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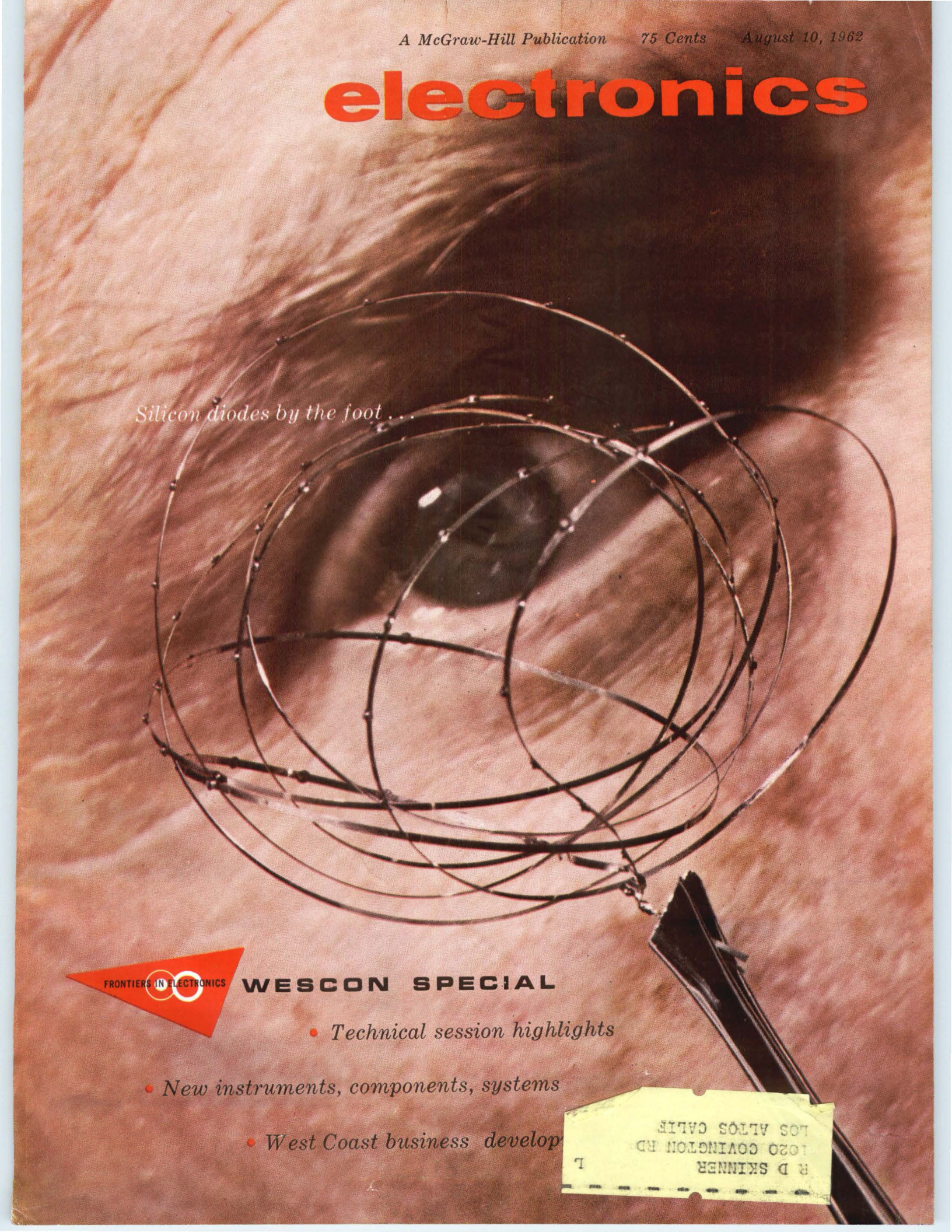
electronics



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WESCON SPECIAL

- *Technical session highlights*
- *New instruments, components, systems*
- *West Coast business develop*

One of the few "Solid-State" Counters that costs less than the *NEW* 1150-A Digital Frequency Meter

Type 1150-A
Digital Frequency Meter . . . $915

- Totalizes events or measures frequency to 220 kc.
- New, brilliant, always in focus, NUMERIK* in-line display. 120° viewing angle . . . 5000-hour lamp life in counting service.
- Fail-safe ring counting circuits eliminate fussy feedback codes and critical voltage levels.
- *Oven-controlled* 100-kc crystal oscillator with ½ ppm stability. Temperature stability better than 5 ppm over an ambient range of 0° to 50°C.

See this new instrument at

WESCON
Booths 643—644

Along with other new General Radio Products

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GENERAL SPECIFICATIONS

Frequency Range: 10 cps to 220 kc

Accuracy: ±1 count ± time-base stability

Time Base: Internal 100-kc crystal oscillator with ½ ppm stability. Provision for external 100-kc time base

Sensitivity: Better than 1 volt, peak-to-peak. For pulses, duty ratio should be between 0.2 and 0.8. Input impedance is 0.5 MΩ shunted by less than 100 pf.

Gate Times: 0.1, 1, and 10 seconds. Also manual start/stop

Reset: Automatic or manual

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August 10, 1962

electronics

A McGraw-Hill Publication 75 cents

Contents continued

electronics

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DEPARTMENTS

Standards and Foreign Sales

AMERICAN manufacturers have spent a great deal of time and money in recent years to promote the sale of electronic equipment and components overseas. But every year we lose opportunities for sales because of our national apathy toward international standardization.

International standardization in electronics is based in large measure upon the recommendations of the International Electrotechnical Commission. The IEC is part of the International Standardization Organization, but keeps its identity inasmuch as it predates the parent body. Both organizations work closely with the United Nations.

The U.S. National Committee for the IEC is a member body of IEC and operates under the American Standards Association. The USNC holds several IEC technical secretariats.

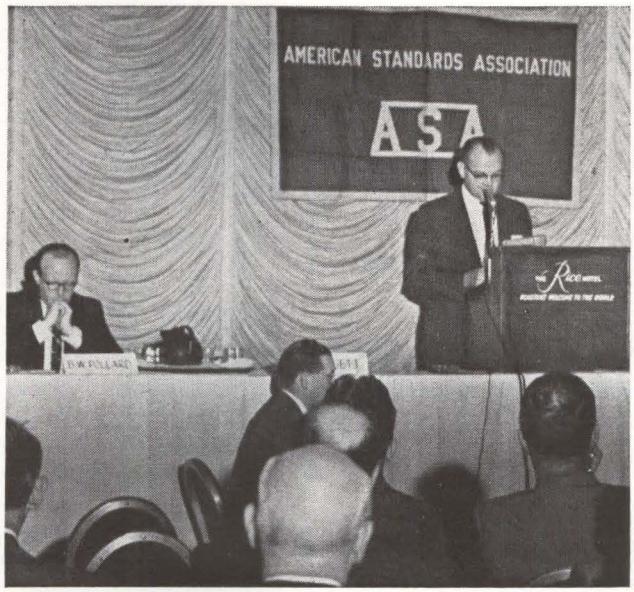
ONE OBJECT of our participation in international standardization is to get IEC recommendations that are acceptable to U.S. manufacturers and compatible with American design practices and production techniques. To do this we must be represented by able delegates when recommendations are being hammered out.

Although the USNC accredits delegates to IEC meetings, the delegates' expenses are usually paid by the companies for whom they work. Trade associations such as EIA and NEMA have contributed, as have professional societies. The government has itself sent delegates.

Yet American participation in IEC activities has never been as effective as it might be. The reason is lack of regular attendance by U.S. delegates at all levels. Of course, when word gets out that IEC is proposing some standard that might hurt the pocketbook of U.S. manufacturers they quickly send delegates to the meeting in question. But these delegates often find, coming in late, that they have an uphill fight on their hands.

THE REASON is not lack of competence. It is, rather, that proposals being discussed at plenary or full committee sessions that our men usually attend have already been formulated long since in working groups or committees. The sponsoring groups are, therefore, understandably reluctant to make major changes.

Our delegates attend IEC sessions often after



only a very short briefing. They then find themselves across the table from engineers who have spent large portions of their professional careers attending international standardization meetings. These professionals know each other well and are thoroughly experienced in the workings of the IEC.

FOR MANUFACTURERS who expect to compete effectively in overseas markets, regular attendance at IEC meetings is a necessary part of engineering overhead. International standardization specialists with reasonable travel budgets are important to foreign trade.

Wise manufacturers do not wait until there is a fire before training a fire-fighting crew. They do not wait until they are sued before engaging legal counsel. And, if they want to sell products overseas they do not wait until a proposed IEC recommendation threatens to pinch the pocketbook before sending engineers to IEC meetings.

SALUTE TO WESCON. This week's Special WESCON Issue reflects, the influence of the West on the electronics industry. The reports previewing the convention and show do more than preview activities, technical developments and new products. They also tell what the West is doing to maintain its lusty growth rate, especially in the technically fruitful aerospace fields.

COMMENT

Sales Engineers

Your *Crosstalk* editorial, What Shortage? (p 3, June 8), is most appropriate.

The need for businessmen understanding technical electronics is greater than many of us realize. This is particularly true in the sales field.

As manufacturers representatives, we need "Sales Engineers." But we don't necessarily need graduate engineers provided we could find people with the right background technically and some training in marketing or sales. About the only way to get such people today is to start with graduate engineers, which is certainly a waste of good engineering talent, carefully trained for engineering work.

Let's have some courses with enough engineering to prepare graduates for the various business needs of the electronics industry, including the important function of selling.

KENNETH E. HUGHES
Kenneth E. Hughes Company, Inc.
Union City, New Jersey

Numerical Prefixes

Most engineers are conversant with milli-, micro-, centi-, kilo- and mega-, and are able to live with deci-, deca- and hecto-. With varying degrees of difficulty we have mastered (?) tera-, nano-, pico- and giga-. However, I agree with R. O. Whitaker in the June 15 *Comment* (p 4) that now is the time to question the continued use of numerical prefixes.

It is generally necessary, when solving problems, particularly those involving microwave frequencies and components, to convert the unit magnitudes to powers of ten. As I see it, the numerical prefix system has four significant difficulties: (1) the newer terms are relatively unfamiliar to many engineers and are not associated with commonly-used radices which would permit mnemonic correlation; (2) the larger terms are limited to powers of 1,000 rather than powers of ten, thus leading to inconsistency in handling; (3) the system is not readily extended to our ever-increasing usable spectrum; and (4) the engineer must translate each unit to the appropriate power of ten in order to solve equations.

I suggest a numerical suffix system of nomenclature as an alternative to the numerical prefix. Positive powers of ten could be denoted by the suffix *pos* and negative powers of ten by *neg*. Thus, 1.23 Gc would be 1.23 pos-nine cycles (per second), and might be written as 1.23(9) cps or 1.23p9 cps; 45.6 picofarads would be 4.56 neg-eleven farads, and might be written 4.56 (-11) f or 4.56n11 f. Such a system is readily extended to any conceivable frequencies or dimensions and is easily handled in numerical computations, with no time lost in translating to the equivalent powers of ten.

Incidentally, Whitaker chose an unfortunate symbol [a circle around the number] in his otherwise acceptable problem illustrating the difficulties of the prefix system. Your comment on relative ease of printing wouldn't hold water if any of literally dozens of appropriate printing designations (such as parentheses, for example) had been used.

RICHARD A. WALL
Sunnyvale, California

Transistor Frequency

Reference my article, Pushing Transistors Above Their Frequency Limits With Parametric Conversion Operation (p 46, June 22).

Since submitting the paper to you, even much better results have been obtained up to 8 Gc with the new Siemens AF 139 transistor in a coaxial housing. Some other excellent results for oscillation at 10 Gc have been demonstrated with a triple-diffused silicon epitaxial mesa transistor only recently fabricated at the Siemens semiconductor factory.

Some errors occur in the article: (1) the inductance in Fig. 2A is 20 nH, not 20 μH; (2) the inductance in Fig. 4A is 25 nH, not 25 μH; (3) in table II, it is not −32 db, but +32 db; (4) transistor Q_2 in Fig. 2A is a TF 65, and Q_3 in Fig. 4A is also a TF 65; (5) the expression following Eq. 9 should be $\omega_a C_c r_b'$, not $\omega_a C_c r_b^1$.

ULRICH L. ROHDE
Munich, West Germany

WHERE SPACE–AGE RESEARCH IS IN ORBIT

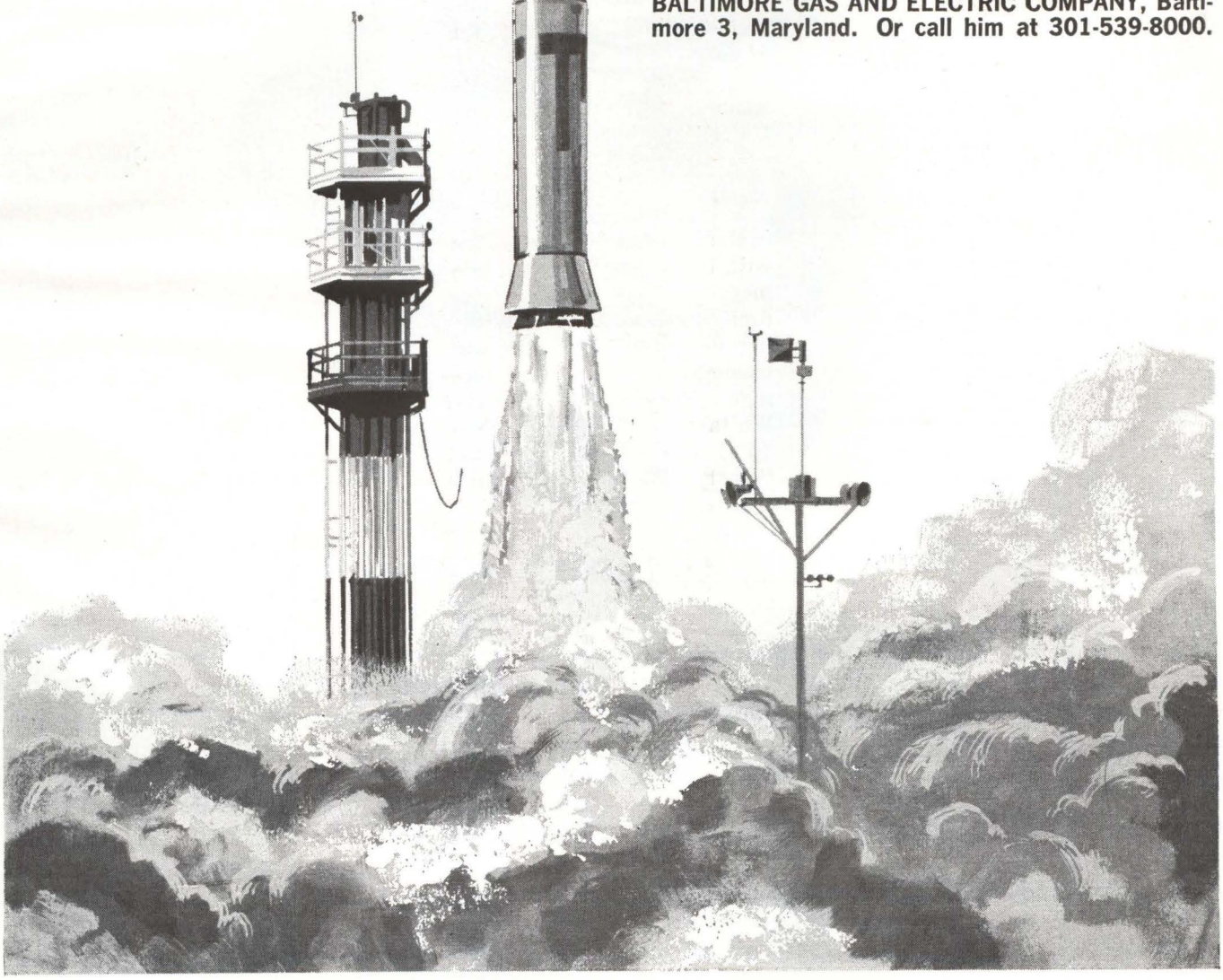
Launching ships is an old story in Baltimore, which has built them by the thousands. The busy shipyards here are still building them, too. But another kind of launching preoccupies many Baltimore-area plants today . . . with electronics for guidance systems, chemicals for propulsion, hardware for the space vehicles themselves. Space-age research and development, engineering and production are expedited by ideal sites, a profusion of **specialized** labor skills, major colleges and universities, proximity to NASA headquarters and Washington, D.C.

Added to these, in Baltimore and its neighboring counties, is fast, flexible transportation . . . by air, land and sea. Stable economy, too. When you want to think **big,** think BALTIMORE.

PUT YOUR PLANT IN

BALTIMORE

For confidential information, write Robert J. George, BALTIMORE GAS AND ELECTRIC COMPANY, Baltimore 3, Maryland. Or call him at 301-539-8000.



Yesterday tetrodes hit a new high of 75,000 watts.

Today it's 120,000 watts.

Yesterday we rated a pair of our new tetrodes at 100 kw output in class C plate-modulated service. Today: over 250 kw! The reason? Rugged, conservative tube design coupled with the advantages of vapor-phase cooling. Our new vapor-cooled 4CV120,000C offers you all this — and cuts cost, too. It eliminates the high-powered driver required by triodes. And the vapor-cooling equipment costs but one-fourth the price of comparable water-cooling equipment. Eimac offers the whole package — pre-engineered.

Eimac's new 4CV120,000C tetrode is an addition to a family of high power tetrodes available in these plate dissipation levels: the 35 kw air-cooled 4CX35,000A and the 50 kw water-cooled 4CW50,000C.

This is another example of the way Eimac meets tomorrow's tube needs today. Another reason to keep your eye on Eimac — for advanced power grid tubes, high power klystrons, microwave tubes, accessories. Eitel-McCullough, Inc., San Carlos, California. Subsidiaries: Eitel-McCullough, S. A., Geneva, Switzerland; National Electronics, Geneva, Illinois. **KEEP YOUR EYE ON**

Eimac

ELECTRONICS NEWSLETTER

Air Force Steps Up Mobile Missile Work

AIR FORCE last week awarded contracts for the Mobile Mid-Range Ballistic Missile (MMRBM). General Precision Equipment Corp. is to develop the stellar-inertial guidance and control system under a contract worth an estimated $200 million. The other awards are for preliminary designs, cost estimates and program plans for other components of the system.

MMRBM will be a solid, two-stage missile capable of rapid launch from both land and sea. Air Force's Ballistic Systems Division is program manager. Navy will help insure sea-launch capability.

The guidance program will be carried out at General Precision Aerospace, Little Falls, N. J. GPA will also independently provide an all-inertial capability for the missile.

Hughes Aircraft and a team consisting of Martin Marietta and Sylvania were awarded program definition contracts for the missile's command and control system.

Other firms selected to compete in preliminary study work are: Hughes and Northrop, integration, assembly, and checkout; Avco and a team consisting of Sperry Rand, Ford Motor's Aeronutronics division and Fairchild-Stratos Corp., reentry system; North American Aviation and Thiokol, propulsion; and AMF and Goodyear Aircraft, transporter-launcher.

The contracts do not mean a full-scale MMRBM project has been formally approved. The Defense Department said that decisions on more detailed study and full development contracts will be made after first phase proposals are evaluated.

July, 1964, Proposed for All-Channel Tv Startup

ELECTRONIC Industries Association told the FCC last week that a poll of all 21 tv set manufacturers revealed a preference for July, 1964 as the cutoff date for shifting from vhf to all-channel tv set production. Dates recommended by individual manufacturers ranged from August, 1963, to June, 1965. The association pointed out that July is when new models are announced. Models to be announced next summer have been frozen by many manufacturers. Some manufacturers asked that distributors and dealers be given until the end of 1964 to clear out vhf sets.

In addition to changeover time needed by set manufacturers, EIA said, tuner manufacturers will need time to increase all-channel tuner production 15 times. Only about seven percent of tuners made in recent years have been all-channel.

Trail of Semiconductor Diode Laser Gets Hot

BOSTON—Richard G. Seed, of Northeastern University, told the Boston Laser Conference last week that he thinks some researcher will achieve diode laser action in the next few months. Several labs are intensifying attempts to produce a semiconductor laser.

Seed reported on a proposed diode laser based on radiative recombination of injected carriers through impurity levels. He is experimenting at AF Cambridge Research Labs on liquid-gas-cooled indium-doped silicon. Pumping is done electrically, by a battery, putting forward bias on the diode to get injected carriers in the base region. Seed said a high-power silicon rectifier probably comes closest to laser diode requirements.

MIT researchers are investigating laser possibilities in their infrared gallium-arsenide diode (p 24, July 27).

Europeans to Buy, Make Armament Control Systems

EUROPEAN ELECTRONICS firms have signed contracts totaling $44 million for the purchase of North American Aviation F15A armament control systems and associated support equipment for Lockheed-NATO fighter aircraft. North American's Autonetics division, manufacturer of the systems, has also granted license agreements to the four firms.

Fabbrica Italiana Apparechi Radio, Italy; Manufacture Belge de Lampes et de Materiel Electronique, Belgium; N.V. Hollandse Signaalapparaten, The Netherlands, and Telefunken GMBH, West Germany are initially buying complete systems. Plans are that they will eventually produce both parts and completed systems under the licensing agreements.

D. G. Fink Appointed IEEE General Manager

APPOINTMENT of Donald G. Fink as General Manager of newly-formed IEEE was announced by W. H. Chase, head of AIEE, and P. E. Haggerty, president of IRE. Fink, unanimous choice of the 14-man AIEE-IRE Merger Committee, will take office when the society is formally created in January. A former

Two Lasers Make the Scene at WESCON

LOS ANGELES—Two lasers will dramatically open WESCON.

Act 1: a 1-joule beam flashes three miles across town, from the Statler Hotel to the Sports Arena. The signal trips a relay, activates a magnetic drum and a stored message of welcome is displayed to conventioneers.

Act 2: a 10-joule beam vaporizes a wire, freeing a 12-foot balloon and the WESCON insignia rises over the arena

IRE president, Fink, who will be leaving his post as director of the Philco Scientific Laboratory to take this position, holds electrical engineering degrees from MIT and Columbia University. He is a former editor of ELECTRONICS.

Latins Won't Tax Each Other's Data Processors

RIO DE JANEIRO—First industrial complementary agreement under the Latin American Free Trade Area treaty (p 34, June 29) has been signed by Brazil, Argentina, Uruguay and Chile.

The four nations agreed to mutual scrapping of all import duties or fees on shipments of electronic data processing machines and special tabulating cards.

Among firms whose machines can move freely from one of the four countries to another are Remington-Rand and IBM. IBM is planning a new factory near Rio.

Optical Character Scanner Reads Four Type Styles

BINGHAMTON, N. Y.—A new optical character scanner that will read simultaneously four different intermixed type styles has been ordered by Beneficial Management Corp., Morristown, N. J., from Link division of General Precision.

A sensor in the scanner detects characters by sensing reflections from characters and their related background. Information obtained is converted and compared with stored information.

The scanner has a reading rate of 600 numbers a second, 500 alphanumeric characters a second, and a load, unload, and scan line-to-line time of 3.3 lines a second.

Rocketborne Transponder Would Aid in Searches

LOS ANGELES—Navy's Pacific Missile Range has awarded Space-General Corp. a $47,000 feasibility and design contract for a system, called Searcher, that would enable vessels to locate downed nose cones, spacecraft and aircraft within an area of about 150,000 square miles.

Plans are to put a direction finder and transponder in a small rocket projectile and loft them to an altitude of about 50,000 feet. This is expected to extend line-of-sight range of beacons in downed equipment from about 10 or 15 miles to about 200 miles. A nonpowered rotor would lower slowly.

The system is to include automatic acquisition and lock-on. A reference generator will indicate true north.

"Traveling Wave" Laser Amplifies Light Image

BELL TELEPHONE LABS reports construction of a pulsed ruby laser that can amplify light directly. Net gain reported was 13 db. It is expected that cascading stages will provide much higher gains. Amplification was demonstrated by the increase in intensity of an illuminated image transmitted through the laser.

The equipment consists of two laser sections separated by an isolator whose active material is lead-oxide glass. The isolator is similar in principal to a microwave Faraday rotation isolator, absorbing reflections of the beam (backward traveling waves) and passing the forward beam.

In the isolator, a disk polarizes the beam traveling forward. A longitudinal magnetic field then rotates the polarization plane 45 degrees at the output, where the beam is passed by a similarly rotated polarizing disk. Reflections find themselves at right angles to the input polarizer and are absorbed.

Japanese to Use Computer As Aid to Flood Control

TOKYO—Hybrid computer will be used for flood prevention control along the Kitikami River system in northern Japan. The Mitsubishi analog computer, with digital inputs, will eventually control five dams, determining how much water each should store or release, and when. Data from rain gages will be radioed to the computer. It will also be programmed to give flood warnings.

In Brief . . .

AUSTRALIAN Department of Civil Aviation will spend $2.5 million in the next four years on 31 vor stations for domestic air routes, 4 dme stations for overseas routes and other airport equipment. These are expected to handle needs until 1970. Airlines will spend $315,000 for airborne guidance aids.

FRANCE will flight test and evaluate Airborne Instruments Lab's Flarescan all-weather landing system for possible use in French and other European civil and military aircraft. The system is also being evaluated in the U. S. by FAA.

AIR FORCE Office of Scientific Research gave 37 grants and awards in June, bringing its 1962 fiscal year total to $28.9 million. Most grants were for unsolicited proposals.

PRODUCTION monitoring and control system for Army's Watervliet Arsenal will be built by Hancock Telecontrol under $114,000 contract.

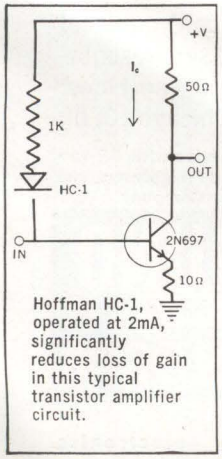
MIT INSTRUMENTATION LAB will get a Honeywell 1800 computer next year to help design circuits and do other work on the Apollo guidance computer project.

MILITARY contracts include $1.4 million from Army to Instruments for Industry for countermeasures equipment; $1 million to Bart Manufacturing for lightweight waveguide for GE's AN/SPS-30 radar; $914,000 to Motorola for AN/APN-132 transponders for Navy.

RADIATION-ORLANDO is to make an electrosensitive printer with an output of 600,000 words a minute, under a $350,000 contract from Lawrence Radiation Lab.

MISSILE CONTRACTS include $1.7 million from the Air Force to Avco-Everett Research Lab, mostly for missile reentry research and monitoring studies, and $2.7 million to Vitro Corp. for engineering services on Navy's Terrier, Tartar and Talos.

KEEP GAIN LOSS TO 30% (OR LESS) PER STAGE AT HIGH TEMPERATURES WITH NEW HOFFMAN TEMPERATURE-COMPENSATING DIODES



Hoffman HC-1, operated at 2mA, significantly reduces loss of gain in this typical transistor amplifier circuit.

Diode Type		Operating Current Milliamperes									
		.5	1	2	5	10	15	20	30	50	70
HC-1 @ –40V - 25°C	V_F	1.375	2.00	3.25	6.75						
	T_C	4.25	6.75	11.75	26.25						
HC-2 @ –40V - 25°C	V_F		1.75	2.75	6.00						
	T_C		8.75	10.00	13.50						
HC-3 @ –36V - 25°C	V_F			1.75	2.75	4.5					
	T_C			7.5	8.25	9.75					
HC-4 @ –36V - 25°C	V_F			1.375	2.25	3.75					
	T_C			2.75	7.0	14.0					
HC-5 @ –33V - 25°C	V_F				1.50	2.25	3.00				
	T_C				6.5	8.25	10.0				
HC-6 @ –33V - 25°C	V_F					1.5	1.7	1.9	2.25		
	T_C					2.25	3.5	4.75	7.25		
HC-7 @ –27V - 25°C	V_F							1.00	1.20	1.60	2.00
	T_C							.60	1.5	3.25	5.0

Max Leakage—1uA V_F Voltage Drop

Max power rating @ 25°C all types 150mW derate 1mW/°C above 25°C

T_C Typical Temperature Coefficient (+ MV/°C @ 25°-100°C)

See the HC-1 Series at WESCON, Booth 514-516

The new Hoffman HC-1 through HC-7 diodes—developed from Hoffman's famous 1N200 Series of diodes—deliver higher biasing impedance and more gain per stage by automatically providing positive, linear temperature compensation for h_{FE} and V_{BE}. Used in the high voltage sections of transistor biasing circuits, they keep gain loss to 30% (or less) while holding power output variation to less than .5% within +25°C to +100°C. No need for padding stages, either, since these new devices are linear and automatically track the transistor.

For complete data, call your nearest Hoffman sales office.

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Semiconductor Division

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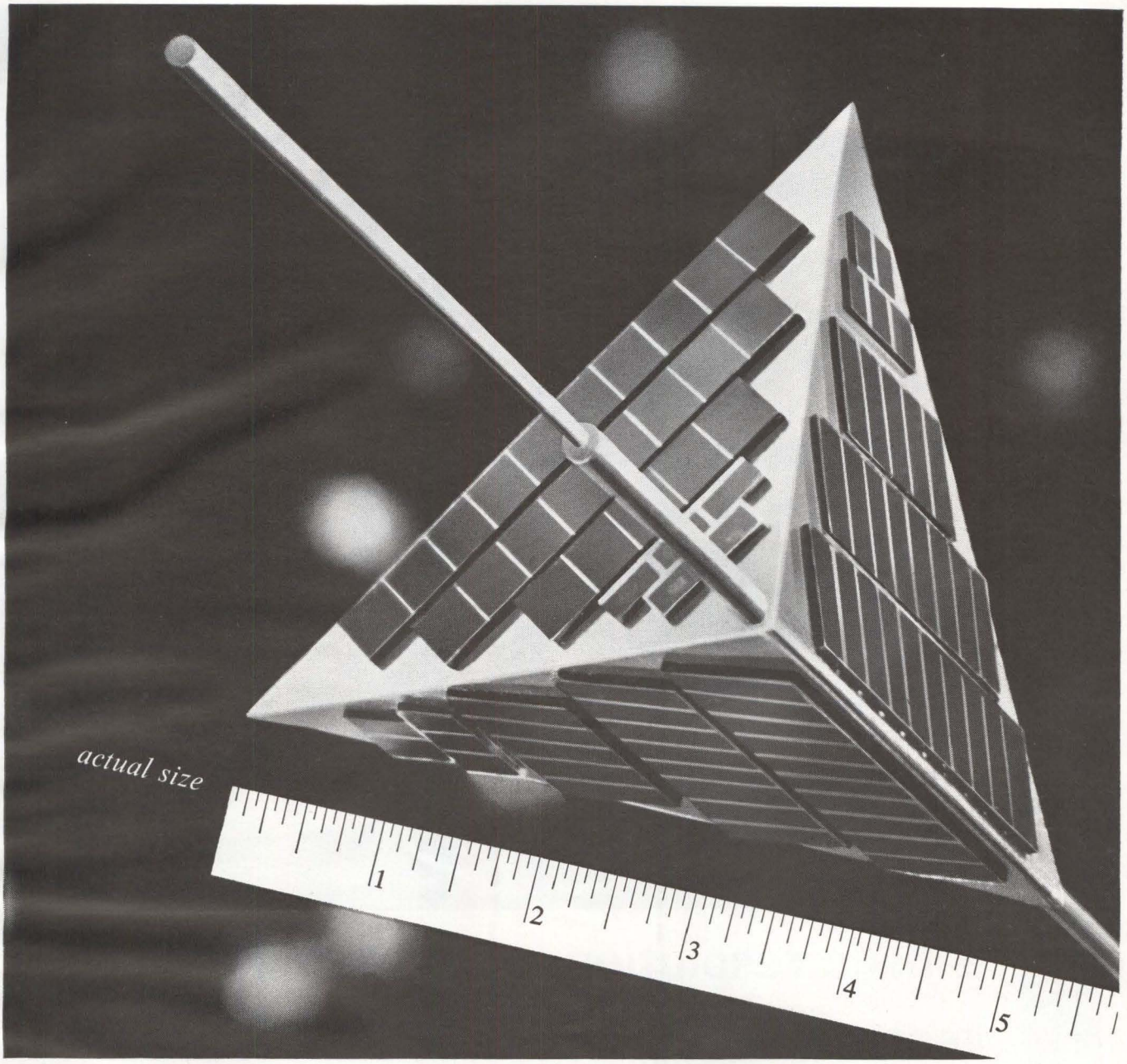

The world's smallest satellite has been developed by Space Technology Laboratories. Its shape will be different from all other satellites before it. STL engineers and scientists have used a tetrahedral configuration to bring about some remarkable characteristics in a space vehicle. There will be no need for batteries nor regulators in flight. The satellite will have no hot side, no cold side. It will require no attitude control devices. No matter how it tumbles in space it will always turn one side toward the sun to absorb energy, and three sides away from the sun to cool instrumentation and telemetry equipment inside. It can perform isolated experiments in conjunction with other projects. Or it can be put into orbit by a small rocket to make studies of its own, up to five or more separate experiments on each mission it makes.

STL is active on hardware projects such as this and as prime contractor for NASA's OGO and an entirely new series of classified spacecraft for Air Force – ARPA. We continue Systems Management for the Air Force's Atlas, Titan and Minuteman programs. These activities create immediate opportunities in: Space Physics, Radar Systems, Applied Mathematics, Space Communications, Antennas and Microwaves, Analog Computers, Computer Design, Digital Computers, Guidance and Navigation, Electromechanical Devices, Engineering Mechanics, Propulsion Systems, Materials Research. For So. California or Cape Canaveral opportunities, please write Dr. R. C. Potter, Dept. G, One Space Park, Redondo Beach, California, or P. O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.

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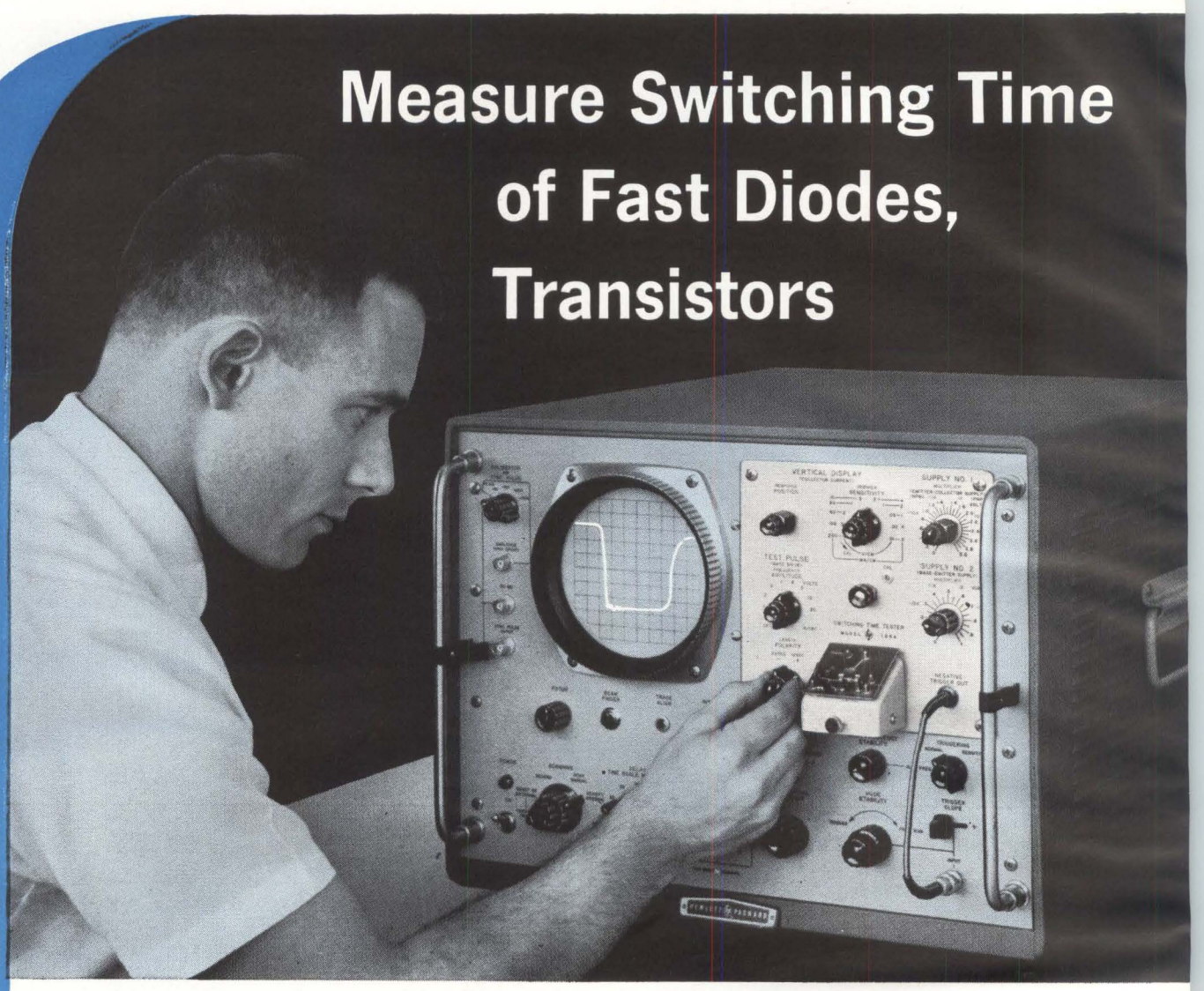
Measure Switching Time of Fast Diodes, Transistors



1 nsec resolution with new plug-in test set for hp 185 1,000 MC scope

A new "state-of-the-art" plug-in for your hp 185 Oscilloscope measures transistor and diode switching time with nanosecond resolution! Just plug in the hp 186A Switching Time Tester . . . and all the versatility of the 185 1,000 MC scope is yours for making switching time tests on transistors, diodes and tunnel diodes, or testing pulse response of active and passive networks. The 185 displays switching characteristics of test elements powered and pulsed by the 186A plug-in. And what's more . . . you can use the X-Y output of the scope for making permanent records with a Moseley AUTOGRAF® or other standard X-Y recorder.

The 186A includes all instrumentation needed for fast pulse testing. It provides a test pulse generator, vertical amplifier for the oscilloscope, and two bias supplies for the device under test. Pulses with less than 1 nsec rise time and up to 20 v output are available for many types of switching tests. Component and network testing is easy with a series of quick-change test adapters that plug into the front panel of the 186A.

Because the vertical amplifier in the 186A provides a rise time of less than 0.5 nanoseconds, you retain the remarkable versatility of the basic 185 scope. Test measurements are displayed on the 10 by 10 cm scope screen, and the high rep-rate pulse generator in the 186A insures clear, continuous, flicker-free display.

Specifications ℌ 186A

(when plugged into ℌ 185A or 185B Sampling Oscilloscope)

PULSE GENERATOR

Amplitude:
0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 volts peak, either polarity

Rise Time:
Less than 1 nsec

Width:
1 μsec or 0.2 μsec

Fall Time:
Less than 3 nsec

Repetition Rate:
Approximately 5 KC to 100 KC, continuously variable

VERTICAL CHANNEL

Sensitivity:
10 mv/cm to 10 v/cm

Bandwidth:
Greater than 800 MC (0.45 nsec rise time)

Noise:
Less than 3 mv

Input Impedance:
50 ohms

BIAS SUPPLIES

Supply #1 (Collector):
0 to ±30 volts 50 ma maximum (0.5 amp with 10% duty cycle)

Supply #2 (Base):
0 to ±10 volts, referable either to ground or supply #1 (20 ma maximum)

TRIGGER OUT

Triggers ℌ 185A or 185B Oscilloscopes

TEST BOARDS (supplied with 186A)

Transistor Test Board
Diode Test Board
Tunnel Diode Test Board
Universal Adapter for circuit tests (optional)

Price

ℌ 186A Switching Time Tester, $1,500.00

And Look at the Scope Itself: Hundreds of Different Measurements, DC to 1,000 MC!

Look what you can do with the ℌ 185B Oscilloscope: Sync on any signal rep rate, look at rf sine waves to 1,000 MC. See clear, bright pictures, 10 cm full scale width, of a single event as long as 100 microseconds, as short as 0.5 nanoseconds. Sync on signals as small as 10 mv. Effectively see any portion of 600,000 sq. cm. display, with a sharp, steady trace!

Besides performing the measurement work of lower frequency scopes, the ℌ 185B is ideal for analyzing rf carrier signals by viewing rf directly; measuring phase angle on signals to 1,000 MC by dual channel viewing with the 187B Dual Trace Amplifier plug-in; analyzing coaxial connectors, cables, attenuators and other devices by observing reflections of fast pulses. It's the first practical, commercially available answer to the need for measuring and viewing nanosecond pulses . . . and broad sweep speed capability and extreme sensitivity increase its usefulness for viewing all types of repetitive waveforms.

ℌ experience, know-how, quality manufacturing techniques and careful testing procedures assure performance according to specs, long life and exceptional instrument value. Check the specifications on these pages, then call your ℌ rep for a demonstration on your bench.

Specifications ℌ 185B with ℌ 187B Dual Trace Amplifier

VERTICAL (Dual Channel)

Bandwidth:	Greater than 800 MC, usable to 1,000 MC; less than 0.5 nsec rise time for any input signal.
Sensitivity:	Calibrated ranges, 10 to 200 mv/cm. Vernier increases sensitivity to 4 mv/cm. Attenuator accuracy, ±3%.
Voltage Calibrator:	20 to 1,000 mv, ±3% accuracy.
Input Impedance:	100 K ohms shunted by 2 pf.

HORIZONTAL

Sweep Speeds:	10 ranges, 10 nsec/cm to 10 μsec/cm, calibrated within ±5%. Vernier increases fastest speed to 4 nsec/cm, provides continuous adjustment between ranges.
Time Scale Magnifier:	7 calibrated ranges x1, x2, x5, x10, x20, x50, x100. Increases maximum calibrated speed to 0.1 nsec/cm, vernier to 0.04 nsec/cm.
Jitter:	Less than 0.03 nsec or 2 mm with x100 expansion, whichever is greater.
Variable Delay Range:	Any portion of the trace may be viewed in detail using the Time Scale Magnifier and the time delay.
Trigger Functions:	(Normal) External trigger 150 mv for 5 nsec or longer, 50 cps to 100 MC. (Sensitive) External trigger 15 mv for 5 nsec or longer, 50 cps to 100 MC. (High Frequency) External trigger 200 mv p-p, 50 MC to 1,000 MC.
Minimum Delay:	Less than 120 nsec, 100 nsec/cm sweep and faster.
Sampling Rep Rate:	100 KC maximum.

SYNC OUTPUT

Amplitude:	Positive, at least 1.5 volts into 50 ohms.
Rise Time:	Less than 2 nsec.
Width:	Approx. 7 μsec.
Recurrence:	One pulse per sample.

GENERAL

X-Y Recorder Output:	Available for making pen recordings of waveforms in MANUAL, RECORD and EXTERNAL scanning modes.
Beam Finder:	Facilitates location of beam that is off-scale vertically or horizontally.
Accessories Furnished:	187A-76A BNC Adapter (2); 187A-76F accessory adapter (2); 185B-21A Sync Probe.
Prices:	ℌ 185B Oscilloscope, $2,300.00; ℌ 187B Dual Trace Amplifier, $1,000.00.

Data subject to change. Prices f.o.b. factory.

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1501 Page Mill Road, Palo Alto, California, Area Code 415, DA 6-7000; Sales and service representatives in all principal areas; **Europe,** Hewlett-Packard S. A., 54-54bis Route des Acacias, Geneva; Canada, Hewlett-Packard (Canada) Ltd., 8270 Mayrand Street, Montreal.

7568

WASHINGTON OUTLOOK

EQUIPMENT SOUGHT FOR GUERRILLA WARFARE

DEFENSE DEPARTMENT'S new emphasis on counter-insurgency or antiguerrilla operations is opening up a big new market for military electronics contractors. Up high on the military's requirements for counter-insurgency equipment is communications.

The Air Force and Army are looking for simple, inexpensive transmitters, ground-to-air radios weighing 30 pounds or less, exceptionally reliable point-to-point communications gear that can be moved in a hurry, portable night-detection television, lightweight airborne loudspeakers, and similar electronics equipment.

The Army has been buying such equipment in increasing quantities in the past year. Now the Air Force, with its new Special Air Warfare Center at Eglin AFB, Fla., is coming into the market. Officals there say procurement of approved electronic hardware will be made through fast, redtape-cutting procedures.

AEROSPACE UNIONS DEMANDING CLOSED SHOP

AEROSPACE CONTRACT DISPUTES raise some of the toughest—and touchiest—union issues that the Kennedy administration has faced. No matter on what terms the aerospace manufacturers and the auto workers and machinists unions finally settle, the results are bound to raise a storm of controversy.

The administration is insisting on a settlement without a strike. To achieve this, President Kennedy has departed from usual disputes-handling procedures with the appointment of a special emergency board to recommend settlement terms.

The 60-day "cooling off" period now in force only delays the inevitable showdown. When it comes, another fight will erupt, depending on which way the board goes on the major issue—the union shop. Opponents of this provision, requiring union membership after 30 days employment, are already warning they'll blast the board if it proposes any form of union security. The unions insist that they must win on this issue if the employers want a restrained wage settlement.

With his own emergency board proposing the settlement terms, President Kennedy finds himself caught in the middle. Whether workers have to join a union to hold their jobs defies compromise. To make it even tougher, Douglas Aircraft signed up with the unions on a modified union security provision, the agency shop, where employees don't have to join the union but must pay dues. The other aerospace companies insist they won't buy even this watered down version.

NATO GOOD CUSTOMER FOR U. S. ELECTRONICS

DEFENSE DEPARTMENT has sold $146.8-million worth of electronics and communications equipment to NATO countries in recent years, according to figures supplied to ELECTRONICS by the Pentagon.

This represents 82 percent of all sales of electronics and communications equipment to friendly foreign governments and 6 percent of total sales of all military equipment to NATO nations. The military sales program is administered by the Office of the Assistant Secretary of Defense for International Security Affairs.

Among the major items on the electronics list: 7,060 AN/SSQ-23 radio sets, 654 AN/SCR radio sets, 50 AN/UPN-12 loran stations, 517 AN/GRC radio sets, 124 AN/VRC radio sets, and 2 AN/BLR-1 ecm systems.

announcing

NEW JERROLD®

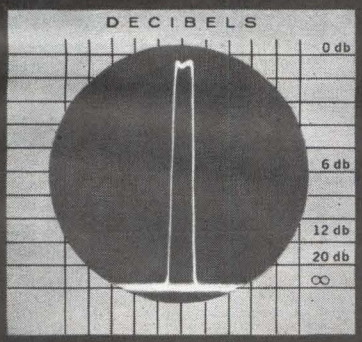
rf LOGARITHMIC AMPLIFIER

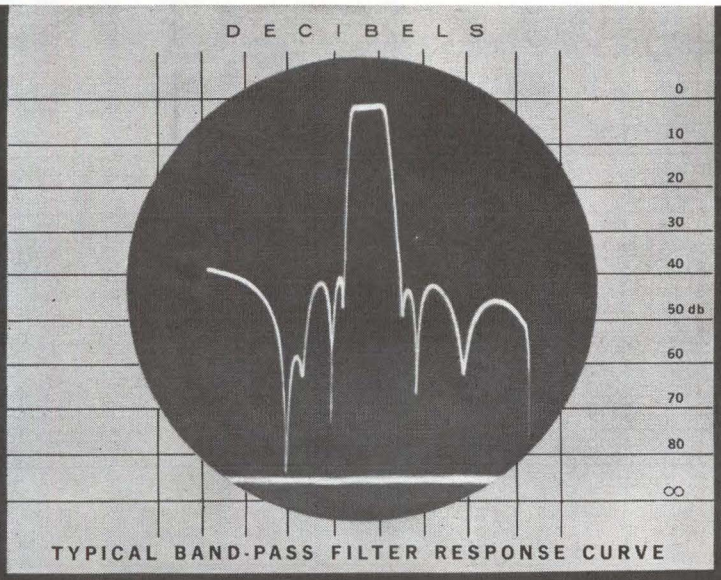
Model LA-5100

500kc to 100mc

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

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





TYPICAL BAND-PASS FILTER RESPONSE CURVE

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

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

$795.00

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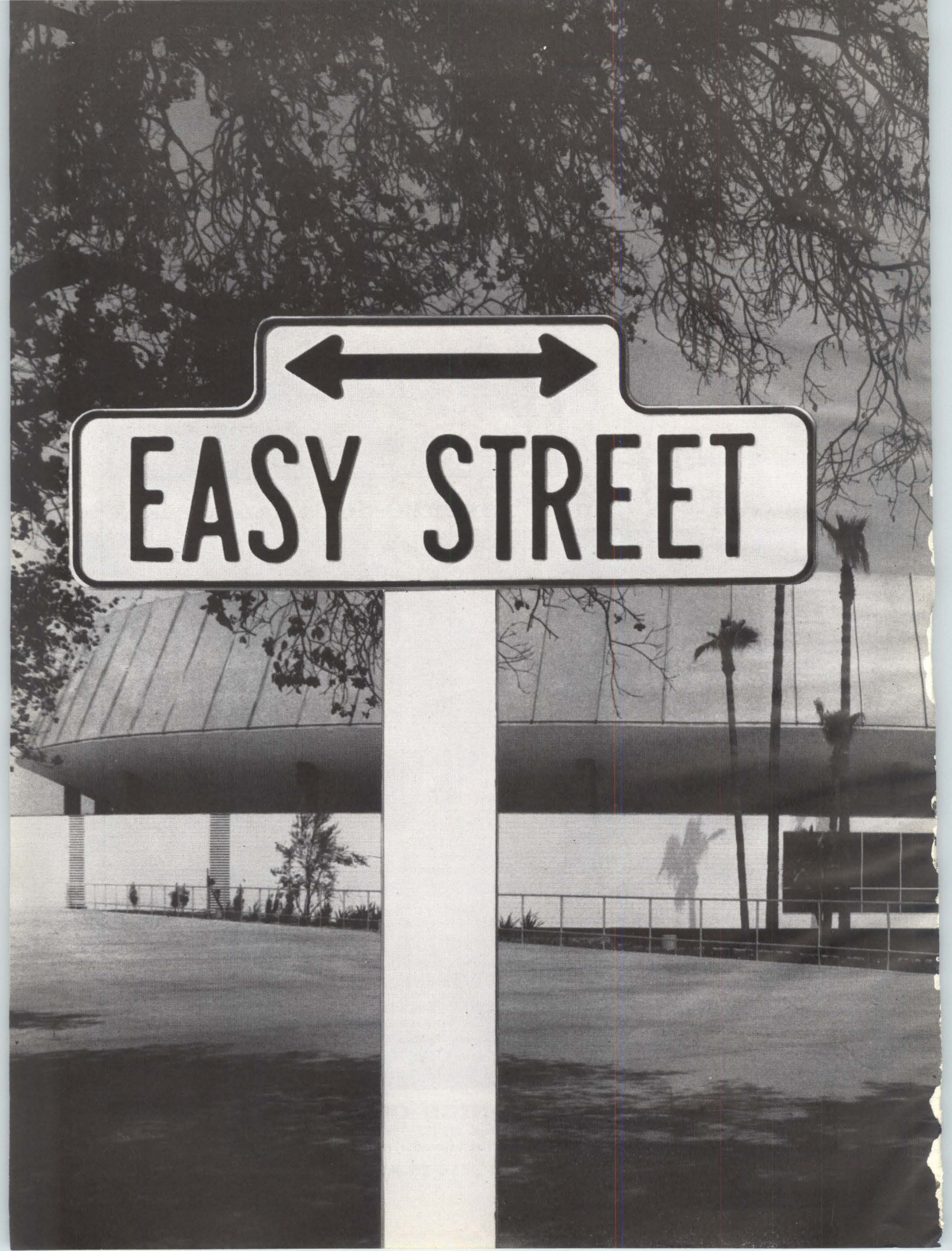
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STABILITY

1-12.4 GC

Introducing a compact electronic instrument to control microwave oscillator frequency

FOR

doppler systems
spectrum analyzers
radio astronomy
parametric amplifier pumps
microwave frequency standards
microwave spectroscopy

You name the application. The Dymec DY-2650A Oscillator Synchronizer will make it easier! Absolute control of frequency is yours when the DY-2650A phase locks your klystron oscillator to a crystal reference, to achieve short-term stability of 1 part in 10^8 per second, 1 part in 10^6 per week. Temperature stability is 1 part in 10^6, 0-50° C. The DY-2650A requires only a small sample of klystron power—less than –10 dbm.

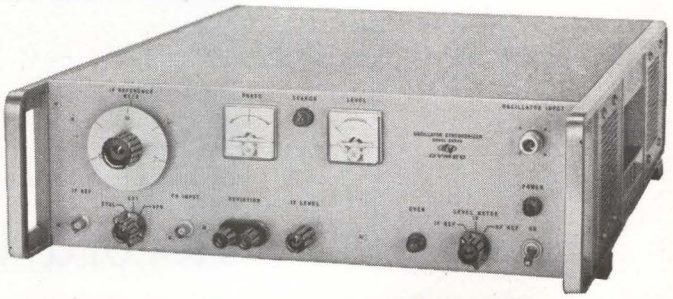
The DY-2650A will synchronize most reflex klystrons, 1 to 12.4 GC, with complete elimination of klystron drift and minimization of all incidental fm caused by klystron noise, power supply ripple and mechanical shock. You can use it for oscillator stabilization, frequency modulation and control, frequency stability monitoring and fm monitoring.

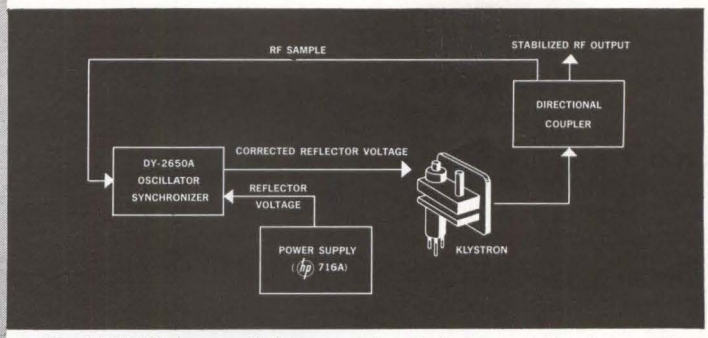
Frequency modulation and control: Use the DY-2650A to apply fm to a klystron oscillator with deviations up to 500 KC at rates to 50 KC.

Manual frequency control: Over 2 MC range of klystron frequency.

Frequency monitoring: Use an electronic counter or frequency meter to monitor the microwave signal for frequency stability.

FM monitoring: Demodulate fm on the test signal, providing an output for monitoring with a VTVM, oscilloscope or other monitoring devices.





The DY-2650A is essentially a crystal-controlled superheterodyne receiver terminating in a phase comparator. An oscillator sample is mixed with harmonics of the rf reference to produce an intermediate frequency of 30 MC, which is compared in phase with the 30 MC reference. For stabilizing a klystron, the resultant phase error voltage is added in series with the klystron reflector power supply voltage.

SPECIFICATIONS

Frequency range: 1 to 12.4 GC
Stability: $1/10^8$ per second, $1/10^6$ per week (over ± 5°C), $1/10^6$ over range 0 to 50°C.
Output circuitry: Suitable for connection to klystron reflector; floating and insulated up to 2000 v dc. A phase lag network provides optimum characteristics for matching klystron sensitivities from 0.05 to 4 MC/volt nominal.
Input power: Less than –10 dbm.
Price: $1,450.00, f.o.b. factory.
Data subject to change without notice.

Describe your requirement today to your Dymec/Hewlett-Packard representative, write Dymec for further information or call Dymec direct. Extension 223 or 224.

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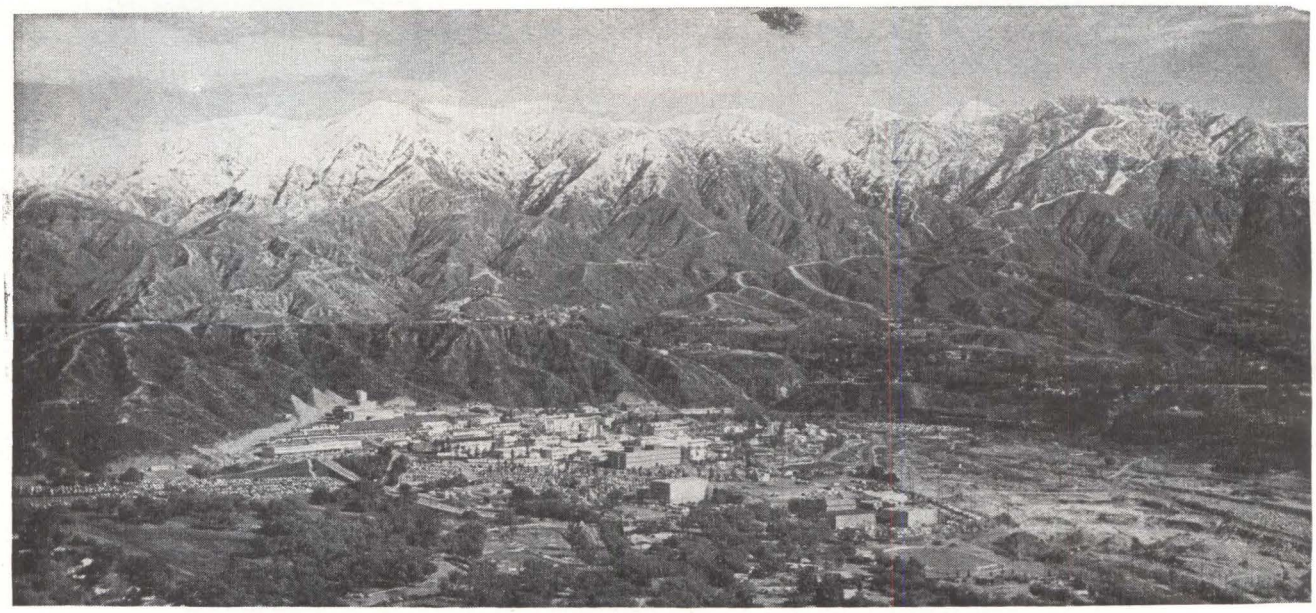


SCIENCE AND SCENERY. *This is Jet Propulsion Laboratories, one of the research centers that has captured a dominant share of the nation's missile and space R&D for the West*

Aerospace R&D Paces West's Record-Breaking Sales

Despite problems, among them shrinking profits, West continues growth

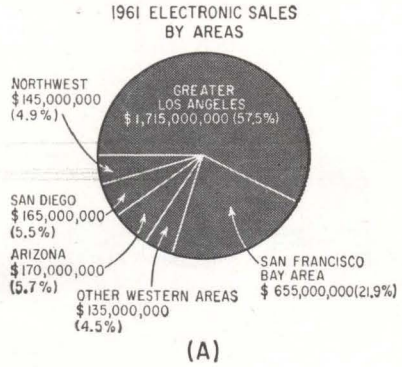
LOS ANGELES—This year, WESCON will be staged against a backdrop of record-breaking sales, but diminishing profit margins for the western electronics industry. Western Electronic Manufacturers Association estimates that its eleven states will capture an even one-quarter of the $13.2 billion forecast for the nation's electronic industry in 1962, but, according to WEMA president William J. Miller, the rising sales will not be accompanied by corresponding profits.

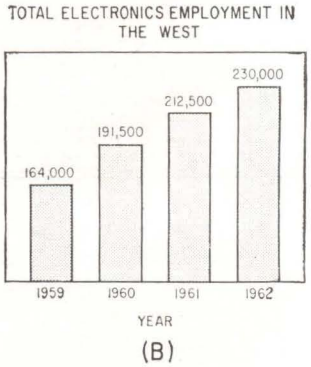
"Mounting costs and increased competition" he says "will limit earnings on the higher sales volume. The gravest problem as far as we in Southern California are concerned is the outspoken plans of Potomac politicians to channel defense work away from this area, which accounts for 62 percent of the West's electronics production, and into labor surplus areas."

OTHER PROBLEMS—Miller, in a recent talk before Los Angeles' Mid-Year Business Outlook Forum, pointed out other problems.

A few are the continued drive for tighter controls on government outlays for new weapons systems to keep within cost estimates, profit probes, renegotiating processes, renegotiating tests, and new incentive-type contracts.

Another westerner, EIA's president Charles F. Horne, recently listed three developments that should figure significantly in the industry's future nationally as well as in the West. One is the Trade Expansion Bill, whose impact remains to be seen. The second is the





GROWTH PATTERNS *compiled by Western Electronic Manufacturers Association: sales (A) employment (B) is also centered in Los Angeles (C). One out of every six employees is an engineer (D)*

law requiring all-channel tv sets. By raising tv set prices, the latter could considerably delay consumer buying, he feels.

The third development, the ruling by Office of Emergency Planning denying the EIA claim that imports of semiconductor products, especially from Japan, threaten American security. EIA, reports Horne, was somewhat discouraged by the OEP statement that the trend of imports will be kept under surveillance and that "the domestic industry should continue to retain the bulk of the important military market without substantial direct competition from import sources." The fact remains that Japanese exports of electronic products to the United States rose from $94 million in 1960 to $120 million in 1961.

SPACE BOOST—More optimistically, WEMA points out that defense and space exploration expenditures continue to spiral, and that the West is in line to receive its share of these dollars.

The 1962 bill for R & D will be about $16.5 billion. It is significant that, in 1961, 41 per cent of all R&D prime contracts were awarded to California companies. Production contracts tend to follow the geographic distribution of R&D awards.

WEMA cites the Apollo program as an example of projects potentially profitable to western electronics firms. The initial contract was awarded to North American Aviation's Space and Information division last fall. The program is expected to involve more than $40 billion before completion. Twenty per cent of this will probably be earmarked for electronic gear.

NASA's Director of Western Operations predicts that California alone will get from 30 to 40 percent of NASA's multibillion-dollar procurement in the next fiscal year.

Early this year electronics pushed ahead of aircraft to become California's leading employer.

Electronics provides employment for 196,000 people, against aircraft's 193,000. Electronic manufacturing employment in the entire West is now approximately 230,000, representing a gain of 17,500 over 1961. Statistics projected for 1962 indicate that, in the eleven western states, 1,010 electronics firms will show a sales volume of $3.29 billion, or 10.2 percent above last year's figure.

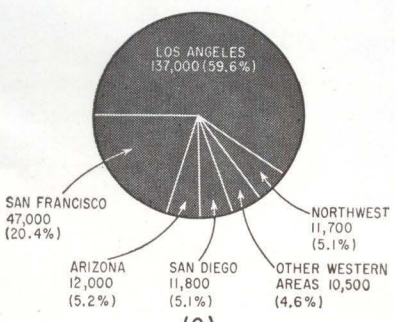
A breakdown by geographical areas shows that the Pacific Northwest now leads the major western electronics centers in growth rate. Centered around Portland and Seattle, the region is expected to chalk up $175 million in sales this year, 20 percent above last year's volume.

Arizona's industry still ranks high on the growth chart and came through with a dollar volume increase from 1960 to 1961 of 17.2 percent. Projected 1962 figures place sales at $185 million, or $15 million better than 1961.

San Diego and vicinity ties with Arizona for third place in sales among western production areas, and is the fourth fastest growing section with a dollar increase of 12 percent anticipated for 1962.

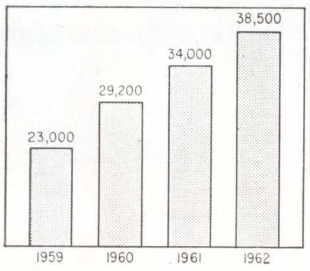
More than half of total 1962 sales in the West will stem from the Los Angeles area's 595 companies, with an anticipated figure of $1.868 billion. The San Francisco Bay area is expected to produce about $730 million. Growth rates for the two areas are 13.4 and 11 percent, respectively.

1962 DISTRIBUTION OF EMPLOYMENT BY AREAS



(C)

GRADUATE ENGINEERS IN ELECTRONICS IN THE WEST



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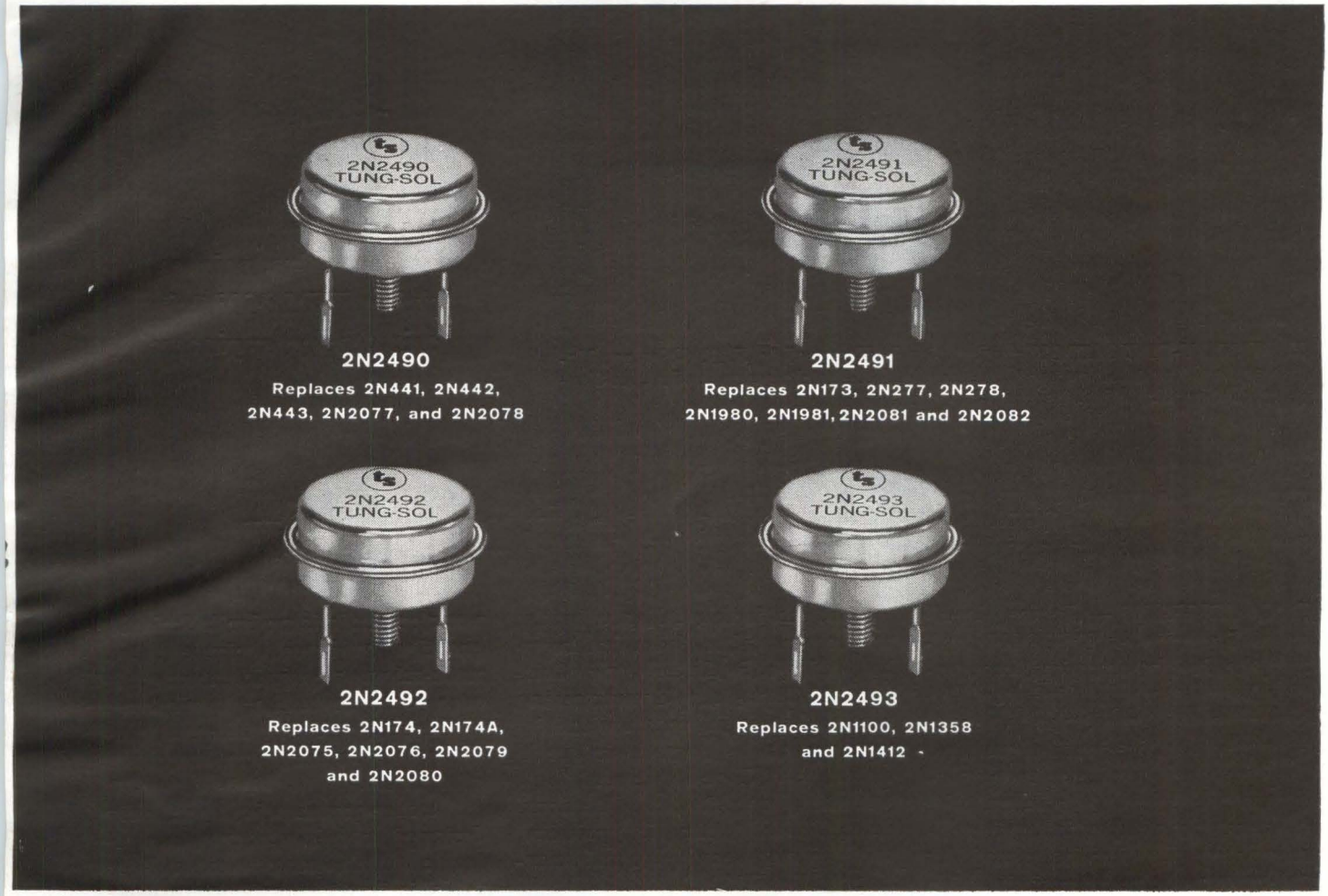
NEW FROM TUNG-SOL

FOUR SUPERIOR 15-AMP HIGH POWER GERMANIUM TRANSISTORS IN THE TO-36 CASE. AVAILABLE "OFF-THE-SHELF" AT COMPETITIVE PRICES

Types 2N2490-2N2493 generally provide lower leakage currents and higher breakdown voltages than the earlier types. Beta fall-off with temperature is relatively flat, making the new types ideal for low-temperature applications. All units

TEST	UNITS	MIN. MAX.	2N2490	2N2077	2N443	2N441	2N2491	2N2077
ICBO (VCB=2V)	mA	Max.	**0.3**	0.2	0.3	0.3	**0.3**	0.2
(1)ICBO	mA	Max.	**3.0**	4.0	8.0	8.0	**3.0**	4.0
(1)ICBO (70°C)	mA	Max.	**6.0**	15.0(2)	*	*	**6.0**	15.0(2)
(1)IEBO	mA	Max.	**3.0**	4.0	8.0	8.0	**3.0**	4.0
BVCES (IC=300mA)	V	Min.	**60**	50	50	40	**50**	50
BVCEO (IC=1A)	V	Min.	**50**	45	*	*	**40**	45
BVCBO	V	Min.	**70**	50	40	50	**60**	50
VBE (VCE=—2V) (IC=5A)	V	Max.	**0.9**	0.9	0.9	*	**0.9**	0.9
SVCE (IC=12A) (IB=2A)	V	Max.	**0.7**	0.9	1.0	*	**0.7**	0.9
hFE (1A)	—	Min.	**45**	25(3)	*	*	**65**	25(3)
hFE (5A)	—	Min.	**20-40**	20-40	20-40	20-40	**35-70**	20-40
hFE (5A) −65°C	—	Min.	**15**	15(4)	*	*	**25**	15(4)
hFE (12A)	—	Min.	**8**	8	*	*	**12**	8

(1) Measured at Max. VCB or VEB
(2) 71°C
(3) 1.2A
(4) −55°C
(5) IC—300mA
* Not Measured



are guaranteed to four minimum beta (h_{FE}) conditions ■ All military TO-36 requirements are met. Cases are Cold-Weld sealed for added reliability over an ambient temperature range of –65°C to +110°C.

2N2082	2N278	2N2492	2N174	2N174A	2N2075	2N2493	2N1100	JAN 2N1358	USN 2N1412
0.2	0.3	**0.2**	0.3	0.3	0.2	**0.3**	*	0.2	0.2
4.0	8.0	**2.0**	8.0	8.0	4.0	**3.0**	8.0	8.0	10.0
15.0(2)	*	**6.0**	15.0(2)	15.0(2)	15.0(2)	**6.0**	*	6.0(2)	6.0(2)
4.0	8.0	**2.0**	8.0	8.0	4.0	**3.0**	8.0	8.0	10.0
40	45	**75**	70	70	80	**85**	80	70	80
25	*	**65**	*	*	65	**75**	*	40(5)	60
40	50	**80**	80	80	80	**100**	100	80	100
0.9	*	**0.8**	0.9	0.9	0.9	**0.8**	0.9	0.9	0.9
0.9	1.0	**0.5**	0.9	0.7	0.7	**0.5**	0.7	0.7	0.7
40(3)	*	**50**	*	40(3)	25(3)	**50**	*	*	*
35-70	35-70	**25-50**	25-50	25-50	20-40	**25-50**	25-50	25-50	25-50
25(4)	*	**20**	*	*	15(4)	**20**	*	*	*
12	*	**10**	*	*	8	**10**	*	*	*

Detailed data sheets, beta-to-temperature curves and comparative data on earlier types are available on request. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193

TUNG-SOL® FULL POWER
POWER TRANSISTORS

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INDUSTRY-EDUCATION *cooperation is discussed by J. S. Coleman, National Academy of Sciences; C. F. Horne, SCIEC chairman, and N. H. Topping, University of Southern California*

Scholarships, science fairs, WESCON trips win future engineers

West Starts Recruiting Early

LOS ANGELES — Future Engineers Program at WESCON typifies the highly organized cooperation between western industry and education to encourage talented youngsters into scientific careers.

