

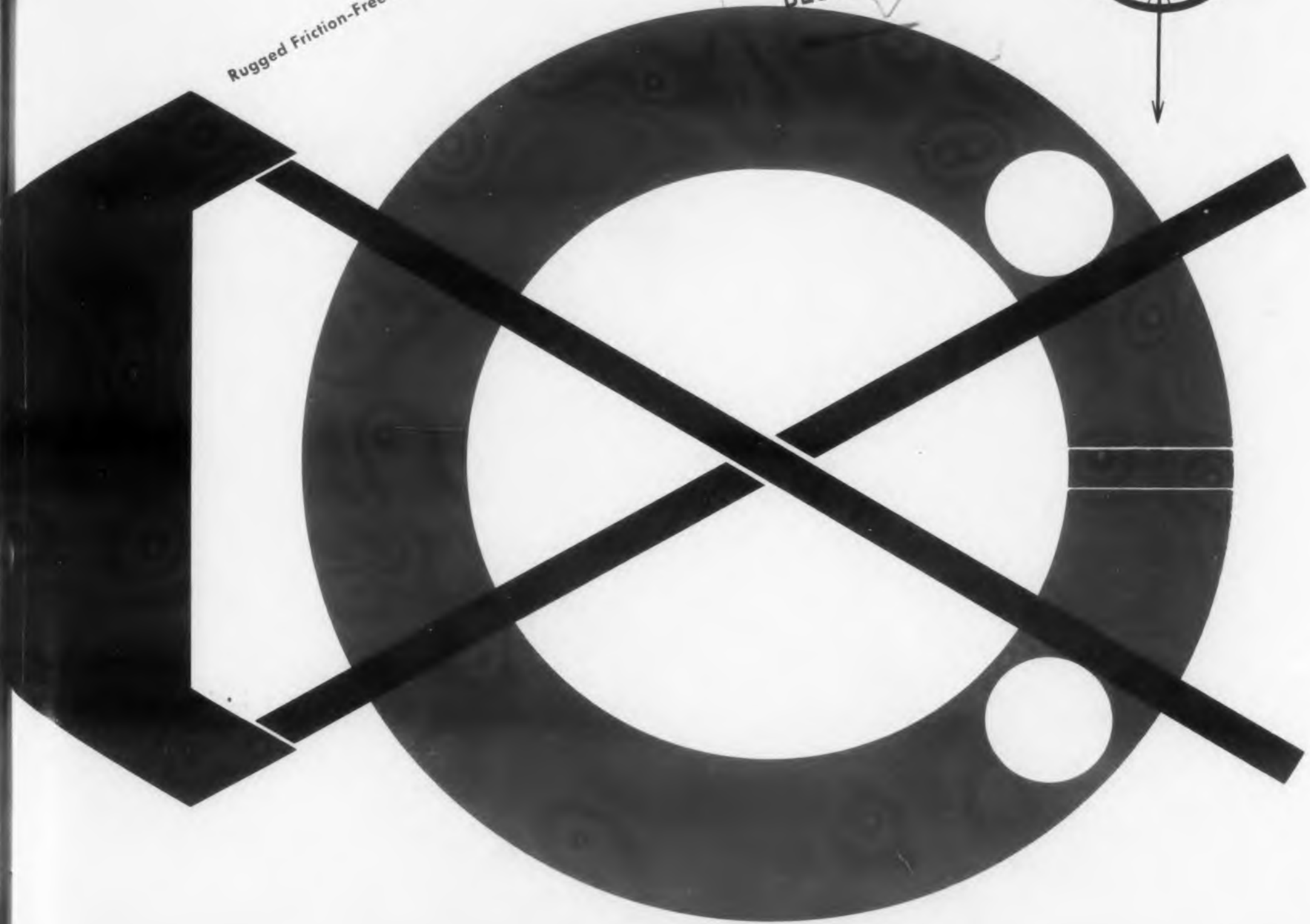
ELECTRONIC DESIGN

B 680282

NOV 15 1957

Rugged Friction-Free Meter Movement . . . page 28

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ELECTRONIC DESIGN

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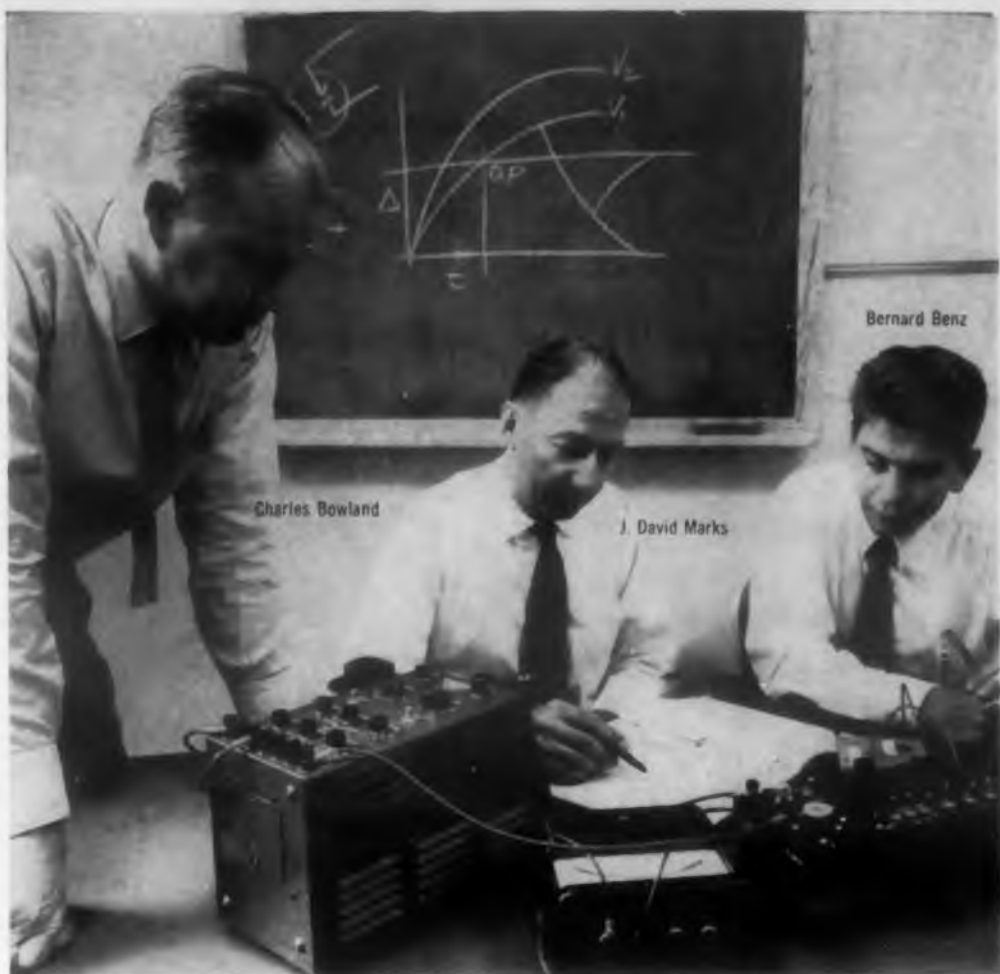
Vol. 5, No. 21

November 1, 1957

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ELECTRONIC DESIGN is published semi-monthly by Hayden Publishing Company, Inc., 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland Jr., Vice-President & Treasurer and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Acceptance under section 34.64 P. L. & R. authorized. Copyrighted 1957 Hayden Publishing Company, Inc. 30,000 Copies this issue.





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Which ceramic characteristics do you need . . .

Characteristic	Material								
	Electrical Porcelain	Steatite	Fused Quartz	Magnesia	Cordierite	Glass Bonded Mica	Raytheon R-95 High Alumina	Forsterite	Zircon
Dielectric Constant (1 mc)	6-7	5.5-6.5	3.7	5.8	4.5	7-8	9	6.5	9
Power Factor (1 mc)	.009	.0008	.00035	.0008	.008	.002	.001	.0002	.0014
Loss Factor (1 mc)	.055	.004	.0013	.004	.03	.016	.009	.0014	.013
Water Absorption (%)	0-1.0	0-.01	0	16	3-8	0.5	0.0	0-0.01	0-0.01
Tensile Strength (p.s.i. x 10 ³)	2.6	13	8	2.8	3	8	25	10	10
Flexural Strength (p.s.i. x 10 ³)	11	20	—	6	7-10	18	45	12	18.5
Compressive Strength (p.s.i. x 10 ³)	30-65	65	200	48	50-95	25	250	80	80
Dielectric Strength (volts/mil)	100-200	250	200	65	200	245	450	250	200
Hardness, Moh's scale	7.5	7.5	5	6	7	—	9	7.5	8
Modulus of Elasticity (p.s.i. x 10 ⁶)	10	14	4	—	5	—	42	—	21
Specific Gravity	2.4	2.6	2.2	3.0	2.5	—	3.7	2.8	3.7
Linear Thermal Expansion 20-100°C (in./in./°C x 10 ⁻⁶)	3.6	6	.20	9.4	2.5-4	—	6.2	8.5	2.5-5
T _E Value (°C)*	—	450°-800°	—	—	750°	—	980°	990°	700°

*T_E is that temperature at which the volume resistivity reaches 1 Meg.

Approximate characteristics of "electronic" ceramic materials. Source: manufacturer sales literature

Reprinted from Electronic Design, November 1, 1956

How Raytheon R-95 High-Alumina Ceramic can save you money—do a better job



Consider well the unusual properties present in Raytheon R-95 High-Alumina Ceramic. If your needs are for a less specialized material, you may find a satisfactory performer at lower cost.

However, when you require a material with remarkably *high resistance to high temperature, shock and vibration; high dielectric strength and high electrical resistance at all temperatures; extreme hardness; high mechanical strength and positive sealing capability*—then you will surely want to be familiar with the ratings of Raytheon's R-95. Proper application of this superior material assures continuing design and assembly economy, particularly where ceramic seals are a factor.

Ceramic parts manufactured from Raytheon R-95 High Alumina are available, either alone or as hermetic ceramic-to-metal assemblies, in accordance with your specifications. The assemblies can be soft or hard soldered into your production in your own plant.

Send sketches or drawings outlining dimensions and tolerances, together with operational conditions. We will be pleased to supply information and help on any of your ceramic needs.

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Ceramic Sales

Waltham 54, Massachusetts

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Editorial

Non-Standard Parts Headaches

When a non-electronics neighbor wanted to give your editor an old 12-in. TV for replacement parts, your editor's spouse said nothing doing. Her basement was cluttered now with boxes of tubes and none could be used to fix those two radios and the hi-fi set! How true. Those old 5-pin 27's, 47's, and 83's in musty boxes are obsolete and definitely non-standard. The logistics of keeping a desirable replacement stock for simple home repair service is quite difficult for most of us. The Military's replacement part problems are considerably more complicated. The non-standard part, specified hundreds of thousands of times each year by designers, is a real military logistics problem.

You get some idea of the Department of Defense's problem when you realize they have an inventory of about 100 billion dollars. Over 3,200,000 items are classified under the Federal Cataloging System. Some 600,000 new items are added each year.

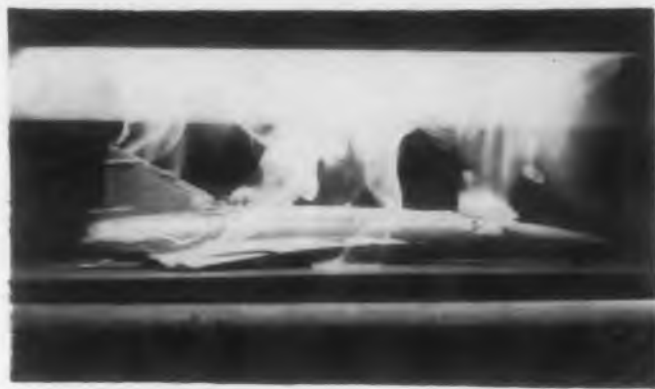
Upwards of 50 per cent of all parts going into modern electronic military equipment are not on approved products lists. Although the freedom to select non-standard parts often leads to otherwise unobtainable outstanding equipment, the logistics problem is greatly aggravated.

The Military are considerably concerned over the high incidence of non-standard parts. Part of their safeguards in preventing irresponsible substitution of parts is the requirement that such parts be okayed by them. Considerable test data and paper work are called for before a waiver is given. This procedure in getting such approvals gives the designer a personal reason for trying to stay with the standard part.

Leo D. Harris of General Electric's LMEE Dept. suggests that these pertinent points be considered before a non-standard part is specified. Have the design approaches using standard parts been explored fully? Do the benefits of a non-standard part justify the cost in time and effort in getting approval? Will the production schedule be upset while getting test data on a non-standard part?—JAL

Engineering Review

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



Thermal Barrier Testing

The simulated jet plane in the photograph is melting from the high-temperature effects produced in a new infra-red elevated temperature test facility. This unit, developed by the Westinghouse Electric Corp., Pittsburgh, Pa. was constructed to study the effects of rapid heating and high temperatures on structural parts of aircraft and missiles. The test equipment can create heat conditions at least three times faster than standard apparatus now in use. This enables engineers to eliminate time lags in the heating cycle, thus simulating heat conditions in flight. At missile speeds, heat is generated faster than dissipated, and metals distort, melt and vaporize. This facility can create temperatures above 2500 F in twelve seconds, and is large enough to permit engineers to test full scale air frames, structural parts, components, and whole aircraft, in simulated flight through the thermal barrier. The test facility consists of banks of tubular quartz infra-red lamps, an ignatron controller, computer channels, strip chart recorders, master control desk, bus duct system, and safety devices.

Radio Web

An electronic system which provides safe navigation and landing patterns for aircraft is under development by Stavid Engineering, Inc., Plainfield, New Jersey. This system, called Radio Web, is the latest entry in the field of air traffic control, and is said to be an immediate answer to this problem. This apparatus offers a flexibility which should accommodate aviation requirements through 1957.

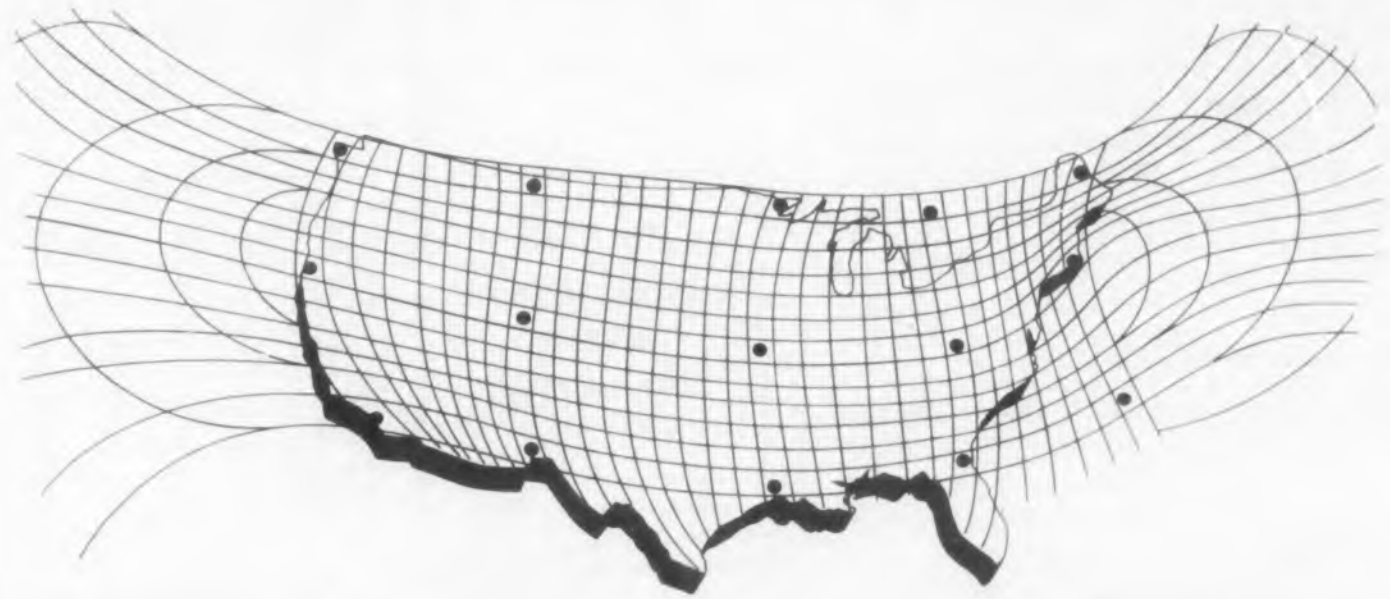
Designed in France by Col. Pierre Gaudillere, director of Société Francaise de Telecommunication, the system has been tested in the vicinity of Paris. All U. S. and Canadian rights are under

the control of Stavid, who hopes to obtain a development contract for the system.

The system basically will consist of modular airborne units and land-based transmitters. It can provide aircraft with information on their heading and distance to destination, a continuous graphic display of position and track, and an air collision warning for both short and long range conditions.

The basic Radio Web system is designed for small and medium size aircraft, where size and weight are of primary importance. However, the system can accommodate all aircraft, regardless of size, speed or operating requirements.

The light craft system carries navigation



Fifteen 100-kilowatt radio WEB transmitters, arranged in adjacent squares, would provide a grid pattern sufficient for accurate navigation anywhere in the U.S. Additional transmitters would extend the system to neighboring countries and continents.

equipment, enables the pilot to determine his location within one mile, and a small responder which places it in a traffic control pattern; while a system for a larger craft incorporates automatic tracking and collision warning devices.

The heart of this system is a series of ground located stations which transmit four carrier modulated signals in a sweep pattern to create a grid of rectilinear lines which are superimposed on an area chart for orientation. As this signal encounters an aircraft, it is detected by a four channel receiver, which drives a series of synchronous detectors. The signal is then analyzed, and the intervals between the received channel are measured. Position coordinates appear automatically in digital form, and the aircraft position is shown on a map by a route tracer. As an aircraft enters a designated air traffic control sector, it transmits position signals on a predetermined carrier frequency channel. As the frequency varies within the channel, as a function of altitude, a ground station can view all planes in the entire sector, at any particular altitude on a cathode ray tube with a map overlay.

Nuclear Powered Aircraft

Preliminary design work, conducted at Lockheed Company, Marietta, Ga., indicates that a large, nuclear powered air transport with virtually unlimited range is practical at this time. An aircraft of this type would not be dependent on large overseas stocks of chemical fuel for military operations.

A fleet of nuclear transports could, for example, move an army division from San Francisco to Manila, land or paratroop the cargo, and return nonstop to America.

The appearance of this nuclear aircraft could resemble the current C-130 combat transport, and use one reactor as a power source. Weight of the nuclear fuel would be insignificant, however, effective shielding could become a major design problem.

Power Failure Located via Radio

An outage locator, designed to detect a tripped recloser along a power line locates faults without subscriber participation. The outage locator designed by Motrel, Inc., Baton Rouge, Louisiana is an FM Transmitter operated automatically in response to a tripped associated recloser, fuse or circuit breaker. Each sectionalizer, equipped with an outage locator, transmits a distinctive coded signal which identifies that sectionalizer.



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Raytheon presents this full complement of both Silicon and Germanium PNP Transistors in the JETEC 30 package including new *RF and AF Types* and several types in an extremely small package.

All these Transistors are made by the Raytheon-perfected *fusion-alloy* process that assures superior electrical performance and supreme reliability; life tests aggregating over 20,000,000 transistor hours show *less than one open per 800,000 hours and no shorts.*

SILICON TRANSISTORS	Type	Case	V _{CE} max. volts	Beta ave.	I _{CO} ave. μ a	I _{EO} ave. μ a	r _b ave. ohms	r _c ave. kilohms	f _{αb} ave. Kc	Noise Factor max. db	Dissipation Coefficient	
											In Air °C/mw	In Sink °C/mw
	2N327	A	-40	14	0.005	0.005	1300	900	300	30	0.43	0.25
	2N328	A	-30	25	0.005	0.005	1500	1000	350	30	0.43	0.25
	2N329	A	-20	50	0.005	0.005	1800	1250	600	30	0.43	0.25
	2N330	A	-20	18	0.005	0.005	1500	1000	500	15	0.43	0.25

COMPUTER TRANSISTORS	Type	Case	V _{CE} max. volts	f _{αb} ave. Mc	H _{FE1} ave. I _B = 1 ma V _{CE} = -0.25V	H _{FE2} ave. I _B = 10 ma V _{CE} = -0.35V	Rise Time* max. μ sec	Dissipation Coefficient	
								In Air °C/mw	In Sink °C/mw
	2N425	A	-20	4	30	18	1.0	0.4	0.18
	2N426	A	-18	6	40	24	0.55	0.4	0.18
	2N427	A	-15	11	55	30	0.44	0.4	0.18
	2N428	A	-12	17	80	40	0.33	0.4	0.18

*I_C = 50 ma; I_{B1} = 5 ma; R_L = 200 Ω ; I_{B2} = 5 ma; Grounded Emitter Circuit

GENERAL PURPOSE AUDIO TRANSISTORS	Type	Case	V _{CE} max. volts	Beta ave. small signal	Power Gain Class A ave. db	I _{CO} ave. μ a	Noise Factor ave. db	Dissipation Coefficient	
								In Air °C/mw	In Sink °C/mw
	2N422	A	-20	90	40	6	6 max.	0.36	—
	2N464	A	-40	22	40	6	12	0.36	0.15
	2N465	A	-30	45	42	6	12	0.36	0.15
	2N466	A	-20	90	44	6	12	0.36	0.15
	2N467	A	-15	180	45	6	12	0.36	0.15
	2N130A	B	-40	22	40	6	12	0.59	—
	2N131A	B	-30	45	42	6	12	0.59	—
	2N132A	B	-20	90	44	6	12	0.59	—
	2N133A	B	-20	50	38	6	6 max.	0.59	—
	CK754	B	-10	300	45	6	—	0.59	—

Your Design is Better

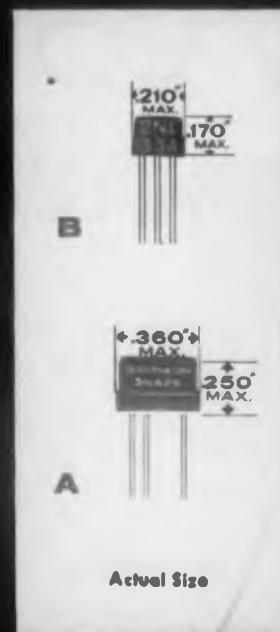
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CIRCLE 4 ON READER-SERVICE CARD FOR MORE INFORMATION

2N1
33A

RAYTHEON
2N329



Write for Data Sheets
on individual types for
complete ratings and
test conditions.

GENERAL PURPOSE RADIO FREQUENCY TRANSISTORS	Type	Case	V _{CE} max. volts	f _{ob} ave. Mc	Beta ave.	C _{ob} ave. μf	r _b [*] ave. ohms	Dissipation Coefficient	
								In Air °C/mw	In Sink °C/mw
	2N413	A	-18	2.5	25	12	70	0.4	0.18
	2N414	A	-15	6	40	12	80	0.4	0.18
	2N416	A	-12	10	60	12	90	0.4	0.18
	2N417	A	-10	20	80	12	100	0.4	0.18

IF AND RF RADIO RECEIVER TRANSISTORS	Type	Case	Circuit Usage	V _{CE} max. volts	C _{ob} μf	Gain db	Type	Case	Circuit Usage	V _{CE} max. volts	C _{ob} μf	Gain db
		2N481	A	Osc.	-12	12 ave.	—	2N413	A	Osc.	-18	12 ave.
	2N482	A	IF	-12	12±2	31*	2N413A	A	IF	-18	12±2	31*
	2N483	A	IF	-12	12±2	35*	2N414A	A	IF	-15	12±2	35*
	2N484	A	IF	-10	12±2	39*	2N414	A	Conv.	-15	12 ave.	26‡
	2N485	A	Conv.	-12	12 ave.	26‡						
	2N486	A	Conv.	-10	12 ave.	30‡						

*Maximum Available Gain @ 455 kc

‡Conversion Gain @ 1 Mc

AUDIO RADIO RECEIVER TRANSISTORS	Type	Case	Circuit Usage	Supply Voltage max. volts	Power Gain		Dissipation Coefficient	
					Class A db	Class B db	In Air °C/mw	In Sink °C/mw
	2N359	A	Output	-16	40*	37‡	0.36	0.15
	2N360	A	Output	-16	37*	34‡	0.36	0.15
	2N361	A	Output	-16	34*	31‡	0.36	0.15
	2N362	A	Driver	-16	41♦	—	0.36	—
	2N363	A	Driver	-16	37♦	—	0.36	—

♦@ 50 mw, 9 volt supply

‡@250 mw, 9 volt supply

♦@ 1 mw, 9 volt supply

All ratings taken at 25°C. All types are hermetically sealed.

Unless otherwise indicated all data taken at V_{CE} = -6 volts, I_C = 1.0 mA



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This coded information is received directly by mobile unit or base station, providing the maintenance department with immediate notification of line failure.

Automatic receiving equipment can be used to cut transmission time to a fraction of a second. Normal range is 35 miles when the unit is mounted at an elevation of 35 feet on a pole.

An FCC ruling now permits electric utilities to engage in one-way signaling on mobile service frequencies to indicate electric line outage.



Isotope Snow Gage: A snowfall gage or meter utilizing Cobalt-60, a radio-active isotope, has been completed jointly by the Tokyo Meteorological Observatory and Tokyo Hydroelectric Power Development Corp.

The instrument, shown above, has been successfully tested at the Sugudai Power Generation Plant in Gumma Prefecture, 100 miles northwest of Tokyo in the heart of the Fammyaku Mountain Range, Japan's area of heaviest snowfall in winters.

The Geiger counter which is suspended in mid-air from the cross-arm measures the intensity of radioactivity given off by Cobalt-60 through the layer of snow, and the measurement will be automatically transmitted to both the weather bureau and the hydro-electric power development station nearby.

The information thereby obtained is regarded as highly valuable in forecasting the beginning of spring thaw and, in addition, the amount of water to be released when the snow melts.

1=4/VOCA^{model 101}

IN ONE INSTRUMENT!

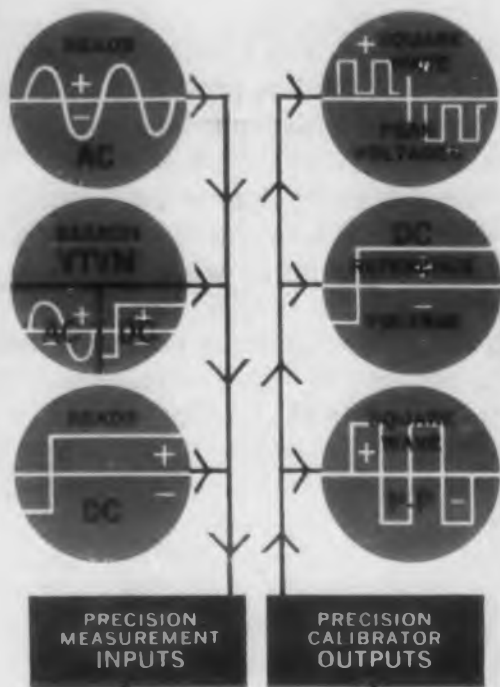
DEMOLAB introduces the VOCA, a precision differential null type potentiometric voltmeter and search VTVM for AC and DC, including a precision calibrator delivering square wave and DC output reference voltages. Plus accessories.

.1V to 500 Volts in a 5 digit readout.
4 Digits .01V to .1V - 3 Digits .001V to .01V. 2 Digits .0001V to .001V - Usable readouts down to 50 uv.

to .05% from 0 to 500 Volts DC
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1 part in 10,000 at low end of each range.
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Amplitude referenced against a Standard Cell. Super regulated power supply for stability.



BUILT-IN FEATURES

RANGE

ACCURACY

READOUT RESOLUTION



Back Mounting with Bench Brackets

ACCESSORY FEATURES:

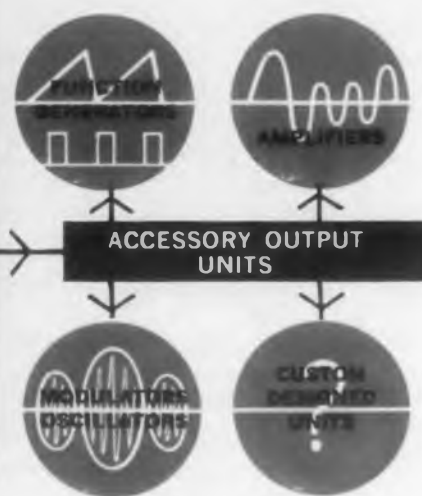
A family of input probes, shunts, and output units extending the AC range and the basic accurate reference standards of the instrument to an infinite variety of functional uses is available.

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ACCESSORIES



INPUT shunts INPUT probes



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Scattering apparatus has Helmholtz coils on a wooden frame to cancel out earth's magnetic field. The beam of free electrons is fired from a conventional electronic gun and the scattered atoms are counted by a hot wire detector.

Electron Exchange Observed

In recent physics, the nucleus of the atom has been mapped and scrutinized with infinite care. Attention to the other partner in the atom, the electron is under intense study at the engineering Research Division of New York University, New York 53, N.Y. The interplay of electrons characterizes natural and technological events, from astrophysics to chemical reactions. The research, under the direction of Dr. Benjamin Bederson, has concentrated on techniques for studying electron behavior, particularly the interaction of free electrons bound in the atomic structure. In addition to inherent physical interest, electron interaction has become a pressing problem in rocket and missile development. When aircraft re-enter the earth's atmosphere, the heat of friction produces electrons that ionize the free atoms of oxygen and nitrogen, and produce a blanket of ions around the rocket body. This blanket or sheath acts as a perfect conductor. It is capable of absorbing radio waves directed to the aircraft, thus depriving it of control. The solution of these problems lies in a knowledge of the cross sections of electron interactions, and the probability

CIRCLE 7 ON READER-SERVICE CARD

Electron Tube News

—from SYLVANIA

Creating New Design Trends—Everywhere in Electronics

IN 110° PICTURE TUBES ...

Sylvania goes into production on the 24AMP4, a 24-inch 110° picture tube that fosters new concepts in set design

In 24-inch tubes—Sylvania applies the 110-degree deflection design to 24-inch picture tubes. The result is a tube 6" wider than it is long. The new dimension permits interesting new concepts in TV chassis design as well as in cabinet styling. The new 24AMP4 presents a new opportunity for TV receiver manufacturers to score again with 110-degree TV sets.

The new 110° 24-inch tube weighs 26.5 pounds, some 6 pounds less than its 90° predecessors. It measures 15 $\frac{5}{8}$ inches in length, 3 $\frac{1}{2}$ inches shorter than 24", short neck, 90° tubes. Useful width is 21 $\frac{3}{8}$ inches. Picture area is approximately 332 square inches. It does not require an ion trap. The 24AMP4 employs a 6.3 V., 600 ma. heater and external conductive coating is rated at 2000 to 2500 uuf.

In 21-inch tubes—Sylvania continues to lead the way in 110-degree, 21-inch picture tubes with the 21CQP4, the



Sylvania's new 24-inch 110° picture tube, type 24AMP4, is 6 inches wider than long

shortest 21-inch picture tube on the market. The tube measures 14 $\frac{7}{8}$ inches in overall length and weighs 20 pounds. The new shorter length in this Sylvania original is made possible by the new non-ion trap gun with electrostatic focus that reduces tube length up to a full inch.

IN CATHODE-RAY TUBE DESIGN

Sylvania develops a 450 ma. 6.3 volt heater for "cooler" TV receivers using series string heaters



New heater uses straight tungsten wire

Sylvania, trend setter in electron-tube design, has developed a 450 ma., 6.3 volt heater for picture tubes. The new heater meets the needs of portable TV receiver designs and lowers component costs. It reduces heat with total set power savings of 18 watts and permits use of a lower wattage, less expensive series resistor.

Here are some of the outstanding features of the new heater development:

- Double helical coil is wound from straight rather than a coiled tungsten wire as in other 450 ma. heaters.
- Rigid mechanical structure virtually eliminates tendency of heater to sag away from cathode cap and cause slow heating and low emission.

Following are the Sylvania tube types that employ the new heater design:

In 90° tubes—14XP4, 14XP4A, 17BKF4, 17BKP4A, 17BSP4, 17CEP4, 21CDP4, 21CDP4A, 21CKF4.

In 110° tubes—17BYP4, 21CSP4.

IN SPECIAL CR TUBES ...

Sylvania expands its line of cathode-ray tubes for commercial and military use

Sylvania announces an expanded line of cathode-ray tubes for both military and commercial applications. The additional types now or soon available include the 3JP7, 7AB series, 5AHP4A and 5AHP7A, 10WP7, 12SP7D, 5UP1 and 3RP1.

Sylvania is also now featuring its line of conventional and special picture tubes for studio monitors and closed circuit TV. The types range in size from 8 inches through 24 inches.

The entire Sylvania cathode-ray tube line incorporates electron guns with more precise parts made to 50 percent closer tolerances. This assures better performance and longer life whatever the application.

Sylvania's 7ABP7A-cathode-ray tube



Creating New Design Trends

IN 100% TUBE TESTING ...

Sylvania develops new automation equipment that makes possible full five-minute pre-heat testing of every receiving tube it makes



Sylvania customers view giant automatic tube tester

Sylvania now subjects each and every receiving tube it manufactures to an automatic five-minute pre-heat and tapping test. This gives added protection against shorts, noise, gas and other tube defects and reduces rejects on receiver-assembly lines.

At Sylvania's Williamsport plant,

the giant machines shown, designed and built under the direction of Sylvania engineers, do the testing automatically. The tubes are loaded on a continuously rotating conveyor belt. Before the belt journey is completed, every tube is subjected to the pre-heat and tapping test. Then the

tubes are automatically repacked for shipment.

This final extensive and intensive quality program at Williamsport combined with testing activities at each individual receiving-tube plant are reasons behind the high quality of Sylvania tubes.

IN TELEVISION ...

Sylvania 6CK4—New Low-Mu Triode for Vertical Deflection Amplifier Service

Sylvania type 6CK4 is a low-mu triode designed for service as a vertical deflection amplifier in TV sets featuring wide-angle picture tubes and high cathode-ray tube accelerating potential.

Design factors including a T6 bulb provide a safety factor for conservative, reliable operation in such applications.

Ratings of type 6CK4 include 2,000 volts peak positive plate, a plate dissipation of 12 watts, and an average cathode current of 100 ma.

Average Characteristics:

Plate Voltage	250 Volts
Grid No. 1 Voltage	-26 Volts
Plate Current	55 ma.
Transconductance	6500 UMHOS
Amplification Factor	6.7
Plate Resistance (Approx.)	1,000 OHMS
Grid Voltage for IB equals 0.5 ma.	-50 Volts
Plate Current at EC equals -38 VDC.	10 ma.
Zero Bias Plate Current: EB equals 100V, EC equals 0 (Instantaneous values)	125 ma.

New 110-degree damper types, 6DA4 and 12D4, have high peak current

Sylvania's new 110-degree damper types 6DA4 and 12D4 feature high peak current capabilities, low tube drop and adequate peak inverse plate voltage rating to make it a most desirable damper for 110° deflection. The 12D4 is a half wave rectifier for 600 ma series string usage. It is the 12-volt version of the 6DA4.

Maximum Ratings (Design Maximum System)

Peak inverse plate voltage	4400 volts
Plate dissipation	5.5 watts
Steady state peak current	900 ma.
Average plate current	155 ma.
Tube voltage drop for IB-250 ma.	20 volts

Sylvania introduces the 6/8CY7 as a combined vertical deflection oscillator and amplifier in TV receivers

Sylvania adds the 6/8CY7 to its TV tube line as a supplement to the 10DE7. The new tube combines two dissimilar triodes in one T6½ envelope for use in 90-degree short neck picture tube circuits. The oscillator section features a high mu triode.

Maximum Ratings

	Oscillator Section	Output Section
Plate dissipation	1.0 watts	5.54 watts
Peak-positive pulse plate voltage	—	1800 volts
Peak cathode current	—	120 ma.
Average cathode current	—	35 ma.



Everywhere in Electronics

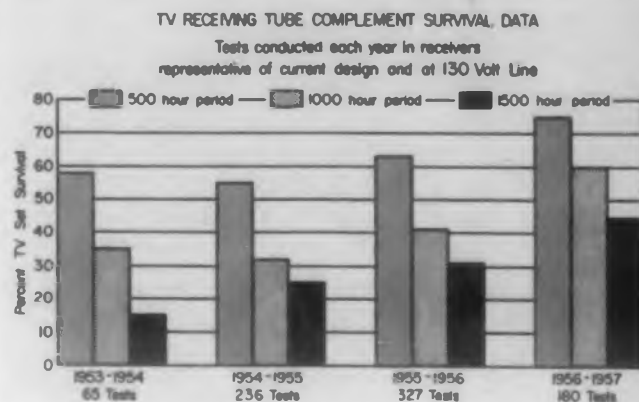
IN TV LIFE TESTING RESULTS...

Percentage of Sylvania TV receiving tube complements surviving 1500 hours has tripled since 1954

Today Sylvania TV receiving tubes are setting new records in life tests. The percentage of TV tube complements surviving 1500 hours of operation at high line conditions has tripled since 1954 and is now at the highest rate in Sylvania history. This means assurance of a better field history as well as substantial savings in line operations for receiver manufacturers.

The overall survival rate for Sylvania TV receiver tubes has increased steadily through the years. In the past year alone there has been an average increase of 15 percent in TV tube complement survival. This represents

the largest increase since 1953 and is a combined achievement of Sylvania's Dynamic Testing Program and better TV circuit design. Under the Dynamic Testing Program, individual Sylvania receiving tube types are evaluated in actual circuit environments in current TV set designs. Sylvania's Joint Engineering and Manufacturing Committee, JEMC, meets weekly to keep testing specs current. This kind of extraordinary care for receiving-tube quality is why Sylvania tubes last longer.



Increasing life of Sylvania tubes is a combined achievement of the Dynamic Testing Program and refinements in TV circuit design for better reliability

IN PROCESS CONTROL...

Sylvania uses an electronic micrometer to control filament coating thickness

Precise control of heater wire coating is of paramount importance in producing top-quality electron tubes. Proper coating means longer tube life and higher emission.

Sylvania controls filament coating thickness to the most exacting tolerances with an electronic micrometer.

The photoelectric device constantly monitors the coating process and registers thickness on electric meters. It immediately detects any thickness deviations and automatically stains the improperly coated heater wire with colored dye. The material can then be easily identified and rejected.



Sylvania's electronic micrometer automatically controls filament coating thickness. It automatically stains improperly coated heater wire with colored dye

IN AUDIO TYPES...

New audio power pentode, type 6BQ5, has high sensitivity

Now Sylvania offers its version of one of the world's finest high-fidelity audio power amplifier tubes. Type 6BQ5 features high power output at extremely low distortion.

The high power sensitivity of type 6BQ5 makes it especially attractive.

The T6 1/2 bulb used by this type is a desirable feature in compact high-fidelity equipment.



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1740 Broadway

New York 19, N. Y.

Creating New Design Trends— —Everywhere in Electronics

IN COMPUTER TUBES...

Sylvania expands the availability of types
5963 and 5964 to meet rising computer demands

Now Sylvania is ready to meet fully the heavy demands from electronic computer manufacturers for types 5963 and 5964.

Type 5963 is a T6½ duotriode featuring high zero bias plate current. The tube is used as a frequency divider as well as in computers.

It performs dependably in intermittent operation. The sharp cut-off twin

triode has individual cathode connections for separate operation of each section. It has a center tapped heater for 6.2 or 12.6 volt operation.

Type 5964 is a T5½ duotriode also featuring high zero bias plate current as in the 5963. The medium mu twin triode maintains its emission capabilities for long periods of operation under cut-off conditions.

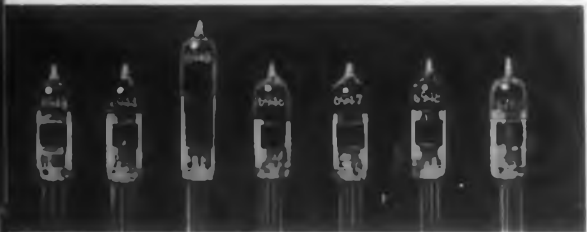


	Computer Service	
	Cutoff Conditions	Zero Bias Conditions
Type 5963		
Plate Supply Voltage	150 volts	150 volts
Grid Voltage	-15 volts	0 volts
Plate Circuit Resistance	20,000 ohms	20,000 ohms
Grid Circuit Resistance	47,000 ohms	47,000 ohms
Plate Current	0	5.1 ma.
Type 5964		
Plate Supply Voltage	150 volts	150 volts
Grid Voltage	-10 volts	0 volts
Plate Circuit Resistance	20,000 ohms	20,000 ohms
Grid Circuit Resistance	47,000 ohms	47,000 ohms
Plate Current	0	5 ma.

IN GUIDED MISSILE TYPES...

Sylvania builds its new guided missile line
to meet the most severe requirements

Despite new extremes in heat, shock and vibration as today's missiles fly



higher and faster, Sylvania's guided missile line is meeting top performance standards.

Behind this outstanding record stands one of the most comprehensive tube developmental programs in the industry. It incorporates radical new tube designs, new materials and techniques to offer the most reliable tubes obtainable today for missile service.

Sylvania now has the following guided missile types available:

Type No.	Description
6943	Sharp cutoff RF pentode
6944	Semi-remote cutoff RF pentode
6788	Pentode audio voltage amplifier
6945	Audio beam power pentode
6946	Medium mu single triode
6947	Double, medium mu triode
6948	Double, high mu triode



Please send additional information on the items checked below.

- | | |
|---|--|
| <input type="checkbox"/> Type 24AMP4 | <input type="checkbox"/> Types 6DA4 and 12D4 |
| <input type="checkbox"/> Type 21CQP4 | <input type="checkbox"/> Type 6/8CY7 |
| <input type="checkbox"/> 450 ma. 6.3 v Heater Picture Tubes | <input type="checkbox"/> Type 6BQ5 |
| <input type="checkbox"/> Special Purpose C-R Tubes | <input type="checkbox"/> Types 5963 and 5964 |
| <input type="checkbox"/> Type 6CK4 | <input type="checkbox"/> Guided Missile Line |

Name _____
Address _____
Company _____

Use this handy
business reply card
to request
additional information
on these important new
Sylvania developments

ities of collision between free and bound electrons under various conditions. As cross sectional reactions can not be accurately calculated for all conditions, it is preferable to reproduce the process experimentally.

A technique for cross-firing a single beam of electrons with a stream of free electrons has been developed, which is applicable to many substances. In this process, it is possible to measure not only total cross sections, but also angular cross sections. Observed with the apparatus are the changes within the bound, or atomic electron. The physicists polarize the atomic electron, change its spin, and differentiate it from the incoming electron. This labeling method provides an important clue to the effect of external electron scattering. With it, the researchers can weigh the importance of polarizability, coulomb, and electrical forces in direct scattering, and can discern the pattern of physical contact in exchange scattering.

Polyglot Maintains Job Security

The translation of a foreign language by means of an electronic computer, at the present state of the art, is limited, according to Messrs. Wall and Niehaus, of the University of Washington, Seattle. A computer translates in a manner similar to the unskilled translator, who first translates on a word for word basis, and then makes improvements in the output, by consideration of the context of the words. A skilled polyglot, on the other hand, accomplishes translation by reading and digesting the source language, and then forming the material into target language sentences, and recording them.

Doubly Oriented Magnets

A new type of sheet material designed to increase the efficiency of transformers, motors, and generators, can be magnetized in four directions. Lower energy losses and reduced noise in electrical equipment can be expected when "four square" silicone iron goes into actual production.

Developed by General Electric, Schenectady, N.Y., this doubly-oriented magnetic sheet material can be made in many useful thicknesses and used in a variety of construction shapes. Orientation in silicone iron is achieved by aligning the individual crystalline grains in the finished sheet material. The doubly oriented four square effect is produced by a type of alignment which yields excellent magnetic properties not only back and forth along the sheet, but also across the sheet.

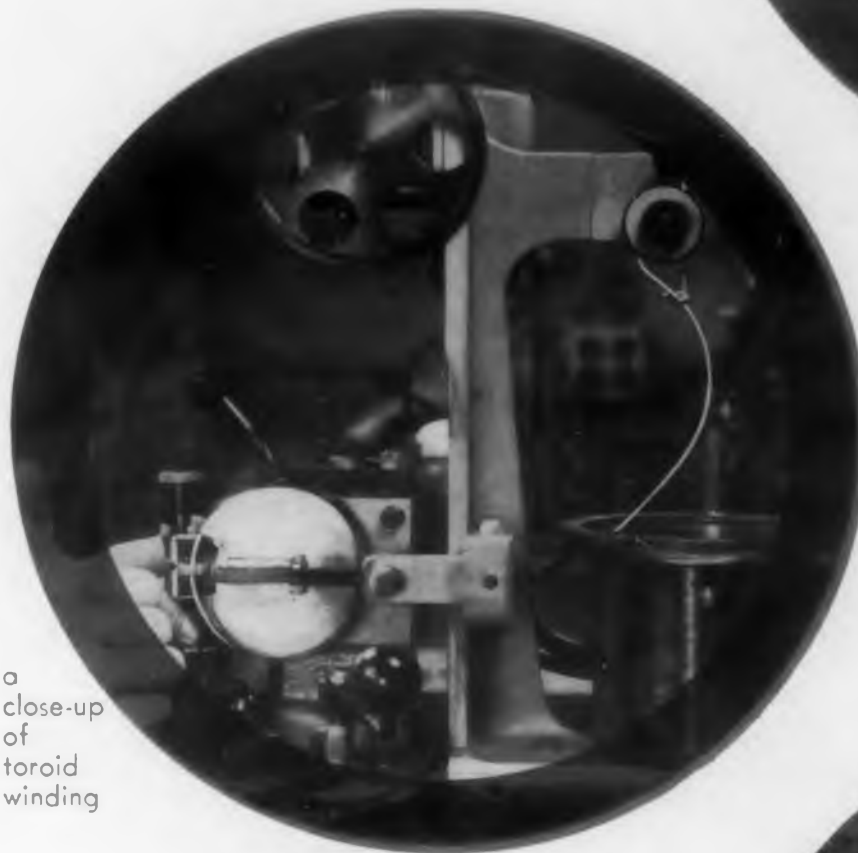
◀ CIRCLE 7 ON READER-SERVICE CARD

plant

Burnell moves a step further in toroid, filter and related network leadership



our new
Pelham
Manor
plant



a
close-up
of
toroid
winding

Burnell & Co. is now producing toroids, filters, and related networks in its new Pelham Manor plant — largest and best equipped of its kind in the country. For customers, this means fast attention to samples, quicker delivery of orders, more solutions to network problems.

look to Burnell to remain first in ...

advanced research

product development

new design ideas

new circuit components

new production methods

economy

Burnell & Co., Inc.

first . . . in toroids, filters, and related networks

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NEW YORK



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720 MISSION STREET
SOUTH PASADENA
CALIFORNIA

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION



main
assembly
line

Engineering Review

Miniaturization Award Announced

Plans to establish an annual Miniaturization Award which will recognize the greatest contribution by an individual or firm to the advancement of the concept of miniaturization were announced by Miniature Precision Bearings, Inc., Keene, New Hampshire. An independent committee of miniaturization authorities representing industry, education, government and technical publications will administer the award. The purpose of the award will be to honor the individual or firm who has made the greatest design or manufacturing contribution toward miniaturization, and to stimulate further activity within industry toward advancement of the concept of miniaturization.

Futuristic Sound

A scientist living at Staines
Is searching with infinite pains
For a new type of sound
Which he hopes, when it's found,
Will travel much faster than planes.

Reproduced by permission of Punch

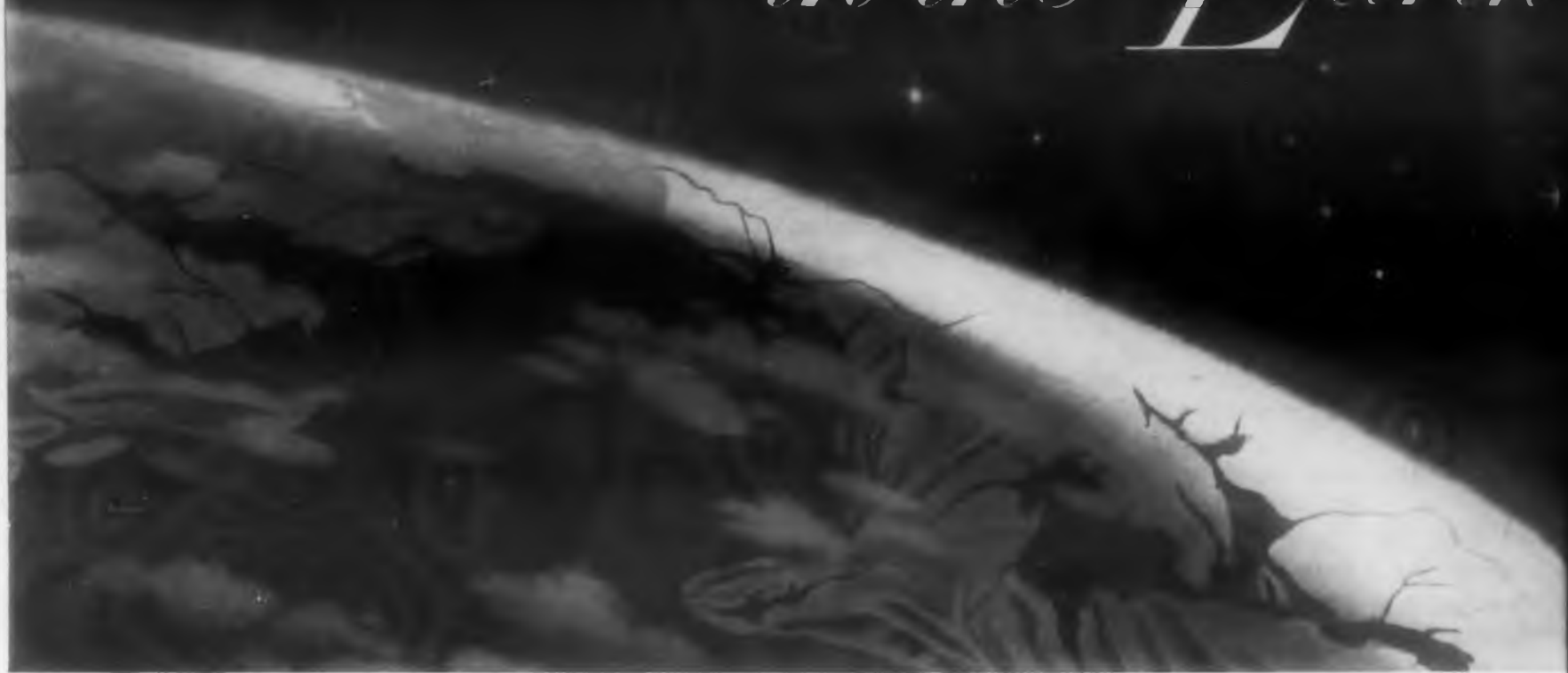
Air Force Adopts Standards

A new certifying standard, developed by the Air Research and Development Command and the Weinschel Engineering Company, Kensington, Md., will provide improved accuracy in calibrating and adjusting Air Force electronic equipment. The standard contains a direct read-out precision power meter, and a voltage ratio calibrator. The Air Force plans to install certifying standards at several depots. Electronic equipment manufacturers served by each of these depots will be required to bring their test equipment to the depot at intervals, to have it certified. In this manner, all test equipment can be uniformly calibrated, and all production electronic equipment will be equally uniform.

CIRCLE NO. 8 ON READER-SERVICE CARD >

PHILCO...

in the Earth



Philco Surface Barrier Transistors Help Give First U.S. Satellite

As the first U.S. Satellite flashes through Outer Space in its orbit around the Earth, tiny Philco Surface Barrier Transistors will be helping to operate the complex scientific instruments it carries.

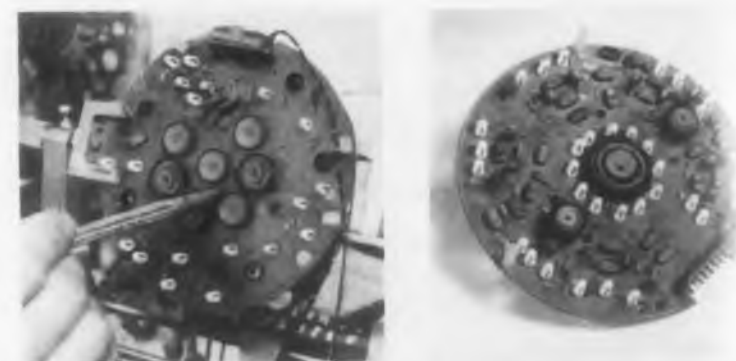
Project Vanguard, a major activity of the International Geophysical Year, is being undertaken for the purpose of gathering original data, vital to International Science as the first giant step in man's eventual conquest of the Universe.

While the Earth Satellite is orbiting in its trackless path, data on temperatures, radiations, micro-meteors and other phenomena will be collected and transmitted back to Earth.

Because of their proven reliability, low current requirements, extremely light weight and miniature size, Philco Surface Barrier Transistors have

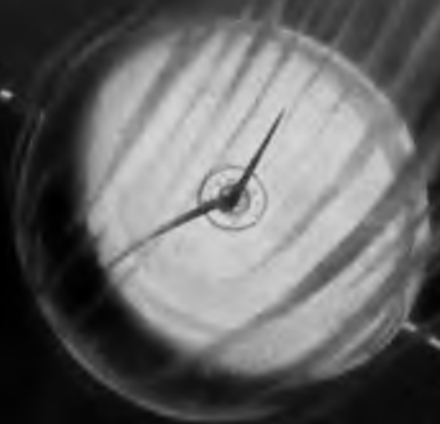
helped solve the gigantic problems of reliability and miniaturization in electronic operation of these Satellite instruments.

Philco Surface Barrier transistors are literally *in the Vanguard* of modern electronics... helping make possible the success of Project Vanguard!



Telemetering pre-modulator circuit cards being assembled at U.S. Research Laboratory, Washington, D.C.

Satellite



a "Voice" ... at 18,000 MPH ... From Its Orbit In Space!

Philco SBT's Still Operate After 126-Mile Plunge To Earth In Early Satellite Flight Test!

Circuit cards carrying Philco SBT's were recently sent aloft in a flight test at White Sands. The rocket attained an altitude of 126 miles ... fell back to Earth (landing on a granite boulder). Although the housing was badly smashed ... all Philco SBT's (except one ... which was lost at point of sphere puncture) continued to operate with original performance characteristics!



Smashed metal housing in which Philco Surface Barrier Transistors fell 126 miles during early Satellite vehicle flight test.



Close-up of actual circuit card, with plastic covering cut-away to show Philco SBT's ... still intact and operable!

Write, wire or telephone for complete information on all Philco transistors.

PHILCO LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA

Measurement of Metals in Solution

A simple, electrolytic method of measuring the presence of minute quantities of metal in solutions, has been developed by chemists at the University of Wisconsin, Madison. This quantitative method of analysis can, for example measure the presence of one part of lead in five trillion parts of solution. The approach, titled "Anodic Stripping Voltammetry with Continuously Varying Potential Using the Hanging Mercury Drop Method," can determine the metallic concentration of any solution if the metallic composite can form an amalgam with mercury. A primary tool of this method is the unusual electrode, which is a tiny drop of mercury, about 0.07 cm in radius, that hangs from a platinum wire.

With this electrode charged negatively, the metal ions in solution slowly electroplate onto the mercury drop. At the end of a suitable period of time, depending on the concentration of metal in the solution, the voltage charge on the drop of mercury is suddenly reversed. This abrupt change forces or "strips" the accumulated metal from the mercury. The concentration can be accurately measured from a positive peak in the current-voltage curve.

Mars Design Contest Repeated

To provide a showcase for projects which often do not appear before interested technical audiences, Mars Pencils sponsors this design contest.

One hundred dollars is paid to winners for the right to reproduce their designs in the Mars Outstanding Design Series. There are no strings attached, the designer is given full credit, and he retains all future rights to the project. The 1957 contest provided cash awards to four winners, one of which was published in this department, p 15, July 19, 1957.

The subject of the entry can be on any topic which might have appeal to design minded readers, have a broad interest, and have an attractive presentation.

Interested parties should submit entries to J. S. Staedtler, Inc., Hackensack, N. J.

◀ CIRCLE NO. 8 ON READER-SERVICE CARD



Bulb Snatching Discouraged: This radioisotope-excited lamp provides marking illumination for periods of up to 10 years or more, with no power or maintenance required. Developed by the U.S. Radium Corp., Morristown, N.J., it measures 6 in. in length and has a luminous diameter of 5 in. Its 1000 microlambert brightness makes it clearly visible at 500 yards. This recently modified unit has a single, highly-efficient port, and one color of emission per lamp is provided. By using different phosphors, these lamps emit in blue, green, yellow or orange-red regions.

Assuring Reliability In Miniaturization

X-rays coupled with photographic enlargement of the radiograph are proving to be an efficient tool in reliability engineering research on miniature electronic components at Battelle Memorial Institute, Columbus, Ohio.

Technologists there find that the technique, which is used as a preliminary check on the cause of component failure, yields useful information concerning failure in about 75 per cent of the cases. Components examined are in the neighborhood of 0.25 in. long. The photographic enlargements are about 2.5 in. long, a 10 diameter enlargement.

Among the electronic components suitable for inspection by this method are diodes, transistors, capacitors, silicon rectifiers, photo-diodes, and possibly some resistors. The radiographs will show types of failure as: burned out leads, displaced capacitor elements, reworked leads, separations of many kinds.

Announcing the Raytheon

— a new type of broadband,
high power.....



QK520
AMPLITRON
TYPICAL OPERATION (PULSED)

ANODE VOLTAGE	40 kv
ANODE CURRENT	35 amps
PEAK POWER OUTPUT	800 kw
AVERAGE POWER OUTPUT	1200 watts
EFFICIENCY	55%
OPERATING BAND (± 1 db)	1225-1350 Mc
PEAK POWER INPUT	80 kw
PHASE STABILITY WITH ANODE CURRENT	1°/amp

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION

The Amplitron is a new type of tube developed by Raytheon, capable of power amplification at microwave frequencies. Amplification is obtained over a broad range of frequencies with no mechanical or electrical adjustments required. This device is a derivative of the magnetron and retains many of its advantages—such as high operating efficiency, construction simplicity, small size, light weight, low operating voltage. Where efficiency counts in high-power systems, the broadband Amplitron has applications of major significance.

The Amplitron uses crossed electric and magnetic fields, a reentrant beam produced by a magnetron-type cathode, and a non-reentrant broadband circuit matched at either end to external circuits.

AMPLITRON*

cross-field microwave amplifier

.....high efficiency

This amplifier has bandwidths of 10% with efficiencies of 50-70% over the entire band. Variations in anode current or voltage have little effect upon the total phase shift. This results in very low phase pushing and excellent reproduction of the input spectrum despite slow pulse rise time and ripple. Because the device has low insertion loss, duplexing may be accomplished at the input rather than the output of the final rf amplifier.

The Amplitron is another example of Raytheon's unequalled leadership in microwave tubes. A limited quantity of preliminary literature will be available shortly; to be sure of a copy, write now.



Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-25

Waltham 54, Massachusetts

*Raytheon Trademark

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION

Battelle technologists K. E. Hassler, J. E. Drennan, and Hall Cary point out that in addition to being a relatively inexpensive and rapid method of checking component failures, radiographic inspection is nondestructive and can be conducted on components prior to load life testing and then correlated with failures occurring during such experimentation.

When devices as small and fragile as many of the miniature electronic parts must be opened for visual inspection after failure, the reliability engineer runs considerable risk of destroying in the opening process the very evidence he is seeking. By changing his experimental procedure to utilize radiography he can reduce this problem.

Potentially this technique can be used with any inspection operation in which the parts are small and inaccessible.

Merle Rhoten, who heads Battelle's radiographic laboratory, describes the X-ray process as one that employs essentially standard procedures. But for best resolution, he says, one should use a small focal spot tube and a focal spot-to-object distance of at least 72 in. This tends to collimate the X-ray beam so that after passing through the object it will produce as small a penumbral shadow as possible. In addition, he suggests the use of high contrast, fine grain film, since it is from this film that the enlarged photographic prints will be made. Through use of extremely fine grain, high contrast film, magnifications of up to 50 diam have been obtained.

Shock at Mach 150

High velocity shock waves reach speeds of more than 1,000,000 mph as they flash along a specially designed shock tube at Lockheed Missiles, Sunnyvale, Calif. These velocities, well above Mach 150, produce temperatures above 100,000 C, and provide valuable data on the flow of ionized gases. Studies in this field are expected to yield information on the properties of superheated gases which will be valuable in the investigation of hypersonic ballistic missiles. It is also expected that this data will be of value in equipment design for outer space travel. To produce the high velocity shock wave, a large high voltage charge is rapidly discharged from a bank of condensers at one end of the shock tube, creating a bubble of superheated gas. Expansion of the hot gas bubble produces a high velocity and an intensely luminous shock wave which flashes down the tube. The wave is boosted to the tremendous speeds and temperatures by external magnetic fields which interact with the high current discharge.

on LAND
at SEA
in the AIR

El-Menco

Dur-Mica

CAPACITORS

do the job **BETTER!**

DM 15
ACTUAL
SIZE

MIGHTY MICAS
Do the Work
of **GIANTS**

Now, Stronger Than Ever . . . give up to 18 years of sure, rugged service!

Put through a series of rough tests, these tiny, tireless workhorses of the electronics industry came up with a record-smashing performance. El-Menco engineers found that El-Menco DM-15, smallest mica capacitor in the world, DM-20 and DM-30 Dur-Mica Capacitors beat all others for long life and tried reliability. Under accelerated conditions of $1\frac{1}{2}$ times rated voltage at 125°C ambient temperature, El-Menco Dur-Micas kept on going strong even after 12,000 hours . . . equal to 18 years or more of service under normal operating conditions.



Write for FREE samples and catalog on your firm's letterhead.

El-Menco Dur-Mica DM-15, DM-20, DM-30, DM-40 and DM-42 Capacitors outlive, outperform, outshine . . .

Longer life . . . tremendous power . . . tiny size . . . terrific stability — silvered mica . . . perfect performance. Test them for yourself and see . . .

DM-15 — tiniest mica capacitor in the world . . . ideal for extreme miniaturization . . . up to 820 mmf at 300 VDCW . . . up to 400 mmf at 500 VDCW.

DM-20 — ideal for new miniaturized designs and printed wiring circuits . . . up to 7500 mmf at 100 VDCW . . . up to 6200 mmf at 300 VDCW . . . up to 43000 mmf at 500 VDCW.



With newly-designed crimped leads . . . Parallel leads simplify use in TV, electronic brains, miniature printed circuits, guided missiles, and countless other applications. El-Menco Dur-Mica Capacitors meet all humidity, temperature and electronic requirements, including military specs.

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

WILLIMANTIC CONNECTICUT

- molded mica
- mica trimmer
- dipped paper
- tubular paper
- ceramic
- silvered mica films
- ceramic discs

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Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Review

Sea Lanes Opened to U.S.

An electronic navigation aid that opens new sea lanes in the North Atlantic approaches to the U.S.A., including the St. Lawrence seaway, and makes existing lanes safer was officially placed in operation recently in Halifax, Nova Scotia. The system, called the Bendix-Decca navigator, is a low-frequency radio position-finding device that can be operated either automatically or manually for continuous mapping of a ship's course and heading. It is unaffected by weather conditions, jamming and other interference. The system consists of three Decca station chains. Each chain is made up of a master station and three slave stations. Two chains are located in Newfoundland, another in Nova Scotia. A fourth in the Quebec area is to be opened soon. The chains will cover an area of one million sq miles.

The stations of each chain transmit signals that form fixed reference lines, like meridians on a map. These electronic reference lines, which cross each other to form a grid pattern, always stay in a fixed position and therefore can be easily shown on a marine chart or map. Spaces between the lines are called lanes. Aboard ship, Decca receiving equipment picks up the signals and shows them on dials, called Decometers, that have numbers corresponding to those given each coordinate on the chart. The navigator reads the Decometers and can readily make a positional fix by referring to the corresponding numbers on the chart. There is also an automatic version of the system which operates a moving pen over a roller-mounted chart. The pen shows the ship's course and position as a continuous moving line on the chart.

Electronic Traffic Control System

Mounting traffic volumes on outmoded highway and street systems, plus the need for rapid city evacuations in case of a natural disaster, such as flood, or an enemy attack, has led to a demand on the part of public officials for a low cost means of interconnected traffic signal control.

A system which answers this need has been developed by Electronic Protection Inc., Melrose, Park, Ill., (see ELECTRONIC COP, June 15, 1957). Called the El-Tec, the device consists of a centrally located uhf radio transmitter, which sends microwave impulses to radio receivers installed in the intersection signal light boxes, and linked to the signal changing mechanism.

Operation of a control on the transmitter, allows the system to function as a normal or rush hour traffic light regulator. A pushbutton control will

... and hold stoplights green along evacuation
 ways in the event of a disaster situation. A
 button control on the dashboard transmitter of
 an emergency vehicle can turn stoplights green
 along the route of police and emergency vehicles
 rushing to a trouble spot. El-Tec is the only system
 thus far to obtain F.C.C. type approval.

Searchlight Sees Target

Talos, the Navy's new long range surface-to-air missile, will be guided to its target by super-radars developed and produced by Sperry Gyroscope Company, Great Neck, New York. A major armament for the cruiser USS Galveston and others, the supersonic Talos missile will use radars that combine many automatic functions. Included in a long-secret class of super-radars developed for the Navy, the SPG-49 Talos and SPQ-5 Terrier missile guidance systems use antennas that resemble gigantic searchlights. The systems are reported to be providing exceptionally high performance for tenacious, stable guidance of supersonic missiles, firing singly or in salvos at individual or multiple targets.

The missile is capable of delivering a high explosive or nuclear warhead, as circumstances dictate, to any altitude from the lowest to the highest that airplanes now can fly, and far beyond the range of human vision.

Powered by a ramjet engine, the supersonic Talos is the second missile to emerge from the Bumblebee guided-missile program sponsored by the Bureau of Ordnance under the direction of the Applied Physics Laboratory of the Johns Hopkins University. The first—Terrier, is in service with the Fleet at this time.



"Searchlight" antenna of Talos missile guides interceptors beyond the range of human sight.



The "Magnetophon" German Tape Recorder—first high fidelity recording machine, subsequently improved and used to record and broadcast Bing Crosby's radio programs for over one year. The predecessor of all American Tape Recorders.



first in Audio

first in Video

and first in Instrumentation

Mincom pioneered and perfected tape recording techniques for the radio and recording industry

...First Transcontinental Broadcast of a Musical Program (Bing Crosby Show) from Magnetic Tape... May 1948

Mincom pioneered the recording and reproduction of off-the-air television from magnetic tape

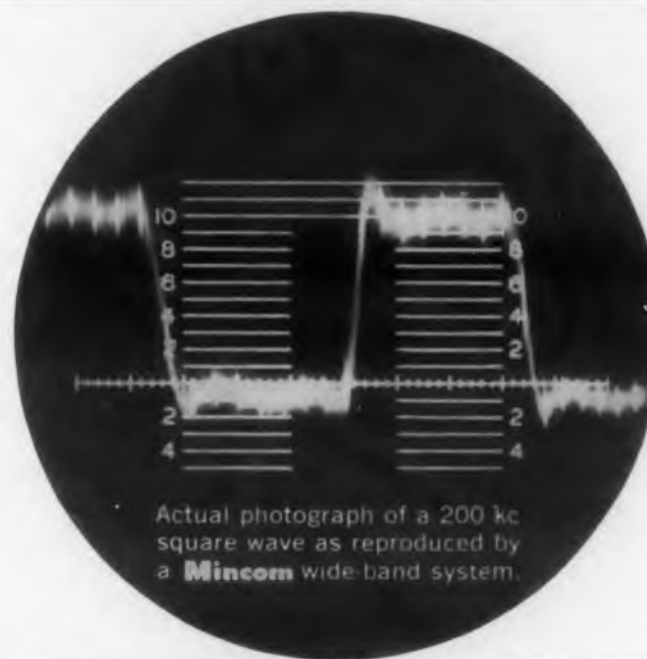
...First Demonstration of Video Tape Recording... November, 1951

Mincom pioneered and perfected the tight-loop drive for instrumentation recording on magnetic tape

...First Tight-Loop Drive Recorder... August, 1952

And now— Mincom has perfected wide-band magnetic tape systems which can be used for: Radar Recording • Wide-band Telemetry • Waveform analysis • Spectrum Monitoring and Closed Circuit Television Recording

Recording capability: from DC to 2.5 Megacycles



Actual photograph of a 200 kc square wave as reproduced by a Mincom wide-band system.

Write for complete specifications



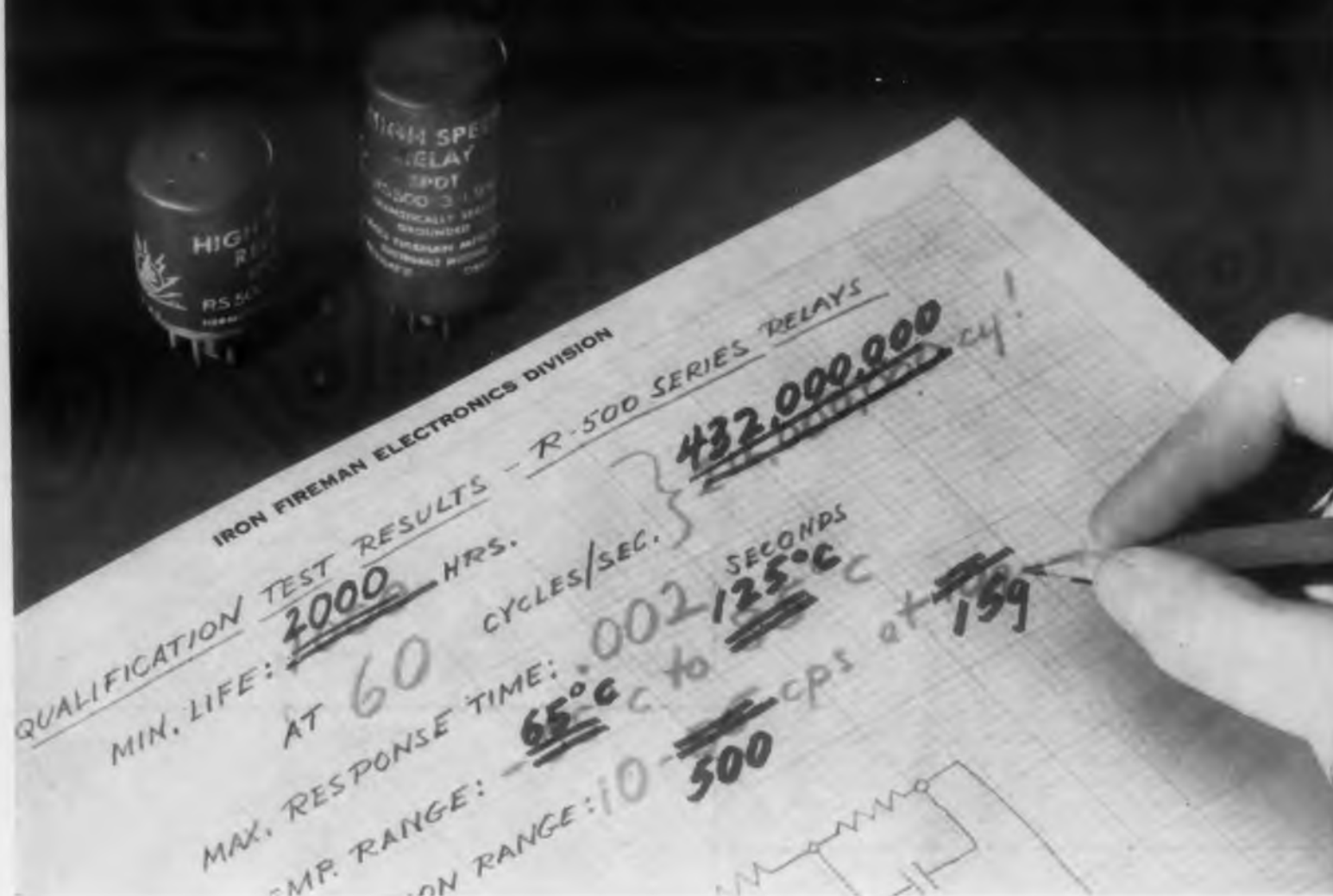
Mincom MINNESOTA MINING & MANUFACTURING COMPANY
 DIVISION

2049 South Barrington Ave., Los Angeles 25, California
 80 Washington Street, Hempstead, New York

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION

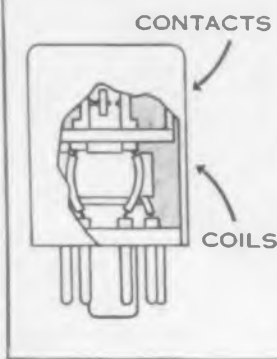
HIGH SPEED RELAYS

by Iron Fireman



NOTICE: Since this advertisement first appeared, continued testing to more rigid requirements have given the results shown in red.

TWO SEALED CELLS



A brand new design

This Iron Fireman high speed relay is a completely new design. It features improved performance and reliability.

The contacts are enclosed in a separate hermetically-sealed compartment within the outer case—which is also hermetically sealed. This double sealing in inert gas eliminates any possibility of contact contamination.

Not even volatile emanations from warm coils or wires can affect the contacts.

This is but one of the factors contributing to exceptional service life. Complete performance data available on request. Write to the address below for information on high speed or sensitive relays.

IRON FIREMAN *Electronics* **DIVISION**

2838 S. E. NINTH AVENUE, PORTLAND 2, OREGON

CIRCLE 12 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Review

Phonograph Arm Prolongs Record Life

A phonograph arm which rests on a record as lightly as a sheet of tissue paper has been developed to prolong the life of records indefinitely. Its tiny daimond stylus will stay in the microgroove of a modern, high-fidelity recording even when the turntable is tilted at an angle of 45 degrees or more. Precise balancing of the turntable no longer is required.

The slender, rugged tone arm, called the Studio Dynetic, is manufactured by Shure Brothers, Inc., Evanston, Ill.

With the Studio Dynetic, it is estimated that records can be played hundreds of times without



Slender tone arm tracks with two grams pressure, and will operate at a 45 degree angle

any signs of wear. The tone arm also will play old, rare records without damaging them. The arm's pressure is so light that the needle can be dragged across the record's grooves while it is turning without causing any audible or visible damage.

The needle life is also indefinitely prolonged. It is estimated that one diamond stylus will last for many years of perfect use, long after a diamond stylus in a conventional hi-fi tone arm would have required replacement.

Conventional needle loads of 6-8 grams produce pressures which exceed the elastic limit of the record material and cause the destruction of the record grooves.

ELECTRONIC DESIGN • November 1, 1957

The Studio Dynetic is designed for use with a standard turntable. It cannot be adapted for use with a record changer, because of the higher tracking pressure required to operate the changer trip mechanisms.

Although it has perfectly free lateral motion, the tone arm itself does not move vertically. Only the tiny head rides up and down on jeweled bearings, making it possible to play even seriously warped records without distortion.

Since the human hand is not capable of handling one-gram weights with precision, a stylus control button has been placed on top of the tone arm to facilitate placing the needle on the record.

The Studio Dynetic comes with a 0.7-mil stylus for long-playing records. This is smaller than the standard 1.0-mil stylus and provides better quality reproduction. A 78-rpm head also is available.

