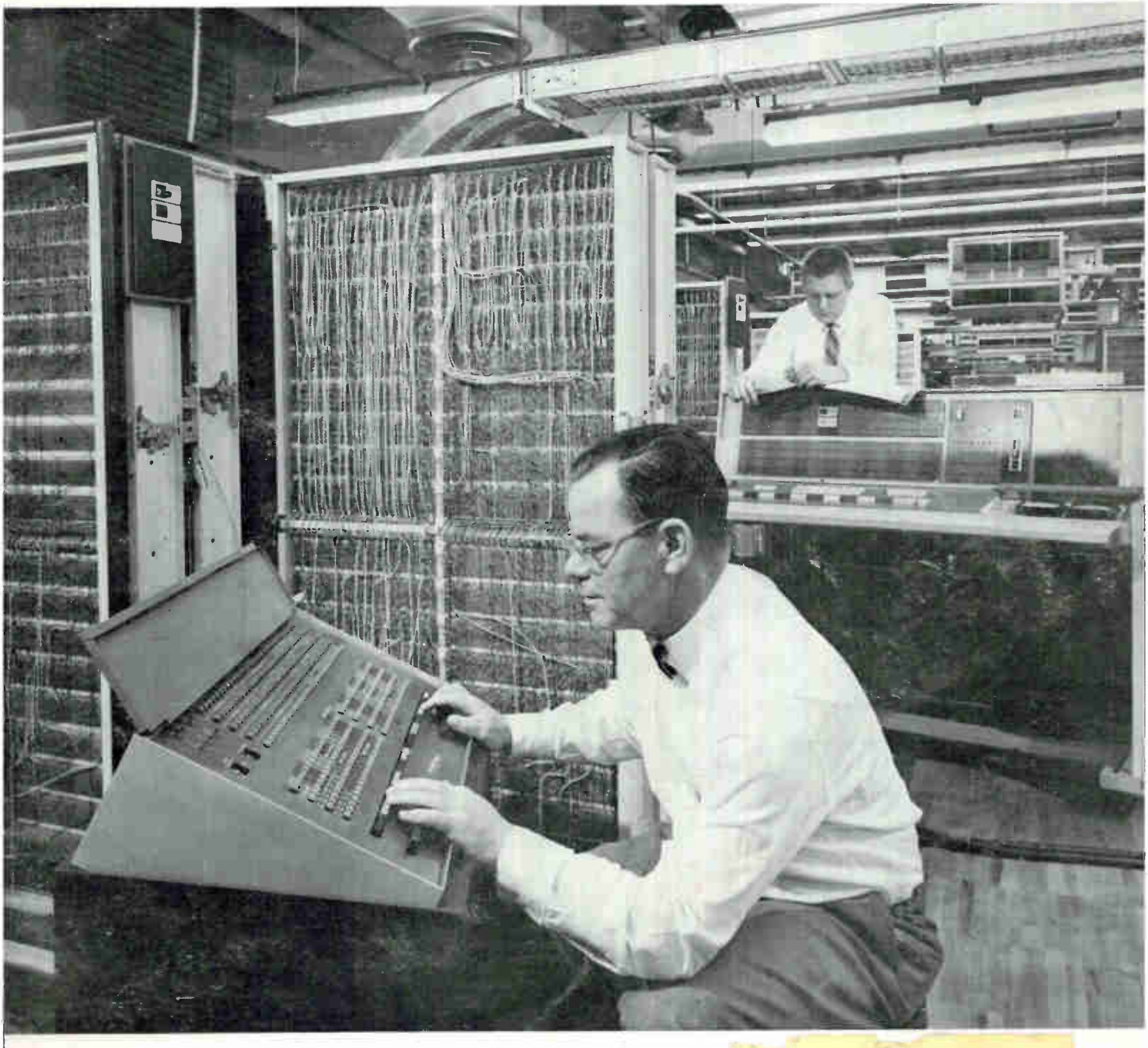
May 12, 1961

electronics

Three-dimensional core-storage memory for computers (below) stores one million bits, needs special design techniques, p 68

Using a microwave radiometer to detect small icebergs, p 72

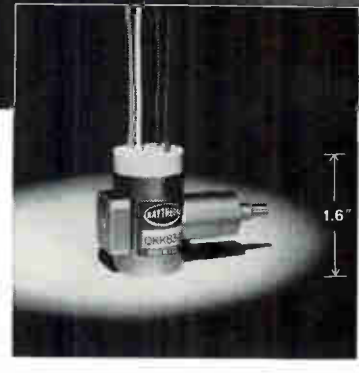
A McGraw-Hill Publication 75 Cents



PARTS SHOW SPECIAL

New Distribution Patterns and Techniques

K_a-BAND KLYSTRON OSCILLATOR, QKK 834, shown with 90° (above) or 180° (right below) positioning of tuner. **Above photo is actual size.**



New klystrons hold characteristics in grueling aerospace environments

K_a- and K-band tubes are tunable from 34.0—35.6 and 23.5—24.5 kMc

Now, Raytheon combines the advantages of small size, extreme ruggedness, thermal stability, and smooth wide-range tunability in a 20mW reflex klystron.

The new QKK 834 for K_a band and QKK 923 for K band are all ceramic and metal tubes with typical electronic tuning range of 110 Mc. The tuner, utilizing a sapphire rod, can be specified for positioning anywhere on the circumference of the resonator at least 90 degrees from output flange (see illustrations above). Write today for detailed technical data or application service to Microwave & Power Tube Division, Raytheon Company, Waltham 54, Massachusetts. In Canada: Waterloo, Ontario.

QKK 834, QKK 923— GENERAL CHARACTERISTICS	
Power Output	20 mW (nominal)
Frequency	34-35.6*; 23.5-24.5† kMc
Resonator Voltage	400 V
Reflector Voltage Range	—65 to —175V
Temperature Coefficient	± 0.5 Mc/°C
Cooling	convection (no blower needed)
Overall Dimensions	1 5/8 x 1 1/16 x 2 in.*

*QKK 834 †QKK 923

RAYTHEON COMPANY

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON

May 12, 1961

electronics

A McGraw-Hill Publication 75 Cents

W. W. MacDONALD, Editor

PARTS SHOW

BUSINESS

ENGINEERING

DEPARTMENTS

New

LAMBDA Transistorized REGULATED POWER SUPPLIES

0 - 34 VDC 5, 10 and 20 Amp
20 - 105 VDC 2, 4 and 8 Amp
75 - 330 VDC 0.8, 1.5 and 3 Amp

CONVECTION COOLED
No Blowers or Filters
Maintenance Free

Highly efficient, radiator type heat sinks eliminate internal blowers, maintenance problems, risk of failure, moving parts, noise and magnetic fields. Units are rated for continuous duty at 50°C ambient.

SHORT CIRCUIT PROOF

All models are completely protected with magnetic circuit breakers, fuses, and thermal overload.

EASY SERVICE ACCESS

Dual-deck, swing-out back construction provides simple and fast service access without the need to remove unit from rack. All major component terminals are accessible from rear.

REMOTE SENSING

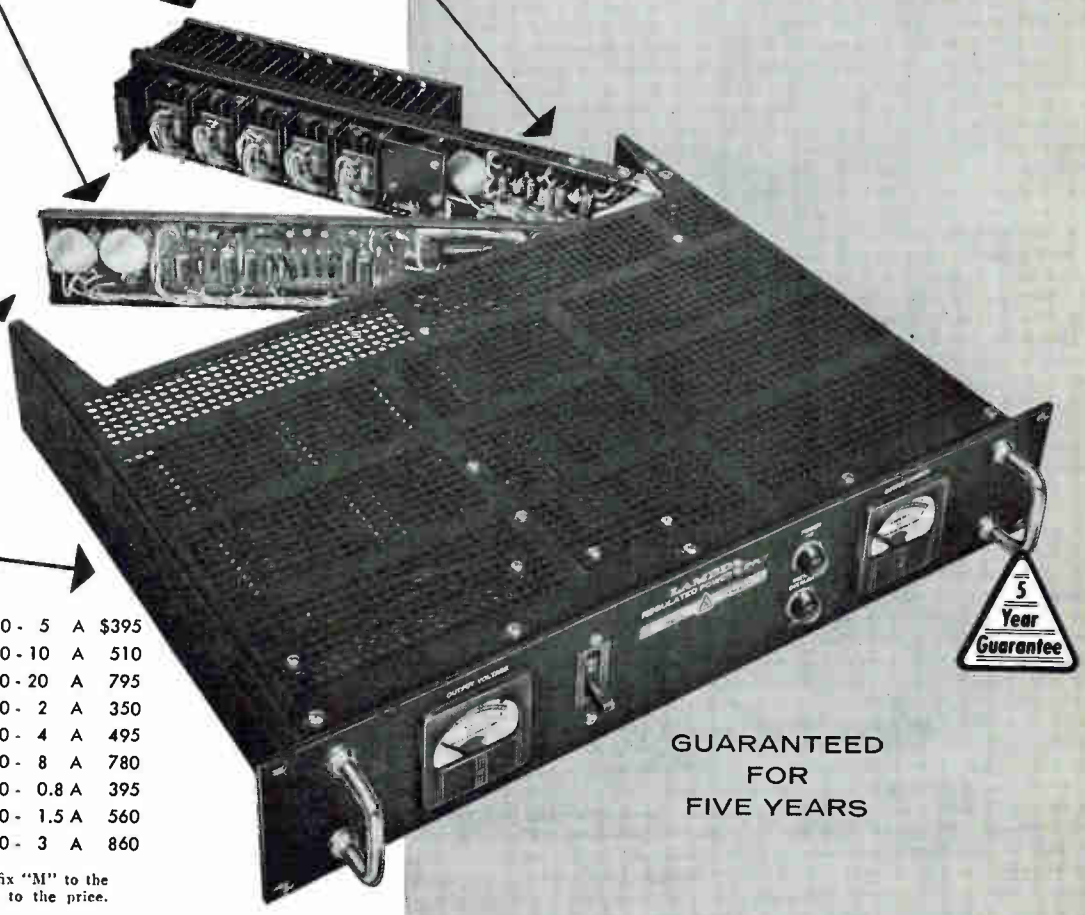
Minimizes effect of power output leads on DC regulation, output impedance and transient response.

NO VOLTAGE SPIKES OR OVERSHOOT

Lambda's design prevents output voltage overshoot on "turn on, turn off," or power failure.

MIL QUALITY

Hermetically-sealed magnetic shielded transformer designed to MIL-T-27A quality and performance. Special, high-purity foil, hermetically-sealed long life electrolytic capacitors.



LA 50 - 03A	0 - 34 VDC	0 - 5	A	$395
LA100 - 03A	0 - 34 VDC	0 - 10	A	510
LA200 - 03A	0 - 34 VDC	0 - 20	A	795
LA 20 - 05A	20 - 105 VDC	0 - 2	A	350
LA 40 - 05A	20 - 105 VDC	0 - 4	A	495
LA 80 - 05A	20 - 105 VDC	0 - 8	A	780
LA 8 - 08A	75 - 330 VDC	0 - 0.8	A	395
LA 15 - 08A	75 - 330 VDC	0 - 1.5	A	560
LA 30 - 08A	75 - 330 VDC	0 - 3	A	860

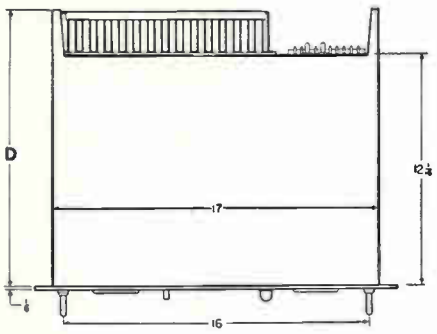
For metered models add the suffix "M" to the model number and add $30.00 to the price.

GUARANTEED FOR FIVE YEARS

LA-117

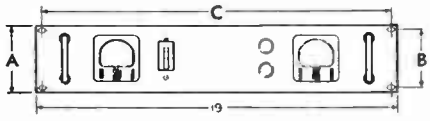
CIRCLE 2 ON READER SERVICE CARD

DIMENSION DRAWINGS



← Top View of All Models

Front View ↓



	MODEL †		
	LA 50-03A LA 20-05A LA 8-08A	LA 100-03A LA 40-05A LA 15-08A	LA 200-03A LA 80-05A LA 30-08A
A	3½"	7"	10½"
B	3"	*4"	*7½"
C	18⅝"	18¼"	18¼"
D	14⅜"	14⅜"	16½"

* These models notched per RETMA Standards
† Includes metered models with suffix "M"

COMPLETE SPECIFICATIONS OF LAMBDA LA SERIES

DC OUTPUT (Regulated for line and load)

Model	Voltage Range (1)	Current Range	Minimum Voltage (1)	Voltage Steps (1)	Price(2)
LA 50-03A	0- 34 VDC	0- 5 AMP	0	2, 4, 8, 16, and 0- 4 volt vernier	$ 395
LA100-03A	0- 34 VDC	0-10 AMP	0	2, 4, 8, 16, and 0- 4 volt vernier	510
LA200-03A	0- 34 VDC	0-20 AMP	0	2, 4, 8, 16, and 0- 4 volt vernier	795
LA 20-05A	20-105 VDC	0- 2 AMP	20	5, 10, 20, 40, and 0-10 volt vernier	350
LA 40-05A	20-105 VDC	0- 4 AMP	20	5, 10, 20, 40, and 0-10 volt vernier	495
LA 80-05A	20-105 VDC	0- 8 AMP	20	5, 10, 20, 40, and 0-10 volt vernier	780
LA 8-08A	75-330 VDC	0- 0.8 AMP	75	15, 30, 60, 120, and 0-30 volt vernier	395
LA 15-08A	75-330 VDC	0- 1.5 AMP	75	15, 30, 60, 120, and 0-30 volt vernier	560
LA 30-08A	75-330 VDC	0- 3 AMP	75	15, 30, 60, 120, and 0-30 volt vernier	860

(1) The DC output voltage for each model is completely covered by four selector switches plus vernier control. The DC output voltage is the summation of the minimum voltage plus the voltage steps and the continuously variable DC vernier.

(2) Prices are for unmetered models. For metered models add the suffix "M" and add $30.00 to the price.

Regulation (line) ..... Less than 0.05 per cent or 8 millivolts (whichever is greater). For input variations from 100-130 VAC.

Regulation (load) ..... Less than 0.10 per cent or 15 millivolts (whichever is greater). For load variations from 0 to full load.

Transient Response ..... Output voltage is constant within regulation specifications for step function:

(line) ..... line voltage change from 100-130 VAC or 130-100 VAC.

(load) ..... load change from 0 to full load or full load to 0 within 50 microseconds after application.

Internal Impedance .... LA 50-03A less than .008 ohms
LA100-03A less than .004 ohms
LA200-03A less than .002 ohms
LA 20-05A less than .06 ohms
LA 40-05A less than .03 ohms
LA 80-05A less than .015 ohms
LA 8-08A less than .5 ohms
LA 15-08A less than .25 ohms
LA 30-08A less than .15 ohms

Ripple and Noise ..... Less than 1 millivolt rms with either terminal grounded.

Polarity ..... Either positive or negative terminal may be grounded.

Temperature Coefficient ..... Less than 0.025 %/°C

AC INPUT ..... 100-130 VAC, 60 ± 0.3 cycle[3]
LA 50-03A....360 watts[4]
LA100-03A....680 watts[4]
LA200-03A...1225 watts[4]
LA 20-05A....390 watts[4]
LA 40-05A....710 watts[4]
LA 80-05A...1350 watts[4]
LA 8-08A....415 watts[4]
LA 15-08A....760 watts[4]
LA 30-08A...1450 watts[4]

[3] *This frequency band amply covers standard commercial power lines in the United States and Canada.*
[4] *With output loaded to full rating and input at 130 VAC.*

AMBIENT TEMPERATURE AND DUTY CYCLE Continuous duty at full load up to 50°C (122°F) ambient.

OVERLOAD PROTECTION:

Electrical ..... Magnetic circuit breaker front panel mounted. Special transistor circuitry provides independent protection against transistor complement overload. Fuses provide internal failure protection. Unit cannot be injured by short circuit or overload.

Thermal ..... Thermostat, manual reset, rear of chassis. Thermal overload indicator light front panel.

METERS ..... Voltmeter and ammeter on metered models.

CONTROLS:

DC Output Controls ... Voltage selector switches and adjustable vernier-control rear of chassis.

Power ..... Magnetic circuit breaker, front panel.

Remote DC Vernier .... Provision for remote operation of DC vernier.

Remote Sensing ..... Provision is made for remote sensing to minimize effect of power output leads on DC regulation, output impedance and transient response.

PHYSICAL DATA:

Mounting ..... Standard 19" Rack Mounting

Size

LA 50-03A, LA20-05A, LA 8-08A 3½" H x 19" W x 14⅜"D
LA100-03A, LA40-05A, LA15-08A 7" H x 19" W x 14⅜"D
LA200-03A, LA80-05A, LA30-08A 10½" H x 19" W x 16½"D

Weight

LA 50-03A, LA20-05A, LA 8-08A 55 lb Net 85 lb Ship. Wt.
LA100-03A, LA40-05A, LA15-08A 100 lb Net 130 lb Ship. Wt.
LA200-03A, LA80-05A, LA30-08A 140 lb Net 170 lb Ship. Wt.

Panel Finish ..... Black ripple enamel (standard). Special finishes available to customers' specifications at moderate surcharge. Quotation upon request.

LAMBDA ELECTRONICS CORP.
515 BROAD HOLLOW ROAD, HUNTINGTON, L. I., NEW YORK 516 MYRTLE 4-4200

Send for complete Lambda Catalog.

electronics
May 12, 1961 Volume 34 Number 19

Published weekly, with Electronics Buyers' Guide and Reference issue, as part of the subscription, by McGraw-Hill Publishing Company, Inc. Founder: James H. McGraw (1860-1948).

Executive, editorial, circulation and advertising offices McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Telephone Langacre 4-3000. Teletype TWX N.Y. 1-1636. Cable McGrawhill, N. Y. Printed in Albany, N. Y.; second class postage paid.

Subscriptions are solicited only from those actively engaged in the field of the publication. Position and company connection must be indicated on orders. Subscription rates: United States and Possessions, $6.00 one year; $9.00 two years; $12.00 three years. Canada, $10.00 one year. All other countries $20.00 one year. Single Copies, United States and Possessions and Canada 75¢; Buyers' Guide $3.00; Single Copies all other countries $1.50; Buyers' Guide $10.00.

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CROSSTALK

"ELECTRONICS IN EUROPE" is the title of Chief Editor MacDonald's upcoming Special Report (June 9) and this photo is the current condition of his desk—give or take another mail call.

It's enough to make a traveling man take up painting.

Instead, he plans to give readers a full-stroke picture of what goes on overseas. Realistically. Bright colors, somber grays, important in-betweens . . . the whole panorama. Meanwhile, in this issue (p 26), three prominent European friends sketch in a bit of the future.

PARTS SHOW

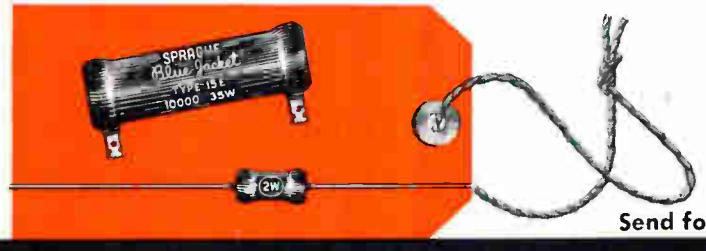
CHANGING marketing patterns and techniques are bringing major expansion to the 24-year-old Electronic Parts Distributors Show to be held in Chicago week after next. Trend of big exclusively franchised distributors taking over from factory-to-factory selling is told on p 28.

Products to be introduced at the show will include stereo f-m broadcast adapters, tuners and receivers; antennas with tubes built in, nuvistor-equipped preamps and a transmitter-receiver with acoustically isolated earphones and mouthpiece for use in high-noise level areas. See p 30.

Mergers and acquisitions are among trends which now point to fewer and bigger parts distributors doing a doubled volume by 1965. These indicators are reflected in the marketing story on p 22. Necessity for thinking and planning big to share and survive in booming industrial electronic parts business is wrapped up on p 132 by one of the top men behind the parts show.

Coming In Our May 19 Issue

METEORFAX. Transmission of facsimile messages up to distances of 1,000 miles over meteor-burst paths appears feasible with the meteorfax technique described in our next issue. According to B. F. Gedaminski and W. G. Griffin, Jr. of Air Force Cambridge Research Laboratories in Bedford, Mass., high-speed transmission of data in this system eliminates the need for storage devices such as magnetic tape. The authors report tests where picture rates in excess of 300,000 bits a second were achieved.



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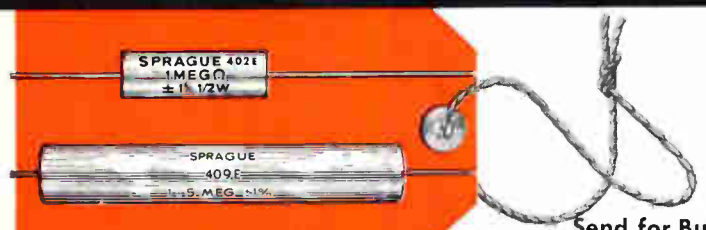

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COMMENT

Gallium Arsenide

We have been intrigued by the letter from C. G. Masters and J. E. Rathmell (Comment, p 6, Mar. 17) concerning the deterioriation of gallium arsenide tunnel diodes. In the editorial comment which follows, you mention that "the gradual deterioration of gallium arsenide devices has been known for about ten months . . . "

As users of GaAs devices, we would like to know whether you could give us more specific information on the deterioration, or refer us to published material on the subject. In particular, do you know whether the same type of deterioration occurs in GaAs variable-capacitance diodes?

BRIAN J. ROBINSON
NETHERLANDS FOUNDATION FOR RADIOASTRONOMY
DWINGELOO, THE NETHERLANDS

Gallium arsenide diodes have come under critical scrutiny at several recent conferences, including the International Solid-State Circuits Conference held in Philadelphia late in February. Reports of deterioriation after prolonged service were mentioned; also reported was deterioration during periods of disuse. Manufacturers report, however, that 2,000-hour life tests at 100 C with a reverse bias of 5 v have yielded no change in characteristics. Researchers acknowledge that behavior of GaAs diodes under forward-bias conditions is not completely understood; apparently several independent mechanisms affect deterioriation in tunneling characteristics. For example, in zinc-doped GaAs, the peak current decreases with age, while in cadmium-doped materials, the valley current goes up. Work is still being done to eliminate the gaps in knowledge.

Japan's Missiles

In the Apr. 7 edition, the section Electronics Newsletter (p 12), you had an item entitled "Japan Will Produce Own Air-Air Missile." The closing statement was to the effect that Japan had bought 40,000 U. S. Sidewinder missiles. Inasmuch as this was public information, would you be kind enough to inform me as to the source of this particular information? As a manufacturer of Sidewinder components, I am very much interested in your statement that 40,000 have been bought by Japan . . .

GEORGE B. MARCHEV
GORDOS CORP.
BLOOMFIELD, N. J.

To be precise, we said Japan's air defense forces "had borrowed the U. S. Sidewinder missile, of which Japan has so far bought about 40,000." The source of this information was Japan's Self-Defense Agency, one of whose spokesmen told McGraw-Hill World News on March 20 that up to the end of fiscal 1960 Japan had bought 40,000 missiles of the Sidewinder type. Not all these were necessarily produced in the U. S.

International News

As a relatively recent subscriber to ELECTRONICS, and in fact a relatively recent resident of the U. S., I have been consistently pleased by the depth and breadth of your magazine's coverage of international news in the electronics technology. One is accustomed to chauvinism in industrial journals; I have yet to detect any substantial note of chauvinism in your stories.

With the world growing smaller daily, and especially with the Free World becoming more interdependent all the time, this broad view is particularly valuable today . . .

A. E. LANDER
WASHINGTON, D. C.

We regard electronics as an international industry and do our best to serve as an international journal. By the way, watch for "Electronics in Europe," coming June 9.

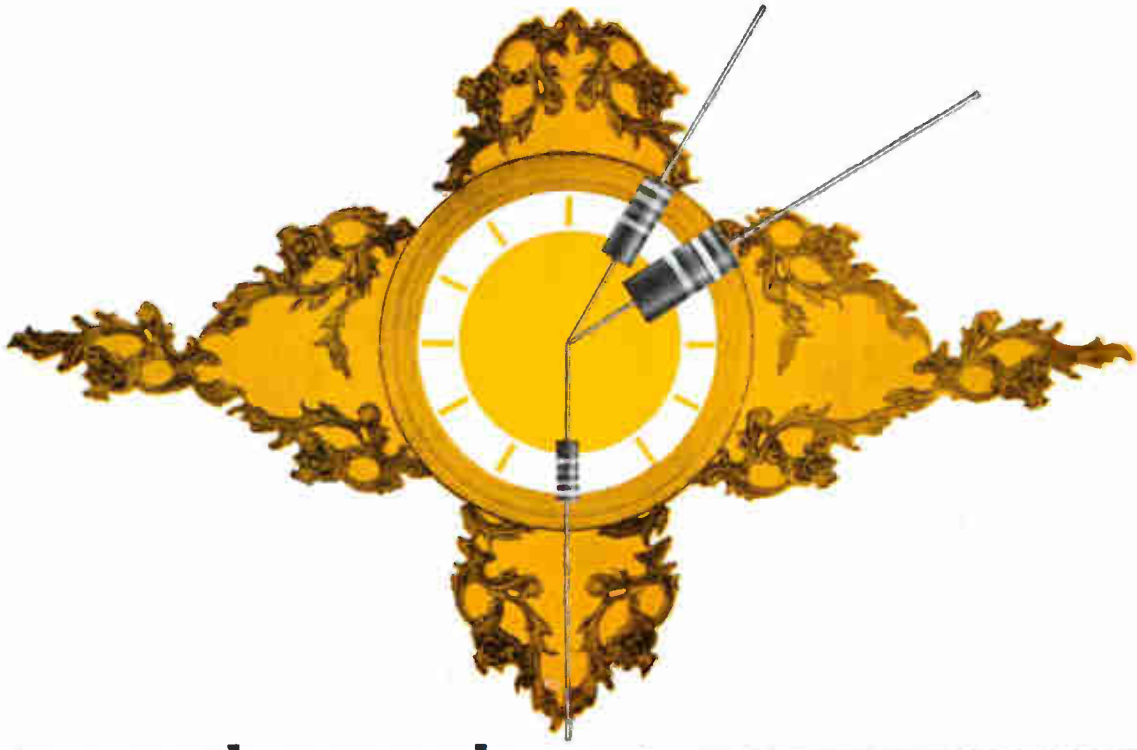
Transistor Socket

In New Products for Mar. 10 (p 242), the item about Augat Bros.' narrow transistor socket should have specified that the socket fits the Clevite Spacesaver power transistor . . .

EBEN S. CHURCH
HORTON, CHURCH & GOFF
PROVIDENCE, R. I.

We omitted the identifying designation Clevite. *Sorry.*

when Time means Money . . .



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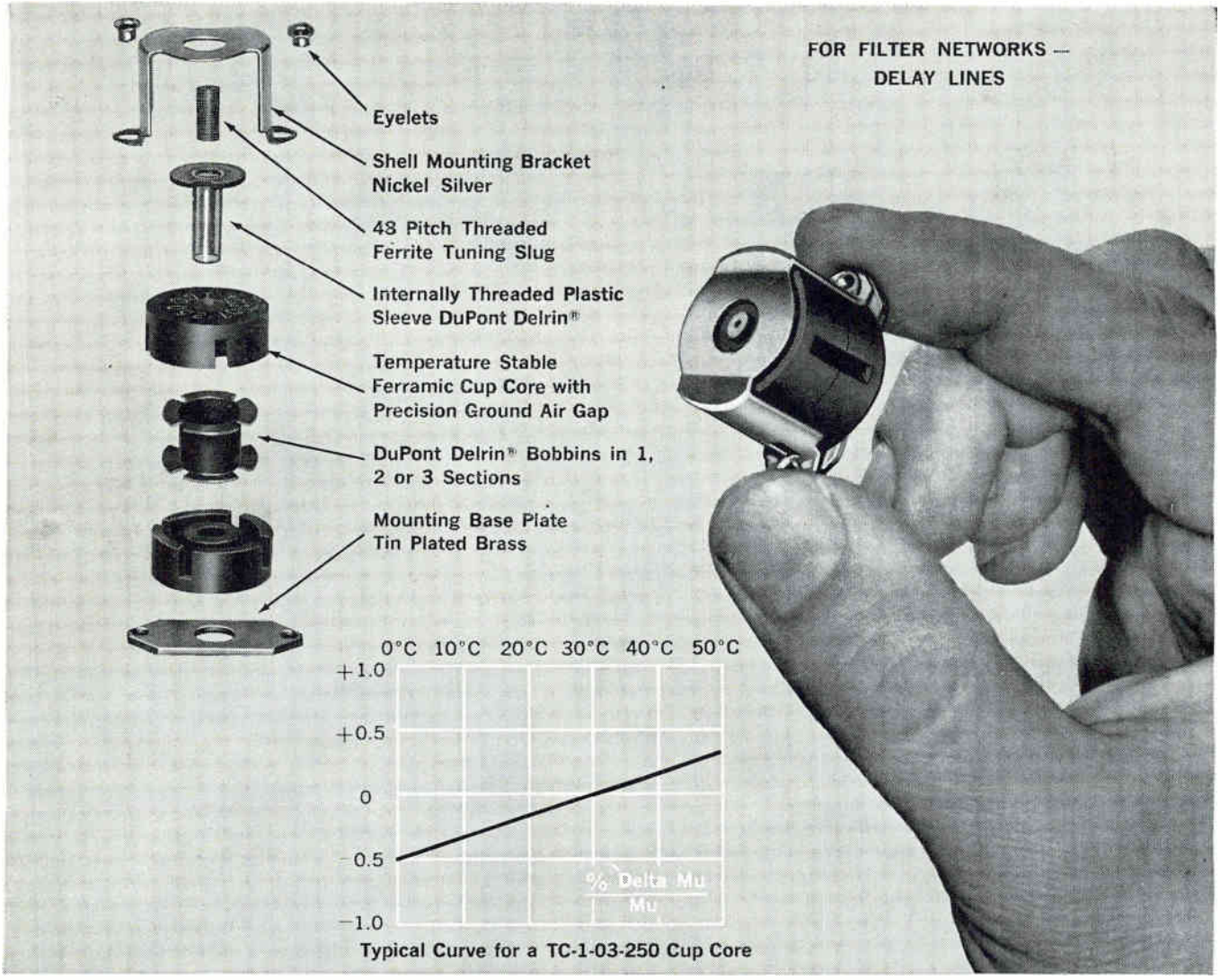

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ELECTRONICS NEWSLETTER

Beacon Speeded Astronaut Recovery

WHEN ASTRONAUT Alan B. Shepard rode his Mercury capsule 115 miles up and 320 miles downrange last Friday, the carrier *Lake Champlain* was standing by near the planned impact point to pick him up. Aiding the carrier helicopters to locate the capsule was a beacon device called Sarah (search and rescue and homing), developed by Simmonds Precision Products.

Sarah system consists of a miniature transmitter in the spacecraft and homing devices aboard the searching ships and aircraft. Transmitter was activated as the craft came down to about 10,000 ft; pulse signals were presented on crt indicators in the craft. Use of the homing device—similar to one carried by the Soviet Union's *Vostok* on its single orbit—permitted the *Champlain* pilots to pick Shepard up and get him safely aboard within half an hour after reentry.

Companies Suggest Joint Effort For Satellite Communications

TWO MAJOR electronics companies last week recommended that satellite communications systems be developed and exploited by joint private enterprise. General Electric went so far as to set up a new company, dubbed Communications Satellites Inc. General Telephone & Electronics recommended to the Federal Communications Commission that the nation's communications companies be authorized to form a single jointly-owned commercial space communications company.

The Bell System has already expressed its willingness to launch experimental communications satellites by Christmas if the National Aeronautics & Space Administration will give immediate approval of the plan.

Both GE and GT&E made their announcements in answer to an FCC request for industry comments on various regulatory and administrative problems relating to the space communications business. GT&E stressed that satellite communications requires "effective utilization of all this country's scientific, engineering and management resources in the communications common-carrier field." GE added that the flexibility and vitality of private enterprise would be reasserted if the system can be accomplished through the cooperative efforts of U. S. industry. GE sees Communications Satellites Inc. as a focal point for cooperative participation by private enterprise in a worldwide commercial satellite system under government regulation.

Former ONR Chief Takes Industry Job

RETIRING Chief of Naval Research Rawson Bennett last week joined Sangamo Electric as a senior vice president and director of engineering. Bennett, who retired from the Navy on Feb. 1, spent much of his service career in electronics. During World War II he headed the electronic design division of BuShips, also served as the principal liaison officer to the Office of Scientific Research & Development. In 1939, he designed a sonar team trainer for antisubmarine and allied work. A 1927 graduate of the Naval Academy, he also holds an M.S. in electrical engineering from the University of California.

Sangamo is a major supplier of sonar equipment and other electronic gear to the Navy.

Semiconductor Conductivity Observed to Oscillate

INVESTIGATIONS at MIT's Lincoln Laboratory are currently attempting to explain—and possibly show the way to exploit—an oscillatory phenomenon observed in germanium, silicon and indium antimonide. Effect manifests itself as an oscillating variation in the conductivity of a semiconductor sample which contains excess minority carriers and is subjected to nearly parallel d-c electric and magnetic fields.

Experimental apparatus has been built at the Lincoln Lab to measure infrared absorption of the free carriers as a function of time during the oscillations.

1960 Instrument Shipments Totaled $120 Million

BUSINESS & DEFENSE SERVICES Administration announced last week that shipments of electrical measuring instruments by U. S. manufacturers in 1960 amounted to about 3.8 million units valued at about $120 million. Military orders accounted for about a sixth of the volume and about a third of the value.

Unfilled orders at the end of the fourth quarter represented a little over 900,000 units valued at $31 million; BDSA estimates this as a production backlog of about three months.

Classification includes instruments for indicating and recording electrical quantities, including instrument relays; iron-vane, dynamometer, rectifier and thermocouple types; watthour, power-factor and phase-angle meters; self-balancing instruments, and oscillographic recorders of both galvanometer and oscilloscope types.

Miniature UHF Transmitter Withstands Space Environment

HIGH-POWER transmitter to operate in the uhf band for missile and space communications has been developed by Space Electronics, Glendale, Calif. The transmitter is housed in a cylinder 13 in. long and 4½ in. in diameter. Company rates the unit as having an output power of 1 to 2 Kw at a frequency of 200 to 400 Mc, says it can operate continuously at temperatures up to 500 F.

Heat generated in the transmitter's environment is conducted away from sensitive electronic elements to a heat-dissipating medium where it is disposed of by ablation or evaporation. Transmitter structure is highly conductive thermally. Special ceramic dielectrics having

high thermal conductivity and low r-f loss are used in the cavities. Concentric cavity-nesting technique gives the unit its necessary mechanical strength while reducing the overall dimensions. Transmitter is virtually solid, and ceramic components are under purely compressive stress.

Radio-frequencies circuits are broadbanded for operation over a 10-Mc frequency range around a center frequency selected by replaceable oscillator crystals.

Soviets Track Satellites With Seventy Stations

VICE CHAIRMAN of the Soviet Academy's astronomical council, A. Masevitch, reported recently that there were 70 satellite tracking stations in the Soviet Union alone, and many in other countries. Masevitch made the statement as part of a report recently on progress thus far in setting up a Soviet tracking network.

The academician said that up until January the USSR's computing center had received data from over 90,000 observations including 37,000 made in 35 foreign countries. He added that Hungarian scientists have developed a simple but efficient computer to process tracking data; three of the computers have been presented as gifts to the astronomical council.

Air Force Develops Blood-Pressure Monitor

AIR FORCE has developed a device which automatically monitors diastolic and systolic blood pressures and provides an electrical signal that can be automatically recorded or telemetered. The portable instrument uses transistor logic to perform its program functions, weighs 35 lb exclusive of recorder or telemeter. Range of operation is between 100 and 200 mm of mercury; measurement can be repeated at intervals varying from one to 15 minutes.

Wright Air Development Division, which developed the automatic monitor, also announced the successful design of a chronic brain polarographic implant unit capable of detecting small changes in availability of cerebral oxygen. The unit is surgically implanted in the skull of an experimental animal; report states that reproducible data can be obtained within 5 days of postsurgical recovery.

USAF Steps Up Experiments In Atmospheric Ducting

PROPAGATION EXPERIMENTS using ducts in the atmosphere over the ocean are being stepped up by Air Force's Cambridge Research Labs. The ducting phenomenon was first observed a couple of years ago, is caused by temperature inversion layers at about 5,000 ft altitude and centered at about 30 deg north and south latitude.

Recent experiment beamed a 425-Mc radar signal eastward from a station on Trinidad. The signal was coupled into the duct, produced strong returns from the Canary Islands, the coast of Africa, and the Atlas Mountains in northern Africa; the mountains are some 3,900 miles from Trinidad.

Electronic Ignition Fires At One Kilocycle

BRITISH automobile subsystems supplier Joseph Lucas Ltd. recently introduced an electronic ignition system capable of producing sparks at the rate of 1,000 per second, equivalent to an 8-cylinder engine speed of 15,000 rpm. A transistor is used in the Lucas development to release current to a high-voltage transformer. Outputs up to 20 Kv can be produced. Ignition system is presently intended for racing-car engines.

Navy Contracts Favor Sub Defense

RECENT CONTRACTS awarded by the Navy show the continuing emphasis on antisubmarine defense.

Control Data Corp. last week announced the receipt of an order for eight digital geoballistic computers to go into the Polaris' Mk 84 fire-control system; value of the production contract is in excess of $4 million. CDC built the functional prototype of the geoballistic computer under a previous prime development contract from BuWeaps for $5 million. Computer receives position data from ship's inertial navigation system (SINS), calculates trajectories to assigned targets until the missiles are fired, at which time the missile's guidance system takes over.

Another contract, for long-range basic research in undersea noise, was awarded to Electro Nuclear Systems Corp. of Minneapolis. Contract is from Office of Naval Research for an undisclosed amount.

Encoding Keyboard Uses Optical Techniques

PHOTOELECTRIC binary-encoding keyboard for use with data-processing peripheral gear was announced last week by Invac Corp., Natick, Mass. The keyboard can put out standard or special 5, 6, 7 or 8-bit binary codes.

When a key is pushed, a binary-coded shutter modulates a bank of light-data channels; the coded signal bears on a bank of photoconductors which produces the required electrical signals. Amplifiers are optional. Standard 44-key alphanumeric keyboard can be used for dual logic (upper case can mean something different from lower case). Keyboard with amplifiers sells for $550.

FCC Reorganization Seeks Work Speedup

REORGANIZATION of the Federal Communications Commission proposed by the Kennedy administration is designed to speed the FCC's work and reduce the lag in handling cases.

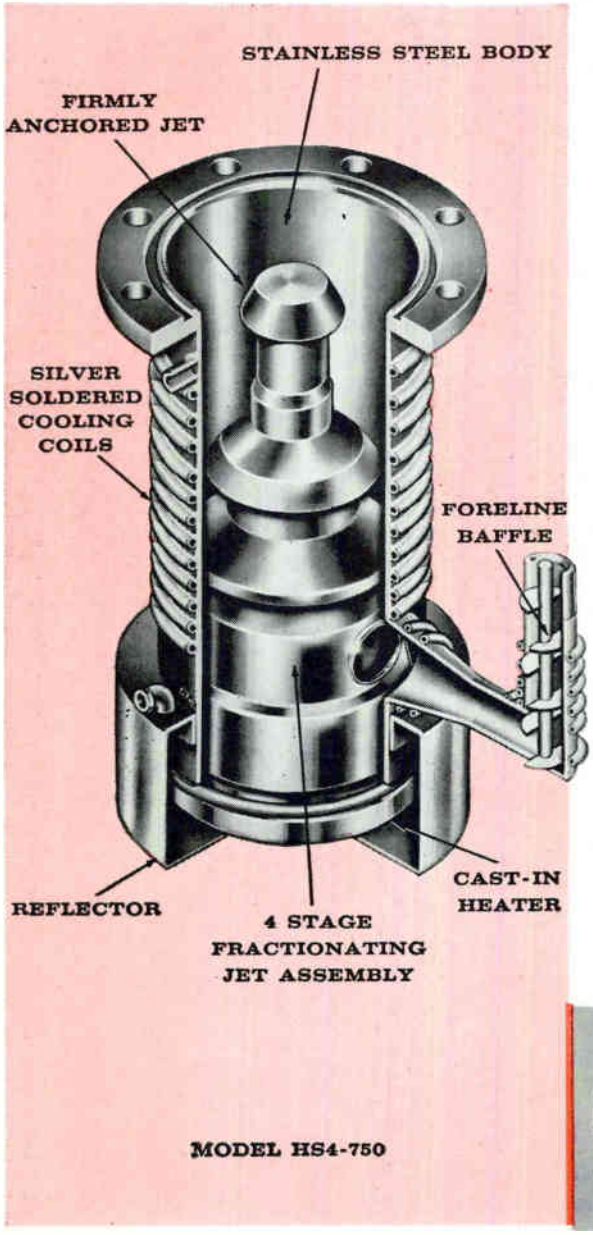
The speedup would be accomplished by permitting the agency to hear cases before panels of commissioners, individual commissioners, hearing examiners, or other employees. The Commission would have the right, with some exceptions, to declare FCC actions final, court recourse for losers.

NOW REACH OPERATING PRESSURES FASTER

. . . with the NRC Model HS4-750 4″ Fractionating Diffusion Pump

Highest speed over the widest range of any 4″ diffusion pump available today.*

The only fractionating 4″ diffusion pump of its type, the Model HS4-750 starts pumping at 400 microns — delivers 750 liters/sec. from 1 micron down and reaches ultimate pressures in the 10^{-10} Torr range. Regardless of variations in water temperature and fluctuations in voltage, performance is assured with only a 6 cfm mechanical backing pump. This outstanding performance is made possible by a completely new boiler and heater plus the new 4-stage fractionating jet design.



Check these additional features:

FIRMLY ANCHORED JET
cannot be hurled into the manifold by accidental release of air through the foreline.

SILVER SOLDERED COOLING COILS
cannot slough off even when pump is operated without cooling water.

FLUID-RETAINING FORELINE BAFFLE
keeps fluid in the pump, even when it is incorrectly air-released.

LONG HEATER LIFE
"cast-in" unit assures good heat transfer to the boiler while keeping watt density low.

LOW BACKSTREAMING
less than 0.02 mg./cm.^{2}/min.

QUICK HEAT-UP AND COOL-DOWN
reduces operating time and use of power.

MINIMUM CLEANING
stainless steel body stays clean . . . entire unit disassembled in 15 sec.

This NRC pump combines all the features which add up to the ideal diffusion pump . . . offers you both top performance and reliable, trouble-free operation. Write for our free catalog containing speed curves . . . see why Model HS4-750 is the best 4″ pump you can find anywhere.

*Immediately available at $395.00 F.O.B. Newton, Mass.

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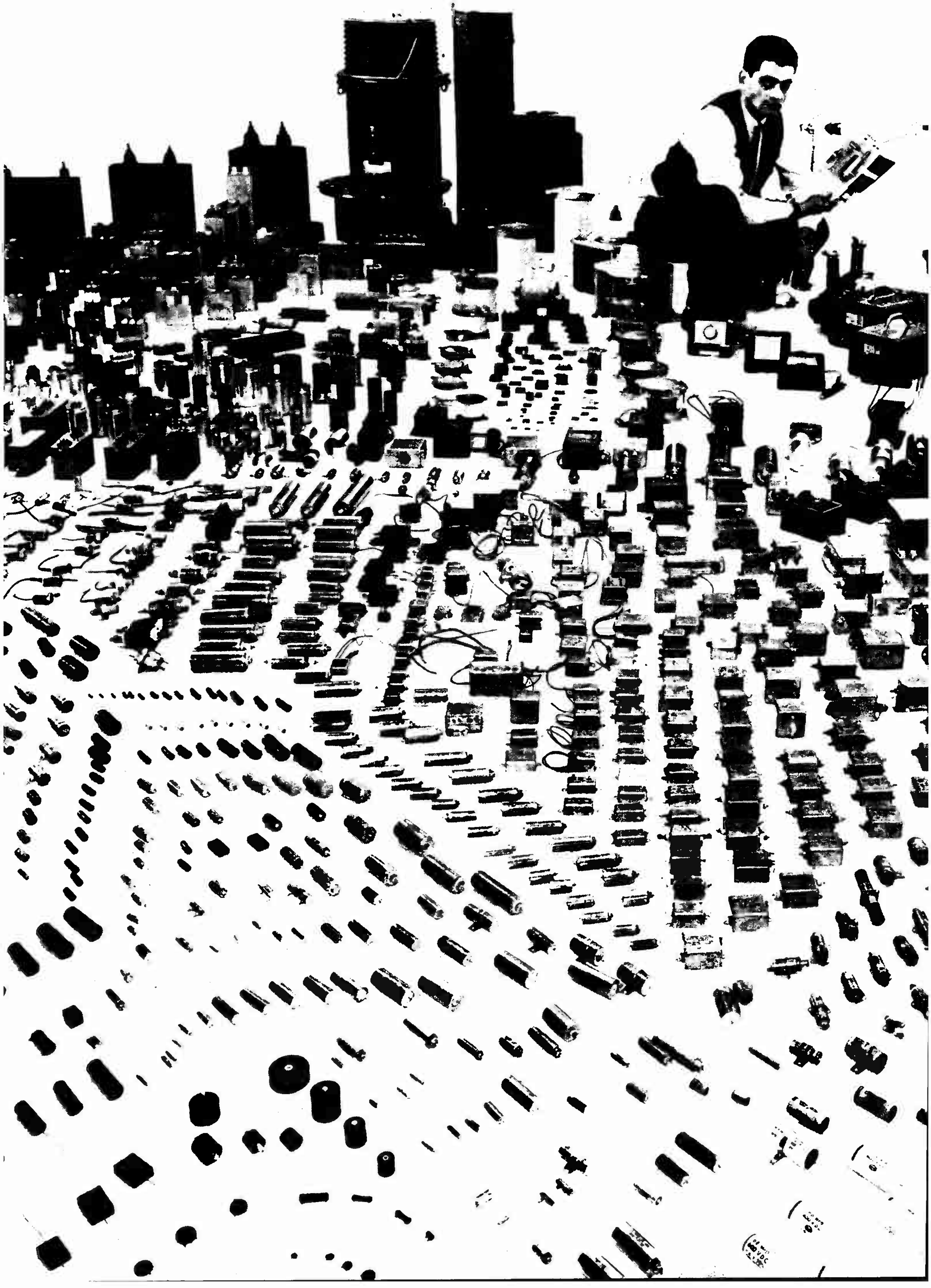

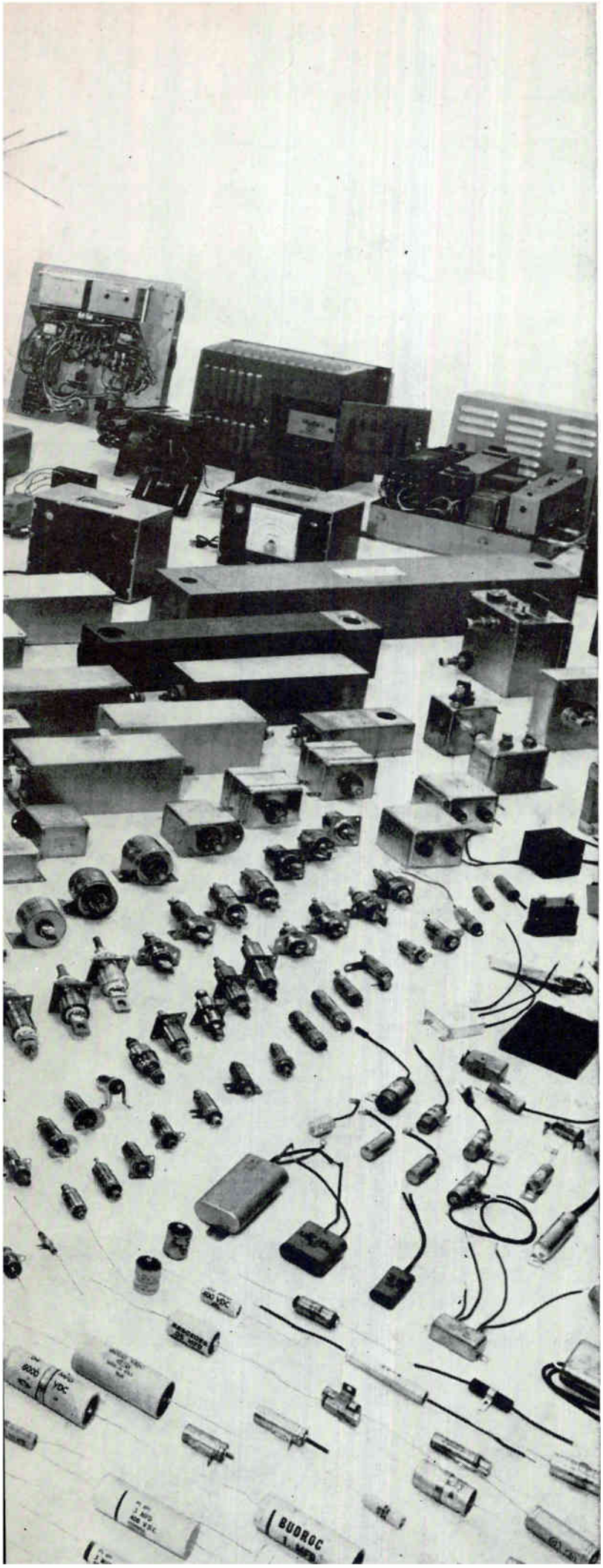

in 50 years... over 3,500,000,000 capacitors

For over fifty years, Cornell-Dubilier has specialized in the design, production and distribution of capacitors. William Dubilier is regarded throughout the world as the "Father of the Capacitor Industry." From a modest beginning in 1910, CDE has continued as the leader in this important phase of electronic components pioneering.

Today the many vast and widespread facilities of CDE provide a single source of unmatched capacitor technology. There are more CDE capacitors in use today than any other make—every conceivable known type, style and class—fabricated and sold by CDE in every part of the world.

Designs still unborn are being conceived and developed in CDE's Research Center . . . particularly "High Reliability" components for the most advanced applications of the Electronics Age.

Be it ceramics, mica, electrolytics, tantalum, film, paper, metalized or types yet unknown, CDE can be depended upon to meet the needs of the Electronics Industry . . . today and in the future.

CDE also produces relays, semiconductors, filters, delay lines, pulse networks, packaged circuits and systems, test instruments, vibrators and converters, and antenna rotors . . . all allied electronic devices frequently associated with capacitor technology.

When you have been around for 50 years there are reasons . . . uncompromising quality of materials, meticulous care in production, exhaustive testing and a compelling "Urge to Serve."

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CDE

highly reliable electronic components and systems

CIRCLE 13 ON READER SERVICE CARD

WASHINGTON OUTLOOK

MORE CENTRAL CONTROL over weapons research and development is being tried in the Pentagon. By overhauling the Defense Dept.'s massive budget-making procedures, Secretary McNamara hopes to have a stronger hand in deciding what weapons and what service will be charged with strategic and tactical roles and missions.

Short-term, between now and Oct. 1, the policy is aimed at deciding what weapons are best. Thus, the Air Force Minuteman, now in development stage, will be pitted against the Navy's Polaris, already in production, to see which one will be relied upon as a mobile, solid-fueled ballistic missile.

Or, the Army's Pershing missile will be pitted against the Air Force's advanced fighter-bomber, and then a decision made as to which should get that tactical chore.

There will be sharper competition among weapons systems, and an early showdown in the three services as to which will win a role for either limited or deterrent missions.

Long-term, what McNamara and his comptroller, Charles J. Hitch, are attempting to arrive at is a consistent and steady spending figure for years to come, and to award money to the Army, Navy and Air Force on a basis of what function each has, rather than on an eenie-meenie-miney-mo system.

These officials claim the savings on "marginal" projects will be so substantial that more funds should be available for higher-priority arms and equipment.

The impact, for industry, will be more in terms of stability. Once an R&D or production project is approved with a specific schedule, it will now be less likely that major changes will be made in the future, barring unforeseen technological developments.

Incidentally, the outlook is for a continuing rise in defense spending in the years ahead. In fiscal 1962, which starts July 1, spending is estimated at $43.8-billion, up $1.3-billion over the current rate.

THE ADMINISTRATION'S tax credit plan to stimulate investment in new plant and equipment is getting more knocks from congressmen and business groups than praise.

After reviewing all of Kennedy's programs to speed recovery and the country's long-term economic growth, the Democrats on the Joint Economic Committee of Congress are doubtful about the tax credit idea. They say the tax credit (which would reduce business taxes by $1.7-billion a year geared to spending on new plant and equipment), might provide "relatively little stimulus in investment unless consumer demand is stimulated." Their thought: a tax cut for individuals might do more good.

Secretary of the Treasury Dillon gave some details on the tax credit plan: companies would be permitted to carry forward unused tax credits for 5 years (to help out companies whose spending fluctuates); but to prevent bunching of expenditures to get the maximum tax credit, below-depreciation spending in a given year would be charged against the depreciation base in future years.

ANOTHER EFFORT is being made in Congress to help self-employed professional men set up their own retirement program. The legislation, sponsored by Rep. Eugene Keogh (D.-N.Y.), would give an income tax deduction to a taxpayer who set up a retirement program acceptable to the Internal Revenue Service. There would be a limit of $2,500 a year deduction.

But it will take presidential backing before it gets through Congress. Many professional organizations are supporting the measure, but the White House is inclined to put the legislation over until next year when the administration intends to try an overhaul of the personal income tax laws.

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1 μμa

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1 μv

10 times previous accuracy, drift less than ±4 μv per day, noise less than 0.2 μv!

425A Microvolt-Ammeter

Now make these difficult measurements quickly, easily

Engineering – minute dc potentials, difference voltages, nulls; resistances from milliohms to 10 megmegohms (with external dc source). Also use with Esterline-Angus, other recorders

Physics, Chemistry – grid, photomultiplier circuits, vacuum ion levels, thermocouple potentials, voltaic currents in chemicals

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Use of a photoelectric chopper instead of a mechanical vibrator, insuring low noise and drift. Protection against 1,000 volt momentary overloads. Probe minimizing thermocouple and triboelectric effects. Heavy ac filtering.

Above are but a few of the reasons why the 425A does the work of complex equipment arrays faster, more simply and with 10 times previous accuracy.

In addition to extremely small voltages and currents, Model 425A measures resistances from milliohms to 10 megmegohms, in conjunction with an external constant current.

Get complete details today from your representative, or write direct.

SPECIFICATIONS

MICROVOLT-AMPLIFIER

Voltages: Pos. and neg. 10 μv to 1 v end scale. 11 ranges, 1-3-10 sequence.
Current: Pos. and neg. 10 μμa to 3 ma end scale. 18 ranges, 1-3-10 sequence.
Input Impedance: 1 megohm on voltage ranges, 1 megohm to 0.33 ohms on current ranges.
Accuracy: ±3% of end scale.

AMPLIFIER:

AC Rejection: At least 3 db at 0.2 cps, 50 db at 50 cps and approx. 60 db or more above 60 cps.
Gain: 100,000 maximum
Output: 0 to 1 v, adjustable
Output Impedance: Depends on setting of output potentiometer; 10 ohms max.

PRICE: 425A, $500.00 (cabinet);
425AR, $505.00 (rack mount).

