

MAR -3 1958

ELECTRONIC DESIGN

MARCH 5, 1958

R 697968

**IRE
Convention
Issue**

23

U.S. DEPARTMENT OF
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MAR 17 1958
POST



Preview of new Products at the 1958 National IRE Convention Starting on Page 80

CARD

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MAGNETIC AMPLIFIERS AND SATURABLE TRANSFORMERS

**FAST RESPONSE
MAGNETIC AMPLIFIERS**
2 ν response Phase reversible

Cat. No.	Supply Freq. in C.P.S.	Power Out. Watts	Volt. Out. V. AC	AC or DC signal voltage req'd for full output.	
MAF-1	60	13	110	1.0	—
MAF-6	400	5	57.5	1.2	0.4
	400	10	57.5	1.6	0.6
MAF-7	400	15	57.5	2.5	1.0

SINGLE ENDED MAGNETIC AMPLIFIERS

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Sig. req'd for full outp. MA-DC	Total res. Contr. wdg. K Ω	Lead res. ohms
MAO-1	60	4.5	3.0	1.2	3800
MAO-2	60	20	1.8	1.3	700
MAO-4	60	400	9.0	10.0	25
MAO-5	60	575	6.0	10.0	25

PUSH-PULL MAGNETIC AMPLIFIERS

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total res. contr. wdg. K Ω
MAP-1	60	5	—	1.2	1.2
MAP-2	60	15	115	1.6	2.4
MAP-3	60	50	115	2.0	0.5
MAP-3-A	60	50	115	7.0	2.9
MAP-4	60	175	115	8.0	6.0
MAP-7	400	15	115	0.4	2.0
MAP-8	400	50	110	1.75	0.6

SATURABLE TRANSFORMERS

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total res. contr. wdg. K Ω
MAS-1	60	15	115	6.0	27
MAS-2	400	6	115	4.0	10
MAS-5	400	2.7	26	4.0	3.2
MAS-6	400	30	115	4.0	8.0
MAS-7	400	40	115	5.5	8.0

All units designed for 115V-AC operation

VARIABLE TEST VOLTAGE MEGOhmmETER NO. 1620



The Freed Type 1620 Megohmmeter is a versatile insulation resistance measurement instrument with a continuously variable DC test potential from 50 to 1000 volts.

Components such as transformers, condensers, motors, printed circuits, cables and insulation material can be tested at their rated voltage and above, for safety factor.

Resistance — 0.1 megohm to 4,000,000 megohms.

Voltage — variable, 50-1000 volts.

Accurate — plus or minus 5% on all ranges.

Simple — for use by unskilled operators.

Safe — high voltage relay controlled.

Self contained — AC operated.

OTHER MEGOhmmETERS AVAILABLE

Type 1620C Megohmmeter — a type 1620 with additional circuitry for testing capacitors.

Type 1020B Megohmmeter — a 500 volt fixed test potential. Range 1 megohm to 2 million megohms.

Type 2030 Portable Megohmmeter — battery operated, 500 volt test potential. Range 1 megohm to 10 million megohms.



FREED

NULL DETECTOR AMPLIFIER TYPE 1140-A

USES

A sensitive null indicator for bridge measurements, providing visual null indications or aural when used in conjunction with headphones. The unit may also be used as a high gain amplifier for general laboratory work.

DESCRIPTION

Functionally the instrument consists of a high gain linear amplifier with a 30 db. input attenuator in addition to the variable gain control. A four-inch panel meter provides visual null indications, the response of the meter circuit is approximately logarithmic over a 40 db. voltage range. Resonant circuits tuned to 60, 400 and 1000 cycles limit the amplifier transmission characteristics to the three audio frequencies commonly used for bridge measurements or it may be used as a non-selective amplifier with filter "off."

SPECIFICATIONS

Input Impedance: 1 megohm in parallel with 25 mmf. **GAIN:** 98 db. with 1 megohm load (6 mmf. shunt capacity), down 1.5 db. at 25,000 cycles, down 5 db. at 50,000 cycles, down 2 db. at 20 cycles.

Null Detector Sensitivity: At 1 kc. 100 microvolts will give a 15% meter deflection.

Selective Amplifier: 26 db. second harmonic attenuation at 60, 400 and 1000 cycles.

Power Supply: 105-125 volts, 50-60 cycles, 35 watts consumption.

Dimensions: 13 1/2" x 8 1/2" x 10".

MIL-T-27A POWER, FILAMENT, PULSE & AUDIO TRANSFORMERS

POWER TRANSFORMERS-STANDARD

All primaries 105/115/125 v., 60 c.p.s.

Cat. No.	Hi Volt Sec.	ct	DC Volts	DC Amps	Filament #1		Filament #2		MIL Case Size
					Volt	Amp.	Volt	Amp.	
MGP1	400/200	✓	185	.070	6.3/5	2	6.3	3	HA
MGP2	650	✓	260	.070	6.3/5	2	6.3	4	JB
MGP3	650	✓	245	.150	6.3	5	5.0	3	KB
MGP4	800	✓	318	.175	5.0	3	6.3	8	LB
MGP5	900	✓	345	.250	5.0	3	6.3	8	MB
MGP6	700	✓	255	.250					KB
MGP7	1100	✓	419	.250					LB
MGP8	1600	✓	640	.250					NB

FILAMENT TRANSFORMERS-STANDARD

All primaries 105/115/125 v., 60 c.p.s.

Cat. No.	Secondary		Test VRMS	MIL Case
	Volt	Amp		
MGF1	2.5	3.0	2,500	EB
MGF2	2.5	10.0	2,500	GB
MGF3	5.0	3.0	2,500	FB
MGF4	5.0	10.0	2,500	HB
MGF5	6.3	2.0	2,500	FB
MGF6	6.3	5.0	2,500	GB
MGF7	6.3	10.0	2,500	JB
MGF8	6.3	20.0	2,500	KB
MGF9	2.5	10.0	10,000	JB
MGF10	5.0	10.0	10,000	KB

PULSE TRANSFORMERS

Cat. No.	Blotch. Osc.	Int. Coupl'g	Low. Per. Out.	Pulse Voltage Kilovolts			Pulse Duration Microseconds	Duty Rate	No. of Weigs.	Test Volt. KV RMS	Char. Imp. Ohms
				0.25	0.25	0.25					
MPT1	✓	✓	✓	0.25	0.25	0.25	0.2-1.0	.004	3	0.7	250
MPT2	✓	✓	✓	0.25	0.25	0.25	0.2-1.0	.004	2	0.7	250
MPT3	✓	✓	✓	0.5	0.5	0.5	0.2-1.5	.002	3	1.0	250
MPT4	✓	✓	✓	0.5	0.5	0.5	0.2-1.5	.002	2	1.0	250
MPT5	✓	✓	✓	0.5	0.5	0.5	0.5-2.0	.002	3	1.0	500
MPT6	✓	✓	✓	0.5	0.5	0.5	0.5-2.0	.002	2	1.0	500
MPT7	✓	✓	✓	0.7	0.7	0.7	0.5-1.5	.002	3	1.5	200
MPT8	✓	✓	✓	0.7	0.7	0.7	0.5-1.5	.002	2	1.5	200
MPT9	✓	✓	✓	1.0	1.0	1.0	0.7-3.5	.002	3	2.0	200
MPT10	✓	✓	✓	1.0	1.0	1.0	0.7-3.5	.002	2	2.0	200
MPT11	✓	✓	✓	1.0	1.0	1.0	1.0-5.0	.002	3	2.0	500
MPT12	✓	✓	✓	0.15	0.15	0.3	0.2-1.0	.004	4	0.7	700

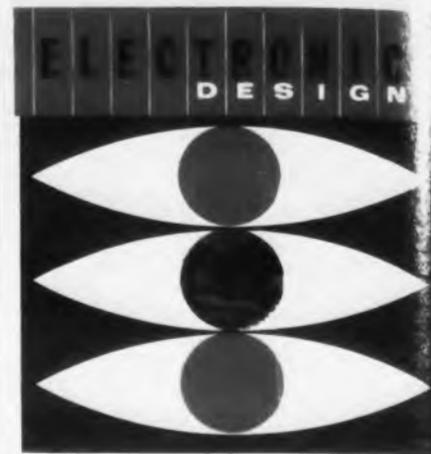
AUDIO TRANSFORMERS

Catalog No.	Application	Impedance				DC Current		
		Prim. Ohms	CL	Sec. Ohms	CL	Prim. Max. Linear MA	Sec. Max. Linear MA	
MGA1	Single or P.P. Plates to Single or P.P. Grids	10K	✓	90K Split	✓	10	10	15
MGA2	Line to Voice Coil	600 Split	✓	4, 8, 16	✓	0	0	33
MGA3	Line to Single or P.P. Grids	600 Split	✓	135K	✓	0	0	15
MGA4	Line to Line	600 Split	✓	100 Split	✓	0	0	15
MGA5	Single Plate to Line	7.6K 4.8T	✓	600 Split	✓	40	40	33
MGA6	Single Plate to Voice Coil	7.0K 4.8T	✓	4, 8, 16	✓	40	40	33
MGA7	Single or P.P. Plates to Line	15K	✓	600 Split	✓	10	10	33
MGA8	P.P. Plates to Line	24K	✓	600 Split	✓	10	1	30
MGA9	P.P. Plates to Line	60K	✓	600 Split	✓	10	1	27

Write for detailed listing, or special requirements, and copies of complete Transformer and Laboratory Test Instrument Catalogs

FREED TRANSFORMER CO., INC.

1727 Weirfield St., Brooklyn (Ridgewood) 27, N.Y.



COVER STORY

IRE Show Highlights

..... Sessions p 22

..... New Products p 80

Preview new products being shown for the first time at the IRE National Convention by turning to the New Products department. Capsule summary of trends in components precedes this section.

Transistor Simulated

Reactances p 24

Very large reactances can be replaced by compact transistor circuits with large savings in cost, size, and weight.

How To Measure FM

Bandwidth at Microwave Frequencies p 36

Mr. Larson provides here a very simple, yet effective technique for measuring fm bandwidth. A few simple components make it possible to measure bandwidths greater than one per cent.

Transistor Voltage

Standards p 50

A proposal for the standardization of power supply voltages for transistor circuits. Recommended voltages are $\pm 1.5, 3, 6, 12, 25, 50,$ and 100 v, with voltages above 100 falling in 50 v increments.

Silicon Diode Application

Notes, Part II p 58

For rapid solution of diode design problems, a nomogram enables quick inspection adjustment of thermal and electrical variables.

◀ CIRCLE 1 ON READER-SERVICE CARD

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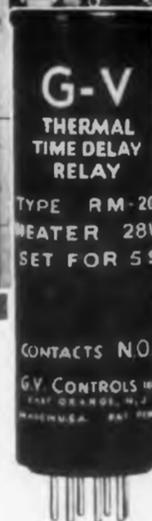
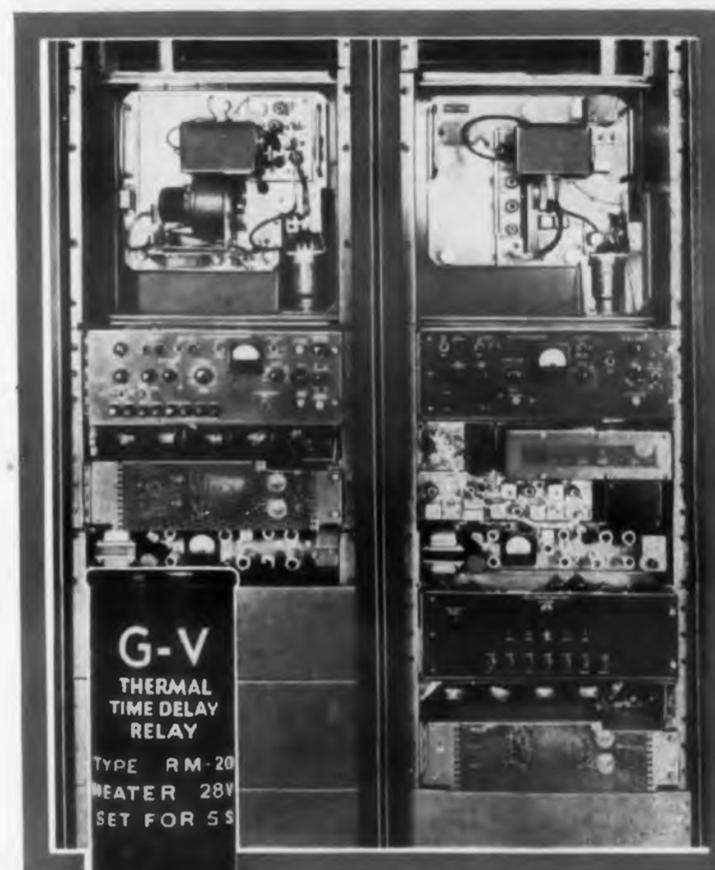
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Hayden Publishing Co., Inc., 830 Third Avenue, New York 22, N.Y.

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ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland Jr., Vice-President & Treasurer and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted under section 34.64 P. L. & R. authorized. Copyrighted 1958 Hayden Publishing Company, Inc. 30,000 copies this issue.



G-V thermal time delay relays...
protect cathodes in RCA's
TV microwave relay system

When the industry required a portable microwave repeater station that behaved like a permanently installed, unattended unit, RCA developed its Television Microwave Relay Station, Type TVM-1A. In it, to protect the unit's cathodes, RCA design engineers rely on G-V thermal time delay relays to delay the application of plate voltage.

In both industrial and military equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data and catalog material.

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NEW

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400 MILLIAMPERES

225 TO 500 PEAK
INVERSE VOLTS

-65°C TO +150°C TEMPERATURE RANGE



Type	Ave. Rectified Current		Peak Inverse Voltage		Reverse Current (μ Adc) max. at indicated volts		
	25°C mA	150°C mA	-65° to +150°C	25°C	volts	at 25°C	at 100°C
1N645	400	150	225	275	225	0.2	15
1N646	400	150	300	360	300	0.2	15
1N647	400	150	400	480	400	0.2	20
1N648	400	150	500	600	500	0.2	20

For all types

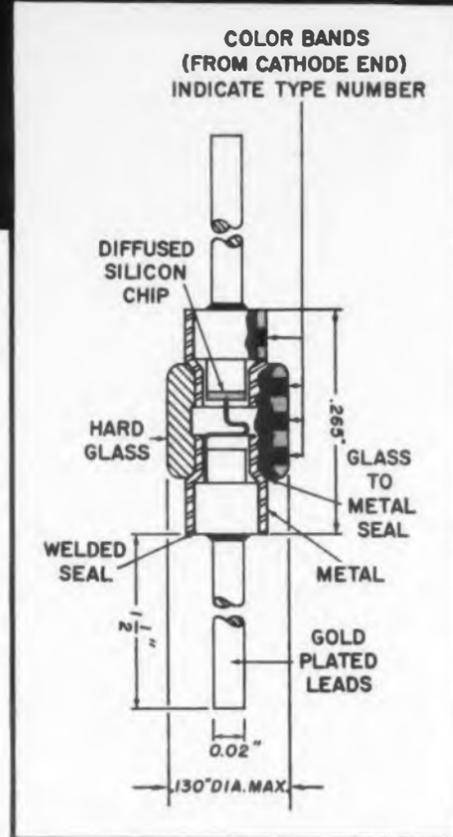
Voltage Drop (400mA, 25°C).....	1.0 V max.
Steady State Peak Forward Current (25°C).....	1.25 A max.
Surge Current (1 sec. 25°C to 150°C).....	3.0 A max.
Dissipation (25°C).....	600 mW max.

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ENGINEERING REVIEW

For more information on developments described in "Engineering Review," write directly to the address given in the individual item.

Airborne TV Gives Pilot Geographical Location



The **Horizontal Situation Display** is a TV device which permits the pilot to see his exact location in relation to the ground. The 45-pound system automatically correlates navigational computer information and presents a TV picture in the form of a map corresponding to the pilot's exact location over the terrain.

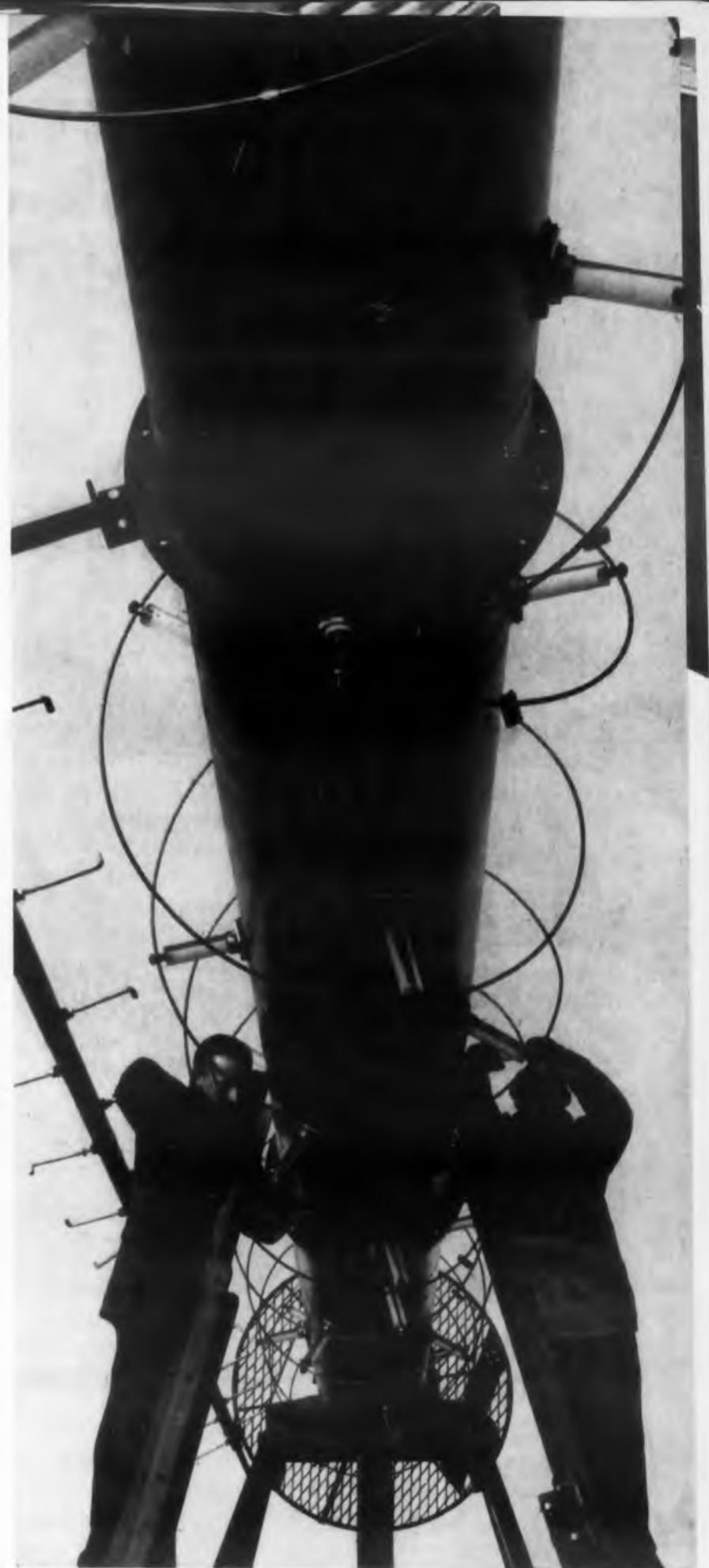
A closed circuit television device that gives an airplane pilot a continuous and automatic pictorial presentation of the aircraft's geographical position and flight track has been developed by Avion Division of ACF Industries Inc.

Designated the Horizontal Situation Display (HSD), the device correlates information fed to it by navigational instruments and presents this information in the form of a map of the territory below the plane. The aircraft position is also indicated on the display screen by a silhouette of the aircraft which changes correspondingly with its movement through the air.

When signals from the navigation computer are fed into the HSD, controls governing the position of the map and plane image in relation to each other are actuated. The result is picked up by the TV camera located in a remote part of the plane and transmitted to the 5-inch cathode ray tube on the pilot's instrument panel. The map, approximately 4 x 3 in., is a micro-filmed chart mounted on a rigid glass plate with only a small but enlarged portion of the slide projected at a time on the vidicon pickup.

The map slide is located on a carriage which is movable in both X and Y directions by means of precision lead screws.

Latitude and longitude drive information to
(Continued on next page)



TV Titan.—This 57-foot-long, 5,500 pound helical television broadcast antenna will soon be blanketing the Seattle, Wash., area with VHF TV picture and sound signals. Designed by General Electric, Syracuse, N.Y., the antenna is self-deicing and can withstand severe lightning and other weather hazards.



Focal point for the requirements of a growing industry

Today great companies in an ever-widening circle depend on Raytheon to supply magnetrons and klystrons for their microwave equipments.

By joining this distinguished roster you can be sure of tubes made to the highest standards of engineering craftsmanship—the ultimate in rugged duty,

first-rate performance and long, dependable life.

Comprehensive data booklets on Raytheon magnetrons, klystrons and special tubes are available on request. Our free Application Engineer Service is at your disposal. There is no obligation. Write for complete details.

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ENGINEERING REVIEW

the lead screws from the computer is transformed into X and Y signals by the coordinate converter.

The image of the aircraft is etched on a glass disk in reticle fashion and is placed directly in the main optical path in close proximity to the map slide. This design feature makes it possible to project both the reticle marker and the map detail on the screen with the same optical system. The reticle marker also is mounted on a carriage which is positioned in X and Y and may be rotated to indicate heading. The reticle lead screws and map lead screws are linked together through the X and Y servos. It is possible to track either by marker or map motion.

Semiconductor Rectifier Use Increasing

Semiconductors as sources of rectified power are achieving increasing popularity, according to statements made at the Winter General Meeting of the American Institute of Electrical Engineers.

"The interest in semiconductor power supplies, which was touched off by early industrial installations in January 1954, continues unabated," R. M. Crenshaw and A. L. Munn of General Electric Co. told a symposium on metallic rectifiers.

According to General Electric, the silicon rectifier's superior characteristics at high voltages and high temperatures is resulting in its broad application for outputs of 100 v dc and up. At lower voltages it is expected that germanium will continue to be used.

High amperage semiconductor rectifiers are replacing mercury arc rectifiers for high current applications, particularly to handle electrochemical loads. The mercury arc rectifier has been the most important source of direct current power in the electrochemical industry, but "semiconductor rectifiers are destined to furnish a much larger proportion of future loads."

◀ CIRCLE 4 ON READER-SERVICE CARD

New Drafting Aid Developed At Eastman

A new drafting technique has been developed at Eastman Kodak Company, Rochester, N.Y., which uses photographs to convey engineering drawing information in a form easier to visualize.

Photographs are reproduced on a translucent material. To this, engineering detail and additional superimposed sketches can be added. The method saves both time and money, according to Walter C. Foulks of the Kodak Park engineering staff, speaking at a recent meeting of the American Society of Mechanical Engineers in New York City. The easy readability of the prints makes them especially useful for equipment assembly and, because of the small cost of photographic reproductions, they fit in situations where expense prohibits the use of engineering drawings. Shop time can often be reduced because one does not have to visualize the end result from a written specification sheet. One can see the scope of the project at a glance from a photograph of existing equipment or a model.

Additional information on this new photodrawing technique can be obtained from Kodak's pamphlet P-22.

First the Law of Parity and Now . . .

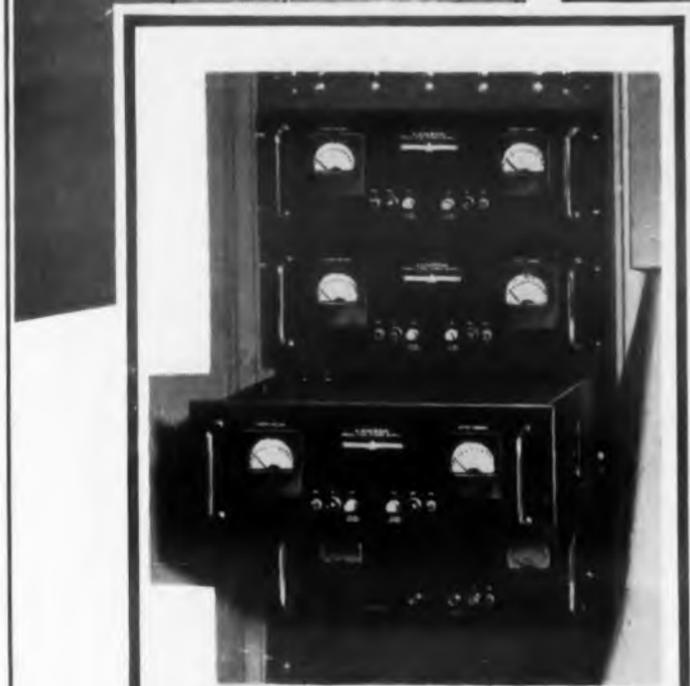
Superatomic energy, a theory which challenges the concept of absolute zero and the speed of light as atomic ultimates, has been proposed by Navy physicist Robert L. Carroll as a possible future rocket power source.

He asserts that as an atom gets colder and becomes less active it gravitates toward the nucleus at an increasing velocity. At a sufficiently cold temperature the atom would collide with and disintegrate the nucleus, releasing its energy.

The Air Force has reportedly agreed to explore the possibility of Dr. Carroll's theory.



Digital Computer Intervention and Display System designed and fabricated by Stromberg-Carlson Company, a Division of General Dynamics Corporation, for the Air Proving Ground Center (ARDC) Armament Division, Eglin Air Force Base. The system is built around the CHARACTERON* Shaped Beam Tube, designed by Stromberg-Carlson for high-speed information display and micro-film recording.



C-800 Lambda Com-Pak Power Supplies used in the Eglin Air Force Base installation require only 7" front panel height.



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COM-PAK® SUPPLIES SAVE PANEL SPACE

Models through 1.5 amperes

Three voltage ranges: 0-200, 125-325, 325-525 VDC

C-200 series— 200 MA—5¼" panel height—from \$159.50
C-400 series— 400 MA—5¼" panel height—from 244.50
C-800 series— 800 MA—7" panel height—from 315.00
C-1500 series—1500 MA—8¾" panel height—from 550.00

Where power supply dependability is vital Stromberg-Carlson specifies standard Lambda power supplies for Air Force Digital Computer Intervention & Display System

Standard Lambda power supplies are components of the Digital Computer Intervention and Display System associated with the UNIVAC Scientific Computer at the Air Proving Ground Center (ARDC) Armament Division, Eglin Air Force Base, Florida.

Available for immediate delivery, Lambda power supplies from stock are being used in major rocket and missile programs, among other military projects. They are specified also for more industrial and research applications than the ten next-most-popular makes combined.

Send for the current Lambda catalog. It covers the complete new Com-Pak series, as well as other rack, bench and portable models, for all needs through 1.5 amperes.



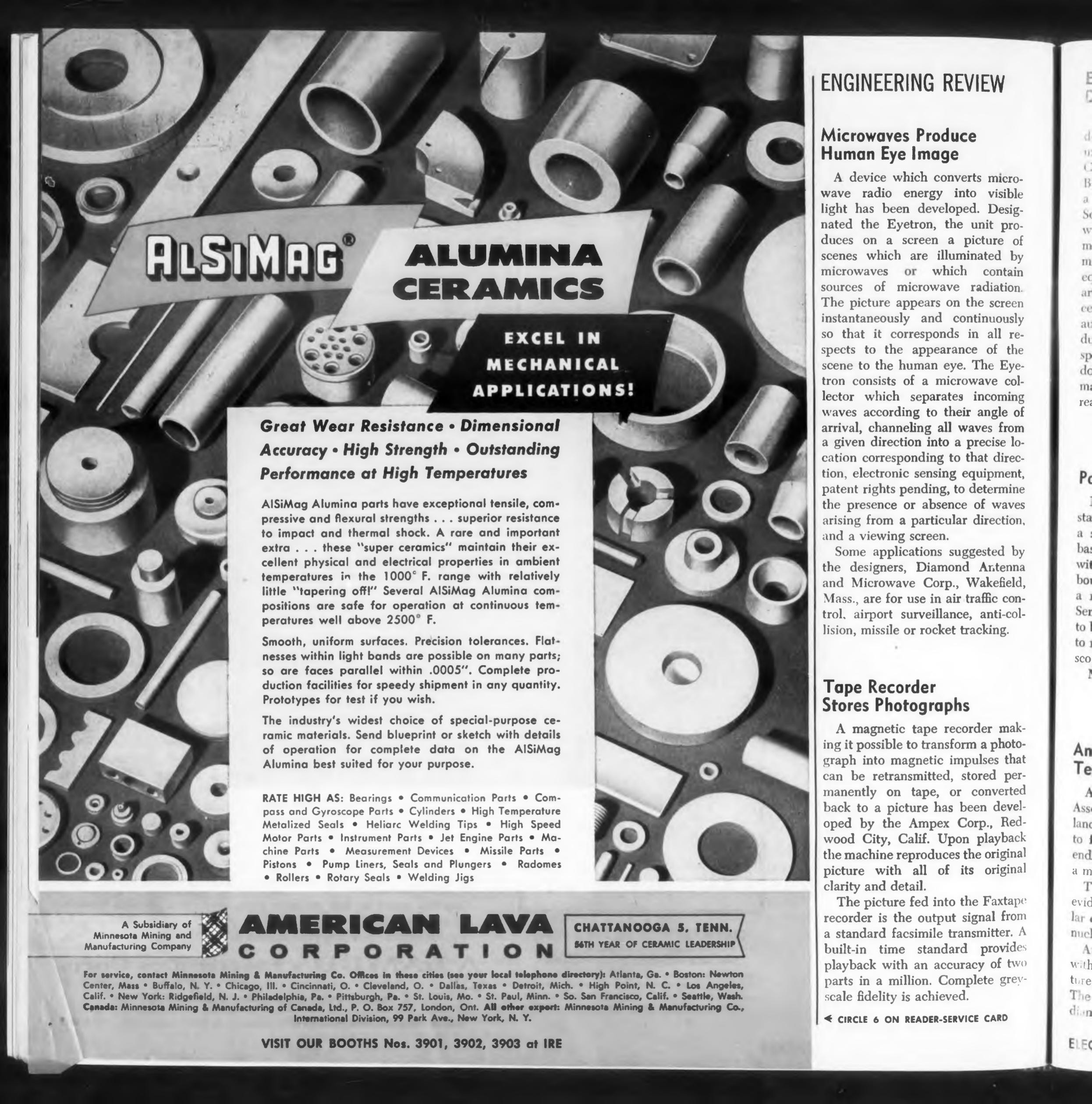
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INDEPENDENCE 1-8500 Cable Address: Lambdatron, New York

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**ALUMINA
CERAMICS**

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MECHANICAL
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ALSiMag Alumina parts have exceptional tensile, compressive and flexural strengths . . . superior resistance to impact and thermal shock. A rare and important extra . . . these "super ceramics" maintain their excellent physical and electrical properties in ambient temperatures in the 1000° F. range with relatively little "tapering off!" Several ALSiMag Alumina compositions are safe for operation at continuous temperatures well above 2500° F.

Smooth, uniform surfaces. Precision tolerances. Flatnesses within light bands are possible on many parts; so are faces parallel within .0005". Complete production facilities for speedy shipment in any quantity. Prototypes for test if you wish.

The industry's widest choice of special-purpose ceramic materials. Send blueprint or sketch with details of operation for complete data on the ALSiMag Alumina best suited for your purpose.

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ENGINEERING REVIEW

Microwaves Produce Human Eye Image

A device which converts microwave radio energy into visible light has been developed. Designated the Eyetron, the unit produces on a screen a picture of scenes which are illuminated by microwaves or which contain sources of microwave radiation. The picture appears on the screen instantaneously and continuously so that it corresponds in all respects to the appearance of the scene to the human eye. The Eyetron consists of a microwave collector which separates incoming waves according to their angle of arrival, channeling all waves from a given direction into a precise location corresponding to that direction, electronic sensing equipment, patent rights pending, to determine the presence or absence of waves arising from a particular direction, and a viewing screen.

Some applications suggested by the designers, Diamond Antenna and Microwave Corp., Wakefield, Mass., are for use in air traffic control, airport surveillance, anti-collision, missile or rocket tracking.

Tape Recorder Stores Photographs

A magnetic tape recorder making it possible to transform a photograph into magnetic impulses that can be retransmitted, stored permanently on tape, or converted back to a picture has been developed by the Ampex Corp., Redwood City, Calif. Upon playback the machine reproduces the original picture with all of its original clarity and detail.

The picture fed into the Faxtape recorder is the output signal from a standard facsimile transmitter. A built-in time standard provides playback with an accuracy of two parts in a million. Complete grey-scale fidelity is achieved.

◀ CIRCLE 6 ON READER-SERVICE CARD

Electronics Volume to Double by 1965

The American electronics industry will almost double its present 12 billion dollar business volume by 1965 according to Frank M. Folsom, Chairman of the Executive Committee of the Board of the Radio Corporation of America. At a meeting of the San Francisco Security Analysts Society, he indicated that the greatest increase would be achieved primarily in industrial equipment, microwave and other forms of radio communication, closed-circuit TV, broadcasting equipment and electronic data processing system areas, a projected growth approaching 300 per cent. The most significant advances will occur in automated sensing and control devices for production, and in data processing. Television spurred by color, should more than double in dollar volume between now and 1965, he estimated, while defense electronics is expected to reach a volume of nearly \$6.5 billion by 1965.

Popcorn Returned to the Gourmet

Popcorn, which has been used in some instances in packaging electronic equipment, is not a savory cushioning material. This conclusion, based on tests of the material in comparison with conventional cushioning agents such as bound hair and cellulosic wadding, was noted in a report released by the Office of Technical Services (PB 131162). Results showed popcorn to be relatively stiff and to have very little ability to recover after compression. Its extreme hygroscopicity causes shrinkage in high humidity.

Moviegoers, a word to the wise is sufficient.

Anticipate Thermonuclear Temperatures Of 40 Million Degrees

A thermonuclear torus is being designed at Associated Electrical Industries, Berkshire, England, which may permit temperatures of thirty to forty million degrees to be reached by the end of the year. The reaction will occur through a mixture of deuterium and tritium.

These higher temperatures may offer further evidence that neutrons produced in this and similar equipment are actually the result of thermonuclear fusion.

At present experiments are being performed with the Sceptre Three, with which temperatures of 12 million deg. will perhaps be achieved. The torus of the Sceptre Three is made of 12-in. diam tubing, the ring diameter being 45 in.

Crystal filters

by BURNELL & CO., INC.



TYPICAL RESPONSE CURVES INDICATING THE VARIOUS SHAPE FACTORS AVAILABLE IN STANDARDIZED BURNELL CRYSTAL FILTERS

Burnell & Company is pleased to announce that it has expanded, to its new plant, the facilities of its crystal division for the production of crystal filters.

Like fine jewels, crystal filters are synonymous with stability, performance and reliability. With the development of advanced production techniques and circuitry by Burnell & Co., they offer vast potential in electronic communications, telemetry, and remote control applications.

Depending on band width and frequency, they may be composed entirely of crystals, or in complex networks, combine quartz crystal elements with stabilized toroidal coils to produce the desired band width and shape factor. Frequency has been extended from low range to the megacycle spectrum so that Burnell Crystal Filters now provide the solution to myriad problems formerly insoluble with even the best of toroidal components.

Standardized, standardized complex designs of lattice networks and their three terminal network derivatives provide high developmental costs. Packaging encompasses a wide range in standard, miniature and sub-miniature sizes with considerable latitude in permissive impedance range from required translator ranges to portable operations. Whether your crystal filter is of standard design or calls for custom specifications, our facilities are at your disposal. Write for new Burnell Crystal Filter Bulletin, XT-455, Dept. 02.

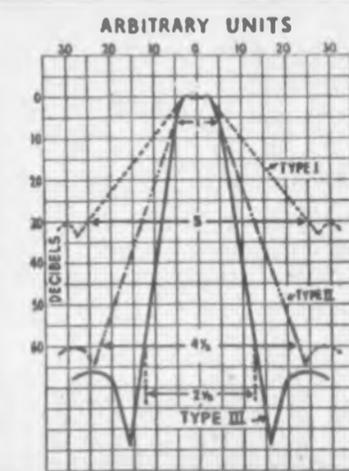
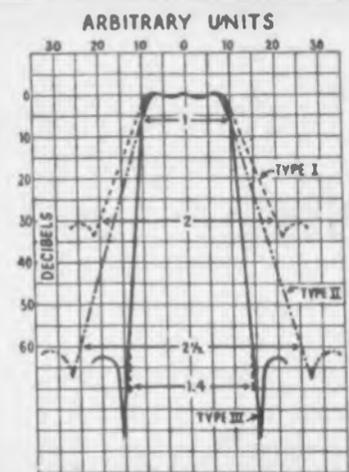
Burnell & Co., Inc.

First in toroids, filters and related networks

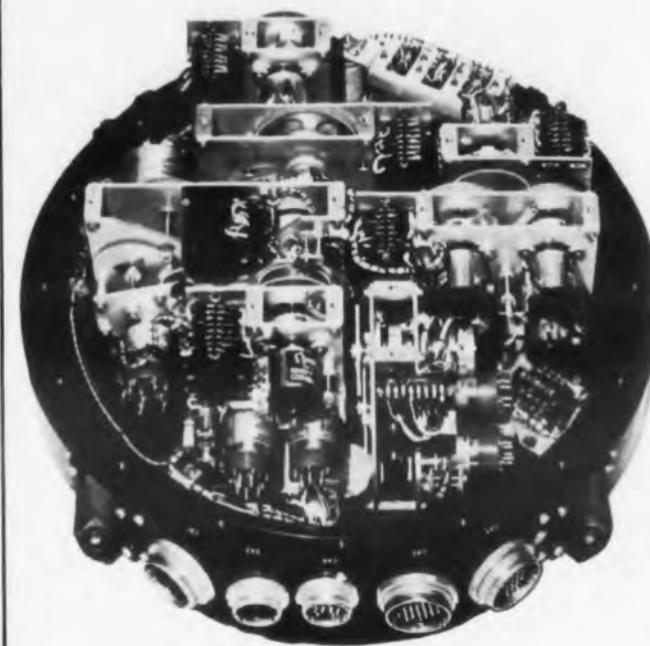


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CIRCLE 7 ON READER-SERVICE CARD



The Air Data Computer provides pressure altitude, indicated air speed, Mach number, true air speed, and vertical speed information.

Automatic Computing of Aircraft Data

A fully automatic integrated air data computer system providing a centralized source of aerodynamic data for various services in an aircraft, has been developed in Britain.

The Central Air Reference System, is completely duplicated for safety reasons each half consisting of a transducer unit, a temperature unit, a computer, and first and second pilots' repeaters. The transducer unit, designed for installation close to the pressure head, is a two-capsule, pitot/static type in which deflection of the capsules is first corrected for instrument error, magnified, and then converted to electrical signals by means of a low-friction, low-hysteresis system statically and dynamically balanced. The signals are transmitted to the computer together with signals from the resistance probe temperature unit, and corrections are applied for position, compressibility errors, and temperature.

The corrected static signal gives pressure altitude and is differentiated to obtain rate of climb or descent. Pitot and static signals are also computed to provide indicated air speed, true air speed, and Mach Number, this information being transmitted to the repeater units by means of synchros.

The fully duplicate system necessitates two pressure heads and two resistance probe temperature units. Dimensions of each measuring unit are approximately 7.5 in. x 6.5 in. x 5 in., and its weight 7 lb. Total power consumption for the duplicated system is estimated to be 60 watts. In



Orders for DRIVER-HARRIS Nickel and Nickel Alloy Wire FILLED IN 24 HOURS

If we receive your order in the morning, it will be shipped out before evening . . . this is the new service policy of Driver-Harris in the manufacture and distribution of 18 most frequently purchased Nickel and Nickel Alloys in wire form. In addition to this new warehouse stocking program, is the improved delivery schedule for Monel, Grade "A" Nickel, Inconel, R Monel and some Stainless Steels with lead time reduced to only 7 days in certain cases. The following list covers immediate availabilities. For complete detailed current listing showing all sizes and specifications, contact the nearest Driver-Harris branch — or call HUmboldt 3-4800 (New Jersey), REctor 2-9579, 80, 81, 82 (New York City).

IN STOCK READY FOR DELIVERY

MONEL 25 wire sizes from .0021 to .091
 GRADE "A" NICKEL 12 wire sizes from .0025 to .091
 GRADE "D" NICKEL 9 wire sizes from .005 to .015
 INCONEL 3 wire sizes from .0253 to .050

STAINLESS STEEL

Type 304 24 wire sizes from .0016 to .164
 Type 316 6 wire sizes from .007 to .0135
 Type 330 25 wire sizes from .0063 to .144
 NICHROME* 65 wire sizes from .0007 to .289
 NICHROME* V 62 wire sizes from .00045 to .289
 CHROMAX* 35 wire sizes from .0031 to .258
 KARMA* 36 wire sizes from .0005 to .036
 ADVANCE* 49 wire sizes from .0008 to .258
 MANGANIN 37 wire sizes from .001 to .1285
 LOHM* 29 wire sizes from .001 to .182
 MIDOHM* 28 wire sizes from .00175 to .182
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LEAD TIME FOR MANUFACTURING WIRE & RIBBON

As low as 10 days for
 COLD DRAWN MONEL wire sizes from .001 to .1875
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As low as 7 days for
 STAINLESS STEEL wire and ribbon
 Types: T-302, T-304, T-305, T-316, T-430, T-446

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CIRCLE 8 ON READER-SERVICE CARD

order to provide good legibility on the Altimeter/V.S.I. and the A.S.I./Machmeter within a reasonable panel area, these instruments are of the moving tape type.

The system was developed by Elliott Brothers, London, England, in conjunction with the Bendix Corporation of America.



Luminous Steel

An opaque fabric woven from stainless steel wire can become a flexible light source when coated with phosphors and a transparent conductive material according to researchers in electroluminescent lighting at the Westinghouse Lamp Division, Pittsburgh, Pa. Before it was curled into a cylinder, the steel fabric was twelve in. sq and lay flat upon the lab bench. Light output visible here resulted from the application of 250 v at 4000 cycles. Other light sources have been made with a nylon base.

We Admittance Our IMPEDANCE Error

The following is a letter we recently received. Our apologies to Robertshaw-Fulton.

"I would like to thank you for the publicity we received in your January 8th issue of ELECTRONIC DESIGN concerning our Universal Bridge, Type B-221, which appeared as item 81 under your Products Section.

"Unfortunately, the photograph appeared inverted from the instrument's normal operating position. Perhaps the bridge will operate better in this position, but since it is an impedance bridge this may change its characteristics to one of an admittance bridge." Boyce M. Adams, M.E., Electronic Instruments Dept.

Another Clevite Break-through!

HIGH FREQUENCY POWER TRANSISTORS



This history-making addition to Clevite's line of PNP germanium power transistors offers long-sought advantages to designers of high frequency audio amplifiers as well as high-speed switching and core driver circuitry in digital computers.

For high frequency audio amplifiers:

(TYPE CTP 1133)
POWER DISSIPATION = 10 WATTS
 at 70°C base temperature
POWER GAIN = 27 to 33 db
 when $I_c = 420$ ma and power output = 2.0 w
POWER GAIN CUTOFF FREQUENCY = 20 kc minimum
 . . . compared with 5 to 7 kc for conventional transistors
DISTORTION = 5% maximum
 at 1.2 w output

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(TYPE CTP 1135)
POWER DISSIPATION = 10 WATTS
 at 70°C base temperature
DC CURRENT GAIN = 40 minimum
 at 0.5 amp
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MICRO-MINIATURE RELAYS

by Iron Fireman



Take a good look

These test results mean what they say. Iron Fireman's micro-miniature relays conform to and exceed the requirements of MIL-R 5757C; and the data, shown in the illustration above, were obtained under the strict requirements set forth in the military specifications.

These brand new Iron Fireman dual-coil, balanced armature relays are designed for applications demanding

either voltage or current sensitive relays with high reliability and performance in small, hermetically sealed enclosures.

These latest additions to the line of dependable Iron Fireman relays are tooled for high production.

WRITE TODAY for *Bulletins 600 and 680*: Iron Fireman Electronics, 2810 S.E. Ninth Ave., Portland 2, Ore.



IRON FIREMAN *Electronics* **DIVISION**

*Manufacturers of high speed relays,
sensitive relays, micro-miniature relays, vertical gyros, slip rings and brushes.*

CIRCLE 452 ON READER-SERVICE CARD

ENGINEERING REVIEW

NBS Summer Career Program Aids Scientist Recruitment

A program which gives students an opportunity to become acquainted with a Government research laboratory during their summer vacation periods is helping the National Bureau of Standards to meet its increasing demand for high-caliber technical graduates. Having discovered for themselves the advantages of a professional career at the Bureau, of the 236 students employed at the Washington laboratories in the past summer, 44 are still on full- or part-time duty and 130 who plan to return to the Bureau have been granted leave without pay to continue their education. One-half of the 208 students employed in 1956 were included in last summer's program. The program, inaugurated in 1948 was extended to the NBS laboratories in Boulder, Colo., in 1956, where it has resulted in a number of permanent appointments.

The Student Trainee Program, which enables college men and women to apply their education in jobs selected according to their interests, is proving mutually beneficial to NBS and the students. Actual participation in laboratory work has been found to be not only an incentive for continuing scientific studies but also a help to the student in formulating career objectives and in integrating classroom work with actual experience.

During the past summer, students aided in projects ranging from radio propagation studies to developing test methods for acoustic tiles. Programming problems for automatic computers, standardizing isotopes used in medicine, measuring the velocity of free-radical recombination, and designing cryogenic equipment were just a few of the activities.

The Student Trainee Program supplements on-the-job experience with a series of lectures and tours designed to familiarize the summer employees with the research proj-

ets carried on throughout NBS. For example, during the past summer, details of the free-radicals research program were presented to the students. They were given the opportunity to view computer facilities, reactors, the solar furnace, and experiments on purification and high temperature physics.

To gain eligibility on the register from which appointments to the program are made, college men and women must pass a written Civil Service Examination for Student Trainees. At the high-school level a limited number of direct appointments are offered winners in the Westinghouse Science Talent Search and other national science competitions. A student who has taken part in the program and is recommended by his supervisor may return each summer while he is completing his education. Trainee appointments are limited to science majors planning careers in the fields of research carried on at the Bureau. The trainee group ranges from high-school graduates entering at the GS-2 level (\$2960 per year) to students who have completed their junior year in college at the GS-4 level (\$3415). Graduates who return to the Bureau receive a GS-5 rating (\$4480), and those who are employed in a permanent capacity are advanced to a grade 7 (\$5335) after three months if they have qualified under a special training agreement during the preceding summer so that their summer work experience can be counted toward promotion. Graduate students are also accepted for summer employment, a master's degree qualifying scientists or engineers for a GS-7 and half the required PH.D work for a GS-9 rating (\$6250).

John Ryder Is New Editor of IRE Proceedings

John D. Ryder, Dean of Engineering at Michigan State University, has been appointed Editor of the IRE to succeed Donald G. Fink. President for 1958. Dean Ryder was appointed at the January meeting of the IRE Board of Directors.

cppe has shipped over 23,000 size 8 synchros

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Such acceptance made it necessary for us to establish another plant in Colorado Springs to produce size 8 synchros.

Accuracies not exceeding 7 minutes max. of error are guaranteed.

A full line of size 8 rotary components is available including AC and DC motors, linear transformers and motor generators.

For full information write or call Sales Department, SUNset 9-7521 (Suburban Philadelphia) or our representatives.

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ACTUAL SIZE

TYPICAL SYSTEM MEASUREMENTS

	Input Voltage (Volts)	Input Current (Amps)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (mV/deg.)	IMPEDANCE		Phase Shift (deg.)	Remarks
						Input	Output		
Transmitter - Control Transformer	28	.111	.74	22.5	300	58 + j28	628 + j233	19	High impedance load on CT
Transmitter - Control Transformer	28	.111	.75	21.8	377	58 + j28		19	50' load on CT
Transmitter - Control Transformer	28	.110	.83	18.2	330	64 + j27		17	5' load on CT
Transmitter - Differential - CT	28	.134	1.70	19.5	340		748 + j304	40	Output to High impedance
Electrical Resolver - Electrical Resolver	11.8	.115		7	120			52	Input to stator
Electrical Resolver - Electrical Resolver	28			15	200			53	Input to rotor

Clifton Precision Products Co., Inc.

Clifton Heights

Pennsylvania

CIRCLE 10 ON READER-SERVICE CARD

VISIT OUR HOSPITALITY SUITE

I.R.E. Convention, March 24-27, Studio K, Barbizon-Plaza Hotel, 106 Central Park So., N.Y.C.





Atom-by-atom buildup of the transparent phosphor screens is accomplished with this vapor phase deposition equipment. An evaporation process may be used.

Transparent Phosphor CRT Now Utilized

Transparent phosphor cathode ray tubes are now being designed into classified military systems and air traffic control systems in what is reportedly the first such application.

The product of ten years of research at General Electric, Schenectady, N.Y., the tubes afford higher resolution capabilities, higher ambient light viewing, and increased burn resistance over conventional tubes. In addition, the phosphors are virtually noiseless with practically constant light output.

Utilizing low temperature condensation or evaporation processes, non-scattering phosphor screens 1-2 microns thick have been achieved as opposed to the 15-25 micron thickness of standard phosphors.

Theoretically, resolutions of 10,000 lines per inch may be attained with these phosphors although only 1000 lines per inch have been obtained at present. This lag is due to the limitations in the electron optics area and not the state-of-the-art of the phosphors.

The normally diffuse reflecting surface of the standard phosphor has been eliminated so that incident light is not reflected permitting displays under extremely high conditions of ambient lighting. Instead the incident light is trapped inside the transparent phosphor tube resulting in excellent contrast. Light which is specularly reflected may be trapped by a light trap. Up to 97 per cent of the external light has been eliminated in this fashion.

What's YOUR Electronic C

Solderability?...

Temperature?...

Unusual Shapes?...

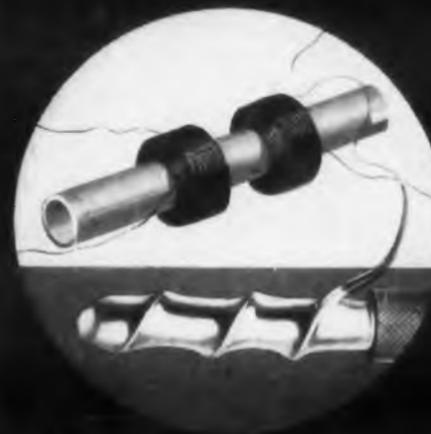
Space?...

Here are five proven solutions to lo



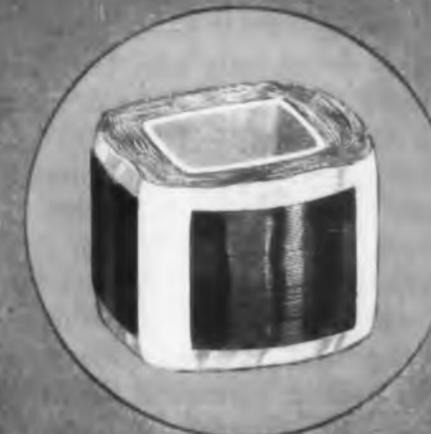
THERMALEZE

A Class "B" 130 C epoxide-polyester film wire for higher temperature windings.



SODEREZE

A polyurethane-coated wire—solders at low temperature—without stripping!



ENAMEL

Modern black enamel with uniform O.D., high tensile for layer-wound coils.

First for Lasting Quality—from Mine to Market!

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Coil Problem?...

Phelps Dodge can supply the right answer to your particular magnet wire problem from its complete, up-to-date line. The products shown here have varied electronic applications. These magnet wires are the result of Phelps Dodge research and development of new materials, combined with practical experience in application engineering.

The complete line of Phelps Dodge magnet wire includes:

Enamel • Formvar • Sodereze® • Bondeze® • Thermaleze® • Grip-eze® • Silicone Enamel
Daglas® • Daglas® Silicone • Paper • Cotton • Multiple Combinations

Lower-cost electronic coils



BONDEZE

Self-bonding wire for turn-to-turn bonding in unusual shaped coils, bobbinless coils, yoke coils, etc.



GRIP-EZE

Controlled friction solderable film wire for winding universal lattice-wound coils, fly-back coils, choke coils, etc.



Wire packaged in Phelps Dodge special "Pakeze" containers if required.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!



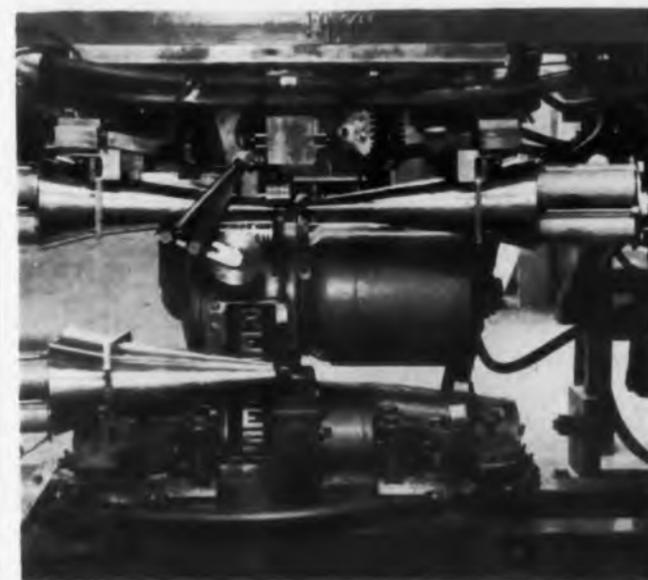
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INCA MANUFACTURING DIVISION
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CIRCLE 11 ON READER-SERVICE CARD

Since the transparent phosphors are in intimate contact with the glass face plate of the tube, the glass may serve as a heat sink allowing greater heat dissipation. In some instances, beam currents in the order of 50-500 times higher than their equivalent standard phosphor tube may be used safely without deteriorating the transparent phosphors.

One unusual development arising from these phosphors is the penetron, a multi-colored device consisting of separate layers of phosphors, with various color emission characteristics. The change of voltage of the cathode ray beam controls the penetration of the beam to the appropriate color emitting layer.



Automated Ultrasonic Welder

An ultrasonic welder, reportedly the first automated, continuous seam welder has been developed by Gulton Industries, Inc., Metuchen, N.J. The unit joins aluminum to aluminum, aluminum to stainless steel, or any two dissimilar or similar metals, as a result of a molecular transference or plastic flow at the interfaces of the two metals below the melting point of either metal. Achieving a rate of speed of 200 in. of welding per min, the welder stands 13 x 12 x 10 ft, and weighs three tons. It is powered by two, 2 kw generators which operate alternately depending on the forward or backward motion of the welding heads, and which supply 500 watts to each welding head. The eight welding heads are driven in the range of 10,000 cps.

Correction

A large error conspicuously occurring in a subtitle is the painful admission we must make about a product written up on page 52 of the February 5 issue. The HD file drum, manufactured by Laboratory for Electronics, Inc., has a storage capacity of 15,000,000 bits, a much more impressive figure than the 15,000 we stated.



Packaged POWER

... at high voltage! ... by the power supply leader...



We are pleased to offer 10 new stock-model high-voltage supplies. All the time-tested reliability of our lower-power industrial H-line equipment, including the famous "BASIC 20" safety and convenience features, at power levels up to 5 KW continuous duty, are available in our new HH units. As always—NJE's high-volume, mass-production techniques hold prices down, quality up!

MODEL	VOLTAGE RANGE	CURRENT RANGE	RIPPLE (% RMS)	PRICE
HH-140	0-2.5 KV	0-1 AMP.	1.0	\$2,200
HH-230	0-5 KV	0-500 MA	1.0	2,400
HH-320	0-10 KV	0-250 MA	1.0	2,550
HH-410	0-15 KV	0-150 MA	1.0	2,750
HH-600	0-25 KV	0-100 MA	1.0	2,980
HH-150	0-2.5 KV	0-2 AMP.	1.0	2,700
HH-240	0-5 KV	0-1 AMP.	1.0	2,950
HH-330	0-10 KV	0-500 MA	1.0	3,280
HH-520	0-20 KV	0-250 MA	1.0	3,500
HH-710	0-30 KV	0-150 MA	1.0	3,800



MODEL HH-MR-240: 0-5 KV, 0-1 AMP DC.
MR-REGULATED TO $\pm 1\%$, 1.0% RMS RIPPLE,
FULL SAFETY AND EQUIPMENT
PROTECTION... \$3,800
WITHOUT REGULATOR... \$2,950
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NJE LEADS THE POWER SUPPLY FIELD

Washington Report

Herbert H. Rosen

Quickening of Pace

What's been done? What's going to be done? What are you doing now? These are the three big questions being asked most often in Washington these days. Congress is now in the process of finding out if the President's request for nearly \$74 billion in FY '59 will or will not do the job. And that job? The defense of the nation against the threat of Russian technological and military supremacy.

Major interest, naturally, is in the department with the largest share of the budget, Defense. How and where it expects to spend its \$40 billions has been of extreme and particular interest since October 1957. Public interest has been at a peak since December, provoked chiefly by the many inquiries being made by Congress.

A preview of general congressional sentiment on the way the Department of Defense conducts itself is reflected in the 17-point program recommended in the interim report of the Johnson Committee. These are the steps the committee feels should be taken immediately by the Administration: 1. Strengthen the Strategic Air Command; 2. Step up dispersal of SAC bases; 3. Step up development of antimissile missiles; 4. Improve the early warning system for manned aircraft and accelerate development of early warning detection of ballistic missiles; 5. Modernize the ground and naval forces; 6. Provide an adequate airlift for troops; 7. Speed up our antisubmarine program; 8. Step up production of the Atlas, Thor, Jupiter and development of the Titan; 9. Reduce lead time in developing weapon systems by cutting down decision times and simplifying procurement procedures; 10. Provide for a freer exchange of technical and scientific information between the nations of the free world; 11. Give serious attention to questions of shelters

◀ CIRCLE 12 ON READER-SERVICE CARD

and stockpiles for civil defense; 12. Reorganize the Department of Defense; 13. Provide increased incentives for trained persons in the military services; 14. Accelerate and expand the R & D programs. Provide funding on a long-term basis, and improve the administration and control within the Department of Defense or through an independent agency; 15. Step up development of manned missiles; 16. Accelerate the development of the Polaris missile system; 17. Start work now on the development of a rocket motor with one million pounds of thrust.

The Key to Survival—Money

The goal of all these points is to buy time. Time to get our ballistics missiles into production. Time to develop radar, guidance, and data processing systems to cope with enemy manned and unmanned missiles.

This year's spending program—January to June, 1958—has been given a substantial transference in the form of a supplemental appropriation. Over \$1.4 billion has been allotted to the Defense Department for IR and ICBM production and bases, antimissile research, and atomic-missile launching submarines. Funds have been earmarked for support of the new operational agency in the DOD, the Advanced Research Projects Agency. The Defense Secretary's emergency fund has been augmented to pay for any rapid breakthroughs that may develop.

In all, defense electronics should exceed \$4 billion in calendar 1958. More than \$1.7 billion should be spent in the missiles field alone. Even at a reduced procurement rate, aircraft electronics should approach \$1.1 billion. Ground type electronics and communications should amount to \$860 million. And electronics share of the R and D category should go beyond the \$40 million level.

This year should also produce some startling developments in electronics because of the emphasis on new techniques. Frequency diversity radar is looked upon as a brand new method for interference-free detection and ranging. The Army's Nike Zeus antimissile program should come up with innovations that will be valuable to the future growth of the industry. More than \$721 million will be spent by the Air Force alone in the area of antimissile detection (part of the defunct Wizard program).

Money—and the quick decision to spend it in designated areas—should be adequate for the current defense program. Yet, in testimony before the House Appropriations Committee, Secretary of Defense McElroy forecasted that he expects to be forced to ask for another supplemental appropriation next January. At this point, industry should consider where it is to get the manpower for these accelerated programs.

Nominal Performance Characteristics of Typical SPRAGUE Magnetic Shift Registers

OPERATING FREQUENCY Maximum (kc)	0-25			0-100			0-200		
	Recommended (kc)			0-90			0-190		
VOLTAGE SIGNAL LEVEL	4	15	30	4	15	30	4	15	30
SHIFT PULSE									
Nominal Operating Current (ma)	160	160	160	140	200	200	220	220	220
Voltage Drop per Stage (v)	3.4	8.0	9.5	8.0	10.0	13.5	6.8	6.0	9.5
Duration (μ sec at $\frac{1}{2}$ amplitude)	7.0	6.5	5.8	2.0	2.0	2.5	1.2	1.2	1.2
Rise Time (μ sec)	1.8	1.8	1.8	0.8	0.8	0.8	0.3	0.3	0.3
Fall Time (μ sec)	0.9	1.8	0.9	0.8	0.8	0.8	0.3	0.3	0.3
Peak Pulse Power (watts)	.55	1.5	1.6	1.12	2.0	2.7	1.5	1.4	2.1
INPUT PULSE									
Amplitude (ma)	15	10	5	15	10	15	15	10	10
Duration (μ sec)	10	10	10	3	3	3	2	2	2
PARALLEL OUTPUT PULSE									
Amplitude (ma)	4	16	32	5	18	30	4.5	16	30
Ratio (min.)	10:1	10:1	10:1	10:1	10:1	10:1	8:1	8:1	8:1
Load Impedance (ohms, min.)	2000	6000	25,000	1800	8000	15,000	10,000	10,000	18,000
DIODE TYPE (or equivalent)	T-7	T-7	T-7	T-7	T-7	T-5	T-7	T-5	T-5
ENGINEERING DATA SHEET	9111	9113	9115	9121	9123	9125	9131	9133	9135

core-diode type magnetic shift register assemblies

... 100% pulse performance tested

Wherever you use Sprague Magnetic Shift Register Assemblies... in the air or on the ground... in counters for industrial controls or basic logic circuits for computers... chances are you'll be looking for uniformity and reliability. That's why Sprague uses truly reliable components throughout their construction. Why every core used is subjected to rigid switching tests before installation. And why every assembly is 100% pulse performance tested before shipment.

Packages matched to the application

assure long register life at minimum cost. Register assemblies for ground use are available in hermetically sealed corrosion-resistant metal cases with glass-to-metal solder-seal terminals for severe environmental conditions, or embedded in plastic for moderate environments. Special minimum volume airborne packages are ideal for limited space applications.

All standard packages are characterized by terminal spacing that simplifies external mounting of semi-conductor diodes, or they can be permanently

packaged as integral assembly components in Sprague special designs.

Single and multiple stage register assemblies are available with read and write provisions to meet most system requirements. Standard designs can easily be modified with additional windings to perform various logical operations.

For Data Sheets on core-diode type magnetic shift register assemblies, write the Technical Literature Section, Sprague Electric Company, 347 Marshall St., North Adams, Massachusetts.

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the mark of reliability

SPRAGUE COMPONENTS:

MAGNETIC COMPONENTS • TRANSISTORS • RESISTORS • CAPACITORS • INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS

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CIRCLE 13 ON READER-SERVICE CARD

MEETINGS

Mar. 16-21: 1958 Nuclear Congress

Chicago Amphitheatre and Palmer House, Chicago, Ill. Sponsored by the AICE, AIEE, IRE, and many others. The congress will include five separate conferences: The Fourth Nuclear Engineering and Science Conference (Mar. 17-21); The Fourth International Atomic Exposition (Mar. 16-21); The Sixth Atomic Energy in Industry Conference (Mar. 17-19); The Sixth Hot Laboratories and Equipment Conference (Mar. 19-20); and The American Power Conference (Mar. 17-19). For more information write to the American Institute of Chemical Engineers, 25 West 45th St., New York 36, N. Y.

March 18-19: Conference on Extremely High Temperatures

Air Force Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass. Sponsored by AFCRC. The purpose of the Conference is to further the exchange of information among those interested in research into temperatures above 30,000 Kelvin. Emphasis will be placed upon theoretical and experimental aspects although the Conference will also cover applications. Write Dr. Heinz Fischer, AFCRC, L. G. Hanscom Field, Bedford, Mass. for details.

Mar. 24-27: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York City. More than 55,000 engineers and scientists from 40 countries are expected to attend this technical convention. Program includes 275 papers, covering the most recent developments in the fields of all 27 IRE Professional Groups, and two special symposia. For information contact E. K. Gannett, IRE, 1 East 79th St., New York, N.Y. (See program on page 22.)

Mar. 27-29: Ninth Biennial Electrical Industry Show and Fifth Electrical Maintenance Conference

Shrine Exposition Hall, Los Angeles, Calif. Some of the topics to be discussed are maintenance to prevent breakdown, maintenance of electrical and electronic equipment and maintenance of lighting to assure peak output. For more details write Paul H. Henrichs, Southern California Edison Co., P.O. Box 351, Los Angeles, Calif.

• THE MOST ADVANCED CONCEPT IN SILICON RECTIFIERS—

DIFFUSED

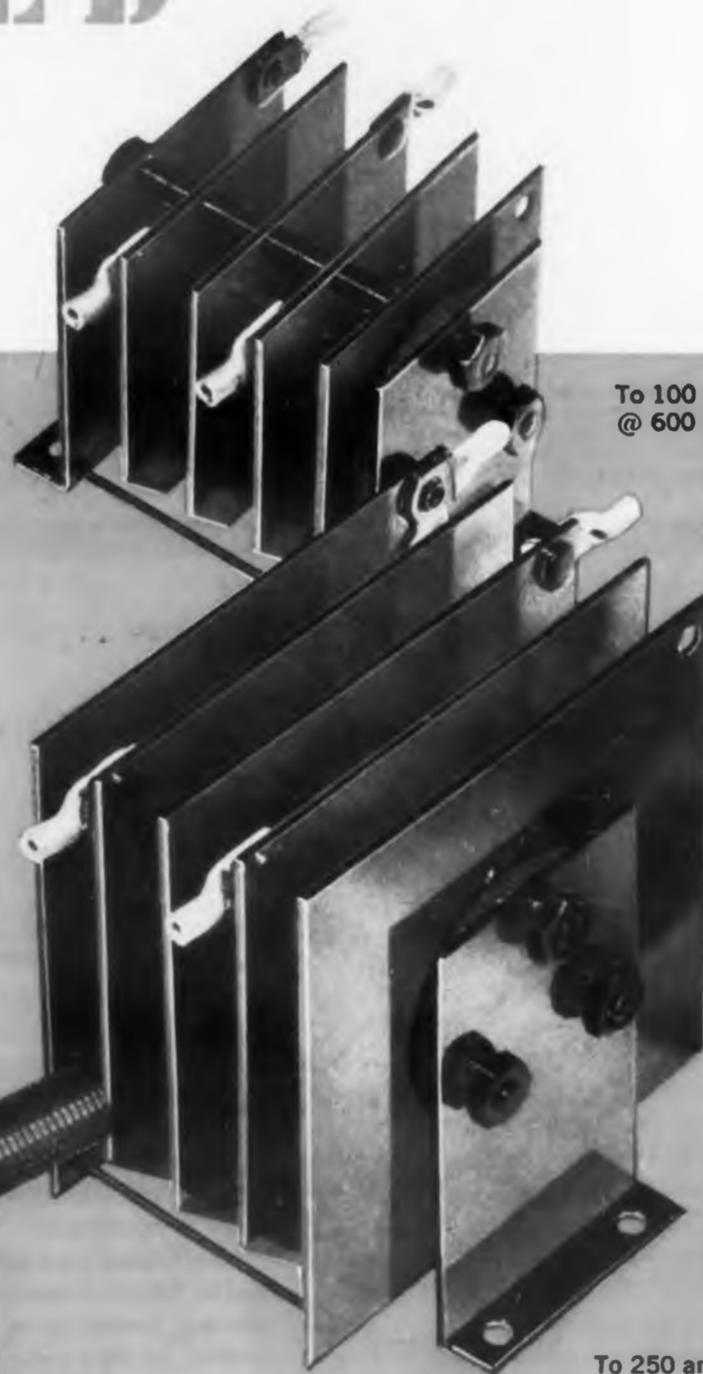
HIGH CURRENT SILICON JUNCTION RECTIFIER!

Actual Size



NOTE ALL THESE ADVANTAGES:

- **High Power Rating**—for power supply applications to 400 amperes at 350 volts peak inverse. To 5,000 amperes in stacked combinations.
- **High Efficiency**—up to 99%, depending on application.
- **Excellent Regulation**—forward drop of less than 1 volt per cell.
- **Reliability**—operates from -65°C to 150°C without derating.
- **Lowest Reverse Leakage**—in microamperes at rated peak inverse.



To 100 amps
@ 600 P.I.V.

To 400 amps
@ 350 P.I.V.

To 250 amps
@ 600 P.I.V.

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CIRCLE 14 ON READER-SERVICE CARD

Mar. 31-Apr. 2: AIEE South West District Meeting

Tulsa, Okla. For information send to the AIEE, 33 West 39th St., New York, N.Y.

Mar. 31-Apr. 2: Instruments and Regulators Conference

University of Delaware, Newark, Del. Sponsored by the IRE, ASME, AICHE, and ISA. For details send to E. M. Grabbe, P.O. Box 45067, Airport Station, Los Angeles 45, Calif.

Apr. 2-4: ASME Conference on Automatic Optimization

University of Delaware, Wilmington, Del. AIEE, IRE, ISA, AICHE with professional groups analogous to the RE will participate in the conference by sponsoring technical papers centered around the theme, "Automatic Optimization." For details write W. E. Vannah, Control Engineering, 330 W. 42nd St., N. Y. 36, N. Y.

Apr. 8-10: Sixth National Conference on Electromagnetic Relays

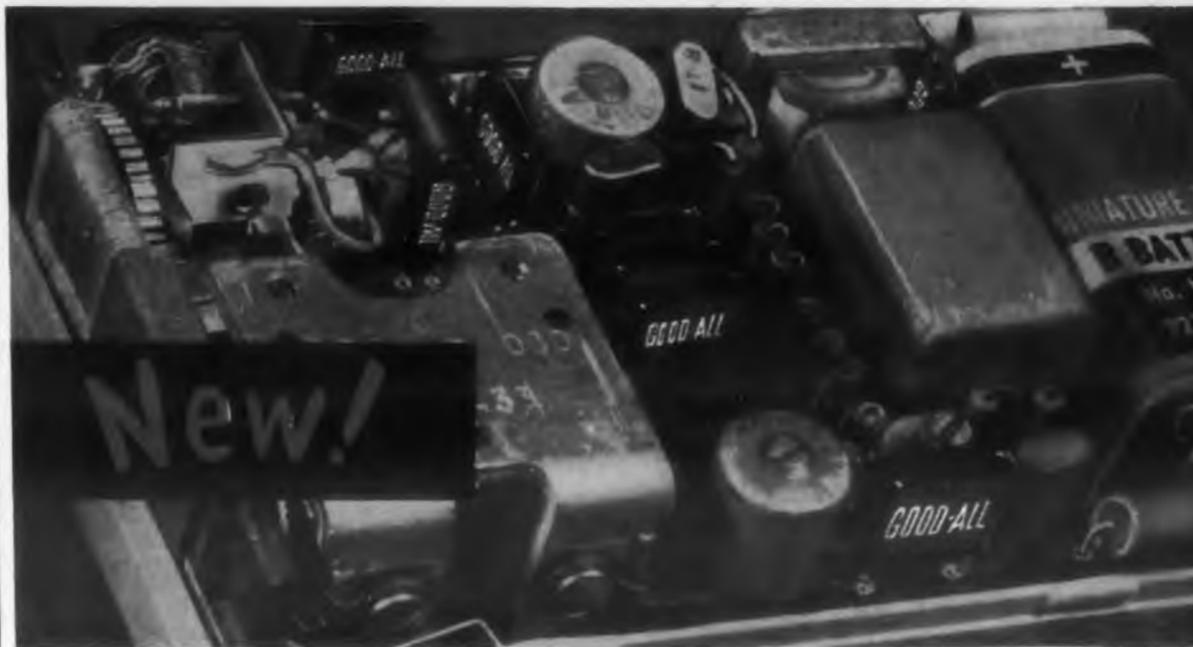
Oklahoma State University, Stillwater, Okla. Sponsored by the National Association of Relay Manufacturers. More information may be obtained from Charles F. Cameron, Dept. of Electrical Engineering, Oklahoma State University, Stillwater, Okla.

Apr. 8-10: Symposium on Electronic Waveguides

Auditorium of Engineering Societies Bldg., 33 W. 39th St., New York. Sponsored by IRE, PGED and PGMTT, and the Department of Defense Research Agencies. The symposium will deal with the interaction of electromagnetic fields and electron or plasma beams in general waveguide regions. The symposium covers the fields of electron beams, plasmas, and electromagnetics to compare the rather widely disparate theories and techniques employed to describe the wave phenomena encountered in the interaction of such fields. For further information contact the Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, New York.

Apr. 10-12: IRE South West Regional Conference and Electronics Show

San Antonio Hotel and Municipal Auditorium, San Antonio, Tex. Write for details to J. O. Parr, Jr., 202 Janis Ave., San Antonio, Tex.



SPACE SAVING CAPACITOR ... tailored for transistors

SLIM LIKE A DISC ... Wafer-thin shape of the Good-All 601PE makes it ideal for upright mounting in tight spaces. →

EXCELLENT TEMPERATURE STABILITY ... The TC of the 601PE is identical with that of a conventional tubular capacitor. →

MOISTURE TIGHT EPOXY COATING ... This tough, durable epoxy has exceptionally high dielectric strength and lead entries are tightly sealed. →

ECONOMICAL ... Competitive in price with ceramic discs in the capacity range of 0.1 MFD and above.

*DuPont's trademark for polyester film.

TYPE 601PE DIMENSIONS
(FOR 50 VDC RATING)

CAP. (MFD)	A	B	D	E	CAP. (MFD)	A	B	D	E
.01	.310	.800	.187	.187	.1	.650	.850	.375	.225
.022	.359	.800	.187	.187	.15	.671	.900	.375	.260
.033	.531	.650	.312	.171	.22	.718	.900	.375	.296
.047	.531	.700	.312	.203	.33	.812	.950	.500	.312
.068	.531	.781	.312	.218					

SPECIFICATIONS

Insulation Resistance—Greater than 75,000 megohms when measured at 100 volts D.C. at 25° C for a maximum of 2 minutes.

Capacity Tolerance—Standard tolerance is 20%.

Winding Construction—Extended foil (non-inductive) MYLAR* Dielectric.

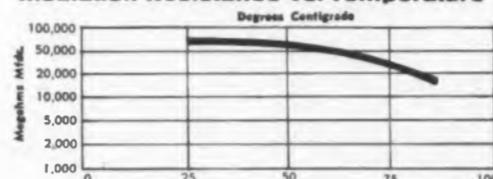
Lead Variations—Formed or straight leads.

Dissipation Factor—Less than 1% at 1,000 cycles per second at 25° C.

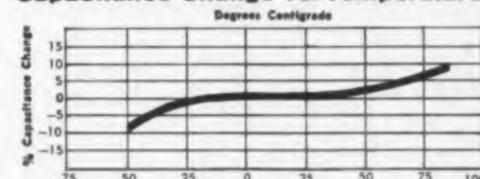
Dielectric Strength—100 volts D.C. for 1 to 5 seconds thru a minimum current limiting resistance of 20 ohms per volt.

Temperature Range—May be operated at full rated voltage to 85° C. Derate to 50% when operating at 125° C.

Insulation Resistance vs. Temperature



Capacitance Change vs. Temperature



TECHNICAL BROCHURE AVAILABLE ON REQUEST

MANY GOOD-ALL CAPACITOR TYPES ARE NOW AVAILABLE AT YOUR LOCAL DISTRIBUTOR



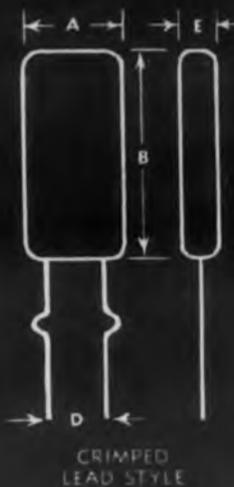
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OGALLALA, NEBRASKA

CIRCLE 15 ON READER-SERVICE CARD

GOOD-ALL

TYPE
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"SLIM LINE"



HUGHES HIGH CONDUCTANCE SILICON DIODES

Hughes, many years a leader in the semiconductor industry, has added another series to its expanding line. These new units can withstand temperatures as high as 200°C while sustaining all the important features your circuits demand:

- high forward conductance
- high reverse voltage
- low dynamic forward resistance
- high back resistance at high temperatures and/or high voltages

They are quality diodes, rugged and reliable like all Hughes diodes. And each is packaged in Hughes' famous glass envelope, designed for complete protection from contamination and moisture penetration. Maximum body dimensions: .107" x .265".

Special types are available, too. Perhaps you have a design with unique requirements and can't find the right diode for the job. If so, ask for a call from one of our sales engineers or visit our booth at the IRE show this month. Either way, we would be pleased to discuss your requirements.

For printed literature, please write: Semiconductor Division, HUGHES PRODUCTS, International Airport Station, Los Angeles 45, California



Creating a new world with ELECTRONICS

HUGHES PRODUCTS

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CIRCLE 16 ON READER-SERVICE CARD

MEETINGS

Apr. 30-May 1-2: 7th Regional Technical Conference & Trade Show

Hobbies Bldg., State Fair Grounds, Sacramento, Calif. Write Ewald W. Berger, 3421 58th St., Sacramento 20, Calif. for information.

May 4-7: 4th National Flight Text Instrumentation

Park-Sheraton Hotel, New York City. Sponsored by the Instrument Society of America. Coverage of all phases of instrumentation for aircraft testing will be offered including sessions on helicopter and power plant instrumentation. Three sessions will be specifically devoted to Missile Instrumentation. Another session will be spent on the instrumentation for ground testing of aircraft and aircraft systems. Theme of the Symposium is "More Data Per Dollar." For details write P.O. Box 113, Bethpage, N. Y.

May 5-7: PGMT&T National Symposium

Stanford University, California. For details, write to Dr. K. Tomiyasu, GE Microwave Lab., 601 California Ave., Palo Alto, Calif.

May 6-9: Western Joint Computer Conference

Ambassador Hotel, Los Angeles, Calif. Cosponsored by IRE, ACM, and AIEE. Theme of the conference will be "Contrasts in Computers," with panel discussions on controversial aspects of modern computers. For more information write David Parry, 6363 Wilshire Blvd., Los Angeles 48, Calif.

May 13-15: Spring Assembly Meeting of the Radio Technical Commission for the Marine Services

Benjamin Franklin Hotel, Philadelphia, Pa. Write R. T. Brown, Radio Technical Commission for Marine Services, c/o Federal Communications Commission, Washington 25, D.C.

May 21-23: AIEE, IRE, RETMA, WCEMA, Joint Electronic Components Conference

Los Angeles, Calif.

June 2-4: National Telemetry Conference

Lord Baltimore Hotel, Baltimore, Md. Sponsored by the AIEE, ARS, ISA, and IAS. The technical program will feature sessions in telemetry in

Type Number*	Max. Forward Current	Max. Rated Average Forward Current		Max. Inverse Current		Test Voltage	Max. Rated Inverse Operating Voltage
	@ +1 Volt	@ 25°C	@ 150°C	@ 25°C	@ 150°C		
1N482B	100mA	200mA	50mA	.025μA	5μA	30V	36V
1N483B	100mA	200mA	50mA	.025μA	5μA	60V	70V
1N484B	100mA	200mA	50mA	.025μA	5μA	125V	130V
1N485B	100mA	200mA	50mA	.025μA	5μA	175V	180V
1N486A	100mA	200mA	50mA	.050μA	25μA	225V	225V
1N487A	100mA	200mA	50mA	.100μA	25μA	300V	300V

(*Lettered and unlettered versions not listed are available.)

Hughes has related types with higher forward currents. Here are three of the many which could be listed:

HD6764	200mA	200mA	50mA	.025μA	5μA	60V	70V
HD6768	200mA	200mA	50mA	.025μA	5μA	175V	180V
HD6773	200mA	200mA	50mA	.025μA	5μA	300V	300V

the IGY program, telemetering overseas, rocket telemetering, industrial telemetering, and data reduction. In addition there will be the annual exhibit staged by manufacturers of telemetering equipment. For further details about the conference write W. J. Mayo-Wells, Program Chairman, 3830 Beecher St., N.W., Washington, D.C.

June 5-6: 2nd National Symposium on Production Techniques

Hotel New Yorker, New York, N.Y. Sponsored by PGPT. For information write John W. Trinka, Sperry Gyroscope Co., Great Neck, L.I., N.Y.

June 9-13: 6th Annual Technical Writers' Institute

Rensselaer Polytechnic Institute, Troy, N.Y. For details contact William E. Price, News Bureau, Rensselaer Institute, Troy, N.Y.

June 16-18: 2nd National Convention on Military Electronics

Sheraton Park Hotel, Washington, D.C. Sponsored by PGMIL. Contact Dr. J. McLaughlin, Naval Research Labs, Washington 25, D.C., for information.

June 22-27: AIEE Summer General Meeting

Buffalo, N.Y.

June 23-27: ASTM 61st Annual Meeting

Hotel Statler, Boston, Mass. Highlighting the meeting will be the 12th Technical Photographic Exhibit of the ASTM. Entries will be accepted from members of ASTM, employees of company members, and engineering students. For further information, contact E. W. Walsh, Chairman, ASTM Photographic Exhibit, Narragansett Electric Co., 15 Westminster St., Providence, R.I.

Paper Deadlines

May 1: Deadline for papers to be presented at the 1958 WESCON Show and Convention. The convention is planned for August 19-22 and is to be held in Los Angeles. Prospective authors should submit 100 word abstracts and either the completed texts or detailed summaries. All material should be mailed to Dr. Robert C. Hansen, Microwave Lab., Hughes Aircraft Co., Culver City, Calif.



Rugged and stable under high temperature conditions, these Corning S-Type resistors provide savings in space and cost.

Now you can have resistors with all these advantages . . .

1. 120° C. operation with 100% power, derating to 200° C.
2. Same size as deposited carbons
3. Wide resistance range
4. Economical cost

To help you solve the problem of small space and high ambient temperature Corning has developed these Type S resistors.

These are not ordinary film-type resistors. They are integral units made by bonding a metallic oxide to a PYREX® glass rod at red heat. They're non-inductive and completely impervious to moisture.

Three sizes are now available in production quantities:

S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 50 ohms to 500,000 ohms.

S-25—1-watt at 120° C. (or 2-watts at 40° C.). Resistance range from 50 ohms to 1.5 megohms.

S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 100

ohms to 4.2 megohms.

Corning Type S resistors have an average change in resistance of less than 1.5% after 1,000 hours at rated power.

Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

Write for detailed descriptive bulletin CD-2.05.

Ask for information on these other Corning resistors:

Type LP—Low-cost, low-power. In 3-, 4-, 5-, and 7-watt sizes.

Type R—Power resistor to MIL-R-11804B. Tolerances of 2% or 5%, 7 to 115 watts. Range: 50 to 1,000,000 ohms.

Type H—High-frequency 2% or 5% tolerance. Standard ranges from 50 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP—High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 50 to 500,000 ohms.

Type WC-5—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traversal and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

*Distributed by Erie Resistor Corporation



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Corning means research in Glass

CIRCLE 17 ON READER-SERVICE CARD



AHEAD AGAIN...

U. S. Radium's Newest Instrument Dial

A current problem in integral instrument lighting is that of obtaining, at reasonable cost, a dial for a particular unit which will light within the brightness ratio spec of MIL-L-25467A. Since different instruments will have different lighting systems and will require different dial configurations and indicia, the dial contractor must be able to vary the opacity of his dials in order that the finished instrument assemblies will light to MIL spec, regardless of the internal light levels and the number and position of the lights.

U. S. Radium's new production process for MIL-L-25467A dials permits the variation of the opacity factors of the background and indicia within wide limits, to provide a compatible instrument-dial assembly. It also allows piece-to-piece uniformity which excels conventional methods for meeting this spec, and at lower unit cost. These advantages, plus the availability of U. S. Radium's light engineering service during the formative stages of light housing design, provide a foolproof working method for eliminating light engineering headaches, cutting costs and speeding delivery.

For information, contact Department D3



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MORRISTOWN, N. J.

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CIRCLE 18 ON READER-SERVICE CARD

IRE National Convention Program

All A.M. sessions begin at 10:00, P.M. sessions at 2:30, Eve. sessions at 8:00 P.M.

Abbreviation Key: Waldorf (W)—Astor Gallery (A), Grand Ballroom (G), Jade Room (J), Sert Room (SE), Starlight Roof (ST). Coliseum (C)—Morse Hall (MO), Marconi Hall (MA), Faraday Hall (F).

Session and Number	Time and Location	Session and Number	Time and Location
Aeronautical Electronics		Instrumentation	
Aeronautical and Navigational Electronics (14)	Tues am-C-MO	Instrumentation Systems (38)	Wed pm-C-MO
Aeronautical and Navigational Electronics (26)	Wed am-W-ST	High Accuracy Instruments (53)	Thur pm-C-MO
Antennas and Propagation		Microwaves	
Propagation and General Antennas-I (40)	Wed pm-C-F	Measurements (32)	Wed am-C-MA
General Antennas-II (47)	Thur am-C-MA	Components (39)	Wed pm-C-MA
Microwave Antennas (54)	Thur pm-C-MA	Tubes (48)	Thur am-C-F
Audio		Antennas (54)	Thur pm-C-MA
Stereophonic Disc Recordings (12)	Tues am-W-SE	Medical Electronics	
Amplifier and Receiver Development (20)	Tues pm-W-SE	Medical Electronics (15)	Tues am-C-MA
Circuit Theory		Nuclear Science	
Modern Delay Lines—Symposium (29)	Wed am-W-SE	Controlled Thermonuclear Power (10)	Tues am-W-A
Filter Design (42)	Thur am-W-A	Atomic Clocks and Masers (18)	Tues pm-W-A
Topological and Group Concepts (50)	Thur pm-W-A	Panel Discussions	
Communications		Educational Needs in Systems Engineering (5)	Mon pm-W-G
Vehicular (2)	Mon pm-W-A	Changing Demands on Engineering Education (17)	Tues pm-W-ST
Broadcast Transmission Systems (11)	Tues am-W-J	Biological Transducers (22)	Tues pm-C-MA
Broadcast Transmission and Communications Systems (19)	Tues pm-W-J	Electronics in Space (24)	Tues eve-W-ST
General Communications Systems (16)	Tues am-C-F	Electronics Systems in Industry (25)	Tues eve-C-F
Long Distance Comm. (52)	Thur pm-W-SE	Planning	
Components		Planning Against Time (13)	Tues am-W-G
Papers on Inductors, Ceramics, Miniature Meters (28)	Wed am-W-J	Production Engineering (8)	Mon pm-C-F
Papers on Capacitors, Filters, Amplifiers and Radiation Effects (36)	Wed pm-W-J	Radar, Military (31)	Wed am-C-MO
Microwave Components (39)	Wed pm-C-MA	Radio Frequency Interference	
Computers		R-F Interference (7)	Mon pm-C-MA
Computers and Control (37)	Wed pm-W-SE	R-F Interference in Military Systems (45)	Thur am-W-G
Magnetics and Computers (41)	Thur am-W-ST	Radio and TV (55)	Thur pm-C-F
Data Reduction and Recording (46)	Thur am-C-MO	Reliability	
General Systems (49)	Thur pm-W-ST	Reliability Through Components (23)	Tues pm-C-F
Control Systems		Reliability Through Systems (34)	Wed pm-W-ST
Telemetry and Remote Control (3)	Mon pm-W-J	Semiconductors	
Automatic Control-General (9)	Tues am-W-ST	Semiconductor Devices (33)	Wed am-C-F
Canadian Postal Operations (30)	Wed am-W-G	Statistics	
Detection Theory		Statistical Applications (27)	Wed am-W-A
Tutorial Session on Applications (1)	Mon pm-W-ST	Telemetry	
Electronic Engineering		Telemetry and Remote Control (3)	Mon pm-W-J
Techniques and Criteria (4)	Mon pm-W-SE	Tubes	
Engineering Writing and Speech (6)	Mon pm-C-MO	Beam and Display Tubes (21)	Tues pm-C-MO
Industrial Electronics (44)	Thur am-W-SE	Microwave Tubes (48)	Thur am-C-F
Information Theory		Ultrasonics	
Code and Detection (35)	Wed pm-W-A	Delay Lines—Symposium (29)	Wed am-W-SE
		Delay Line Measurements (43)	Thur am-W-J
		Radiated Acoustic Power Measurement (51)	Thur pm-W-J

EDITORIAL

'58 IRE National Convention

World's Biggest Ice Breaker

Where else will so many people meet so many other people? Mike Todd's highly publicized extravaganza at Madison Square Garden catered to 10,000. That party will be outdone by the IRE National Convention. Over 15,000 will be present each day. You could have done some limited table hopping at Todd's show to enlarge your acquaintance a bit. At the Coliseum you can booth hop 850 times meeting new faces with common interests every time. You can join in the discussion at any one of 255 sessions.

Todd, of course, had champagne. Most parties count on cocktails to spread congeniality. No forced chemical change is needed at the IRE Convention, however, to break down the engineer's reserve or inhibitions, because the catalyst is simply the interesting new product, the provocative session paper (or the common malady, tired feet).

To persist in this soliloquy, I can't help but think of another markedly similar point between Todd's show and the IRE Show. Prizes could be won at both; for the person who wants to escape it all, suites at nearby hotels are dispensing hospitality à la Todd.

Break the Ice with Your *ED* Editor

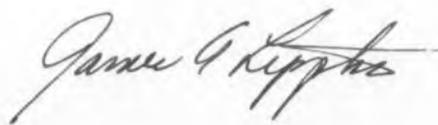
In making your rounds, make it a point to stop and meet some of your *ED* editors. We'll have an editorial office for that purpose at Booths 4101-4102 (next to the elevators). We'd like to hear about what you're doing and at the same time twist your arm to do some writing for us. We have a list of articles that we want somebody to do. Maybe you'll be interested.

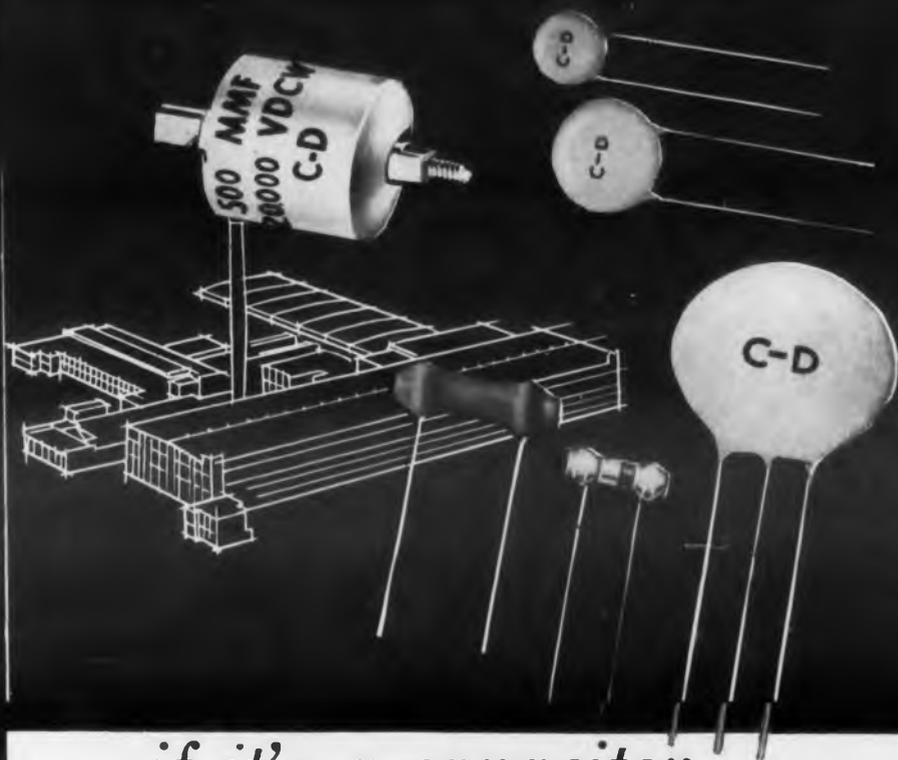
We're especially interested in lining up some engineers to critique U.S.S.R. literature. If you're at all intrigued by something like this, let's chat.

Incidentally, this year's IRE Convention marks the anniversary of associate editor, George Rostky joining our staff. We met George at the Coliseum—we're looking for others like him again this year.

Latest New Product Information

You can preview many of the new products being introduced at the show by scanning the New Products department in this issue. To get the very latest on new products, check our booth. We will post announcements and pictures of new devices unveiled at the show, opening day. As a matter of fact, one of the best things you can do when you get to the Coliseum is to take the elevator to the fourth floor and turn left. You'll see us standing there.





if it's a capacitor...

C-D *makes it...*

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Transistor-Simulated Reactances

Richard H. Stern
Norden Ketaf Corp.
Milford, Conn.

Circuit designs using large values of reactance are often limited by the cost, size, or weight of the reactors. The compact transistor circuits described here can substitute for chokes and capacitors wherever cost and size are important. Applications include the suppression of spike and ripple voltages in power supplies, or use in delay networks requiring large lumped-constant reactances.

THE CIRCUIT designer is frequently caught between circuit specifications requiring the use of large values of reactance and limitations of cost, size, or weight which prohibit large reactors. In the past there was no choice but to accept the inferior performance resulting from economic restrictions. The advent of transistors made possible a solution of this problem in certain applications. In power supplies, for example, transistorized regulators can sometimes be substituted for conventional filter circuitry.

This solution is not wholly satisfactory. If bat-

teries are used as regulator reference sources, periodic replacement must be made; on the other hand, alternate reference sources such as diodes are costly. A true voltage regulator will not pass changes in dc level, causing unregulated parts of a system to vary in level with respect to the regulated parts. Changes in dc input level to the regulator due to changes in ac line input voltage impose high collector dissipation upon certain stages of a series regulator.

An alternate approach to the problem is suggested by the vacuum tube operational amplifier developed by Ragazinni *et al* during World War II as a refinement and generalization of the Miller effect. The transistor equivalents of these circuits are compact, light and inexpensive units which simulate large values of reactance within a linear operating region. Although these circuits present an impedance to input signals which is a function of frequency, they depart from ideal reactive behavior in a number of important respects. Because their performance depends upon transistor current gain, they are inoperable above transistor cutoff frequency. The capacitive reactance circuits do not show infinite impedance at dc and the inductive circuits do not show zero impedance at dc. Nevertheless, in well-biased Class-A operation, they furnish extremely large values of reactance in small space at little cost.

The principal applications envisioned for the circuits developed in this article are filtering and decoupling. However the circuits and analytical treatments are equally applicable to phase shift and delay network applications.

Transistor-Simulated Capacitance

The circuit for a transistor-simulated shunt capacitance is shown in Fig. 1. Both pnp and npn transistors are suitable, and the unit may be placed across a positive or negative polarity load. This circuit effectively multiplies the capacitance of the base capacitor by the current gain, h_{fe} of the transistor. Analytically, the current through the transistor may be represented as²

$$i_c = h_{oe} v_c + h_{fe} i_b + I_{CEO} \quad (1)$$

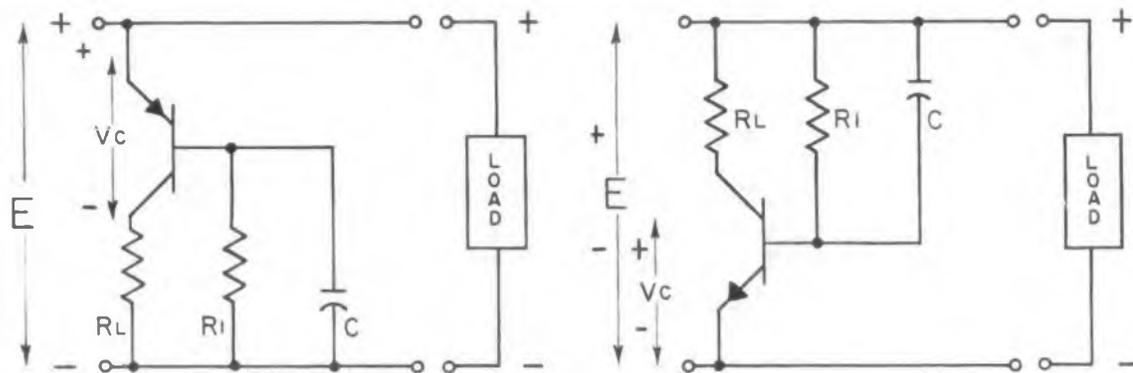


Fig. 1. Circuit for transistor-simulated shunt capacitance. The value of the capacitance used in the base path is multiplied by the transistor gain.

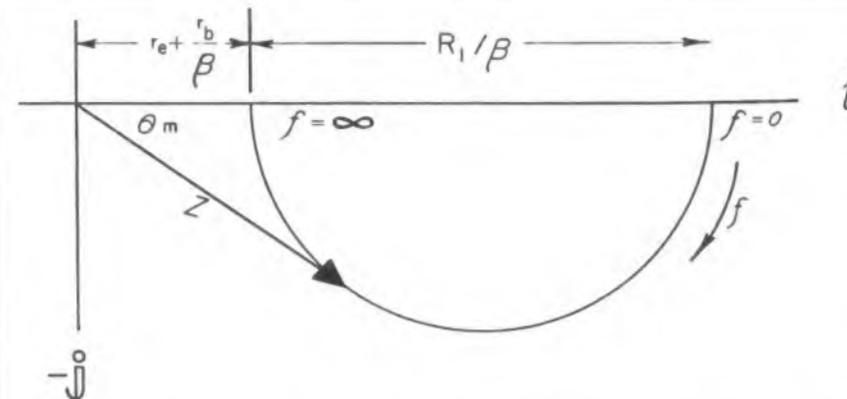


Fig. 2. Complex plane representation of eq. (3) illustrating the variation in impedance with respect to frequency.

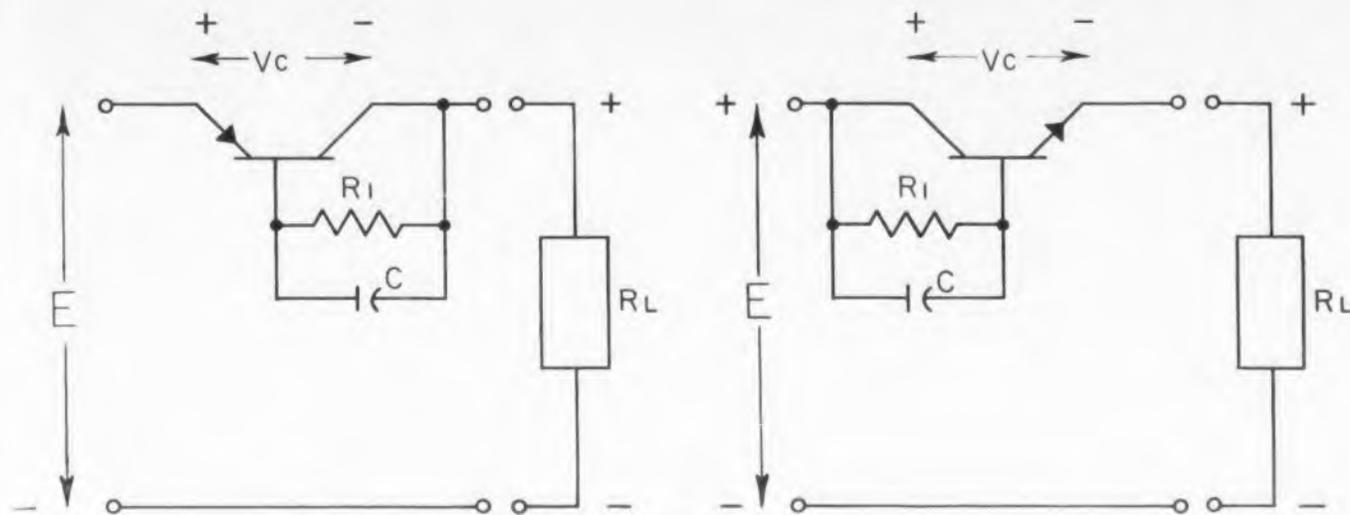


Fig. 3. Transistor simulated series capacitance, modified from the circuit of Fig. 1.

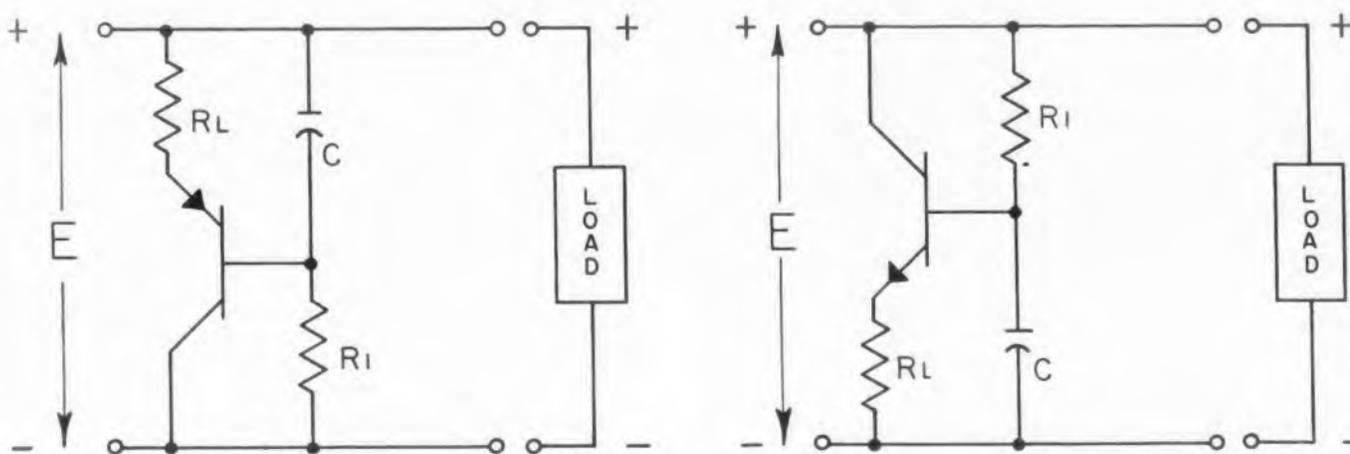


Fig. 4. Shunt inductance circuit, using only capacitance as a reactive parameter.

Substituting into this equation the values of v_c and i_b obtained by replacing the transistor with its z -parameter equivalent and then writing loop equations, the equation may be rewritten as follows:

$$i_c = h_{oe} (e - i_c R_L) + h_{fe} \frac{e}{h_{ie} + R_1 / (1 + R_1 C s)} \quad (2)$$

If the impedance of the unit is defined as the voltage across it divided by the current through it, then

$$z_{unit} = \frac{e}{i_c} \approx h_{ib} + \frac{1}{h_{fe} / R_1 + h_{fe} C s} \quad (3)$$

This approximation is correct so long as $i_c \approx h_{fe} i_b$

From Equation 3 it can be seen that, essentially, the circuit does multiply the value of capacitance used in the base path by the transistor gain, h_{fe} . The advantage to be obtained by adding stages of gain is apparent. Moreover, while for "real" capacitors the capacitance is roughly proportional to size, for transistor-simulated capacitors the capacitance increases exponentially with size. Each stage of gain (and consequent increment in size, weight, and cost) multiplies capacitance rather than merely adding capacitance.

The complex plane representation of z_{unit} from

Equation 3 is shown in Fig. 2, illustrating the variation in impedance with respect to frequency. It may be seen from the figure that maximum phase shift can be set at any desired frequency by choice of a suitable value of C , and that maximum phase angle can be set at any desired value by choice of a suitable value of R_1 .

In Fig. 3, the circuit of Fig. 1 is shown as modified for use as a series capacitance. Conversion to negative polarity loads may be effected by reversal of the direction of conduction of the transistor and associated base paths. The analytic approximation of the impedance of this circuit is the same as that given in (3) for the shunt capacitance circuit, and the complex plane representation in Fig. 2 is therefore applicable as well.

Transistor-Simulated Inductance

Transistor-simulated inductances could be developed from the circuits of Figs. 1 and 3 by substitution of small inductors for the capacitors shown. However, it is much more desirable from an engineering standpoint to use no inductors at all. For this reason, alternative circuitry is developed which requires only capacitance as a reactive parameter. Only grounded collector configurations are used. Grounded emitter configurations are unsatisfactory because the effec-



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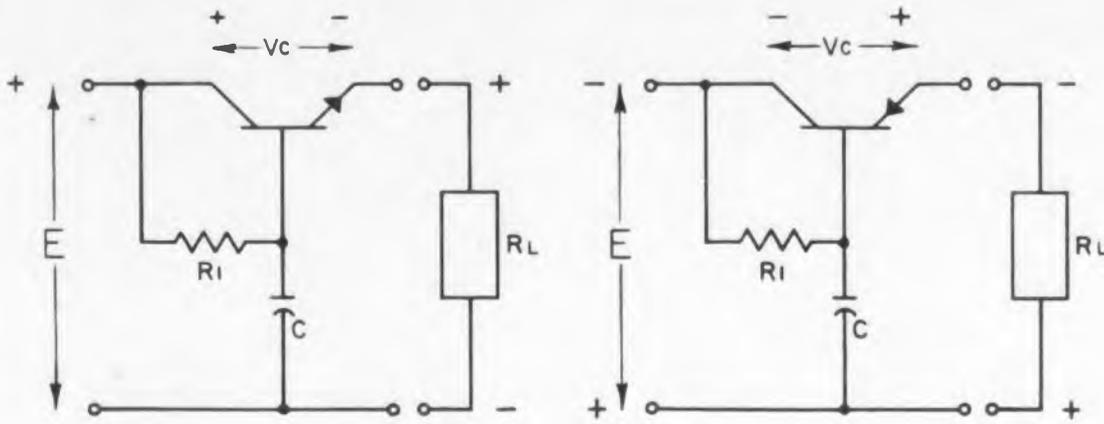


Fig. 5. Transistor simulated series inductance, using only capacitance as the reactive parameter.

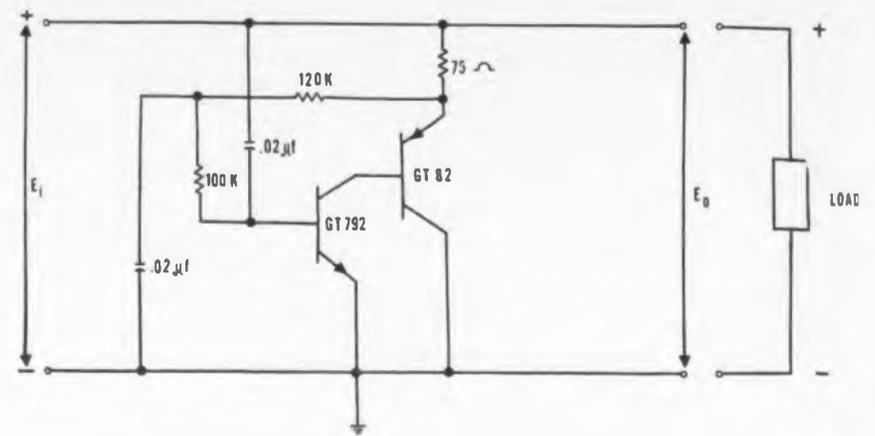


Fig. 6. Practical two-stage transistor-simulated shunt capacitance, designed to replace a 6 v, 150 μf capacitor.

tiveness of the circuit depends on the path through the capacitor being the element which controls magnitude of base current. If no external resistance is used in the emitter circuit, the only resistance shunting the capacitor is h_{ie} or $r_b + h_{fe} r_e$. Since this quantity is of the order 2K for common transistors, crossover frequency will be unduly high unless very large capacitances are used. But this, of course, defeats the whole economic advantage to be gained from the circuit. Hence, the load must be placed in the emitter path.

Analytic expressions for the approximate impedances of the transistor-simulated shunt and series inductance circuits may be developed as

was done in Equations 1-3. For the shunt inductance circuit of Fig. 4, the expression is

$$z_{unit} = \frac{e}{i_c} \approx \left(R_L + \frac{R_1}{h_{fe}} \right) + R_1 R_L C s \quad (4)$$

while for the series inductance circuit of Fig. 5, the expression is

$$z_{unit} = \frac{v_c}{i_c} \approx \frac{R_1}{h_{fe}} + R_1 R_L C s \quad (5)$$

Effect of Parameter Variation

When an exact value of effective reactance is required, negative feedback should be employed

to lessen the effect of h_{fe} variation with temperature and with manufacturing control.³ On the other hand, if a variable capacitance is desired, advantage may be taken of the decrease in h_{fe} displayed by transistors as quiescent current increases.⁴ A variable resistance or another transistor (the base of which is controlled) may be substituted for the bias resistor R_1 of Figs. 1, 3, 4 and 5 in order to control quiescent current level. Variation in R_1 does not substantially affect the real part of the denominator in Equations 3, 4 and 5—and thereby alter the dc level—since the quantity R_1/h_{fe} will tend to remain constant when both numerator and denominator vary in the same direction. A variable reactance as de-

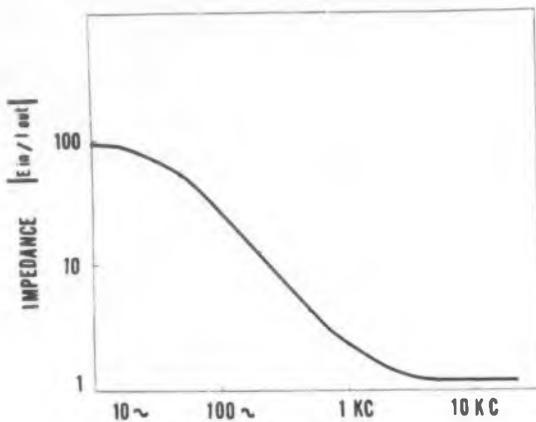


Fig. 7. Effective impedance versus frequency for circuit of Fig. 6.

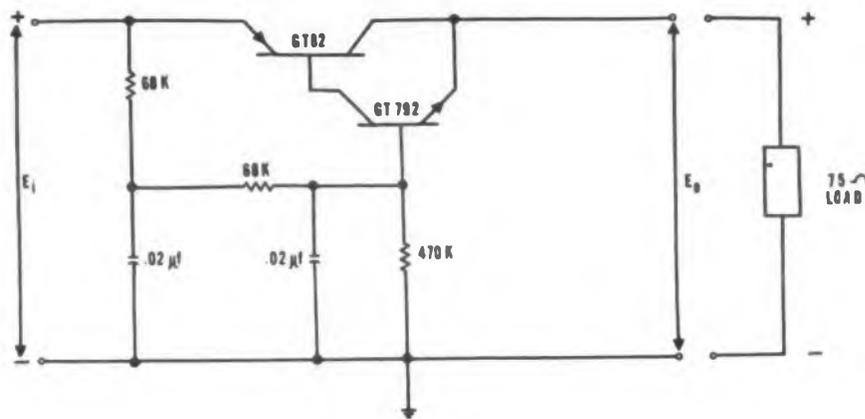


Fig. 8. Emitter follower effect used to match a 75 ohm load to a 470 K terminated filter.

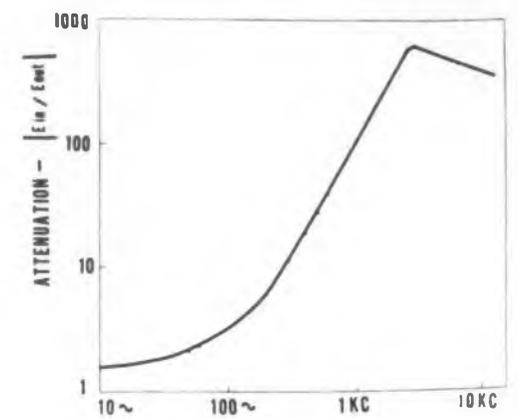


Fig. 9. Attenuation for circuit of Fig. 8. Maximum attenuation of 55 db occurs at 2kc.

described here is suitable for use in changing the operating frequency of an oscillator, e.g. as in AFC systems, or for varying the crossover frequency of a filter.