The pickup may be connected to any high fidelity preamplifier and is designed to operate into a load of 10,000 ohms or more.

The delicately balanced tone arm rides securely in the record grooves and will not jump even though there may be dancing or heavy walking close by.

Metal Flaws Detected With Electronic Probe

Equipment that examines steel, aluminum, and titanium for internal flaws has been placed in operation at the Republic Aviation Corporation. Manufactured by Sperry Products Co., Danbury, Connecticut, the unit employs electronic principles similar to the sonar detection system used in tracking and locating enemy submarines. The device sends out high-frequency pulse waves which penetrate the part and return to the transmitting source. Interpretation of the time lapse between transmission and return of the signal and the amplitude of the return echo wave as shown on a cathode-ray oscilloscope screen indicates the presence of defects, and the location and extent of any flaw.

Search unit positioning is operated electrically from a master control console located at one corner of the tank, providing the operator an unobstructed view of the work. There is also a pendant control unit with five "plug-in" stations located around the tank for on-the-spot inspection of defect signals.

The equipment also features an alarm system which signals the operator when a defect has been located. This modern flaw detection and evaluation equipment is capable of pulsed wave transmission at frequencies ranging from 200 kc to 25 mc, and is used in the inspection of metal plate, tape skins, forgings and rolled and extruded bars and shapes.

Simplify ordering and assure uniformly high quality of performance, with the advantage of Norden-Ketay's nationwide field engineering service. The following 6 pages describe modular units in Norden-Ketay's family of control components.

You may use the coupon below to request literature on any units.



NORDEN-KETAY CONTROL COMPONENTS

SIMPLIFY AUTOMATIC CONTROL SYSTEMS



Digital Comparators



Amplifiers



Tachometers



Servo Motors



Digital Converters



Gear Trains

Check numbers of bulletins desired.

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Have a sales engineer call for an appointment.

Norden-Ketay Corporation • Stamford, Connecticut

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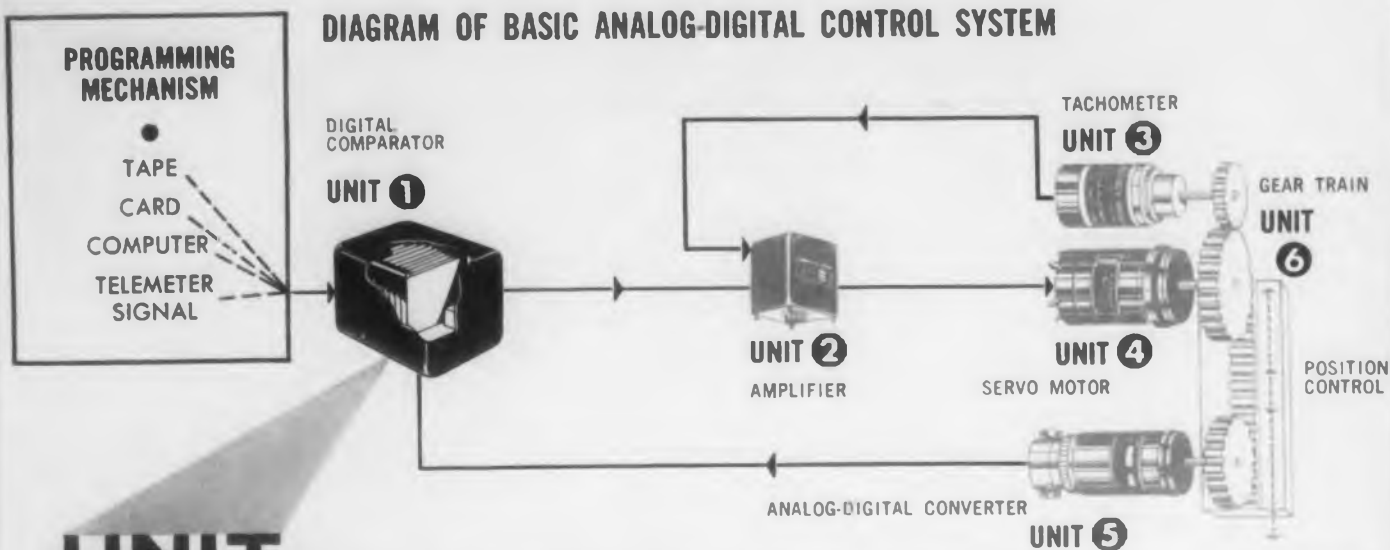
Herbert H. Rosen

Defense Girds for Battle of the Dollar

Of late there has been a smattering of good and bad news from the Department of Defense. Money problems continue to plague the policy planners, necessitating further reductions in program and procurement. On the other hand, past R & D efforts have made a test ballistic missile fly thousands of miles. A new radar capable of detecting targets 3000 miles distant will be operational soon, and the possibility of an antimissile missile grows day by day.

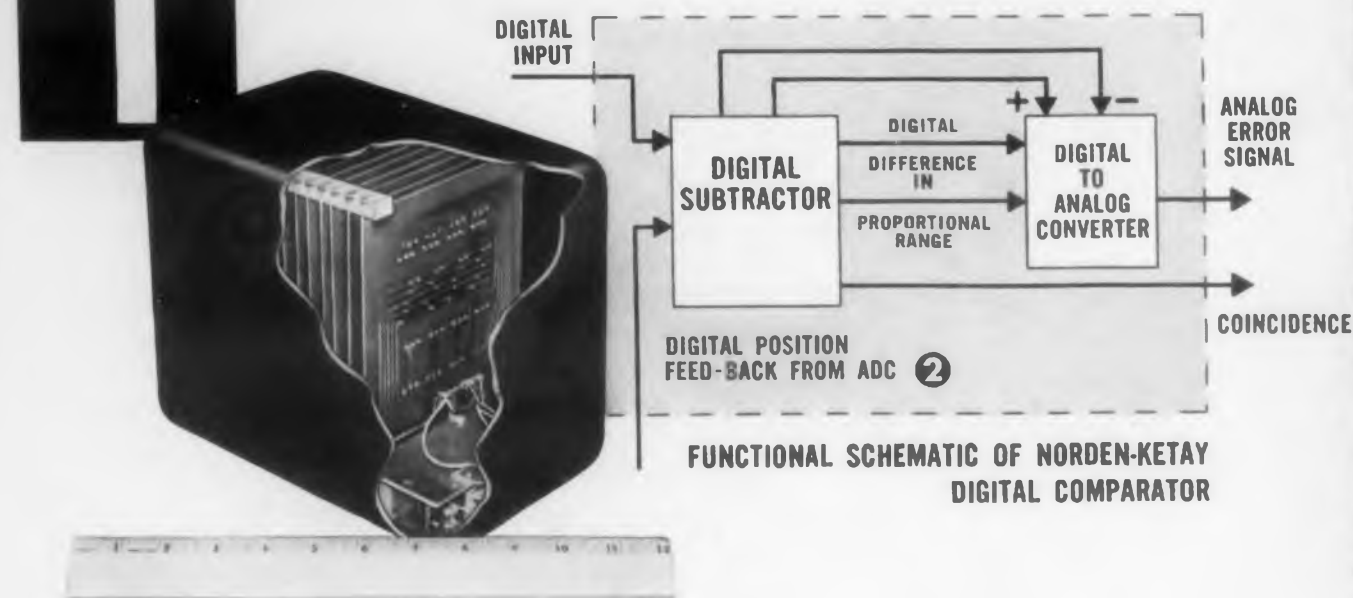
Former Secretary of Defense Charles E. Wilson had set the tenor of the Defense program. "It is far better to buy equipment than to pay people." So the people have to go. The armed services are to be reduced by about 200,000 within this fiscal year. That number may be raised early in 1958 if the tide of spending does not change. This nearly eight percent reduction in manpower will have serious effects elsewhere in the DOD. Fewer ships can be sailed. A smaller number of air wings can be maintained. The Army will have fewer divisions to man. Thus, the equipment normally used in these ships and planes and the usual support of the troops in the field will follow the same pattern of reduction. Whether the current scheme of stretchouts and cancellations will prove effective can be proved only on a month-to-month basis. So far, the program has been a dismal failure. Cuts that went into effect as of July 1 are still not reflected in current spending. In fact, August expenditures were at a rate of about \$42 billion a year. If this trend should continue, Defense will spend more than \$19 billion by January 1. Assuming that the Treasury Department can borrow enough money to pay these debts, then Defense spending for the first half of 1958 should be more sharply curtailed. McElroy must live under a \$38 billion ceiling. And the Treasury Department can't borrow beyond a congressionally set \$275 billion debt limit. A dilemma!

Today, the electronics industry is feeling the pinch, but not as badly as it did earlier in the fiscal year. Granted, there is less overtime and more demands for efficiency and less waste. However, the flow of DOD contracts has just about been resumed after a hiatus that started in July. The still troublesome area is in the region of contract renewals and extensions. The military services are now cutting into the muscle of some programs. Very marginal projects have little chance of survival. Even those that are nearing a solution but still have that shaded element of doubt are suspect



UNIT

DIGITAL COMPARATOR



New design permits true digital control with conventional servo motors and amplifiers

Norden-Ketay has packaged a new Digital Comparator that works with standard servo units to give servo systems the stability and reliability of digital control techniques. Used with N-K 13-bit and 19-bit analog-digital converters, the Digital Comparator simplifies circuitry and provides absolute reference by eliminating pulse counting.

In operation, a binary feedback signal indicating position of the controlled device is fed to the comparator by the ADC. This signal is compared with a parallel binary signal encoded from tape, cards, computer, or other command source. Lack of coincidence between the programmed and actual positions produces an error-modulated AC output. This signal indicates the magnitude and direction of the positional error and activates the servo motor to drive the device to coincidence.

100% transistorized, printed circuit design eliminates tubes and relays, making possible a rugged package for severe environments, with great flexibility in range and configuration. By effectively bridging the gap between digital programming and analog control, the Digital Comparator opens up a wealth of possibilities for simplified solutions to difficult control problems.

Send coupon on page 134 for Bulletin #418 containing data on Digital Comparators. Norden-Ketay Corporation, Western Division, 13210 Crenshaw Boulevard, Gardena, California.

GENERAL SPECIFICATIONS

Weight: 10 lbs. Voltage req'd: -13, -11, +2 VDC; 115 VAC. Input: 13 and 19 bits. Output signal: 60 cps to 1000 cps.

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CONTROL COMPONENTS



and subject to curtailment. Originality, efficiency, (in)expensiveness, and speed will be in demand more than ever before.

DOD Releases New Reliability Report

An 800-page document reviewing all conceivable aspects of reliability is now in the hands of officials at the Department of Defense and is available to industry from the Government Printing Office. It represents over 15 months of activity by the nine task groups of the Advisory Group on Reliability of Electronic Equipment. AGREE was established under the Director of Electronics, James Bridges.

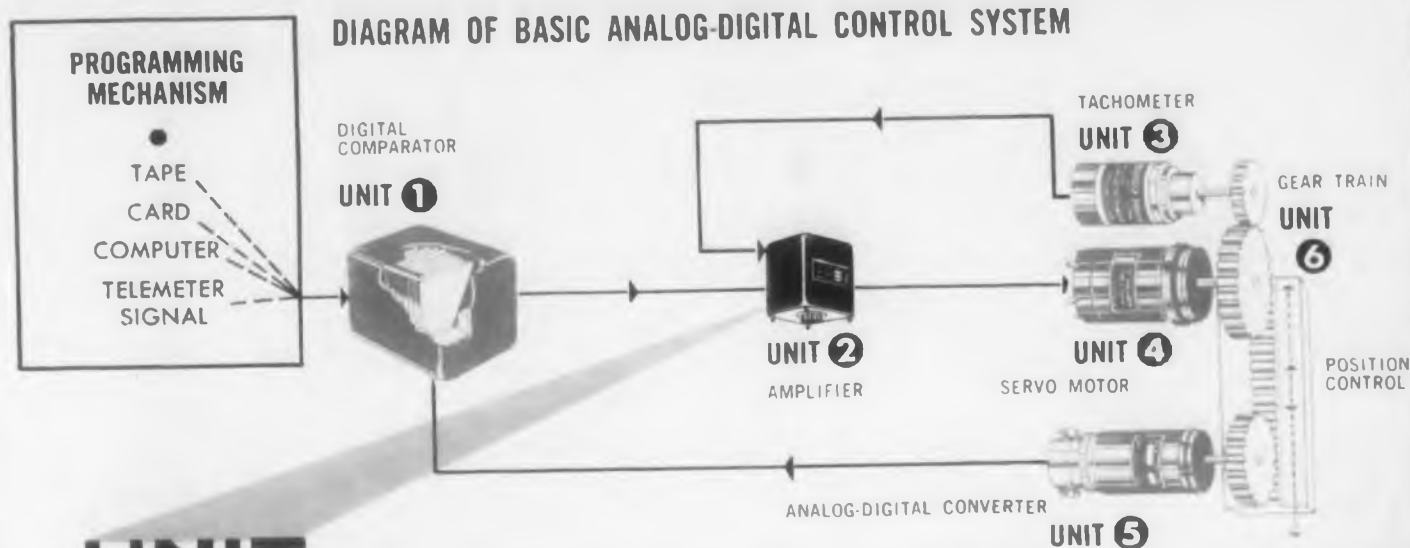
The nine task groups looked at reliability from a number of vantage points: practicality, statistics, packaging, storage, procurement, definitions, controls, regulations and directives. Tables have been developed outlining acceptability figures for reliability. Engineering failure analysis has been recommended as mandatory procedure for all test failures. Also, the groups suggested action toward achieving reliability of component parts and tubes should be gradual. It should begin with temporary measures to maintain the present degree of inherent reliability through a more critical inspection procedure and through semiannual requalification.

These represent only a few of the many recommendations contained in the full report. One strain runs throughout the document. Many of the recommendations are contained in rules and regulations already in force. Except, that few engineers in industry or the Government know precisely where they are referenced; or for that matter, that they exist. Therefore, one of the results of this study may be a consolidation of several advisory groups and watchdog agencies in the Department of Defense.

In this way, some gain toward implementing the many rules and regulations could be achieved. It has been suggested that such a consolidation could be possible by joining the programs of AGREE, the Advisory Group on Electronic Component Parts, and ASES. In effect, the Directorate of Electronics would have its own Bureau of Standards for component parts. It would be responsible, for example, for establishing new specifications before a component part gets into use. It would serve as a judiciary board having the prestige and authority to enforce the standards and specifications it develops.

No matter what form it may take, it can be safely assumed that DOD's report on reliability is probably one of the most important documents to come out of the Pentagon in recent years.

Correction: In the Sept. 1 issue we mistakenly referred to the DOD report on reliability as being 800 pages long. As finally printed, the report—entitled "Reliability of Military Electronic Equipment"—was reduced to 377 pages.



UNIT
2

SERVO AMPLIFIERS



Wide choice of Norden-Ketay amplifiers permits exact matching of units with servo motors

Servo amplifiers are available to drive the complete line of Norden-Ketay servo motors, varying from size 8 (1.75 watts, control phase) to size 23 (16 watts, control phase). High gain, low response time, and compact size are outstanding characteristics, resulting from the unique design features introduced by Norden-Ketay.

The standard selection includes amplifiers of electronic, magnetic, and transistor types. Transistorized resolver amplifiers, combined with N-K precision resolvers, can achieve overall system accuracy better than 0.07% from -55° to $+110^{\circ}\text{C}$.

To broaden the system designer's field of operation, modifications of standard units are available to provide satisfactory operation over a wide range of ambient temperatures (-55°C to $+125^{\circ}\text{C}$), and under adverse environmental conditions.

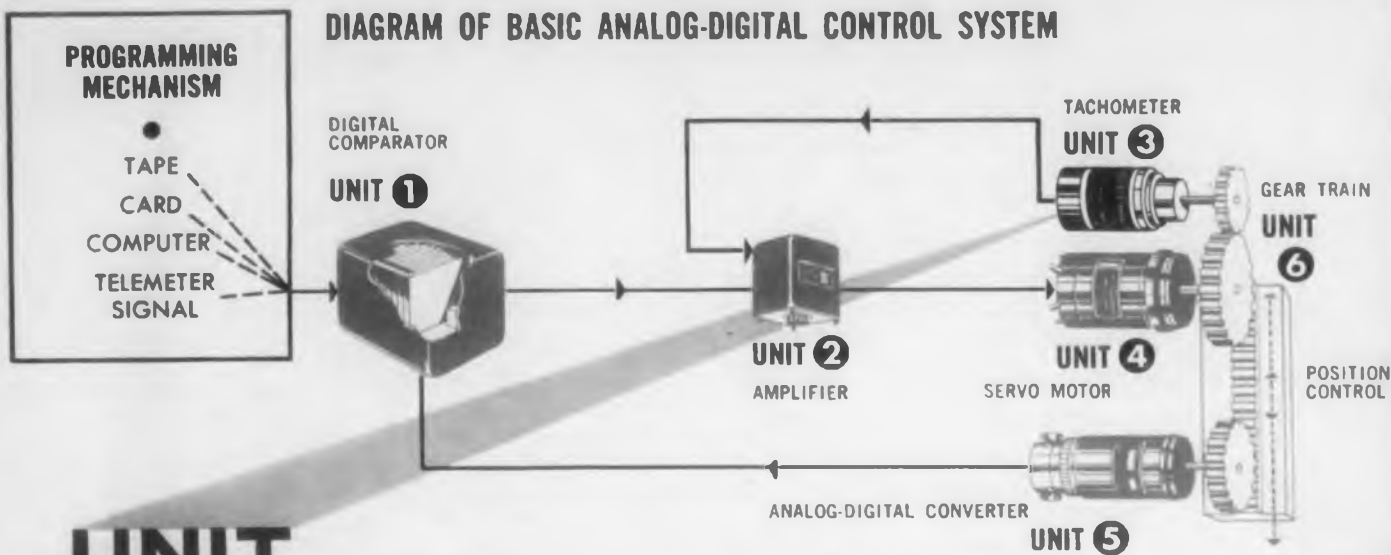
Where standard units do not meet your particular requirements, Norden-Ketay welcomes requests for the design of special amplifiers.

For Bulletin #382 with full information on amplifiers, send coupon on page 134. Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

CIRCLE 16 ON READER-SERVICE CARD FOR MORE INFORMATION

CONTROL COMPONENTS



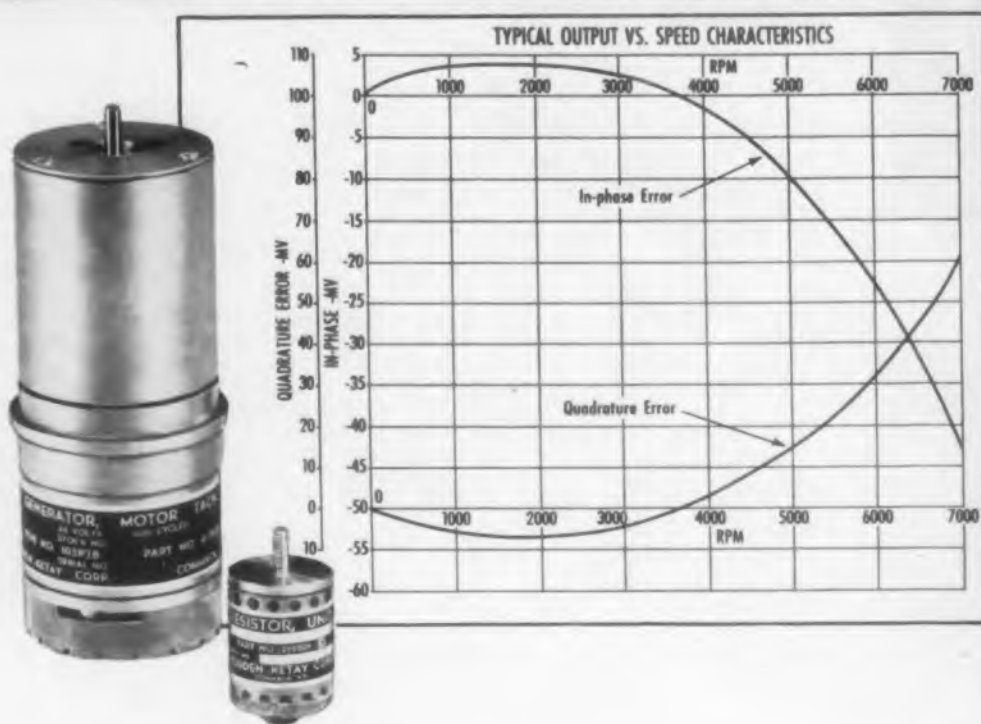


UNIT 3

TACHOMETERS



Variations can be specified in tachometer dimensions, voltages, frequency, shafts and lubrication for extreme temperatures



Tachometers present the designer with a new range of possibilities for control systems

Norden-Ketay offers tachometers designed for accurate computations and for use in velocity servo systems and stabilizing systems. Units are pre-aged to insure lifetime stable operating characteristics.

Norden-Ketay's integrating tachometers assure extremely accurate computations over a wide range of ambient temperatures.

The voltage output is pre-trimmed to $\pm 0.2\%$, saving the systems engineer considerable time and money when installing a tachometer into a new system or replacing tachometers.

Linearity of $\pm 0.12\%$ of the voltage output at 3600 RPM from 0 to 4000 RPM. Temperature compensation holds output gradient to $\pm 0.3\%$ from -55° to $+80^\circ\text{C}$. This compensation is done with a pas-

sive network which increases reliability, eliminates radio noise and phase shift problems that occur with a thermostat-controlled heater unit. Extremely high ratio of signal to in-phase fundamental null voltage of over 800 to 1. For extremely precise integration, a magnetic amplifier-controlled heater holds output gradient to $\pm 0.02\%$ over a temperature range of -55° to $+80^\circ\text{C}$.

For damping tachometer purposes Norden-Ketay has improved the basic Mark 12 and Mark 16 types by providing internal features that insure greater reliability, stability, and lower null voltages.

Send coupon on page 134 for Bulletin #423 containing data on wide selection of Tachometers. Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

CIRCLE 17 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

Nov. 11: Regional Technical Conference on Plastics for Airborne Electronics

The Ambassador Hotel, Los Angeles, Calif. Sponsored by the Southern California Section of the Society of Plastics Engineers. Among the topics to be discussed are the electrical, chemical, and mechanical properties of various plastics. Silicones, encapsulations, and polyurethanes in electronic systems will also be covered. Address inquiries to Jack G. Fuller, Hercules Powder Co., 3460 Wilshire Blvd., Los Angeles 5, Calif.

Nov. 11-13: Radio Fall Meeting

King Edward Hotel, Toronto, Canada, Sponsored by the Electronic Industries Association (formerly RETMA). There will be sessions on international standardization, reliability in receivers, all aspects of radio and television, and the design, development, and application of electronic devices such as transistors, vacuum tubes, and cathode ray tubes. For more information write to J. A. Caffiaux, EIA, 11 W. 42nd St., New York 36, N.Y.

Nov. 11-13: Third Annual Instrumentation Conference

Biltmore Hotel, Atlanta, Ga. The theme of this conference will be "Instrumentation for Data Handling" with special symposiums on electronic instrumentation as applied to medicine and the sales and purchasing aspects of electronic instrumentation. Papers should be submitted to Lamar Whittle, Federal Telecommunications Lab., 1389 Peachtree St., N. E., Atlanta, Ga. For more information write B. J. Dasher, School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Ga.

Nov. 13-14: Mid-America Electronics Convention

Municipal Auditorium and Hotel Muehlebach, Kansas City, Mo. Sponsored by the Kansas City Section of the IRE. There will be exhibits and twelve technical sessions. Approximately thirty papers will deal with medical electronics, airborne electronics instrumentation, engineering management, electronics in nucleonics and a diversity of other subjects. Persons who want to submit papers should contact the Technical Papers Chairman, MAECON, 5109 Cherry St., Kansas City 10, Mo. The deadline for submissions is Aug. 15. For more information write Richard L. Clarke, 425 Volker Blvd., Kansas City 10, Mo.



CONTROL COMPONENTS

Nov. 13-15: Eighth National Conference on Standards

St. Francis Hotel, San Francisco, Calif. Sponsored by the American Standards Association. Emphasis will be on standards as a key to progress and profits. Sessions will cover radiation exposure, electronics, industrial preparedness, motion pictures and television, purchasing, company standards, technical communications, government standards and safety. For more information, write to D. E. Denton, ASA, 70 E. 45th St., New York 17, N.Y.

Nov. 13-15: First Annual Industrial Audio-Visual Exhibition

Trade Show Building, New York City. The exhibit will feature current audio-visual equipment and techniques for conducting training sessions, sales meetings, visual presentations, and advertising promotions. For information write Exhibitions, Inc., 17 E. 45th St., New York 17, N.Y.

Nov. 15-16: New England Radio-Electronics Meeting

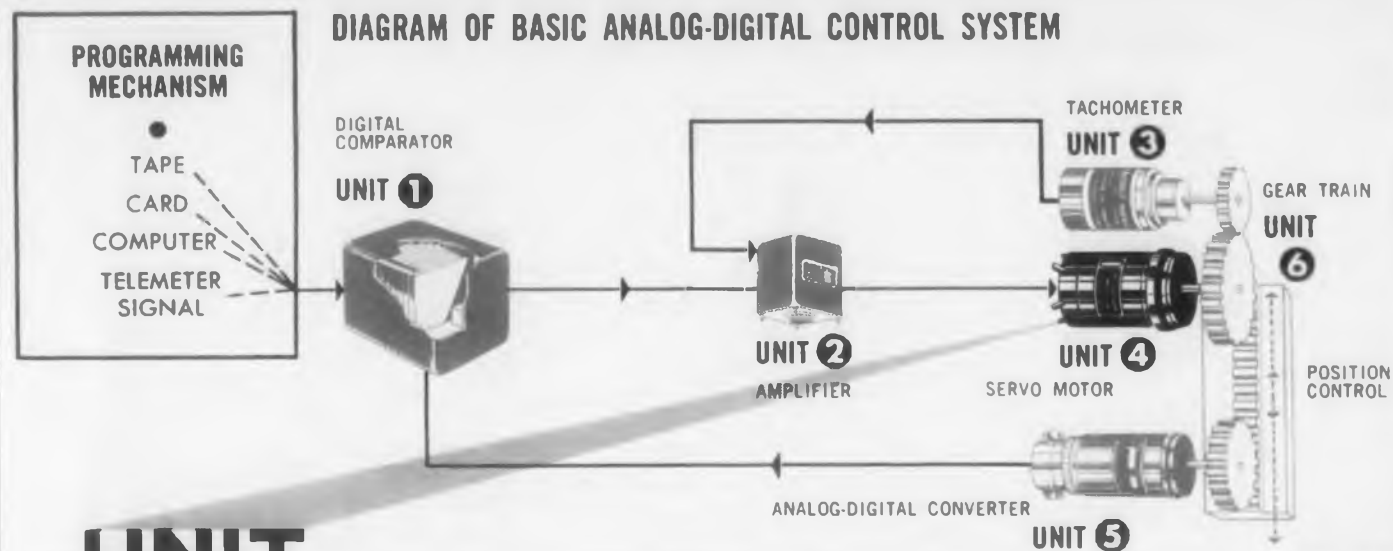
Mechanics Hall, Boston, Mass. Jointly sponsored by the Boston and Connecticut Valley Sections of the IRE. The meeting will include exhibits. Write Donn S. Randall, Larcom Randall Advertising, Inc., 51 Melcher St., Boston 10, Mass., for more information.

Nov. 18-21: Conference on Magnetism and Magnet Materials

Hotel Sheraton-Park, Washington, D.C. Sponsored by the Magnetism Subcommittee of the Basic Science Committee of the AIEE. For further details write L. R. Maxwell, U. S. Naval Ordnance Lab., Silver Spring, Md.

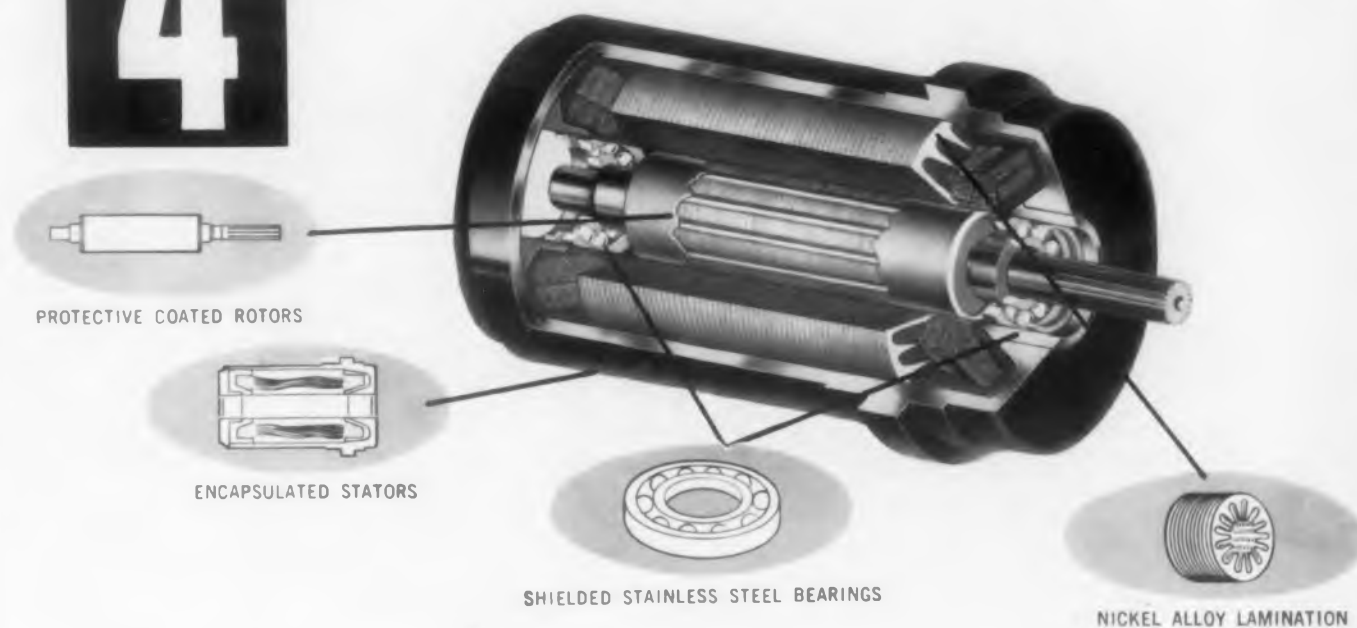
Nov. 19-21: Symposium on Electromagnetic Interference

Fort Monmouth, N.J. Sponsored by the U. S. Army Signal Engineering Labs. The purpose of the symposium is to smoke out those technical factors, theoretical and practical, which limit the efficient use of the electromagnetic spectrum and to invite discussion of means to attain more efficient usage of the spectrum to satisfy future electronic density needs. Both classified and unclassified papers will be read. Principal subject areas to be covered are systems approach, electromagnetic wave propagation, antennas, transmitters, and receivers. Address requests for information to Commanding General, U. S. Army Signal Engineering Labs., Ft. Monmouth, N.J., Attn: SIGFM/EL-DPS (Symposium).



UNIT
4

SERVO MOTORS



High torque-to-inertia ratios of Norden-Ketay servo motors give fast, precise response

The ability to correct error rapidly and precisely in minute increments recommends Norden-Ketay servos for control systems where a combination of high torque and reliability are important. High acceleration, smooth performance at near-stall conditions, and operation at low control voltages assure fast, dynamic servo response.

A complete range of sizes and types enables the designer to fill his requirements in size, characteristics, and special construction features with standard Norden-Ketay units. Diameters of .750" (size 8) to 2.250" (size 23) are available. Standard 400 cycle motors have stall torques varying from 0.25 to 7.0 inch-ounces, while 60 cycle units are rated from 1.45 to 7.0 inch-ounces.

Special design features in standard models provide

a variety of shaft extensions and control voltages. Control phases can be driven directly from vacuum tube plates or from transistors. Units can be supplied with low input power requirements for the control phase, to control the performance of a relatively large motor.

Norden-Ketay servos can be combined with gear trains or tachometers to produce geared servomotors or geared servomotor-tachometer generators.

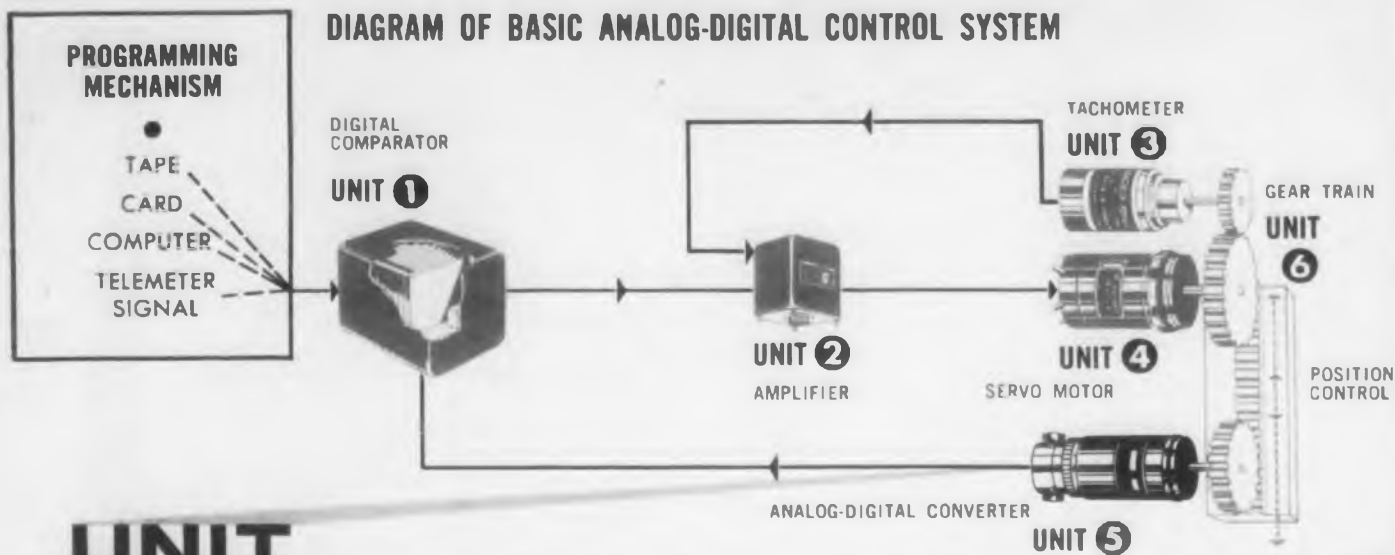
The availability of these design variations in a complete size range of standard motors simplifies system design, reduces component costs, and speeds delivery.

Send coupon on page 134 for Bulletin #385 containing data on Servo Motors. Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

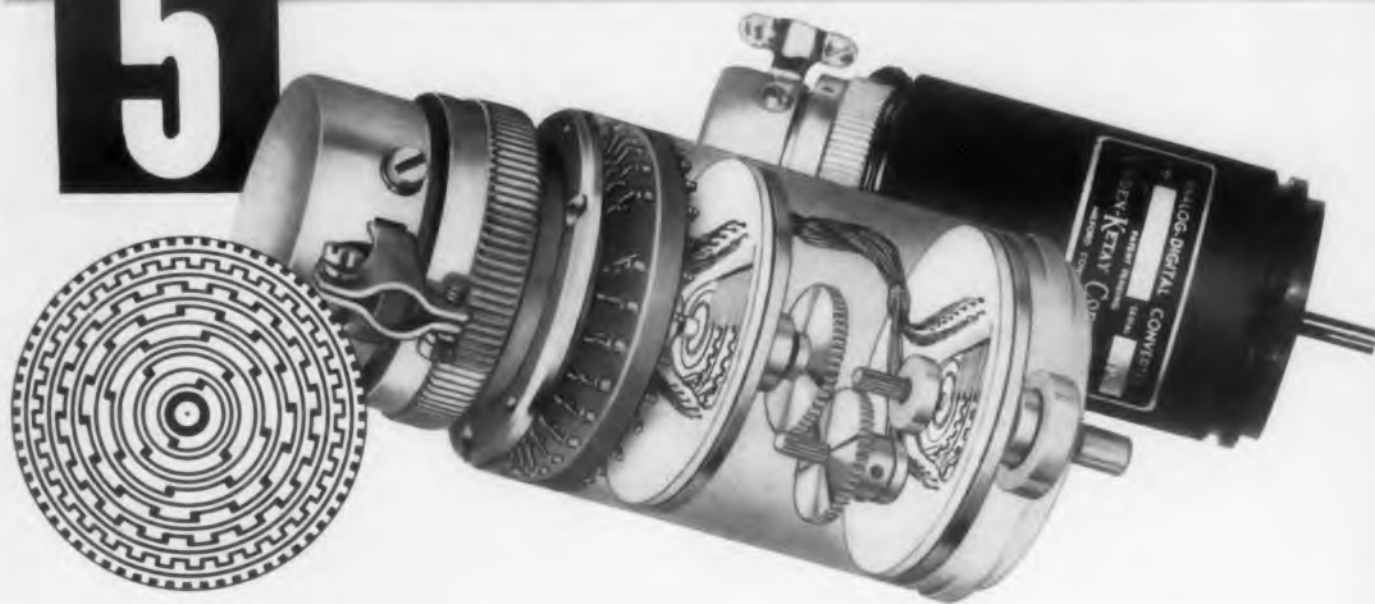
CONTROL COMPONENTS





UNIT 5

DIGITAL CONVERTERS



Unique dual-brush logic increases system versatility and simplifies circuit design

Encoding of brush selection logic on the binary disc in the Nordén-Ketay Analog Digital Converter (ADC) simplifies control systems by eliminating external circuitry otherwise required for unambiguous readout.

The simultaneous availability of both digit and complement allows two-directional operation with increasing count in both directions, simplifies subtraction and error-checking circuitry, and permits direct push-pull drive of bi-stable output networks.

The large digital capacity of the Converter provides sufficient digital increments to locate position and measure error with virtually any desired degree of precision up to one part in 524,288. This extreme precision is achieved without sacrifice of stability (as in the case of conventional analog systems) because of the positive on-off operation of the digital circuits, which are not subject to drift or noise-induced errors. The position indication is unique for every point. No errors can occur due to lost pulses, supply

voltage transients, or even a power failure during which time the encoder position is changed.

PERFORMANCE FEATURES

ADC-7-BNRY	Unambiguous, natural binary encoders, designed as airborne, multi-turn, digital servo components. 128 counts per turn; total ranges to 524,288 counts.
ADC-13-BNRY	
ADC-19-BNRY	
ADC-2-BCD	Unambiguous 8-4-2-1 binary-decimal encoders. 100 counts per turn; total counts of 2, 3, 4 decimal digits.
ADC-3-BCD	
ADC-4-BCD	
ADC-2B-16	Unambiguous, natural binary encoder with capacitance sensing of low-order digits. 2 ¹¹ counts per turn; 2 ¹⁹ total counts, for guidance and control, antenna position digitalizing.

These ADC units meet military specifications. Cyclic binary encoders and other encoding devices for special applications can be ordered for particular requirements. Send coupon on page 134 for Bulletin 372B containing data on Nordén-Ketay Analog Digital Converters. Nordén-Ketay Corporation, Instrument & Systems Division, Milford, Conn.

CIRCLE 19 ON READER-SERVICE CARD FOR MORE INFORMATION

CONTROL COMPONENTS



Meetings

Dec. 1-6: Annual Meeting of The American Society of Mechanical Engineers

Statler and McAlpin Hotels, New York City. New aircraft, solar power, metal processing, nuclear energy, safety, education and plastics are some of the topics to be covered. For more information write L. S. Dennegar, The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y.

Dec. 3-4: Joint Symposium on Human Factors in Systems Engineering

Penn-Sherwood Hotel, Philadelphia, Pa. Sponsored by the Philadelphia Sections of the IRE and the Professional Group on Military Electronics and by the Human Factors Society of America. There will be sessions devoted to engineering approaches to systems synthesis, human factors approaches to systems synthesis, and human factors information. There will also be a panel of engineers and human factors experts. Requests for information should be addressed to Conrad Fowler, American Electronic Labs., 121 N. 7th St., Philadelphia, Pa.

Dec. 4-5: 1957 National Conference of the IRE Professional Group on Vehicular Communications

Hotel Statler, Washington, D.C. The central theme for the conference is "Meeting the Demands for Vehicular Communications?". For details write to R. E. Tall, 1210 National Press Bldg., Washington 4, D.C.

Dec. 9-13: Seventh Eastern Joint Computer Conference and Exhibit

Sheraton-Park Hotel, Washington, D.C. Sponsored by the IRE, Association for Computing Machinery and AIEE. "Computers with Deadlines to Meet" will be the central theme. Papers will be presented on record keeping materials handling, traffic, deadline data reduction, communication, flight simulation, and other computer deadline areas. For details, write to Malcolm B. Catlin, Council for Economic and Industry Research, Inc., Arlington 2, Va.

Dec. 18-19: EIA Conference on Maintainability of Electronic Equipment

University of Southern California, Los Angeles, Calif. Sessions will cover military concepts and requirements for maintainability, ground environment equipment, missile maintainability, airborne equipment maintainability, and road blocks to maintainability. For additional information contact Engineering Office, Electronic Industries Association (formerly RETMA), Rm. 650, 11 W. 42nd St., New York 36, N.Y.

Jan. 6-8: Fourth National Symposium on Reliability and Quality Control

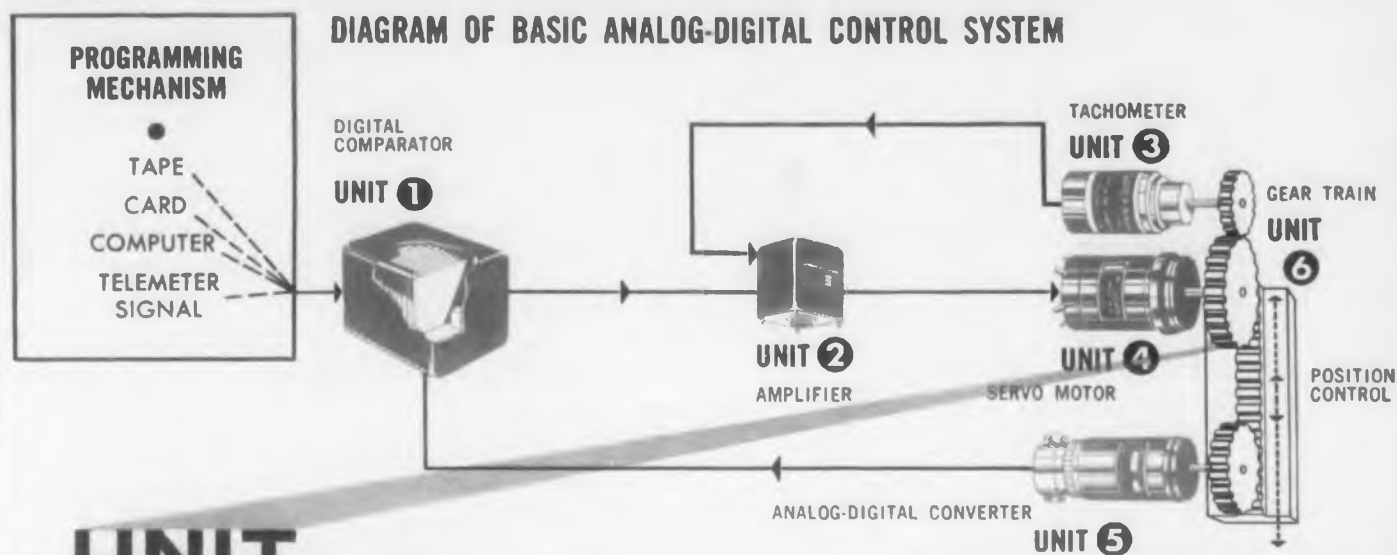
Hotel Statler, Washington, D.C. Sponsored by the IRE, ASQC and AIEE. Covering fields of reliability in the electronic industries, the symposium will encompass the following topics: reliability organization and management; theory and mathematical techniques; application of these techniques; design information; and education and training for reliability. For detailed information, contact Richard M. Jacobs, RCA Bldg. 108-2, Moorestown, N.J.

Jan. 22-24: EIA 1958 Conference on Automation

Arizona State College Auditorium, Tempe, Ariz. Sessions will consider the place of automation in the electronic industries, the application of computers to control of machinery outside the electronic industries, and the economic, educational, and social aspects of automation. Write to the Engineering Office, Electronic Industries Association (formerly RETMA), Rm. 650, 11 W. 42nd St., New York 36, N.Y. for full details.

Jan. 28-31: Fourteenth Annual National Technical Conference of the Society of Plastics Engineers

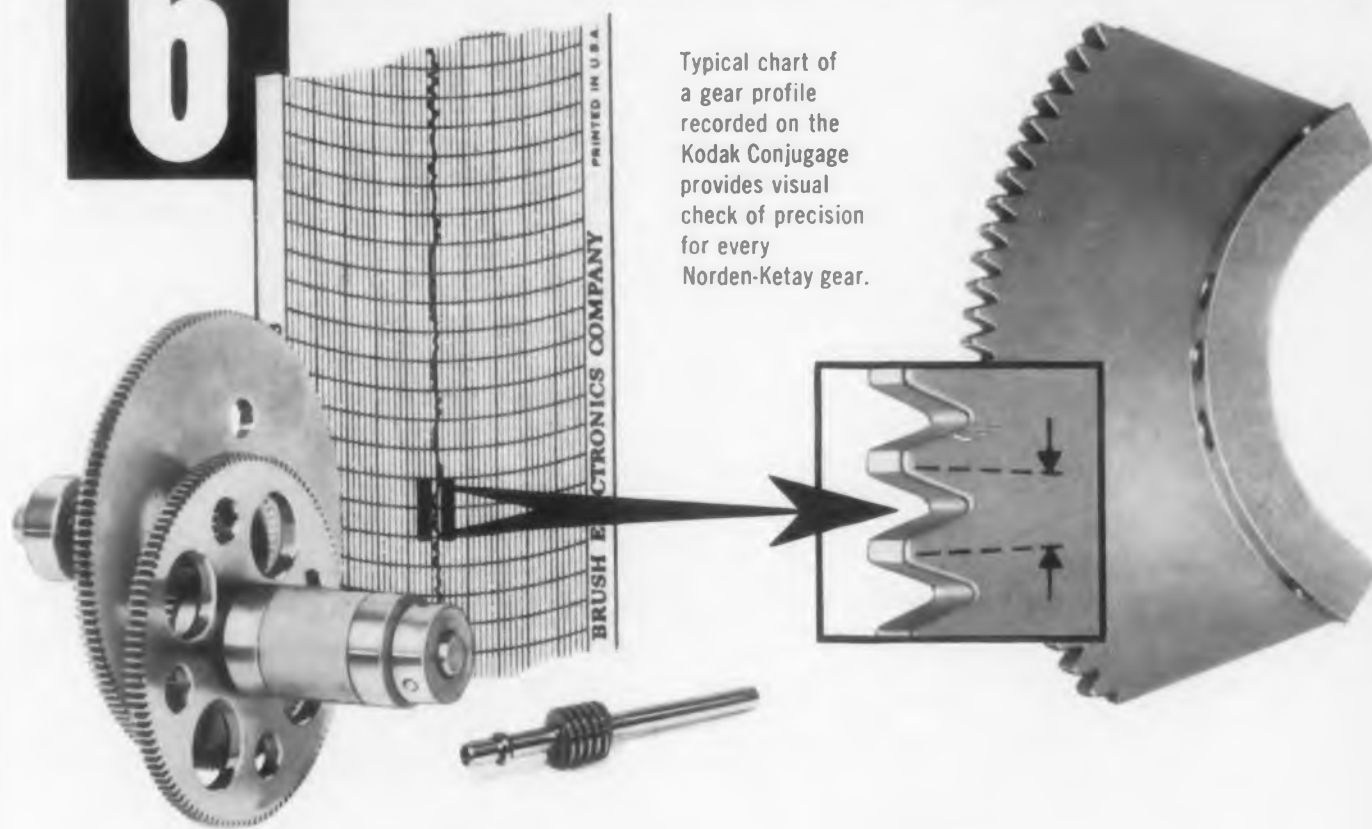
Sheraton-Cadillac Hotel, Detroit, Mich. The theme of the conference will be "Progress Through Plastics Engineering." Its sessions will deal with radiation and plastics, epoxy resins and embedment, extrusion, injection molding, education, packaging, plastic tooling, mold design, new materials, test methods, reinforced plastics, color and finishing, foam compression molding, sheet forming, and research. For further details write to Lewis A. Bernhard, Society of Plastics Engineers, Inc., Suite 116-34 E. Putnam Ave., Greenwich, Conn.



UNIT

6

GEAR TRAINS



Precision gear trains maintain high accuracy of servo systems to exact performance requirements

To maintain the high level of accuracy developed by Norden-Ketay components in control systems, the Florida Gear Division produces a full range of Gear Trains to precision tolerances.

With skills and facilities capable of cutting, shaving, and grinding gears from 3 to 200 D.P., to meet the exacting requirements of military specifications, Norden-Ketay has the precise answer to every gearing problem.

Extensive experience in gear engineering design for major military projects is an important asset of the

Florida Gear Division in tailoring gear assemblies to the particular demands of high performance systems.

Application engineers are on call to go over your gearing requirement with a view toward obtaining the desired results with the simplest and most efficient gear combination.

Write to: Norden-Ketay Corporation, Florida Gear Division, Miami, Florida, or send coupon on page 134 for Capabilities and Facilities Bulletin #431.

CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION

CONTROL COMPONENTS



Low Plate Voltage Tube Circuit Design

David Fidelman

THE INTRODUCTION of a series of tubes operating with a 12 v plate potential is a significant recent development in vacuum tube design. These tubes offer the possibility of obtaining considerable circuit simplification—particularly in regard to power supply problems where a source of 12 v dc or higher is required. Such applications include mobile equipment such as used in military and commercial vehicles, automobiles and pleasure craft, and other applications involving low-voltage driving, switching and control functions. Conventional techniques are used in the design of circuits using these tubes. Often a circuit may use both low-voltage tubes and transistors, and the tubes may be used to drive a transistor output stage to deliver several watts of power to the load.

The 12 v tubes were initially designed for use in automobile radio receivers, where they permit the complete elimination of the vibrator power supply. This represents a substantial gain in reliability.

Experience has shown that conventional tubes cannot be used with low plate voltages with any degree of reliability. New approaches in design and construction were required to make tubes for low plate voltage operation whose characteristics approach those of conventional tubes operating at much higher plate voltages. In these new tubes, although the plate supply voltage has been reduced by as much as 95 per cent, the transconductance is at a reasonable value and the g_m , μA —the efficiency of the tube—is five times as great as in conventional tubes.

Tube Design Problems

The primary difficulty in making tubes operate at plate voltages as low as 12 v is in maintaining adequate plate current and gain in the tube. Much closer interelectrode spacings than in conventional tubes, altering the electrode geometry to take advantage of contact-potential bias, and special processing techniques, solved this trouble.

Another problem encountered with these tubes is the wide variation in supply voltages over which they must operate satisfactorily. In an automobile radio receiver, for example, the supply voltage obtained from the battery-generator may vary between 10 and 16 v, a ± 23 per cent variation. This voltage variation simultaneously affects the screen, plate and heater voltages, since they all obtain their

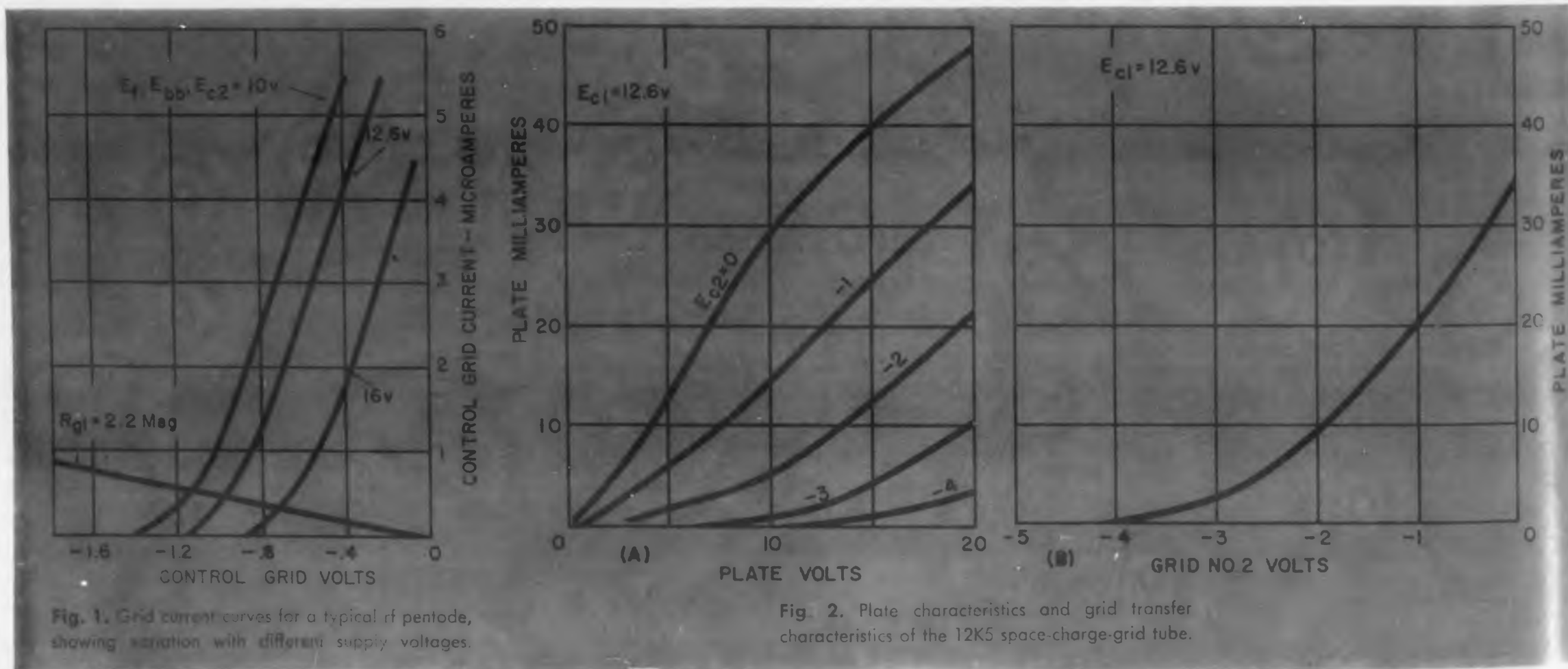


Fig. 1. Grid current curves for a typical rf pentode, showing variation with different supply voltages.

Fig. 2. Plate characteristics and grid transfer characteristics of the 12K5 space-charge-grid tube.

power directly from the primary supply. At low voltages it is difficult to maintain adequate plate current and transconductance to prevent excessive loss of gain. At high line voltages, the main problems are sublimation of the cathode material, grid emission, and heater burn-out.

High line voltage operation problems are minimized by selection and control of the cathode material, choice of a proper cathode temperature, and proper grid construction. Sublimation of cathode material is avoided by the use of low-sublimation alloy cathodes with controlled amounts of trace impurities. Heaters are operated at a compromise power input which is low enough to reduce the operating temperature of the cathode to a point where negligible sublimation is encountered yet sufficiently high to insure adequate performance at low line conditions. Grid emission is controlled by proper choice of grid material and construction, as well as by cathode operating temperature. In tubes which require high cathode temperatures, high-conductivity side-rod material or wide grid connectors are used to lower the grid temperature.

Obtaining high plate resistance at low anode potentials has been a major problem in the design of the low-voltage tubes. The plate resistance is considerably influenced by secondary emission of electrons from the plate to the screen grid. Special materials and processing of the tube during its manufacture are required to reduce secondary emission. Because of the low voltages, there is very little plate or screen dissipation. It is therefore possible

to use surfaces which are too fragile for higher voltage operation, but which will give operational stability and long life at low voltages. Special materials and aging—such as carbonized nickel upon which there is probably a layer of cathode material—provide a composite surface which reduces the secondary emission of electrons. The effect of this composite surface is to some extent analogous to the coating of an optical prism or lens to reduce the reflection of light from the surface.

Almost all low-voltage tubes require grid-leak or contact-potential bias. This is obtained by using a grid resistor of the order of 2 to 15 megohms between grid and ground. This necessitates close control of grid current, since changes in line voltage will cause changes in grid current and bias. A typical set of grid current curves for 10, 12.6 and 16 v supplies is shown in Fig. 1. Assuming a grid resistor of 2.2 megohms, it can be seen from these curves that as the voltage increases, the grid bias shifts from -0.95 v to -0.7 v, due to an increase in plate current, screen current, and cathode operating temperature, with a corresponding decrease in grid-current—which is probably due to the presence of positive ion currents to the grid or by grid emission. Because of this shift toward low bias and higher current drain, the tube transfer characteristics must be linear near zero bias to minimize distortion.

Where transistors are used in the output stages to furnish output powers in the order of watts, sufficient power at a plate voltage of 12 v must be developed to drive the transistor to full output. The

required driving power may be 50 mw or more. A radical departure from conventional tube design was innovated to solve this problem. The principle of the *space-charge grid* is used in 12 v power tetrodes to increase effectively the cathode area. This results in low output impedance and high transconductance.

The internal construction of the 12K5 tube which uses this space-charge grid principle is as follows: a first grid is placed adjacent to the cathode with a positive accelerating potential applied to it, and the control grid is located between this accelerating grid and the plate. The electrons from the cathode are accelerated by the first grid, and are believed to be grouped into thin sheaths in which the space-charge density is low. Since the factor which limits current in tubes is the repulsion between electrons where the space-charge density is high, this grouping of electrons into layers of low charge density helps to achieve high space currents. Eight or 10 ma plate current can be obtained in the 12K5 with only 2 v plate potential.

Circuit Design

Although 12 v tubes permit the use of conventional vacuum-tube circuits in equipment design, the differences in design of the tubes introduce certain problems in connection with their uses. These are

- obtaining sufficient gain and matching into the load, since g_m and r_p are not quite the same as in conventional tubes;
- stability of gain, since in many applications the power supply can vary from 10 to 16 v;
- providing agc in radio receivers, since the normal agc potential has a magnitude comparable to the anode potential of the i-f amplifier;
- the input resistance of the tube cannot be as high as in conventional tubes, because of grid current which is used for self-bias. This presents difficulties in applications that require high input impedances.

The use of extremely close interelectrode spacings to obtain sufficient gain results in low plate resistance and high grid to plate capacity, but from the data in Table 1 it can be seen that the transconductance is at a reasonable value compared with conventional tube types, and that the ratio $g_m/\mu a$ is better. With the tube data given in the table, rf voltage gains of 1822, 393 and 190 (from antenna to mixer grid, including gain due to impedance step-up) have been achieved at 600 kc., 1 mc and 1.5 mc respectively.

Maintaining stability of gain becomes an important problem particularly at low line voltages, where it is necessary to maintain adequate plate current and transconductance to prevent excessive loss in voltage gain of the stage. A comparison of the characteristics and performance at 12.6 and 10 v for a typical tube is shown in Table 2. With con-

Table 1. Comparison of the characteristics of low voltage type 12CX6 and conventional type 12BD6 rf amplifier pentodes.

Tube Type	I_b (ma)	I_{c2} (ma)	G_m (μ mhos)	R_p (ohms)	G_m/I_b (μ mhos/ma)	Test Conditions
12CX6	3.0	1.4	3100	40K	1033	$E_f = E_{bb} = E_{c2} = 12.6$ v $E_{c1} = 0$; $R_{G1} = 2.2$ Meg
12BD6	9.0	3.0	2000	700K	222	$E_f = 12.6$ v; $E_{bb} = 250$ v $E_{c2} = 100$ v; $E_{c1} = 3.5$ v

Table 2. Comparison of the characteristics and performance of rf amplifier pentode for normal and low line voltages.

Supply volts $E_f = E_{bb} = E_{c2}$	I_b (ma)	G_m (μ mhos)	Gain (antenna to mixer grid)		
			600 kc	1 mc	1.4 mc
12.6	2.6	2468	1822	393	190
10.0	1.5	1980	1930	350	148
Deviation	-42%	-20%	+6%	-11%	-22%

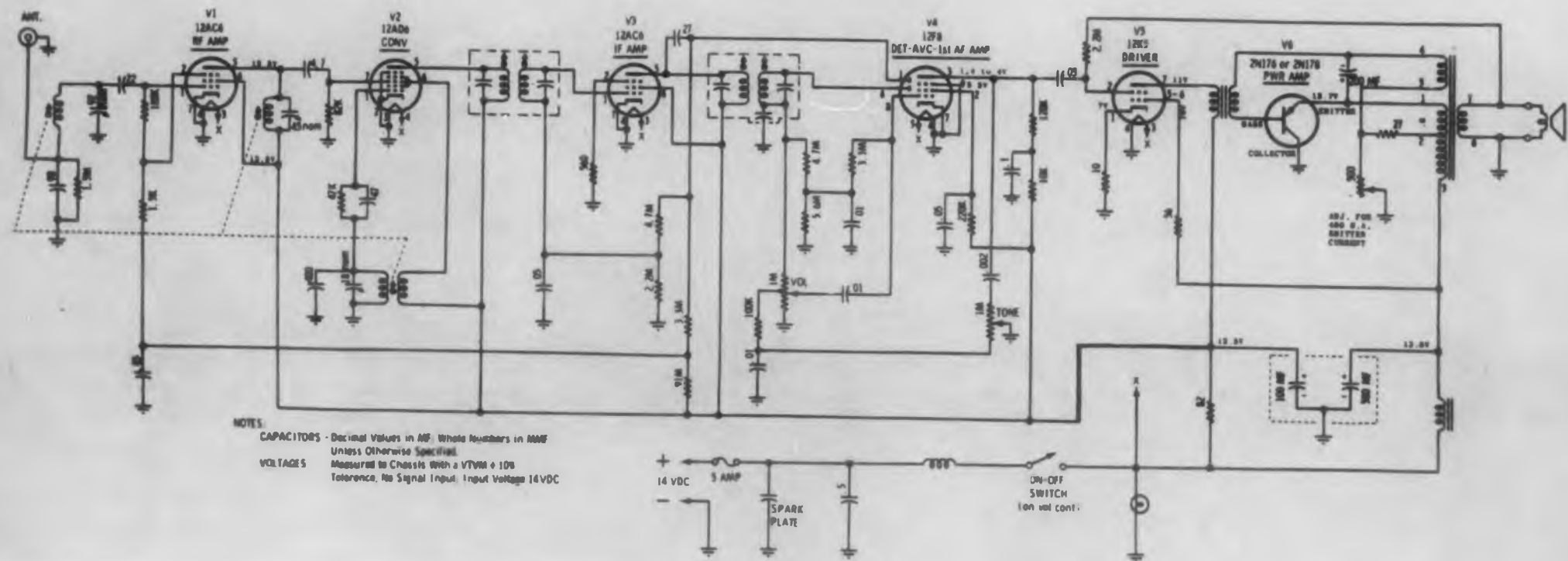
(Note: $R_{G1} = 2.2$ Meg; $E_{c1} = 0$ volts; $E_{c3} = 0$ volts)

Table 3. Characteristics of presently available 12 volt tubes.

Function	Tube Type	Heater Voltage	Plate Voltage	Grid No. 1 Voltage	Grid No. 2 Voltage	Grid No. 3 Voltage	Plate Current	Grid No. 1 Current	Grid No. 2 Current	g_m (μ mhos)	μ	R_p (ohms)	Power Output	Remarks
RF Pentodes	12AC6	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	.60 ma	—	200 μ a	750	—	500 K	—	Remote cutoff pentode
	12AF6	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	1.0 ma	—	0.5 ma	1350	—	300 K	—	Sharp cutoff pentode
	12BL6	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	1.35 ma	—	0.5 ma	1350	—	500 K	—	Sharp cutoff pentode
	12CX6	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	3.0 ma	—	1.4 ma	3100	—	40 K	—	Sharp cutoff pentode
	12DE8(f)	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	1.3 ma	—	0.5 ma	1500	—	300 K	—	Single diode—remote cutoff pentode
	12DK8(f)	12.6 v	12.6 v	0 v (a)	12.6 v	cathode	3.0 ma	—	1.4 ma	3100	—	40 K	—	High permeance diode—sharp cutoff pentode
Converter	12AD6	12.6 v	12.6 v	1.1 v rms	12.6 v	0	.45 ma	50 μ a	1.5 ma	260 (b)	—	1 Meg	—	Pentagrid converter
I-F Amplifier	12CN5	12.6 v	12.6 v	0 v (a)	12.6 v	cathode (internally)	4.5 ma	—	3.5 ma	3800	—	40 K	—	Sharp cutoff pentode
Audio Driver	12J8(e)	12.6 v	12.6 v	0 v (a)	12.6 v	—	14 ma	—	3.0 ma	5400	—	4 K	20 mw	Double diode—power tetrode
	12K5	12.6 v	12.6 v	12.6 v	-2.0 v	—	8 ma	35 ma	—	7000(c)	—	0.8 K	40 mw	Space-charge grid power tetrode
Audio Amplifier	12AE6(d)	12.6 v	12.6 v	0 v (a)	—	—	.75 ma	—	—	1000	15	15 K	—	Double diode detector—medium μ triode
	12AJ6(d)	12.6 v	12.6 v	0 v	—	—	.75 ma	—	—	1200	55	45 K	—	Double diode detector—high μ triode
	12EL6(d)	12.6 v	12.6 v	—	—	—	—	—	—	—	—	330 K	—	Double diode detector—high μ triode
	12F8	12.6 v	12.6 v	0 v	12.6 v	cathode	1.0 ma	—	0.38 ma	1000	—	330 K	—	Double diode detector—remote cutoff pentode
Miscellaneous	12AL8	12.6 v	12.6 v	0 v (a,d)	—	—	.25 ma(d)	—	—	550(d)	15	27 K(d)	—	Medium μ triode—space charge
	12U7(g)	12.6 v	12.6 v	12.6 v	0 v (a,e)	—	.25 ma(e)	50 ma(e)	—	8000(c,e)	—	1.0 K(e)	20 mw(e)	Grid tetrode
				0 v	—	—	1.0 ma	—	—	1600	20	12.5 K	—	Medium μ double triode

*NOTES: (a) Grid #1 resistor = 2.2 Meg (e) Power tetrode characteristics
 (b) Conversion transconductance (f) Pentode characteristics
 (c) Grid #2 to plate (g) Each section
 (d) Triode unit characteristics

Tubes listed in Table 3 may be obtained as follows: CBS Hytron, all except 12AC6, 12DE8, 12DK8, 12EL6, 12AL8; General Electric, 12AD6, 12AF6, 12BL6, 12F8, 12K5; Radio Corp. America, 12AF6, 12BL6, 12AD6, 12K5, 12AE6, 12AJ6, 12F8; Raytheon, 12AF6, 12BL6, 12CX6, 12AD6, 12CN5; Sylvania, all except 12DE8, 12DK8; Tung-Sol, all except 12CX6, 12DK8, 12CN5, 12J8. G.E. plans to release improved versions of the 12AF6, 12BL6, 12K5 in September. Developed but not publicly announced at this writing are Raytheon's 12DK7 and 12EM6, both 9-pin combined detector-transistor drivers, one- and two-diode sections respectively. Fig. 3 (below) represents a typical hybrid auto radio schematic. Circuit shown is Motorola's Model BKA6T. Note the use of the 12K5 transistor driver.



Schematic circuit diagram of a typical hybrid automobile radio receiver, Motorola Model BKA6T

ventional higher voltage tubes, the maximum allowable reduction in g_m when tested with only the heater voltage reduced is about 40 per cent. In the case of the tube illustrated, the gain at 600 kc with a 10 v supply is actually higher than at 12.6 v, due to the increased plate resistance at 10 v, which provides a better match for the load.

Providing age in 12 v tubes is troublesome since the age voltage is about the same as the anode potential of the i-f amplifier. In a typical radio receiver, a signal strength of 0.1 v will result in an age voltage of -6 v. When this voltage is applied to the grid of the rf amplifier stage, the incoming signal is fed directly to the grid of the converter stage by means of the interelectrode capacity of the tube, and can be sufficient to overload the converter. This can be avoided by applying the age voltage to the suppressor grid as well as to the control grid.

At the present time, the major application of the 12-volt tubes is in the manufacture of radio receivers for automobiles with 12-volt ignition systems. A considerable circuit simplification and a reduced drain on the battery results from their use. The most widespread circuit is the *hybrid*, in which a transistor is used as the power amplifier, while all the other tubes are 12-v tubes. The entire vibrator power supply is eliminated—thus dispensing with precisely those components which are the most common causes of trouble in car radios. The total current drawn from the battery by a typical hybrid receiver is 1.7 amp compared with 4.1 amp for a conventional vibrator type.

The circuit is fairly conventional in design, except for the absence of the power supply and certain minor differences required by the use of the 12 v tubes. As has already been discussed, the age voltage is applied to both the input grid and the suppressor of the first stage, and a portion of it is also taken to the i-f amplifier. In the converter-oscillator, the secondary winding of the transformer is connected so that the screen current is carried through the winding, thus providing stable oscillation even when the supply voltage is as low as 9 v.

A high-current driver stage is required to drive the transistor power amplifier—and for this purpose a high-current space-charge grid tube—a 12K5—is used. The input power required by the transistor stage is 50 mw, which at 12 v can only be delivered by use of the space-charge tube. The plate current characteristics of the 12K5, shown in Fig. 2, show that peak plate currents approaching 40 ma in the vicinity of zero bias are possible with the tube. The output audio power is then delivered to the loud-speaker by the transistor power amplifier stage.

As the 12 v tube series becomes more familiar to electronic engineers, they will be more widely applied in mobile systems, low voltage switching circuits, and control circuits.

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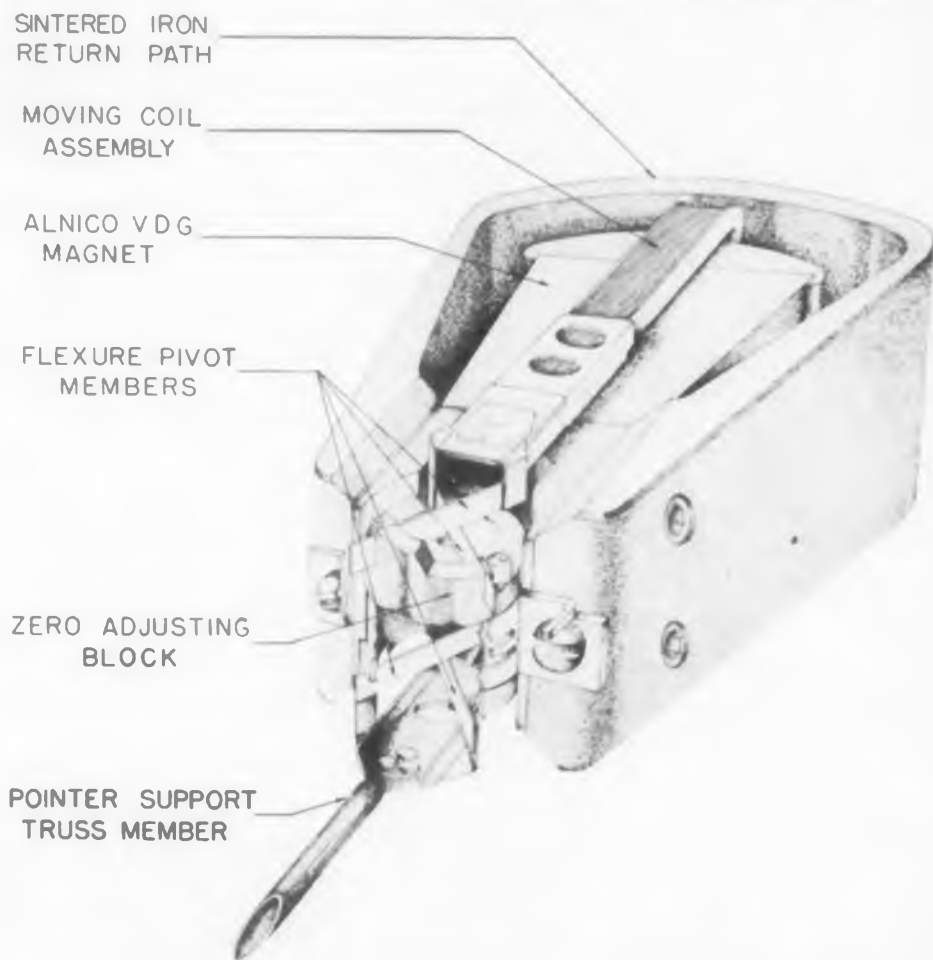
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This unique movement eliminates conventional pivots, V-jewels, and hairsprings from moving coil, permanent magnet devices.

ee Meter Movement

The new mechanism, designed by the Marion Electrical Instrument Co., Manchester, New Hampshire, is a gravity-compensated flexure pivot. This unusual suspension provides a frictionless bearing which permits infinite resolution without axial or radial play. Pivot members serve as calibrated springs and provide the restoring torque for the moving coil.

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	44 MA Max.	22 MA Max.	14 MA Max.	10 MA Max.	7 MA Max.

Duty: Continuous
Dropout: 30 to 60% of pickup
Contact Rating: .25 AMP at 28 V.D.C. resistive load
Operation Time: 4 milliseconds max. @ rated voltage
Dielectric Strength: Sea level: 500 V RMS. High altitude: 500 V RMS

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THE HEAT-OF-FUSION principle is used to control the temperature of an integrating rate gyro designed to maintain a temperature tolerance of 1.3 degree C. The self-contained temperature control maintains a temperature of 80 C, although other temperatures can be achieved. Because fusion temperature control devices are rugged, self-contained, and use no tubes or relays, they are well suited to military application.

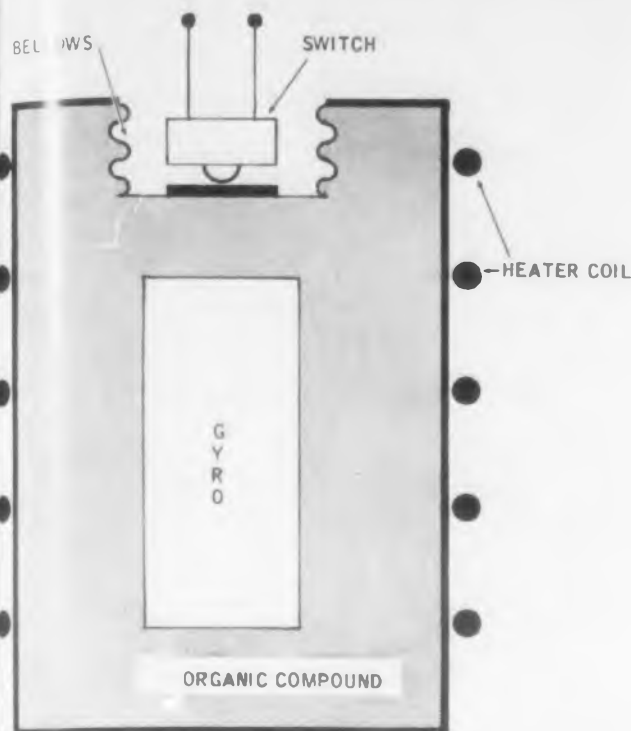
Designed by General Electric's Light Military Electronic Equipment Dept., the KR-8 gyro has its temperature control and thermal insulation within one case. The temperature control uses the volume expansion that occurs when certain organic com-

pounds change from liquid to solid state. The gyro is placed in a container completely filled with the organic compound. As the temperature changes, the compound expands or contracts, moving a bellows which actuates a switch. The switch is connected to a heater surrounding the container.