Data subject to change without notice
Price f.a.b. factory

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CABLE "HEWPACK" · DAVENPORT 6-7000
FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

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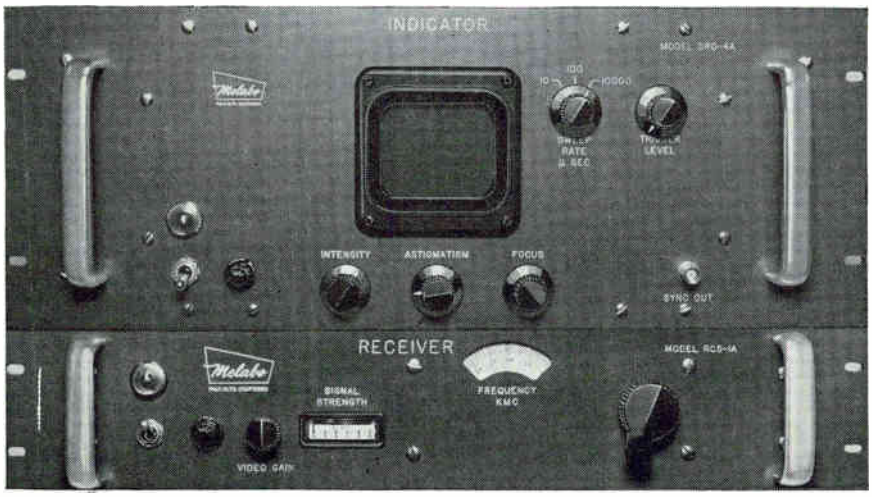
hp headquarters for precision AC and DC voltmeters

WHY PAY for superhet sensitivity in range monitoring, lab work when the Melabs



TEST RECEIVER

permits field strength readings and rf pulse analysis at extremely low cost!

For only $900.00, a microwave receiver of moderate sensitivity and high selectivity, usable with separate synchroscope for pulse observation! The first high-performance, low-cost receiver of its type on the market!

These small, transistorized receivers are available today for the U, L, S, C, X and P bands, with similar models soon to be available in these ranges: 18-26.5 KMC, 26.5-40 KMC. Battery-operated cabinet models also available on special order for portable field use.

Receivers for all frequency bands are identical except for tuning cavity and dial. The DRO-4A display unit designed for use with the receiver can be used with all models, is packaged separately for maximum flexibility. Only one interconnecting video cable is required.

SPECIFICATIONS

Frequency Ranges:	Model RCU-1: 400 MC-1 KMC Model RCL-1: 1-2 KMC Model RCS-1A: 2-4 KMC Model RCJ-1: 4-8 KMC Model RCX-1: 8-12.4 KMC Model RCP-1: 12.4-18 KMC
Sensitivity:	– 40 dbm minimum
Selectivity:	1% at 3 db (maximum)
Video Bandwidth:	4 MC
Dial Accuracy:	1%
Weight:	Receiver, 15 lbs.; display, 30 lbs.
Size:	Receiver, 3½" x 15" x 19"; display, 7" x 15" x 19"
Sync sweep speed:	10, 100, 10,000 μsec
Price:	$900.00 (add $150 for model RCX-1 or Model RCP-1) DRO-4A Display Unit, $900.00

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Employment opportunities at Melabs are exceptional for ambitious engineers and physicists. Write in confidence.

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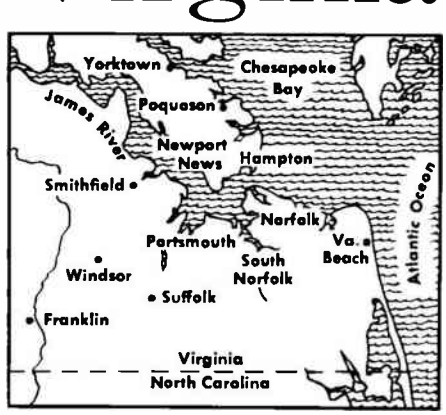
Look into Hampton Roads, Virginia

Freedom from rehandling costs can save your plant many dollars a year. And in the Hampton Roads area, you enjoy that saving both seaward and landward. There's deep-water frontage available, and more to come along planned extensions of present channels. And it's backed with rail and highway service by 8 major railroads and 45 scheduled truck lines. Ask VEPCO for site and economic data on the pleasant, hospitable, conservatively governed communities surrounding this well-served ice-free port. Write, wire or phone in confidence.



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Clark P. Spellman, Manager—Area Development, Electric Building, Richmond 9, Virginia • MIlton 9-1411
Serving the Top-of-the-South with 2,086,000 kilowatts—due to reach 2,720,000 kilowatts by 1963.

WHO SAID IT COULDN'T BE DONE?

OHMITE'S
NEW ONE-WATT
Vitreous-Enameled Resistor
With Axial Leads

Lots of people thought this tiny "1-watter" was impossible. But here it is. And for the first time in this power rating, circuit designers can get all the advantages of a wire-wound, vitreous-enameled resistor with axial leads—high temperature operation, up to 350°C; ±5% tolerance; low temperature coefficient; low "noise" level; stability; and strong, welded construction.

Construction is the same as Ohmite's 3, 5, and 10-watt sizes—including ceramic core, uniform winding, tough Ohmite vitreous enamel coating, and traditional Ohmite reliability.

Resistance values range from 1 to 6000 ohms. But you can find out all about this *exclusive* Ohmite development by writing for *Bulletin 147F. Do it now!*

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Rheostats Power Resistors
Precision Resistors Variable Transformers
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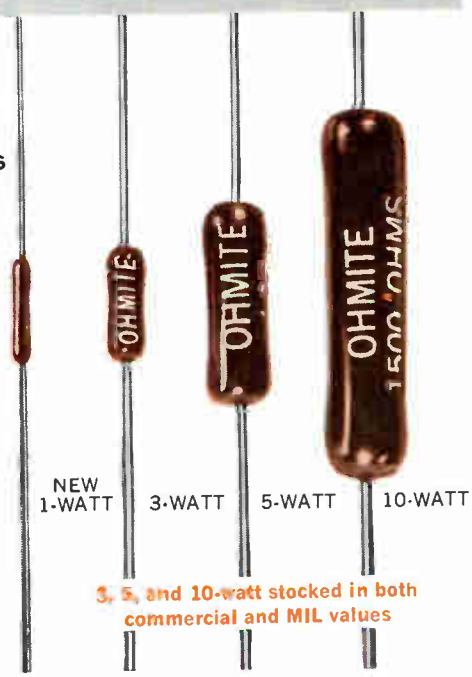
OHMITE

Now 4 Sizes



3, 5, and 10-watt stocked in both commercial and MIL values

CIRCLE 19 ON READER SERVICE CARD 19

A full line of capacities from 10 to 52 points. Capable of millions of steps without adjustment.

Fast "Off-The-Shelf" delivery

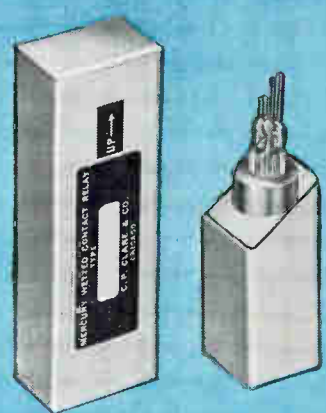
Overnight delivery on many items at factory prices

When standard CLARE relays or switches meet your needs, distributor service saves you time, costs you no more.

Top quality
—the same fine design and long life you get in CLARE custom-built relays and switches.

Easy purchasing
—you can order CLARE relays at the same time you purchase other components... have them delivered together.

Engineering assistance
—always available from CLARE field engineers who work in close cooperation with CLARE distributors.



NOW AVAILABLE
...mercury-wetted contact relay modules for mounting on your own printed circuit board

Type HGM relay module (left) with cut-away (right) showing mercury-wetted switch capsule and coil potted in steel enclosure.

Your nearby CLARE distributor can now supply you with the new CLARE mercury-wetted relays, steel enclosed and ready for mounting. They combine the famous CLARE billion-operation reliability with unusual ease of handling and application. You can choose either the standard CLARE HG relay module or the HGS, super-fast and super-sensitive. Each module contains the CLARE mercury-wetted contact switch capsule with contacts continually wetted by capillary action. They never bounce, never get dirty, never weld and never wear out.

A compact telephone type relay of unequaled long life and superior performance.

A highly reliable switching device for single or multiple circuit control... wide mounting versatility.

Single or multiple switch capsules potted in steel container. Gives billions of operations with no maintenance.

A crystal can relay with unusual flexibility and a variety of mounting styles.

# of top-quality Clare relays

From these distributors

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3. **Radio Specialties Co., Inc.**
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7. **R & D Supply, Inc.**
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   Miami 32, Florida

CENTRAL

10. **Relay Sales, Inc.**
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    West Chicago, Illinois
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    Cleveland 15, Ohio
13. **M G Electronics & Equipment Co.**
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For more complete information on the full line of CLARE components, address:
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Relays and related control components

CIRCLE 21 ON READER SERVICE CARD

Distributors' Volume to Double by '65

CHICAGO—Fiercely-competitive electronic parts distributing business has yet to persuade its participants to reveal figures necessary for assembly of detailed statistics, charts and graphs. Best estimates set $1.2 billion as distributors' total share of $3 billion worth of parts sold during 1959.

Distributors' business was $1.55 billion during 1960 and total sold by them is expected to reach at least $2.3 billion by 1965, according to management of the Parts Show here week after next.

Industry has come a long way from 1937 beginnings of Chicago show when 20 to 30 distributors were earning a few thousand dollars a year handling parts for hams and experimenters.

Receiving tube renewal volume alone has grown from 27 million units, year the show started, to 171 million in 1959, accounting for nearly half of $369 million total receiving tube volume in the most recent year for which industry figures are available. Distributor transistor volume jumped from $130,000 in 1954 to more than $24 million in 1959.

Many of today's nearly 3,000 distributors earn several million dollars annually, with additional volume expected to follow widespread move into industrial electronic parts.

Newest trend has manufacturers setting up from 25 to 250 new, bigger and better financed distributor organizations. Capable of assuming heavier inventory and sales responsibilities, these outlets offer standard components in industrial quantities at factory prices for immediate delivery, plus special pricing structures for quantities as high as 5,000 units. Geographically closer to users, they can provide faster prepaid delivery than air shipments from the factory itself.

Exclusive franchises are a growing trend among electronics manufacturers who arrange to stock distributors and then follow up with training and equipment to help their people sell.

Fantastically snowballing variety and volume of parts in recent years is leading many manufacturers to conduct sales training programs to help distributor staffs follow-through with customers preconditioned by advertising.

Recent boost in industrial electronic parts distribution results from increasing number of applications for variety of new components and equipments.

New industrial applications for electronic equipment will continue to increase. So will types of products and number of customers—but not necessarily the number of distributors.

Here's what executives in the electronic parts distribution business see ahead:

Mergers and acquisitions will result in emergence of large, well managed, well staffed and well financed industrial distributors.

Big industrial distributors of future won't have space to duplicate several complex lines in depth, so they'll be selective. Staffs will be better trained in specialized product knowledge, so they'll have to be better paid, another factor which will call for stronger financial backing of distributors for the future.

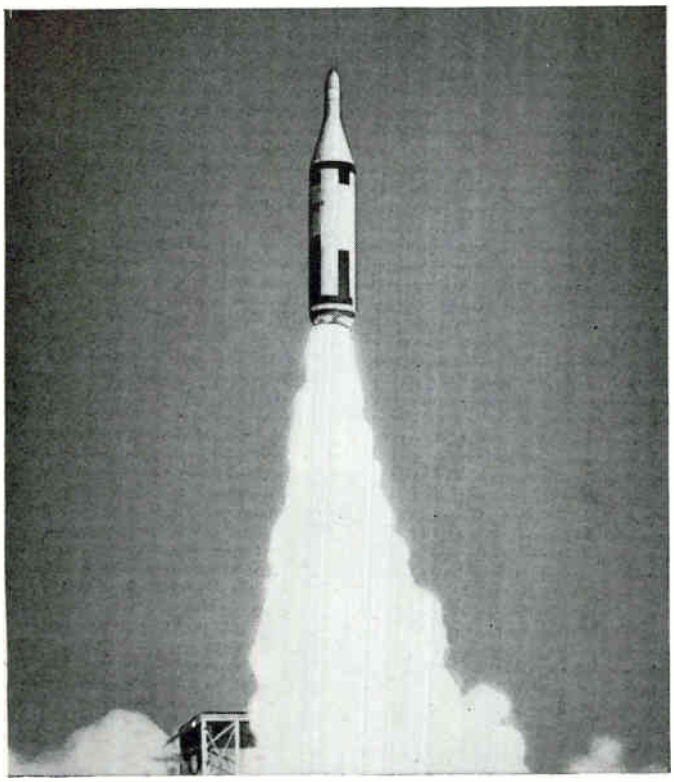
British Manufacturers Cut Television Prices

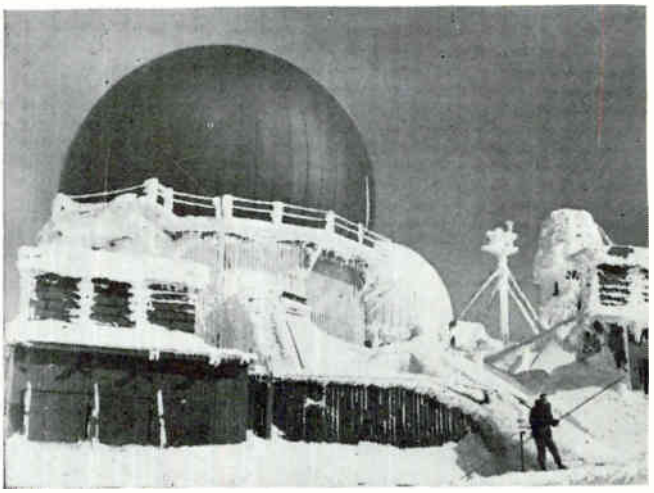
LONDON—British television receiver retailers are experiencing a slump in buying, according to English sources. The slump was emphasized recently by price reductions of about 25 percent for 17- and 21-inch sets.

General Electric Co., Ltd. cut its 21-inch models from $255.78 to $209.74; 17-inch sets from $185.22 to $144.06. The company's 17-inch portable, $173.46, was dropped to $161.70.

Because of credit restrictions and heavy purchase taxes, stock has been piling up in shops and factories, and British observers report widespread distress selling for several months. Trade circles feel

In Arctic cold...



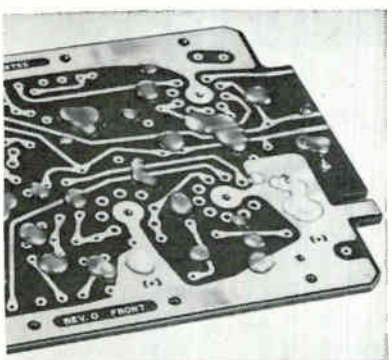


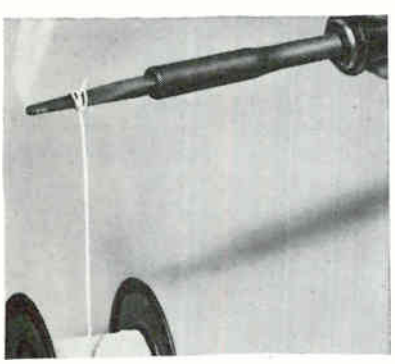
General Electric Silicone Fluids offer reliability from —65°F to 400°F as liquid dielectrics and heat transfer media in aircraft, missiles and ground installations. Excellent dielectric properties are virtually unchanged over wide ranges of temperature and frequency.

or missile heat...

G-E Silicone Rubber Insulation is used in missiles and space vehicles because of its excellent insulating properties, resistance to temperature extremes, moisture and ozone and its long-time stability in storage.

G-E silicone insulations do the job!





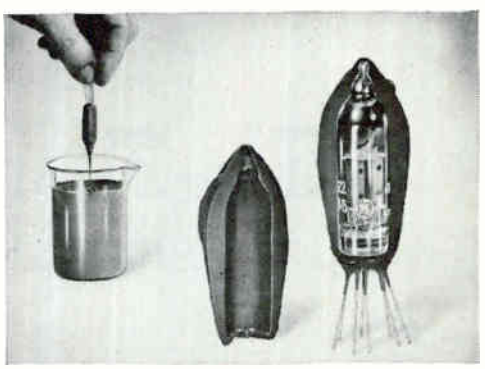
RTV* Liquid Silicone Rubber comes in a wide range of viscosities for potting, encapsulating, impregnating and sealing. RTV resists heat, cold, ozone, moisture; protects against high-altitude arc-over.
*Room Temperature Vulcanizing

G-E Silicone Varnishes provide excellent protection against moisture and high operating temperatures. Applications include conformal protective coatings for printed circuits, resistor coatings, transformer impregnation, etc. New varnishes cure at low temperatures.

New Silicone Dielectric Greases maintain physical and electrical properties from —65°F to 400°F, offer protection against moisture and oxidation. Used as corrosion inhibitors, lubricants, heat transfer media and release agents.

Silicone Rubber Wire Insulation withstands soldering heat without damage; matches or exceeds vital properties of insulation costing three times as much. Provides long service life at 500°F; momentarily withstands temperatures up to 5500°F. Flexible as low as —150°F, it resists moisture, ozone, nuclear radiation.

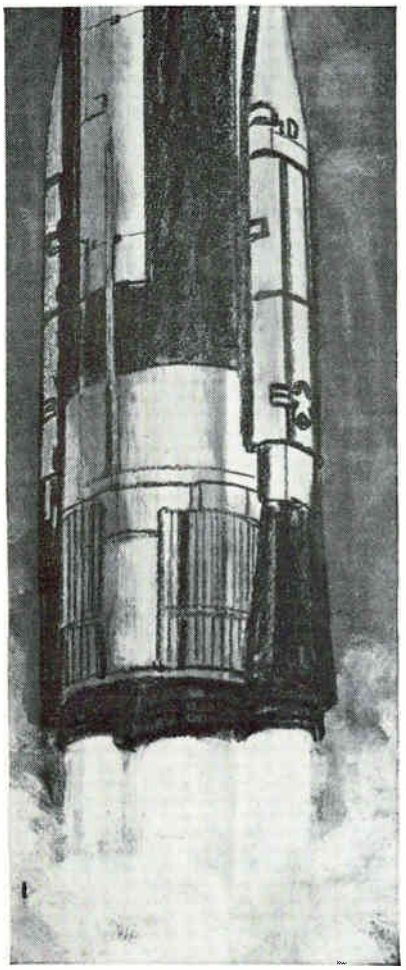
Send for technical data, "Silicones-for-Insulation." Section N1131, Silicone Products Department, Waterford, New York.

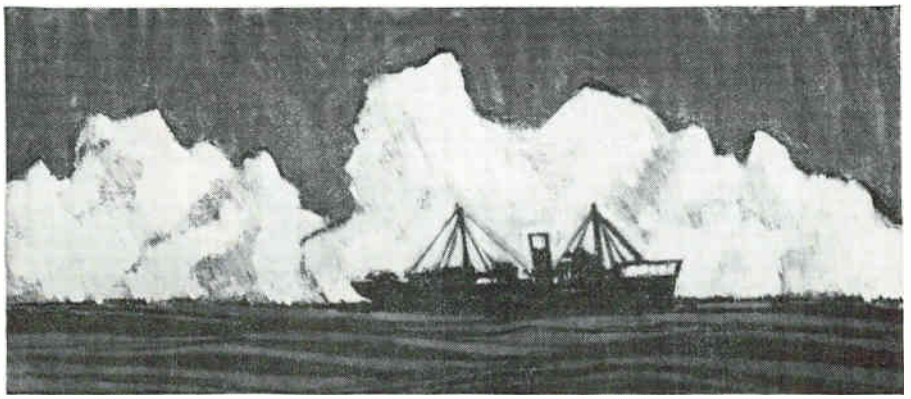


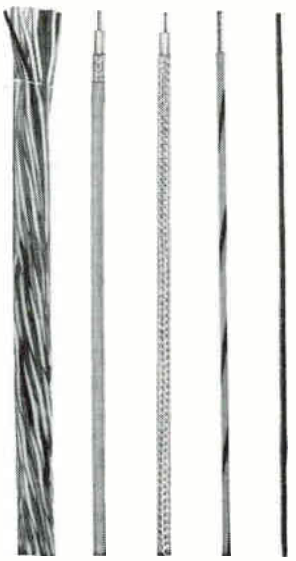
GENERAL ELECTRIC

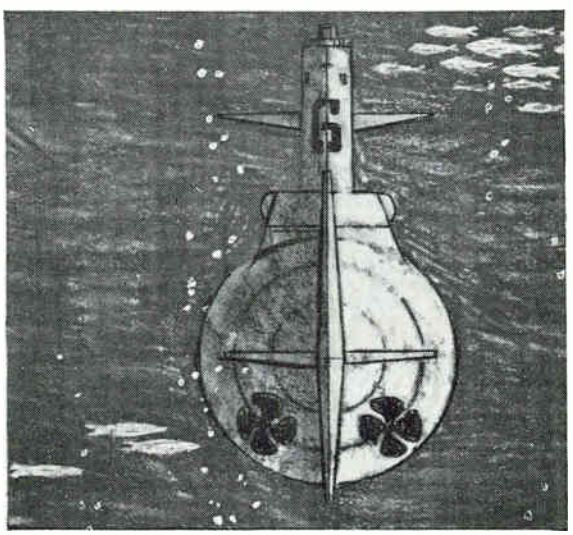
3M COMPANY CHEMICALS

THE RAW MATERIALS OF PROGRESS









KEL-F® Brand Plastic wire coating— tough skin for problem environments

Rattling vibration . . . shattering cold . . . water immersion —even problem environments like these are overcome by electrical wiring and cable utilizing KEL-F Brand Plastic as the coating.

The Surprenant Mfg. Co., Clinton, Massachusetts, has been using KEL-F Plastic as a wire coating for the past 10 years. The reason? It meets their own high quality standards and rigid requirements, as well as military specifications.

They have developed cable jacketing and wire coating of KEL-F Plastic with resistance to extreme vibration, acceleration, shock and cut-through, even at temperatures as low as —69.5°F. This non-flammable insulation exhibits good dielectric qualities and has a low dissipation factor, with zero moisture absorption and excellent compressive strength with resultant resistance to cold flow.

In areas where space is at a premium, Surprenant Mfg. Co. has found that it is easy to achieve excellent concentricity, even at very thin extrusions, using KEL-F Plastic. It extrudes at 475-625° F., and is melt-processible. The plastic may be custom-colored too, and Surprenant coatings and jackets are available in 9 stock colors (including white), and transparent.

If environment is a problem for your electrical wiring, a skin of KEL-F Plastic may well be the answer. For complete performance data, write today to: 3M Chemical Division, Dept KAX-100, St. Paul 6, Minnesota.

"KEL-F" is a Reg. T.M. of 3M Co.

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

PARTS SHOW

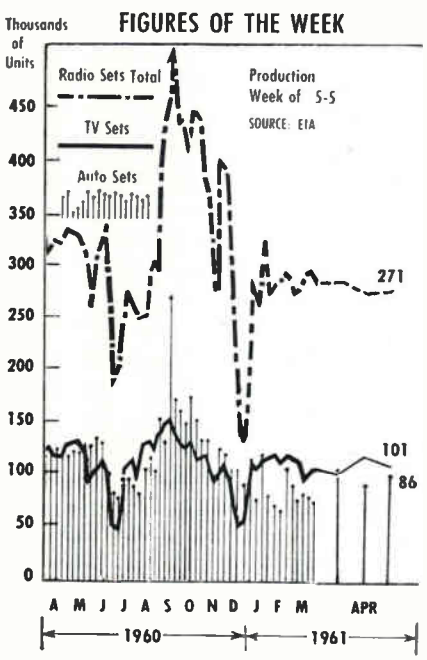
price cutting is partly aimed at clearing the way for 19- and 23-inch sets.

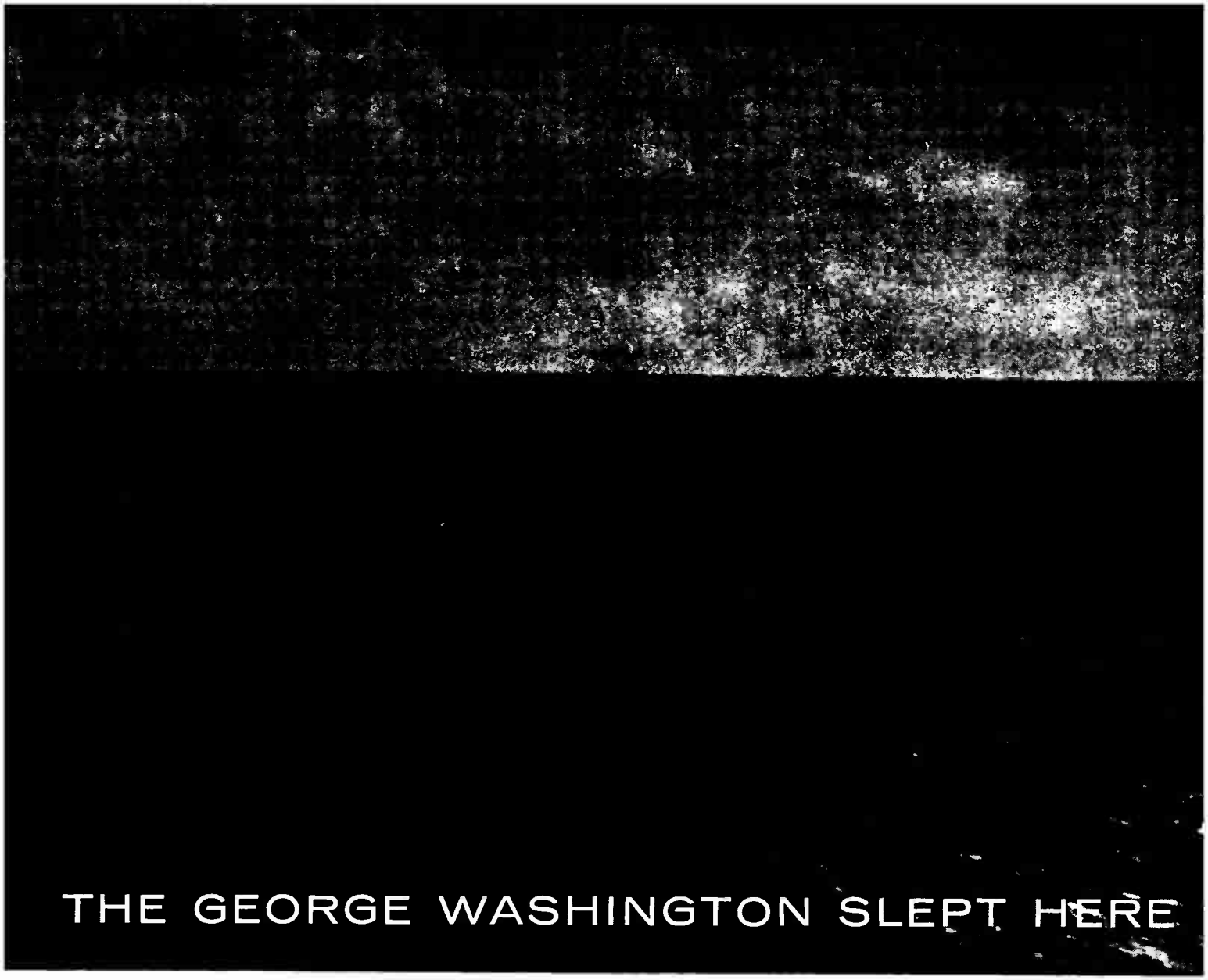
Although factory inventories have dropped slightly from the one million unit level of last year, manufacturers are prepared for the possibility of production cuts later this year.

Transistor Sales Rise One Million Units

TRANSISTOR SALES in February gained by more than one million units and $2.7 million over totals for January this year, according to Electronic Industries Association.

February sales for units sold at factories were 13,270,428 valued at $25,699,625. The month before, 12,183,931 units worth $22,955,167 were sold. During the first two months of this year, total transistor sales were 25,454,359 compared with 19,134,292 sold during the same period in 1960. Revenue from sales during 1961's January-February period was $48,654,792 as against $49,546,150 during the two-month period last year.





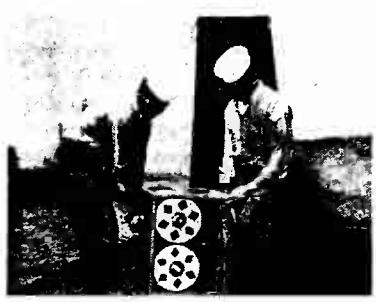
THE GEORGE WASHINGTON SLEPT HERE

BUT NOT FOR LONG. Somewhere off the Atlantic coast the big nuclear-powered *George Washington* catnapped between vibration tests made during submarine launchings of the first two Polaris missiles.

The firings were made part of "first-of-a-class" tests conducted by the Navy's David Taylor Model Basin during a 2-month period last summer. Vibration characteristics of the sub's hull, fairwater, missile and propulsion systems were recorded.

Mounted in the torpedo room of the *George Washington* were two oscillographs and a 14-channel magnetic tape recorder for recording the output from 38 velocity transducers—all products of Consolidated Electrodynamics Corporation. Output of the transducers, recorded on the tape recorder and oscillographs, was electrically integrated to produce signals proportional to displacement.

CAPABLE...RUGGED—The Electric Boat Division of General Dynamics Corporation built the *George Washington*. Electric Boat was responsible for the design and construction phase, and tested the sub at dockside and at sea in builder's trials that included tests of the torpedo system, missile firing, maneuvering and vibration characteristics, and the electrical and hydraulic systems.

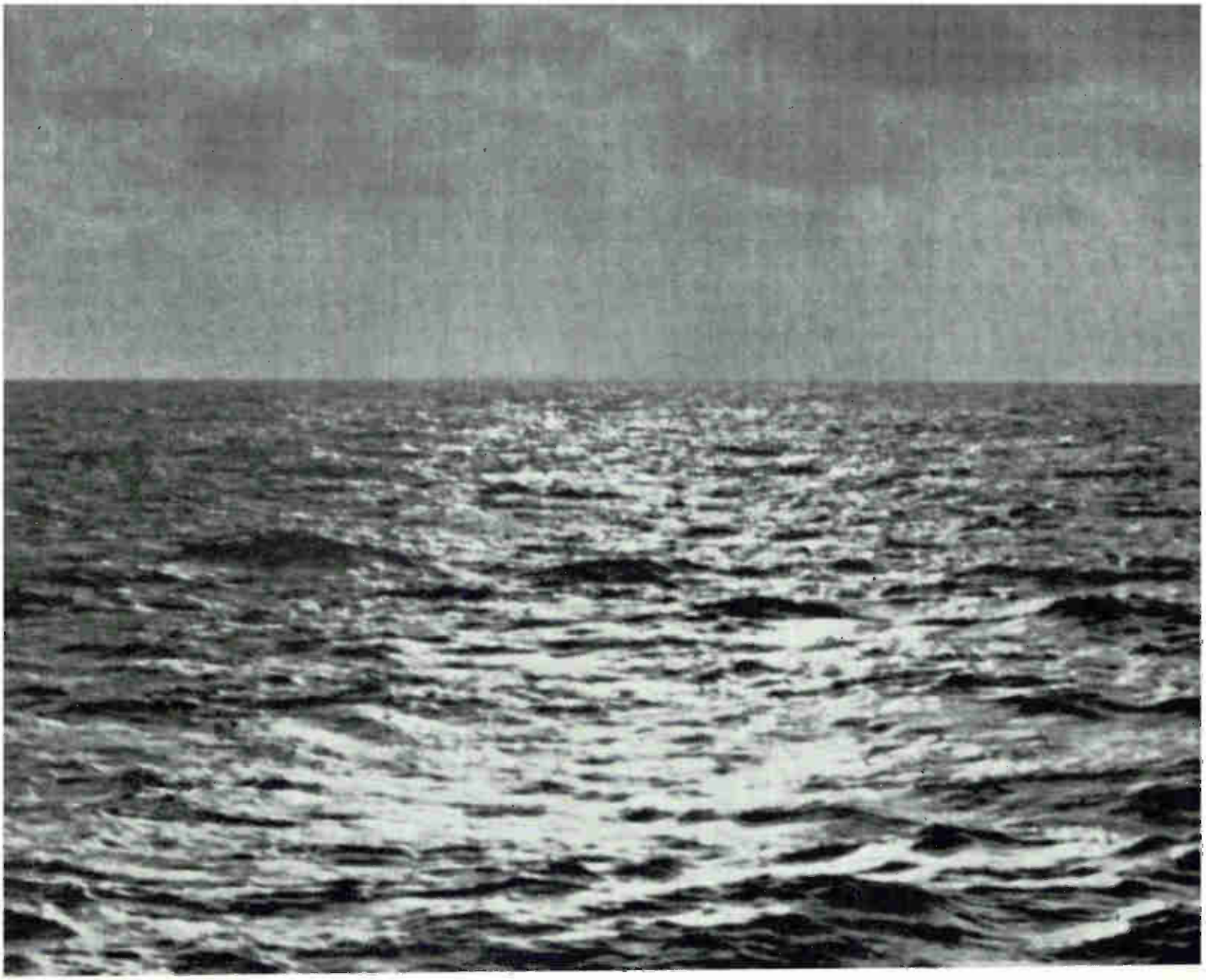


At Electric Boat, CEC equipment has proved its capability—and ruggedness—in the highly important area of design measurement. The two oscillographs with DATARITE Magazines have been moved in and out of a sub as many as 25 times to help solve problems of malfunctioning systems. They've operated at 25 to 30-degree pitch and roll angles at sea and at 70-degree angles in the laboratory.

THE SEARCH FOR A TRUE SUBMARINE—CEC's role in the development of submarines as a stronger arm in the nation's defense began with the habitability cruise of the *Nautilus*, the first U.S. nuclear-powered sub. On board was a "specialist" in atmospheric hydrocarbons: a CEC mass spectrometer. It had been modified for use by the U.S. Naval Research Laboratory on the *Nautilus* to detect and measure contaminants that affect the underwater capability of submarines—contaminants from paints, floor wax, and cleaning solvents, from the breakdown of fuel oils and lubricants, even from cooking.

The mass spectrometer was converted by CEC at the Naval Research Laboratory for continuous analysis of gaseous and liquid samples in a mass range broadened to include masses from 2 to 150.

The instrument faced measurement problems never encountered in a labora-



tory: the roll of the ship, ambient temperatures as low as 50°F., humidities ranging as high as 80 to 90%. Even routine tests became tedious, but the mass spectrometer continued to collect and analyze gas vapor trace contaminants—contaminants that might make the atmosphere aboard nuclear subs unwholesome for crew members to live and work in during long periods of submergence.

HISTORY IN HEADLINES—When the habitability cruise ended, the Navy had many facts it needed and immediately launched a similar program for each of its nuclear subs. The use of cleaning solvents was rigidly controlled. Later, all painting was terminated several weeks before a long submergence period. Finally, all materials containing undesirable contaminants that could not be eliminated aboard ship were simply left ashore.

What has happened since in the Navy's search for a true submarine is headline history. In the fall of 1957, the *Nautilus* was submerged for 5½ days under the Arctic ice pack. In the months that followed, her sister subs set 16-day and 30-day endurance records . . . then a 2-month record . . . then a circumnavigation of the world that lasted 84 days and 41,519 miles.

CEC's applications of mass spectrometry and data recording to underseas problems are perhaps unprecedented. Mass spectrometry and data recording continue to have countless applications in other vital military and defense programs, in research laboratories and throughout industry. There are endless uses for CEC mass spectrometers, oscillographs, tape recorders and transducers. The widespread use of these instruments tells only part of the company's product story.

As one of the world's principal suppliers of precision electronic instrumentation, Consolidated Electrodynamics continues to develop the techniques and electronic tools that give man the ability to measure, and in part control, the dynamic and expanding boundaries of his physical environment.

Since 1937, through research and advances in technology, CEC has helped speed U.S. development of aircraft, missiles, nuclear reactors, and automatic petrochemical plants. With the dawn of an era of automation, CEC's capabilities in instrumentation are available to all men of science and industry. It is an era in which man will be limited only by his imagination.

CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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CIRCLE 25 ON READER SERVICE CARD

EUROPEANS

EASTWOOD

JACOBAEUS

de FERRANTI

Three significant statements to ELECTRONICS' *editor MacDonald, now back in New York and hard at work writing a special report about "Electronics in Europe" for our June 9th issue:*

By E. EASTWOOD
Marconi's Wireless Telegraph Company, Ltd.
Great Baddow, England

THE AIRSPACE above the British Isles is one and indivisible. All aircraft, whether military or civil, wish to have the freedom of this airspace in order to operate at maximum efficiency, but this freedom can only be achieved if the principle of control is accepted by all users.

It has been Air Traffic Control philosophy hitherto that any aircraft may use the airspace and is free to choose whether it will cooperate with the A. T. C. system. This attitude is clearly impossible in the era of high air traffic density into which we have now entered.

The modern jet airliner has overridden the boundary that has been assumed to exist between civil and military traffic, so that the only real distinction that can now be drawn is between the needs of a generalized military and civil traffic control system on the one hand and the requirement for the active phase of air defense on the other.

In order to exercise control it is necessary that ground controllers have complete knowledge of the content of the airspace. This essential information cannot be derived from procedural sources alone but must be obtained from a radar system capable of surveying the whole airspace at all altitudes, unaffected by precipitation echoes and ground returns. Such a system would demand judicious deployment of a number of radars operating at different frequencies, the information from this network being transmitted to a central station where the positional data on aircraft could be correlated with the supplementary procedural information being fed into the system from the traffic side.

Such a library of processed information, which could be the content of an electronic store, would be available to all users of the airspace, i.e. those responsible for civil flights, those responsible for the movements of military aircraft and, finally, to the defense authorities who would be responsible at all times for deciding whether the airspace contained aircraft of unknown origin whose presence constituted a threat to the safety of the country.

According to this view it is inevitable that ground radar shall cease to be regarded as a mere navigational aid for use in the terminal area only; it is necessary that it be seen for what it is—the only possible monitor over the complete airspace.

By CHRISTIAN JACOBAEUS
L. M. Ericsson Telephone Co.
Stockholm, Sweden

THE PRINCIPAL product of the electronics industry is brain work. The articles it produces are being increasingly perfected in their functions while being constantly reduced in size.

Hardware in the sense of product volume and product weight is being eliminated as far as possible. The capital equipment of the electronics industry is often on quite a modest scale, counted per employee, especially as only in exceptional cases are production series of any considerable length. A very large part of the cost of advanced products lies in research and development.

This trend has been accentuated in recent years, not only directly through developments in technique, but also indirectly through the shortage of engineers, which has forced up the levels of salaries. How, then, should one get to grips with the problem?

LOOK INTO THE FUTURE

Manufacturers can to some extent train selected members of their staffs, but the main contribution to the engineer cadres must come from educational institutes. What manufacturers can do is to rationalize their engineering work.

There are many possibilities in this respect, most of which are well known to those in charge of engineering organizations. I shall here deal with only one of them, which might be called "the advanced use of computers".

In the telecommunications industry we now use computers almost as a matter of routine for a multitude of problems. The best known use perhaps is for filter computation.

Another application is for switch and circuit provision in telephone plants.

Two methods are available for this purpose, a direct computing method based on mathematical expressions, and a simulating method based on simulation of the interplay between the different parts of a plant.

For electronic exchanges it has been possible to study in advance the function of the logic circuits by running a corresponding program in a computer. Likewise it has been possible to simulate alternative structures of transmission systems. All the data involved in these procedures are of an analytical character.

We hope that in future we shall be able to solve problems involving the essential elements of synthesis.

In other words, we hope to be able to inject primary data, and possibly a general principle for the solution, after which the computer would deliver an optimal solution in the desired respect. This would presumably have to be done by means of a learning process. The computer would initially present solutions to problems, and the solutions would be criticized by the technicians.

The computer can then be informed of the criticism and adjust its actions accordingly. The solution must be presented in a form which permits the simple derivation of production documents, for example in the form of a tape which can be used for the direct control of a wiring machine.

For a large number of logic circuits with relays or solid state components this should be possible without too great a development effort. Solutions would probably be attainable for other circuits as well, such as oscillators and amplifiers.

Development on these lines requires intimate cooperation between the engineers and the mathematicians.

Computer technique can be of valuable assistance, too, and in the long run indispensable, in an entirely different field, the field of patents. At present no patents office in the world can be expected to make a reliable examination of inventions in electronics. This is because it has obviously not been possible to arrange and cross-reference the vast amount of new material that exists.

If a computer could be acquired for storage of references to earlier patents, publications, constructions, etc., an efficient examination of patents would be possible. If done on an international basis, a mass of duplicated work by highly qualified patents engineers could be avoided.

By BASIL Z. de FERRANTI
Ferranti, Ltd.
London, England

A FUNDAMENTAL LAW is emerging in the computing field, namely that the power of usefulness of a computer increases as the cube of its cost.

Thus the future of computing may well be with large central machines using small satellite computers on the customer's premises and high speed data links for communication. However a "communications barrier" is now evident.

If a breakthrough can be achieved here comparable to the breakthrough in power distribution, due to the use of high voltage alternating current the whole shape of the computer business will be radically altered.

Can Radar Tell Difference Between Hail and Rain?

UNIVERSITY OF ARIZONA scientists are now completing basic studies needed for developing better radar techniques to differentiate between rain and hail storms.

The work is being done by Benjamin M. Herman and Louis J. Batten of the university's department of meteorology and climatology. Discoveries so far indicate that, contrary to general belief, hailstones may reflect many times more energy than equivalent-size raindrops provided the radar wavelength is larger than the particle size—if the wavelength is smaller the reverse is true. Also, use of two or more different wavelengths of radar to produce variations in reflectivity makes it possible to determine both presence—and size—of hail.

Microwave Network To Control Pipeline

TRANSISTORIZED microwave control system now being constructed in Texas will handle Magnolia Pipeline Company's 540-mile oil transmission network.

The control system will be operative by January 1962 and manage the flow of 235,000 barrels a day.

Nearing completion are 12 microwave relay towers and stations along a 335-mile segment of the pipeline. The system was built by Dresser Electronics, Inc.

New Distribution Patterns to Dominate Parts Show

Servicing the industrial market is seen as a big challenge to the parts distributor and an opportunity for vastly increased business. Back-to-school sessions scheduled outside of show hours will bring distributors up to date on technology and business

One of the exhibit halls at last year's Parts Show.

By CLETUS M. WILEY, Midwestern Editor

CHICAGO—Widespread distributor penetration of the industrial electronics market during the past few months will bring a major expansion to the 24-year-old Electronic Parts Distributors Show here week after next (May 22-24). A new industrial conference section will take over an additional half of the seventh floor of the Conrad Hilton Hotel where the show will have its headquarters.

Rarely thought of as a new products show—leaving most components to be introduced through OEM channels—the Parts Show pulls a switch this year, documenting its "What's New" theme with brand new stereo f-m broadcast adapters, tuners and receiving compenents, nuvistor-equipped preamplifiers, radio controls for a wide range of industrial applications, a sound-isolated two-way portable radio network, a self-powered, self-contained public-address system and even a so-called sidearm screwdriver.

More than 300 exhibitors bought out all available space even earlier than last year in two basement halls of the Hilton Hotel, plus fifth and sixth floor display areas. Half of latter space has been allocated to audio and hi-fi manufacturers. Total of 12,500 manufacturers and distributor reps are expected to attend this month's show.

Special seventh floor addition will bring together distributors and manufacturers who have recently been setting up new distributor networks to serve industrial customers faster and better than the manufacturer can himself.

Trend away from factory-to-factory selling and toward giving industrial electronics distributor a more important role is rapidly spreading and seen as the pattern of the future.

Distributors handled only two to three percent of the industrial electronics market 15 years ago, according to Sam Poncher, head of his own Newark Electronics company and president of the Electronic Industry Show Corporation which runs the show.

"Industrial electronics market is now expanding at a far greater pace than any other segment of this growth industry," Poncher says. Changes accelerated during the past year are expected to boost growth 20 to 25 percent a year, increase electronic parts business 10 times in next 10 years and eventually bring over over 75 to 90 percent of the industrial parts market to distributors, he believes.

Back-to-school movement is the "most significant technical and business trend in the electronics parts business today," says Kenneth C. Prince, general manager of the show which is also sponsored by the Association of Electronic Parts and Equipment Manufacturers, Inc., Electronic Industries Association, Producers of Associated Components for Electronics, Western Electronics Manufacturers Association and National Electronic Distributors Association.

"We're all going back to school to fill in the gaps in the knowledge we need to keep up with this fast-moving technology," Prince said in outlining management and sales seminars scheduled at nonconflicting hours to bracket both ends of 9:00 a.m. to 6:00 p.m. exhibition periods all three days of the show.

"Manufacturers and distributors are both increasingly aware of the need for updating their product and business administration knowledge," he says.

Scene will be repeated week after next

Distributor workshop seminars. billed as one of the most ambitious self education attempts ever made by an industry, will be new in timing, format and subject matter. Nonconflicting schedule has been designed to permit managerial personnel to attend both workshops.

Management seminar will cover inventory management, personnel management, profit management, effective communications and product information.

Sales seminar will include sessions on catalog sheets, brochures and uses, selling specific products, account development and opening new accounts.

Common problem areas will be analyzed by professional staff and informally discussed by small, noncompetitive groups at tables, summarized and then reinforced with take-home materials.

Wider use of standardized parts to save inventory, space and backup is seen as a third major and growing trend within the parts industry.

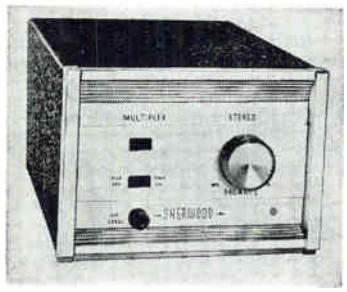
Broad range of parts to be shown offers sufficient versatility for most designs without added expense of short component runs for special designs, distributors say.

Soundproof two-way radio by Globe Electronics gets workout from air-hammer operator

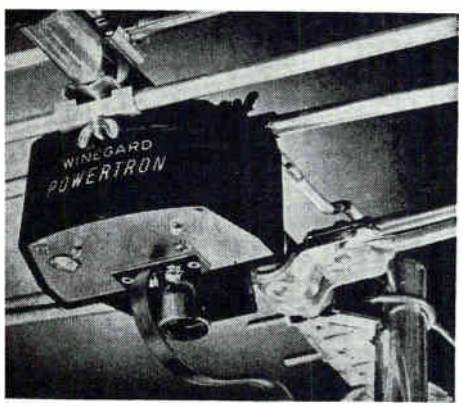
STEREO F-M Among NEW PRODUCTS

Other new items at Parts Show include soundproof helmet transmitter-receiver, tv antenna with built-in preamplifier, barium-ferrite loudspeaker that fits in wall

PARTS SHOW



Three-tube f-m sterco adapters by Sherwood Electronic Labs



Tv antenna by Winegard has built-in frame-grid amplifier

CHICAGO—Timely items in the new products section of the Electronic Parts Distributors Show week after next will be stereo broadcast receivers and adapters of type being introduced by Sherwood Electronic Labs of Chicago.

Starting with three-tube plug-in adapter, line includes a self-powered unit at $59.50, combination adapter and f-m tuners for stereo-phono combinations and an 18-tube, 30-watt dual receiver, priced at $299.50—all offered for delivery before the June 1 date set for beginning f-m stereo broadcasts.

A soundproof earphone-mouthpiece combination containing a seven-transistor two-way radio for use chiefly in high-noise level operation, such as around jet planes, oil fields, foundries and auto racetracks, will be introduced by Globe Electronics division of Textron, Council Bluffs, Iowa.

Glycerine-filled rubber pads cover the ears. Right earpiece contains receiver circuit; the left, rechargeable batteries. Mouthpiece houses transmitter and audio control.

Globe will also introduce an accessory device to provide selective calling on citizen band and commercial two-way radios. The calling device activates the radio unit only when individual using unit is being called.

Television antennas with a built-in electronic tube will be introduced by Winegard Company, Burlington, Iowa. Each of three models has amplifier with 6DJ8 frame-grid tube mounted directly on antenna boom and coupled to driven elements to amplify signals before any line loss occurs. Voltage gains range from 5 to 9. The antenna may be used to amplify signals to a single tv set or to as many as 10 antenna plug-in outlets.

Low-noise, high-gain nuvistors will be featured in new series of preamplifiers covering amateur bands from 3½ Mc to 220 Mc being introduced by American Electronics, Mineola, L. I. The company will also introduce a compact transmitter for 6 through 80-meter phone and c-w service: it's capable of handling 90 watts.

A radio-control system adaptable for opening and closing gates, controlling traffic lights, fork-lift trucks or operating cemetery chimes will be introduced by Perma-Power, Chicago. Company is also planning to unveil a transistor garage-door operator.

Sidearm screwdriver that converts a conventional screwdriver into a high-torque tool will be introduced by Vaco Products, Chicago. The handle flops over at right angles to the blade.

Public-address speakers using barium-ferrite ceramic magnets to permit highly efficient shallow loudspeakers that may be mounted between wall studs of a house will be introduced by Quam-Nicholas Company, Chicago.

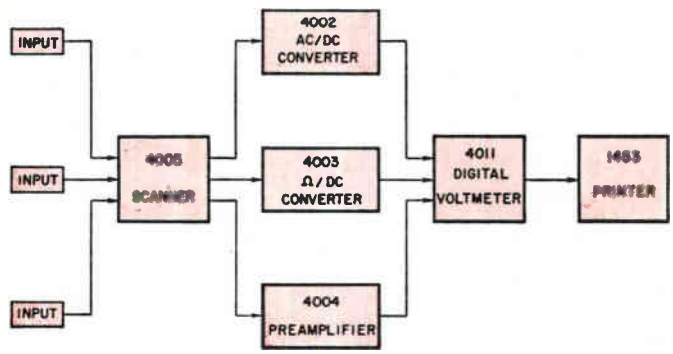
More than 300 exhibitors will show new products ranging from such basic components as cables, transformers, switches, relays, transistors; through microphones, headsets, testers and loudspeaker baffles to citizens band gear, transceivers, hi-fi systems and transistor tv cameras.

EXPANDABLE MODULAR DIGITAL MULTIMETER

Picture this self contained, automatic system working for you—the compact Beckman 4011 .01% dvm; together with converters for measuring low millivoltage DC, AC and ohms; a scanner which allows automatic readings of 29 sources of information; and finally, the Beckman solid-state, digital printer to make a permanent, indexed record of all the readings.

Price for the complete system about $4800

For detailed specifications on all these instruments and their use together, write for Brochure A4011.



Beckman 4011 a complete portable dvm is available, as are the other modules shown above, as a portable package.

BERKELEY DIVISION
of Beckman Instruments, Inc.

INSTRUMENTAL • Beckman • IN YOUR FUTURE

Richmond, California

T-29

Stripfilm picture and optically recorded sound track message (inset) are projected and reproduced in synchronism by Kalart Co. still projector

Still Projector Syncs Optical Sound Track

OPTICALLY RECORDED sound messages are scanned and reproduced in synchronism with the projection of an accompanying picture in a 35-mm stripfilm projector that has been developed by Kalart Co., Plainville, Conn.

Variable density recorded sound messages and pictures are arranged alternately on standard 35-mm motion picture film. As each image is projected on a screen, the related sound message is scanned by a photocell system, and reproduced by the built-in amplifier and speaker.

Each frame is advanced automatically once the operator has threaded the machine, centered and focused the first image and set the sound volume level.

The machine handles the new sound-on-filmstrip programs, as well as standard silent filmstrips and slides.

Picture frame and related sound frame size are each 24 × 36mm. While the picture is in position for projection by the five inch, f3.5 lens, the adjoining sound frame is in curved contact with a scanning head cylinder that contains a rotating scanner using four light beams. The multiple beams are produced optically from a single 60 cycle heated exciter lamp.

The four beams serially illuminate a 90 degree segment of the scanning head which contact the complete sound recording area. The beams move vertically as they rotate, passing from one horizontal sound track line to the next. A gas filled photocell picks up the modulated light, and provides input to the amplifier.

A 120 cycle filter in the amplifier eliminates hum caused by a-c heating of the lamp, which causes peaks of light at half cycles of maximum current. Power output is 3 watts maximum, total harmonic distortion 5 percent, frequency response 80 cps to 8 Kc.

As the end of each sound track is reached, a mechanical sensor encounters a notch cut in the film strip's edge, placed to allow a short delay, then advance to the next frame. A maximum message time of 18 seconds can be recorded.

Controls are provided to hold a frame for discussion, repeat of a picture, rapid advance and reverse.

The company will process sound from magnetic tape or disc, along with picture negatives, to produce combined programs.

New System Stores, Sends Space Images

DALLAS—Space vehicles will be able to obtain and transmit back to earth clear, detailed photographic images of the moon and the planets, as well as smaller objects in space, even in extremely dim light, by means of a system called ISTAR (Image Storage Translation and Reproduction).

The new concept was announced today by the Astronautics division of Chance Vought Corp., which has received an initial contract for more than $250,000 from the Navy for further reserach and development.

Vought Astronautics already has constructed an ISTAR test system and demonstrated potential capabilities of the new technique, which is neither a television system nor a facsimile one. Company officials said the contract from the Bureau of Naval Weapons is for development of a very advanced unit to evaluate the equipment's future role in space.

The system is highly resistant to damage from outer space radiation; it is compact, lightweight and requires very little power to operate.

Working with Chance Vought in development of the system were Haloid Xerox, Inc., Rochester, N. Y., and General Electrodynamics Corp., Garland, Texas.

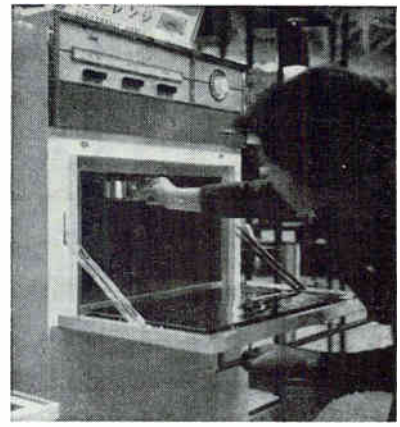
Navy Awards Contract For Air-to-Air Missile

SPARROW III air-to-air guided missile contract for about $7.8 million has been announced by Navy's Bureau of Naval Weapons. The contract, which went to Raytheon, will cover production of the missile and associated gear.

Designated Sparrow III-B, the new all-weather missile will be used by Navy's F4H-1 Phantom II supersonic jet interceptors. The fast and long-range fighter will soon form part of the deployed operational forces. The missile can be used by F3H-2 Demon fighters now using older versions of the Sparrow.

Raytheon will make the missiles at plants in Lowell, Mass. and Bristol, Tenn. Final checkout will be made at Oxnard and Point Mugu, Calif.

Data processing computer, first from Matsushita Electric's plant built in Yokohama last year



Hayakawa Electric's 2,500-Mc electronic range reportedly carries a $2,800 price tag

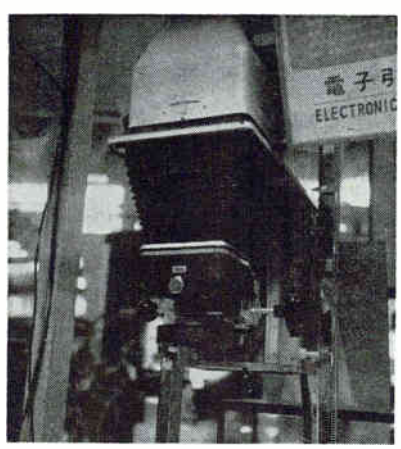
Tokyo Fair Features Electronic Items

TOKYO (McGraw-Hill World News) —The Fourth International Trade Fair, which ended Sunday, featured numerous new electronic products. Among them were applications of thermal converters and photo-electronics.

Sanyo Electric came out with a refrigerator, thermal pack, thermos can, and panel cooling system, with 16, 12, eight, and 88 thermo-modules respectively. Each module consists of 10 pairs of thermal converters.

Sanyo started developing a thermal converter in 1956 and now claims it is producing its thermal converter (bismuth and tellurium) at 25 percent of the cost of other manufacturers, or about $2.80 per converter. With completion of its thermal converter plant in July, Sanyo plans to produce monthly one million thermal converters.

Specifications for its panel cooling system are d-c input 2.2 Kw, 25 a, maximum cooling capacity −20 C, and water circulation 0.2 cubic meter/per hour.



Electronic enlarger (Hayakawa Electric) expands 35-mm film to 67 cm × 80 cm pictures

Pilots, Forecasters To Test New System

ONE-YEAR TEST of direct pilot-to-weather-forecaster communications systems has been agreed to by Federal Communications Commission and Federal Aviation Agency. U. S. Weather Bureau also will participate. The service will operate at 122.6 Mc.

Tests will be conducted in the Washington, D. C., and Kansas City areas.

FCC statement on the tests says the objective will be to determine degree of need and best ways of making such direct information transmissions to greatest number of users.

