirements by Mycalex Corporation of America

Our key to successful service has always been: 1) search for the best design, 2) make efficient and trouble-free tooling, and 3) produce high quality components.

The need for a uniform measure of quality control to meet today's extraordinary requirements for reliable performance dictates that all responsible companies accept the specifications spelled out in the MIL-Q-9858 Quality Assurance Program.

Mycalex Corporation of America is therefore proud to announce that we have committed ourselves to meet this exceptionally high level of quality that must be achieved to meet the requirements of the MIL-Q-9858 specifications.

Sound planning has created a Quality Control Department with clearly defined responsibilities for establishing and enforcing the procedures and necessary documents to assure that all materials and services meet the standards in our specifications and contracts. Our Quality Control System includes procedures exactly designed by ourselves to meet requirements unique to our products; and, of course, our entire system is applied to all Government and commercial contracts equally.

We are never satisfied that our Quality Control is perfect; this new system is a firm basis for continued improvements.

Precision-molded materials

SUPRAMICA® 620 "BB" ceramoplastic	SUPRAMICA 560 ceramoplastic	SUPRAMICA 555 ceramoplastic
MYCALEX® 410 glass-bonded mica	MYCALEX KM glass-bonded mica	MYCALEX 410X glass-bonded mica

Precision-fabricated materials

SUPRAMICA 620 ceramoplastic	SUPRAMICA 500 ceramoplastic	MYCALEX 400 glass-bonded mica
MYCALEX K glass-bonded mica	MYCALEX 385 glass-bonded mica	

If you are interested in the complete details of our accuracy program, we will be glad to mail you a copy of

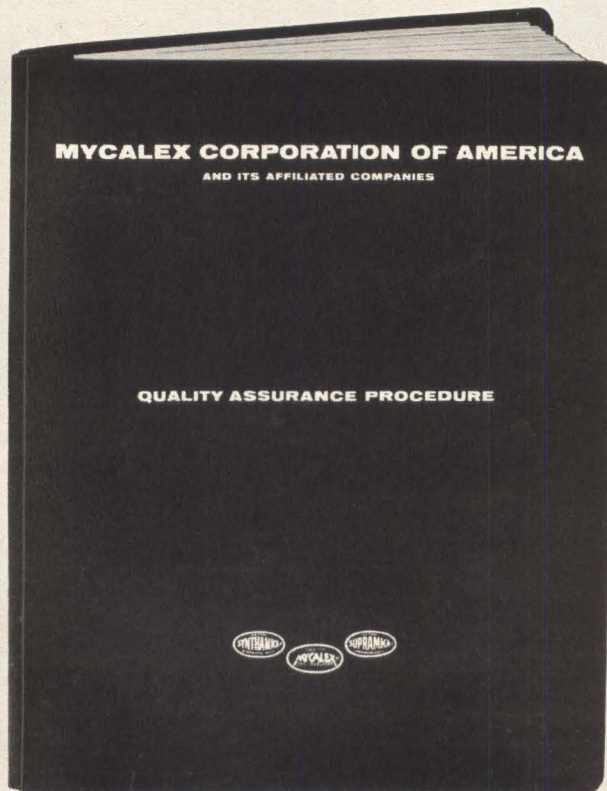
our Quality Assurance Procedure manual on request. Please send this request on company letterhead.



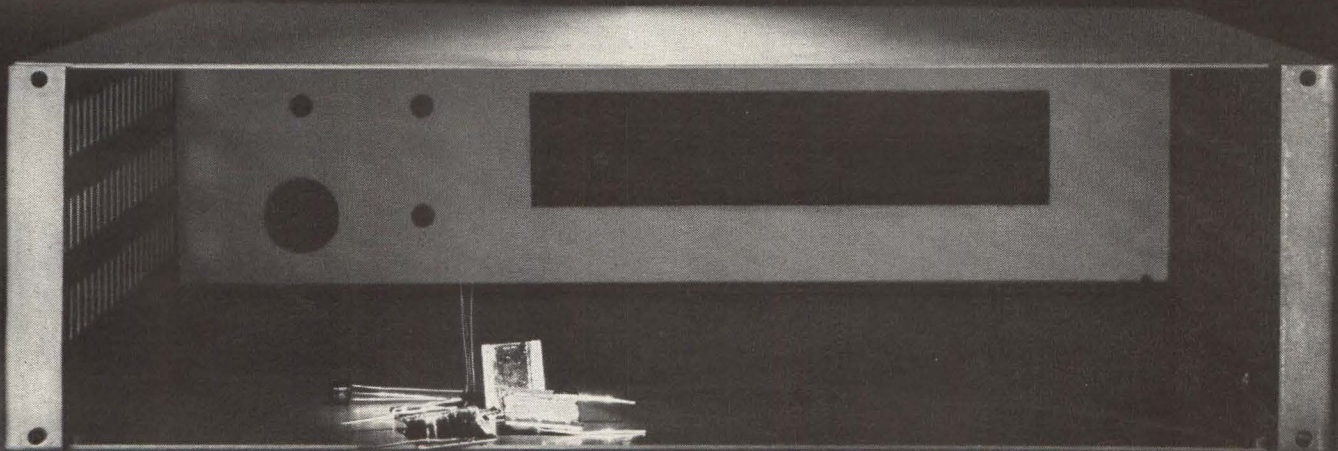
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CORPORATION OF AMERICA

World's largest manufacturer of ceramoplastics, glass-bonded mica and synthetic mica products.



Dept. AE, 125 Clifton Boulevard, Clifton, N. J.



These are the "critical" components in Hughes new digital voltmeter



All solid state-5 digit readout-fast-quiet-\$2795

An entirely new concept in circuitry design enables Hughes to bring you a digital voltmeter equal or superior in performance to devices priced at \$3000 to \$4000 or more.

The Hughes 5000 Digital Voltmeter is an all electronic solid state unit incorporating a new and unique voltage to frequency converter* as the heart of the machine. This device represents a breakthrough in the state of the art and practically eliminates the use of critical or trouble-

making components. The result is a voltmeter offering remarkable reliability, accuracy, ease of maintenance, and high noise rejection common to integrating type voltmeters. Compare its specifications with any voltmeter on the market.

This remarkable unit forms the backbone of a new line of digital measuring instruments which possesses complete capability for remote programming, printout, and system integration with a minimum of interface problems. Under final development are ratio capability and auxiliary AC and ohms converters. These devices, like the basic DC machine, are designed for simple integration with existing scanner and printout equipment to realize full system capability. We would like to demonstrate the Hughes 5000 Digital Voltmeter and prove to you that it is the best value on the market. Write, wire or call Hughes Instruments, 2020 Oceanside Boulevard, Oceanside, California. For export information write Hughes International, Culver City, California.

SPECIFICATIONS — Hughes 5000 Digital Voltmeter— Ranges: ± 9.9999 volts, ± 99.999 volts, ± 999.99 volts with full 5-digit readout. Accuracy: $\pm .01\%$ of reading or 1 digit. Linearity: $\pm .005\%$ of full scale. Resolution: $100 \mu\text{V}$ over entire lowest range. Input impedance: 1000 megohms on ± 9.9999 volt scale, 10 megohms on higher ranges. Features: Automatic polarity; automatic ranging; 9 readings per second average. Faculty to incorporate automatic programming and printout. Mechanical: 5.25" panel height with 17" panel width. Detachable ears are provided for mounting in a standard 19" rack. *Patent Pending

HUGHES
 HUGHES AIRCRAFT COMPANY
 HUGHES INSTRUMENTS
 OCEANSIDE, CALIF.

CIRCLE 97 ON READER SERVICE CARD

Pulse Laser Yields 100 Megawatts

*Kerr-cell unit has
10-milliradian beamwidth,
5-nsec rise time*

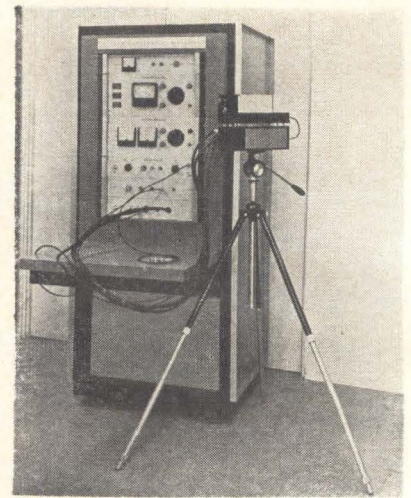
ANNOUNCED by Korad Corporation, 2520 Colorado Ave., Santa Monica, Calif., model K-1Q is a Kerr-cell controlled laser intended for studies in communications, chemistry, optical radar, radiation effects and non-linear optics. Typical pulse output at room temperature is 1 joule with a peak output power of 50 to 100 Megawatts. While the laser head is normally operated as a Kerr-cell controlled oscillator, the cell may be easily replaced by an external mirror, permitting operation as a conventional laser oscillator. In this mode of operation, an output of 15 to 20 joules may be obtained. If both external mirrors are removed, the head can function as an amplifier. Moreover, ruby or other laser material can be substituted without disassembly of the head.

The systems electronics will store up to 4,750 joules of energy in a 380 μ fd capacitor bank. Energy level is presettable and the 5,000 volt

charging supply is automatically disabled when the selected level is reached. During normal operation, 3,500 joules are used to trigger the lamp and the current pulse into the flashlamp is fed through a pulse-shaping coil to prolong lamp life. A 0 to 45 Kv trigger supply is provided and the unit contains a Q-spooiler (Kerr Cell) power supply and sync controls.

Operation of the model K-1Q can be either manual or semiautomatic. Automatic repetitive operation is available with an accessory trigger generator. Remote control is also available as an accessory and both the laser head and electronics are provided as separate units.

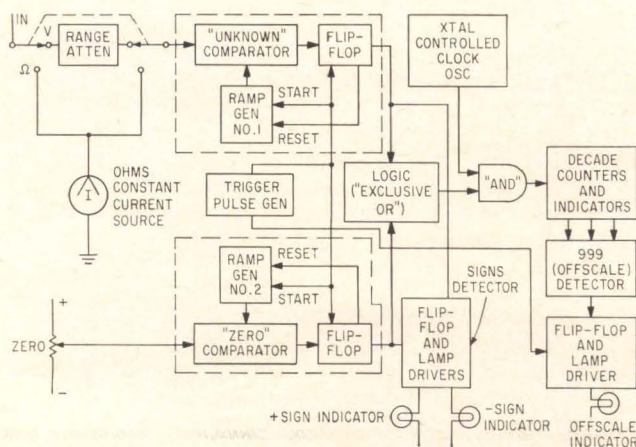
Having high output and small size, the laser head features a simple external control for orientation of beam polarization plane and a spring-mounted crystal to reduce strain. It may be used as a Q-spooled system, conventional oscillator or an amplifier. The laser electronics unit features presettable energy storage level, variable charging rate, fast charging time of 10 sec to full energy, capacitor values of 140, 240 or 380 μ fd and pulse-shaped output for prolonged lamp life. It has a maximum en-



ergy storage of 4,750 joules, a high voltage charging supply delivering 0 to 5 Kv at 160 ma, a Kerr-cell supply of 0 to 25 Kv at 1.5 ma and discharge time between 0.1 and 5 millisecond depending upon load. The Kerr shutter delay varies between 50 and 1,000 μ sec, 300 v pulse output and the sync pulse is 150 v with 30 μ sec duration. The model K-1Q sells for \$22,000.

CIRCLE 301, READER SERVICE CARD

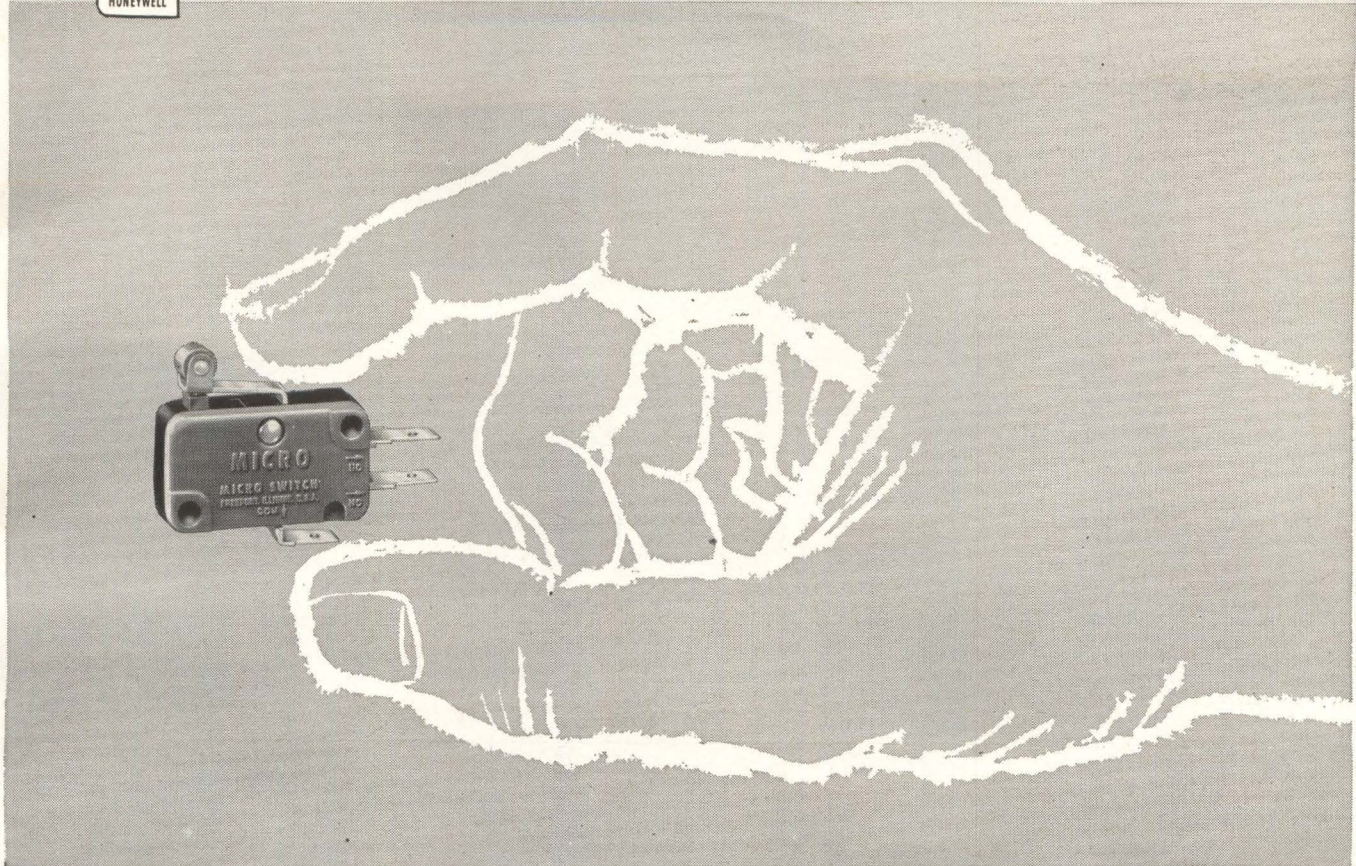
Compact DVMs Have 0.1-Percent Accuracy



MANUFACTURED by Harmon-Kardon, Plainview, New York, Reporter series solid-state digital voltmeters are available in three models and will be shown for the first time at WESCON. All of the models (Reporter 33, 34 and 35) have a unique regenerative voltage comparator that combines the functions of a precision ramp generator, voltage comparator and memory circuits into one accurate and reliable circuit. According to the manufacturer, it is this circuit that makes possible a precision



MICRO SWITCH Precision Switches



"V3" HIGH CAPACITY MINIATURE SWITCHES

TAILORED TO YOUR NEEDS —RIGHT OFF THE SHELF

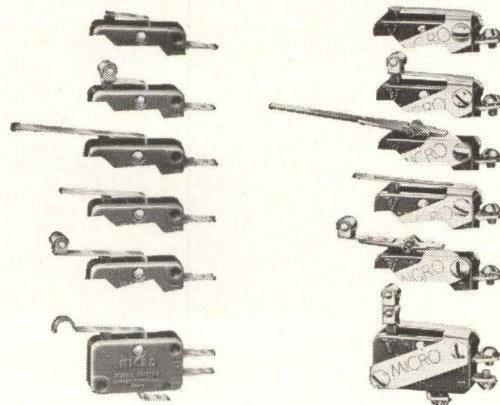
Simply because they are so readily adaptable to so many applications, Series "V3" Miniatures are among the most widely used snap-action switches.

Added variations in terminals, circuitry, actuators and assemblies have continually extended their capabilities in aircraft, industrial equipment, appliances, vending and business machines.

Twenty years of refinement by MICRO SWITCH has resulted in packing increasingly higher capacity and greater reliability into these miniatures. They are listed by UL and CSA for 15 amps, 125-250 vac. "V3" Miniatures are the heart of a variety of assemblies: Multi-circuit Toggles, Rotary Selectors, Door Interlocks, etc.

Write for Catalog 63 "Small Basic Switches", or call our Branch Office nearest you (see Yellow Pages).

COMPLETE SELECTION OF ACTUATORS
INTEGRAL AUXILIARY



MICRO SWITCH

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A DIVISION OF HONEYWELL

IN CANADA: HONEYWELL CONTROLS LIMITED, TORONTO 17, ONTARIO

HONEYWELL INTERNATIONAL—SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD. MANUFACTURING IN UNITED STATES, UNITED KINGDOM, CANADA, NETHERLANDS, GERMANY, JAPAN.

"The Light Touch In Automation and Control"

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6 Years Ago

as

RELIABLE

System Components

And Still Does!



Reliability in computer components means a great deal to IBM and its customers; down time is extremely expensive. Clairex photoconductive cells, because of their rigidly controlled parameters and ability to perform indefinitely with little or no maintenance, have been among components used for years by IBM. The Clairex cells function as the "eyes" of important IBM light-actuated tape drive controls.

These tape drives are now operating in thousands of computer systems around the world — providing daily proof through performance of Clairex reliability!

You too can enjoy this confidence in supply. Clairex cells have been employed by hundreds of major firms in outer space, photography and dozens of other interesting fields. These cells offer a broad range of characteristics to the design engineer in the largest line of both glass and metal photoconductive cells available to the industry.



CLAIREX CORPORATION

The Oldest Manufacturer of Cadmium Sulfide and Cadmium Selenide Photoconductive Cells

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"New 16 page Photoconductive Cell Design Manual Free on Request".



DVM at unusually low cost. Voltage sensitivity is available to 1 mv and each voltage scale is accurate to ± 0.1 percent of full scale, ± 1 count to 10 percent beyond full scale reading. This feature permits overlapping scales and the ability to obtain a four digit reading on a three digit instrument. A special switch allows automatic blanking of all indicators when the selected range scale is exceeded, and an Off Scale arrow appears whenever a voltage or resistance measurement is greater than the scale setting.

Reporter series DVMs also feature fully automatic polarity switching and indicating, automatic ohm indication, tracking illuminated decimal point and high over-voltage protection on both resistance and voltage scales. The units weigh 20 pounds, operate on 115 or 230 va-c at 40 to 400 cps and consume only 20 watts. Reporter 33 measures voltages between 0.01 and 999 and resistances between 1 ohm and 999K. Model 34 reads voltages from 0.001 to 999 and resistances from 1 to 999K. Model 35 is similar to model 34, except that it incorporates outputs that permit its use as a basic analog to digital converter. Model 33 sells for \$495, model 34 for \$595 and model 35 for \$695.

CIRCLE 302, READER SERVICE CARD

Process-Viewer Develops 35-mm Moving Film

MODEL 3800C Rapromatic Film Processor-Viewer recently announced by Analab Instrument Corp., Div., The Jerrold Corp., 15th & Lehigh Ave., Philadelphia, Pa., will photograph, develop and display 35 mm films of scope patterns in a 70 second shoot-to-view process. According to company engi-

SPECIFY HANDSETS

by

Stromberg-Carlson



... for mobile radio, dictating systems, carrier, microwave and other applications.

Illustrated are lightweight models No. 33 and No. 35. Both incorporate push-to-talk switches and high-gain receivers and transmitters. These Stromberg-Carlson handsets meet a great variety of needs in a broad range of industrial applications.

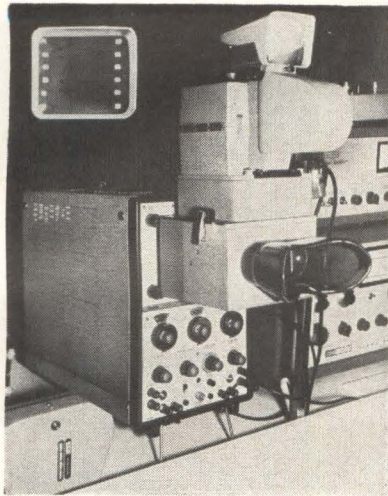
No. 33 lightweight handset is furnished with a rocker bar switch.