Observation of the fusion process reveals that the melting substance experiences changes in volume that are quite large, amounting on the average to about ten per cent of initial volume. The temperature of the solid-liquid mixture remains fixed at the melting point until the fusion process is completed. The energy available from such a process is very high. For equivalent mechanical action with a bimetal operated



Mothballs (naphtalene) used as the organic compound which controls the gyro temperature.



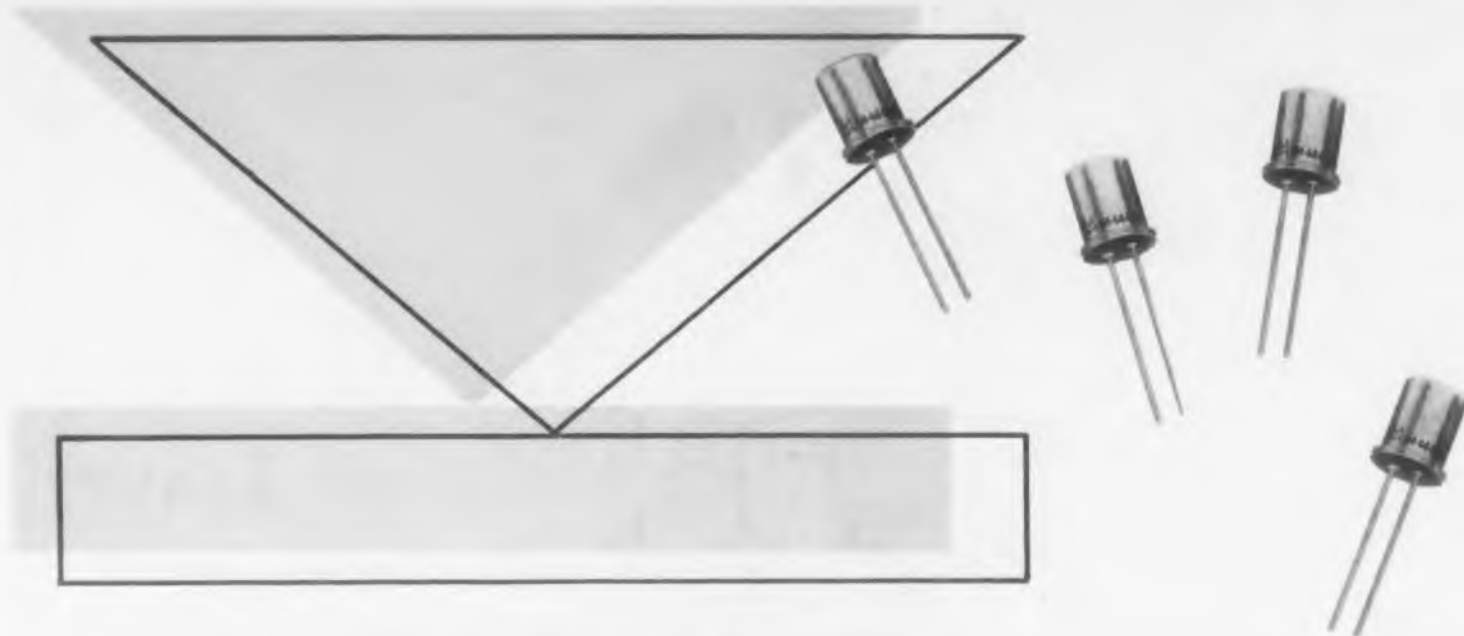
Fusion temperature control unit. When the temperature drops, the compound expands and closes a snap switch that turns on the heaters.

controller, 5000 times as much material would be required as in the fusion temperature device.

Choice of the compound used for a specific application depends on its melting point. A sharp melting point is required and the organic compound must be of high purity. For some compounds, such as anthraquinone, volume expansion may be as high as 17 per cent. By suitable combination of organic compounds, nearly any temperature environment can be achieved. Problems involved in the design of a specific temperature control include selection of a proper compound or mixture, design of filling apparatus to melt the compound and fill the container, selecting proper volume of compound, determining heat flow in the container, the travel of the bellows and switch, and selecting the cycling rate.

The complete gyro unit has shown a maximum wander of 6/10ths degree for a period of more than four hours when tested on a servoed table. The gyro has a dc permanent magnet torque motor which requires no reference current. The torque motor coil construction requires no shaft and is inherently resistant to vibration and "g" loading. The gyro has a twelve pole variable reluctance type of signal generator. At a speed of 24,000 rpm its minimum life is about 1000 hours. So as to facilitate the removal of the gyro from the temperature controller, open-ended design is used. The controlling compound is sealed in a double cup arrangement.

For further information about this product, turn to the Reader Service Card and circle 320.



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Maximum Reverse Current @ Maximum Rated Voltage	.05	.5		ma

* Units having anode connection to case designated as M14A. Units having cathode connected to case designated as M14C. Numerical suffix indicates peak inverse voltage.

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This is Part I of a two part series which studies the travelling wave tube from the viewpoint of the user. It describes the procedure in selecting the proper operating performance and circuit design most suited for a particular application, and the practical problems associated with designing and packaging a travelling wave amplifier. Part II will emphasize solenoid design, focusing, and power supplies.

The Selection and Application of Travelling Wave Tubes—I

N. Hansen and A. Nielsen

Federal Telecommunication Labs.

A Division of I.T.&T.

Nutley, N. J.

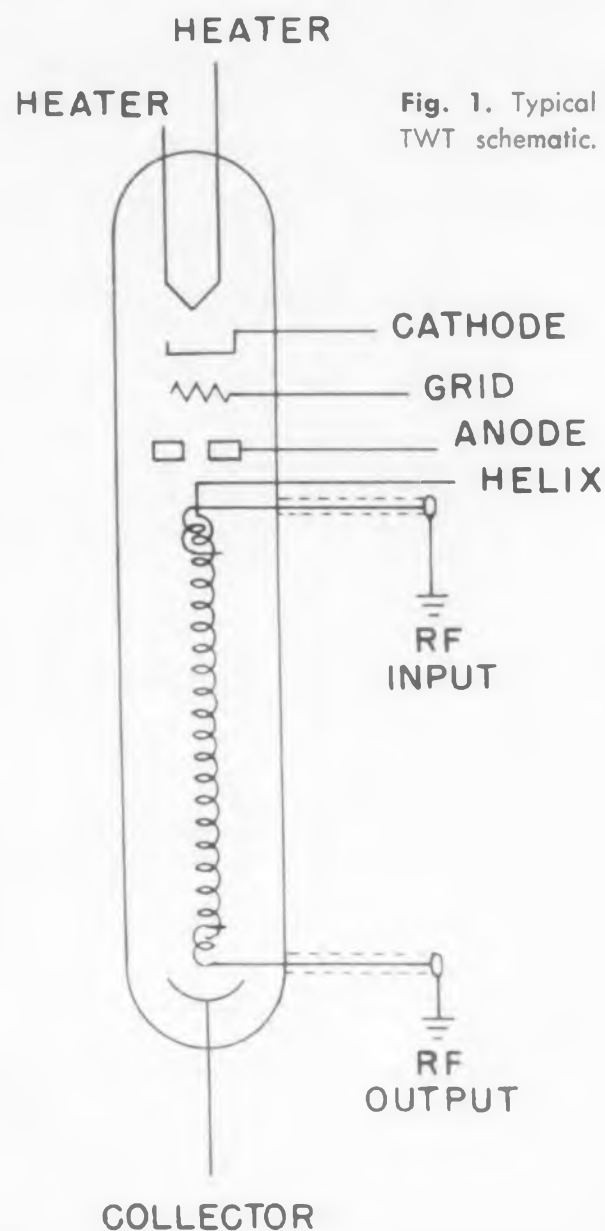


Fig. 1. Typical TWT schematic.

SELECTING a travelling wave tube can be a design problem deserving just as much consideration as a complicated circuit analysis. In order to utilize the various characteristics of a typical low power travelling wave tube (Fig. 1) for any given application it is necessary to elaborate on how these characteristics are obtained. This tube can be operated in several ways depending upon the external voltages and controls on each of these elements.

Beam Voltage

The beam or helix voltage must be adjusted for one of three effects: maximum power output, maximum small signal gain or maximum bandwidth. For a given frequency the gain will be a function of this voltage as shown in Fig. 2. The point of maximum gain is the synchronous voltage; Fig. 3 shows how it varies with frequency. It can be seen that for a given tube, at the higher frequencies, the synchronous voltage is practically constant and a wide bandwidth may be obtained at the proper voltage. This is a result of the use of the helix, as the phase velocity of the helix structure is relatively independent of frequency if properly designed. Some control is still available, however, and the shape of the frequency response curve may be altered to produce a shift in center frequency. Fig. 4 describes this phenomenon in a typical travelling wave tube, where $E_1 > E_2 > E_3$. The adjustment now becomes very critical, since a small change can greatly alter the response curves.

At higher synchronous voltages narrow band operation may be obtained, but since the structure is inherently a wide band device, the noise figure will

be high. A band pass filter to reduce noise-level would be advantageous, if a narrow band amplifier is desired.

While changing the beam voltage to obtain various effects, beam power has also been changed. Beam current will also increase with increased voltage causing even more beam power. Assuming a fixed efficiency, power output will increase linearly with beam power. For higher beam voltages and narrow band operation the power output capabilities of the TWT are greatly increased. The gain and power output characteristics at a given frequency are illustrated in Fig. 5 plotted on log-log paper in dbm or dbw. The constant gain lines serve as references. As the helix voltage is increased from E_1 to E_2 , the saturated power output increases and the gain decreases.

In most applications these factors are so designed in the tube that one setting of the helix voltage will enable the tube to operate satisfactorily over a two to one bandwidth with a relatively constant gain and power output. In any event it can be determined whether the tube will have to be operated with sacrifices in gain or power output. The voltage should be specified to the circuit designer, i.e., either E_1 , E_2 or E_3 .

The saturation characteristics of a TWT can be useful in applications where constant power output is required. The saturated power output as a function of frequency is usually rather constant as compared to small signal power output, a characteristic useful for linear gain. As the voltage is decreased to E_3 , a broader saturation characteristic and a more non-linear small signal gain results.

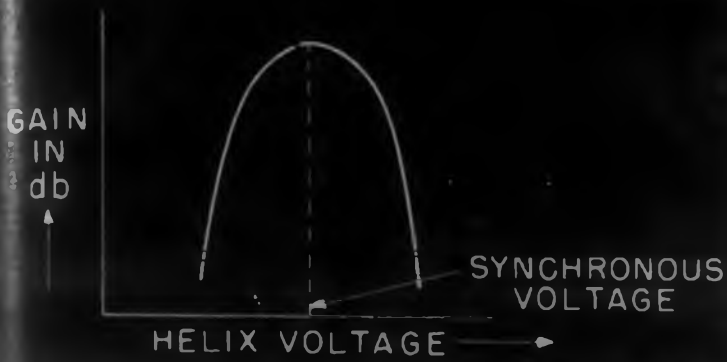


Fig. 2. Gain as a function of helix voltage.

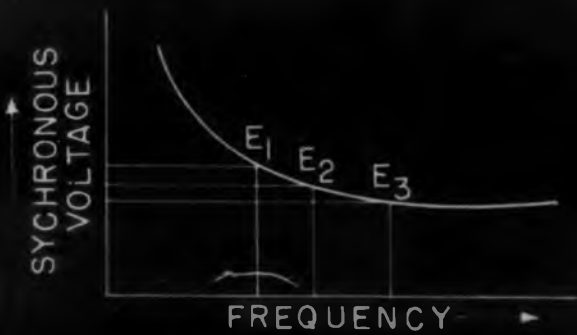


Fig. 3. Showing synchronous voltage as a function of frequency.

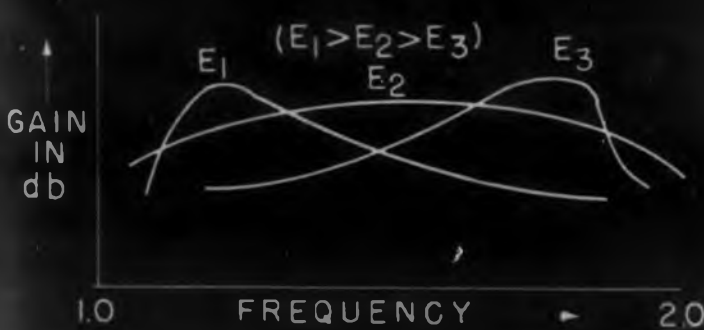


Fig. 4. Frequency response as a function of synchronous voltage.

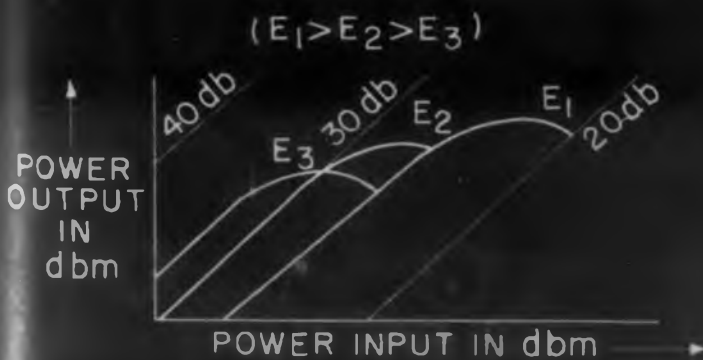


Fig. 5. Power and gain as a function of synchronous voltage.

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Helix Modulation

Modulation of the helix voltage which controls the electron velocity results in a relative shift in phase of the rf output. This phase modulation characteristic superimposed on the synchronous voltage curve (Fig. 6), shows that a small amplitude modulation might also exist if the gain curve were not flat on top. The voltage versus phase shift curve is not perfectly linear, however, and if linearity is desired the beam current must be held constant. This is shown in Fig. 7. This type of control has many applications in heterodyning and Doppler simulation.

Grid Control

Grid control is a familiar parameter. Since beam current is a function of grid

bias, and rf gain is related to beam current the grid may be used as a means of gain control. The gain in db varies inversely with grid bias voltage to unity gain and approaches the cold loss or helix attenuation of the tube as in Fig. 8. The drop off above the maximum is due to defocusing. Variations of 100 db are possible.

Ideally the control grid would have no effect on beam velocity. In most cases however, the effects are not negligible and as bias is increased the phase shift may increase by as much as 180 deg. The bias specified to the circuit designer may be selected to give the desired stage gain or if the tube is used as a switch it can be used to establish the isolation. Experience with some tubes shows greater tendency to oscillate at higher beam currents, and the net result then is to specify the maximum

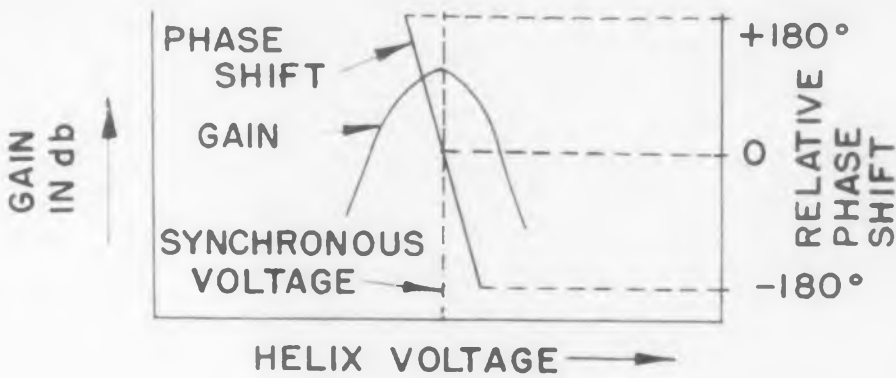


Fig. 6. Relative phase shift and gain vs. helix voltage.

Fig. 7. Relative phase shift vs. helix voltage with constant rf output and beam current.

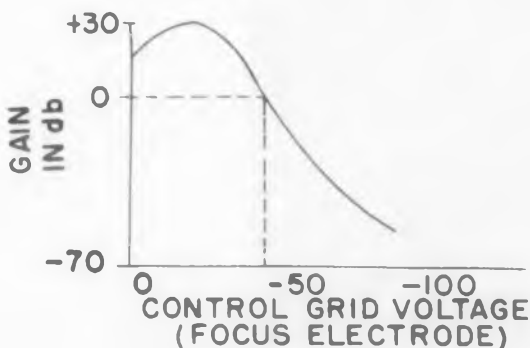
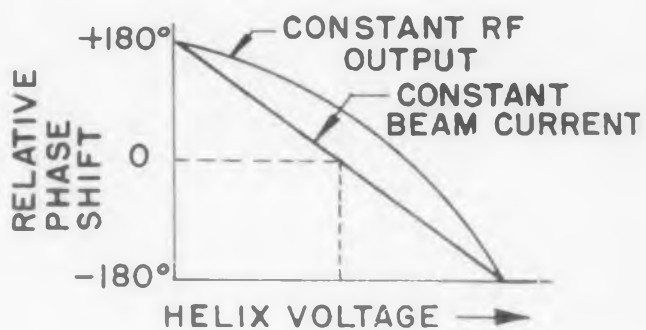


Fig. 8. Gain vs. control grid voltage.

just below this point. Also, the bias has a defocusing effect in some cases and the specified value may be that which gives minimum helix current. Pulsing the beam by means of the control grid can be useful from the standpoint of power dissipation. In higher power tubes the power supply requirements are of great concern when size and weight are factors. For instance, a 10-w cw tube having an efficiency of 10 per cent would require a 100-w power supply and cooling system. Pulsing this tube at a low duty cycle involves only a simple video circuit, and the power and cooling required would be greatly reduced. Anode or cathode pulsing can also be used, although the pulsing circuitry is usually cumbersome.

Solenoid Focusing

Another very important parameter in the operation of a TWT is the solenoid flux density. This is sometimes as critical as beam voltage especially in the higher power tubes where helix intercept current is critical as far as dissipation is concerned.

Current regulation in the solenoid will also have effects on TWT performance. The flux density must be adequate to focus the beam such that the beam current transmission is high. However if too much flux is applied, a minor misalignment in solenoid-helix axis can cause the intercept current to the helix to rise. Consequently, an optimum solenoid flux density can be expected. In the case of an electromagnetic solenoid, the current must be regulated in order to stay within tolerances.

If the flux density is increased to give an optimum beam transmission, the gain of the tube will be optimized and the noise figure will be minimized. If solenoid power is of larger concern, these parameters may be sacrificed slightly in order to reduce power by decreased solenoid current. This type of operation is not recommended since strict current regulation is required to hold the parameters within their tolerances.

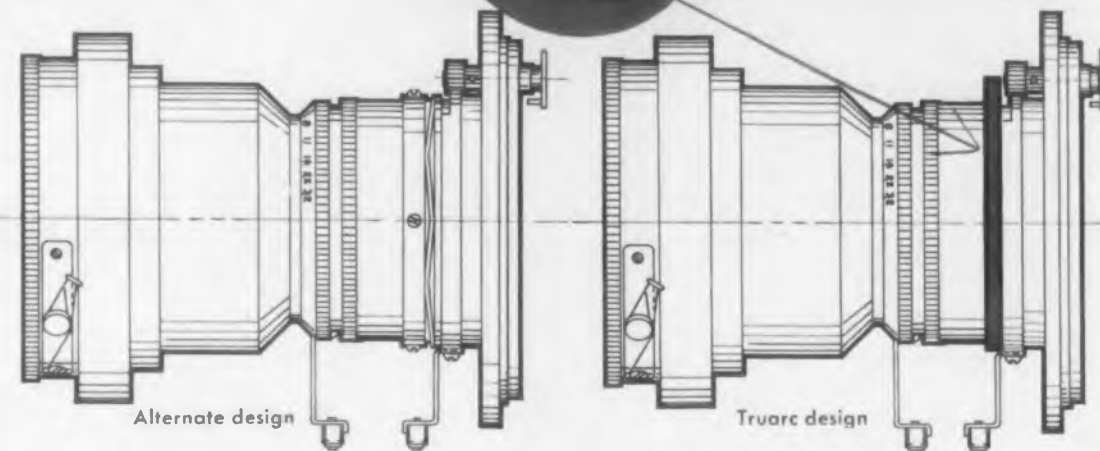
The high power TWT deserves individual attention. The problems associated with this tube are those already mentioned plus cooling, strict power supply design, and protective circuitry. An improper adjustment in this case may cause the loss of the tube. The maximum helix and collector power dissipation must be kept in mind during adjustment. The beam duty cycle in the case of pulsed tubes can be protected by limiting circuitry in the pulser; however, the rf input power and duty cycle must be kept within the maximum power handling capabilities of the helix.

A low noise tube in contrast deserves just as much attention but not for the same reasons. Electrode voltages, solenoid current and physical tube-solenoid alignment are all critical parameters in order to form the beam correctly. A rigorous adjustment is required to minimize noise figure.

Waldes Truarc Retaining Ring eliminates 7 parts, saves \$8.88 in sub-assembly of aerial reconnaissance camera

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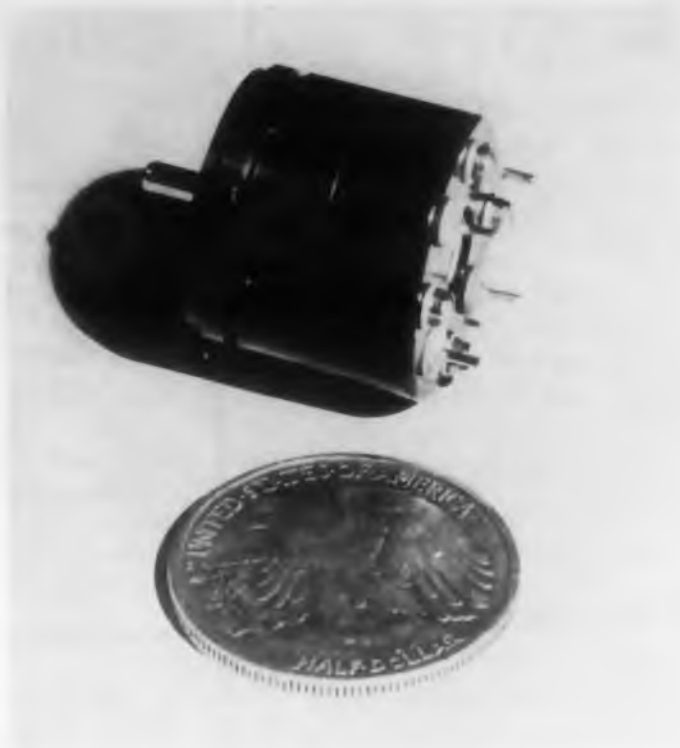
Illustrated here is a typical Series "EMRA" Environmental Connector shown fully wired and potted.



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Miniature Microsyn

ACCURATE translation of angular displacement into an ac voltage is provided by this microsyn despite its small size. A range of 30 deg with a linearity of 0.5 per cent to ± 7 deg, 1 per cent to ± 10 deg and 5 per cent to ± 15 deg makes possible the design of accurate wide range control systems. Because of its small size it can be substituted in systems which previously used a synchro to obtain a miniature pick-off device. Since the microsyn does not use brushes or slip rings it is easier to assemble and costs less than a synchro.

The 11MP-02F microsyn, manufactured by Lear Inc., Grand Rapids 2, Michigan, is the smallest self-contained unit in production. It has a signal to noise ratio of 100 to 1 and a sensitivity of 500 mv per deg. Null voltage is a maximum



Solid quartz-filled potting compound increases reliability and helps maintain an accurate null under vibration.

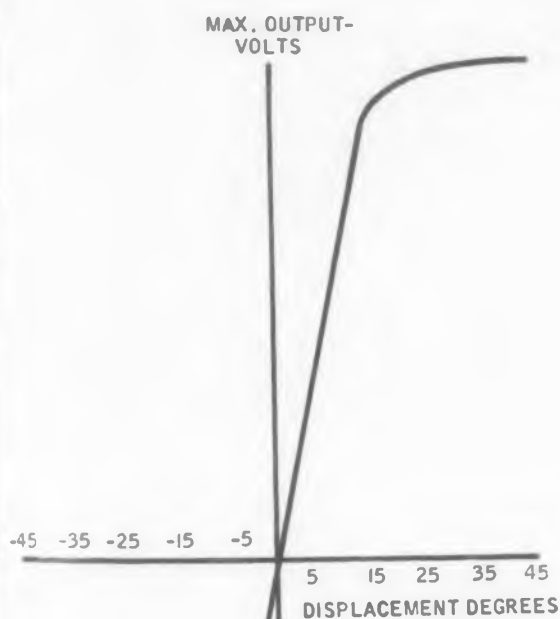
of 5 mv with a 20 v excitation. This corresponds to 0.1 deg of angular displacement.

Potting Compound for Stability

The housing contains a solid, quartz-filled potting compound which gives high stability to the aluminum shelf and maintains a constant null output under the most severe environmental conditions. The units are vibration tested per MIL-E-5272A, Procedure 3. Thermaleze-wire windings on high temperature bobbins and internal connections of Teflon wire assure reliable operation in ambients of over 300 F. Normal operating temperature range is -80 F to $+185$ F. Excitation is 20 v, 400 cps, or 35 v, 800 cps. Alternate connections can be provided to meet specific application requirements. The unit is 1.161 in. long, with a diam of 1.093 in. Maximum weight is 1.2 oz.

Subminiature microsins can be used for position indication in gyros, control follow-up devices, and control force sensors. Typical industrial applications are in computation, process control, measurement of pressure and temperature in linear balancing systems, motion and torque amplification in self-balancing servo systems.

For further information on this product turn to the Reader Service Card and circle 31.



Linearity of voltage output for angular displacement is retained over a 30 deg range from -15 to $+15$ deg.

New polyclad insulation eliminates core taping



(Left) New Polyclad resin provides complete insulation, eliminates taping required for former uncoated core (shown above).

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Positive protection against the effects of humidity and high-voltage stress, new Westinghouse Polyclad resin coating eliminates the need for taping the core or encasing it in a plastic or aluminum box—*insulation costs are reduced 15%*.

The resin forms a smooth, continuous coating; rounded corners prevent shorting wire to core, allow winding directly on core. Strains induced into the magnetic core are much less than with ordinary insulation—magnetic values stay constant.

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Editor's Note: This is the second part of a two-part article. Part I dealt with test techniques necessary for thermal evaluation of commercial airborne electronic equipment. Part II deals with design improvements. Though the scope of the article is limited to airborne electronic equipment, the information provided should prove helpful to design engineers coping with thermal problems.

Thermal Design—II

Harry M. Passman

Collins Radio Co.
Cedar Rapids, Ia.

IMPROVEMENTS in thermal design have evolved as a result of the test program outlined in Part I of this article (ED Oct. 1, 1957). Efforts were directed toward keeping all components below their maximum rated temperature. Where possible, a new temperature level below the maximum allowable is established to provide maximum reliability—based on life test data.

Use of Improved Tube Shields

For years, designers have used shiny JAN tube shields for electrostatic shielding and hold down functions. They used them because they were stand-

ard parts and because they didn't know that these shields acted as tube ovens, blocking effective heat transfer by conduction, convection, and radiation (three out of three).

Early tests showed that bare bulbs or windowed shields gave lower bulb temperatures than shiny JAN shields. Further test work led to the development of the Collins 66J heat reducing tube shield (Fig. 2). Fig. 3 shows the temperature rise of a 12AU7 with 7.4 w dissipated using various commercially available tube shields.

The 66J shields can reduce bulb temperature rise as low as 55 per cent of the value obtained with shiny JAN shields.



Fig. 2. Collins 66J heat reducing tube shield.

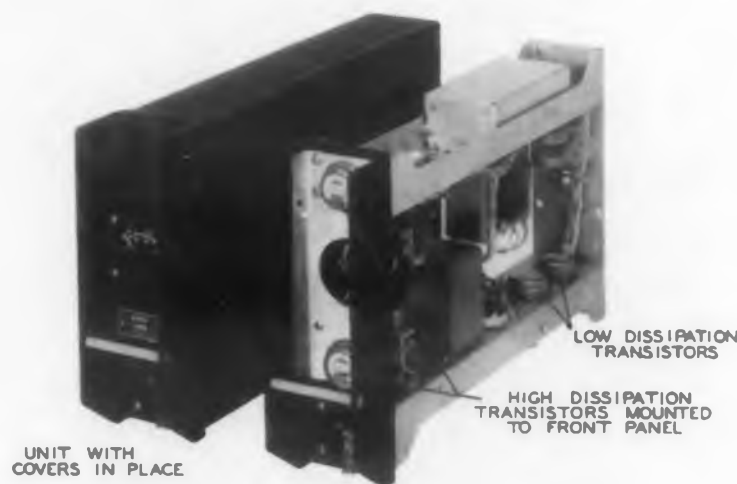


Fig. 3. Hot spot temperature rise vs tube shield type for a 12AU7 miniature tube.

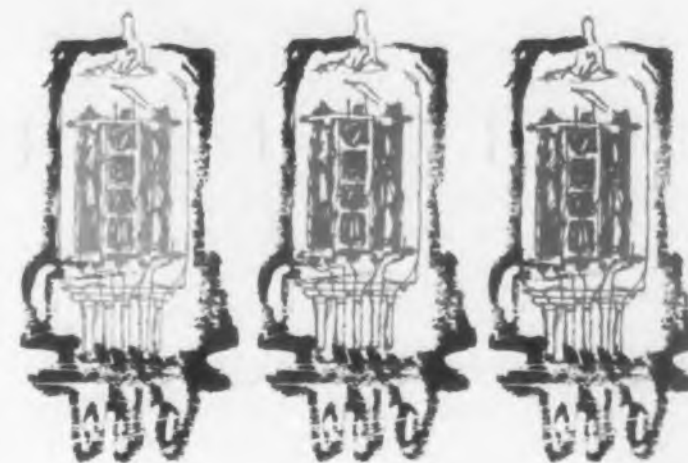


Fig. 1. Shiny JAN shield provides electrostatic shielding and hold down feature while tube cooks.

Proper Location of Components

a. General Grouping. Fig. 4 shows an ATR case divided up into zones of desirability. Zone 1, the front doghouse area, is the most desirable. Zone 6, the upper central area, is the least desirable. Assume we were to distribute dozens of small heat sources uniformly throughout the case shown in Fig. 4 and then install it in a typical shelf installation. Under these conditions, increasing zone numbers would have increasing temperature rise. The front doghouse area has even greater significance than these numbers indicate. In a typical shelf installation, this area is exposed to the 80 F cabin atmosphere, whereas the rest of the case is sur-

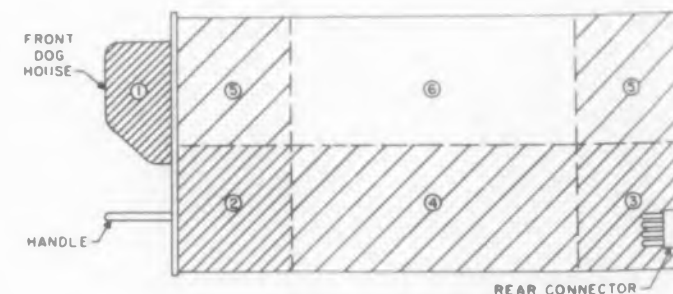


Fig. 4. Side view of ATR case showing zones of desirability.

rounded by hot boxes. This front area runs considerably cooler than any other location in the case and should be treated as an extremely choice area, reserved for temperature sensitive components such as transistors and electrolytic capacitors. Let us take an example to show how to utilize the zones of desirability concept. Assume we have a short 1/4 ATR equipment which has both miniature tubes and transistors with the following dissipations:

Max. Allowable Temperature	Component Description	Watts Dissipated
165 C	6 Miniature tubes—3 w	18 w
85 C	2 germanium transistors 1/2 w each	1 w
105 C	4 transistors—1 w each	4 w
150 C	2 relays normally on— 3 w each	6 w
	Misc. resistors, etc.	4 w
85 C	1 electrolytic capacitor	
		33 watts

Assume that we have complete freedom of location of all components for purposes of explanation. Obviously, circuit considerations will necessitate compromises in actual equipments.

First, a quick check on the practicality of a non-forced aircooled 1/4 ATR equipment with 33 w. Fig. 5 shows average case rise versus watts per square inch of case area for an equipment on an individual shockmount. A short 1/4 ATR case has 293 square inches of case area.

$$\frac{\text{watts}}{\text{in.}^2 \text{ case area}} = \frac{33 \text{ watts}}{293 \text{ in.}^2} \text{ or } 0.113 \text{ watts/in.}^2$$

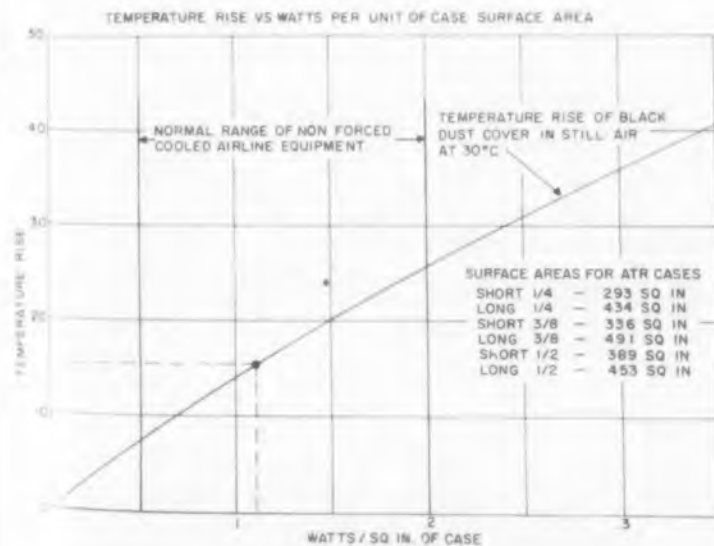


Fig. 5. Temperature rise vs watts per unit of case area.



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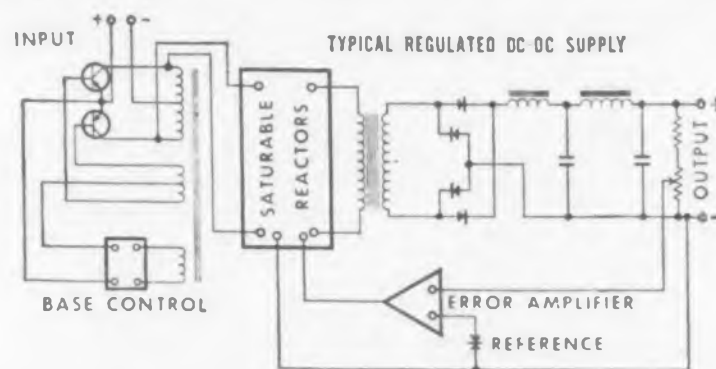
These all-semiconductor supplies have proven their reliability in many applications including the powering of telemetering transmitters, sensing units, servo motors, airborne TV systems, gyros, recording motors, etc. Power Sources' engineers are familiar with the modern environmental requirements of MIL-E-5400 and MIL-E-8189.

Standard techniques have been developed and incorporated into production units which provide excellent regulation over wide tem-

perature excursions. Power Sources can furnish outputs of up to 500 volt-amperes with 1% over-all regulation, from -55°C to $+85^{\circ}\text{C}$ and after rough environmental handling. Regulation techniques including saturable reactors for high efficiency DC output regulation and many combinations of series and parallel transistor-Zener diode regulators for both AC and DC regulation.

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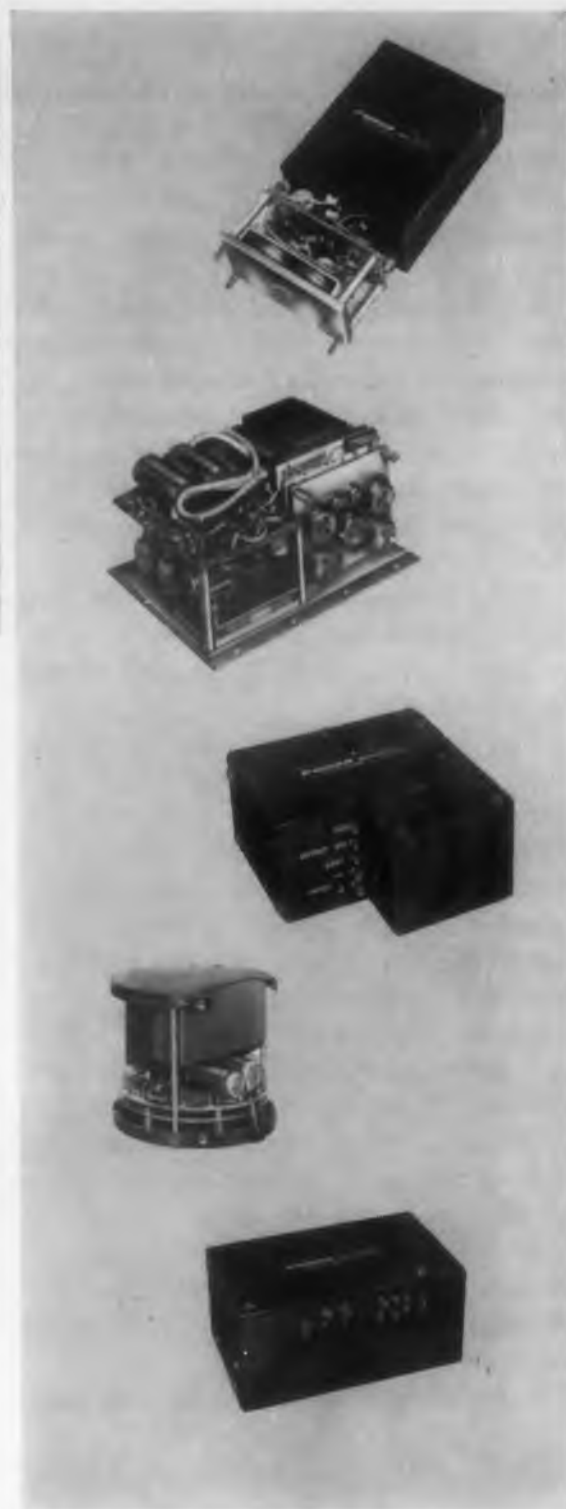
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Referring to Fig. 5, 0.113 w/in.^2 falls comfortably in the normal range of nonforced cooled equipment and has an average case rise of 15 C .

With an ambient of 55 C , the average case temperature will be

$$55 \text{ C} + 15 \text{ C} = 70 \text{ C}.$$

Fig. 6 shows a layout designed to give the most possible protection to the electrolytic capacitor and germanium transistors. It also offers protection to the 105 C transistors by isolating them from the heat producing miniature tubes and relays which are all located on the upper deck. In this design, the upper deck will run considerably hotter than the lower deck.

If the germanium transistors were located on the upper deck chassis along with the miniature tubes in zone 6, they would run well over their maximum ratings.

Fig. 7 shows an all transistorized passenger address amplifier with an output of 40 w . This design posed a problem because the two output transistors dissipated high power and were temperature sensitive. The equipment contains other transistors which were low power dissipators and were also temperature sensitive. In order to keep the power transistors within their rating, they were located in the front doghouse area and the front panel effective area was tripled by adding fins which extend forward. These fins increased the effective case area by 20 per cent and allowed the power transistors to operate within their limit without unduly heating up the inside of the case. The low dissipating transistors were located in the lower rear area of the case, away from the hot front panel. Transformers, relays, and other dissipators were located on the upper deck.

b. Individual Location. In addition to general

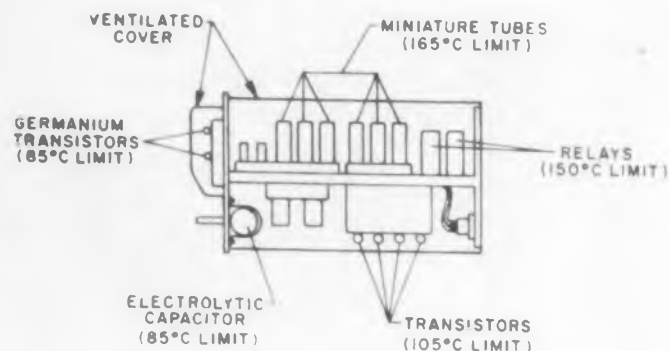


Fig. 6. Example of equipment layout — side view of short 1/4 ATR unit with 33 w dissipated.

grouping, a great care must be taken in individual locations of components.

Avoid close concentration of heat dissipators such as resistors. A group of resistors mounted close together in a row on a terminal board may exceed their maximum rated temperature and even scorch the terminal board even though they are all running at $1/2$ their maximum wattage rating. Avoid location of critical components in close proximity to hot components. Beware of sneak conduction paths. Fig. 8 shows a typical example. A wire wound resistor dissipating several watts and a $1/2 \text{ w}$ carbon resistor dissipating only $1/8 \text{ w}$ are soldered to the same terminal. The $1/2 \text{ w}$ resistor heats up above its maximum allowable temperature even though it dissipates only $1/8 \text{ w}$, because of the excellent conduction path through the component leads.

There are many other situations where individual component location details can cause trouble. Fortunately, thermal testing will show them up and they can be remedied with minor modifications.

In the case of general grouping, design errors normally require complete redesign to correct. Therefore, grouping must be well thought out early in the design or costly redesign may be necessary.

Dust Cover Ventilation Design

Thermally speaking, the best dust cover for a nonforced cooled equipment is no dust cover at all. However, a dust cover is normally required to protect personnel from high voltage and to protect the equipment in handling and against foreign objects. Airline covers are limited by ARINC specifications 404 to ventilating holes no longer than $1/8 \text{ in}$.

Normally, a completely perforated cover will yield lower average inside temperatures than a partially closed cover. The top surface of the cover

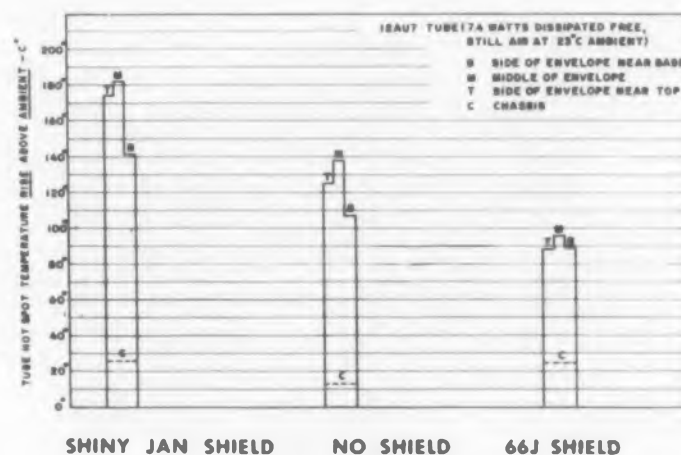


Fig. 7. Short 1/4 ATR passenger address amplifier with extended front panel area.

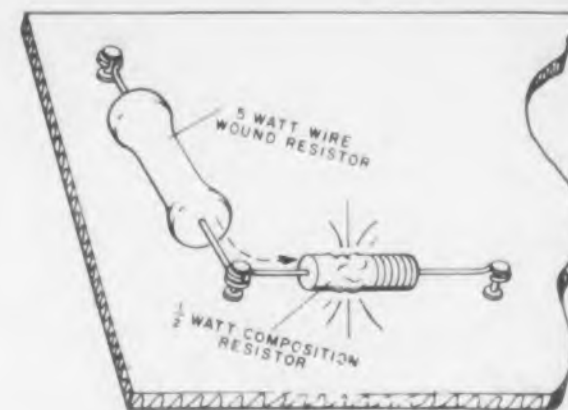


Fig. 8. Conduction path from high dissipator to low dissipator.

is especially important because of natural convection cooling. Perforating the top surface of the cover will result in considerable reduction in temperature rise of components in the upper area of the case.

If it were not for the new optical ARINC cooling system, it would be safe to completely perforate all covers and let it go at that, but alas. . . .

Covers for Optional ARINC Cooling. Airlines maintain spare equipments at major airports for hasty replacement of malfunctioning equipment (These reliable radios do occasionally malfunction.) Because of their problem of spares, the airlines consider it very desirable to be able to use the same radio for both nonforced cooled and ARINC cooled installations. They are just beginning the transition to ARINC cooled radio racks. This transition will go on for many years and airlines will have aircraft with and without the optional cooling.

Collins has done considerable thermal testing in an effort to establish compromise covers which will

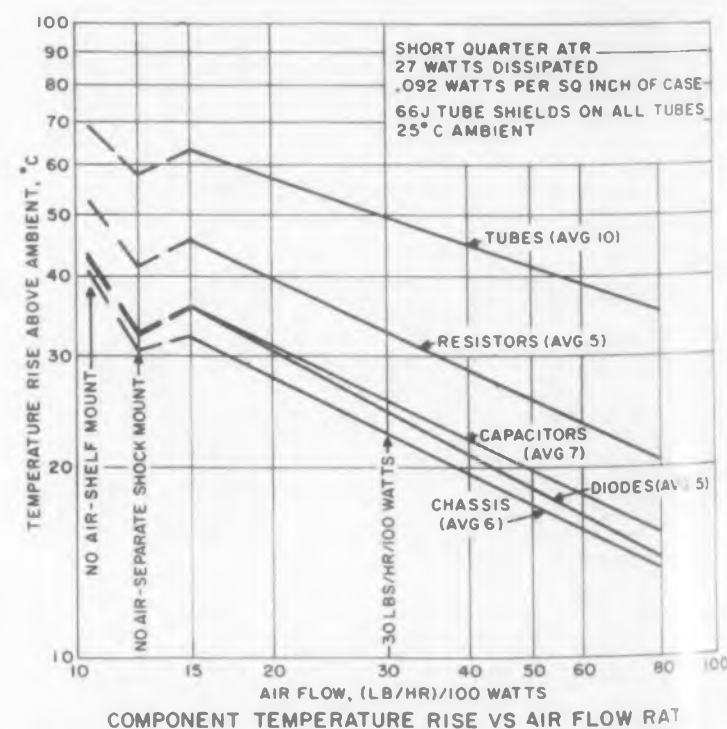


Fig. 9. Component temperature rise vs air flow rate.

work effectively or without ARINC cooling. As many as 15 different cover ventilating configurations have been tried on a single equipment. Each equipment presents a separate problem but some generalities can be drawn. In the case of the non-forced cooled equipment, we want to come as close as possible to a completely perforated cover.

In the case of ARINC cooled equipment (air drawn through the radio and down into a plenum duct via an exit hole in the rear area of the cover bottom surface), we want to route cooling air into contact with tubes, transistors and other critical components while keeping this air away from precision gear trains, open switch and relay contacts, r-f sliding contacts, and other areas affected by contaminants in the cooling air. We want to avoid short circuiting the air into the outlets without first routing it through important component locations.

The compromise cover must favor the nonforced cooled situation since it will be the worst situation for the equipment.

We have found that this compromise cover usually ends up with most of the upper 2/3 of the cover perforated (including the top) except for areas to be protected from contaminants. The bottom usually has few openings except for the ARINC cooling outlet holes. The bottom 1/3 of the sides is usually closed except for some occasional perforations near the front.

Fig. 9 shows average temperature rise of tubes, resistors, capacitors, and chassis for various test conditions with and without ARINC cooling on a typical airline equipment.

Note that component temperature rise is considerably higher without air than with ARINC cooling. The ambient temperature in the rack is also higher without air (approaching 55 C) than with ARINC cooling (approximately 30 C).

Thus, the compromise cover must favor the non-forced cooled situation.

Conclusions

Improved thermal design requires familiarity with the environment in which equipment is installed. Good general layout plus close attention to detailed component replacement and mounting is also essential.

Temperature-reducing shields and other special devices as well as proper selection of components and conservative electrical design are basic for a reliable end equipment.

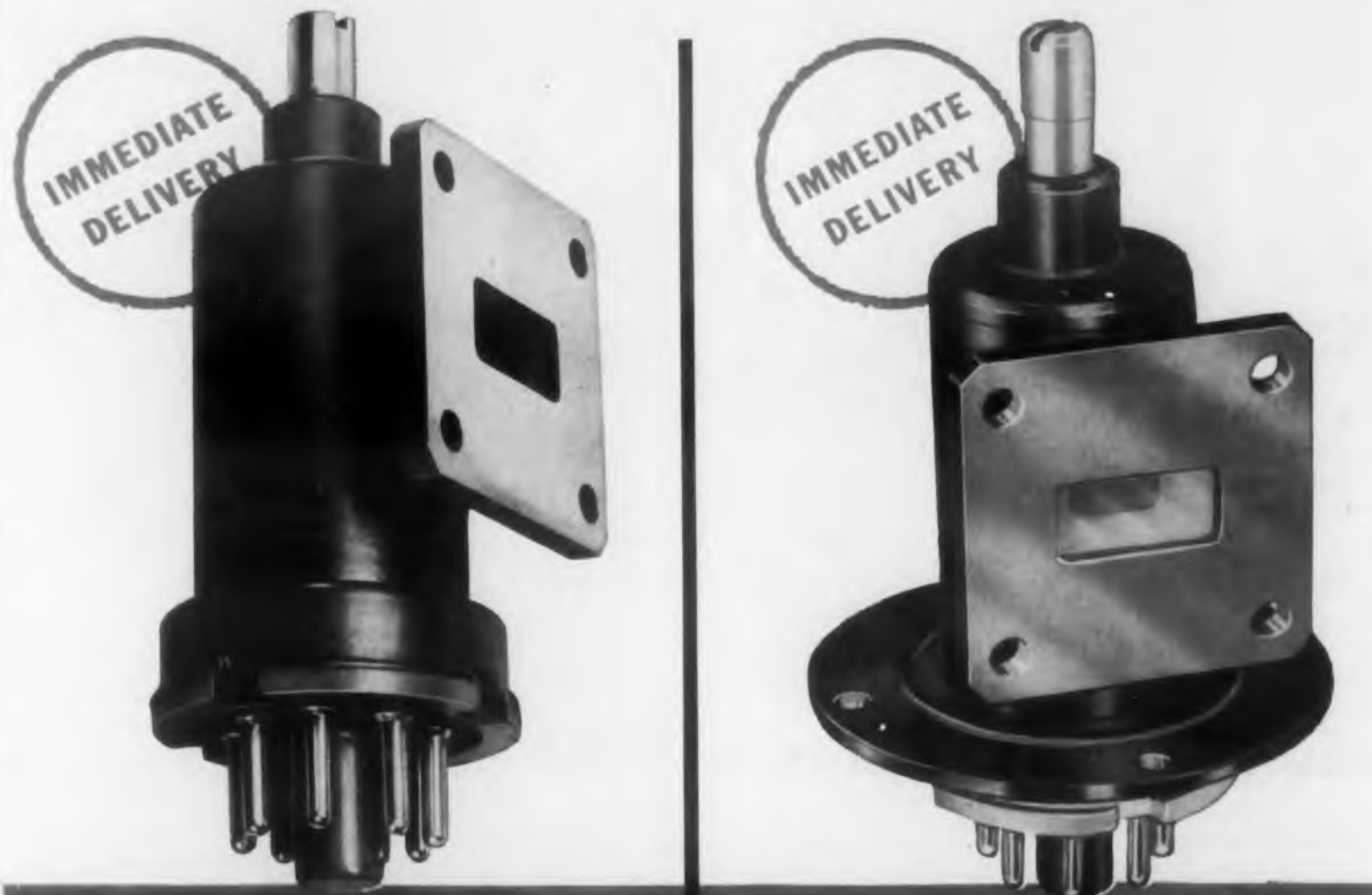
Dust covers must be effective and yet practical from the customer's standpoint.

You cannot guess your way into good thermal design—laborious thermal testing with adequate test facilities and proper test techniques are fundamental to reliable equipment free of weak links.

From a paper presented by the author at the National IRE Convention, March 1957.

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include minimum leakage and excellent test modes. Dimensions and operating features are similar to those of SRU-55. Write or phone your nearest Sperry district office for more details.

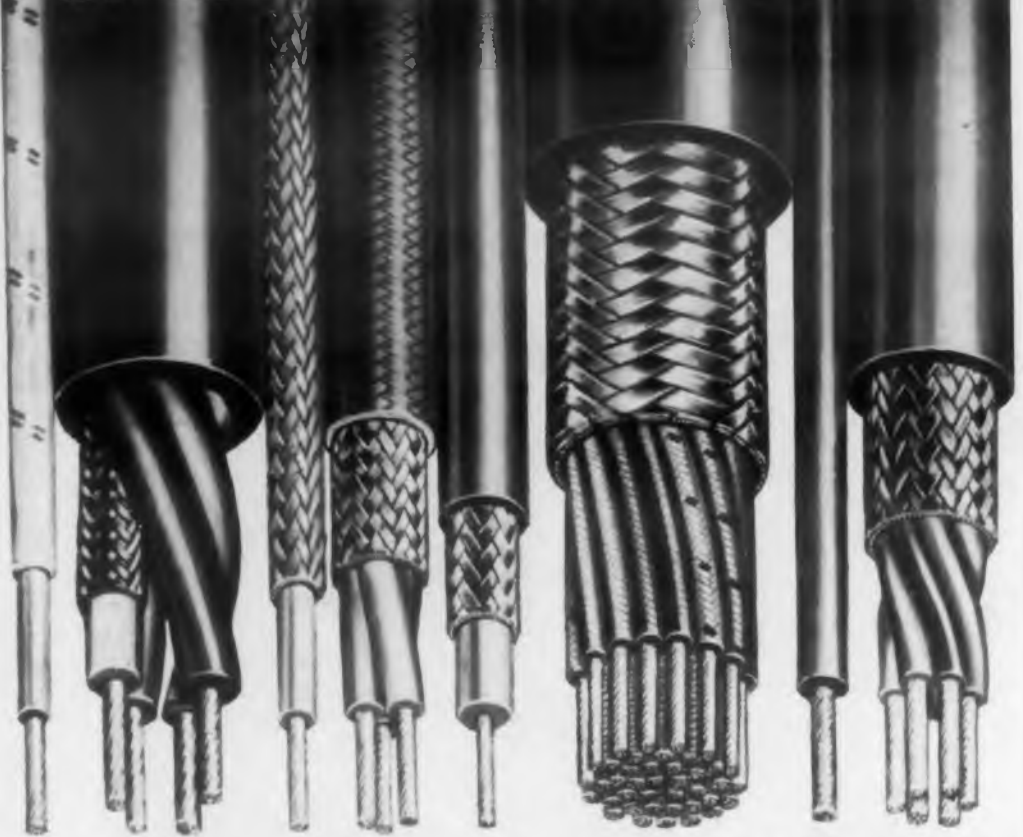
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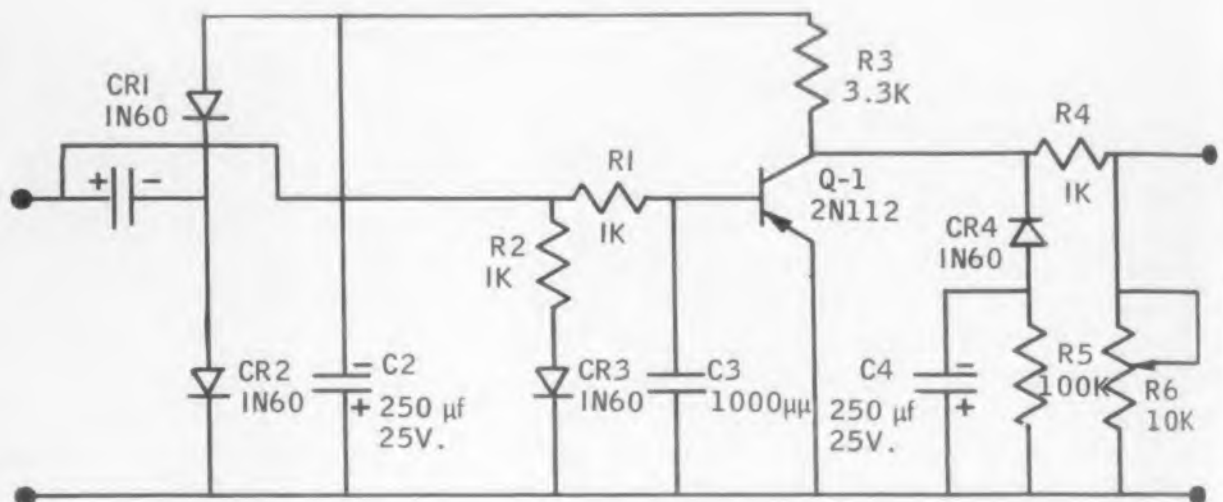
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Self-Powered Square Wave Attachment



Design of the sine-to-square wave converter permits the use of the input sine wave as the sole source of power. Diodes CR1 and CR2 together with capacitors C1 and C2 form a voltage-doubler half-wave rectifier, which supplies the power for the transistor stage. The same input signal serves to drive the 2N112 transistor to saturation through R1. The square wave output, developed across R3, has a rise time of less than 0.5 per cent of the wave period.

DESIGNED as a plug-in unit for sine wave oscillators, this square wave attachment is a simple device for converting sine waves to square waves without elaborate circuitry or additional power. The attachment derives its power from the sine wave source, no batteries are required. The square wave output is sharp and symmetrical enough to be suitable for many test purposes.

The attachment, manufactured by Mandrel Industries, Inc., 5134 Glenmont Drive, Houston, Tex., will provide a 17 v peak-to-peak square wave with a 3000 ohm or less internal resistance, when driven with a 25 v rms sine wave from a 600 ohm source. This output impedance depends upon the attenuator setting. The square wave has a rise time of less than 0.05 per cent of the period from 5 cps to 20,000 cps and a duty cycle of 50 per cent, ± 2 per cent. The square wave is still good and in most cases usable to beyond 100,000 cps.

As illustrated, a simple voltage-doubler half-wave rectifier circuit is made up of the diodes CR1, CR2 and capacitors C1 and C2. This converts the output of the oscillator to dc power for the single transistor stage built up around a high-

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frequency 2N112 transistor. The same sine wave output of the oscillator also serves as the signal source to drive the 2N112 to saturation through $R1$. A resistor-diode combination ($R2$, $CR3$) serves to balance the load on the oscillator during the transistor cutoff portion of the circuit operation. Square wave output is developed across the collector resistor $R3$. $C3$ balances out capacitive effects in the transistor at high frequencies and helps maintain a 50 per cent output waveform duty cycle.

Output clipping is provided by a bootstrap biasing network consisting of $CR4$, $C4$ and $R5$. Without this circuit, power supply ripple appears on the output when the transistor is cut off. Signal attenuation is achieved by means of the $R4$ - $R6$ combination. $R4$ also serves to protect the unit in case of a short circuit.

Packaged in a chromium-plated steel case, the device is provided with banana plugs for insertion into the oscillator binding posts, two output binding posts, and a conventional output attenuator-setting dial.

For further information on this product, turn to the Reader's Service Card and circle 323.

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Replace—Mechanical Tuners with a

Voltage Variable Capacitor

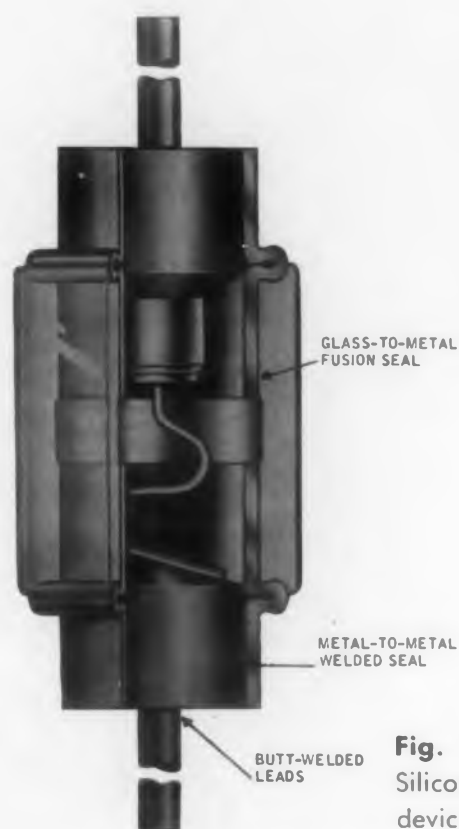


Fig. 1. Construction of the Varicap. Silicon is enclosed in ceramic material; device may be used in 150 C ambient

THIS MINIATURE, high-Q, voltage-variable capacitor is now available in production quantities, and can be used to replace mechanically-varied capacitors. Enabling the design of miniaturized afc, frequency modulation and voltage tuning circuits with low power consumption, the Varicap can be obtained in capacitances ranging from 20 to 56 μf , with a standard four volts applied.

Developed by Pacific Semiconductors, Inc., 10451 West Jefferson Blvd, Culver City, Calif., the Varicap utilizes the principle that when an increasing voltage stress is applied to a semiconductor diode, the displacement domain at the p-n junction widens. The resulting decrease of capacitance between the two segments may be accurately calculated, and varies essentially as $1/\sqrt{v}$, when the semiconductor is biased in

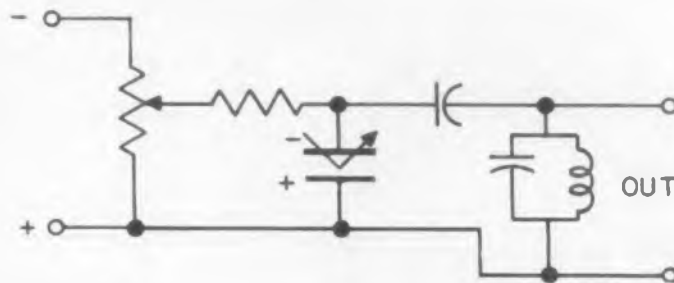


Fig. 2. Voltage tuning circuit. A potentiometer is used to vary the bias placed across the Varicap. The resulting change in shunt capacitance changes the frequency response of the LC tank circuit. PSI's suggested symbol for the voltage-variable capacitor is used in these drawings.

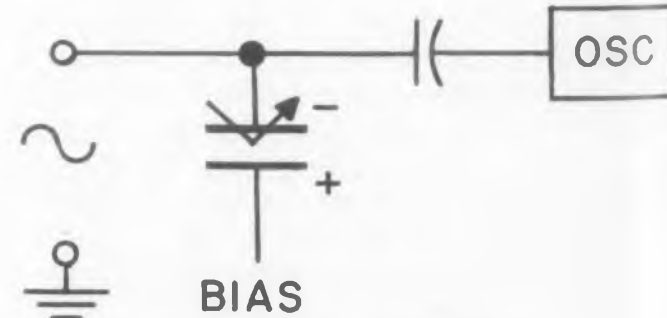


Fig. 3. Frequency modulation circuit. The shunt capacitance of the Varicap is altered by the applied signal, with a consequent modulation of the oscillator frequency. This semiconductor device may be used from 5 to 500 mc.

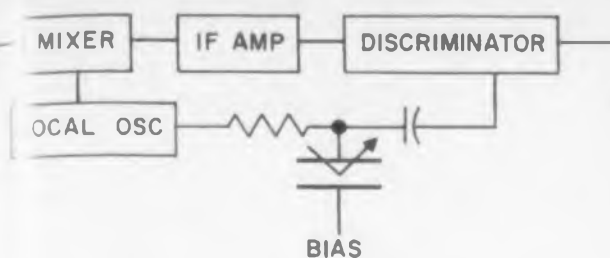


Fig. 4. Automatic frequency control circuit.

The output frequency of the local oscillator is modulated by the Varicap circuit which is affected by the change in discriminator output. A series capacitance is used to block the bias applied to the semiconductor.

the reverse direction. Construction of the unit is shown in Fig. 1.

A silicon device, the Varicap is useful at temperatures ranging from -65 to 150 C. The capacitance and incremental change in capacitance remain almost constant in this range. The capacitance and the series resistance of the Varicap are independent of frequency over the range from 5 to 500 mc.

Series resistance measurements show a typical range from 4.2 ohms for the $56 \mu\text{f}$ unit to 8.5 ohms for the $20 \mu\text{f}$ unit. This low impedance may be desirable in a number of transistor circuits. Typical Q is from 13.5 to 18.7, and capacitance change for any unit is from 50 per cent of the nominal capacitance (taken at 4 v bias) to 225 per cent, from 0 to -8v applied. Maximum bias voltage is -20v . The Varicap measures 0.265 in. length, 0.14 in. diam.

Applications

Designed to be used wherever an ordinary variable capacitor can be used, the Varicap functions efficiently in a voltage tuning circuit such as sketched in Fig. 2. In a communications transmitter or receiver a manually operated potentiometer would be used to change the voltage applied across the Varicap. To frequency modulate a subcarrier oscillator, for example, the signal is applied across the semiconductor, which changes the operating frequency, as in Fig. 3. An afc circuit using the voltage-variable capacitor is shown in Fig. 4.

Clearly the device will find application in telemetering subcarrier oscillators, where weight and volume are at a premium as well as low power consumption; to modulate sweep generators, for multiplexing and for frequency shift keying.

For further information on this product, turn to the Reader Service card and circle 39.

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Cooling of Power Transistors

Melvin Mark
Consulting Engineer
1384 Massachusetts Ave.
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THE POWER transistor is being utilized more and more, and requires no small amount of attention from the cooling point of view. Its allowable surface temperature is low compared to a vacuum tube while its dissipation is high and its surface area small.

Externally, the power transistor consists generally of a shell or case, at one end of which is a plate or copper base, sometimes with a threaded stud on it. (See Fig. 1.) This plate or base is a critical external part of the transistor, and manufacturers give allowable plate temperatures as a function of power output. The problem then is to cool this plate as efficiently as possible.

Free convection and radiation can provide acceptable transistor surface temperatures only where the wattage dissipation is small and the ambient temperature is low relative to the transistor case temperature. Also, there must be sufficient space surrounding the transistor to allow for the development of the fluid velocities associated with free convection. Sea level operation is often assumed; but for high altitude operation, free convection becomes practically non-existent. Lack of free convection, combined with the tight packaging requirements makes forced convection an attractive solution for the cooling problem.

In forced convection, fins, or extended surface area, properly designed, can reduce the amount of air required for cooling (ref. 1). A very useful technique for finning components is the "cold plate" or "cooled chassis" (ref. 2). This is essentially a plate-fin heat exchanger on which the component is mounted. Applying this technique to the power transistor results in finning the plate of the transistor. The stud, where one exists, extends down into the plate, drawing the transistor tight against the plate surface. In the absence of a stud, screws may serve the same purpose (Fig. 2).

The surface temperature (or base temperature) of the transistor is fixed by the particular electrical application and the heat dissipated. The inlet air temperature is given by whatever is available either in the aircraft or other source. For the transistor mounted on the cold plate (Figs. 1, 2), the following equation can be written.

$$t_s - t_1 = (t_s - t_{cp}) + (t_{cp} - t_1) \quad (1)$$

where t_s is the transistor surface temperature

t_1 is the inlet air temperature

t_{cp} is the cold plate temperature adjacent to the transistor

q is the heat dissipated

$$\text{But } t_s - t_{cp} = q L_c / k_c A_c \quad (2)$$

where L_c , k_c , and A_c represent the equivalent length, conductivity and area for the conductive path drop from the transistor to the cold plate. (This is made up largely of the contact resistance between transistor and cold plate.) The cold plate equation can then be written (ref. 2)

$$t_{cp} - t_1 = q (1/hS + 1/Wc_p) \quad (3)$$

where h and S are the heat transfer coefficient and surface area for the cold plate, W is the airflow rate and c_p the specific heat for air.

Substituting equations (2) and (3) into (1)

$$t_s - t_1 = q (L_c/k_c A_c + 1/hS + 1/Wc_p) \quad (4)$$

which, rewritten, becomes

$$\frac{t_s - t_1}{q} = \frac{L_c}{k_c A_c} + \frac{1}{hS} + \frac{1}{Wc_p} \quad (5)$$

The first term on the right hand side of equation (5) depends on the contact resistance between transistor and cold plate, the second and third terms depend on the airflow rate W .

Tests on three different power transistors mounted on cold plates were conducted at various power levels, and transistor temperatures measured as a function of flow rate W . The three power transistors were the H-7 and H-10 (Minneapolis-Honeywell), and the 2N242 (Sylvania). Each was fastened by studs or screws drawing the transistor case tight against the cold plate. No mica insulating washers were used; instead the whole cold

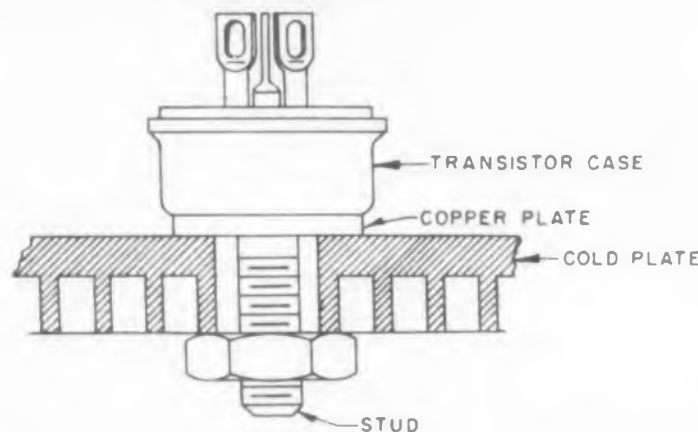


Fig. 1. Stud type transistor on cold plate

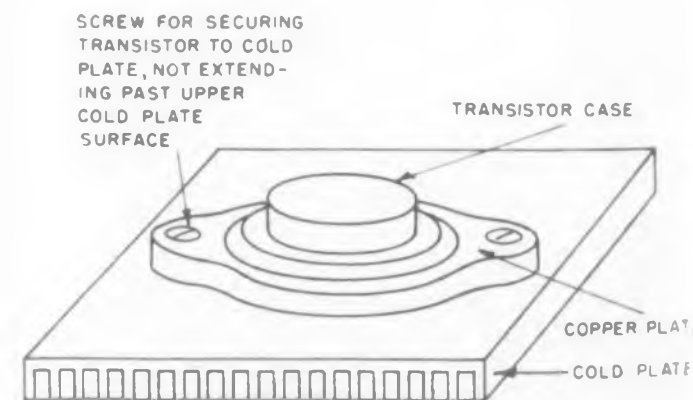


Fig. 2. Transistor secured to cold plate by screws

Fig. 3. Transistor case temperature rise above inlet air, per watt; and pressure drop through cold plate vs air flow rate for three different transistor types.

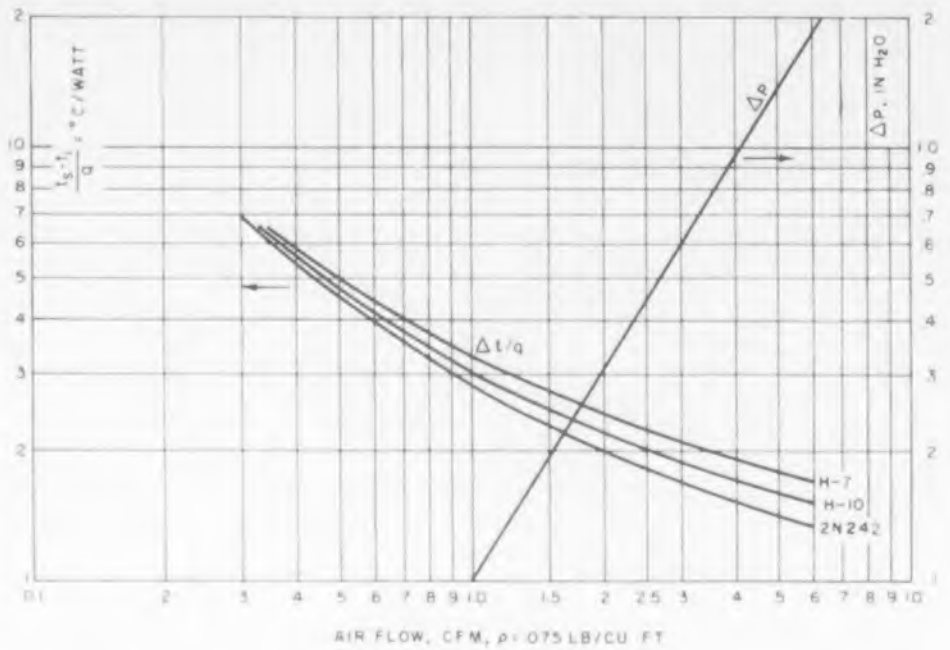


plate was electrically insulated by means of a gasket. This eliminated the temperature drop across the mica washer, normally between the transistor and the mounting surface. The cold plates were of aluminum, two by two in. square, with 1/4 in. high fins, .050 in. thick and ten fins per in. The surface of the cold plate opposite the transistors, against the fins, consisted merely of an aluminum sheet metal cover, 1/32 in. thick. The results of the tests, plotted in the form of equation (5) are given in Fig. 3. Pressure drop is also given.

Equation (5) may be rewritten by substituting the proper values for h , S , and c_p , and converting from W in lbs. per hr., to C in cfm (at sea level conditions, 14.7 psia, 21 deg C). For low flow rates,

$$\frac{t_s - t_i}{q} = \frac{L_c}{k_c A_c} + \frac{1.73}{C} + 0.77 \quad (6)$$

where t_s and t_i are in deg C and q is in watts. The tests which resulted in Fig. 3 were conducted with the transistor and cold plate completely insulated so that no radiation or convection took place from the transistor case. The only heat path then, was through the cold plate into the air except for some loss through the insulation. The $(t_s - t_i)$ values plotted were corrected for any heat loss through the insulation, making the results conservative.

The results of these tests show that to maintain $t_s = 85$ C for the H17, for example, with 5 w dissipation and $t_i = 60$ C would require about 1/2 cfm with the cold plate described. This amount of air might be further reduced by increasing the size

of the cold plate or the number of fins per in. But the amount to be gained by this is limited by the value of $1/Wc_p + L_c/k_c A_c$ in equation (5). Increasing the area of the plate or increasing the number of fins affects only the $1/hS$ term, which has the value 0.77 deg C per w for the two by two, 10 fin per in. cold plate. The magnitude of the $L_c/k_c A_c$ term varied with the particular transistor, being 0.35 deg C per w for the 2N242, 0.5 for the H-10, and 0.8 for the H-7.

The cold plate technique appears to be a very satisfactory one for cooling power transistors with air. From a packaging point of view the technique adapts itself to any number of overall system schemes and has advantages which have been discussed elsewhere in the literature (ref. 2). In addition, the technique offers a positive method for insuring that the transistor temperature efficiently remains at a proper level consistent with the required performance and reliability expected.

ACKNOWLEDGEMENT

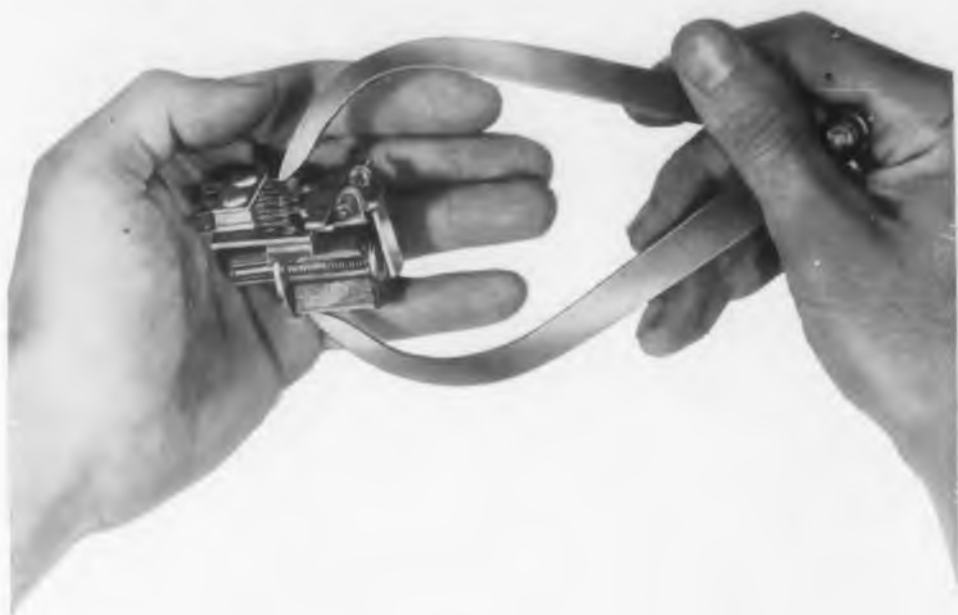
The heat transfer work on the power transistors reported here was carried out at the Laboratory For Electronics, Inc., with the help of J. Rogers. The author is grateful to Dr. M. Meyer of LIFE for his assistance in making the material available for publication.