Numerous youth science programs are helping assure an adequate supply of scientists and engineers for the decades ahead by nurturing their interest in high school. Many of the WESCON student participants, for example, are winners of science fairs which reach more than 800,000 students in southern California alone.

ENROLLMENTS RISE — Importance of such programs is indicated by the expectation that California's population in the 18-to-21 age group will rise 70 percent in the 1960's.

Southern California is "the only place in the nation" with increasing college enrollment in scientific and technical fields, points out Charles F. Horne, chairman of the Southern California Industry-Education Council (SCIEC), and president of EIA.

During 1958 to 1961, the number of engineering undergraduates at UCLA jumped 17 percent, while nationally such enrollment dropped by 12,000 or 9.2 percent.

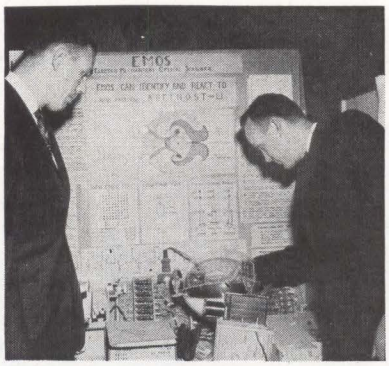
NATIONAL NEED—Horne says that industry-education cooperation must be intensified if the nation is to meet the expected national need of 81,000 new engineers a year—twice the present supply.

"The continuing cold war battles will be won by knowledge and know-how and both Russia and Communist China are demonstrating fanatical faith in education and indoctrination as a path to world supremacy," Horne warned.

Russia, reports the National Science Foundation, is producing twice as many engineers and scientists as the U. S.

SCIEC was formed in 1957 when it was realized that the concentration and rapid growth of scientific industry in the West would cause an overwhelming demand for scientific personnel. It was reportedly the first attempt to promote and coordinate individual youth science programs.

Programs sponsored include science centers where students may work on projects under technically qualified guidance, science fairs, math-science weekends, career guidance center, teacher workshops, community study on technical education and the Future Engineers of America.



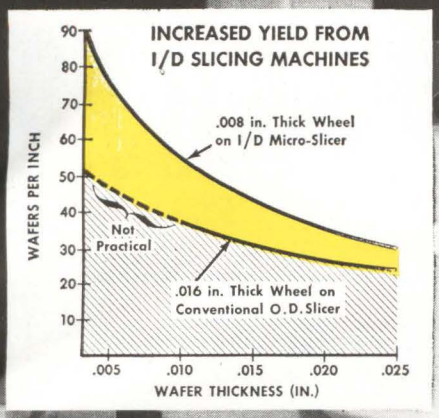
STUDENT PROJECT. *Electromechanical optical scanner, entered at the Future Engineers Show by Ronald Sheets, is examined by J. L. Grigsby and H. C. Poulter, of the San Francisco IRE selection committee, Sheets' sponsor*

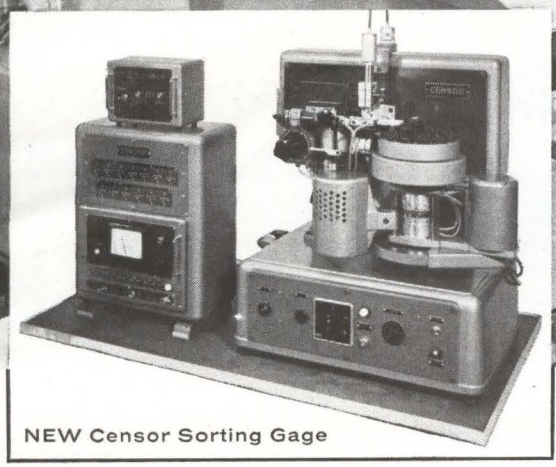
Another organization, specifically designed to help students in electronic engineering and related fields, is the 11-state Western Electronic Education Fund. It is managed by four trustees from WEMA and most of the donations are from WESCON. Starting with $3,000 in 1952, the fund has risen to $20,000 total in 1961, when more than 60 students were aided.

WESCON PROGRAM—The Future Engineers Program includes an exhibit of student experiments, a seminar, awards luncheon and field trips. Participants are guests of WESCON.

This year, 31 students will compete for $2,800 in scholarships, including the $1,000 Lee DeForest award for the best experiment and the $300 Frederick E. Terman award for the best seminar presentation. Entrants are in most cases nominated by IRE sections.

Examples of the exhibits are an r-f mass spectrometer, entered by Keith Edwards, of Pasadena; demonstration of photovoltaic cell response to infrared, by John Nicholson, Alamagordo, and a differential thermal analyzer for detecting impurities in chemical compounds, by Deborah Fitzgerald, of Redlands.





NEW Censor Sorting Gage

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I/D Micro-Slicer®—the Productivity Champion introduced to the semiconductor industry by DoALL. Uses new super-thin DoALL I/D (annular) diamond wheels. Yields up to 40% more wafers per crystal than other types of machines . . . can save you up to $50,000 per year in materials alone.

Fully automatic, large capacity Micro-Slicer with hydro-mechanical indexing gives guaranteed repeatability to within ±.0002". Other features include vibration-free spindle drive and recirculating coolant system.

CENSOR—a completely new sorting gage—another DoALL first. High-speed electronic machine automatically gages, sorts, and counts up to 3,600 silicon and germanium dice per hour . . . holds tolerances as close as .000004". Thickness range from .0008 to .040". At each of five settings, dice are sorted into 13 tolerance groups.

O.D. Microtom-atic® Slicing and Dicing Machine and Wheels. Three DoALL models handle every type of hard, brittle, or friable materials.

Accessories—including carbon blocks, crystal mounting wax, and precision measuring equipment.

See a sound color movie of the I/D Micro-Slicer in action, right in your own office. Or arrange for a demonstration of this equipment at the DoALL Hall of Progress in Des Plaines. Call your DoALL Sales-Service Store today.

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Serving you locally through your DoALL Sales-Service Store

Here's Your Best Buy in I/D Diamond Wheels!

COMPARE VALUE with any other annular wheel on the market: 200% diamond concentration based on 72 carats per cu in. • *Four* layers of diamonds electrostatically oriented in matrix of controlled hardness • I/D concentricity within .002" TIR • Precision-lapped cutting edges • Specially rolled and heat-treated backing.

MT-5

DoALL ...the Productivity People

Visit DoALL Booths 3709 & 3710 at the WESCON Show, Los Angeles, August 21-24

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2 MODELS
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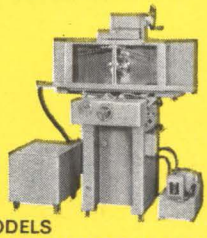


3 MODELS
O.D. MICROTOM-ATIC
Slicers and Dicers

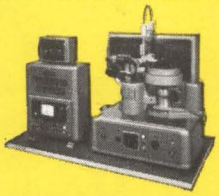
WHEELS

O.D. and I/D DIAMOND WHEELS

Sizes to fit *all* machines

SORTING GAGES

FULLY AUTOMATIC
WAFER GAGING & SORTING



ACCESSORIES

CARBON BLOCKS

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VACUUM COMPONENTS

PUMPS • VALVES • BAFFLES • GAUGES

The best performing and most reliable vacuum components come from NRC. All these components are shipped from stock. For additional information, write for product data sheets.

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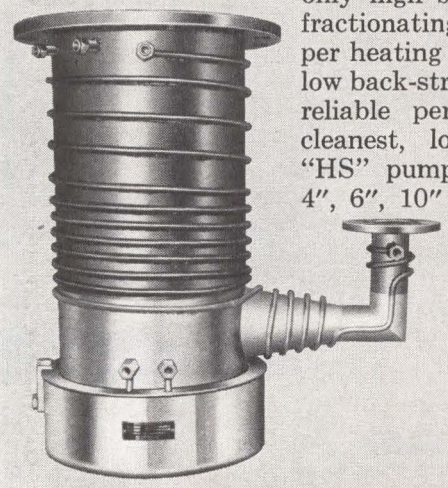
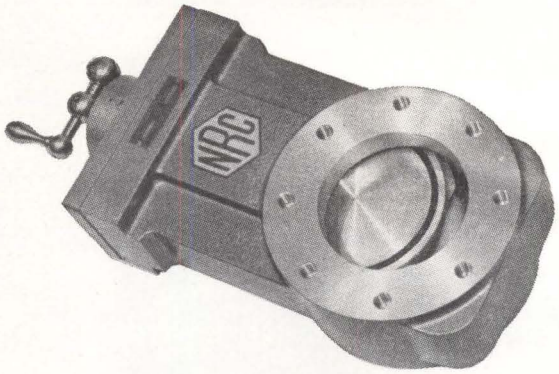
DIFFUSION PUMPS



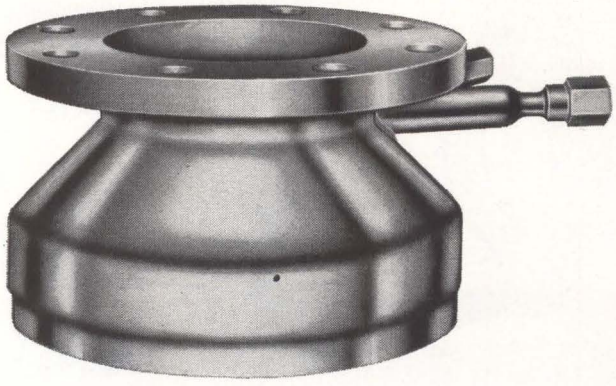
NRC's new "HS" Series Diffusion Pumps is the only high speed line with fractionating design, no super heating necessary, and low back-streaming for top, reliable performance and cleanest, lowest vacuum. "HS" pumps available in 4″, 6″, 10″ and 32″ sizes.

SLIDE VALVES



The new NRC Slide Valves are the best by comparative tests. The "HC" Series valves now provide valved systems with very high and ultrahigh vacuums (10^{-8} torr and lower) at *conventional* prices. Available in 4″ and 6″ sizes.

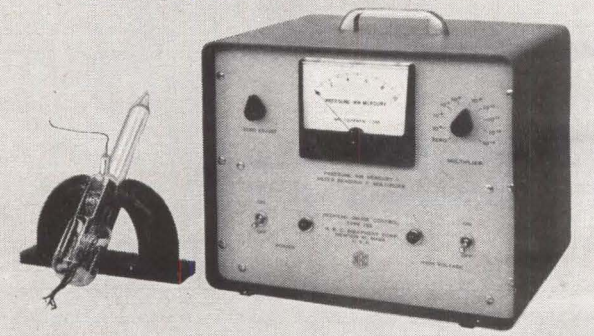
CRYO AND MOLECULAR BAFFLES



NRC's Circular Chevron Cryo Baffles provide exceptionally high conductance for maximum *useful* pumping speed.

NRC's new Molecular Sorbent Baffles provide truly *clean* vacuums by use of three full trays of sorbent material (Zeolite) and built-in heater for regenerating easily.

VACUUM GAUGES



From 1 x 10^{-3} to 10^{-10} torr range, the most accurate, reliable gauge in NRC's improved Bayard-Alpert type, the Model 751.

At pressures *below* 1 x 10^{-9} torr, "there is only one really satisfactory gauge commercially available, the Redhead Gauge, NRC's Model 752." The 752 is *not* "X-Ray limited", is magnitudes less "gassy" because there is *no* hot filament, is 50 times more sensitive than typical Bayard-Alpert gauges. The result is more accuracy below 10^{-9} torr than any other gauge. If you really want accurate, reproducible measurements in the ultrahigh vacuum range, use the Model 752.

MANUFACTURING PLANTS IN NEWTON, MASSACHUSETTS AND PALO ALTO, CALIFORNIA

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MAGNETIC TAPE INSTRUMENTATION

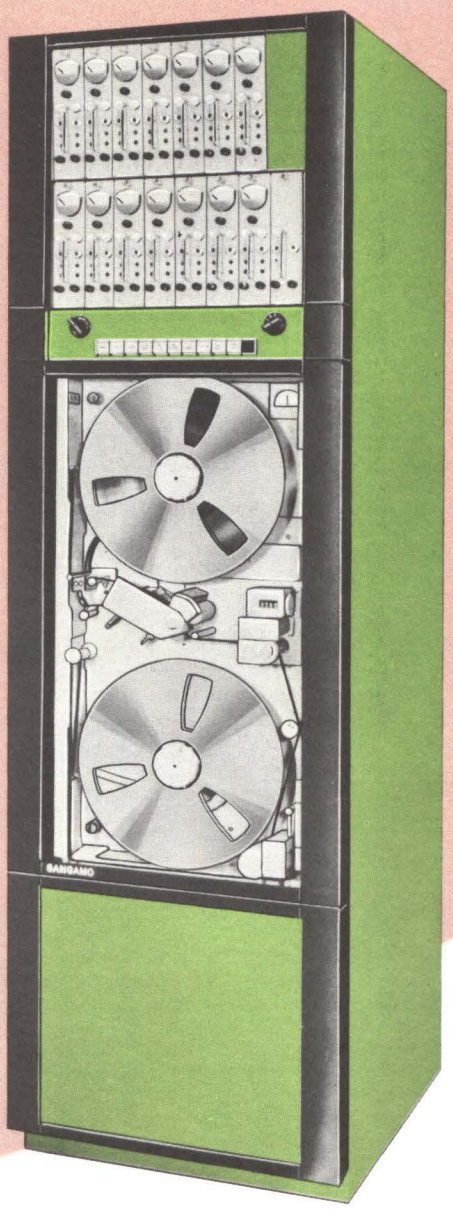
You get

MORE ACCURATE DATA

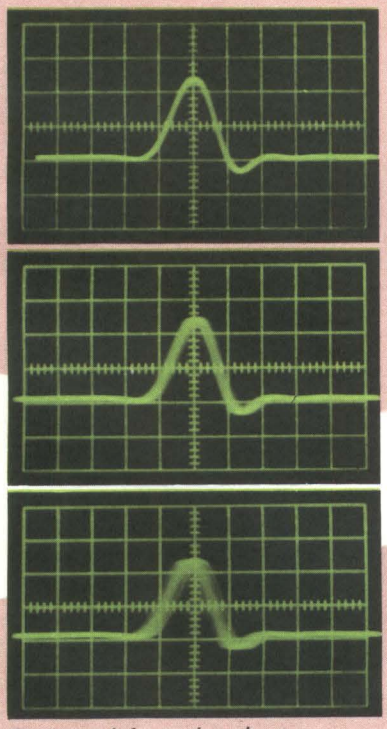
with SANGAMO SPEED CONTROL

MAGNETIC TAPE
INSTRUMENTATION

Sangamo's Unmatched Tape Speed Control System Assures Undistorted Data Reduction . . . Unsurpassed Recording/ Reproducing Accuracy.



In every magnetic tape application, reproducibility of tape speed has a direct bearing on the validity of data. Sangamo Recorder/Reproducers with their unequalled tape synchronized servo, provide tape speed reproducibility previously believed unattainable. With a light mass capstan drive and Sangamo's exclusive eddy-current damping system, instantaneous time displacement error is less than ±25 microseconds at 60 and 30 ips. The reproduce system can correct for record speed deviations of ±15% per second over a range of ±10% without loss of synchronism.



You get this accuracy in a *general purpose* Sangamo Recorder/Reproducer which also features:

- **Automatic switching of 4 speeds of FM and Direct record and reproduce electronics.**
- **7 to 28 channels of data.**
- **Solid state construction throughout.**
- **Reel-to-reel and loop capability in a single transport.**

JITTER LESS THAN 1 PART PER 1000

Oscilloscope photographs display pulse-to-pulse jitter in a single channel for a complete record/reproduce cycle on a Sangamo Model 471 at 60 ips. Pulse width is 5 microseconds and jitter is shown for the time intervals of 0.5, 1.5 and 5.0 milliseconds.

For more information about these and other benefits, write, wire or phone.

ELECTRONIC SYSTEMS

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

ES62-2

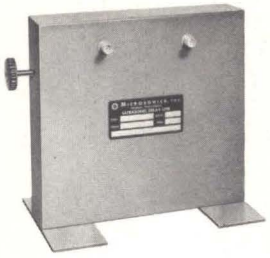
MICROSONICS

DELAY LINES

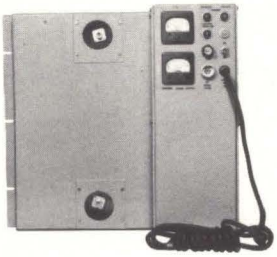
MICROSONICS

... unexcelled source for ultrasonic delay lines

NEW VARIABLE DELAY LINE Microsonics' new ultrasonic variable delay lines are continuously adjustable from 5 to 200 μsec with longer delays possible. Multiple variable outputs may be adjusted together or separately as well as through an adjacent output, over a limited range. Other characteristics: Frequency—20 to 60 mc; Band width—8 to 20 mc; Spurious—30 to 40 db.



NEW TEMPERATURE CONTROLLED ULTRASONIC DELAY LINES Microsonic temperature-controlled delay lines are for use as recirculating memories in systems where a phase coherent storage loop is a prerequisite. They may be used for IF Cancellors, Long Time Integrators, Delay Line Filters, Time Compression and Real Time Spectral Analysis. These controlled systems provide temperature excursions not greater than .01°C. Short term stability shall not exceed .003°C/minute over a twelve-hour period. Units have been furnished with .007°C stability over two weeks.



Microsonics has been selected time after time by major system manufacturers to develop and build ultrasonic delay line equipment. Systems using Microsonics delay lines include ASR-2, 3, 4, 5; UPS-1; FPS-30; SPS-38; SPS-6; ARSR; CPN-18; HAWK; APQ-72; MPS-23. Many of these applications have required advancements in the state of the art.

All of Microsonic's ultrasonic delay lines are hermetically sealed and meet the most rigid military environmental tests of shock, vibration, temperature and altitude.

Inquiries should be made directly to:

MICROSONICS INCORPORATED

Hingham Industrial Center, Hingham, Massachusetts

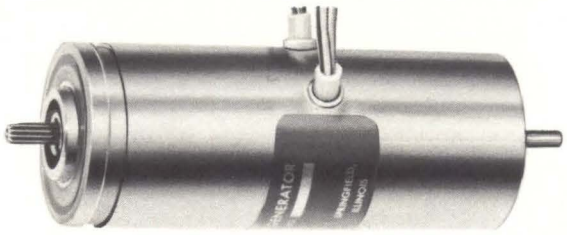
SANGAMO *MICROSONICS*

PRECISION

MOTORS

SANGAMO PRECISION MOTORS

NEW—SIZE 5 and SIZE 8 SERVO MOTORS. A size 5 (0.5″ dia.) and size 8 (0.75″ dia.) control motor, motor generator and synchronous motor have recently been added to Sangamo's extensive line of Precision Motors. Both units are designed for 400 cps excitation and are manufactured of corrosion resistant stainless steel. The size 8 can be provided with integral gear reducers.



NEW FEATURE ADDED TO SIZE 10 and 11 MOTOR GENERATORS Sangamo's standard size 10 (.938″ dia.) and size 11 (1.062″ dia.) servo motor generators are now available with a rear shaft extension to permit mechanical coupling and/or speed checks after the unit is installed. Positive alignment is assured by the use of three ball bearings in each unit.

SYNCHRO

SYNCHRONOUS MOTOR

GEARED MOTOR GENERATOR

We at Sangamo have been designing and producing AC servo motors, Induction Generators, Motor Generators, Drag Cup motors, Synchronous motors, Synchros, and PM Generators for more than 20 years.

We can supply—on short notice—hundreds of designs for both 60 and 400 cycle input sources with frame sizes ranging from size 5 to size 25. The materials, finishes, and performance of these units are tailored to meet applicable military specs. Most of our motors and motor generators are available with integral reduction gear ratios, and selected current designs can be furnished to operate at total temperatures of up to 200°C.

This is sure: whether it's a "stock" motor or a special requirement motor, if it comes from Sangamo it is ultra-reliable, competitively priced, and delivered on time.

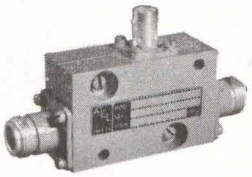
Write for complete information.

SANGAMO *PRECISION MOTORS*

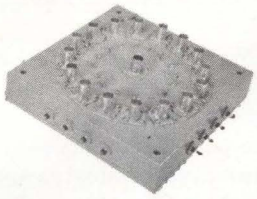
SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

PM62-1

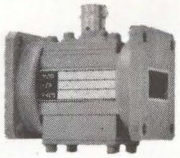


Broadband 20-1000 mc switch

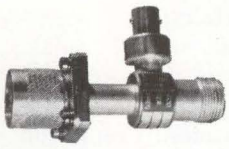


Single pole, 16 throw UHF switch

Single pole, double throw, broadband switch

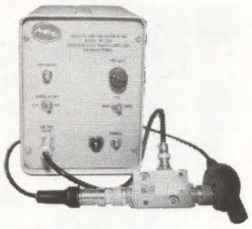


Typical waveguide switch



Coaxial, single pole, single throw switch

3 KW beacon side lobe suppression switch



The AEL Modulator is a typical application of AEL solid state crystal switches for square wave or pulse modulation of signal sources to achieve greater power output with wide frequency bands

Self-operating AEL Microwave Power Limiters protect crystal diodes and prevent receiver overload in radar and crystal video receivers in the vicinity of high power microwave transmitters. Can be supplied in L, S, C and X band frequencies

AEL® brings you the largest and most varied line of

SOLID STATE CRYSTAL SWITCHES

available in the industry today

Through a continuing program of basic development in solid state crystal switches, AEL has made numerous contributions to the state-of-the-art in this field. We have the capability to achieve virtually any characteristic desired in a solid state switch. For example, we have developed and produced individual switches to meet each (also combinations of) the requirements listed at right.

AEL solid state crystal switches are characterized by their extremely low switching power requirements, very fast switching speeds, low forward insertion losses, high back isolation, high power, and capability to function over almost the entire RF spectrum from 10 mc upwards into millimeter bands.

Other features include light weight, wide temperature operating range, extremely compact physical configurations, and conformance to MIL specifications. They are superior in most respects to ferrite devices.

Numerous applications exist for these switches including . . . square wave or pulse modulation of signal sources to achieve greater power output with broad bandwidths; commutators for Wullenweber arrays; antenna lobe switching; and rapid selection of channels.

For complete catalog information on the extensive line of AEL solid state crystal switches, write to:

- **FREQUENCY RANGE**
  from 10 mc to over 35 Gc
- **BROAD BANDWIDTH**
  20-1000 mc in one switch . . .
  200-8200 mc in one switch
- **HIGH POWER**
  to 10 KW
- **HIGH SPEED**
  as fast as 0.2 nanoseconds
- **LOW INSERTION LOSS**
  down to 0.1 db
- **HIGH ISOLATION**
  to 150 db
- **MULTIPLE THROWS**
  switches built with as many as 32 throws
- **RELIABILITY**
  to meet missile requirements
- **COAX, WAVEGUIDE & STRIPLINE**

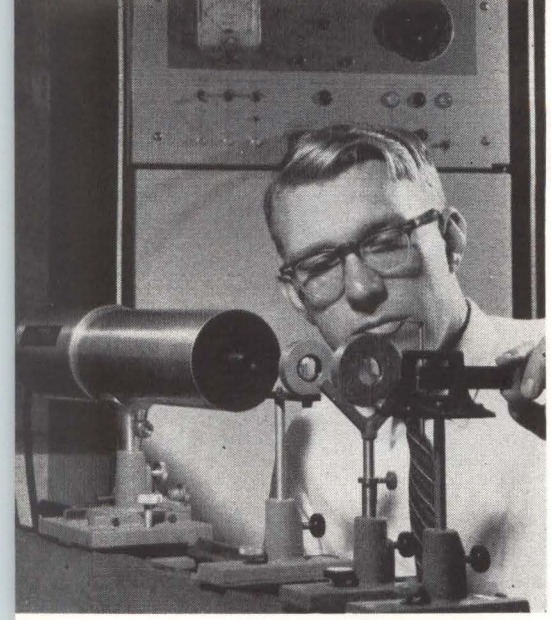
AEL®

VISIT US AT THE
WESCON SHOW
BOOTH #3044

American Electronic Laboratories, Inc.

RICHARDSON ROAD, COLMAR, PENNSYLVANIA • just north of Philadelphia • Engineers: Investigate the rewarding opportunities at AEL

WESCON Spotlights



RUBY LASER, *a high-power model developed at Hughes Research Labs, will be used in WESCON's opening ceremony to trigger the welcoming message*

Program, exhibits and special events carry out convention's theme

By HAROLD C. HOOD
Pacific Coast Editor

LOS ANGELES—WESCON this month, for the first time in its 14-year history, sports a theme: "Frontiers in Electronics." Its technical program, exhibits, and the special events scheduled for August 21 through 24 have been carefully tailored to amplify this theme.

Number of contributed-paper sessions has been trimmed from last year's 40 to 21, and such timely topics as space electronics and telemetry, pattern recognition, antennas and propagation, and solid state devices will be explored in depth (for previews of technical papers, see page 59).

SPECIAL SESSIONS — Supplementing the regular sessions to be held mornings at the Statler Hotel will be five special afternoon sessions dealing with subjects of particularly high interest.

"Biological Aspects of Communications" will be held Tuesday afternoon and will present insight into studies presently underway in the related fields of communications and biology. Two sessions on Wednesday, entitled "Weather Satellites and Data Processing" and "Research in Nuclear Test Detection" will run serially.

Special session on Thursday, delving into various types of electrically propelled spacecraft systems, will be "Advanced Propulsion Systems." Among electrostatic thrust devices to be discussed will be the cesium ion engine, the oscillating electron engine, the Penning discharge ion engine, and the duoplasmatron-type engine.

Wind-up special session to be held Friday will feature five NASA/JPL speakers and is headlined "Lunar Exploration."

A record 1,250 display booths will house exhibits from 850 companies in LA's mammoth Sports Arena and annex, both of which will be air-conditioned to beat the Southland's well-remembered August heat spells. Exhibit hours will be 9:30 a.m. to 6:30 p.m. each day except Wednesday when the area will be open at noon and close at 9:00 p.m.

WESCON's inquiry card system, instituted last year and proving very popular among literature-collecting conventioneers, will be used again. Similar to regular credit cards, name-and-address plates are issued at registration and assure post-convention receipt of desired literature and data hand-outs.

NEW PRODUCTS — Noteworthy new products to be introduced are far too numerous to list all here (see page 130), but some are:

Infrared Industries, Inc., will unveil a tunable microvoltmeter combining a tunable amplifier, a variable bandpass filter, an extremely low-noise amplifier and microvoltmeter. The device features plug-in preamplifiers for matching input impedances from a few ohms to many megohms, and a-c and d-c outputs proportional to meter deflection.

Exhibiting for the first time at WESCON, Wilk Instruments will preview five new precision measuring instruments. Among these are a Lindeck potentiometer and microvolt source having 20 ranges of voltage measurement from 0-1 mv to 2 v with accuracies to 0.1 percent of each range, and an a-c calibrator with a range from 0 to 1,511.0 v, accuracy of 0.1 percent, and a resolution of 0.01 v.

Eitel-McCullough will show a series of grid-type power tubes which heat to full operating condition from dead cold in one second. Some of the series feature unusually high transconductance and operate at higher frequencies than previously available units. Also to be introduced is a 20-watt twt, capable of withstanding 210-g shocks and giving 45-db gain over a 500-Mc

ELECTRON MIRROR *microscope being introduced by General Mills can magnify up to 1,500 times and display dynamic electrical properties of specimens*

Frontiers in Electronics

WESCON EXHIBITS *will be housed in the pancake-shaped Sports Arena (center) and an annex. This year's 1,250 display booths sets a record*

band around 8 Gc.

Among new items to be displayed by Beckman's Helipot Division is its Hallefex voltage generator. Two models of this tiny thin-film Hall-effect device to be shown measure $\frac{3}{8} \times \frac{1}{2}$-inch and $\frac{1}{4}$-inch square.

C-W LASER—Perkin-Elmer's continuous-wave, helium-neon laser will be shown for the first time. Developed jointly with Spectra-Physics, Inc., the device weighs 13 pounds, has a 1-mw output at 11,530 angstroms, a spread of less than one minute of arc, and will sell for around $7,500. Interferometry and spectrum analysis are among potential applications.

Among six products to be introduced by Melabs are a laboratory receiver with frequency coverage from 500 Mc to 1,100 Mc, an all-solid-state, C-band microwave frequency source, and a triode oscillator solid-state tripler P-band parametric amplifier pump source.

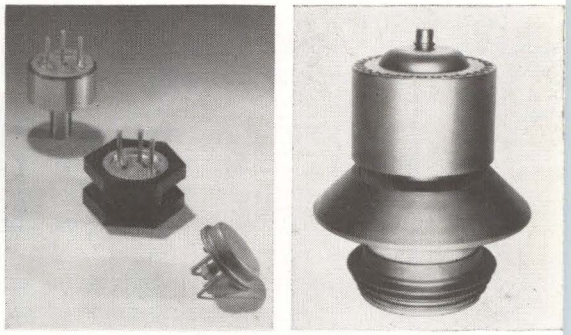
Computer Control Co. will debut a "multiple slit" shaft encoder reportedly having four times the accuracy of any available single-slit unit of equal case size. Model to be demonstrated is packaged in a 3.5-inch case and has a 2^{15} accuracy.

A new line of high power waveguide ferrite circulators for applications at frequencies from S-band through Ka-band will be shown by Microwave Associates. Also to be seen for the first time are two TWT's for both commercial and military applications, a new line of high power varactors, and a ruggedized miniature isolator less than $\frac{1}{2}$-inch long and weighing less than 2 ounces.

DIGITAL INDICATOR—General Radio's booth will feature several new items, including an octave-band noise analyzer, a transistorized, low-cost counter, and a reportedly unique digital indicator. The latter has a bright white display of 10 digits, measures $\frac{5}{16}$-inch from front to rear number, and features a 120-degree viewing angle.

For the do-it-yourself fans, thirteen new Knight-Kits will be on display in Allied Radio's booth. Included will be a 32-watt transistorized stereo amplifier, and a 1-watt transistorized portable 2-way radio.

General Mills will introduce a new electron mirror microscope characterized by an electron optical mirror which acts as both specimen and reflecting surface. The unit displays dynamic behavior, such as moving electric charge patterns and magnetic domains set in motion by mechanical strain. Magnification is from 20× to 1500×.



NEW FLAT PACK *(left center is being used by Minneapolis-Honeywell for 65-amp transistors. Eimac is showing vapor-cooled high-power tetrodes (right)*

A new line of 5-digit voltmeters, capable of making 5,000 measurements per second, will be introduced by Non-Linear Systems. Accuracy of ±0.01 percent of reading +1 digit is maintained to top speed.

Montrose Division of Bendix Corp. will unveil size 10 and 11 ra-

diation-resistant synchros suitable for operation at 800 F.

Among new products to be introduced by five divisions of Minneapolis-Honeywell are a rack-mounted Visicorder oscillograph with heated platen, a series of 65-amp *pnp* germanium power transistors, a new magnesium-oxide ceramic which serves as both an electrical insulator and a thermal conductor, and a hermetically-sealed switch occupying less than 0.14 cubic inch.

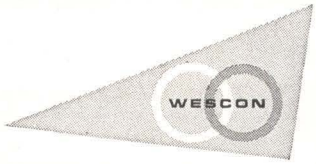
FIELD TRIPS—This year's field trips will include visits to Consolidated Electrodynamics and Burroughs plants in Pasadena, Rocketdyne's engine test facility in the Santa Suzana Mountains, Litton's Guidance and Control Systems facilities in Woodland Hills, and Jet Propulsion Laboratory. NBC Color Studios in Burbank will open its doors to WESCON attendees for a glimpse of latest electronic equipment used for network color telecasts. For those desiring a breath of salt air, a trip has been scheduled to Hughes Semiconductor Division at Newport Beach, and the Navy is sponsoring a cruise out of Los Angeles Harbor on an LCG class missile cruiser.

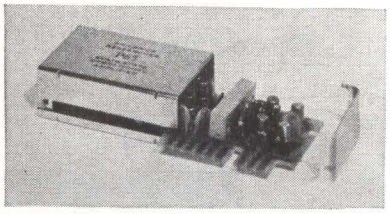
SPEAKERS—Featured speaker at WEMA's annual luncheon will be Assistant Secretary of Defense John H. Rubel. Employed by Hughes Aircraft for 13 years, Rubel has extensive industrial experience encompassing fields of airborne systems, radar, digital and analog computers, guidance and control systems and communications sub-systems.

Thursday evening's All-Industry Banquet will be addressed by RCA's president Elmer W. Engstrom. His address is titled "The Challenge of Electronic Progress". National presidents of both the IRE and AIEE are expected to comment on the recent merger.

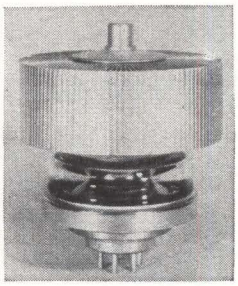
Theme of the all-industry cocktail party is "A Night in Hollywood" and will be held in Hollywood's colorful Paladium.

As in the past eight years, the annual Distributor-Representative-Manufacturer Conference will precede WESCON on Monday, August 20, and will be in the Ambassador Hotel's Convention Center.

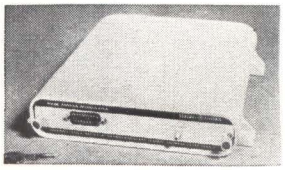




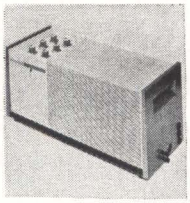
SLIDE-IN *board is used in Philbrick amplifier*



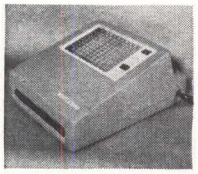
BEAM PENTODE *by Penta Laboratories melds metal and glass*



SLIM LOOK *is feature of GE phase position demodulator*



BECKMAN *power supply has perforated case, recessed controls*



INPUT STATION *for Datex data colecting system*

Designs Compete for WESCON

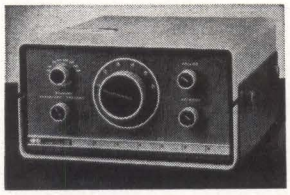
LOS ANGELES—The field of 150 entries submitted in WESCON's fourth Industrial Design Contest has been narrowed down to 20 new products, from 14 companies.

The 20 finalists will be displayed on the Sports Arena concourse. Four will be awarded certificates of excellence and the one judged best in design will receive the newly established Pacesetter Award.

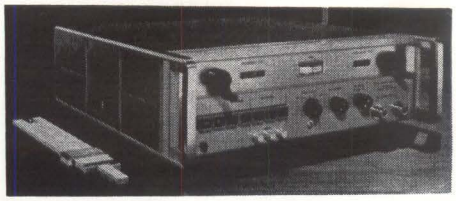
Last year's winners of awards of excellence were submitted by Collins Radio, Hewlett-Packard, Kaar Engineer, Precision Instruments and Tektronix. The finalists this year are:

Direct optical reader and random access file, National Cash Register; marine radiotelephone, Kaar Engineering; ultracentrifuge, power supply and ratio fluorometer, Beckman Instruments; two differential operational amplifiers, George A. Philbrick Researches.

Pulse position demodulator and radiometer, General Electric; beam pentode, Penta Laboratories; microwave absorber, B. F. Goodrich; electronic module weld head,

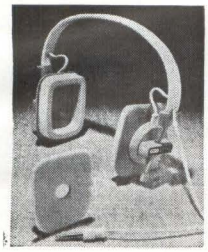


VISIBILITY *is key to Kaar radio-telephone design*

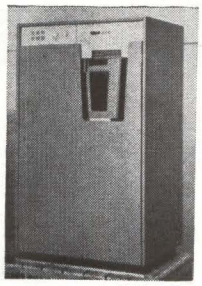


SELECTORS *are grouped on Hewlett-Packard signal generator*

CONSOLE *for Minneapolis-Honeywell H800 doubles as desk*



RANDOM ACCESS *card file by National Cash Register*



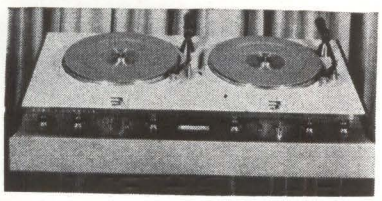
COMFORT *is emphasized in Clevite headphone*

AWARDS

Hughes Aircraft; portable announcer, Collins Radio Co.; two computer consoles, Minneapolis-Honeywell.

Data collection system, general purpose input station, Datax Corp; headphone, Clevite Corp; signal generator, Hewlett-Packard; Milli-K multicontact connector, Cannon Electric Co.

Judges are Jon W. Hauser, Robert J. Fujioka, Dean Meyers, all designers, and John Coleman and Joseph D. Thompson, of the Los Angeles Art Center.



DISK JOCKEYS *can tote Collins Radio announcer*

Will Satellite Tv Be Too Expensive?

WASHINGTON—Telstar is focusing attention anew on the economics of space communications. While the predictions for message traffic are relatively optimistic, government sources and the tv networks see no economic advantage in satellites tv transmission.

Edward R. Murrow, U. S. Information Agency chief, doubts his agency can afford satellite tv. Government economists say cost and use estimates are too speculative to guess at rates for services. If the first global system has capacity to spare, tv rates might be low to avoid wasting the capacity.

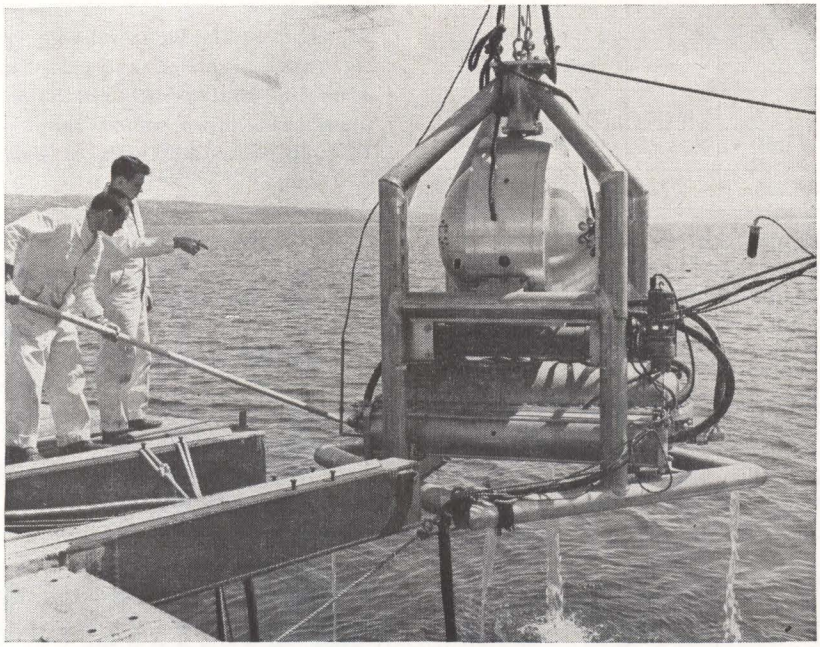
Cost estimates range from $200 to $500 million: AT&T figures $200-million for a 50-Telstar system with 20 ground stations and 600 two-way voice channels, Lockheed sees $259-million for 1,000 channels in two synchronous satellites with costs of $420-million by 1975.

Telex, telephone and telegraph services between the U. S. and Europe will generate up to $450 million annual revenue by 1970 and require 1,900 voice channels, thinks Booz, Allen and Hamilton. In its report to FCC, the ad hoc carrier committee forecast a need for 4,650 channels by 1970. AT&T expects 12,000 will be required by 1980. Government economists look for $1 billion to $2 billion revenue by 1980 and feel that would mean an economic system.

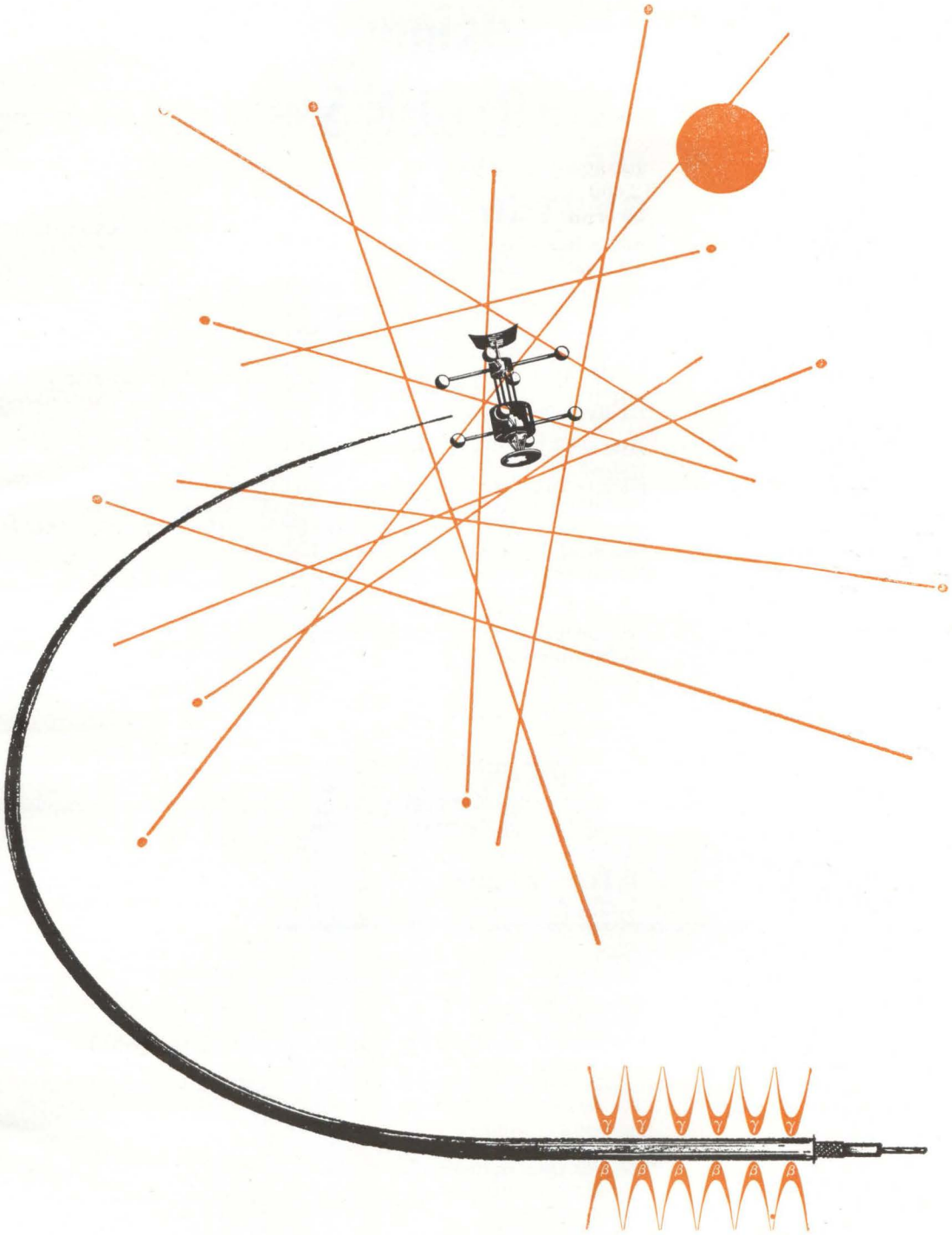
Air Force Buys Third Portable Traffic Control

COMPACT AIR TRAFFIC CONTROL and communications systems will be supplied to the Air Force by RCA under a $7.5-million contract from USAF Electronic Systems Division. This is the third of 14 mobile control systems planned to make Air Force equipment compatible with FAA systems. Total contracts now awarded exceed $13 million. Each control system, transportable by air, includes six radar vans, intercom and electronic landing assistance equipment.

Hydroacoustic Transducer for ASW Studies



HIGH-POWER, LOW-FREQUENCY *sound generator, shown under test at lake, was designed by General Dynamics/Electronics for Navy anti-submarine-warfare studies. A pump-driven valve amplifier converts a fluid flow to vibratory energy, driving two aluminum hemispherical pistons (seen below apex of frame). An electronic oscillator is used for control*



radiation resistance through irradiation

LEADER IN RADIATION CHEMISTRY FOR ELECTRONIC WIRE AND CABLE

RAYCHEM CORPORATION

MEETINGS AHEAD

ENERGY CONVERSION PACIFIC CONFERENCE, AIEE; Fairmount Hotel, San Francisco, Calif., **Aug. 13-16.**

PRECISION ELECTRONIC MEASUREMENTS INTERNATIONAL CONFERENCE, IRE-PGI, NBS, AIEE; NBS Boulder, Labs., Boulder, Colo., **Aug. 14-17.**

WESTERN ELECTRONICS SHOW AND CONFERENCE, WEMA, IRE; Los Angeles, Calif., **Aug. 21-24.**

METALLURGY OF SEMICONDUCTORS CONFERENCE; American Institute of Mining, et al; Ben Franklin Hotel, Philadelphia, Pa., **Aug. 27-29.**

BALLISTIC MISSILE & SPACE TECHNOLOGY SYMPOSIUM, U.S. Air Force and Aerospace Corp.; Statler-Hilton Hotel, Los Angeles, **August 27-29.**

MAINTAINABILITY OF ELECTRONIC EQUIPMENT, EIA Engineering Dept. & Dept. of Defense; U. of Colorado, Boulder, Colo., **Aug. 28-30.**

INFORMATION PROCESSING, INTERNATIONAL CONFERENCE, IRE-PGEC, IFIPS, AIFPS; Munich, Germany, **Aug. 29-Sept. 1.**

INFORMATION ON THEORY INTERNATIONAL SYMPOSIUM, PGIT and Benelux Section of IRE; Free Univ. of Brussels, Belgium, **Sept. 3-7.**

ADVANCED TECHNOLOGY MANAGEMENT CONFERENCE, IRE-PGEM, AIEE, et al; Opera House on World's Fair Grounds, Seattle, Wash., **Sept. 3-7.**

DATA PROCESSING EXHIBIT, Assoc. for Computing Machinery; Onondaga County War Memorial, Syracuse, N. Y., **Sept. 4-7.**

PETROLEUM INDUSTRY CONFERENCE, AIEE and ISA; Carter Hotel, Cleveland, Ohio, **Sept. 9-14.**

ENGINEERING MANAGEMENT, IRE-PGEM, AIEE et al; Hotel Roosevelt, New Orleans, La., **Sept. 13-14.**

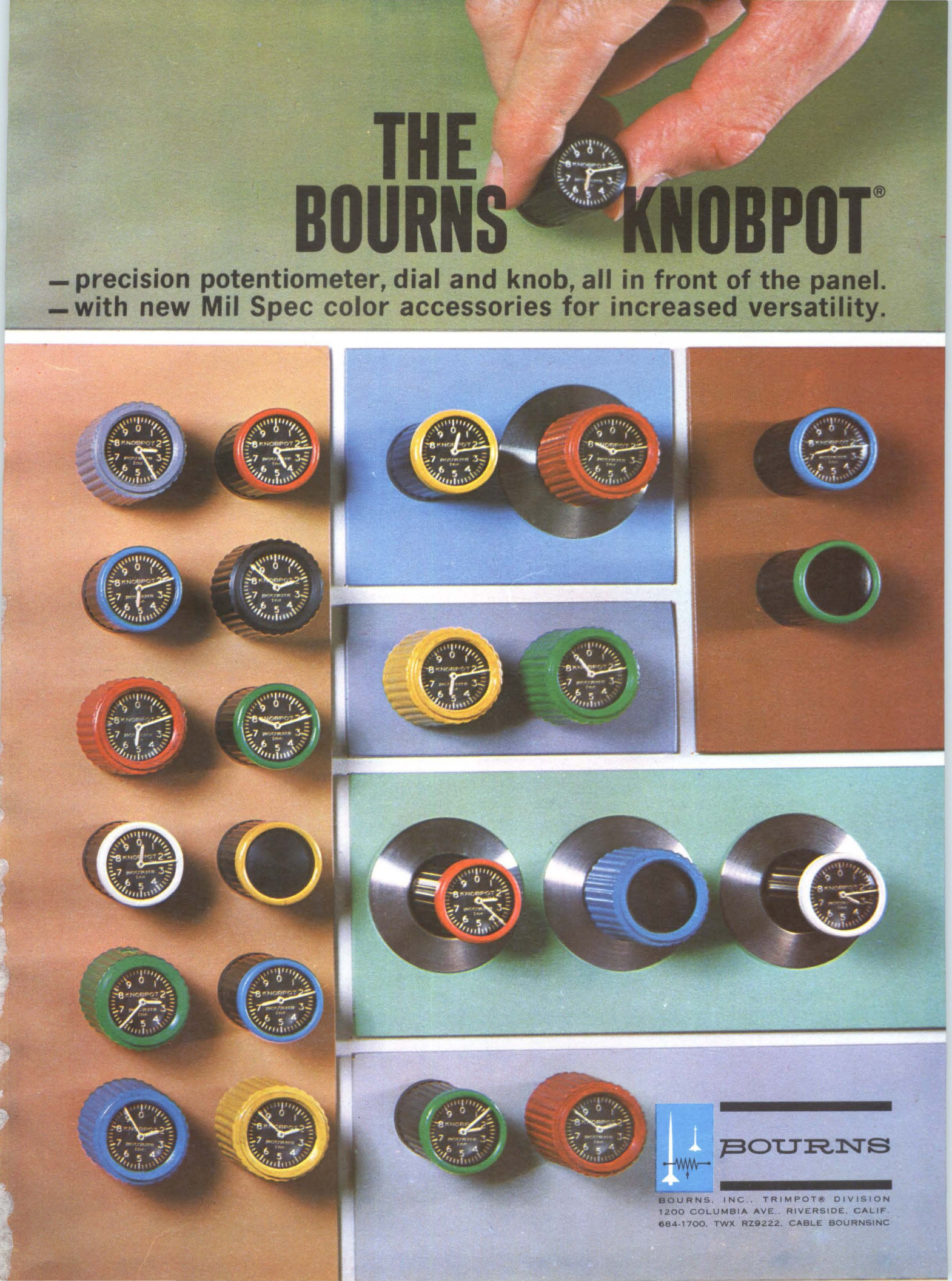
ENGINEERING WRITING AND SPEECH SYMPOSIUM, IRE-PGEWS; Mayflower Hotel, Wash., D. C., **Sept. 13-14.**

ELECTROCHEMICAL SOCIETY MEETING; Statler-Hilton Hotel, Boston, Mass., **Sept. 16-20.**

RECTIFIERS IN INDUSTRY MEETING, AIEE; Deshler-Hilton Hotel, Columbus, Ohio, **Sept. 18-19.**

ADVANCE REPORT

MILLIMETER & SUBMILLIMETER CONFERENCE, IRE-PGMTT; *Jan. 8-10, 1963, Orlando, Fla. Sept. 15 is the deadline for submitting 3 copies of a 500-word abstract to: J. J. Gallagher, Technical Program, Millimeter & Submillimeter Conference, MP-172-Box 5837, Martin Company, Orlando, Fla. Topics may include the following: mm and sub-mm transmission lines, quasi-optical techniques, mm sources & stability considerations, mm & sub-mm resonant structures, mm components & power measurements, mm receivers, harmonic generation & detection, mm spectroscopy, mm masers.*

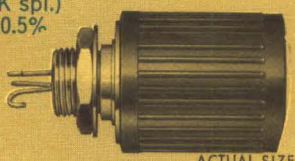

THE
BOURNS KNOBPOT®
— precision potentiometer, dial and knob, all in front of the panel.
— with new Mil Spec color accessories for increased versatility.
BOURNS
BOURNS, INC., TRIMPOT® DIVISION
1200 COLUMBIA AVE., RIVERSIDE, CALIF.
684-1700, TWX RZ9222, CABLE BOURNSINC

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

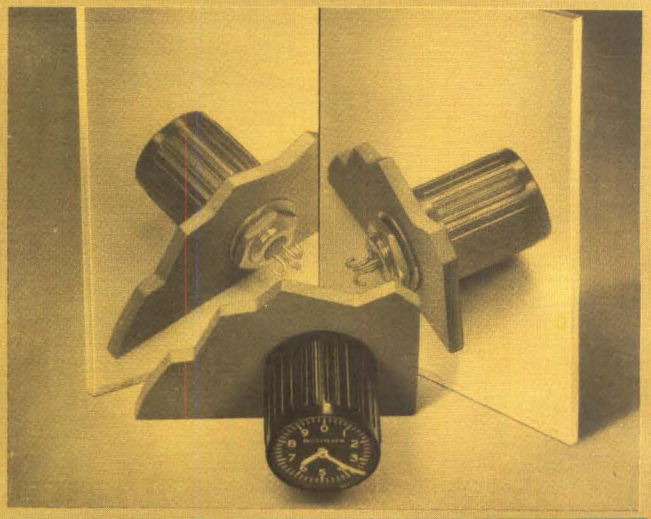
With the new Bourns Knobpot, nothing is behind the panel but the solder hooks and the bushing. Everything else is out in front, integrated into a single, compact unit. (Just ¾" in diameter by 1" long, the easy-to-mount 10-turn Model 3600 Knobpot is shorter by ½" than comparable potentiometers alone—to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

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

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



ACTUAL SIZE



NOW YOU CAN MULTIPLY THE USEFULNESS OF KNOBPOT

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

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

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

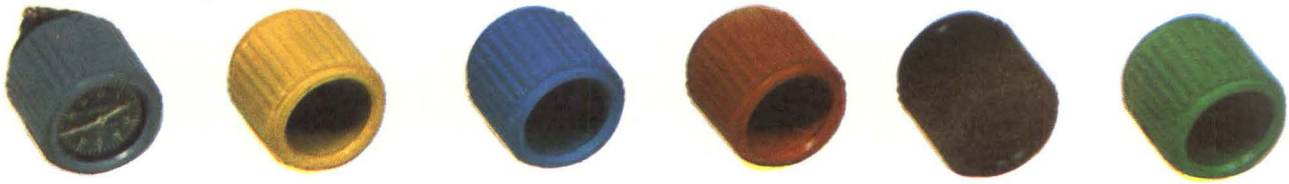
WITH ANY OF THESE ACCESSORIES OR ANY COMBINATION OF THEM

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

COLORED SNAP-RINGS

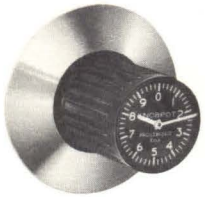
To color-code control panels or impart higher style to equipment design.

COLORED MIL-SPEC SLIP-OVER KNOBS



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

STAINLESS STEEL SKIRTS



For a finishing touch of high-polish glamour.

LOCKING DEVICE (BRAKE)

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

BOURNS

BOURNS, INC., TRIMPOT® DIVISION
1200 COLUMBIA AVE., RIVERSIDE, CALIF.
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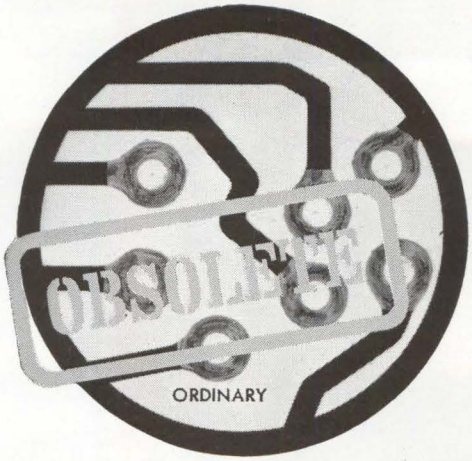
WRITE FOR FULL INFORMATION ON KNOBPOT AND KNOBPOT ACCESSORIES

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

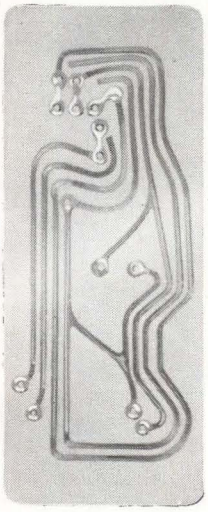
75TH Anniversary Year



NO OXIDE . . . NO CONTAMINATION

in bright copper F. E. P. encapsulated

FREE•FLEX* CIRCUITRY



Now—break the oxidation habit! Apply Garlock FREE-FLEX Circuitry with pure, bright copper conductors. Through an exclusive Garlock technique, the need to oxide conductors has been eliminated. This reduces the possibility of contamination, results in a bright copper conductor.

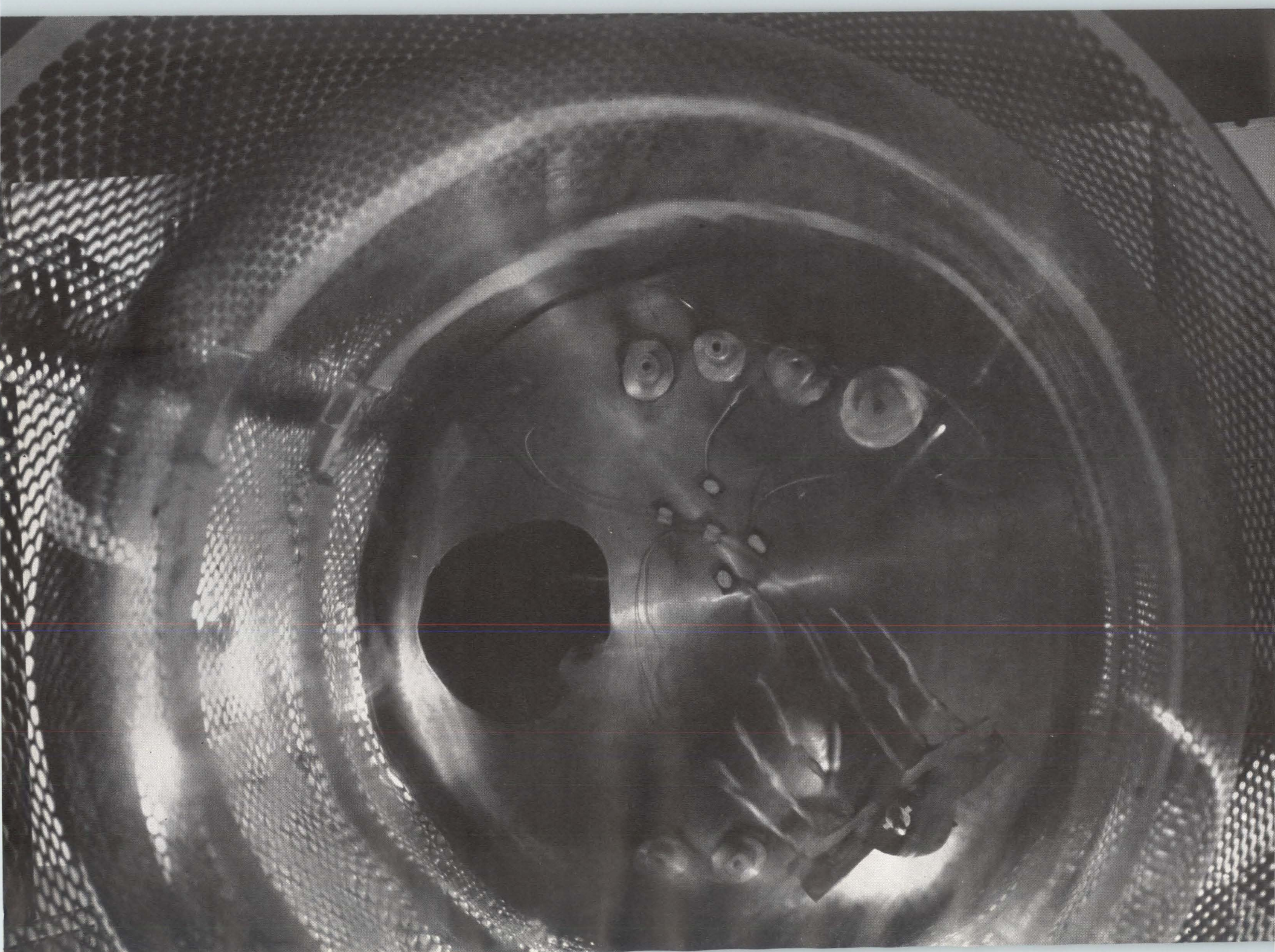
In addition, FREE-FLEX Circuitry is not merely laminated. It is *completely encapsulated* between layers of F.E.P. Teflon† . . . selected by Garlock Material Value Analysis for its unmatched electrical, physical and thermal properties. This Garlock-developed encapsulating system is equivalent to a class A hermetic seal . . . provides line-to-line and line-to-ground protection . . . resists penetration of harmful moisture and gases . . . eliminates short circuits. And, the remarkable strength of F.E.P. Teflon prevents harmful cracking or deterioration through aging.

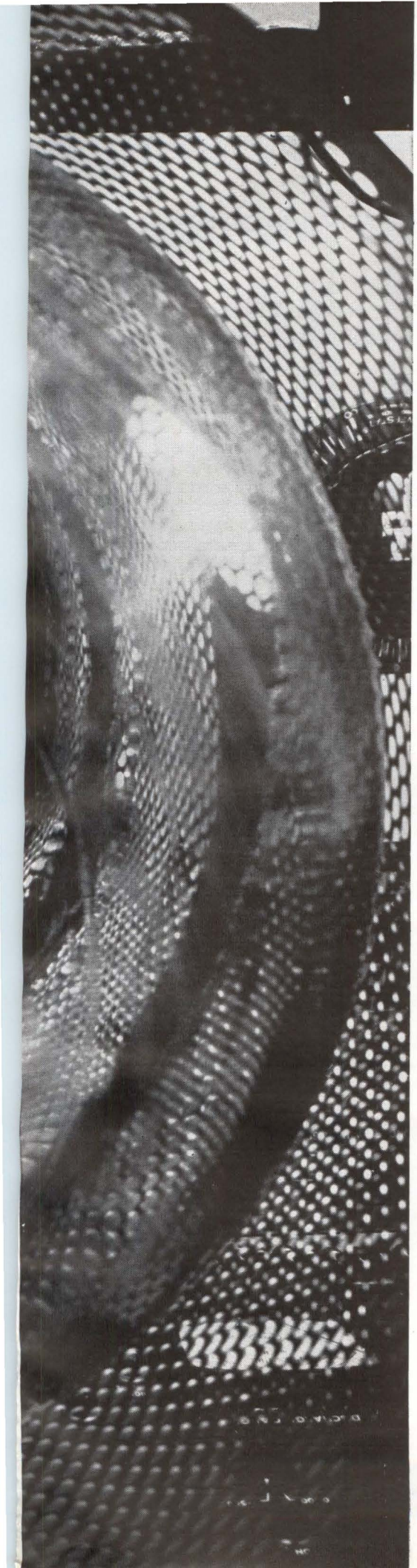
FREE-FLEX Circuitry is lighter, more flexible . . . can be folded, twisted, bent around corners . . . reduces package size and weight . . . can be soldered by conventional or infrared automatic methods . . . saves installation time and money.

For unmatched reliability specify Garlock FREE-FLEX Circuitry. It costs no more than ordinary flexible circuitry. For details call your nearest Garlock Electronic Products representative, or write for Engineering Manual AD-195, Garlock Electronic Products, Garlock Inc., Camden 1, N.J. **In Canada:** Garlock of Canada Ltd., Toronto, Ont. **Order from the complete line** of quality Garlock products . . . Packings, Gaskets, Seals, Molded and Extruded Rubber and Plastic Stock and Parts.

*Garlock Trademark †Du Pont Trademark

GARLOCK





Vacuum-Impregnation Proof

Humidity Proof

(MIL-STD-202B, METHOD 106A)

Immersion Proof

(MIL-R-27208A; PARAGRAPHS 3.28 AND 4.6.23)

Salt-Spray Proof

(MIL-R-27208A; PARAGRAPHS 3.20 AND 4.6.15)

. . . Daystrom Squaretrims®

Daystrom engineering and fabrication techniques not only assure full compliance to MIL-R-27208 but also offer processing protection not covered by this specification. The bonus advantages are resistance to immersion and resistance to vacuum encapsulation with potting resins.

Daystrom guarantees compliance to all operating parameters per the following table of environmental limits of MIL-R-27208.

ENVIRONMENT	LIMIT	
Thermal Shock	Total Resistance	≦ ±1% + 0.05Ω
	Setting Stability	≦ 1% + 1 resolution
Resistance — Temperature Characteristic	Characteristic	≦ ±0.007%/°C
Moisture Resistance	Total Resistance	≦ ±1% + 0.05Ω
	Insulation Resistance	≧ 10 Megohms
Acceleration	Total Resistance	≦ ±1% + 0.05Ω
	Setting Stability	≦ 1% + 1 resolution
Shock	Total Resistance	≦ ±1% + 0.05Ω
	Setting Stability	≦ 1% + 1 resolution
Vibration	Setting Stability	≦ 1% + 1 resolution
	Total Resistance	≦ ±1% + 0.05Ω
	Operating Torque	≦ 150%
Salt Spray	No appreciable corrosion	
Effect of Soldering	Total Resistance	≦ ±1% + 0.05Ω
Life	Total Resistance	≦ 2% + 1 resolution
	Setting Stability	≦ 2% + 1 resolution
	Dielectric W.V.	≦ 1 Milliampere
	Operating Torque	≦ 150%
Low Temperature Operation	Setting Stability	≦ 1% + 1 resolution
	Operating Torque	≦ 150%
	Total Resistance	≦ ±1% + 0.05Ω
High Temperature Exposure	Setting Stability	≦ 1% + 1 resolution
	Total Resistance	≦ ±1% + 0.05Ω
	Operating Torque	≦ 150%
	Dielectric W.V.	≦ 1 Milliampere
	Insulation Resistance	≧ 1,000 Megohms
Rotational Life	Total Resistance	≦ 2%

DAYSTROM, INCORPORATED

POTENTIOMETER DIVISION

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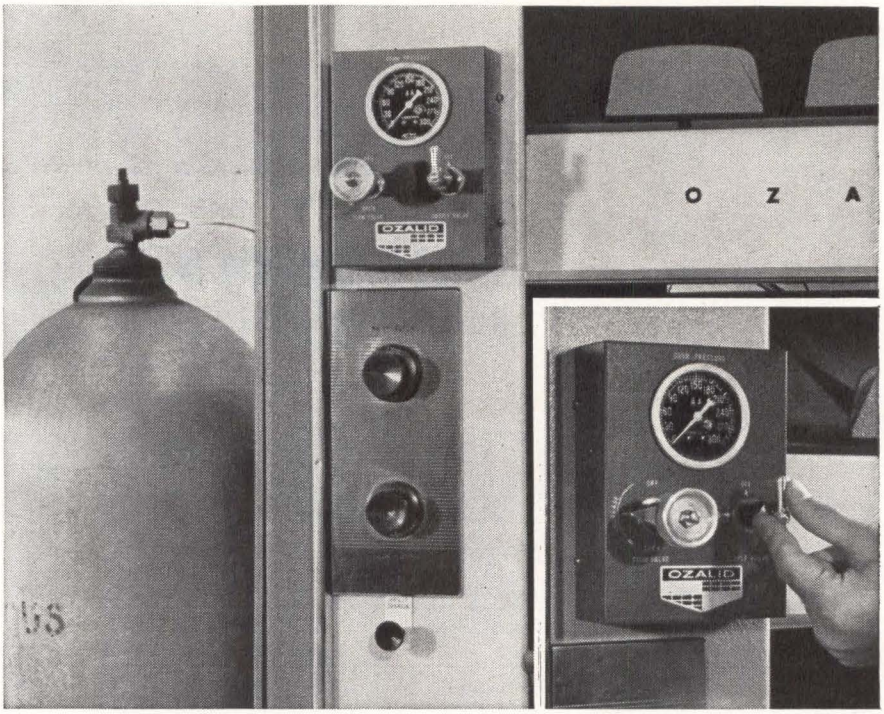
OZALID NEWSLETTER

NEW IDEAS TO HELP YOU WITH ENGINEERING REPRODUCTION AND DRAWING



Ozalid® Anhydrous Ammonia System consists of control box mounted on machine and tubing to connect equipment with anhydrous ammonia cylinder, which may be remotely located. Developer handling becomes simply, "valve on, valve off."

New anhydrous ammonia gas system provides ultimate convenience, cuts developer costs up to 50%, gives from 2 to 6 months developing from a single cylinder!

A simplified, completely safe Ozalid Anhydrous Ammonia Kit brings the convenience of pressurized ammonia gas development to your dry-developing diazo whiteprinter. Depending on machine use intensity and model, the unit saves enough on ammonia costs to pay for its initial expense in as short a time as a year.

A low price tag is only the first of several reasons you should consider using Ozalid Anhydrous Ammonia in your diazo installation. Contents of a single cylinder give up to six months of developing, reducing developer handling to a minimum.

Heater rods, sealing sleeves, and other vital parts in the developer section have longer life because corrosive action is lessened. Machine warm-up time is shorter. Improved employee morale results in increased production. What's more, chances are you'll see an improvement in print quality.

The Ozalid Anhydrous Ammonia Kit is specifically engineered to meter anhydrous ammonia in the simplest, most efficient method for use with diazo machines. Units have been proved in the field, and are already giving a high degree of customer satisfaction.

Conversion Kits fit all Ozalid dry diazo machines and can be easily installed on practically all others regardless of make. Price of the kit is $235.00. For information ask your Ozalid man, or write Ozalid, Johnson City, N.Y., Dept. 186.

New fast reprinting, erasable sepia intermediate

Here's a highly transparent intermediate with a specially prepared paper base that makes reprints faster, yet is easily erasable. Ozalid 402 IZE is its name, has a dark sepia image (but you can rub it out with an ordinary abrasive eraser), has an ideal matte surface for pencil and ink additions, picks up fine line detail beautifully, has excellent covering power, yet is surprisingly low priced. Drafting room comments include, "like see-through"..."excited about erasable feature"..."excellent for overlay work." Ask your Ozalid man for samples and demonstration.

Crease and crumple this tracing paper. Then, make a print! Surprise!