No. 35 comes with a button switch, or with both the button and rocker bar switches.

Get technical data on these and other handsets from our Industrial Sales Department.

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS
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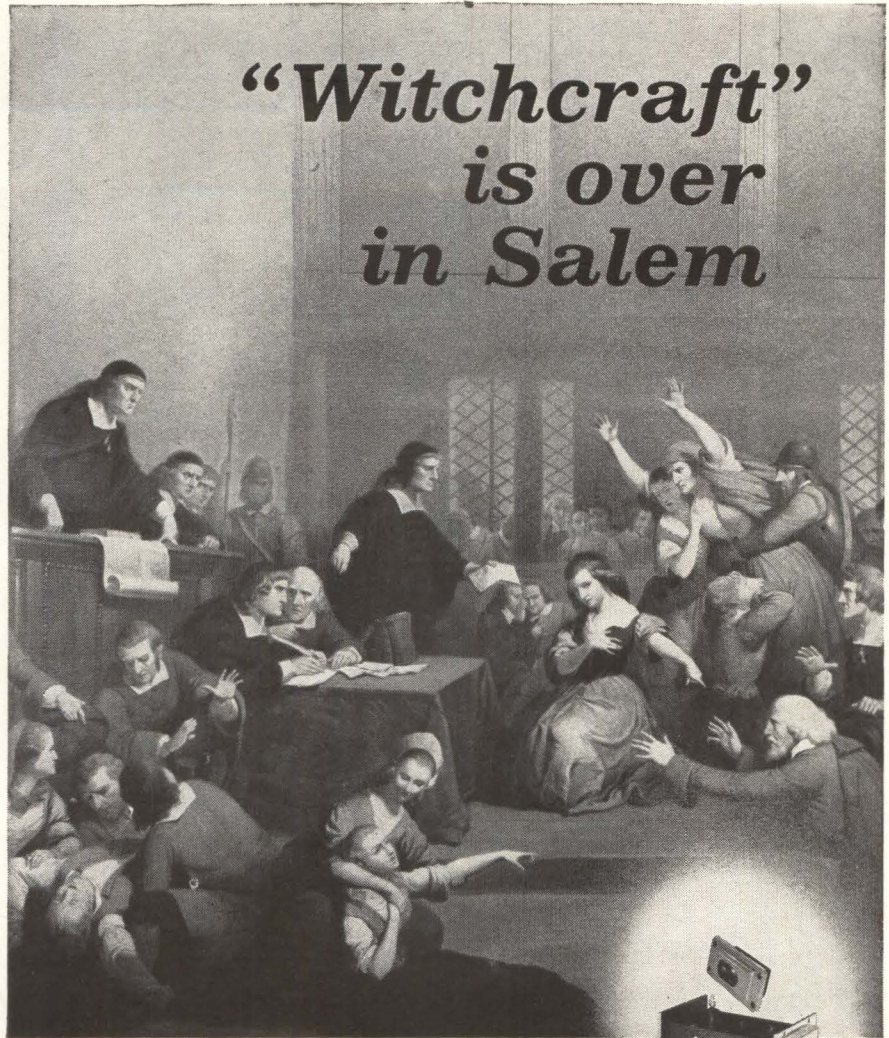
neers, the new device solves a major problem in high-capacity filming of scope displays and will prevent any possibility of having to redo test setups or experiments because films of results are a washout. The entire process takes place in the thermostatically controlled chamber within the model 3800C. The shutter of the continuous-motion camera remains open, as the film advances at a speed of 10 inches per



second. Other discrete, faster speeds are also available. Once the film is shot, it is mated with a glass-fiber web that is the same length and width as 35 mm film. Called a Raproroll, the web is saturated with monobath photographic developer and fixer. The exposed film and the chemical web are mechanically pressed together by pressure rollers so that the film emulsion and chemicals are in constant contact until the image is fully developed. The processor-viewer automatically strips the film from the roll and pulls it before the viewer for inspection. The film can then be further analyzed or stored for later use if satisfactory. Model 3800C is priced at \$2,000 and Model 3625 camera at \$920. (303)

Millimeter Power Source Produces 0.1 to 50 Watts

MILLIMETER wave power source being introduced by Litton Industries Electron Tube Div., San Carlos, Calif., will provide c-w or pulsed power for any of a number of liquid-cooled floating drift tube



"The Trial of George Jacobs," 1692 — by Matteson*

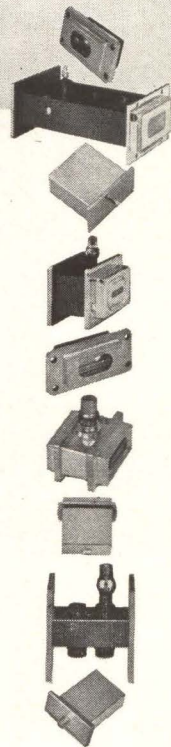
Salem's early witchcraft trials brought hardship and tragedy to many pioneer families. Only through the efforts of serious-minded community leaders was this persecution finally ended.

Similarly, "witchcraft" in the tube manufacturing industry has caused hardships on the equipment tube user. Now, Metcom announces perfected **hard-brazing** techniques, which remove much of this "witchcraft" in the production of gas switching tubes. **Hard-brazing** permits evacuation of tubes prior to gas filling to pressures of 1×10^{-8} torr, while the tube is baking at high temperatures. Metcom tubes thus processed offer uniform characteristics, exhibiting extra long life.

Please write for details and complete listings, and our 1963 catalogue.

Visit our booth #4324 at Wescon!

*Courtesy of Essex Institute

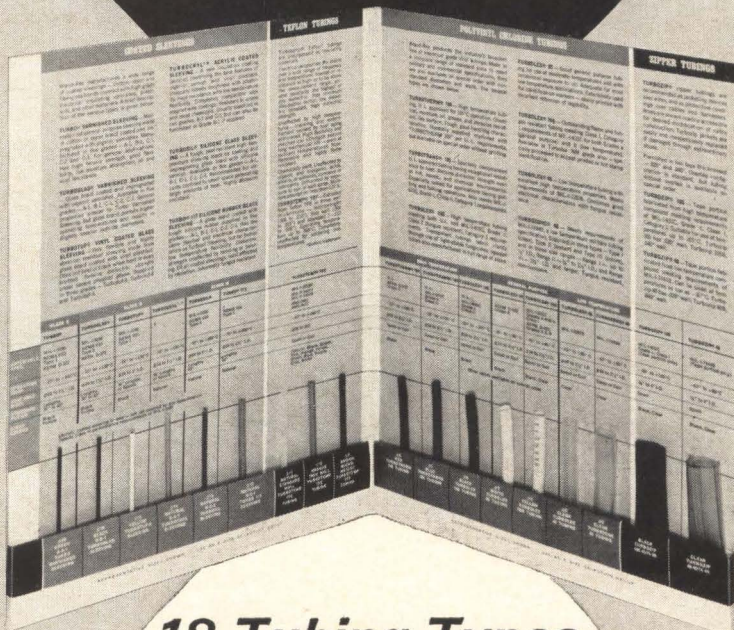




for better

METCOM INC.
SALEM, MASSACHUSETTS
microwave tubes and devices

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18 Tubing Types

This new folder contains samples and complete technical performance data for the entire Turbo insulating tubing and sleeving line — including:

- TURBO COATED SLEEVINGS
- TURBO TEFLON TUBINGS
- TURBO POLYVINYL CHLORIDE TUBINGS
- TURBOZIP TUBINGS

You'll find this the most useful tool you've ever had for selecting the right tubing or sleeving for any application!

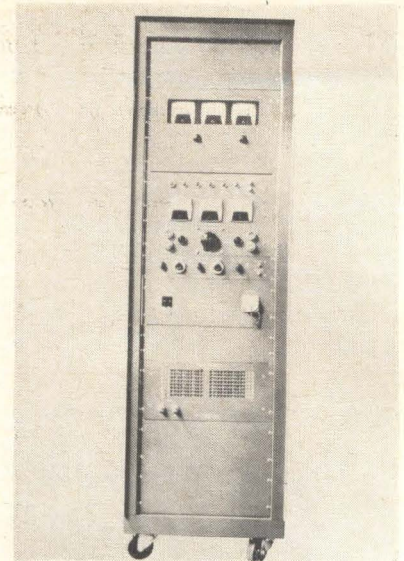


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For Sales Service as you like it, contact any of the following Brand-Rex Tubing Distributors:

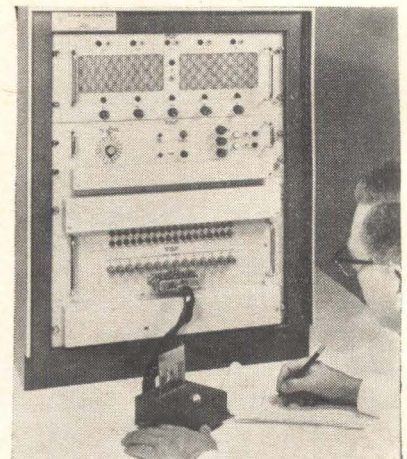
Adtape & Label Co.	Cadillac Plastic & Chemical Co.	Illumintronic Engineering Corp.	Port Plastics, Inc.
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klystrons between 23 and 74 Gc.

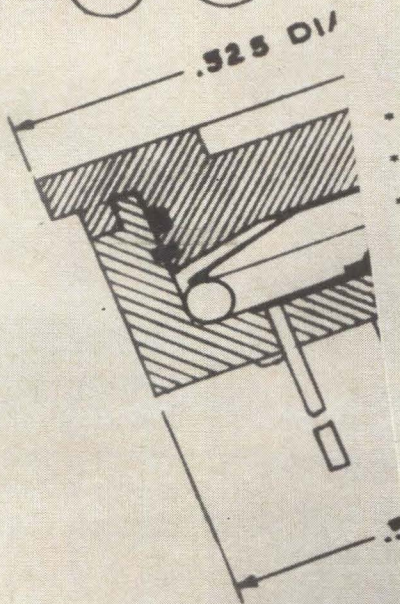
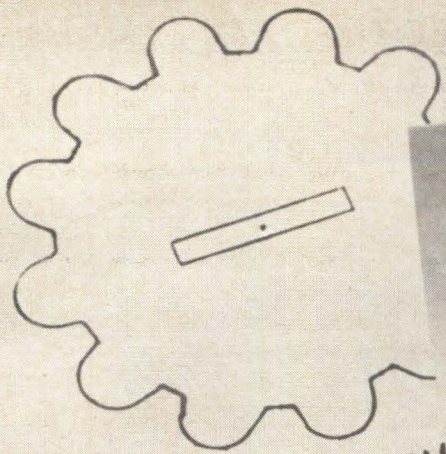
According to the manufacturer, the new unit is ideal for applications such as RFI research, component testing, antenna range testing, space communications and plasma research. Called the model 258, the device is manually tuned and consumes 1,800 watts of primary power at 115 or 220 volts a-c. Pulse modulation duty is rated up to 100 percent. The unit weighs about 500 pounds and is supplied in a standard 19" rack and panel configuration with casters to facilitate moving it about.

CIRCLE 304, READER SERVICE CARD



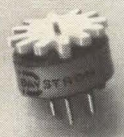
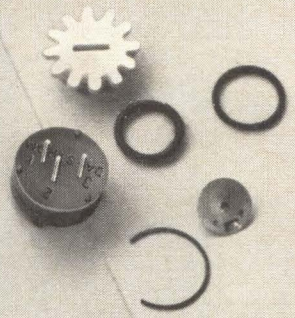
Test Instrument for Integrated Circuits

INTEGRATED circuit tester, model 659A, is announced. Features are its capacity (36 tests on devices with up to 14 terminals), its programming simplicity (plug-in circuit boards for bias, limits, timing, and sorting), and its convenient,



- * SQUARETRIM RESIST. ELEMENT
- * SPECIAL ALLOY WIPER
- * GOLD-PLATED DUMET LEADS
- * STAINLESS RETAINING RING
- * KEL-F ADJUST. KNOB
- * BUNA RUBBER O-RING
- * DIALLYL PHTHALATE HOUSING

•TOTAL 7 PARTS = 1 POT
 DAYSTROM MODEL 515
 COMMERCIAL TRIMMER



NEW LOW-COST COMMERCIAL TRIMMER: Simplicity and ease of fabrication now make possible this high-reliability Daystrom potentiometer at low cost. ■ It dissipates 1 full watt in still air @ 55°C., measures only 0.317" x 0.525" (shown actual size), and is offered in resistance ranges from 10Ω to 50K. ■ Operating temperatures are -55°C to +150°C. ■ The reliability stems from the use of the same basic resistance element as the famous MIL Squaretrims®, with the "wire-in-groove" winding technique. ■ A unique Buna rubber O-ring between the housing and the adjustment knob seals the unit against humidity, and also prevents wiper shift during shock and vibration. ■ The Daystrom Model 515 is a single-turn potentiometer with stops, and can be adjusted either with screwdriver or fingertips. ■ Investigate this new addition to the Daystrom line for computers, EDP systems, power supplies, or other commercial applications. ■ Write for full specifications!

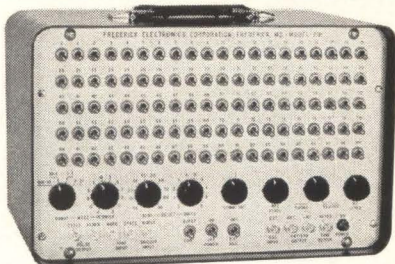
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MORE THAN
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PATTERNS



PULSE PATTERN GENERATOR

MODEL 201

FEATURES:

- generates pulse patterns of any length from one to one hundred pulses with any combination of pulses on and off — over 2¹⁰⁰ possible patterns;
- provides three different forms of pattern outputs; non-return-to-zero (NRZ), return-to-zero (RZ), and audio tone transmission gates for generation of keyed tone and two tone patterns;
- operates with a pulse spacing continuously variable from 100 milliseconds to 10 microseconds or from an external drive;
- recycles continuously or triggers in bursts of single patterns on external command;
- provides bit and frame synchronizing pulses;
- constructed of entirely solid-state construction and designed for a long trouble-free life.

Simulates Virtually ANY Digital Data Signal

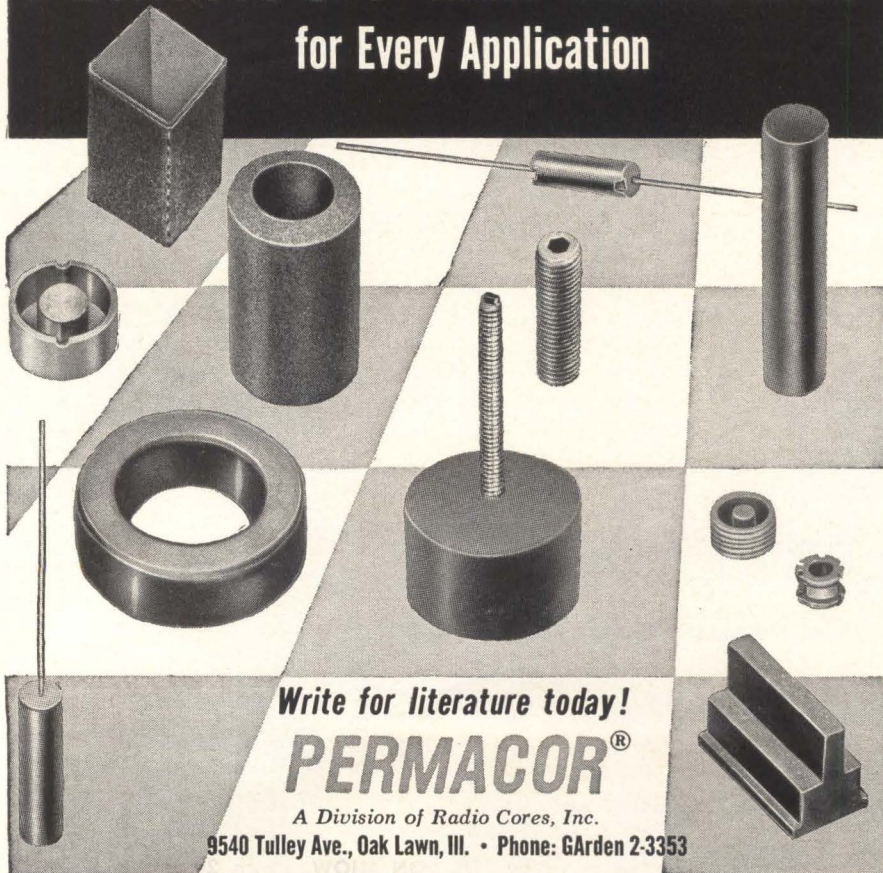


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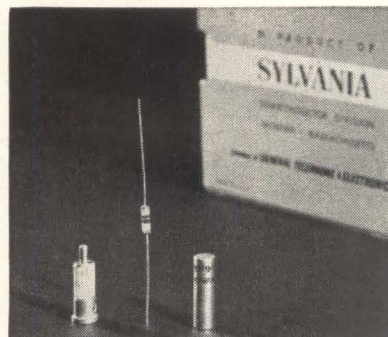
PERMACOR[®]

A Division of Radio Cores, Inc.

9540 Tulley Ave., Oak Lawn, Ill. • Phone: GArden 2-3353

small size (only 19 in. wide, 28 in. high, and 20 in. deep). For the user, these features mean virtual elimination of operator error, quick change from one device to another, anti-obsolescence for future device types. Test times can be varied from 30 millisecc up to 5 sec, making it possible to perform 36 tests in approximately 1 sec. Basic price is \$16,500. Texas Instruments Incorporated, 3609 Buffalo Speedway, Houston, Texas.

CIRCLE 305, READER SERVICE CARD



Microwave Diodes Are 100 Percent Verified

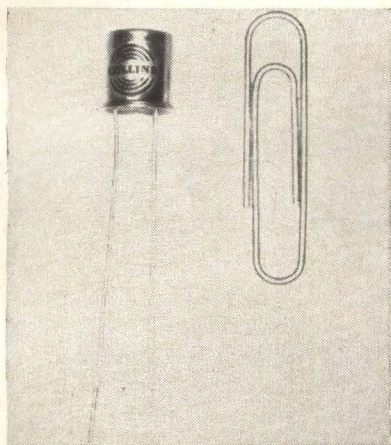
A SERIES of 100 percent verified microwave diodes for ultra-reliability requirements covering the frequency range from 1 Gc through 35 Gc are available. The diodes are available in (left to right) ceramic, DO-7 all glass and coaxial packages. Each unit is processed through 14 separate tests. The diodes are individually serialized, tested for applicable electrical parameters and then subjected to operational tests. The new diodes also are sample tested to various destructive design criteria. Sylvania Electric Products Inc., 730 Third Ave., N. Y., N. Y. (306)



Power Supply Is Closely Regulated

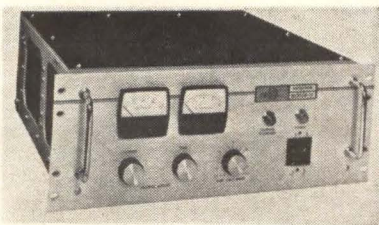
MODEL KS 60-10 M provides 0-60 v at 0-10 amp of constant current or constant voltage with practically

instantaneous automatic cross-over from one mode to the other depending on the voltage and current control settings and load resistance. This 0.01-percent regulation and stability power supply embodies an independent bridge for each mode, series pass transistors and silicon controlled rectifier preregulation for fast, close control and high efficiency. Wide range response provides controlled current from 50 ma to 10 amp with voltage compliance from 0 to the voltage control setting. Kepeco Inc., 131-38 Sanford Ave., Flushing, N. Y. (307)



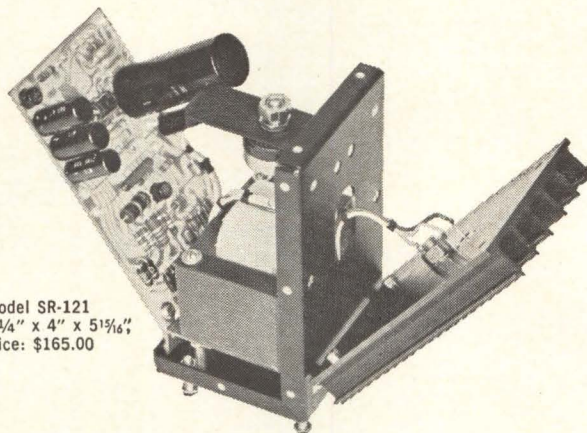
Inductor Toroids Are Miniature Size

MICRO INDUCTOR TOROIDS (MIT's) are packaged in transistor-sized cases and are suitable for machine insertion and printed-circuit applications. Inductance values range from 1 mh to 200 mh with a nominal Q of 15 at 20 Kc. Operating temperature range is from -55 C to +85 C. OEM price range is \$2.75 to \$12.50, depending upon type and quantity. Collins Radio Co., Components division, Santa Ana, Calif. (308)



Regulated D-C Supply Has High Power Rating

COMPACT 2,250-w regulated d-c power supply is about half the size



Model SR-121
Size: 3 1/4" x 4" x 5 1/16"
price: \$165.00

Low cost Silicon DC power in space-saving Transpac® modules

200 ma to 8 amps



Typical of the ERA Silicon Transpac Series is the compact SR-121, 1 amp, 11 to 13 volt dc power module that is ultra-stable and fully repairable. It will operate continuously, full load, at temperatures up to 71°C with no heat sink or air blow. This model is just one of the 42 High Current Silicon Transpacs available from stock.