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From a paper presented at the IRE National Conference on Aeronautical Electronics, May, 1957

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True Differential DC Amplifier Common Mode Rejection of 74 Db at 30 Kc



Model 450-1800A dc amplifier is offered with a fixed gain linearity of 0.1 per cent and a high current linearity of 0.5 per cent. Common mode rejection at dc is 100 db, at 400 cps is 80 db, and from 400 cps to 30 kc it is 74 db. Gain is smoothly adjustable from 1.5 to 1000. Equivalent input drift is ± 2 mv. Equivalent input noise from 0 to 1000 cps is 20 μ v peak to peak. Chopper Intermodulation is less than 0.1 per cent. Frequency response is 3 db loss at 30 kc. Maximum available output voltage is ± 18 v (open circuit) and ± 8 v (5000-ohm load.) Weighing 14 lb, amplifier is available in an individual case or in four-unit rack mounted frame.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman Street, Waltham 54, Mass.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION



**Transistor
Power
Supply**
Limits Current

A low-cost dc laboratory power supply, designed for use with transistors, provides instantaneous and positive protection against overload, current creep, overheating, short circuits and other conditions encountered in experimental transistor circuit work. Current limiting is accomplished through the use of solid state elements. Operates from 115 v, 60 cps, and provides voltages of 6, 12, 18, 24 and 30 v with limiting current ranges of 1, 3, 10 and 30 ma.

Western Apparatus Co., Dept. ED, 2001 Greenleaf St., Evanston, Ill.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION



**Electrolytic
Capacitors**
One to 125 μ f

These aluminum electrolytic capacitors have only a few μ a of electrical leakage in a range from 1 to 125 μ f. Ratings are from 4 to 150 v dc, and operating temperature from -20 to $+85$ C. Lengths range from 5/8 to 1-1/4 in. and diameters from 3/16 to 5/16 in. Centered axial leads permit automatic insertion in printed circuit boards.

The Magnavox Company, Dept. ED, Fort Wayne 4, Ind.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION



Series Relay
10 a, 115 v Contact
Ratings

The SM series relay, in a plug-in transparent dust-proof enclosure. Utilizing standard octal and 11 pin bases, this relay comes in contact arrangements up to 3 pdt. Contacts are rated at up to 10 a at 115 v ac, non-inductive. Coils in all standard ac and dc voltages are also available for plate circuit applications. The unit measures 1-7/16 x 1-7/16 x 2-1/8 in. high. The relay wiring diagram is printed on the enclosure.

Line Electric Co., Dept. ED, 271 S. 6th St., Newark 3, N.J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Carrier Frequency Level Transmitter
Range 2 to 1350 Kc



This carrier frequency level transmitter, designated as type TFPS-75, has its frequency range available in four steps from 2 to 1350 kc for narrow band measurements. For wide band measurements, it may be continuously varied from 2 kc to 1350 kc. The Type TFPS-75 has distortion of less than 0.1 per cent, and adjustable voltage level from -70 to +11 db, and an output which is flat within 0.2 db over the entire frequency range. The output impedance of the instrument can be switch set at 0, 75, 150 or 600 ohms.

International Telephone and Telegraph Corp., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

it's *Just in Performance Reliability and Quality* **Kepeco**
**FOR VOLTAGE REGULATED
POWER SUPPLIES**

**KR
SERIES**



**1.5 Amp.
KR
SERIES**

MODEL KR-16MC	OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount			Price
				W	H	D	
	0-150	Each supply	KR16	19"	12 1/4"	17"	\$625
	100-200	has two	KR17	19"	12 1/4"	17"	\$625
	195-325	15 Amp	KR18	19"	12 1/4"	17"	\$695
	295-450	outputs	KR19	19"	12 1/4"	17"	\$695



**600 ma.
KR
SERIES**

MODEL KR-8M	OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount			Price
				W	H	D	
	0-150	Each supply	KR 8	19"	10 1/2"	13"	\$330
	100-200	has two	KR 5	19"	10 1/2"	13"	\$240
	195-325	10 Amp	KR 6	19"	10 1/2"	13"	\$240
	295-450	outputs	KR 7	19"	10 1/2"	13"	\$250



**300 ma.
KR
SERIES**

MODEL KR-4	OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount			Price
				W	H	D	
	0-150	Each supply	KR 12	19"	7"	11"	\$270
	100-200	has two	KR 3	19"	7"	11"	\$180
	195-325	5 Amp	KR 4	19"	7"	11"	\$180
	295-450	outputs	KR 10	19"	7"	11"	\$190



**125 ma.
KR
SERIES**

MODEL KR-1C	OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount			Price
				W	H	D	
	0-150	Each supply	KR 11	19"	7"	11"	\$180
	100-200	has one	KR 1	19"	7"	7 1/2"	\$ 90
	195-325	3 Amp	KR 2	19"	7"	7 1/2"	\$ 90
	295-450	output	KR 9	19"	7"	7 1/2"	\$ 97

To Include 3" Current and Voltage Meters, Add M to Model number (e.g. KR 16 M) and Add \$30.00 to the Price
To Include Dust Cover and Handles for Table Mounting, Add C to Model number (e.g. KR16 C) and Add \$10.00 to the Price
To Include Meters, Dust Cover and Handles, Add MC to Model number (e.g. KR 16 MC) and Add \$40.00 to the Price

PRICES F O B Flushing

★ **FAST RECOVERY TIME** ★ **GOOD STABILITY** ★ **LOW OUTPUT IMPEDANCE**

Kepeco **KR** Voltage Regulated Power Supplies are conservatively rated and are designed for continuous duty at 50°C ambient.

REGULATION: Less than 0.2 volts for line fluctuation from 105-125 volts and less than 0.2 volts for load variation from 0 to maximum current.

RIPPLE: Less than 3 mv. rms.

STABILITY: The output voltage variation is less than the regulation specification for a period of 8 hours.

RECOVERY TIME: Less than 50 microseconds. The excursion in the output voltage during the recovery period is less than the regulation specification.

OUTPUT IMPEDANCE: Less than 0.1 ohms from 20 cycles to 100KC. Less than 0.5 ohms from DC to 20 cycles. Many units have very much lower output impedance.

featuring

All models available
for 400 cycle operation
on special order.

- Fast recovery time, suitable for square wave pulsed loading.
- Voltage range continuously variable without switching.
- Either positive or negative may be grounded.

- Advanced vacuum tube regulator circuitry.
- Power requirements 105-125 volts, 50-65 cycles.
- Locking type voltage control AC, DC switches, fuses, and pilot lights.

- Terminations on rear of unit.
- Oil filled condensers.
- Color Grey Hammertone.
- Guarantee one year.

SEND FOR BROCHURE B-576 — SPECIFICATIONS ON NEW MAGNETIC, TRANSISTOR AND TUBE VOLTAGE REGULATED POWER SUPPLIES AND SEMI-CONDUCTOR DC TO DC CONVERTERS



KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N.Y. • INDEPENDENCE 1-7000

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

ESC corporation, first in custom-built delay lines,

announces the opening of its new . . .

electronic components division

ESC®

pulse transformers

medium and low-power transformers

filters of all types

pulse-forming networks

miniature plug-in encapsulated circuit assemblies

*exceptional employment opportunities
for engineers experienced in pulse techniques*



ESC CORPORATION • 534 BERGEN BOULEVARD • PALISADES PARK, NEW JERSEY

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Waveguides For Test Equipment



A series of test equipment ferrite isolators, designed to meet the exceptionally high performance characteristics required for test equipment applications, is available covering extremely broad frequency ranges. Models WR-90, WR-112, WR-157, and WR-187 waveguide sizes may be obtained with a variety of flange combinations. Other sizes are presently being developed for use as test equipment and should be available shortly.

Airtron, Inc., Dept. ED, 1101 W. Elizabeth Ave., Linden, N.J.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION



**Ultrasonic
Transducer**
**400 W
Continuous**

This M-203B transducer is a rugged, low-cost, high-power ultrasonic generator which can operate continuously with 400 w of electrical input power at 26 kc. A sound pressure of one million dynes/cm² results in the vicinity of the transducer when radiating into open water with 100 electrical w input to the structure. Cavitation is evident at this power level throughout a region of about 80 degrees total angle.

Massa Labs., Inc., Dept. ED, 5 Fottler Rd., Hingham, Mass.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1 1957

High Reliability Capacitors

High Average Current Rating

A line of high reliability capacitors designed to withstand mechanical, electrical and thermal abuse are manufactured with Mylar film for low leakage, and Kraft tissue for exceptional durability. Extended foil construction permits an average current up to 2 a per μf at all power frequencies, and much higher instantaneous values in pulse networks. Capacity drift with temperature throughout a range of -55 to $+125$ C is less than ± 5 per cent. Insulation resistance exceeds 30,000 meg $\times \mu\text{f}$ at 25 C. Designated as B-125, the line is available in 200 v, 400 v and 600 v ratings, and in all case styles.

Electron Products Co., Dept. ED,
430 N. Halstead Ave., Pasadena, Calif.

CIRCLE 53 ON READER-SERVICE CARD

Tantalum Foil Capacitors

0.25 to 140 μf



A line of high quality tantalum foil, electrolytic capacitors is produced in limited quantities for engineering evaluation and use. Carrying the trade designation Tan-O-Mite, a designation which also applies to tantalum wire units, the Series TF capacitor features the extraordinary shelf and operating life, stability and greater capacitance per unit volume that is characteristic of tantalum metal units. Wide operating temperature range, -55 to $+85$ C, is another feature of these capacitors.

Supplied in sealed metal cases in three sizes, the Series TF units collectively offer a capacitance range of 0.25 to 140 μf . Working voltages up to 150 v are available.

Olin Mfg. Co., Dept. ED, 3653
Howard St., Skokie, Ill.

CIRCLE 54 ON READER-SERVICE CARD

CIRCLE 55 ON READER-SERVICE CARD >

NEW LATCHING SUB-MINIATURE RELAYS

EXCLUSIVE

*By Filtors,
smallest and lightest
hermetically sealed latching
sub-miniature relays,
magnetically held—
no power drain—
and electrically reset.
2PDT, 4PDT and 6PDT*

*High shock and vibration
resistance.*

*All made to
MIL-R-25018 (USAF)
and MIL-R-5757C.*

Dry circuit relays available

Write for catalog

*Leading manufacturers of
hermetically sealed
sub-miniature relays.*

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*Port Washington,
Long Island, New York
Port Washington 7-3850*



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LIGHTEST**

ALSiMAG[®] ALUMINA CERAMICS

*have more to
offer!*

WIDEST VARIETY of Alumina materials available from any source. Vitrified or porous compositions . . . 85% and higher. Industry approved . . . accurately controlled. Greater freedom for designers who can usually find in our special purpose AlSiMag Alumina materials the exact combination of characteristics desired. Custom formulations for unusual requirements.

SUPER PROPERTIES: High strength—tensile, flexural, compressive. Superior electrical characteristics at high temperatures and frequencies. Rugged resistance to thermal shock, mechanical shock, vibration, abrasion. Hardness up to 9 on Mohs' scale. Chemically inert. Permanently rigid. Withstand radiation bombardment without producing contaminants.

OTHER PLUS FACTORS: Precision tolerances. Wide range of physical sizes and shapes, standard and custom designs. Fast delivery in any quantity. Prototype service if desired . . . enables designer to test performance under actual operating conditions before investing in tooling. Continuing research to satisfy customers' current and future requirements.

Blueprint or sketch, with details of operation, will bring you complete information on the AlSiMag Alumina best suited for your application. **NEW Bulletin 575** covering several of the most popular AlSiMag Aluminas sent on request.

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56TH YEAR OF CERAMIC LEADERSHIP

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New Products



**Insulated
Terminals**
High
Dimensional
Stability

A new one-shot mold manufacturing technique offers insulated molded diallyl phthalate terminals to meet military approval MIL-M-18794, type SDG. The 52-01 has the highest dimensional stability of all Diallyl compounds developed to date and is recommended for high precision components. Its high resistance to thermal shock prevents cracking around metallic inserts during soldering. Gold plated terminals are used for non-corrosion and faster soldering. Diallyl 52-01 is completely non-corrosive to other metals, allowing safe installation in sealed or open systems.

Alac, Inc., Dept. ED, P.O. Box 471, Glendale, Calif.

CIRCLE 57 ON READER-SERVICE CARD

Adjustable Wire Wound Resistor 0.001 Per Cent Accuracy



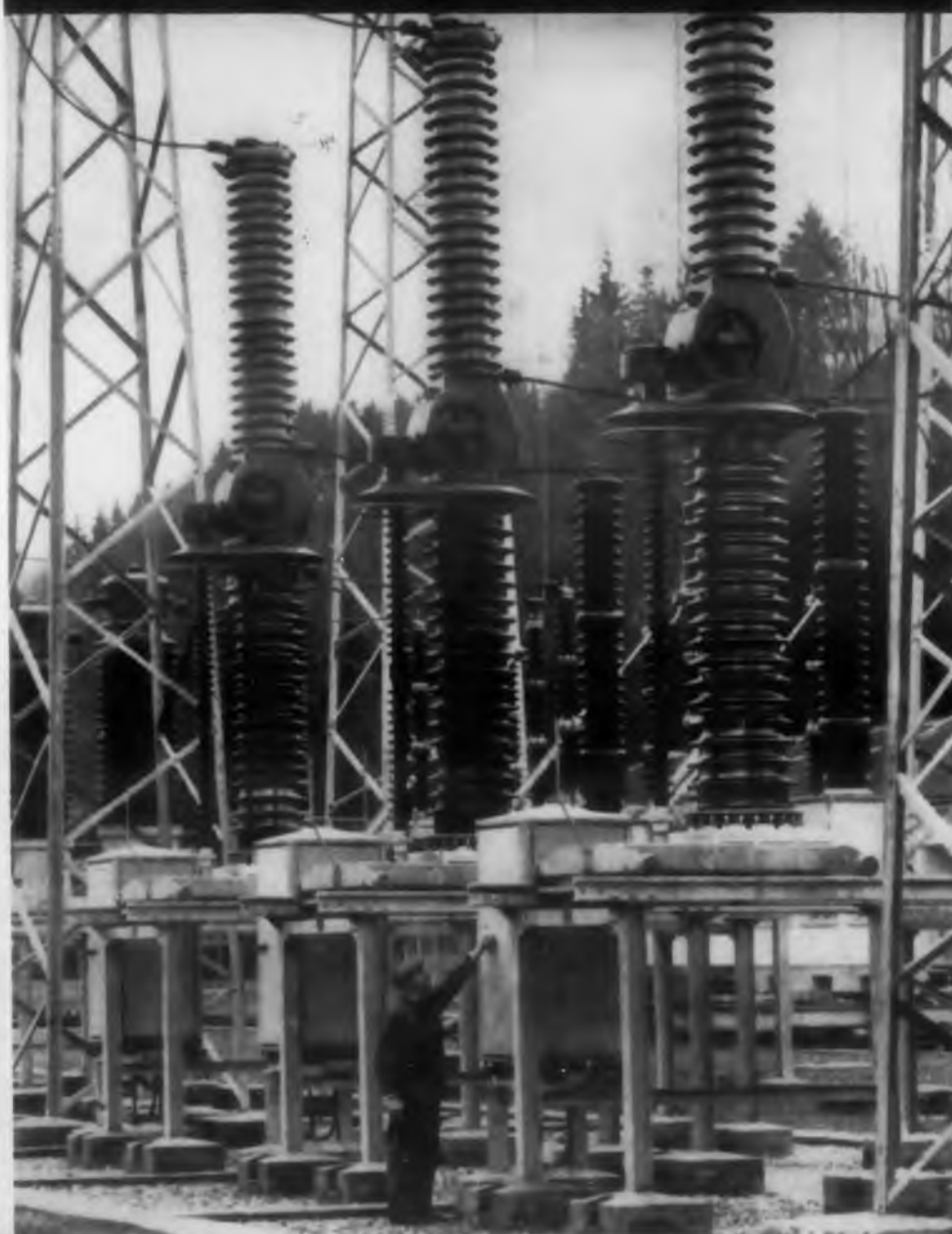
This encapsulated unit is a precise trimming potentiometer embedded within the body of a precision wire wound resistor. Similar temperature coefficient wire is used for both the main and trimming sections. With values up to 1.5 meg, Comp-U-Trim 113 can be adjusted to 0.1 per cent of the nominal value and trimmed to 0.001 per cent. Special temperature coefficients and wider trimming variations are available on request.

Eastern Precision Resistor Corp., Dept. ED, 675 Barbey St., Brooklyn, N. Y.

CIRCLE 58 ON READER-SERVICE CARD

◀ CIRCLE 56 ON READER-SERVICE CARD

**CIBA Araldite EPOXY RESINS
IMPROVE EFFICIENCY and
SERVICE LIFE
of giant 220-KV low oil switches...**



**IDEAS IN THE
MAKING WITH
CIBA ARALDITE
EPOXY RESINS**

**High Voltage Supply
0.001 Per Cent Regulation**

The high voltage supply has a stability comparable to that of a standard cell through the use of temperature-regulated primary and secondary voltage standards and chopper stabilization of the regulating amplifier. Both the chopper stabilization and temperature regulation are accomplished by means of plug-in units which may be added at any time to the standard HVCST Series. Available in two ranges, 800 to 2500 v and 500 to 1500 v with reversible polarities, these supplies can deliver an output current of 5 ma. The output impedance is less than 1 ohm. Regulation for line voltage changes from 100 to 125 v is better than 0.001 per cent. Long term stability is 0.005 per cent. These supplies are suited for precision spectroscopy and fast coincidence applications where the new fourteen stage multiplier phototubes are used.

Tullamore Electronics Lab., Dept. ED, 6055 S. Ashland Ave., Chicago 36, Ill.

CIRCLE 59 ON READER-SERVICE CARD

**Low Cost Socket
For 4X150A Type Tubes**



Designed for commercial and military application with high power tubes of the 4X150A type. This low cost high efficiency uhf socket is available in several versions—with or without integral 2700 μ f screen grid bypass capacity, with cathode terminals grounded to shell. A high quality heat resistant steatite chimney is also available featuring tapered construction which directs air flow through the tube cooling fins.

E. F. Johnson Co., Dept. ED, Waukegan, Minn.

CIRCLE 60 ON READER-SERVICE CARD

CIRCLE 61 ON READER-SERVICE CARD ➤



Wherever insulation long-life and dependability is a problem . . . and a must . . . because of service conditions, or design and operating "specs" that demand more than ordinary results, CIBA Araldite Epoxy Resins have an unmatched history of applicational successes to serve as effective guides to new design and maintenance developments.

Here is one of them . . . a case of CIBA Araldite Epoxy Resins being quickly . . . effectively . . . and economically combined with glass cloth to "wrap up" the insulating job securely.

C I B A

"FIRST IN EPOXIES"

In the U. S. and Canada, CIBA produces basic resins only.

CIBA COMPANY INC., Plastics Division
Kimberton, Pennsylvania

ED-11

Please send me full information on CIBA Epoxy Resins for

<input type="checkbox"/> Tooling	<input type="checkbox"/> Structural Laminates	<input type="checkbox"/> General
<input type="checkbox"/> Electrical	<input type="checkbox"/> Multi-purpose Adhesives	<input type="checkbox"/> Surface Coatings
		<input type="checkbox"/> Plastic Body Solders

NAME _____

COMPANY _____ TITLE _____

ADDRESS _____

CITY _____ STATE _____

New Products

Digital Voltmeter Production Measuring



Primarily for making precision voltage measurements up to 120 v dc, Model 310 A provides accuracy of 0.1 per cent of full scale and readings at a rate of 60 per sec—automatically or on command. Measurements are displayed by four digits. Coded outputs of each figure provide a signal source, operate matrices, punches, or categorizing equipment.

Franklin Electronics, Inc., Dept. ED, Bridgeport, Pa.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

Servoamplifier Drives Hydraulic Servovalves



The Model 33 servoamplifier produces a dc differential current in the push-pull output stage that is proportional to the input signal, which may be either dc or 60 cps ac. The high impedance output stage minimizes phase lags. The unit is designed to drive pneumatic or hydraulic servovalves in power servo applications. Features include: excellent dynamic response; 60 cps excitation for feedback elements such as variable reluctance or E-type transformer pickoffs, synchros, or potentiometers; panel meter for monitoring system performance; and provision for plug-in compensating networks to alter servo system dynamic response.

Raymond Atchley, Inc., Dept. ED, 2340 Sawtelle Blvd., Los Angeles 64, Calif.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Why pot specs

Look what Spectrol is doing for designers

*Custom-designed to measure rate of flow
in jet aircraft fuel system*

Specially designed to be immersed in fuel, both the stainless steel housing and shaft gear are gear-driven independently—electrical connection is made through the external slip ring assembly mounted in line with the shaft.



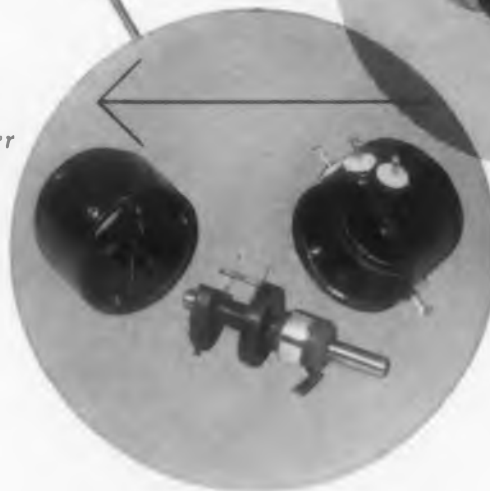
*Unique miniature
corrosion-free switch pot*

Specifically designed for a precise multiple switch application . . . this miniature unit combines a printed circuit wafer with Rhodium plated segments for long, corrosion-free life in a rugged anodized aluminum package.



*Center-positioning pot for a
barometric altitude computer*

This pot was designed to give a torque of only 0.75 oz./in. and a position return accuracy of 0.5% of the applied voltage. Mechanical rotation is limited by internal stops which withstand a 3.0 in./lb. static load.



*Special design for an airborne FM-FM
telemetry system*

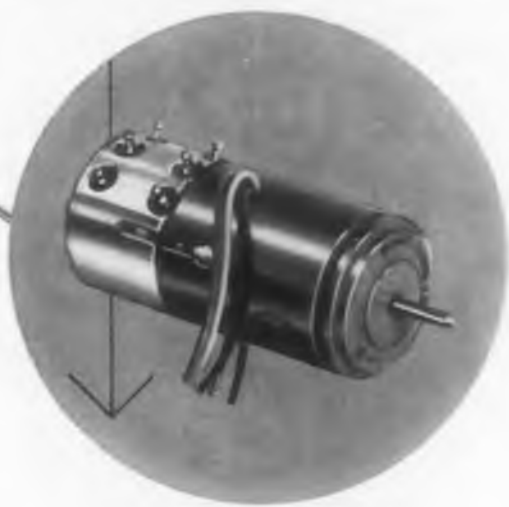
One of these transducers modulates each of the 12 channels in the system. The plug-in connector replaces standard terminals to facilitate quick changes.



CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

go to Spectrol

in record time!



Space problem solved by Spectrol's precise "in-line" mechanism

A double element potentiometer assembled directly on the "Autosyn" shaft without gear train or coupling devices to give maximum economy of space and weight.

See how fast
Spectrol delivers
precision
potentiometers

You can depend on Spectrol to design and deliver the pot you need when you need it

Send us your requirements or write for Spectrol's catalog describing the complete line and the name of our representative in your area. For precision prototypes *in record time*, you can depend on Spectrol's highly experienced engineering staff. Our reliability program assures unsurpassed performance.

A COMPLETE LINE OF STANDARD PRECISION POTENTIOMETERS



ELECTRONICS DIVISION
of CARRIER CORPORATION
1704 South Del Mar Ave., San Gabriel, Calif.

Please send information on:

- Standard potentiometers
- Linearity Testers
- Representative in my area
- Regular mailings of Spectrol Product News
- Have Representative call

Name _____

Title _____

Company _____

Address _____

ED

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

Missile Weighing System Determines Center of Gravity

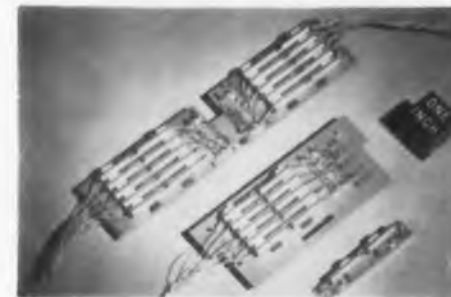


A new digital weighing system employs two load cells feeding into a digital reading weight indicator. The two load cells contain strain gage pickups and are mounted on two hooks or saddles used to support the missile. Input of the digital indicator is alternately switched between the two load cells. Readings are then quickly formalized to determine the center of gravity. Accuracy of the system is said to be 0.1 per cent.

Performance Measurements Co., Dept. ED, 15301 W. McNichols Rd., Detroit 35, Mich.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetostriction Filters Wide Variety of High Q Types



A series of high-Q filters is now being produced in a variety of frequencies and bandwidths for use on spectrum analyzers, as narrow band circuit filters, as the frequency-determining element for oscillators, and for use as comb-filter arrays in classified equipment. They are readily adaptable to either transistor or vacuum tube circuits, and can be used in telemeter systems, or where single or multiple narrowband filter channels are required. In combination with a single vacuum tube or transistor, they provide a very stable oscillator circuit.

Filter input impedance depends on the resonant frequency and is in the range of 20 to 90 ohms. Insertion loss for most types is between 14 and 18 db. Filter output impedance (untuned) ranges from 600 ohms to 2000 ohms. Temperature change of resonant frequency over the range of -60 to +80 C is within ± 8 ppm per deg C.

Raytheon Manufacturing Co., Missile Systems Div., Dept. ED, Bedford, Mass.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

For quick bonding, turn to turn, with a single application of heat or solvent . . .

Specify

**PHELPS
DODGE
BONDEZE®**

MAGNET WIRE



Enlarged cross section shows:
1. Bondeze and bonding action
2. Formvar insulation
3. Copper

These successful uses of Bondeze suggest unlimited new redesign possibilities, often at overall savings.



COILS

Random-wound, layer, paper-section and solenoid coils for brakes and clutches, instruments, television, radio and other applications.

TRANSFORMERS

Paper-section, random-wound, oil-filled, air-cooled and high voltage for distribution, current, X-ray, television, radio and other applications.

MOTORS

Windings for shaded pole, series fields, instruments, induction and others.

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

FIRST FOR
LASTING QUALITY—
FROM MINE
TO MARKET!



**PHELPS DODGE COPPER PRODUCTS
CORPORATION**

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



**Crystal Filter
Miniature Design**

Selectivity of the order attained by several cascaded double-tuned if stages in the 200-500 kc range has been attained by this crystal filter. Unit is hermetically sealed for environmental stability. Since the response curve is crystal-controlled, no alignment is required. Filters are also available to custom requirements in the 3 to 15 mc range.

Blackhawk Engineering, Dept. ED, 1912 Woodruff Ave., Janesville, Wis.

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

**Flight Programmer
Continuous Function Output**



Various linear and nonlinear functions for the planned flight of missiles are provided by this flight programmer. The desired functions are etched as lines and bars on a copper clad epoxy glass laminate which moves in spiral tracks cut in the programmer housing. In addition to the pulse functions, reverse, and stop information, a nonlinear function is carried along the entire length of the program. Information for the pulse and command functions are wiped off by contactors. The voltage and pulse-function timing, as controlled by the moving circuit, can be held to very accurate and repeatable values because of the resolution which is attainable on the lengthy laminate. This programmer unit has been qualified in a vibration environment of 12 g from 10 to 2000 cps.

Western Design & Mfg. Co., Dept. ED, Santa Barbara Airport, Goleta, Calif.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 75 ON READER-SERVICE CARD >

Emerson & Cuming, Inc.

Plastics for Electronics

SHORT FORM CATALOG

This, our general, short-form catalog, contains a brief listing and description of some of the materials we have available. More detailed information on those listed below as well as our other products is available in individual brochures on each of the various lines mentioned, and we will be very pleased to supply you with any of these or any other information you may desire upon request.

Eccosorb
Microwave Absorbers

For Free Space Rooms — 50 Mc thru Microwaves!
Flexible or Rigid — Waveguide Absorbers!

Eccosorb FR is a series of broadband rigid foam microwave absorbers for use in "free space" rooms. Antenna measurements made in a room lined with this absorber are comparable to those made at an outdoor test range. It reflects less than 2% of normal incident energy over the design frequency range, i.e., reflectivity is down greater than 18 db. Selected pieces can be supplied at less than 1% reflectivity. It is effective against parallel, perpendicular and circular polarizations. The absorber is white surfaced for good lighting conditions and is extremely light in weight. Outdoor exposure has no harmful effect on absorber performance. Eccosorb FR is supplied in blocks 1' x 3'. Thickness is dependent upon the longest wavelength at which it is to be effective. Power dissipation exceeds 2 watts/sq. in. Self-extinguishing after exposure to flame.

Eccosorb AN is a light weight flexible foam sheet broadband microwave absorber. Used mainly for lining antenna nacelles and enclosures, it can readily be cemented to or draped over items which produce undesired reflections. It reflects less than 2% of normal incident energy over the design frequency range. Eccosorb AN is equally effective against parallel, perpendicular and circular polarizations and is relatively insensitive with respect to incident angle.

Eccosorb CHW is a series of broadband anechoic chamber absorbers for use in the v.h.f. u.h.f. and microwave regions, offered in three standard types. It is composed of light weight pyramids, mounted on a rigid foam base and is broadbanded. For example, Eccosorb CHW 560 is effective at 50 mc. and at all higher frequencies, extending even into the microwave region. Thus, an anechoic chamber which uses Eccosorb CHW 560 can be used to make v.h.f., u.h.f. and microwave measurements, simultaneously if desired. This opens the possibility of simultaneous checking of several complete systems installed in an aircraft or missile.

Eccosorb CH is a series of broadband absorbers for use in microwave darkrooms. Reflecting less than 2% of the energy incident upon its surface, this

absorber permits antenna measurements to be made indoors with the same reliability and none of the weather uncertainty of outdoor measurements. It is light weight and flexible — composed of enmeshed, rubberized fibers and supplied in sheets, 2 feet by 2 feet. Thickness is dependent upon the longest wavelength at which the absorber is effective. The surface is white in color for good light reflection.

Eccosorb MF is a series of plastic rod and sheet which is used in waveguide as absorbers, attenuators, terminations and loads. Over the entire microwave frequency range these materials have a high total dissipation factor. Attenuation per unit length is, therefore, high.

Eccosorb Panelling offers a prefabricated large size portable absorber panel which because of its light weight can readily be moved from place to place and erected within minutes. The panels are offered in convenient sizes and individual panels can be readily locked to adjoining ones to present a continuous absorber wall and electrical screen.

Eccosorb RM is a flexible sheet absorber which is broadbanded throughout X band and can be used at 600° F. It can be contoured to compound curves and can be cut into smaller pieces. When properly installed Eccosorb RM is completely moisture tight.

Eccosorb Caps are metallic housings lined on the inside with an appropriate Eccosorb product. They are used to cap or cover a radiating antenna 1.) to confine the radiated energy within the cap and 2.) to terminate the antenna in essentially free space conditions. Eccosorb Caps are provided with a Type N bulkhead connector so that a probe can be attached internally to monitor antenna output. They can be supplied to cover the frequency range from 200 MC to 30,000 MC.

Eccosorb HT is a broadband microwave absorber useable to 1200° F. It is supplied as light weight ceramic blocks. Because of its high temperature capability, Eccosorb HT can be used where high power levels must be absorbed.

SHORT FORM CATALOG

Plastics for Electronics

Emerson & Cuming, Inc.

869 Washington Street, Canton, Mass.

Stycast Casting Resins

Epoxy! Polyesters! Polystyrenes! Foams!

Stycast 2850GT is an epoxy casting resin which has excellent high temperature properties, good adhesion to a wide range of materials, an extremely low thermal expansion coefficient and low shrinkage during cure.

Stycast 2741 is an epoxy system of controlled flexibility. Resultant compositions can be made semi-rigid or rubbery. Cure may be at room temperature. Exceptional adhesion to metals, plastics, glass, etc.

Stycast 1090 is a low weight (Specific Gravity 0.6) epoxide casting resin for electronic embedments. It has an extremely wide temperature range of usefulness. Low shrinkage during cure and low thermal expansion coefficient are other important properties. It cures at room or elevated temperature to a black, rigid, opaque solid. It is particularly useful in airborne embedment applications. Stycast 1090 has a low dielectric constant and, therefore, has minimum effect on circuit operation. When cured the material is completely unicellular; moisture absorption is negligible. The weight of Stycast 1090 is much less than half of that of other commonly used casting resins.

Stycast TPM-2 and Stycast TPM-3 are low loss, low dielectric constant thermosetting casting resins. They are useable over an extremely wide temperature range. When fully cured, they are resilient, white, opaque solids.

Stycast 1095 is a low weight epoxy casting resin which flows easily and cures readily with Catalyst 17 to a 500° F. continuous use material. Its specific gravity is 0.61.

Stycast 2651 is an easy to use, low cost, epoxy type casting resin with excellent adhesion to metals, plastics and ceramics. It is a general purpose material and is useful in almost all applications. It has a low thermal coefficient of expansion and is stable over a temperature range of -100 to +400° F.

Stycast 2662 is an epoxide casting resin which exhibits outstanding physical and electrical properties at elevated temperature. Heat distortion temperature is in excess of 500° F. It can be used for short periods of time at 600° F. Continuously at 500° F. At 500° F. volume resistivity is 10¹¹ ohm-cm. Stycast 2662 is used for electronic embedments, a high temperature sealer/adhesive and as a surface coating.

SALES REPRESENTATIVES

NEW ENGLAND

Smith & Purdy Associates
944 Main Street
Walpole, Mass.
Montrose 8-2460

NEW YORK

Stanley Fishner
P. O. Box 1012
Rome, N. Y.
Rome 6302

DAYTON

Robert G. Siff & Associates
341 No. Robert Blvd.
Dayton 2, Ohio
Hemlock 1254

WICHITA

Engineering Services Company
618 George Washington Blvd.
Wichita, Kans.
Amherst 2-6516

LOS ANGELES

McCarthy Associates
1055 East Walnut Street
Pasadena, California
Ryan 1-8810

NEW YORK

P. G. MacNeill
100 Wellwood Drive
Fayetteville, N. Y.
Neptune 7-9205

PHILADELPHIA

Andco Sales-Engineering
5823 Greene Street
Philadelphia 44, Pa.
Victor 4-9100

CHICAGO

Warren B. Cozzens Company
845 Chicago Ave.
Evanston, Illinois
Davis 8-4800

DENVER

Hytronic Measurement, Inc.
1295 South Bannock Street
Denver 23, Colorado
Sherman 4-2241

SAN FRANCISCO

McCarthy Associates
441 West California Avenue
Palo Alto, California
Davenport 5-6136

NEW YORK

L. E. Markle, Jr.
115 Mill Street
Williamsville 21, N. Y.
Plaza 4592

WASHINGTON, D. C.

Ted Britt, Rm. 14
1500 Massachusetts Avenue, N.W.
Washington 5, D. C.
Columbia 5-2694

ST. LOUIS

Engineering Services Company
6635 Delmar Blvd.
St. Louis 5, Mo.
Volunteer 3-3661

DALLAS

Lawrence Sales Company
P. O. Box 13026
Dallas 20, Texas
Fleetwood 2-7484

SEATTLE

Ray Johnston Company
11009 Evanston Avenue
Seattle 33, Washington
Emerson 0956

NEW YORK

The Creek Corporation
Lumber Road, Post Office Box 104
Roslyn, L. I., N. Y.
Roslyn 3-0827

CLEVELAND

Midwest Sales Company
3219 West 117th Street
Cleveland 11, Ohio
Winton 1-2700

KANSAS CITY

Engineering Services Company
4550 Main Street
Kansas City 11, Mo.
Jefferson 1, 7765

SAN DIEGO

McCarthy Associates
934 West Laurel Street
San Diego 1, California
Belmont 9-4015

FLORIDA & SOUTHEAST

Dbm. Research Corporation
Stoddard Building
Cocoa Beach, Florida
Cocoa Beach 2458

QUEBEC-ONTARIO

M. J. Howard & Company
132 Crocus Avenue
Ottawa, Canada
Central 5-9931

Eccofoam Plastic Foams

Foam in Place! Pack in Place!

Liquids Powders Sheet Stock

Eccofoam PS is a series of low weight, extremely low loss polystyrene plastic foams of adjusted dielectric constant. It finds use in microwave lens, waveguide and antenna applications.

Eccofoam Hi K 1000F is a one-part pack-in-place adjusted dielectric constant ultra high temperature foam of a ceramic base. It is available in dielectric constants 2.0 through 6.0 and is capable of continuous operation at 1000° F. Being a one-part system it is very simple to use. It is silver in color. This material is also supplied in sheet form.

✓ **Eccofoam Hi K 625D** is a one-part epoxide "pack-in-place" artificial dielectric foam. It is available in a range of dielectric constants from 2.0 to 7.0. It is useable at 500° F. continuously. Higher temperature usage is also possible. Samples have been subjected to 1000° F. Supplied in a form resembling damp sand. A one-part system, no mixing of components is required. Sheets of this material are also available.

Eccofoam DPT is a one-part "pack-in-place" epoxide foam useable to 500° F. when fully cured. No mixing is required. It is used as received, packed or tamped into cavity to be filled and cured at moderately elevated temperature. The finished foam is extremely fine and uniform.

Write for Technical Bulletins on Any of these Materials

Eccoseal Impregnating Resins

EPOXIDES — POLYESTERS

LOW LOSS HIGH TEMPERATURE NON-FLAMMABLE

✓ **Eccoseal W28G**, a one-part epoxide, intended primarily as an impregnant for transformers and coils. Also used as a casting resin. Has excellent high temperature properties. Impregnated units have operated continuously at 200° C. (392° F.) and for short periods as high as 250° C. (482° F.) It is solvent-free and requires no catalyst addition. Cures to a thermosetting plastic; vacuum treatment assures complete filling of windings. Adhesion to a variety of materials is outstanding. Shrinkage is very low.

Eccoseal W19 is a low viscosity epoxide impregnant and casting resin. It can be cured at room or elevated temperature. It is used to embed small items or impregnate large windings.

Eccoseal W44HT polymerizes 100% by weight into an excellent high temperature, completely non-flammable solid. Manufactured as a light brown, low viscosity liquid, with good wetting characteristics. Long pot life when properly catalyzed. Stable as an impregnant over the temperature range -90° F. to +400° F. A high dielectric strength material with relatively low dissipation factor.

Eccoseal High Q is a low loss impregnant and coating used for a wide variety of R.F. and Microwave applications. It is a resin in solvent solution. Thinner supplied for dilution. Based on polystyrene, its coatings have excellent moisture resistance, low dielectric constant, low loss, and high insulation resistance. Used as a lacquer for RF coils, as a reinforcing medium to up-grade paper, fabric and wood. It is a general purpose coil dope.

Eccoseal W66 is an epoxide impregnating resin which is stable at 600° F. Supplied as a relatively low viscosity liquid and is used with Catalyst #17.

Eccofoam PT is one of a series of pack-in-place epoxy foams. It can be cured completely at room temperature and then is capable of use at 300° F. continuously, or 350° F. for short periods. The bulk density of Eccofoam PT is about 20 lbs./cu. ft. It is extremely fine and uniform in structure. It is supplied in two components resembling damp sand. Used as a potting compound, for sandwich structures, a light-weight adhesive or caulking compound, for thermal insulation and light weight structures.

Eccofoam FP is rigid polyurethane foam-in-place liquid resin. Upon addition of a catalyst, it expands and finally cures to a rigid thermosetting unicellular foam of specified density. It can be processed completely at room temperature. Volumes of several cubic feet of excellent structure can be made in one pouring due to the very low exotherm developed.

Eccofoam S and Eccofoam FS respectively, are rigid and flexible polyurethane foam sheets. Eccofoam S is available in a wide range of densities. Both will withstand a wide temperature range.

Eccofoam LM is a one-part pack-in-place type ceramic foam which when cured will produce a very fine grained, rigid foam structure of 18-20#/cu. ft. Thermally stable at 1200° F. It exhibits very low dielectric loss over the entire temperature range of use.

Eccocoat Plastic Surface Coatings

Liquids and Powders — for Brushing,

Dipping, Spraying, or Dusting!

Eccocoat EC 200 is a general purpose spray, brush, or dip epoxide surface coating. It can be cured at room temperature or rapidly at elevated temperature. Surface coatings of Eccocoat EC 200 are of a quality heretofore obtainable only in baked finishes. It is clear; its films are transparent.

Eccocoat Powder HP is a one part epoxy system composed of a finely divided powder. The method of use is to suspend the powder in a flowing gas stream such as air and to dip therein preheated components or circuits. The powder melts in place and coalesces to a smooth thin film. Multiple films can be applied by reheating and redipping. Final cure is accomplished after applying the proper coating thickness. Excellent adhesion and moisture resistance are outstanding characteristics. Temperature capability is 450° F.

✓ **Eccocoat PCA** is used as a spray coat and cement for printed circuit boards. It is an effective cement for bonding components to the boards. This is usually combined with the coating procedure. Excellent bond strength is achieved even against glass components. Field tests indicate that Eccocoat PCA cemented boards are capable of withstanding accelerations in excess of 100 G's without failure.

Eccocoat C26 is a clear epoxide surface coating which has exceptional high temperature properties. It can be used continuously at 500° F. and for short periods up to 600° F. Surface resistivity is above 10¹⁵ ohms at room temperature and remains above 10¹⁴ even at 500° F. Moisture and chemical resistance is outstanding. For example, prolonged exposure to Skydrol at high temperature is not harmful. Eccocoat C 26 is applied by dip, brush, or spray.

Write for Technical Bulletins

Eccobond

Adhesives, Cements and Sealants

Liquid, paste or powder

Highly Resistive or Conductive!

Eccobond 55 is a low viscosity epoxide adhesive for joining metal, glass, ceramics and plastics and for crack filling. It can be cured at room temperature or for rapid cures at elevated temperature. The adhesive is white in color (other colors available) and is rigid when cured.

Eccobond 45 is a controlled flexibility epoxide adhesive. It is designed for use where shock and peel resistance are desired. Cures at room temperature or more rapidly at higher temperature. Adhesion to metals, glass, ceramic and plastic: excellent.

Eccobond 76 is an epoxide adhesive and sealant capable of continuous use at 500° F. and for short periods at 600° F. It is used to bond metal, glass, ceramic and high temperature plastic compositions. The aircraft industry uses Eccobond 76 as a metal to metal structural sealant. The material has excellent resistance to chlorinated hydraulic fluids, e. g., Skydrol 500. Eccobond 76 is supplied as a highly viscous liquid. When mixed with Catalyst #14, a powder, it is a non-flowing paste. Final color is black.

Eccobond Solder 56C is a plastic cement which when cured has extremely low electrical resistance. It can be cured at temperatures as low as 120° F. in 2 hrs. or in a matter of a few minutes at elevated temperature. Supplied in paste form, the cement will not flow when applied. It adheres tenaciously to metal, glass, ceramic and plastics. It is used for making electrical connections where hot soldering is impractical, for example, to nichrome wire, or conductive plastics and at locations which cannot be subjected to high temperature.

Eccobond Paste 88 and Eccobond Powder 98 are one-part adhesives which are applied and then merely heated to effect cure. Simplicity of use is the big advantage. Both are outstanding at high temperatures. Eccobond Paste 88 has replaced riveting and soldering in many applications.

Eccomold

Laminating Resins

Low loss! Non flammable! Ultra high temperature!

Eccomold L65 is a laminating resin of low loss and low dielectric constant used in applications where outstanding electrical characteristics are required—radomes, dielectric support pieces, printed circuit boards, etc. It is a thermosetting material. Parts made from it withstand 300° F. continuously.

Eccomold L44 is a resin for use with glass reinforcement to produce laminates of outstanding electrical qualities. Laminates of over 50% by weight glass loading are structurally and electrically sound at temperatures in excess of 200° C. Readily pigmented to a variety of colors with excellent surface finish. It will not support combustion.

Eccomold L28 is a general purpose epoxide laminating resin. Cures at room temperature (Catalyst #9) or higher heats (Catalyst #11) to produce high strength laminates. Used in conjunction with fiberglass cloth or mat. Matched metal, vacuum bag or wet layup can be used. Catalyst #11 is recommended for long pot life in production applications and/or where high temperature properties are needed in the finished laminate.

Eccomold L266 an epoxide laminating resin with outstanding high temperature properties. Fiberglass laminates made with it will withstand 500° F. continuously, or 600° F. for short periods.

Eccostock

Plastic Rods and Sheets

High Temperature — Light weight

Low Loss

Adjusted Dielectric Constant

Stycast 0005 — Plastic rod and sheet for RF and Microwave insulation. This is a specially developed clear plastic material featured by low dissipation factor, excellent high and low temperature stability and machining ease. It is available in rods and sheets.

Stycast Hi K is a series of plastic rod and sheet stock of adjusted dielectric constant. Dissipation factor is low. It is intended for RF and Microwave applications. The material is white and opaque. It is available as standard material in the following dielectric constants: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15. Standard rod sizes are 1, 2 and 3 inch diameters. Standard sheet thicknesses are 1/2 and 1 inch. Other dielectric constants and sizes are available on special order. From 10⁸ to 10¹⁰ cycles the variation in dielectric constant is ±0.15 maximum; dissipation factor is below 0.001. Volume Resistivity — greater than 10¹⁴ ohm-cm³. Dielectric Strength — greater than 500 volts/mil.

Stycast Lo K is low dielectric constant, low loss and low weight thermosetting plastic rod and sheet for RF and Microwave insulation. It is specifically designed for use in coaxial, waveguide and antenna support problems. Due to low dielectric constant, reflections in transmission lines are minimized.

Eccostock R25 is epoxide rod and sheet stock capable of operating at 500° F. Readily machinable, it has a variety of uses, including bobbins for coils and resistors, terminal boards and insulators. It can be cemented easily.

Eccostock R19 is epoxide rod and sheet which is featured by machining ease and moderately high temperature properties. The material is useable continuously from -100° F. to +350° F. Physical and electrical properties are outstanding.

Eccostock R20 combines light weight, machining ease, good dimensional stability and good high temperature properties. The material is completely unicellular; moisture absorption is negligible. Operating temperature range is from -100° F. to +350° F. Its specific gravity is 0.61.

Ecco Reflector and Ecco Luneberg Lens

3" 7" 12" 18" 36" Diameters Target cross sections to 56,000 sq. ft.

The Ecco Luneberg Lens is a variable dielectric constant device of spherical contour which focuses an incident plane electromagnetic energy wave to a point on its surface, or conversely produces a plane wave from a point source. There are many unique applications for the Ecco Luneberg Lens; one important application is rapid wide angle scanning of a radiation beam by moving a small feed over the surface of the stationary lens; another is an efficient electromagnetic energy reflector.

The Ecco Reflector is effective as a passive target for radar energy. It has a large radar cross section which is essentially constant over a wide conical viewing angle. The Ecco Reflector is compact, rugged, light in weight and easily installed. It is broadbanded throughout the microwave frequency range. The reflector is based on the Ecco Luneberg Lens. Energy incident upon the lens is focused and reradiated in the direction from which it originated. In this respect, it is similar to a corner reflector. The Ecco Reflector is far superior to the corner reflector for wide angle coverage; it has a radar cross section approximately eight times that of a circular corner reflector of the same radius.

Emerson & Cuming, Inc.
669 Washington Street, Canton, Mass.

Plastics for Electronics

Foil-Type Strain Gages

High Sensitivity and Stability

These foil type rosette strain gages, belonging to the SR-4 series, are of bonded filament type construction. The rosettes have a sensitivity that is 8 per cent higher than that of previous rosettes. They need no lateral corrections except in the most precise testing problems, can withstand temperatures to 300 F in continuous service and are thinner, more flexible and more easily applied than bonded wire SR-4 strain gages.

Baldwin-Lima-Hamilton Corp., Electronics and Instrumentation Div., Dept. ED, Waltham, Mass.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Microfilm Mounter

High Speed



Designed for high speed, automatic mountings of microfilms of engineering drawings and other large volume documents, the Automatic Mounter transfers microfilm from reels to aperture cards at a speed of 2000 mountings per hr. The unit will process either negative or positive microfilm reels, and incorporates an automatic detection system which immediately stops the mounter if either card or film imperfection exists.

Dexter Folder Co., Filmsort Div., Dept. ED, 50 South Pearl St., Pearl River, N.Y.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

NPN Transistors

Switching and Amplifier Use

Four new germanium alloyed junction transistors, types 2N444, 2N445, 2N446, and 2N447 have been announced. Of the npn variety, these transistors are especially useful for small signal amplifier and high speed switching applications. The four units offer alpha cutoff frequencies ranging from 0.5 to 10 Mc and small signal current gain ranges from 15 to 125.

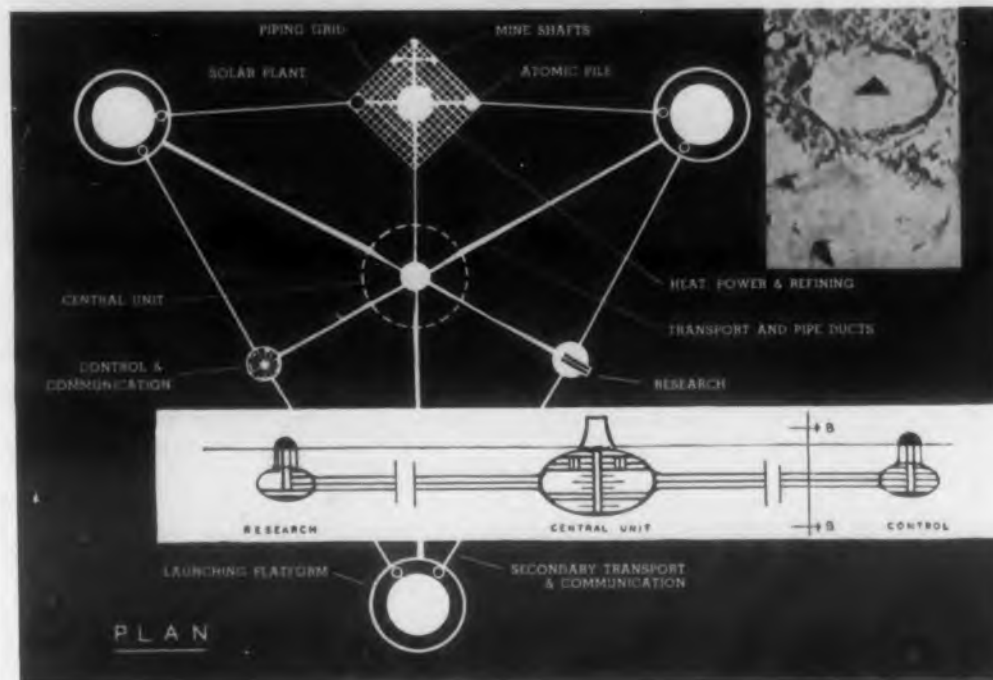
General Transistor Corp., Dept. ED, Jamaica, N.Y.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 75 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1, 1957

MARS outstanding design SERIES



lunar base

Tomorrow's realities depend on research and imagination today. Both were used extensively in the planning of this lunar base designed by William G. Harvey, Jr. to accommodate space ships and travelers. The suggested location is "Aristotle," one of the craters near the north pole of the moon. Most of the base is beneath ground level to minimize temperature changes. Living quarters are spacious and recreational facilities include a swimming pool and basketball court. Power is supplied by solar plants during the day and atomic pile at night. Research, living and working areas are joined by monorail subway.

No one can be sure which of today's new ideas will become reality tomorrow. But it will be important then, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—from sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and—last but not least—the Mars-Lumochrom, the new colored drafting pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored drafting pencil, 24 colors.

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

at all good engineering and drawing material suppliers

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION



William G. Harvey, New York industrial designer, one of the winners in the 1957 MARS Contest. Mr. Harvey's project, "Lunar Base," is featured in the MARS presentation on this page.

MARS announces new design contest

The MARS Outstanding Design Contest of 1957 created such wide interest that MARS Pencils is sponsoring another contest for 1958.

If you are an engineer, architect or student, the MARS contest offers you a "showcase." It provides you with a valuable opportunity to have projects you designed shown in leading magazines where they will be seen by the men in your profession.

You are invited to send in your projects. For every submission that is accepted

MARS pencils will pay you \$100

This \$100 is paid you simply for the right to reproduce your project in the MARS Outstanding Design Series. There are no strings attached. You will be given full credit. All future rights to the design remain with you. You can reproduce it later wherever you like and sell or dispose of it as you wish.

The subject can be almost anything—aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. Projects will be selected on the basis of appeal to design-minded readers, broad interest, attractive presentation. Do not submit a design that is in production. In fact, the project does not need to have been planned for actual execution. It should, however, be either feasible at present or a logical extension of current trends. It cannot be unrealistic or involve purely hypothetical alterations of natural laws.

There is no deadline for entries but the sooner you send yours in, the greater the probability of its selection for the 1958 MARS Outstanding Design Series.

It is Simple To Submit a Design For Mars Outstanding Design Series

Just mail in an inexpensive photostat or photocopy of the subject—one you can spare, since it cannot be returned—and a brief description.

If your entry is accepted, we will ask you to send in a clear photograph or rendering of the design (so that we can make a sharp photograph) suitable for reproduction—after which your material will be returned to you.

Send your entry to:

J.S. STAEDTLER, INC.

Hackensack, New Jersey

New Products

Gear Heads and Reducer

Ratios up to 14,730 to 1



Modular construction results in a gear head, a double-ended reducer or a single-ended concentric shaft reducer. All employ the same basic components, thereby making possible quick delivery. These units are available in ratios up to 14,730:1. Output torques up to 100 oz in. and backlash is 30 min max. An integral internal slip clutch on the output shaft can be provided.

Sterling Precision Corp., Instrument Div., Dept. ED, 34-17 Lawrence St., Flushing 54, N.Y.

CIRCLE 76 ON READER-SERVICE CARD



Teflon Film

**Wettable,
Bondable**

A clear Teflon film, Type S, may be completely wetted on one surface and displays non-slip characteristics. The surface treatment does not involve chemical etching; light transmission qualities are unimpaired. The film is applicable as a slot liner and inter-phase insulation and transformer interlay. Complete bonding to potting resins eliminates the possibility of voids and hot spots. The film is available in thickness gauges of 1, 2, 3 and 4 mils. Dielectric strength is 3200 v per mil, dielectric constant is 2 from 60 to 10⁸ cps, and dissipation factor over the same range is 0.002. Tensile strength in machine direction or transverse direction is 4000 psi, ultimate elongation in both directions is 400 per cent.

Dilectrix Corp., Dept. ED, Allen Blvd. & Grand Ave., Farmingdale, N.Y.

CIRCLE 77 ON READER-SERVICE CARD

A page from a spiral-bound notebook. The page features a dark horizontal band across the middle and a dashed line below it. A box containing the text "this is" is overlaid on the page. The page is otherwise blank.

this is

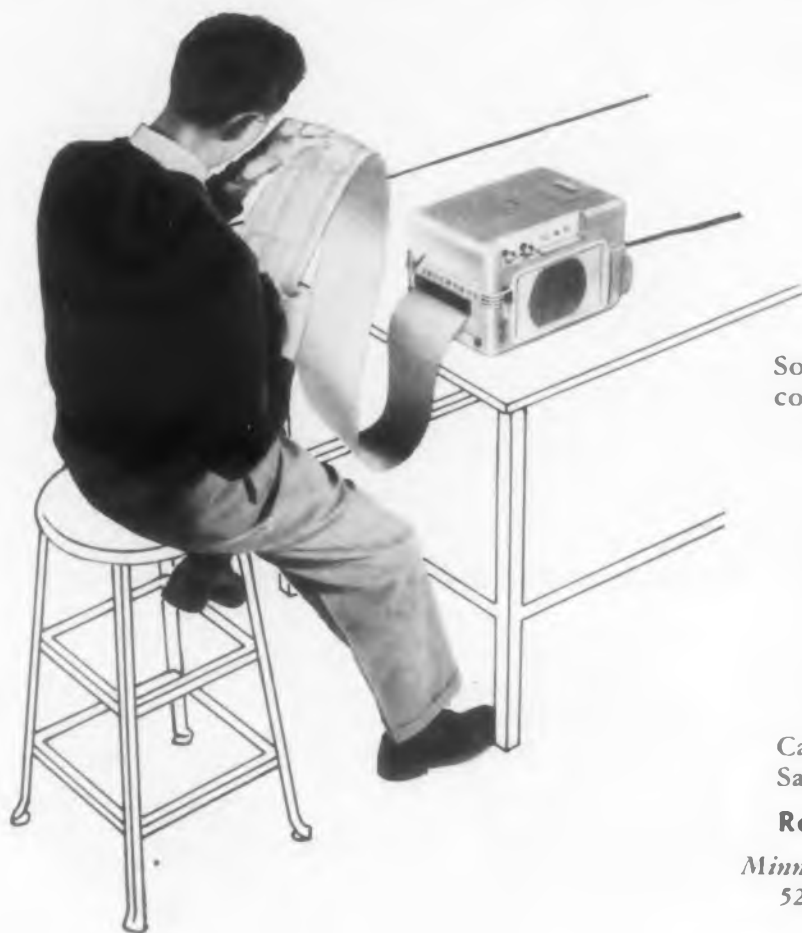


This Visicorder Oscillograph record* is a symbol of the leadership that is typical of Honeywell engineering. In laboratories all over the world the Visicorder's instantly-readable direct records are showing the way to new advances in rocketry, control, computing, product design and component test and in nuclear research.

*reproduced actual size, unretouched

The Model 906 Visicorder is years ahead of the trend. It is the first oscillograph that combines the convenience of direct recording with the high frequencies and sensitivities of photographic-type instruments. The Visicorder alone among oscillographs lets you monitor high-speed variables as they go on the record.

a record of leadership



Some of the general features which give the Visicorder leadership in the direct-recording field are:

- Frequencies from DC to 2000 cps without peaked amplifiers or other compensation
- Six channels plus 2 timing traces on 6" paper
- Deflection 6" peak to peak; traces may overlap
- Record speeds 0.2, 1, 5, and 25 inches per second, minute, or hour
- Records require no liquids, powders, vapors, or other processing

Call your nearest Minneapolis-Honeywell Industrial Sales Office for a demonstration.

Reference Data: Write for Visicorder Bulletin

*Minneapolis-Honeywell Regulator Co., Heiland Division,
5200 East Evans Avenue, Denver 22, Colorado.*

MINNEAPOLIS
Honeywell



Heiland Division

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Industrial Photocopier

Permits Mass Production

This versatile camera process is designed for photo-offset printing archives for industrial designs, mass production of photostatic copies, transfer of designs and microfilming. The Copy-clerk enlarges, reduces, making a dry, direct positive in seconds. It is ideal for plant photos, photomechanical preliminary work, for large-sized silk screen printing, and industrial recordings.

Photorapid of America, Inc., Dept. ED, 320 Broadway, N.Y., N.Y.

CIRCLE 79 ON READER-SERVICE CARD



Sealed Receptacle

Protects Equipment

A series of sealed, rigid receptacles prevent leakage of air, water, and dust from reaching the working parts of equipment.

A brass cap is applied by soft soldering to silicon bronze cast receptacles to fabricate the sealed assembly. The assembly is cadmium plated in accordance with QQ-P-416a, Class 1, Type I. Used with existing sealed stud assemblies, these receptacles will take pressures up to 90 psi.

Camloc Fastener Corp., Dept. ED, 22 Spring Valley Rd., Paramus, N.J.

CIRCLE 80 ON READER-SERVICE CARD

Adjustable Mag Amp Regulator

Operates on 45 to 70 Cps

This Satformer is essentially a variable autotransformer, with the output voltage controlled by a magnetic amplifier. With high overload capacity and adjustable output voltage, this low priced tubeless regulator operates on 45 to 70 cps, without reconnection or adjustment. Designed for use in a regulated rectifier, or an ac line voltage regulator, this unit will keep output voltage constant over a wide range of input voltage, frequency, load, with few watts of control power.

McHenry Control Corp., Dept. ED, P.O. Box 604, Norwalk, Conn.

CIRCLE 81 ON READER-SERVICE CARD

New Products

Motor-Generator

Two Speeds, Precise Frequency



Push button frequency adjustment at any location can be provided by this 1200 rpm synchronous motor and revolving field generator set. Generator speed is 1080 rpm for 360 cps, 1320 rpm for 440 cps. Generator rating is 5 kw, 3 phase. Voltage regulation is ± 1 per cent from no load to full load.

Kato Engineering Co., Dept. ED, Monkato, Minn.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

Isolated Power Supply

Low-Noise Supply for Bridge Circuits



This line of low-voltage transistor-regulated Isoplys was designed especially for strain-gage bridges, and other applications requiring an ungrounded low-noise power supply. Models A8/10-100A and A11/13-100A employ low-capacitance transformer construction used in other Isoplys. The low value of shunt capacitance and the transformer shielding make the supply suitable for bridge circuits requiring an off-ground low noise supply, high speed direct-coupled circuits requiring an undergrounded supply, and special circuits requiring a floating supply for bootstrapping.

These models feature adjustable regulated outputs of 8-10 or 11-13 v dc, conservatively rated at 100 ma. Regulation is 0.4 per cent no load to full load, and is 0.2 per cent for a 100 per cent change in line voltage.

Elcor, Inc., Dept. ED, P. O. Box 354, McLean, Va.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Cost a problem in

consider this:

**These PROVED-IN-USE
ELECTRO-SNAP assemblies
are now
STANDARD production items!**



MODEL A9-6—Rotary release switch. 2-position D.P.D.T., simultaneous action. Vibration resistant; binder screw termination. Dimensions: $1\frac{1}{4}$ "x $1\frac{1}{4}$ "x $3\frac{3}{16}$ "



MODEL C3-8—Vibration-free, positive detent-action, cut-off switch with potted wire leads in D.P.D.T. with simultaneous action. Dimensions: $1\frac{7}{8}$ "x $3\frac{3}{16}$ "x $1\frac{5}{8}$ "



MODEL C3-13—High current, manually-operated cut-off switch. Will simultaneously interrupt 4 circuits of 40 amps, 30 V. DC — or much higher voltages with lower amperages. Has 8 separate circuits available in one control device. Dimensions: $5\frac{1}{16}$ "x $1\frac{1}{2}$ "x $1\frac{1}{2}$ "



MODEL A9-7—Multi-pole, ganged, sub-miniature assembly with rotary actuation. Positive detent-action gives exact indexing for accurate control. Dimensions: $3\frac{7}{32}$ "x $1\frac{1}{8}$ "x $2\frac{3}{32}$ "



MODEL A4-67—Manual pushbutton actuated, 2 to 6 circuits; single pole to triple pole; simultaneous action. Available with various colored buttons.



MODEL HS25-4—Hermetically-sealed rocket safety switch, highly vibration resistant. Roller actuated. S.P.D.T., 1 circuit; 4 amps @ 30 V DC, res.; 2.5 amps., ind. Dimensions: $3\frac{3}{32}$ "x 1 "x 1 "

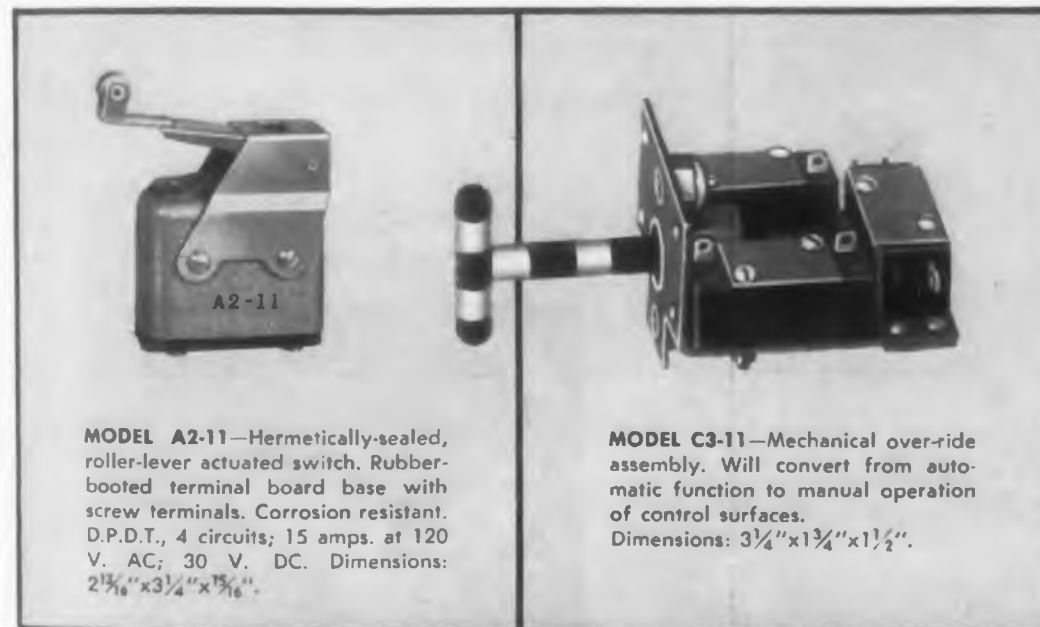
CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

n designing your controls?

● Over the years, ELECTRO-SNAP has developed literally thousands of special switches which are now available as standard production models.

Most important—one of them may be *exactly right* for your needs. And that will mean *standard switch economy* for you . . . plus *proved* precision, performance, stability and operational long-life!

Why not investigate the huge selection of precision-engineered ELECTRO-SNAP standard switches and control assemblies? Describe the particular application you have in mind, together with complete specifications — and we will promptly forward you our recommendations and full technical data.



MODEL A2-11—Hermetically-sealed, roller-lever actuated switch. Rubber-booted terminal board base with screw terminals. Corrosion resistant. D.P.D.T., 4 circuits; 15 amps. at 120 V. AC; 30 V. DC. Dimensions: 2 $\frac{3}{8}$ " x 3 $\frac{1}{4}$ " x 1 $\frac{3}{8}$ ".

MODEL C3-11—Mechanical over-ride assembly. Will convert from automatic function to manual operation of control surfaces. Dimensions: 3 $\frac{1}{4}$ " x 1 $\frac{3}{4}$ " x 1 $\frac{1}{2}$ ".



MODEL H1-43—Stepless adjustment, roller-arm actuated, D.P.D.T. 4 circuit limit switch. Ribbed case hermetically sealed against heat and cold. Highly shock resistant. 10 amps @ 125/250 V. AC; 30 V. DC. Life 200,000 ops. Dimensions: 1 $\frac{1}{4}$ " x 3 $\frac{3}{4}$ " x 1 $\frac{1}{2}$ " (Also available D.P.D.T.)



MODEL C1-4 — Hermetically-sealed, multi-pole assembly. Automatically actuated with manual over-ride for powering and de-powering multiple circuits.

Check **ELECTRO-SNAP...**
for **STANDARD SWITCH ECONOMY**
as well as custom "specials"—
engineered to your specifications



**ELECTRO-SNAP
SWITCH & MFG. CO.**
4216 W. Lake St., Chicago 24, Illinois
VA. 6-3100 TWX # CT-1400

SPECIALISTS IN ELECTRO-MECHANICAL SWITCHES AND CONTROLS

FOR MORE INFORMATION CIRCLE 84 ON READER-SERVICE CARD

Coordinate Converter Polar to Cartesian



Model ER-95 converter was designed specifically to match the ER 90 X-Y plotter, but is applicable wherever conversion from polar to cartesian coordinates is required. Conversion is achieved by a sine-cosine potentiometer linked to a null-seeking servo. Speed of pot positioning is 360 deg per sec and sensitivity is 0.5 mv dc per deg.

Mandrel Industries, Inc., Industrial Instruments Div., Dept. ED, P.O. Box 13243, Houston 19, Texas.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Series Delay Lines Linear Phase Response



A unit of Type 4T Series Delay Lines consists of 60 sections of m-derived networks. Each of these networks was especially designed to give linear phase response up to at least 70 per cent of its cutoff frequency and less than 2 per cent overshoot. These results are achieved by means of mutual coupling between two halves of a section, as well as mutual coupling between two adjacent sections. These delay lines can be potted in resin compound to afford maximum protection from shock, vibration, and humidity.

There are more than 50 types available for this series. The total time delay can be made any value from 0.3 to 60 μ sec. The impedance can be made any value from 50 ohms to 2000 ohms. Specifications are as follows: cutoff frequency mc equals 19.2 divided by the total time delay of the line in micro-seconds. Rise time is less than 5 per cent of the time delay. Accuracy of the time delay is ± 2 per cent. The physical size is 3-1/2 x 3 x 6 in.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N. J.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION



Variety—you can choose from a wide range of finishes for magnesium

Smart, modern furniture is just one example of how finishes for magnesium are widening design horizons. Whether for appearance, protection, or a combination of both, the right finish is available. Magnesium can be painted, chemically treated, electroplated, and coated with plastic or rubber.

To meet the rigorous standards set by the aircraft industry, there are air dried and baked paint finishes with excellent adhesion, maximum imperviousness and good wear resistance. Various types of chemical pickling provide the right

paint base. Anodizing provides exceptional corrosion, heat and abrasion resistance. In addition, any metal which can be applied by electroplating may be deposited on magnesium.

What about your products? If you're not making use of magnesium lightness, strength and durability—and the variety of finishes for magnesium—there's no better time to start than right now. Contact your nearest Dow sales office or write to us for more information. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1405L.

YOU CAN DEPEND ON

DOW

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Spectrum Analyzer Wide Dispersion



The maximum dispersion of the Model TSA-W analyzer has been widened to cover 100 kc (with a 7 kc resolution) to 70 mc (with a 50 kc resolution). A marker has been provided with a range of 80 mc which employs a vernier control for measurements of small frequency differences. A pulse width scale calibrated in usec has been added to the marker. A logarithmic display in addition to the linear display permits detailed examination of minor lobes.

Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N.Y.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Multi-Circuit Timers Offer Wide Flexibility



A new line of time delay relays and sequence program switches offers up to six load circuits in the repeat-cycle time and up to five load circuits in the reset-cycle unit. The timers were developed to meet all the varied requirements of sequence programming, thus avoiding the need for custom-made units for each program. In effect, just one type could be used to meet the range of requirements that would otherwise require as many as 25 different types or timers. This makes possible the benefits of mass production of a few types, instead of small-lot production of many types.

Automatic Timing & Controls, Inc., Dept. D, King of Prussia, Pa.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Low-Frequency Crystals

Accurate Control from 4 to 15 Kc



These low-frequency duplex crystal units are designed to provide accurate frequency control in the audio range of from 4 to 15 kc. Designated as type RH-8DP, they may be used in aircraft navigation equipment, telephone carrier systems, communication systems, and test equipment. They are available in either standard 1-1/2 in. HC-13/U metal holder, hermetically sealed, or in glass bulbs.

These crystals meet MIL C-3098B specifications for shock, vibration, aging, and moisture resistance. They are operable over a temperature range of -55 to +90 C with a stability of ± 0.02 per cent.

Dynamics Corporation of America, Reeves-Hoffman Div., Dept. ED, Carlisle, Pa.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Telemetering Position Transducer

Linearity within 1 Per Cent



This telemetering position transducer provides a frequency change of 4 per cent in the associated oscillator circuit with each inch of shaft movement. The unit forms the inductive portion of a Hartley type oscillator employing a single triode tube. Output signals to ten transducers can be mixed, transmitted on a single channel to a remote receiver which will separate the signals by filtering.

The unit operates with a center frequency from 900 cps to 6000 cps. Frequency change is linear within 1 per cent over a stroke of 3.2 in. and frequency drift with temperature is less than 0.1 per cent per 100 F. Harmonic content is less than 1 per cent. The unit has an operating temperature range of -90 to +275 F, is 6.5 in. long and weighs 8.2 oz.

L. Collins Corp., Dept. ED, 2820 E. Hullett St., Long Beach 5, Calif.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering problem:

Pressure-tight fastening of transit cases

The solution:

A specially modified **LINK-LOCK**

Applied Design Company

engineers worked with

Simmons to develop this successful

LINK-LOCK application

Simmons LINK-LOCK, with design modifications developed in cooperation with the Engineering Department of Applied Design Company, Buffalo, New York, resolves special closure requirements in rigidly specified transit cases like the aluminum equipment container shown.

Here, the bowed LINK-LOCK engagement blade provides the double advantage of maintaining constant fastener pressure and permitting considerable mounting tolerance. This container is just one of many important products in which Applied Design specifies standard and special Simmons Fasteners.

Here's why LINK-LOCK is ideal for use on military cases produced to exacting specifications as well as on inexpensive commercial containers:

- Impact and shock resistant (positive-locking).
- High closing pressure with light operating torque...insures pressure-tight seals where required.
- Available in 3 sizes, for heavy, medium, and light duty.
- Compact design...lies flat against case even when unlocked.
- Opening and closing by wing-nut, screwhead, or hex nut.
- Flexible engagement latch design...can be varied to suit different conditions.

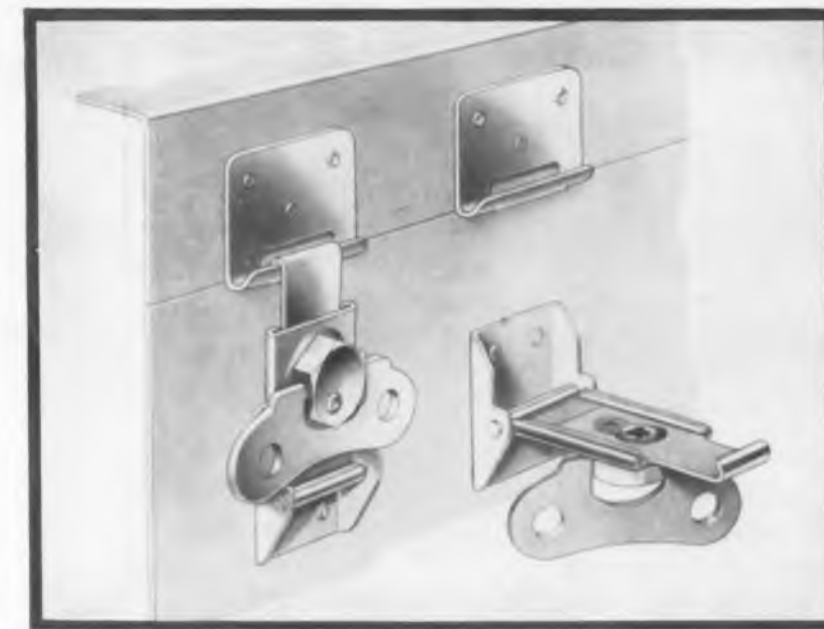
Also available: Spring-Loaded LINK-LOCK. Ideal for the less expensive containers where costs won't permit precision production. Spring provides take-up to compensate for set in gasketing, irregularities of sealing surfaces, and mounting inaccuracies.