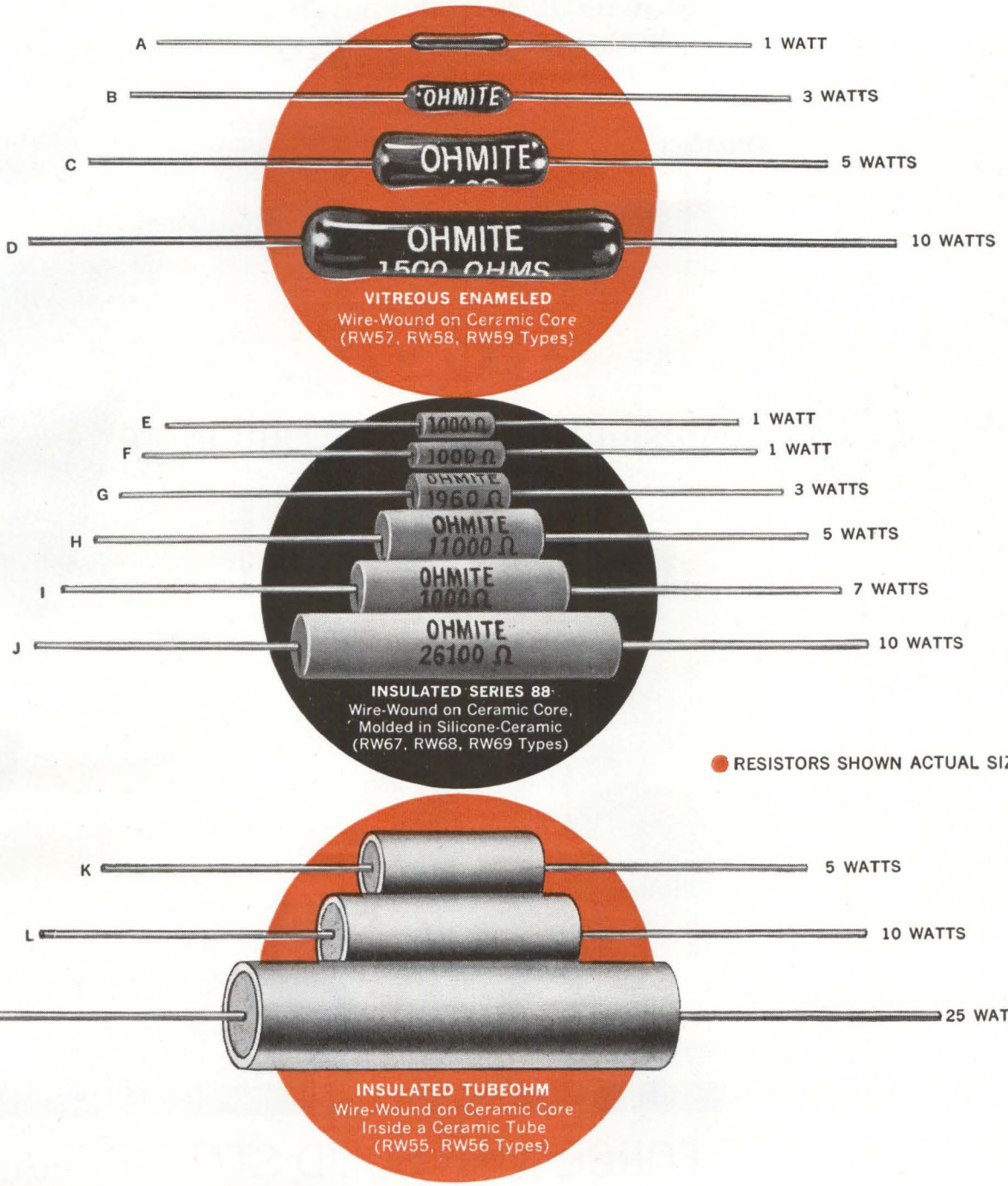
New Ozaclear isn't called "clear" for nothing. This tracing paper permits only a hint of fracturing from creases and crumpling ever showing up on a print. Ozaclear is 100% rag, with an excellent surface for pencil and ink. But it's that "no bruising" quality that makes it stand out. Its exclusive Ozalid-perfected transparentizer holds its own against heavy pencil pressure, leaving no trace of ghosting when these lines are erased. Want more details about permanent, non-yellowing, high strength Ozaclear? Ask your Ozalid representative or write Ozalid, Johnson City, N.Y., Dept. 186.

Lennox gives branches up-to-the-minute changes on reproducible masters!

With eight scattered branches and factories, Lennox Industries (Marshalltown, Iowa) uses Ozalid diazo intermediates to get out new product drawings and drawing changes quickly and maintain perfect standardization among plants.

Single duplicate originals are sent to each plant, the plant, in turn, making as many clear, sharp prints as needed. Simple, fast, error-proof!

Ozalid, A Division of General Aniline & Film Corporation. In Canada: The Hughes-Owens Co. Ltd., Montreal



PROBLEM SOLVERS
IN AXIAL LEAD RESISTORS

MINIATURE CIRCUITS: Resistors A, B, E, F pack 1 to 3 watts in sizes smaller than many nonpower units.

INSULATED RESISTORS: Choose from two types, E to J and K to M. Meet all MIL requirements for insulation.

PRECISION AND POWER COMBINED: Use E to J for tolerances down to 0.05%; A to D for tolerances to 1%.

MIL REQUIREMENTS: All pertinent MIL-R-26C types.

WELDABLE LEADS: Nickel—specify "weldable" (untinned).

HIGH TEMPERATURE OPERATION: A to D and K to M are rated up to 350°C; E to J, 275°C or 350°C depending on the application.

LOW TEMPERATURE COEFFICIENT: Use resistors E to J for 20 ppm/°C, standard.

IMMEDIATE DELIVERY: A, B, C, D, G, H, J stocked in popular MIL and commercial values. Call your electronic distributor or the factory.

Write for "Axial Lead" Literature

Rheostats • Power Resistors • Precision Resistors • Relays • R.F. Chokes • Germanium Diodes • Variable Transformers • Tantalum Capacitors • Tap Switches

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ANOTHER **NEW** PRODUCT OF FAIRCHILD RESEARCH

new

silicon semiconductor strain gage

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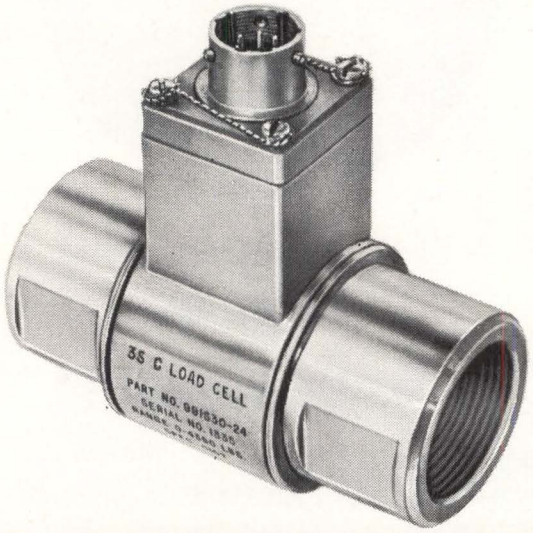

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Latest addition to the Fairchild Semiconductor Transducer family offers exceptional accuracy, 0-100 to 0-25,000 lb range plus these outstanding characteristics

- .0007 maximum deflection
- ¼v dc full scale on unamplified output
- infinite resolution
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- tension and/or compression
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Fairchild's unique modular construction provides for optional

- internal amplification to 5v dc
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- internal emitter follower

For more information write Dept. 57 E

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Transducers/Rate Gyros/Potentiometers/Accelerometers

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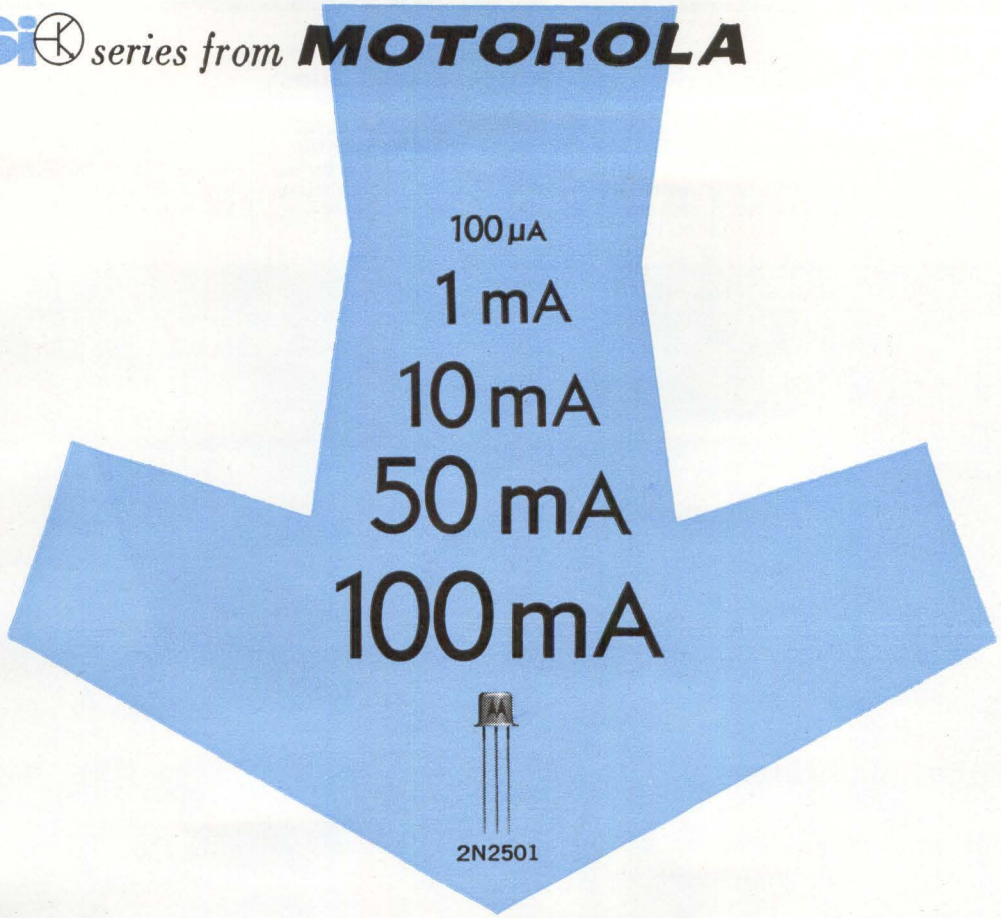
another Si *series from* **MOTOROLA**



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

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

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

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

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

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

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

MOTOROLA 2N2501* PERFORMANCE SPECIFICATIONS

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

*TO-18 Package

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

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

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

MOTOROLA
Semiconductor Products Inc.

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Microwave tubes and ferrite devices for aerospace applications

1
25-WATT HIGH EFFICIENCY AMPLITRON*
For S-band space telemetry applications, only 14 oz. QKS 997.
*Raytheon Trademark

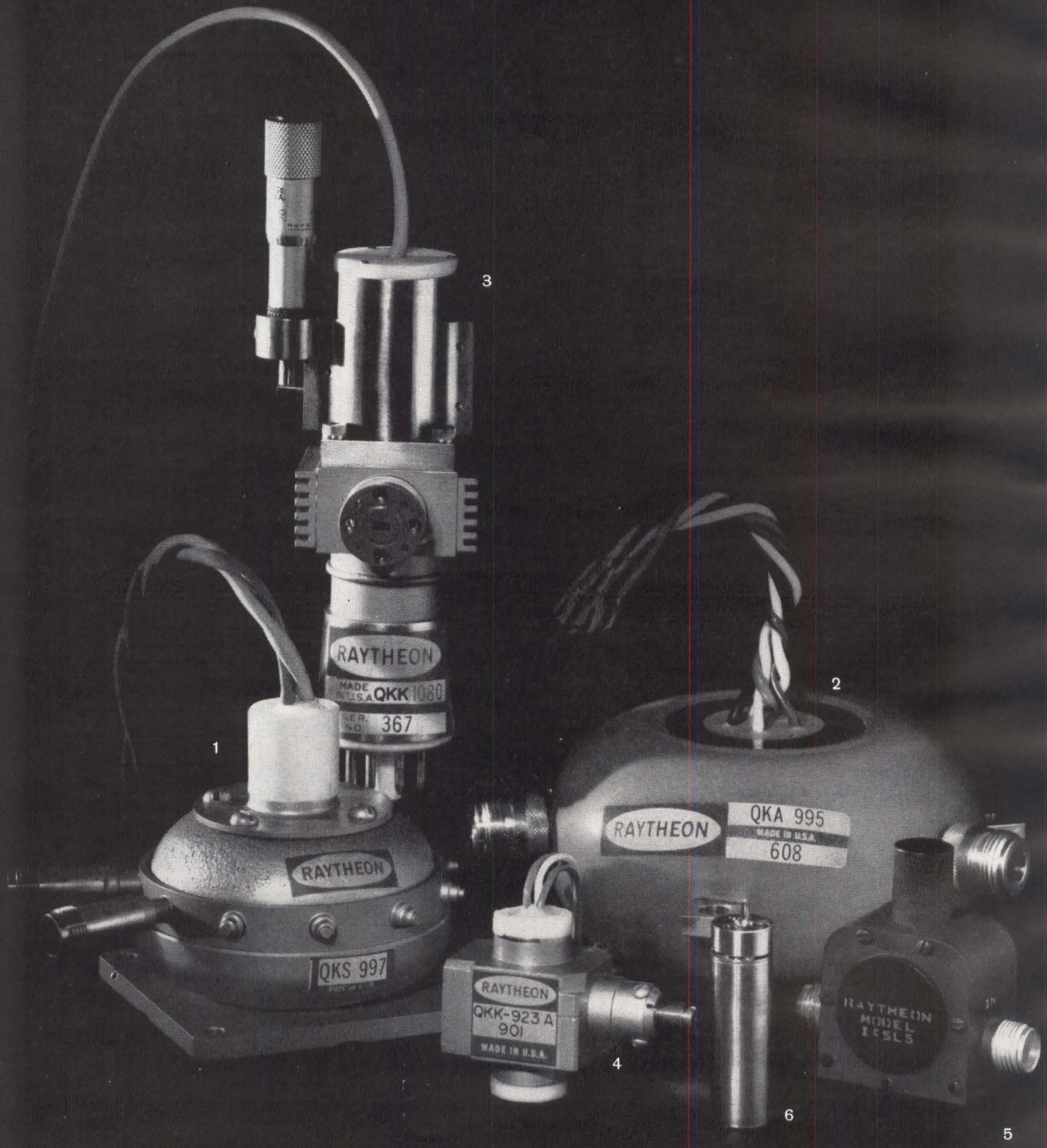
2
SMALLEST, MOST EFFICIENT M-BWO
Has 3⅞ inch diameter, delivers 50 watts at 2.2-3.2 kMc. QKA 995.

3
MILLIMETER KLYSTRONS COVER 50-120 kMc
Nine tubes; all tune with single vernier adjustment. QKK 1080.

4
EXTREMELY RUGGED K-BAND KLYSTRON
Has excellent thermal stability, low microphonics. QKK 923.

5
COMPACT ISOLATOR FOR SPACE SYSTEMS
Matches QKS 997 Amplitron, 15-20 db min. isol., 1.20 max. VSWR. I_cSL5.

6
IR DETECTORS TO 30 MICRONS
Include variety of types, high sensitivity, fast response. QKN 1004.



Aerospace microwave systems designers:

Raytheon accelerates delivery of microwave tubes for aerospace applications

These completely different lightweight microwave tubes and ferrite devices are all built and tested for rated performance in aerospace environments. Each unit is the end result of extensive designing, redesigning and production testing.

For performance and applications data on these and other aerospace microwave tubes and devices, please write, outlining your particular area of interest, to Raytheon Company, Microwave and Power Tube Div., Waltham 54, Mass.

RAYTHEON

See these Raytheon microwave tube developments at WESCON—Booth 727-728

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9 billion dollars to build a better one.

We're living in a needing, buying, growing America—a time for new and improved products and services—the creation of new jobs. More than ever, a businessman with an idea, with the urge for something better will move ahead with our expanding economy.

But after the idea, what follows can be a costly period of research and development. Not necessarily—if you use the immense 9-billion-dollar fund of research and patent information that's available at your U.S. Department of Commerce. Think of the saving—in time and money.

For example: there are reports on extensive research by your Government in new products and processes. A translation of data on inventions and discoveries abroad—information on over 3 million patents—a fortune in patents owned by your Government. All this is yours—for your use and your benefit.

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- Measures "In-Circuit" Q of Self-Resonant Circuits

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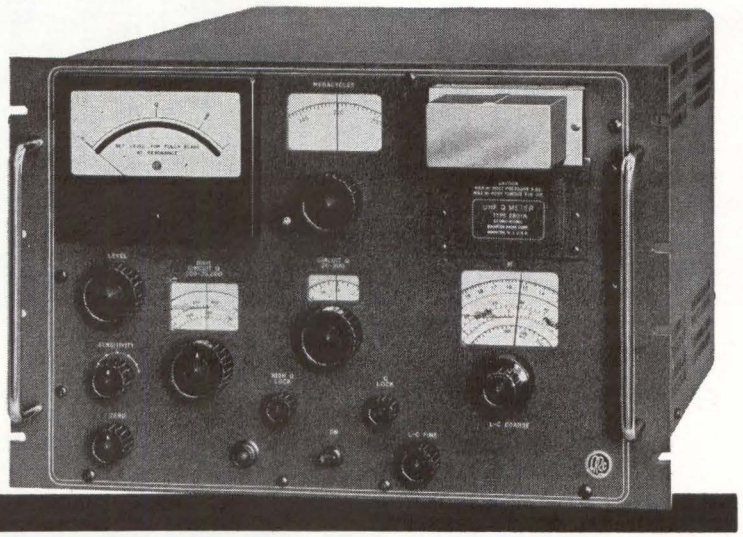
Measure Q Directly...

210-610 MC

TYPE 280-A

UHF Q METER

—measures COMPONENTS, CAVITIES and SEMI-CONDUCTORS



Q MEASUREMENT CHARACTERISTICS
Q RANGE:
Total Range: 10 to 25,000*
High Range: 200 to 25,000*
Low Range: 10 to 200
*10 to approx. 2,000 employing internal resonating capacitor
Q ACCURACY: ±20% of indicated Q
Q CALIBRATION:
High Q Scale:
Increments of 1-5% up to 2,000
Low Q Scale: Increments of 3-5%

SPECIFICATIONS:

RADIO FREQUENCY CHARACTERISTICS
RF RANGE: 210 to 610 MC
RF ACCURACY: ±3%
RF CALIBRATION:
Increments of approximately 1%
RF MONITOR OUTPUT:
10 mv. minimum into 50 ohms*
*At frequency monitoring jack

INDUCTANCE MEASUREMENT CHARACTERISTICS
L RANGE: 2.5 to 146 mμh*
*Actual range depends upon measuring frequency
L ACCURACY: ±11 to 15%*
*Accuracy depends upon resonating capacitance
L CALIBRATION:
Increments of approx. 5%

RESONATING CAPACITOR CHARACTERISTICS
CAPACITOR RANGE: 4 to 25 μμf
CAPACITOR ACCURACY:
±(5% + 0.2 μμf)
CAPACITOR CALIBRATION:
0.05 μμf increments, 4-5 μμf
0.1 μμf increments, 5-15 μμf
0.2 μμf increments, 15-25 μμf

MEASUREMENT VOLTAGE LEVEL
RF LEVELS:
25, 40, 80, 140, 250 mv. nominal*
*Across measuring terminals

POWER REQUIREMENTS
280-A: 105-125/210-250 volts, 60 cps, 140 watts
280-AP: 105-125/210-250 volts, 50 cps, 140 watts

PRICE
280-A: $2,610.00 280-AP: $2,610.00
F.O.B. Rockaway, N. J.

The new UHF Q Meter Type 280-A is a unique self-contained instrument for measuring the RF characteristics of components in the UHF range. The instrument consists of a specially designed oscillator, Q measuring circuit, and resonance indicator and, in application, is similar to its counterparts in the lower frequency ranges. In addition to performing conventional Q Meter measurements, in which the unknown component is resonated with the internal calibrated capacitor, the output of the oscillator and the input of the resonance indicator are available externally for directly measuring the Q of self-resonant devices.

The UHF Q Meter differs from conventional Q Meters in that it measures the actual percentage bandwidth of the resonance curve and, from this data, computes and reads out circuit Q. The test circuit is first tuned to resonance by adjusting oscillator frequency and/or resonating capacitance. The circuit is then detuned from the half-power point on one side of the resonance curve to the opposite half-power point by adjusting a calibrated dial, coupled to the oscillator frequency control, which directly reads out circuit Q.

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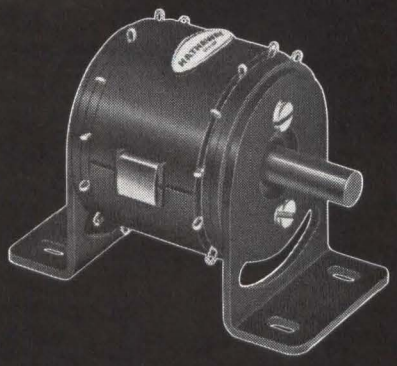
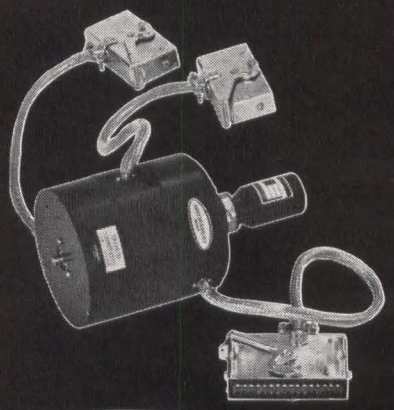
CIRCLE 50 ON READER SERVICE CARD→

HATHAWAY COMPONENTS RANK FIRST IN RELIABILITY



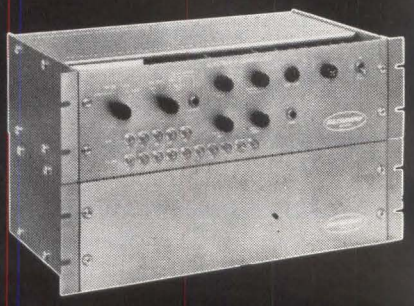
Hathaway

RSB COMMUTATOR provides the advantage of a high-performance commutator in an unusually compact package...Can be supplied with 1 to 24 contacts per deck; number of decks and poles per deck as required...Ideal for applications where low cost is a factor...Exceptional stability to environmental influences.



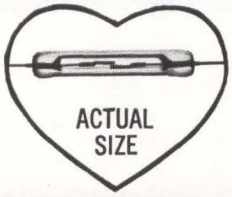
Hathaway

SHUTTER CONTROLLED RSC COMMUTATOR offers the benefit of precise phasing control to **any specific timing sequence**... Especially suited to systems requiring break before make operation, or controlled time periods between adjacent decks... Permanently lubricated prior to assembly.



Hathaway

ELECTRONIC COMMUTATOR combines the advantages of both mechanical and electronic commutators...Scanning rate up to 1000 data points per second and 12 levels per cross point permits **simultaneous scanning** of differential inputs, shields of balance lines, calibration circuits and associated data.



Heart of Hathaway Commutators is the DRIREED —Industry's Most Nearly Perfect Switch.

HATHAWAY TUNING FORK FREQUENCY STANDARDS

Greatest possible resonator reliability is available in this advanced line of frequency standards. Use them in aircraft and missile guidance systems ...as a constant speed control of aircraft generators...as a time reference for high-speed counting, ballistics measurement, geophysics...in instrument power supplies...as a fixed audio oscillator. **They eliminate the count down circuits required with crystals, and meet all military and commercial specifications.**

TYPE 40

FREQUENCY: 400 cycles per second (other frequencies available in same package). **ACCURACY:** ±0.2% (when used with recommended circuit). **STABILITY:** Less than .01% total deviation (—54°C to +85°C) may be attained when used with the optional frequency trim circuit. Less than .004% total deviation (+15°C to +35°C) may be attained when used with the optional frequency trim circuit.

TYPES 66 AND 76

FREQUENCY: Type 66—400 cps (240 - 2,000 cps available in same size package). Type 76—10,000 cps (2,000-10,000 cps available in same size package). **ACCURACY:** (when used with recommended circuit) ±.02% (—54°C to +85°C, no heater power). ±.002% (+15°C to +35°C, no heater power). ±.005% (—54°C to +85°C, with heater power).

TYPES 65 AND 75

FREQUENCY: Type 65—400 cycles per second (240 to 2,000 cps available in same size package). Type 75—10,000 cycles per second (2,000 to 10,000 cps available in same size package). **ACCURACY:** ±.02% (—54°C to +85°C, no heater power). ±.002% (+15°C to +35°C, no heater power). ±.005% (—54°C to +85°C, with heater, after 30 min. warm up).

Hathaway INSTRUMENTS, INC.
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SKyline 6-8301
TWX DN 656
FOREIGN REPRESENTATION BY TERMINAL RADIO INTERNATIONAL, LTD., 3 W. 61ST ST., N. Y. 23, N. Y.

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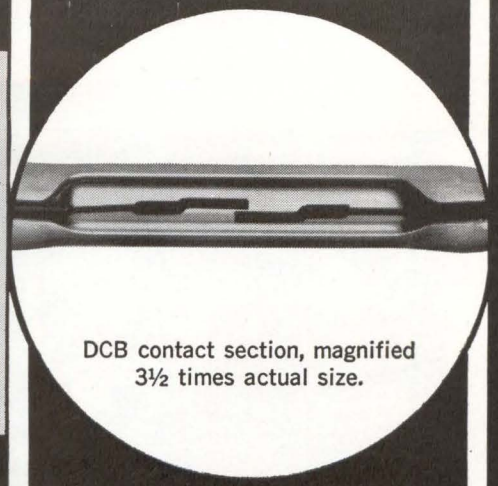
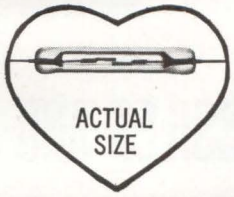
HATHAWAY DRIREED RELAYS

The highest available life ratings, and today's maximum in miniaturization and resistance to environmental effects are yours with the Hathaway Drireed Relay family. Reliability approaches that of solid state relays at a fraction of their cost and with drift-free operation. Relays are designed for printed circuit or on the chassis mounting and are miniaturized to save you up to 75% design space. **Made-to-order relays are a Hathaway specialty...we will furnish a modular assembly of any number of contacts in a completed form.**



DCB contact section, magnified 3½ times actual size.

NOW YOU CAN REPLACE LARGE, CONVENTIONAL REEDS WITH HATHAWAY DCB DRIREED CONTACTS... TWICE THE LIFE OF COMPETITIVE REEDS!

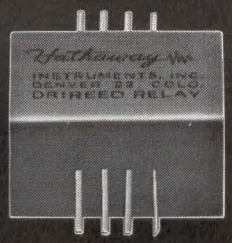


Heart of Hathaway Relays is the DRIREED —Industry's Most Nearly Perfect Switch.

Hathaway

SERIES M (MINIATURE)

OPERATE TIME — TYPICAL: 600 microseconds, including bounce, for 28 vdc unit. **OPERATING TEMPERATURE:** —54°C to +85°C continuous. **VOLUME:** 0.110 cubic inches.



Hathaway

SERIES F (BUILDING BLOCK DESIGN)

NOMINAL VOLTAGE: 6 volts, 12 volts and 28 volts DC. **OPERATING TEMPERATURE:** —54°C to +85°C.

Hathaway

SERIES A, B AND C

VIBRATION: 20 g's to 2,000 cps, energized or non-energized. **SHOCK:** 50 g's. **CONTACT RATING:** 12 VA AC operation; 4 VA for DC operation; maximum current 125 ma and maximum voltage 200 volts. **CONTACT LIFE:** 5,000,000 operations at full load. 25,000,000 operations at half load. 1,000,000,000 operations at dry circuit (less than 2 ma).

See these NEW HATHAWAY PRODUCTS for the first time at WESCON

F SERIES—FORM C DRIREED RELAY

RF COAXIAL DRIREED RELAY

AUTOMATIC RESPONSE PLOTTER—3

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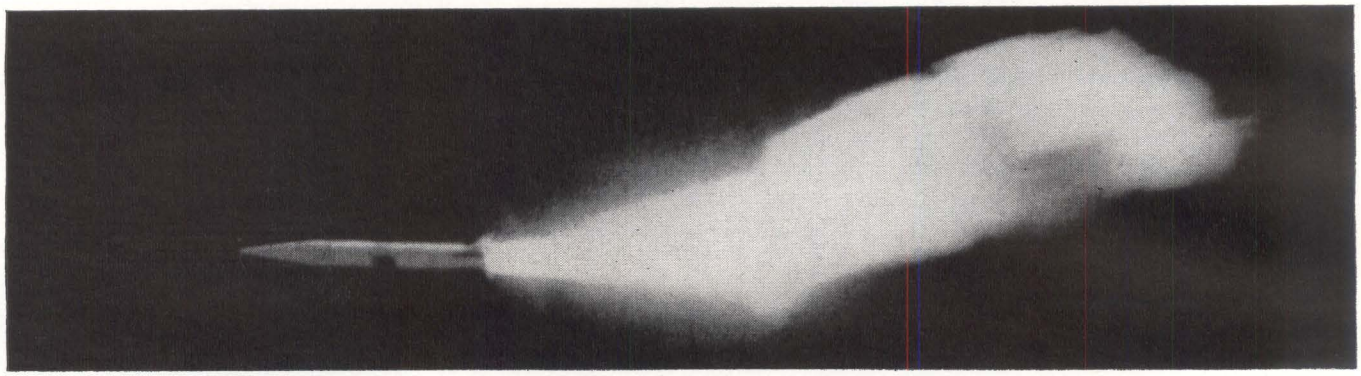
CASES IN SERVO CONTROL . . . NO. 4

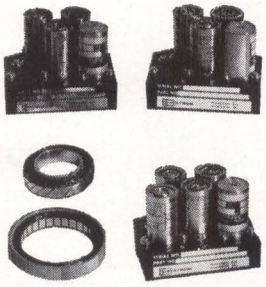


Douglas Skybolt

North American A3J

DAYSTROM TRANSICOIL'S ROSTER OF MODERN MISSILES AND AIRCRAFT ...AND OUR SERVO ASSEMBLIES ABOARD THEM

Height Indicator



Guidance Controls

As on a multitude of other weapons systems, Transicoil subsystems are aboard both Skybolt and the A3J. ■ For Skybolt, Transicoil supplies the guidance control packages shown at left. These consist of gimbal-mounted synchro resolver transmitters; azimuth, roll and pitch repeater assemblies; and synchro computing resolvers. ■ For the A3J, Transicoil supplies the radar height indicator shown at left. This precision airborne instrument, which utilizes synchro data from the altimeter, consists of control transformer, motor generator, transistorized servo amplifier, anti-backlash gear train, and the meter indicator itself. ■ All rotating components are size 8 in both applications, and are manufactured by Transicoil. This is design excellence and reliability. This is Daystrom Transicoil. Write for booklet, "Cases in Servo Control".

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3. **Voltage-limiting control to limit compliance.**
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Ask for Specification Sheet 3072C for all the facts.

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*BRIEF SPECIFICATIONS

MODEL	CURRENT RANGE		†VOLTAGE COMPLIANCE AT	
	MIN.	MAX.	MAX. I	MIN. I
C612A	1 μa	100 ma.	260 V	100 V
C631A	1 μa	100 ma.	420 V	300 V
*C638A	0.5 μa	100 ma.	2100 V	1500 V
C624A	2.2 μa	220 ma.	260 V	100 V
C632A	2.2 μa	220 ma.	420 V	300 V
*C636A	2.2 μa	220 ma.	735 V	600 V
C629A	2.2 μa	300 ma.	205 V	150 V
C633A	2.2 μa	300 ma.	420 V	300 V
C620A	5 μa	500 ma.	110 V	50 V
C621A	5 μa	500 ma.	160 V	100 V
C613A	10 μa	1 AMP	115 V	50 V
C614A	10 μa	1 AMP	170 V	100 V
*C628A	10 μa	1 AMP	215 V	150 V
*C630A	10 μa	1 AMP	280 V	200 V
*C625A	22 μa	2 AMP	150 V	75 V
*C626A	22 μa	2 AMP	190 V	100 V
*C615A	22 μa	3 AMP	125 V	50 V
*C618A	22 μa	3 AMP	170 V	100 V

* Voltage limiting control standard. Optional on all other models.
† For current vs. voltage compliance curves, request Specification Sheet 3072C.

ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED
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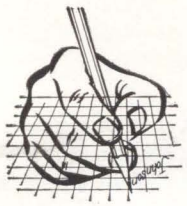

Time after time engineers specify Johnson components!

Whatever the choice . . . a tiny, color-coded nylon Collet Knob — or a flexible shaft coupling to handle both axial and angular shaft offset . . . time and time again design and development engineers specify Johnson components!

Manufacturers of more than 5,000 items for all segments of the electronic industry, Johnson offers a wide line of connectors; tube sockets; air variable capacitors; plus the hardware items described at the right. In addition, a complete line of heavy duty RF components is available for broadcast transmitting, RF heating, antenna phasing, and other commercial applications.

Equipment in this line includes: fixed and variable inductors; antenna phase sampling loops; isolation filter inductors; tower lighting filters; feed-thru bowl insulators; static drain chokes; RF contactors; and heavy duty make-before-break switches. For information on the Johnson RF component line, write for Catalog 560 — for detailed specifications on all other Johnson electronic components, write today for our newest components catalog!

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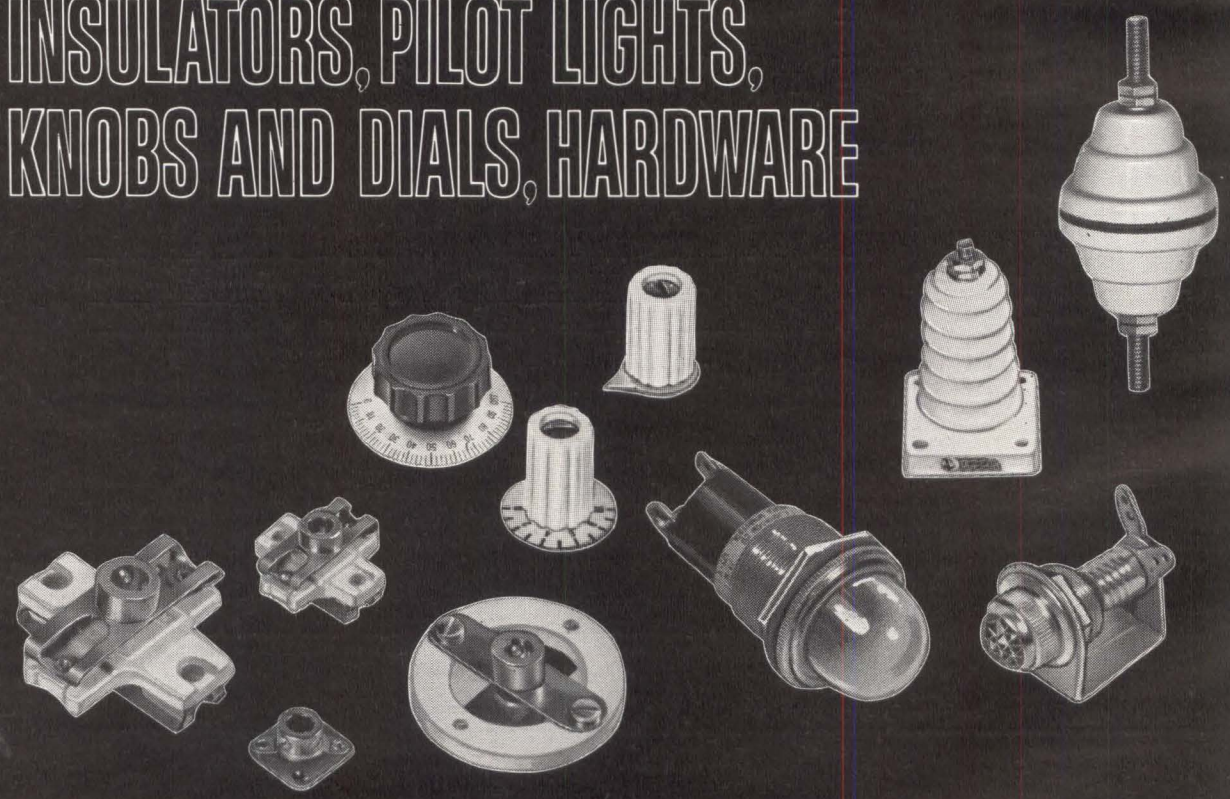
INSULATORS—Low loss, high-voltage breakdown in either steatite or porcelain. High quality with heavy nickel-plated brass hardware — suitable for exposed applications. A complete line for immediate delivery from stock includes: Thru-panel Bushings and Insulators; Antenna Strain and Feeder Types; Cone and Stand-off Insulators; Lead-in Bushings; and Feed-Thru Bowl Assemblies.

PILOT LIGHTS — Over 47 separate assemblies immediately available from parts distributors throughout the country for original equipment or in-the-field replacement. Continuous indication neon types; models for high and low voltage incandescent bulbs; standard or wide angle glass; and lucite jewels. Specials, including types meeting military specifications, also available in production quantities. Detailed specifications listed in Pilot Light catalog 750 a — write today for your copy.

COLLET KNOBS AND DIALS — Rugged molded nylon body — fresh, modern styling — available in 13 colors. For 1/8" shafts — ideal for laboratory or test instruments. Four types: Basic Knob; Pointer Knob; Dial Knob, 10-0/180°; and Dial Knob, 10-0/270°. Other Knobs and Dials — Distinctive matching line of knobs and dials with brass inserts. Molded of tough, black phenolic to MIL-P-14 specifications. Metal dials and pointers are etched, satin aluminum, anodized finish. **SHAFT COUPLINGS** — Flexible and rigid types for coupling 1/4" to 1/4"; 1/4" to 3/8"; and 3/8" to 3/8" shafts. **FLEXIBLE SHAFTS** — 3" to 6" lengths for out of line or up to 90° angular control. **PANEL BEARINGS** — For use on 1/4" shafts and panels up to 3/8" thick. **CRYSTAL SOCKETS AND CERAMIC PLUG** — For low capacity, high voltage and high temperature operation. Glazed steatite, Grade L-4 or better. DC-200 impregnated. **RF CHOKES** — High quality construction. For 1.7 to 30 mc range and VHF.

INSULATORS, PILOT LIGHTS, KNOBS AND DIALS, HARDWARE



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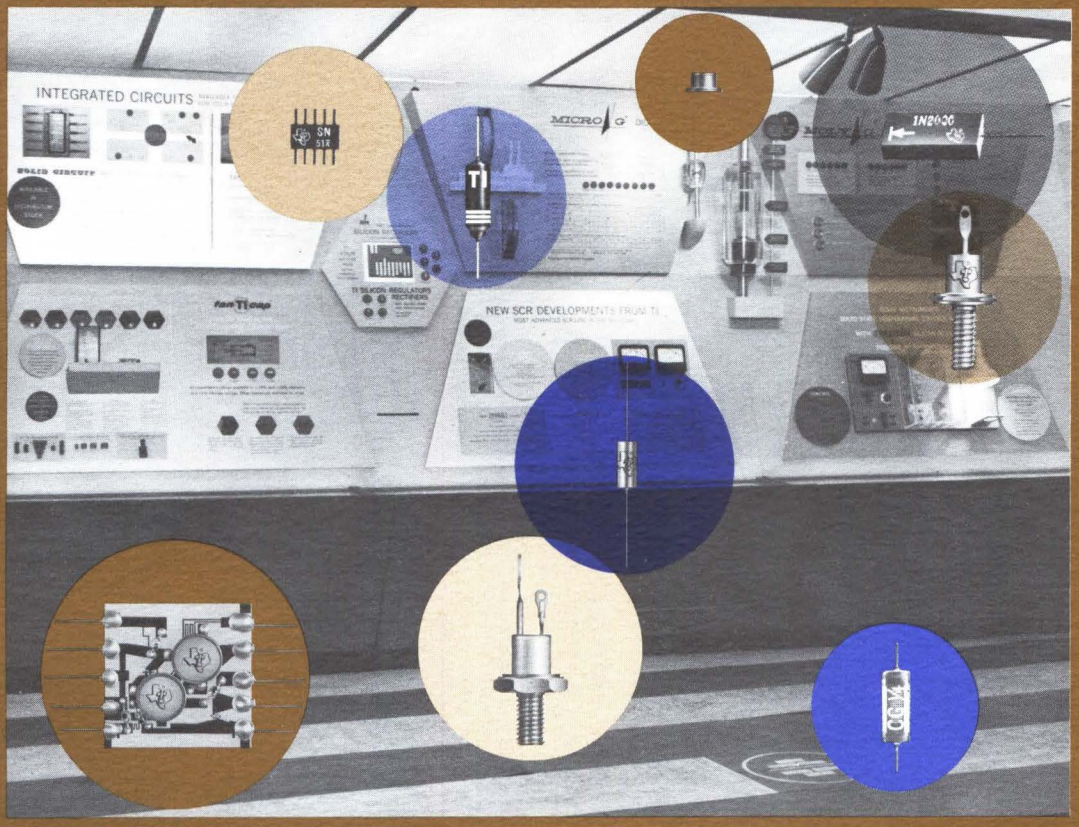

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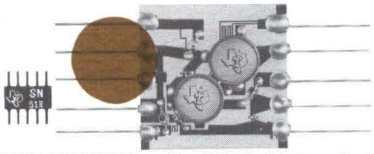
TEXAS INSTRUMENTS COMPONENTS



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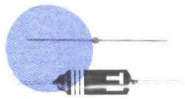

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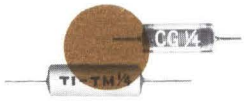

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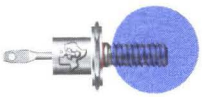

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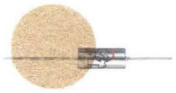

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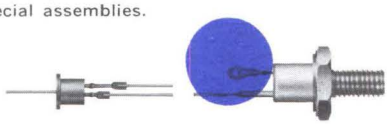

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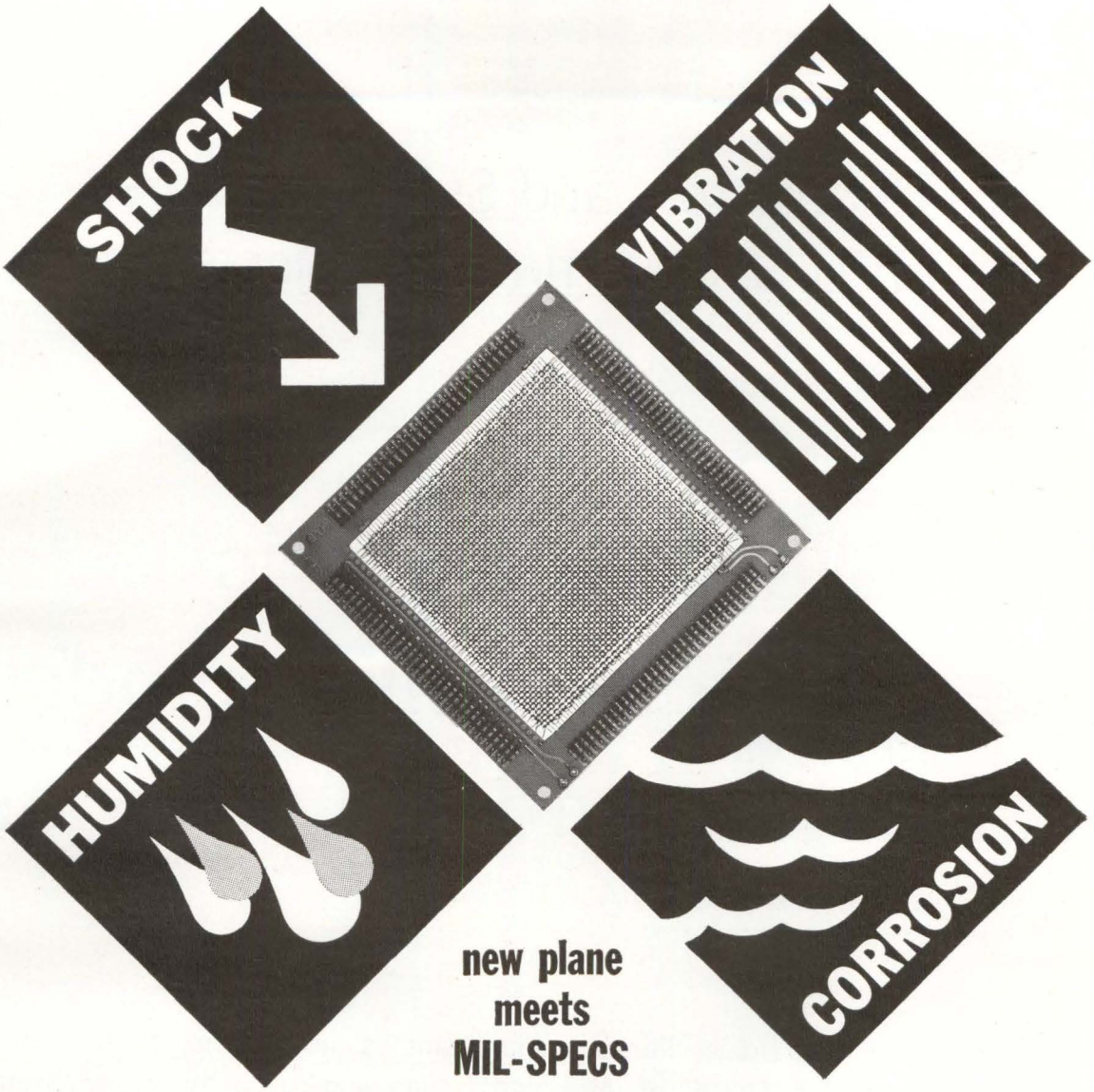

This typical 64 x 64 plane was subjected to rigid tests by the United States Testing Company, Inc., — punishing shock, high and low frequency vibration and corrosion from salt spray and humidity — in accordance with MIL-E-4970, MIL-T-4807 and MIL-STD-202B. Test results showed no degradation of windings or evidence of discontinuities or deterioration. Indiana General now offers this ruggedized plane for either coincident current or linear select applications for any matrix size at only a slight increase in cost over standard units. These planes can be organized into any capacity memory system for military or industrial equipment. Designing cores, planes, stacks, complete memory systems to withstand environmental conditions are typical of IGC's engineering abilities. **Phone or write for copy of U. S. Testing Company Report to** Indiana General Corporation, Electronics Division, Keasbey, New Jersey.

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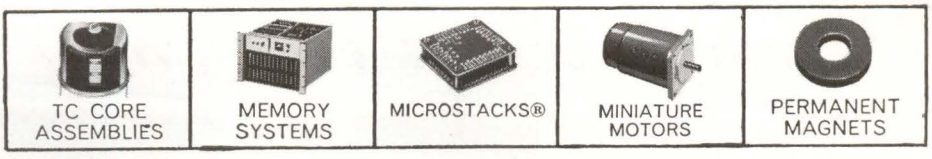

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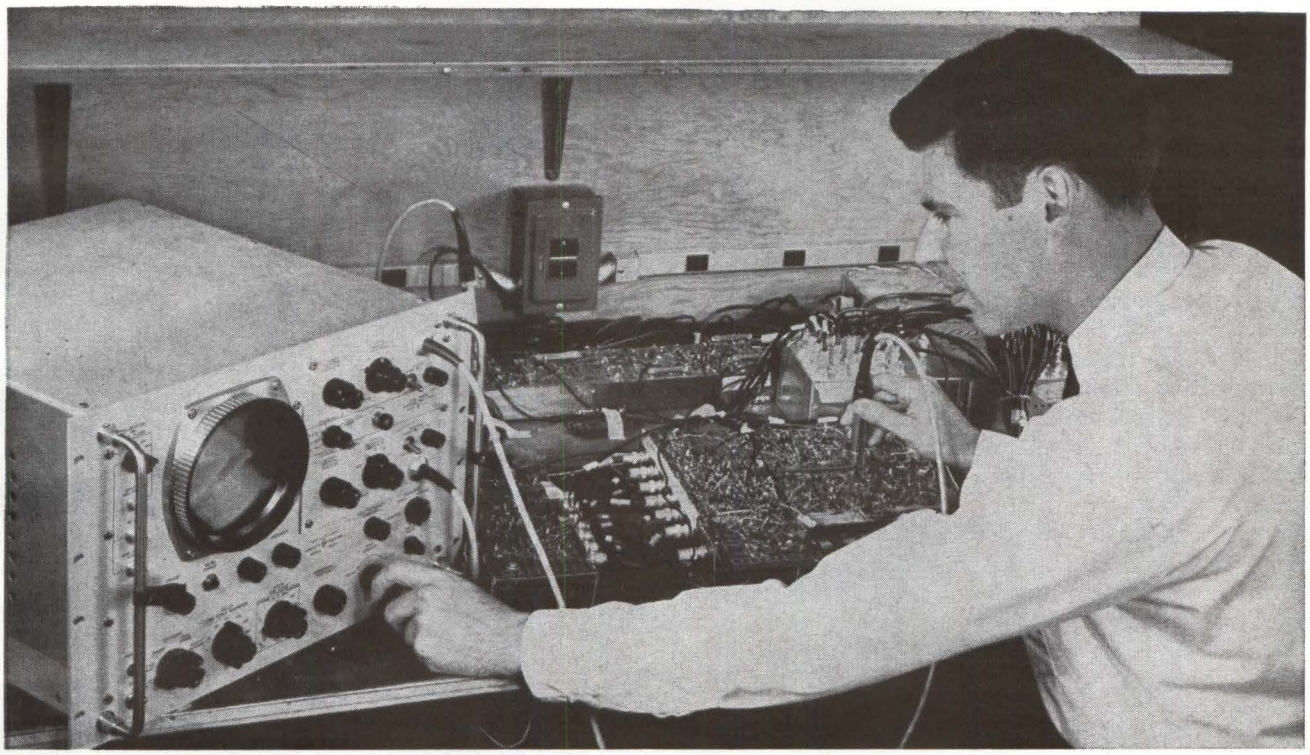
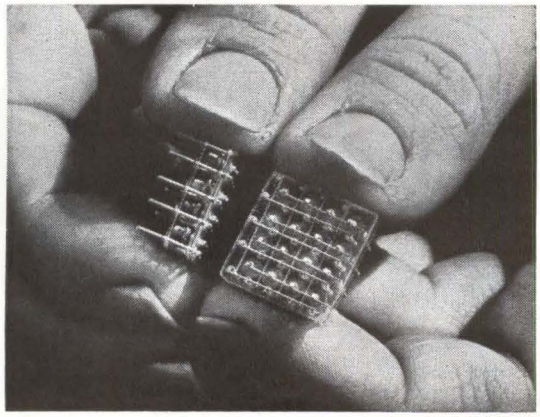


HIGH-SPEED *digital differential analyzer using 82 tunnel diode circuits, built by Bendix Research Laboratories*

1962 WESCON: A Technical Preview

Advances described include use of tunnel diodes in high-speed differential analyzer and low-power memory, chirp signals to transmit digital data, new strain transducer and an optical decision filter

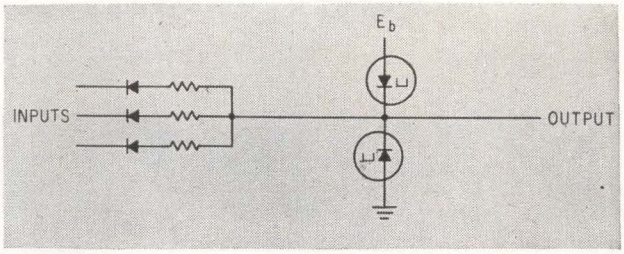


NON-DESTRUCTIVE *random-access memory by Litton Systems, Inc*

By HAROLD C. HOOD Pacific Coast Editor

NEW APPLICATIONS for tunnel diodes, a novel jam-proof communication technique, space instrumentation systems and several new solid-state devices will be among the technical advances featured during the upcoming four-day 1962 WESCON technical program. Although the number of technical sessions has been cut almost in half this year, most of the papers are considered to be of exceptionally high quality by the technical program committee.

100-MC TUNNEL DIODE DDA—High-speed tunnel-diode circuits are reported to have been used in complex logic configurations at Bendix Research Laboratories, where a two-integrator serial DDA (digital



LOGIC CIRCUIT, *heart of digital differential analyzer, uses two tunnel diodes with valley switching—Fig. 1*

differential analyzer), using 82 such circuits operating at a clock rate of 100 mc, has been built.[1] All tunnel diodes used are standard germanium 1N3129 units with a nominal peak current of 20 ma.

To overcome limitations frequently imposed by inadequate tolerances and design inflexibility, a new basic circuit was developed. A variation of the Goto pair, it uses valley switching instead of peak switching and has one end of the pair grounded rather than employing the usual double-ended circuit. (See Fig. 1). Backward diodes are used in the coupling elements. Improved tolerances of the circuit are due to locking characteristics of tunnel-diode pair circuits; design flexibility is realized with valley-current switching.

AND, OR and MAJORITY operation may be achieved by the one basic circuit by shunting one tunnel diode with a resistor, thus adjusting the difference between valley currents of the two tunnel diodes. Valley currents typically range from 1.5 to 2.5 ma.

Power is supplied to the gates and directionality of information flow is provided by a three-phase clock. Undesired interaction between circuits is reduced by using two types of germanium backward diodes. Devices having a nominal peak current of 70 μa, a nominal forward drop of 75 mv at 5 ma, and nominal capacitance of 3 pf are used where a fanout of 3 is used. Otherwise, diodes with a nominal peak current of 400 μa, a nominal drop of 75 mv at 5 ma, and a nominal capacitance of 10 pf are used. Coupling resistors are 100 ohms, and clock source impedance for each gate is fixed by 10-ohm resistors.

P-N JUNCTION STRAIN TRANSDUCER—Elastic strain effects on the resistance of p-n junctions have recently been noted and the possibility of utilizing them in transducer applications has been investigated. Raytheon Research Division fabricated some experimental device structures, and found that when they are subjected to forces of a few thousand dynes, their resistance changes by more than three orders of magnitude.[2]

A conical stylus directed at right angles to the diode surface, parallel to the junction plane, applies the stress. The strain effect manifests itself as a current increase across the shallow p-n junction subjected to aniso tropic stress; its reported magnitude exceeds those of any strain effects of conventional strain sensors.

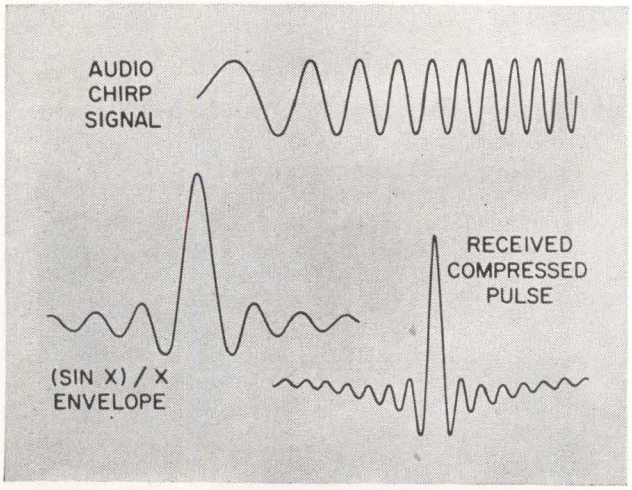
Depending on electrical and mechanical stress biases applied, devices can be operated at various impedance and sensitivity levels. Sensitivity for a given electrical bias varies with the junction material, junction depth, and the diameter of the stressed region. Junction depth is the main determining factor, since sensitivity goes up exponentially as depth decreases.

Microphones are one possible application of the new device. One experimental model, under reverse bias from a high-impedance supply and subjected to a speech level of 60 db at five feet, was found to have 100 mv output. Frequency response of the device extends far beyond the audible range. The strain transducer described can be made considerably smaller and lighter than conventional transducers.

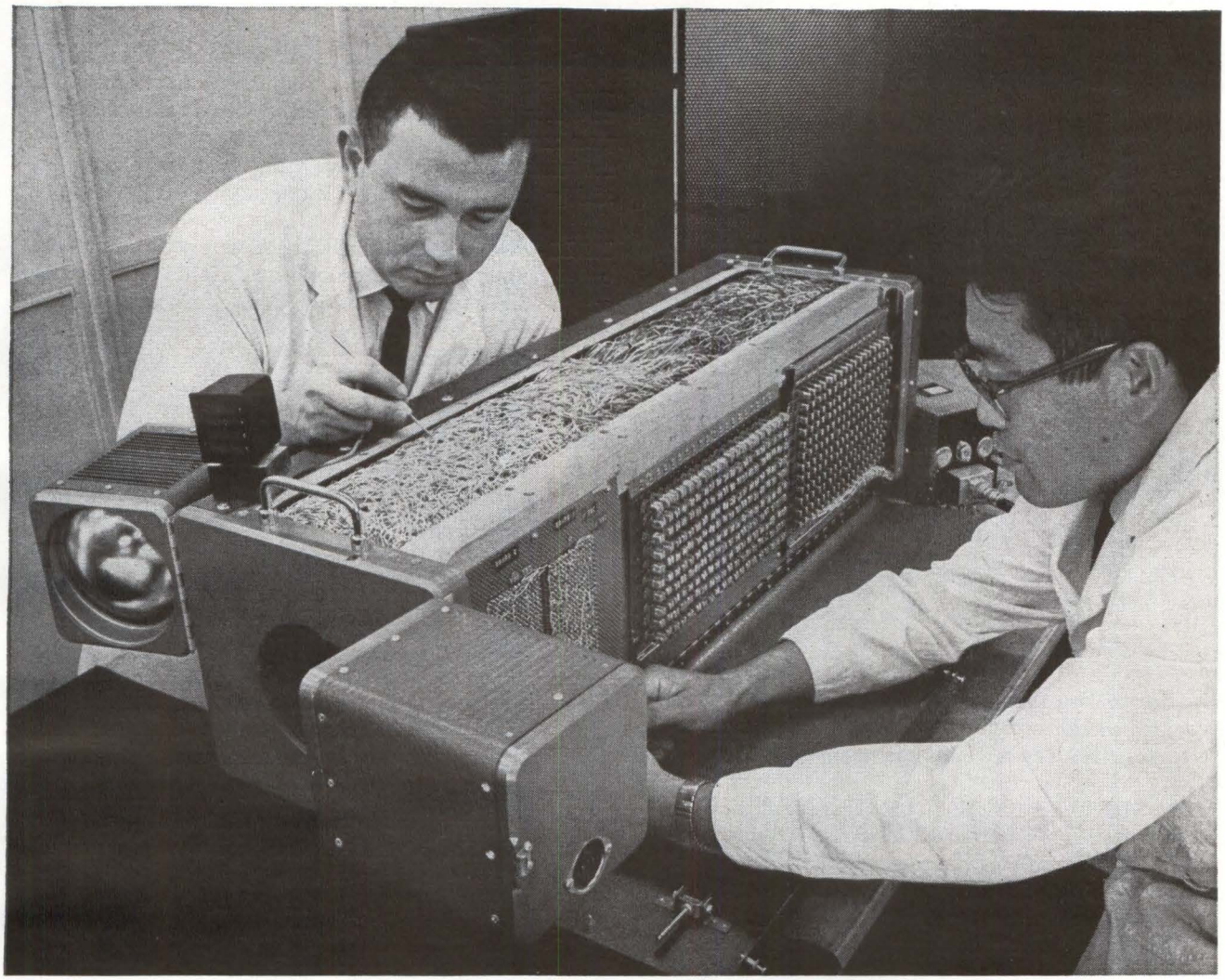
PLANAR EPITAXIAL PNPN SWITCH—A versatile planar epitaxial three-terminal pnpn switch, exhibiting high turn-off gain, high switching speed, high breakover voltage, low holding current, and low on-state resistance has been developed by Sylvania Electric Products.[3] Suggested applications include cross-point matrix switching, digital information switching, core driving, memory elements, flip-flops, and other uses where a bistable characteristic is required.

The device is fabricated with two planar diffused junctions and two epitaxial layer growths on a degenerate p-type substrate. A narrow p-type layer surrounds the gate terminal, and junctions between cathode and gate and the middle, or forward bias blocking junction, are oxide-protected planar junctions. Reverse bias blocking junction is bounded on both sides by epitaxially-grown, high-resistivity p-and n-type materials.

Turn-off gains in the unit have ranged from 6 to 12 at a load current of 50 ma, or 250 to 1,000 times holding current (current at which the sum of the pnp and npn alpha reaches unity.) Holding currents have been observed from 50μA to 200 μA, and gate turn-on currents from 1 to 3 μA are typical. Turn-on and turn-off times are 50 to 100 nsec, and switching



CHIRP SIGNAL *is an interference-resistant and jam-proof medium of communication developed at RCA. Signal above contains only ten cycles—Fig. 2.*



OPTICAL DECISION *filter, developed by Astropower, using perceptron principles, recognizes three-dimensional geometric shapes. Wiring of associative networks is seen at top*[8]

characteristics are currently being improved.

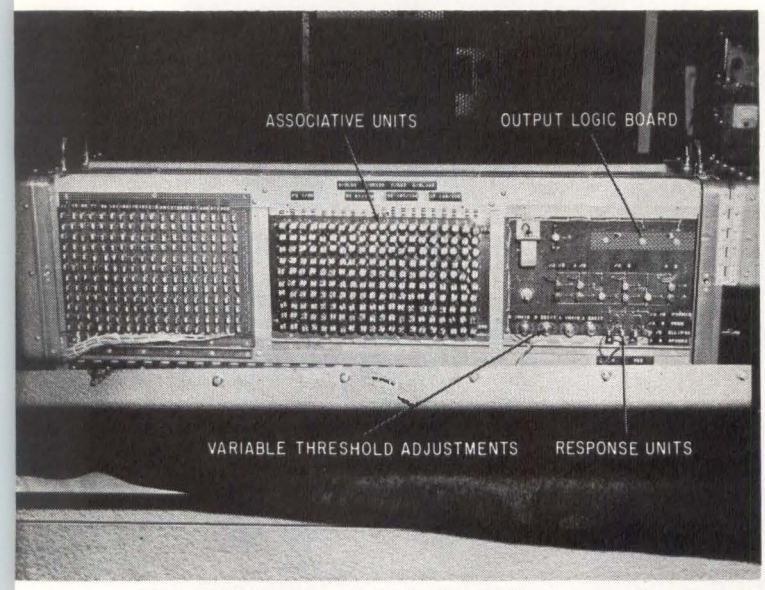
Forward breakover voltages are over 100 v, and with the addition of a gate cathode shunt, are found to be very uniform. At 50 v forward bias, leakage is less than 200 nA. The current-carrying capability is in the hundreds of milliamperes range. High reliability of the device reportedly is shown by its ability to withstand 300-deg C storage temperatures.

NON-DESTRUCTIVE MEMORY — Circuit techniques used by Litton in a new non-destructive random-access tunnel-diode memory minimize the limitation on switching rate imposed on most memories by the speed of addressing and readout circuits, and permit a significant reduction in power requirements. The device can operate at frequencies up to 10 Mc over the entire military environmental spectrum, and appears well suited for low to medium capacity scratch-pad applications in military and space equipment where weight, volume, and power considerations are paramount.[4]

A non-destructive read technique is used so that the writeback portion of a conventional destructive read cycle is not required. Clear-write cycle time has been reduced by a circuit approach which allows a word to be cleared and written in simultaneously. A direct-coupled read amplifier, able to drive several logic gates, eliminates normal requirements for a buffer register and associated delays.

Also, thermal environment sensitivity has been minimized so that large variations in tunnel-diode parameters may be tolerated and voltage transients over 10 percent have no effect. Using the two voltage states of a tunnel diode to represent binary information, the memory requires only a single amplifier stage for discrimination. Conventional requirements for strobing the memory-cell output signal are eliminated by the direct-coupled readout. Each bit of the memory is represented by the interconnection of a tunnel diode, a resistor, and a conventional diode. Silicon tunnel diodes were selected for their higher voltage swing and broad operating temperature range, even though their switching speed is considerably lower than that of germanium units. One-ma devices are used, and write currents of 1.2 ma, and read and bias currents of less than 1 ma are required.

Average dissipation of 2 mw per bit can be obtained, or 1,000 words of 20 bits each with a total



CIRCUITS *of optical decision filter are clearly seen along side of unit*

dissipation of less than 40 w. The photograph shows two welded modules each containing the basic memory element circuits for 16 bits of memory.

CHIRP SIGNALS FOR COMMUNICATIONS—Work done at RCA's Defense Electronic Products division in Tucson confirms the theory that chirp pulses, used extensively to obtain increased radar range, are a useful new technique for transmitting digital information, with practical advantages over frequency shift keying and other commonly used methods. Areas of application include teletypewriter and data entry systems.[5]

These long frequency-modulated pulses, having continuous frequency changes in one direction without reversal for the duration of the pulse, can use existing voice channels effectively, have excellent noise discrimination characteristics for low bit rates, are less affected by Doppler shift and single-sideband frequency translation than other systems, and show relatively high immunity to certain periodic man-made interferences. Other advantages include adaptability to any bandwidth, resistance to jamming, and no requirement for synchronization.

Figure 2 shows a chirp signal covering the voice bandwidth, which could be transmitted over many existing voice channels. This pulse is linearly frequency modulated from 300 to 3,300 cps, has exactly 10 cycles, and is 0.00555 second long. Transmission could be at 180 bits a second.

Signal-to-noise ratio can be improved by pulse-compression techniques using matched filter correlation. The pulses may be generated by pulsing a matched filter, this being the reverse of the detection process. The impulse, applied through a resistor mesh, establishes a chirp wave on the transmission line, causing the wave emerging at one end to be ascending in frequency and that at the other end to be descending in frequency. A suitable resistor mesh is shown in Fig. 3.

Considerable reciprocity is possible with most chirp-pulse configurations: input or output may be at either end of the transmission line, inputs and outputs may be reversed, modulators may be used as demodulators, pulses may be compressed or expanded, and pulse frequency may increase or decrease.

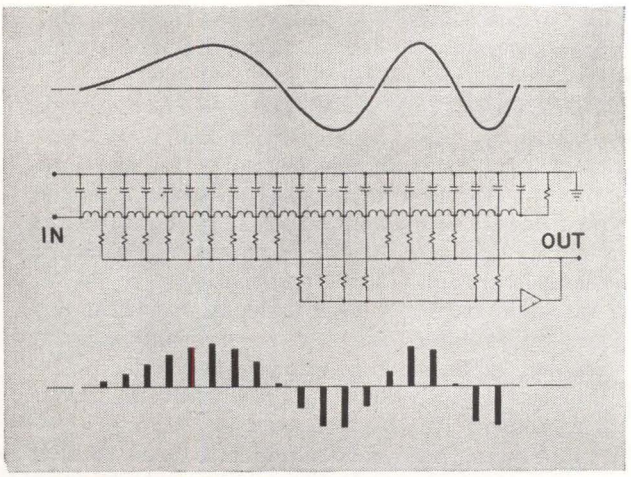
HALL-EFFECT ENCODER—A magnetic angle encoder using two microminiature Hall-effect probes and a single-track magnetic drum offers possibilities for reliable, compact high-resolution units for inertial guidance and space-platform use. Readout at zero angular rate can be accomplished by this AC Spark Plug Co. device since direct measurement is made of the magnetic drum's recorded field rather than the usual time derivative of flux.[6]

A semiconductor crystal mounted in a plane parallel to and within 0.0003 inch of the drum surface constitutes the probe. Both indium arsenide and indium antimonide crystals have been used to sense the vertical component of the drum's magnetic signal.

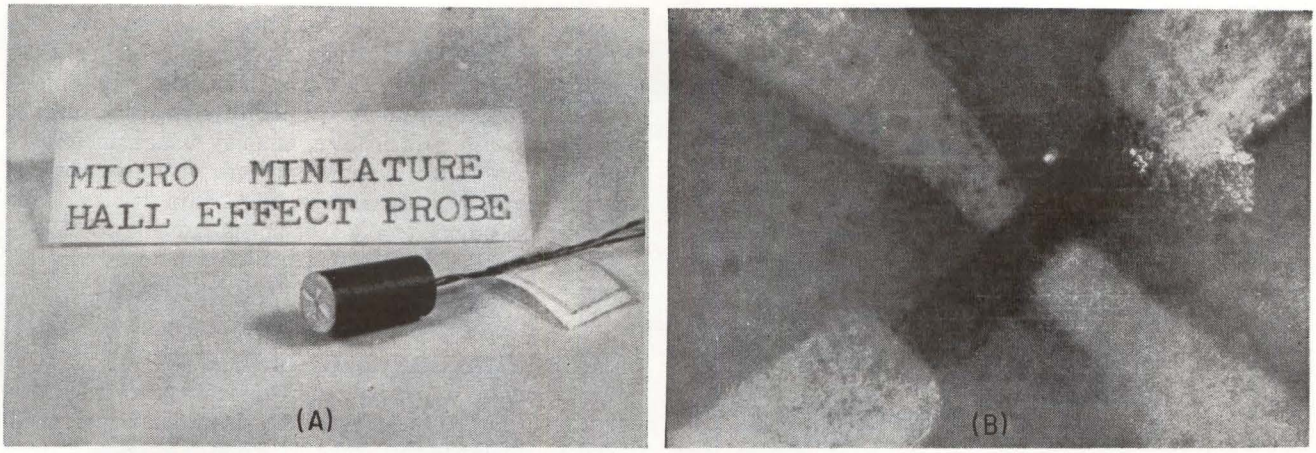
Probe excitation is 10 mw at 40 kc. The resulting signal, which is amplified, detected, and shaped into square waves for input to a digital computer or bidirectional counter, can be amplitude or carrier phase modulated by the balancing resistor between the crystal input and output. Maximum modulating frequency is about 1,000 cps; it is set by drum size, maximum rpm, and recorded bit packing density.

Bit densities of 180 bits an inch can be resolved, and angular resolution within 11 minutes of arc has been obtained using a 1.8-inch-diameter single-track magnetic drum and two probes placed 90 degrees apart. The two probes sense direction and double angular resolution. A probe is shown in Fig. 4.

Both plated CoNi and sprayed iron-oxide magnetic dispersion have been used for coating the aluminum drum with a 0.0005-inch magnetic layer. While a track width of only 0.03 inch is required, the drum used is 0.125 inch wide. Electronic synchronization of the master oscillator and a synchronous recording drive motor is used for initially writing the one-zero



RESISTOR MESH *used for generating a chirp signal—Fig. 3*



HALL EFFECT *microminiature probe used in AC Spark Plug magnetic angle encoder, shown to indicate scale, (A); close-up of probe face, (B)—Fig. 4*

NRZ pattern. A track closure with a given number of bits and only 3 percent jitter is thus assured.

SELF-FOCUSING ANTENNA—Sperry Gyroscope will describe a fundamentally unique self-adaptive antenna array which shows promise of providing added efficiency and economic advantages for communications systems and for very high gain antennas.[7] Operating on a closed-loop basis, the antenna system automatically forms and directs its beam by using phase-locked receivers to lock on to the carrier of the signal. Coherent reception and transmission are provided by self-adjusting phase shifters.

The paper describing ATHESA (Automatic Three-dimensional Electronic Scanning Array) enumerates techniques for broadband modulation and for operation at separate frequencies for transmission and reception. Effective aperture of the array reportedly can be made larger than its physical area.

Signals received from the cooperating transmitting station are used for measuring the differences in path length, or phase, to the various elements of the array. Included are differences due to atmospheric inhomogeneities, antenna tolerances, and mutual coupling. These phase differences are then removed by means of phase-locked loops which self-adjust the system, and it receives or transmits with an effective aperture equal to the sum of all reflector apertures.

Prime applications are in the construction of large antennas having close tolerances, interferometer systems where high-gain communication simultaneous with electronic tracking is required, and for the transmission of power.

Main features of the system include automatic inertialess tracking on an instantaneous closed-loop basis, r-f power transmission, and practical methods for providing very high gain (70 db) and obtaining accurate orbital data on a beacon satellite while simultaneously communicating with it.

OPTICAL DECISION FILTER—A self-organizing image filter, developed by Astropower, Inc., automatically recognizes and classifies 3-dimensional objects regardless of shape and orientation in relation to the viewing device.[8] Its ability to differentiate between cubes, spheres, pyramids, and ellipsoids suggests many applications for reconnaissance, photo interpretation and star-field recognition for space probes. Techniques of analog neural networks are used.