SPECIFICATIONS COMMON TO ALL MODELS

Input: 105-125 VAC, 50-400 cps	Short Circuit Protection: Automatic, with automatic recovery
Line Regulation: Less than $\pm 0.01\%$ or 5 mv for full input change	Remote Sensing: Remote sensing facilities available
Load Regulation: Less than 0.05% or 8 mv for 0-100% load change	Interconnection: Series or parallel operation permissible
Ripple: Less than 800 microvolts RMS	Remote Voltage Control: Provision for external control of output voltage
Long Term Stability: Less than 5 mv	Output Connection: Ungrounded outputs, either positive or negative terminals may be grounded
Transient Response: Less than 50 microseconds for step line or load change	
Maximum Operating Temperature: 71°C, free air, full ratings, convection-cooled	
Temperature Coefficient: Less than 0.01% per degree C or 3 mv	

42 HIGH CURRENT MODELS FROM STOCK

200 MA Series	0-5 VDC
500 MA Series	0-61 VDC
1 Amp Series	0-61 VDC
2 Amp Series	0-46 VDC
4 Amp Series	0-45 VDC
8 Amp Series	0-32 VDC

Check the full range of solid-state TRANSPAC DC Power Modules, Converters, Inverters and Frequency Changers. Send for your ERA catalog today!



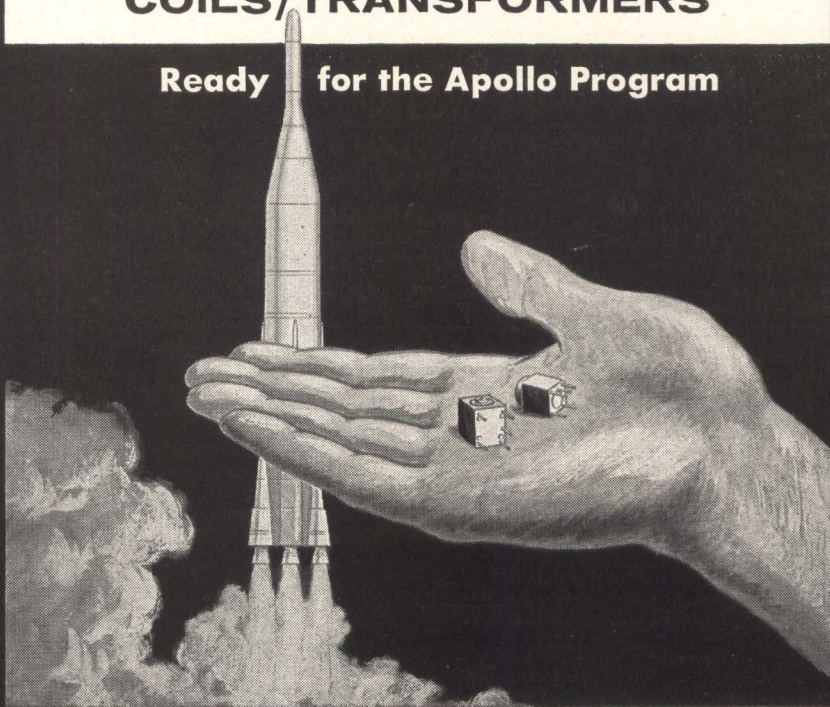
ELECTRONIC RESEARCH ASSOCIATES, INC.

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SUBSIDIARIES: ERA Electric Co. • Advanced Acoustics Co. • ERA Dynamics Corp. • ERA Pacific, Inc.
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NEW MINIATURE SHIELDED—TUNABLE COILS/TRANSFORMERS

Ready for the Apollo Program



CAREFULLY DESIGNED FOR REPEATED RELIABILITY

The basic approach taken in the design and processing techniques of Delevan's new shielded tunable coils and transformers is to advance the state-of-the-art by producing a highly reliable component to exacting requirements for the Apollo Program. Extensive environmental testing in Delevan's modern in-plant laboratory continually monitors the quality of these products, insuring repeated reliability.

DSV-DSH DESIGN FEATURES

Here are the characteristics found in Delevan's highly reliable miniature shielded tunable coils:

- Maintainable tuning core torque with repeated core cycling
- Minimum coil form thickness for highest possible "Q", and L range
- Compatibility of coil form material and potting material for maximum moisture resistance
- A tuning feature requiring no extra space provision for core in extended position
- Vibration and shockproof
- A foolproof encapsulation to eliminate possibility of improper fills or cures which may allow entry of moisture
- Electrostatically and electromagnetically shielded

For additional information write Delevan Electronics Corporation, 270 Quaker Road, East Aurora, New York, 14052.

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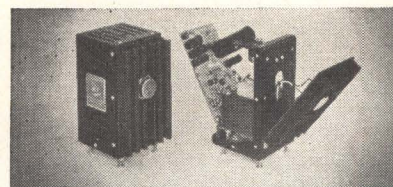
of previously available units with approximately the same electrical specifications. Utilizing silicon controlled rectifiers, the DCR150-15 is only 7 in. high. It accepts inputs centered at 208 or 230 v and delivers either constant voltage, variable from 0 to 150 v, or constant current ranging from 1.5 to 16.5 amperes. Price is \$825. Sorensen, a Unit of Raytheon Co., Richards Ave., South Norwalk, Conn.

CIRCLE 309, READER SERVICE CARD



R-F Coax Connectors Are Weatherproof

MICROMINIATURE, threaded coupling, r-f coaxial connectors are designed for use with the newest types of tiny, lightweight cable in missile satellite, shipboard, undersea and other important applications. The GM series feature a protective finger design carrying ground completely away from the contact through the connector. They are available in various configurations of plugs, jacks, receptacles, adapters, etc. Other features include low vswr and reduced noise level. Operating temperature is - 65 F to + 260 F. General RF Fittings, Inc., 702 Beacon St., Boston 15, Mass. (310)

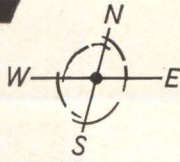


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THE SR SERIES of silicon high current modular power packs provide the full advantages of silicon semiconductor designs at prices competitive with available germanium equivalents. Units feature extremely high stability, low drift and capability of continuous opera-

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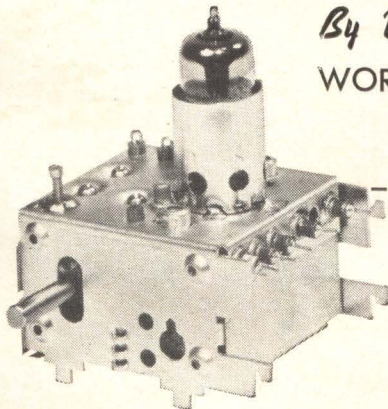
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WALLER CORPORATION, CRYSTAL LAKE, ILLINOIS

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electronics • August 9, 1963

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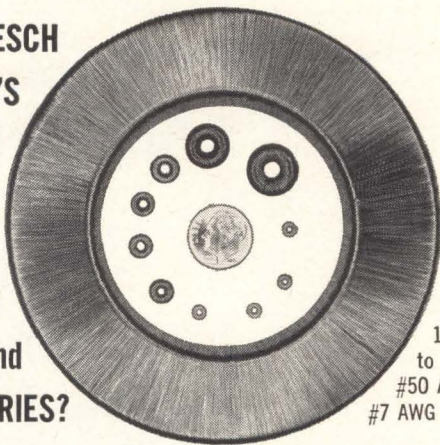
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- Megohm Input Impedance
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- Ratio & Multiple Ratio
- Scaling Function
- Trigger Level Control
- Standard Frequency Outputs
- Remote Controllable
- Printer Output
- Readout Storage
- 7 Parts in 10⁹ Day Stability
- Nixie In-Line Readout
- Decimal & Unit Display
 - Model 40-81 Fits 14" Rack (no plug-in) \$2350.00
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107

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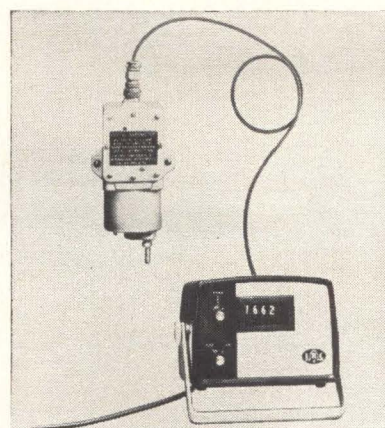
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Danbury, Conn. Tel: Pioneer 3-3886 Teletype: DANB 468

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tion at 71 C ambient with full ratings and without heat sinking or air blow. Available are units which provide the choice of d-c outputs from 0 up to 300 v d-c at current ratings of 100 ma, 200 ma, 500 ma, 1 amp, 4 amp, and 8 amp. Input is 105-125 v a-c, 50-400 cps, line regulation better than ± 0.01 percent and load regulation better than 0.05 percent. Ripple is less than 800 μ v rms. Temperature coefficient is less than 0.01 percent/deg C. Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N. J.

CIRCLE 311, READER SERVICE CARD



Pressure System Has Digital Readout

RUGGED pressure system offering laboratory accuracy under field conditions is being marketed. A servo-controlled digital readout facilitates the system's use. Accuracy of ± 0.15 percent is maintained by a built-in compensation network that adjusts for changes in line voltage, frequency, and ambient temperature. The transducer has infinite resolution; the system, excellent repeatability. Standard pressure ranges are from 0-20 in. of water to 0-600 psi; higher and lower ranges are available; power requirements are 115 v, 60 or 400 cps. Price is \$950. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. (312)

Tiny Thermistors Have High Reliability

ONLY 0.005 in. in diameter, these Micro-bead thermistors are said to have the highest power sensitivity

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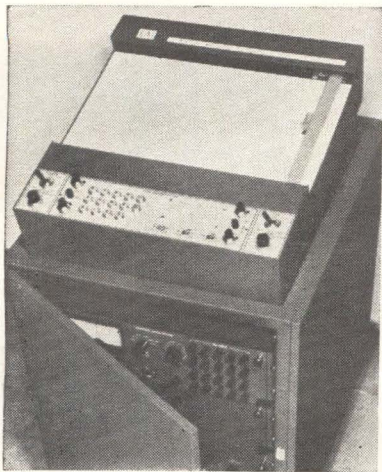
HOGAN FAXimile recorders are available with up to 2000 individual styli for simultaneous recording. A wide range of stylus spacings is offered—up to 100 to the inch for high-speed facsimile, television and radar recorders and high resolution printers and plotters. Chart widths to 30" and feed rates to 50" per second.

Hogan specializes in electrolytic techniques for event, spectrum analysis, oscillograph and facsimile recording, frequency time analysis and special purpose binary and gray scale record applications. Hogan electrolytic recording papers provide a permanent high contrast black on white record which is reproducible on most conventional office duplicators.

Whatever your recording problem may be—contact HOGAN FAXimile, a subsidiary of TELautograph Corporation, 635 Greenwich Street, New York 14, N. Y.

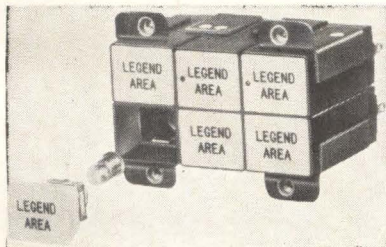
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A SUBSIDIARY OF TELAUTOGRAPH CORPORATION

presently available. They are suited for use where speed of response and low heat dissipation are critical factors: gas chromatography, high altitude temperature measurement, microwave power measurement, medical, biological uses. Victory Engineering Corp., 122-48 Springfield Ave., Springfield, N. J. (313)



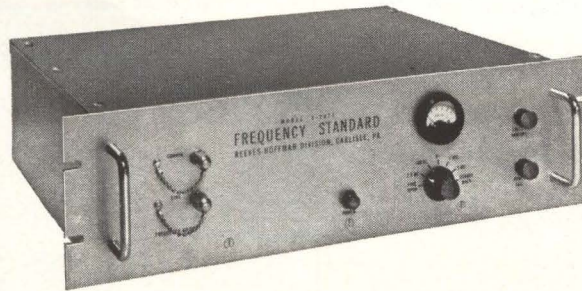
Digital Plotters Offer High Speed

LOW COST, versatile, digital plotters designed for scientific, industrial and military uses where fast, accurate, graphic recording of digital coordinate data is needed, have been announced. The 3110-3120-3130 Dataplotter series operate both on-line with a digital computer and from card or paper tape readers, and are capable of plotting points, symbols, or lines at speeds as high as 100 points or 70 lines a minute on a 10 in. by 15 in. plotting board. Electronic Associates, Inc., Long Branch, N. J. (314)



Indicator Lights in Various Cap Colors

ONE of several subminiature indicator lights available, the Modulite display module is designed for simple building block field assem-



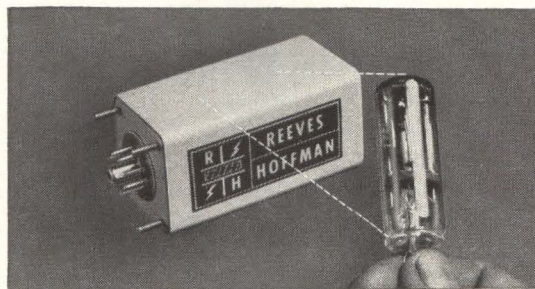
2.5 mc Frequency Standard offers stability of $2 \times 10^{-11} \left(\frac{\Delta F}{F}\right)$ per day

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 milli-second 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 5¼-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

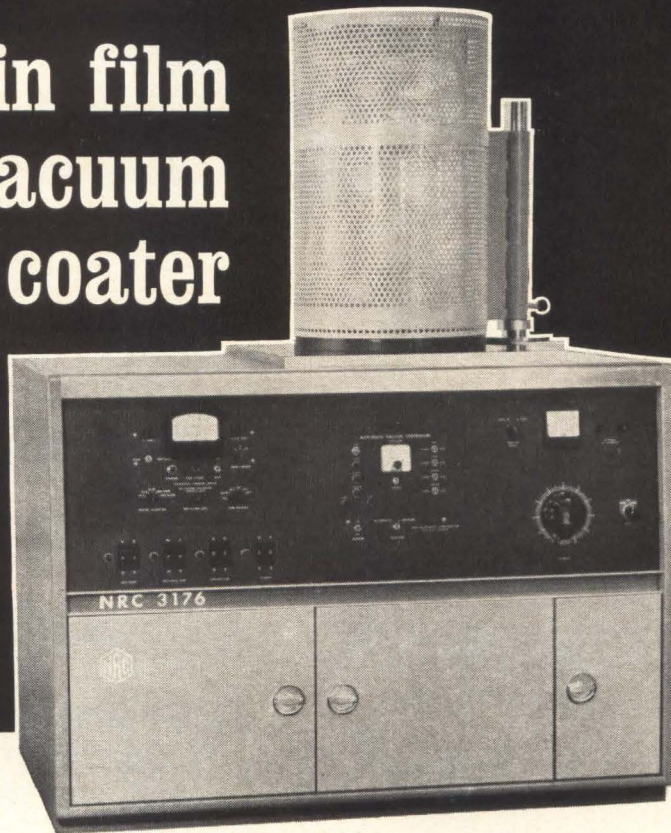


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NEW FROM NRC

thin film vacuum coater



NRC's Model 3176 Vacuum Coater is a unique vacuum evaporation system for thin film deposition in R&D and production programs. Unmatched for versatility, reliability and ease of operation, the Model 3176 is used in the areas of solid state electronics, optics, magnetic films, memory planes and solar cells.

Exclusive features include: ■ **Fastest Useful Pumping Speed** . . . with high performance, lowest backstreaming NRC diffusion pump rated at 1500 liters/sec. ■ **Highest Conductance/Lowest Outgassing** . . . with the new NRC Slide Valve which was specifically developed for maximum pump efficiency. ■ **More Efficient Baffling** . . . with single circular chevron cold trap-baffle combination. ■ **Easy, Fast Operation** . . . with all controls (manual or automatic) conveniently mounted on front panel. ■ **Maximum Versatility** . . . used with 18" or 24" work chambers — electrical and mechanical feed-throughs interchangeable.

The Model 3176 has a new sophisticated appearance and is ready to operate. Merely connect power and water supply. Write or call for data sheet.

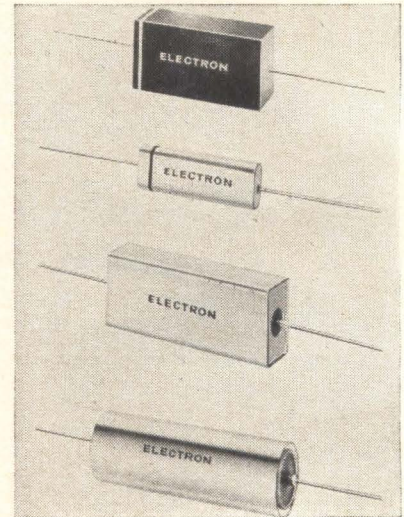


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bly. Modules can be mounted singly or grouped for multiple array. Each light assembly is a complete, enclosed unit with $\frac{3}{4}$ in. by $\frac{5}{8}$ in. full face legend area. Convenient front panel access permits simple relamping or legend change. Lens caps of translucent plastic are available in various colors. Marco-Oak Industries, Inc., 207 S. Helena St., Anaheim, Calif.