SEND TODAY for the Simmons Catalog for complete information and engineering data on LINK-LOCK and other Simmons Industrial Fasteners. Engineering service is available; outline your particular fastening problems. Samples on request.

CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION



Twelve special loop-blade LINK-LOCK fasteners are used in this aluminum transit case designed by Applied Design Company.



Standard No. 2 LINK-LOCK (Medium-Duty). Available with screw-head, wing-nut as shown, or hex nut.

SIMMONS

FASTENER CORPORATION

1763 North Broadway, Albany 1, New York

QUICK LOCK • SPRING-LOCK • ROTO-LOCK • LINK-LOCK • DUAL-LOCK • HINGE-LOCK

New Products



Magnetic Storage Drum
General Purpose

A general purpose drum, Model 512A is built to meet the requirements of permanent storage problems, yet is versatile enough to be used as a laboratory instrument. The unit has capacities to 625,000 bits and speeds up to 12000 rpm. A 500 kc drum operation is attainable with this model, and it accommodates up to 240 magnetic read/record heads. The 512A measures 5 in. diam by 12 in. long, and is vertically mounted to provide optimum operator conditions.

Bryant Chucking Grinder Co., Gage & Spindle Div., Dept. ED, P.O. Box 620, Springfield, Vt.

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION



Wideband DC Amplifier
35 v, 40 Ma Output

Model 111BF wideband dc amplifiers utilize a chopper circuit to provide stable and accurate amplification of μv level signals from strain gages, thermocouples and other types of transducers used to measure dynamic physical phenomena such as strain, pressure, flow, vibration and temperature. The amplifiers can be used to drive strip recorders, wideband oscilloscopes, voltage controlled oscilloscopes, voltage controlled oscillators, recording galvanometers, tape recorders, chemical or industrial process control elements, computers, and many other types of indicating and recording instruments. Features include: less than 2 μv drift; less than 5 μv noise; 35 v, 40 ma output; dc to 40 kc bandwidth; 10,000 ohm input impedance, low output impedance.

Kintel, Dept. ED, 5725 Kearny Villa Rd., Box 623, San Diego 12, Calif.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION



MICRO SWITCH Precision

... FIRST IN PRECISION SWITCHING

Six Examples OF HOW DESIGNERS OF A WIDE VARIETY OF PRODUCTS USE MICRO SWITCH PRECISION SWITCHES TO SIMPLIFY AND IMPROVE PERFORMANCE

Switch-controlled automatic coffee brewer adds 22 cups to the pound



These lever-actuated switches control every step



"Our coffee brewer would have been impossible without these MICRO SWITCH precision switches," says the head of a concern which makes automatic brewers for coffee vending machines. Photo shows three of seven switches which control every step of the brewing process. Precision switch operation produces 22 more cups of excellent coffee to the pound. MICRO SWITCH general purpose basic switches offer a wide variety of actuating means and operating characteristics. The actuators, like the rigid lever type shown, are constructed as an integral part of the switch. (Catalog 62)



Send for catalog 62 on Basic Switches

MICRO SWITCH can help your research and development program. There are always new switches at MICRO SWITCH. Call the nearest branch for technical engineering assistance.

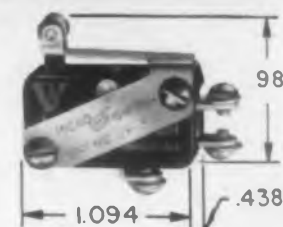


Send for catalog 83 on Enclosed Switches



Throttle control switches centralize jet pilot's handling of many functions

This throttle control, equipped with MICRO SWITCH precision switches, gives a jet plane pilot the utmost centralized control possible. Photo shows a throttle control quadrant with three MICRO SWITCH V3 switches which "allow a mechanical perfection comparable to a fine watch," according to the designer. MICRO SWITCH V3 switches have the highest electrical capacity for their size of any switch available. They have been developed to meet the exacting requirements of designers for an extremely small switch with no sacrifice of quality or precision. V3 switches are available in a wide variety of terminal designs, contact arrangements and operating characteristics. (Catalog 74)



Small V3 switches with high electrical capacity

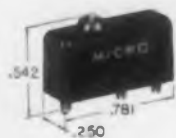
Switches have uses unlimited



MICRO SWITCH nerve centers help automatic camera take a photo every five seconds

MICRO SWITCH precision switches trigger all phases in the operation of an automatic camera. Despite the delicate functions of the switches, these units require a minimum of maintenance. In fact, the maker is now overhauling one that has logged over 65,000 photos. "MICRO SWITCH units," says the designer, "offer better quality and more dependability." (Catalog 62)

45 switches actuate intercoupler device to speed tabulation of accounting information



Each key connects with a subminiature switch

This device couples such a machine as a cash register, for instance, with a card-punching machine to record accounting data. "Small size of MICRO SWITCH subminiature switches

make them efficient, reliable and an 'ideal package'," say the designers. "MICRO SWITCH technicians keep us posted on up-to-date developments and make our research and development work easier." (Catalog 75)

Switches hold abrasive wheel true while cutting discs as thin as .0145 in.



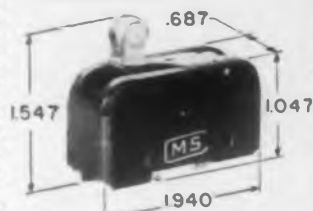
MICRO SWITCH TYPE ML Switches are key controls of this equipment

An abrasive wheel wears down while cutting, constantly decreasing in diameter. One of the switches used on this cutter keeps the wheel at a constant distance from the rod center.

"MICRO SWITCH precision switches enable us to cut high nickel alloy rods to extremely critical tolerances," say the designers. The switches control the complete feeding and cutting cycle. The two MICRO SWITCH ML switches shown combine rugged construction with precision, snap-action switching. (Catalog 83)



Millions of repeat operations — no maintenance



Roller-lever actuated switches control operating cycle



Switches do "thinking" and this machine out-produces battery of drill presses

With MICRO SWITCH precision switches actuating the various operating steps of this turret drill, one operator can keep three or four machines at work. Main advantage of the use of MICRO SWITCH units, according to the designer is simplification of controls. This factor means that one setup can perform six to eight jobs. "We build a high quality machine and we demand high quality components," he says. (Catalog 62)

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



DC Power Supplies

5 to 15 Kv



The Series 9000 Hi-Sel dc power supplies, features air insulation for minimum weight and selenium rectifiers for small size. Units of the 900 series operate from a 115 v, 50 to 400 cps source and are available with maximum output ranging from 5 to 15 kv, 2.5 and 5 ma. Sizes vary from 7-3/4 x 4-1/4 x 3 in. to 9 x 8-1/2 x 6 in. The power packs feature low ripple in all current ratings of 0.5 to 2 per cent, and good dynamic load regulation.

Sorensen & Co., Inc., Beta Electric Div., Dept. ED, 333 E. 103 St., New York 29, N.Y.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Isolation Transformer

Low Internal Capacitance



The A4W Isoformers have a secondary winding that has low shut capacitance to ground, low capacitance to primary winding, and high leakage resistance to both primary and ground. These transformers operate from an input of 117 v ac, 60 cps and supply from 2.5 to 150 v ac at 4 w. These miniature isolation transformers are suited for dc isolation such as in electrometers, low shunt capacitance sources of heater energy for high-speed circuits where the cathode has a high signal potential to ground, and noise free sources of filament heater energy. Dimensions of the unit are 1-5/8 in. wide x 2-1/4 in. long x 3 in. high.

Elcor Inc., Dept. ED, P.O. Box 354, McLean, Va.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Split-Wedge Transducer

Measures Angle of Attack to Mach 3



Model 2562 vane transducer provides accurate angle of attack or side slip formation at speeds and altitudes throughout a wide operational range. Damping is maintained at 0.5 of critical. Recovery time for 63 per cent of a step input at 110 knots is 0.075 sec, and sensitivity is 0.2 deg from 90 knots to 125 knots and 0.1 deg from 125 knots to Mach 3.

Giannini & Co., Inc., Dept. ED
918 E. Green St., Pasadena, Calif.

CIRCLE 98 ON READER-SERVICE CARD

Test Oscillator

Push Button Operated



This instrument is designed to expedite repetitive-type operations in laboratory, production, and maintenance applications. It provides 8 preset frequencies (user-specified) within the range of 15 cps to 150 kc at a source impedance of less than 0.5 ohm. Normal warm-up time is eliminated, assuring stable readings when the instrument is switched on. The instrument is portable, and weighs 6-1/2 lb.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 99 ON READER-SERVICE CARD

P&B PROGRESS

IMPROVED! SEALED COIL, TELEPHONE-TYPE RELAY.

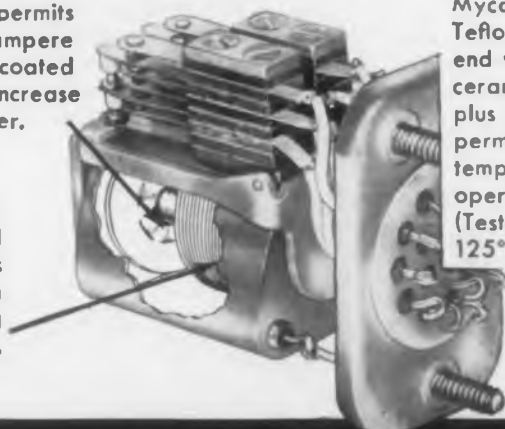


NEW! DUAL HERMETIC SEAL INCREASES RELAY RELIABILITY AND TEMPERATURE RANGE

LOOK AT THESE GREAT NEW FEATURES

New bobbinless coil saves space, permits use of more ampere turns of Teflon coated wire with no increase in coil diameter.

Hermetically sealed coil prevents gases from contaminating contacts.



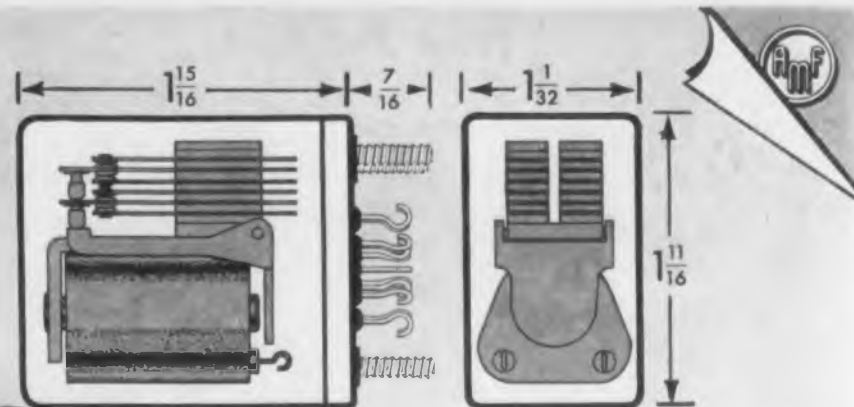
Mycalex stack, Teflon wire and end washers and ceramic pushers, plus sealed coil, permit high temperature operations. (Tested up to 125° C.)

Hermetically sealing the coil of the MH "Seal-Temp" substantially increases the reliability and life of this popular telephone-type relay. Considered a major reason for relay failure, contact contamination due to outgassing of the coil has been eliminated by this sealing process.

The "Seal-Temp" has a temperature range considerably broader than ordinary relays... from -65° C to +125° C. This is achieved by constructing the stack of Mycalex, employing ceramic pushers, and by using Teflon coated wire throughout.

For applications where reliability, long life and broad temperature ranges are required, the MH "Seal-Temp" relay could well be the answer. Write, wire or call today for complete information.

POTTER & BRUMFIELD, INC., PRINCETON, INDIANA / SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY



MH "SEAL-TEMP" RELAY

GENERAL: Insulating Material: Ceramic, Mycalex and Teflon.
Insulation Resistance: 1,000 meg ohms min.
Breakdown Voltage: 500 V. RMS.
Shock: 30g's.
Vibration: 5g's 55 to 500 cps.; .032" max. excursions 5-55 cps.

Temperature Range: -65°C to $+125^{\circ}\text{C}$.
Pull-In: Approximately 75% of nominal voltage at 25°C .

Terminals: Miniature plug in; hook end solder.
Enclosure: Short "M" Can, hermetically sealed.

CONTACTS: Arrangements: Up to 6 springs per stack. (4PDT)
Material: $1/8$ " Silver (others available).
Load: 5 amp. 115V. AC resistive.

COILS: Resistance: Up to 22,000 ohms.
Power: 100 mw per movable arm min.; 4 watts max. DC at 25°C . (200 mw min. to meet shock or vibration requirement at 25°C .)

Duty: Continuous.
Insulation: Teflon.
Coil Chamber: Hermetically sealed.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL
ELECTRONIC, ELECTRICAL AND REFRIGERATION DISTRIBUTORS

Potter & Brumfield, inc.

PRINCETON, INDIANA

SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

Manufacturing Divisions also in Franklin, Ky. and Laconia, N.H.

Mail the coupon for complete engineering data on the new MH Series, plus new compact catalog of standard type relays. If you need answers to a specific application problem write in detail.



Potter & Brumfield, Inc., Princeton, Indiana
Attn: T. B. White, Brig. Gen. USMC (Ret.)
Special Projects Engineer

Please send me complete engineering data on the new MH Series Relay plus the new compact catalog of P&B standard relays.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Terminal Boards For Severe Climatic Conditions



Designated 2303-1, 2303-2 and 2303-3, these terminal boards are especially applicable where high temperature and humidity are encountered. The boards are made of grade L5 silicone impregnated ceramic, are $5/16$ in. wide and are equipped with type X1558 terminals. Each board has 4-40 threaded stand offs at each end which not only serve for mounting but as terminals for grounding connections to the chassis. All metal parts are silver-plated brass.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Avenue, Cambridge 38, Mass.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Converter

Low Level DC to High Level DC



High voltage dc can be obtained from a low voltage dc supply with these transistorized power converters. The TPC-2 is designed for 12 v input and 150 v, 400 ma or 300 v, 200 ma output. Draws 6.85 a full load and 1.12 a no load and has an efficiency of better than 75 per cent. Operate at ambients up to 150°F under continuous full load conditions.

Southwestern Industrial Electronics, Dept. ED, 2831 Post Oak Rd., Houston, Tex.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

SPRINGS ON YOUR MIND?



- Your next thought should be of the Spring Engineers at John Chatillon & Sons. Send them your blueprints and specifications for study and recommendation.

- With more than 120 years of experience and knowledge at their command, they can provide you with the exact spring you require—on time, at competitive prices.

- Chatillon has the trust of the largest users of springs in the world because of the Chatillon reputation for filling orders that others would consider impossible.

- Next time, benefit by the thorough knowledge of Chatillon Spring Engineers. They'll be glad to help you. Send your blueprints to: Department D-2.

JOHN
CHATILLON
& SONS

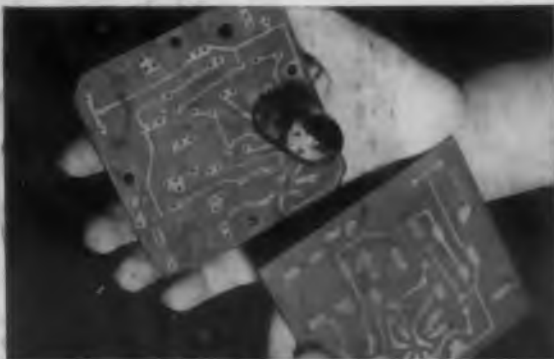
85 CLIFF STREET, NEW YORK, N. Y.

Manufacturers of Precision Springs and Force Measuring Instruments Since 1835.

CIRCLE 103 ON READER-SERVICE CARD

RICHARDSON — plastics for electronics

... laminated—molded



COPPER-CLAD INSUROK

Choice of various grades. Copper bonded to one or both sides. Outstanding electrical properties after humidity conditioning. High flexural and tensile strength. Holds metal inserts and lugs securely. Excellent bond strength and heat resistance.



FABRICATION

Complete facilities for punching or machining precision parts from laminated INSUROK to your specifications in any quantity—for electrical or mechanical applications.



MOLDED PLASTICS

Parts molded from standard or special plastics materials as required for your product, including newest plastics. Produced by compression transfer or injection processes. Metal inserts molded in position.



LAMINATED INSUROK

Available in sheets, rods, and tubes in NEMA and special grades. Properties to meet practically any electrical or mechanical requirements. Many sizes and thicknesses.

technical services

Experienced Richardson engineers will analyze your requirements and help you select the material, and best manufacturing process for your needs . . . and when your requirements are unusual, Richardson offers extensive background for developing special plastics materials for your product. Also, Richardson is equipped to provide complete facilities and techniques for molding, laminating, molded laminates, and fabricating. You are assured the correct material and process for each application. These research, design, and engineering services are yours without cost or obligation, of course. Write or phone, today.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

Write for 12-page booklet

"INSUROK® Laminated Plastics—Molded Plastics"

The
RICHARDSON COMPANY
LAMINATED AND MOLDED PLASTICS

Dept. 16, 2682 Lake Street
Melrose Park, Ill.

New Products

Polystyrene Capacitor High Q



Type 194P Styracon capacitors use an especially processed polystyrene film for their dielectric. They are protected against moisture as well as mechanical damage in installation by pre-molded mineral-filled phenolic shells with resin end seals. Their high Q, minimum dielectric absorption, and high insulation resistance make them suitable for applications in tuned circuits, timing and integrating circuits, and in inter-stage coupling networks in high quality amplifiers. They have standard capacitance ratings at standard working voltages of 50, 100, 200, 400, and 600 v dc.

Sprague Electric Co., Dept. ED, North Adams, Mass.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Delay Line High Resolution



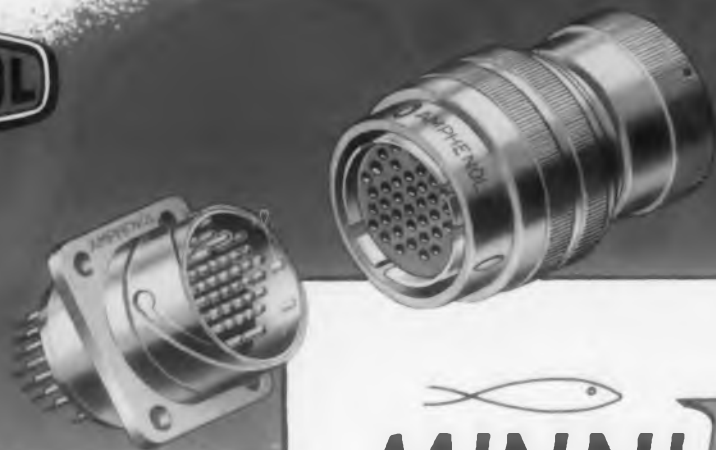
Measuring 4-1/4 in. sq, the Model V-203 has a 0.5 μ sec total delay and 580 ohm characteristic impedance. At full delay its rise time is 0.035 μ sec and attenuation 0.5 db. A rotary switch provides a resolution of one part in 120. The switch has been tested mechanically for a quarter-million cycles of operation with no sign of wear. Delays up to 10 μ sec and impedances up to 5000 ohms are possible.

Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N.Y.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 113 ON READER-SERVICE CARD →

ELECTRONIC DESIGN • November 1, 1957



MINNIE

MINIATURE CONNECTORS

AMPHENOL's 67 Series of *MINNIE* connectors are quick-disconnect, multi-contact, miniature bayonet lock types.

Descriptive part numbering has been assigned to *MINNIE*'s, making identification easy. Shell type, construction class, size, insert number, contacts and alternate positions are all numbered.

Part Number Example



Shell type numbers correspond to the "AN" nomenclature and are fully described on the following pages; shell designs are similarly listed. Insert sizes and contact arrangements are shown below. "P" or "S" in insert style identify pin or socket contacts. Alternate insert positions are shown on the following page.

MINNIE CONNECTORS ARE AVAILABLE AS Plugs, Cable and Panel Receptacles and Single Hole Mounting Receptacles in four constructions, five shell sizes and 17 insert arrangements.

SIZE 12 INSERTS			SIZE 14 INSERTS					
	12-60 3/16	12-7 7/20		14-5* 5/20	14-63 5/16	14-9* 9/20	14-61* 8/20, 1/Shielded	14-12* 12/20

SIZE 18 INSERTS				
	18-64* 14/16	18-24* 24/20	18-62* 19/20, 1/Shielded	18-65 7/20, 4/16

Nominal Current Rating	
CONTACT	CURRENT
#20	7.5 Amperes
#16	17.0 Amperes

NOTE: All inserts have an "A" rating except 14-5 which has a "B" rating.

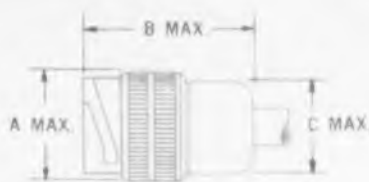
SIZE 20 INSERTS			SIZE 22 INSERTS				
	20-37 37/20	20-66 19/16		22-67 25/16	22-48 48/20	22-68 36/20, 2/16	22-69 40/20, 2/16

*Available in Hermetically Sealed Receptacles—use "H" for shell design in part number for ordering. In 67-04 shell type only.

CABLE TO CABLE RECEPTACLES

67-01PXX-XXX with form for potting seal

"P" construction for potting—fully conforming to the "E" requirements of MIL-C-5015C when potted. Disposable polyethylene potting form.



SIZE	A	B	C
12	875	1 668	812
14	982	1 668	920
18	1 232	1 668	1 170
20	1 375	1 668	1 312
22	1 468	1 735	1 425



67-01EXX-XXX with grommet for individual wire seal

"E" construction—fully conforming to the "E" requirements of MIL-C-5015C. Unitized grommet clamp individually seals each conductor at back.



SIZE	A	B	C
12	875	1 690	875
14	982	1 690	982
18	1 232	1 690	1 232
20	1 375	1 690	1 375
22	1 468	1 750	1 468



67-01JXX-XXX for use with jacketed cable

"J" construction—waterproofing cable type for use with jacketed cable.

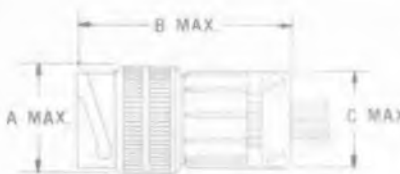


SIZE	A	B	C	D
12	875	2 038	687	250
14	982	2 038	787	375
18	1 232	2 038	1 037	656
20	1 375	2 038	1 160	750
22	1 468	2 100	1 273	875



67-01CXX-XXX general duty

"C" construction—with standard cable clamp for un-jacketed individual wire leads—strong support for wires.



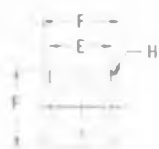
SIZE	A	B	C
12	875	2 088	812
14	982	2 088	937
18	1 232	2 088	1 185
20	1 375	2 088	1 312
22	1 468	2 150	1 437



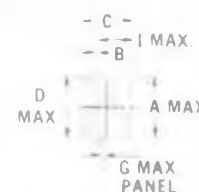
RECEPTACLES

67-02EXX-XXX panel mounting receptacle

Standard 4-hole panel mounting receptacles—mate with plugs listed on opposite page.



SIZE	A	B	C	D	E	F	G	H	I
12	.656	.062	828	687	812	1 031	187	125	.562
14	.781	.062	828	.812	906	1 125	187	125	.562
18	1 032	.093	828	1 062	1 062	1 312	187	125	.562
20	1 156	.093	828	1 187	1 156	1 437	187	125	.562
22	1 281	.093	937	1 281	1 250	1 562	187	125	.562



VOLTAGE RATING

	RATING	MECHANICAL SPACING (NOMINAL)	FLASHOVER V-RMS*	TEST V-RMS	RECOMMENDED WORKING VOLTAGE	
					DC	AC
Sea level (unsealed)	A	.034	2 000	1 500	700	500
	B	.046	2 300	1 800	840	600
Sea level (sealed)	A	.034	2 500	2 000	700	500
	B	.046	3 000	2 500	840	600
70 000 ft (unsealed)	A	.034	500	375	175	125
	B	.046	600	450	210	250
70 000 ft (sealed)	A	.034	2 500	1 500	700	500
	B	.046	3 000	1 800	840	600

*TYPICAL FLASHOVER VOLTAGES AT STANDARD CONDITIONS.

UNSEALED Refers to connectors with no provisions made for sealing front or rear areas.

SEALED Refers to connectors that are potted or pressurized in mounting, having front and rear areas sealed.

SHELL DESIGN "E" & MIL-C-5015C "E" REQUIREMENTS

AMPHENOL MINNIE's are the first miniature connectors to fully meet the "E" requirements of MIL-C-5015C, the current specification governing A-N (now MS) type connectors. To meet this requirement, connectors must first pass stringent temperature cycling and vibration tests and then be subjected to moisture resistance tests. In the latter test, connectors are sealed into a chamber containing water. Temperatures are varied every hour in order to cause heavy condensation to form on the connectors. This test lasts for 20 days—before, during and after the connectors are tested for insulation resistance. To pass, the insulation resistance between each contact and all other contacts must be not less than 100 megohms.

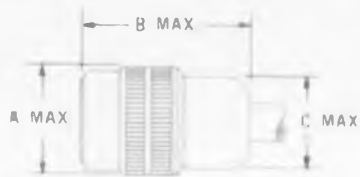
MINNIE OPERATING TEMPERATURES

MAXIMUM	MINIMUM
125°C.	-55°C
257°F.	-67°C

PLUGS

67-06PXX-XXX with form for potting seal

"P" construction for potting—fully conforming to the "E" requirements of MIL-C-5015C when potted. Disposable polyethylene potting form.



SIZE	A	B	C
12	.937	1.668	.812
14	1.062	1.668	.920
18	1.352	1.668	1.170
20	1.475	1.668	1.312
22	1.606	1.735	1.425



67-06EXX-XXX with grommet for individual wire seal

"E" construction—fully conforming to the "E" requirements of MIL-C-5015C. Unitized grommet/clamp individually seals conductor at back.



SIZE	A	B	C
12	.937	1.690	.875
14	1.062	1.690	.982
18	1.352	1.690	1.232
20	1.475	1.690	1.375
22	1.606	1.750	1.468



67-06JXX-XXX for use with jacketed cable

"J" construction—waterproofing cable type for use with jacketed cable.

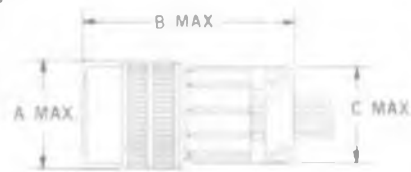


SIZE	A	B	C	D
12	.937	2.038	.687	.250
14	1.062	2.038	.787	.375
18	1.352	2.038	1.037	.656
20	1.75	2.038	1.160	.750
22	1.606	2.100	1.273	.875



67-06CXX-XXX general duty

"C" construction—with standard cable clamp for unjacketed individual wire leads—strong support for wires.



SIZE	A	B	C
12	.937	2.088	.812
14	1.062	2.088	.937
18	1.352	2.088	1.185
20	1.475	2.088	1.312
22	1.606	2.150	1.437



67-03EXX-XXX round flange receptacle—rear mount



SIZE	A	B	C	D	E	F	G	H
12	1.031	.093	.828	.750	.156	.968	.760	.697
14	1.156	.093	.828	.875	.156	.968	.885	.822
18	1.406	.093	.828	1.125	.156	.968	1.135	1.072
20	1.531	.093	.828	1.250	.156	.968	1.260	1.197
22	1.656	.093	.937	1.375	.250	1.062	1.385	1.322

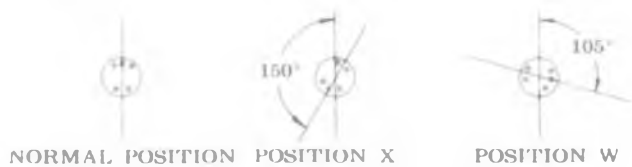
67-04EXX-XXX round flange receptacle—front mount



INSERT POSITIONS

Unless otherwise specified, MINNIE'S are furnished with the normal insert position as shown below. By adding "X" or "W" to the part number (see page 1) alternate inserts are furnished.

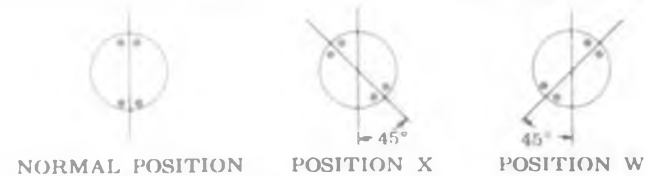
SIZE 12



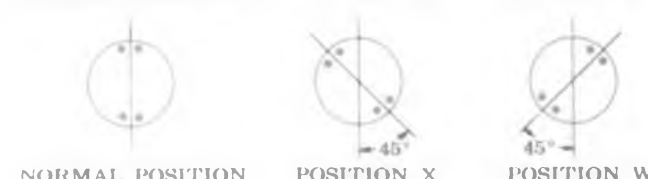
SIZE 14



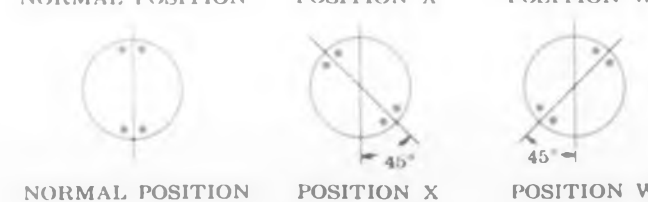
SIZE 18



SIZE 20



SIZE 22



TEAR OUT this 4 page catalog
for ready reference

AMPHENOL



ruggedly built
to resist
shock and
vibration

environmentally
sealed to
resist moisture
and humidity


MINNIE
MINIATURE CONNECTORS

Meet **MINNIE**—a complete line of miniature connectors with outstanding reliability features! The first miniatures to meet fully the “E” performance requirements of MIL-C-5015C, **MINNIE**'s are available as plugs, cable and panel receptacles and single hole mounting receptacles. Besides offering the first true miniature “E” construction, **MINNIE**'s are made in potting, jacketed cable and cable clamp types. There are 5 shell sizes and 17 insert arrangements, including shielded contact designs.

In a cut-away drawing on page 4 of the attached catalog, some of **MINNIE**'s mechanical features are shown. When mated, the spring-loaded, three bayonet coupling provides a positive locking action, and a constant compensating force which eliminates the effects of any face seal compression “set”. In the unitized grommet seal, the clamp and grommet form a single unit for ease of assembly and maintenance. The visual full engagement indicator is an inspection aid—when the connectors are fully engaged the orange line is covered.

Additional details about **MINNIE**'s may be learned from the complete catalog attached to this advertisement. Tear it out along the perforated line.

imaginatively
designed—
new reliability
features!

NEW

NEW

NEW

NEW

NEW

NEW

NEW

NEW

NEW

NEW

NEW

NEWEST

NEW



NEW

NEW

NEWEST

NEW

NEW

NEW

NEWEST

THE MOST COMPLETE LINE AND THE ONLY
MINIATURE CONNECTOR LINE FULLY CONFORMING
TO THE "E" REQUIREMENTS OF MIL-C-5015C

NEWEST

NEW

NEW

NEW



FOR COMPLETE CATALOGING

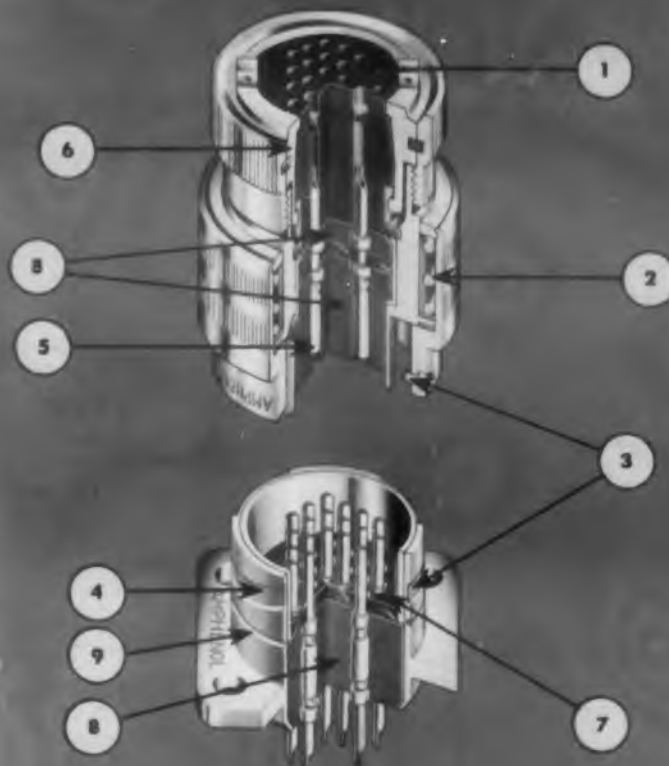
A REMARKABLE NUMBER OF
RELIABILITY FEATURES . . .
ALL BUILT INTO THE AMPHENOL

MINNIE

CONNECTORS

FEATURES

1. Environmentally sealed with unitized back end grommet. (Also available with provision for potting.) Either grommet seal or potted seal meets moisture resistance requirement of MIL-C-5015C, Paragraph 4.5.21.
 2. Spring-loaded coupling ring provides a positive locking action in the bayonet slot, and a constant compensating force which eliminates the effects of resilient face seal compression set.
 3. Stainless steel bayonet slots and pins reduce wear and frictional characteristics. The three pin bayonet coupling minimizes the rocking action of the mated plug and receptacle.
 4. Flattened incline angle of bayonet slots reduces mating force requirement.
 5. Hooded contacts resist test prod damage as defined in Paragraph 4.5.14 of Amphenol Specification 340-43-2108.
 6. Unitized grommet seal; clamp and grommet form a single unit for ease of assembly and maintenance.
 7. Face seal gasket with individual barriers to isolate each contact.
 8. Hard insert dielectric (plus resilient face seal) positively retains contacts with no possibility of contacts being pushed out of the insert.
 9. A visual full engagement indicator is included in the design to insure the user that he has fully engaged the connectors. The indicator is an orange line around the receptacle shell.
- When using mated sealed connectors, no derating for altitude is necessary at 70,000 feet.
 - Test voltage 1,500 volts RMS 70,000 feet on sealed connectors.
 - Vibration per Method 204 of MIL-Std-202A. 10 to 2,000 cps at 20 g's.
 - Temperature cycling range per MIL-C-5015C, Paragraph 4.5.3 increased to 257°F. maximum and -67°F. minimum.



Place This
Reference Catalog
with your other

AMPHENOL Catalogs

A copy of AMPHENOL
SPECIFICATION 340-43-2108

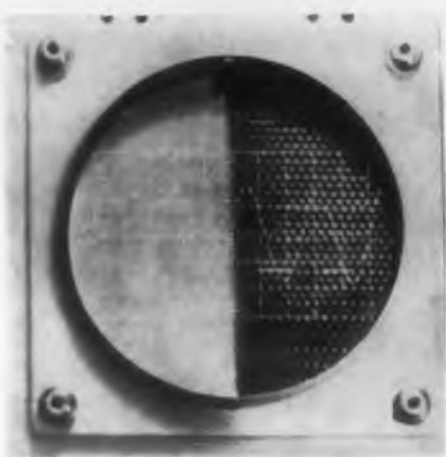
covering MINNIE connectors is
also available.

Including supplementary test data,
this Specification will
give you the most
complete picture of
AMPHENOL's remarkable
miniature connectors

AMPHENOL

Scope Shadow Screen

Allows Viewing in Bright Light



This screen blocks off the ambient light that blurs the cathode ray tube image when the instrument is used outdoors or in a brightly lit laboratory. The shape of the screen openings permits full observation of the scope image from any point within 45 deg of the face-on position. Tests indicate that under adverse lighting conditions, the contrast of the oscilloscope image is increased by a factor of 20 to 1 through use of the shadow screen.

Van-Dee Products, Dept. ED, 300 Ocean Ave., Laguna Beach, Calif.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Converters

Low DC to High DC

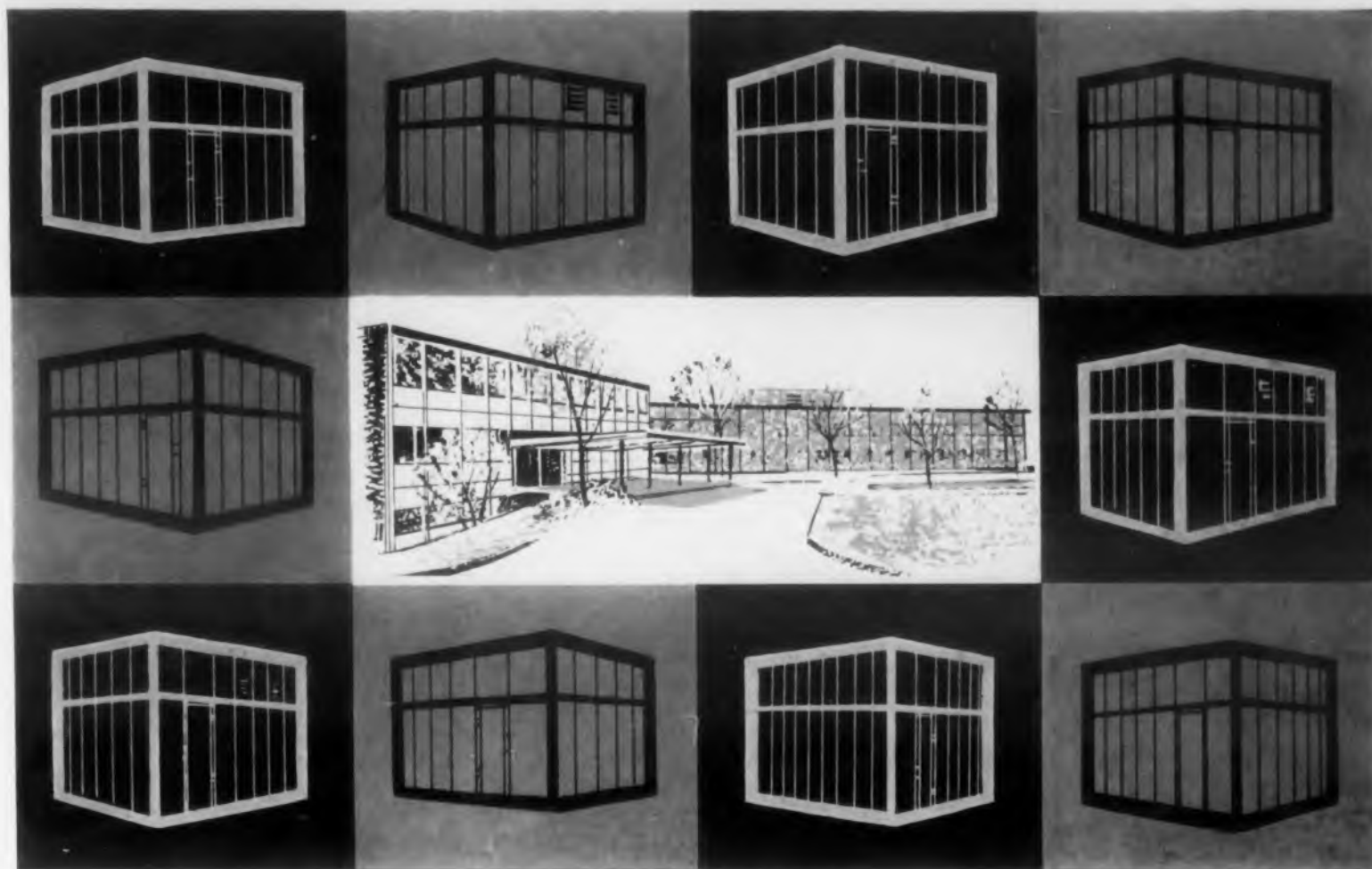


Series SC-325 converters are used in converting low voltage dc to high voltage dc for operating mobile and aircraft electronic equipment. A solid state device, the converter features high efficiency, compactness and light-weight, and operation under high shock, vibration and acceleration. The operating ambient ranges from -55 to $+75$ C. From an input of 6, 12 or 28 v, an output of 325 v at 100 or 200 ma is supplied.

Kepco Labs. Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 113 ON READER-SERVICE CARD



RCA Cherry Hill center studies TV interference in 35 ACE shielded enclosures

FCC regulations governing receiver radiation specifically state that r-f interference in the frequency range of 450 kc to 25 mc cannot exceed 100 microvolts as measured on the power line connected to the TV receiver. RCA thoroughly tests the prototype of every TV set it manufactures, both color and black and white, against these FCC regulations. And it's all done with great accuracy in one of the thirty-five Ace enclosures at RCA's modern Television Engineering Laboratories at the Cherry Hill Center, Camden, N. J. Actually the largest number of shielded enclosures ever installed at one site, these represent an important part of one of the best equipped engineering laboratories in the world.

Here, thorough shielding is a must, for numerous engineering tests involving interference are often under way at the same time. Other receiver studies carried out in these rooms include tests for gain, selectivity, sensitivity, and general circuit design.

Each of the Ace RFI-Design* rooms is constructed of prefabricated galvanized steel panels and frames with special r-f leak-proof doors of the same material. They provide over 100 db attenuation at all frequencies from 14 kc to 1000 mc. All are ventilated from a central air conditioning source.

An interesting collateral function of these enclosures is their use as

*Lindsay Structure

partitions to section off areas of the engineering department. Should the occasion arise, two adjacent rooms may be combined into a large one merely by removing adjoining walls and bolting the remaining structure together. Similarly, dimensions can be easily changed by adding or removing interchangeable panels.

The Cherry Hill installation is a stimulating illustration of the way standard Ace enclosures are solving today's shielding needs. They can be equally effective in your own plant. An Ace Sales Engineer would be glad to discuss it with you. Or, write for further information—a free catalog on standard Ace enclosures is yours for the asking.



First and Finest In Shielded Enclosures

ACE ENGINEERING & MACHINE CO., INC. • HUNTINGDON VALLEY, PENNSYLVANIA
CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR DYNAMOTORS...



MODEL GY. Includes ratings through 110 watts continuous duty and 300 watts intermittent duty. Outputs to 650 volts.



MODEL G. The all new "Twinvolt" Dynamotor. Operates from 6 to 12 volt input.



TYPE SF. Built to the most exacting specifications. Up to 75 watts continuous duty and 200 watts intermittent duty. Input voltage 6 to 115. Output voltage up to 750 volts.

For further information send for Bulletin 1530.

SANGAMO
Electric Company
Electronic Components Division

SPRINGFIELD, ILLINOIS

SG57-3

make **SANGAMO** your major source!

FOR COMMERCIAL AND MILITARY

Sangamo Dynamotors are available in two basic design series: the rugged "G" series for commercial use, and the "S" series for special purpose and military applications. Both types are small, compact, yet capable of unusual output and high efficiency under the most rigorous conditions of service.

DEPENDABLE DELIVERY SCHEDULES

Sangamo utilizes the latest production techniques in the manufacture of power supply units. Push line type of operation contributes substantially to accelerated production—aids in fulfilling all delivery schedules. Specify Sangamo for *dependable* units and *dependable* delivery that meets *your* production schedules.

EXPANDED PLANT FACILITIES

A new 200,000 square foot "controlled conditions" plant, in Pickens, South Carolina is geared for full capacity production of Dynamotors, Rotary Converters, Generators, Special DC Motors—all built to meet your most exacting specifications for quality and performance.

ENGINEERING HELP AVAILABLE

Sangamo maintains a complete engineering and technical staff to assist any organization with its power supply planning. Ask for an engineering analysis and recommendations for power supply units to meet your special application problems.



CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Reluctance Pressure Transducer High Level DC Output



The P900 transducer is a reluctance pressure pickup with high level dc output. It has infinite resolution, high frequency response, and ruggedness to shock and vibration. Suited for airborne, test stand and laboratory applications, such as TOE type voltage controlled telemetry, air data and guidance systems, and direct dc data recording.

Datran Electronics, Div. of Mid-Continent Mfg. Inc., Dept. ED, 3615 Aviation Boulevard, Manhattan Beach, Calif.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Differential Analyzer Separates Pulse Groups



This single-channel differential analyzer, for use in scintillation spectrometry, proportional counting and similar applications, is constructed to ORNL Specification Q1192. Model 695 is a differential pulse height analyzer for separating groups of pulses of varying amplitudes. The instrument passes on to the output only those pulses whose peaks fall between two predetermined amplitude levels and rejects all other signals.

Input signal consists of positive pulses from 0 to 100 v. Rise time is 0.2 μ sec; resolving time is 0.5 μ sec. Channel width is variable from 0 to 5 v by a 10-turn 0.1% helical potentiometer.

The Victoreen Instrument Co., Dept. ED, 4800 Hough Ave., Cleveland 3, Ohio.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

Line Voltage Regulator

Heavy Duty, 0.5 Per Cent Regulation

Type 75-113-0 line voltage regulator is an all-magnetic 3 kva regulator for use with 115 v, 400 cps single-phase and 3-phase military ground support equipment. Regulation is held within ± 0.5 per cent against line changes between 100 to 130 v, load changes from 2.5 to 25 a, and frequency changes between 380 and 420 cps.

Magnetic Research Corp., Dept. ED, 3160 W. El Segundo Blvd., Hawthorne, Calif.

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Torque Measuring System

Shaft-mounted Pick-up



This torque measuring system eliminates need for trunion mounted dynamometers. It is applicable to electric motor testing, or shaft and transmission testing. Air propeller shaft torque is proportionate to viscosity. The system features a shaft mounted torque pickup coupled to a digital indicator. Overall system accuracy is coordinated to 0.25 per cent. The system is available in eight different capacities, ranging from 100 lb-in. to 3000 lb-in. Indicator can be provided with coded digital outputs for connection to computers or remote recording stations.

Performance Measurements Co., Dept. ED, 15301 W. McNichols Road, Detroit 35, Michigan.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Slide Rule Calculator

For Communications Systems Use

Known as the Glennite communication system calculator, this multiple slide rule has been designed to assist the communications systems engineer in establishing the basic parameters of a one-way radio communications system. The calculator incorporates such independent variables as transmitting frequency, receiver bandwidth, receiver input noise figure, receiver input signal, transmitter power output, path loss, total antenna gain, total path distance, horizontal ray altitude.

Gulton Industries, Inc., Nuclear Instrumentation Div., Dept. ED, 212 Durham Ave., Metuchen, N.J.

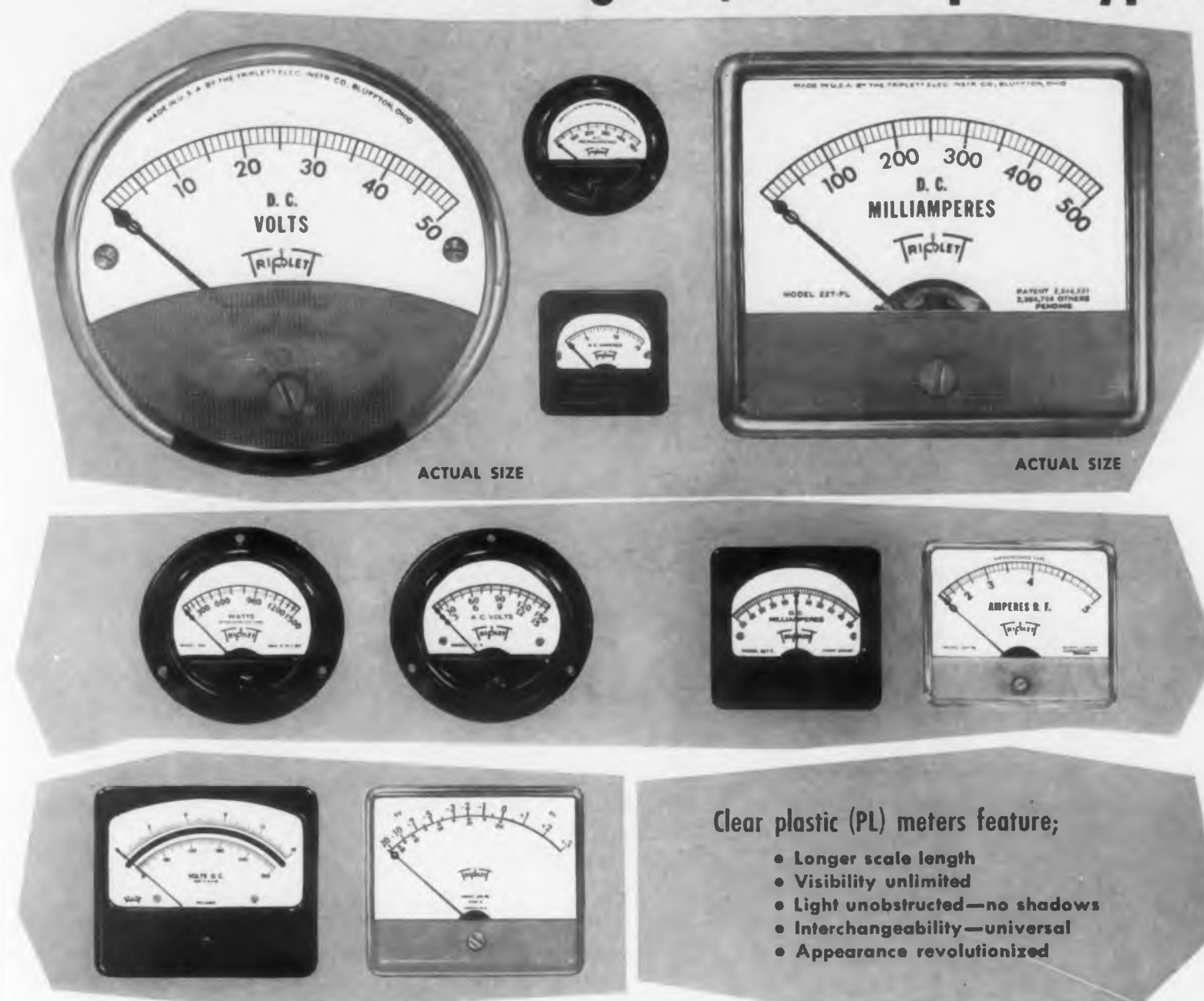
CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

TRIPLET

Reliability...

through 15,631 accepted types



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* TRIPLET 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.

TRIPLET 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 117 ON READER-SERVICE CARD FOR MORE INFORMATION

TAKING STOCK IS GOOD BUSINESS

If you're in business, you take inventory at least once a year. It's essential to the health of your business to know where you stand. But have you taken stock of yourself recently? Do you know where you stand when it comes to cancer?

A once-a-year health checkup can tell you. The chances of curing cancer are far greater when it is detected early and treated promptly. Living proof are the 800,000 Americans who *have been cured*.

Yet lung cancer now kills 24,000 men annually...eight times as many as twenty years ago. And thousands of these deaths could have been prevented *if the cancer had been diagnosed early and treated promptly*.

That's why it's vital for every man to have a health checkup every year, including a chest x-ray. Further, if a cough or hoarseness lingers for more than two weeks — one of cancer's danger signals — an immediate visit to the doctor is indicated.

Give yourself the same break you give your business. Take that personal inventory regularly — have a health checkup every year.

AMERICAN
CANCER
SOCIETY

New Products

Rotary Solenoids Solder Terminals



These rotary solenoids with solder terminals eliminate a secondary terminal normally required with pig-tail type leads, as well as the necessity for splicing to coil leads. Terminals are compression glass insulated thereby providing high resistance to tensile and impact shocks.

G. H. Leland, Inc., Dept. ED, 123 Webster Street, Dayton 2, Ohio.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Heavy Duty Synchronous Motor 40 in.-oz Torque

A new reduced size heavy duty synchronous motor with a torque rating of 40 in.-oz at 1 rpm is available with speeds of 1/2 to 360 rpm through gearing, and 1800 rpm direct drive. The motor starts instantly with full load at rated torque and will operate continuously with a maximum temperature rise of 45 C above ambient. Housed in a stamped steel case, it measures 2-1/2 in. diam x 1-3/4 in. depth. Operative in any position, the motor can be stalled indefinitely without damage to the coil.

Hurst Tool & Mfg. Co., Dept. ED, Princeton, Ind.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Readout Accurate and Fast



The unity ratiometer has wide application with dc analog computers, and is especially designed for ease of operation and simplicity of readout. The high-speed readout includes an automatic polarity indicator. Models UV-100 and RV-1, have accuracies of 0.05 and 0.1 per cent respectively.

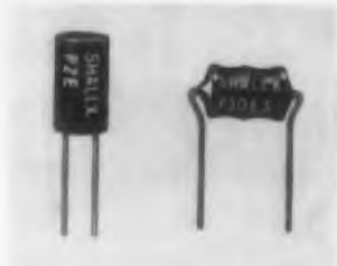
Servonics, Inc., Dept. ED, Alexandria, Va.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

Miniature Wirewound Resistors

For Printed Circuits



Two miniature precision wirewound resistors, designed to meet the size and mounting requirements of printed circuits, are available in fixed non-inductively wirewound types sealed in epoxy resin and suitable for operation in ambients up to 125 deg C. The distance between leads is closely controlled for manual or automatic insertion in printed circuit boards. The P-2 resistor is 27/64 in. long and 13/64 in. diam. Resistances to 200K with tolerances to 0.1 per cent available. The power rating for 1 per cent tolerance has been tentatively established at 0.3 w for a 125 C ambient.

Shallcross Manufacturing Co., Dept. ED, Collingdale, Pa.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION


Ferrite Load Isolators
 Miniaturized Series

This series of smaller ferrite load isolators offers savings in size and weight without sacrifice of previously high electrical characteristics. Illustrated is a miniaturized ferrite load isolator 1 in. long, weighing only 9 oz. and giving more than 10 db isolation over a band width of 8500-9600 mc with less than 1 db insertion loss while operating at 100 kw peak and 100 w average power. The isolators provide a compact solution to long-time and other magnetron loading problems.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd., Los Angeles, Calif.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

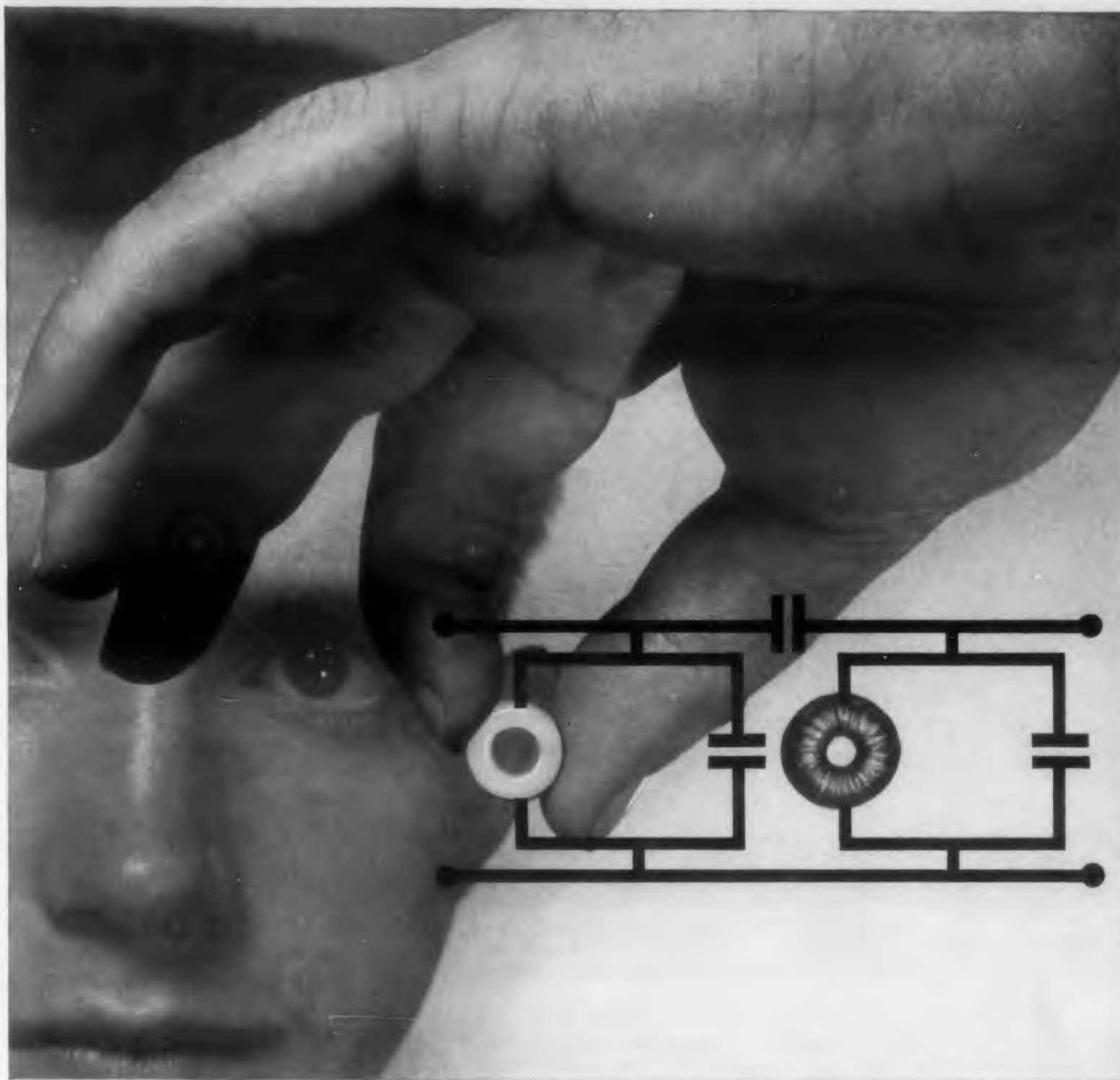
Encapsulated Transformers

Miniaturized; 100 C Operation

These 400 cps transformers are designed to operate continuously in ambient temperatures of 100 C. The line features filament and power transformers with contour molding in epoxy resin and grain-oriented steel for miniaturization.

Sterling Transformer Corp., Dept. ED, 297 N. 7th St. Brooklyn 11, N.Y.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION


**Now you can use molybdenum permalloy powder cores
 in miniaturized circuits**

When your engineering neighbor talks about "Cheerios" these days, he's apt to be discussing a new breakfast cereal-sized molybdenum permalloy powder core which has found a happy niche as a miniaturized filter component. Guided missiles, which are filling the troposphere these days, typically use these little fellows in their amplifier circuits. Small (down to .300-in. ID), they are tough and easy to use. They also provide a markedly high degree of stability with time, temperature and magnetization.

Made by Magnetics, Inc. (Performance-Guaranteed, of course) they provide the highest permeability and lowest core losses possible in use in filter, audio and carrier frequency circuits. We provide extras, too—you may specify our very

exclusive feature—color-coding. Color-coding tells your assemblers how many turns to put on your cores without the lost time and extra expense of special testing.

Want more facts? There's a brand new bulletin (PC-103A), full of important information. It's yours by writing Magnetics, Inc., Dept. ED-35, Butler, Pennsylvania.

MAGNETICS inc.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION



● U.S.G. specializes in difficult moldings involving precision tolerances, intricate shapes, delicate wall sections, inserts, molding around metallic structures, etc.

They are equipped with unusual "know how" gained as pioneers and leaders in fluorocarbon plastics fabrication, and the most modern facilities and techniques for cold molding and sintering of TEFLON*, and the injection molding of KEL-F† (as well as nylon, polyethylene, polystyrene and other plastics) in large and small production quantities.

Send us your difficult fluorocarbon molding problems for quotations. They may not be difficult at all for us. Turning them out in our regular stride can mean improved quality at considerable savings in cost.

And call upon us, too, for your requirements of fluorocarbon plastic and nylon sheets, discs, tape, rods, tubing, bars, cylinders, etc. from the world's largest and most complete stocks.

Write for literature and quotations.

United States Gasket Company
Camden 1, New Jersey

*du Pont Trademark
†Minn. Mining & Mfg. Trademark

United States Gasket *Plastics Division*

OF THE GARLOCK PACKING COMPANY
CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Tube Magnetic Shields

Fits 7 and 9 Pin Sockets



Fitting all 7 and 9 pin vacuum tube socket assemblies, this shield virtually prevents all outside magnetic interference. The Co-Netic shielding material used is insensitive to shock and may be worked or transported without affecting its magnetic shielding qualities. It also does not retain residual magnetism nor require periodic annealing.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 No. Elston Ave., Chicago 22, Ill.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire Clips

Easily Attached

The Cradleclip wiring system consists of binders and extensible clips for unsupported wiring, and cradles with extensible clips for anchored wiring. The binders and cradles are moulded from tough Nylon and are virtually unbreakable. The extensible clips are of moulded Neoprene which combines the right degree of toughness and flexibility to hold any type cable securely and without damage. Ideal for service in all climatic conditions with a temperature range of -60 to $+100$ C. Cradleclip wiring system is reported to take 5 sec for each fixing point.

Electrovert Inc., Dept. ED, 489 5th Ave., N.Y. 17, N.Y.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Relay

60 Operations Per Sec



Model DT-100 spdt 1-a, 115 v ac switch is hermetically sealed in hydrogen atmosphere with platinum contacts wetted in clean mercury to provide trouble-free operation. Sixty operations per sec possible. No contact bounce or maintenance.

Hamlin, Inc., Dept. ED, 1316 Sherman Ave., Evanston, Ill.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

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 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 tested at 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 130 ON READER-SERVICE CARD

DELIVER

YOUR
PROJECT
ON TIME



with
EECO
COMPUTER-SERIES
PLUG-INS

Originally developed for EECO custom systems and proven in critical use, new EECO Computer-Series Plug-ins represent a refinement of the building-block concept to a degree hitherto unknown. Each of the full line of reliable, tested, and proven circuits is a complete off-the-shelf packaged function, performance-engineered for application where ultra-conservative design at the component level is essential because of system complexity.

New EECO Computer-Series Plug-ins enable you to meet your project delivery schedules by reducing systems-development time to a bare minimum and practically eliminating drafting and layout time. Your engineers can concentrate on system design instead of routine circuit detail. Your technicians can cut fabrication time and step up production by performing simple point-to-point wiring instead of wiring complex circuits. And system prototypes can generally be built directly without need for the "breadboard" stage.

Detailed information on
Computer-Series Plug-ins,
Standard-Series Plug-ins,
Systems Development Racks,
Power Supplies,
D-C Amplifiers
...and other EECO products
is available in
Catalog No. 856-A.
Write for your copy—today.

ENGINEERED ELECTRONICS COMPANY
(formerly EECO Production Company)



a subsidiary of
Electronic Engineering Company
of California

506 EAST FIRST STREET
SANTA ANA, CALIFORNIA

CIRCLE 131 ON READER-SERVICE CARD

I-F Transformers

Small Size



These i-f transformers are being manufactured for transistorized circuits in sizes of 3/4, 1/2 and 3/8 in. All are engineered and mass-produced to meet any specific requirements of unloaded Q, ranging from 40 to 200 for the 3/4 and 1/2 in. sizes, and as high as 140 for the smaller 3/8 in. size.

Radio Industries, Inc., Dept. ED, 5225 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

Standardized RF Chokes

for PC Boards

Inductance values of a series of standardized radial lead coils range from 0.47 to 10,000 μ h. Each coil is hermetically encapsulated in molded alkyd plastic; all coils easily conform to MIL specs. The body mold is flattened at the lead exit to permit secure placement of coils on printed circuit boards. The radial leads are suitable for either automation equipment or hand insertion. Leads are spaced at 0.1 in. increments. The radial lead coils are stock items. Delivery is made off-the-shelf.

Delevan Electronics, Dept. ED, East Aurora, N.Y.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

HV Capacitors

Ceramic Cases



These ceramic-cased capacitors now replace a former line of glass-cased capacitors with marked improvement in resistance to thermal and mechanical shock. The ceramic surface provides outside identification markings which are extremely legible and resistant to wear. Capacitors are designed for use in high-voltage power supplies, video coupling circuits, and energy storage systems where compactness and reliability are needed.

Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York 56, N.Y.

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW

precisioneered

HYCOR

ENCAPSULATED

TOROID

COILS

Freeze them . . . boil them . . . expose them to extreme mechanical shock . . . HYCOR Type "P" Plastic Encapsulated Toroids maintain their precision performance through it all. Hermetically sealed in an extra-tough plastic compound, they stand up under:

- Temperatures of -55°C . to $+125^{\circ}\text{C}$.
- 95% humidity . . . boiling salt water
- Amazing degree of mechanical shock
- MIL-C-16923, Type C, specification tests

Easily mounted or stacked on a single screw. High quality turret terminals can be used to mount other components. Ideal for chassis mounting. Also available cased and unencapsulated.

WRITE FOR BULLETIN STP.



INTERNATIONAL RESISTANCE COMPANY

HYCOR DIVISION

12970 Bradley Ave., Sylmar, California

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION



this man knows what's **INSIDE**
his **BLACK BOX FILTER**

He's taking advantage of a new trend spearheaded by Sprague toward unitized filter assemblies. Sprague's individual cylindrical filter elements can be taken from the shelves, wired in any configuration which available space dictates, and used! Black boxes, when used at all, serve only as "wrappers".

Now many of your most complex r-f interference problems can be solved in this way. It reduces inventory problems and cuts your manufacturing costs. Order the elements and package them yourself in your system, or else Sprague can do the packaging for you.

Even if unitized filter assemblies do not add up to the answer to your

problem, you're sure to benefit from Sprague's library of more than four thousand proved filter designs... three laboratories for filter research and development... complete facilities for interference measurement and control... field consulting service... and mass production facilities on the East and West Coasts.

If you, too, have an interference problem, pick up your phone and call your nearest Sprague Electric Field Engineering Laboratory. They are located at 12870 Panama Street, Los Angeles 66, Calif. (TEXas 0-7531); 224 Leo Street, Dayton 4, O. (ADams 9188); 347 Marshall Street, North Adams, Mass. (MOhawk 3-5311).

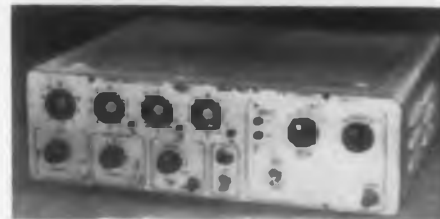
see **SPRAGUE**® for filters

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Frequency Indicator and Counter

Indicates CPS, Kc or RPM



Model 7340C frequency indicator and counter is a low-cost instrument easily operated by non-technical personnel. The input signal (photocell, tachometer generator, or flowmeter) is counter during a known time base (0.1, 1, 10 sec) and displayed, with automatic decimal point location, in cps, kc, or in rpm with proper transducer.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

Electro-Magnetic Clutches

Coupled When De-energized



These reverse acting electro-magnetic clutches and clutch brakes differ from the conventional types in that the input and output shafts are coupled when the coil is de-energized. Energization of the coil uncouples the shafts and applies the brake to the output shaft if a brake is required. Braking surfaces are flat and are rated at 8 oz in. minimum torque.

Sterling Precision Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N.Y.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Polystyrene Capacitors

Zero Temperature Coefficient

Special types are available with zero temperature coefficient and stability of 0.008 per cent. Other coefficients are available, such as -40 ppm per deg C. The line includes any capacitance value from 0.05 μ f up, with a tolerance of 0.1 per cent in any solder

FOR SMOOTH, CONTINUOUS LINE VOLTAGE CONTROL OF HEAT, LIGHT, POWER, SPEED

Adjust-A-Volt

TYPE 100 BU
VARIABLE TRANSFORMER



• **COMPACT** •
EASILY MOUNTED

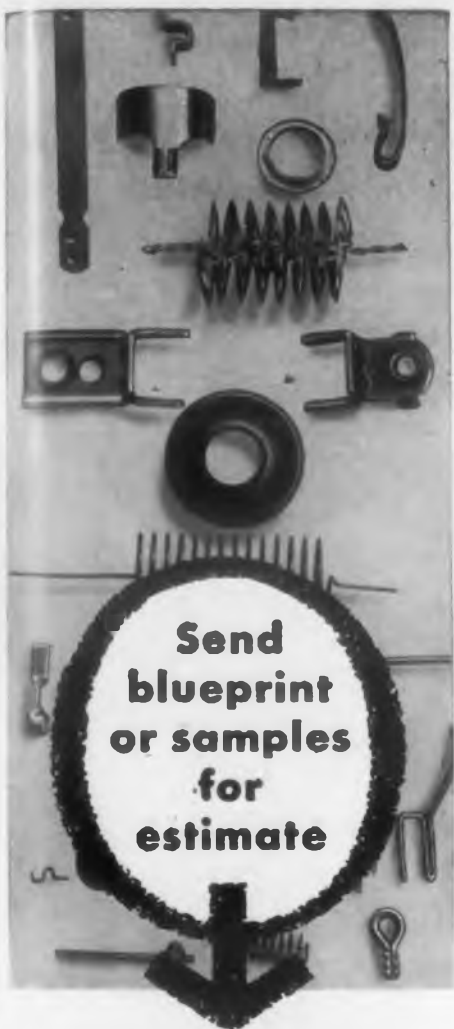
This highly efficient transformer is designed for single-hole, back-of-panel mounting for variable AC voltage control of up to 165 VA applications.

The 100 BU features the LoRes alloy-plated brush track to assure long life and low maintenance by eliminating commutation surface oxidation and deterioration. Its specially designed rotor spring provides uniform pressure from full-brush to no-brush condition. It also incorporates a new snap-in brush design. This compact transformer, which delivers any output from zero to 17% above line voltage, contains high-performance strip silicon steel core. Coils are bank-wound on toroidal machines of our own design and manufacture.

To control larger amounts of power, our compact 300 BU is also available with a maximum load rating of 0.4 KVA. Write for the complete Adjust-A-Volt catalog. There's no obligation involved, of course.

STANDARD
ELECTRICAL PRODUCTS CO.
2240 E. THIRD ST., DAYTON, OHIO

CIRCLE 139 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 140 ON READER-SERVICE CARD

sealed metal container. Units for ac operation with silicone impregnated range up to 20 kv. Standard types in CP70 cans, bathtub either adjustable or fixed, or metal tubulars in very small sizes are available with temperature coefficient of -100 ppm per deg C and stability of 0.04 per cent from stock.

Melray Electronics Mfg. Corp., Dept. ED, 38 Austin St., Worcester, Mass.

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Flat-faced CRT

Face has Uniform Thickness



An improved version of the 3UP1, this small-sized cathode ray tube features a two-piece bulb design permitting the flat faceplate to have a uniform thickness. The tube has a phosphor screen size of $1\frac{1}{8} \times 1\frac{3}{4}$ in., electrostatic focus and deflection, $1\frac{9}{16}$ in. neck diam, $7\frac{1}{2}$ in. tube length with a standard 12-pin base. For use as a display indicator, the 3UP1 can be made available with various screen colors and persistances.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Saturable Reactors

High Sensitivity



These saturable reactors have high permeability magnetic cores with high sensitivity. Six ampere turns will control nearly 2000 w in the largest of these standard reactor assemblies. Power outputs range from 50 to 2000 w, with only 2 a turns being required for control of the smallest unit.

Control, Div. of Magnetics, Inc., Dept. ED, Box 391, Butler, Pa.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION



YOU TOO CAN REDUCE REJECTS!



Anton Machine Works, Brooklyn, manufacture magnetron anodes for radar, Geiger counter, X-ray and transmitter tubes.

PROBLEM: Minute burrs must be precisely removed from magnetron anodes... without altering contours. Accurate deburring is absolutely essential to eliminate deflections that change tube frequency.

SOLUTION: Operators use AO Spencer Stereoscopic Microscopes to effectively view and remove burrs with a small scalpel.

RESULT: Rejects practically eliminated. Productivity substantially increased.

You, too, may have a deburring problem... or other problems involving surface quality, measurements or assembly of small components. If so, why not investigate the most modern... versatile... and complete line of Stereoscopic Microscopes.

American Optical
Company

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK

DEPT. W219
GENTLEMEN:

Please rush new Stereoscopic Microscope brochure 5856.

NAME _____

ADDRESS _____

CITY _____

ZONE _____ STATE _____

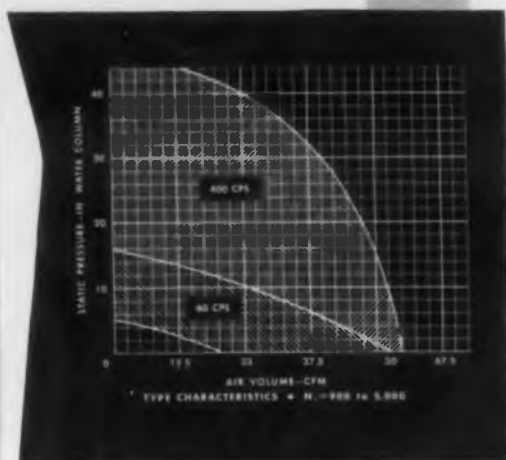
CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

Model M Multistage Blowers

...16" of water at 3300 RPM



- Suction or Pressure
- Optional Air Filters
- Weight: 9-12 lbs.
- Blower: 8¼" Max. O.D.
- 13" Max. Length



- Applications:
- Computer Tape Slack Control
- Multiple Tube Seal Cooling
- Multiple Remote Spot Cooling
- Microwave Cavity Pressurizing
- Plot Chart Paper Stabilizing
- 60 CPS or 400 CPS
- 1Ø or 3Ø
- Commercial and Military Specs.
- Model M also supplied in duplex combination with squirrel cage blowers as shown.



ROTRON MFG. CO., INC.

SCHOONMAKER LANE • WOODSTOCK • NEW YORK

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Precision Film Resistor

Operates at 150 C



Series 77 metal film resistors can be used at 1/4 w rating in an ambient of 150 C, or up to 1/2 w at 105 C. Temperature coefficient of resistance is 0 ± 30 ppm per deg C over -55 to $+150$ C regardless of resistance value. Temperature coefficients of 0 ± 20 ppm per deg C can also be provided. Resistance range available is 100 ohms to 300 K. Standard tolerance ± 1 per cent; tolerances of ± 0.5 or ± 0.25 per cent can be supplied.

Ohmite Manufacturing Co., Dept. ED, 3657 Howard St., Skokie, Ill.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Multipurpose Slip Rings

For AC, DC, and RF



Multipurpose slip rings for ac, dc, rf, and for aircraft, marine and ordnance purposes, can be incorporated in water tight, explosion proof, or standard enclosures. This design features quick removal of the armature without brush disassembly. Special slip rings can be made to customer requirements.

Electro Mechanical Co., Dept. ED, 32700 Ford Rd., Garden City, Mich.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire-Wound Resistors

Vacuum Impregnated

This epoxy-encapsulated wire-wound precision resistor is vacuum impregnated and vacuum cast to eliminate hot spots caused by voids in windings. Designated Series EP, the new line utilizes tension-free winding and meets MIL-R-93A and MIL-R-9444. The resistors are heat cycled before encapsu-

How to Charge HIGH-FLUX Magnets



Day-long production charging in complete safety and comfort.

Use the MODEL 942 Magnet Charger

RECOMMENDED BY LEADING MAGNET MAKERS

This high powered condenser discharge unit will saturate large Alnico and ceramic permanent magnets of any shape, using interchangeable, plug-in pulse transformers or wire-wound fixtures. 100,000 ampere-turn output of basic unit can be increased to 200,000 ampere-turns at any time by adding 100 μ f condenser banks and appropriate pulse transformer. Adapters for multi-pole rotors, rod, bar, ring and various other shapes are available.

Operates from regular 115 volt, 60-cycle line with only intermittent 10-ampere drain (the few seconds when condensers are charging). Mounted on casters for convenient mobility. Price of basic unit with pulse transformer is less than \$2,100.



WE CAN HELP YOU
Our 12 years of magnet charging experience is yours for the asking — send a sample magnet or sketch for free charging analysis.

Write for Technical and Application Data

Radio Frequency LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

CIRCLE 148 ON READER-SERVICE CARD

this is it...



A LIGHT-BEAM

GALVO

RUGGED

Will take
25 G's!