Classification of objects is made from their 2-dimensional projection through a 15-inch focal length, f:5.2 lens on a 20 × 20 mosaic of silicon photovoltaic cells. Decision-making circuit resembles that used in Cornell Aeronautical Lab's Perceptron, and contains an associative memory logic system, response logic network, and digital logic network. The last of these selects indicator lights for the machine's readout.

Analysis of the 20,000 threshold majority logic units initially used in development resulted in a reduction to 400 in the final version. These follow photocell amplifiers and precede the conventional digital readout logic. Sometimes called a votetaker, this basic circuit has a binary readout depending on whether the algebraic sum of the input signals is greater than or less than the threshold. It tests each pattern for some majority-logic proposition, and if the proposition is true, switches to its high state.

To establish typical recognition patterns of the four different shapes, 200 images of each were selected to provide samples of various photocell retina configurations. Parameters specifying the samples were fed to an IBM 709 that determined which of the 400 sensory points were illuminated for each pattern.

The possibilities of using a multi-sensor unit with radar, infrared and optical inputs for follow-on models are being investigated.

IONOSPHERE PLASMA PROBE—An instrument has been developed at University of Utah's Upper Air Research Laboratory for measuring the plasma frequency of the ionosphere, so that electron densities can easily be computed. Designed for rocket or satellite payloads, the device obtains data directly by exciting the plasma with an r-f field from an antenna and varying the frequency.[9] This method is

reported to have considerable advantages over previous techniques in which it was necessary to transform the induced changes of antenna impedance into the plasma characteristics, such as plasma frequency, electron density, and collision frequency.

When an r-f electromagnetic field is created, free electrons in an ionized medium add a lagging or inductive current to the free-space capacitive or displacement current. This added current is a function of the electron density, and being 180 deg out of phase with the free space capacitive or displacement current, tends to cancel it. As the exciting frequency is reduced, the inductive current increases and the two components become equal at some frequency known as the resonant frequency of the plasma. The plasma's equivalent circuit is a parallel L-C-R resonant circuit, and its resonant frequency is that of the plasma. Resistance of the circuit is a measure of the frequency of electron collisions. By measuring the resonant frequency of the ionosphere and its Q, it is possible to determine both electron density and collision frequency.

In one of two basic systems being used for plasma frequency measurement, the frequency of an oscillator is continuously swept through a band corresponding to the expected plasma frequencies. As the frequency is swept, phase measurements between antenna voltage and current are made. An f-m/f-m telemetry system transmits to earth the phase—frequency plot; the frequency at which the phase passes through zero corresponds to the parallel resonant point of the plasma. Results from an Astrobee 200 rocket test incorporating this equipment will be presented.

RANGER LUNAR CAPSULE ANTENNA—Several unique requirements were specified for a telemetry antenna built by Aeronutronic for JPL's Ranger lunar capsule. It must provide a circularly polarized 960-mc single-lobe beam directed along the local lunar vertical with maximum gain within a 90-degree cone centered on that vertical. Embedded in eight inches of balsa, it must operate within a minimum size spherical cap volume. Total weight of the antenna must be less than one pound, and it must survive a 3,000-g shock.[10]

To achieve lunar vertical orientation, the ball of the capsule is weighted and floated in a fluid at neutral buoyancy. Once this freely gimbaled pendulum attains proper orientation, the fluid is drained and the inner ball caged.

The antenna is a turnstile made of two crossed dipole radiators curved to fit the spherical cap. Radiating poles are the outer conductors of strip transmission line sections. Circular polarization is obtained by reactive tuning of the transmission line sections, to produce conjugate impedances for the dipoles with essentially equal resistive and reactive magnitudes. The dipoles, when connected in parallel to a single coaxial line, have equal-magnitude impedances in quadrature, and the resultant purely resistive impedance may be designed to equal the characteristic impedance of common transmission lines.

Use of a single coaxial feed line minimizes thermal leakage since this cable has to penetrate the insulated equipment housing. The antenna design techniques permit using identically shaped dipoles, resulting in excellent beam rotational symmetry which is important in the lunar capsule system. Greater design versatility than is possible with certain related techniques dependent on the free-space impedance of differently shaped dipoles in parallel also resulted. Results of 3,000-g impact tests will be presented.

FIELD EMISSION DEVELOPMENTS—Follow-on developments to those reported last year in ELECTRONICS (Aug. 11, 1961, p. 141) issued last year will be detailed by W. P. Dyke of Field Emission Corp.[11] These include a field-emission cathode-ray tube with a measured resolution of 2,000 lines per inch, a multiple-tip field cathode switch tube having switched 1 Mw of power, and microwave devices that modulate emission at microwave frequencies.

In FEC's laboratories, stable emission at d-c current densities above 10^7 amp per sq cm has been demonstrated, as well as at pulsed current densities in excess of 10^8 amp per sq cm for various cathode materials. Pulsed beams with current densities of several hundred amps per sq cm and microperveances of the order of 10 have been emitted by compact multiple-tip cathodes. Life tests show that adequate cathode stability is maintained for over 15,000 hours at power dissipation levels above 100 w.

Commercially available models of flash x-ray tubes and systems have been pushed to a level where a 40-lb system provides 140 Mw peak power, and experimental tubes have achieved a peak power of 4 KMw with 10^9 roentgen x-ray intensity. These accomplishments are due to the use of field-emission-related processes to generate extremely high-density electron beams from small, unheated multiple-tip cathodes.

By extracting the high-density electron beam through a thin metal window in another laboratory development, dose rates as high as 10^{13} rads/sec have been produced. Fields of application for these devices include radiology, quality control and nondestructive testing, hypervelocity and ballistic studies, and radiation chemistry.

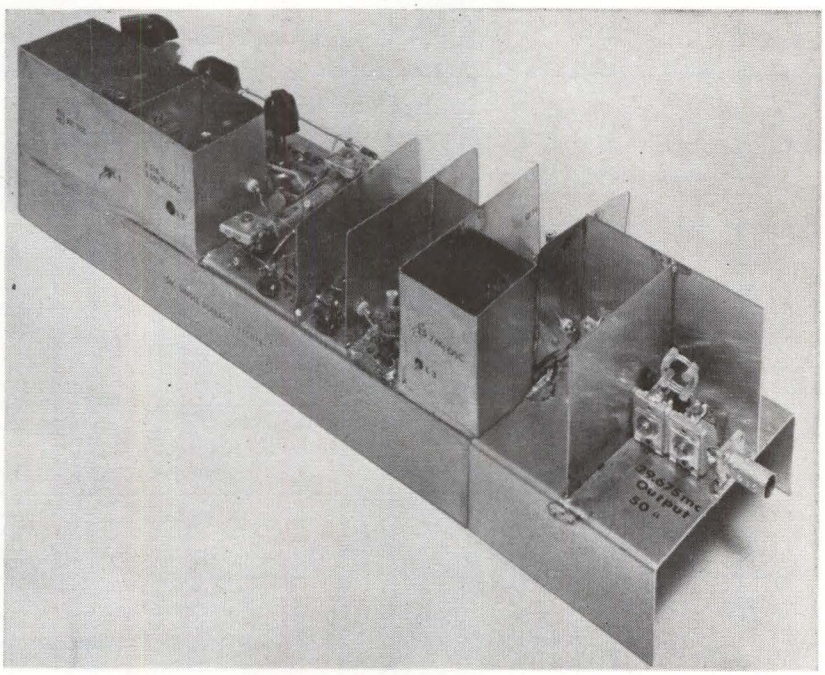
REFERENCES

(All papers prepared for the 1962 Western Electronic Show and Convention, Los Angeles.)
(1) E. R. Beck and G. A. Brumm, Bendix Corp., Experimental 100-mc Tunnel-Diode DDA.
(2) W. Rindner and R. Nelson, Raytheon Co., A New p-n Junction Strain Transducer.
(3) T. A. Longo, M. Miller, A. E. Derek and J. D. Eknaian, Sylvania Electric Products, Planar Epitaxial PNPN Switch with Gate Turn-off Gain.
(4) J. Y. Payton, Litton Systems, A Practical Non-Destructive Random Access Tunnel-Diode Memory.
(5) M. R. Winkler, Radio Corp of America, Chirp Signals for Communications.
(6) E. R. Strandt, General Motors Corp., A Hall Effect Incremental Angle Encoder.
(7) M. Breese and P. Sferrazza, Sperry Gyroscope Co., A Self-Focusing Antenna.
(8) R. D. Joseph, P. M. Kelly, and S. S. Viglione, Astropower, Inc., An Optical Decision Filter.
(9) O. C. Haycock and K. D. Baker, University of Utah, Ionosphere Plasma Frequency Probe.
(10) W. G. Scott, Ford Motor Co., Range Lunar Capsule Antenna.
(11) W P. Dyke, F. M. Charbonnier, and F. J. Grundhauser, Field Emission Corp., Recent Developments in Field Emission.

SINGLE-SIDEBAND EXCITER

Uses Planar Silicon Transistors

Silicon transistors used in single-sideband circuits can increase reliability of ssb exciters; the transistors have low noise and high output impedance. Increased efficiency of ssb radio communications can result from use of solid-state exciters



BRASS R-F SHIELDS *were used in the construction of a prototype 10-meter ssb exciter*

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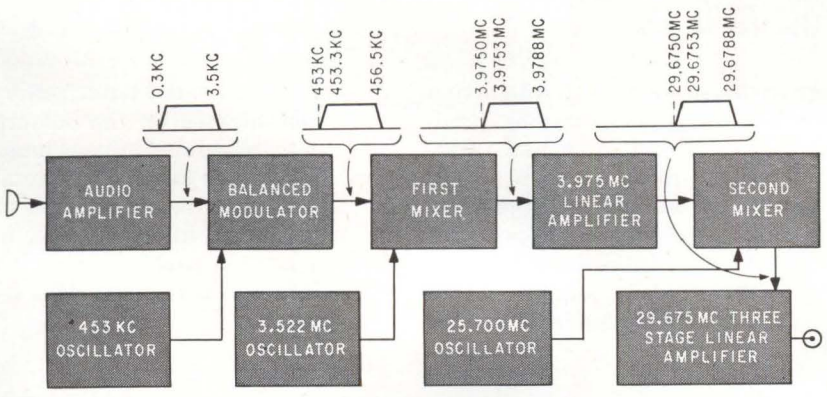
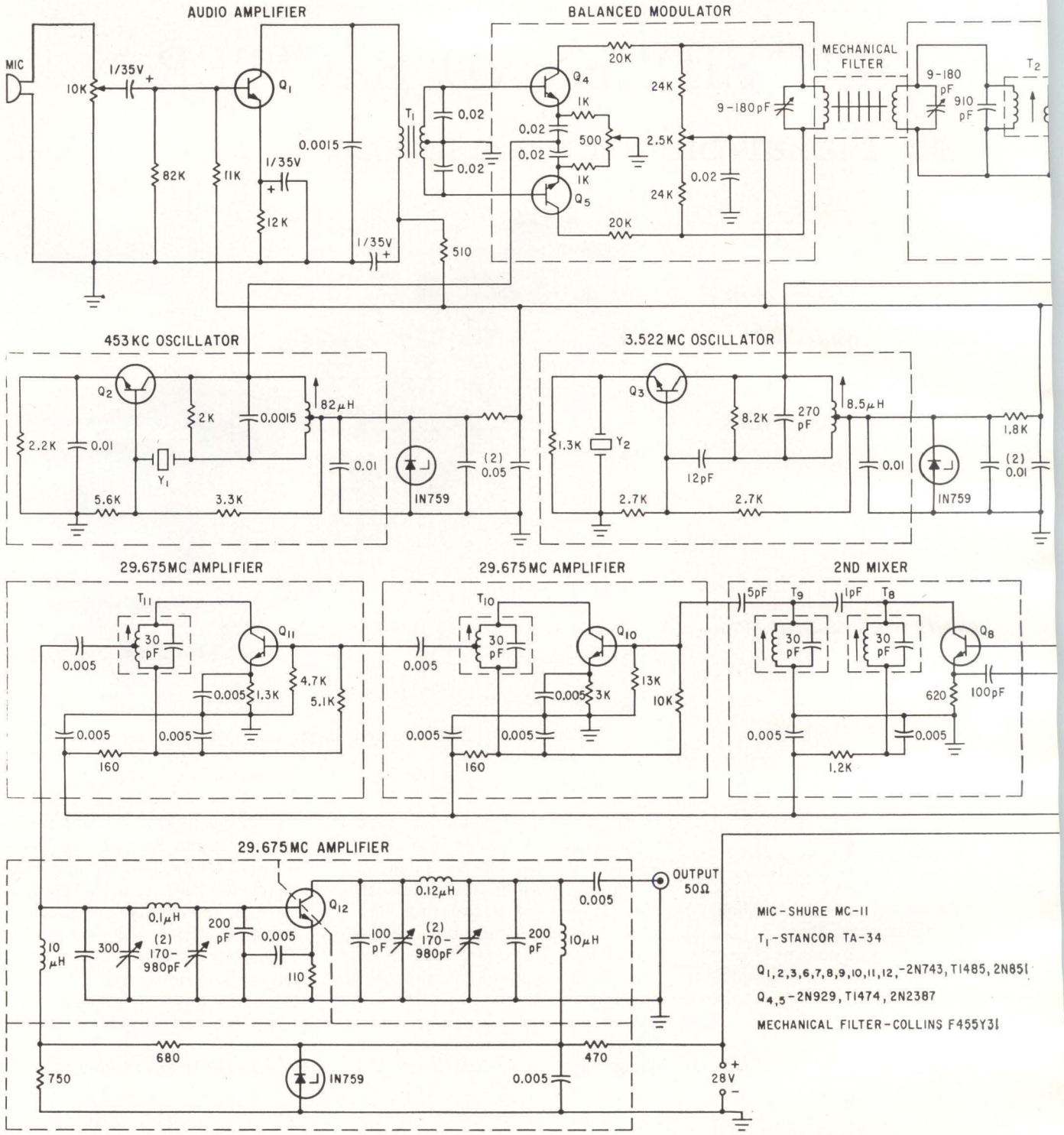
AN ADVANTAGE of single-sideband (ssb) systems is that all signal processing may be done at relatively low power levels. Semiconductor components are well suited to such applications, particularly silicon transistors.

Only one sideband of a conventional amplitude-modulated signal is necessary to convey intelligence. The carrier and one sideband may be omitted with no loss of information. When the modulating signal is a single-frequency tone, the ssb signal is a sinusoidal wave whose amplitude is a direct function of the modulation amplitude. Its frequency is a direct or an inverse function of the modulation frequency for upper and lower sideband, respectively. A voice-modulated ssb signal may be considered the result of translating the voice frequencies intact to a position higher in the frequency spectrum. Thus the function of an ssb exciter is frequency translation. For reception, the ssb signal must be translated down to its original position in the frequency spectrum, an operation that is the reverse of the process used in the exciter.



SSB EXCITER *for upper sideband frequency synthesis—Fig. 1*

SSB SYSTEMS — Requirements that must be met in an ssb system are control of frequency accuracy and stability, incidental amplitude and frequency modulation, injection oscillator distortion, and carrier and undesirable sideband suppression. Since all frequency translations are additive or subtractive operations, the total frequency shift of the demodulated ssb signal is the algebraic sum of all injection oscillator frequency errors, neglecting propagation and doppler shift. A frequency error of 100 cps will impair intelligibility, so it is necessary



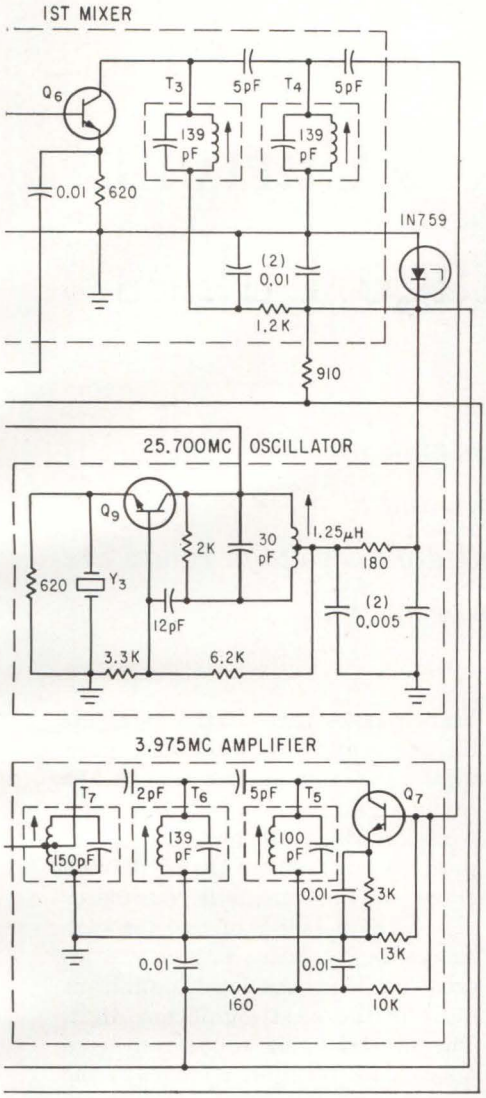
UPPER OR LOWER SSB *frequency synthesis can be obtained with this 10-meter single-sideband exciter—Fig. 2*

to maintain rigid frequency control. Overall frequency, accuracy and stability must be in the order of 0.2 to 2.0 parts in 10^6 to insure quality communications using the high-frequency spectrum.

Incidental amplitude and frequency modulation of any of the injection oscillators in the ssb system will cause the generation of new sidebands and resulting system distortion. The injection oscillators' signals must be free of distortion to prevent unwanted mixing products. Overall distortion and intermodulation products should be at least 40 db below one tone of a standard two-tone test signal for satisfactory performance of ssb equipment. Ideally, suppression of the carrier and undesired sideband should be complete. Practically, it is desirable to have at least 40 db suppression.

In designing an exciter, efforts were concentrated on the balanced modulator, mixers and linear amplifiers. While the oscillator circuits employed are stable, no attempt was made to design ultrastable oscillators, since this problem is conventional and has been treated in several papers.

SSB SILICON EXCITER—Upper sideband frequency synthesis, uti-



CRYSTAL COMPLEMENT			
SIDEBAND	Y_1	Y_2	Y_3
UPPER	453KC	3.522MC	25.700MC
LOWER	457KC	3.518MC	25.700MC

K = X 1,000

lizing the circuit of Fig. 1 and 2, required a magnetic microphone, which had an output of −71 db. An audio amplifier was needed to raise this level and to provide a balanced input to the balanced modulator. The silicon planar 2N929 transistor was chosen for the balanced modulator because of its low noise and high-output impedance. Transistors Q_4 and Q_5 are selected units matched on h_{FE} and on 1 *Kc* h_{fe}, r_{oep}, and c_{oep}. The narrow production spread of parameters makes this selection simple.

The balanced modulator has two inputs; audio feeding into the bases in push-pull and a 453-Kc carrier injection signal feeding into the emitters in parallel. With this configuration, the carrier signals appear at the collectors in phase with equal amplitude, and to a great extent balance each other. The degree of transistor matching helps determine the amount of balance, carrier suppression. Amplitude balance is achieved by the emitter potentiometer that adjusts emitter current, hence h_{fe}, and the collector potentiometer that adjusts the ratio of collector carrier voltages. A carrier suppression of 20 db is obtained without resorting to phase balancing.

When audio is present, mixing occurs in the nonlinear emitter-base diodes of Q_4 and Q_5 and produces a collector frequency spectrum that includes the audio, carrier, carrier plus audio, carrier minus audio, and other second and higher-order mixing products. This spectrum is applied to the Collins F455Y31 mechanical filter, which passes only the carrier-plus-audio component or primary upper sideband.

VARIABLE CAPACITORS — To preserve the 1-db maximum ripple in the 3.1-Kc bandpass of the mechanical filter, the driving generator impedance must be $\geq$ 50,000 ohms. This is assured by using the high-output-impedance 2N929. Variable capacitors resonate the filter input and output transducers at 455 Kc. This filter provides an additional 30 db carrier suppression and 40 db to 60 db sideband suppression. Overall carrier suppression is 50 db.

The three injection oscillators have common emitter series-fed Hartley configurations. The frequency controlling crystals are calibrated at series resonance. Silicon zener diodes (1N759) supply a regulated 12 volts.

In the first mixer circuit, T_2 transforms the input impedance of Q_6 into 50,000 ohms to satisfy the mechanical filter's matching requirements. Transistor Q_6 is biased class-B, with the 3.522-Mc injection signal applied to the emitter and the 453-Kc ssb signal applied to the base. The mixer is additive, with the sum, 3.975 Mc, selected by filters T_3 and T_4. The injection signals are suppressed 17 db minimum below the 3.975-Mc ssb signal at the output of T_4.

Transistor Q_7 is a small-signal class-A linear amplifier whose gain is just offset by the insertion loss of the high-Q filiters T_5, T_6 and T_7. The 3.522-Mc injection signal is suppressed 40 db minimum below the 3.975-Mc ssb signal at the output of T_7.

The second mixer is similar to the first except for frequencies. It also is additive with filters T_8 and T_9 selecting the sum, 29.675 Mc. Suppression of the 25.700-Mc injection signal is at least 24 db below the ssb signal.

LINEAR AMPLIFIERS — Transistors Q_{10} and Q_{11} are small-signal class-A linear amplifiers designed for maximum gain consistent with the suppression requirements. Peak-envelop-power (pep) output of Q_{11} is 3 mw. All unwanted radiation is suppressed 40 db below the 29.675-Mc ssb signal. Filter T_{11} is tapped for a 50-ohm load so the preceding circuits may be used as a low-power exciter. Transistor Q_{12} is a class-A linar amplifier. An L-C pi network at the input of Q_{12} matches the preceding stage output to the translator input impedance. A similar network provides output tuning and loading into a 50-ohm load for Q_{12}. The pep of the exciter is $\geq$ 90 mw.

Every stage except the audio amplifier must be r-f shielded. In constructing the prototype exciter, adequate shielding was obtained by building each stage in an enclosed brass compartment. Also for isolation, the power supply for each oscillator was decoupled by a low-pass R-C pi filter. The 29.675-Mc frequency was selected for convenient demonstration. Similar performance can be expected over the h-f range. The selection of transistors can be varied to match requirements. For severe requirements, an NPN planar 2N929 for the modulator and several epitaxial 2N743's could be used. Lower sideband frequency synthesis may be generated by changing crystal Y_1 from 453 Kc to 457 Kc and Y_2 from 3.522 Mc to 3.518 Mc (Fig. 2).

Precise Converter Takes Current Analog of Digital Voltage Pulses

Digital-to-analog conversions are carried out with high precision using a binary-weighted network of wire-wound resistors and a well-regulated transistor power supply. Eleven-bit digital voltage values are converted to current analog outputs to a resolution of one bit

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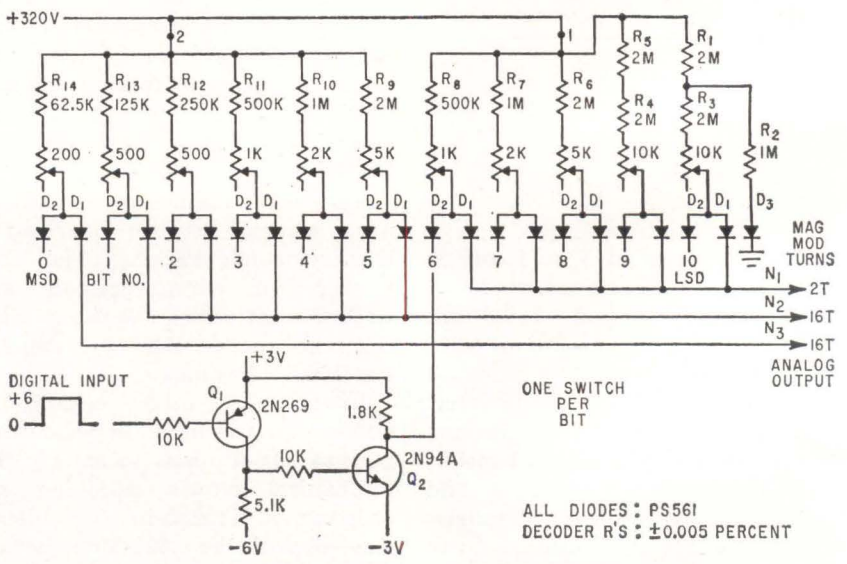
WITH THIS DIGITAL-TO-ANALOG converter (decoder), an 11-bit digital value can be converted to a current analog. The conversion is accurate to a digital resolution which for 11 bits is one part in 2,048 or 0.049 percent. The decoder has maintained this accuracy over the temperature range of −50 deg C to +60 deg C.

The precise currents are obtained from a binary-weighted network of precision wire-wound resistors and a well-regulated transistor power supply.

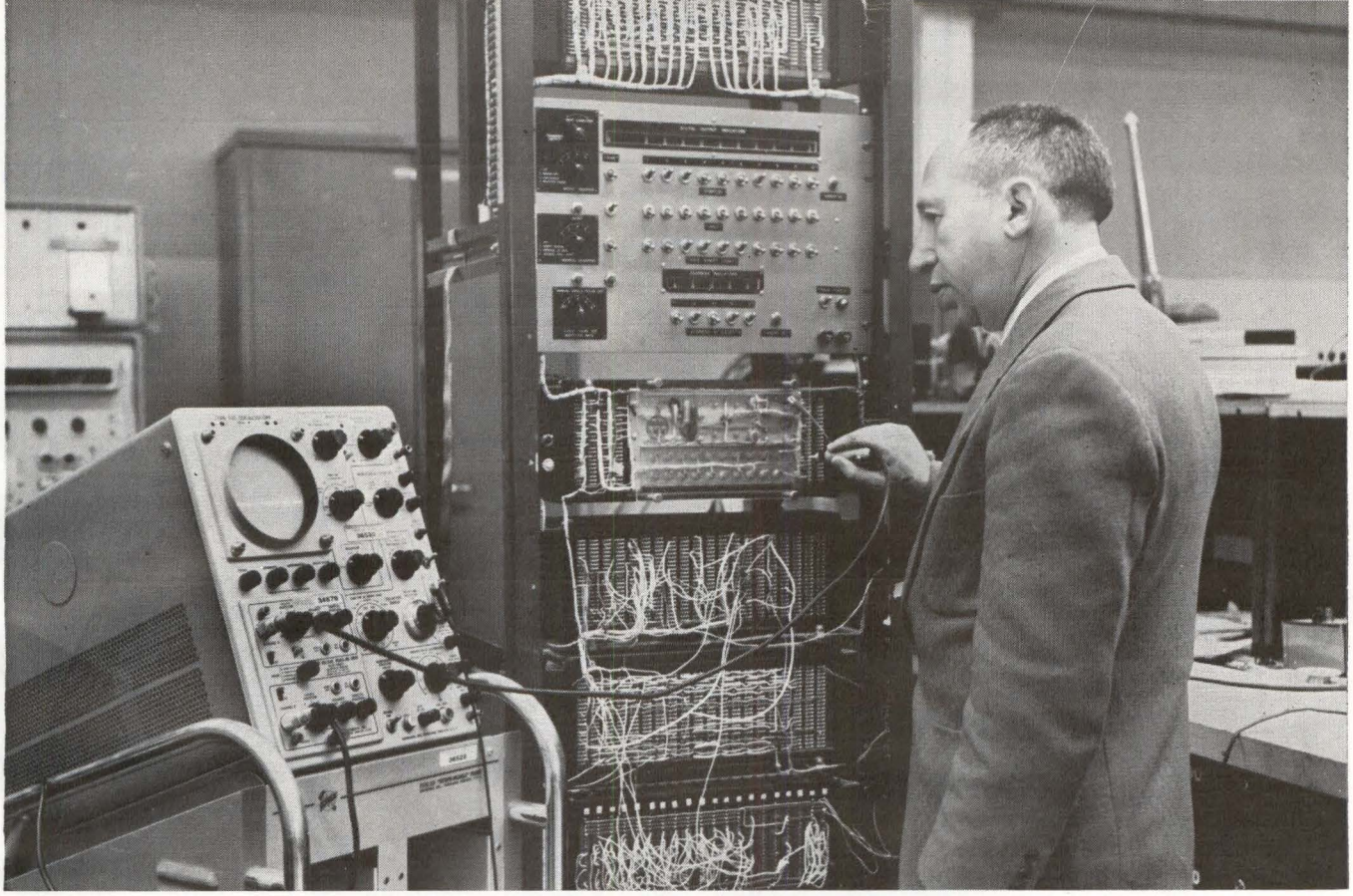
Typically, a decoder circuit includes a resistive network, a reference power supply and a set of switches. The resistive network provides the binary weighting for conversion. The power supply provides either the voltage or current analog and the switches activate the resistor network to switch the binary references as required by the digital input. Each element affects the conversion accuracy. High-precision decoders must keep the errors introduced by each to a minimum.

This decoder includes a parallel network of binary-weighted precision resistors, high-conductance silicon junction diode switches, and a transistor high-voltage regulated power supply. The impedance of the precision wire-wound resistor network is much greater than that of the load. Thus each resistor produces a constant current source to provide binary current values to the load. These currents are switched by diodes activated by the flip-flops of the digital input register. The decoder low impedance load for this application is a magnetic modulator or comparator.

DECODER CIRCUIT—Figure 1 shows the decoder weighted current network and the transistor switching circuit. The resistor branches are identified by the bit numbers zero through 10. The bit zero branch takes care of the sign, the bit one branch the most significant digit, and the bit 10 branch the least significant digit. The network resistors are proportioned to produce an ampere-turns driving force in the magnetic modulator related by a factor of two for each succeeding resistive branch and increasing from the least significant digit to the most significant digit. The digital value to be converted appears in the flip-flop stages of the output register driving the transistor switches and the analog current output of the converter appears in the windings of the magnetic modulator. The current is



ELEVEN-BIT DECODER *network and switch—Fig. 1*



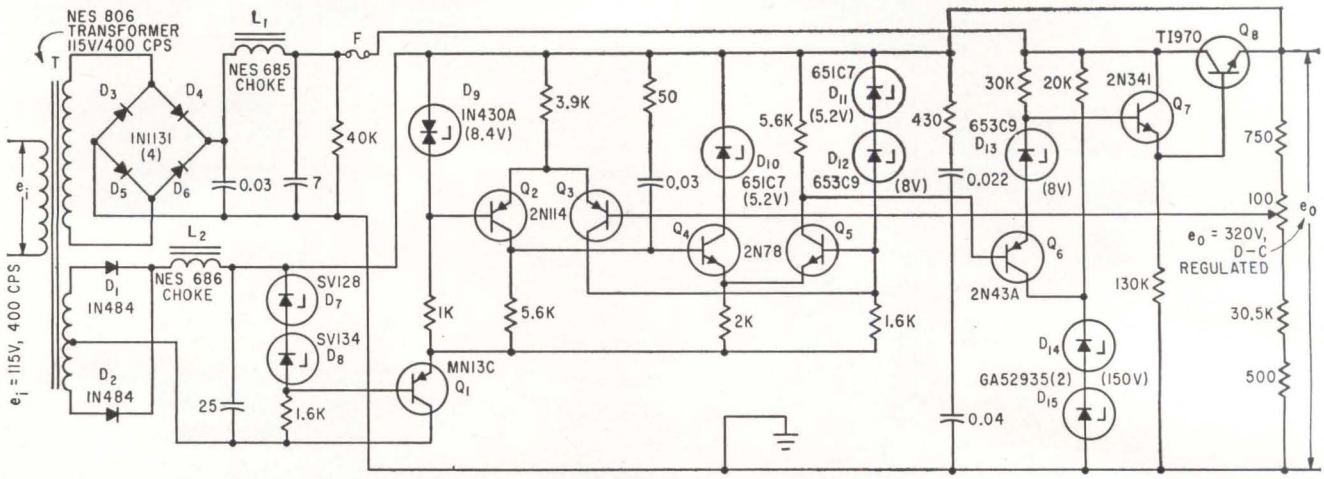
DIGITAL-ANALOG CONVERTER. *Author measures a d-c level output from converter*

maintained in the resistor network by the 320-volt transistor-regulated power supply. A digital value in the output register flip-flops sends the output level of the ZERO output of the flip-flops to ground when the register holds a ZERO and to +6 volts when the register contains a ONE. The ZERO output of each of the flip-flops is connected to a diode, D_2 (Fig. 1), of the resistor network through the two-transistor switch circuit. When the output level of a flip-flop goes to ground, the collector of the transistor switch, Q_2, tied to diode D_2 of the associated resistor branch goes to −3 volts. Diode D_2 conducts and diode D_1 stops conducting. As a result, the resistor current for this branch passes through the transistor Q_2 and not through the magnetic modulator. When the flip-flop level is at +6 volts, diode D_2 stops conducting and diode D_1 conducts. Current from the associated resistor branch is now switched to the magnetic modulator winding. Thus, for all stages of the output register containing a ONE, current enters the magnetic modulator winding and is prevented from entering for those stages containing a ZERO. Current from each of the resistive branches is additive in the magnetic modulator windings. Further, windings N_1 and N_2 are together additive but N_3, the sign winding, is subtractive, producing a magnetic effect opposite to that produced by windings N_1 and N_2.

DECODER POWER SUPPLY—The power supply for the decoder provides the currents in the binary weighted precision resistors. It is a well-regulated power supply with semiconductor (silicon junction) diodes in the rectifier and transistors in the series regulator. The power supply is capable of delivering 60 milliamperes at 320 volts. The regulation is better than ±0.01 percent for ±10 percent line voltage variation and for load current change from no load to full load. Ripple voltage is less than 20 millivolts peak-to-peak and the supply has a long-term stability of −0.015 percent.

Figure 2 shows the power supply. The high voltage rectifier uses the full-wave bridge circuit consisting of silicon junction diodes, D_3, D_4, D_5 and D_6. The rectified output is filtered and fed to the transistor regulator consisting of Q_2 through Q_8. A sample of the output d-c voltage is taken from the output bleeder resistor at the 100-ohm trimpot and compared to the 8.4-v reference of a 1N430A silicon diode in the difference amplifier consisting of transistors Q_2 and Q_3. The error between these two voltages is fed to the transistor amplifier, Q_5 through emitter follower Q_4, and to the driver amplifier, Q_7 through emitter follower Q_6. The driver amplifier Q_7 provides the drive for the series regulator transistor Q_8.

REGULATOR FEATURES—Power for the regulator transistors is provided by the separate low-voltage full-wave center-tapped rectifier consisting of silicon junction diodes D_1 and D_2. This supply is also regulated, using a series regulator transistor Q_1, the output of which is referenced to silicon junction reference diodes, D_7 and D_8. A notable feature of this supply is that it provides a high output voltage with a transistor regulator. This is accomplished by referring the reference diode to the high-voltage side of the output of the regulator and by taking advantage of the low reverse dynamic impedance of high-voltage reference di-



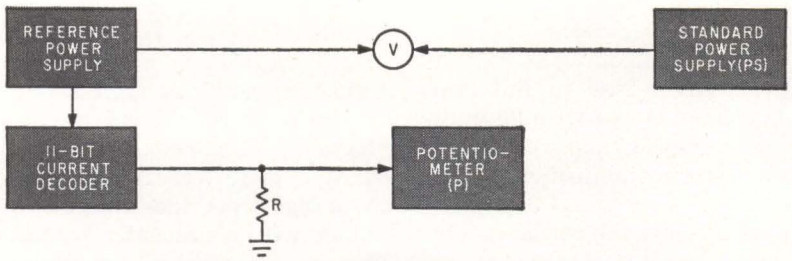
REFERENCE POWER SUPPLY *relies on a temperature-compensated silicon junction zener diode as the basic reference element with precision wire-wound resistor network to obtain error signal—Fig. 2*

odes, D_{14} and D_{15}. These have a 150-volt reference voltage. Application of the diodes greatly improves regulation. In addition, the 1N430A diode improves stability of the supply with temperature. The 1N430A is a temperature-compensated reference diode. Ordinary reference diodes are susceptible to voltage change with temperature.

Design of a high-precision decoder for conversion accuracies of ±0.025 percent places stringent requirements on its elements—the resistors, the power supply and the switches. This is especially true if operation is expected over a large temperature range as is desired in this unit. The precision resistors must be stable to better than ±0.025 percent and must track each other closely with temperature. The switching diodes must have a uniform and stable forward voltage drop that varies little with temperature and the power supply must have good stability and also not vary with temperature. The factors that contribute to the conversion errors are (1) change in resistance of the network resistors, (2) change in diode forward voltage drop, (3) diode back (reverse) currents, (4) change in power supply voltage and (5) variation of load impedance (magnetic modulator resistance).

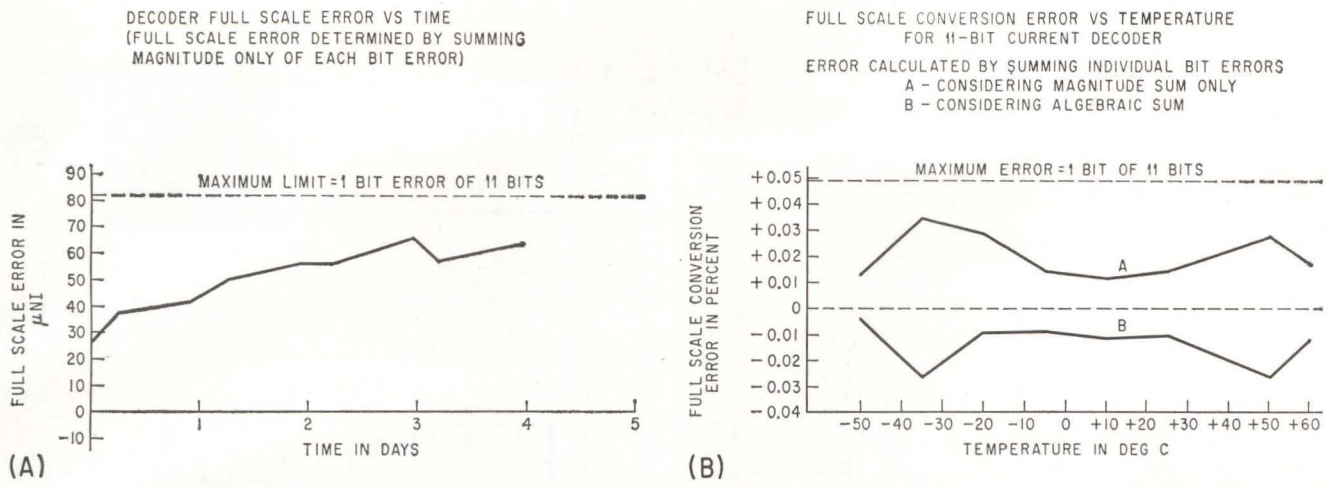
MINIMIZING ERRORS—The resistor error is minimized by selection of highly stable precision wire-wound resistors. The diode error is minimized by using silicon junction diodes of high conductance (low forward voltage drop) and low reverse current. Although the silicon junction diode characteristically has low reverse current, this property can vary considerably between diodes and careful selection of type is required for minimum values of reverse current. Furthermore, the supply voltage is made sufficiently large (320 volts) so that the possible variation of the diode forward voltage with temperature does not introduce sizable errors. The change in power supply voltage is controlled by a regulated supply using a temperature-compensated zener diode (1N430A) that can also be temperature controlled. Stability of conversion accuracy with time and temperature can be further enhanced by including a full-scale check circuit to compensate for supply and component variation with time and temperature. This was not found necessary in this design. The effect of the magnetic modulator load is accommodated by limiting the number of analog outputs fed by one decoder such that the error introduced by the drop across the modulator is less than one part in 2,048 of the supply voltage of 320 volts.

ERROR ANALYSIS—An error analysis of the decoder shows that the total output conversion error is the sum of the errors introduced by the resistors, the power supply and the diodes. Diode reverse current is small and can be neglected. Since the accuracy required is one part in 2,048 or 0.049 percent the sum of the errors introduced by the resistors, the power supply and the diodes cannot exceed this figure. If the error is split equally among the three elements, the contribution of each to the error is 0.016 percent. Thus the resistors must maintain an overall accuracy of ±160 parts per million (ppm), the power supply cannot vary by more than ±50 mv and the diode



PS – KIN TEL D-C POWER SUPPLY MODEL NO. 50-B-25, DRIFT = ±0.01%
P – RUBICON POTENTIOMETER, TYPE B, ERROR LIMIT ±1μV
V – KIN TEL D-C MICROVOLTMETER MOD 203, DRIFT = 10μV
R – STANDARD RESISTER, GENERAL RADIO, 20 OHMS OR 10 OHMS ±0.05% TOLERANCE

MEASUREMENT CIRCUIT *used in determining overall conversion accuracy—Fig. 3*



FULL-SCALE *conversion error variation with time (A) and full-scale conversion error versus temperature for 11-bit current decoder (B)—Fig. 4*

forward voltage should not change by more than ±50 mv. The errors, however, are a function of the characteristics of the components and therefore do not necessarily divide equally. At room temperature the resistor and diode forward voltage errors can be adjusted to zero by trimpot. If this is done, the predominant remaining error is the reference power supply variation. The resistor stability and diode reverse currents also introduce errors. Their magnitudes, however, do not influence the required conversion accuracy materially.

The tighter requirements of temperature operation take advantage of compensation between the switching diode forward voltage and the resistor temperature coefficient. The forward voltage of the diode decreases with increasing temperature. The theoretical figure for this change is approximately −2 mv per degree C[1]. The resistor temperature coefficient can be either positive or negative. A positive coefficient, however, can be utilized to offset the negative diode coefficient. The resistors used have characteristically positive coefficients over the desired temperature range.

RESISTOR TOLERANCE — The effect of resistor tolerance on conversion accuracy is another factor of interest in considering the overall conversion accuracy of the decoder. A set of parallel, binary-weighted resistors of equal tolerance do not each contribute equally to the full scale conversion error.[2] The least significant digit (LSD) weighted resistor contributes less to the full scale error than does the most significant digit (MSD). It is therefore possible for the LSD resistors to have poorer tolerance than the MSD resistors. The LSD resistors can change more than the MSD resistors without affecting the conversion accuracy as greatly. This fact is used to good advantage in the variation of decoder accuracy with temperature.

TEMPERATURE STABILITY— The overall conversion accuracy of the decoder was evaluated for stability at room temperature and for variation with temperature from −50 degrees C to +70 degrees C. A block diagram of the measurement circuit is shown in Fig. 3.

Before start of the test the current in each weighted branch was adjusted to its exact value with the trimpot. The adjustment and the subsequent measurements were made by noting the voltage across a standard 10-ohm resistor for the lower valued resistor branches (bit numbers zero through five) and across a 20-ohm standard resistor for the higher valued resistor branches (bit numbers six through 10).

The stability test at room temperature covered a period of approximately four and one-half days. The individual bit currents and the power supply voltage were measured twice a day during this interval. Figure 4A shows the change in computed full-scale conversion error. The full-scale error is computed by adding the errors obtained for each bit current, ignoring the sign of the individual bit error. Thus, this represents the worst error. The non-zero initial error shown in the figure is the result of drift occurring in the interval of several days between adjustment of the unit and start of the measurement run. The overall drift observed during the test is less than 410 microampere-turns (0.025 percent). This is equivalent to one-half bit in 11-bits.

The variation with temperature is shown in Fig. 4B. The d-c reference supply went out of regulation at 60 degrees C. This was caused by the high voltage Zener diodes rising in voltage with temperature and causing saturation of the 2N43A transistor in the regulator. Use of a slightly lower voltage diode with a better temperature coefficient can correct this.

The full-scale conversion error with temperature in the figure is computed from measurements on the individual bit outputs in two ways. Curve A is the full-scale error computed by summing only the magnitude of the bit errors. Curve B is the full-scale error computed using the algebraic sum of the bit errors. Either method of error computation gives a maximum error less than one bit and almost equal to one-half bit of eleven-bits.

REFERENCES

(1) Variation of Forward Characteristics of Junction Diodes With Temperature, IRE Proc, p 101, Jan. 1955.
(2) N. Aron and R. Goundry, The Weighted Resistor Decoder: An Error Analysis, Electro-Technology, April 1961.

Instrument uses a close-coupled magnetic core for current sensing, has a sensitivity up to 2.5 × 10^{-7} coulomb per volt of response

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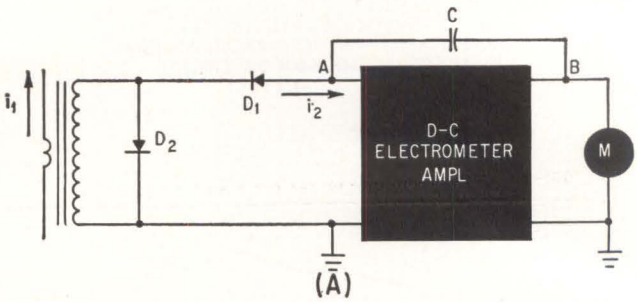


CURRENT INTEGRATION CIRCUITS: *unidirectional*

HOW TO MEASURE COULOMBS

IT IS OFTEN necessary to determine the quantity (coulombs) of electrical current in one or more pulses or cycles. The current integral, however, may be difficult to determine when the current pulse is irregular in duration, shape or amplitude, or where the current cannot be conveniently measured because of lack of a good ground connection or prevailing high potential levels. The circuits presented here overcome these obstacles and provide a convenient, precise means for measuring the integral of current pulses.

The current is allowed to flow through a transformer primary winding consisting of one or more turns linking a close-coupled magnetic core (Fig. 1A). A current will then flow in the secondary winding, proportional to the current in the primary and to the transformer turn ratio. This secondary current flows through diode D_1, charging capacitor C to a potential proportional to the integral of the current. The operational amplifier, which is a d-c inverting electrometer, is an impedance transformer and provides an input impedance of about 10^{14} ohms and a low output impedance suitable for driving a meter or equivalent readout device.

The operational amplifier causes point A to be driven continuously to near zero or ground potential, whereas point B varies as a charge is accumulated on capacitor C. Leakage of the charge on C through diode D_1 is held to a low rate by the high reverse resistance of the diode and the fact that only a small potential, commonly known as the error signal, appears across diode D_1.

Diode D_2 prevents a voltage from being generated across the transformer secondary because of current flow in the primary in a direction opposite to the current of interest, or to energy stored in the magnetic field.

If the integral of a bidirectional current is to be measured, the circuit of Fig. 1A can be modified to that of Fig. 1B.

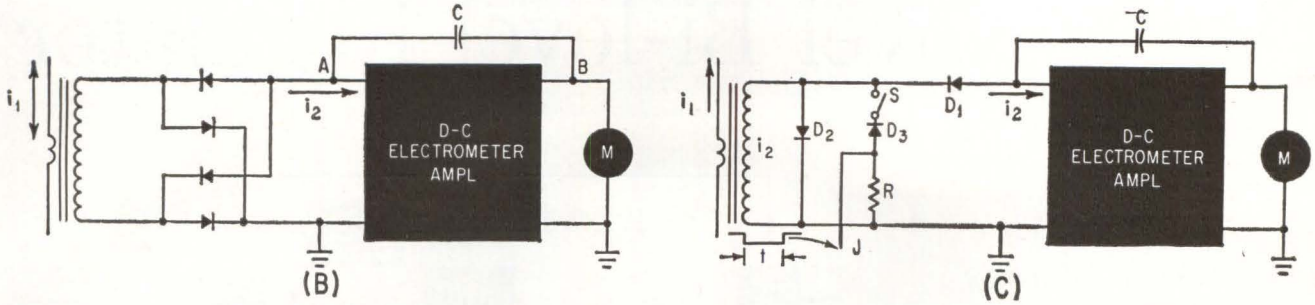
GATING—Sometimes it is desirable to control the response of the instrument so that it is insensitive except during a period t corresponding to the duration of a gating pulse. This feature is easily provided in either the unidirectional or bidirectional circuit. For example, in Fig. 1C a gate has been added to the unidirectional circuit by adding switch S, diode D_3, resistor R and connector J. With the switch closed, diodes D_2 and D_3 short out the transformer secondary, preventing any input from charging capacitor C. If, however, a gating current pulse is applied to J, resulting in a voltage drop of 40 to 50 volts across R, then diode D_3 is biased off and the circuit responds as the original unidirection circuit during the gating pulse.

For optimum gating, it is necessary to select the circuit parameters as follows: resistance of R, small compared to the transformer secondary impedance; ratio of gating current amplitude to transformer secondary current, large; and the slope of the current versus voltage characteristics for diodes D_2 and D_3, much steeper than the diode D_1 slope. Usually a high-conductance germanium diode, such as type T-9, is used for D_2 and D_3, and a high inverse potential silicon diode such as type 1N302A for D_1.

Calibration of the integrating ammeter is simple, since only the turn ratio of the current transformer and the value of capacitor C significantly influence calibration. The sensitivity in coulombs per volt of response can be calculated by sensitivity $= CN_2/N_1$, where C is in farads, and N_1 and N_2 are the number of transformer primary and secondary turns.

The natural action of the transformer, being a true ratio device, causes the instrument to be relatively independent of the characteristics of diode D_1, the frequency response of the amplifier, and other factors.

TRANSFORMER ADVANTAGES—A current transformer in the input provides: isolation of the measuring equipment from the circuit being measured, allowing operation without a common-ground connection and at different potential levels; measurement of the sum or difference in current flowing in two or more wires; a step-up or step-down of the current being measured, through choice of transformer turn ratio; and separation of very low frequency or steady-state direct currents from fast pulsating currents by the normal transformer action. This latter feature can be used, for example, in measuring phototube current to separate



(A); bidirectional (B); gated unidirectional (C)—Fig. 1

IN IRREGULAR PULSES

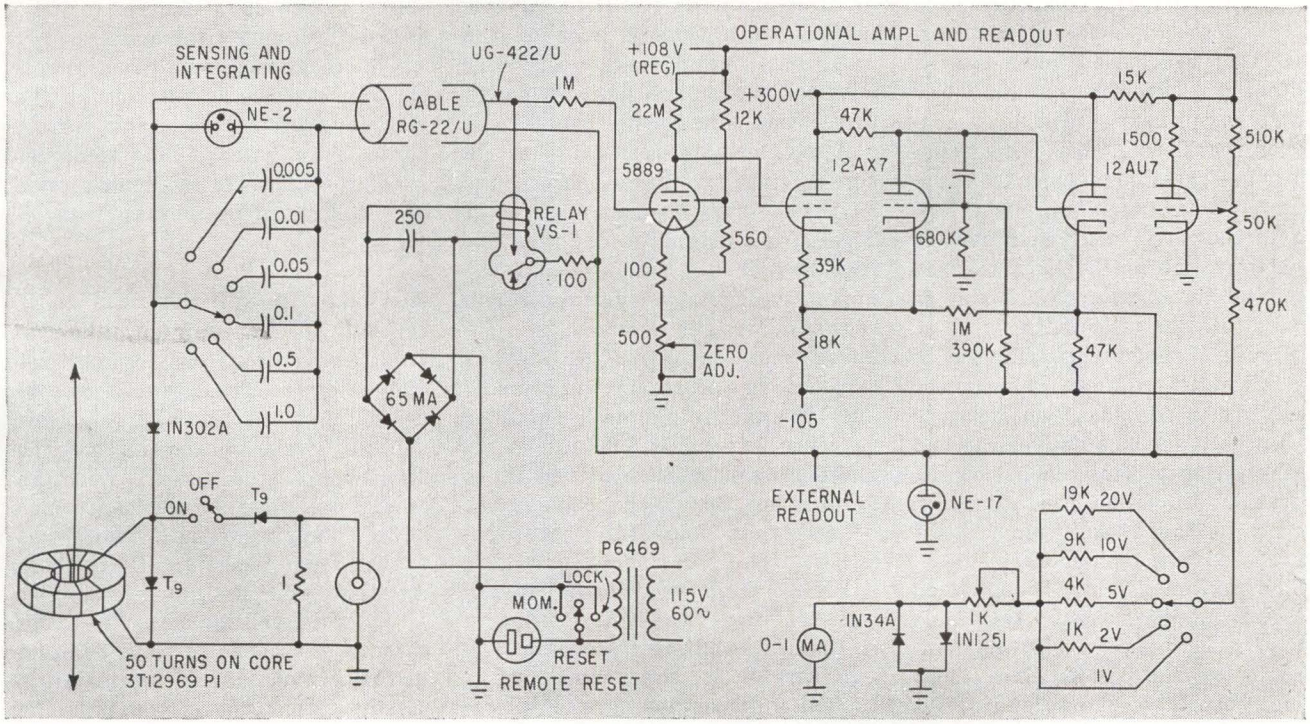
dark current from pulse signal current.

The instrument (Fig. 2) provides six sensitivity ranges from 5×10^{-5} coulomb per volt to 2.5×10^{-7} coulomb per volt of response. The current-sensing and integrating components are in a small box and connected to the operational amplifier and readout device with Twinax cable, to provide the usual instrument remote pickup.

The amplifier has an electrometer tube input followed by a noninverting 12AX7 stage. Half of the 12AU7 is an output cathode follower. A one-megohm resistor connection from the output to the cathode of the second stage provides some positive feedback, increasing the open-loop gain. The second half of the 12AU7 is a shunt voltage regulator, providing regulated voltages that are used for the plate, screen and filament supply of the input stage.

The integral of one or more current pulses flowing in a conductor is measured simply by inserting the conductor through the hole in the transformer toroidal core. The integral measurement is indicated by the meter and is continuously displayed until the instrument is reset. The single galvanometer readout (Fig. 2) has five full-scale sensitivities from 1 to 20 volts. This is useful when the integral of random signals, which cannot be repeated, is measured and the sensitivity switch at the remote pickup has been adjusted for an off-scale or very small meter indication.

The author is indebted to co-developer John C. Roubik. The work was performed for the U. S. Atomic Energy Commission.

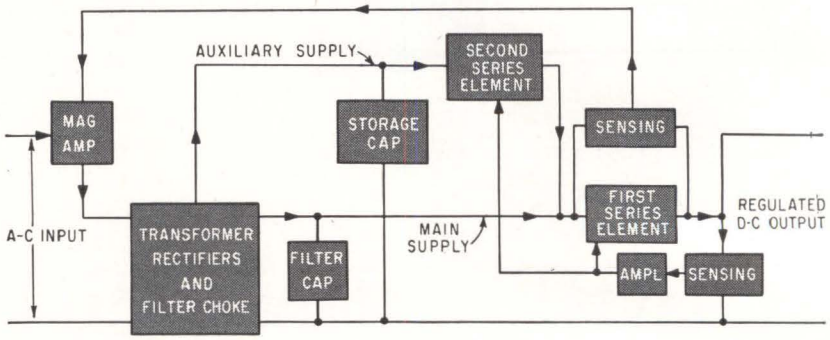


INTEGRATING AMMETER *has the range switch at the pickup for maximum convenience. If a commercial electrometer is used, only the sensing and integrating portions of this circuit are needed—Fig. 2*

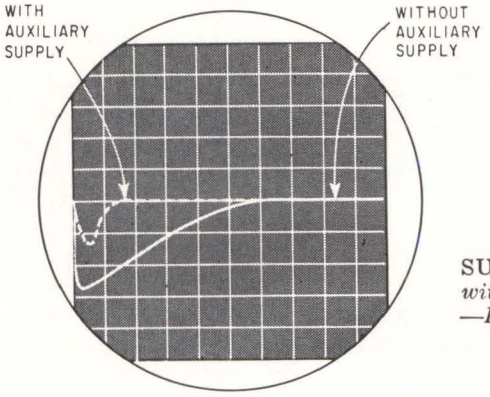
Novel Bi-level Regulator

Solid-state unit uses bilevel voltage principle to improve on efficiency of series-regulator circuits. Gives faster response than comparable switching type regulators and is 20 percent more efficient than series regulators

By F. L. WARD
President, Atlas Controls Inc., Natick, Mass.



WHEN SUDDEN LOAD *is sensed second series element is operated, delivering current from the auxiliary supply—Fig. 1*



SUPERIMPOSED RESPONSES *with and without auxiliary supply —Fig. 2*

THIS REGULATOR principle gives fast response (approaching that of the series regulator) and combines this advantage with the component and size economy of nondissipative circuits that use such components as switching transistors, magnetic control amplifiers and silicon controlled rectifiers. (Switching regulators use variable mark-space chopping to adjust the d-c output). Owing to the novel method, reservoir capacitors one-tenth the size used in switching regulators are able to handle full-load transients.

Figure 1 shows the principle of the bilevel regulator. One power transformer provides two separate output voltages, one delivering load to the output terminals in normal operation, the other, an auxiliary, higher voltage, delivering load-current during transients.

The auxiliary supply is connected to the main output terminals through the second series element. As long as the first series element is not saturated, the second series element is biased in the off state, *with zero dissipation.* Saturation of the first series element occurs with a sudden load increase, causing the lower level output voltage to drop momentarily. During this period—the response time of the magnetic amplifier—the auxiliary level takes over and delivers power to prevent voltage undershoot.

Applying this reasoning to an actual circuit, voltage across the low level series element remains at 2 volts, the magnetic amplifier has response of 0.1 seconds, and the upper level voltage (not necessarily regulated) is set at about 20 volts above the output. The storage capacitance necessary to handle load during the magnetic-amplifier response interval is 5,000 μf—a reduction in magnitude of ten times from the 50,000-μf capacitance necessary in comparable preregulated units.

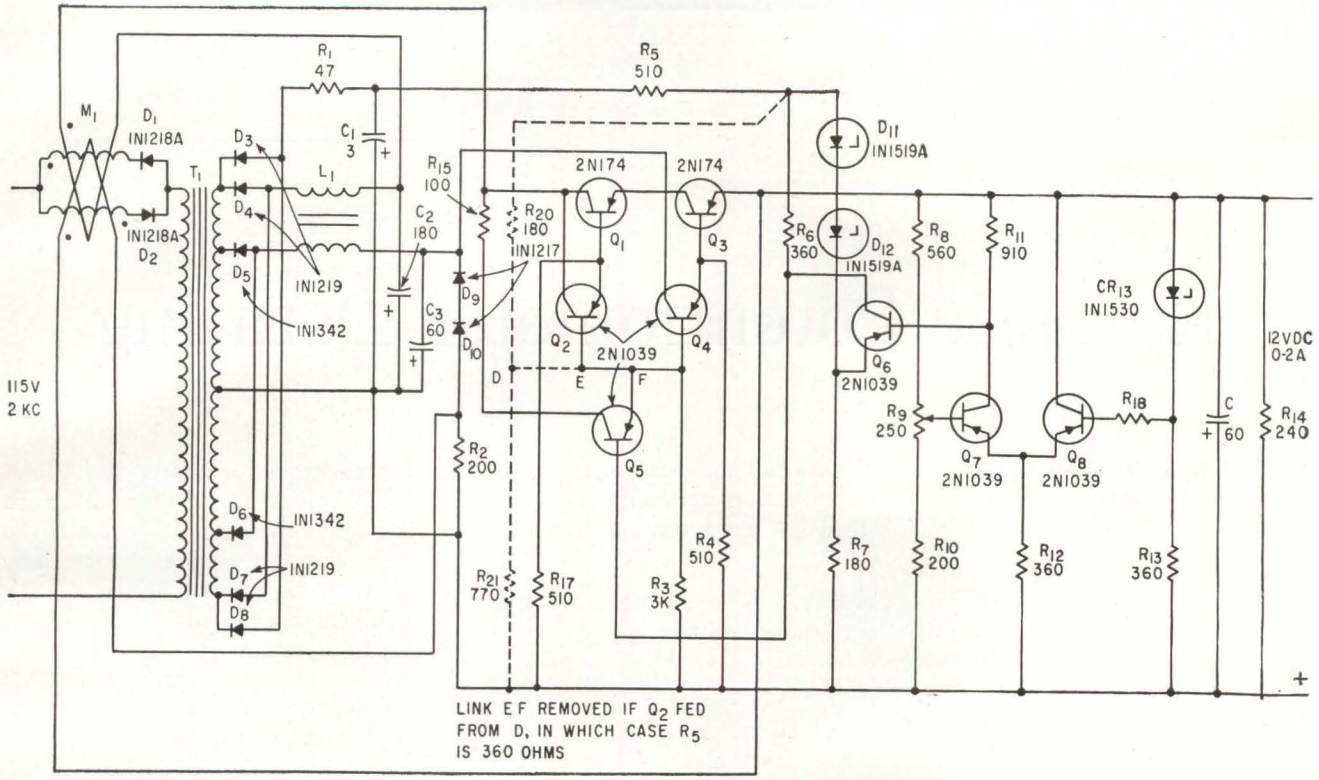
Figure 2 illustrates the advantage of the two-level regulating method in handling transients.

Figure 3 is a schematic of a typical unit employing the bilevel circuit. The low-level d-c output uses rectifiers D_5 and D_6, one winding of choke L_1, plus capacitor C_3. The auxiliary level uses rectifier D_4 and D_7, plus the second winding of choke L_1 and capacitor C_2. It operates only during transients.

The magnetic amplifier controls the low level d-c by referencing the voltage drop across transistor Q_2 against the forward bias of diodes D_9 and D_{10}, providing a long term low voltage drop across transistor Q_3.

DRIVE CIRCUIT—Transistors Q_4 through Q_6 and their circuits provide a conventional drive circuit for transistor Q_3. Transistor Q_1 is connected between the high and low voltage levels, biased off by the 1 to 2 volt drop across Q_3. With the application of a sudden load to the power supply output, power is drawn from capacitor C_3 through transistor Q_3. Owing to reactance of choke L_1, voltage across C_3 drops rapidly. At the same time, the regulator circuit tends to maintain steady output voltage by reducing voltage across Q_3. As the voltage across Q_3 approaches saturation,

Reduces Storage Capacitance



THIRD SUPPLY *delivers bias to zener D11 and control transistors. Alternative method of controlling auxiliary output is shown by dotted connections—Fig. 3*

the bias on Q_1 reduces, Q_1 conducts, and delivers output current.

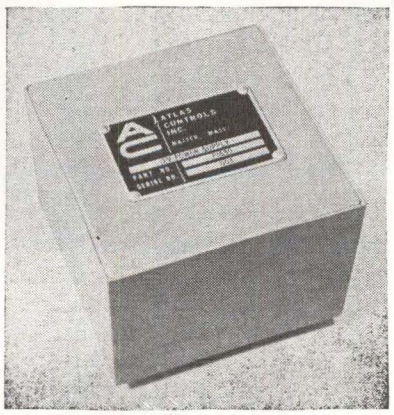
Thus energy from the upper d-c level transfers to the lower level, which maintains the lower voltage at a point high enough to prevent complete saturation of Q_3. The magnetic amplifier during its response interval of approximately 0.1 second restores voltage across Q_3 to its set value of 2 volts.

Another method of driving the high-level transistors, shown by dotted lines in Fig. 3, involves an additional resistance divider. It sets a reference voltage at the junction of resistors R_{20} and R_{21}, at a point slightly below the steady-state value of the low-level voltage. With a sudden dip in voltage, transistors Q_1 and Q_2 are driven by the reference source for the duration of the transient. Under steady state conditions, Q_1 and Q_2 are biased off by the difference between reference voltage and low-level voltage.

Rectifiers D_3 and D_8 with resistor R_1 and capacitor C_1, provide bias voltage for zener diode D_{11}.

The reference for magnetic amplifier M_1 consists of diodes D_9 and D_{10}. The forward drop against each of these diodes is approximately 0.7 volt, so that total reference voltage for M_1 is 1.4 volts.

Magnetic amplifier M_1 also has an extra control winding in series with the auxiliary high-voltage output. This winding cuts back the magnetic amplifier if current persists in the auxiliary voltage line.



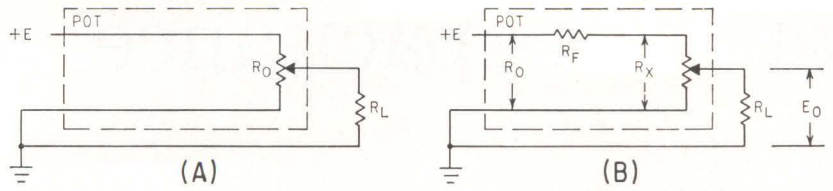
COMPACT *potted power unit gives increased efficiency*

The reference amplifier is indifferent to its source of current, so without this extra control winding, the regulator could continue to use Q_1 after application of a sudden load. In this case, after current is drawn through the second control winding for more than 0.1 second, the magnetic amplifier starts to drop back, restoring the circuit to its steady state condition.

Of the application advantages of the regulation technique, probably the most significant is reduction in the amount of storage capacitance.

The storage capacitance is roughly inversely proportional to the voltage drop across the series transistors. If 10,000 μf is required with a series drop of one volt, then only 1,000 μf would be necessary if ten volts were dropped across the series element or elements.

Reduction in the value of capacitance not only saves space, it saves considerable expense in those low-temperature applications requiring tantalum capacitors.



POTENTIOMETER *without (A) and with (B) a fixed resistor at one of its terminals*

POTENTIOMETER DERATING

L/N	P_L/P_O	L/N	P_L/P_O
100	0.98	2	0.44
50	0.96	1	0.25
20	0.91	0.5	0.11
10	0.82	0.2	0.03
5	0.69	0.1	0.008

Realistic Potentiometer Derating

By HANS H. WORMSER
Chief Product Engineer,
Markite Corp., New York, N. Y.

NOMINAL power rating of a potentiometer is not necessarily its true power-dissipation capability since this capability is often affected by the application.

With a finite load impedance between the wiper and the ground terminal (A), when the wiper is near the full-voltage terminal, the total current drawn by the potentiometer is determined by the applied voltage E and by the parallel resistance between the potentiometer and its load. All this current must be carried between the $+E$ terminal and the wiper. For a load impedance of zero, the voltage is directly applied to the wiper; this is a dangerous condition—commonly recognized as likely to cause a potentiometer element to burn out.

The basic power-dissipation capacity of a potentiometer, while expressed in watts, actually is determined by the maximum current that can be drawn continuously through its terminals or any part of its resistance element. When the current is not the same in all parts, as with a loaded unit, a potentiometer may burn out if the dissipation rate of one part is disproportionate.

A useful parameter for power-dissipation derating is L, the ratio between the load impedance and R_o, the resistance of the potentiometer from the full-voltage-end terminal to ground. For potentiometers whose load is returned to a center tap, the denominator is half the potentiometer resistance. The analysis of (A) shows how to decrease the nominal power rating of a potentiometer without a wiper load for any given load ratio L:

$$L = R_L/R_O \quad (1)$$

Current (I_o) in the track due to excitation voltage is

$$I_O = E/R_O \quad (2)$$

When the external load is applied and the wiper is near the upper ($E+$) terminal, additional current I_L flows through the wiper and positive terminal. For this analysis the limiting condition is

$$I_L = E/R_L \quad (3)$$

Total current in the power terminal and potentiometer element adjacent to the power terminal is

$$I_T = I_O + I_L$$
$$I_T/I_O = 1 + I_L/I_O \quad (4)$$

From Eq. 2 and 3, $I_T/I_o = 1 + R_o/R_L$. Also

$$I_T = I_O\,(1 + 1/L) \quad (5)$$

Let the nominal rated power (P_o) of the potentiometer when unconnected to the load be

$$P_O = I_T^2\,R_O \quad (6)$$

Derated power (P_L) of the potentiometer when the load is connected is

$$P_L = I_O^2\,R_O$$
$$P_L = I_T^2\,R_O/(1 + 1/L)^2$$
$$P_L = P_O/(1 + 1/L)^2$$
$$P_L/P_O = 1/(1 + 1/L)^2 \quad (7)$$
$$P_L/P_O = [L/(1 + L)]^2 \quad (8)$$

When R_L approaches ∞, L approaches ∞, and $P_L = P_o$; that is, with an infinite load impedance, a 2-w potentiometer can dissipate 2 w. When $R_L = R_o$, $L = 1$ and $P_L/P_o = \frac{1}{4}$; this means that with a load ratio of 1, a 2-w potentiometer can dissipate only $\frac{1}{2}$ w. When R_L approaches 0, L approaches 0 and P_L/P_o approaches 0; therefore, with the wiper shorted to ground, the potentiometer should theoretically dissipate no power.

When the potentiometer has a fixed resistor at its upper end [R_F, (B)], the maximum position of the wiper results in an output voltage E_o or a voltage ratio of N; thus

$$I_L = E_O/R_L$$

From Eq. 4,

$$I_T/I_O = 1 + (R_O/R_L)\,E_O/E \quad (9)$$

From Eq. 1, $L = R_L/R_o$. Also

$$E_O/E = N \quad (10)$$

From Eq. 1, 9 and 10,

$$I_T/I_O = 1 + N/L \quad (11)$$

From Eq. 5, 7 and 11

$$P_L/P_O = [1/(1 + N/L)]^2 \quad (12)$$

The table plots the derating factor P_L/P_o against values of L/N.

When only the maximum unloaded voltage ratio R_x/R_o of (B) is known

$$N = SL/(L + S - S^2) \quad (13)$$

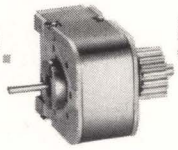
where $S = R_x/R_o$. From Eq. 12 and 13, the derated power relation becomes

$$P_L/P_O = 1/[1 + S/(L + S - S^2)]^2$$
$$P_L/P_O = [(L + S - S^2)/(L + 2S - S^2)]^2 \quad (14)$$

Equation 14 shows that even when L approaches 0, the potentiometer can dissipate some power, that is,

$$P_L/P_O = [(1 - S)/(2 - S)]^2$$

DISSIPATION EXAMPLE — For a potentiometer rated at 2 w, whose maximum output under load is N = 0.50, and whose L is 5, L/N 5/0.5 = 10. From the table, P_L/P_o = 0.82. This unit can dissipate 2 w × 0.82 = 1.64 w under the given load.

Sigma Cyclonome®, a new class of motor. Delivers 5 inch-ounce torque in precise 18° steps, up to 450 steps/sec., on simple drive circuits. No stand-by power to maintain holding torque.  5.5 cubic-inch package.

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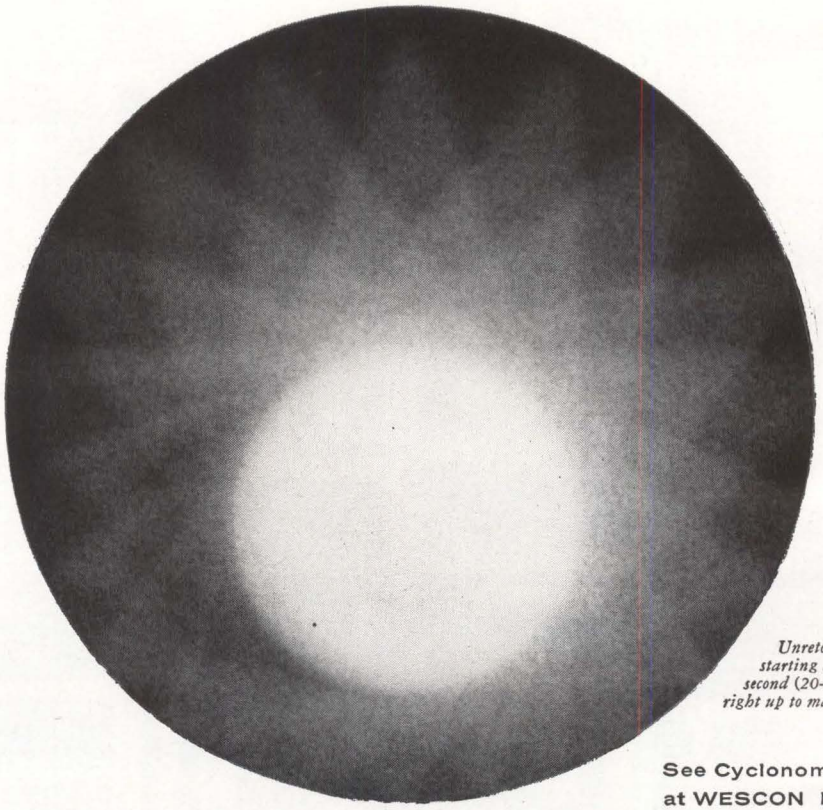

Unretouched photo of Cyclonome starting and stopping 450 times per second (20-18° steps per revolution right up to maximum speed).