Forecasters will use the direct transmission system to answer questions as they come in from pilots and give explanations on hazardous weather conditions along the line of flight. Plans are to stress the form in which information is transmitted for accurate translation in the aircraft. Research will also be done to determine interference hazards to adjacent channels.

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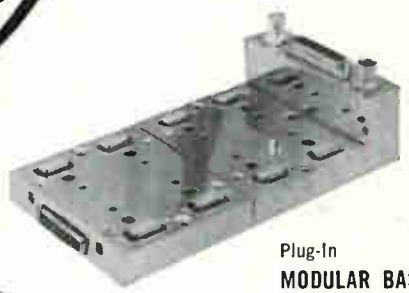

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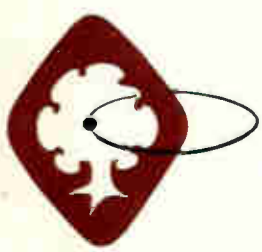

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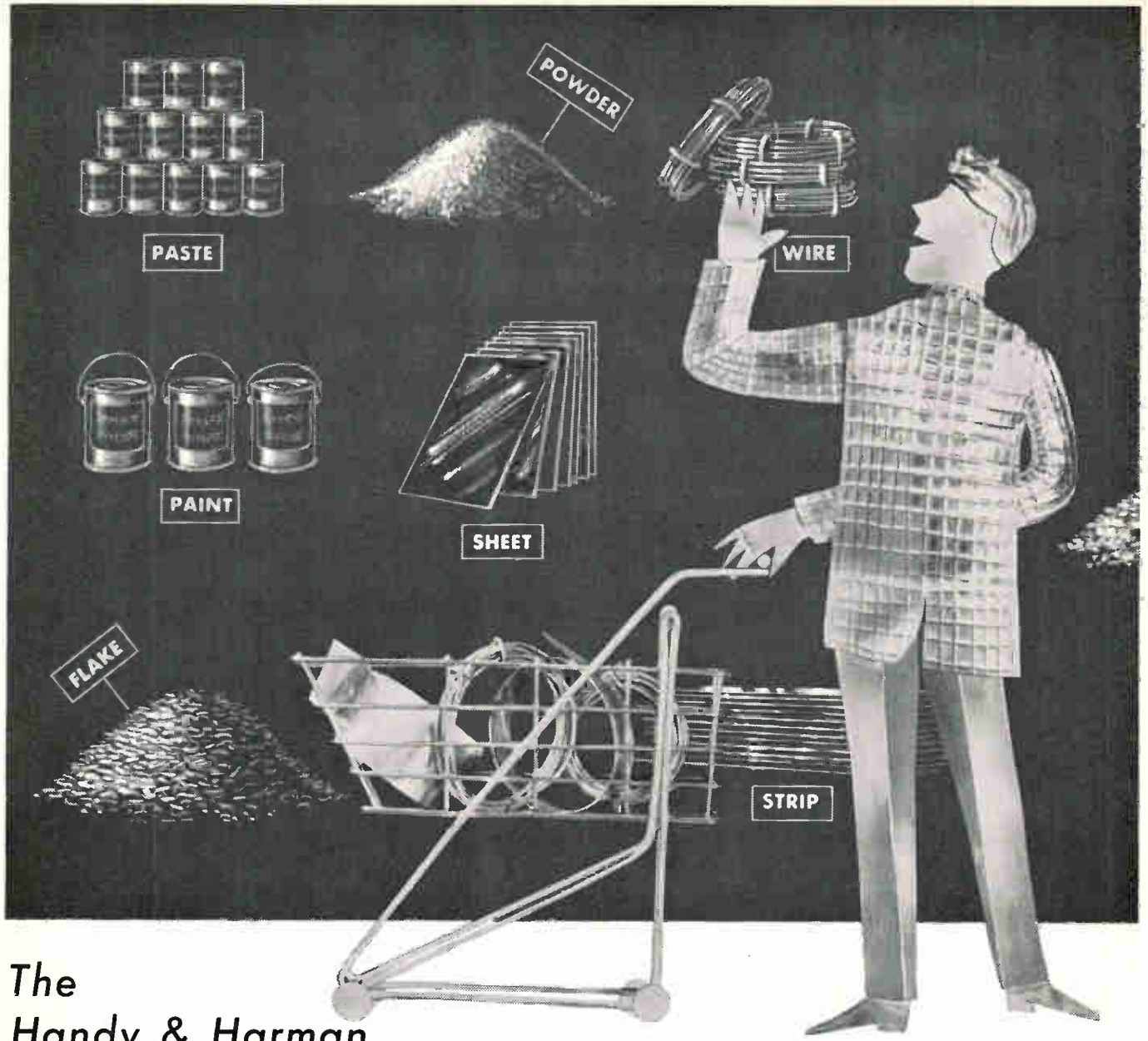

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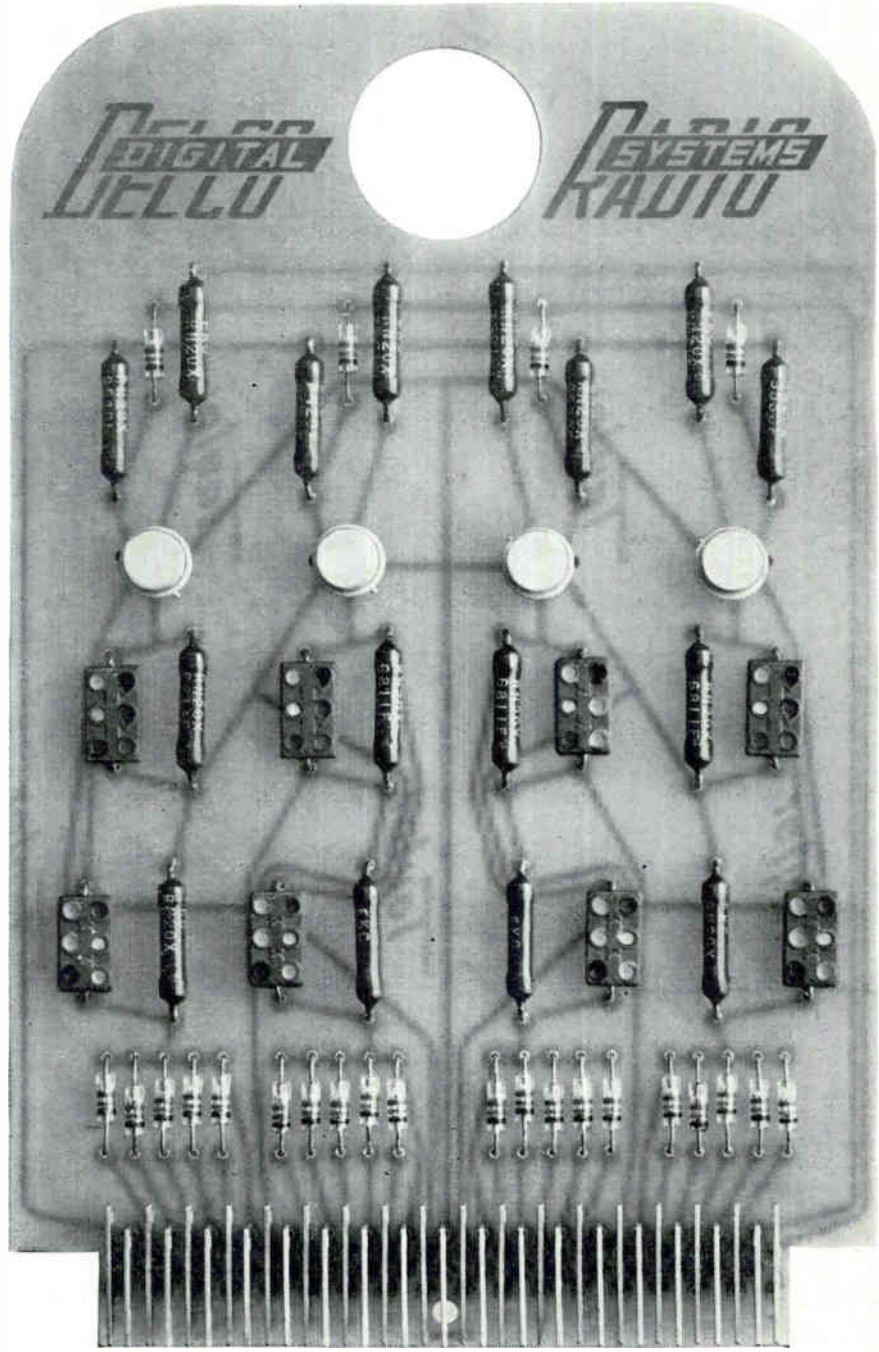

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May 15-17: Microwave Theory & Tech., National Sym., PGMTT of IRE; Sheraton Park Hotel, Wash. D. C.

May 17: Reliability & Quality Control, Product Engineering, Joint PGRQC and PE of IRE; Willkie Memorial, N. Y. C.

May 22-24: Communications Symposium, (GLOBECOM V) PGCS of IRE, AIEE; Sherman Hotel, Chicago.

May 22-24: National Telemetering Conf., PGSET of IRE, AIEE, IAS, ARS, ISA; Sheraton Towers Hotel, Chicago.

May 22-25: Electronic Parts Distributors Show, Electronic Industry Show Corp.; Conrad Hilton Hotel, Chicago.

May 23-25: Large Capacity Memory Techniques for Computing Systems, Office of Naval Research; Dept. of Interior Auditorium, Wash., D. C.

May 31-June 2: Frequency Control Symposium, U. S. A. Signal R & D Lab.; Shelbourne Hotel, Atlantic City, N. J.

May 31-June 2: Radar Symposium, Univ. of Michigan Inst. of Science & Technology; Ann Arbor, Mich.

June 5-8: Instrument-Automation Conf. & Exhibit, ISA; Royal York Hotel, Toronto, Ontario, Canada.

June 8-9: National Electrical Manufacturers Assoc., NEMA; Biltmore Hotel, Los Angeles.

Aug. 22-25: WESCON, L. A. & S. F. Sections of IRE, WCEMA; Cow Palace, San Francisco.

Sept. 11-15: Instrument-Automation Conf. and Exhibit, ISA; Sports Arena, Los Angeles.

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Nov. 14-16: Northeast Research & Engineering Meeting, NEREM; Commonwealth Armory and Somerset Hotel, Boston.

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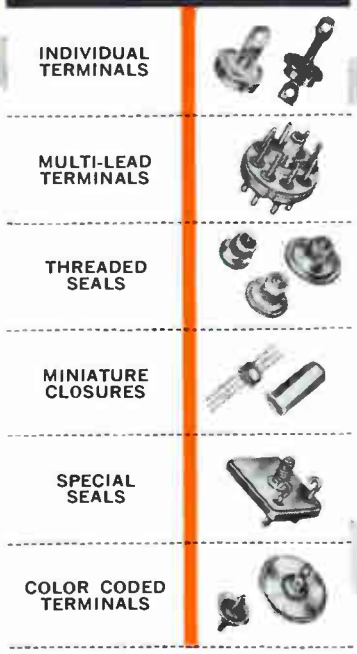

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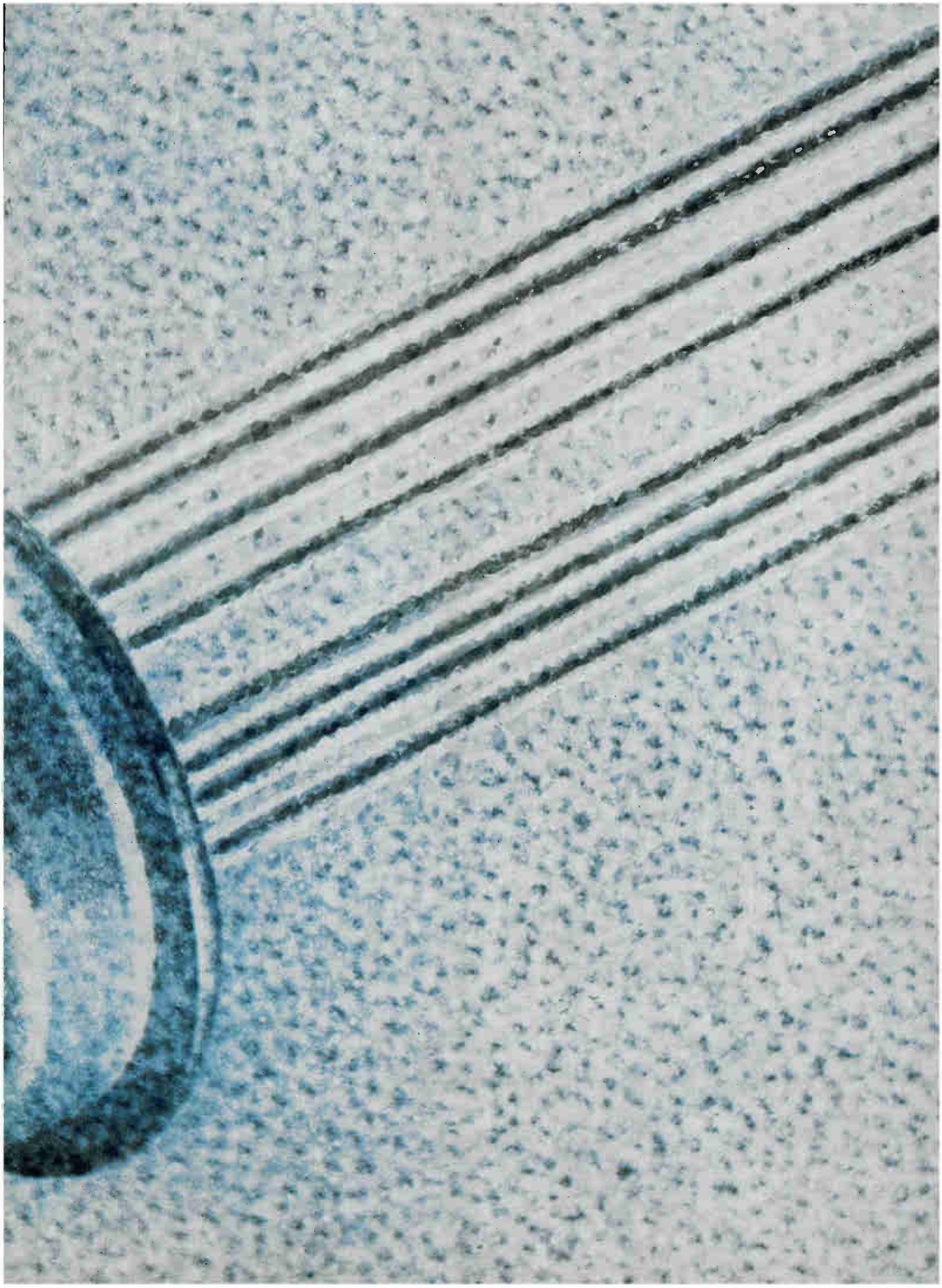

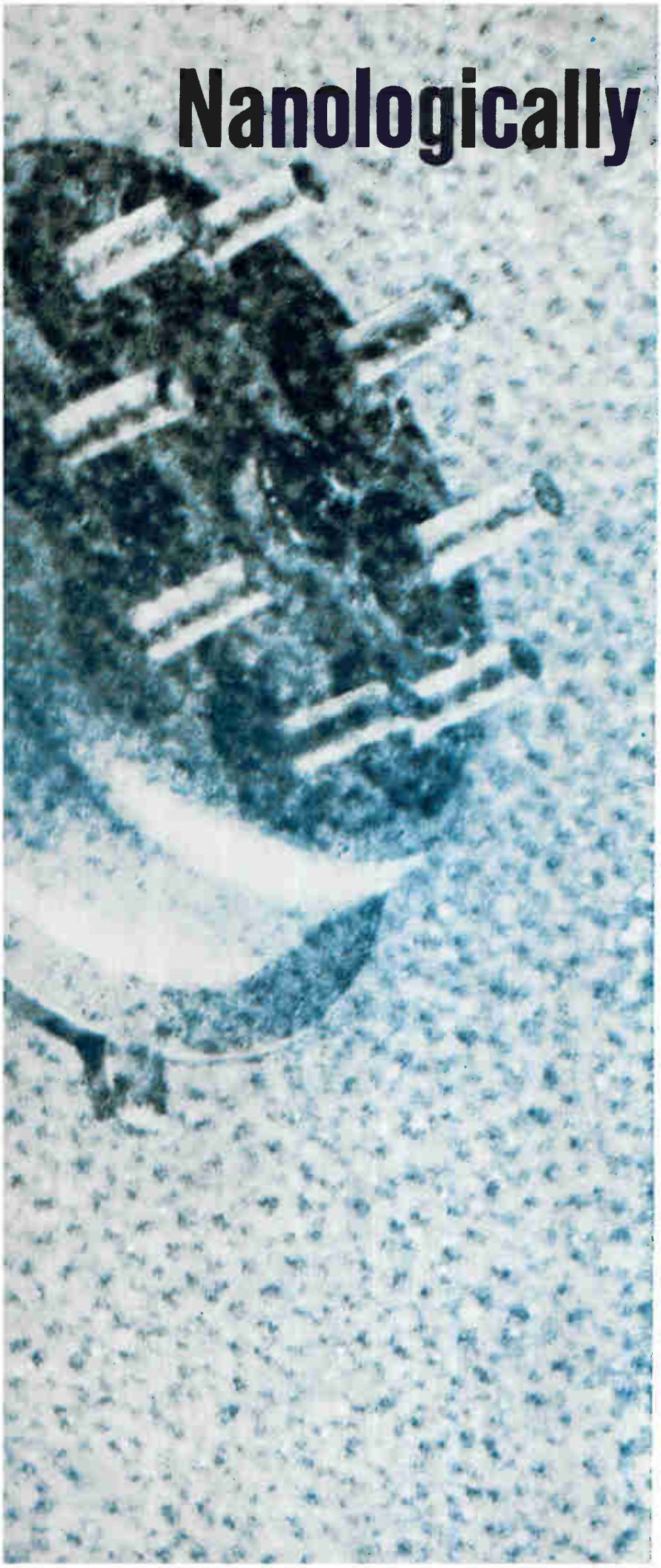

Nanologically speaking

THINK ABOUT IT: Six diodes interconnected in a single, standard-size transistor can. General Instrument Research Labs thought about it . . . then produced it along with a whole new array of computer logic "nanocircuits" that offer unusual design flexibility. ■ The General Instrument concept permits nanocircuits to be transferred directly to conventional-component circuitry. This approach frees the circuit designer of the limitations of ordinary microcircuitry. And, because the heat-generating elements are kept outside the can, circuit reliability is increased. ■ It is this applied imagination, which General Instrument brings to all semiconductors, that underlines the distinction between rhetoric and reason. ■ Get specific details about General Instrument nanocircuits from one of our sales offices or the franchised distributor nearest you. Or write for Bulletin NC-10. General Instrument, Semiconductor Division, 65 Gouverneur Street, Newark, New Jersey.

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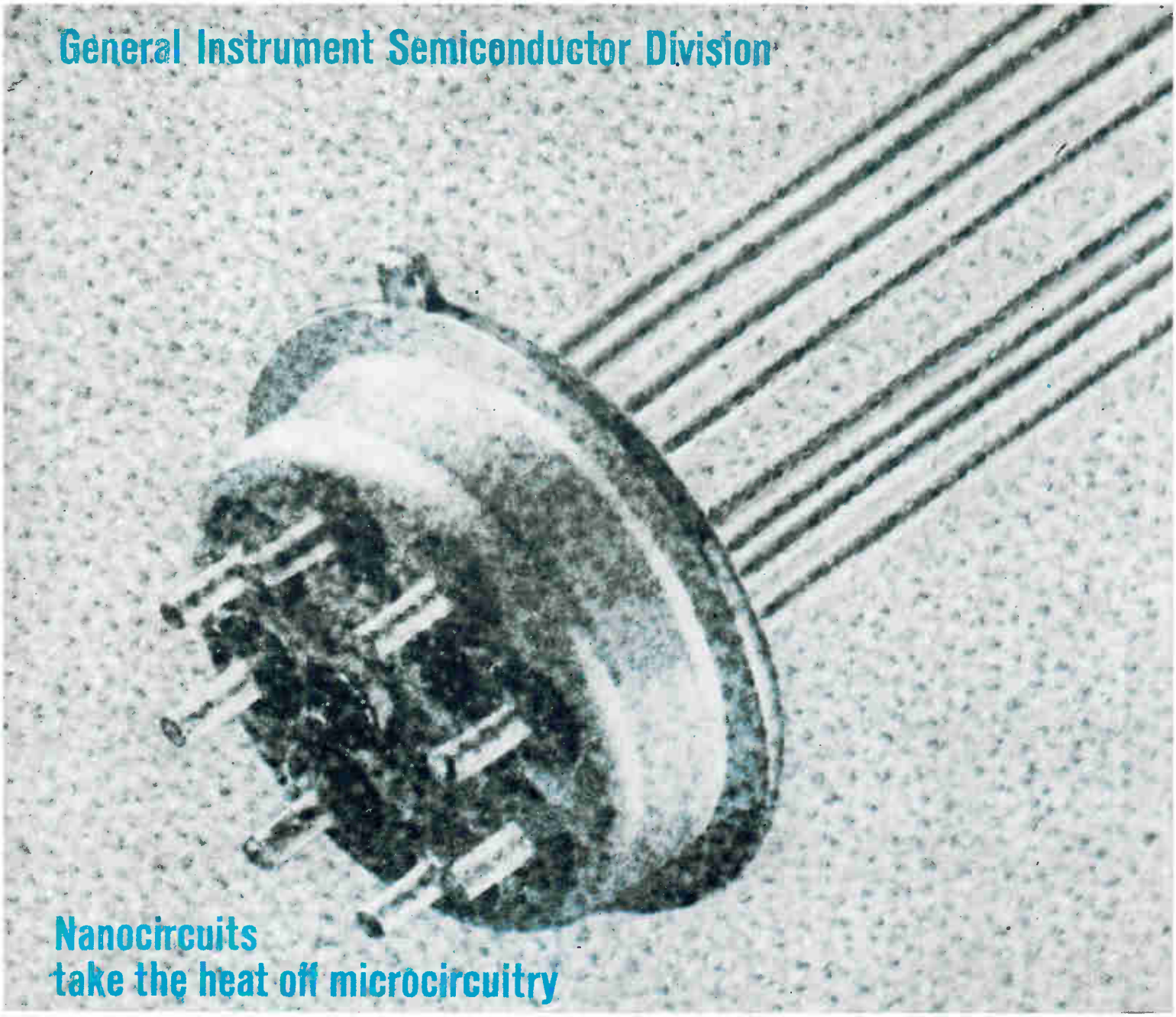

Nanocircuits take the heat off microcircuitry

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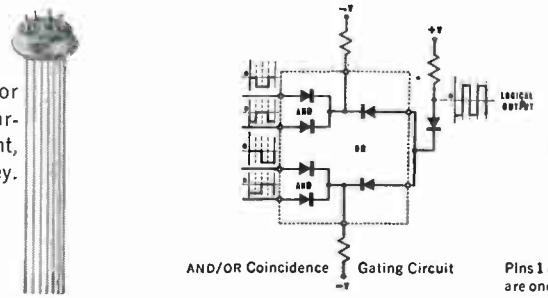
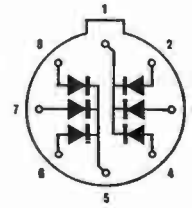


AND/OR Coincidence Gating Circuit



Pins 1 & 5 are 'n' commons. Pins 2, 3 & 4 are one set of 'p' leads; 6, 7 & 8 the other.

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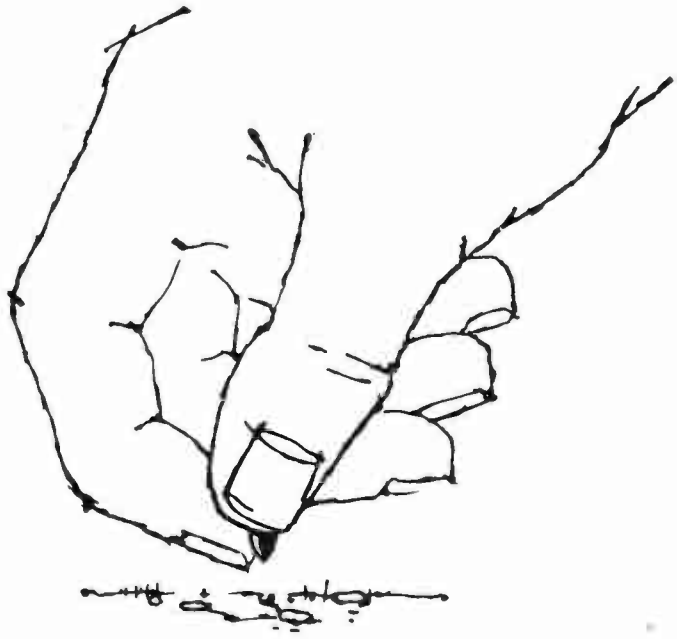

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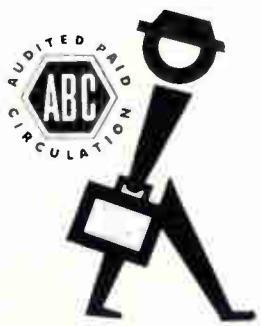

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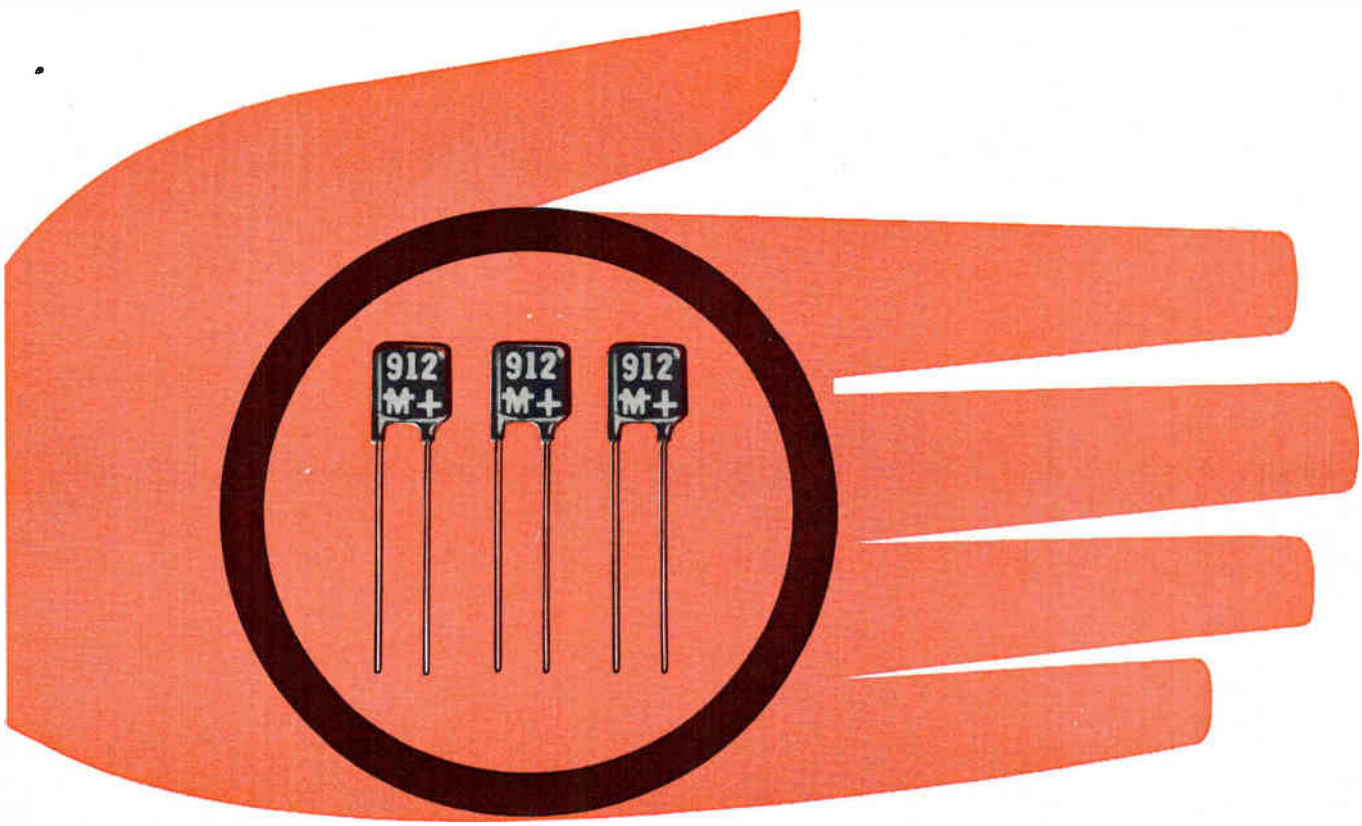

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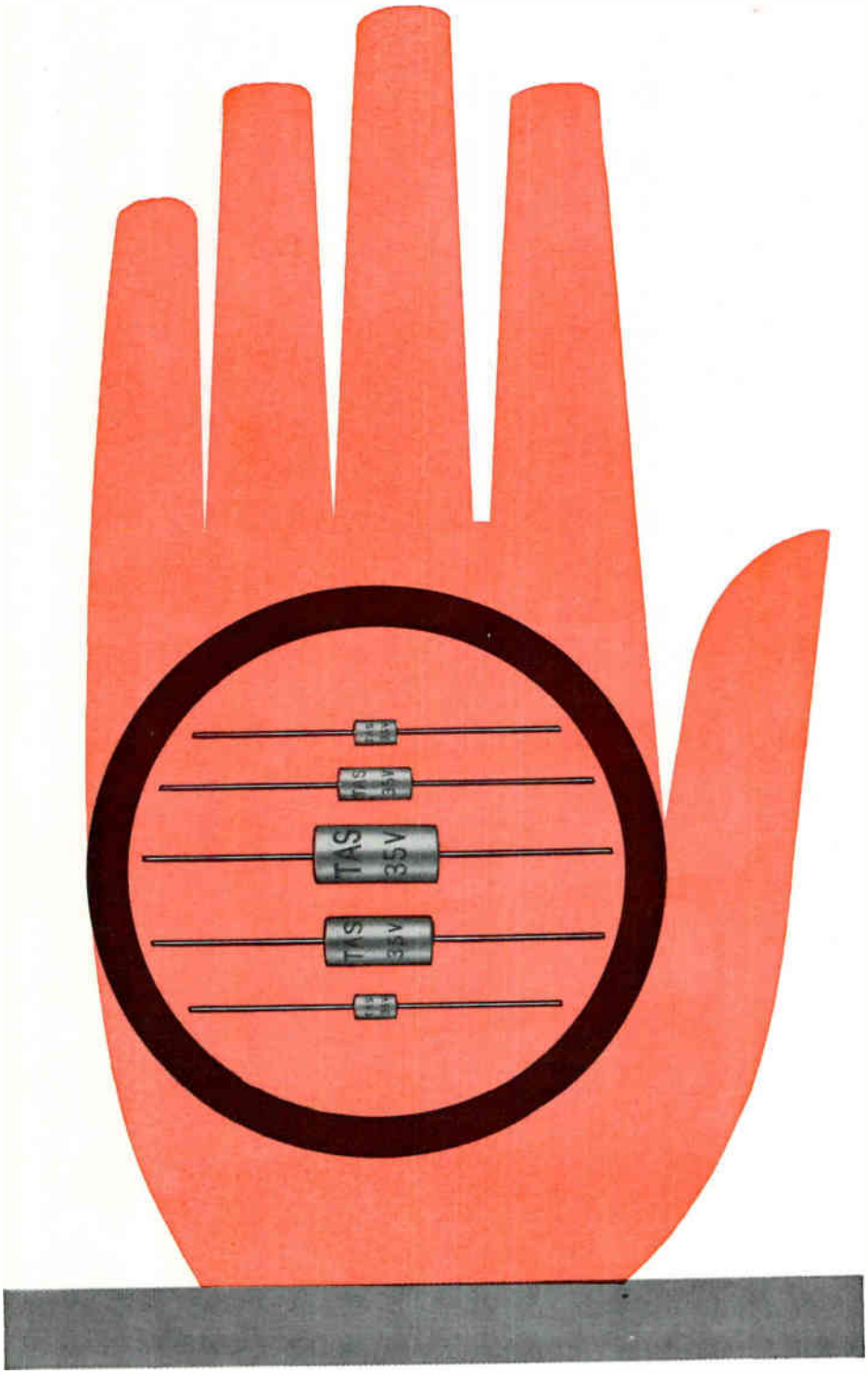

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The May free reprint is an article from the May 5th issue. It is a two page article by Fred W. Kear—Digital Control Uses Unijunction Transistors.

The bistable characteristic of the unijunction transistor makes it a useful control device for digital circuits, replacing many components used in conventional transistor switching circuits, reducing packaging size and lessening maintenance problems. This article discusses the use of unijunction transistors in readout and control circuits.

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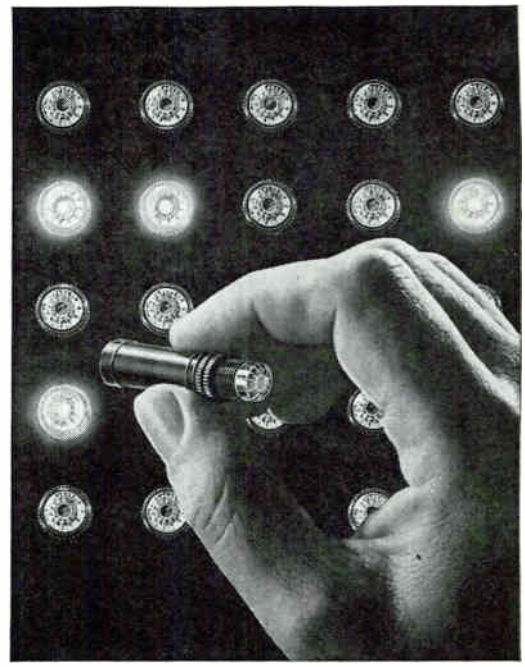

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The George D. Barbey Co., Inc.
FR 6-7451
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Graybar Electric Company
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SWIECO, Inc.
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Harrison Equipment Company
CApitol 4-9131

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Milwaukee
Electronic Enterprises, Inc.
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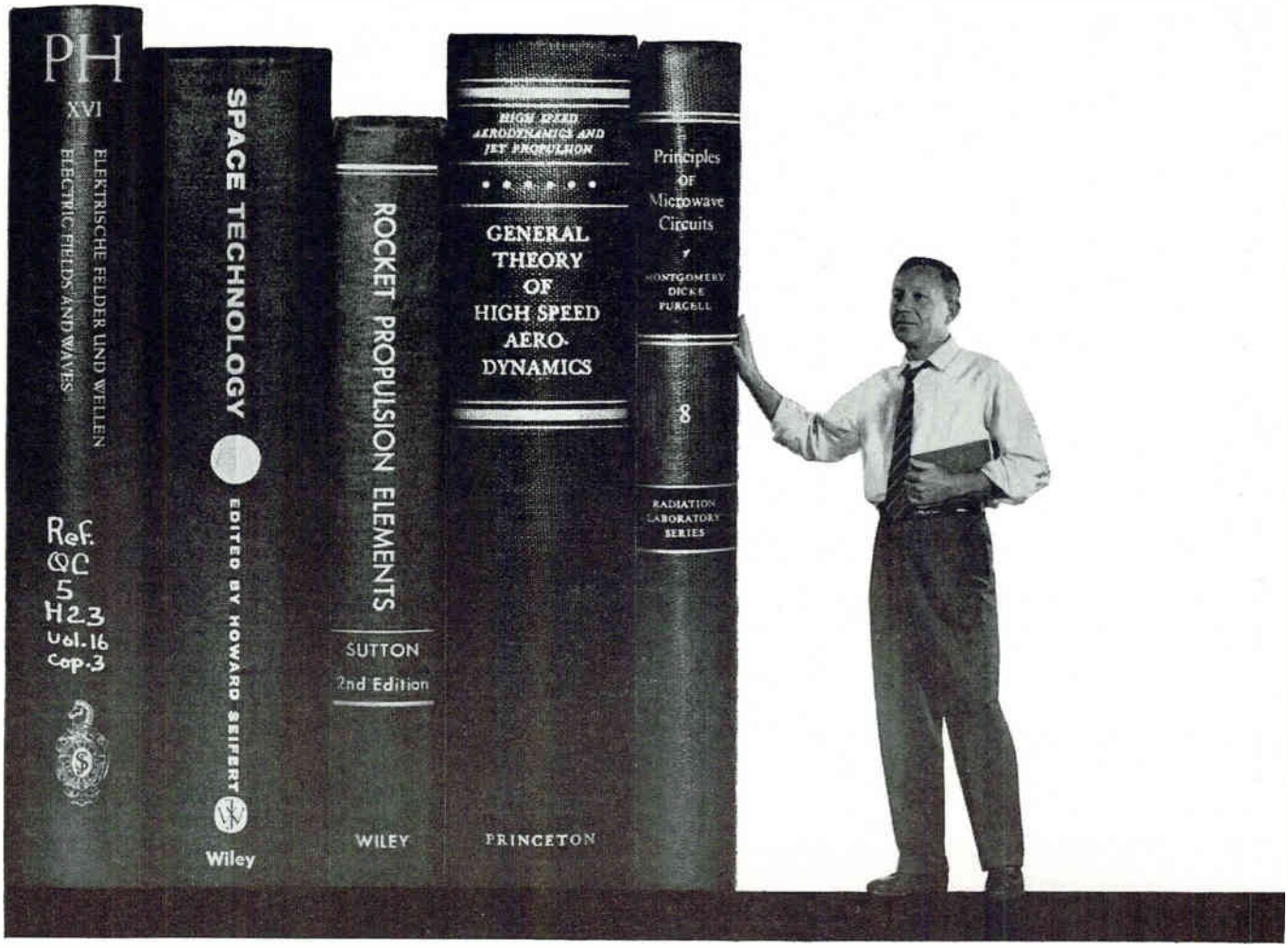
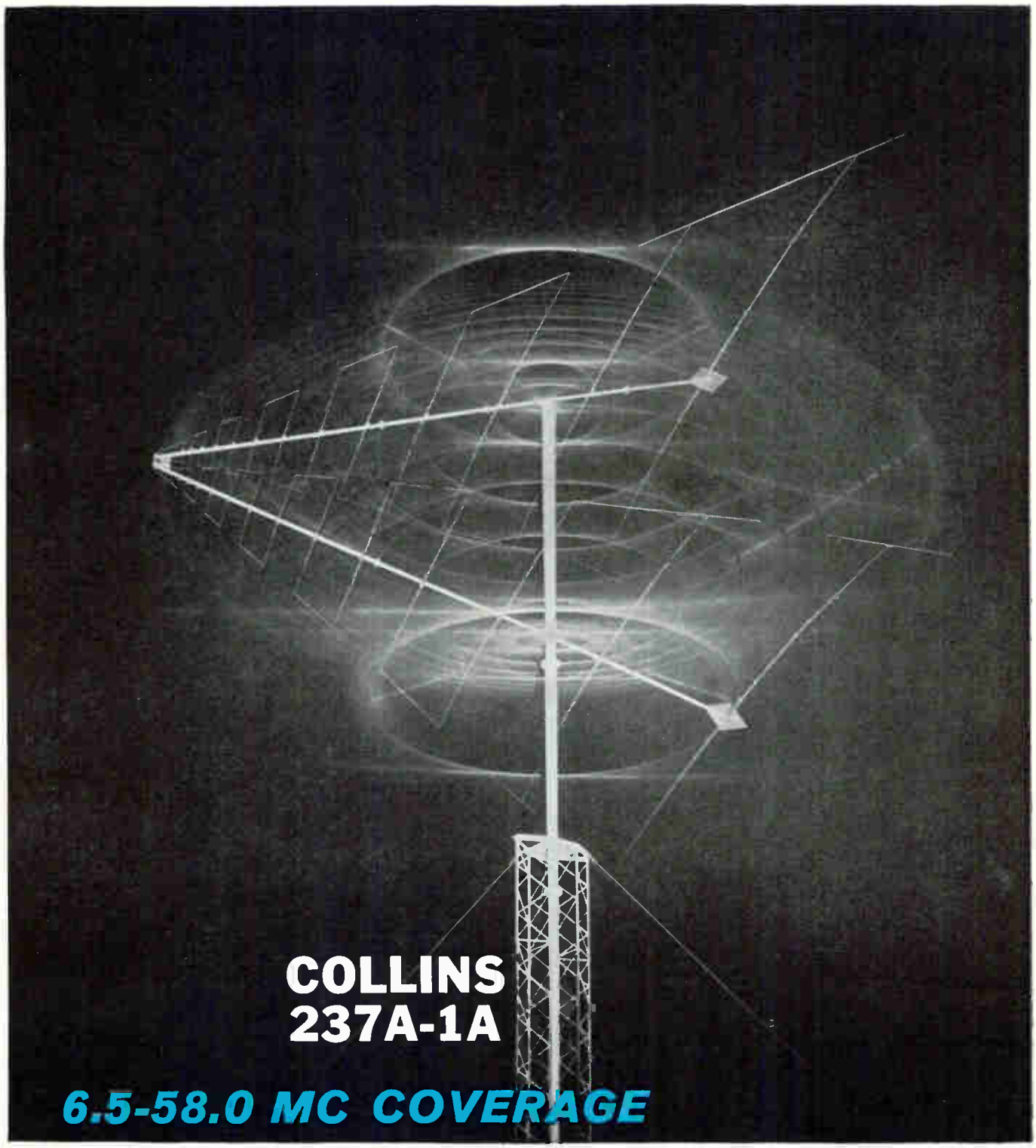


space systems planning and engineering in a unique role

The scientists and engineers of Aerospace Corporation are in the forefront of advanced planning and general systems engineering. Their unique role: critical civilian link uniting government and the scientific-industrial team developing space systems and advanced ballistic missiles. In providing broad scientific and technical leadership to every element of this team, they are engaged in activities spanning the spectrum from formulating new weapons systems concepts to technical supervision of the over-all industry team performing research, development, and test of missile/space systems. Specific activities include investigation of techniques for improving the state-of-the-art in propulsion, structures, guidance, communications and other engineering skills related to missile/space missions; feasibility studies of new weapons systems concepts and preliminary design of promising systems; formulation of development programs; conduct of critical experiments; technical supervision of the development and test program. Men with these backgrounds are invited to write to Mr. George Herndon, Aerospace Corporation, Room 110, P. O. Box 95081, Los Angeles 45, California.

Organized in the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government.

AEROSPACE CORPORATION



IN A SINGLE, ROTATABLE ANTENNA

Collins 237A-1A Log Periodic Antennas with frequency independent radiation patterns and constant input impedances have been proven in communication installations throughout the world. High performance and broadband coverage eliminate the need for multiple antenna structures and reduce site costs. A reversible rotator and rotary coaxial connection facilitate full 360° rotation of the unidirectional antenna. Easily installed by use of tilt up mast. Other broadband antennas available for wide frequency ranges within the 2-10,000 mc spectrum. Write for descriptive brochure.

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

Only the New AIL Type 74

offers a continuously Tunable (40 to 180 mc) IF Amplifier

for continuous automatic noise figure measurement

Adding new versatility to your Automatic Noise Figure Measurement equipment, AIL now offers the outstanding Type 74 Automatic Noise Figure Indicator with a tunable Frequency IF Amplifier...or you can purchase the Tunable IF Amplifier for modification of your present Type 74 equipment.

Single frequency units are also available with greater sensitivity and broader bandwidth.

The AIL Type 74 is designed to permit the adjustment of receiver parameters to minimize noise figure. No special training is required for use on the production line, in the laboratory, or in the field.

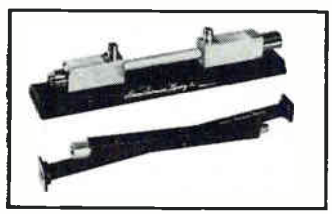
check these high performance features

Noise Figure Range, RF or IF	High range —23 to 36 db with extension to infinity Low range —0 to 25 db
Accuracy	Automatic: Low range ±1/2 db; High range ±1 db Manual: ±0.1 db with AIL Type 30 Attenuator
Automatic Operation	AGC range: 65 db minimum
Manual Operation	Front panel IF gain control
Input Frequency	30 and 40 to 180 mc (tunable); other frequencies available
Sensitivity	100 microvolts
Bandwidth	2.0 mc minimum
Recorder Outputs	Noise figure and AGC

Standard Models Available

Part Number	IF (mc)	Band-Width	Sensi-tivity	Price
07413	30 (fixed)	6	50	$765
07416	60 (fixed)	6	100	$765
07414	30 & 40 to 180	2	100	$830
07404*	30 & 40 to 180	2	100	$330

*IF Amp. Only



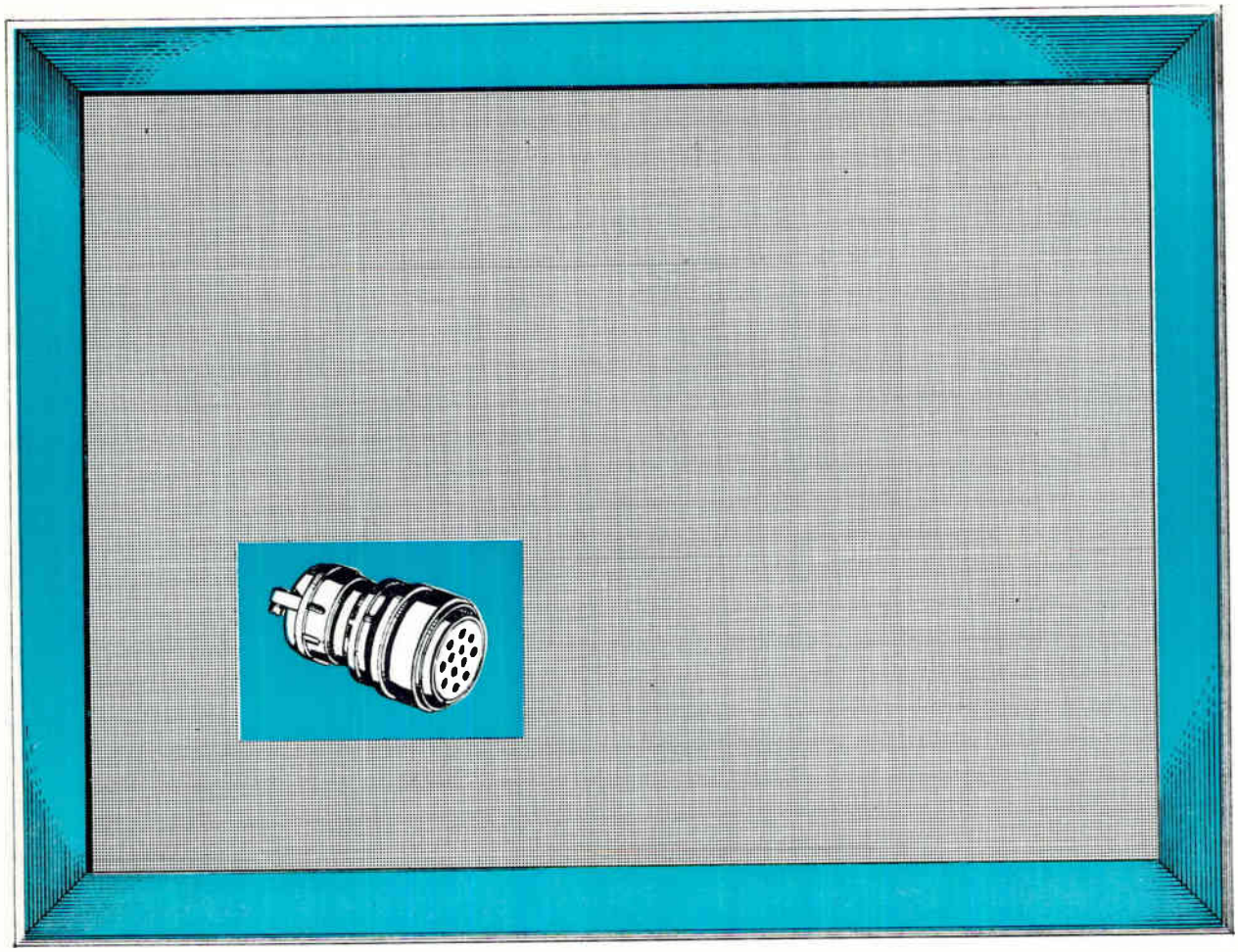
Twelve AIL Type 70 Noise Generators provide continuous coverage from 12 mc to 40,000 mc...most complete line of noise generators available for automatic noise figure measurements.

Write for full information to:

AIRBORNE INSTRUMENTS LABORATORY

DEER PARK, LONG ISLAND, NEW YORK

A DIVISION OF CUTLER-HAMMER INC.



The Avnet System

created a new Concept of Readiness--5 years ago!

The dots above represent Avnet's stock of different types in 1 particular line of components (in this case, connectors). There are over 70,000 dots. Avnet's assembly facilities enable them to supply over 70,000 different types of connectors in any quantities, to meet emergency and prototype requirements. This flexibility is what The Avnet System means by "Readiness" to fill an order. Any order.

Is this a *new* state of Readiness at Avnet? Did Avnet recently stock all their Centers? Did Avnet *rush* to set up Assembly Facilities for Bendix Connector Prototype Requirements?

No!

This state of Readiness at Avnet is 5 years old. 5 years ago Avnet foresaw today's electronic requirements and began stocking in *depth*. Then assembly facilities were set up to maintain a stock in *breadth*. Depth × Breadth × Flexibility × 8 Service-Stocking Centers × On-the-spot quality control × Thorough knowledge of assembly operations for prototype needs × 5 years experience actually doing it = Readiness. It's an old story at Avnet.

And each new day brings more and more companies who want to benefit by Avnet's unique, historic Readiness. Is *your* company among them?

AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP.

Avnet Service Centers and Stocking Facilities: Los Angeles, Cal. · Sunnyvale, Cal. · Seattle, Wash. · Salt Lake City, Utah · Chicago, Ill. · Dayton, Ohio · Westbury, L. I. · Burlington, Mass.

BENDIX SCINTILLA CONNECTORS	MECHANICAL PRODUCTS	SPERRY SEMICONDUCTORS	BABCOCK RELAYS	CONTROL SWITCH DIVISION	RHEEM SEMICONDUCTORS	GREMAR CONNECTORS
ROBERTSON SPLICE & CONNECTOR CASES	SPRAGUE CAPACITORS	KING SUBMIN. HI-TEMP CERAMIC CAPACITORS	TIC PRECISION TRIMMERS	U.S. SEMCOR SEMICONDUCTORS	SANGAMO CAPACITORS	MICRODOT CONNECTORS
CLARE RELAYS	AVNET AUTO. CONNECTOR AND CABLE TESTER	AVO MULTI-RANGE METERS	WIDNEY OORLEC CONSTRUCTIONAL SYSTEM	GENALEX TUBES	SULLIVAN PRECISION MEASURING APPARATUS	SERVO DESIGN AND TESTING EQUIPMENT

Mail me information on the components circled at left.

NAME:_____

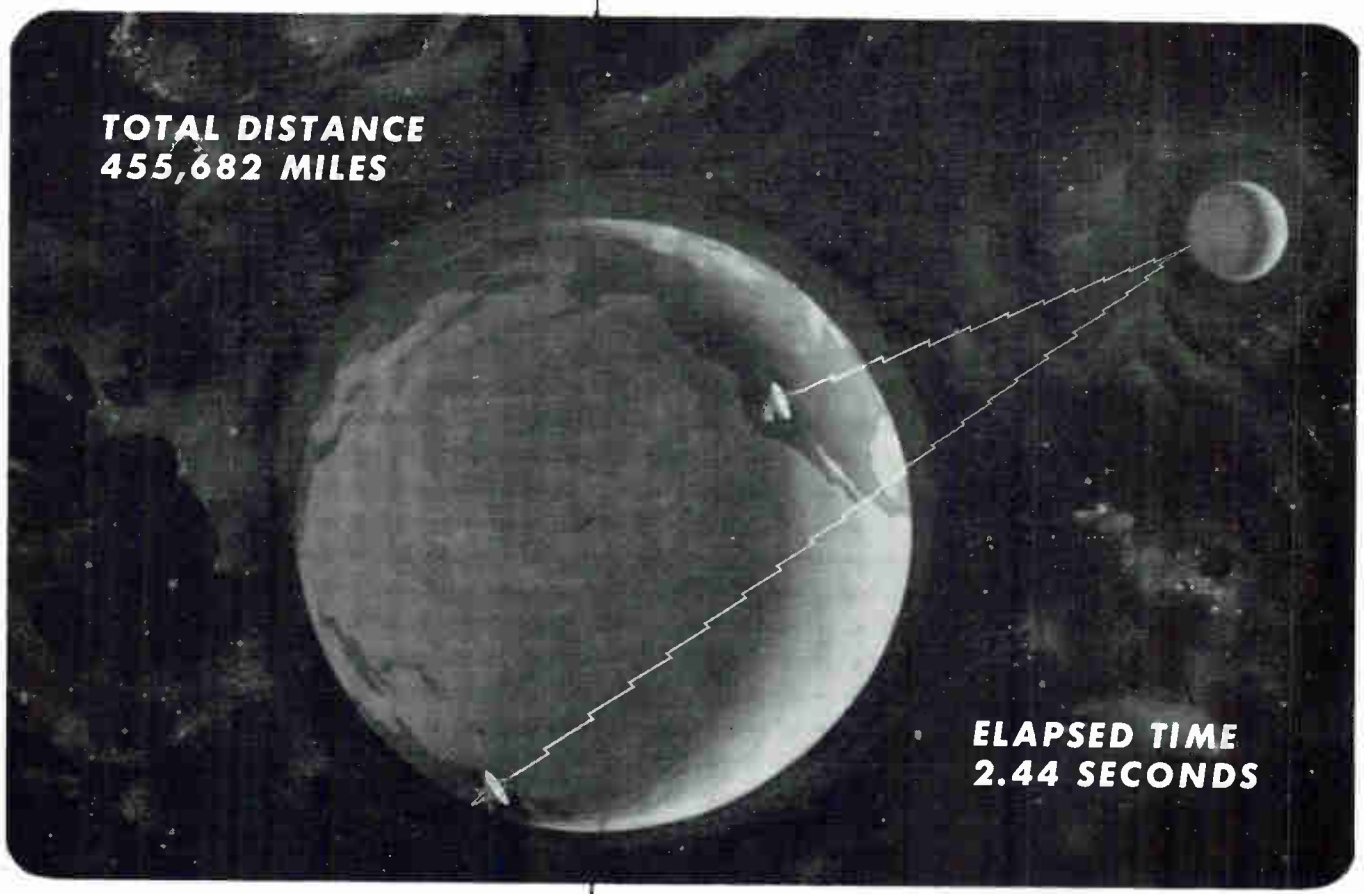
TITLE:_____

(Clip this bottom section to your letterhead, mail to The Avnet System, Publications Section, 70 State Street, Westbury, Long Island, N. Y. Your request will be expedited within 90 minutes of receipt.)

CIRCLE 49 ON READER SERVICE CARD

Notable Achievements at JPL

MOON BOUNCE... a collaborative project of the National Aeronautics and Space Administration, the Jet Propulsion Laboratory, and the Australian Ministry of Supply to link two continents by radio signals bounced off the Moon



On February 10, 1961, California and Australia were linked in the first international space communication experiment that bounced voice messages between the two points via the Moon. The words were beamed at the Moon from the Jet Propulsion Laboratory transmitter at Goldstone, California to the receiver at Woomera, Australia.

Principals in the conversation were Dr. Hugh L. Dryden, NASA Deputy Director, whose voice was relayed from Washington by telephone; Dr. Lee DuBridge, President of California Institute of Technology, who spoke directly from Goldstone; and Alan Hulme, Australian Minister of Supply at Woomera.

The occasion tested the new Australian station, the second of three Deep Space Instrumentation stations developed and directed for the National Aeronautics and Space Administration by the Jet Propulsion Laboratory.

CAREER OPPORTUNITIES AT JPL
IN THESE FIELDS — NOW

Electronic Engineers

. . . for component and system design of deep space communications, instrumentation, and automatic control equipments.

. . . for microwave and RF solid state circuit design and flight evaluation.

. . . for project management assignment on advanced development and contracted effort in space communications.

Physicists

. . . for analysis in communications theory, orbital mechanics, guidance and control, and systems performance.