COMPACT

Size: Only 2.6"
x3.62"x3.615"

sensitive

.105 microamps
per millimeter

Here is a new series of light-beam galvanometers that were developed to withstand the extremely severe conditions of shock and vibration encountered in field servicing and testing of jet aircraft.

Through unique folding of the light beam, great compactness is achieved while retaining sensitivity to the highest degree... equal to that of laboratory instruments!

These Howell Galvanometers feature excellent readability. They are readily adaptable to existing instruments. They are competitively priced.

Resistances: 20, 100, 500 and 1000 ohms. Short period; high speed response. Sealed construction.

For full information
please write or wire



HOWELL INSTRUMENT Company
3101 Trinity St. • Fort Worth 7 Texas

SALES-ENGINEERING OFFICES

VALLEY STREAM, L.I., N.Y.: 108 So. Franklin • LO 1-9220
DAYTON, OHIO: 209 Commercial Bldg. • Michigan 4563
CHICAGO, CALIFORNIA: 105 N. Bradfield St. • NE 6-8970

CIRCLE 149 ON READER-SERVICE CARD

lation and post-cured before final inspection, thus resulting in long term stability of resistance under rigid environmental temperature conditions. The series has an operating range from -65 to $+125$ C and a temperature coefficient of ± 0.00002 C.

Kelvin Electric Co., Dept. ED, 5907 Noble Ave., Van Nuys, Calif.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

Mylar Metallized Capacitor

Reliable to 125 C



This Mylar metallized capacitor, Type RQL, in a hermetically sealed case is extremely reliable at temperatures up to 125 C without derating. Type RQL is available in a wide range of case styles and constructional variations similar to those from type CPO 4 thru CPO 11 in Mil-C-25A. Electrical specifications of Mil-C-18312, recently issued by the Navy, are met.

Astron Corp., Dept. ED, E. Newark, N.J.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

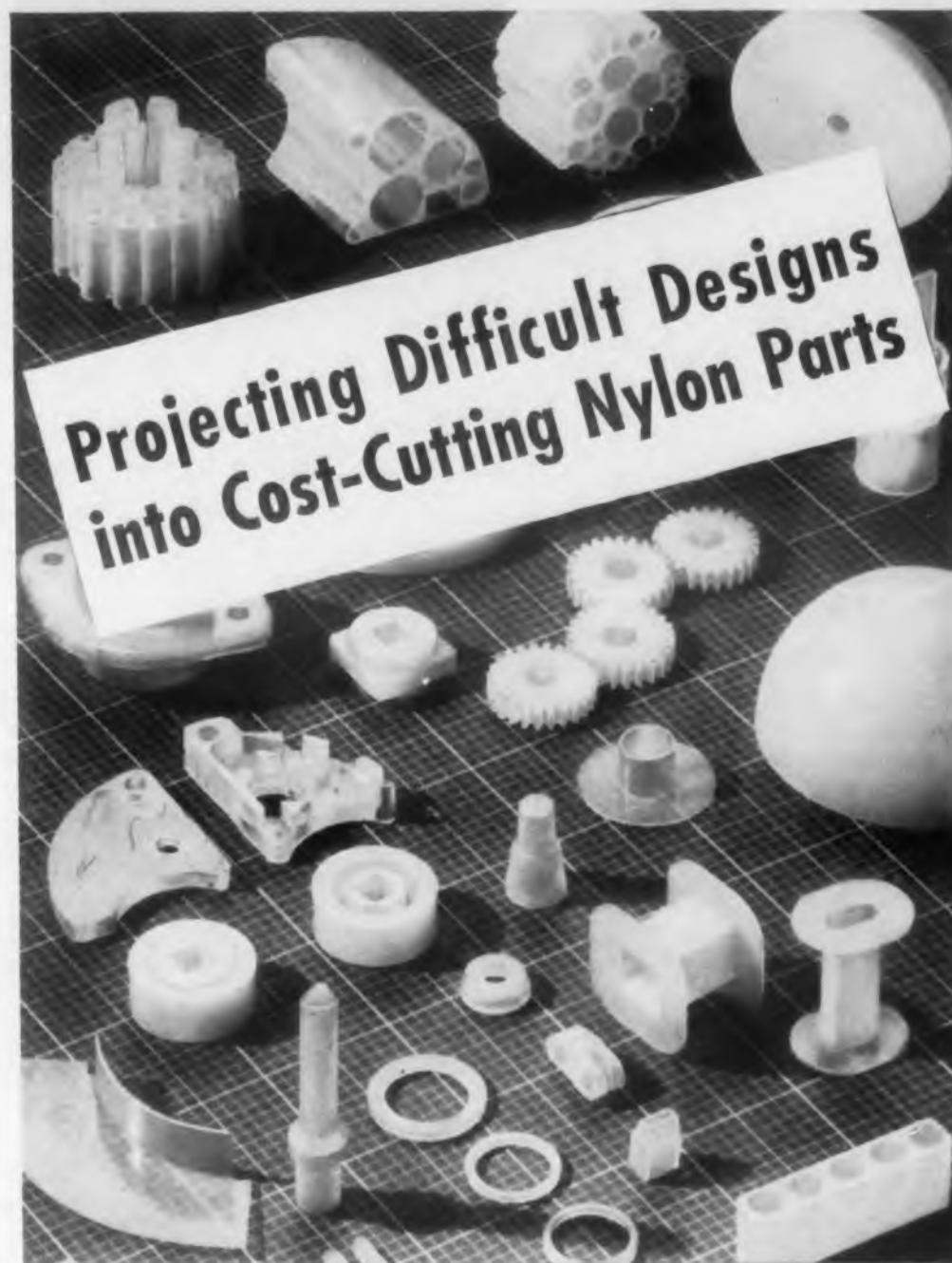
Dc Power Supply

0.001 μ sec recovery

Model 170 is designed to replace storage battery and floater combinations widely used for spectrophotometers, sensitive dc amplifiers and other applications where stability, low noise, and transient requirements are severe. Input is 105-125/210-250 v, 50/60 cps. Output 6 v adjustable ± 5 per cent, 0.5 a; 2 v adjustable ± 5 per cent, 0-100 ma. Ripple and noise at 6 v output is 1 mv RMS max, at the 2 v output this figure is 0.5 mv RMS max. Recovery time of the unit is 0.001 secs (63 per cent). Line regulation for both the 6 and 2 v output is 0.01 per cent maximum, with no load to full load regulation, 0.05 per cent for 6 v output and 5 per cent for 2 v output.

American Electronic Laboratories, Inc., Dept. ED, Philadelphia, Pa.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION



Bring us your difficult Nylon parts problems. U.S.G. specializes in difficult precision moldings—produces them by injection molding in volume production with accompanying cost economies.

Produces them in Chemiseal Nylon (du Pont Zytel) which has the highest compressive strength, is the most rigid, has the best resistance to heat, abrasion, chemicals, solvents, oils and greases—and is the lowest priced of the standard Nylon compositions.

Whatever your Nylon part requirements, check your methods and costs with U.S.G. "Know-how."

Or if your requirements are extruded stock—U.S.G.'s new ultra-modern Extrusion Plant offers bubble-free Nylon rod in diameters up to 3"; Nylon sheet and tape 12" wide in thicknesses from .002" to 1/8"; Nylon pressure tubing from 1/8" to 1/2" O.D. in two types—for 1000 psi and 2500 psi.

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

also
A COMPANY IS KNOWN
... BY THE FACILITIES IT KEEPS



FLUSHING, N. Y., PLANT NO. 1

FLUSHING, N. Y., PLANT NO. 2

East to West... Flushing, New York, to Culver City, California

On Filtron's Staff: Engineering specialists in component design, development and production. . . **In Filtron's Plants:** The most modern and completely equipped laboratories for research and testing, to MIL specifications; high speed quality manufacturing

and assembly. . . **In the Field:** Competently staffed mobile engineering laboratories to solve problems on-the-job at complex electronic installations.

From
FILTRON'S
5
PLANTS

- RF INTERFERENCE FILTERS
- RF FIELD ENGINEERING SERVICE
- RADAR PULSE PACKAGES
- PULSE FORMING NETWORKS
- SPECIALTY CAPACITORS
- DELAY LINES

Send for our catalog



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CULVER CITY, CAL., PLANT NO. 1



CULVER CITY, CAL., PLANT NO. 2

FILTRON IS KNOWN FOR ITS PRODUCTS... THE FACILITIES WE KEEP EXPLAIN WHY

REPRESENTED IN CANADA BY: AIRCRAFT APPLIANCES & EQUIPMENT LTD.
 585 Dixon Side Road, Toronto

FILTRON COMPANY, INC.
 FLUSHING, LONG ISLAND, NEW YORK
 PLANTS IN FLUSHING, NEW YORK, AND CULVER CITY, CALIFORNIA

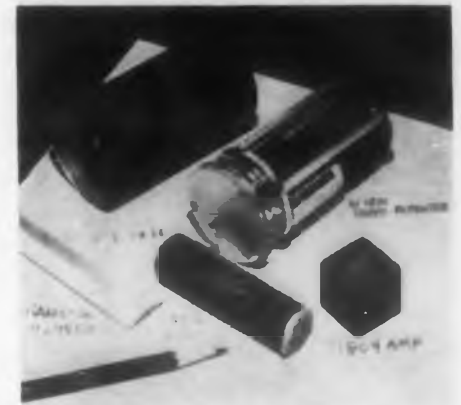


TWO OF FILTRON'S COMPLETELY EQUIPPED MOBILE LABORATORIES

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Servo Repeater System Weighs 2 Oz.



Model W1801 servo repeater system includes a transistorized servo amplifier, motor synchro, power supply and gear train, all in a housing 2 in. in diameter by 4 in. long. Power supply requirements are 10 w, 400 cps, at either 115 v or 26 v. Total weight is 12 oz. The transistorized servo amplifier is available separately, in a long case for minimum mounting surface, or in a 1-in. cube for minimum volume. Weight is 2 oz. The amplifier includes a 90 deg phase shaft required for two-phase induction-type servo motors, therefore no external capacitors are required.

Waldorf Instrument Co., Dept. ED, Wolf Hill Rd., Dix Hills, Huntington Station, N.Y.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltmeter and Calibrator Null-Type Measurement of AC



Combined in this instrument called the Voca, is a precision differential null type potentiometric voltmeter for both ac and dc, and a vtvm calibrator. The null-type measurements can be applied to sine wave voltages, and dc and square wave voltages are supplied as accurate reference standards. The Voca is designed as an aid for production line testing, as well as for the laboratory.

Demolab Corp., Instrument Div., 1550 N. Highland Ave., Hollywood, Calif.

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CIRCLE 350 ON READER-SERVICE CARD ->

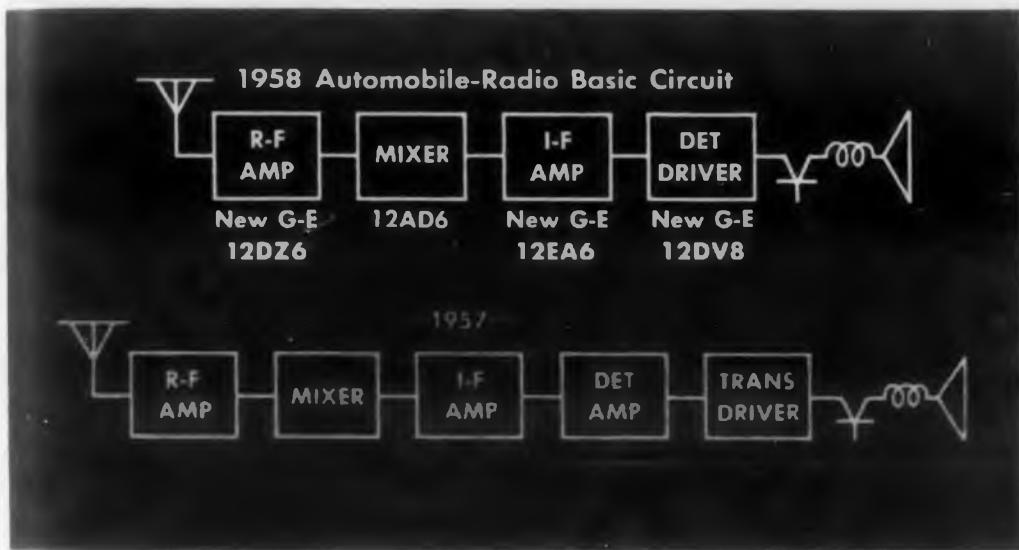
ELECTRONIC DESIGN • November 1, 1957

TUBE DESIGN NEWS



FROM THE RECEIVING TUBE DEPARTMENT OF GENERAL ELECTRIC COMPANY

Three New General Electric Tubes Cut Automobile Radio Costs, Simplify Circuitry, Improve Reception



Two years' creative design and development by G-E tube engineers, who worked in close cooperation with the major manufacturers of automobile radios, stand back of three new high-gain tubes that make 1958 car radios more economical to build, with fewer sockets. From the time 12-volt vibratorless radios appeared, frequent conferences between car-radio designers and G-E tube engineers have called into play the latest and best in tube thinking. The G-E 12AF6 was one important outcome. This was 1956's largest-selling new receiving tube!

Now . . . a year later . . . General Electric promotes still higher standards of car-radio performance with Types 12DZ6, 12EA6, and 12DV8. Phone any G-E tube office on the next page for full information.

EXTRA-SENSITIVE PERFORMANCE IN 1958 CAR RADIOS—YET FEWER TUBES!

A G-E 9-pin miniature detector-driver tube now does the work of both the detector-amplifier and transistor-driver tubes formerly used. At the same time, new high-gain G-E r-f and i-f amplifier tubes materially increase sensitivity, for clearer reception.

Noise Rejection is Design Feature of G-E Twin Pentodes 3BU8 and 6BU8

Showing by their performance how up-to-the-minute tube engineering can benefit the TV manufacturer—reduce his costs, improve picture quality—General Electric's 3BU8 and 6BU8 are thrifty multi-function tubes that within a single envelope, perform both noise-cancellation and AGC functions.

Turn page to study the recommended application of these tubes! Oscilloscope readings are included—also plate-characteristics curves—in order to aid television circuit designers.

35,000,000th 5-Star Tube Milestone in High Reliability



RIGHT: R. M. Duncan, manager of General Electric's Owensboro, Ky., tube plant (second from right), and two of his staff inspect the 35,000,000th 5-Star high-reliability tube, a 6X4, which has just passed its initial electrical-characteristics tests. Record high total for use tubes proves their wide use in critical military, airborne, and industrial applications.

Tear off and keep this sheet for reference. It contains useful tube-application data

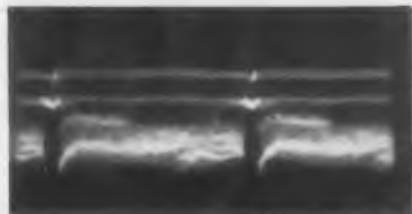
Developed and designed by G.E., Types 3BU8 and 6BU8 are twin pentodes that provide outstanding low-noise performance, with economy. The two tubes are identical except for heater ratings (3.15 v, 6.3 v). Also, the 3BU8 has controlled heater warm-up for service in 600-ma series-string circuits.

Cathode, Grid No. 1, and screen grid are common for both sections of the 3BU8 and 6BU8. Use of a

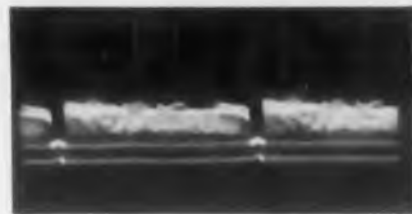
common No. 1 grid makes possible the rejection of noise pulses from both tube sections. The recommended application for these G-E twin pentodes is: one section, AGC keyer or amplifier . . . the other section, combined sync amplifier, separator, and clipper.

Reproduced below from photographs, are scope readings of tube performance, element by element, in this recommended application.

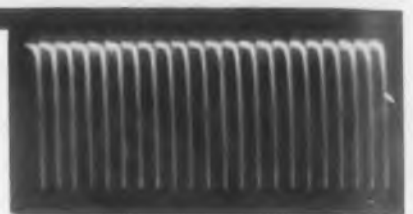
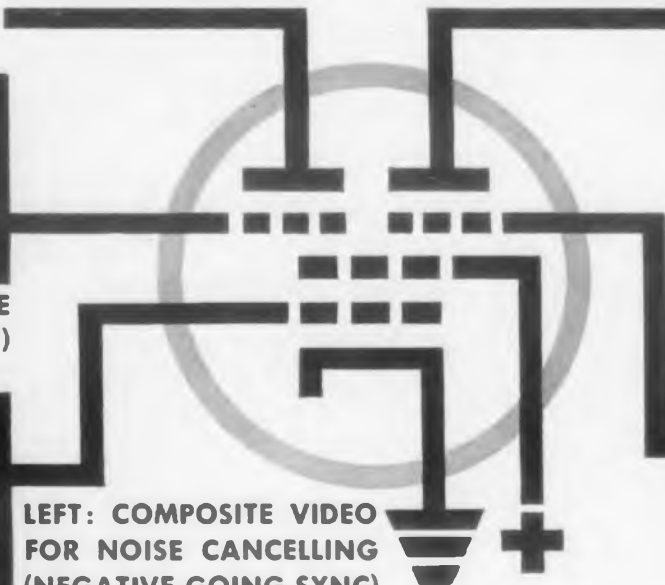
AGC VOLTAGE OUTPUT



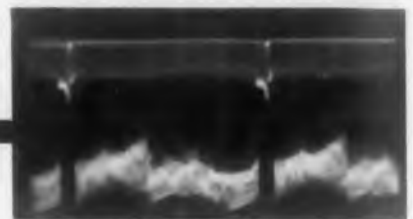
DIRECT-COUPLED COMPOSITE VIDEO (POS.-GOING SYNC)



LEFT: COMPOSITE VIDEO FOR NOISE CANCELLING (NEGATIVE-GOING SYNC)

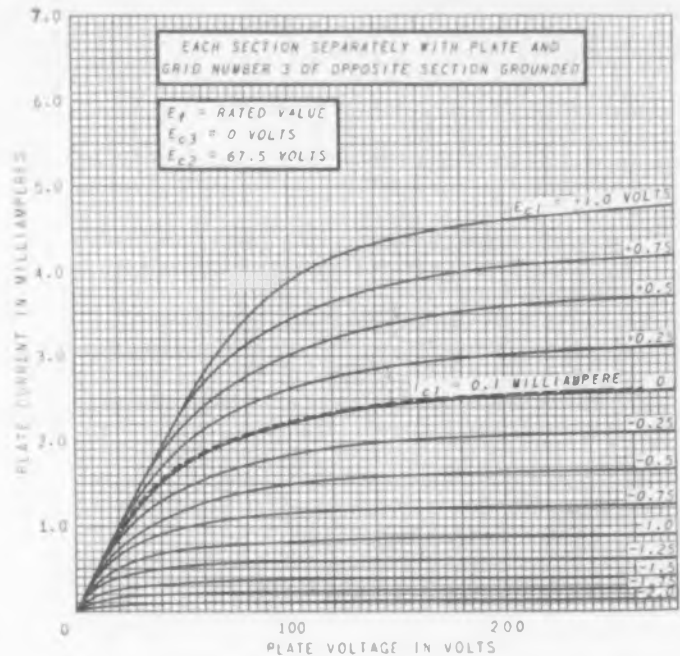
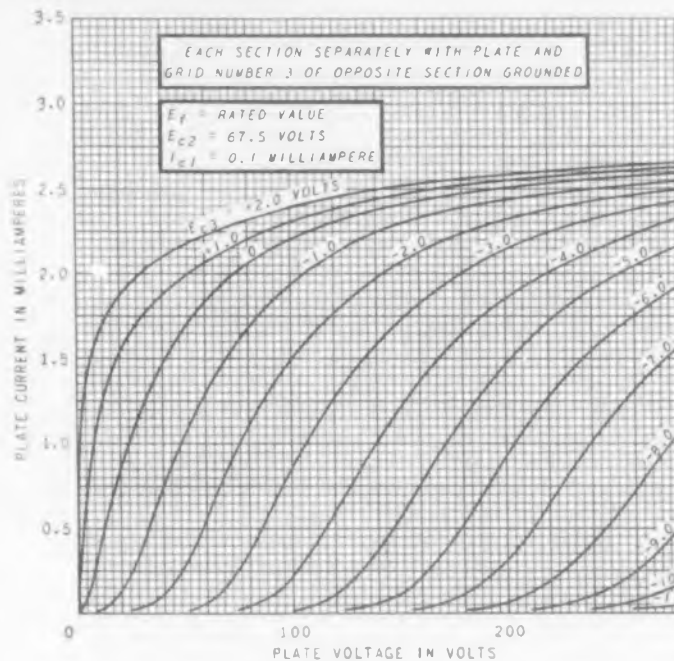


SYNC PULSE OUTPUT



COMPOSITE VIDEO

SHOWN BELOW ARE AVERAGE PLATE CHARACTERISTICS, TYPES 3BU8 AND 6BU8



For further information, write or phone your nearest G-E tube office below:

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 Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-B 16

Progress Is Our Most Important Product



RECEIVING TUBE DEPARTMENT, GENERAL ELECTRIC COMPANY, OWENSBORO, KENTUCKY

Precision Power Resistor
Range of 1 to 900 Ohms



Rated at 2.5 w at 70 C, resistance range of the type P-1 power resistor is from 1 to 900 ohms. It meets the requirement of MIL-R-26C, Style RW 59, Characteristic G. One per cent is the standard tolerance but the resistor is available in tolerances down to 0.1 per cent on special order. Length is 1/2 in.

Mepco, Inc., Dept. ED, Morristown, N.J.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Spectrum Analyzer
Stability of 2 Per Cent



This unit analyzes any complex electrical waveform continuously within its frequency range and presents a readout showing the frequencies included in the waveform and the amplitudes of each of the frequency components. Waveforms may be continuous or discontinuous. The analysis is performed over successive 10 sec periods. Readout is a bar graph. Long-term stability is better than 2 per cent. Filter and integrator circuits are set at factory, and require no readjustment.

Edin Co., Inc., Dept. ED, 207 Main St., Worcester S, Mass.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 350 ON READER-SERVICE CARD

ELECTRONIC DESIGN • November 1, 1957

HOW TO ADD TO THE Saleability OF MANY ELECTRICAL PRODUCTS

- ... Instruments
- ... Appliances
- ... Small Motors
- ... Radio, TV.

Audio Equipment

TO ENGINEERS, Stackpole Slide Switches in more than a dozen inexpensive types offer many interesting design possibilities for improving product performance.

TO BUYERS of today's instruments and appliances, the convenience of unique and attractive modern switching arrangements exerts strong sales appeal that far exceeds the modest cost involved.

Stackpole Slide Switches cover the 1/2 to 3 ampere range. They vary from simple ON-OFF units to types that provide complicated inter-circuit switching in minimum space—often with less costly mountings than conventional switches. *Electronic Components Division, STACKPOLE CARBON COMPANY, St. Marys, Pa.*

DP-DT—"Battery-Line" changeover type

3P-DT Detent Optional

SP-DT 0.75 amp. Spring-return

SP-ST—Pushbutton, Momentary contact

3-Position 0.5 amp. Detent

4-Position with detent

SP-DT—Plunger type, Spring return

SP-DT 4 gangs, common base

SP-DT 3 amps. Detent

3-Position 0.5 amp. Detent

SP-DT 1 amp. Detent

DP-DT 0.5 amp. Detent

3-Position 3 amps. Detent

STACKPOLE

S-L-I-D-E SWITCHES

STACKPOLE
BULLETIN RC-10D

New SLIDE SWITCH DATA

Stackpole Bulletin RC-10D — just out — gives complete ratings, dimensions, modifications, and other specifications for all standard Stackpole Slide Switches. Write for your copy or see your local Stackpole representative

KEY TO CONTACT ARRANGEMENTS

POSITION 1	
POSITION 2	
POSITION 3	
POSITION 4	

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

Question 5a:
**What in the last
 analysis made you decide to
 work at Hughes?**



HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
 SCIENTIFIC STAFF RELATIONS
 Hughes Aircraft Company, Culver City, California

We wanted to find out why we have been so successful in attracting such high-calibre engineers to the Hughes Research and Development Laboratories. So we had an independent research organization ask a 15% random sample of our 2,700 engineers and scientists just what attracted them to Hughes.

Of all the things they look for in a job—of all the things they like about Hughes—these four headed the list:

1. EXCELLENT SALARY. Talk to the engineers in our Research and Development Laboratories, and 55.8% of them will tell you that one of the reasons they came to Hughes was the favorable salary structure. You can choose your electronics career in either the military or commercial fields. *Contact Hughes today.*

2. INTERESTING WORK—with opportunity for advancement. 48.7% of our engineers were attracted, by such rewarding projects as guided missiles, armament control systems, ground radar, microwave tubes and antennas, digital computers, miniaturized communications systems. Sound interesting? *Contact Hughes today.*

3. EXCELLENT WORKING CONDITIONS—coupled with scientific atmosphere, high calibre of associates, and prestige of the firm—is one reason why 34% of our engineers came here. They like the exceptional facilities, unusual freedom, the small project groups headed by top scientists. Is this what you seek? *Contact Hughes today.*

4. PLEASANT CLIMATE. We're pretty lucky at Hughes to work in the wonderful, sunny climate of Southern California—and that's one of the advantages that attracted 28.2% of our engineers... Here carefree living is the order of the day... and beaches, mountains and deserts are practically next door. Envious? *Contact Hughes today.*

A resume of your education and experience will bring by return mail a copy of our interesting new booklet, illustrating and describing the many and varied activities at Hughes.

CIRCLE 551 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Target Acquisition Computer

Less Than 1 Deg Error



Model 8-1101 is a precision analog computer which accepts dc voltages representing X, Y, and Z coordinates and performs transformation to azimuth angle, elevation angle, and slant range. Geographic range is also available as an output signal. Total dynamic and static errors are less than 1 deg.

Dynalysis Development Labs., Inc., Dept. ED
 1194 Wilshire Blvd., Los Angeles 25, Calif.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION



Variable Voltage Transformer

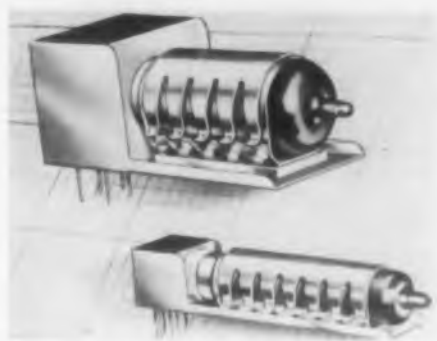
10 to 250 Kva Service

Designed for 10 to 250 kva service for line voltage compensation, or as full range control units with transformation ratings to 100 kva, this line of single unit variable voltage transformers is now available with single or three phase units for operation on 240/480 v. Features of this heavy duty transformer include motorized voltage control drive, which can be remotely controlled if desired; single transformer rather than ganged construction, and extreme ruggedness and reliability. A typical 3 phase line voltage compensation unit will operate on either 230 or 460 v. At 230 v, it will deliver an output range of 230 ± 50 v at 300 a.

M. T. Welding Products Corp., Dept. ED, 03
 37th Ave., Oakland 1, Calif.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Heat-Dissipating Tube Shield For Printed Circuits



These right-angle heat-dissipating tube shield clamps for printed circuit application contain integral sockets for miniature and subminiature tubes. All sockets are of a standard mica filled type cast on to the shield assembly in a mica filled epoxy resin. The epoxy resin withstands continuous operating temperatures of 175 C. Bulb temperature of the tube is maintained to within 5 C of the heat sink temperature per watt of heat-dissipation. Excellent retention, shock and vibration protection in extreme environmental conditions are provided. Socket leads extending through holes near the edge of the printed circuit board are affixed by dip-soldering.

International Electronic Research Corp., Dept. ED, 145 W. Magnolia Blvd., Burbank, Calif.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

Moving Target Simulator Operates in K or Ku-Band



Designed to check radar range tracking circuits, calibrate radar range marker circuits, and perform other tests on either K or Ku-Band radar equipment, this simulator provides a microwave return signal with the same pulse characteristics as the transmitted radar signal. The return signal may be adjusted to have a continuously varying range and then used to check the radar range tracking circuits, and it will also provide a series of fixed range echo pulses which may be used to calibrate the radar range markers in field work or laboratory.

Aircraft Armaments Inc., Dept. ED, Cockeysville, Md.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957



Subminiature Hughes silicon power rectifiers pictured with some of the standard vacuum tubes they replace.

Body diameter: 0.105-inch max.
Body length: 0.265-inch max.

NEW, AT HUGHES LOW-POWER RECTIFIERS WITH HIGH-VOLTAGE CAPABILITIES

Once again, Hughes has supplemented its line of silicon rectifiers—this time, with units rated up to 600 volts yet using the famous Hughes subminiature glass package. Like other Hughes rectifiers, these have the advantages of low forward voltage drop and low back leakage enabling them to handle power values that are large for the size of the rectifier. Features of this kind, combined with exceptional efficiency, make them ideal for electronic power supply applications where they can be used in place of many vacuum tube rectifiers.

Descriptive literature for the entire rectifier series is available upon request. Please write: SEMICONDUCTOR DIVISION • HUGHES PRODUCTS
International Airport Station, Los Angeles 45, California

SPECIFICATIONS

HR10311
Peak Reverse Voltage (E_r) @ $-2\mu A$ 500V @ 25°C
Reverse Current (I_r) @ -450 Vdc 35 μA @ 150°C
Max. Ave. Inverse Current (I_{iav}) @ 315V_{rm}, @ 200mA 20 μA @ 25°C
Max. Ave. Rectified Current (I_o) 200mA @ 25°C

HR10312
Peak Reverse Voltage (E_r) @ $-2\mu A$ 600V @ 25°C
Reverse Current (I_r) @ -550 Vdc 35 μA @ 150°C
Max. Ave. Inverse Current (I_{iav}) @ 385V_{rm}, @ 200mA 20 μA @ 25°C
Max. Ave. Rectified Current (I_o) 200mA @ 25°C
Maximum operating and storage temperature $-65^\circ C$ to $+150^\circ C$
Derate average rectified current 1.5mA/°C above 25°C

The HR10311 and HR10312 have the famous glass package developed years ago at Hughes. This package, still the finest available, is tiny, but sturdy, thereby fulfilling all of the requirements for miniaturization while providing reliable operation under severe conditions of shock and vibration.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

© 1957, HUGHES AIRCRAFT COMPANY



CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

BRAND MULTI-CONDUCTOR CABLE GIVES RCA'S BIZMAC SYSTEMS . . .

- top signal fidelity
- freedom from cross talk



RCA'S Bizmac Business System Units combine to perform foolproof results in business efficiency. Connecting these units are three extremely flexible, abrasion resistant, Turbo-Brand multi-conductor cables, custom manufactured for RCA.

RCA says, "Brand cables transmit signals between our Bizmac units with high fidelity and without disrupting cross talk between signal lines."

One Brand cable (a) transmits a five micro-second pulse "write signal." Low impedance drive allows transmission of signals through 400 feet of balanced lines. The cable has nine twisted pairs of AWG 22 color coded conductors. The shielding of #36 tinned copper wires is braided over the conductor assembly. The over-all jacket is of .030" brown plastic. Another cable (b) transmits "tape control" signals which have a five micro-second pulse with about a three micro-second rise time across the conductors. Each of the 12 pairs of conductors are shielded with a #36 tinned soft copper braid, and the over-all jacket is of .030" red polyvinyl chloride. The other cable (c) transmits "read signals" that resemble a full sine wave whose period is 70 micro-seconds. The 12 twisted pairs of AWG 22 conductors have a tinned copper over-all shielding braided over the conductor assembly. The over-all jacket is of .030" black vinyl plastic.

The accumulated experience of the William Brand & Co., Incorporated Engineering, Research and Production Departments is always available. You are invited to use these services in the solution of any of your wire and or cable problems.

THE WILLIAM BRAND & CO., INCORPORATED

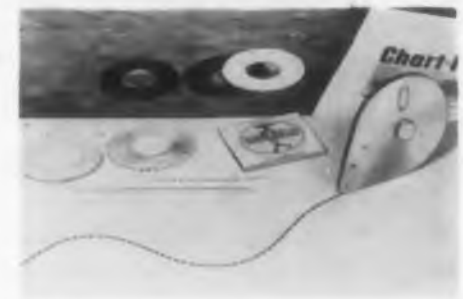
WILLIMANTIC 2 **TURBO BRAND** CONNECTICUT

electrical and electronic wires and cables • harnesses and cable assemblies • plastic and coated insulating tubings • identification markers

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Tape Pen Simplifies Drawings



The Tape-Pen applies a precision-slit printed tape quickly and with great accuracy, following a straightedge, french curve, or in any freehand design. Three bearing points keep it at right angles to the work surface and insure perfectly flat application of the tape. The Tape-Pen and Curve-Line tape are offered as a time-saving method in making layouts and working drawings.

Chart-Pak, Inc., Dept. ED, Leeds, Mass.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION

Computing Transformer High Output



Called the Model 20-C, this device can provide a substantial power output, sufficient in many instances to eliminate power amplifiers. Applications include use in analog computers wherever the product of a voltage and a shaft angle is required, in the control of 2-phase servo motors, and in the supply of power to torque motors.

At an input of 115 v, 400 cps, the output voltage range of the Model 20-C is ± 80 v. Due to low output impedance, a linearity of ± 0.35 per cent is obtained with a 1000-ohm load. With a 2000-ohm load, the linearity is ± 0.18 per cent. Under maximum load conditions, the quadrature component of output is approximately 5 mv per volt of the primary excitation voltage. Basic resolution is 0.13 per cent, and interpolation by a resistive brush permit any required value of output voltage.

Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

Precision Potentiometers

Linearity of 0.5 Per Cent



Available in 5 and 10-turn models, types HC-100 and HC-105 feature side terminals, shorter internal lead length, and lower end resistance. Encased in Grade XX laminated phenolic, they measure 1 in. diam and have a standard linearity of ± 0.5 per cent.

Type HC-100 is rated at 4 w. Its weight is 2.3 oz and standard resistance values range from 500 to 100,000 ohms. Type HC-105, weighs 1.8 oz, is rated at 3 w, and has resistance values ranging from 250 to 50,000 ohms.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Tetrode For SSB

1 Kw Output



Designated the 4CX1000A, this new tube type incorporates the advantages of ceramic-metal construction and high temperature processing. Specifically designed for single side band operation, the tube is a low-voltage, high-current Class AB, RF or AF linear amplifier tube, exhibiting high power gain and exceptionally low distortion characteristics. The 4CX1000A achieves its maximum rated output power with zero grid drive, thus minimizing driver stage design problems and eliminating one source of distortion.

Fairchild-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

D-B SUB-CHASSIS REGULATED POWER SUPPLIES

— compact, rugged units for original equipment and lab. work
— all low priced.

model 4-200X



400 VDC — 200 MA
— excellent regulation

This is a versatile unit built for highly dependable operation. Regulation—for 105 to 125 V line: 100 MV change; NL to FL: 100 MV change. Adjustable by factory from 250 to 420 VDC.

bulletin 1025

model 5-300XA



500 VDC — 300 MA
— adjustable, regulated

Adjustable from 250 to 500 VDC by simple internal changes. Regulation—for 105 to 125 V line: .05% change; NL to FL: .05% change. Size—W: 5"; L: 12 1/2"; H: 5 3/8" above deck.

bulletin 1017

model 3-150XHS



300 VDC — 150 MA
— Mil. Spec components

Dependable power for mobile computers and amplifiers. Excellent regulation and low ripple. Factory adjust 250-425 VDC; pot range 50 volts. Withstands high humidity.

bulletin 1023

model .28-2MX



28 VDC — 2 Amps

A compact, unregulated source of power for operating relays, motors, switching circuits, etc. Size: W: 3 1/2"; L: 9 1/2"; H: 4 1/2" above chassis, 1" below chassis.

bulletin 1026

models 1.5-70X, 2.5-70X, 3-70X



Exceptionally Small Types

—W: 4 1/8"; L: 5"; H: 4 1/4" above chassis; 1 3/4" below chassis. Ripple below 4 MV RMS.

outputs:

150 VDC—70 MA, fixed

(model 1.5-70X)

250 VDC—70 MA* (model 2.5-70X)

300 VDC—70 MA** (model 3-70X)

*adjustable at factory: 220-260V

**adjustable at factory: 240-350V

bulletin 1028

models 1-20X, 1.5-20X, 2-20X



Octal plug-in units

—only 2 1/2" wide; 2 3/8" long; 4 1/4" high. Ripple below 5 MV RMS.

outputs:

105 VDC—20 MA (Model 1-20X)

150 VDC—20 MA (Model 1.5-20X)

210 or 105 VDC @ 20 MA

(Model 2-20X) bulletin 1027

models .28-5MX; .28-5MXR



28 VDC—5 Amps—adjustable

Transformer taps on Model .28-5MX permit adjusting to 28 volts for variations in line and load.

28 VDC—5 Amps

—regulated by mag. ampl.

Model .28-5MXR—regulation for 115V

$\pm 10V$ line: $\pm 0.25V$; NL to FL: 0.5 V.

bulletin 1018

bulletin 1019

With the wide range of voltages and currents offered by these units, design engineers can quickly find a model compatible with their needs. Each unit features simplified design, highest quality components, easy-to-trace wiring, and high reliability.

dressen-barnes

DRESSEN-BARNES CORP.
250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION



profit

taxes

labor

finance

sales

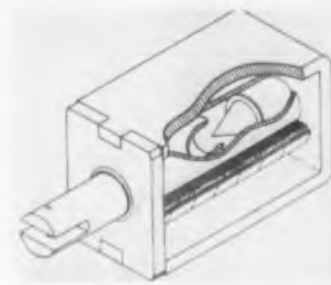
marketing

obsolescence

manufacturing



New Products



Solenoid
Lifting Force of 1.4 Lb

Model 200 solenoid is a dc combination solenoid-magnet type. Overall size with plunger is 1 in. wide x 1-7/32 in. deep x 2-1/2 in. high. Plunger travel distance is 3/4 in. Weighing 7 oz, it has a lifting force of 1.4 lb. Operating voltage is 117 v.

Parks Electronics Corp., Dept. ED, P.O. Box No. 946, Redwood City, Calif.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

Autographic Plotter

Evaluates Tests in Process

The Model 114 autographic plotter is a multi-channel recording and plotting instrument for use with strain gage, thermocouple, or other mv inputs. It automatically receives and plots each channel on an individual graph so that test personnel can quickly evaluate results. The Model 114 is available in 24, 48, or 96 channels.

Gilmore Industries, Inc., Dept. ED, 5713 Euclid Ave., Cleveland 3, Ohio.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

Telemetry Oscillator

High Stability, Low Power Input



Less than half the size of previous models, this voltage controlled telemetry oscillator needs one-hundredth the power of the smallest former unit, has better stability and linearity. Packaged in less than a tenth cubic foot, power requirement per oscillator is 30 mw and linearity is $\pm 1/2$ per cent of FBW. Drift is less than ± 3 per cent.

Dorsett Laboratories, Inc., Dept. ED, 401 1/2 Boyd St., Norman, Okla.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

The Only Weekly Newsmagazine that helps the engineer with his Business Problems



Electronic executives are confronted with a maze of business problems unrelated to the technical problems which surround their products. *Electronic Week* is designed and written with the prime purpose of aiding the engineer-executive with these business problems. *Electronic Week* concerns itself with the trends and significant developments in marketing, manufacturing, labor, finance, taxes, profits, people and plants — brings this concise, timely information to your desk each Monday morning. By January 1st publisher's guarantee will exceed 10,000 copies.

a HAYDEN publication

New York 21: 19 East 62nd Street. TEmpleton 8-1940
Chicago 11: 664 North Michigan Ave. SUperior 7-8054
Los Angeles 36: 5720 Wilshire Blvd. WEbster 8-3881

Transformers

Operation from -50 to $+130$ C



These types can now be supplied in versions designed to exceed the requirements of MIL-T-27A specification, Class S. This specification covers transformers and inductors with life expectancies of greater than 10,000 hr and operating conditions from -50 to $+130$ C.

Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION



Blind Bolts

Three Piece Construction

This fastener was designed for blind applications where the work is accessible from only one side, such as tanks and close-out panels. A simple three piece fastener, the blind bolt consists of a core bolt, a threaded expander nut which resists installation torque and locks the core bolt in place, and a sleeve which has the characteristics of expanding to fill and seal a hole, over a large range of clearances.

Hi-Shear River Tool Company, Dept. ED, 2600 W. 247th St., Torrance, Calif.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957



Sixty Volt Power Transistor Type 2N296

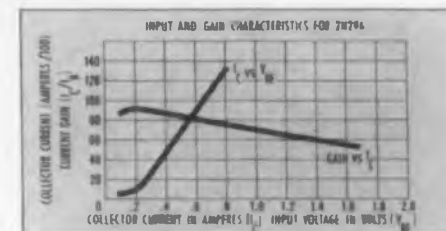
Sylvania develops a high voltage power transistor with optimum performance factors for a wide range of circuit applications.

Now Sylvania offers type 2N296, a PNP germanium alloy transistor designed for high voltage power amplifier or switching applications where supply voltages are 25-30 volts. The new unit is already finding growing use in computer, telephone and aircraft circuits.

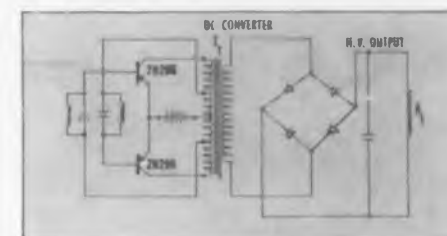
The new 2N296 is physically identical with Sylvania type 2N242 and can be used as its high voltage companion.

Here are the general features of the new 2N296

- 25 Watts. Max. Dissipation (Mounting base maintained at 25° C)
- 2 Amps Collector Current
- 60 Volts Max. Collector Voltage
- 0.8 Saturation Voltage (Typical)
- 20 Minimum Current Gain
- 85° C Storage Temperature
- 100° C Junction Temperature (Operating)
- Temperature Gradient (from junction to mounting base) 3° C/Watt
- New Welded Hermetic Seal Construction



Input and Gain Characteristics for Type 2N296



Transistorized DC Converter with Type 2N296

Call or write your Sylvania representative for complete particulars on the new 2N296 60-volt power transistor.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N.Y.
In Canada: Sylvania Electric (Canada) Ltd.,
Shell Tower Bldg., Montreal

SYLVANIA

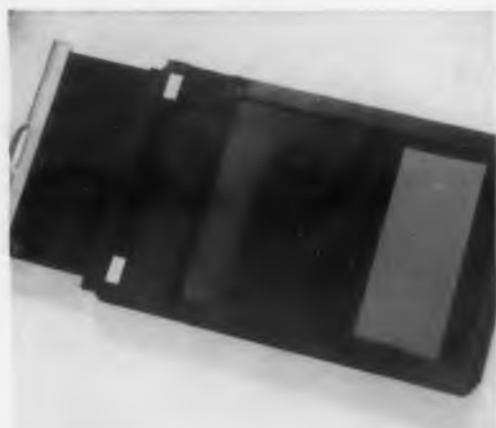
LIGHTING • RADIO • ELECTRONICS • TELEVISION • METALS & CHEMICALS

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

take
it
in
color



and you put Synthane laminated plastics to work



Slide for cut film holder—made from Synthane sheet because Synthane is opaque to infrared rays.

At first glance the connection between color photography and Synthane laminated plastics may seem obscure. Actually, Synthane has long been at home in the manufacture and processing of film and in the developing of the finished picture.

Many types of rolls, loop sticks, and structural parts made of Synthane are used by the film manufacturer. Racks, film sprockets, reels and rollers employ Synthane in developing processes. In the infancy of color pictures (and ever since), racks and reels made of Synthane proved to be exactly what were needed to resist developing solutions, prevent film fogging through contamination. Film holder slides and

various parts for cameras are other uses of Synthane in photography.

The photographic industry needs Synthane for its unique combination of properties. Resistance to moisture and chemicals, non-fogging qualities, its hard, smooth surface are all important characteristics. Synthane is tough, light in weight (half the weight of aluminum) and easily machined. These and many other chemical, electrical and mechanical properties make Synthane valuable throughout the length and breadth of industry.

Over 30 grades in sheet, rod or tube form or completely fabricated by us are looking for work with you. Write for information.



CHEMICAL RESISTANCE



LIGHT WEIGHT



EASILY MACHINED



MECHANICAL STRENGTH

SYNTHANE . . . industry's unseen essential

SYNTHANE CORPORATION, 42 RIVER ROAD, OAKS, PA.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Sampling Switches Precise Phase Relationship



Series 107 of sampling switches has up to five poles with 60 shorting channels or 30 non-shorting channels per pole. All poles are locked in precise phase relationship. Construction of the switch affords replacement of all brushes quickly without force or phase adjustments. Typical applications include airborne and shipboard oscilloscope displays, stabilization of groups of high gain dc amplifiers, error indicating systems, and in multichannel data systems.

General Devices, Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

Unijunction Transistor Analyzer Oscilloscope Display



Polyphase TA-10 unijunction transistor and diode checker can trace on an oscilloscope the negative resistance or emitter characteristic curves of the GE type ZJ14 unijunction transistor. Interbase and emitter voltages are metered and adjustable by front panel controls. Semiconductor diode checking of all types of diodes is readily performed by oscilloscope display of forward and reverse current characteristic curves. Go, no-go type quality control and production checking procedures are easily set up. A transistor circuit power supply is automatically provided because of the instrument's power supplies rated at 100 v, 100 ma.

Polyphase Instrument Co., Dept. ED, East 4th St., Bridgeport, Pa.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

Power Supply

Regulation ± 0.15 Per Cent



The Model 300-B B-power supply, utilizes printed circuits for compactness and provides a regulated 0-300 v dc output and unregulated 6.3 or 12.6 v ac filament outputs. Electrical characteristics of the 300-B include 0-150 ma output current, regulation accuracy of ± 0.15 per cent or ± 0.3 v, whichever is greater, 5-mv rms max ripple, 2 ohms internal impedance, 105-125 v ac 50/60 or 400 cps input range, and two 6.3 v 5 a filament voltage circuits which may be connected in series or parallel.

Sorenson & Co., Inc., Dept ED, Richards Ave., S. Norwalk, Conn.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

Recorder Line

New Case Designs Provide Flexibility



Unitized construction provides ease of maintenance and maximum flexibility. Simple chart speed and range change are two advantages of unitized construction. The 12-in. circular chart has straight time coordinates which increases readability. The amplifier, slide wire, standardizing mechanism, and range standard are the same as previous models. The circular chart recorder utilizes the same case as the multipoint recorder 6705.

Also offered is a small case multipoint strip chart, Model 6702, offering up to 12 points on a full size strip chart in a small size case, and a four pen mechanical recorder, Model 7812, providing functional space for a maximum of control additives and accuracy items.

Weston Electrical Instrument Corp., Dept. ED, Newark, N. J.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION



Waldorf announces an important new design concept... MICROMATION

MICROMATION—the logical result of Waldorf's unique talent for compressing more performance and reliability into less space.

MICROMATION—making use of Waldorf's credo of less space, less weight, less heat, less power, to provide just the first of a series of related components and assemblies for servo and computer applications.

MICROMATION now makes available—

Model W1801—Transistorized Servo Repeater System; size 2" Dia. x 4" long, weight 13 oz. including amplifier and power supply.

Model W1803—Transistorized Servo Amplifier; size 13/16" Dia. x 2 3/4" long, weight 2 oz.

Model W1804—Transistorized Servo Amplifier; size 1" x 1" x 1".

In the housing of the W1801 Servo Repeater System illustrated are all the electronic and electromechanical components to develop shaft position output with torque exceeding 20 oz.-in. Static accuracy is within 0.1° of input from synchro or transducer. Velocity constant is 60 sec.⁻¹. Requires only 115V, 400 cps supply. Other configurations are available to suit your requirements. Uses include control of positioning devices, valves or computer elements.

May also be used as aircraft indicators. Meets military specifications.

Model W1803 Amplifier as used in the W1801 Servo Repeater is designed for minimum mounting surface—13/16" Dia.

Model W1804 Amplifier is identical electrically but packaged for minimum volume—1" x 1" x 1".

Both accept synchro, potentiometer, or other transducer data. Both drive size 8 or size 10 motors.

Interested?

If these product improvements—or the coming innovations in MICROMATION—integrators, differentiators, coordinate-converters, vector solvers and power supplies challenge your imagination, why not ask for further data?

Waldorf

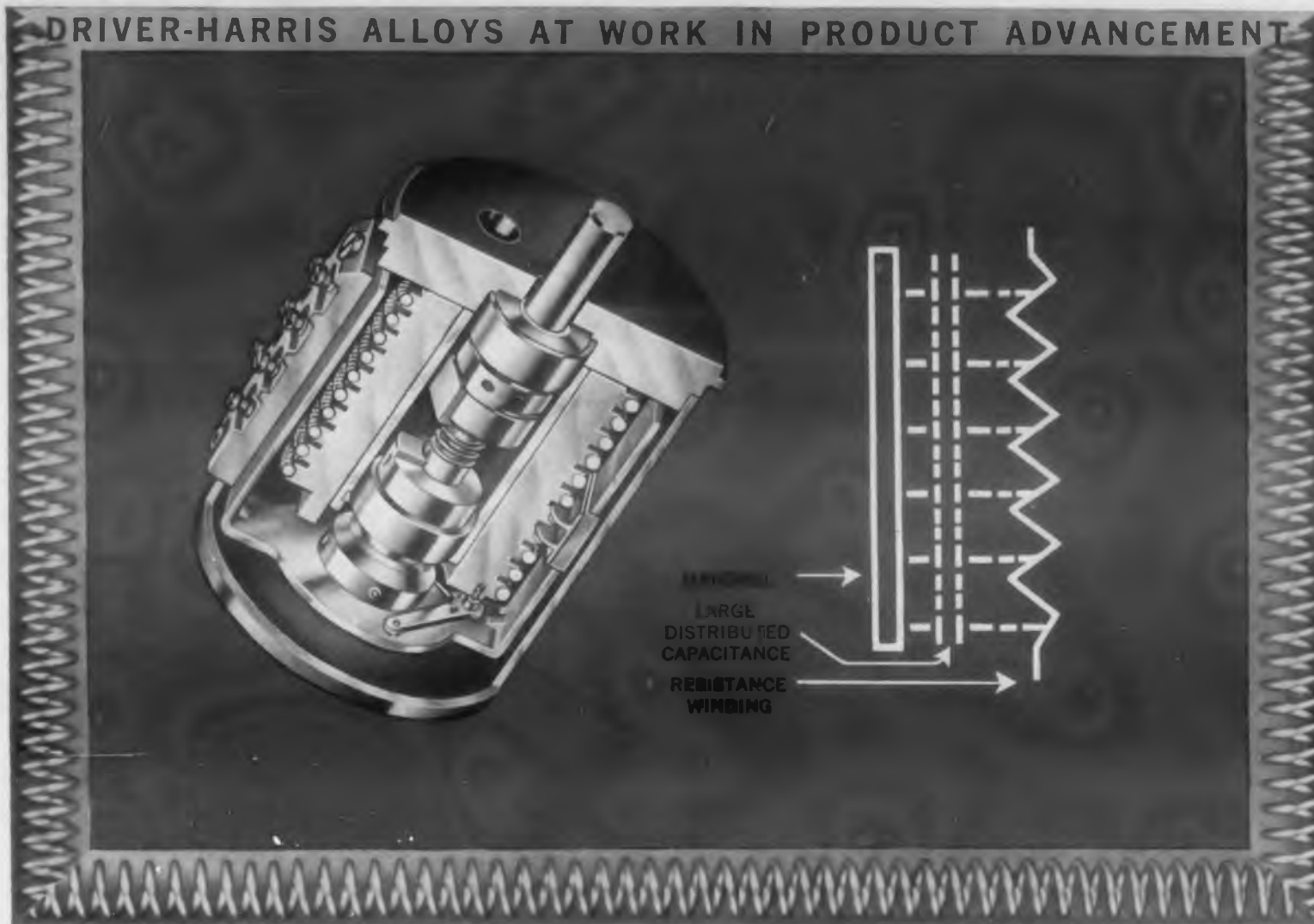
INSTRUMENT COMPANY

Division of F. C. Huyck & Sons

DEPARTMENT EB-44 • ELECTRONICS DIVISION • WALDORF INSTRUMENT COMPANY • HUNTINGTON, LONG ISLAND, NEW YORK

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

DRIVER-HARRIS ALLOYS AT WORK IN PRODUCT ADVANCEMENT



Phase Shift Compensation Eliminated In New HELIPOT® Precision Potentiometers

SPECIAL D-H ALLOYS MAKE AIR-CORE WINDINGS PRACTICAL!

Helipot's purpose in designing its new, air-core wound series 7700 Potentiometers was to make possible operation at higher frequencies with 0° phase shift—thereby eliminating compensation circuitry.

In nearly all multi-turn potentiometers, resistance wire is wound on an insulated copper-wire mandrel. This type of mandrel is used because it has uniform diameter, good heat conductivity and high thermal capacity. However, a disadvantage of such construction is the relatively large distributed capacitance between the resistance winding and the mandrel. When such a potentiometer is used as an AC voltage divider, the output generally differs in phase and magnitude from the desired output. This interferes with the effective use of high accuracy potentiometers unless compensation is applied somewhere in the circuit.

Helipot engineers desired to eliminate these problems by eliminating the copper-wire mandrel. But the elimination of the mandrel also

eliminated the support for the winding. Needed, therefore, was a type of wire that would make a self-supporting air-core winding.

At Helipot's request, Driver-Harris went to work with these specifications: The wire must be of dependable uniform hardness so that in stretching it, equal spacing between turns is obtained, free of creep. This is essential to linearity. The wire also must be of unvarying diameter for uniform resistance. And its surface must be extremely clean—free of oxide coating to minimize contact "noise".

Driver-Harris produced the wire—a special hard-drawn form of Karma* and Nichrome* V. And Helipot produced its new 10-turn series 7700 potentiometers in a resistance range from 200 to 5000 ohms. With this radically new air-core winding, linearity approaches the resolution of the unit without resort to padding or shunting. And phase shift in AC circuitry is reduced to less than 0.1°.

Since 1899, Driver-Harris has produced 132 special-purpose alloys in just this fashion—in answer to a particular problem and extraordinary specifications. If your own engineering and product development plans currently hinge upon a special alloy—why not bring your problem to Driver-Harris. Your inquiry is invited.

*T.M. REG. U.S. PAT. OFF.



Driver-Harris* Company

HARRISON, NEW JERSEY • BRANCHES: CHICAGO, DETROIT, CHEVYCHANG, LOUISVILLE
Distributor: ANGLIS-CAMPBELL, INC., Los Angeles, San Francisco • in Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES
CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Transfer Coaxial Switch Independent Solenoids



Wide flexibility in coaxial circuit switching is provided by independently operating solenoids. User has complete control over make-before-break and break-before-make. This feature increases the designer's latitude in application engineering. Unit is built to standards of high reliability, and is designed to meet MIL-E-527A. Size of this switch is 3 x 3-1/4 x 2-1/4 in. and weighs only 13 oz with mounting bracket. Adaptable to various coil voltages from 28 to 120 v dc, this unit is supplied with N-type connectors, other types on special request.

Transco Products, Inc., Dept. ED, 12210 Nebraska Ave., Los Angeles 25, Calif.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Connectors Mount In Knock-Out Holes



Called Change-outs, this line of connectors mounts directly in knock-out or threaded holes in wiring boxes, panels, and ducts. Greatly reducing time required to replace defective units with stand-by units, they are available with 2, 3 or 4 contacts for 8 through 20 applications with a 600 v maximum rating.

Joy Manufacturing Co., Electrical Products Div., Dept. ED, 1201 Macklind Ave., St. Louis 10, Mo.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Coil Winding Counter Double Predetermination

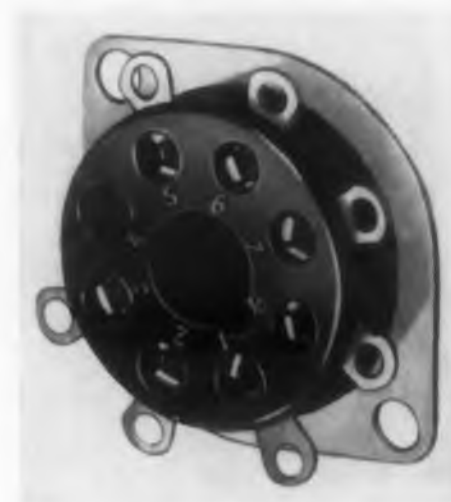


Specifically designed for winding tapped coils, the Model U 280 Z has two predeterminations, each independently settable to a total of 999,999, one for the tap and one for the final with knockoff by split switches. The counters add and subtract to a maximum speed of 5000 rpm. Both predeterminations are simultaneously reset to zero for repeat cycling by quick lever or automatically by motor. Other applications for these counters are processes requiring a warning or deceleration signal.

Presin Co., Dept. ED, 12128 W. Pico Blvd., Los Angeles 64, Calif.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Klystron Tube Socket Reduces Assembly Time



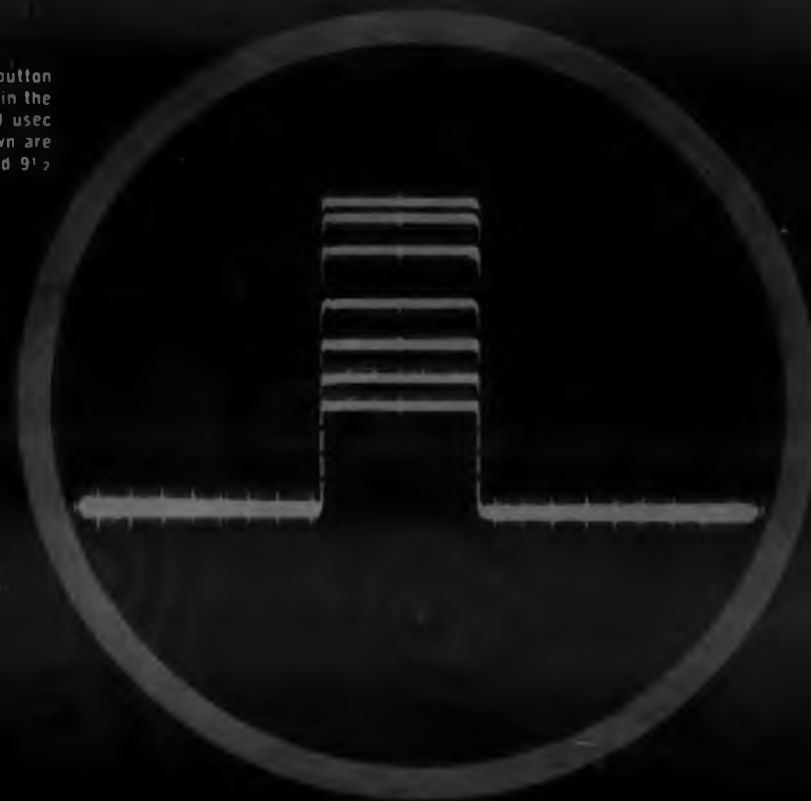
Use of this moulded chassis-mounted octal socket for the JAN-CRP-2K45 thermally tuned klystron permits substantial reduction in assembly time. Self-aligning gold plated contacts are flexibly mounted in slightly oversize orifices of a glass filled diallyl phthalate socket body. The socket provides accurate alignment and probe penetration in the wave guide mount avoiding any mismatch. Design of the tube socket also eliminates the need for insulated bushings and any contact shorting to the wave guide tube mount. Contact tabs are easily accessible for fast accurate circuit assembly.

Globe Electrical Mfg. Co., Dept. ED, 1729 W. 134th St., Gardena, Calif.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1, 1957

Fidelity of 404 push-button attenuation is shown in the multiple exposure of a 1 usec pulse. The db levels shown are 1/2, 1 1/2, 3 1/2, 5 1/2, 7 1/2 and 9 1/2



0.018 usec
RISE TIME

100,000 pps
REP. RATE

Du Mont



Pulse Generator

Repetition rates up to 100,000 pps, manual trigger for single pulse

0.018 usec maximum pulse rise and fall time

Pulse width continuously adjustable from 0.05 to 100 usec

50 volts maximum output into 50 ohm impedance

59.5 db of attenuation in 0.5 db steps with no pulse degradation

Hard tube circuitry eliminates jitter due to hydrogen thyatron erratic firing.



The Du Mont 404 Pulse Generator sets new standards for stability and versatility, outmoding pulse generators employing hydrogen thyatrons. The performance of the 404 reflects the entirely new "hard-tube" circuitry concept employed.

The capabilities of the 404 provide excellent facilities for ultra-high frequency studies at moderate cost. Its hair-line firing of sharp-edged pulses, push-button stepped attenuation, high rep rate, minimum jitter, easy-to-use front panel and control layout, internal delay from 2 usec before trigger to 100 usec after—all add up to a multiple use instrument that's good for years of dependable performance.

Price \$675

Rack-mounting model \$690

Write For Complete Technical Details ...

DU MONT

TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC. • CLIFTON, NEW JERSEY

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

One of the  Series

yardsticks

You choose the measure . . . whether Editorial? Circulation? Frequency? Format? Readership? . . . then let us demonstrate to your satisfaction the best, and most logical, media buy in the industry.

ELECTRONIC DESIGN • New York • Chicago • Los Angeles

New Products

Oscillograph Recorder

Offer 19 Channels

The Dynograph direct writing model 503 is designed for applications requiring more than 8 channels of information on one recording chart. Up to 19 recording channels are available using either ink or electric curvilinear recording. The recorder features fast response, high sensitivity, and absolutely drift-free recording through the use of a patented chopper amplifier. The manufacturer supplies 24-1/2 in. printed paper, either in roll or folded form, and 500 foot unprinted rolls as desired. The paper is driven by a synchronous motor and eight speed gear box, providing instant selection of speeds of 1, 2.5, 5, 10, 25, 50, 100, and 250 mm/sec., accurate to 1 per cent. Paper is driven from both edges.

Offner Electronics Inc., Dept. ED, 5320 N. Kedzie Ave., Chicago, Ill.

CIRCLE 186 ON READER-SERVICE CARD

Coaxial Terminations

Precise Resistance from DC to 1000 Mc



Accurate resistance values from dc to 1000 mc are maintained in these units by Filmistors—thin platinum films in ceramic forms which are assembled in coaxial sections. Vswr is less than 1.2 to 1000 mc, characteristic impedance 50 ohms, peak voltage 100 v. Type BNC or Type TNC male or female connectors are available. Units have gold-plated electrical contacts and chrome satin exterior finish.

Stoddart Aircraft Radio, Inc., Dept. ED, 6644 Santa Monica Blvd., Hollywood 38, Calif.

CIRCLE 187 ON READER-SERVICE CARD

Molded Potential Transformers

Carry 600 VA Without Overheating

Designed for circuits up to 5 kv, both indoor and outdoor types are available in this butyl-molded potential transformer line. Specifications for the 5 kv butyl-molded potential transformers—indoor and outdoor types—include 0.3 ASA accuracy and a 60 kv impulse level. Ratios of 20:1, 35:1, and 40:1 are provided for line-to-line or line-to-neutral use on 4800 v systems and lower. Thermal capacity is increased, with the new transformers able to carry over 600 v a at 30 C ambient without overheating. Butyl construction with stainless steel accessories result in a minimum of maintenance or replacement.

General Electric Co., Instrument Div., Dept. ED, Schenectady 5, N.Y.

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION



Soldering Tool For Printed Circuits

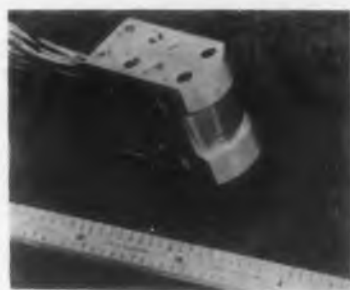
Called Soldering Aids, these tools are designed for servicing compact equipment. The fork end of the tool disconnects soldered joints. The spade end removes solder from a lug hole. Tips are of tempered steel and are hard-chrome plated to shed solder.

CBS-Hytron, Dept. ED, Danvers, Mass.

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Head

Directly Coupled to Thermocouples



This 7-channel magnetic tape recording head can be directly connected to thermocouples to record without the use of amplifiers, using only 20 μ w. The head has been designed to withstand high shock and vibration forces as well as high temperature and thermal shock. Other features include gap alignment scatter under 1/10 mil, mounting base machined to within 90 deg \pm 15 sec of the gap line and tape guides integral with the head.

Data Storage Devices Co., 7828 Burnet Ave., Dept. ED, Van Nuys, Calif.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

RECTIFIERS—Both vacuum and gas filled tubes with peak inverse voltage ratings from 200 to 15,000 volts. Included are tubes with special features such as fast warm-up, cold cathodes, clipper service ratings and rugged construction.



TELEPHONE TYPES — A highly specialized line of vacuum and gas filled tubes in both the 300 and 400 series.



THYRATONS—An extensive line of thyratrons for use as grid control rectifiers, relays and noise generators. Inverse voltage ranges from 100 to 5,000 volts. Sizes from subminiatures to ST 16 bulbs. Filamentary as well as hot and cold cathode types are available.



VOLTAGE REGULATOR AND REFERENCE TUBES—Gas filled tubes designed to specific voltages for regulating small currents. Also used to make available reference voltages for high current supplies. Sizes from sub-miniatures to bantams, including many reliable, ruggedized types.



TWIN POWER TRIODES—The most complete line of high current twin power triodes developed especially for regulated power supply usage. Current and power ranges up to 800 milliamperes and 60 watts respectively. Included are rugged types in both low and medium mu construction.

HYDROGEN THYRATONS—Used primarily as switching tubes in line type radar modulators, these tubes permit accurate control of high energy pulses. Sizes from miniatures to the VC 1257. Peak pulse power ranges from 10 kilowatts to 33 megawatts.

CHATHAM

EXPANDS TO MEET INCREASED SPECIAL PURPOSE TUBE DEMANDS

100,000 Square-Foot Addition Doubles Existing Facilities

The creative engineering that has been responsible for many Chatham "originals", now has larger and improved facilities to help you solve your special purpose tube problems.



CHATHAM ELECTRONICS Division of TUNG-SOL ELECTRIC INC.

General Office and Plant: Livingston, New Jersey
SALES OFFICES: CHICAGO, DALLAS, LIVINGSTON, LOS ANGELES

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION



ROTARY JOINTS

These are just a few of the hundreds of rotating joints that have established NRK as the No. 1 source for such assemblies. Whatever your need for radar or microwave components, you will find at NRK complete facilities and matchless experience for designing and manufacture.



Microwave Assemblies, Radar Components and Precision Instruments... manufactured and designed to your specifications.



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Chicago 41, Illinois

Eastern Sales Office
Box 445, Westfield, M. J.
West Coast Representatives
Bray and Carter
2232 W. 11th St., Los Angeles 6, Cal.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Computer Power Supplies Transistorized, Multi-Output



Three types are available for operation from either standard line input, from 400 cps input or from 24 v dc input. A typical line operated model produces seven outputs ranging from +30 v dc at 2 amp to -30 v dc at 5 amp. Standard regulation is 1 per cent.

Universal Transistor Products Corp., UAC Electronics Division, Dept. ED, 143 E. 49th St., New York 17, N.Y.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

Solderless Test Prod Holds Wire Firmly

To connect a wire to this test prod, a trigger on the gun shaped body is pulled and the stripped end of the wire is inserted. Releasing the trigger forms a solid contact. Called Trigger Qwik, the prod is made of molded styrene and can be used in most standard test sockets.

General Cement Mfg. Co., Dept. ED, Rockford, Ill.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Resistor Allows Viewing of HV Pulses



This pulse resistor permits observation or measurement of the magnitude and rise time of current pulses encountered in magnetrons and other devices by providing a means for applying the pulse as a signal to a crt. The pulse resistor views current wave-forms with rise times from 0.01 to 0.5 μ sec. A phone plug termination makes possible direct insertion into a live circuit.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

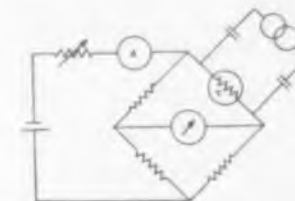
Using Thermistors

Edited by
FENWAL ELECTRONICS

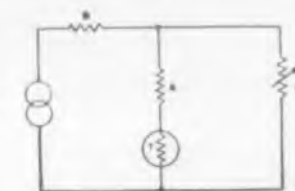
This is the third in a series of news columns devoted to thermistors — a device that is super-sensitive to temperature change.

The example in point: power measurement and voltage control.

A bead thermistor can be used to balance a bridge circuit, allowing the thermistor current to be measured and its DC power calculated. This is done with a 2000 Ω bead thermistor in a 200 Ω bridge circuit with a variable resistor in series with the bridge. This will heat the thermistor enough to lower the resistance to 200 Ω and balance the circuit to determine the H.F. power. By applying a source of high frequency power to the thermistor through capacitors this will further heat the thermistor and the bridge will be unbalanced. Then reduce the DC power until the bridge balances again. Calculate the new DC power, and the difference between the two calculations is the H.F. power.



To maintain constant voltage a thermistor with a suitable series resistor "A" can be placed in parallel with a load in a circuit. As the load resistance increases there is a reduced drop across resistor "B." This tends to raise the voltage across the load. The thermistor heats up, reduces its resistance, and more current passes through it and through resistor "B." This brings the voltage across the load back to its original state. Controls like this can maintain as close as 1% voltage regulation over a broad range of load resistance, or any voltage from 1/2 volt to 100 volts can be regulated in this way with suitable circuitry.



Engineers: these and other thermistor applications are discussed in 12-page catalog EMC-1. Write for your copy to FENWAL ELECTRONICS, INC., 313 Mellen St., Framingham, Massachusetts.



Makers of Precision Thermistors

CIRCLE NO. 201 ON READER-SERVICE CARD

Investigate
ADVANTAGES
of the New
MASSA
ELECTRODYNAMIC
RECORDER

TRUE RECTILINEAR MOTION
CRITICAL ACOUSTIC DAMPING
WIDER FREQUENCY RANGE
INK OR ELECTRIC WRITING



FEATURES

LIGHTWEIGHT ELECTRODYNAMIC DRIVE for true rectilinear recordings free of distortions.

CRITICAL ACOUSTIC DAMPING eliminates resonant peaks overshoot and ringing.

WIDER FREQUENCY RANGE reproduces signals up to 200 cps.

MICROMETER ADJUSTING SCREWS conveniently located for accurate pen alignment.

DECIMAL SPEED CHANGER with 3 speeds. Max. — 200 mm/sec.

DISPOSABLE INK CARTRIDGE hermetically sealed prevents evaporation and maintains correct ink viscosity.

NEW PEN DESIGN with mechanical filter permits splatter-free writing at all frequencies.

WEIGHT 9 lbs. — **Dimensions** 13" L x 4 3/8" W x 4 1/2" H.

Also available is the Massa Model M-220 **DUAL CHANNEL DC AMPLIFIER** with self-contained power supply. Sensitivity range is 5mV/mm to 200 volts full scale with compensation to yield flat response from dc to 200 cps.

Write to Dept. 14 for technical data.

Other Massa Products for Industry:
SONAR TRANSDUCERS ULTRASONIC CLEANERS
ACCELEROMETERS PREAMPLIFIERS
MICROPHONES AMPLIFIERS
HYDROPHONES RECORDERS

precision in  electroacoustics

MASSA
LABORATORIES, INC.
HINGHAM, MASSACHUSETTS

CIRCLE NO. 202 ON READER-SERVICE CARD



Radar CRT
16-In. Diam

Designated the 16AKP7, this 16-in. all glass cathode ray tube is intended for radar display. Providing higher resolution and more reliability than existing 16-in. metal cone tubes, there is no need to insulate the cone from its surroundings.

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, Elmira, N.Y.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

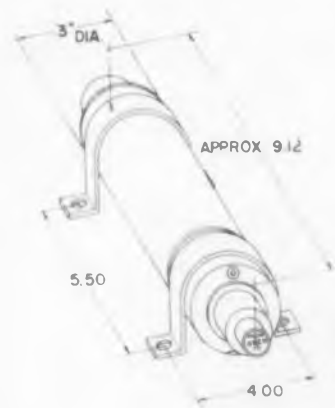
Inertia Switch

Actuated by Excessive Vibration

If unusual vibrations occur in a piece of equipment the inertia switch senses the trouble, shuts off the machine, or sounds an alarm. The switch operates when subjected to a thrust in any horizontal direction. A vibration of thrust under the minimum duration of 1/30 of a second will not actuate the switch. Force-of-actuation settings may be supplied from 1.5 to 10 or more g.

Minneapolis-Honeywell Regulator Co., Micro-Switch Div., Dept. ED, Freeport, Ill.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION



10 PDT Switch
Low Contact Resistance

Type SWM-9610-04 10 pole double throw switch is hermetically sealed and capable of electrically opening or closing and manually opening with a contact resistance of 0.1 ohms max at 300 ma and 6 v dc. Contacts are capable of carrying 15 amp with a make or break capacity of 5 amp 125 v. The self-stepping unit contains arc suppressors for contact protection.

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

in
tape
wound
cores ...



Only

G-L

can offer you...

► **consistent uniformity...**

The engineering staff of G-L Electronics completely re-engineered the tape wound core and its manufacturing process to assure the production of consistently uniform, high quality cores. Now, through new, exclusive, G-L production and advanced test procedures, you can be sure of getting "Precision Made" tape wound cores with the greatest uniformity ever achieved in commercial quantities. Proof comes not only from our own exhaustive tests but also from customers who report unbelievable uniformity with every core.

► **prompt deliveries...**

Production line techniques have been worked out to make sure that every order is completed in time to meet delivery dates. You can depend upon a delivery date quoted by G-L Electronics so that you can schedule your own operations with confidence.

Proof of our claims will come when your order for G-L cores is filled. Write, wire, call or teletype us about your requirements.

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CAMDEN 5, NEW JERSEY

WOodlawn 6-2780 TWX-761 Camden, N.J.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

looking for a pot?

Try the "Flyweight"



YES, try the SERIES 304!

When your available space isn't large enough to hold an active sand flea, but you must have a single turn potentiometer of utmost reliability and linearity, try the SERIES 304, a "flyweight" in the ranks of Daystrom precision, wire-wound potentiometers.

Check these outstanding features:

SIZE: 0.5" dia. by 0.375"

LINEARITY: Precision winding techniques give the SERIES 304 a linearity of from 3% to 0.3% standard, or as good as 0.18% on special order.

RELIABILITY: The exceptionally rugged construction of this potentiometer gives it a service life of not less than 500,000 cycles.

STABILITY: Only materials of low (and similar) temperature coefficients are used in order to produce great stability under all temperatures.

AVAILABLE WITH: Integral shaft lock
Servo or panel mount
Rotational stops

Write TODAY for complete details on this and other precision potentiometers from DAYSTROM PACIFIC POTENTIOMETER DIVISION!

Openings exist for highly qualified engineers.

DAYSTROM PACIFIC

A division of DAYSTROM INC.

POTENTIOMETER DIVISION

9320 Lincoln Boulevard Los Angeles 45, California

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products



Vane Pump Cartridge
Small Computer Drive

This miniature cartridge weighs 2.5 oz and will deliver 1.04 gpm at 1000 psi and 10,000 rpm. It has an output of 0.06 hp, and is less than 1 1/8 in. diam . . . smaller than a wrist watch. Other capacities are available. Suggested uses include small radar drives, small computer drives, and coolant applications. Vickers Inc., Dept. ED, Detroit 32, Mich.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature RF Tube With Internal Shield

A miniature, high-mu, high transconductance twin triode, the ECC85/6AQ8 tube has been specifically designed for use in am and fm receivers as a grounded-grid or grounded-cathode r-f amplifier and as a self-oscillating frequency converter or cascode amplifier. Through the use of an internal shield separating both triode sections, the tube reduces oscillator radiations from the antenna of the receiver to an extent not obtainable with previously available twin-triodes. Higher transconductance permits increased front-end gain and lower noise.