Generalized Transistor-Simulated Impedance

The foregoing analysis may be expanded from the special cases developed to the generalized case of the transistor-simulated impedance. Proceeding according to the methods of Eqs. 1-3 for the generalized grounded emitter case, it may be shown that the admittance of the base circuit is multiplied by the current gain of the transistor. For the generalized grounded collector case, it may be shown that the impedance approximates

$$\frac{Z_c}{h_{fc}} + \frac{Z_L Z_c}{Z_e} \quad (6)$$

where Z_c is the impedance shunting the collector, Z_L is the load in the emitter path, and Z_e is the impedance from base to ground, shunting the emitter. In the series impedance connection, the transfer function of the circuit approximates Z_c/Z_e ; the similarity between this expression and the transfer function of the vacuum tube operational amplifier should be noted. The utility of the generalized transistor-simulated impedance circuit is that band-pass and band-rejection filters may be developed which are not loaded down when used to feed low impedance loads. In general, it may be said that the loading effect is reduced by a factor of $1/h_{fc}$ —since in the grounded emitter case the filter admittance is multiplied by h_{fc} , while in the grounded collector case the filter looks into a load of $h_{fc} R_L$ (emitter follower effect).⁵

Applications Data

A practical two-stage transistor-simulated shunt capacitance circuit is shown in Fig. 6. Designed to replace a 6 v electrolytic capacitor in an application where specifications permitted only mica, paper, or ceramic capacitors, the unit provides the effect of about 150 μ f at intermediate frequencies and a minimum impedance of 1.2 ohms at 5 kc. Beyond 20 kc, impedance rises because of loss of gain due to internal phase shift. If this is undesirable, suitable feedback correction may be employed to extend range. The effective impedance of the circuit, E_{in}/I_{in} , is plotted against frequency in Fig. 7. When developing such a circuit, the designer should avoid a cascaded emitter configuration in order to keep input impedance down. The latter acts as a series resistive component to the simulated capacitance, determining minimum impedance for the unit. Input impedance can be kept down, also, by keeping collector current in the first

stage relatively high, since $h_{ib} \approx 26\text{mv}/I_c$.

The circuit shown in Fig. 8 uses emitter follower effect to match a 75 ohm load to a 470 K terminated filter. A maximum attenuation of 55 db is attained at 2 kc, beyond which frequency, attenuation decreases due to phase shift losses. A plot of attenuation— E_{in}/E_{out} —is shown in Fig. 9. When designing such a circuit, quiescent collector voltage should be kept low to permit high dc current, but collector voltage must exceed peak input voltage variation to avoid overdriving.

The designer can adapt a conventional regulator circuit to a filter-simulation circuit by regarding the latter as a regulator which uses a function for its reference rather than a constant. The reference battery or diode of the regulator is then replaced by the output of an RC network.

The circuitry described here will help the electronics designer to avoid a conflict between performance requirements and space, weight and cost limitations. Principal consideration has been given to an effort to develop inexpensive low-pass filters for applications where the suppression of ripple, spike and input voltage fluctuation are more important than the maintenance of an absolute dc level. The circuits presented are equally appropriate for use in delay or phase-shifting networks which require large lumped-constant reactances. The development of variable reactances and of generalized transistor-simulated impedances has also been suggested. The compactness and relatively large current-handling capabilities of these circuits will recommend them as substitutes for chokes and capacitors wherever cost and size are important considerations.

References

1. Ragazinni, Randall, Russell. *Proceedings of the IRE*, Vol. 35, No. 5, 1947, p. 444. See also *Electron Tube Circuits*, Seely; 1950, pp. 160-161.
2. *Transistor Electronics*, Lo, Endres, Zawels, Waldhauer, Cheng. Prentice-Hall, New York, N.Y., 1955. P. 84, Fig. 3-2(b).
3. *Transistor Bias Stabilization*, Penfield. *Audio*, June and July, 1956.
4. *Transistor Electronics*, Lo, Endres, Zawels, Waldhauer, Cheng. Prentice-Hall, New York, N.Y., 1955. Pp. 205-206.
5. For a more elaborate treatment of the generalized transistor filter, see *RC-Transistor Network Design*, I. M. Horwitz, *ELECTRONIC DESIGN*, Aug. 1 and Aug. 15, 1957, pp. 28-31; *RC Active Filters*, Linvill, *Proceedings of the IRE*, Vol. 42, March 1954, p. 555; *Transistor Negative Impedance Converters*, Linvill, *Proceedings of the IRE*, Vol. 41, June 1953, p. 725; *Theory of the Negative Impedance Converter*, Merrill, *Bell Systems Technical Journal*, Vol. 30, 1951, p. 88. However, the use of the negative impedance converter involves more exacting design work than does the relatively simple circuitry described here. For routine regulation applications where the unique negative impedance characteristic of the converter is not required, such effort probably will not be justified.

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Simplifying Circuit Design with Floating Power Supplies

John F. Walton
Elcor, Inc.
McLean, Virginia

Floating power supplies have not seen widespread use in circuit design despite the fact that they simplify circuitry and solve many design problems. When a floating supply is resorted to, it is usually conceived of as a bias supply, because appreciable current will limit the life of a bias supply. This is not the case with circuits operated for short periods of time from batteries, or for circuits operating from isolated electronic supplies. With substantial currents available, isolated supplies can be used to furnish plate and screen energy, resulting in new and simple circuits with many advantages.

A SUITABLE power supply needs a carefully isolated secondary and a low shunt capacitance from the dc output to ground. Either batteries may be used or an electronic supply such as the one manufactured by Elcor, Inc., P. O. Box 354, McLean, Virginia. This supply uses special construction to insure capacitive isolation from ground (see *ELECTRONIC DESIGN*, Jan. 15, 1957). Such supplies permit the addition of two or three extra stages often found necessary in removing the bugs from an instrument, without exceeding the capacity of the original supply.

Cathode Followers

The familiar triode cathode follower can be improved upon in several ways for applications requiring more critical circuit performance. Fig. 1 shows a pentode cathode follower in which the screen grid is direct coupled to the cathode by means of an isolated supply. In this circuit the usual advantages of the pentode cathode follower, namely, higher input impedance, better linearity, and nearer unity gain are obtained without the disadvantages inherent in the conventional capacitance coupling between cathode and screen grid. A bootstrapped triode cathode

follower circuit is an alternate solution for obtaining higher input impedance, or a bootstrapped pentode cathode follower operated in its positive grid region. This makes possible relatively high currents at moderate plate voltages and yields a very low output impedance. A close analogue of this is shown in Fig. 2. In transistor circuits bootstrapping is essential in obtaining a high value of input impedance. The circuit of Fig. 2 in addition to high input impedance has a gain very close to unity and good linearity.¹

Fig. 3 is a transistor analog of a constant-current cathode. The circuit incorporates a constant-current cathode or emitter load impedance. It will handle signals whose peak-to-peak potentials are nearly equal to the sum of the B+ and B- supply voltages.

Where performance requirements are unusually rigid, requiring not only very high input impedance and gain very near unity, but also very low output impedance and the capability of supplying peak charge and discharge currents several times the quiescent tube current to a capacitive load, and, further, requiring the advantages of direct-coupling, the superior cathode follower and driver² of Fig. 4 is most satisfactory.

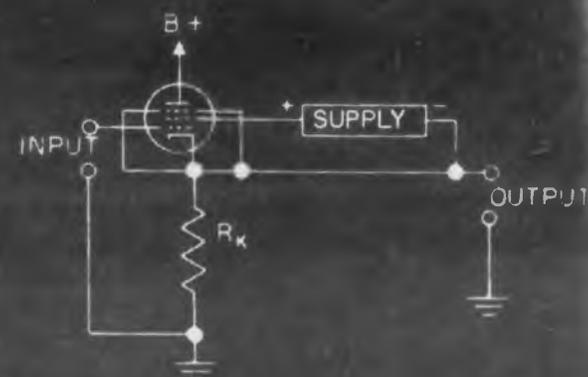


Fig. 1. Pentode cathode follower.

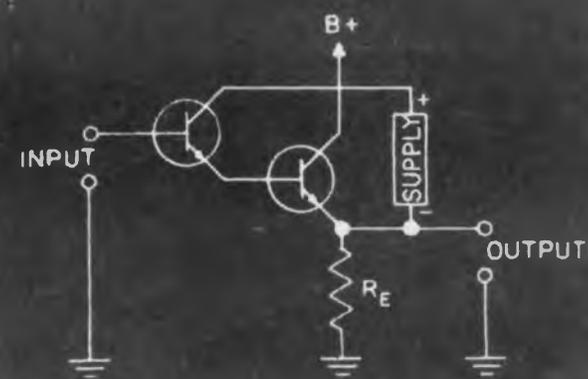


Fig. 2. Bootstrapped emitter follower.

The transistor circuit of Fig. 5 is the approximate analogue of the superior cathode follower and driver shown in Fig. 4. This emitter follower and driver would be suitable for sweep and deflection needs.

Sweep Generators

Because of their improved gain and linearity, these cathode and emitter followers lend themselves very appropriately to certain sawtooth, ramp, or sweep voltage generators. It is interesting to note that introductions to sweep voltage generators occasionally start with a bootstrap sweep circuit. After extolling its merits and simplicity, some authors then dismiss the circuit to make it practical. Actually the circuit is very practical. An improved version shown in Fig. 6 is very simple to design; it requires no linearity adjustments; ramp voltage change with respect to time is quite linear; and the circuit is very independent of tube changes.

Greater ramp voltage excursion and even better linearity may be achieved by replacing B_k (Fig. 6) with a constant-current cathode load impedance. A transistor version with the latter suggestion appears in Fig. 7.

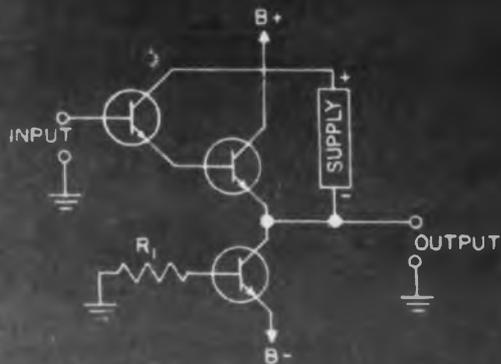


Fig. 3. Constant-current bootstrap emitter follower.

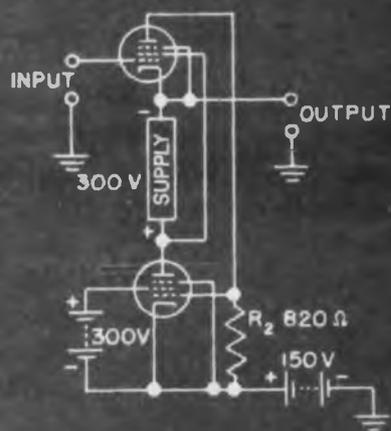


Fig. 4. Superior-cathode follower and driver.

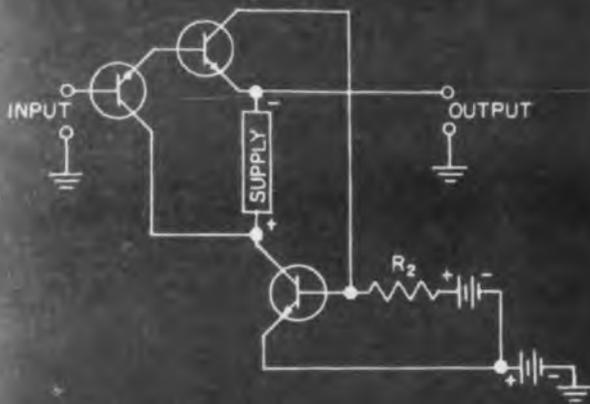


Fig. 5. Emitter follower and driver.

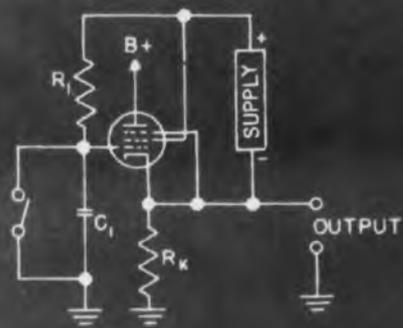


Fig. 6. Driver.

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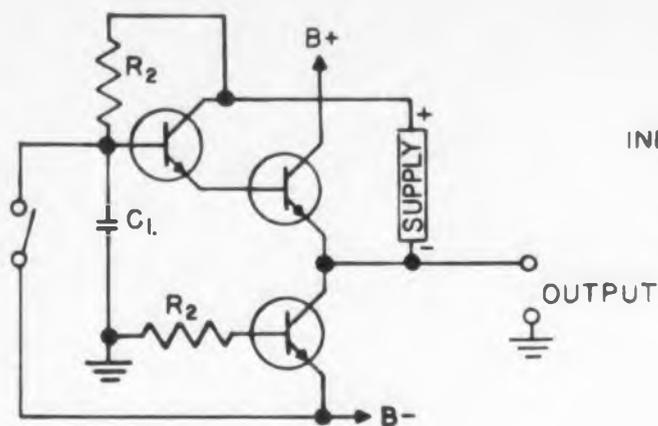


Fig. 7. Bootstrapped transistor ramp-voltage generator.

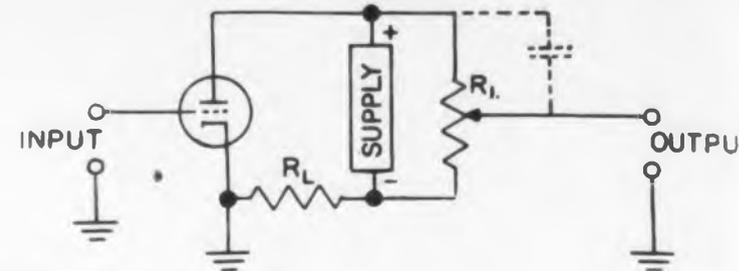


Fig. 8. Basic direct-coupling circuit with adjustable output bias.

Amplifiers

Cathode and emitter followers are but one general application in which isolated supplies are extremely helpful. Other improvements are possible in the performance of amplifiers. The availability of an isolated supply enables the designer to interchange the location of power supply and plate load resistor, achieving a simple method of direct coupling (Fig. 8). The output voltage across R_L is some value between 0 potential and some negative value that depends on the plate current. This is convenient for feeding the fol-

lowing stage directly. In class A amplifiers where R_L may be a moderately high resistance which would result in too negative a bias for the following stage, a voltage divider may be connected across the isolated supply in Fig. 8. The voltage divider acts only to divide the dc voltage and not the signal. The divider may load the supply slightly or as much as desired, but this in no way loads the amplifier. If needed, the output may be taken simultaneously at several dc biases.

Another improvement made possible by the use of a floating supply is increased linearity of amplification. Fig. 9 shows an amplifier with

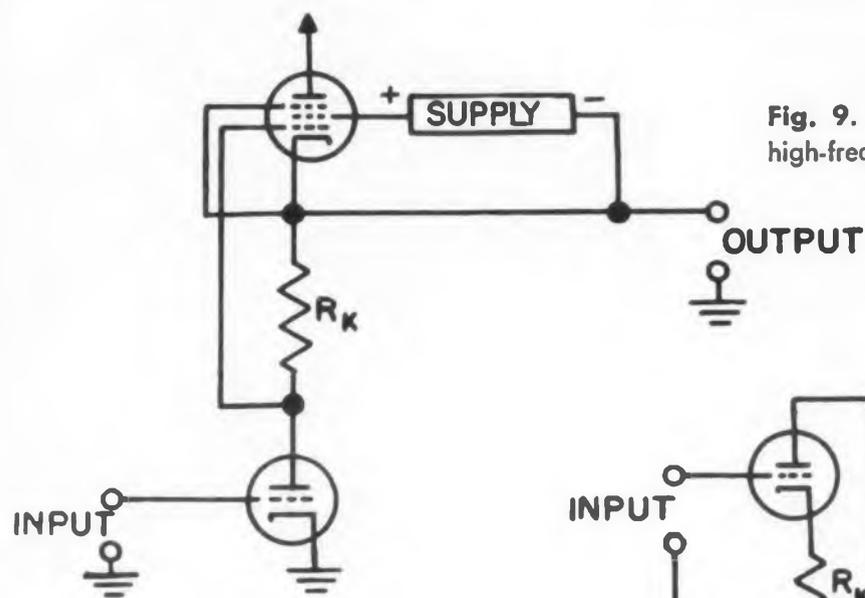


Fig. 9. Linear amplifier with good high-frequency response.

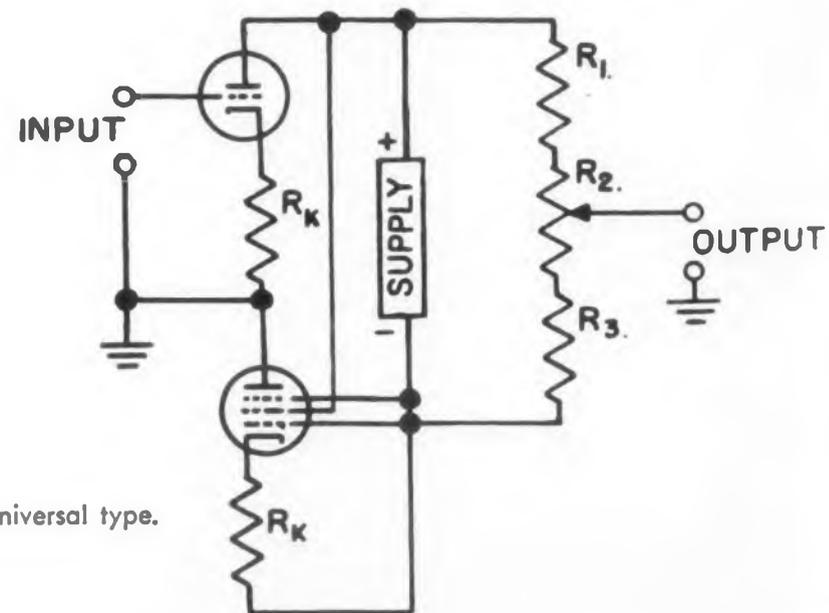


Fig. 10. Linear amplifier, universal type.

Good linearity obtained by means of a constant current plate load impedance. Along with the improvement in linearity over the conventional triode amplifier comes higher gain (very close to the μ of the triode) nearly constant output impedance, and better high frequency response. A combination of the circuits found in Figs. 8 and 9 produces the circuit of Fig. 10 having a group of desirable properties:

Gain equals the μ of the triode.

Distortion is substantially lower than the conventional triode or pentode amplifier.

Output impedance is approximately the plate resistance of the triode and is nearly constant over the entire output voltage range.

Output bias is adjustable plus or minus with respect to ground, which is very suitable for direct coupling to other circuits.

No signal degeneration occurs across the cathode bias resistor of the triode, since the plate current is nearly constant.

One isoply furnishes all plate circuit and screen grid energy and output bias voltage.

Decoupling from other circuits is essentially complete.

The signal output voltage is high compared to conventional amplifiers with the same supply voltage.

These amplifiers are the starting points for a host of more specialized circuits. There are several types of difference amplifiers utilizing isolated supplies to obtain superior operating performance along with direct coupled output. Also, the design of direct coupled feedback circuits is accomplished with uncommon facility. In the design of direct-coupled logical networks, isolated supplies produce a considerable simplification. The use of isolated supplies combines the means of direct-coupling and plate circuit energy source into one unit which is simpler than designing a circuit and then a suitable common power supply. They afford essentially complete decoupling, often a trouble spot in conventional design. Appropriate bias voltages are obtained very simply.

Considering the cost of isolated supplies separately, its use may be found a more costly method in some systems. In other cases the overall cost would be comparable to conventional methods, or less costly. Considering the savings in design time and effort, the often superior circuit functioning, increased reliability, ease of servicing and breadboarding, and elimination of many normally required components, there are many cases where the use of floating supplies is the most economical one.

Footnotes:

1. Philip J. Anzalone. *Electronic Design*, Vol. 5, No. 11 (June 1, 1957) p. 39.

2. John H. Reaves. *Electronics*, Vol. 27, No. 8. (Aug. 1954) p. 172.



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Accuracy Requirements in Sine, Cosine Transmission

Leo Young

Electronics Div.,
Westinghouse Electric Corp.,
Baltimore 3, Md.

USE OF angular position information has application in such devices as analog computers and radar displays. The transmission of such information is often accomplished by resolving the direction at the transmitter into sine and cosine signals. These are then amplified before reconstituting them into the original direction information at the receiver.

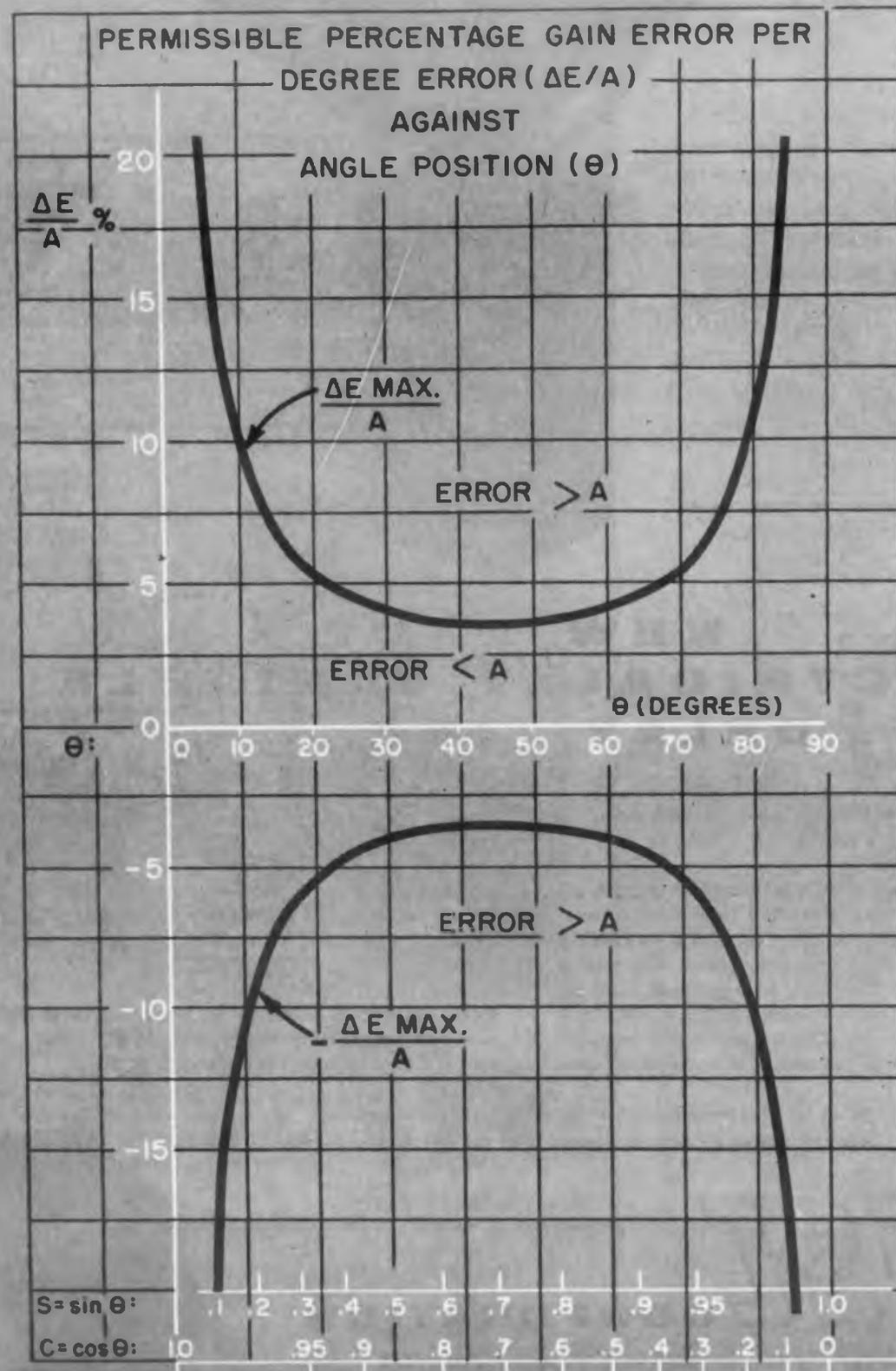
Accuracy is specified in terms of angle, but is determined by the linearity in the sine and cosine channels. The sine and cosine amplifiers are so designed that their combined deviations from linearity are some function of amplitude (and hence angle), which keeps the angle error within a fixed upper bound. It is the purpose here to derive this function and present graphs, so that the angular accuracy can readily be expressed in terms of amplifier performance, and vice versa.

Problem Formulation

An angular position of θ deg of arc at the transmitter is reproduced to an accuracy of $\pm A$ deg at the receiver, due to amplifier distortion. The components, $s = \sin \theta$, and $c = \cos \theta$, are resolved and amplified and finally recombined to give the direction θ . The two amplifier's (for s and c) have a voltage gain G , defined by

$$G = \frac{\text{Output voltage at carrier frequency}}{\text{Input voltage at carrier frequency}} \quad (1)$$

This gain will generally not be constant over the selected operating range, but will have some average value G_0 . The percentage deviation of G from G_0 at any point will be defined as the percentage



distortion at that point. The exact choice of G_0 is arbitrary, but its precise value is unimportant for small distortions. Let the percentage error or distortion be

$$E = \frac{100(G-G_0)}{G} \quad (2)$$

Let E_s and E_c be the percentage errors of the sine and cosine amplifiers, respectively. They are functions of the normalized inputs s and c , and are therefore both functions of θ .

Problem Analysis

At the input to the amplifier the two voltages s and c are related by

$$\tan \theta = \frac{c}{s} \quad (3)$$

Owing to distortion, the output angle differs from θ by a small amount $d\theta$. Taking logs and differentiating eq. 3 yields

$$d\theta = sc \left(\frac{ds}{s} \right) - sc \left(\frac{dc}{c} \right) \quad (4)$$

where θ is in radians. Converting to degrees and introducing A and E gives

$$\frac{\pi A}{180} = \frac{sc}{100} (E_s - E_c) \quad (5)$$

or,

$$\Delta E = \frac{1.745 A}{\sin \theta \cos \theta} \quad (6)$$

where

$$\Delta E = E_s - E_c$$

Eq. (5) gives angular error when E_s and E_c are known; and eq. (6) shows how E_s and E_c must be limited when A is specified as the maximum permissible angle error.

Notice that E_s and E_c are not constant, but are functions of θ . Also note that A depends on E_s and E_c only through their difference.

Explanation and Use of Graph

If the maximum permissible angle error is specified and denoted by A , then eq. (6) determines the maximum distortion, ΔE_{max} . $\Delta E_{max}/A$ is plotted against θ on the graph, using eq. (6). To determine whether a given pair of sine, cosine amplifiers is sufficiently linear, their distortions E_s and E_c are measured for each as a function of their inputs. E_s/A and E_c/A are then plotted on the graph as functions of the normalized inputs, s and c , respectively. The curves are finally subtracted, and a plot of $\Delta E/A$ against θ is thus obtained. If it falls between the two curves, $\pm \Delta E_{max}/A$, then the two amplifiers reproduce the original direction θ everywhere to an accuracy of $\pm A$ degrees or better.

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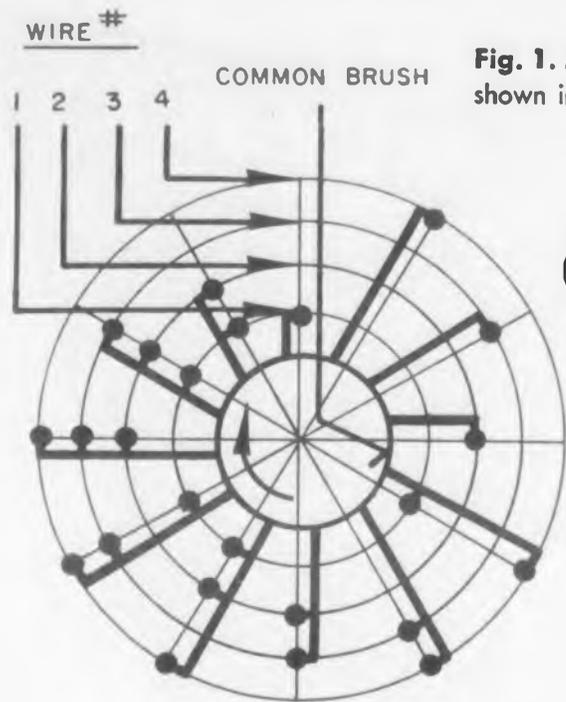


Fig. 1. A code wheel for radial brushes, shown in position 1.

Code Matrices for Indexing

Walter C. Tooker
Hughes Aircraft Company
Culver City, California

Number of Wires	Max. No. of Positions	Number of Wires	Max. No. of Positions
2	3	9	511
3	7	10	1023
4	15	11	2047
5	31	12	4095
6	63	13	8191
7	127	14	16383
8	255	15	32767

Table 1. A table of possible positions with a definite number of wires.

IN SERVO mechanisms of the type that index to discrete positions, the number of wires between the transmitter and receiver can be reduced to a minimum by a code matrix. The maximum number of positions which can be defined by the interconnecting wiring is

$$\text{Positions}_{\max} = 2^n - 1$$

where n represents the number of wires. Table 1 shows a definite number of possible positions with a definite number of wires.

In setting up the matrices, there are two general approaches.

a. A possible configuration for concentric rings of contacts on the rotor with a radial arrangement of the stationary brushes is the first approach, and is shown in Fig. 1.

b. Fig. 2 shows a single ring of contacts on the rotor (code wheel) with the stationary brushes arranged circumferentially.

The selection of the proper approach depends on three factors:

- The uniformity of position spacing
- Number of positions required
- Space available

In approach *b*, the brush spacing is equal to 360 degrees divided by the number of positions and the space available will determine whether it can be used. If the spacing is non-uniform, approach *a* is mandatory.

Matrices for the single ring of contacts on the code wheel are set up as shown in Table 2, Part a, shows the contact positions possible with four wires. *b* is a matrix for checking for ambiguity in the results of part a. It should be noted that the contacts and spaces are arranged with a 45 deg slope in the matrix.

This matrix may also be used for concentric rings of contacts on the code wheel. However, as the number of positions is increased, the difficulty of creating a 45 deg matrix increases. If the number of positions is large, a binary matrix is easier to set up. Such a matrix is exemplified in Tab. 3 but it is suitable only for a concentric arrangement.

Single	(A) 1	(B) 2	(C) 3	(D) 4
Double	(E) 1, 2 (I) 2, 4	(F) 1, 3 (J) 3, 4	(G) 1, 4	(H) 2, 3
Triple	(K) 1, 2, 3 (N) 2, 3, 4	(L) 1, 2, 4	(M) 1, 3, 4	
Quadruple	(O) 1, 2, 3, 4			

Table 2. Matrices for a code wheel with a single ring of contacts.

a. Contacts possible with four wires.

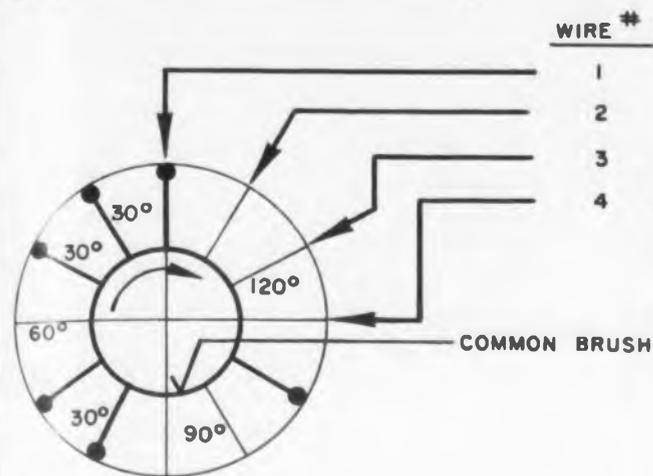
Wire No.	Position														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	•	•	•	•		•				•		•			
2		•	•	•	•		•			•		•	•		
3			•	•	•	•		•			•		•	•	
4				•	•	•	•		•			•		•	•
Check	A	E	K	O	N	M	I	C	G	B	F	L	H	J	D

b. Matrix to check for ambiguity.

Wire No.	Position														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	•		•		•		•		•		•		•		•
2	•	•			•	•			•	•		•	•		•
3	•	•	•					•	•	•		•	•	•	
4	•	•	•	•	•	•	•								
Check	O	N	M	J	L	I	G	D	K	H	F	C	E	B	A

Table 3. A four wire matrix for determination of concentric contact arrangements.

Fig. 2. A code wheel for circumferential brushes, shown in position 1.



Sample Problem

To illustrate both types of code wheels, one may consider the problem of indexing 12 equally spaced positions.

With 12 positions required, 4 wires are necessary. (See Tab. 1).

For circumferential brushes, the brush spacing will be $360/12 = 30$ deg. Examination of the matrix in Tab. 2 for 15 positions shows that it is not suitable for this arrangement. The matrix shown in Tab. 4 is arranged for 12 positions.

Using the matrix for 12 positions, the two types of brush arrangements are shown in Figs. 1 and 2.

In Fig. 1, the connection between the contacts and the common slip ring would be made on the reverse side of the code wheel. If photoetched code wheels are used in this arrangement of brushes, the matrix would have to be of the binary type. The binary matrix lends itself to interconnections on one side of the code wheel.

For a reprint of this article circle 26 on the Reader-Service Card.

Wire No.	Position											
	1	2	3	4	5	6	7	8	9	10	11	12
1	•	•	•		•	•			•			
2		•	•	•		•	•			•		
3			•	•	•		•	•			•	
4				•	•	•		•	•			•
Check	A	E	K	N	M	L	H	J	G	B	C	D

Table 4. A 12 position, four wire matrix for radial or circumferential brush arrangement.



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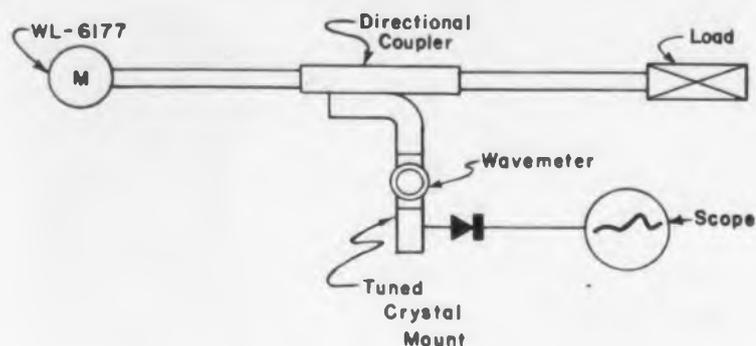


Fig. 1. The components employed for the simple measurements are a directional coupler to sample the energy, a wavemeter, a tuned probe crystal mount, and an oscilloscope.

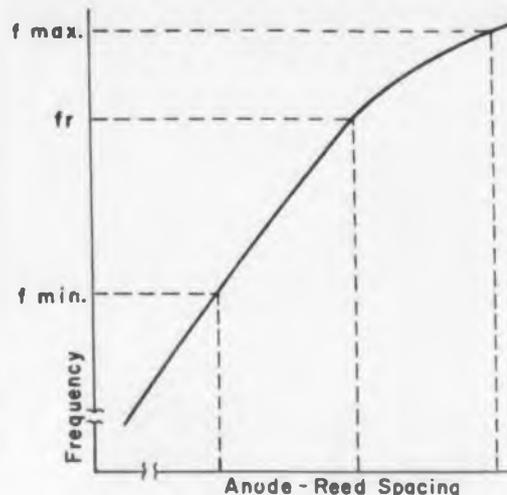


Fig. 2. The magnetron's tuning rate curve.

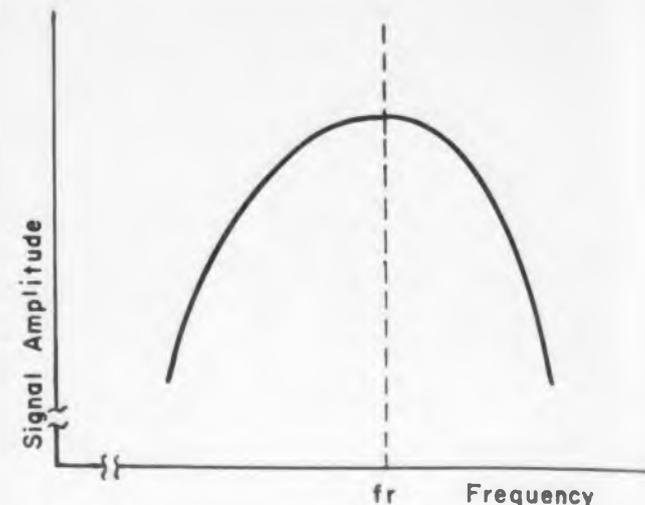


Fig. 3. Response curve of the tuned probe crystal mount.

How To Measure FM Bandwidth at Microwave Frequencies

R. G. Larson
Electronic Tube Division,
Westinghouse Electric Corporation
Elmira, New York

A very simple method has been found to measure fm bandwidth at microwave frequencies. This method is especially effective when the bandwidth is greater than can be easily observed on a spectrum analyzer. The method can be used with any kind of signal source. With proper attenuation to protect the crystal, it can be used for any power level from a few milliwatts up. The method can be used for any frequency band for which the few simple components are available. The technique is most useful for fm amplitudes of one per cent or greater. It is not precise enough for amplitudes less than 0.1 per cent.



Physical measurements on a typical magnetron.

A NEED for a technique to measure large bandwidths arose during investigation of the properties of the WL-6177 magnetron. This tube provides a cw signal at about 4300 mc with an fm amplitude of ± 1 per cent. The fm rate is approximately 100 cps. To measure this bandwidth, a simple combination of standard components is effective and easy to use. (See Fig. 1.) The cost is relatively low.

A series of graphs shows how this simple system works. A tuning rate curve, shown in Fig. 2, shows the change of frequency produced by changing the position of a driven reed inside the vacuum envelope of the magnetron. With the reed at rest, a rest frequency, f_r , is generated. As the reed is driven, it oscillates between a maximum and minimum displacement position. This gives rise to a maximum frequency, f_{max} , and a minimum frequency, f_{min} .

A tuned probe crystal mount, with a

response as shown in Fig. 3, detects the energy. When the probe is tuned accurately to the rest frequency, any shift in frequency will give a lower amplitude response on the scope. This is easily done when the scope's dc amplifier is used with zero drive voltage, V_d .

An absorption cavity wavemeter is used to measure the frequency. When the wavemeter is set at a frequency within the range of the magnetron, an absorption of energy causes a reduction of signal amplitude at that frequency.

A crystal rectifies the signal, and the resultant dc output is displayed on a cro. The negative characteristic of the crystal causes positive power output to deflect the oscilloscope trace downward.

The drive voltage, shown in Fig. 4, is sinusoidal. The anode-reed spacing is proportional to the drive voltage by nature of the reed construction. The frequency, however, does not vary sinusoidally because of the non-linearity of

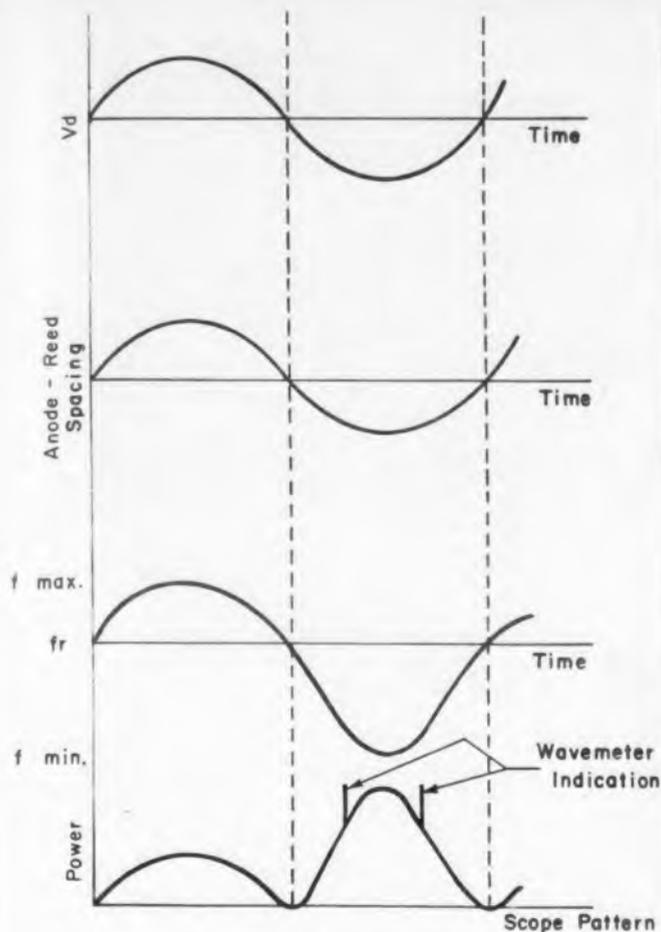


Fig. 4. Time relationship of the drive voltage, anode reed spacing, frequency variation, and power output.

the tuning rate curve. With the probe tuned to rest frequency, the scope trace is deflected downward a maximum amount. With drive voltage applied, the pattern appears on the screen.

When the wavemeter is tuned from a value above maximum frequency toward the range of the output frequency, the first indication is a spike on top of the smaller "hump" on the trace at maximum frequency. The frequency at which this indication appears is noted in the bottom curve of Fig. 4.

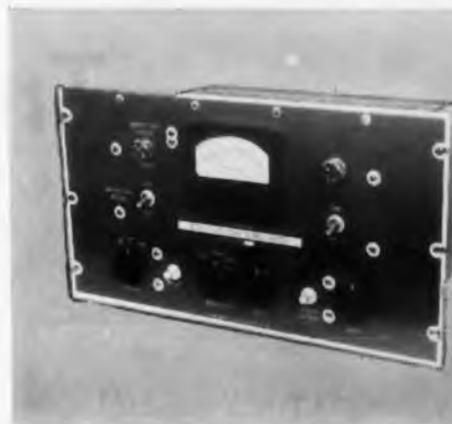
As the wavemeter tunes through the fm range of the magnetron, this spike splits into two spikes. They move down the smaller "hump," climb the larger "hump," then disappear at the top at minimum frequency. The difference between maximum and minimum frequency is then directly measured to the accuracy of the wavemeter, 0.05 per cent.

This method of bandwidth measurement is speedy, precise, and easy.

For precise power measurements in all bands



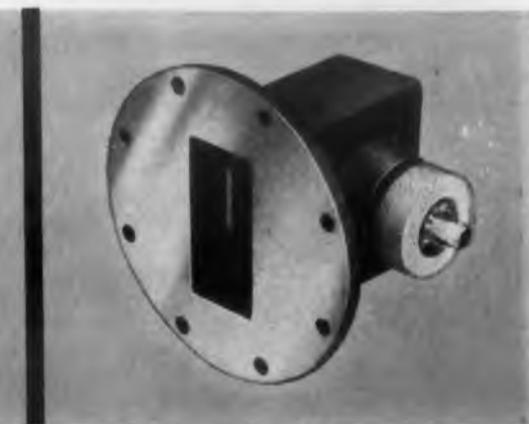
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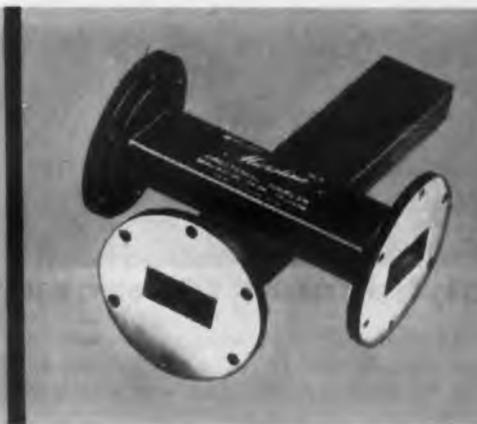
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accurate value of the fundamental sine wave.

The dynamometer instrument, developed by Trio Laboratories Inc., 4025 Merrick Road, Seaford, N.Y., gives a true rms reading with an accuracy of 1/4 per cent of full scale. This is somewhat better than electronic wave-squaring instruments and overcomes the disadvantages of thermocouple detectors. A multi-stage high-gain amplifier converts the signal voltage into a current sufficient to drive the dynamometer movement. A large amount of current feedback assures that the overall gain remains constant and eliminates line voltage effects. A laboratory standard mirror-scale meter with hand-drawn markings provides readability and accuracy.

The meter will find application in the measurement of ripple and noise in audio circuits where the true rms value is significant. Measuring the value of the fundamental with high accuracy is important in data type synchros, carrier systems, and control systems. The instrument overcomes the errors inherent in peak-reading instruments in the presence of thin spikes, and the harmonic distortion errors of averaging meters. The accuracy of true rms measurement is shown in the curves of the figure. In computing the value of the fundamental

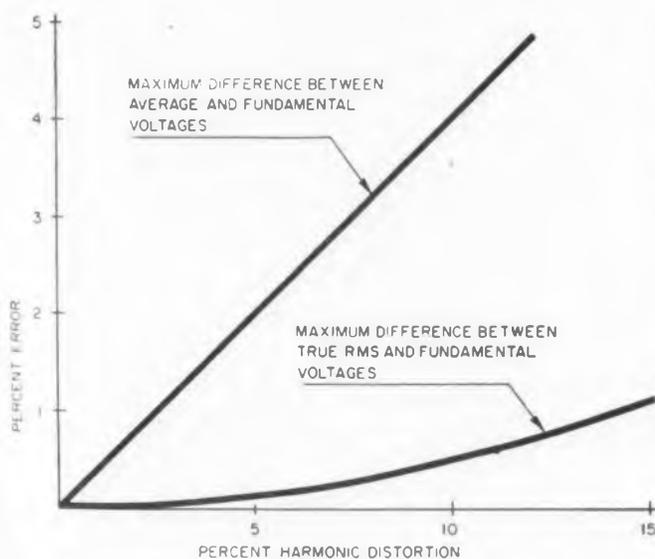


Precision vtvm reads true rms (opposite page)

from the true rms of a complex wave, the accuracy is much less for a given harmonic distortion.

Ranges up to 500 rms full scale are available with a frequency response of 50-2000 cps. A military version of the instrument is in development for field test and ground support equipment applications.

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Computed errors between true rms voltage of a complex wave and value of the fundamental, and between average voltage and value of the fundamental.



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DC Current Ranges (Full Scale)	±100 μ ma to ±100ma 10 ranges	None	±0.001 μ a to ±1ma 7 ranges	Not Applicable	±0.001 μ a to 1 amp 19 ranges
Input Impedance	10 megohms below 10mv-30 megohms at 30mv-100 megohms above 30mv	10 megohms below 10mv-30 megohms at 30mv-100 megohms above 30mv	10,000 ohms	Infinite at null	10 megohms at 30mv and below 100 megohms above 30mv
Measurement Accuracy	3%	3%	3% on 2 lower ranges, 4% above	0.02%	3%
Max. Output as Amplifier	1 volt across 1000 ohms	1 volt across 2000 ohms	1 volt across 1000 ohms	Not Applicable	1 volt across 500 ohms
Equiv. Input Drift (Max. Long Time)	10 μ v	15 μ v	<2 μ v	0.01% stability	10 μ v
Price	\$550	\$350	\$325	\$625	\$550

*The 301 utilizes a null voltmeter to indicate difference between voltage being measured and output of its variable DC supply. Its null meter has 4 full scale ranges from ±0.05 to ±50 V.

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Horace E. Darling
The Foxboro Company
Foxboro, Massachusetts

A TYPICAL industrial application of the "ratio amplifier" is in flow ratio control with all electronic control systems. This device is especially handy for accurately adjusting the blending proportions of two components of a process.

Amplifier Specifications

In one application, this ratio amplifier is to operate from a 60 cycle line regulated to within two per cent. It must meet rather exacting requirements.

- Its 9:1 continuously adjustable ratio must provide, at one extreme, a 10 to 50 ma output for a 10 to 23.33 ma input, and at the other extreme, a 10 to 23.33 ma output for a 10 to 50 ma input.
- It must supply a 600 ± 60 ohm load with a current constant to within 1/2 per cent of full scale.
- An ambient temperature rise of 100 F must not change the output current more than one per cent.
- The "zero" of the system is such that a 10 ma input must always deliver a 10 ma output regardless of ratio setting.
- The system must maintain 1/2 per cent linearity and stability.

Variable Feedback or Constant Gain?

A high current gain magnetic amplifier with lots of degenerative current feedback tends to be immune to changes in temperature, load resistance, supply voltage, and other factors which affect internal gain.

This particular application calls for an amplifier whose zero and span are to be stable to 1/4 per cent. This requires an open loop current gain 400 times the net gain of the system. Thus, a gain of 1200 and a gain of 133 are required at the extremes.

The desired current ratio could be achieved by varying the amount of feedback. However, it was decided that a constant gain magnetic amplifier would be most suitable. The input is attenuated through the desired range by a precision variable resistor.

Amplifier Design Details

A 10 ma input must look like a zero to the amplifier. Hence, 10 ma are balanced out by a reference current from a Zener diode system. Fig. 1 shows the amplifier in block form.

A precision amplifier-attenuator is an important building block in electronic control systems. In use, this device accepts a direct current from a measuring system and delivers a direct current, accurately related to the input by a manually adjustable ratio.

The output current must be independent of moderate changes in temperature, load resistance, and power supply voltage. What is required, in effect, is a direct current transformer with continuously adjustable transformation ratio.

Resistance values for the input circuit elements are shown in Fig. 2. For maximum sensitivity, a measurement change of 10 to 23.33 ma must produce a 10 to 50 ma output change. This represents minimum control resistance.

Maximum control current will be about 3 ma. To achieve a current gain of 1200 with a high degree of stability, a current feedback factor of .995 was chosen. Thus, the maximum net error signal that the amplifier sees is $(1 - .995) \times 3\text{ma}$ or 15 μa . Accordingly the magnetic amplifier was designed to deliver a 10 to 50 ma change as an open loop amplifier, for a 15 μa control signal change. This calls for an open loop current gain of 3300.

The complete amplifier, with its two stages of amplification is shown in Fig. 3. Winding specifications are given in the Appendix.

Input Stage

The input stage uses two toroidal cores of 3 mil "Hymu 80" tape. This magnetic material is sensitive to very small magnetizing forces, yet has the moderately square hysteresis loop required for good current gain.

The 90 turn feedback winding, in series with the load, produces the desired current feedback. Since all the output current flows through the feedback winding, copper resistance changes with temperature cannot appreciably alter the feedback ratio. A highly stable amplifier results, approximating a constant current source. The feedback is actually accomplished as a flux balance in the input stage cores.

The 500 turn winding biases the first stage for linear operation and, with the control circuit open, adjusts the output current to 10 ma. The Zener source provides this bias current.

The control signal, applied to the 1000 turn winding, is derived from a voltage developed across a fixed resistor. Its magnitude is directly related to the total control circuit resistance. This fact is used to provide the required ratio adjustment. A 50 ohm negative temperature coefficient resistor in series with the control winding neutralizes resistance changes due to temperature. This is essential to eliminate span error.

The 5 turn shorted winding provides a low impedance path for second harmonic signals and decouples the input stage from the measuring system. A scope, across the open circuited 1000 turn winding with the 5 turn winding also open would show a large second harmonic signal. With the 5 turn winding shorted, most of this induced voltage disappears. In fact, the 1000 turn winding itself can now be shorted with only a small effect on the amplifier's zero. This provides higher power gain than can be obtained with conventional circuitry, since the usual decoupling resistor in the control circuit is no longer required.

Output Stage

The second stage uses two cores of 4 mil "Orthonol" tape. This material has a high saturating flux density and a nearly square hysteresis loop, allowing high power and current gains.

The output of the first stage flows into the 200 turn winding of the second stage through a 10 ohm resistor. This adjusts the interstage circulating current to the bias level required for the output stage. This 10 ohm resistor can be eliminated by using a smaller wire size for the 200 turn winding.

The 1000 turn winding of the output stage provides derivative feedback to stabilize the amplifier when the overall feedback loop is closed. Since this type of high gain amplifier has an appreciable transport lag and time constant, hunting will occur when the feedback loop is closed. Derivative feedback is obtained by a resistor and capacitor in series with the feedback winding, all across the load. Adjusting this resistor changes the gain vs phase shift characteristics of the amplifier over wide limits, and by

properly polarizing the feedback winding for positive feedback, counteracts the amplifier's tendency to hunt. The amount of derivative feedback required is related to the time constant of the output filter.

A 50 μ f filter in the output leaves a 20 per cent ripple. This may not be sufficiently smooth dc for many purposes. A pi network, comprising two 50 μ f capacitors and a 1.5 henry choke can reduce the ripple to 1/2 per cent. This would require a de hunting resistor of approximately half the value of that used with a single capacitor.

A Zener diode system, corrected for a small

inherent temperature error, supplies a constant current for the reference resistor. With the use of high quality wire wound resistors, the Zener system's output current can be made constant to .05 per cent for a 100 F temperature rise. This system is used also to provide bias current to the first stage of the magnetic amplifier. All units operate from a common power transformer.

Silicon junction diodes are used throughout to minimize temperature effects on the front-to-back ratio as well as to keep forward resistance of the rectifiers constant.

(Continued on following page)

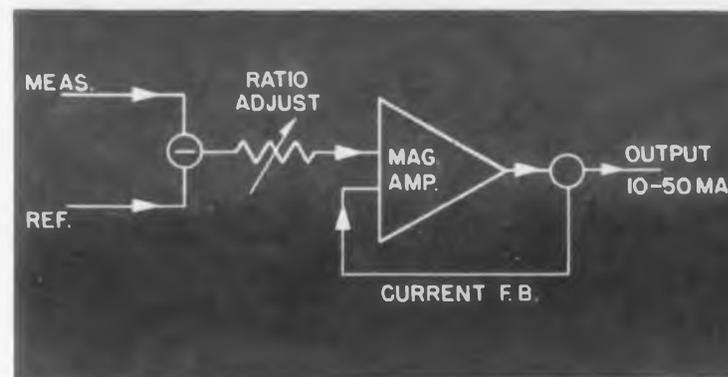


Fig. 1. Block diagram of ratio amplifier.

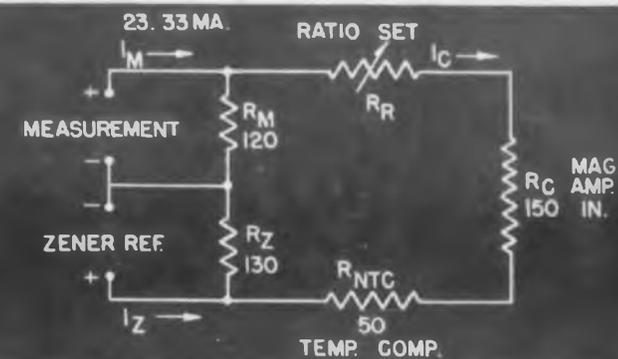


Fig. 2. Amplifier input circuit. The voltage developed across the 150 ohm resistor is the input to the magnetic amplifier.

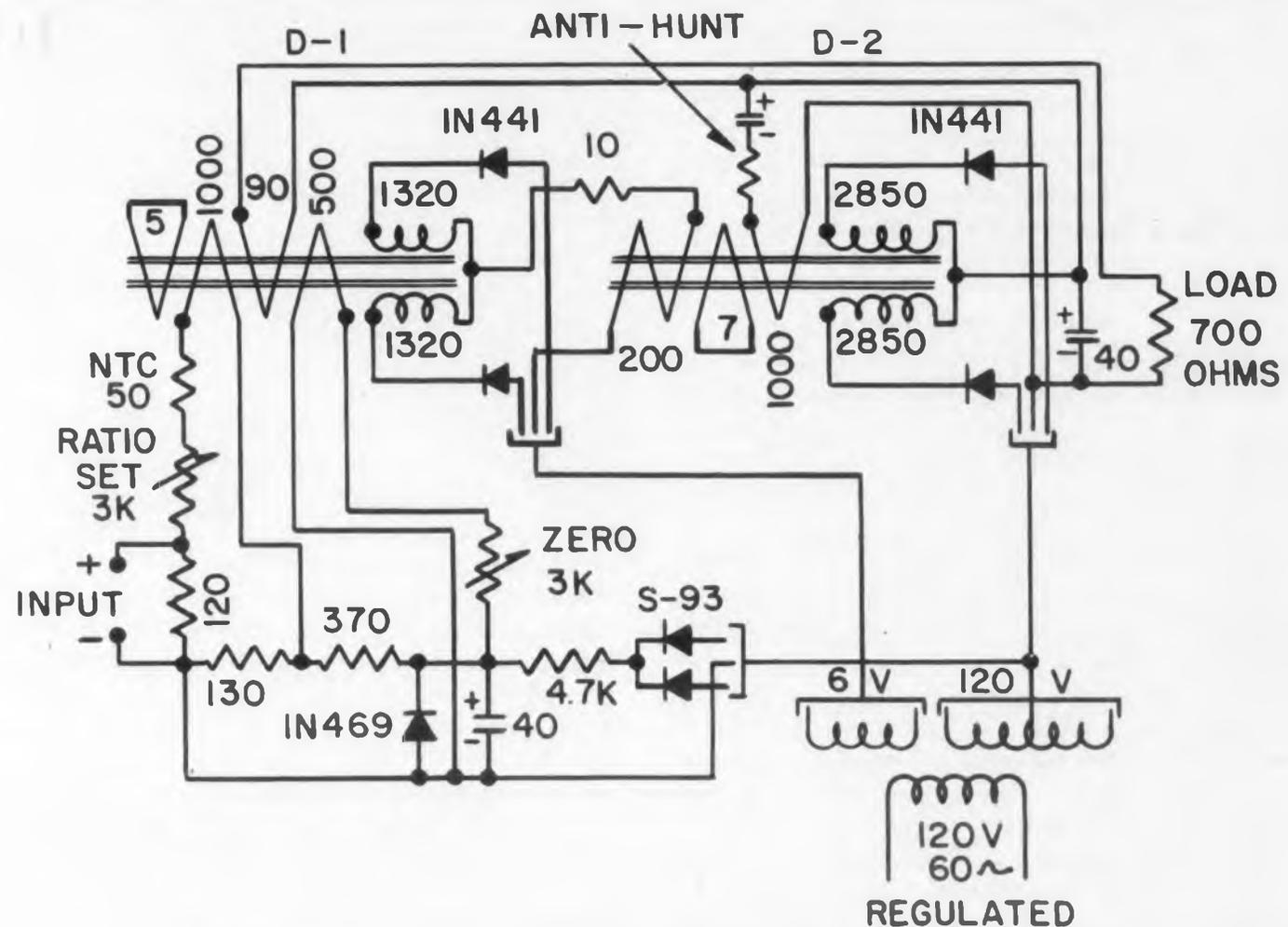


Fig. 3. Ratio amplifier schematic. The system uses two stages of magnetic amplification.

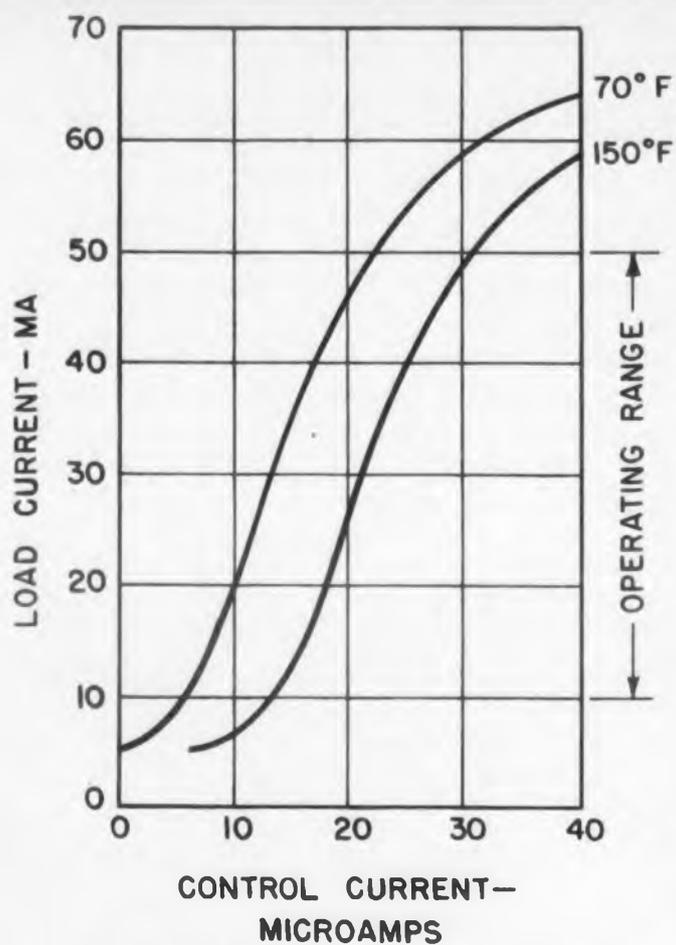


Fig. 4. Open loop transfer characteristic of ratio amplifier.

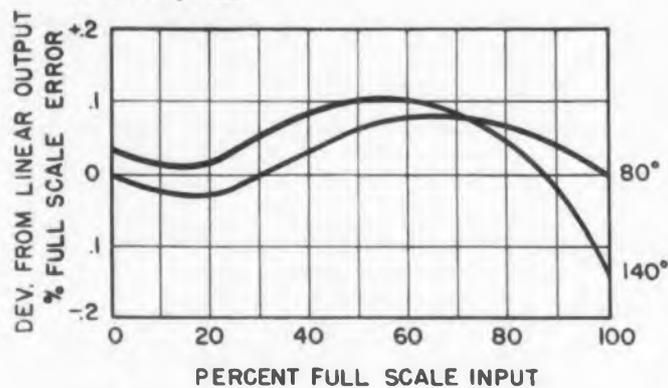


Fig. 5. Linearity and temperature response.

Amplifier Performance

With the derivative circuits disconnected, and the current feedback winding shorted, the open loop transfer characteristic of the amplifier is determined by measuring input vs output current into a 700 ohm load. The results for two ambient temperatures are shown in Fig. 4. The effect of temperature on the open loop gain of the amplifier is to produce a slight zero shift, amounting to 0.2 per cent of full scale in terms of the closed loop operation.

With the de hunting and feedback circuits connected, the amplifier performance is measured using input current from a battery through an adjustable resistor. This insures that the input signal remains sufficiently constant to allow accurate measurements of both input and output currents. Both currents were sent through precision ten ohm resistors. The voltage drop across these resistors was measured with a Rubicon

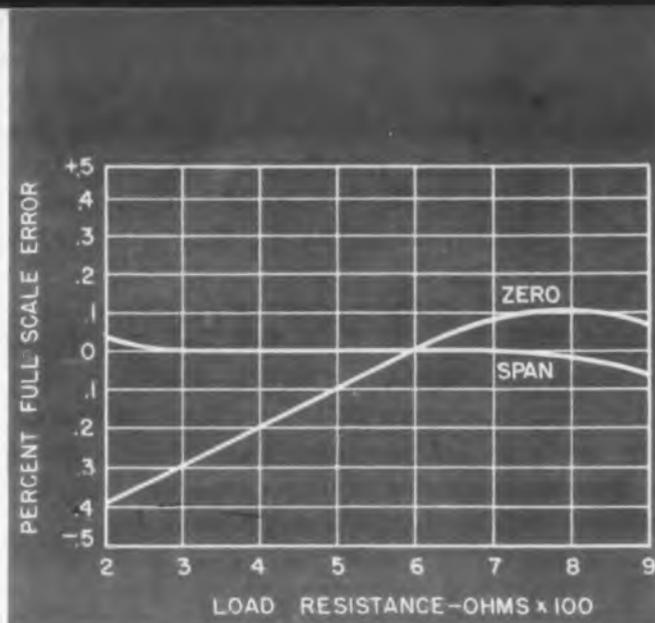


Fig. 6. Ratio amplifier constant current properties.

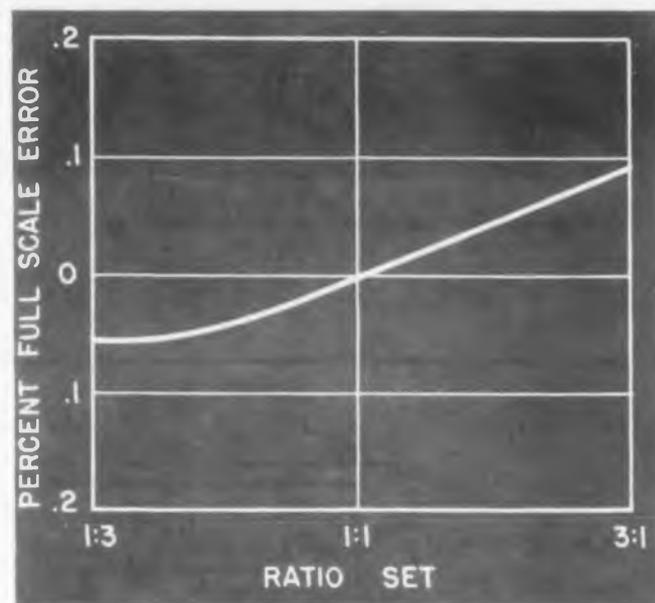


Fig. 7. Effect of ratio setting on "zero."

potentiometer, as shown in Fig. 8. With this calibration, the currents are read directly in milliamperes to four figures.

Load Resistance Variation

Fig. 6 shows the effect of load resistance change on the output current of the amplifier. The specifications call for an output current change of no more than 1/2 per cent for a load resistance change of 10 per cent. Actual measurement showed a span error of .01 per cent full scale and a zero error of .06 per cent. Extending the load resistance variation from 200 to 900 ohm gave maximum errors relative to the 600 ohm load of .38 to .1 per cent zero shift and .04 to -.04 for span change. This is a striking illustration of the constant current properties of the amplifier.

Ratio Set

The system requires that the output remain

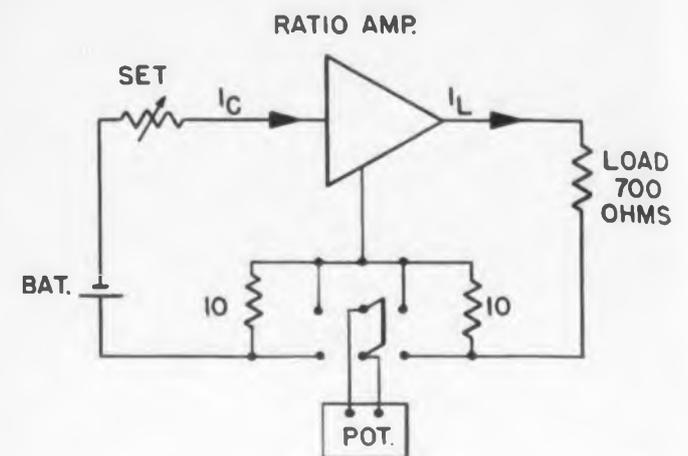


Fig. 8. Circuit for precision testing of ratio amplifier.

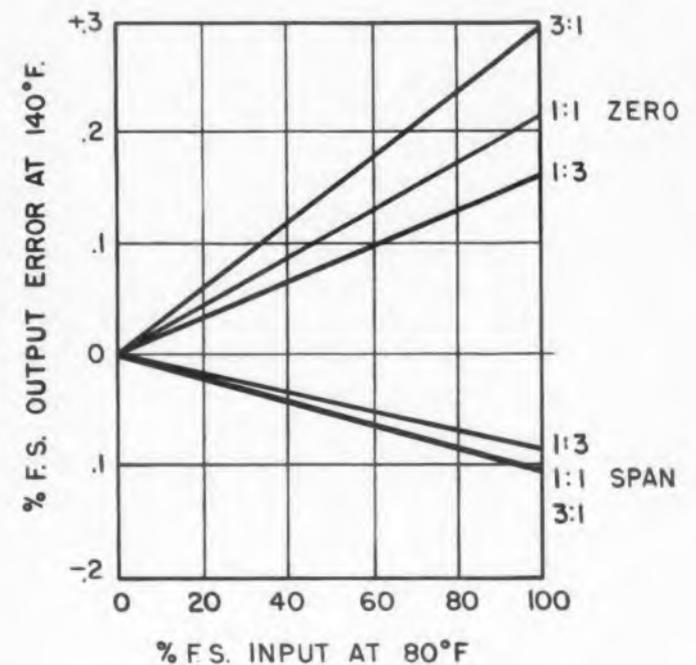


Fig. 9. Effect of ratio setting on temperature response.

at 10 ma when the input is 10 ma regardless of the position of the ratio set resistor. If the voltage drop produced by the 10 ma input is equal and opposite to that produced by the Zener reference, then, theoretically, no current should flow in the control circuit. However, in spite of the use of the shorted decoupling winding, a small residual voltage is induced with its magnitude affected by the total control circuit resistance. Fig. 7 shows that a .1 per cent net error results as the ratio resistor is changed through its limits. A high quality variable resistor is essential since changes in contact resistance have the same effect as changes in ratio setting.

Linearity and Temperature Response

With a 1:1 ratio setting for several tests, the amplifier had a zero shift of +.47 per cent per 100 F rise and a span change of -.28 per cent per 100 F rise. The repeatability was .1 per cent. Results for a typical run are shown in Fig. 5.

Temperature Effect

The effect of temperature is somewhat affected by the ratio setting as shown in Fig. 9.

Zero Stability

The system's zero stability depends on the Zener reference, which, in turn, depends on the type of power supply regulation. In ac regulators having high distortion (20 per cent), a flat top waveform is produced whose peak value remains constant while the wave form varies with supply voltage. Such a wave form, rectified and filtered, produces a different average direct current output than a true sine wave of the same peak value. Hence, different regulators would supply different voltages to the Zener diode, causing it to operate at a different region of its characteristic. This introduces a small zero error. Wave form also affects the gain and zero of magnetic amplifiers, since these devices are frequency sensitive.

A Constant Current Source

This amplifier constitutes a true variable transformation ratio dc transformer. If the measurement signal is replaced by the Zener reference, a highly stable constant current generator is formed. The output current can readily be adjusted over a 5:1 range.

Appendix

First Stage Construction Details

Core: .938 in. od x .75 in. id, x .25 in., 3 mil Hymu 80 tape in protective box. (Magnetics Inc. No. 50003-3D). Core area = .135 cm²; core length = 6.74 cm.

Two carefully matched cores are required.

Gate Winding: 1320 turns of no. 34 copper wire over each core. Cover with one layer of 1 mil Mylar tape.

Feedback Winding: 90 turns of no. 34 copper wire wound over gate winding. Place cores together with paper separating washer and bind with one layer Mylar tape.

Control Winding: 1000 turns of no. 40 copper wire wound over two core assembly. Cover with one layer Mylar tape.

Bias Winding: 500 turns of no. 38 copper wound over control winding. Cover with one layer of Mylar tape.

Decoupling Winding: 5 turns of no. 22 copper with shorted terminals.

Second Stage Construction Details

Core: 1.5 in. od x 1 in. id x .375 in., 4 mil Orthonol tape in protective box. (Magnetics Inc. No. 50026-4A). Core area = .544 cm²; core length = 9.84 cm. Two matched cores required.

Gate Winding: 2850 turns of no. 32 copper wire over each core. Place cores together with paper separating washer. Bind with one layer of 1 mil Mylar tape.

Control Winding: 200 turns of no. 36 copper over both cores. Cover with one layer Mylar tape.

Anti-hunt Winding: 1000 turns of no. 38 copper wire. Cover with one layer Mylar tape.

Decoupling Winding: 7 turns of no. 22 copper with terminals shorted.

(All copper wire is triple Formvar covered.)

From a paper presented at the IRE-AIEE Special Technical Conference on Magnetic Amplifiers, September, 1957 at Pittsburgh, Pa.

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Read and Write Transistor Circuits for Magnetic Drums

A general approach to the design of transistorized magnetic drum read-write circuits for high reliability is presented in this article.

Part I, which appeared in a previous issue of ELECTRONIC DESIGN, outlined considerations for writer circuits. Part II, presented here, concludes the article with consideration of the read preamplifier.

B. A. Mangan

International Business Machines Corp.
Kingston, N. Y.

Part II

THE FUNCTION of the read preamplifier is to accept an input signal of approximately 30-50 mv and faithfully amplify it to a useful amplitude. In addition, the read preamplifier must reject a 10 mv signal and any pickup noise. Fig. 1 shows a preamplifier ideally suited to fulfill the above specifications. Operation of this circuit is in the megacycle range. This is obtained by the use of a drift transistor.

Essentially, the circuit consists of a push-pull emitter-coupled input stage feeding both sides of an emitter-coupled output stage.

- The advantages of this configuration are:
- Overall gain is increased.

A conversion from double-ended input to single-ended output is obtained without the use of a transformer.

Operation

A positive signal at the base of Q5 (as shown in Fig. 1) produces an increase of current through the load resistor. A negative signal at the base of Q6 also increases the current through the load. In the case of pickup noise, both signals are of the same polarity, hence they tend to cancel. However, since Q2 and Q4 look into different impedances, complete cancellation does not occur. This latter condition is of little consequence, however, since the small noise output can subsequently be amplitude-discriminated. It can also be seen in Fig. 1 that the circuit presents a high impedance to the read signal. The number of voltage sources have been kept down and are so chosen that the loss of any source will not result in the destruction of any component.

The emitter-coupled stage is a highly linear amplifier for small signals. Fig. 2 (a) indicates the gain stability as a function of the biases on the two

transistors. It can be seen that in the useful operating range, the gain is fairly independent of bias. However, the operating point will shift as the difference between the two biases varies. This effect can be minimized by returning both bases to the same source. Variations in beta will displace the curves as shown in Fig 2 (b). However, the ac gain is fairly independent of this parameter. As a result, the circuit configuration is inherently stable. Since both transistors are always in the active region, the effects of I_{co} can be swamped out. For the emitter coupled stage in Fig. 3 we have:

$$I_e = I_{c1} \left(1 + \frac{1}{B_1} \right) + I_{c2} \left(1 + \frac{1}{B_2} \right) - I_{co1} - I_{co2}$$

$$I_{c2} = \frac{I_e - I_{c1} \left(1 + \frac{1}{B_1} \right)}{1 + \frac{1}{B_2}} + \frac{I_{co1} + I_{co2}}{1 + \frac{1}{B_2}}$$

$$\text{Let } \gamma = 1 + \frac{1}{B_2} \text{ and } \phi = 1 + \frac{1}{B_1}$$

$$I_{c2} = \frac{I_e - \phi I_{c1}}{\gamma} + \frac{I_{coT}}{\gamma}$$

$$I_{c2} - \frac{I_{coT}}{\gamma} = \frac{I_e - \phi I_{c1}}{\gamma}$$

Where: $I_{coT} = I_{co1} + I_{co2}$, each being the maximum I_{co} at the highest allowable temperature.

Using this arrangement, I_e must be kept small to satisfy the high frequency requirements ($f_{co} = I/I_e$). Knowing I_{coT} , and that it must be swamped out, fixes the value of I_{c2} . This will determine a suitable

value for I_{c1} . Therefore, the values of R_e and R_c are also determined.

Discrimination against small signals is accomplished by shifting the operating point of the second stage. Fig. 2 (a) shows that cutoff occurs for equal base voltages. To reject a small input signal, e_{s1} (as shown in Fig. 1), the relation between the bases should be $E_{bQ5} = E_{bQ6}$ minus the voltage gain times the input signal. These base voltages are taken from a common divider so chosen that the current through it will swamp out the base currents. This minimizes variations in the operating point as Q6 turns on and off.

Conclusion

To the extent that the circuits described are concerned with the application of transistors to magnetic drum requirements, the circuits are therefore typical of some of the problems encountered in reliable design. It must be remembered, however, that reliability and a good basic design are not necessarily one and the same. It is the responsibility of the circuit designer to settle for nothing but the optimum design, and then to build further reliability into it.

Whereas much has been written on the many facets of reliability, it is nevertheless true that there is still a need for a set of rules (or a general procedure) to cover the design of high-reliability circuits. To have a true value, however, each set of rules must be identified with a particular field of endeavor. The design of faster, more reliable circuits for drum applications is continuing.

As the state of the art of transistors improves and better techniques are developed for their utilization, reliability far in excess of that of present-day systems will be realized.

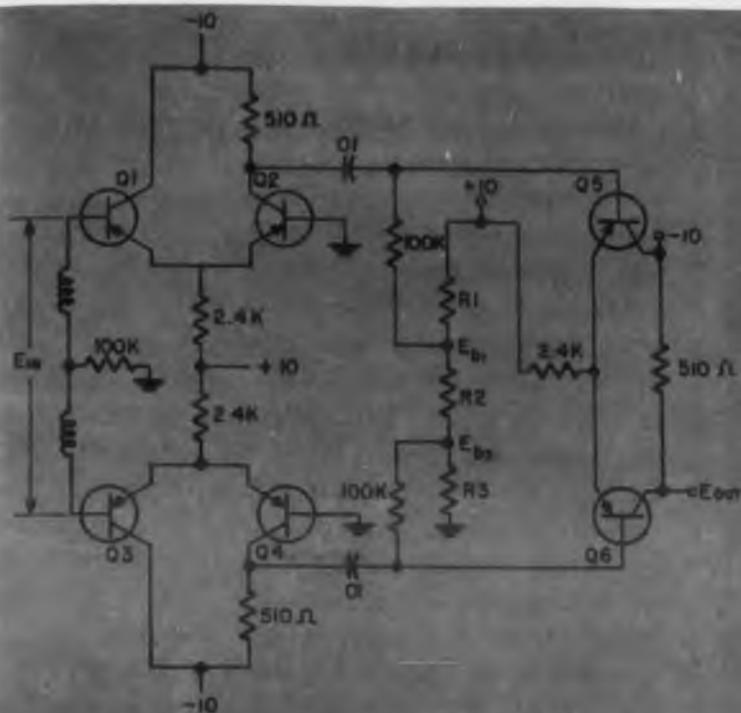


Fig. 1. Read preamplifier circuit.

Fig. 2. Output current vs base 1 voltage. a—as a function of base 2 voltage. b—as a function of beta.

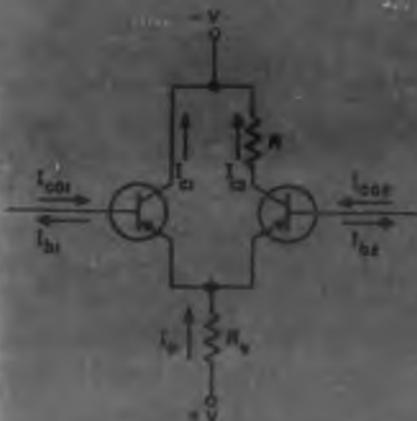
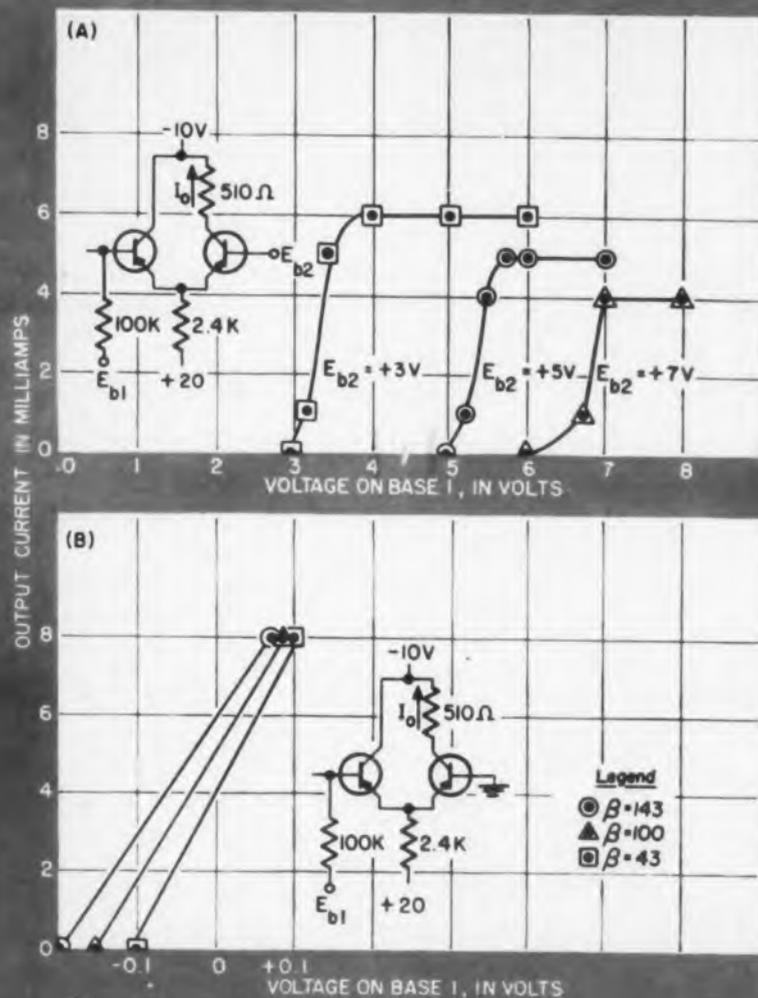
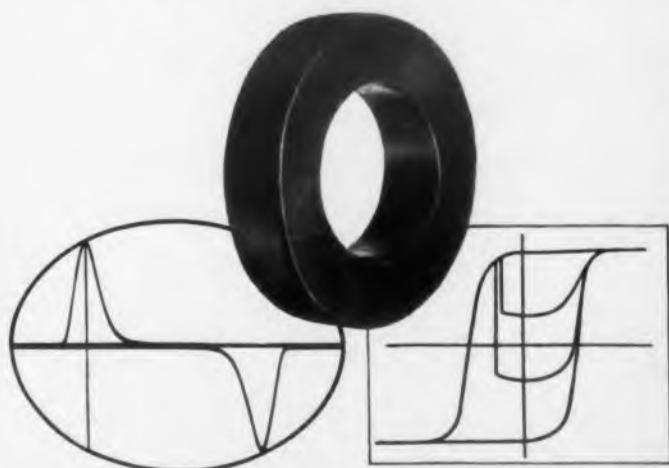


Fig. 3. Simplified emitter-coupled amplifier.

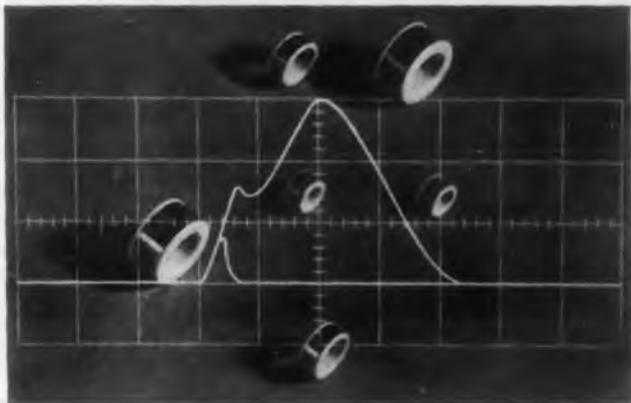


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Improved Power Fault Protection

This article describes a simple high speed fault-protection circuit which provides both dump tube and rectifier-blocking protection. The circuit was designed for use with a 10 kw, 10 kv plate voltage supply used in tests of medium power transmitting tubes, but is easily adaptable to other applications involving high, medium or low power equipment.

John T. Mark

Electron Tube Division
Radio Corporation of America

ELECTRONIC equipment operating at high voltages and powered by rectifier-filter-type supplies capable of storing large amounts of energy can be seriously damaged or destroyed by arcovers or other faults. Although such equipment is usually provided with electro-mechanical overload relays and circuit breakers which remove primary power in the event of a fault, these devices do not protect the equipment against damage by the energy stored in the power supply filter, and may not remove primary power rapidly enough to prevent damage to the power supply itself.

For adequate protection against fault damage it should be possible to shunt the faulted tube or circuit in a few microseconds. The shunting device should be capable of dissipating the energy stored in the filter or delivered by the power supply during the interval required for the removal of primary power. Dump tube or electronic crowbar circuits designed to provide such high speed protection have been described^{1,2} and are now in use in commercial and military high power electronic equipment. Increased protection can be obtained if the power supply rectifier is blocked at the same time. In this way no energy is delivered to the filter in the interval required for the electromechanical protective devices to operate.

Operation of Dump Tube Circuit

The essential elements of the fault-protection circuit is shown in Fig. 1. The dump tube is an RCA 5563-A mercury vapor thyratron connected across the 10 kv dc supply leads to the equipment load.

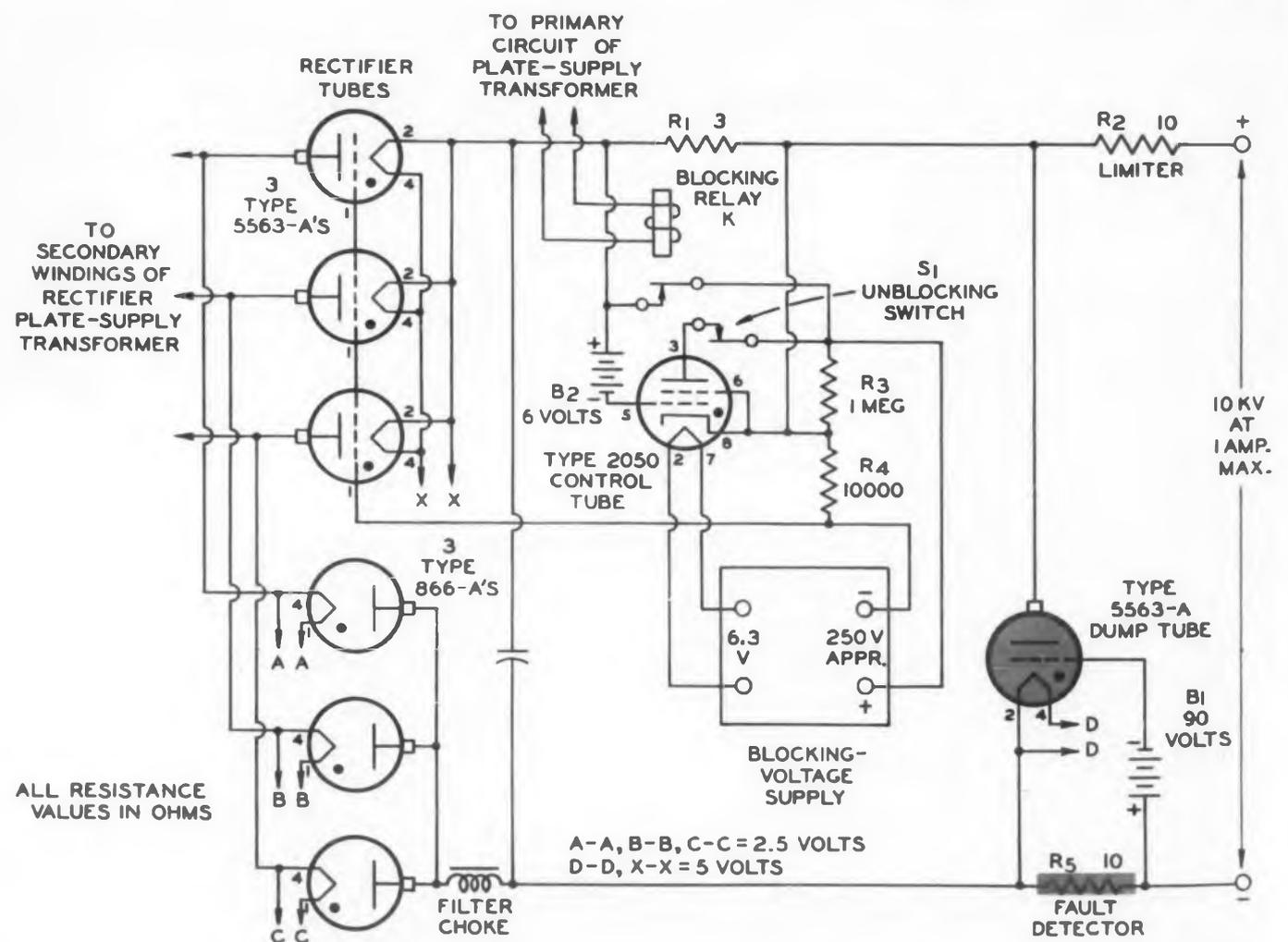


Fig. 1. High-speed fault-protection circuit showing dump tube.

Under normal load conditions the dump tube is prevented from conducting by the 90 v grid bias supplied by B_1 . When a fault occurs in the load circuit the resulting surge voltage—developed across the fault-detector resistor R_s —overcomes the battery bias and fires the dump tube. Because the impedance of the ionized dump tube is substantially lower than that of the load and the limiting resistor R_s , the dump tube diverts the current delivered by the power supply. When the overload relay or circuit breaker operates, the energy stored in the filter circuit is dissipated.

The time required for a dump tube circuit to divert the current is determined by the tube ionization time and by the reactance of the firing circuit. A mercury vapor thyratron such as the RCA 5563-A has a rated ionization time of approximately 10 μ sec, but can be ionized in a considerably shorter time if its grid is triggered by a suitably steep waveform. Although the rated ionization time of a hydrogen thyratron such as the 5C22 is only 0.1 to 0.2 μ sec, such extremely rapid ionization can only be achieved if the fault detection circuit has extremely good high-frequency characteristics. In general, adequate protection can be obtained with an ionization time of 10 μ sec. The amount of energy that can be delivered by a low frequency rectifier-filter system during this interval is not great enough to cause damage.

Operation of Rectifier-Blocking Circuit

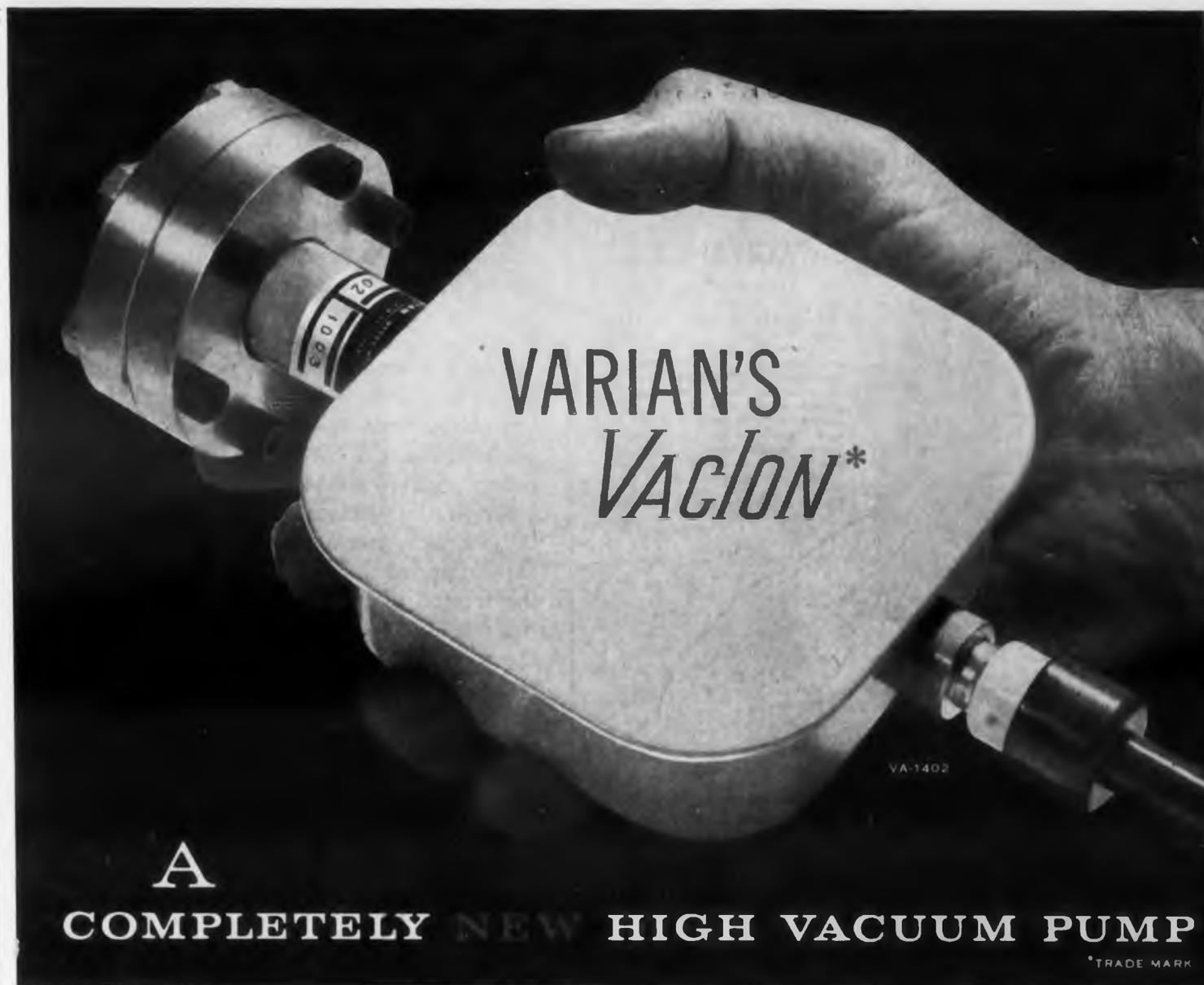
Additional protection for the faulted circuit is obtained by the use of grid-control rectifier tubes which can be blocked simultaneously with the firing of the dump tube.

The rectifier shown in Fig. 1 is a 3 ϕ half wave type using an RCA 866-A and an RCA 5563-A in each phase. The use of the 5563-A's permits the rectifier to be turned off by a relatively small blocking voltage to the grids. The blocking voltage is obtained from a simple low voltage dc supply; its application to the rectifier tube is controlled by the 2050 hydrogen thyratron.

The unblocking switch S_1 , and the contacts of the blocking relay K are normally closed. When filament power is applied to the rectifier tubes and the dump tube, the blocking-voltage supply circuit is energized and applies +250 v to both plate and grid 1 of the 2050. This is more than enough to overcome the -6 v grid bias supplied by battery B_2 , and fires the 2050. The resulting drop across R_s - -250 v - blocks the 5563-A rectifier tubes.

Application of plate-supply power to the rectifier tubes opens the contacts of relay K , removing the positive dc supply from grid 1 of the 2050. The 2050, however, continues to conduct because it cannot be deionized except by removal of plate voltage. It therefore keeps the rectifier tubes blocked.

The unblocking switch S_1 is a spring-return type



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which, when pressed, removes plate voltage from the 2050. The resulting deionization of the control tube removes the short across R_3 , reduces the drop across R_1 to a negligible value and unblocks the 5563-A rectifiers. When S_1 is released the 2050 control tube is held in the deionized state by the -6 v bias supplied by B_2 . During these starting-up operations the 5563-A dump tube is, of course, cut off by the -90 v grid bias supplied by B_1 .

Fault-Protection Action

Under normal load the maximum drops across R_1 (3 v) and R_3 (10 v) are too small to overcome the battery bias voltages on the grids of the 2050 control tube and 5563-A dump tube, so that these tubes remain deionized. Under fault conditions, however, the voltages across R_1 and R_3 very rapidly become large enough to trigger the control tube and dump tube. The rectifier is then blocked and the faulted circuit shunted in microseconds. The control tube will continue to conduct and keep the rectifier blocked after primary plate power is removed. It will maintain the rectifier tubes in the blocked condition after the fault has been cleared and plate power reapplied. The rectifier cannot be unblocked except by means of the switch.

In many cases, a fault is present or develops at the instant the power supply is turned on, with the result that the dc output voltage of the supply does not rise to the normal value. In such cases, an ac-coupled or voltage-sensitive fault-detection circuit might not respond to the fault, and would not provide the desired protection. The fault-detection circuit shown in Fig. 1 is free from these disadvantages because it is direct coupled, current sensitive, and substantially independent of the dc operating voltage. In addition, the rectifier-blocking feature automatically prevents application of power to a faulted circuit.

Although this fault-protection circuit is not "fail safe," it is conservatively designed and extremely reliable. Similar circuits have been used for several years in the RCA Electron Tube Division laboratories, and have given very little trouble.

Complete Protection Circuit

A schematic of the complete fault-protection circuit is shown in Fig. 2. The unblocking switch S_1 , is a spring-return type equipped with make-before-break contacts. When pressed, the lower (make) contact closes first, maintaining a large current flow through R_1 . In this way the rectifier tubes are not without blocking protection during the unblocking operation. The upper (break) contact then opens, and removes plate voltage from the 2050. The rectifier, therefore, is not unblocked until S_1 is released. N_1 and N_2 are neon indicator lamps which show whether or not the rectifier is blocked. S_2 , which was not shown in the simplified circuit diagram of Fig. 1, is a normally-open spring-return switch which provides a convenient means for checking the operation of the rectifier-blocking

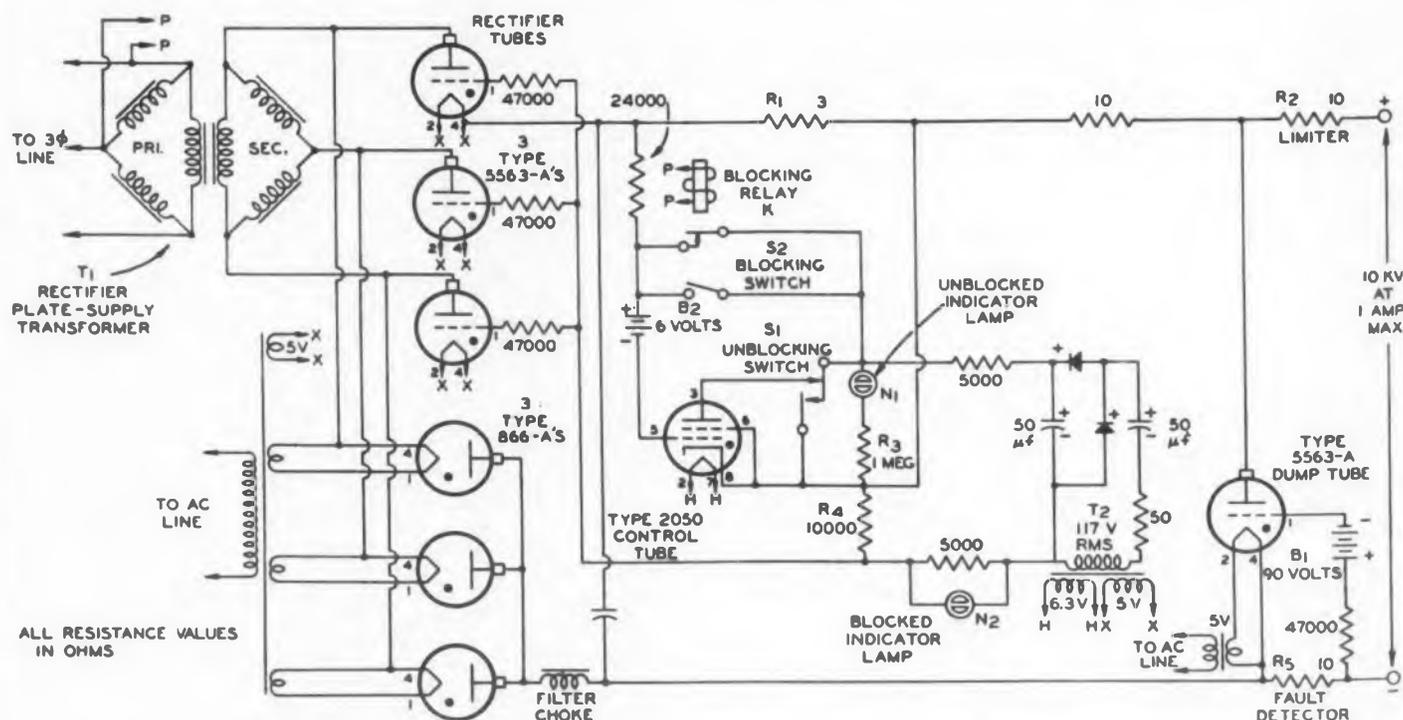


Fig. 2. Complete fault-protection circuit.

circuit. It is connected in parallel with the contacts of relay K, open when the rectifier is operating under normal load conditions. Momentary pressure on S_2 , therefore, triggers the 2050 control tube, and blocks the rectifier.

Design and Construction

In the design of the power-supply circuit, consideration was given to the fact that the supply would have to be capable of operation under short-circuit conditions during the interval required for the dump tube and control tube to ionize. No special components were required, because experience showed that standard components were fully capable of standing the anticipated short-time overloads without damage. The inductance of the filter choke was the minimum critical value³. Excessive choke inductance can cause the development of a negative voltage kick after the rectifier has blocked. This kick may be of sufficient magnitude to exceed the piv rating of the rectifier tubes, causing arc back.

Considerable care was taken in layout and lead dress to minimize reactance, because excessive reactance may be responsible for transients which can cause the blocking and dump tube circuits to misfire.

Note that S_1 , S_2 , and the entire blocking-voltage supply circuit, including the heater supply for the 2050 control tube, are at high potential. The expense of a supply transformer having adequate primary insulation for T_2 , may be avoided, as shown, by the use of a conventional 6.3/5 v filament transformer with its 117 v primary used as the high voltage secondary and its 5 v winding as the primary. The entire transformer, as well as all components and wiring of the blocking-voltage supply circuit, and the blocking and unblocking switches must be insulated from ground for the peak output voltage of the rectifier.

The effectiveness of this protection circuit is demonstrated by the fact that when a small piece of soft solder wire is placed across the output terminals of the supply, only a small spit and flash results. The solder is not marred and shows no evidence of an arc even when examined through a 10-power magnifier. In operating tests, the supply was repeatedly turned on into a short circuit, and short-circuited while delivering 10 kv, without damage.

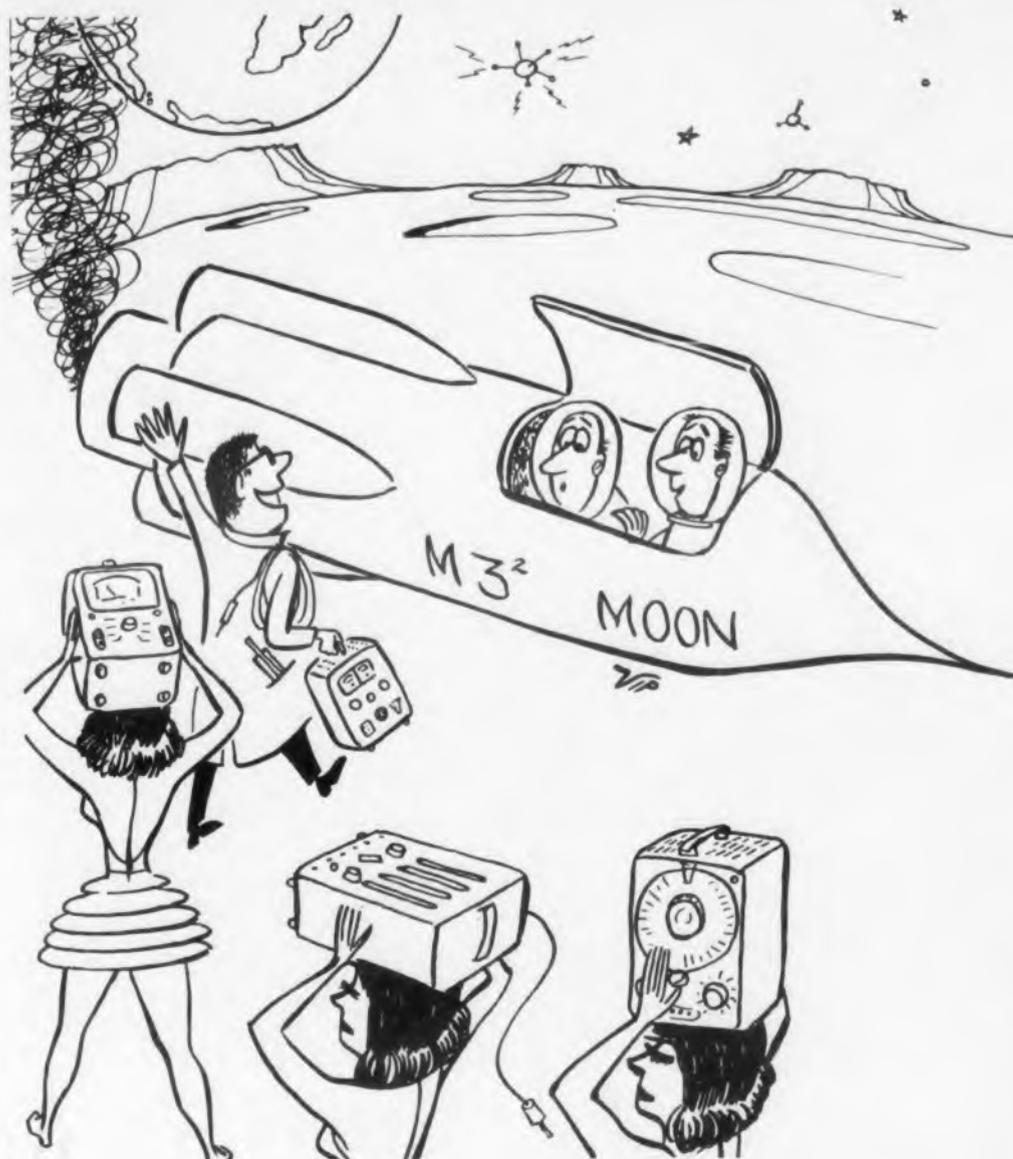
Acknowledgements for valuable assistance in the development of this circuit are due to A. C. Grimm, S. E. Penny-packer, and F. S. Keith of the RCA Electron Tube Division, Lancaster, Pa.

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1. High-Speed Electronic Fault Protection for Power Tubes and their Circuitry, W. N. Parker, M. V. Hoover. *IRE Convention Record*, 1955.

2. Gas Tubes Protect High-Power Transmitters, W. N. Parker, M. V. Hoover. *Electronics*, Jan. 1956.

3. RCA Transmitting Tube Manual TT-4, pp. 74-77.



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A proposal for the standardization of power supply voltages for transistor circuits. Recommended voltages are $\pm 1.5, 3, 3, 12, 25, 50$ and 100 v, with voltages above 100 falling in 50 v increments. The method used to select these voltage standards, akin to that originally used to select standard resistor values, is described.

Transistor Voltage Standards

W. W. Wells
Autonetics Division
North American Aviation, Inc.
Downey, Calif.

TRANSISTOR supply voltage requirements have placed greater demands on power supplies. While the majority of the vacuum-tube voltage requirements fall within a 2:1 range between 150 and 300 v, most transistor requirements are spread over a 100:1 range between 1.5 and 150 v.

A method for arriving at standard voltages is to select a series of voltages that are equally spaced by a constant multiplying factor. In this way the percentage difference between an ideal power supply voltage and the closest standard voltage would always be less than a certain fixed amount no matter what part of the voltage spectrum was needed. Fig. 1 shows a fairly uniform spread of transistor power supply voltages used by a number of aircraft companies.

The homogeneity of transistor circuit voltage requirements over the voltage spectrum from 1.5 to 150 makes it desirable to use a system of power

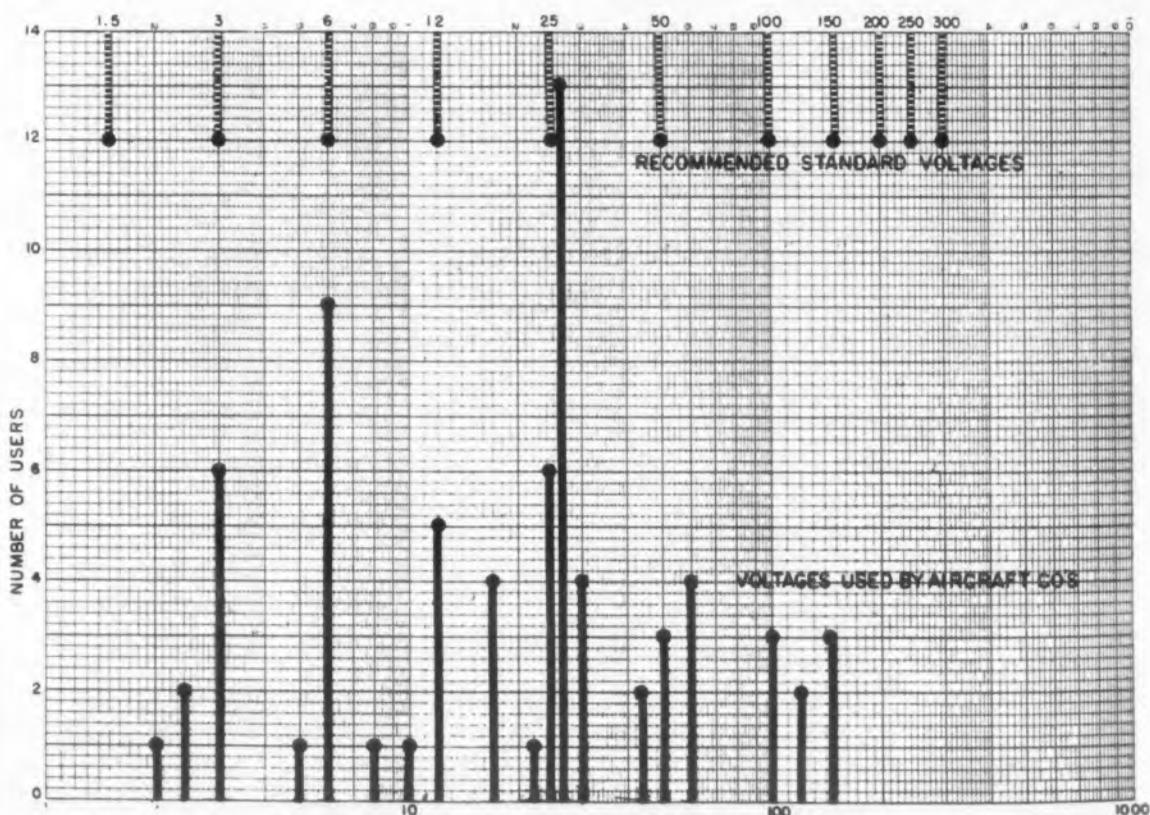


Fig. 1. Proposed standard power supply voltages.

supply voltages separated a given percentage from each other. In this manner the engineer selecting a standard voltage near 2 v or 80 v would not be penalized more for one requirement than the other. An illustration might clarify this position further.

Suppose standard voltages were set up as 3, 50, and 100 v. Now let two circuits be designed which must use one of these standard voltages but which will be optimized when using 12 and 75 v, respectively. The engineer who needs 12 v is penalized by a factor of 4:1 by going to either 3 or 50 v. On the other extreme the circuit that works best at 75 v is only penalized 1.4:1 by going to 50 or 100 v.

If only three voltages were permissible they would be 1.5, 15, and 150, separated by a factor of 10:1. If thirteen were permissible the 20 per cent tolerance series used for resistors would suffice. The desirable series falls in between these two; one does not include enough and the other has too many.

Standard Voltages

A series spaced by a factor of 2:1 is recommended as shown here with voltages about 100 v spaced in 50 v increments: ± 1.5 , 3, 6, 12, 25, 50, 100, 150, 200, 250, and 300 v. This series retains the 2:1 spacing between values for transistor voltages below 100 v and retains the most popular vacuum-tube voltages above 100 v. It also seems as though a ratio of less than 2:1 would yield more power supply voltages than desirable and a ratio of over 2:1 would not include enough voltages.

Several of the voltages in this recommended series are standards now in popular usage. The 1.5 and 3.0 v voltages could be supplied from dry cells or electronic supplies. The 6 and 12 v storage batteries are in common use. In the 20 to 30 v range, 22-1/2, 23, 24, 25, 27-1/2, 28, and 30 are all used extensively. For reasons already stated, the 25 v supply, which is consistent in the 2:1 spread for 25, 50, and 100 v, was picked. In the region of 50 v, 45, 50, 55, and 60 are used; 50 was chosen.

Transistor Specs Influenced

A transistor rated by the manufacturer for a maximum collector voltage of 30 v must not be operated above 30 v: the collector might break down and damage could result if the collector current were not limited.

If a circuit engineer were to design a circuit around the type 2N118 transistor (rated at 30 v) using the recommended power supply voltages, it is doubtful that he would want to choose the 50 v supply, because it exceeds the transistor ratings by a large margin. Because the next lower standard supply voltage is 25 v, he would prefer to use this one for a resistive load and 12 v for an inductive load. If a transistor rated for a maximum of 20 v were selected, it is possible that the 25 v supply might still be used, and most transistors would work satisfactorily. This is because manufacturers

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cannot produce a production run of transistors with a single value of breakdown voltage (due to process control) but rather a spread of values which range above and below the rated value. Reliable manufacturers choose transistors from their distribution so that most, if not all, of those shipped fall above the value in question.