. . . for analysis of digital communication and control systems; real-time digital computer and closed-loop systems.

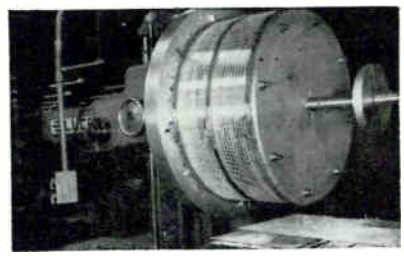
. . . for research and development of servo and control mechanisms for large ground based and spacecraft antenna systems.

•

Other opportunities exist for electronic engineers and physicists in many areas at JPL which has been assigned the responsibility for the nation's Lunar, Planetary and Interplanetary unmanned exploration programs.

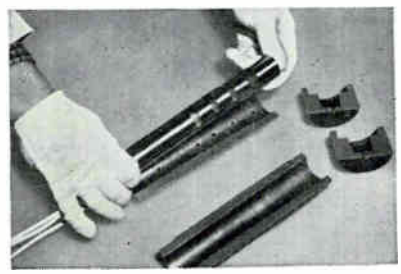
jpl

CALIFORNIA INSTITUTE OF TECHNOLOGY
JET PROPULSION LABORATORY
PASADENA, CALIFORNIA



FABRICATED

ELECTRO-PLATED



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No Compromise

IN THE DESIGN OR PRODUCTION OF

CUSTOM SLIP RING ASSEMBLIES...

. . . at Breeze. With the depth of design and production capabilities and facilities at Breeze Corporations, your slip ring requirements are met without compromise. Breeze produces custom slip ring assemblies by *all* of the reliable methods and techniques, thus assuring you of a unit tailored to meet your unique requirement.

Let Breeze provide you with an uncompromised design and production analysis before you buy.

You'll want a copy of the new Breeze catalog 66SR which describes a wide range of custom units as well as Breeze standard slip ring assemblies.

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BREEZE CORPORATIONS, INC.

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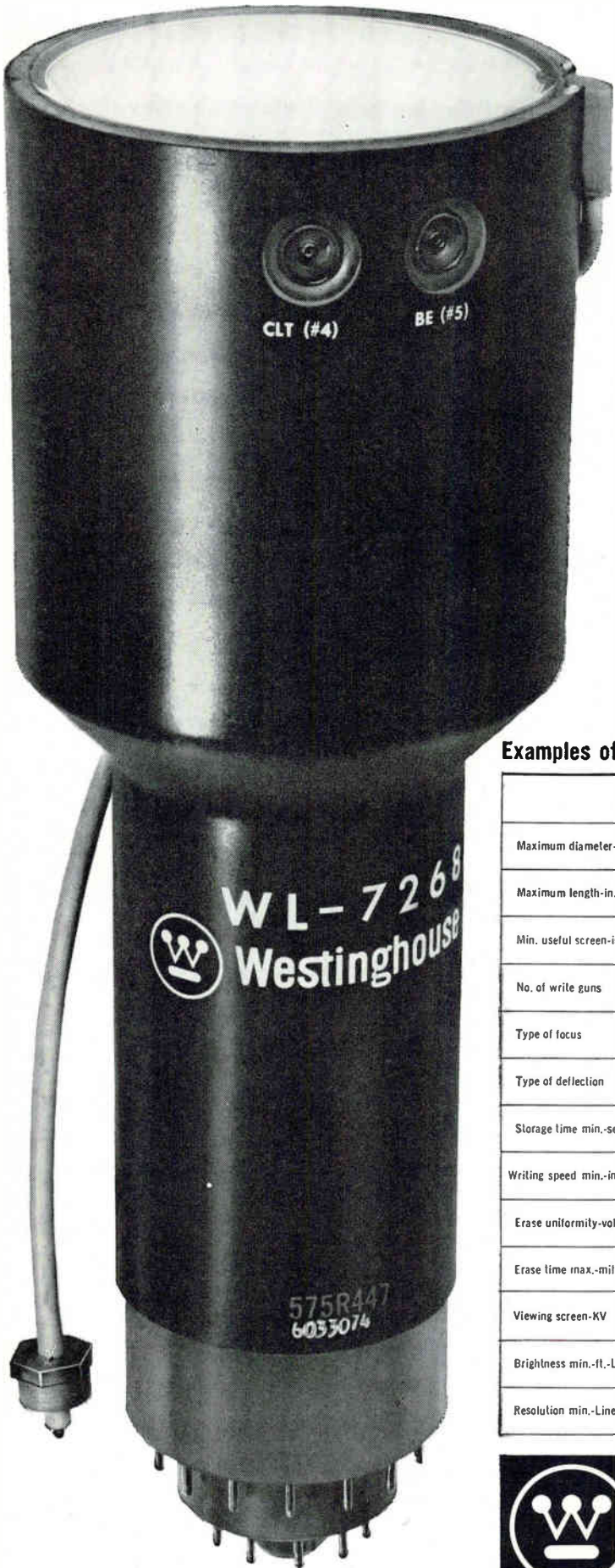
Manufacturers of electrical, electro-mechanical and hydro-mechanical components and systems and fabricated metal products.

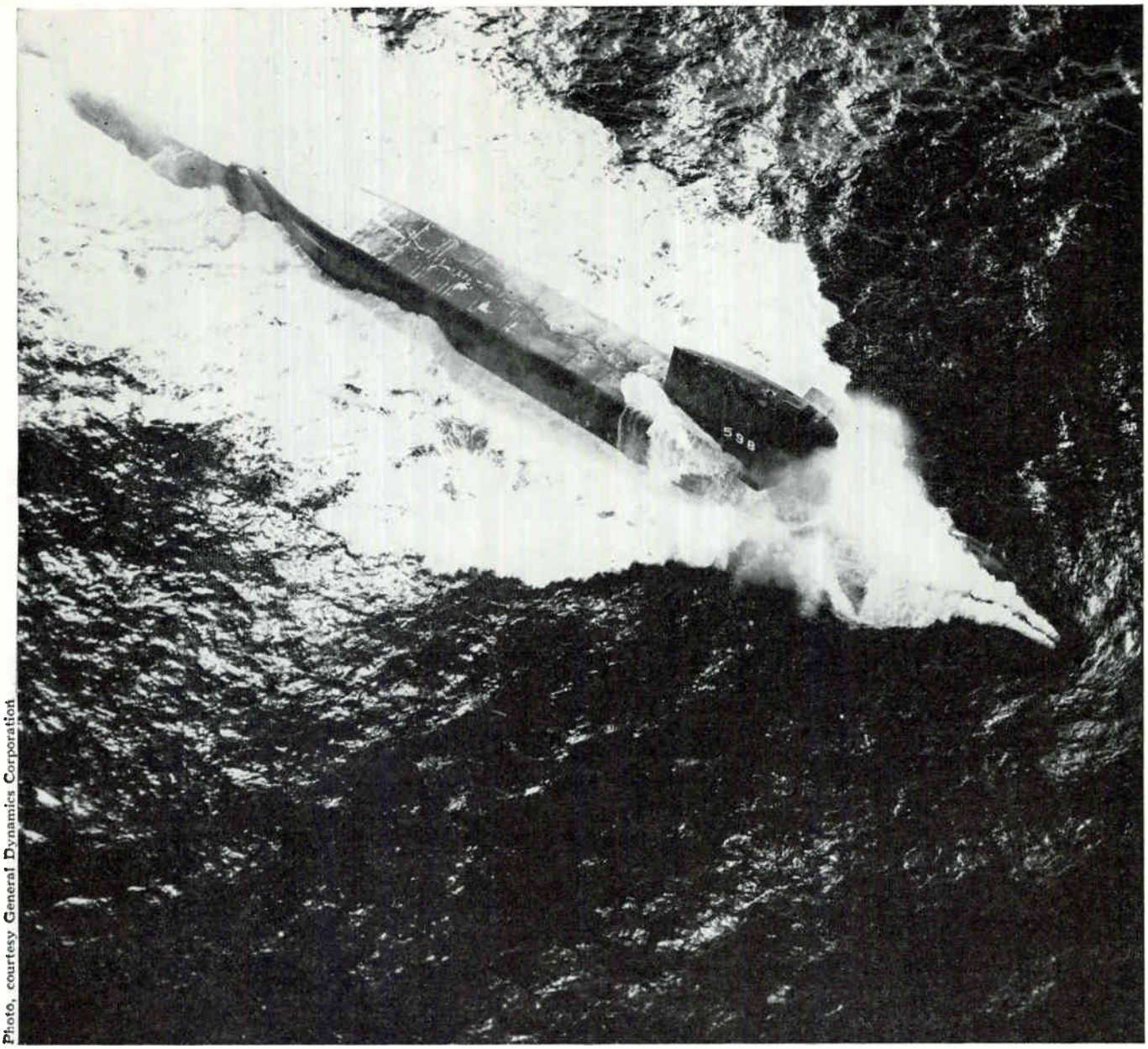


Display storage tubes custom made for you. Westinghouse laboratory facilities and engineering staff assure you of the most advanced design facilities at the lowest possible cost. Each tube is specially designed to meet your requirements and must prove its ruggedness by passing the most severe environmental test conditions before approval. Westinghouse Display Storage Tubes combine high writing speed with excellent resolution, brightness, and storage capability. They incorporate a unique Westinghouse flood gun design which simplifies collimation and system set-up procedure. If you have a display storage problem, why not find out how we can help solve it? Write on company letterhead to: Westinghouse Electric Corporation, Elmira, N. Y. You can be sure . . . if it's Westinghouse.

Examples of Westinghouse display storage tube design capabilities

	WL-7268	WX-4363	WX-4187/ WL-7952	WX-4611/ WL-7632	WX-4511	WX-4418/ WL-7174	WX-4581/ WL-7748	WX-4584	WX-4614/ WL-7033
Maximum diameter-in.	5¼"	5¼"	5¼"	5¼"	5¼"	4½"	5 9/16"	5¼"	5⅛"
Maximum length-in.	16"	16"	15"	15"	15"	10"	13⅜"	15"	11½"
Min. useful screen-in.	4"	4"	4"	4"	4"	3"	3.8"	4"	4"
No. of write guns	2	2	1	1	1	1	1	1	1
Type of focus	ES	ES	ES	ES	ES	Mag.	ES	ES	ES
Type of deflection	ES	ES	ES	ES	ES	Mag.	ES	ES	Mag.
Storage time min.-sec.	5	30	60	30	60	30	20	6	60
Writing speed min.-in./sec.	4 x 10⁴	4 x 10⁴	4 x 10⁵	4 x 10⁵	4 x 10⁵	2 x 10⁵	3 x 10⁵	1.2 x 10⁶	1 x 10⁵
Erase uniformity-volts	1	2	2	2	2		1	2	
Erase time max.-millisec.	50	50	50	50	50	5		10	50
Viewing screen-KV	10	10	5	5	10	15		5	9
Brightness min.-ft.-L	2,500	2,000	200	200	2,500	10,000	1000	200	2,000
Resolution min.-Lines/in.	50	65	50	50	50	35	50	50	65

Westinghouse



Photo, courtesy General Dynamics Corporation

MIGHT on the MAIN

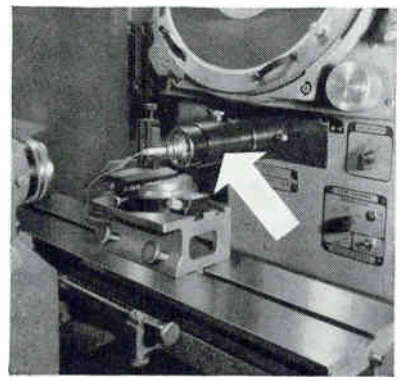
EDO CONGRATULATES THE U.S. NAVY on its mighty deterrent fleet, symbolized by the *U.S.S. George Washington* on operational patrol – fast, far-ranging, Polaris-armed. Edo is proud to share as prime contractor in the Navy's Polaris program by designing and building systems that are being tested and proved daily as the *George Washington* and her FBM sister ships prowl their protective missions . . . "a fleet that will never attack first, but possess sufficient powers of retaliation, concealed beneath the sea, to discourage any aggressor from launching an attack upon our security."*

President John F. Kennedy's State of the Union message, January 30, 1961

Edo CORPORATION
College Point 56, L. I., New York

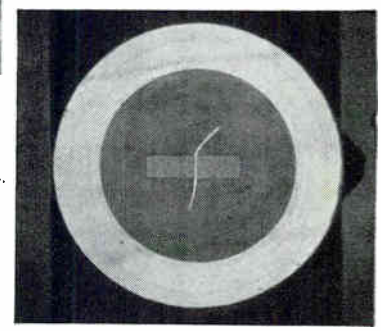
In Canada:
Edo (CANADA) LIMITED
Cornwall, Ontario

Model FC-14 J & L Optical Comparator



CENTRALITE adapter (arrow) slips easily into place on J & L Optical Comparator — used here to inspect tiny read/record head.

CENTRALITE image of read/record head clearly shows two magnetic poles separated by aluminum foil insulator at 31.25 magnifications.



NOW...closer inspection of micro-assemblies

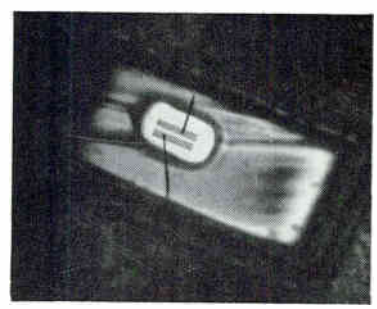
...with CENTRALITE and PARABOLITE

Simply slip on a CENTRALITE or PARABOLITE adapter, and your J & L TC-14 or FC-14 Optical Comparator becomes even *more* versatile. You'll use it for critical inspection jobs that may have previously seemed impossible.

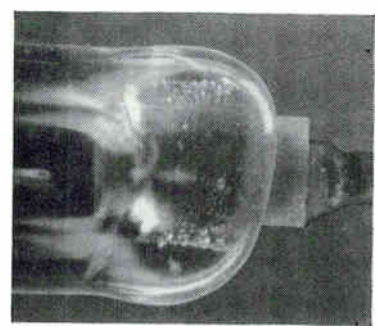
For example, CENTRALITE provides a highly concentrated light which now permits the projection of a precise image of a tiny read/record head used in a computer component. Light is concentrated intensely on the part and reflected back through the J & L projection system onto the Comparator screen. CENTRALITE is also used for micro-inspection of a mesa diode assembly.

PARABOLITE permits detailed examination of a tiny tunnel diode assembly by surrounding it with concentrated light. Simply by rotating the diode, you can take a close look at seal, bubble configuration at fusion points, gold contact to wafer, and other critical details.

Solve *your* inspection problems with J & L Optical Inspection Equipment. Send for Catalog LO-6013 now.



Micro inspection of this mesa diode assembly at 100 magnifications is clearly detailed with CENTRALITE.



PARABOLITE makes possible a sharp close-up of bubble configuration at the fusion point of this tunnel diode (50 magnifications).

JONES & LAMSON MACHINE COMPANY

539 Clinton Street, Springfield, Vermont

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

Nowhere is this closeness more apparent than at Lockheed. Here, with each passing day, new technological advances help bring nearer the exploration of Mars, the Moon and Venus.

As the time grows shorter, the pace grows faster. New designs in Spacecraft and Aircraft are rapidly being developed —and the number continues to mount. Included are: Missiles; satellites; hypersonic and supersonic aircraft; V/STOL; and manned spacecraft.

For Lockheed, this accelerated program creates pressing need for additional Scientists and Engineers. For those who qualify, it spells unprecedented opportunity. Notable among current openings are: Aerodynamics engineers; thermodynamics engineers; dynamics engineers; electronic research engineers; servosystem engineers; electronic systems engineers; theoretical physicists; infrared physicists; hydrodynamicists; ocean systems scientists; physio-psychological research specialists; electrical—electronic design engineers; stress engineers; and instrumentation engineers.

Scientists and Engineers are cordially invited to write: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 1505, 2408 N. Hollywood Way, Burbank, California. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. U.S. citizenship or existing Department of Defense industrial security clearance required.

LOCKHEED

CALIFORNIA DIVISION

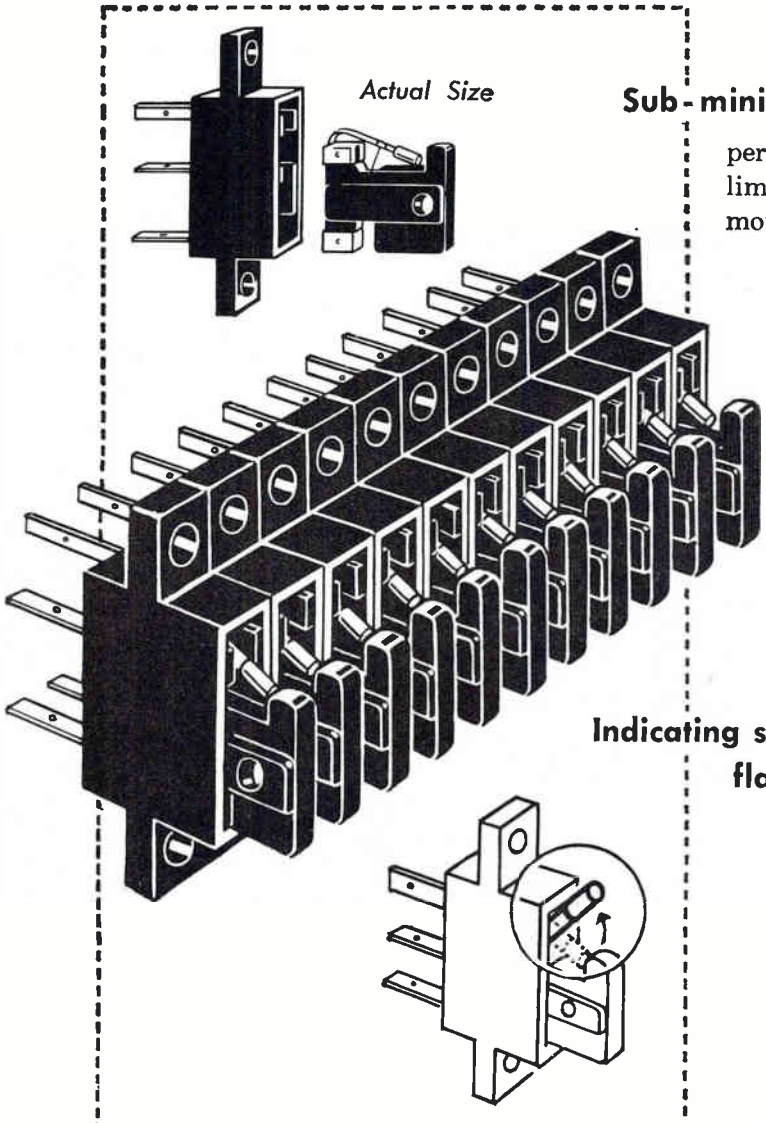
Reading clockwise: Venus, Moon, Mars. Approximate distance from Venus to Earth, 25,000,000 miles; from Moon, 240,000 miles; from Mars, 50,000,000 miles.

Photos courtesy of Mount Wilson and Palomar Observatories.

NEW! BUSS . . .

Signal Indicating · Alarm Activating

GMT Fuse & HLT Fuseholder



Sub-miniature design

permits multiple mounting of fuses in limited space. Fuseholders can be mounted on ¼ inch horizontal centers.

Fuse and holder combination readily adaptable for use in equipment operating at 300 volts or less, such as: communication equipment, business machines, computors, control equipment or other multiple circuit apparatus where space is at a premium.

Indicating spring flashes color-coded flag when fuse opens

to give quick, positive identification of faulty circuit.

Indicator spring also makes contact with an alarm circuit so, it can be used to flash a light—or sound audible signal on fuse panel or at a remote location.

Ask for bulletin GMCS on BUSS GMT fuses and HLT holders.

561

In the BUSS line,
you'll find the type and size fuse to fit your every need
. . . plus a companion line of clips, blocks and holders.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
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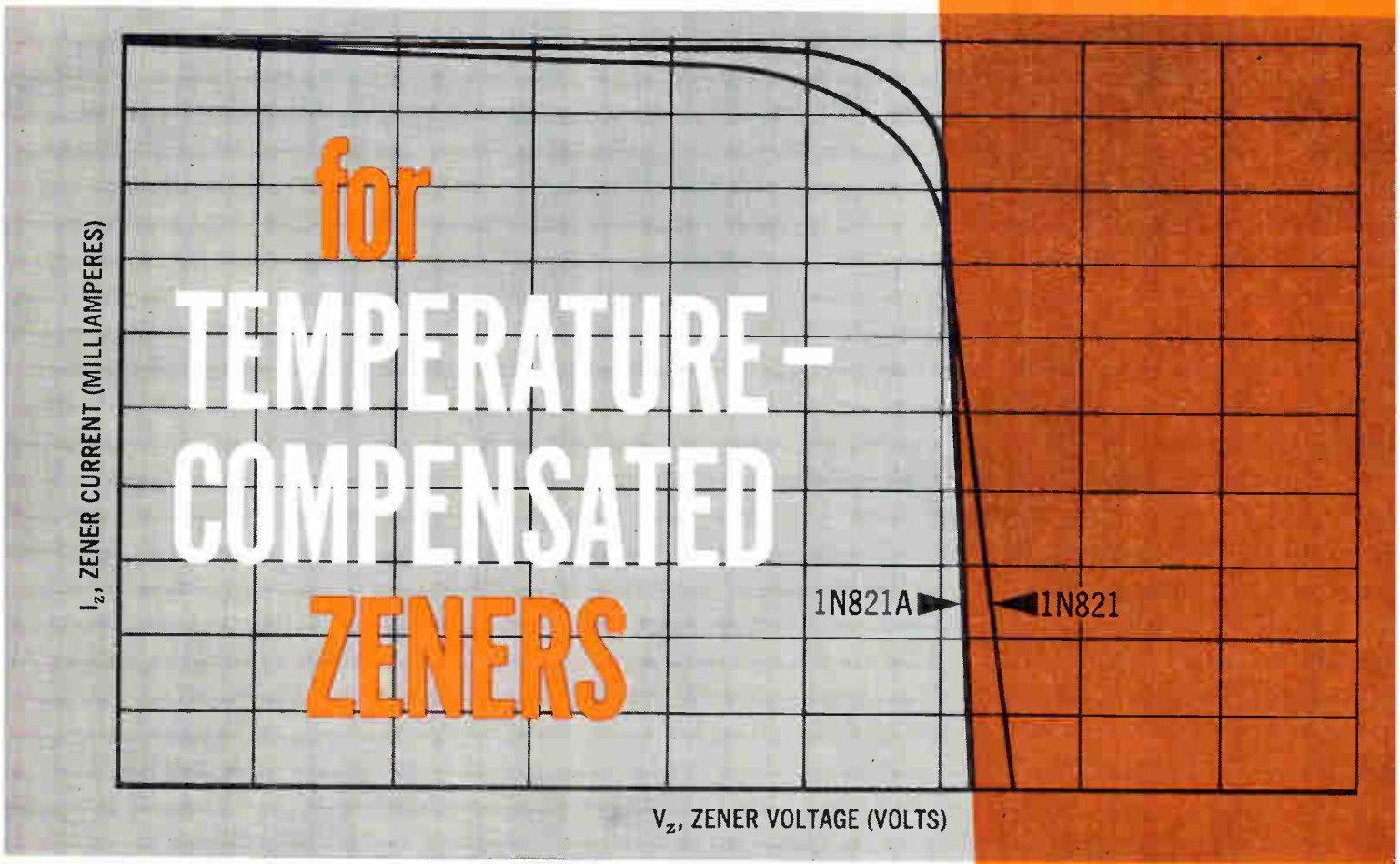
BUSSMANN MFG. DIVISION, *McGraw-Edison Co.*, UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.

A NEW SLANT



Typical Operating Characteristics Curve

from MOTOROLA

LOWER DYNAMIC IMPEDANCE MINIMIZES VOLTAGE FLUCTUATIONS ... helps reduce circuit complexity ... eliminates components

The above curve emphasizes the principal advantage of Motorola's new 1N821A series – 6.2 volt temperature-compensated reference diodes. The slant, or slope, of the curve is due to the extremely low dynamic impedance of these new devices ... 8 ohms typical, 10 ohms maximum.

Because of this extremely low dynamic impedance (nearly half that of units available elsewhere), reference voltage fluctuations due to current changes are minimized ... a primary concern in reference applications. This amazing voltage stability allows you to simplify the complex constant-current circuits previously required ... reducing components and increasing reliability. And, this new 1N821A series costs no more than the higher impedance units.

This dramatic achievement in a single zener device is a typical example of Motorola leadership in zener research and development. Motorola refinements have been responsible for making these versatile devices more useful in an ever widening field of applications.

Another facet in Motorola's zener leadership is an emphasis on reliability second to none. Unique production processes, exhaustive in-process control, continuous life-testing and conservative ratings contribute to a growing preference for Motorola zeners. If you are using zener diodes ... be sure you have complete information on the design and production advantages to be gained by specifying "Motorola".

CIRCLE 58 ON READER SERVICE CARD

VERSATILE MOTOROLA ZENERS . . .
offer you many design advantages

WIDE SELECTION – enabling you to use the precise device for your exact circuit requirements. Over 2,070 different devices are available covering seven wattages . . . and five temperature-compensated series. Three standard tolerances are offered: 5%, 10% and a 20% tolerance for lower-cost, non-critical applications. Matched sets are available in tolerances as low as 1%. Motorola also has a variety of military-qualified zeners.

OUTSTANDING PERFORMANCE – is one of the big advantages you gain when using Motorola zeners. These include lower dynamic impedance, lower temperature coefficients and sharper knees. Units are measured at the 1/4 power level – the point of typical usage. Dynamic impedance is measured at two points and 100% scope-checked.

COMPLETE SPECIFICATIONS – Motorola supplies you with the industry's most comprehensive specifications . . . giving you the complete picture of the diode characteristics. Temperatures are fully specified. Forward current ratings are specified and guaranteed.

RELIABLE OPERATION – exclusive process and quality control procedures assure extreme uniformity, high stability and longer life. Motorola's million-dollar reliability program has resulted in a level of reliability acceptable for the most critical applications.

IMMEDIATE AVAILABILITY – Motorola Zener Diodes are available "off the shelf" from 28 experienced industrial distributors. For fast delivery of any Motorola zener, contact the distributor nearest you.

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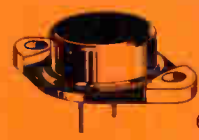
1/4M2.4AZ thru 1/4M6.8AZ
6.8 - 200 volt diffused units
1/4M6.8Z thru 1/4M200Z

MOTOROLA 400 mW ZENERS
6.8 - 200 volt diffused units
1N957 thru 1N992
1N962B thru 1N992B*
*to meet the requirements of MIL-S-19500/117

MOTOROLA 3/4 WATT ZENERS
6.8 - 200 volt diffused units
3/4M6.8Z thru 3/4M200Z



MOTOROLA 50 WATT ZENERS
6.8 to 200 volt diffused units
50M6.8Z thru 50M200Z
1N2804 thru 1N2846
1N2804B thru 1N2846B*
*to meet the requirements of MIL-S-19500/114

MOTOROLA 10 WATT ZENERS
6.8 to 200 volt diffused units
10M6.8Z thru 10M200Z
1N1351 thru 1N1375
1N1806 thru 1N1815
1N2970 thru 1N3015
1N2970B thru 1N3015B*
*to meet the requirements of MIL-S-19500/124A

MOTOROLA 1 WATT ZENERS
6.8 to 200 volt diffused units
1M6.8Z thru 1M200Z
1N3016 thru 1N3051
1N3016B* thru 1N3051B*
*to meet the requirements of MIL-S-19500/115

MOTOROLA 1.5 WATT ZENERS
6.8 to 200 volt diffused units
1.5M6.8Z thru 1.5M200Z

MOTOROLA 400 mW TEMPERATURE-COMPENSATED ZENERS
6.2 volt diffused units
coefficients to .001%/°C
1N821 thru 1N827
1N821A thru 1N827A
8.4 volt diffused units
coefficients to .001%/°C
1N3154 thru 1N3157
(Replaces 1N430, although only 1/50 the size)
1N3154A thru 1N3156A

MOTOROLA 3/4 WATT TEMPERATURE-COMPENSATED ZENERS
9.3 volt diffused units
coefficients to .0005%/°C
1N2620 thru 1N2624

MOTOROLA 1/2 WATT TEMPERATURE-COMPENSATED ZENERS
9.0 and 11.7 volt diffused units
coefficients to .0005%/°C
1N935 thru 1N939
1N941 thru 1N945

FOR COMPLETE TECHNICAL INFORMATION on the specific Motorola Zeners most applicable to your circuits, write to Technical Information Department, Motorola Semiconductor Products, Inc., 5005 East McDowell Road, Phoenix 10, Arizona. Or contact your nearest Motorola Semiconductor Distributor.

ZENER-RECTIFIER APPLICATIONS HANDBOOK—Motorola's new Zener Diode-Rectifier Handbook is a valuable reference book for circuit engineers. This 200-page guide to basic theory, design characteristics and applications is available through your Motorola Distributor. Price $2.00.

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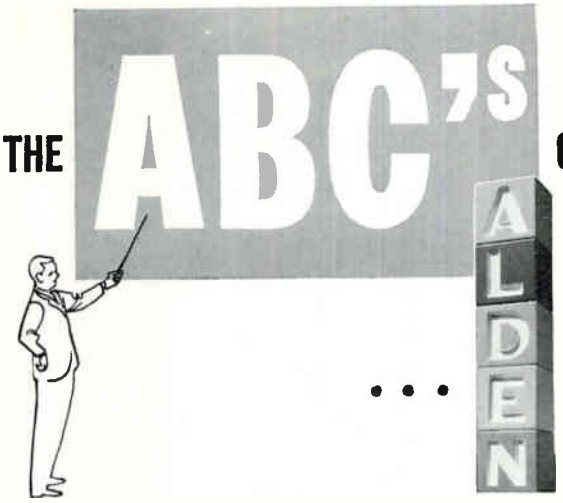
MOTOROLA ZENER DIODES

THE ABC'S OF ELECTRONIC PACKAGING



. . . using Building Block Techniques

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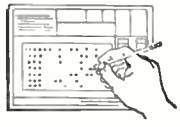

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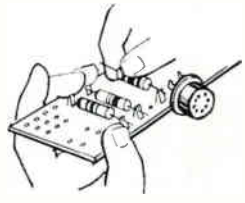

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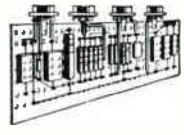

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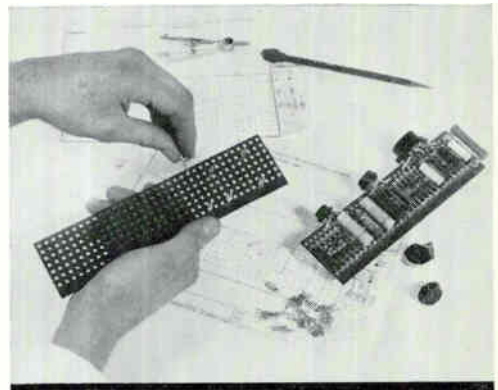
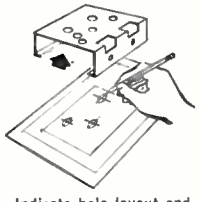


B ORGANIZE YOUR CIRCUITRY BY FUNCTION FOR PLUG-IN FLEXIBILITY!



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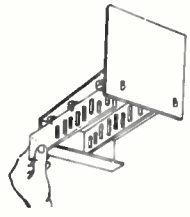

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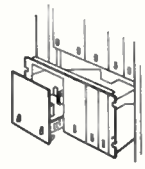

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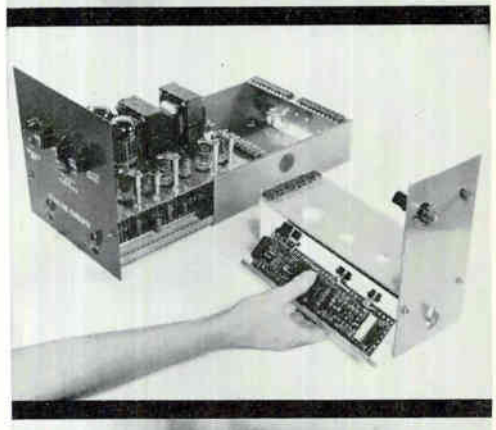

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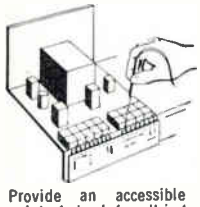

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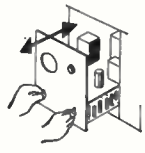

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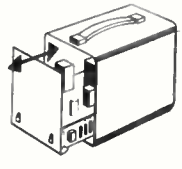

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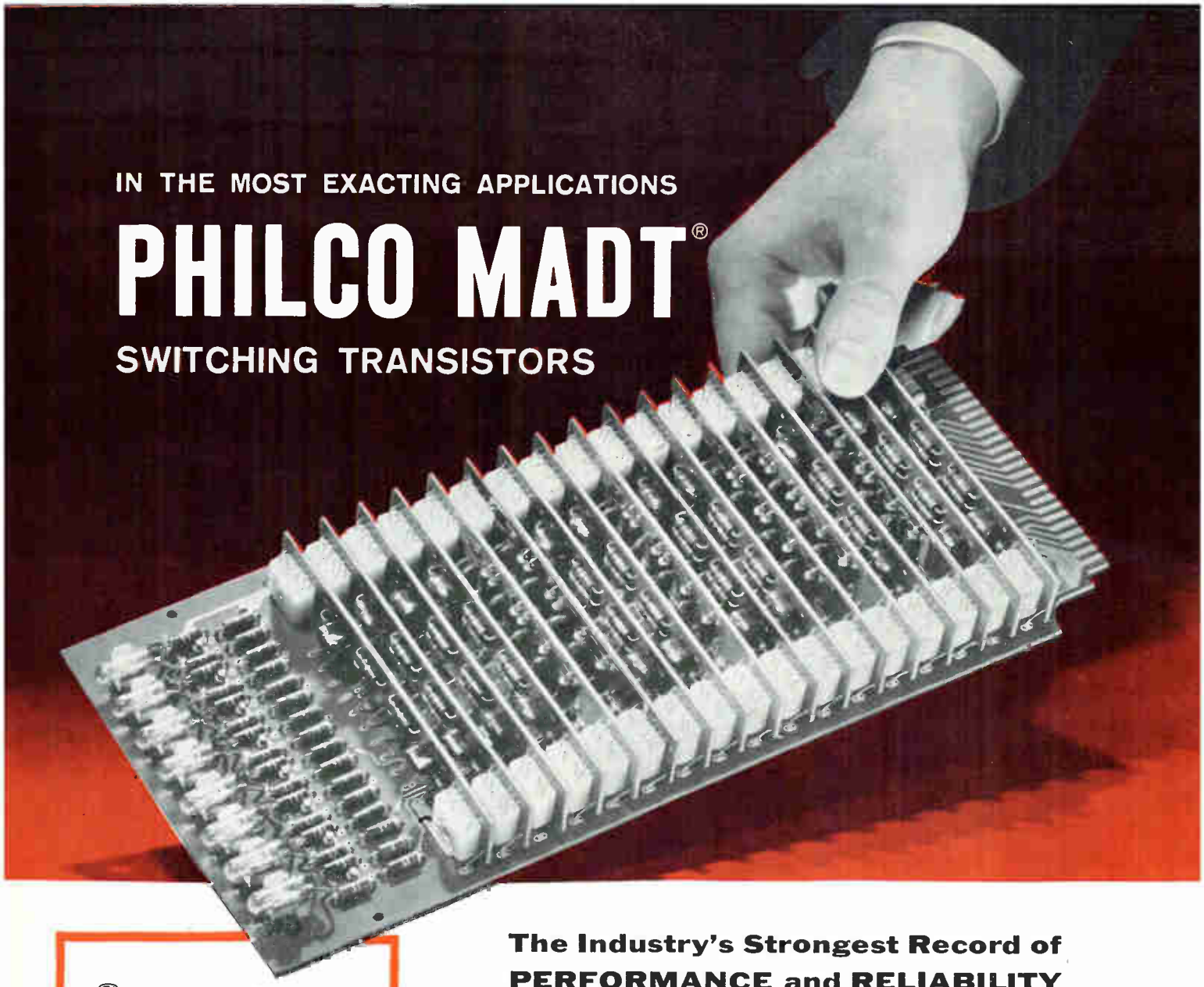

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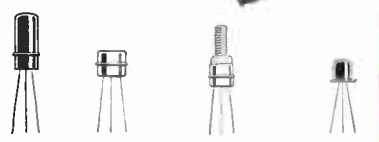
SWITCHING TRANSISTORS



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In high-speed computers, control systems, guidance systems and many other critical military and industrial switching applications, Philco's patented high-frequency Micro Alloy Diffused-base Transistors are used more widely than any other type. There are many reasons for this broad acceptance. Philco MADTs are available in a full range of types, each designed and produced to tight specifications for specific applications. They are manufactured by Philco's patented Precision-Etch* process on the world's first fully-automatic transistor production lines . . . under rigid quality control. Philco MADTs have proved their outstanding performance capabilities and reliability in *billions of transistor hours of actual field operation* . . . far more than any other type of transistor.

There is a Philco MADT to meet your requirements . . . offering the advantages of cadmium junctions for cooler operation . . . low collector capacitance . . . low saturation voltage . . . high beta with good linearity . . . excellent frequency response . . . low hole storage time . . . and excellent temperature stability.

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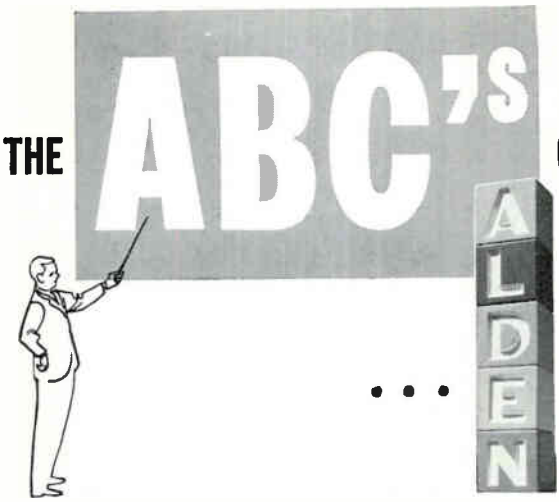

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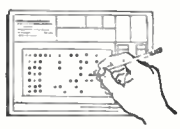

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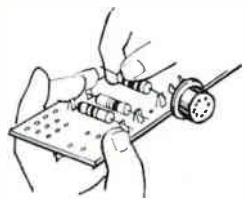

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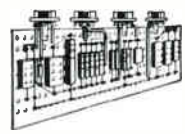

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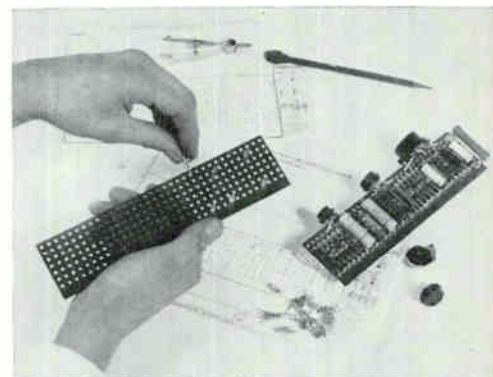

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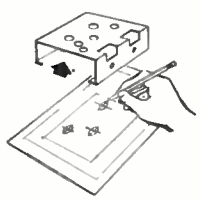

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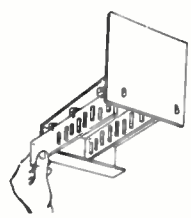

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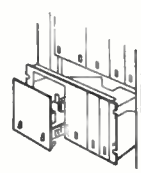

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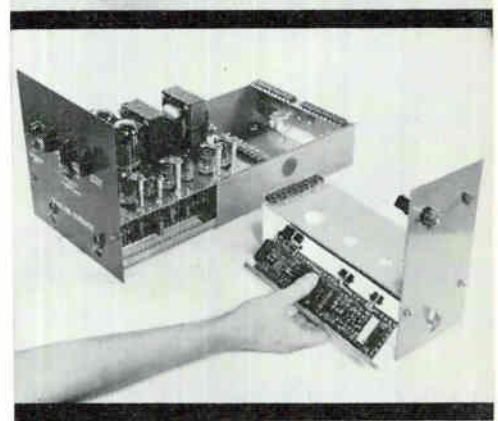

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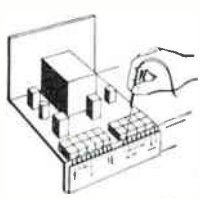

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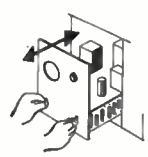

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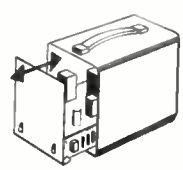

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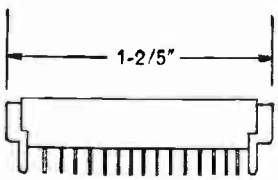
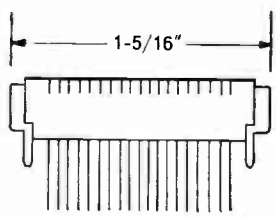
DIMENSIONS (ACTUAL SIZE)

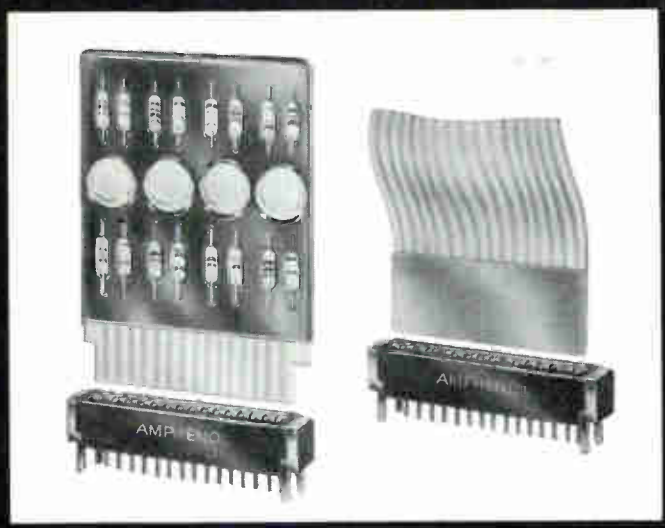


Micro Edge
64 SERIES



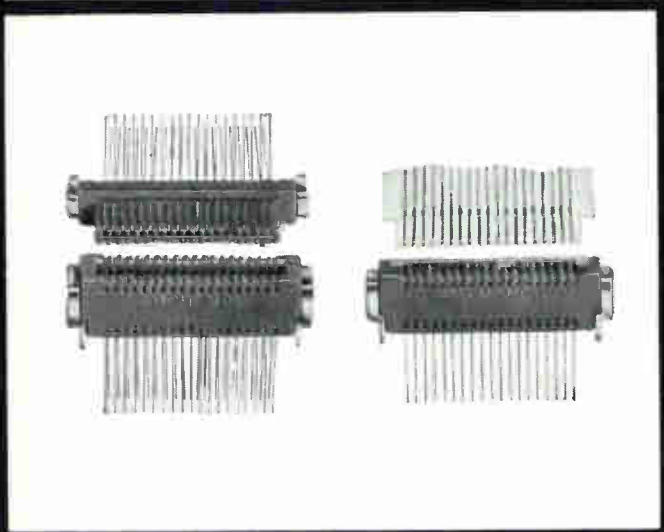
Micro Min
74 SERIES

Micro Mod
96 SERIES



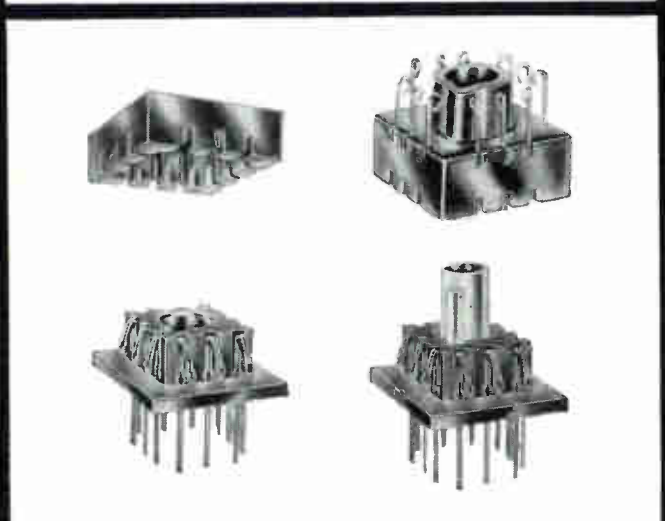
Micro Edge

Receptacle for flexible printed wiring or printed circuit boards. 15 contacts on .0 centers, with 2 lines of interference per circuit.



Micro Min

19 contact receptacle with mating components mounting board or 38 cont rack & panel/modular pair. Contacts on .050" centers.



Micro Mod

12 contacts on .075" centers. 2 types available for either modular use or for cable-to-cable, cable-to-chassis or board-to-chassis usage.

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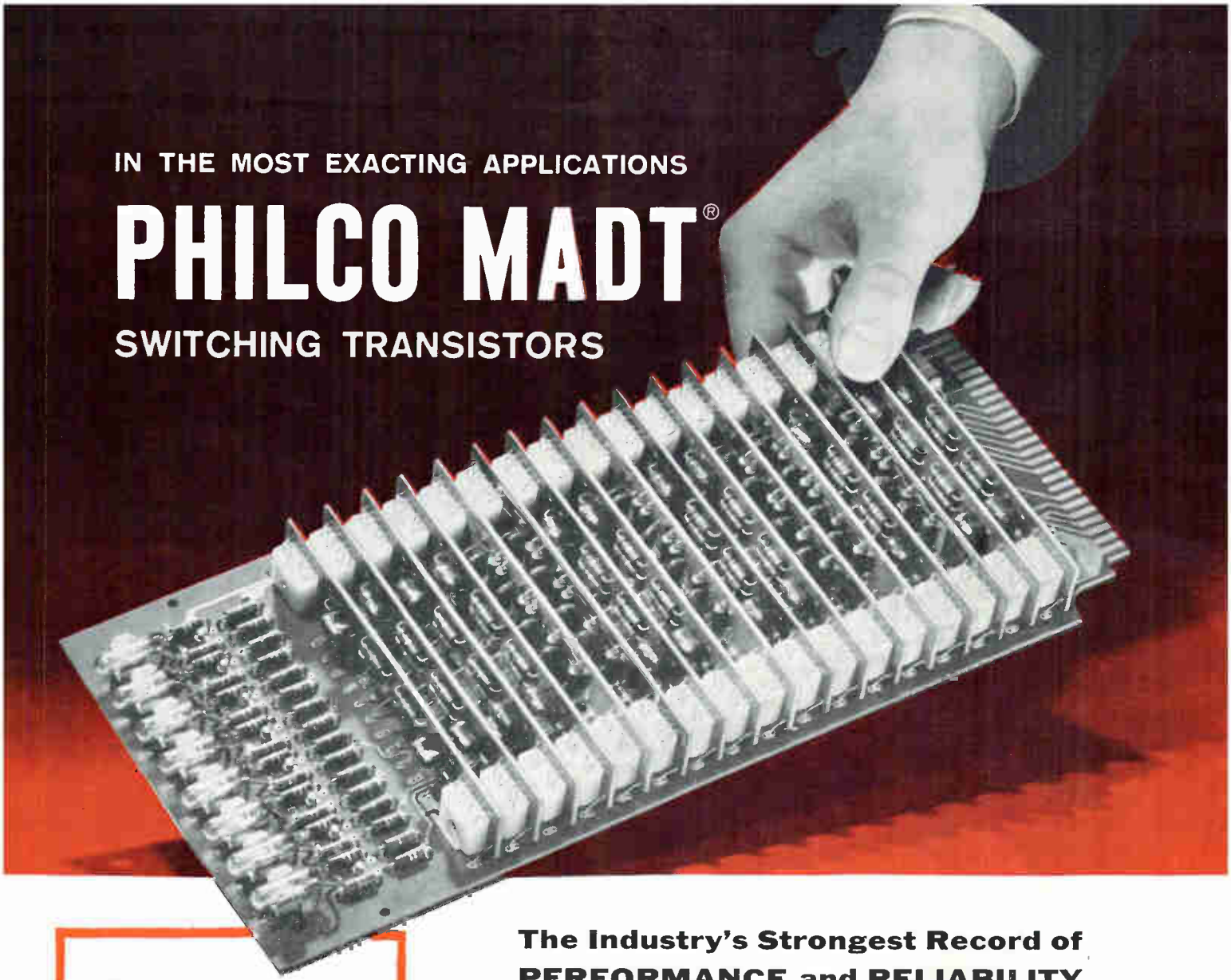

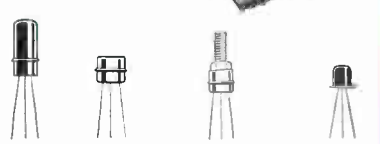

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electronics
May 12, 1961

Glow-Tube Programmer Controls Neutron Spectrometer Experiments

Multielement glow tubes are used as switches to control sequence of operation. Tubes can be cascaded to provide more than ten individual functions

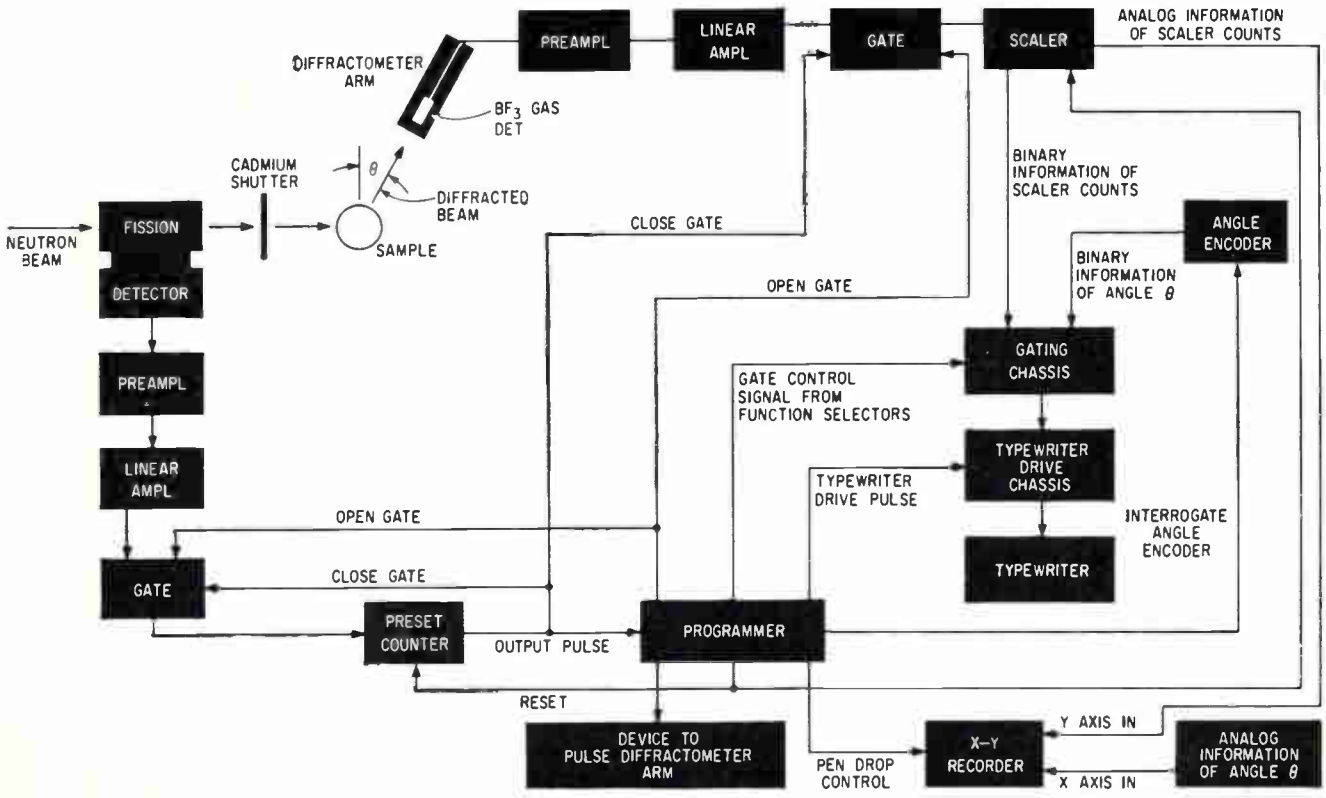
By EDWARD W. JOHANSON.
Argonne National Laboratory
Argonne, Illinois

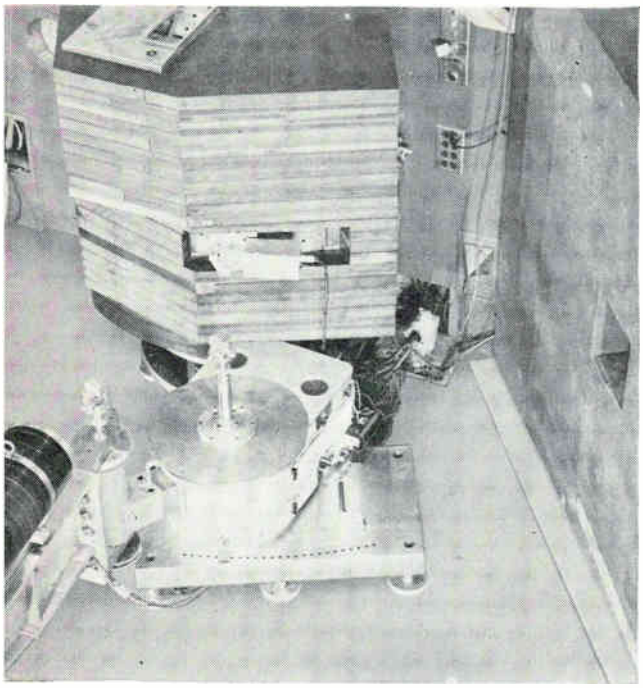
COUNT DATA can be recorded automatically and mechanical motions controlled automatically in neutron diffraction experiments by using glow-transfer tubes as switches or control devices.

In the experiments (see Fig. 1), the neutron beam emerges from the reactor, passes through a fission detector, strikes the sample and is diffracted. The diffractometer arm that determines the angle θ is moved through the diffracted beam pattern, and the BF_3 gas-type detector tube mounted on the diffractometer arm detects the diffracted beam. The counts from the BF_3 detector enter a scaler for later print-out. The electronic information of the angle θ of the diffractometer arm enters an angle-encoder for later print-out. Output of the fission detector is fed through an amplifier to a pulse counter. The counter is preset to determine the length of time of data accumulation and initiates data recording. This method of preset counting eliminates counting errors due to the reactor level fluctuations because the counting time is based on the number of neutrons passing through the fission detector.

The programmer outlined in Fig. 2 is turned on by the output pulse of preset counter. A 60-cycle square wave, generated from the line frequency, drives the first glow-trans-

FIG. 1—Experiment is controlled and accumulated data are recorded automatically by glow-tube programmer





General view of neutron diffractometer shows reactor side wall

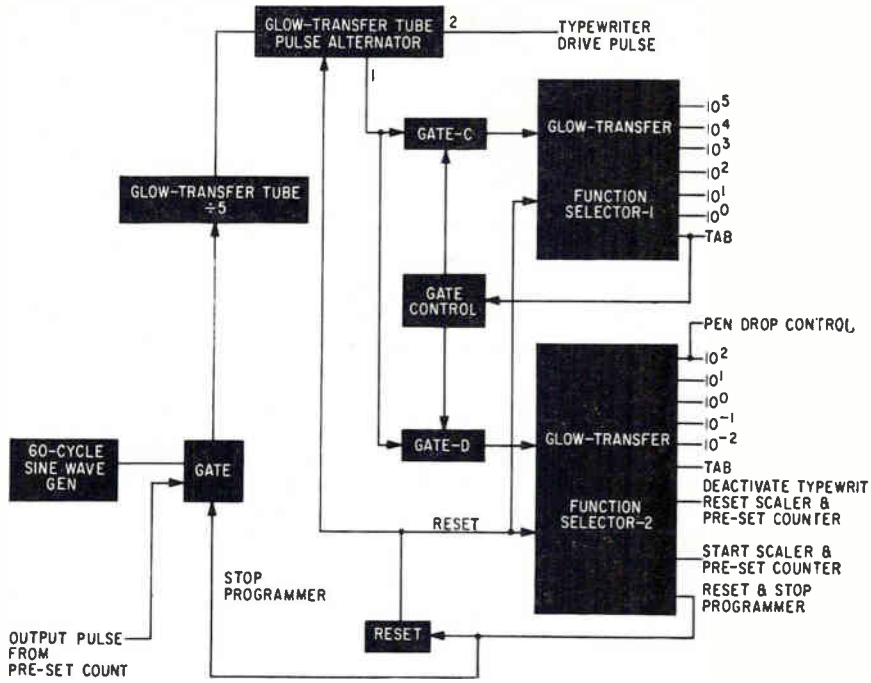


FIG. 2—Block diagram of programmer, in which function selector 1 controls readout of scaler count, selector 2 controls angle readout

fer tube. Output of this tube is one pulse for every 5 input pulses. After this division by 5, the pulses are transmitted to the pulse-alternator glow-tube. Alternate output cathodes of this glow-tube are connected to form two groups of five cathodes each. Output of this tube, then, as it is being driven, alternately comes from output cathode group 1 and output cathode group 2. Hence, the designation pulse-alternator or alternator.