See Cyclonomes "Live" at WESCON Booths 223-224

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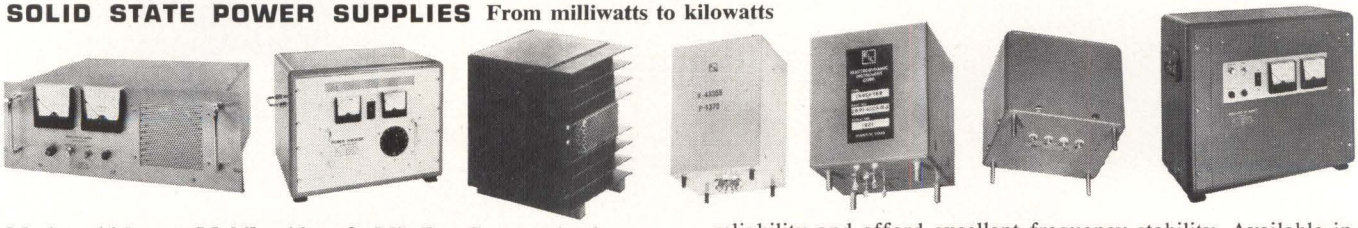

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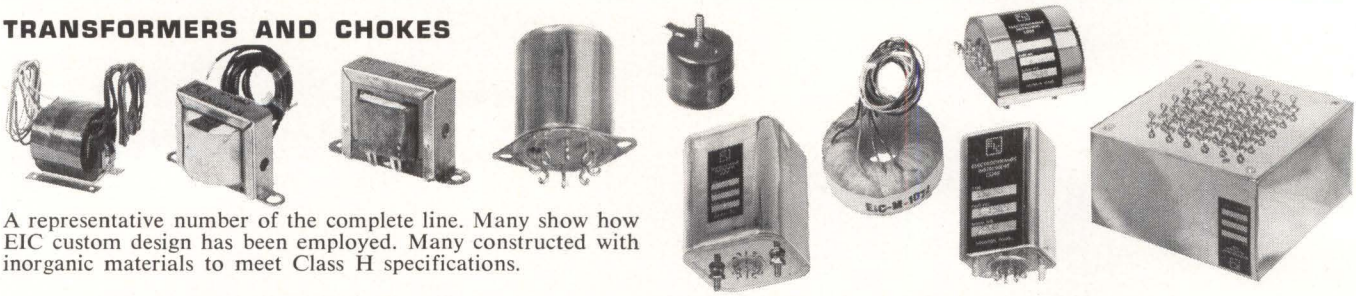

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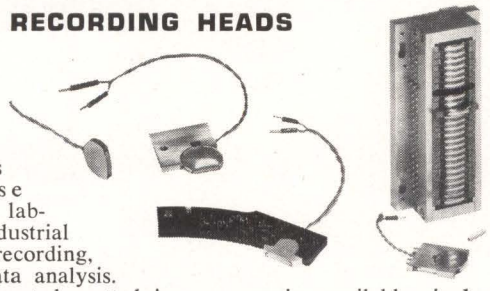

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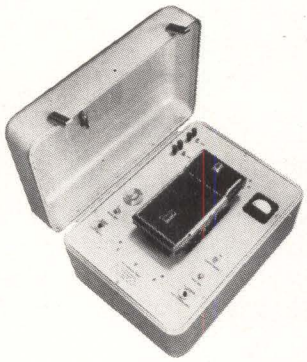

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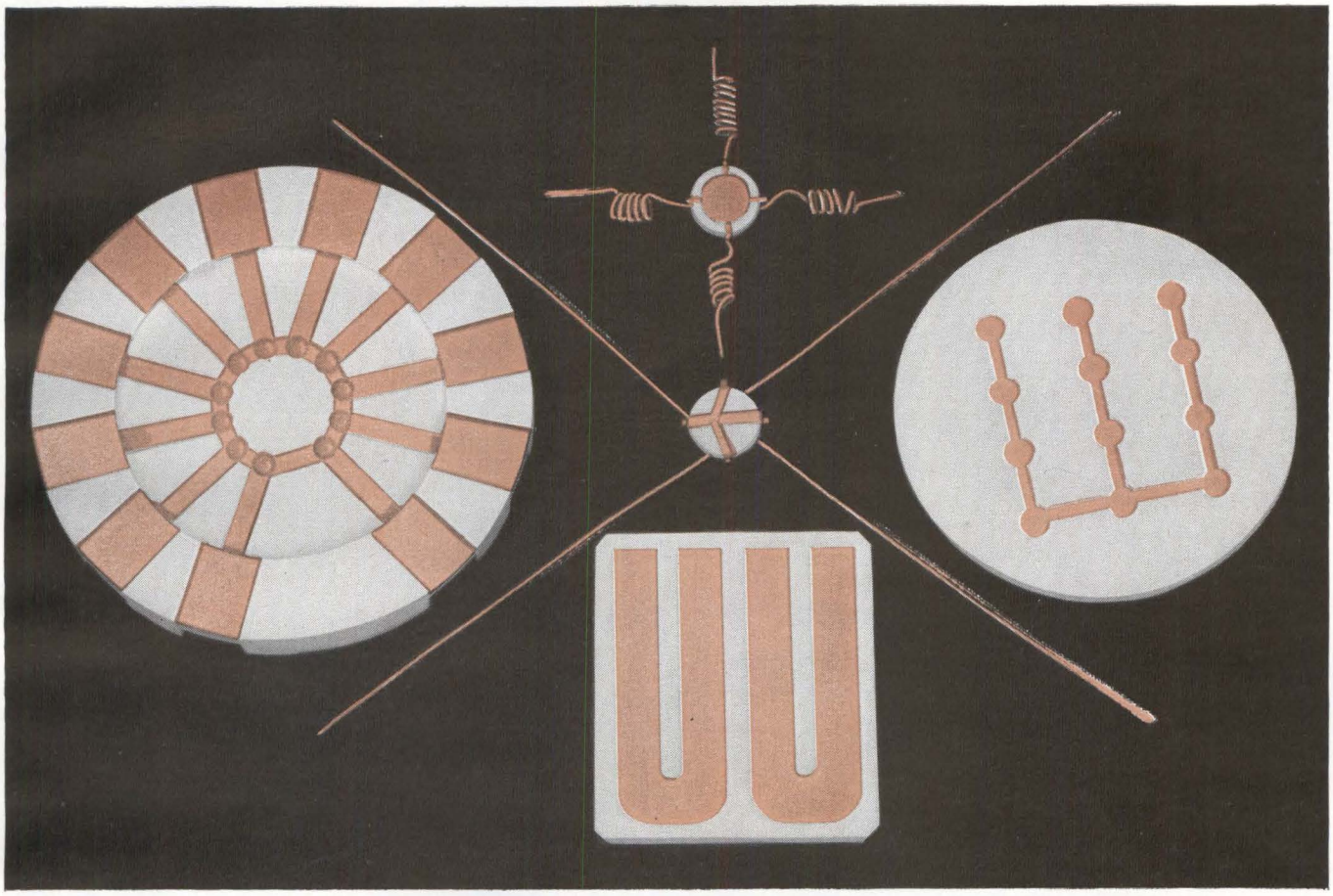

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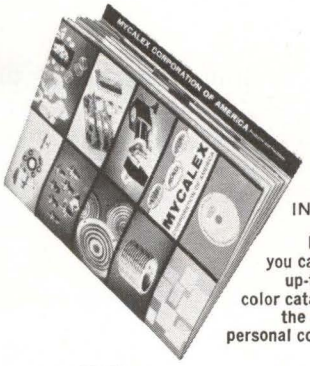

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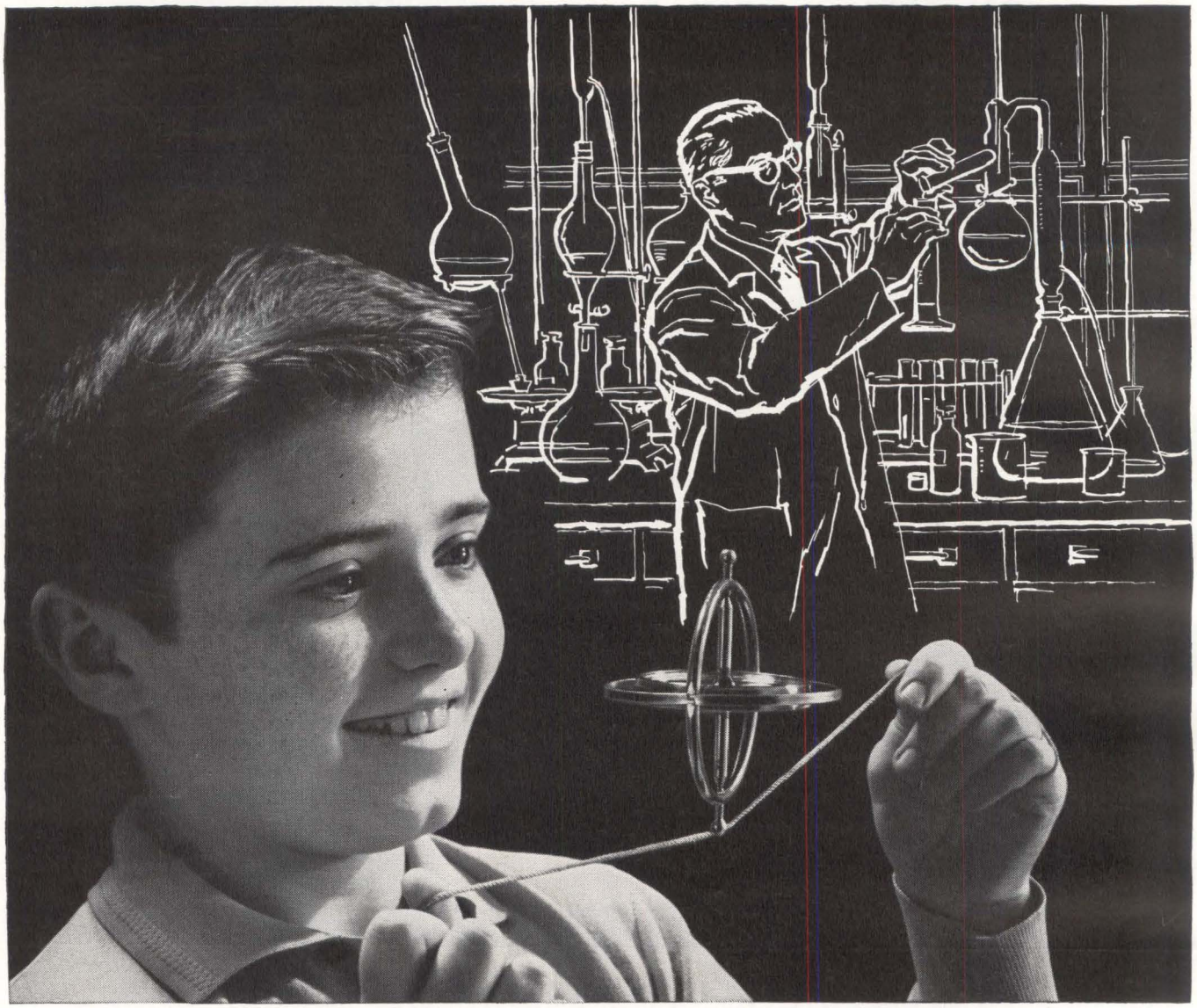

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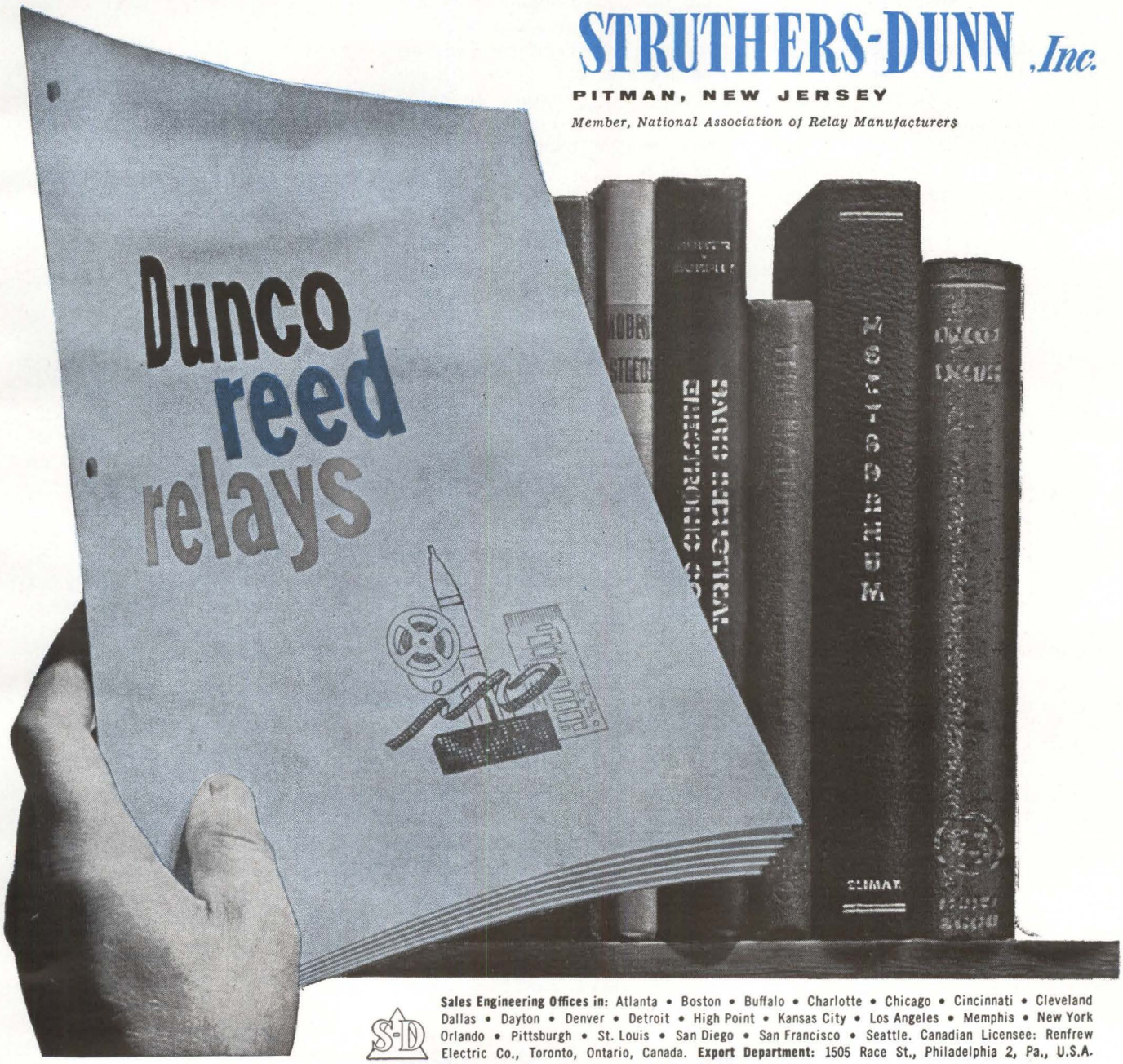

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Mercury and Cadmium Improve IR Detectors

Infrared detectors combine properties ideally suited to airborne reconnaissance

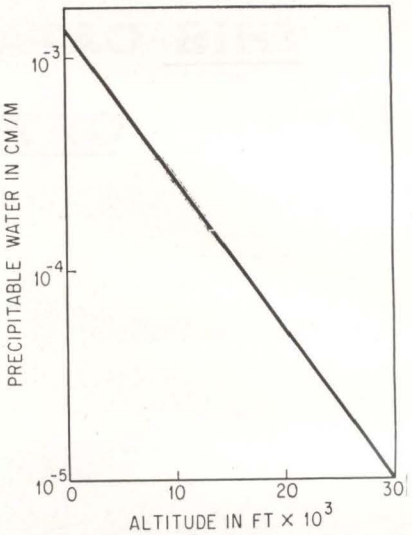
By F. G. WHELEN
I. E. DISTELHORST
Electronics Systems & Products Div.
Martin Company, Baltimore, Md.

AIRBORNE reconnaissance capabilities can be improved by newly developed infrared detectors, particularly where low noise equivalent temperature is required. Mercury-doped and cadmium-doped germanium detectors have been produced that provide an ideal combination of characteristics for these applications.

One objective of a development program underway for several years is improved detection in the middle and far infrared regions. For most airborne reconnaissance missions, peak detector sensitivity is required from 8 to 14 microns, corresponding to the atmospheric transmission window. In these applications, sensitivity beyond 14 microns contributes little but requires additional cooling and adds complexity to the system. Ideally, therefore, peak response should be in the region of 8 to 14 microns with sharp cutoff above 14 microns to reduce cooling requirements.

Gold-doped germanium detectors, which have been produced for some time, have found acceptance for ground mapping and color discrimination applications. They are sensitive over 2 to 9 microns and operate at 77 degrees K, unlike copper- and zinc-doped germanium which require temperatures of 4 degrees K.

More recently, cadmium- and mercury-doped germanium detectors have been produced, providing characteristics even more suitable for airborne reconnaissance. Their advantages are particularly evident where low noise equivalent temperature is required to discriminate the target of interest from background objects having nearly the same ambient temperature.



Precipitable water plotted on logarithmic scale and altitude on linear scale are linearly related—Fig. 1

Mercury-doped germanium detectors have been produced with measured peak detectivity D^* of 3×10^{10} cm/watt and 500-degree K blackbody D^* of 1.4×10^{10} for an aperture of 60 degrees and an operating temperature of 35 degrees K. The new detectors have nearly optimum response from 8 to 14 microns, corresponding to the atmospheric window. Peak sensitivity corresponds closely to the peak of ambient temperature objects. Also, mercury-doped germanium requires cooling only to 40 degrees K.

TEST RESULTS—The properties of mercury-doped germanium, particularly in relation to the low noise equivalent temperature (NET), are similar to cadmium-doped germanium, which has been tested extensively at Martin. Results of these tests were used to compare performance of cadmium- or mercury-doped germanium to gold-doped germanium for airborne reconnaissance.

Assumptions made in the calculations include mean ground temperature of 300 degrees K, minimum sensitive area of one detector

NR Diode Report Slated for WESCON

MAGNETIC properties of the bonded negative-resistance diode will be described at WESCON. Extensive studies of these devices were made at Raytheon Research Division. Results of these experiments will be reported in a paper by A. P. Schmid and W. Rindner, which also discusses a number of potential applications.

Sensitivity of the bonded negative-resistance diode, which considerably exceeds that of conventional magnetic transducers, was measured as a function of temperature, bias and frequency. Using the figure of merit usually applied to Hall-effect devices, sensitivities as high as 165 volts/amp kilogauss were obtained at room temperature. With proper biasing, output was also found to be independent of temperature over the temperature range of 0 to 70 degrees Centigrade.

Other characteristics of the bonded NR diode include low bias requirements and magnetic sensitivity that is a linear function of field up to 4 kilogauss. Small size of the devices is also a desirable feature and has resulted in fabrication of packaged units of less than 10^{-3} cubic inches.

Bonded NR diodes also have a current-controlled negative-resistance characteristic, which combined with the magnetic properties make possible a number of unusual circuit applications. The devices are most attractive as an element for sensing a-c rather than d-c fields. Potential applications of the bonded NR diode include use as modulators, choppers, multipliers and field probes, several of which are discussed in the conference paper.

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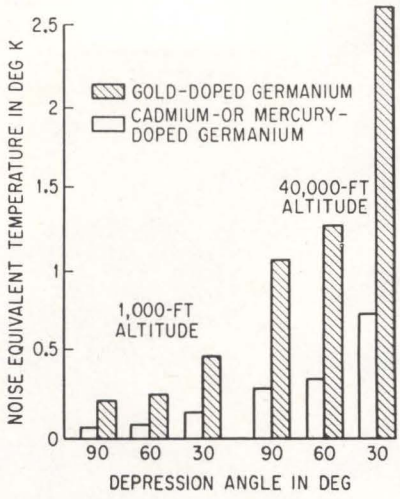


Noise equivalent temperature of cadmium- or mercury-doped germanium is several times that of gold-doped germanium—Fig. 2

COMPARATIVE DETECTOR PERFORMANCE

Detector	Altitude in feet	Depression angle in deg	E_o	T_a	NET in deg K
Cadmium-doped germanium (8–13 microns)	1,000	90	0.3	0.87	0.069
		60	0.26	0.85	0.082
		30	0.15	0.79	0.152
	40,000	90	0.3	0.65	0.247
		60	0.26	0.62	0.348
		30	0.15	0.52	0.718
Gold-doped germanium (3–8 microns)	1,000	90	0.3	0.383	0.213
		60	0.26	0.37	0.255
		30	0.15	0.338	0.483
	40,000	90	0.3	0.248	1.04
		60	0.26	0.24	1.24
		30	0.15	0.204	2.53

of 10^{-4} cm² and angular width of the strip mapped of 2.36 radians. System overall optical efficiency ranges from 0.3 to 0.15 as scanner depression angle makes less of the parabolic mirror effective, scan efficiency is 0.667 and 25 detectors are used in an array. Effective D^* for the 300-degree K field is 5×10^9 for both gold-doped germanium over the region of 3 to 8 microns and cadmium- or mercury-doped germanium over the region of 8 to 13 microns.

Flights at 1,000 and 40,000 feet are considered. For the low-altitude flight, the ratio of altitude to aircraft speed is 1.26 and system angular resolution is 10^{-3} radians. For the high-altitude flight, the altitude to speed ratio is 0.02 and resolution is 0.2×10^{-3} radians. Diameter of the primary parabolic mirror in the cases of both altitude levels is 15.25.

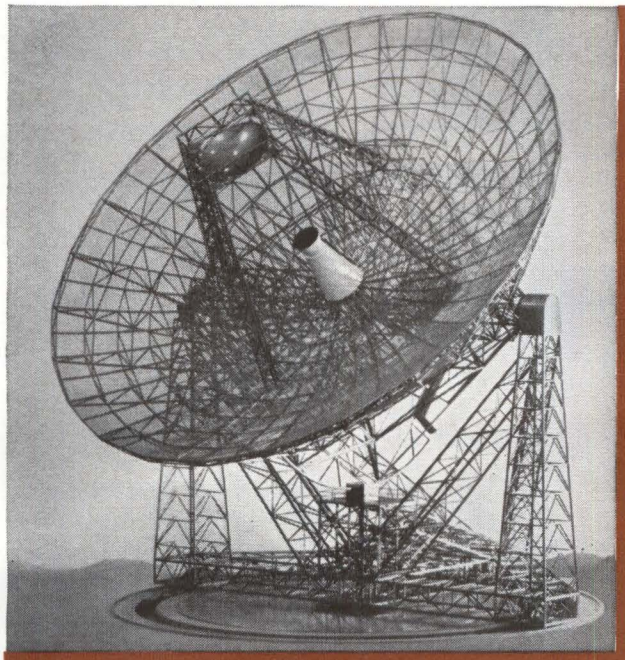
To determine spectral atmospheric transmission, an atmosphere is assumed in which sea-level temperature is 20 degrees C and relative humidity is 80 percent. Thus precipitable water per meter path length is 1.4×10^{-3} cm, and precipitable water at 30,000 feet altitude is 1×10^{-5} cm/meter. The straight-line relationship between precipitable water plotted on a logarithmic scale and altitude plotted on a linear scale is shown in Fig. 1.

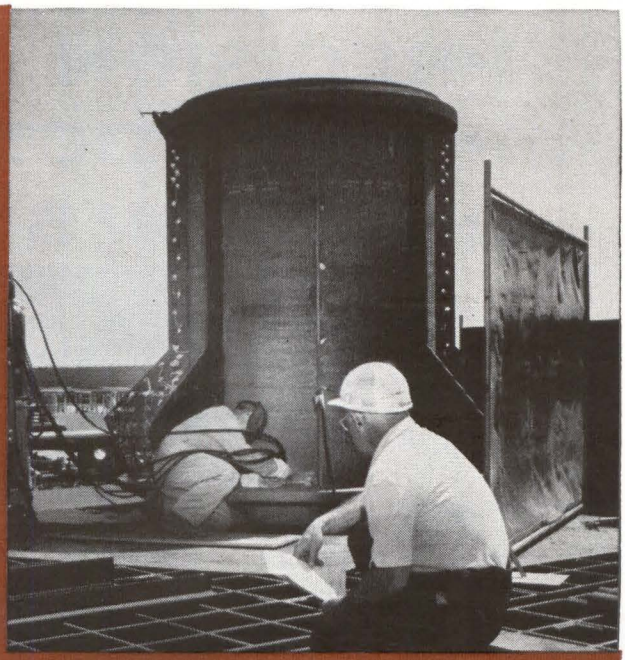
Correcting for pressure, precipitable water in a vertical column from sea level to 1,000 feet altitude is 0.381 equivalent sea-level cm and to 40,000 feet is 2.27 equivalent sea-level cm.

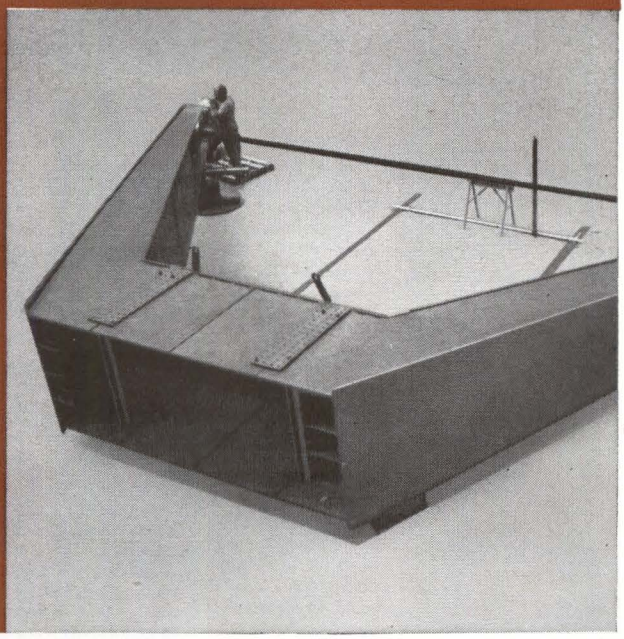
CALCULATING NET — These values were substituted into the equation for noise equivalent temperature. For cadmium- or mercury-doped germanium at 1,000 and 40,000 feet, NET was calculated to be $1.8 \times 10^{-2}/E_oT_a$ and $5.6 \times 10^{-2}/E_oT_a$, respectively, where E_o is system overall optical efficiency and T_a is atmospheric transmission. For gold-doped germanium at 1,000 and 40,000 feet, NET was calculated to be $2.46 \times 10^{-2}/E_oT_a$ and $7.64 \times 10^{-2}/E_oT_a$, respectively.

Using the Kellog and Greenfield curves[1] for transmissivity from 8 to 13 microns and the Larmore and Passman tables[2] for transmission from 3 to 7 microns, the results shown in the table were obtained. These results are also plotted in Fig. 2. Results with cadmium-doped and mercury-doped germanium are 3 or 4 times better than gold-doped germanium for the atmospheric conditions chosen and are less than the mean ground fluctuation of 1.5 degrees C by at least a factor of 2 in all cases.

It is noteworthy that under poorer atmospheric conditions, the comparative performance of cadmium- or mercury-doped germanium infrared detectors would pro-







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vide an even greater improvement in noise equivalent temperature.

REFERENCES

(1) Kellogg and Greenfield, Proc IRIS, 5, p 207.
(2) Larmore and Passman, Proc IRIS, 1.

Explanation Offered for Angels on Radar Displays

ANGELS or false targets on radar displays have lent credence to many flying saucer reports, as well as causing considerable confusion. The cause of angels has never been fully understood, although they are partly explained by sharp discontinuities of temperature and moisture in the atmosphere.

False targets are produced by backscattering from inhomogenities in the atmosphere only at short ranges, indicating the need for further explanation of angels. At Air Force Cambridge Research Laboratory, P. J. Harney analyzed results of many observations made at the laboratory and by the Weather Bureau and Wright Air Development Center. From this information, he suggests a model of the mechanism of false radar targets.

The conditions necessary for producing angels are found typically in the Kansas area. On hot summer days, radar displays may be cluttered with angels, although there is not a cloud in the sky. The pattern of the clutter is quite similar to that of certain types of cloud populations found in Florida. This pattern results from a condition called Benard cell circulation. Although no clouds were present, it is suggested that this type circulation was present in Kansas.

Benard cell circulations produce concave reflecting surfaces at altitudes up to about 6,000 feet. The radar beam reflected by these dish-like surfaces produces angels. A number of these reflecting surfaces in a huge undulating layer would present slowly changing aspects.

A low-angle radar beam under certain conditions could be reflected from one surface to another before returning to the radar. Because of the undulating nature of the reflecting surface, the target would appear to be moving rapidly. The model could also explain occasional transmissions of vhf and uhf signals over great distances.

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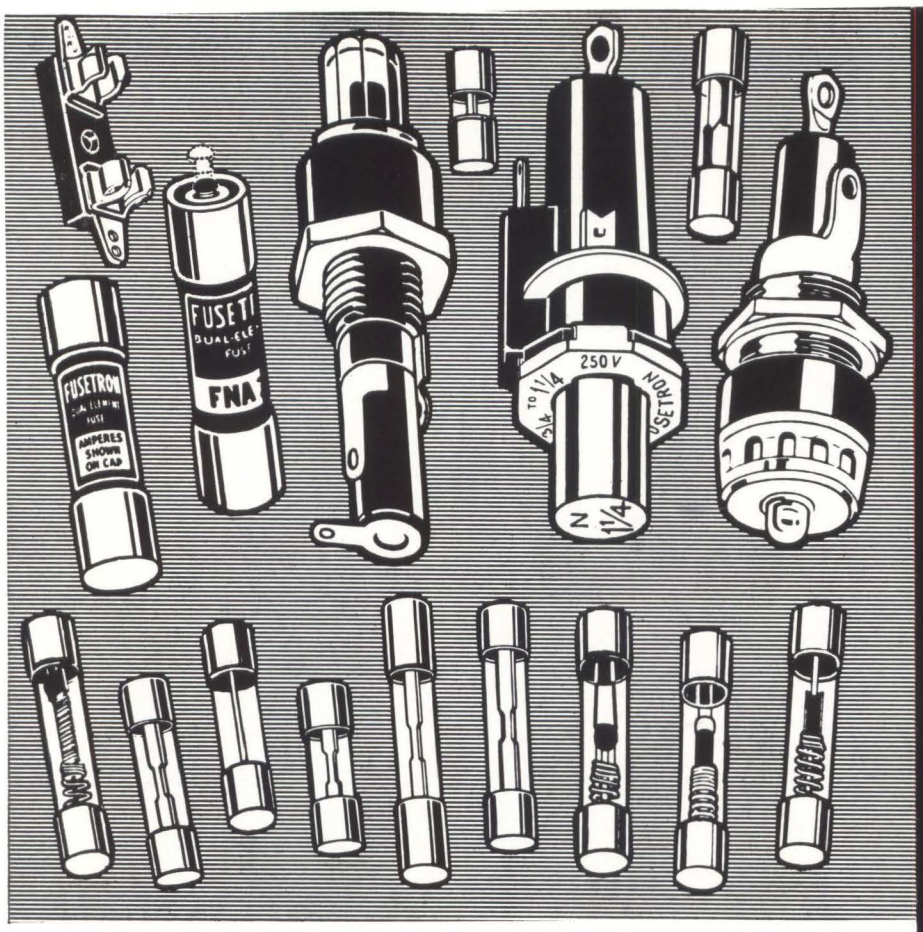

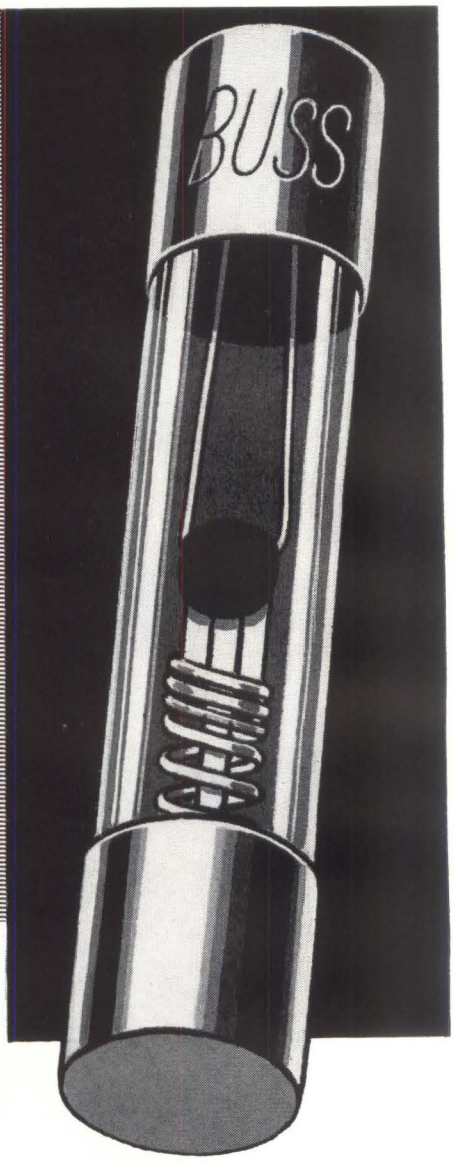

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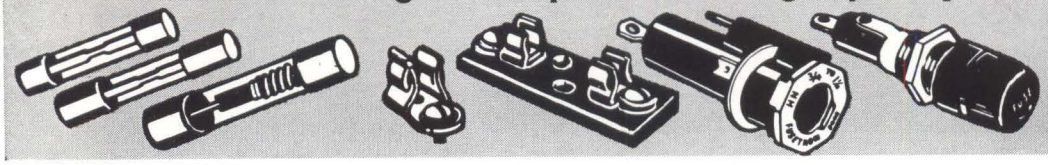

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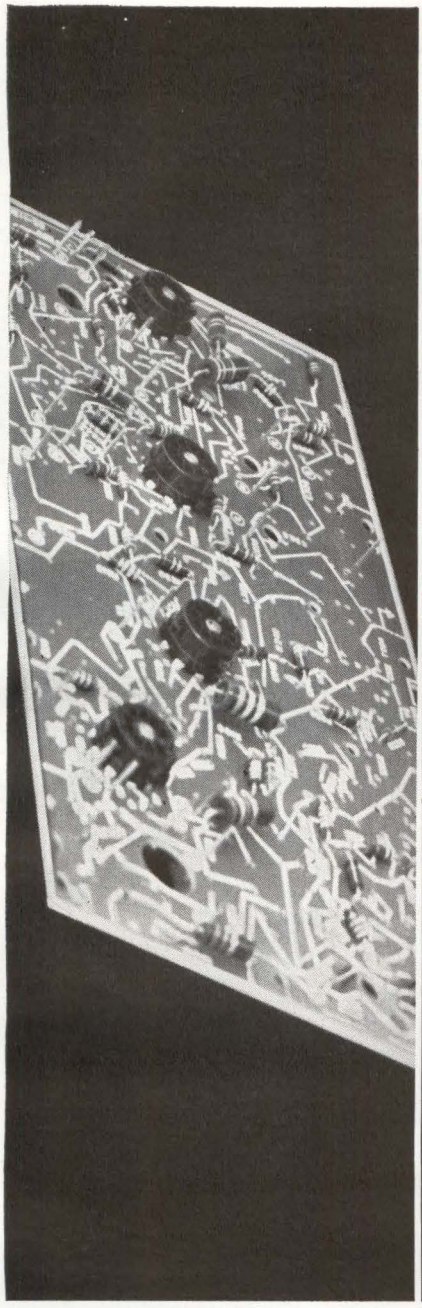

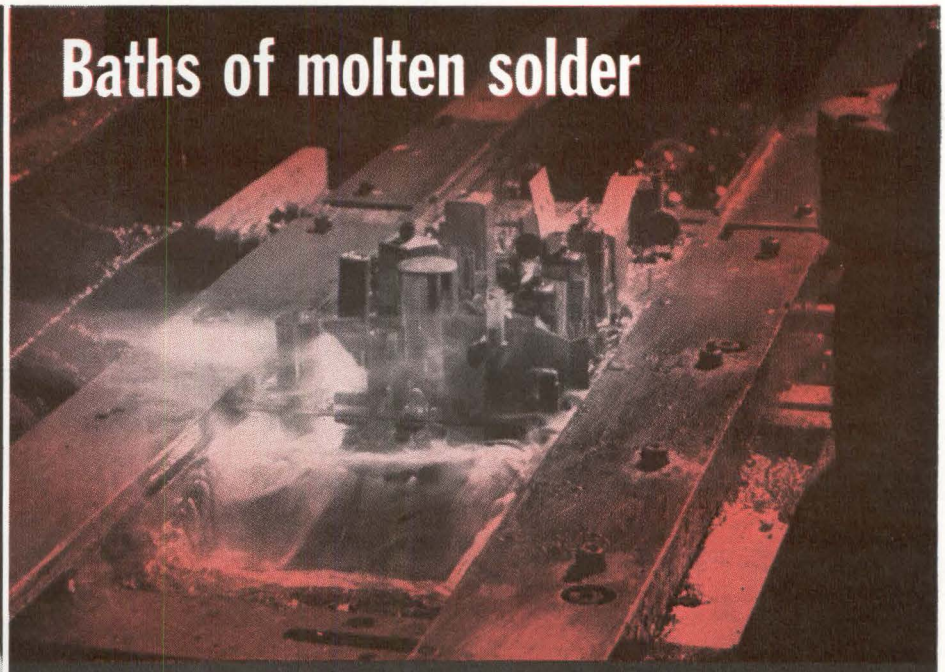

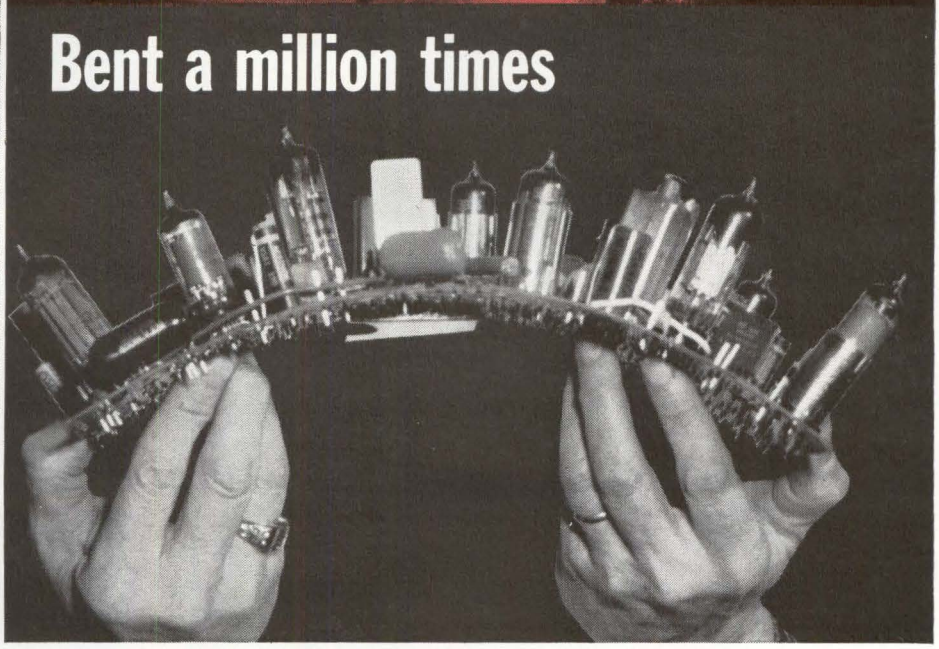

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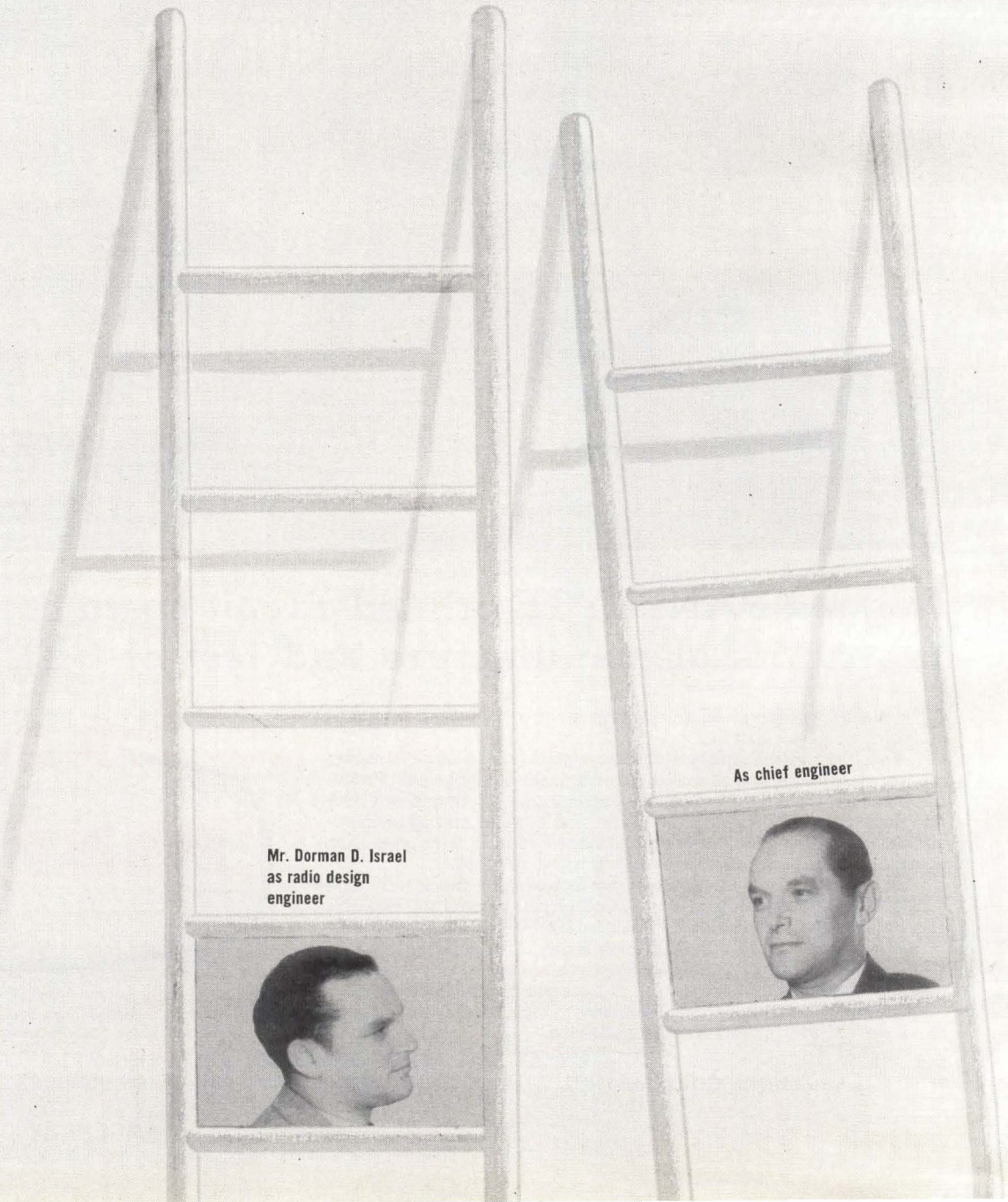

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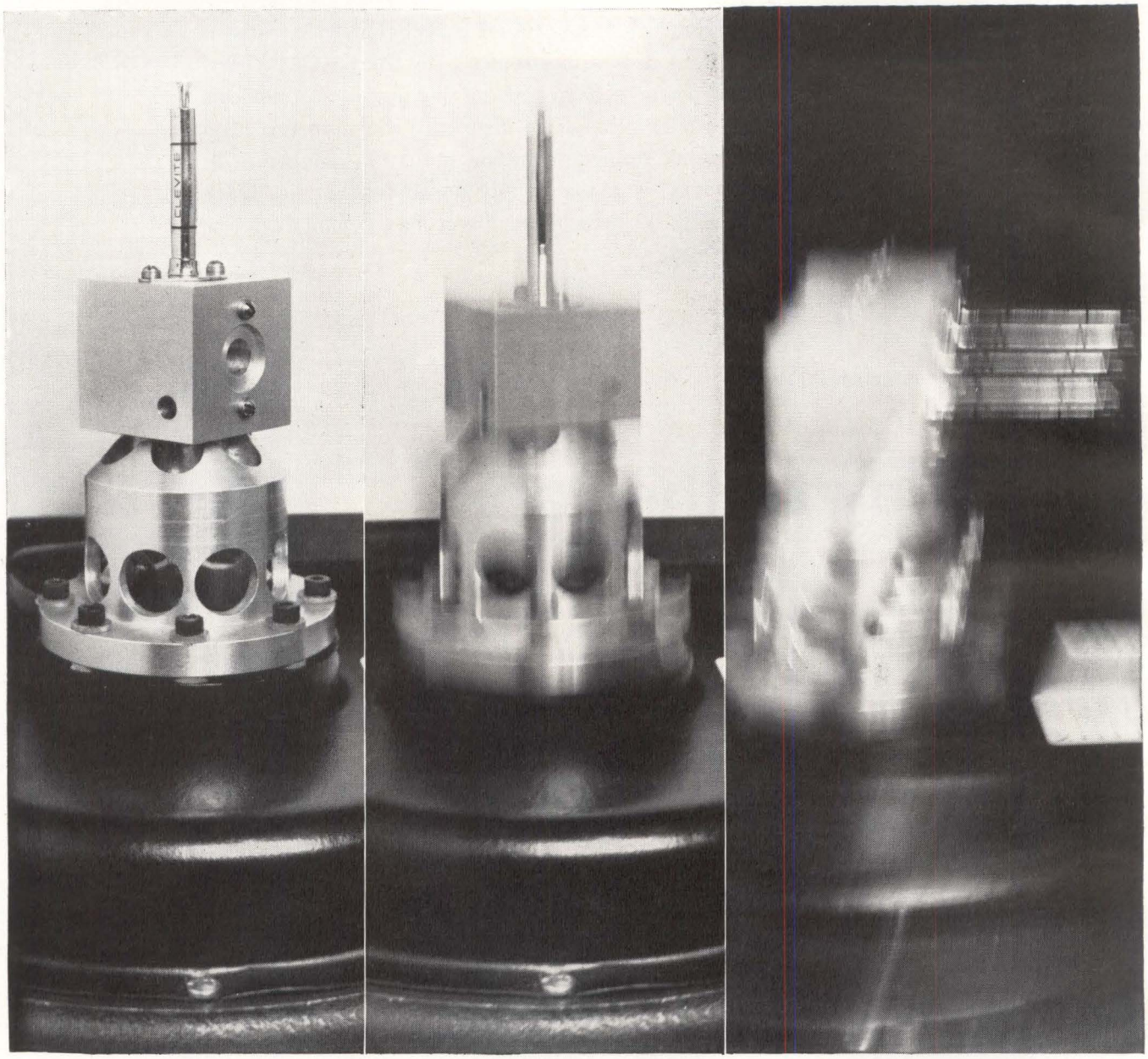

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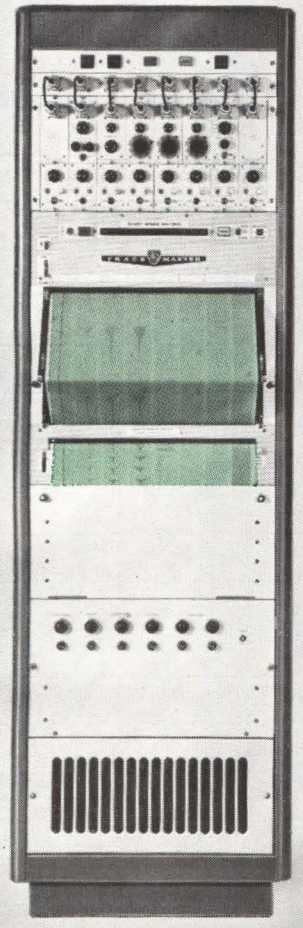

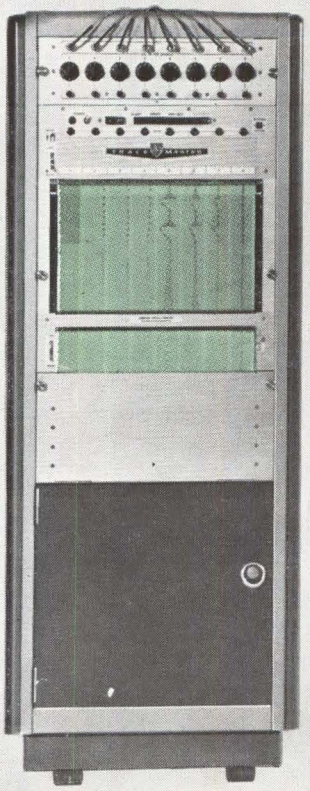

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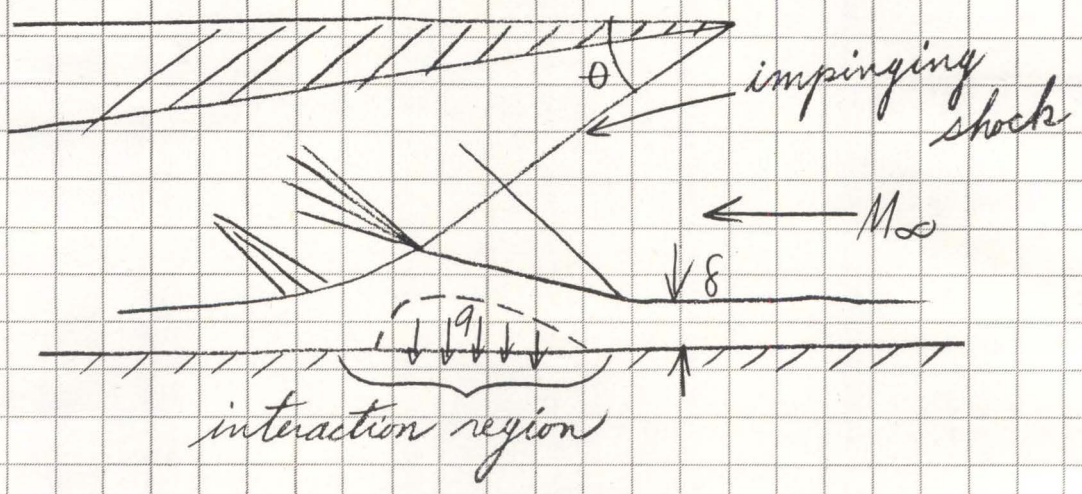

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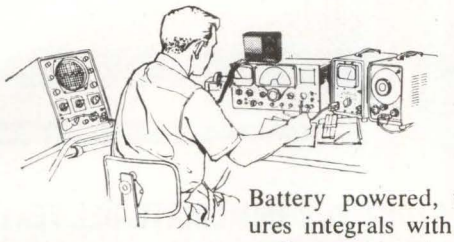

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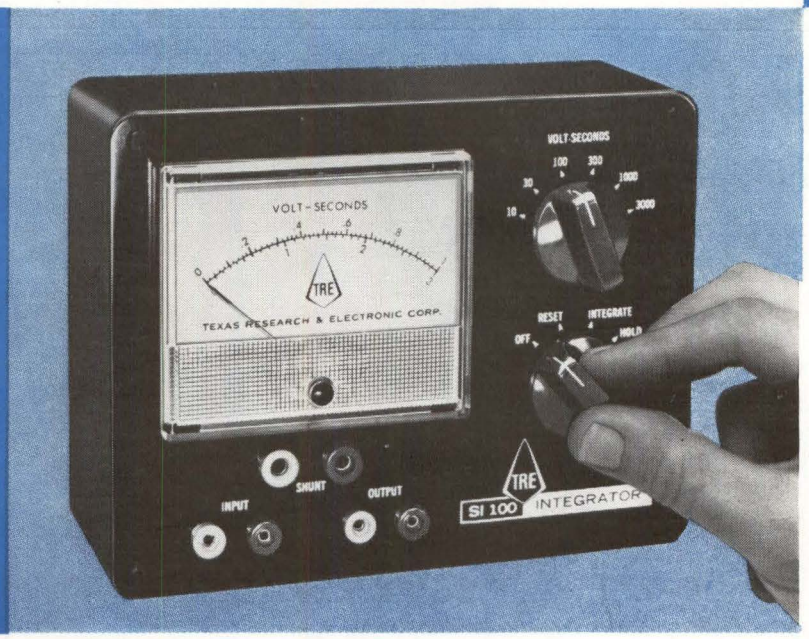

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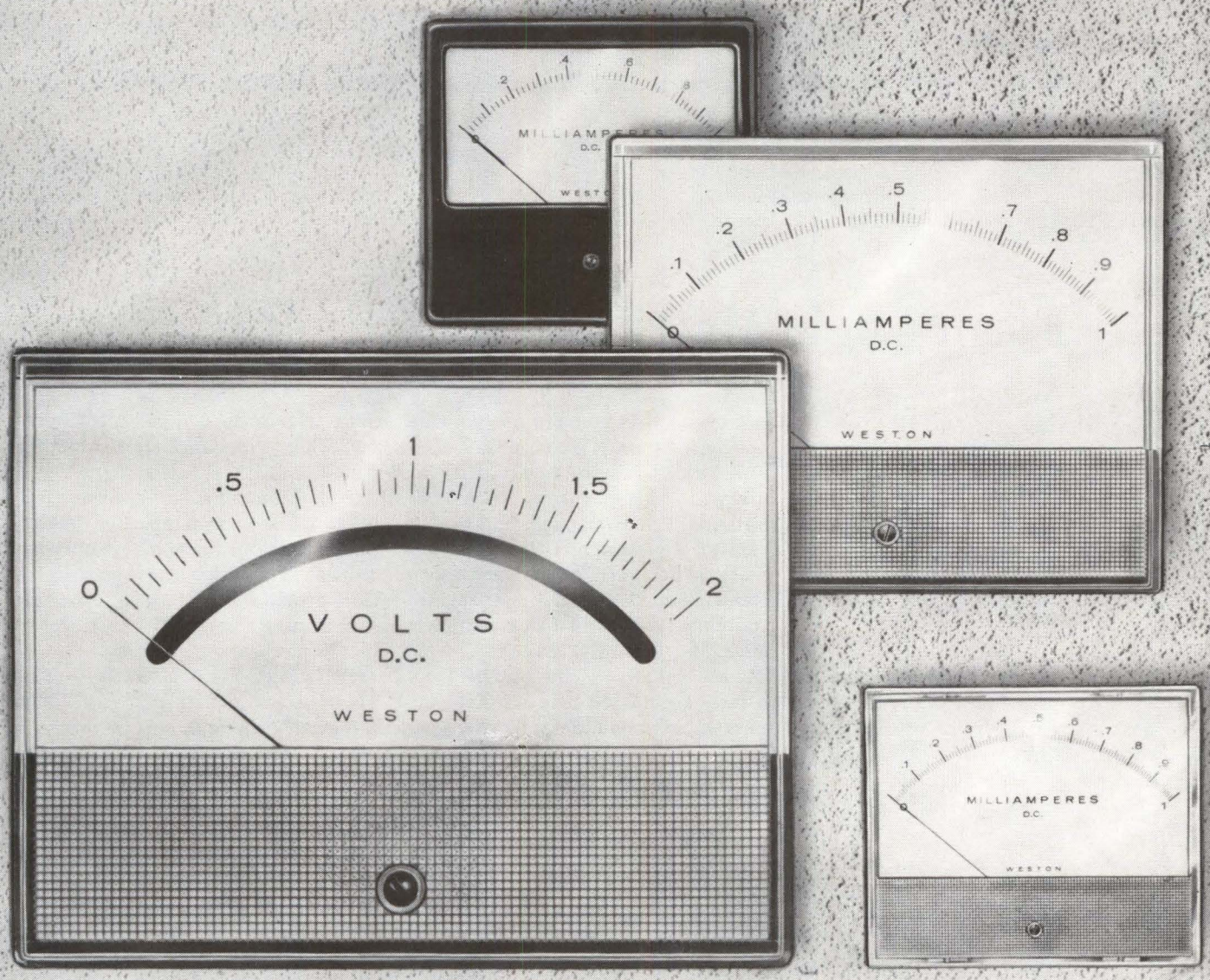

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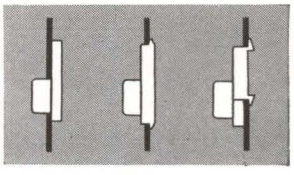

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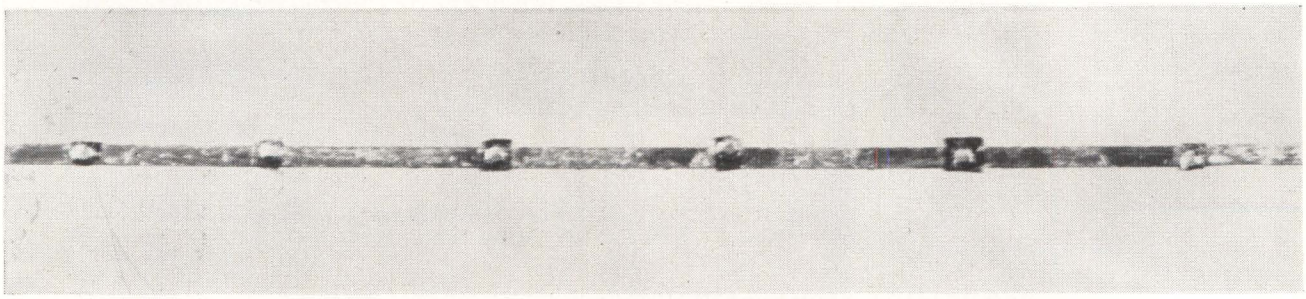


THIN GLASS *chain links many silicon diodes. Use for designing memory plane does not require redesign of circuits*

Form Logic Matrix with Diode Ribbons

Use diodes sealed in flexible strips, simplify gate hook up

By J. G. HAMMERSLAG
President,
Delta Semiconductors, Inc.,
Newport Beach, Calif.

DIODES BY the tens of thousands are used in modern electronic systems, particularly in digital computers. This great demand for diodes may result in diode-selection problems for some circuit designers concerned with computer logic. One approach is to arrive at circuit simplification without the necessity of discarding the entire integrated circuit if one component fails.

Over a year ago, Delta Semiconductors designed a compact diode component that combined several individual diodes in a compact glass envelope (see ELECTRONICS, Apr. 21, 1961, p 78). Delta now perfects a fully-automated process that permits rapid production of many low-cost, high-reliability silicon diode junctions fused to a continuous gold-plated ribbon. Diodes are available in ribbon strips, measuring 0.032 in. wide and approximately 0.008-in. thick. (See cover).

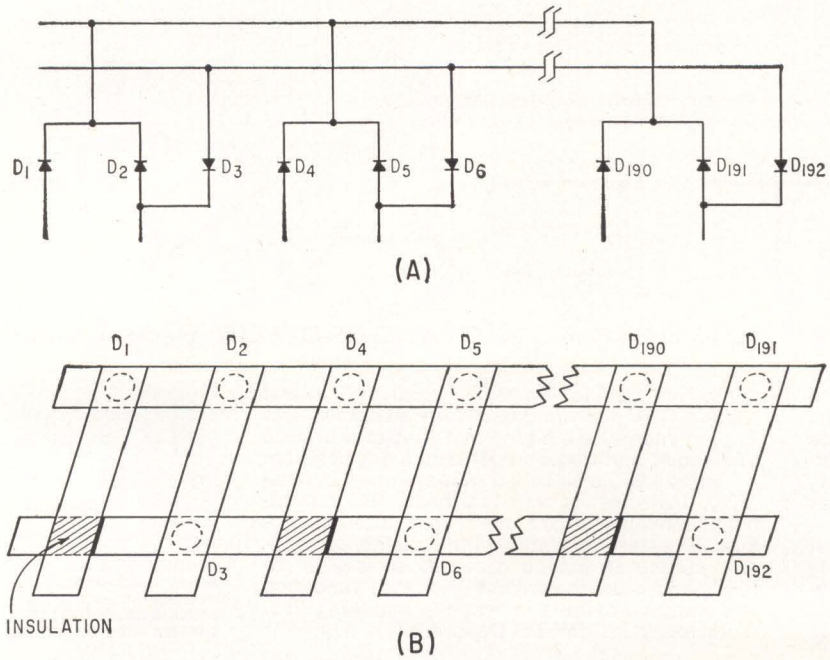
Diode junctions are formed individually, with a compatible hyperpure glass seal fused directly to the silicon. This thin glass encapsulation provides an integral hermetic seal around the entire junction.

IMPURITIES ISOLATED — The glass seal completely isolates any impurities that might be present during the manufacturing process and keeps them in the glass, preventing future migration of the impurities to the junction. Solid-glass seal also eliminates air space around the junction and greatly increases heat dissipation.

The diodes themselves are either diffused or alloyed types, made by manufacturing techniques similar to those used for making diode junctions for standard glass packages. High parameter combinations can be obtained, with switching speeds as high as two nanoseconds, conductance up to 500 milliamps at one volt.

Since the glass which is fused to the junctions has a relatively high melting point, the limiting factor for the temperature operating range of the diodes is the silicon itself, and diodes can be operated between −65 deg C. and +200 deg C. The size of the diode pellets themselves varies somewhat with the parameter requirements, but the diameter of the pellet can generally be kept below 0.020 inch.

Once sealed, the entire diode



MEMORY PLANE *schematic (A) of diode core. Construction (B) with diode ribbon strips shows how factory-welded matrix replaces 192 individual diodes*

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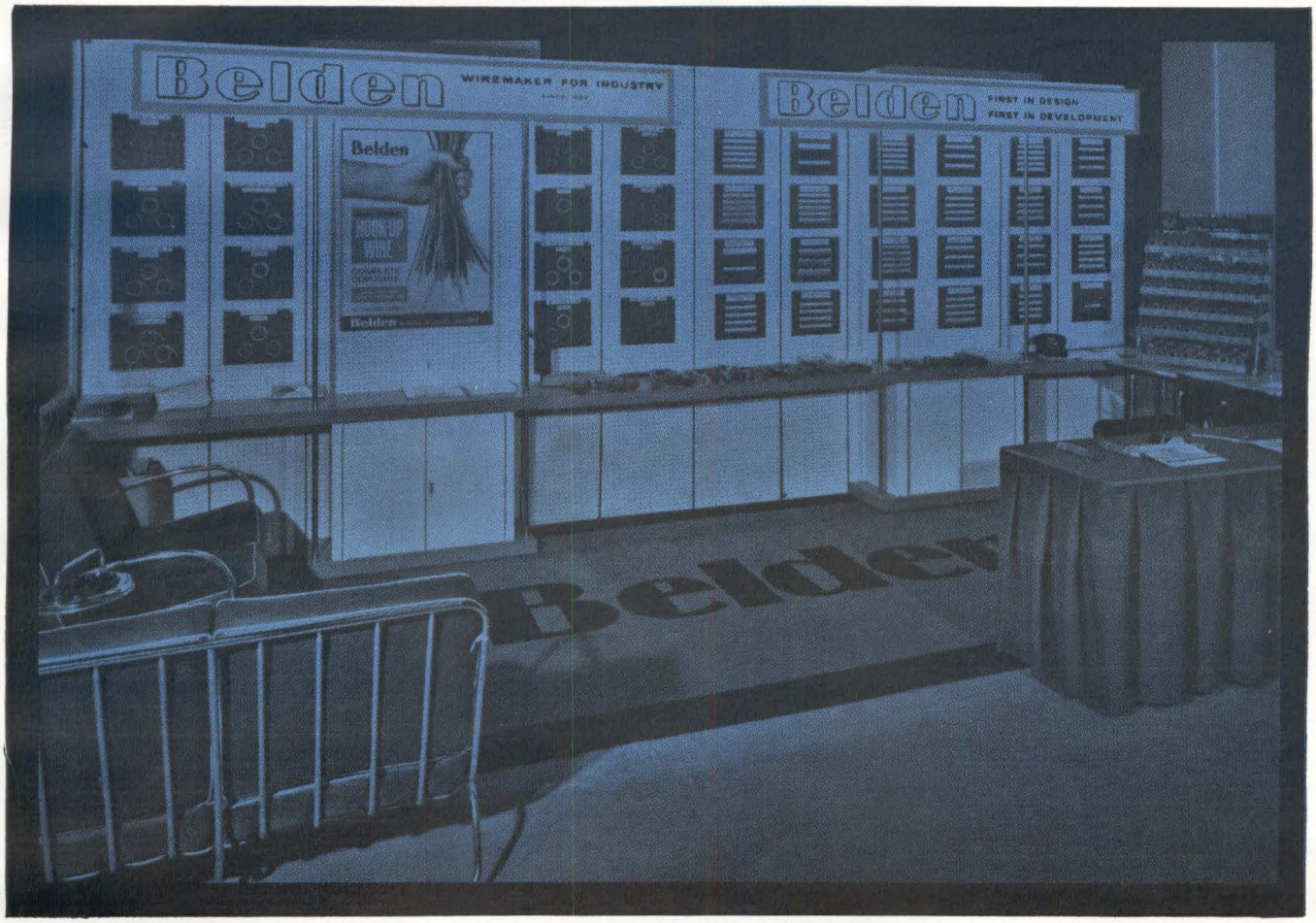

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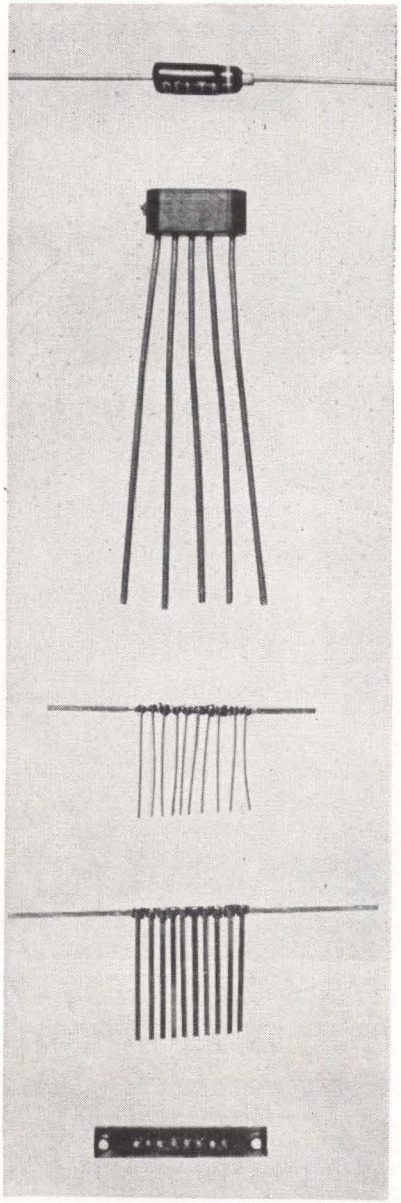
pellet is fused to the gold-plated ribbon, through a completely automated process, which allows for variable spacing of the diode junctions from 0.020 in. to 2.5 in. apart. The completed ribbon with diodes attached, is known by the trade name Deltastrip Diodes. Because of the simplified manufacturing process and the elimination of relatively costly glass package diodes, the cost of the assemblies can be maintained at a level somewhat less than comparable individual glass package diodes or integrated circuits.



DIODE UNITS *illustrate evolution from standard glass component, top, to direct-wired poly diode with four junctions plus common lead, next. Third unit from top is ribbon strip with leads welded, followed by ribbon strip with sweat-soldered connections. Bottom unit is ribbon strip in matrix for direct mounting on etched circuit board connectors.*

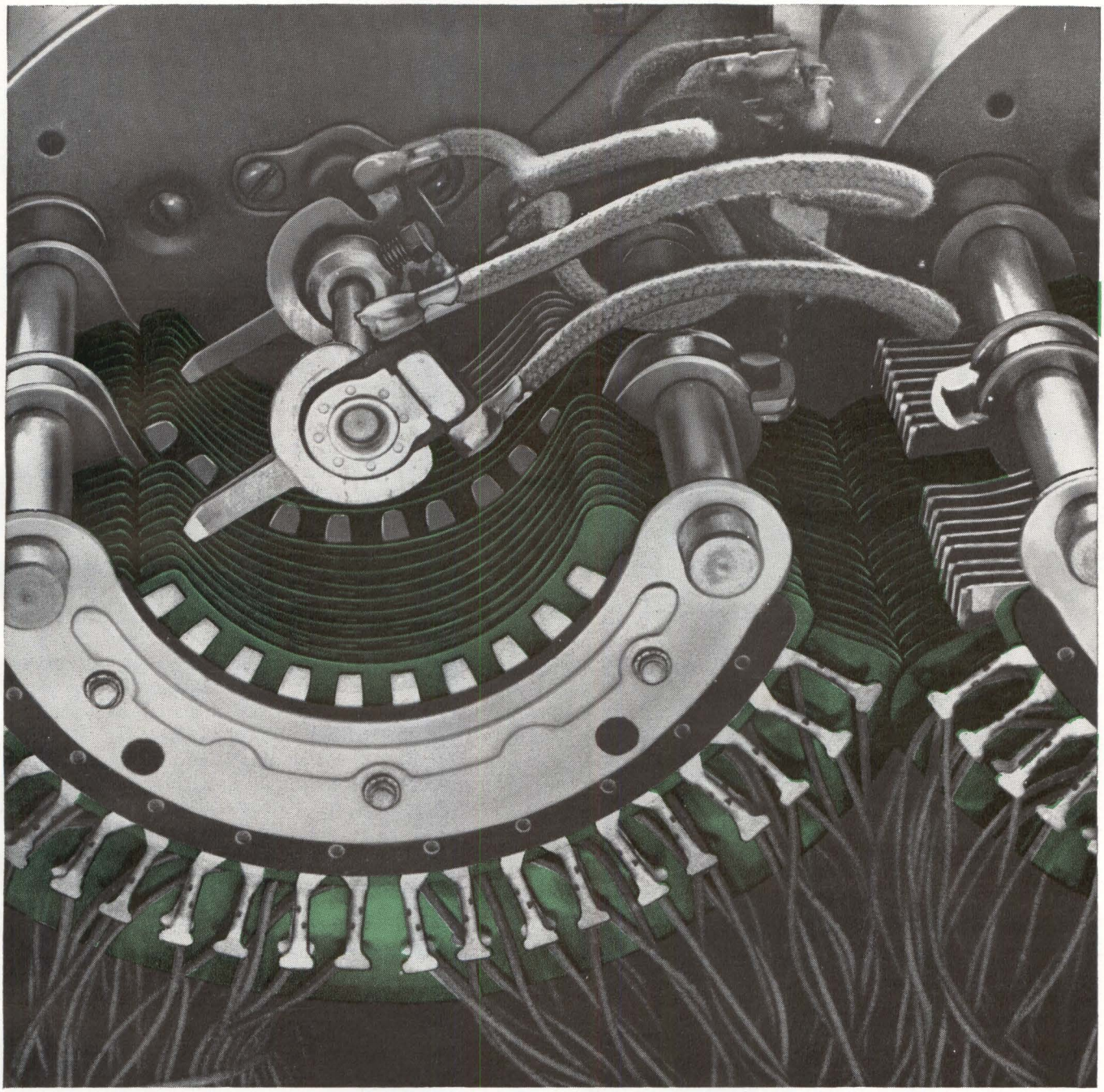
GATING STRIP—Since the gold-plated ribbon is a common connection to either the anode or cathode of each diode, the entire diode strip assembly can form part of a gate circuit or core driver circuit. The strip can be cut into various lengths to provide groups of three or more diodes, as required. The diode pellets are pretested before they are attached to the strip and parameters are carefully matched to provide compatible junctions, as well as similar polarity on the strips.