The manufacturer has little control over the way a product is used in research and development. It is only after a product has gone into production and trouble arises that the component supplier is called in. One good way to decrease the possibility of the misuse of a component is to establish standards in such a way that it will be more difficult to go wrong.

Transistor Ratings

As shown above, a transistor rated for a maximum of 30 v will probably be used with a 25 v supply for a resistive load; this is a 20 per cent safety factor when the transistor is operated in a cut-off condition. On the other hand, a transistor rated for a maximum of 20 v could be operated from a resistive load and a 25 v supply, as stated above, with a good probability that many units would work satisfactorily. As frequently seems to happen, these transistors might all have a collector breakdown above 25 v and work satisfactorily. But in production, when large quantities are used, a certain percentage of the transistors will inevitably have a breakdown just above 20 v and would not be suitable for the application.

If the standard supply voltages are adopted and used by a majority of users, the transistor manufacturer will have gained the tremendous advantage of knowing the universal market requirements for collector voltage. By adding 20 per cent to these standard supply voltages, a new series of voltages is obtained, which are ideal ratings for transistor collector voltage. This new series will be $\pm 2, 4, 8, 15, 30, 60,$ and 120 v. Circuit designers will then be in a position to use the recommended power supply voltage and to operate transistors out to their maximum ratings with a 20 per cent safety factor. This will certainly tend to discourage the use of the next higher standard voltage because of the very obvious overrating of transistor collector voltage.

Other Advantages

The above series of voltages (2, 4, 8, etc.) would be ideal voltage ratings for capacitors when used in circuits using the standard voltages recommended here. Component manufacturers will be able to produce parts to be used in systems already designed as standard voltages will be available.

Checkout equipment for testing components will be simplified if only standard voltages are needed to power the components. Standard power supplies can be designed and used in many systems without redesigning for new voltages in each new system.

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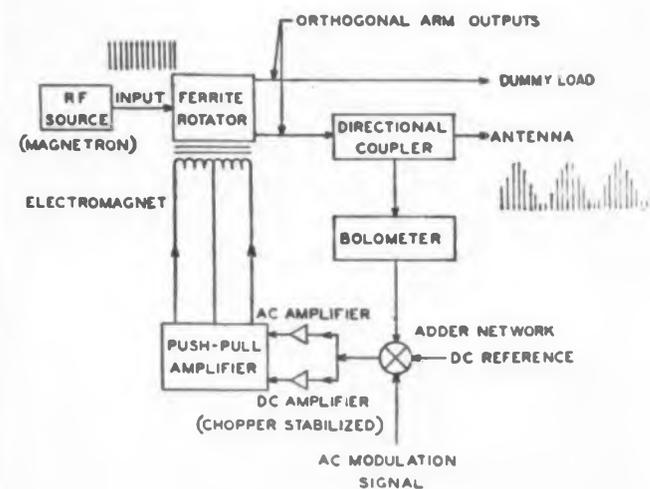
WITHOUT bulky mechanical equipment, this device accurately splits, attenuates, or modulates microwave power. With the advantage of a closed loop system, it automatically regulates output waveform and amplitude, and can handle frequencies from 3 to 10 mc.

Airtron, Inc., of Linden, N.J., designed reserve gain into this 5 tube system at a total cost of only 25 watts of power consumption.

One can feed power from a klystron or magnetron into this unit and electronically stabilize the amplitude, modulate the power with sine or square waves, split the power and direct it into two discrete outputs, and attenuate or simply monitor the output.

The unit features a voltage standing wave ratio of no more than 1.2, insertion loss from 1 to 20 db, and 2 per cent stability. Sine wave modulation frequency can be as high as 150 cps and square wave modulation can go to 50 cps. The harmonic distortion for 10 db sine wave modulation does not exceed 5 per cent.

The block diagram illustrates the operation. A klystron or magnetron microwave source feeds



This block diagram (discussed in the text) shows how the plumbing and electronic components work together.



This is the compact control box for the programmed microwave attenuator.

a ferrite rotator. A magnetic field applied to a ferrite rod in the rotator, rotates the plane of polarization of the rf wave traveling along the guide. Two coupling windows, 90 degrees apart in a section of circular waveguide, sense this rotation of the rf wave.

As the electric field rotates, the power ratio between the two windows changes. A bolometer detector couples the rotator to an operational amplifier's feedback circuit. The bolometer's output, which represents the actual power in the waveguide, is compared with reference signals to provide an error signal which is fed to the amplifier. The amplifier, in turn, drives the electromagnet which applies the magnetic field to the waveguide ferrite.

Though the ferrite is sensitive enough to find laboratory applications, it can also handle quite high power levels. In the X band, it can accept 100 watts of average power and 100 kw peak. In the C and S bands, it can handle three times these levels.

For further information, turn to the Reader-Service Card and circle 42.



Here is the plumbing associated with the attenuator. At the upper left is the directional coupler and attenuator. To its right are the orthogonal junction, the ferrite rotator, and a 45 degree twist. The dummy load is shown at the lower right and the bolometer mount at the lower left.

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Transistor

Heat Sinks



POWER transistors using these new heat sinks no longer require large surface mounting areas for heat dissipation. Combining convection and radiation cooling, these new heat dissipators can solve many power transistor application problems where conduction cooling is not feasible.

Designed by International Electronic Research Corporation, 145 West Magnolia Boulevard, Burbank, Calif., they allow efficient and compact form factors in equipment where it is now necessary to allow large surface areas for heat dissipation.

By keeping transistors cooler, they improve their operation and extend their life. In addition, they reduce the heat transferred into printed circuit boards.

The heat dissipators are made of aluminum with a black anodize finish. They have holes for convective cooling, and slots, which provide a tight spring friction fit on the transistor.

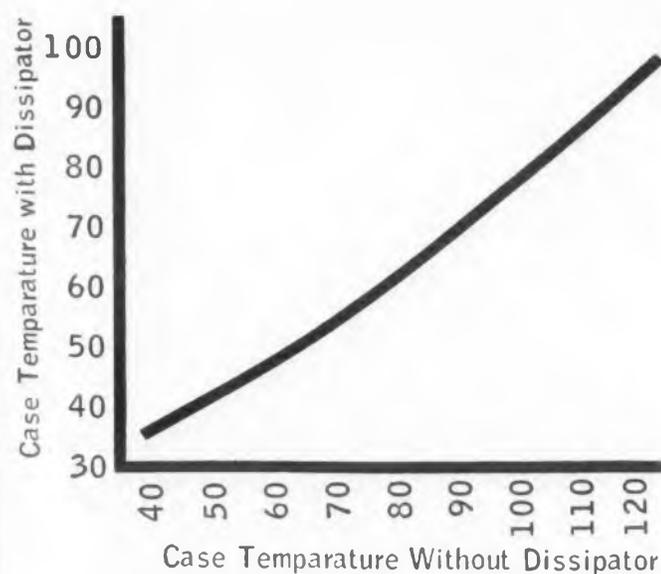
Tests were made to compare the cooling efficiency of these units with other designs. The guinea pig was a power transistor screwed into a small soldering iron. A thermocouple attached to the top center surface of the transistor monitored the temperature.

The new heat dissipator was compared with bare aluminum samples, with and without convective holes, and with a black anodized sample without the holes. It was found superior to all the others. The graph, shown below, illustrates how effectively it reduces case temperature.

Models are available to fit various transistor case sizes.

For more information, simply turn to the Reader-Service Card and circle 45.

See these dissipators at the Radio Engineering Show at Booth 3704.



This graph compares transistor case temperatures with and without the heat sink. Temperatures are in degrees Centigrade.

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Code No.	Max. Fwd. Voltage Drop @ Indicated DC Current	Max. Rev. DC Cur. @ Test V.		Test Voltage	Min. Break-down Voltage	Reverse Recovery
		25° C.	150° C.			
1N658	1 @ 100 mA	.05 μ A	25 μ A	50V	120V	80K Ω in 0.3 μ sec†
1N457	1 @ 20 mA	.025 μ A	5 μ A	60V	70V	
1N458	1 @ 7 mA	.025 μ A	5 μ A	125V	150V	
1N459	1 @ 3 mA	.025 μ A	5 μ A	175V	200V	
DR668	1 @ 200 mA	.025 μ A	5 μ A	60V	80V	
DR669	1 @ 200 mA	.025 μ A	5 μ A	125V	150V	
DR670	1 @ 200 mA	.025 μ A	5 μ A	175V	200V	
			100° C.			
1N625	1.5 @ 4 mA	1 μ A	—	10V	30V	15K Ω in 0.15 μ sec‡
	—	10 μ A	50 μ A	20V	—	—
1N627	1.5 @ 4 mA	20 μ A	100 μ A	75V	100V	400K Ω in 1.0 μ sec†
1N629	1.5 @ 4 mA	20 μ A	100 μ A	175V	200V	400K Ω in 1.0 μ sec†
DR677	1 @ 100 mA	0.5 μ A	25 μ A	20V	30V	15K Ω in 0.15 μ sec‡
DR673	1 @ 100 mA	0.5 μ A	10 μ A	75V	100V	400K Ω in 1.0 μ sec†
DR675	1 @ 100 mA	0.5 μ A	10 μ A	175V	200V	400K Ω in 1.0 μ sec†

*Reverse voltage at which a reverse current of 100 μ A flows.
†When switching from 5 mA to -40V.
‡When switching from 5 mA to -20V.



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Part II

Silicon Diode Application Notes

Arnold Bergson
Raytheon Mfg. Co.
Newton, Mass.

Medium power silicon diodes can be applied where small size, high efficiency, high temperature operation, high reverse resistance and medium forward current are required. Equations and criteria for use in designing silicon diodes into practical circuits are given here, together with problem examples.

mally range from 0.7 to 1.0 volt at 25 C, with a temperature coefficient of $-1mv/^{\circ}C$. R_d will vary over many orders of magnitude with diode size and type. Both parameters are normally given in manufacturer's literature.

Thermal Functions

There has been a recent industry wide tendency to simplify the form of limiting thermal curve (Fig. 2, Part I) to the form:

$$P_{fda} = \frac{T_s - T_c}{K_d R_{ti}} \text{ watts} \quad (6)$$

where T_s = maximum (inoperative) storage temperature

(continued on page 60)

THE BASIC equations described in the previous article ELECTRONIC DESIGN, March 1, 1957, require separate solution for a trial set of electrical and thermal conditions of limiting diode operation. In many cases repetitive solution will be required for optimum design. For rapid solution, and to permit simple inspection of the results of adjusting independent variables, it is convenient to adapt the main functions to nomograph form.

Electrical Functions

The general equation for forward power dissipation (P_{fd}) is:

$$P_{fd} = I_a E_o + K_f^2 I_a^2 R_d \text{ watts} \quad (1)$$

where, P_{fd} = forward power dissipation

E_o = approximate diode threshold voltage

K_f = theoretical forward current form factor

R_d = diode dynamic forward resistance

I_a = diode forward average current

Equation (1) lends itself readily to three scale nomograph presentation using the following scales (a) $K_f^2 R_d$, (b) I_a , and (c) P_{fd} . E will nor-

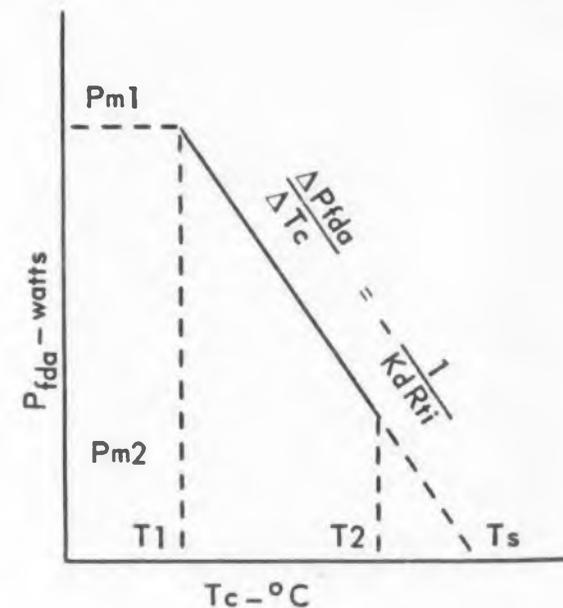
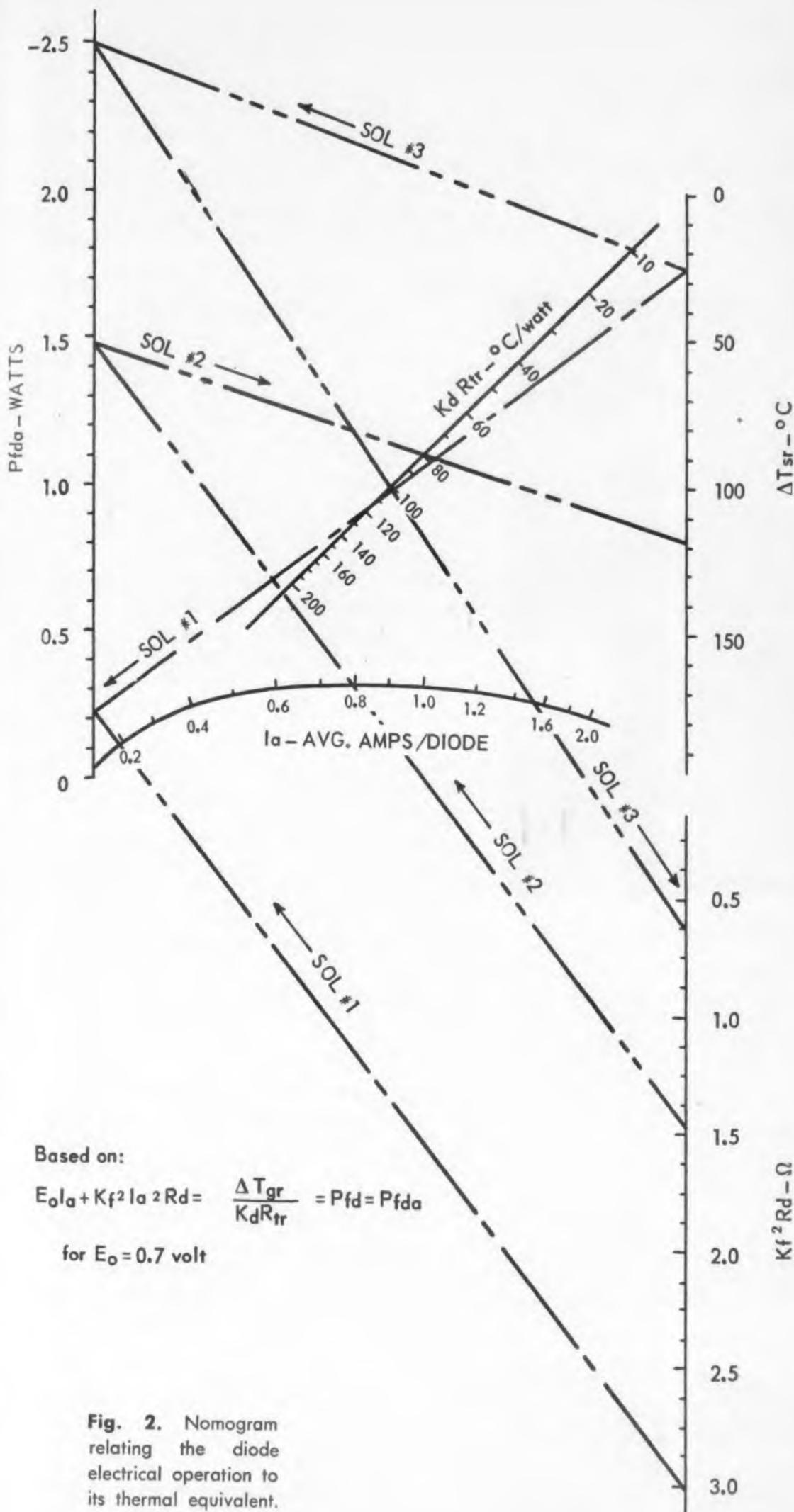


Fig. 1. Modified thermal limit curve. The range covered is usually limited to some extreme temperatures, T_1 and T_2 .



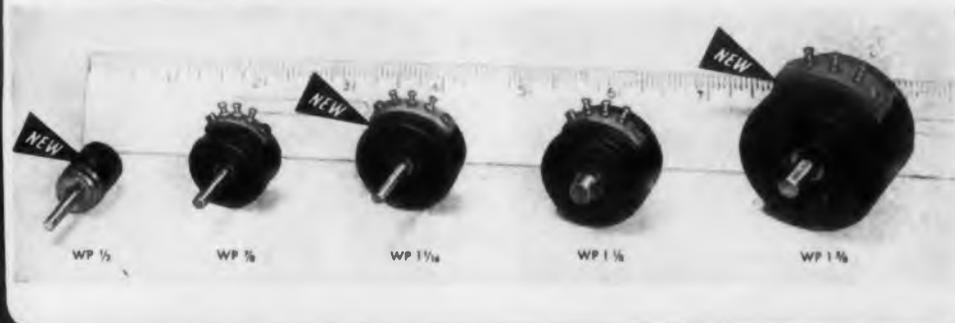
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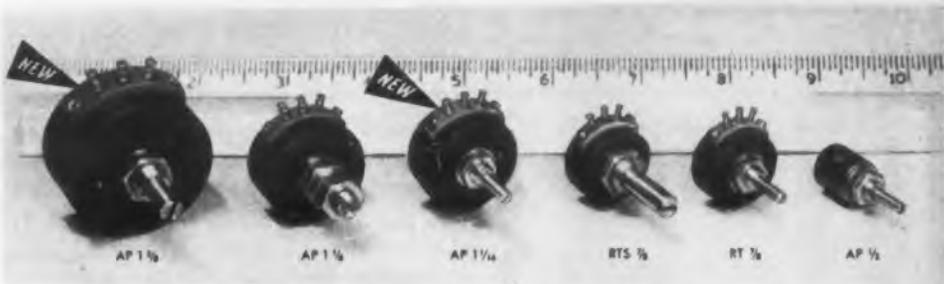
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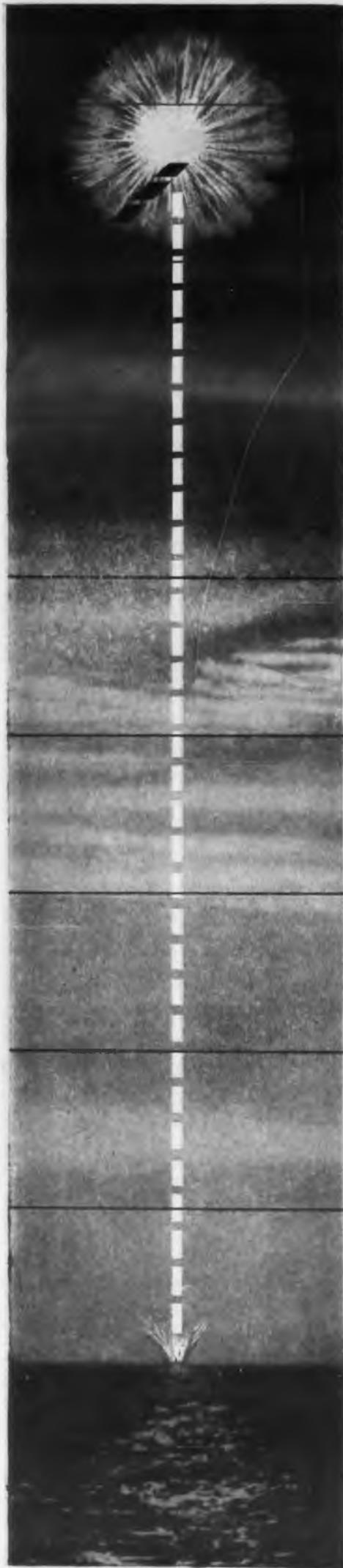
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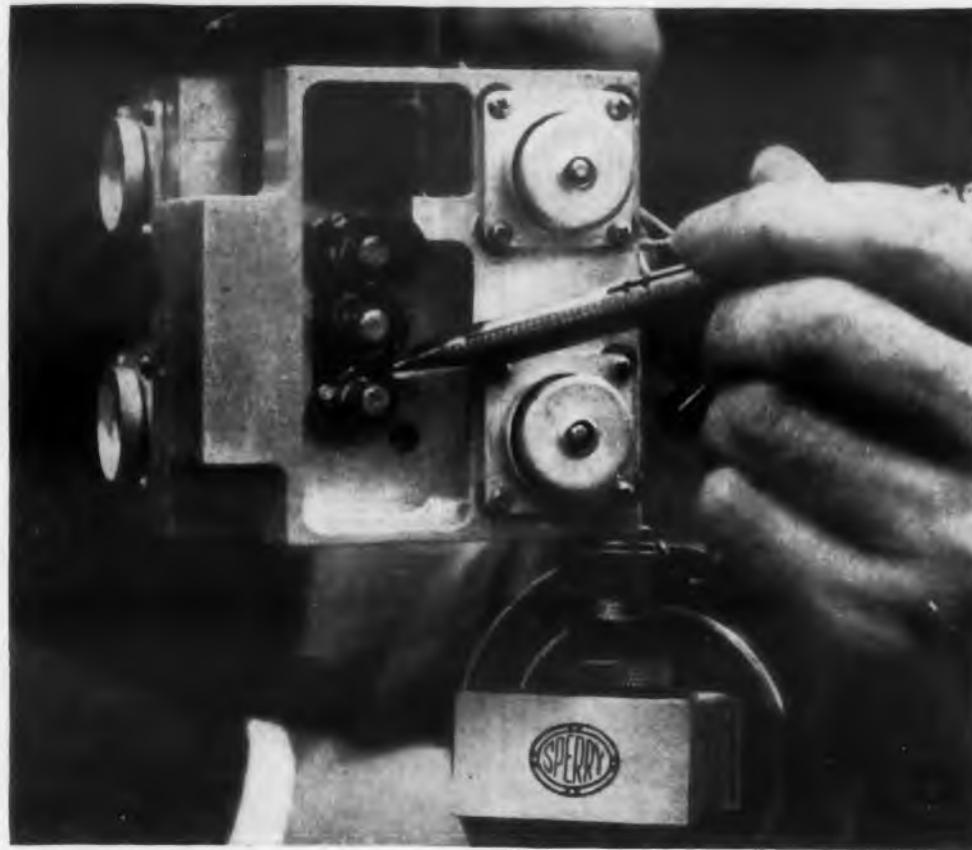
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Sperry klystron tests OK after missile explosion and 1½-mile plunge into sea



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Sperry engineers estimate the tube withstood an explosive force more than 100 times gravity when the missile was exploded 1½ miles in the air. Then the tube plummeted down to the ocean. It smashed into the surface at several hundred miles an hour. Hitting water at

this speed is like hitting solid concrete.

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T_o = case temperature
 R_{tt} = maximum effective, diode internal thermal resistance
 K_d = a derating factor
 P_{fda} = maximum allowable forward power dissipation

The modified thermal limit curve is plotted in Fig. 1. The range covered by this curve is normally limited to some extreme temperatures, T_1 and T_2 , where:

when $T_c \leq T_1$, $P_{fda} = P_{mi}$ (7) (and) when $T_2 < T_c \leq T_3$, P_{fda} may be derated to zero, but T_2 may equal T_3 for a given diode.

The choice of the test measurement point is purely arbitrary. Equation (6), covering case temperature measurement, can be generalized to include any reference point from ambient (ground) to junction as follows:

$$P_{fda} = \frac{\Delta T_{sr}}{K_d R_{tr}} \text{ watts} \quad (8)$$

where T_{sr} = the temperature difference between the junction and the reference point

R_{tr} is the effective thermal resistance between the junction and the reference point

K_d = is a derating factor.

Equation (8) can be conveniently adapted to a three scale nomograph for using the following scales: (a) ΔT_{sr} , (b) P_{fda} , and (c) $K_d R_{tr}$.

Combined Electro-thermal Functions

By equating the actual forward power dissipation (P_{fd} , eq. 1) to the maximum allowable forward power dissipation (P_{fda} , eq. 8), a single equation is produced relating the diode electrical operation to its thermal environment:

$$E_o I_a + K_f^2 I_a^2 R_d = \frac{\Delta T_{sr}}{K_d R_{tr}} = P_{fd} = P_{fda} \quad (9)$$

Since the power scales are common, the resulting nomograph will have five scales, of which three are linear, and two exponential. In order to provide maximum legibility and accuracy, it is necessary to limit use of each nomograph to a single diode type.

The nomograph shown in Fig. 2 covers a family of silicon diodes having a nominal power dissipation rating of approximately 0.5 w at 150 C case temperature. This family is a large one, covered by many manufacturers, in several types of junctions (bonded, fused, and diffused) in different mechanical packages (coaxial lead, stud). Temperature reference points used by the various manufacturer's range from ambient and case, to junction.

Nomogram Problems

The problems selected for nomogram solution illustrate the range and flexibility of this method.

Problem 1: A bonded silicon diode has a forward current of $I_f = 0.3$ ampere at 1.0 v dc. The derated internal thermal resistance can be found from a published curve to be: $K_d R_{tr} = 120$ degrees C/w from junction to ambient. Storage temperature is given as 150 C. From the above data, determine the maximum output current which can be used from a three phase bridge in an ambient temperature of 125 C:

Solution: Assume $E_o = 0.7$ v, and calculate $R_d = \frac{E_f - 0.7}{I_f} = 1$ ohm. K_f (from the Table, Part I) is 1.74, and $K_f^2 R_d$ is 3.03 ΔT_{sr} is 150 - 125 or 25 degrees. Draw a line on the nomograph connecting 25 degrees on the ΔT_{sr} scale and 120 C/w on the $K_d R_{tr}$ scale. Extrapolate to the P_{jda} scale, and read the maximum allowable forward power dissipation as 0.22 watts. Find 3.03 on the $K_f^2 R_d$ scale, and draw a line connecting this point with the previously determined point on the P_{jda} scale. This line passes through the I_a scale at an average, per diode current of 0.18 ampere. The total bridge output current will then be triple this value or 0.54 ampere.

Problem 2: A fused silicon diode has a forward specification of 0.5 ampere at 1.0 v, dc, for an R_d of 0.6 ohm. Given a storage temperature of 175 C, and a $K_d R_{tr}$ of 80 C/w from junction to ambient, determine the maximum ambient temperature at which an output current of 1.6 amperes can be supplied from a single phase center tap supply:

Solution: Since each diode will supply half the load current, find point 0.80 on the I_a /diode scale, and $K_f^2 R_d$ ($1.57^2 \times 0.6 = 1.47$) on its scale. Connect these points and extrapolate to the P_{jda} scale, reading 1.48 watts. Connecting this point to 80 C/w on the $K_d R_{tr}$ scale, and extrapolation to the ΔT_{sr} scale, read 118 degrees. The ambient temperature (max.) is then 175 - 118 or 57 C.

Problem 3: A stud mounted, diffused junction, silicon diode has a forward of 2.0 amperes at 1.0 v, dc. Δt_{sr} and $K_d R_{tr}$ are 175 C, and 10 C/w (junction to case), respectively. It is required to supply 3.0 amperes to a resistive load through a capacitor input filter. The supply will be a single phase bridge, and diodes will be operated at a maximum case temperature of 150 C. The capacitor will cause a poorer current from factor than that indicated by the Table (1.57). Find the maximum value of K_f which can be used:

Solution: From the above data, $\Delta T_{sr} = 175 - 150 = 25$ C. From the nomograph find $P_{jda} = 2.5$ w. Each diode will carry an average current of 1.5 amperes. Therefore, the nomograph gives a maximum permissible value of $K_f^2 R_d$ as 0.625. The dynamic resistance, R_d is $(1.0 - 0.7) / 2.0$ or 0.15 ohm. Therefore K_f is the square root of $0.625/0.15$ or 2.02. Since the resistive load value of K_f is 1.57, an increase of about 30 per cent up to 2.02 is permissible.

Problem 1: A bonded silicon diode has a forward current of $I_f = 0.3$ ampere at 1.0 v dc. The derated internal thermal resistance can be found from a published curve to be: $K_d R_{tr} = 120$ degrees C/w from junction to ambient. Storage temperature is given as 150 C. From the above data, determine the maximum output current which can be used from a three phase bridge in an ambient temperature of 125 C:

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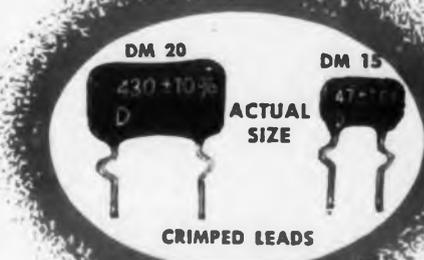
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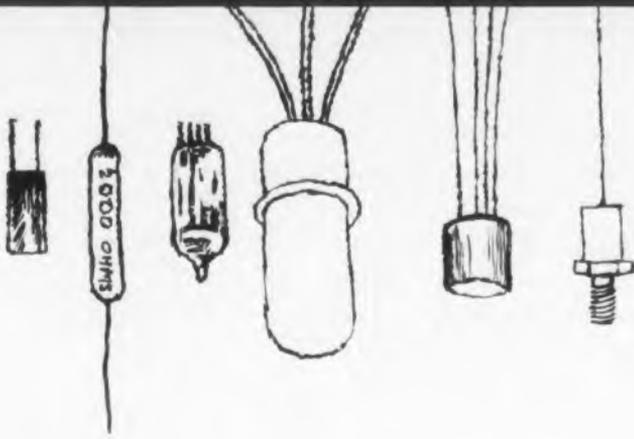
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S.A. 1078

CIRCLE 51 ON READER-SERVICE CARD



Designing Components for New Applications

PRESENTED here is a method for accomplishing the design and development of a given component to meet the requirements of a future electronic system. A specific example is given—the design and development of a miniature, environment-free, electrical connector for airborne equipment.

Preliminary Thinking

Once the requirements of a future electronic system are known, it should be determined whether existing components will meet the advanced system requirements. Where new components are needed, it is necessary to list the design and performance requirements necessary to make the component function properly in the advanced electronic system, and bring these requirements to the attention of component manufacturers.

Prototype Development

Two approaches may be pursued in order to obtain the prototype design

and development of a given component based upon the performance requirements of the advanced electronic system. The usual method is to write a design specification and prepare outline drawings, which are then released to the component manufacturers for bid. An alternate approach is to induce direct development by a component manufacturer if there appears to be a wide application for a non-existing product. If a large market is anticipated, it would be financially beneficial and a credit to the manufacturer's reputation to design and develop a component to meet these requirements.

Example

In one case—because of the universal need for miniature electrical connectors—Douglas selected the latter approach and submitted a list of requirements to all known connector manufacturers in June, 1955. All of the connector manufacturers commented favorably on the re-

The prevailing philosophy prior to World War II was to design and build electronic systems from available components and then test them to determine their capabilities. Depending upon their performance, the systems were then applied to the installations for which they were suitable.

With the rapid advance in the state of the art during the past fifteen years, this former philosophy has, of necessity, yielded to that of designing and developing components to meet the requirements of future electronic systems.

The philosophy presented here is based on a paper presented by Ted. A. Thompson of Douglas Aircraft Co., Inc. at the 1957 National Conference on Aeronautical Electronics.

requirements and expressed a desire to develop a connector for the DC-8. Only one, however, was willing and in a position to undertake the development and tooling program on their own capital.

Coordinating closely with Douglas engineering, this one company completed the development of an acceptable prototype connector in August, 1955. By October of the same year they were tooled on a basic insert arrangement and by November were prepared to submit specimens for test.

Seeing the progress which had been made and being impressed by the Douglas emphasis on dual sources a second company submitted hand made prototype connectors for Douglas evaluation in November, 1955. Many detailed comments on their design were submitted by Douglas, but connectors modified accordingly have not yet been presented.

A third company, working completely independent of Douglas engineering, showed a prototype miniature connector in December, 1955, but stated that much development work remained and did not leave the sample for comment. Samples for the evaluation were not received until April, 1956. Detailed comments were immediately submitted by Douglas and connectors ordered for test. The connectors for test were not received, however, until September, 1956, and then still with reservations.

Tests

When prototype components, which have been designed to meet the performance requirements of the advanced electronic system, are received, testing is necessary to evaluate their operational capabilities and to determine their reliability under various environmental conditions. Tests are usually selected to simulate the worst conditions under which the component is expected to function in service. Tests may also be performed to discover how the component will operate under unrealistically severe circumstances in order to reveal its application limitations.

When test results establish the suitability of a given component for the advanced electronic system, its application to other future or presently existing systems should be considered. Since it was designed to meet future performance requirements, it may contribute favorably to the reliability of other systems.



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CIRCLE 52 ON READER-SERVICE CARD

Synchronization of a Computer

Gerald Smoliar
Manager

Magnetic Computers Dept.
Remington Rand Univac
Division of Sperry Rand Corp.
Philadelphia, Pa.

Jacob Keilsohn
Senior Engineer

IN ELECTRONIC computing systems, the central computer operates at high speed. The pulses in the central computer circulate essentially at uniform speed. In contrast, the speeds of auxiliary units such as input and output devices are slower and irregular. Their pulses occur at random in respect to the central computer speed.

The slower, irregular speeds of auxiliary units must be synchronized with the higher, uniform speed of the central computer. This especially is important in the case of input devices which transmit the information to the central computer where the problem will be solved.

A shift register is used for synchronization. A register holds information, in the form of numbers, before it is fed into the central computer. A shift register can hold information or keep it moving so the information is released to the central computer at the right time.

This paper describes how a new type of shift register was used to solve the synchronization problem in the Cambridge Computer, built by Remington Rand Univac for the Air Force Cambridge Research Center, Cambridge, Mass. The new register used Ferractor[®] magnetic amplifiers developed by Remington Rand Univac. The Cambridge Computer was the first to use the

Ferractor amplifier and its related circuitry.

The Cambridge Computer

Because all normal amplifying functions in the Cambridge Computer are performed with Ferractor cores, the computer is considered a magnetic device. Germanium diodes are used for the logical operations of gating[°] and buffing[†]. Magnetic amplifiers perform the functions of pulse shaping and delay. Separate components aren't needed for these functions.

The Cambridge Computer is relatively restricted in input-output function, because it lacks the array of auxiliary equipment found in more diversified computing systems. Despite its specialization, the Cambridge Computer still has many external communication paths.

There are data links for real-time operation, an in-and-out paper-tape punch and reader, and a modified typewriter for input and output. Consideration of the typewriter only will involve all fundamental principles of the operation of the synchronizer.

Data is transferred from the typewriter

[°] A gate is a device whose output is energized when all inputs are energized.

[†] A buffer is a device whose output is energized when one or more inputs are energized.



Fig. 1. Ferractor magnetic cores shown in the packaging stage. Note small size of the cores.

through a shift register. The 10 characters of a computer word (sign digit and space between words not counted) are assembled in the register.

The digits coming from the typewriter occur at random in relation to the central computer speed. The order in which the digits are typed is reversed in the computer. The operator types the most significant digit first while the word is carried in the computer with the least significant digit first.

For example, in the number 357, the operator types the most significant digit 3 first. The computer carries the least significant digit 7 first. This is done so the result of a carry may be recorded after the carry. In this respect, the computer functions like a person adding numbers. When adding digits, a person begins at the right (the least significant) and works to the left (toward the most significant).

During computing, the sign of a word is stored separately. Even though the sign is part of the word-pulse sequence within the computer memory, it presents no special synchronizing problem.

The Magnetic Amplifier

The Ferractor amplifier consists of two windings on a toroid of square hysteresis loop magnetic material. The core is made from a metal

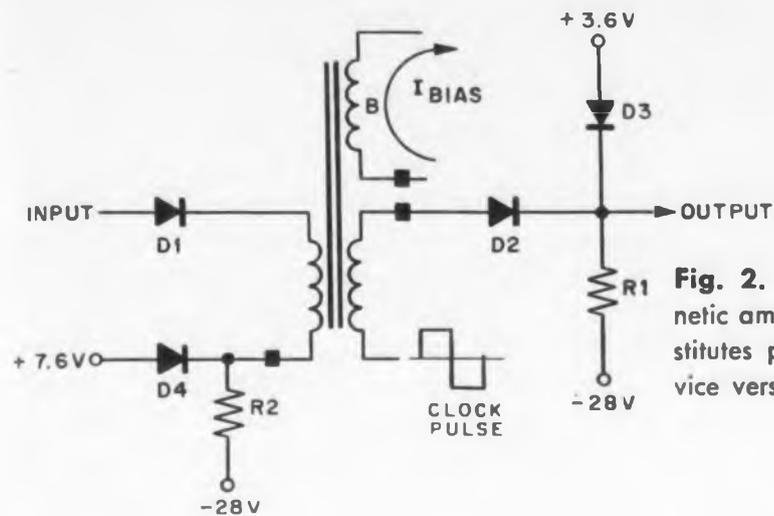
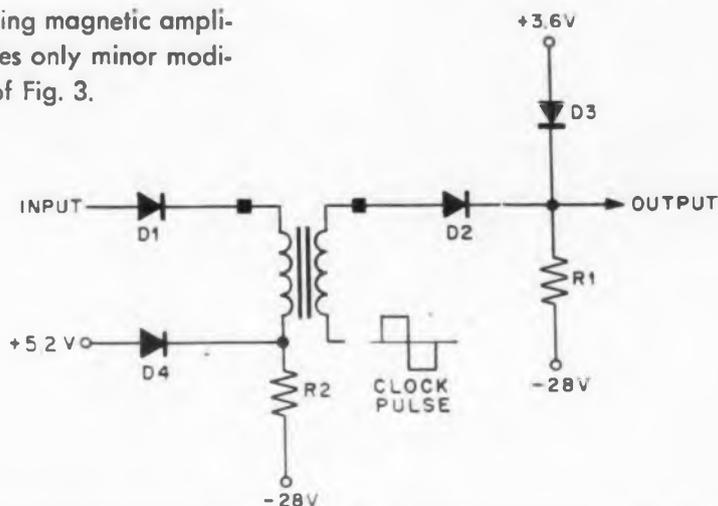


Fig. 2. A complementing magnetic amplifier. The amplifier substitutes pulses for no pulses and vice versa.

Fig. 3. A non-complementing magnetic amplifier. This amplifier embodies only minor modifications of the amplifier of Fig. 2.



bobbin which is first wound with a metallic tape and then wound with wire. The finished amplifier is about one-tenth of an inch in diameter (See Fig. 1). The Ferractor cores have proven more reliable, require less power, last longer and are smaller than vacuum tubes.

A pulse applied to the amplifier input will bring the core from the normal flux state of $+B_r$ to $-B_r$ on the opposite point of the hysteresis loop. The core then presents a high impedance to a clock pulse which will return the core to $+B_r$ without producing appreciable output. If there is no input pulse, the core stays at $+B_r$ for the entire input period. The clock pulse then encounters a low impedance and produces an output pulse.

The device shown in Fig. 2 is an amplifier since the power required to change the polarity of the core is much less than the power which can be sent through the output winding. The core also reshapes and delays the pulses.

With minor modifications, this circuit is the one most frequently used in the Cambridge Computer. The circuit complements the information. It substitutes pulses for no pulses and vice versa.

The circuit is modified to make a true amplifier by adding a bias winding carrying direct current and phased opposite to the input winding, as

shown in Fig. 3. In this type of amplifier, an input pulse brings the core from $-B_r$ to $+B_r$, so the clock pulse finds it in the low impedance state. The input pulse thus produces an output. When there is no input pulse, the bias current returns the core to $-B_r$. The succeeding clock pulse produces no output. This is a non-complementing amplifier type.

Recirculating registers may be made by cascading strings of these amplifiers and connecting the output of the string back to the input. However, a true shift register is preferred for the assembly and transfer of asynchronous information. This register is a component which can hold the information in essentially static form or circulate it, either at computer rate or one pulse at a time.

The shift register is more versatile than a static register which holds numbers until they are ready to be used, or a dynamic register where the numbers are circulated constantly.

Shift Register

The shift register is based on the non-complementing amplifier. It has two input circuit differences and one difference in operating timing. Fig. 4 shows the shift register circuitry.

The shift register operates with the same timing as the rest of the computer. But the action

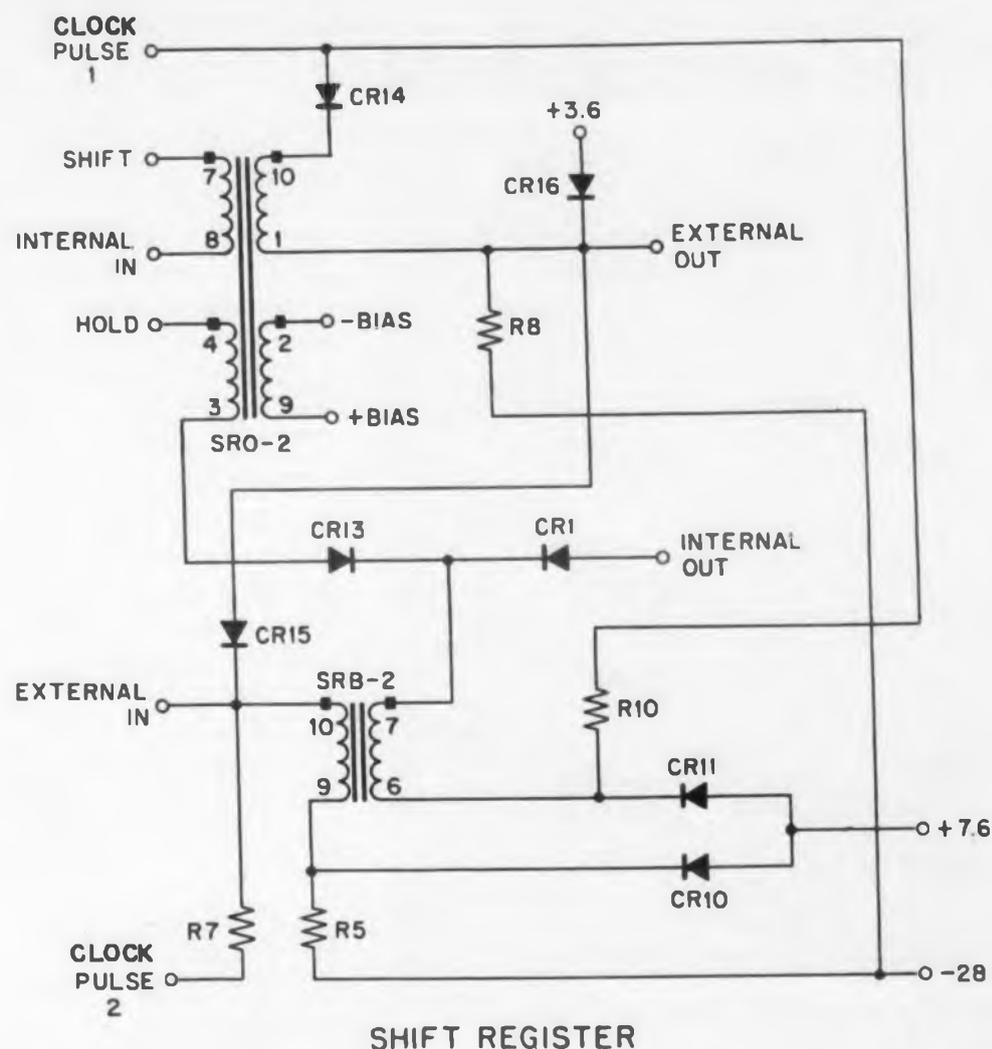


Fig. 4. A typical shift register. There is an additional input winding for each amplifier. In addition, there is a second core with two windings for each bit of information.

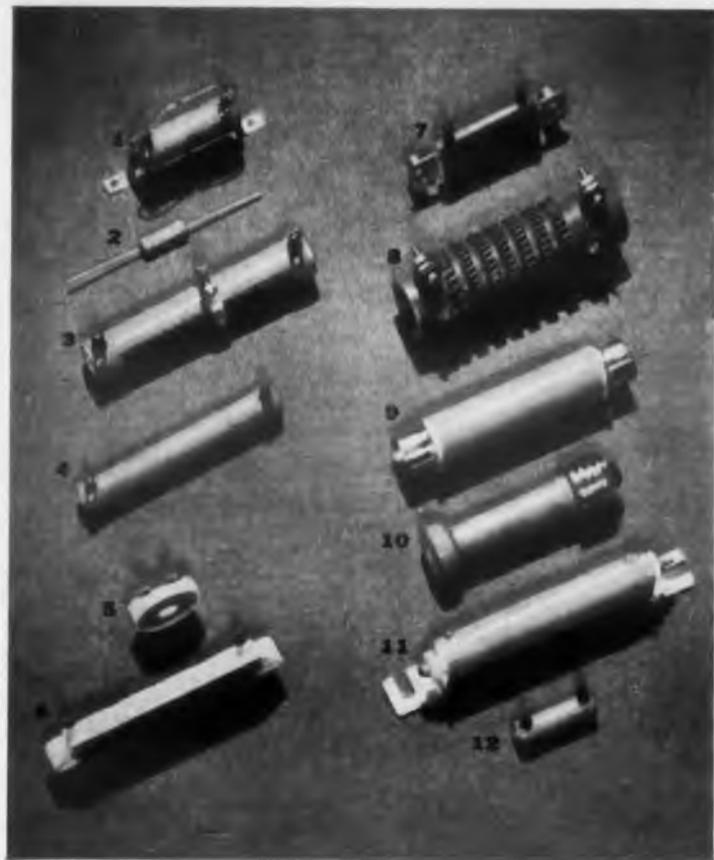
is in three steps instead of two. These steps are: 1—input to the lower core, 2—interrogate the lower core, setting or not setting the upper core, and 3—clock pulse to the upper core.

Information enters the shift register through the lower Ferractor core which is called the blocking core. A pulse applied at the external input makes the blocking core a low impedance. One half cycle later an interrogating pulse in the hold winding tries to send current through both cores. If the blocking core has been brought to low impedance, the hold pulse brings the amplifying or output core to $+B_r$. On the third half cycle, the clock pulse produces an output.

When the shift register is used for static information storage, a series of hold pulses causes the information to circulate back and forth between the output and blocking cores. The output of the upper core is connected through a diode to the input of the lower core in Fig. 4. If no shift or hold pulses are applied for one cycle, the register is cleared. This results since the bias resets the output core and the negative excursion of the second clock pulse resets the blocking core.

Shifting is done by reading into an output core from the preceding blocking core, rather than from the one shown directly below the output core in Fig. 4. In this way, a series of shift pulses

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will move the information through the register at computer rate.

Intercommunication of shift register stages is accomplished by joining the *INT OUT* to the *INT IN* terminal of the stage immediately to the right. In these circumstances, information would move from left to right.

Either direction could have been chosen. If both were needed, one more winding on each output core and one more diode at the *CRI3-CRI* junction would suffice. In operation, both left and right shifts are needed. Since plenty of time is available for these operations the left shift is done by moving the information 10 places to the right in the 11-bit loop.

Information can enter the computer in parallel through all external input terminals, or serially, through any terminal with a series of shifts. It can be read out in either form as well.

The operator register, one of the shift registers, is used for most input-output operations. It consists of four loops of 11 bits each, with each loop containing one of the four bits of a character.

All entries in the register are made at the most significant digit position. Information from input devices is presented to the computer in the form

of five bits (the fifth being a parity bit for checking purposes) and a sprocket.

The sprocket must be shaped to a computer-sized pulse and properly timed, because it appears at an arbitrary time and must trigger logical operations in the computer. The sprocket pulse is shaped through an R-C network. It is longer than three computer pulse times, but shorter than two word times or 24 computer pulse times.

This pulse then sets flip-flop A, Fig. 5, and shapes the sprocket to computer pulse-size. To time the pulse is the function of flip-flop B, Fig. 5. At the proper time, the state of flip-flop A is sampled. The flip-flop may be set, partly set, or reset. The result of this sampling is placed in flip-flop B.

If flip-flop A is fully set, flip-flop B will be fully set. If flip-flop A is being set, a partial set will be passed to flip-flop B. The possibility of a partial set in flip-flop A makes flip-flop B necessary. The partial set is allowed to recirculate in flip-flop B for time enough to cause the partial set to either disappear or build up to full size. The result then is sampled. Either a full-sized sprocket or no pulse is obtained.

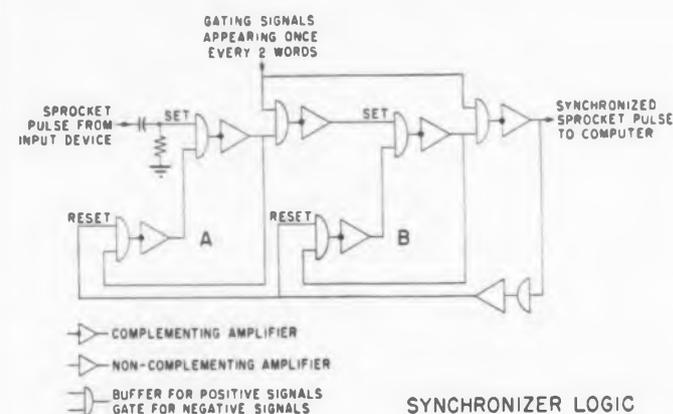


Fig. 5. Synchronizer logic. Two flip-flops (A and B) are used in a set, partial set, or reset condition.

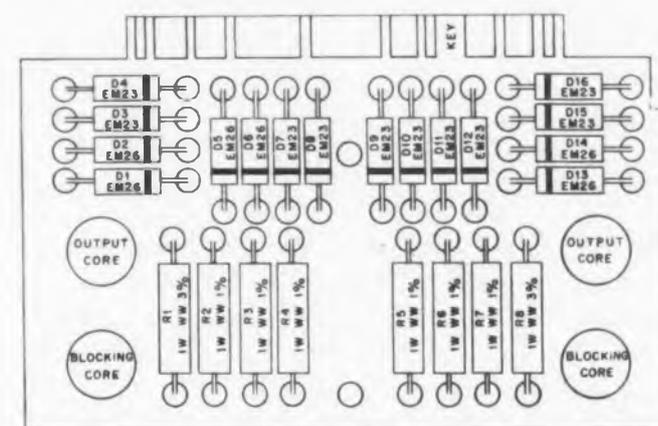


Fig. 6. A shift register package on a single card.



If no pulse is received, a second sampling of flip-flop A is made. This always results in a full set of flip-flop B, and a full-sized sprocket at the end of the waiting time. Generation of the sprocket clears flip-flop A and B, allows the four information bits of the input data to be placed in the most significant digit position of the shift register, and starts the register shifting to the right 10 places. Since the register is 11 digits long, the information now is in the least significant digit position. This arrangement ensures that the computer will operate on the least significant digit first. The computer now is ready to accept another input character.

This operation can be stopped either by a special fill character or by a counter which keeps track of the number of characters in a word. The information, now in computer sequence, goes out of the register at computer rate by means of a full word of shift pulses. The transfer operation is complete.

Construction

Like most of the computer components, the shift registers are made of standard printed-wiring cards. These cards are interconnected by using backboard wiring of the machine. Fig. 6 shows the shift register on a single card which holds four cores and associated circuitry—two bits of shift register storage. The card circuits as they appear in the computer are shown in the photo on the facing page.

Testing

The shift register's versatility makes testing it in the computer a simple operation. In normal sequence of testing, typewriter operation is checked out and then used to generate the characters to fill the shift register. Operation of the register is observed when it is holding information in static form and when it is shifting continuously. A check is made to determine that the characters are correct and that they can be cleared out by dropping the hold and shift lines.

Conclusions

Maintenance experience on these components has been very satisfactory to date. The Ferractor cores perform normal amplifying functions, prove more reliable, require less power, last longer and are smaller than vacuum tubes. This usage provides another example of the excellent reliability of magnetic amplifiers using Ferractor cores.

The new shift register, using Ferractor amplifiers, is able to effectively synchronize the relatively high speed of the central computer with the input-output devices.

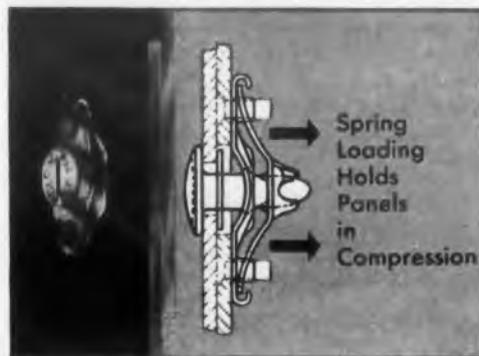
The work reported here was sponsored by the Air Force Cambridge Research Center under contract AF30(62)-1055.

Quick-Opening Fasteners

Selecting Small Fastenings for Metal Closures

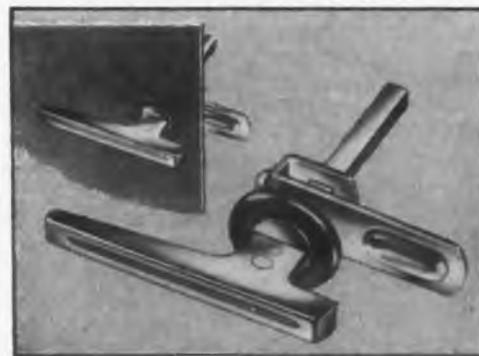
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(John D. Folley, Jr. & James W. Altman, Research Scientists, American Institute for Research)



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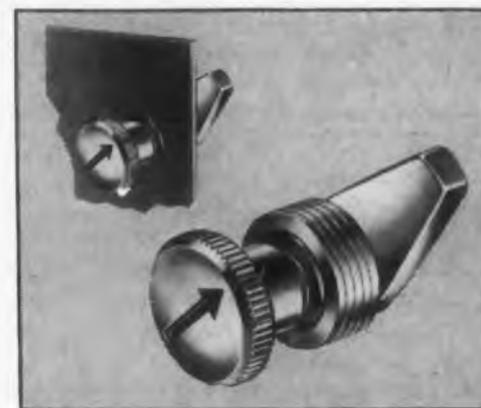
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Small doors and panels can be fastened with greatest speed and lowest cost with the Southco Adjustable Latch.

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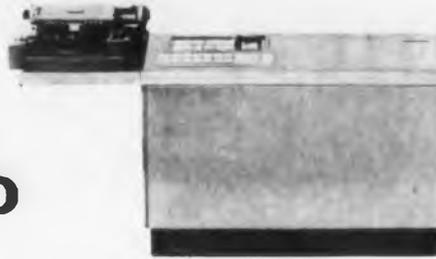
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* Quotation from "Designing Electronic Equipment for Maintainability"; Machine Design, July 12, 1956.

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Size	17 sq. ft.	6.5 sq. ft. plus table for typewriter.	45 sq. ft.	9.2 sq. ft. plus table for typewriter & control unit.	11 sq. ft.	COMPACT, DESK-SIZED, COMPLETELY MOBILE
Input-Output	Keyboard only — tape at extra cost.	Independent tape preparation at extra cost.	Extra cost peripheral equipment required.	Tape and typewriter for numerical input-output only. Independent tape preparation at extra cost.	Tape typewriter for alpha-numeric input-output standard equipment.	DELIVERED COMPLETE. NO ADDITIONAL EQUIPMENT NEEDED TO PREPARE DATA, PROGRAM OR REPORTS
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While shown with only one potentiometer element, the unit is also available with dual or multiple elements, with separate functional or linear outputs. A Bourdon Tube pressure unit is used for pressures in excess of 100 psi, so that the units have ranges from 0-5 psi to 0-5000 psi. Direct application to control functions is permitted by a maximum full-scale output of 60 v. The transducer has a life in excess of 500,000 cycles and will operate over a temperature range of -55 C to +85 C. Overall length is 3 in.

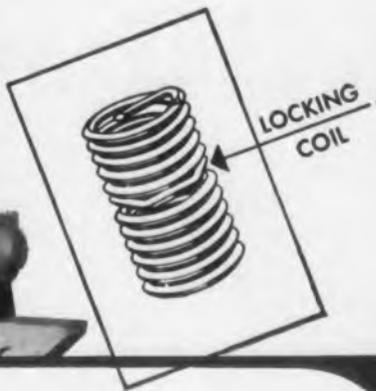
For more information about this product turn to Reader-Service Card and circle 57.

Pressure Transducer

uses carbon film element



Pressure transducer with cover removed. The pressure capsule (1) and resistance element (4) are both mounted on a common yoke (2). A precious metal wiper (3) welded to the free end of the capsule rides the surface of the resistance element, which is fastened to the yoke arms. Thermal expansion of parts has been kept down to 0.001 per cent per degree C. A guide rod (5) rides freely in a Teflon guide (6) and becomes effective only under severe shock and vibration. A stop bar (7) prevents overload damage.



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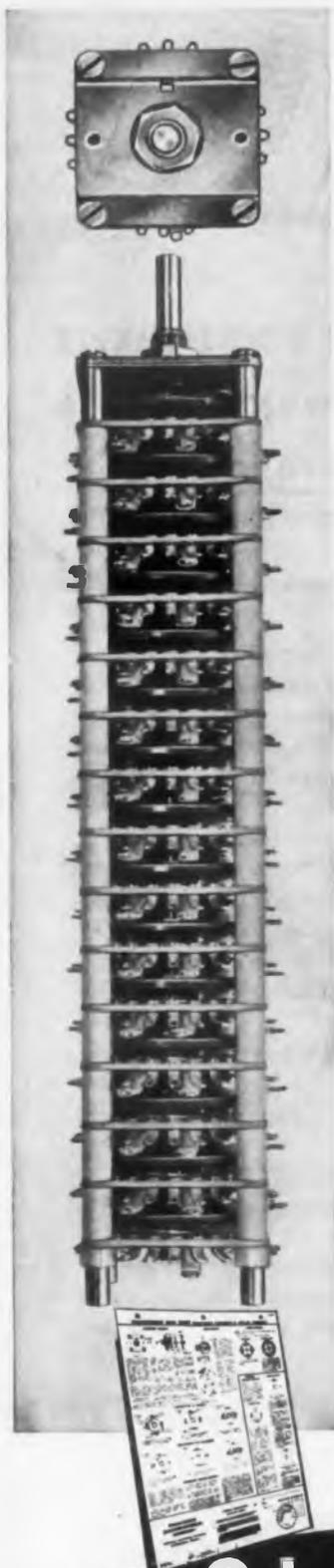
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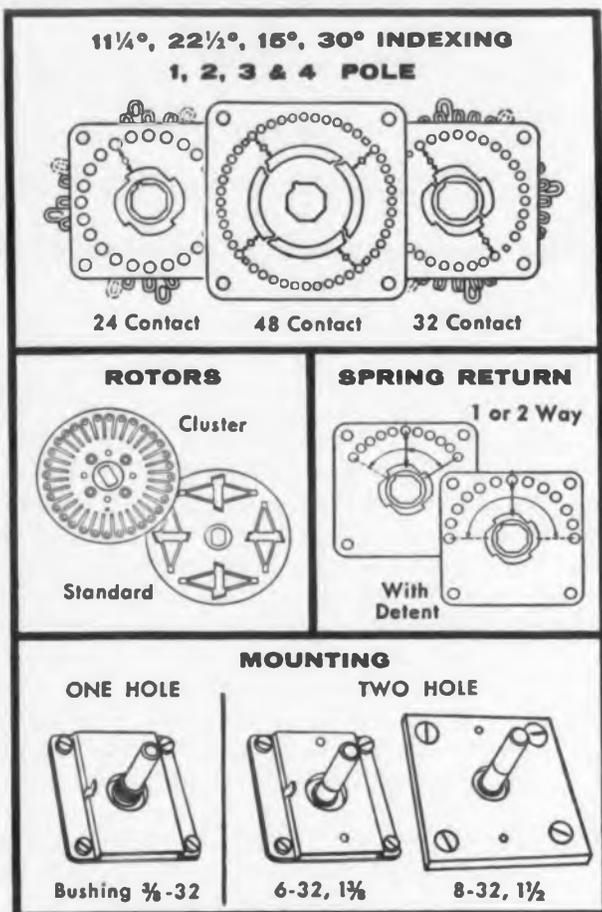
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Fig. 1 shows an elementary form of magnetic commutator. Each magnetic amplifier has a dc signal input winding, a carrier winding, and output terminals. The gates allow carrier current to flow into only one magnetic amplifier at a time, effectively interrupting the other circuits. The outputs are mixed in some suitable circuit. The gates are opened sequentially upon command from a ring counter.

Fig. 2 illustrates a common type of magnetic amplifier which might be used in such a commutation system. It is constructed from two toroidal cores. The carrier windings *C1* and *C2* and the bias windings *B1* and *B2* are applied to the two cores separately. The cores are stacked, and feedback and input windings applied. If there were no bias current, the first cycle of carrier current would saturate the cores, and thereafter windings *C1* and *C2* would offer little impedance to the carrier.

However, bias current flowing during the half cycle when the carrier current is blocked by the diodes will reset the magnetic flux to about point *P* on the *B-H* curve of Fig. 3. On the next conducting cycle, carrier current will flow for ap-

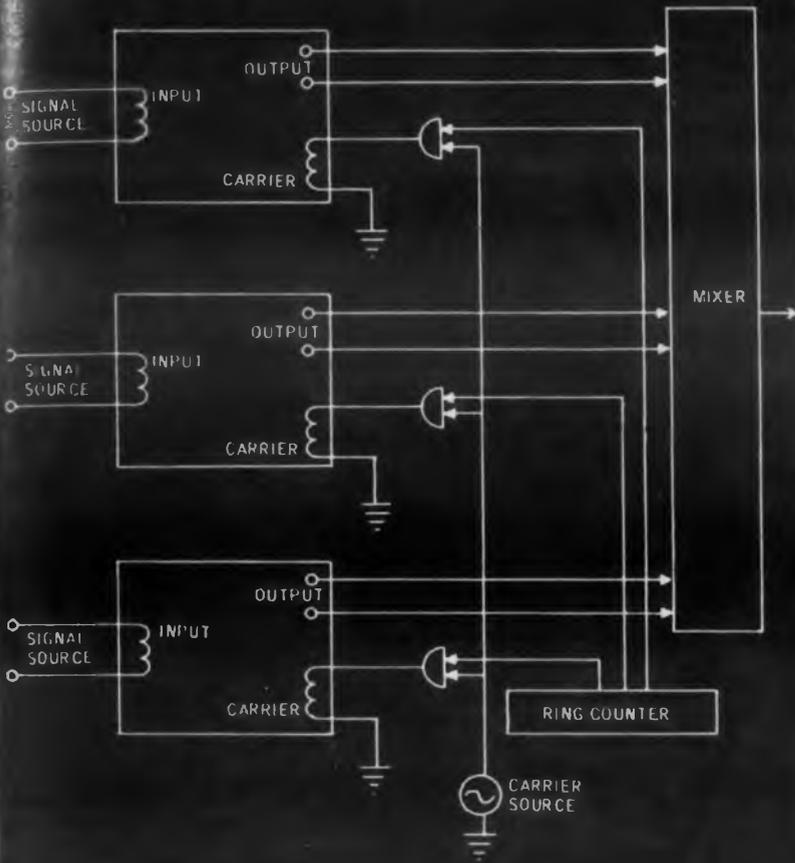


Fig. 1. An elementary form of magnetic commutator. Each amplifier has a signal input winding, a carrier winding and output terminals. Gates allow carrier current into only one magnetic amplifier at a time.

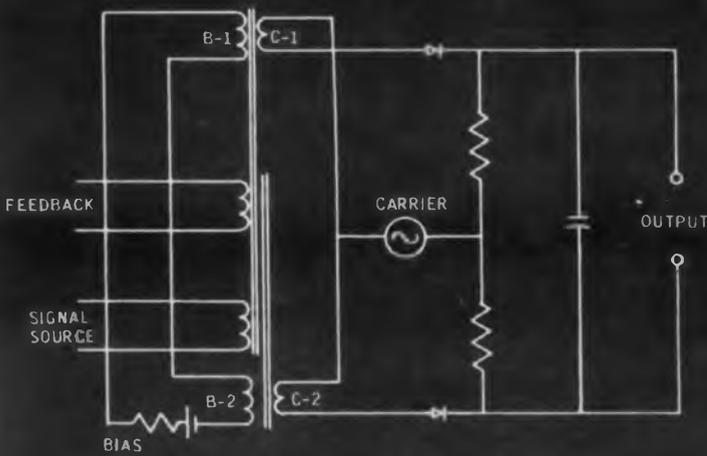


Fig. 2. An analog type magnetic amplifier which can be used in commutation systems. The signal winding and feedback windings act oppositely with respect to the carrier flux, making the average currents in the load resistors differ in accordance with the net dc input signal.

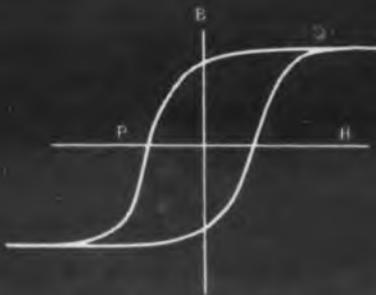


Fig. 3. When the carrier in Fig. 2 is blocked by the diodes, the bias resets the flux to about point P on the B-H curve.

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proximately 90 deg. The exact amount of current flow depends upon the total flux resetting the cores, including the flux due to signal source and feedback windings. The two latter windings act oppositely on the two cores with respect to the carrier flux. Hence, the average currents flowing through the two load resistors will differ in accordance with the net dc input signal to the magnetic amplifier. A capacitor across the output terminals smooths the output voltage. This magnetic amplifier can be commutated by simply interrupting the carrier.

A more accurate system, in which the output tends to be independent of the linearity of the amplifiers, is illustrated in Fig. 4. Here, the magnetic amplifiers function simply as null detectors. In the case of an analog system, the converter might be eliminated. The output is available as the feedback current, or as the voltage drop across a resistor in series with the feedback loop.

The null detecting amplifier must provide a "yes" or "no" answer to the question of whether

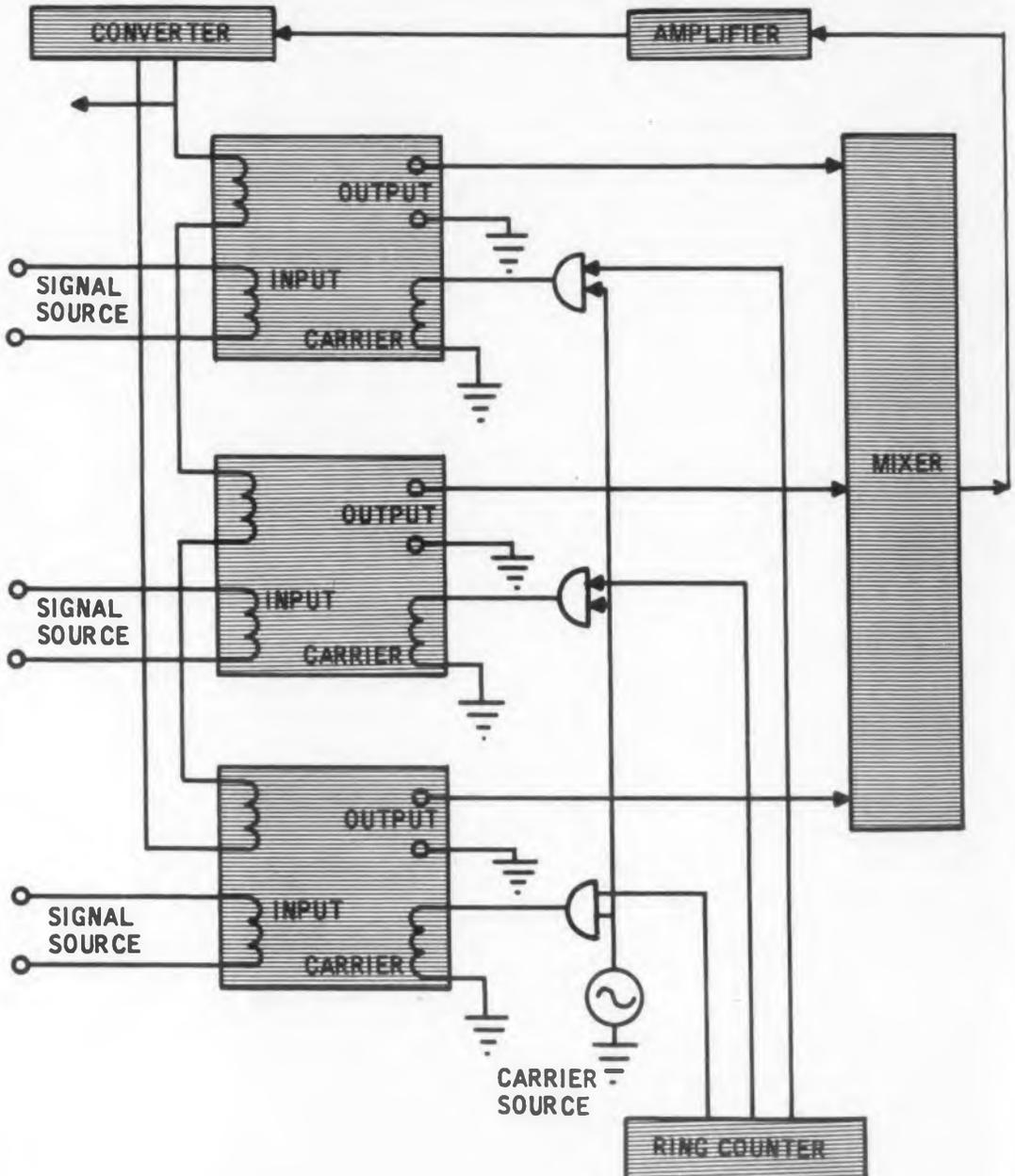


Fig. 4. A more accurate commutation system than that of Fig. 1. Here the magnetic amplifiers function as null detectors.

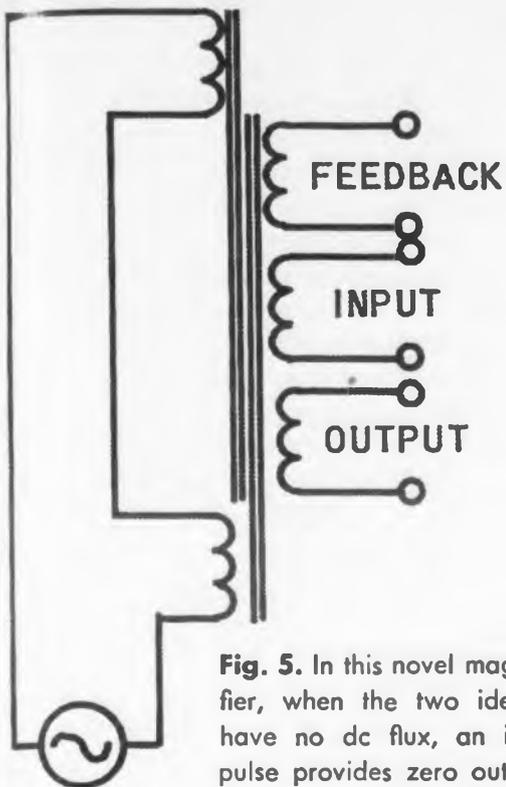


Fig. 5. In this novel magnetic amplifier, when the two identical cores have no dc flux, an interrogation pulse provides zero output. Any dc flux due to input and feedback windings causes an unbalance which provides an output pulse with a polarity dependent on the relative magnitudes of the input and feedback flux.

the feedback current is too great. It may hence be operated as a digital device, considering each cycle of the carrier current to be an interrogation pulse. The corresponding output pulse will be positive or negative depending on the magnitude of the feedback current.

The converter becomes a digital-analog device whose output constitutes the feedback current. The converter register is set up iteratively, by first trying 1/2, then 1/4, 1/8, and so on. After each trial, the appropriate flip flop is reset or not as determined by the polarity of output pulse. After ten cycles, the feedback current would be within 0.1 per cent of the correct value, and the shift register would move on to the next channel. The digital output is available serially at the converter input, or in parallel from the converter register.

A novel magnetic amplifier, particularly suited to digital operation is shown in Fig. 5. If the two cores are identical and have no dc flux, then an interrogation pulse should provide zero output. Any dc flux due to input and feedback windings will cause an unbalance and an output pulse will be produced whose sign depends upon the relative magnitudes of the input and feedback fluxes.

From a paper presented at the Western Electronic Show and Convention, San Francisco, Calif., August 1957.

A major resistor development for major commercial and military equipment producers

STACKPOLE

Coldite 70⁺

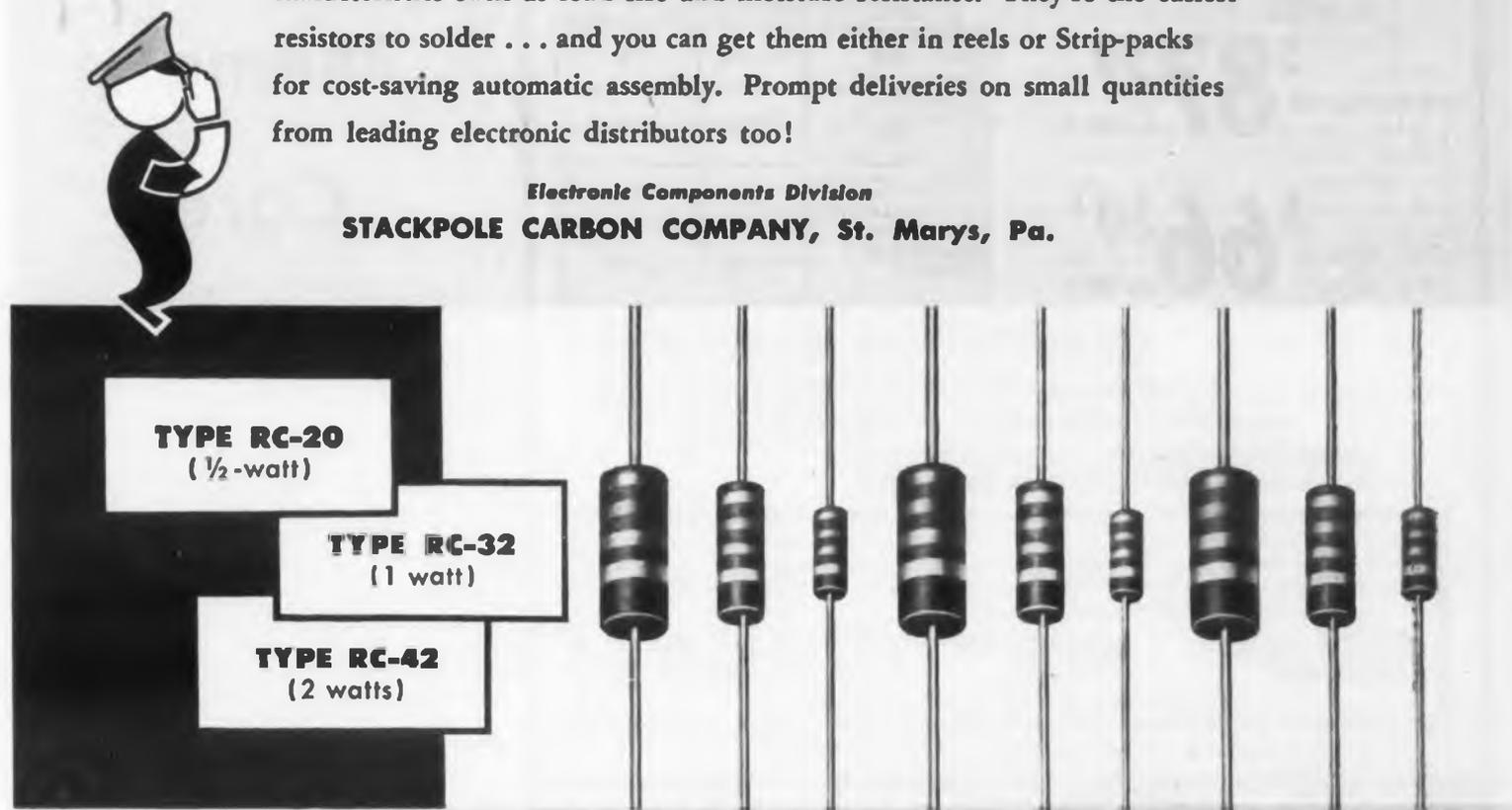
FIXED COMPOSITION

RESISTORS

Stackpole Coldite 70+ Resistors substantially exceed MIL-R-11B and other critical requirements . . . *at regular resistor prices.* Exclusive Stackpole cold-mold processing assures truly outstanding performance in essential characteristics such as load life and moisture resistance. They're the easiest resistors to solder . . . and you can get them either in reels or Strip-packs for cost-saving automatic assembly. Prompt deliveries on small quantities from leading electronic distributors too!

Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pa.



. . . In all standard values and tolerances

CIRCLE 62 ON READER-SERVICE CARD

BUYERS are delighted ... DESIGNERS are inspired ... TUFF-TUBE

Fiberglass-Epoxy Laminated Tubing



Picture of an economy-minded P.A. in his moment of glory! Just placed a production order for Lamtex TUFF-TUBE and is counting the money he's saved. He used to buy NEMA grade G5 glass-melamine tubing—then he heard about TUFF-TUBE's new low price that's the talk of the industry.



Picture of a real smart designer who has just checked the specs on Lamtex TUFF-TUBE. He used to think that NEMA grade G5 glass-melamine tubing was good enough. Now he's convinced that TUFF-TUBE is more than just "good enough"—it's ideal. Below are a few reasons why.

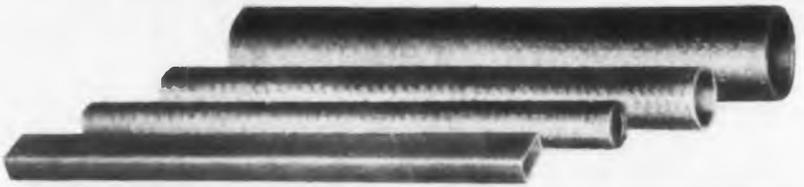
PURCHASE PRICE COMPARISON (3/16 ID x 1/32 Wall)

Glass-melamine G5 **\$87⁵⁰** per 100 ft.

TUFF-TUBE **\$66³⁰** per 100 ft.

SPECIFICATIONS COMPARISON

	Lamtex TUFF-TUBE	Typical Glass-Melamine
INSULATION RESISTANCE megohms	100,000	75
DIELECTRIC STRENGTH volts per mil, short time	500	225
WATER ABSORPTION %, 24 hr. immersion	.20	3.9
AXIAL COMPRESSIVE STRENGTH psi	20,000	13,000



Electronic design engineers are using TUFF-TUBE for waveguides, coil forms, spacers, component jackets, antenna housings, brush holders, tuning coils, motor insulation, commutator and printed circuit forms, and many other applications that require any or all of these characteristics:

INSULATION RESISTANCE
DIELECTRIC STRENGTH
HUMIDITY-PROOF

HIGH TEMPERATURES
LIGHT WEIGHT
HIGH STRENGTH

THIN WALLS, FROM .008"
SMALL DIAMETERS, FROM .062"
DIMENSIONAL STABILITY

AVAILABLE IN ALMOST ANY CROSS-SECTION SHAPE

Write for complete info — design features, tech data, application notes.



LAMTEX

INDUSTRIES, INC.

51 STATE STREET • WESTBURY, NEW YORK

CIRCLE 63 ON READER-SERVICE CARD



Mechanical sorter in operation. Cores are fed into the tube at the top and delivered to the three cups in front—the acceptable cores in the right cup, the intermediate cores in center cup, and reject cores in the left cup.

Automatic Classifier Speeds Selection of Magnetic Memory Cores

AUTOMATIC checking of "squareness ratio" and switching time of magnetic memory cores can be performed with the instrument shown. Quality decisions are made by an electronic circuit which evaluates both the switching rate and total flux change produced by a switching current of controlled rise time and duration. Unique electronic circuitry is employed for producing the controlled switching pulse and evaluating the resultant voltage generated in a single-turn secondary winding. Mechanical selector gates are automatically energized in accordance with pre-set quality limits to segregate the cores into one of five grades. The instrument is manufactured by Rixon Electronics, Inc., 2414 Reddie Drive, Silver Springs, Md.

Operation

Core handling and sorting is automatically accomplished by a mechanical system with a single input chute and three to five output chutes. This unit automatically places the ungraded core in a sequential carrier, passes the core through the electronic evaluation system where a mechanical stop is positioned to represent classification, and carries the core to the output chute appropriate for its class. It handles approximately 1000 cores an hour.

Electronic Circuitry

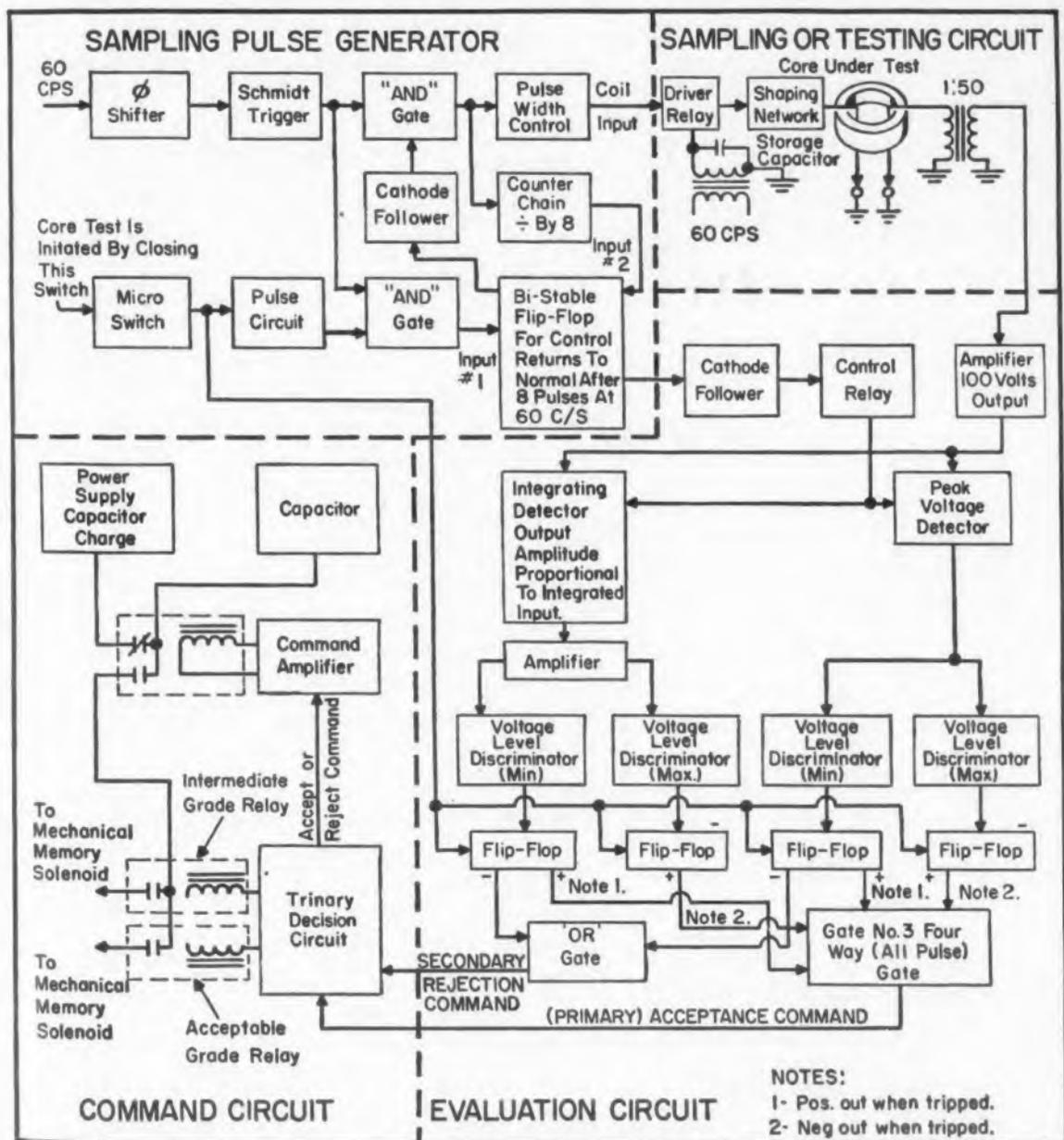
The electronic circuitry has four major divisions—sampling pulse generator, core sampling circuit, evaluation circuit, and command circuits. Evaluation of the core consists of measuring the

peak voltage and total energy induced in a circuit linked by the resultant core flux. The sampling circuit is designed to balance out any voltage induced directly by the driving circuit and develop voltages proportional only to the rate of change of flux in the core under test.

Eight successive and identical driving pulses are applied to the core under test by means of the Sampling Pulse Generator. Evaluation as performed by the Evaluation Circuit, is based on two measurements—the peak amplitude of the voltage pulse to determine the maximum rate of change to flux, and the time-voltage integral to determine the total flux change.

The Command Circuit accepts the quality information from the evaluation circuit and delivers current pulses to the appropriate relay within the mechanical unit to deliver the core to the proper output chute.

For additional information on this product, turn to the Reader-Service Card and circle 64.



How the various circuits are inter-related in the Automatic Memory Core Classifier.

GIANNINI AC OUTPUT ACCELEROMETER

*Wide Dynamic Range
Extremely Low Threshold
Low Null*



ACCURATE, CONSISTENTLY RELIABLE AC output, proportional to linear acceleration, is provided by this new Giannini accelerometer. Available in ranges from ± 1 g to ± 20 g, the instrument has a full scale output of 6 volts which may be fed directly into a relatively low impedance with little or no phase shift.

NULL VOLTAGE IS 0.015 VOLTS, of which at least 90% is harmonic, assuring a wide dynamic range for the instrument. With a basic threshold sensitivity as low as 0.0001 g/g, input accelerations on the order of 0.0017 g's will provide a 10 millivolt change in output.

NO COULOMB FRICTION IS EXHIBITED in this design, bearings are eliminated by suspending the mass between

two disc springs. Acceleration inputs move the magnetically damped mass, causing a proportionate change in the output voltage of a differential transformer. Cross-talk effect is minimum (0.003 g/g at 10 g cross acceleration on a 1g instrument); repeatability and hysteresis are below thresholds of measuring equipment.

IDEAL SECOND ORDER SYSTEM RESPONSE is achieved in the Model 24614 by magnetic eddy-current damping. The hermetically sealed instrument is oil-filled for stability of output under vibration. Specially designed and constructed for use in critical airborne control, stabilization, and flight test applications, the instrument is readily adapted to telemetering.

Giannini measures & controls:

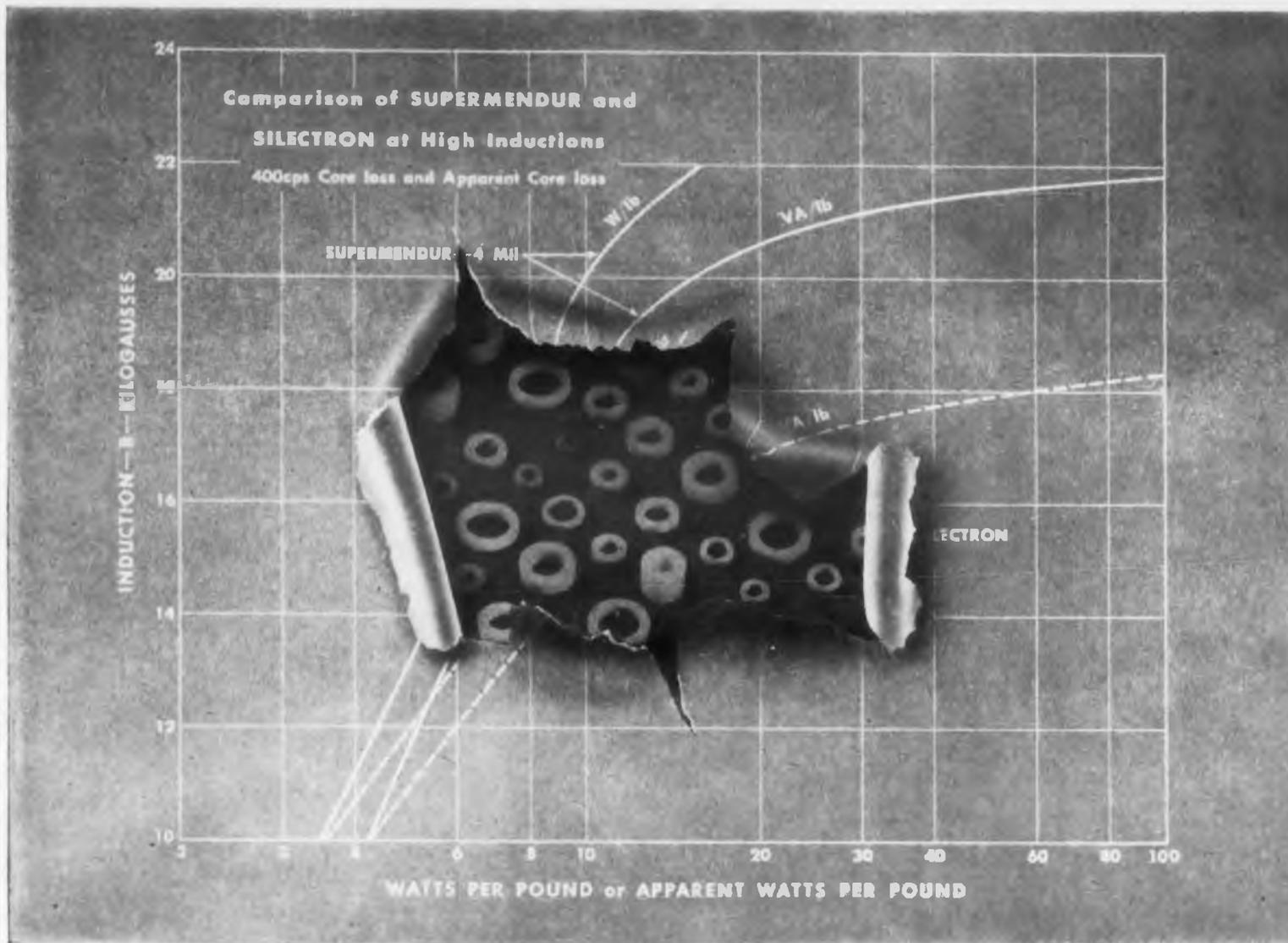
ω	β	θ	ψ	τ	v	ϕ
δ	Ω	u	b	P	ΔP	T
T_s	P_s	Q_c	M	T_o	P_r	TAS

PRECISION
INSTRUMENTS
AND CONTROLS

Giannini

G. M. GIANNINI & CO., INC., 918 EAST GREEN STREET, PASADENA, CALIF.

CIRCLE 65 ON READER-SERVICE CARD



SUPERMENDUR TAPE WOUND CORES ... A Real Breakthrough in Miniaturization

The successful development of tape wound cores of Supermendur represents a giant step in the field of circuit miniaturization and simplification. The unique characteristics of this new rectangular-loop core material in the range of induction from 16 to 22 kilogausses permit significant weight and size reduction of toroidal transformers and magnetic amplifiers.

Supermendur, an oriented cobalt-iron-vanadium alloy, combines the high saturation flux density of the cobalt-iron alloys with the desired hysteresis loop rectangularity of the oriented 50% nickel-irons.

Coercive forces substantially lower than those of previously available cobalt-iron alloys are obtained. The lower core losses and excitation properties of Supermendur show a decided improvement in high density characteristics compared with oriented silicon steel, as illustrated by the curves

partially shown above. *Complete curves are available in a new Supermendur Bulletin TC-113, available on request.*

Specific advantages of Supermendur cores in toroidal transformers are: high operating induction, low core loss, low exciting current and high permeability at high induction. In magnetic amplifiers or saturable reactors, they include: rectangular hysteresis loop, high saturation induction and moderate excitation at high induction. Advantages in all uses are: thin tape, small size and low weight.

Supermendur is an ideal material for high temperature core components, because of its high Curie temperature.

• Supermendur is manufactured by Arnold under license arrangement with the Western Electric Company. We'll be glad to send you additional information or furnish you engineering assistance on any of your tape core applications if you'll just drop us a line.

WSW 7026

Visit us at the
IRE SHOW
NEW YORK
March 24 through 27
BOOTH 2201-2205

THE ARNOLD ENGINEERING COMPANY



Main Office & Plant: Marengo, Illinois
Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:
Boston: 49 Waltham St., Lexington Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

CIRCLE 66 ON READER-SERVICE CARD



Shield Insert Keeps Tubes Cool

FULL CONTACT between tube and shield, and therefore better heat dissipation, is made possible by the triangular configuration of this insert. The insert is made of black cadmium-plated beryllium copper, measuring 0.0015 in. thick. Besides providing heat-dissipating qualities, the insert's succession of oppositely oriented triangles acts as a cushion for tubes under environmental stress.

The Full-Contact inserts, made by Atlas E-E Corp. of Woburn, Mass. represents the end result of a train of thought originating at the Navy Electronics Laboratory. In October, 1956 the NEL issued a supplement to their Reliability Design handbook describing a corrugated insert which had been designed at the laboratory for use in TS Shields. This liner, although of a square-wave configuration contacting only about one-half of the tube surface, served to reduce bulb temperatures by 50 C or more. Reports were received of spectacular results in prolonging tube life through its use. The present insert, by increasing the contact area to between 95 and 98 per cent, provides even better results.

The insert however lowers only one of the three thermal barriers existing in a tube and shield assembly. The remaining two barriers exist between shield and shield base, and between shield base and chassis. Work had also been done in these areas by the Navy, and re-

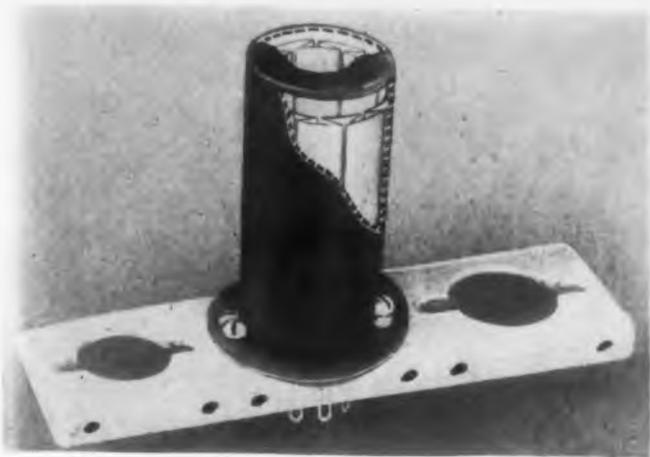


Fig. 1. The one piece shield assembly, showing the Full-Contact insert in place. The surfaces of the insert plus the one-piece construction of the shield lower the usual barriers to heat conduction.

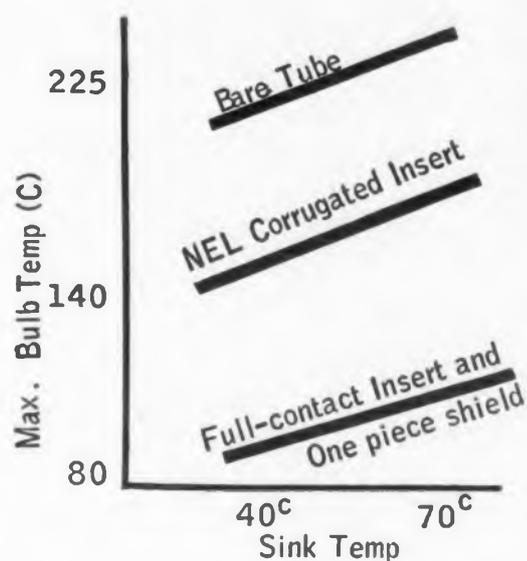


Fig. 2. Bottom curve approximates the cooling performance of the insert in a one-piece shield, using a type 5687 tube.

Recently Atlas E-E Corp. has developed the one-piece assembly as shown in Fig. 1. The comparative performance of the different types of assemblies is shown in the graph, Fig. 2. As compared to a bare tube (type 5687), the NEL corrugated insert provides a substantial improvement. The one-piece shield and base assembly, along with the Full-Contact insert, afford even cooler operation, in fact in many cases it is below the curve as shown.

The Full-Contact inserts are available in widths to 1-1/2 in. either in strips or cut to fit a particular shield. The one-piece shield assembly is furnished with double-head screws which, when installed in place of the usual tube base screws, allow the unit to be twist-locked in place.

For more information on the insert and one-piece shield, turn to the Reader-Service Card and circle 69, or stop by at Booth 4235 at the IRE Show.



Airtron's advanced engineering departments offer tomorrow's microwave designs... today!



New Transmitter-Receiver Unit of the Bendix Radio RDR-1D Airborne Weather Radar System. Airtron's new Mixer-Ferrite Duplexer substantially aided Bendix Radio in designing and realizing a . . .

- 50% size reduction
- 48% input power reduction
- 40% weight reduction
- while maintaining equal performance.

Ferrite Licensee of Hughes Aircraft

Airtron, Inc., with one of the most advanced engineering departments and manufacturing facilities in the microwave field, has recently designed, under developmental contract, a new high-performance mixer-ferrite duplexer for the new transmitter-receiver unit of the Bendix Radio RDR-1D Airborne Weather Radar System.

The difficult assignment of designing and developing this assembly similar in design to the previous one developed by Airtron was undertaken at the extensive engineering facilities of Airtron, Inc., in Linden, New Jersey. The highly skilled engineering staffs of all of Airtron's divisions functioned as a team in developing this new ferrite rotational duplexer and low noise figure mixer assembly. Through the combined efforts of its advanced engineering teams, working closely with the skilled technical staffs of its manufacturing facilities both here and in Cambridge, Mass., a new mixer-ferrite duplexer was designed, developed and perfected which gave improved performance with a considerable reduction in size and weight that met the stringent requirements set forth.

Production follows development and Airtron's extensive manufacturing facilities are fully equipped with the latest in production facilities, from compounding special ferrite materials to precision casting and dip-brazing final assemblies to meet and satisfy the needs of industry. It was Airtron, Inc. who pioneered in the development of one transmission line to carry both "C" and "X" band frequencies . . . the double-ridged waveguide, ARA-136 and produced it in production quantities.

This is just one example of the confidence industry has placed in the creative ability of Airtron's exceptional engineering staff. Couple this with one of the most extensive manufacturing facilities in the microwave field and you know why Bendix Radio and other leading manufacturers and users of weather radar systems and microwave components come to Airtron, Inc., for prototype design — specify Airtron components for their microwave requirements . . . and Look To Airtron Today For Their Microwave Designs Of Tomorrow.

SEE US AT BOOTH #3318 IRE SHOW

Airtron inc. 1107 WEST ELIZABETH AVE. LINDEN, N. J.
AIRTRON, CAMBRIDGE (FERRITE) DIVISION CAMBRIDGE, MASS.

MICROWAVE AND ELECTRONIC ENGINEERS — OUTSTANDING OPPORTUNITIES WITH AIRTRON, INC.

CIRCLE 70 ON READER-SERVICE CARD

Do It Yourself

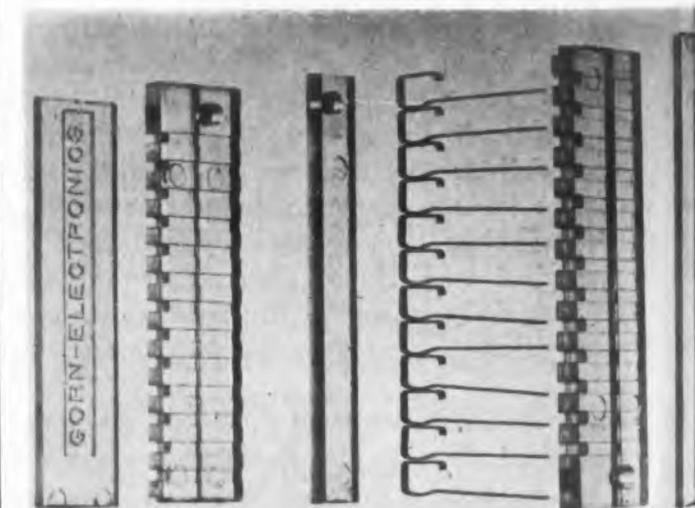
Printed Circuit Assemblies

PRINTED circuit board assemblies can now be put together quickly with off-the-shelf stock parts. The parts include a channel framework, strips of appropriately cut plastic for the bodies of receptacles, contacts, and printed circuit board guide rails.

Gorn Electric Co., Inc., of Stamford, Conn., conceived the idea of these structural parts and connectors to eliminate the delays in ordering special connectors and hardware.

The receptacles, made of nylon, polystyrene, or diallyl phthalate are quickly and easily assembled. The contacts are slipped into notches on the edge of plastic strips, and their crimped ends are held in grooves by outside strips of plastic. The strips are available in long lengths which may be cut to size.

The receptacle assembly can be held together with screws and nuts, as shown in the photograph, or they can be cemented together with



ELECTRONIC DESIGN • March 5, 1958



Wherever you require high power, consider

DELCO HIGH POWER TRANSISTORS

Thousands of Delco high power germanium transistors are produced daily as engineers find new applications for them. In switching, regulation, or power supplies—in almost any circuit that requires high power—Delco transistors are adding new meaning to compactness, long life and reliability.

All Delco transistors are 13-ampere types and, as a family, they offer a collector voltage range from 40 to 100 volts. Each is characterized by uniformly low saturation resistance and

high gain at high current levels. Normalizing insures their fine performance and uniformity regardless of age. Also important—all Delco transistors are in volume production and readily available at moderate cost.

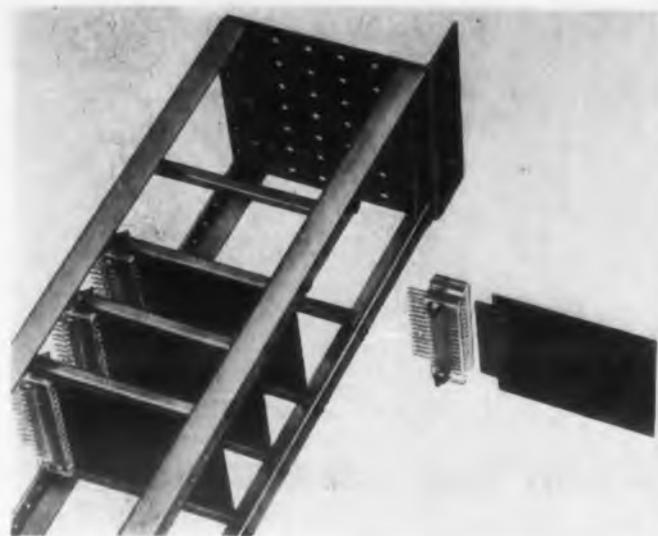
For complete data contact us at Kokomo, Indiana or at one of our conveniently located offices in Newark, New Jersey or Santa Monica, California. Engineering and application assistance is yours for the asking.

DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

BOOTH 1619 AT THE I. R. E. SHOW

CIRCLE 71 ON READER-SERVICE CARD



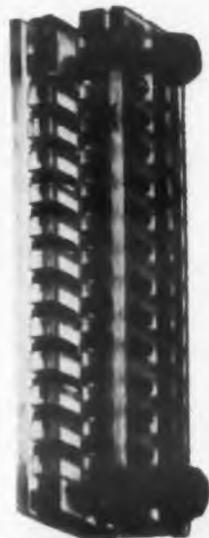
a special cement which is provided.

A large variety of contact types is available. The contacts may be made of phosphor bronze, spring temper brass, or beryllium copper; and may be terminated in solder eyes, turrets, taper tabs, wire wrap forms, or dip solder lugs. Two facing contacts may be joined or kept separate. The resistance at the spring action contacts is no greater than five milliohms.

The channels supplied for the framework can be cut and spaced to suit individual requirements. The guide rails are available to take printed circuit boards from 1/16 to 1/4 in. thick.

Receptacles are secured to the channels with cotter pins, allowing just enough play to ease the insertion of the printed circuit boards when there isn't perfect alignment.

For more information and specifications on a prototype kit for experimental use, turn to the Reader-Service Card and circle 72.



The parts on the left can be quickly assembled to make the complete printed wiring receptacle.



MODEL 372 SLIDING COAXIAL TERMINATIONS

This equipment, available only from Narda, provides the most convenient means for evaluating the residual VSWR of coaxial slotted lines. VSWR of the element is 1.05 or less; covers range from 2000 to 12,400 mc.

N Connector, male or female \$110 C Connector, male or female \$116



MODEL 371 FIXED COAXIAL TERMINATION

This Narda coaxial termination is the first and only to cover the entire frequency range from S to X band. Same range and element VSWR as above.

N Connector, male or female \$55 C Connector, male or female \$58



3, 6, 10 and 20 DB



40 DB HIGH POWER

HIGH DIRECTIVITY COUPLERS

The 40 db High Power Coupler is another exclusive Narda product. Similar to standard types, except that coupling irises are in the narrow wall, it may be used at full rated power of the waveguide size. Nominal coupling value is 40 db; directivity 40 db. Directivity for 3, 6, 10 and 20 db couplers is also 40 db. Standard cover flanges on primary line; low VSWR termination and standard cover flange on secondary. All bands covering frequencies from 2600 to 18,000 mc.



STANDARD REFLECTIONS

Narda offers five values of reflections for each of six different waveguide sizes—the most complete choice we know of! Provides calibrated reflections or VSWR's for use in standardizing reflectometers or calibrating slotted line impedance meters.

SPECIFICATIONS

Reflection Coefficient	0.00	0.05	0.10	0.15	0.20
Accuracy	0.002	0.0025	0.0035	0.0045	0.007
VSWR Equivalent	1.00	1.105	1.222	1.353	1.50

Models for 2.60 to 18.0 kmc, from \$125 to \$300

Complete Coaxial and Waveguide Instrumentation for Microwaves and UHF—including:

DIRECTIONAL COUPLERS
TERMINATIONS
FREQUENCY METERS
HORNS

TUNERS
ECHO BOXES
SLOTTED LINES
BENDS

ATTENUATORS
STANDARD REFLECTIONS
BOLOMETERS
THERMISTORS



the narda
microwave corporation

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CIRCLE 73 ON READER-SERVICE CARD

Microwave engineers—

Where can you use these exclusive features offered by narda?



Waveguide and Coaxial IMPEDANCE METERS

Exclusively in Narda Waveguide and Coaxial Impedance Meters, the carriage mounting and drive mechanism are integral with the precisely machined transmission line casting. This insures permanent accuracy and freedom from slope errors—no more tedious adjustment or possibility of misalignment.

Other features include angle-mounted scale and vernier for optimum visibility; readily removable supporting pedestal; and smooth carriage travel action. Waveguide models, accurate for VSWR's of 1.01, are available for complete coverage from 2600 to 18,000 mc; N or C Connector coaxial models, from 1500 to 12,400 mc.

WAVEGUIDE IMPEDANCE METERS

Frequency (kmc)	Narda Model	Residual VSWR	Price
2.6 — 3.95	224	1.01	\$425
3.95— 5.85	223		350
5.3 — 8.2	222		325
7.05—10.0	221		270
8.2 —12.4	220		250
12.4 —18.0	219		270

COAXIAL IMPEDANCE METERS

Frequency (kmc)	Connectors (One Male, One Female)	Narda Model	Price
1.5 to 12.4	Series N	231	\$360
1.5 to 12.4	Series C	232	390

MAIL COUPON TODAY FOR
FREE CATALOG AND NAME OF
NEAREST REPRESENTATIVE

The Narda Microwave Corporation
160 Herricks Road
Mineola, N. Y.
Dept. ED-1

NAME _____

COMPANY _____

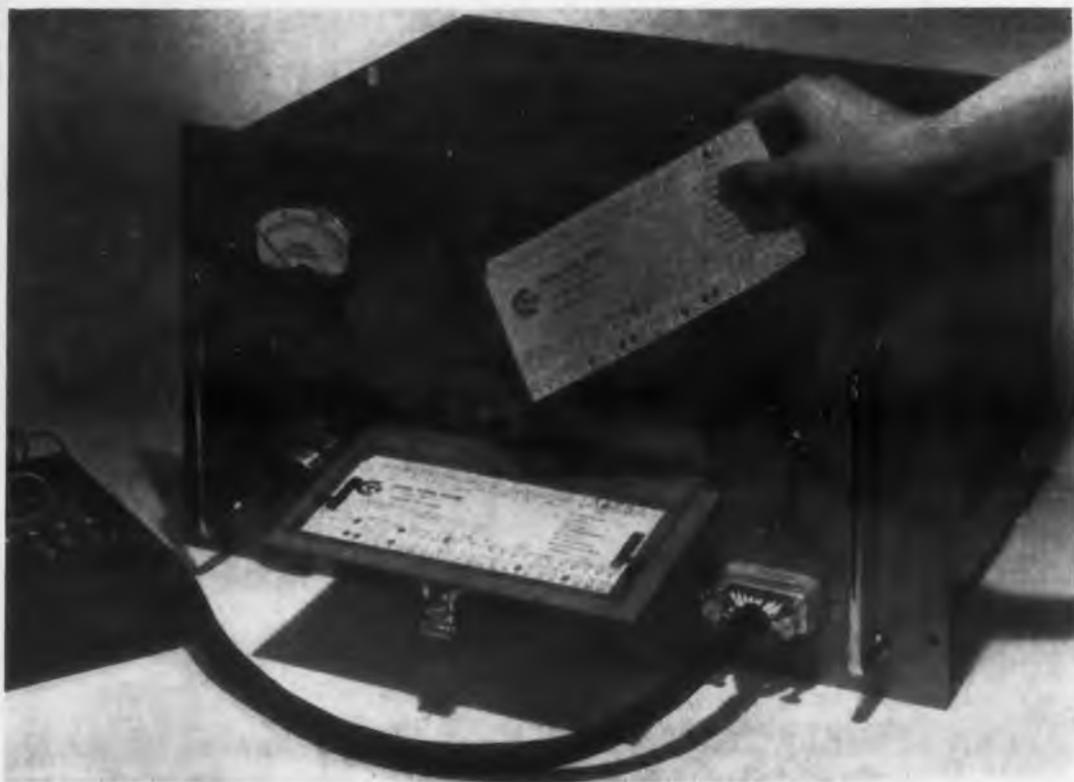
ADDRESS _____

CITY _____ ZONE _____ STATE _____



NEW PRODUCTS

PREVIEW OF THE 1958 IRE SHOW . . .



COMPONENT TESTER

Punched Cards allow simplified programming for the incoming inspection of transformers, relays, resistors, transistors, diodes, capacitors, and similar items. The component tester is able to make a complete series of tests according to values indicated by a punched card, thus enabling it to make complex tests and yet permitting instant change-over to the next type of component.

California Technical Industries, Division of Textron, Inc., Dept. ED, 1444 Old County Rd., Belmont, Calif.

IRE Booth No. 1111, 1112

CIRCLE 74 ON READER-SERVICE CARD

DC-AC CHOPPERS

Twin-Contacts in these choppers serve to increase their over-all reliability. The units have two independently adjustable, parallel connected contacts, making a total of four for spdt and eight for dpdt. Case size is 1-1/4 x 1 x 2-11/16 in. Electrical noise and thermal emf's are nearly eliminated through the use of a Mu-metal case, internal shielding, and a novel plug-in low loss base with gold plated pins. Eleven different models are available for use either on 50, 60, 94 or 120 cps.

Stevens-Arnold, Inc., Dept. ED, 22 Elkins St., South Boston, Mass.

IRE Booth No. 2937

CIRCLE 75 ON READER-SERVICE CARD



SILICON CONTROLLED RECTIFIER

Control of the Volume of Power fed into a load is the featured characteristic of this semiconductor device. Six models of the silicon rectifier will be available in sample form at the show. These devices are all rated at an average forward current of 5 amp at 125 C stud temperature and variously at 25, 40, 75, 100, 150 and 200 pivw. All models have a typical gate current to fire of 10 ma at 25 C and a typical minimum holding current of 10 ma.

General Electric Co., Semiconductor Products Dept., Dept. ED, Syracuse, N.Y.

IRE Booth No. 2906

CIRCLE 76 ON READER-SERVICE CARD

See us at our booth (4101-02) for the latest information on products announced at the show.

ELECTRONIC DESIGN, together with ELECTRONIC WEEK-ELECTRONIC DAILY, will maintain a running coverage of products announced just prior to or during the IRE show. Information and photographs of these items will be displayed at our booth.

In this issue, you will find a preview of the majority of products to be exhibited. In collecting this information, we have taken note of a few components, described more fully on the following pages, which you may find of interest:

In the semiconductor field, there have been more significant developments in devices related to the transistor than in refinement of the conventional transistor itself. Described on the opposite page, for instance, is a heavy duty silicon rectifier which is controlled by a minute voltage. Zener diodes will be displayed in an interesting fashion by International Rectifier Corp. An X-Y graph of each diode will be plotted on the spot; a look at one of these shows a very sharp breakdown curve. Thermistors are being supplied in accurately matched pairs for gas analysis by Fenwal Electronics. Other devices of interest include Transitron's silicon transistors which, with a R_{CS} of 1.5 ohm, permit 80 w ratings.