CIRCLE 315, READER SERVICE CARD

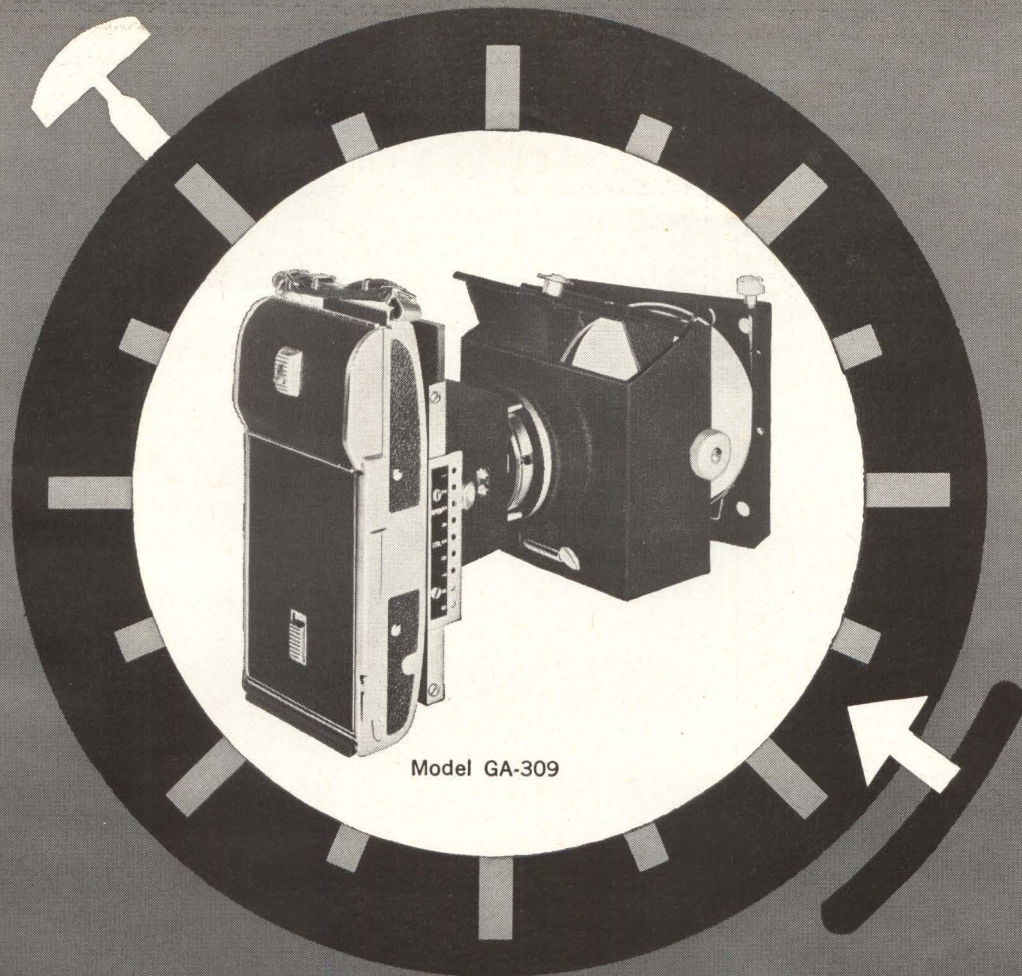


Film Capacitors of Metalized Mylar

THIN FILM metalized Mylar capacitors, series 2D, are offered in hermetically-sealed rectangular and round tubulars and wrap-and-fill and epoxy-case styles. They are available in 100 v d-c ratings, and in capacitance values 0.001 through 15.0 μ f, for operation at temperatures from -55 C to $+125$ C. Capacity tolerances of ± 20 percent are standard; tolerances to ± 1 percent are available. Units are intended for use in a range of a-c and d-c circuit applications. Electron Products Division of Marshall Industries, 1960 Walker Ave., Monrovia, Calif. (316)

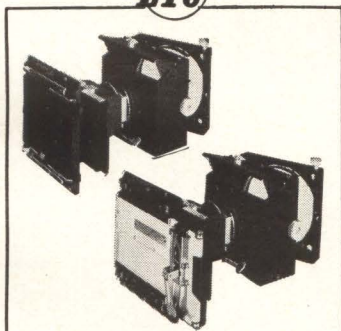
Film Resistors Are Precision Units

LINE of precision film resistors, with tolerances down to 0.01 percent and temperature coefficients standardized at 20 ppm, has been developed. The resistors will also be available at 15, 10 and 5 ppm, meeting all applicable specifications



Model GA-309

NEW "UNIVERSAL" OSCILLOSCOPE CAMERAS



INTERCHANGEABLE-BACK. USE POLAROID OR GRAFLEX. Standardize on one camera, change backs. Use Polaroid film, film negatives, or glass negatives—single or multiple exposure.

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Model GA-300A*	f/2.8 lens	\$345
Model GA-300*	f/1.9 lens	\$375
Model GA-309*	f/1.9 lens,		
	multiple exposure	\$390

*Features front-hinged, swing-away, and lift-off mount.

ONE GENERAL ATRONICS INTERCHANGEABLE-BACK CAMERA MEETS ALL YOUR 'SCOPE RECORDING NEEDS. New General Atronics GA-300 series oscilloscope recording cameras present the versatility of interchangeable-back design (models GA-301,A, and GA-309,A). Convert from multiple exposure to single exposure, or from Polaroid film to Graflex film. You can standardize on one high quality camera—add adaptors and backs at nominal accessory cost.

Complementing adaptability, General Atronics standardizes front-hinged, swing-away and lift-off mounting on all GA-300 series cameras. All attach to standard 5" bezels, or directly to scope panels. And so it goes—feature for feature, General Atronics is your best camera buy.

Check the 3-fold combination of General Atronics quality, application-adaptability, and more features per camera dollar. Send for complete data—write Dept. E8963.

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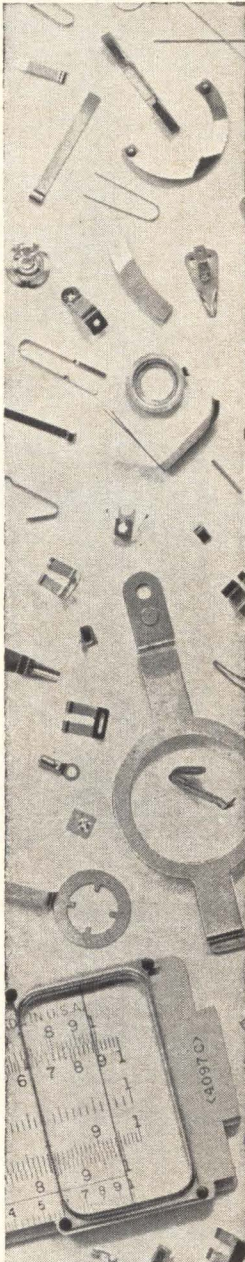
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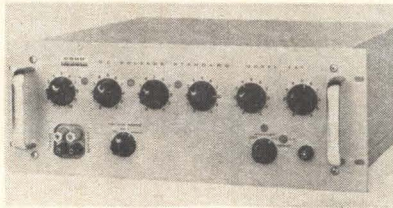
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of MIL-R-10509D. Known as the DU series, the units provide a balanced dual construction. Nominal temperature coefficient can be selected, and values of 0 ppm, or a wide variety of values from - 100 to + 1,000 ppm/deg C are available. Angstrom Precision Inc., 7341 Greenbush Ave., N. Hollywood, Calif.

CIRCLE 317, READER SERVICE CARD



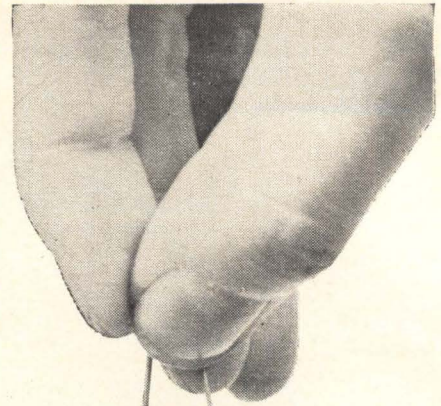
D-C Standard Has High Accuracy

PRODUCTION of a d-c standard that supplies voltages from 0 to over 1100 v has been reported. Model 321 uses six 11-position detent dials and a range switch to set the level of output voltage. Accuracy of the output voltage is within 0.01 percent of setting. Stability for eight hours is 0.0025 percent; for 30 days 0.005 percent. Current up to 25 ma is available at all voltage levels. The range switch permits selection of output voltage in three ranges. The six decades provide resolution of 10 μ v on the 10-v range, 100 μ v on the 100-v range and 1 mv on the 1,000-v range. Price is \$1,995. Cohu Electronics, Inc., 5725 Kearny Villa Rd., San Diego, Cal. (318)



Wideband Amplifier Spans 15 cps to 180 Mc

MODEL 104 wideband amplifier has 15 cps to 180 Mc frequency response, and a usable gain to 300 Mc. Response is ± 0.5 db from 25 cps to 150 Mc. Instrument consists of three separate amplifiers which



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CARBON FILM RESISTOR

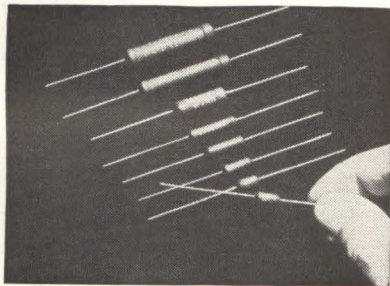
Rohm

TOYO ELECTRONICS INDUSTRY CORPORATION

P. O. BOX 103 CENTRAL KYOTO JAPAN

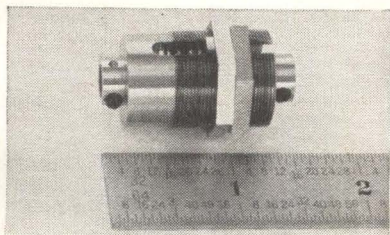
CIRCLE 209 ON READER SERVICE CARD
August 9, 1963 • electronics

can be used individually or in cascade for an overall gain of 100 (40 db). Two amplifiers are identical, with gains of 10 (20 db), 50-ohm input impedances, and max outputs of 1.4 v (peak-to-peak) into a 50-ohm load. The third amplifier is a unity-gain (zero db) impedance matching amplifier with a 1-meg-ohm, 10-pf input impedance. This amplifier reduces loading and matches other impedance systems to a 50-ohm coaxial system with no loss. Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio. (319)



Silicone Resistors Offered in 8 Sizes

A LINE of miniature silicone precision resistors in eight sizes ranging from 1 to 12.5 w is offered. The S-Coat units are developed for circuitry where low temperature coefficient (± 20 ppm) and close accuracy (± 1 percent or closer) must be combined with characteristics such as low drift, no noise, high momentary overload capacity, resistance to vibration and zero voltage coefficient. S-Coat resistors, designed to exceed MIL-R-26C for Characteristics G or V, are available in a wide range of resistance values. Ward Leonard Electric Co., Mount Vernon, N. Y. (320)

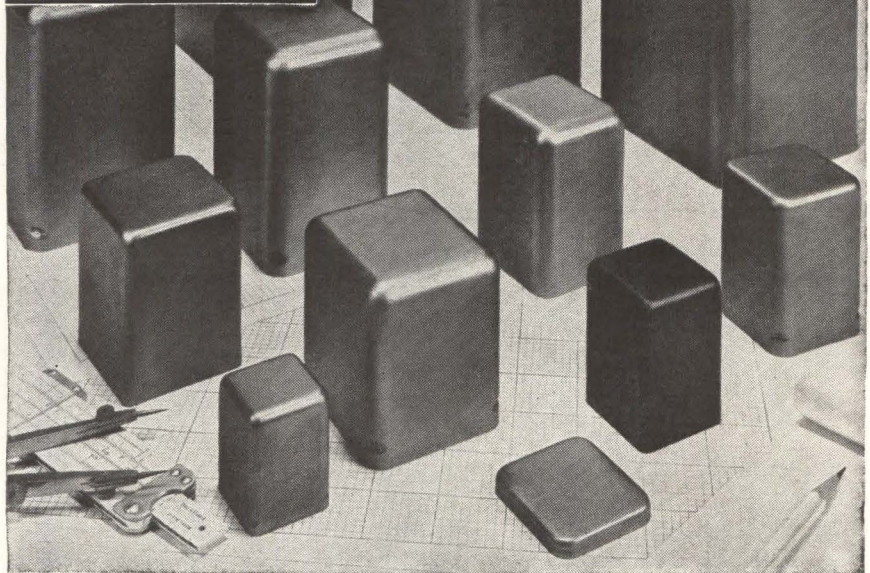


Slip Clutches Are Torque Limiting

IN-LINE slip clutches can be used to limit torque or prevent overloading between rotating components

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on the West Coast

• *What are your casing problems? Let our specialists help you solve them.*

The Pacific Division of the Arnold Engineering Company makes the most complete line of cans and mounting hardware on the Coast—all produced to exacting standards of quality and finish. Included in the extensive range of steel cans, end bells and brackets for mounting transformers are all necessary standard shapes and sizes to meet Mil-T specifications.

Also included are cans drawn and fabricated from high permeability materials such as Mumetal and

4750. These and other nickel-iron alloys are available to help you solve shielding problems where transformers must be protected from the effects of stray magnetic fields.

New press equipment is available to produce special drawn shapes quickly, and with a minimum of tooling cost, to meet your requirements. Other Arnold Pacific Division products for the transformer industry include a complete line of silicon steel and nickel-iron laminations. Thin-gauge parts and "miniatures" are a specialty. *We'll welcome your inquiries.*

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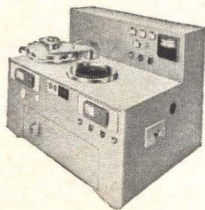
PACIFIC DIVISION

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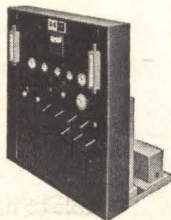
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New Hayes Graphite Element Vacuum Furnace develops vacuums from several hundred microns down to 10^{-4} Torr and temperatures from ambient to 4500°F... in minutes. Brings new economy to solution and precipitation hardening, brazing, annealing, tempering, sintering, degassing.



New Hayes H₂ Generator combines high-pressure ammonia dissociator and palladium alloy diffusion cell in a compact unit that produces ultra-pure hydrogen at the lowest cost ever. Savings can amortize the unit's cost in 1 year or less.

Demonstrations of both units will be conducted by Herb Western, Howie Ogert, Bill Diman, Stu Ashton, Bill Allen and Carl Paulson. Meanwhile, for complete facts, Write C. I. Hayes, 845 Wellington Ave., Cranston 10, Rhode Island.



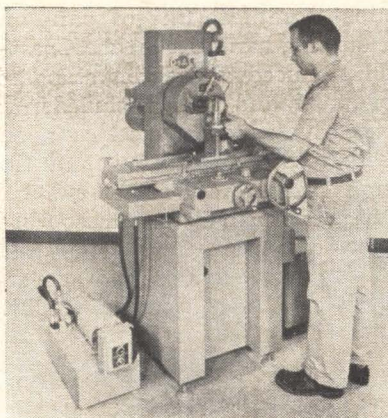
ESTABLISHED 1905

without the necessity of adding idler gears, extra shafts, bearings, etc. The torque limiting feature is a spring-loaded cork-to-steel disk. It can be attached directly between two concentrically aligned shafts and fixed into position by inserting roll pins or gear clamps. Torque adjustment is accomplished easily by rotating one of the hex type jam nuts, using the other jam nut as a locking device. Slip torque can be varied from 0 to 50 in. oz. Clutch is available in shaft sizes of 0.120, $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in., or any combination of these sizes. Sterling Instrument, 76 East 2nd St., Mineola, N. Y.

CIRCLE 321, READER SERVICE CARD

Custom-Coded Encoders For Digital Systems

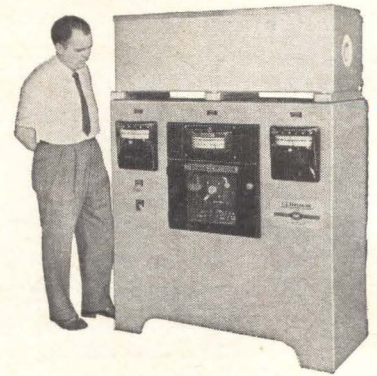
CUSTOM-CODED analog/digital shaft position encoders for digital information and control systems are available. Custom coding allows designers of digital systems to specify position feedback or manual input devices that will work directly into variously designed digital computing circuits without additional code translation circuitry. The encoders are a brush-type design, with capacities of 5 to 11 bits per disk providing 30 to 2048 counts per revolution—each count a separate code or shaft position. Warner Electric Brake & Clutch Co., Beloit, Wis. (322)



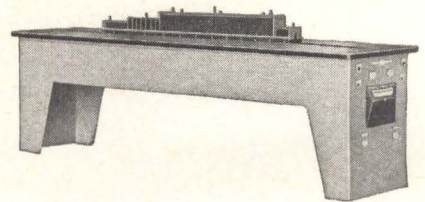
Slicing Machine For Crystal Wafering

LOW-COST model 40 I/D Micro-Slicer crystal wafering machine is designed specifically for research and development applications. Man-

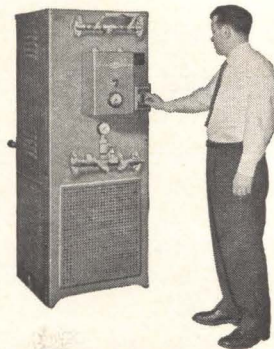
diffusion furnace



glass diode furnace



dry-box air dryer



for semi-conductor production

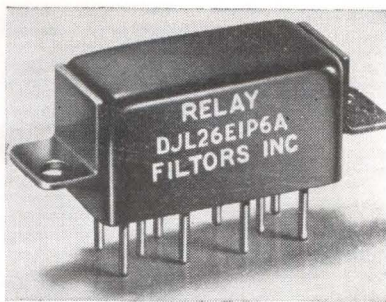
Newest developments from the oldest manufacturer of electric industrial heating equipment! C. I. Hayes performance-proved furnaces, dryers, atmosphere generators are ready to help you get maximum yields of quality work... whether you're producing solid state devices, connectors, vacuum tubes, magnetrons, or waveguides. Ask for Data Sheets F-3 (Diffusion), F-2 (Soldering), and DAG-1 (Dryer). C. I. Hayes, Inc., 845 Wellington Ave., Cranston 10, R. I.



ESTABLISHED 1905

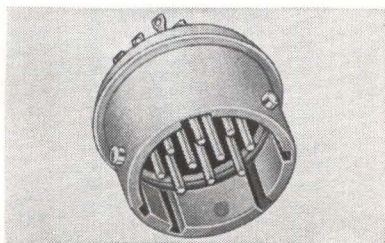
CIRCLE 210 ON READER SERVICE CARD
 August 9, 1963 • electronics

ually operated, this machine is priced for laboratory or limited production. Cutting is done with a stainless-steel wheel that has the inside diameter of a 0.006 or 0.008-in.-thick diamond cutting edge. Wafers are produced with superior finish, flatness and parallelism. Kerf loss is said to be reduced 40 to 50 percent over other slicing techniques. The DoALL Co., Des Plaines, Ill. (323)



Latching Relay Features Small Size

HALF-SIZE crystal-case magnetic latching relay is announced. The two-coil unit is sealed with a new electron-beam welder which welds without contaminating flux in a near perfect vacuum. This offers users highest relay reliability. Unit conforms to requirements of MIL-R-5757D. Temperature range is -65 to 125 C. Dielectric strength is 1,000 v rms, 500 v rms between contacts. Insulation resistance is 1,000 megohms minimum; contact arrangements, 1 or 2 pdt; contact rating: 2 amp resistive, 4 amp overload. Filters, Inc., East Northport, N. Y. (324)



Multi-Pin Connectors Rated at 5 Amperes

BROAD range of multi-pin connectors in the MIL C 26482, MIL C 5015, and MIL C 25955 series are introduced. They are rated at 5 amp with peak voltages at 1000. All are hermetically sealed and have a leak

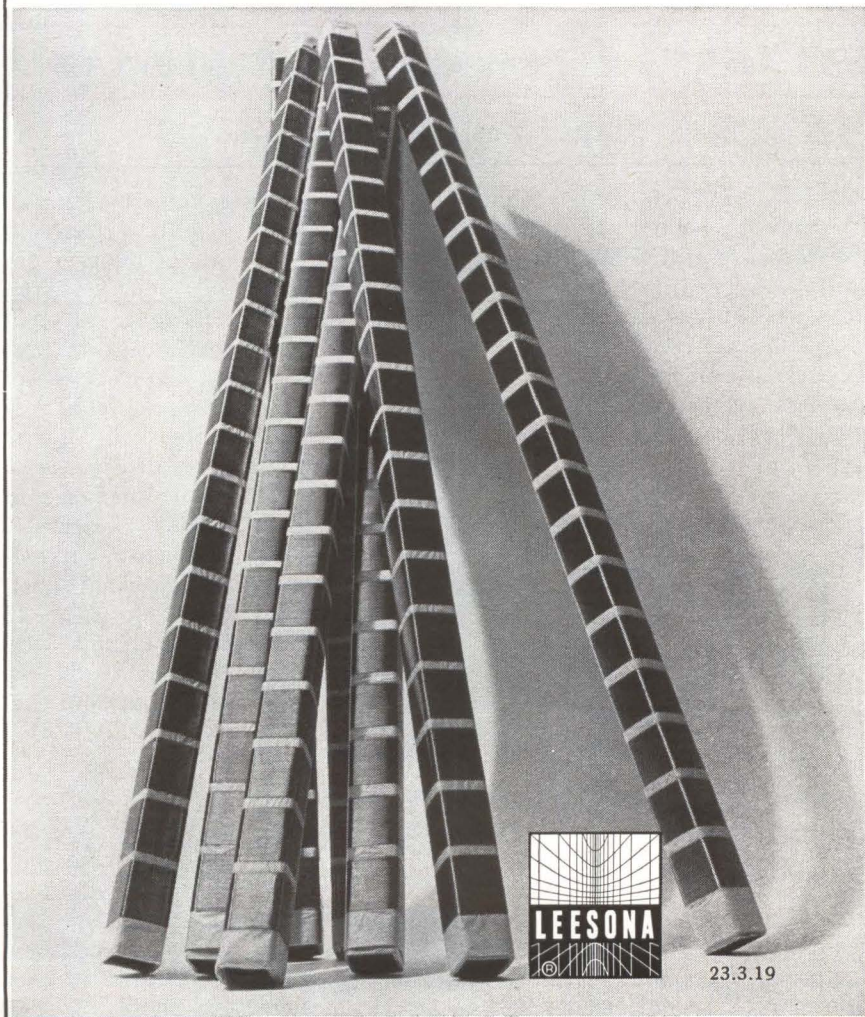
for top efficiency in winding stick-wound coils

Whatever your production requirements—long runs, short runs, special jobs, automatic or manual operation—there's a precision-engineered Leeson coil winder admirably suited to meet them.