A typical application of diode strips is a core driver assembly on a computer memory plane matrix. Because of increased data handling speeds, it is desirable to have the core driver diodes located as close to the memory cores as possible. Other important factors are price, size, simple installation and high reliability, as well as the specific parameters of various diode types.

MEMORY APPLICATION—In a specific core memory plane designed by Ampex Computer Products, the diode strips are sweat-soldered directly onto pretinned etched connections on the inner edge of the matrix. In this particular application, high reliability is achieved through the reduction in the number of soldered or welded connections. A reduction in size by a factor of ten to one or more over the use of individual diodes has also been accomplished.

Sizeable cost reduction has been effected through the reduction of assembly time, elimination of individual diodes and their connections. Serviceability has also been greatly simplified and replacement, if necessary, can easily be made in the field which greatly reduces computer down time.

In another application the diode ribbons are cut into equal lengths up to a foot. Several strips are interconnected with transverse gold-plated ribbons welded to the semiconductor junctions, forming a matrix. Through the use of a steel rule die, these strips can be cut up into groups of three or more diodes. These units would become part of a gate circuit with individual strip leads preattached. The result is a very low cost and highly



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RAPID PRODUCTION *of silicon diode junctions lowers cost. Ribbon is shown as it comes off fully automated fabrication machine. Diodes can be spaced from 0.20 inch to two and one half inches along ribbon*

reliable gate circuit, requiring diodes with common anode or cathode interwired.

FLEXIBLE CIRCUITS — The structure of the ribbon allows use in flexible substrates, on curved surfaces or other difficult applications.

In still another application, a memory plane required 192 conventional glass package diodes which had to be mounted and soldered individually to the frame, see Fig. A. In this case, an especially high saving in assembly time and cost, as well as an increase in inherent reliability was achieved simply by replacing the 192 diodes with two strips superimposed upon each other, see Fig. B. One strip consisted of 128 diodes spaced 0.037 inches apart (common cathodes) and the other superimposed strip consisted of 64 diodes spaced 0.074 inches apart (common anodes). The entire 192 diode assembly was potted in epoxy and soldered in one operation to the memory plane, eliminating literally hundreds of individual soldering operations.

Diodes by the foot prove successful in a wide range of applications. Greater reliability, improved heat dissipation, simplified installation, easier serviceability, reduction of production time and reduced cost, and a large degree of miniaturization result from their use.

Since the processes involved in the manufacture and installation of the diode ribbons are in common use, little or no redesign of existing circuits or assembly techniques is required. The concept proves to be a practical step forward in the advance of miniaturization, added reliability and cost reduction of space-age electronics equipment.

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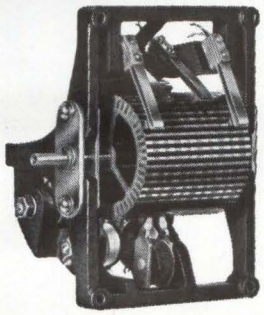

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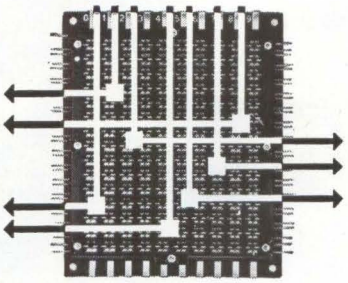

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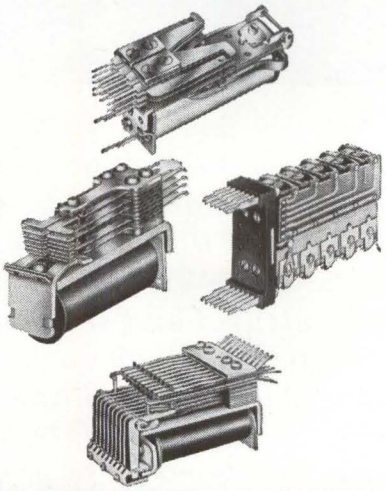

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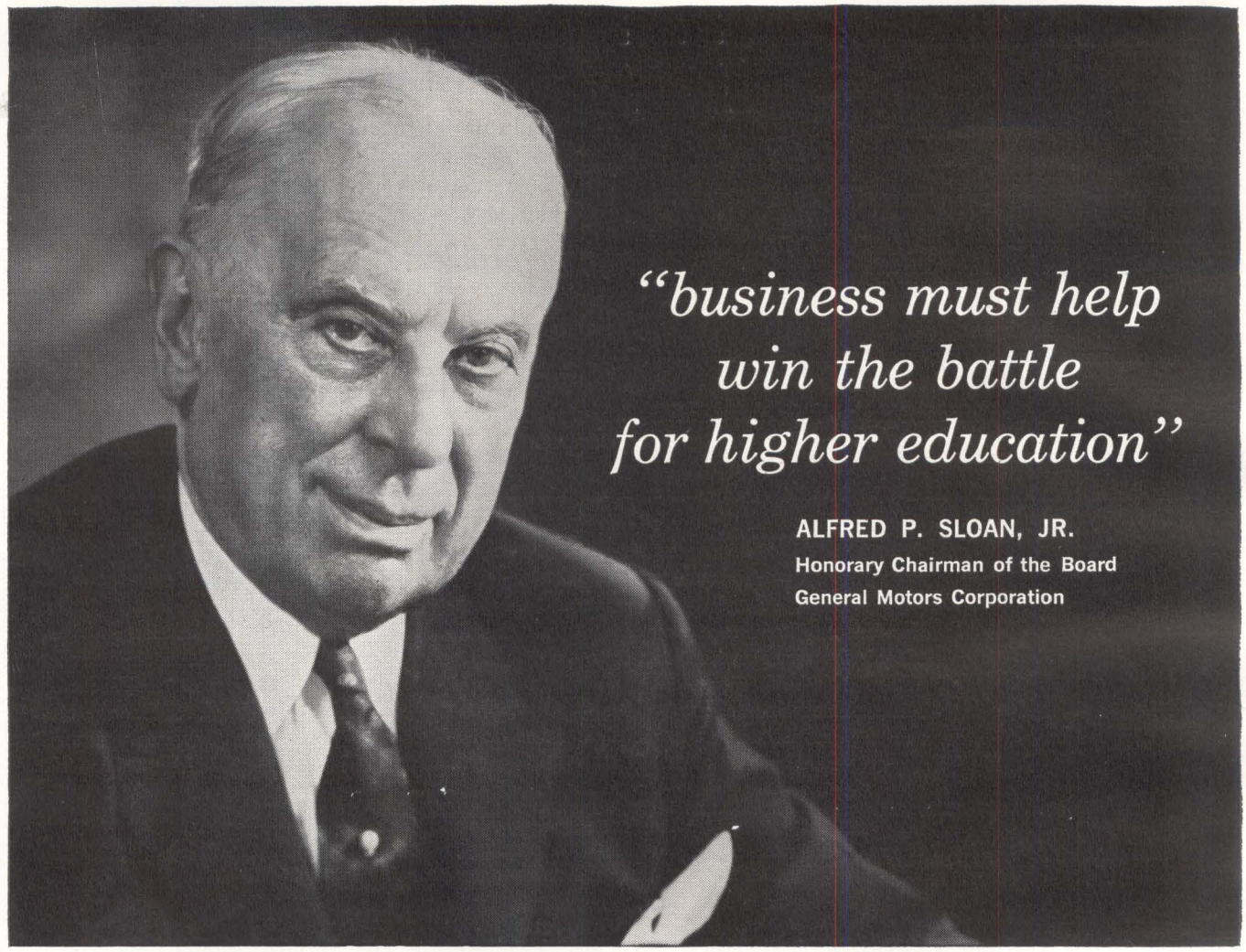

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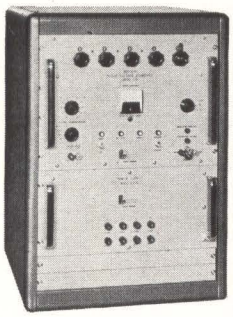

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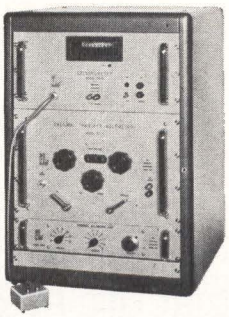

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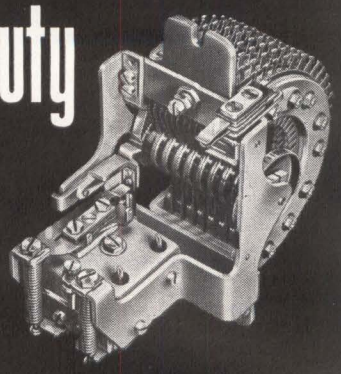

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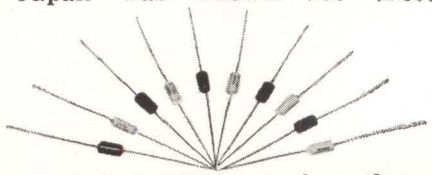

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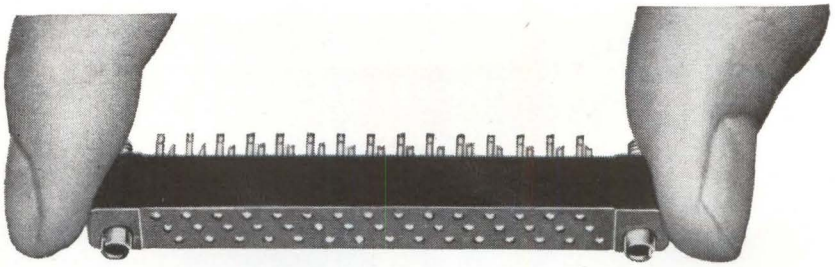

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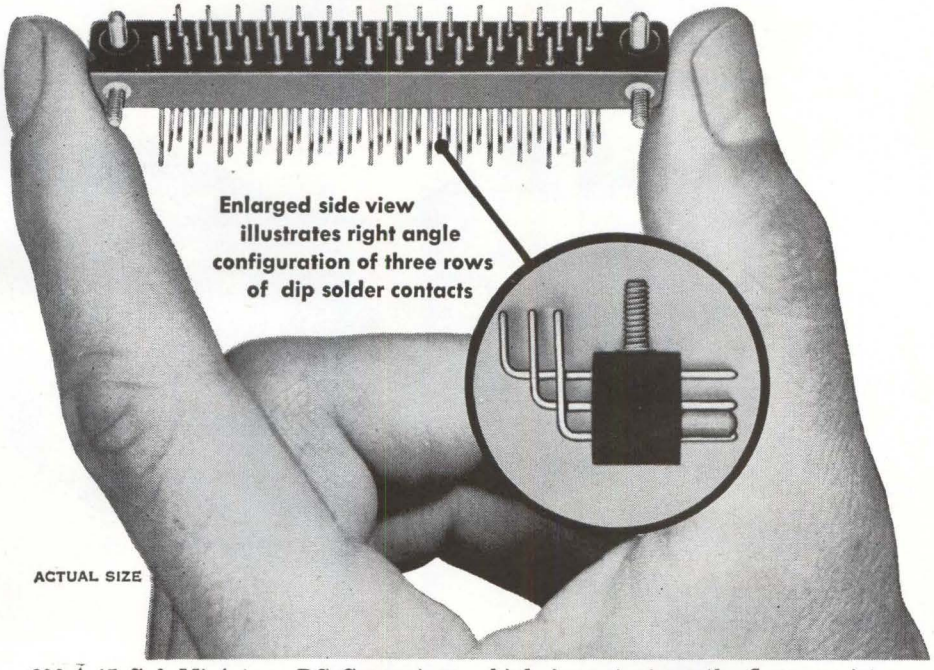

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Said Max Planck:

"The energy of a quantum is directly proportional to the frequency of vibration of its electromagnetic wave."

A new window in space is being opened by scientists at Lockheed Missiles & Space Company. While the visible spectrum of stars is observable from the earth, photons of several hundred to several thousand electron volts are filtered out by the atmosphere: Hence undetectible on the earth's surface.

Very hot stars may have coronas—as does our sun. Scientists speculate that, if it were possible to study that portion of the frequency range known as "soft" X-rays (which may emanate from the coronas of very hot stars), we might gain new insights into the evolution and constitution of the universe.

To initiate a search for celestial sources of "soft" X-rays, Lockheed (under NASA sponsorship) has developed and built photon counters to be carried aboard sounding rockets. Thus a survey of the night sky will be made for sources which emit photons in the 100-to-10,000 electron volt energy range.

Of interest to most engineers and scientists is the fact that this investigation was originated by a young Lockheed physicist. He realized that no serious attempt was being made to investigate those wave lengths just below the ultraviolet. Many similar developments have been evolved by Lockheed people who find here the creative freedom they need to pursue their own original ideas.

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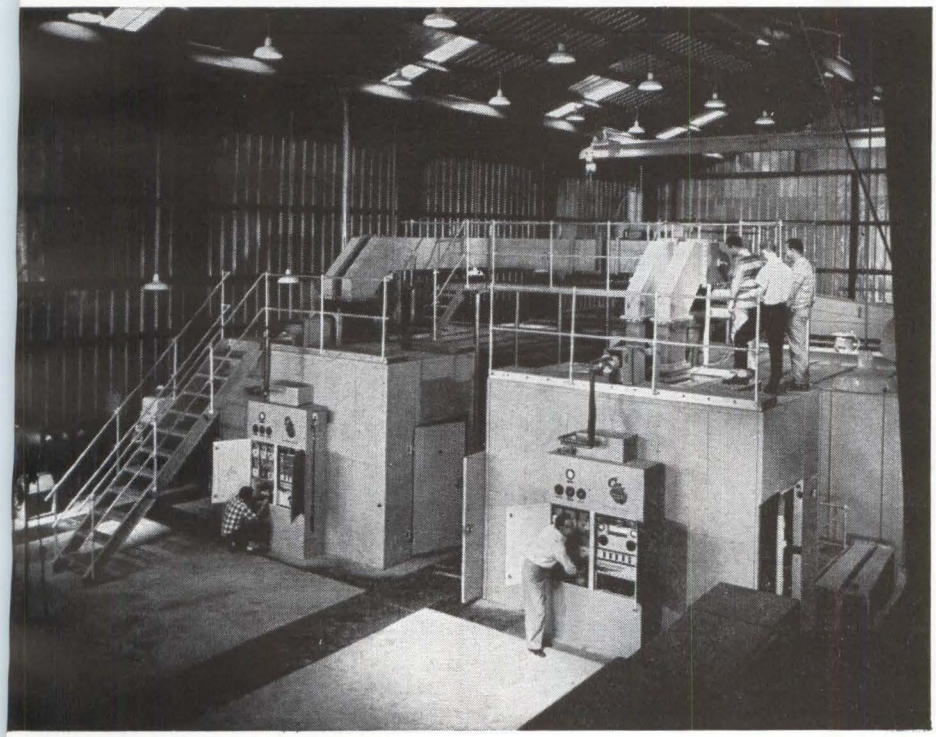

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Provided under sub-contract to General Electric and R.C.A., these transmitters from Continental Electronics are another contribution to our country's defense.

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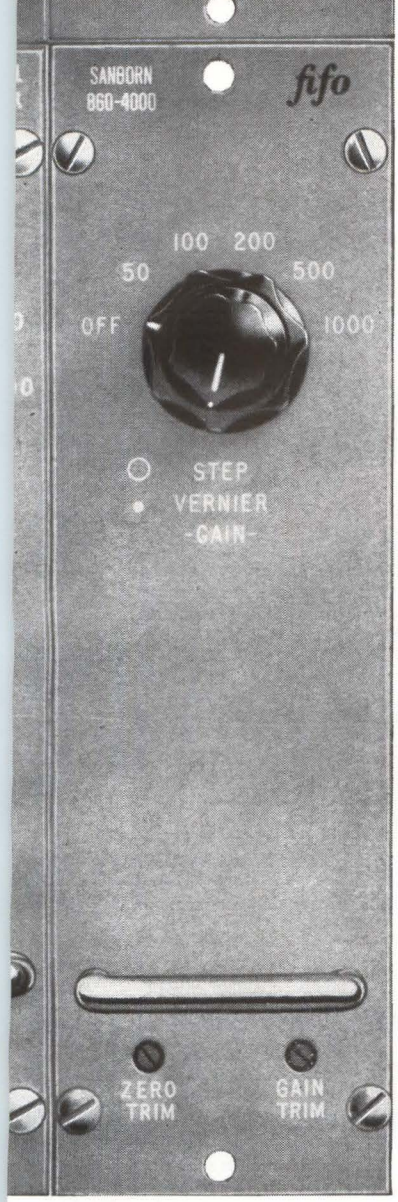
MANUFACTURING COMPANY • MAILING ADDRESS: BOX 17040 • DALLAS 17, TEXAS
4212 S. BUCKNER BLVD. • EV 1-7161 • LTV SUBSIDIARY OF LING-TEMCO-VOUGHT, INC.
Designers and Builders of the World's Most Powerful Radio Transmitters

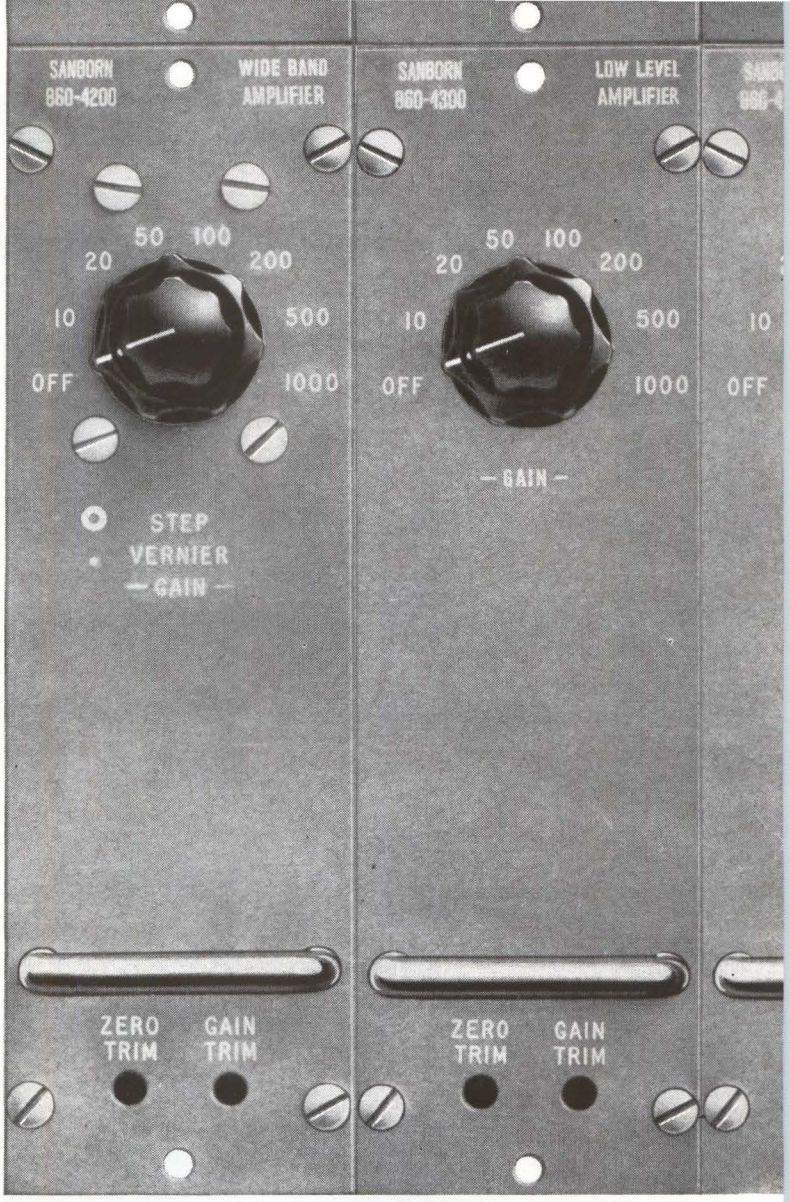
ENGINEERS... FOR STIMULATING WORK ON THE ELECTRONICS FRONTIERS OF TOMORROW WITH A DYNAMIC, CREATIVE ORGANIZATION, SEND RESUME TO DIR. OF PERSONNEL

CIRCLE 111 ON READER SERVICE CARD



Sanborn data amplifiers

(Three types available now — more on the way)



(Specifications and prices subject to change without notice; prices are FOB Waltham, Mass.)

Match amplifier characteristics much more closely to your over-all *system* requirements — and pay for only the performance you need — by choosing from these newly-developed, all solid-state DC data amplifiers now available from Sanborn. Ask your local Sanborn Sales-Engineering Representative for complete specifications, application help and a copy of the Industrial Division Catalog — or write the Main Office in Waltham.

• • • • •

Wide Band, Floating Input—Floating Output "FIFO"

Bandwidth DC to 3 db down at 10 KC • Input isolated from output • Max. gain 1000, smooth gain covers intermediate ranges or switch out for calibrated gains of 1000 to 50 • Input impedance 100 meg. min. at DC, output impedance 60 ohms • Output capability ±10 V at 10 ma • Common mode rejection (1000 ohms in either input lead) 160 db at DC, 120 db at 60 cps • Linearity ±0.1% of 10 V full-scale at DC • Recovery from 500% overload is 300μsec to 1% of f.s. output • Recovery from 20 V overload is 1 millisecond to 1% of f.s. output • Model 860-4000 "FIFO", $825. Model 860-4000P (grounded output ±5 V at ±100 ma, impedance less than 1 ohm), $900.

DC—50 KC, 3-Terminal Floating Amplifier

Gain 1000 to 10 in 1, 2, 5 ratios; does not phase invert • Input impedance 100 meg. at DC • Output ±10 V ±100 ma, impedance less than 0.2 ohm • Linearity ±0.01% of 10 V output • Gain stability ±0.01% at DC at constant ambient for 40 hours • Model 860-4200, including internal power supply, $650.

Narrow Band, Floating Input — Floating Output

Bandwidth DC to 3 db down at 100 cps • Optional plug-in output filters to limit bandwidth • Floating input isolated from floating output • Gain 1000 to 10; fixed step attenuator, gain trim and zero trim controls • Input impedance 300,000 ohms min., output impedance 75 ohms • Output ±5 V, ±2.5 ma • Linearity ±0.05% of 5 V output • Recovers from ±10 V overload in 200 ms • Common mode rejection (1000 ohms in either input lead) 130 db at 60 cps • Model 860-4300, $425.

INDUSTRIAL DIVISION
SANBORN COMPANY
175 Wyman Street, Waltham 54, Massachusetts
A SUBSIDIARY OF HEWLETT-PACKARD COMPANY

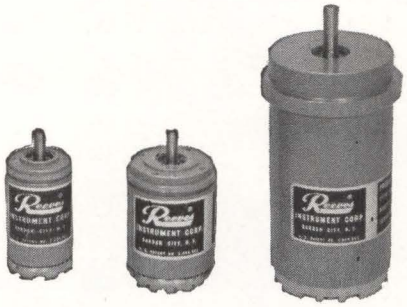
CIRCLE 113 ON READER SERVICE CARD

AT WESCON — SEE THESE NEW DC DATA AMPLIFIERS AT BOOTHS 558-560.

Reeves

HIGH *Precision*

RESOLVERS, SYNCHROS and PHASE SHIFTERS



For data transmission; coordinate transformation and conversion; computer chain; and sweep applications. Write for data file 108.

STANDARD RESOLVERS

Reeves produces a full line of both compensated and uncompensated resolvers in standard BuOrd size 23, 15 and 11 cases. The size 23 series has a functional accuracy of 0.05%; resolvers in the other two series have an accuracy of 0.1%.

HIGH PRECISION SIZE 23 RESOLVERS

A new series of extremely accurate resolvers, which include a 0.01% functional accuracy computing resolver with 100% compensation; and a data transmission resolver with 20 second accuracy. They represent the ultimate in precision for resolvers of this case size.

30-SECOND SIZE 23 SYNCHROS

These three wire synchros are the most accurate units available in a standard BuOrd size 23 case. Both transmitters and control transformers can be supplied, designed for either 400-cycle or 60-cycle input.

PRECISION PANCAKE RESOLVERS

0.005% functional accuracy computer resolvers with 100% compensation; and 10-second accuracy data transmission resolvers. Integral bearing design permits direct mounting to gimbal structure. Beryllium housings provide highly stable operation under conditions of extreme temperature variation.

BOOSTER AMPLIFIERS

A complete line of vacuum tube and transistorized booster amplifiers, for use in conjunction with compensated resolvers. Transistorized units contain two fully encapsulated amplifiers in a single case.

SEE OUR DISPLAY AT WESCON—BOOTHS 907 AND 908

REEVES INSTRUMENT CORPORATION

A Subsidiary of Dynamics Corporation of America
Roosevelt Field, Garden City, New York

3RV62

ALL NEW from Ingersoll Products

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EMCOR II Modular Enclosure System provides an exclusive combination of appearance and structural features for distinct, individualized customer identity. Recessed, flush or extended panel mountings; choice of aluminum trim or grillwork extrusions, an assortment of customer nameplate styles, double width frames, pontoon bases and side panels, multi-function enclosures; superior structural strength second to none; externally removable side panels; 1¾" pull-out Work Writing Surfaces plus many more features designed to stimulate your imagineering. Your investigation of the EMCOR II Line will be rewarded by virtually unlimited application possibilities.

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INGERSOLL PRODUCTS

Division of Borg-Warner Corporation

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MODULAR ENCLOSURE SYSTEM

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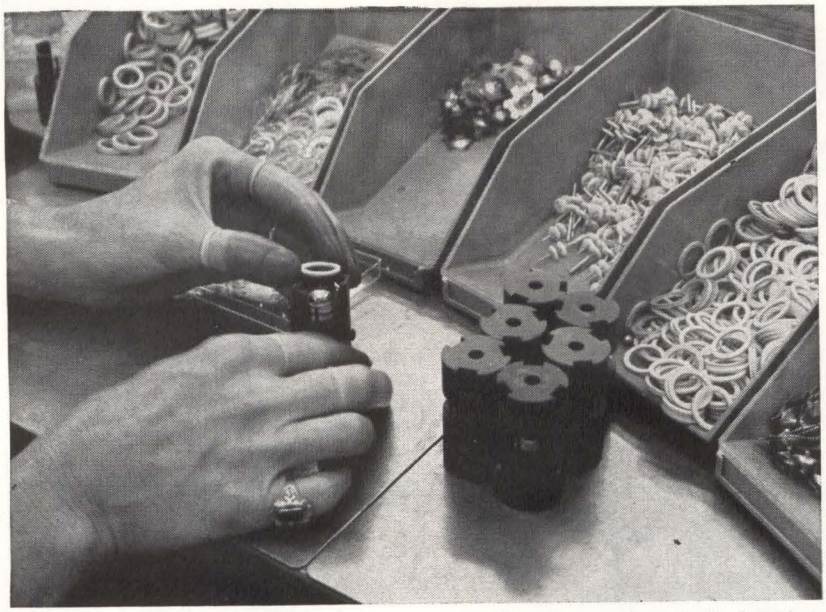
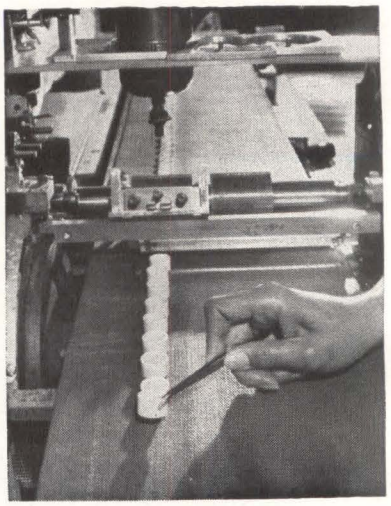


METALIZED-CERAMIC *parts are assembled with metal parts in brazing jig. Many metals can be plated on the metalized ceramics and many types of metal can be brazed to the metalized ceramic*



METALIZING COATING *is applied automatically by rollers to ends of ceramic cylinders. The cylinders will be heated in a six-stage hydrogen furnace to fuse the coating to the ceramic*

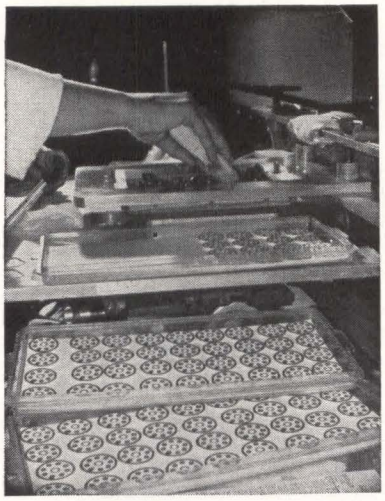
Process for Metalizing Ceramic is Automated

Vacuum tight seals are stronger than the ceramic sections

By S. R. JEPSON
Eitel-McCullough, Inc.
San Carlos, Calif.

CERAMIC TO METAL seals can be made in two ways. The first process produces a mechanical bond between the metal and ceramic, but a bond that will not hold a vacuum and is weaker than either the metal or the ceramic and thus will open under sufficient stress. The other process produces fusion between metal and ceramic; it gives seals that will hold a vacuum of 10^{-8} mm Hg at over 700 C, and the bond is stronger than the ceramic.

Vacuum-tight ceramic to metal seals have been used for a number of years for power and microwave tubes. Now the seals are being used for rocket igniter casings, connector inserts, semiconductor envelopes and caustic coolant shielding. Mass production of high quality seals is justified in many cases and a high degree of automation is possible.



METALIZING COMPOUND *is applied to octal tube headers by silk screen process*

Ceramic blanks are made from aluminum or beryllium oxide. Alumina provides both electrical and thermal insulation while beryllia is a good electrical insulator and has the thermal conductivity of white brass. The blanks are checked for mechanical tolerances, purity, and hardness, then immersed in a dye which seeps into fine cracks and indicates them by a bright red mark. Acceptable blanks are then cleaned in a strong detergent.

METALIZING — The metalizing compound is a thick grey fluid made with four parts molybdenum and one part manganese suspended in a nitrocellulose lacquer base. It can be applied with rollers, hypodermic syringe or silkscreen. The automated roller press shown in one of the photographs is used to metalize the ends of small cylinders. A conveyor belt carries the blanks under a roller which deposits a thin film of the compound on the surface to be metalized. The conveyor then passes through an infra-red drying oven. The coating process takes about six minutes. Larger blanks are placed in mandrels and are spun at a few-hundred rpm. Metalizing compound is applied with hand-held rollers or hypodermic syringes. The compound drys in about fifteen minutes

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 Nemours Building, Wilmington 98, Delaware.

Freon® solvents
Better Things for Better Living... *through Chemistry*

DU PONT
REG. U.S. PAT. OFF.

SEE THIS DEMONSTRATION IN BOOTH #3734 AT WESCON!

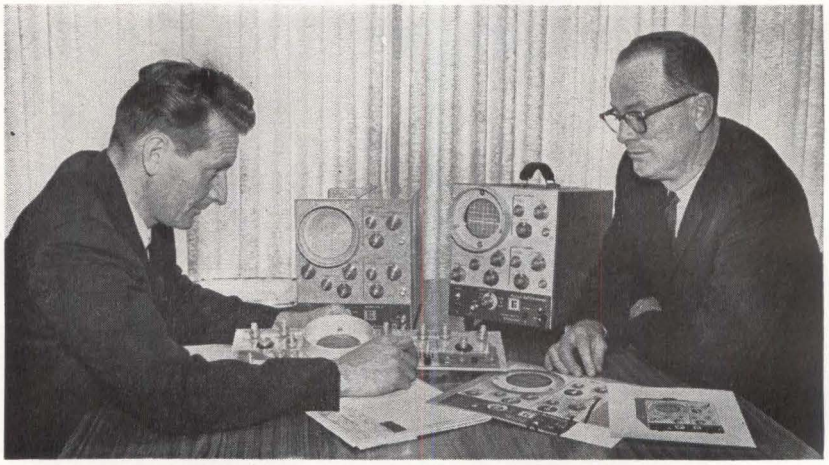
in the open air.

Fusing the metalizing compound to the ceramic is accomplished in a six-stage hydrogen atmosphere furnace. Parts are carried into one end of the 50-foot long automated furnace on a conveyor, heated in six stages to 1,450 C, then emerge from the opposite end. In the furnace the molybdenum in the coating forms a 0.001 inch film on the surface of the ceramic and the manganese combines with other elements in the ceramic to form a bond at the interface of the molybdenum and ceramic.

Metalized areas of the ceramic can be plated with nickel, copper, silver, and gold, or they can be brazed to metal parts using pure copper, copper alloys, or silver. Ceramic-metal assemblies are stacked in precision brazing jigs with brazing alloys sandwiched between the metal-ceramic surfaces. As many as 14 pieces have been brazed into one assembly. Metals to which the metalized ceramic can be brazed include nickel-iron alloy, copper, kovar, nickel, copper-nickel alloy, tungsten, molybdenum, and steel, including stainless. After brazing, the assemblies are cleaned, can then be plated if required.

Typical mass production ceramic-to-metal seal processes include 0.02 inch diameter beryllia diode envelopes 0.065 inches long, 1-inch diameter alumina rod brazed to a 0.125 inch thick, 3-inch diameter tungsten disk, brazing to the inner and outer edges of a 0.03 inch thick ceramic disk, and brazing sapphire to copper for microwave windows.

Printing Trick Speeds Panel Mockups



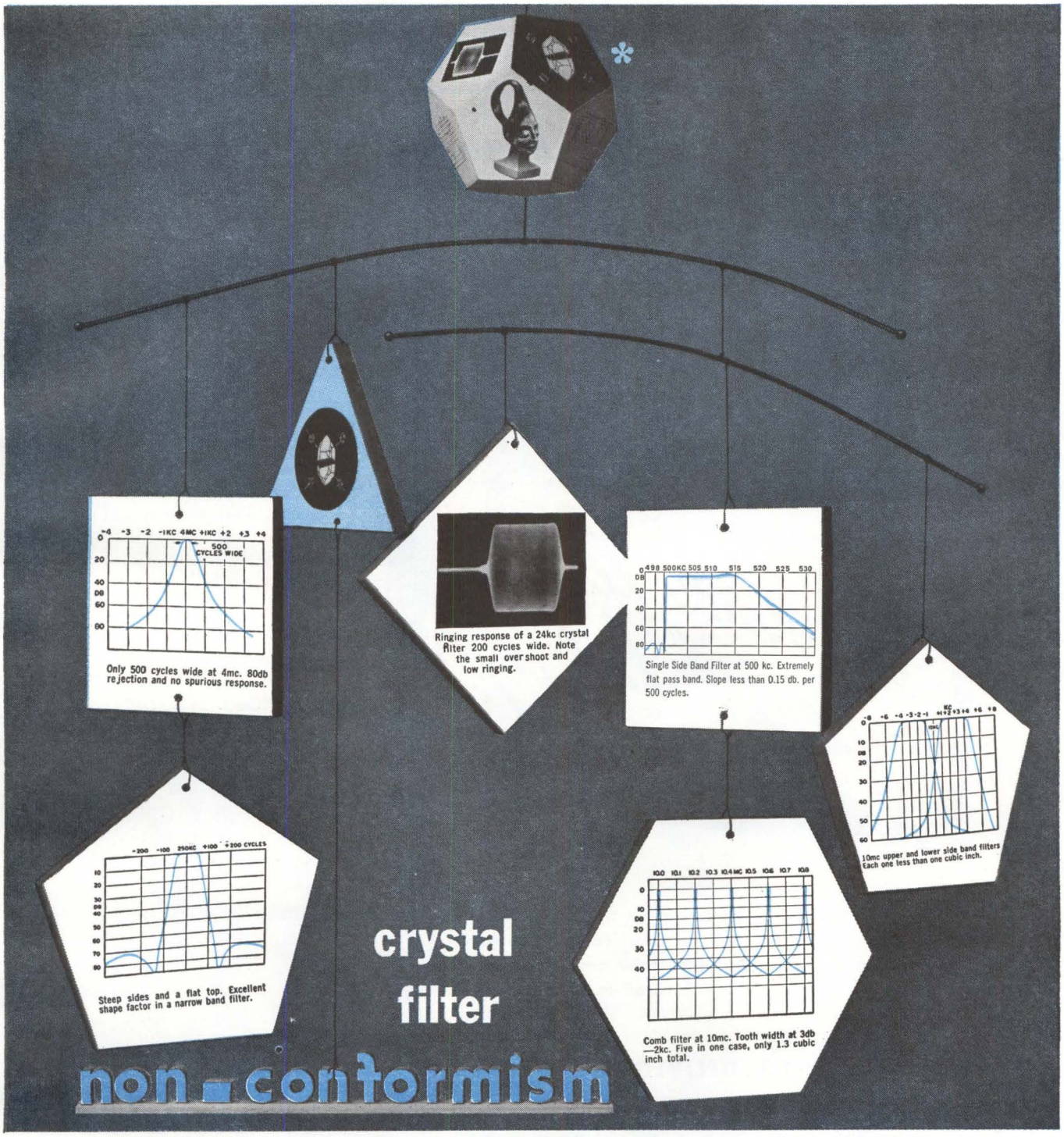
PRODUCTION MODEL *scope at right had front panel design established in advance by realistic colored mockups of various configurations*

A TRANSPARENT OVERLAY system, originally designed to provide printers with an inexpensive check of color work, is being used to produce models of electronic instruments quickly and with high accuracy.

Marketing samples and production mockups of precision instruments should duplicate the color, typography, hardware and other essentials of proposed designs. Close simulation of alternative designs for proposed instruments allows realistic decisions about the best approach.

Time is usually important in the mockup stage of electronic instrument production. Front panel instrument mockups can be made with silk screen panel, which tends to be time consuming, or a hand-painted comprehensive, which tends to be inaccurate. The overlay technique, called Color-Key, uses 0.002 inch thick polyester film coated with a light-sensitive material. It was developed for the printing industry by Minnesota Mining and Manufacturing Co. to check color break, value and register before costly lithographic plates are made. The photograph indicates how the process was used to produce a front panel mockup for a new Packard Bell oscilloscope.

The front panel is first fabri-



Those *non-conformists* at Burnell's engineering laboratory aren't satisfied with just producing the broadest range of crystal filters, toroids and communication networks: through their constant efforts to satisfy tomorrow's space age electronics problems, they have developed a whole new family of sophisticated crystal filters, with exceptional and unusual characteristics, contributing to increased circuit flexibility as graphically demonstrated above.

Those same *non-conformists* have also made considerable progress solving other electronics/space age problems. A typical example of this has been their work with the application of Time Domain Synthesis; producing an unlimited inventory of wave forms for new applications, and resulting in substantial reductions of size and weight, eliminating the need for complex active circuitry for its support.

*Join the *non-conformists*—write today for your free *Non-Conformist* paper weight and Crystal Filter Catalog XT-455. Yes! Your circuits *can* profit today from tomorrow's research.

Burnell & Co., Inc.

PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

EXECUTIVE OFFICE AND PLANT
DEPT. E-8
PELHAM, NEW YORK
PELHAM 8-5000
TELETYPE PELHAM 3633

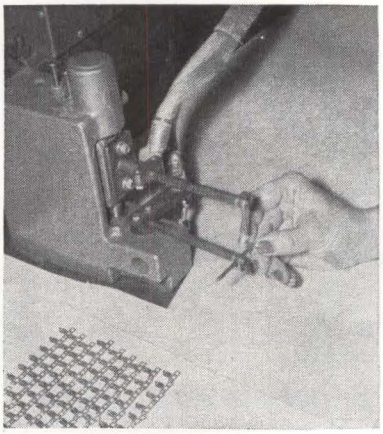
PACIFIC DIVISION
SOUTH PASADENA, CAL.
MFD. IN CANADA
BY EDO (CANADA) LTD.
CORNWALL, ONT.
WELLINGTON 2-6774

DIVISIONS: Gray & Kuhn, Inc., Pelham, New York • GLP Electronics, Inc., Bristol, Conn. • Guillemin Research Laboratory, Cambridge, Mass.

cated to the desired shape and then painted with the base color the instrument is to have; or the base color is simulated with colored paper. Then the dial markings are printed in the desired color on a separate piece of paper and photographed. Since instrument lettering in this instance is to appear in three different colors, three different colored overlays are produced from the photograph; the basic process is similar to that used in reproducing colored pictures in books and magazines. The overlays are then fastened to the panel with tape or mechanical fasteners, and hardware such as switches and knobs are added.

The oscilloscope mockup was prepared by Consultants for Product Design in conjunction with Creative Type Co.

Welded Connections and Welded Sealing



CONTACT CONTAMINATION is one of the major causes of trouble in relays and choppers, and a major source of contamination is the solder flax used for making internal connections and sealing the cans. Cambridge Scientific Industries, Cambridge, Md., has therefore turned to spot welding for internal connections in their choppers and to heliarc welding for sealing the can.

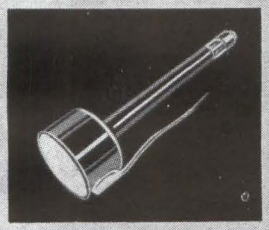
The sealing operation using heliarc welding is accomplished in a closed chamber filled with nitrogen. Thus the choppers are subject only to an inert gas during sealing and in operation.

DU MONT at WESCON...

SEE WHAT THE INDUSTRIAL TUBE LEADER IS DISPLAYING

HIGH RESOLUTION, HIGH BRIGHTNESS

MICRO-SPOT CATHODE-RAY TUBES*



Cathode-ray tubes with a .0007" spot size, or over 1400 lines/inch resolution, provide the ultimate in detailed displays for the most precise investigations. Types specified here are some of the high-resolution family of tubes designed and manufactured by Du Mont. Complete details on request.

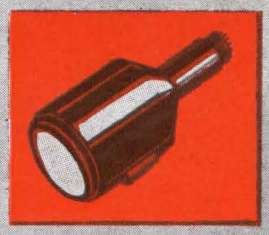
CATHODE-RAY TUBES—.0007" SPOT SIZE

Type	Dia.	Length (nom.)	Type Defl.	Type Focus	Accel. Volts	Line Width
K1972	3"	14-9/16"	Mag.	Mag.	20 kv	.0007" @ 10 uA
K1871	5¼"	16-5/8"	Mag.	Mag.	20 kv	.0007" @ 10 uA

*Including Fiber Optic Faceplates

DIRECT-VIEW STORAGE TUBES

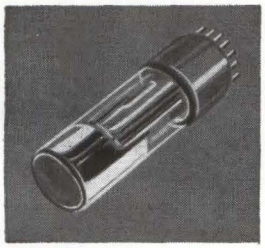
Tubes with lightning-fast indications and controllable retention...including Scan Converters and 5-inch diameter types. Du Mont Direct-View Storage Tubes offer brighter, flicker-free displays. Electrostatic deflection available. DVST's available in all sizes from 2-3/4" to 21"— for all applications from underwater to airborne.



TYPICAL DIRECT-VIEW STORAGE TUBES

Type	Dia. Max.	Writing Guns		Storage Time (min.) Sec.	Writing Rate (min.) in/sec.	Erasing Uniformity Ratio, Max.	Resolution (min.) lines/in.
		Defl.	Focus				
K1938	2-11/16"	Elec.	Elec.	30	2×10^3	0.5	50
7448	5-5/16"	Elec.	Elec.	40	3×10^5	0.5	50
K1826	10-3/8"	Mag.	Elec.	180	1×10^4	0.5	50
K1810	20-5/16"	Mag.	Mag.	180	5×10^4	0.5	30

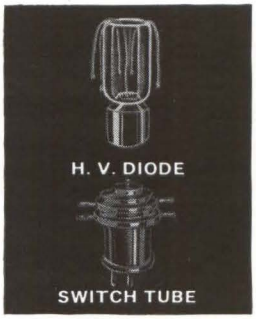
INCREASED SENSITIVITY MULTIPLIER PHOTOTUBES



See two new types: Type 2276 — a 1-1/4" flat end-window, 10-stage MPT with S-1 cathode luminous sensitivity of 30 ua/lumen — twice that ordinarily available in these photomultipliers; Type 2284—offering extra ruggedness and shortness for space economies. Du Mont image converters, image dissectors and other photo-sensitive tubes will also be shown. MPT's for every application from space exploration to sub-strata.

QUALITY POWER TUBES

A complete new line of Power Tubes—on display for the first time by Du Mont. Typical of those to be seen are: Power Triodes, High-Voltage High-Current Diodes, Rectifier Tubes, Ionization Gauges, Switch Tubes and High-Voltage Pulse Modulator Triodes. See the complete line — already accepted and in use as high-quality items.



SEE THEM ALL AT WESCON BOOTHS 2129—31

DU MONT

ALLEN B. DU MONT LABORATORIES

ELECTRONIC TUBE DIVISION

DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

750 Bloomfield Avenue, Clifton, New Jersey

CIRCLE 121 ON READER SERVICE CARD 121

500:1

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

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

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

DC polarity reversal switch for negative or positive voltage measurements.

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

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

Taut band suspension meter to eliminate meter stickiness.

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

PARTIAL 803B SPECIFICATIONS

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

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

VOLTAGE RANGE . . . . . 0 to 500V

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

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

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

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

PRICE . . . Cabinet $875.00
Rack $895.00

Prices and data subject to change without notice.

John Fluke Mfg. Company, Inc.
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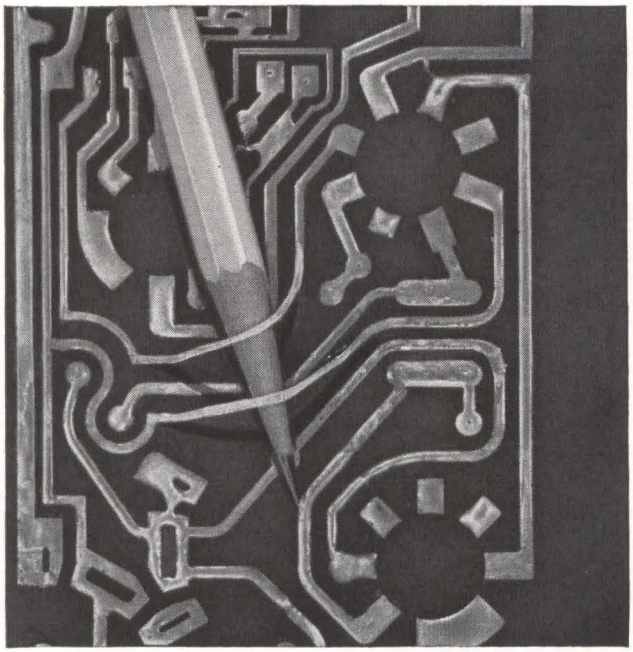
FLUKE INSTRUMENTS

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

Printed Circuit Designers! AVOID Wire Failures at Soldering Temperatures



You've never had a printed circuit fail at room temperature. But you may often have experienced loose wire trouble in the soldering pot or during solder roller coating.

Synthane G-10R, a special glass epoxy base laminate, was developed especially to eliminate wire failures during the soldering operation—approximately 500°F.

G10-R meets or beats NEMA and MIL specs for peel strength at room temperature and has a *hot* peel strength of 2 to 4 lbs. per inch of width after immersion for 15 seconds at 500°F* instead of the customary 0.1 to 0.2 lbs. per inch of width.

G-10R is available in sheets 36″ x 36″ or 36″ x 48″ and in the usual foil thicknesses. Write for new folder on all Synthane metal-clad laminates.

*Tests made on 1/16 & 1/8″ wires.

SYNTHANE

CORPORATION OAKS, PENNA.

GLendale 2-2211 TWX Valley Forge 735U

Synthane-Pacific 518 W. Garfield Ave., Glendale 4, Calif. TWX GLDL 4417U

Synthane Corporation, 36 River Rd., Oaks, Pa.

Gentlemen:

Please send me your latest brochure on Synthane G-10R and other Synthane copper-clad laminates.

Name_____

Address_____

City_____ Zone____ State_____

ONLY PERKIN GIVES YOU THIS CHOICE IN 30A DC POWER SUPPLIES

MODEL TVCR040-30

TRUE DYNAMIC REGULATION OF BOTH VOLTAGE AND CURRENT

DC OUTPUT: 0-40v, 30a. STATIC REGULATION: (Line) E ±0.01% or ±2mv, I ±0.02% or ±3ma; (Load) E ±0.02% or ±4mv, I ±0.05% or ±7.5ma; DYNAMIC REGULATION: Line ±50mv for inst. ±10V line change, Load ±0.5v for FL change. RIPPLE RMS: E 2mv, I 5ma. RESPONSE: 50μ sec. $1295.

MODEL TVR040-30

VOLTAGE REGULATION WITH ADJUSTABLE CURRENT LIMITING

DC OUTPUT: 0-40v, 0-30a. STATIC REG: Line ±0.01%, Load ±0.02%. DYNAMIC REG: Line ±50mv for inst. ±10v line changes, Load ±0.5v for FL change. RIPPLE RMS: 2.0 mv. RESPONSE: 50μ sec. CURRENT LIMITING REGULATION ACCURACY: ±0.1% or ±30ma. $1120.

Only Perkin gives you these two big choices in 30a DC power supplies:

1. A supply that has true voltage regulation *and* current limiting with automatic voltage programming.
2. A supply that has both voltage and current regulation with automatic voltage and current programming.

Both these all-solid state units are transient-free. Both feature current limiting adjustable from *0* amps upwards, series and parallel operation, remote sensing, and immunity to short circuits. Off-the-shelf delivery, prepaid in U.S.

Write for complete technical information.

PERKIN
electronics

345 Kansas St., El Segundo, Calif., SPring 2-2171

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KEW

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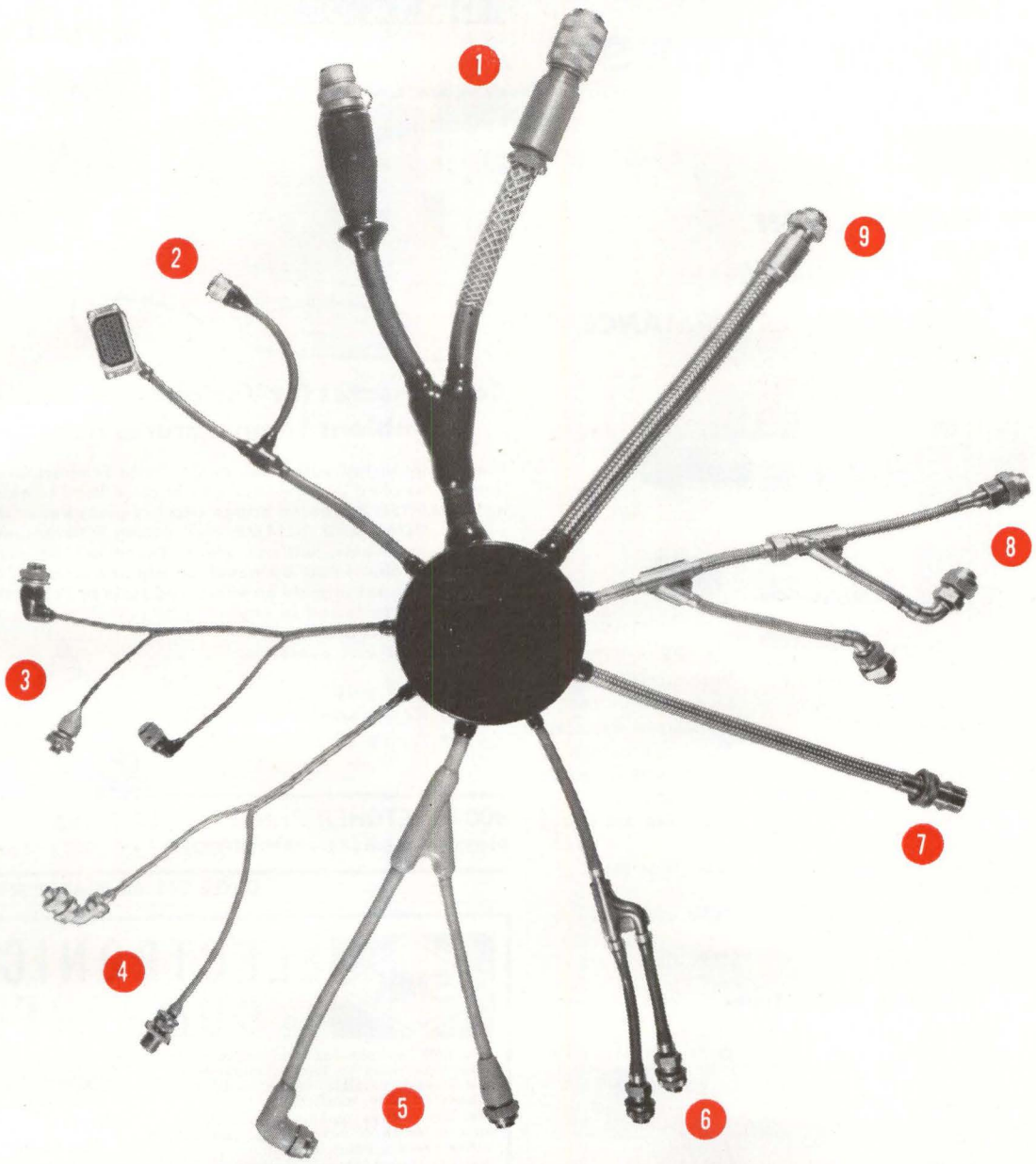

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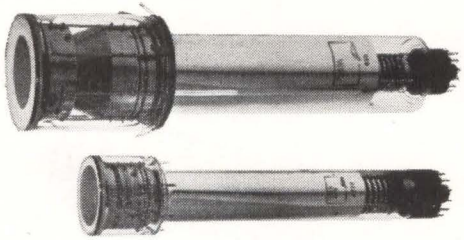
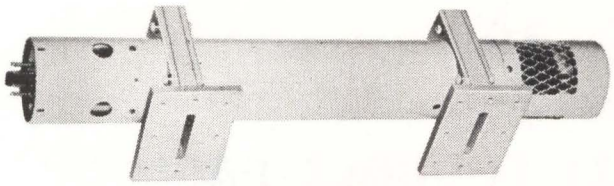


Tube Type	Feature	Application
5820	3″ Standard, High Sensitivity (None Field Mesh)	Monochrome Broadcast Studio and Outdoor
75PC11	3″ Low Spurious Signal High Sensitivity	Monochrome Broadcast Studio and Outdoor
75PC12	3″ Low Spurious Signal High S/N Ratio	Monochrome Broadcast Studio and VTR
4415	3″ High Quality High Sensitivity	Color (Red and Green)
4416	3″ High Quality High Sensitivity	Color (Blue only)
7389A	4 1/2″ Super High Quality High S/N Ratio	Studio and VTR
7295A	4 1/2″ High Quality	Studio, Outdoor and VTR

Traveling Wave Tubes



TYPICAL PPM TYPE TUBES

TYPE	FREQUENCY RANGE (MC)	POWER OUTPUT (W)	BEAM VOLTAGE (V)	BEAM CURRENT (mA)	GAIN (db)
2W401	1700 - 2300	20	2200	65	37
3W402	2300 - 2900	17	2200	65	37
3W20	2400 - 3200	5	2600	35	35
6W401	5850 - 6450	14	3100	40	40
7W25	6400 - 7200	8	2700	25	38
7W402	6425 - 7125	13	3100	40	40
8W403	7100 - 7900	12	3100	40	40
8W23	7200 - 7800	5	2500	25	36
11W174	10500 - 11800	1	2300	8	27

Our products will be on display at the WESCON Show, Booth #3454 & #3455

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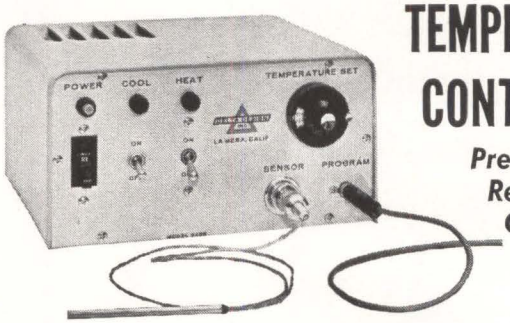
Tokyo Shibaura Electric Co., Ltd. Tokyo, Japan *Toshiba* Quality Since 1875

CIRCLE 126 ON READER SERVICE CARD

DELTA DESIGN

SOLID STATE TEMPERATURE CONTROLLER



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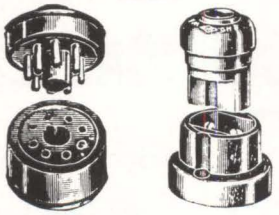
S-G1101 S-H1101
Miniature Plugs and Jacks

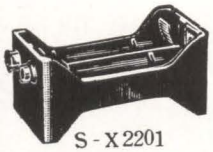


S-I 5201
S-I 5202
U.S. Connector

S-I 5701
S-I 5702
Plug Socket

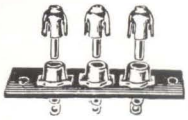
S-I 7901
Connector for microphone

S-J 2801
Rotary Switch



S-X2201
Battery Holders

TV Adapter



S-Q 2501
Pin Jack Terminals for amplifier

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SG-5000

Transitron offers computer circuit designers a highly reliable, better performing, subminiature glass silicon planar epitaxial diode. Careful development, supported by stringent environmental and life tests, has solved all mechanical and electrical problems. The result is the SG-5000 — a premium unit that fully meets military specifications.

At the same time, Transitron has improved upon the selected performance of silicon planar epitaxial diodes now available. In addition to the recognized features of higher forward conductance, faster switching and lower capacitance, the uniformity of planar epitaxial construction lets Transitron offer tightly controlled forward voltages at specified current levels. The SG-5000 is available in quantity with digital marking for quick diode type identification.

Another step in Transitron's continuing efforts to offer the industry's widest variety of silicon diode types is the introduction of the 1N3604-6 and 1N3062-9 series of silicon planar epitaxial diodes. All Transitron silicon diodes, including the newest types, can be packaged as multiple-chip assemblies to your specification. All are now available through your Transitron distributor.

TENTATIVE DATA — SPECIFICATIONS AT 25°C					
Type	Maximum Forward Voltage @ 200mA	Maximum Inverse Current @ −75V	Minimum Inverse Voltage @ 100μA	Maximum Capacitance @ 0V @ 1Mc	Maximum Reverse Recovery Time*
SG-5000	1.0V	0.1μA	100V	2 pf	2 nsec

*(I_F= 10mA, V_R = — 6V, recovery to 1 mA, R_L = 100 ohms)

Transitron invites your inquiry regarding further details of its silicon planar epitaxial diodes. Write today.

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1 TRANSISTOR ENGINEERING
an Introduction to Semiconductor Integrated Circuits

Just Published. Equips the reader with a basic understanding of the principles of transistor theory and design so that any of the DC or high-frequency parameters and characteristics can be directly related to the physical properties of transistor materials. **By Alvin B. Phillips, Motorola, Inc. 370 pp., 203 illus., $12.00**

2 THE AGE OF ELECTRONICS

Just Published. Specialists discuss the present state of several fields of electronics and their possible future projections. Covers electromagnetic theory, communications, use of computers in scientific research, radio astronomy and radio telescopes, transistors, masers, and satellite relays. **Ed. by Carl F. Overhage, Lincoln Lab., M. I T. 256 pp., illus., $7.95**

3 INTRODUCTION TO RADAR SYSTEMS

Just Published. Covers modern developments and techniques in radar systems engineering. Ranges from prediction of radar range performance to applications in detecting extraterrestrial objects. Treats subsystems and major components, and how signals are detected in noise and information is extracted from signals. **By Merrill I. Skolnik, Electronic Communications, Inc. 636 pp., 379 illus., $14.50**

4 DELAY TABLES
for Finite- and Infinite-Source Systems

Just Published. Presents tabulated values to enable the operations researcher and engineer to deal quickly with important classes of delay systems. **By A. Descloux, Bell Telephone Labs, Inc. 448 pp., $15.00**

5 HANDBOOK OF SEMICONDUCTOR ELECTRONICS

Thorough, comprehensive guide for all concerned with the design and application of semiconductor devices. Covers transistors, diodes, and photocells, giving principles of operation; technology; including fabrication; circuit applications; and reference to methods of mathematical analysis. **Ed. by Lloyd P. Hunter, IBM. 2nd Ed., 916 pp., 678 illus., $18.50**

6 MATHEMATICS MANUAL

Just Published. Helps you solve all kinds of mathematical problems—business, engineering, or scientific—faster and easier. Gives important definitions, principles, theorems, corollaries relationships, and the methods most commonly used in mathematics. **By F. S. Merritt,** *Engg. News-Record.* **387 pp. 178 illus., $9.50**

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7 ELECTRONICS DRAFTING

Simple, clear self-training guide to all types of electronic diagrams and drawings. Covers symbols and terms: use of drafting tools; mechanical diagrams; visualization; lettering; etc. **By K. Karl Kuller, Hammarlund Mfg. Co. 286 pp., 139 illus., $8.00**

8 ELECTRON DEVICES AND CIRCUITS

Gives facts, descriptions, and explanations regarding the operating fundamentals of all types of electron devices and their application in common circuits. Covers and stresses the similarity between tubes, transistors, and magnetic amplifiers. Explains operation of devices in terms of energy balance, with frequent use of dimensional analysis. **By John M. Carroll,** *Electronics.* **334 pp., 226 illus., $8.75**

9 A SURVEY OF SWITCHING CIRCUIT THEORY

Short, direct introduction to modern switching theory for both combinational and sequential circuits. Requires only moderate knowledge of mathematics and provides many examples of solutions of problems. **Ed. by E. J. McCluskey, Jr., Princeton Univ., & T. C. Bartee, MIT Lincoln Labs. 205 pp., 60 illus., $7.75**

10 RADIO-ELECTRONIC TRANSMISSION FUNDAMENTALS

Simplified, comprehensive guide for everyone interested in successful handling of high-power electrical energy of radio frequency. Covers techniques and underlying principles for everything from radio transmission to such diverse fields as induction and dielectric heating, plasma generation, and medical and chemical applications. **By B. Whitfield Griffith, Jr., Gen. Electrodynamics Corp. 612 pp., 217 illus., $10.75**

11 MATHEMATICS FOR PLEASURE

Just Published. Gives wide variety of mathematical games, puzzles, brainteasers, and magic squares. Includes easy puzzles, hard puzzles, puzzles to challenge your reasoning power and ingenuity. Puzzles range in knowledge required from simple arithmetic to elementary algebra and logic. **By Oswald Jacoby with William H. Benson. 208 pp., $4.95**

12 COMPUTER HANDBOOK

A vast array of facts and data for ready use in every phase of designing and using analog and digital computers. Covers the full range of design practices, circuits, components, and systems. Includes programing and coding, producing flow diagrams, and organizing problems for computers. By 65 specialists. **Ed. by Harry D. Huskey, Univ. of Calif., Berkeley, & Granino A. Korn, Univ. of Ariz. 1251 pp., 1099 diagrams, tables, & illus., $25.00**

13 ENGINEERING FUNDAMENTALS FOR PROFESSIONAL ENGINEERS' EXAMINATIONS

Helps you prepare for and pass the closed-book portion of state licensing examinations. Covers all phases—mathematics, mechanics, fluid mechanics, thermodynamics, mechanics of materials, electricity and electronics, chemistry, and economics and investment theory. **By L. Polentz, Prof. Eng. 394 pp., $9.50**

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Gives a wealth of practical information to help meet everyday design problems involving the use of transistors and other semiconductor devices. Covers a wide range of applications, from simple one-transistor "push-pull" amplifiers to complex computer switching circuits equipped with high-power transistors. **Ed. by John M Carroll,** *Electronics.* **390 pp., 600 illus., $9.50**

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Fully illustrated volume presents vital information on all major types of superconductive devices. Progresses in careful stages from principles of superconductivity through detailed explanations of cryotron circuit types. Particular emphasis is given to computer devices. **Ed. by John W. Bremer, G.E. Computer Lab., 183 pp., 6x9, 42 illus., $8.00**

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LARGE SCREEN OSCILLOSCOPE HAS RESPONSE TO 5 MC

The new ITT Model LS 421 is a sampling oscilloscope *with a low frequency display capability.* It has the advantages of a large screen with exceptionally high resolution, plus a small, compact, modular control console. It has application as a general purpose lab scope for research and development activities, as a high speed readout for computers and display systems and wherever detailed observation of pulses and complex waveforms with high resolution and linearity is required.

LS 421 FEATURES:

VERSATILITY
X and Y plug-ins are completely symmetrical, thus allowing interchangeability of plug-ins normally associated with X and Y functions.

EASY MAINTENANCE
There is easy accessibility for servicing. Side panels are removable at the push of a button. There are no screws to remove. The deflection amplifiers are on swing-out chassis for easy access.

LARGE SCREEN
A 14″ rectangular Cathode Ray Tube provides a full screen of 9″ x 12″

For further information about the LS 421 Large Screen Oscilloscope, write for Data File No. E-1654-3, or call your local representative for a demonstration.

XY PLOTS
A unique *random* sampling method which allows the unit to be used as an XY plotter for phenomena varying at a DC rate or as high as 5 mc.

The system takes 50,000 samples per second, independent of the frequency of the waveform being displayed.

MODULAR CONTROLS
A modular Control Unit contains sampling circuitry, the control panel for indicator functions, and spaces for X and Y plug-ins.

CONVENIENCE
The Indicator and Control Unit are separate to allow the Indicator to be placed in the most convenient viewing position. The scope is packaged for rack, bench or mobile cart mounting.

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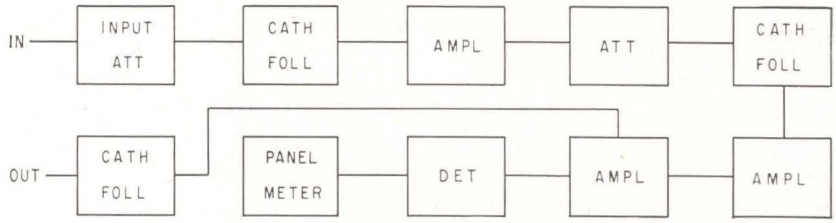


Measuring A-C Between 10 Cps and 100 Mc

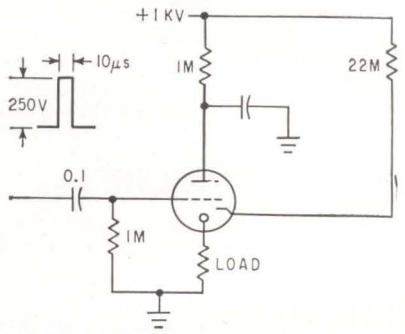
Voltmeter measuring less than 100 μv to 300 v is also preamplifier

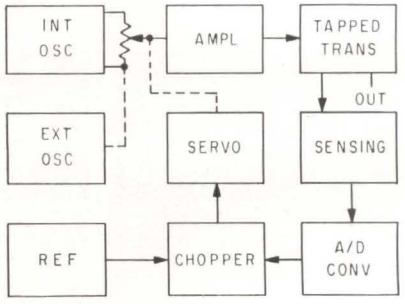
ANNOUNCED by Keithley Instruments Inc., 12415 Euclid Ave., Cleveland 6, Ohio, the model 120 wideband voltmeter measures a-c voltage from less than 100 μv to 300 v in 12 overlapping ranges. It can also be used as a wideband preamplifier. The amplifier can withstand up to 400 v. on the upper range scale therefor there is no danger of overvoltage changing calibration or burning out the probe. The signal source is not loaded by a nonlinear device having varactor properties. Using high-frequency transistors in conjunction with thermionic devices, amplifier response is 10 cps to 100 Mc ±2 percent between 20 cps and 50 Mc. Input impedance is 1 megohm shunted by 25 pF which can be increased to 10 megohms with a probe used for measurements below 300 mv. Noise level is less than 70 uv rms and d-c drift is eliminated. Oscilloscope output of 200 mv for full-scale output on any range is available for simultaneous viewing during measurements. When used as a wideband preamplifier, output impedance is 50 ohms with a rise time of less than 6 ns. Gain stability is assured by over 100 db of negative feedback. There is a complete absence of low-frequency jitter either due to amplifier noise or line transients. Change of range is by interstage attenuator.

CIRCLE **301**, READER'S SERVICE CARD

Cold Cathode Trigger Tube Operates Within 250 ns

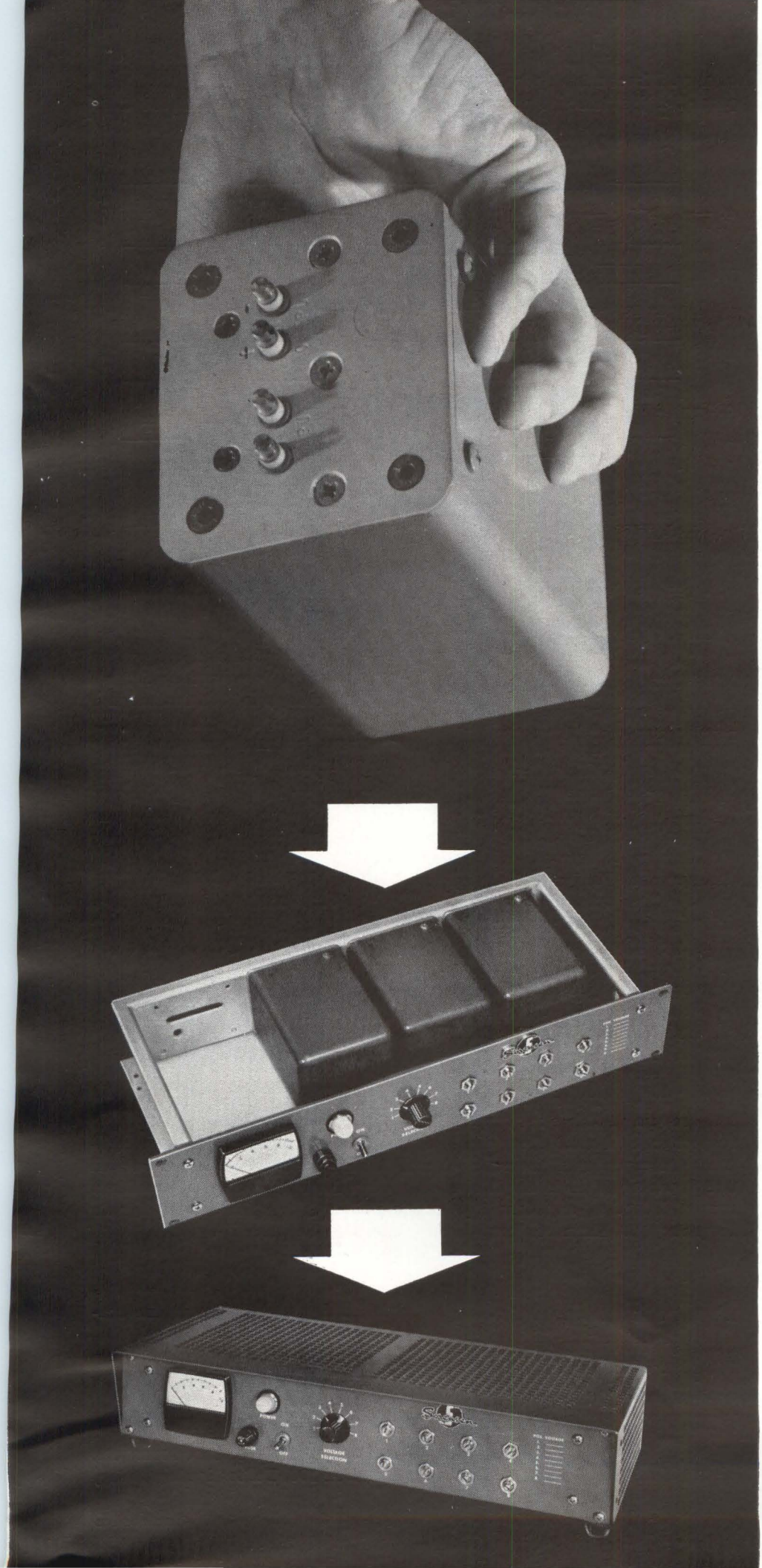
RECENTLY announced by E.G.G. Inc., 160 Brookline Ave., Boston 15, Mass., the krytron cold cathode tubes features short delay between triggering and firing of 250 ns, need no warmup time, less than 25 ns jitter, operation in high radiation environment, instant firing keep-alive and high hold-off voltage. They were designed for applications where a high peak pulse current of several hundred amperes and a short anode delay time of a few tenths of a microsecond are required. Under design are krytrons with no keep-alive electrode and 2,500 ampere peak current and 1 μsec duration capability at high voltages. They can be used to replace spark gaps, triggering flash tubes, timing mechanisms, detonators, and have been used as high energy film markers, photomultipliers and shunting devices. The sketch shows typical operation in a trigger circuit. **(302)**





Audio Standard Variable Between 35 Cps and 20 Kc

ANNOUNCED by Holt Instrument Labs., Oconto, Wisconsin, the model 323 provides fully variable voltage between 10 mv and 1,000 v at frequencies between 35 cps and 20 Kc with output distortion less than 0.03 percent throughout most of the range. Absolute calibration of 0.03 percent and short term stability of 0.01 percent permit use as a working standard. The unit provides up to 30 watts output and can supply up to 10 amperes for use in wattmeter or ammeter calibration. An external oscillator can be used to provide any other desired fre-



New from Sorensen... custom-designed DC supplies at standard product cost, off-the-shelf delivery!