Capacitors being exhibited include a British electrolytic type with an interesting end seal; the Daly Ltd. electrolytic employs a compressed plastic plug to provide hermetic sealing. Pyramid Engineering will display a low-leakage series of electrolytics. Vitramon's standard line of thin design axial radial capacitors will be expanded by the addition of a few new types.

Some of the more rugged relays exhibited include a 200 C unit, manufactured by Union Switch and Signal, that will withstand 55 g shock, 25 g vibration, and have a contact bounce of less than 250 μ sec. An impulse latching relay, utilizing only one coil instead of the usual two, will be exhibited by Comar Electric. Other electromechanical devices of interest include a chopper from Airpax Products exhibiting very low noise over a 40 kc bandwidth.

first in
Performance
Reliability
and Quality

KEPCO

TRANSISTORIZED V. R. P. S.*

- REGULATION (for line or load) 0.03% or 0.003 Volts (whichever is greater)
- RIPPLE 1 mv. rms.
- RECOVERY TIME 50 microseconds
- STABILITY (for 8 hours) 0.03% or 0.003 Volts (whichever is greater)
- Tubeless.
- 0.005% resolution with 10 turn voltage control.
- Continuously variably output voltage without switching.
- External overload and short circuit protection included.
- Either positive or negative can be grounded.
- Units can be series connected.
- Suitable for square wave pulsed loading.
- Power requirements: 105-125 volts, 50-65 cycle. 400 cycle units available.
- Terminations on front and rear of unit.
- High efficiency.
- Low heat dissipation.
- Compact, light weight.
- Color: grey hammer tone.
- Suitable for bench or rack use.
- Voltmeter and ammeter provided.

the most complete line
of POWER SUPPLIES

* VOLTAGE REGULATED POWER SUPPLIES

Model	Output Volts	Output Amps.	Output Impedance Ohms		Rack Mount		
			DC-1 KC	1 KC-100 KC	W	H	D
SC-32-0.5	0-32	0-0.5	0.02	0.2	19"	3½"	13"
SC-32-1	0-32	0-1	0.01	0.1	19"	3½"	13"
SC-32-1.5	0-32	0-1.5	0.01	0.1	19"	3½"	13"
2SC-32-1.5 DUAL OUTPUT	0-32	0-1.5	0.01	0.1	19"	7"	13"
SC-32-2.5	0-32	0-2.5	0.01	0.1	19"	3½"	13"
SC-32-5	0-32	0-5	0.005	0.05	19"	5¼"	13"
SC-32-10	0-32	0-10	0.001	0.01	19"	8¾"	13"
SC-32-15	0-32	0-15	0.001	0.01	19"	10½"	13"
2SC-100-0.2 DUAL OUTPUT	0-100	0-0.2	0.1	1.0	19"	5¼"	13"
SC-150-1	0-150	0-1	0.05	0.5	19"	5¼"	13"
SC-300-1	0-300	0-1	0.1	1.0	19"	8¾"	13"



KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N. Y.

INDEPENDENCE 1-7000

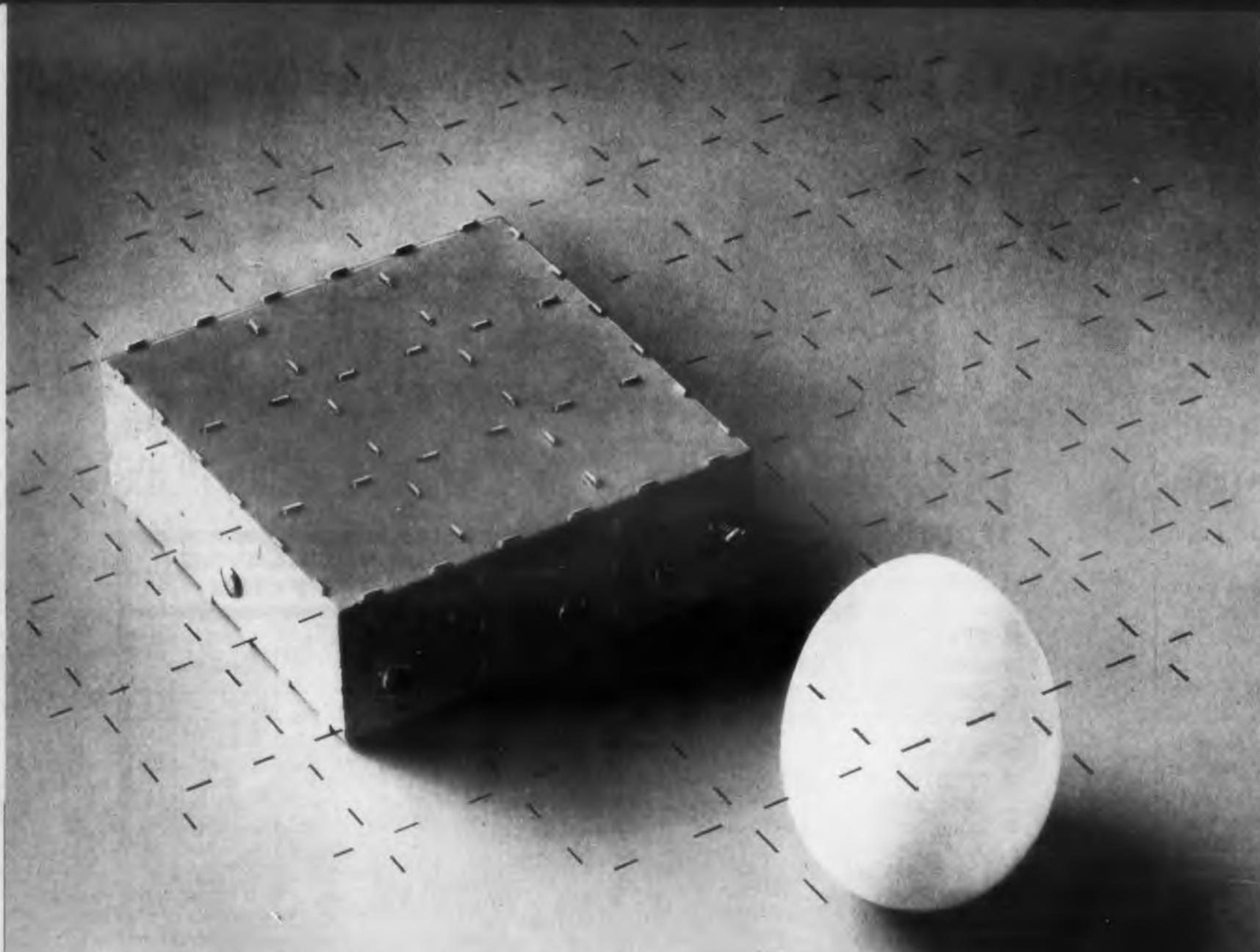
KEPCO OFFERS MORE THAN 120 STANDARD VOLTAGE REGULATED POWER SUPPLIES COVERING A WIDE RANGE OF MAGNETIC, TRANSISTOR AND TUBE TYPES. MOST MODELS AVAILABLE FROM STOCK. SEND FOR BROCHURE B-581



Model
SC-32-0.5
SC-32-1
SC-32-1.5
SC-32-2.5

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CIRCLE 77 ON READER-SERVICE CARD



**Better shape factor
over wider frequency range**

Daven's new EGG CRATE LC filters...

Center frequency: covers the range from 0.4 MC to 60.0 MC depending upon specific requirements. Center frequency stability: ± 1.0 KC per MC from -55°C to $+105^{\circ}\text{C}$. Shape factor: BW_{60}/BW_6 to 2.1. Shape factors can be modified for optimum time delay.

In addition to these outstanding specifications, Daven's new LC filters offer a unique type of construction which makes them the most rugged filters ever built. Small cells are welded

together to form the partitioned shield compartment...making this the first filter with truly continuous mechanical and electrical bond...providing a high degree of inter-circuit shielding.

Daven's new LC filters are ideal for shaping the pass band of AM/FM or FM/FM data link receivers, double or single side band receivers and generators, direction finding receivers, communication and telemetering receivers, and spectrum analyzers. So versatile, in fact, that applications are almost limitless. Write today for complete, newly-published technical data.

THE **DAVEN** CO.  LIVINGSTON, NEW JERSEY

TODAY, MORE THAN EVER, THE DAVEN © STANDS FOR DEPENDABILITY



NEW PRODUCTS

at the IRE Show

Power Supply

Cannot be short circuited



Overcoming the limitations of previously available types, these Transpac power supplies may be completely short circuited without damage to the semiconductors or other components. The units are available in 150 and 300 v dc ratings, 0-100 ma. Input is 105-125 v ac, 60 or 400 cps. Regulation is better than 0.1 per cent. Size of the 150 v model is 3-1/16 x 3-9/16 x 4-7/8 in.

Electronic Research Associates, Inc., Dept. ED, 67 Factory Place, Cedar Grove, N.J.

IRE Booth No. 2705

CIRCLE 79 ON READER-SERVICE CARD

Cooling Motor

Changes speed according to altitude



The E2123-200 is a high-speed, 3-phase, 400 cps motor. It automatically changes speed with varying altitudes and air densities to provide constant cooling efficiency from sea level (high density) to 70,000 ft. Used in conjunction with a 4-in. impeller the motor delivers 145 cfm at 0" SP at sea level and

◀ CIRCLE 78 ON READER-SERVICE CARD

changes speed to deliver 440 cfm at 0" SP at 70,000 ft. This motor is rated at a minimum life of 1000 hrs at a 125 C ambient. This 1.4 lb motor meets the requirements of MIL-M-7969A, MIL-E-5272A, Air Force spec #32590 and MIL-P-721B. This motor type can also be produced in 1-phase, 400 cps or variable (320 to 1000 cps.)

Air-Marine Motors, Inc., Dept. ED, Amityville, N.Y.
IRE Booth No 2315

CIRCLE 81 ON READER-SERVICE CARD

Zener Diodes

Temperature range of
-65 to +200 C



A line of miniature glass Zener diodes has been designed for clipping, limiting, regulating, and similar applications. They are made with gold alloyed ohmic contacts in order to withstand high operating temperatures.

Low voltage types GZ1 through GZ6 cover the Zener voltage range from 2 v through 8 v in approximately ± 10 per cent stops. Special selections from types GZ1 through GZ6 and available with tolerances of ± 5 per cent. Units with Zener voltages from 8 v through 51 v are available with similar tolerances. These diodes are designed to function at an extended operating and storage temperature range of from -65 to +200 C. They are rated at 250 mw at 25 C and derated at 1 mw per deg C above 25 C.

Hoffman Electronics Corp., Semiconductor Div., Dept. ED, 930 Pitter Ave., Evanston, Ill.
IRE Booth No. 3830

CIRCLE 82 ON READER-SERVICE CARD

CIRCLE 83 ON READER-SERVICE CARD >

DU PONT

REG. U. S. PAT. OFF.
Better Things for Better Living
Through Chemistry

ELECTRONIC DESIGN

LATEST PROPERTY AND APPLICATION DATA ON

TEFLON®

fluorocarbon
resins

NEWS

Flush antennas for supersonic aircraft use insulators of TEFLON® to beat shock...cold...heat

TFE-fluorocarbon resins



INSULATORS of TFE-fluorocarbon resins withstand severest climatic and flight conditions. High dielectric strength, moisture repellence, keep 1 KW of RF power isolated even in rare-

fied and humid air. (Antenna by Dorne & Margolin, Inc., Westbury, N. Y.; parts machined from TEFLON TFE-fluorocarbon resins by Tri-Point Plastics, Inc., Albertson, L. I., N. Y.)

Insulation of TEFLON® resin permits soldering in tightly wired equipment

Nineteen relays are incorporated in this 6 x 6 x 5-inch relay unit that outperforms a previous unit nine times its size. Wire insulation and sleeving of TFE-fluorocarbon resins are used because they withstand the heat of soldering irons during the

WIRE INSULATION and sleeving of TEFLON TFE-fluorocarbon resins permit tight wiring in this miniaturized relay unit for the supersonic B-58. (Unit by Potter & Brumfield, Inc., Princeton, Ind.; wire and sleeving by Warren Wire Co., Pownal, Vt.)



final assembly where the working area is very limited. TFE-fluorocarbon resins are rated for continuous use at 260°C. The heat resistance and high dielectric strength of these materials permit miniaturization of electronic components. Sensitivity of high-frequency equipment is maintained by the low attenuation factor of insulation made of Du Pont TEFLON resins.



TFE-fluorocarbon resins are among the few insulators that remain effective at microwave frequencies under severe conditions of mechanical and climatic shock. This is proven by their use as insulators in flush antennas for supersonic and near-sonic aircraft such as the Boeing 707.

To keep weight down, the parts are used as both insulators and structural members. They are machined to tolerances of one mil. TFE resins have practically zero moisture absorption. Thus, their almost ideal electrical characteristics are not altered by humidity. Sensitivity of high-frequency equipment is maintained by their low attenuation factor. Dielectric constant and power factor of TFE-fluorocarbon resins are extremely low, and remain virtually unchanged through the high frequency and temperature ranges. In tests, flush antennas equipped with insulators of TEFLON resins withstand continued immersion, minus 60°F. to 250°F. cycling, and 50 to 1000 cps vibration at 10 g acceleration.

Reliability is insured since the excellent electrical characteristics of TFE resins do not change with time, even at elevated temperatures. To find out how the properties of these resins can help you solve tough design problems, write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Rm. 18-3-5, Du Pont Bldg., Wilmington 98, Del.

In Canada: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

**VISIT THE DU PONT EXHIBIT
BOOTH 4410-4412**

at the
1958 I. R. E. SHOW
The Coliseum
New York City
March 24 through 27

TEFLON®

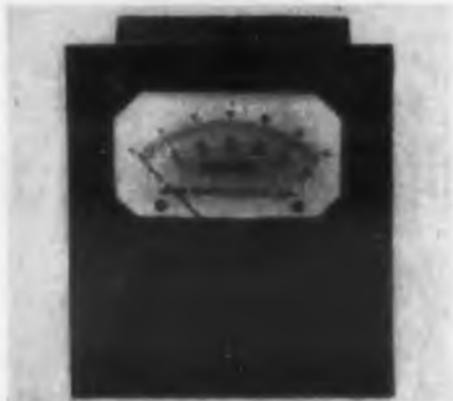
is a registered trademark . . .

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

NEW PRODUCTS at the IRE Show

Phase Meter

Direct measure regardless of peak values



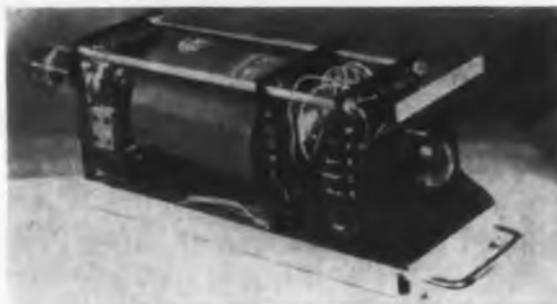
The 410 panel mounted phase meter is suitable for measuring phase angle between two periodic potentials of any shape, sinusoidal or nonsinusoidal, regardless of the relations between the peak values. It requires no adjustment, including zeroing, for obtaining a phase reading. The instrument consists of two clipping circuits, one for each channel, a rectifier and a panel meter. Accuracy is ± 2.5 per cent of full scale on all ranges for input voltages of 110 ± 10 v and ± 3.5 per cent on all ranges for input voltages of 110 ± 20 v. The operating frequency is 20 to 1000 cps, with no effect on accuracy. The impedance is 5500 ohms per phase on standard model.

Advance Electronics Lab., Inc., Dept. ED,
249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 84 ON READER-SERVICE CARD

Decade Counter

Resets in one microsecond



Designed as a companion unit to the decade counters types 101 and 102 whose counting rate is 10 kc and 100 kc respectively, this 1 mc Nixie readout unit resets to zero in less than 1 μ sec. All outputs are available for print-out or other applications. The power requirements are 300 v-30 ma dc, and 6.3 v-0.9 amp ac.

Burroughs Corp., Electronic Tube Div., Dept. ED, P.O. Box 1226, N. Plainfield, N.J.
IRE Booth No. 1718, 1724

CIRCLE 85 ON READER-SERVICE CARD

AMP-lok

The new concept in



multiple connector design

. . . IT'S SELF-ANCHORING

AMP-lok eliminates the necessity for supplementary mounting devices in through panel multiple connector applications.

AMP-lok obsoletes all it replaces because of the following design features:

- contacts are identical . . . self-cleaning . . . recessed for safety
- finger grip engagement and disengagement
- polarized to eliminate circuit error
- wide panel thickness accommodation — one simple mounting hole required
- color-coding available

AMP-lok can be used as a safe, free-hanging multiple connector, also.

Additional literature and samples available on request.

AMP INCORPORATED

GENERAL OFFICES:

3539 Eisenhower Blvd., Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada, Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP — Holland N. V. 's-Hertogenbosch, Holland
Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan



CIRCLE 86 ON READER-SERVICE CARD

Servo Cam Assembly

Adjustable limits for switching purposes



For use in servo mechanisms where it is desired to actuate switches and similar devices at predetermined angular limits, the T-159 cam assembly can be adjusted through 180 deg. A balanced clamp secures the assembly to the shaft as well as locking the cams for the desired setting. Maximum diameter is 1-1/8 in. and hubs are available for 1/8, 3/16, and 1/4 in. shafts.

Sterling Precision Corp., Dept. ED, 54-17 Lawrence St., Flushing 54, N.Y.
IRE Booth No. 1621

CIRCLE 87 ON READER-SERVICE CARD

Silicon Rectifiers

Ratings up to 16,000 piv



Designed for forced-air or liquid cooling, these rectifiers utilize metallized ceramic housings with ferrule-type terminals for insertion into standard 30-amp fuse clips. Available in peak inverse voltage ratings of from 1500 to 16,000 v at rectified dc output currents ranging from 210 to 360 ma. For short durations, load current several times the rated values can be withstood.

Primarily designed for airborne power supplies, these units can also be used for dc over-potential testing damping out oscillation in electric welding circuits, pulsing of magnetrons, or as power supplies in electrostatic precipitators due to their ability to withstand surge currents.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.
IRE Booth No. 3915, 3917

CIRCLE 88 ON READER-SERVICE CARD

We will feature the AMP Automated Shielded Wire Ferrule at the IRE Show. Visit our Booth #2427-29.

NEW PRODUCTS

at the IRE Show

Delay Line

Delays of 5 to 100 μ sec



This delay box offers standard impedances of 50, 73, or 93 ohms and delays of 5, 15, 10, 25, 50, and 100 μ sec. A jumper for connecting and two delays in series is provided, as well as two adaptors from BNC to uhf or type N connectors.

Electrical & Physical Instrument Corp., Engineering Div., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.

IRE Booth No. 3240

CIRCLE 89 ON READER-SERVICE CARD

SSB Generator

For X-band use



The 3036 side band generator covers the frequency range of 8.5 to 9.6 kmc. A 20 db suppression of the undesired side band frequency and 15 db suppression of the carrier has been obtained. No tuning of the microwave assembly needed.

Microwave Development Labs., Inc., Dept. ED, 92 Broad St., Babson Park, Mass.

IRE Booth No. 3415

CIRCLE 90 ON READER-SERVICE CARD

CIRCLE 91 ON READER-SERVICE CARD

"We
want
these tubes
for our new
military circuits,
but can you
mass-produce
them in
this
country?"

MILITARY
SYSTEMS
MANAGER

CLOSED
AREA

RELIABLE PREMIUM-QUALITY FRAME GRID TUBES



Amperex 5847
Broadband Amplifier Pentode

- ▶ plug-in replacement for Type 404A in existing equipment
- ▶ high figure of merit
- ▶ frame grid construction



Amperex 6688
Reliable, Reggeized, Broadband Amplifier Pentode

- ▶ for similar applications as the 5847, but with improved beam pin arrangement and higher transconductance
- ▶ figure of merit of 250 Mc as broadband amplifier
- ▶ serves entire stages in IF and video amplifiers
- ▶ improves signal-to-noise ratio
- ▶ preferred for new equipment design, particularly airborne applications
- ▶ long-life cathode
- ▶ frame grid construction

AND EXACTING INDUSTRIAL APPLICATIONS...

It's the
frame grid
construction
that makes
the difference!



◀ Frame Grid
as used in Amperex 6922

Grid-to-cathode spacing tolerance determined by carefully controlled diameter of grid support rods (centerless ground) and by frame cross-braces between these rods. Extremely fine grid wire eliminates the "island effect" usually encountered in conventional tubes with equally close grid-to-cathode spacing. Rigid support of fine wires reduces mechanical resonance and microphonics in the grid.

▶ Conventional Grid
as used in 6BQ7A tube

Grid-to-cathode spacing tolerance depends on accuracy of grid dimensions, obtained by stretching on a mandrel, and on tolerances of holes in top and bottom mica rod supports. Diameter of grid wire must be large enough to be self-supporting.



...and **Amperex**® said

by March, 1958!"

FOR MILITARY SYSTEMS REQUIREMENTS



Amperex 6X21

Reliable, Rugged, High-Gain Twin Triode

- ▶ for reliable radar cathode stages
- ▶ for high-speed computer operation
- ▶ for HF, IF, mixer and phase-inverter stages
- ▶ high transconductance ($G_m = 12,500 \begin{smallmatrix} +2000 \\ -2000 \end{smallmatrix}$)
- ▶ low noise
- ▶ long-life cathode
- ▶ new "dimple" anode
- ▶ frame grid construction



Amperex 6X4

Miniature UHF Twin Tetrode

- ▶ 5 watts total anode dissipation
- ▶ 5.5 watts useful power in load (100%)
- ▶ maximum ratings apply up to 100 Mc
- ▶ unsurpassed for low-power UHF transmitter applications
- ▶ saves entire stages in equipment design
- ▶ useful in frequency multiplier chains
- ▶ frame grid construction

...Now Mass-Produced in the U.S.A. by Amperex



ACTUAL SIZE OF
FRAME GRID USED IN 6X22

The frame grid is the closest approach to the ideal "physicist's grid" — the grid with only electrical characteristics but no physical dimensions. It results in

- ▶ higher transconductance
- ▶ tighter G_m and plate current tolerance
- ▶ low transit time
- ▶ low capacitances
- ▶ lower microphonics
- ▶ rugged construction



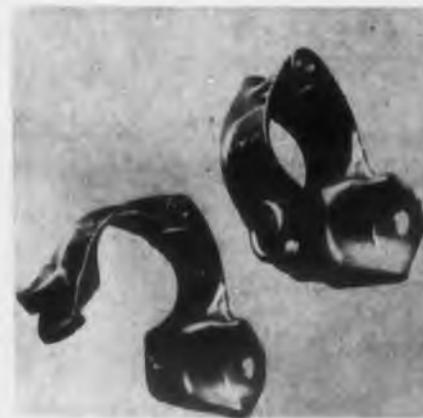
ask **Amperex**

about premium-quality tubes
for special reliability requirements

Semiconductor and Special Purpose Tube Division
AMPEREX ELECTRONIC CORP., 230 Duffy Avenue, Hicksville, L. I., N. Y.
In Canada: Rogers Electronic Tubes & Components, 11-19 Brentcliffe Road, Leaside, Toronto 17

Wire Clamp

Can be permanently mounted



This clamp can be permanently mounted by means of a rivet or bolt and is opened or locked in a quarter turn. Designed primarily for wire bundles, the unit is available from 1/4 to 1-1/4 in. diam types.

Camloc Fastener Corp., Dept. ED, 22 Spring Valley Rd., Paramus, N.J.

IRE Booth No. 4306, 4308

CIRCLE 92 ON READER-SERVICE CARD

Switch

Miniature 10 amp model



The type 16 10-amp miniature switch measuring 1/4 x 7/16 x 25/32 is available with screw end terminals, and bottom taper tab and solder terminals. The switch provides over 20,000,000 life cycles. Double break contact arrangement is employed. A broad field of application is possible by combining the switch with an assortment of miniature actuators. Actuator designs include panel mounted toggles, oil-tight push-buttons, and spring pivoted lever, roller, levers. Illinois Tool Works, Licon Switch & Control Div., Dept. ED, 2501 N. Keeler Ave., Chicago 39, Ill.

IRE Booth No. 3842

CIRCLE 93 ON READER-SERVICE CARD

◀ CIRCLE 91 ON READER-SERVICE CARD

Transistors

Computer, r-f and audio types



Part of the component line available from the manufacturer are 13 germanium and fusion alloy transistors in a case measuring 0.002 cu. in. There are four computer, four general purpose rf and 5 general purpose audio types. Four types of glass silicon rectifiers all rated at 400 ma forward current, having piv ratings from 225 to 500 v, and the CK1053 low power, subminiature time indicator for determining electronic component and equipment life are also included in the line.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

IRE Booth No. 2611-2614

CIRCLE 80 ON READER-SERVICE CARD

Ultrasonic Cleaners

Wide range of mass-produced sizes



Series 600 ultrasonic cleaners cover two types of submersible transducers and seven different process tanks. Thirteen ultrasonic systems in all are available. Powered by the model G-601 generator, the stainless steel tanks in this series range from 1/2 gallon to one gallon capacity with single or double tank compartments. Some use external recirculating systems and others have self-contained recirculating pumps, filters and temperature controls. Models NT-604 and NT-605 transducers are hermetically sealed in heliarc-welded stainless steel cases for use in installed process tanks, metal-finishing and heavy duty cleaning tanks.

The Narda Ultrasonics Corp., Dept. ED, 160 Herricks Rd., Mineola, N.Y.

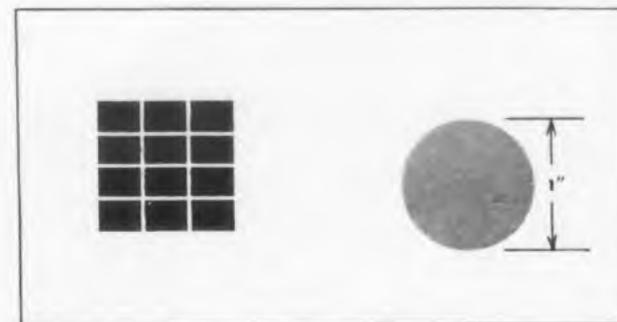
IRE Booth No. 4053, 3021, 3607, 3609

CIRCLE 218 ON READER-SERVICE CARD

HOW ONE CONCEPT IN POTENTIOMETER DESIGN SOLVES THREE BASIC PROBLEMS

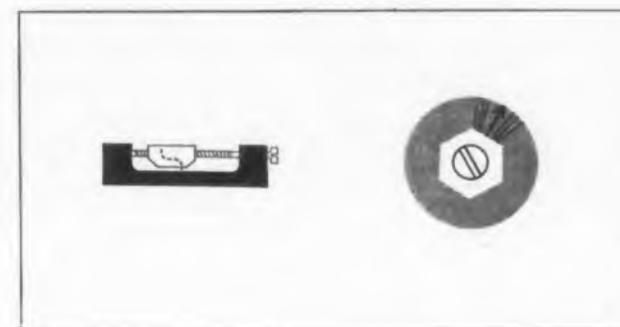
SPACE-SAVING SIZE AND SHAPE

You can pack a lot of Bourns potentiometers into a small space—12 in one square inch of panel area (or 17 TRIMPOT JR.* units!) Fit them into corners, between other components, flat against chassis or printed circuit boards. Mount them individually or in stacked assemblies.



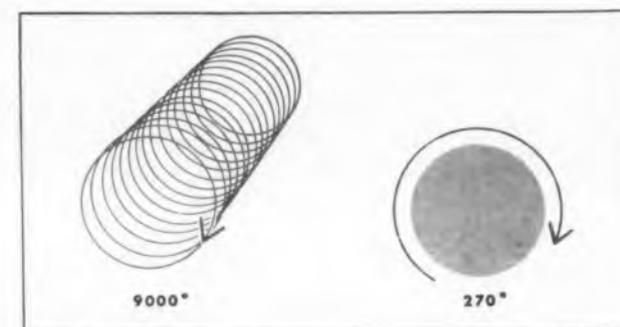
ADJUSTMENT STABILITY

Bourns potentiometers are *self-locking* (no lock nuts required). Any adjustment *remains stable*. Shock, vibration or acceleration can't affect a setting. Bourns potentiometers are helping thousands of engineers make reliability a reality.



CIRCUIT BALANCING ACCURACY

Bourns potentiometers are 33 times as accurate as conventional single-turn rotary types—the screw-actuated mechanism provides 9000° of rotation instead of only 270°. Circuit balancing, calibration—adjustments of all types are easier, faster, more precise. And repeatability is assured.



BOURNS

Laboratories, Inc.

P. O. Box 2112 • Riverside, California

ORIGINATORS OF TRIMPOT® TRIMIT® AND POTENTIOMETER INSTRUMENTS

*Trademark

HERE ARE ADJUSTMENT POTENTIOMETERS TO MEET ALL YOUR REQUIREMENTS

high performance military potentiometers and rheostats



General Purpose Type

The original wirewound TRIMPOT®. Model 200 (terminals L, S or P—see drawings below). 105°C operation. 0.25 watt. Also available as a rheostat, Model 201 TrimR® (terminal L only).



Micro-Miniature Potentiometer

The TRIMPOT JR.® Model 222 is so small you can fit 17 units in one square inch of panel space. 175°C operation. One watt. Humidity proof. (Terminals L or W).



Dual Potentiometer

TWINPOT® Model 209 is two potentiometers in one. (L). 105°C operation. 0.25 watt.



High-Temperature Operation

175°C operation. One watt. TRIMPOT Model 260. (L, S or P). Available as a rheostat Model 261 (L).



High-Resistance Wirewound

Hi-R® TRIMPOT Model 207 (L). Resistances to 250 K. 175°C operation. Two watts. Rheostat: Hi-R TrimR Model 208. (L).



High-Resistance Deposited Carbon

An unusually significant achievement in military quality potentiometers—infinite resolution at 125°C operation. 0.25 watt. Uses the RESISTON® element, a product of 3 years of Bourns research. 20K to 1 megohm range. TRIMPOT Model 215. (L, S or P).



Humidity Proof, 135°C Operation

TRIMPOT Model 236. (L, S or P). 0.8 watt. Also available as a rheostat, Model 231. (L).

*low-cost commercial adjustment potentiometer**



TRIMIT®—an important new development for manufacturers of computers, industrial controls, communications equipment and high-quality test and measuring equipment. Provides 33 times the adjustment accuracy of single-turn rotaries, occupies only a fraction of the space, and has far greater stability of setting—at no additional cost. Wirewound Models 271 (L), 273 (S), 275 (P). Carbon Models 272 (L), 274 (S), 276 (P).

military and commercial units available in these terminal types:

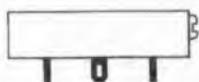
L = Leads, insulated, stranded



P = Pins, printed circuit



S = Solder lugs



W = Wires, uninsulated



Visit our booth #3716-3718 at the I. R. E. Show

BOURNS

Laboratories, Inc.

P. O. Box 2112 • Riverside, California

ORIGINATORS OF TRIMPOT® TRIMIT® AND POTENTIOMETER INSTRUMENTS

Write for detailed technical information on Bourns Potentiometers. Please specify the model or type and mention your application.

*Trademark

CIRCLE 96 ON READER-SERVICE CARD

High Voltage Resistors

For high temperature ambients

These pyrolytic carbon alloy film resistors, type PVX can operate in high ambient temperatures with improved stability under high voltage loads.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia, Pa.
IRE Booth No. 2821, 2825

CIRCLE 219 ON READER-SERVICE CARD



Switches

A lighted panel type includes nameplate in one unit

Among the switch and control products which will be displayed are these lighted push-button panel switches (shown), a long life miniature snap-action switch, and an adjustable sealed limit switch. The lighted push-button panel switches (series C6) are of modular design. Most of the models combine a nameplate, pilot light and switching unit into a single assembly. Two or more switch units may be stacked side-by-side in one panel slot. Through variation of circuit arrangements, colored lights for color monitoring, and colored push buttons for color coding, a large number of operating and indicating conditions can be provided for sequencing, movement limit, start-and-stop, and similar applications. Models are available with push-push alternate action, momentary contact, momentary contact with over-centering, and an assembly for pilot light duty only which includes no switching mechanism.

The miniature snap-action switch (model E4-134) measures 25/32 in. long and has a mechanical life rating of 1,000,000 operations at 0.005 over travel. It is electrically rated at 0.5 amp 125/250 v ac.

The adjustable sealed limit switch (model H11-2), is designed for control or indicating applications at any exposed locations on machines or aircraft. All exposed metal parts are stainless steel or Monel, and the entire switch is corrosion resistant.

Electro-Snap Switch & Mfg. Co., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.
IRE Booth No. 2225

CIRCLE 220 ON READER-SERVICE CARD

DESIGN ACHIEVEMENTS WITH **SUPRAMICA*** CERAMOPLASTICS



OPTICALLY FLAT CAPACITY COMMUTATOR
PLATE | SUPRAMICA 500



HIGH-TEMPERATURE AIRCRAFT TERMINAL
BLOCK | SUPRAMICA 560



HIGH-TEMPERATURE A-N CONNECTOR
| SUPRAMICA 560



RADIATION RESISTANT AIRCRAFT ENGINE
CONNECTOR | SUPRAMICA 555



HIGH TEMPERATURE FIREWALL
THERMOCOUPLE | SUPRAMICA 555



ORGANIC VAPOR FREE HIGH TEMPERATURE
SEALED RELAY | SUPRAMICA 555

HIGH TEMPERATURE ceramoplastic INSULATION

SUPRAMICA ceramoplastics provide broader design scope for product engineers

Increased thermal endurance . . . total, permanent dimensional stability . . . better electrical properties . . . lower density and improved machineability of SUPRAMICA ceramoplastics bridge the design gap between organic plastics and conventional ceramics. The world's most nearly perfect insulation, SUPRAMICA ceramoplastics allow product engineers to meet the requirements of today's thermal problems.

There is no possibility of shrinkage, growth or age polymerization since the materials are completely inorganic, made with SYNTHAMICA* synthetic mica. Metal inserts molded in SUPRAMICA ceramoplastics cannot loosen during thermal cycling because coefficients of expansion are

closely matched. Other desirable properties are high dielectric strength, radiation and arc resistance, low electrical loss, resistance to moisture, oil and organic solvents. In thousands of military and critical industrial applications, SUPRAMICA ceramoplastics are contributing to better, safer, more reliable operation of electrical and electronic equipment.

Write for complete technical information.

SUPRAMICA* 560 — for temperatures over 500°C (932°F)

SUPRAMICA* 555 — for temperatures up to 650°F

SUPRAMICA* 500 — sheet and rod material for machining

*SUPRAMICA is a registered trademark of Mycalex Corporation of America. 560 and 555 and 500 are trademarks of Mycalex Corporation of America.

SYNTHAMICA is a trademark of Synthetic Mica Company, a Division of Mycalex Corporation of America.

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IRE SHOW BOOTH
Nos. 2221 & 2223

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CORPORATION OF AMERICA

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CLIFTON, NEW JERSEY

SALES OFFICES:
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WASHINGTON - MIAMI



WORLD'S LARGEST MANUFACTURER OF GLASS-BONDED MICA AND CERAMOPLASTIC PRODUCTS.

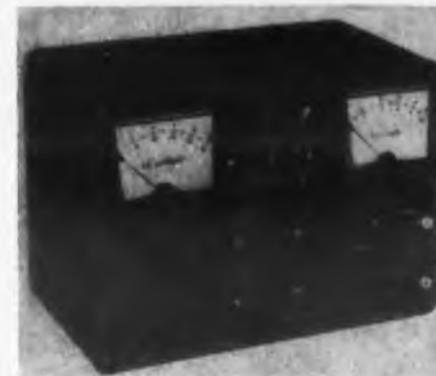
CIRCLE 99 ON READER-SERVICE CARD

NEW PRODUCTS

at the IRE Show

Diode Tester

Provides rapid, accurate testing



Model DT-257 diode tester is designed to measure the characteristics of medium and low-power semiconductor diodes. A lever switch is provided which automatically selects the desired test voltage and meter ranges for both forward and reverse tests. The reverse voltage supply is regulated to 0.5 per cent. Either one of three preset voltages or a continuously variable voltage covering the range from 0 to 150 v may be selected. The forward voltage supply is continuously variable from 0 to 2 v. Accuracy of the voltage and current meters is ± 2 per cent. The instrument is housed in the company's CA-846 modular case (11-1/2 x 8-3/8 x 6-1/8 in.).

Teletronics Lab., Inc., Dept. ED,
54 Kinkel St., Westbury, N.Y.

IRE Booth No. 3417

CIRCLE 100 ON READER-SERVICE CARD

VSWR Monitor

Handles up to 500 w



Type 1273 vswr monitor satisfies requirements for a lightweight, rugged unit to monitor r-f power, vswr, and side-tone. Built into a

section of transmission line, it furnishes two dc voltages representing incident and reflected power.

Power handling capacity ranges up to 500 w depending on reflected power. Output to indicator is one volt (nominal) from 500 ohms. The unit may be used to modulate a sub-carrier oscillator for telemetry. Frequency range is 100 to 400 mc.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy., Cambridge 42, Mass.

IRE Booth No. 3038, 3039

CIRCLE 101 ON READER-SERVICE CARD

Frequency Converters Supply 330 to 3700 cps power



Models 411, 421, and 431 frequency converters are used in conjunction with equipment requiring 330 to 3700 cps power. Power output is 250 va for model 411, 500 va for model 421 and 1000 va for model 431. All three units are useable with loads having power factors ranging from 0.7 leading to 0.7 lagging. The converters provide full power output over the entire output voltage range of 90 to 130 v through the use of an impedance matching circuit. A Wein bridge oscillator covers the entire range of 330 to 3700 cps in seven bands.

Specifications include less than 2 per cent harmonic distortion; voltage regulation of ± 2 per cent from no load to full load; frequency stability of better than 0.25 per cent after 15-min warm-up; and frequency accuracy within 3 per cent of dial calibration.

Tel-Instrument Electronics Corp., Dept. ED, 728 Garden St., Carlstadt, N.J.

IRE Booth No. 3406, 3408

CIRCLE 102 ON READER-SERVICE CARD

CIRCLE 103 ON READER-SERVICE CARD

ZENER

for every
circuit!



International

Rectifier Corp.



XY Plot of Reverse Breakdown Characteristics Supplied with Each Diode!

Here's the versatile zener line—a type for every application—coupled with a new service conceived to conserve engineering time! Excellent characteristics, especially in terms of low impedance values, hermetic sealing, all-welded construction and a high thermal capacity package qualify these diodes for your consideration. Receiving a plot of characteristics with each diode eliminates guesswork and tedious testing on your part—means more time for creative engineering. Inquire further about these diodes... and the special application services we are prepared to offer you.

SEE THE COMPLETE LINE DEMONSTRATED AT BOOTHS 3915-3917, I.R.E. SHOW

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281 • CABLE RECTUSA

NEW YORK AREA OFFICE: 132 EAST 70TH ST., PHONE TRAFALGAR 9-3330 • CHICAGO AREA OFFICE: 205 W. WACKER DR., PHONE FRANKLIN 2-3888 • NEW ENGLAND AREA OFFICE: 17 DUNSTER STREET, CAMBRIDGE, MASS., PHONE UNIVERSITY 4-6520 • PENNSYLVANIA AREA OFFICE: SUBURBAN SQUARE BUILDING, ARDMORE, PENNA., PHONE MIDWAY 9-1428

WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS • SELENIUM • GERMANIUM • SILICON

VOLTAGE REGULATOR TYPES

500 MILLIWATT TYPES	INT'L DIODE TYPE	ZENER VOLTAGE RANGE	I _s MAX. mA	DYNAMIC IMPEDANCE		NOMINAL TEMP. COEFFICIENT %/°C
				Z _z (OHMS)	@ I _s mA	
	MZ 3.9	3.6-4.3	125	1.5	25	-.04
	MZ 4.7	4.3-5.1	100	1.5	20	0
	MZ 5.6	5.1-6.2	90	2.3	17.5	+.03
	MZ 6.8	6.2-7.5	75	3	15	+.05
	MZ 8.2	7.5-9.1	60	4.5	12.5	+.06
	MZ 10	9.1-11	50	6.8	10	+.07
	MZ 12	11-13	40	12	7.5	+.075
	MZ 15	13-16	33	23	6	+.08
	MZ 18	16-20	27	45	5	+.085
	MZ 22	20-24	23	70	4.5	+.09
	MZ 27	24-30	18	90	3.5	+.095
MINIATURE STYLE M						
	IZ 3.9	3.6-4.3	250	1	50	-.04
	IZ 4.7	4.3-5.1	200	1	40	0
	IZ 5.6	5.1-6.2	175	1.5	35	+.03
	IZ 6.8	6.2-7.5	150	2	30	+.05
	IZ 8.2	7.5-9.1	120	3	25	+.06
	IZ 10	9.1-11	100	4.5	20	+.07
	IZ 12	11-13	80	7.5	15	+.075
	IZ 15	13-16	65	15	13	+.08
	IZ 18	16-20	55	30	10	+.085
	IZ 22	20-24	45	45	9	+.09
	IZ 27	24-30	35	60	7	+.095
STYLE S Pigtail Construction						
	3Z 3.9	3.6-4.3	850	.5	150	-.04
	3Z 4.7	4.3-5.1	700	.5	125	0
	3Z 5.6	5.1-6.2	625	.75	110	+.03
	3Z 6.8	6.2-7.5	525	1	100	+.05
	3Z 8.2	7.5-9.1	425	1.5	80	+.06
	3Z 10	9.1-11	350	2.5	70	+.07
	3Z 12	11-13	275	4	50	+.075
	3Z 15	13-16	225	7.5	40	+.08
	3Z 18	16-20	200	15	35	+.085
	3Z 22	20-24	160	22.5	30	+.09
	3Z 27	24-30	125	30	25	+.095
STYLE T Stud Construction						
	10Z 3.9	3.6-4.3	2500	.25	500	-.04
	10Z 4.7	4.3-5.1	2000	.25	400	0
	10Z 5.6	5.1-6.2	1750	.4	350	+.03
	10Z 6.8	6.2-7.5	1500	.5	300	+.05
	10Z 8.2	7.5-9.1	1200	.75	250	+.06
	10Z 10	9.1-11	1000	1.25	200	+.07
	10Z 12	11-13	850	2	170	+.075
	10Z 15	13-16	650	4	140	+.08
	10Z 18	16-20	550	7.5	110	+.085
	10Z 22	20-24	450	12	90	+.09
	10Z 27	24-30	350	15	70	+.095
STYLE T Stud Construction						
	ZZ 3.9	3.6-4.3	110	3	22	-.045
	ZZ 4.7	4.3-5.1	90	4	18	-.01
	ZZ 5.6	5.1-6.2	70	5	14	0
	ZZ 6.8	6.2-7.5	60	10	12	+.025
	ZZ 8.2	7.5-9.1	50	15	10	+.035
	ZZ 10	9.1-11	40	25	8	+.05
	ZZ 12	11-13	30	40	7.5	+.06
	ZZ 15	13-16	25	60	5	+.07
	ZZ 18	16-20	20	80	4	+.08
	ZZ 22	20-24	16	125	3.5	+.09
	ZZ 27	24-30	13	200	3	+.095
350 MILLIWATT						
	HZ 27	24-30	200	7	40	0
	HZ 33	30-36	150	10	30	+.03
	HZ 47	43-51	110	20	22	+.06
	HZ 68	62-75	75	60	14	+.075
	HZ 100	91-110	50	180	10	+.085
	HZ 150	130-160	35	370	7	+.095
HIGH VOLTAGE 5 WATT						

REFERENCE ELEMENT TYPES

	IN-430	8.0-8.8	50	15	10	$\pm .002$ -55° to +100°C
	IN-430A	8.0-8.8	50	15	10	$\pm .001$ -55° to +100°C
	IN-430B	8.0-8.8	50	15	10	$\pm .001$ -55° to +150°C



ARMA *relies*

*on Photocircuits
plated-thru holes*

Heart of TITAN ICBM Inertial Guidance System

When the Titan's electronic umbilical cords are severed, the giant missile begins life. With no ground contact, its unjammable inertial guidance system must work...there's no second chance.

Arma Division of American Bosch Arma Corporation, maker of the Titan's computer brain, demands printed circuit boards that must function the first time...every time. A defect, at any assembly point, means discarding the board and the costly components mounted on it.

That's why Arma relies on PHOTOCIRCUITS printed circuit boards with *plated-thru holes* to do the job.

PHOTOCIRCUITS pioneered *plated-thru holes*...manufactures them with built-in reliability for military and industrial applications.

Plated-thru hole reliability is based on PHOTOCIRCUITS' unequalled experience in every phase of printed circuitry. Consistent dependability is the result of proper design, precision production and advanced quality control techniques.

Check the advantages of *plated-thru holes* by PHOTOCIRCUITS...the largest and most experienced manufacturer in printed circuitry. For complete information, write our Engineering Department PS-2 today.

PHONES
GLEN COVE 4-8000
FLUSHING 7-8100

CABLE
PHOCIRCO



Photocircuits

C O R P O R A T I O N

G L E N C O V E , N E W Y O R K

SEE US AT THE IRE SHOW, BOOTH #s 2302-2304

CIRCLE 104 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Ferrite Isolators

L-band types for low to high power



The L-band, WR-650 waveguide-size absorption ferrite isolators provide constant isolation for low, medium and high power microwave applications. All these units operate over the range from 1250 to 1350 mc. Isolation is 10 db min, insertion loss 0.5, input vswr 1.15, and average power handling capacities are 100, 2000 and 5000 w respectively. While the low and medium power versions do not require cooling, the high power unit requires either forced air or a liquid cooling agent. Recommended liquid flow is one gallon per minute with the cooling liquid at a maximum temperature of 65 C.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.
IRE Booth No. 3318

CIRCLE 105 ON READER-SERVICE CARD

Epoxy Resin

For dipping applications



Specifically designed for dipping applications, No. 253 Scotchcast resin is a flexible, all solids material which can be applied in a controlled thickness with no run-off during the cure.

Since the new resin can be applied by dipping, brushing, or spraying, as well as extrusion, costs of molds are eliminated.

Pot life is from two to four days at room temperature. The cured specific gravity is 1.44; water absorption is 0.52 per cent; heat aging weight loss is 0.02 per cent after 168 hours at 105 C; and the dielectric strength is 450 volts per mil. The resin meets all Mil-T-27A requirements.

Minnesota Mining and Manufacturing Co., Dept. ED, 900 Bush St., St. Paul 6, Minn.
IRE Booth No. 3901, 3903

CIRCLE 106 ON READER-SERVICE CARD

For
SERVO MOTORS
and
MOTOR GENERATORS

YCBTBS*



*TRANSLATION: You Can't Beat
The Bendix "Supermarket"

Our "supermarket" of rotating components offers a larger variety of high-precision, low-inertia servo motors, rate generators and servo motor generators than any other single source. Bendix units are available in frame sizes 5, 8, 10, 11, 15, 20 and 28; they meet or exceed practically any applicable specification and include both corrosion-resistant and high-temperature models. Volume-production prices. Immediate delivery in many cases. Why not find out about our "supermarket" service!

FEATURING
CENTER-TAPPED
CONTROL
WINDINGS . . .



. . . for use in transistor circuits and for either parallel or series operation. Reduce size and weight of transistorized packages by eliminating coupling transformers. Standard models, or will wind to meet your specific requirements.

Eclipse-Pioneer
Division

Teterboro, N. J.

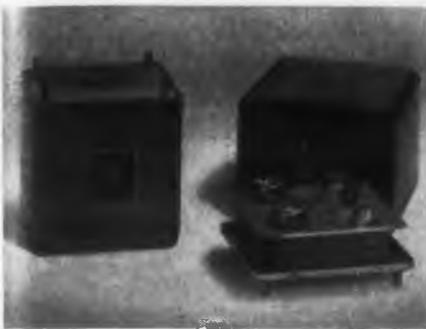
Bendix
AVIATION CORPORATION

District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C. Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

CIRCLE 107 ON READER-SERVICE CARD

Transistorized Inverters

Ratings up to several kva



These inverters transform low voltage dc to either 60 or 400 cps. An addition to the Transpac line, the inverters are available in stock models with ratings up to 250 va, 15 v ac, or on order with ratings up to 5 kva. Input is 24 v dc nominal. The inverters are self-starting, with diode stabilized design, which use type E core magnetic circuits. Efficiencies of these units exceed 90 per cent.

Electronic Research Associates, Inc., Dept. ED, 67 Factory Place, Cedar Grove, N.J.
IRE Booth No. 2705

CIRCLE 108 ON READER-SERVICE CARD

Microwave Absorbent

Lightweight film type



A lightweight, space-saving microwave absorbent, this material is designed for frequency coverage ranging from 9317 to 9434 mc. It is also available for coverage at other frequencies upon request. It measures 22 x 22 x 0.03 in., and weighs 2.5 to 3 oz per sq ft. Maximum reflection is rated at 4 per cent.

B.F. Goodrich Sponge Products, Dept. ED, Shelton, Conn.
IRE Booth No. 3232

CIRCLE 109 ON READER-SERVICE CARD

CIRCLE 110 ON READER-SERVICE CARD

VHF Transistors!

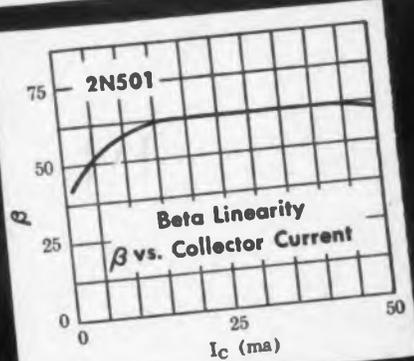
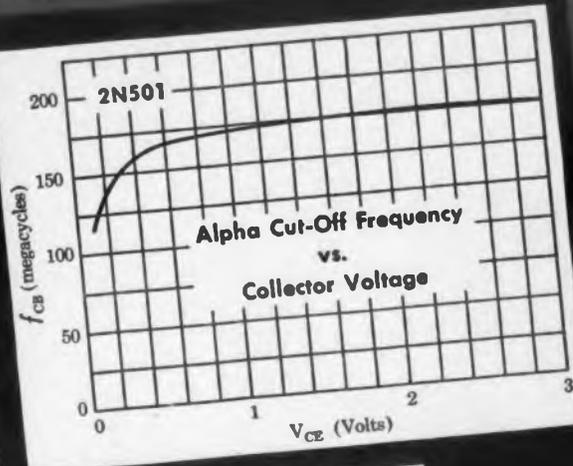
First From

PHILCO



New family of Micro Alloy Diffused-base Transistors (MADT)*

- Rise, Storage, Fall Time in Low μ sec Range
- High Oscillator efficiency at 200 mcs
- Amplifier gains of 10 db at 200 mcs



MADT FAMILY APPLICATIONS DATA

TYPE*	f _{max}	Power Gain	Oscillator Efficiency	Class of Use
2N499	250 mcs (min)	10 db at 100 mcs	25% at 100 mcs (min)	oscillator and amplifier to 100 mcs
2N500			25% at 200 mcs (min)	oscillator to 400 mcs
2N501		Ultra high-speed switch typical t _r = 12 μ sec; (18 max.); t _s = 7 μ sec; (12 max.); t _f = 4 μ sec; (10 max.). In circuit with current gain of 10 and voltage turnoff.		
2N502†	500 mcs	10 db at 200 mcs		amplifier to 250 mcs
2N503†		11 db at 100 mcs (min.)		amplifier to 100 mcs
2N504	50 mcs	46 db at 455 KC		high gain IF amplifier

*Available in voltage ratings up to 35V and dissipation ratings to 100 mw.
†In JETEC TO-5 Case (widely known as JETEC 30 Case).

Here is a major breakthrough in the frequency barrier . . . a new family of field-flow Micro Alloy Diffused-base Transistors. Philco MADT's extend the range of high gain, high frequency amplifiers; high speed computers; high gain, wideband amplifiers and other critical high frequency circuitry.

MADT's are available to various voltage and frequency specifications for design of high performance transistorized equipment through the entire VHF and part of the UHF spectrum. These transistors range in f_{max} from 250 mc to as high as 1000 mc. MADT gains are typically 10 db at 200 mc and greater than 16 db at 100 mc. A low cost general purpose unit is available which will deliver typically 18 db at 50 mc and 32 db at 10 mc.

Make Philco your prime source of information for high frequency transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. ED-358

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistor

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA



NEW PRODUCTS

at the IRE Show

Laminated Plastics

High temperature and
flame retardant

Phenolite grade G-11 is a glass base epoxy material which retains 70 per cent flexural strength at 150 C for one hour, and is stated to be superior to other glass base grades in insulation resistance and dielectric strength. It has high impact strength, low in water absorption and dissipation factor measurements, and meets MIL-P-18177-A. Type G-11 is also available as a copper clad material. Another material, grade XXXP-467, is a flame retardant hot punching type also being announced.

National Vulcanized Fibre Co., Dept. ED, Box 311, Wilmington, Del.

IRE Booth No. 4419, 4421

CIRCLE 111 ON READER-SERVICE CARD

Static Inverter Supplies

Provide 400 cps ± 0.01 per cent



This line of static inverter supplies has been developed from similar items which the company has been building for some time. Covering a range of power ratings, the units are particularly suitable for gyro wheel supplies or where 400 cps accurate to ± 0.01 per cent is required. Waveform, simplicity of circuitry, fast starting time, and good voltage regulation are featured.

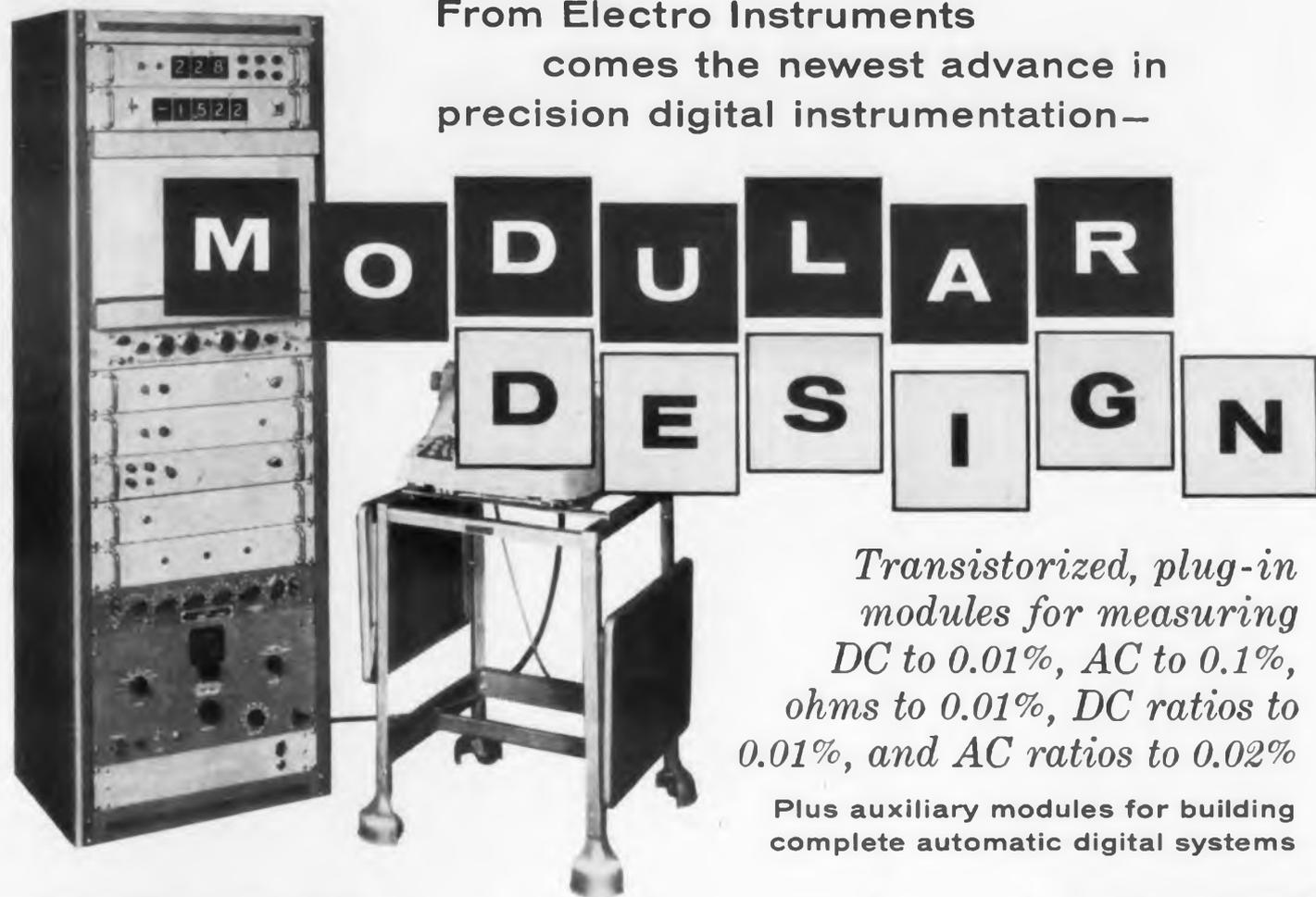
Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N.Y.

IRE Booth No. 1518 and 1520

CIRCLE 112 ON READER-SERVICE CARD

CIRCLE 113 ON READER-SERVICE CARD >

From Electro Instruments
comes the newest advance in
precision digital instrumentation—



*Transistorized, plug-in
modules for measuring
DC to 0.01%, AC to 0.1%,
ohms to 0.01%, DC ratios to
0.01%, and AC ratios to 0.02%*

Plus auxiliary modules for building
complete automatic digital systems

*Typical digital, missile electrical
checkout system using the new E-1
modular design. All E-1 modules
are designed to fit standard 19" racks.*



DC DIGITAL VOLTMETERS

Specifications	Model DVA-400	Model DVA-500
Display	4 digits, polarity, decimal point	5 digits, polarity, decimal point
Range	.0001-999.9 volts	0.0001-999.99 volts
Accuracy	± 1 digit	$\pm (0.01\% \text{ and } 1 \text{ digit})$
Automatic Features	Polarity, ranging	Polarity, ranging
Controls	Digits gain, manual and automatic ranging, power on-off-standby	Digits gain, manual and automatic ranging, power on-off-standby

Write for Bulletins 180.1 and 180.2



AC-DC DIGITAL VOLTMETERS

Specifications	Model DVA-410	Model DVA-510
DC	Same as DVA-400	Same as DVA-500
AC		
Accuracy	0.1% or 2 digits	0.1% or 2 digits
Frequency Response	30-10,000 cycles	30-10,000 cycles
Range	.0001-999.9 volts	0.0001-999.99 volts
Controls	Same as DVA-400, AC-DC	Same as DVA-500, AC-DC

Write for Bulletins 180.1, 180.2, 180.4

Now build precision
digital voltmeters,
digital ohmmeters,
digital ratiometers,
or complete digital,
missile electrical
checkout systems
from standard,
off-the-shelf modules.

Modules never become obsolete—As needs change simply regroup present modules or add new ones. Your system is always up-to-date at minimum cost and engineering. Internal construction is also modularized for maintenance ease.

Fully transistorized circuitry—All transistor circuits on encapsulated plug-in cards

- gives increased reliability
- reduces power consumption
- lowers heat dissipation
- permits miniaturized packages
- eliminates radio noise and line transients

Many new advanced application features and specifications—The result of thousands of applications and field experience from more than 2,500 digital instruments and systems.

- Now you can "read through" superimposed ripple on DC—and know its magnitude—by using the calibrated digits gain control located on the front panel. Steps by 1, 2, 3, 4, 5, 10, 50 and 100 digits.
- Controlled ranging by switch position—"automatic," "hold," "manual"—enables operator to manually control range position but still select automatic ranging in the same instrument.
- Power control for "on," "off," and "stand by" positions.
- Wider dynamic range covering all voltages from 100 microvolts to 1,000 volts, resistance range from 10 milliohms to 10 megohms—in single instruments.
- Input power frequencies from 50 to 400 cycles.
- New balance logic for faster down ranging.
- Automatic AC ranging from 30 to 10,000 cycles.
- Controlled stepping switch drive increases switch life by a factor of five—proved by actual tests.
- Meets many MIL specifications.

MAXIMUM FLEXIBILITY

1. Universal 3½" x 19" x 12" chassis with mounting hardware for any rack.
2. Digital outputs may also drive storage matrices, go-no go comparators, and other auxiliary modules.
3. All contacts readily accessible at rear panel on connectors.
4. With auxiliary plug-in modules, digitized data is provided in printed form, punched cards or tape with no modification to basic measuring instruments.



DIGITAL OHMMETERS

Specifications	Model DOA-400	Model DOA-500
Display	4 digits	5 digits
Range	00.01 ohms to 10 megohms	000.01 ohms to 10 megohms
Automatic Features	Ranging	Ranging
Controls	Digits gain, manual and automatic ranging, power on-off-standby	Digits gain, manual and automatic ranging, power on-off-standby

For accuracy specifications see Bulletin 180.3
Write for Bulletins 180.1, 180.3



AC RATIO METERS

Specifications	Model DRA-480	Model DRA-490
Display	5 digits	5 digits
Ratio Range	0.0000-1.0999	0.0000-1.0999
Accuracy*	± 2 digits	± 2 digits
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby, reference selector

External Reference 1 volt rms
*Calibration at 400 cycles; 60 cycle models also available.
Write for Bulletin 180.9



DC RATIO METERS

Specifications	Model DRC-400	Model DRC-500	Model DVC-400†
Display	4 digits	5 digits	4 digits, polarity
Ratio Range*	.0000-.9999	.00000-.99999	00.01-99.99 volts
Accuracy	± 1 digit	± (0.01% and 1 digit)	± 1 digit
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby	Digits gain, power on-off-standby

External Reference** 1 to 10 volts 10 to 100 volts ±100 volts
*Models DRA-400L and DRA-500L, 10% overscale read out. For higher ratio ranges, see Bulletin 180.7.
†Recommended for computer applications.
**Internal reference supply optional; specify DRA in place of DRC.
Write for Bulletins 180.1 and 180.7

Complete specifications are available on all basic and auxiliary modules. Write for your set of catalog sheets today.

**ELECTRO
INSTRUMENTS**
INC. 3794 Rosecrans Avenue
San Diego, California

Transistor Socket

Compression mounted Teflon unit

A low-loss transistor socket, Teflon-insulated for environmental extremes, has been announced. The sockets are of compression-mounted design to cut assembly time. They are also suitable for subminiature tubes with in-line leads, and are applicable to printed circuits.

Fluorocarbon Products, Inc., Div. of United States Gasket Co., Dept. ED, 602 N. 10th St., Camden, N.J.
IRE Booth No. 4036, 4037

CIRCLE 114 ON READER-SERVICE CARD

Shock Testing Machine

Portable unit for testing units up to 60 lb



Simulating shocks with closely controllable and repeatable waveforms, the type 15575 shock machine is a portable completely integrated instrument occupying 22 x 39 in. of floor space. Assemblies weighing up to 60 lb may be tested.

Utilizing the vertical-drop design, the unit requires no auxiliary reservoir of power, since impact on various materials of different configuration generate the desired wave shapes. The range of shock pulses provided is from 2 msec at up to 700 g peak acceleration to 60 msec at up to 25 g peak acceleration. Precision and uniformity of the pulse shape is preserved by structural rigidity in design.

Barry Controls, Inc., Dept. ED, 700 Pleasant St., Watertown 72, Mass.

IRE Booth No. 2534

CIRCLE 115 ON READER-SERVICE CARD

← CIRCLE 113 ON READER-SERVICE CARD

NEW

FILTORS NEW MICRO-MINIATURE...THE MOST ADVANCED DESIGN



Filtors, the leading specialists in the development and manufacture of sub-miniature relays is proud to announce the addition of the new Powrmite micro-miniature relay to its existing line of traditionally outstanding relays.

In every field of achievement there is always one leader. In

Leading manufacturers of hermetically sealed micro and sub-miniature relays.

relays with highest available reliability the leader is Filtors, Incorporated. All of the experience and know how gained in attaining its position of leadership have gone into making Filtors new Powrmite micro-miniature relay *truly reliable*—again the leader in a field of many.

FILTORS, INC.

Main office and plant: Port Washington, N. Y., POrt Washington 7-8220
West coast office: 13273 Ventura Blvd., Studio City, Cal., STanley 3-2770

VIBRATION 20 G'S AT 2000 CPS •
50 G'S SHOCK • 2 AMP OR DRY
CIRCUIT • -65°C. TO +125°C.

NEW PRODUCTS

at the IRE Show

Binary Timer

Generates 128 binary counts



This binary timer provides 128 binary counts at a rate of one per second. The unit is comprised of a recently designed commutator and brush assembly plus low inertia gold plated code drums driven by a 28 v dc chronometric type motor. Each data frame, or second of time, contains a synchronizing commutator pulse, followed by an identifying 8 bit train of pulses.

Instrument Development Labs., Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.

IRE Booth No. 3925

CIRCLE 117 ON READER-SERVICE CARD

Choppers

Noise level below 10 μ v

Type 2300 and 2400 choppers feature noise levels below 10 μ v in low-impedance circuits. These noise levels are for band widths extending from a few cps up to 40 kc, and are measured by a thermocouple voltmeter for a true rms reading. These few microvolts of chopper noise can be further reduced by restricting the band width.

The contacts are rated for operation in dry and nearly dry circuits, yet will withstand surges as high as 2 ma at 100 v into resistive loads. Drive is rated at either 400 \pm 20 cps (type 2300) or 60 \pm 6 cps (type 2400) at 6.3 \pm 0.6 volts rms. Normal operating temperature range is -65 to +100 C. In usual applications the choppers can be expected to remain within ratings for over 5000 hours.

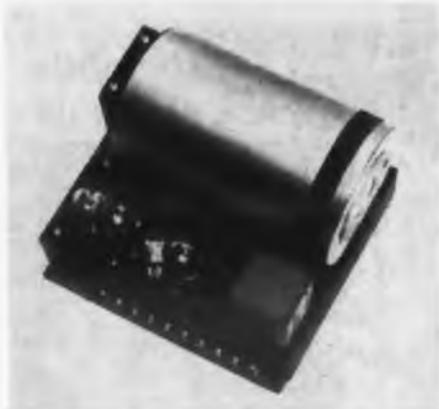
Airpax Products Co., Cambridge Div., Dept. ED, Cambridge, Md.
IRE Booth No. 3502, 3504

CIRCLE 118 ON READER-SERVICE CARD

← CIRCLE 116 ON READER-SERVICE CARD

Fork Amplifier

Frequency accurate to 1 part in 10^7



The fork amplifier, model FK5, is designed for maximum frequency stability. An oven is added for applications requiring a frequency source accurate to 1 part in 10^7 . The FK5 chassis is 6-5/8 x 6-1/2 x 4 in. high, and the FK5A (with oven) is 5-1/6 in. high. The amplifier may be mounted in any position. Power requirement is 200-300 v dc and 6.3 v ac. No regulated B+ supply is required. Temperature stability of the oven is well within 0.1 C at the fork assembly.

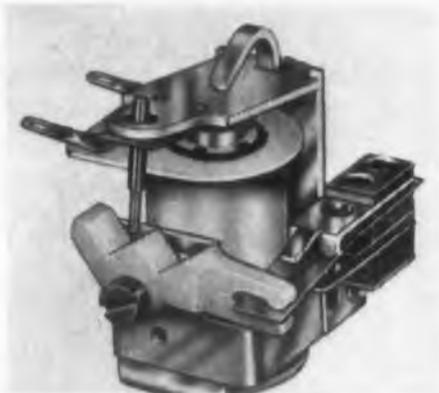
Time Facsimile Corp., Dept. ED, 540 W. 58th St., New York 19, N.Y.

IRE Booth No. 1824

CIRCLE 119 ON READER-SERVICE CARD

Impulse Latching Relay

One coil provides efficient operation



Type W impulse latching relay features an insulated rocker arm activated by a single coil, instead of the two coils usually used. In this one-coil design, the contacts are set up in one position when the coil is energized or pulsed and return to the first position on the next pulse.

Designed for both ac or dc operation, the relay has a coil rated from 2 to 7 w dc, or from 15 va to 115 va ac. The larger values are for a 4 pdt combination. The relay measures about 2 in. high.

Comar Electric Co., Dept. ED, 3349 W. Addison St., Chicago 18, Ill.

IRE Booth No. 3821

CIRCLE 120 ON READER-SERVICE CARD

CIRCLE 121 ON READER-SERVICE CARD >



At IBM Poughkeepsie, N. Y.

Where high temperature plastic tubing is necessary as capacitor lead insulation in their electric accounting machines, IBM counts on Turbotherm® 105 or Turbotrans® 105 U/L approved extruded tubing. In addition, Turbotrans 105 tubing meets the requirements of MIL-I-631C, Grade c, Class II, Category 1.



BE SURE TO VISIT THE

SEE HOW BRAND ELECTRICAL INSULATING TUBINGS

assure product performance
for major manufacturers

At United Transformer New York, New York

To assure long service life, U.T.C. covers the leads of their high temperature transformers with Turbo 117[®] silicone rubber coated glass tubing. A Class H material with outstanding heat resistance and low temperature flexibility, the five available grades meet NEMA VS1-1957 and the performance requirements of MIL-I-3190A.



At Allis-Chalmers Norwood, Ohio

For stator connections in their semi-enclosed slot motors, Allis-Chalmers uses Turbotuf[®], a highly flexible, heat resistant, vinyl coated glass tubing. This Class B material is supplied in two grades meeting all requirements of the NEMA VS1-1957 and the MIL-I-3190A specifications.

At American Bosch Springfield, Mass.

Miniature electric windshield wiper motors require moisture resistant insulation, so American Bosch chooses Turbo[®] varnished tubing, a cotton or rayon braid coated with a tough, organic varnish. Manufactured in five grades it meets the Class A requirements of MIL-I-3190A, ASTM D-372, and NEMA VS1-1957.



At Lockheed Marietta, Georgia

To provide low temperature abrasion protection for wiring assemblies, Lockheed uses Turbozone[®] 40 extruded plastic tubing for use in the C-130 Hercules. This tubing meets the requirements of MIL-I-7444A(2) and is available in three size ranges — from .022" to 2.500" inside diameter.



At Avco's Crosley Div. Cincinnati, Ohio

For applications ranging from test and fire control equipment to navigational and radar units, Crosley selects Turbolex[®] 76 general purpose plastic tubing, a flame and fungus resistant material operable from -40°C to +80°C. This tubing meets MIL-I-631C, Grade a, Class 1, Category 1 and ASTM D-922.

High dielectric strength; flame, fungus, moisture, solvent or abrasion resistance; low temperature flexibility; high temperature operation; chemical inertness . . . whatever your requirement in a coated textile or an extruded plastic tubing, there is a Brand product to meet your specifications. Turbo tubings are manufactured in all standard colors and a range of sizes #24 (.022") to 2½" I.D. Produced with engineer-supervised techniques, subjected to continuous in-process inspection testing, Turbo tubings meet and exceed all applicable military and commercial specifications. Samples are available, your inquiry is invited.

THE WILLIAM BRAND & CO., INCORPORATED

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electrical and electronic wires and cables • harnesses and cable assemblies • plastic and coated insulating tubings
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BRAND SUITE AT THE BARBIZON-PLAZA HOTEL DURING THE I.R.E. SHOW

GENERAL TRANSISTOR'S PRODUCTION

Breakthru

PNP	NPN	NPN
2N 315	2N 356	2N 444
2N 316	2N 357	2N 445
2N 317	2N 358	2N 446
		2N 447

- NEW MODERN PLANTS
- EXPANDED FACILITIES
- STREAMLINED ORGANIZATION
- STEPPED-UP PRODUCTION
- INCREASED LABOR FORCE
- APPLIED RESEARCH

Modern success stories don't "happen," they're caused — that's why General Transistor started "Operation Breakthru" 10 months ago.

Management recognized that a surge of increased business could strain manufacturing and quality control facilities. Before a bind could develop, "operation breakthru" was inaugurated . . . and can now be called a complete success.

Another modern manufacturing plant was added to General Transistor's 3 plants — this additional facility increases storage area, expands the quality control section and enlarges the manufacturing space. Additional equipment and machinery have been purchased. Technical and labor force have been increased to satisfy the demand of industry.

Operation breakthru is a success — your assurance of continued reliable production, prompt deliveries and realistic prices.

The management and employees of General Transistor wish to thank their customers for making

GENERAL TRANSISTOR—"THE FASTEST GROWING NAME IN TRANSISTORS"
Write today for complete all types list wall chart.

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GENERAL TRANSISTOR CORP.

91-27 138TH PLACE JAMAICA 36, NEW YORK

In Canada: Desser E-E Ltd., 441 St. Francis Xavier, Montreal 1, Quebec
FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP. 95-27 SUTPHIN BLVD. JAMAICA 35, NEW YORK
FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP.
91-27 138TH PLACE JAMAICA 35, NEW YORK



NEW PRODUCTS at the IRE Show

Rheostats

Ring types rated at 100 and 150 w



These 100 and 150 w ring rheostats have twin-shoe self-lubricating contacts; molded ceramic base and core featuring high density, low porosity, and high dielectric strength. Ratings of 100 and 150 w rings are based on a 300 C rise in 40 C ambient. Both sizes are available in resistance values to 10,000 ohms. Tapered windings, tandem mountings, dial plates, and other accessories are available.

Ward Leonard Electric Co.,
Dept. ED, Mt. Vernon, N.Y.
IRE Booth No. 2231

CIRCLE 123 ON READER-SERVICE CARD

Chopper

Thermal stability low noise

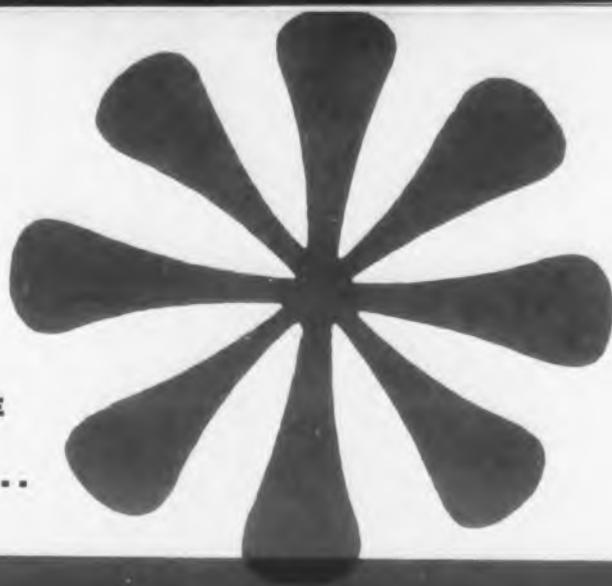


Having low thermal construction, this chopper is useful in dc amplifiers requiring thermal stability and low noise. Contact ratings and reliability are identical with the company's standard external coil units. As in the standard

◀ CIRCLE 122 ON READER-SERVICE CARD

CIRCLE 506 ON READER-SERVICE CARD ▶

YOUR
REFERENCE
GUIDE TO....

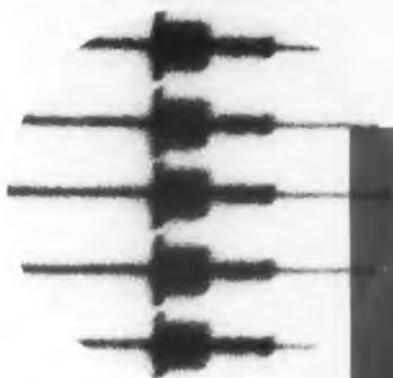
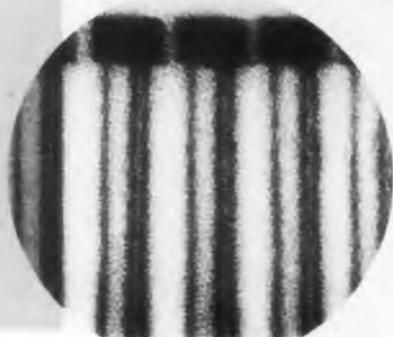


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A WIDE
SELECTION OF
Transistors
COVERING ALL
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COMPLETE
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OF
Rectifiers
WITH
BROAD
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Breakthru

PNP	NPN	NPN
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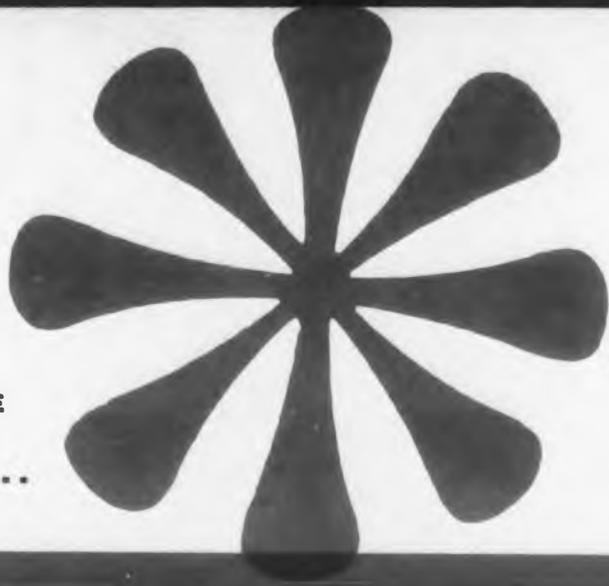


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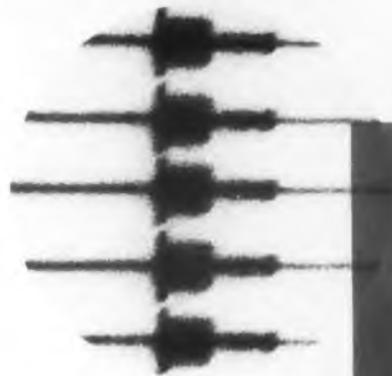
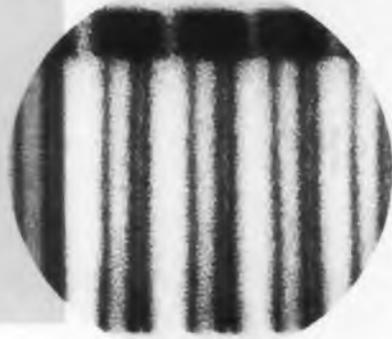


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SILICON	AMPLIFIER & COMPUTER				2N332 2N333 2N335	
	UNIJUNCTION				2N489* 2N490* 2N491* 2N492* 2N493* 2N494* *A PN Device	
POWER					2N451 2N452 2N453 2N454	
GERMANIUM	AUDIO PNP	2N43 2N43A 2N44 2N44A		2N525		
	COMPUTER PNP	2N123		2N394 2N395 2N396 2N397 2N450 2N518		
	COMPUTER NPN				2N78 2N167 2N78	
	HIGH FREQ. AMPLIFIER NPN					
	TETRODE NPN					4JD3BI
	IF NPN				2N168A 2N169 2N169A 2N292 2N293	
GERMANIUM	AUDIO PNP	2N186 2N186A 2N187 2N187A 2N188 2N188A 2N189 2N190 2N191 2N192 2N241 2N241A 2N265				
			2N319 2N320 2N321 2N322 2N323 2N324 2N508			

FOLD OUT PAGE FOR G-E RECTIFIERS

RECTIFIERS for your every need!

SILICON / GERMANIUM
GREATER POWER - HIGHER TEMPERATURE RATINGS

G-E Semiconductor Rectifiers are the largest selling in the industry!

1N115 Series: For direct chassis mtd., or on lins, permitting forward currents up to 1.5 amps, temperature up to 170° C with derating. Extremely low reverse current at max. junction temperature. **1N253 Series** offers specifications designed for applications requiring forward current up to 1.0 amp, temperature up to 150° C, such as power supplies and magnetic amplifiers.



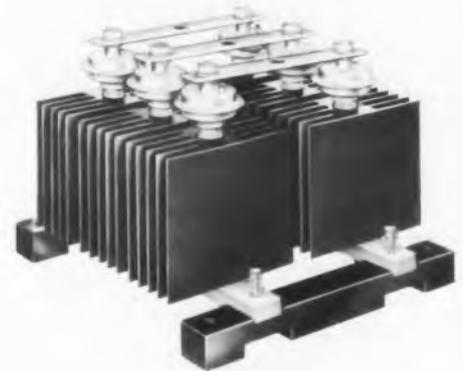
SILICON
LOW
CURRENT



4JA411 Stacks: Combine high temperature operation (up to 150° C) with increased ratings (up to 18 amps d-c). Hundreds of stack combinations to meet a variety of circuit conditions. High efficiency plus excellent regulation.



SILICON
HIGH
CURRENT



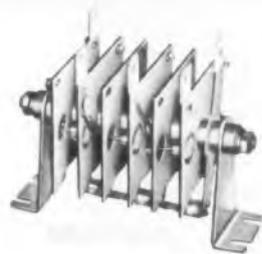
Large area junction type. Operating temperature to 200° C. D-C outputs as high as 85 amps per rectifying element. Lower cost 4JA62 and 6211 units are for applications which do not require the full current ratings of 4JA60 line. Reverse polarities provided in 4JA61 and 4JA63 units. Stack combinations offer d-c outputs up to 915 amps.

1N536 Series; 1N1095-96: Designed for maximum forward conductance at high operating temperatures. The 1N440-440B Series is similar to the 1N536 Series but with extremely low reverse current. The 1N1487 Series provides less expensive units for lower temperature requirements. No heat sink required. Ratings up to 160° C ambient.

Designed for individual cell applications in the 2 to 20 amp. range. High junction temperature ratings, extremely low forward voltage drop and thermal resistance. May be mounted directly or electrically insulated from heat sink with mica-washer mounting kit provided with each unit.



SILICON
MEDIUM
CURRENT

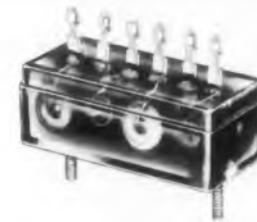


Stacks provide a broad range of power applications with d-c outputs up to 100 amps.

Mounted in standard eight-pin tube base (4JA220 and 4JA420 Series) or rectangular design with solder lug connections (4JA221 and 4JA421 Series). Available in a large number of circuit configurations. One to six cells may be potted in a single circuit. Individual cell specifications determine ratings. Derating from free air ratings is not necessary. 4JA220-21 Series utilize 1N91-93 cells; 4JA420-21 Series utilizes 1N536-540, 1N1095-96 cells. (See BASIC RATING CHART)



POTTED
RECTIFIER
CIRCUITS



4JA221 Series (Germanium)
4JA421 Series (Silicon)



USAF1N315 1N315, 1N368
1N91 Series

USAF1N315; 1N315: Designed for high operating temp. (up to 85° C) and low reverse current. USAF1N315 meets Air Force Specification MIL-E-1/1088. The 1N368 type features a very low reverse current at a high d-c reverse voltage. **1N91 Series:** Alloyed junction type combining very low forward resistance with high back resistance to give almost 100% efficiency. 1N93 is the commercial version of the G-E U.S. Navy approved USN 1N93 rectifier. 1N151 Series and 1N158 are single and double-fin units, respectively.

GERMANIUM
LOW
CURRENT



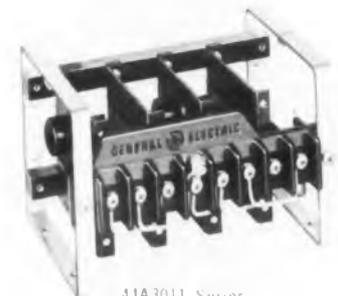
4JA211 Series

4JA211 Stacks: The industry's most widely used semiconductor rectifier. Hundreds of thousands in use. May be arranged in stacks up to 12 fins to produce over 160 different circuit configurations. Small size, light weight, excellent regulation.

GERMANIUM
MEDIUM
CURRENT



Single Fin Mount



4JA3011 Series

For general purpose power supplies, control devices, blocking circuits, and many other applications. Extremely low power dissipation and forward voltage drop provide excellent regulation and efficiency. Available in stacks up to 12 fins providing ratings in thousands of watts, depending on circuit design, with operation to 85° C. Transient PIV's up to 600 volts per cell.

BASIC RATING CHART

Choose the performance range required for your particular needs from one of the most comprehensive line of rectifiers in the industry. Complete specifications are available through your distributor or G-E Semiconductor Products Dept. District Sales Office. Order by JETEC or G-E Type No.

RECTIFIER CELLS

JETEC or G-E Type No.	PIV	Max. I_{oc} at T°C	Max. 1 Cycle (60 cps) Surge	Max. Storage Temp. °C
1N91	100	150ma at 55° amb.	25A	85°
1N92	200	100ma at 55° amb.	25A	85°
1N93	300	75ma at 55° amb.	25A	85°
USN1N93	300	75ma at 55° amb.	25A	85°
1N151	100	500ma at 55° amb.	25A	85°
1N152	200	500ma at 55° amb.	25A	85°
1N153	300	500ma at 55° amb.	25A	85°
1N158	380	500ma at 55° amb.	25A	85°
1N253	95	1000ma at 135° stud	4A	150°
1N254	190	400ma at 135° stud	1.5A	150°
1N255	380	400ma at 135° stud	1.5A	150°
1N256	570	200ma at 135° stud	1.5A	150°
1N315	100	100ma at 85° amb.	5A	95°
USAF1N315	100	100ma at 85° amb.	5A	100°
1N368	200	100ma at 85° amb.	10A	85°
1N440	100	300ma at 100° amb.	15A	175°
1N440B	100	500ma at 100° amb.	15A	175°
1N441	200	300ma at 100° amb.	15A	175°
1N441B	200	500ma at 100° amb.	15A	175°
1N442	300	300ma at 100° amb.	15A	175°
1N442B	300	500ma at 100° amb.	15A	175°
1N443	400	300ma at 100° amb.	15A	175°
1N443B	400	500ma at 100° amb.	15A	175°
1N444	500	300ma at 100° amb.	15A	175°
1N444B	500	425ma at 100° amb.	15A	175°
1N445	600	300ma at 100° amb.	15A	175°
1N445B	600	350ma at 100° amb.	15A	175°
1N536	50	500ma at 100° amb.	15A	175°
1N537	100	500ma at 100° amb.	15A	175°
1N538	200	500ma at 100° amb.	15A	175°
1N539	300	500ma at 100° amb.	15A	175°
1N540	400	500ma at 100° amb.	15A	175°
1N1095	500	425ma at 100° amb.	15A	175°
1N1096	600	350ma at 100° amb.	15A	175°
1N1115	100	1.5A at 85° stud	15A	175°
1N1116	200	1.5A at 85° stud	15A	175°
1N1117	300	1.5A at 85° stud	15A	175°
1N1118	400	1.5A at 85° stud	15A	175°
1N1119	500	1.5A at 85° stud	15A	175°
1N1120	600	1.5A at 85° stud	15A	175°
1N1301	50	1.5A at 85° stud	300A	200°
1N1302	100	1.5A at 160° stud	300A	200°
1N1304	200	1.5A at 160° stud	300A	200°
1N1306	300	1.5A at 160° stud	300A	200°
1N1487	100	250ma at 125° amb.	15A	175°
1N1488	200	250ma at 125° amb.	15A	175°
1N1489	300	250ma at 125° amb.	15A	175°
1N1490	400	250ma at 125° amb.	15A	175°
1N1491	500	250ma at 110° amb.	15A	175°
1N1492	600	250ma at 95° amb.	15A	175°
4JA60A	100	70A at 120° stud	900A	200°
4JA60B	200	70A at 120° stud	900A	200°
4JA60C	300	70A at 120° stud	900A	200°
4JA60F	50	70A at 120° stud	900A	200°
4JA60G	150	70A at 120° stud	900A	200°
4JA60H	250	70A at 120° stud	900A	200°
4JA61A	same as 4JA60A, except reverse polarity			
4JA61B	same as 4JA60B, except reverse polarity			
4JA61C	same as 4JA60C, except reverse polarity			
4JA61F	same as 4JA60F, except reverse polarity			
4JA61G	same as 4JA60G, except reverse polarity			
4JA61H	same as 4JA60H, except reverse polarity			
4JA62A	100	40A at 120° stud	900A	200°
4JA62B	200	40A at 120° stud	900A	200°
4JA62C	300	40A at 120° stud	900A	200°
4JA62D	400	40A at 120° stud	900A	200°
4JA62F	50	40A at 120° stud	900A	200°
4JA62G	150	40A at 120° stud	900A	200°
4JA62H	250	40A at 120° stud	900A	200°
4JA62J	350	40A at 120° stud	900A	200°
4JA63A	same as 4JA62A, except reverse polarity			
4JA63B	same as 4JA62B, except reverse polarity			
4JA63C	same as 4JA62C, except reverse polarity			
4JA63D	same as 4JA62D, except reverse polarity			
4JA63F	same as 4JA62F, except reverse polarity			
4JA63G	same as 4JA62G, except reverse polarity			
4JA63H	same as 4JA62H, except reverse polarity			
4JA63J	same as 4JA62J, except reverse polarity			

RECTIFIER STACKS

G-E Type	PIV (up to)	Max. I_{oc} at T°C (up to)
4JA211	630 V	6 amps. at 55° amb.
4JA411	3360 V	18 amps. at 25° amb.
4JA3011	630 V	48 amps. at 55° amb.
4JA3511	630 V	100 amps. at 55° amb.
4JA6011	840 V	573 amps. at 35° amb.
4JA6211	840 V	430 amps. at 35° amb.



SILICON / GERMANIUM ADVANCEMENTS

MEAN GREATER STABILITY - FASTER SWITCHING - MORE POWER

General Electric's new streamlined line of transistors offers you both standard reliable transistors that you have used successfully for years, and exciting new devices that are extending the range of applications suitable for transistorization.

For multivibrators, pulse generators, flip-flops, etc., the Unijunction Transistor enables you to simplify circuitry, and in many cases reduce the number of transistors used by as much as half.

For servo amplifiers, switches, DC to DC (or AC) converters, etc., G.E.'s Silicon Power Transistor's power handling ability allows you to design equipment never before practical.

For high frequency switching applications, the 2N394-2N397's extreme stability of h_{FE} and I_{CO} - I_{EO} simplify your design problems and contribute to high equipment reliability.

Whatever your application is, be sure to check your G-E Semiconductor Products District Sales Manager first.



MAXIMUM RATINGS

TYPICAL VALUES

MAXIMUM COLLECTOR DISSIPATION (@ 25° C (mw) P _C)	BREAKDOWN VOLTAGE (VOLTS) BV _{CB}	COLLECTOR CURRENT (ma) I _C	MAXIMUM STORAGE TEMP. (° C) T _{STG}	D-C CURRENT GAIN h _{FE}	ALPHA CUTOFF FREQ. (mc) f _α	POWER GAIN (db) G _e	SATURATION VOLTAGE (VOLTS) V _{CE (SAT)}	COLLECTOR CAPACITY (μaf) C _{ob}	COLLECTOR TO BASE CURRENT (μa) MAX I _{CO} (@ V _{CB})	
150	45	25	200	15	30.0	35	.4	7	4	30
150	45	25	200	35	33.0	39	.4	7	4	30
150	45	25	200	50	38.0	42	.4	7	4	30
P _{AV}	BV _{CB}	I _C	T _{STG}	η	f _{max}	R _{θJC}	V _{BE (SAT)}	I _{BE (MOD)}	I _{CO} @ V _{CB}	
350	45	50	200	0.56	0.9	5.6	2.2	12	1	60
350	55	50	200	0.56	0.7	7.5	2.4	12	1	60
350	45	50	200	0.62	0.8	5.6	2.6	12	1	60
350	55	50	200	0.62	0.7	7.5	2.8	12	1	60
350	45	50	200	0.68	0.7	5.6	3.0	12	1	60
350	55	50	200	0.68	0.65	7.5	3.2	12	1	60
P _C	BV _{CE}	I _C		h _{FE}	f _α	R _{θJC} (MAX) Ohms		I _{BE (MOD)}	I _{CO} (ma) @ V _{CB}	
85w	65	5A	150	16	400kc	4			20	65
85w	65	5A	150	12	400kc	2.5			50	65
85w	30	2A	150	30	400kc	6			20	30
85w	65	2A	150	15	400kc	10			20	65
					f _α	G _e	Freq of G _e	C _{ob}	(μaf)	
240	-30	-300	100	53	1.3			40	-16	-45
155*	-25*		100	53	1.3			40	-16	-45
240	-30	-300	100	31	1.0			40	-16	-45
155*	-25*		100	31	1.0			40	-16	-45
240	-30	-300	100	52	2.5			25	-10	-45
*Ratings based on military test requirements										
150	-15	-125	85	30 Min.	8.0			15	-6	-20
150	-10	-200	100	20 Min.	5.5			12	-6	-10
150	-15	-200	100	25 Min.	7.0			12	-6	-15
150	-20	-200	100	30 Min.	7.0			12	-6	-20
150	-10	-250	100	30 Min.	10.0			12	-6	-10
150	-12	-125	85	30 Min.	6.0			12	-6	-6
150	-12	-125	85	60 Min.	11.0			12	-6	-12
65	15	20	85	70	9.0			3	5	15
75	30	75	85	30	9.0			2.5	1.5	15
65	15	20	85	70	9.0	28	500kc	3	5	15
50	10	20	85		100.0	14	60mc	1.8	25	7
65	15	20	85	40	8.0	30	455kc	2.4	5	15
65	15	20	85	72	9.0	24	455kc	2.1	5	15
65	25	20	85	72	9.0	24	455kc	2.4	5	15
65	15	20	85	25	6.0	24	455kc	2.1	5	15
65	15	20	85	25	7.0	30	455kc	2.4	5	15
							P ₀			
100	-25	-200	85	24	0.8	28	300	40	-16	-25
200	-25	-200	85	24	0.8	30	750	40	-16	-25
100	-25	-200	85	36	1.0	30	300	40	-16	-25
200	-25	-200	85	36	1.0	30	750	40	-16	-25
100	-25	-200	85	54	1.2	32	300	40	-16	-25
200	-25	-200	85	54	1.2	32	750	40	-16	-25
75	-25	-50	85	24	0.8	37		40	-16	-25
75	-25	-50	85	36	1.0	39		40	-16	-25
75	-25	-50	85	54	1.2	41		40	-16	-25
75	-25	-50	85	75	1.5	43		40	-16	-25
100	-25	-200	85	73	1.3	35	300	40	-16	-25
200	-25	-200	85	73	1.3	35	750	40	-16	-25
75	-25	-50	85	110	1.5	45		40	-16	-25
240	-20	-200	85	33	2.0	30	750	25	-16	-25
240	-20	-200	85	48	2.5	32	750	25	-16	-25
240	-20	-200	85	48	3.0	35	750	25	-16	-25
140	-16	-100	85	70	2.0	39		25	-16	-16
140	-16	-100	85	90	2.5	41		25	-16	-16
140	-16	-100	85	80	3.0	43		25	-16	-16
140	-16	-100	85	125	3.5	45		25	-16	-16

Geared
to
Serve
You

Many G-E Tu
transistors and
Check for your
out to your gro
rectifiers, see y



The man to know: your r

Headquarters
General Electric Company
1224 West Genesee Street
Syracuse, New York
Phone: GRanite 6-4411

General Electric Company
701 Washington Street
Newtonville 60, Mass.
Phone: DEcatur 2-7120
F. J. Van Poppelen, Jr.

The foregoing specifications and data are presented to give you a general and compact guide to General Electric's broad line of Semiconductor Products. You may obtain detailed information concerning any of the devices listed by contacting your nearest G-E Semiconductor district representative, your local G-E Tube Distributor, or by writing to:

**General Electric Company
Semiconductor Products Department
1224 West Genesee Street
Syracuse, New York**

ny G-E Tube Distributors now have adequate inventories of G-E
istors and rectifiers to give you immediate delivery on your orders.
eck for yourself and see if his service facilities and prices don't work
to your great advantage. For really fast delivery of transistors and
tifiers, see your G-E Tube Distributor first.



QUICK REFERENCE TRANSISTOR MANUAL

This famous pocket-size reference is now in its enlarged second edition. It gives you all the facts—

- Basic Semiconductor Theory
- Parameter Symbols
- Specifications of G-E Transistor Types
- Tabulation of JETEC Registered Types
- Application and Design Information
- Circuit Diagrams

and other information frequently needed.

This 112 page manual is available at your local G-E Tube Distributor, or enclose 50 cents (no stamps, please).

Write to your nearest G-E Semiconductor Products representative

Company Street
111
General Electric Company
2111 South Green Road
Cleveland 21, Ohio
Phone: EVergreen 2-0680
A. C. Osinck

Company Street
1
General Electric Company
1434 Westwood Blvd.
Los Angeles, California
Phones: BRadshaw 2-7322
GRanite 8-8312

20
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R. W. Olsen

General Electric Company
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Clifton, New Jersey
Phones: GRegory 3-6387
New York—WIsconsin 7-4065
A. Woolaver
J. G. Walton
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D. W. L. Hickie

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Skokie, Illinois
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Chicago—IRying 8-8668
R. E. Berry
V. J. Huntoon
L. A. Mooney
R. R. Faullin

GENERAL  ELECTRIC

units, this chopper has complete electrostatic shielding of the coil from the contact assembly. Modular construction permits use of interchangeable coils in the operating frequency range of 0-700 cps. Thermal stability under general laboratory conditions is less than $\pm 2 \mu\text{v}$.

The Bristol Company, Dept. ED, Waterbury 20, Conn.
IRE Booth No. 3932

CIRCLE 124 ON READER-SERVICE CARD

Sweep and CW Signal Generator

Separate units providing sweep-marker



Model M5-X/L5-X is a combination of two separate instruments which work together to provide a sweep-marker system. This instrument covers a range of 20 to 40 mc with other ranges from 1 mc to 100 mc available.

The top unit contains two identical variable oscillator and attenuator systems. Each oscillator provides 1 v rms into 50 ohms (metered). Frequency calibration is made in 0.25 mc increments, with accuracy of better than 0.25 per cent. The bottom unit is the sweep generator which provides 1 v rms into 50 ohms. Output is flat to better than 5 per cent, with sweep width variable from 0 to 40 per cent of center frequency. Included in this section is a crystal-controlled 1 mc harmonic generator marker system and output attenuator.

Telonic Industries, Inc., Dept. ED, 73 N. 2nd Ave., Beech Grove, Ind.

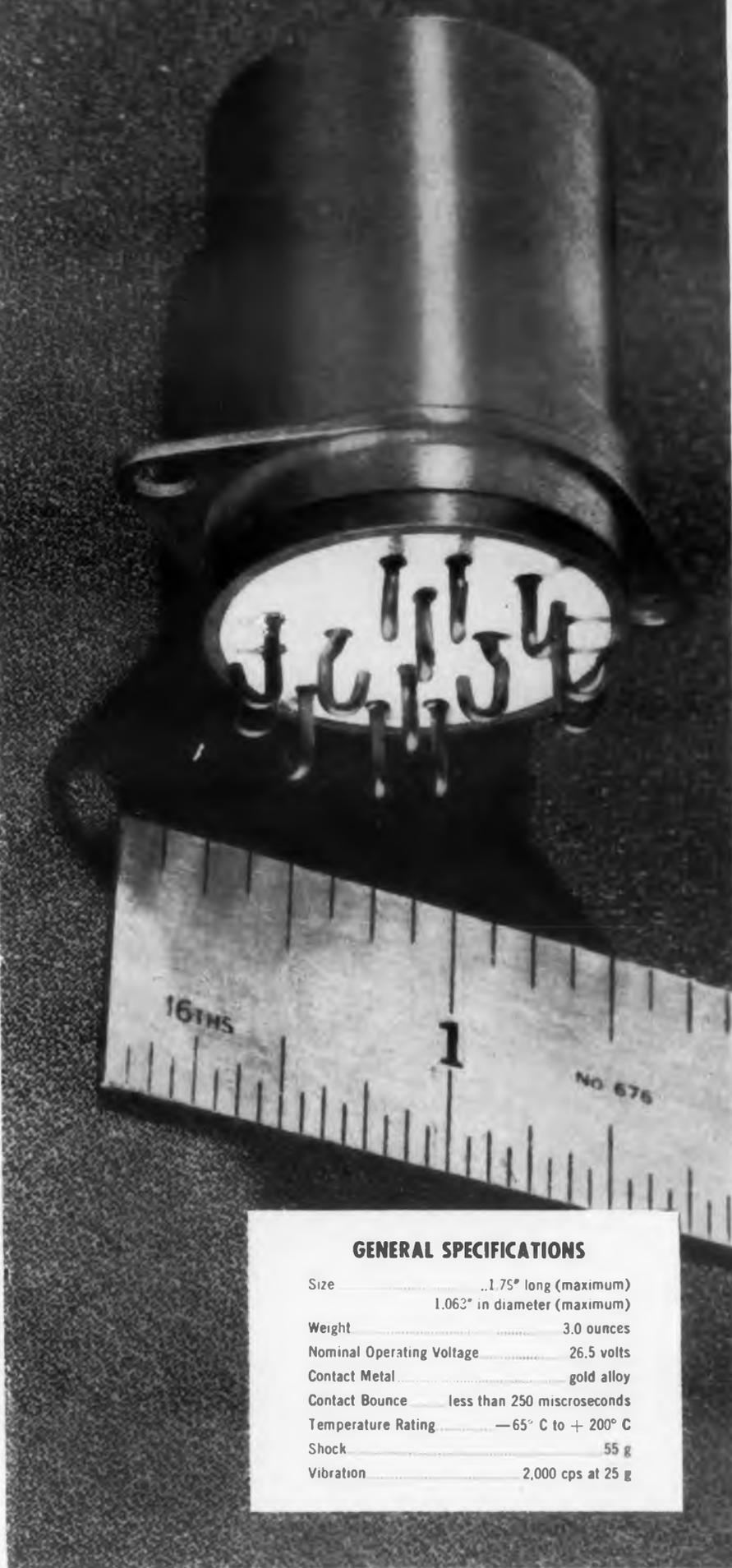
IRE Booth No. 3826

CIRCLE 125 ON READER-SERVICE CARD

◀ CIRCLE 506 ON READER-SERVICE CARD

CIRCLE 126 ON READER-SERVICE CARD ▶

FOR THE FIRST TIME



GENERAL SPECIFICATIONS

Size1.75" long (maximum)
1.063" in diameter (maximum)
Weight3.0 ounces
Nominal Operating Voltage26.5 volts
Contact Metalgold alloy
Contact Bounceless than 250 microseconds
Temperature Rating-65° C to +200° C
Shock55 g
Vibration2,000 cps at 25 g

a new 4PDT relay to meet all requirements of MIL-R-25018!

Don't compromise with the Class C, Type II, Grade 3 requirements of MS 24114-9, MIL-R-25018. You don't have to any more. Now Union Switch & Signal has a 4PDT, rotary-armature relay designed to meet these specifications *completely*. It is the first of its type to do so. In fact, it *exceeds* some of the rugged requirements.

Here is the kind of performance you can expect from this new relay:

High operating temperature. Even at an ambient temperature of 200° C, this relay gives optimum performance. The use of ceramic material provides consistently high insulation resistance. As a result, you can install this relay closer to engines. You often can use it *without* temperature controlled boxes. Always, you will find it supremely rugged and reliable.

High in shock resistance. This new UNION Relay withstands shock *greater* than 55 g for 11 milliseconds—and continues to operate. In vibration tests, it shows no contact chatter up to 2,000 cycles at an acceleration of 25 g.

New high in contact reliability. Contact reliability of this relay is *six times* that of comparable devices because of its new 2-button, bifurcated contacts. Bifurcation also increases current carrying capacity (each button easily handles a full 2-ampere load) . . . and makes gold alloy contacts practical for both low- and high-level loads.

Contact reliability is enhanced, too, by the ceramic insulation which contains no volatile material to contaminate contacts and by separate hermetic sealing of the magnet coil.

New torsion-type rotary-armature suspension improves resistance to thermal shock . . . increases reliability over the entire temperature range . . . and greatly extends the operating life of this new 4PDT relay. Call or send the coupon for complete information about this and other miniature relays manufactured by Union Switch & Signal.

COMPLETE FACTS

Union Switch & Signal, Dept. ED-38
Division of Westinghouse Air Brake Co.
Pittsburgh 18, Pennsylvania

Please send the following:

Complete description of your new 4PDT relay which meets every requirement of MIL-R-25018. Catalog of other miniature dc and ac relays which you manufacture to MIL-R-25018, MIL-R-6106C, and MIL-R-5757C requirements. Description of your Digital and Alpha-Numerical Indicators for data display.

Name

Position

Firm

Address

City State

Also, put me on your technical mailing list.

See our Booth # 2122-2124 at IRE Show—New York City



UNION SWITCH & SIGNAL

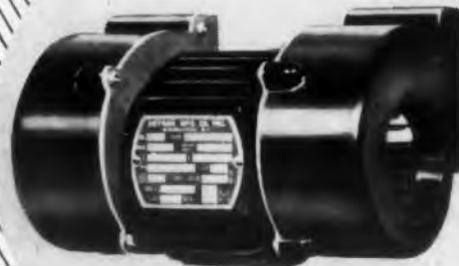
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

From sea level to 70,000 ft.

ROTRON 400 CPS
ALTIVAR® fans
are 500% lighter,
draw 95% less power,
are 50% quieter
... compared with any
conventional
constant speed counterpart.

- **ALTIVAR**® induction motor fans increase speed 3 to 5 times from sea level to 70,000 ft.
- This pioneer development by Rotron in 1953 made high-altitude cooling a practical proposition for the first time.
- The air movers shown here and others can be provided with Rotron **ALTIVAR**® high-altitude motors. The Rotron catalog lists numerous standard **ALTIVAR**® designs. Others will be built to order.



See Rotron At IRE Booths 2334-2336



ROTRON mfg. co., inc.
WOODSTOCK • NEW YORK

CIRCLE 127 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Coaxial Termination

Terminates pulses with 1 μ sec time



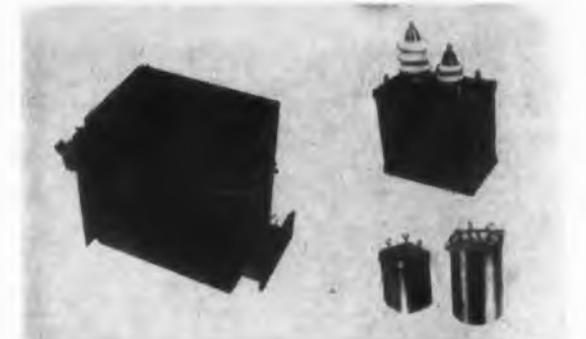
A one per cent terminating resistor mounted in a BNC male connector provides resistance values of 50, 73, and 93 ohms. The units can be used as satisfactory terminations in wide band pulse line systems from dc to pulses of one μ sec rise time (approximately 400 mc). Maximum rated pulse voltage is 200 v and average rated power dissipation is 1/2 w.

Electrical & Physical Instrument Corp., Engineering Div., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.
IRE Booth No. 3240

CIRCLE 128 ON READER-SERVICE CARD

Transformer Line

High power pulse types plus others



This microwave manufacturer is offering a variety of magnetic components and assemblies, including high and low power pulse transformers, specialized audio transformers, current limiting filament transformers for high power magnetrons, and hermetically sealed power supplies. Radar modulators in sealed packages of minimum size and weight are also available including soft tube conventional types and magnetic types.

Specifications on one of these, the high power pulse transformer package, are as follows: 1600 kw peak pulse power, 1050 w average, 0.5 to 4 μ sec pulse width, duty cycle of .00066, 8.7 kv peak input, impedance ratio 503:48 ohms. Self contained dc filament supply uses silicon diodes.

Airtron Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.
IRE Booth No. 3318

CIRCLE 129 ON READER-SERVICE CARD

Servo Package

Used in radar scanning systems



Model T-950 which is a compact servo-package combining a servo motor, a geared reducer, a magnetic clutch-brake and a potentiometer. In this particular unit, the motor drives the potentiometer arm at a speed corresponding to a radar scan rate of approximately 40 rpm. Upon a given signal the motor can be uncoupled and the potentiometer braked within 2 msec.

Sterling Precision Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N.Y.

IRE Booth No. 1621

CIRCLE 130 ON READER-SERVICE CARD

Crystal Filters

Feature High Selectivity



These crystal filters permit single conversion with high selectivity in the early stages of the receiver close to the antenna. Specifications include a center frequency of 10.7 mc; shape factor of 2:1; insertion loss of approximately 1 db, and size of 2-3/8 x 1 x 1-1/32 in. Model 10MA has a 6 db bandwidth of 30 kc and model 10MF has a bandwidth of 3.5 kc.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy., Cambridge 42, Mass.

IRE Booth No. 3038, 3039

CIRCLE 131 ON READER-SERVICE CARD

CIRCLE 132 ON READER-SERVICE CARD



MINIATURIZED S

HOT . .

We don't see many hot-skillet applications for sealed relays these days. But, if there were, General Electric miniaturized sealed relays could do the job—even in scorching bacon grease!

The best of laboratory equipment is used to check the continuous operation of all G-E sealed relays at ambient temperatures of *plus 125 C*. And, special forms are now available for use at ambients up to *200 C*! Inherent temperature-resistant characteristics qualify *all* General Electric sealed relays for use on

SEALED RELAYS



but still in service!

any job where extreme heat is a serious environmental problem.

Extreme high-temperature operation is just one of the many "plus" features—such as high-shock resistance, high-vibration resistance, low-temperature operation, and rugged construction—you get with all Miniature, Sub-miniature, and Micro-miniature G-E sealed relays. Today, General Electric sealed relays are proving their reliability on a wide variety of military and industrial electronics applications.

What's more, you get all of General

Electric's complete line of standard-listed relays on only *3-week shipment from receipt of order*—plus—rapid service on samples and prototypes.

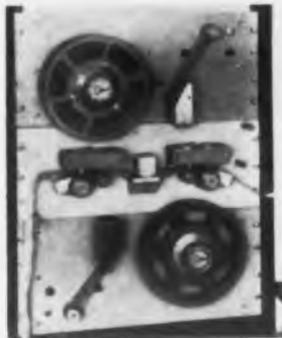
For further information, contact your G-E Apparatus Sales Office—or—write to General Electric Co., Section 792-9, Schenectady 5, N. Y., for your copy of the brand new G-E sealed relay catalog. *Specialty Control Dept., Waynesboro, Va.*

Progress Is Our Most Important Product

GENERAL  ELECTRIC

NEW PRODUCTS at the IRE Show

Punched Tape Reader Provides strip and reel feed



The Dykor paper tape reader offers the advantages of strip and reel feed by combining both in one unit. The unit stops within one character at a reading rate of 600 characters per sec and within two characters at 750. The tape is set in motion when a solenoid squeezes the tape against a continuously-rotating capstan. To stop tape motion, the driving solenoid is released, and stop solenoids engage the tape against non-rotating capstans. Fast reading is made possible through photoelectric sensing using silicon photocells. All standard 5, 6, 7, or 8 level tapes (plus sprocket hole) are handled and 11/16, 7/8, or 1 in. wide tape can be used interchangeably.

Digitronics Corp., Dept. ED,
Albertson Ave., Albertson, Long
Island, N.Y.