Pulses from group 1 pass through either gate C or gate D to drive the function selectors. The pulses from group 2 operate the relays that provide the power to the key solenoids of the electric typewriter.

At the start of the programming cycle gate C is open, gate D is closed and all glow-tubes and flip-flops are reset. After the programmer is activated the first pulse from the alternator moves the beam of function selector 1 to cathode 1 (Fig. 3). This cathode is now drawing current and provides current to the typewriter gate control transistors Q_1 and Q_2. Transistors Q_1 and Q_2 both saturate, energizing the four HGS-1048 mercury relays. Contacts of these relays switch the binary information in the 10^5 decade to the typewriter drive circuit.

In this circuit the binary infor-

WHAT A NEUTRON DIFFRACTOMETER IS AND DOES

Thermal neutrons emanating from the reactor have a wavelength of approximately 1 A which is of the same order as the interatomic distances in matter. Consequently, a solid or crystal serves as a three-dimensional diffraction grating for thermal neutrons. When a well-collimated monochromatic neutron beam is incident upon crystalline sample, each atom serves as a diffraction or scattering point, and the interferences of these diffracted beams give a neutron diffraction pattern.

If the sample is a single crystal, the observed pattern is a three-dimensional array of diffraction spots. If the sample is a powder composed of small randomly-oriented crystallites, the resulting diffraction pattern is a series of cones originating from the sample. In direct analogy with x-ray diffraction procedures, it is possible to determine the unit cell dimensions and geometry from the angular positions of the diffraction spots and from the intensities of the spots to determine the positions of the atoms within the unit cell.

Neutrons and x-ray diffraction have many common features; however, their differences make them supplemental tools to each other in crystal structure determinations. X-rays are scattered by the electrons of an atom, and, hence, the scattering power of atoms increases with atomic number. The x-ray diffraction contribution from electron-poor light elements, such as hydrogen and carbon, may be completely obscured by the scattering from electron-rich heavy atoms, such as thorium and uranium. Scattering of neutrons is by the atomic nuclei, and scattering from light atoms is of the same order as from heavy atoms and, in fact, can be greater.

Consequently, neutron diffraction has proved valuable in locating the positions of light atoms in crystal structures. This same difference is also useful in the studies of ordering in alloys of elements of nearly the same atomic number. The neutron has a magnetic moment and hence is scattered by the magnetic moments of atoms in magnetic materials. It is possible by applied magnetic fields or thermal means to separate the magnetic from the nuclear scattering and obtain the orientations of the magnetic moments or magnetic structure of the material.

In essence, a sample acts as a diffraction grating and scatters the incident neutrons so that there are peaks of high intensities at various angles, and the data recorded is the intensity of the scattering and the angle at which it occurs.

mation is converted to decimal form and selects the proper number solenoid on the output writer. Now the second pulse out of the alternator applies power to the selected solenoid, and the number is printed.

The numbers on the cathodes of the function selector tubes indicate the decade in the scaler or angle encoder being set up for printing. When the beam has progressed as far as the tab operation in function selector 1, a pulse is generated which activates the flip-flop in the function selector gate control. The flip-flop voltage levels control the gates and thus stop the pulses to function selector 1 and allow the pulses to drive function selector 2 by opening gate *D*.

This same cathode current of selector 1 also activates a relay, whose contacts when closed cause the angle θ encoder to be interrogated and the angular information to be stored in a relay memory for printout. Function selector 2 now prints out the angle number stored in the memory in the same fashion as the scaler from selector 1 was printed out.

When function selector 2 has completed the tab step at cathode 6, the current of cathode 7 deactivates the typewriter. This is done by discontinuing the pulses from output cathode group 2 of the alternator. At this step of the programming, the scaler and preset counter are reset to zero. The beam of function selector 2 now is moved to cathode 8 which causes the scaler and preset counter to start counting. The final step of selector 2 resets and stops the programmer.

At times during the activation of either function selector 1 or 2, additional relays are energized to perform single functions. These include activation of the drive for the diffractometer arm, activation of the recorder pen-drop mechanism, and providing a pulse that is used to open or close the cadmium shutter in front of the gas counter for background recording.

This glow-tube programmer was prepared for S. Sidhu, M. Mueller and L. Heaton of Argonne National Laboratory. The author thanks G. T. Weiss, R. B. Hoger and J. H. Erickson for their help. The work reported here was performed under the auspices of the U.S. Atomic Energy Commission.

BIBLIOGRAPHY

J. Millman and H. Taube "Pulse and Digital Circuits," p 335, McGraw-Hill Book Co., Inc., New York, 1956.

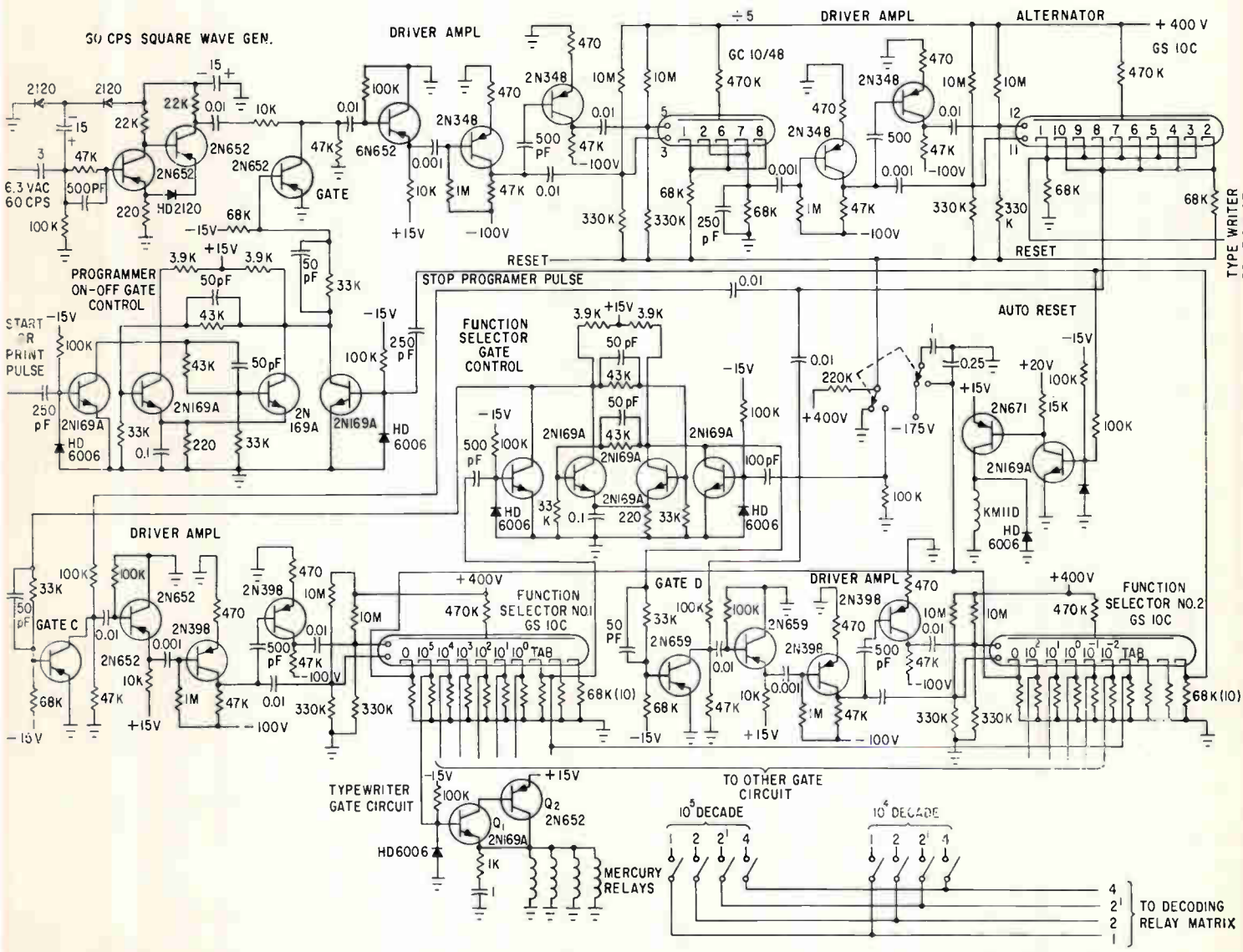


FIG. 3—Schematic of programmer shows two function selectors cascaded in series so that each cathode does only one job

Three-Dimensional Core Memory

Storage unit handles 16,384 words, each of 72 bits length, by a three-dimensional process of word selection and read. The memory cycle time for selecting any word at random from the system is 2.18 microseconds

MAGNETIC CORE STORAGE is established in the data processing industry and is an efficient and reliable technique for the high-speed main memories in digital computers. Millions of magnetic cores are used in computer memories without failures due to core deterioration; in addition, advances in technology have consistently lowered core switching time, resulting in the high-speed magnetic memories presently used. The economics of memory construction has improved, along with increased speed, due to improvements in the techniques of addressing and selecting storage locations within the memory.

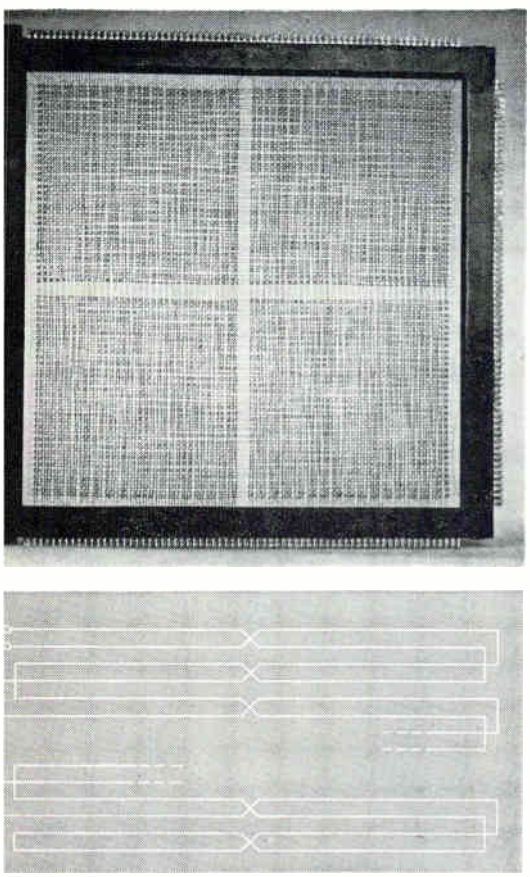


FIG. 1—Plane of core memory elements, top, with arrangement of sense windings for minimum noise

The number of lines that are activated to select and store information at any given address in a memory determines the dimensions of memory selection, with most core-memory systems today having either two or three dimensions of selection. Two-dimensional memory is often called word-organized, word-oriented, linear access, or just 2-D memory. Two-dimensional units are used in small, fast memories, but the cost of logical selection usually tends to make such two dimensional memories uneconomical for large-capacity storage. In large-scale memories, three dimensional or 3-D selection becomes less costly than 2-D.

In the three-dimensional memory of 16,384 words, each word is addressed by selecting one of 128 X lines and one of 128 Y lines. Information is stored in 3-D, and also 2-D, by a digit or bit, or Z line, that permits a 1 or a 0 state to be set in each core of the selected word. In a two-dimensional memory of the same size, a single line must be selected to address a word; that is, one of 16,384 word lines is selected. The cost difference between 3-D and 2-D is between selection for only 256 lines in 3-D and selection for 16,384 lines in 2-D.

The IBM 7302 core storage unit has 16,384 words addressed by three-dimensional selection. Each word has 72 bits of information for a total storage unit capacity of 1,179,648 bits. A magnetic core for each of these bits is set to one of its two possible remanant states to store either a 1 or a 0 in binary. The cores are ferrite material and are switched by the coincidence-of-address selection currents. The memory cycle time is 2.18 microseconds. There are no programming restrictions, so that any random address may be selected repetitively at full cycle time.

The memory is a solid-state system. Graded-base transistors are used as logic and sensing elements and as core drivers. The ferrite cores are conventional torroids 30 × 50 ×12 mils in size.

Cores for the memory were selected on the basis of switching time and drive current. For a 2.18 μsec cycle time, maximum core switching time was set at 0.4 μsec, and nominal half-select current at 0.6 amp or less with 0.1 μsec rise (T_r) time.[1, 2]

Actual core parameters are: full-select current of 1.17 amp nominal with T_r at 0.1 μsec, and delta noise at 1.0 mv per pair. Under marginal drive conditions switching time is 0.43 μsec maximum with minimum 1 at 110 mv and maximum 0 at 33 mv.

Figure 1A shows a complete plane of cores. The over-all plane is approximately 10 inches square with a center-to-center core spacing of 0.0625 inch. Each of the 72 planes has one bit for each word in the memory, or a total of 16,384 cores; these are wired into a 128 × 128 matrix.

The Z lines include four sense windings and four inhibit windings; each of these link a rectangular core-matrix 32 × 128. The sense and inhibit matrices are interlocked and perpendicular to each other. This configuration allows only 1,024 cores to share a given pair of windings, and reduces the proportion of core noise in the total sense segment noise caused by pulsing an inhibit segment.

The shape of the sense segment is rectangular for optimum use

Accommodates One Million Bits

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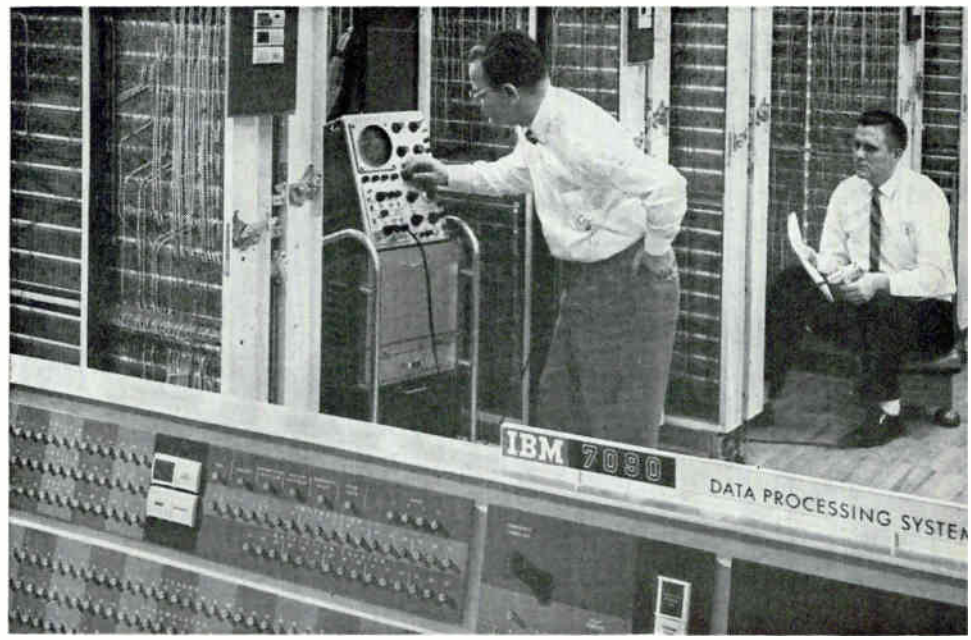


Engineers check out a newly installed 7090 digital computer. This machine uses transistor logic and core storage

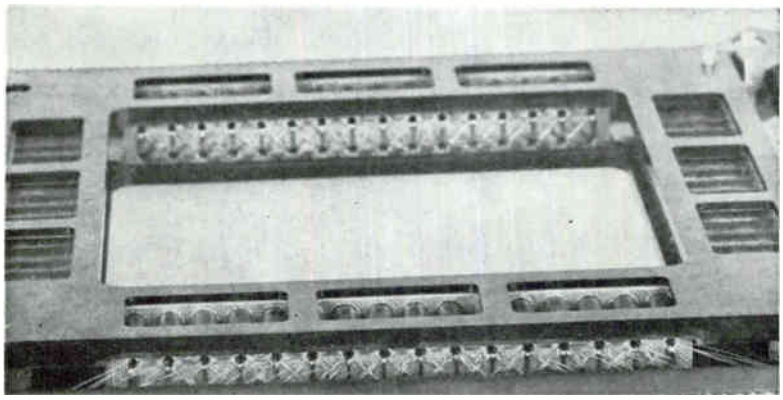
with staggered read. Compared with a conventional square segment, this shape reduces by 50 per cent core half-select noise at strobe time.

All but the sense windings are conventional. The sense configuration, Fig. 1B, has the following advantages over diagonal winding: shorter physical and electrical length decreases signal attenuation and delay. Smaller time delays between cancelling components improve noise cancellation. Transmission characteristics of the X lines become approximately equal to the characteristics of the Y line. This last advantage occurs because the sense line is parallel to the X line just as the inhibit line is parallel to the Y line; this provides uniform distributed capacitance from both X and Y to array ground. The same wire orientation is maintained in every core: the sense and X lines are separated by the inhibit and Y lines to reduce capacitance and assure its uniform distribution. Originally this arrangement caused electrostatic coupling between the adjacent inhibit and Y lines; that is, when a large number of inhibit drivers were turned on, capacitively coupled noise spikes were propagated on the Y lines. This problem was solved by careful pulse timing.

The 72 planes of the complete array are connected by word selection lines. The 16,384 words of the basic memory have 72 bits each. With the IBM 7090, however, the array operates with 32,768 words of 36 bits. In this modified system, two words are read out simultaneously.

In the initial design of word selection, electromagnetic and electrostatic coupling between selection lines was a serious problem. Close spacing between adjacent lines, rapid change rate of drive current, and relatively long lines led to noise spikes on unselected lines during drive-pulse rise and fall; these spikes were greater than 35 per cent of the drive current.

FIG. 2—Part of the load sharing matrix switch



The problem of this cross-talk was solved through two measures. First, the external array jumpers for the X and Y lines were connected so that any two would be adjacent in only a few planes. In other words, any two selection lines, each comprised of 72 connected X or Y lines, would at worst be immediately adjacent over only a small part of their total length. In this way, the worst possible coupling occurred only between alternate lines that ran parallel through most of the array.

Second, alternate planes in the array were turned over; this arrangement separated the planes in a pair by only about 0.06 inch, but separated the pairs by 0.75 inch.

The combination of both corrective measures reduced cross-talk between lines to less than 10 per cent of the drive current. In the final machine, this reduced percentage was more than enough to eliminate cross-talk problems.

Cooling was another important consideration in designing the basic array. Excessive heat can cause undesirable changes in core properties. Because one address may be selected continuously, core temperature stabilization was re-

quired. To achieve good heat transfer and uniform temperature distribution in spite of a power dissipation of about 42 mw in each core switched, the array was immersed in liquid.

All windings in the array resemble lossless transmission lines and terminate in pure resistances equal to their characteristic impedances. The liquid environment with its increased dielectric constant decreased Z_0 and increased the time delay (T_d) in all lines. This undesirable increase in T_d was a most important consideration in selecting the liquid. As a result, a commercial inhibited transformer oil with a low dielectric constant was chosen as the coolant.

The choice of a liquid environment yields several fringe advantages: the entire array, together with load-sharing switch assemblies and terminating resistors, is immersed in a tank of oil more compact than a blower system would have been. Lower rated power resistors can be used, and the reduced Z_0 value eases demands on the inhibit drivers.

Because the X and Y lines have the same distributed inductance and very nearly the same distributed capacitance, the properties of both lines are virtually identical. Immersed in oil, the lines have a Z_0 of 100 ohms. Since the drive system produces a nominal half-select current of 0.585 amp to be driven into this impedance, read and write pulses must be 58.5 volts. With the same current, the inhibit drive requires 53 volts across the Z line impedance of 90 ohms.

A load-sharing matrix switch[3] provides read and write pulses in the X-Y drive system. The use of a direct drive system would require a peak inverse voltage of at least 125 volts because read and write currents are of opposite polarity and the X and Y drive lines must be driven bidirectionally. Existing high-speed core-driver transistors cannot reliably withstand voltages this high. Furthermore, a conventional matrix switch would be unsatisfactory because of high inductances and the excessive currents needed to provide the voltage step-up. A load-sharing switch, however, provides pulses with reasonable transistor dissipation and

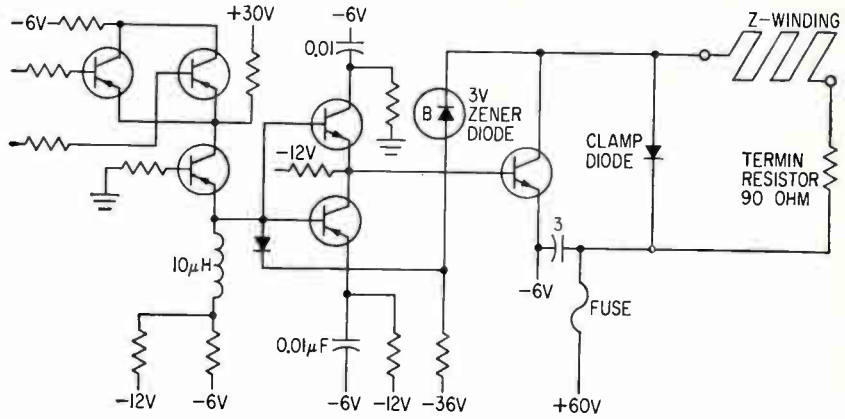


FIG. 3—Schematic of the circuit that feeds the Z selection lines; this circuit is similar to those used in the X-Y drivers

permits voltage step-up without either excessive power per drive, or high series inductance.

Figure 2 shows a 16-output load-sharing matrix switch. Each address-selection coordinate of the memory uses eight of these devices, for a total of 16 switches. Each switch has 32 single-turn input windings, 16 nine-turn output windings and a bias winding.

An address is selected from the memory address register by the decoding logic. For a given address, the logic generates two patterns, one to turn on the drivers of the Y-axis switch and one to turn on the drivers of the X-axis switch. In both switches 16 drivers turn on at read-time and a complementary 16 turn on at write-time. Drivers are in pairs, and the address determines which of the two conducts for read and which conducts for write. As a result, driver currents of opposite polarity for read and write cancel out in all but one of the 16 switch cores. At the same time, the one switch core receives the total current of 16 drivers for both read and write.

Because the switch cores are in a low remanent state at the start of each read current pulse, maximum core flux is required; this is furnished by the d-c bias winding, which provides a slight average current unbalance in each switch core.

Each X-Y driver has a nominal current of one-sixteenth of the switch core magnetizing current plus 56 per cent of the half-select current; this is about 0.36 amp. With a 9 to 1 step-up ratio, the 32 single-turn windings of the switch each require less than 8 volts. The X-Y drivers terminate in a 56-ohm resistance to 30 volts plus the total resistance of the leads and switch windings.

A medium-power graded-base transistor is used in the X-Y driver circuit. The germanium transistor, packaged in an air-cooled sink, operates about 3 volts out of saturation. A Zener diode in the feedback loop determines the operating level of the output.

The Z driver circuit has the same configuration as the X-Y circuit; this is shown in Fig. 3. The Z circuit also uses the medium power transistor. Transistor specifications include a rating of 90 volts for collector-to-emitter breakdown voltage with a grounded-emitter large-signal current gain greater than 100 at 0.66 amp.

A direct drive supplies the inhibit current to the 32 × 128 segment of the core plane. The Z winding terminates in a 90-ohm resistor plus wiring resistance to a 60-volt supply. Excessive peak voltage is prevented from reaching the driver transistor by a clamping diode.

Timing for the Z driver is staggered for two reasons. First, since the Z and Y lines are parallel, charging currents are induced on the Y windings when the Z pulse turns on and off. By phasing the Z pulse timing to groups of planes, the cumulative effect of the charging currents is reduced.

Second, the write pulse propagation time through 72 planes is 220 nanoseconds. In each plane inhibit pulse timing must overlap this write pulse. However, time-stag-

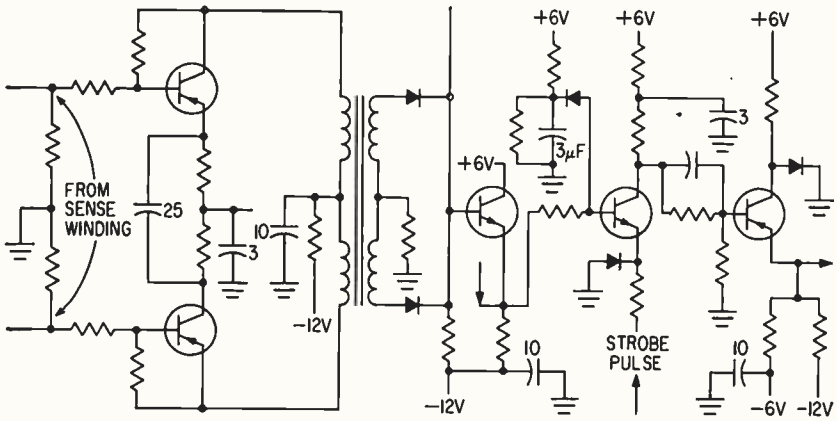


FIG. 4—Sense amplifier handles readout signals and has high gain for component frequencies in the range 300 to 800 Kc

gering the Z pulses to overlap an early write pulse in the first planes and a delayed write pulse in the last planes reduces the total memory cycle. Furthermore, the Z pulse width can be reduced, and for the next cycle, read time can start sooner into the top plane.

The delay of the Z current is about 80 nanoseconds in oil and the characteristic impedance is 90 ohms. The delay of the X and Y currents is about 200 nanoseconds with a Z_o of 100 ohms. Drive currents into the array have rise and fall times of about 100 nanoseconds.

Since the windings resemble lossless transmission lines, each must terminate in a resistance equal to its Z_o, or risk long recovery times and reflections.

The resistive load presented to the drive systems is virtually constant. Wire resistance causes some current distortion, but this is minimized by the matrix switch. As the series resistance of the line becomes effective, the current into the first plane decreases slightly. The line presents a load of 100 ohms at the beginning of the pulse; this resistance increases, however, as the wavefront propagates through the array. Therefore, the peak input current to the first plane is higher than the peak output current from the last plane. With a series resistance in each primary driver, the matrix switch allows some primary winding voltage change. This aids in matching the driver system to the array by compensating for some wire resistance.

The sense winding is segmented for three reasons. First, the common-mode Z noise on each sense amplifier for a segment is reduced to one-sixteenth the noise of a full 128 × 128 sense and Z plane.

Second, the time difference is reduced between the signals traveling in two directions from a switching core in the plane. If the time difference is too great, strobe timing must be wider, two half-amplitude signals will be sensed at different times, and cycle time increases somewhat.

Third, with the Y-axis drive intersecting only 32 cores on each segment, the winding reduces the delta noise. Part of the read-drive noise on the sense line is the noise level remaining from the first of two staggered read pulses; this pulse intersects 128 X-axis cores in each plane and runs parallel to the sense winding. The rest includes the half-select noise of the one uncancelled core of the Y-axis drive, and the delta noise caused by the current rise of the second read pulse. Because of the segmented configuration, only 15 core pairs contribute to the delta noise.

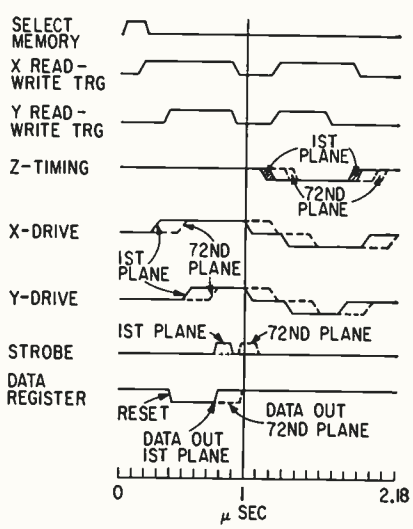


FIG. 5—Timing of control waveforms circulated in the core-storage unit

Figure 4 shows the sense amplifier circuit. Each sense segment uses four preamplifier channels. Frequency discrimination is used, and much of the relatively high frequency noise on the sense winding is blocked by the circuit cut-off frequency. In addition, the amplifier strobes and sets a clipping level for the usual amplitude and time discrimination.

Prior to strobe time, frequency discrimination of more than the bit one signal attenuates readout noise in the sense amplifier. For a band of frequencies in the 200 to 800 Kc range, the bit one has a relatively high amplitude. Because of the interstage transformer, low cut-off frequency of the preamplifier stage is about 100 Kc. High cut-off frequency is about 2 Mc.

Figure 5 shows the cycle timing for the memory. Strobe timing of the sense amplifier resembles Z timing in that both are staggered in groups of planes. As the read pulse travels through the 72-plane stack, the sense strobe timing coincides with the core peaking time for each plane.

The IBM 7302 core storage unit is six times faster than its predecessor, the IBM 738. Both storage capacity and speed in the two units is similar. However, with the increase in speed and smaller size of the 7302, the advancement of technology is significant.

The coincident current memory has proved significantly more economical than the word-oriented type. Improved ferrites, components, and design techniques are further advancing core memory technology, and there is every reason to believe in the eventual feasibility of coincident current core memories which are even larger, faster, and more economical.

REFERENCES

(1) M. H. Cook, E. H. Melan and E. C. Schuenzel, High-Speed Ferrite Core for a Coincident-Current Memory, Electronic Components Conference, May, 1959.

(2) B. R. Eichbaum, The Development of High-Speed Coincident-Current Memory Cores, Conference on Magnetism and Magnetic Materials, Nov., 1959.

(3) G. Constantine, Jr., A Load-Sharing Matrix Switch, *IBM Journal of Research and Development*, p. 204, 2, No. 3, July, 1958.

Sensitive Microwave Radiometer Detects Small Icebergs

Since icebergs and sea water do not radiate thermal microwave energy at the same rate, their differing apparent temperatures allow radiometer to detect icebergs that are invisible to radar

By T. V. SELING* and D. K. NANCE*, AC Spark Plug Div., General Motors Corp., Milwaukee, Wis.

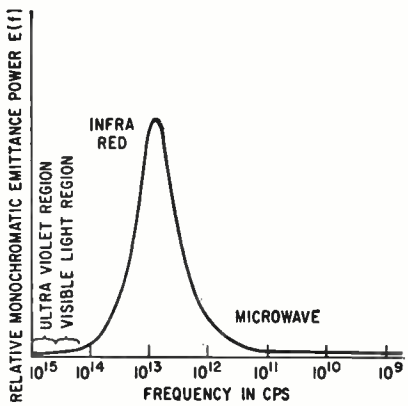


FIG. 1—Black body emittance characteristic

A NOVEL APPROACH has been tried for spotting icebergs in the North Atlantic shipping lanes. An experimental microwave radiometer has detected icebergs by using the same property that makes the icebergs difficult or impossible to detect by radar.

The U. S. Coast Guard operates the International Ice Patrol, responsible for charting the positions of icebergs and issuing warnings to ships. Coast Guard aircraft based at Argentia NAS, Newfoundland, do the patroling. In clear weather, icebergs can be spotted by eye. When the area is blanketed by fog, which is most of the time in that area, the patrol planes have to rely on radar.

Icebergs are poor radar targets because they are highly absorbent for microwaves; in radar terms, they have small backscatter cross-sections. Small icebergs, called growlers, cannot be detected at all except with carefully adjusted radars. Also, it is hard for radar to tell the difference between an iceberg and a ship.

For these reasons the Coast Guard decided to look into microwave radiometry—measurement of radiant energy in the microwave region—as an alternative to radar for locating and identifying icebergs. Initial studies were encouraging and a feasibility test was made with equipment installed in a Coast Guard patrol plane.

The concept of apparent temperature was used to predict test results. A black body, according to Planck's law, radiates energy as a function of temperature and frequency, as shown in Fig. 1, and as given by

$$E(f) = 2\pi hf^3/[c^2\,(e^{hf/kT} - 1)]$$

where $E(f)$ is spectral emittance in watts/m²/cps, f is frequency in cps, h is Planck's constant (6.62×10^{-34} joule sec), c is the velocity of light (3×10^8 m/sec), k is Boltzman's constant (1.38×10^{-23} joule/deg K), and T is absolute temperature in degrees K.

In the microwave region the exponential term can be replaced by a series expansion, resulting in the Rayleigh-Jeans Law, which states

$$E(f) = 2\pi kTf^2/c^2$$

The Rayleigh-Jeans law can be used throughout the entire microwave spectrum and well into the infrared region without significant error.

It can be shown generally that any antenna has an average gain inversely proportional to the square of the frequency. The net combination of the square-law frequency

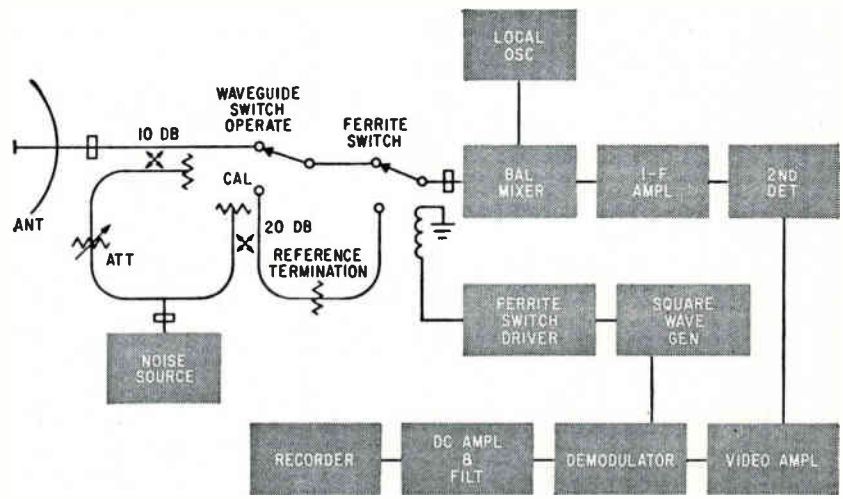


FIG. 2—Noise generator provides a reference signal corresponding to temperature of about 20 C, and also provides signal that keeps system output zero except when target is present

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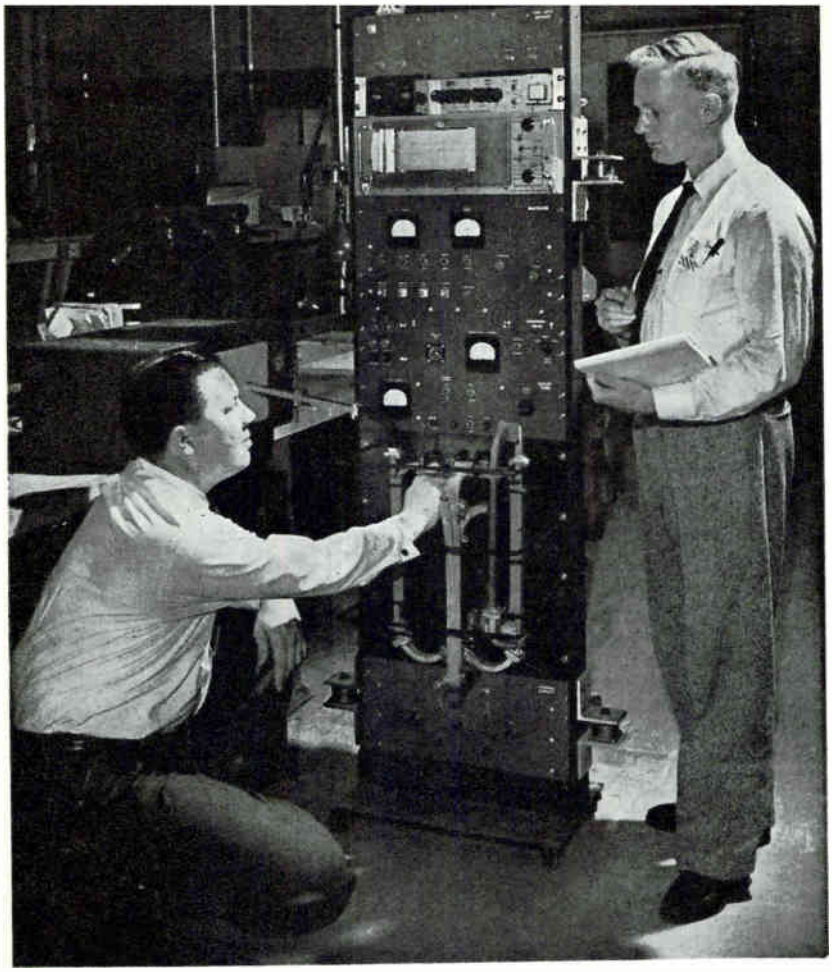

Authors are calibrating the radiometer with dummy antenna at —18 C

dependency of the thermal radiation and the inverse square law of frequency dependence of antennas makes the thermal radiation received by a microwave antenna independent of frequency. Thus, the received thermal radiation is proportional only to the temperature of the target and the bandwidth of the receiving system. That is, $P = kBT$, where P is the received thermal power in watts, B is the bandwidth of the receiver and k and T are as previously defined.

Most objects are not "black" in the microwave region but radiate with an efficiency ϵ, the emissivity. A simple thermodynamic argument shows that the emissivity of any object is equal to its absorptivity, α, and also equal to one minus its reflectivity, ρ:

$$\epsilon = \alpha = 1 - \rho$$

The *apparent temperature* of an object is the temperature that a black body ($\epsilon = 1$) would have to be at to radiate the same amount of power. The sky appears cold at microwave frequencies, about —250 C in the 3-cm band. In the same frequency range the sea, with an emissivity of 0.35 and a reflectivity of 0.65, has an apparent temperature of —150 C. But icebergs, with emissivity and absorptivity of about 0.9, have an apparent temperature of —50 C, or 100 C hotter than the sea. Thus the high absorptivity of ice makes it a good target for a radiometer but a bad one for radar.

Emissivities were computed from the dielectric constants and conductivities of ice and sea water. Icebergs proved to have somewhat smaller emissivities, probably because they were covered with a thin film of water.

A radiometer antenna will indicate an antenna temperature equal to the weighted average of the temperatures of everything in its field of view. The idea of antenna temperature can best be explained in terms of the received thermal power. The total available noise power (Johnson Noise) from a resistor terminating a transmission line is given by $P = kBT$. Therefore the antenna can be considered a termination of the receiving transmission line that is at a temperature equal to the weighted average of the temperature of everything within its field of view.

If a small iceberg fills only part of the field, the rise in antenna temperature will be less than the apparent temperature difference between the sea and the iceberg. For the feasibility test, the standard iceberg was chosen to be a growler 40 feet across. Icebergs much smaller than this are generally not considered dangerous to shipping. The system used in the feasibility test was an X-band (9,000 Mc) radiometer using a two-foot parabolic antenna with a beamwidth of four degrees. At an altitude of 1,000 feet, the change in antenna temperature was predicted to be approximately 30 C for a 40-foot growler.

The experimental system was a comparison radiometer. The system block diagram is shown in Fig. 2. Following the antenna are the microwave circuits for calibration and noise balancing. Calibration is done by switching the input between the two ends of a double-ended termination. This termination is used to insure that in the calibrate mode, the system output is zero. This corresponds to a target at ambient temperature. After the system zero is established, a test signal from an argon-tube noise source is injected into the reference termination through a 20-db precision multihole directional coupler. This provides a test signal equal to an apparent temperature of approximately 50 C. The noise source is divided by a waveguide tee so that the equivalent reduction in the temperature of the noise tube is 23 db.

In operation, the ferrite switch connects the receiver alternately to the antenna and reference termination. With the antenna pointed at the water, the antenna temperature is approximately —150 C, while the reference temperature is approximately 20 C. To minimize the effects of receiver gain variations, a small amount of noise is injected in the antenna transmission line through a directional coupler to make the apparent antenna temperature equal to the reference temperature. The system's output is always zero except when a target is present, and the variations in the receiver gain do not produce

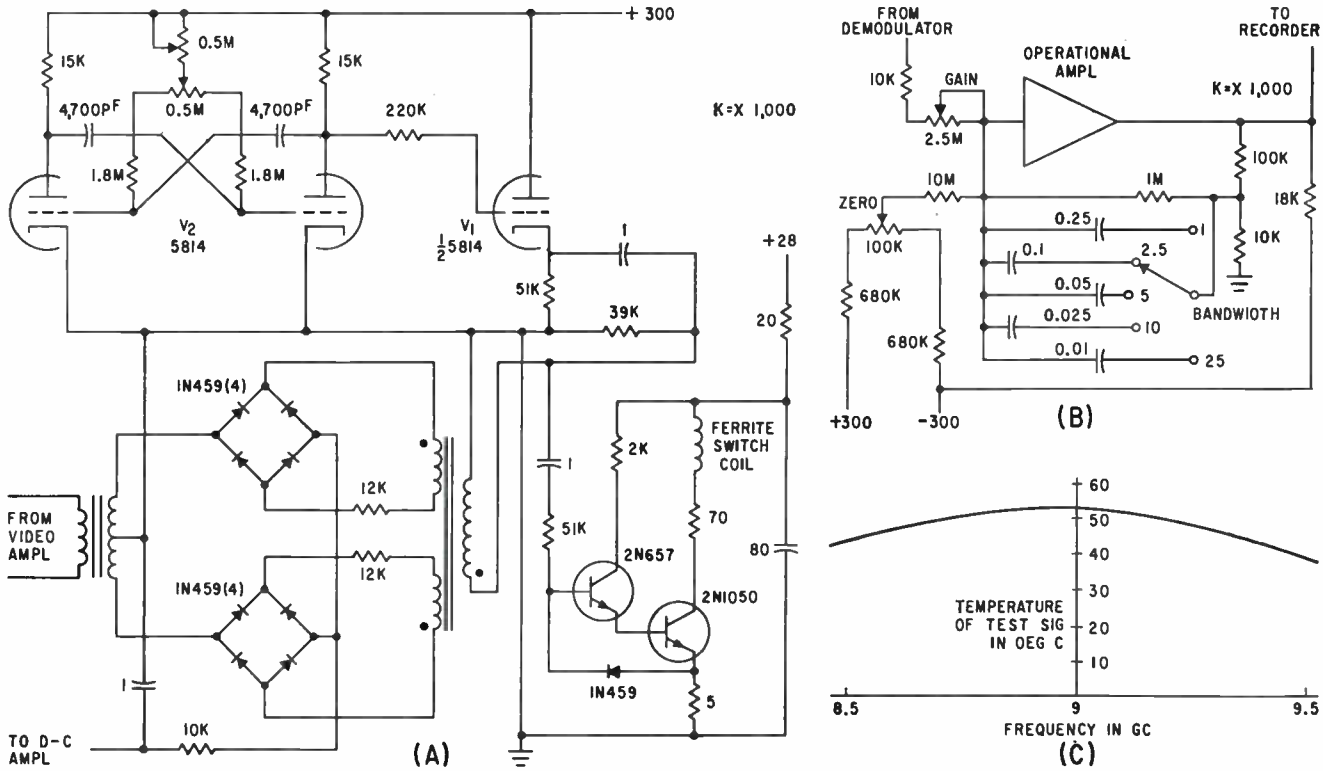

FIG. 3—Demodulator and ferrite-switch driver (A); amplifier-filter (B); frequency sensitivity of test signal (C)

false targets or increased noise.

The ferrite switch is a Faraday rotational type driven at 125 cps. The square-wave-modulated noise signal is amplified by a modified X-band radar receiver. The balanced mixer uses matched 1N23C diodes. Receiver bandwidth is 5 Mc and the noise figure is 8.5 db (double sideband). Following the second detector is the video amplifier which amplifies the detected square wave. At this point the amplitude of the square wave is proportional to the difference between reference temperature and antenna temperature. With noise balancing, this difference is zero when no target is present. The amplified square wave is detected by a phase-sensitive demodulator, which produces a d-c voltage proportional to the change in antenna temperature and the polarity of the signal: positive for warm signals, negative for cold. This d-c output is amplified and filtered with a d-c operational amplifier. The d-c amplifier is used to drive a Brush recorder.

The 125-cps timing square wave is generated by a free-running multivibrator. The multivibrator output supplies the reference voltage for the phase-sensitive demodulator and the drive signal for the ferrite switch driver. The ferrite switch driver is a two-stage transistor current amplifier used as a single-ended switch to control the coil current of the ferrite switch. A small bar magnet is used to bias the ferrite switch so that a single-ended driver can be used. The schematic of the demodulator and ferrite-switch driver is shown in Fig. 3A.

Demodulator output is amplified and filtered by a Philbrick UPA-2 operational amplifier. This stage provides a gain control, low-pass filter with variable cutoff frequency, and zero adjust for the pen recorder that is driven directly by the amplifier. The schematic of the amplifier-filter is shown in Fig. 3B. The 18,000-ohm resistor from the amplifier output to the −300 volt supply is used to shift the operating point of the amplifier stage to provide equal response to signals of both polarities. This is necessary to compensate for the loading of the pen recorder. The bandwidth of the amplifier is calibrated directly in equivalent noise bandwidth.

Output fluctuations due to receiver noise had an rms value of 4 C referred to receiver input, with output bandwidth of 2.5 cps.

Environmental tests were made on the radiometer system to ensure that humidity, cold storage, and vibration did not affect the system performance.

Final calibration of the system was made by checking the standard test signal from the argon noise tube against a cold load. A dummy antenna was placed in a temperature chamber and allowed to stabilize at −18 C.

By using the cold load and measuring temperature of the reference

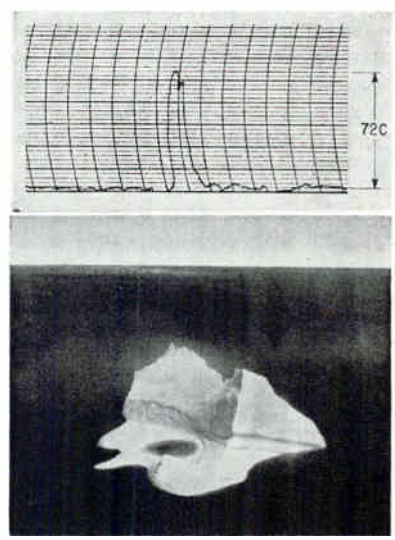

FIG. 4—Iceberg with puddle of water makes its own distinctive trace

termination, absolute calibration of the radiometer was made. A cold load was used rather than a hot load to simulate more closely the expected signals and to minimize the effect of detector nonlinearities. Figure 3C is a plot of the value of the standard test signal against frequency. Frequency sensitivity is due to variations in the waveguide components.

The radiometer was mounted on a relay rack and suspended by rubber shock mounts in a frame bolted to the aircraft. In one of the photographs the equipment is shown being calibrated by the authors. The waveguide at the left led down to the antenna, a two-foot paraboloid with Cutler feed, bolted to the airframe and pointing straight down. An aluminum box with a honeycomb plastic bottom was riveted to the skin of the aircraft as a radome.

The installation was made and checked out in flight in less than two days. The fixed antenna required only a small hole in the aircraft and no structural modification. Targets were detected by flying directly over them, with either radar guidance or by eye. A system for operational use would need a scanning antenna.

A short flight near Milwaukee showed that the equipment was operating properly. The shore of Lake Michigan made a convenient target, since the apparent temperature of the beach was about 20 C, and that of the water about −150 C.

The aircraft was flown to Argentia Naval Air Station, Newfoundland, headquarters of the International Ice Patrol. A series of flights was made over icebergs and ice fields. Icebergs of different sizes and shapes showed a striking uniformity in apparent temperature, 60 to 70 degrees C warmer than the sea. This was less than the 100 degree difference predicted from theory, probably because of a thin water film on the ice.

Figures 4 and 5 show results. The puddle visible on the iceberg of Fig. 4 shows as a dip on the radiometer recording. Figures 5A and 5B show recordings of a large iceberg. The first was made from 500 feet, just under a thick cloud layer; the other, from 2,400 feet, just above the clouds, showing that the effect of cloud cover on detectability is slight. The sharp pip of Fig. 5C is the recording of a growler about the size of an automobile, seen from 500 ft. This growler could not be seen on radar.

A series of flights was made over various types of ships. Metal ships had been expected to appear colder than the sea, since the emissivity of metal is almost zero. However, the apparent temperatures of ships ranged all the way from 50 degrees below sea temperature to 80 degrees above. Ships are made of many different materials topside, and metal ships are often largely nonmetallic when seen from straight overhead. Figure 5D shows the recording of a freighter that looked hot at one end and cold at the other. Thus, ships could be told from icebergs by scanning with a narrow beam.

The experiment showed that icebergs make good targets for a radiometer, even when they are not visible to radar, and that ships have a signature on a radiometer that they do not have with radar (both positive and negative outputs).

Besides iceberg detection, experiments with several other applications of microwave radiometry have been made in surveillance, detection and navigation.

A surveillance radiometer operating at K_a band (35,000 Mc) was built to evaluate the capabilities of high-performance rapid-scan radiometers. Figure 5D is a radiograph made with this radiometer and Fig. 5E is a photograph of the same area. Although this radiograph was made in 175 seconds, equal quality has been achieved in about 30 seconds. A great deal of detail can be seen in the radiograph: the supporting legs and central discharge pipe of the water tower; a telephone pole and its crossarm; the overhead lamp on the building at the right.

Reflections are important in interpreting microwave radiographs. Two men near the center of the picture are not detectable, since their apparent temperatures are near that of the background. Their reflections in the comparatively cold concrete walk, however, are visible.

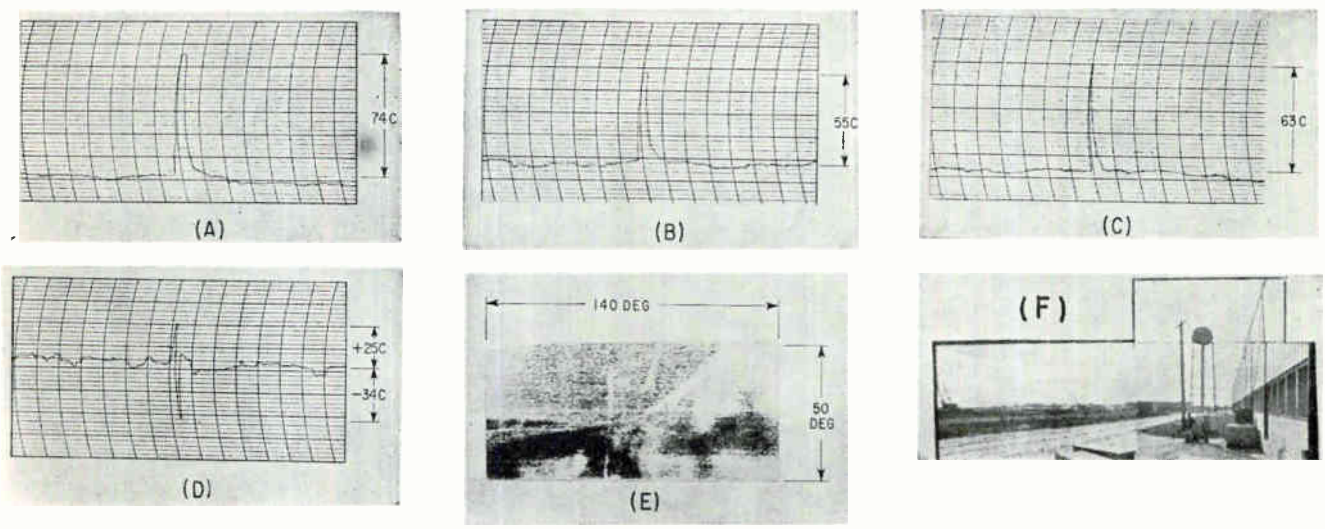

FIG. 5—Iceberg from 500 feet altitude just below a cloudbank (A), and same iceberg from 2,400 feet (B) above cloudbank: little difference is noticed. Growler signature from 500 feet (C). Positive and negative signature of a freighter (D). Radiograph (E) and photograph (F) of same scene

Monostable Pulse Generator

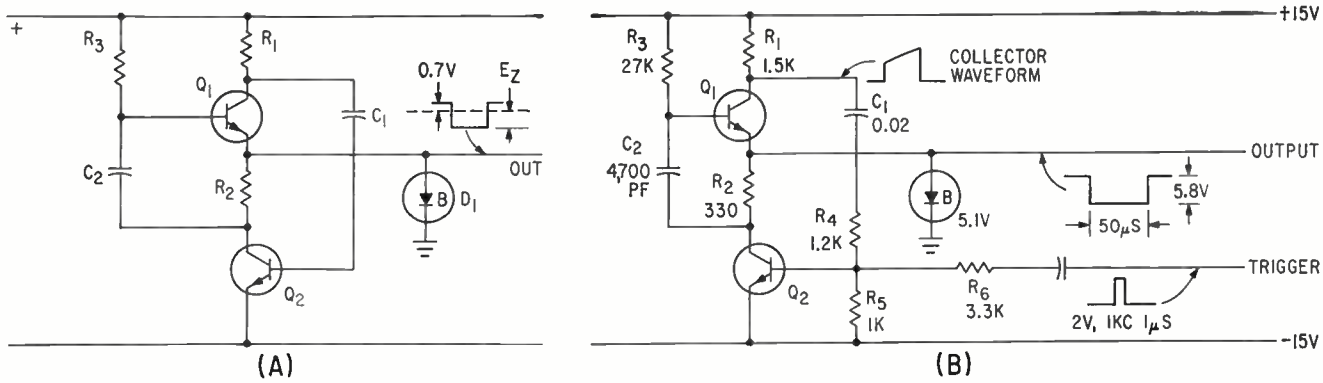

FIG. 1—Basic circuit (A) is adapted for use with positive trigger as shown by (B)

By C. M. STEWART,
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THERE IS A FREQUENT need for simple circuits that produce pulses of known length and amplitude when triggered by an external pulse. This circuit is useful in many applications.

The pulse generator circuit is shown in Fig. 1A. Initially transistor Q_1 is bottomed, drawing base current through R_3. Base current to Q_2 is blocked by C_1, therefore this transistor is cut-off and current flows from the positive supply through R_1, Q_1 and the Zener diode D_1 only. The Zener diode is connected so that the current is flowing from anode to cathode and the voltage drop across it is only 0.7 v. Voltage at the output terminal is 0.7 v above ground.

When the circuit is triggered, transistor Q_1 starts to turn off, and the voltage on its collector attempts to rise. Capacitor C_1 begins to charge through R_1 and the base-emitter junction of Q_2. The base current flowing into Q_2 turns Q_2 on and its collector voltage falls towards the negative supply. The voltage across C_2 was initially nearly zero and it cannot change instantaneously, therefore the fall in voltage on the collector of Q_2 is transmitted to the base of Q_1 speeding the turn off of this transistor. Action is regenerative with Q_1 turning off and Q_2 turning on.

Current through the Zener diode reverses as Q_2 turns on and Q_1 turns off. Voltage at the emitter of Q_1 will therefore fall towards the negative supply until it is caught below ground at the Zener voltage of the diode. The base of Q_1 will, however, be pulled down almost to the value of the negative supply by the bottoming of Q_2. Thereafter C_2 will begin to charge through R_3 towards the positive supply. Transistor Q_1 will remain off until the voltage on its base has risen above the value at which its emitter is clamped by the Zener diode. Transistor Q_1 will then turn on, reversing the flow of current into C_2 and the base of Q_2. Now, Q_2 will turn off, the action being regenerative until the original state is restored.