Amperex Electronic Corp., Special Purpose Tube Div., Dept. ED, 203 Duffy Ave., Hicksville, N.Y.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Turns Counting Dial Reads 1/100 of Turn



The Digidial features easy readability at extreme angles of vision. Having a 10-turn range, the unit gives direct numerical readings in full turns, tenths, and hundredths.

Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

reliable RELAYS

adapted
for
printed
circuits



Terminals
solder into
the printed
circuit.
Wiring is
eliminated.

For AC or DC operation. Miniature and subminiature sizes. Open, dust tight enclosed and hermetically sealed. Wide Range of models. Contact combinations to 8PDT. Ultra sensitive or heavy current contacts. Many special features.

Tell us what you need or send for catalog.

MAGNECRAFT

Electric Company

3350D W. Grand, Chicago 51, Ill.

CIRCLE NO. 211 ON READER-SERVICE CARD

5

Helpful Heart Facts



1 Some forms of heart disease can be prevented... a few can be cured.

2 All heart cases can be cared for best if diagnosed early.



3 Almost every heart condition can be helped by proper treatment.

4 Most heart patients can keep on working—very often at the same job.



5 Your "symptoms" may or may not mean heart disease. Don't guess—don't worry. See your doctor and be sure.

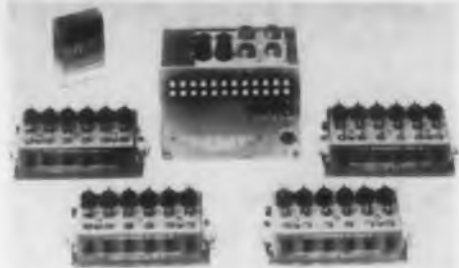
FIGHT FEAR WITH FACTS

Help
Your
Heart
Fund



Help
Your
Heart

Bridge-Balancing System Calibrates 24 Transducer Channels



This miniature system is for use with strain gauges, accelerometers, or any resistance type transducer to control, balance and automatically calibrate up to 24 transducer channels. Four Model 6-104 bridge balance and calibrating units make up the system. Unitized construction allows 24 channel capacity in a total volume of 160 cu in. Provisions are made to insert matching damping resistors and calibration resistors for recording oscillograph galvanometers.

B & F Instruments, Inc., Dept. ED, 4732 N. Broad St., Philadelphia 41, Pa.

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION

Explosive Switch Quick Reliable Response



Model 1186 explosive switch will withstand 2000 cps at 100 g. Response time is 100 μ sec. Input leads positively open after firing signal. Contacts are insulated for potentials to 1000 v, rated for 10 amp continuously; and momentary currents of 100 amp. The switches are furnished spdt or spst.

Raymond Engineering Lab., Inc., Dept. ED, Smith St., Middletown, Conn.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Recorder For Slow Speed Operation



Model TT-100 multi-channel magnetic tape recorder has been specifically developed for slow speed operation. Up to three record channels can be provided at speeds from 0.05 to 1-7/8 ips using 1/4-in. tape or 5-in. NARTB reels. The instrument weighs 5 lb and measures 12 x 6 x 4 in. Power requirement is 6 v dc, ranging from 100 to 300 ma. The unit operates from -20 to +165 F.

Precision Mechanism Co., Dept. ED, 922 Terminal Way, San Carlos, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

A New Concept of TIME...



... this Complete NEW Line of HAYDON* TIMING MOTORS

Here is a complete line of timing motors that includes the right choice for every APPLICATION... entirely re-designed for finer performance. Features include: slower basic rotor speed (450 rpm), controlled lubrication, total enclosure, smaller size, superior accuracy, quieter operation and longer life.

HYSTERESIS... the ideal general-purpose motor.

INDUCTOR... extra torque (30 ounce inches) for display and other heavy-duty jobs.

CLUTCH... allows automatic re-setting without external clutches.

REVERSIBLE... a hysteresis type with 2 coils, each producing opposite rotation.

DIRECT CURRENT... a permanent magnet type for 6 to 32 volts.

400 CPS... miniature and heavy-duty models for airborne instrumentation.

FOR COMPLETE INFORMATION, write today for new catalog... or contact the HAYDON Field Engineer nearest you.

*Trademark Reg. U.S. Patent Office

HAYDON
AT TORRINGTON

A SUBSIDIARY OF GENERAL TIME CORPORATION

HEADQUARTERS FOR
TIMING

HAYDON Manufacturing Company, Inc.
2235 ELM STREET, TORRINGTON, CONN.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

Machlett ML-6544

A New Forced-Air Cooled Triode

For Use As Switch Tube in Hard-Tube Pulse Modulators

For Radar Applications



Machlett Laboratories, Inc. offers the designer a new forced-air-cooled, shielded grid triode designed primarily to operate as a switch tube in hard-tube pulse modulators in radar applications. Ruggedly constructed electrodes of the ML-6544 are of such a design as to provide electron beaming essential in keeping grid current to a minimum. This, in addition to the increased heat dissipation capabilities of the rugged control-grid structure, reduces grid emission to a negligible quantity.

The following tentative ratings apply:

<i>Electrical Characteristics</i>	
Filament Voltage	6.0 Volts
Filament Current	60 Amps
<i>Maximum Ratings</i>	
Peak Plate Voltage	25 kv
D-C Plate Voltage	20 kv
D-C Grid Voltage	-600 Volts
Peak Positive Grid Voltage	1500 Volts
Peak Cathode Current	75 Amps
D.C. Plate Current	100 mA
Grid Dissipation	45 watts*
Plate Dissipation	1000 watts
*150 cfm @ 0.8" water	

*Sufficient air cooling must be provided to keep glass seal temperatures no more than 175°C under all conditions of operation.

For full technical data on this or any other Machlett tube type, write:

Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Connecticut

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

A NEW CASE for a BEEDE ELECTRIC METER

MODERN

EASY
TO READ

REASONABLY
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FOR SMALL POWER-UNIT PANELS
INDUSTRIAL TEST UNITS—COMMUNICATION EQUIPMENT, ETC.

LONG LASTING AND ACCURATE TO THE DOT

BEEDE ELECTRICAL INSTRUMENT CO., INC.

PENACOOK, N. H.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Liquid Lock Washer 219

Information about a liquid sealant for threaded fasteners is offered in a bulletin of 4 pages. The literature tells what the sealant is, what it does, what are its several uses, what are its properties, and how it is applied. It also lists available grades and explains how to choose the right one. Graphs, drawings, and photographs provide illustration. American Sealants Co., 103 Woodbine St., Hartford 6, Conn.

Etched Parts 220

Bulletin 90 describes photo-forming of metal parts for a variety of industrial and commercial products. Etched to very close tolerances and often in intricate patterns, photo-formed parts are used by such major industries as aircraft, chemical, natural gas, petroleum, stone, rubber, metalworking, instrument, electrical and electronics. Among the parts listed in this illustrated bulletin are filters and strainers for the various processing industries, carburetor strainers, and unperforated specialties. Two processes covered in the bulletin—chemical and electrolytic etching—are reportedly applicable for almost all types of metals. Superior Tube Co., 1521 Germantown Ave., Norristown, Pa.

Transistored Amplifiers 221

Two design problems and the transistorized amplifiers created to solve them are presented in a 4-page case history brochure. Shown with inside photographs and detailed specifications are a 20 w amplifier for public address systems that fits into a 50 cu in. package and a transistorized plug-in high-gain audio amplifier that is directly interchangeable with a vacuum tube unit. Universal Transistor Products Corp., 143 E. 49th St., New York 17, N.Y.

Tube Pin Straightener 222

A precision-drilled 27-hole tube pin straightener for use with Burroughs 6700-6701 type beam switching tubes is featured in a recent brochure. Also presented in the bulletin are a 26-pin wiring plug for use with sockets accommodating the same tubes and a 14-hole tube pin straightener and 13-pin socket wiring plug for the Burroughs type 6844 tube and socket. Star Expansion Products, Div. of Star Precision Devices, 142 Liberty St., New York, N.Y.



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Designed for multiple voltage control ranging from -150 volts at 600 ma, to +300 volts at 250 ma. Up to 6 different voltages per drawer. Can be made to ANY specification.



TRANSVAL engineers have set new standards for high stability, light weight power supplies based on advanced techniques of applying transistors. The units shown above are only a few of the many developed by Transval that meet specifications never before considered practical for transistorized power supplies. Among the leading builders of missiles, rockets, and piloted aircraft using Transval transistorized power supplies are Douglas, North American, Northrop, Hughes, Beckman, Norden Ketay, and Canadian Applied Research Ltd.

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CIRCLE NO. 224 ON READER-SERVICE CARD

X-ray Conversion Table

Complete X-ray fluorescent spectrometer conversion tables for tapaz, lithium fluoride, sodium chloride, ethylene diamine d-tartrate (EDDT), and ammonium dihydrogen phosphate (ADP) analyzing crystals are described in 86-page book now published by Philips Electronics, Inc., Mt. Vernon, N.Y. Compiled by Maurice C. Powers, Technical Services Div., the book contains two sections. Part I lists elements by ascending atomic number and relates them to the proper two-theta angles. Part II lists ascending two-theta angles and relates them to the proper elements. The cost of the book is \$2.00 and can be obtained by mailing remittance to Bulk Mailing Service, P.O. Box 456, Mt. Vernon, N.Y.

Conversion Made Easy

To save time and temper and eliminate errors a booklet of conversion tables has been published. With these tables the switch from the U.S. to the Metric system and back again is a painless one. To convert units of length, weight, and volume from one system into the other no calculation is required. The appropriate answer is obtained by reading it directly from the proper table. A copy of the booklet may be obtained by sending \$1.00 to M. Stand, 527 Lexington Ave., New York 17, N.Y.

Oscillographic Recording

225

The 150 Series 1-, 2-, 4-, 6-, and 8-channel oscillographic recording systems are the subject of a recent 4-page folder. Given are descriptions and specifications of all basic assemblies; 12 different interchangeable plug-in preamplifiers; 2- to 8-channel output recording systems; and 6- and 8-channel mobile console systems and programmer for analog computer readout. Sanborn Co., Industrial Div., 175 Wyman St., Waltham 54, Mass.

Plastic Plugs and Caps

226

Bulletin No. P 5708 presents a complete line of plastic plugs and caps for protecting internal and external threaded parts, ends of tubes, and other equipment. Its 18 pages cover more than 200 different plastic protectors molded from rigid acetate and from flexible vinylite. Major plug and cap designs for each of two lines are described in individual sections, with key specifications given in table form. Over 100 photographs and drawings depict different types of caps and plugs and their installation. S. S. White Plastics Div., 10 E. 40th St., New York 16, N.Y.



This relay may look like just another Sigma 11F, but this is not the case. It's the new 11F with AC adjustment. As such, it is the only AC relay available in the low price field that can boast such small size and all-around satisfactory performance within its ratings. This is why it sits so smugly at the top of the page, without even a headline.

It should be pointed out here and now that this relay is strictly an on-off deal... if you're looking for something fancier, Sigma probably has it (at a higher price). But, where you don't need the frills—in such items as water heater controls, tape recorders, and small battery-powered

emergency lights used in restaurants, gambling casinos and federal penitentiaries—the 11F-ACS has no peer.

For the less technical-minded (who can't figure out the specs from the comprehensive application data above), the AC 11's have an operating level of 0.3 volt-ampere and will switch one ampere resistive loads at 28 VDC or 120 VAC. They are suitable for applications requiring UL Approval. Size, 1 1/2" square x 1" high, max. Price ranges from about \$2.00 to \$3.00 list in sample quantities (which are available), to about half that in quantities the designers dream about.



Packaging of the Series 11F relays is also an exclusive in the relay field. The relays fit snugly into specially designed molded foam layers which hold 25 or 50 relays apiece and stack neatly (i.e. the bottom of the top layer is the top of the bottom), eliminating the need for individual wrappers, fillers, boxes, bags, etc., and which might simplify inspection and assembly handling. The executives illustrated are really contemplating possible end-uses for these white foam layers. Suggestions so far include: raw material for making Christmas decorations, lawn ornaments, backyard toboggan runs, and a replacement for marshmallow fluff in peanut butter sandwiches. Any other constructive suggestions will be welcomed.

Inquiries about the 11F AC relay are also invited.

SIGMA

SIGMA INSTRUMENTS, INC., 91 Pearl Street, South Braintree 85, Massachusetts

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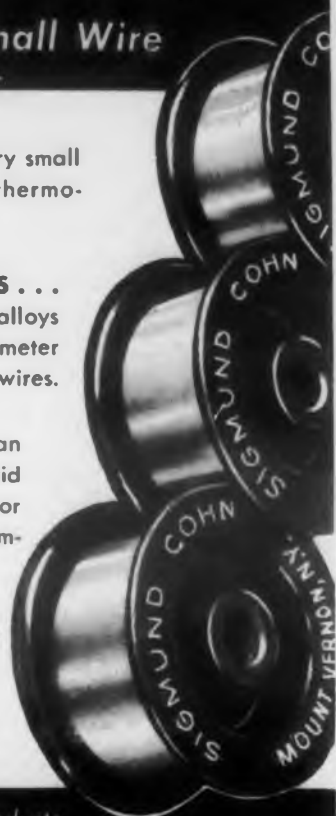
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BASE METAL WIRES . . . Very small diameter — for filaments, thermocouples, resistance units.

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ONE FLICK RESETS this
HIGH SPEED *Electric* COUNTER

Model "YE" by
DURANT

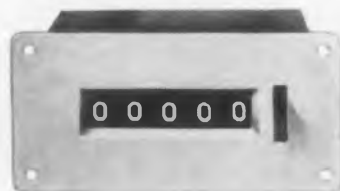
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First high-speed electrically actuated counters with added advantage of electric reset. Clean-cut, legible 3/16" figures, white on black. Ideal for all high-speed electric counting applications — accurate at high, low or intermediate speeds.

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CIRCLE 229 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Audio Amplifiers

230

A line of audio frequency amplifiers has recently been cataloged with 12 pages of text, photographs, charts, and diagrams. Specifications listed in this catalog, No. 16-C, are based on normal vacuum tube characteristics. Individual coverage is given to preamplifiers, boom microphone preamps, line amplifiers for magnetic film playback, plug-in chassis in kit form, mounting frames, and power supplies. Cinema Engineering, Div. of Aerovox Corp., 1100 Chestnut St., Burbank, Calif.

Test Equipment

231

Test instruments for electronic control and measurement are described in 24-page catalog B now available. Included are detailed design and performance specifications, 22 schematic diagrams, typical application circuits, numerous constructional photos and a useful application summary. Illustrated throughout, the catalog covers industrial and laboratory instruments with related accessories and includes micro-micro-ammeters, amplifiers and similar products. Keithley Instruments Inc., 12415 Euclid Ave., Cleveland 6, Ohio.

Pulse Height Analyzer

232

Bulletin PHA-2 introduces the model PHA-2 100-channel quartz line pulse height analyzer. Making use of a pulse-height-to-time converter unit and an ultrasonic delay line memory, the instrument is used for the rapid accumulation of data on the amplitude distribution of electrical pulses arriving at random time intervals. It can be applied to the study of any phenomena where events can be expressed in terms of electrical pulses of varying amplitudes. Nucleonic Corp. of America, 196 Degraw St., Brooklyn 31, N.Y.

Radar Tracking

233

"True Tracking" and "Off-Center" radar developments are described in 6-page illustrated brochure now available. "True Tracking" radar shows immediate differentiation between moving vessels and stationary objects. "Off-Center" radar gives greater, more important scanning area information while retaining "close-in" definition. Mark III technical data included. Adaptability to existing Mark III radars is explained. Sperry Gyroscope Co., Great Neck, N.Y.

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When you get the frequency, phase angle, and amplitude loci plotted on these worksheets, you've got a "standardized" permanent record of the system you are checking.

The Complex Plane Conversion Chart, Worksheet #104, should be particularly helpful. On it are plotted the loci of constant closed-loop gain (in units of voltage ratio) on the horizontally axial circles, and the constant-loop phase (in degrees) on the vertically axial circles. These loci are plotted over Cartesian coordinates, the ordinate of which represents the unreal, and the abscissa the real, component of the gain vector.

Suggestions for an uniform procedure in working up the different curves are included.

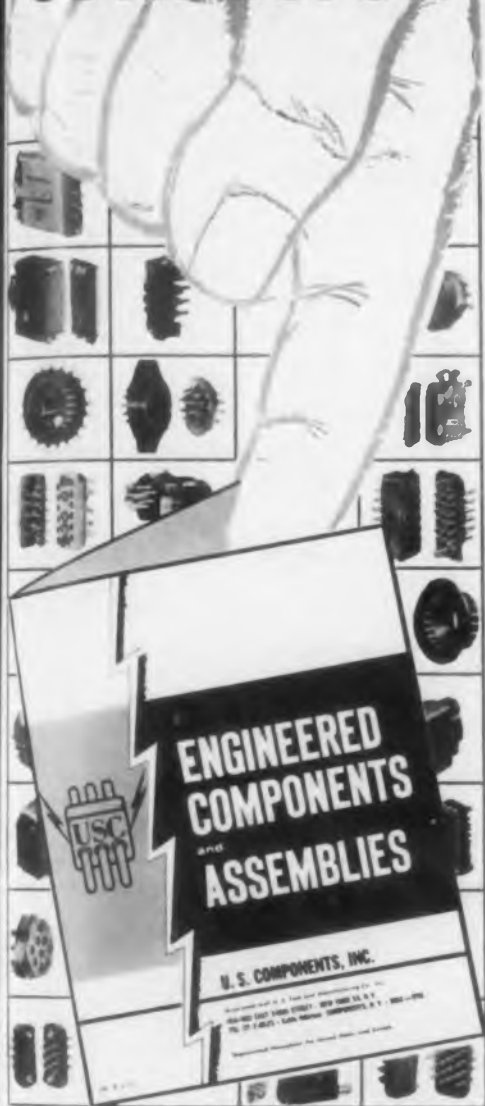
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CIRCLE NO. 235 ON READER-SERVICE CARD

Test Instruments 236

A 2-page brochure describing ten completely transistorized instruments is now available. The leaflet lists five test instruments in a self-powered series, including waveform generator, pulse generator, frequency meter, transistor curve tracer, 30 mc generator. Two power-measuring devices are listed. In microwave instrumentation the brochure describes a klystron power supply, standing wave amplifier, microwave test set. Cubic Corp., 5575 Kearny Villa Rd., San Diego 11, Calif.

Test Precision Delay Generator 237

The description and operation of the precision delay generator, type 6010 designed as a piece of laboratory type test equipment for applications which require accurate variable, time interval pulses are described in 4-page brochure now released. The information on the precision delay generator is divided into three parts: trigger, delay and regulated power supply generators, and the operation of each unit is given. The waveforms from the delay generator are illustrated along with the particular specifications for each waveform such as rise time, pulse width and amplitude. All other operating specifications, both electrical and physical are included in the brochure. Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia 7, Pa.

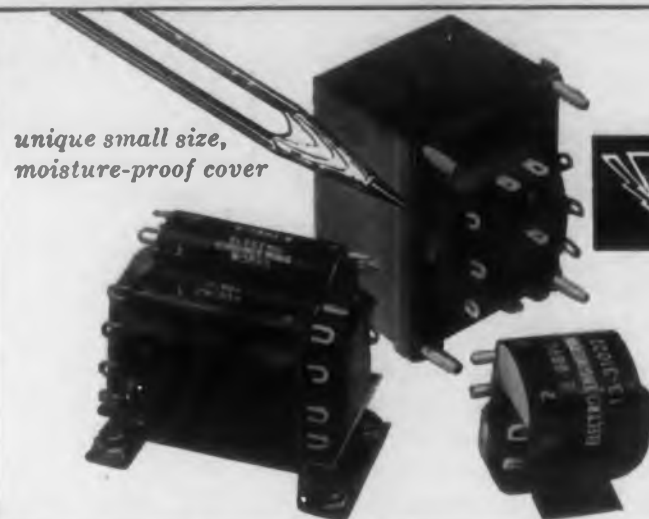
Tape Wound Cores 238

Bulletin TB-102 contains 8 pages of information on a line of tape wound cores. It describes the three types of material from which the precision made cores are manufactured and explains and illustrates test procedures. Standard test limits are given in chart form and graphs show constant current flux reset data. The catalog also contains information on protective boxes, vibration and shock procedures, standard and special core sizes, and order information. G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N.J.

Electrical Hardware 239

Brochure designed to serve as a convenient file reference for those who require such components as small switches, controls, tube bases, terminal boards, sockets, or who need such services as phenolic or ceramic molding cooling, stamping or specialized assembling in connection with the production of electrical units is now available. Printed in color, the brochure points up the supply of standard parts; and builder of special electrical products designed to customer specifications. Alcor Mfg. Co., 4444 W. Roosevelt Rd., Chicago 24, Ill.

unique small size,
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- Minimum size and weight
- Meet MIL-T-27A Grades 2 or 5 requirements
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... slash temperature rise as much as 50%



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Custom built EPSEAL miniaturized transformers achieve temperature rise as low as 50% of comparable sized units, in ambient temperatures as high as 125 degrees C. A new transformer encapsulation process, in combination with unique coil construction (patent pending), offers the electronics engineer reduced temperature rise in smaller and lighter-weight transformers. Packaged in smooth, hard-covered materials without bulky exterior sealing. Write for complete particulars and design specifications to

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CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION



Vitramon CAPACITORS

will help you build

WIDE TEMPERATURE RANGE

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VITRAMON capacitors . . . fine-silver electrodes fused to pure porcelain enamel dielectric . . . operate predictably over a range of more than 300°C and come back from the extremes — unaltered.

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RUGGED LOW LOSS STABLE VAPORPROOF

LOW NOISE MINIATURE

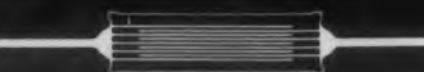
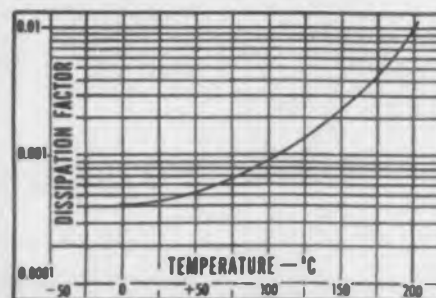
The biggest names in electronics use VITRAMON capacitors in guided missiles, jet ignition, proximity fuses and in radar, servo, guidance, fire control, telemetering and carrier telephone systems.

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VITRAMON capacitors have low dissipations from -55°C to 250°C.



Two materials — a monolithic block of porcelain enamel and fine-silver electrodes — fused into one strong, stable, efficient and effectively homogeneous **RELIABLE** unit.

CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

B·A

COMPLETE, ACCURATE TRANSISTOR TESTING EQUIPMENT

Baird-Atomic Transistor Test Equipment has been specifically designed and developed to provide highly accurate transistor characteristics and classification data. The units illustrated below are part of our complete line of transistor testing instruments.



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The transistor tester that is rapidly becoming the standard of the industry . . . for h parameters and equivalent T coefficients . . . NPN and PNP junction and surface-barrier transistors . . . grounded-base or emitter circuits . . . alpha and beta cut-off . . . I_{co} . . . and C_c . Test frequency from 100 cps to 1 mc.

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Model KP1



Measures all h parameters . . . provisions for measuring transistor reverse characteristics and external measurement of I_{co} . Wide range of test conditions — I_c and I_e , variable from 0.5 to 300 ma; V_c , 0 to 100 volts; frequency 200 cps to 200 KC.



BETA, $h_{11} - I_{co}$
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Light . . . portable — completely self-contained . . . utilizes transistorized, printed-circuit construction. Contains 1 KC oscillator and long-life mercury-cell power supply. Provision for collector waveform observation . . . meter overload protection.

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CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Impregnating Resins 243

A line of impregnating resins known as Eccoseal is described in 10-page brochure now released. Included are materials for transformers, coils, capacitors, and electronic circuits. Several of the impregnants are epoxides; one can be used to temperatures as high as 600 F. One is extremely low loss; others feature low viscosity, long room temperature pot life, and moderate curing temperatures. Emerson and Cuming Inc., 869 Washington St., Canton, Mass.

Varistors and Thermistors 244

Two technical bulletins concerning voltage-sensitive resistors and negative temperature coefficient-resistors have been released. No. GR-2 deals with physical and electrical characteristics of Type BNR varistors—voltage-sensitive resistors; and GR-3 covers the physical and electrical characteristics of Types B, F and H Thermistors—negative temperature coefficient resistors. Both bulletins contain charts, tables, and conversion curves relative to application of varistors and thermistors. Carborundum Co., Global Div., P.O. Box 339, Niagara Falls, N.Y.

Pulse Circuit Components 245

Bulletin No. 731 gives complete engineering data on miniature and subminiature pulse circuit components for radar, computers, and similar applications. Pulse transformers, packaged blocking oscillator circuits, and pulse circuit engineering kits are fully described with illustrations, dimensional data, and performance characteristics. Information formerly contained in Bulletins BO and KA is brought up to date and condensed in two pages for quick reference. CBC Electronics Co., Inc., 2601 N. Howard St., Philadelphia 33, Pa.

Antenna Pattern Measurement 246

Technical paper now available entitled "Antenna Pattern Instrumentation" describes a complete microwave test equipment system for antenna pattern measurements in the frequency band from 1000 mc/s to 10,500 mc. Discussed in detail, are the various components of the system, including transmitter, heterodyne frequency meter, and recording receiver. The paper also discusses other applications, including calibration of attenuators, impedance measurement, and field strength measurement. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y.



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Ask for data file 111C



Environmental Effects on Precision Potentiometers

BY ALBERT W. GREEN
Research Engineer
Helipot Corporation

AND KEITH S. SCHULZ
Research Laboratory Supervisor
Helipot Corporation

Presented at the 1956 WESCON

Beckman® Helipot Corp., Newport Beach, Calif.
a division of Beckman Instruments, Inc.

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The reason is simple: the amazing tolerance limits, the low cost, and the unbelievable accuracy and uniformity of Wilmad precision glassware have made many metals, plastics and ceramics far too expensive.

If you design electric or electronic devices of any kind such as wave guide tubes, UHF tuners and cavities, voltage regulators, capacitors, dashpots, etc., investigate the economy and efficiency of precision glassware. Our engineers welcome the opportunity of discussing any of your design problems with you. Send for our new bulletin today.

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Three things make LOCKTITE Holder tower over all other holders on the market:

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For supreme satisfaction use LOCKTITE with imported CASTELL 9030 lead in 19 degrees, the same quality lead that made CASTELL wood pencil famous in every civilized country in the world. Call your Dealer today.

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CIRCLE 250 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Calorimeter

251

The ways and means to eliminate rf radiation hazards by the use of water loads and calorimetric techniques, are discussed in technical reports now available. They describe simple methods to absorb and evaluate power so that equipment may be energized, operated and adjusted under full load without hazards to operating and area personnel. The information comprises a set of illustrations, technical reprints and instruction book excerpts covering both waveguide and coaxial energy sources. Emphasis is in the power region between fractional watt to over 50,000 w average and 20 Mw peak power involving the frequency spectrum between vhf and 40,000 mc. Chemalloy Electronic Corp., Gillespie Airport, Santee, Calif.

HF Inducers

252

The first two issues of Inerductor Notes—published from time to time to keep you informed of the progress in the development and use of high-frequency electrically-controllable inductors have been printed. The series of notes will review such factors as temperature characteristics, hysteresis, magnetic bias, frequency range, and Q of the units themselves. There will also be discussions of circuitry developed particularly for use with controllable inductors and typical applications of these devices in commercial and military equipment. CGS Laboratories Inc., Stamford, Conn.

Selenium Rectifiers

253

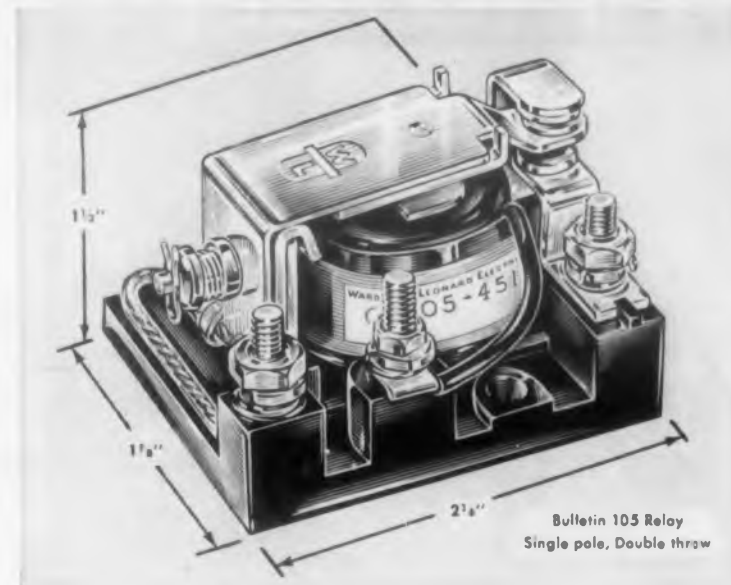
Advantages and disadvantages of "Selenium Rectifiers for High Voltage DC Power Supplies" are the primary features of the 12-page bulletin recently released. In the discussion, the economics of selenium rectifiers as compared with high voltage rectifier tubes is covered. Illustrated with photos, diagrams, and tables, this technical bulletin also contains specifications, key features, and a bibliography. Sorensen & Co., Inc., Beta Electric Div., 333 E. 103rd St., New York 29, N.Y.

Relay Study

254

Available in a three-ring loose-leaf binder is the latest in a series of engineering bulletins providing a comprehensive report on the Type 4 relay. An addition to previous relay studies, the new bulletin deals with specific applications involving coils and contact arrangement of the Type 4, showing four basic groups in actual size drawings. Photographs, features, operating specifications, and other technical data on coil characteristics and contact forms are included for enclosed and hermetically-sealed relays. Phillips Control Corp., Joliet, Ill.

Compact power relay... high contact ratings



More relay for your money—that's the big thing you get when you specify Ward Leonard's Bulletin 105 for light power switching jobs.

No delicate, misapplied telephone- or instrument-type relay, the 105. From rigid phenolic base to ample silver-to-silver, self-cleaning contacts, the 105 is built to deal with power . . . just like the larger Ward Leonard relays and contactors. And yet it's extremely compact and low in cost.

You'll find the Bulletin 105 relay—in SPST, SPDT, DPST, and DPDT types—ideal for controlling power to electric heaters, signals, pumps, radio and TV transmitters and public address systems.

Check your catalog file today for Bulletin 105. If it's missing write to: Ward Leonard Electric Co., 77 South Street, Mount Vernon, N. Y. (In Canada: Ward Leonard of Canada Ltd., Toronto.)

7.5

ENGINEERING DATA SINGLE POLE BULLETIN 105 RELAY

Contact Ratings

Volts	D.C. Amps.*		A.C. Amps.*	
	N.O.	N.C.	N.O.	N.C.
0-24	20	15	20	15
25-125	1/2	1/2	20	15
126-250	—	—	15	10

*Ratings are non-inductive.

COIL VOLTS: 6, 8, 10, 12, 24, 32,
48, 115, 230
AVG. COIL WATTS: 2 D.C., 3.75
A.C.

PICK-UP: 85% or less of rated
voltage
WEIGHT: 5 ounces
TERMINALS: Stud type

LIVE BETTER...Electrically

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POLYSTYRENE CAPACITORS ARE AVAILABLE IN HERMETICALLY SEALED, NON-MAGNETIC METAL TUBES, OR BATH TUBS, AS SINGLE, DUAL OR DECADE UNITS, ALSO FILM WRAPPED SECTIONS SEALED WITH A HIGH GRADE PLASTIC DIELECTRIC.

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CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Mica Washers 257

More than 80 stock sizes of flat washers and an equal number of disc blanks of natural mica, are listed in specification bulletin now released. Bulletin No. 2660 includes washers and discs in mica thicknesses of from 0.00025 to 0.02 in. or more. Ford Radio & Mica Corp., 536 63rd St., Brooklyn 20, N.Y.

Scaler-Ratemeter 258

Appropriately called the "Mighty Midget," a portable scaler-ratemeter that takes up only one-fourth the area of conventional units is featured in Bulletin N-8. Providing highly accurate measurements for nuclear labs, medical isotope studies, and atomic science training programs, the Model RCR-2 is pictured in this 2-page bulletin. It also includes specifications, advantages, and a description of the device. Nucleonic Corp. of America, 196 Degraw St., Brooklyn 31, N.Y.

Ceramic Capacitors 259

Subminiature ceramic capacitors are described in 4-page brochure, now available. The Thinline and Ultra-high Frequency capacitors are tabulated in eight types of ceramic material, showing power factors, tolerances, temperature range and characteristics. Mucon Corp., 9 St. Francis St., Newark 5, N.J.

Electric Stop Clock 260

A new industrial, laboratory, or military electrical reset time totalizer, Type 691, is the subject of discussion in Bulletin PB-691. Containing operating features and application data, this 4-page, illustrated bulletin includes an exploded view of the device showing design principles. Detailed descriptions of material, rating, construction specifications supplied. Cramer Controls Corp., Centerbrook, Conn.

High Voltage Supply 261

Pertinent technical information on the Model 212 high voltage supply is contained in a data recently released. In addition to a picture of the unit, specifications such as output, range, coarse and fine control, polarity, and regulation are supplied. Radiation Instrument Development Lab., 5737 S. Halsted St., Chicago 21, Ill.

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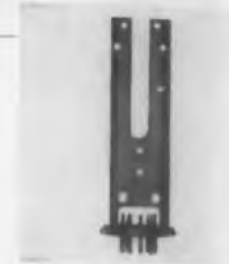
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MINI-MITE
miniaturized SET SCREWS
CUT YOUR COSTS!

ACTUAL
SIZE



Blowup shows precision made MINI-MITE Set Screws with perfectly formed beads which assure easy insertion of driving tools.

For miniaturized applications Setko MINI-MITE Set Screws can cut your costs in four important ways. Reduces initial cost, no extra charges are incurred because of special design. Increases production rates because MINI-MITES are made with watch makers precision, threads mesh precisely—insert perfectly. Cuts down on rejects in sub or final assembly because of consistent uniform quality. Immediate availability in Slotted, Socket and Socket Cap types in sizes #0, #1, #2 and #3 and in a wide selection of metals, finishes, lengths and points to choose from.

FREE TEST SAMPLES Send Today for your Free test samples of MINI-MITES or send your specifications and we will send samples.

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Bartlett, Illinois

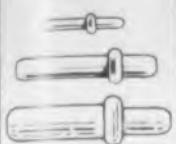
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50% SAVINGS

with

BEAD CHAIN® Multi-Swage Parts

CONTACT PINS



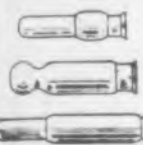
TERMINALS



JACKS



FRICTION CONTACTS



also PRINTED CIRCUIT MINIATURE PARTS

Contact pins, terminals, jacks or any small tubular parts. Maximum 1/4" diameter x 1 1/4" length.

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PROMPT, 24-HOUR OFF-THE-SHELF SERVICE

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CANTON 3, OHIO
Pioneers in the development of high alumina ceramics
phone: Glendale 6-8195

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

Coiled Cords

266

Detailed attention is given to communication and power coiled cords in a comprehensive catalog of 16 pages. The catalog cites the general characteristics, applications and inherent features of coiled cords, the wire types and constructions available, and the terminations that can be used. Descriptions and outline drawings are shown for standard communication and power supply types. Also presented are outline dimensions and complete engineering data for rubber and thermoplastic plugs and connectors that can be molded on to the cords. A feature of the catalog is a complete characteristic check list that permits ordering, with complete specifications, of self-designed coiled cords to meet exact requirements. Essex Wire Corp., Cords Limited Div., 121 Dodge Ave., DeKalb, Ill.

Long Life Selenium Rectifiers

267

Physical and electrical specifications of a standard line of smaller selenium rectifiers are given in Bulletin No. 251. The result of an improved vacuum process, the new rectifiers require no artificial barrier layer and have an estimated life of 100,000 hr. The cell sizes are much smaller than conventional units of the same ratings. The bulletin is a substitution guide which compares these rectifiers with other types. Radio Receptor Co., Semi-Conductor Div., 240 Wythe Ave., Brooklyn 11, N.Y.

Thermostats and Controls

268

Two bulletins have been issued, one on electric thermostats, and the other on thermostat accessories. The first, Bulletin RT-810, discusses a direct-acting model and a reverse-acting one. Both thermostats are available in temperature ranges up to 550 F and are rated at 20 a at 115 vac, and 15 a at 230 vac. The 4-page pamphlet contains general and cutaway views, dimension tables and other data for the bulbs, dimensional drawings, wiring and panel opening data.

The second bulletin, RT-819, covers a variety of modern accessories for electric thermostats and limit controls. Also 4 pages, it contains detailed drawings and diagrams of available thermostat cases, devices for adjusting temperature controls, mounting brackets, and stuffing boxes. Robertshaw-Fulton Controls Co., 110 E. Otterman St., Greensburg, Pa.

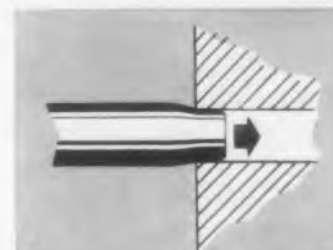
SPIROL - the spring PIN with PERFECT CHAMFER



For Smoother Insertion!

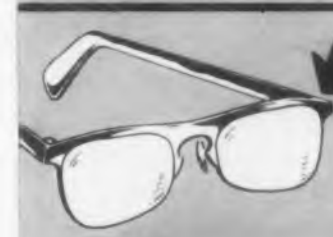
A. Smoothly rounded radius where chamfer meets shank eases insertion into hole. No sharp break to "bite" and resist insertion. B. Chamfer angle is precisely designed to offer minimum thrust resistance and maximum compression leverage.

OTHER UNIQUE SPIROL FEATURES



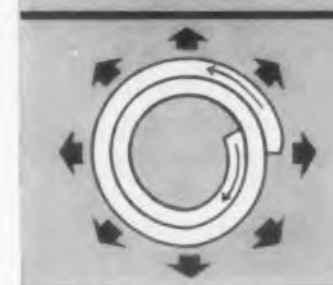
WIDER HOLE TOLERANCES

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.



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.



SHOCK RESISTANCE

High resistance to shock and vibration permits use of "medium duty" SPIROL pins in a wide variety of materials with wide range of bearing loads. Heavy and light duty SPIROL pins also available in stock.

NON-HEAT-TREATED METALS can be specified in standard SPIROL pins for extra corrosion-resistance or conductivity. Less resilient metals are usable because stress is evenly distributed throughout the spiral cross-section, giving maximum spring action.

FREE! Write for literature on Spirol Pins.



SPIROL PIN

C. E. M. COMPANY • 90 SCHOOL ST. • DANIELSON, CONN.
CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

Another **NEW**
CLARE PLANT
to give you relays
of unequalled
quality



New C. P. Clare & Co. plant at Fairview, N. C. will expand manufacturing facilities which have been under way in Fairview for two years.

● Before midyear 1958 CLARE will be serving customers from a new factory at Fairview, N. C. —a facility that will match the manufacturing advantages of our Chicago plant, itself only five years old.

This CLARE expansion is made necessary by the tremendous growth of the electronics industry and the increasing demand for precise components, including relays whose life can be measured in billions of operations.

Facilities of virtually clinical cleanliness are required for this kind of precision. That's why CLARE plants in both Chicago and Fairview maintain complete control of the temperature, humidity and cleanliness of the air . . . immaculate walls and floors . . . powerful, yet shadowless lights, for assembly of small parts.

If yours is a product whose long life, reliable performance and freedom from maintenance depends on relays, it will pay you to know ALL about CLARE relays. C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 2700 Jane Street, Toronto 15, Ontario. Cable Address: CLARELAY.

CLARE RELAYS
FIRST in the industrial field

CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

P.V.C. Tubing 271

Polyvinylchloride tubing, metal reinforced and highly flexible has been made the subject of a 1-page data sheet. A description of the tubing is amplified with illustrations and brief notes on its advantages, specifications, and sizes. A sample accompanies the leaflet. Newage Industries, Inc., 222 York St., Jenkintown, Pa.

Permanent Foil Nameplates 272

Bulletin 177 features four types of self-bonding anodized aluminum foil nameplates. Each type is listed in a table with directions for applying, recommended surfaces, and temperature and water resistance data. The 4-page illustrated pamphlet also contains information on custom design services, military specifications, and application tools. Complete instructions for ordering are included. Samples of the nameplates will be sent with the bulletin. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 9, Wis.

Transistors 273

Bulletin G-120 describes a line of pnp and npn transistors for radio r-f and i-f applications. It also contains valuable information about 4, 6, and 7 transistor radio kits together with accompanying circuit diagrams. General Transistor Corp., Jamaica, N.Y.

Vitreous Enamel Capacitors 274

Catalog 57-1A describes a complete line of miniature porcelain or vitreous enamel fixed capacitors. Performance, dimensions, and all pertinent technical data are illustrated. The booklet also has a complete listing of all part numbers. Vitramon, Inc., Box 544, Bridgeport 1, Conn.

Ceramic Research Facilities 275

A laboratory for exploratory and development work in industrial ceramic technology is described in a 20-page brochure. The illustrated text outlines facilities for analytical chemistry, material preparation, body formation, and general process development and testing. Gladding, McBean & Co., 2901 Los Feliz Blvd., Los Angeles 39, Calif.

WIDE TEMPERATURE RANGE

Davohm Series 850 Hermetically Sealed Metal Film Resistors...

Can be used from -65°C to 150°C . These resistors are sealed with 300° solder. The resistance element is a noble metal alloy deposited on the inner surface of a boro-silicate glass. All elements are unaffected by extreme temperature variations. All resistors from 2 ohms to 4 megohms have the same positive temperature coefficient.

Try these in your critical applications. Write for complete information.

Now carried in stock by your local distributor.

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

World's Largest Manufacturer of Attenuators



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SELECT A HI-FI KIT

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Get the facts...compare...and
you'll buy University KwikKits!
KEN-12 for 12" speakers & systems \$44.75*
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ROOM-BALANCED PERFORMANCE



HEAVIER CONSTRUCTION



PRECISION MECHANICAL DESIGN



NEW FOLDED HORN DESIGN



EVERYTHING YOU NEED



PROFESSIONAL RESULTS

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Write for FREE ILLUSTRATED KwikKit BOOKLET
Desk C-1, University Loudspeakers, Inc.,
80 So. Kensico Ave., White Plains, N.Y.

LISTEN

University sounds better



CIRCLE 277 ON READER-SERVICE CARD FOR MORE INFORMATION

3 New Spring Loaded Diode Clips . . . to hold fragile leads securely



Here are CTC's three new spring loaded diode clips — capable of handling wire diameters ranging from .005" to .085" and designed primarily to grasp the fragile pigtail leads of diodes, transistors

and other similar components.

These new clips are brass, finished in bright alloy plate. All are available with screw stud mount or with rivet mount in five shank lengths.

Such versatility makes these diode clips unique — typical of CTC's original thinking. And like all CTC's other products they have the family traits of high standards in design, precision, and reliability.

For more information and a price list, write to Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Massachusetts.

CIRCLE 278 ON READER-SERVICE CARD FOR MORE INFORMATION

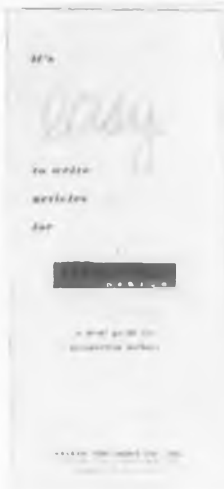
attention authors

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.

ELECTRONIC DESIGN

19 East 62nd Street
New York 21, New York



Constant Voltage Transformers 280

Four pages of facts and figures on constant voltage transformers for electron tube 6.3 v filament supply are presented in Circular CVF-269. The folder describes the operation of these transformers and lists electrical and mechanical data and prices for five stock devices. Illustrating the text are photographs and schematic and dimensional diagrams. Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.

Hi-Pot Testing 281

A comprehensive 10-page article on high potential testing is available free of charge. The article covers such subjects as ac high potential testing, dielectric circuits, ac test equipment, limiting destruction, design for production, testing time vs voltage, and dc high potential testing. Included are drawings, seven application photographs, and two ac-dc hi-pot catalog pages. Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill.

Subminiature Connectors 282

Completely revised, a 12-page brochure catalogs a series of subminiature connectors. Listed with specifications, outline drawings, photographs, and general information are guide pins and sockets, aluminum hoods, polarizing screwlocks, anodized aluminum protective shells, hermetic plugs, and panel cutouts. The catalog also contains instructions for ordering. It is punched for notebook insertion. DeJur-Amsco Corp., Electronic Sales Div., 45-01 Northern Blvd., Long Island City 1, N.Y.

Small Plastic Stock Parts 283

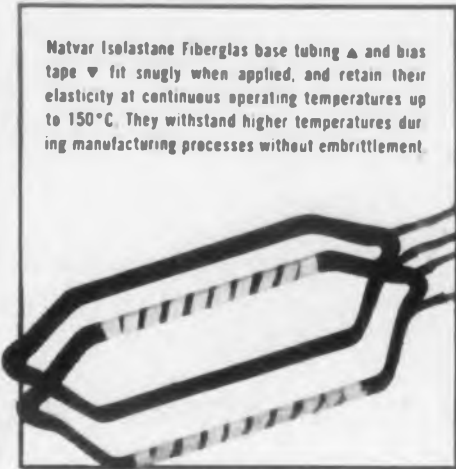
Small injection molded and extruded plastic parts in nylon, marlex, polyethylene, butyrate, and vinyl comprise a list of over 2000 stock items in the 1957-1958 Catalog 500A. Among the many types of industrial parts catalogued are plug, grip-plug, and cap closures for round, square, rectangular, oval, and triangular tubing. There are also angle iron, bar and channel type closures. Other items include wire tips, bumpers, spacers, rollers, extruded plastic welting, T molding, and a wide assortment of both specialized and general usage parts. Catalog describes automatic production processes whereby qualified parts may be custom-made without charges for tooling and dies. PIPCO International Corp., 1731 Stanford St., Santa Monica, Calif.



—for continuous performance at temperatures up to 150°C



—for sharp bends and irregular surface:



Natvar Isolastane Fiberglass base tubing and bias tape fit snugly when applied, and retain their elasticity at continuous operating temperatures up to 150°C. They withstand higher temperatures during manufacturing processes without embrittlement.


*ISOLASTANE is Natvar's new elastomeric isocyanate type coating for Fiberglass braid and tape. Registration pending.

Natvar Isolastane is now making important savings possible. It makes it unnecessary to use expensive Class H materials to solve temperature problems during the manufacture of products which do not require Class H rating.

Isolastane is outstanding in its

- ELASTICITY (EXTENSIBILITY)
- RESISTANCE TO HEAT
- RESISTANCE TO CRAZING AND CRACKING
- RESISTANCE TO SOLVENTS, INCLUDING THE ASKARELS
- TOUGHNESS AND ABRASION RESISTANCE
- WET DIELECTRIC STRENGTH
- LOW TEMPERATURE FLEXIBILITY
- FUNGISTATIC QUALITIES
- ADHESION TO GLASS

Full technical data and samples are available on request.



Natvar Products

• Varnished cambric—cloth and tape	• Slot cell combinations, Aboglas®
• Varnished canvas and duck	• Isoglas® sheet, tape, tubing and sleeving
• Varnished silk and special rayon	• Vinyl coated and varnished tubing and sleeving
• Varnished—Silicone coated Fiberglas	• Extruded vinyl tubing and tape
• Varnished papers—rope and kraft	• Styroflex® flexible polystyrene tape
	• Extruded identification markers

Ask for Catalog No. 23

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION
TELEPHONE RAHWAY 7-8800 CABLE ADDRESS NATVAR: RAHWAY, N. J.

243 Randolph Avenue—Woodbridge, N.J.

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and



HERMETICALLY SEALED!!!

MEPCO TYPE C-1H deposited carbon film resistor answers the need for application where space and reliability are major factors.

CHARACTERISTICS:

Size: 1/4" x 7/64"

Leads: 1 1/2" #26 hot solder dipped

Wattage: 1/10 watt at 70°C

Enclosure: Alumina/solder end seals

Resistance: 100Ω to 100K

Tolerance: 1%

Voltage: 100 V.D.C. continuous
.25KV peak

Other types from 1/10 to 2 watts
Request Catalog WC-1

mepeco, inc. MORRISTOWN
NEW JERSEY

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Ideas for Design

Cementable Teflon Insulation for Rotating Electronic Components



BOBBIN AFTER IMPREGNATION
APPEARS THOROUGHLY BONDED



IMPREGNATED BOBBIN AFTER
SLITTING COIL AXIALLY

TEFLON insulation materials make possible the design and commercial production of 400 F ambient (480 F operating temperature) servo type rotating electrical components. Use of bondable Teflon permits longer life and reliability.

When Teflon was first introduced, its excellent chemical and physical properties were exploited. The one singular attribute that was symbolic of Teflon was its very low coefficient of friction or, to use the vernacular, "nothing sticks to it." The original literature on Teflon highlighted its chemical inertness, high temperature stability, zero moisture absorption, high impact strength, non-adhesiveness, and good electrical insulation properties at high frequencies and high temperatures. In recent years, Teflon has become a prime electrical insulation material for high temperature machines.

To date component manufacturers have been using a double standard in Teflon applications. First of all, because of its low coefficient of friction, Teflon is used as a mold material. Molding compounds will not stick to it, thus releasing the potted assembly. Secondly, electrically Teflon is used as a magnet wire, slot, and turn, and phase insulation where the prerequisite is to impregnate or encapsulate the unit providing well

bonded mass to achieve: *a.* Increase insulation resistance; *b.* Inhibit moisture absorption; *c.* Increase heat conductivity; and *d.* Shock and vibration stability.

Teflon with a normal finish will not achieve the desired characteristics of the second category (see above).

Reliability studies made at Norden-Ketay in 1956 revealed that 400 F units employing Teflon insulation and impregnated with silicone varnish failed under shock and vibration. The varnish flaked and did not adhere to the Teflon surface but jammed air gaps and contaminated ball bearings. Teflon tieing cords also unknotted themselves causing air-gap jamming. It further was revealed that the temperature rise of the units was excessively high. It became evident that a bondable Teflon was a necessity.

Teflon material suppliers were called upon to apply a bondable finish to all Teflon material used in units. This is accomplished by either etching or priming the Teflon surface with silicone, silica, mica, etc. Dummy bobbins were insulated and wound with both plain and bondable Teflon. The results of this test revealed that plain Teflon would calender off films of cured varnish leaving a loose winding that unraveled. The etched Teflon section cured out to a solid mass, as shown.

Temperature rise tests were run on Norden-Ketay 008E2A (400 F ambient) size 8 servo motors. Results were as follows:

Unit	Winding	Ambient Temp. C.	Temp. Rise C.	Input Power Watts	Im-pregnate
101	Plain Teflon	29.0	28.1	3.66	DC 997
100	Etched Teflon	29.0	24.7	3.69	DC 997

The units were mounted on 2-1/4 x 2-1/4 x 5/16 aluminum test stand, run at stall until the temperature stabilized.

Although the difference in temperature rise is only 3.4 C, or 12 per cent lower for etched Teflon, it represents tremendous gains when interpolated in hours of insulation life based upon established data that derates class H insulation life by 50 per cent for every 10-12 C temperature rise.

In using bondable Teflon insulation for high temperature electrical servo components, reliability and life are increased.

Other uses for bondable Teflon are: fractional hp motors, toroidal cores, transformers, relays, solenoids, insulation for potted amplifiers, gaskets and printed circuit card base material.

Theodore J. Silver, Section Head, Materials & Standards Engineering, Norden-Ketay Corp., Precision Components Div., Stamford, Conn.

THE MARK OF QUALITY



VERSATILE, RELIABLE ELECTRICAL COMPONENTS FOR YOUR PRODUCTS



d-c motors

Barber-Colman offers a large variety of compact, high-quality d-c motors for industrial equipment and aircraft control applications. Output up to 1/10 hp . . . available in both permanent magnet and split series types . . . various mountings and speeds. Also offered with gearheads for use as small actuators . . . or equipped with blowers for cooling hot tubes, circuit components, and other confined equipment. Lightweight radio noise filters available for compact, integral mounting on Barber-Colman motors.



tach generators

For accurate speed indication and servo rate control applications Barber-Colman tach generators supply up to 40 volts per 1,000 rpm within plus or minus 0.5% linearity. Available in several frame sizes with maximum rated outputs up to 7,000 rpm or 100 volts. While standard temperature range is -65 to +200° F, Barber-Colman tach generators have been manufactured for -65 to +500° F ambient.



polarized d-c relays

The Barber-Colman Micropositioner is an ultra-sensitive polarized d-c relay capable of operating on input powers as low as 40 microwatts. Available with three types of adjustment: null-seeking . . . symmetrical magnetic-latching . . . or conventional form C snap-acting. Can be operated in excess of 100 cps. Selection of enclosures and mountings. The Micropositioner can also be supplied with integral transistor preamplifiers, greatly reducing the input required for contact operation.



choppers

The Barber-Colman Microverter is the new ac-dc chopper that features extremely low driving power . . . low noise level . . . excellent stability . . . long contact life. It can be used to convert a low-level d-c signal, such as 10 microvolts produced by thermocouples and photocells, into a low-level a-c signal which can be further amplified to operate control apparatus. The Microverter can also be used as a synchronous rectifier to convert low-level a-c signals to d-c without loss. Another important field of application is chopper-stabilized operational amplifiers where zero drift is important.



resonant relays

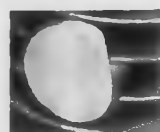
The Barber-Colman JYZA resonant relay is characterized especially by its low operating power and narrow band width. Coil impedance is high enough to be operated in the plate circuit of a vacuum tube without impedance matching devices. These relays can be supplied tuned to any frequency between 115 and 400 cps. Units have been built to resonate as low as 16-2/3 cps. Band width varies from approximately plus or minus 0.5% to plus or minus 1% depending on input and calibrated frequency.

TECHNICAL BULLETINS AVAILABLE on all of the above products. Write today for copies.

BARBER-COLMAN COMPANY

Dept. W, 1883 Rock Street, Rockford, Illinois
CIRCLE 287 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW—self-locking UNBRAKO socket head cap screws



The Nylok* self-locking feature locks these screws securely in place, seated or unseated, wherever you stop wrenching! They won't work loose. Can be used repeatedly. Tough, resilient nylon locking pellets permanently installed. Successfully withstand temperatures ranging from -70 to 250°F . Familiar UNBRAKO knurled heads for sure finger grip and fast assembly—accurate hex sockets for positive, non-slip internal wrenching. Heat treated alloy steel, controlled fillets, continuous grain flow lines, fully formed Class 3A threads for maximum strength and exact fit. Can be used as adjusting screws. Pellets act as liquid seals. Standard sizes from #6 to 1 in. diameter. Also available in plated finishes and in stainless steel. Write for Bulletin 2193. Unbrako Socket Steel Division, STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

*TM Reg. U.S. Pat. Off., The Nylok Corporation

STANDARD PRESSED STEEL CO.

UNBRAKO SOCKET SCREW DIVISION

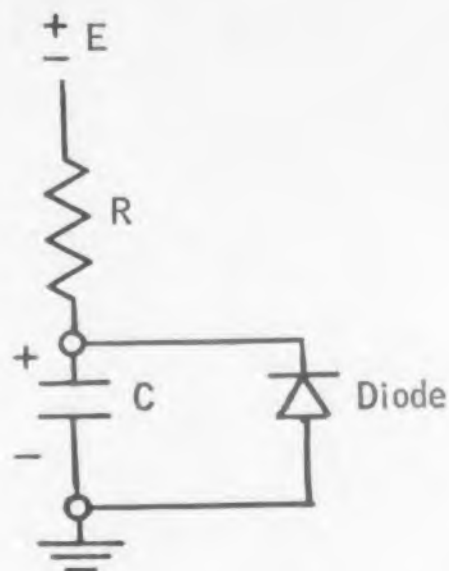
We also manufacture precision titanium fasteners. Write for free booklet.

SPS

JENKINTOWN PENNSYLVANIA

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Ideas for Design



Typical charging circuit with capacitor protection.

Capacitor Protection

It was desired to use a tantalum capacitor in a circuit which would normally have the correct polarity of voltage across the capacitor. Under certain circuit failures or incorrect installation of equipment by the operator, however, a wrong polarity of voltage of amplitude sufficient to destroy the capacitor could be present.

Referring to the circuit, the correct polarity of voltage across the capacitor is shown to be positive. A small silicon or germanium diode is added so that if the applied voltage is negative instead of positive, the diode will conduct and no voltage will appear across the capacitor. This is seen to be a very simple method of preserving expensive tantalum capacitors.

Ronald G. Matteson, Stromberg-Carlson Co., a Div. of General Dynamics Inc., 1400 Goodman Street, North, Rochester, N.Y.

Tamper-Proof Trim Pots

A reduction of up to 40 per cent in the cost of trimmed resolvers and other precision computing elements is possible by using adjustable miniature trimming potentiometers. Unfortunately, they have not been tamper-proof in the field.

A method, developed at Ford Instrument Company, removes the possibility of accidental changing of the screwdriver setting. By making the screwdriver slot of preformed solder, it is only necessary to touch the lead with a soldering iron after adjusting the value of the trim to completely remove the



Time/Frequency Calibrator a Compact, Accurate and Inexpensive Secondary Frequency Standard

★ Crystal-controlled fundamental frequencies at 10 kc, 100 kc, 1 Mc and 10 Mc; usable harmonics to 1,000 Mc

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Write for Complete Data

Type 1213-C Unit Time/Frequency Calibrator: \$235.00

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GENERAL RADIO Company

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Broad Avenue at Linden Ridgefield, N. J. NEW YORK AREA 1000 N. Seward St. LOS ANGELES 18

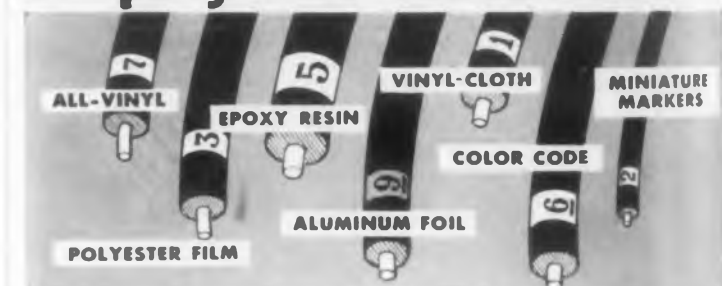
8055 13th St. Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA

1182 Los Altos Ave. Los Altos, Calif. SAN FRANCISCO 6605 W. North Ave. Oak Park Ill. CHICAGO

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Self-sticking Wire Markers now come in seven stock materials tailored to job requirements. The Brady "Perma-Code" system cuts cost of assembly and installation of electrical and electronic parts. They meet NEMA and NMTBA specs and provide permanent around-the-wire identification for 1/5¢ per lead.

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COLOR CODE — Conform to NEMA specifications. You get two-way identification with both color and number.

MINIATURE MARKERS — Specially designed for small diameter wires, electronic and subminiature assemblies.

Listed in SWEET'S Product Design File.

Stocking Distributors in 200 principal cities. Write for free working samples and new Bulletin No. 130-D.

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ELECTRONIC DESIGN • November 1, 1957

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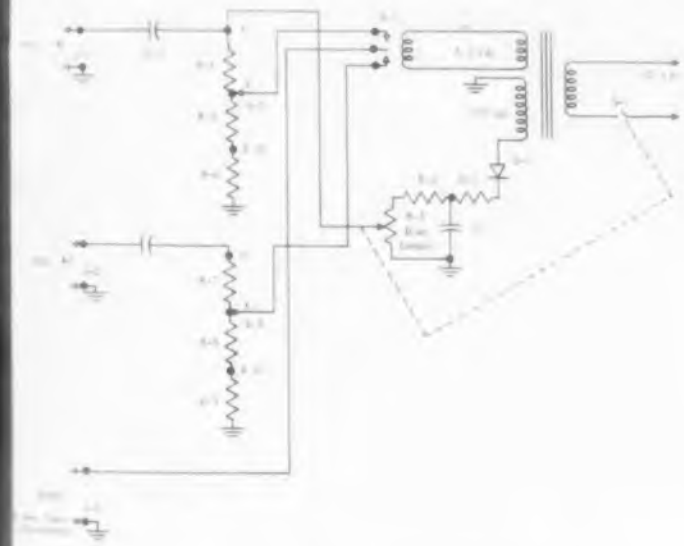
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of readjustment. In addition, the surrounding can be designed so the flow of solder will lock the rotor to the frame and seal the entrance. Pat McKeown, Project Engineer, Ford Instrument Co., Long Island City, N.Y.



Simplified Electronic Switch

The electronic switch shown assumes only a fraction of the complexity of more conventional switches while performing the same basic functions. The heart of the unit is a de-ac chopper unit; to avoid contact bounce a Stevens-Arnold A-12 chopper is used. Adjustment of the dc bias control, R-3, permits both waveforms to be superimposed or



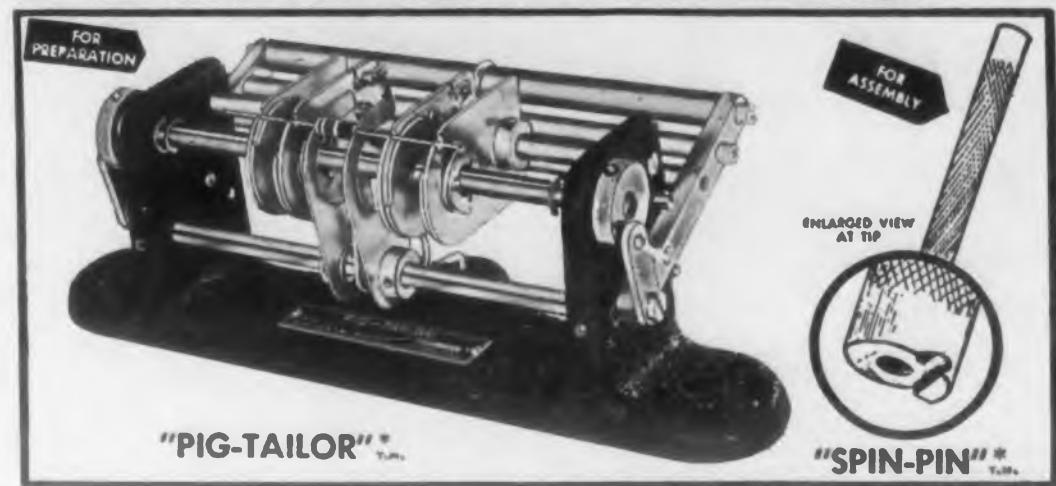
viewed separately on the oscilloscope screen. The bias supply is adjustable from 0 to 150 v.

R-3 is a 5 meg potentiometer which is ganged to an spst switch and D-1 is a selenium rectifier. R-1 and R-2 are respectively 100 k and 1 meg composition resistors. Attenuator resistors R-4 and R-7, 25 meg; R-5 and R-8, 25 k; and R-6 and R-9, 25 k should be exact values. C₁ is rated at 40 μfd, C₂ and C₃ are .25, 400 v capacitor. K-1 may be either mounted horizontally or vertically. When mounted in a horizontal position best results are obtained with pins 1 and 4, of the octagonal base, horizontal. The switch is housed in a LMB box chassis, 3 x 4 x 6.

Joseph Chernof, 6851 Wyngate St., Sunland, Calif.

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4. "S" leads for terminals.	9. Invaluable labor saving.	4. 90% operator training time.	9. Excessive lead tautness.
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* PATENT PENDING

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PROBLEM #5

Design an hermetically sealed, miniaturized, power supply to provide 6600V, DC, at 100 microamperes load, when connected to a source of 115V, 400 cps. Power supply to operate in an ambient temperature range between minus 55°C and plus 85°C. Minimum life to be 5000 hours at full load. Full load input current must not exceed 0.05A. Output voltage regulation, no load to full load, to be 400 volts DC maximum. Maximum ripple voltage at full load to be 250 volts, peak to peak. Casing to be in accordance with the applicable requirements of MIL-T-27. Power supply to have low external magnetic field. Preferred maximum dimensions to be 3 3/4" by 3 3/4" by 1 3/4" thick.

SOLUTION BY PEERLESS

Power supply: Hermetically sealed, AC to DC.
Construction: Oil filled metal casing in accordance with applicable requirements of MIL-T-27.
Duty cycle: Continuous.
Life: Greater than 10,000 hours. (Measured)
Ambient temperature: Plus 85°C maximum, minus 55°C minimum.
Input: Two terminals, 115V, 380 cps to 420 cps.
Input Current: .045A at full load.
Output: One terminal and case, 6600V DC at 100 microamperes.
Regulation: 350V, no load to full load.
Ripple voltage: 200V peak to peak.
External field: Nil.
Dimensions: 1-17/32" by 3-17/32" by 3-19/32"
plus 1-1/16" over terminals.

Peerless transformers have long been the first choice of engineers. One important reason for this marked preference is the fact that the Peerless engineering staff is unsurpassed in designing transformers to unusual and difficult specifications. Undeviating dependability is assured by the most rigid quality control and advanced custom production techniques.

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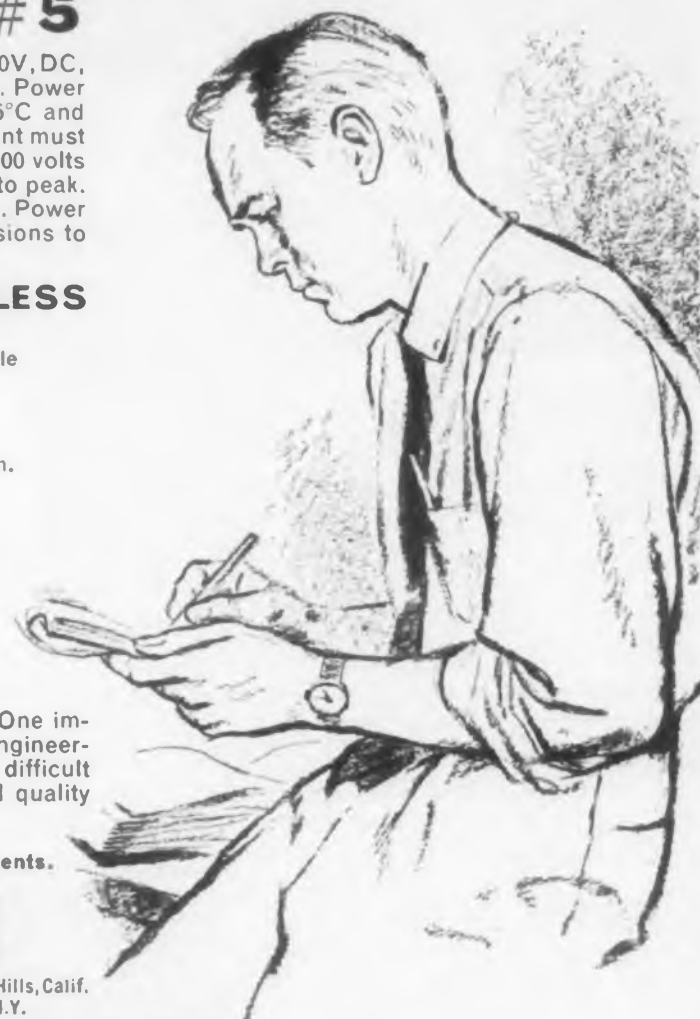
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Junior Utility Ovens

- Low cost • Easy to operate
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Junior Sized: 24" x 24" x 34"
Temp. range to 1000°F.



Model	Internal dimensions	Temperature range
CA 250	22" w by 20" d by 23" h	up to 250°F
CA 550	20" w by 17" d by 22" h	100° to 550°F
CA 650	20" w by 17" d by 22" h	100° to 650°F
CA 1000	18" w by 15" d by 21" h	100° to 1000°F

Ideal for:
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Drying
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Processing
Heat Treating
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Sample Testing

90 day Guarantee on workmanship and materials.

All 4 models have baked hammertone gray finish with an inside lining of Armco aluminized sheet steel.

STANDARD EQUIPMENT: Bottom drip pan, 2" above oven floor; interlocking switches for fan and heating element prevents heat element being turned on unless fan is running; pilot light for oven; pilot light for heating element.

SPECIAL EQUIPMENT: Temperature control instrumentation and non-standard power supply arrangement available.

ALSO A COMPLETE LINE OF HEAVY DUTY, CUSTOM BUILT INDUSTRIAL OVENS AND DRIERS.
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EXPANDED SCALE FREQUENCY METER

- ★ Drives 0-1 ma recorder
- ★ No reference frequency required
- ★ Portable or rack mounted



The Beckman/Berkeley Model 404 is specifically designed for fast, accurate monitoring of frequencies near 400 cps. With its large scale expansion, reading errors due to parallax are insignificant. Useful for production inspection measurements of generating units as well as other applications where a record of frequency is desired. Priced at only \$330 for the portable, \$380 rack mounted. For data sheet, write Dept. D11.

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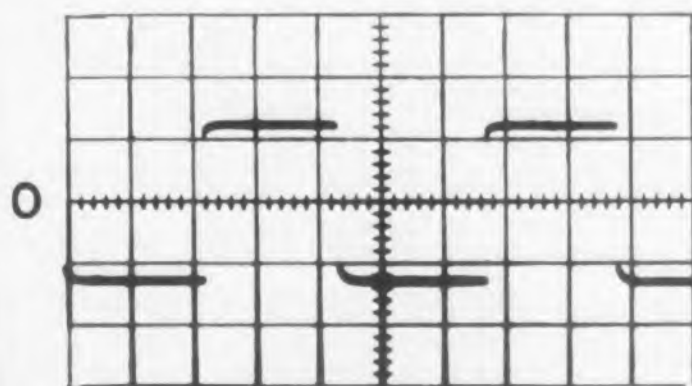
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Ideas for Design

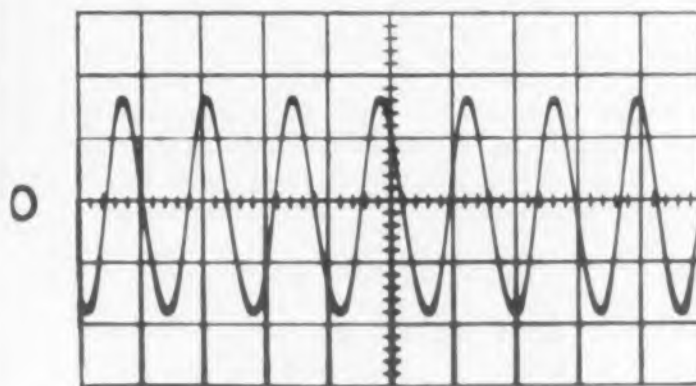
Identifying Polaroid Records

When taking photographs with a Polaroid Camera, data for each picture is usually recorded on the back of the photo or on a separate sheet of paper. An efficient, permanent method is shown here.



INPUT VOLTAGE

VERTICAL: 1V / DIV
HORIZ.: 1MS / DIV



OUTPUT VOLTAGE

Before covering the Polaroid picture with the protective coating, the data can easily be written on the face of the photo with a sharp instrument (paper-clip, scribe, screw-driver etc). The protective coating, then applied, preserves both photo and data, and the data is then directly adjacent to the waveform.

G. K. Machol, Research Engineer, IBM Corp.,
San Jose, Calif.

attention idea men



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.



ELECTRONIC DESIGN

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NEW! Syncramental motor provides precise bi-directional stepping



ACTUAL SIZE 1.5" DIA. X 2.525"

The Syncramental Motor accurately translates pulses to incremental shaft position . . . rotates potentiometers, counters, rotary switches, control mechanisms. Features a clutch mechanism, rather than ratchets, to index the shaft through action of two LEDEX Rotary Solenoids.

Angular increment per pulse is 36° either direction . . . maximum stepping rate, 15 per second . . . load capacity, up to 2 lb. in. starting torque . . . life expectancy, 2 million steps . . . dimensions, 1.500" dia. x 2.525" long . . . weight, 13 oz. . . standard Servo mounting.

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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 Armorpil 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."

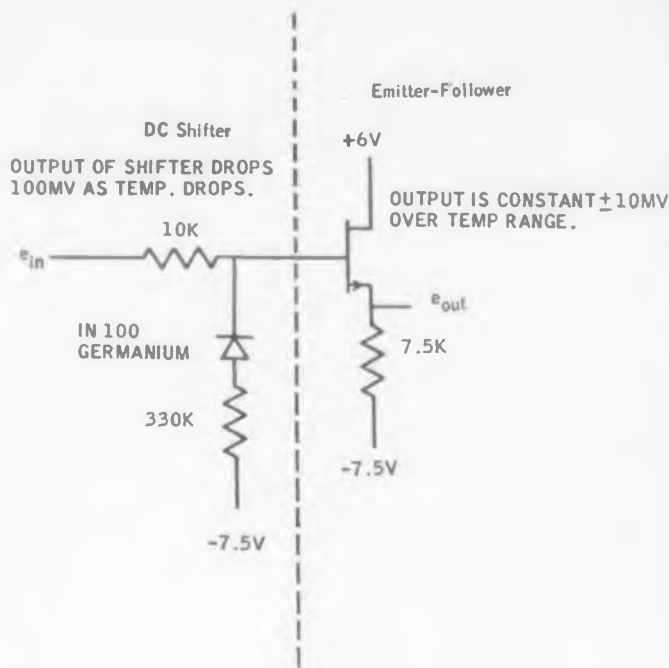
An Armorpil room can be installed, expanded, altered, or dismantled and moved easily because special compression joints eliminate any need for soldering the modular panels. "We intend to order another Armorpil enclosure shortly," says Mr. Ford. "We're perfectly satisfied with Armorpil's performance." Armorpil panels can be specified in a variety of faces and cores. For full details and a free Armorpil sample, write: United States Plywood Co., Dept. ED-11-57, 55 W. 44th St., N. Y. 36, N. Y.

Weldwood ARMORPLY®

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Driftless Emitter-Follower

A driftless emitter-follower was needed to couple a dc signal of about 250 mv. The temperature range was from room value to about 55 C. Silicon transistors such as the Texas Instru-



ment 905 and the Raytheon CK 791 (npn and pnp respectively) were tried. Measurement showed about 100 mv of output change, which was not enough.

Solution Found

Our solution (see circuit) was to feed the emitter-follower with an attenuator or dc shifter using a 10,000 ohm resistor and a back-biased germanium diode. This diode changes conductance as heat changes in such a way as to compensate for the normal emitter-follower drift. Since the compensation was too great, and caused an opposite error greater than the original drift, the diode effect was reduced with a series resistor.

Using this arrangement, the output drift with heat was reduced to less than 10 mv. The circuit is not critical of the diode or transistor used.

D. H. Bryan, Research Engineer, Hughes Aircraft Co., 5440 W. Century Blvd., Los Angeles, Calif.

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5 7/16"

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 - adjustable in timing from 0.1 second to more than 10 minutes.
 - available in AC or DC models which offer delays on energizing and de-energizing, manually-actuated time delay switch, remote push button control, hermetically-sealed units.