IRE Booth No. 1730

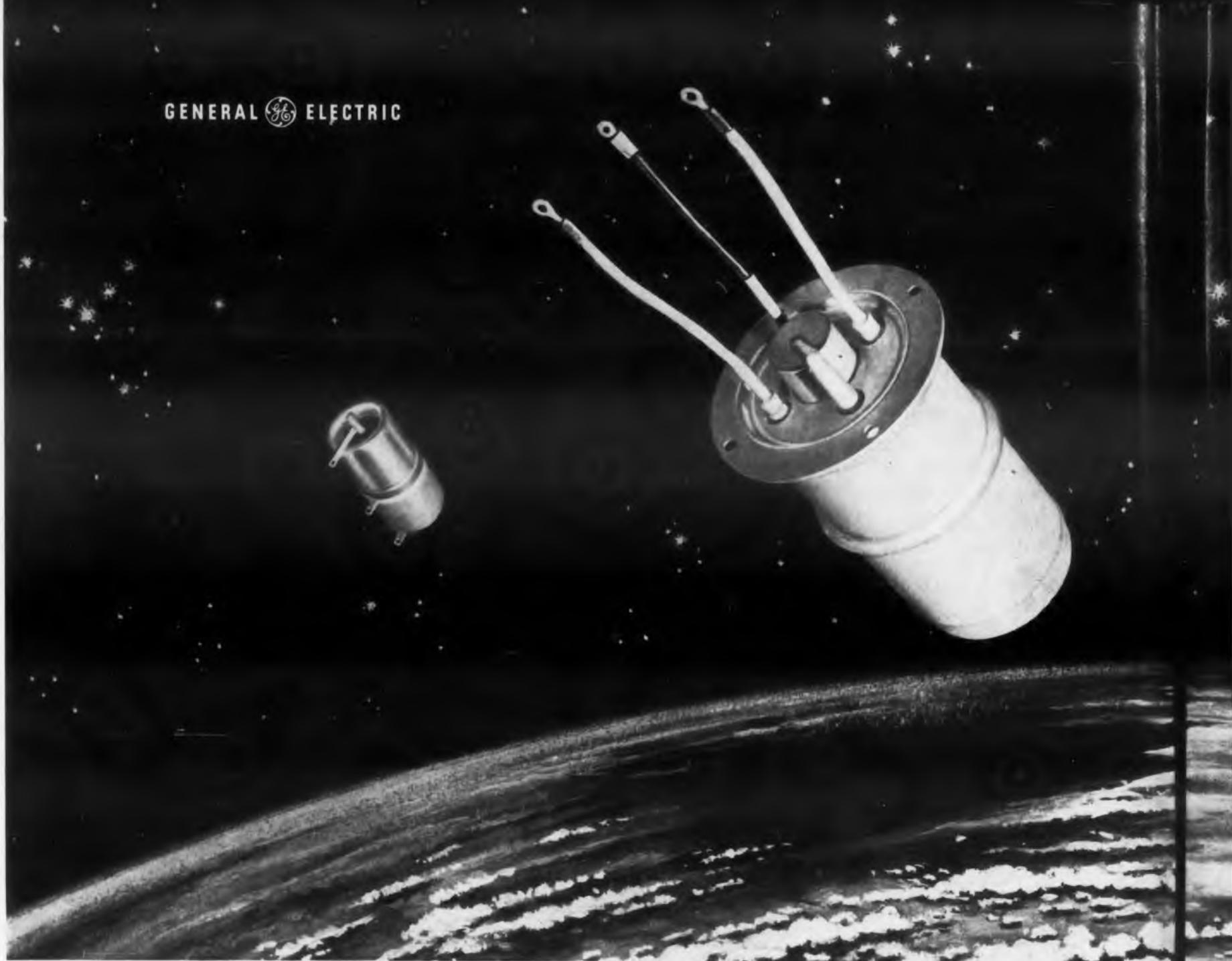
CIRCLE 133 ON READER-SERVICE CARD

Decade Counter Maximum frequency of 1 mc

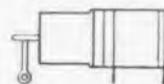


Model M6744 transistorized decade counter occupies 3.75 cu in. and has a maximum operational frequency of 1 mc. The decade

GENERAL ELECTRIC



New General Electric Hydrogen Thyratrons S

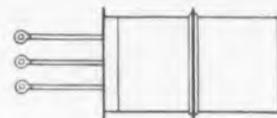


A RUGGED, CERAMIC HYDROGEN THYRATRON DESIGNED FOR USE IN GUIDED MISSILES

This new General Electric ceramic hydrogen thyratron is designed to withstand up to 21G vibration, at 20 to 2,000 cycles per second. Among a number of construction features contributing to the unusual strength of this tube is a special cathode assembly newly developed by G-E engineers. This assembly is rigidly fastened to the tube's envelope in a single, continuous, vibration-free structure.

CHARACTERISTICS:

Peak Anode Voltage—7 KV
Average Anode Current—25 milliamperes
Peak Anode Current—75 amperes
Anode Dissipation Factor—0.5 x 10⁹



A HYDROGEN THYRATRON ESPECIALLY DESIGNED FOR HIGH-POWER RADAR PULSE MODULATORS

Below are shown the approximate envelope sizes and power outputs of two thyratrons now in use in high-power radar, as compared to the new G-E developmental tube.

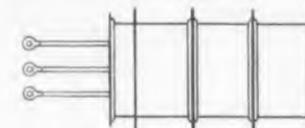
TYPE 1257 TYPE 5948 NEW G-E DEVELOPMENT

8 1/2" x 20" 5" x 16" 6" x 11"

Avg. Power 33 KW Avg. Power 12.5 KW Avg. Power 66 KW
Peak Power 33 MW Peak Power 12.5 MW Peak Power 33 MW

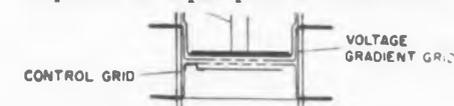
CHARACTERISTICS:

Peak Anode Voltage—33 KV
Average Anode Current—4 amperes
Peak Anode Current—2,000 amperes
Anode Dissipation Factor—40 x 10⁹



A HIGHER-VOLTAGE DESIGN FOR SUPER-POWER RADAR PULSE MODULATORS

The use of a voltage gradient grid in this hydrogen thyratron permits the tube to operate at a higher anode voltage and to deliver a higher peak power. One tube can now do the work of two or more thyratrons usually required in super-power modulators.



CHARACTERISTICS:

Peak Anode Voltage—40 KV
Average Anode Current—2.2 amperes
Peak Anode Current—2,400 amperes
Anode Dissipation Factor—45 x 10⁹



Speed Design of Super-Power Radar

When tube designers and equipment manufacturers work together on advanced projects early in the planning stages, vital time is saved. Also, future availability of new tubes in desired quantities is assured.

The three developmental General Electric hydrogen thyratrons shown above are examples. New design and manufacturing techniques—and new applications of materials—were conceived by G-E designers to meet the specific needs of advanced super-power

radar equipments now being developed. The result, months saved in the development of both new tubes and the equipment in which they will be used.

Call any of the General Electric Power Tube offices listed at the bottom of this page now if you are planning or developing advanced electronic equipment—and take advantage of General Electric's comprehensive facilities and experience. *Power Tube Department, General Electric Company, Schenectady, New York.*

Inspect these three new hydrogen thyratrons in the General Electric exhibit at the IRE Show.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

0245-0481-11

consists of four binary circuits separately constructed in an individual cartridge assembly, each of which is independently usable as a flip-flop or binary stage. Each binary module is replaceable in the decade and packaged with a hermetically sealed header, and additionally protected by complete encapsulation in epoxy resin.

In addition to the 1 mc model, the decade is available in 800 kc and 400 kc models. Silicon transistor models are available for operation at temperatures in excess of 100 C. The decade output is 6 v with 0.1 μ sec rise time.

The Walkirt Co., Dept. ED, 141 W. Hazel St., Inglewood 3, Calif.
IRE Booth No. 3923

CIRCLE 135 ON READER-SERVICE CARD

Temperature Test Chambers

Standard line of 30 cu ft units



The series 30 group of temperature test chambers provide 30 cu ft of work space and have outer dimensions of 4-1/2 x 5 x 7-1/4 ft high. The units have low temperature ranges of -40 F, -100 F, -120 F, and high temperature ranges of +240 F, or +350 F optional. The units can provide for relative humidities of 20 to 98 per cent (limited by +35 F dewpoint) and 5 per cent at +160 F. The chambers are heliarc welded, with stainless steel interior and a positive seal dual door gasket.

Tenney Engineering, Inc. Dept. ED, 1090 Springfield Rd., Union, N.J.

IRE Booth No. 1516

CIRCLE 136 ON READER-SERVICE CARD

◀ CIRCLE 134 ON READER-SERVICE CARD

EASTERN REGION
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) Wlconsin 7-4065, 6, 7, 8

CENTRAL REGION
3800 North Milwaukee Ave., Chicago 41, Ill.
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Blvd., Los Angeles 64, Cal.
Phones: GRanite 9-7765; BRadshaw 2-8566

HICKOK EXCLUSIVE

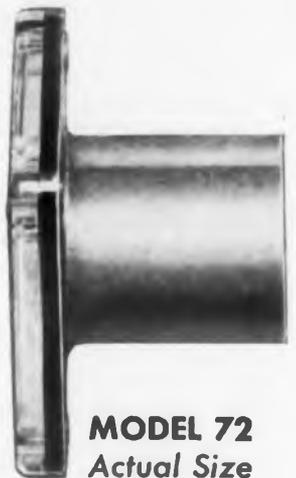
RUGGEDIZED

LONG SCALE

SUB-MINIATURES

1" barrel 1% accuracy 1" depth

- ★ FEATHER-WEIGHT
- ★ RUGGEDIZED & SEALED
- ★ SELF-SHIELDED
- ★ IN PRODUCTION
- ★ HIGH SENSITIVITY
(to 50 microamperes)
- ★ PRECISION ACCURACY
(to 1% of full scale)



MODEL 72
Actual Size

This unusual instrument development meets all the requirements of MIL-M-10304A as applicable, and is available in all standard DC ranges.

The completely self-shielded 180 degree arc-angle movement features a new type pivot with a new reinforced jewel holder and other construction advantages designed to withstand exceptionally high impact and vibration without impairing the accuracy or functioning qualities of the meter.



ALSO AVAILABLE

- 2-1/2", 3-1/2" and 4-1/2" round case styles with standard scale lengths in AC or DC ruggedized types.
- 3-1/2" and 4-1/2" round case styles with 250° arc-angle long scale types in DC or AC Rectifier ruggedized.

*We invite your inquiry and specification details.
(Form MSM and Catalog 37 are available at your request.)*

THE HICKOK ELECTRICAL INSTRUMENT CO.
10525 Dupont Avenue • Cleveland 8, Ohio

Visit us at the I.R.E. Show, Booth Nos. 3516 and 3518

CIRCLE 213 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show



Multiturn Dial
Eliminates ambiguity

The Colvern multi-turn dial has a quick change indicator to avoid ambiguity. Ten and 15 turn dials are available with accuracies of 1 part in 1000 and 1 part in 1500 respectively.

British Radio Electronics Ltd., Dept. ED, 1833 Jefferson Pl., N.W., Washington 6, D.C.
IRE Booth No. 2815

CIRCLE 94 ON READER-SERVICE CARD

Oscilloscope

Highly linear sweep in low frequency range



The model 85-A oscilloscope is designed particularly for the teletype communications field and allied operational systems. Emphasis has been placed on providing superior low frequency sweep linearization and balanced input dc amplifiers of high gain. The oscilloscope generally fulfills the technical specifications outlined in MIL-O-15525D, with greatly improved capabilities in the low frequency spectrum.

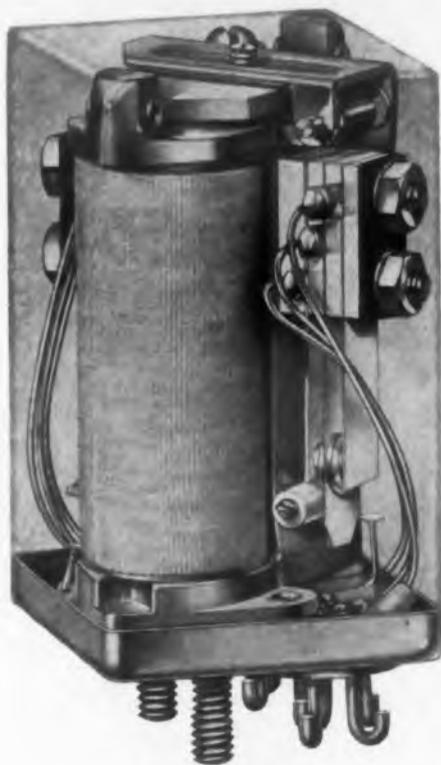
Specifications for the horizontal sweep include range of 3 cps to 40 kc in 4 bands with a minimum of 5 per cent frequency overlap on each end of each band; linearity of ± 1 per cent on all frequencies up to 5 kc, and ± 2 per cent on frequencies above 5 kc; recovery time of less than 1 part in 100 frequencies up to 5 kc, and less than 1 part in 70 above 5 kc. The vertical and horizontal amplifiers have identical characteristics. Input impedance is single ended, 1 meg, shunted by 25 μf on all attenuator positions. Input sensitivity is 5 mv/cm to 500 v/cm. Band pass is 0 to 250 kc.

James S. Spivey, Inc., Dept. ED, 4908 Hampden Lane, Washington 14, D.C.

CIRCLE 95 ON READER-SERVICE CARD

HIGH Sensitivity RELAYS

for Military Equipment
and
Commercial Applications



- Switching Capacities up to 5a., 30 v., d.c.
- Sensitivity down to 9 mw.
- Coil Resistances to 20,000 Ohms.
- Environmental specifications will meet latest revision of MIL R-5757 and MIL R-20518.
- Standard contact arrangement up to 4 Form A and 2 Form C.

For commercial and industrial applications see the new Series SC high sensitivity relay at Booth 2709

Radio Engineering Show

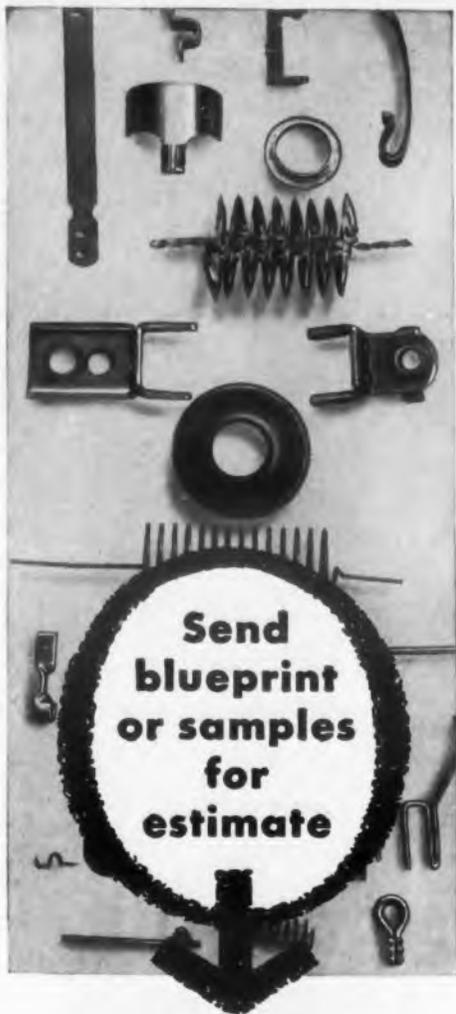
WRITE FOR RELAY DATA BULLETIN

B

BASO, INC.

Dept. RN-1, Milwaukee 1, Wisconsin

CIRCLE 214 ON READER-SERVICE CARD



Send
blueprint
or samples
for
estimate

WIRE FORMS and METAL STAMPINGS

We'll prove that our high speed production means lower unit costs for you!

You'll save two ways — (1) the initial low unit cost made possible by high speed machines; (2) precision and quality control guarantees accurate parts and performance.

STRAIGHTENING AND CUTTING
Perfect straight lengths to 12 feet.
.0015 to .125 diameter.

WIRE FORMS
.0015 to .125 diameter.

SMALL METAL STAMPINGS
.0025 to .035 thickness.
.062 to 3 inches wide.

Specializing in production of parts for electronic, cathode ray tubes and transistors.

Write for illustrated folder.

**ART WIRE AND STAMPING
COMPANY**

17 Boyden Place, Newark 2, N.J.

CIRCLE 215 ON READER-SERVICE CARD



Printed Circuit Module

Pulse transformer
measuring 1 in. sq

Type BA transformer has been designed to include all qualities required for printed circuit applications keeping low cost in mind. Plug in terminals are arranged on the accepted 0.1 in. grid. The units are keyed for easy insertion with automatic machinery. Four spacers provide board clearance to eliminate condensation problems. Epoxy encapsulated pulse transformers and toroids in the plastic BA case meet applicable sections of MIL-T-27A and 21038. Dimensions: 15/16 in. sq, 1/2 in. high, 1/4 in. pins.

Polyphase Instrument Co., Dept. ED, Bridgeport, Pa.

IRE Booth No. 2235

CIRCLE 97 ON READER-SERVICE CARD

Servo Amplifier

Provides 15 w of controlled power



Requiring 115 v 60 cps power, this amplifier is capable of supplying up to 15 w controlled power for the operation of standard 60 cps servo motors. The amplifier has a nominal 30 k input impedance, voltage gain of 400, 90 deg phase shift and as a plug-in unit, it sits on a miniaturized 28 v dc regulated power supply as required.

Also being shown is a hermetically-sealed, high gain (30,000) servo amplifier designed to meet MIL-E-5400A and MIL-E-5272A. The unit, measures 1-15/32 x 1-29/32 x 4-3/32 in. has an input impedance of 200 ohms, 90 deg phase shift, can drive a 60 cps 6 w servo motor from a 0.1 mv, 60 cps input and requires only 28 v dc at 350 ma power.

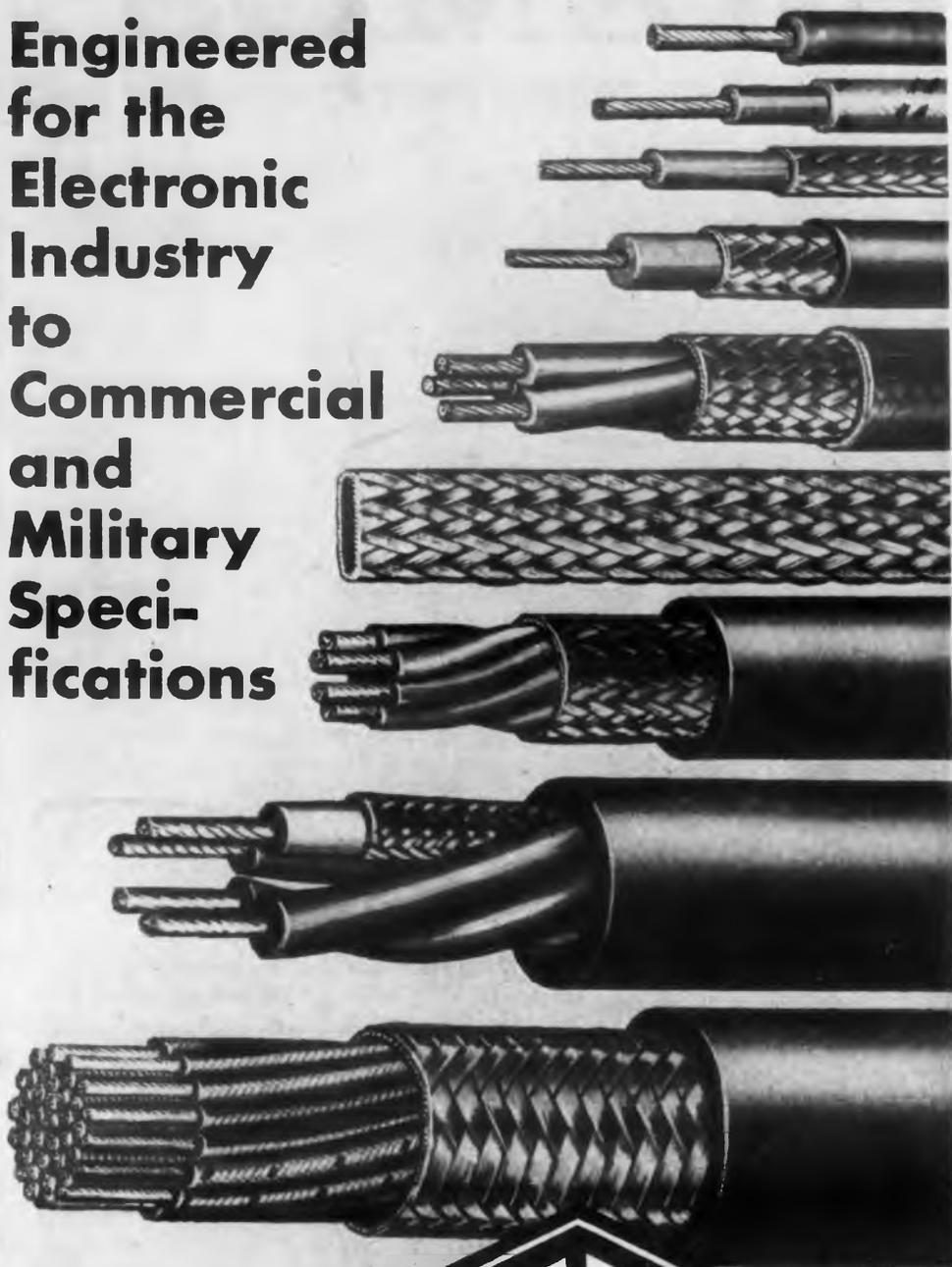
M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

IRE Booth No. 1316

CIRCLE 98 ON READER-SERVICE CARD

WIRES & CABLES

Engineered
for the
Electronic
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CIRCLE 216 ON READER-SERVICE CARD

PRODUCT-DESIGN MEMOS FROM DUREZ

Electrical-grade phenolic

Fire-retardant prepreg

Large inserts no problem



Brain cells for a bird

Chill fog swirls in around the slim white missiles poised on their launchers. From clouds massing above, snow begins to spiral faster and faster.

For these silent sentinels on 24-hour watch, weather can be an enemy. Within the missile, and in the incredibly complex electronic brain that guides it, thousands of parts and connections must be ready to function perfectly in the few vital seconds of the rocket's flight.

This is one of the basic reasons why many thousands of mechanical and electrical missile components are made with *Durez 16274 Natural*, a mineral-filled phenolic with highly stable electrical characteristics.



Molded by standard compression or transfer methods, 16274 has excellent surface finish and can be machined with tung-

sten carbide tools. It is designed to meet the requirements of Mil-P-14D, Type MFE.

If these properties suggest a place for 16274 in a current project, check the coupon for a special 4-page bulletin detailing properties and molding and finishing procedures. For an evaluation sample, write us on your business letterhead.

Fire-retardant prepreg

Now you can meet the most exacting requirements for reinforced plastic parts that must be strong, tough, and flame-retardant.

You get these properties in a new prepreg, made with *Hetron*® polyester, that eliminates weighing, mixing, and pouring of resin in your plant.

This material provides exceptionally high tensile, flexural, and impact strengths; smooth glossy surface; and excellent wet-strength retention. It is self-extinguishing without the use of additives.

The drapable sheet conforms to complex curvatures, facilitating layup. It is supplied in rolls up to 60 yards long, which have



shelf life of six months or more under normal storage conditions.

For a list of manufacturers of prepreg materials, write us. For data on the *Hetron* resins with which they are made, check the coupon.



The Black & Decker Mfg. Co.

Big inserts no problem

Do you hesitate to specify large molded-in-phenolic inserts for fear the phenolic will crack?

Your molder can now allay your apprehensions—with *Durez 18001 Black*.

Developed specifically for use with large metal inserts, as in this brush-holder cap for an electric hammer or saw, 18001 is highly crack-resistant. It combines many other qualities: high dielectric strength, excellent dimensional stability; arc resistance of 180 seconds by ASTM D495—and low cost.

For a more complete rundown on 18001, check the coupon and we'll send you technical data.

For more information on Durez materials mentioned above, check here:

- Electrical-grade molding compound, Durez 16274
- Hetron polyester resins (technical data file)
- Phenolic molding compound, Durez 18001

Clip and mail to us with your name, title, company address. (When requesting samples, please use business letterhead.)



PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

2203 Walck Road, North Tonawanda, N. Y.

CIRCLE 141 ON READER-SERVICE CARD



Where's the motor?

Inside-Out

Motor

Makes

Shallow "Saucer"

Fan

YOU WONDER where the motor is, when you see this fan with a "new look." Saucer-shaped, with its driving motor built into the propeller hub, it embodies an entirely new concept in fan design.

The rotor, which is part of the propeller hub, surrounds the stator. It rides on high quality ball bearings. The stator is secured to spokes on the rear of the fan, which, in turn, are secured to the rim. A terminal block on the rim connects a single phase, 115 v line (50-60 cps) to the fan's 2-pole

ELECTRONIC DESIGN • March 5, 1958

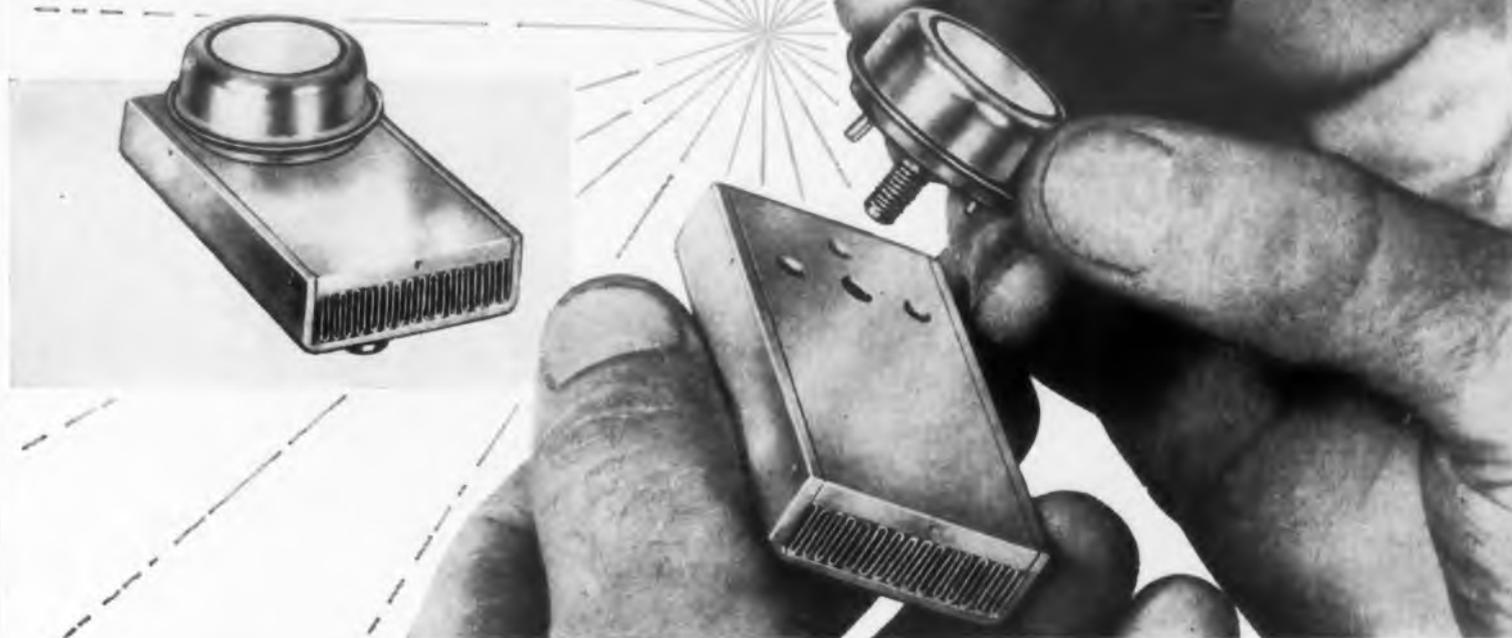
induction motor. Wiring enters the stationary winding through one of the spokes.

Developed by Rotron Manufacturing Company of Woodstock, N.Y., for cooling electronic consoles, the new design constitutes a step forward in space conservation. The fan's axial length is down to no more than the depth of the propeller, about 2-1/2 in. With a diameter of about 7 in., the fan weighs but a trifle more than a pound and a half.

In free air, the fan delivers 280 cfm to keep temperature rise down to only 25 deg F for 2 kw heat dissipation inside a cabinet. It maintains a 35 C winding temperature rise.

The "saucer" fan is designed for use with the modern washable dust filters. Its pressure buildup is adequate to overcome the loss of head introduced by the filter in addition to the back pressure in the equipment. The airflow can be di-

UAP COLD PLATE controls TRANSISTOR junction temperature!



minimizes transistor derating for thermal conditions . . .

UAP cold plate U-521330, designed for Collins Radio Company, dissipates heat generated by power transistors used in ground and airborne electronic circuits. The heat is transferred across a pressure thermal contact to cooling air. The cold plate controls the transistor junction temperature within operating limits compatible with the installation. Therefore, transistor derating is minimized.

The cooling air, which is forced through the cold plate, can be ducted from an air cycle refrigeration system; a ram air supply; an air manifold within

the electronic compartment or a pressurized equipment package.

The aluminum cold plates are bonded by UAP's dip braze method which produces extremely lightweight assemblies with maximum heat transfer area within the core. Cold plates can be used individually or assembled in manifolded banks.

DESIGN PERFORMANCE CHARACTERISTICS OF U-521330 COLD PLATE

Air flow: 7 lbs. per hr.
Air pressure drop: 0.25" H₂O corrected to .0765 density
Temperature drop in cold plate: 1.5°C per watt dissipated
Weight: Approximately 1 oz.
Performance characteristics can be modified to requirements.

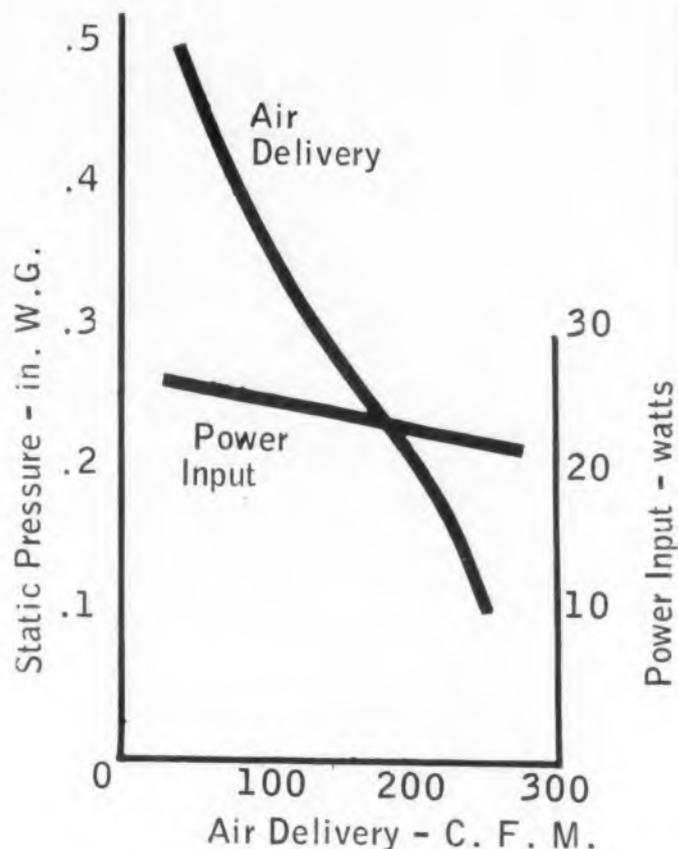
For complete information call the nearest UAP Contractual Engineering Office

CALIFORNIA 1101 Chestnut St., Burbank Calif., VI 9-4236
NEW YORK 50 E. 42nd St., New York 17, N. Y., MU 7-1283
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a famous family of aircraft essentials since 1929

UNITED AIRCRAFT PRODUCTS, INC.
1116 BOLANDER AVENUE, DAYTON, OHIO
CIRCLE 143 ON READER-SERVICE CARD



Static pressure and power input curves for 60 cycle operation.

rected in either direction, simply by reversing the fan end-to-end.

Three servo-motor clamps secure the fan to a panel or filter box at either end of the venturi. Both ends of the venturi have "servo" type clamping rims.

The fan meets all government specifications for humidity, fungus, and altitude.

For further information on this unusual fan, turn to the Reader's Service Card and Circle 142. IRE Booth No. 2334-6

New trends and developments in designing electrical products . . .

"Work backward"—a new design approach that's bringing the advantages of General Electric permanent magnets to fields traditionally reserved for electromagnets

A new approach to the design of motors, generators, relays, and similar products is making it possible to produce smaller, more efficient and economical units by using permanent magnets, instead of electromagnets.

The new approach is simply to "work backward." That is, design the most efficient magnet assembly first, and then the rest of the component.

In the past, where designers tried to replace electromagnets in these products, permanent magnets often proved uneconomical. Here's why:

The traditional approach was to work the permanent magnet into an existing design for a wire-wound field, to save the cost of new dies and other major manufacturing changes.

Under these conditions, permanent magnets will seldom show to best advantage. But, by using the "work backward" approach, many outstanding results can be obtained.



FIGURE 1 — G-E Alnico 5 magnet helps 2-pole motor develop 1/150 hp at 10,000 to 15,000 rpm.

For example, permanent magnets had been limited to fractional-hp applications, such as the 1/150-hp toy-locomotive motor in Figure 1.

But today, through imaginative design and more efficient alloys, permanent magnets are now used for rotors and stators in much larger equipment.

The DC tachometer generator in Figure 2, for example, uses a 2-lb. G-E Alnico 6 stator.

The permanent magnet provides greater reliability and accuracy than copper windings, over wide ambient temperatures. It eliminates an external power source and field regulating equipment. And, there is no replacement problem since the magnet — unlike wire — never burns out.

These are some of the advantages that can be realized from early con-



FIGURE 2 — 46-frame DC tachometer generator with Alnico 6 stator.

sideration of the permanent magnet in design.

Alone, these can more than justify the cost of redesigning equipment to eliminate wound fields. Yet, there are other advantages that result from the magnet's ability to supply a constant field without external excitation, including:

- Elimination of field interruptions due to power failure.
- Elimination of heat and need for costly cooling equipment and insulation — thus conserving valuable weight and space.
- Elimination of danger from faulty wiring or damaged insulation.

These are important advantages where equipment must be reliable despite severe environmental conditions. But equally important to the designer is the permanent magnet's superior volumetric efficiency. A G-E Alnico magnet can usually supply a given magnetic field in a fraction of the space needed by even the best designed electromagnet.

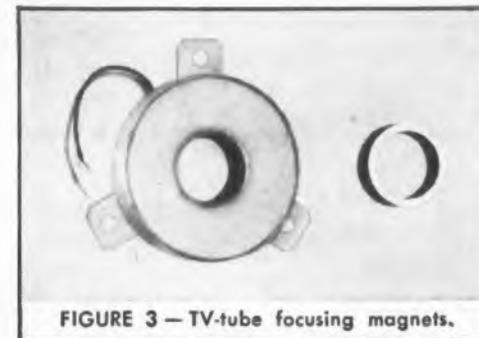


FIGURE 3 — TV-tube focusing magnets.

The TV-tube focusing magnets in Figure 3 gives some idea of the savings in space and weight a designer can effect.

The electromagnet weighs 2 lbs., and takes up 16.35 cubic inches. The G-E Alnico 5 permanent magnet weighs just 15 ounces, and requires only 1.30 cubic inches — a space-saving of 87%.

In addition to the problem of economics, two other traditional objections to permanent magnets have also been largely eliminated:

First, early permanent magnets were relatively unstable. But modern permanent magnet materials from improved manufacturing techniques are really "permanent" . . . even under temperature and humidity conditions ruinous to electromagnets.

Second, applications requiring "on-off" field action seemed outside the capabilities of permanent magnets. But modern design techniques have developed practical ways to handle this by shunting flux around the air gap.

With the new high-energy alloys and the development of more scientific design methods, the future for permanent magnets — and the opportunity for designers — is virtually unlimited.

For example, a recent use of the "work backward" approach has, for the first time, made it possible to use powerful Alnico magnets to supply uniform fields in equipment like traveling wave tubes.

General Electric Magnet Engineers have accumulated a wealth of information on the problems of redesigning for permanent magnets. They will share their knowledge with you at any stage of the magnet design project.

For more information, or the services of a G-E Magnet Engineer, write: *Magnetic Materials Section of General Electric Company, 7820 N. Neff Road, Edmore, Michigan.*

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 144 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Silicon Transistors

Ratings up to 80 W

Low R_{cs} , typically 1.5 ohm, enables the ST400 and 2N389 60-v transistors to operate at currents to 5 amp. The units are useful in servo-amplifiers, relay drivers, and power switching applications. Other applications include audio amplifiers, dc to ac power converters and voltage regulators.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.

IRE Booths No. 3912, 3914

CIRCLE 145 ON READER-SERVICE CARD

Electrolytic Capacitors

Feature low leakage current



Series ML electrolytic capacitors is designed for use in miniature devices such as transistorized radio receivers, portable tape recorders, and hearing aids. The low leakage current of type ML capacitor prevents excessive current drain and permits proper functioning in coupling capacitor applications.

The maximum permissible leakage current is determined from the expression $.03VC + 2$, where V is the rated dc working voltage, and C is the rated capacitance in microfarads. The units are designed to operate from -20 to $+65$ C. The capacitors withstand the rated working voltage (from 3 to 100 v) for 500 hours at the rated ambient temperature.

Type ML can be supplied with an insulating paper sleeve (designated as type MLS) or without one (type ML). A plastic sleeve capacitor is also available (type MLV). For mounting on printed circuit boards, both leads are brought out at one end and the metal case covered with an insulating paper tube. This type is referred to as AMLS.

Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N.J.
IRE Booth No. 2832

CIRCLE 146 ON READER-SERVICE CARD

Relay

Operates at +200 C



This 4pdt relay has the following characteristics: Operates in an ambient temperature of +200 C, withstands 55 g shock for 11 msec, withstands 25 g vibration up to 2000 cps, and has a contact bounce of less than 250 μ sec. Insulation consists of all ceramic material in order to maintain high resistance at maximum operating temperature. The coil is hermetically sealed from the contact structure. The relay retains the rotary principle of operation standard in the Company's line of relays.

Westinghouse Air Brake Co., Union Switch & Signal Div., Swissvale, Pa.
IRE Booth No. 2122, 2124

CIRCLE 147 ON READER-SERVICE CARD

Coil Winder

Produces cross-wound coils



The No. 111 coil winder is equipped with a precision traverse system to produce accurate cross-wound coils. The machine is also equipped with an electronic drive and other attachments to speed up production and reduce handling operations. A programming attachment automatically stops the winder for the removal of taps. A pie-winding attachment automatically indexes coils. Gears are located on fixed centers so that a machine operator can change from one coil specification to another by dropping the new gears into place without using tools.

Universal Winding Co., Dept. ED, P.O. Box 1605, Providence, R.I.
IRE Booth No. 4313, 4315

CIRCLE 148 ON READER-SERVICE CARD



INSUROK[®] XT-901 by Richardson

Here's another new Richardson product which offers many advantages for electronic and electrical applications.

New INSUROK XT-901, as shown in the photos above, is flame retardant. This self-extinguishing feature is not affected by age or service conditions. This material also resists the formation of a carbonized path in the presence of an arc, which feature is desirable in many high voltage applications. Electrical characteristics of this paper base laminate, which is identified by its distinctive red color, exceed the published NEMA values for XXXP phenolic laminates. Electrical and arc resistance properties are retained after exposure to high humidity or immersion in water.

Write today to Dept. 33 for more information on new XT-901.

See XT-901 in Booth 1628—I.R.E. CONVENTION
New York Coliseum—March 24-27, 1958



the RICHARDSON COMPANY

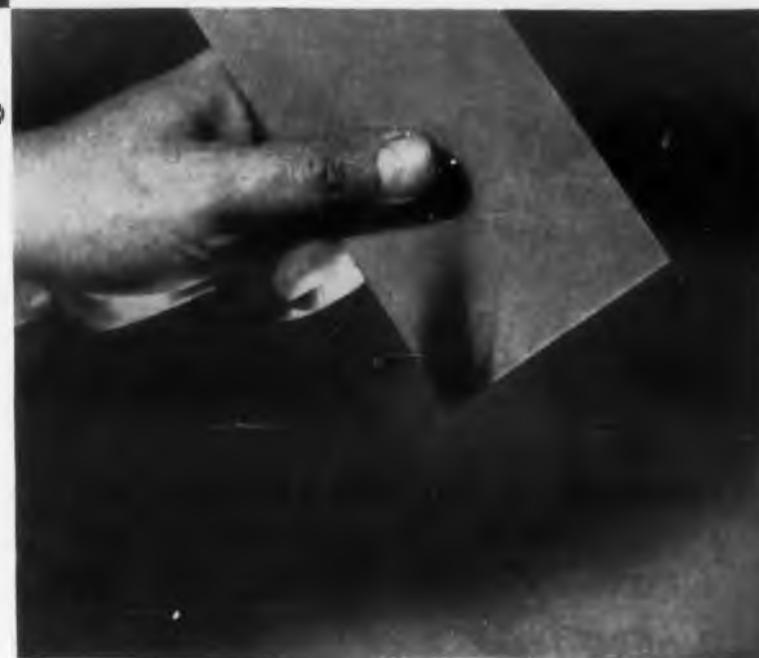
RICHARDSON
PLASTICS

LAMINATED and MOLDED

2682 LAKE STREET • MELROSE PARK, ILLINOIS • OFFICES IN PRINCIPAL CITIES

CIRCLE 149 ON READER-SERVICE CARD

new flame retardant plastic laminate



It is readily fabricated and punches in the temperature range of 225-275°F.

USES FOR XT-901 INCLUDE:

- High voltage applications such as the TV fly-back transformer.
- Applications involving sliding contacts because XT-901 has superior wear and abrasion resistance coupled with excellent arc resistance.
- Riveted assemblies such as relays because low cold flow assures retention of spacing.

Additional features are low water absorption and good dimensional stability under humid conditions.

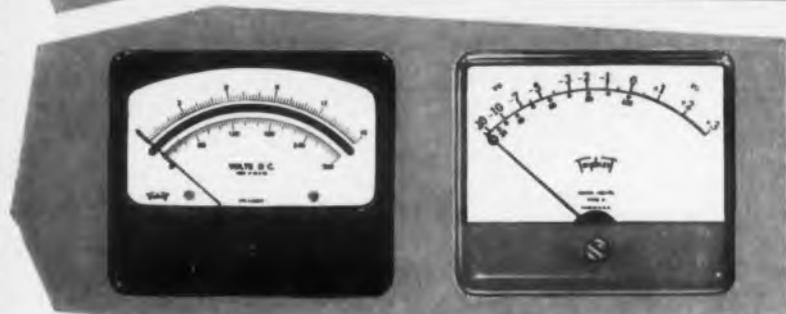
TRIPLETT

Reliability... through 15,631 accepted types



ACTUAL SIZE

ACTUAL SIZE



Clear plastic (PL) meters feature;

- Longer scale length
- Visibility unlimited
- Light unobstructed—no shadows
- Interchangeability—universal
- Appearance revolutionized

UNIQUE FEATURES AND CHARACTERISTICS

These guarantee superior quality in *all* TRIPLETT meters:

- High torque to weight ratio for extra rugged movement. Specially developed bearings withstand severe vibration and reduce friction to a minimum.
- Bearings are microscopically graded not only for depth and radius, but also for *polish*. Only best quality jewels are used.
- Unique hardening method assures uniformly hard pivots.
- High flux scientifically aged alnico magnets for greatest permeability. Micrometrically balanced all metal frame construction protects bearings against vibration from any direction.
- Simplicity of frame construction assures easy, accurate alignment in servicing.
- Dials are all metal—no paper dials are ever used—will not become abrasive, warp, crack or discolor under normal conditions. (Printing presses in Triplet's own plant allow fast, inexpensive service on special dial requirements.)
- Extra strong ribbed pointers precisely balanced with triple "slide and lock" adjusting weights.
- Insulations provide extra allowance for breakdown voltages.
- All metal parts processed, all molded parts pre-cured to eliminate distortions from stresses and strains.

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • 52 years of experience • BLUFFTON, OHIO

Triplet design and development facilities are available for your special requirements for meters and test equipment.

CIRCLE 150 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Potentiometer
Dissipates 2 W at 60 C



Offering high stability under temperature cycling in a small size, these Aceset potentiometers will dissipate 2 w at 60 C. They are available in nine resistance ranges between 100 and 25,000 ohms. Temperature cycling stability is made possible through the use of 20 ppm temperature co-efficient wire.

Mechanical specifications include a rotation of 330 deg nominal and size of 1/2 in. diam by 5/16 in. body length. Electrical specifications feature voltage breakdown of 1000 v dc, electrical angle of 325. deg nominal, resistance tolerance of $\pm 10\%$ and linearity of $\pm 5\%$.

Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville, Mass.
IRE Booth No. 1807

CIRCLE 151 ON READER-SERVICE CARD

DC Power Supply
0 to 60 v, 7.5 amp



A rack-mounted, continuously variable power supply, model 810-A delivers from 0 to 60 v at 0 to 7.5. Regulation at any output voltage is less than 0.05 v output change from no load to the full 7.5 amp. The dc internal impedance is less than 0.007 ohms. Ripple is 7 mv rms. Overload and short circuit protection are provided by magnetically-operated circuit breakers.

Harris Labs., Inc., Dept. ED, 45 Industrial Rd., Berkeley Heights, N.J.
IRE Booth No. 1910

CIRCLE 152 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 5, 1958

60-V Power Supply

Regulation of 0.05 v, for 0 to 7.5 amp



Model 810A is a transistorized unit providing regulation at any output voltage of 0.05 v output change from no load to the full 7.5 amp. Internal impedance (dc) is less than 0.007 ohms. Ripple is 7 mv rms. Overload and short circuit protection are provided by magnetically-operated circuit breakers.

Harrison Labs., Inc., Dept. ED, 45 Industrial Rd., Berkeley Heights, N.J.
IRE Booth No. 1910

CIRCLE 153 ON READER-SERVICE CARD

Power Supplies

Two precision rack mounted units



The first of two power supplies being featured is MTR060-5 shown. This unit is a transistorized magnetic amplifier regulated dc supply having an output voltage of 0-60 v at 5 amp and an ac input of 95-135 v single phase, 60 cps. The ripple supplied is 2 mv rms maximum; line regulation (static) is less than ± 5 mv; and dynamic line regulation is less than 10 mv. Static load regulation is less than 25 mv for no load to full load changes. All of these regulation accuracies are applicable for any output setting between 0 and 60 v dc.

The second supply, model MTB300-200, is a B+ type with circuitry similar to the above. The ac input on this unit is 105-125 v, single phase, 50-400 cps. Ripple is 6 mv peak to peak, and regulation is ± 0.1 per cent for line and load. Dynamic impedance is 1 ohm from 20 to 20,000 cps. Unit is supplied in rack panel construction, and has dimensions of 5-1/2 in. high x 19 in. wide. The dc output rating is 300 v ± 10 per cent at 200 ma.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.
IRE Booth No. 3711, 3713

CIRCLE 154 ON READER-SERVICE CARD

Continental Connector announces...

NEW

Closed Ring



Entry

CONTACT*

3 1/2 TIMES ACTUAL SIZE

CLOSED ENTRY DESIGN... FOR 100% MORE RELIABILITY

A solid ring limits socket contact expansion to maximum tolerance of pin diameter. This prevents over-stress of the individual socket contact leaves and possibility of any contact distortion. Also, an oversized probe cannot enter the socket contact. Even "rocking" and "prying" actions will not distort the contact.

Constant and uniform insertion pressure is guaranteed while a consistently low millivolt drop is maintained. The new contact was developed for use in intercontinental ballistic missiles and other applications requiring high reliability. It is another example of Continental Connector's constant research into improved design.

Technical brochures on various Continental Connectors are available free on request. Specify your requirements to Electronic Sales Division, DeJur-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y.

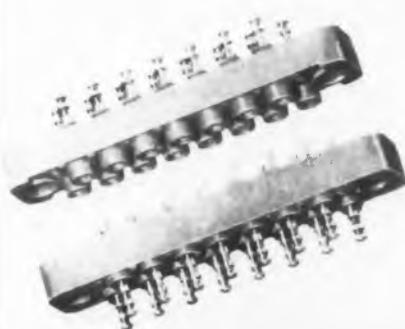
★ Solid Construction—Cannot be Forced Out of Shape

★ Extremely High Reliability—Indestructible in Normal Maintenance

★ Maintains Low Millivolt Drop Under Constant and Uniform Insertion Pressure

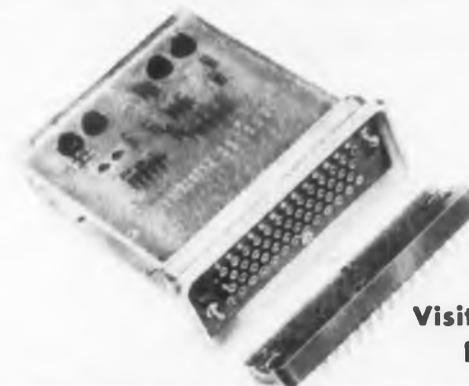
★ Terminations Include Solder Cup, Turret, or Solderless Taper Pin (Solder Cups can be hot pre-filled, if desired.)

AVAILABLE IN ALL STANDARD CONTINENTAL CONNECTORS



15 Contact Plug and Receptacle with New Closed Entry Contacts and Turret Terminals.

*PAT. PENDING



Continental Connector and New Closed Entry Contacts Used with Printed Circuit Application for Classified Intercontinental Ballistic Missile.

Visit us at the I.R.E. Show
Booths 3911-3913.

DeJUR

electronic
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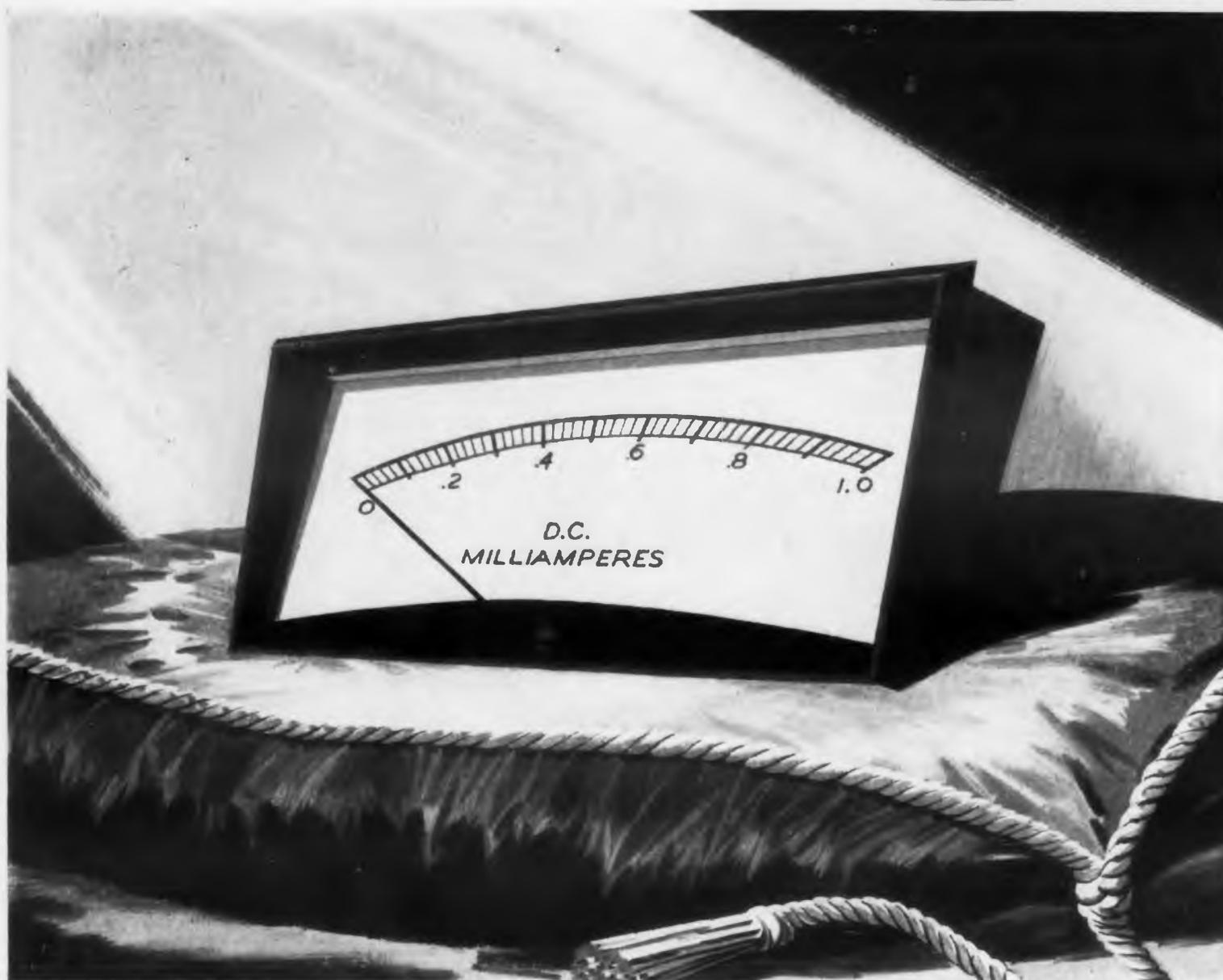
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CIRCLE 155 ON READER-SERVICE CARD



MODEL 561

NEW PRODUCTS at the IRE Show



*With a disappearing waste line
and no bay window, this new API meter
trims itself into your instrument*



The beauty on the pillow is designed to complement your product; not hog it. Its bottom $\frac{1}{3}$ —the part you don't need to see—is tucked behind your panel. What's left is today's best looking meter, with a modern picture frame look.

The forte of this slim design is its obvious good looks, but other features are worth mentioning: like easy back-of-panel lighting through a translucent

rear window, and almost-nil magnetic panel effect.

For a good look at the Model 561, ask for Data Sheet 10; for a better look see us at the show; for the best, order a sample. We know you'll want to look at one, so we made up a quantity. To whet your appetite, the sample price is \$10.00. A request on your company letterhead will bring a 200 microampere Model 561 to your door by air.

**Assembly Products Inc.**

CHESTERLAND 17, OHIO

Booth 3815, IRE Show, Coliseum, N.Y.C. March 24-27

CIRCLE 156 ON READER-SERVICE CARD

Trimming Capacitor Kits

Seven types for various mounting needs



Each of these seven kits includes from four to nine piston capacitors designed for a particular mounting application. The PK11 kit contains 5 glass and invar miniature trimming capacitors for panel mount uses. The PK12 kit contains similar trimmers designed especially for printed circuit applications. The PK13 kit features 4 lead mountings for shock resistance, and polarization for wiring board plug in. The PK14 kit houses 5 glass dielectric split stator trimmers for standard panel mount. The PK15 kit includes 4 quartz split stator trimmers for panel mount. The PK16 kit offers 9 glass and invar and glass and brass trimmers for panel mount. The PK17 kit includes 4 quartz dielectric trimmers.

JFD Electronics Corp., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.

IRE Booth No. 2333

CIRCLE 157 ON READER-SERVICE CARD

S-Band Ferrite Isolator

With standard coaxial connectors



These S-band ferrite isolators are equipped with female type N connectors to meet particular coaxial requirements. Frequency range is 2670 to 2930 mc. The unit's characteristics are as follows: frequency range, 2670 to 2930 mc; isolation, 20 db min; insertion loss, 0.8 db max; input vswr, 1.2 max, and power handling capacity of 10 w average with a 2:1 load vswr.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.

IRE Booth No. 3318

CIRCLE 158 ON READER-SERVICE CARD

Zener Diodes

Full line of 65 will be exhibited



A complete line of silicon Zener voltage regulator and reference diodes comprised of a series of types in each of seven styles will be displayed. The 64 types includes: miniature types rated at 500 mw, standard top-hat style with pigtail leads rated at 1 w; 3.5 and 10 w types featuring stud construction; double-anode types rated at 350 mw; 5 w multiple junction high voltage types; and the 1N430, 1N430A, and 1N430B reference element types. All diodes in this group are designed for temperatures of -65 to $+150$ C and high load current capacity. An x-y plot of the reverse breakdown characteristics is supplied with each of the diodes.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.
IRE Booth No. 3915, 3917

CIRCLE 159 ON READER-SERVICE CARD

Circuit Breaker

Miniature unit with ratings up to 10 amp



The model SM3 circuit breaker is a series-overload type designed for operation at 110 v at either 60 or 400 cps, or for 50 v dc. It is available in ratings from 50 ma to 10 amp. A choice of two time delay curves is offered, for fast or slow overload response. The breaker is also available for instantaneous-trip response.

Since the SM3 combines magnetic actuation with hydraulic time delay, its current capacity and trip points are free from ambient temperature effects. The breaker will maintain its 125 per cent trip point from -65 to $+125$ C.

Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N.J.
IRE Booth No. 3811, 3818

CIRCLE 160 ON READER-SERVICE CARD



Here are laminations for miniaturization

If you are making transformers for transistorized or other miniaturized equipment, information about our ultra-small size "performance-guaranteed" laminations can be important news to you. These nickel-iron laminations are produced in standard gauges, and are available in Hy Mu 80, 48 Alloy and, if required, Orthonol.

Dry-hydrogen annealed by our exclusive process, these laminations provide all-important uniform quality. This annealing at a dewpoint of -60° C. brings our Performance-Guaranteed laminations to ultimate permeability from as little as 5% of that value in the unannealed state.

Like all laminations from Magnetics, Inc., the "miniatures" are packed in standard nine-inch boxes to facilitate handling in your plant, and are immediately available from stock. These features alone provide substantial savings.

Edges of these fine tolerance laminations are cut off squarely and cleanly to minimize air gap where mating parts are butted. Thus, high operating efficiency is insured.

There's no room here for the really detailed story, but for complete information on our "Performance-Guaranteed" magnetic laminations, send for our newest catalog—just published—ML-41. Write today. Magnetics, Inc., Dept. ED-41, Butler, Pennsylvania.

MAGNETICS inc.

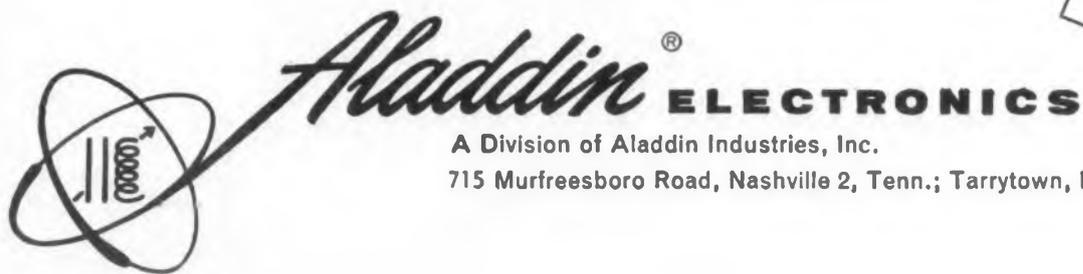
CIRCLE 161 ON READER-SERVICE CARD



more and more people are thinking of Aladdin as the standard of the electronic industry in pulse transformers

ALADDIN:

- supplies an Encyclopedia of pulse circuits, specifications, terminology and available styles;
- makes micro-miniature (transistor size) units;
- offers a comprehensive product line
- sells standard, commercial units, at mass-production prices.



A Division of Aladdin Industries, Inc.
715 Murfreesboro Road, Nashville 2, Tenn.; Tarrytown, N. Y.; Pasadena, Calif.



CIRCLE 162 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Microsecond Indicator

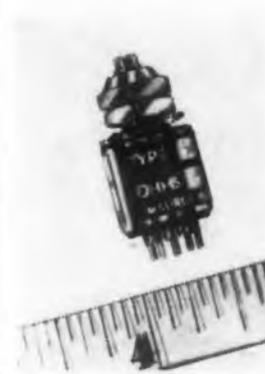
Measures time between two points of a pulse



The fundamental application of the type 206 microsecond indicator is to measure the time interval between any two points of one or two pulse waveforms with a high degree of accuracy. Operation using an oscilloscope is as follows: first, balance the time delay between two channels by using an identical signal for both inputs and record the reading of the delay dial as T_1 ; then apply two input signals under test separately to both channels E_1 and E_2 ; adjust the delay lines again until the pulse of E_2 is aligned with the pulse of E_1 channel; record the dial reading as T_2 . The difference between T_1 and T_2 is the time delay between the two input signals.

Advance Electronics Lab., Inc., Dept. ED,
249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 163 ON READER-SERVICE CARD



Trimming Potentiometer

Dissipates 1/2 w at 150 C

Type 50-M14 trimming potentiometer will dissipate 1/2 w at an ambient temperature of 150 C, and derate at 250 C. It is housed in a 1/2 in. diam by 1/2 in. long stainless steel case. Mechanical stops are built to withstand 60 oz-in torque, and the housing has been rolled over the ceramic terminal board. The unit can withstand a 1500 v rms dielectric breakdown test at room temperature.

Maurey Instrument Corp., Dept. ED, 7924
So. Exchange Ave., Chicago 17, Ill.
IRE Booth No. 3825

CIRCLE 164 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 5, 1958

Electrolytic Capacitors

Hermetically sealed types, up to 150 wdc



The positive connection of the Daly electrolytic capacitors is hermetically sealed by a compressed plastic plug. The foil, rivet, and internal connections are high purity aluminum. Availability range is 5 μ f to 150 μ f covering voltages from 6 to 150 wdc. Tube diameter varies from 1/4 to 1/2 in. Lengths vary from 3/4 to 1-1/8 in., including the seal. Leads are at right angles to the axis of the capacitor and are suitable for printed circuit or tag board mounting. Positive lead cannot make accidental contact with the can.

British Radio Electronics Ltd., 1833 Jefferson Pl., N.W. Washington 6, D.C.
IRE Booth No. 2815

CIRCLE 185 ON READER-SERVICE CARD

Relay

Rugged unit for low level switching



Frame and header assembly or bridge-type construction affords high resistance to shock, vibration, and temperature in this relay. Over-size instrument type bearings at both ends minimize hinge friction. The unit is hermetically sealed and filled with inert gas.

Contacts are dpdt, rated at 100,000 operations minimum at 2 amp, 28 v dc or 115 v ac, non-inductive. Available for low level and dry current switching. Resistance range, 22 to 500 ohms and up. Power requirement, 500 mw, dc. Insulation to ground, 500 v ac rms minimum. Insulation resistance, 100 meg minimum at 500 v oc, 25 C. Vibration, 10-55 cps at 10 g acceleration; 55-500 cps at 20 g. Shock, 40 g for 11 msec. Weight, 0.35 to 0.55 oz. Dimensions 0.797 x 0.875 x 0.359 (maximum).

Magnecraft Electric Co., Dept. ED, #3350D W. Grand Ave., Chicago 51, Ill.
IRE Booth No. 2342

CIRCLE 186 ON READER-SERVICE CARD



For your Magnetic Shielding Problems . . .

MUMETAL is the answer!



Write for your copy
"MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. ED-3

Mumetal shields will give instant relief to interference caused by extraneous magnetic fields. This material can cure many troubles—solve many a problem for you.

Use it where high permeability is required at low flux densities, such as in input and microphone transformers, hearing aid diaphragms, instruments, wire and tape recorders, etc. For properly heat treating Mumetal, we can also offer commercial hydrogen annealing facilities.

A fund of technical data on shields

and other applications for Allegheny Ludlum Mumetal is available—let us help with your problems.

In addition to Mumetal and other high-permeability alloys, we offer a range of magnetic and electrical alloys and steels that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment. • Let us supply your requirements. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry

Allegheny Ludlum

Warehouse stocks of AL Stainless Steels carried by all Ryerson plants

CIRCLE 187 ON READER-SERVICE CARD

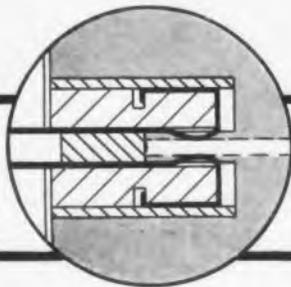


WSW 8094

NEW!

GORNET* and GORNECTORS*

GORN



Cutaway detail shows printed circuit board held in place by spring-action contact.

OFF-THE-SHELF STRUCTURAL PARTS AND CONNECTORS TO BUILD YOUR SPECIAL PRINTED CIRCUIT BOARD PACKAGES

The GORNET and GORNECTOR concept offered by the Gorn Electronics Division make it possible for the first time for the Electronic packaging Engineer to order stock parts to build Printed Circuit Board Assemblies. Standard GORNET parts and GORNECTOR receptacles are available to accommodate any Printed Circuit Board Size, thickness, number of terminations, and number of boards to form a rigid electronic printed circuit board module. Standard printed circuit board guide rails are also available to facilitate printed circuit board insertion. The GORNECTOR receptacles can be supplied

terminated in solder eyes, turrets, taper tabs, wire wrap forms, dip solder lugs, with contacts joined or separated for top and bottom circuit connection or individual face termination. Available in a variety of materials and finishes, these standard elements are suitable for a variety of military and commercial environments. Easily polarized or color coded, GORNECTORS increase assembly efficiency and correct utilization. Great effort has been made in developing the GORNECTOR to design the most efficient electrical contact to transfer electric signals from printed circuit board to wire.

For full details on the GORNET or GORNECTOR including specifications on the handy "prototype" kit for experimental purposes write: GORN ELECTRIC CO., STAMFORD, CONN.

*Pat. Pend.

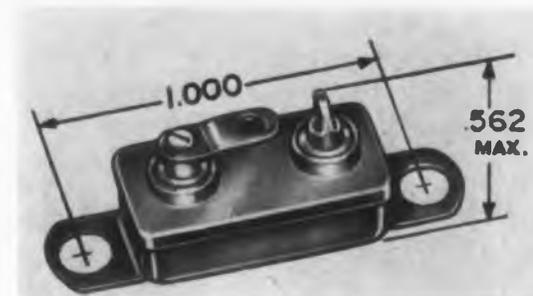
CIRCLE 188 ON READER-SERVICE CARD



ELECTRONICS DIVISION

NEW PRODUCTS at the IRE Show

Thermostat Sensitivity of ± 1 F



Featuring good sensitivity in a small size, the Thermostwitch measures 1.25 in. long x 0.562 in. high x 0.401 in. deep and has a sensitivity of one deg F. Temperature changes act to expand or contract the stainless steel outer shell which actuates the inner assembly to make or break totally enclosed contacts. Operating temperature limits are -65 to $+220$ F. No resonant frequencies occur between 5 and 500 cps vibration. Testing at 500 cps vibration with 10 g acceleration, the temperature set point will not shift over ± 3 F.

Fenwal, Inc., Dept. ED, Pleasant St., Ashland, Mass.

IRE Booth No. 3001

CIRCLE 189 ON READER-SERVICE CARD

Analog-Digital Converter

Speeds of up to 200,000 conversions per sec



An addition to the company's Datrac line of high-speed analog-digital converters, the Transicon Datrac is designed primarily for industrial usage. Applications include scaling of data into engineering units, linearizing transducer nonlinearities, and arithmetic operations for function generation. As a digital-to-voltage converter the unit has speeds of up to 200,000 conversions per sec. As a voltage-to-digital converter, the speed is 5 μ sec per binary bit maximum. Up to 100,000 alarm tests can be performed per second. Accuracy is ± 0.05 per cent, $\pm 1/2$ least significant digit, regardless of code. Available output control current is 25 ma.

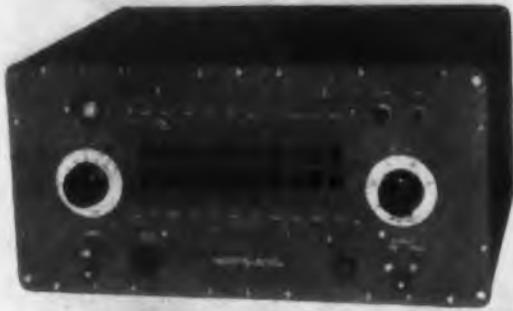
Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

IRE Booth No. 3823

CIRCLE 190 ON READER-SERVICE CARD

Test Oscillator

Calibrates fm/fm sub-carrier units



Push-button selection of frequency is featured in the model TO-258 telemetering test oscillator. The unit is designed to provide convenient calibration for sub-carrier units of fm/fm telemetering systems. Standard fm/fm frequencies from 400 cps to 70 kc are supplied with calibrated deviation control of ± 15 per cent of center frequency. Distortion is less than 1 per cent to 21 ma rms, frequency error is less than 1 per cent and output voltage is constant to 1 db from 1 to 25 v.

Teletronics Lab., Inc., Dept. ED, 54 Kinkel St., Westbury, L.I., N.Y.
IRE Booth No 3417

CIRCLE 191 ON READER-SERVICE CARD

Video Sweep Generator

For use with wide band circuitry



Intended for the observation of frequency versus amplitude characteristics of wide band circuitry, such as radar and video amplifiers, type 1105 radar-video generator features high output and low harmonic distortion. It provides a sweep from 50 kc to 10 mc and has an r-f output adjustable from 1 mv to 2 v peak-to-peak into a 75 ohm load from 75 ohm source. The r-f output signal may be attenuated from 0 to 63 db by means of a pushbutton attenuator. The swept oscillator, of the variable-permeability type, has an extremely linear incremental frequency characteristic, and is keyed at a 60 cps rate to provide a return trace baseline. Ten crystal-controlled frequency markers are provided to indicate 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 mc points.

Tel-Instrument Electronics Corp., Dept. ED, 728 Garden St., Carlstadt, N.J.
IRE Booth No. 3406, 3408

CIRCLE 192 ON READER-SERVICE CARD



What do these latest aircraft and missiles have in common?

All are equipped with Genisco flight control or instrumentation accelerometers.

What better proof of reliability?

With component reliability getting increased attention from missile and aircraft designers, it is significant to note the number of supersonic weapon systems equipped with Genisco accelerometers.

A complete list reads like a roll call of tactical and strategic missiles and aircraft now in the nation's arsenal. Included are such weapons as the *Atlas, Thor, Nike Ajax, Nike Hercules, Bomarc, LaCrosse, Bull Pup, Talos, Dart, Matador, Corporal* and *Territor* missiles; and the *F100D Super Sabre, F101 Voodoo, F106A*, and Canada's *CF105* aircraft. What better proof of the reliability of Genisco instruments than this acceptance by designers of these weapons?

Combining product reliability with guaranteed delivery schedules and competitive pricing has made Genisco the free world's largest producer of potentiometer-type flight and fire control accelerometers. More than 40,000 have been delivered to date.

Send for technical data sheets on all Genisco Accelerometers.



MODEL GLH



MODEL DDL



MODEL GHO



MODEL GAH

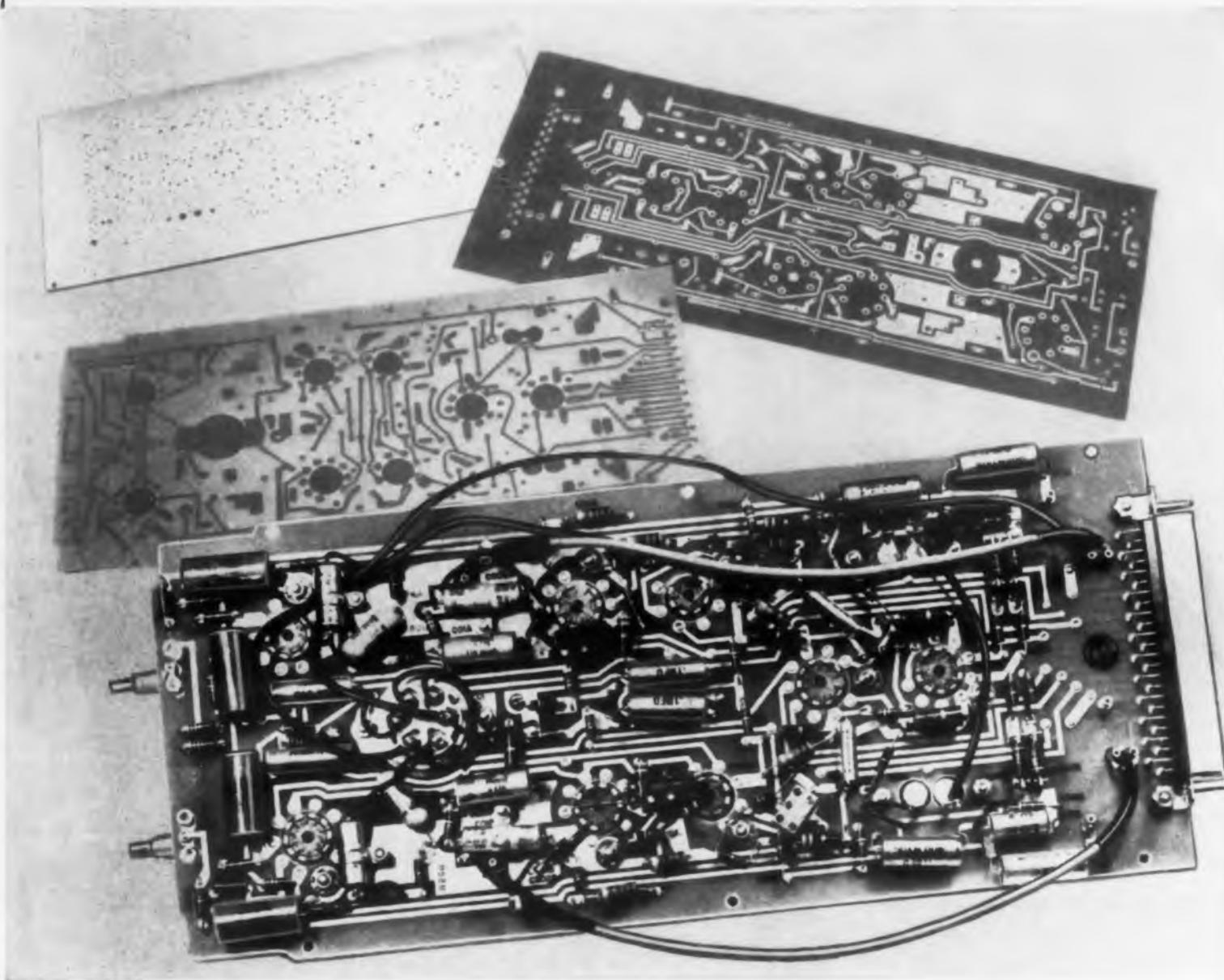


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CIRCLE 193 ON READER-SERVICE CARD

Industrial Laminates

from the company that really knows the electrical and electronics industry—General Electric



Courtesy Photocircuits Corp., Glen Cove, N.Y.

Gold-plated and dip-soldered at 500 F° . . .

No blisters, no bond failure with 11558 . . . newest Textolite® copper-clad laminate

Reliable in roughest applications — that's new General Electric Textolite 11558. Printed circuits made from this easy-to-machine G-10 copper-clad laminate stand up through processes that ruin ordinary copper-clads—come out ready to give top reliability in computers and missiles. Here's the kind of treatment 11558 takes without blistering, bond failure, or circuit breaks:

- 30 minutes in boiling trichloroethylene
- 15 minutes plus, in gold-cyanide plating solution
- 2 minutes in 500° F. solder bath

Find out about the *full* line of Textolite laminates in Sweet's Product Design File, Catalog 2b/Gen. Fabricated Textolite parts come to you from independent local fabricators geared to give you speedy delivery. (They're listed in the Yellow Pages under "Plastics.") For prompt, expert help with special problems, write to *Technical Service, Laminated Products Dept., Section ED-83, General Electric Co., Coshocton, Ohio.*

CIRCLE 194 ON READER-SERVICE CARD

Textolite®
INDUSTRIAL LAMINATES
GENERAL  ELECTRIC

See our booth in the
giant General Electric exhibit
at the IRE Show, March 24-27.

NEW PRODUCTS at the IRE Show

Sine-Cosine Potentiometer ±0.05 per cent peak to peak accuracy



The Colvern precision sine cosine potentiometer, type 9600, makes possible a low accuracy of ±0.05 per cent peak to peak. The machined light alloy case if fitted with resistance elements wound on shaped cards, each card covering 180 deg. These pairs of cards are joined with metal bridges giving 360 deg of track. Center taps are on a single turn of wire. One or two pairs of concentric cards can be fitted, each carrying two brushes to give either one sine and cosine or two separate sine and cosine outputs.

British Radio Electronics Ltd., Dept. ED, 1833 Jefferson Pl., N.W., Washington 6, D.C.
IRE Booth No. 2815

CIRCLE 195 ON READER-SERVICE CARD

Frequency Meter

Five heads cover 170 kc to 700 mc range



The 90680 series consists of self-indicating, absorption frequency meters covering the range of 170 kc to 700 mc. This frequency range is covered by five basic heads. Each head has three or four plug-in inductor probes and the same number of individual frequency calibrations. A single 500 μamp, end-indicating, plug-in circuit is used with each of the heads. The indicating circuit is partially self-limiting so that a high power signal will not damage it.

James Millen Mfg. Co., Inc. Dept. ED, 150 Exchange St., Malden, Mass.
IRE Booth No. 2523

CIRCLE 196 ON READER-SERVICE CARD

Magnet Wire

Thermal life of 30,000 hr at 180 C

A polyester film coated magnet wire, Beldtherm provides good resistance to heat aging, solvents, and abrasion. At temperature of 130 C, the magnet wire possesses the desirable qualities which Formvar has at 105 C. Thermal life is rated at 30,000 hr at 180 C. However, this test measures limiting temperature only, and does not take into consideration the other properties, such as cut through values at elevated temperatures. Therefore a Class B rating has been assigned. Under favorable conditions the wire may be used where Class F insulations are indicated.

Belden Mfg. Co., Dept. ED, 4647 W. Van Buren, Chicago, Ill.
IRE Booth No. 1630

CIRCLE 197 ON READER-SERVICE CARD

Phase Meter

Direct reading unaffected by input amplitude

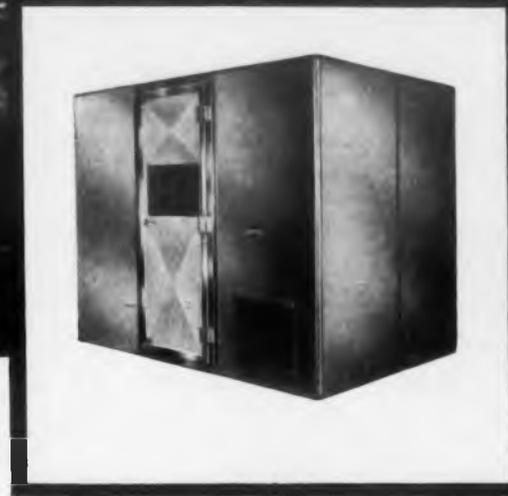


Series 405 precision phase meters measure the phase angle between two alternating voltages without either amplitude or frequency adjustment. The phase angle is presented directly in degrees on an 8 in. rectangular panel meter with mirror scale. No ambiguity exists at zero degree, and the instrument is perfectly stable for measuring a small fraction on the degree on all eight ranges including the 0-12 deg range. The circuitry consists of a coincident slicer and cathode-c coupled limiter stages with plate-to-grid degeneration providing equal accuracy for symmetrical waveforms of any shape.

Specifications are as follows: Type 405L has a frequency range from 1 cps to 20 kc; Type 405H has a range from 8 cps to 500 kc. The relative accuracy is $\pm 1/4$ deg and the absolute accuracy is ± 1 deg or 2 per cent at any range. Input voltage is 0.3 v to 70 v for type 405L, and 2 v to 40 v for type 405H. Input impedance is 3 meg shunted with 20 μ f on both input channels for type 405H, and 6.8 meg for type 405L.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 198 ON READER-SERVICE CARD



Critical testing at Westinghouse conducted in 49 Ace shielded enclosures

The Westinghouse Electronics and Air Arm Divisions, Friendship Airport, Baltimore, Md. plants, have almost unbelievably high r-f interference ambient caused by radar transmitters, missiles, military planes, spot welders, motors, powerful transmitters, and other types of electric/electronic equipment. Testing critical electronic equipment under these adverse interference conditions is extremely difficult. The slightest outside interference would distort readings.

Westinghouse takes no chances. The flight control fighter armament systems, missile guidance systems, radar, and ship-board transmitters under design and development at the plant are completely shielded from outside interference and from each other by 49 Ace shielded enclosures.

See us at the IRE Show—Booth 1728.

The Ace patented RFI* and Cell-Type Designs provide the high attenuation required for satisfactory results at all frequencies. All enclosures are designed and constructed to insure permanent r-f leak-proof performance. Size-flexibility is another feature. The modular construction of the panels and doors permits rapid alteration of the size of the enclosure. Small rooms can be joined to make larger units or large enclosures can be converted into smaller ones.

If you have a shielding problem—big or small—in your plant, you'll want to talk to an Ace Engineer about an effective yet economical solution. Be sure to write for free catalog on standard Ace enclosures.

*Lindsay Structure



First and Finest in Shielded Enclosures
ACE ENGINEERING AND MACHINE CO., INC.

Tomlinson Road • Huntingdon Valley • Pennsylvania

CIRCLE 199 ON READER-SERVICE CARD

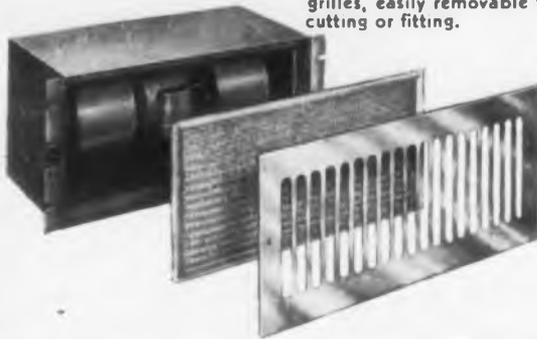
McLEAN FANS & BLOWERS*

*Patented

FOR ELECTRONIC APPLICATIONS

RACK MOUNTED FOR EASY ASSEMBLY • FIT STANDARD 19" RACKS
STANDARD MODELS FOR OTHER RACK WIDTHS AND ANY ANGLE OF AIR DISCHARGE

Save sensitive components in computers, control units, etc. McLean's ready-to-use packaged units pressurize cabinet with cool, filtered air keeping dust out. All rack fans feature smart, heavy gauge, stainless steel grilles, easily removable filters, and standard RETMA notching to eliminate cutting or fitting.

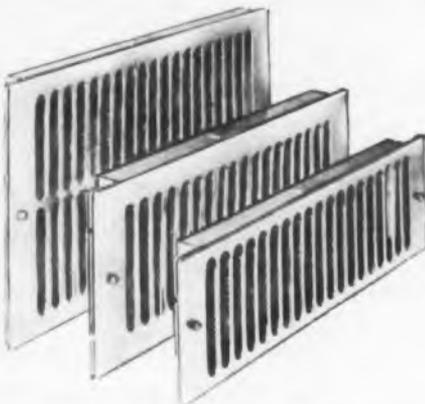


STANDARD RACK MOUNTED FANS & BLOWERS

Over 15 models available in panel heights of 3 1/2" to 12 1/4" in increments of 1 3/4". Range, 80 to 1200 cfm. All units feature quiet operation, no electrical noise and maximum air delivery. Blower units provide better air delivery against pressure and higher velocity for faster cooling. Highly reliable, rubber mounted, 115 volts, 60 cycle motors. Also Mil. Spec. and DC motors available. Permanent filters.

RECESSED MODELS

Provide higher performance with minimum panel height. Filter and blower are recessed into the unused portion of the open base commercial type rack. Fit 3 1/2", 5 1/4", 7", 8 3/4" and 10 1/2" panel heights and deliver 150 cfm to 800 cfm. Highly reliable, rubber mounted, 115 volts, 60 cycle motors. Mil. Spec. and DC motors available. Permanent filters.



FILTER GRILLE ASSEMBLIES

Developed as air outlets for racks without louvres. Prevent back flushing of dust when blower is not on. Use also as inlet for filtered air with exhaust fan. Permanent filter acts as R-F shield. Mount on upper part of cabinet . . . top, front or rear. Fit standard 19" racks (or other widths), in 3 1/2", 5 1/4", 7", 8 3/4" and 10 1/4" heights. Filter may be removed without removing assembly from rack. Disposable filters available.

HALF PANEL WIDTHS

For narrow racks or where space is a problem. Fit half the width of standard 19" racks leaving balance of space for other components. Blower model (5 1/4" high) delivers 100 cfm. Fan model (7" high) delivers 225 cfm. Powered by highly reliable, rubber mounted, 115 volts, 60 cycle motors. Mil. Spec. and DC motors available. Permanent type filter.



HALF PANEL WIDTH FILTER-GRILLE ASSEMBLIES ALSO AVAILABLE



MIL. SPEC. BLOWERS

Meet most rigid specifications. Mount in any position. Deliver 10 cfm. Fit 3 3/4" cube. Continuous duty, totally enclosed motor, 1/300 hp. 115 volts, 60 cycle, 3400 rpm.



RING TYPE FANS

175 to 395 cfm. Fan diameters, 6 1/2" and 8". Motors totally enclosed, highly reliable, 115 volts, 60 cycle, 3000 rpm. Mil. Spec. and DC motors available. Other sizes available.

FREE! 12 Page Cooling Article
16 Page Catalog • Individual Spec. Sheets

McLean Engineering Laboratories

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Agents in Principal Electronic Manufacturing Areas

Most Models Available
For Rapid Delivery

mclean

CIRCLE 200 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Capacitors

300 v, 100 μ f, featuring thin design



This radial series of capacitors has ratings of 300 v up to 100 μ f. An extension of the company's axial radial series, the units feature a thin design of 5/64 to 7/64 in.

The capacitors are produced by the company's standard process: silver electrode fused to porcelain enamel bonded into a homogenous unit that requires no hermetic seal. The process results in humidity immunity, Q in excess of 2500 dissipation factor less than 0.0003, insulation resistance greater than 50,000 ohm farads, capacitance drift less than 0.05 per cent, and temperature coefficient of 115 ± 25 ppm/deg C through the range from -55 to 125 C.

Vitramon, Inc., Dept. ED, Box 544, Bridgeport, Conn.

IRE Booth No. 2401, 2403

CIRCLE 201 ON READER-SERVICE CARD



Differential DC Amplifier

Completely isolated input and output

Model 114A differential dc amplifier features floating input and output both of which are completely isolated from each other. Specifications include 120 db common-mode rejection from dc to 60 cps, gain of 10 to 1000 in 5 steps with continuous variation in between, gain accuracy of 1 per cent from dc to 10 cps, 3 per cent to 30 cps, 3 db down at 120 cps. Dc gain stability and linearity is 0.1 per cent. There is less than 5 μ v noise, and less than 5 μ v drift at gain of 100 or above. Maximum output capability is 10 v at 10 ma.

Cohu Electronics, Inc., Kin Tel Div., Dept. ED, 5725 Kearny Villa Rd., San Diego 11, Calif.
IRE Booth No. 3401, 3403, 3405

CIRCLE 202 ON READER-SERVICE CARD



TEST
INSTRUMENTS

for

LABORATORY/PRODUCTION

automatic continuous



NOISE FIGURE measurement

The AIL Type 72 Automatic Noise-Figure Indicator permits rapid and accurate evaluation of parameters that effect receiver noise figure. This equipment finds wide use in the laboratory as well as on the production line. Noise figure can be measured over the 30 to 26,000 Mc range when either an AIL Type 70A Coaxial or an AIL Type 70B Waveguide Gas-Discharge Noise Generator is used. Accuracy of measurement is ± 0.5 db over a 0 to 20 db range. The Noise Generator furnishes an excess noise output of 15.3 ± 0.25 db.

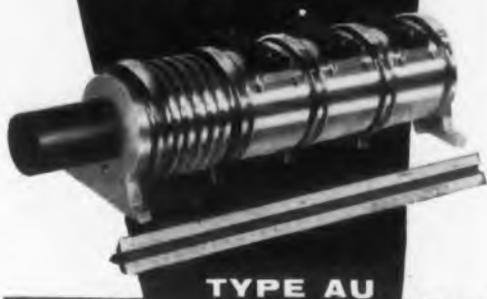
Detailed literature is available on request.



1345 NEW YORK AVENUE
Huntington Station, L. I., N. Y.

CIRCLE 203 ON READER-SERVICE CARD

MODULAR DESIGN



TYPE AU

SCANNING SWITCH

BY

 **ASCOP**

Maximum flexibility and ease of servicing have been achieved in the design of this Type AU multiplexer by ASCOP. Building block construction enables easy adaptation of the switch to a wide variety of requirements in systems using electrical time sharing techniques. Switch sections, gear reduction modules, and drive units can be changed rapidly in the field for system alterations and servicing. Reduction units can be installed between switch sections for various speed combinations. Only minutes are needed for replacing or changing any module. Brushes and contact surfaces are readily accessible for inspection. Each contact plate is externally phaseable with respect to shaft position while in operation.

DESIGN DATA

Contact plates per section: 2

Poles per plate: 1, 2 or 3

Contacts per pole: To a maximum of 240

Phase error between poles: $\pm 5\%$

Leakage resistance: 100 megohms nominal
1000 megohms with more frequent service

Scanning rate: Up to 30 rps

Motors: 60 cps, 400 cps, or D.C.

Duty: Continuous

For Further Information, Write:

 **ASCOP**

Electro-Mechanical Division
Applied Science Corporation of Princeton
P.O. Box 44, Princeton, N. J.

CIRCLE 204 ON READER-SERVICE CARD

Spectrum Analyzer

Uses triodes in place of klystrons



Full frequency range covered in one r-f head and use of triodes in all local oscillators are featured in this spectrum analyzer. Frequency range is from 10 mc to 16 kmc by interpolation. Sensitivity from 10 mc to 1000 mc is 85 dbm or better, ranging down to a figure of 50 dbm at 16,000 mc. Spectrum resolution is 10 kc measured at 3 db bandwidth points. Regulated plate supplies are employed to provide maximum stability. A panel mounted meter and selector switch is available to monitor line voltage and power supply voltages.

Lavoie Labs., Inc., Dept. ED, Morganville, N.J.
IRE Booth No. 3242-43-44

CIRCLE 205 ON READER-SERVICE CARD

Phase Meter

Measures down to 0.01 deg



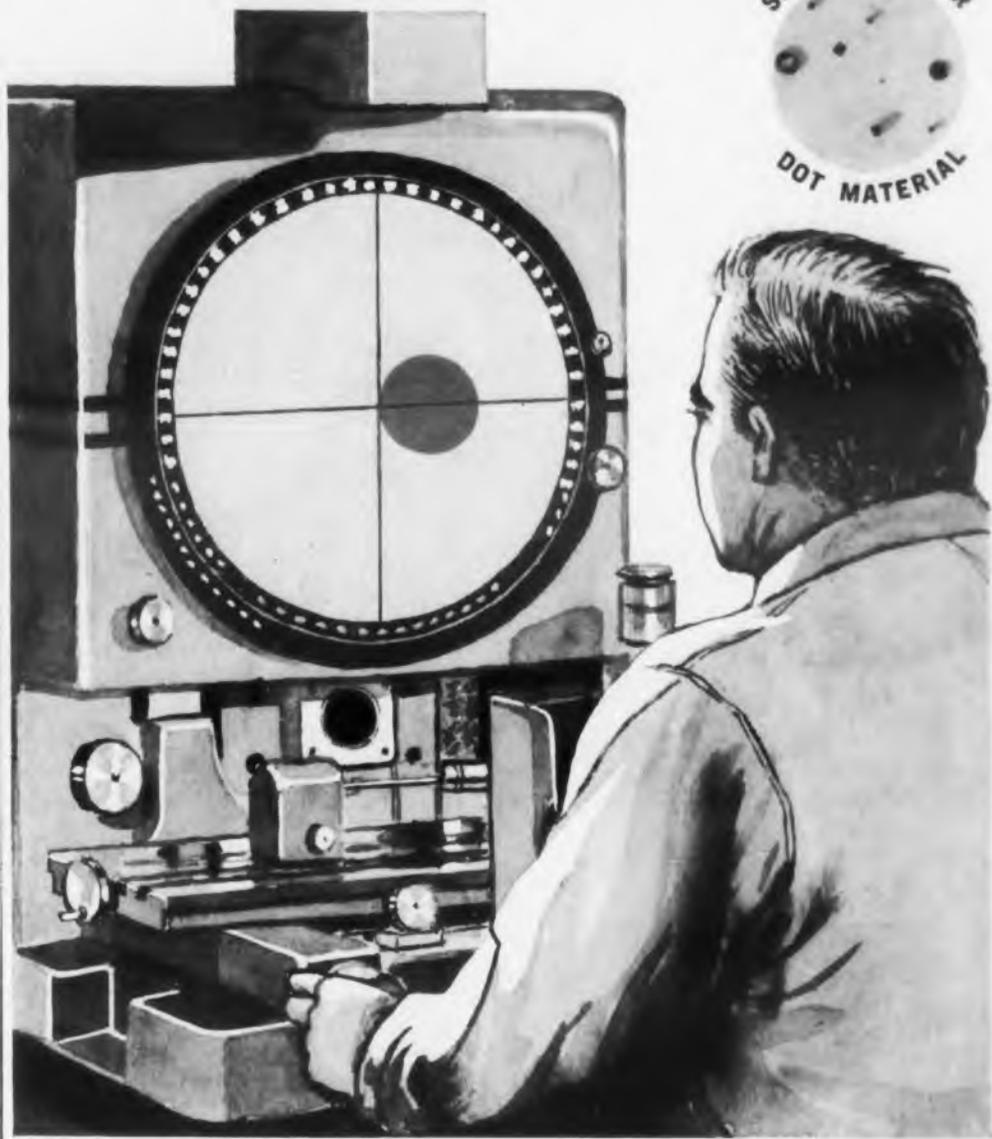
Model 200AB phase meter features high sensitivity, and high input impedance for the reference input as well as for the signal input. As with other of the Company's instruments, model 200AB measures phase angles by the multiplying principle which permits measurements to be made accurately in the presence of noise and harmonic voltages. The instrument can be used to measure in-phase and quadrature components of voltage and may be used to measure phase angles in the order of 0.01 deg. The unit, measures from 0 to 360 deg without ambiguity.

The Industrial Test Equipment Co., Dept. ED,
55 E. 11th St., New York 3, N.Y.

IRE Booth No. 3229

CIRCLE 206 ON READER-SERVICE CARD

SEMI-CONDUCTOR
DOT MATERIAL



WITH ALPHA UHP* Ultra High Purity DOT MATERIAL

ONLY THE BEST ARE CHOSEN

ULTRA HIGH PURITY METALS — *continuous spectrographic analyses assure purity of elements to 99.999+.*

METALLURGICAL RESEARCH — *facilities, trained personnel, and skills available for your development problems.*

EXTENSIVE SPECIALIZED EQUIPMENT & FACILITIES — *for production of specific alloy requirements.*

ALLOYING — *atmospheric control, basic melts, and other techniques guarantee complete uniformity.*

INSPECTION — *precise control and measurement of physical dimensions and alloy compositions.*

PACKAGING — *scientifically cleaned, counted, and packaged.*

BREAK THROUGH the quality barrier on Dot Material **SPECIFY ALPHA UHP***

*trademark

ALPHA
METALS, INC.

69 WATER ST., JERSEY CITY 4, N. J.— HEnderson 4-6778
midwest division ALPHA-LOY CORP.
2248 S. Lumber St., Chicago, Illinois — MOnroe 6-5280



AT IRE SHOW Booth 4323... CHEMISTS, METALLURGISTS, AND ENGINEERS
PRESENT TO DISCUSS YOUR CURRENT PROBLEMS.

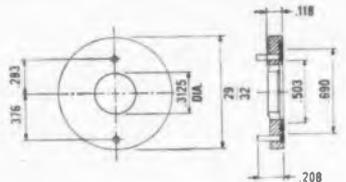
CIRCLE 207 ON READER-SERVICE CARD

high precision? low cost?



Electro Tec Flat Pancake Slip Rings May Answer This Double Question

If wide temperature range, low torque, high current density and inexpensive design are prime considerations in your circuits, Electro Tec round pancake slip rings mounted radially will serve your purpose.



Miniature pancake units are yet another product of Electro Tec's superior manufacturing techniques and facilities for producing precision quality miniature units, at low cost.

If your design involves a problem in commutation, or if your present units are capable of improvement *at no extra cost*, call or write Electro Tec. There is an Electro Tec engineer near you. He will be glad to visit you and help on your design problems.

Write for illustrated literature.

ELECTRO TEC CORP.

P. O. Box 37B, SOUTH HACKENSACK, N. J.

*Products of Precision
Craftsmanship*



Pat. No. 2,696,570

Visit our booth 1216-1220 at the IRE show.
CIRCLE 208 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Phase Shifter

Accuracy of 0.1 deg



Type 208 consists of resistant-capacitance phase shifter networks, and electron-tube phase inverter, and an output cathode follower. Phase angle lag can be read directly at 400 cps. Phase range is 360 deg with a maximum error of less than 0.1 deg at 400 cps. Maximum input signal is 25 v rms. Impedance looking into the output is 300 ohms shunting resistance, and 2 μ f series for dc blocking. Input impedance is about 100 K in series with 2000 μ f to ground.

Advance Electronics Lab., Inc., Dept. ED,
249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 209 ON READER-SERVICE CARD

Audio Spectrograph

Three visual analyses in 85-12,000 cps range



The Sona-Graph recorder is a sound spectrograph that makes a permanent, storable, aural record in addition to three visual analyses. The display graphs are made in two switched bands, the first from 85 cps to 6 kc, and the second from 6 kc to 12 kc. A characteristic of the recorder is that with slight loss in output amplitude it can be adapted to study subsonic vibrations.

The first of these displays, the Sonagram, relates frequency and intensity to time; the second, the Section, relates intensity (over a wider dynamic range than the first) to frequency at any selected time. The third displays amplitude.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N.J.

IRE Booth No. 2608, 2610

CIRCLE 210 ON READER-SERVICE CARD



GRAY CODE



BINARY



BINARY
CODED DECIMAL

LIBRASCOPE SHAFT POSITION-TO-DIGITAL CONVERTERS

Equipped with ANTI-AMBIGUITY
DOUBLE BRUSH PICKOFFS

Useful in a wide variety of applications, including digital aircraft and missile controls, machine tool controls, digital readout from strip chart recorders, and as the modulator and de-modulator in pulse-code modulated radio links.

GRAY CODE MODEL — Capacity of 8 binary digits (single brush pickoff).

BINARY MODEL — Capacity of 7 to 19 binary digits.

BINARY CODED DECIMAL MODEL
Capacity range from 0-1999 to 0-35,999.

Units for special codes or capacities are built to meet specific requirements.

SHOCK ENDURANCE.....20g

TEMPERATURE RANGE...-50° to 83°C min.

CODE DISCS.....Rhodium plated phenolic

PICKOFFS.....Multiple wire brush.

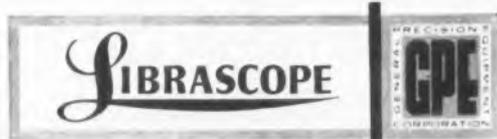
Two pickoffs/channel

ROTATION.....Continuous, either direction.

RUGGED—NON-MAGNETIC—LONG LIFE
MAY BE READ WHILE IN MOTION

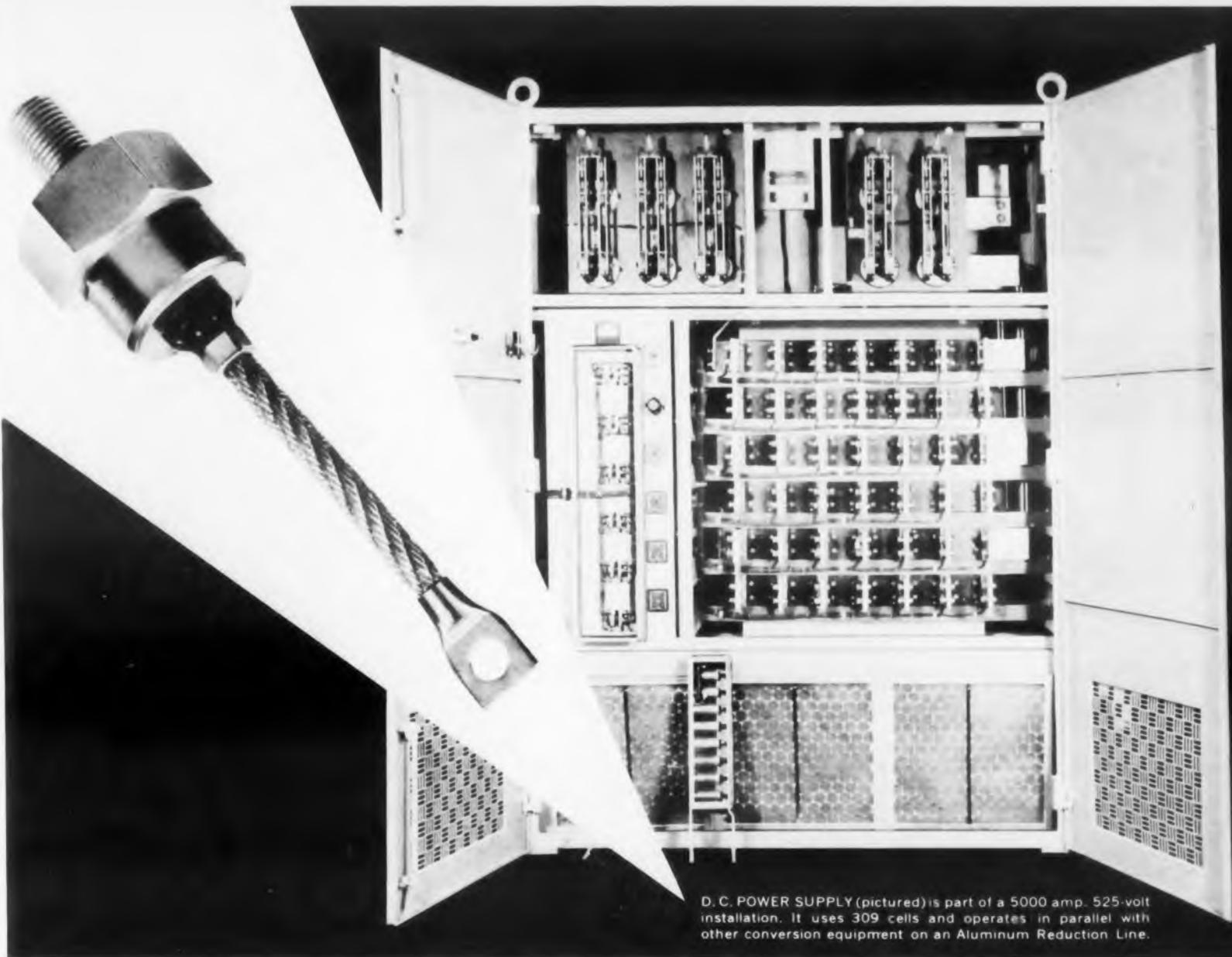
SPECIAL CONVERTERS DESIGNED TO MEET
YOUR INDIVIDUAL PROBLEMS

Send for illustrated brochure



LIBRASCOPE, INCORPORATED
40 East Verdugo St. • Burbank, California
CIRCLE 211 ON READER-SERVICE CARD

CIRCLE 505 ON READER-SERVICE CARD ➤



D. C. POWER SUPPLY (pictured) is part of a 5000 amp, 525-volt installation. It uses 309 cells and operates in parallel with other conversion equipment on an Aluminum Reduction Line.

WESTINGHOUSE, LEADER IN ELECTRONICS, BRINGS YOU

MORE EFFICIENT DC POWER

WHEREVER YOU
NEED IT!

ELECTRO-CHEMICAL
PROCESSING

INDUSTRIAL POWER SUPPLIES

GROUND AND AIRBORNE POWER SUPPLIES

COMPUTERS

ELECTROPLATING

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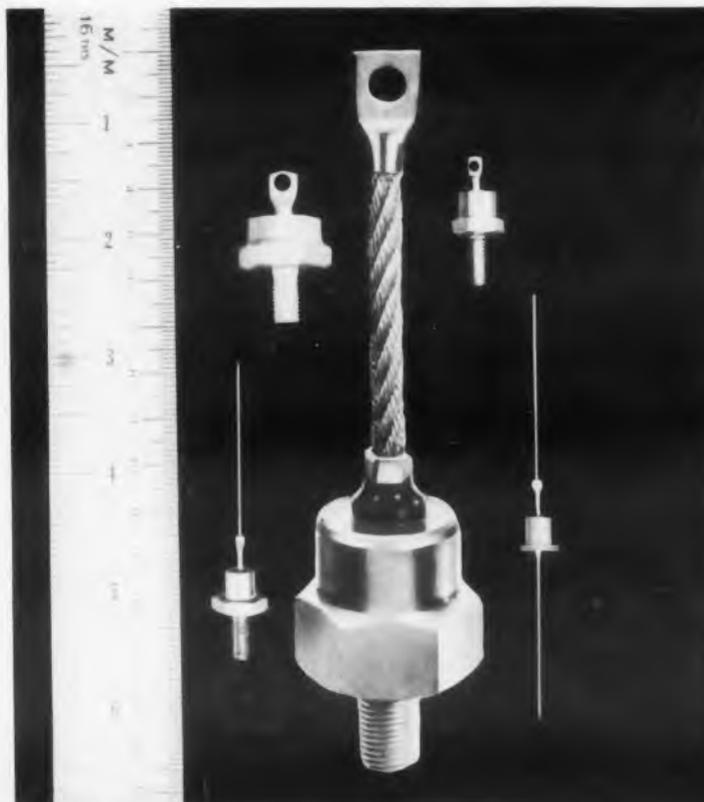
FOR THE ANSWER TO YOUR APPLICATIONS, TURN THE PAGE



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“BEEF UP” DC POWER AT LOWER COST!

Now, greater power output at lower cost is obtainable for countless applications—from smallest to heaviest industrial jobs (such as arc welding, electroplating, electro-chemical processing, etc.). Westinghouse silicon and germanium rectifiers give more efficient rectification, making possible important reductions in space, weight, and cost. Ruggedly designed to meet a wide range of operating conditions, they are hermetically sealed and are characterized by their long life, no detectable aging, excellent reliability and mechanical stability. For full information on Westinghouse Semiconductors, mail coupon on the page after next.



SILICON POWER RECTIFIERS

The d.c. forward currents for single cells range from 50 milliamperes to 150 amperes with maximum peak inverse voltages up to 1000 volts. Bridge configurations are assembled to give any desired combinations of d.c. forward current and output voltages.

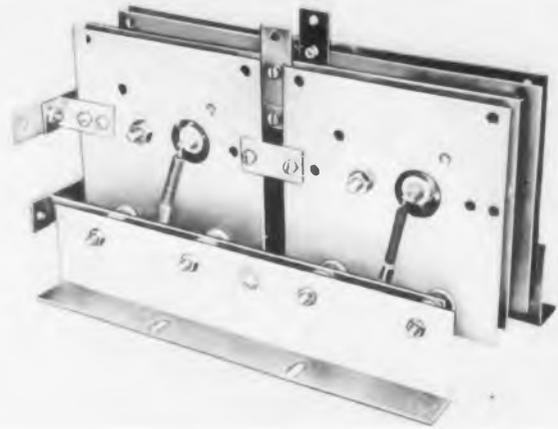
Type	P.I.V. (max)	Peak Reverse Current Max.	Maximum Current at 150°C case	Thermal Drop Junction to Case
Low Power				
305	50-1000	1.5 ma	1.6 amps	5°C per watt
307	50-600	.5 ma	1.6 amps	5°C per watt
308	50-600	.5 ma	1.6 amps	5°C per watt
320	50-1000	1.5 ma	1.6 amps	5°C per watt
Medium Power				
302	50-600	20 ma	35 amps	1°C per watt
303	50-600	10 ma	18 amps	1.5°C per watt
304	50-600	10 ma	12 amps	2°C per watt
341	50-600	10 ma	6 amps	2°C per watt
High Power				
319	50-500	40 ma	110 amps	.3°C per watt
322	50-500	40 ma	110 amps	.3°C per watt
326	50-500	40 ma	110 amps	.3°C per watt
327	50-500	50 ma	140 amps	.2°C per watt
328	50-500	50 ma	140 amps	.2°C per watt

SEMICONDUCTORS

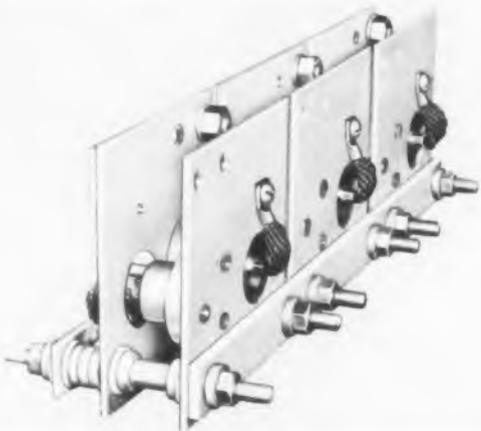
BRIDGES



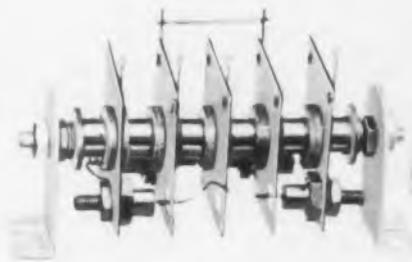
This is a 4-1-1 single-phase full-wave bridge using 303 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 27 amperes d.c. with convection cooling, or 53 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.



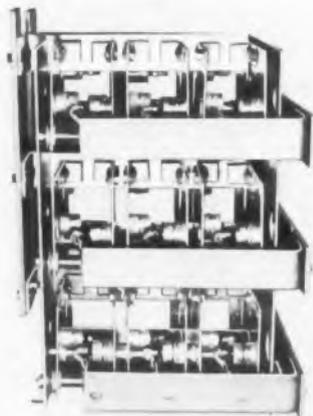
This is a 4-1-2 single-phase full-wave bridge using 302 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 94 amperes d.c. with convection cooling, or 178 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.



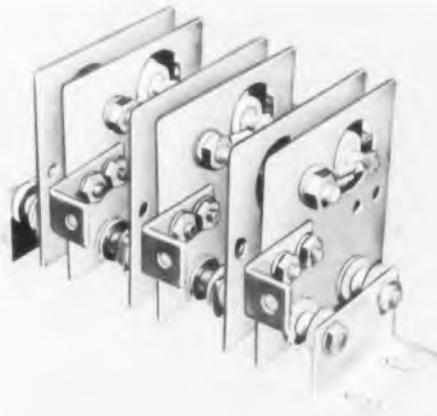
This is a 6-1-1 three-phase full-wave bridge using 322 cells on 5" x 5" copper plates. At an ambient temperature of 30° C it will deliver up to 132 amperes d.c. convection cooled, or 330 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are welding, electro-plating, chemical reduction, arc furnaces, motor drive, battery chargers, etc.



This is a 4-1-1 single-phase full-wave bridge using 305 cells on 1 1/2" x 1 1/2" copper plates. At an ambient temperature of 30° C, it will deliver up to 3.2 amperes d.c. with convection cooling. The primary applications are power supplies, relays, solenoids, mag amps, etc.