The pulse produced by this circuit has good rise and fall times because in each case the output voltage is charging towards one of the supplys and is caught by the Zener diode at a voltage less than the supply voltages. This is useful, particularly when the load has some capacitance. Output impedance during the length of the pulse is fixed by the dynamic impedance of the Zener diode and is of the order of 5 to 30 ohms. Output impedance

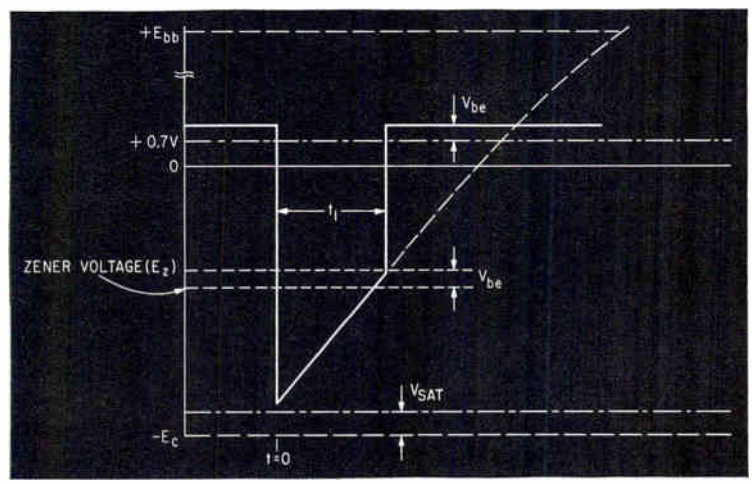


FIG. 2—Voltage waveform across C_2 is basis for determining expression for t_1

Employs Zener-Diode Clamp

during the rise time is fixed by R_2.

Figure 1B shows a circuit with some additional components. This circuit is triggered by a positive pulse and since, initially, Q_1 is bottomed, R_4 is required to prevent the pulse being decoupled to ground through C_1 and Q_1. Resistor R_5 provides a path for the current discharging capacitor C_1. Series connected resistor R_6 limits the current drawn from the triggering source. Value of this resistor depends on the trigger pulse voltage.

A diode may be necessary in series with the base of Q_1 if the maximum base-emitter voltage of the transistor is otherwise exceeded.

The circuit designer must know the length of pulse required; amplitude of pulse; and maximum current required from the pulse.

The amplitude of the pulses fixes the voltage of the Zener diode and this must be less than the voltage of the negative supply.

Maximum value of R_2 is determined by the maximum current required from the pulse. Most of the current through this resistor also flows in the load, but sufficient excess current must be allowed to flow through the Zener diode to enable it to stabilize.

Value of R_1 is fixed either by the permissible standing current of the circuit or the fall time required on the output pulse, particularly if the load has some capacitance.

Figure 2 shows the waveform on C_2. Here

$$t_1 = R_3 C_2 \log_e \frac{E_{bb} + E_c - V_{sat}}{E_{bb} + E_z - V_{be}}$$

Voltages V_{sat} and V_{be} are normally small compared with E_c and E_{bb}, hence to a close approximation

$$t_1 = R_3 C_2 \log_e \frac{E_{bb} + E_c}{E_{bb} + E_z}$$

where only the magnitude of E_c and not the sign is considered.

The maximum value of R_3 is that which provides just enough base current to Q_1 to bottom it in the initial state.

The time constant of $R_1 + R_4$ and C_1 must be long enough to hold Q_2 bottomed for a time exceeding the length of the output pulse so that this part of the circuit takes no part in the timing.

If the exact value of the external load is known, the Zener diode is not essential and the circuit can be modified as shown in Fig. 3A, but the output pulse will not be rectangular as the turn-on point of Q_1 is not so clearly defined.

If a voltage supply with a value less than that of E_c is available, diode catching can be used to eliminate the Zener diode as shown in Fig. 3B.

An extremely useful feature of this pulse generator is that it can also be triggered by a negative pulse as shown in Fig. 3C. Note that resistor R_4 is no longer required.

When R_4 is connected into the circuit, a positive pulse equal in length to the output pulse appears at the collector of Q_1 and this may be used externally provided the loading does not upset circuit operation.

This pulse generator circuit is intended for output pulses of from 2μs duration up to seconds. Leakage resistance of timing capacitor C_2 should always be much greater than resistor R_3 (Fig. 1A and 1B).

No special transistor type numbers are shown in the diagrams as a wide variety of types both *pnp* and *npn* have been used with equal success. The *pnp* types will give a circuit with positive output pulses.

Mark to space ratios of greater than 1 are easily obtainable.

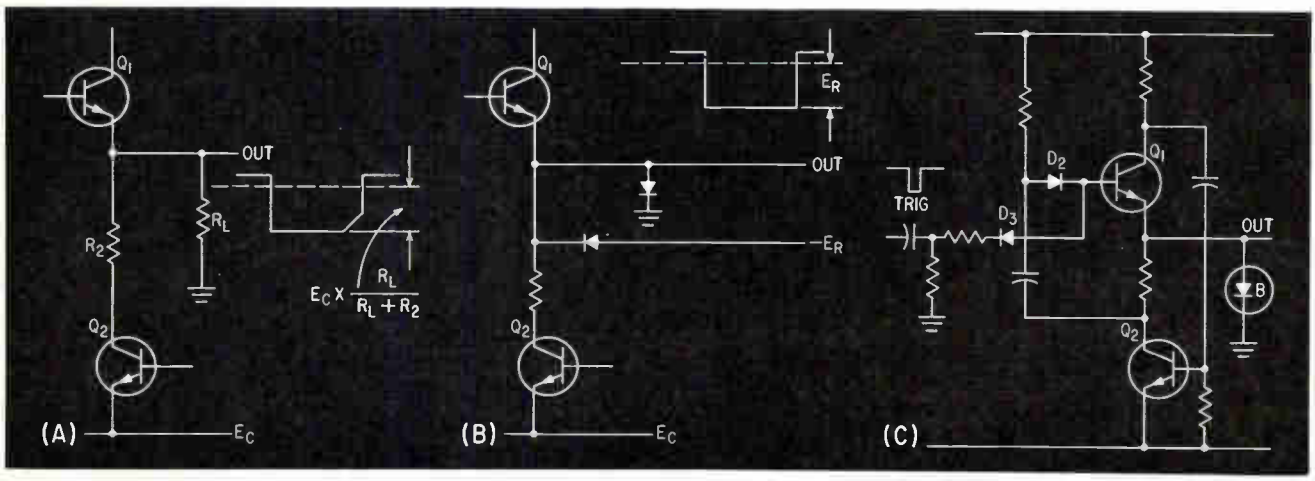
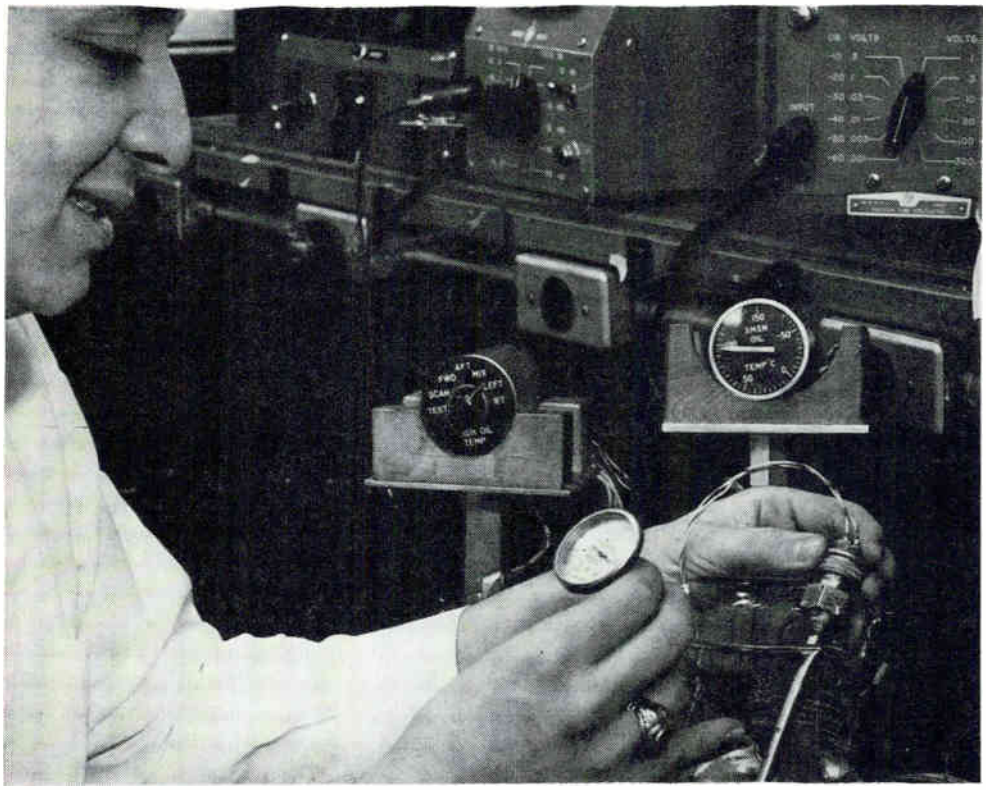


FIG. 3—Methods of eliminating the Zener diode are shown in (A) and (B). Circuit for triggering with negative pulse is given in (C)

Solid-State Parallel-Mode Scanner



Engineer checks oil temperature reading from scanner system, against direct reading from thermometer

Monitor system handles parameters that can be converted to a change of electrical resistance. A diode array checks the maximum or minimum values of input signal; by replacing the diodes with transistors, source of signal being displayed can easily be identified

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COMPLEXITY of modern instrumentation has increased the number and cost of indicators needed for showing the state of equipment within a system, and indicating whether the equipment is working properly. Scanning techniques using mechanical steppers are used for monitoring temperature, pressure, resistance and other variables on a serial or step-by-step basis; however, such systems are relatively slow in operation and are subject to mechanical wear and breakdown. This article describes a solid-state monitoring system that checks a range of variables in a parallel (rather than serial) mode and reports when any one of the measured parameters exceeds (or falls below) a predetermined limit.

The parameter to be measured may be of any physical or electrical variable that can be expressed as a change of resistance. Some of physical quantities for which transducers exist are temperature, pressure, gas density, resistance, vibration, light intensity, displacement (linear or rotation), level (conductive liquids), acceleration and strain gages (high level). Developments in transducer engineering are certain to expand this list.

An early use of one monitor to observe several different inputs consisted of an indicator and its manually operated selector switch. This led to a single indicator with memory capability (peak reading VTVM's) and a stepping switch. Recent developments include solid-state switching techniques to increase the reliability and speed of mechanical systems. However, the basic sequential nature of such systems leads to defects and in some circumstances it is possible for a failure to occur before the stepper has had time to report a fault condition.

The use of computer type OR and AND circuits for minimum and maximum selection is cited in the literature.[1] A typical circuit is shown in Fig. 1, for which the output voltage E_o will be approximately equal to the lowest of the input voltages. The output voltage E_o will actually exceed the minimum input voltage by the magnitude of the d-c drop across the diode. At low transducer outputs, the drop across the conducting diode is signicant and it becomes necessary to employ a compensating diode D_4 as shown in Fig. 1. The compensation circuit shown in Fig.

Reads System Physical Parameters

1 results in similar bias currents through both conducting and compensating diodes for the entire range of input signals when used with a servo indicator. This circuit yields an error due to discrepencies in diode characteristics. If a nonrebalancing indicator is used (a vtvm is a typical example) then it becomes difficult to maintain similar currents through the conducting and compensating diodes. This will result in an additional scale error of small magnitude.

The demands of military and industrial instrumentation almost preclude the use of germanium diodes for these circuits. A typical silicon diode will exhibit a d-c drop of 0.2 to 0.7 volt over a wide range of ambient temperature (−65 C to +100 C). In most accurate instrumentation systems this 0.5-volt variation cannot be neglected and some technique must be used to compensate for the error. In addition, analytical investigation reveals a range of about 0.1 volt in which two diodes are partially conducting. Within this region of multiple diode conduction, the output voltage is a complex function of input voltages and diode characteristics. The output voltage is, however, bounded by the two active input voltages and is always between these narrow limits.

The circuit of Fig. 1 selects the algebraic minimum of the input voltages. Thus, a polarity reversal of the transducer supply voltage gives a circuit whose output is equal to the maximum input voltage. Other configurations of supply voltage are also possible and yield circuits with similar appearance and properties.

Figure 1 circuit offers a method of achieving adequate scanning performance with an economical and reliable system. It does, however, contain some inherent features that result in performance disadvantages. Since it is a pure d-c system, it requires d-c indicators. While the output levels are fairly high, use of chopper stabilized direct-current vtvm's or d-c servos increases system cost. This system is also unable to identify the source of signal that it displays.

The system to be described retains the best features of Fig. 1, while offering improvements in performance and reductions in circuit complexity. The circuit of Fig. 2 uses an OR circuit in an a-c—d-c configuration to achieve its objective. The circuit uses a servo indicator, but similar operating characteristics may be obtained with vtvm indicators. The a-c and d-c voltages are in tandem across the transducer potentiometers. The magnitude of a-c or d-c voltage at the wiper reveals the amplitude of the physical parameter being sensed. The d-c voltage opens or closes a diode. The a-c signal voltage is thus transmitted with no loss in amplitude. Once the signals have passed through the conducting diode, it is easy to block the d-c with a coupling capacitor and measure the a-c output voltage with an a-c indicator. Under the common conditions of one diode conducting and the remaining diodes off, the d-c drop across the diode becomes unimportant. In addition, since the a-c resistance of the diode is negligible with respect to the input impedance of the amplifier (at null), the a-c drop may be neglected. Only when there are two or more inputs in close electrical proximity (within 0.10 volt d-c) does the dissimilarity between diodes have any effect. Under this condition, the output of the indicator will read somewhere between the two similar inputs. This region occupies such a narrow band that it may usually be neglected. A fur-

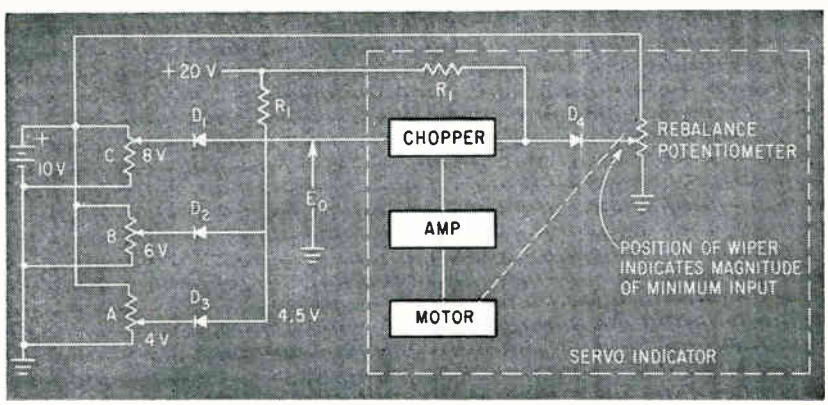

FIG. 1—In this basic three-diode monitor system, readout is obtained from the potentiometer with lowest output voltage

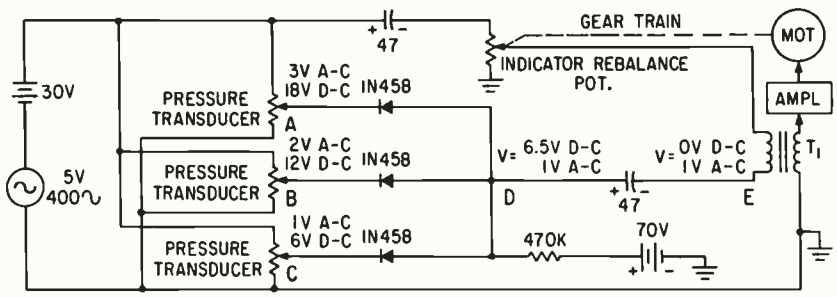

FIG. 2—Superimposing an a-c signal on the d-c control voltage overcomes variable diode conduction and permits an a-c servo to be used

ther advantage of this system is its immunity to change in diode bias current caused by variations in input or power supply levels.

Figure 1 uses potentiometer transducers (pressure vibration or acceleration). The same system may be constructed using resistive transducers (temperature and light intensity). This is done by driving each resistive transducer from a source of constant current a-c + constant current d-c. An example is shown in Fig. 3. The voltages across the resistive transducers may be operated upon as were the output voltages of the potentiometers. This method of using a constant voltage source in series with a resistor does not produce a true constant current, and the error produces a slightly nonlinear dial; however, the nonlinearity is small and is usually not obvious to the eye. The system of Fig. 2 can make a source identification scheme by substitution of transistors for diodes as shown in Fig. 4. Figure 4 is connected to transmit the highest signal and display this signal upon the common indicator. Investigation of the bias conditions with the assumed inputs reveals that the highest d-c voltage is transmitted through to the common emitter point *A*. If point *A* were to have the d-c potential associated with any input other than *B*, heavy base current would be drawn through the transistor associated with inputs *C* or *D*. This base current would draw additional current through R_1 and bring the potential of point *A* up to that of the highest input. This type of indirect reasoning can preclude any but the highest input being transmitted through to the output at point *A*. The component values may be designed to have sufficient collector current through the one conducting transistor to operate one of the source identifying devices (*E*, *F*, *G*). As before, reversal of certain bias voltages results in a system that can transmit, display and identify the lowest null.

The a-c voltage output at point *A* is the active input multiplied by the a-c gain of an emitter follower. This gain can be stabilized at 0.9985 ±0.0010, where it represents a variation in gain of 0.1 percent over a wide range of ambient temperature. The collector current of the active transistor may be designed to be in the 1 to 5-ma range. There are many ways of revealing the active transistor by visual or audible means, as Fig. 4 shows.

Transistors improve certain aspects of system performance. The selecting mode (common point of all emitters) is now fed from source impedances that are lower by the h_{fe} of the active transistor. This produces sharper transition areas and generally superior performance. The circuit selects and indicates the lowest pressure within 0.5 percent at room temperature. An additional error allowance of 0.5 percent is necessary to cover a temperature range of −55 C to +71 C. The complete system includes a manually operated selector switch that overrides the scan circuit and displays oil pressure at any particular point. This complete system (including power supplies for the transducers) was packaged in two 2 inch diameter cans of 3.5 inch length. Total system weight (exclusive of transducers) is 18 ounces. It is believed that each can length could be reduced by 0.5 to 1 inch.

Requirements for source identification increase system size and weight: it is estimated that a system with source identification and a manual selector switch could be packaged in two 2 inch diameter cans of 5 inch length.

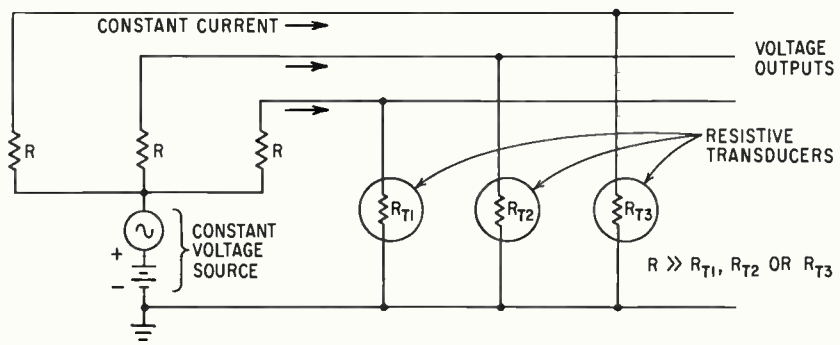

FIG. 3—When using resistive transducers, rather than potentiometer transducers, a constant current supply enables the output voltage to be directly proportional to transducer resistance

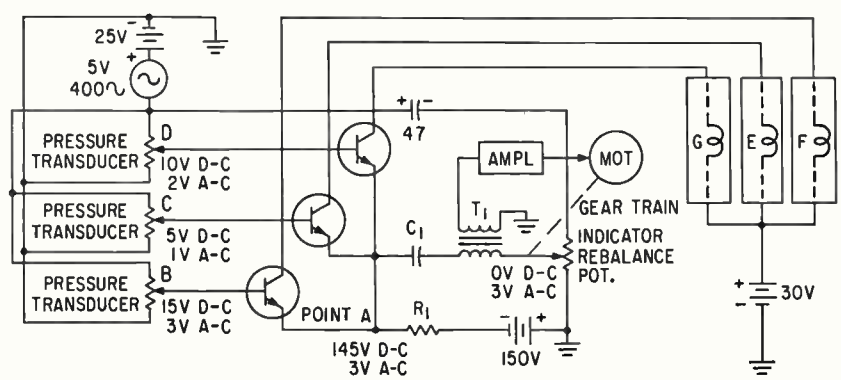

FIG. 4—Transistors in the monitor circuit, instead of diodes, operate an indicating device to show which transducer output is being displayed

REFERENCES

(1) Rose, Patent 2,783,453.
(2) D. M. Considine, Process Instruments and Control, Sec. 8, 34.

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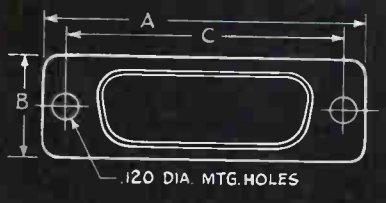

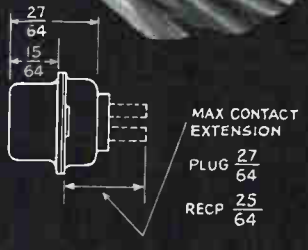

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15	DASM—15P	DASM—15S	1 17/32	31/64	1.312
25	DBSM—25P	DBSM—25S	2 5/64	31/64	1.852
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TRANSFORMING
Resistance-Capacitance and Resistance-Inductance Networks

These charts for canonic-one-terminal-pair R-C and R-L circuits eliminate tedious calculations in design problems involving network transformations

By H. J. BLINCHIKOFF,
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Westinghouse Electric Corp.,
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FILTERS designed with low-Q elements, preemphasis and deemphasis networks, phase and amplitude equalizers, and networks synthesized from prescribed functions all contain combinations of inductors, capacitors and resistors. Sometimes, because element values are impractical or because the quality factor (Q) of the reactance is impossible to obtain in a reasonable size, it is desirable to change the configuration of a network.

This article deals with the transformation of canonic one-terminal-pair R-C and R-L circuits. A canonic network is one that realizes a particular impedance function with the minimum number of elements. The equations transforming one network to another may be obtained in two ways. The first method is to set the impedance of one circuit equal to the impedance of the other. Equating the coefficients of the frequency terms yields simultaneous equations that must be solved for the transformation equations. The second method consists of synthesizing the impedance function into networks of Foster forms, Cauer forms or combinations of both. The charts here minimize the tediousness of making such network transformations.

Figures 1 through 14 show all possible transformations of three and four-element canonic R-C networks. Below each figure are the equations for performing the transformation. Equations for five or more elements are not given because of their infrequent use. However, they can be found by either of the two methods.

SYMBOL KEY

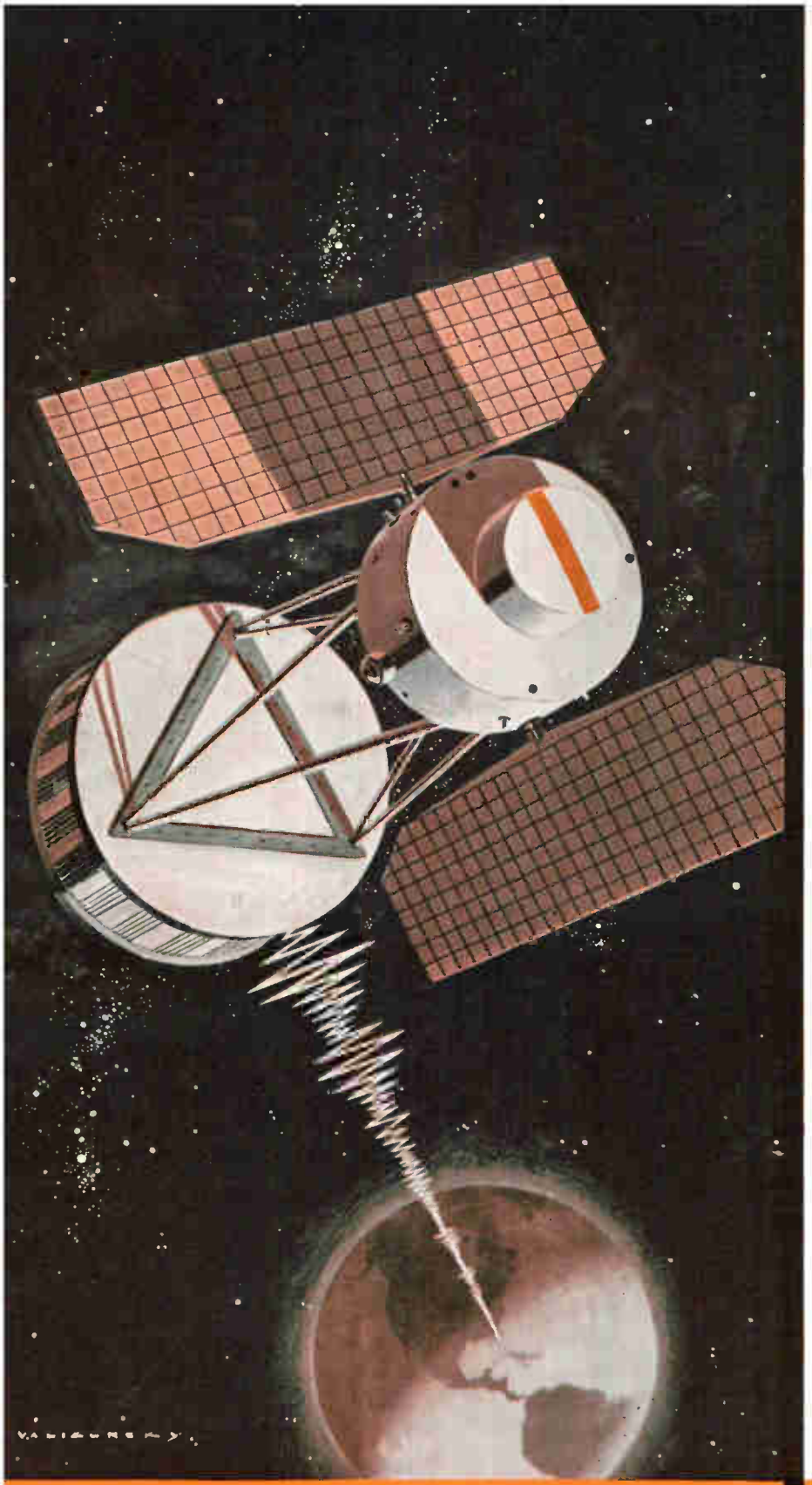
The equations describing the element values of some of the networks have been simplified in the charts by substitution of symbols for more complicated relationships. These symbols represent the following expressions.

(1) Coefficients A, B, D, and E represent combinations of R and C. They can be determined from the applicable equations on the chart.

(2) $W = A(A - P^2)/P(AD - PE)$
$X = (A - P^2)/(E - PD)$
$Y = (AD - PE)/(A - P^2)$
$Z = P(E - PD)/(A - P^2)$
where $P = (B + \sqrt{B^2 - 4A})/2$

Separating the input impedance for R-C networks $Z(j\omega)$ into its real and imaginary parts, $Z(j\omega) = Re\ Z(j\omega) + Im\ Z(j\omega) = R(\omega) + jX(\omega)$, shows that the real part of an R-C impedance is a monotonically decreasing function of frequency. It has its maximum value at zero frequency and its minimum value at infinite frequency. The imaginary part of an R-C impedance is never positive from $\omega = 0$ to $\omega = \infty$: at zero frequency, it may be zero or (negatively) infinite; at infinite frequency, its value is always zero.

Chart I shows the s-plane pole-zero distributions of the impedance for the various networks in Fig. 1 through 14. Properties of R-C impedance function are: poles and zeros are simple and are restricted to the negative real axis of the s-plane (σ axis); poles and zeros alternate; the lowest critical frequency is a pole which may be at $s = 0$; the highest critical frequency is a zero which may be at infinity;



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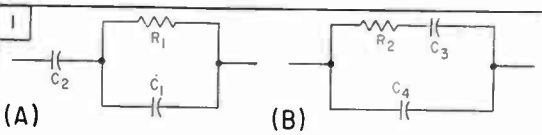
P-Z CHARACTERISTIC I

1



(A)

$$R_1 = R_2\left(\frac{C_3}{C_3+C_4}\right)^2$$

$$C_1 = C_4\ (C_3+C_4)/C_3$$

$$C_2 = C_3 + C_4$$

(B)

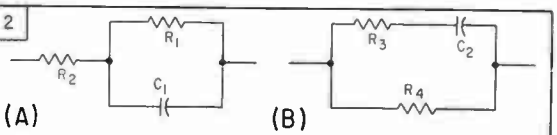
$$R_2 = R_1\left(\frac{C_1+C_2}{C_2}\right)^2$$

$$C_3 = C_2^2/(C_1+C_2)$$

$$C_4 = C_1C_2/(C_1+C_2)$$

P-Z CHARACTERISTIC II

2



(A)

$$R_1 = R_4^2/(R_3+R_4)$$

$$R_2 = R_3R_4/(R_3+R_4)$$

$$C_1 = C_2\left(\frac{R_3+R_4}{R_4}\right)^2$$

(B)

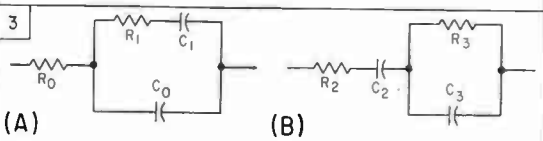
$$R_3 = R_2\ (R_1+R_2)/R_1$$

$$R_4 = R_1 + R_2$$

$$C_2 = C_1\left(\frac{R_1}{R_1+R_2}\right)^2$$

P-Z CHARACTERISTIC III

3



(A)

$$R_0 = R_2$$

$$C_0 = C_2C_3/(C_2+C_3)$$

$$R_1 = R_3\left(\frac{C_2+C_3}{C_2}\right)^2$$

$$C_1 = C_2^2/(C_2+C_3)$$

(B)

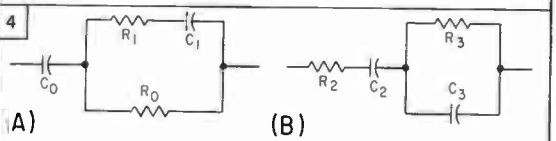
$$R_2 = R_0$$

$$C_2 = C_1 + C_0$$

$$R_3 = R_1\left(\frac{C_1}{C_1+C_0}\right)^2$$

$$C_3 = C_0\ (C_1+C_0)/C_1$$

4



(A)

$$R_0 = R_2 + R_3$$

$$R_1 = R_2\left(\frac{R_2+R_3}{R_3}\right)$$

$$C_0 = C_2$$

$$C_1 = C_3\left[\frac{R_3}{(R_2+R_3)}\right]^2$$

(B)

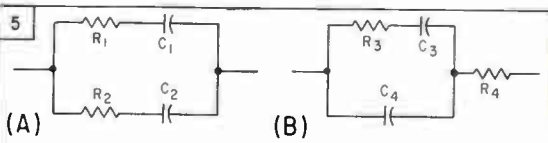
$$R_2 = R_1R_0/(R_1+R_0)$$

$$R_3 = \frac{(R_0)^2}{R_1+R_0}$$

$$C_2 = C_0$$

$$C_3 = C_1\left(\frac{R_1+R_0}{R_0}\right)^2$$

5



(A)

$R_1 = W \qquad R_2 = X$

$C_1 = Y \qquad C_2 = Z$

$$A = R_4R_3C_4C_3$$

$$B = R_4C_4 + R_3C_3 + R_4C_3$$

$$E = R_4C_4C_3$$

$$D = C_4 + C_3$$

(B)

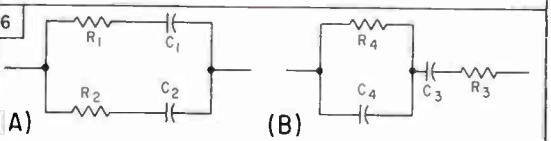
$$R_4 = R_1R_2/(R_1+R_2)$$

$$R_3 = \frac{(R_1^2C_1+R_2^2C_2)^2}{(R_1+R_2)(R_1C_1-R_2C_2)^2}$$

$$C_4 = \frac{C_1C_2(R_1+R_2)^2}{R_1^2C_1+R_2^2C_2}$$

$$C_3 = \frac{(R_1C_1-R_2C_2)^2}{R_1^2C_1+R_2^2C_2}$$

6



(A)

$R_1 = W \qquad R_2 = X$

$C_1 = Y \qquad C_2 = Z$

$$A = R_3R_4C_3C_4$$

$$B = R_3C_3 + R_4C_4 + R_4C_3$$

$$E = R_4C_3C_4$$

$$D = C_3$$

(B)

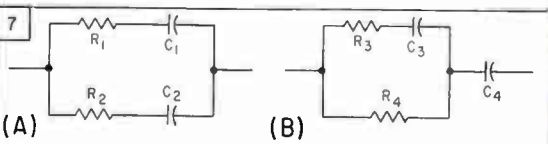
$$R_4 = \frac{(R_1C_1-R_2C_2)^2}{(R_1+R_2)(C_1+C_2)^2}$$

$$R_3 = R_1R_2/(R_1+R_2)$$

$$C_4 = \frac{C_1C_2(C_1+C_2)(R_1+R_2)^2}{(R_1C_1-R_2C_2)^2}$$

$$C_3 = C_1 + C_2$$

7



(A)

$R_1 = W \qquad R_2 = X$

$C_1 = Y \qquad C_2 = Z$

$$A = R_3R_4C_3C_4$$

$$B = R_3C_3 + R_4C_4 + R_4C_3$$

$$E = C_3C_4(R_3+R_4)$$

$$D = C_4$$

(B)

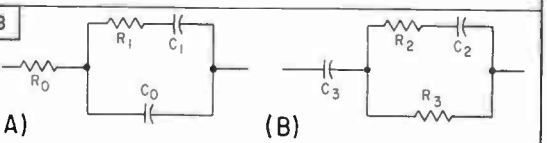
$$R_3 = \frac{R_1R_2\,(R_1C_1^2+R_2C_2^2)}{(R_1C_1-R_2C_2)^2}$$

$$R_4 = \frac{(R_1C_1^2+R_2C_2^2)}{(C_1+C_2)^2}$$

$$C_4 = C_1 + C_2$$

$$C_3 = \frac{C_1C_2(C_1+C_2)(R_1C_1-R_2C_2)^2}{(R_1C_1^2+R_2C_2^2)^2}$$

8



(A)

$$R_0 = R_2R_3/(R_2+R_3)$$

$$C_0 = \frac{C_3}{1+\left(\frac{C_3}{C_2}\right)\left(\frac{R_3}{R_2+R_3}\right)^2}$$

$$R_1 = \frac{\left[C_2\,(R_2+R_3)^2+R_3^2C_3\right]^2}{(R_2+R_3)\,R_3^2C_3^2}$$

$$C_1 = \frac{C_3}{1+\left(\frac{C_2}{C_3}\right)\left(\frac{R_2+R_3}{R_3}\right)^2}$$

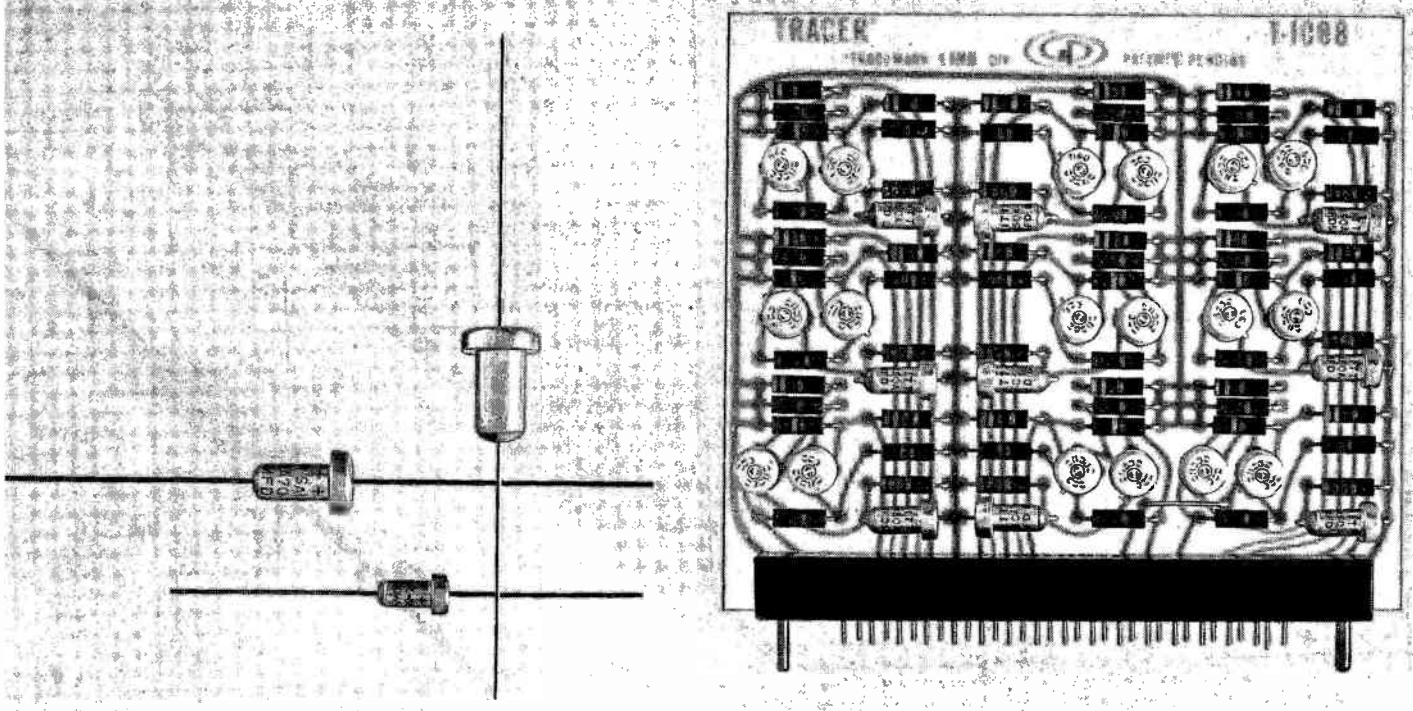
(B)

$$R_2 = R_0\left(1+\frac{R_0(C_1+C_0)^2}{R_1C_1^2}\right)$$

$$R_3 = R_0 + R_1\left(\frac{C_1}{C_1+C_0}\right)^2$$

$$C_3 = C_1 + C_0$$

$$C_2 = \frac{R_1^2C_1^3C_0\,(C_1+C_0)}{\left[R_2(C_1+C_0)^2+R_1C_1^2\right]^2}$$



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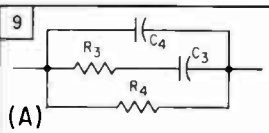
P–Z CHARACTERISTIC IV

9



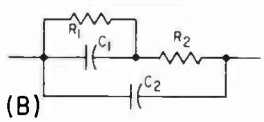
(A)

$R_3 = R_2\left(1+\frac{R_2}{R_1}\right)$

$R_4 = R_1 + R_2$

$C_3 = C_1\left[R_1/(R_1+R_2)\right]^2$

$C_4 = C_2$



(B)

$R_1 = R_4\left(\frac{R_4}{R_3+R_4}\right)$

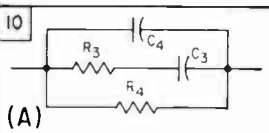
$R_2 = R_3R_4/(R_3+R_4)$

$C_2 = C_4$

$C_1 = C_3\left(\frac{R_3+R_4}{R_4}\right)^2$

P–Z CHARACTERISTIC IV

10



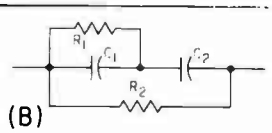
(A)

$R_4 = R_2$

$R_3 = R_1\left(\frac{C_1+C_2}{C_2}\right)^2$

$C_3 = C_2/\left(1+\frac{C_1}{C_2}\right)$

$C_4 = C_2/\left(1+\frac{C_2}{C_1}\right)$



(B)

$R_1 = R_3\left(\frac{C_3}{C_3+C_4}\right)^2$

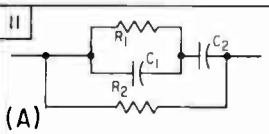
$R_2 = R_4$

$C_1 = C_4\left(1+\frac{C_4}{C_3}\right)$

$C_2 = C_3 + C_4$

P–Z CHARACTERISTIC IV

11



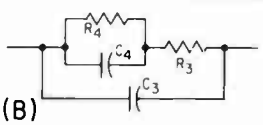
(A)

$R_1 = \frac{(R_3+R_4)R_3R_4^3C_4^2}{\left[C_3(R_3+R_4)^2 + R_4^2C_4\right]^2}$

$R_2 = R_3 + R_4$

$C_1 = C_3\left[1+\frac{C_3}{C_4}\left(\frac{R_3+R_4}{R_4}\right)^2\right]$

$C_2 = C_3\left[1+\frac{C_4}{C_3}\left(\frac{R_4}{R_3+R_4}\right)^2\right]$



(B)

$R_4 = \frac{R_2}{1+\frac{R_1}{R_2}\left(\frac{C_1+C_2}{C_2}\right)^2}$

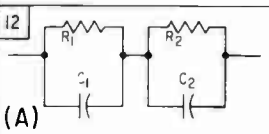
$R_3 = \frac{R_2}{1+\frac{R_2}{R_1}\left(\frac{C_2}{C_1+C_2}\right)^2}$

$C_3 = \frac{C_1C_2}{C_1+C_2}$

$C_4 = \frac{\left[R_1(C_1+C_2)^2 + R_2C_2^2\right]^2}{R_2^2C_2^2(C_1+C_2)}$

P–Z CHARACTERISTIC IV

12



(A)

$C_1 = W \quad C_2 = X$

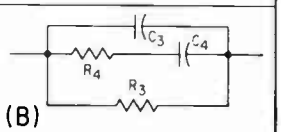
$R_1 = Y \quad R_2 = Z$

$A = R_3R_4C_3C_4$

$B = C_4R_4 + C_3R_3 + R_3C_4$

$E = R_3R_4C_4$

$D = R_3$



(B)

$R_4 = \frac{R_1R_2(R_1+R_2)(C_1+C_2)^2}{(R_1C_1-R_2C_2)^2}$

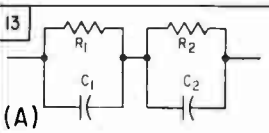
$R_3 = R_1 + R_2$

$C_4 = \frac{(R_1C_1-R_2C_2)^2}{(C_1+C_2)(R_1+R_2)^2}$

$C_3 = C_1C_2/(C_1+C_2)$

P–Z CHARACTERISTIC IV

13



(A)

$C_1 = W \quad C_2 = X$

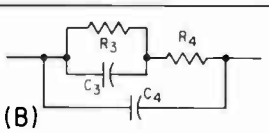
$R_1 = Y \quad R_2 = Z$

$A = R_3C_3R_4C_4$

$B = R_3C_3 + R_4C_4 + R_3C_4$

$E = R_3R_4C_3$

$D = R_3 + R_4$



(B)

$R_3 = \frac{(R_1C_1-R_2C_2)^2}{R_1C_1^2+R_2C_2^2}$

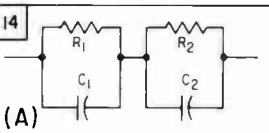
$R_4 = \frac{R_1R_2(C_1+C_2)^2}{R_1C_1^2+R_2C_2^2}$

$C_3 = \frac{(R_1C_1^2+R_2C_2^2)^2}{(R_1C_1-R_2C_2)^2(C_1+C_2)}$

$C_4 = C_1C_2/(C_1+C_2)$

P–Z CHARACTERISTIC IV

14



(A)

$C_1 = W \quad C_2 = X$

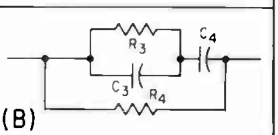
$R_1 = Y \quad R_2 = Z$

$A = R_3C_3R_4C_4$

$B = R_3C_3 + R_4C_4 + R_3C_4$

$E = R_3R_4(C_3+C_4)$

$D = R_4$



(B)

$R_3 = \frac{R_1R_2(R_1+R_2)(R_1C_1-R_2C_2)^2}{(R_1^2C_1+R_2^2C_2)^2}$

$R_4 = R_1 + R_2$

$C_3 = \frac{C_1C_2(R_1^2C_1+R_2^2C_2)}{(R_1C_1-R_2C_2)^2}$

$C_4 = \frac{R_1^2C_1+R_2^2C_2}{(R_1+R_2)^2}$

CHART I–RC IMPEDANCE POLE–ZERO CONFIGURATIONS IN THE S PLANE

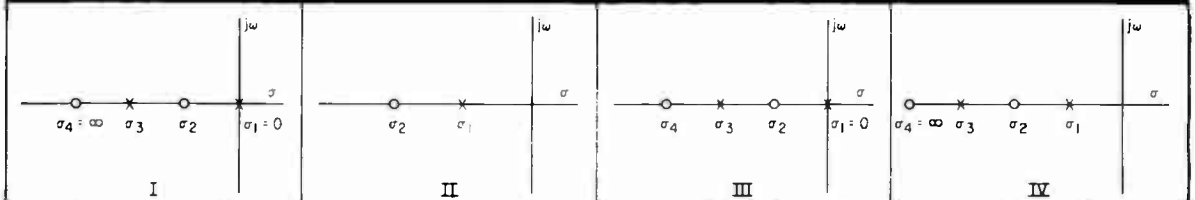


CHART II–RL IMPEDANCE POLE–ZERO CONFIGURATIONS IN THE S PLANE

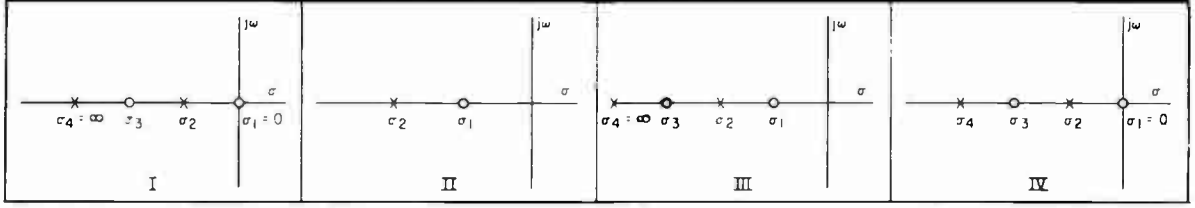


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CHART III — POLES AND ZEROS OF RC NETWORKS AND RL NETWORKS

P-Z Char	Fig	RC NETWORKS				RL NETWORKS			
		$-\sigma_1$ (Pole)	$-\sigma_2$ (Zero)	$-\sigma_3$ (Pole)	$-\sigma_4$ (Zero)	$-\sigma_1$ (Zero)	$-\sigma_2$ (Pole)	$-\sigma_3$ (Zero)	$-\sigma_4$ (Pole)
I	1A	0	$\frac{1}{R_1(C_1+C_2)}$	$\frac{1}{C_1 R_1}$	∞	0	$\frac{R_1}{L_1}$	$\frac{R_1(L_1+L_2)}{L_1 L_2}$	∞
I	1B	0	$\frac{1}{R_2 C_3}$	$\frac{C_3+C_4}{R_2 C_3 C_4}$	∞	0	$\frac{R_2}{L_3+L_4}$	$\frac{R_2}{L_3}$	∞
II	2A	$\frac{1}{R_1 C_1}$	$\frac{R_1+R_2}{R_1 R_2 C_1}$			$\frac{R_1 R_2}{L_1(R_1+R_2)}$	$\frac{R_1}{L_1}$		
II	2B	$\frac{1}{(R_3+R_4)C_2}$	$\frac{1}{R_3 C_2}$			$\frac{R_3}{L_2}$	$\frac{R_3+R_4}{L_2}$		
III	5A	0	$\frac{1}{R_2 C_2}$	$\frac{C_1+C_2}{(R_1+R_2)C_1 C_2}$	$\frac{1}{R_1 C_1}$	$\frac{R_1}{L_1}$	$\frac{R_1+R_2}{L_1+L_2}$	$\frac{R_2}{L_2}$	∞
III	5B	0	$\frac{1}{P}$	$\frac{C_3+C_4}{R_3 C_3 C_4}$	P A	A P	$\frac{R_3}{L_3+L_4}$	P	∞
III	6B	0	$\frac{1}{P}$	$\frac{1}{R_4 C_4}$	P A	A P	$\frac{R_4}{L_4}$	P	∞
III	7B	0	$\frac{1}{P}$	$\frac{1}{(R_3+R_4)C_3}$	P A	A P	$\frac{R_3+R_4}{L_3}$	P	∞
IV	12A	$\frac{1}{R_2 C_2}$	$\frac{R_1+R_2}{R_1 R_2(C_1+C_2)}$	$\frac{1}{R_1 C_1}$	∞	0	$\frac{R_1}{L_1}$	$\frac{R_1 R_2(L_1+L_2)}{(R_1+R_2)L_1 L_2}$	$\frac{R_2}{L_2}$
IV	12B	$\frac{1}{P}$	$\frac{1}{R_4 C_4}$	$\frac{P}{A}$	∞	0	$\frac{A}{P}$	$\frac{R_4}{L_4}$	P
IV	13B	$\frac{1}{P}$	$\frac{R_3+R_4}{C_3 R_3 R_4}$	$\frac{P}{A}$	∞	0	$\frac{A}{P}$	$\frac{R_3 R_4}{(R_3+R_4)L_3}$	P
IV	14B	$\frac{1}{P}$	$\frac{1}{R_3(C_3+C_4)}$	$\frac{P}{A}$	∞	0	$\frac{A}{P}$	$\frac{R_3(L_3+L_4)}{L_3 L_4}$	P

the slope $dZ/d\sigma$ is negative.

Chart III lists equations for calculating the poles and zeros associated with each network.

The close relationship between R-L and R-C circuits permits Fig. 1 through 14 to be modified for application to R-L networks: (1) In the schematics, replace all capacitors by inductors, retaining the same subscripts. (2) In the transformation equations, replace C by $1/L$.

As an example, consider Fig. 1: C_1 to C_4 are replaced by L_1 to L_4 respectively; then, replacing C by $1/L$, the equations for Fig. 1B become $L_3 = L_2(L_1 + L_2)/L_1$, $L_4 = L_1 + L_2$ and $R_2 = R_1\,[(L_2 + L_1)/L_1]$ [3].

Properties of the real and imaginary parts of R-L networks are identical with those of an R-C admittance. The real part of an R-L impedance is a monotonically increasing function of frequency. It has its minimum at zero frequency and its maximum at infinite frequency. The imaginary part of an R-L impedance is never negative from $\omega = 0$ to $\omega = \infty$: at zero frequency, its value is always zero; at infinite frequency, it may be zero or (positively) infinite.

Chart II illustrates the s-plane pole-zero distributions of the R-L impedances given in Fig. 1 through 14 after substitutions. Properties of R-L impedance functions are: poles and zeros are simple and are restricted to the negative real axis of the s-plane (σ axis); poles and zeros alternate; the lowest critical frequency is a zero which may be at $s = 0$; the highest critical frequency is a pole which may be at infinity; the slope $dZ/d\sigma$ is positive.

In addition to R-C networks, Chart III lists the applicable equations for calculating the poles and zeros associated with R-L networks. As an example of the pole and zero calculation of an R-L circuit, consider Fig. 1A. The pole σ_2 is found from the equation $\sigma_2 = -R_1/L_1$.

BIBLIOGRAPHY

Zverev and Blinchikoff, "Network Transformations for Wave Filter Design," ELECTRONICS, p 52, June 26, 1959.
M. E. Van Valkenburg, "Introduction to Modern Network Synthesis," Ch. 6, John Wiley & Sons, Inc., 1960.
N. Balabanian, "Network Synthesis," p 52, Prentice-Hall, Inc., 1958.

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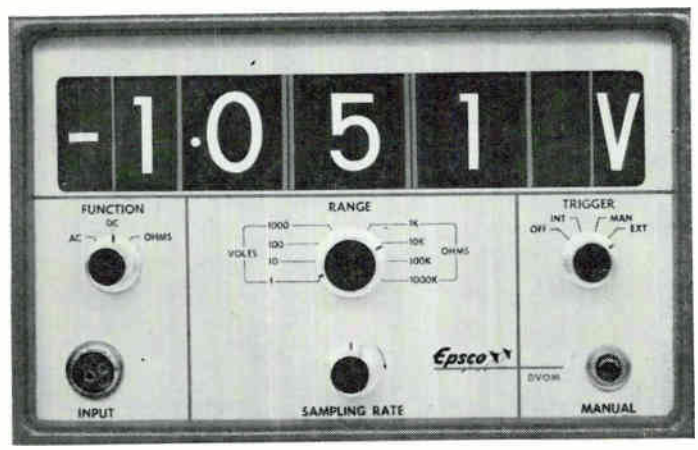

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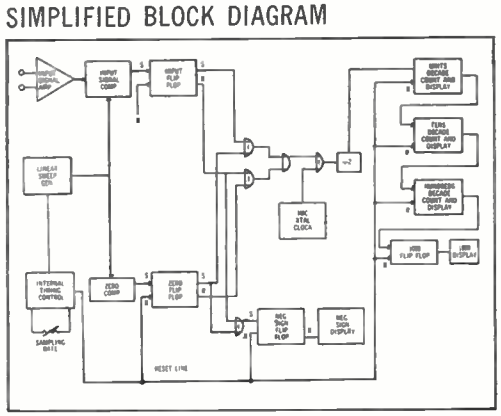

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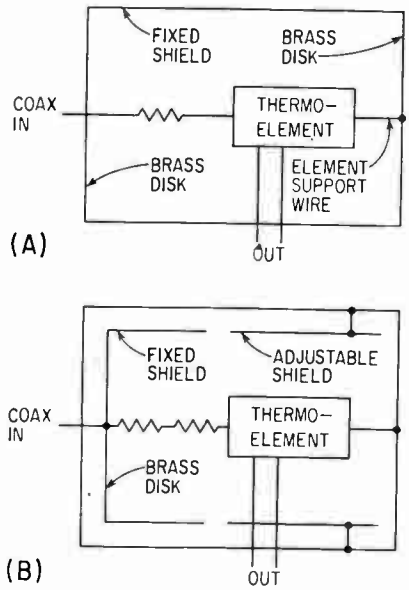

One fixed inner brass shield is satisfactory for 50-volt converter (A) while one of two cylindrical inner shields in 100- and 200-volt units (B) is axially adjustable

ACCURATE rms voltage measurements up to 30 Mc are possible using thermal voltage converters. They can also be used to determine quickly the effect of frequency on other rms instruments.

The thermal voltage converters, developed by the National Bureau of Standards, are inexpensive and simple to construct. However, they provide excellent a-c to d-c performance. Accuracy is at least 0.1 percent at frequencies up to 10 Mc and 0.2 percent at 30 Mc.

Reactance is low and computable. Frequency influence on the converters can be estimated with reasonably simple equations. Results agree well with values measured using other methods up to 40 Mc.

The converters can be used to calibrate commercial r-f thermocouple voltmeters and, with a sine-wave generator, electronic voltmeters. Because of their nearly flat response, applied frequency and its stability are not critical.

A thermoelement with low input current rating and a series impedance are used in the thermal voltage converter to develop an output emf that is dependent on input voltage. In these r-f converters, a d-c voltage is substituted for the a-c voltage to be measured.

In the transfer technique used, the same a-c voltage is applied to the converter and the similar device under test. The input is adjusted to obtain the desired indication on the device, and the converter reading is noted. A d-c input is then provided to the converter and adjusted until the same reading is obtained. The d-c input voltage can then be measured with any appropriate apparatus. Requirements of the transfer instrument are that it permit precise readings, have small frequency influence and have good short-time frequency stability.

The influence of frequency on other rms instruments can be readily determined by a-c to d-c difference tests. The same a-c and d-c input voltages are connected to the converter and to the instrument. While switching between a-c and d-c voltage inputs, the voltages are adjusted so that the same indication is obtained on the instrument under test.

The difference in converter indications is noted and, with the scale factor of the converter, is used to determine the a-c to d-c difference (frequency response) of the instrument. Because these differences are relatively stable, measurements usually need not be repeated.