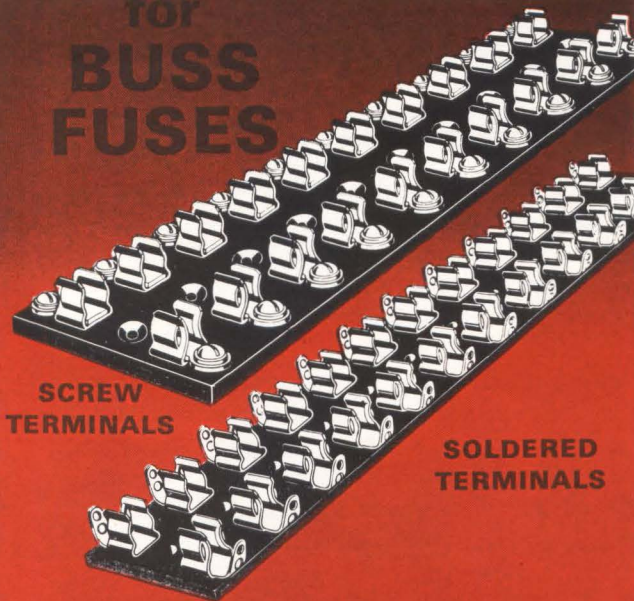
For long runs, Leeson No. 107 automatic coil winder will give you volume production. Automatic paper feed up to 15 inserts a minute, electronic speed control, maximum density winding, up to 28" stick; automatic spiral winding, easy transfer of wire turns, paper-miss detector, one operator can run two or more machines. Wire sizes No. 19 to No. 50 (B&S).

For short runs, Leeson No. 108 will give you quick setup and ease of operation for maximum production flexibility. Principal adjustments can be made in less than two minutes. 2400 rpm maximum winding speed. Auxiliary gearing to space wire sizes No. 10 to No. 50 (B&S). New "Programonitor" stops machine automatically for multiple taps—eliminates banks of counters.

Write Leeson Corporation, Warwick, Rhode Island. Or call Leeson at 5700 W. Diversey Ave., Chicago 39, TU 9-5735; 1500 Walnut St., Philadelphia 2, KI 6-1720, or A. R. Campman & Co., 1762 W. Vernon Ave., Los Angeles, AX 3-6265.



BLOCKS for BUSS FUSES



Standard type — 1 to 12 pole.

BUSS

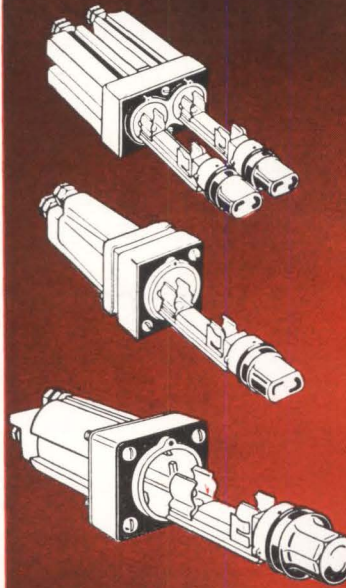
Write for BUSS
Bulletin SFB.

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

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Bulletin SFB.

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

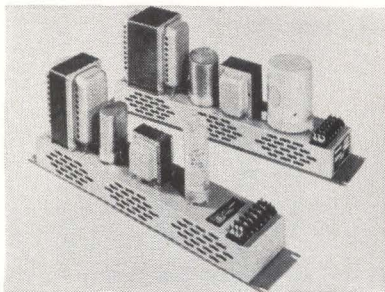
BUSS: the complete line of fuses.

CIRCLE 117 ON READER SERVICE CARD

CIRCLE 117 ON READER SERVICE CARD

rate of less than 10^{-8} cc of helium as measured on mass spectrometer at a pressure differential of one atmosphere. The line is available in shell sizes and in standard shell and contact finishes for most popular applications. Dage Electric Co., Hurricane Road, Franklin, Ind.

CIRCLE 325, READER SERVICE CARD



D-C Power Supplies Suited for Bench Use

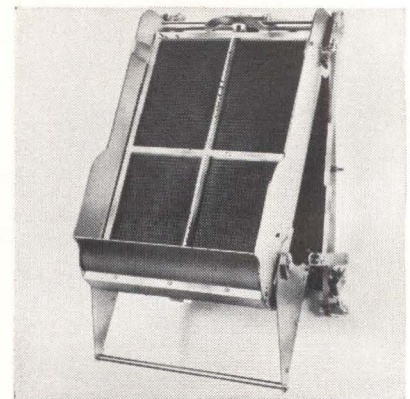
LINE of Powerguard solid state fixed d-c voltage power supplies are announced. Depending on output voltage specifications, load regula-

tion ranges from less than 1 percent to 4 percent with output voltage maintained at ± 1 percent for ± 15 percent input voltage variation. Units are designed so that there are no "hot" leads or terminals above the chassis, except for the terminal block. They are therefore well-suited for bench operation and provide increased safety in routine maintenance of rack-mounted units. Inherently self-protecting automatic current-limiting design provides load short-circuit protection. A total of 18 different units are available with power ratings from 50 to 300 w. Stancor Electronics, Inc., 3501 Addison St., Chicago 18, Ill. (326)

Inductive Components Are Custom Designed

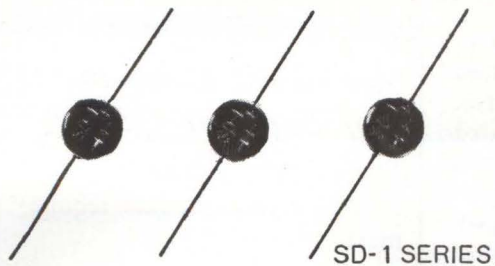
NOW BEING OFFERED are custom-designed components, including complex wave filter networks designed for operation within the frequency range of 400 cps to 100 Mc. Specific

types include r-f and i-f coils and transformers, oscillator coils, band pass filters, and electromagnetic delay lines. Recoil Products Division of Hi-G, Inc., Bradley Field, Windsor Locks, Conn. (327)



Programming System Fits Standard Rack

MODEL 909, a new plugboard programming system to provide flexible program control in electronic equipment, is available. It has



SD-1 SERIES

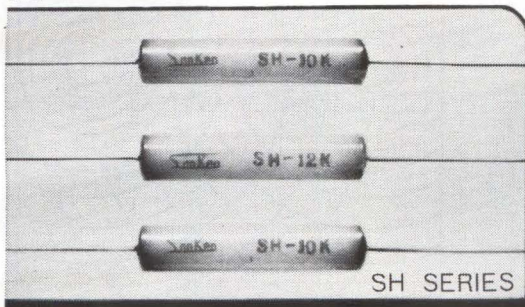
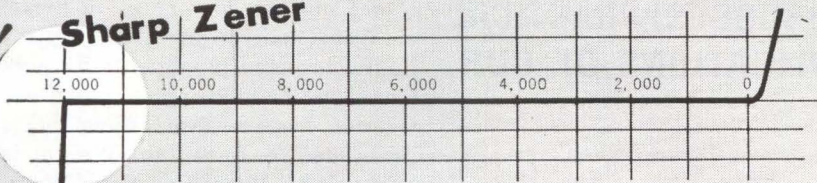
GREATER STABILITY & HIGHER RELIABILITY LOWER PRICE

by Resin Molding Process

Completely Passivated!

Performance is unchangeable
by time or environment

Sharp Zener



SH SERIES

For High Voltage Supplies
SH Series

SH-6K	PRV 6,000 v	DC 30 mA
SH-8K	8,000	30
SH-10K	10,000	30
SH-12K	12,000	30

For TV Sets
SD-1 Series

SD-1	PRV 400 v	DC 500 mA
SD-1A	600	500
SD-1B	800	500
SD-1C	1,000	500

Sanken

SANKEN ELECTRIC CO., LTD.

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Cable: SANKELE TOKYO

CIRCLE 211 ON READER SERVICE CARD

..... of unquestioned high quality

BUSS FUSEHOLDERS



- LAMP INDICATING
- SIGNAL ACTIVATING
- SERIES HKA

For 1/4 x 1/4 inch BUSS GLD Fuses, 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.

CIRCLE 117 ON READER SERVICE CARD

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.

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Just call
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IN PROBLEM-SOLVING
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MEASURING EQUIPMENT

SEE US AT WESCON (Booth 4017) where we'll show you the latest "frontiers" in this fast-moving area of electronics.

If you can't be there, we'll bring a **DEMONSTRATION** of our equipment right to your own lab. Write for a demonstration. Circle inquiry number for full specifications.

GAUSSMETERS — Today's most complete line. Portable and laboratory instruments to measure fields from .001 gauss to 30,000 gauss, full scale.

"HALL-PAK" HALL DEVICES — 10 devices to meet a growing variety of magnetic probe applications.

HALL MULTIPLIERS — for application in power measurement, phase meters, analog computers, modulators and many others.

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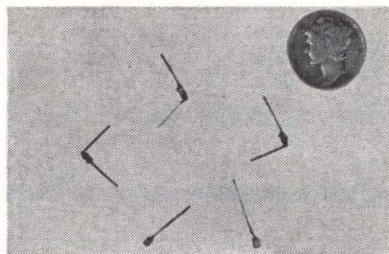
4017

IT'S
MAGNETIC

BOOTH 4017, WESCON, AUG. 21-23

3,264 positions and is designed to fit standard racks. System includes receiver, plugboard and plugwires. Receiver is of satin chrome plated steel and is equipped with a mechanical interlock to prevent closing if the plugboard is not properly seated. Receiver panels and plugboards available in phenolic or diallyl phthalate material with choice of contact springs in nickel or gold plated beryllium-copper. Easily inserted plugboards have 48 horizontal and 68 vertical positions. Overall system dimensions: 17 $\frac{1}{8}$ in. by 26 $\frac{1}{2}$ in. by 6 $\frac{1}{8}$ in. Weight is 52 lb. MAC Panel Co., High Point, N. C.

CIRCLE 328, READER SERVICE CARD



Capacitors Are Ultraminiature

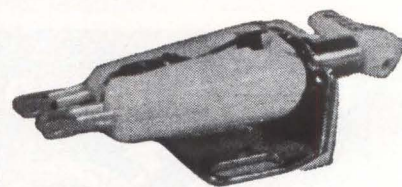
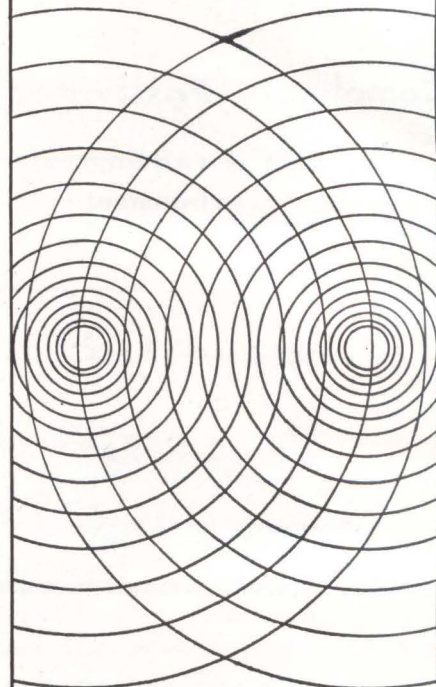
NOW AVAILABLE are capacitors measuring 0.125 long by 0.060 wide by 0.040 thick, which will cover the range of 0.022 μ f at 20 v to 2.2 μ f at 2 v. This should interest design engineers working on integrated circuits or thin film circuits who are faced with the need to provide relatively large capacity values in their circuitry. Price range is from \$1 to \$2, depending on quantity. Components, Inc., Biddeford, Maine. (329)

Ammonia Dissociator Cuts Costs

PRODUCING high-purity, low-dew-point atmospheres of 75 percent H₂ and 25 percent N₂ at the rate of 20 SCFH, a laboratory model (AD20) ammonia dissociator provides semiconductor manufacturers with a low-cost, experimental means of comparing the relative merits and costs of dissociated ammonia and hydrogen in alloying, soldering and brazing processes. Company says semiconductor pro-

Acoustical Components of Superior Quality

JAPAN PIEZO supplies 80% of Japan's crystal product requirements.



STEREO CARTRIDGE Crystal — "PIEZO" Y-130 X'TAL STEREO CARTRIDGE

At 20°C, response: 50 to 10,000 c/s with a separation of 16.5 db. 0.6 V output at 50 mm/sec. Tracking force: 6 ± 1 gm. Compliance: 1.5 × 10⁻⁶ cm/dyne. Termination: 1M Ω + 150 pF.

Write for detailed catalog on our complete line of acoustical products including pickups, microphones, record players, phonograph motors and many associated products.



JAPAN PIEZO ELECTRIC CO., LTD.

Kami-renjaku, Mitaka, Tokyo, Japan

BURN-OUT PROOF
SHOCKPROOF



**NEW ac/dc OMNI-METER
SOLID STATE
SUPERIORITY**

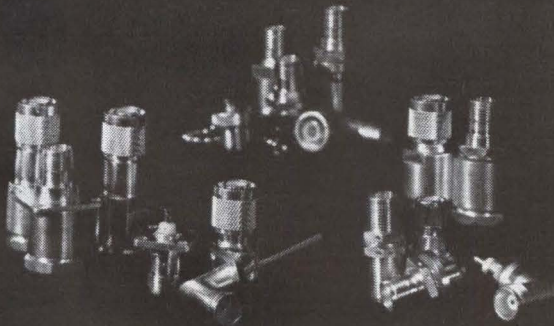
K-mag 600 Omni-Meter is the first precision test instrument with all prime functions that is burn-out proof and shockproof. A new type second-harmonic magnetic amplifier, taut-band meter, and solid state circuits make the K-mag 600 exceptionally rugged, yet highly accurate. Its $\pm 1\%$ accuracy is not even damaged by such overload abuse as dead shorts across a 1000 volt supply on the ampere and ohm ranges. The special magnetic amplifier features no zero drift with extreme linearity and gain stability. Push button controls, single probe for all functions, and automatic polarity switching for simplified operation. Measurement functions include AC-DC volts, AC-DC amps, and ohms. The rugged K-mag 600 will maintain its rated accuracy for years without recalibration. Request Bulletin 600 from Keinath Instrument Company, 1313 Chesapeake Avenue, Columbus 12, Ohio.

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the finest precision
coaxial connectors*



*TNC

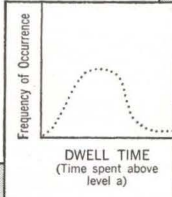
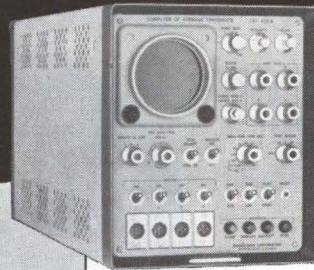
General RF Fittings, Inc.

702 BEACON STREET, BOSTON 15, MASSACHUSETTS
Telephone: 617 267-5120

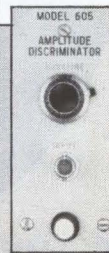
CIRCLE 214 ON READER SERVICE CARD

electronics • August 9, 1963

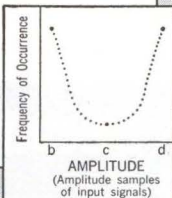
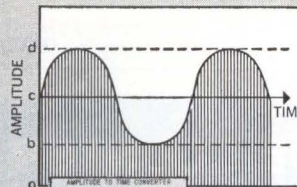
**NOW -- THE MNEMOTRON CAT*
OFFERS INCREASED ON-LINE
FLEXIBILITY FOR HISTOGRAMS**



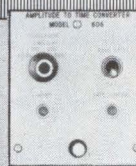
Model
605



Model 605 Amplitude Discriminator — accepts analog signals and provides a bar graph of the time an analog signal exceeds a preset threshold level; dwell time histograms are therefore computed.



Model
606



Model 606 Amplitude to Time Converter provides for the gating of analog signal inputs to permit sampling of the signal at rates up to 1800 times a second and sorts amplitudes into 400 separate addresses; amplitude density spectra determinations are thereby performed.

MNEMOTRON's Computer of Average Transients, the CAT 400B, is unique in its ability to isolate transient signals from high background noise. Now — with the addition of two accessories — CAT 400B provides expanded capabilities for computation of specialized on-line histograms. An unlimited number of histograms are easily performed.

Capabilities include: ■ Distribution of intervals between events ■ Distribution of pulse amplitudes ■ Amplitude density spectra ■ Dwell time histograms. Our Applications Department would be happy to discuss your particular histogram requirement.

* Patented



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CIRCLE 119 ON READER SERVICE CARD

119

NEW ... for designers of microminiature circuits that require MICROMINIATURE COMPONENTS

WESCON BOOTHS 320-321

MINIKIN is the only connector of its size that is weatherproof...with bayonet lock. Excellent VSWR!

Use wherever RG196/U Cable is used

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9700-1	Jack	RG196/U
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9702-1	Single Hole Mount Jack Receptacle	
9656-1	Single Hole Mount Feed Thru Jack to Jack	
9654-1	Right Angle Single Hole Mount Jack Receptacle	
9653-1	Right Angle Solder Mount Jack Receptacle	
9657-1	Single Hole Mount Jack	RG196/U

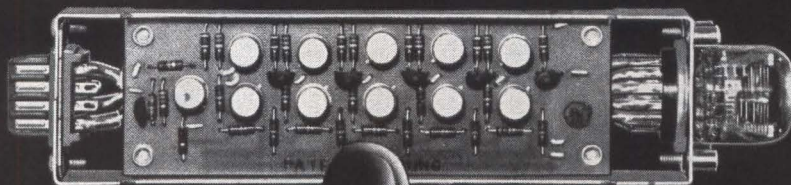


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INDIANAPOLIS TELEPHONE
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CIRCLE 215 ON READER SERVICE CARD

DECADE COUNTER MODULES



- ▶ One circuit counts and drives the display
- ▶ Only one power supply voltage required

Anadex now brings you the lowest-priced, solid-state NIXIE® display counters available. Featuring low power consumption—only 15 ma per decade at 230 v DC, they require only one power supply voltage. Compact design—only 1 3/4" x 1 1/4" x 6 1/2"—permits use in 1 3/4" rack panel.

See us at WESCON
Booth 4138

Anadex INSTRUMENTS, INC.

7617 HAYVENHURST AVENUE, VAN NUYS, CALIFORNIA
Phone: 213-873-6620 TWX: 213-781-6811

MODEL DC-100

Counting rate: 0-100 KC
Display: Ultra long-life, wide-angle NIXIE tube.
Unit Price \$94 each including NIXIE tube.

MODEL DC-101

Same as Model DC-100, except provides 10-line decimal electrical read-out in addition to NIXIE tube.

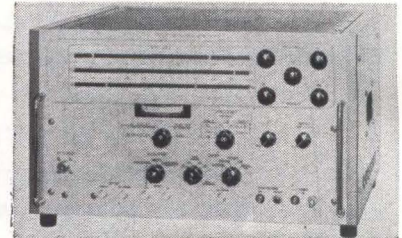
Unit Price \$109 each including NIXIE

MODEL DC-102

Preset decade counter module. Same as Model DC-100, except a 10-position preset switch is substituted for NIXIE tube. Provides voltage level change at coincidence.
Unit Price \$109 each.