Need a custom-designed power supply at low cost and fast delivery? A Sorensen QM Voltage Selector may be your answer.

1. To match your special voltage/wattage requirements we combine standard, component-type transistorized QM DC supplies.

2. The QM's are mounted on a standard chassis (five sizes available). A panel is added . . . without panel controls, or with such optional features as pilot light, switch, fuse, voltmeter, and front panel pot adjust.

3. You receive a complete, multiple-output power supply that exactly meets your specifications. Up to eight different voltage outputs; up to six different voltage/wattage combinations—all on one rack. No external heat sink is required (heat sink area provided by mounting area and chassis).

QM Voltage Selectors give you all the advantages of the transistorized QM series: Regulation ±0.05% (line and load comb.); ripple less than 1MV RMS; instant starting, fast response.

For complete information on this versatile DC power supply, contact factory or circle reader service card **284.**

Sorensen

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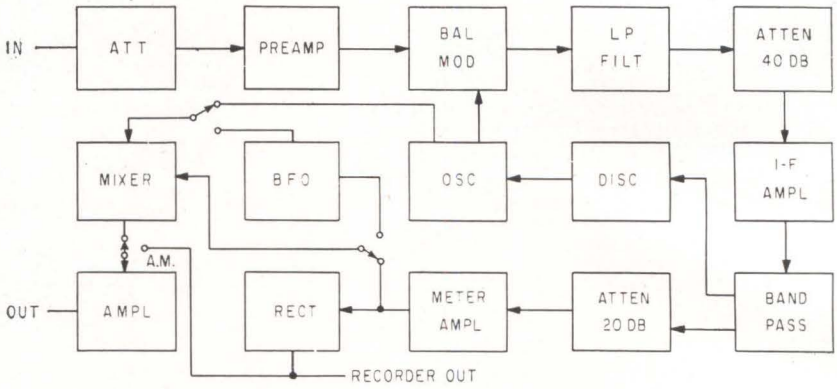
quency. Direct reading in-line dials permit adjustment of output voltages to desired level.

CIRCLE **303**, READER'S SERVICE CARD



Wave Analyzer Has AFC and Digital Readout

Continuous wideband linear tuning covers range between 1 Kc to 1.5 Mc

NEW from Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, California, the model 310A high-frequency wave analyzer covers the range between 1 Kc and 1.5 Mc with a tuning resolution within 200 cps throughout entire range. Afc hold-in range is ±3 Kc at 100 Kc with tracking speed approximately 100 cps per sec. This can be used to track a harmonic component of a drifting signal while the amplitude is being measured. Voltage range is 10 μv to 100 v full scale with ±5 percent accuracy. Meter sensitivity is indicated by an illuminated front panel range scale. Three switchable bandwidths are available: 3 Kc, 1 Kc and 200 cps. Active feedback filters having flat passband response but dropping 24 db per octave with respect to band cutoff frequency are used. Three outputs are available: one is proportional in amplitude to meter deflection and identical in frequency to harmonic component being measured and can be used by an external digital counter; the second is a d-c signal corresponding to meter deflection and can supply 1 ma into a 1,500-ohm load for recorder driving; the third is a signal in the bfo mode corresponding to the signal indicated on the tuning indicator. This last output is useful as a signal source for bandpass

measurements where the 310A is used as both signal source and measuring voltmeter. A carrier reinsertion oscillator demodulates either inverted or non-inverted ssb signals. Conventional a-m signals can also be detected. **(304)**

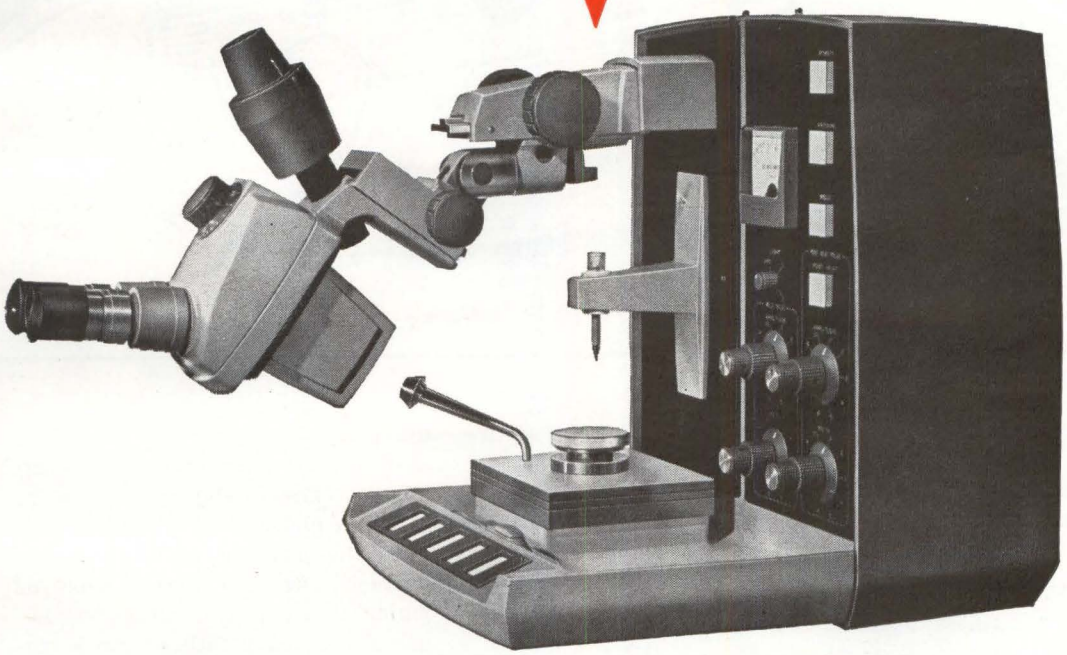
Production Wheel

FLOTRON INDUSTRIES, INC., 1201 E. Grand Ave., El Segundo, Calif., announces a production wheel that combines a number of field tested assembly fixtures on two turntables 15 in. and 23 in. in diameter, completely integrated to provide easy one hand transport from one station to another. **(305)**

Precise Thermistors

YELLOW SPRINGS INSTRUMENT CO., INC., Box 106, Yellow Springs, Ohio,

revolutionary new single point resistance MICROWELDER



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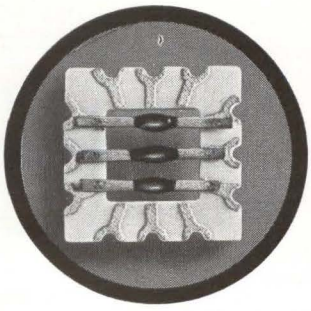

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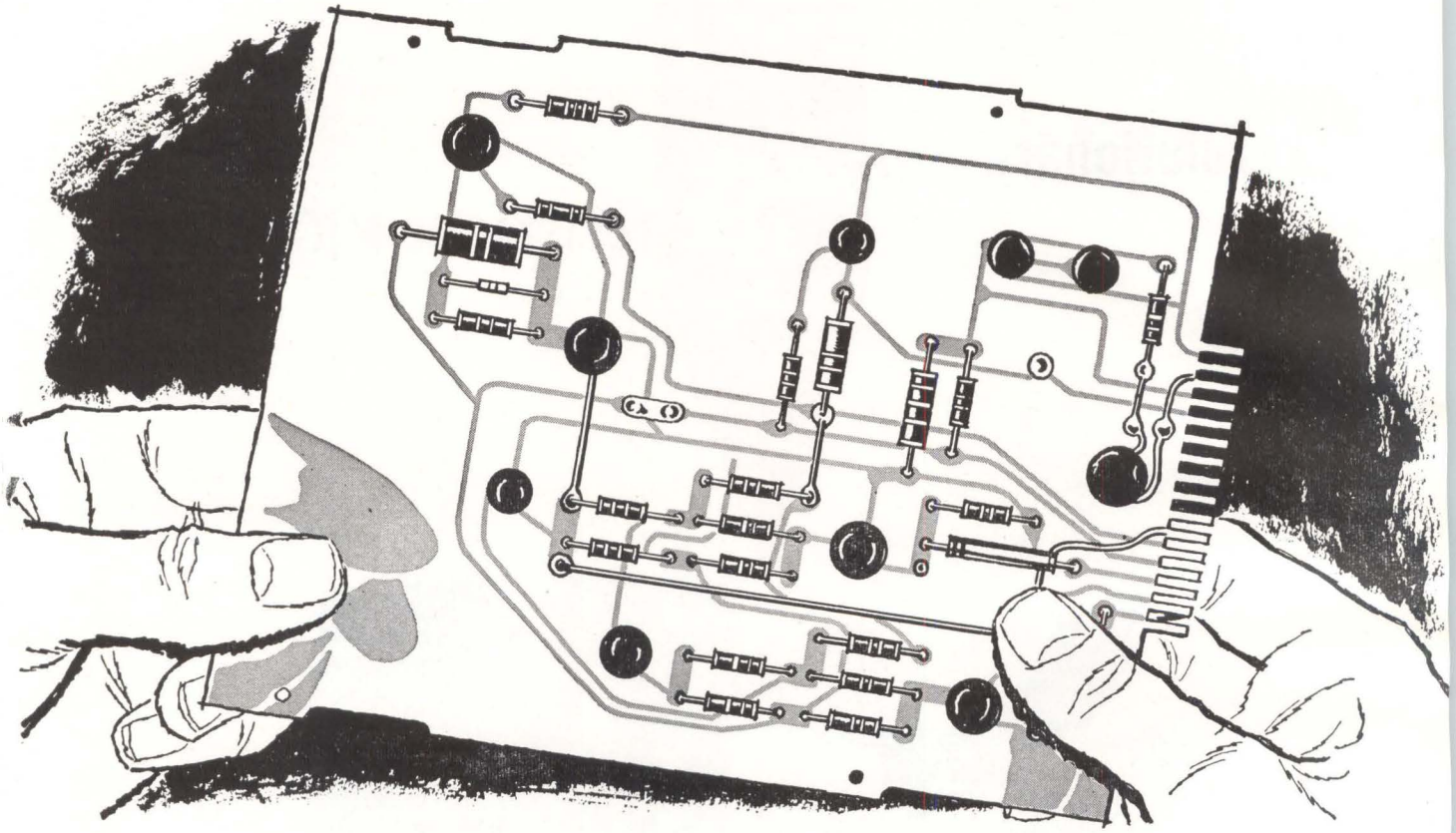
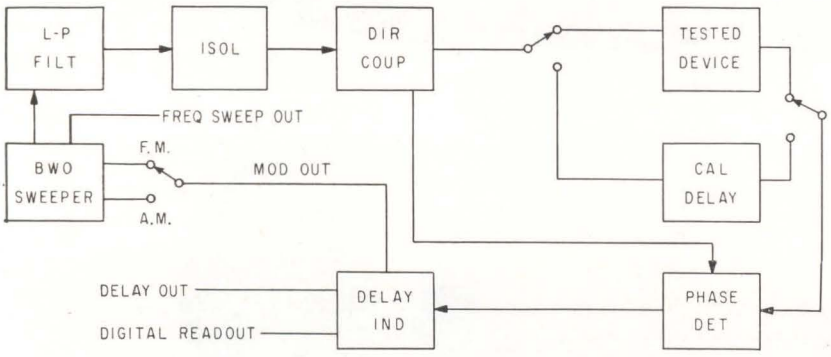


offers precise thermistors mounted in 2-in. Teflon probes. A stiffening wire in the heat sealed Teflon tube may be bent with finger pressure to any required shape and the entire probe then assumes that shape.

CIRCLE 306, READER'S SERVICE CARD



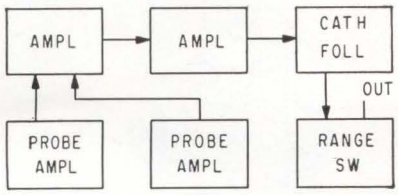
Delay Distortion Test Set Has Resolution of 0.25 ns

INTRODUCED by Wiltron Co., 717 Loma Verde Ave., Palo Alto, Calif., the model 310 test set measures time delay of various frequency components through a microwave system with a time resolution of ¼ nanosecond and in conjunction with a detector can perform time delay measurements from 300 Mc to 12.4 Gc. Calibration is by standardized time delay through a length of transmission line. Delay distortion is typically measured by applying an f-m modulated, swept-frequency signal to the input of the equipment under test and observing the phase shift of the demodulated f-m component. Time delay distortion is equal to phase shift in radians divided by angular modulation frequency. The new device achieves simplicity by making measurements at r-f frequency rather than hetrodyning to i-f frequency as is customary. Instrumentation for carrying out these measurements is based on this company's 301 phase detector in conjunction with the delay distortion test set. Digital readout is provided for better resolution and ease of reading. The f-m is by a built-in modulator. **(307)**

Expanded Scale Meters

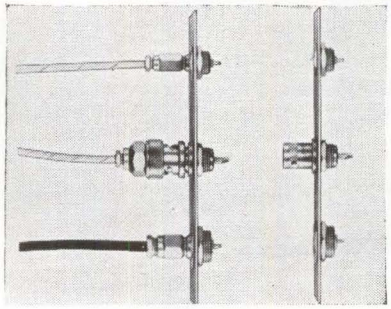
QUALITY ELECTRIC CO., 3700 S. Broadway, Los Angeles 7, Calif. Line of expanded scale meters includes: voltmeters—both d-c and a-c to 10 Kc, accuracies to ±0.5 percent of center scale value; frequency meters—±0.25 percent of

center scale accuracy, frequencies 3200 cps; true rms voltmeters—to 20 Kc bandwidth, ±2 percent of full scale accuracy; r-f ammeters—to 30 Mc at ±2 percent of full scale accuracy. **(308)**



Dual Probe Electrometer Measures 2×10^{-15} Amp

MANUFACTURED by Vacuum-Electronics Corp., Terminal Drive, L. I., N. Y., the model EL-1 electrometer is a very high impedance micro-microammeter providing meter indications over the range between 10^{-4} and 2×10^{-15} ampere with minimum noise. Two probes are supplied, one provides preamplification for currents between 10^{-10} and 2×10^{-15} amperes and the other from 10^{-4} to 2×10^{-13} ampere. Drift on the most sensitive scale is 0.002 percent per hour. Output is displayed on a temperature-compensated, mirror-separated two-scale meter with knife edge pointer. Two ten turn potentiometers are provided for fine and coarse zero set adjustment. **(309)**



R-F Connectors Insulated with Teflon

SEALECTRO CORP., 139 Hoyt St., Mamaroneck, N. Y., offers a new design in r-f bulkhead receptacle which features virtually no protrusion beyond the mounting surface. The ConheX recessed r-f bulkhead receptacle is bushing mounted from the rear, providing complete protection for the critical female receptacle within the equipment enclosure. It is available in 90-, 75-, and 50-ohm sizes. Design features very low vswr through optimum impedance matching. **(310)**

Glass Preforms

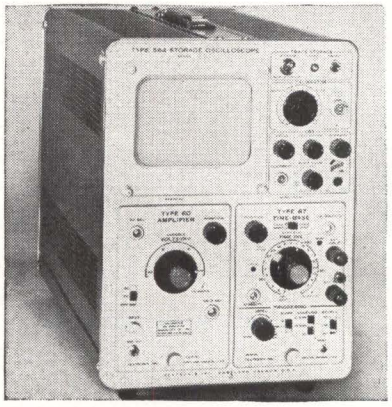
FERROXCUBE CORP. OF AMERICA, Saugerties, N. Y., announces glass preforms featuring the lead-free 195 glass. This is said to provide a 50 percent stronger sealing bond between metal and glass. **(311)**

Deviation Bridge

INDUSTRIAL INSTRUMENTS INC., 89 Commerce Road, Cedar Grove, N. J., announces the model DB-1 deviation bridge, which in some instances is

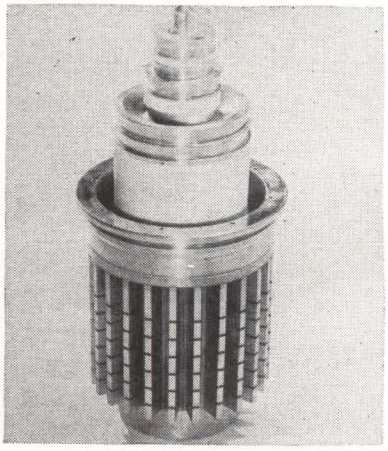
utilized for laboratory measurements of small quantities of resistors, and in other cases for high production testing.

CIRCLE **312**, READER'S SERVICE CARD



Storage Oscilloscope Employs Ceramic CRT

TEKTRONIX, INC., P. O. Box 500, Beaverton, Ore. Model 564 provides both conventional and storage modes of oscilloscope operation. It accommodates more than 10 types of plug-in preamplifiers and sweep generators, including 0.35 nsec-risetime sampling plug-ins, a 4-trace vertical amplifier plug-in and a delaying sweep plug-in with extreme triggering flexibility. It has a storage time of over 1 hr with no appreciable depreciation of the display, an erase time less than 0.5 sec, a writing rate of better than 25,000 cm/sec, and a contrast ratio of better than 4:1. **(313)**



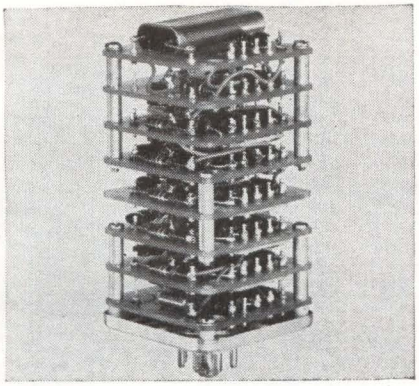
Vapor-Cooled Triode Has High Power Level

THE MACHLETT LABORATORIES, INC., 1063 Hope St., Springdale, Stamford, Conn. The ML-7482 vapor-cooled general purpose triode is ca-

pable of 400-Kw c-w output. The anode is designed to dissipate 200 Kw in c-w operation and substantially more during momentary overloads or intermittent operation. Sturdy coaxial grid and cathode mounting structures provide low-inductance and high-dissipation r-f terminals and cathode is sturdy, self-supporting, stress-free, thoriated-tungsten filament. **(314)**

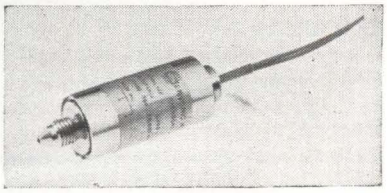
Semiconductor Tools

THE DOALL CO., Des Plaines, Ill., announces machines and tools for slicing, inspecting and handling semiconductor materials. Included are the I/D Micro-Slicer and the Censor automatic electronic grading machine. **(315)**



Crystal Oscillators Have Plug-In Design

BLILEY ELECTRIC CO., Union Station Building, Erie, Pa., offers a line of crystal oscillators in plug-in modules for range 60 cps to 15 Mc. Designed for use in counters, signal generators or as a time base in measurement and frequency control systems, they feature glass-sealed crystal units, transistorized circuitry and oven control. **(316)**



Pot Type Transducer Senses Pressure

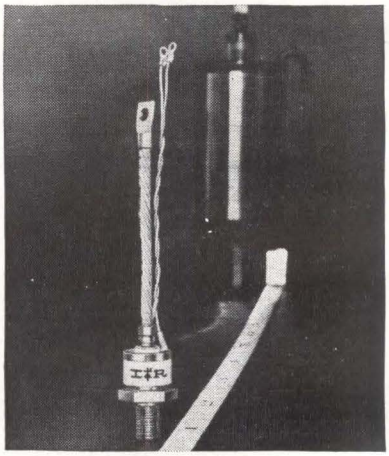
SERVONIC INSTRUMENTS, INC., 1644 Whittier Ave., Costa Mesa, Calif.,

offers a high-pressure potentiometer type transducer for missile, ground support and oceanography applications. Model 2081 has an operating range of 0-350 through 0-20,000 psi, and measures $\frac{3}{4}$ in. diameter by $1\frac{1}{2}$ in. length. Instrument is capable of withstanding 50 g vibration at 2,000 cps, with a static error band of $\pm$ 1.0 percent including linearity, hysteresis, and repeatability.

CIRCLE **317**, READER'S SERVICE CARD

Microwave NME

LFE ELECTRONICS, 1079 Commonwealth Ave., Boston 15, Mass. The Allscott 123 microwave noise measuring equipment separately measures both f-m and a-m noise modulation from 2.7 Gc to 18.0 Gc and can resolve a-m s-b power to a limit of 133 db below carrier. **(318)**



Controlled Rectifiers Are Ruggedly Packaged

INTERNATIONAL RECTIFIER CORP., 233 Kansas St., El Segundo, Calif. JEDEC types 2N1909-1916 and the 71RC series of 70 ampere rated silicon controlled rectifiers replace ignitrons and thyratrons in inverting, frequency changing, motor control and space vehicles. They are 25 to 500 prv rated. **(319)**

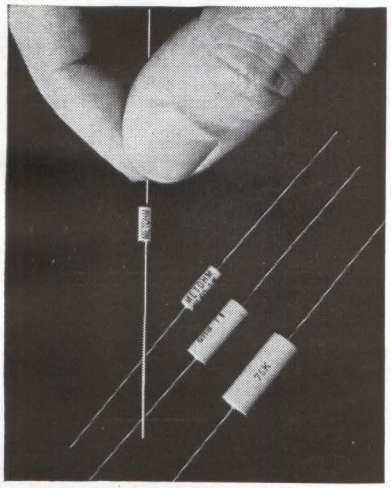
Diffusion Furnace

HEVI-DUTY HEATING EQUIPMENT DIV., Basic Products Corp., 304 Hart St., Watertown, Wisc. Diffusion furnace enables semiconductor manufacturers to obtain temperature uniformity of $\pm$ $\frac{1}{2}$ C in the processing zone. The temperature uniformities are

repeatable for each production profile and at each setting up to the max operating temperature of 1,300 C. **(320)**

Strip Chart Recorder

NEFF INSTRUMENT CORP., 1088 E. Hamilton Road, Duarte, Calif. Type 401 is a strip chart, self-balancing, potentiometric recorder. Writing is accomplished by heated ink drawn by capillary action to the paper surface. **(321)**



Metal Film Resistor Has High Stability

WARD LEONARD ELECTRIC CO., Mount Vernon, N. Y., announces a $\frac{1}{10}$ w metal film precision resistor for military and industrial electronic use where high reliability, high stability, close accuracy, low TC and compactness are vital. Type WL55 Metohm has resistance values to 100,000 ohms max and resistance tolerances ±1 percent down to ±0.05 percent available. **(322)**

A-C Calibrator

WILK INSTRUMENTS, 3700 South Broadway, Los Angeles 7, Calif., offers an a-c calibrator with a range of 0 to 1,511.0 v, accuracy of 0.1 %, resolution of 0.01 v. **(323)**

Glass Delay Medium

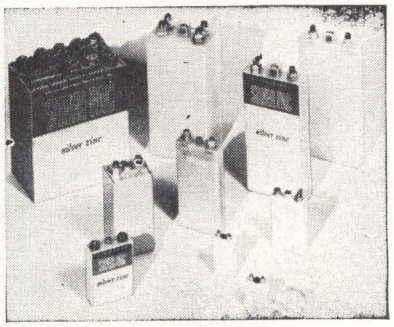
CORNING ELECTRONIC COMPONENTS, Bradford, Pa., has developed a glass delay medium with a low tempera-

ture coefficient. Code 8877 provides storage capacity between 3,500 and 4,000 bits. Chief applications will be in delay lines used as buffers and memories in digital computers and processing equipment.

CIRCLE 324, READER'S SERVICE CARD

Ceramic Capacitors

ASTRON CORP., 255 Grant Ave., East Newark, N. J., offers microminiature, square plate low voltage ceramic capacitors for high temperature and high reliability application. **(325)**



Silver-Zinc Batteries Suited to Missile Use

GOULD-NATIONAL BATTERIES, INC., E-1200 1st National Bank Building, St. Paul 1, Minn., offers a line of silver-zinc batteries in 14 standard sizes. Their size, weight and ability to withstand shock and vibration make them particularly suitable to application in torpedoes and missiles. Cells can be designed to meet varying requirements. **(326)**

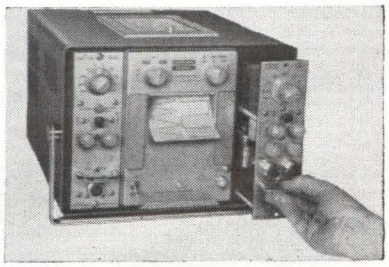
D-C Power Supplies

DRESSEN-BARNES ELECTRONICS CORP., 250 No. Vinedo Ave., Pasadena, Calif. The 60 series all solid state modular supplies are available in a variety of voltage ratings from 2 to 200 v at output current ratings of from 1 amp to 20 amp. **(327)**

Reed-Switch Relays Designed for Computers

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Line of reed-switch relays is designed for computer and data processing applications. Internal magnetic bias design assures fast,

positive contact closing. Operational characteristics show true spdt or Form C contacts. With this design, the possibility of overlap of contacts (the NO closing before the NC opens) is eliminated. **(328)**

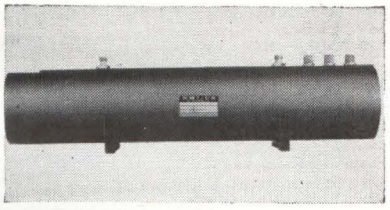


Strip-Chart Recorder Features Versatility

MASSA DIV. of Cohu Electronics, Inc., 280 Lincoln St., Hingham, Mass., announces the Meterite portable two channel rectilinear writing strip-chart recorder. It can be used directly with systems and transducers measuring power, current voltage, resistance, impedance, transconductance, reactance, audio frequency, r-f amplitude, events waveforms and other phenomena or variables that may be presented as electrical signals. **(329)**

Data Amplifier

SANBORN CO., 175 Wyman St., Waltham 54, Mass., offers a d-c to 100 cps data amplifier with floating, isolated input and output; plug-in output filters for limiting bandwidth; high common mode rejection, gain stability and linearity. **(330)**



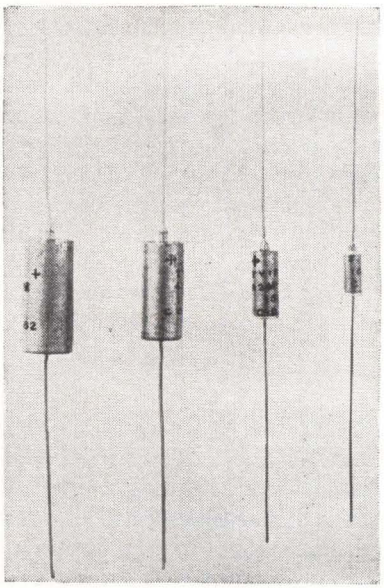
S-Band TWT Uses PPM Focusing

EMI/US, 1750 N. Vine St., Los Angeles, Calif., introduces a 2-Kw pulsed S-band twt for applications where broadband response is required. The E-114 intended for countermeasures systems and frequency scanning radar, is rated at a minimum power output of 2,000 w, with high gain and excellent small

signal gain. It utilizes periodic permanent magnet focusing, and is designed to operate over a temperature range from −65 to 100 C.
CIRCLE 331, READER'S SERVICE CARD

Telemetry Antennas

TECHNICAL APPLIANCE CORP., Sherburne, N. Y., offers several versions of the D-1365 multi-mode telemetry and command antenna. They provide instantaneous selection of several polarization modes and a wide choice of controls, including constant speed, remote, variable speed remote, slaved and automatic tracking. **(332)**



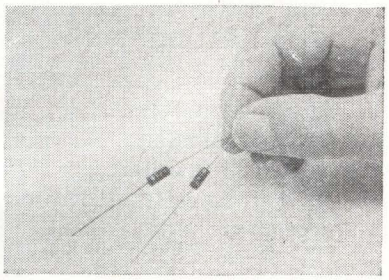
Tantalum Capacitor Operates to 85 V

CORNELL-DUBILIER ELECTRONICS, 50 Paris St., Newark 1, N. J. Type TY solid-tantalum capacitor operates up to 85 v and 85 C with no voltage derating. It can be supplied with no derating at 125 C. Capacitance values range from 0.1 to 6.8 μf. It is available in sizes of from $\frac{1}{4}$ in. length, $\frac{1}{8}$ in. diameter to $\frac{3}{4}$ in. length, $\frac{3}{8}$ in. diameter. **(333)**

Cable Test Set Has High Accuracy

ROHDE & SCHWARZ SALES CO. (USA) Inc., 111 Lexington Ave., Passaic, N. J. Portable cable test set is used for carrying out fault location and maintenance measurements on tele-

communication and power cables. It operates on test voltages of 4.5 or 125 v d-c, and is accurate in fault location to ± 0.1 percent or ± 0.5 divisions of slide-wire scale. Functions include measurement of insulation, resistance, resistance difference, capacitance, and resistance to earth. **(334)**

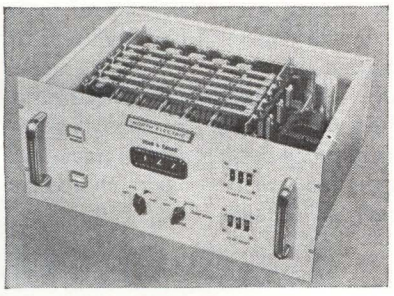


R-F Chokes Feature High Reliability

NATIONAL RADIO CO., 37 Washington St., Melrose, Mass. Encapsulated r-f chokes, called N-Caps, are virtually impervious to extremes of heat, cold, moisture and shock. The R-1550 series have inductance values from 0.1 to 330.0 μh. Size is 0.157 in. dia. 0.375 in. length. **(335)**

Flexible Cable

SANDERS ASSOCIATES, INC., 95 Canal St., Nashua, N. H., announces a low-cost Flexprint flexible printed cable for interconnection of computer module systems. It conducts low power signals with the highest possible s/n ratio. **(336)**



Crossbar Scanner Is Modularized

NORTH ELECTRIC CO., Galion, O. The Scan-A-Cross featuring a 600 point wired crossbar switch is complete with power supply, relay circuitry and connectors in a standard 19 in. rack module. Its 14 5/16 in. by 8 3/4 in. by 5 3/8 in. size crossbar has a 5 by

12 crosspoint configuration with 10 Form A silver or gold contacts per crosspoint. Scanning capability is 200 three-wire channels, 300 two-wire channels, and 600 one-wire channels at speeds from 0-30 closures per sec per pole.
CIRCLE 337, READER'S SERVICE CARD

Shielding Material Offers 100 DB Insertion Loss

METEX ELECTRONICS CORP., Clark, N. J., has developed Polastrip, an oriented-wire shielding material having a 100 db insertion loss. It can be used to shield the doors on high-power radar units. **(338)**

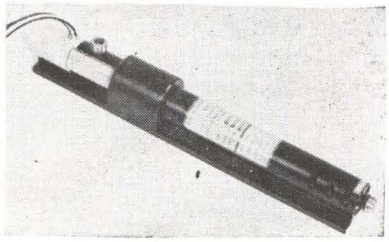
H-F Relay Achieves Fast Operate Time

JENNINGS RADIO MFG. CORP., P.O. Box 1278, San Jose 8, Calif., presents the type RS8 vacuum transfer relay for high frequency, high current applications. It has heavy copper contacts to achieve continuous current ratings of 18 rms amp at 25 Mc. This rating can be doubled with forced air cooling. Peak test voltage rating is 30 Kv, yet the unit occupies only $3\frac{11}{16}$ in. by $2\frac{1}{2}$ in. Rated operating voltage is 10 Kv at 25 Mc, 28 Kv at 2.5 Mc. Operate time is fast because contacts need not move very far to recover dielectric strength. **(339)**

Strip-Chart Recorders Have Fast Response

F. L. MOSELEY CO., 409 No. Fair Oaks Ave., Pasadena, Calif. Model 680 Autograf recorders are servo potentiometer type instruments with fast response and broad versatility. They have an accuracy of 0.2 percent full scale and a pen

speed of ½ sec full scale. Recording is made on 100-ft roll charts, 6 in. wide with a 5-in. writing span. Eight chart speeds and 10 calibrated voltage ranges are controlled from the front panel. **(340)**

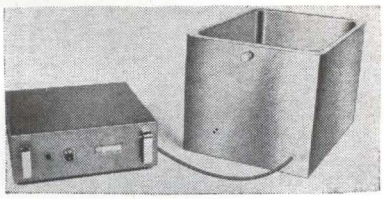


T-W Tube Features Ruggedness

EITEL-MCCULLOUGH, INC., 301 Industrial Way, San Carlos, Calif. Proved capable of withstanding repeated 120 g shocks, the X1020 twt gives 4 db gain and 20 watts output over a 500 Mc band around 6 Gc. Same tube will give a minimum of 10 w over the full octave of frequencies from 4 to 8 Gc. **(341)**

Ovens Provide Proportional Control

CONTROL INDICATING CORP., a division of Hi-G, Inc., Windsor Locks, Conn., has available proportional control ovens for components or circuits. They completely eliminate moving parts and contacts, and provide stability of temperature within 0.01 C or better, and less than 0.05 C for long term service. Temperature settings can be prescribed from 10 C above ambient, up to 125 C. **(342)**



Ultrasonic System Cleans Large Parts

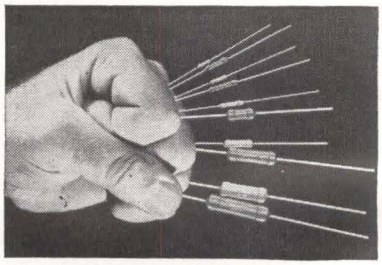
DELTA SONICS, INC., 12918 Cerise Ave., Hawthorne, Calif., has introduced a fully solid state ultrasonic system for heavy volume-large parts cleaning applications. It features a 2,000 w, 25 Kc transistorized generator, model DS-2000A

(priced at $1,300) with a 17 gallon capacity transducerized stainless steel tank, model UT-17 (priced at $1,200).

CIRCLE 343, READER'S SERVICE CARD

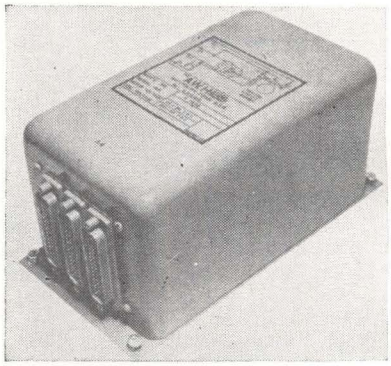
Digital Voltmeters

NON-LINEAR SYSTEMS, INC., Del Mar, Calif., announces model 10 digital voltmeters. Accuracy of ±0.01 percent of reading +1 digit is maintained up to top speed of 5,000 completely independent d-c voltage readings per sec. **(344)**



Miniature Resistor Offers High Power

DALE ELECTRONICS, INC., P. O. Box 488, Columbus, Neb., announces the G series wire wound, silicone coated resistor. Presently available in five sizes: 1, 1.5, 2.25, 4 and 7 w in values ranging from 10 ohms to 60,000 ohms, depending on size and tolerance. Available tolerances are 0.05, 0.1, 0.25, 0.5, 1 and 3 percent. The resistors are shown in comparison with RS resistors of comparable wattage. All G types have gold flash copper terminations. **(345)**



Stepping Switch Controls 468 Circuits

THE A. W. HAYDON CO., 230 N. Elm St., Waterbury 20, Conn., announces a motorized stepping switch, capable of controlling 468 circuits, in a

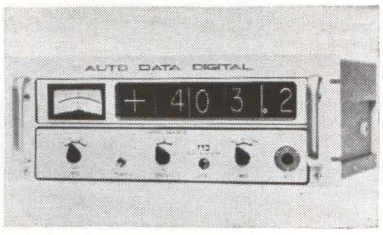
hermetically sealed housing only 4 in. square and 7 in. long. Unit has equivalent packaging in excess of 4 circuits per cu in., weight density of 8 circuits per oz. **(346)**

Cabinets Provide Climate Control

DEXON INC., 3517 Raleigh, Minneapolis 16, Minn., is producing a fully government-approved line of modularly connected Primaire climate control cabinets capable of providing dust, temperature and humidity control in a start-to-finish assembly line setup. This includes instrumentation such as ultrasonic cleaning, flushing, filtering, baking, balancing, sealing, curing and inspection. **(347)**

Switchlight

PENDAR, INC., 14744 Arminta St., Van Nuys, Calif. Multicircuit momentary switchlight series combines tease-proof snap action with low bounce wiping-action contacts. Rated at 2 amp resistive, 0.5 amp inductive, 30 v d-c or 125 v a-c for 100,000 operations. **(348)**



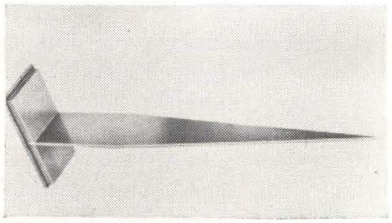
Digital Voltmeters Are Fully Automatic

AUTO DATA, 943 Turquoise, San Diego, Calif. The 2640 series transistorized digital voltmeters are designed for production measurement applications and general purpose laboratory use. Automatic ranging

and polarity change are standard features. Readout presentation is four digit edge-lighted numerals complemented by a front panel meter which extends the resolution to essentially five digits and verifies the null balance condition.
CIRCLE **349**, READER'S SERVICE CARD

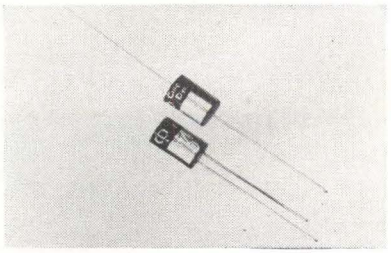
Power Transistors

SILICON TRANSISTOR CORP., Carle Place, L. I., N. Y. A line of *pnp* silicon power transistors in 75 and 85 w ranges will enable design engineers to employ complementary circuit push-pull output stages, eliminating an input and output transformer and several resistors and diodes. **(350)**



Terminations Withstand Shock

FILMOHM CORP., 48 W. 25th St., New York 10, N. Y. Employing Filmcard glass fibre resistance card as the base, a series of low vswr waveguide terminations are said to be extremely rugged, durable and virtually unbreakable even under the most severe shock and vibration. The low cost terminations are available in power ratings of from ¼ to 3 w. **(351)**



Current Regulators Simplify Circuitry

CIRCUIT DYNE CORP., 480 Mermaid St., Laguna Beach, Calif. New series of Currector current regulating devices measure only 0.385 in. in diameter by 0.60 in. long. They are readily usable on etched

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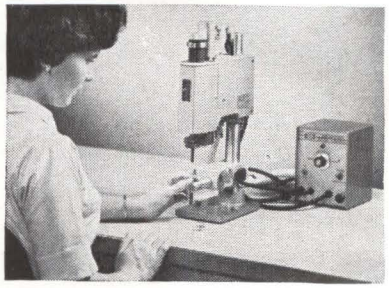
circuit boards, where spacing between boards is critical, and for welded module configuration. The CP7 series are available with standard current values from 1.00 to 10.00 ma at approximately 5 percent increments, and in polar or non-polar types. Operating range is 5 to 20 v with current regulation of ± 1.5 percent of full scale.
CIRCLE 352, READER'S SERVICE CARD

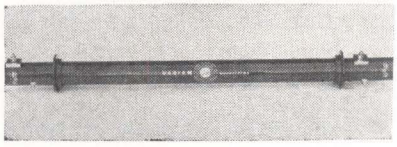


Welding Heads Have Forces to 60 Lb

RAYTHEON CO., 225 Crescent St., Waltham 54, Mass., announces two new press-type resistance welding heads with a range of welding forces up to 60 lb. Model Q and its twin pneumatically-operated model QB, are designed for precision welding of relay contacts, modules, larger electrical and industrial components, and hermetic sealing of transistor packages. **(353)**

Magnetic Shields

MAGNETIC SHIELD DIVISION Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill., announces magnetic shields of a retrofit design which provide adequate magnetic isolation and also are held to very close dimensional tolerances particularly as to o-d considerations. **(354)**



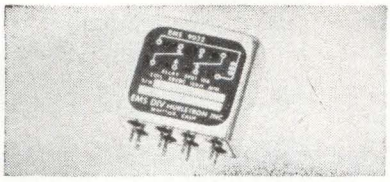
TWT Pulse Amplifier Covers 870-1,000 Mc

VARIAN ASSOCIATES, 611 Hansen Way, Palo Alto, Calif. The VA-137C is a twt for use as a final amplifier in multi-output-tube radar equipment. It produces a peak output of

5 Kw with pulses as long as 600 μsec. The VA-137C, which is liquid cooled, uses a periodic permanent magnet for focusing **(355)**

Delay Lines

DELTIME INC., 608 Fayette Ave., Mamaroneck, N. Y., has available 10- and 5-millisecond magnetostrictive delay lines suitable for data storage in computer systems. **(356)**

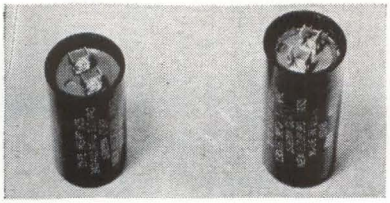


High-Speed Relay Offers Compact Design

HURLETRON INC., 528 W. Lambert Rd., Whittier, Calif. Miniature 10 amp dpdt relay conforms with MIL-R-6106-C Amendment No. 1. It weighs 1.3 oz and measures 1.015 in. by 0.515 in. by 1.4 in. high. Specifications include minimum current per Mil spec, vibration of 20 g to 2,000 cps and shock of 50 g 11 ±1 ms. It is rated 10 amp with grounded case and terminal layout is 0.200 in. grid spaced. **(357)**

Tiny Choppers

COLLINS ELECTRONICS, INC., Stevensville, Md. Hermetically sealed Mini-Chops, with a case $\frac{1}{4}$ in. thick, $\frac{5}{8}$ in. wide and $\frac{3}{4}$ in. high, are available at any specific frequency range from 1,000 cps down. **(358)**



A-C Electrolytics Feature Ruggedness

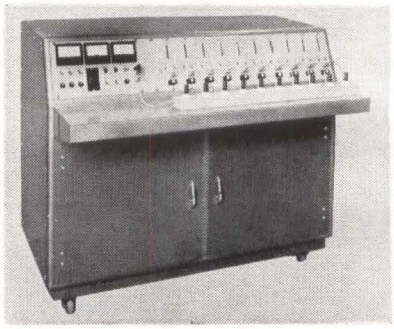
AEROVOX CORP., New Bedford, Mass., offers a-c electrolytic capacitors with a new type of cover seal. Construction eliminates possibility of shorts between the formerly used

metal ring and the terminals. Product exceeds all U.L. specifications for an air gap (electrical creepage) clearance from live parts to ground. Cover cannot be jarred loose even under severe conditions of vibration and shock.

CIRCLE **359**, READER'S SERVICE CARD

Capacitance Bridge

GENERAL RADIO CO., West Concord, Mass. Type 1615-A, a ± 0.01 percent precision capacitance bridge for use in the standardization laboratory, has a range from 10^{-17} to 10^{-6} farad, direct-reading. **(360)**

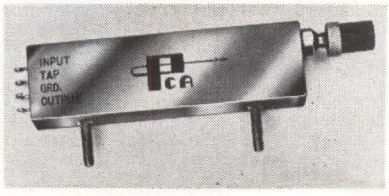


Dry Circuit Tester Operates Automatically

HI-G, INC., Bradley Field, Windsor Locks, Conn. The Miss Tester, a completely packaged automatic contact resistance tester, is offered to component manufacturers and users for dry circuit testing of make-break contact devices. **(361)**

Memory Stacks

FERROXCUBE CORP. OF AMERICA, Saugerties, N. Y., offers memory stacks constructed with planes capable of storing up to 1,984 information bits per plane. **(362)**



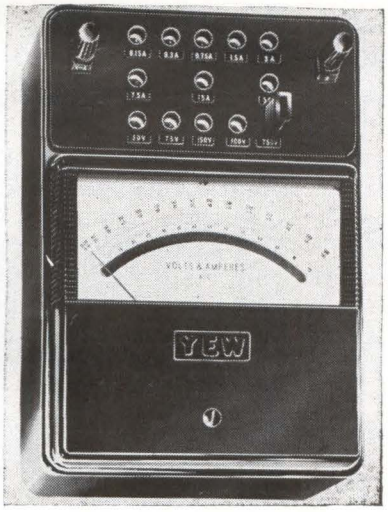
Delay Lines Offer High Reliability

PCA ELECTRONICS, INC., 16799 Schoenborn St., Sepulveda, Calif. Unit illustrated may be used as a

self-contained variable delay line, or as a vernier or trimmer adjustment section in conjunction with a fixed delay line. Range: 0.05-1.0 μsec total delay. Rise time: approximately 0.14 μsec. Attenuation: less than 15 percent. Impedance: 500 to 1,000 ohms. Cost: $95 each in small quantities. **(363)**

Wide Range Oscillator

HULL INSTRUMENTS, 726 Mission St., So. Pasadena, Calif. The 700 series Decalock oscillator generates ultrastable frequencies up to 1 Mc with 5 digit setability. It is useful in calibration of measurement channels in f-m/f-m telemetry systems. **(364)**



Volt-Ammeter Standard Is Versatile, Portable

YOKOGAWA ELECTRIC WORKS, INC., 40 Worth St., New York 13, N. Y. Model SPF-13R measures up to 30 amp a-c and 750 v a-c in 13 ranges without accessories to an accuracy of $\pm$0.5 percent of full scale value. Scale length is approximately 5$\frac{1}{8}$ in. Ambient temperature influence (max) is 0.1 percent with $\pm$10 C variation from $\pm$25 C. Size of unit: 7$\frac{1}{8}$ in. by 10$\frac{1}{4}$ in. by 4$\frac{3}{4}$ in. Weight: 10$\frac{1}{4}$ lb. Price: $195. **(365)**

Cable Ties Comply With MIL-T-713A

GUDEBROD BROS. SILK CO., INC., 225 W. 34th St., New York 1, N. Y. Gude-Ties eliminate the use of clamps and plastic tie straps. They

are made of soft Nylon braid and microcrystalline wax and comply with the requirements of MIL-T-713A including fungus proofing. Advantages include as much as 95 percent saving in material cost and substantial installation cost savings. Gude-Ties are available in a variety of lengths.

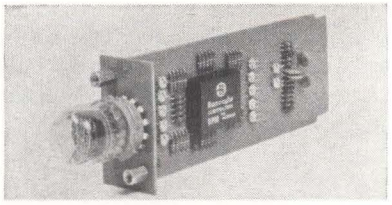
CIRCLE **366**, READER'S SERVICE CARD

Super-Silent Fan Moves Air at 60 CFM

ROTRON MFG. CO., INC., Woodstock, N. Y. The Whisper Fan, designed to move 60 cu ft of air per minute, measures 1½ in. deep by 4 11/16 in. sq. It has a built-in venturi block which serves as a frame for the complete unit. It is designed for continuous duty, requiring no maintenance, and operates at a quiet 18 db. It improves equipment performance by minimizing drift due to temperature changes within an enclosure, and extends life of components and tubes. **(367)**

Potentiometers

VOGUE INSTRUMENT CORP., 2350 Linden Blvd., Brooklyn 8, N. Y., has precision potentiometers in sizes from 1 in. to 3.31 in. with linearities up to 0.005 percent. **(368)**

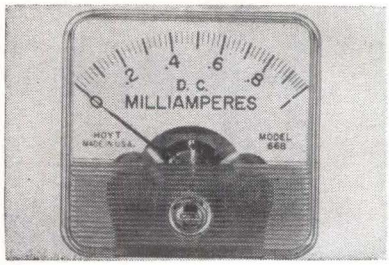


Solid State Counter Provides In-Line Readout

BURROUGHS CORP., P. O. Box 1226, Plainfield, N. J. Type BIP-8001 has a 100 Kc frequency capability and provides visual in-line readout

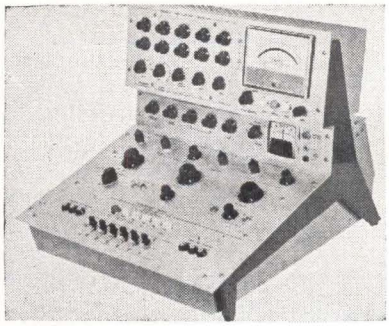
of the data by use of a Nixie indicator tube. Unit utilizes plug-in p-c construction and has an overall size of 1¼ by 2¼ by 7½ in. Counter features the use of a 90 silicon diode Bipco matrix package. The entire diode matrix is fabricated simultaneously from a single piece of silicon with diodes positioned to perform the counting function. The diodes are then joined to two circuit plates which provide input and output connections to the matrix.

CIRCLE **369**, READER'S SERVICE CARD



Miniature Meters Present Clear Scale

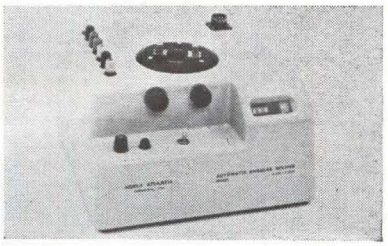
HOYT ELECTRICAL INSTRUMENT WORKS, INC., 42 Carleton St., Cambridge 42, Mass. The long scale (close to 1¾ in.) of the No. 668 meters presents high clarity due to the shadow-free clear plastic case and precise scale rendering. Meters feature jeweled bearings, high torque movement and accuracy within 2 percent. They are available for d-c applications in ammeters, milliammeters, and microammeters covering ranges from 5 amp to 100 μa. Also offered as d-c voltmeters up to 300 v. self-contained. **(370)**



Semiconductor Tester Operates Automatically

TEST EQUIPMENT CORP., P. O. Box 13185, Houston 19, Texas. Wide range semiconductor d-c tester with 1 percent meter accuracy measures breakdown voltages up to 1,000 v

and leakages down to 1 na full scale. Current gains from 5 to 50,000, base voltage, and saturation voltage can be measured with test currents up to 10 amp at 15 v. Test conditions for the five d-c tests are selected to within 0.5 percent by control panel switches. All tests can be sequenced at 0.5 sec each. **(371)**

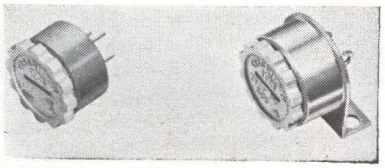


Angular Divider Tests Automatically

NORTH ATLANTIC INDUSTRIES, INC., 200 Terminal Drive, Plainview, N. Y. Model AAD-7100 is an angular divider for the automatic testing of precision rotary components. A synchro or resolver is mounted on the unit and automatically positioned to an angle indicated by the standard source driving the AAD-7100. The angular error can then be read directly from the digital counter readout. Price is approximately $3,000. **(372)**

Electrometer

WAYNE KERR CORP., 1633 Race St., Philadelphia 3, Pa. The M141 precision electrometer provides an accuracy of 0.1 percent from 1 mv to 10 v, in 44 effective ranges, and current from 10^{-7} to 10^{-15} amp, with an input impedance greater than 10^{16} ohms. **(373)**

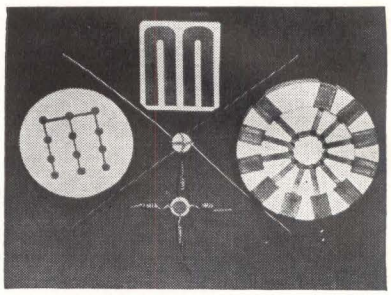


Miniature Trimmer Features Knob Adjust

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa. A ½-in. round trimming pot enables finger-tip adjustments to be easily made from either the top or the side

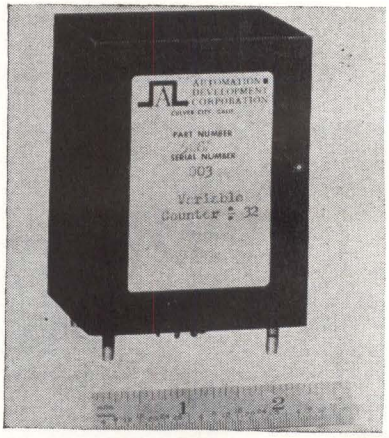
of the unit. Type CT-110 is designed for both military and industrial applications. Standard resistance range is from 10 ohms to 50,000 ohms. Standard tolerance is ±5 percent. Power rating is 1.0 w at 50 C, and operating temperature range is −55 C to 150 C.

CIRCLE **374**, READER'S SERVICE CARD



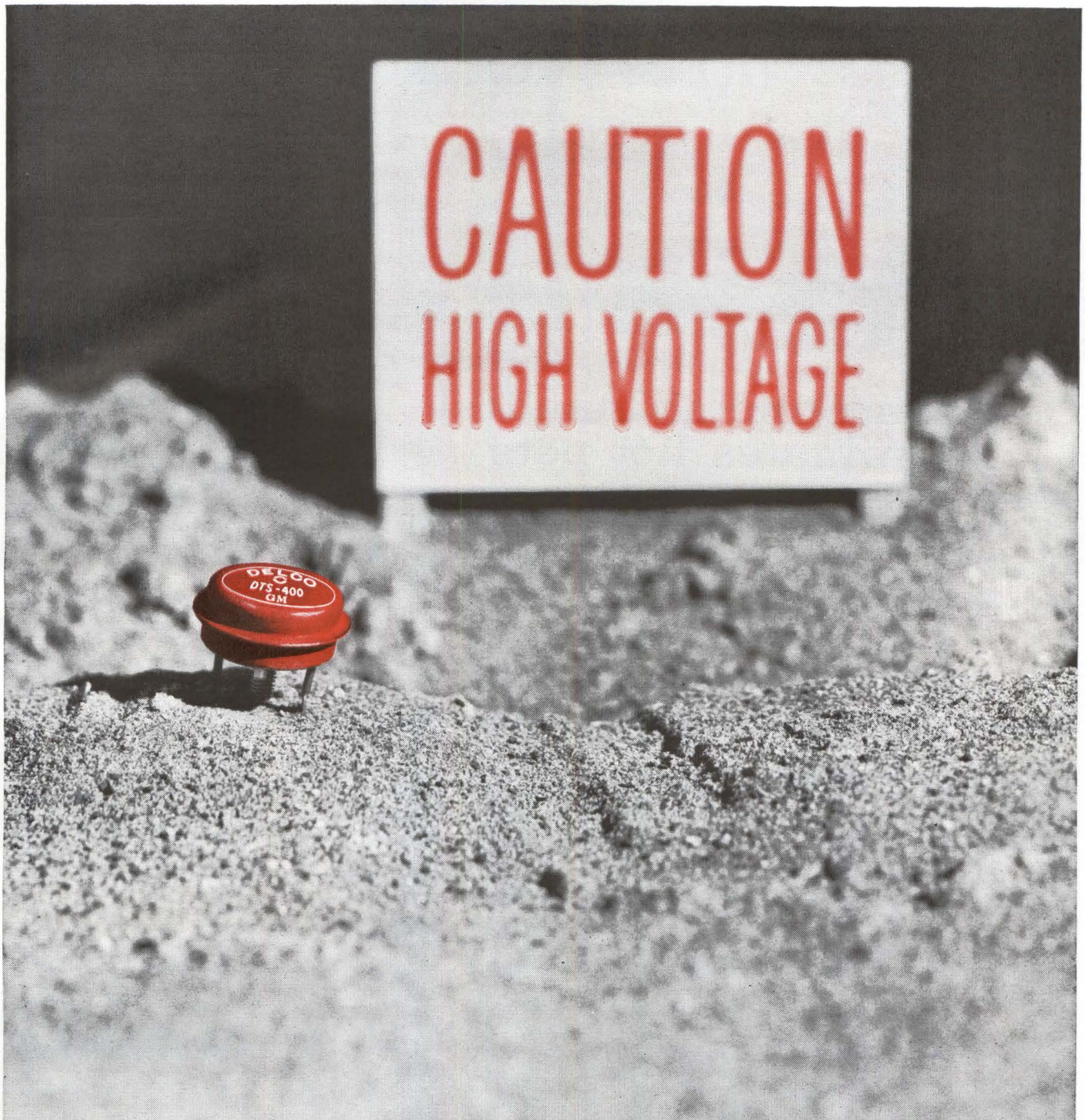
Metalized Ceramoplastic Exhibits Ruggedness

MYCALEX CORP. OF AMERICA, Clifton Blvd., Clifton, N. J. Metalized Supramica 620 BB has proved unusually rugged in the production of metalized circuits. In recent tests the material exhibited a pull strength as high as 10 lb in a disk of only $\frac{1}{8}$ in. in diameter. It features total dimensional stability; a dissipation factor, dielectric constant and loss factor at 1 Mc of 0.0023, respectively; 1,100 F heat distortion temperature; max temperature endurance of 1,200 F (unstressed); 5,000 psi tensile strength; 30,000 psi compressive strength. **(375)**



Variable Counter Has Digital Servo Uses

AUTOMATION DEVELOPMENT CORP., 11824 W. Jefferson Blvd., Culver City, Calif. Model 508A variable



This is the new DTS-400 from Delco Radio . . . one of the highest voltage silicon power transistors available. The DTS-400 offers Vceo, Vcbo and Vces of 400 volts. Because of its high voltage capabilities and its ability to withstand high temperatures, this transistor offers a significant advancement in the art of power conversion.

The Delco DTS-400's capabilities make possible "direct to line" voltage hook-ups eliminating the need for transformers or other devices in between . . . and their related space and weight requirements. Production samples of the new DTS-400 silicon power transistor are available now to help you reduce the size, weight and cost of your power package. For complete engineering data, write or call our nearest sales office.

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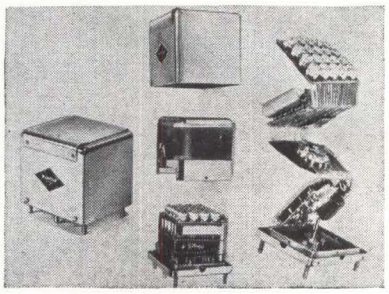
MUrdock 7-3770	TRinity 3-6560	UPton 0-8807	GRanite 2-2668	775-5411
AREA CODE 201	AREA CODE 313	AREA CODE 213	AREA CODE 315	AREA CODE 312

DELCO RADIO DEPENDABILITY RELIABILITY

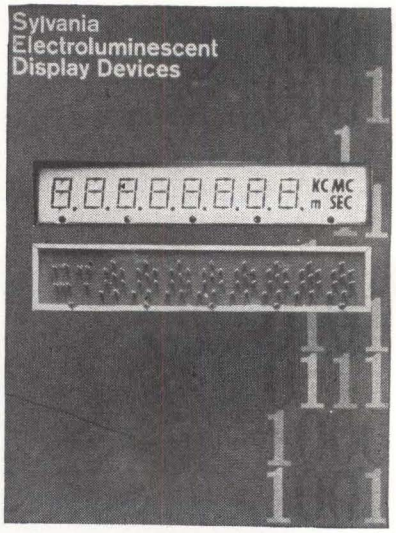
General Sales Office: 700 E. Firmin, Kokomo, Ind., Gladstone 2-8211—Ext. 500 • Area Code 317 • Division of General Motors, Kokomo, Ind.

counter is designed for digital servo applications so as to achieve optimum performance with variable pulse rate (or count) input. Units can be manufactured for almost any binary number and supplied in MIL-T-27A cases or plug-in cards. Single unit price is $245 (with quantity discounts).
CIRCLE **376,** READER'S SERVICE CARD



Crystal Oscillator Provides 20 Channels

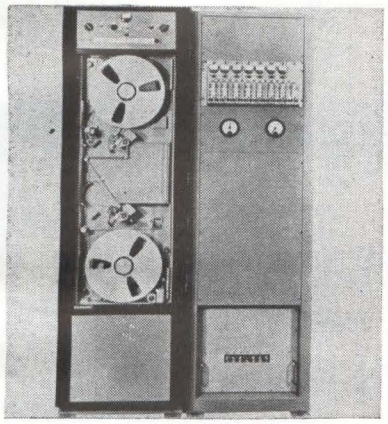
MONITOR PRODUCTS CO., INC., 815 Fremont, S. Pasadena, Calif. A 20-channel temperature-controlled crystal oscillator utilizes flexible circuitry with all components including capacitors, crystals, switch wafers, and oscillator mounted directly on the circuitry. Circuitry folds up into an area of less than 15 cu in. Unit provides 20 separate externally adjustable channels each with a frequency stability of 1 part in 10^6 from −55 to + 95 C. **(377)**



Electroluminescent Readout Device

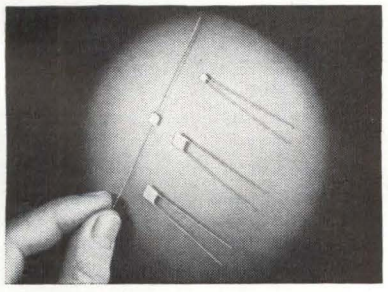
SYLVANIA ELECTRIC PRODUCTS INC., 730 Third Ave., New York 17, N. Y. The NU78A, a solid state unit, does not require a filament and is

therefore highly reliable when operated under rated conditions. The devices may be viewed over almost 180 deg. The ¾-in. size numeric requires only 8 Mw of power with all segments energized. Decay time of a typical EL phosphor is 2-5 μsec. Electroluminescent lamps decrease gradually in light output with operation. When operated as a display device, many thousands of hours of operation are obtained. **(378)**



Recorder/Reproducer Offers Time Delay

SANGAMO ELECTRIC CO., Springfield, Ill. The 480 series magnetic tape recorder/reproducer provides a fixed or continuously variable time delay between record and reproduce or between two reproduce operations on a pre-recorded tape. The desired delay (up to 30 sec at 60 ips) can be set by timers located on the second cabinet or by the data itself. The delay is accomplished by storing the tape in a bin located between the two capstans. **(379)**

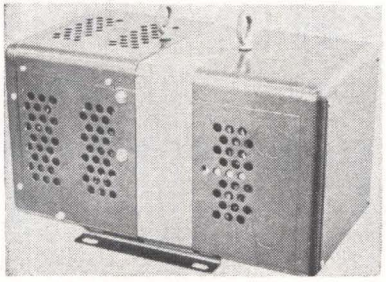


Thin Plate Capacitors Show High Stability

HI-Q DIVISION, Aerovox Corp., Olean, N. Y. Subminiature thin plate capacitors available in a variety of temperature coefficients permit maximum circuit component density

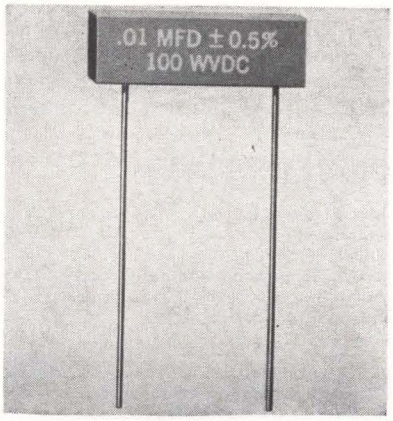
as a result of their slim rectangular design. All units are rated at 50 vdcw at 85 C and derated 50 percent at 125 C. Made with axial or radial leads, the ceramic capacitors are suited for transistorized circuits.

CIRCLE 380, READER'S SERVICE CARD



Line Regulator Uses No Moving Parts

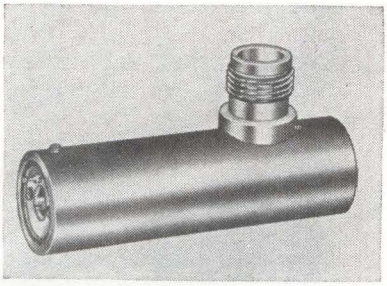
SOLA ELECTRIC CO., 1717 Busse Road, Elk Grove Village, Ill. Designed for 3-100 Kva use, the Solatron line voltage regulator is an electronic magnetic device offering fast response to line voltage changes or load conditions. Also, since it does not utilize moving parts, a high degree of reliability plus no maintenance is benefited. It features a ±1 percent output voltage envelope for variations of ±10 percent from selected nominal, zero to full load, and 57-63 cps. **(381)**



Thin Capacitor Has Polystyrene Dielectric

ARCO ELECTRONICS, INC., Great Neck, N. Y. Type PE capacitor, 0.1 in. thick, is designed for filter and p-c applications. It is available in the capacitance range of 0.001 to 0.01 μf. Higher values are being designed and lower values may be obtained on special order. Tolerance

range is from ±5 percent to ±¼ percent. Voltage rating is 100 vdcw; insulation resistance, 10^{12} ohms minimum at 25 C. Price: 35 cents to $3 per unit depending on quantity and tolerance. (382)

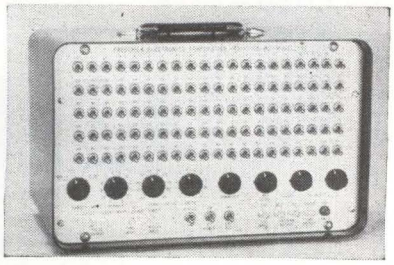


Pulsed Oscillators Designed for C-Band

TRAK MICROWAVE CORP., Tampa, Fla. Engineered for smallness and reliability are a pair of C-band plate-pulsed oscillators for radar beacon transmitters. Both operate at 5.4 to 5.9 Gc. The 9186C (illustrated) has a power output of 50 w minimum. It is ⅝ in. in diameter and 2⅛ in. long excluding projections. Type 2979C has a power output of 400 w minimum. It is 1 in. in diameter by 4 in. overall length, less output connector. (383)

Power Computer

OHIO SEMICONDUCTORS, 1205 Chesapeake Ave., Columbus 12, O. The Halltron model PC-523 3-phase power computer is an accurate wide band unit with rugged industrial construction and equipped with built-in output meter mounting flanges to add versatility. (384)

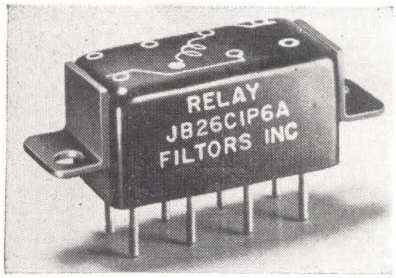


Pulse Pattern Generator Has Solid-State Design

FREDERICK ELECTRONICS CORP., 414 Pine Ave., Frederick, Md. Model 201 pulse pattern generator will generate pulses of any length from

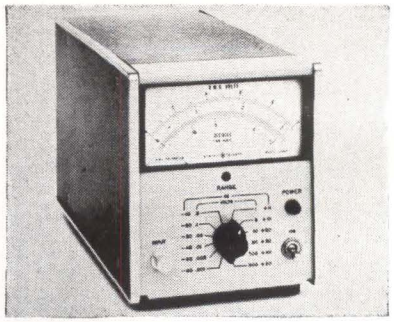
1 to 100 pulses with any combination of pulses from on and off—over 2^{100} possible patterns. It provides three different forms of pattern outputs: NRZ, RZ, and audio tone transmission gates for generation of keyed tone and two tone patterns. It operates with a pulse spacing continuously variable from 100 millisec to 10 μsec or from an external drive.

CIRCLE 385, READER SERVICE CARD



Crystal-Can Relay Measures 0.400 in. High

FILTORS, INC., 30 Sagamore Hill, Port Washington, N. Y. The Demi-J half-size crystal-can relay has a standard 0.2 in. grid header, yet it measures only 0.400 in. in height. Special automated welding equipment used to seal the unit assures a consistently reliable seal, and reduces the hazards of contact contamination. Specifications: 250 mw pull-in power, 30 g vibration from 5 to 2,000 cps, 2 amp or dry circuits contacts, 150 g shock, and an ambient temperature range from −65 to 125 C. **(386)**



RMS Voltmeter Covers Broad Range

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model 3400A makes possible accurate measurements of a broad range of sinusoidal or non-sinusoidal waveforms. It responds accurately to all

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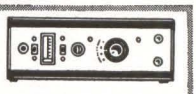

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REGULATION	1.8 V/A	1.4 V/A
METER	0-20 V/0 - 10A	.....
DC IMPEDANCE	1.8 ohms	1.4 ohms
PANEL FEATURES	On-off, meter function switches. Pilot light, variable DC control, insulated binding posts, fuse, 6' cord.	4-position voltage adjustment switch, pilot light, wing nut output terminals, 6' cord.

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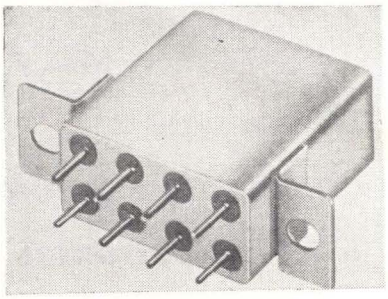
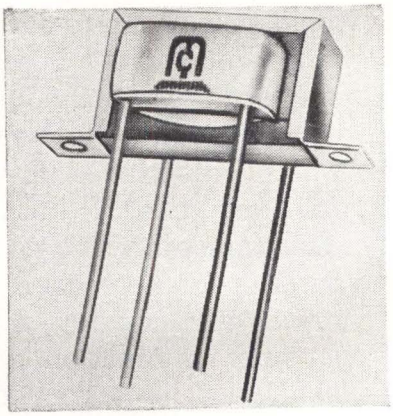
signals with a peak amplitude/rms amplitude ratio of 8:1. Accuracy is within ±1 percent of full scale from 50 cps to 3 Mc or within ±5 percent of full scale over its entire frequency range (10 cps to 8 Mc). Voltage range of 100 μv to 300 v is covered in 12 ranges, with a lowest full scale reading of 1.0 mv.