A converter with a thermoelement in series with a wire-wound resistor for current limiting can be used for highly accurate voltage measurements at audio and ultrasonic frequencies. Frequency range is limited primarily by residual reactance of the resistor. Recent tests have shown that good performance can sometimes be obtained up to nearly 1 Mc.

The new converter was developed to evaluate converters using wire-wound resistors. Its cylindrical deposited-carbon resistors are mounted coaxially in a brass cylinder as shown in the figure. The resistors are in series with a uhf 5-ma thermoelement having a short straight heater in line with its supports. Residual reactances are much smaller than those of wire-wound resistors and can be computed approximately, so that frequency errors can be estimated. They can make accurate rms voltage measurements of 1 to 200 volts at frequencies from 3 cps to 30 Mc. Better resolution is obtained using a specialized potentiometer than a millivoltmeter for reading output.

The 100- and 200-volt converters contain two resistors and a 10-ma thermoelement. One of two cylindrical inner shields can be axially adjusted to minimize distributed capacitance between the resistors and the outer cylinder, which considerably extends frequency range. The 50-volt converter operates well with a single resistor and only one fixed inner shield.

The higher range voltage converters require up to 2 watts power and have marked warm-up drift although it is of short duration. A 5-ma thermoelement in series with metal-film resistors of higher resistance could reduce power requirements and drift. However, frequency range would probably be reduced for the same accuracy.

Depletion Layer Acts As Ultrasonic Transducer

EXPERIMENTAL ultrasonic transducer promises high efficiency conversion at microwave frequencies. The 830-Mc operating frequency of present units is expected to be extended to 10,000 Mc, where efficiency should be one hundred times that of other known transducers.

The new device, in the early stages of development at Bell Labs, is a piezoelectric transducer that uses a semiconductor depletion layer. Primary application of the transducer is expected to be in ultrasonic delay lines. Its high op-

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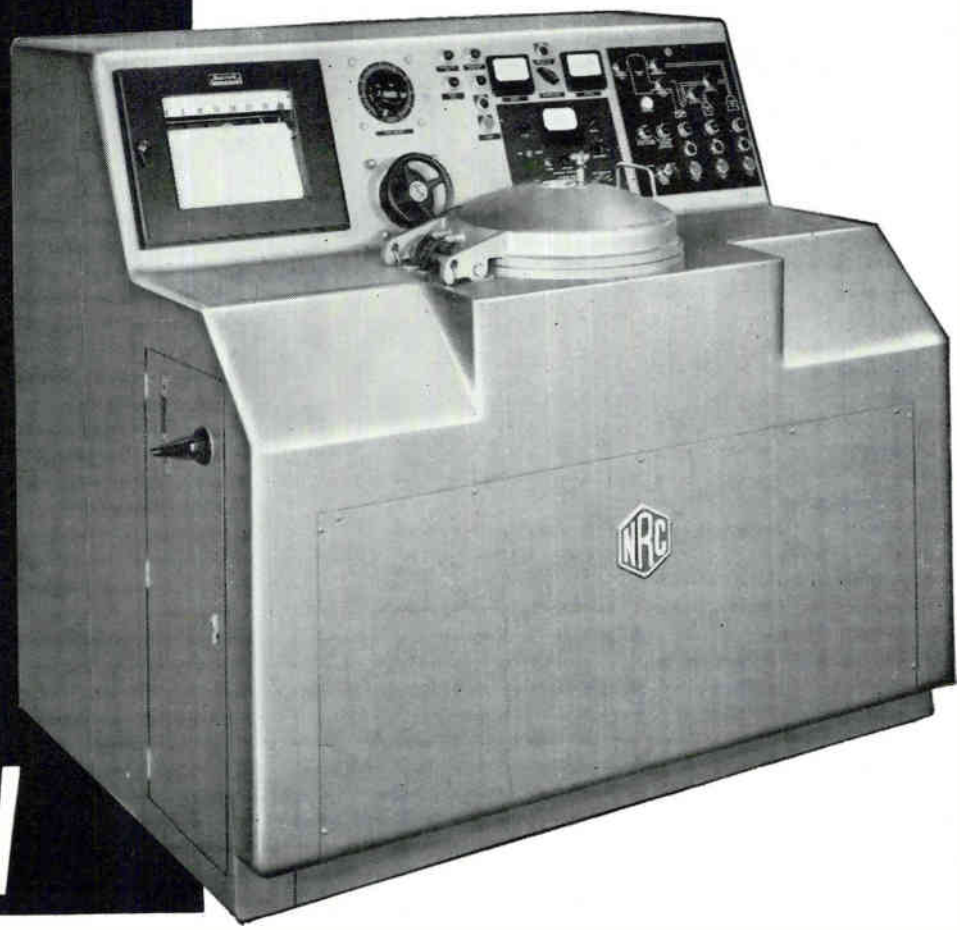

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erating frequency and wide bandwidth will enable the depletion layer transducer to store large amounts of information.

The depletion layer ultrasonic transducer may also be used as a tool for studying the acoustical properties of materials at higher ultrasonic frequencies. It is expected to generate high-amplitude ultrasonic waves in materials at microwave frequencies. It should also be capable of detecting very weak waves more efficiently than existing transducers.

The transducer consists of a thin metal film deposited on a plate of piezoelectric semiconductor material such as gallium arsenide. The film constitutes a nonohmic rectifying contact that causes formation of a depletion layer. Thickness of the layer can be controlled with a negative bias voltage across the interface.

When a-c voltage is applied, most of the voltage drop occurs across the layer, which behaves like a very thin piezoelectric crystal that is bonded to a solid. The electric field is very large because of the thinness of the layer (10^{-3} to 10^{-5} cm), and considerable piezoelectric stress can be produced in it.

Because the layer is so thin, greatest efficiency of the transducer is at very high frequencies. Its high efficiency permits generation of ultrasonic waves from small electrical signals and detection of very weak ultrasonic waves.

Resonant frequency of the transducer is dependent on layer thickness, which can be controlled by bias voltage. Frequency control adds flexibility to the device that conventional piezoelectric transducers do not have.

Bandwidth of present models measured at 600 Mc is 5 percent, an order of magnitude greater than typical ceramic transducers operating at frequencies below 10 Mc. Even greater bandwidths can be achieved at the higher operating frequencies anticipated. Significance of larger bandwidths is that a comparable increase can be expected in the amount of information transmitted.

The use of ultrasonic delay lines at high frequencies has been limited because ultrasonic waves could not be generated or detected effi-

ciently and because the waves are attenuated in the delay material. Higher efficiency of the depletion layer transducer makes possible delay lines having longer delay times. Combined with the larger bandwidths, longer delays will enable storage of large amounts of information.

The transducer is relatively simple to manufacture. Improvements in fabrication processes and circuit techniques should greatly extend the frequency range of the new ultrasonic transducers.

Swedes Plan Railborne Radio Telescopes

ASTRONOMICAL research, space communications and development of radio equipment are anticipated applications of four railborne radio telescopes. Two of the 12-meter diameter units will be built in the first phase of the project by the radio-astronomic research center at Rao, according to the Stockholm Dagens Nyheter. The center, which is on the west coast of Sweden, is operated by the Chalmers Institute of Technology, Gothenburg.

By mounting the radio telescopes on railroad cars, they can be operated in parallel to effectively combine their surface areas. Thus two of the telescopes will provide a surface corresponding to the size of the Harvard University telescope with a diameter of nearly 19 meters.

The telescopes can also be separated by as much as 100 meters. In this case, they would function as an interferometer. Rails for the telescopes will be laid crosswise in an east-west and north-south direction.

Total cost will be significantly reduced by building the 12-meter antennas over that of a 25-meter radio telescope originally planned. In addition, the 12-meter systems provide greater flexibility. For example, an object in space like the Russian Venus probe can be monitored by one unit without interrupting regular astronomical observations.

The use of two antennas also permits a more precise determination of the location of a space object than has been possible.

Improved Wire for Precision Wound Resistors

By EDWIN SHUTTLEWORTH,
Assist. Vice-President,
Driver-Harris Company,
Harrison, New Jersey

PRECISION WIRE-WOUND RESISTORS are used in circuits that require a precisely calibrated resistance value that must be maintained over a wide temperature range.

During World War II, precision wire-wound resistors were generally wound with Nichrome V, which has a specific resistance of 650 ohms per circular mil foot, and a tcr (temperature coefficient of resistance) of 0.01 percent per deg C. Using this alloy, a resistor calibrated to exactly 1,000 ohms at 25 C would increase in resistance one percent, or 10 ohms at 125 C.

In the late 1940's, an alloy modification of the basic 80 nickel 20 chromium alloy Nichrome V had produced a new alloy called Karma which was heat treated to control tcr and specific resistance. This alloy had a specific resistance of 800 ohms per circular foot and a tcr of 0.002 percent per deg C.

This alloy made possible resistors of the same dimensions, using the same wire diameter, with a 23-percent increase in resistance. Further, the improved tcr offered a fivefold improvement in accuracy over a wide temperature range. A resistor wound with the new alloy to 1,000 ohms would change less than 0.2 percent or 2 ohms at 125 C. For many years, this level of accuracy was more than sufficient.

Requirements for resistors in miniature satellite computers developed the need for closer control of tcr on a production basis and a new process Karma wire, now available to fill this need was recently announced.

The major advantage offered by the new process wire is a tcr of

TABLE I—TEMPERATURE STABILITY

Time at Temperature	Resistance Change in % @ 150° C.	@ 200° C.	@ 300° C.
0	0	0	0
100 Hours	−0.010	−0.02	+0.05
200 "	−0.015	−0.025	+0.070
300 "	−0.016	−0.025	+0.080
400 "	−0.016	−0.025	+0.080
500 "	−0.016	−0.025	+0.075

TABLE II—PROPERTIES OF ALLOYS USED AS FINE RESISTANCE WIRE [a]

Alloy Name	Alloy Composition, Approx., per cent	Resistivity, ohms per circular mil foot	Mean Temperature Coefficient of Resistivity, ppm per deg. Cent. based on reference temp. of 77 F (25 C)	Maximum Thermal emf versus Copper, mv per deg. Cent.	Temperature Range (for Values in Columns 4 and 5), deg. Cent.[b]	Specific Gravity	Coefficient of Thermal Expansion × 10^{-6} per deg. C 20 C to 200 C
Karma	76 Ni, 20 Cr + Fe +Al	800	0, ± 5	+0.003	−65 to +250	8.10	13.3
Nichrome V	79 Ni, 20 Cr, 1 Si	650	+ 80, ± 20	+0.006	−65 to +250	8.41	12.5
Nichrome V	79 Ni, 20 Cr, 1 Si (Stabilized, 888 Alloy)	675	+ 60, ± 20	+0.006	−65 to +250	8.11	12.5
Nichrome	58 Ni, 16 Cr, 1 Si, bal. Fe	675	+ 110, ± 30	+0.002	−65 to +250	8.25	12.8
Advance	55 Cu, 45 Ni	294	0, ± 20	−0.045	−65 to +150	8.90	14.5
Manganin	84 Cu, 12 Mn, 4 Ni	290	0, ± 15	−0.003	+15 to + 35	8.41	18.7
Midohm	77 Cu, 23 Ni	180	+ 180, ± 30	−0.037	−65 to +150	8.90	15.7
Hytemco [c]	70 Ni, 30 Fe	120	+3900, ±300	−0.04	−50 to + 20	8.46	12.0
			+1500, ±100	−0.01	+20 to +100	8.46	12.0
95 Alloy	90 Cu, 10 Ni	90	+ 150, ± 50	−0.026	−65 to +150	8.90	16.0
Lohm	94 Cu, 6 Ni	60	+ 700, ±200	−0.022	−65 to +150	8.90	16.2
30 Alloy	98 Cu, 2 Ni	30	+1400, ±300	−0.011	−65 to +150	8.91	16.1

[a] the values given either meet or surpass the specified requirements of ASTM Specification B267-60T. These listed are Driver-Harris alloys

[b] limited only by insulation

[c] temp coeff of resistivity is given for two temp ranges

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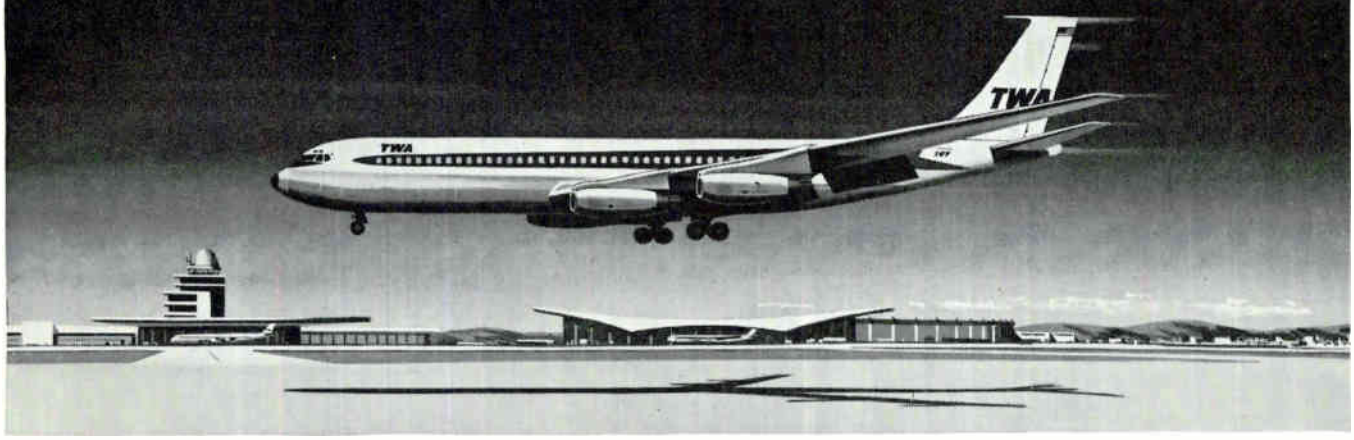

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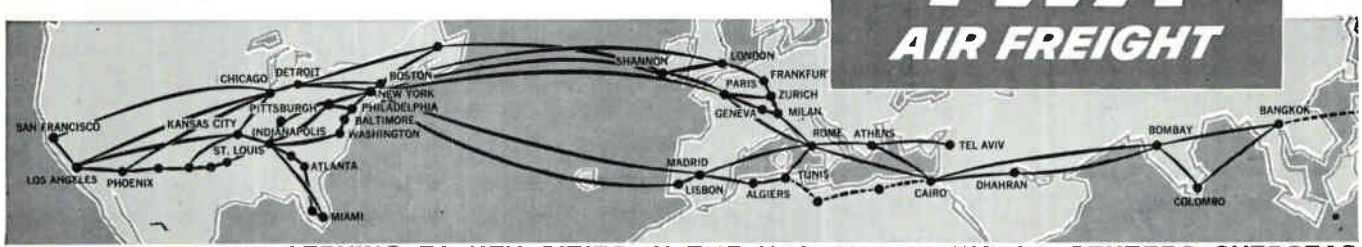

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less than 0.0005 percent per deg C. Now a 1,000-ohm resistor changes less than 0.05 percent or 0.5 ohm over the temperature range from 25 C to 125 C.

The data given in Table I shows the high-temperature stability of the wire. This data shows the resistance drift of 0.0015 insulated wire wound as a single layer on a ceramic bobbin. All data was taken after an initial aging for 24 hours.

The drift rates indicate stability to at least 200 C, which is well over the maximum hot-spot temperature of present-day precision wire-wound resistors. Drift usually is so slight that processing of trial bobbins is eliminated.

Further gains in new wire come from an increase in physical property values which means fewer breaks in winding resulting in fewer rejects, more units wound per spool, and increased efficiency from winders. The average weight of wire per spool has also been increased, thus reducing downtime.

Experience with these new process techniques augurs well for the development, in the near future, of wires that have characteristics of interest to the precision potentiometer, as well as the precision resistor industry.

Table II gives names and properties of alloys used as fine resistance wires.

Induction Motor Given Two Speeds

IN THE PAST, speed changing of the squirrel-cage induction motor was possible only by winding two separate windings in one frame, and using only one winding at a time. This was wasteful and resulted in a much larger, heavier and more expensive machine.

Now, over half a century after the invention of this motor by Tesla, a British engineer[1] has devised a technique that makes it possible to obtain speed changing, in any ratio, from a single-winding induction motor.

The two-speed motor looks exactly like a standard motor. No new process is involved. But an analytical method was devised for grouping and connecting the coils. And any manufacturer who is equipped to

make normal induction motors is equipped to make two-speed induction motors.

The basic designs for each speed combination have to be done by an engineer of high technical competence, and it is desirable to have such designs available for each speed combination. But thereafter, particular machines for different voltages and output powers can be designed according to a routine, as for a standard machine.

The new method of speed changing is called pole-amplitude modulation, because of the logic on which it depends. In a conventional three phase induction motor, the waveform for each phase has an approximate sinusoidal distribution around the stator assembly. If the amplitude of this waveform is modulated in space by suitable coil reconnections, the resultant waveform around the stator will have a different spatial distribution. This effect is similar to that obtained, in time, by modulating a radio carrier and considering the resultant sidebands. If, for example, the resultant waveform of one phase-winding of a pole-amplitude modulated 8-pole machine is examined, it will be found to contain waveforms corresponding to 6 and 10-pole machines, mixed.

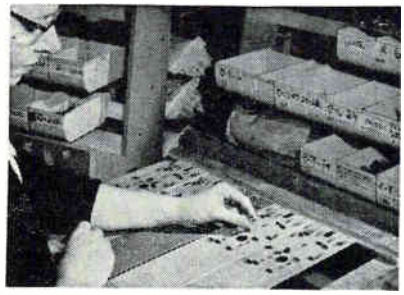
Under certain conditions and by correct relative displacements between the three separate phase-windings, it is possible to eliminate one pole number from the resultant three-phase field and to obtain a pure three-phase field corresponding to a single speed. In the case referred to above, speeds correspond to either 6-pole or 10-pole machines.

Uniform acceleration is obtained for full speeds backwards and forward. Two-speed motors have been developed from 1½ hp by 850 hp, but there are no limitations. So far British manufacturers have shown more interest for the larger, high-voltage machines.

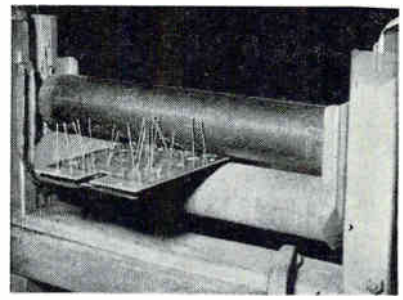
The sponsors involved in developing these motors offer licensing patent rights to American manufacturers.[2]

REFERENCES

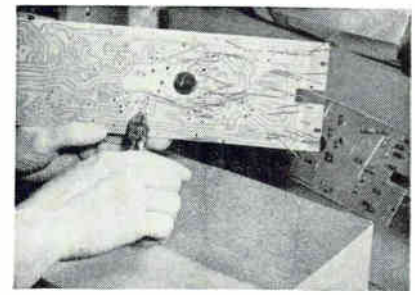
(1) G. H. Rawcliffe, Head of Electrical Engineering Department, University of Bristol, Bristol, England.
(2) National Research Development Corporation of England, 1925 K Street, N. W., Wash. 6, D. C.



Boards are held in open rack while components are dropped in place



Pad is placed between components and rubber roller



Excess lead lengths are cut off. Box catches lead ends

Wringer Crimps Leads Under Circuit Boards

AN OLD-FASHIONED, hand-cranked washer wringer makes an ingenious aid to hand assembly of printed wiring boards. Used at Electronic Associates, Inc., Long Branch, N. J., to supplement mechanized equipment, it bends all the leads on a board at once. This permits batch-type board assembly, even for short runs, rather than tedious one-at-a-time lead insertion, crimping and cutting.

Jumper wires, flush-mounted axial lead components and small disk components are assembled. Bulky or delicate components, or components requiring stand-off mounting are added later. The method is used, for example, when only a few each of several kinds of resistors are required. If a large number of the same kind of resistor is required, automatic insertion and crimping machines are used.

The wringer is modified to provide a half-inch space between the rollers. The top roller is steel and the bottom roller is padded with rubber. The spacing between them can be varied to adjust pressure. Before the board is passed, components down, between the rollers, it is covered with a pad of foam rubber glued to a blank board. The pad equalizes pressure, is a further safeguard against component damage and allows the board to be turned upside-down.

As the board passes between the rollers, the components are pressed flush with the board and the leads are bent tightly to the underside.

The wringer is set up to the right of an assembly rack. The assembler takes five or six boards and puts them face up on the rack. She picks up a handful of one kind of component, puts the required number into each board, then repeats with the next component.

After crimping, an assembler on the right side of the wringer clips each lead near the bend. Occasionally, a crimp must be tightened with the clipper pliers.

Component leads and jumpers are not cut to size in advance, as the method works best with long leads. If leads are stiff, they can be bent at right angles to the body before insertion. Soft leads can be bent as they are inserted in the board.

Jumper wires are generally formed in advance. They are prepared by winding a spool of wire on a bar rotated in a lathe. The resulting coil is slit into jumpers by cutting along the two sides of the bar with a milling machine.

An added bonus is that wringing breaks the oxides on the leads, improving soldering quality.

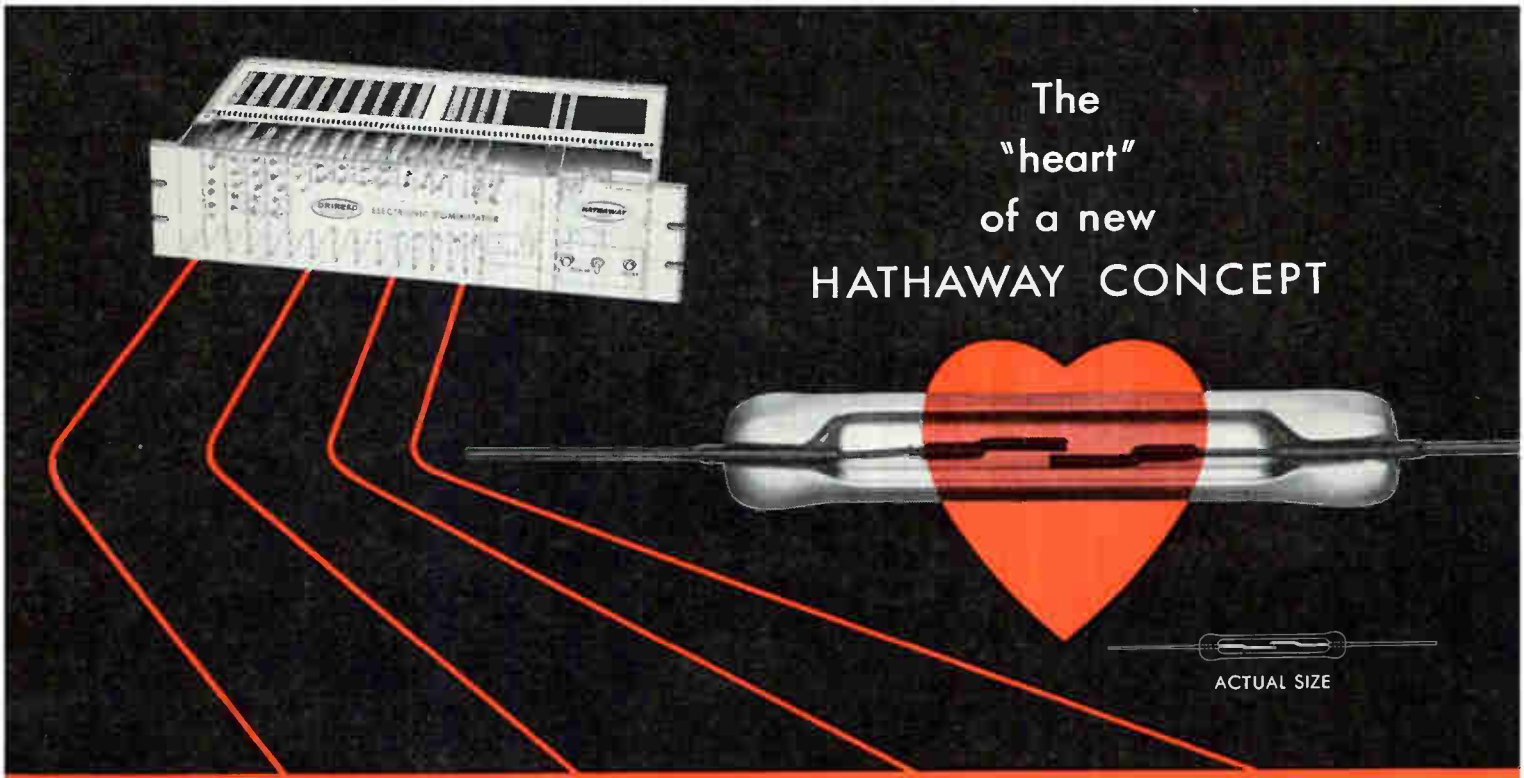
Comparator Gages Fragile Part

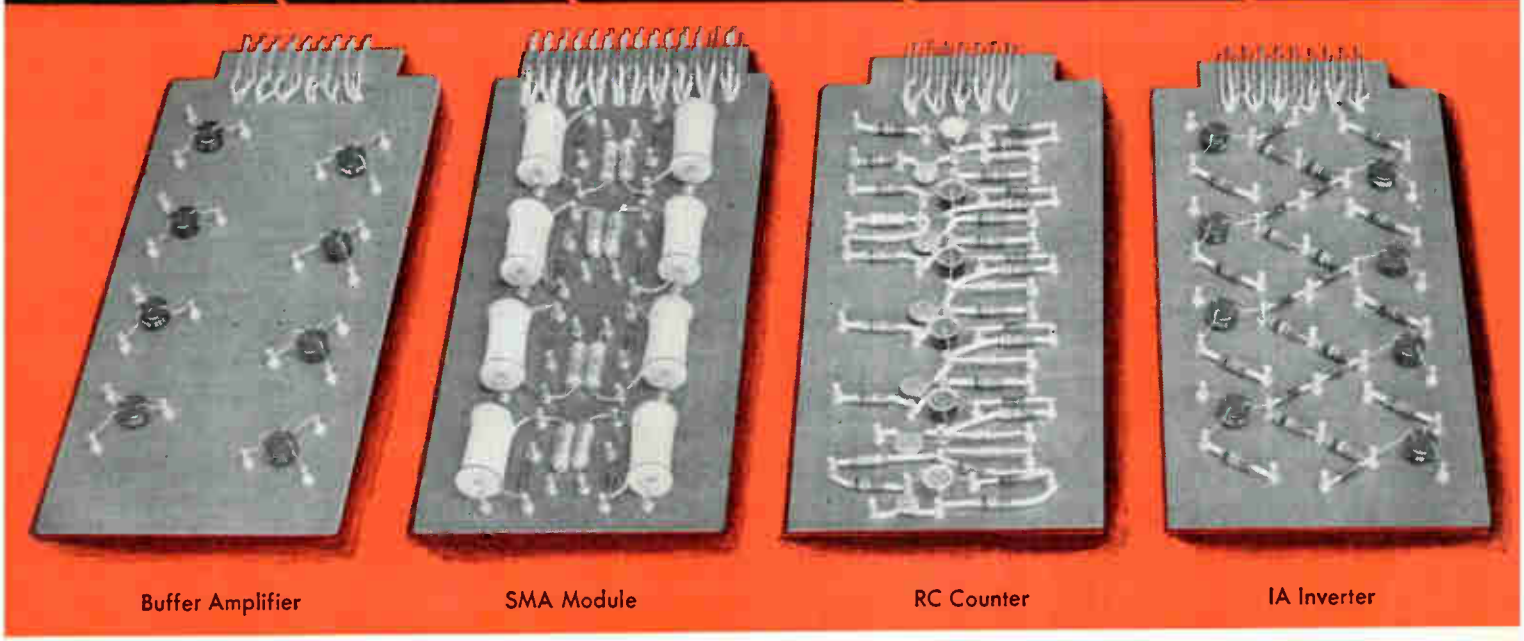
OPTICAL COMPARATORS are used by Bay State Electronics, Boston, Mass., to gage, balance and adjust photoelectrically-controlled irises for Keystone cameras.

An iris is placed in a fixture which simulates the mounting casting in the camera. Lines scribed on the fixture indicate alignment of the iris leaf and stop positions for various light levels. The iris is checked in horizontal and vertical positions, since the camera may be used in either position.

With the fixture horizontal, the iris is statically balanced by adjusting small, coiled wire counterweights with tweezers. The fixture is then turned to the vertical position where the face of the iris is reflected onto the comparator screen. Current which would normally be supplied by a photoelectric cell is provided through an adjustable microampere power source. When the iris is energized, the edge

Photoelectric control is energized during gaging





DRIREED ELECTRONIC COMMUTATORS

the Newest and Best!

The NEW Hathaway DRIREED Electronic Commutator, designed to utilize Hathaway's DRIREED contact, is illustrated above in a typical rack mounted unit. Applications include telemetry, thermocouple scanning, computer inputs, strain gage scanning, transducer scanning, and PDM coding.
The unit can be packaged and tailored to fit your particular requirements.

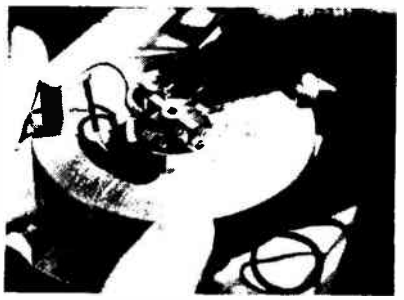
FEATURES:

- Eliminates the transfer gain problem—closed circuit resistance less than 100 milliohms.
- No back current or channel to channel crosstalk—open circuit resistance greater than 3×10^{12} ohms.
- Output isolated from power ground and needs no "common"—isolated dual ended contacts.
- Solid state drive circuit—transistor logic control of mechanical contact operation.
- Up to 1,000 sequential data points per second—DRIREED has resonant frequency of above 2700 cps.
- Long life, highest reliability—contact rating 10 million operations at 100 milliampere, 115 volts 60 cps, resistive load; 1 billion operations at low signal levels.

PRICE AND PERFORMANCE of this commutator make it worth considering in your application. Please address your inquiries to the address below.

Hathaway INSTRUMENTS INC.

HATHAWAY DENVER
5802 EAST JEWELL AVE.
DENVER 22, COLORADO
A division of **Hathaway Instruments, Inc.**



Fixture simulates mounting in camera

Magnified view of part is used to judge alignment

of the leaf must match the graduated line which represents the stop opening on the face of the fixture. The radial centerline of the leaf aperture must coincide with the scribed arc. The fixture is next revolved 90 degrees and the balance checked again while the iris is energized.

Comparator gaging during adjustment prevents mechanical distortion of the fragile iris leaf. A comparator with a large aperture lens (Jones & Lamson TC-10) is used so the entire iris visible in the fixture at five times magnification.

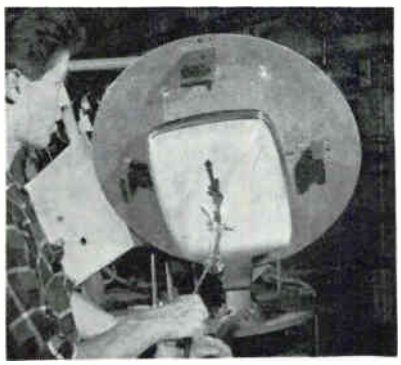
Conveyor Time Is Used For Tv Tube Processing

TV PICTURE TUBES spend hours on overhead conveyors passing between production steps. Some of this conveyor time is used at the Lansdale Division of Philco Corp., Lansdale, Pa., to dry the internal conductive coating and flash getters after exhaust.

The internal coating is applied by brush while the tube is rotating on a vacuum chuck. A drying riser is slipped over the neck of the tube

before the tube is returned to the conveyor. As the conveyor passes over an air manifold, the risers collect the air and direct it into the neck. A sheet metal duct built around the manifold directs the air.

The gettering station is provided with two fixtures, each flashing alternate tubes. Each fixture



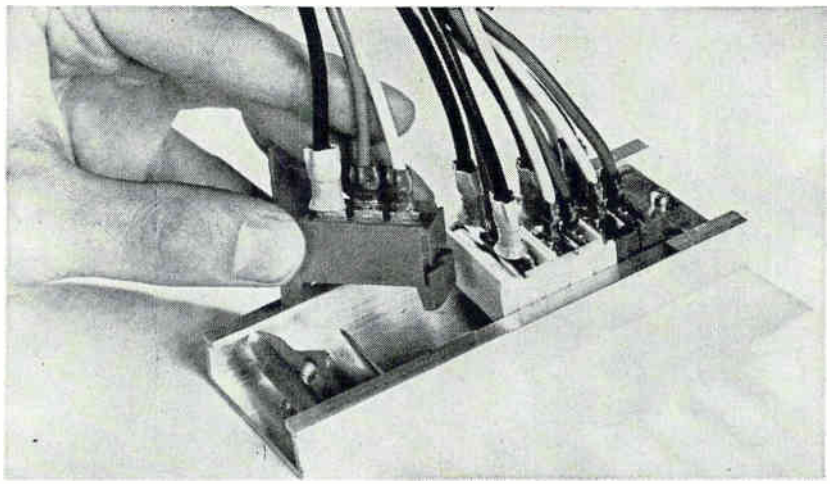
Application of conductive coating

Drying riser fits onto neck of tube

Getter flashing fixture moves with tube on conveyor

has two r-f coils, one for each basic tube size. Fixture design permits the unused coil to be shorted out and the coil in use to be raised by a lever until it surrounds the getter. The fixture moves along with conveyors. After the getter is flashed, the coil is lowered to permit the tube to pass.

New On The Market



Modular Terminal Blocks

HIGH DENSITY WIRING

BASES FOR Termi-Blok are modular 3-circuit common and 6-circuit common insulated cage assemblies, which fit into extruded aluminum track. The cages are tin-plated brass in nylon insulators. Series 3 design accommodates three circuits per inch of track; series 4 has four circuits per track inch.

Stainless steel common spring members accept tab terminals in two thicknesses. No tools are required for terminal insertion or withdrawal. Individual cages can be added by unlocking the end-locks. End locks are fixed in place with a screwdriver.

Current rating is 35 amp, or maximum wire temperature of 105 C; insulation is rated 1,500 v d-c at sea level.

Vibration according to MIL-T-7928C; corrosion resistance and humidity per MIL-T-7928C on a 3-way cage. Manufacturer is AMP Inc., Eisenhower Blvd., Harrisburg, Pa.

CIRCLE 301 ON READER SERVICE CARD

Temperature Cycler

−100 TO +500 F IN 12 MIN

TEMPERATURE chamber, model 1060F, is announced by Delta Design, Inc., 3163 Adams Ave., San Diego 16 Calif. Portable table-top model completes a cycle from −100 to +500 F in less than 12 minutes.

Control accuracy is ±½ F. Test volume is 10 × 7 × 7 in. Unit can be automatically cycled between preset temperatures with a timer. At −65 F consumption of liquid CO_2 is less than 3½ lb per hour. The unit weighs 40 pounds.

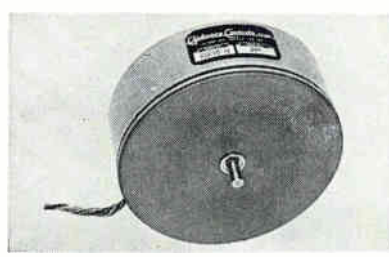
CIRCLE 302 ON READER SERVICE CARD

Shaft Encoders

TO 8,192 COUNTS

SIZE 30 and 50 models of gray code analog digital shaft encoders have high reliability, long life and high accuracy.

Type GSE 50 is 13-bit model, provides total of 8,192 counts per revolution. It has an o-d of 4.875 in. and a length of 1.750 in. excluding shafts. The device is available also with counts per revolution of 2,048 and 4,096. Size 30 models



furnish counts from 256 to 2,048.

Life tests in excess of 10,000 hours at average slew speeds of 500 rpm have shown no appreciable signs of surface damage to the disks, abnormal brush wear, or loss of the readout accuracy of ±½ digit. Units meet or exceed all applicable MIL-specs.

Manufacturer is Guidance Controls Corp., 110 Duffy Ave., Hicksville, L. I., N. Y.

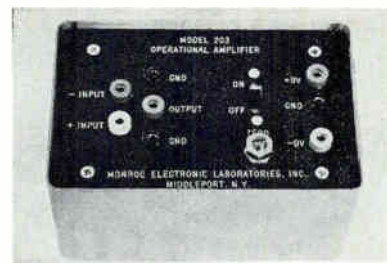
CIRCLE 303 ON READER SERVICE CARD

Operational Amplifier

BATTERY OPERATED

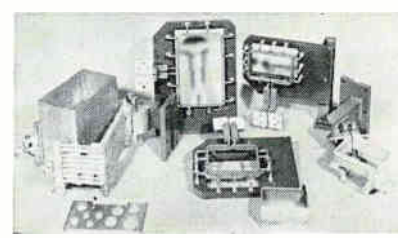
SOLID-STATE, battery-operated, operational amplifier is offered by Monroe Electronic Laboratories, Inc., 33 Vernon St., Middleport, N. Y.

Model 203 is a compact, low cost, transistor unit with open-loop gain greater than 10,000, common-mode



rejection at 60 cps greater than 10,000, unity gain bandwidth of approximately 500 Kc, and voltage drift less than one mv per day under laboratory conditions. It operates off two 9-v batteries, drawing a quiescent current of less than 2 ma, can deliver ±5 volts at 10 ma. Price is $99.50, with batteries.

CIRCLE 304 ON READER SERVICE CARD

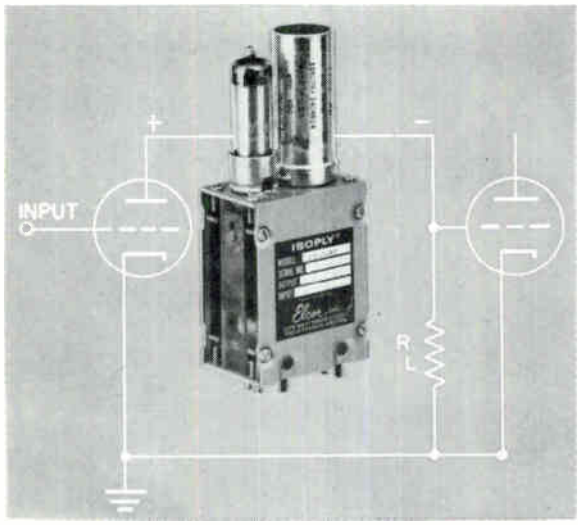


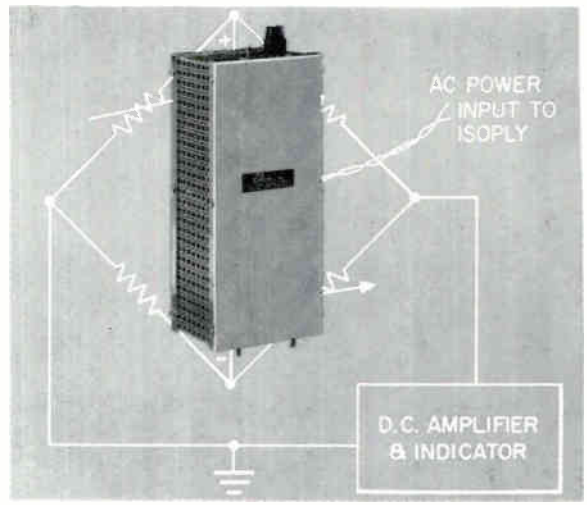
Unsoldering Equipment

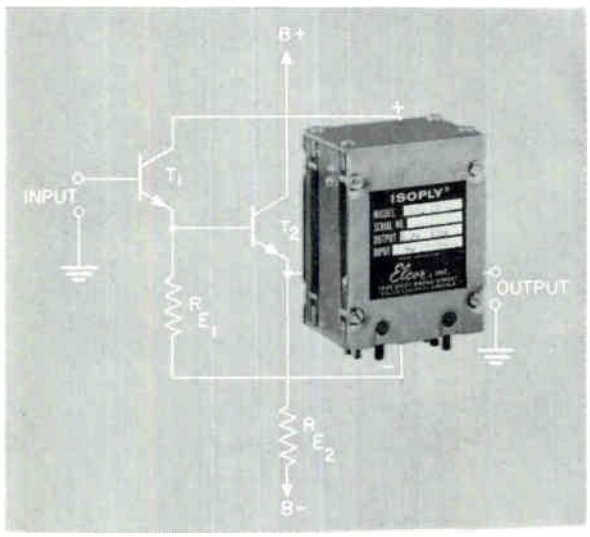
PLANT OR FIELD USE

UNSOLDERING cases containing expensive components can be accomplished with 5-Kw, 450-Kc, induction heating unit.

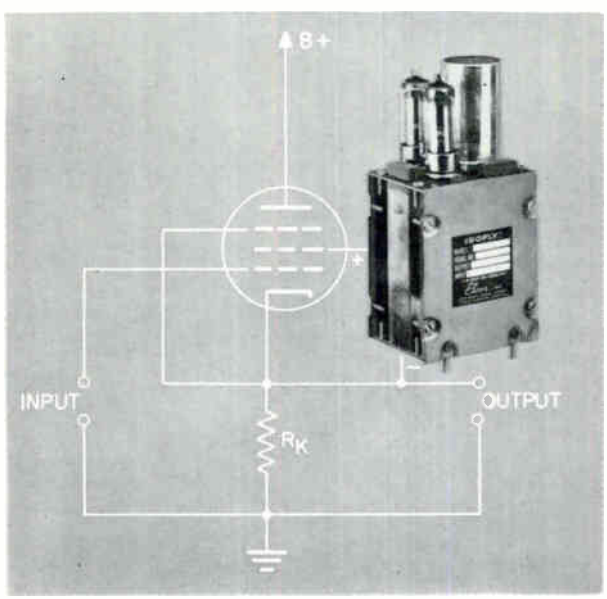
The instrument cases that can be unsoldered are 2 in. by 4 in., 4 in. by 6 in., 6 in. by 8 in., and cylindrical up to 4 in. o-d. All cases are







Circuit designs made simpler and more economical with new Elcor ISOPLYS®



Isoplys (isolated power supplies) can be used ungrounded. Unlike conventional power supplies, Isoplys have low shunt capacitance to ground and low noise in ungrounded applications. They are relatively insensitive to power line fluctuations and give excellent frequency response.

Many components once thought essential in conventional circuits can be eliminated. Design and assembly time can be speeded. Troublesome interaction between circuits is substantially reduced. This also helps simplify maintenance as well as solve difficult circuit problems.

Let Isoplys help simplify a circuit design you are working on now. Be prepared for design problems in the future.

Elcor

write for full information:

ELCOR Incorporated

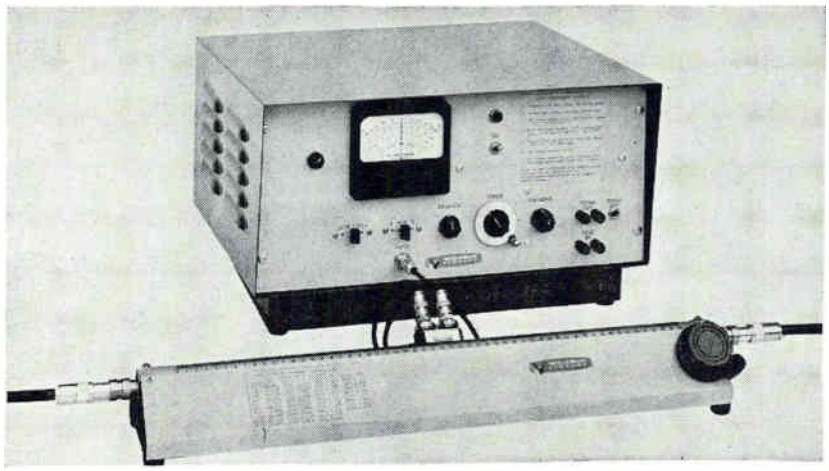
Subsidiary of Welex Electronics Corporation
Sales / R & D Laboratory / Manufacturing
1225 W. Broad Street / Falls Church, Virginia
JEfferson 2-8850

made of thin gage aluminum that is first copper-plated, then tin-plated.

Intermittent heat pulses of approximately 4 seconds on, 4 seconds off allow time for the heat to equalize. Water-cooled jackets provide cooling where required.

Cases shown in the photograph illustrate some applications. Equipment is manufactured by Induction Heating Corp., 181 Wythe Ave., Brooklyn, N. Y.

CIRCLE 305 ON READER SERVICE CARD



Microwave Phase Meter

DIRECT READING: 300 MC TO 4 GC

DIRECT READING microwave phase meter checks relative phase between two signals in 300 Mc to 4 Gc range. Resolution is 0.1 degree. It uses square-law detector response in a standing-wave pattern. The standing-wave pattern is the resultant of the combination of the two signals whose relative phase is being measured.

The phase meter offers a servo output for automatic feedback phase control, can serve as an element of a phase-correcting system. The meter can be adapted for automatic swept-frequency phase measurement with recorder output.

Model 300 is priced at $2,500, 6 week delivery, from Wiltron Co., 717 Loma Verde Ave., Palo Alto, Calif.

CIRCLE 306 ON READER SERVICE CARD

Gain/Loss Measuring Set

UHF, VHF AND MICROWAVE

INSTRUMENT for measuring gain, loss, noise figure and other transmission characteristics of systems and components at uhf, vhf and microwave frequencies is announced by Kay Electric Co., 14 Maple Ave., Pine Brook N. J.

Model 625-A Gain-Set incorporates mixing, i-f amplifying, attenuating, detecting and indicating elements, as well as power supply and control circuits. The set has low noise figure and is highly stable. The signal to be measured feeds a crystal mixer having low noise figure; external mixers, can be used. Dimensions are 16 × 7 × 14 inches; weight is 25 lb. Power is 117 v a-c, 50 watts.

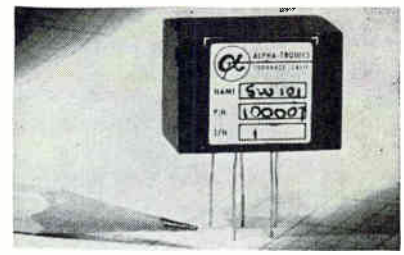
CIRCLE 307 ON READER SERVICE CARD

Low-Level Switch

5-MV RESOLUTION

SOLID STATE low-level switch handles inputs from 0 to ±1 volt with resolution of 5 mv.

Type SW 101 has switching transient of less than 4 mv, switches on command from 0 to 1,000 samples per second. Error band is less than 50 mv and load



can be varied from 1,000 to 10,000 ohms without affecting it. Device requires no external transformer and gating power is less than 2.5 mw. The closed-circuit impedance is less than 100 ohms.

Delivery is 30 days, from Alpha-Tronics Corp., 1033 Engracia, Torrance, Calif.

CIRCLE 308 ON READER SERVICE CARD

Muffin Fan

COMPACT DESIGN

LYTRON, INC., 42 Brookford St., Cambridge 40, Mass. All aluminum heat exchanger with matching fan for efficient rejection of heat from liquid cooled systems. Compact design of coil and fan combination allows multiple stacking of units to handle high heat loads in a minimum space. Lytron "Inner-Fin" construction maintains high heat transfer rates over a wide range of flow and temperature conditions.

CIRCLE 309 ON READER SERVICE CARD

Ultrasonic Solder Pots

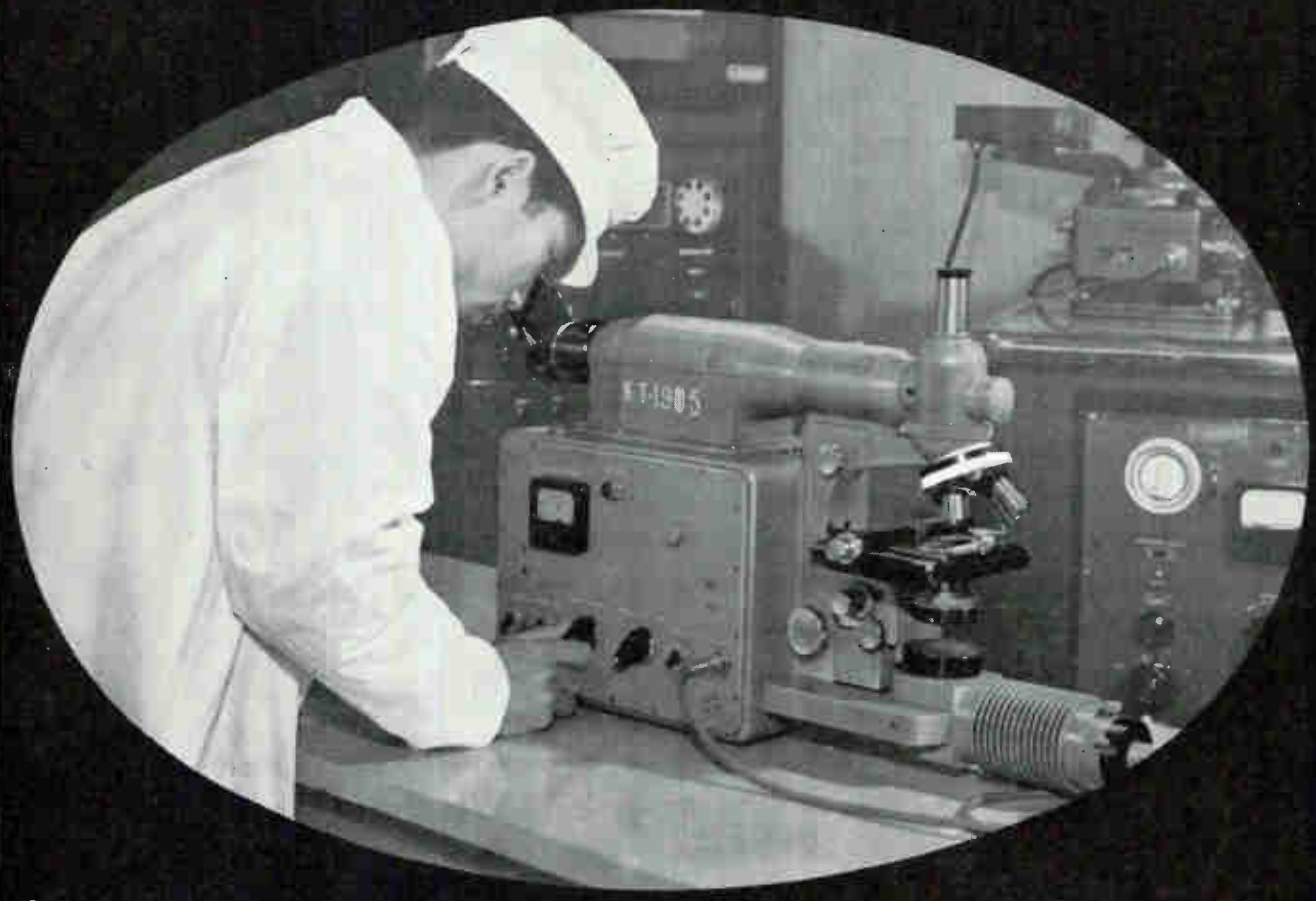
10, 50, 100 WATTS

AVAILABLE in 10, 50 and 100 watt sizes, line of ultrasonic solder pots is announced by Vibro-Ceramics Div., Gulton Industries Inc., 212 Durham Ave., Metuchen, N. J.

Ten-watt model G-10 (genera-

A new tool for the semiconductor industry...

NEC'S INFRARED MICROSCOPE



There has been no device for viewing stress and impurities in silicon crystals. Now NEC's development of the infrared microscope effectively fills this need.
The microscope uses an NEC image tube rated at 1.3 microns, the most sensitive commercially available. When using the 40x objective and 15x ocular lenses, IR magnification is 1,080x.
Solid state applications are inspection of silicon crystals and other intermetalic compounds for stress and impurities. Other applications are in biological and medical research.

INFRONICS at NEC

Since 1954, NEC has been concentrating on industrial applications of infrared energy and is among the leading producers of devices utilizing infrared. In addition to the microscope these include optical pyrometers, night viewers, and a pupiloscope. This year NEC will demonstrate developments in IR communications.

PERFORMANCE

Electrical
Input voltage: 100-115 v. 50 or 60 c/s
Power consumption: 70 watts

Optics
Visible image: 20x to 1,500x
IR image: Naked eye, 40x to 1,080x
Photographic film, 4.3x to 120x

Wavelengths
Visible: 0.4 μ to 0.76 μ
IR: 0.76 μ to 1.3 μ (with filter)

Dimensions (mm.)
Width length height
700 x 180 x 400
Weight: 23 kg.

NEC *Nippon Electric Company Limited.*

Systems / Components

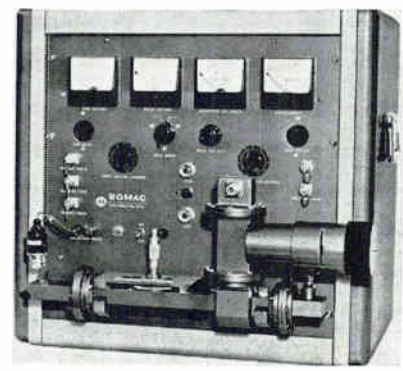
P.O. Box 1, Takanawa, Tokyo, Japan

tor) and SPT-10 (transducer and pot) has interior pot diameter of ⅜ in.; 50-watt model has ½ in. pot; 100-watt has 2 inch pot. Cavitating action cleans and solders simultaneously, without flux.

Capacities of the heating element, as distinct from the generator, range from 20 to 200 watts, depending on the model. Transducers have efficiencies of 80 percent and can operate to 650 F.

Price is $249 for the 10-watt model, including generator; availability is three weeks.

CIRCLE 310 ON READER SERVICE CARD

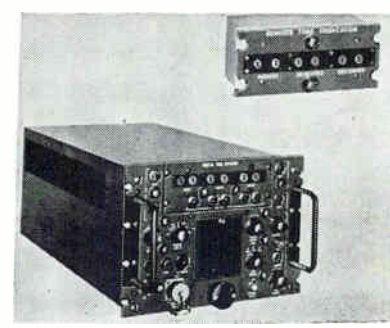


Magnetron Test Set

FOR C- OR X-BAND

BOMAC LABORATORIES, INC., Salem Road, Beverly, Mass. Type BLP-002K is designed for testing beacon magnetrons. The modulator, capable of producing 0.5 and 1.0 μsec pulses having a peak amplitude of 3.0 Kv at 2.0 amp, is provided with an internal trigger source, necessary control and meters, plus test jacks for pulse shape viewing test results through an oscilloscope.

CIRCLE 311 ON READER SERVICE CARD



Timing Set

FOR DATA SYSTEMS

HALLICRAFTERS CO., 4401 W. 5th Ave., Chicago 24, Ill. Time correla-

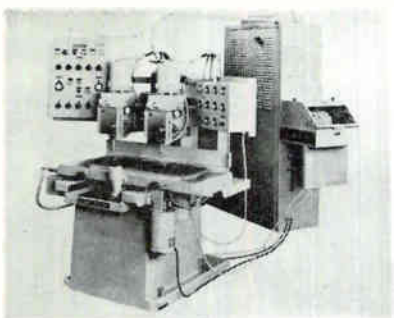
tion of simultaneous recording processes at up to 10 or more separate locations with a precision within ±1 sec per day is provided by the ETS-1 electronic timing set. Basic unit is a self-contained pulse generator, binary-decimal time encoder and 24-hr numerical clock that will control up to 10 remote time indicators while providing composite binary coded time signals and timing marker pulse trains.

CIRCLE 312 ON READER SERVICE CARD

Heat Sink

OWEN LABORATORIES, INC., 55 Beacon Place, Pasadena, Calif. Heat sink for use at the bread-board stage of solid state circuit design holds up to three semiconductors.

CIRCLE 313 ON READER SERVICE CARD



Drilling Machine
TAPE CONTROLLED

LELAND-GIFFORD CO., Worcester 1, Mass. This tape controlled drilling machine is designed to produce the complicated and precise hole patterns required in electronic p-c boards. It employs a modified GE Mark II numerical positioning control with fast tape reader that can be programmed by a Flexowriter or directly from the drilling machine using art work or a sample board. Positioning accuracy is ±0.001 in., non-accumulative, with repeatability of ±0.0005 in.