®REGISTERED TRADE MARK BURROUGHS CORP.

ducers who have converted from hydrogen to dissociated ammonia report cost reductions ranging between 60 and 80 percent without deterioration of product quality. C. I. Hayes, Inc., Cranston, R. I.
CIRCLE 330, READER SERVICE CARD



Sweep Signal Generator Offered in 5 Ranges

NEW 630A series provides in one transistorized instrument precise frequency tuning plus known absolute power output of 10 dbm leveled to better than $\pm 1/2$ db at rated output over each range. The series is available in 5 ranges: 1-2, 2-4, 4-8, 8-12.4 and 12.4 - 18 Gc. Frequency is continuously adjustable over the entire range of each instrument. Balanced bolometers assure constant power output over wide temperature range. Adjustable markers on the slide rule dial, calibrated in Gc, determine the upper and lower limits of sweep range. A separate marker is used to set single frequency operation. Two electronically generated pips, for frequency calibration of external equipment, may be set with additional markers. Alfred Electronics, 3176 Porter Drive, Palo Alto, Calif. (331)



Function Generator Offers Delayed Output

NOW BEING OFFERED is the type 255 function generator with a ramp output having a totally independent time base from the other functions of square, triangle and sine waveform. By using this feature and the triggering capabilities of the other

waveforms, delayed output functions are available. Exact Electronics, Inc., 455 S. Second Ave., Hillsboro, Ore. (332)



Vacuum Evaporator for Thin Film Research

MODEL VE-20 vacuum evaporator employs pressure-programmed electronic circuitry to achieve completely automatic control of all valving-pumping sequences. Operational sequences of start, vent and stop are push-button-initiated and require no valving decisions by the operator. Typical pump-down performance is approximately five minutes to 1×10^{-5} torr or better. Ultimate pressure without liquid nitrogen in the cold trap is in the 10^{-7} torr range, with liquid nitrogen in the 10^{-8} torr range. An 18-in. by 30-in. bell jar with implosion shield and automatic motor-driven hoist is standard. Mikros, Inc., 7634 SW Capitol Highway, Portland 19, Ore. (333)



Sine-Wave Oscillator Has Low Distortion

MODEL RCD-2 is an ultra-pure sine-wave oscillator featuring extremely low distortion and accurate frequency selection over the frequency range of 0.1 cps to 99.9 Kc. Patented circuitry produces an open

NEW from DEI

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SIMPLICITY ...

STABILITY ...

AN ADVANCED
PCM
SIMULATOR



- Accurately Calibrated Clock
- Simplified Programming and Operation
- Zero Referenced Output
- Up to One Megabit for all Formats

Another new digital product from Defense Electronics, Inc. for calibration and checkout of PCM telemetry systems and components is the PTS-2A Simulator . . . available NOW!

It is versatile enough to simulate signals—from 1 bit to 1 million bits per second—ordinarily received from satellites and space vehicles yet sufficiently flexible to permit exercising PCM telemetry stations.

PRECISE calibration of the bit-rate (up to 1 mc) is achieved through a stable, accurate internal clock (within 0.1%) with thumbwheel control and exponential "push button" range selection.

SIMPLIFIED operation and rapid selection of code and word length is afforded through use of three-position bit-switches.

STABLE bit-rate is assured by a temperature-controlled, servo-stabilized bit-rate oscillator.

The all solid-state PTS-2A features true linear phase plug-in filter cards for exact simulation of transmitted waveform, inputs for superimposing jitter and noise in the output and a front-panel frame pulse output for synchronization of an oscilloscope. A modular, detachable power supply . . . and color-coded, keyed digital cards facilitate maintenance.

Write for DEI bulletin PTS-2A . . . or call:



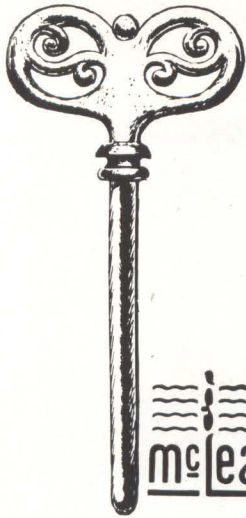
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Defense Electronics, Inc.

Main Office:

5455 Randolph Rd. Phone: 301-WH 6-2600
Rockville, Md. TWX: 301-949-6788

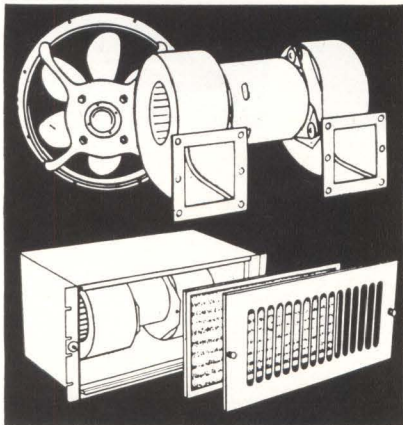
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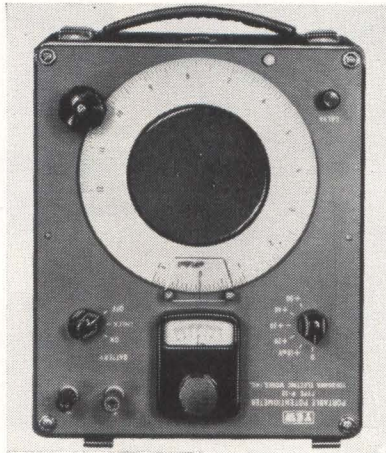
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circuit output of 5 v rms with max distortion of less than 0.02 percent from 90 cps to 20 Kc, and less than 0.1 percent at 20 cps and 99.9 Kc. Output amplitude exhibits less than 0.01-percent jitter, noise and short term variation, and less than 0.02-percent variation with a 10-percent line voltage change. Output frequency is accurate within ± 1 percent, is independent of line or load variations, and changes less than ± 0.025 percent per deg C. Optimization, Inc., 7243 Atoll Ave., N. Hollywood, Calif.

CIRCLE 334, READER SERVICE CARD



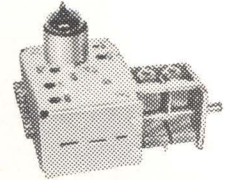
Potentiometer for Checking Millivolts

PORTABLE potentiometer, model P-32, is designed for quick and precise calibration of millivolt sources in the field. It measures -1 to $+62$ mv to an accuracy of $\pm (0.1$ percent $+ 50 \mu v)$. Each 10-mv increment is spread out on a 6.5 in. diameter dial with 200 graduations, each representing $50 \mu v$. Zener diodes regulate reference voltage. The standard cell is not required. Self-powered, the unit operates on two 6.5-v mercury cell batteries. Size is $8\frac{1}{2}$ in. by 10 in. by $6\frac{1}{2}$ in. Weight is 14 lb. Price is \$330. Yokogawa Electric Works, Inc., 40 Worth St., New York 13, N. Y. (335)

Encapsulated Toroid Features Durability

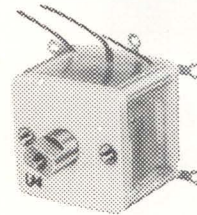
TYPE ET encapsulated toroidal inductor is available. Two case sizes with inductance ranging from 2.6 millihenries to 30.4 henries are offered. The encapsulated enclosure provides a unit of unusual durabil-

• AM-FM Tuner Unit •



AM SEC. CAPACITY: MAX. 377PF
 :MIN. 12PF
 TUBE: 6AQ8, 12DT8, 17EW8

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CIRCLE 216 ON READER SERVICE CARD

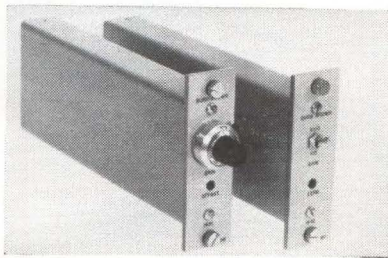
electronic and armament systems research specialists

To perform analysis translation of system requirements into performance specifications. Prepare subsystem and system error analysis for parametric tradeoff system optimization, prepare studies in weapon system effectiveness, terminal ballistics, vehicle penetration and attrition and target vulnerability. Perform basic or applied research to the solution of current design development, production, service and operational problems. Develop new mathematical concepts to handle advanced problems in the field of systems design and interpretation.

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ity under the most severe environmental conditions. The molded header-terminal assembly permits an excellent seal and assures dimensional stability. Pin terminals are arranged on 0.10 in. grid spacing for rapid, errorless p-c board installation. From 2 to 8 terminals can be supplied to satisfy a variety of applications for inductors, tapped inductors, and transformers. Sangamo Electric Co., Springfield, Ill. (336)

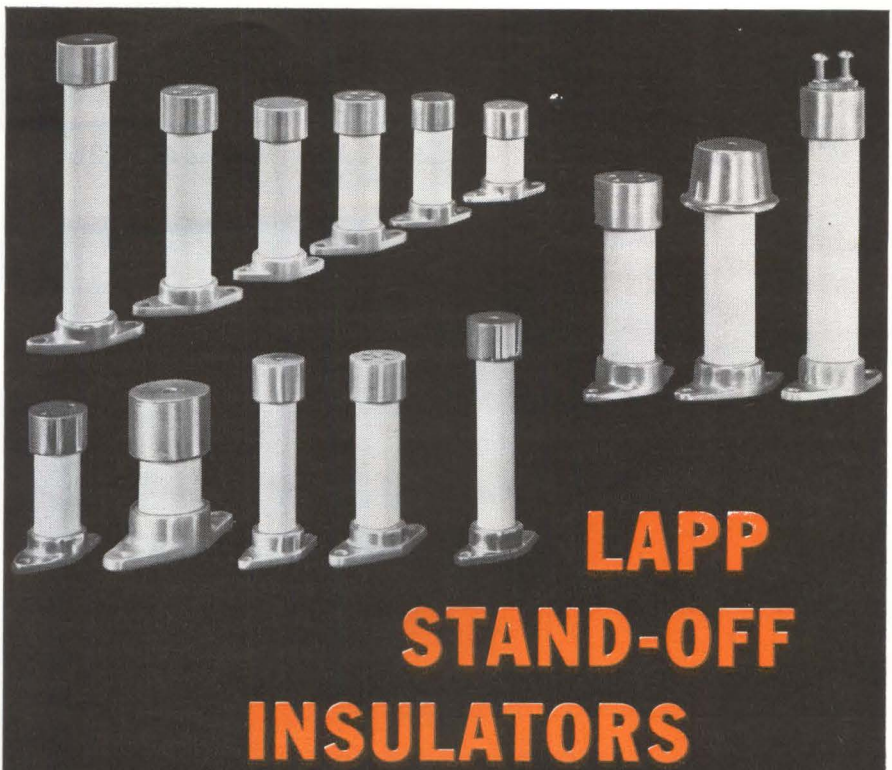


Galvanometer Driver Coupled with Preamp

CONTINUOUSLY adjustable gains from 0 to 1000 with 1-percent response from d-c to 5 Kc are featured by the combination of model 1631 galvanometer driver and the model 1632 preamplifier. Up to 8 pairs of the all-solid-state units can be mounted in a 3½-in. by 19-in. rack space. Model 1631 provides a 10-turn, locking potentiometer for continuously-adjustable gain control, and an electrical offset control over the full output range of ±10 v at 100 ma. The galvanometer is protected by positive output current limiting and matched with selectable output impedance. Model 1632 provides selectable gains of 10 and 100 with input impedance greater than 1 megohm. Drift and noise are held to less than 25 μv/deg C and 10 μv, rms, respectively. Burr-Brown Research Corp., Box 6444, Tucson, Ariz. (337)

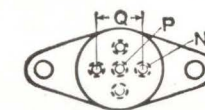
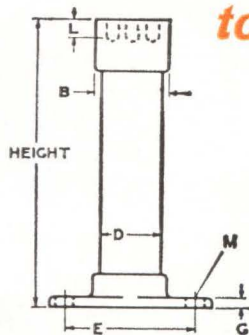
Time-Delay Unit Is Solid-State Device

SOLID-STATE time-delay unit in the half-size crystal can relay package has been developed. Designed to meet all applicable military environmental specifications, the new timing capsule provides accurate,

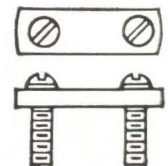


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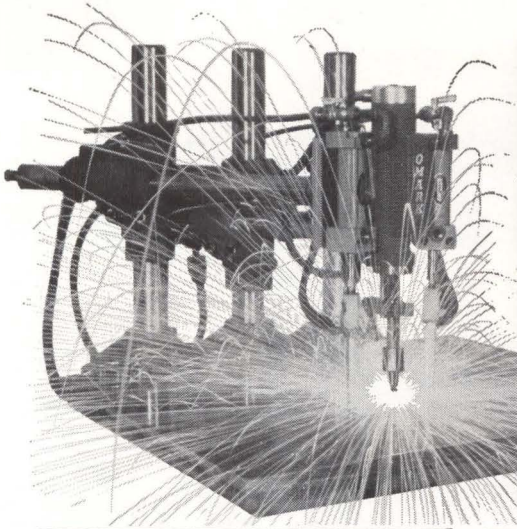
Cat-log No.	Material	Cantilever Strength inch-pound	Height in inches	B	D	E	G	L	M	N	P	Q
14761 24229	Porcelain Steatite	375 450	4-6-8	1 3/8	1	2 1/4	3/16	3/32	3/32	1/4-20	1/4-20	3/16
14760 24114	Porcelain Steatite	600 700	4-6-8-10	1 5/8	1 1/4	2 5/8	7/32	3/8	3/32	1/4-20	1/4-20	1 3/16
22408 41775	Porcelain Steatite	1200 1400	6-8-10-12	1 7/8	1 1/2	2 7/8	1/4	7/16	3/32	1/4-20	1/4-20	1 3/8
13981 24110	Porcelain Steatite	1800 2100	6-8-10-12	2 1/4	1 3/4	3 3/4	1/4	5/16	1 1/32	5/16-18	5/16-16	1 1/4
42588	Porcelain	4000	6-8-10-12	3 1/8	2 1/2	5	3/8	1/2	1 1/32	5/16-18	5/16-16	2

Lapp

Insulators shown are standard. Similar insulators available with caps or bases on both ends.

WRITE for Bulletin 301-R.
Lapp Insulator Co., Inc.,
207 Sumner Street, LeRoy, N. Y.

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RELAY CASE SHOWN FULL SIZE. 1—Looking directly into 0.011" case; no distortion, burn-through. 2 and 3—Diagonal views showing clean welding of small studs to thin nickel-silver case. 4—End view: accurately and permanently positioned studs.

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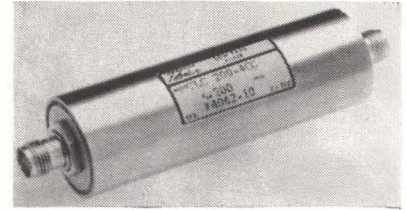
OMARK INDUSTRIES, INC.

CIRCLE 124 ON READER SERVICE CARD



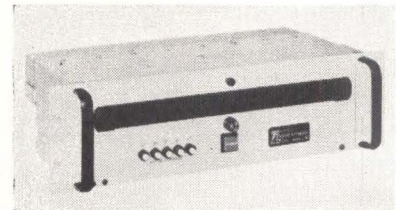
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repeatable delays ranging from a few millisecond up to 60 sec. The timing is externally controlled and may be used to trigger a companion half-size four-pole crystal can relay. The timing package will operate over a temperature range of - 65 C to + 125 C and under vibration levels of 20 g from 5 to 2,000 cps. Branson Corp., 41 South Jefferson Road, Whippany, N. J.
CIRCLE 338, READER SERVICE CARD



Low-Pass Filters Have Low Insertion Loss

A SERIES of low-pass Chebishev filters feature insertion losses as low as 0.05 db. Filter is a modular type, model TLC, made up of 1 to 8 resonant sections (3 to 17 poles), depending on the filtering characteristics desired. Its design permits any cut-off frequency to be specified from 50 Mc to 1500 Mc, and limits insertion losses to 0.05 db per section. A full 8-section filter will therefore exhibit only 0.4-db loss while providing 60-db rejection at 1.2 f_c . Impedance is 50 ohms, vswr is 1.5/1 max, and power rating is 300 w. Telonic Engineering Corp., 480 Mermaid St., Laguna Beach, Calif. (339)



Multiplexer Is Ground Based

SERIES OM2000 ground based Caplexer, a transistorized time division multiplexer employing a capacitive charge sampling technique, is announced. This sampling technique enables the use of greatly reduced sampling apertures, efficient pre-sampling filtering, intermixed signal level capability and

There's nothing so simple or satisfactory as recording with



High-altitude weather data from radar ceilometer is recorded instantly and vividly on ALFAX electro-sensitive paper. 20-minute-chart segment shows returns to 30,000 feet.

Progressive innovators are obtaining vital information never before possible and often unsuspected in such fields as . . .

■ **LONG RANGE RADAR DETECTION**

As opposed to scope cameras, operator sees returns instantly, evaluates more rapidly, gets permanent record with increased sensitivity.

■ **RADAR SAMPLING**

Tone shades keyed to signal intensity provide vivid "picture" of radar return even when bulk of data is gated out.

■ **SONAR ACTIVE AND PASSIVE**

Unparalleled identification and location of returns even in poor signal to noise ratio through integrating capability of Alfax paper.

■ **OCEANOGRAPHY**

High resolution capability, dynamic tone shade response with Alden recording techniques adding synchronizing ease provide "optimization" of underwater sound systems.

■ **FREQUENCY ANALYSIS, SAMPLING AND REAL TIME**

Intensity modulation and frequency vs. real time provide continuous vital information with permanence and past history to achieve previously unattainable evaluation.

■ **SEISMIC STUDIES**

Dynamic response at high writing speeds yields discrete geological data at resolution never before possible.

■ **HIGH SPEED FACSIMILE**

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- broad, dynamic response of 22 distinct tone shades
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- records in the sepia area of the color spectrum where the eye best interprets shade differentials in diminishing or poor light
- writing speed capabilities from inches per hour up to 1400 inches/second
- captures 1 microsecond pulse or less
- dynamic range as great as 30 db
- integration capability for signal capture in signal to noise ratio conditions worse than 1 to 4
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By merely passing a low current through Alfax everything from the faintest trace signal of microsecond duration to slow but saturated signal can be seen instantly, simultaneously.

Alfax Paper, roll-in presentation recorder labs and component recorders for your own experimentation are all readily available.



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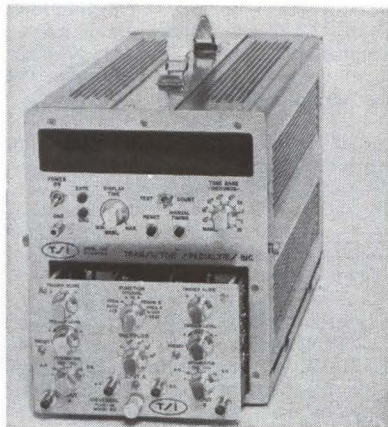
Alden Research Center, Westboro, Mass. Dept. A-1

CIRCLE 217 ON READER SERVICE CARD electronics • August 9, 1963

can provide optional simultaneous sampling. Units provide front panel control of either sequential or binary address operating modes. Sampling rates as high as 200 Kc are available. Full scale input of ± 25 mv to ± 10 v are available in standard units. Either floating or single ended input systems can be accommodated with very high common mode rejection available. Sampling apertures as low as 0.25 μ sec are available. Towson Laboratories, Inc., 200 E. Joppa Road, Baltimore, Md. (340)

Encapsulating Press For Components

MODEL 359E press is a 10-ton capacity unit for straight semiautomatic molding as well as for semi-automatic compression or transfer molding. It is designed specially for encapsulation of electrical and electronic components. Hull Corp., Hatboro, Pa. (341)



Modular Counters Measure to 500 Mc

MODEL 500 solid-state counter has a direct count capability of 100 Mc and, when used in conjunction with turret-tuning model 520 frequency extender plug-in, it facilitates measurements to 500 Mc in six fixed steps. Overall capabilities of the 500 series instruments include precision frequency measurements from d-c to 500 Mc, time interval and period from 0.1 μ sec to 10 sec (periods averaged over 1 to 10⁵ periods) and frequency ratio from 0 to 20 Mc over 1 to 10⁵ periods for greater resolution. Sensitivity is 100 mv for a-c or d-c signals, with stability better than ± 2 parts in 10⁵ per week. Transistor Specialties, Inc., 11 Terminal Drive, Plainville, N. Y. (342)

Instant Graphic

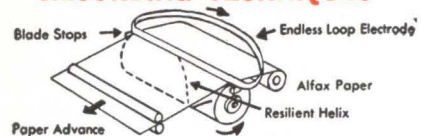


Helix recording of ultrasonic inspection of rocket case-to-liner bond. Dynamic tone shades accurately portray bonding effectiveness — middle tones show porous areas; light spots are bubbles.

Simple, reliable Alden "flying spot" helix recording techniques— combined with ALFAX electro-sensitive paper produce visible, informative "pictures" of sonar, radar, infrared and other instrumentation outputs. Pulse length, relative strength and timing of electronic signals are continuously integrated on a single real-time recording. Data from sampling arrays, time-base signals, or scan or sweep sources are synchronized with the Alden "flying spot" helix and presented as scale model "visual images" of observed phenomena, with new and essential meaning instantly revealed.