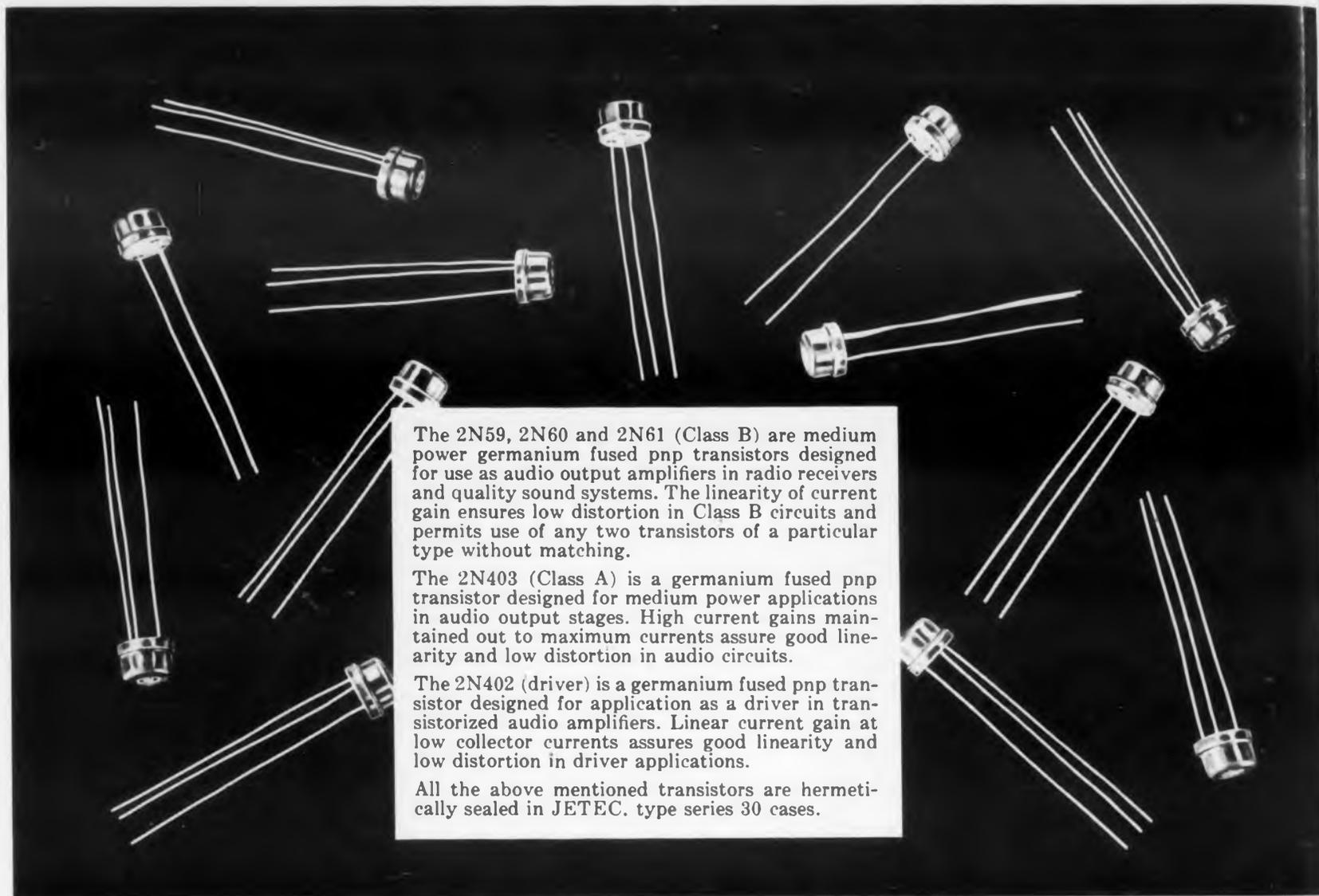


This is a 6-1-6 three-phase full-wave bridge using 322 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 780 amperes d.c. with convection cooling, or 1980 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are electro-plating, battery forming, arc furnaces, chemical reduction, motor drive, etc.



This is a 6-1-1 three-phase full-wave bridge using 302 cells on 3" x 3" copper plates. At an ambient temperature of 30° C, it will deliver up to 61 amperes d.c. with convection cooling, or 132 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.

WESTINGHOUSE GERMANIUM TRANSISTORS



The 2N59, 2N60 and 2N61 (Class B) are medium power germanium fused pnp transistors designed for use as audio output amplifiers in radio receivers and quality sound systems. The linearity of current gain ensures low distortion in Class B circuits and permits use of any two transistors of a particular type without matching.

The 2N403 (Class A) is a germanium fused pnp transistor designed for medium power applications in audio output stages. High current gains maintained out to maximum currents assure good linearity and low distortion in audio circuits.

The 2N402 (driver) is a germanium fused pnp transistor designed for application as a driver in transistorized audio amplifiers. Linear current gain at low collector currents assures good linearity and low distortion in driver applications.

All the above mentioned transistors are hermetically sealed in JETEC, type series 30 cases.

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Please send me full information on the following Semiconductors:

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TITLE _____

COMPANY _____

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Type	Collector Supply Voltage Volts	Power Output Milliwatts	Maximum Collector Dissipation @ 25°C Milliwatts	Collector Load Impedance Ohms	Power Gain Decibels	Collector-to-Base Cutoff Current Micro-amps	Junction Temperature Centigrade
Class B Applications							
2N59	-9	300	180	250*	30	-15†	+85°C
2N60	-9	300	180	250*	28	-15†	+85°C
2N61	-9	300	180	250*	26	-15†	+85°C
Class A Applications							
2N403	-9	30	180	500	34	-15†	+85°C
Driver Applications							
2N402	-9	2	180	10,000	39	-15†	+85°C

*Collector to Collector Load Impedance

†VCB = minus 20V

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**SUPERIOR
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for electron
GUN MOUNTS?

Because this firm

- ★ Has pioneered many new manufacturing techniques
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- 1 -
New! 110°
deflection
gun

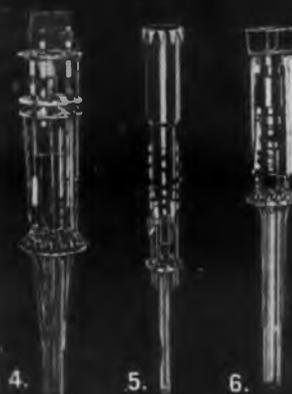


- 2 -
Electro-
static
focus gun

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Electro-
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gun

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quality electron gun mounts**

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deflection
gun



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Special
purpose
gun

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Short neck
90° gun

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GRegory 2-2500

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CIRCLE 212 ON READER-SERVICE CARD

◀ CIRCLE 505 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 5, 1958

Waveguide Rotary Joints

Broad band operation at high speeds

Series DIC-6500 waveguide rotary joints is of the in-line type and features ranges from 2600 mc to 18 kmc and operation at speeds up to 100 rpm. The joints employ special transducers from rectangular to loaded circular waveguide, producing a pure circularly symmetric TM mode. Because of the purity of the mode, no dissipative mode suppressors are required so that insertion loss is held to a minimum, and there is no phase shift with mechanical rotation.

Vswr is less than 1.5, insertion loss is less than 0.1 db, and the variation of insertion loss with rotation is less than 0.05 db.

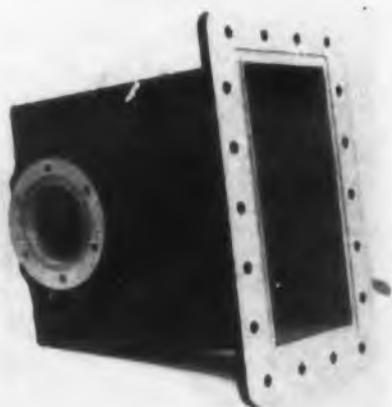
Diamond Antenna & Microwave Corp., Dept. ED, 7 North Ave., Wakefield, Mass.

IRE Booth No. 3237, 3239

CIRCLE 221 ON READER-SERVICE CARD

Microwave Transition Member

• Offers high heat dissipation



Featuring a high heat dissipation rate, this transition member of a microwave transmission line is a high-power waveguide component with a wide bandwidth. In conventional transition construction, the probe has a minimum opportunity to dissipate the heat generated by high power conduction, and the coax insulator tends in time to break down. In place of the round bar customarily placed at the quarter wave point, between the probe and transition sides to aid in heat dissipation, this transition member uses a flat bar at this point. The flat shape allows greater freedom of positioning for a given area. Better impedance matching with minimum loss results, and wider bandwidth becomes possible. Bandwidths up to 40 per cent of center frequency with a standing wave ratio of 1.1:1 have been achieved.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

IRE Booth No. 2344

CIRCLE 222 ON READER-SERVICE CARD

Looking for a "POT"?



PANEL MOUNT SHOWN,
SERVO MOUNT OPTIONAL

ACTUAL SIZE

SERIES 341 **TEN-TURN PRECISION** **POTENTIOMETER**

Smaller in diameter than a fountain pen — no longer than a shriveled up Gryllidae Gryllus*, this tiny "pot" offers ultimate precision in the smallest package on the market.

Check some of the standard specifications of this precision-built, wire-wound, ten-turn potentiometer:

- SIZE:** 0.55" x 1.02"
- WEIGHT:** 10 gms. max.
- BACKLASH:** Essentially zero
- PHASE SHIFT:** Less than 0.1° at 400 cps
- VIBRATION:** 20gs to 2000 cps (3 attitudes)
- POWER:** 2.5 watts at 40°C, 0 watts at 140°C

* also known as a cricket

STANDARD MODELS AVAILABLE IN PRODUCTION QUANTITIES NOW . . . SPECIAL REQUIREMENTS CAN USUALLY BE MET. WRITE TODAY FOR COMPLETE INFORMATION CONCERNING THIS AND OTHER MINIATURE WIRE-WOUND, PRECISION POTENTIOMETERS.

Openings exist for highly qualified engineers

WRITE TODAY FOR DETAILS

ACTUAL SIZE

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A division of DAYSTROM INC.

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In Canada: Daystrom Ltd
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Toronto 10, Ontario

Export: Daystrom International
100 Empire Street
Newark 12, New Jersey



Series
304

One-turn, Wire-wound,
Precision
Potentiometer.
LOW COST
HIGH PERFORMANCE

CIRCLE 223 ON READER-SERVICE CARD

NEW PRODUCTS

at the IRE Show

Synchronous Motor

Rotation accurate to ± 0.1 deg



Model GS synchronous motor features a constant angular rotation (± 0.1 deg) no load to full load. The motor is provided with an integral start motor, and is capable of operating from a vacuum tube amplifier on signal frequencies from 60 to 3600 cps. The unit will operate single phase in the plate circuit of a single-ended amplifier or as a two-phase motor when driven by a push-pull amplifier, providing up to 1/100 hp output. The motor current is about 75 ma per phase. The power input may be as high as 20 w.

Times Facsimile Corp., Dept. ED, 540 W. 58th St., New York 19, N.Y.

IRE Booth No. 1824

CIRCLE 137 ON READER-SERVICE CARD

Magnetic Recording Test Unit

A modular read-write test system



This read-write system for magnetic tape or drum memories measures 11 in. high x 11 in. wide x 9 in. deep. Individual units are entirely transistorized and printed

CIRCLE 138 ON READER-SERVICE CARD ▶

EIMAC FIRST

Covering the spectrum
with reliable ceramic tubes



AF-
VHF

Ceramic Tubes

2CL40A
2C39B
2C39WA
3CX100A5
3CPN10A5
4CX300A

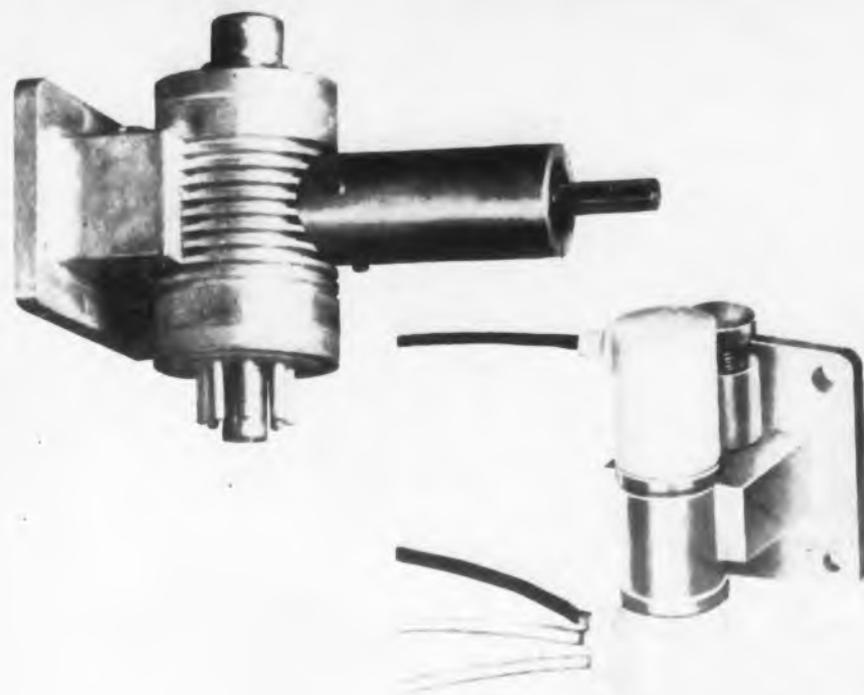
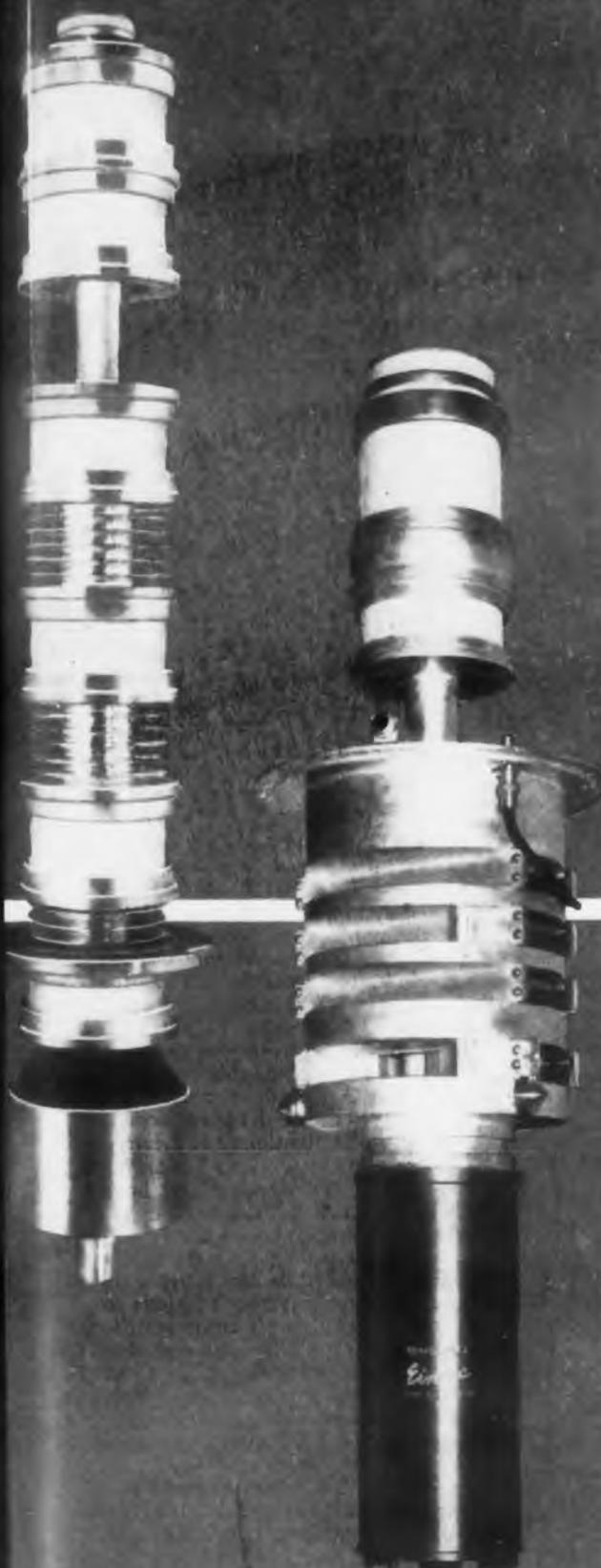
4CX250B
4CX250K
4CX250M
4CX1000A
4CX5000A
X629

X635
X656
X685C
X693
X694

UHF
Ceramic Tubes

2C39B
2C39WA
3CX100A5
3CPN10A5
3K2500LX
3K2500SG

3K3000LQ
3K50,000LA
3K50,000LF
3K50,000LQ
3KM2500LT
3KM3000LA
3KM50,000LQ



From audio into super high frequencies, Eimac covers the RF spectrum with modern ceramic tubes. This incomparable ceramic electron tube family — more than one-third of the Eimac line — includes reflex and amplifier klystrons, negative grid tubes, rectifiers, pulse modulators, and receiving tubes. The tubes illustrated are typical of more than 40 Eimac ceramic tube types that are being selected by leading equipment manufacturers for use in all types of applications — from tropo-scatter to industrial heating, from single side-band to pulse.

The advantages of reliable Eimac ceramic tubes include: resistance to damage by impact, vibration, and heat; smaller size; and better processing techniques.

Do it yourself — subject an operating Eimac ceramic tube to impact at our unique display, booths 2409-2412, during the New York IRE Show, March 24-27.



EITEL-McCULLOUGH, INC.
SAN BRUNO CALIFORNIA

Eimac First with ceramic tubes that can take it

SHF
Ceramic Tubes

1K125CA
1K125CB
1K20XS
1K20XK
1K20XD

1K20KA
X563
X639
X686

X300A
X250B
X250K
X250M
50,000LQ
M50,000SG
M170,000LA
6K50,000LQ
X576
X597
X626
X685C
X693

circuit techniques are utilized throughout. The modular units pictured above are, from top to bottom, a 10 bit shift register for parallel-to-serial conversion of incoming data or serial-to-parallel conversion of outgoing data, a ten channel NRZ write-amplifier, a ten channel NRZ read-amplifier, and a regulated power supply. The units are compatible with all other units in the company's line of transistorized pulse programming equipment.

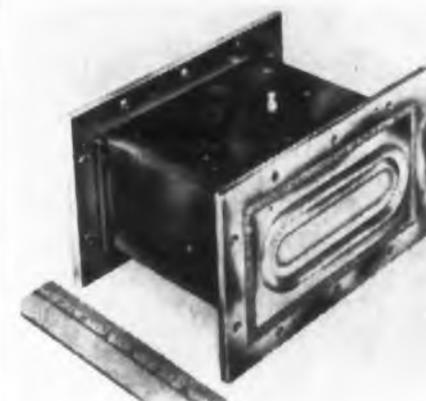
Navigation Computer Corp.,
Dept. ED, 1621 Snyder Ave., Phil-
adelphia 45, Pa.

IRE Booth No. 1311

CIRCLE 139 ON READER-SERVICE CARD

Duplexer Tube

Two megawatt unit for L-band use



The MA-336/7166, first in a series of L-band high power duplexer tubes, is conservatively rated at 2 megawatts peak power and 4 kw average power for continuous operation over a minimum life span of 500 hr.

Features of the tube include a ruggedized window construction for high reliability under thermal shock or mechanical strain during high power operation. The keep-alive structure of the tube makes possible controlled TR leakage energy over 500 hr operation. This is evidenced by a negligible change in the overall noise figure of crystals mounted behind the tube. Overall length of the MA-336 is 7-1/4 in.

Microwave Associates, Inc., Dept.
ED, Burlington, Mass.

IRE Booth No. 3508, 3510

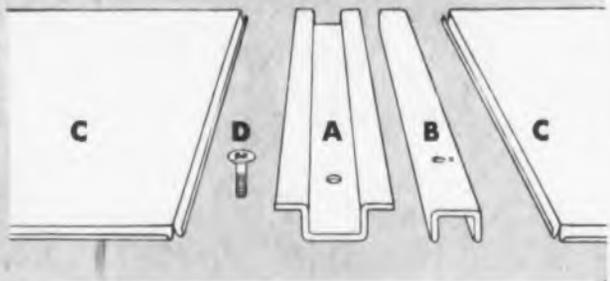
CIRCLE 140 ON READER-SERVICE CARD

◀ CIRCLE 138 ON READER-SERVICE CARD

LINDSAY STRUCTURE

application requires only

4
BASIC
PARTS
yet
installations
are unlimited



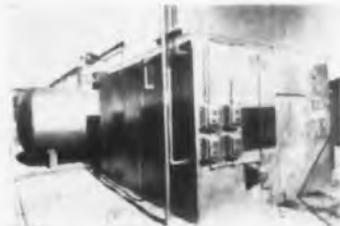
A—FLANGED FRAME
B—TENSIONER
C—PANEL SHEETS
D—LOCK SCREWS

Lindsay Structure makes possible the prefabrication of enclosures for instruments, testing machines, radio and radar equipment; housings for processing, shielding, large towers and industrial equipment; truck and trailer bodies; and buildings. All shapes and sizes are possible to any desired dimension within $\frac{1}{2}$ inch. Lindsay Structure has demonstrated its efficiency in hundreds of different applications, and in all workable metals.

With Lindsay Structure you save the cost of expensive dies and "tooling" up. Production can be started almost immediately . . . and assembly handled by workers without special training . . . and uniformity of finished structures is assured with die-drawn, die-cut Lindsay components to exact size requirements.

And there need be no delay in changing models, sizes, or other details that would normally slow down production — even in the largest Lindsay Structure units.

Make use of Lindsay Structure's 78,085 panel sizes for your housing, enclosure, building or equipment requirements. Write for descriptive folder, or send a single-line drawing for prompt cost estimate.



LINDSAY STRUCTURE DIVISION

INTERNATIONAL STEEL COMPANY

1427 Edgar Street



Evansville 7, Indiana



Canadian Affiliate: Lindsay-International, Ltd., Port Credit, Ontario

CIRCLE 224 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show



I-F Transformers

For transistor circuits

This line of i-f transformers, series 35, is designed for transistor circuits. The unit pictured is a typical 455 kc i-f unit. Other transistor i-fs designed for frequencies up to 10.9 mc are similar in appearance but taller.

Aladdin Electronics, Dept. ED, 703 Murfreesboro Rd., Nashville, Tenn.

IRE Booth No. 1816

CIRCLE 225 ON READER-SERVICE CARD

Relay

Stands 500 cps 10 g vibration



Type BHSM-HT relay is rated at 500 cps at 10 g vibration. The unit uses cross-bar palladium contacts, silicone-glass pile up insulators, a welded bracket assembly and frame, Teflon magnet wire, and a Kel-F-Coil bobbin. The relay is designed to operate at a temperature range of -65 to $+125$ C and will withstand 30 g operating shock or 70 g non-destructive shock.

Available in contact form up to 4pdt rated 3 amp at 32 v dc or 115 v ac non-inductive. Coils can be furnished up to 130 v dc with a minimum sensitivity of 0.2 w per pole and a maximum coil dissipation of 3.75 w. Approximate weight is 3.25 oz. Approximate dimensions are 1.332 x 0.960 x 1.643 in.

Essex Wire Corp., RBM Div., Dept. ED, 1601 Wall St., Ft. Wayne 6, Ind.

IRE Booth No. 2525

CIRCLE 226 ON READER-SERVICE CARD



Turn in your slide rule, Smedley!

Smedley aimed his guided missile at the moon—and scored a bulls-eye on a farm pond just outside Keokuk. The ducks didn't lay for weeks.

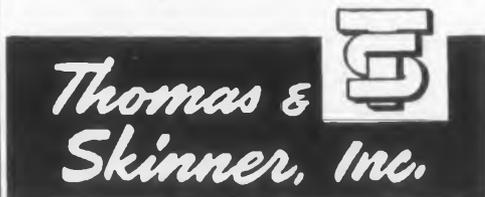
Smedley's mistake: he based his schedule on an over-optimistic delivery date by a supplier of laminations . . . and, as zero hour approached, he had to accept substitute laminations not meeting specifications.

Thomas & Skinner could have helped Smedley. T&S handles inquiries promptly . . . quotes realistic delivery dates . . . and then ships on schedule with products meeting customer specifications in every respect. T&S's entire staff is constantly aware of the importance of handling customer orders, no matter how big or little the order, no matter how big or little the customer. All T&S customers are VIP's to the T&S staff.

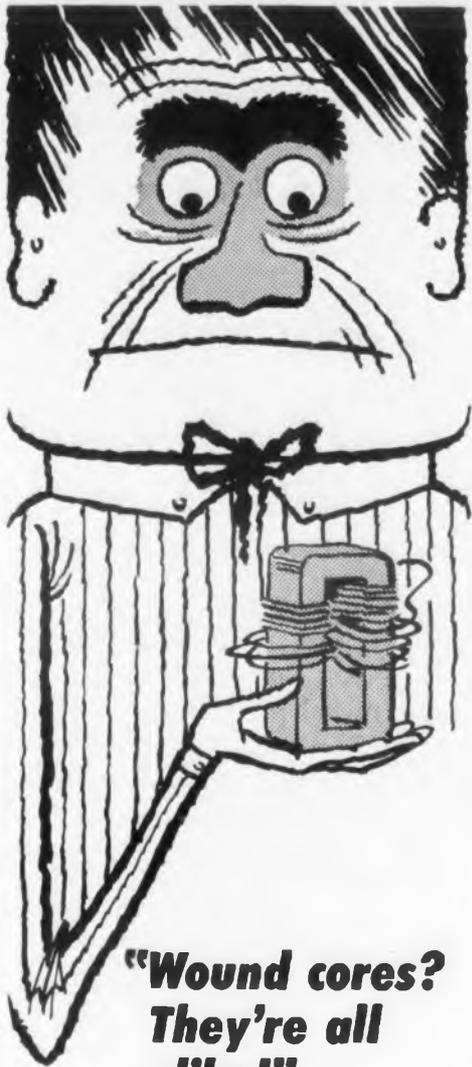
Specify T&S laminations for your next project. Write for new lamination catalog, Bulletin L-1057.

SPECIALISTS IN MAGNETIC MATERIALS

Permanent Magnets  Magnetic Tapes 
Laminations  and Wound Cores 



1157 E. 23rd St., Indianapolis 7, Indiana
CIRCLE 227 ON READER-SERVICE CARD



**"Wound cores?
They're all
alike!"**

says Slipstick Smith

We beg to differ. Some wound cores may not meet specifications. Some may not arrive on time. Some may never arrive at all! There *is* a difference, Mr. Smith.

Now consider wound cores from Thomas & Skinner . . .

Thomas & Skinner handles inquiries promptly . . . quotes realistic delivery dates . . . and then ships on schedule with wound cores (as well as all T & S products) meeting customer specifications in every respect. T & S's entire staff is constantly aware of the importance of handling customer orders, no matter how large or small the order, no matter how large or small the customer. All T & S customers are VIP's to the T & S staff.

Specify T & S OrthoSil® Wound Cores for your next project. Write for Bulletin WC-356.

See us at
Booth 2926 I.R.E. Show,
March 24-27

**Thomas &
Skinner, Inc.**

CIRCLE 228 ON READER-SERVICE CARD

Electronic Measuring Equipment

Twenty-two models will be exhibited



Heading the list of 22 instruments being introduced by this manufacturer at the show are the 120 A and 120 AR oscilloscopes. With a range from dc to 200 kc, the 120 A (cabinet mount) and 120 AR (rack mount) have a sweep speed range of 1 μ sec/cm to 0.5 sec/cm. They include a X5 sweep expansion on all ranges, with vernier for continuous control. Fifteen calibrated sweeps are provided, in 1-2-5 sequence. Automatic synchronizing is provided on any internal or external voltage; scopes may also be triggered by line voltage. Calibrated identical bandwidth vertical and horizontal amplifiers provide convenient phase measurement.

Other instruments that will be featured are: four microwave sweep oscillators, covering the G, J, X and P bands engineered to speed measurements between 3.95 and 18.0 kmc; the 721A transistor power supply having a 150 ma maximum output, with output resistance less than 0.2 ohm; the 218A digital delay generator, producing two exact time intervals or pulse delays independently adjustable from 1 to 10,000 μ sec in 1 μ sec steps; the 606A signal generator, covering the broad frequency range of 50 kc to 65 mc; the 340A noise figure meter; enabling a semi-skilled worker to do receiver and component optimizing jobs in a few minutes; the 345A i-f noise source, designed specifically for i-f amplifier noise measurement, includes temperature-limited diode sources operating at either 30 or 60 mc; the 425A microvolt meter, a high stability voltmeter which reads voltages of 10 μ v to 1 v in 18 ranges and currents of 10 μ amp to 3 ma.

Some of the other instruments are: the 434A calorimetric wattmeter; the 355A and 355B 50 ohm attenuators; the P532A waveguide frequency meter; and the 152B oscilloscope differential amplifier.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

I.R.E. Booth No. 2509, 2511, 2513, 2515

CIRCLE 229 ON READER-SERVICE CARD

ELIN POWER OSCILLATORS...

to "System-mate" Your Equipment
Requirements!

CABINET MODEL
DK-102 (2 watts)
DK-106 (6 watts)



Pot. Pending.

RACK MODEL
DK-102R (2 watts)
DK-106R (6 watts)

In applications concerning strain gauges, bridge-type transducers, time correlation, precision 400 cycle gyro testing, process control and preflight missile checkout, ELIN Precision Power Oscillators prove compatible and, in combination with other equipments, readily yield superior systems!

The desirable features of ultra-precise frequency and amplitude stability, low distortion and high output power capacities, make ELIN Precision Power Oscillators the ideal "System-mate" in these applications, and are derived from an exclusive High-Q LC tuned circuit and a special voltage-sensitive bridge combined in a circuit employing a large amount of negative feedback.



FREQUENCY (FIXED)—250 cps. to 15,000 cps. **VOLTAGE (OUTPUT)**—10, 30 & 100 volts RMS, all with floating center-tapped output. **DISTORTION**—0.1% maximum harmonic content, 0.05% maximum AC hum, 0.01% maximum noise. **CALIBRATION ACCURACY**— $\pm 0.02\%$ under usual lab ambient conditions*, checked against station WWV as a primary standard. **FREQUENCY STABILITY**— $\pm 0.5\%$ maximum, under usual lab ambient conditions*, $\pm 0.02\%$ maximum per ± 10 volts variation in line voltage, $\pm 0.05\%$ maximum, zero to full load. **AMPLITUDE STABILITY**— $\pm 0.1\%$ maximum under usual lab ambient conditions*, $\pm 0.02\%$ maximum, per ± 10 volts variation in line voltage, $\pm 0.2\%$ maximum, zero to full load.

Special models operating from other prime power sources, with higher power capacities and at other frequencies supplied to your specs in cabinet or rack styles. Write today!

*Lab ambient, 10°C to 40°C.

Reg. U. S. Pat. Off.

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Precision Power Oscillators

ELECTRONICS INTERNATIONAL CO.

145 West Magnolia Boulevard, Burbank, California

Special Products Division of International Electronic Research Corporation, Burbank, California

CIRCLE 230 ON READER-SERVICE CARD

Miller



* K-TRAN IS A REGISTERED TRADEMARK

THE FAMOUS K-TRAN^{*}

I.F. TRANSFORMERS



A complete line of the finest I.F. transformers available anywhere at any price. Both standard and miniature sizes in all of the commonly used I.F. frequencies are stocked for immediate delivery. Conventional as well as printed circuit types are available for both vacuum tube and transistorized applications. Original equipment manufacturers will find the K-Tran the ideal choice for new equipment designs thus saving valuable engineering manhours and being assured of a top quality transformer designed by engineers with over 30 years of manufacturing experience in electronic components. The K-Tran also makes an excellent replacement transformer and will give results equal to or better than the original.

AVAILABLE IN THE FOLLOWING FREQUENCIES

CAT. NO. Printed Circuit Types	CAT. NO. Regular Standard Types	Dimensions: 3/4" square x 2" high	FREQ.	USE
13-PH1	12-H1		262 KC	Input transformer
13-PH2	12-H2		262 KC	Output transformer
13-PH6	12-H6		262 KC	Output transformer with diode filter
13-PC1	12-C1		455 KC	Input transformer
13-PC2	12-C2		455 KC	Output transformer
13-PC6	12-C6		455 KC	Output transformer with diode filter
13-PC7	12-C7		455 KC	Input transformer for battery radios
13-PC8	12-C8		455 KC	Output transformer for battery radios
13-PC9	12-C9		455 KC	Input transformers for AC-DC radios
13-PC10	12-C10		455 KC	Output transformer for AC-DC radios
	13-W1		1500 KC	Input and interstage transformer
	13-W2		1500 KC	Output transformer
6203-PC	6203		4.5 MC	Input or interstage transformer
6204-PC	6204		4.5 MC	Discriminator transformer
6205-PC	6205		4.5 MC	Ratio detector transformer
1463-PC	1463		10.7 MC	Input or interstage transformer
1464-PC	1464		10.7 MC	Discriminator transformer
1465-PC	1465		10.7 MC	Ratio detector transformer
6230-PC	6230		44 MC	TV Converter I.F. Transformer
6231-PC	6231		44 MC	TV First I.F. Transformer
6232-PC	6232		42.5 MC	TV second I.F. Transformer
6233-PC	6233		42.5 MC	TV third I.F. Transformer
6234-PC	6234		44 MC	TV fourth I.F. Transformer

Available Through Your Local Distributor

Miller Quality Products are recognized by the entire electronics industry as representing the finest in workmanship, performance, and dependability.

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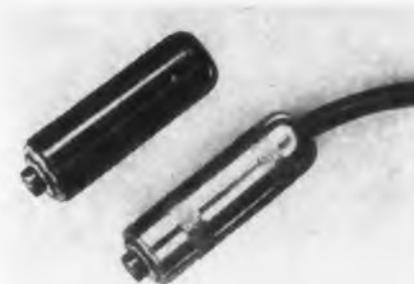
Warehouse Stock
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Toronto 10, Ontario, Canada

CIRCLE 231 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Cord Mounted Switch

Rated at 250 ma



Designed for numerous remote control applications, this push button switch, enclosed in a handle, provides a cord mounted or pendant switch. Housing is nickel plated brass or black phenolic. The red or black push buttons are non-locking. The switch is rated at 250 ma, non-inductive load, ac 30 w maximum.

Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill.

IRE Booth No. 2228

CIRCLE 232 ON READER-SERVICE CARD

Tape Recorder

Three motor drive, 7.5 and 15 ips speeds



This tape recorder, Type 800, has a 10-1/2 in. reel capacity with speeds of 7.5 and 15 ips. Equalization automatically switched with speed change. Signal-to-noise ratio is 60 db at 1 per cent distortion. Frequency response is 30 to 20,000 cps ± 2 db at 15 ips. The recorder can accommodate up to four full or 1/2 track. With a 3 motor drive, the unit features individually and functionally illuminated push button relay controls, provision for remote control, and a tape edit button which allows easy run-off of unwanted tape.

Presto Recording Corp., Dept. ED, P.O. Box 500, Paramus, N.J.

IRE Booth No. 1211

CIRCLE 233 ON READER-SERVICE CARD



Mixer Crystal

Improved noise figure in C and X band

The MA-423A is a point contact silicon mixer diode which requires no dc bias. It is mechanically interchangeable with other diodes of the 1N23 series, but provides improved receiver noise figures of 7 db or better when used with a 1.5 db i-f strip at 30 mc. For radar receivers which employ image termination techniques and which are designed to use 1N23C or 1N23E diodes, circuit adjustment of i-f impedance match, local oscillator drive, and r-f match may be necessary to derive maximum receiver noise figure improvement with the MA-423A.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.

IRE Booth No. 3508, 3510

CIRCLE 234 ON READER-SERVICE CARD

Sweep Generator

Checks response to 0.01 db



Model 1099 sweep generator, covering the 100 kc to 20 mc range with crystal markers throughout this range, enables response measurements to be made with a discrimination of at least 0.01 db. A stabilized output level of 3 v max is provided, and the instrument is supplied with detector probes on both input and output. With these probes a greatly amplified indication can be obtained of the deviation of an amplifier frequency response from level. Measurements are largely independent of input level changes.

Marconi Instruments, Dept. ED, 111 Cedar Lane, Englewood, N.J.

IRE Booth No. 3315, 3317

CIRCLE 235 ON READER-SERVICE CARD

IN A HURRY FOR TEFLON* INSULATED High Temperature Wire & Cable?



YOU GET IT FASTER FROM

Super-Temp

MAGNET WIRES • HOOK-UP WIRES
CABLES • TUBING

COMPLETE

SERVICE: SUPER-TEMP'S management is not the ivory tower type! They are always available for personal discussion and advice. Your order, small or large, receives immediate interest, attention and continuous supervision at all production stages.

"KNOW-HOW": Years of experience, talent and craftsmanship at all levels are at your disposal. SUPER-TEMP's advanced engineering skills are your assurance of high precision, dependable products.

TESTING FACILITIES: Quality production is insured by every conceivable environmental and physical test in SUPER-TEMP's modern research laboratory equipped with the latest scientific testing instruments.

PRODUCTION EQUIPMENT: SUPER-TEMP is now and will continue to be the industry's most completely integrated plant for all phases of wire and cable production. High speed, modern machines assure volume production with sustained reliability.



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Contains valuable information and specifications.

*DuPont Polytetrafluoroethylene

SHIELDED AND JACKETED MINIATURE CABLES

Coax, Single Conductor and Multi-Conductor Constructions
All Wires, Braided Shieldings and Jacket Specifications Available

TEFLON INSULATED MAGNET WIRES

Nos. 14 to 50 AWG Single, Heavy, Triple and Quad Thicknesses

TEFLON INSULATED HOOK-UP WIRES

Tape wrapped and extruded. All color codings including stripes

SILICONE ENAMEL INSULATED MAGNET WIRES

Nos. 14 thru 50 AWG Single and Heavy Insulations

SPECIALTY WIRES AVAILABLE USING TEFLON, GLASS & SILICONE

TEFLON TAPE (Unsintered) — SUPER-TEMP welcomes your inquiries on our new Teflon Tape production facilities. Extra long lengths available.

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Agents in Principal Electronic Manufacturing Areas

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Now

An all-around pressure-tight seal for hinged-cover transit cases with

LINK-LOCK and **HINGE-LOCK**



● LINK-LOCK
○ HINGE-LOCK



No. 3 LINK-LOCK



No. 3 HINGE-LOCK

Two HINGE-LOCK and two LINK-LOCK Fasteners provide all-around sealing pressure on this container manufactured for the U.S. Navy by the Bonded Structures Division, Swedlow Plastics Company.

The new Simmons HINGE-LOCK, used in combination with LINK-LOCK, provides an even, pressure-tight seal on equipment containers and transit cases with hinged covers. A half-turn applies pressure to both types of fasteners. When pressure is released HINGE-LOCK becomes a free-operating hinge, and LINK-LOCK disengages to permit opening.

Originally developed by Simmons Fastener Corp. for the Engineering Department of Swedlow Plastics Company, Bonded Structures Division, HINGE-LOCK is similar in principle and appearance to LINK-LOCK. Both are available in light and medium duty sizes as matched hardware. LINK-LOCK is also available in a higher-capacity, heavy-duty size.

SEND TODAY for complete data, including dimensions, capacities. Engineering service is available... Outline your requirements. Samples on request.

Visit us at Booth 1020, DESIGN ENGINEERING SHOW,
International Amphitheatre, Chicago, April 14-17, 1958
See our 8 page catalog in Sweet's 1958 Product Design File

SIMMONS FASTENER CORPORATION 1763 North Broadway, Albany 1, New York

QUICK-LOCK • SPRING-LOCK • LINK-LOCK • HINGE-LOCK • ROTO-LOCK • DUAL-LOCK

CIRCLE 237 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Copper Clad Laminates

Epoxy paper and epoxy glass bases

Two copper clad laminates, types 11574 and 11558, will be featured. Type 11574 self-extinguishing epoxy paper laminate has: flame retardancy; outstanding cold punching; high mechanical strength; and high insulation resistance. Type 11558 cyanide proof copper clad epoxy glass laminate features: resistance to cyanide plating solutions; resists cleaning solvents such as MEK; and it withstands thirty seconds plus in 500 F solder pot. A high mechanical strength allows use of minimum thickness in fabricated parts.

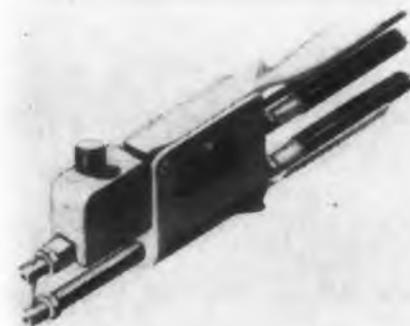
General Electric Co., Chemical and Metallurgical Div., Dept. ED, Coshocton, Ohio.

IRE Booth No. 2914

CIRCLE 238 ON READER-SERVICE CARD

Welding Attachment

Welds wires of 8 or 10 gage



A heavy-duty handpiece accessory for precision welders, the UT-865 is capable of welding wires of 8 or 10 gage and smaller. The accessory is adaptable to existing weldmatic precision welder models and handles up to 500 watt seconds of energy. It is especially useful in heavy-gage thermocouple welding, and in performing general heavy-duty precision welding in hard-to-reach locations.

The handpiece provides adjustable pressure ranging from 1 to 25 lb and has a 3 to 1 mechanical advantage. The electrodes are pressure sensitive, firing only when a pre-set pressure is reached, regardless of electrode spacing or configuration.

Unitek Corp., Weldmatic Div., Dept. ED, 380 N. Halstead Ave., Pasadena, Calif.

IRE Booth No. 4417

CIRCLE 239 ON READER-SERVICE CARD

How to house a MONSTER*



AMCO MODULAR SYSTEM FOR INSTRUMENT ENCLOSURE

Amco provides the most complete system for custom instrument enclosure, at mass production cost! One of many exclusive features of the Amco system is provision for internal mounting (as seen above) of Amco standard 19", 38", and 57" wide panels.

Panels, frames, turrets, blowers, bench cabinets, chassis slides, these and the other standardized Amco components do the entire enclosure job . . . with ease, versatility, and reasonable cost. Conform to EIA (formerly RETMA) mounting provisions. Write for full information. You'll see why Amco is years ahead.

**SEE US AT THE IRE SHOW
BOOTHS 1919 AND 1921**



ENGINEERING CO.

7333 W. Ainslie St. • Chicago 31

CIRCLE 240 ON READER-SERVICE CARD

Oscilloscope

Small 6 x 8 x 13 in. unit

A portable, relatively inexpensive unit, the Serviscope features balanced dc coupled amplifiers giving flat response to 6 mc (-3db) and having a rise time of better than 0.06 μsec for less than 2 per cent overshoot. Both automatic sync and precision trigger level are provided as well as TV field and frame sync selectors. Voltage and time calibrating signals facilitate quantitative measurements and X- expansion, about the center, gives a 50 cm effective trace length. Eighteen sweep speeds and an attenuator permit time and voltage measurement over the ranges 0.1 $\mu\text{sec}/\text{cm}$ to 0.5 sec/cm and from 20 mv to 250 v, ac or dc respectively. The unit weighs 16 lb and measures 6-1/2 x 8-1/2 x 13-1/2 in. overall.

Scopes Co., Inc., Dept. ED, 22-02 Raphael St., Fairlawn, N.J.

IRE Booth No. 2815

CIRCLE 241 ON READER-SERVICE CARD

Testing Chamber

Accurately tests capacitor coefficients



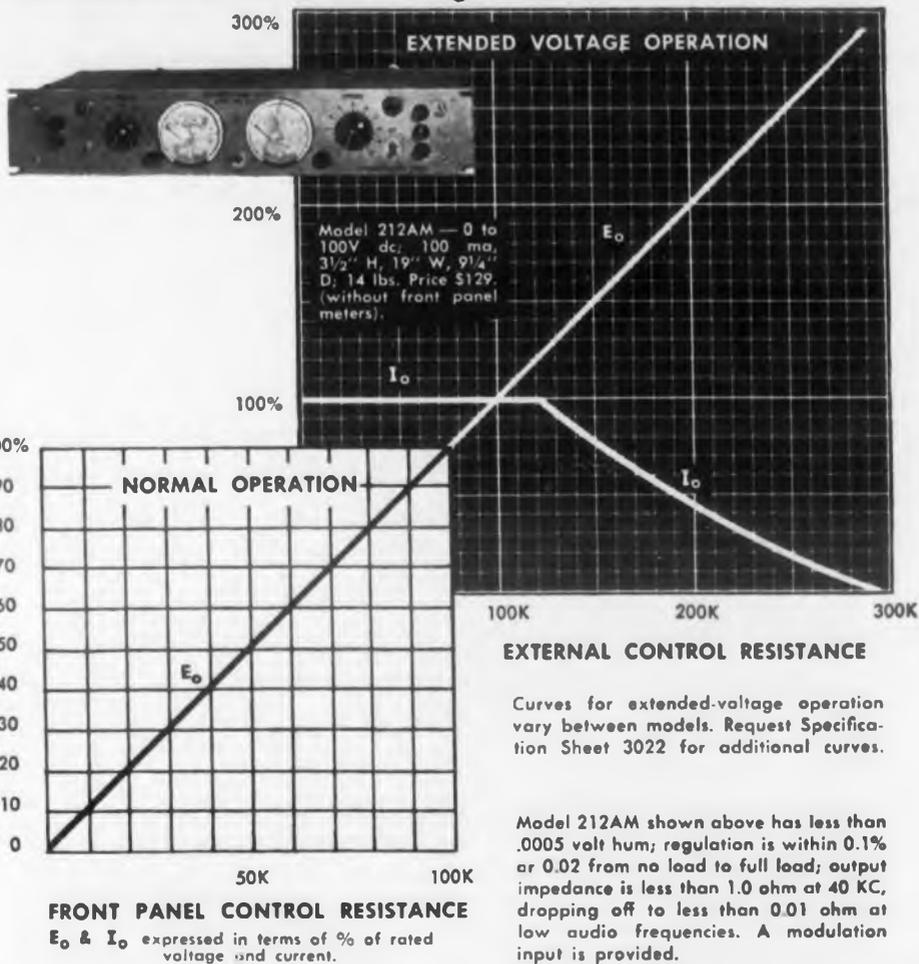
The FB-411 capacitor coefficient testing chamber features adjustable indicating temperature control for the range of $+150$ to -70 C, with proportioning action for heating or cooling demand, whichever is being controlled. A stainless steel inner chamber is furnished for encasing capacitors being tested. Movable dampers are provided to permit rapidly circulating air through this inner chamber for rapid cooling or heating effect. At stabilized conditions, the movable dampers are kept closed, and a very small circulator within the member circulates the air to prevent stratification. This equipment permits stability of items on test to as close as $\pm 1/10$ F, as measured with static load conditions. The refrigeration equipment employs Freon-13 and Freon-22 coolants in a patented arrangement.

Conrad, Inc., Sub. Crampton Mfg. Co., Dept. ED, 141 Jefferson St., Holland, Mich.

IRE Booth No. 3834

CIRCLE 242 ON READER-SERVICE CARD

REGATRON Programmable Power Packs



RELIABLE, DEPENDABLE...

this power pack will furnish almost three times its rated maximum voltage

The extra margin of safety built into every E/M Power Pack is no idle boast. E/M's smallest Power Pack, Model 212A, is rated at 0—100V dc and 0—100 ma . . . yet it can and will deliver almost three times its rated maximum voltage at reduced current. What's more, operation beyond its rated voltage is a *practical, safe performance feature.*

Notice too, that within normal operating limits, 100% rated current is always available . . . even at a fraction of a volt.

But that's not all . . . for automatic test facilities, Regatron Programmable Power Packs have provisions for the simplest remote control system known—a variable resistor.

Constant current models, transistorized models . . . see them at the IRE show—Booths 3837 & 3839.

For a detailed account of how Regatron Programmable Power Packs can be used for automatic control and automation, send for your copy of Bulletin 765.

© Registered U. S. Patent Office. Patents pending.

ELECTRONIC MEASUREMENTS CO., Inc.

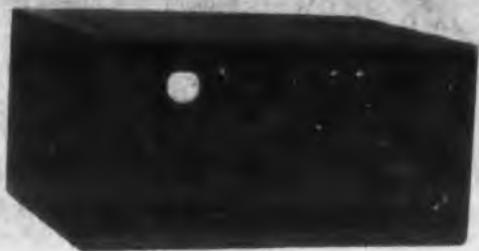
Eatontown • New Jersey

CIRCLE 243 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Computing Transfer Oscillator

Measures cw and pulsed frequencies



A computing transfer oscillator, model 7580, which measures cw and pulsed frequencies using the harmonic multiplying factor, will be introduced. The instrument extends the range of the companion 10 mc Eput meters to beyond 12 kmc. Accuracies are in the order of 3 parts in 10^7 .

A nomograph mechanism determines and displays the harmonic number of the fundamental at zero-beat against the unknown. The harmonic number is preset into two built-in decimal counting units which scale the fundamental so that the associated counter presentation is a direct-digital reading of the unknown. The transfer oscillator has a built-in crystal detector, harmonic generator, and tuning stubs for maintaining input sensitivity.

Beckman Instruments, Inc., Berkeley Div., Dept. ED, 2200 Wright Ave., Richmond 3, Calif. IRE Booth No. 3416, 3418

CIRCLE 245 ON READER-SERVICE CARD



Cabinets and Racks

Of magnesium alloys

Utilization of corner castings and extrusions in the fabrication of control and instrument cabinets, racks, and chassis are featured. Emphasis is placed on late developments in fabricating light-weight metals such as aluminum and thorium based magnesium alloys.

Falstrom Co., Dept. ED, Falstrom Court, Passaic, N.J.
IRE Booth No. 1116

CIRCLE 246 ON READER-SERVICE CARD

MORE
PERFORMANCE
PER
DOLLAR
than any
other amplifier



MODEL USA-3

- **RELIABILITY:** No electrolytic capacitors or glow tubes. Designed to prevent self-destruction even when the output is short circuited.
- **DRIFT, NOISE, OFFSET:**
Under 100 microvolts
- **LARGE OUTPUT VOLTAGE:**
230 volts peak-to-peak
- **WIDE FREQUENCY RANGE:**
DC to 100kc (attenuation less than 3db) when connected as a gain-of-ten amplifier.
- **COMPACT SIZE:** 7" x 2 1/2" printed circuit board, mounts by any convenient method.

One of several types of modular packaging available at slight extra cost.



For full information, write
George A. Philbrick Researches, Inc.,
Dept. ED 1. Ask for Bulletin USA-3.

GEORGE A.

PHILBRICK

RESEARCHES, INC. Hubbard 2-3225
230 Congress Street, Boston 10, Mass.

CIRCLE 247 ON READER-SERVICE CARD

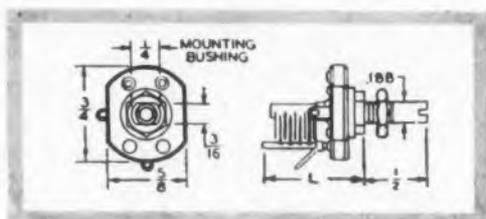
Save space
with these
Johnson
miniature
capacitors!



ACTUAL
SIZE

**Perfect for
compact RF
equipment . . .**

These tiny variable capacitors provide the ideal solution to compact design problems. Requires just $\frac{5}{8}$ " x $\frac{3}{4}$ " panel area—the longest model extends only $1 \frac{17}{64}$ " behind panel. Soldered plate construction, oversized bearings, and heavily anchored stator supports provide extreme rigidity—torque is steady—rotor stays "put" where set! Bridge-type stator terminal provides extremely low inductance path to BOTH stator supports. Nickel-plated rotor contact—steatite end frames DC-200 treated. Single section, butterfly, and differential types available.



SPECIALS—Johnson Miniature Air Variables are available in production quantities with the following features:
1. Locking bearing. 2. 180° stop. 3. Various shaft extensions. 4. High torque. 5. Silver or other platings.

For complete information on these miniature capacitors or other Johnson electronic components—write for your free copy of our newest components catalog.

Free
Catalog

Contains complete specifications on all Johnson electronic components.



E. F. Johnson Company

2519 Second Ave. S.W. • Waseca, Minnesota

CIRCLE 248 ON READER-SERVICE CARD

Backward Wave TWT

Narrow band, voltage tunable types



Available for S and X bands, the BA-1 and BA-2 backward wave traveling wave tube amplifiers find use as voltage tunable filters, possessing between 10 and 25 db gain. The narrow band characteristic makes possible their use as pre-selectors in wide-band receivers. Specifications for the BA-1 include: frequency range, 2.4-3.6 kmc; bandwidth, 0.1-1.0 per cent; magnetic field, 600 gauss; capsule length, 15 in. and a net weight of 1 lb. The BA-2, available for 8.2 to 12.4 kmc use, has similar characteristics.

Huggins Labs., Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

IRE Booth No. 3927, 3929

CIRCLE 249 ON READER-SERVICE CARD

True RMS VTVM

3 per cent accuracy for 5 cps to 500 kc



Model 900 true rms vacuum tube voltmeter reads either true rms or average value of input voltage as selected by front panel switch. Frequency range is 5 cps to 500 kc. Seventeen ranges cover 0.0015 to 300 v full scale. Input resistance is 10 meg for all ranges. Input capacitance is approximately 20 μ f. The peak voltage rating in 5 times peak value of sine wave required for full scale meter deflection. Accuracy is 3 per cent for any signal whose frequency components are between 5 cps and 500 kc. The voltage at output terminals is proportional to instantaneous square of input voltage. Output voltage at full scale meter deflection is approximately 75 mv.

John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

IRE Booth No. 3413

CIRCLE 250 ON READER-SERVICE CARD

BULOVA

FAMED FOR PRECISION SINCE 1875



NEW ST-73X

"SHOCK MOUNTED" QUARTZ CRYSTAL

The Bulova ST-73X need never be babied. Effective new shock mounting and traditional Bulova manufacturing precision result in a rugged, extremely stable, frequency determining element for missiles, aircraft and other applications involving extreme environmental problems.

Where frequencies must be maintained with ultra-reliable stability under high shock and temperature conditions, you'll find no adequate substitute for Bulova quality.

THE ST-73X FEATURES: Frequency Range from 16 KC through 350 KC, with lower frequencies possible in holders of different configuration; Shock Tests of 100 G; Dynamic vibration tests met per MIL-T-5422, MIL-E-5272 and MIL-E-5400 without adverse results; Storage Temperatures over a range of -65°C. to $+135^{\circ}\text{C.}$ can be coupled with an operation temperature range of -55°C. to $+100^{\circ}\text{C.}$; Low excursions of frequency ($\pm .015\%$) over this range.

Precision Bulova Quartz Crystals are now available in quantity for frequencies from 16 KC and lower to 100 MC and above.



BULOVA

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Electronics Division
Woodside 77, N. Y.

Write Dept. A-738 For
Full Information and
Prices on Quartz Crystals

SEE US AT THE IRE SHOW BOOTH NOS. 1811-1813
CIRCLE 251 ON READER-SERVICE CARD

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PERSONNEL MANAGER
ABOUT
ELECTRONIC DESIGN'S
"CAREER'S SECTION"**

If your company is trying to attract skilled electronic design, development or research engineers, tell your Personnel Manager about **ELECTRONIC DESIGN**. Here is a concentrated audience of 25,000 engineers ready to read about the advantages offered by your plant.

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"Career's Section."**

NEW PRODUCTS at the IRE Show

VHF Receivers

35 to 150 mc range

Two VHF panoramic receivers designed to provide coverage from 35 to 150 mc have been added to the Trak line of receivers. All models feature three inductor-tuned rf stages in a double-superheterodyne circuit providing greater than 60 db attenuation of spurious responses and noise figures down to 4.5 db.

Models PAN-1D and PAN-1E, which cover the upper part of the band, have a 5 in. crt to display received signals logarithmically, with a dynamic range of 60 db as an 8 to 1 variation in observed amplitude. A precision marker circuit permits frequency measurements of signals to within 1 per cent accuracy. Model PAN-2, sweeping the lower part of the range, offers both an externally operated step marker and calibrated adjustable band edges which control upper and lower sweep limits individually. Any 5 mc segment of the band can be displayed across the full width of the crt.

CGS Labs., Inc., Dept. ED, 391 Ludlow St., Stamford, Conn.

IRE Booth No. 1310, 1312

CIRCLE 252 ON READER-SERVICE CARD

Servopot

Furnished completely aligned



This servopot is an integral combination of a two-phase instrument servomotor, gear reduction, slip clutch, and precision potentiometer. The instrument eliminates the need for mounting, testing and aligning separate units. The slip clutch is factory adjusted to permit servo operation into potentiometer stops without damage. Standard pots feature 0.5 per cent linearity and are available with resistances from 35 to 80,000 ohms. Single, multi-turn, and non-linear models are available.

Diehl Mfg. Co., Dept. ED, FINDERNE Plant, Somerville, N.J.

IRE Booth No. 2237

CIRCLE 253 ON READER-SERVICE CARD

LOW NOISE

AC AMPLIFIER

has selectable bandwidths
and a 400 megohm, 3 mmf input

VERSATILITY teams up with high input impedance in this new, improved broad-band amplifier. Used as a general purpose preamplifier or as an isolation amplifier, it fits neatly in scores of tests at both audio and ultrasonic frequencies.



TYPICAL applications are: vibration and noise studies, work with accelerometers and hearing aids, and pulse amplification. A 5-volt 50-ohm output is provided for driving oscilloscopes, sound level meters, and pen recorder power amplifiers.

FEATURES of the Model 102B are: accurate decade gains of 0.1 to 1000; selectable bandwidths of 2 cps to 150 kc or to 1.7 mc; noise below 10 microvolts with 150 kc response, and below 20 microvolts with 1.7 mc response.

Two very low capacitance input probes are available: 5 mmf, 2 cps to 150 kc response; and 20 mmf, 2 cps to 1.7 mc response.

NEW CATALOG B gives detailed data on the Model 102B and all other Keithley Instruments and accessories. Your copy will be sent promptly upon request on your company letterhead.



CIRCLE 254 ON READER-SERVICE CARD

If it's
**TOP-QUALITY
 INSULATION
 you need in
 TEFLON®**



...then you need
CHEMPLAST

NOW AVAILABLE: Top-quality wire-coatings of "Teflon," in wall-thicknesses from 0.030" to 0.225"; all sizes of rod from 1/32" to 2", to nearest 0.001" at no extra cost.

Here's what you get in wire insulations by Chemplast:

- **MAXIMUM PHYSICAL AND ELECTRICAL** properties of "Teflon" . . . Chemplast coated wire, made by our own special process, uses high molecular weight "Teflon" exclusively.

- **EXCEPTIONAL CONCENTRICITY** of coating around wire.

- **CONTROLLED TIGHTNESS** of coating to wire.

Here's what you get in rod from Chemplast:

- **STRESS-RELIEVED ROD** . . . no further treatment necessary.

- **NO CONTAMINANTS** . . . snow-white color.

- **ANY LENGTH** . . . normally supplied in 12-foot lengths, but we'll ship it any length you say.

And in all Chemplast products for the electronics industry:

- **MADE FROM VIRGIN "TEFLON"** . . . meet AMS 3651B and MIL-C-17B specifications.

- **IMMEDIATE DELIVERY** on all sizes.

Chemplast also supplies tape, tubes, sheets, and molded shapes of "Teflon." Write today for a prompt quotation.

CHEMPLAST INC.

3 CENTRAL AVE., EAST NEWARK, NEW JERSEY

TEFLON is the Du Pont Company's trade-mark for its tetrafluoroethylene resins.

CIRCLE 255 ON READER-SERVICE CARD

Motion Testing System
 Complete system for wide variety of needs



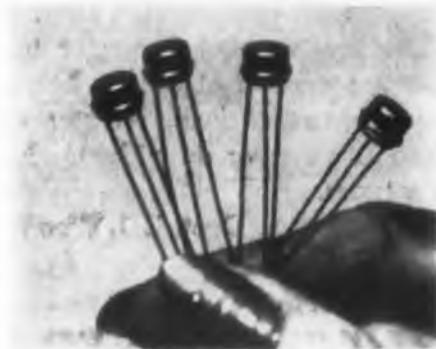
A complete sine-wave and complex motion testing system will be exhibited which will include a model T888 high output wide-band amplifier, model TEMC control console (shown), and a model C10 vibration exciter featuring the Unimode suspension of the moving element assembly. Designed for high g acceleration tests on relatively light specimens, the system is capable of vibrating sinusoidally 102 lb to 10 g; 42 lb to 20 g and 22 lb to 30 g. Random motion testing is attained by the simple addition of a T67 or T88 compensation console. Capable of 850 lb rms force, the C10 will vibrate 67 lb to 10 g rms with 30 g peaks; 25 lb to 20 g rms, 60 g peaks; and 11 lb to 30 g rms, 90 g peaks.

Textron Inc., MB Mfg. Co. Div., Dept. ED, 781 Whalley Ave., New Haven, Conn.
 IRE Booth No. 1723, 1725

CIRCLE 256 ON READER-SERVICE CARD

Transistors

For computer applications



Four germanium alloy transistors designed for computer applications will be among the semiconductor devices exhibited by this company. Designated types 2N312, 2N356, 2N357, and 2N358, the units feature rapid switching, high constant beta characteristics, and excellent leakage stability. The transistors have base-off-the-can construction for applications where it is necessary to isolate all elements.

Sylvania Electric Products, Inc. Dept. ED, 1740 Broadway, New York 19, N.Y.

IRE Booth No. 2402, 2408, 2501, 2507

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NEW PRODUCTS at the IRE Show

Attenuators

Feature low noise level

The resistive elements and contacts in these attenuators are embedded in a special tough, glass-fiber plastic compound which provides protection against extreme humidity, mechanical shock, and wide temperature variations. Brushes are secure, so they cannot trip. The switching noise level is kept extremely low.

International Resistance Co., Dept. ED, 401 N. Broad St., Phila., Pa.
IRE Booth No. 2821, 2825

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Thermal Time Delay

For airborne applications

The H series of thermal time delay relays are designed for airborne or other military applications. They will operate under vibration to 500 cps at 10 g and shock up to 50 g. Factory preset from 3 sec to 3 min, the hermetically sealed relay will operate at altitudes to 70,000 ft. They are ambient temperature compensated from -65 to +125 C. The spst normally open or normally closed contacts are rated at 3 amp 120 v ac or 2 amp 32 v dc resistive loads. Heater voltages are from 5 to 125 v ac or dc with standard 6.3, 26.5 or 117 v types.

Curtiss-Wright Corp., Dept. ED, Wood-Ridge, N.J.

IRE Booth No. 1327

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Standoff Terminal

Operates at 1000 C temperatures

This insulated standoff terminal can operate in the high temperature region of 1000 C and still maintain its electrical function. The terminal will also operate in an environment exposed to nuclear bombardment. High strength alumina is used as the insulator, permitting the terminal to withstand greater than 0.05 lb-ft impact on the



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Fillister Head Screws

SIZE	Threads Per Inch	Major Diam.	Pitch Diam.	Minor Diam.	Pitch	Depth of Thread
000	120	0.034	0.0286	0.0260	0.00833	0.00400
00	90	0.047	0.0403	0.0326	0.01111	0.00721
0	80	.060	.0519	.0438	.01250	.00812
1	72	.073	.0640	.0550	.01389	.00902
2	56	.086	.0744	.0628	.01786	.01160
3	48	.099	.0855	.0719	.02083	.01353
4	40	.112	.0958	.0795	.02500	.01624

SIZE	Head Diam.	Height of Head	Depth of Slot	Width of Slot	Tap Drill	Body Drill
000	.056	.031	.014	.012	#71 (.026)	#63 (.037)
00	.068	.038	.014	.023	#65 (.035)	#55 (.052)
0	.090	.050	.022	.025	3/64 (.047)	#51 (.067)
1	.111	.062	.024	.027	#53 (.059)	#47 (.078)
2	.132	.073	.029	.030	#50 (.070)	#42 (.093)
3	.153	.084	.035	.032	#47 (.078)	#37 (.104)
4	.174	.096	.040	.034	#43 (.089)	#31 (.120)

All Tolerances are per AN and MIL Specs. OR BETTER.

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GENERAL ELECTRIC

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IZOD type test, and 400,000 psi compression.

Final terminal assembly test results show a resistivity at 25 C of greater than 10^{14} ohms per cm cube. At 800 C, the figure is 10^6 , and at 900 C, it is 4×10^5 . The material is impervious to water absorption, and is unaffected by fungus growth.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd., Los Angeles 16, Calif.
IRE Booth No. 1618

CIRCLE 264 ON READER-SERVICE CARD

Wave Analyzer System

Provides power spectral density analysis



A basic wave analyzer system, consisting of oscillator and analyzer, is equipped with the TP-633 power integrator that accepts intermediate frequency output from the analyzer, producing a direct current analog proportional to power spectral density.

Front panel controls allow output analog to be made proportional to peak level, to average value, to mean square value, and to continuous time integral—linear or square—of the voltages in the narrow frequency band input. The averaging time is continuously adjustable in three decades. Provision is made for dividing by the bandwidth to make output directly proportional to power spectral density. Scale factors are provided by a calibrated input potentiometer. Circuitry is provided for remote operation.

Technical Products Co., Dept. ED, 6670 Lexington Ave., Los Angeles 38, Calif.
IRE Booth No. 3032

CIRCLE 265 ON READER-SERVICE CARD

Transducers

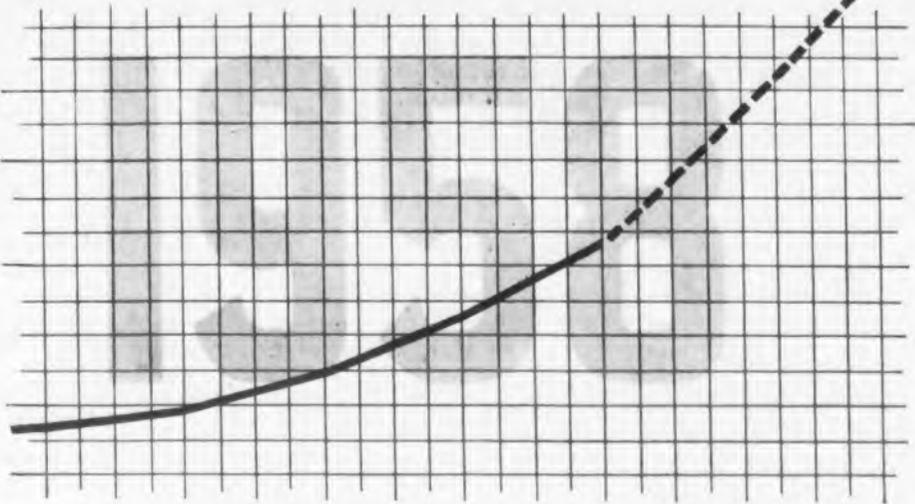
Displacement and pressure

The "Compu-Tran" displacement transducer features higher sensitivity and a longer linear range for equivalent cost. The pressure transmitter is a low cost item useful in ground environment testing, multiple pressure scanning and alarm systems.

International Resistance Co., Dept. ED, 401 N. Broad St., Phila., Pa.
IRE Booth No. 2821, 2825

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These positions require an E.E. degree plus 4-6 years' experience in electronics. Experience must include electronic design work in any of the following: servomechanisms, radar systems, analog or digital computers, fire control systems or ground support equipment. Missile guidance and/or infra-red experience will be helpful but is not essential.

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This year's IRE Convention marks the anniversary of Associate Editor George Rostky joining our staff. We met George at the Coliseum. We're looking for others like him again this year. What does it take? A degree in electrical engineering, a few years' design experience, and a desire to communicate ideas. Writing reports should have been more enjoyable than distasteful to you. If interested . . .

Check with us at
ELECTRONIC DESIGN'S
Booth 4101-2.

NEW PRODUCTS at the IRE Show

Fan Assemblies Easily mounted



These square-mounted packaged assemblies eliminate the inconvenience of mounting ring fans and their accessory components. The same fan may be used to either suck or blow air, and may be mounted inside or outside a cabinet. The filter can be either permanent or disposable. Fan orifice is recessed for maximum air delivery. Three sizes are currently in stock.

McLean Engineering Labs., Dept. ED, P.O. Box 228, Princeton, N.J.
IRE Booth No. 3825

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Servo Motor Tach

Linearity of 0.2 per cent
to 5400 rpm



Type 18-MTG-6302 servo motor tach has an operating temperature range from -54 to $+125$ C and a starting voltage as low as 1-1/2 v. The unit consists of 115 v 400 cps 2 phase size 18 servo motor with a size 15 tachometer integrally mounted on the motor shaft. The servo motor has a high torque to inertia ratio, a no load speed of 4700 rpm, a rotor moment of inertia of 5.73 gm-cm², develops a stall torque of 2.4 oz-in. with a power input of 9.2 w per phase. The unit is rated for continuous duty at stall.

The tach's output is 3.1 v per 1000 rpm, null voltage of 13 mv max, and has a linearity within 0.2 per cent up to 5400 rpm. Entire unit weighs 20 oz.

John Oster Mfg. Co., Avionic Div., Dept. ED,
1 Main St., Racine, Wis.
IRE Booth No. 2129

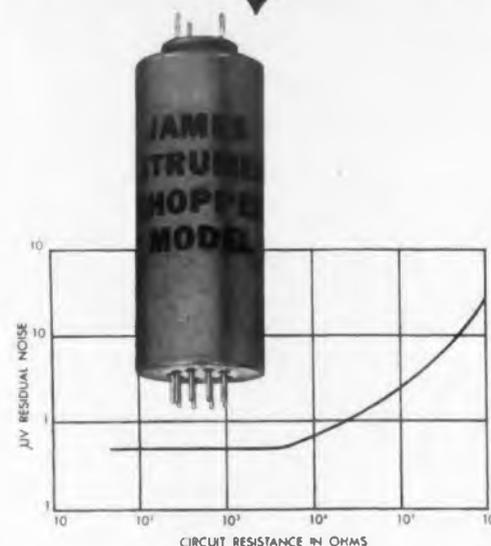
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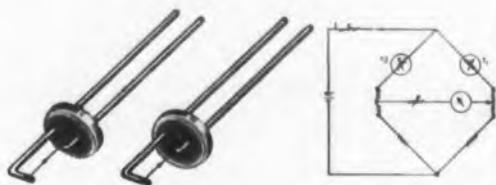
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Using Thermistors

Edited by
FENWAL ELECTRONICS

MATCHED THERMISTORS FOR GAS ANALYSIS

Now Fenwal Electronics offers resistance and voltage-current matched thermistor assemblies which are particularly useful for gas chromatography and other gas analyses.



The matched thermistor assemblies above are used in a balanced bridge circuit. One assembly is in each arm of the bridge and equal current is applied to each. The thermistors, self-heated by the passage of current, will dissipate heat at equal rates if the medium surrounding each thermistor is identical. The meter will show an equilibrium reading.

If the thermal conductivity of the gas surrounding either one of the thermistors should change, the rate of heat dissipation will also change, altering the resistance of the thermistor and unbalancing the bridge, thus causing a reading on the meter. The meter can, therefore, be calibrated to give an accurate indication of the percentage of a foreign element in the gas being analyzed, as related to a known reference gas.

It's all based on the unique characteristic of thermistors — when temperature rises, resistance falls. This relationship occurs whether the thermistor is self-heated, as in the example above, or externally heated through a liquid, gas or solid.

Write FENWAL ELECTRONICS, INC., 32 Mellen Street, Framingham, Mass., for complete information on matched thermistors (Bulletin EM-14), and for many other thermistor applications (Catalog EMC-1).



Design — Engineering — Production
of Precision Thermistors
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Vacuum Storage Cart

For tube components

A vacuum storage cart for storing certain components of electronic tubes while awaiting the completion of other components has been developed. Storage of these parts under vacuum assures that they will be clean and more easily degassed when they are finally assembled in the completed tube.

F. J. Stokes Corp., Dept. ED, 5500 Tabor Rd., Philadelphia 20, Pa.
IRE Booth No. 4415

CIRCLE 272 ON READER-SERVICE CARD

Printed Circuit Connectors

Bifurcation provides larger contact surface



The Bellows Action contact for printed circuit connectors provides a redundant circuit with two independent spring leaf contact actions for greater reliability. Coil spring action grip of the bifurcated contact clasps printed circuit board over its entire contact area. A gold plated phosphor bronze spring retains tension when used with either undersized or oversized tolerance boards. The contact resistance is rated at less than 20 mv at 5 amp.

Wiring styles include eyelet lug for soldering, solderless wire wrap lug, taper tab solderless wiring, and contacts for dip soldering.

Dejur-Amsco Corp., Electronic Sales Div., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

IRE Booth No. 3911, 3913

CIRCLE 273 ON READER-SERVICE CARD

AC Battery Unit

Delivers 110 v, 300 w

Incorporating a 15 v Silvercel battery and transistorized converter, with 80 to 90 per cent efficiency, this unit delivers 300 w of 110 v ac 60 cps power continuously for several hours and can be recharged from a 110 v ac outlet. The ac battery assembly weighs less than 20 lb and is the size of a 9 in. cube.

Yardney Electric Corp., Dept. ED, 40-50 Leonard St., New York, N.Y.

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MODEL GS SYNCHRONOUS MOTOR
60 poles minimize rotational cogging

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It is capable of operating from a vacuum tube amplifier on signal frequencies from 60 to 3600 cps. It was developed to provide the extremely accurate and invariable speed required for driving fork-synchronized



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It can be operated single phase in the plate circuit of a single-ended amplifier or as two-phase motor when driven by a push-pull amplifier—providing up to 1/100 hp output. The motor current is about 75 milliamperes per phase. The power input may be as high as 20 watts.

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Size of a postage stamp

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Telecomputing Corp., Dept. ED, 915 N. Citrus Ave., Los Angeles 38, Calif.

IRE Booth No. 2128

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Film Resistors

Feature stability



A line of high stability molded film resistors have been developed to provide improved moisture resistance and insulation properties. The resistors fulfill requirements of MIL-R-10509B. These units are available in 1/2 w style in ± 1 per cent and 5 per cent tolerances for standard ranges of 10 ohm to 2 meg.

Wirt Co., Continental-Carbon Div., Dept. ED, 5221 Greene St., Philadelphia 44, Pa.

IRE Booth No. 2209

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Rate Gyro

Tough, subminiature unit

This subminiature floated rate gyro the RG-100 can take 100 g's of shock and 15 g's at 2000 cps vibration in any axis. Damping is held to within 15 per cent for any required percentage of critical. The dynamically balanced hysteresis motor reaches full 24,000 rpm operating speed in less than 20 seconds. It is wound for two or three phase operation and is rated at three watts. The temperature range is from -40 to $+200$ F.

Fairchild Controls Corp., Dept. ED, 225 Park Ave., Hicksville, N.Y. or 6111 E. Washington Blvd., Los Angeles 22, Calif.

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Circuit reliability can be improved and distortion reduced at the same time by using the tables and curves in the manual. Engineers, engineering students, and laboratory technicians can now select the proper tubes and their associated components to suit the needs of almost any type of circuit with greater reliability than ever before. The manual contains conductance curves for more than 70 of the most representative vacuum tubes used in all services. #210, 8½" x 11", stiff cover, spiral binding, \$4.25.

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Sampling Switch

Used with surveillance radar

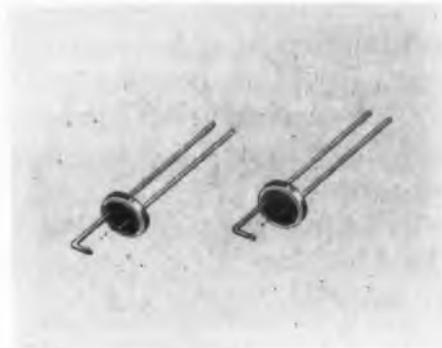
This rotary switch has such applications as from surveillance type radars, sonars, and magnetometers. This unit has 3 poles, 16 non-shortening contacts per pole, operating at 30 rps. Of the 16 positions, one carries a reference frame voltage, and each of the other fifteen samples the returned response of a 25 deg cone. Noise levels considerably less than 0.1 mv are available for 1 mv signal levels in a 50 ohm circuit. The unit is hermetically sealed and withstands MIL-E-8189 environmental conditions.

Instrument Development Labs., Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.
IRE Booth No. 3925

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Matched Thermistors

For gas analysis



Voltages are matched at four points to within 0.03 v in these thermistors. Matching measurements are made while the unit is suspended in helium at 25 C. The thermistor beads used are also matched to within 5 per cent resistance at 25 C. Matched assemblies of this type are useful in gas chromatography where the thermistor assemblies are used in a balanced bridge circuit. The thermistors, self-heated by the passage of current, will dissipate that heat according to the thermal conductivity of the surrounding medium.

Fenwal Electronics, Inc., Dept. ED, Mellen St., Framingham, Mass.
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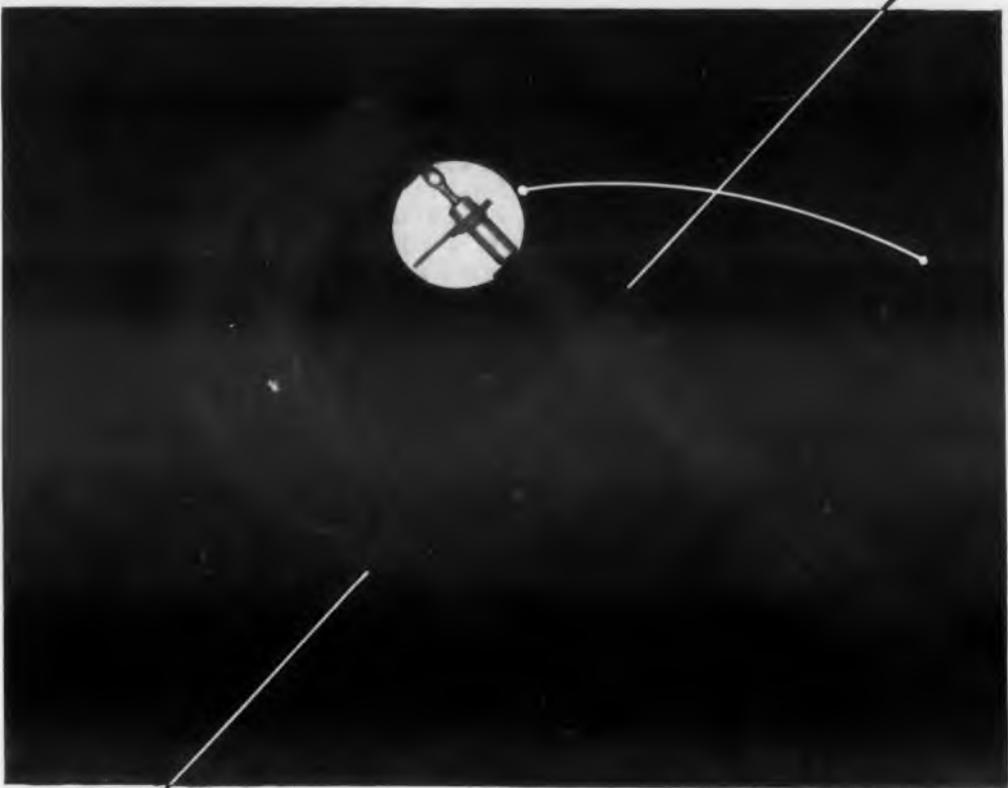
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MODEL TAA-113

Nominal Firing Voltage	113 V
Leakage Resistance (95V)	5×10^{10} ohms
Acceleration	20,000 G
Vibration	10 - 55 cycles at .06 D.A.
Operating Temperature	-65° to 160°F
Energy Transfer	3000 ergs

Victoreen's new cold cathode gas trigger diode is ideal for use where weight, space and high G considerations are involved. It can be used for isolation purposes, electronic switching, RC timing circuits, or relaxation

oscillators.

Victoreen micro-miniature diodes are available now and can be supplied with a variety of different characteristics. Full details are available on request.

AA-7080

See Victoreen's new micro-miniature cold cathode gas trigger diode on display for the first time at the
IRE SHOW BOOTH 2232



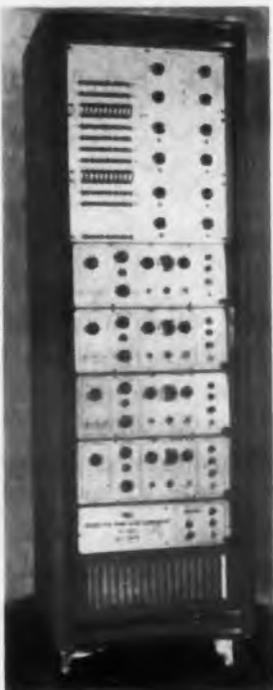
The Victoreen Instrument Company

Components Division

5806 Hough Avenue • Cleveland 3, Ohio

CIRCLE 287 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show



Pulse Code Generators

Ten bit codes provided at 1 mc rates

Designed for study and test of memory components, the 5100A series of pulse code generators provide high speed pulse programs at high impedance and high power output. Single and multiple channel 10 bit pulse codes are provided at clock rates to mc, with controllable repeat of selected intervals. Output from each channel is variable from 50 ma to 5 amp peak current, with rise and fall time control provided. Multiple channel outputs, positive and negative around ground, may be paralleled for high pulse current or the formation of complex codes.

Instruments are comprised of various combinations of coding units and output amplifiers. Amplifiers are self-contained, with integral power supply, and may be driven by any general purpose pulse generator.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

IRE Booth No. 3611, 3613

CIRCLE 288 ON READER-SERVICE CARD

Klystron Test Facility

Produces up to 50 kv pulses

Model 42M modulator is a complete laboratory test facility for high-power pulsed klystrons. The modulator produces 0 to 50 kv pulses at currents from 0 to 15 amps with repetition rates from 10 cps to 10 kc.

With an external pulse-group generator, the 50 kv pulser will recover and respond to pulses of varying widths occurring less than 1 μ sec apart, producing pulses with rise and fall times of approximately 0.25 and 0.5 μ sec respectively.

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Microamperes
can be measured
quickly
accurately!



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Saves you time and headaches in making measurements that previously were slow, inaccurate, cumbersome . . . Measures currents in transistors, magnetic amplifiers, resonant circuits, filters, servo systems, recording heads, etc. Using an oscilloscope, observe current waveforms and transient currents.

CLAMP-ON PROBE gives you fast, one-hand operation. Speeds laboratory and production testing.

INSERTION PROBE gives you greater accuracy, increased sensitivity and wider frequency range.

SPECIFICATIONS

SENSITIVITY: 3 μ a to 100 ma full scale with Insertion Probe (300 μ a to 100 ma with Clamp-On-Probe).

ACCURACY: $\pm 2\%$ of full scale at 1 KC ($\pm 5\%$ clamp-on).

FREQUENCY: Flat within $\pm 2\%$ 100~ to 100 KC, -3 db at 10~ and 1 MC, (clamp-on $\pm 5\%$ 200~ to 100 KC, -3 db at 50~ and 1 MC.)

INPUT IMPEDANCE: 2 ohms plus 8 μ h, 60 mmf to ground from 3 μ a to 1 MA. Negligible impedance and capacitance 300 μ a to 100 MA.

OSCILLOSCOPE CONNECTION: 0.1 volt into 10 K ohms.

PRICE: \$290.00 including both probes.

OTHER INSTRUMENTS AVAILABLE:

Miniature DC Coupled Decade Amplifier
Isolation Amplifier
Regulated Power Supplies

Write for complete information

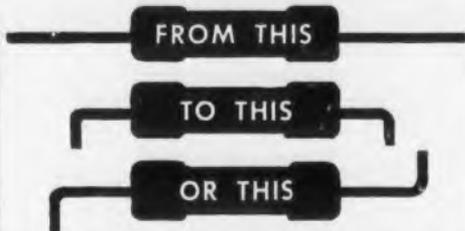
Visit us, BOOTH #3015, I.R.E. SHOW



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LABORATORIES
MORRISTOWN, NEW JERSEY

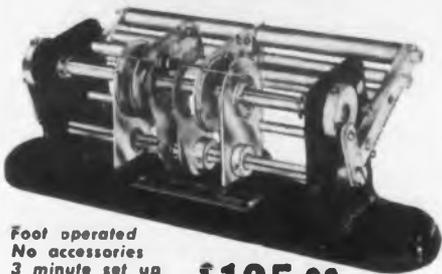
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a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

PIG-TAILORING eliminates:

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- Long nose pliers
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- Broken leads
- Short circuits from clippings
- 65% chassis handling
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- Haphazard assembly methods.

PIG-TAILORING provides:

- Uniform component position
- Uniform marking exposure
- Miniaturization spacing control
- "S" leads for terminals
- "U" leads for printed circuits
- Individual cut and bend lengths
- Better time/rate analysis
- Closer cost control
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Pays for itself in 2 weeks

"SPIN-PIN"[®]

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

- No Training
- No Pliers
- No Clippings
- Uniform Crimps
- 22 Sizes

**PAYS FOR ITSELF
THE FIRST DAY!**

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DESIGNERS & MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

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Arbitrary arrangements of pulses can be achieved with the following limitations. The maximum allowable pps under pulse-group operation is 15,000 and the effective duty cycle must be less than 0.01. An internal trigger generator is provided for single-pulse operation with pulse widths of either 0.5 or 5 μ sec and repetition rates from 10-5000 pps.

Levinthal Electronic Products, Inc., Dept. ED,
Stanford Industrial Park, Palo Alto, Calif.
IRE Booth No. 1205

CIRCLE 291 ON READER-SERVICE CARD

Clutch-Brakes

Miniature 4 oz-in. units



These units are available in a number of configurations, consisting of clutches, brakes, clutch-brakes, and a special dual clutch-brake. Other models are available for fail-safe or reverse energization applications. The method of mounting is with a standard 1/2 in. diameter servo mount, on either or both ends, with concentric output and input members. Shown is the model FB-59 Microbrake.

All units feature fast response time with low coil wattage. A typical clutch will reach the first time constant of maximum torque in less than 2.5 μ sec, using a 1.6 w, 25 v coil. The coil wattage is low enough that extreme reduction in performance is not encountered under conditions of continuous energization. A non-rotating coil is used, which eliminates the drag and objectionable limitations of slip-rings.

The minimum torque of standard clutches and brakes is 4 oz-in., while the de-clutched drag will be less than 0.06 oz-in. Class 5 instrument bearings are used throughout. The rotor design features no radial or axial displacement when engaging or dis-engaging, and gives zero backlash when engaged.

Magtrol, Inc., Dept. ED, 240 Seneca St., Buffalo, N.Y.

IRE Booth No. 1230, 1232

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you can wind your filter coils
WITHOUT CORE ADJUSTMENTS

on **pre-adjusted
filter cores**

- guaranteed effective permeabilities within $\pm 3\%$, $\pm 2\%$ or $\pm 1\%$ of specifications, instead of the usual 10% to 50% spread
- measured, adjusted and grouped for magnetic characteristics at the factory
- a complete line of pot-type ferrite cores from $\frac{5}{8}$ " to $1\frac{3}{4}$ " diameter, with bobbins and hardware for each size
- available in quantity to manufacturers of communications, telemetering and computer equipment

***There's Nothing Else
Even Remotely Like These
Pre-Adjusted Potcores***

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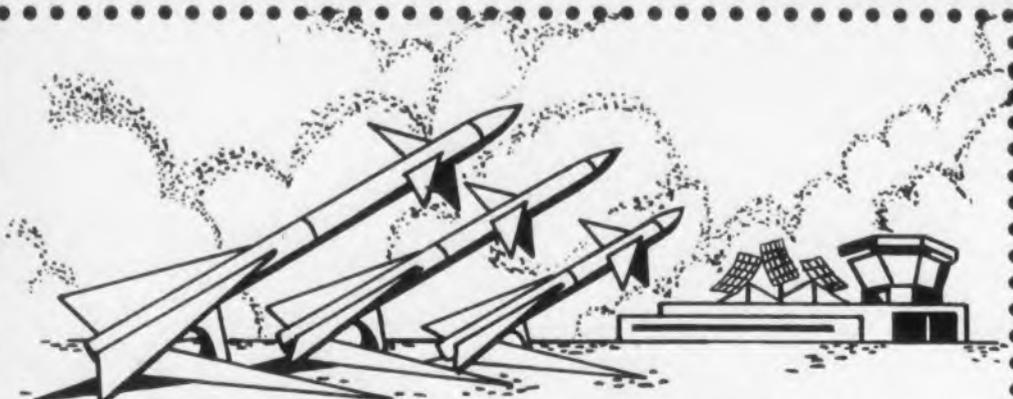
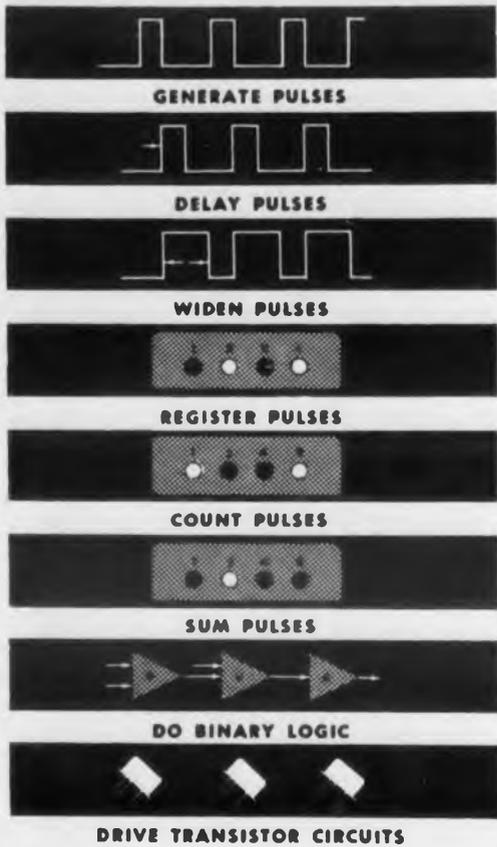
Write for literature describing standard sizes available from stock, exact permeability values, and number of turns required for any given inductance.

FERROXCUBE CORPORATION OF AMERICA
50 East Bridge Street, Saugerties, New York



Manufacturers of ferrite cores for recording heads, magnetic memories, TV flyback transformers, pulse transformers, filters, inductors, high frequency shields and power transformers.

CIRCLE 293 ON READER-SERVICE CARD



From the launching pad to machine controls—

NAVCOR completely transistorized pulse programming equipment is being utilized to do many military and industrial jobs, and do them well! The original concept of functional units pioneered by NAVCOR, and already proven in thousands of hours of use-test, feature quickly interchangeable modular blocks creatively engineered for multi-purpose operations. Write for data and specifications that will show how NAVCOR transistorized pulse programming equipment can be effectively used in your current computer project.

IRE SHOW — BOOTH #1311

NEW PRODUCTS at the IRE Show

DC Motor

Multiple output provided by 3 shafts



Three output shafts are provided on this permanent magnet dc motor to satisfy multiple use applications. The motor, used with this gearhead, incorporates the manufacturer's symmetrical, progressive lap type armature winding to provide electrical balance, superior commutation, and low radio noise output. Magnets are stabilized to eliminate demagnetizing effects due to sudden reversals. Elementary control circuits provide dynamic braking.

Barber-Colman Co., Electrical Components Div., Dept. ED, 1800 Rock St., Rockford, Ill.
IRE Booth No. 3833

CIRCLE 297 ON READER-SERVICE CARD

Shielded Wire Ferrule

Permite automated pigtailing



Designed expressly for grounding the shield braid of coaxial conductors, a machine is featured which feeds and attaches these ferrules and pigtails simultaneously to shielded wire leads. The machine's dual applicator permits attachment of ferrule and pigtail wire to a double ended shielded wire jumper or to two shielded wire leads at the same time, with pigtail wire whose length can be adjusted in the applicator. The firm reports that the process can reduce the cost of pigtailing by 75 per cent by eliminating the wire preparations formerly required.

AMP Incorporated, Dept. ED, Harrisburg, Pa.
IRE Booth No. 2427, 2429

CIRCLE 298 ON READER-SERVICE CARD

NAVIGATION COMPUTER CORPORATION

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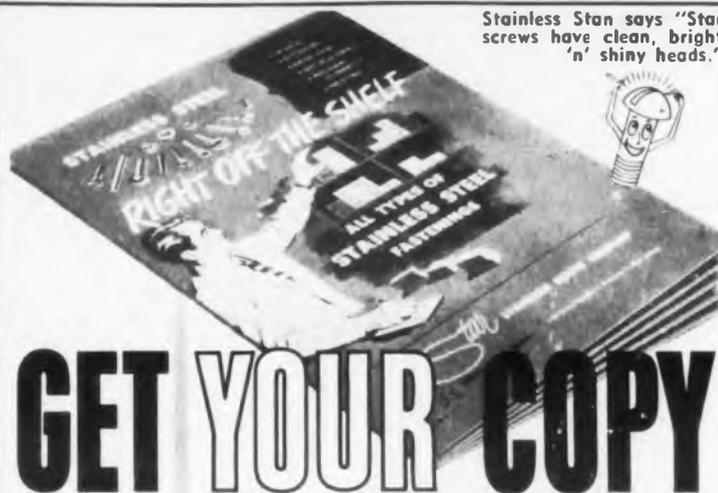
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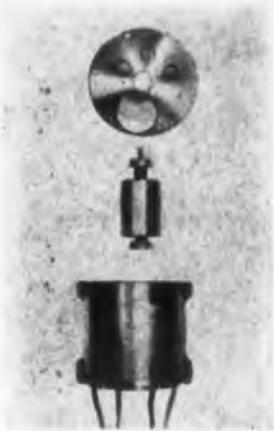
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CIRCLE 296 ON READER-SERVICE CARD



Two-Phase Servo Motor

For high ambient temperatures

This 115 v, 400 cps servo motor can operate in air at 600 deg F or in a stream of 550 F jet fuel. It weighs only 2-1/2 lb and can withstand vibration of 15 g's to 2000 cps. At 600 deg F it can accelerate at 4500 radians per second from stall, and maintain a positional accuracy of 1/2 degree.

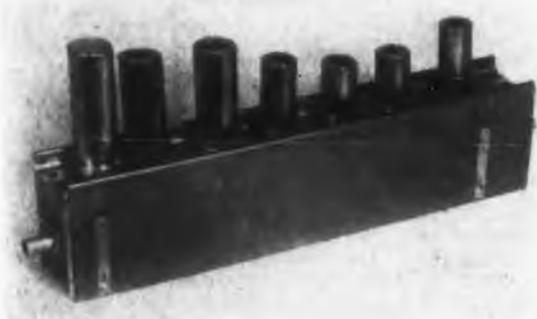
Electronics Division, Thompson Products, Inc., Dept. ED, 2196 Clarkwood Road, Cleveland, Ohio.

IRE Booth No. 2527, 2529, 2531

CIRCLE 299 ON READER-SERVICE CARD

Video Amplifier

200 cps to 50 mc

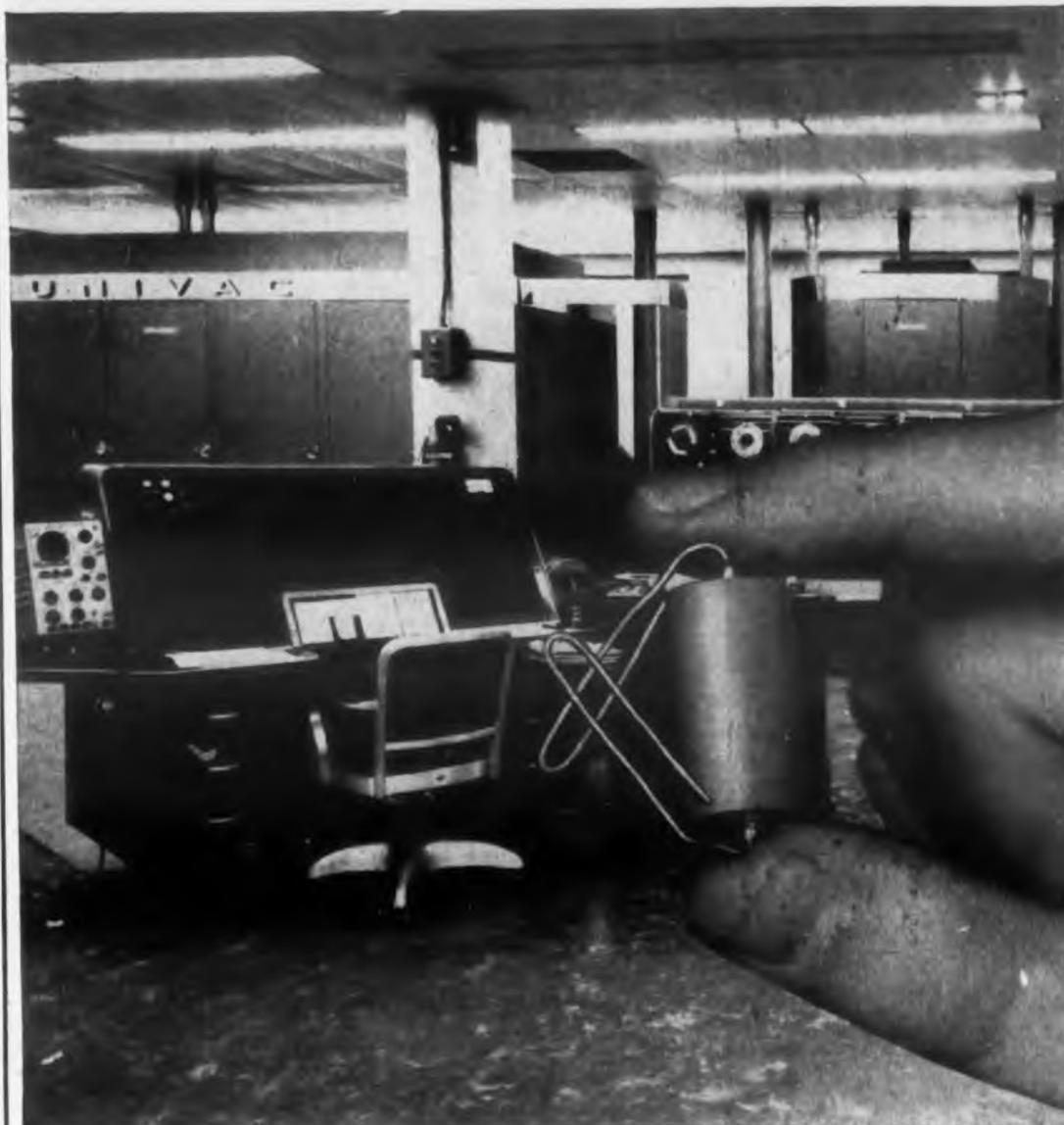


The model 600 is a super video wide band amplifier which can be used singly or as a component unit in an electronic system. The specifications include: bandpass of 200 cps to 50 mc; gain of 40 db +1-1/2 db (into matched load); input impedance of 90 ohms, vswr less than 1.5:1; and an output impedance of 90 ohms, vswr less than 2.1. Pulse rise time is 10 msec, and noise figure is approximately 9 db. The unit may be used as an external preamplifier; a post amplifier in noise figure measurement and a pulse amplifier in nuclear work. The M-600 is a metal unit 12 in. long x 2-1/2 in. wide x 4 in. high including the tubes. The tube complement consists of one 6CB4, two 6AK5, one 6CY5, one 6CC6, and one 12A4.

Instruments for Industry, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N.Y.

IRE Booth No. 2830

CIRCLE 300 ON READER-SERVICE CARD



TESTS BY REMINGTON RAND PROVE . . .

Du Pont MYLAR[®] provides greater reliability, longer life for capacitors used in Univac[®]

PROBLEM: The Remington Rand Division of the Sperry Rand Corp. had to find a capacitor of high reliability that could meet the requirements of extra-sensitive circuits found in UNIVAC* Data Automation Systems.

SOLUTION: In a series of accelerated tests by Remington Rand, various types of capacitors were exposed to conditions more exacting than those found in normal operation of UNIVAC

Systems. These tests proved that capacitors made with "Mylar"† polyester film offered greater reliability and longer life, with an extra margin of safety in moisture resistance. The tests documented the fact that "Mylar" provides excellent insulation resistance at high temperatures . . . "Mylar" does not deteriorate with age or voltage stresses within normal operating ranges.

RESULTS: By using capacitors made with "Mylar", Remington Rand has

improved the performance of another component in UNIVAC Systems . . . has helped improve the performance of UNIVAC Systems themselves.

HOW CAN "MYLAR" HELP YOU? Whether you make guided missiles or tiny components, it will pay you to investigate the unique advantages of using "Mylar" film . . . or products made with "Mylar". Send for a copy of our new booklet containing detailed information on properties and applications.



BETTER THINGS FOR BETTER LIVING
THROUGH CHEMISTRY

DU PONT
MYLAR[®]
POLYESTER FILM

*UNIVAC is a registered trademark of Sperry Rand Corporation.
†"MYLAR" is Du Pont's registered trademark for its brand of polyester film.

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room E-11, Wilmington 98, Del.

Please send your booklet listing properties, applications and types of "Mylar" polyester film available (MB-11).

Application _____
Name _____ Title _____
Company _____
Address _____
City _____ State _____



"MYLAR" offers a unique combination of properties valuable for electrical design



HIGH TENSILE STRENGTH. "Mylar" is the strongest plastic film. Instron tester shows an average strength of 20,000 lbs. psi.



HIGH DIELECTRIC STRENGTH. Average of 4,000 volts per mil . . . average power factor of 0.003 at 60 cycles . . . dielectric constant above 3.0 at 72°F., 1,000 cycles.

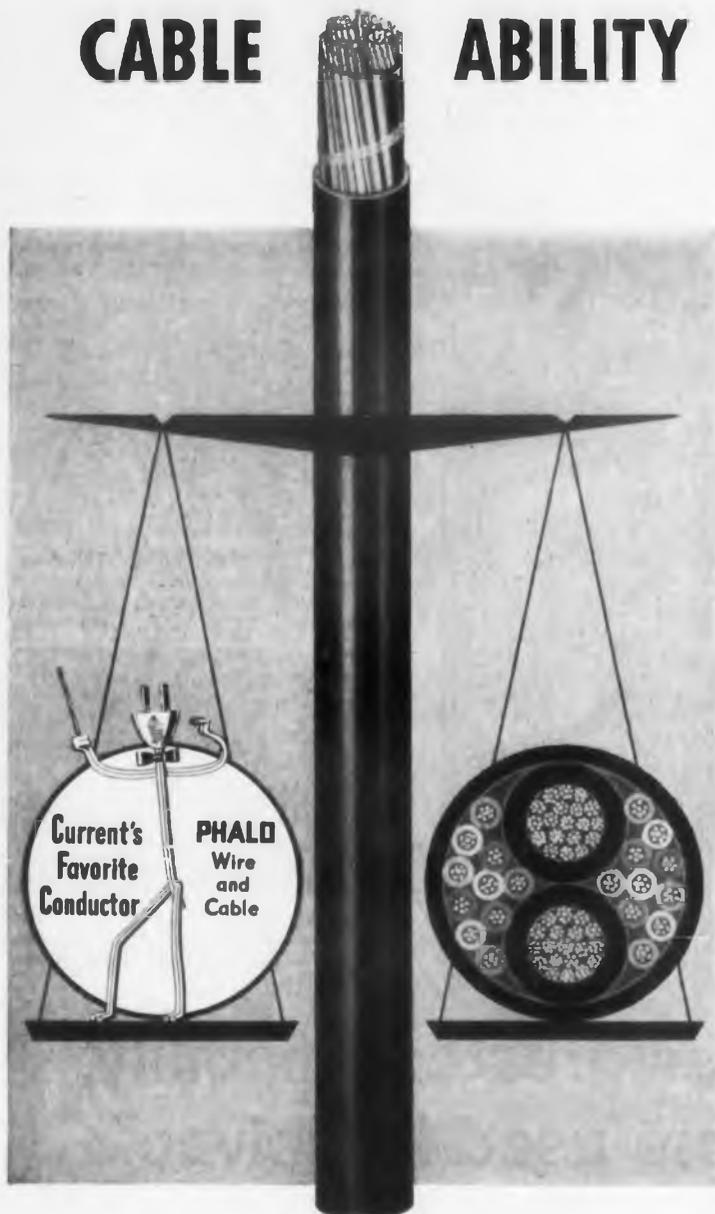


THERMAL STABILITY. Tests prove "Mylar" has an effective operating range, -80°F. to 300°F. . . won't brittle with age.

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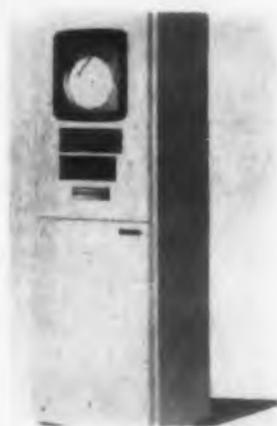
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NEW PRODUCTS



Telemetering System

Operates over single pair of wires

Multiplexed transmission permits incoming data signals and outgoing supervisory commands to be carried over a single pair of wires by synchronous time-division sampling devices. This telemetering station has a capacity of 165 on-off type supervisory controls or 17 telemetered analog signals, or a combination of both. The system checks itself once each second and, if necessary, makes automatic calibration and synchronization adjustments. It is compatible with available dc transducers at input and with all types of dc meters and recorders at output.

Applied Science Corp. of Princeton, Dept. ED,
Post Office Box 44, Princeton, N. J.

CIRCLE 460 ON READER-SERVICE CARD



Decade Amplifier

High sensitivity at low frequencies

A low noise, general purpose instrument, model 40-A transistorized decade amplifier has selectable bandwidth for improved sensitivity during measurements at the lower frequencies. The amplifier noise figure is made independent of the magnitude of the driving impedance through the use of a vacuum tube at the input stage. The input impedance is in excess of 10 meg. A constant 600 ohm output impedance is useful for driving passive networks. A gain of 10 or 100 is available over the frequency range of 2 cps to 1 mc with an accuracy of ± 0.2 db from 10 cps to 300 kc and ± 1 db from 5 cps to 500 kc. Gain is down 3 db at 2 cps and 1 mc. Noise with shorted input terminals is 4 to 7 μ v. Maximum output is 3 v rms or 1 mw.

Zacharias Electronics Corp., Dept. ED, P.O. Box 172, Livingston, N.J.

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AUTO-BRIDGE

The newest addition to Industrial Instruments Auto-Bridge line of automatic and semi-automatic test equipment is the Model AB-3X2, manual-feed, manual-sort bridge. Fully automatic hopper or tape-fed equipments have a definite place in component testing, but they are not the most efficient system whereby a large variety of small and medium-size lots of components can be tested.

The Model AB-3X2 is manually loaded and unloaded. One of the two colored lights indicates whether the component under test is "in" or "out" of preset tolerance. Plug-ins are used to set the "high" and the "low" limits and the standard jig supplied with the equipment accepts most wire lead components. There are no meters to read . . . the only interpretation required by the operator is to determine which of the two colored lights is lit. A true limit bridge principle is used. There is no drift in the operating point and daily calibrations are not necessary.

TABLE OF SPECIFICATIONS

	RANGE	ACCURACY	PRODUCTION RATE
Capacity	100 uuf to 15 uf lower at reduced accuracy	$\pm 0.3\%$	Depending on type of feed 7500 electrical tests per hour. Many components can be fed with an overall rate of 5000 per hour
Resistance	10 ohms to 5 megohms, higher at reduced accuracy	$\pm 0.3\%$	
Impedance	10 ohms to 5 megohms, higher at reduced accuracy	$\pm 0.3\%$	

For complete details on this economical Auto-Bridge as well as our full line of associated equipment, write . . .



Industrial Instruments Inc.

89 Commerce Road, Cedar Grove, Essex County N. J.

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GRADE	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES			RELATIVE COST Based on XXXP on Arbitrary Scale of 1	
	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance		Surface Resistance
						Pounds to Pull 1" Strip				
						1 Oz	2 Oz			
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	> 10 @ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	> 10 @ 475°F	200,000	.92
XXP-239-1 PHENOCCLAD	4.2	.035	0.67	15,500	250	8	11	> 10 @ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	> 10 @ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	> 10 @ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	> 10 @ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	> 10 @ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	> 30 @ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	> 30 @ 500°F	2,000,000	3.55

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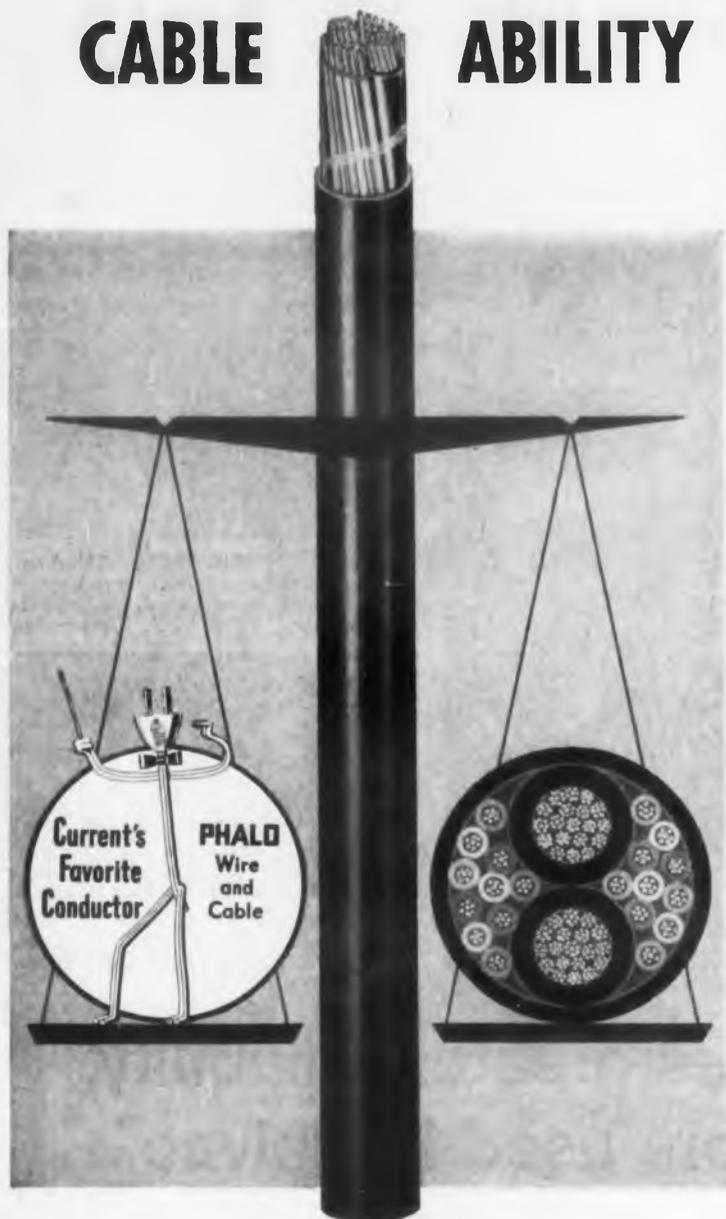
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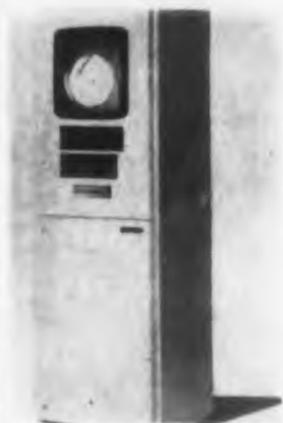
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NEW PRODUCTS



Telemetering System

Operates over single pair of wires

Multiplexed transmission permits incoming data signals and outgoing supervisory commands to be carried over a single pair of wires by synchronous time-division sampling devices. This telemetering station has a capacity of 165 on-off type supervisory controls or 17 telemetered analog signals, or a combination of both. The system checks itself once each second and, if necessary, makes automatic calibration and synchronization adjustments. It is compatible with available dc transducers at input and with all types of dc meters and recorders at output.

Applied Science Corp. of Princeton, Dept. ED,
Post Office Box 44, Princeton, N. J.

CIRCLE 460 ON READER-SERVICE CARD



Decade Amplifier

High sensitivity at low frequencies

A low noise, general purpose instrument, model 40-A transistorized decade amplifier has selectable bandwidth for improved sensitivity during measurements at the lower frequencies. The amplifier noise figure is made independent of the magnitude of the driving impedance through the use of a vacuum tube at the input stage. The input impedance is in excess of 10 meg. A constant 600 ohm output impedance is useful for driving passive networks. A gain of 10 or 100 is available over the frequency range of 2 cps to 1 mc with an accuracy of ± 0.2 db from 10 cps to 300 kc and ± 1 db from 5 cps to 500 kc. Gain is down 3 db at 2 cps and 1 mc. Noise with shorted input terminals is 4 to 7 μ v. Maximum output is 3 v rms or 1 mw.

Zacharias Electronics Corp., Dept. ED, P.O. Box 172, Livingston, N.J.

CIRCLE 461 ON READER-SERVICE CARD

HIGH SPEED TESTING...



• CAPACITORS

• RESISTORS

• INDUCTANCES

Manual-Feed — Manual-Sort **AUTO-BRIDGE**

The newest addition to Industrial Instruments Auto-Bridge line of automatic and semi-automatic test equipment is the Model AB-3X2, manual-feed, manual-sort bridge. Fully automatic hopper or tape-fed equipments have a definite place in component testing, but they are not the most efficient system whereby a large variety of small and medium-size lots of components can be tested.

The Model AB-3X2 is manually loaded and unloaded. One of the two colored lights indicates whether the component under test is "in" or "out" of preset tolerance. Plug-ins are used to set the "high" and the "low" limits and the standard jig supplied with the equipment accepts most wire lead components. There are no meters to read . . . the only interpretation required by the operator is to determine which of the two colored lights is lit. A true limit bridge principle is used. There is no drift in the operating point and daily calibrations are not necessary.

TABLE OF SPECIFICATIONS

	RANGE	ACCURACY	PRODUCTION RATE
Capacity	100 uf to 15 uf lower at reduced accuracy	$\pm 0.3\%$	Depending on type of feed 7500 electrical tests per hour. Many components can be fed with an overall rate of 5000 per hour
Resistance	10 ohms to 5 megohms, higher at reduced accuracy	$\pm 0.3\%$	
Impedance	10 ohms to 5 megohms, higher at reduced accuracy	$\pm 0.3\%$	

For complete details on this economical Auto-Bridge as well as our full line of associated equipment, write . . .