CIRCLE 314 ON READER SERVICE CARD

Linear Motion Pot
12-IN. STROKE

NEW ENGLAND INSTRUMENT CO., 39 Green St., Waltham, Mass. Linear motion pot has a wire wound element with high resolution and a

standard linearity of 0.05 percent. It is available in any size from 2 to 24 in. in length.

CIRCLE 315 ON READER SERVICE CARD

Resistors

SPRAGUE ELECTRIC CO., 35 Marshall St. North Adams, Mass. For use under conditions of high humidity, epoxy-coated carbon-film resistors rate for full wattage operation at 70 C.

CIRCLE 316 ON READER SERVICE CARD

D-C Amplifier

OPERATIONAL TYPE

EMBREE ELECTRONICS CORP., 933 Farmington Ave., West Hartford 7, Conn. Model B/100/M is a high-gain plug-in type of operation d-c amplifier for analog computers, system simulation, and control applications. It is designed to provide low cost additional amplifier capacity for existing analog computer facilities. Inherent drift is low enough not to require chopper stabilization for many applications. Amplifier case is aluminum with a flat back finish and provides maximum shielding against stray pickup and hum. Output is 6 ma over a range of ±100 v d-c.

CIRCLE 317 ON READER SERVICE CARD

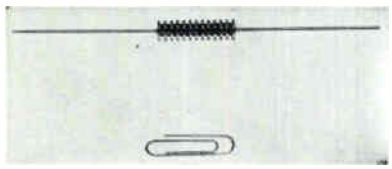
Modularized Filters

SOLID STATE

BAKER MFG. CO., 5660 N. River Road, Marine City, Mich. Solid state modularized filters used in conjunction with ordinary power supplies afford reduction of ripple comparable to the addition of 10-20,000 μf across the line. The E-1015-A unit,

rated at 1 amp to 30 v input, affords a nominal ripple reduction ratio of 50-1.

CIRCLE 318 ON READER SERVICE CARD



Wire-Wound Resistor
HIGH FREQUENCY

REON RESISTOR CORP., 155 Saw Mill River Road, Yonkers, N. Y. High frequency wire-wound resistors can be manufactured with resistance values as high as 1 megohm. The resistors are guaranteed to an accuracy of 0.005 percent. All units in the new line exhibit a rise time of less than 0.2 μsec and a capacitance of less than 0.1 $\mu\mu$f.

CIRCLE 319 ON READER SERVICE CARD

Miniature Delay Line

COLUMBIA TECHNICAL CORP., 61-02 31st Ave., Woodside 77, N. Y. Design for lumped-constant delay lines combines ultracompact packing with high delay-to-rise time ratios.

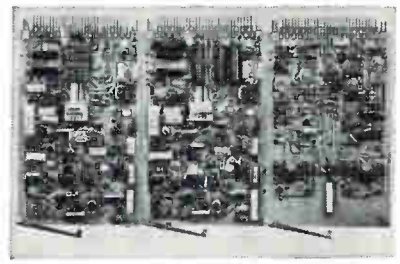
CIRCLE 320 ON READER SERVICE CARD

Spectrum Analyzer
TRANSISTORIZED

POLARAD ELECTRONICS CORP., 43-20 34th St., Long Island City 1, N. Y. Model SA-84T mobile, transistorized, microwave spectrum analyzer covers the frequency range from 10 Mc to 40,880 Mc. It is capable of a number of operations, including spectral measurements, detection and identification of spurious signals, countermeasures analysis,

measurement of the frequency difference of two r-f signals, and testing microwave oscillators.

CIRCLE 321 ON READER SERVICE CARD



Conversion System

A-C TO D-C

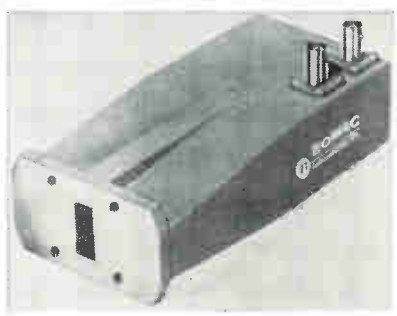
ADAGE INC., 292 Main St., Cambridge 42, Mass., announces an a-c to d-c conversion system implemented with all solid-state precision amplifiers and semiconductor switches. A single channel of a-c/d-c conversion is accomplished with three standard 5 by 8 in. p-c modules; two channels require the addition of only a single extra module. The p-c modules may be combined with any Voldicon voltage digitizer for a wide variety of a-c measurements.

CIRCLE 322 ON READER SERVICE CARD

Building Block

CONTROL EQUIPMENT CORP., 19 Kearney Rd., Needham Heights 94, Mass. Comprised of two transistor-driven high-speed reed relays in one module, the block is used as a switch or gate in digital systems.

CIRCLE 323 ON READER SERVICE CARD



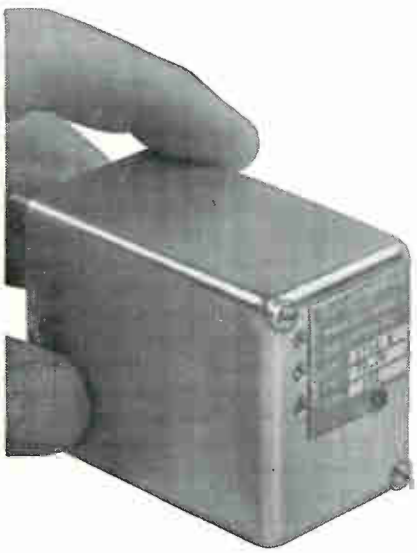
Noise Source

FOR MICROWAVE TESTING

BOMAC LABORATORIES, INC., Salem Road, Beverly, Mass. Compact, rugged X-band gas discharge noise source is designed to measure the noise figure of receivers. Features:

TELEMETRY BY TELE-DYNAMICS

Universal Millivolt Subcarrier Oscillator



For your aerospace telemetry needs here is a new Subcarrier Oscillator with true differential input . . . direct actuation from outputs of grounded or ungrounded thermocouples, strain gage bridges and any transducer with millivolt level output. Other features include isolated input and output, high common mode rejection with no D.C. level restrictions and all silicon semiconductors.

Tele-Dynamics' Type 1254A directly replaces the combination of preamplifier and high-level subcarrier oscillator now used in FM telemetry and assures reliable operation in aerospace environments.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone: TRinity 8-3000.

See this and other new Tele-Dynamics' components in Booth E 50 at the National Telemetering Conference May 22nd, 23rd, 24th at Sheraton Towers, Chicago.

TELE-DYNAMICS
DIVISION
AMERICAN BOSCH ARMA CORPORATION

CIRCLE 205 ON READER SERVICE CARD

---

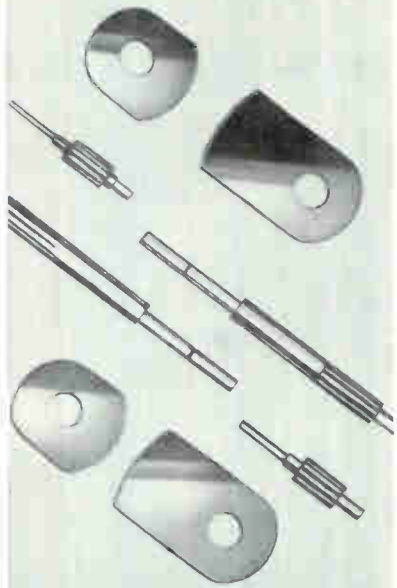
20 to 200 D.P.

Send your prints for quotations

- SPURS
- HELICALS
- WORM AND WORM GEARS
- STRAIGHT BEVELS
- LEAD SCREWS
- RATCHETS
- CLUSTER GEARS
- RACKS
- INTERNALS
- ODD SHAPES

Production of fine-pitch gears of extreme accuracy for all kinds of instruments is a specialty of ours.

FOR INSTRUMENTS



THE *Finest* IN GEARS

Beaver Gear Works Inc.

1021 PARMELE STREET, ROCKFORD, ILLINOIS

MEMBER OF AGMA

CIRCLE 204 ON READER SERVICE CARD

MINIATURE Electrolytic CAPACITORS

Time Tested Quality

- Wide range of capacities and voltages.
- Excellent low temperature characteristics.
- Stable, low leakage, high temperature characteristics.
- Rugged, excellent under severest operating conditions.
- Non-polarized types available for audio, cross-over, and other AC applications.

SMT and SMTU

Aluminum case with patented construction, molded bases with thermoset plastic and silicone rubber seals. Hermetic sealing for wide temperature applications. Supplied with transparent plastic insulating sleeves.

SMT-AXIAL LEAD

Temperature:
−30°C to +65°C
−40°C to +85°C
−30°C to +105°C

SMTU
Upright Mounting

BMT and BMTU

Plastic cased with thermoset resin end fill; available in two temperature ranges. Economically priced.

BMT-AXIAL LEAD

Temperature:
−30°C to +65°
−40°C to +85°C

BMTU
Upright Mounting

Types SMTU and BMTU are available in multiple section units in common cathode and common anode. We invite your inquiry.

ILLINOIS CONDENSER COMPANY
1616 N. Throop Street Chicago 22, Illinois
Telephone: EVerglade 4-1300
Export: 15 Moore St New York 4 New York

"Foremost manufacturers of Electrolytic Capacitors for almost 30 years"

CIRCLE 111 ON READER SERVICE CARD

The termination, usually attached externally as an accessory, is included within the waveguide. The entire unit, exclusive of waveguide, is epoxy-resin potted to secure tube, leads, and other parts within the housing.

CIRCLE 324 ON READER SERVICE CARD

Gold Saver

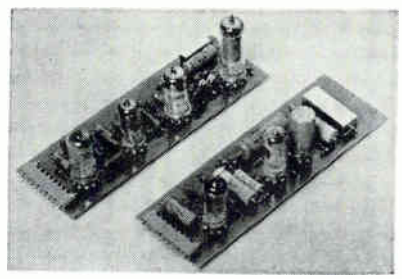
TECHNIC, INC., P. O. Box 965, Providence, R. I. Cyanide or alkaline gold, which formerly was lost in the conventional plating process, is recovered by resin charges.

CIRCLE 325 ON READER SERVICE CARD

Surge Controller
PLUG-IN DEVICE

HOLLYWOOD TELEVISION CO., 1949 Moffett St., Hollywood, Fla. Model 20-100 Surgitron is a plug-in device for effectively controlling "turn on" surge currents in television sets, hi-fi equipments, and any other applications where greatest strain occurs when the power switch is first turned on. The device consists of a rugged wire wound surge resistance that is automatically shunted out after the initial surge current has dropped off. Price is $.30 (10,000 and up).

CIRCLE 326 ON READER SERVICE CARD



D-C Amplifier
OPERATIONAL TYPE

RAYMOND ATCHLEY DIVISION, American Brake Shoe Co., 2339 Cotner Ave., Los Angeles 64, Calif. Chopper stabilized d-c amplifier com-

bines flexibility with performance to provide versatility and dynamic accuracy. High gain maintained over a wide band makes the unit ideal in analog computation and control system applications that demand precision at high speed. Output is ±100 v with a 10,000-ohm load and will operate at 75 ma positive output and pulses to 200 ma. Output can be short-circuited without damage. A gain of 125,000 is available from 5 to 500 cps, and the gain is 10^8 at d-c.

CIRCLE 327 ON READER SERVICE CARD

Miniature Switches
WITH POTTED LEADS

THE MILLI-SWITCH CORP., Gladwyne, Pa., announces that it can supply potted leads on its entire line of precision miniature switches. The leads, shown here on a B-PL Milli-Switch, are intended to provide a strong, positive joint with low-temperature solder. All basic switches in the line conform to MIL-S-6743.

CIRCLE 328 ON READER SERVICE CARD

Distortion Oscillator

KROHN-HITE CORP., 580 Massachusetts Ave., Cambridge 39, Mass. A 1 cps to 100 Kc oscillator features 0.01 percent amplitude stability and only 0.01 percent distortion.

CIRCLE 329 ON READER SERVICE CARD

Amplitude Modulators
SEVEN MODELS

RANTEC CORP., Calabasas, Calif., announces a series of Faraday rota-

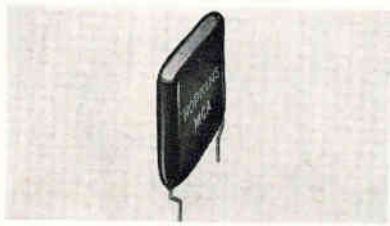
tion amplitude modulators. The units can also be ordered as suppressed carrier balanced modulators or as reciprocal modulators, as variable attenuators and switches. At a given frequency in the specified band, the units will produce an attenuation range of 0.5 db max to 25.0 db min. Models are available in seven different ranges from 2.6 to 18 Gc.

CIRCLE 330 ON READER SERVICE CARD

Positioning Fixture

NORMAN EPSTEIN, R. D. 2, Carmel, N. Y. The Robot-Vise has from one to three arms, each terminating in a machinist's clamp that can bear a weight up to ten pounds.

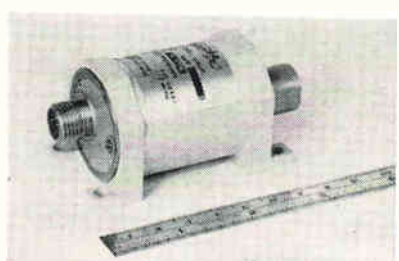
CIRCLE 331 ON READER SERVICE CARD



Capacitors
EXTREMELY THIN

HOPKINS ENGINEERING CO., 12900 Foothill Blvd., San Fernando, Calif., announces a line of miniature Mylar-epoxy dipped capacitors which feature an ultra-thin shape to fit into narrow chassis spaces. Units are suited for p-c and transistor applications. A typical 0.01 μf unit measures 0.525 in. wide, and is only 0.225 in. thick. Excellent temperature stability results in a capacitance change of only 1.5 percent at 85 C.

CIRCLE 332 ON READER SERVICE CARD



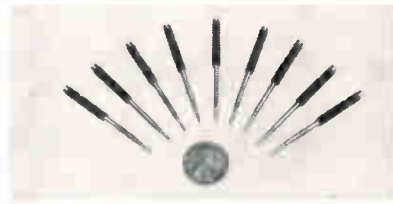
Pressure Transducers
LIGHTWEIGHT

DAYSTROM-WIANCKO ENGINEERING CO., 255 N. Halstead St., Pasadena,

CIRCLE 209 ON READER SERVICE CARD

Calif. Small size and low power requirement of the P2-3000 series variable-reluctance d-c pressure transducers are suited to applications with critical weight limitations. Type P2-3076, for pressure ranges up to 5,000 psig, weighs 5 oz and requires only 3 ma at 28 v d-c for 0 to 5-v d-c output. Low output impedance (1,000 ohms) and mutually isolated input, output and ground circuits minimize noise problems on long lines.

CIRCLE 333 ON READER SERVICE CARD



Galvanometer

HIGH FREQUENCY

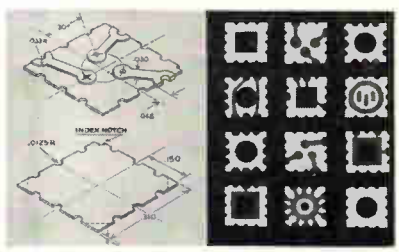
CENTURY ELECTRONICS & INSTRUMENTS INC., P. O. Box 6216, Pine Square Station, Tulsa 10, Okla., has developed a light-beam recording galvanometer having a natural frequency of 13,000 cps. The h-f unit is one of a line of galvanometers designated model 212 series. The line features high sensitivity and 2 percent linearity in most frequency ranges for deflections to 8 in. peak-to-peak.

CIRCLE 334 ON READER SERVICE CARD

Divider-Combiner

RADAR-COMBINER CORP., Pickard Dr., Syracuse 11, N. Y. Coaxial power divider-combiner divides input power equally between two mutually isolated outputs.

CIRCLE 335 ON READER SERVICE CARD



Micromodules

METALLIZED

MITRONICS, INC., 1290 Central Ave., Hillside, N. J. Micromodules with thicknesses from 0.010 in. up are

made from 96 percent alumina and metallized with molybdenum manganese and various techniques of plating which make parts suitable for soldering or brazing. They are suitable for hermetic seals. Intricate and mechanized circuitry may be applied by screening and other methods.

CIRCLE 336 ON READER SERVICE CARD

Contact Protectors

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Eight subminiature diode contact protectors, voltage range from 30-300 v, eliminate arcing and erosion across miniature relay contacts.

CIRCLE 337 ON READER SERVICE CARD

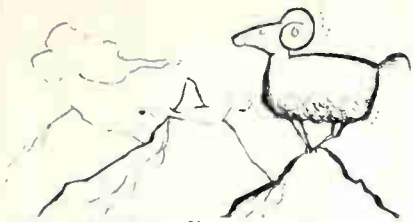
Silicon Diode
HIGH-SPEED

RHEEM SEMICONDUCTOR CORP., 350 Ellis St., Mountain View, Calif. High-frequency silicon diode JAN 1N251 is available per MIL-E-1/1023. It features nanosecond switching and low leakage for critical logic, detector and other h-f applications. It provides 0.15 μsec reverse switching time; 0.1 μa d-c reverse current at $-$ 10 v; 1.0 v d-c forward voltage at I_F of 5 ma; 150 mw power dissipation and 30 v reverse voltage.

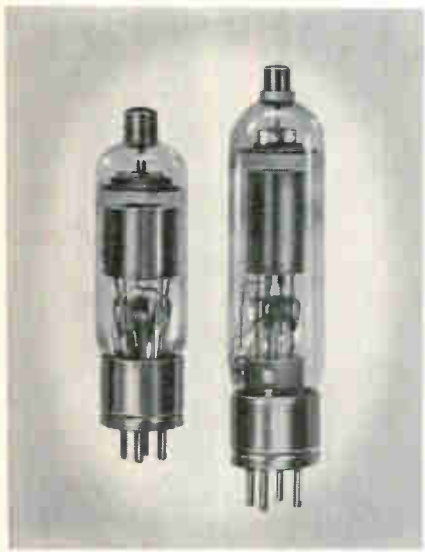
CIRCLE 338 ON READER SERVICE CARD

Telemetry Equipment
DIVERSITY COMBINERS

GULTON INDUSTRIES, INC., 212 Durham Ave., Metuchen, N. J., an-



ALWAYS BETTER ON THE "PEAKS"



CETRON GASEOUS RECTIFIERS

★ Better Peak Inverse Voltage!
★ Better Peak Current Ratings!

The Cetron 6013/3B and 5892/6B Xenon rectifier tubes shown here are typical of this outstanding line of full and half-wave rectifiers.

Meet Your Requirements With The Full Line Of Dependable Cetron Xenon, Mercury Vapor and Vacuum Rectifiers.

	6013 3B	5892 6B
Peak Inverse Voltage	1000	1250
Peak Current, Amps	25.0	77.0
Average Current, Amps	3.0	6.4
Filament Voltage	2.5	2.5
Filament Current	9.0	21.0

Cetron Rectifiers are capable of meeting all requirements of JAN Military specifications.

Cetron Engineers are available to assist in your tube requirements.

BE CERTAIN WITH CETRON—FOR THYRATRONS, RECTIFIERS, TRIODS AND PHOTO CELLS

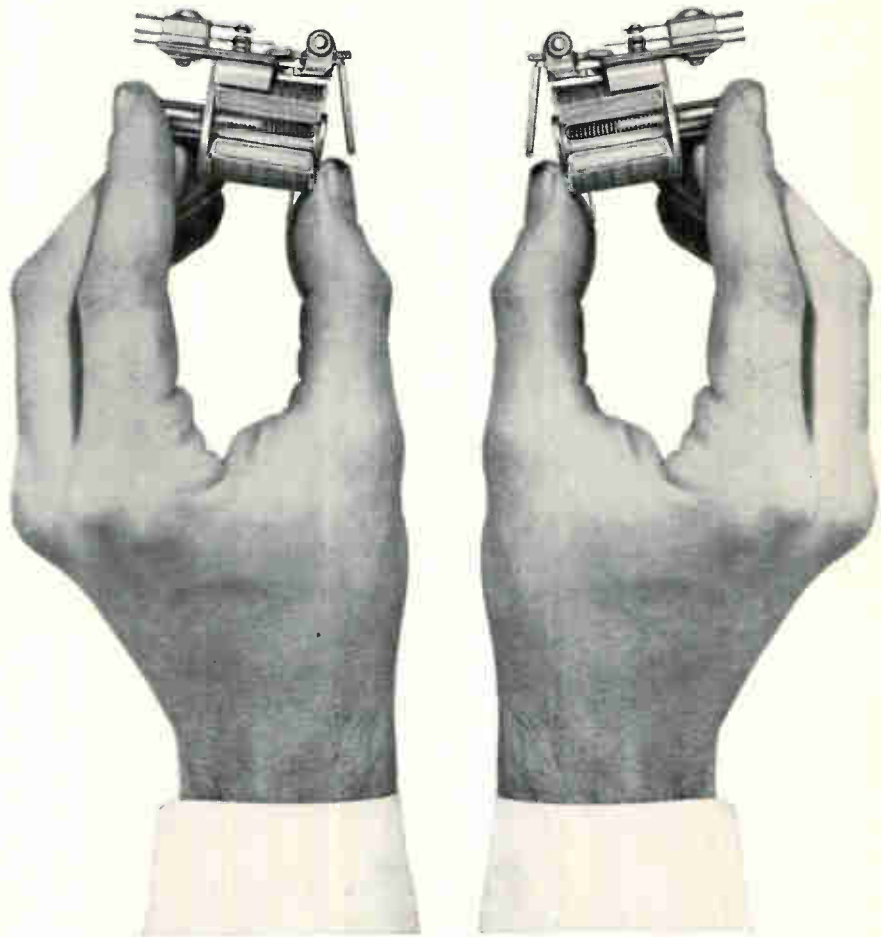
CETRON ELECTRONIC CORPORATION

715 Hamilton Street • Geneva, Illinois

CIRCLE 214 ON READER SERVICE CARD

May 12, 1961

DELAY RELAY? LOAD RELAY? BOTH!



The Type A Silic-O-Netic Relay is a light, small time-delay relay. *It weighs a mere three ounces, gives you any delay you spec from 0.25 to 120 seconds. Keeps at it, too, for several million operations; the time-delay element cannot stick, bind, or wear.*

The Type A Silic-O-Netic Relay is a light, small load relay. *The continuous-duty coil does the trick. The Silic-O-Netic can be energized continuously, eliminating lock-in auxiliary circuits. Saves wire. Saves work. Saves space. Saves money.*

Here, then, is a time delay relay that doubles as a load-carrier. The Type A offers SPDT or DPDT switching, with contact capacity up to three amps. Consumes, at most, two watts of AC power, three watts of DC. Available for use on one of twenty standard AC and DC operating voltages, and on request, for others. Costs far less than the two relays you would need to replace it; well worth a closer look. Write for Bulletin 5003.

HEINEMANN ELECTRIC COMPANY

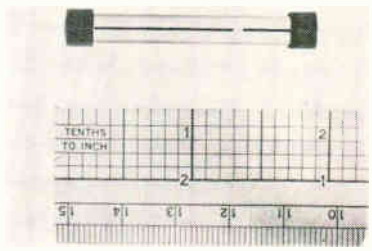
176 BRUNSWICK PIKE TRENTON 2, NEW JERSEY

SA 2377

CIRCLE 121 ON READER SERVICE CARD 121

nounces telemetry diversity combiners in three models. Used as accessory equipment to improve signal-to-noise ratios for telemetering systems, the combiners are designed to handle most types of signals, including pcm/f-m, pdm/f-m and f-m/f-m with bandwidths up to 5 Mc. The combiner has 2, 3 and 4 channel configurations.

CIRCLE 339 ON READER SERVICE CARD



Ampere Hour Meter
MINIATURIZED

CURTIS INSTRUMENTS, INC., 45 Kisco Ave., Mount Kisco, N. Y. Model 100 direct-reading miniature ampere hour meter operates with negligible current. The device integrates time vs current by electrolysis between mercury electrodes. Suggested uses include a battery life indicator, an elapsed time meter and a combined integrator and indicator for analog devices.

CIRCLE 340 ON READER SERVICE CARD

Capacitor

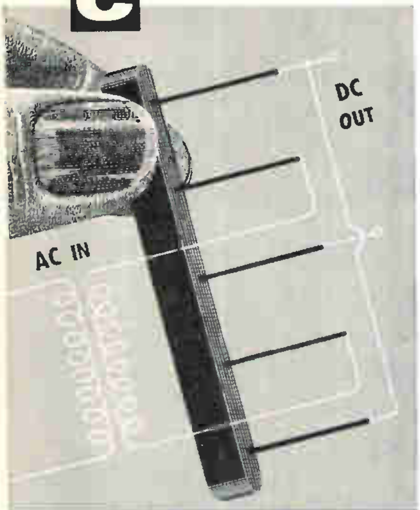
SPRAGUE ELECTRIC CO., North Adams, Mass. Tantalex Feed-Thru capacitor features effective bypassing of r-f interference on low voltage d-c power circuits.

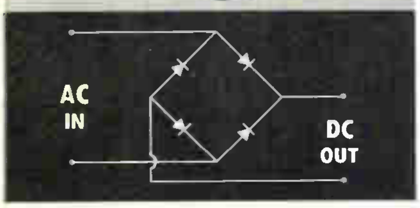
CIRCLE 341 ON READER SERVICE CARD

Film Viewer
WIDE-SCREEN

THE GEOTECHNICAL CORP., 3401 Shiloh Road, Garland, Texas, has available a 16 mm film viewer that

C C NEWS





Packaging Versatility

in Value-engineered Epoxy Encapsulated Silicon Diodes

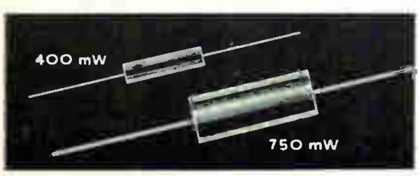
When your design requirements are for multiple diodes in **one** high-quality package, we've got the best answer. Example shown — ¼″ x ¼″ x 2.75″ — is a full-wave bridge containing 4, 1000-PIV sections. The unit is also basic to the 3-Φ voltage doubler. The economy of such packaging is readily seen.

CONTROLS COMPANY OF AMERICA

ELECTRON DIVISION

811 West Broadway Road
P.O. Box U Tempe, Arizona

Write for catalog sheets and quotations on our full line of epoxy encapsulated devices.



CIRCLE 227 ON READER SERVICE CARD

DRAWING BOARD NEWS......... No. 2

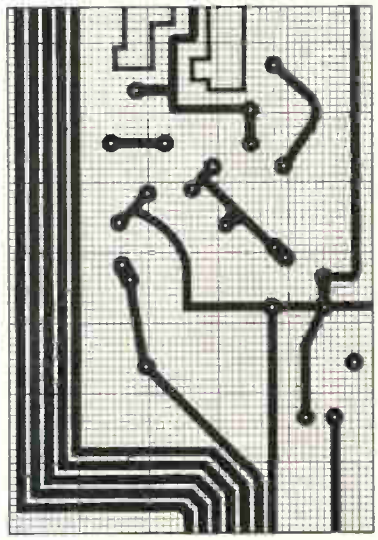
Published by Chart-Pak, Inc., originator of the tape method of drafting

CHART-PAK DIE-CUT PRINTED CIRCUIT SYMBOLS CUT TEDIOUS DRAFTING

You don't have to *draw* all the circles, ovals, fillets, teardrops, elbows, tees and radii for printed-circuit master drawings, anymore.

Chart-Pak brings them to you die-cut from pressure-sensitive black crepe paper — a thousand in each handy, low-cost roll. You just strip them off a convenient split backing—*press them down!*

You get accurate, opaque, non-reflective symbols that reproduce perfectly. You make revisions easily, yet Chart-Pak doesn't come off by itself. Ten symbols available, in many decimal sizes.



Circuits "Tape-Up" Fast on Chart-Pak Precision Grid

Crisp, clean lines make it easy to position Chart-Pak symbols and tapes, precisely, on this grid. Distances between any two lines are guaranteed accurate within plus or minus .005″.

Chart-Pak precision grids are printed on tough, stable .0075″ DuPont "Mylar"® — can be used over and over again. Available with 30″ x 20″ grid area; 8 or 10 lines per inch.

Conductor Paths come in a roll, too!

Chart-Pak circuit tapes give you fast, "inkless" conductor paths (1/32″ or wider) — accurate to plus or minus .002″ in width.

New! "Tape-Saver" Package

Available all-black — also in white-back tape, handy for registering two circuits, back to back, on a Precision Grid. (You see white, but it disappears when photographed against white background.)

◀ **Write for new Chart-Pak Catalog of pressure-sensitive materials that simplify drafting.**

CHART-PAK, INC.
ORIGINATOR OF THE TAPE METHOD OF DRAFTING
161 RIVER ROAD, LEEDS, MASS.
Dealers in principal cities

CIRCLE 216 ON READER SERVICE CARD

Coils for Contact Capsules

TYPE	DC-V	Ohms	Nom. Watts	Nom. Amp/ Turns
S	6 12 24	100 360 1400	.40	250
M	6 12 24	50 175 820	.70	250
T	6 12 24 32 48	100 400 1600 2800 4600	.35	125

Coto-Coils

COTO-COIL CO., INC.
65 Pavilion Avenue
Providence 5, R. I.

Write for Bulletin and Prices

CIRCLE 123 ON READER SERVICE CARD

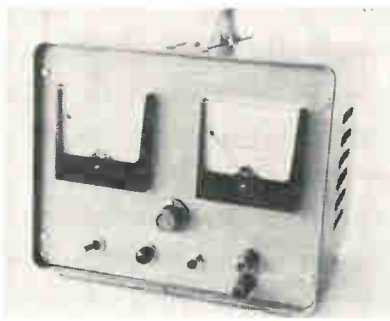
features a motorized film drive, a remote operator control, and data magnified 20 times on a large viewscreen. The operator can locate data of interest quickly by using a pushbutton to traverse the film in either direction at 120 cm/sec.

CIRCLE 342 ON READER SERVICE CARD

Pulse Generator

GENERAL APPLIED SCIENCE LABORATORIES, Merrick and Stewart Avenues, Westbury, N. Y. Pulse generator has a frequency range of 1 to 20 Mc in three overlapping ranges and a rise and fall time of less than 0.006 μsec.

CIRCLE 343 ON READER SERVICE CARD



Low Resistance Meter
TRANSISTORIZED

LYTEL CORP., 1404 San Mateo S. E., Albuquerque, N. M., announces a circuit resistance meter that measures from 0 to 200 milliohms. It features an exclusive meter safing circuit. Applications: Quality control of p-c boards by high current through hole plating and printed circuit measurements, locating high resistance solder joints in cable assemblies, and other low resistance measurements.

CIRCLE 344 ON READER SERVICE CARD

Voltage Divider
TRANSFORMER-TYPE

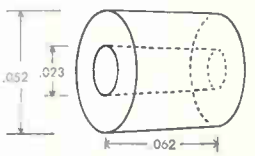
ELECTRO SCIENTIFIC INDUSTRIES, 7524 S.W. Macadam Ave., Portland 19, Ore. Model DT-72 transformer-type a-c decade voltage divider provides certified linearities starting

GLASS BEADS BY THE BILLIONS

AT SUBSTANTIAL SAVINGS

Recently perfected, new production techniques have resulted in a superior glass product at significantly lower cost to you. Quality of bead cut assures more uniform glass-to-metal seal. Parts supplied clean, ready for production line use.

O.D. —.049 to .055
I. D. — .021 to .025
LENGTH — .062 ± .005
MATERIAL: Soft Glass - KG - 12 or G - 12 Glass



PRICE: $1.25 /M (F.O.B. Destination U.S.A.)

OTHER QUALITY GLASS PRODUCTS ALSO AVAILABLE FROM THIS RELIABLE WEST COAST SOURCE

Hanibal offers a complete range of semiconductor glass housings. Prompt quotations will be supplied on glass parts fabricated to your custom specifications. Brochures covering the full range of Hanibal's precision glass housing are available on request.

Hanibal GLASS, INCORPORATED

PRECISION DRAWN GLASS TUBING AND ROD

3025 South Kilson Drive
Santa Ana, California
Kimberly 9-0371

CIRCLE 218 ON READER SERVICE CARD

Are you selling the whole buying team

Tough competition *demands* that the electronics man be reached and *sold* wherever you find him: *Research, Design, Production, and Management.* Only advertising in electronics reaches all four... the same men your salesmen call on. Put your advertising where it works *hardest* . . . .

in **electronics**

MEASURE DISPLACEMENT WITH HIGHER OUTPUT VOLTAGES AND LOWER REACTION TORQUE...

GIANNINI CONTROLS SIGNAL GENERATORS

Because of balanced magnetic structure and small air gaps, **Giannini Controls' Signal Generators** translate displacement into ac voltages with higher output voltages and lower reaction torque than differential transformers. Infinite resolution. No slip rings or brushes. Low impedance. Integral demodulator available for dc output. Rotary and linear models. Use to transduce position, force, weight, velocity, acceleration. **When it's from Giannini Controls you get it on time, it works when you get it, and it keeps on working.** For additional information on Signal Generators request data sheet SGC-15-1-1.

Giannini Controls Corporation
A NAME TO PLAN WITH
1600 South Mountain Avenue, Duarte, California
SERVO COMPONENTS & SYSTEMS • AIR DATA INSTRUMENTS & SYSTEMS
INERTIAL INSTRUMENTS & SYSTEMS
Sales engineering offices: Glendale • Caldwell, N. J. • Pasadena • Denver • Palo Alto • Seattle • New York
Chicago • Dayton • Washington, D. C.
GCC 1-24

CIRCLE 125 ON READER SERVICE CARD

at ½ ppm at the larger dial settings and improving to better than 1/100 ppm at the small settings. All units are certified for use as a primary ratio standard in terms of an ESI standard traceable to the National Bureau of Standards. Units may also be certified directly by the NBS.

CIRCLE 345 ON READER SERVICE CARD

Transmitter Adapter
SINGLE-SIDEBAND

KAHN RESEARCH LABORATORIES, INC., 81 South Bergen Place, Freeport, L. I., N. Y., is producing a ssb transmitter adapter capable of operation from 1 to 50 Mc. Unit not only covers standard h-f communications bands but also makes practical high efficiency Class C ssb operation, utilizing the EER system for scatter transmission. Existing or brand new a-m transmitters may be easily adapted to produce peak envelope power of from 3 to 4 times their carrier rating for ssb operation.

CIRCLE 346 ON READER SERVICE CARD

Power Varactors
IN SUBMINIATURE CASE

MICROWAVE ASSOCIATES, INC., Burlington, Mass., has introduced a series of 55 silicon power varactors housed in a hermetically sealed, reversible cartridge for a wide variety of applications in the 1 Mc to 10,000 Mc region. Wide scale use is anticipated in h-f/vhf/uhf and microwave communications transmitters and receivers, radar transmitters, beacon transmitters, and test equipment.

CIRCLE 347 ON READER SERVICE CARD

Literature of

TAPE RECORDER Mnemotron Corp., 3 North Main St., Spring Valley, N. Y. Folder describes a two-channel analog data tape recorder/reproducer system.
CIRCLE 348 ON READER SERVICE CARD

POWER SUPPLIES Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. The company *Journal* reports the development of two power supplies for high power semiconductor work which can limit their output currents to selectable values.
CIRCLE 349 ON READER SERVICE CARD

TRANSLATOR Adler Electronics, Inc., 1 LeFevre Lane, New Rochelle, N. Y. A vhf tv heterodyne translator, VST-1, is described in a single data sheet.
CIRCLE 350 ON READER SERVICE CARD

HYBRIDS Microwave Development Laboratories, Inc., 15 Strathmore Rd., Natick, Mass. Bulletin gives mechanical and electrical characteristics of sidewall short-slot hybrids.
CIRCLE 351 ON READER SERVICE CARD

INERTIA SWITCHES Inertia Switch Inc., 311 W. 43rd St., New York 36, N. Y. Data sheet describes typical inertia switches and lists applications.
CIRCLE 352 ON READER SERVICE CARD

THERMOCOUPLES Cryogenics, Inc., Stafford, Va., has issued a bulletin which discusses gold-cobalt/copper thermocouples.
CIRCLE 353 ON READER SERVICE CARD

METALS & JEWELS A. & M. Fell Limited, 1 Lambeth High St., London, S.E.1, England. "Transistor Engineering in Metal & Jewels" covers synthetic ruby for alloying molds, jig handling, and measuring equipment.
CIRCLE 354 ON READER SERVICE CARD

IN-CIRCUIT TESTING Molecular Electronics, Inc., a subsidiary of Precision Circuits, Inc., 87 Weyman Ave., New Rochelle, N. Y. A 12-page guide, written by the company president, discusses in-

the Week

circuit testing with particular application to diodes, rectifiers and transistors.

CIRCLE 355 ON READER SERVICE CARD

TELEMETRY RECEIVER Vitro Electronics, 919 Jesup-Blair Drive, Silver Spring, Md. Data sheet describes an f-m crystal controlled phase-lock telemetry receiver for satellite tracking.

CIRCLE 356 ON READER SERVICE CARD

TRANSFORMERS Sola Electric Co., Elk Grove Village, Ill. Bulletin lists advantages of standard sinusoidal constant voltage transformers.

CIRCLE 357 ON READER SERVICE CARD

VOLTMETER Ballantine Laboratories, Boonton, N. J., has published a brochure on voltmeter 317 which measures 300 microvolts to 300 volts at frequencies from 10 cps to 11 Mc.

CIRCLE 358 ON READER SERVICE CARD

PHASE ANGLE ANALYZER Ad-Yu Electronics Lab., 249 Terhune Ave., Passaic, N. J. Bulletin gives specifications and suggests applications for Vectorlyzer, type 202.

CIRCLE 359 ON READER SERVICE CARD

CATHODE TUBES Raytheon Co., 55 Chapel St., Newton 58, Mass. A 12-page handbook for equipment design engineers charts specifications for industrial and military cathode subminiature electron tubes.

CIRCLE 360 ON READER SERVICE CARD

CERAMICS CHART American Lava Corp., Manufacturers Rd., Chattanooga 5, Tenn. Chart No. 611 provides engineers with mechanical and electrical properties of AlSiMag ceramics.

CIRCLE 361 ON READER SERVICE CARD

LAMINATED PLASTICS Continental-Diamond Fibre Corp., Newark, Del. Twenty-page catalog covers grade selection, sizes, and property values of industrial laminated plastics in sheet, rod and tube form. Please write directly to the company for copies.

PARTS SHOW

Poncher: think and plan big

ELECTRONIC parts distributors will have to think and plan big if they want to share and survive in the booming industrial electronic parts business, says the number one man behind the Parts Show week after next in Chicago's Hilton Hotel.

Since manufacturers are merging all over the place, so should distributors, says Sam Poncher, president of Electronic Industry Show Corporation.

As president of Newark Electronics Corp., one of the biggest U. S. distributors of industrial electronic parts, Poncher has been involved in wrapping up details of a merger which promises to bring $4½ million additional sales to his company (details were due to be announced Wednesday.)

An early and leading advocate of exclusive franchises, Sam is also one of the leaders behind the trend toward winning distributors a bigger share of the industrial electronic parts market.

"After hammering away for the past 15 years, we've finally convinced most manufacturers producing industrial items that we can really do a better job of handling inventories and small orders than they can," Poncher says.

More than half of U. S. manufacturers of industrial electronic parts will take part in this year's new seventh floor industrial conference. "We expect this section to take a whole floor by next year," Sam adds. "No doubt it will become a permanent part of future shows."

Electronic parts business has grown even faster than anticipated because new industries in transistors and computers have added their business to replacement and repair volume in the non-industrial sector, reports Poncher. He believes the industry can only continue to grow and that parts distribution business can only do even better.

Poncher got his start like most other distributors, traveling around to manufacturers, buying up their surplus and discontinued parts and worrying about the credit risks associated with an exclusively dealer-service business.

Shortly after buying his firm with his brother in 1934, Sam began astonishing broadcast stations, airlines and other industrial users by personally soliciting their business. "We had this industrial market pretty much to ourselves until the time our catalogue went national—about 1940," he says.

Year-to-year comparisons reflecting growth of Newark Electronics are hard to make because the company switched last year from a calendar year to an August 31 fiscal year. Thus 1960 figures are for eight months, instead of 12.

In the shortened period of 1960 the company showed dollar earnings of $166,082, slightly better than $161,092 earned during the full 12 months of 1959.

Sales for the first six months of the current fiscal year were $6,691,-521, an 18-percent rise over $5,-664,538 in first half of last year.

Profits were $133,211, a 52-percent increase over $87,776 reported for the first half of 1960.

Poncher expects to do even better in the second half, "especially if the economy turns up as expected. We should hit at least $15 million in sales for the year."

A network of 16 full time sales offices, recently opened from New York to California, supplies his firm with readings of the sales and profit potentials of a region, spots local companies which might be likely targets for the mergers Poncher preaches as a necessity for survival. Economic shakeout may leave as few as 200 efficiently operated electronic parts distributors for the future, he believes.

Following his own advice to think big, Sam has been sponsoring his own parts show for 14 years. Last year's edition was attended by 68 suppliers, cost him $25,000.

Five-year target for Newark Electronics is to be five times as large as today. Although Sam says he won't be happy until his company is doing a minimum of $50 million in annual sales, his real aim looks more like $100 million.

Resdel Engineering Hires A. F. Boscia

ARCHIE F. BOSCIA has been named chief engineer of Resdel Engineer-

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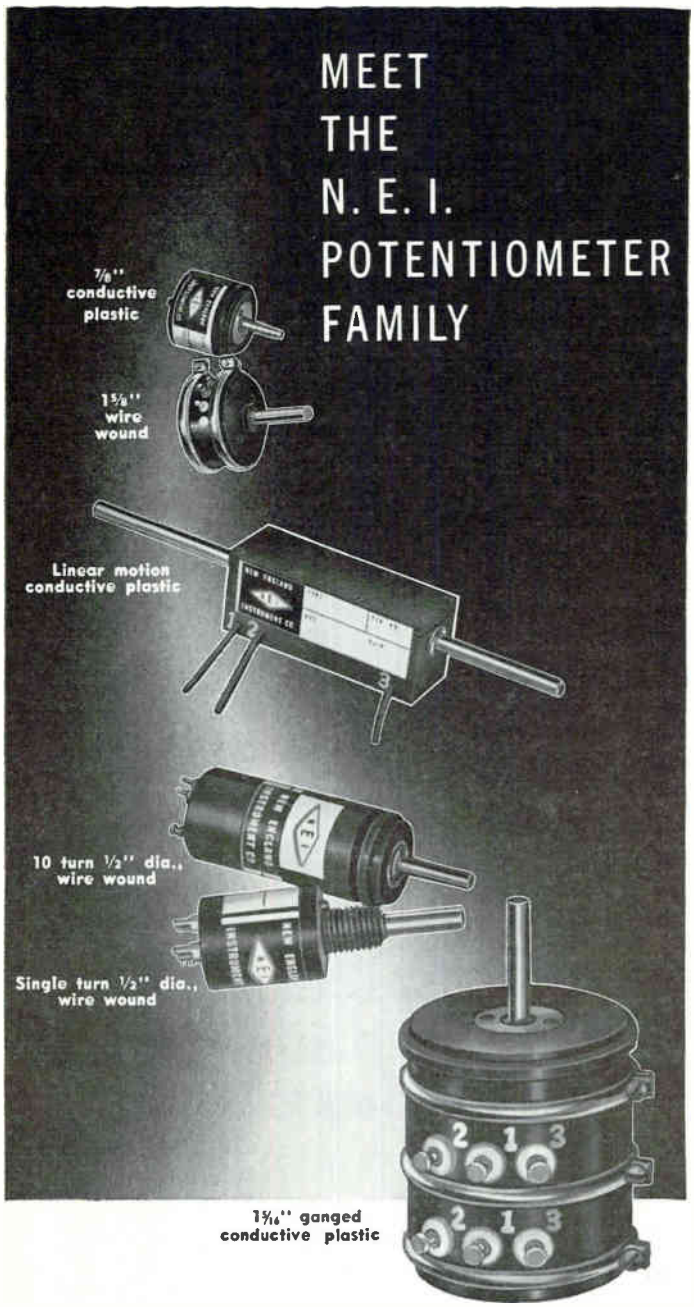

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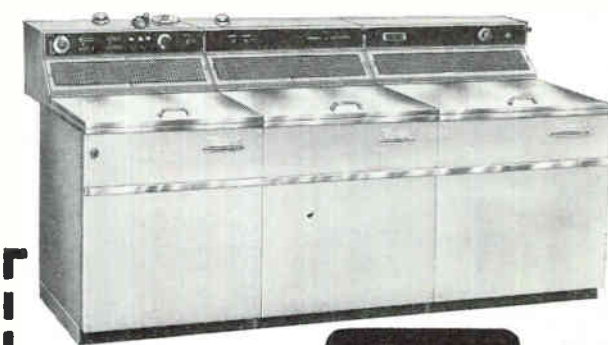

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CIRCLE 133 ON READER SERVICE CARD

ing Corp., Pasadena, Calif. Company specializes in R&D and the manufacture of vhf, uhf equipment with ultraphase stability.

Boscia was formerly associate director of R&D at Collins Radio Co., Burbank, Calif.

GE's Gifford Named JTAC Member

RICHARD P. GIFFORD, manager of engineering for the General Electric Communication Products Department, Lynchburg, Va., has been appointed a member of the Joint Technical Advisory Committee of the IRE and EIA.

The committee evaluates technical and engineering information relating to the radio art. It advises government bodies and industry and professional groups.

Gifford previously had served on a number of JTAC subcommittees on communications, including the recent Ad Hoc Subcommittee on Space Communications.

Astrosonics Forms Laboratory Division

CREATION of Astrosonic Development Laboratories, a division of Astrosonics, Inc., has been announced by John Perkins, president of the Syosset, L. I., developer and manufacturer of sonic products for industry and government.

William K. Fortman has been named director of research for the new division.

Gulton Industries Hires Group Manager

MAX LOWY has been named manager of systems integration for Gulton Industries, Inc., Metuchen, N. J. He will be responsible for coordi-

nating and integrating the work of Gulton's eleven domestic divisions in the engineering of complete systems for the corporation.

Lowy has been associated with Data Control Systems in Danbury, Conn., Space Technology Laboratories in Los Angeles, Calif., and the Jet Propulsion Laboratory at the California Institute of Technology.

FXR Elects Ebert To Board of Directors

JOHN E. EBERT, vice president, microwave division, of FXR, Inc., has been elected to the company's board of directors. FXR, of Woodside, N. Y., manufactures microwave test instruments and associated equipment.

Wickersham Joins DIT-MCO Staff

PRICE D. WICKERSHAM has joined the staff of DIT-MCO, Inc., Kansas City, Mo., as manager of the newly formed systems engineering division, which will be responsible for the company's research and development program.

Formerly with Thompson-Ramo-Wooldridge, Inc., Wickersham has had over 18 years experience in the field of electronic research and de-

velopment in the instrumentation and test equipment fields.

Appoint Pritchard Chief Engineer

THE TECHNICAL MATERIEL CORP., Mamaroneck, N. Y., manufacturer of communications equipment, announces the appointment of B. D. Pritchard as chief engineer. He comes to TMC from Montana State College where he was senior research engineer and also acted as a consulting engineer for TMC.

Powertron Ultrasonics Forms New Division

POWERTRON ULTRASONICS CORP., Garden City, L. I., N. Y. has announced formation of a wholly-owned division, Powertron New England, in West Springfield, Mass.

The new division is headed by Theodore M. Jordan, president.

REL Names Freseman To Executive Post

APPOINTMENT of William L. Freseman to a new post of assistant to the president of Radio Engineering Laboratories, Inc., communications subsidiary of Dynamics Corp. of America, is announced.

Freseman previously was vice

president of International Standard Engineering, Inc., a subsidiary of ITT Corp., and also manager of the ITT Projects Group.

Burton Announces New Building

CONSTRUCTION of a new headquarters building in Northridge, Calif., for the Burton Mfg. Co. of Santa Monica, is now under way, according to Burton president William J. Miller.

Upon completion of the $250,000 27,000-sq ft plant about July 1, it will be occupied by Burton's Instrument Division and Trans Electronics, Inc., a wholly-owned subsidiary now situated in Canoga Park.

PEOPLE IN BRIEF

Martin J. Ruthford advances at Capehart Corp. to director of military marketing. **Lawrence Nadel,** formerly with Aerojet-General Corp., joins the Western Development Labs of Philco Corp. as director of the system program office. **Robert H. Sugarman** transfers from the U.S. Army Signal Research and Development Laboratory to AEL, Inc., as head of the signal environment section. **Robert R. Owen** promoted to manager of technical liaison for Datalab, a division of Consolidated Electrodynamics Corp. **Richard E. Hillger** advances to vice president for research at Air Technology Corp. **Howard J. Rowland** leaves D. S. Kennedy & Co. to join Antenna Systems, Inc., as director of research and development. **James L. Winget,** ex-Perkin-Elmer Corp., appointed manager of the Inductosyn Dept. of Del Electronics Corp. **Theodore W. Cooper,** previously with Hughes Aircraft, chosen manager of operations division by Micro Systems, Inc. **Warren A. Christopherson** promoted to senior engineer at IBM's San Jose, Calif., engineering center. **George L. Curtis** and **Bogdan R. Stack** promoted to associate laboratory directors at ITT's Federal Labs. **George Konkol** of Sylvania Electric Products Inc. advances to general manager of microwave device operations.

EMPLOYMENT OPPORTUNITIES

electronics

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HORIZONS INC. Cleveland, Ohio	120*	4
HUGHES AEROSPACE ENGINEERING DIV. Hughes Aircraft Company Culver City, California	49*	5
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NATIONAL CASH REGISTER CO. Electronics Division Hawthorne, California	119*	11
PHILCO WESTERN DEVELOPMENT LABS. Palo Alto, California	118*	12

Continued on page 140

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electronics WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE

Personal Background

NAME .....

HOME ADDRESS.....

CITY..... ZONE..... STATE.....

HOME TELEPHONE.....

Education

PROFESSIONAL DEGREE(S).....

MAJOR(S) .....

UNIVERSITY .....

DATE(S) .....

FIELDS OF EXPERIENCE (Please Check)

5121

☐ Aerospace	☐ Fire Control	☐ Radar
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☐ Components	☐ Microwave	☐ Transformers
☐ Computers	☐ Navigation	☐ Other .....
☐ ECM	☐ Operations Research	☐ .....
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	Technical Experience (Months)	Supervisory Experience (Months)
RESEARCH (pure, fundamental, basic)	.....	.....
RESEARCH (Applied)	.....	.....
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DEVELOPMENT (Model)	.....	.....
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electronics

WEEKLY QUALIFICATIONS FORM FOR POSITIONS AVAILABLE

(Continued from page 138)

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P-6542	122*	16

*These advertisements appeared in the 5/5/61 issue.

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OB3	.70	4D32	17.50	250R	10.00	811A	3.50	5854	1.00
OC3	.50	4E27	7.50	251A	50.00	813	10.00	5879	1.25
OD3	.30	4J30-61	PUR	252A	4.75	814	2.50	5881/6L6WGB	2.00
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1AD4	1.50	4PR60A	50.00	257A	2.50	816	1.85	5896	1.50
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1B24A	10.00	4X250B	22.50	259A	2.50	829B	9.50	5915	.85
1B35	1.85	5BP1A	9.50	262B	2.50	832	2.00	5930/2A3W	2.00
1B35A	3.00	5C22	10.00	FP-265	5.00	832A	6.75	5932/6L6WGA	2.00
1B58	25.00	5CP1A	9.50	267B	5.00	833A	35.00	5933/807W	1.25
1B59/R1130B	7.50	5CP7A	9.50	271A	9.00	836	1.00	5933WA	5.00
1B63A	12.50	5CP11A	9.50	272A	2.75	837	.80	5948/1754	75.00
1C/3B22	3.50	5J26	25.00	274A	2.00	838	1.00	5949/1907	75.00
C1K/B	7.50	5LP1	7.50	275A	3.00	842	5.00	5956/E36A	9.00
1P21	30.00	5R4GY	.90	276A	4.00	845	7.50	5962/BS101	3.00
1P22	7.00	5R4WGB	5.00	283A	2.50	850	12.50	5963	1.10
1P25	8.00	5R4WGY	3.00	287A	1.85	866A	1.75	5964	.75
1P29	2.25	5RP1A	9.50	293A	2.50	869B	50.00	5965	1.00
2-01C	10.00	5RP7A	75.00	HF-300	25.00	872A	3.50	5977/6K4A	1.25
2AP1A	5.00	5RP11A	25.00	300B	5.00	884	1.00	5979/BS1	4.00
2BP1	5.00	5SP1	25.00	304TH	30.00	885	.65	5980/BS2	6.00
2C36	18.85	5SP7	25.00	304TL	40.00	913	8.50	5987	7.50
2C39	3.50	6AC7W	.35	310A	2.50	918	.65	5992	2.00
2C39A	9.50	6AG7Y	.75	311A	2.25	920	2.50	5993	4.00
2C39B	18.75	6AK5W	1.00	313C	1.00	927	.85	6005/6AQ5W	1.00
2C40	7.00	6AN5	1.85	323A	5.00	931A	3.00	6011/710	8.75
2C42	3.00	6AR6	.75	328A	2.25	959	.50	6012	4.00
2C43	7.50	6AS6	.85	336A	2.00	1000T	90.00	6021A	2.00
2C50	4.00	6AS7G	2.50	337A	2.25	CK-1006	2.00	6032	10.00
2C51	1.50	6B4G	2.50	347A	1.00	1237	2.00	6037/QK-243	15.00
2C52	1.50	6BL6	30.00	348A	2.00	1500T	125.00	6044	3.50
2D21	.50	6BM6	30.00	349A	1.50	1614	2.75	6045	1.15
2D21W	1.00	6BM6A	30.00	350A	3.50	1616	.50	6050	1.00
2E22	2.50	6C4W	2.50	350B	1.00	1619	.20	6072	1.50
2E24	2.50	6C21	10.00	352A	6.00	1620	3.50	6073	.75
2E26	2.50	C6J	11.50	354A	7.50	1624	.75	6074	1.50
2E30	2.50	C6J/A	15.00	355A	7.50	1625	.35	6080	2.75
2J21-50	PUR	6J4WA	1.00	393A	5.00	1846	50.00	6080WA	4.50
2J42	50.00	6J6W	.75	394A	2.50	2050	1.25	6080WB	10.00
2J51	50.00	C6L	2.50	395A	2.00	2050W	1.50	6082	3.00
2K22	20.00	6L6GAY	.75	396A/2C51	2.00	5 45	10.00	6087/5Y3WGTB	3.00
2K25	8.50	6L6WGA	2.00	398A/5603	3.00	5550	30.00	6098	5.00
2K26	30.00	6L6WGB	2.00	401A/5590	1.00	5586	100.00	6099	.75
2K28	25.00	6Q5G	2.50	403A/6AK5	.65	5641	1.75	6100/6C4WA	1.25
2K29	25.00	6SC7GTY	1.00	403B/5591	3.00	5642	1.50	6101/6J6WA	1.00
2K30	50.00	6SJ7WGT	1.25	404A/5847	10.00	5643	3.00	6108/BS213	2.50
2K34	75.00	6SL7WGT	.75	407A	3.50	5644	2.50	6109/BS404	1.00
2K35	250.00	6SN7W	.50	408A/6028	2.00	5647	3.50	6111A	2.00
2K41	12.50	6SN7WGT	.75	409A/6AS6	1.00	5651	.75	6112	2.00
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2K43	125.00	6V6GTY	.75	417A/5842	7.50	5654/6AK5W/		6130/3C45	5.00
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2K54	10.00	10KP7	15.00	450TH	40.00	5678	1.25	6186/6AG5WA	1.50
2K55	15.00	12AT7WA	1.25	450TL	40.00	5686	1.85	6189/12AU7WA	1.50
2P21	40.00	12AY7	1.00	CK-503AX	.75	5687	1.50	6197	1.75
2X2A	.80	12DP7	7.50	CK-510AX	1.00	5691	5.00	6198	85.00
3AP1	2.00	12GP7	12.50	575A	12.50	5692	2.00	6201/12AT7WA	1.75
3B23/RK-22	2.00	16F	10.00	576	12.50	5693	3.50	6202/6X4WA	1.50
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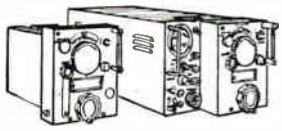

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