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EXCLUSIVE ALDEN RECORDING TECHNIQUES



Resilient helix provides low inertia, constant electrode pressure over a wide range of recording speeds. Endless loop electrode deposits ions on the Alfax Paper when a signal appears on the helix. The electrode "blade" moves continuously to provide a freshening of its surface, for thousands of feet of continuous recording. Precision blade stops maintain precise, straight-line electrode relationship to the resilient helix, while protecting paper sensitivity by acting as paper chamber seal-off.

Alden "flying spot" recorders are available . . .

- for any recording speed from 8 rpm to 36,000 rpm
- with any helix configuration — linear 360° sweep — nonlinear — reciprocating — multi-helix
- in any record size — 2", 5", 8", 11", 19" . . . to five foot widths
- plus plug-in modular construction — interchangeability with a high degree of flexibility and adaptability

It's simple to get started.



Alden "flying spot" Component Recorders, detachable drives, plug-in electronics, accessories are available to incorporate the Alden instant graphic recording techniques into your instrumentation.

Alden instant graphic recording laboratories — complete with all plug-in units and accessories for fast set up — to cover a variety of recording modes — are available.

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Westboro, Mass.

CIRCLE 125 ON READER SERVICE CARD 125

SYNC SHUTTER NOW STANDARD



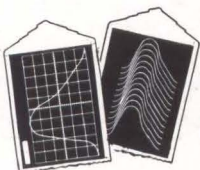
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Literature of the Week

SERVOAMPLIFIERS Helipot Division of Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif. Data sheet 63542 covers three models of transistorized servoamplifiers. **CIRCLE 343, READER SERVICE CARD**

THIN-FILM FLIP-FLOP Halex, Inc., 139 Maryland St., El Segundo, Calif. Specification sheet on model 1010FF microminiature thin-film flip-flop provides complete specifications with diagrams. **(344)**

D/A CONVERTER Scientific Data Systems, 1649 Seventeenth St., Santa Monica, Calif., has published an information bulletin describing a simplified method of digital-to-analog conversion. **(345)**

COAXIAL DIRECTIONAL COUPLERS Philco Corp., Sierra Electronic Operations, 3885 Bohannon Drive, Menlo Park, Calif. Bulletin describes eight coaxial directional couplers which provide overlapping coverage of frequencies from 1 to 1,200 Mc at power levels up to 1,000 w. **(346)**

THERMISTORS Victory Engineering Corp., 122-48 Springfield Ave., Springfield, N. J., offers a data sheet on ultra-small, ultra-sensitive Micro-Bead thermistors. **(347)**

MICROMINIATURE ACCELEROMETERS Columbia Research Laboratories, Woodlyn, Pa. Data sheet covers latest models in the 606 series of high sensitivity, very high frequency response microminiature accelerometers. **(348)**

HEATING EQUIPMENT C. I. Hayes, Inc., 800 Wellington Ave., Cranston 10, R. I. A 4-page bulletin describes and illustrates practically every type of industrial heating equipment used in the manufacture of solid state electronic devices. **(349)**

RECORDER/REPRODUCER Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. Capabilities of the type VR-3600 predetection magnetic tape recorder/reproducer are described in a 4-page bulletin. **(350)**

GALLIUM ARSENIDE Sylvania Electric Products Inc., Towanda, Pa., announces availability of a technical information bulletin on gallium arsenide. **(351)**

CABINET COOLING PANEL Rotron Mfg. Co., Inc., Woodstock, N. Y., has made available a technical data sheet on the Twinpax-2 cabinet cooling panel. **(352)**

AMMETER AND AMPLIFIER Kin Tel division, Cohu Electronics, Inc., Box 623, San Diego 12, Calif. The 203A d-c microvolt ammeter and amplifier is described in data sheet 16-5. **(353)**

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CIRCLE 218 ON READER SERVICE CARD
August 9, 1963 • electronics

Del. Specification guide cites the proper Alathon polyethylene and Zytel Nylon resins for insulating and jacketing many kinds of wire and cable. (354)

DATA REFERENCE FILE Hammarlund Systems and Instruments Co., 185 Dixon Ave., Amityville, L. I., N. Y. File contains information on systems and components for: industrial tone signaling; data acquisition, logging and readout; modular electrical instrumentation. (355)

D-C AMPLIFIERS Cemco Instruments, P.O. Box 355, Alamo, Calif. Data sheet No. 3 covers model 1502 silicon transistor and 1503 germanium transistor d-c amplifiers. (356)

TRANSDUCERS Endevo Corp., 801 South Arroyo Parkway, Pasadena, Calif., has published a specification comparison sheet that organizes differences for handy reference between its 25 piezoelectric transducers. (357)

INSULATING MATERIALS Westinghouse Electric Corp., Micarta Div., Trafford, Pa. Information on 19 insulating materials—varnishes, impregnating resins, and enamels—has been issued in the form of individual loose-leaf technical data sheets. (358)

FERROMAGNETIC PLASTICS The Polymer Corp., 2120 Fairmont Ave., Reading, Pa. A 10-page manual provides design and engineering data on ferromagnetic plastics. (359)

RANDOM NOISE GENERATOR Quan-Tech Laboratories, Inc., Boonton, N. J., is offering a technical data sheet describing the model 420 random noise generator. (360)

STORED PROGRAM SIMULATOR Telemetrics, Inc., 12927 So. Budlong Ave., Gardena, Calif., has released 4-page data sheet No. 42 on model 513 stored program simulator. (361)

FREQUENCY CONTROL HANDBOOK Hill Electronics, Inc., Mechanicsburg, Pa. A 44-page handbook and catalog lists standardized crystals, filters and frequency sources. (362)

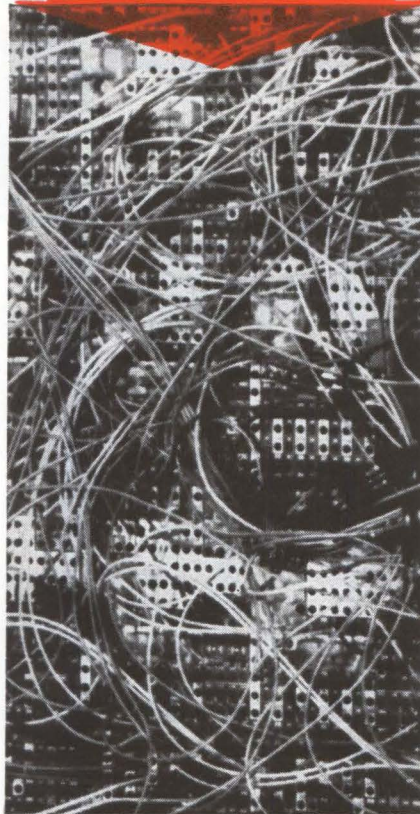
STATIC INVERTER Microdot Inc., 220 Pasadena Ave., South Pasadena, Calif., has available a data sheet on the laboratory model 1S106 250 v-a static inverter. (363)

TUBES AND SEMICONDUCTORS Thor Electronics Corp., 287 Morris Ave., Elizabeth, N. J. A 16-page catalog lists over 4,000 tubes and semiconductors by type along with their prices. (364)

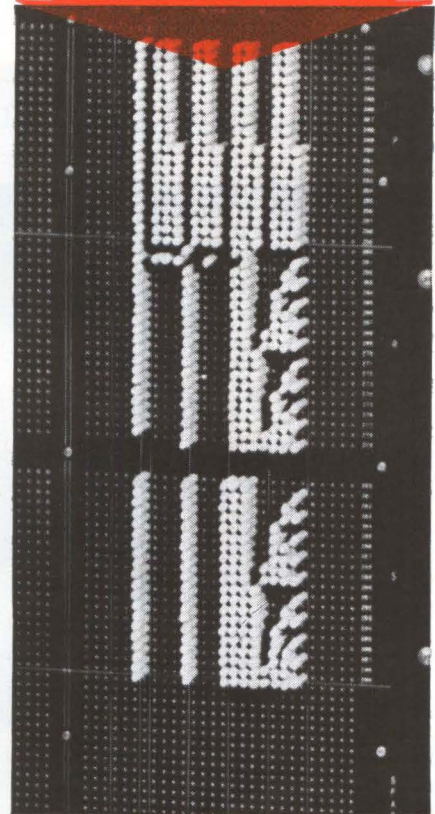
TRAVELING-WAVE TUBES Calvert Electronics Inc., 220 E. 23rd St., New York 10, N. Y. Bulletin No. 616 describes two new English Electric Valve traveling-wave tubes for microwave links. (365)

A-C LINE VOLTAGE STABILIZERS General Electric Co., Schenectady 5, N. Y. Bulletin GEA-7376 discusses voltage stabilizing devices for sophisticated and highly automated equipment. (366)

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**WESCON
63!**

**WESCON TEAM:
Townsend and Granger**



SHARING top responsibilities for this year's WESCON are two native-born Midwesterners who have long been prime movers behind the dramatic growth of the electronics industry in the San Francisco Bay area:

- John V. N. Granger (right) who heads up the Palo Alto firm bearing his name, is chairman of the convention's Executive Committee

- Calvin K. Townsend, board chairman of Jennings Radio in San Jose, is serving as chairman of WESCON's Board of Directors.

GRANGER—Named "The Outstanding Young Electrical Engineer of 1952", Granger earned his AB Degree in physics and mathematics from Cornell College in his home state of Iowa, went on to receive an MA in communications engineering at Harvard. The early days of World War II found him instructing Army and Navy officers at Harvard's pre-radar school and he later served in France as a technical advisor in radar countermeasures to the First Tactical Air Force.

Returning to Harvard after VE Day, he earned his PhD with a thesis on low-frequency aircraft antennas, then moved West to

organize an antenna research program at Stanford Research Institute. Prior to forming Granger Associates in 1956, he established a reputation as a top authority in several areas of electronics, including advanced communications techniques, ECM, and aircraft antennas.

Granger's early interest in a career in journalism and art are evident in his current activities. The articulate recipient of IRE's Seventh Region Achievement award in 1955 has served on the Board of Governors of the Committee for Art at Stanford, and is much in demand as a toastmaster and after dinner speaker. He readily delegates responsibilities in his fast-growing organization, but points out that he personally is "the principal keeper of the corporate image."

"John has an over-riding interest in people," comments a long-time business associate. "He likes to get to know people in depth, and probably has as many truly close friends as anyone in the industry."

TOWNSEND—One of these friends is Cal Townsend, who for the past four years has been a fellow member of the WESCON

Board. Born in Lima, Ohio, he graduated from the University of California at Berkeley, and for the next 18 years, was active in the field of business organization in Northern California. He teamed up with Jo Emmet Jennings in 1942 to found the company today recognized as a basic supplier of non-thermionic devices in the Western World. Jennings Radio, recently annexed as a wholly-owned subsidiary by ITT, has also made substantial inroads in the communications field, and manufactures high-power electrical devices for public utilities and other industrial electrical customers.

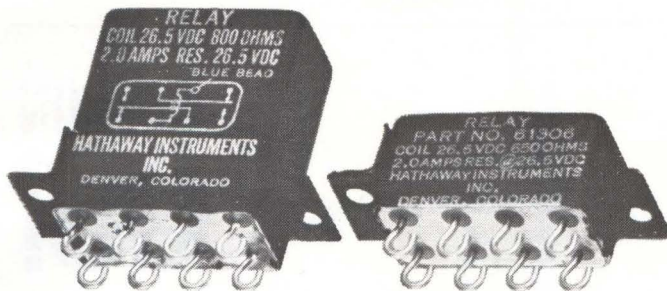
Long active in Bay Area industry affairs, Townsend was an early advocate of a strong industrial association for the Western states and was instrumental in forming what is now the Western Electronics Manufacturers Association. He served successively as its treasurer, vice president, and president (1957) and is a past chairman of its San Francisco council.

Townsend is a staunch supporter of the trade convention concept for cross-fertilization of ideas. "No amount of reading of journals and papers," he claims, "can ever quite equal the extraordinary good that accrues from face-to-face trading of information and ideas, at seminars, and in formal meetings, at booths and in corridor conversations." He hastens to point out that the "Western" in WESCON can be misleading—60 percent of this year's booth space will be occupied by companies from East of the Rockies.

An astute businessman, and shrewd judge of people, Townsend admits that some of his talents may be inherited. Years ago his paternal grandfather introduced Townsend's Snake Oil, a product which is still being distributed in Kentucky. One of the product's more promising salesmen was a poetically inclined youth named James Whitcomb Riley.

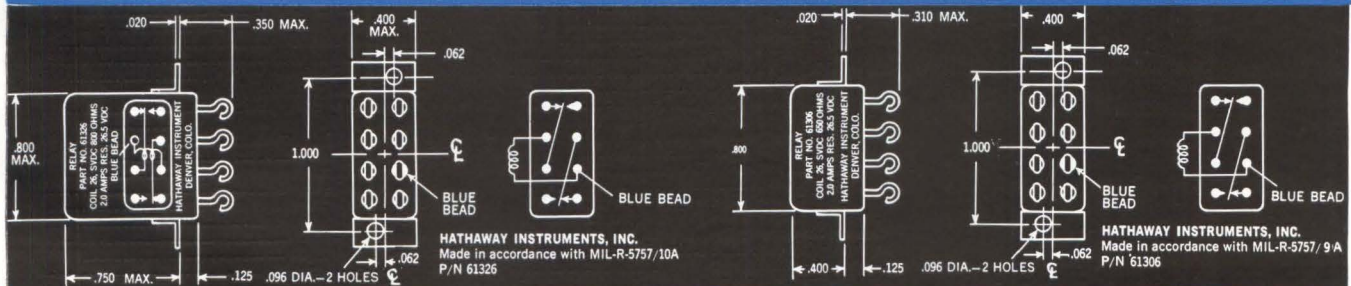
**Sylvania Promotes
R. W. Payne**

ROBERT W. PAYNE has been named manager of the electronics manu-



SMALL ANSWERS FOR BIG PROBLEMS

HATHAWAY crystal case relays—because of their small size, reliability, and bent for all-purpose duty—are an ideal answer for the toughest switching problem. They're rugged enough for military use, yet sufficiently inexpensive to fit many commercial applications. ■ The half-size relay, while somewhat less inexpensive than its bigger brother, loses none of its reliability. And in some respects (e.g., vibration and timing), it out-performs the full-size unit. Where weight or size is a consideration, this design is the better choice. ■ In addition to meeting all standard military requirements of MIL-R-5757D, variations in mounting, termination, coil resistances, and operating parameters are available in both unit sizes. Chances are, there's a Hathaway relay for your requirements, or we can make it.



SPECIFICATIONS	FULL SIZE	HALF SIZE
CONTACT ARRANGEMENT	Double Pole, Double Throw	
CONTACT RATING	2.0 AMP Resistive @ 26.5 VDC	
TEMPERATURE RANGE	-65°C to +125°C	
VIBRATION	15G, 10 to 2000cps	20G, 10 to 2000cps
SHOCK	50G with an 11 ± 1 MS time duration	
COIL VOLTAGE (NOMINAL)	26.5 VDC (other voltages available as needed)	
OPERATE TIME	6.0 MS Max. at 25°C	4.0 MS Max. at 25°C
RELEASE TIME	6.0 MS Max. at 25°C	4.0 MS Max. at 25°C
CONTACT BOUNCE	1.0 MS Max. at 25°C	2.0 MS Max. at 25°C
COIL RESISTANCE	800 OHMS ±10% at 25°C for 26.5 VDC	650 OHMS ±5% at 25°C for 26.5 VDC
MINIMUM OPERATING VOLTS	18.0 VDC Max. for 26.5 V Nom.	
WEIGHT	0.7 Oz. Max.	0.3 Oz. Max.
P/N	61326	61306

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5800 EAST JEWELL, DENVER 22, COLO.



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reson-ator

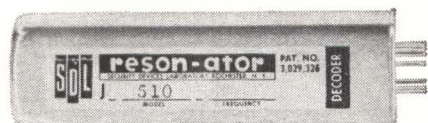
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ELECTRONICS DIVISION OF
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facturing plant of Sylvania Electric Products Inc. in Muncy, Pa. He was formerly manufacturing superintendent at the plant.

The announcement was made by Charles W. Hosterman, manager of manufacturing for the eastern operation of Sylvania Electronic Systems, a division of the company. The Muncy facility produces a variety of electronic component assemblies which are used in military systems produced by the operation. Payne succeeds Orville Jensen who has resigned.

Name Emanuelson Vice President

ROY EMANUELSON has been named a vice president and director of the Power division of High Voltage

Engineering Corp., Burlington, Mass.

Emanuelson joined the company in 1949 and has served in several key posts. Most recently he has been responsible for developing the insulating core transformer, a major new product of the company.

Porter Organizes New Company

ERNEST A. PORTER, former chairman of the board of Boonton Electronics Corp., has announced formation of a new corporation, Porter Electronic Laboratories, in Boonton, N. J.

The new firm will market precision test equipment.

WESCON

Exhibitors and Booth Numbers

WESCON 63!

A

Abscoa Industries	705
Ad-Yu Electronics, Inc.	4233
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Accurate Instrument Co.	4322
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Ace Engineering & Machine Co., Inc.	1311
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Aerojet-General Corp.	1117
Aerovox Corp.	211
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Camblock Div., Waltham Precision Instrument Co., Inc.	814

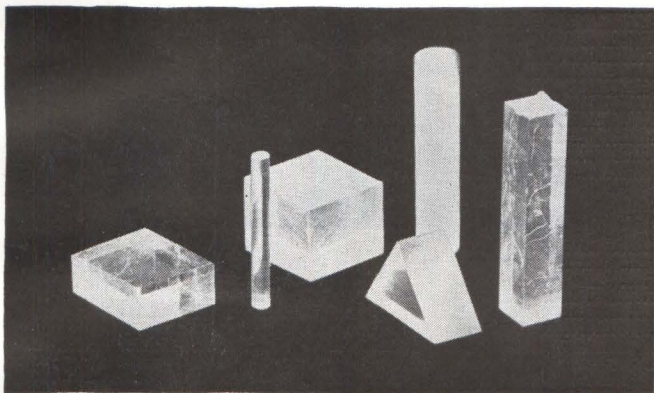
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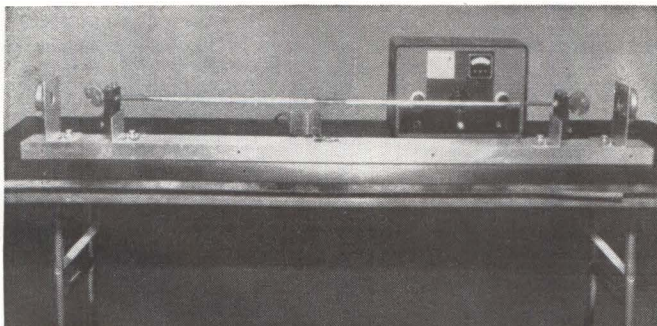
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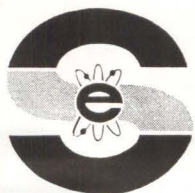
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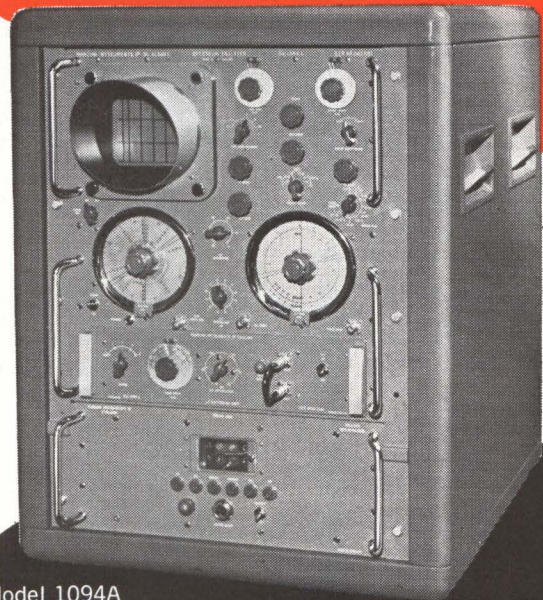
electronics • August 9, 1963

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3 mc to 30 mc
6 cps selectivity

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- 60db dynamic range.
- Selectivity 6 cps, 30 cps and 150 cps.
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THE SERVO ANALYZER

'The Mercury' Model 1990 SERVOMATIC® ANALYZER

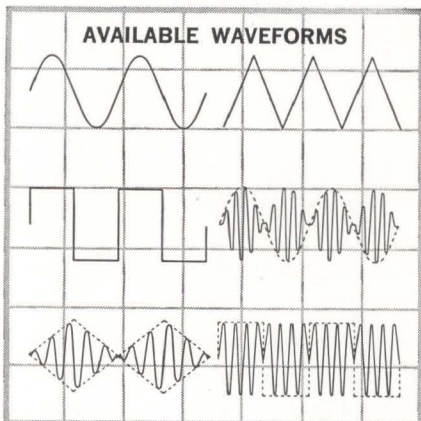


This all new, all electronic servo analyzer offers new capabilities to meet the ever growing needs of production test, field checkout, and laboratory analysis of automatic control systems. Following are just a few of the expanded features of the Model 1990:

- Modulation frequencies continuously tunable in five ranges from 0.005 cps to 1 KC
- Carrier frequencies from 50 cps to 10 KC
- Eleven waveforms available including:
 - 0° and 90° sine modulated & unmodulated
 - 0° and 90° triangle modulated & unmodulated
 - 0° square wave modulated & unmodulated
 - Synchronized sweep
 - Sync pulse
- Direct reading of phase from 0° to 360°
- Direct reading of amplitude in db

Simple modifications are available to provide additional capabilities such as:

- Higher or lower carrier frequencies
- Higher modulation frequencies
- Oscillator to provide "bow tie" patterns



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Centre Circuits, Inc.	1214
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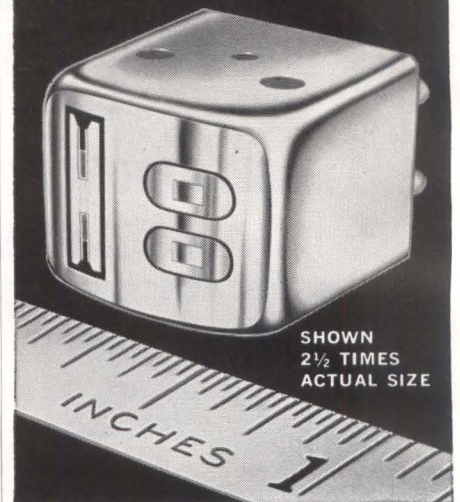
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First of a new series of combination heads to be available in production quantities, Nortronics' 4-Track Stereo head combines Record/Playback and Erase functions in one miniature case. Saves space in compact equipment—cuts component costs with a single head and one mounting bracket instead of two—cuts assembly and adjustment time! Case size measures only 0.490" high, 0.575" wide, and 0.580" deep—the same size case as previously used for our Record/Playback head alone!