Industrial Instruments Inc.

89 Commerce Road, Cedar Grove, Essex County, N. J.

CIRCLE 463 ON READER-SERVICE CARD

CIRCLE 507 FOR G.E. SPREAD >

CIRCLE 509 FOR NATIONAL >

THE NATIONAL SCENE

TEN-TO-ONE THE Copper Clad Laminate YOU WANT IS HERE!

From these ten basic PHENOLITE® Grades, you can select the base material, resin, properties and price to fit your present printed circuit need.

If your problem is finding a suitable cold-punch material, try samples of XXXP-470-1. It's designed for use in automated production equipment. If you are looking for higher heat resistance, check Grades G-10 and G-11.

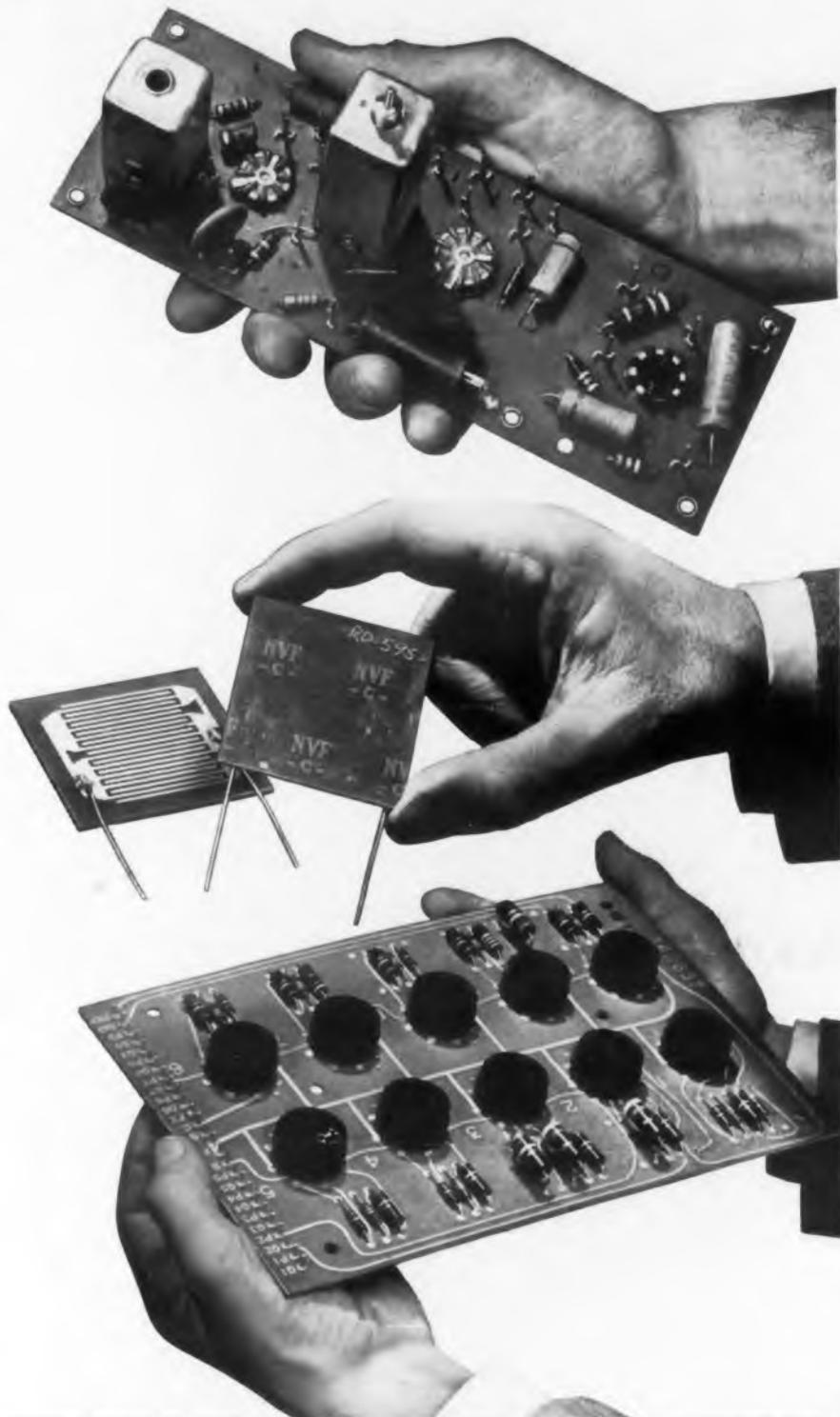
Out of National's research laboratories come new advances every day. See your National Representative about new products and applications. He can keep you posted on the full line of PHENOLITE Laminated Plastic, Vulcanized Fibre and National Nylon for electronic applications across-the-board. In the meantime, write for our new "PHENOLITE Copper Clad Data" folder. Address Dept. F-3.



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VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE

In Canada:
NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

SEE THESE PRODUCTS ON DISPLAY AT
THE I.R.E. SHOW, BOOTH 4419-21.



TYPICAL TEST VALUES ON COPPER CLAD PHENOLITE

GRADE	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES			RELATIVE COST Based on XXXP on Arbitrary Scale of 1	
	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance		Surface Resistance
						Pounds to Pull 1" Strip				
	10 ⁶ Cycles	10 ⁶ Cycles	¼%, % 24 Hrs	Psi	Degree F	1 Oz	2 Oz	Secs to Blister 1" Square > Greater Than	Megohms, Etched Retma Comb Pattern, 96 Hrs/35°C/90% RH	1/16" Thk. 1 Oz. Copper 1 Side
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	> 10 @ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	> 10 @ 475°F	200,000	.92
XXP-239-1 PHENOCCLAD	4.2	.035	0.67	15,500	250	8	11	> 10 @ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	> 10 @ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	> 10 @ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	> 10 @ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	> 10 @ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	> 30 @ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	> 30 @ 500°F	2,000,000	3.55

AIU



Alumalytic*

bring General Electric



Twist-tab capacitors in 1" and 1.375" diameter sizes feature G-E etched foil to increase effective anode area. They come supplied with printed circuit board mountings or regular solder eyelet terminals and twist-tab lugs. (Unit at left is actual size. Units above are shown 1/2 actual size.)

* ALUMALYTIC

Alumalytic is General Electric's trademark for its electrolytic capacitors made with 99.99% pure aluminum foil.

Alumalytic capacitors give you:

- Longer shelf life because of less oxide deterioration
- Longer operating life because of lower leakage currents
- Higher reliability because the foil contains fewer impurities

Capacitors

quality to the el

Alumalytic capacitors for very high microfarad applications, such as found in computer power supplies, come in $1\frac{3}{8}$ ", 2", $2\frac{1}{2}$ " and 3" case diameters. Ratings up to 35,000 mfd; 350 vdc are available. Units are made to exacting specifications under closely controlled conditions. (Capacitor above is shown $\frac{1}{2}$ actual size.)



Insulated metal tubular capacitors are available in all popular ratings, with choice of insulated or uninsulated wire leads or solder eyelet terminals at either or both ends. Uninsulated metal tubular units are also available. (Unit above is shown actual size.)

capacitors

electrolytic field

Competitively priced units made with 99.99% pure aluminum foil

Now you can get electrolytic capacitors that are backed by General Electric's long experience in making capacitors for the most critical electronic applications. New DC Alumalytic capacitors are especially designed to meet the growing need for higher quality and more reliable electrolytic capacitors.

Production quantities of Alumalytic capacitors are now available for immediate shipment. They are offered in a broad range of popular types and ratings for radio and television applications, as well as for phonographs, tape recorders, sound systems, computers and similar equipment.

Although the recently developed Alumalytic capacitors are competitively priced, they are made with extremely high quality (99.99% pure) aluminum foil, a feature normally found only in more expensive, specialized types. This high purity foil makes possible a superior dielectric film. With it, units operate at lower leakage currents, and offer superior shelf life at both normal and elevated temperatures. Other materials used in the G-E Alumalytic capacitors are of similar high quality.

Alumalytic capacitors are manufactured by scientifically controlled methods at General Electric's new Irmo, South Carolina plant. Laboratory tests, built right into the production lines, constantly check quality. Millions of capacitors already delivered have passed the most exacting specifications.

For more information and for complete service assistance on your specific problems, contact your nearest General Electric Apparatus Sales Office. Or write to General Electric Company, Section 449-2, Schenectady, N. Y.

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GENERAL  ELECTRIC

Visit booth #2928 at New York I.R.E. Show, March 24-27.



AND THEY ARE **RUGGED!**

NEW DONNER TEST INSTRUMENTS

New Donner design integrates the most wanted mechanical and electrical features to create test and measuring instruments of high durability. These instruments will stand up in the field and in the lab. New circuitry provides improved specifications.

*Mechanically and electrically
these features add up to*

RELIABILITY

The NEW Donner instrument line includes sine wave generators, low frequency generators, wave analyzers and wow and flutter meters. Shown are models 1202 Sine Wave Generator and 2102 Wave Analyzer.

Donner's new mechanical configuration combines functional styling with sturdy construction. Strong one-piece aluminum castings support 1/8" plate aluminum panels. In turn, reinforced shaft brackets are firmly anchored to these heavy plate panels, so binding, shifting and dial discrepancies are eliminated.



◀ MODEL 1202 SINE WAVE GENERATOR

- 1 cps to 1 mc, plus overlap, in 6 decades
 - Less than 0.1% distortion
- 600 ohms constant output impedance, no dc
- 6 volts rms maximum. 2% calibration accuracy
 - 0.5% stability. Regulated power supply
 - Price (f.o.b. factory) \$265.00

MODEL 2102 WAVE ANALYZER

- 30 cps to 50 kc coverage, 3% calibration accuracy
 - 160 μ v to 500 volts rms full-scale sensitivity
 - Broad and narrow crystal filter selectivities
- VTVM reads harmonic components directly in percent and db
 - Simple operation, portability, reliability
 - Price (f.o.b. factory) \$495.00



For complete technical information on Donner's rugged new line of test equipment, please address Dept. 193

See the whole Donner line at the IRE, Booth #3616. Console styled analog computers, transistorized accelerometers and rugged new test instruments

DONNER SCIENTIFIC COMPANY

CONCORD, CALIFORNIA

CIRCLE 508 ON READER-SERVICE CARD

Transducer

Provides precise voltages and frequencies



Designed for flight test instrumentation where 115 v 400 cps power is available, the Gepod provides controlled excitation of information transducers. The unit will energize three transducers and demodulate their output signals to a form suitable for in-flight recording and/or energizing an air-to-ground telemetering link. When gyros are used Gepod will supply adequate power of precisely controlled frequency to operate 3 gyro spin motors. Measuring 6 x 7 x 13 in. (including shock mount), the instrument weighs 15 lb.

Bloc Corp., Dept. ED, Maple Ave., Atkinson, N.H.

CIRCLE 464 ON READER-SERVICE CARD

32-V Power Supply

0.03 per cent regulation



Model SC-32-1 power supply delivers 0-32 v, 0-1 amp. Regulation for line or load is less than 0.03 per cent or 0.003 v, whichever is greater. Ripple is 3 mv rms. Recovery time is 50 μ sec. Stability for eight hours is 0.03 per cent or 0.003 v. Output impedance is 0.01 ohms. Additional features include 0.005 per cent resolution by means of a 10-turn voltage control.

Kepeco Labs., Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 465 ON READER-SERVICE CARD

◀ CIRCLE 507 FOR G.E. SPREAD

NEW! See these at the IRE Show

Tape-Programmed *Supertester*[®] speeds production testing

Complete testing of wiring, components, voltages, and dynamic characteristics is performed on electronic and electrical equipment by the CTI Supertester. The new Model 180 automatically selects circuits, values, and tolerance limits according to the specifications dictated by a punched tape. High-accuracy bridges are used to make measurements which include the following:

Impedance	A-C Voltage
Resistance	D-C Voltage
Continuity	Leakage



CABLE TESTER

Checks complex cables, branch circuits
Hi-pot and leakage tests — each conductor
checked against all others

Performing simultaneous continuity, leakage, and hi-pot tests, the CTI Cable Tester is ideal for both simple cables and complex, branching cables and wiring harnesses. Front-panel controls give independent selection of test conditions: continuity limits from 0.1 to 10 ohms, currents up to 2 amps, high-potting to 1500 volts d-c, and leakage limits from 1 to 500 megohms.

BOOTHS 1111 and 1112
IRE Convention and Radio
Engineering Show
New York City
March 24-27, 1958



Engineers: Career opportunities are currently available at CTI.

CIRCLE 467 ON READER-SERVICE CARD



Automatic

COMPONENT TESTER

Punched cards program tests for . . .

transformers	transistors
chokes	relays
resistors	diodes
capacitors	plug-in networks

Incoming inspection is performed automatically! Virtually no set-up time required. Short or long runs are made with equal efficiency. On receiving a shipment of transformers, for example, the operator merely places in the tester a card punched for that particular type of transformer. As each transformer is put in a test connection jig, the tester sequences the specified tests of primary impedance, excitation current, winding ratio, winding polarity, leakage current to the core.

OTHER CTI PRODUCTS ON DISPLAY

Dynamic Flight and Altitude Simulators
Radome Bore-sight-Error Measuring Systems
*Tape Reader, Punch, and Duplicator
VSWR Measuring and Recording Systems
*Microwave Sources
Antenna-Pattern Recording Equipment
*Variable-Polarization Antennas

*Indicates equipment being introduced for the first time.

For more information, see these instruments at the I.R.E. Show or write to Department 9-35

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BELMONT, CALIFORNIA

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of PARTS AND
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AND LIGHT METALS.



Torque Testing FIXTURE

A universal fixture with 1000 uses. Holds driver in accurate alignment; in instrument bearings. Provides rapid engagement with test sample...torque is applied and measured with Sturtevant Torque Wrench.

Model TTF 1/4 Capacity 0-200 In. lbs.
Model TTF 1/2 Capacity 0-150 Ft. lbs.

Write for Bulletin TF

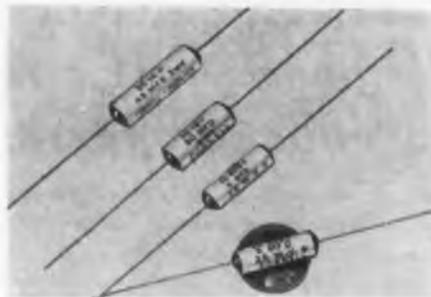
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ADDISON QUALITY ILLINOIS

CIRCLE 468 ON READER-SERVICE CARD

NEW PRODUCTS

Electrolytic Capacitors

Miniature sizes for low voltage use



Type EC electrolytic capacitors are available in ratings from 3 to 75 v dc working, and in capacitances from 1 to 250 μ f, depending on voltage ratings. Operating temperature range is -20 to $+65$ C. The smallest case size is 0.187 in. diam and 1/2 in. long, and the largest is 0.375 in. by 1-1/2 in. The capacitors are housed in tubular ceramic cases. Capacitor sections are sealed with cast resin making them moisture-tight and heat resistant.

Cornell-Dubilier Electric Corp., Dept. ED,
S. Plainfield, N.J.

CIRCLE 480 ON READER-SERVICE CARD

How To Get Things Done



BOARDMASTER VISUAL CONTROL

Gives you a Graphic Picture of your operations, spot-lighted in color. You See what is happening at a glance. Facts at eye level—saves you time, prevents errors.

Simple, flexible—easily adapted to your needs. Easy to operate. Type or write on interchangeable cards, snap in grooves. Ideal for production, scheduling, sales, traffic, inventory, etc. Made of metal. Compact, attractive.

Complete Price \$49⁵⁰ Including Cards

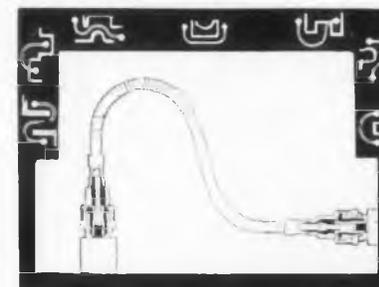
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CIRCLE 482 ON READER-SERVICE CARD

FLEXIBLE SHAFTS

Handle wide variety of control applications.



The Flexible Shaft today, although not complicated, is a specific component designed for specific applications. Industry in many fields, i.e., automotive, automation, aircraft, electronics, radio and television, machinery, and marine (to name but a few)

have found flexible shafting to be more economical and yet more productive than whatever means they were employing to control motion from one unit to another where obstacles in the path of installation were impossible to do away with.

There are two types of flexible shafts. One is the power drive flexible shaft which utilizes a cable wound to rotate in one direction only. The outer layer of wire of the cable determines the direction rotation, and is wound so that the slack is taken up when the shaft is in operation, making it practically impossible for the cable to spring from its original shape. The other type is the remote control flexible shaft in which the cable is wound so that the slack is taken up no matter which direction the shaft is turned. The remote control shaft provides for both rotation and reciprocation, such as the opening and closing of a valve.

••• For complete information as to how flexible shafting may help you solve your specific control problem, write F. W. Stewart Corporation, 4311-13 Ravenswood Ave., Chicago 13, Illinois.

CIRCLE 483 ON READER-SERVICE CARD

Transformers and Chokes

Can design provides good thermal quality



This line of standard 400 cps transformers and chokes features a can design only slightly larger than the actual magnetic core. Power range up to 200 w at 400 cps is available in case sizes ranging from 1-1/4 x 1 x 1 up to 2-1/2 x 2 x 2-1/8 in. The proximity of the double-ended can to the coil and core provides minimum thermal distances, while contact with the core allows the base to dissipate heat in a heat-sink mounting. Reduction of case size also decreases the weight and volume of epoxy required for potting.

Magnetic Circuit Elements, Inc., Dept. ED,
3722 Park Pl., Montrose, Calif.

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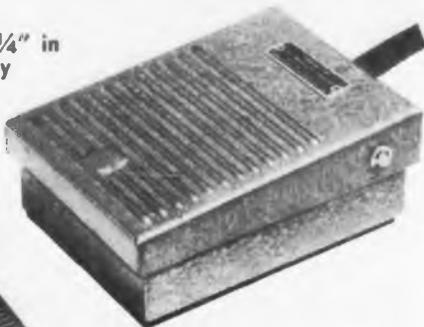
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NEW LINEMASTER

designed especially for original equipment manufacturers by America's Footswitch Leader

Hi-treadlite

Just 3½" x 2½" x 1¼" in size with strong gray hammertone finished steel housing, skid-proof rubber base pad, this 9½ oz. switch has long service life, high electrical rating.



Available in SPDT, 4 terminal, and simulated DPDT circuits. Combine any two to form a Hi-treadlite twin switch. Special cordsets, nameplates and colors available.

Write for prices, bulletin and complete catalog of the more than 75 Linemaster footswitch models.

LINEMASTER SWITCH CORP.

130 Putnam Road, Woodstock, Connecticut

CIRCLE 484 ON READER-SERVICE CARD

All the right connections for

FIERY PERFORMANCE



Faced with the problem of high temperature? Deutsch Miniature Electrical Connectors thrive on a caloric diet...operate at 250° F. without damage.

Among these torrid performers are Deutsch 9600 Series push-pull receptacles and 9700 Series push-pull plugs, perfectly matched for use in ballistic missiles, rockets and supersonic aircraft. Despite vibration, altitude and shock, they make all the right connections... in crowded, remote, blind and ballistic installations.

Prototypes and modifications of these and other miniatures are available for quick delivery from the Deutsch Model Shop.

Deutsch miniatures are as easy to operate as striking a match. Simply push in for positive lock and seal; pull back for instant disconnect.

Hot and bothered for more facts on the construction and operational features of Deutsch miniatures? Write for Data File 332.

The Deutsch Company

7000 Avalon Blvd. • Los Angeles 3, Calif.



CIRCLE 485 ON READER-SERVICE CARD

Teflon Hook-Up Wire

For aircraft and missiles

Teflon insulated hook-up wire was developed for use in aircraft, rocket and missile wiring, distribution and power transformers, integral and traction motors. Extruded Teflon coating on the silver-plated copper wire conductor makes the wire capable of continuous service over a temperature range of -90 to +260 C. It is easily stripped.

Haveg Industries, Inc., Halocarbon Div., Dept. ED, 900 Greenbank Rd., Wilmington 8, Del. IRE Booth No. 4216

CIRCLE 486 ON READER-SERVICE CARD

Clutch-Brake Assembly

Operates on less than 5 w



Model FD electromagnetic clutch-brake is designed to couple and uncouple a mechanical load upon receipt of a signal. A braking torque is automatically applied to the load shaft when decoupled. The operating coil requires less than 5 w power and may be wound for any specified dc voltage rating. Hermetically sealed power units packs measuring 2 x 2 x 1/2 in. are available for operation from 115 v 60 cps.

General Technology Corp., Dept. ED, 44 N. Dean St., Englewood, N.J.

CIRCLE 487 ON READER-SERVICE CARD

Radar Pulse Systems

Packaged units save space

Savings in space and weight are made possible by the incorporation of several matched radar transmitter components in one package, called a Pulsepak. For instance, a typical space-saving situation occurs when high voltage components are at virtually the same potential. If packaged separately, each would need insulation from its own enclosure, but they may all be placed close together in the same container. The units furnish outputs meeting reasonable performance requirements of any specific radar system employing a hydrogen thyratron tube.

Filtron Co., Inc., Dept. ED, Flushing, N.Y. IRE Booth No. 1502, 1504

CIRCLE 488 ON READER-SERVICE CARD

Fafnir presents a

NEW series of MINIATURE BALL BEARINGS



featuring



1. Vacuum melt 440C stainless steel
2. Balanced design
3. Precision tolerances

Fafnir now offers a series of miniature ball bearings, developed expressly for precision instrument applications, where performance and long life are vital.

Bearings in this new series are manufactured entirely of extra clean, vacuum melt, 440C stainless steel, to eliminate the chances of pits and imperfections in the races. Superior race finishes make supersensitive bearings with low torque values.

They are made to ABEC-5 tolerances or better, and offer a "balanced design" because each bearing is equipped with a separately designed retainer. Thus the pitch circle of the balls is centered between the bore and outside diameter.

Write for bulletin listing sizes and dimensions, available in Fafnir's new precision miniature series. The Fafnir Bearing Company, New Britain, Conn.

Four design variations in each size
Open Type • Two Shields
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FAFNIR BALL BEARINGS

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PLASTICS DIVISION
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CIRCLE 491 ON READER-SERVICE CARD

NEW PRODUCTS

Cables and Connectors

50 and 160 ohm low capacitance types



Two miniature cable and connector assemblies have been developed. The Twinax component is a 160 ohm, low capacitance connector with two shielded and jacketed conductors. This connector is a slide-on type, keyed for polarity. The Triax is a screw-type, 50 ohm connector with double shielded coax insulated between the shields.

Microdot, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE 492 ON READER-SERVICE CARD

Audio Voltage Standard

Stable supply with 30 cps to 20 kc range



The model AVS-320 audio voltage standard has output voltages of 1, 10, 100, and 300 rms. Frequency range is 30 cps to 20 kc; input voltage 1 v rms; output regulation of plus 0.1 per cent for a period of 30 days, with distortion of less than 0.025 per cent. Power source is 105 to 125 v ac 60 cps, 150 w.

Holt Instrument Labs., Dept. ED, Oconto, Wis.

CIRCLE 493 ON READER-SERVICE CARD

High Temperature Connector

A push-pull type for 500 F operation

A 500 F push-pull connector will be featured in this company's display of miniature connectors. Included in the exhibit will be miniature electrical connector applications for black box packag-

NOW! GET THIS NEW



problem-solving
**Set Screw
Catalog 21
FREE**

Brings you up to date on latest developments in all types of Set Screws, including Hopper-Fed for Automations.

You'll find this new, comprehensive Setko Catalog an invaluable reference manual in solving tough, puzzling Set Screw problems. Lists all standard set screws... plus many special types designed for unusual conditions of vibration; close precision setting; resistance to tampering, chemicals or heat; extra holding power; etc. Describes many specific ways in which Setko Set Screws cut costs and improve product quality.

Partial Contents of New Setko Catalog 21:

- Hopper-Fed Headless Set Screws, with New Automated Feed System
- Self-Tapping Set Screws and Fasteners
- Standard Hexagon Socket
- Zip-Grip Self-Locking
- Nu-Cup Set Screws
- Self-Locking Offset
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- Isothermal Heat-Treated Set Screws
- Stainless Steel Set Screws
- Cap Screws, Pipe Plugs

* Indicates Setko Set Screw "Firsts"!

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263 Main St., Bartlett, Ill. (Chicago Suburb)

We Specialize in Solving Puzzling Set Screw Problems

CIRCLE 494 ON READER-SERVICE CARD

High
Vacuum
Switch



108 MILLION CYCLES

STILL GOING STRONG!



The new Pioneer high vacuum switch may be your answer for a compact, rugged, long lasting, single pole double throw high voltage relay. Ideally suited for switching purposes in DC pulse systems and in many circuits where a fast-acting relay is required in a high voltage circuit, or under varying atmosphere conditions.

For application in Mining, Chemical, Aircraft and Petroleum Industries.

Write for descriptive literature and specifications. Dept. ED-3.

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CIRCLE 495 ON READER-SERVICE CARD



Shielded room, 10' x 20' x 8', designed and manufactured by SHIELDING, INC., Riverton, N. J., for Magnavox Corporation, Ft. Wayne, Ind.

Sectional shielded room of metal-faced Weldwood Plywood gives positive RF seal, needs no maintenance

"Our Armorply shielded room, manufactured by Shielding, Inc., does a first-class job of isolating electrical equipment undergoing radio interference tests," reports Jack Ford, Magnavox standards engineer. "The 3/4-inch plywood core separating the zinc-coated steel faces eliminates any possibility of short circuits. Also neither periodic repair nor painting is needed."

An Armorply room can be installed, expanded, altered, or dismantled and moved easily because special compression joints eliminate any need for soldering the modular panels. "We intend to order another Armorply enclosure shortly," says Mr. Ford. "We're perfectly satisfied with Armorply's performance." Armorply panels can be specified in a variety of faces and cores. For full details and a free Armorply sample, write: United States Plywood Co., Dept. ED 3-5-58, 55 W. 44th St., N. Y. 36, N. Y.

Weldwood[®] ARMORPLY[®]
CIRCLE 496 ON READER-SERVICE CARD

Push Button Switches Designed for your Miniaturization Program

These Grayhill Switches are designed and built for long dependable service. They are silent action momentary contact with an exceptionally long life. Series 2000 Snap Action Switch also available.



Series 4000
SPST
1/2 Amp.—
115 V. AC
Normally Open
or Normally
Closed



Series 35
DPST
.50 Amp.—
115 V. AC
Normally
Open



Series 23
SPST
1/4 Amp.—
115 V. AC
Normally
Open



Series 30
.10 Amp.—
115 V. AC
Normally Open
or Normally
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Series 39
SPST
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Actual
Size

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CIRCLE 497 ON READER SERVICE CARD

ing and special rack and panel installation. In addition to rack and panel units, the line is made up of edgelite panel, hermetic and miniature connectors of all types, including push-pull, positive locking and sealing units.

The Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.

I.R.E. Booth No. 3921

CIRCLE 498 ON READER-SERVICE CARD

Digital Test Equipment

A transistorized building block line



Designed for use by engineers involved in the development and production of computer systems, this equipment features ease of application, high speed, and compactness. The transistors used make possible pulse speeds of 5 mc.

Counters, shift registers, and pattern generators as well as other test set ups can be assembled from the units. Only three voltages are used, +10, -3, and -15.

Digital Equipment Corp., Dept. ED, Maynard, Mass.

CIRCLE 499 ON READER-SERVICE CARD

Frequency Meter and Counter

10 cps to 100 kc range with high stability



Model WE-120 five-decade frequency or events per unit of time meter and counter uses decade glow transfer tubes for both digital presentation and digital division of the time base frequency. Frequency range is 10 to 100,000 cps, and stability is 0.001 per cent ± 1 count. Sensitivity is 75 mw to 120 v rms, with 105-125 v, 75 w power input.

Westport Electric, Dept. ED, 149 Lomita St., El Segundo, Calif.

CIRCLE 500 ON READER-SERVICE CARD

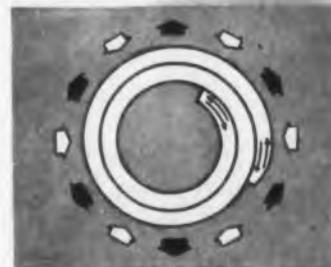
SPIROL - the spring pin made with Low-Cost Non-Heat-Treated Metals



Nickel stainless steel SPIROL pins are used as corrosion-proof fastenings on "Moen" one-handle mixing faucets. SPIROL pins can be made with lower-cost, non-heat-treated metals — stainless steel, brass, and ordinary copper — because stress is evenly distributed throughout the spiral coils, giving full radial spring action, with no flexing concentrated along a "hinge" line.

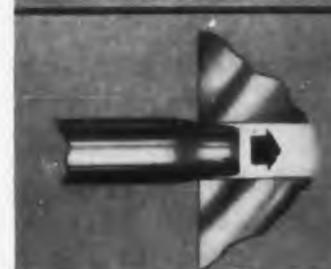
SHOCK RESISTANCE

High resistance to shock and vibration permits use of "medium duty" SPIROL pins in the majority of applications. Heavy and light duty SPIROL pins also available in stock.



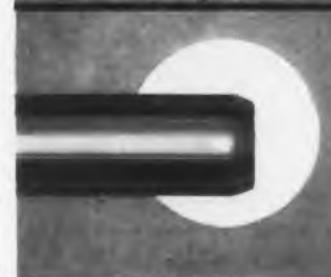
WIDER HOLE TOLERANCES

Both plus and minus hole tolerances are allowed because spiral construction permits greater flexibility in expansion and compression. The wider hole tolerances eliminate precision reaming requirements, reduce drilling rejects, cut costs.



PERFECT CHAMFER

A. Smoothly rounded radius where chamfer meets shank eases insertion into hole. No sharp break to "bite" and resist insertion. B. Chamfer angle is precisely designed to offer minimum thrust resistance and maximum compression leverage.



MINIATURE PINS — SPIROL is the only spring type pin available in these miniature diameters: 1/32" — .039" — 3/64" — .052". Unique spiral cross-section retains flexibility and strength in smallest sizes. Other standard sizes up to 1/2" diameter.

FREE! Write for literature on Spirol Pins.



SPIROL the true spring **PIN**

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Economical . . . clean, sharp Class 2 threads . . . high strength to weight ratio . . . built-in electrical insulating properties . . . stable over a wide range of temperatures . . . resilient and elastic, conform to irregular shapes, seal, don't loosen under vibration . . . non-magnetic . . . non-corrosive . . . chemical resistant . . . in colors to order.

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NEW PRODUCTS

Magnetic Amplifier

Linear dc output controlled by dc signal



Model 420 magnetic amplifier has a trans-impedance of 50,000 ohms and delivers a linear dc output from 10 μ w of dc control signal. Frequency response extends from dc to 25 cps, depending on circuits used. Model 420 contains a push-pull, full-wave, reversible-polarity magnetic amplifier, and uses negative feedback for stabilization and linearity. Performance is not impaired by distorted supply waveforms, 10 per cent voltage and frequency variations, or temperatures from -55 to +85 C. Unit measures 1-1/2 in. diam by 3 in. high.

Acromag, Inc., Dept. ED, 22519 Telegraph Rd., Detroit 41, Mich.

CIRCLE 513 ON READER-SERVICE CARD

Memory Cores

Less than 1 μ sec switching time

One of four products being announced are these memory cores, available in S-4 material, with switching time of less than one μ sec with 550 ma full drive. At recommended operating conditions the "one" output voltage is greater than 60 mv and "zero" output voltage less than 6 mv.

A zinc ferrite material is also available. Expected to gain wide acceptance in transformer applications, this material has a loss of less than 85 mw per cubic centimeter at 15 kc. Initial permeability is rated at 2000 and maximum at 3600. Ballast for high frequency lighting systems is another application presently being explored.

Two other products consist of a line of high temperature solid pin headers for use in tubes where uniformity and ability to withstand severe environmental conditions are required, and a line of vacuum tight high-temperature ceramic-to-metal cable end seals designed for use as terminations with mineral insulated cable.

General Ceramics Corp., Dept. ED, Crows Mill Rd., Keasbey, N.J.

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GERMANIUM

RECTIFIER POWER SUPPLY

Model RS40B



0 - 110 V.D.C. 20 Amps 1% Ripple

• Vacuum Varnish Impregnated Magnetic Components • Short Circuit and Overload Protection • Non-Ageing Germanium Rectifiers • Natural Draft Cooling • 4 1/2" Rectangular 2% Accuracy DC Panel Meters • BUDGET PRICED

Additional Specifications

Regulation: 5-6% from 1/10 load to full load at 110v. output.
Duty: Continuous at 40°C.
Polarity: Positive and negative terminals are above ground and isolated from the AC input. Either terminal may be grounded.
Input: 120 volts AC 60 cycles single phase
Controls: Power switch, voltage control, input circuit breaker, load fuse in indicating type fuse holder and pilot light.
Terminals: Input — Barrier type terminal board at rear
Output — Insulated panel mounted binding posts and barrier type terminals at rear.
Dimensions: 22"L x 19"H x 15"D.
Weight: 160 lbs.

Bulletin No. 204 On Request

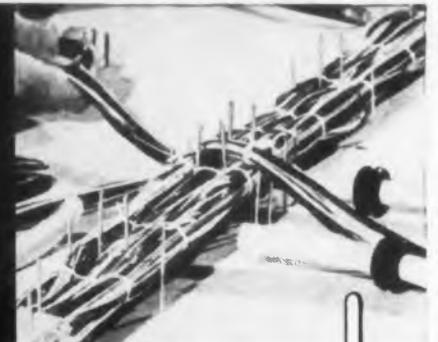


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with HASSALL HARNESS BOARD POSTS

These new harness posts speed multi-circuit wiring harness assembly. Posts may be nailed into the board with no pre-drilling. Hassall posts are tempered and hardened, nickel plated, and tops are milled round to ease wire placement and removal. Lengths available: 1", 1 1/2", 2", 2 1/2", 3" and 4". Write today for prices.

John Hassall, Inc., P.O. Box 2202 Westbury, Long Island, N.Y.



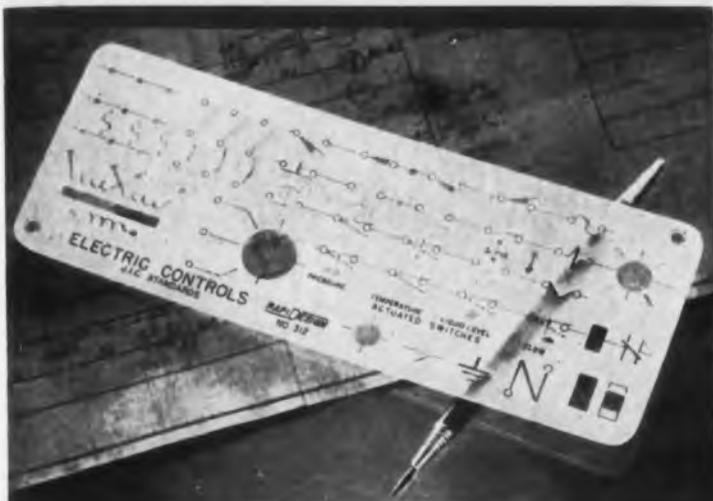
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NO. 312 ELECTRONIC CONTROLS TEMPLATE

ACTUAL SIZE 9" X 3 3/4"

J. I. C. STANDARD SYMBOLS AS RECOMMENDED BY THE JOINT INDUSTRIAL CONFERENCE IN MARCH 1953.

DESIGNED TO ASSIST IN THE DEPICTION OF CIRCUITS IN ELECTRICALLY CONTROLLED MACHINERY AND ELECTRIC AUTOMATION OF PRODUCTION PROCESSES.

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CIRCLE 518 ON READER-SERVICE CARD

Digital Clock

Output accurate to nearest second



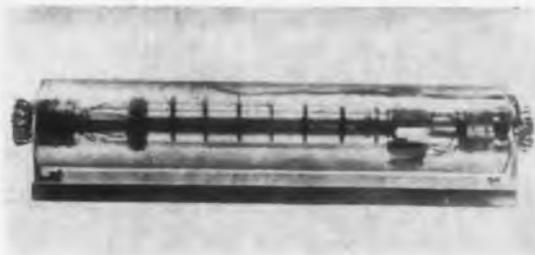
Suitable for providing time data to logging systems or data handling systems, model 2600 digital clock produces multiple digital representations of time to the nearest second. Up to three independent, parallel, decimal outputs are available in one unit, with time resolutions of seconds or minutes.

Chrono-log Corp., Dept. ED, Box 4587, Philadelphia 31, Pa.

CIRCLE 519 ON READER-SERVICE CARD

Magnetostrictive Storage Unit

Making possible a 3 μ sec access rate



Having a rate of access of 3 μ sec as against 10 μ sec or more for usual delay lines this magnetostrictive storage unit consists of eleven 120- μ sec delay lines. Ten of these lines are storage units capable of storing 60 bits of information at a 1 mc prf for a total of 600 for the 10 lines. The eleventh line is intended as a clock and/or synchronization line for purposes of controlling the time slots in a computer.

Read coils can be installed every 3 μ sec along the length of the line. Using the write coil and the first read coil of the clock line as the basic timing unit, maximum timing stability is achieved while temperature changes are immaterial and will not cause the storage lines to drift. Each line may be driven by a single tube or transistor.

The storage unit is constructed around a central supporting rod or shaft for purposes of ready accessibility and servicing. Input and output coils of the delay lines can be wound for any desired impedance, tube, or transistor. The inherent temperature coefficient of the line is 0.005 per cent per deg C, but may be improved by temperature-compensating techniques.

The unit measures 40 in. long and 7 in. diameter. Weight is 25-1/2 lb.

Deltime, Inc., Dept. ED, 608 Fayette Ave., Mamaroneck, N.Y.

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CIRCLE 521 ON READER-SERVICE CARD

new Microsecond Indicator

TYPE 206



USE IT TO MEASURE:

- Phase Angle between two pulse-modulated sine waves.
- Time interval between any two points of an irregular pulse.
- Time delay of a four-terminal network.
- Time interval between an incident and its reflected pulses through a medium.

Specifications:

Channel 1—Time Delay: 0.5 us total delay in step of 0.05 us.

Channel 2—Time Delay: Part 1—Continuously variable from 0 to 0.1 us, with resolution time less than 8×10^{-11} second; Part 2—Step variable from 0 to 6 us in step of 0.1 us.

Maximum Sweep Rate: The maximum repetition rate of the oscilloscope sweep should be less than 100 KC.

Maximum Output: 6 volts peak to peak.

Price: \$584.00

Type 206 consists of two variable delay lines, a pulse-forming circuit and two gating circuits. The fundamental application of this instrument is to measure time interval between any two points of a single (or two) pulse with a high degree of accuracy.

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BOOTH No. 3606

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CIRCLE 522 ON READER-SERVICE CARD



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MEET NEW GOVT. SPEC. Mil-T-713A

Tapes are available in both Nylon and Dacron and in wax-free and resin-coated finishes. FREE! Write today for free samples.

New! TEFLON COATED FIBERGLASS TAPES
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NEW PRODUCTS

Preset Counters

Feature reliability, count rate above 5000 cps



Since cold cathode glow counters and transistors are the only critical components, this counter provides substantial reliability. Available with single and dual presets, 2 to 6 digits, and optional Nixie-in-line readout, tentative specifications include a count rate above 5000 cps, sensitivity of 50 mv at 20,000 ohms, and a pulse output of 30 v. Output relay is mercury wetted, hermetically sealed, spdt.

Dynapar Corp., Dept. ED, 5150 Church St., Skokie, Ill.

CIRCLE 524 ON READER-SERVICE CARD

Temperature Measuring System

An adiabatic type for remote indication



Application of this system can be made to any situation requiring direct reading remote temperature indication. System accuracy and range are essentially that of the total temperature probe, and can be supplied for any span from -60 to +1000 F. A typical system, the FT-104, consists of a resistance thermometer, control unit with a temperature-controlled silicon diode reference bridge circuits, and a chopper type servo millivoltmeter for display purposes.

North Atlantic Industries, Inc., Dept. ED, 603 Main St., Westbury, N.Y.

CIRCLE 525 ON READER-SERVICE CARD

Glass-Base Epoxy Laminates

Easily machinable

An epoxy-impregnated plastic laminate, designated as Grade G-11, with a continuous-filament woven glass fabric base has been developed. It is anticipated that Grade G-11 will be eventually

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LEPEL Electronic Tube
GENERATORS—1 KW; 2½ KW;
5 KW; 10 KW; 20 KW; 30 KW; 50 KW;
75 KW; 100 KW.

LEPEL Spark Gap Converters
2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.

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attention authors

Because an electronic design engineer must have hundreds of ideas to draw upon for each individual design decision, the editorial staff of *ELECTRONIC DESIGN* is continually trying to add to this storehouse of ideas. We are, therefore always interested in material based on your own experience which would be of immediate practical use to electronic design, development and research engineers. It is not difficult to write an article for *ELECTRONIC DESIGN* if you know what to write about and how we like to have our stories written. To simplify the preparation of an article, we have drawn up a brief guide for authors. Send for your copy today.



Edward E. Grazda, Editor.

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NULL METER

A PHASE SENSITIVE NULL METER WHEREIN NOISE AND HARMONIC VOLTAGES ARE EFFECTIVELY ELIMINATED



MODEL 100A

- Allows separate balance of in-phase or quadrature in null circuits.
- Eliminates the necessity for filters.
- High sensitivity.
- Direction of null clearly shown on zero centered meter.
- Synchro zeroing without recourse to coarse and fine switching.

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SUB-MINIATURE HERMETIC ELAPSED TIME INDICATORS.

You, too, can afford the space to keep track of time! From now on, these really small (1 1/4") Elapsed Time Indicators will keep company with the best of Electronic Miracles.



The illustration shows how the operating time of various sections of an electronic console can be monitored.

The dial type units read up to 2,500 hours in one hour increments, while the digital type units read up to 9999.9 hours in one-tenth hour increments. Designed for military applications, these 4 1/2 ounce units can save valuable panel space in industrial and electronic applications.

The 400 cycle models now in production are described in Bulletin AWH ET 602.

The A. W. HAYDON COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices

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covered by a future military specification of its own; it does conform to Military Specifications MIL-P-18177 at present. Grade G-11 possesses low moisture absorption, and low dissipation factor properties, maintaining these characteristics over a wide range of humidities and temperatures. It can be easily machined because of its high bond strength, and is fungi-resistant.

Synthane Corp., Dept. ED, 12 River Rd., Oaks, Pa.

CIRCLE 530 ON READER-SERVICE CARD

Transformer Kit For blocking oscillator design



The Pulsite transformers in this kit are specifically designed for use in preferred blocking oscillator circuits. For example, in NBS preferred circuit no. 46, cathode output is 60 to 85 peak volts with pulse durations of 0.1 to 10 μ sec, depending on transformer used. The kit consists of eight oscillator units with turns ratios of 1:1:1 and open-circuit primary inductances from 0.08 to 150 mh and two interstage units with turns ratios of 5:1:1.

Airpax Products Co., Transformer Div., Dept. ED, Middle River, Baltimore 20, Md.

CIRCLE 531 ON READER-SERVICE CARD

300 Deg Panel Meter Available in sensitivities to 100 μ amp



Featuring 8-1/2 in. of useable linear scale in a 4-1/2 in. diam meter, these units cover 15 per cent more scale than the 250 deg instruments previously manufactured by this company. Response time and dampening of these meters surpass MIL 10304A. The instruments are hermetically sealed and ruggedized. Meters can be furnished in standard ranges from 100 μ amp and up, with accuracies from 0.5 to 2 per cent. They are available in 2-1/2, 3-1/2, and 4-1/2 in. sizes, round or square. Other sizes and meters more sensitive than 100 μ amp can be built.

Miller Instrument Co., Dept. ED, 165 E. Lincoln St., Escondido, Calif.

CIRCLE 532 ON READER-SERVICE CARD



covered by patents

THIRTEEN BRISTOL HIGH-SPEED RELAYS IN THIS CONVERTER!



Twelve-and-a-half microvolt resolution at 20 readings per second! That's the outstanding feature of the analogue-to-digital converter, developed by Non-Linear Systems, Inc., Del Mar, California, to "digitalize" the output of low-voltage transducers in either ground or airborne service.

It's significant that Non-Linear Systems engineers selected thirteen miniature Bristol Syncroverter* high-speed relays (inset, top) for use in the converter scanning circuits. This versatile, high-speed, polarized relay has earned an enviable reputation for reliability, long life and immunity to shock and vibration in just such critical low-level, dry-circuit applications.

Are dry circuits your problem?

If so, we believe we have the answer. Dry-circuit reliability and long life are outstanding features of the Syncroverter high-speed relay. It's unaffected during severe shock and vibration. It has fast pull-in and drop-out and negligible contact resistance, and it operates reliably over a wide temperature range.

More than 20 models available

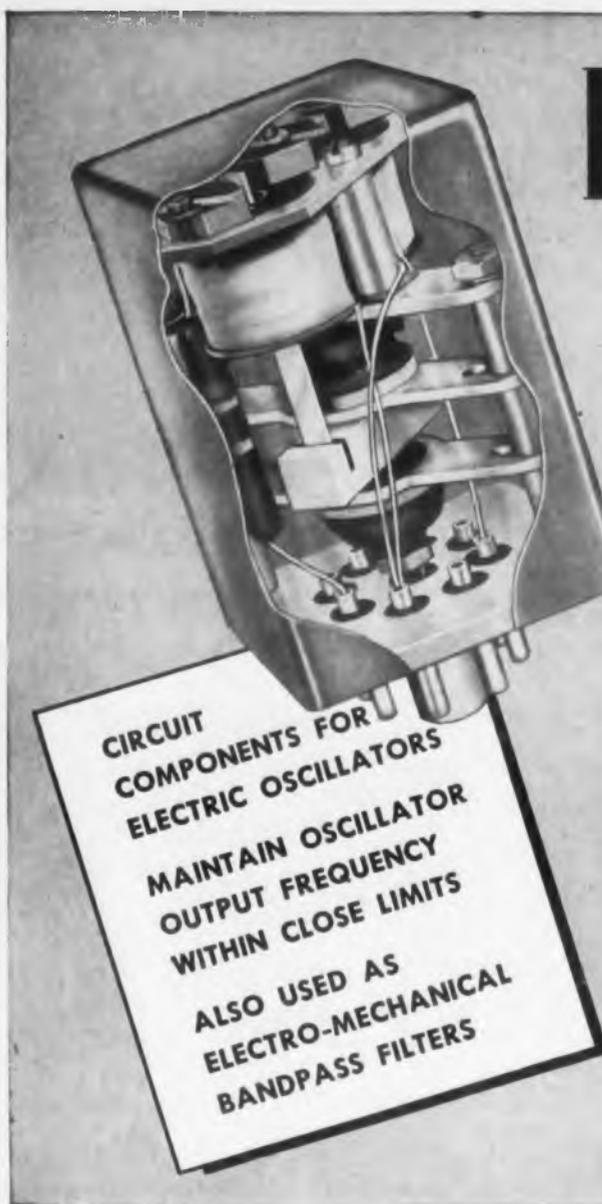
You can specify Bristol Syncroverter high-speed relays in an extremely wide variety of operating characteristics and in various case and mounting arrangements. Ask us for complete details. Write: The Bristol Company, 151 Bristol Road, Waterbury 20, Conn.

B.3A

*T. M. Reg. U. S. Pat. Off.

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ROSC

OSCILLATOR CONTROLS

FEATURES

- High accuracy
- Stability of frequency control
- Self starting
- Infinite service life
- Integral, sealed, magnetically shielded
- Standard octal tube pin connectors
- Small, light weight

CIRCUIT COMPONENTS FOR ELECTRIC OSCILLATORS MAINTAIN OSCILLATOR OUTPUT FREQUENCY WITHIN CLOSE LIMITS ALSO USED AS ELECTRO-MECHANICAL BANDPASS FILTERS

APPLICATIONS

- Electrical and Acoustical Measurements
- Electrical Communication Systems (Selective Calling)
- Remote Operation and Supervisory Control of Machinery and Apparatus
- Electrical Computers and Telemetry Systems
- Electro-Mechanical Bandpass Filters

Frahm Oscillator Controls, Type ROC, make possible the design and construction of inexpensive, precision tone generators that are small and light weight. These generators will have accurate output frequency and output voltage with very nearly sinusoidal wave shape.

They can be made with any one nominal control frequency between 20 and 1100 cps. They will control the output frequency of circuits, under specified conditions, constant within $\pm 0.15\%$ of the nominal control frequency.

We particularly encourage your inquiries and correspondence on special applications and problems. If you haven't explored these Frahm Oscillator Controls we'll be glad to send you complete specifications, characteristics, etc. Write for Bulletin **34-ED**.

B-708

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LABORATORY & SCIENTIFIC EQUIPMENT
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CIRCLE 301 ON READER-SERVICE CARD

NEW LITERATURE

Silicone Sponge Sheets 302

The properties of Cohrlastic R-104070 silicone sponge rubber sheets for -100 to 480 F applications are detailed in this 2 page data sheet. These silicone sponge rubber sheets meet AMS 3195 and 3196 and many commercial specifications. Data sheet, as well as a sample of the silicone sponge rubber are available. Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.

Visual Analysis Techniques 303

A bulletin series covering technical notes on applications of panoramic techniques in the solution of measurement problems has been released. The series covers actual case histories, the function and use of various types of instruments, results achieved with combination instrumentation systems, technical explanations and solutions of both common and unusual problems. Panoramic Radio Products, Inc., Mount Vernon, N.Y.

Reflex Klystron 304

Describing a low voltage, reflex klystron for the frequency range of 8.5 to 10.5 kmc, the bulletin includes special features and applications. The oscillator produces a minimum output power of 20 mw at a beam potential of 300 v when operating into a load having a measured vswr of less than 1.1.

The oscillator features broad band; low cost; small size; waveguide output; base shield flange; integral cavity and tuner with a single-screw tuning covering the full frequency range; free convection cooling; compensated for ambient temperature changes; all electrical connections through standard small-wafer octal base. Sperry Gyroscope, Electronic Tube Div., Great Neck, New York.

Metal Film Resistors 305

This four page brochure describes and gives specifications of metal film resistors especially designed for use from dc to



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Resistance

plus **KNOTTING POWER**

Ben Har Lacing Tapes — Teflon/Fiberglas

Aircraft fuels demand lacing tapes that can "take it". Ben Har Lacing Tapes can! Especially formulated of two highly inert materials — Teflon* and Fiberglas**. In Ben Har Tapes the Fiberglas is Teflon coated to give the braid a "tooth". Will not slip after knotting. Ben Har Tapes will not shrink, never cut through insulations. Pliable from -100°F. to 500°F. Wax-free, will not support fungus. Non-absorbent. Four sizes and nine colors — write for prices and samples.

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Flexible

LACING TAPES

CIRCLE 306 ON READER-SERVICE CARD

90,000 mc. Described are waveguide metallized glass attenuator elements, coaxial load resistors, metal film resistance card, metallized mica elements 0.001 in. thick and miniature metal film rod and disc type resistors. Applications of the resistors are microwave attenuators, coaxial low and high power loads, Tee pads, precision low vswr terminations, strip line resistors, directional couplers, and coaxial attenuators. Filmohm Corp., 48 W. 25th St., New York 10, N.Y.

Special Cams 307

This illustrated booklet, No. SC-1, describes a service for providing industry with special cams of every type, whether the need is for a single piece or for production lots. Many of the modern manufacturing and testing facilities utilized in the precision operations are illustrated. Included among the facilities described in detail are cam millers, cam grinders, turret lathes, visual comparators, air gages and an optical rotary table re-engineered to the company's specifications. The American Cam Co., Inc., P. O. Box 2106, Hartford, Conn.

Pulse Transformers 308

A 12-page catalog, C 201, describes pulse transformers, toroids, and filters. With schematics showing typical uses, it provides detailed circuit applications and design hints. Pulse Engineering, 2657 Spring St., Redwood City, Calif.

Facilities Brochure 309

Facilities which span the full spectrum of engineering and design services are described in a 6-page folder. A data processing and electronic digital computer service are among those mentioned. Photographs illustrate the text. Allstates Design & Development Co., Inc., 25-27 N. Warren St., Trenton, N.J.

Relays 310

A 20-page catalog shows a full line of relays for electronic, electrical, and industrial use. It contains technical data on relays of all types. Kurman Electric Co., Div. of Norbute Corp., 191 Newel St., Brooklyn, N.Y.

in the Spring.

■ A young man looks for high tensile strength, corrosion-resistance and close tolerances . . . especially if he is a design engineer who plans to incorporate the spring in his own machinery.

■ When you require springs, consult the spring engineers at John Chatillon and Sons. They have over 120 years of experience in designing and manufacturing all types of springs and they can solve *all* your spring problems.

Send specifications and blueprints to Department D-1.

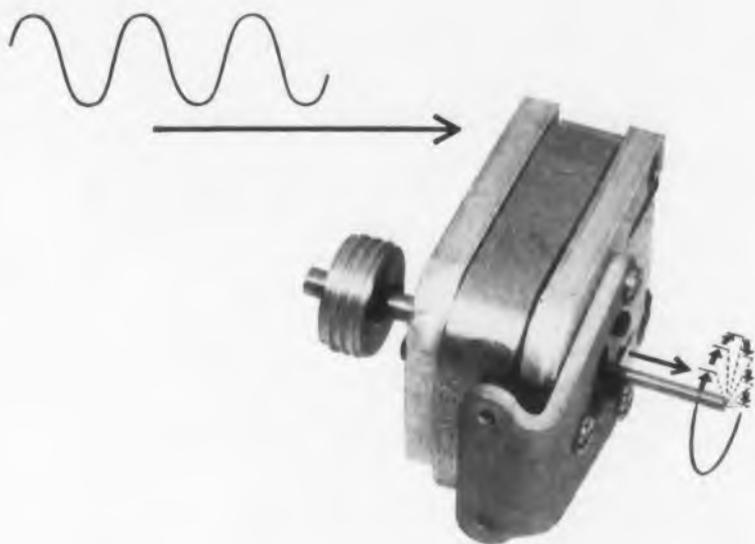
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Manufacturers of Precision Springs and Force Measuring Instruments Since 1835.



CIRCLE 311 ON READER-SERVICE CARD



99% magnetic stepping motor— 1% moving part (TOUCHES ONLY BALL BEARINGS)

... 8000 STEPS PER MINUTE

... INSTANT START, NO SLIP, NO CLATTER

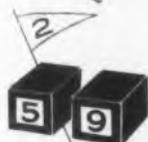
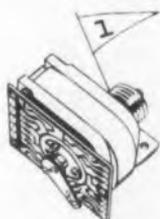
... IT WORKS

THE SIGMA CYCLONOME® STEPPING MOTOR* behaves like a 10-pole synchronous motor, but because of small inertia and high torque it comes to a dead stop between *each half cycle* up to rated maximum of 130 cps. It continues to run synchronously at frequencies well above this maximum, but eventually fails to stop on command on a selected pole.

Since stopping and starting torques are roughly equal, it makes a good counter of cycles or pulses. It accepts sine waves or square pulses, but requires reversals. These reversals may be provided by straight AC signals, DC pulses supplied alternately to separate windings, or DC pulses to one winding with a reference or bias DC in the other.

As proof that this dandy little motor works and can do some useful jobs, three "for instances" that we've built are shown. In (1), some rather elaborate switching is done by a commutating switch driven by the motor. At (2), it functions as a self-checking digital readout switch. In the third example (3), the motor is housed with and drives a 6-digit Veeder-Root register at rates up to 8000 CPM (sold for some time as the Sigma Cyclonome Counter).

*Pat. app. for



TYPE 12D CYCLONOME STEPPING MOTOR SPECS INCLUDE:

TORQUE OUTPUT: approximately 100 gram-cm. for every 18° of rotation (optimum input signal)

INERTIA: 0.6 gram-cm².

INPUT POWER: ½ to 12 watts depending on speed requirements

SIZE: 2½" x 2½" x 1½"

• Why you would want to get shaft positions out of electrical cycles is, of course, your business, but there is a thinly disguised feeling around here that (maybe?) one of these gadgets might be just what you've been looking for. If you can withstand the Tumult and get past the Lions, you can see a Cyclonome Motor stepping at BOOTH 2628-2630, at the athletic contest in March. If not, write for Bulletin.

SIGMA INSTRUMENTS, INC.

91 Pearl Street, So. Braintree 85, Massachusetts

CIRCLE 312 ON READER-SERVICE CARD

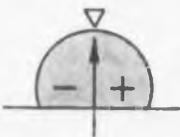
ACTUAL SIZE



Overall dimensions: 4" x 8" x 7½" deep, wt. 14 lbs.

ADJUSTABLE
POWER SUPPLY
0-300 V, 200 ma

\$89.50
f.o.b. factory
Immediate delivery



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CIRCLE 313 ON READER-SERVICE CARD

NEW LITERATURE

Economical Packaging 314

Packaging cost reduction from original package design to final product shipment is the subject of this pocket-size booklet, titled "How to Ship More Economically in Corrugated Boxes." The 24-page publication includes information on the designing, testing and storing of product packages. Illustrated with photographs and drawings, the booklet also offers information on the planning of the shipping department and on economy considerations in the packing, sealing, warehousing and shipment of corrugated boxes. Hinde & Dauch, Sandusky, Ohio.

Transistor Manufacture 315

A brochure to show the reader exactly how the germanium alloyed junction transistor is manufactured is now available. Included in this eight-page brochure are photographs and a flow chart which shows the step-by-step operations in the production of the transistor from raw material to finished product. General Transistor Corp., 91-27 138th Place, Jamaica, New York.

Potted RF Chokes 316

Potted Chokes are fully described in a four page, two color bulletin, number 125. These units, available from stock, are epoxy encapsulated and meet performance requirements of MIL-C-15305A, Grade 1, Class B. The bulletin includes a section covering theory of typical application in rf circuits. NYT Electronics, Inc., 2979 Ontario St., Burbank, Calif.

Panel Lamp Chart 317

A chart on panel and flashlight lamps has been compiled, and is now available. The chart is a composite listing, arranged numerically, of all panel and flashlight lamps manufactured by Chicago Miniature, General Electric, National Carbon (Eveready), Radio Corporation of America, Raytheon, Tung-Sol and Westinghouse. Simply by checking the lamp number the user can determine at a glance the respective manufacturers, bulb type, base, volts, amps and bead color. All bulb types are illustrated with physical dimensions. The Radio-Electronic Master, 60 Madison Ave., Hempstead, N.Y.

CERTIFIED TO LATEST MIL-R-94B 19A SPECS



Newly Developed CTS Military Variable Resistors

Complete line composition and wirewound military variable resistors now in production. Dependable, exceptionally good delivery cycle. Tested and certified to meet latest specs of MIL-R-94B characteristics X and Y, and MIL-R-19A.

Composition controls Styles RV2 (1 watt), RV4 (2 watts) and RV5 (1/2 watt miniaturized) meet latest MIL-R-94B specs. Wirewound controls Styles RA20 (2 watts) and RA30 (4 watts) meet latest MIL-R-19A specs. All are available in a variety of shafts, bushings and resistances. All except Type 65 are available in 2 or 3 section concentric shaft and straight shaft tandem constructions.



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INDIANA

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CIRCLE 318 ON READER-SERVICE CARD

Powdered Metal Processes 319

This 16-page, pocket-size booklet, in color, shows how to cut precision parts costs with a powdered metal process. The booklet tells what the powdered metal process is and does. It states advantages and limitations, illustrates good and bad parts-design factors, and charts material specifications. Reese Metal Products Corp., Lancaster, Pa.

Electronic Master Catalog

The 1958 Radio-Electronic Master Catalog is ready. The largest yet, it has 1584 pages, 11,500 pictures, and over 150,000 items from 350 manufacturers. It gives detailed descriptions, specifications, and prices for standard stock items. An index pinpoints all products. Some of those listed are: tubes, test equipment, capacitors, resistors, relays, coils, antennas and accessories, transformers, recording and public address systems, high fidelity equipment, hardware, tools, transmitters, communications receivers, wire and cable, speakers, microphones, rectifiers, converters, amateur gear, switches, and volume controls. *The cata-*

log may be obtained from electronic parts distributors. Names will be furnished on request by United Catalog Publishers, Inc., 60 Madison Ave., Hempstead, N.Y.

Crystal Diodes 320

A crystal diode replacement guide is now available. The guide contains special data on miniature diodes plus complete listings for all general purpose diodes. Sylvania Electric Products, Inc., 100 Sylvan Road, Woburn, Mass.

Chassis Latches 321

Bulletin 27L introduces two electronic chassis latches with interchangeable handles and forks. The 4-page folder lists specifications and tells, step by step, how to install and remove the latches. Labeled dimensional drawings show handle and fork assemblies. Weight, material, and finish are given for all catalog part numbers; and panel thickness and adjustment ranges are given for fork assemblies. Camloc Fastener Corp., 22 Spring Valley Rd., Paramus, N.J.



*hold crystals
secure
against shock
and vibration
with*



BIRTCHER CRYSTAL CLIPS

MATERIAL
Type 302
stainless steel

SIZES
Available in heights
and modifications
to fit nearly all
popularly used
crystals.

Crystals and similarly shaped miniature components can be held securely in place even under severe conditions of vibration and shock with Birtcher CRYSTAL CLIPS. The unique design of the clip permits easy access for service even in crowded chassis.

Write for catalog

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CIRCLE 322 ON READER-SERVICE CARD

New

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INPUT 28V D.C. $\pm 10\%$

OUTPUT Nom. 115V $\pm 2\%$ 400 CPS $\pm 0.01\%$
1 ϕ (2- or 3-phase output available)

RATINGS: 30VA 50VA 100VA
Higher ratings available.

APPLICATION:

For gyro wheel supplies and where precise 400 cycle voltages are required in aircraft, radar and missile computers.

FEATURES:

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(Send for Bulletin S-864)



PERFORMANCE SPECIFICATIONS

MODEL NUMBERS	$\pm 0.01\%$ CPS $\pm 0.05\%$ CPS	SIS 40311 SIS 40315	SIS 40511 SIS 40515	SIS 410011 SIS 410015
INPUT VOLTAGE	28V DC $\pm 10\%$			
MAX. OUTPUT POWER	30VA	50VA	100VA	
OUTPUT VOLTAGE	115V AC (Adjustable $\pm 10\%$)			
OUTPUT FREQUENCY	400 CPS $\pm 0.01\%$ 400 CPS $\pm 0.05\%$			
VOLTAGE REGULATION	$\pm 1\%$ For Line Variations $\pm 2\%$ For Load Variations			
FREQUENCY DISTORTION	3% Maximum At Full Load			
LOAD POWER FACTOR	+0.5 to -0.5 Maximum			
MILITARY SPECS.	MIL-E-5400A B MIL-E-5272A			
AMBIENT TEMPERATURE	-55°C to +71°C when mounted to heat sink			
VIBRATION	20G 10 to 2000 CPS			
UNIT DIMENSIONS	L5" D 2 7/8" H 2 13/16"	L8" D 2 7/8" H 2 13/16"	L10" D 4 1/2" H 2 13/16"	
WEIGHT (Approx.)	2 lbs.	3.5 lbs.	5 lbs.	



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CIRCLE 324 ON READER-SERVICE CARD

NEW LITERATURE

Germanium Rectifiers 325

Bulletin GEA-5773C is a 6-page write-up on germanium component rectifiers. It describes fan and blower cooled types, telling when and how each is best used. It also discusses series and parallel operation, and voltage and current ratings. A brief section tells how to order by model number. The folder has graphs, tables, dimensional drawings, and cut-aways. General Electric Co., Schenectady, N.Y.

Conversion Factors 326

A wall chart of conversion factors may be had free. On it are common conversions, and many not so common. The usual changes include: inches to centimeters, watts to horsepower, and cubic feet to liters. Among the rare ones are: atmospheres to kilograms per square centimeter, centimeters per second to miles per hour, microns to meters, and quintal to pounds. Precision equipment Co., 4401 N. Ravenswood Ave., Chicago 40, Ill.

Magnetic Flowmeter 327

This catalog discusses principle and operation of magnetic flowmeters. It gives advantages and specifications of the units. Fischer & Porter Co., 461 Jacksonville Rd., Hatboro, Pa.

Copper Foil 328

Publication D-8 is an 8-page booklet about copper foil and its uses. The text covers three grades of electro-deposited sheet copper. One is for printed circuits, another is for insulating and electrostatic shielding, and the third is for metal laminating. Properties and thicknesses are given for each grade. Photographs illustrate the booklet. The American Brass Co., Copper Foil Dept., Waterbury, Conn.

Potentiometer Catalog 329

This 26-page booklet describes ten potentiometers, both single and multi-turn, with various linearities and dissipations. Specifications and sizes of potentiometers are given. Hardwick, Hindle, Inc., George Rattray & Co. Div., 116-08 Myrtle Ave., Richmond Hill, N.Y.

SAGE

"Silicohm" POWER RESISTORS

NOW AVAILABLE IN 10 STANDARD SIZES

TYPE "S" AXIAL LEAD RESISTORS

	Length	Diam.	Resistance
SS2W	1/2"	X 1/4"	to 1300 ohms.
S2W	5/8"	X 1/4"	to 5000 "
S3W	3/4"	X 1/4"	to 8500 "
SS5W	7/8"	X 5/16"	to 12000 "
SR5W	1"	X 5/16"	to 16000 "
SL5W	1 1/8"	X 5/16"	to 22500 "
SS7W	1 1/4"	X 5/16"	to 28000 "
S7W	1 3/8"	X 5/16"	to 32000 "
SS10W	1 13/16"	X 3/8"	to 53000 "
S10W	1 15/16"	X 3/8"	to 60000 "

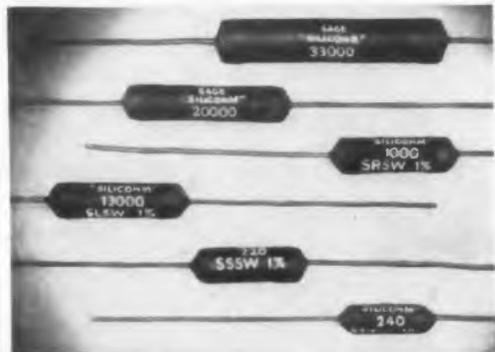
Add these features
at moderate cost:

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ELECTRONICS CORPORATION

309 North Goodman St., Rochester 7, N. Y.

CIRCLE 330 ON READER-SERVICE CARD

Strain Gage Calibrator 331

A 4-page folder describes a universal calibrator for wire strain gages, their transducers and thermocouples. The text covers the features, uses, operation, and specifications of the instrument. Prices are also given. A keyed drawing locates the unit's controls, and captions tell what they are for. Photographs and a schematic provide further illustration. Allegany Instrument Co., Inc., 1091 Wills Mountain, Cumberland, Md.

Technology of Materials 332

Technical information on materials to meet unusual conditions in processing or operation is featured in an 8-page booklet "Advanced Materials Technology." The first issue gives data on a self-bonded KT silicon carbide which provides "high strength" and other outstanding properties up to 4000 F. Thermal shock problems are treated; an improved heating element is discussed and some uses of zirconium are explained. Another feature is a question and answer treatment on ceramic to metal bonds. Carborundum Co., Research & Development Div., Niagara Falls, N.Y.

NPN Silicon Diode 333

A 4-layer npnp silicon diode is discussed in this four-page folder which is now available. Including a brief discussion of the theory and function of the device, the publication shows a series of application diagrams described as indicative of a few of the immediately apparent potentialities. Also included is the characteristic curve of the device in its standard test circuit used at the laboratory, as well as a tabulation of the characteristics displayed under these conditions. Beckman Instruments, Inc., Shockley Semiconductor Lab., Mountain View, Calif.

FHP Geared Motors 334

Form 6 announces ready-made fractional gear reducer motors which rotate clockwise and come in 16 output speeds. The 2-page sheet explains the unit's make-up and features and outlines its specifications. A table lists idling speeds and starting torques next to catalog numbers. Photographs illustrate the motor, and drawings show its dimensions. Merkle-Korff Gear Co., 213 N. Morgan St., Chicago 7, Ill.

**ONE FLICK RESETS this
HIGH SPEED *Electric* COUNTER**

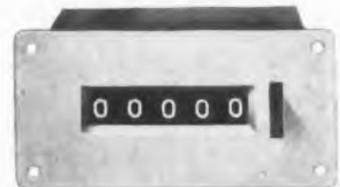
Model "YE" by
DURANT
(Test count-life over 70 million)
Offered in **TWO STYLES:**
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First high-speed electrically actuated counters with added advantage of electric reset. Clean-cut, legible 3/16" figures, white on black. Ideal for all high-speed electric counting applications — accurate at high, low or intermediate speeds.

DURANT MANUFACTURING CO.
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Compact, with great rigidity — entirely enclosed against dust and moisture. Base or panel mount. Speeds to 1500 C.P.M.

PRODUCTIMETERS
SINCE 1879 *Count Everything*

CIRCLE 335 ON READER-SERVICE CARD

DATA TAB

W H E A T

1954	2016	2012	2075	197
SEP	DEC	MAR	MAY	JLY
2171	2195	2113	2185	206
		.12	.84	.6
	2081	2107	217	208
	.82	.06	.72	.8
	2184	2115	21	209
	2181	2106	21	208
	183	6112	1	79
	4	.13		
	3	.14		

This typical application of the Hupp "Data-Tab", lighted by 2,300 G-E 2-pin lamps, posts wheat prices. It can easily be adapted to deliver practically any message—instantly.

WHEAT PRICES, TEAM SCORES OR TRAIN SCHEDULES, G-E 2-PIN LAMPS CAN ANNOUNCE THEM ALL!



Actual size

By arranging more than 2,300 tiny G-E 2-pin lamps in rectangular patterns, or modules, and then flashing combinations of the lamps, Hupp Electronics Company's* new data tabulator can spell out any message—instantly! Designed for push-pull sockets, G-E 2-pin lamps are used because they're so easy to install and maintain. Simplified construction of lamps and socket takes less space.

For many applications, the G-E 2-pin lamp offers special advantages. It weighs about half as much as conventional lamps with the metal base. You get positive electrical contact, and because there's no solder to soften, G-E 2-pin lamps give good performance up to 600°F.

Two-pin lamps "live" longer because there's no glass bead needed to hold the heavy-duty lead-in wires. (This means no resonant frequency differential that helps break filaments in other lamps.) Discover how they can give your products improved design and operation—and more sales appeal. For further information on G-E 2-pin lamps write: General Electric Co., Miniature Lamp Dept. ED-38, Nela Park, Cleveland 12, Ohio.

*713 Circle Avenue, Forest Park, Illinois.

Progress Is Our Most Important Product

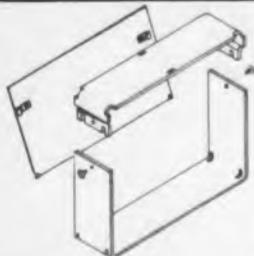
GENERAL  ELECTRIC

CIRCLE 336 ON READER-SERVICE CARD

Vector

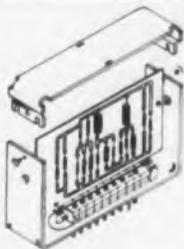
Frame Loc Cases

NEW



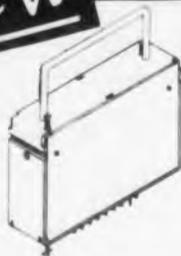
A HANDSOME CASE FOR PLUG-INS WITH UNIQUE SNAP-OUT SIDE PANELS

Two piece aluminum frame fastened with only two screws. Side panels snap into frame and brace it. Many stock sizes available. Also made to desired size for production orders.



HOLDS COMPACT CIRCUITRY WITH MAXIMUM ACCESSIBILITY

Vector Terminal Structures, or Printed Circuits mount neatly. Ideal for Transistor assemblies as well as tube circuits. Pre-punched board, ZIP terminals, Transistor clips and unique Vector hardware answer every need.



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Introduces!

"Custom-Made"
MOLDED
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ASSEMBLIES

MOLDED-ON PLUGS

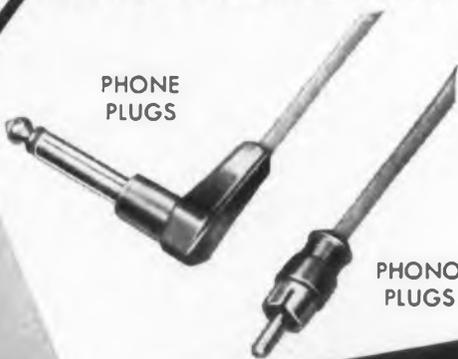
Completely
Electrically Shielded

Ask to see these
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new components at the

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Innumerable Terminations

EQUIPMENT MANUFACTURERS —

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SWITCHCRAFT

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Chicago 22, Ill.

Canadian Rep: Atlas Radio Corp., Ltd., 50 WIngold Ave., Toronto, Canada.

CIRCLE 338 ON READER-SERVICE CARD

NEW LITERATURE

Instrumentation Cables 339

Multiconductor instrumentation cables are the topic of Bulletin RCD-400. Described with pictures are cables for telemetering, data recording, circuit control testing, and electronic computers. The 8-page booklet discusses insulating and jacketing materials, color coding, and military specifications. Data on stock types are listed in tables. The pamphlet is punched to fit a notebook. Rome Cable Corp., Rome, N.Y.

Spring Materials 340

This 8-page bulletin explains the mechanical and metallurgical changes which take place in materials at elevated temperatures, the setting or relaxation of the spring, and loss of spring rate. The bulletin also presents some available solutions to these problems by proper selection of materials, choice of design stresses, and the use of certain manufacturing processes. Associated Spring Corp., Bristol, Conn.

Interval, Frequency Meter 341

Detailed specifications for a time interval and frequency meter are compiled in a 1-page leaflet. Performance and construction data are also given. A photograph illustrates the unit. Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.

Mobile Radio Equipment 342

Catalog 457 covers two-way mobile radio antennas, accessories, and towers. It gives a full page to the description, specifications, and illustration of each unit. Both base station and vehicular antennas are shown. Among other accessories, the 40-page booklet lists clamps, cable connectors, and sundry mounts. Communication Products Co., Inc., 2-Way Mobile Radio Div., Marlboro, N.J.

Transducer Calibrating 343

A unitized sub-miniature system is illustrated and described in Bulletin BBU. Complete specifications and additional information are given on both Models 6-104 and 50-B. B & F Instruments, Inc., 4732 North Broad St., Philadelphia 41, Pa.

Machlett ML-6908

A New High Power Rectifier Tube For Radar Installations



Machlett Laboratories, Inc., offers the designer a new high power rectifier tube, ML-6908. An oil-immersed high-vacuum rectifier tube capable of passing 10 amperes peak anode current, the ML-6908 is particularly suitable for high power radar installations. The tube is adaptable to certain pulsing circuits as a hold-off diode and to power

supplies where insensitivity to low ambient temperatures as well as high current at high power are necessities. The ML-6908 incorporates a thoriated-tungsten filament of catenary design which permits both high peak inverse voltage and low internal voltage drop. A heavy wall copper anode protects the tube against overload.

General Specifications: Filament: 12v, 23a; Max. Voltage Drop 2400v at 10 amps. peak; Peak Inverse Anode Voltage, 150,000v; Peak Anode Current, 10a; Anode Dissipation, 200w.

Average D-C Load Current: 3-phase double-Y parallel, filtered, choke input: 9.0 amps. 3-phase, full-wave, choke input; 4.5 amps.

Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Connecticut

CIRCLE 344 ON READER-SERVICE CARD

Footswitch

345

The "Nautilus" waterproof footswitch is described in a 2-page bulletin. The bulletin indicates it has a rugged aluminum casting for long life and a piston type actuator sealed with an "O" ring. Linemaster Switch Corp., 130 Putnam Rd., Woodstock, Conn.

Precision Gears

346

A 64-page supplement lists over 2,000 additional precision instrument components. It includes such items as 24 to 200 pitch spur gears, Precision II stock gears, anti-backlash gears and couplings. PIC Design Corp., Sub. Benrus Watch Co., Inc., 477 Atlantic Ave., E. Rockaway, N.Y.

Transistor Data Chart

347

Complete, up-to-date technical information is included in the four-page transistor data chart, just released. The brochure features specifications and application data for almost 500 transistors and shows over 170 types introduced during recent months. Kahle Engineering Co., 1313 Seventh St., N. Bergen, N.J.

Mobile Radio

348

Two-way mobile radio equipment is described in a 38-page brochure. The booklet shows the wide range of equipment designed to fit individual needs based on present FCC rulings. It also tells how today's units are being engineered, taking into consideration such factors as FCC policies.

Included in the booklet are sections on "What's inside the case," frequency, bandwidth, voltage, and descriptions of cases, cabinets and mountings. General Electric Co., Communications Products Dept., Electronics Park, Syracuse, N.Y.

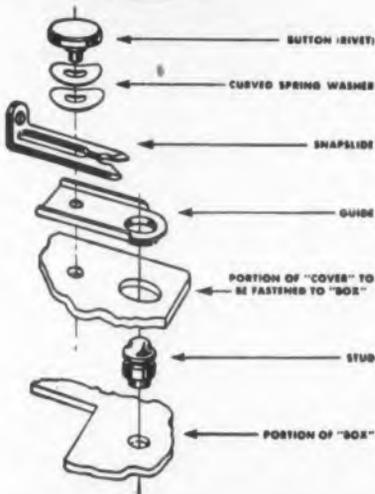
Etched Parts

349

Photo-formed parts and two ways to etch them are the topics of Bulletin 90. Step by step, the 8-page booklet explains chemical and electrolytic etching, and cites the advantages of each process. It tells what materials can be etched, and to what extent the etching process limits raw material, pattern, and tolerance. The booklet also lists diverse uses for etched parts. Superior Tube Co., Photo-Forming Dept., Norristown, Pa.



How can YOU use this simple, rugged SNAPSLIDE FASTENER?



This positive, quick-action fastener was originally developed to hold airborne equipment with security—even under severe stress and shock of carrier-based aircraft operations—and yet permit equipment replacement in a matter of seconds.

A wide variety of industrial uses has been found for the fastener. Perhaps you can use it profitably. It requires no tools; thumb and finger fasten and release. Even with repeated use no adjustments are necessary. Available in two sizes, with parts to match different thicknesses of mounting plates.

Write for details.

Dependable Airborne Electronic Equipment Since 1928

AIRCRAFT RADIO CORPORATION
BOONTON, NEW JERSEY



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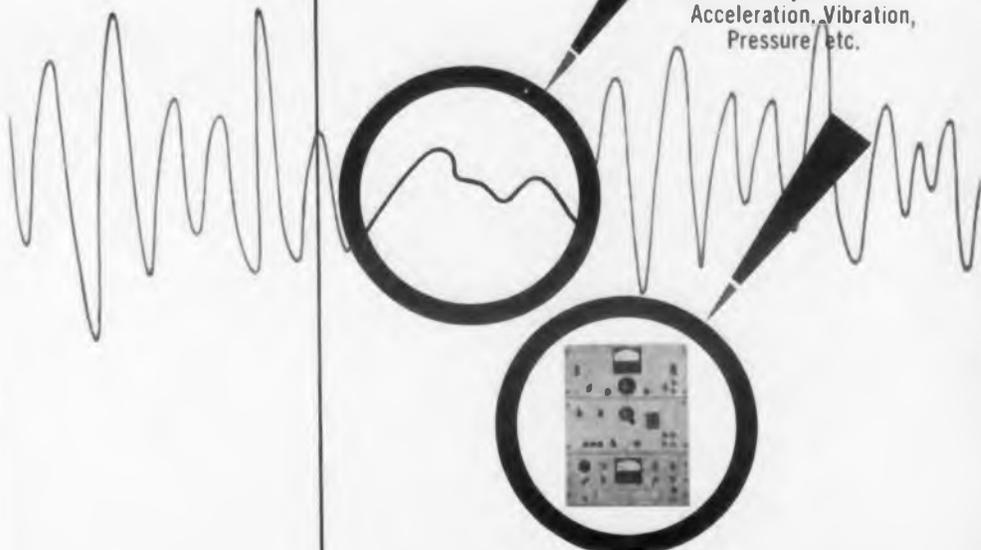
POWER SPECTRAL DENSITY ANALYSIS OF RANDOM WAVES

PROVIDED BY

TP-625 WAVE ANALYZER SYSTEM
WITH POWER INTEGRATOR

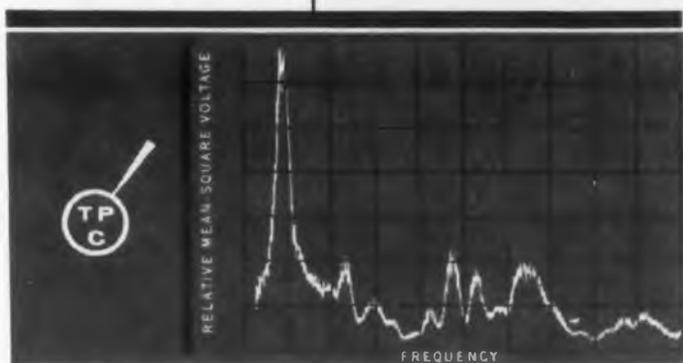
An Important Design

and Environmental Testing
Tool for Analysis of
Acceleration, Vibration,
Pressure, etc.



Integrity in instruments for over a quarter-century assures reliability of the TP-625 Wave Analyzer System. It provides accurate, practical, economical solutions to problems in a wide range of applications. It determines frequency and amplitude of components in a complex wave ranging from 2 to 25,000 cycles. And, with the TP-633 Power Integrator, it produces a direct current analog output proportional to power spectral density. Analog can be made proportional to peak level, average value, mean square value, as well as continuous time integral—linear or square—of the voltages in a narrow frequency band.

TRACKS AUTOMATICALLY: Other auxiliary equipment includes Servo Drive that allows automatic tracking to frequency set by speed of equipment being analyzed.



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6000 cps

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a high force vibration exciter system**



With new 6000 cps rating, the MB Model C10VB electrodynamic exciter further extends the complex motion testing range . . . yet delivers 1750 pounds force for sinusoidal testing with an MB Model T666 15 KVA amplifier (36,000 watt plate dissipation).

This is versatile equipment. With an MB T666 amplifier and TEMC control cabinet, it has the "muscle" to subject electronic products and other critical components to accelerations up to 58 "g". Adding an MB T88 Complex Motion Console equips it for duplicating the actual "noise" or random motion of the environment. This system is designed with an eye to future needs.

What's more, the exciter works in environmental test chambers,

so that vibration can be combined with heat, cold, altitude. This not only saves test time, but gives more realistic data on performance as well.

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CIRCLE 352 ON READER-SERVICE CARD

NEW LITERATURE

Terms for Switches 353

Standard definitions for snap-acting switches are fully-illustrated in a folder now available. An exploded view of a typical switch on the cover clearly identifies the basic parts and general construction of snap-action switches. The inside pages show the snap-action mechanism to illustrate definitions. Four carefully-executed drawings, show an entire operating cycle and visually point-up the definitions given in the text. Hetherington, Inc., Delmar Drive, Folcroft, Pa.

High Temperature Switch 354

This data sheet describes a switch which has a very high electrical rating for its size and is designed for use at 600 F. The case, cover, and plunger are molded of a special type of glass-bonded synthetic mica. A photograph and dimension drawing of the switch are included and operating characteristics, electrical data, and prices are covered. Minneapolis-Honeywell Regulator Co., Micro-Switch Div., Freeport, Ill.

P C Design Guide 355

Technical Bulletin P-9b on standard printed circuit tolerances is now available. The Bulletin contains clearly defined guides for design engineers and layout draftsmen in the preparation of original circuit designs. Photocircuits Corp., Glen Cove, N.Y.

Laminated Plastics 356

A 20-page bulletin provides a full description of the manufacture, application, and various forms of Lamicoid laminated plastics. Fold-outs list the various grades of the material and include specifications, physical and electrical characteristics, and sizes. Mica Insulator Co., Schenectady 1, N.Y.

Wire Processing 357

A four-page bulletin is available describing this company's facilities for wire processing. The processed wires described include plated, etched, or enameled types, as well as anodized aluminum. Sigmund Cohn Corp., 121 S. Columbus Ave., Mt. Vernon, N. Y.

Where You Use

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Hook-Up Wire (Type E and EE)—AWG 10 through 32 per MIL-W-16878B. Extruded or fused wrapped. Striped and solid colors.

Lead Wire—AWG 32 and larger. "Teflon" insulation, outer jacket glass fiber braid w/"Teflon" impregnate.

Miniature Cable—AWG 10 through 32. Extruded or fused wrapped primary insulation. "Teflon", Nylon, Glass or Vinyl jacket.

Multi-Conductor Cable—AWG 10 through 32. "Teflon", Nylon, Glass, or Vinyl jacket, optional.

Air Frame Wire—AWG 10 through 32 per MIL-W-7139A. Striped and solid colors.

Miniature Coaxial Cable—AWG 22 through 32. Insulation thickness .004" to .007" for 300V service. Striped and solid colors.

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900 Greenbank Road
Wilmington, Delaware

Synchronous Motors 359

Complete technical, operational, and design data on the permanent magnet synchronous motor are given in Bulletin No. PB117. Detailed specifications on all five types are included in addition to material and construction information. Cramer Controls Corp., Centerbrook, Conn.

1958 TV Manual 360

A four-page brochure describing and explaining the advantages of using manuals in service work is now available. Description is also given of earlier television volumes as well as seventeen radio service manuals. Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.

Relays and Contactors 361

DC contactors and relays are described in a 32 page catalog, GEA-6621. Extensive selection and application data are provided, including ordering instructions, full product descriptions, photographs of representative units, and pertinent technical data. General Electric Co., Schenectady 5, N.Y.

Microwave Components 362

Available is a catalog of waveguide and coaxial components. Featured are wideband coaxial terminations for all standard lines in current use. Radar Design Corp., 2360 James St., Syracuse, N.Y.

Color-Matching Plastics 363

A 20-page brochure tells about a service for color-matching plastics to other materials. Liberally illustrated with 4-color photographs, the text shows how matches are made from existing samples or new formulations. It discusses research work being done to improve the life and weather resistance of color in plastics. Concentrates for coloring polyethylene are described. Eastman Chemical Products, Inc., Kingsport, Tenn.

How to Ruin Transistors 364

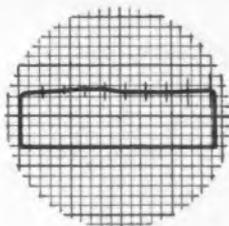
Information on how NOT to use transistors is contained in a new type of "how to do it" booklet. A dozen ridiculous cartoons can help rush you through the coffee break. General Transistor Corp., 91-27 138th Place, Jamaica, N.Y.

Telonic

Specializing in Sweep
and Marker Generator
Equipment

SWEEP GENERATORS

ULTRA WIDE RANGE
For Rapid Engineering, Alignment, Testing
of RF Circuitry



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At Full Sweep Width
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**1 to 200 mc
IN ONE SWEEP!**

Flat output over 0.5v
p. to p. into 50 ohm
load!

THE TELONIC H-2 and H-3 achieve very wide sweep widths by heterodyning TWO SWEEP OSCILLATORS. Since they are sweeping 180° out of phase with each other, the sweep widths are additive. The output leveling circuit maintains a flat output over the entire range. Tuning one oscillator tunes the center frequency of the heterodyne output, and varying the drive voltage of both wobblers varies the sweep width.

These unique instruments are very useful in the designing and testing of broad-band video, IF, and RF amplifiers, filters, impedance matching devices, etc.

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BEECH GROVE, INDIANA

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H-2



H-3

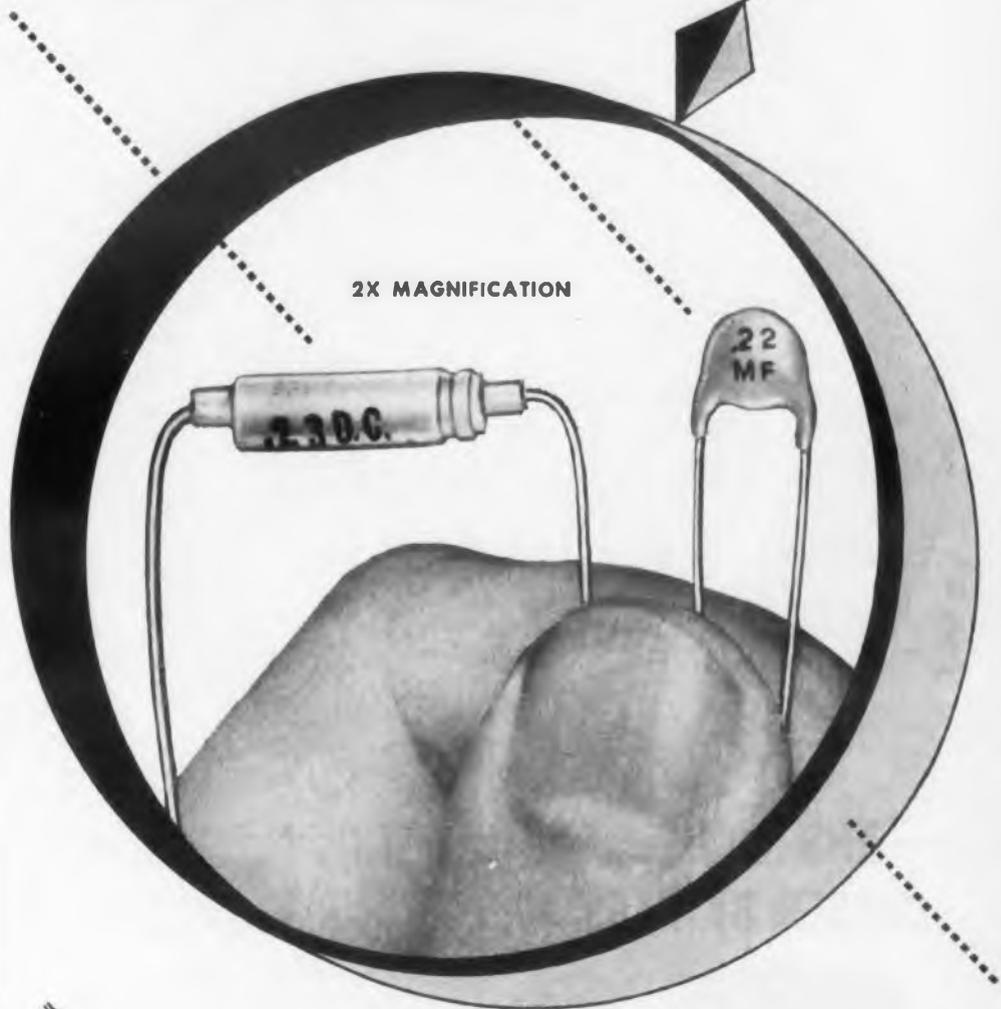
SPECIFICATIONS

Model	H-2	H-3
Center freq'cy	1 — 200 Mc.	
Sweep width	1 — 200 Mc.	
Sweep Range	1 — 300 M.C	
Output into 50Ω	.4V P. to P.	.5V P. to P.
Flatness at max. sweep	15% to 150 Mc. 20% to 300 Mc.	10% to 150 Mc. 15% to 300 Mc.
Attenuation	Toggle switch 0, 10, 20, 30, 40, 20, 20, 10, 6, 3 db. plus vernier attenuation of 0-10 db.	Turret-type attenuator plus vernier attenuation 0-10 db.
Display linearity	Better than 1:2:1	
Leakage	Below 10 μv volts	
Marker System	Birdy by-pass type external marker input	
Style	Portable	Bench
	6 plug-in crystal markers	
	Zero base line and horizontal sweep voltage	

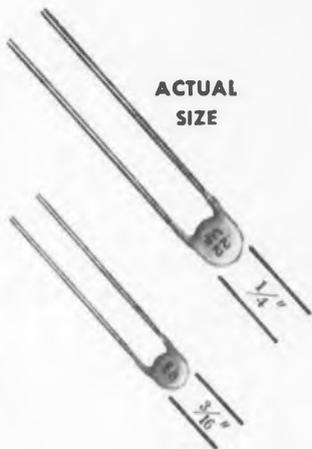
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.10 mfd	$\frac{3}{16}$ " diameter
.22 mfd	$\frac{1}{4}$ " diameter
.47 mfd	$\frac{3}{8}$ " diameter
1.0 mfd	$\frac{9}{16}$ " diameter
2.2 mfd	$\frac{3}{4}$ " diameter

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**PREVENT
COSTLY
"BIG TUBE"
FAILURES**

**— AND EQUIPMENT "DOWN TIME" LOSSES
CAUSED BY HEAT, SHOCK AND VIBRATION!**



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The most complete electron tube heat-dissipation information is yours for the asking! Technical data comprised of IERC and independent laboratory test reports will be sent upon request on your company letterhead.

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When shapes are too complex to machine or cast . . . when thin walls and super-fine internal finishes are vital . . . BART Electroforming is often the answer. And no other process approaches it for maintaining identical dimensions throughout mass production runs.

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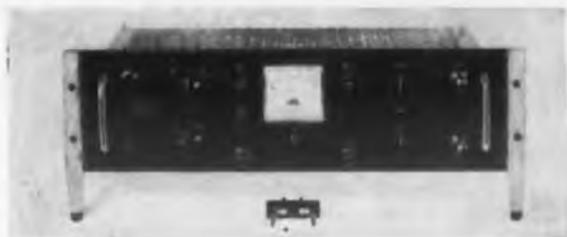
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2 NEW INSTRUMENTS by TECHNITROL

THE DYNAMIC DIODE TESTER



An invaluable means for the rapid, accurate checking of semiconductor diodes for irregularities. The dynamic curve, more revealing than static testing, is quickly apparent on the screen, and is readily adapted to volume testing. And the easy portability of this 16-pound instrument makes it ideal for field work as well as for bench or rack installation.

Designed for use with the Cathode Ray Indicator, this moderate-price instrument provides for a variety of back and forward voltages, as well as independently-controlled ranges for back and forward currents.

THE CATHODE RAY INDICATOR



Send for Bulletin 1002

Provides a visual indicating device for the dynamic display of electrical signals and is intended primarily as an output indicating device for such instruments as the Dynamic Diode Tester and transistor curve tracers.

Also makes an ideal display unit for analog computer and other applications where the repetitive cycle rate of display is consistent with screen persistences of available five-inch cathode ray tubes.

High-quality components assure a stable instrument which provides a very sharp focused beam on the face of the tube.

Designed for standard 19" relay rack mounting or with separate mounting legs at additional cost.

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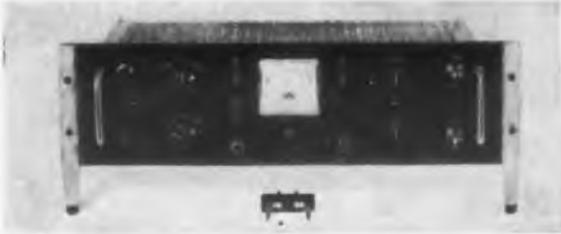
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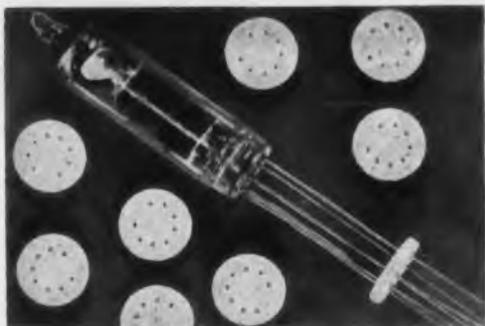
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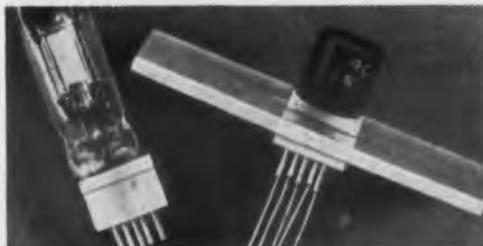
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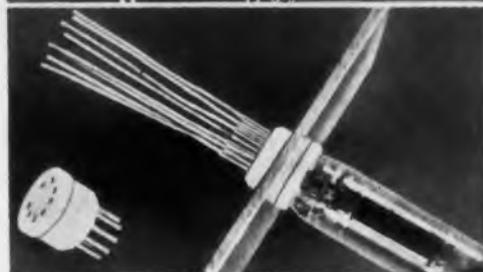
CIRCLE 383 ON READER-SERVICE CARD



TUBE LEAD INSULATORS



COMPRESSION MOUNTED SOCKETS FOR TRANSISTORS & SUBMINIATURE TUBES



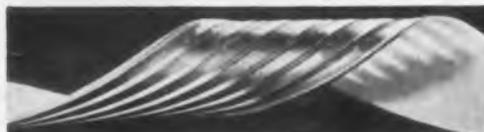
TEFLON SPAGHETTI TUBING



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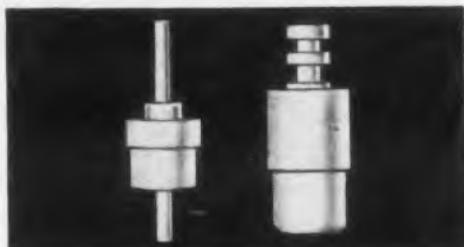
THE QUALITY LINE OF TEFLON* INSULATED COMPONENTS

High reliability factor—
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TRIMMERS

Write for Catalog No. EC-757

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Camden 1, N. J.

Fluorocarbon Products Inc.

CIRCLE 384 ON READER-SERVICE CARD

NEW LITERATURE

Circuit Analyzer 385

This 22 page, two color catalog describes, in detail, the operation of circuit analyzers, designed to expedite the testing of complex, multiple circuitry in the aircraft, missile, electronic and related fields. The text includes instructions, applications and specifications for each circuit analyzer. Comprehensive illustrations, diagrams and charts highlight important operational features. One section is devoted to a description of test consulting services. Dit-Mco, Inc., 911 Broadway, Kansas City, Mo.

RF Suppression Filters 386

Specifically designed for shielded enclosures and individual applications, this catalog presents a listing of the rf suppression filters. It includes both high power and low power suppression filters for use in single, dual and 3 wire circuits. The catalog gives the complete physical and electrical characteristics. Axel Bros., Inc., Electronics Div., 134-20 Jamaica Ave., Jamaica 18, N.Y.

Electric Brakes 387

A technical report of over 40 pages with numerous illustrations describes the advantages and construction of the company's power-safe electric brakes. The brakes have replaceable facings and are of the released-when-energized type. Warner Electric Brake & Clutch Co., Beloit, Wisconsin.

Compressed Air Dryers 388

The 12-page bulletin describes models of heatless, self-activating, zero-dew-point dryers designed to prevent moisture fouling. Containing graphs and drawings, the bulletin gives operating capacities, dimensional data, standard specifications and installation information on the dryers. Van Products Co., 5825 Swanville Rd., Erie, Pa.

Facilities Brochure 389

Detailed facts and figures on "Engineering and Production Capabilities" are provided in this 12-page, 40 photograph brochure. Lear Inc., 3171 So. Bundy, Santa Monica, Calif.

NEW E-T-A OVERCURRENT CIRCUIT BREAKERS

**Unique tripping
characteristic assures full
. . . positive protection!**

- Flexible in application. Dependable performance.
- Available in current ratings of 50ma. -80ma. -100ma. up to 25 ampere
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PRODUCTS CO. OF AMERICA

5058 N. Elston Ave., Chicago 30, Ill. KI 5-1554

E-T-A Products Co. of Canada, 265 Craig St. W., Montreal 1, Que. UN 1-5998

CIRCLE 390 ON READER-SERVICE CARD

Titanium Strip 391

The physical and chemical characteristics of Titanium strip are covered in a data sheet, now available. It was prepared to meet the increasing demand for information on this subject. The data sheet gives details on ultra-thin and the extremely close tolerance Titanium in the aircraft, instrumentation, and chemical industries. American Silver Co., 36-07 Prince St., Flushing 54, N.Y.

Modular Enclosure System 392

A line of vertical cabinets which provide up to 200 per cent more load carrying capacity, is featured in this 36-page catalog. Also included are a number of other basic products and component parts produced by the company. Elgin Metalformers Corp., 630 Congdon Ave., Elgin, Ill.

Copper Plating Process 393

An acid copper plating process is described in a 3-page technical paper. In addition to the various features and advantages of the process, the literature

also covers such topics as preparation and maintenance of copper sulphate and copper fluoroborate baths, recommended temperatures, current densities and agitation. Sel-Rex Corp., Nutley, N.J.

Current Governors 394

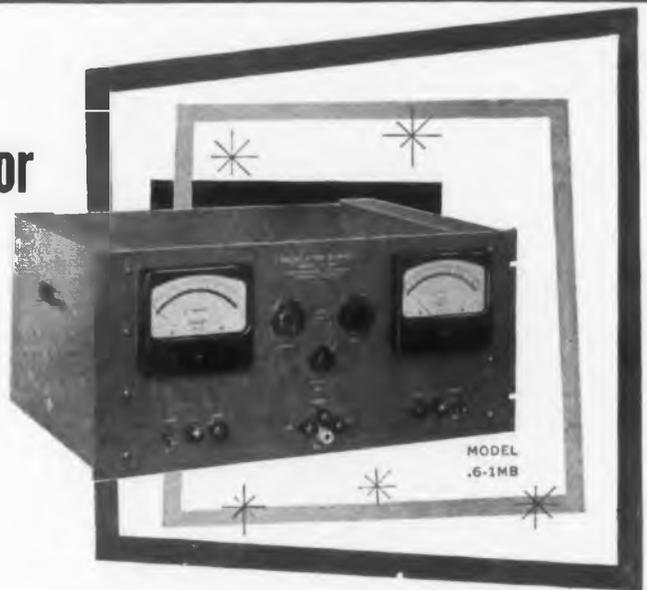
Current governors for constant current from 1 ma to 30 amps are described in Bulletin No. 957. It indicates that each of them is a two terminal current stabilizer, modulator and dynamic electronic load. The bulletin shows primary uses in production testing and laboratory operation of various current sensitive devices. North Hills Electric Co., Inc., 402 Sagamore Ave., Mineola, N.Y.

Project Summaries 395

An 8-page booklet, entitled "Technical Project Summaries" describes twenty-four military and industrial electronics projects. The booklet is intended to highlight the development capabilities of Pickard and Burns, Inc., 240 Highland Ave., Needham 94, Mass.

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New Dressen-Barnes quality units designed for the numerous applications requiring tight regulation and low ripple. These low-voltage, high-current models require NO DERATING of output current, or regulation and ripple specifications, from 1 to 60 VDC. Bench or Rack mounting. Meters accurate to 1%.

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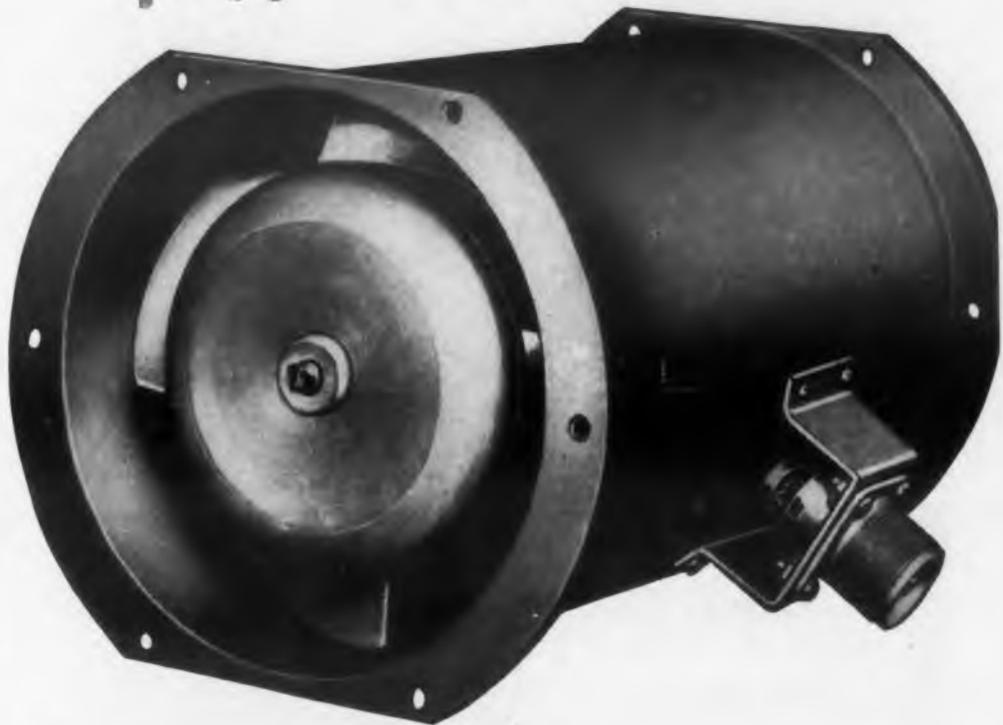
DRESSEN-BARNES CORP. • 250 North Vinedo Avenue, Pasadena, Calif.

CIRCLE 396 ON READER-SERVICE CARD

ENGINEERS!

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IT IS USED FOR VENTILATION . . . de-fogging . . . de-icing . . . cooling electronics . . . it is used on aircraft, in electronic equipment and on missiles.

IT IS LIGHT . . . fans weigh from 10 ounces to 50 pounds . . . made of magnesium and aluminum alloys.

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IT IS USED BY THESE COMPANIES . . . Boeing, Douglas, Fairchild, GE, Grumman, Hallicrafters, Lear, Lockheed, Martin, Motorola, North American, RCA, Raytheon, Sylvania, Vertol, Western Electric, Westinghouse.

IT IS MADE BY JOY MANUFACTURING COMPANY, Oliver Building, Pittsburgh 22, Pa.

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CIRCLE 397 ON READER-SERVICE CARD

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SERIES W



General Purpose Relays

MEASURE ONLY: 1½" x 1½" x 1⅞"

BUT CARRY: to 25 A. resistive at 115-230 V., A. C.; 1 h.p., 125 V., 2 h.p., 250 V., A. C.; D. C. and other higher ratings on request.

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MOUNTINGS: Socket, panel and sidewall arrangements standard; others to meet special needs.

"Diamond H" engineers are prepared to work out variations of these rugged, dependable relays to meet your specific requirements in such applications as automation controls, appliances and air conditioning equipment, or what you will. Just ask.

THE

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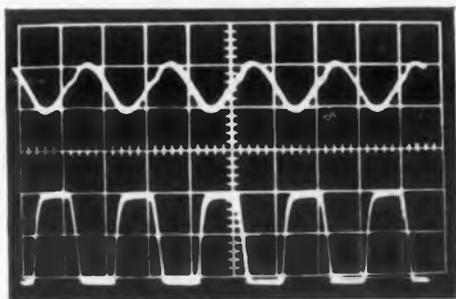
Square-Wave Adapter for Sine-Wave Oscillator

A SQUARE wave with a sharp rise time and a somewhat greater voltage output than obtainable with standard laboratory oscillators (such as the H.P. 200 C), is often needed to drive a low impedance load.

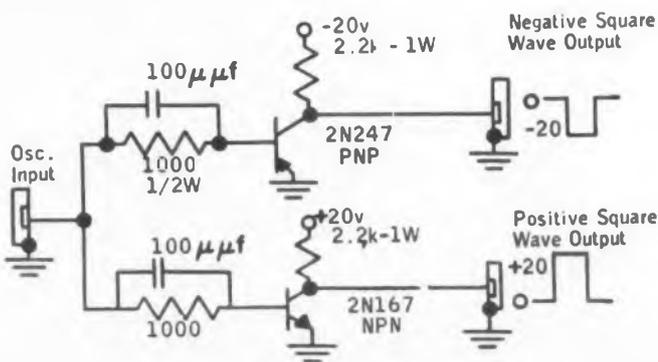
A transistor emitter follower of the design shown can be used after the standard oscillator. It has the characteristics of high input impedance and is capable of driving a low output impedance. Since a low input signal will drive it from cut-off to saturation, this device makes an excellent clipper. By using a pnp and a npn transistor, either positive or negative square waves of amplitude equal to the supply voltage may be obtained. Transistors with high alpha cutoffs should be used. A GE 2N167 npn and an RCA 2N247 pnp drift transistor work very well. The photographs show the 100 kc 6v pp sine wave into the clipper and the 20 v output negative-going square wave. The rise time of the square wave is about 0.5 msec. The fall time is about 1 msec at 100 kc.

The circuit was built in a small box, and batteries were used to power the transistor. The box was plugged onto the oscillator output terminals, and the circuit was energized when square waves were needed.

Thomas F. Prosser, Senior Electronics Engineer, Marchant Calculators, Inc., Dept. ED, Oakland, Calif.



Input shown above, output below.





BACKGROUND OF QUALITY



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For when it comes to Roebing Magnet Wire, *quality* means—unsurpassed ingredients of consistent excellence... wire-making skill based on decades of experience... and exacting testing and inspection.

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General Ceramics ferrites for television, radio and instrumentation offer designers and engineers a wide range of economical standard components. All are application tested for highest efficiency electrically and mechanically. The fact that leading electronic manufacturers specify Ferramics is due to the program of continuing research and equipment modernization by which General Ceramics keeps pace with the industry's needs as to quality *and costs!* Bulletins are available; write to General Ceramics Corporation, Keasbey, New Jersey, Dept. ED.

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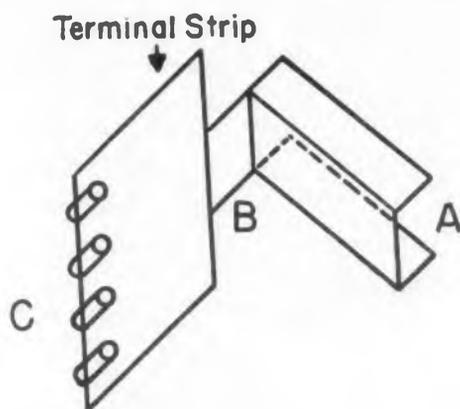
Get \$10.00 plus a by-line for the time it takes you to jot down your clever design idea. Payment is made when the idea is accepted for publication. Full information and an "entry blank" can be obtained by circling #166 on the Reader's Service Card.

New Terminal Strip Design for Toroids Reduces Scrap

IN WINDING magnetic cores for servo systems it becomes necessary to wrap many thousands of turns of small mil wire around small cores. This increases the possibility of breaking leads when soldering and unsoldering connections. The wire is very brittle from #AWG 30 on up and is apt to waste manufacturing time spent in the winding of a core.

The solution to the problem is to use a simple type of terminal strip which is held on by the wire wrapped around the core itself. All connections made within the core are made at this terminal strip; and all connections made outside of the core are made on this strip also. Thus, once a core has been wound, there is no stress or strain on the internal wiring with subsequent broken leads.

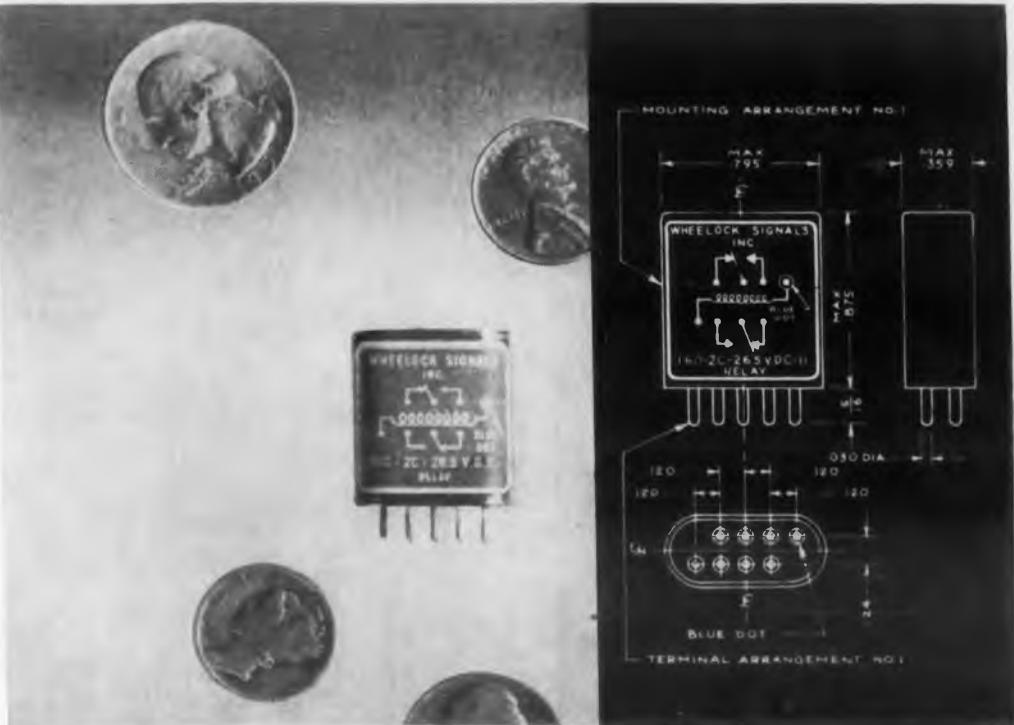
Ralph S. Gootner, System Field Engineer, International Business Machines, Lexington, Mass.