CIRCLE 387, READER'S SERVICE CARD



Microminiature Relay Failure Rate Tested

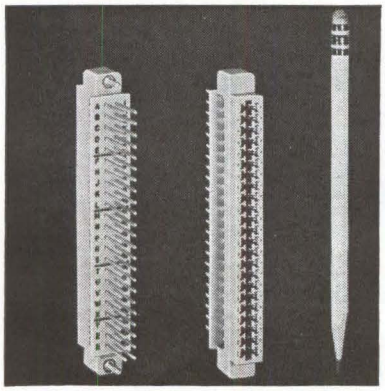
BABCOCK RELAYS, 1645 Babcock Ave., Costa Mesa, Calif. The BR-12-S87 is backed by a demonstrated failure rate of less than 0.18 percent in 10,000 operations with a 90 percent confidence factor. Through use of gold-plated headers, the new unit is claimed capable of substantially reduced socket contact resistance in plug-in applications, and better solderability with p-c lead terminals. (388)



Converter Transformers Offer High Reliability

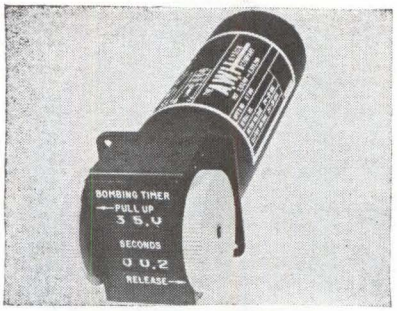
MICROTRAN CO., INC., 145 E. Mineola Ave., Valley Stream, N. Y. Line of d-c/d-c converter transformers permit conversion of low voltage d-c to high voltage for operating mobile and military electronic equipment. They have d-c input voltage varying from 2.7 v to 4 v and output volt-

ages of 500 v d-c. Constructions are available in either hermetic, open frame or epoxy, printed circuitry type. **(389)**



Card-Edge Connector Has Removable Contacts

ELCO CORP., Philadelphia, Pa. Series 6016 is a card-edge connector with cantilevered, bifurcated contacts. Photograph shows 46-contact model, a 23-position, double-contact connector, for use on double-sided card. Connector may also be used on a single-sided card as a 2 3-position, single-contact model. Series is designed for automatic wire wrap technique; but may also be hand-wrapped. **(390)**



Precision Timer Provides Two Ranges

THE A. W. HAYDON CO., 230 N. Elm St., Waterbury, Conn., has available a line of precision timers providing two adjustable timing ranges in a single 2¼ in. diameter housing less than 6½ in. long. Driven by a miniature d-c motor with a high accuracy chronometric governor, the timer uses two precision clutches to obtain the required timing. Accuracy of each of the timing functions is better than 100 millisec over the voltage range of 24-30 v d-c and temperature range of −54 C to 71 C. **(391)**

PRODUCT BRIEFS

TELEMETRY PREDETECTION RECORDING/PLAYBACK SYSTEM handles any type modulation. Price is $75,000. Defense Electronics, Inc., Washington-Rockville Industrial Park, Randolph Rd., Rockville, Md. **(392)**

PRESSURE SWITCH for missile use. Device carries 3 amp under 35 g vibration. Servonic Instruments, Inc., 1644 Whittier Ave., Costa Mesa, Calif. **(393)**

TINY ELASTOMERIC MOUNTINGS for control of shock and vibration. None larger than 1 in. in largest dimension and some smaller than an aspirin tablet. Lord Manufacturing Co., Erie, Pa. **(394)**

SWITCH LIGHT is front relamping, front mounting. It features 4 independent MS flange base lamps with silicon rubber color filters. Controls Co. of America, 1420 Delmar Drive, Folcroft, Pa. **(395)**

HIGH TEMPERATURE SOLDER, new 525 alloy. It is designed to eliminate cracked glass to metal seals. Alpha Metals, Inc., 46 Water St., Jersey City 4, N. J. **(396)**

WIRE INSULATION saves weight, size and cost. Turbogard (patent pending) is flame-retardant. Brand-Rex Div., American Enka Corp., 31 Sudbury Road, Concord, Mass. **(397)**

BI-PIN CARTRIDGE LAMPS with legends and lampholders. They are designed chiefly for computers and data processing equipment. Drake Mfg. Co., 4626 North Olcott Ave., Chicago 31, Ill. **(398)**

D-C DIGITAL VOLTMETER is low-cost, transistorized. It has ranges of 1, 10, 100 and 1,000 v, with an accuracy of ± 0.1 percent. Dynascan Corp., 1801 W. Belle Plaine, Chicago 13, Ill. **(399)**

INDICATOR LIGHTS have modular construction. This facilitates servicing, replacement and rearrangement in the field. Marco Industries Co., 207 S. Helena St., Anaheim, Cal. **(400)**

NONLINEAR POTENTIOMETERS meet any required output function. Winding is fabricated to the exact function configuration. Duncan Electronics, Inc., 2865 Fairview Road, Costa Mesa, Calif. **(401)**

REDUCTION MECHANISMS, 5:1 and 10:1 units. Devices are offered in a wide variety of shaft and body configurations. National Radio Co., 37 Washington St., Melrose, Mass. **(402)**

STATIC FREQUENCY CONVERTERS with ultra low harmonic content. Basler Electric Co., Highland, Ill. **(403)**

SILICON CONTROLLED RECTIFIERS for use in power control and switching. Available with ratings of 4.7, 10 and 16 amp. Fansteel Metallurgical Corp., North Chicago, Ill. **(404)**

MERCURY-WETTED-CONTACT RELAYS with multiple capsules. They provide

double-, three-, and four-pole contact assemblies. Automatic Electric Co., 400 N. Wolf Road, Northlake, Ill. **(405)**

OCEANOGRAPHIC INSTRUMENT in a 5 in. by 6 in. carrying case. Unit measures salinity, temperature and conductivity in situ. Industrial Instruments, Inc., 89 Commerce Road, Cedar Grove, N. J. **(406)**

SEAWATER BATTERY SYSTEMS are miniaturized modules. The high-energy silver chloride-magnesium units are available in cylindrical and rectangular shapes. Yardney Electric Corp., 40-50 Leonard St., New York, N.Y. **(407)**

C-C TV CAMERA is environment-proof. Full resolution is provided up to 2,000 ft from camera to control unit. Cohu Electronics, Inc., Kin Tel Division, 5725 Kearny Villa Road, San Diego 12, Calif. **(408)**

FRACTIONAL H-P MOTORS guaranteed for 20,000 hr continuous duty; 25 models available. McLean Syntorque Corp., West Hurley, N. Y. **(409)**

PNP GERMANIUM POWER TRANSISTORS operate at a collector current of 65 amp. Several voltage ranges are offered. Minneapolis-Honeywell Regulator Co., 1015 S. Sixth St., Minneapolis 4, Minn. **(410)**

2 KVA A-C REGULATOR has solid state design. Two types available: rack and panel or bench. Dresser Electronics/HST Division, 555 N. Fifth St., Garland, Texas. **(411)**

MICROWAVE TRANSMISSION-COEFFICIENT BRIDGE for continuous oscilloscope display. It measures characteristics of passive and active networks. Dielectric Products Engineering Co., Inc., Raymond, Maine. **(412)**

LOCKING MECHANISMS for ball-bearing slides. They fit any packaging need. Jonathan Mfg. Co., 720 E. Walnut Ave., Fullerton, Calif. **(413)**

BLOWERS and filter grille assemblies. The rfi equipment meets or exceeds all requirements of MIL-I-6181D. McLean Engineering Laboratories, Princeton, N.J. **(414)**

MICROWAVE TEST EQUIPMENT and sophisticated system components. A variety of antenna feeds are offered. Budd-Stanley Co., Inc., 175 Eileen Way, Syosset, N. Y. **(415)**

R-F SHIELDED ENCLOSURES and accessories. The latter include power line filters and waveguide air vents. Shielding Division of Shieldtron, Inc., Riverton, N.J. **(416)**

SINGLE-POINT RESISTANCE MICROWELDER welds ½ mil wire on 3 mil centers. Versatile device provides millisecond operation. Aerojet-General Corp., Azusa, Calif. **(417)**

FIVE-GALLON ULTRASONIC CLEANER with solid state transducers. The Polysonic System 320 is priced at $499.95. Ultrasonic Industries Inc., Ames Court, Engineers Hill, Plainview, L.I., N.Y. **(418)**

Literature of the Week

PUSHBUTTON SWITCHES Licon Div., Illinois Tool Works Inc., 6615 W. Irving Park Rd., Chicago 34, Ill., offers a brochure on the 01 series of miniature lighted pushbutton switches. (419)

THERMOCOUPLES Hoskins Mfg. Co., 4445 Lawton Ave., Detroit 8, Mich., has available a technical report on tungsten/tungsten-rhenium thermocouples. **(420)**

MAGNETIC SHIELDS Magnetic Shield Div. Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill., offers data sheet on magnetic shields for close fit and retrofit tubes. **(421)**

HALL EFFECT BIBLIOGRAPHY Helipot Div. of Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif. A 10-page bibliography conveniently lists reference material on Hall effect devices. **(422)**

ENVIRONMENTAL TEST CHAMBERS Conrad, Inc., 141 Jefferson St., Holland, Mich., has published a 56-page catalog in looseleaf form on environmental test chambers. **(423)**

STATIC INVERTERS Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N. J. Six-page bulletin provides technical details on solid-state d-c/a-c inverters. (424)

AMPLIFIER TEST CONSOLE Cohu Electronics, Inc., KinTel Div., Box 623, San Diego 12, Calif., has issued two-page data sheet on the model 111/112 amplifier test console. (425)

TRIMMING POTENTIOMETER Daystrom, Inc., Archbald, Pa., offers a data sheet on the 201 series Squaretrim subminiature trimming potentiometer. **(426)**

MICROWAVE CATALOG Turbo Machine Co., Lansdale, Pa., issues a catalog on fixed delay package waveguide systems and components. (427)

STRAIN GAGE RECORDING Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif. Bulletin describes a simple, reliable and economical method for recording in digital form the output of strain gages. **(428)**

FOIL TANTALUM CAPACITORS General Electric Co., Schenectady 5, N. Y. Bulletin covers a line of 85C, foil Tantalytic capacitors. **(429)**

PULSE GENERATOR Servo Corp. of America, 111 New South Road, Hicksville, L. I., N. Y., offers a folder on the Servopulse model 4500 10-Mc pulse generator. **(430)**

FILTERS Polyphase Instrument Co., E. Fourth St., Bridgeport, Pa. Bulletin 78 is a 12-page, 2-color selection guide for LC filters. (431)

SWITCHING TRANSISTORS Radio Corp. of America, Harrison, N. J. Six-page bulletin 62S3 describes high-

reliability, double-diffused, *npn* silicon planar, very-high-speed switching transistors. **(432)**

SOLID-STATE TRANSDUCERS Semtran Instruments, Inc., Route 73, Industrial Center, Maple Shade, N. J. Brochure describes transducers featuring high output, stability, and low cost. **(433)**

CERAMIC CAPACITORS Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J. Bulletin H6 deals with the Dot series of microminiature ceramic capacitors for insertion into p-c boards. **(434)**

NIXIE TUBES Burroughs Corp., P. O. Box 1226, Plainfield, N. J. has published a 28-page Nixie indicator tube catalog with complete information on all Nixie tube types. **(435)**

POTENTIOMETERS Carter Mfg. Corp., 23 Washington St., Hudson, Mass. Series of technical data sheets describe semiprecision, precision, and custom-designed pots and potentiometric transducers. **(436)**

BONDING & IMPREGNATION ADHESIVE Isochem Resins Co., 221 Oak St., Providence 9, R. I. Technical data bulletin covers Isochemfil 219 system for bonding and impregnation of motor laminates, iron cores and transformers, as well as glass cloth and paper laminations. **(437)**

PRESSURE TRANSDUCER Columbia Research Laboratories, Mac Dade Blvd. & Bullens Lane, Woodlyn, Pa. Technical bulletin describes model 100-P pressure transducer which measures 0.005 to 4,000 psi. **(438)**

DIODES National Transistor Mfg., Inc., 500 Broadway, Lawrence, Mass., Bulletin E-504 is entitled "Measuring Forward Conductance and Reverse Leakage of Silicon and Germanium Diodes". **(439)**

MICRODENSITOMETER Hogan FAXimile Corp., 635 Greenwich St., New York 14, N. Y. Product data bulletin No. 19 describes a rapid scanning microdensitometer. **(440)**

ULTRAMINIATURE CAPACITORS Aerovox Corp., 740 Belleville Ave., New Bedford, Mass. Bulletin lists design and capacity specifications of new ultraminiature capacitors. **(441)**

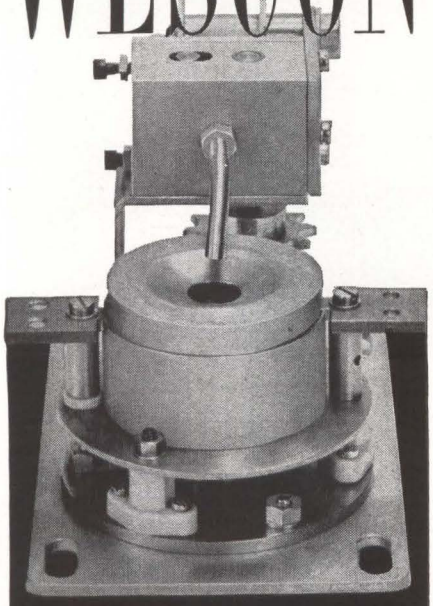
STEPPING SWITCHES Chicago Dynamic Industries, Inc., 1725 Diversey Blvd., Chicago 14, Ill., has released a catalog sheet on a 36-pole, 24 or 32-position removable wafer stepping switch. **(442)**

SCR POWER UNITS Electrologic Corp., 4165 W. 11th Terrace, Fort Lauderdale, Fla. Four-page brochure illustrates and describes industrial packaged scr power units. **(443)**

PARTICLE-MONITOR RECORDER Royco Instrument Inc., 440 Olive St., Palo Alto, Calif., has issued a leaflet on a digital-printing auxiliary for airborne- or liquidborne-particle monitor application. **(444)**

GLASS-TO-METAL SEALS Seal-A-Metic Co., 1 John St., Haledon, N. J., has available a data sheet on basic glass-to-metal technology. **(445)**

BOOTH 3731 WESCON



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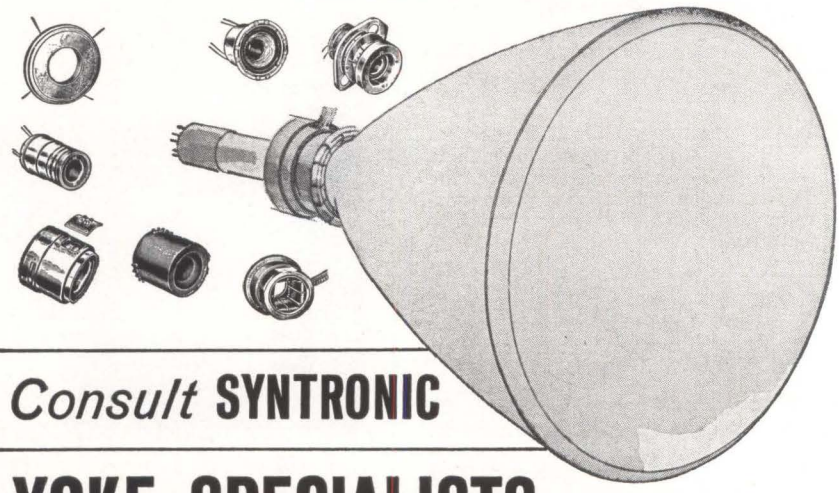

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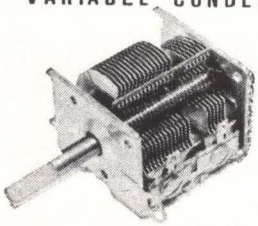

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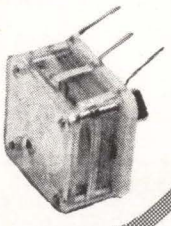

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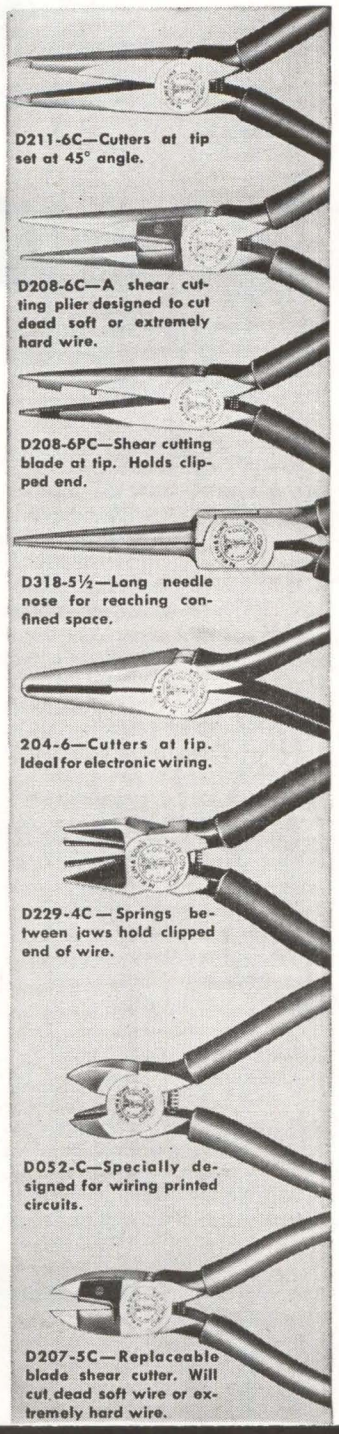

D211-6C—Cutters at tip set at 45° angle.

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Duncan: WESCON's Galloping Chairman

LOS ANGELES—Chairman of the 1962 WESCON Board is Donald C. Duncan, energetic and affable president of Duncan Electronics and long acknowledged as one of the nation's top authorities on potentiometers.

Duncan has exhibited an intense interest in West Coast industry affairs resulting in his holding in rapid succession such posts as secretary, treasurer, vice chairman, and a director of WEMA. In 1958 he was elected president of the association, and a year later became director of WESCON. His appointment as board chairman this year was the natural culmination of his four-year tenure on the board.

EARLY YEARS—Born at State College, Pa., in 1918, Don grew up near the Penn State campus—where his father was a professor of physics—and matriculated there in 1936. He had completed several engineering courses while still in high-school, and left the campus as a double-degree graduate (EE and ME).

He worked as a test engineer for GE until the outbreak of World War II, when he was "loaned" to the Navy Bureau of Ships, Electrical Section, in Washington, D. C. Five years later he had achieved the rank of senior engineer.

Moving to California he teamed up with Arnold Beckman, a Cal Tech professor whose pH meters were finding an increasing number of applications throughout agriculture and industry. Working his way up from sales manager of the Helipot division of Beckman Instruments, he became vice president and general manager in 1951. Under Duncan's management, Helipot grew from a 100-man organization to one with well over 1,000 employees and branch offices in New Jersey and Canada.

His new company, formed two years ago, still manufactures potentiometers under some of the Helipot patents, and has pushed forward the technology of several new areas.

Commenting on the rapid increase in formation of new companies within the industry, Don states that many capable engineers are being forced into administrative positions when they should be working at what they can do best —engineering. "On the other hand," he points out, "the manager of any electronics company must stay close to engineering to be effective".

WESCON'S ROLE — Now that WESCON has attained the status of one of the country's largest trade shows, Don visualizes it as an increasingly important medium for disseminating information among all facets of industry as well as to the public, and financial and governmental groups.

"WESCON provides a meeting place where exhibitors can display their wares," he observes, "but more importantly, it provides the opportunity to familiarize ourselves with the needs of our customers and to observe what others are doing in similar areas. In a fast-moving industry where we have to keep informed or fall by the wayside, WESCON's job is to provide the best possible atmosphere for exchanging information on all levels."

With the separation of trade exposition and technical program, he believes that the proper emphasis can be placed on both activities.

Don's energy and diversity of interests extend to his two-acre, Santa Ana ranch situated on a hill overlooking Newport Beach where he leads an active family life with his wife Janet and their three daughters. His hobbies include woodworking, gardening, and animal husbandry. His efforts in the third category focus primarily on four horses and a mule, a variety of dogs, cats, chickens, geese, mallard ducks, parakeets, fish, and a spirited young steer named Martini.

Duncan Electronics is one of the

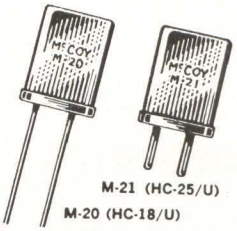
McCoy CRYSTALS & CRYSTAL FILTERS

Regardless of its size, type, or frequency any crystal bearing the name McCoy can be relied upon to deliver the ultimate in frequency control despite wide temperature variations and extreme conditions of shock and vibration.

M-1 (HC-6/U)

METAL ENCASED STANDARD SIZE AND MINIATURE CRYSTAL UNITS

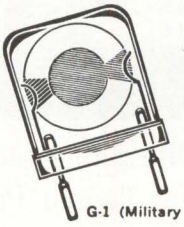
SHOWN ACTUAL SIZE



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

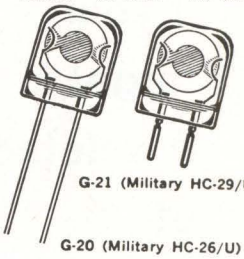
The crystals that made the name of McCoy a synonym for quality. Metal encased, HC-6/U size is available in frequencies from 500.0 kc to 200.00 mc.

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


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

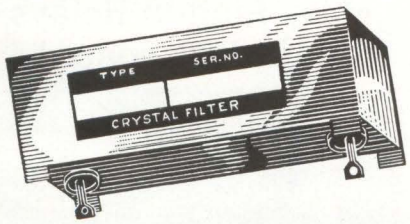
This vacuum sealed, hard glass crystal unit possesses all of the quality features for which the McCoy M-1 is so famous. It has long term frequency stability five times better than the conventional metal types. Available in frequencies from 1000 kc to 200 mc.

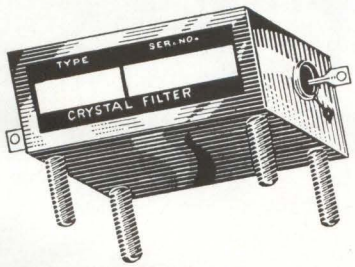
This vacuum sealed, hard glass crystal unit meets the new CR-73/U and CR-74/U specifications. It has long term frequency stability five times better than the conventional metal type. Available in frequencies from 5000 kc to 200 mc.


SHOWN ACTUAL SIZE

MICRO MODULE CRYSTALS (GLASS)

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.



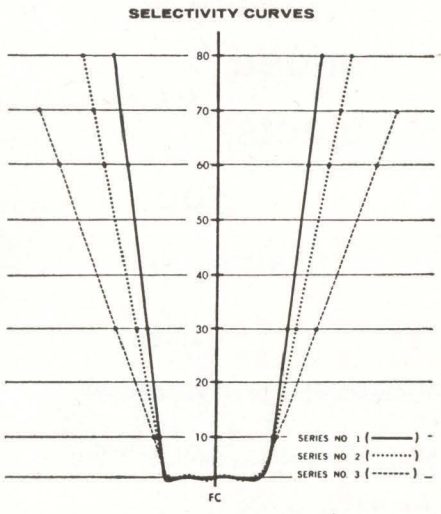


CRYSTAL FILTERS

McCoy crystal filter engineering and production capabilities are among the finest in the world and constantly in demand by industry, the military, and everyone searching for quality. A complete technical staff stands ready at all times to discuss your filter requirements. Many standard models are available without costly design and prototype charges.

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%



SEE THE NEW McCoy HIGH-FREQUENCY CRYSTALS AND CRYSTAL FILTERS at BOOTH No. 2087 WESCON SHOW LOS ANGELES SPORTS ARENA AUGUST 21-24

McCoy ELECTRONICS CO.
Dept. 1862
MT. HOLLY SPRINGS, PA.
Phone: HUnter 6-3411
Area Code: 717
SUBSIDIARY OF OAK MANUFACTURING CO.

Write today for our free illustrated catalogs which include complete listing of MIL-C-3098C military specifications. For specific needs, write, wire or phone. Our research section is anxious to assist you.

very few companies in the industry to sport a hitching post near the executive parking area. When the mood strikes, Don saddles up and gallops off to work.

Tellerman Assumes New Tempo Position

JACOB TELLERMAN has been named chief engineer and director of development for the newly-established Systems division of Tempo Instrument Inc., Plainview, L. I., N. Y. He was formerly responsible for advanced digital techniques on the engineering staff.

Before joining Tempo, Tellerman was supervisor of computer development for American Bosch Arma.

General Electric Promotes Dickerson

ARTHUR F. DICKERSON has been named manager of advanced engineering for the Advanced Product Planning Operation (APPO) of General Electric's Electronic Components division in Schenectady, N. Y.

Formerly advance project planning manager for the operation, Dickerson replaces James D. Keister who transferred to the com-

pany's Defense Systems department.

IFI Names Zolides Plant Manager

WILLIAM H. ZOLIDES has been appointed plant manager of Instruments For Industry, Inc., Hicksville, N. Y. He will be responsible for production, quality control, procurement, and plant engineering.

Before joining IFI, Zolides was associated with Potter Instrument Co., The Liquidometer Corp., Norden-Ketay Corp., and Chance-Vought Aircraft Corp.

Micro-Radionics Hires Chief Engineer

OLIVER R. PRICE has been named chief engineer of Micro-Radionics, Inc., Van Nuys, Calif., manufacturer of precision microwave components and test equipment.

Before taking this post, Price was project engineer, heading the advanced studies section, of Hughes Aircraft Research and Development Laboratories.

Elect Schwartz to Burmac Board

MISCHA SCHWARTZ, acting head of electrical engineering department

of Brooklyn Polytechnic Institute, has been elected to the board of directors of Burmac Electronics Co., Inc., Farmingdale, L. I., N. Y.

Schwartz joined the teaching staff of Brooklyn Poly in 1952, soon became professor of electrical engineering and has been acting head of the department since January of this year. From 1947 to 1952 he was a project engineer with the Sperry Gyroscope Co.

Announce Formation Of New Company

ANNOUNCEMENT was recently made of the formation of Intercontinental Instruments Inc., Farmingdale, N. Y., an electronics firm involved in the data processing, spectrum analysis and pulse generation areas, both in government contract and commercial fields.

Leroy Packer, formerly director of the Electronics division of the General Applied Science Laboratories, Inc., was named president of the new firm.

PEOPLE IN BRIEF

Edward L. Dashefsky moves up from div. mgr. to a v-p of Raytheon Co. **George A. Louis** promoted to chief product engineer of the Solid State div. of the Nuclear Corp. of America. **Norman M. Wittman,** ex-P. Wall Mfg. Corp., has formed his own soldering consulting and engineering service in Paterson, N. J. **Andrew F. Haiduck** advances to president of the Astronics div. of Lear Siegler, Inc. **Leon D. Carr,** formerly with Sperry Gyroscope Co., appointed head of the application engineering dept. of Hi-G, Inc. **Michael A. Moscarello,** previously

with Ford Instrument Co., named operations mgr. of the Defense Products div. of Fairchild Camera and Instrument Co. **Wayne A. Burnett** elevated to director of technical planning and **Robert L. Riddle** succeeds him as head, Electronic Systems dept. at HRB-Singer, Inc. **William R. Sweeney,** formerly with SoundScriber Engineering Corp., elected v-p, government operations, of Daystrom, Inc. **John F. Emhardt,** president of Ken Metal Industries, Inc., elected a member of the board of Volkert Stampings, Inc. Babcock Electronics Corp. advances **Alden C. Packard** to g-m of the Military Products div. **Arthur Goldsmith,** formerly with Wilcox Electric Co., appointed senior staff engineer at the Chicago Center, Motorola Military Electronics div. **Robert E. Swift,** until recently with Sprague Electric Co., named v-p and g-m of Genistron of Illinois. **Harold E. Felix** leaves Midwestern Instruments to join the Martin Co. Space Systems div. as a principal staff engineer. **Leonard D. Seader,** from Granger Associates to Applied Technology, Inc., as a project engineer.

Wescon Exhibitors And Booth Numbers

A

B

C

J

K

L

M

S

T

U

V

W

XYZ

electronics

WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE

ATTENTION: ENGINEERS, SCIENTISTS, PHYSICISTS

This Qualification Form is designed to help you advance in the electronics industry. It is unique and compact. Designed with the assistance of professional personnel management, it isolates specific experience in electronics and deals only in essential background information.

The advertisers listed here are seeking professional experience. Fill in the Qualification Form below.

STRICTLY CONFIDENTIAL

Your Qualification form will be handled as "Strictly Confidential" by ELECTRONICS. Our processing system is such that your form will be forwarded within 24 hours to the proper executives in the companies you select. You will be contacted at your home by the interested companies.

WHAT TO DO

1. Review the positions in the advertisements.
2. Select those for which you qualify.
3. Notice the key numbers.
4. Circle the corresponding key number below the Qualification Form.
5. Fill out the form completely. *Please print clearly.*
6. Mail to: D. Hawksby, Classified Advertising Div., ELECTRONICS, Box 12, New York 36, N. Y. (No charge, of course).

COMPANY	SEE PAGE	KEY #
AF SC-AFLC Joint Professional Professional Placement Office New York, New York	193	1
ANTENNA SYSTEMS INC. Hingham, Massachusetts	192	2
ATOMIC PERSONNEL INC. Philadelphia, Pennsylvania	190	3
AVCO RESEARCH AND ADVANCED DEVELOPMENT a division of Avco Corporation Wilmington, Massachusetts	194	4
THE BENDIX CORPORATION Kansas City Division Kansas City, Missouri	196	5
BRISTOL COMPANY Waterbury, Connecticut	70*	6
DOUGLAS AIRCRAFT CO. Missile and Space Systems Div. Santa Monica, California	96	7
ESQUIRE PERSONNEL SERVICE INC. Chicago, Illinois		
GENERAL DYNAMICS ASTRONAUTICS San Diego, California	17–20*	9
HOUSTON INSTRUMENT CORP. Bellaire, Texas	190	10
JET PROPULSION LABORATORY Pasadena, California	190	11
LOCKHEED MISSILES & SPACE CO. Div. of Lockheed Aircraft Corp. Sunnyvale, California	110	12
LOS ALAMOS SCIENTIFIC LABORATORY Los Alamos, New Mexico	190	13
McDONNELL St. Louis, Mo.	192	14

CONTINUED ON PAGE 192

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electronics WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE

(cut here)

(Please type or print clearly. Necessary for reproduction.)

Personal Background

NAME .....

HOME ADDRESS .....

CITY .....**ZONE**.....**STATE**.....

HOME TELEPHONE .....

Education

PROFESSIONAL DEGREE(S) .....

MAJOR(S) .....

UNIVERSITY .....

DATE(S) .....

FIELDS OF EXPERIENCE (Please Check)

81062

☐ Aerospace	☐ Fire Control	☐ Radar
☐ Antennas	☐ Human Factors	☐ Radio—TV
☐ ASW	☐ Infrared	☐ Simulators
☐ Circuits	☐ Instrumentation	☐ Solid State
☐ Communications	☐ Medicine	☐ Telemetry
☐ Components	☐ Microwave	☐ Transformers
☐ Computers	☐ Navigation	☐ Other .....
☐ ECM	☐ Operations Research	☐ .....
☐ Electron Tubes	☐ Optics	☐ .....
☐ Engineering Writing	☐ Packaging	☐ .....

CATEGORY OF SPECIALIZATION

Please indicate number of months experience on proper lines.

	Technical Experience (Months)	Supervisory Experience (Months)
RESEARCH (pure, fundamental, basic)	.....	.....
RESEARCH (Applied)	.....	.....
SYSTEMS (New Concepts)	.....	.....
DEVELOPMENT (Model)	.....	.....
DESIGN (Product)	.....	.....
MANUFACTURING (Product)	.....	.....
FIELD (Service)	.....	.....
SALES (Proposals & Products)	.....	.....

CIRCLE KEY NUMBERS OF ABOVE COMPANIES' POSITIONS THAT INTEREST YOU

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

CONTROLS ENGINEERS

*

INSTRUMENTATION SPECIALISTS

are invited to investigate the advantages of affiliation with

LOS ALAMOS SCIENTIFIC LABORATORY

the Laboratory with a reputation for leadership in

NUCLEAR ROCKETRY

a program with a future

LASL is expanding its ROVER test facilities and establishing a permanent organization at the National Nuclear Rocket Development Center near Las Vegas, Nevada. Career opportunities exist for capable electronics engineers involving the design and analysis of controls and instrumentation systems in connection with very high power, fast start-up, nuclear reactors.

CONTROLS SYSTEMS ENGINEERS:

Work involves design and analysis of closed-loop feedback control systems and programmers controlling reactor and flow systems. Included are such areas as reactor power control, turbo pump control, mass flow rate or thrust control systems, profile programmers, and automatic start-up and sequencing equipment. Work requires a B.S., M.S., or Ph.D. degree in Electrical Engineering plus substantial experience with design, operation and analysis of feedback control systems. A good background in mathematics and theory of servomechanisms is important.

INSTRUMENTATION ANALYSTS:

This work involves the determination of instrumentation requirements for each test, reduction of test data, and data analysis. A B.S., M.S., or PhD. degree in Electrical Engineering or Nuclear Engineering plus substantial experience in instrumentation utilizing transducers, multiplex systems, and magnetic tape recording and decoding is required.

Los Alamos Scientific Laboratory offers many attractive employment benefits, including liberal compensation for extended work week at the test site.

Laboratory representatives will attend the Wescon meetings in Los Angeles August 21st through 24th. For further information or interview appointment, telephone Mr. Robert Meier at MADISON 9-1933 during the convention, or write

Recruiting Department

LOS ALAMOS SCIENTIFIC LABORATORY

P. O. Box 1663

Los Alamos, New Mexico

An equal opportunity employer.

U. S. citizenship required.

EMPLOYMENT OPPORTUNITIES

The advertisements in this section include all employment opportunities — executive, management, technical, selling, office, skilled, manual, etc.

Look in the forward section of the magazine for additional Employment Opportunities advertising.

— RATES —

DISPLAYED: The advertising rate is $40.17 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured 7/8" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED: $2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box numbers—count as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

CHIEF ENGINEER

To $22,500 Per Year

BSEE, however a MS or PHD is preferred. Experience at the department or program level, where groups of engineering and support personnel were supervised. Knowledge of Digital Systems and Solid State Devices required. Company client assumes all expenses.

ESQUIRE PERSONNEL SERVICE INC.
202 S. State St. Chicago 4, Ill.

ELECTRONIC CIRCUIT DESIGNERS

Excellent opportunity in New Products Department of rapidly growing company making recorders and laboratory test instruments. Requirements are a degree in electrical engineering from a leading college or university and three or more years experience in instrument circuit design employing both vacuum tubes and transistors. All development work would be on proprietary instruments.

Write in confidence to:

Technical Director
HOUSTON INSTRUMENT CORPORATION
4950-4951 Terminal Avenue
Bellaire 101, Texas.

POSITION VACANT

Department of Scientific & Industrial Research, New Zealand. Vacancy No. 9/62/2096: Scientific Officer, (Electronics Engineer) Institute of Nuclear Sciences, Lower Hutt. The Institute of Nuclear Sciences has a vacancy for an Electronics Engineer to supervise the maintenance and modifications to electronic equipment now in operation at the Institute, including four mass spectrometers and three low background shielded counter assemblies with associated electronics used for tritium and carbon-14 age determination measurements and to plan and design electronic equipment for experiments planned using the 3 Mec Van de Graaff accelerator to be installed at the Institute. The electronic group is expected to expand considerably within the next few years as plans are being formulated for the purchase and installation of a Research Reactor. The qualifications desired are an honours degree in Physics, an Engineering degree in Electricity or a similar qualification from a chartered professional institute with experience in the designing of transistorized pulse and digital circuits. The salary offered is up to 2,300 pounds a year according to age and experience. Fares payable-minimum first class rail and/or steamer fares by shortest and most direct route to New Zealand plus fares from port of arrival to destination in New Zealand. In addition certain other actual expenses are payable and details of these can be obtained, together with application forms, from the New Zealand Consulate-General, Suite 530, 630 Fifth Avenue, New York 20, N. Y. Applications close August 31, 1962.

jpl needs

SENIOR ELECTRONIC ENGINEERS

DIGITAL COMMUNICATIONS TECHNIQUES

To lead communication demodulation development employing programmable or general purpose digital machines. Study and development is long term, aimed at developing practical demodulation hardware for ground station use. Applicant should have MSEE or better and be interested in making a practical contribution to spacecraft reception implementation.

Send complete resume to
PERSONNEL DEPT. 334

JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY
4814 OAK GROVE DR. • PASADENA, CALIF.

"An equal opportunity employer"

E. E.'s

For professional, individualized fee-paid service write for confidential application.

A national employment agency for the Nuclear & Scientific Fields.

ATOMIC PERSONNEL, INC.
Suite 1207L, 1518 Walnut St., Phila. 2, Pa.

COMMUNICATIONS APPLICATION ENGINEER

Analysis of advanced electronic communication systems including radio, carrier, telephone, microwave:

Must have design and marketing experience with commercial and military users.

EE degree, 5 yrs. exp. min.

Send Resume to:

Microwave Services International Inc.
Consulting Engineers
Route 46 Denville, N. J.

Electronic Instrument Technicians

The Oak Ridge National Laboratory
Operated by
UNION CARBIDE NUCLEAR COMPANY
at
Oak Ridge, Tennessee
Has openings for

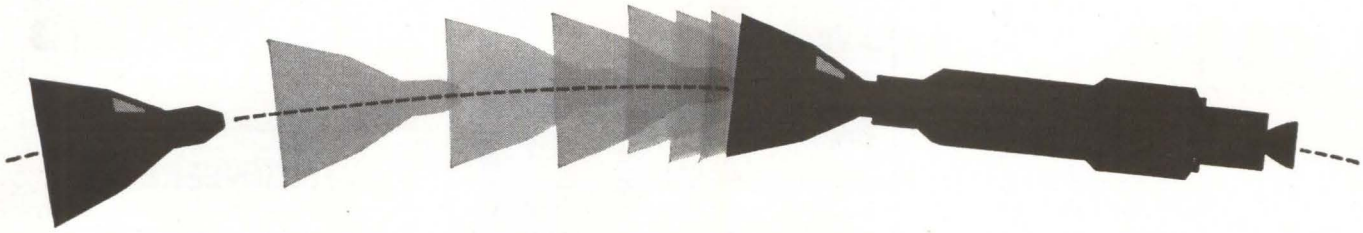
Highly skilled electronic instrument technicians to work with electronic engineers in the development, installation and maintenance of electronic systems. Digital data handling, transistorized pulse height analyzers, analog and digital computer systems are only a few examples.

Minimum high school education, with additional training in electronics and at least three years' experience in installation and maintenance of complex electronic systems. Entrance rate $3.10 per hour; $3.16 per hour after six months. Reasonable interview and relocation expenses paid by Company.

Excellent Working Conditions
and
Employee Benefit Plans
An Equal Opportunity Employer

Send detailed resume to:

Central Employment Office
UNION CARBIDE NUCLEAR COMPANY
Post Office Box M Oak Ridge, Tennessee



GEMINI

first manned rendezvous in space

How do you dock a two-man spacecraft with another vehicle in earth orbit? What happens when astronauts are weightless for a week or more? Project Gemini is calculated to answer these vital questions. The test of rendezvous techniques alone is a crucial experience in man's drive for the moon —and the results will be invaluable.

Unusual capabilities are needed to solve the intricate and demanding problems of Gemini (and, after Gemini, Apollo).

NASA needs senior aerospace engineers with 6 to 10 years experience in . . . . Systems analysis and studies • Systems engineering • Spacecraft and flight missions • Reliability assessment • Launch vehicles and propulsion • Systems integration and checkout.

NASA offers you unequaled resources and unlimited opportunities for professional growth and recognition. Send just one resume to NASA, Director of Professional Staffing, Dept. 502, NASA Headquarters, Washington 25, D.C. Positions in various locations and in other disciplines—many requiring less experience—are also available.

All qualified applicants will receive consideration for employment without regard to race, creed or color, or national origin. Positions are filled in accordance with Aero-Space Technology Announcement 252-B.

electronics

WEEKLY QUALIFICATIONS FORM FOR POSITIONS AVAILABLE

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*These advertisements appeared in the 8/3/62 issue.

ELECTRONIC ENGINEERS

☆ ☆ ☆

AEROSPACE SYSTEMS ORIENTED

SCIENTISTS ENGINEERS

Investigate Career Opportunities With The

UNITED STATES AIR FORCE

☆ ☆ ☆ ☆

The United States Air Force has designated the AIR FORCE SYSTEMS COMMAND as the single overall manager for the many steps involved in the acquisition of aerospace systems—including applied research, advanced technology, development, test, procurement, contract management and missile site activation.

To provide essential direction and support to this broad spectrum of challenging programs, AFSC maintains its own in-house capability through a number of divisions, centers and contract management regions located throughout the nation. The responsibilities and missions assigned to these highly specialized organizations embrace most of the basic scientific and engineering disciplines and their inter-relations.

The staff of AFSC makes direct contributions to some of this nation's most challenging and vital aerospace programs. This provides an opportunity for the scientists and engineers of AFSC to work across a broad spectrum of technical areas. Many of the basic ideas, techniques, and concepts on which future Air Force systems are based come from AFSC's own staff.

The United States Air Force has assigned the AIR FORCE LOGISTICS COMMAND the mission of insuring that Air Force combat units throughout the world are equipped for instant action to meet any emergency. To accomplish this, AFLC is responsible for supply and maintenance of aerospace systems, equipment and supplies for the entire Air Force. The Command also has sizeable and complex service engineering responsibilities.

Staffing of AFLC's installations provides engineer career opportunities in the logistics areas of maintenance, procurement and supply and in areas concerned with planning and preparing for support of future space vehicles.

Current positions are open for engineers with B.S., M.S., and PhD. degrees.

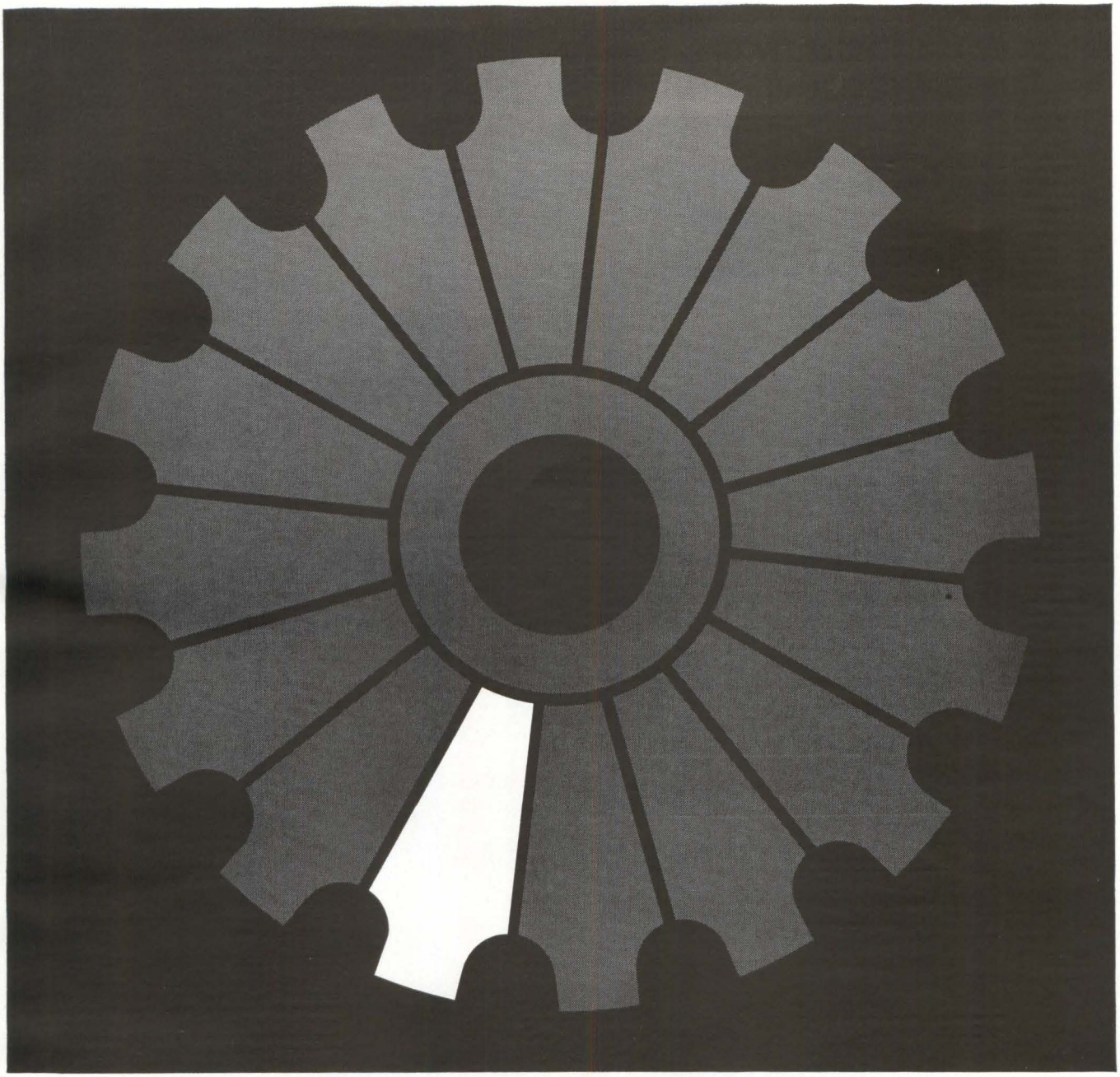
For more information and the career opportunities available, send resume to:

AFSC - AFLC

JOINT PROFESSIONAL PLACEMENT OFFICE

527 Madison Avenue, New York 22, New York

An Equal Opportunity Employer



FOR OUTER SPACE . . . THE COG AND THE WHEEL.

Program-oriented approach to space age problems lets engineers and scientists at Philco Western Development Laboratories play an important . . . and totally satisfying role in communications and control projects associated with major U. S. satellite programs. The typical Philco WDL program starts with careful analysis of the mission requirements and ends with field activation of equipment, plus test and . . . in many cases . . . continued operation. Thus, the engineer and scientist who begin the project are "on the spot" when theory and advanced techniques become operational equipment. Every cog in the Philco WDL space achievement is an integral part of the wheel.

Write in confidence for information on how you can find your career at Philco WDL, with the additional rewards of ideal living on the San Francisco Peninsula and professional and monetary advancement commensurate with your own ability. Requirements include B.S. or advanced degree (electronics, mathematics, physics), and U. S. Citizenship or currently transferable D.O.D. clearance. Address Mr. Patrick Manning, Department E-8..

PHILCO
A SUBSIDIARY OF
Ford Motor Company

WESTERN DEVELOPMENT LABORATORIES
3875 Fabian Way, Palo Alto, California
an equal opportunity employer

7760

Outstanding Opportunities

in an

ADVANCED COMPUTER CENTER

Challenging, unique, and immediate positions are available at **all levels** for personnel interested in these areas:

PROGRAMMING
MECHANIZATION
OPERATION AND MAINTENANCE
DEVELOPMENT OF ADVANCE CAPACITY TECHNIQUES

COMPUTERS YOU'LL USE

DIGITAL IBM 7090's

ANALOG EAI PACE

HYBRID COMPUTERS

COMPUTER APPLICATIONS IN

ORBITAL MECHANICS
SPACE PHYSICS
NUCLEONICS
AERO-THERMO HYDRODYNAMICS
ENGINEERING
ADAPTIVE SYSTEMS
PATTERN RECOGNITION
SYSTEM DEVELOPMENT
REAL TIME SYSTEMS

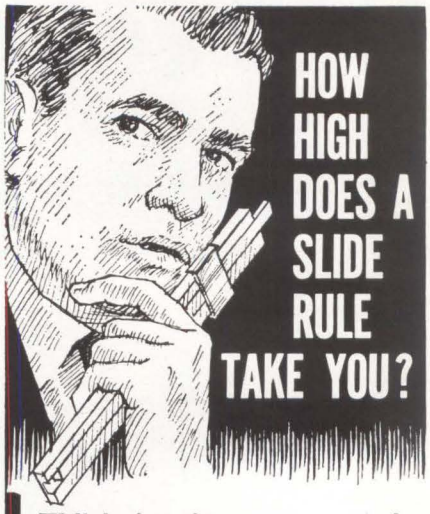
We invite you to inquire further by sending your resume to:

Mr. G. Starr
Employment Services
12214 Lakewood Blvd.
Downey, California

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

SPACE AND INFORMATION SYSTEMS DIVISION

North American Aviation



HOW HIGH DOES A SLIDE RULE TAKE YOU?

Well, look at the management echelon of your company . . . are they engineers? Or are you blocked by an executive barrier which only salesmen or financial men may aspire to pass? Most decision-makers at Bendix are engineers because Bendix is essentially an engineering corporation. Thus we offer you a barrier-free opportunity plus many other professional inducements. Investigate them!

ELECTRONIC TEST EQUIPMENT DESIGN ENGINEERS

To develop, design and supervise construction of special electronic test instruments, and to direct the technical activities of others in the organization. These positions require familiarity with test equipment problems and inspection techniques. Past association with military electronic equipment or experience in precision measurement of production items would assist you in qualifying for these positions. EE degree required.

SYSTEMS COORDINATING ENGINEERS

Responsible for technical management and coordination of mechanical and electrical systems in development and production. Program includes directing the activities of other engineering support groups and manufacturing organizations as well as maintaining liaison with outside design agencies. Requires a basic knowledge of production techniques and processes employed in sheet metal, light or heavy tooling, and gaging. Minimum of 4 years experience in the engineering phases of a manufacturing organization. ME or EE with mechanical experience necessary.

COMPONENTS SPECIALISTS

EE or physics degree with 4 to 6 years experience in gaseous tube design and/or production. Requires the application of gas tubes to triggering and control circuitry.

KANSAS CITY is a delightful place to live; visitors frequently call it America's most beautiful city. Living costs are moderate; recreational, cultural and educational facilities are plentiful. Choice suburban living only minutes away; no traffic problems.

We cordially invite you to submit your resume in strict confidence to Mr. D. M. BOWEN, Technical Personnel Representative.

THE Bendix CORPORATION

KANSAS CITY DIVISION

Box 303-DR, Kansas City 41, Missouri

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

LONG TERM PRIME CONTRACTOR FOR USAEC

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE

The advertising rate is $27.25 per inch for advertising appearing on other than a contract basic. Contract rates quoted on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

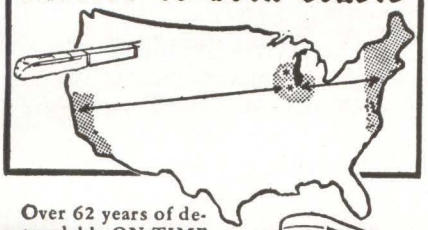
BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

The publisher cannot accept advertising in the Searchlight Section, which lists the names of the manufacturers of resistors, capacitors, rheostats, and potentiometers, or other names designed to describe such products.

Send NEW ADS or inquiries to Classified Adv Div. of Electronics P. O. Box 12, N. Y. 36, N. Y.

LIFSCHULTZ
FASTEST TO BOTH COASTS



Over 62 years of dependable ON-TIME Freight Forwarding Service.
We welcome your inquiry.

PROMPT DAILY PICKUP and DELIVERY

LIFSCHULTZ FAST FREIGHT

CIRCLE 955 ON READER SERVICE CARD

SMALL AD but BIG STOCK
of choice test equipment and surplus electronics
Higher Quality—Lower Costs
Get our advice on your problem
ENGINEERING ASSOCIATES
434 Patterson Road — Dayton 19, Ohio

CIRCLE 956 ON READER SERVICE CARD

OSCILLOGRAPH—RECORDER
Six-Channel, High-Speed, light spot recorder, uses process free paper. In like-new condition. Used for demonstrator only. Will sacrifice.
C. H. STOELTING CO.
424 N. Homan Chicago 24, Illinois
Tel: SAcramento 2-3833

CIRCLE 957 ON READER SERVICE CARD

TUBE SPECIALS

3CX100A5 (replaces 2C39B, 2C39A & 2C39WA) Tested and fully guaranteed **$9.95** ea.
6146 Brand new **$3.25** ea.
5654/6AK5W/6096 Brand new highly reliable 6AK5 **$.95** ea.

ELECTRO SALES CO.
1608 Milwaukee Ave., Chicago 47, Ill. BR 8-8080

CIRCLE 958 ON READER SERVICE CARD

FOR RESEARCH — DEVELOPMENT & EXPERIMENTAL WORK
Over 10,000 different electronic parts: waveguide, radar components and parts, test sets, pulsers, antennas, pulse xmfrs, magnetrons, IF and pulse amplifiers, dynamotors, 400 cycle xmfrs, 584 ant, pedestals, etc.
PRICES AT A FRACTION OF ORIGINAL COST!
COMMUNICATIONS EQUIP CO.
343 CANAL ST., N. Y. 13, WO 6-4045
CHAS. ROSEN (Fomerly at 131 Liberty St.)

CIRCLE 959 ON READER SERVICE CARD

"Opportunity" Advertising
Think
"SEARCHLIGHT"
First

EXCELLENT USED LABORATORY EQUIPMENT

Moseley, Model 2S X-Y Recorder. 11" x 14"..$735
Electro-Instruments, DVA-400 Digital Voltmeter, .0001—999.9 VDC. .01% Precision.....$1000
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Link Aviation 250400 Phase Comparator System with Pwr. Supply.....$785
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OB3	.70	4AP10	10.00	35T	10.00	NL-760	20.00	5784	2.50
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OD3	.30	4C35	15.00	FP-54	100.00	803	3.50	5796	10.00
C1A	8.50	4CX250B	30.00	FG-57	10.00	804	15.00	5800/VX-41	7.50
1AD4	1.50	4CX1000A	125.00	RK-60/1641	1.50	805	7.50	5803/VX-55	5.00
1B24	7.50	4D32	15.00	HY-69	3.00	807	1.50	5814A	1.35
1B24A	12.50	4E27A	27.50	BL-75	3.00	807W	2.25	5829	1.00
1B35A	3.00	4J32	100.00	75TL	17.50	808	2.50	5836	50.00
1B63A	10.00	4J34	100.00	TG-77	7.50	809	5.00	5837	50.00
1C/3B22	5.00	4J50	100.00	HF-100	10.00	810	15.00	5840	2.50
C1K	7.50	4J52	35.00	100TH	12.00	811	2.50	5845	6.00
1P21	32.50	4PR60A	50.00	100TL	12.00	811A	4.00	5852	5.00
1P22	8.00	4X150A	13.50	FG-105	25.00	812A	4.75	5876	7.50
1P25	10.00	4X150D	15.00	F-123A	5.00	813	12.50	5879	1.15
1P28	15.00	4X150G	25.00	FG-172	25.00	814	3.50	5881/6L6WGB	2.00
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2-01C	10.00	4X250F	30.00	212E	50.00	816	2.25	5893	10.00
2AP1A	8.50	5BP1A	9.50	FG-235	50.00	826	3.50	5894	18.85
2B23	20.00	5C22	17.50	242C	10.00	828	12.50	5915	1.00
2BP1	10.00	5CP1A	9.50	244A	3.50	829B	10.00	5931/5U4WG	3.50
2C36	22.50	5CP7A	9.50	245A	3.50	832	2.50	5933/807W	3.00
2C39A	9.75	5D21	7.50	249B	10.00	832A	7.50	5948/1754	100.00
2C39B	15.00	5J26	50.00	249C	5.00	833A	37.50	5949/1907	50.00
2C40	7.50	5JP1	7.50	250R	10.00	836	2.50	5963	1.00
2C42	3.00	5LP1	7.50	250TH	25.00	837	1.00	5964	.85
2C43	7.50	5R4GY	1.25	251A	50.00	842	7.50	5965	.85
2C46	5.00	5R4WGA	4.00	254A	3.50	845	7.50	5976	50.00
2C50	4.00	5R4WGB	6.00	FG-258A	100.00	849	75.00	5993	5.00
2C51	1.50	5R4WGY	2.00	259A	3.50	851	50.00	6005/6AQ5W	1.50
2C52	1.50	5RP1A	9.50	262B	3.50	866A	1.90	6012	4.00
2C53	7.50	5Y3WGT	1.25	267B	5.00	869B	50.00	6021A	2.00
2D21	.50	5Y3WGTB	2.50	271A	12.50	872A	5.00	6032	10.00
2D21W	1.00	6AC7W	.50	274A	3.50	884	1.25	6045	1.15
2E22	3.00	6AC7WA	2.00	283A	3.50	885	.85	6072	1.50
2E24	2.25	6AG5WA	1.50	287A	3.50	889RA	150.00	6073	1.50
2E26	2.50	6AG7Y	1.00	QK-288	250.00	891R	200.00	6074	1.75
2J42	75.00	6AK5W	1.25	HF-300	25.00	913	9.50	6080	3.35
2J51	50.00	6AK5 (WE)	.75	300B	5.00	920	2.50	6080WA	5.00
2J55	90.00	6AL5W	.60	304TH	35.00	927	1.50	6080WB	10.00
2K22	25.00	6AN5	1.75	304TL	35.00	931A	3.50	6082	3.35
2K25	8.50	6AN5WA	3.50	307A	.50	1000T	80.00	6087/5Y3WGTB	2.50
2K26	35.00	6AQ5W	1.00	310A	3.50	R1130B	10.00	6101/6J6WA	1.50
2K28	25.00	6AR6	.75	311A	3.50	1500T	150.00	6106	1.50
2K29	25.00	6AS6W	1.00	313C	1.50	1614	2.75	6115/QK351	50.00
2K30	50.00	6AS7G	2.50	323A	6.00	1620	4.00	6130/3C45	6.50
2K33A	200.00	6AU6WA	1.25	328A	3.50	1624	1.00	6136/6AU6WA	1.25
2K34	75.00	6B4G	3.35	329A	4.50	1625	.50	6146	3.00
2K35	200.00	6BA6W	.75	336A	2.50	1635	2.00	6159	3.50
2K39	150.00	6BE6W	1.50	337A	3.50	1846	50.00	6161	35.00
2K41	50.00	6BF7W	2.00	347A	1.00	1855	250.00	6186/6AG5WA	1.50
2K42	125.00	6BH6W	2.75	348A	4.50	2050	1.25	6189/12AU7WA	1.50
2K43	200.00	6BL6	20.00	349A	3.50	ZB-3200	100.00	6197	1.75
2K44	125.00	6BM6	25.00	350A	3.50	5516	7.50	6201/12AT7WA	1.85
2K45	20.00	6BM6A	30.00	350B	2.50	5528/C6L	3.50	6202/6X4WA	1.50
2K47	150.00	6C4W	2.50	352A	8.50	5545	20.00	6211	.75
2K48	50.00	6C4WA	1.00	354A	12.50	5550	30.00	6213	2.50
2K50	175.00	6C21	17.50	355A	12.50	5552/FG235	50.00	6216	3.00
2K54	10.00	6D4	1.50	371B	2.50	5553/FG258	100.00	6236	125.00
2K55	15.00	6F4	3.50	388A	2.00	5557/FG17	5.00	6248	250.00
2K56	50.00	C6J	10.00	393A	5.00	5558/FG32	10.00	6263	9.00
2P21	40.00	C6J/A	15.00	394A	3.00	5559/FG57	10.00	6265/6BH6W	2.75
2X2A	1.25	C6J/K	20.00	395A	2.25	5560/FG95	25.00	6291	35.00
3A5	.75	6J4	1.75	396A/2C51	1.50	5561/FG104	50.00	6293	4.50
3AP1	3.50	6J4WA	2.50	398A/5603	3.00	5586	125.00	6299	37.50
3B4	2.50	6J6W	.60	401A/5590	1.00	5608A	6.00	6316/BL800A	100.00
3B24W	3.00	6J6WA	1.00	403B/5591	3.00	5636	2.25	6322/BL25	12.50
3B24WA	5.00	6K4	2.00	404A/5847	7.50	5642	2.25	6336	8.75
3B25	2.50	6L6GAY	.75	407A	3.75	5643	3.00	6336A	12.75
3B26	2.25	6L6WGA	1.50	408A/6028	2.75	5647	3.50	6344/QK235	500.00
3B28	3.00	6L6WGB	2.00	409A/6AS6	1.00	5651	1.00	6350	1.25
3B29	5.00	6Q5G	2.50	410R	75.00	5654/6AK5W	1.50	6352	7.50
3BP1A	7.50	6SJ7WGT	1.25	GL-414	80.00	5656	5.00	6385	10.00
3C22	15.00	6SK7W	.75	416B/6280	20.00	5663	1.00	6390	125.00
3C23	4.00	6SK7WA	2.00	417A/5842	9.50	5665/C16J	35.00	6394	12.75
3C24/24G	7.50	6SL7WGT	1.25	418A	9.50	5667	125.00	6438	5.00
3C33	7.50	6SN7W	.50	420A/5755	5.00	5670	1.00	6442	25.00
3C45	3.50	6SN7WGT	1.00	421A/5998	7.50	5672	1.35	6463	1.00
3CX100A5	12.50	6SN7WGTA	2.50	429A	6.50	5675	10.00	6485	1.50
3D21A	5.00	6SU7GTY	.85	GL-434A	10.00	5678	1.25	6533	7.50
3D22	8.00	6V6GTY	1.00	450TH	40.00	5686	2.25	6542	5.75
3DP1A	5.00	6X4W	.75	450TL	40.00	5687	1.50	6550	3.00
3E29	7.50	6X4WA	1.50	578	5.00	5691	5.00	6807	20.00
3GP1	2.50	6X5WGT	1.00	KU-610	5.00	5692	3.50	6883	3.50
C3J	7.50	SRL7H	100.00	NL-623	10.00	5693	3.50	7044	1.50
C3J/A	9.50	7AK7	2.50	631-P1	5.00	5696	1.00	7521	100.00
3J21	35.00	7MP7	22.50	673	15.00	5718	1.50	7580	35.00
3J31	100.00	10KP7	15.00	676	30.00	5720/FG33	17.50	8002R	25.00
3JP1	5.00	12AT7WA	1.50	677	40.00	5721	100.00	8005	10.00
3K21	125.00	12AU7WA	1.50	701A	5.00	5725/6AS6W	1.50	8008	7.75
3K22	125.00	12AX7W	1.35	703A	1.50	5726/6AL5W	.75	8013A	5.00
3K27	150.00	12AY7	1.00	707B	2.50	5727/2D21W	1.25	8014A	30.00
3K30	100.00	C16J	25.00	715C	15.00	5728/FG67	10.00	8020	4.50
3KP1	9.75	FG-17	5.00	719A	12.50	5749/6BA6W	1.00	8025A	7.50
3RP1	7.50	HK-24	5.00	721B	5.00	5750/6BE6W	1.50	9003	2.00
3WP1	12.50	25T	10.00	723A/B	3.50	5751/12AX7W	1.35	9005	3.50

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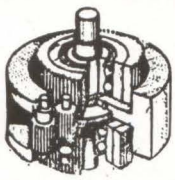

The 1:1 reverse ratio spur gears are 48-tooth, 32 pitch brass with 3/16" available face. On one side, the shaft is 23.64" dia. for 11/16" and has a pin hole, then increases in dia. to .377" for the remaining 3/16" of length. On the other side, the shaft is .377 dia. 1/4" lg. 2-13/16" dia. is required to clear the body.
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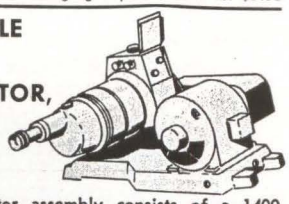

The generator assembly consists of a 1400-watt, 120-volt, 400-cycle inductor-alternator and a 400-watt, 27-volt D.C. generator. The alternator rotor and the D.C. generator armature are mounted on a common shaft, which is dual-belt-driven by a 3-H.P., 1750-R.P.M., 115/230-volt, single-phase 60-cycle electric motor. Weatherproof output box is mounted on top of the stator shell. It contains a rheostat, adjustable resistor, two pin jacks for plugging in an A.C. voltmeter. Size: 28" W., 33" L., 18" H. Weight, approx. 250 lbs.
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No. 146 Forward & Reverse 4-0-4. Input shaft 5/16" dia. x 3/4" long: Output shaft 15/64" dia x 9/16" long. Control shaf 11/64" dia. x 11/16" long. Cast aluminum construction. Approx. size 4 1/2" x 4 1/2" x 4". **$18.50 ea.**

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5068750 Delco 27.5 VDC 160 rpm w. brake	6.50
5068571 Delco PM 27.5 VDC 10,000 rpm (1x1x2")	5.00
5069790 Delco PM, 27 VDC, 100 RPM, Governor Controlled	15.00 ea
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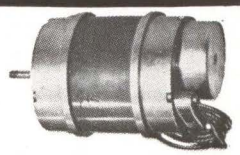

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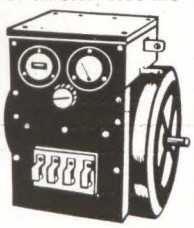
6DG Diff. Gen. 90/90V 60 cy.	25.00
6G Syn. Gen. 115/90VAC 60 cy.	34.50
7G Syn. Gen. 115/90VAC 60 cy.	42.50
C56701 Type 11-4 Rep. 115V 60 cy.	20.00
C69405-2 Type 1-1 Transm. 115V 60 cy.	20.00
C69406 Syn. Transm. 115V 60 cy.	20.00
C69406-1 Type 11-2 Rep. 115V 60 cy.	20.00
C78248 Syn. Transm. 115V 60 cy.	12.50
C78410 Repeater 115V 60 cy.	20.00
FPE 49-7 Diehl servo motor, 115 volts, 60 cycle, 10 watts	30.00

400 CYCLE, 3 PHASE GENERATOR

BY MASTER ELECTRIC



Type AG, frame 364Y, 7.5 kw, 3428 rpm, pf .95 Star connected 120/208 3 phase, 22 amps. Delta connected 120 volt single phase 6 amps. Self excited. Complete with control box, voltage regulator, AC voltmeter and frequency meter. Shaft 1" dia., 2" long; overall dim. of unit: 21"6x18"x 20".
Price **$395.00** each

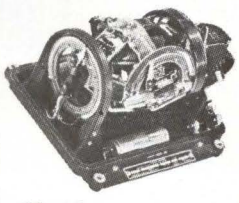
SENSITIVE INTEGRATING GYROS

This is the famous HIG Gyro which is being used in missile guidance systems, radar stabilization and fine control systems. Government cost approximately $1500.
PRICE **$50.00**

400 CYCLE PM GENERATOR

Mfgd. by T K M Electric Corp.
Model #A-12
120/208 volts, 400 cycle, 1 or 3 phase, 1 kva, pf 0.8, rpm 8,000. Approx. dim. 6" x 5 1/2". Internal spline drive. **Price $100.00**

HONEYWELL VERTICAL GYRO MODEL AG7044A17



115 volts, 400 cycles, single phase, 35 watts. Pitch and roll potentiometer pickoffs 890 ohms, 40 volts max. AC or DC. Speed 20,000 rpm, ang. momentum 12,500,000 gm-cm 2/sec. Erection system 27 VAC, 400 cycles, time 5 min. to 1/2°; caging mechanism operates on 24 VDC.
$49.50

400-CYCLE FREQUENCY METER IN PORTABLE METAL CASE

Range, 380-400 cps. 100-130 VAC. Nine vibrating reeds. Frequency increments of 5 cps. Frequency accuracy is ± 0.3% at 77° F. with sine wave input. With test leads. 3 1/4" x 3 1/4" x 6". Winslow Model 360. **$12.50**

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SPERRY microwave memo

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

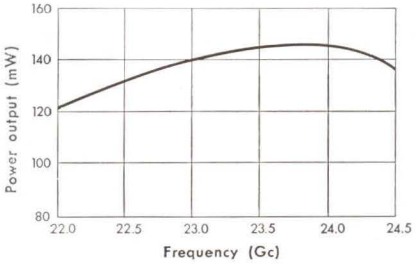
The SRK-291, a new low-cost K band reflex klystron oscillator offering dramatic cost savings in microwave systems, is now available from Sperry Electronic Tube Division within 60 days from receipt of your order! Sperry's new tube operates at frequencies ranging from 21 to 24.5 Gc. Within these frequency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

PARAMETRIC PUMPING APPLICATIONS

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

OTHER APPLICATIONS

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



SRK-291, typical P out vs. Freq.

NEW, FREE BROCHURE

A new, free brochure describes the capabilities of the SRK-291 in greater detail. For your copy, write to Sperry Electronic Tube Division, Sec. 147, Gainesville, Florida.

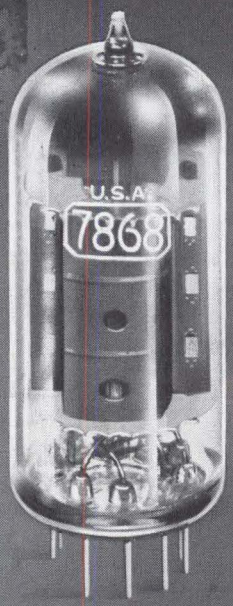
Since the SRK-291 is available within 60 days, it represents an *immediate* solution to your present problems, whether you are designing a new system or concentrating on improved performance for an operational one. Cain & Co., which represents Sperry nationally, has a sales engineer near you. He'll be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

SPERRY ELECTRONIC TUBE DIVISION

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

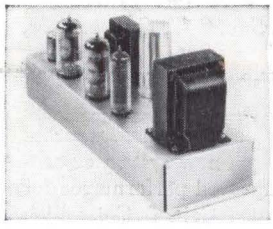
CIRCLE 901 READERS SERVICE CARD

Why Wurlitzer chose the RCA-7868 NOVAR Power Pentode for its Electronic Pianos



"High Power Sensitivity, High Power Output Capabilities and Low Cost"...

THE WURLITZER COMPANY



This is the power amplifier stage of the new Wurlitzer Console Electronic Piano, *first mass-produced instrument of its kind on the market.* The two power pentodes are RCA-7868 novar types. Why did Wurlitzer engineers choose novar tubes?

Because:

- "The RCA-7868 offers high power sensitivity, high power output capabilities and low cost."
- "Comparative tests were run on other tubes with equal results from the standpoint of distortion at power outputs of 20 and 30 watts, but the novar tube performed at reduced cost."
- "In addition to supplying power at lower cost than other types, the novar 7868 also permitted us to ship the instruments with the tubes in their respective novar sockets without special mounting clamps or packing materials."
- "The compactness of the tube permitted us to install it in amplifiers where vertical clearance is quite limited."
- "Novar construction permits more efficient heat conduction through the base pins to the sockets and the chassis, thus transferring heat from the tube bulb to a greater cooling area."

The RCA-7868 supplies 25 and 35 watts of audio power in Wurlitzer Model 4100 and 4430 electronic organs respectively, and 15 watts of audio power in the Wurlitzer console electronic piano.

The unique design features that made these novar types a wise choice for Wurlitzer may also be the answer to *your* circuit design problem. For more information on novar tube types see your RCA Field Representative or write Commercial Engineering, Section H-19-DE-2, RCA Electron Tube Division, Harrison, N. J.

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