The new 4-track stereo combination head is offered in two different versions, and although engineered to meet different applications, both heads deliver outstanding high frequency response due to their laminated core construction. PREMIUM (RSQ) head designed for professional broadcast use and studio applications—offers low core-loss characteristics never before available in any mass produced magnetic head. STANDARD (TSQ) head designed for use in home-type high fidelity tape recorders.

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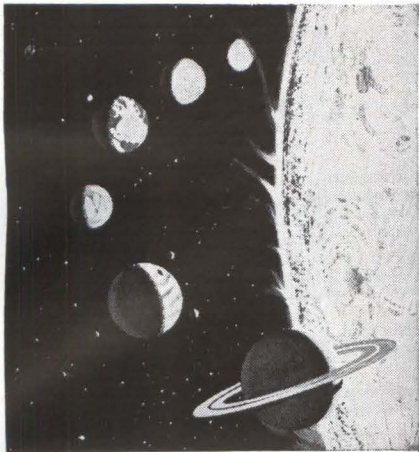
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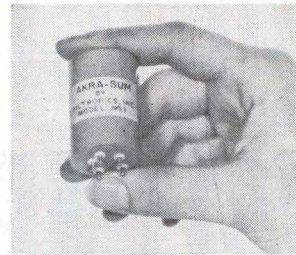
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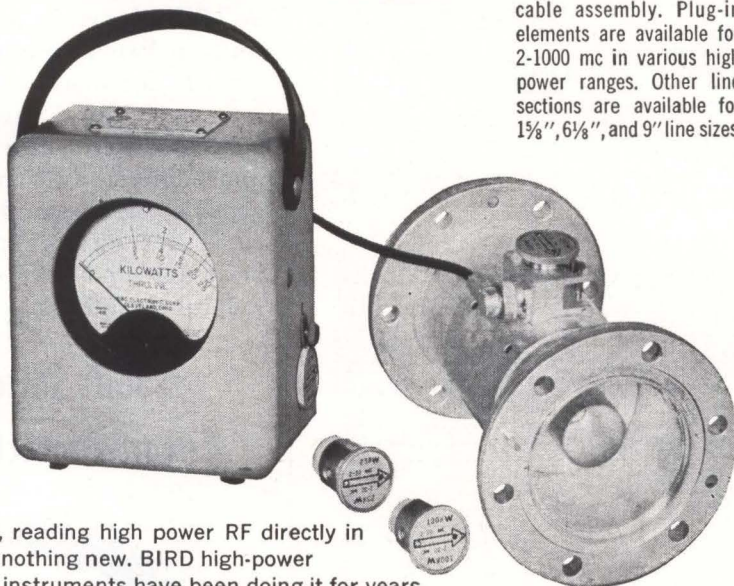
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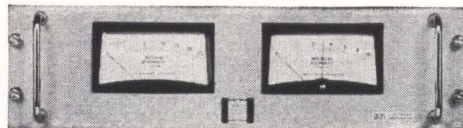
BIRD Model 460 THRULINE Wattmeter includes 3½" line section, meter, and cable assembly. Plug-in elements are available for 2-1000 mc in various high power ranges. Other line sections are available for 1½", 6½", and 9" line sizes.

For BIRD, reading high power RF directly in kilowatts is nothing new. BIRD high-power THRULINE instruments have been doing it for years.

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The NEW WATTCHER* Model 3127 RF monitor is used with a dual element line section for continuous reading of forward and reflected power. It also provides an automatic shutdown of the transmitter in case of transmission line system or antenna failure.



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The complete line of BIRD THRULINE RF Directional Wattmeters, along with all other BIRD instruments is covered in the new BIRD General Catalog GC-63. You may obtain your copy by writing BIRD.



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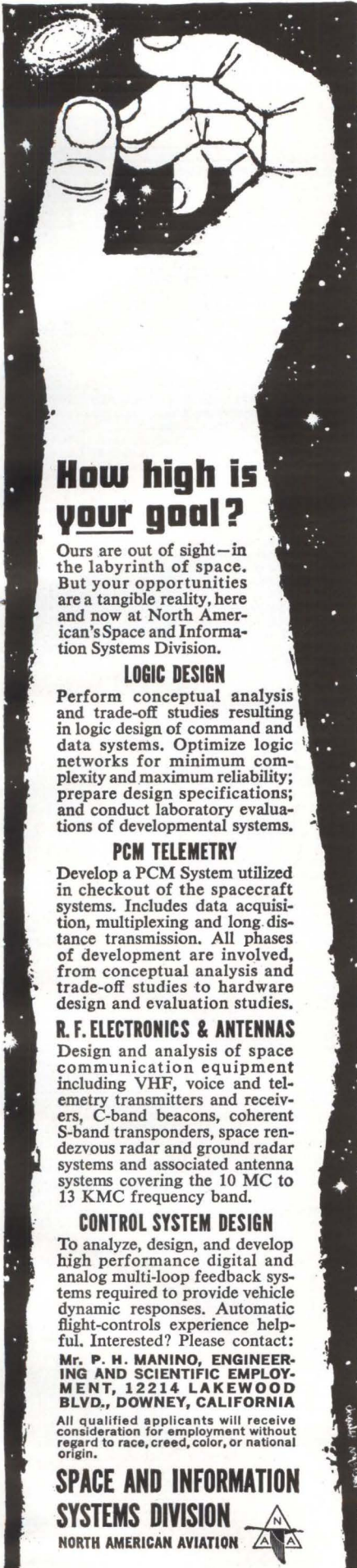
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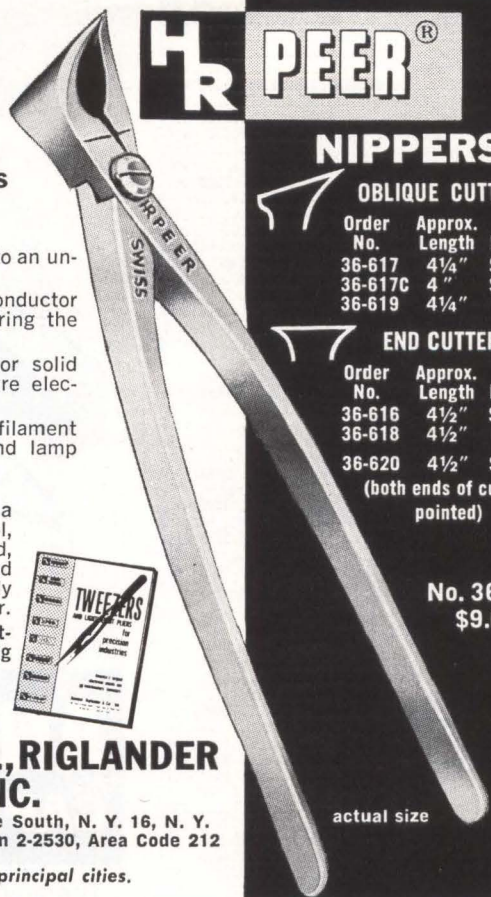
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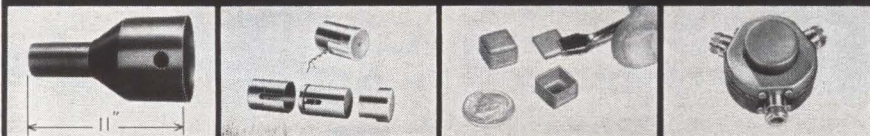
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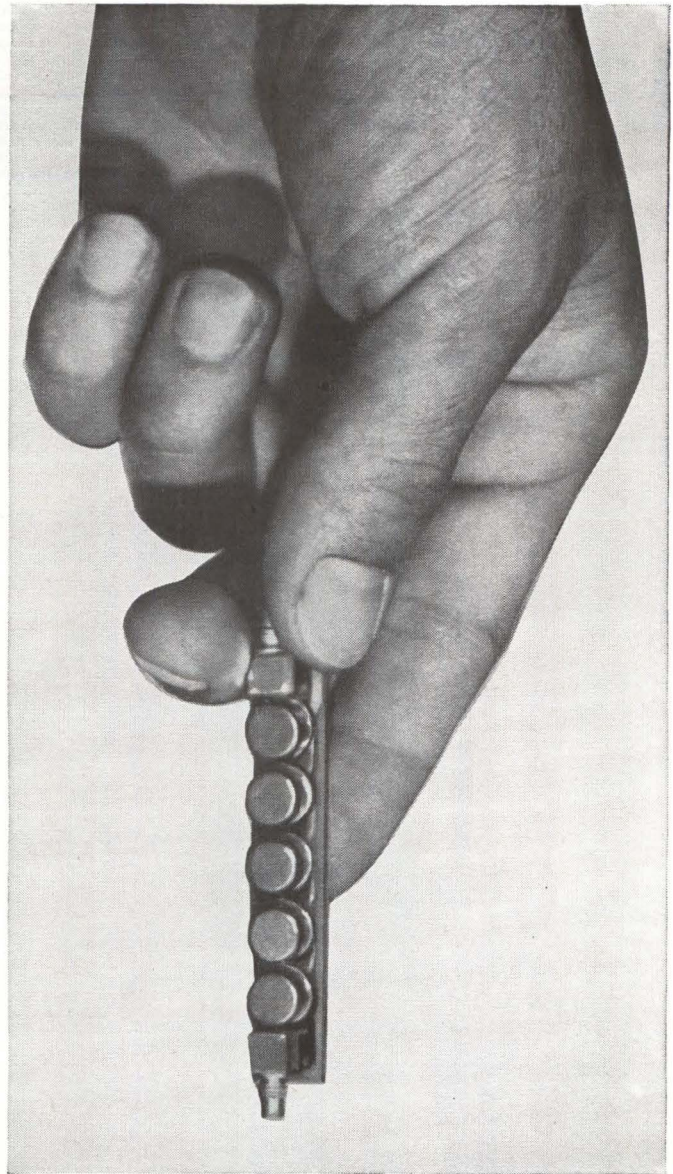
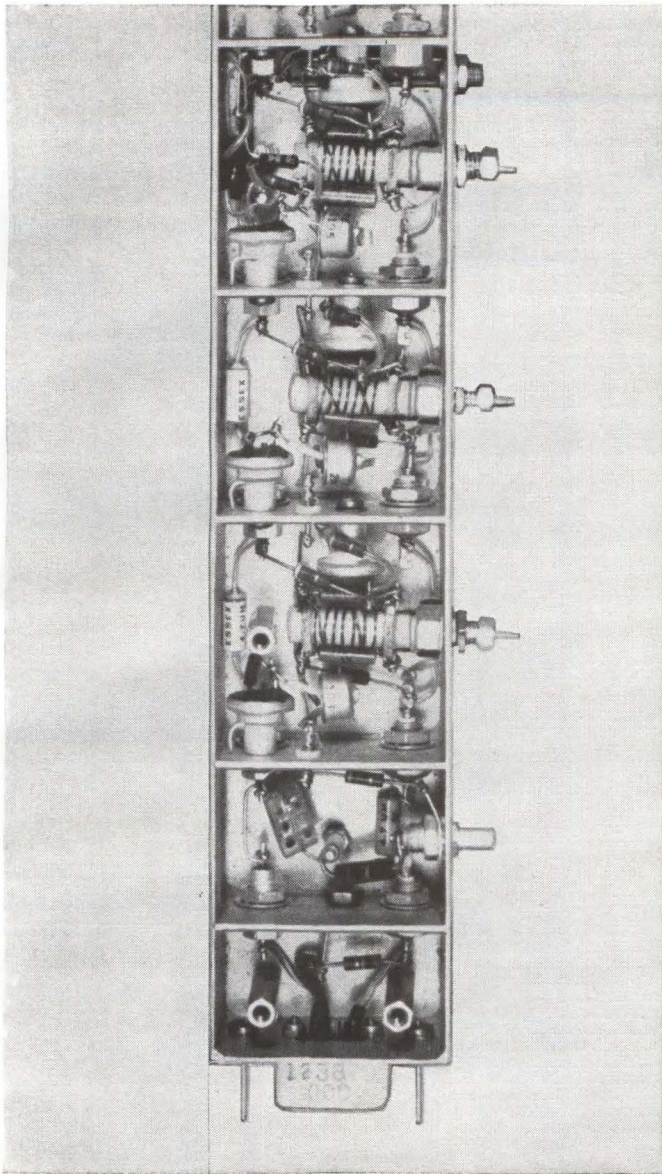
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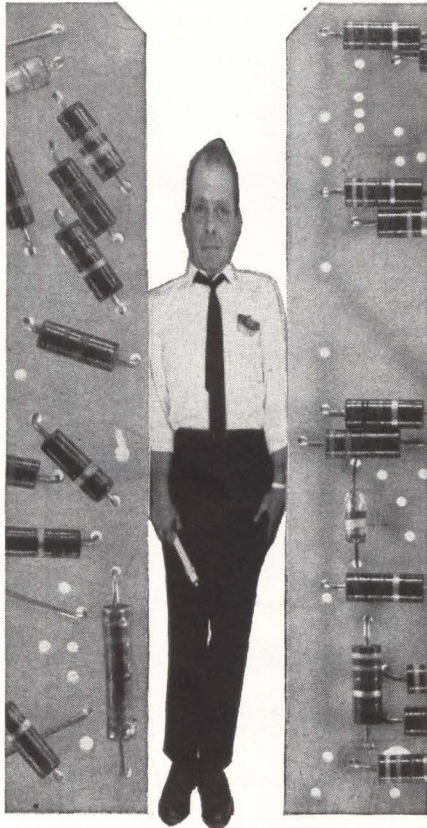
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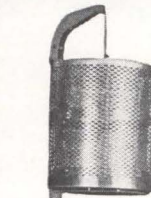
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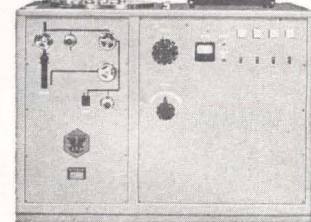
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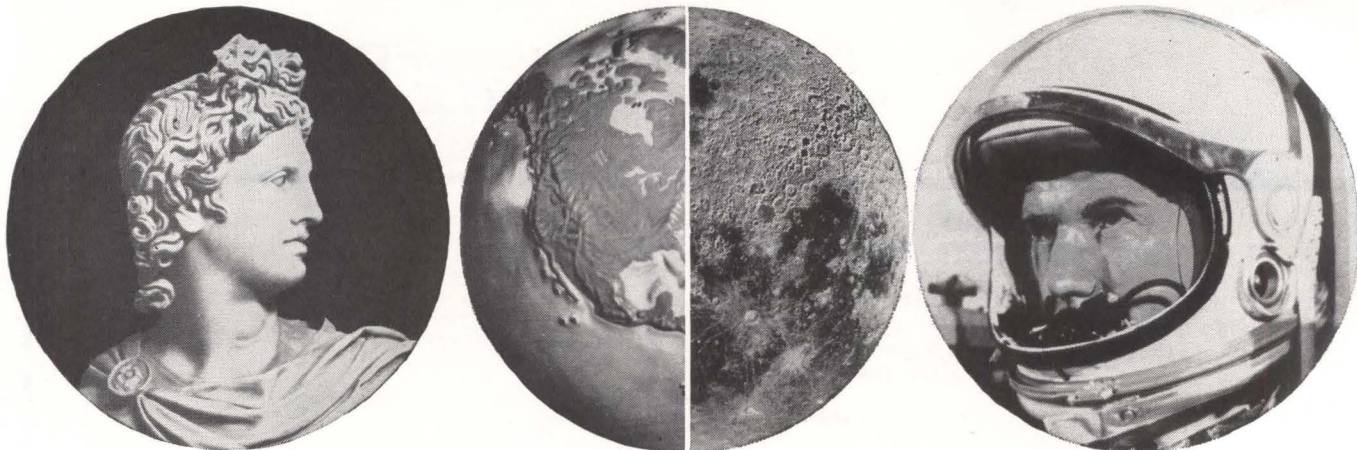
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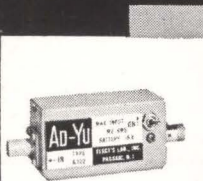
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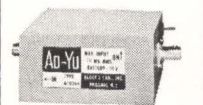
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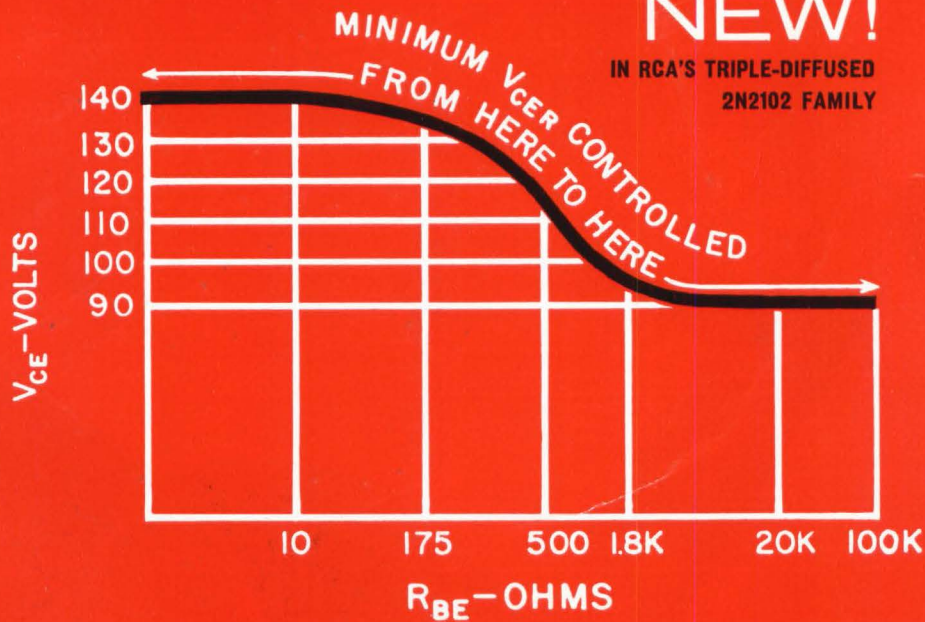
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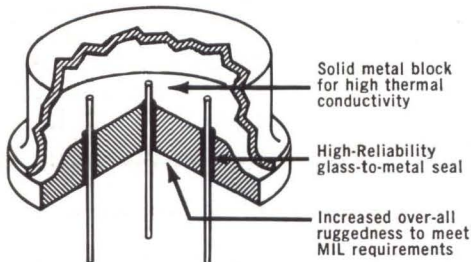
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