A. This part of the terminal strip is fitted over the core prior to the winding. The windings will act as mechanical security for the strip.

B. When a core is completed, the fold is made at this point leaving the darkened portion for the thickness of the windings. The lugs are folded back over the windings, with the overall result of permanent terminals for use and very little additional space required. The fold can be held down by a strip of tape running across the board and then through the core center.

C. As many lugs as needed to accommodate the core.



Wheelock SIGNALS CRYSTAL CASE RELAYS
resist

high temperatures . . . up to 125° C
and excessive vibrations . . . 2000 cps at 20 g

These new Wheelock Crystal Case relays will solve all your space problems! Wheelock engineers designed these precision-made relays smaller than small . . . about the size of a quarter . . . lighter than lightweight . . . approximately .35 oz. . . and sensitive enough for milli-second operation, yet so rugged to withstand rigid military environmental specifications.

For consistent reliability, extended life and never-failing performance, specify Wheelock Crystal Case relays for your electronic applications. Wheelock will help you solve your relay problems . . . they will gladly recommend the relay to suit your needs.

Write for additional details and literature.

consistently high reliability
inherent in design and
performance

SPECIFICATIONS

- TEMPERATURE -65° to 125° C
- DIELECTRIC 1000 VRMS; 750 VRMS across contact gaps
- INSULATION RESISTANCE 10,000 megohms at 25° C; 100 megohms at 125° C
- CONTACT ARRANGEMENT SPDT—2PDT
- CONTACT RATING 2 amps resistive at 28 VDC or 115 VAC
- CONTACT LIFE 100,000 operations
- CONTACT RESISTANCE05 ohms
- SHOCK JAN-S-44 Test in excess of 100 g all planes
— no opening
- VIBRATION 10-55 cps at 1/4" excursion and 0-2000 cps
at 20 g acceleration
- ENCLOSURE Hermetically sealed dry nitrogen filled
- TERMINAL & MOUNTING Mounting arrangements to your specs
- PICKUP TIME5 milliseconds approx.
- DROP-OUT TIME 1.45 milliseconds approx.
- WEIGHT35 oz.
- COIL POWER350 milliwatts
- COIL RESISTANCE up to 6000 ohms
- SIZE359 in. x .797 in. x .875 in.

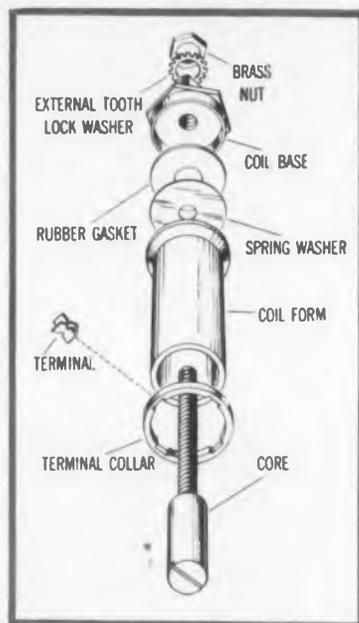
Wheelock

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UNIVERSAL CERAMIC COIL FORMS FOR MILITARY AND COMMERCIAL APPLICATIONS



National Company, one of the nation's oldest suppliers of quality coils and coil forms, now introduces, for immediate delivery, a new line of ceramic coil forms, engineered to meet the most rigid military and commercial applications.

Available in 5 standard sizes, with or without terminal collars. Terminal collars accept up to four terminals per collar.

Internal, pre-set torque spring provides smooth, vibration-proof means of positioning and locking the adjusting cores. Keep coils tuned as set, even under severe vibration and shock.

Powdered iron cores available in choices of standard and long-core lengths. Color-coded to indicate optimum frequency ranges.

All material used are in accordance with applicable MIL-Specs.

Coil forms, collars, and terminals available at your National Parts Distributor. Coil forms supplied with spring washer, rubber gasket, coil base, external tooth lock washer and brass nut. Cores may be ordered from National Company. Pre-assembled forms to your prints quoted by National Company upon request.

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Since 1914 **National** COMPANY, INC., MALDEN 48, MASS.

CIRCLE 22 ON READER-SERVICE CARD

IDEAS FOR DESIGN



These Parts Were Cold Headed

These cold-headed members of the nail family include items having both "heads" and "collars." Among the items having heads are standard nails, identification nails having letters formed in their heads, hobby-size railroad spike (top left), nails made from square and rectangular wire stock, nails having special points (needle point, top right for example), and nails having special purpose heads (cupped head, for example). Among the items having collars is a stud-gun nail (center—flat piece above collar bends over), electronic wiring post which is driven into harness board up to collar (long item near bottom), peg for toy top (top left), and nails to which components are secured by riveting the section of shank above the collar. Also included are several items made on nail machines and given secondary operations. Threaded nails and ski-pole point (right) are in this category. Parts shown are made from steel, copper and copper alloys, and aluminum. Note also the wide range of sizes represented.

Process Described

In making parts on nail machines, reel-mounted wire stock feeds into a cylindrical opening formed by semi-cylindrical grooves in mating die blocks. The wire comes to rest with the leading end projecting beyond the ends of these gripping dies. The dies close, clamping the wire, and a heading punch strikes the protruding end, forcing the metal into the desired head shape. The punch retracts, the gripping dies open, and the wire moves forward and is pinched off. The dies close again, the forming punch strikes, and the cycle repeats. The point of the nail is formed in the cut-off operation. The

ELECTRONIC DESIGN • March 5, 1958

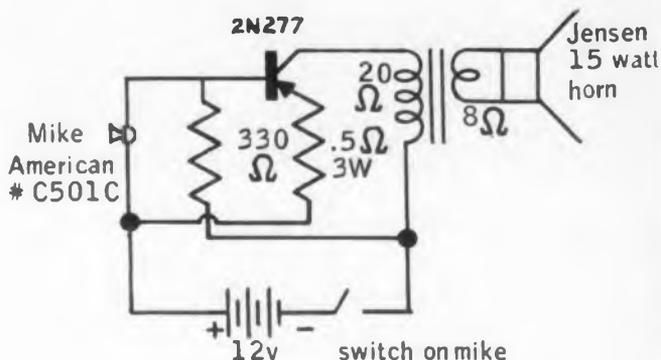
process takes place very rapidly and hundreds of parts can be produced per minute.

In this manner heads and collars of thousands of sizes and shapes can be formed on a wide variety of metals to close commercial tolerances. Secondary operations, such as roll threading, machining and plating can adapt the nail-machine product for many made-to-order applications.

The ingenuity of the designer is required in recognizing parts which should be specified for cold heading. The manufacturer will work out the details of production and will often make helpful suggestions which will lower costs and/or improve the product.

John Hassall, Inc., Westbury, N.Y.

Simplified Public Address System



During the course of designing a portable public address system various circuits were tried and discarded because of relative complexity. What was needed was a battery operated, transistorized, 3 to 5 w unit. The circuit shown indicates how this unit was simplified without sacrificing performance.

A single 2N277 pnp power transistor is driven directly by a single-button carbon microphone which has a nominal dc resistance of 100 ohms. The microphone is used as a part of the base bias voltage divider as well as the source of audio voltage to drive the power transistor. A small resistor is used in series with the emitter to prevent runaway. The output transformer is wound on 3/8 x 3/8 stack, 20 ohms Z to 8 ohms Z, with a primary dc resistance of approximately 1 ohm. Were a speaker available with an impedance of 16 ohms and a dc resistance of less than 1-1/2 ohms, the output transformer would not be needed. The circuit is self-contained and is powered by a pair of 6 v lantern batteries in series, but could easily be used in an automobile with the storage battery as a source of power. Power output is 5 w maximum with dry battery power supply.

J. Frank Brumbaugh, Marine Project Engineer, Heath Co., Benton Harbor, Mich.



Readin',



Synthane plastic laminated bushings and breaker arms for automotive ignition.



'Ritin', and Reliability

Dependable operation of a school bus, a truck, or your own car involves the functioning of many parts. One breakdown can wipe out the memory of ten thousand trouble-free miles.

Some of these parts are made of laminated plastics. They're usually unseen, unsung, small in size yet efficiently performing their job.

Their cost is relatively insignificant when compared with the cost of equipment in which they work, but it should be sufficient to insure dependability.

Actually, what you pay for Synthane laminated plastics is little or no more than you'd pay for any

other plastic laminate. But the Synthane price includes top quality materials, product control, excellent facilities and workmanship, an assurance of continuous supply, and a long reputation for fair dealing.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative nearest you.

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New York Coliseum—March 24-27, 1958

NO MORE EXTERNAL BOOSTER AMPLIFIERS



with the new combination resolver-booster by *Reeves* INSTRUMENT CORPORATION

specifications

Transformation ratio: $1.000 \pm .001$
Phase shift: $0^\circ \pm 3'$
Functional accuracy: 0.1%
Input impedance: over 8 megohms
Frequency: 400 c.p.s. $\pm 5\%$
Max. amplitude: 14 V. r.m.s.
Temp. range: $-55^\circ \text{C. to } 80^\circ \text{C.}$
Power requirements:
30 V. d.c. @ 6 ma. per amplifier

An outstanding advance in MINIATURIZATION without sacrifice of performance or precision.

Shown FULL SIZE in the illustration above, this latest Reeves achievement in miniaturization for airborne applications takes up a fraction of the space occupied by a conventional resolver with external boosters. Yet performance, accuracy and dependability are in every way equivalent or better.

The new Reeves Combination Resolver-Booster consists of the time-proven R151 Precision Resolver with two PLUG-IN TRANSISTORIZED BOOSTER AMPLIFIERS built onto it as shown. The amplifiers provide standardization for transformation ratio and phase shift over a wide range of temperatures. Specifications given are maintained for production units without culling. Additional data on request.

REEVES CONTINUOUS RESOLVER CHECKER



Provides continuous 360° check on resolver functional accuracy, and yields permanent record of results.



REEVES INSTRUMENT CORPORATION
A SUBSIDIARY OF DYNAMICS CORP. OF AMERICA, 223 EAST 91st ST., NEW YORK 28, N. Y.
CIRCLE 169 ON READER-SERVICE CARD

IDEAS FOR DESIGN



Plastic Microphone Diaphragm Solves Moisture Problem

A new transistorized dynamic microphone, developed by Motorola, Inc., Communications & Industrial Electronics Div., 4501 W. Augusta Blvd., Chicago 51, Ill., utilizes a plastic diaphragm in place of the usual paper cone. It is used to impart greater moisture resistant characteristics.

The enclosed transistor amplifier reduces noise pickup by boosting output to approximately carbon microphone level. This also eliminates need for a preamplifier at the transmitter. The transistor amplifier draws its power from the usual carbon microphone source.

Printed Wiring Technique Makes Control Panel

We had the problem of a serviceable, yet inexpensive control panel for a single piece of test equipment. A panel with decals to designate the controls proved unsatisfactory because the decals were easily scratched off. An engraved panel was considered too expensive since there would be only one instrument of a kind.

The solution turned out as follows: A "positive" layout of the desired panel was made and



Test set using etched printed-wiring board, for panel. It is attractive, yet unexpensive.

then exposed on a piece of epoxy resin copper-clad board with a black base color. The panel was then etched. The procedure for exposing and etching was the same as that used in making printed circuits except that the solder plating process was eliminated. The panel was sprayed with clear lacquer to preserve the copper luster and prevent tarnishing. The resulting panel was inexpensive and serviceable as well as attractive.

James E. Rogers, Electronic Technician, National Cash Register, Hawthorne, Calif.



Magnetic Parts Holder

Small permanent magnet is worn as a ring to simplify assembly of tiny parts in precision manufacturing at Owensboro, Ky. tube plant of General Electric Co. Motion studies reveal that U-shaped Alnico 5 magnets step up this "tweezer" operation by 12 per cent. Formerly, time was lost through extra motions in picking up tiny parts individually from bins.

General Electric Co., Metallurgical Products Dept., Detroit, Mich.

The SCOTCH No. 6 Electrical Acetate Film

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BRAND

Tape in this



relay



costs $\frac{3}{4}$ of a penny.



The relay must last 25 years minimum.

Annual insulation cost: 3/100¢!

Can you afford less than

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For complete information on the full line of "SCOTCH" Brand Acetate Film Tapes, just write on your letterhead to 3M Co., St. Paul 6, Minn., Dept. ON-38.

SEE US at the IRE Show—Booth 3901—for your electrical insulation requirements.

Tapes • ceramics • resins • plastics • tubings • varnishes • mica • varnished constructions • rigid and flexible laminates.

"SCOTCH" IS A REGISTERED TRADEMARK OF MINNESOTA MINING AND MANUFACTURING CO., ST. PAUL 6, MINN.

MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW



CIRCLE 170 ON READER-SERVICE CARD

"Special" Versions of Standard Switches

HAYDON 6100 SERIES SWITCHES

Unusual switching problems do not always require expensive solutions. The "special" switch shown right, for example, is basically an "upgraded" version of a standard Haydon hermetically sealed miniature switch. In missiles and rockets, where subminiature switches must do a big job, the No. 61191—rated at 10 amps—will function consistently under environmental extremes. Unlike unsealed switches, Haydon Hermetically Sealed Switches maintain their ratings at all altitudes.



Specifications	Standard (6100)	"Special" (61191)
Contact Gap, min.	.015	.035
Operating Force, max.	9 oz. or 22 oz.	32 oz.
Release Force, min.	3 oz. or 6 oz.	6 oz.
Differential Travel, max.	.0005—.005	.012
Overtravel, min.	.007	.007
Electrical Ratings, 30 Volts D.C.	3 amps, Inductive 5 amps, Resistive	10 amps, Inductive 10 amps, Resistive
Life at Rated Load (actuations)	100,000	10,000 (Inductive) 25,000 (Resistive)

Haydon 6100 Series Switches are available with a wide range of characteristics and can be used with a variety of Haydon standard actuators, such as those shown at the left. Haydon also provides a complete design and development service to solve your problems in hermetically sealed switches and suitable actuators. For further information, write for data on the Haydon No. 61191 Switch.



HAYDON Switch INCORPORATED
WATERBURY 20, CONNECTICUT

CIRCLE 171 ON READER-SERVICE CARD



Direct-Reading Output-Power Meter for Audio Frequencies

0.2 mw to 100 Watts

★ Auxiliary db scale, with multiplier, reads -10 to +50 db above 1 mw reference level

★ Forty discrete impedances over range of 2.5 to 20,000 ohms

★ Input impedance within ±2% of indicated value over most of range

★ Indicated power is accurate to within ±0.25 db at full scale

★ Over-all frequency characteristic of power indication flat to ±0.5 db from 20 c to 10 kc; within ±0.75 db to 15 kc

Type 783-A Output-Power Meter: \$370

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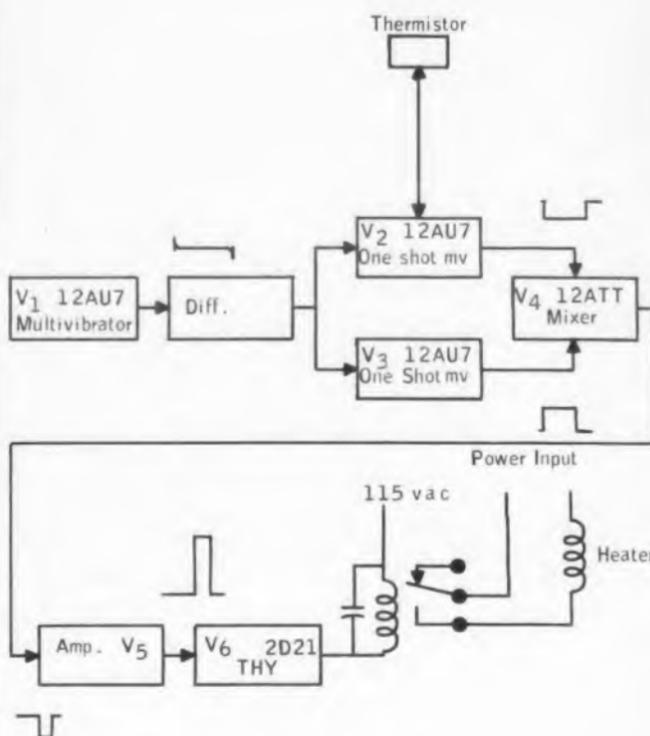
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IDEAS FOR DESIGN

Precision Electronic Temperature Controller



The precision electronic temperature controller shown in block diagram form, works on the principle of comparing two pulses. The first temperature pulse is generated by V_2 . The width of this pulse is controlled by the resistance change of a temperature sensitive element—thermistor. The second reference pulse is generated by V_3 , having the same phase and amplitude, but different polarity than the temperature pulse. The width of this pulse can be preset to any desired value, and its width is unaffected by temperature change. These two pulses are fed into a mixer stage, V_4 , where they are compared algebraically.

Two possible conditions should be considered:

a. If the temperature is lower than desired, the temperature pulse will be wider than the reference pulse. A positive peaked voltage will result. This difference in positive voltage will fire a thyatron V_6 , and energize a heating element;

b. If the temperature is higher than desired, the temperature pulse will be narrower than the reference pulse. The resulting difference will be a negative peaked voltage. This voltage will not be able to keep thyatron V_6 fired and it will recycle automatically. The relay contacts of the heating element will interrupt, which will cause lowering in temperature.

Gleb Denijanenko, Design Engineer, Bell Aircraft Corp., Buffalo, N.Y.



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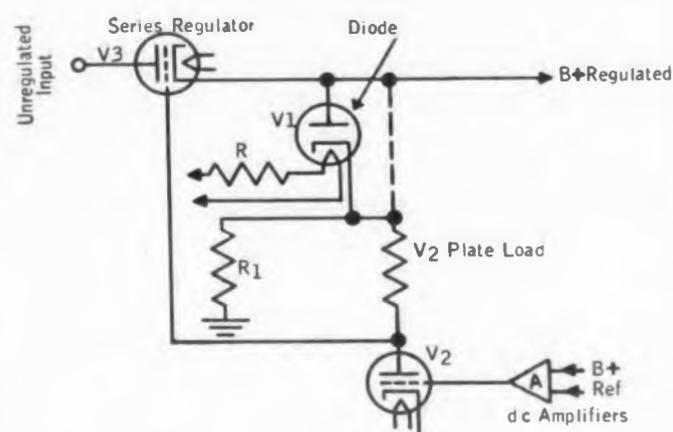
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Series Regulator Warm-Up

In regulated-power supplies the tubes in the rectifier and amplifier circuits warm-up faster than the series regulator tube (V_3). This causes the series tube to conduct high currents when the cathode is not up to proper operating temperature; thus, tube life is shortened. The usual, costly solution is to use a time-delay relay somewhere in the circuit.

An inexpensive, yet simple and effective answer to this problem is to use a diode as shown in the accompanying circuit. The dotted line indicates the connection used in most regulators.

In the modified circuit, regulating action cannot occur until diode V_1 conducts, thereby connecting the plate load resistor of V_2 (the last



Modified Voltage Regulator Circuit. Diode prevents V_3 from being overloaded until heater reaches normal operating temperature.

amplifier tube) to $B+$. If warm-up of V_1 is delayed by inserting a resistor (R) in series with its filament, a large bias is maintained on the series regulator until its filament is at the proper operating temperature.

The value of R can be between 4.7 and 5.6 ohms or can be determined experimentally. R_1 is added to insure that the circuit "fails safe" under all conditions.

With this circuit, not only are series regulator tubes protected, but the output voltage of the regulator rises smoothly to its pre-adjusted value without overshoots; thus it gives added protection to the load circuit.

S. Bernstein-Berverly, 205 So. Broadway, Tarrytown, N.Y.

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FACTS



Accuracy measured in millionths of an inch, made visible to the human eye. Steel balls, the heart of New Departure precision ball bearings, held to 5 millionths of an inch or less in sphericity. Graph at left shows sphericity variation of a ball on the order of one millionth of an inch (.000001") measured by Talyrond Machine. Graph radial divisions are .00001".



The extreme accuracy of New Departure ball bearing component parts is now playing a vital role in successful missiles for the Army, Navy and Air Force. Above—typical bearing parts, less separator—unretouched photograph.

PORTRAIT of PRECISION!

A mechanism is only as accurate and reliable as the bearings supporting its moving parts. For the designer the problem is how to achieve the essential rigidity or accuracy of location, yet be assured of extreme freedom of rotation.

A "tip-off" to the solution lies in the chart above—super-precise steel balls, the heart of New Departure precision ball bearings. For, with balls held to 5 millionths of an inch or less out-of-roundness and other bearing parts finished with comparable care, such bearings can be mounted and preloaded to provide the hairsplitting exactness of location and ease of rotation required of the finest precision instruments.

The AChiever guidance system proved in tests of the Air Force's Thor ballistic missile demands tolerances often measured in millionths of an inch, as is the case with the New Departure ball bearings on which the AChiever's precision gyros turn.

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Cat. No.	430-A	440-A	450-A	431-A	441-A	451-A	432-B	442-B	452-B
Zin Zout	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.
Max. Power	1/2 watt								
Insertion Loss	10 db			zero db at low freq. approx. 0.3 db at 200 mc			zero db at low freq. approx. 0.5 db at 200 mc		
dB Switched	41 db in 6 steps						101 db in 9 steps		
Steps	20 db, 10 db, 5 db, 3 db, 2 db, 1 db						20 db, 20 db, 20 db, 20 db, 10 db, 5 db, 3 db, 2 db, 1 db		
Frequency Range	DC to 500 mc								
Accuracy of Attenuation	Within 0.1 db to 500 mc Better accuracy at lower frequencies								
Connectors	BNC type UG-185/U								
Dimensions	2 1/4" x 8 3/4" x 2 1/8"						2 1/4" x 11 1/2" x 2 1/8"		
Weight	2 1/2 lb.						4 lb.		
Price	\$65			\$60			\$100		

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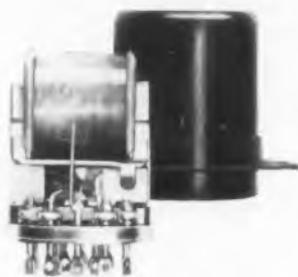


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PATENTS

Radio Frequency Amplifier

Patent No. 2,799,736. R. J. Hannon.
(Assigned to Standard Coil Products Co., Inc.)

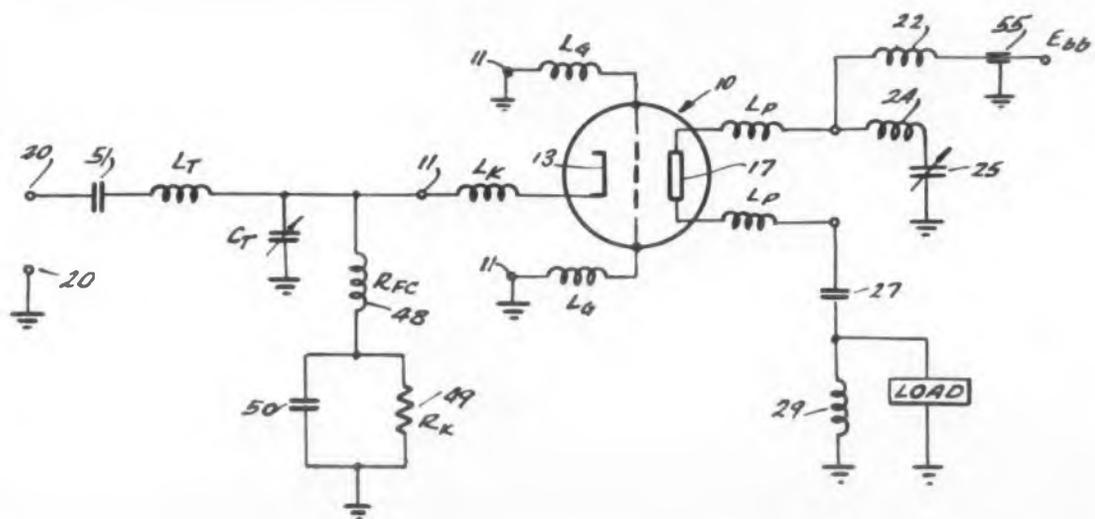
Considerable research has been done seeking to extend the upper frequency range of tubes for use in amplifier circuits. This has been dictated by ultra-high frequency TV broadcasting. One tube which has been developed has two terminal leads to the grid and plate and the electrodes are positioned in such manner that the capacity between electrodes is greatly reduced. Even with this improved construction the tubes could not operate in a range of frequency above the self-resonant frequency of itself.

The amplifier of the patent is designed to enable the type of tube described to operate above the resonant frequency of the tube. One manner in which this is partly accomplished is by making the structure of the plate and the lead inductances a part of the output resonator. Another problem with these tubes has been the noise factor which was unsatisfactory. This is because the distributed inductance of the leads to the cathode and grid with the shunt capacitance and resistance from the control electrodes to ground, constitutes an L attenuator with the result that the input signal is decreased whereas the noise energy which is applied directly across the grid and cathode is unaffected and hence the noise factor is poor. This has been overcome in the amplifier herein by inserting the input signal directly at the point where the noise energy is applied to the amplifier as in a T network.

In the circuit illustrated, the grid of the tube is connected to ground through

two leads with the inductance of the leads represented by L_G , and the inductance of the lead to the cathode is represented by L_K . The signal is applied to the input terminals 20 which are connected with the cathode through a coupling capacitor 51 and a T network consisting of inductors L_T and L_K and shunt capacitor C_T . The signal appears across the shunt network formed by an r.f. choke 48 which is in series with a bias resistor 49 and shunt capacitor 50. The inductance of the two leads to the plate 17 are represented by L_P with the plate potential applied to one lead through a choke 22. This same lead is connected to ground through an inductor 24 and trimmer capacitor 25. The other lead for the plate is connected with the load through a coupling capacitor 27 with an inductance 29 in parallel with the load. In the amplifier circuit shown, the input circuit provides an analog transformer in which the primary is the T network and the output termination is the capacity between cathode and grid and the input resistance so that a non-attenuated signal is applied across the inherent resistance and capacitance of the tube. The noise factor at uhf is substantially reduced. The noise factor has been reduced from 18 db to 10.5 db at 887 megacycles.

The self biasing resistor 49 and bypass condenser 50 determines the operating bias for the grid. The rf choke 48 isolates the high frequency from the bias elements. Examples of the values of the various circuit components is given in the patent. A variation in the plate circuit of the amplifier is also illustrated and described.



Receiver Circuit

Patent No. 2,808,507. Frank L. Pawlowski. (Assigned to Motorola, Inc.)

The frequency modulated radio receiving system of the patent includes carrier wave selecting and converting apparatus, amplitude limiting apparatus, frequency discriminating apparatus and signal reproducing apparatus which are serially connected to form a receiving channel. The system limits the amplitude of the received signal modulated carrier wave and detects and reproduces the modulation components of the signal. These circuit parts are operative to transmit noise which appears in the channel. A noise squelch system is provided which functions as will now be described. The higher frequencies are accentuated for applying modulation signals and noise from the frequency discriminating apparatus to a limiter. The limiter is coupled to a high pass filter which selects noise at frequencies above the modulation signal frequencies at the output of the limiter. Coupled to the amplitude limiting apparatus is means for deriving a first control voltage therefrom. A rectifier is coupled to this means and to the high pass filter which rectifies the noise selected by the filter and produces a second control voltage of opposite polarity to the first control voltage. The rectifier also differentially combines the first and second control voltage to produce a third control voltage. A squelch circuit controls the signal reproducing apparatus to prevent the latter from responding to noise or signals appearing in the channel so long as the third control voltage exceeds a predetermined value.

Efficient And Stabilized Semiconductor Amplifier Circuit

Patent No. 2,810,024. Thomas O. Stanley. (Assigned to Radio Corporation of America)

The circuit disclosed is a class B push-pull signal amplifying circuit using a first and a second semiconductor of opposite conductivity types. An input circuit applies signals to the base electrodes of the pair of devices which are in parallel. The input circuit includes a low impedance biasing network such as a third semiconductor and including a resistive

element between the base electrodes. The emitter electrode of the first device is connected with the emitter electrode of the second device. An output circuit is provided between the emitter electrodes of the devices and a point of fixed reference potential for deriving an output signal therefrom. A signal feedback circuit connects a point between the output circuit and the emitter electrode with the input circuit. This feedback circuit has a low impedance at signal frequencies to provide a relatively high dynamic input impedance for the semiconductor devices whereby efficient signal transfer is accomplished.

Electronic Relay Control

Patent No. 2,807,757. Robert W. Callinan. (Assigned to the United States of America)

A remotely-controlled relay system is described which is adapted to respond to signal-modulated radio carrier waves. A receiver receives the waves and detects the modulation component. A rectifier converts this modulation component to a direct-current potential. The output circuit of the rectifier comprises a resistor and capacitor in parallel whereby upon cessation of reception of the carrier waves, the direct-current potential is maintained for a time determined by the time constant of the resistor and condenser. A relaxation oscillator circuit comprises a thyatron tube and an electromagnetic relay having a coil and a movable armature. A battery applies a positive potential to the anode of the tube through the coil. A portion of the battery supplies the heater circuit and the negative terminal is connected to the grid in series with the resistor and an additional current limiting resistance. The potential of the cathode heating battery maintains the tube nonconducting. A condenser is provided between the anode and cathode of the tube. The tube coil, and the last mentioned condenser forms the relaxation oscillator so that when a direct-current potential appears across the output circuit of the rectifier, the tube is rendered conducting and the oscillator circuit begins oscillating. The resultant current in the coil actuates the armature of the relay and a circuit controlled by the armature.



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Magnetic Power Amplifiers

Airpax magnetic power amplifiers control the current to both phases of split-phase motors. Standby power is thus greatly reduced and full torque is produced under load. Amplifiers are polarity sensitive. Airpax units for 6 or 10 watts per phase for 400-CPS motors are in stock at the Seminole Division, Fort Lauderdale, Florida.



LOW-NOISE LONG-LIFE Choppers

Noise levels, especially in low-impedance circuits, of these new choppers are below 10 microvolts. This is RMS wide-band noise extending from a few CPS up to 40 KC; still lower noise levels can be achieved in particular application by filtering. In usual application, these low-noise Airpax choppers can be expected to remain within ratings for over 5,000 hours use. These choppers are manufactured at the Cambridge Division, Cambridge, Maryland.



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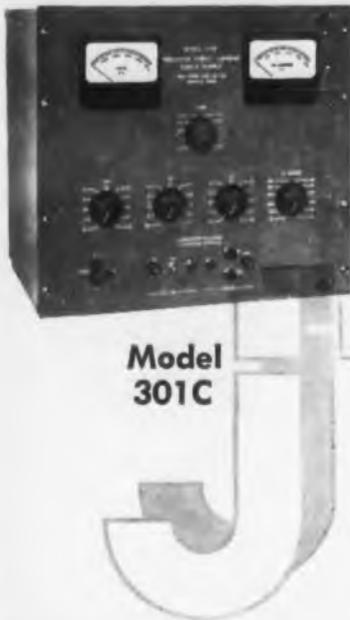
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REGULATION VS. LOAD—.005% or 1 millivolt for 200 milliamperes load change.
STABILITY—.005% per hour, .01% per day.
REFERENCE ELEMENT—Eppley standard cell.
RIPPLE—Less than 2 millivolts RMS.
VOLTAGE RESOLUTION—.5 millivolt for any output voltage.
CALIBRATION ACCURACY— $\pm .1\%$ or 2 millivolts.
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PRICE—\$995.00 f.a.b. Seattle.

OUTPUT VOLTAGE	600 to 3100 volts DC	0 to 555 VDC; 0 to -250 VDC; 0 to -25VDC; 2 to 6.3VAC@5A	500 to 1600 volts	0 to 530VDC; 0 to -225; 0 to -22.5VDC; 6.3VAC @ 3A.
OUTPUT CURRENT	0 to 15maDC	0 to 300ma	0 to 1ma	0 to 100ma
OUTPUT POLARITY	pos. or neg.	pos., neg., or floating	pos. or neg.	pos., neg., or floating
REGULATION VS. LINE	.01% max. for 20% line change	.01% for line change from 105 to 130 volts	.03% max. from 100 to 130 volts	.01% for line change from 105 to 130 volts
REGULATION VS. LOAD	.01% max. for 10ma change	.01% from 0 to 300ma	.03% no load to full load	.01% for load change from 0 to 100ma
STABILITY	.005% per hour	.01% per hour	.02% per hour	.01% per hour
RESOLUTION	10mv at any output voltage	2mv over entire range	100mv at any output voltage	2mv over entire range
CALIBRATION ACCURACY	Better than .5%	Better than .5%	2%	
RIPPLE	Less than 5mv RMS	1mv or less	5mv max.	1mv or less
SIZE AND WEIGHT	19"W x 10½"H x 14"D—46 lbs.	Cab. 9¾"W x 13"H x 14"D—32lbs; Rack 19"W x 8¾"H x 16¾"D—32 lbs.	19"W x 7"H x 13"D—22 lbs.	Cab. 13"H x 9¾"W x 14"D—32lbs; Rack 8¾"H x 19"W x 16¾"D—30 lbs.
PRICE	\$595.00	Cab. \$335; Rack, \$355	\$209.00	Cab., \$260; Rack, \$280

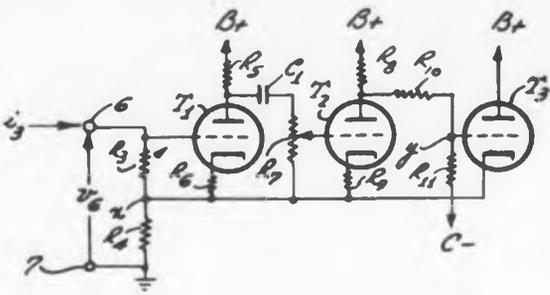
OUTPUT VOLTAGE	500 to 5100 volts DC	500 to 1600 volts	500 to 2000 volts DC	500 to 1600 volts
OUTPUT CURRENT	0 to 1ma	0 to 1ma	0 to 5ma at 500 to 1500 volts; 0 to 2ma at 1500 to 2000 volts	0 to 1 ma
OUTPUT POLARITY	pos. or neg.	pos. or neg.	pos. or neg.	pos. or neg.
REGULATION VS. LINE	.01% max. from 100 to 130 volts	.03% max. from 100 to 130 volts	.01% max from 100 to 130 volts	.01% max. from 100 to 130 volts
REGULATION VS. LOAD	.01% max. no load to full load	.03% no load to full load	.03% no load to full load	.01% max. no load to full load
STABILITY	.005% per hour	.01% per hour	.005% per hour	.005% per hour
RESOLUTION	100 mv at any output voltage	100 mv at any output voltage	100mv at any output voltage	100mv at any output voltage
CALIBRATION ACCURACY	1%	1%	Better than 1%	Better than 1%
RIPPLE	5mv max.	5mv max.	Less than 5mv RMS	Less than 5mv RMS
SIZE AND WEIGHT	19"W x 10½"H x 14"D—42 lbs.	19"W x 7"H x 13"D—22 lbs.	19"W Rack x 7"H x 13"D—27 lbs.	19"W Rack x 7"H x 13"D—27 lbs.
PRICE	\$595.00	\$265.00	\$435.00	\$395.00



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CIRCLE 217 ON READER-SERVICE CARD

PATENTS



Artificial Inductor

Patent No. 2,800,586. G. H. Towner. (Assigned to Northrop Aircraft, Inc.)

An inductor which has a large value of inductance but is of relatively small size has many advantages. The patentee has devised an artificial inductor which does not use coils and occupies relatively small space. This inductor also has application in an oscillator and in a resonance circuit having a high Q . Other applications of the inductor are for a remotely variable inductor using simple control means and a tone control circuit.

The artificial inductor is shown in the figure and comprises a resistor R_3 which may be variable over a range from 0-10 kilohms. Across this resistor is connected an amplifier of three tubes in which the last tube T_3 is a cathode follower tube with its cathode resistor R_4 of say 27 kilohms in series with the resistor R_3 . The condenser C_1 and resistor R_7 form an R-C differentiator. The mathematical analysis of the circuit is given in the patent and the circuit has been tested for conformance with inductor characteristics. For example a square wave input applied to the terminals 6, 7 produces an output of spiked or peaked wave form across the output resistor R_4 . A triangular wave input will result in a square wave output and a sine wave input will result in a sine wave output which is 90° out of phase with the input wave. The value of inductance can be varied by varying the resistor R_3 or R_7 . The equivalent inductor resistance is essentially the value of resistor R_3 .

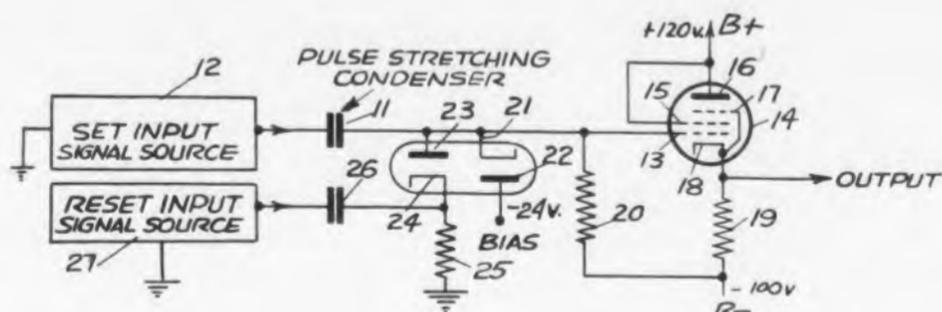
The artificial inductor may have a capacitor connected across the terminals 6 and 7 which results in a resonant circuit. As a consequence the inductor may also be modified to provide an oscillator. The oscillator circuit is the same as that

of the figure with the capacitor across terminals 6, 7 and a feed-back loop consisting of a blocking capacitor and resistor between the plate of the tube T_2 and the grid of the tube T_1 . A blocking capacitor is also provided between the plate of the tube T_2 and the grid of the tube T_3 . In another modification the capacitor may be removed whereupon the circuit becomes essentially a "perfect" inductor with practically no resistance. A proper amount of feed-back voltage in effect cancels the applied voltage across the resistor R_3 . In addition the circuit may be modified to provide a tone control which is also illustrated and described in the patent. The oscillator output is secured across the resistor R_4 .

Grounded Grid Power Amplifier

Patent No. 2,810,793. Warren B. Bruene. (Assigned to Collins Radio Company)

The amplifier uses a tube having a first tuned impedance circuit between the cathode of the tube and ground. The signal source is applied across this impedance circuit. A signal current detector is in series with the signal source and has a direct voltage output which is proportional to the signal current. A voltage detector is in parallel with the first cathode impedance circuit and has a direct voltage output which is proportional to the signal voltage and further has a polarity which is opposite to that of the current detector output. A potentiometer consisting of resistor with a variable tap has one end of the resistor connected to the output of the signal current detector and the other end of the resistor connected to the output of the voltage detector. A grid current detector is in series with the grounded-grid of the tube and has a direct voltage output which is proportional to the grid current. A second tuned impedance circuit has a variable resistive component connected in series between the plate of the tube and the load. A servo system has its error input connected between the tap on the potentiometer and the output of the grid current detector. The output of the servo system is coupled to the second impedance circuit so that its resistive component is varied in a manner to equalize the voltage on the tap with the voltage output of the grid current detector.



Pulse Stretchers

Patent No. 2,802,101. C. F. West et al. (Assigned to Raytheon Manufacturing Company)

The pulse stretcher circuit finds particular application in computers for generating a gating pulse. This application requires a gating pulse which is precisely instituted and terminated. A control signal sets the beginning of the pulse and a second control signal resets the circuit or the ending of the pulse. For this service bistable multivibrators or so-called flip-flop circuits have been extensively used as well as a one pulse multivibrator having a circulating delay line or the so-called dynamic flip-flop circuit. Both of these types of circuit use dc coupling which requires components which are critical in nature and for this reason such circuits are generally unstable in operation.

The circuit shown in the figure initiates a gating pulse by a negative triangular control signal generated at the source 12. The leading edge of this negative control signal drives the cathode 21 of a diode more negative than the cathode 22 so that a current flows through this diode and resistor 20 to a source of negative potential B-. This flow of current charges the capacitor 11 so that the trailing edge of the control pulse raises the potential on the control grid 13 of the cathode follower amplifier tube 14. As a consequence, the cathode follows the grid potential and produces an output pulse across the cathode resistor 19 or at the output terminal. The charge on the capacitor 11 leaks off slowly through the resistor 20 and therefore maintains the control grid 13 positive and maintains the potential of the pulse at the output terminal although at a somewhat decreasing level. The pulse is terminated by a negative reset control signal generated at the source 27 which is applied through the capacitor 26 to the cathode 24 of the second diode. This negative pulse renders this diode conducting and discharges the charge on the capacitor 11

which terminates the pulse. This circuit is not critical in operation so that changes in circuit values which may arise from aging of the tubes or variations in supply voltage does not affect operation of the circuit. In addition the switching time from pulse off to pulse may be less than one tenth of a microsecond.

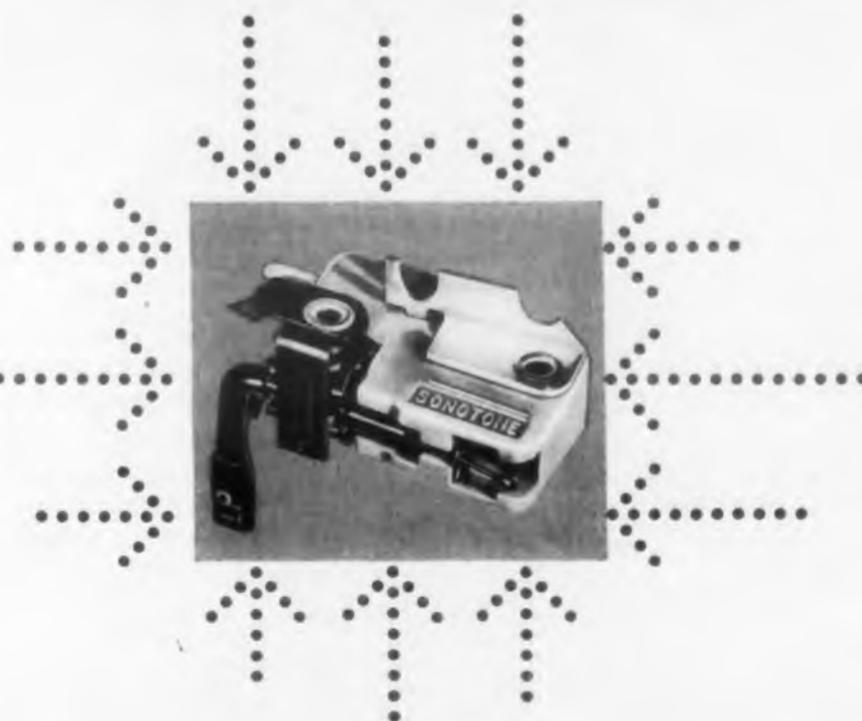
There is also illustrated and described, a modification of the circuit of the figure whereby the input control signal may be a positive triangular pulse. This circuit requires relocation of the diode which charges the condenser into the connection from the control signal source 12 to the grid 13 of the amplifier tube and relocation of the capacitor 11 between this diode and the grid 13 with one plate being grounded. There is also shown three other circuits which develop regenerative pulses for extending the duration of the gating pulse or maintaining its potential amplitude over a long period.

Time Delay Control

Patent No. 2,809,297. Edward C. Hartwig and Francis T. Bailey. (Assigned to Westinghouse Electric Corporation)

The control circuit consists of an amplifier having a first input terminal, a second input terminal, a first output terminal and a second output terminal. A photo-sensitive device has a third output terminal and a fourth output terminal. The third output terminal is connected to the first input terminal and the fourth output terminal is connected to the second input terminal. Circuit means connects the first output terminal to the control grid of a discharge tube. Other circuit means connects the second output terminal to the cathode. A time constant network is provided in series with the anode and cathode of the tube. A second discharge tube has this network connected between its control electrode and cathode. A current responsive means is provided between the anode and cathode of the second tube.

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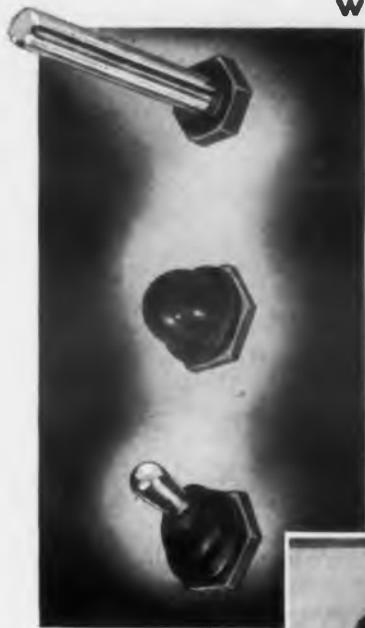
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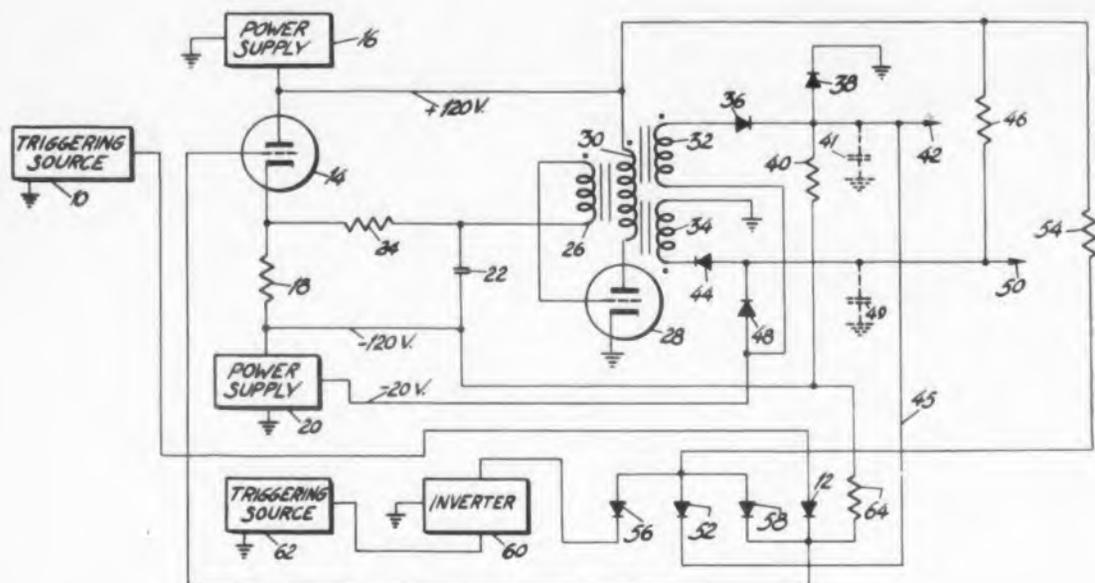
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Flip-Flop Circuit

Patent No. 2,795,696. D. C. Evans.
(Assigned to Bendix Aviation Corporation)

Many improvements have been made in flip-flop circuits seeking to improve their performance. Many of these circuits are of the Eccles-Jordan type which use a pair of tubes with interconnections between plate and grid of resistances and capacitances. By the application of a triggering pulse, one tube becomes conducting and the other becomes non-conducting. Such circuits, however, require resistances and capacitances of precise values for securing desirable operating characteristics and this necessarily results in increasing the cost of the circuit. Such circuits also require input and output stages requiring additional tubes which further increases the cost and complexity of the circuit. In the field of electronic computers large numbers of flip-flop circuits are used and for such uses a flip-flop circuit of lower cost and greater dependability is very desirable.

The circuit disclosed in the figure overcomes the disadvantages discussed above and makes use of an oscillator stage. This stage is normally non-oscillating but upon being triggered is set into oscillation. By the use of a pair of rectifier circuits, low and high voltages are produced in the outputs when the oscillation circuit is non-oscillating and produces high and low voltages when the oscillations begin. The circuit

components are well illustrated in the circuit diagram of the figure. The oscillator makes use of a tube 28 and the inductors 30 and 26. Assume that the oscillator is non-oscillating, a trigger pulse generated from the source 10 supplies a positive pulse through the diode 12 to the control grid of the tube 14. This tube becomes conducting and the potential increase across the cathode resistor 18 is applied to the control grid of the oscillator tube 28 through the winding 26. Increasing conduction through the oscillator tube 28 is fed back to the control grid through the windings 30 and 26 which regenerative action sets the tube into oscillation.

When the oscillator is non-oscillating a potential of -20 volts appears at the output 42 from the negative power supply 20, winding 32 and diode 36. During the non-oscillating condition of the oscillator, a zero potential appears at the output 50 because of the low potential drop through the diode 44 and winding even though this output terminal is connected with the power supply 16 through a resistor 46. When the triggering pulse from the source 10 sets the oscillator circuit into oscillation the potential at the output 42 becomes zero through the coupling between the winding 30 and 32. Similarly the potential on the output 50 becomes -20 through the coupling between the windings 30 and 34. This potential relationship continues until a triggering signal is generated by the source 62. This triggering

signal is inverted in 60 into a negative potential applied to the cathode of the diode 56 which appears on the anode as a result of current flow through a circuit from power supply 16, resistor 54 diode 56 and inverter 60. This negative signal appears also on the anode of diode 58 as well as the cathode resulting from current flow from supply 60, through resistor 64, diode 58, resistor 64 and the negative power supply 20. The negative potential on the cathode of diode 58 biases the grid of tube 14 to cut off. With cessation of conduction through the control tube, the grid of the oscillator tube 28 is biased below oscillating level and the oscillation ceases to restore the initial potential on the outputs 42 and 50.

In the Eccles-Jordan type of flip-flop circuit, one of the two tubes is always cut off with the result that the tubes of this circuit present different impedances at different times because of the "cathode interface impedance" which is relatively large at cut off. This fact tends to produce undesirable transients when a tube is triggered. In the circuit of the figure this difficulty is overcome by having some current at all times flowing through the oscillator tube 28 but it is at such a low level that it is below the condition of oscillation of the oscillator circuit. This flow of current avoids any "cathode interface impedance" and provides a flip-flop circuit of stability.

Color Television Image Reproducing System

Patent No. 2,806,899. Vladimir K. Zworykin. (Assigned to Radio Corporation of America)

The reproducing system of the patent uses a cathode-ray tube with a luminescent screen having a plurality of groups of subelemental size areas. Each area of the groups has fluorescent material to produce light of a different color when it is excited by the beam of the cathode-ray tube. The primary electron beam is controlled to effect scanning of successive elemental areas of the screen and to determine intensity of the light produced in accordance with the received signals. The system provides means which is responsive to the primary electron beam

for developing at each of the elemental screen areas, a single secondary electron beam for each of the groups of subelemental screen areas. Each of the secondary electron beams are controlled to selectively excite any one of the color screen areas of its group of the screen.

Radio Receiver

Patent No. 2,810,071. Richard T. Race. (Assigned to Motorola, Inc.)

The radio receiver is of the superheterodyne type to be used in a vehicle so that it is energized from the battery of the vehicle which provides a direct current potential having a nominal value of 12 volts. The receiver includes a voltage amplifier for the received radio frequency signals which uses a first vacuum tube. The received radio frequency signals are converted to intermediate frequency signals which converter uses a second vacuum tube. The intermediate frequency signals are amplified which i-f amplifier includes a third vacuum tube. A demodulator demodulates the intermediate frequency signals to provide audio frequency signals. A control voltage is derived representing the average value of the amplified intermediate frequency signals which applies the control voltage to the first and third vacuum tubes for controlling their gain. The audio signals are amplified by a fourth vacuum tube and at least one power transistor device which provides the audio output signals. A loudspeaker is coupled to the power transistor device for reproducing the audio output signals. The fourth vacuum tube and the power transistor device are coupled to means which produce audio frequency current sufficient to drive the loudspeaker so as to produce sound at a level which can be conveniently heard in the vehicle. A form of power supply provides operating potential for the receiver circuit from the battery power supply and includes a filter and direct current connections to each of the vacuum tubes and to the power transistor device. This power supply derives a single direct current voltage from the battery and applies only this single voltage to all of the circuits of the entire receiver so that all of such circuits are energized by a voltage no greater than that of the battery.

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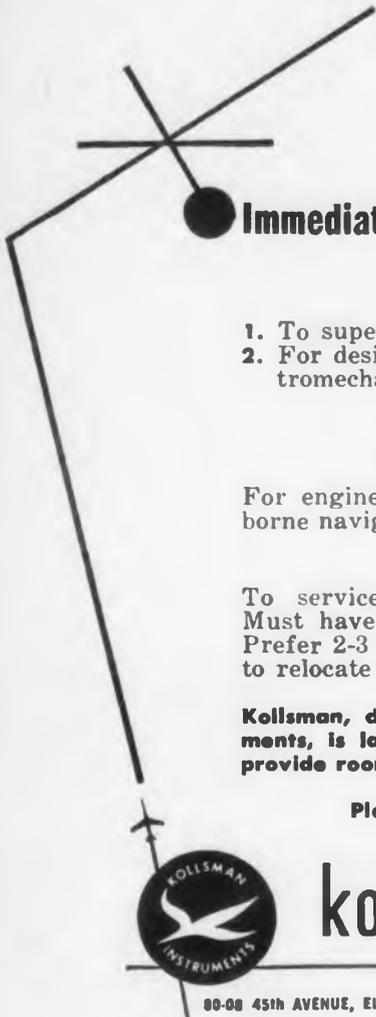
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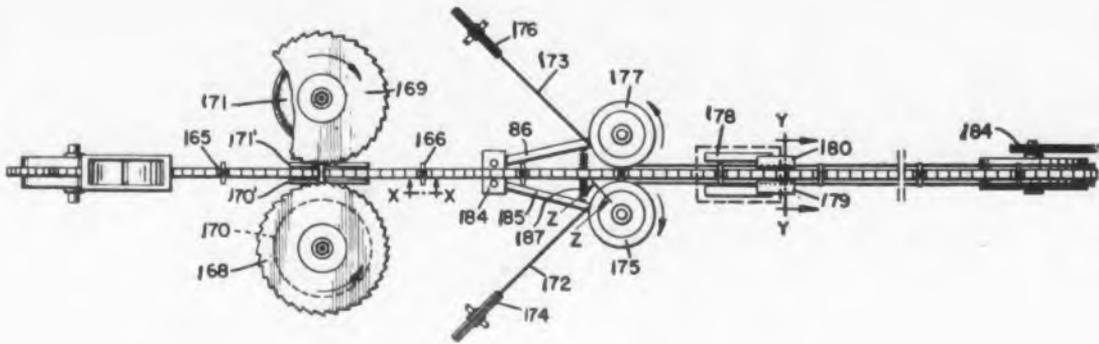


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PATENTS



Processes For The Manufacture Of Multiple Strand Electrical Conductor Leads

Patent No. 2,810,670. Faust R. Gonsett. (Assigned to L. A. Young Spring & Wire Corporation (1/2) and Fretco, Inc. (1/2))

The patent is directed to a method of making that type of conductor commonly used as the leads between a television antenna and the receiving set. This type of conductor consists of spaced bars to which the two conductors are secured in spaced relation so that the conductor is air insulated.

In the broader aspect of the process the insulating cross bars are of plastic material. The ends of bars and the two conductor wires are heated in a suitable oven. Each conductor wire is pressed into the opposite ends of the plastic bars so that they are embedded in the plastic. Upon cooling, the conductors are securely fastened to each end of the bar. An automatic machine is used which feeds the spaced insulating bars into spaced clips on an endless chain and at the same time a conductor wire is fed to each side of the cross bars from spools. The bars and conductors are heated in an oven and each conductor wire is then pressed into the ends of the bar where they are secured upon cooling.

In the more detailed method of making this conductor, the plastic bars are loaded into spaced clips on the endless chain or conveyor. While the plastic bars are held on the conveyor they come into contact with a saw on each side which cuts a kerf into each end of the plastic bar. Wire is then fed from each side of the conveyor and into the kerf. The bars and conductors then pass through an oven and pressure is applied to the ends of the plastic bars to close the kerf onto the conductors. In this manner each wire

is firmly embedded and attached to an end of the plastic bar.

Magnetic Amplifier and Flip-Flop Circuit Embodying the Same

Patent No. 2,798,168. Theodore H. Bonn, John Presper Eckert, Jr., and Robert P. Talambiras. (Assigned to Sperry Rand Corporation)

The circuit uses a core having a substantially rectangular hysteresis loop on which core there are a plurality of windings. A first source of spaced power pulses feed current through a first winding, and output means receives this current. A second winding has a bias arrangement for normally applying magnetizing forces to the core during the spaces between power pulses. These magnetizing forces are in the opposite direction to the magnetizing forces set up by the power pulses. The power pulses and bias have such amplitudes that during the spaces between pulses the bias will drive the magnetization of the core so far in one direction that the next power pulse cannot saturate the core when it drives the magnetization of the core in the other direction. A second source of spaced input pulses is coupled to one of windings on the core which pulses have a polarity as to oppose the magnetizing effect of the bias so that during the presence of an input pulse, the power pulses will repeatedly drive the core to saturation. The duration of the input pulses are long enough so that a plurality of power pulses occur between the beginning and end of each input pulse. A filter between the second source and the windings blocks current at the frequency of the power pulses so that currents at the frequency of the power pulse will not flow through the second source.

Pulse Modulation Circuit

Patent No. 2,804,595. Robert O. Soffel. (Assigned to Bell Telephone Labs.)

The circuit modulates a carrier wave under the control of direct current signal pulses. The circuit includes, therefore, a carrier source and a source of direct current signal pulses. One or more modulator output circuits are provided having a predetermined impedance. A dummy output circuit is also provided having substantially the same impedance as the modulator output circuit. A first diode is used between the carrier source and the modulator output circuit. A second diode is used between the carrier source and the dummy output circuit. The first diode is biased in the forward direction and the second diode is biased in the reverse direction in the presence of a signal pulse. This bias arrangement permits the carrier to pass through the first diode to the modulator output circuit. The first diode is biased in the reverse direction, the second, in the forward in the absence of a signal pulse thereby blocking the carrier from the modulator output circuit and presenting a terminating impedance to the carrier source which is much the same as presented thereto by the modulator output circuit.

Semi-Conductor Squelch Circuit

Patent No. 2,809,240. Larry A. Freedman. (Assigned to Radio Corp. of America)

The circuit is a semi-conductor signal amplifier device in which the signal input circuit is between the base and emitter electrodes and the signal output is from the collector electrode. A bias voltage is provided between the base and emitter electrodes in the forward direction. An energizing means is connected with the collector electrode through resistive means connected so as to establish a substantially zero potential between the base and collector electrodes at static operating conditions. A direct current automatic gain control is used with the input circuit which is responsive to an increase in signal strength to decrease the bias voltage between the base and emitter electrodes on signals exceeding a predetermined value and to increase the gain as the amplitude of the applied signals begins to exceed the predetermined value. The agc thereafter decreases the gain of the amplifier for further increase in the amplitude of the applied signal.

Differencer Circuit

Patent No. 2,807,730. Henry W. Kaufmann. (Assigned to Sperry Rand Corp.)

A signal generator is provided having an input and an output which generator produces regularly spaced output signals at the output during predetermined spaced output time periods. The generator also includes means which is responsive to an input signal occurring during one of the spaced output time periods for inhibiting an output signal during a next subsequent output time period. A gating device has first and second gating control inputs which device is responsive to coincident signals at the first and second gating control inputs for effecting a predetermined gating output state. The output of the pulse generator is coupled to one of the gating control inputs. A control signal is applied simultaneously to the generator input and to the other of the gating control inputs during a selected one of the output time periods.

Two Stage Magnetic Amplifier

Patent No. 2,809,241. Seymour Weissman. (Assigned to The W. L. Maxson Corp.)

The magnetic amplifier comprises several stages, the first stage including a magnetic core, a first output winding and a first control winding on the magnetic core. A control voltage is applied to the latter winding. The second stage includes a magnetic core having a second control winding and a second output winding on the core. A first rectifier and a load are in series with the second output winding. An interstage coupling circuit includes a second rectifier in series with the first output winding and the second control winding to which a voltage is applied of the same frequency as above. The rectifiers are poled to pass current during alternate half cycles of the alternating current. The cores and windings have dimensions and are so arranged that the first stage remains saturated and the second stage remains unsaturated throughout the entire ac cycle when no control voltage is applied. To the second stage there is connected means for altering its magnetization so as to substantially eliminate a dead space in the amplifier characteristic in which the amplifier produces no appreciable output in response to a control voltage.



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Books

Soviet Education for Science and Technology

Alexander G. Korol, *The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York, N.Y., 513 Pages, \$8.50.*

Perhaps the most comprehensive study to date, this book examines the organization and effectiveness of Soviet formal training in science and technology in an effort to evaluate the overall quality of Soviet-trained scientists and engineers. It concentrates the investigation on the two representative fields of physics and mechanical engineering.

Though not intended as a comparative study, the book refers to American educational data as a frame of reference by which the scale of Soviet education could be concretely appreciated.

The book deals with education through the graduate level. The investigation probes organization, curricula, instruction, textbooks, student selection, any many other aspects of Soviet education. It is well documented with 56 tables. An extensive annotated bibliography and 15 appendices round out this excellently organized study.

Atomic Energy Facts

Prepared by the U.S. Atomic Energy Commission. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 216 Pages, Paper bound, \$2.00.

This up-to-date compilation of information on atomic energy, though intended primarily for industrial management, is also of interest to the layman.

Well illustrated, with 86 drawings, photographs, and flow charts, it combines and organizes material from many Atomic Energy Commission sources.

Devoted entirely to peaceful uses of atomic energy, the volume describes the organization, functions, and technical in-

formation services of the AEC. Sources of technical information and services are presented in addition to information on how to obtain licenses and patents.

Five of the nine chapters are technical, dealing with the production of uranium and thorium, power reactors, fuel cycles, reactor materials, research reactors, and the characteristics and production of radioisotopes.

The volume does not report on weapons programs or basic research in universities.

Industrial Electronics Handbook

R. Kretzmann, Philosophical Library, 15 East 40th Street, New York 16, N.Y. 298 Pages, \$12.00.

This second edition is an enlarged version of an earlier work which was very valuable to those engaged in the supervision or maintenance of industrial equipment. The book was printed in the Netherlands. Perhaps its greatest weakness for American readers is that it was translated into English rather than American. Nevertheless, the American reader should not have too much trouble translating *main voltage to line voltage* and *earth to ground*. Most of the tubes referred to are Dutch types—a small inconvenience.

Perhaps most disappointing about this book and its sequel, "Industrial Electronics Circuits" is the absence of discussion of magnetic amplifiers and transistors, with their growing role in industrial electronics.

In spite of these shortcomings, the book is an excellent practical handbook on electronic relays, counters, timers, rectifiers, control, and other devices. It describes the principles and properties of the various classes of hard and soft electron tubes with typical applications and circuits.

Industrial Electronics Circuits

R. Kretzmann, Philosophical Library, 15 East 40th Street, New York 16, N.Y. 194 Pages, \$10.00.

A sequel to "Industrial Electronics Handbook," this book concentrates on the circuitry most often employed with industrial electronic applications. There are nearly 200 circuits together with parts lists and descriptions of the functions of component parts.

American readers will have to acclimatize to *picafarads* for *micromicrofarads* and to the use of Dutch tube types. A convenient adjunct to the book would have been a translation of Dutch tube types to American equivalents.

The circuitry is presented under six categories: photoelectrically controlled apparatus; counting circuits; stabilizing circuits; contact and control devices; oscillator- and amplifier circuits; and rectifier and motor control circuits.

Despite the shortcomings which this book shares with the "Industrial Electronics Handbook," both books can be invaluable to the designer of industrial electronic apparatus.

Closed Circuit TV System Planning

M. A. Mayers and R. D. Chipp, John F. Rider Publisher, Inc., 116 West 14th Street, New York 11, N.Y. 250 Pages, \$10.00

This book is not intended for the electronic design engineer. For those thinking of using closed circuit TV, it is a complete advisory source. An excellent guide for those who must plan and evaluate these systems, it answers questions related to the organization of such systems such as space requirements, cost of equipment and installation, types of equipment available and manpower required to operate and maintain the equipment.

Principles of Properties of Materials

Jacob Porter Frankel, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 228 pp, \$6.00.

An outgrowth of a series of lectures delivered to an undergraduate class at Northwestern Technological Institute, this volume takes a new approach to the subject by emphasizing principles and properties of materials rather than the materials themselves. The author has explicitly written a very basic text and not a reference book. Since it is intended as an introduction to all fields of engineering, discussions of such matters as magnetic properties and some of the properties of liquids have been omitted.

Digital Computer Components and Circuits

R. K. Richards, Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J., 511 pp, \$10.75.

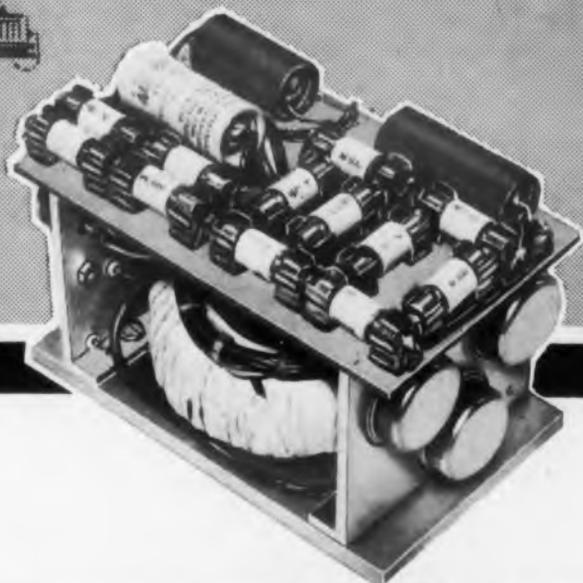
In this clear delineation, emphasis is laid on the presentation of information to reduce ideas about arithmetic and logic to a working machine. Many of the topics included represent components and circuits of an experimental nature which have never been utilized in working computers but which offer proven or potential advantages. Logical functions and digital storage, basic operations to be performed by a digital computer, are discussed at length. The various advantages and disadvantages of the several approaches to design are thoroughly explored. Intended as a companion book to the author's "Arithmetic Operations in Digital Computers," this present volume is nevertheless an entirely separate work intended as a reference source for the practicing engineer and as an aid in introducing the newcomer to the field. Brief discussions of Boolean notation, counters, and adders are repeated here.



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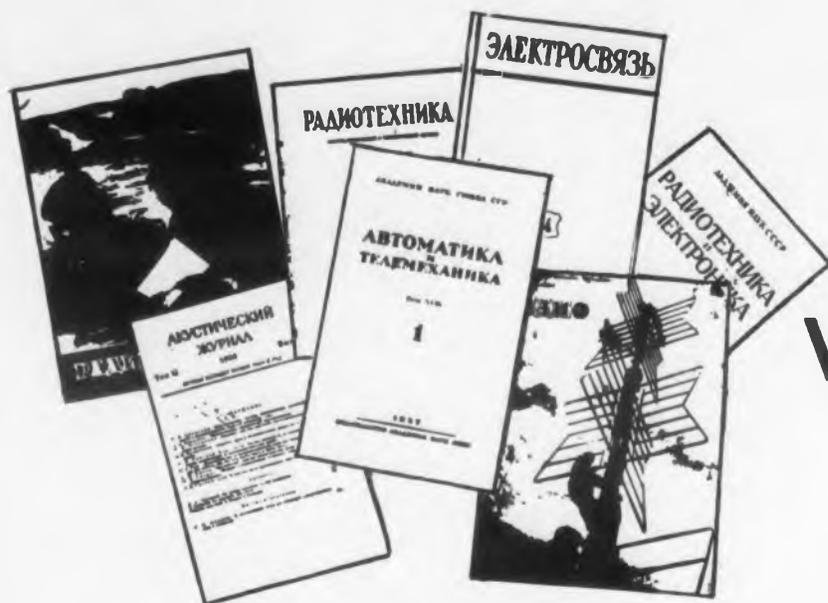
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What The Russians Are Writing

J. George Adashko

RADIO ENGINEERING AND ELECTRONICS

(Contents of *Radiotekhnika i Elektronika* No. 6, 1957)

TUBES AND THERMIONICS

Trends in the Development of Thermionic Cathodes, B. M. Tsarev (pp 675-687, 6 figs).

Modern types of thermionic cathodes are classified with respect to the principal requirements that they must satisfy in modern electron tubes, primarily those employed for the amplification and generation of uhf waves up to the millimeter range. Possible new types of cathodes of the future are described.

Electron Waves in Decelerating Systems. Non-linear Equations of Traveling Wave Tubes, L. A. Vaynshteyn (pp 688-695, 1 fig).

The equations of the nonlinear theory of traveling wave tubes are derived, analyzed, and solved by successive approximation. The forces acting on the electron beam in the nonlinear operating mode and certain other problems in the nonlinear theory of traveling wave tubes are discussed. Reference is made to an article by A. Nordsieck in *Proc. IRE*, vol. 41, p. 630 (1953).

Theory of Electron Beam Shaping, V. T. Ovcharov (pp 696-704).

The author develops a method for finding the electrical field within an electron beam, when the trajectories and the magnetic field (if used) are given, with allowance for the intrinsic charge of the beam.

The method proposed and developed in this article can be used to solve many beam problems so far unsolved. It leads, for example, to a demon-

stration of the practical realizability of the so-called Brillouin beam—a cylindrical beam with constant axial velocity in the homogeneous magnetic field. Configurations such as a converging axially-symmetrical beam for a plane cathode, a ribbon-like beam for a cathode having an area greater than that of the ribbon in a homogeneous transverse magnetic field, and others, can also be treated.

"Phasochron" Backward Wave Oscillator, S. I. Tetel'baum (pp 705-713, 6 figs).

This oscillator uses distributed interaction between the electron beam and the traveling wave field. The phase velocity of the electron bunches is opposed to their forward velocity, so that an internal feedback is produced if the waveguide system employed has a positive normal dispersion. The author develops an approximate theory for such a generator, constructed of a nonretarding two-conductor waveguide system, and gives test results.

Concerning the Electron Energy Distribution of Electrons From Antimony-Caesium Cathodes, A. I. Pyatnitsky (pp 714-725, 14 figs).

Discusses the experimentally established difference in the current-voltage characteristics of the photocurrent between a Sb-Cs cathode and a Ag-Cs layer. Refers to work by Apker, Taft and Dickey (*Physical Review*, 1948, vol. 74, 1462), Bardeen (*Physical Review*, 1947, vol. 71, 717), Apker, Taft, and Dickey (*Physical Review*, 1949, vol. 76, 270), and Taft and Apker (*Physical Review*, 1949, vol. 75, 1181).

Interdepartmental Seminar on Cathode Elec-

tronics, N. L. Yasnopol'skiy and A. E. Dyklop (pp 814-816).

This is the fifth session sponsored by the Institute of Radio Engineering and Electronics of the Academy of Sciences, U.S.S.R. It was held on April 8, 1957 and was devoted to secondary electron emission. The contents of about 15 papers are briefly reported.

Quantum Effects in the Interaction Between Electrons and High Frequency Fields in Resonators, V. L. Ginzburg and V. M. Fayn (pp 780-789).

In the analysis of the quantum effects that take place when electrons pass through a cavity resonator, it is shown that the only quantum effect is essentially the interaction between the electrons and the zero-order oscillations of the field in the resonator. Accordingly, the calculations do not require the use of quantum-mechanical methods and reduce to a simple utilization of the Nyquist quantum formula.

CIRCUITS

Operating Modes of a Symmetrical Multivibrator, N. A. Zheleztssov, M. I. Feygin (pp 751-761, 12 figs).

An approximate method is used to break down the multi-dimensional phase space into the subspaces of the motions of the individual orders, in which the symmetrical multi-vibrator circuit is analyzed. The parasitic capacitances and grid currents are taken into account. The self-oscillation frequency is calculated for positive grid bias. Nonlinear theory of considerable complexity is used in the discussion. A brief reference is made to an experimental verification of the theoretical results, for which good agreement is claimed.

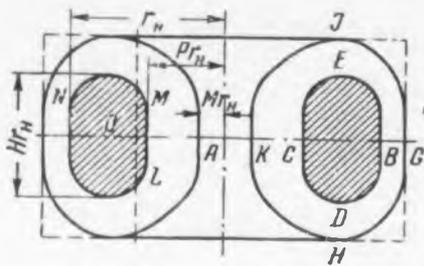
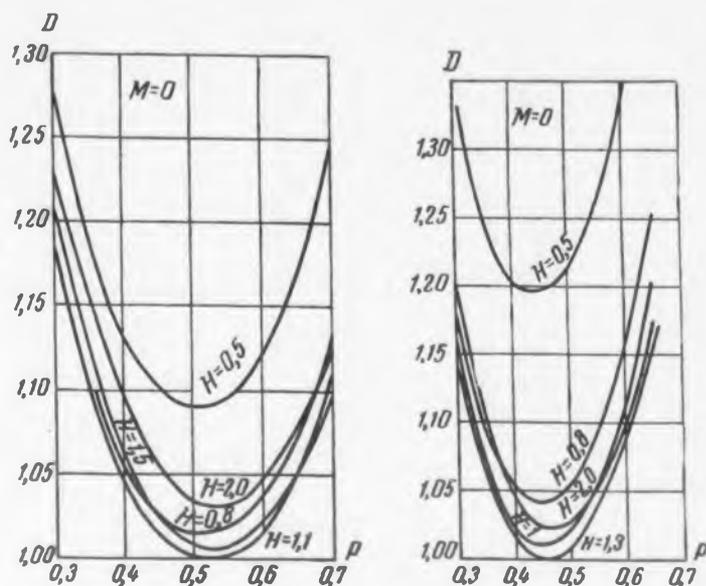


Fig. 1. Transverse section of toroidal core of the (oval) form investigated by Rabkin and Novikova.



Figs. 2 and 3. Dependence of loss angle (D) on the dimensional ratios H and P (which are defined on Fig. 1) for cores in which the magnetization losses predominate (Fig. 2) (left) and for those in which hysteresis losses predominate (Fig. 3).

RECEPTION

Concerning an Optimum Detector for Weak Signals in the Presence of Noise, B. S. Fleyshman (pp 726-734, 1 fig).

The author proposes a more accurate analysis of the problem than Peterson, Birdshall, and Fox, "The Theory of Signal Detectability," *Transactions IRE*, Information Theory, 1954, vol. 4, 171-212, or D. Middleton "Statistical Criteria for the Detection of Pulse Carriers in Noise," *Journal of Applied Physics*, 1953, vol. 24, 371-391, because the latter include only the quadratic term of the expansion of $\log I_0(x)$. The results obtained are in agreement with those quoted by Bussgang and Middleton "Optimum Sequential Detection of Signals in Noise," *Transactions IRE*, Information Theory, 1955, vol. 1, 518, without employing so many simplifying assumptions.

Passage of Fluctuation Signals Through a Detector, with Account of the Effect of Bias and Limitation, E. G. Logachev (pp 735-750, 3 figs).

A general expression for the correlation function of the current at the detector output is used to derive an expression for the correlation function of the noise current at the output of a fluctuation-signal detector at low frequencies, making due allowances for bias and limiting. Cites articles by Middleton on the sub-

ject (*Quarterly of Applied Mathematics*, 1948, page 445, and *Journal of Applied Physics*, 1946, vol. 17, 778).

CIRCUIT ELEMENTS

Calculation of Toroidal Coils with Ferrite Cores, Operating at Audio Frequencies, L. I. Rabkin and Z. I. Novikova (pp 762-768, 3 figs).

The article contains a method for determining the optimum ratio of the dimensions of a toroidal magnetic core, so as to guarantee minimum coil volume for a specified Q or a maximum Q for a specified volume. The calculations are based on the assumption that the ratio of the outside diameter of the coil to its internal diameter is constant. See Figs. 1, 2, and 3.

PHYSICS

Grapho-Analytical Method of Plotting Trajectories of Charged Particles in Magnetic Fields, N. I. Shtepa, (pp 790-795, 4 figs, 1 table).

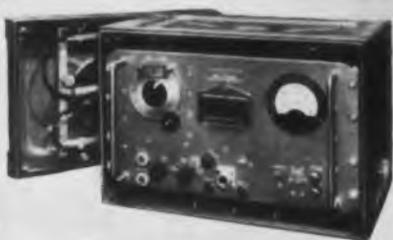
Unlike all other approaches to the problem, this article proposes methods with which it is possible to determine trajectories other than those in axially-symmetrical fields (principally paraxial rays), and treating only nonrelativistic particles. This article treats relativistic particles in magnetic fields, provided that the field distribution is known.



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MEASUREMENTS

Calculation of Resolving Power of Automatic Frequency Analyzers, N. V. Terpugov (pp 796-806, 10 figs).

A method is given for the calculation of the dynamic frequency characteristics of filtering systems. The results of an experimental test on several filtering systems are cited, and generalizations are made concerning their selection and concerning the procedure used to calculate such systems. See Fig. 4.

WAVE PROPAGATION

Allowance for Multiple Scattering in Diffusion UHF Propagation in the Troposphere, D. M. Vysokovskiy (pp 807-809, 2 figs).

Techniques usually employed in multiple X-ray scattering are generalized to include the calculations of the effect mentioned in the title.

ELECTRICAL COMMUNICATIONS

(Contents of *Elektrosvyaz* No. 7, 1957)

TELEVISION

Power Spectrum and Correlation Function of Television Signal, N. G. Deriugin (pp 3-14, 10 figs).

It is shown that the best analytic representation of both the power spectrum and the correlation function of a television signal is in the form of a product of three simple functions, which are determined experimentally for the power spectrum and which can be approximated by experimental curves from which the correlation function of the television signal can be calculated.

CIRCUITS

Concerning the Design of Cathode Followers Operating in the Pulse-Amplification Mode, E. N. Mokhov (pp 15-25, 11 figs).

Analysis of the cathode follower circuit with allowance for the duration and character of the rise of the applied pulses applied to it. Design curves are plotted to facilitate the choice of optimum parameters of a stage so as to prevent tube overload by rapid pulse buildup. A method is given for calculating the influence of nonlinearity of the tube characteristics on the overload of the stage. An illustrative example is given.

Construction of Modulation-Signal Feedback Loops in Radio Transmitting Apparatus, V. A. Khatskelevich, L. M. Shur (pp 26-33, 6 figs).

Continuation of an article published by the authors in the November 1956 issue of *Elektrosvyaz* (*ED* July 15, 1957), attention being now

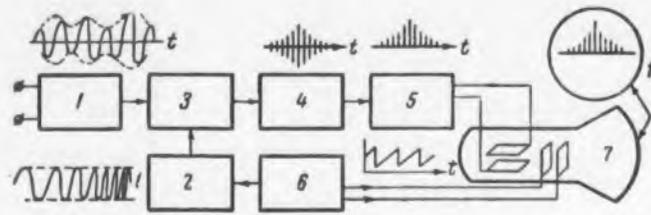


Fig. 4. Block diagram of frequency analyzer: 1—hf amplifier; 2—fm generator; 3—mixer; 4—if amplifier; 5—detector; 6—sweep generator; 7—CRT.

devoted to the choice of the feedback-loop elements. Some ideas are presented concerning a procedure for correcting the frequency characteristics of the loop so as to obtain effective modulation-signal feedback.

Other Articles

Thyratron Circuit for Disconnecting High-Voltage DC Circuits, A. D. Artym (pp 34-41, 9 figs).

Induction Between All-Copper Lines and Steel Lines Through a Third Line, P. K. Akul'shin (pp 42-48, 4 figs).

Method for Calculating Losses in Circuits of Step-by-Step Automatic Telephone Stations with Single Step Preselection, R. A. Avakov (pp 49-56, 6 figs, 1 table).

Analysis of Five-Digit Codes for Letter-Printing Telegraph Apparatus, Yu. I. Savitski and V. M. Timofeev (pp 57-62, 2 tables).

Procedure for Measuring Telegraph Distortions, K. P. Lishai (pp 63-67, 5 figs).

Corrosive Action of Current in a DC Wire-to-Ground Loop of a Communication Cable, M. I. Mikhailov and K. K. Nikol'ski (pp 68-72, 4 figs).

ELECTRICAL COMMUNICATIONS

(Contents of *Elektrosvyaz* No. 6, 1957)

CIRCUITS

Production of High Harmonics with the Aid of a Magnetic Harmonic Generator, L. T. Kim (pp 58-60, 5 figs).

Several circuits are given for obtaining high harmonics with the aid of a magnetic generator,

loaded by a complex load. The circuits make it possible to obtain readily one or two harmonics of the fundamental frequency with a considerable suppression of the remaining harmonics. Reference is made to an article by Peterson, Manley & Wrathall "Magnetic Generation of a Group of Harmonics," *Bell System Technical Journal*, vol. 16, no. 4, 1937.

Analysis of the Operation of a Reactive Trigger Circuit and a Procedure for its Design, A. S. Vladimirov (pp 15-27, 5 figs).

Theoretical analysis of the reactive trigger circuit with anode coupling. Recommendations are made on the choice of parameters to insure the most stable operating condition for the circuit. Methods for engineering design are also given. An example of a circuit design based on the analysis is shown.

Contribution to the Design of Multistage Amplifiers with Junction Transistors, I. N. Migulin (pp 34-41, 8 figs).

The generalized theory of transistor and vacuum tube amplifiers, developed by Kulikovskii in the November 1955 issue of *Radiotekhnika* (*ED*, April 15, 1956) and by Migulin in the September 1956 issue of *Elektrosviyaz* is used to present an analysis and a design procedure for junction transistor amplifiers.

Design of Spark Quenching Circuits, F. F. Zhdanov (pp 47-51, 1 fig, 1 table).

Equations are derived for a variety of spark quenching circuits to operate under various conditions. The results are tabulated, and the limits of the validity of all these equations are indicated in the table.

CIRCUIT ELEMENTS

On the Design of Broadband Grid Transformers for a Specified Input Impedance Characteristic, Y'a L. A'lterman (pp 42-46, 7 figs).

A method is given for the calculation of the optimum parameters of a broadband grid transformer based on the analysis of the specified input impedance characteristic. It is proposed that the required input impedance of the transformer be obtained by means of a shunt, consisting of an active resistance, connected in the secondary winding and equal to the internal impedance of the generator. Using the resultant simple equations, it is possible to determine the maximum transformation coefficient for a specified value of the reflection coefficient.

COMMUNICATIONS

Concerning Certain Geometric Properties of the

Optimum Code, N. K. Ignat'ev (pp 3-9, 1 fig).

Discussion of the choice of the best configuration of signal space to contain the dots of an optimum-code signal (i.e., a code, insuring maximum signal entropy, other conditions being equal). Cases are investigated, in which the dots of the signal are placed in a volume of an n -dimensional sphere, on the surface of an n -dimensional sphere, and in the volume of an n -dimensional cube.

Electronic Telegraph Apparatus, B. P. Terent'yev (pp 52-57, 6 figs).

Description of a telegraphic letter-printing apparatus in which all the basic operations (formation of code transmission, synchronization, decoding at the receiver, etc.) are performed with the aid of vacuum tubes. The circuit of the electronic portion of the apparatus is given and the mechanical parts of a model of the apparatus are briefly described.

Loading of Channels by Service Conversations between Telephone Operators, V. M. Belous (pp 61-63, 5 figs).

It is indicated that the group systems are not satisfactorily operated from the point of view of protecting them against overloads. A method for protecting group channels against high voltages, occurring during service conversation between telephone operators, is given.

RECEPTION

Overshoots of Fluctuations and their Correlation Characteristics, B. I. Tikhonov (pp 10-14, 5 figs, 1 table).

The author reports on an experimental investigation of the distribution of overshoots of normal and Rayleigh fluctuations with respect to duration, and estimates their correlating ability.

WAVE PROPAGATION

Propagation of Meter and Decimeter Waves over the Earth's Uneven Surface, N. D. Dymovich (pp 28-33, 4 figs, 1 table).

The propagation of radio waves over an uneven surface (in particular, one varying sinusoidally in one plane) is examined from the point of view of the laws of geometric optics. A transcendental equation is derived, the graphical solution of which gives the coordinates of the reflection points. An equation is given for the difference in the paths of the direct and reflected rays. The validity limits of the proposed calculation methods are discussed. Comparison of the results of the method given here with a more rigorous diffraction method and with the experimental data shows good agreement with both.



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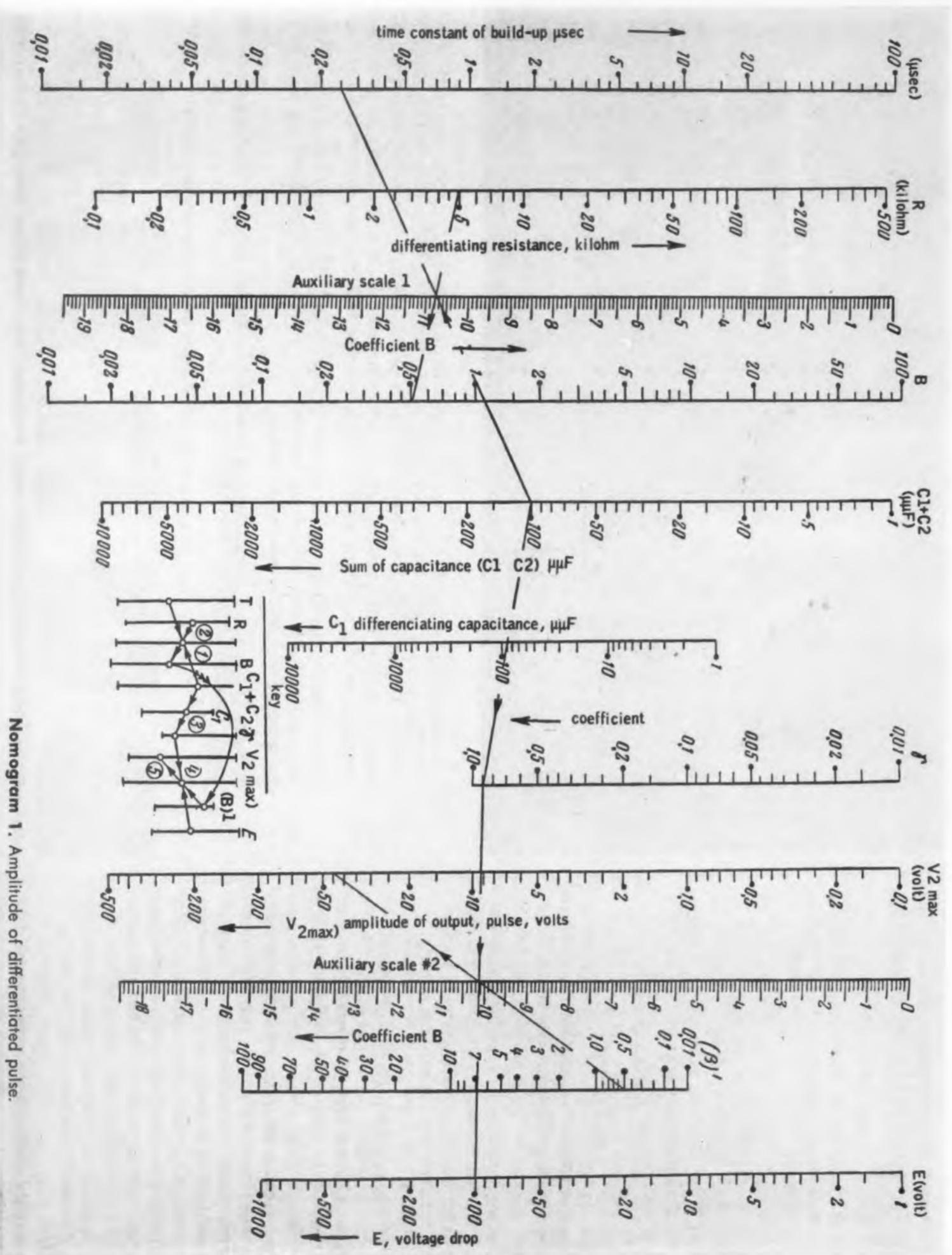
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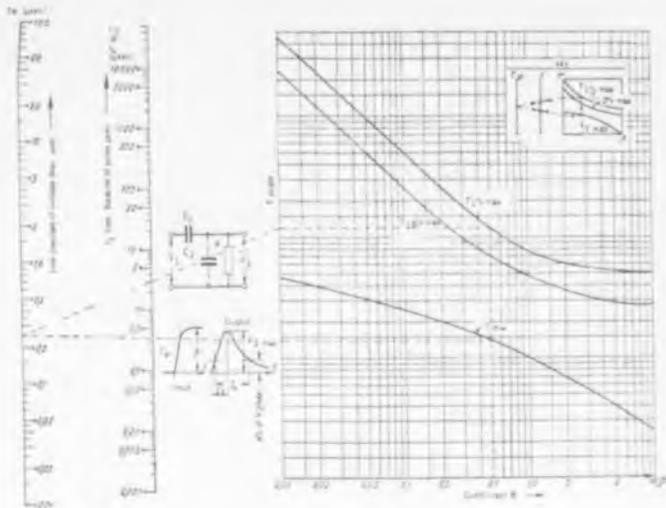
CIRCLE 426 ON READER-SERVICE CARD

R-C Differentiator Nomograms

J. George Adashko



Nomogram 1. Amplitude of differentiated pulse.



Nomogram 2. See next page.

THESE nomograms yield the amplitude and duration of pulses obtained by differentiation of rising and falling voltages. The differentiation is effected by the circuit shown in nomogram 2. Here R is the differentiating resistance, C_1 the differentiating capacitance, and C_2 the parasitic capacitance parallel to resistance R . If the input signal is of the form

$$V_1 = E(1 - e^{-t/\tau_\phi})$$

the equation for the output pulse is

$$V_2 = \frac{E C_1}{\tau_\phi (C_1 + C_2)} \frac{[e^{-t/\tau_\phi} - e^{-t/R(C_1 + C_2)}]}{1 - \frac{1}{R(C_1 + C_2) \tau_\phi}}$$

where τ_ϕ is the time constant of the voltage drop. The maximum amplitude of the differentiated voltage is

$$V_{2max} = \frac{E C_1}{C_1 + C_2} \left[\frac{1}{\beta} \right]^{\frac{\beta}{\beta-1}} = \frac{E C_1}{C_1 + C_2} e^{\frac{-t_3}{R(C_1 + C_2)}}$$

where $\beta = \tau_\phi / R(C_1 + C_2)$. By determining V_{2max} , we find the delay of the peak of the differentiated pulse relative to the start of the voltage applied to the differentiator. This time is $t_3 = 1/\beta - 1 \tau_\phi \ln \beta$. In the same manner, it is possible to determine the time delay of any part of the differentiated pulse, expressed as a fraction of the maximum value, that is, the duration of the pulse at a given voltage level. If one defines $\gamma = C_1 / (C_1 + C_2)$ and $T = t/\tau_\phi$ one may write $t_\gamma = \tau_\phi T_n$ where n is the percentage of V_{2max} at which the duration of the pulse is measured. From this one obtains

$$V_{2max} = E \gamma e^{-\beta T_{max}} \text{ and } t_3 = \tau_\phi T_{max}$$

(Continued on following page)

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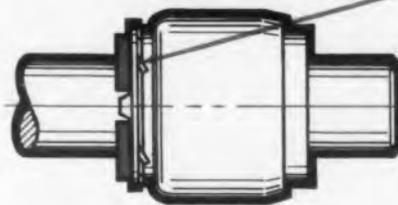
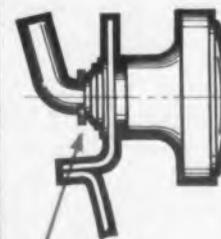
application: external for shafts
range: .077 in. — .755

The Waldes Truarc Grip Ring requires no groove, holds fast by friction forces, can be used again and again. It provides a positioning shoulder secure against moderate thrusts or vibration. The ring's unusually large radial width exerts considerable frictional hold against axial displacement.

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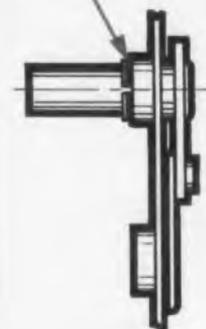


Rings save \$300 per die, \$.03 unit

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Rings save \$32.42/M:

Swift Business Machine Co. replaced collars and set screws in hollow shaft assembly of its adding machine with series 5555 grip rings, saving \$32.42 per 1000 units. Rings require no groove, make possible positioning adjustments without slippage encountered when set screws were used.



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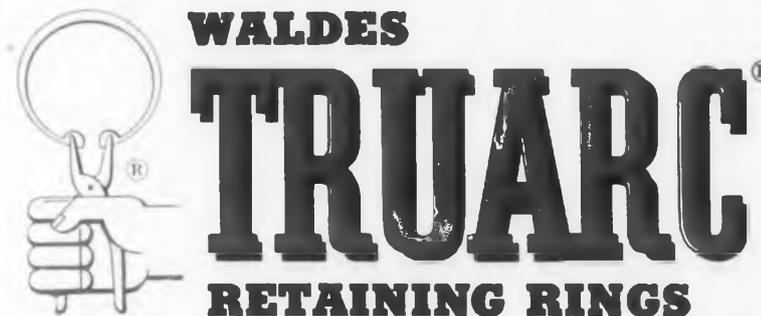
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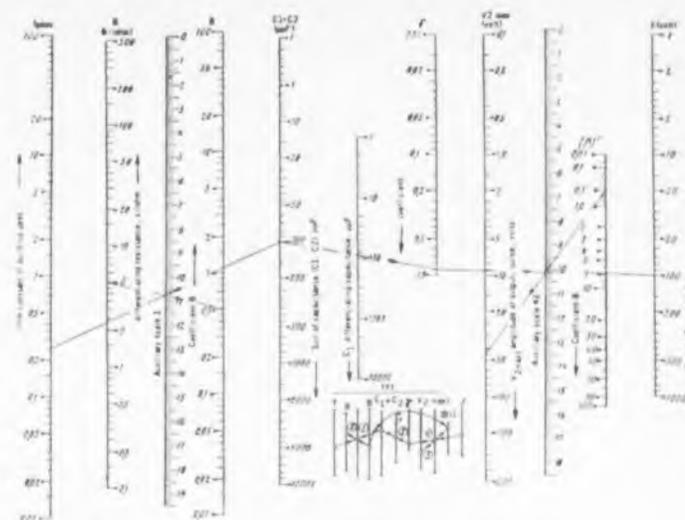
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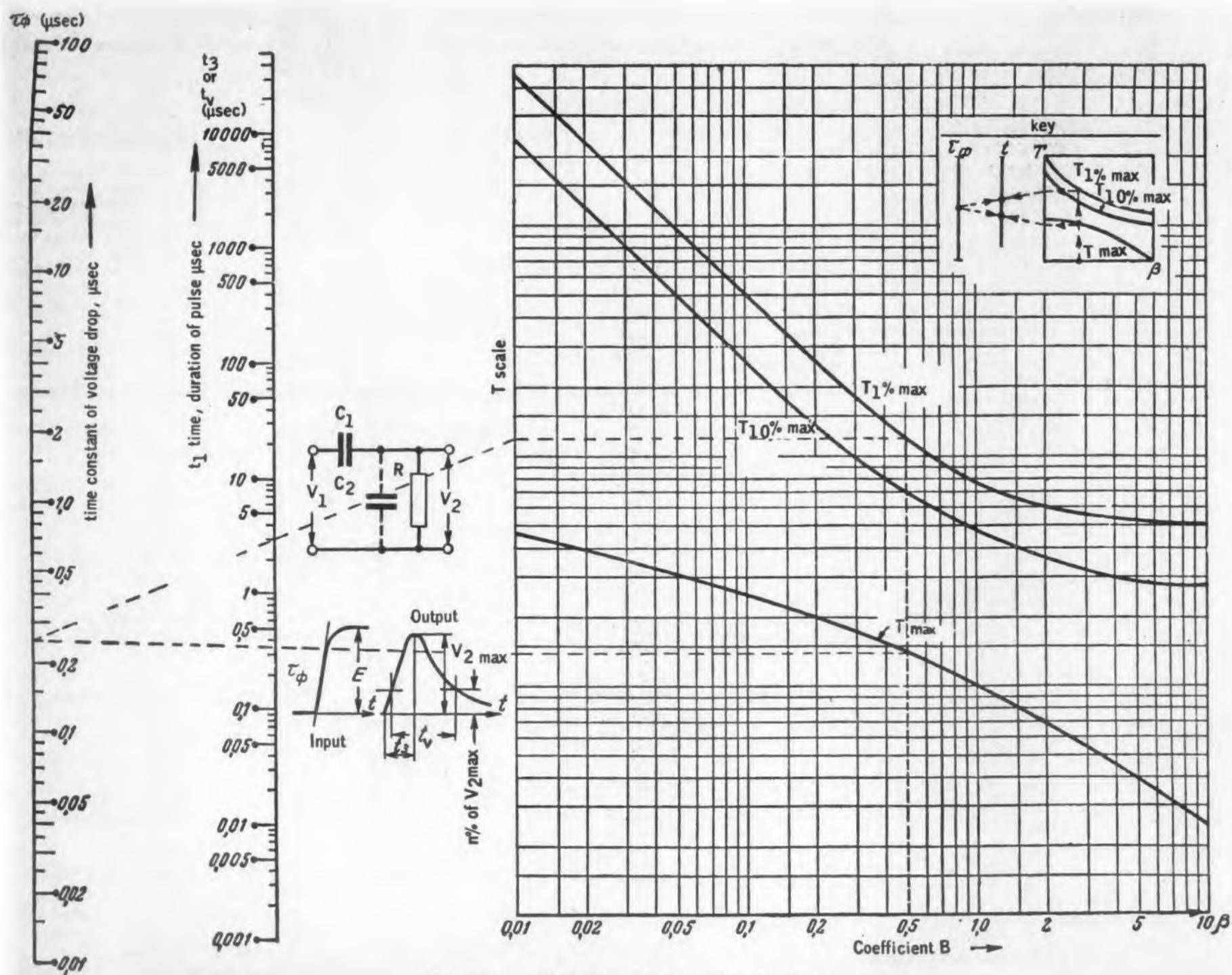
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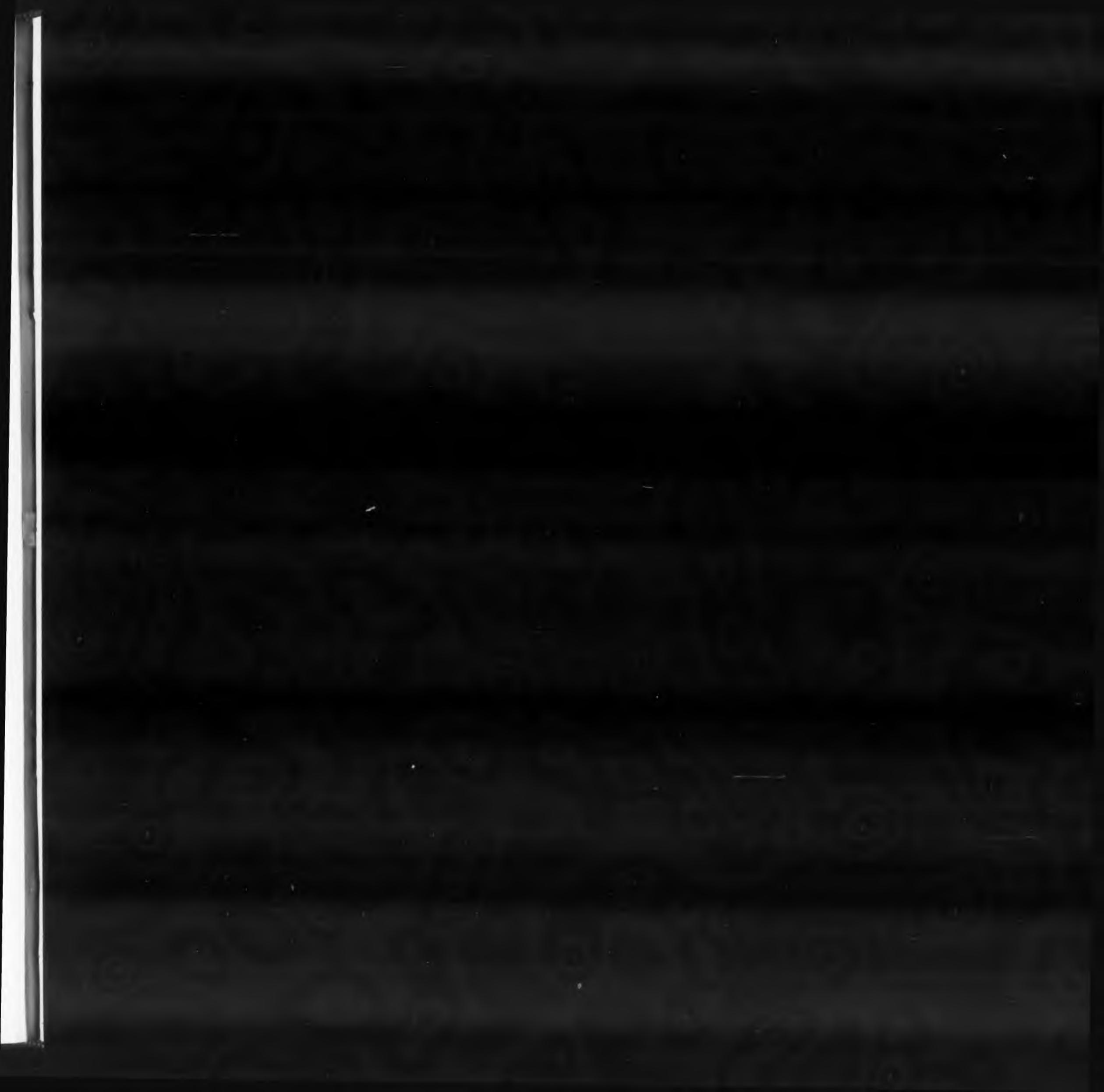
CIRCLE 427 ON READER-SERVICE CARD



Nomogram 1. See previous page.



Nomogram 2. Duration of differentiated pulse.



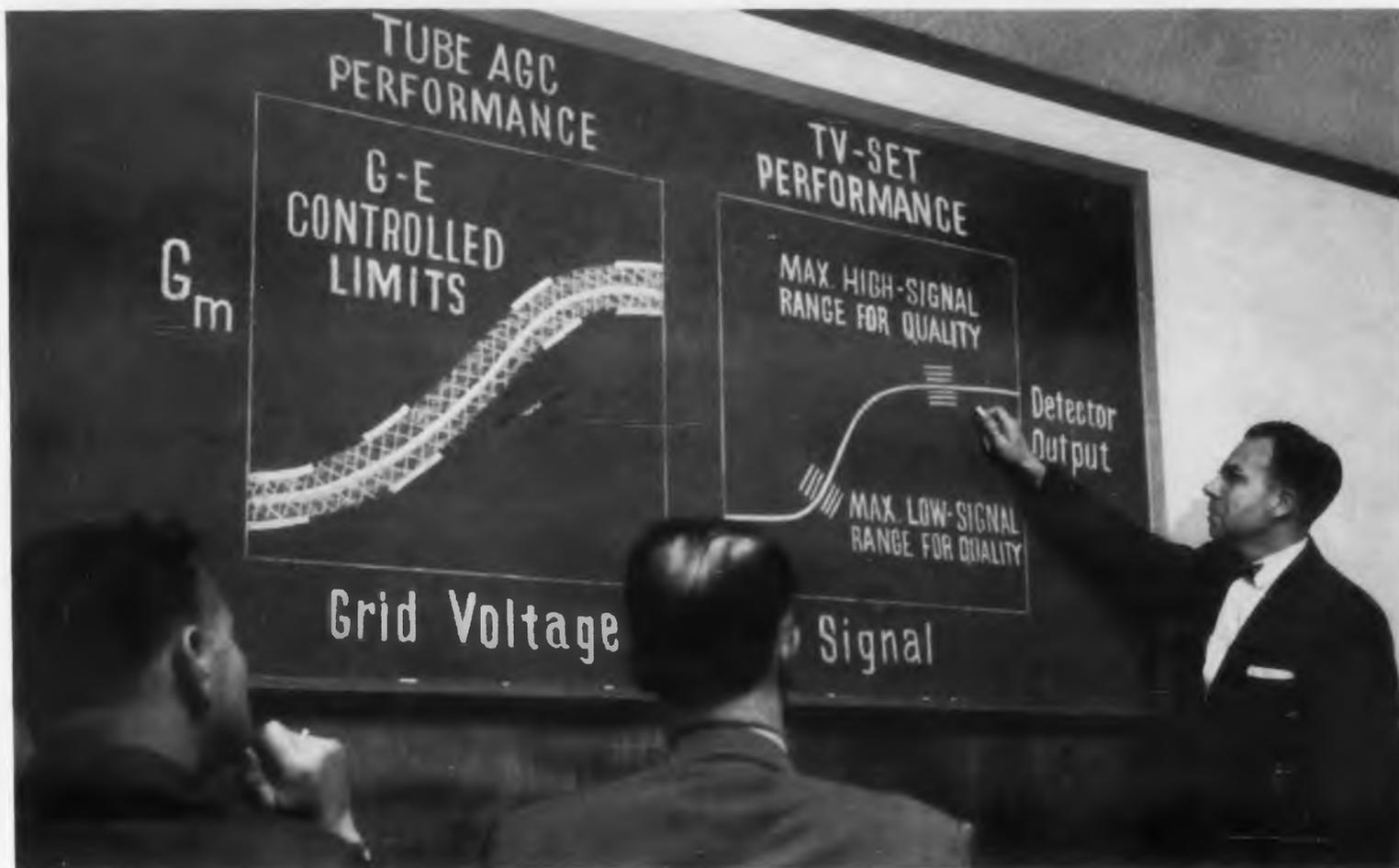
GENERAL  ELECTRIC

TUBE DESIGN NEWS

FROM THE RECEIVING TUBE DEPARTMENT OF GENERAL ELECTRIC COMPANY



General Electric Improves TV Reception Through New, Close Controls of Tube AGC Performance!



How General Electric's close control of tube AGC characteristics stabilizes TV-set performance! R. E. Moe, Manager of Engineering, General Electric Receiving Tube Department, shows the relationship that exists

between tightly-controlled characteristics of an IF-amplifier type, and television-receiver performance that is held to quality levels at important points such as the high-signal and low-signal reception areas.

More and tighter controls than the industry has used before, are being applied by General Electric to critical IF-amplifier tubes for sockets with AGC. Television manufacturers and owners benefit in improved reception, whether in low, intermediate, or strong-signal areas.

In the past, the practice has been to hold quality controls to the high and low ends of the AGC voltage range, which led to variations—often wide—in the shape of the actual tube performance curve. Now, by doubling the number of control points,

General Electric helps stabilize the performance of IF-amplifier types at all signal levels.

In addition: through median, or "lot-center" control methods, a heavy preponderance of General Electric tubes manufactured and shipped follow the center line of the optimum performance curve (see chart at left, above). The percentage of tubes which approach the outside control limits is exceedingly small.

Because tubes for fringe-area TV must amplify extremely weak signals, high tube gain is fundamental—and,

from the standpoint of a receiver manufacturer, must be uniform and predictable in every lot of tubes he installs. Strong-signal reception, on the other hand, calls for equally uniform and predictable grid cut-off characteristics.

By promoting consistent tube AGC performance at all voltages, General Electric's new, close control methods help make it possible for television builders to offer the public sets that are economical in circuitry and transform signals of any strength into pictures with superior quality.

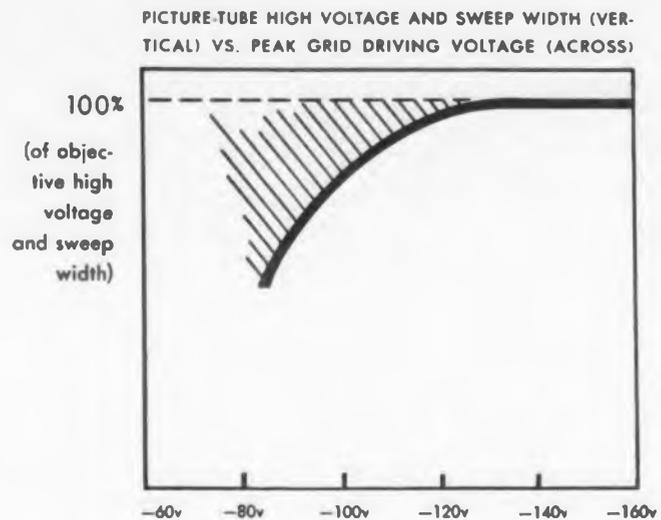


Tear off and keep this sheet for reference. It contains useful tube-application data.

WITH TV SWEEP TUBES, INADEQUATE GRID DRIVE CAN CAUSE ...

- ... Loss of sweep width—giving a narrowed and distorted picture.
- ... Reduction in the picture-tube voltage—less brightness and contrast.

RIGHT: curve shows how sweep width and high voltage both are reduced by grid voltage that is insufficient. The shaded area indicates less-than-desired picture performance. Designers, by providing for ample grid drive in the sweep circuit, can contribute importantly to superior TV.

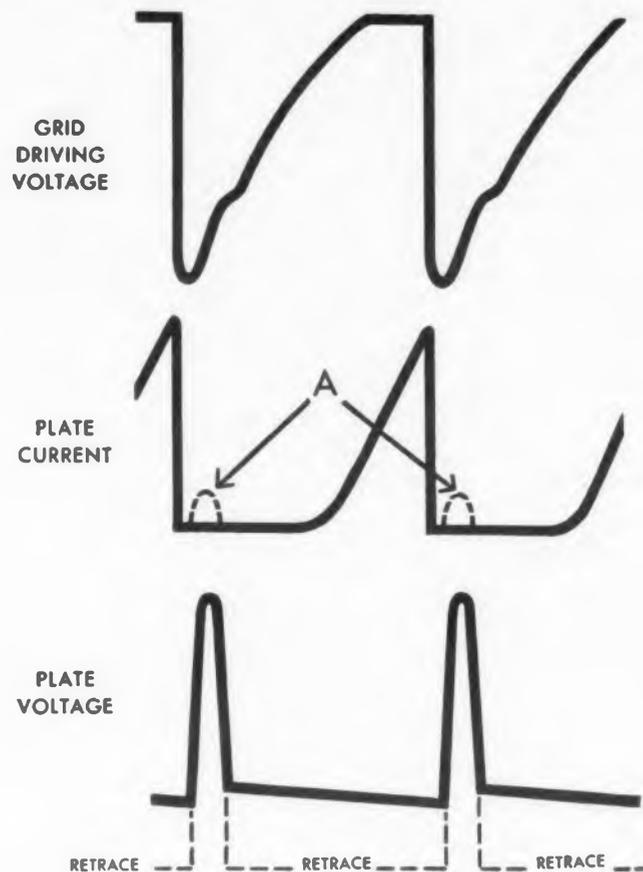


Low Grid Drive Will Fail to Hold Tubes at Cut-Off. Circuit Energy Suffers.

In the center curve at right, "A" indicates the undesirable plate-current flow that can occur when grid drive is insufficient to hold a horizontal-amplifier tube at cut-off. This flow acts as a shunt on the stored energy of the circuit. The result is a loss of high voltage and sweep width of as high as 50%.

TV designers must guard against two contingencies. One is insufficient grid voltage provided for in the sweep circuit itself. After the circuit has been checked with this in mind, the designer should assure himself that the sweep tubes he selects will meet those standards of performance required for high picture-tube voltage and full sweep width at all times.

Here General Electric assists by carefully controlling, through high-voltage testing, the cut-off and other characteristics of 6DQ6-A's and other sweep tubes *before* they reach the set manufacturer's hands. More dependable TV quality results.



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