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IDEAS FOR DESIGN—ENTRY BLANK

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Here is my design idea for possible publications in your *Ideas For Design* department. I can expect \$10 for this idea if accepted for publication.

(Ideas suitable include: 1. new circuits or circuit modifications, 2. new design techniques, 3. designs for new production methods, 4. clever use of new materials or new components in design, 5. design or drafting aids, 6. new methods of packaging, 7. design short cuts, or 8. cost saving tips)

STATEMENT OF THE PROBLEM—

MY SOLUTION. AND WHY— (Please be explicit. Included sketches or photos that will help get the idea across)

Signed _____
Title _____
Company _____
Address _____

(Place illustrations on separate sheet if necessary)

Report Briefs

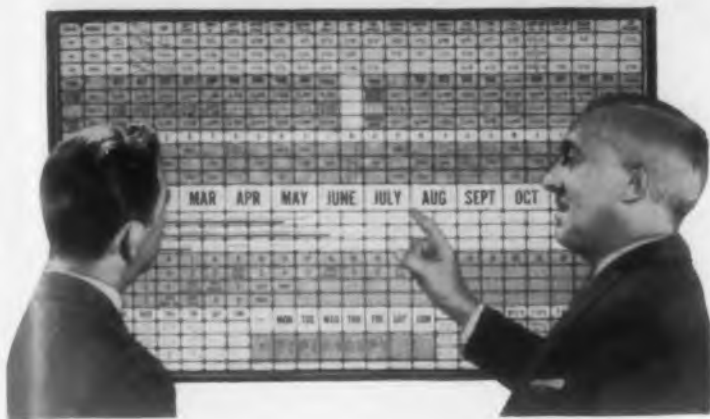
Velocity Jump Amplifiers

This report is devoted chiefly to the results of experiments with two velocity-jump amplifiers consisting of a helix input, the drift tubes, and a helix output. The electrostatic lenses existing between the various electrodes were used for focusing. It was established, that instead of the confined flow plasma frequency reduction factors, those for ion-neutralized flow are more correct for electrostatically focused flow. Because of the long plasma wavelengths corresponding to these reduction factors, it does not seem possible to construct a tube of this type with practical gain. Suggestions are made concerning tubes consisting of short sections of helix operating at different potentials which could be made practical for low current densities. Oscillations were discovered at a number of frequencies and a helix oscillator requiring no focusing is proposed to make use of these resonances. *Experiments with Electrostatically Focused Velocity Jump Amplifiers*, William M. Mueller, Div. of Electrical Engineering, Electronics Research Lab., Microwave Tube Group, Berkeley, Calif., PB 131031, March 1957, 66 pp., \$1.75. Order from OTS, U.S. Dept. of Commerce, Washington 25, D.C.

Decision Rule, Executive

This paper reports some of the findings of a research team that has been developing new methods to enable production executives to make better decisions and to make them more easily than they can with prevailing procedures. With the cooperation of a manufacturing concern, the new methods have been developed in the context of a set of concrete production scheduling problems that were found in a factory operated by the company. The new method, published for the first time in this paper, involves: (1) formalizing and quantifying the decision problem (using a quadratic criterion function) and (2) calculating a generalized optimal solution of the problem in the form of a (linear) decision rule. *Linear Decision Rule for Production and Employment Scheduling*, Charles C. Holt, Franco Modigliani, and Herbert A. Simon, Carnegie Institute of Technology, Graduate School of Industrial Administration, Pittsburgh, Pa., PB 125029, March 1955, 55 pp., microfilm \$3.60, photocopy \$9.30. Order from Library of Congress, Washington 25, D.C.

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CIRCLE 302 ON READER-SERVICE CARD FOR MORE INFORMATION

Mangin Mirror

A microwave antenna was designed on the principle of the Mangin Mirror optical system, a system that comprises a spherical reflector with an in-contact spherical corrector plate. Theoretical investigations were made by optical techniques. The overall aberration characteristics indicated that such a system is superior to either the paraboloid or the spherical reflector. *Mangin Mirror*, R. C. Gunter, Jr., F. S. Holt, and C. F. Winter, Cambridge Research Center, Electronics Research Directorate, Cambridge, Mass., PB 125236, Apr. 1955, 38 pp, microfilm \$3.00, photocopy \$6.30. Order from Library of Congress, Washington 25, D.C.

Microwave Printed Circuits

This investigation of microwave printed circuits was initiated in Feb. 1953 for the purpose of studying uses and applications of symmetrical strip transmission line in practicable microwave circuits. Most of the investigations conducted under this contract used air as the dielectric. Symmetrical strip transmission line involved the use of two parallel ground planes (electrically equivalent to the outer conductor of coaxial line) and a centrally mounted strip conductor (electrically equivalent to the center conductor of coaxial line). A partial list of strip-transmission-line applications benefiting from this study is included in the Appendix. *Theoretical and Experimental Investigation of Microwave Printed Circuits*, H. S. Keen, Airborne Instruments Laboratory, Inc., PB 131019, Nov. 1956, 22 pp, \$0.75. OTS, U.S. Dept. of Commerce, Washington 25, D.C.

Pressure Gage Calibration

The necessity for a reliable procedure for calibration of dynamic pressure gages was indicated by a survey of the pertinent literature and by consultations with research groups familiar with the use of dynamic pressure detectors. These investigations indicated that essentially two methods have shown the response of such instruments. These two methods are described briefly and their shortcomings pointed out. The requirements for a valid procedure, together with the necessary equipment, are described. No actual results could be included, since only preliminary data have been obtained so far due to late delivery of the calibrating equipment by the contractor. Also high persistency of the scope screen falsified the records taken by the camera and only visual observation was possible. *Calibration Method and Equipment for Dynamic Pressure Detectors*, Paul Torda and Walter Ira Weiss, Polytechnic Institute of Brooklyn, Brooklyn, N.Y., PB 131148, July 1948, 8 pp, \$.50. Order from OTS, U.S. Dept. of Commerce, Washington 25, D.C.

Model G-625

Model G-627

AERO-POT

miniature trimming potentiometers

potentiometers

featuring extreme reliability!

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The Aero-Pot is adjustable throughout 32 turns by means of a slotted leadscrew. Resistance range: 100 to 100,000 ohms in one case size. Can be supplied completely sealed. Write for literature.

* PATENT APPLIED FOR

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INSTRUMENTS

WHERE ELECTRONICS MEETS THE EYE

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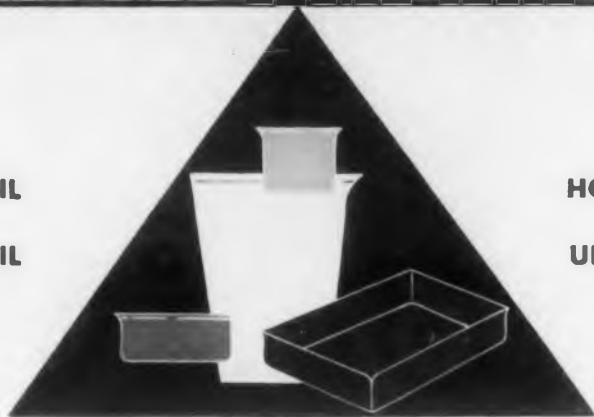
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Patents

Automatic Volume Control for Amplifiers

Patent No. 2,799,737. Stanley R. Rich.
(Assigned to United States of America)

The automatic volume control circuit for an amplifier uses a rectifier to rectify a portion of the amplifier output. The rectified portion of the output is applied to a capacitor and to a grid of at least one of the amplifier tubes in order to reduce the gain of the tube. A rectifier rectifies another portion of the amplifier output and applies this second rectified portion of the output to a second capacitor. A resistor of a relatively low value bridges the second capacitor whereby a quick discharge path is provided for this capacitor. A tube is provided between the two capacitors so that the potential applied to the amplifiers to reduce the gain can be discharged quickly to ground whenever the potential of the second capacitor becomes less negative than the potential of the first capacitor.

Phase Comparator

Patent No. 2,796,556. J. J. Larew. (Assigned to General Electric Company)

The phase comparator described compares the phases of two input signals and produces two direct current output signals whose relative amplitudes are related to the phase difference between the input signals. A positive voltage and a negative voltage is produced whose relative polarities depend upon the relative amplitudes of the direct current output signals. There are two output circuits each of which comprises a gas-filled tube having a control grid and an anode. The positive voltage is connected to a control grid through suitable means which also connects the negative voltage to the other control grid. An alternating voltage is supplied to the anodes of the tubes. A part of the circuit restricts current flow through the tubes to the period when the anodes are at approximately their maximum positive voltage.

Measurement of C R T Screen Color Uniformity

Patent No. 2,799,825. Austin E. Hardy.
(Assigned to Radio Corporation of America)

The patent is directed to a method of testing the screen of a CRT for color uniformity. The screen carries a mixture of two fluorescent phosphors. The method includes the scanning of the screen with an electron beam and causing selected, successive portions of the screen to fluoresce. Separate electrical signals are derived simultaneously from the light emitted from each of the phosphors. A portion of this scanning is blanked in order to establish a zero signal level. The separate signals are applied to separate deflection circuits of an oscilloscope. The amplitude of each of these separate signals is adjusted to a predetermined amplitude. An elongated trace of a predetermined length and inclination is obtained on the oscilloscope. By measuring the width of the trace an indication is obtained which is proportional to the ratio of one phosphor with respect to the other.

Symmetrical Bridge for Reducing Vacuum Tube Hum

Patent No. 2,799,805. Julius J. Hupert.
(Assigned to A.R.F. Products, Inc.)

A hum reducing circuit is described for use with tubes having separate cathode and heater. A source of pulsating current is provided for energizing the heater. A parallel circuit is provided across the source including a pair of series connected capacitors and a resistance having a tap. Between the cathode and the junction of the pair of capacitors, there is a cathode return resistor. An impedance is connected between the cathode and the tap to provide a relatively low impedance in parallel with the leakage impedance between the cathode and the heater and to provide a relatively high impedance in series with the cathode resistor.

Transistor Oscillator

Patent No. 2,797,328. E. G. Miller, Jr.

This patent describes an oscillator for use as a secondary frequency standard utilizing a crystal frequency controller and transistors in a balanced base-to-base coupled circuit. The salient features of the oscillator circuit are that a crystal is connected between the base electrodes of a pair of transistors to accomplish a high impedance path across the crystal, and a tuned antiresonant circuit comprising a capacitance and inductance is connected in parallel and the combination is connected between the collectors of the transistors. Feedback is provided by an inductance that is coupled to the tuned antiresonant circuit and connected to the emitters.

High Impedance Circuit

Patent No. 2,795,654. J. R. MacDonald

This patent describes a circuit possessing a very high impedance ratio transformation for coupling very high impedance circuits with relatively low impedance circuits, in which a low input shunt capacitance and conductance is present and the amplification is approximately unity. An input triode tube has a first triode serially connected between its plate and a positive voltage and a second triode serially connected after a resistor between its cathode and a negative voltage. The grid of said first triode is coupled back to the cathode of the input triode and serves to decrease the input capacitance by increasing the gain of the input triode, while the second triode controls the magnitude of the current through said input triode to near a constant value. The output is taken from the cathode of the input triode.

Trigger Circuit

Patent No. 2,797,319. N. F. Moody

This patent describes a high-speed trigger circuit adapted to function as a discriminator circuit for millimicrosecond work. The trigger circuit is principally designed to provide sensitive and stable operation without variation of the discrimination level due to change in tube characteristics or replacement of tubes. The circuit utilizes in part a secondary-emission tube which

has a dynode coupled through a rectifier to provide positive feedback to the control grid of the tube only at the time an input pulse is present. The trigger circuit is arranged to provide discriminator action in which the level of discrimination is defined by a bias which is obtained in such a way that the discriminating level is independent of tube characteristics.

Compound Action Gain Control

Patent No. 2,801,302. T. H. Quinn

This patent discloses a gain control circuit for controlling the gain between the stages of pulse amplifiers whereby the gain control circuit has substantially the same input and output impedance irrespective of variation and does not exert any deleterious operational effects on the various circuits with which it is employed. The gain control circuit utilizes a pair of tubes; one of the tubes is used as a cathode follower wherein an input signal is impressed on the grid and the output is taken from the cathode and impressed on the grid of the other tube. The cathode load of the second tube is adjustably coupled to the cathode load of the first tube and variably bypassed by a capacitor to provide different degrees of degeneration so as to vary the circuit gain.

Pulse Transformer

Patent No. 2,799,836. R. E. Heller et al

This patent describes an improved transformer particularly adapted as a pulse transformer because it has small leakage inductance and distributed capacitance. The transformer structure essentially comprises an insulating coil frame having the shape of a pair of truncated cones with the bases joined and having an axial aperture through which a leg of a closed magnetic circuit passes, a primary winding formed of a few turns of strip electrical conductor radially wound about said core within said coil aperture, a single layer secondary winding helically wound about said coil frame with its axis essentially parallel to the axial aperture. The single layer secondary winding can be a group of single layer coils connected in parallel in order to produce a high voltage output.

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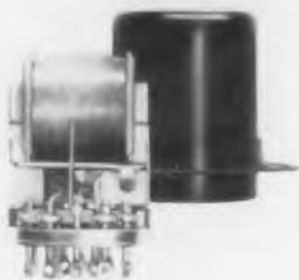
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Books

Synthesis of Passive Networks

Ernst A. Guillemin, John Wiley & Sons, Inc., 440 4th Ave., N.Y. 16, N.Y. 741 pages, \$15.00.

This book is a logical, comprehensive approach to linear passive network synthesis. The author avoids shortcuts in his treatment of the two essential techniques of network synthesis, the approximation problem and the realization techniques. Topics covered in this book include properties of driving-point and transfer impedances, synthesis of I.C. RC, and RL driving-point impedances, transformerless driving-point impedance synthesis, methods of transfer function synthesis, the approximation problem, and time domain synthesis. The coverage is sufficiently detailed so that the reader who digests the material should be able to work independently in the field. Included are numerous illustrative and practice problems. A good understanding of both essential mathematics and basic circuit analysis is considered prerequisite to the use of this volume.

Standard Handbook for Electrical Engineers, Ninth Edition

Edited by Archer E. Knowlton, McGraw-Hill Book Co., Inc., 330 W. 42 St., N.Y., N.Y., 2230 pages, \$19.50.

This book, the work of one hundred collaborators, is available to serve the busy engineer as directly, as simply, and as authoritatively as possible, within the confines of a tolerably sized volume. It is a basic tool for facts, figures, and formulas, for on the job information. The extensive revision of the book in this edition includes new or enlarged sections on such subjects as transistors, nuclear power, new dielectrics for capacitors, many new synthetic resins and plastics, electrical measurement for automation, new lighting, recent metals, elec-

trical conductor tables, 12 volt automotive systems, telemetering, and magnetic amplifiers in motor control.

The Science of Engineering Materials

J. E. Goldman, Editor, John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 528 pages, \$12.00.

An outgrowth of the Carnegie Conference on Solid State Physics held in June 1954, this book attempts to answer the "why" of material behavior. It is the work of a number of scientists in numerous physical and engineering fields and is intended to catalyze curriculum revisions and formalize the introduction of solid-state science into the engineering curriculum. The opening chapters provide the necessary background in modern physics and also offer an analysis of the general scope and terminology of the solid state. Since, in essence, this compilation functions primarily as an outline of solid-state science in its broadest terms a qualitative explanation of the properties of cements, polymers, and glasses plus metals, alloys and semi-conductors has been included.

Basic Physics

Vol 1 & 2 Combined, Alexander Efron, John F. Rider & Co., 116 W. 14th Street, N.Y. 11, N.Y., 692 pages, \$7.60.

Here are two readable and well organized volumes in one binding, covering the fundamentals of classic and modern physics, at an intermediate level. Special effort has been made to make this course self teaching. The book contains 800 illustrations and descriptions of basic demonstration experiments. Problems of graduated difficulty are found at the end of each chapter.

Analytical Design of Linear Feedback Controls

G. C. Newton, L. A. Gould, J. F. Kaiser,
John Wiley & Sons, Inc., 440 4th Ave., N.Y.,
N.Y. 419 pages, \$12.00.

Taking as their starting point, the system specifications, the authors include descriptions of the input, the disturbances, and the desired response of linear feedback controls. They include a statement of the basis on which system performance will be judged, in the form of a performance index. The design objective is to minimize or maximize the chosen performance index. Analytical design is a method used in accomplishing this objective.

Contents of this book includes adjustment of parameters to minimize errors, stochastic signals, limitation of saturation tendencies in fixed elements, the design of control systems for minimum bandwidth, and an application of analytical design theory to a practical problem. Important appendices, a glossary, and numerous problems are also included.

Notes on Analog-Digital Conversion Techniques

Edited by Alfred K. Susskind, The Technology Press, M.I.T., Cambridge, Mass. 416 Pages, \$10.00.

This presentation is aimed primarily at readers who have been away from formal academic work for some time, and who have little previous knowledge of the field. Some background information is included, and an effort was made to develop methods of presentation which require a minimum of sophistication. The choice of subject ma-

terial was based primarily on what was considered to be of greatest interest to the practicing engineer. The subject matter is divided into three parts. The first part pertains to systems applications of digital information processing that influence the specifications for analog to digital conversion devices. In the second part, a detailed engineering analysis and evaluation of a variety of conversion devices are presented. The third part is devoted to a case study based on development work done in the development laboratories of M.I.T.

Selection and Application of Metallic Rectifiers

S. P. Jackson, McGraw-Hill Book Co. Inc.,
330 West Forty-Second Street, New York
36, N.Y. 326 Pages, \$8.00.

In line with the increasing use of metallic rectifiers, this book is planned to serve as a guide for engineers and technicians in the selection and application of rectifiers. It gives information on their fundamentals and characteristics, and use in a wide variety of electronic and electrical equipment.

Fundamental rectifier circuits are covered, and such related circuitry as filter circuits and transformer requirements. A section deals with the general characteristics of metallic rectifier cells, and provides a guide to the selection of the proper component. The general discussion of metallic rectifiers includes information on ratings, rating methods, and how to use typical data supplied by manufacturers. This book includes a considerable amount of design data in the form of curves and equations, and a selection of illustrated problems.

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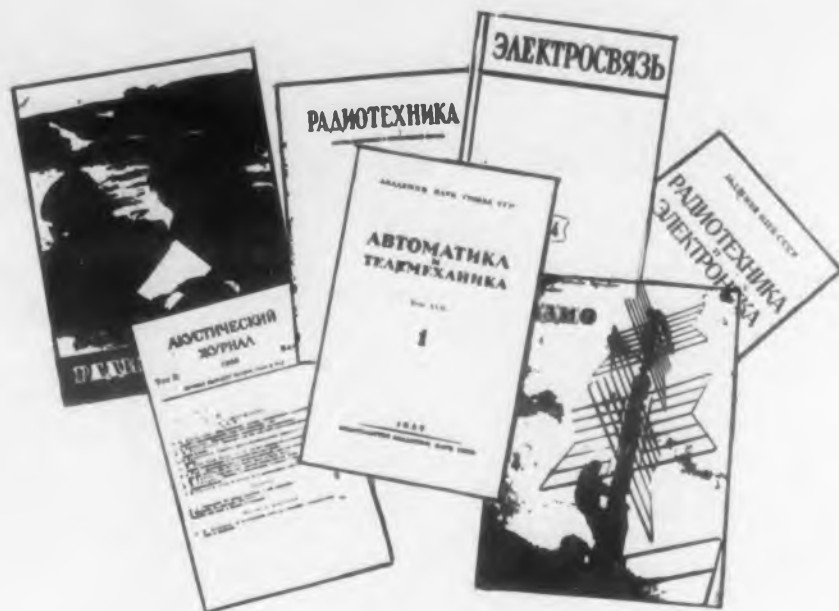
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What the Russians are Writing

J. George Adashko

AUTOMATION AND TELEMECHANICS

(Contents of *Avtomatika i Telemekhanika* No. 3, 1957)

INFORMATION THEORY

On the Calculation of the Correlation Function of a Stationary Random Process from Experimental Data, B. N. Kutin, (22 pp, 5 figs).

Whenever the correlation function of a stationary random process is calculated from experimental data, the fact that the process is observed during a finite time introduces certain errors. These errors are estimated for various forms of autocorrelation functions, determined approximately from the experimental data by various methods. The equations derived make it possible to obtain mean-squared error resulting from the calculation. Reference is made to "Statistical Errors in Measurements on Random Time Function" by Davenport, Johnson, and Middleton (*Journal Appl. Phys.*, Vol 23, No. 4, 1952).

Determination of Periodic Modes in Systems with Response Curves Composed of Two Straight Lines of Prescribed Slopes. Part II. M. A. Aizerman, F. R. Gantmakher, (8 pp, 6 figs., 2 tables).

The method described in the first part of the paper (*Avtomatika i Telemekhanika*, No. 2, 1957, *ED* September 15, 1957) is extended to include all types of piecewise-linear characteristics composed of segments that are parallel to two specified direc-

tions; the treatment is also extended to all types of periodic modes.

RELAYS

Investigation of Simplest Relay Follow-Up System, G. V. Gerken-Gubanov, (6 pp, 11 figs).

Analysis of the motion of a relay servo-mechanism system that synchronizes from an initial error in the presence of backlash, of a relay pull-in to drop-out voltage ratio, and of time delay in the operation and drop-out of the relay.

Synthesis of Relay Circuits with the Aid of Machines, F. Svoboda (Prague), (16 pp, 19 figs).

A Czechoslovak semi-automatic experimental machine for the synthesis and analysis of combination relay circuits. The machine operates with indeterminate switching functions and consists of a switching-function generator, circuit-simulation model, decoder, and function collator. The use of this machine, in conjunction with the combination method of synthesis, expedites greatly the circuit design (increases the speed up to ten times). Moreover, it makes it possible to design circuits with more variables, inputs, and outputs, than could be obtained manually.

Concerning Criteria for the Evaluation of Electromagnetic Relays, B. S. Sotskov (6 pp).

Derivation of a general criterion, characterizing

the properties of the actuating and sensing devices of a relay. It is shown that relay performance depends also on relay reliability, on its weight in volume, and on its pull-in and drop-out power.

Improvement of Dynamic Properties of Automatic-Regulation System with the Aid of Aperiodic Feedback, S. Ia. Berezin, (11 pp, 12 figs).

Aperiodic feedback is examined from the point of view of the improvement it makes in automatic regulation systems. Practical methods of obtaining aperiodic feedback are given, and its advantages are demonstrated with experimental data.

REGULATING SYSTEMS

Diagram for Finding the Real Frequency Characteristic from the Open-Loop Logarithmic Characteristics of an Automatic-Regulation System. Iu. M. Astapov, (2 pp, 1 fig).

To evaluate the transient behavior of an automatic regulation system from specified trapezoidal or triangular response curves it is first necessary to plot the characteristics of the system in the real-frequency domain. The author transforms the conventional circle-diagram equation to produce a new diagram consisting only of circles and straight lines passing through the origin.

Analytic Expression for the Static Characteristic of the Sensing Element of a Saturated-Reactor Regulator, E. A. Iakubaitis, (6 pp, 7 figs).

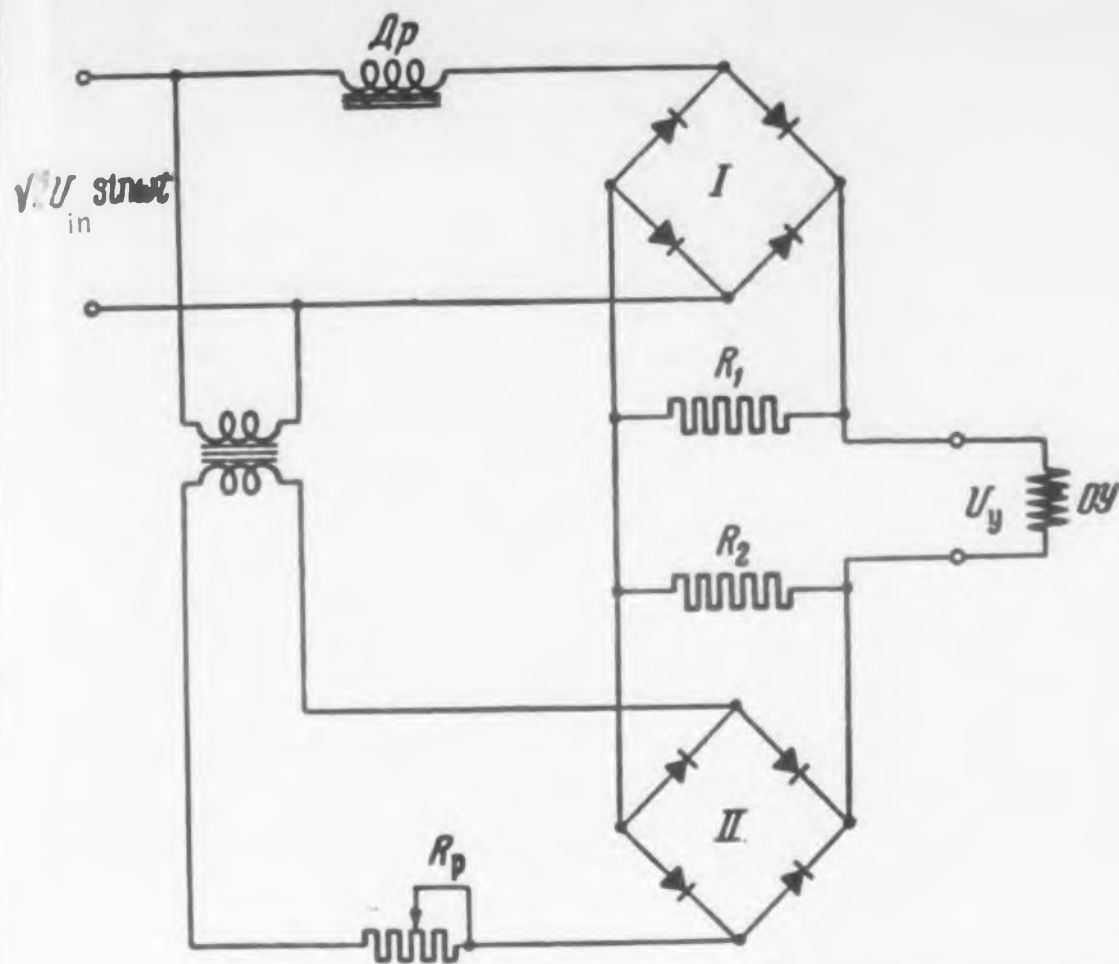


Fig. 1. Measuring element of a saturated reactor regulator (OY—control winding of amplifier).

Piecewise-linear approximation of the magnetization curve of the saturated reactor and of the voltage-current characteristic of the semiconductor rectifier are used to obtain an analytic expression for the static response of the sensing element of a saturated-core regulator shown in Fig. 1.

MAGNETIC AMPLIFIERS

Simplified Design of Magnetic Amplifiers with Iron-Nickel Alloy Cores, N. A. Kaluzhikov (5 pp, 1 fig).

An approximate method, suitable for medium-power amplifiers where optimization is not paramount. It is based on the use of experimentally-plotted BH curves (both ac and dc) of the core material for a certain "standard size" core, with proper rescaling for other sizes.

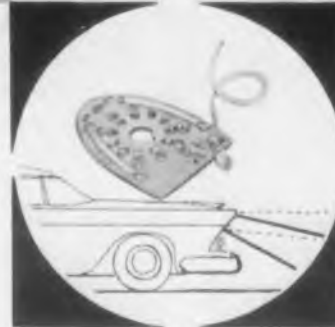
TRANSIENT ANALYSIS

Transients in Transistor Starting Circuits, N. I. Brodovich (7 pp, 8 figs, 1 table).

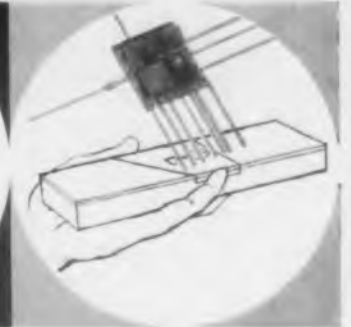
Equations are derived for the time variation of the current in a switching circuit containing a point-contact transistor. Curves plotted from these equations show the response of a standard circuit with various values of gain and time constant to unit step pulse. The response speed of operation of the circuit is determined and requirements are formulated for point-contact transistors used in high-speed switching circuits.



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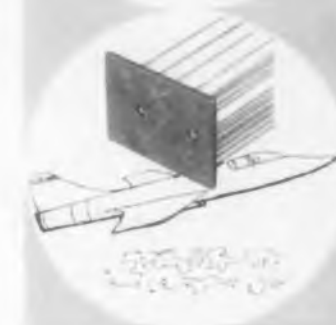
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ELECTRICAL COMMUNICATIONS

(Contents of *Elektrosviaz* No. 3, 1957)

CIRCUIT ANALYSIS

Generalized Analysis of Amplifier Stages, A. A. Rizkin (6 pp, 5 tables).

The generalized equivalent circuits, derived by the author previously (*Elektrosviaz*, January 1956, *ED* May 15, 1956) are used to write down generalized matrices for several types of tube and transistor circuits. Analysis of a high-frequency transistor stage is used as an example. Please refer to Figs. 1, 2, 3, and Tables 1-5.

Investigation of Self-Oscillation Modes in Junction-Transistor Oscillator, S. M. Gerasimov (11 pp, 17 figs).

Failure of a junction-transistor self-excited oscillator to operate at high frequencies may be due to phase unbalance. Phase compensation circuits are proposed to raise the frequency limit, and recommendations are made with respect to the choice of optimum self-excitation mode.

Type of Circuit	Y_1	Y_2	Y_3	m	n
1 Grounded cathode	Y_{gk}	Y_{ag}	Y_{ak}	0	1
2 Grounded grid	Y_{gk}	Y_{ak}	Y_{ag}	1	0
3 Grounded anode	Y_{ag}	Y_{gk}	$Y_{ak} + S$	0	-1

Table 1. The tabulated admittances are for grid-cathode, anode-grid, and anode-cathode. S represents transconductance. (Refer to Fig. 1.)

Type of Circuit	R_1	R_2	R_3	m	n
1 Grounded emitter	r_b	$r_c - r_m$	r_e	0	-1
2 Grounded base	r_e	r_c	r_b	0	1
3 Grounded collector	r_b	r_e	r_c	1	0

Table 2. (Refer to Fig. 2.)

$[y]$	$\begin{bmatrix} Y_1 + Y_2 + mS & -Y_2 \\ (m-n)S + Y_2 & -(Y_2 + Y_3) \end{bmatrix}$
$[z]$	$\frac{1}{[y]} \begin{bmatrix} -(Y_2 + Y_3) & Y_2 \\ (n-m)S - Y_2 & Y_1 + Y_2 + mS \end{bmatrix}$
$[d]$	$\frac{1}{Y_1 + Y_2 + mS} \begin{bmatrix} Y_2 & 1 \\ [y] & (m-n)S + Y_2 \end{bmatrix}$
$[f]$	$\frac{-1}{Y_2 + Y_3} \begin{bmatrix} (n-m)S - Y_2 & 1 \\ [y] & -Y_2 \end{bmatrix}$
$[a]$	$\frac{1}{(m-n)S + Y_2} \begin{bmatrix} Y_2 + Y_3 & 1 \\ -[y] & Y_1 + Y_2 + mS \end{bmatrix}$

$$[y] = [Y_1(Y_2 + Y_3) + nSY_3 + (Y_2 + mS)Y_3] = [Y_{ag}(S + Y_{gk} + Y_{ak}) + Y_{gk}Y_{ak}]$$

Table 3. The admittances in the last line of the equation are anode-grid, grid-cathode, and anode-cathode. (Refer to Fig. 3.)

NOISE REJECTION

Noise Rejection of Receivers with Finite Recovery Time, A. M. Vasil'ev (5 pp).

An equation for the probability density of signal reception in a receiver with a finite recovery time is derived for the general case. A solution, obtained for low-intensity noise only, makes it possible to determine, for the general case, the ratio of the correct to false signals.

RADIO RELAY

Determination of the Basic Parameters of Apparatus used in Multichannel Radio-Relay Lines, S. V. Borodich (10 pp, 4 figs).

The report of a proposed procedure for determining the optimum values of the basic parameters of multi-channel frequency-multiplexing fm radio-relay line apparatus proposed in abbreviated form to International Consultative Committee on Radio and accepted at its eighth plenary session in September 1956.

CONTACTLESS SWITCHING

Contactless Switching Devices Using Transformer Ferroresonant Circuits, Ia. G. Koblentz, D. A. Iakovenko (10 pp, 16 figs).

Description of transformer coupled ferroresonant trigger and counting circuits proposed by the authors, leading to an improvement in the on to off current ratio and permitting the use of cheaper ferrite cores. The circuits developed can be used for control units in automatic telephone stations and in other branches of industry.

Other Articles In This Issue

Methods for Producing Artificial Telephone Traffic, N. V. Reshetnikov, (6 pp, 4 tables).

Statistical-theory methods for determining the load on a telephone station or cable in inaccessible and partly-accessible locations.

Polytonic System of Long-Distance Dialing, V. N. Zachesov (5 pp, 3 figs).

Abstract of "An Experimental Polytonic Signal-

$[z]$	$\begin{bmatrix} R_1 + R_3 & -R_3 + mr_m \\ R_3 + nr_m & -R_1 - R_3 + mr_m \end{bmatrix}$
$[y]$	$\frac{1}{[z]} \begin{bmatrix} -R_3 - R_3 + mr_m & R_3 - mr_m \\ -R_3 - nr_m & R_1 + R_3 \end{bmatrix}$
$[d]$	$\frac{-1}{R_2 + R_3 - mr_m} \begin{bmatrix} -R_3 + mr_m & [z] \\ 1 & -R_3 - nr_m \end{bmatrix}$
$[f]$	$\frac{1}{R_1 + R_3} \begin{bmatrix} R_3 + nr_m & [z] \\ 1 & R_3 - mr_m \end{bmatrix}$
$[a]$	$\frac{1}{R_3 + nr_m} \begin{bmatrix} R_1 + R_3 & -[z] \\ 1 & R_2 + R_3 - mr_m \end{bmatrix}$

$$-[z] = [R_2(R_1 + R_3) + R_1R_3 - r_m(mR_1 + nR_3)] = [r_c(r_b + r_e) + r_b(r_c - r_e)]$$

Table 4.

$[M]$	$K_u = \frac{U_2}{E_0}$	$K_I = \frac{I_2}{I_1}$	Z_{in}	Z
$[z]$	$\frac{Z_{21}Z_n}{H_z}$	$\frac{Z_{21}}{Z_n - Z_{22}}$	$\frac{Z_{11}Z_n - [z]}{Z_n - Z_{22}}$	$\frac{Z_{22}Z_0 + [z]}{Z_0 + Z_{11}}$
$[y]$	$\frac{Y_{21}Z_n}{H_y}$	$\frac{Y_{21}}{-[y]Z_n + Y_{11}}$	$\frac{Y_{21}Z_n - 1}{[y]Z_n - Y_{11}}$	$\frac{Y_{11}Z_0 + 1}{[y]Z_0 + Y_{22}}$
$[d]$	$\frac{d_{22}Z_n}{H_d}$	$\frac{d_{22}}{-d_{21}Z_n + 1}$	$\frac{ d Z_n + d_{12}}{-d_{21}Z_n + 1}$	$\frac{Z_0 + d_{22}}{-d_{21}Z_0 + d }$
$[f]$	$\frac{f_{11}Z_n}{H_f}$	$\frac{f_{11}}{f_{21}Z_n + f }$	$\frac{Z_n - f_{12}}{f_{21}Z_n + f }$	$\frac{ f Z_0 - f_{12}}{f_{21}Z_0 + 1}$
$[a]$	$\frac{Z_n}{H_a}$	$\frac{1}{a_{21}Z_n + a_{22}}$	$\frac{a_{11}Z_n + a_{23}}{a_{21}Z_n + a_{22}}$	$\frac{a_{22}Z_0 + a_{12}}{a_{21}Z_0 + a_{11}}$

$$H_z = -Z_{22}Z_0 + Z_{11}Z_n + Z_0Z_n - [z]; \quad H_f = |f|Z_0 + Z_n + f_{21}Z_0Z_n - f_{12};$$

$$H_y = Y_{11}Z_0 - Y_{22}Z_n - [y]Z_0Z_n + 1;$$

$$H_d = Z_0 + |d|Z_n - d_{21}Z_0Z_n + d_{12};$$

$$H_a = a_{22}Z_0 + a_{11}Z_n + a_{21}Z_0Z_n + a_{12}.$$

Table 5. Z_k is the load impedance.

ing system" by Lovell, McGuigan, and Murphy, *Bell System Tech. Journal*, Vol. 34, No. 4, 1955.

Calculation of the Productive Capacity of Equipment in Telegraph Lines, P. V. Prakhov (11 pp, 7 figs).

Bandwidth Required for Transmission of Amplitude and Frequency Manipulated Telegraph Signals. (8 pp, 4 figs).

RADIO ENGINEERING

(Contents of Radiotekhnika No. 3, 1957)

TELEVISION

Electron-Optical Method for Varying the Scale of a Television Image, I. I. Tsukkerman (6 pp, 5 figs).

The projection section of an image orthicon is converted into a variable-magnification electron-optical system without image inversion. A scale change with a 5:1 ratio was produced in an experimental tube, with considerable improvement in the reproductions of the fine details, although substantially more photocathode illumination was required.

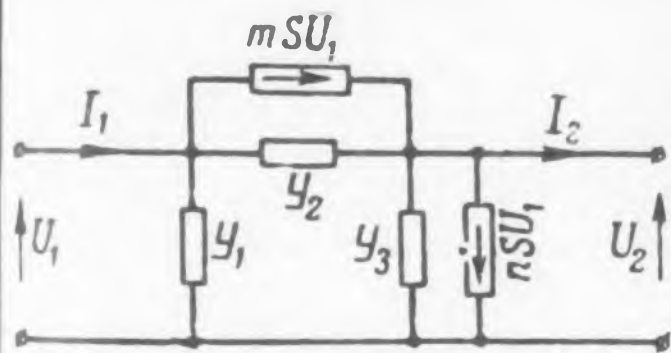


Fig. 1. Generalized equivalent circuit suitable for vacuum tube circuits (yielding an admittance matrix) (S is Russian symbol for transconductance.)

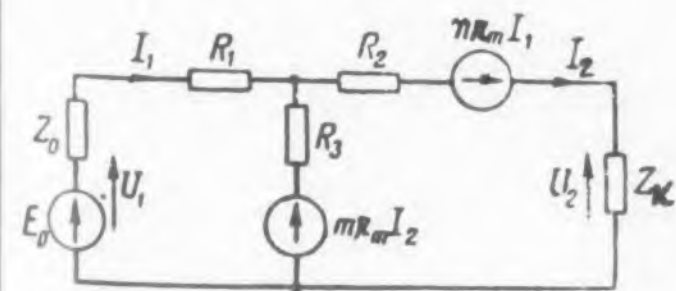


Fig. 2. An equivalent circuit leading to an impedance matrix (more suitable for transistor circuits) (Z_k represents the load impedance)



Fig. 3. Generalized four-terminal network. The following matrix equations apply:



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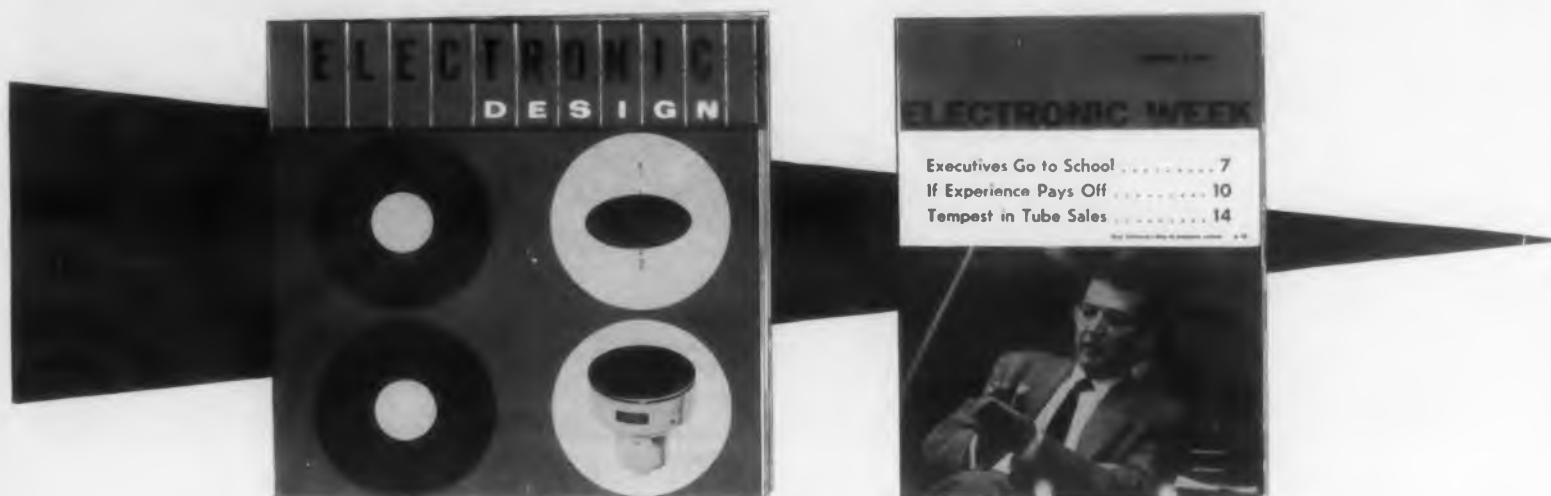
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PRIME INTEREST PUBLISHING

Russian Translations

Video Recording, M. O. Gliklikh, M. I. Tsiklis (8 pp, 8 figs).

An evaluation (with discussions invited) of the principles of television program recording. The methods treated are recording on a continuously-moving film and recording with intermittent exposure of the film.

A Method for Obtaining High-Accuracy Vertical Scanning, L. L. Santo (7 pp, 10 figs).

In compatible color television systems such as "Chromacoder" and others, sequential color frames are produced with ordinary cameras and are then superimposed by means of a special electronic system. To produce exact coincidence of the rasters it is necessary to have sweep generators of high precision, and the oscillators feeding the vertical deflection coils must permit adjustment of the current waveform. The required circuitry is discussed in detail by the author. Refers to "Development and Operation of a Line-Screen Color Kinescope" (Bond, Nicoll, and Moore, *Proc. IRE*, 1951, No. 10) and "A Technique for Nonlinear Function Generation" (P. N. Nikiforuk, *Electronic Engineering*, 1955, No. 325).

Spiral Scanning in Television, L. D. Fel'dman, M. Z. Iudich (6 pp, 8 figs).

Spiral scanning is preferred when sharpness of the central portion of the image is paramount and poor definition at the edges is acceptable. The authors explain the operating principles and list the advantages and shortcomings of several systems, including those used by "Laboratoire Derveaux" of France in their equipment. The new types of sweeps are proposed for the first time.

Such scanning can be used to "freeze" rotating objects on the screen by turning the rotor of the phase-shifter at the same speed as the object, but in the opposite direction. It can be conceivably used to measure the speed of a rocket where Doppler effect causes a sawtooth frequency variation. This requires rotating the received image, the angle of rotation being a measure of the rocket speed.

Characteristic of Aperture Effect in Television, G. I. Bialik (14 pp, 6 figs).

Characteristics of the aperture effect in television — frequency, pulse, and transient — are shown to be derivable from single distribution law, pertaining to the distribution of a unit light flux, and are expressed as functions of the distribution law. Deductions given can be applied not only to television, but also to other electron-optical systems.

Permissible Value of Periodic Noise in a Television Channel, A. P. Efimov, (8 pp, 7 figs. 1 table).

Permissible periodic noise level of a television channel is correlated with the properties of the channel and with peculiarities of human vision. Proposed theories are verified experimentally.

Use of Computers for Statistical Analysis of Television Communication, E. I. Galitskaia, V. A. Gar-mash, D. S. Lebedev (4 pp, 3 figs).

Computer techniques can be used to derive multi-dimensional probability-distribution functions for the gradations of the brightness of a television image. Using signals produced by strips of motion picture film, the authors compute the one-dimensional probability distribution function, the correlation functions, and the value of the entropy from the two-dimensional probability distribution function obtained for two frames.

Selection of Video Amplifiers, Iu. N. Prozorovski (5 pp, 6 figs).

Approximate calculations are used to determine when it is advisable to use compensated RC amplifiers or distributed-parameter amplifiers. Factors determined are the optimum number of stages and the minimum slope of the transient response of compensated amplifiers, as well as the most effective placement of tubes in multi-stage distributed-parameter amplifiers. With modern tubes it is possible to obtain low-gain compensated RC amplifiers with bandwidths up to 200-300 mc, and relatively high gain is attainable up to 100-150 mc.

Pulse Limiter Design, S. I. Krize (5 pp, 6 figs).

Analysis of video pulse limiters with emphasis on the nonlinearity of the current-voltage characteristics of the limiting element and on the finite buildup time of the operating pulse.

FEEDBACK AMPLIFIERS

Concerning Amplifiers with Combined Feedback, N. A. Suslov, (5 pp, 4 figs).

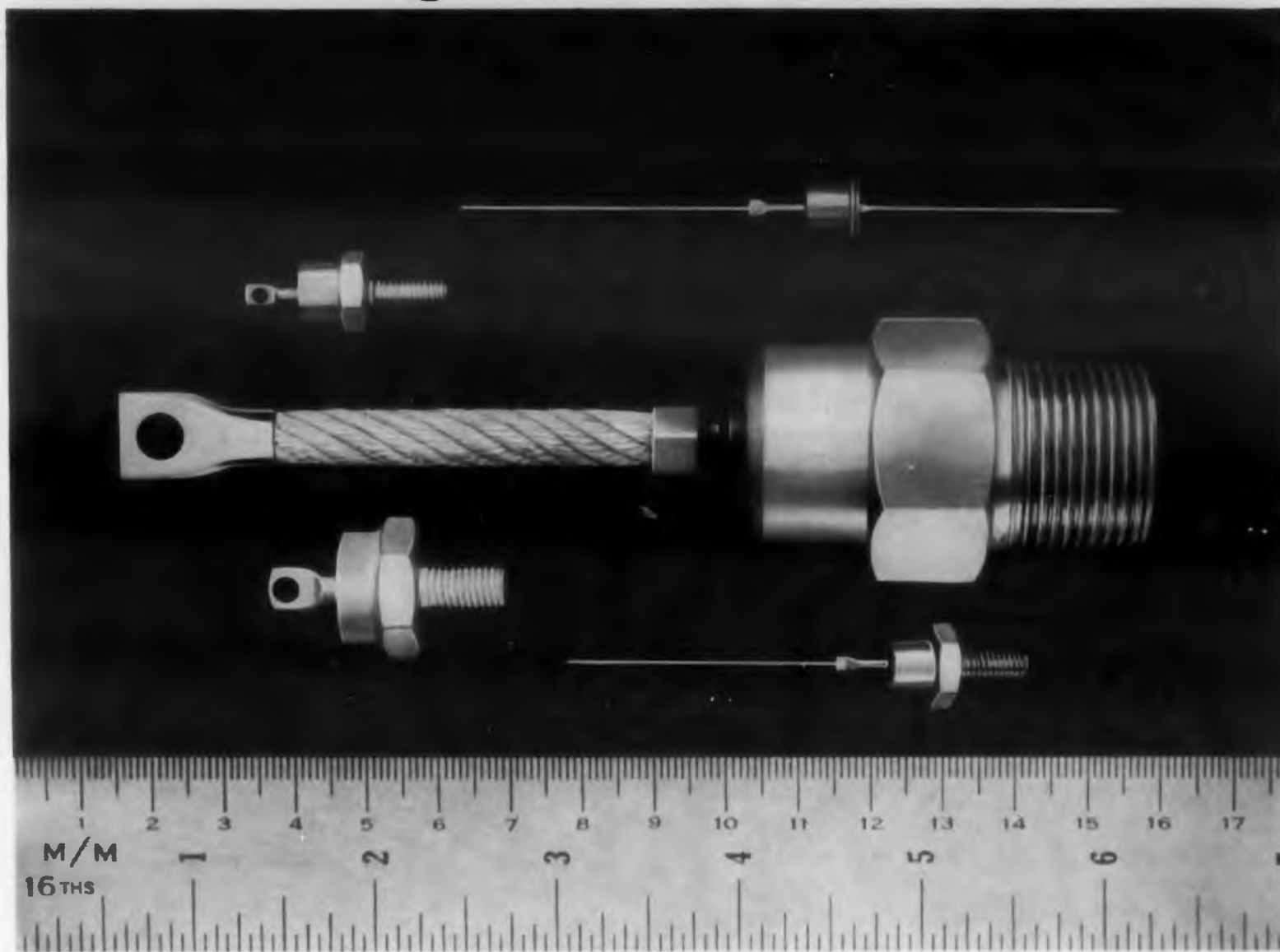
Several errors were found in M. M. Ayzinov's "Pulse Amplifiers with Double-Channel Feedback" Radiotekhnika, July 1955, ED January 1, 1956. It is shown that the amplifier proposed gives poorer results than a simple frequency-compensated amplifier circuit. The editor adds that others, too, wrote in about these errors.

MEASUREMENTS

Errors in the Determination of Q with a Q-Meter, I. S. Pavlov (4 pp, 1 fig, 1 table).

The error in the readings of a Q meter is shown to be hyperbolically related to the actual Q of the element. Certain general conclusions are drawn concerning the accuracy of Q meters.

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Design of Two-Phase Networks

E. Brenner

THE design of a network which at two pairs of output terminals delivers two voltages which differ in phase by 90 deg has, in recent years become a matter of interest because such networks are used in certain approaches to single side band transmission. The basic structure of such a network is shown schematically in Fig. 1 and the requirements of the networks may be stated by means of the equations:

$$\left| \frac{V_{o1}}{V_i} \right| = \text{const and } \left| \frac{V_{o2}}{V_i} \right| = \text{const.} \quad (1)$$

$$\text{angle of } V_{o1} - \text{angle of } V_{o2} = \pi/2, \omega_1 \leq \omega \leq \omega_2 \quad (2)$$

All-pass networks (i.e. networks which in the desired frequency range has constant attenuation) are suitable for N_1 and N_2 . Such networks have transmission factors of the form

$$\frac{V_o}{V_i} = \alpha \frac{p - p_1}{p + p_1} \quad (1a)$$

where p is the complex frequency variable (replaced by $j\omega$ in the sinusoidal steady state) and α is a constant which is less than unity if pure reactance realization is to be avoided. Choosing the lattice configuration shown in Fig. 2 for each of the networks, and terminating the lattice in the resistance R_o we have

$$Z_1 = R_o \frac{1 - V_o/V_i}{1 + V_o/V_i} \text{ and } Z_2 = R_o^2/Z_1 \quad (3)$$

By Brune synthesis it can be shown that the arms of the lattice have the form shown in Fig. 3 where

$$R_1 = R_o \frac{1-\alpha}{1+\alpha}; R_2 = 4 R_o \frac{\alpha}{1-\alpha^2}; C = \frac{(1+\alpha)^2}{4 R_o \alpha p_1} \quad (4)$$

and

$$R'_1 = R_o^2/R_1; R'_2 = R_o^2/R_2; L = R_o^2 C/16 \quad (5)$$

In order to obtain the required phase shift, several such lattice networks are connected in cascade to form N_1 and N_2 . When terminated in R_o each chain of lattice networks has a transmission factor which is the product of factors of the form of Eq. (1a).

The number of lattice elements in each chain is determined by the tolerance of phase shift error in the desired frequency interval.

In addition to Eqs. (4) and (5) the equations for the circuit elements in the r th arm of the chain of n lattice networks are shown to be

$$C_r = \frac{(1 + \alpha)^2}{4 R_o \alpha p_r}, L_r = R_o^2 C_r/16$$

where

$$p_r = \omega_1 \frac{\text{sn} \left[K' \frac{4r \pm 1}{n}, k' \right]}{\text{cn} \left[K' \frac{4r \pm 1}{n}, k' \right]}$$

and

$$k' = \sqrt{1 - k^2} \quad k = \omega_1/\omega_2$$

sn and cn are the elliptic sine and cosine functions respectively

K' is the complete Jacobian elliptic function of the first kind and modulus k' [i.e. $F(1, k') = K'$]

The type of approximation which this design furnishes in the phase characteristics within the frequency range f_1 to f_2 is the "Tchebychev" approximation. Formulas for the nature of the approximation in terms of n and detailed proofs are given in the original paper. The general method used employs the potential analog to network functions.

Abstracted from an article by G. Wunsch, Nachrichtentechnik, Vol. 7, No. 5, May 1957 pp 200-205.

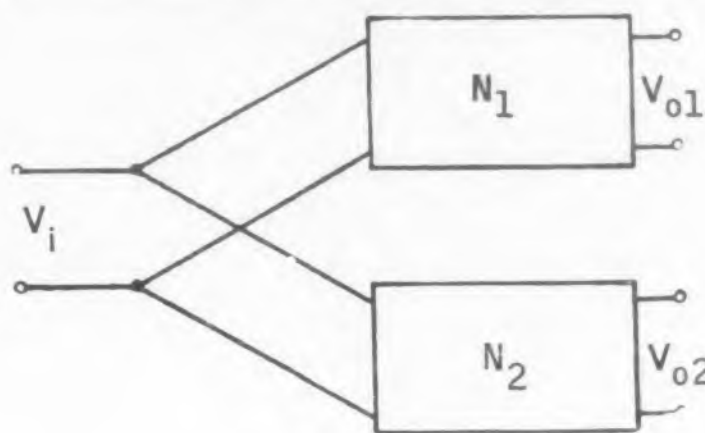


Fig. 1. Basic network.

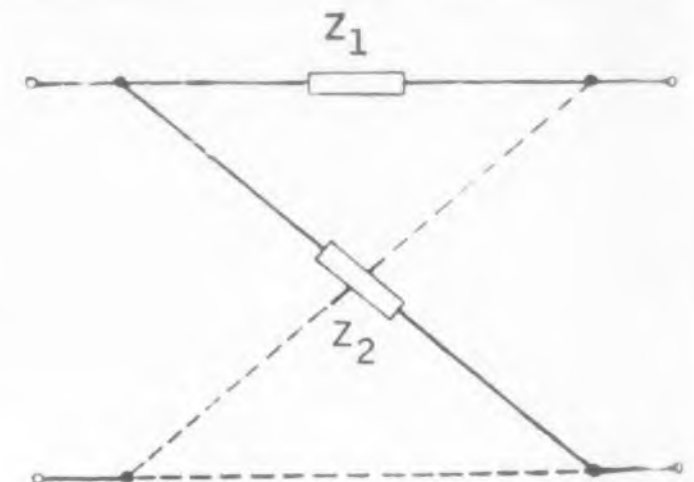


Fig. 2. Lattice network.

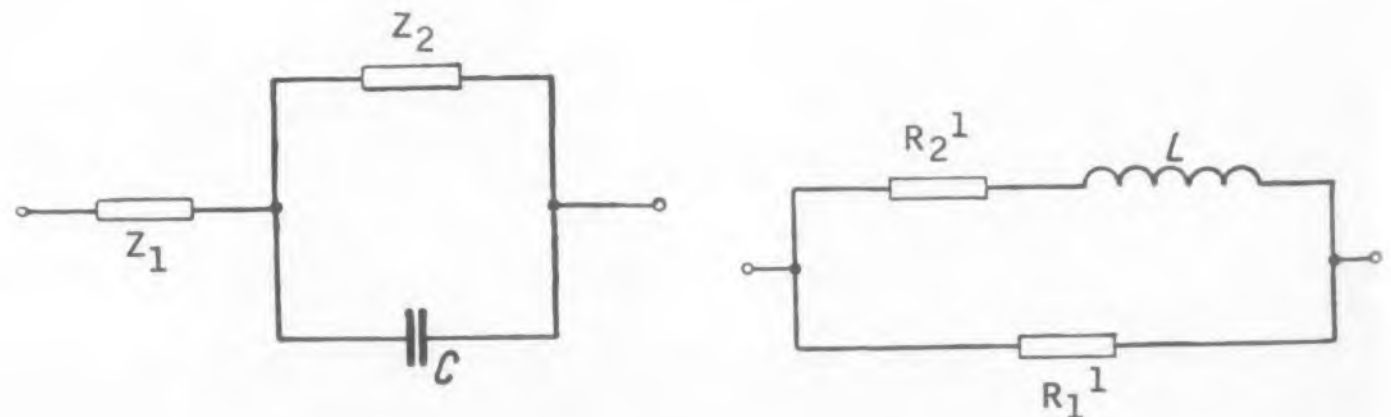


Fig. 3. Arms of a lattice a) Z_1 b) Z_2

Hall-Effect Oscillator

A FEEDBACK circuit which consists of a magnetic circuit containing ferromagnetic core material and a semiconductor (indium-antimonide) pellet with feedback can be used not only as a dc power amplifier but also as an oscillator. The basic circuit, shown in Fig. 1 consists of a ferromagnetic circuit which has the semiconductor pellet in the air gap. The six contacts on the semiconductor are arranged for experimental purposes so that the resistance between them can be controlled and measured.

If it is assumed that the effective permeability of the magnetic circuit is much greater than that of free space then the total Hall voltage, V_h is given by

$$V_h = \frac{k_h}{h} B_m I (1 - KI) \quad (1)$$

where

$$K = \frac{\mu_a k_h}{gh} \frac{N}{(r+r_h)}$$

k_h is the Hall constant ($m^2/\text{amp-sec}$)

h is the thickness of the pellet

B_m is the magnetic induction due to I_b

and the remaining parameters are defined through the figure. It is noted from Eq. 1 that a finite Hall voltage can result when KI becomes unity. Moreover B_m has a value even when I_b is zero because of the residual flux. This analytical work is verified by experiment and leads to an oscillator circuit in which the winding carrying I_b is omitted. To accomplish this, capacitances of various values (18-70 μfd) were introduced in series with the remaining winding (N). With I constant (1 a) oscillations are produced in the path of i_h (150-75 cps). Initially these experiments were carried out at a temperature below room temperature (-24°C).

The basic circuit also functions at room temperature but the Hall constant k_h and the resistance r_h (of the semiconductor pellet) are, for indium antimonide, markedly temperature dependent and decrease rapidly for increasing temperature. The use of indium-arsenide improves this defect, especially at room temperature.

Abstracted from an article by M. J. O. Strutt Archiv der Elektrischen Uebertragung, Vol. 11, No. 6 June 1957, pp 261-265.

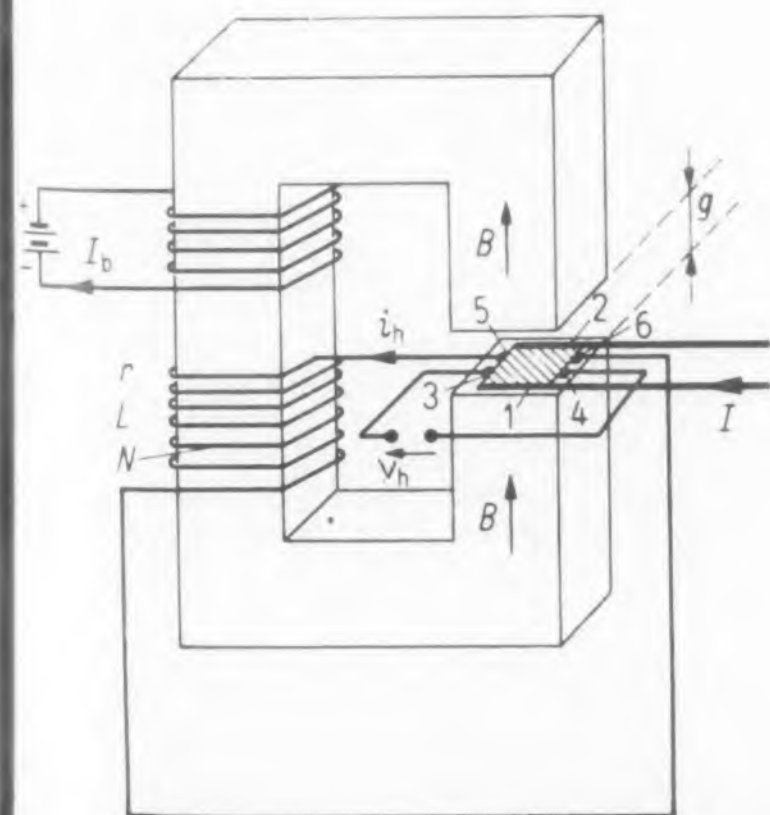


Fig. 1. Basic arrangement for feedback amplifier using the Hall Effect.

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Standards and Specs

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AIEE Standards

AIEE No. 1d, GUIDE FOR THE PREPARATION OF TEST PROCEDURES FOR THE THERMAL EVALUATION OF ELECTRICAL INSULATING MATERIALS, JUNE 1957

Principles are established for the development of test procedures for the thermal evaluation of electrical insulating materials and simple combinations of materials used in rotating electric machines, transformers, and other types of electric equipment. The objective of the test procedures is to provide methods for determining the relative thermal life of insulating materials. Copies of publication are available from the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N.Y.

AIEE No. 1e, GUIDE FOR THE PREPARATION OF TEST PROCEDURES FOR THE THERMAL EVALUATION OF INSULATION SYSTEMS FOR ELECTRIC EQUIPMENT, JUNE 1957

A general guide is provided for the preparation of systems test procedures and for suggesting the points to be considered in the preparation of specific instructions for the thermal evaluation of insulation systems for equipment. Copies of this publication are available from the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N.Y.

Capacitors

MIL-C-10950B, CAPACITORS, FIXED, MICA DIELECTRIC, BUTTON STYLE, GENERAL SPECIFICATIONS FOR 30 JULY 1957

The scope of the spec has been expanded to include a temperature range of -55°C to $+125^{\circ}\text{C}$. Characteristics W and X have been deleted. Electrical measurements are now required during the last 30 minutes of the vibration test to determine intermittent contacts or open or short circuits. The life test for the -55°C to $+85^{\circ}\text{C}$ capacitors has been changed from 1000 hours at 450vdc to 250 ± 8 hours at 750 vdc. For the -55°C to $+125^{\circ}\text{C}$ styles the life test is of 1000 hours ± 12 hours duration at 750 vdc. Newly issued detail spec sheets 1 through 6 cover capacitor styles CB11, CB13, CB14, CB21, CB31, CB50, CB75, CB76, CB85, and CB86.

MIL-C-3965, CAPACITORS, FIXED, ELECTROLYTIC (TANTALUM), AMENDMENT 1, 28 June 1957

The duration of the pull test has been corrected to read 30 seconds instead of 30 minutes. The capacitance change requirement listed on figure 1 for

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"Be sure to keep on course, Miss Quimby, for if you get five miles out of the way, you'll be over the North Sea, and you know what that means."

She climbed to 6,000 feet. Freezing cold and still fog. She pointed her nose down. The comforting clatter of the Gnome engine changed to a coughing splutter. It was conking out! She leveled off, figuring how she'd ditch.

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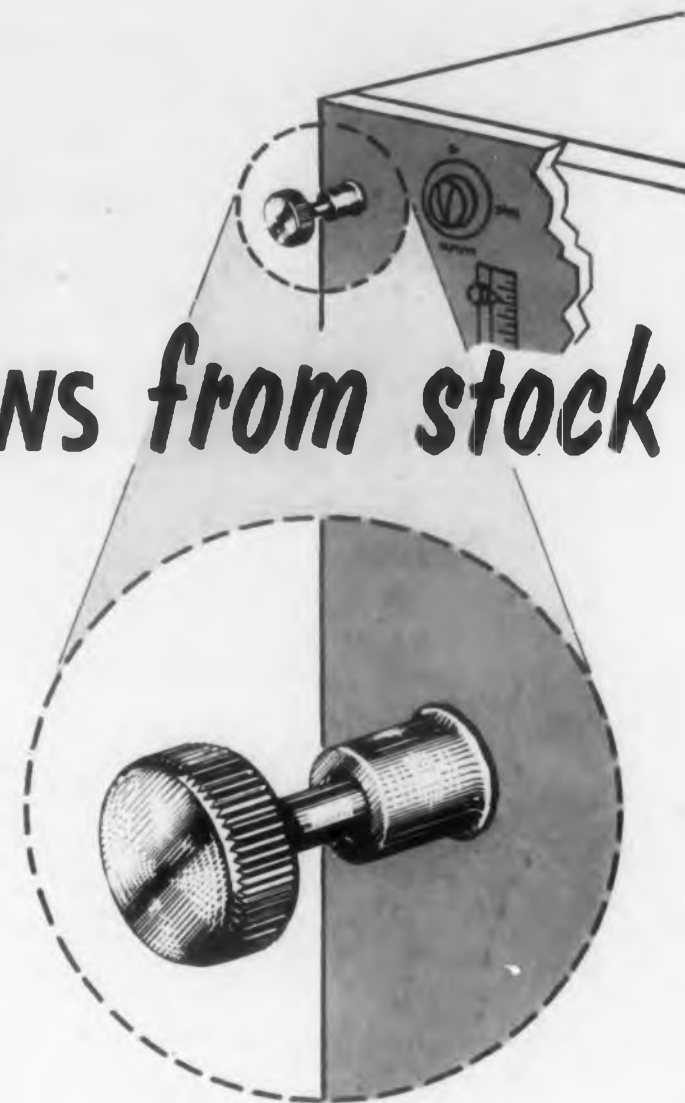
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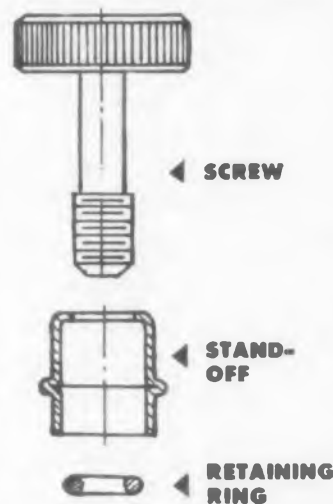
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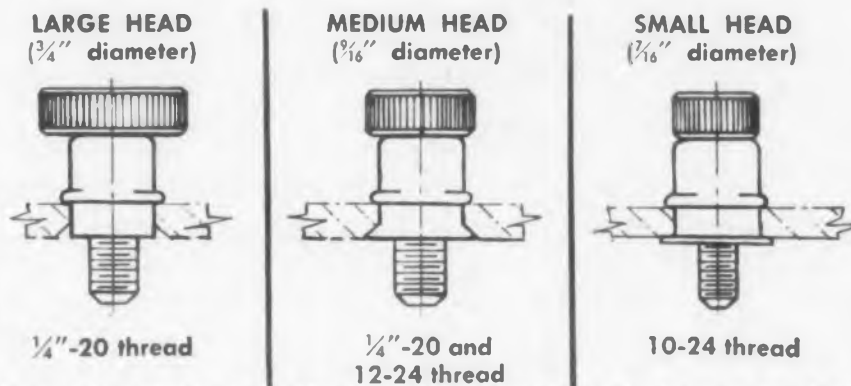


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to 30 volts inclusive at a temperature of 175°C, has been changed from +10-0% to +20-0%. The requirements for packing, packaging, and marking for shipment have been revised.

Insulating Compounds

MIL-I-930A, INSULATING AND JACKETING COMPOUNDS ELECTRICAL (FOR CABLE, CORD, AND WIRE), 16 JULY 1957

The scope of this spec has been expanded to include low-temperature characteristics of certain compounds. The maximum permissible percentage of free elemental sulphur for rubber latex insulating compounds has been changed from 0.25% to 0.5%. Inspection procedures have been established to cover any instances in which inspection procedures for cable, utilizing compounds covered in this spec, are not covered in the cable spec. A test method for determining the free elemental sulphur content has been established. The test for physical properties of insulation and jacket has been expanded to delineate the specimens, their size, condition, and age more clearly. Test methods have been added for tensile stress, tear resistance, brittleness temperature, torsional stiffness, cold tension recovery time.

Resistors

MIL-R-10509B, RESISTORS, FIXED, FILM (HIGH STABILITY)

The following Military Standards have been declared inactive for new designs effective April 1957: MS90170, MS90171, MS90172, MS90173, and MS90174. For new designs, the following styles should be used RN65, RN70, RN75, and RN80.

MIL-R-14293A, RESISTORS, FIXED, HIGH MEGOHM (HERMETICALLY SEALED), 28 JUNE 1957

Fixed, hermetically sealed resistors of high resistance values are covered by this spec. These resistors have a resistance range of 10^8 to 10^{10} ohms, inclusive, with a resistance tolerance of 5% at 25°C and are capable of operation at 70°C. They are not intended for use in equipment where vibration resistance is a requirement.

Cancelled Spec

MIL-P-3414, PLASTIC-MATERIAL, MOLDING; RIGID THERMOPLASTIC, CELLULOSE ACETATE BUTYRATE; FOR USE IN ELECTRONIC, COMMUNICATIONS, AND RELATED ELECTRICAL EQUIPMENT, NOTICE 1, 3 JUNE 1957

This spec has been cancelled. The material formerly covered by this spec is now to be procured in accordance with the requirements of Federal Spec L-P-349a, Plastic Compounds, molding, Cellulose Acetate Butyrate; and Molded or Extruded Parts, dated 30 July 1956.

ELECTRONIC DESIGN • November 1, 1957

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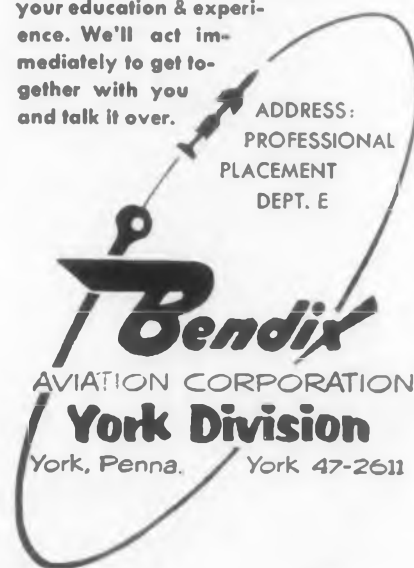
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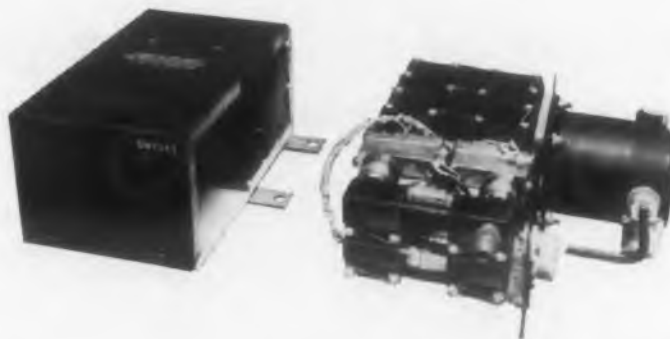
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Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000****	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC,	4,400 ohms.			
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10
H-37A	Transistor Output	TF1A15YY (DCR50)	500 CT (DCR50)	50 (DCR5)	3.5	300-10,000	+15
H-40A	Transistor Output	TF4RX17YY	500 CT (DCR26)	600 CT	10	300-10,000	+15

*Can be used for higher source impedance, with some reduction in frequency range.

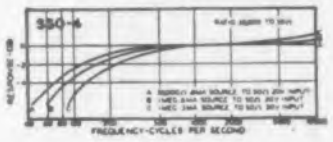
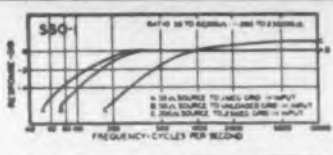


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Standard of the industry for 18 years, these units provide 30-20,000 cycle response in a case 7/16 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

Type No.	Application	Pri. Imp.	Sec. Imp.
O-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
O-2	Mike, pickup or line to 2 grids	50, 200/250, 500/600	50,000
O-3	Dynamic mike to 1 grid	7.5/30	50,000
O-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
O-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
O-10	Push-pull plates to line plate to plate	30,000 ohms	50, 200/250, 500/600
O-12	Mixing and Matching	50, 200/250	50, 200/250, 500/600
O-15	10:1 single plate to 1 grid	15,000	1 megohm
O-20	Transistor to line	1,500 CT	500/125 (split)



SUB-SOUNCER AUDIO UNITS

UTC Subbouncer and sub-subbouncer units provide exceptional efficiency and frequency range in miniature size. Constructional details assure maximum reliability. SSO units are 7/16 x 3/4 x 43/64 . . . Weight 1/2 oz.

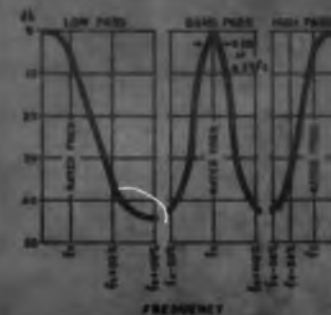
TYPICAL ITEMS

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3700
SSO-2	Interstage /3:1	+ 4 V.U.	10,900	0-.25	90,000	750	3250
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	35
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	4.6
SSO-5	Reactor 50 HY at 1 mil. D.C.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	3.3
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	125

*Impedance ratio is fixed 1:1250 for SSO-1, 50:1 for SSO-3. Any impedance between the values shown may be employed.

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UTC standardized filters are for low pass, high pass and band pass application in both interstage and line impedance designs. Forty-five stock values, others to order. Case 1-3/16 x 1-11/16 x 1 1/2 - 2 1/2 high . . . Weight 6-9 oz.



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These inductors are available in values from 10 to 1000 mh. They are available in both SMD and through-hole versions.

Type No.	Inductance	DC Max.
HVC-6	10 mh.	100
HVC-6	50 mh.	65
HVC-6	100 mh.	35
HVC-6	.25 hy.	22
HVC-6	.6 hy.	14
HVC-6	1.5 hy.	9
HVC-6	2.8 hy.	7.2

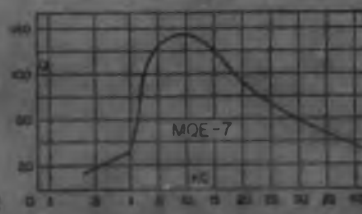


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MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz. MIL type TF4RX20YY.

TYPICAL ITEMS

Type No.	Inductance	DC Max.
MQE-2	12 mhy.	100
MQE-4	30 mhy.	65
MQE-7	100 mhy.	35
MQE-9	.25 hy.	22
MQE-11	.6 hy.	14
MQE-13	1.5 hy.	9
MQE-15	2.8 hy.	7.2



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Special alloy cathode material; minimizes "cathode interface" and interelectrode leakage; increases mechanical strength.

Pure-tungsten heater provides long life under conditions of frequent "on-off" switching.

Why

RCA TUBES

are specified for COMPUTER DESIGNS

Long-life reliability ...the result of selected materials, rigid quality controls, and exacting inspection and test procedures...makes RCA tubes the right choice for electron computer designs. *Materials* are selected and processed to assure low gas-evolution and to provide relative freedom from "cathode interface". *Quality Control* extends from purity-control of manufacturing areas, through careful selection and training of personnel, to 100% microscopic inspection of tube structures at more than a half-hundred check points. *Sample Testing* of tubes from each production run makes certain that no tubes are released for shipment until long-life test data are complete for the "lot". Super-Sensitive tests for high resistance shorts, 100-hour survival-rate life tests and 5000-hour life tests on a continuous sampling basis weed out potential early-hour failures and provide a "quality monitor" to assure *long-life reliability*.

RCA tubes for computers are ideally suited to applications as gated amplifiers, frequency dividers, pulse amplifiers, cathode followers, "on-off" switching. Illustrated above are medium- μ twin triodes: 5963, 5964, 5965, 6211, 6350; pentagrid amplifier: 5915; power pentode: 6197; twin diode: 6887.

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